United States Army
Corps of Engineers
Norfolk District

Millennium Project

Arlington National Cemetery
Arlington, VA 22211
Contract No: W91236-13-R-0012

Specifications

Construction Documents

3 June 2013

JACOBS

AMMANN & WHITNEY

in association with

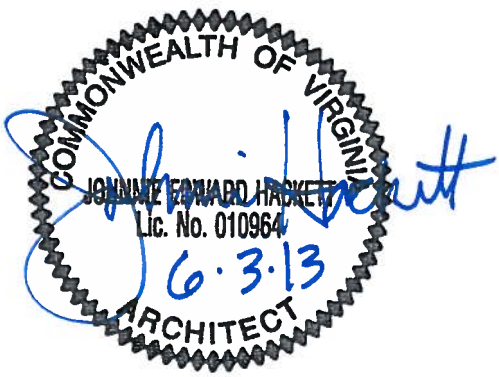
Beyer Blinder Belle Architects & Planners LLP
Sasaki Associates, Inc.
Rice Associates
Wetlands Studies and Solutions, Inc.

SECTION 00 01 07

SEALS PAGE
05/13


COMMONWEALTH OF VIRGINIA
FRANK R. GRAZIANO
Lic. No. 32099
6/3/13
PROFESSIONAL ENGINEER


COMMONWEALTH OF VIRGINIA
LEE ANDREW CRAFT
Lic. No. 029751
6/3/13
PROFESSIONAL ENGINEER


COMMONWEALTH OF VIRGINIA
JOHNNIE EDWARD HACKETT
Lic. No. 010964
6·3·13
ARCHITECT


COMMONWEALTH OF VIRGINIA
SCOTT WALOWSKY
Lic. No. 46770
6-3-13
PROFESSIONAL ENGINEER

PROJECT TABLE OF CONTENTS

-- End of Project Table of Contents --

SECTION 00 31 19

EXISTING CONDITIONS INFORMATION
05/13

PART 1 GENERAL

1.1 SUMMARY

Included in this Section For Information Only:

a. "Arlington National Cemetery Millennium Project - Final Geotechnical Report" dated May 2013, prepared by Geo Environmental Section, Norfolk District, U.S. Army Corps of Engineers, Norfolk, VA.

b. "Remedial Action Work Plan" prepared by A-Zone Environmental Services, LLC, Charles Town, WV, dated 22 April 2013.

c. Storm and Sanitary Sewer Drains Drawings - Arlington National Cemetery.

d. Water Distribution Drawings - Arlington National Cemetery.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

NOT USED.

-- End of Section --

US Army Corps
Of Engineers
Norfolk District

ARLINGTON NATIONAL CEMETERY
MILLENNIUM PROJECT
ARLINGTON, VIRGINIA

Final Geotechnical Report

May 2013

PREPARED BY:
Geo Environmental Section, Norfolk District
U.S. Army Corps of Engineers
Fort Norfolk, 803 Front Street
Norfolk, VA 23510

[Page Intentionally Left Blank]

FINAL GEOTECHNICAL REPORT

Arlington National Cemetery-Millennium Project
Arlington, Virginia

PREPARED BY:
Geo Environmental Section, Norfolk District
U.S. Army Corps of Engineers
Fort Norfolk, 803 Front Street
Norfolk, VA 23510

May 2013

[Page Intentionally Left Blank]

INTRODUCTION

This report has been prepared to provide a general characterization of the subsurface conditions at the project site and provide geotechnical recommendations. The report provides a general overview of the soil and geologic conditions with detailed descriptions at discrete boring locations. This summary briefly discusses some of the major topics mentioned in the attached report. Accordingly, the report should be read in its entirety to thoroughly incorporate the recommendations provided.

SUMMARY

The Millennium Site will be developed to increase burial space at Arlington National Cemetery. The proposed project will provide a projected 56,000 new burial spaces. The in-ground full casket burial spaces will be provided by pre-placed concrete crypts. In-ground cremation remains burial spaces are provided by direct burial method. Two columbarium types are proposed: Inward-Facing Columbarium Courts and the Perimeter Columbarium Wall. Other amenities and features include: 2 committal shelters; Ft. Myer perimeter wall/gate and jogging path; stream restoration; roadway and maintenance drive; pedestrian sidewalks/stairs and bridge; site furniture including benches; waste receptacles, etc.; and utility relocation and extension. The project will also include several retaining walls along the perimeter and interior of the site.

The following evaluations and recommendations were developed based on our field exploration, laboratory testing program, and understanding of the proposed construction:

- Fill induced settlements will be on the order of 1" or less depending on the depth of the fill. A surcharge and consolidation period of 90 days is recommended to mitigate differential and total settlement in areas with fills in excess of 10'.
- The proposed columbarium niche structures, committal shelters, and retaining walls can be supported by a deep foundation system consisting of 35 to 40 foot long 14" diameter auger cast piles with an estimated 70 ton allowable compressive capacity and are summarized below for the various structures:

Location	Allowable Capacity (tons)*	Estimated Pile Cutoff Elevation (feet)	Pile Tip Elevation (feet)	Depth (ft)
Columbarium 10/11	70	124 to 127	90 to 93	35
Columbarium 12	70	158.5	118.5	40
Columbarium 13	70	158	118	40
Columbarium N73	70	172	137	35
Columbarium N74	70	172	132	40
Columbarium N75	70	171.5	131.5	40
Wall Sections 1 - 4	70	> 145	varies	35
Wall Sections 1 - 4	70	< 145	varies	40
Note: *Based on static load test for FS of 2				

- Over excavation of fill materials is expected in the vicinity of the old stump dump and old warehouse area for support of columbarium niche structures, manholes, and pavements. The extent of undercut shall extend to natural material for support of structures and be replaced with compacted controlled structural fill. Replacement under pavements may be limited to three feet. The undercut and replacement of man maid placed fill may be in excess of 10 feet deep to remove deleterious material.
- The near surface soils are not expected to be suitable for reuse as structural fill. The near surface soils may be reused on site for general grading. The natural fine subgrade soils are highly moisture sensitive and may lose stability when wet or subjected to construction equipment.
- A permanent excavation support system in recommended along McNair Road and Humphrey's Drive to facilitate construction. The support system may include soil nails, sheet piles, helical anchors, etc.
- In areas to receive fill where existing slopes are 1V:4H and steeper, the ground surface should be benched back prior to filling activities. Such benching will therefore be required along the ravines, sides of over excavation areas and other steeply sloping areas of the site.
- Prior to fill placement a permanent "French" drain should be installed in all of the existing ravines and natural drainage ways to preserve water pathways and prevent the buildup of water pressure beneath compacted fills.
- Highly plastic clays, (CH) and silts (ML/MH) shall not be used for backfill behind retaining walls. As an alternate to the on-site soils, off site borrow materials such as VDOT No. 57 stone, ASTM C-33 sand, or select granular fill may be used as backfill behind below grade walls.
- The pavement subgrade material generally classified as CH in accordance with USCS. A design CBR value of 4 was used for pavement design analysis, which is about two thirds of the average CBR obtained from VDOT Pavement Design Guide for Subdivision and Secondary Road. Pavement shall consist of the following section:

  Drive Lanes: 2" of SM-9.5A
  3" of BM-25A or IM-19A
  4" of VDOT 21A Crushed Stone
  4" of Rapid Drainage Material Base Course
  4" of VDOT 21A Crushed Stone
  Stabilized Subgrade

  The top 12inches of subgrade shall be Lime Stabilized to achieve a CBR Value of 8 or lime stabilization may be replaced with Tensar TriaAx TX160 placed over subgrade.

TABLE OF CONTENTS

1. PURPOSE

The purpose of this report is to present the results of subsurface exploration and to provide geotechnical recommendations for use in preparation of the final design of the Arlington National Cemetery Millennium Expansion project. The recommendations provided are based on structural loads, initial site grading, 05 April 2013 design submission, and other information provided by Jacobs Engineering.

The report summarizes the results of the subsurface exploration and laboratory testing undertaken by the Norfolk District U.S. Army Corps of Engineers (Corps). The report presents our understanding of the project, reviews the exploration procedures, and presents our observations, evaluations, and recommendations. The report does not address any archeological or environmental concerns. Please refer to the appropriate reports which specifically address these concerns.

2. PROJECT INFORMATION

2.1. Scope of Work: The U.S. Army Corps of Engineers, Norfolk District, Geo-Environmental Section, Engineering Branch had responsibilities to provide Geotechnical recommendations for the proposed project. As part of our services a subsurface geotechnical exploration and testing program was performed. This report discusses the subsurface conditions encountered and provides foundation and earthwork recommendations for the Arlington National Cemetery Millennium Project.

2.2. Proposed Construction: The Millennium Project will be developed to increase burial space at Arlington National Cemetery. The proposed project will provide at least 56,000 new burial spaces. The in-ground full casket burial spaces will be provided by pre-placed concrete crypts in a 3’ x 8’ grid. In-ground cremation remains burial spaces are provided by direct burial method in a 5’ x 5’ grid. Each of these areas will incorporate traditional Arlington National Cemetery engraved memorial stones on white marble. Columbarium spaces are provided by pre-cast concrete niches, each 12” wide x 15” high x 20” deep. Each columbarium niche will be enclosed with the traditional Arlington National Cemetery engraved marble shield. Two columbarium types are proposed: Inward-Facing Columbarium Courts and the Perimeter Columbarium Wall. The inward-facing columbarium niche sections will be approximately 9 feet in height and six feet wide. The perimeter columbarium wall will be between 11 and 13 feet in height and act as a retaining wall along McNair Road. Additional major components of the project will also include a retaining wall bordering the existing stream that will range in height from just a few feet to heights in excess of 25 feet along with a pedestrian bridge that will connect Columbarium 13 and the South Committal Shelter. Other amenities and features include: 2 committal shelters; Ft. Myer perimeter wall/gate and jogging path; stream restoration; roadway and maintenance drive; pedestrian sidewalks/stairs; site furniture including benches; waste receptacles, etc.; and utility relocation and extension.

Previous columbarium structures at Arlington National Cemetery have been supported by a deep foundation system. In addition, a value-engineering study for the current project determined that a deep foundation support system would be more cost effective than using conventional shallow foundation construction for the columbarium structures and retaining walls. As a result, it was the decision of the Designer of Record to utilize a deep foundation system for the support of the structures.

Structural loading was provided by Amman & Whitney and Jacobs Engineering for the major components of the Millennium Project. Based on the correspondence from Amman & Whitney dated September 2012, maximum loads along niche wall/structures and retaining walls is 8,000 lb/linear foot with most niche wall loads on the order of 4,000 to 6,000 lb/linear foot and maximum column loads for the committal shelters are expected to be 150,000 lbs or less. Loading information for the pedestrian bridge was provided by Jacobs Engineering on 3 May 2013. The bridge foundations were designed for an allowable axial capacity of 70ton with a top of pile cap elevation of 151' and 154' for the South and North abutment, respectively.

Site grading information is based on the design submission dated 05 April 2013 and modification discussed over the phone with Jacobs Engineering (JE) on 25 April 2013. Maximum cut and fill required to reach the planned grade is expected to be approximately 17' and 37' respectively. The change in elevation required to meet the planned grade are shown in Sheet CF-100 included in Appendix A.

To facilitate traffic flow at the Millennium project, the design calls for the construction of two bridges along the planned loop road. The plans require the contractor to design and construct these features to meet various requirements stated in the plans and specifications. As these elements have yet to be designed and loading information is not available, this geotechnical report does not address or provide recommendations for the bridge design.

2.3. Site Description: The Millennium Project is located on a 27-acre site along the existing northwest boundary of Arlington National Cemetery and the old picnic grounds of Joint Base Ft. Myer/Henderson Hall (FMHH). The area is known as Section 29. The site is bounded to the west by McNair Road and extends roughly to Humphrey's Drive on the East, Ord & Weitzel Drive on the North and Ft. Myer Chapel on the South. The location of the site is shown in the Site Vicinity Map included in Appendix A.

The project area can be generally characterized as a ravine with a channel at the bottom of the ravine running in a northeasterly direction across the site. Slopes down to the channel are relatively steep from both the west and east. The majority of the site is wooded, with that on the western portion (Ft. Myer picnic area) of the site being sparse. The northern most portion of the site is referred to as the "old warehouse area" and currently serves as a parking and staging area for grounds maintenance workings and equipment. Concrete masonry unit structures exist in this area and additional structures have been demolished in the recent past. Southwest of the old warehouse area is a relatively flat portion of the site which is commonly referred to as the "stump dump"

area. This area has historically been used for disposal of organic materials and other debris from work across the cemetery.

2.4. Available Information: Previous geotechnical explorations were performed by the Baltimore District for the rerouting of the storm drainage at JBMHH and an earlier concept of the millennium expansion. The subsurface explorations were completed in June and October of 2006 for the storm drainage and original concept, respectively. Both explorations were performed within the proposed expansion site. Data from these reports is included in Appendix H and is provided for informational purposes only. In addition, environmental borings and wells from the expanded environmental investigation being performed were available.

3. DATA COLLECTION

3.1. General: A subsurface exploration consisting of fifteen (15) soil borings and in-situ testing consisting of one (1) dilatometer tests and eleven (11) cone penetration tests were performed to further identify the subsurface material properties and define the subsurface stratigraphy. The subsurface exploration was performed by In-Situ Soil Testing. L.C. and Geo Services Corporation for A-Zone Environmental Services (A-Zone) under contract to the Norfolk District. Laboratory Testing was performed by Independent Consultants & Engineers, Inc. for A-Zone under contract with Norfolk. A-Zone is also under contract to perform additional environmental testing and services identified in the Preliminary Assessment Report prepared by Shaw Environmental Report dated July 2009 along with the work described above.

3.2. Location: The test locations were marked in the field utilizing conventional survey equipment by Rice Associates. Locations that were offset to facilitate testing were resurveyed after completion. Locations of the subsurface exploration tests are shown on the Subsurface Exploration Plan included in Appendix A.

3.3. Soil Test Borings: The Standard Penetration Test (SPT) borings were performed along the perimeter of the site and near proposed structures. Locations were based on the concept layout as shown in the Charrette Report dated 7 September 2012. Fifteen soil borings were advanced to depths ranging between 15 and 95 feet below the ground surface (bgs) which have been designated as 12DH-52 through 12DH-66. The soil borings were performed between October 1st and 5th 2012. The test borings were performed with either an all-terrain mounted drill or truck mounted drill rig utilizing hollow stem auger (HSA) drilling procedures. Soils samples were obtained with a standard 1.4" I.D., 2" O.D., and 30 inch long split-spoon sampler driven with a 140-lb automatic hammer freely falling 30 inches. The number of blows required to drive the sampler for each 6 inch penetration increment was recorded. The recovered soil samples were visually classified in the field in general accordance with ASTM D 2488 by representatives of the Norfolk District. A portion of the recovered soil from the SPT test was obtained and placed in a sealed glass jar and returned to the Norfolk District Office for review and laboratory testing assignment. The soil boring logs are included in Appendix B.

3.4. Temporary Monitoring Well: Temporary monitoring wells were installed after completion of borings 12DH-55, 12DH-60, and 12DH-62. The wells consisted of 2 inch PVC pipe with a 5 foot slotted section at the end of the pipe (filter tip consisted of a standard standpipe piezometer). The boreholes were backfilled with clean sand (concrete sand) to within 5 feet of the well depth. After stabilized groundwater levels were obtained, the wells were removed. Please refer to section 4.3 Groundwater Conditions of this report for additional information. Additional groundwater information obtained from the environmental sampling in included in section 4.3 of this report as well.

3.5. Dilatometer Soundings: The subsurface exploration program included one (1) Dilatometer Sounding (DMT), designated as 12DMT-10. The DMT sounding was performed by In-Situ Soil Testing, L.C. in accordance with ASTM D 6635. Dilatometer testing was performed at approximate one foot depth intervals beginning generally one foot below the existing ground surface. The dilatometer was advanced by quazi-static pushing utilizing the hydraulic system of the testing platform. The DMT sounding was performed to a refusal depth of 36 feet bgs. The dilatometer field test data was reduced by In-Situ Soil Testing LC using established correlations and the results of the data reduction are provided in Appendix C.

3.6. Cone Penetration Test: The subsurface exploration program consisted of eleven (11) Cone Penetration Tests (CPT) designated as 12CPT-19 through 12CPT-25 and 12CPT-29 through 12CPT-32. Locations 12CPT-26 through 12CPT-28 were omitted during the field operations because they were judged to be unnecessary after the SPT borings were performed. The CPT tests were performed by In-Situ Soil Testing, L.C. in accordance with ASTM D 5778. The tests were performed to a refusal depth generally between 40 and 85 feet bgs. Cone resistance, friction resistance, and pore pressure were recorded at approximate 5cm intervals. The field test data was reduced by In-Situ Soil Testing, L.C. using established correlations and the results are provided in Appendix C.

3.7. In-Situ Shear Testing of Soils: Advanced in-situ soil testing consisting of borehole soil shear testing was performed at four selected locations/depths. Testing was performed at 12DH-53 at a depth of 27.6 feet, 12DH-55 at depths of 6.4 and 14.2 feet, and 12DH-65 at a depth of 46.8 feet bgs. A shear head was lowered into a three inch diameter borehole shaped from the removal of a 3 inch diameter undisturbed sample pushed through the HSA. A normal stress was applied laterally to the sides of the borehole. After a waiting period allowing the soil to consolidate and dissipate excess porewater pressure from the applied normal stress, the shear head was pulled upward to measure the strength of the soil in contact with the plates of the shear head. This process was repeated with increasing normal stress to completion of the test. The results are provided in Appendix D**.**

3.8. Laboratory Testing: A geotechnical laboratory testing program was performed on selected samples recovered from the site that consisted of 38 soil classification tests (ASTM D2216, D4318, D422 w/o hydrometer, and D1140). The results of these tests were used to aid in our classifications shown on the soil boring logs. In addition, geotechnical laboratory testing consisting of a (1) one-dimensional consolidation test

performed in accordance with ASTM D2435, one drained direct shear test in accordance with EM 1110-2-1906, and a (1) unconfined compression test in accordance with ASTM D2166 on samples from thin wall Shelby tubes. The results of these tests were used to aid in our evaluation of anticipated settlement and evaluation of global stability. The laboratory test results are provided in Appendix D.

4. SUBSURFACE CONDITIONS

4.1. Regional Geology: The project area is located within the Coastal Plain Physiographic province close to the "fall line" which separates this province from the Piedmont Physiographic Province. The Coastal Plain consists of marine and fluvial deposits of the tertiary and cretaceous age. The project site is shown to be underlain primarily by the Potomac Formation and the Bacons Castle Formations at higher elevations near Humphreys Drive. The basal part of the Potomac Group is predominantly light gray to white fluvial sand and gravel containing some lenses of silt and clay. Overlying the sands and gravels are complexly interbedded clays, clays and silt which also contain pockets and layers of sand, gravel and ironstone. The Quaternary river terrace deposits are comprised mainly of relatively compact gravel and sand in a clay or silt matrix. Lenses of medium to stiff silt and clay, and peaty beds are locally intercalated with the sand and gravel.

4.2. Subsurface Conditions: The subsurface conditions discussed in the following section and those shown on the boring logs represent interpretations of the boring data. The lines designating strata breaks on the boring logs and those indicated below represent approximate boundaries between soil types, as the transition may be gradual or may occur between samples.

The generalized subsurface stratigraphy, below, is our interpretation of the soil stratigraphy and subsurface conditions at the project site based on our subsurface exploration and available information. The interpretation necessarily assumes uniform subsurface conditions across the site, which is probably, but not necessarily, correct. The general descriptions, below, should not be considered as a substitute for the borings logs. Generalized subsurface profiles are included in Appendix B of this report.

Surficial soil was encountered to depths ranging from two (2) to 10 inches bgs in the soil test borings where observed. This soil is typically a dark-colored soil material containing roots, fibrous matter, construction debris, and/or other organic and deleterious components.

FILL was encountered at boring locations 12DH-52, 55, 58, 60, 61, 65, and 66. The fill was identified at four general areas which are the old warehouse area, stump dump area, disposal location of excess material from the stormwater diversion/interceptor project, and near existing site development. The fill encountered at the old warehouse area (borings 12DH-58 and 66) generally consisted of Brown/Dark Gray, Clayey Medium to

Fine SAND with little cobbles to a depth between two and six feet bgs. The fill encountered at the old stump dump area (borings 12DH-60 and 61) generally consisted of Tan/Gray, CLAY with some fine sand and organics and Reddish Brown Clayey Fine SAND with little organics which included wood from stumps. This fill was encountered to a depth ranging between 4 and 11 feet bgs. Boring 12DH-52 was located where excess spoils from the million gallon interceptor project were placed. This material generally consisted of Gray/Reddish Brown/Tan, CLAY with trace to some fine sand and gravel which was encountered to a depth of 16 feet bgs. The fill noted in borings 12DH-55 and 65 were judged to be placed for original site improvements due to the proximity of the borings in relation to roadways. The fill was noted to be six (6) inches and two (2) feet in thickness at locations 55 and 65 respectively. The material generally classified as Brown/Orangish Brown, Clayey SAND and gravel with debris.

Underlying the Surficial soil or Fill, natural soils consisting of Reddish Brown/Pale Red CLAY with little to some fine sand to Clayey Fine SAND classifying as CH, CL, and SC was encountered across the site except in the area of the stump dump and old warehouse (12DH-58, 60, 61, and 66). The material was judged to be encountered to a depth between 6 and 14 feet below the existing ground surface. This has been designated as Stratum I_A for this report. Uncorrected SPT N-values ranged from 5 to 37 blows per foot (bpf) with an average of 12bpf. CPT tip resistance ranged from 8 to 63 tons per square foot (tsf) with an average of 22tsf. The DMT modulus ranged from 94 to 971tsf with an average of 398tsf.

The moisture content for the Stratum I_A materials was observed to range between 10.9 and 36.6 percent with an average value of 22.9 percent. The percent fines (passing No. 200 Sieve) were observed to range between 39.6 and 90.9 percent with an average value of 78.6 percent. The average Liquid Limit was observed to be 64 with an average Plastic Index of 38, for the samples tested.

Underlying the Surficial soil or Fill, natural soils consisting of Reddish Brown and Reddish Brown Mottled Tan, Silty Fine SAND to Clayey Fine SAND classifying as SM, and SC was encountered along Humphreys Drive east of the drainage channel. This material is associated with the Bacons Castle Formation. This material was judged to be encountered to a depth between 32 and 39 feet below the existing ground surface (elevation 173.2 to 143.6). This has been designated as Stratum I_B for this report. Uncorrected SPT N-values ranged from 2 to 37 blows per foot (bpf) with an average of 11bpf. CPT tip resistance ranged from 39 to 1025 tons per square foot (tsf) with an average of 133tsf.

The moisture content for the Stratum I_B materials was observed to range between 3.6 and 15.7 percent with an average value of 11.2 percent. The percent fines (passing No. 200 Sieve) were observed to range between 7.3 and 25.6 percent with an average value of 17.3 percent. For the samples tested.

Underlying Stratum $I_{A\&B}$, Stiff to Very Stiff, Gray to Bluish Gray Mottled Reddish Brown CLAY with trace to some fine sand typically classifying as CH was encountered.

The material was judged to be part of the Potomac Formation. The material extended to an approximate depth of 6 to 71 feet bgs (elevation 148.9 and 128.4) and to the termination of 12DH-52, the material has been designated as Stratum II for this report. This stratum was not encountered in the vicinity of the old stump dump and warehouse areas (12DH-58, 60, 61, and 66). Uncorrected SPT N-values ranged from 15 to 39 bpf with an average of 25 bpf. CPT tip resistance ranged from 22 to 104 tons per square foot (tsf) with an average of 64tsf. The DMT modulus ranged from 811 to 3790tsf with an average of 1805tsf. Several samples of Stratum II material exhibited "slickensides", smooth surfaces of a seam in the hard clay.

The moisture content for the Stratum II materials was observed to range between 22.8 and 34.7 percent with an average value of 29.5 percent. The percent fines (passing No. 200 Sieve) were observed to range between 71.5 to 86.4 percent with an average value of 86.4 percent. The average Liquid Limit was observed to be 63 with an average Plastic Index of 39. Results the in-situ borehole shear testing and direct shear testing performed on the Stratum II materials are summarized in the table on 4.2-1.

Table 4.2-1: Summary of Borehole Shear and Direct Shear Testing

Advanced Laboratory Testing Summary Table			
Sample ID	Depth (ft)	Test	Results
12DH-53	27.6	Borehole Shear Test	ϕ' = 15.7° c = 348psf
12DH-55	6.4	Borehole Shear Test	ϕ' = 26.0° c = 302psf
12DH-55	14.2	Borehole Shear Test	ϕ' = 17.7° c = 561psf
12DH-65	46.8	Borehole Shear Test	ϕ' = 15.3° c = 45psf
12DH-55	13.5	Direct Shear Test	ϕ' = 12.9° c = 168psf

Underlying Stratum II, Loose to Dense, Light Gray Mottled Yellowish/Reddish Brown Clayey SAND to Silty Fine SAND with trace to some clay classifying as SM, SC, and SM-SC was encountered. This material was judged to be encountered to the termination of Borings 12DH-53, 61, and 63 though 65 at a depth between 9 and 64 feet bgs (elevation 129.8 and 97.5) and has been designated as Stratum III for this report. Deeper termination elevations were noted to be in the area of the old stump dump and warehouse areas. Uncorrected SPT N-values ranged from 6 to 40 bpf with an average of 20 bpf. CPT tip resistance ranged from 30 to 270 tons per square foot (tsf) with an average of 122tsf. DMT tests encountered refusal conditions prior to encountering this stratum; as a result, modulus values were not obtained in this stratum.

The moisture content for the Stratum III materials was observed to range between 9.2 and 25.3 percent with an average value of 16.2 percent. The percent fines (passing No. 200 Sieve) were observed to range between 9.2 to 39.6 percent with an average value of 20.9 percent. The material was determined to be non-plastic in nine (9) of the 13 samples tested. The average Liquid Limit was observed to be 31 with an average Plastic Index of 15 for the four (4) remaining samples.

Underlying Stratum III, Firm to Stiff, Light Gray CLAY with some fine sand and gravel to Clayey Fine SAND classifying as CH and SC was encountered in borings 12DH-54 through 56. This material was judged to be encountered to a depth between 39 and 71 feet bgs (elevation 118.5 and 114.2) which has been designated as Stratum IV_A for this report. Uncorrected SPT N-values ranged from 14 to 34bpf with an average of 24bpf.

The moisture content for the Stratum IV_A materials was observed to range between 28.9 and 30.8 percent with an average value of 29.9 percent. The percent fines (passing No. 200 Sieve) were observed to range between 42 to 56.4 percent with an average value of 49.2 percent.

Underlying Stratum III and IV_A, Medium Dense to Dense, Light Gray Silty Fine SAND with little clay classifying as SM and SM-SC was encountered. This material was judged to be encountered to the termination of Boring 12DH-57 and at a depth of 89.5 feet bgs (elevation 95.7) in 12DH-54 which has been designated as Stratum IV_B for this report. Uncorrected SPT N-values ranged from 16 to 45bpf with an average of 26 bpf. CPT tip resistance ranged from 16 to 187 tons per square foot (tsf) with an average of 65tsf. DMT tests encountered refusal conditions prior to encountering this stratum; as a result, modulus values were not obtained in this stratum. For the sample tested from Stratum IV_B the moisture content and limits were observed to be 22.1 percent and non-plastic, respectively.

Underlying Stratum $IV_{A\&B}$, Very Dense, Greenish Gray, Fine SAND with little silt and mica visually classifying as SM was encountered. This material was encountered at the termination of Boring 12DH-54 at a depth of 95 feet bgs (elevation 90.2) which has been designated as Stratum V for this report. SPT N-values were not recorded since a spoon refusal was encountered. Spoon refusal is defined as a rate of 100 blows per 6” of penetration.

4.3 Groundwater Conditions: Groundwater information obtained at the site is summarized in the tables 4.3-1 & 2.

Table 4.3-1: Summary of Groundwater Conditions (1 of 2)

Location ID	Ground Surface Elevation (ft.)	Water Level (ft.)		Hole Cave In (ft.)		Date of Observation	Remarks
		Depth	Elevation	Depth	Elevation		
12DH-52	187.83	--	--	25.9	161.93	10/8/2012 6:20	
12DH-55	159.86	30.2	129.66	--	--	10/8/2012 6:45	40' Temporary Pipe
12DH-62	157.62	34.5	123.12	--	--	10/8/2012 7:30	25' Temporary Pipe
12DH-63	157.08	--	--	28.8	128.28	10/4/2012 8:55	
12DH-64	199.39	--	--	71.5	127.89	10/5/2012 12:30	
12DH-65	199.6	32	167.6	60.5	139.1	10/5/2012 12:25	
12DH-54	185.19	52.8	132.39	53	132.19	10/8/2012 6:10	
12DH-53	184.77	51	133.77	53	131.77	10/8/2012 6:55	
12DH-57	167.23	37.7	129.53	47	120.23	10/8/2012 7:55	
12DH-56	157.47	--	--	26.3	131.17	10/8/2012 8:05	
12DH-66	110.26	3	107.26	4.5	105.76	10/8/2012 9:15	
12DH-60	125.9	8.1	117.8	--	--	10/8/2012 9:30	10' Temporary Pipe

Table 4.3-2: Summary of Groundwater Conditions (2 of 2)

Location ID	Ground Surface Elevation (ft.)	Water Level (ft.)		Hole Cave In (ft.)		Date of Observation	Remarks
		Depth	Elevation	Depth	Elevation		
12SMY-SB6	125.8	9.73	116.07	--	--	11/5/2012	See well log
12-ESMY-SB1	109.53	6.64	102.89	--	--	11/5/2012	See well log
12OWA-SB1	117.15	6.84	110.31	--	--	11/5/2012	See well log
12OWA-SB3	106.98	2.41	104.57	--	--	10/26/2012	See well log
12-OWA-SB4	104.5	5.17	99.33	--	--	11/6/2012	See well log
12-OWA-SB6	100.28	2.86	97.42	--	--	10/26/2012	See well log
12-OWA-SB7	98.65	3.54	95.11	--	--	10/26/2012	See well log
12-OWA-SB10	111.54	8.16	103.38	--	--	10/25/2012	See well log
12-OWA-SB11	107.17	4.62	102.55	--	--	10/26/2012	See well log
12-FMM-SB2*	153	21.75	131.25	--	--	11/16/2012	See well log
Note: *Elevation was extrapolated from topographic information							

Groundwater levels fluctuate with seasonal changes, periods of heavy or little rainfall, pumping from wells, and other factors. The field measurements do not reveal the actual year-round groundwater conditions.

The near surface clayey soils encountered in the borings can cause perched groundwater to be found close to the ground surface, especially during wet periods. Perched conditions occur when surface or subsurface water is prevented from draining deeper into the subsurface by layers of relatively impermeable soil located near the surface.

5. GEOTECHNICAL DESIGN RECOMMENDATIONS

5.1. General: The following findings and recommendations and are based on our observations at the site, interpretation of the field and laboratory data obtained during our subsurface exploration, our experience with similar subsurface conditions and projects, and the project information available at the time this report was prepared.

5.2. Anticipated Fill Induced Settlements: Significant grading will be performed across much of the site with the deep fills located in the ravines and natural drainage ways. It is anticipated that the final grades are expected to be up to 20 feet higher than the existing grades in these deep fill locations. The weight of such fills will cause compression/consolidation in the underlying soils over time resulting in settlements at the ground surface.

Determination of anticipated settlement amounts and rates are both imprecise due to variability in the amount of fill and a number of soil characteristics (plasticity, permeability, over consolidation ratio, etc.). The magnitude and rate of settlement will vary across the site and will be affected by the properties of the existing soil along with the type and depth of new fill. Based on our assumptions and calculations, settlements on the order of one inch (1") may be expected for fills on the order of 20 feet in thickness.

Due to the anticipated settlement and to minimize post construction differential settlements for the proposed structures, the areas of fill in excess of 10 feet in thickness shall be surcharged with additional soil and allowed to consolidate for a period of time. Refer to Section 6, Earthwork Consideration for details on surcharging this site.

5.3. Shallow Foundation Design for Lightly Loaded Structures: Based on our evaluations, lightly loaded structures may be supported on a conventional shallow foundation system bearing on approved natural soils or properly compacted controlled structural fill. Continuous foundations with a 4klf service load and column foundations with 60kip service load may be designed for a maximum net allowable bearing pressure of 2,000 pounds per square foot (psf).

Lightly loaded continuous foundations should have a minimum width of 24 inches and independent column foundations should have a minimum width of 36 inches to reduce the possibility of a 'punching ' shear failure. The structural elements should be centered on the foundation element to provide uniform load transfer, unless the foundations are

proportioned for eccentric loads. Due to the highly plastic soils encountered, foundations should bear at a minimum depth of 48 inches below the finish site grades for bearing capacity considerations and soil shrink/swell effects. Foundation shall be a minimum of five feet or the width of the foundation whichever is greater from the crest of any slope of 3H:1V or steeper. Spacing between footings shall be at least 1.5 times the width of the larger foundation to minimize any reduction in bearing capacity due to overlapping zones of influence.

Over excavation of fill materials is expected in the vicinity of the old stump dump and old warehouse area for support of columbarium niche structures and manholes. The extent of undercut shall extend to natural material for support of structures and be replaced with compacted controlled structural fill. This undercut and replacement may be in excess of 10 feet deep.

5.4. Anticipated Shallow Foundation Settlements: Total settlement of column foundations with a service load of 50 kips and continuous wall foundations loaded to 2klf is expected to be on the order of ¾" inch, or less. Actual settlements experienced by the structure and the time required for the subsurface soils to settle will be influenced by undetected variations in the subsurface conditions, actual structural loads, final grading plans, the quality of fill placement, and foundations construction.

Differential foundation settlement has not been evaluated at this time since it is dependent on the distribution of loads and the variability of the underlying soils which can be assessed after final site grades and locations are presented. Acceptable differential settlement will be defined as an angular distortion of less than 1/500. The angular distortion is defined as the difference in settlement between two points divided by the distance between the points.

5.5. Auger Cast-In-Place Pile Foundations: The design team has elected to utilize a deep foundation support system for the retaining walls and the columbarium niche structures; therefore axial and lateral pile capacities have been determined for 14" diameter auger cast piles. Pile lengths were determined based a top of pile elevation three feet below the site elevation of structures and a 70 ton allowable capacity. The results of the geotechnical engineering evaluations for auger cast-in-place piles are provided in table 5.5-1.

Table 5.5-1: Summary of Auger Cast Pile Compression Capacities

Location	Allowable Capacity (tons)*	Estimated Pile Cutoff Elevation (feet)	Pile Tip Elevation (feet)	Depth (ft)
Columbarium 10/11	70	124 to 127	90 to 93	35
Columbarium 12	70	158.5	118.5	40
Columbarium 13	70	158	118	40
Columbarium N73	70	172	137	35
Columbarium N74	70	172	132	40
Columbarium N75	70	171.5	131.5	40
Wall Sections 1 - 4	70	> 145	varies	35
Wall Sections 1 - 4	70	< 145	varies	40
Note: *Based on static load test for FS of 2				

Individual piles should be spaced a minimum of four pile diameters apart from the center to center of each pile. Settlements associated with individual piles and groups are anticipated to be relatively immediate and on the order of 0.5 inch or less.

Adequate steel reinforcement design for both tensile and lateral loads is required for each auger cast-in-place pile to be constructed. Also, the piles require a minimum shear resistance of 17 kips due to potential slope failure planes which is discussed further in section 5.9.

5.5.1. Auger Cast-In-Place Pile Test Program: At least two control piles should be installed to check the installation procedures for the auger cast-in-place piles for each pile diameter and capacity that is selected for the project. We recommend that the pile axial compressive capacity be verified by up to ten (10) pile load tests located near 12DH-53, 54, 55, 60, 61, 62, 12CPT-20, 23, DH-4, 15, and DH-30 these should **NOT** be production piles.

Load tests shall be in accordance with ASTM D 1143; except as otherwise noted below. The load test shall consist of the "Quick Load Test Method For Individual Piles" up to a total test load of 140 tons, followed by the "Loading In Excess of Standard Test Load" up to 200 tons, or until failure of the test pile occurs. Load application shall be in increments of 10% of the applied load. Time interval between load increments shall be 15 minutes. The full test load shall be maintained for one hour. The Contractor shall provide a load frame and test jack capable of applying a minimum 300 ton axial load to the test piles. Reaction auger-placed piles shall be used in lieu of other reaction frame methods; and these reaction piles, as well as the reference and testing apparatus, shall be independently monitored for movement. A minimum of four dial gauges mounted 90 degrees apart is required; along with two sets of parallel wires, mirrors, and scales, to monitor the movement of the top of the test piles. An additional single set of wires, mirrors, and scales will be required to monitor the top of each reaction pile for movement. All movement

data shall be recorded. A calibrated load cell shall be used to measure the load application on the pile. The load cell shall have an accuracy of ± 1%. A spherical bearing shall be placed between the ram and the reaction beam to reduce eccentric loading. The pile design service load is 70 tons.

Each test pile shall be instrumented with pairs of vibrating wire strain gauges located at two different levels; (1) bottom of the clay layer (i.e. top of bearing layer) and (2) bottom of the bearing sand layer (i.e. tip of pile) to obtain information about the shaft friction developed within the different subsoil strata. The exact depths of these gauges will be determined based upon the soil profile observed from withdrawals of adjacent reaction piles. These strain gauges shall be "Vibrating Wire Rebar Strain Meters" (Sister bars). Two strain gauges shall be installed at each depth mounted 180 degrees apart.

The load test should not be performed until the grout has achieved the design compressive strength as verified by compressive strength tests on grout specimens. In addition, the pile load test should not be performed until after a minimum 7 day waiting period following installation of the test pile. Application of the test load should be performed under the direction of the geotechnical engineer.

5.6. Lateral Pile Resistance: Lateral resistance was limited to a pile head deflection of ¼". Pile head deflection was determined using the computer program LPile based on established p-y correlation in the program. The applied lateral load was increased or decreased until approximately ¼" of deflection resulted. The pile was assumed to have a compressive strength of 4000psi with 60ksi reinforcement consisting of four number 7 bars. The output information is attached in Appendix E and summarized table 5.6-1.

Table 5.6-1: Summary of Lateral Pile Resistance

Location	Ultimate Lateral Load for 1/4" Head Deflection (kip)	Location	Ultimate Lateral Load for 1/4" Head Deflection (kip)
12DH-53	25	12DH-61	8
12DH-54	22	12DH-62	12
12DH-55	18	12DH-63	16
12DH-57	13	DH-24	10
12DH-58	9	DH-26	14
12DH-60	8	DH-4	9

*A FS of 2 is recommended for lateral capacity.

5.6.1. Battered Piles

If the allowable lateral load capacities indicated are not sufficient to resist the applied lateral loads, then battered piles could be utilized to resist the applied loads. The allowable lateral load of the battered pile can be computed as the horizontal component of the recommended allowable axial compressive capacity based on the geometry of the batter. Due to construction difficulties, pile batter shall not exceed a batter of 1H:4V or roughly 14 degrees.

5.7. Lateral Earth Pressure: All below-grade walls should be designed to resist the lateral earth pressure. Earth pressures on walls below grade are influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction, and the strength of the materials being restrained.

The most common conditions assumed for earth retaining wall design are the active and at-rest conditions. Active conditions apply to relatively flexible earth retention structures, such as freestanding walls, where some movement and rotation may occur to mobilize soil shear strength. Walls that are rigidly restrained, such as basement and tunnel walls should be designed using at-rest earth pressures. A third condition, the passive state, represents the maximum possible pressure when a structure is pushed against the soil, and is used in wall foundation design to help resist active or at-rest pressures.

Highly plastic clays, (CH) and silts (ML/MH) shall **NOT** be used for backfill. As an alternate to the on-site soils, off site borrow materials such as VDOT No. 57 stone, ASTM C-33 sand, or select granular fill may be used as backfill behind below grade walls. The recommended lateral earth pressure coefficient for design of retaining or below grade walls using these soils is provided in table 5.7-1.

Table 5.7-1: Lateral Earth Pressure Coefficients

Lateral Earth Pressures						
Soil Type	Lateral Earth Pressure Coefficient (k)			Equivalent Fluid Pressure (γ_{eq}) pcf		
	At-rest (K_o)	Active (K_a)	Passive (K_p)	At-rest	Active	Passive
Select Granular Fill	0.42	0.28	3.54	55	36	460

Refer to attached sketch for Select Granular backfill limits recommended retaining wall details.

Our recommendations were given assuming that the ground surface above the wall is level. The recommended earth pressures and soil weights were provided assuming that a constantly functioning drainage system, consisting of slotted 4 inch diameter PVC pipe (min), are installed between walls and crushed stone backfill to prevent the accidental buildup of hydrostatic pressures and lateral stresses in excess of those stated. If a functioning drainage system is not installed, lateral earth pressures should be determined using the buoyant weight of the soil and hydrostatic pressures calculated with the unit weight of water (62.4pcf) should be added to these earth pressures to obtain the total stresses for design.

Heavy equipment should not operate within 5 feet of below grade walls and earth retaining walls to prevent lateral pressures in excess of those cited. Adjacent footings or other surcharge loads located a short distance outside the below grade walls will also

exert appreciable additional lateral pressures. Surcharge loads should be evaluated using the appropriate active or at-rest pressure coefficients provided above. The effect of surcharge loads should be added to the recommended earth pressures to determine the total lateral stresses.

5.8. Slope Stability: Evaluation of the global stability of the retaining walls was performed along several cross sections taken across the site and labeled Sections A through F. The location of these sections can be seen on the subsurface exploration plan included in Appendix A.

The sections were typically divided into four zones or stratums which comprise the overburden clay, Potomac clay formation, yellowish brown/tan fine sand, and rock/weather rock at depth. The lower clay deposit is part of the Potomac Formation; the clays are very stiff and are highly over consolidated. Published shear strength data on the Potomac clays generally shows the clays to have high effective peak strengths; however, the residual shear strength can be significantly less than the peak strength due to saturation of the clay, shearing along previously sheared, or the soil being highly fractured. For this project, laboratory and in-situ shear strength testing was performed from the lower clay deposit. Table 5.8-1 shows the shear strength values and other parameters used in the slope stability analysis:

Table 5.8-1: Summary of Engineering Properties for Slope Stability

Zone/Stratum	Moist Unit Weight(pcf)	Cohesion, psf	Effective Angle of Internal Friction, ϕ'
I_A/Overburden Clay	96	increased w/ depth 500+113/ft depth	NA
II/Potomac Formation	110	0	15°
III & IV YellowBrn & Gray Sand	120	NA	33°
V/Dense Sand	160	0	37°
Fill	115	0	32°

Global stability analysis was evaluated on the existing condition and the retaining walls after construction. A distributed load of 100psf was used along McNair Road for a traffic loading. Another distributed load of 350psf was used to represent the preplaced crypt section. Since the auger cast piles are going to be used for support of the retaining wall, shear reinforcement of 17kips was included at a 20' spacing. The shear resistance was determined in accordance with ACI 318.05 equation 11.33.

The slope stability program, Slide, developed by Rock Science was used to analyze stability of the existing and proposed grading of the project site. A minimum factor of safety of 1.25 was used which is consistent with the Fairfax County Department of Public Works and Environmental Services Geotechnical Requirements. Fairfax County

requirements were used because the County has developed specific guidelines and requirements to address the unique geotechnical challenges presented by the Potomac Formation clays. Block and circular failure surfaces were analyzed using, Bishops, Janbu, Corps, and Spencer's procedures. Individual and automatic searching failure planes were performed to determine the critical slip surface for a given slope. Stability results are included in Appendix F and a summary of the global minimum factory of safety is presented in table 5.8-2.

Table 5.8-2: Global Minimum Factors of Safety

Section	Global Minimum FS	
	Existing	After Construction
A	1.779	1.276
B	2.315	1.574
C*	1.509	1.591
D**	1.662	1.69
E	1.939	1.335
F***	1.294	1.277
Notes: *Slip surface in area of construction. Minimum FS is 1.509 on existing slope **Slip surface in area of construction. Minimum FS is 1.532 on existing slope ***Slip surface in area of construction. Minimum FS is 1.21 on existing slope		

The critical failure surfaces were found out to cross the planned pile lengths. Therefore the piles should be designed to resist a minimum shear force of 17 kips to maintain the global minimum factor of safety presented in the table above.

5.9. Pavement Design Recommendations: The pavement subgrade material generally classified as CH in accordance with USCS. Based on NAVFAC DM7 Manual and the VDOT Pavement Design Guide for Subdivision and Secondary Road, a design CBR value of 4 was used for pavement design analysis. The design CBR is about a 2/3rd reduction from the anticipated value. Pavement analysis was performed using the pavement design software PCASE using an estimated traffic consisting of 60 kip 5-axle trucks and passenger cars. A traffic volume of 10 trips per day of large trucks and 50 passenger cars per day for 25 years were used for this analysis. The recommended pavement section is below:

Drive Lanes:
2" of SM-9.5A
3" of BM-25A or IM-19A
4" of VDOT 21A Crushed Stone
4" of Rapid Drainage Material Base Course
4" of VDOT 21A Crushed Stone
Stabilized Subgrade

The near surface soils contain high amounts of fines (silts and clays); therefore, the top 12inches of subgrade shall be Lime Stabilized with 4 to 6 percent lime. After stabilization, the top 12inches of subgrade shall be compact subgrade to 95% ASTM D 1557 (Modified Proctor). Lime stabilization may be replaced with Tensar TriaAx TX160 placed over subgrade. In addition, proper drainage needs to be maintained during construction to facilitate construction as the material may become unstable during wet weather. In addition, perched groundwater may be encountered during excavations. Due to the fine grain soil and poor drainage condition a subdrain system shall be installed as part of the pavement (see attached sketch and Section 6.13 of this report).

5.10. Seismic Site Classification: A Seismic Site Class D is recommended for this site based on Chapter 20 of ASCE 7. Determination of the seismic site class was based on a 100' deep standard penetration tests and in conjunction with the subsurface stratigraphy.

6. CONSTRUCTION RECOMMENDATIONS

6.1. Site Preparation: Proper site preparation will be critical to this project in order to achieve satisfactory performance of the structure. It is recommended that a geotechnical engineer be retained during construction to provide soil engineering services for site preparation and foundation construction phases of the project. The geotechnical engineer can perform appropriate evaluations to help assure proper support of the proposed construction.

Site preparation for the building areas (includes columbarium, shelters, burial areas, and retaining walls) and pavements should include complete removal of demolition debris, man placed fill soils, surface vegetation, surficial soils, organic material, trees, tree stumps, roots and organic laden soil. The depth of removal of these materials is typically expected to be on the order of twelve (12) inches. Additional stripping and grubbing should be expected to remove stumps and root mats. Stripping should be performed to a horizontal distance of at least the thickness of fill but not less than ten feet beyond the limits of the columbarium, shelters, and retaining wall footprints, and five feet beyond the limits of pavement in the undeveloped areas. Areas of construction should also be cleared of soft, wet, or disturbed soils. Over-excavated areas should be backfilled with properly compacted suitable fill. During the clearing and stripping operations, positive surface drainage should be maintained to prevent the accumulation of water.

After stripping, the exposed subgrade soils in the areas of development of roadways and structures should be proofrolled with a 20 to 30-ton loaded dump truck or other pneumatic-tired vehicle of similar size and weight. Proofrolling should be observed by a geotechnical engineer and the Contracting Officer's Representative. Proofrolling should be performed during a time of good weather and not while the site is wet, frozen, above planned grade, or severely desiccated. Any unsuitable materials that are observed to yield or rut noticeably during proofrolling should be undercut and replaced with

compacted imported controlled structural fill or stabilized in-place as recommended by the geotechnical engineer and approved by the Contracting Officer.

A perched water table can be expected on this site and proper planning will be required. The near surface subgrade soils are moisture sensitive and will lose stability if these soils become wet and are subjected to construction traffic. As a result, site preparation should be performed during an extended period of dry weather. Undercutting or reworking of the near surface soils may be necessary if the exposed subgrade soils become unstable during construction.

The natural fine subgrade soils were noted to be above the optimum moisture needed for compaction (based on laboratory test); therefore, they will require drying by aerating or disking before being compacted to develop a suitable subgrade for areas to receive compacted controlled fill, pavement, or concrete slabs-on-grade. Any fill materials, aggregates, and/or concrete should be placed as soon as possible over the approved subgrade in order to reduce exposure of the subgrade to weather and construction activity. It is important to stress that the subgrade needs to be properly prepared and protected during construction to minimize the degradation of these soils.

6.1.1. Benching: In areas where existing slopes are 1V:4H and steeper, the ground surface should be benched back prior to filling activities. Such benching will therefore be required along the ravines, sides of over excavation areas and other steeply sloping areas of the site. Failure to properly bench/slope the ground surface prior to filling would result in poor bonding and problems such as significant differential settlement or slope failures. Details and Locations are included in Appendix G.

6.1.2. Ravine Drainage: Prior to fill placement a permanent "French" drain should be installed in all of the existing ravines to preserve the natural water pathway and prevent the buildup water pressure under the fill placement. The French drain shall consist of a six (6) inch diameter perforated PVC schedule 80 pipe wrapped with an eighteen inch thick layer of VDOT 57 with the entire system enveloped in a filtration geotextile. The geotextile should be non-woven except that heatbonded non-woven geotextiles shall not be used. The geotextile should meet AASHTO M 288-96, Class 2 Geotextile Survivability requirements and meet the AASHTO M 288-96 geotextile criteria for filtration (i.e. minimum permittivity of 0.2 sec -1 and a maximum apparent opening size (AOS) equal or less than 0.25 mm sieve). Details and Locations are included in Appendix G which shall daylight into the stream within the middle of the site.

6.2. Foundation Construction: Foundation subgrades shall be observed, evaluated, and verified for the design bearing pressure by a geotechnical engineer after excavation and prior to reinforcement steel placement. In addition, hand auger probes shall be performed to verify the subsurface soil conditions below the foundation elements.

If soft, unsuitable soils, or deleterious fill materials are encountered during foundation construction, localized undercutting or in-place stabilization of foundation subgrades will be required. Undercut excavations in planned foundation areas should be widened. The need for, and extent of, undercutting should be based on field observations made by a geotechnical engineer at the time of construction. Any over excavation should be backfilled with properly compacted structural fill; or lean concrete to the planned foundation bearing elevation as approved by the Contracting Officer.

Excavations for foundations should be made in such a way to provide bearing surfaces that are firm and free of loose, soft, wet, or otherwise disturbed soils. Foundation concrete should not be placed on frozen or saturated subgrades. If such materials are allowed to remain below foundations, settlements will increase. Foundation excavation should be concreted as soon as practical after they are excavated. If an excavation is left open for an extended period, a thin mat of lean concrete should be placed over the bottom to minimize damage to the bearing surface from weather or construction activities. Water should not be allowed to pond in any excavation.

6.3. Auger-Cast Pile Construction: Each planned auger cast-in-place pile location should be augered and cased to the preplanned depth below existing site grades. All production piles should be installed in the presence of an experienced engineering technician (under the direct supervision of the geotechnical engineer) who should keep a record of each pile's construction. Verification of the proper pump pressure and grout volumes should be recorded during the grouting procedure for each pile. Records should also be made for date of installation, size, and length of pile and tip elevation for each pile.

The completed piles shall be plumb to within 2%, if vertical, or shall be installed to within 2% of the piles designed batter, as determined by the angle from the vertical, if planned as a batter pile. Pile groups should be constructed from the interior of the group going outward to preclude damage to the recent grout placed for interior piles within the group.

Auger cast-in-place piles should be constructed by rotating a continuous flight of hollow shaft augers to the specified tip elevation. Pile grout should then be injected into the auger at controlled and carefully monitored pressures. The rate of grout injection and the rate of auger withdrawal should be controlled to maintain a positive grout pressure at all times. The auger should be withdrawn at a smooth, steady constant rate while grout pressures are maintained. A minimum waiting period of 12 hours should be provided before installing a pile that is within four pile diameters of the previously installed pile. This waiting period is necessary to allow the initial set of the grout to occur prior to the placement of adjacent piles.

Grout pressures should be determined in the field based on rate of grout injection and control of grout return around the auger. Care should be taken to verify the heaving of existing soil surfaces or damage to completed piles does not occur. Based on our past

experience, grout pressures of about 100 psi at the auger and 150 psi at the pump have been successfully used.

Volume measurements of grout during placement should be carefully obtained. In general, the volume of grout placed should exceed the net volume of the pile by about 15%. This increased volume is generally attributed to consolidation of weaker soil zones, as well as some filling of soil voids.

Volume measurements are typically based on a calibration of the grout pump which consists of a determination of the volume of grout that is pumped per pump stroke. The calibration should be performed prior to installation of the piles, under the direction of the geotechnical engineer.

Grout fluidity (Army Corps of Engineers CRC.C-79), grout temperature and grout compressive strength specimens (ASTM C109) should be performed during pile installation. Testing should be preformed twice daily; in the morning and in the afternoon.

The Contractor shall be prepared to provide special provisions to maintain cover when constructing batter piles such as PVC pipe.

Potential auger cast-in-place pile contractors should be allowed to review the soil test boring logs. The contractor selected for the auger cast-in-place pile installation should have at least five years of acceptable experience.

6.4. Controlled Structural Fill: Fill placed beneath buildings, structures, and under roadways which will raise the site to the finished subgrade shall be compacted structural fill. Controlled structural fill material under buildings and the roadways should be non-expansive and free of organic matter, debris, and particles larger than 2-inches in size. Proposed fill materials should be subjected to laboratory tests consisting of, but not necessarily limited to, moisture density determinations, Atterberg limits, and sieve analysis. Compacted controlled fill shall extend at least 10 feet beyond the building limits or to a distance equal to the height of the fill. Areas to receive fill which are sloped surfaces, steeper than one foot vertical and four feet horizontal (1V to 4H) shall be plowed, stepped and benched so that the fill material will bond with the existing materials. Steps or benches shall be 1 foot vertical to 2 feet horizontal (1V to 2H). Controlled Structural Fill under buildings and structures should classify per USCS as SW, SP, SP-SM, or SM with a maximum of 20 percent fines passing the No. 200 sieve. Controlled Structural Fill under roadways shall include all materials suitable under building and structures and include material classified per USCS as SC, ML, or CL with a maximum liquid limit of 45 and a plasticity index of greater than 15.

6.5. Suitability of On-site Material for Reuse: The onsite soils are not suitable for reuse as structural fill. The onsite soils may be reused on site for general grading in the pre placed burial crypt areas and general fill areas. The natural fine subgrade soils are highly moisture sensitive and may lose stability when wet or subjected to construction

equipment. Based on the laboratory testing, the in-situ moisture content is expected to be greater than three percent higher than the optimum moisture needed for compaction. As a result the contractor should expect that the onsite soil will require drying by aerating or disking before being reused in suitable areas and to develop a suitable subgrade for areas to receive compacted controlled fill, pavement, or concrete slabs-on-grade. It is important to stress that the subgrade needs to be properly prepared and protected during construction to minimize the degradation of these soils.

6.6. Surcharge and Consolidation Period for Large Fills:

To minimize post-construction differential settlements, a surcharging program shall be executed for large fill areas before commencing construction. The surcharging program shall consist of the placement of a minimum of an additional 8 feet of fill above the design grade and allowing the foundation soils to settle and stabilize under the site and preload fill. The contractor shall take into account the consolidation period in scheduling and phasing the project construction. Areas subjected to Surcharge and Consolidation Periods are shown in figure D-001 in Appendix G.

i. Fill material shall meet the REQUIREMENTS of satisfactory materials for earthwork, roadwork, and utilities systems and will be compacted to 95% of a Modified proctor.

ii. The placement REQUIREMENTS for surcharge are as follows: Surcharge material shall consist of excess available onsite material from excavations. If an insufficient Quantity of material is unavailable onsite imported material shall be supplied by the contractor from off base. The top limits of the surcharge fill shall extend 5 feet beyond the limits of surcharge with side slopes no steeper than 2H:1V. Surcharge shall be compacted by a minimum of five passes by the hauling and spreading equipment. Material shall be place in maximum of one foot lifts and as a minimum 5 in place density shall be taken per lift.

iii. Settlement plates shall be placed on natural subgrade immediately prior to placement of site fill as indicated. The foundation surface for each plate shall be graded smooth and level. The locations of the settlement plates shall be determined by scaling from features on the contract drawings. Minor adjustment in the location of a settlement plate to avoid utilities or structural foundation features will be permitted, but shall be approved by the Contracting Officer. Any settlement plate rendered inoperable by the Contractor's operations shall be replaced immediately at no cost to the Government. Refer to the SETTLEMENT PLATE DETAIL in Appendix E for additional installation requirements and monitoring of the settlement plates.

iv. The consolidation period shall be 90 calendar days unless the contracting officer's representative allows a shorter time period. The surcharge fill shall remain in place until settlement readings indicate the foundation soils have stabilized under

the surcharge load. The consolidation period shall commence once the surcharge fill has reached the required top elevation.

v. Excavated surcharge fill material may be used in other portions of the permanent construction, at the contractor's option. Excess excavated surcharge fill material shall be disposed of off the base.

6.7. Expansive Soils: Expansive Soils such as "marine clays" of the Potomac Formation are not permitted as structural fill for building pads, foundation backfill, backfill around structure, or behind retaining walls. Expansive Soil is defined by the International Building Code as:

"Soils meeting all four of the following provisions shall be considered expansive, except that tests to show compliance with Items 1, 2 and 3 shall not be required if the test prescribed in Item 4 is conducted:

1. Plasticity Index (PI) of 15 or greater determined in accordance with ASTM D 4318.
2. More than 10 percent of the soil particles pass a No. 200 sieve (75 μm), determined in accordance with ASTM D 422.
3. More than 10 percent of the soil particles are less than 5 micrometers in size, determined in accordance with ASTM D 422.
4. Expansion Index greater than 20, determined in accordance with ASTM D 4829.

If the PI of the soil is 20 or less (e.g., PI ≤ 20) and the LL is 45 or less (e.g., LL ≤ 45), the Plasticity Index Corrected (PI_{cor}) or the Expansion Index Corrected (EI_{cor}) may be substituted in the above definition of expansive soils. PI_{cor} and EI_{cor} are defined as:

$$PI_{cor} = \frac{PI \times (\% \text{ Passing No. 40 Sieve})}{100} \text{ and } \frac{EIcor = EI \times (\% \text{ Passing No. 4 Sieve})}{100}$$

6.8. Compaction Requirements: The contractor shall provide proper compaction equipment to meet compaction requirements based on a modified Proctor (ASTM D 1557). Due to the higher energy from the modified Proctor, the optimum moisture content of the material will be lower than a standard Proctor. The in-situ moisture content of the subsurface material is expected to be higher than the optimum moisture content from a modified Proctor. The contractor should be prepared to adequately dry the in-situ soils prior to placement as backfill. The minimum compaction requirements for this project are listed on the following page.

Structures, foundations, and concrete slabs: Compact top 12 inches of subgrade and subsequent lifts to 95 percent of ASTM D 1557.

Roads, parking areas, crypt burial area, and retaining walls: Compact top 12 inches of subgrade and subsequent lifts to 95 percent of ASTM D 1557.

Green Areas: Compact to 85 percent of ASTM 1557.

Proper compaction equipment should be utilized by the contractor to achieve the required compaction. For areas which do not permit the use of heavy compaction equipment (utility trenches and near retaining structures) lift thickness may need to be reduced to achieve the required compaction. During fill operations, positive surface drainage should be maintained to prevent the accumulation of water. Each lift of fill should be tested in order to confirm that the degree of compaction is attained. Field density tests to verify fill compaction should be as required by the earthwork specification.

The moisture of backfill material should be maintained within three percentage points of the optimum moisture content as determined from the modified Proctor. Compaction requirements may be reduced by 5 percent for cohesive material, defined as material containing more than 40 percent fines (material passing the No. 200 sieve) with a PI greater than 12 in accordance with ASTM D 4318 except in Green Areas.

6.9. Groundwater: It is important to note that perched groundwater near the ground surface may be encountered during utility and site grading in the Old Warehouse area. Construction dewatering may be necessary during periods of heavy precipitation and for utility excavations. If perched groundwater is encountered, the placement of a layer of open graded crushed stone, similar to VDOT No. 57, may be placed at the base of the excavation to stabilize the subgrade prior to backfill operations, after all soft or loose material is removed. Dewatering techniques such as sumps with pumps and well points may be needed for utility excavation.

6.10. Stormwater Management Ponds: Slopes shall be no steeper than one foot vertical to three feet horizontal (1V to 3H). Consideration shall be given to flatten slopes where mowing is required. Pipes shall be bedded in natural material or on properly compacted suitable fill as required above. Backfill of pipes shall be limited Controlled Structural Fill under roadways as defined in section 6.3 with a minimum of 30 percent passing the No. 200 sieve by weight. A granular bedding material under pipes shall not be used, except as noted. Due to the difficulties in obtaining proper compaction around anti-seep collars, anti-seep collars shall not be used. Therefore, the last 1/3 portion of the downstream pipe shall be wrapped with a one foot thick VDOT 57 crushed stone with a non-woven geotextile fabric around the perimeter of the stone.

6.11. Permanent Excavation Support System: Since site constraints do not permit, excavations in the onsite soils to be sloped back at a grade of 2 horizontal to 1 vertical (2H:1V) along McNair Road and Humphrey's Drive a permanent excavation support system in recommended to facilitate construction. The support system may include soil nails, sheet piles, helical anchors, etc. Soil parameters can be provided once a type of support system is selected.

6.12. Temporary Excavation Support System: If space and site constraints permit, excavations in the onsite soils should be sloped back at a grade of 2 horizontal to 1 vertical (2H:1V) and should meet all the requirements of OSHA regulations. Sloped surfaces shall be covered with an erosion control mat to prevent sloughing or raveling the surface. Alternative methods for excavation support may be needed where space limitations and site constraints prevent the soil from being sloped back. Such alternatives may consist of soldier pile and wood lagging walls, with anchors and wales. All excavation support systems shall be designed by a registered professional engineer working for the Contractor. Alternative methods may be required for construction of the underground subway station and tunnel system.

6.13. Subsurface Drainage Requirements: A pavement subdrainage system is required under the roadways in accordance with Army ETL 1110-3-435. The subdrainage system will facilitate the removal of moisture from the pavement base course by means of pipe subdrains connected to the RDM (Rapid Drainage Material) layer of the base course. Subdrains will be placed along the edges of the roadways. The subdrains consist of ASTM C33 #57 stone surrounding a 6" diameter perforated pipe with the entire system enveloped in a filtration geotextile. The geotextile should be non-woven except that heatbonded non-woven geotextiles shall not be used. The geotextile should meet AASHTO M 288-96, Class 2 Geotextile Survivability requirements and meet the AASHTO M 288-96 geotextile criteria for filtration (i.e. minimum permittivity of 0.2 sec -1 and a maximum apparent opening size (AOS) equal or less than 0.25 mm sieve).

Appendix A - Site Vicinity Map & Subsurface Exploration Plan

Geologic Map of Virginia

General Site Location

ANC Millennium Project Site Vicinity Map

0 1 2 3km

Date Printed: 11.26.2012

Map Scale: 1:108336

Developed By: Geospatial Services Section, USACE Norfolk District
Via CorpsMap:
https://corpsmap.usace.army.mil/nao
Email: geospatial@usace.army.mil

ANC Millennium Site Vicinity Map

0 50 100 150m

Date Printed: 11.27.2012 Map Scale: 1:3386

Developed By: Geospatial Services Section, USACE Norfolk District
Via CorpsMap:
https://corpsmap.usace.army.mil/nao
Email: geospatial@usace.army.mil

0' 40' 80' 120'

GRAPHIC SCALE

Profile A

Profile B

Profile C

Profile D

Profile E

Profile F

US Army Corps of Engineers®
Norfolk District

NO.	DESCRIPTION	DATE	BY	APP.

DESIGNED:
DRAWN: RLH
CHECKED: RGD
SUBMITTED:
DATE: Nov 2012
SCALE: AS SHOWN
PROJECT NO. XXXXXX
NORFOLK DISTRICT FILE NO. XXXXXXXX–
DRAWING NO. XXX–XX–XX
SPECIFICATION NO.
Last revised on:
File name:
Plot scale: 1:1

NORFOLK DISRTICT
CORPS OF ENGINEERS
NORFOLK, VIRGINIA

PRELIMINARY REPORT

ARLINGTON NATIONAL CEMETERY
MILLENNIUM PROJECT
ARLINGTON, VIRGINIA

SUBSURFACE EXPLORATION PLAN

SHEET REFERENCE NUMBER
B–101

SHEET 1 OF 2

0' 40' 80' 120'

GRAPHIC SCALE

US Army Corps of Engineers®
Norfolk District

NO.	DESCRIPTION	DATE	BY	APP.

DESIGNED: RLH
DRAWN: RLH
CHECKED: RGD
SUBMITTED:
PROJECT NO. XXXXXX
DRAWING NO. XXX-XX-XX
Last revised on:
File name:
DATE: Nov 2012
SCALE: AS SHOWN
NORFOLK DISTRICT FILE NO. XXXXXXXXX-
SPECIFICATION NO. XXX-XX-XX
Plot scale: 1:1

NORFOLK DISRTICT
CORPS OF ENGINEERS
NORFOLK, VIRGINIA

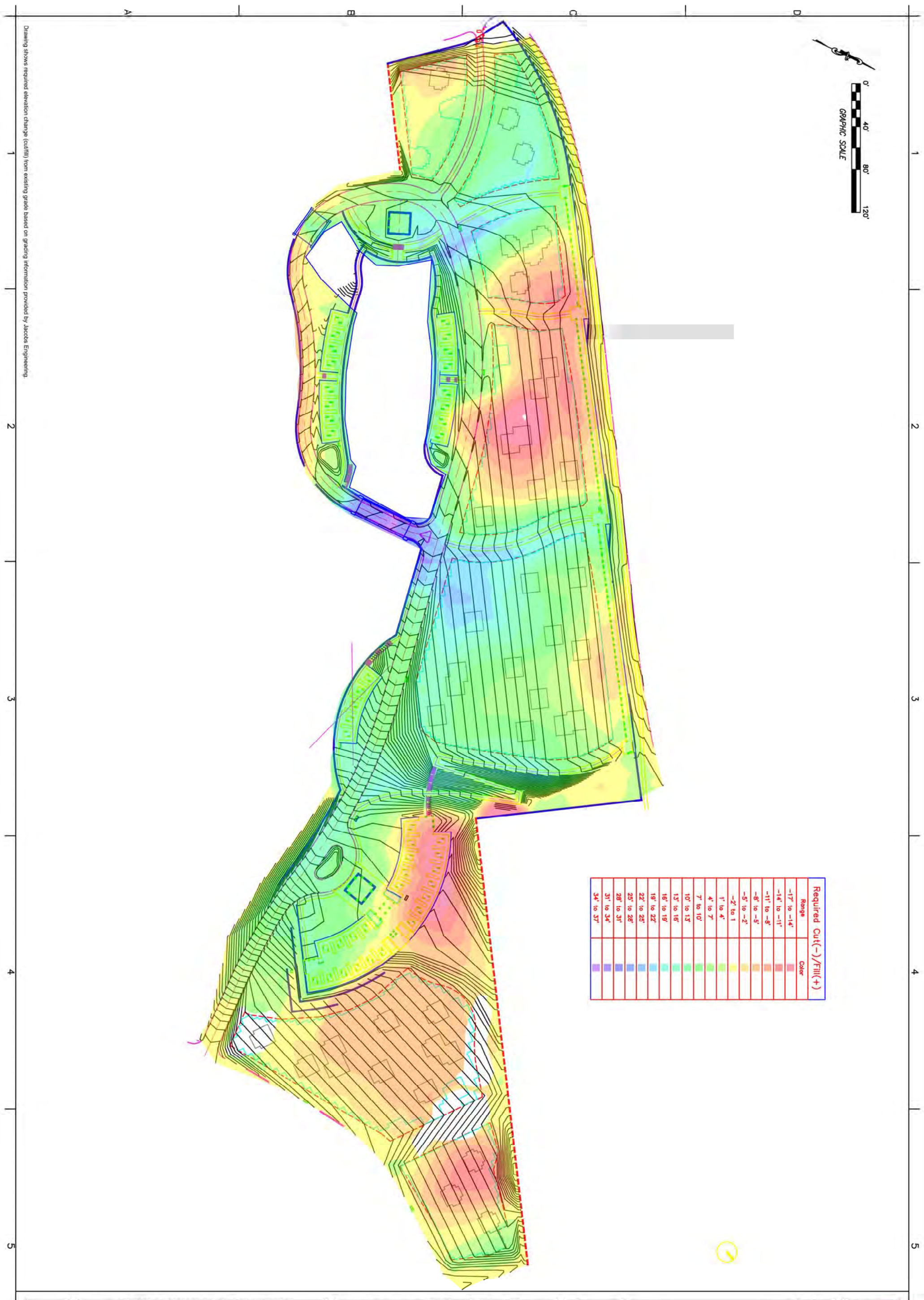
PRELIMINARY REPORT

ARLINGTON NATIONAL CEMETERY
MILLENNIUM PROJECT
ARLINGTON, VIRGINIA

SUBSURFACE EXPLORATION PLAN

SHEET REFERENCE NUMBER
B-102

SHEET 2 OF 2



Drawing shows required elevation change (cut/fill) from existing grade based on grading information provided by Jacobs Engineering.

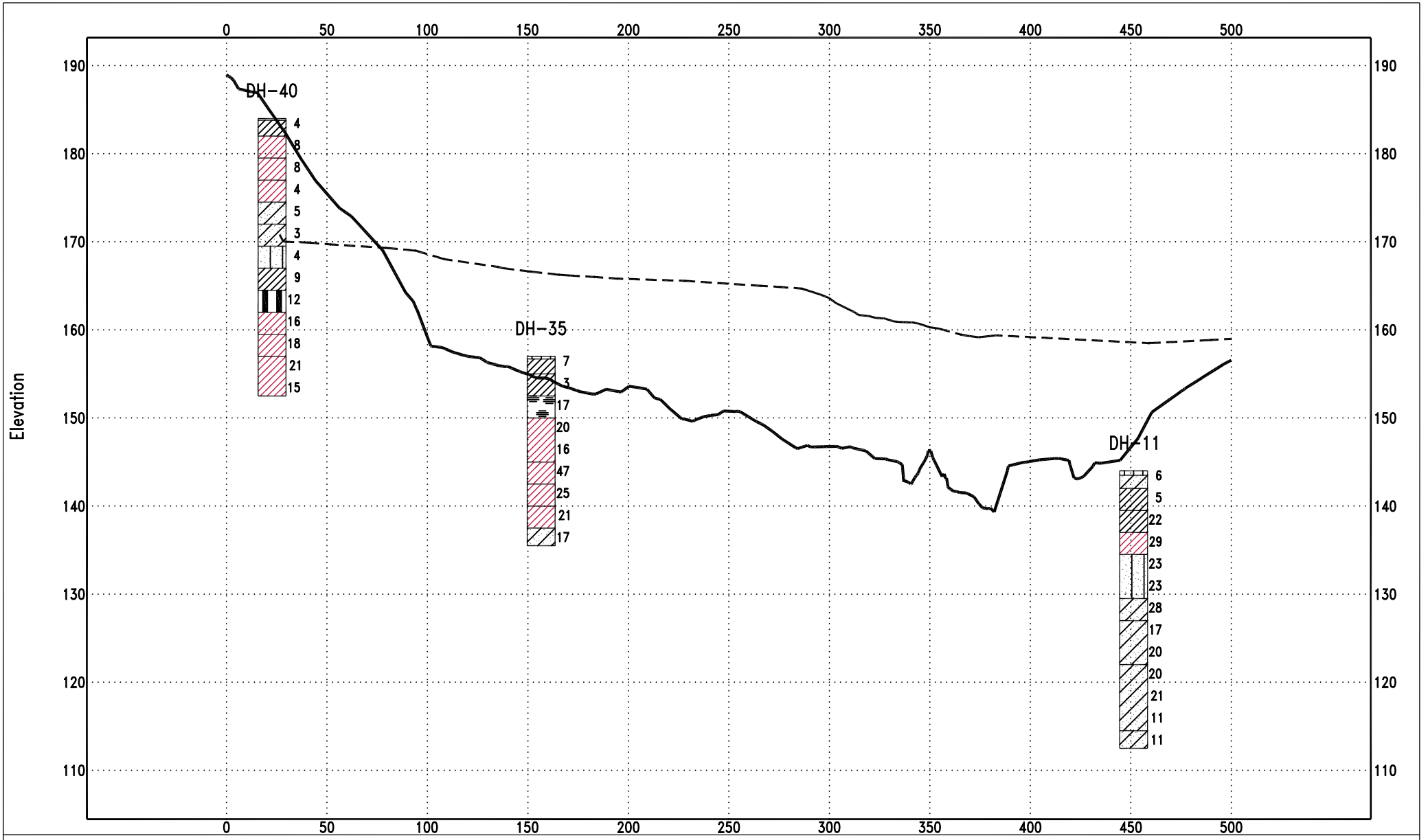
SHEET REFERENCE NUMBER	CF-100
	ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT ARLINGTON, VIRGINIA
	EXCAVATION AND FILL PLAN
	NORFOLK DISRTICT CORPS OF ENGINEERS NORFOLK, VIRGINIA
	FINAL REPORT
DESIGNED:	CHECKED: RGD
DRAWN: RLH	SUBMITTED:
DATE:	Apr. 2013
SCALE:	AS SHOWN
PROJECT NO.	XXXXXX
NORFOLK DISTRICT FILE NO.	XXXXXXXX-
DRAWING NO.	XXX-XX-XX
SPECIFICATION NO.	
Last worked on:	Plot scale: 1:1
File name:	

MARK	DATE	DESCRIPTION	BY	APP.

US Army Corps of Engineers
Norfolk District

Appendix B - Soil Boring Logs and Subsurface Profiles

Soil Boring Logs have not been included in the specifications but are shown in the Project Plans.



Graphic Symbol Legend

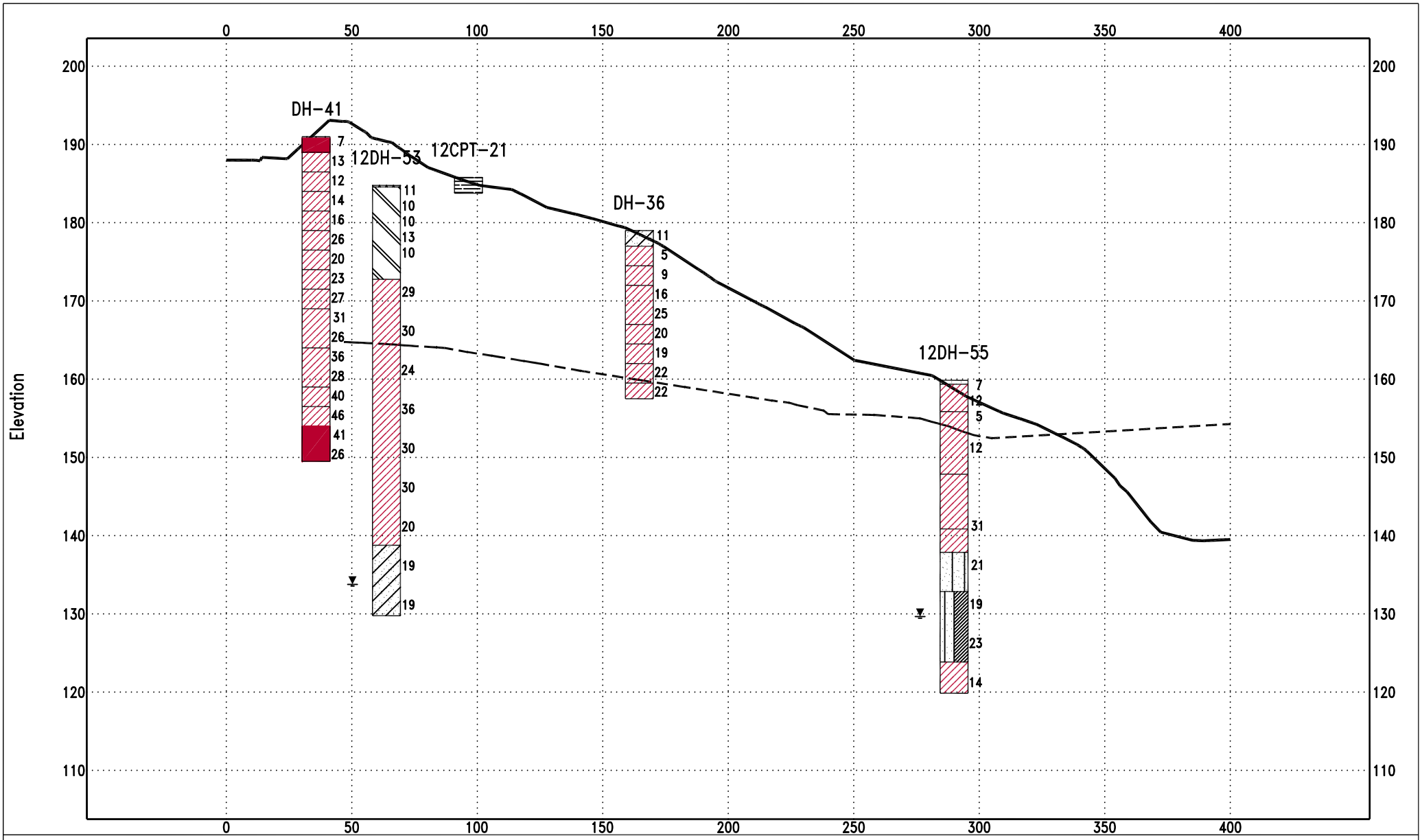
- Asphalt
- Bedrock
- Fat clay, high plasticity
- Lean clay, low to moderate plasticity
- USCS Low to High Plasticity Clay
- Fill
- Clayey gravel
- Silty gravel
- USCS Poorly-graded Gravel with Clay
- USCS Poorly-graded Gravel with Silt
- Elastic silt
- Low to moderate plasticity silt
- Clayey sand
- Silty Sand
- Silty Sand to clayey sand
- Clean, poorly graded sand to silty sand

Project: Millennium Expansion
Installation: ANC
Location: Arilington, Virginia
Date:

Profile A

LEGEND

- Existing Ground Surface
- Proposed Finish Elevation



Graphic Symbol Legend

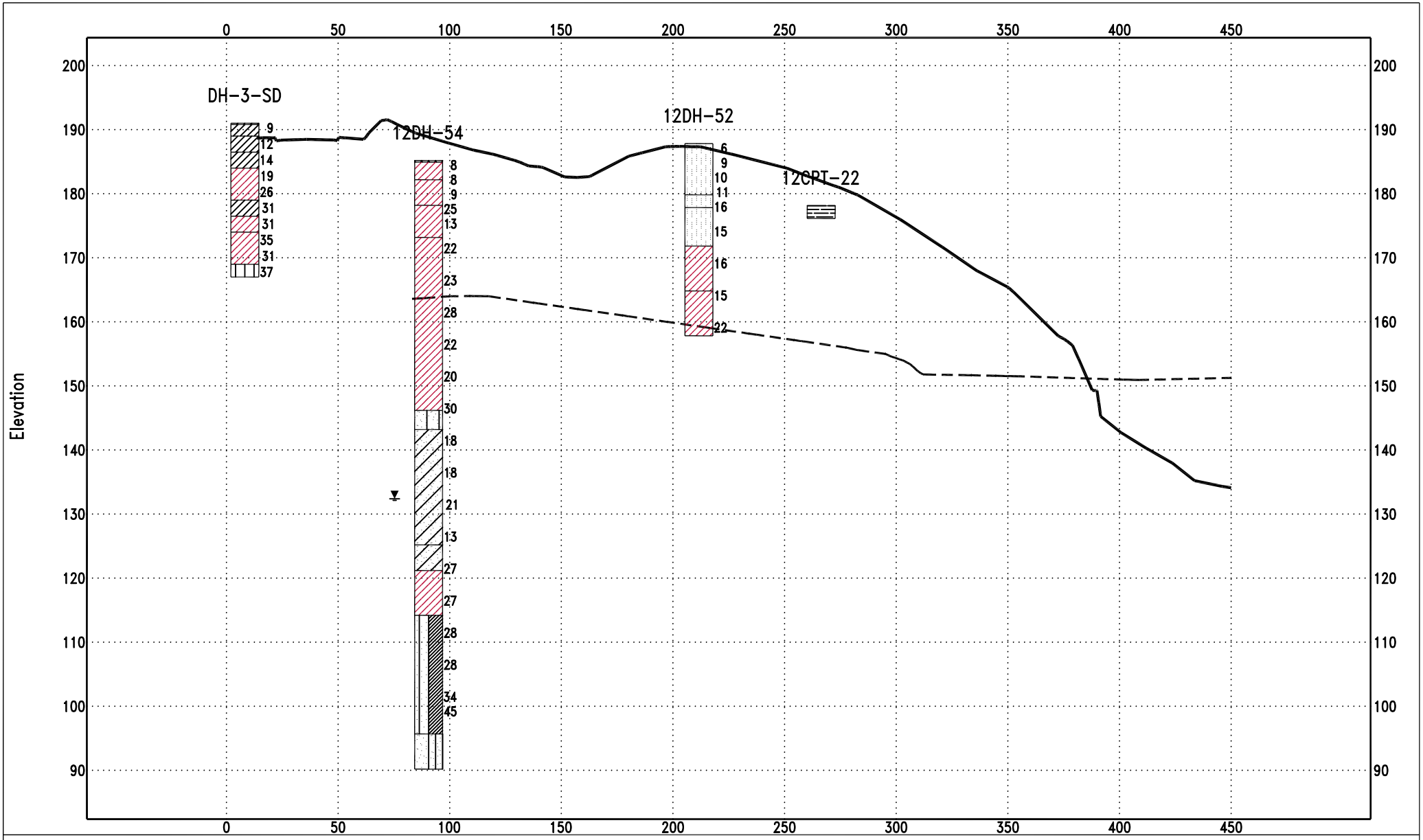
- Asphalt
- Bedrock
- Fat clay, high plasticity
- Lean clay, low to moderate plasticity
- USCS Low to High Plasticity Clay
- Fill
- Clayey gravel
- Silty gravel
- USCS Poorly-graded Gravel with Clay
- USCS Poorly-graded Gravel with Silt
- Elastic silt
- Low to moderate plasticity silt
- Clayey sand
- Silty Sand
- Silty Sand to clayey sand
- Clean, poorly graded sand to silty sand

Project: Millennium Expansion
Installation: ANC
Location: Arilington, Virginia
Date:

Profile B

LEGEND

- Existing Ground Surface
- Proposed Finish Elevation



Graphic Symbol Legend

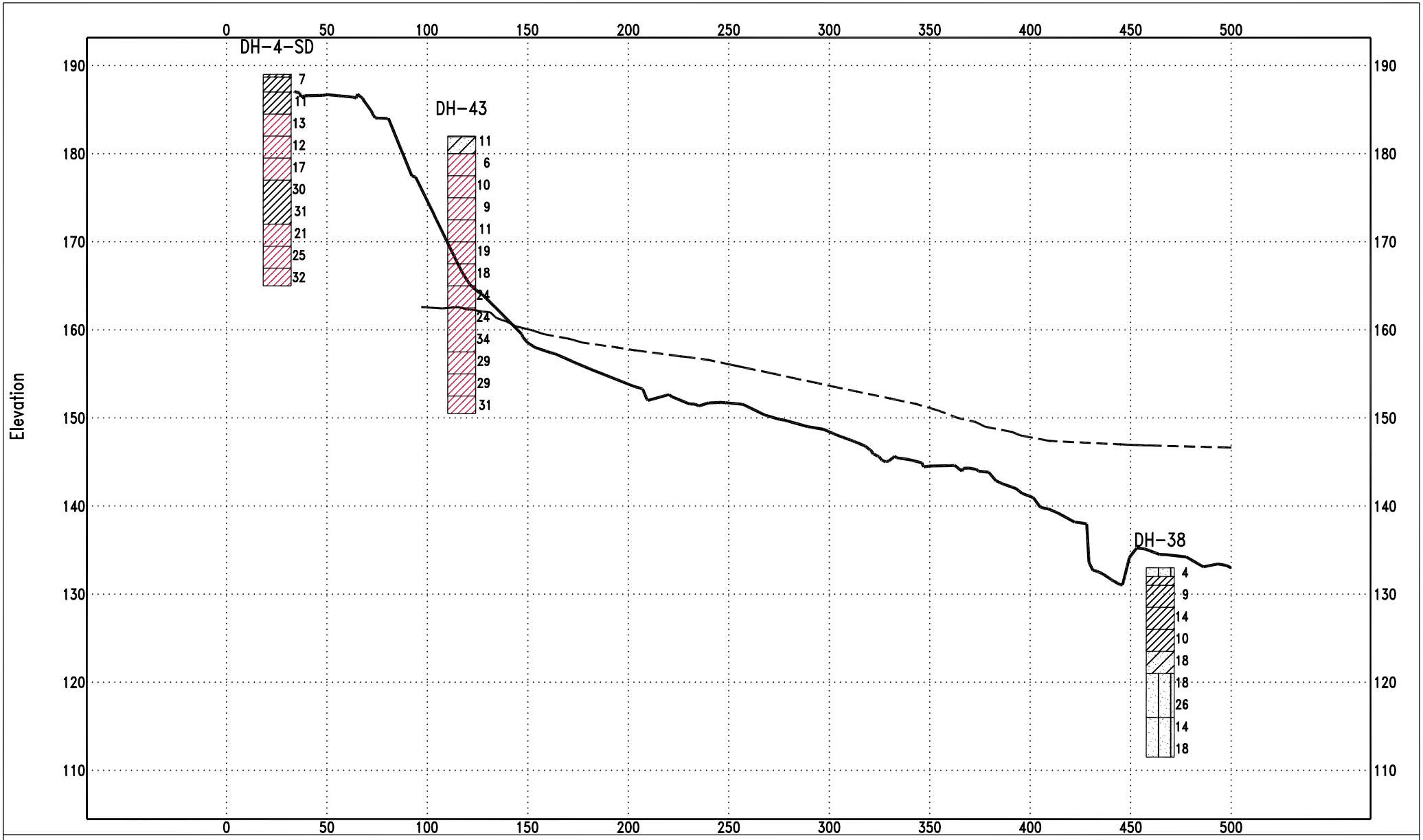
- Asphalt
- Bedrock
- Fat clay, high plasticity
- Lean clay, low to moderate plasticity
- USCS Low to High Plasticity Clay
- Fill
- Clayey gravel
- Silty gravel
- USCS Poorly-graded Gravel with Clay
- USCS Poorly-graded Gravel with Silt
- Elastic silt
- Low to moderate plasticity silt
- Clayey sand
- Silty Sand
- Silty Sand to clayey sand
- Clean, poorly graded sand to silty sand

Project: Millennium Expansion
Installation: ANC
Location: Arilington, Virginia
Date:

Profile C

LEGEND

- Existing Ground Surface
- Proposed Finish Elevation



Graphic Symbol Legend

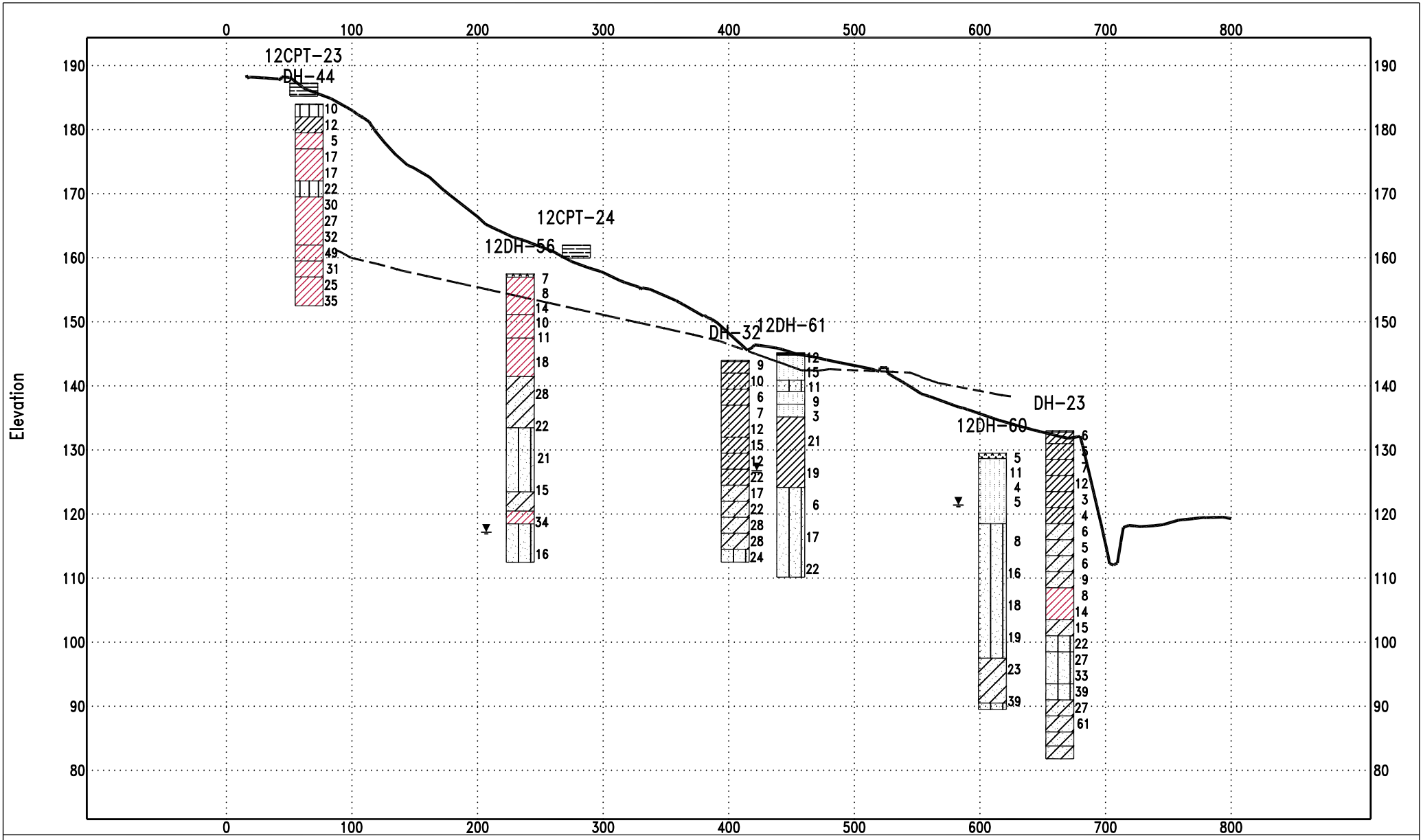
- Asphalt
- Bedrock
- Fat clay, high plasticity
- Lean clay, low to moderate plasticity
- USCS Low to High Plasticity Clay
- Fill
- Clayey gravel
- Silty gravel
- USCS Poorly-graded Gravel with Clay
- USCS Poorly-graded Gravel with Silt
- Elastic silt
- Low to moderate plasticity silt
- Clayey sand
- Silty Sand
- Silty Sand to clayey sand
- Clean, poorly graded sand to silty sand

Project: Millennium Expansion
Installation: ANC
Location: Arilington, Virginia
Date:

Profile D

LEGEND

- Existing Ground Surface
- Proposed Finish Elevation



Graphic Symbol Legend

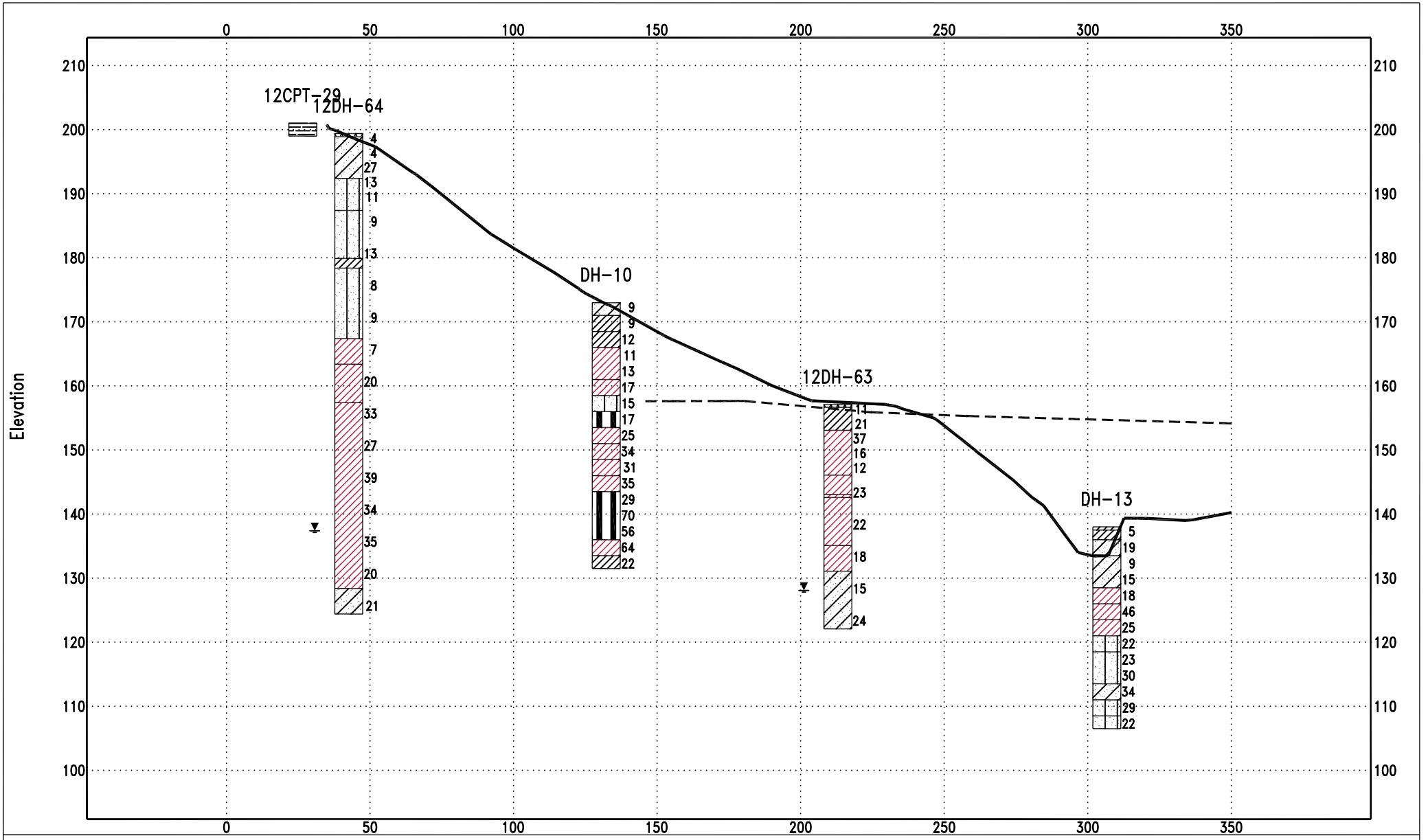
- Asphalt
- Bedrock
- Fat clay, high plasticity
- Lean clay, low to moderate plasticity
- USCS Low to High Plasticity Clay
- Fill
- Clayey gravel
- Silty gravel
- USCS Poorly-graded Gravel with Clay
- USCS Poorly-graded Gravel with Silt
- Elastic silt
- Low to moderate plasticity silt
- Clayey sand
- Silty Sand
- Silty Sand to clayey sand
- Clean, poorly graded sand to silty sand

Project: Millennium Expansion
Installation: ANC
Location: Arilington, Virginia
Date:

Profile E

LEGEND

- Existing Ground Surface
- Proposed Finish Elevation



Graphic Symbol Legend

- Asphalt
- Bedrock
- Fat clay, high plasticity
- Lean clay, low to moderate plasticity
- USCS Low to High Plasticity Clay
- Fill
- Clayey gravel
- Silty gravel
- USCS Poorly-graded Gravel with Clay
- USCS Poorly-graded Gravel with Silt
- Elastic silt
- Low to moderate plasticity silt
- Clayey sand
- Silty Sand
- Silty Sand to clayey sand
- Clean, poorly graded sand to silty sand

Project: Millennium Expansion
Installation: ANC
Location: Arilington, Virginia
Date:

Profile G

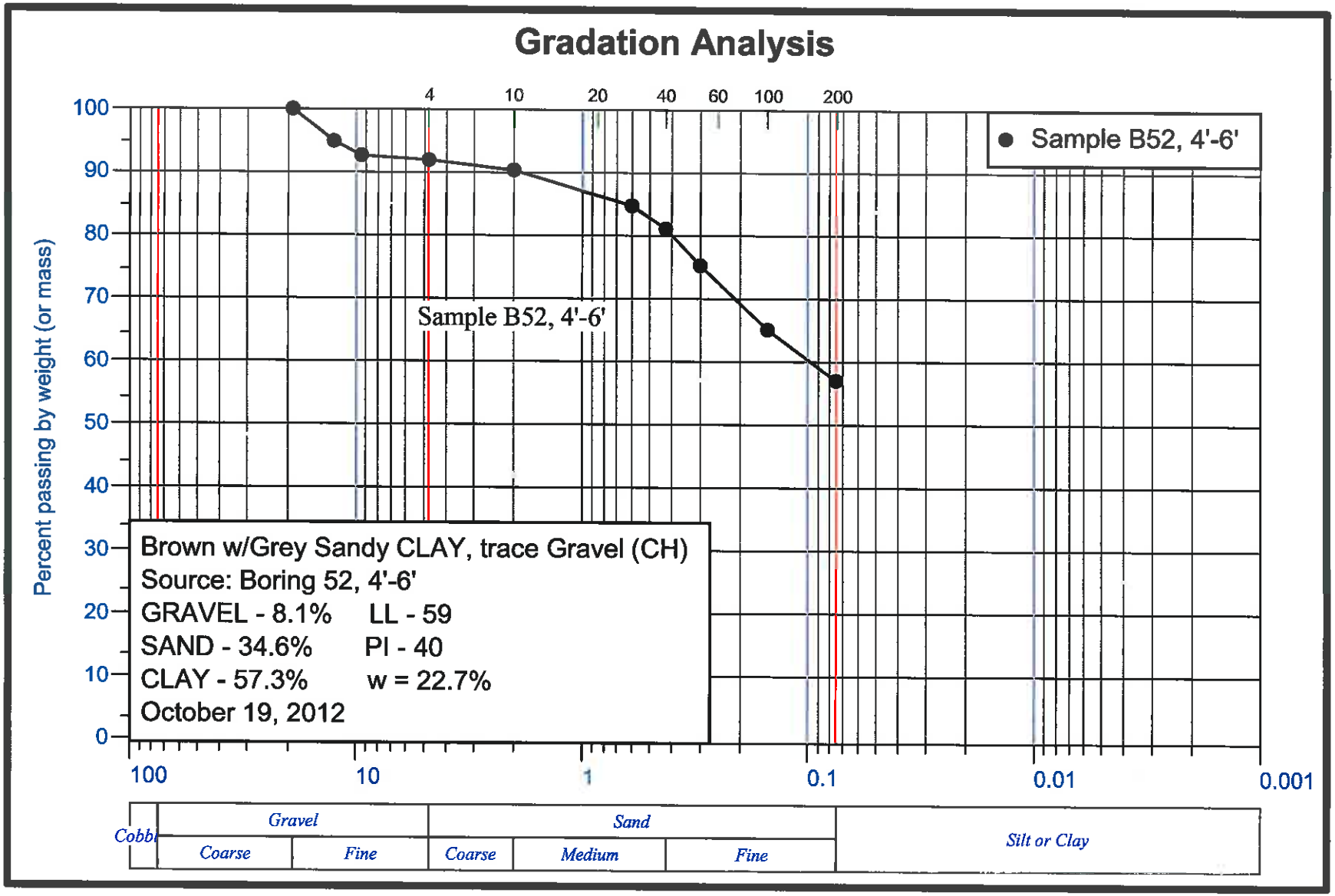
LEGEND

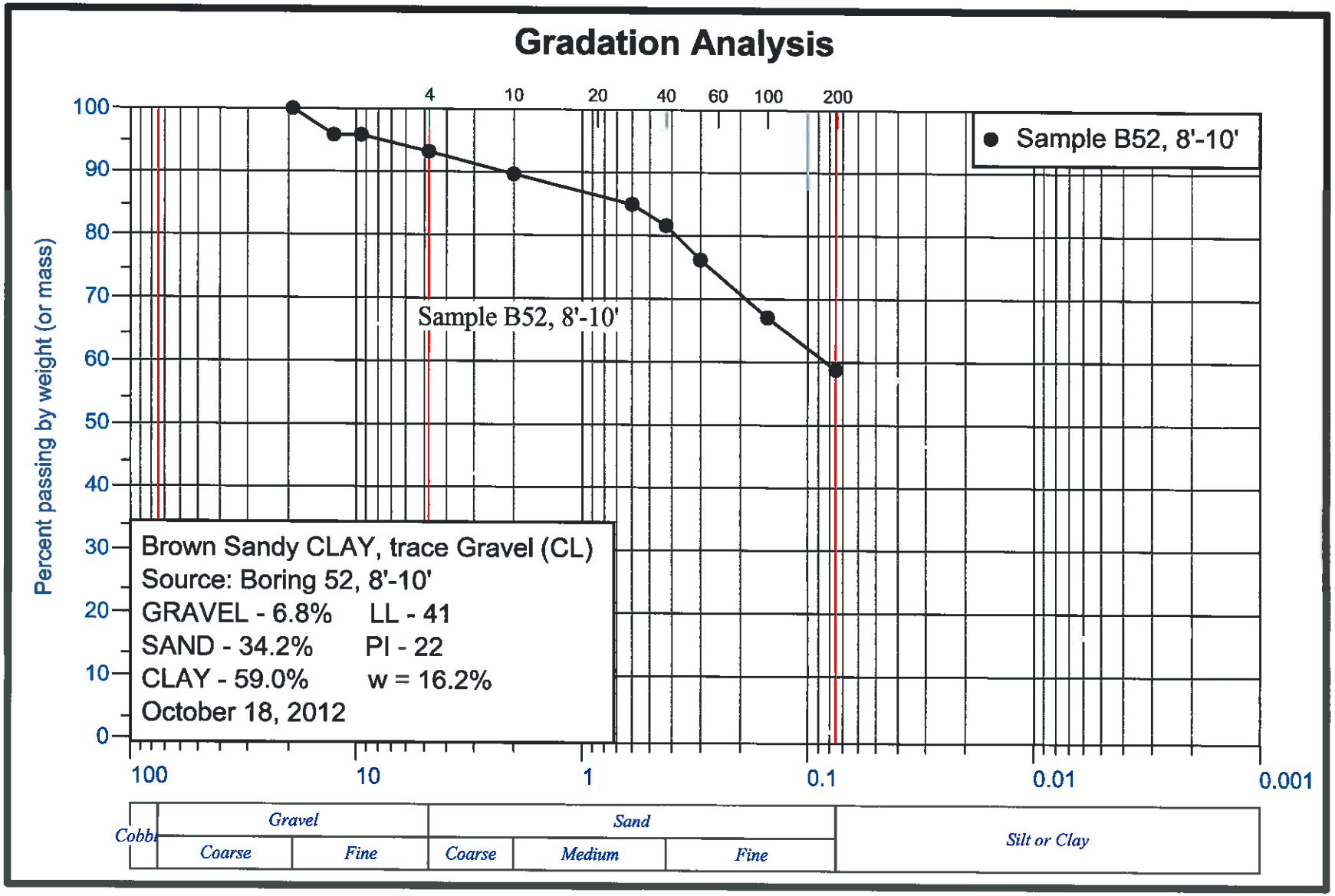
- Existing Ground Surface
- Proposed Finish Elevation

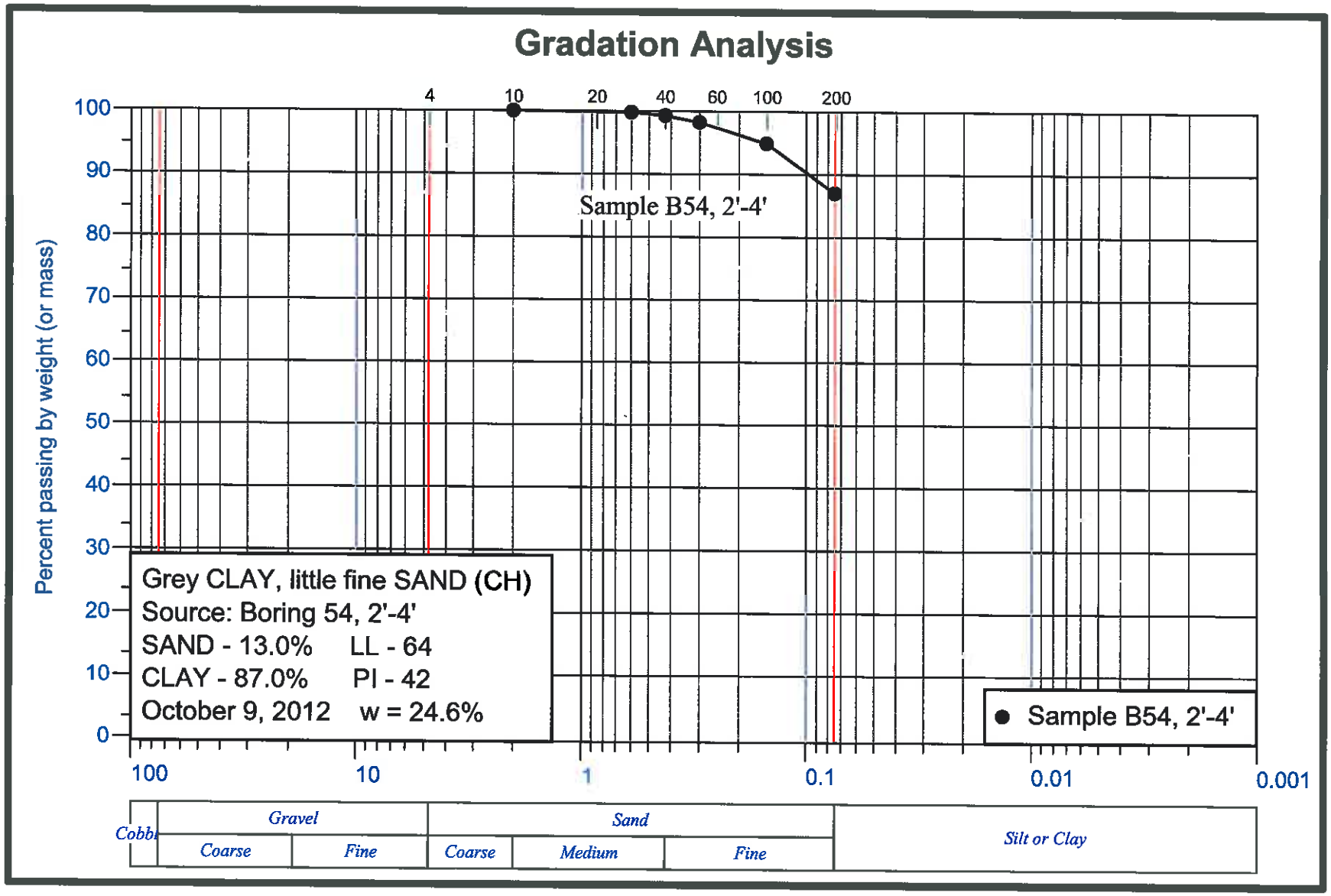
Appendix C - In-situ Testing Results

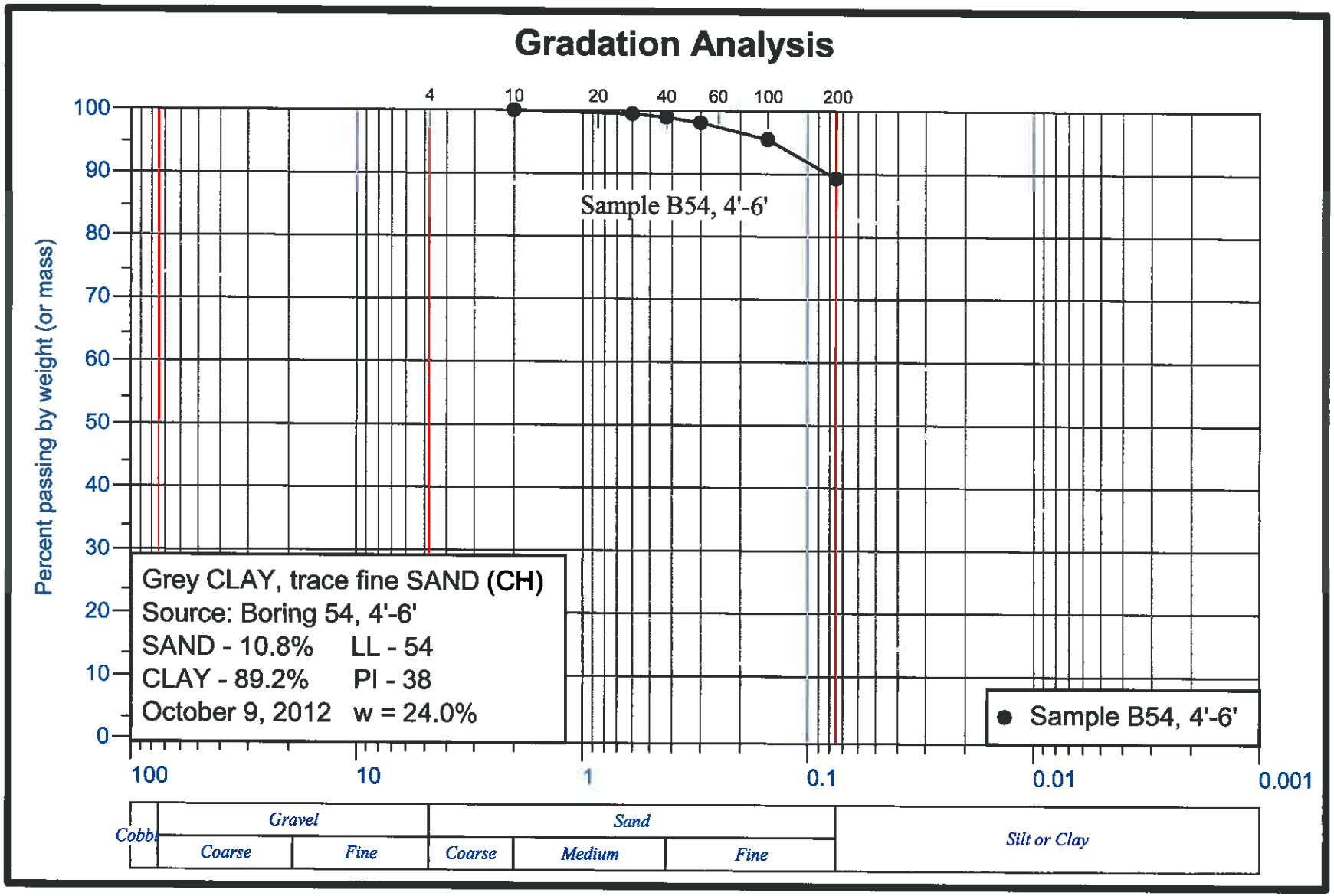
In-situ Testing Results have not been included in the specifications but are shown in the Project Plans.

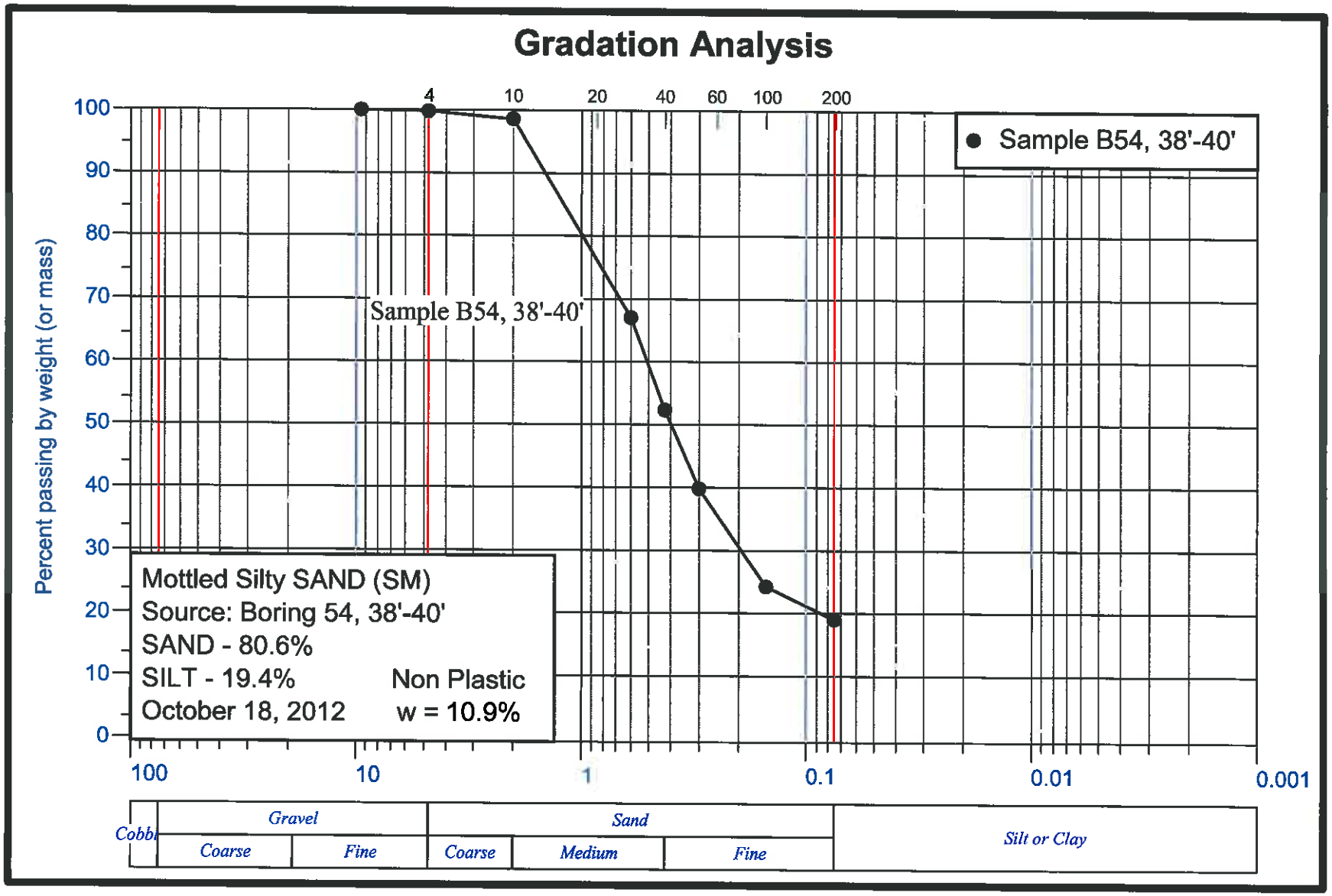
Appendix D - Geotechnical Laboratory Testing Results

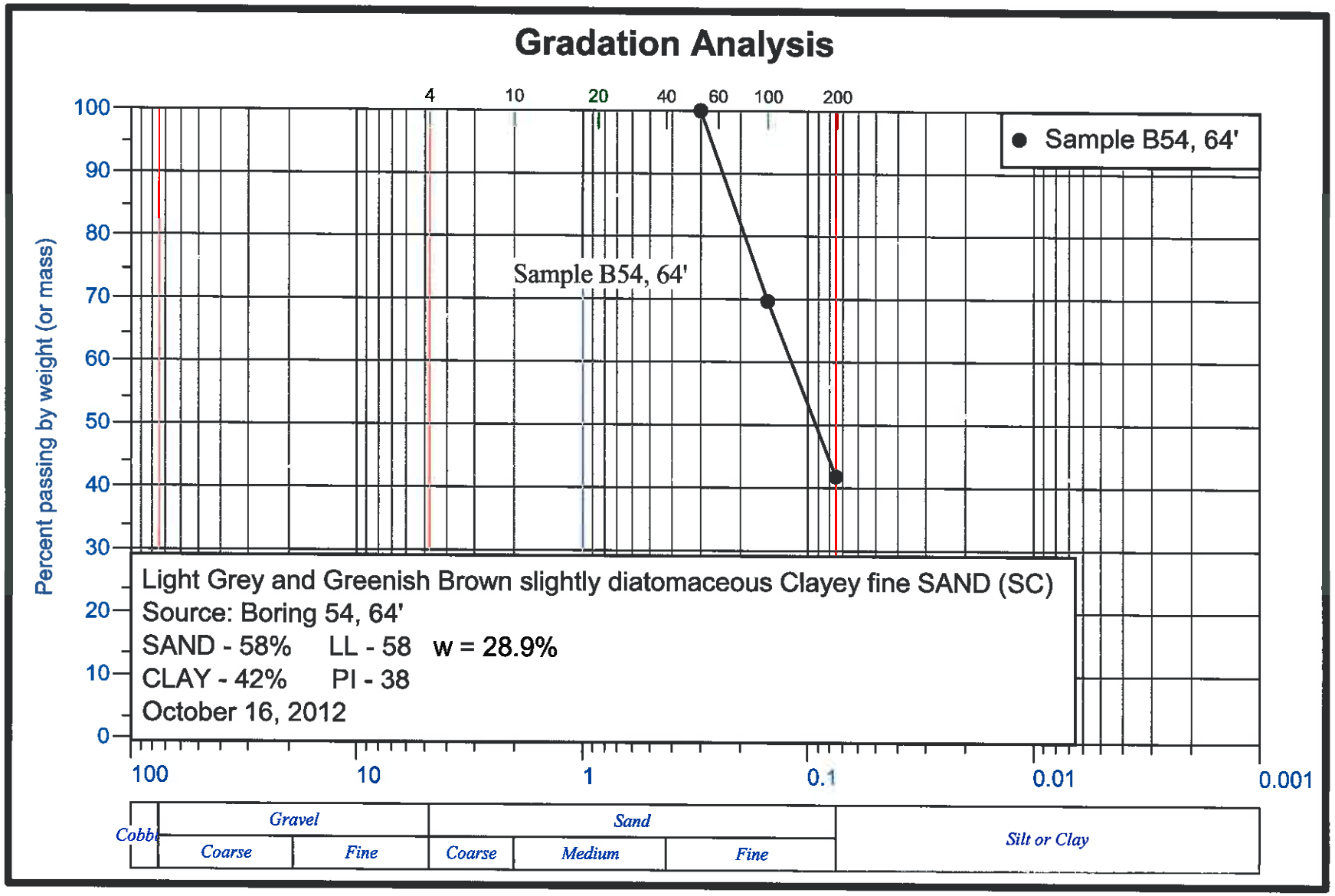

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B52, 4'-6'
Sample B52, 4'-6'
Brown w/Grey Sandy CLAY, trace Gravel (CH)
Source: Boring 52, 4'-6'
GRAVEL - 8.1%
LL - 59
SAND - 34.6%
PI - 40
CLAY - 57.3%
w = 22.7%
October 19, 2012
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

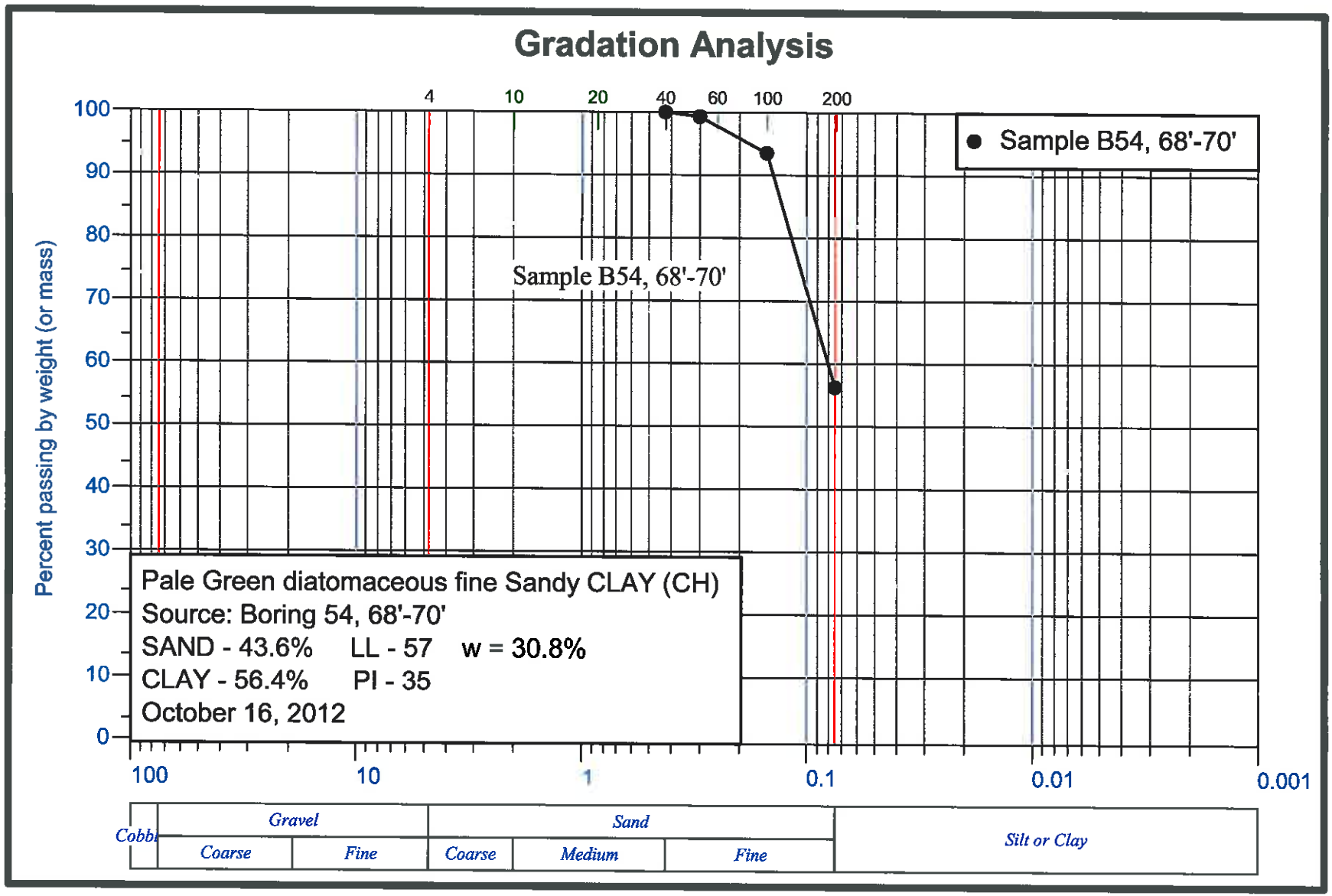

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B52, 8'-10'
Sample B52, 8'-10'
Brown Sandy CLAY, trace Gravel (CL)
Source: Boring 52, 8'-10'
GRAVEL - 6.8%
LL - 41
SAND - 34.2%
PI - 22
CLAY - 59.0%
w = 16.2%
October 18, 2012
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

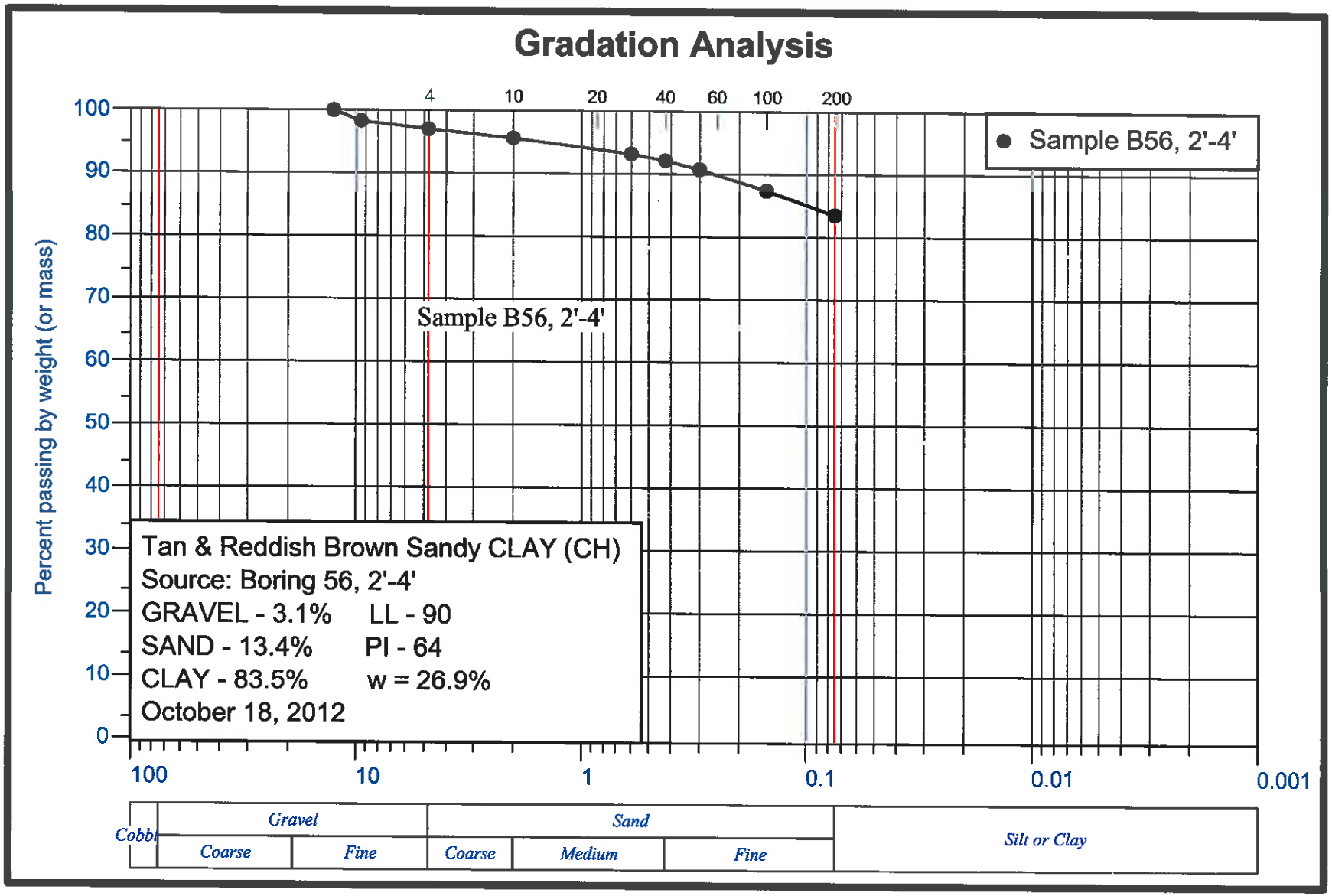

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B54, 2'-4'
Grey CLAY, little fine SAND (CH)
Source: Boring 54, 2'-4'
SAND - 13.0% LL - 64
CLAY - 87.0% PI - 42
October 9, 2012 w = 24.6%
Sample B54, 2'-4'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

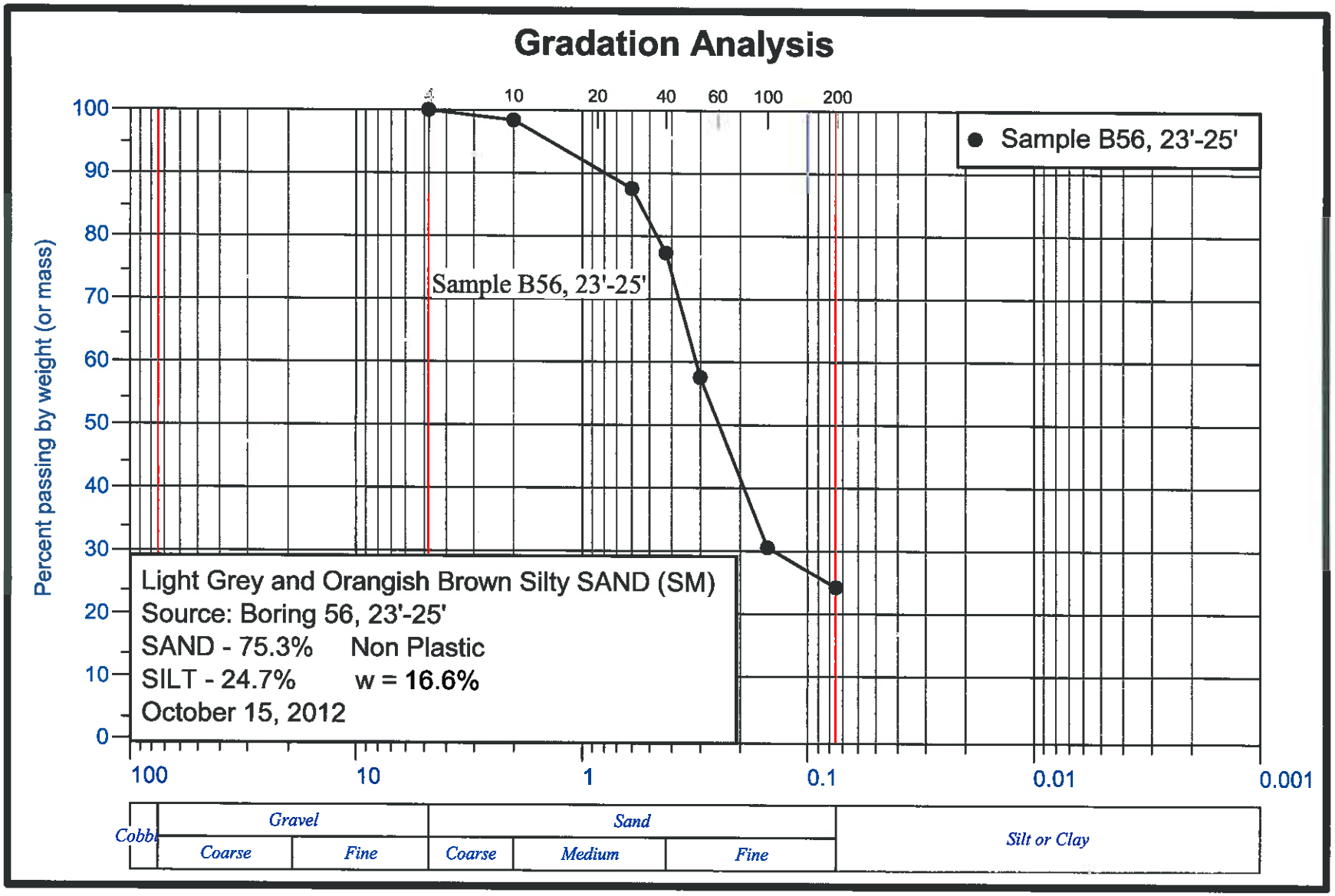

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B54, 4'-6'
Grey CLAY, trace fine SAND (CH)
Source: Boring 54, 4'-6'
SAND - 10.8% LL - 54
CLAY - 89.2% PI - 38
October 9, 2012 w = 24.0%
Sample B54, 4'-6'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

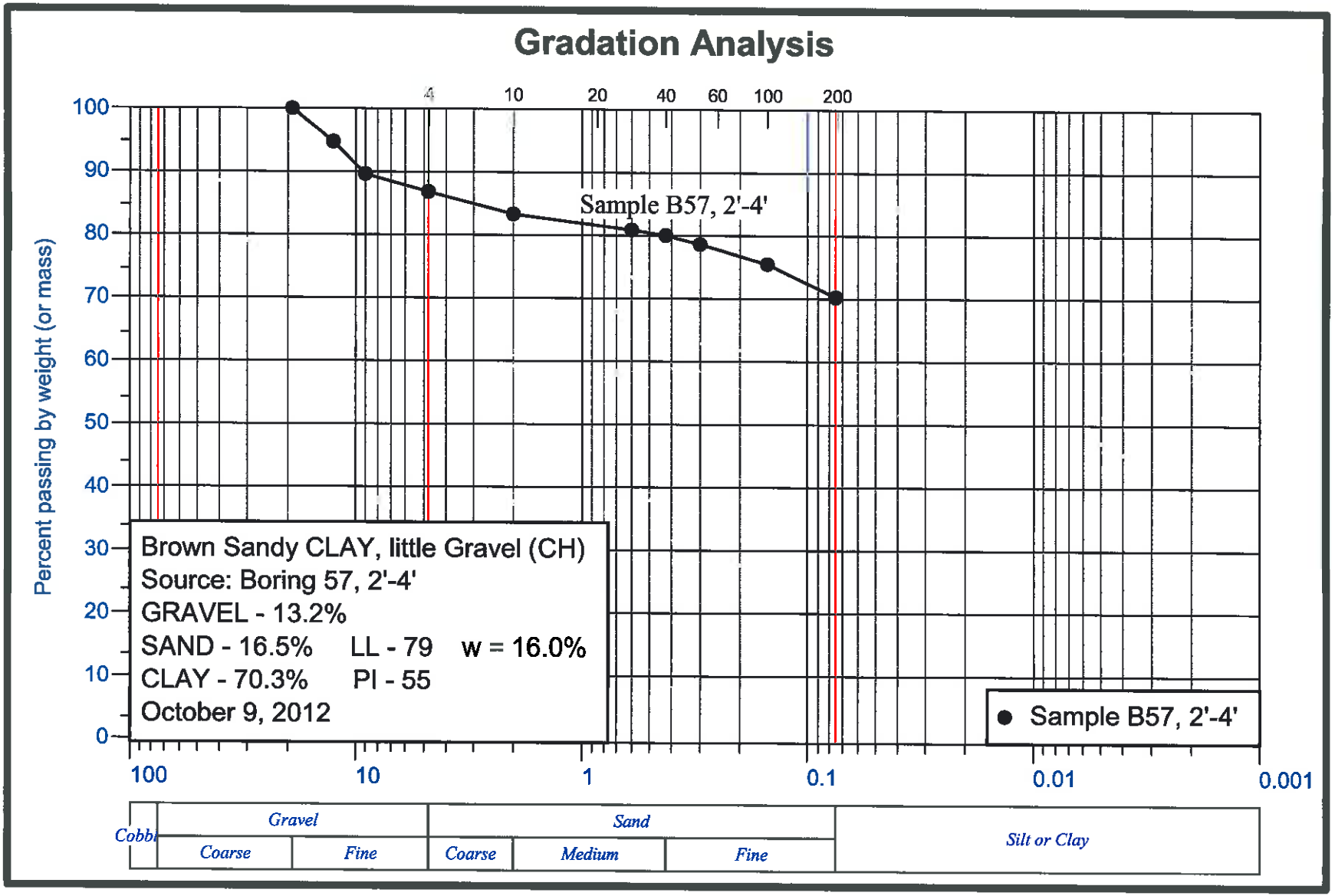

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B54, 38'-40'
Sample B54, 38'-40'
Mottled Silty SAND (SM)
Source: Boring 54, 38'-40'
SAND - 80.6%
SILT - 19.4%
Non Plastic
October 18, 2012
w = 10.9%
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

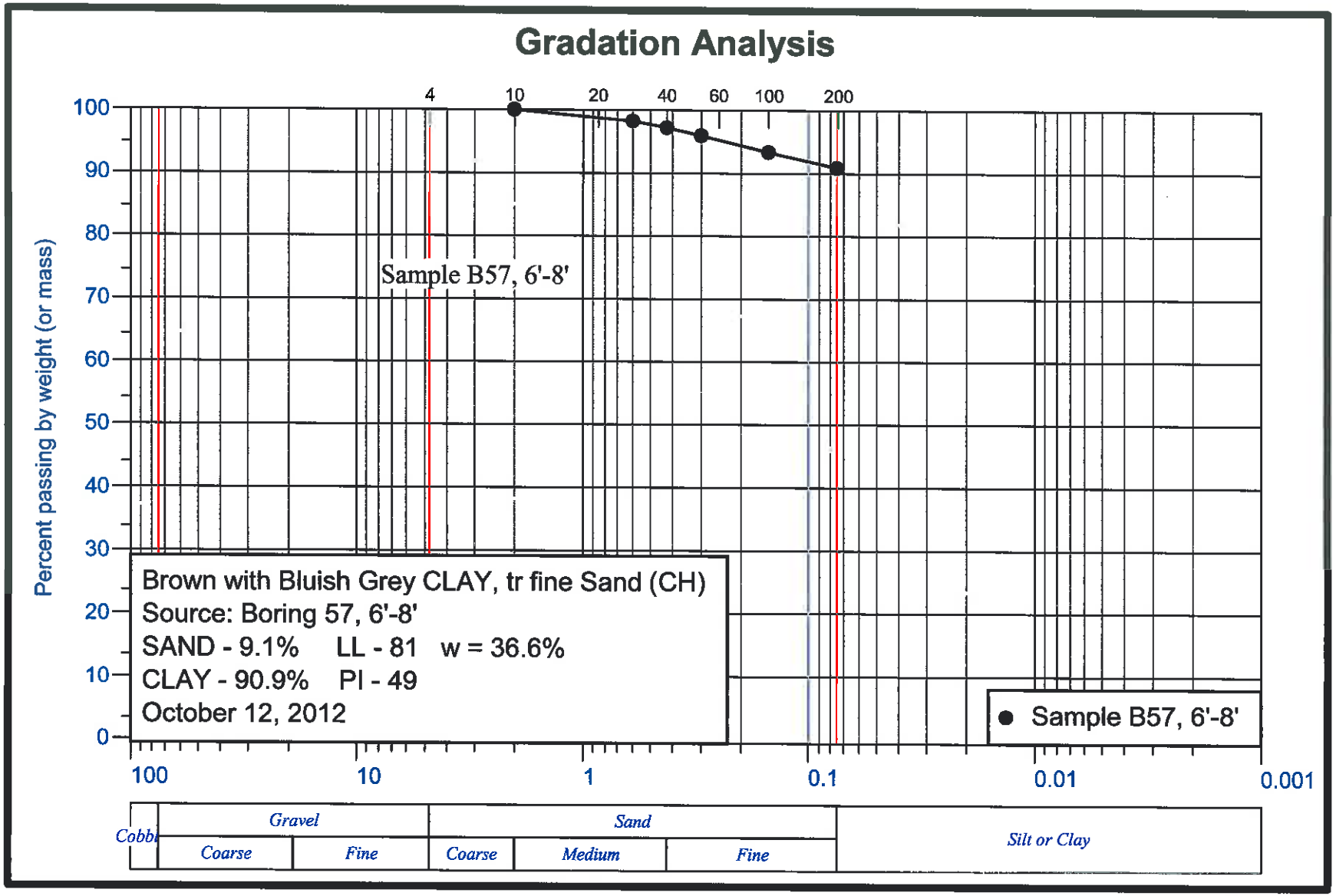

Gradation Analysis
4
10
20
40
60
100
200
Sample B54, 64'
Sample B54, 64'
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
Light Grey and Greenish Brown slightly diatomaceous Clayey fine SAND (SC)
Source: Boring 54, 64'
SAND - 58% LL - 58 w = 28.9%
CLAY - 42% PI - 38
October 16, 2012
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

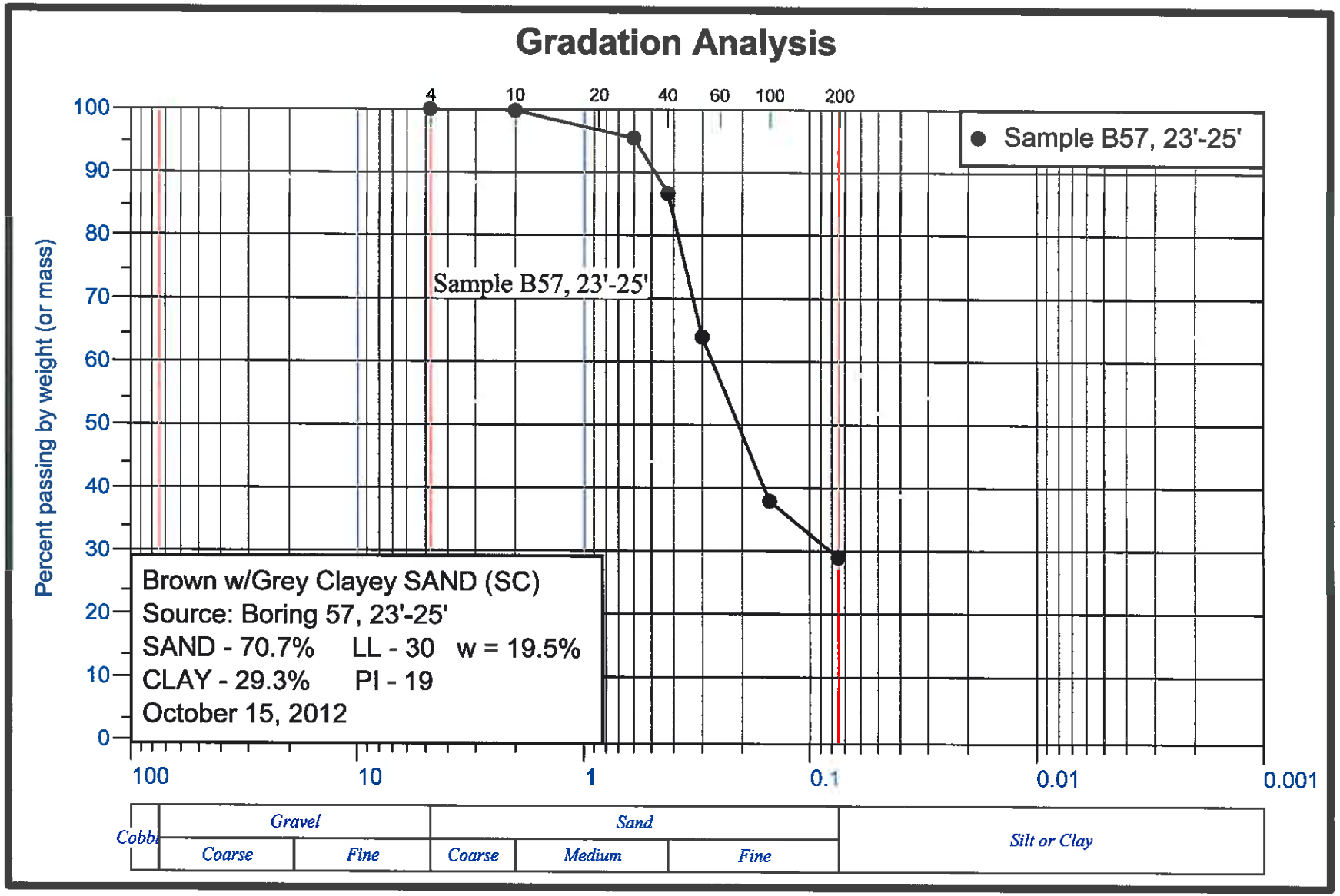

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B54, 68'-70'
Sample B54, 68'-70'
Pale Green diatomaceous fine Sandy CLAY (CH)
Source: Boring 54, 68'-70'
SAND - 43.6% LL - 57 w = 30.8%
CLAY - 56.4% PI - 35
October 16, 2012
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

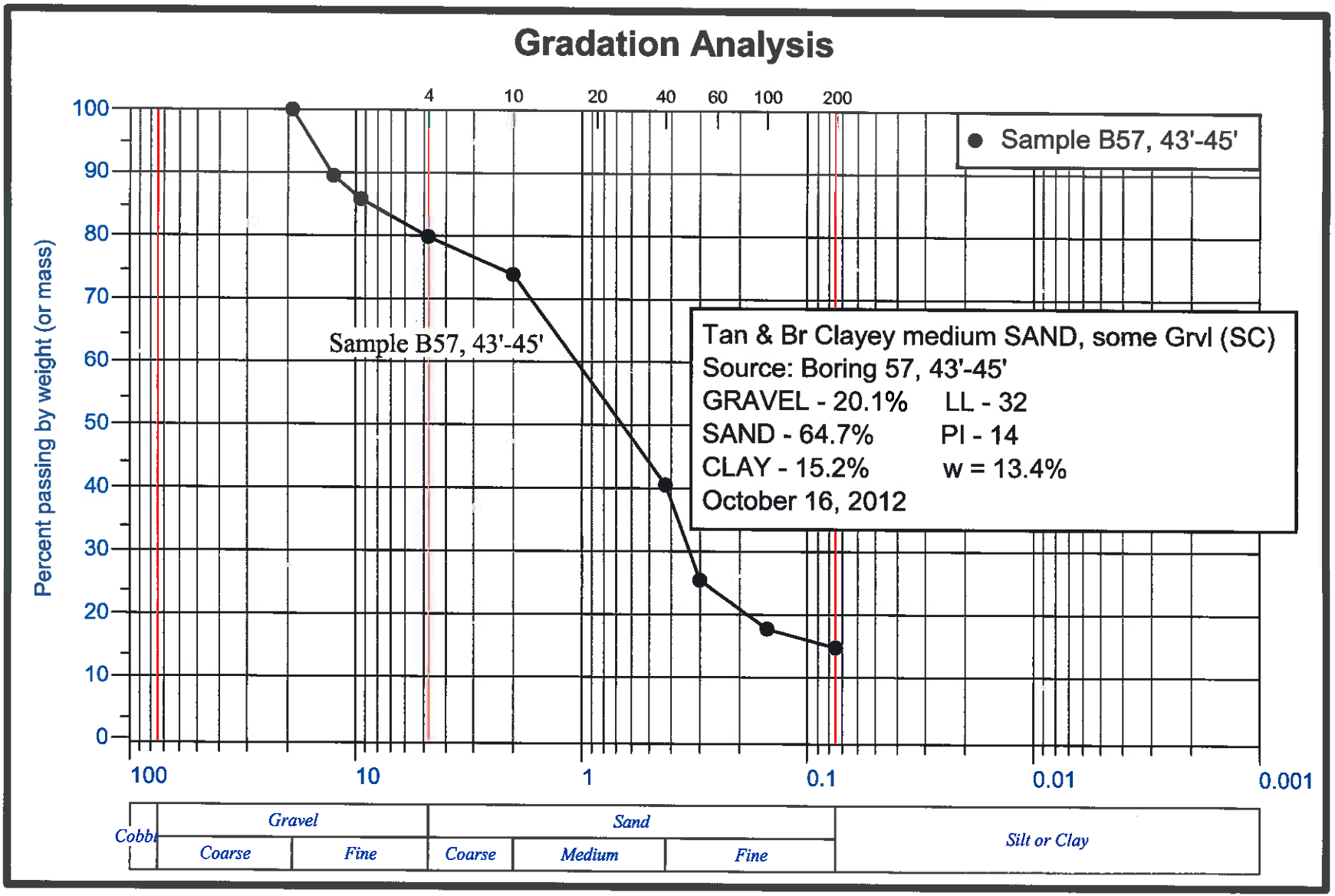

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B56, 2'-4'
Sample B56, 2'-4'
Tan & Reddish Brown Sandy CLAY (CH)
Source: Boring 56, 2'-4'
GRAVEL - 3.1%
LL - 90
SAND - 13.4%
PI - 64
CLAY - 83.5%
w = 26.9%
October 18, 2012
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

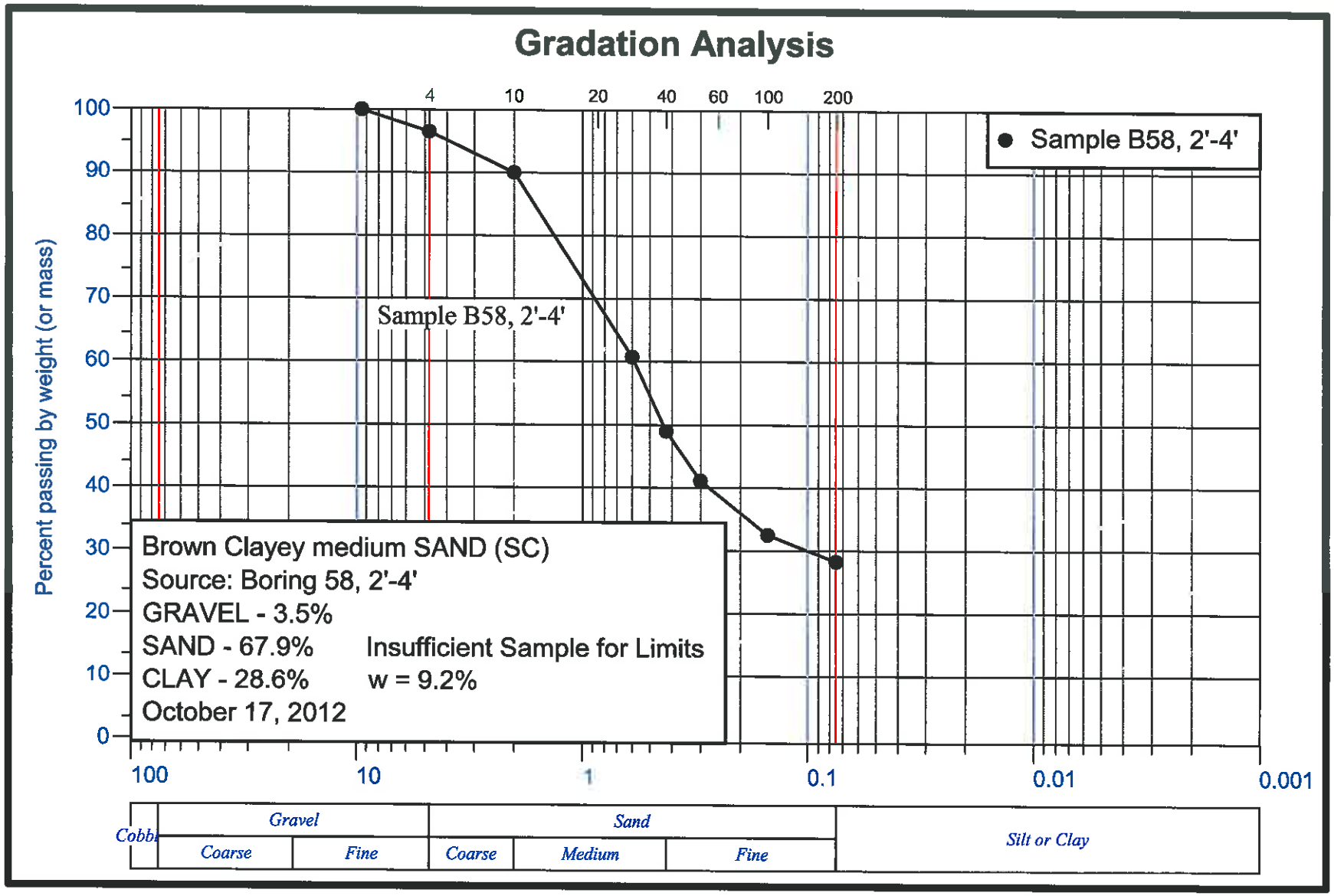

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B56, 23'-25'
Sample B56, 23'-25'
Light Grey and Orangish Brown Silty SAND (SM)
Source: Boring 56, 23'-25'
SAND - 75.3% Non Plastic
SILT - 24.7% w = 16.6%
October 15, 2012
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

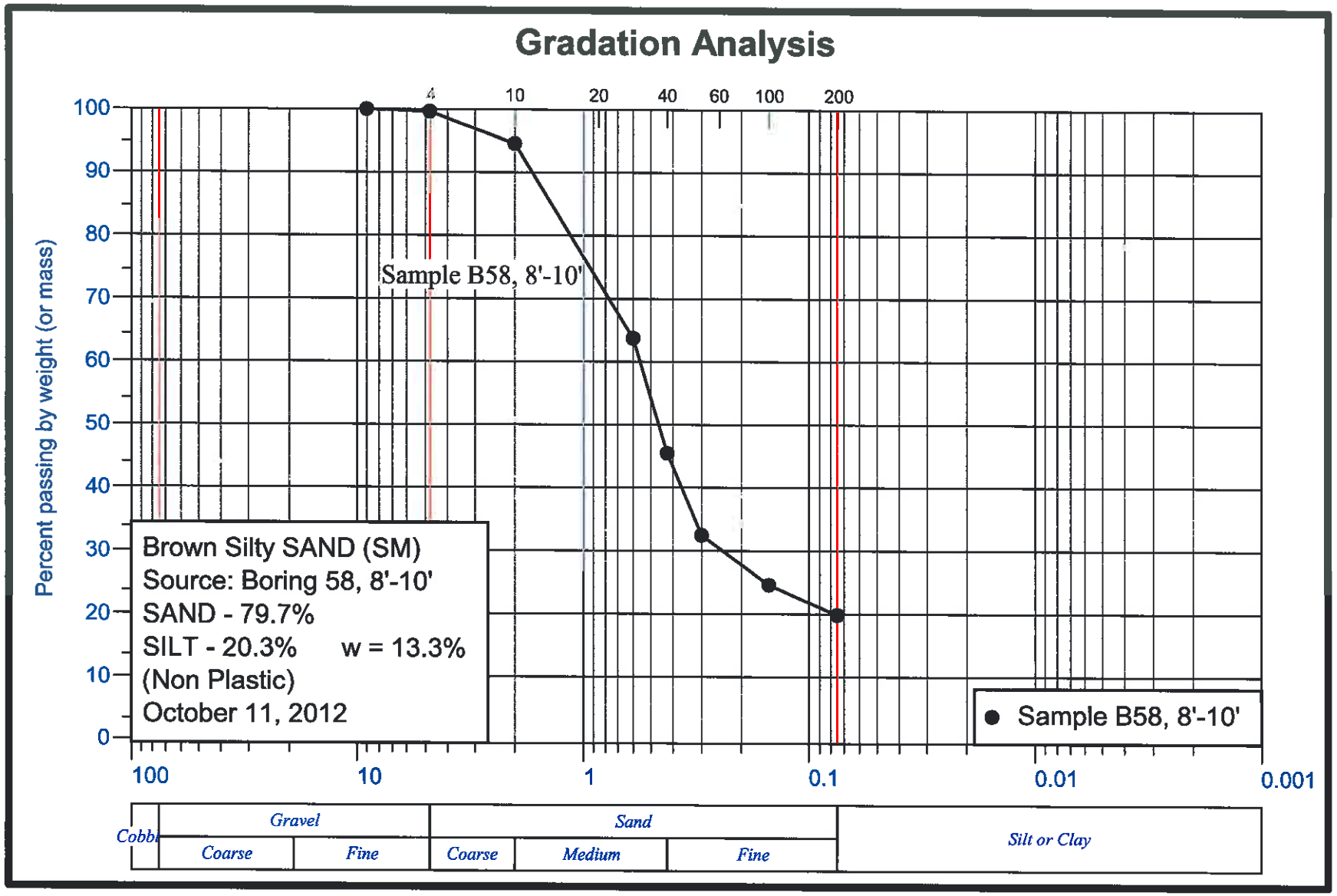

Gradation Analysis
4
10
20
40
60
100
200
100
90
80
70
60
50
40
30
20
10
0
Percent passing by weight (or mass)
Sample B57, 2'-4'
Brown Sandy CLAY, little Gravel (CH)
Source: Boring 57, 2'-4'
GRAVEL - 13.2%
SAND - 16.5% LL - 79 w = 16.0%
CLAY - 70.3% PI - 55
October 9, 2012
Sample B57, 2'-4'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

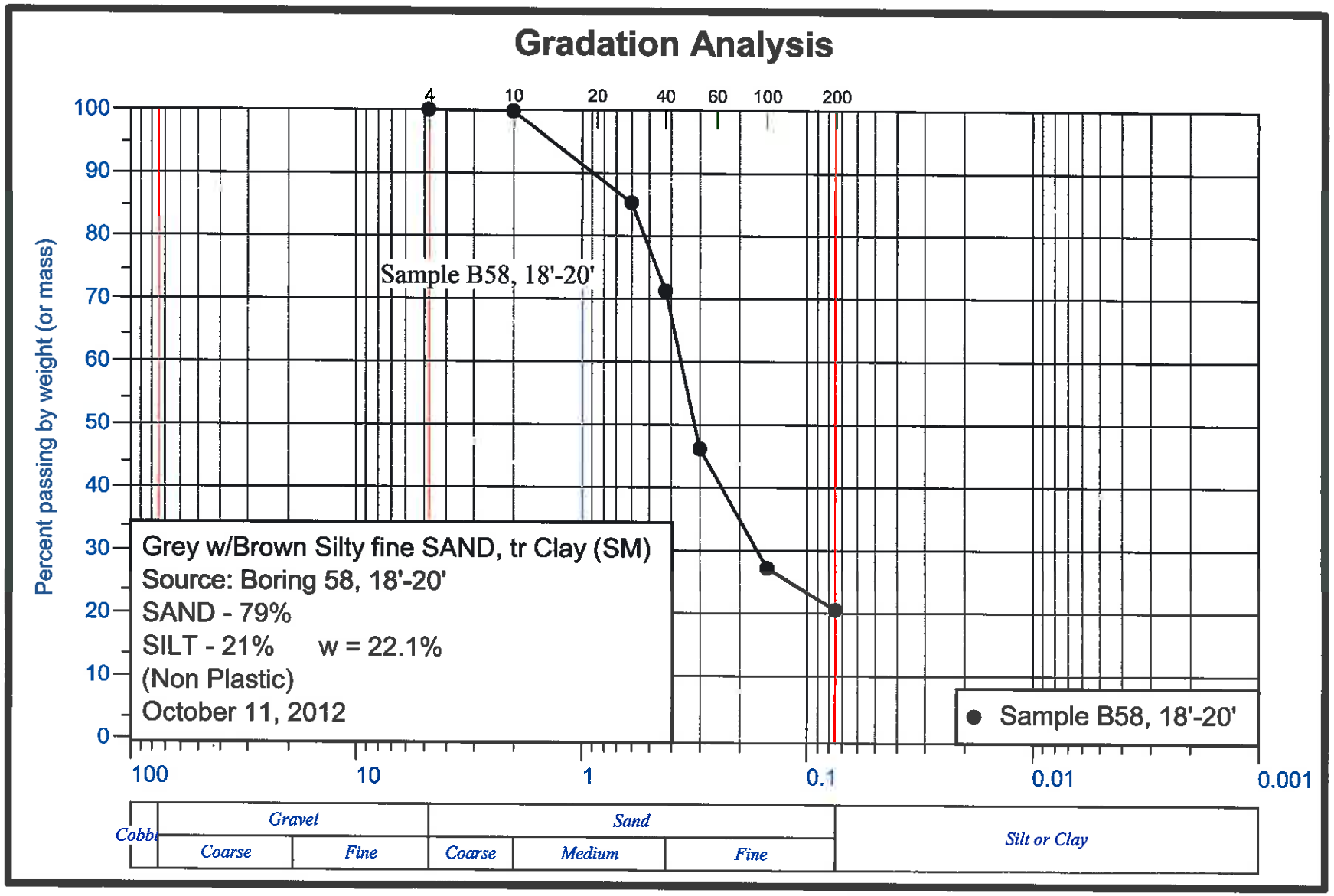

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B57, 6'-8'
Brown with Bluish Grey CLAY, tr fine Sand (CH)
Source: Boring 57, 6'-8'
SAND - 9.1% LL - 81 w = 36.6%
CLAY - 90.9% PI - 49
October 12, 2012
Sample B57, 6'-8'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

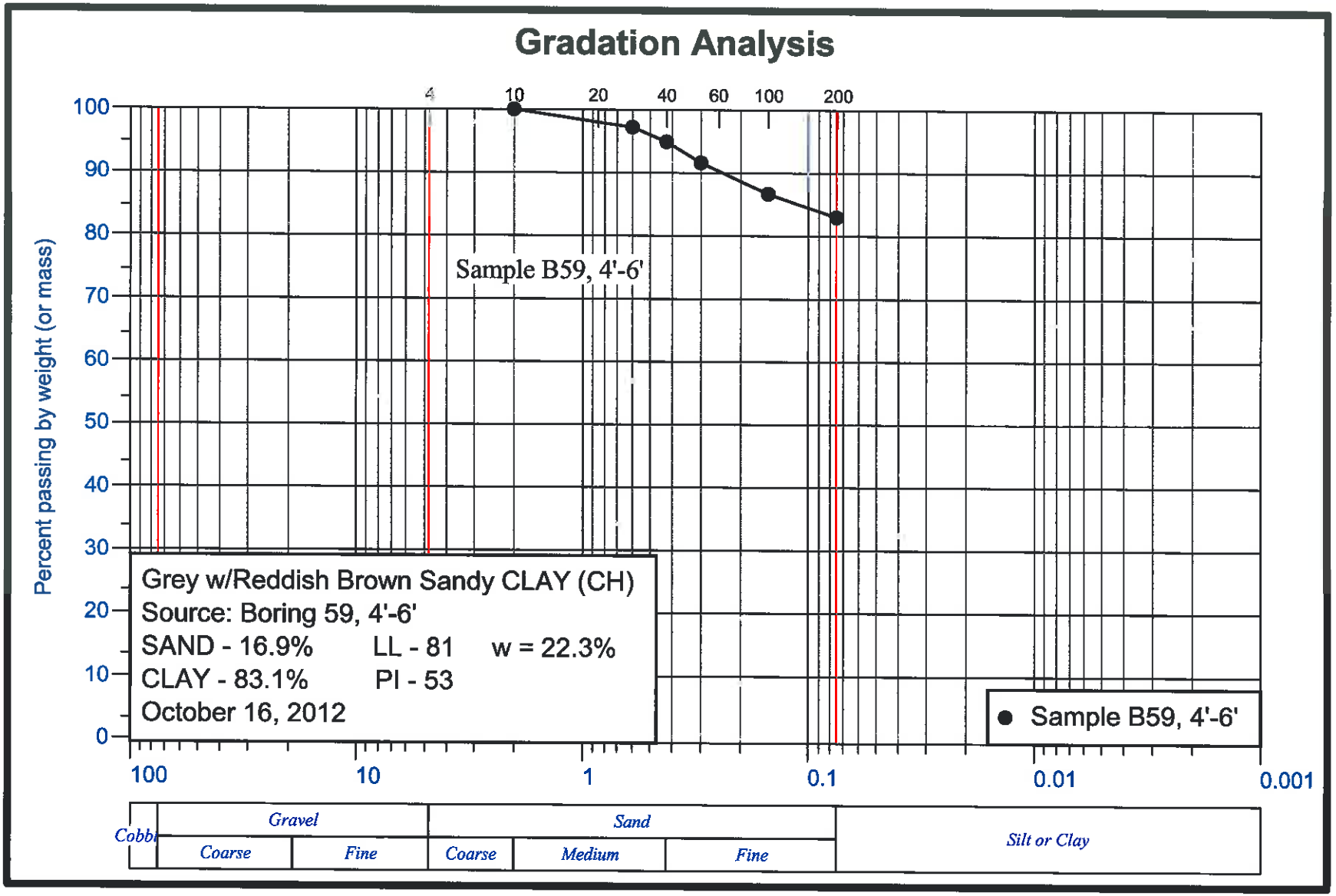

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B57, 23'-25'
Sample B57, 23'-25'
Brown w/Grey Clayey SAND (SC)
Source: Boring 57, 23'-25'
SAND - 70.7% LL - 30 w = 19.5%
CLAY - 29.3% PI - 19
October 15, 2012
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

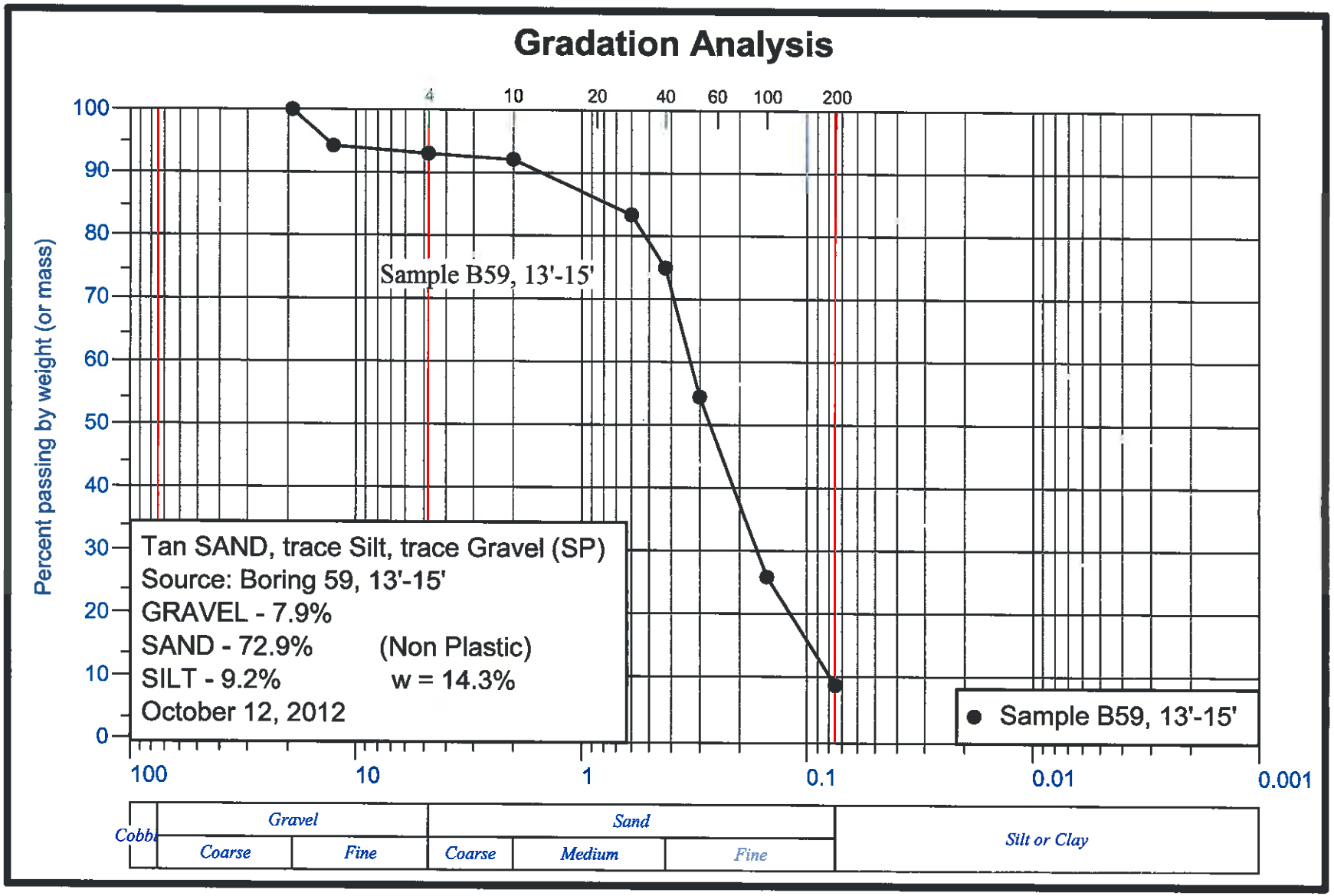

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
100
10
1
0.1
0.01
0.001
Sample B57, 43'-45'
Sample B57, 43'-45'
Tan & Br Clayey medium SAND, some Grvl (SC)
Source: Boring 57, 43'-45'
GRAVEL - 20.1%
LL - 32
SAND - 64.7%
PI - 14
CLAY - 15.2%
w = 13.4%
October 16, 2012
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

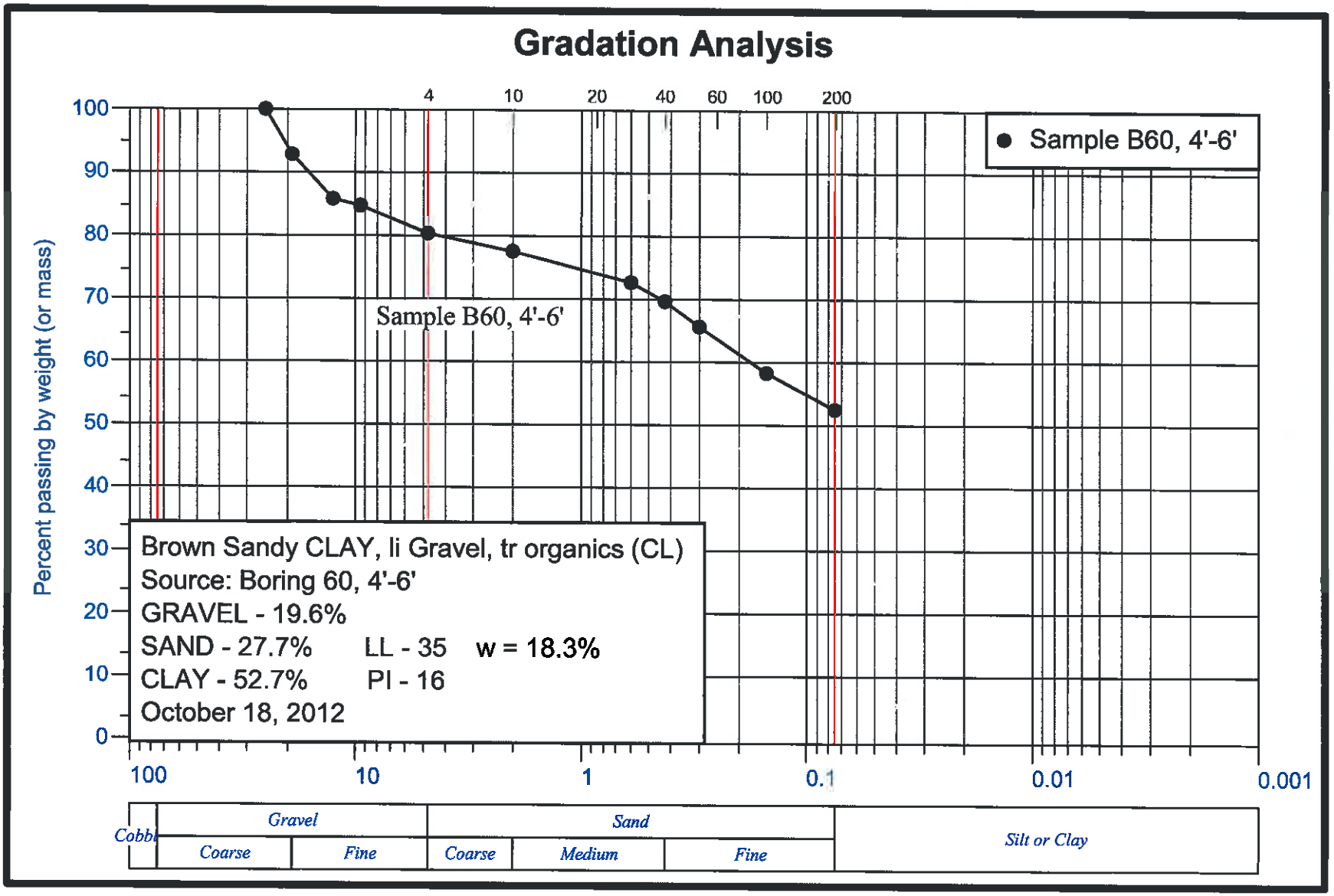

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B58, 2'-4'
Sample B58, 2'-4'
Brown Clayey medium SAND (SC)
Source: Boring 58, 2'-4'
GRAVEL - 3.5%
SAND - 67.9%
CLAY - 28.6%
October 17, 2012
Insufficient Sample for Limits
w = 9.2%
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

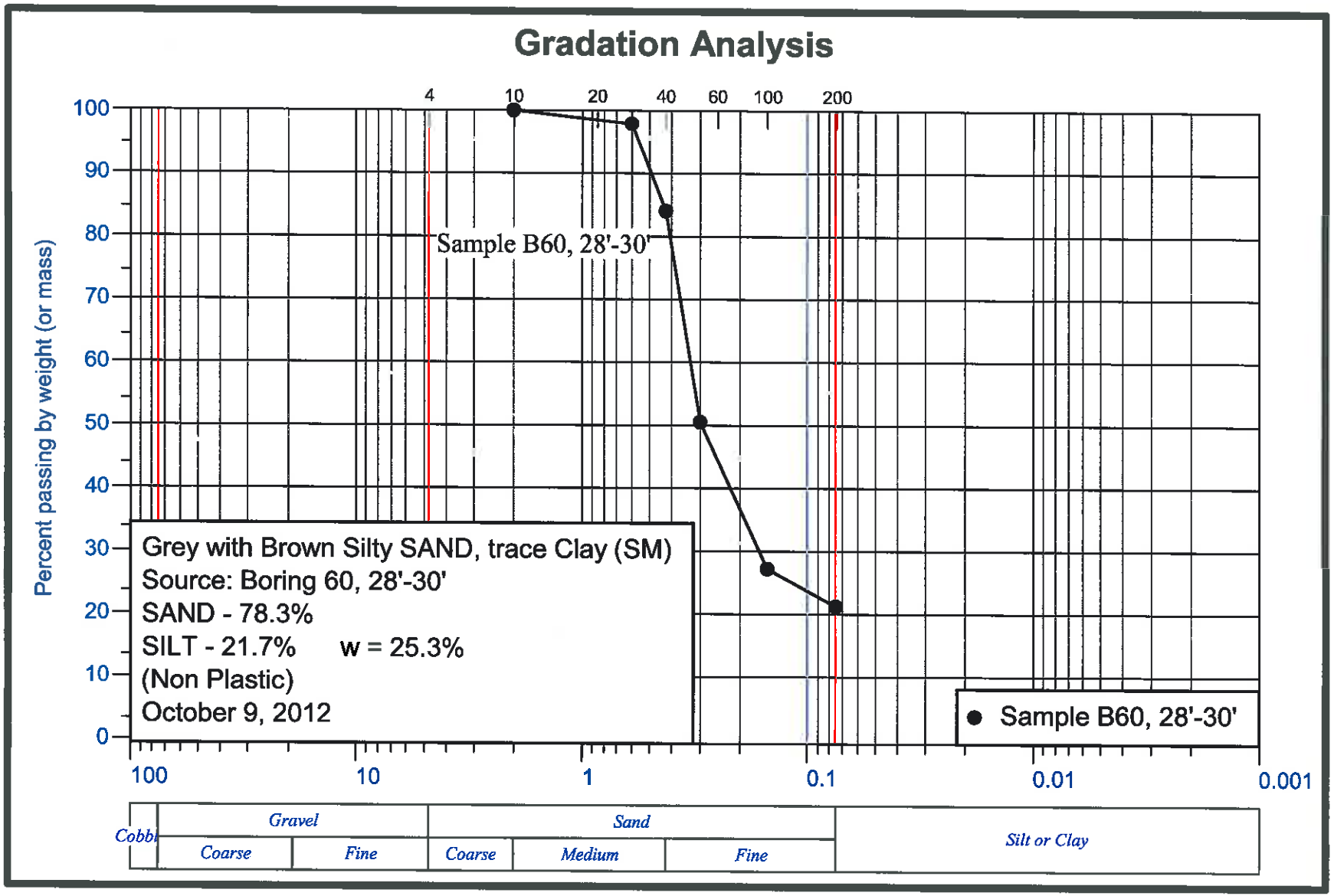

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B58, 8'-10'
Brown Silty SAND (SM)
Source: Boring 58, 8'-10'
SAND - 79.7%
SILT - 20.3% w = 13.3%
(Non Plastic)
October 11, 2012
Sample B58, 8'-10'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

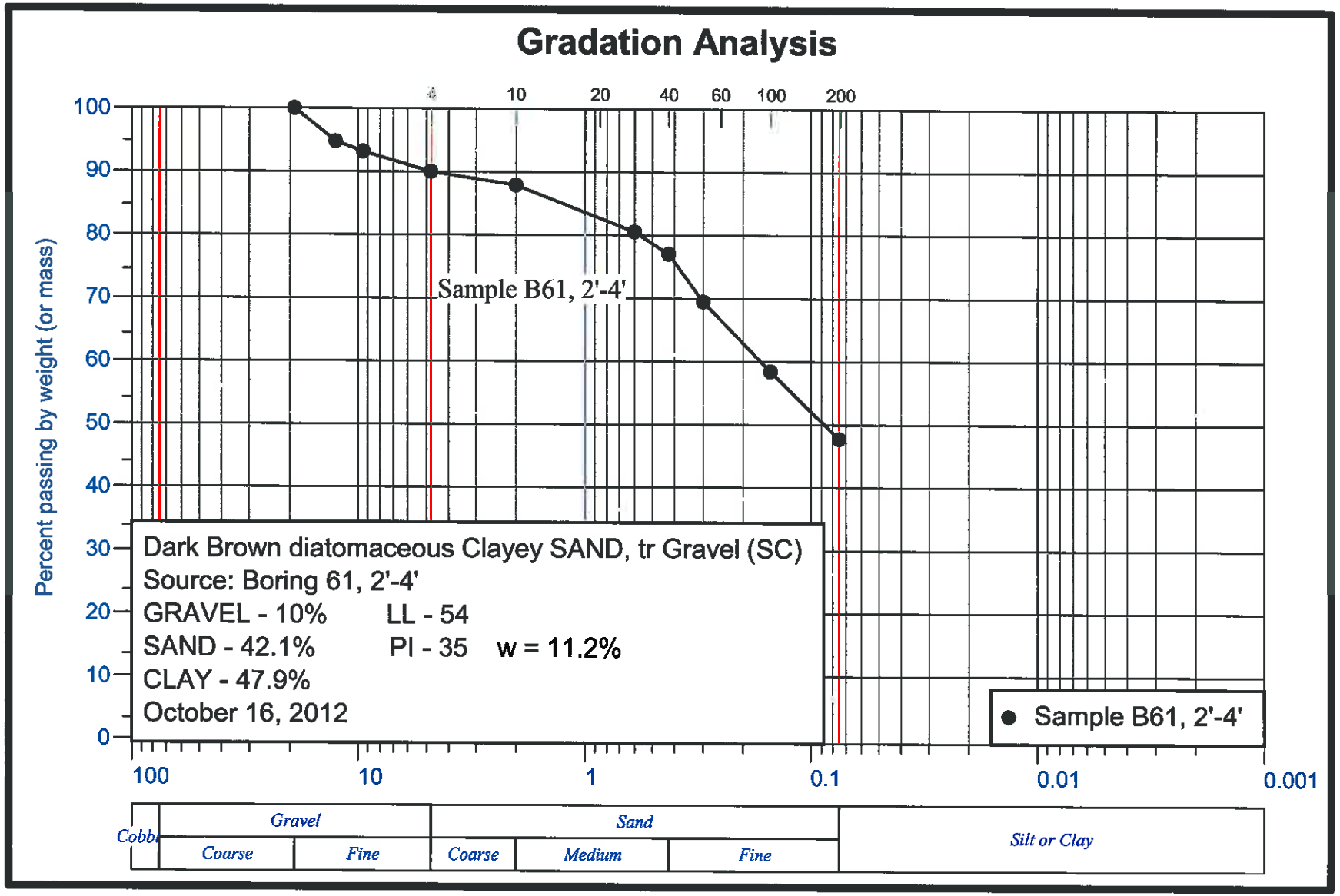

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B58, 18'-20'
Grey w/Brown Silty fine SAND, tr Clay (SM)
Source: Boring 58, 18'-20'
SAND - 79%
SILT - 21%
w = 22.1%
(Non Plastic)
October 11, 2012
Sample B58, 18'-20'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

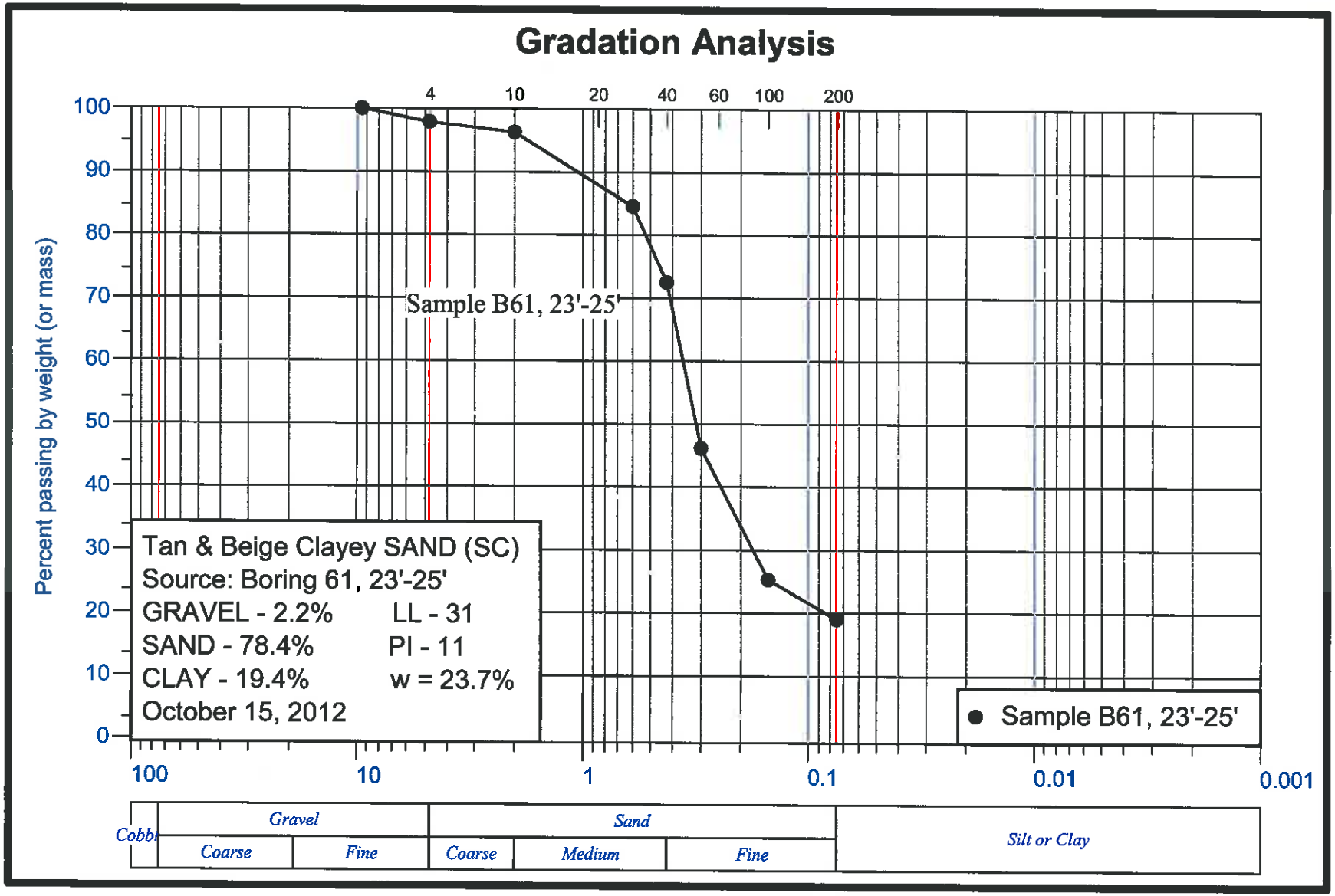

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B59, 4'-6'
Grey w/Reddish Brown Sandy CLAY (CH)
Source: Boring 59, 4'-6'
SAND - 16.9%
LL - 81
w = 22.3%
CLAY - 83.1%
PI - 53
October 16, 2012
Sample B59, 4'-6'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

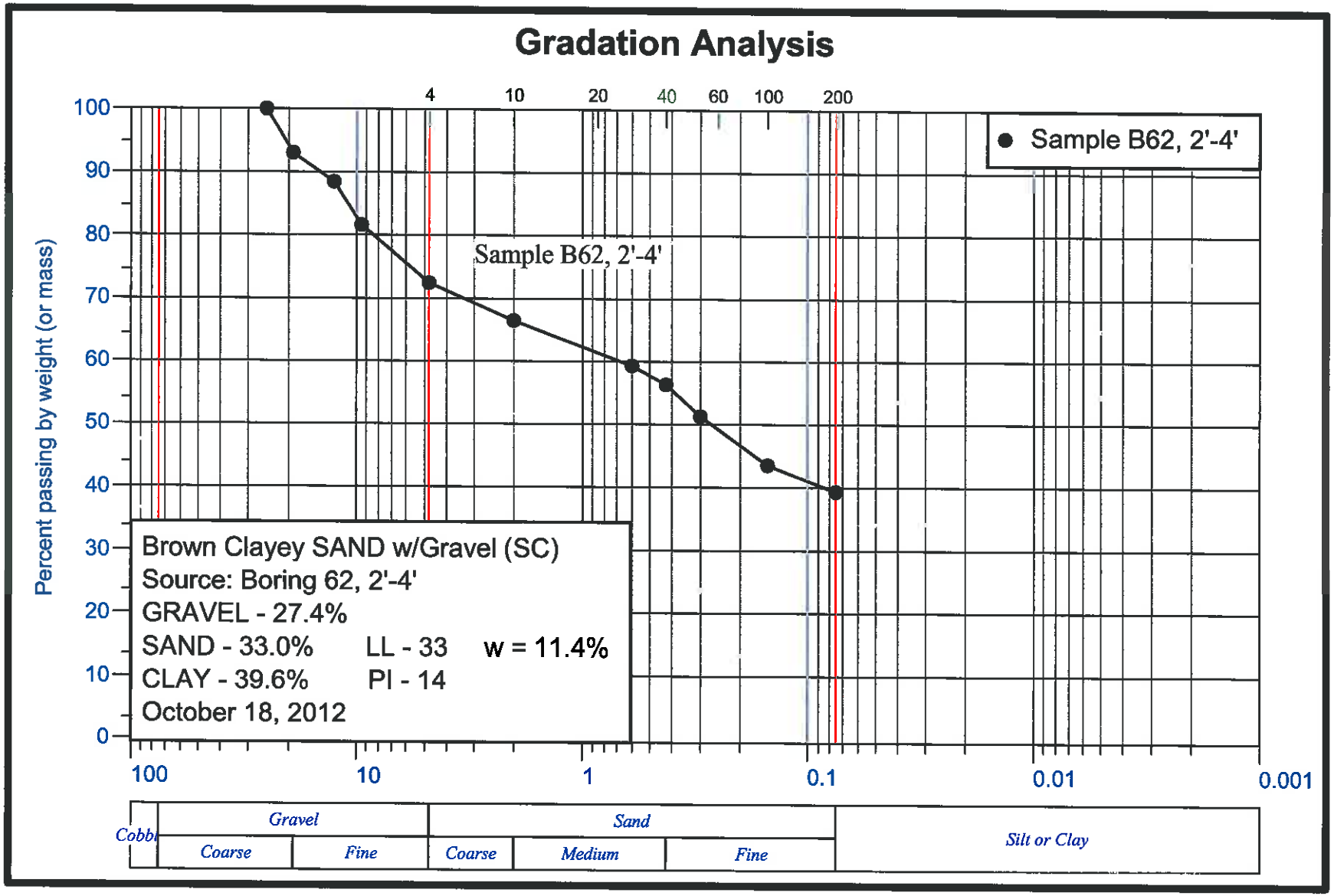

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B59, 13'-15'
Tan SAND, trace Silt, trace Gravel (SP)
Source: Boring 59, 13'-15'
GRAVEL - 7.9%
SAND - 72.9% (Non Plastic)
SILT - 9.2% w = 14.3%
October 12, 2012
Sample B59, 13'-15'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

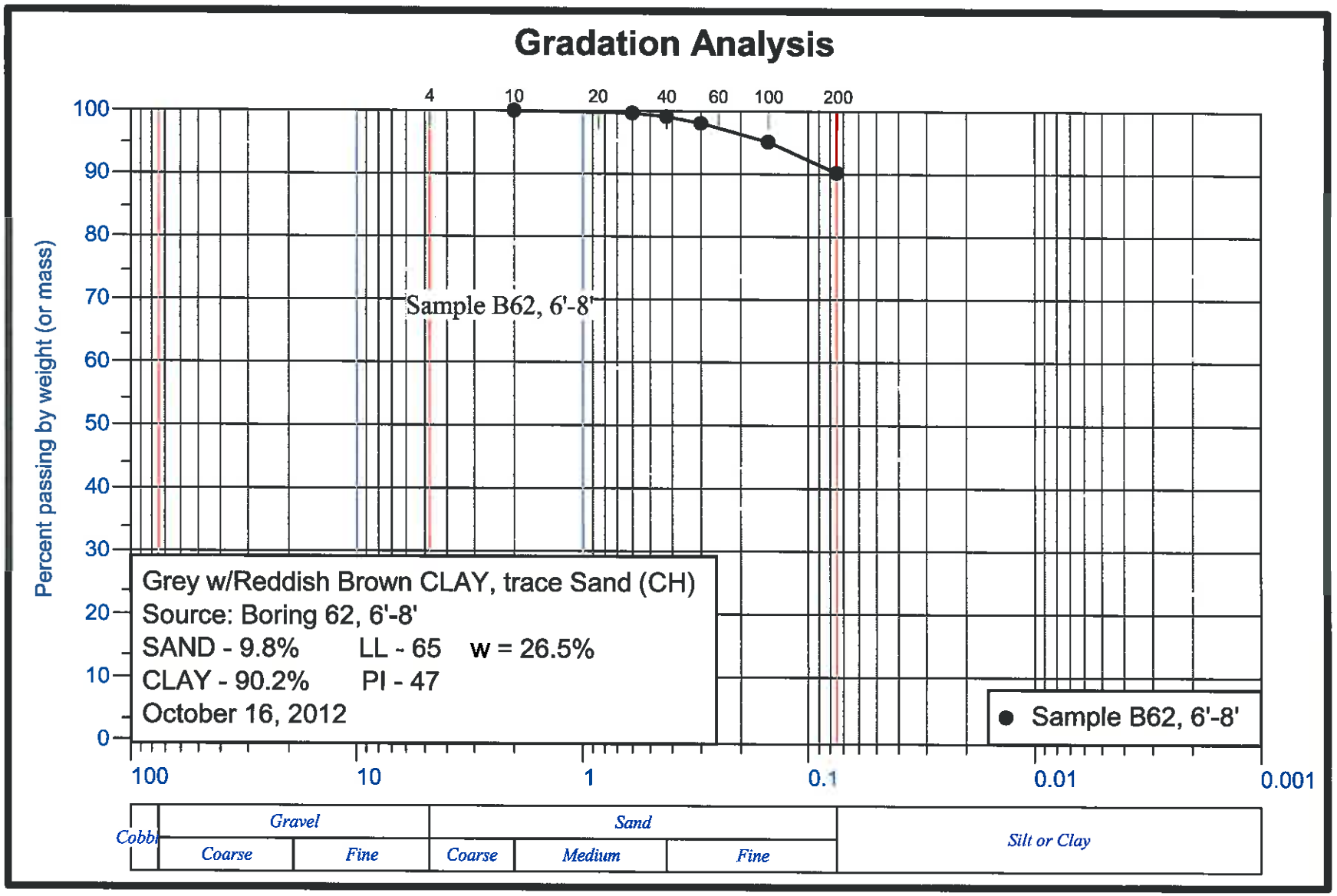

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B60, 4'-6'
Sample B60, 4'-6'
Brown Sandy CLAY, li Gravel, tr organics (CL)
Source: Boring 60, 4'-6'
GRAVEL - 19.6%
SAND - 27.7%
LL - 35
w = 18.3%
CLAY - 52.7%
PI - 16
October 18, 2012
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

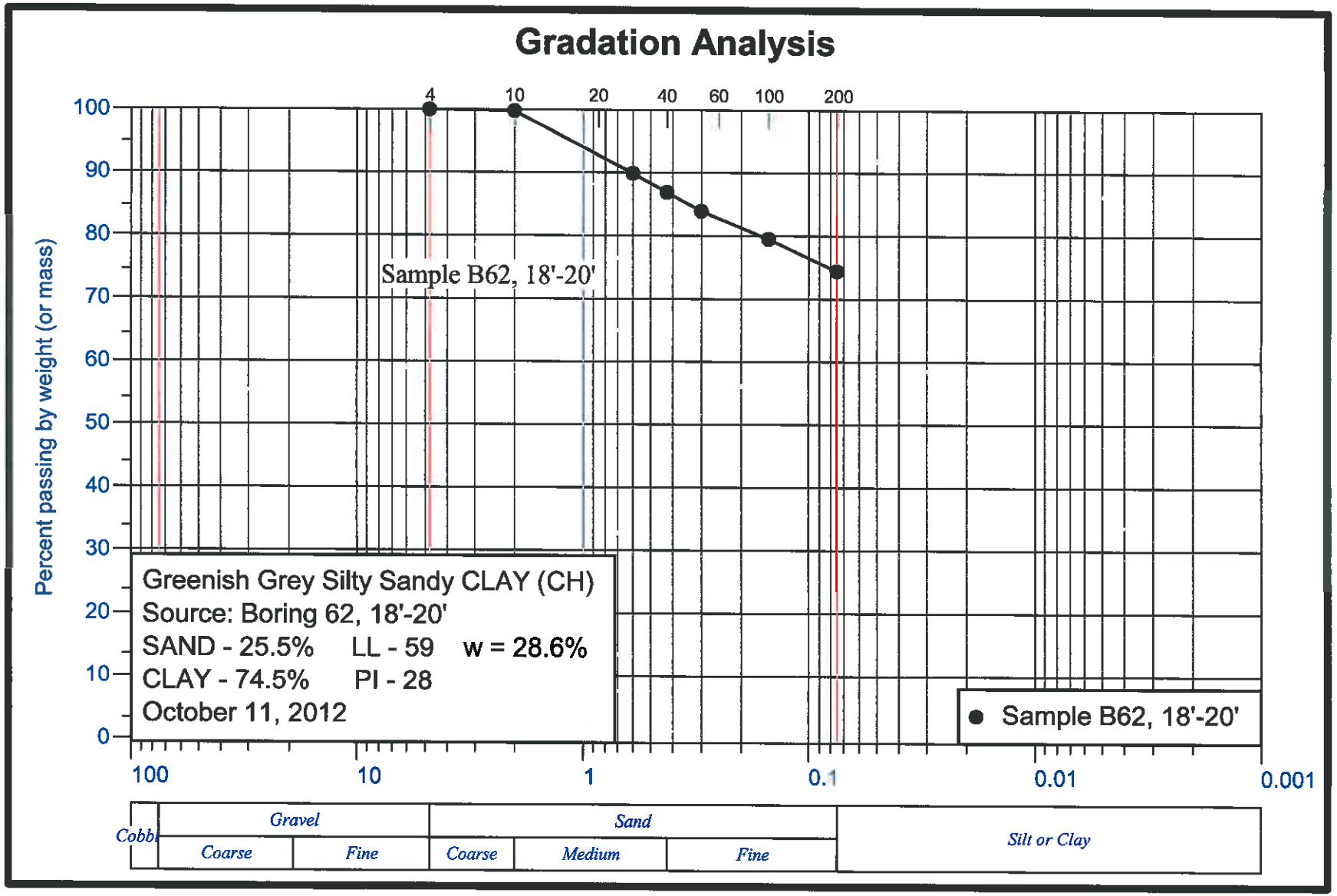

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B60, 28'-30'
Grey with Brown Silty SAND, trace Clay (SM)
Source: Boring 60, 28'-30'
SAND - 78.3%
SILT - 21.7%
w = 25.3%
(Non Plastic)
October 9, 2012
Sample B60, 28'-30'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

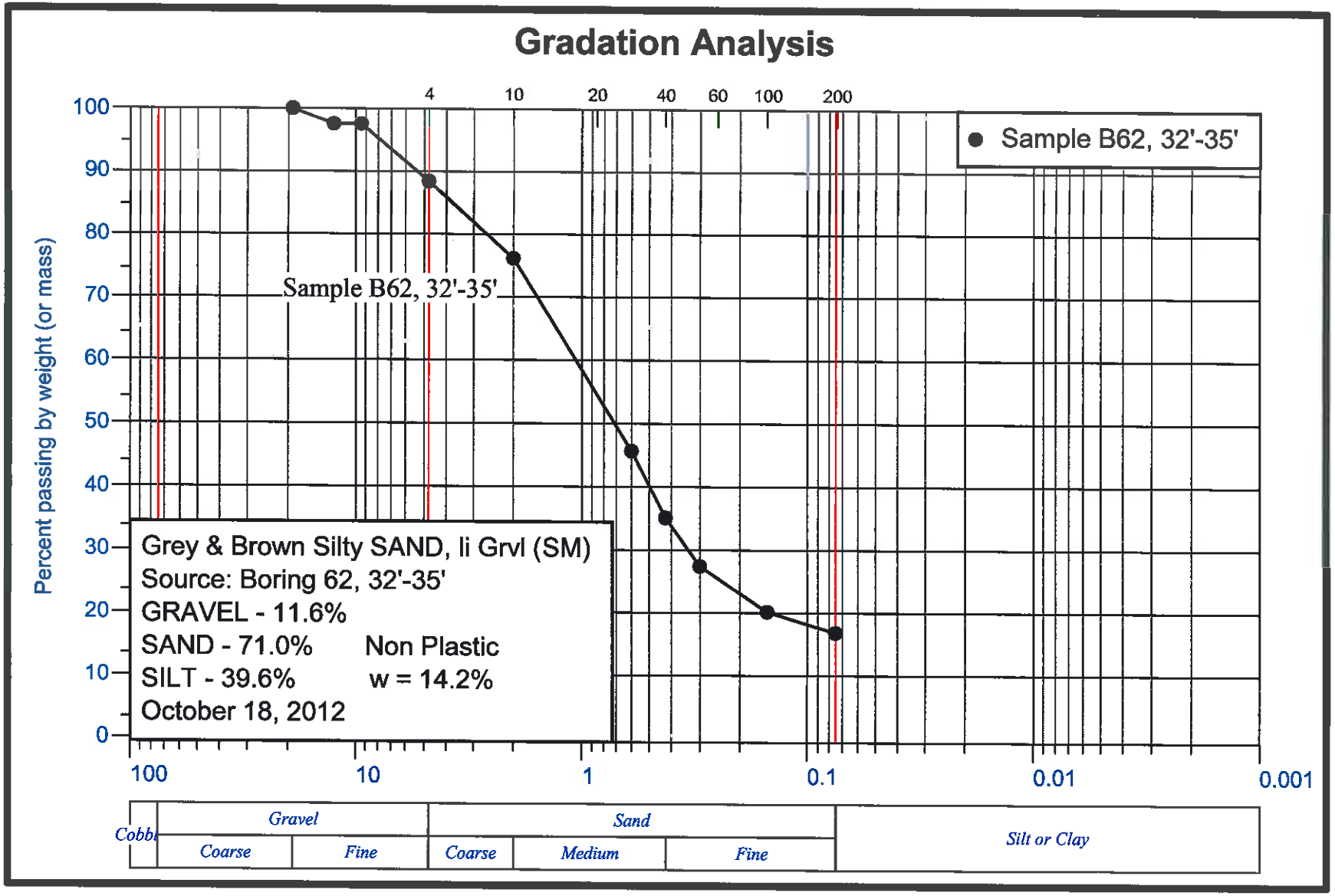

Gradation Analysis
4
10
20
40
60
100
200
100
90
80
70
60
50
40
30
20
10
0
Percent passing by weight (or mass)
Sample B61, 2'-4'
Dark Brown diatomaceous Clayey SAND, tr Gravel (SC)
Source: Boring 61, 2'-4'
GRAVEL - 10%
LL - 54
SAND - 42.1%
PI - 35
w = 11.2%
CLAY - 47.9%
October 16, 2012
Sample B61, 2'-4'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

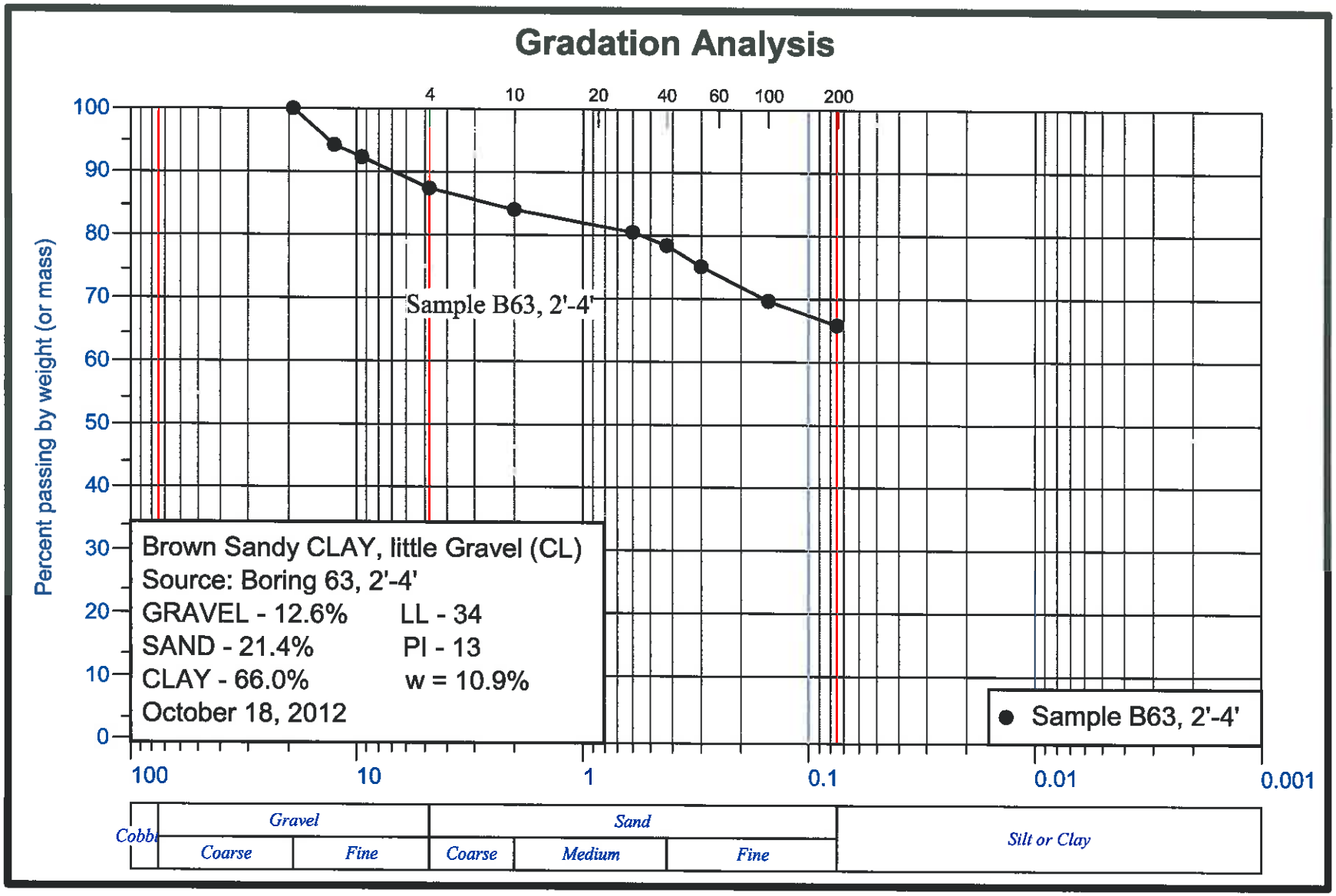

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B61, 23'-25'
Tan & Beige Clayey SAND (SC)
Source: Boring 61, 23'-25'
GRAVEL - 2.2%
SAND - 78.4%
CLAY - 19.4%
October 15, 2012
LL - 31
PI - 11
w = 23.7%
Sample B61, 23'-25'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

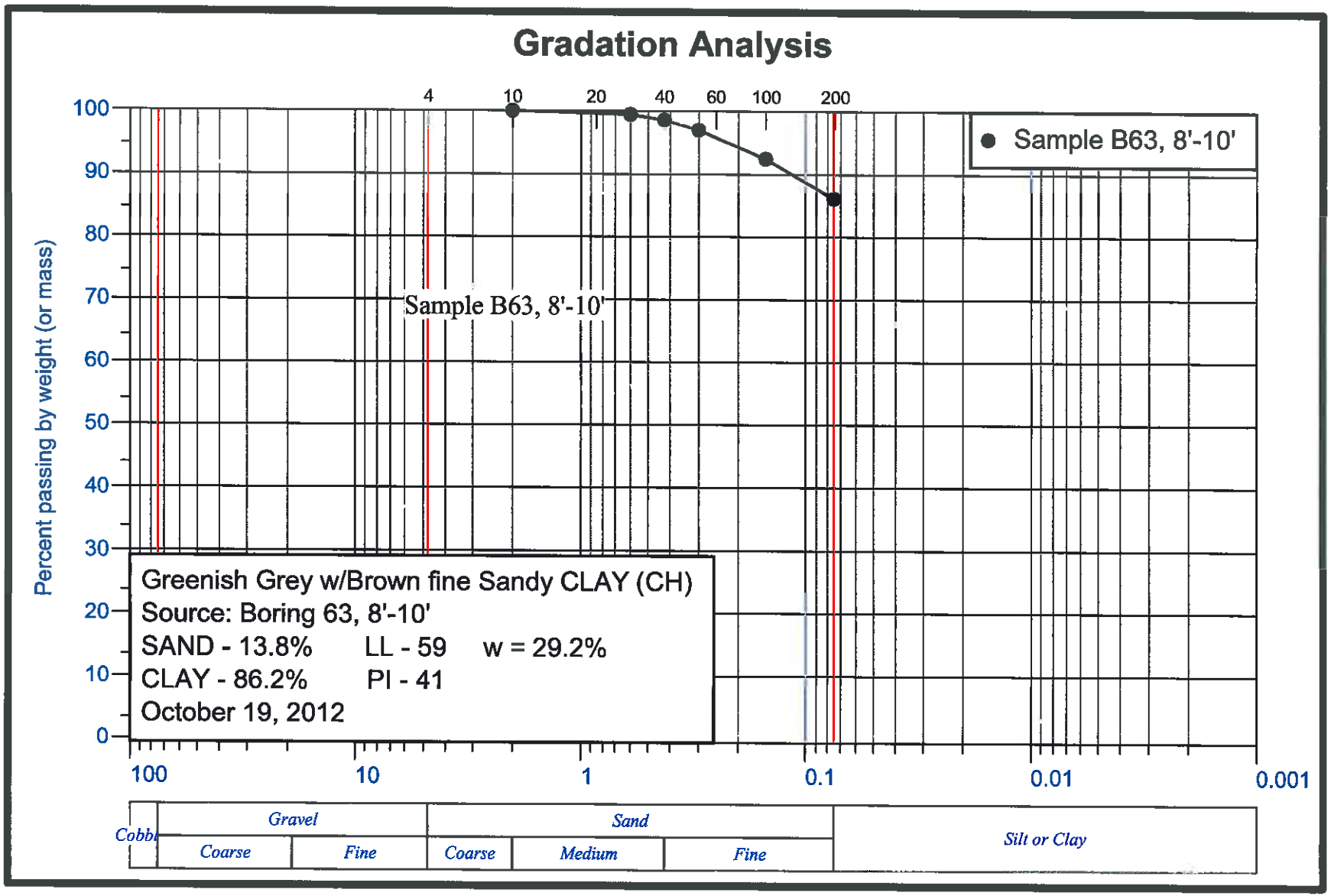

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B62, 2'-4'
Sample B62, 2'-4'
Brown Clayey SAND w/Gravel (SC)
Source: Boring 62, 2'-4'
GRAVEL - 27.4%
SAND - 33.0%
LL - 33
w = 11.4%
CLAY - 39.6%
PI - 14
October 18, 2012
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

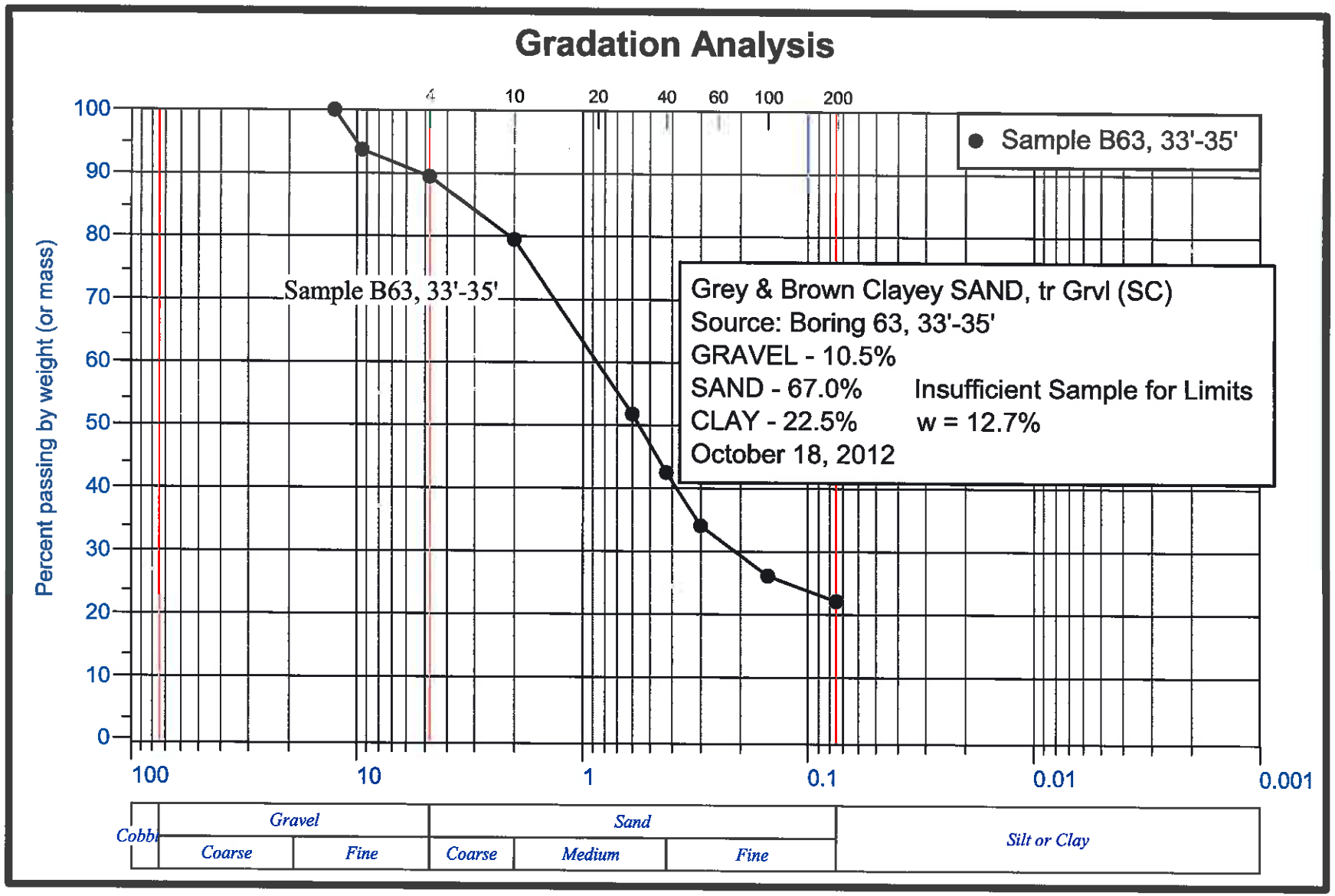

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B62, 6'-8'
Grey w/Reddish Brown CLAY, trace Sand (CH)
Source: Boring 62, 6'-8'
SAND - 9.8%
LL - 65
w = 26.5%
CLAY - 90.2%
PI - 47
October 16, 2012
Sample B62, 6'-8'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

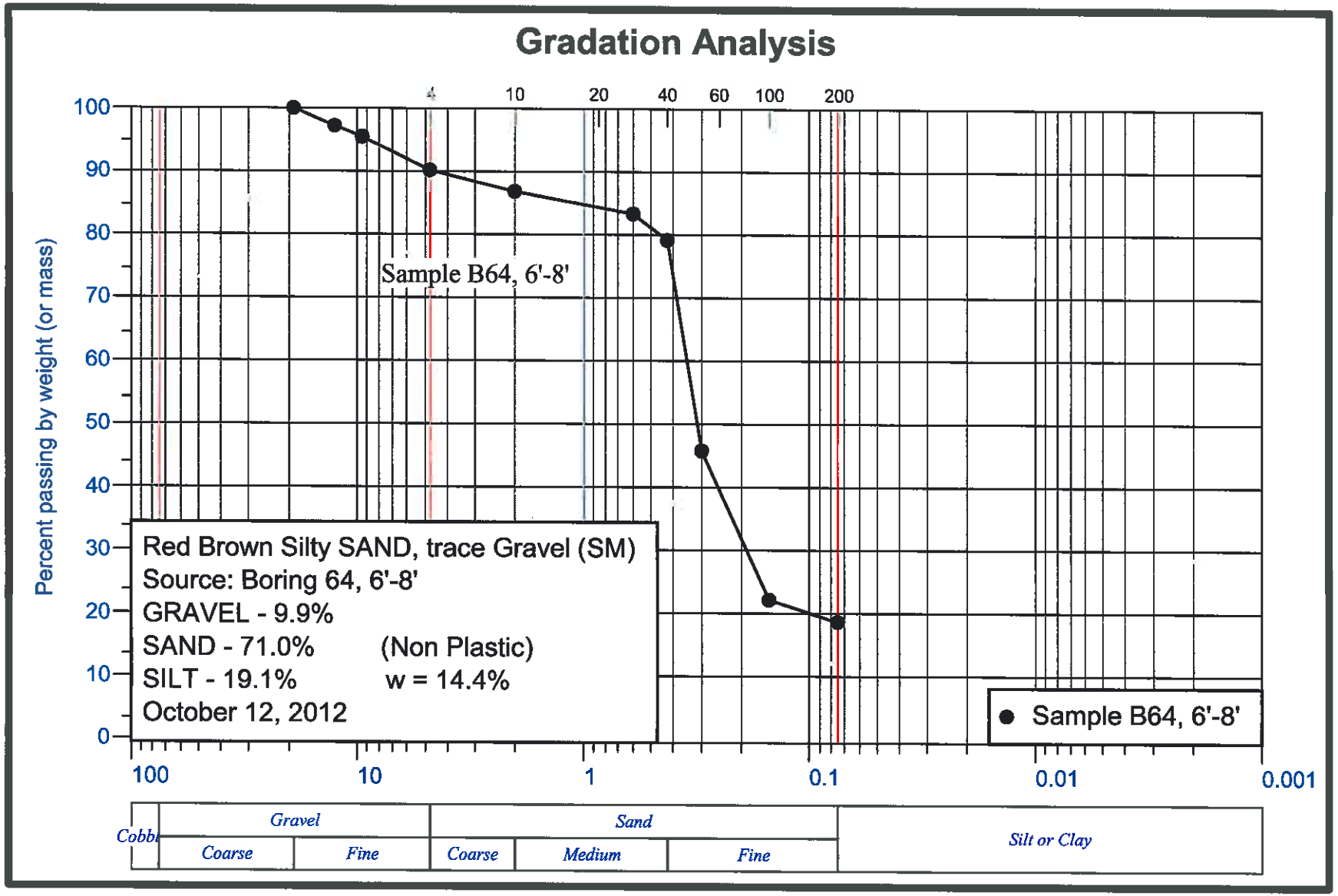

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B62, 18'-20'
Greenish Grey Silty Sandy CLAY (CH)
Source: Boring 62, 18'-20'
SAND - 25.5%
LL - 59
w = 28.6%
CLAY - 74.5%
PI - 28
October 11, 2012
Sample B62, 18'-20'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

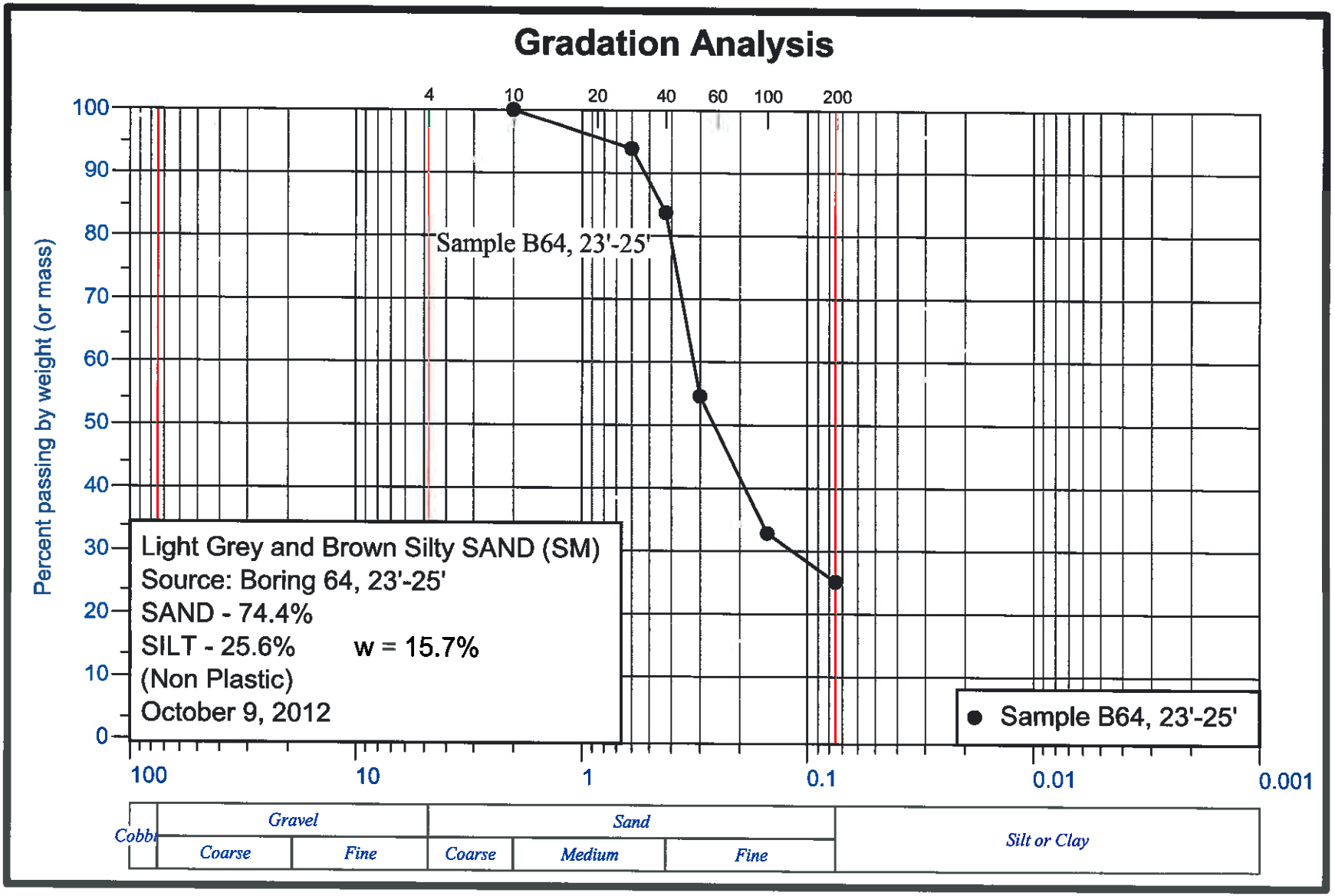

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B62, 32'-35'
Sample B62, 32'-35'
Grey & Brown Silty SAND, li Grvl (SM)
Source: Boring 62, 32'-35'
GRAVEL - 11.6%
SAND - 71.0%
Non Plastic
SILT - 39.6%
w = 14.2%
October 18, 2012
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay


Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B63, 2'-4'
Brown Sandy CLAY, little Gravel (CL)
Source: Boring 63, 2'-4'
GRAVEL - 12.6%
LL - 34
SAND - 21.4%
PI - 13
CLAY - 66.0%
w = 10.9%
October 18, 2012
Sample B63, 2'-4'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

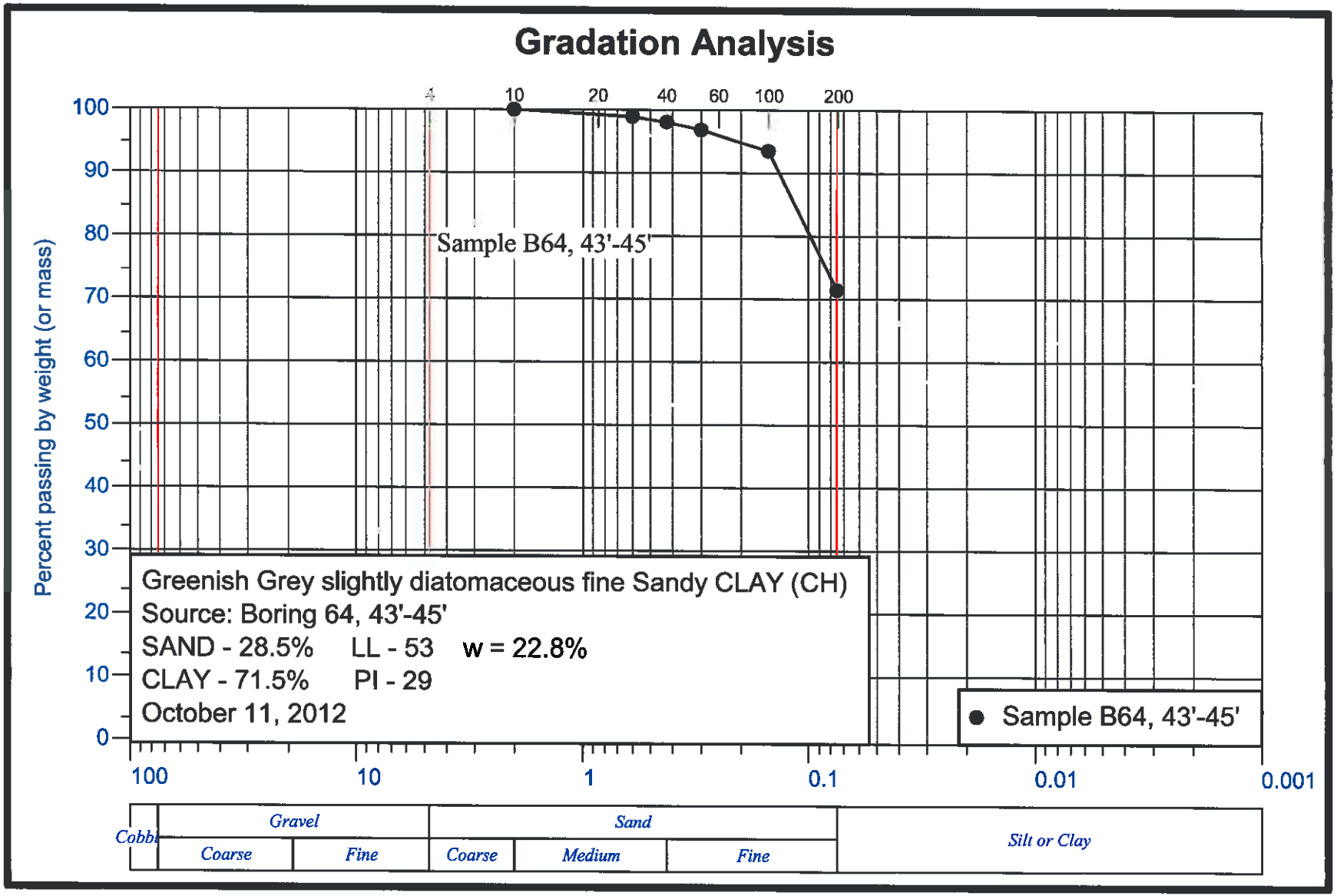

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B63, 8'-10'
Sample B63, 8'-10'
Greenish Grey w/Brown fine Sandy CLAY (CH)
Source: Boring 63, 8'-10'
SAND - 13.8%
LL - 59
w = 29.2%
CLAY - 86.2%
PI - 41
October 19, 2012
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

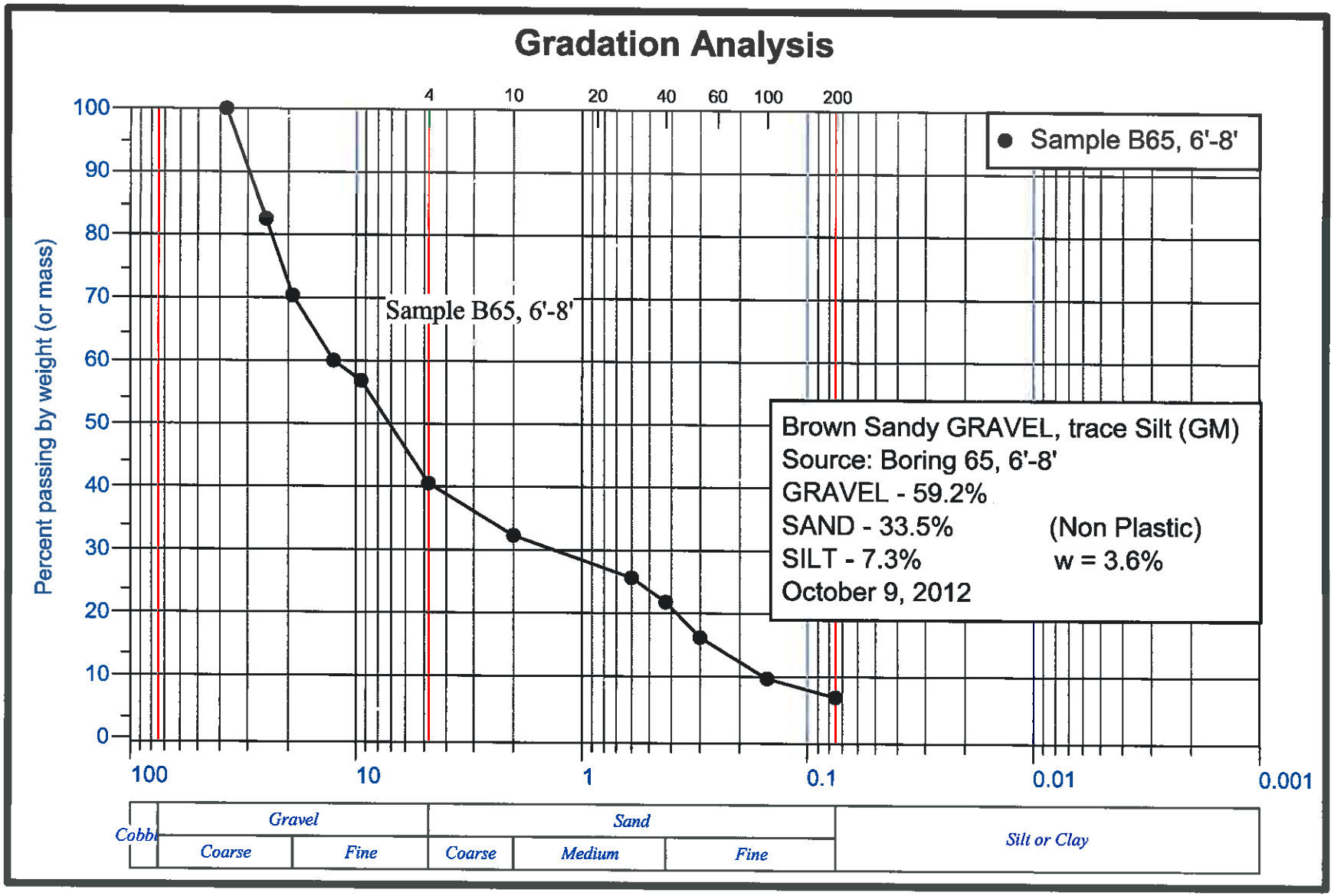

Gradation Analysis
4
10
20
40
60
100
200
Sample B63, 33'-35'
Grey & Brown Clayey SAND, tr Grvl (SC)
Source: Boring 63, 33'-35'
GRAVEL - 10.5%
SAND - 67.0%
CLAY - 22.5%
October 18, 2012
Insufficient Sample for Limits
w = 12.7%
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

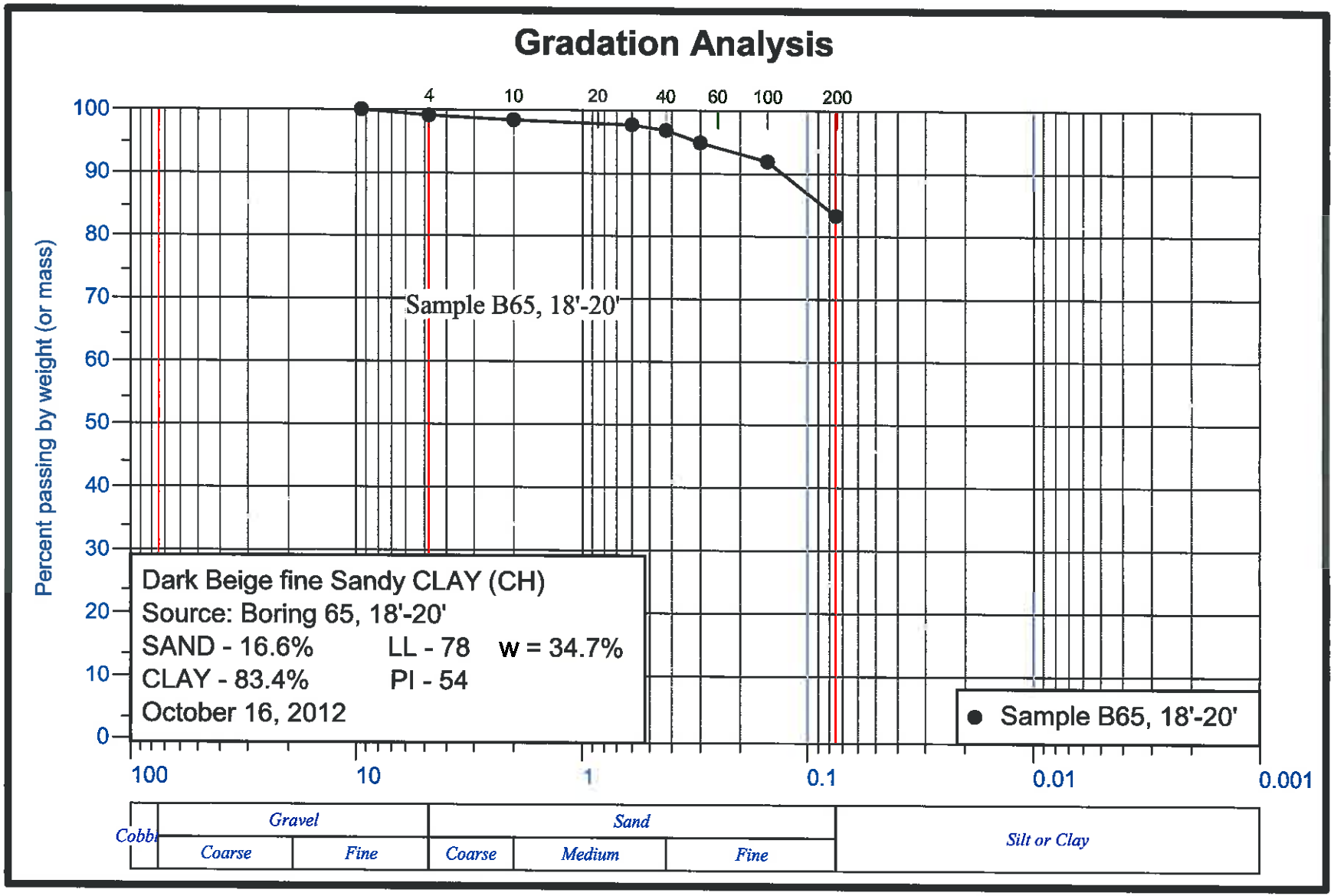

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B64, 6'-8'
Red Brown Silty SAND, trace Gravel (SM)
Source: Boring 64, 6'-8'
GRAVEL - 9.9%
SAND - 71.0%
(Non Plastic)
SILT - 19.1%
w = 14.4%
October 12, 2012
Sample B64, 6'-8'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

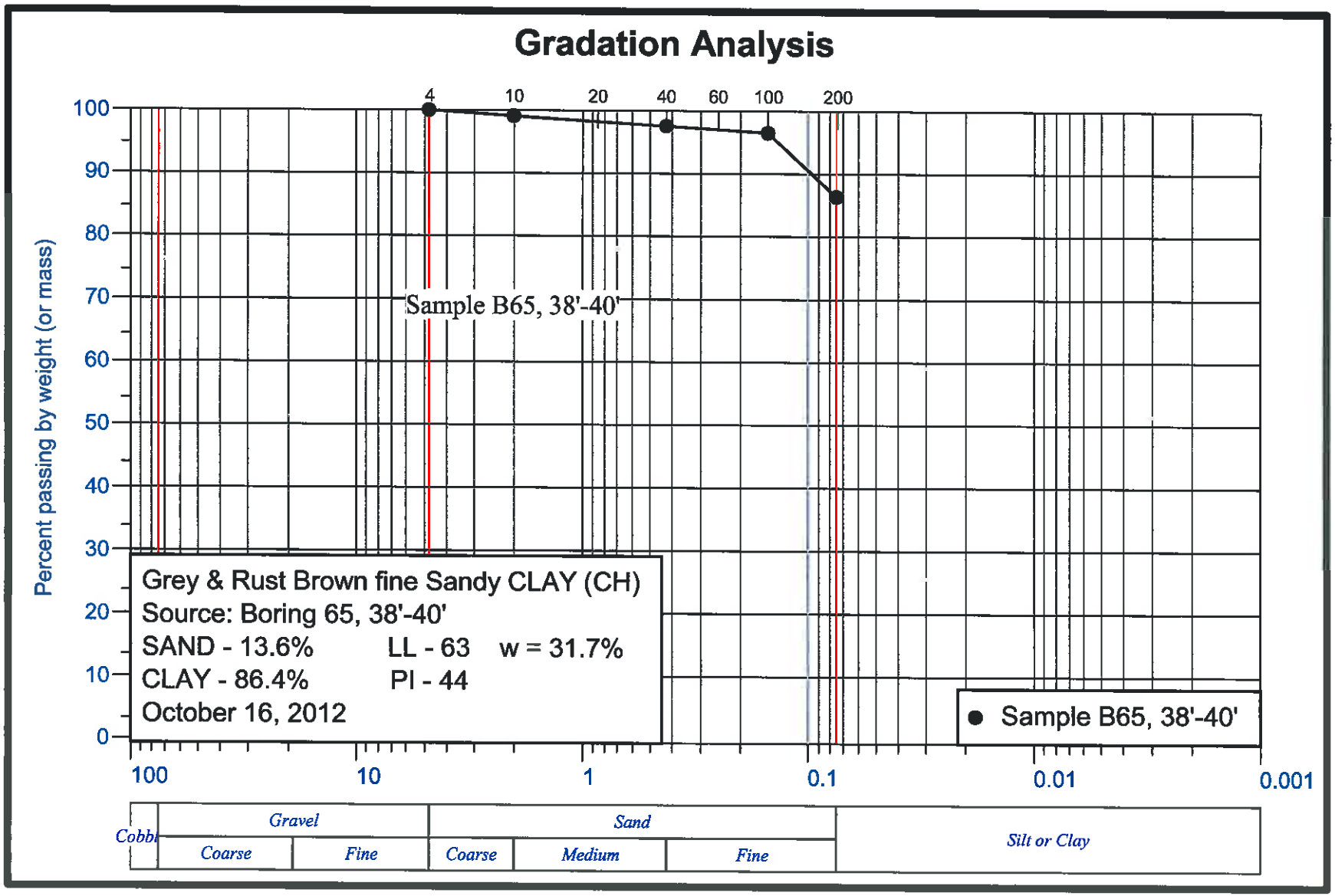

Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B64, 23'-25'
Light Grey and Brown Silty SAND (SM)
Source: Boring 64, 23'-25'
SAND - 74.4%
SILT - 25.6%
w = 15.7%
(Non Plastic)
October 9, 2012
Sample B64, 23'-25'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

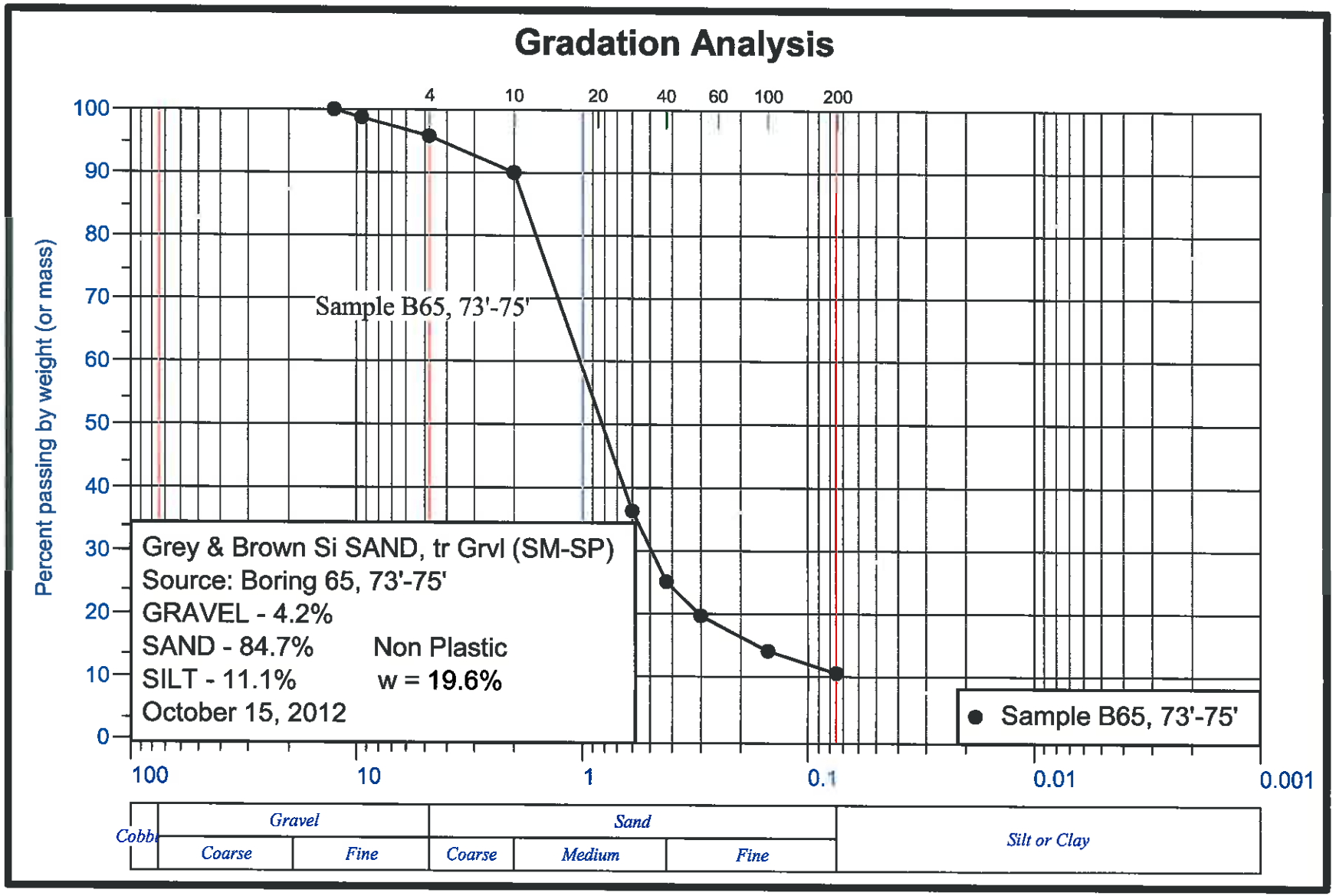
Gradation Analysis

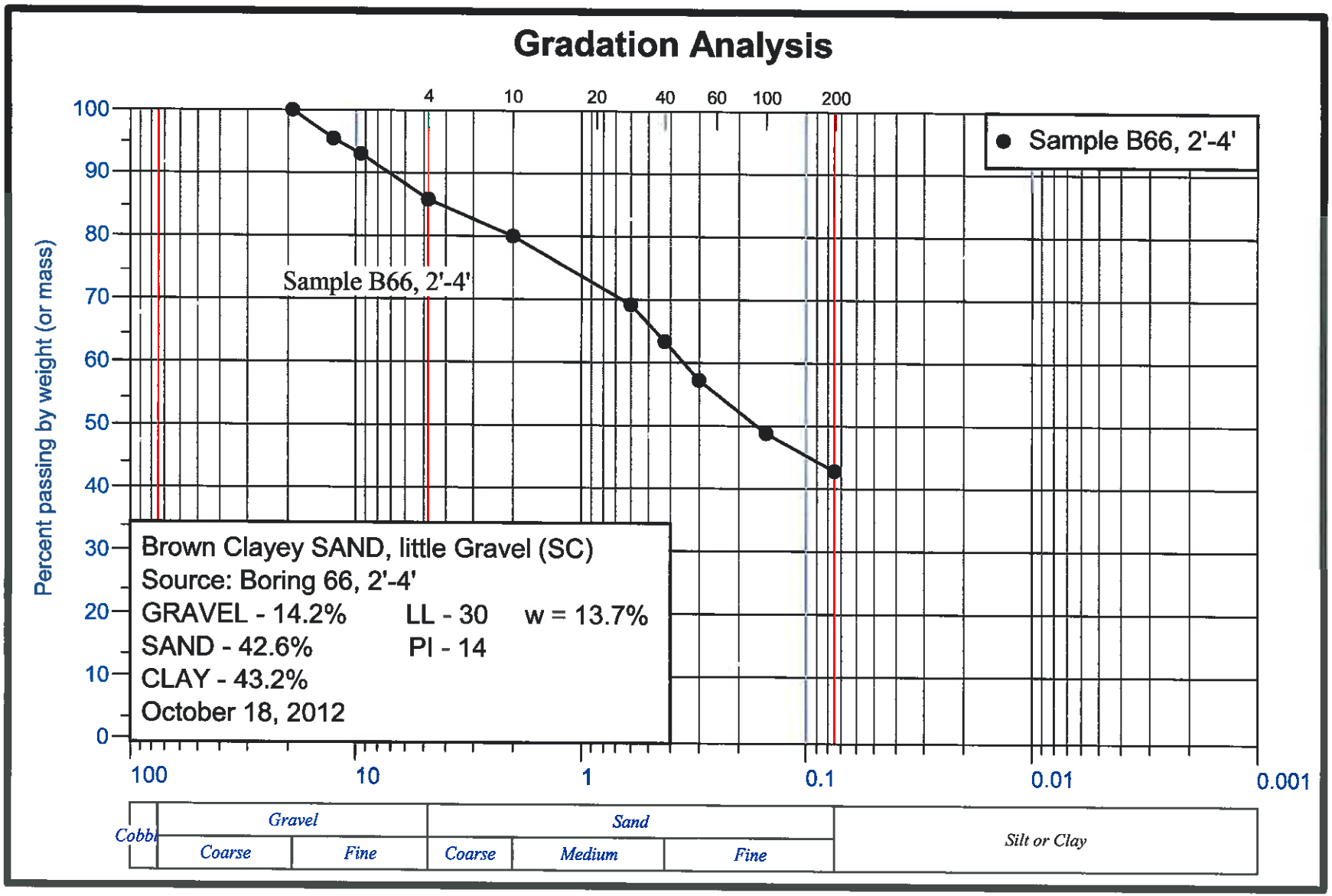


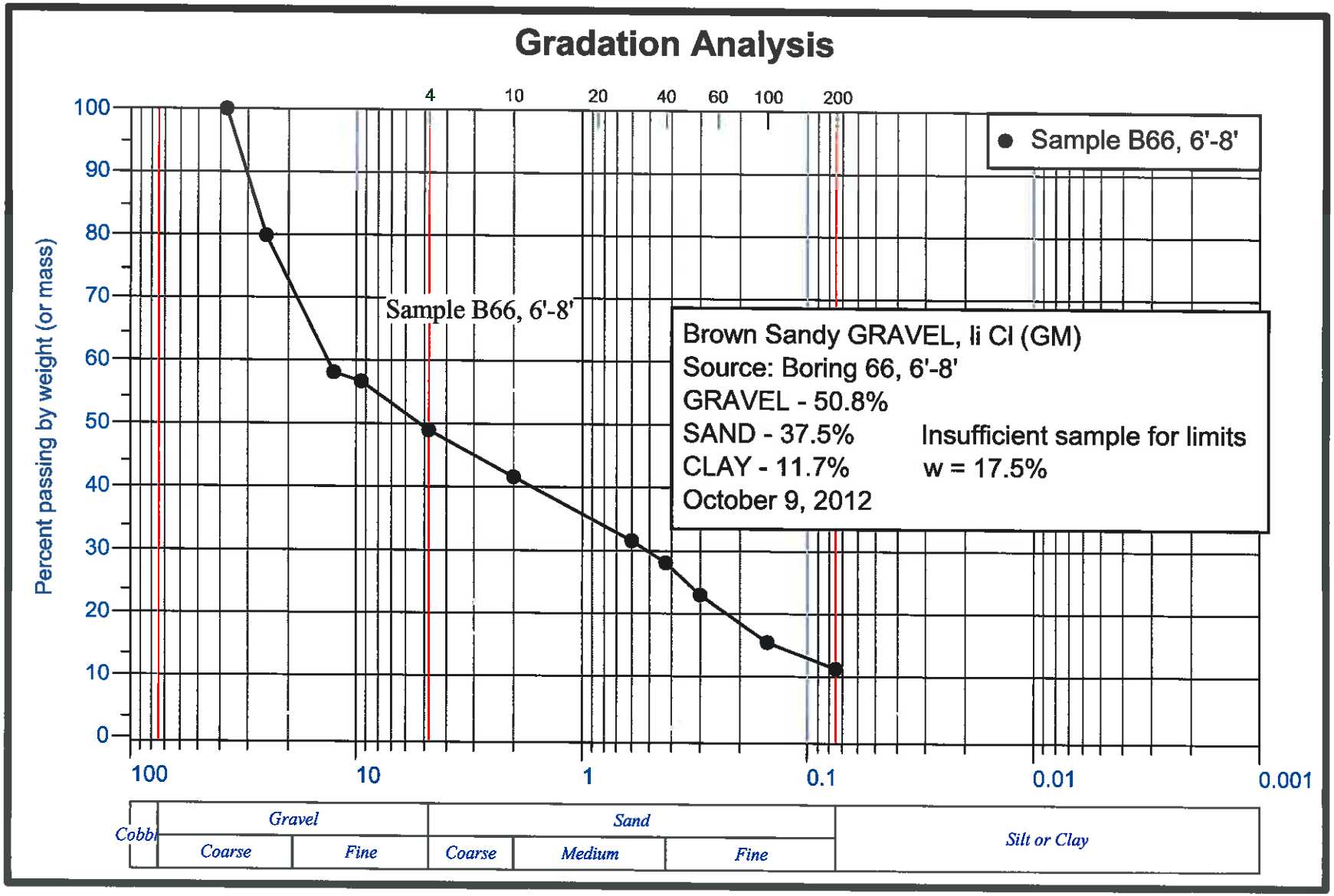

Gradation Analysis
4
10
20
40
60
100
200
100
90
80
70
60
50
40
30
20
10
0
Percent passing by weight (or mass)
Sample B65, 6'-8'
Sample B65, 6'-8'
Brown Sandy GRAVEL, trace Silt (GM)
Source: Boring 65, 6'-8'
GRAVEL - 59.2%
SAND - 33.5%
(Non Plastic)
SILT - 7.3%
w = 3.6%
October 9, 2012
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay


Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B65, 18'-20'
Dark Beige fine Sandy CLAY (CH)
Source: Boring 65, 18'-20'
SAND - 16.6%
LL - 78
w = 34.7%
CLAY - 83.4%
PI - 54
October 16, 2012
Sample B65, 18'-20'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay


Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B65, 38'-40'
Grey & Rust Brown fine Sandy CLAY (CH)
Source: Boring 65, 38'-40'
SAND - 13.6%
LL - 63
w = 31.7%
CLAY - 86.4%
PI - 44
October 16, 2012
Sample B65, 38'-40'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay


Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B65, 73'-75'
Grey & Brown Si SAND, tr Grvl (SM-SP)
Source: Boring 65, 73'-75'
GRAVEL - 4.2%
SAND - 84.7%
Non Plastic
SILT - 11.1%
w = 19.6%
October 15, 2012
Sample B65, 73'-75'
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay


Gradation Analysis
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
4
10
20
40
60
100
200
Sample B66, 2'-4'
Sample B66, 2'-4'
Brown Clayey SAND, little Gravel (SC)
Source: Boring 66, 2'-4'
GRAVEL - 14.2%
LL - 30
w = 13.7%
SAND - 42.6%
PI - 14
CLAY - 43.2%
October 18, 2012
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay


Gradation Analysis
4
10
20
40
60
100
200
Sample B66, 6'-8'
Percent passing by weight (or mass)
100
90
80
70
60
50
40
30
20
10
0
Sample B66, 6'-8'
Brown Sandy GRAVEL, li Cl (GM)
Source: Boring 66, 6'-8'
GRAVEL - 50.8%
SAND - 37.5%
CLAY - 11.7%
October 9, 2012
Insufficient sample for limits
w = 17.5%
100
10
1
0.1
0.01
0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay

UNCONFINED COMPRESSION TEST

11/27/2012

Date: 11/16/12
Client: A-Zone Environmental
Project: Arlington National Cemetery
Project No.: 40-12125
Location: Arlington Cemetery #40-12125 / 12DH65. Tube
Depth: 45.0'-47.0' **Sample Number:** 6
Description: Gray fat clay
Remarks:
Type of Sample: undisturbed
Assumed Specific Gravity=2.7 **LL=**65 **PL=**32 **PI=**33

Parameters for Specimen No. 1

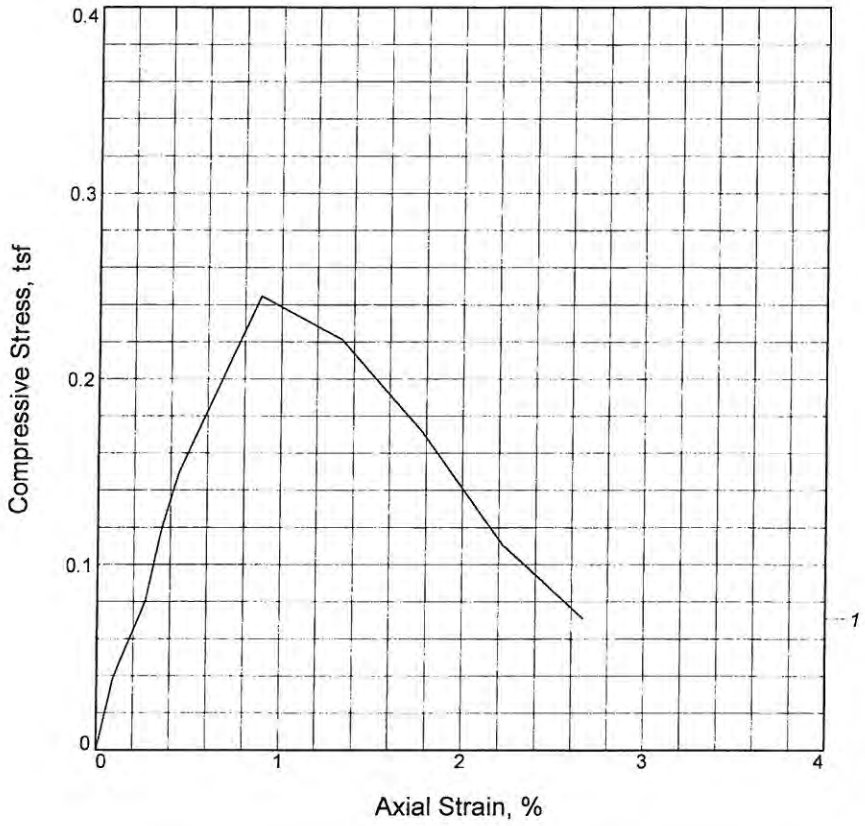
Specimen Parameter	Initial
Moisture content: Moist soil+tare, gms.	493.100
Moisture content: Dry soil+tare, gms.	387.400
Moisture content: Tare, gms.	42.600
Moisture, %	30.7
Moist specimen weight, gms.	1091.2
Diameter, in.	2.86
Area, in.²	6.42
Height, in.	5.63
Wet density, pcf	115.0
Dry density, pcf	88.0
Void ratio	0.9148
Saturation, %	90.5

Test Readings for Specimen No. 1

Strain rate, %/min. = 0.90
Unconfined compressive strength = 0.245 tsf **at reading no.** 6

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf
0	0.0000	0.000	0.0	0.0	0.000
1	0.0050	3.400	3.4	0.1	0.038
2	0.0100	5.300	5.3	0.2	0.059
3	0.0150	7.200	7.2	0.3	0.081
4	0.0200	10.800	10.8	0.4	0.121
5	0.0250	13.400	13.4	0.4	0.150
6	0.0500	22.000	22.0	0.9	0.245
7	0.0750	20.000	20.0	1.3	0.221
8	0.1000	15.600	15.6	1.8	0.172
9	0.1250	10.100	10.1	2.2	0.111
10	0.1500	6.500	6.5	2.7	0.071

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, tsf	0.245			
Undrained shear strength, tsf	0.122			
Failure strain, %	0.9			
Strain rate, %/min.	0.90			
Water content, %	30.7			
Wet density, pcf	115.0			
Dry density, pcf	88.0			
Saturation, %	90.5			
Void ratio	0.9148			
Specimen diameter, in.	2.86			
Specimen height, in.	5.63			
Height/diameter ratio	1.97			

Description: Gray fat clay

LL = 65	**PL** = 32	**PI** = 33	**Assumed GS**= 2.7	**Type:** undisturbed

Project No.: 40-12125
Date Sampled: 11/16/12
Remarks:

Client: A-Zone Environmental

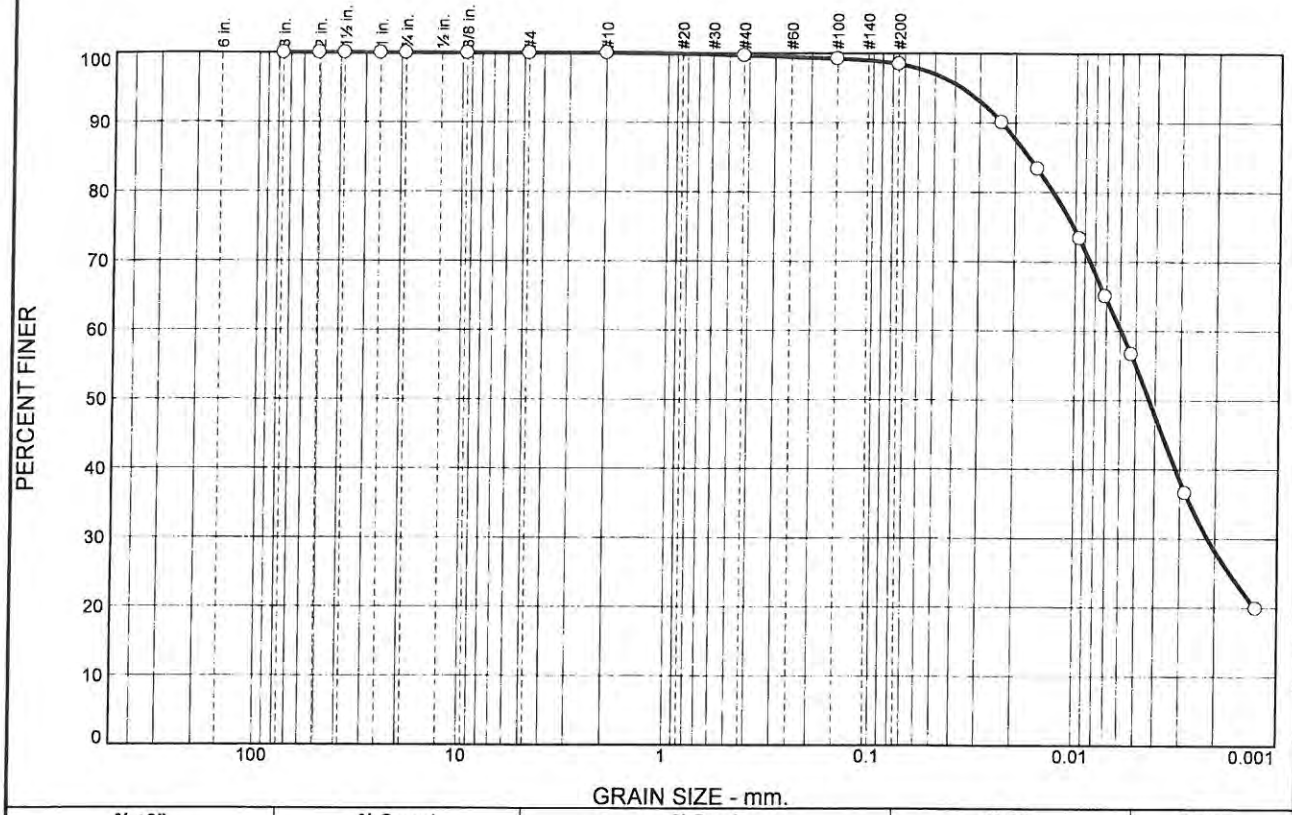
Project: Arlington National Cemetery

Location: Arlington Cemetery #40-12125 / 12DH65. Tube
Sample Number: 6 **Depth:** 45.0'-47.0'

UNCONFINED COMPRESSION TEST
Independent Consultants & Engineers, Inc.

Figure _____

Particle Size Distribution Report



% +3"	% Gravel	% Sand	% Silt	% Clay
0.0	0.0	1.5	43.4	55.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0		
2"	100.0		
1 - 1/2"	100.0		
1"	100.0		
3/4"	100.0		
3/8"	100.0		
#4	100.0		
#10	100.0		
#40	99.7		
#100	99.2		
#200	98.5		

* (no specification provided)

Material Description

Gray fat clay

Atterberg Limits

PL= 32 LL= 65 PI= 33

Coefficients

D_{90}= 0.0233 D_{85}= 0.0170 D_{60}= 0.0059
D_{50}= 0.0043 D_{30}= 0.0022 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-5(40)

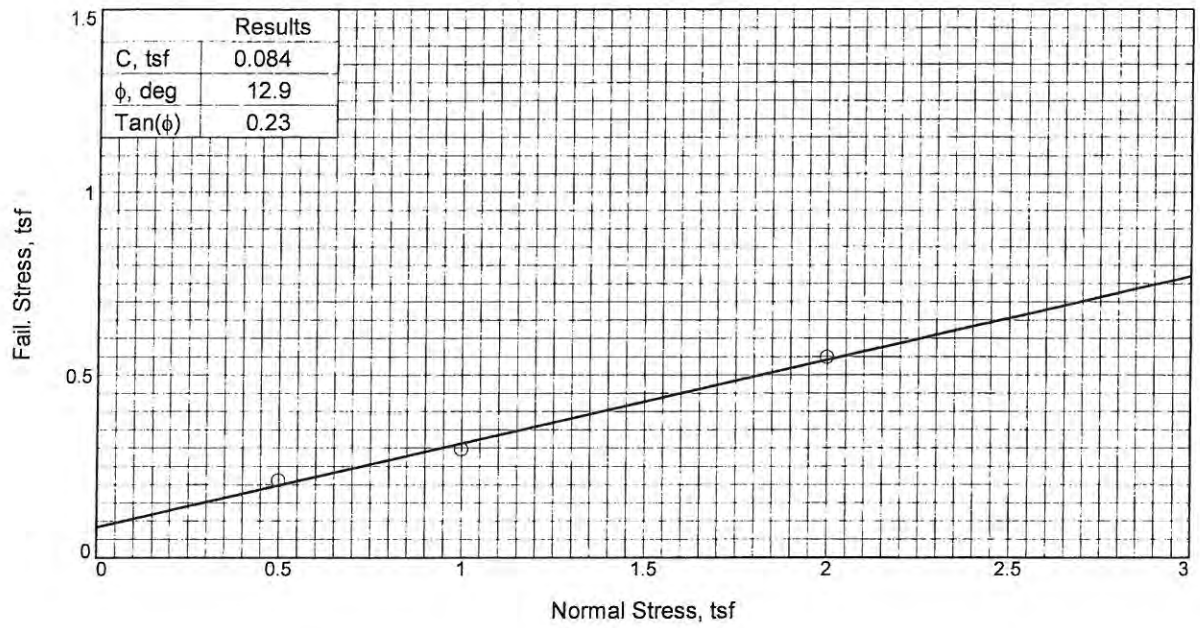
Remarks

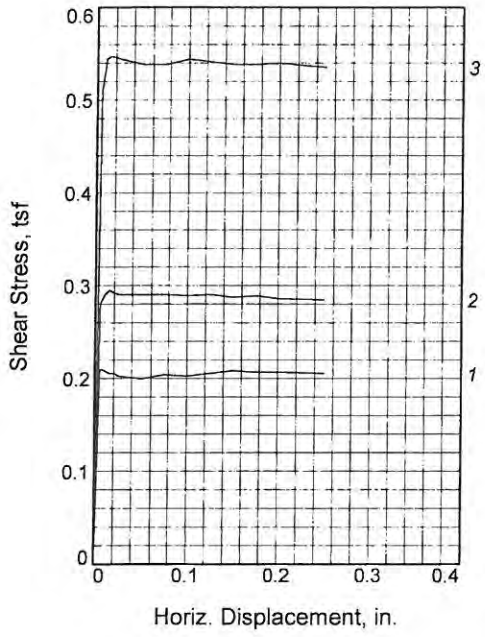
Location: Arlington Cemetery #40-12125 / 12DH65. Tube
Sample Number: 6 **Depth:** 45.0'-47.0'

Date: 11/16/12

Independent Consultants and Engineers, Inc.

Client: A-Zone Environmental
Project: Arlington National Cemetery
Project No: 40-12125 **Figure**





Sample No.		1	2	3
Initial	Water Content, %	29.7	29.7	29.7
	Dry Density, pcf	90.2	90.2	90.2
	Saturation, %	92.1	92.1	92.1
	Void Ratio	0.8697	0.8697	0.8697
	Diameter, in.	2.50	2.50	2.50
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	31.7	31.7	31.7
	Dry Density, pcf	90.5	90.7	91.0
	Saturation, %	99.3	99.8	100.6
	Void Ratio	0.8622	0.8585	0.8514
	Diameter, in.	2.50	2.50	2.50
	Height, in.	1.00	0.99	0.99
Normal Stress, tsf		0.500	1.000	2.000
Fail. Stress, tsf		0.210	0.295	0.547
Displacement, in.		0.01	0.02	0.02
Ult. Stress, tsf				
Displacement, in.				
Strain rate, %/min.		0.06	0.06	0.06

Sample Type: Tube Sample
Description: Greenish brown fat clay

LL= 72 **PL=** 26 **PI=** 46
Assumed Specific Gravity= 2.7
Remarks: Shear plane pre-cut prior to testing
Repeated shear test

Figure

Client: A-Zone Environmental

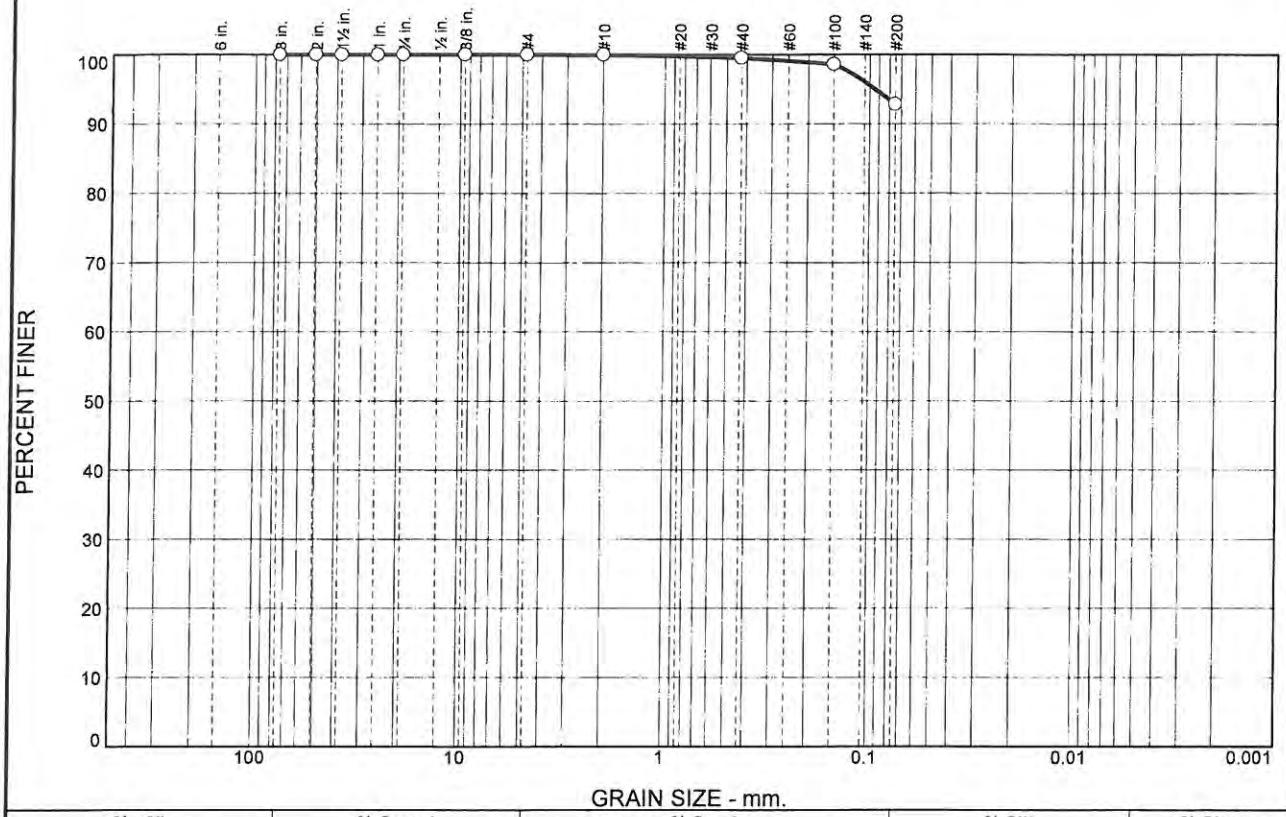
Project: Arlington National Cemetery

Location: Arlington Cemetery #40-12125 / 12DH55. Tube
Sample Number: 8 **Depth:** 13.0'-14.7'
Proj. No.: 40-12125 **Date Sampled:** 11/30/12

DIRECT SHEAR TEST REPORT

Independent Consultants & Engineers, Inc.

Particle Size Distribution Report



% +3"	% Gravel	% Sand	% Silt	% Clay
0.0	0.0	7.2	92.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0		
2"	100.0		
1 - 1/2"	100.0		
1"	100.0		
3/4"	100.0		
3/8"	100.0		
#4	100.0		
#10	100.0		
#40	99.5		
#100	98.6		
#200	92.8		

* (no specification provided)

Material Description

Greenish brown fat clay

Atterberg Limits

PL= 26 LL= 72 PI= 46

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(49)

Remarks

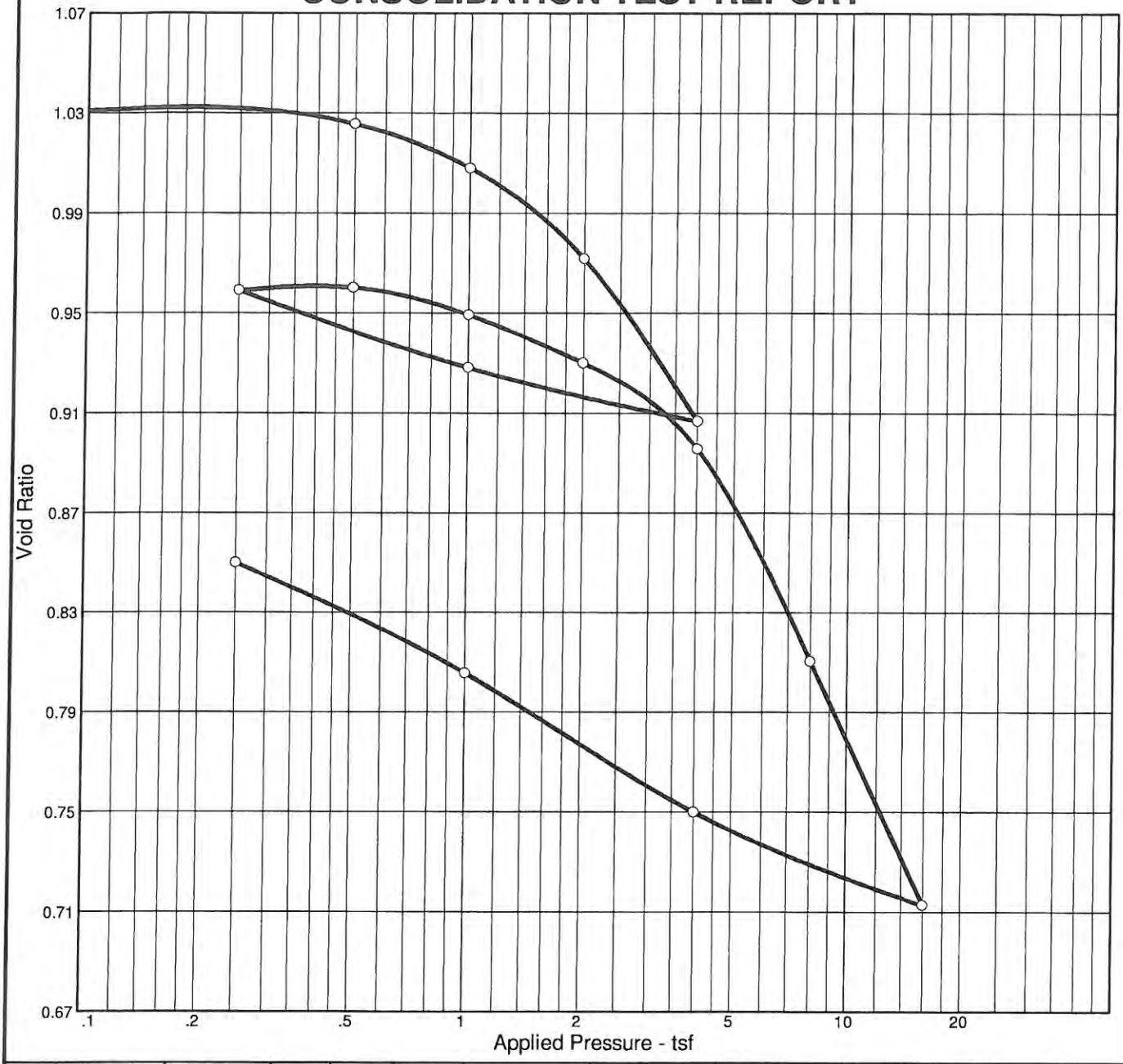
Location: Arlington Cemetery #40-12125 / 12DH55. Tube
Sample Number: 8 **Depth:** 13.0'-14.7'

Date: 11/30/12

Independent Consultants and Engineers, Inc.

Client: A-Zone Environmental
Project: Arlington National Cemetery
Project No: 40-12125 **Figure**

CONSOLIDATION TEST REPORT



Natural		Dry Dens.	LL	PI	Sp.	Overburden	P_c	C_c	C_r	Swell Press.	Swell	e_o
Sat.	Moist.	(pcf)			Gr.	(tsf)	(tsf)			(tsf)	%	
93.8 %	35.8 %	83.0	74	45	2.700		3.02	0.33	0.06			1.031

MATERIAL DESCRIPTION	USCS	AASHTO
Brown with red & gray fat clay	CH	A-7-6(47)

Project No. 40-12125 **Client:** A-Zone Environmental
Project: Arlington National Cemetery

Location: Arlington Cemetery #40-12125 / 12DH55. Tube. 5.5'-7.5'

INDEPENDENT CONSULTANTS & ENGINEERS, INC.

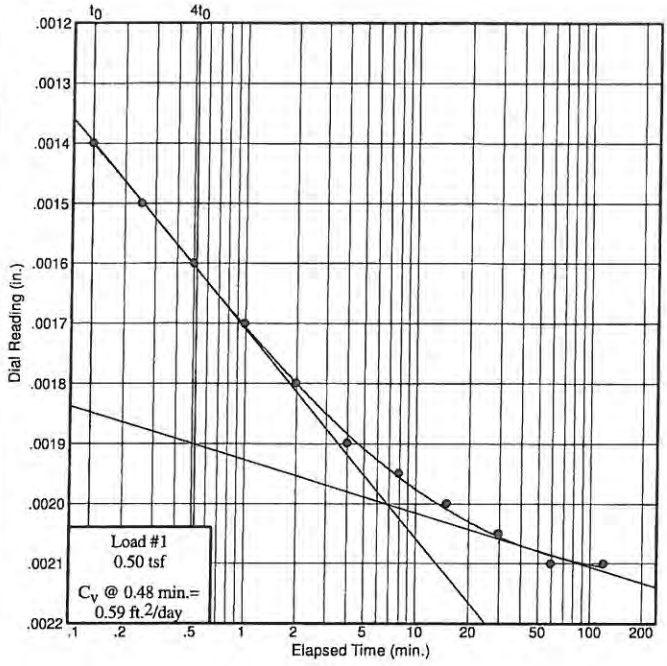
Remarks:
0.25 tsf required to prevent swell

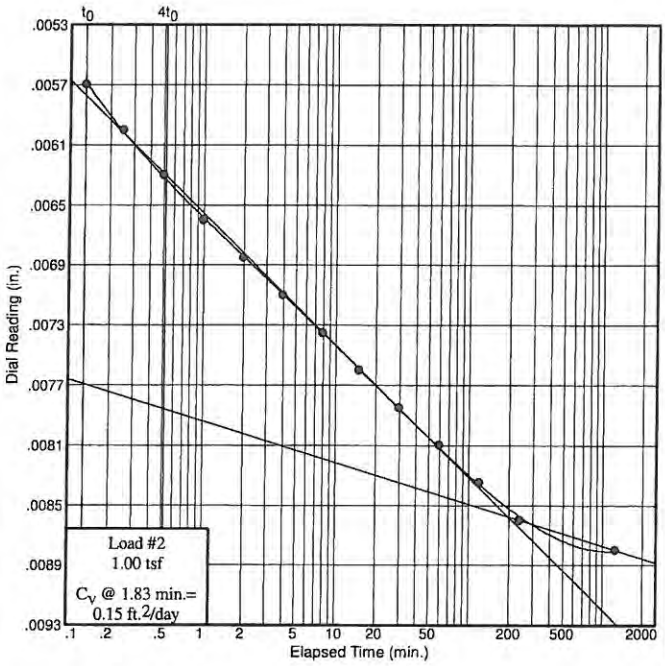
Figure

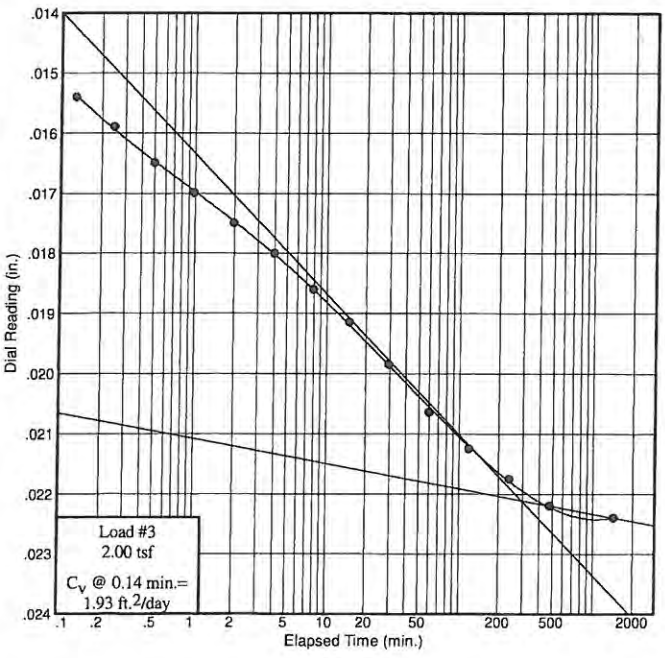
Dial Reading vs. Time

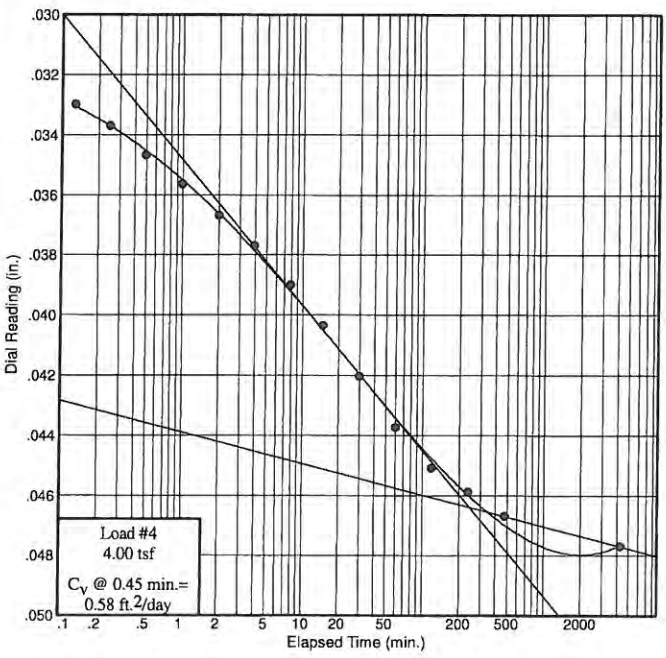
Project No.: 40-12125
Project: Arlington National Cemetery

Location: Arlington Cemetery #40-12125 / 12DH55. Tube. 5.5'-7.5'









Dial Reading vs. Time

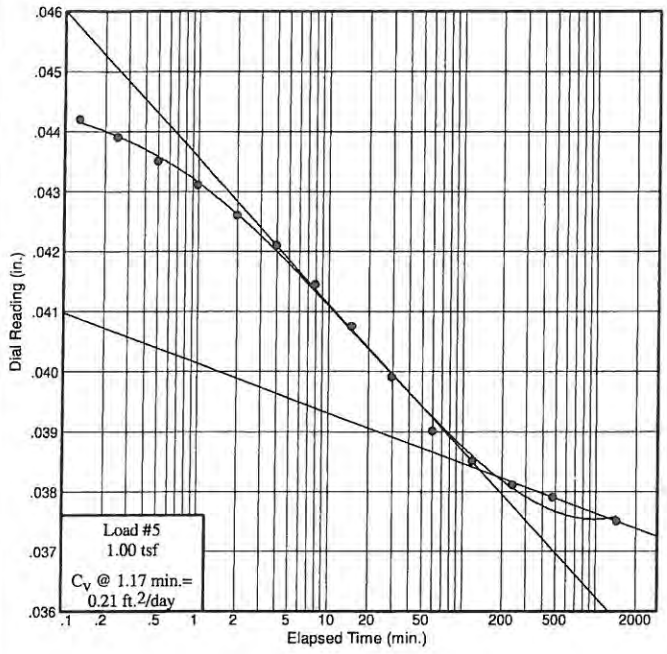
INDEPENDENT CONSULTANTS & ENGINEERS, INC.

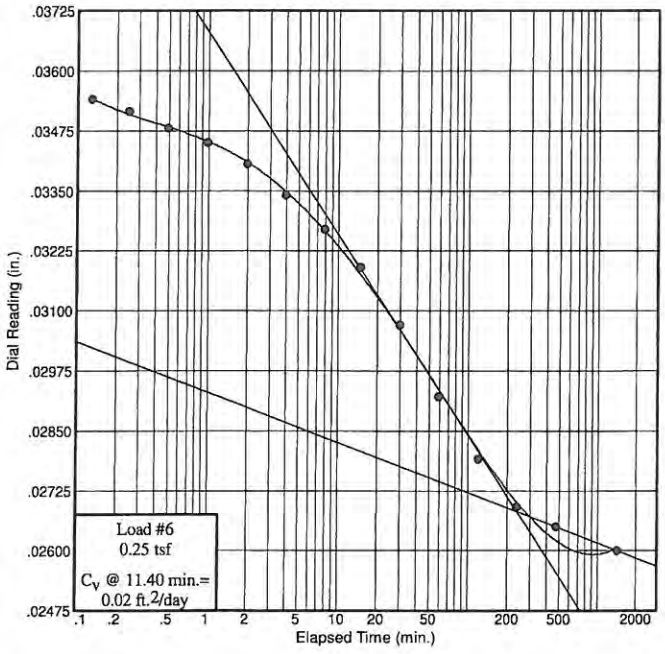
Figure

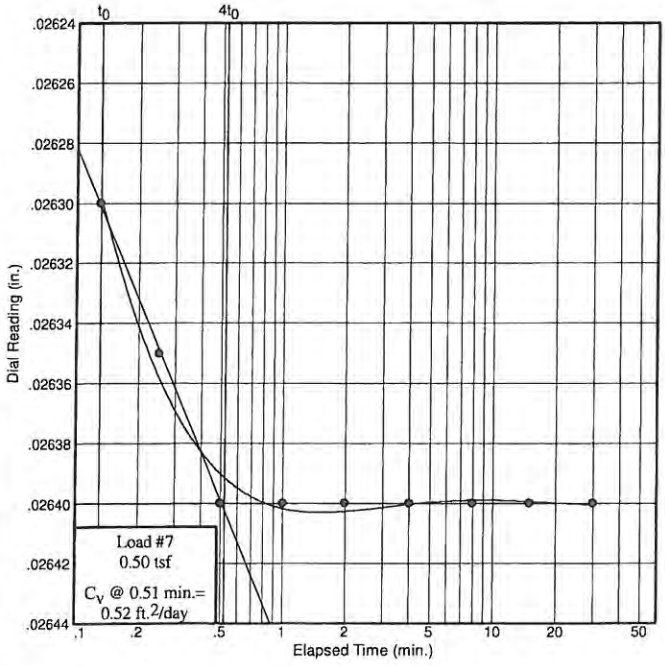
Dial Reading vs. Time

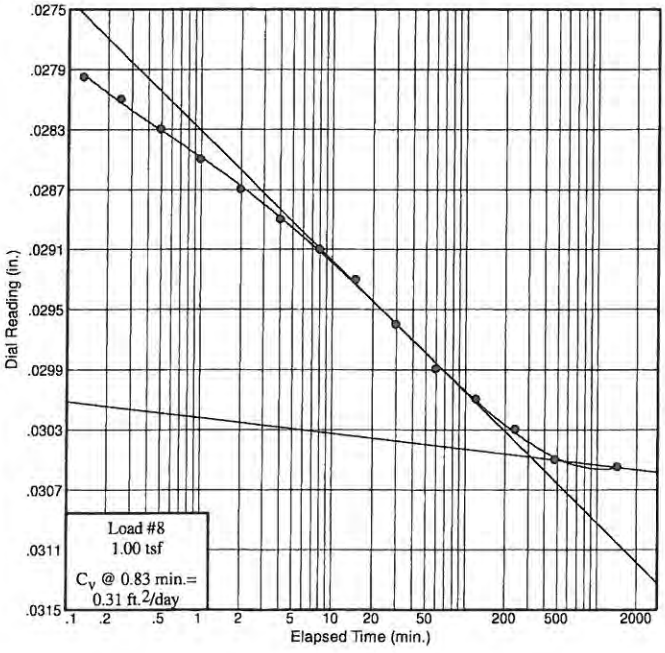
Project No.: 40-12125
Project: Arlington National Cemetery

Location: Arlington Cemetery #40-12125 / 12DH55. Tube. 5.5'-7.5'









Dial Reading vs. Time

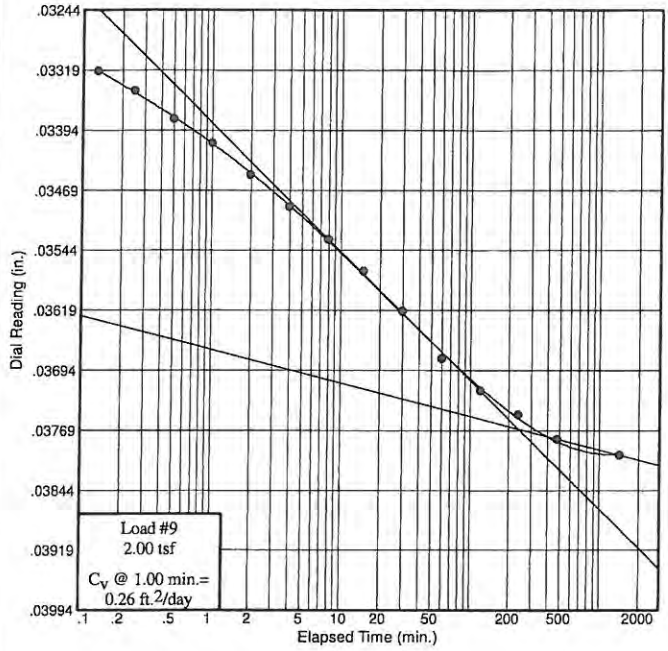
INDEPENDENT CONSULTANTS & ENGINEERS, INC.

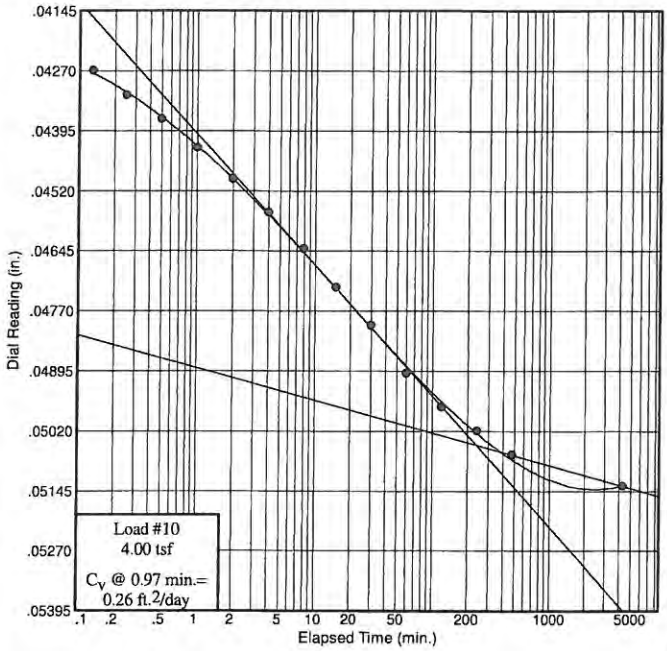
Figure

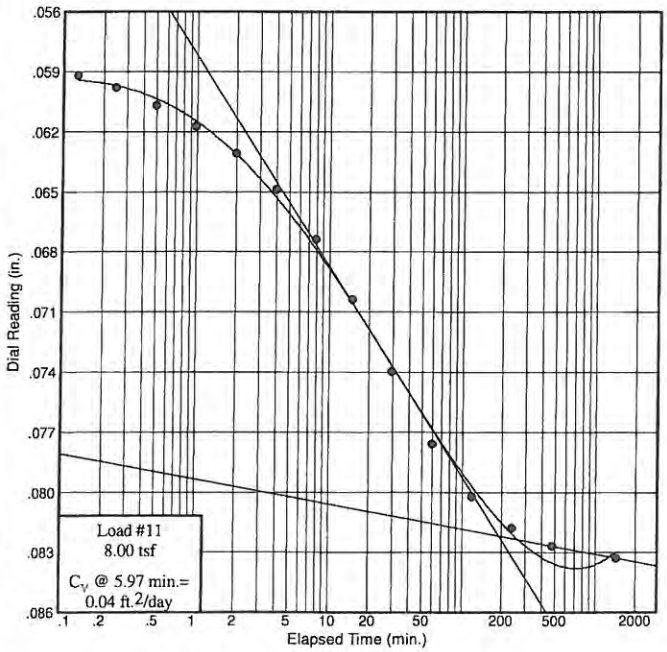
Dial Reading vs. Time

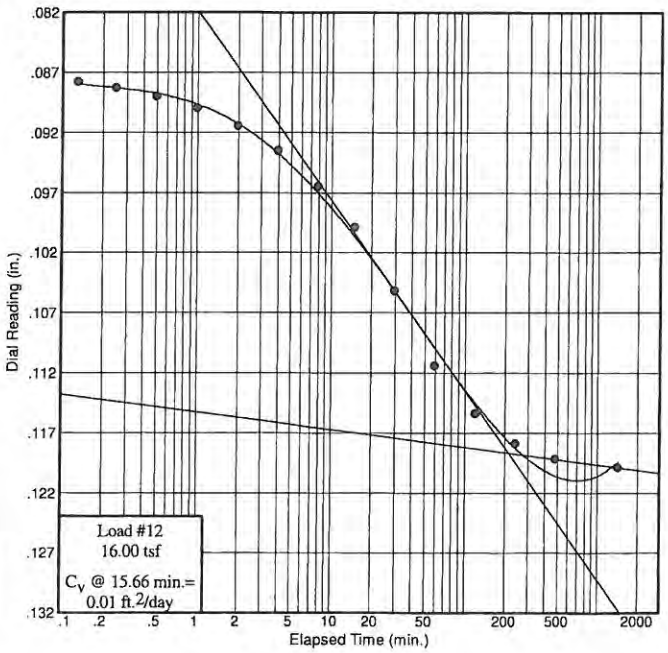
Project No.: 40-12125
Project: Arlington National Cemetery

Location: Arlington Cemetery #40-12125 / 12DH55. Tube. 5.5'-7.5'









Dial Reading vs. Time

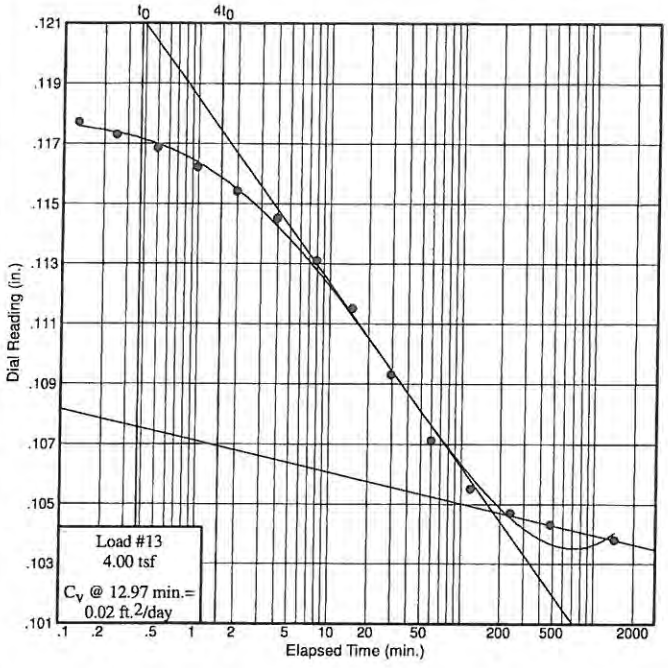
INDEPENDENT CONSULTANTS & ENGINEERS, INC.

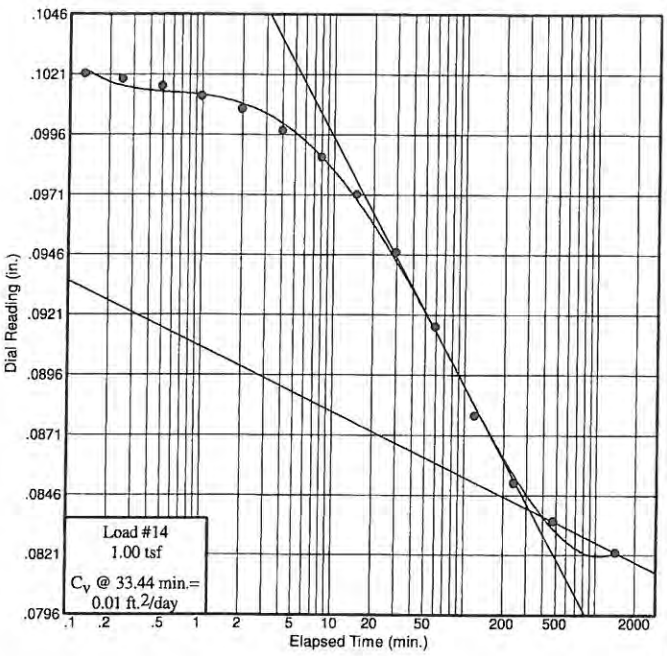
Figure

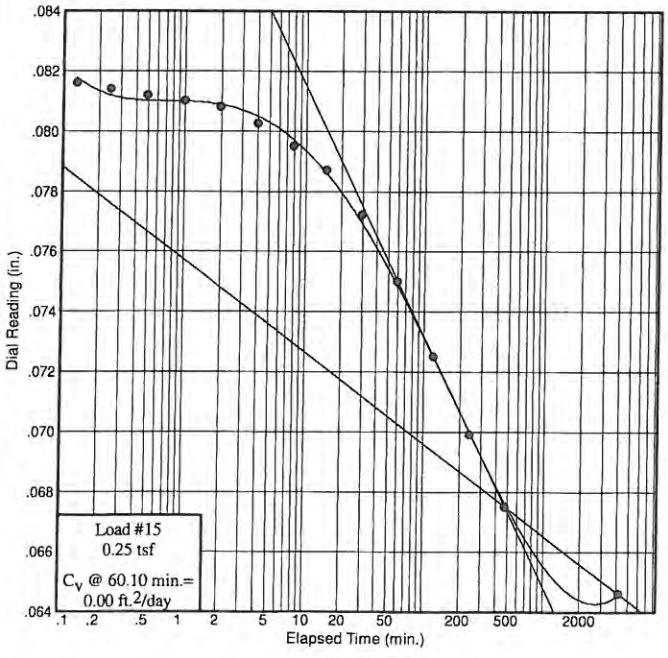
Dial Reading vs. Time

Project No.: 40-12125
Project: Arlington National Cemetery

Location: Arlington Cemetery #40-12125 / 12DH55. Tube. 5.5'-7.5'





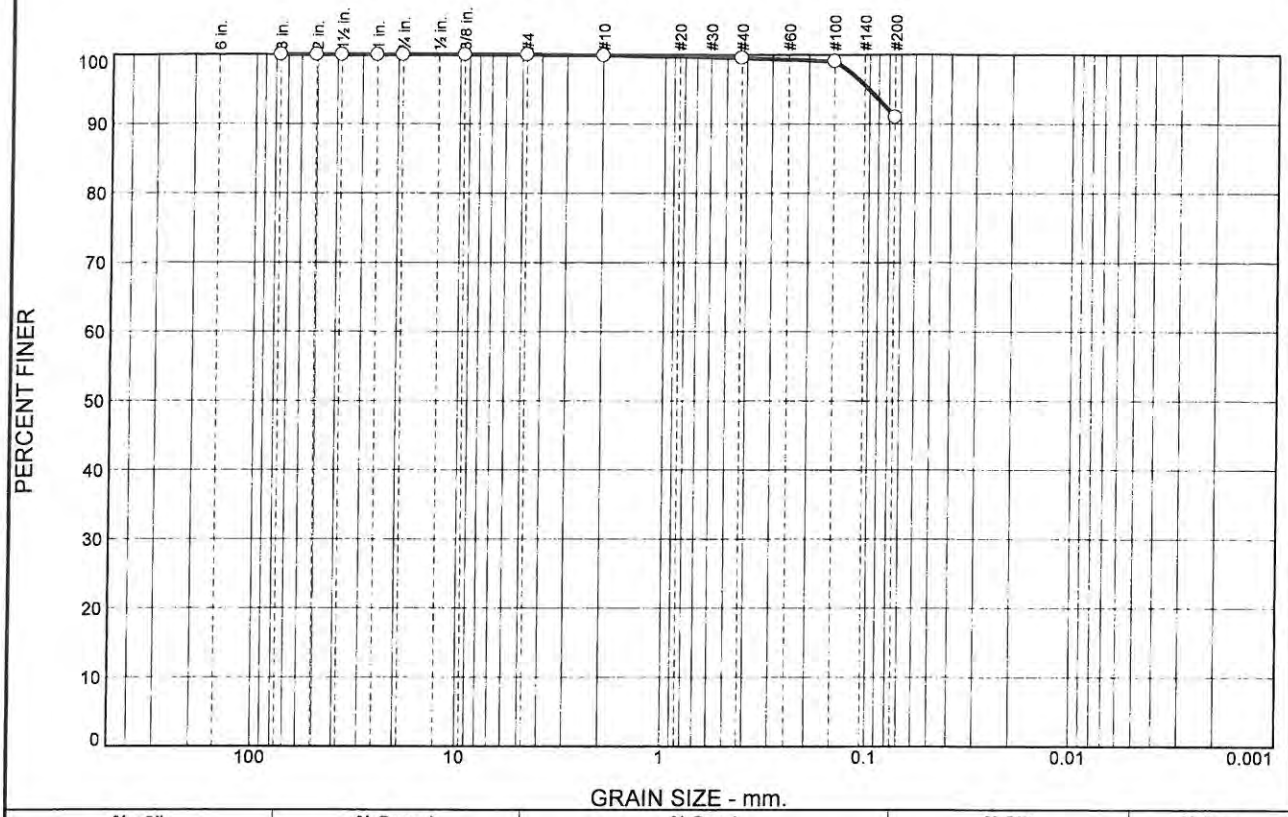


Dial Reading vs. Time

INDEPENDENT CONSULTANTS & ENGINEERS, INC.

Figure

Particle Size Distribution Report



% +3"	% Gravel	% Sand	% Silt	% Clay
0.0	0.0	9.0	91.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0		
2"	100.0		
1 - 1/2"	100.0		
1"	100.0		
3/4"	100.0		
3/8"	100.0		
#4	100.0		
#10	99.9		
#40	99.5		
#100	99.0		
#200	91.0		

* (no specification provided)

Material Description

Brown with red & gray fat clay

Atterberg Limits

PL= 29 LL= 74 PI= 45

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(47)

Remarks

Location: Arlington Cemetery #40-12125 / 12DH55. Tube. 5.5'-7.5'
Sample Number: 7 **Depth:** 5.5'-7.5' **Date:** 11/30/12

Independent Consultants and Engineers, Inc.

Client: A-Zone Environmental
Project: Arlington National Cemetery
Project No: 40-12125 **Figure**

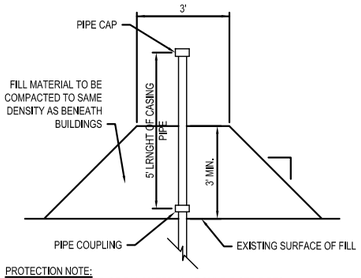
Appendix E - Lateral Pile Deflection Outputs

Lateral Pile Deflections Plots have not been included in the specifications but may be obtained from the Norfolk District USACE, Geo-Environmental Section.

Appendix F - Global Stability Critical Surfaces

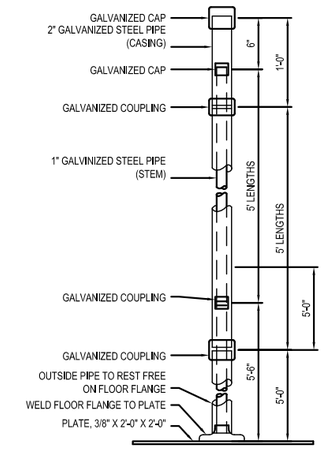
Global Stability Critical Surfaces have not been included in the specifications but may be obtained from the Norfolk District USACE, Geo-Environmental Section.

Appendix G - Design Details



PROTECTION NOTE:
A PROTECTIVE MOUND OF FILL MATERIAL AROUND RISER PIPES SHALL BE MAINTAINED ABOVE CONSTRUCTION SURFACE AT ALL TIMES DURING PLACEMENT OF REQUIRED AND SURCHARGE FILL. THE PLACEMENT OF THE PROTECTIVE MOUND SHALL BE BY METHODS WHICH WILL NOT CAUSE DISTURBANCE NOR DAMAGE TO THE PLATE AND RISER PIPES. THE FILL IN THE MOUND SHALL BE BROUGHT UP UNIFORMLY AROUND THE RISER PIPES; SOME HAND LABOR MAY BE REQUIRED. CARE SHALL BE TAKEN TO MAINTAIN THE VERTICALITY OF THE RISER PIPES. METHODS OF PLACEMENT SHALL BE SUBJECT TO APPROVAL BY THE CONTRACTING OFFICER.

PROTECTION OF SETTLEMENT GAGES DURING CONSTRUCTION



SETTLEMENT GAGE NOTES:

1. 1" STEEL PIPE (STEM) SHALL BE SECURELY FASTENED TO THE FLANGE.

2. THE CONTRACTOR SHALL FABRICATE AND INSTALL THE SETTLEMENT GAGE SHOWN. A STANDARD 2" PIPE CAP SHALL BE INSTALLED SNUGLY ON EACH 2" RISER PIPE. THE PIPE CAP SHALL HAVE A HOLE DRILLED THROUGH ITS CENTER WITH A DIAMETER SLIGHTLY LARGER THAN THE O.D. OF THE 1" PIPE. PIPES SHALL BE EXTENDED IN 5' SECTIONS AS FILL AND SURCHARGE FILL IS CONSTRUCTED, ALWAYS REPLACING THE PIPE CAP SNUGLY. BOTH PIPES SHALL BE MAINTAINED 1-3 FEET ABOVE LEVEL OF PROTECTIVE MOUND.

3. 2" STEEL PIPE SHALL NOT IN ANY WAY BE FASTENED TO THE PLATE OR FLANGE.

4. SEE SPECIFICATION SECTION: EARTHWORK FOR ADDITIONAL REQUIREMENTS FOR SETTLEMENT GAGES.

SETTLEMENT GAGE

CONSOLIDATION PERIOD FOR FILL:

I. TO MINIMIZE POST-CONSTRUCTION SETTLEMENTS DUE TO LARGE FILL PLACEMENT, A WAITING PERIOD SHALL BE OBSERVED BEFORE COMMENCING CONSTRCUTION OF ANY PERMANENT STRUCTURES. CONSTRUCTION OUTSIDE OF 10 FEET FROM THE SURCHARGE AREA MAY PROCEED DURING THE WAITING PERIOD.

II. MATERIAL USED SHALL BE SATISFACTORY MATERIAL DEFINED IN SECTION 31 00 00 EARTHWORK AND BE PLACED AND COMPACTED AS SPECIFIED IN SECTION 31 00 00 EARTHWORK.

III. SURCHARGE FILL BELOW ELEVATION SHALL BE PLACED AND COMPACTED AS SPECIFIED FOR EMBANKMENT FILL. SURCHARGE FILL ABOVE ELEVATION NEED ONLY BE COMPACTED BY THE HAULING AND SPREADING EQUIPMENT.

IV. SETTLEMENT PLATES SHALL BE PLACED ON NATURAL SUBGRADE IMMEDIATELY PRIOR TO PLACEMENT OF SITE FILL. THE FOUNDATION SURFACE FOR EACH PLATE SHALL BE GRADED SMOOTH AND LEVEL. THE LOCATIONS OF THE SETTLEMENT PLATES ARE SHOWN ON THIS SHEET. MINOR ADJUSTMENT IN THE LOCATION OF A SETTLEMENT PLATE TO AVOID UTILITIES OR STRUCTURAL FOUNDATION FEATURES WILL BE PERMITTED, BUT SHALL BE APPROVED BY THE CONTRACTING OFFICER.

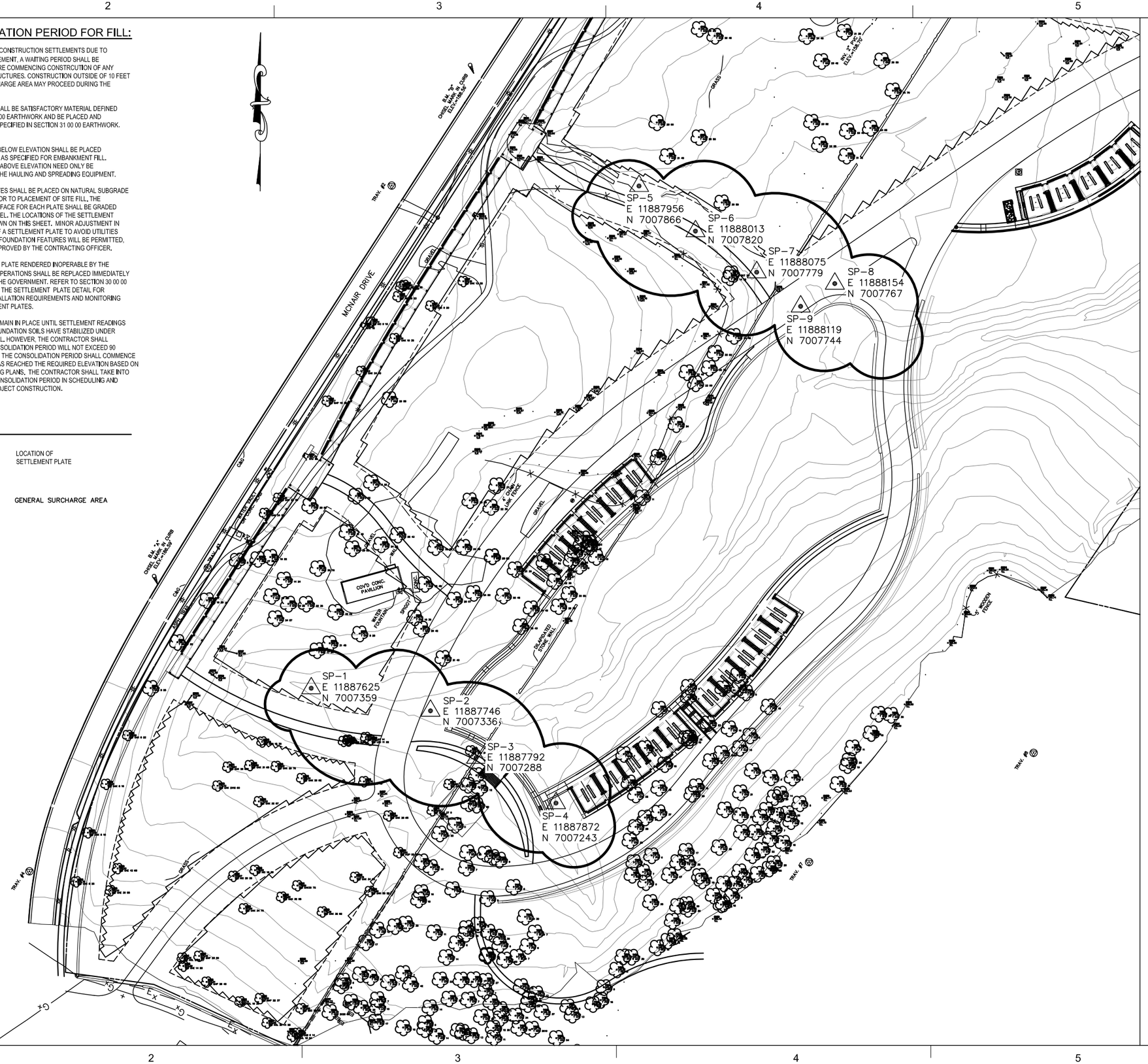
ANY SETTLEMENT PLATE RENDERED INOPERABLE BY THE CONTRACTOR'S OPERATIONS SHALL BE REPLACED IMMEDIATELY AT NO COST TO THE GOVERNMENT. REFER TO SECTION 30 00 00 EARTHWORK AND THE SETTLEMENT PLATE DETAIL FOR ADDITIONAL INSTALLATION REQUIREMENTS AND MONITORING OF THE SETTLEMENT PLATES.

V. THE FILL SHALL REMAIN IN PLACE UNTIL SETTLEMENT READINGS INDICATE THE FOUNDATION SOILS HAVE STABILIZED UNDER THE FILL MATERIAL. HOWEVER, THE CONTRACTOR SHALL ASSUME THE CONSOLIDATION PERIOD WILL NOT EXCEED 90 CALENDAR DAYS. THE CONSOLIDATION PERIOD SHALL COMMENCE ONCE THE FILL HAS REACHED THE REQUIRED ELEVATION BASED ON THE CIVIL GRADING PLANS. THE CONTRACTOR SHALL TAKE INTO ACCOUNT THE CONSOLIDATION PERIOD IN SCHEDULING AND PHASING THE PROJECT CONSTRUCTION.

LEGEND

LOCATION OF SETTLEMENT PLATE

GENERAL SURCHARGE AREA



1"=50' 0' 12.5' 25' 50' 100' 150'

US Army Corps of Engineers
Norfolk District

BY	APP.	DESCRIPTION	DATE	REV.

DESIGNED:	RLH	DATE: 15 Jan 13	
DRAWN:	JLS	CHECKED: RLH	
PROJECT NO.	PN65734	SUBMITTED: RGD	SCALE: AS SHOWN
CONTRACT NO.		NORFOLK DISTRICT FILE NO.	SPECIFICATION NO.

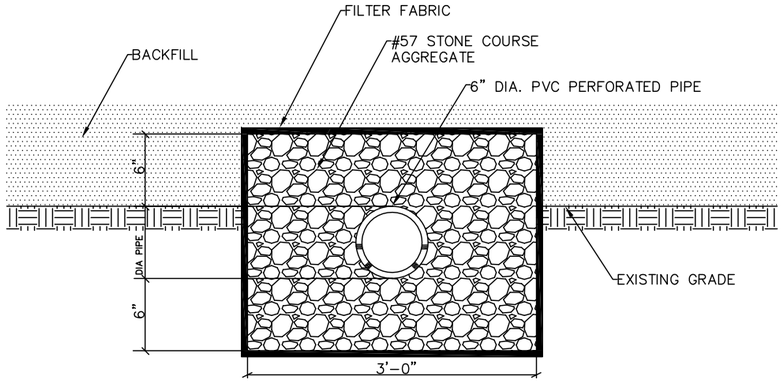
U.S. ARMY CORPS OF ENGINEERS
NORFOLK DISTRICT
CEMETERIES CONSTRUCTION
803 FRONT STREET
NORFOLK, VA 23510

JANUARY 2013

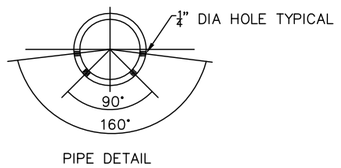
Millennium Expansion
Arlington National Cemetery

SETTLEMENT PLATE LOCATION PLAN

SHEET REFERENCE NUMBER
D-001
SHEET XXX OF XXX



TRENCH DETAIL



PIPE DETAIL

PVC PERFORATED PIPE DRAIN

LEGEND

AREA REQUIRING DRAINAGE

1"=50'

0' 12.5' 25' 50' 100' 150'

US Army Corps of Engineers
Norfolk District

NO.	DESCRIPTION	DATE	BY	APP'D

DESIGNED:	RLH	DATE:	15 Jan 13
DRAWN:	JLS	SCALE:	AS SHOWN
CHECKED:	RLH	SUBMITTED:	RGD
PROJECT NO.	PN65734	CONTRACT NO.	
		NORFOLK DISTRICT FILE NO.	
		SPECIFICATION NO.	

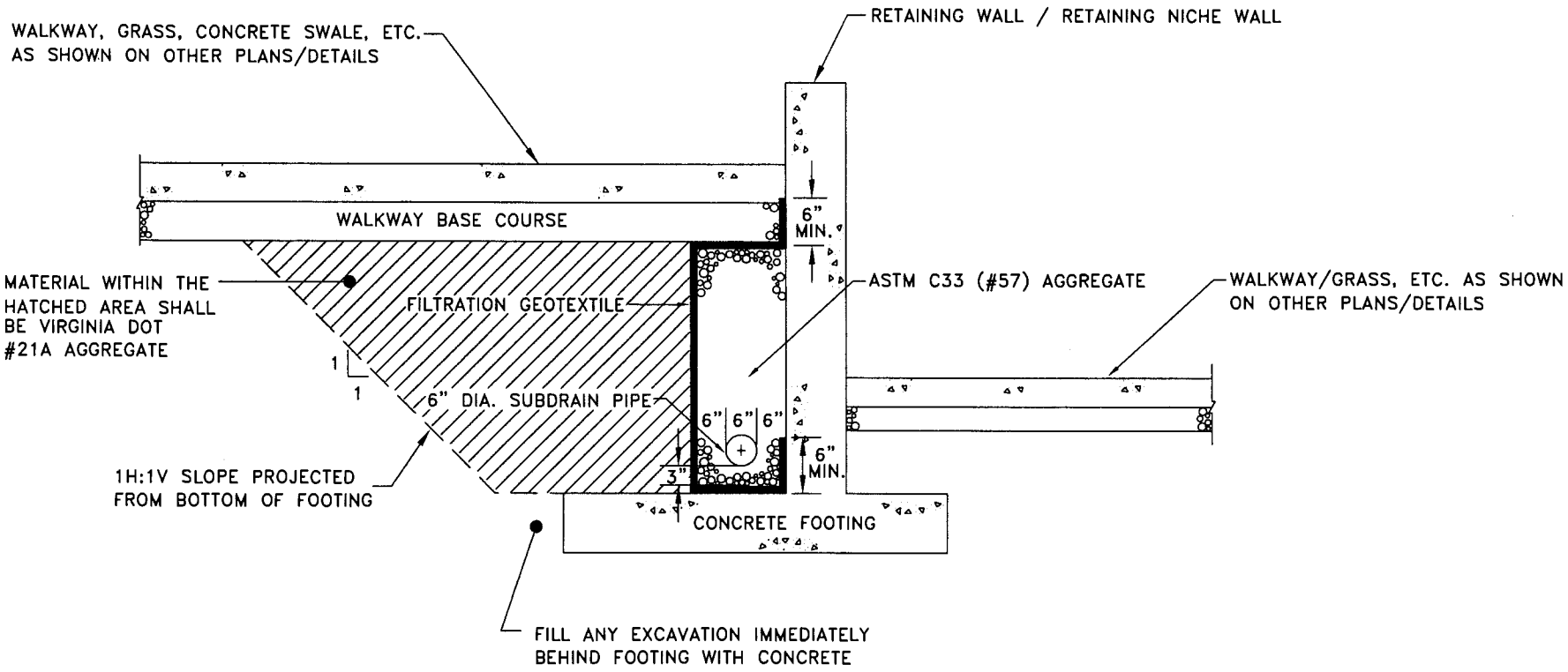
U.S. ARMY CORPS OF ENGINEERS
NORFOLK DISTRICT
CENTER FOR CONSTRUCTION
803 FRONT STREET
NORFOLK, VA 23510

JANUARY 2013

Millennium Expansion
Arlington National Cemetery

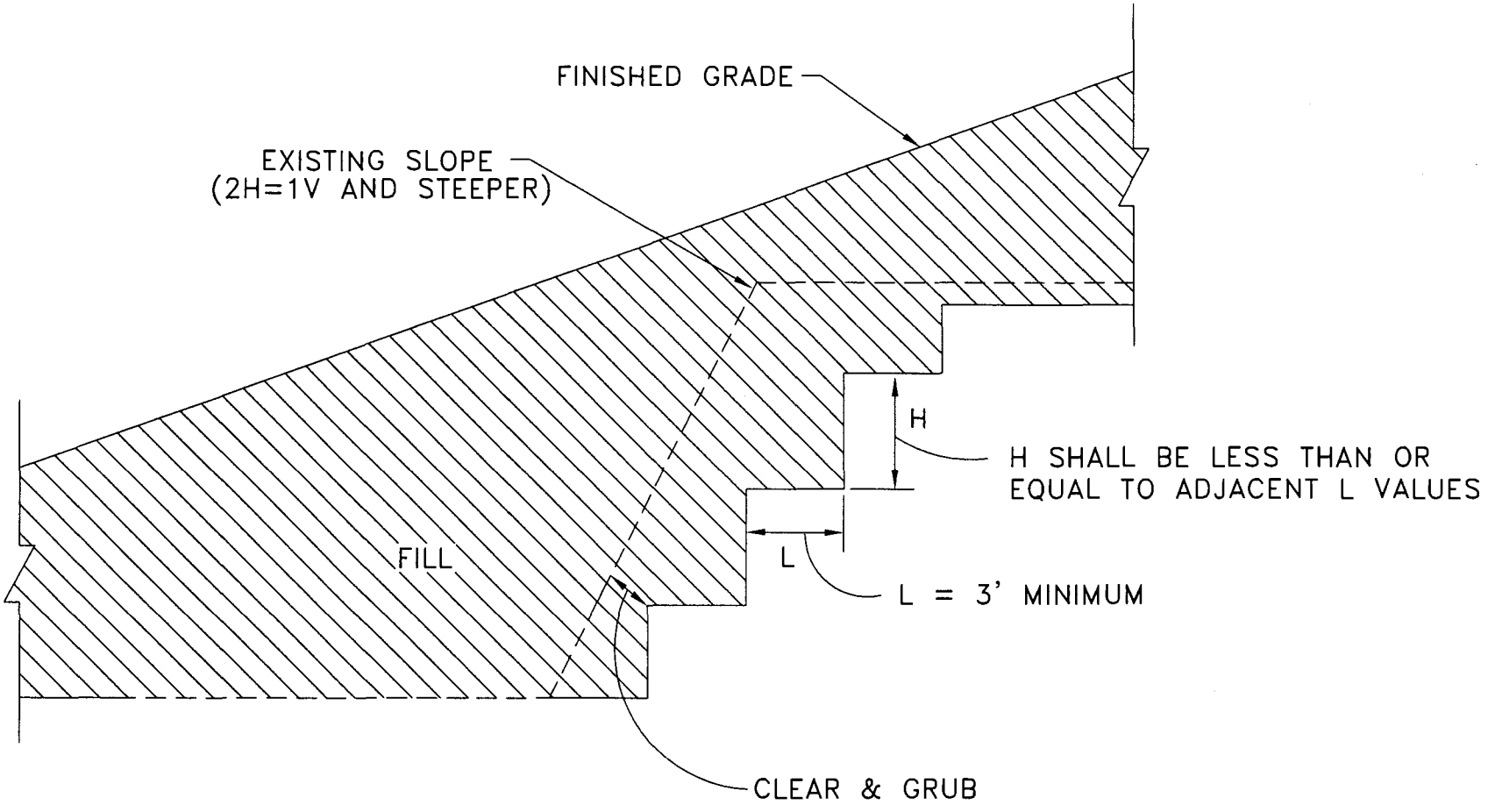
TRENCH DRAIN LOCATION PLAN

SHEET REFERENCE NUMBER
D-002
SHEET XXX OF XXX



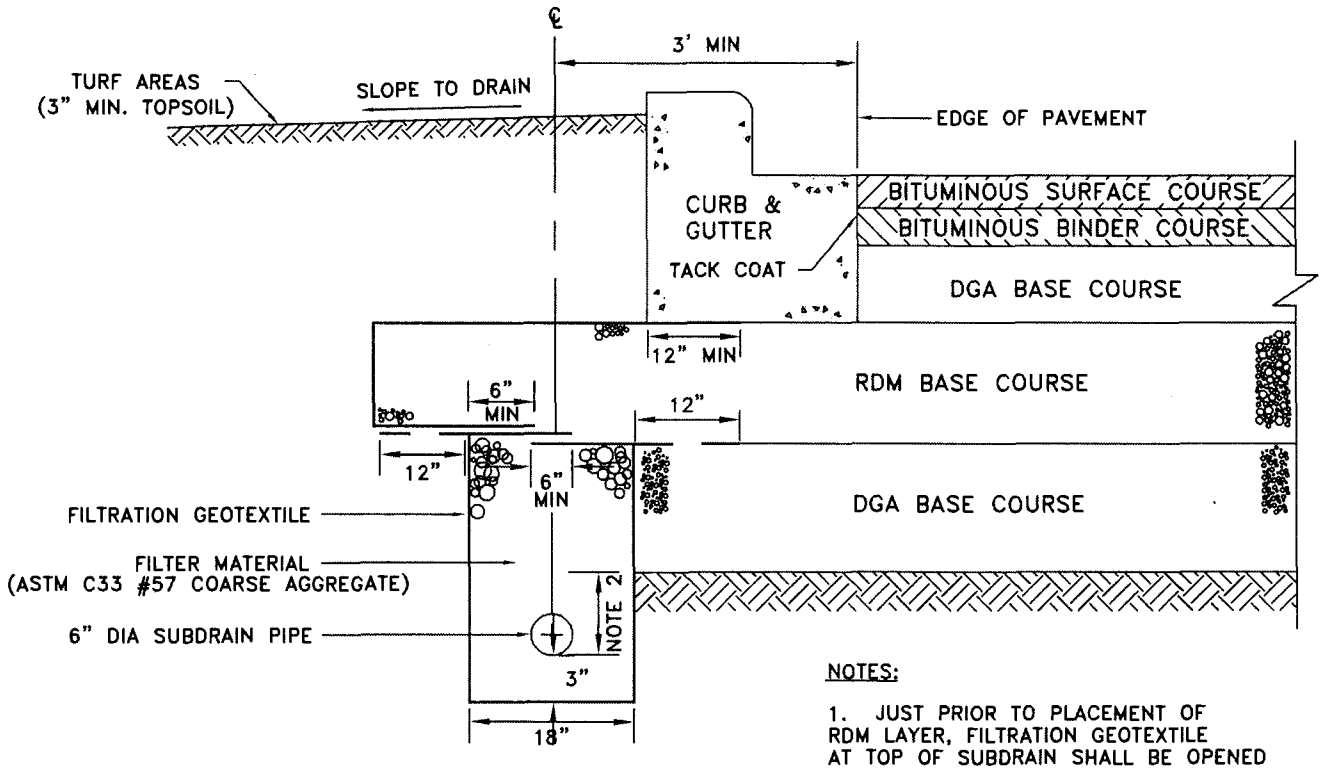
RETAINING WALL/NICHE WALLS – MATERIAL BEHIND WALLS & WALL DRAINAGE REQUIREMENTS

N.T.S.



BENCHING DETAIL

N.T.S.



RDM: RAPID DRAINAGE MATERIAL
DGA: DENSE GRADED AGGREGATE

NOTES:

1. JUST PRIOR TO PLACEMENT OF RDM LAYER, FILTRATION GEOTEXTILE AT TOP OF SUBDRAIN SHALL BE OPENED UP AND LAID BACK ON TOP OF THE UNDERLYING LAYER AS SHOWN. (SEE DASHED LOCATION)
2. VARIES SEE SHT ** & **.

TYPICAL PAVEMENT EDGE SUBDRAIN DETAIL

N.T.S.

Appendix H - Available Geotechnical Information

Available Geotechnical have not been included in the specifications are shown in the Project Plans.

REVISED DRAFT
REMEDIAL ACTION WORK PLAN

ARLINGTON NATIONAL CEMETERY
MILLENNIUM PROJECT
ARLINGTON, VIRGINIA

Prepared for:

United States Army Corps of Engineers
Norfolk District
803 Front Street
Norfolk, Virginia 23510-1096
(757) 201-7075

Prepared by:

A-Zone Environmental Services, LLC
2181 Berryville Pike
Charles Town, West Virginia 25414
(304) 724-6458

A-Zone Project No. 91236.003
Contract No. W91236-11-D-0053
Purchase request No. W2GLG-2205-0494
Task Order No. 0003

22 APRIL 2013

SIGNATURE SHEET

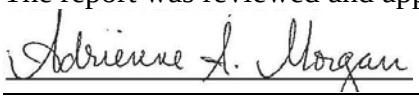
This *Remedial Action Work Plan* (RAWP) was prepared for the exclusive use of United States Army Corps of Engineers (USACE) and its contractors in performance of the soil removal and groundwater treatment activities proposed in conjunction with the Arlington National Cemetery Millennium Project located in Arlington, Virginia. The RAWP was prepared by A-Zone Environmental Services, LLC (AZONE). AZONE accepts no responsibility for either the use or adaptation of this plan by others.

The RAWP was prepared in accordance with USACE project requirements and general Commonwealth of Virginia Department of Environmental Quality guidance for petroleum storage tank and voluntary cleanup sites. The plan was prepared by:

22 April 2013

Michael A. Bruzzesi, CPG Date
Senior Geologist/Program Manager
A-Zone Environmental Services, LLC
VA CPG No. 2801 001428

The report was reviewed and approved by:



22 April 2013

Jesse Morgan Date
Senior Geologist/Quality Assurance Manager
A-Zone Environmental Services, LLC

TABLE OF CONTENTS

FIGURES

TABLE OF CONTENTS (Cont.)

FIGURES (cont.)

TABLES

ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AMSL	above mean sea level
ANC	Arlington National Cemetery
AST	aboveground storage tank
AZONE	A-Zone Environmental Services, LLC
bgs	below ground surface
COPC	constituent of potential concern
CPG	Certified Professional Geologist
EPA	United States Environmental Protection Agency
EESI	Expanded Environmental Site Investigation
ESMY	Area East of the Salvage Metal Yard
FMM	Fort Meyer Mound
IDW	investigation-derived waste
JBM-HH	Joint Base Myer-Henderson Hall
MDL	method detection limit
MEK	2-butanone
mg/kg	milligram per kilogram
mg/l	milligram per liter
MS	matrix spike
MSD	matrix spike duplicate
MTBE	methyl tert butyl ether
NPS	National Park Service
OWA	Old Warehouse Area
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
PID	photo-ionization detector
PPE	personal protective equipment
QA	quality assurance
QC	quality control
RAWP	Remedial Action Work Plan
RL	reporting limit
ROX	ROX Engineering, Inc.
SCS	Site Characterization Study
SDS	Stormwater Diversion/Interceptor Stockpile
SHAW	Shaw Environmental, Inc.
SI	Site Investigation
SMY	Salvage Metal Yard
SVOC	semi-VOC
TAL	Target Analyte List
TCE	trichloroethene
TCL	Target Compound List
TPH	total petroleum hydrocarbons
TPH-DRO	diesel range TPH
TPH-GRO	gasoline range TPH

LIST OF ACRONYMS AND ABBREVIATIONS (Cont.)

ug/kg	microgram per kilogram
ug/l	microgram per liter
USACE	United States Army Corps of Engineers
UST	underground storage tank
VDEQ	Commonwealth of Virginia Department of Environmental Quality
VDEQ-CWTGC	VDEQ construction worker in a trench groundwater contacted
VDEQ-CWTGNC	VDEQ construction worker in a trench groundwater not contacted
VDEQ-T3CGWSL	VDEQ Tier III commercial groundwater screening level for restricted groundwater use commercial land use inhalation of indoor air
VOC	volatile organic compound
VOV	volatile organic vapor

1.0 INTRODUCTION

This Remedial Action Work Plan (RAWP) details the remedial activities proposed by the United States Corps of Engineers (USACE) to address soil and groundwater impacts identified within the limits of the Arlington National Cemetery (ANC) Millennium Project located in Arlington, Virginia. The plan also provides general guidance for handling underground storage tanks (USTs) or other buried items of environmental concern (e.g., drums) should they be encountered during construction activities. The remedial activities will ultimately be performed by the contractor selected for construction of the Millennium Project (herein referred to as the Contractor). The Millennium Project is being managed by the USACE and entails the development of approximately 27 acres of land at ANC to allow for expanded burial capacity. The land proposed for expansion comprises the northeastern portion of ANC and property recently transferred to ANC from Joint Base Myer-Henderson Hall (JBM-HH), which bounds ANC to the north and west. The area proposed for expansion includes undeveloped wooded land, landscaped areas, parking areas, and cemetery maintenance yard. The expansion project will include tree removal, building demolition, and mass grading and placement of in-ground crypts (for casket burials), niche structures and walls for cremated remains (columbariums), and supporting features such as roadways, walkways, retaining walls, committal structure, utilities, and landscaped areas. A site location map, aerial photographs, site plan, and development concept maps are included as Figures 1 through 6.

The RAWP was prepared by A-Zone Environmental Services, LLC (AZONE) under contract by the USACE. The plan was prepared to address impacted soil and groundwater identified within the limits of the land comprising the Millennium Project. The impacted soil and groundwater was identified during an Expanded Environmental Site Investigation (EESI) conducted by AZONE between October 2012 and February 2013. The EESI focused on confirming past environmental findings and further assessing impacts at select Areas of Concern (AOCs) identified within the limits of the Millennium Project. The AOCs selected for further investigation included the Salvage Metal Yard (SMY), area east of the SMY (ESMY), Old Warehouse Area (OWA), Ft. Meyer Mound (FMM), and Stormwater Diversion/Interceptor Stockpile (SDS). Based on the findings of the EESI, remedial activities and/or further assessment were recommended at all five AOCs. The findings of the EESI and recommendations were presented in an EESI report submitted to the USACE, dated 19 April 2013.

A detailed discussion of the SITE history and site assessment findings are provided in the EESI. This RAWP provides a concise discussion of the site history and assessment findings and detailed discussion of the proposed remedial actions, engineering controls, and institutional controls proposed to address identified environmental concerns associated with site development. The RAWP was prepared in accordance with USACE project requirements and general Commonwealth of Virginia Department of Environmental Quality (VDEQ) guidance for petroleum storage tank and voluntary cleanup sites. Before the start of construction or implementation of any of the proposed remedial activities, an Accident Prevention Plan (APP) will be prepared by the Contractor and approved for use by the USACE. The APP will include a Site-Safety and Health Plan (SSHP) and Activity Hazard Analyses (AHAs) for each task as attachments and will comply with applicable USACE and Occupational Safety and Health

Administration (OSHA) requirements. The RAWP and APP will be required reading for all USACE, Contractor, and subcontractor staff participating in the Millennium Project construction activities and copies of the RAWP and APP will be maintained on the work site at all times.

Upon successful implementation of the recommended remedial actions, incorporation of the engineering and institutional controls, and completion of development, AZONE believes that no further assessment and/or remedial activities will be warranted.

Photographs of the AOCs and areas warranting remedial action are included as Attachment 1. An electronic copy of this RAWP is provided on the diskette included as Attachment 2.

2.0 SITE DESCRIPTION

ANC is located in Arlington County, Virginia, at the western terminus of Memorial Drive, directly across the Potomac River from the Lincoln Memorial. The cemetery is bound to the east by Routes 110 and 27. ANC is approximately 545 acres in size and functions as an active historical military shrine, a contemporary military cemetery honoring those who serve in the Armed Forces, and as a popular visitor attraction. ANC is the only National cemetery operated by the United States Army. All other cemeteries fall under the jurisdiction of the Veterans Administration. More than 250,000 people are entombed at ANC and more than 4 million people visit the cemetery annually. A site location map, aerial photographs, site plan, and development concept maps are included as Figures 1 through 6.

ANC is surrounded primarily by lands owned and occupied by the federal government and the State of Virginia. Privately-owned residential and commercial areas are near, but not adjacent to, the cemetery's northern and southwestern boundaries. Adjacent military installations include JBM-HH (located to the west and north), the Pentagon (located to the southeast), and Navy Annex/Federal Office Building 2 (located to the south). The Navy Annex/Federal Office Building 2 is vacant and is in the process of being razed. The National Park Service (NPS) owns and maintains land within and adjacent to the cemetery to the north and east (the Netherlands Carillon, Iwo Jima Memorial, and Memorial Drive including the Hemicycle-Women in the Military Memorial) and south (Air Force Memorial). Two residential neighborhoods are within close proximity of the cemetery; one near Henderson Hall and one located north of Fort Myer and MacArthur Dive.

ANC is divided into two geomorphically distinct areas: a relatively flat low-lying area to the east and Arlington Ridge to the west. The eastern portion of the cemetery exhibits few of its natural features since nearly 200 years of occupation have resulted in alterations to the natural landform. The area along the ridge generally reflects the natural land form. Topography within the cemetery gently rises from approximately 20 feet above mean sea level (AMSL) at the southeastern corner to approximately 100 feet AMSL at the base of Arlington Ridge. The land slopes at a moderately steep gradient to the cemetery's highest elevations. These elevations are found along Arlington Ridge in the western portion of the cemetery near Fort Myer Gate. In this area, elevations range from approximately 200 to 215 feet AMSL.

Groundwater is not used at ANC or surrounding area as a potable or irrigation water supply. Based on discussions with ANC facility staff and our experience working in Arlington County, potable water is supplied to the Arlington area by the local municipality and the local municipality does not allow groundwater to be used for potable or irrigation purposes in areas serviced by the local municipality. Potable water is also used for irrigation at ANC; however, regular irrigation is limited to a few areas and is used on a limited basis for the rest of the cemetery.

General descriptions of the AOCs selected for further investigation during the EESI and where remedial activities are proposed are discussed in the following sections.

Salvage Metal Yard (SMY)

The SMY is located on the northwestern portion of ANC and comprises the northern portion of the Millennium Project. The SMY is bound to the west and north by wooded land, to the east by the ESMY, and to the south by the OWA. Topography of the area slopes gently to the east-southeast. The area surface is entirely covered with gravel, hard-pack soil, asphalt pavement, and grass. This area is currently used by the ANC and their subcontractors as a storage yard. Numerous stockpiles of gravel and fill dirt, a scrap metal rolloff, and various equipment and supplies were noted in the area. The SMY has historically been used as a storage yard for supplies and equipment. A map depicting the limits of the SMY and site features is included as Figure 8.

Area East of the Salvage Metal Yard (ESMY)

The ESMY is located on the northwestern portion of ANC and comprises the northern portion of the Millennium Project. The ESMY is bound to the west by the SMY, to the north by wooded land, to the east by Ord and Wetzel Drive, and to the south by the OWA. Topography of the area slopes gently to the south-southeast. The area surface is entirely covered with gravel, hard-pack soil, and grass except for the northern portion. A few overgrown mounds of boulders and debris were noted on this portion of the area. This area is currently used by ANC landscaping subcontractors for parking personal vehicles. In the past, equipment and materials were likely stored at the ESMY. A map depicting the limits of the ESMY and site features is included as Figure 8.

Old Warehouse Area (OWA)

The OWA is located on the northwestern portion of ANC and comprises the northeastern portion of the Millennium Project. The OWA is bound to the west and south by wooded land, to the north by the SMY and ESMY, and to the east by Ord and Wetzel Drive. Topography of the area is terraced and slopes gently to the south-southeast. An unnamed western-flowing stream is situated within the wooded area bounding the OWA to the south. The area surface is entirely covered with gravel, hard-pack soil, asphalt pavement, and grass. One permanent building remains at the area, Building 108. Building 108 is used to store equipment and materials for cemetery maintenance. Seven additional buildings formerly occupied the area, Buildings 101 through 107, all of which were razed between 2001 and 2005. The historical uses of the buildings are listed below:

- Building 101 - Garage used for ANC equipment and vehicles.
- Building 102 - Storage of paint, thinner, oil, and hydraulic fluids.
- Building 103 - Pesticide storage and grounds maintenance.
- Building 104 - Pesticide storage and horticulture.
- Building 105 - Office space.
- Building 106 - Locker room, rest room, and lunchroom.
- Building 107 - Storage, maintenance shops, and rest rooms.
- Building 108 - Storage for herbicides. This building is still in use. A large open-bay storage area is located on the western half of the building that is used to store sand, salt, soil, and wood wastes that are processed into mulch.

These buildings were originally heated by heating oil stored in AST and UST systems and used ASTs and USTs to store petroleum products for distribution (gasoline and diesel fuel) and used oil. All of the ASTs and USTs were removed in the late 1990s. The OWA has historically been used as a storage yard for supplies and equipment and maintenance yard. A map depicting the limits of the OWA and site features is included as Figure 9.

New temporary mobile storage boxes have been added so that the maintenance contractors can store small equipment and materials. The OWA is still used by outside companies to maintain the grounds. The OWA is currently used to park vehicles and equipment and for outdoor storage of construction, maintenance equipment, and debris created during maintenance of the cemetery (i.e., wood, stone, and fill dirt).

Fort Meyer Mound (FMM)

The FMM is located at the northern extent of property recently transferred from JBM-HH to ANC and comprises the west-central portion of the Millennium Project. The vast majority of the mound is located on JBM-HH property; however, this area will be improved in conjunction with expansion of the cemetery. Intermixed soil and debris comprising the mound "spills" over the brick and stone wall separating JBM-HH and ANC property. The FMM is bound to the west, south, and east by wooded land and to the north by a JBM-HH maintenance facility. The mound represents a topographic high and slopes steeply in all directions. The area surface is entirely covered with hard-pack soil and grass. A small intermittent drainage channel (stream) is located at the southeastern base of the mound.

Construction debris, scrap metal, and wagon wheels are documented to have been disposed of in the mound. Past investigations have unearthed a 1,000-gallon UST, several 10-gallon metal drums, metal debris, and petroleum-impacted soil. Additional items removed from the mound include a 3,000-gallon heating oil UST, drums of waste oil, ASTs containing diesel fuel and gasoline, PCB-impacted soil, and a shed containing various quantities of motor oil, gear oil, lubricating oil, hydraulic fluid, transmission fluid, and antifreeze. During the EESI, AZONE observed debris protruding from the mound along its sides. Observed debris included wood, concrete, and asphalt. A map depicting the limits of the FMM and site features is included as Figure 10.

Stormwater Diversion/Interceptor Stockpile (SDS)

The SDS comprises the central portion of property recently transferred from Fort Meyer to ANC and comprises the west-central portion of the Millennium Project. The SDS is bound to the west by McNair Drive, to the north and south by grassy land, and to the east by wooded land. Topography of the area slopes steeply to the north, east, and south. The area surface is entirely covered with hard-pack soil and grass. A small intermittent drainage channel (stream) bounds the SDS to the north and another intermittent stream is located in close proximity to the east (on ANC property).

The SDS was created from 2008 through 2009 during installation of a stormwater diversion/interceptor at JBM-HH to facilitate the expansion of ANC. Stormwater from JBM-HH needed to be diverted off the Millennium Site. To divert stormwater, a 1,000,000-gallon underground detention basin was installed north of the intersection of Jackson Avenue and McNair Road. Excess soil from the project was stockpiled on the eastern side of McNair Road and comprises the SDS. A map depicting the limits of the SDS and site features is included as Figure 11.

3.0 MILLENNIUM PROJECT DEVELOPMENT

The Millennium Project entails the development of approximately 27 acres of land to allow for expanded burial capacity. The land proposed for expansion comprises the northeastern portion of ANC and property recently transferred to ANC from JBM-HH, which bounds ANC to the north. The area proposed for expansion includes undeveloped wooded land, landscaped areas, parking areas, and an ANC maintenance yard. The expansion project will include tree removal, building demolition (Building 108), and mass grading and placement of in-ground crypts (for casket burial), niche structures, traditional in-ground burial, and walls for cremated remains (columbariums), and supporting features such as roadways, walkways, retaining walls, committal structure, utilities, and landscaped areas. Development concept maps are included as Figures 5 through 6. When the Millennium Project construction is complete, there will be a capacity for about 30,000 internments.

Mass grading will entail the disturbance of a few to more than 16 feet of soil underlying the vast majority of the Millennium Project footprint. The current plan indicates maximum cut and fill quantities of 16 and 30 plus feet, respectively. The majority of the excavation will entail preparation of the areas for burial of caskets. Current plans include mass excavation of these areas and installation of pre-place concrete crypts, followed by backfilling and restoration of the disturbed areas. In areas where columbariums and traditional casket internments will be located, less excavation and grading is anticipated since these structures are sited closer to the existing site grades. The vast majority of soil generated during grading is expected to meet beneficial reuse criteria and will be used on site as general backfill. If additional fill is needed to achieve proposed grades or meet engineering requirements, imported fill will be used.

Based on AZONE's review of historical and recent groundwater measurement data for the SITE, construction activities may encounter groundwater at lower elevations of the site typically

located to the north. Mass grading is not expected to achieve excavation depths below the water table.

4.0 EESI FINDINGS

The EESI was conducted by AZONE between November 2012 and February 2013 and was conducted to address environmental concerns associated with the expansion of the cemetery. Environmental concerns included the potential to unearth impacted soil and encounter impacted groundwater associated with removed petroleum USTs and current and past facility operations (e.g., maintenance yard operations and storage of pesticides, chemicals, equipment, and scrap metal). Historical documents indicated all of the UST cases within the AOCs were "closed" by the VDEQ; however, impacted soil and groundwater was left in place at several of the former UST locations. In areas where impacted soil and groundwater were left in place, closure was granted by the VDEQ based on the minimal risk posed to sensitive receptors by the impacted media and property use at the time of their determination.

Constituents of potential concern (COPCs) at the AOCs include total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), semi-VOCs (SVOCs), polychlorinated biphenyls (PCBs), pesticides, herbicides, and metals. The AOCs selected for further investigation included the SMY, ESMY, OWA, FMM, and SDS. Further investigation of these AOCs was recommended by the USACE based on the findings of past studies conducted by the USACE and others.

The objective of the EESI was to consolidate historical data, further assess soil and groundwater quality at AOCs warranting further study, and evaluate if conditions of media (soil, groundwater, and soil gas) warrant cleanup, engineering controls, institutional controls, special handling and disposal of disturbed media, and/or specialized health and safety protocols to minimize health risks for construction workers. The data was also used to evaluate health and safety risks to future site users (workers and visitors). Of particular concern is the handling of soil that will be disturbed during development. Development will entail mass grading and soil disturbance. Soil quality data collected during the EESI was used to determine if the disturbed soil can be used for beneficial reuse on site or requires special handling and off-site disposal or treatment.

Historical assessment activities conducted prior to the EESI included UST and aboveground storage tank (AST) removal and assessment, petroleum-impacted soil removal, installation of groundwater monitoring wells, and collection of soil, groundwater, surface water, sediment, and soil gas samples for laboratory analysis. Assessment activities comprising the EESI included advancement of test borings, installation of groundwater monitoring wells, and collection of soil and groundwater samples for field screening and laboratory analysis.

Historical reports reviewed and relied upon during the EESI included the following:

- **Comprehensive Storage Tank Report**, for ANC, prepared by ROX Engineering, Inc. (ROX), dated 22 January 1998.

- **Site Characterization Report**, for ANC OWA, prepared by ROX, dated 25 January 2002.
- **Millennium Environmental Support Investigation Report**, for ANC Millennium Project, prepared by Shaw Environmental, Inc. (SHAW), dated April 2011.
- **Expanded Environmental Site Investigation Report**, for ANC Millennium Project, prepared by AZONE, dated 22 February 2013.

Other reports which provided helpful site information and history of ANC include the following:

- **Arlington National Cemetery Master Plan-Environmental Assessment**, for ANC, prepared by USACE, dated September 1997.
- **Constraints Summary**, for ANC Millennium Project, prepared by the USACE, dated December 2005.
- **Final Geotechnical Report**, for ANC Millennium Project, prepared by the USACE, dated April 2007.
- **Charrette Report**, for ANC Millennium Project, prepared by the USACE, dated 7 September 2012.

A concise summary of the environmental investigations conducted and findings related to historical site use and soil and groundwater quality are discussed in the following sections.

4.1 Historical Site Use and Background

ANC has been under continuous control of the federal government since 1864. Prior to use by the federal government, the first recorded ownership of the land comprising ANC was President George Washington's adopted grandson George Washington Parke Custis. After the death of George Washington Parke Custis and his Wife, Mary Lee Fitzhugh, Custis' only child, Mary Anna Randolph Custis, and husband, Robert E. Lee, took ownership of what was then a 1,100 acre tract of land and lived at Arlington House until 1861. The property was confiscated by the federal government when property taxes levied against the Arlington estate were not paid in person by Mrs. Lee. The property was offered for public sale 11 January 1864 and was purchased by a tax commissioner for "government use, for war, military, charitable, and educational purposes". On 15 June 1864, 210 acres in the immediate vicinity of Arlington House were set aside as a national cemetery for Union soldiers and sailors at the request of Major General M.C. Meigs, Quartermaster General of the Union Army, and ANC was established.

The federal government dedicated a model community for freed slaves, Freedman's Village, near the current Memorial Amphitheater, 4 December 1863. More than 1,100 freed slaves were given land by the government, where they farmed and lived during and after the Civil War. They were turned out in 1890 when the estate was repurchased by the government and dedicated as a military installation. Arlington House (also referred to as Custis-Lee Mansion) and the grounds in its immediate vicinity are administered by the National Park Service (NPS).

ANC now occupies approximately 545 acres of land and is the eternal resting place for more than 250,000 of our Nation's service men and women and numerous national monuments. More

than 4 million people visit ANC annually. In addition to in-ground burial, ANC also has one of the larger columbarium complexes for cremated remains in the country. A site location map and aerial photograph are included as Figures 1 and 2, respectively.

Storage Tanks

In 1998, ROX was tasked by ANC to summarize the status of petroleum storage tanks currently in use and formerly used at ANC. Based on the findings of ROX's report, three aboveground storage tanks (ASTs) and seven USTs were formerly located and used at the OWA for the storage and/or dispensing of new and used (waste) petroleum products. The reported tank locations are depicted on Figure 9. Information concerning tank construction, capacity, use, dates of operation, and release history is summarized on Table 1.

The dates the ASTs were installed at the OWA are unknown. Tank 9 was removed in 1993 and Tanks 8 and 19 were removed in 1996. There are no documented releases from the ASTs during their use. Tanks 4, 5, 6, 10, 16, and 17 were removed in 1993 and Tank 7 was removed in 1996. Based on observations made during removal of the USTs, releases occurred from Tanks 4, 5, 6, 10, 16, and 17. Evidence of a release was noted in the form of petroleum-stained soil, soil exhibiting petroleum odors, free product sheen observed on groundwater entering the tank excavations, and elevated detections of petroleum constituents in soil samples collected for laboratory analysis. It is unknown whether or not a release occurred from Tank 7. The VDEQ assigned Case Nos. 90-0437 and 92-1775 to the releases associated with Tanks 4, 5, 6, 10, 16, and 17 and required further assessment and/or cleanup.

Cleanup consisted of excavation and on-site treatment of impacted soil (estimated to be a total of 60 tons). The quality of soil, groundwater, and surface water was evaluated during a Site Characterization Study (SCS) conducted in 1996 that included soil sampling, installation and sampling of groundwater monitoring wells, and sampling of a nearby and topographically-downgradient stream. All of the UST cases were "closed" by the VDEQ in 1997; however, impacted soil and groundwater was left in place at several of the former UST locations (Tanks 5, 6, 10, 16, and 17). In areas where impacted soil and groundwater were left in place, closure was granted by the VDEQ based on the minimal risk posed to sensitive receptors by the impacted media and property use at the time of their determination (active warehouse and maintenance yard). All of the wells were closed shortly after case closure was granted.

Site Characterization Study

In January 2005, ROX conducted a SCS at the OWA for Cetrom, Inc. The SCS consisted of reviewing and summarizing historical data and collecting soil and building material samples for laboratory analysis. Soil samples were collected throughout the OWA and were analyzed for gasoline and diesel range TPH (TPH-GRO and TPH-DRO, respectively), pesticides, and metals.

ROX concluded that the data collected during past investigations concerning the UST releases was reliable and did not indicate the need for further assessment and/or cleanup. Pesticides and metals were detected in several of the soil samples collected by ROX at relatively low concentrations. ROX did not believe the pesticide and metal detections warranted further study and/or cleanup. Elevated concentrations of TPH-GRO were detected in a sample collected between Buildings 103 and 104, near former UST location Tank 8. It should be noted that Tank 8 was used to store heating oil not gasoline and ROX was unable to identify a source of the gasoline impacts. Further assessment of this area was recommended by ROX. An additional recommendation made by ROX that is applicable to the Millennium Project was to assess the SMY and Stump Dump.

Millennium Environmental Support Investigation

In July 2009, SHAW conducted a limited Site Investigation (SI) in support of the Millennium Project. SHAW was under contract by the USACE. The SI focused on several AOCs identified by SHAW during an earlier Preliminary Assessment (PA). The PA identified six AOCs on the property proposed for expansion of ANC including the SMY, ESMY, OWA, FMM, Western Point of Humphreys Avenue, and Creek Bed South of the OWA and Stump Dump. The AOC locations are depicted on Figure 3.

The SMY was considered an AOC because of the storage of scrap metal in this area, historical reports of oil staining, and presence of TPH in soil samples collected for laboratory analysis from the area. The ESMY was considered an AOC because facility staff stated organic odors were noted in this area in the past. The location and source of the odors is unknown. The OWA was considered an AOC because of the area's long history of use for the storage and mixing of chemicals and pesticides, maintenance of equipment, past storage of petroleum in ASTs and USTs (some of which had documented releases), and potential for former buildings to have contributed lead to soil from painted surfaces. The FMM was considered an AOC because of the potential burial of construction debris, scrap metal, wagon wheels, drums, and tanks in this area which was formed by mass stockpiling of soil. The Western Point of Humphreys Avenue was considered an AOC because wood fill was noted in the area during a geotechnical investigation. The Creek Bed South of the OWA and Stump Dump was considered an AOC because of suspect soil staining noted during an inspection and because of potential runoff from the OWA.

Activities conducted by SHAW to investigate and assess the AOCs included reviewing historical files and documents and collecting surface soil, sediment, surface water, groundwater, soil gas, and paint chip samples for field screening and laboratory analysis. The sampling locations were selected to provide good spatial coverage of the AOC, to assess locations where impacts would be expected based on current or past site activities, and evaluate the background concentrations of metals in surface soil. The sampling locations at the SMY and ESMY are depicted on Figure 8 and the sampling locations at the OWA are depicted on Figure 9.

Field screening of surface soil was conducted with field meter (XRF) that measured the concentration of select metals in soil. Surface soil sampling was limited to the SMY, ESMY, and OWA with samples collected for some or all of the following analysis: Target Compound List (TCL) VOCs, SVOCs, TPH-GRO, TPH-DRO, PCBs, pesticides, and Target Analyte List (TAL) metals. Groundwater sampling was limited to the OWA with samples collected for TPH-GRO and TPH-DRO analysis. Groundwater samples were collected from test pits excavated at the OWA. Soil gas samples were collected from all six of the AOCs with samples collected for the following analysis: select VOCs, select SVOCs, TPH, and select polycyclic aromatic hydrocarbons (PAHs). Information for the SHAW soil and groundwater sampling locations is summarized on Table 2.

Based on the findings of SHAW's study, further investigation and assessment was recommended at the SMY, ESMY, and OWA. SHAW's findings as they relate to soil, groundwater, and soil gas conditions at the AOCs is discussed in detail in Sections 4.3, 4.4, and 4.5. A summary of the

assessment activities conducted at each AOC and basis for the recommendations for further study are as follows:

- **SMY** – A total of 10 surface soil and 10 soil gas samples were collected from the SMY. All 10 of the surface soil samples were field screened for metals with an XRF. Two of the surface soil samples were also submitted for laboratory analysis of TCL VOCs, TCL SVOCs, PCBs, pesticides, and TAL metals. Metals were not identified at concentrations warranting concern in the field screening samples or laboratory samples. TPH-DRO were detected in one of the laboratory samples at an elevated concentration (2,200 milligrams per kilogram [mg/kg]). TPH and tetrachloroethene (PCE) were detected in soil gas samples at elevated concentrations. The elevated detection of TPH-DRO in soil and elevated detections of TPH and PCE in soil gas warranted further assessment (to evaluate the nature and extent of these COPCs in soil and groundwater at the AOC). The SMY soil analytical results are summarized on Table 3.

- **ESMY** – A total of eight surface soil and eight soil gas samples were collected from the ESMY. All eight of the surface soil samples were field screened for metals with an XRF. One of the surface soil samples was also submitted for laboratory analysis of TCL VOCs, TCL SVOCs, TPH-GRO, TPH-DRO, PCBs, pesticides, and TAL metals. Metals were not identified at concentrations warranting concern in the field screening samples or the laboratory sample. TPH and VOCs were detected in soil gas samples at elevated concentrations. The elevated detection of TPH and VOCs in soil gas warranted further assessment (to evaluate if these COPCs are present in soil and groundwater at the AOC). The ESMY soil analytical results are summarized on Table 4.

- **OWA** - A total of 23 surface soil, 3 groundwater, 16 soil gas, and 10 paint chip samples were collected from the OWA. All 23 of the surface soil and all 10 paint chip samples were field screened for metals with an XRF. Seven of the surface soil samples were also submitted for laboratory analysis of TCL VOCs, TCL SVOCs, TPH-GRO, TPH-DRO, PCBs, pesticides, and TAL metals. The groundwater samples were submitted for laboratory analysis of TPH-GRO and TPH-DRO. With the exception of lead, metals were not identified at concentrations warranting concern in the field screening samples or laboratory samples. It should be noted that lead was not detected at elevated concentrations in the laboratory samples. TPH-DRO and SVOCs were detected at concentrations warranting concern in the laboratory soil samples. TPH-GRO and TPH-DRO were not detected in the laboratory groundwater samples. VOCs, TPH, and PAHs were detected in soil gas samples at elevated concentrations. The elevated detection of TPH-DRO and SVOCs in soil and elevated detections of VOCs, TPH, and PAHs in soil gas warranted further assessment (to evaluate the nature and extent of these COPCs in soil and groundwater at the AOC). The OWA soil and groundwater analytical results are summarized on Tables 5 and 13, respectively.

In addition to the assessment conducted at the AOCs, SHAW also collected surface soil samples for laboratory analysis from undeveloped portions of ANC to evaluate metals concentrations in soil. The background soil analytical results are summarized on Table 6.

No further work was recommended by SHAW at the remaining AOCs. Although no further work was recommended at the FMM by SHAW, the USACE believed some additional sampling was warranted to address the lack of soil analytical data, limited area and depths assessed, and potential burial of debris and materials that could result in impact to surrounding soil. Thus, the USACE requested that the FMM be included in the EESI. Additionally, the USACE recommended that another large soil stockpile that was not assessed by SHAW, the SDS, be investigated. The USACE believed assessment of this stockpile was warranted to assess what types of materials comprise the stockpile (to assess for the potential burial of debris and materials of concern) and quality of the soil stockpiled.

EESI

Between October 2012 and February 2013, AZONE advanced a total of 33 direct-push environmental test borings within the AOCs. AZONE also advanced five hand-auger environmental test borings within core holes drilled through the concrete floor slab of Building 108 (existing OWA warehouse). The boring locations are depicted on Figure 4. The borings were advanced to collect soil samples for field screening and laboratory analysis. Temporary groundwater monitoring wells were also installed in select borings to collect groundwater samples. The distribution of borings was as follows: 7 borings were advanced at the SMY (12-SMY-SB1 through 12-SMY-SB6 and 13-SMY-SB7), 4 borings were advanced at the ESMY (12-ESMY-SB1 through 12-ESMY-SB4), 23 borings were advanced at the OWA (12-OWA-SB1 through 12-OWA-SB20, 13-OWA-SB21, 13-OWA-SB22, and 13-OWA-SB23), 3 borings were advanced at the FMM (13-FMM-SB1, 13-FMM-SB2, and 13-FMM-SB3), and the remaining 5 borings were advanced at the SDS (12-SDS-SB1 through 12-SDS-SB5). The borings advanced at the SMY and ESMY are depicted on Figure 8, the borings advanced at the OWA are depicted on Figure 9, the borings advanced at the FMM are depicted on Figure 10, and borings advanced at the SDS are depicted on Figure 11. Information for the EESI soil and groundwater sampling locations is summarized on Table 2.

Temporary groundwater monitoring wells were installed in two of the test borings advanced at the SMY (12-SMY-SB6 and 13-SMY-SB7), one of the test borings advanced at each of the ESMY and SDS (12-ESMY-SB1 and 12-SDS-SB2), seven of the borings advanced at the OWA (12-OWA-SB1, 12-OWA-SB3, 12-OWA-SB4, 12-OWA-SB6, 12-OWA-SB7, 12-OWA-SB10, and 12-OWA-SB11), and two of the borings advanced at the FMM (13-FMM-SB2 and 13-FMM-SB3). The well locations are depicted on Figures 7, 8, 9, 10, and 11. The wells were installed to further assess groundwater quality. Well construction information is provided on Table 9.

Analytical data collected during the EESI were compared to VDEQ and EPA screening levels for commercial land use. VDEQ and EPA screening levels relied upon for soil include the most-current VDEQ Tier III screening concentrations for restricted commercial/industrial land use (VDEQ-T3SCRs) and EPA, Region III, Regional Screening Levels for industrial soil (EPA-RSL-ISs). Expected background concentrations of metals in soil were also considered when evaluating metal detections above VDEQ and EPA screening levels. Background metal data for soil generated from past ANC investigations and in published literature was considered. Screening levels for groundwater did not include comparison to drinking water standards since groundwater is not currently and will not be used in the future at ANC or Millennium Project as

a potable water or irrigation water source. VDEQ screening levels relied upon for groundwater include the most-current VDEQ Tier III commercial groundwater screening level for restricted groundwater use commercial land use inhalation of indoor air (VDEQ-T3CGWSL), construction worker in a trench groundwater not contacted (VDEQ-CWTGNC), and construction worker in a trench groundwater contacted (VDEQ-CWTGC). The EPA has not established screening levels for non-potable use groundwater.

Based on the EESI findings, AZONE believed that remedial actions, institutional controls, and/or further assessment was warranted to address impacted soil and groundwater identified at the SMY, ESMY, OWA, FMM, and SDS. General conclusions are presented below:

- The vast majority of soil that will be generated during mass grading and construction within the limits of the Millennium Project is expected to be acceptable for beneficial reuse as general fill on site (from an environmental standpoint).

- SVOCs were detected in soil samples collected from the ESMY, OWA, and FMM at concentrations above VDEQ and EPA screening levels for a commercial use property. The metals arsenic and chromium were detected in soil samples collected from the SMY, ESMY, OWA, FMM, and SDS at the concentrations above VDEQ and EPA screening levels for a commercial use property; however, the concentrations of these metals were within expected background levels. TPH were detected at elevated concentrations (above 100 mg/kg) in soil samples collected from the SMY, OWA, and FMM. Locations where SVOCs were detected at concentrations above VDEQ and EPA screening levels in soil and TPH were detected at elevated concentrations in soil are depicted on Figures 8, 9, 10, 12, and 13.

- SVOC and TPH-impacted soil warranting excavation, removal, and disposal or treatment at a permitted facility is present at the SMY, ESMY, OWA, and FMM. The estimated limits of impacted soil requiring excavation, removal, and disposal/treatment are depicted on Figures 8, 9, 10, 12, and 13.

- Groundwater is present at depths ranging from approximately 2 to 23 feet bgs beneath the SMY, ESMY, OWA, FMM, and SDS. The shallowest depths correspond to the northern portions of the Millennium Project and lower topographic elevations. Based on proposed development in all but the SDS, groundwater will not likely be encountered. Deep excavation at the SDS (deeper than 20 feet bgs) could encounter groundwater.

- VOCs, SVOCs, and total metals were detected in groundwater samples collected from the OWA at concentrations above VDEQ and EPA screening levels for a commercial use property and a construction worker working in a trench. It should be noted that dissolved metals were detected in the groundwater samples at concentrations above VDEQ and EPA screening levels. TPH were also detected at elevated concentrations (above 1 mg/l) in groundwater samples collected from the OWA. VOCs were detected in a groundwater sample collected from the SDS at concentrations above VDEQ and EPA screening levels for a commercial use property and a construction worker working in a trench. Locations where VOCs and SVOCs were detected at concentrations above VDEQ and EPA

screening levels in groundwater and TPH were detected at elevated concentrations in groundwater are depicted on Figure 14.

- VOC-impacted groundwater identified beneath the SDS may warrant the incorporation of engineering controls into the columbarium structure proposed along the southern portion of this area. The location where VOC-impacted groundwater was identified at the SDS is depicted on Figure 15.

- Further assessment of soil and groundwater quality at the OWA and SDS and further assessment of soil gas quality at the SDS may be warranted to better characterize fill materials that will be disturbed during mass excavation and construction (at the SDS), better define the limits of soil requiring excavation, removal, and disposal/treatment (at the OWA), and assess the need for worker protections and engineering controls (at the SDS).

- Institutional controls are warranted to minimize human health risks to future site users (i.e., workers and site visitors). It should be noted that institutional controls proposed for the Millennium Project in this RAWP include limiting site use to commercial land use and restricting the use of groundwater for any purpose. Both of these controls are already in place at ANC and should be continued in the future.
- The human health risk posed by the impacted media proposed to be left in place following development is expected to be minimal.
- Upon successful implementation of remedial actions, incorporation of the institutional and engineering controls, and completion of development, AZONE believes that site conditions will not warrant further assessment, further remedial action, or monitoring.

The EESI findings as they relate to soil and groundwater quality are discussed in Sections 4.2, 4.3, 4.4, and 4.5. The EESI findings as they relate to human health risks are discussed in Section 4.6.

4.2 Geology and Hydrogeology

Topography of the property comprising the Millennium Project is characterized by rolling and steep terrain, with elevations ranging from approximately 90 to 200 feet above sea level. The closest major surface water body to the SITE is the Boundary Channel which is a channel associated with the Potomac River. Boundary Channel and the Potomac River are located approximately 2,000 feet east of the Millennium Project property and flows to the south. An unnamed small stream traverses the central and southern portion of the Millennium Project property. The stream is located at the base of a steep ravine and flows to the northeast. A small southern flowing tributary to the stream is located at the southern base of the FMM. Another small southern flowing tributary to the stream bounds SDS to the east. Although the stream and its tributaries appear to constantly flow water, they are likely strongly dependent on rainfall, with higher flow expected during rain events. Site and area topography and the location of the above-referenced surface water bodies are depicted on Figures 1 and 4.

The SITE is located within the Coastal Plain physiographic province. The Coastal Plain is underlain by a thick wedge of sediments that increases in thickness from a featheredge near the Fall Zone to more than 4,000 meters under the continental shelf. These sediments rest on an eroded surface of Precambrian to early Mesozoic rock. Two-thirds of this wedge is comprised of late Jurassic and Cretaceous clay, sand, and gravel that were stripped from the Appalachian mountains, carried eastward by rivers and deposited in deltas in the newly formed Atlantic Ocean basin. A sequence of thin, fossiliferous marine sands of Tertiary age overlies the older strata. The marine sands were deposited in warm, shallow seas during repeated marine transgressions across the Coastal Plain. Late-Tertiary and Quaternary sand, silt, and clay, which cover much of the Coastal Plain, were deposited during interglacial highstands of the sea under conditions similar to those that exist in the modern Chesapeake Bay and its tidal tributaries.

According to the *Geologic Map of Virginia* (DMR, 1993), the SITE is underlain by the Potomac Formation comprised of pebbly, poorly sorted quartzo-feldspathic sand interbedded with sandy clay and silt with minor organic-rich clay and silt and Pliocene age terrace fluvial deposits comprised of sandy gravel, gravelly sand, poorly to well-sorted sands, and thin to medium beds of clay and silt. Soils underlying ANC include the Bourne Series, Myatt Series, and Tetotum Series. These soils are described as deep to very deep, nearly level to sloping soils formed in unconsolidated sediments of the coastal and river terraces. These soils are characterized by gray and red clays with interbedded sand lenses grading into clay lenses. Native soil encountered during advancement of the test borings was consistent with the soil types described in the reviewed literature.

Based on field observations made by past studies and AZONE during our recent study, soil underlying the Millennium Project property is comprised mainly of silt and clays with varying amounts of sand and gravel and sands with some to little silt and clay to the maximum explored depth of 30 feet below ground surface (bgs). Thick layers of fill, as thick as 27.5 and 17 feet, were encountered during advancement of test borings at the top of the FMM and SDS, respectively. The fill comprising the FMM appears to be a mixture of soil and debris (concrete, asphalt, wood, and brick). Much of the debris is visible on the side of the mound and ranges in size from a few inches to several feet. The fill comprising the SDS appeared to be reworked native soil with some debris noted (brick and concrete fragments). The lithology encountered during advancement of each boring is provided on the boring logs included in Attachment 4.

Based on groundwater measurements obtained from the recently installed wells, the depth to groundwater beneath the SITE ranges from approximately 2 to 23 feet bgs. Groundwater flow beneath the SITE is to the south-southwest, mimicking area topography. Groundwater measurements obtained from the wells are summarized on Table 10. A groundwater contour map prepared from the well measurement data obtained during the recent groundwater sampling event is included as Figure 7.

Groundwater is not currently used and will not be used in the future as a potable drinking water or irrigation water supply at the SITE. Based on AZONE's experience working in Arlington, groundwater is not used or designated for use as a potable water supply in the Arlington area. Potable drinking water is provided to the SITE and area surrounding the SITE by the local municipality. The local municipality's potable water sources are surface water reservoirs.

4.3 Soil Quality

The general type of soil encountered during advancement of test borings was discussed in Section 4.2.

The 2009 surface soil and EESI soil analytical data was compared to VDEQ screening levels for a commercial use property (VDEQ-T3SCRs) and EPA, Region III screening levels for a commercial use property (EPA-RSL-IS). The metals were also compared to concentrations of metals detected in background surface soil samples collected during the 2009 sampling event and background concentrations for eastern Virginia (USGS 1984). It should be noted that the VDEQ-T3SCR and EPA-RSL-IS established for chromium is for total chromium (combined chromium III and chromium VI), with the vast majority of risk posed by the presence of chromium VI. The VDEQ has not established a VDEQ-T3SCR for chromium III, but the EPA has established an EPA-RSL-IS for this metal. VDEQ-T3SCRs and EPA-RSL-ISs have not been established for one of the most-commonly detected constituents at the AOCs, TPH; however, detections above 100 mg/kg are typically considered detections of note. This concentration also represents the VDEQ's release reporting requirement for a petroleum release from an UST. The comparisons are included on analytical summary tables identified in the following sections.

Salvage Metal Yard (SMY)
In 2009, two surface soil samples (ANC-SS-05 and ANC-SS-10) were collected from the SMY. The two surface soil samples were analyzed for TCL VOCs, TCL SVOCs, TPH-GRO, TPH-DRO, PCBs, pesticides, and TAL metals. The surface soil analytical results and soil gas data also collected in 2009 suggested the presence of elevated concentrations of VOCs and TPH in soil. To further assess soil underlying the SMY, seven additional test borings (borings 12-SMY-SB1 through 12-SMY-SB6 and 13-SMY-SB7) were advanced at the SMY during the EESI. The borings were advanced in areas where the highest degree of impact in surface soil was identified and soil gas data suggested the presence of VOCs and SVOCs during the 2009 sampling event. Surface and subsurface soil samples were collected for laboratory analysis during advancement of the EESI borings. The soil samples were analyzed for some or all of the following: TCL VOCs, TCL SVOCs, TPH-GRO, TPH-DRO, and TAL metals. The type of chromium was speciated in one of the samples found to contain chromium at elevated concentrations.

Soil underlying the SMY is comprised of silt and clays with varying amounts of sand and gravel and sands with some to little silt and clay to the maximum explored depth of 20 feet bgs. No petroleum or chemical staining, petroleum or chemical odors, and elevated PID readings (above background) were noted during advancement of the EESI borings.

The soil analytical results are summarized on Table 3. Twelve TCL VOCs (acetone, 2-butanone [MEK], ethylbenzene, isopropylbenzene, methyl tert butyl ether [MTBE], methylene chloride, tetrachloroethene [PCE], toluene, trichloroethene [TCE], m,p-xylene, o-xylene, and total xylenes), 11 SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene), TPH-GRO, TPH-DRO, one PCB (aroclor 1260), one pesticide (alpha-chlordane), and 21 TAL metals (aluminum, arsenic, barium, beryllium,

cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, sodium, thallium, vanadium, and zinc) were detected in the soil samples at concentrations above their analytical method reporting limit (RL).

Two metals (arsenic and chromium) were detected at concentrations above VDEQ and EPA screening levels; however, the concentrations of these metals were within expected background. Speciation of chromium determined that the type of chromium present in soil was likely chromium III. The concentrations of chromium detected in the samples were below EPA-RSL-ISs for chromium III. Elevated concentrations of TPH-DRO in soil (above 100 mg/kg) were detected at surface soil sampling location ANC-SS-10 and in the subsurface soil sample collected from boring 12-SMY-SB3. TPH-DRO was detected in these two samples at concentrations of 2,200 and 239 mg/kg, respectively.

Current development plans for the SMY include mass excavation and grading of the entire area. Mass excavation and grading is expected to entail excavation and removal of the upper 6 to 7 feet of soil underlying this area. The soil will be removed and graded for traditional casket burial. At the conclusion of installation, the disturbed area will be restored to achieve grades close to existing grades. The analytical data collected to date suggest the vast majority of the soil comprising the SMY will be acceptable for beneficial reuse as fill on site (from an environmental standpoint); however, soil containing TPH at concentrations above 100 mg/kg is proposed for excavation, removal, and transport to a permitted facility for disposal or treatment. The analytical data and field observations suggest the soil containing TPH at elevated concentrations is limited and localized in extent (to sampling locations ANC-SS-10 and 12-SMY-SB3), with excavation and removal not anticipated to exceed 2 to 6 feet bgs. The estimated limits of TPH-impacted soil proposed for excavation and removal is depicted on Figures 8 and 12 and represents approximately 150 to 200 cubic yards (225 to 300 tons). Based on the type and concentrations of COPCs detected in the samples, the soil is expected to meet criteria for disposal/treatment as a non-hazardous, petroleum-impacted waste.

Area East of the Salvage Metal Yard (ESMY)

Soil gas data collected in 2009 suggested the presence of elevated concentrations of SVOCs and TPH in soil at the ESMY. To further assess soil underlying the ESMY, one test boring (12-ESMY-SB1) was initially advanced during the EESI in the area where the 2009 soil gas data suggested the most-elevated concentration of SVOCs and TPH. A surface soil sample was collected for laboratory analysis during advancement of this boring. Based on the analytical results, three additional borings (borings 12-ESMY-SB2, 12-ESMY-SB3, and 12-ESMY-SB4) were advanced in close proximity to sampling location 12-ESMY-SB1 to further assess the extent of SVOC-impacted soil. Surface and subsurface soil samples were collected for laboratory analysis during advancement of these borings.

Soil underlying the ESMY is comprised of silt with varying amounts of clay, sand, and gravel and sands with little to silt and clay to the maximum explored depth of 15 feet bgs. No petroleum or chemical staining, petroleum or chemical odors, and elevated PID readings (above background) were noted during advancement of the EESI borings. The soil sample collected for laboratory analysis from the initial boring, 12-ESMY-SB1, was analyzed for TCL VOCs, TCL SVOCs, TPH-GRO, TPH-DRO, and TAL metals. The follow-up samples collected from borings

12-ESMY-SB2, 12-ESMY-SB3, and 12-ESMY-SB4 were only analyzed for TCL SVOCs. The type of chromium was speciated in one of the samples found to contain chromium at elevated concentrations. The soil analytical results are summarized on Table 4.

Two TCL VOCs (acetone and methylene chloride), 13 SVOCs (acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene), TPH-DRO, and 17 TAL metals (aluminum, antimony, arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, vanadium, and zinc) were detected in the soil samples at concentrations above their RL.

One TCL SVOC (benzo(a)pyrene) and two metals (arsenic and chromium) and were detected at concentrations above VDEQ and EPA screening levels. Benzo(a)pyrene was detected above VDEQ-T3SCRs and EPA-RSL-ISs in the surface soil sample collected from boring 12-ESMY-SB1. It was not detected above VDEQ and EPA screening levels in the deeper soil sample (subsurface soil sample) collected from this boring or surface soil or subsurface soil samples collected from surrounding borings advanced to delineate the extent of benzo(a)pyrene-impacted soil. The concentrations of the arsenic and chromium detected in the sample were within expected background. Speciation of chromium determined that the type of chromium present in soil was likely chromium III. The concentrations of chromium detected in the samples were below EPA-RSL-ISs for chromium III.

Current development plans for the ESMY include mass excavation and grading of the entire area. Mass excavation and grading is expected to entail excavation and removal of the upper 3 to 5 feet of soil underlying this area. The soil will be removed and graded for traditional casket burial. The analytical data collected to date suggest the vast majority of the soil comprising the ESMY will be acceptable for beneficial reuse as fill on site (from an environmental standpoint); however, soil containing benzo(a)pyrene at concentrations above VDEQ and EPA screening levels is proposed for excavation, removal, and transported to a permitted facility for disposal or treatment. The analytical data and field observations suggest the benzo(a)pyrene-impacted soil is limited and localized in extent (to sampling location 12-ESMY-SB1), with excavation not anticipated to exceed 3 feet bgs. The estimated limits of benzo(a)pyrene-impacted soil proposed for excavation and removal is depicted on Figures 8 and 12 and represents approximately 40 to 60 cubic yards (60 to 90 tons). Based on the type and concentrations of COPCs detected in the samples, the soil is expected to meet criteria for disposal/treatment as a non-hazardous, petroleum-impacted waste.

Old Warehouse Area (OWA)

In 2009, 8 surface soil samples (ANC-SS-13, ANC-SS-15, ANC-SS-18, ANC-SS-32, ANC-SS-42, ANC-SS-43, ANC-SS-44, and ANC-SS-45) were collected from the OWA. The surface soil samples were analyzed for TCL VOCs, TCL SVOCs, TPH-GRO, TPH-DRO, PCBs, pesticides, and TAL metals. The surface soil analytical results and soil gas data also collected in 2009 suggested the presence of elevated concentrations of VOCs, SVOCs, and TPH in soil. To further assess soil underlying the OWA, 23 additional test borings (designated 12-OWA-SB1 through 12-OWA-SB20, 13-OWA-SB21, 13-OWA-SB22, and 13-OWA-SB23) were advanced at the

OWA during the EESI. The borings were advanced in areas where ASTs and USTs were formerly located, former chemical and petroleum storage and equipment maintenance areas, and the highest degree of impact in surface soil was identified and soil gas data suggested the presence of VOCs and SVOCs during the 2009 sampling event. Surface and subsurface soil samples were collected for laboratory analysis during advancement of the borings. The soil samples collected during the EESI were analyzed for some or all of the following: TCL VOCs, TCL SVOCs, TPH-GRO, TPH-DRO, PCBs, pesticides, herbicides, and TAL metals. The type of chromium was speciated in one of the samples found to contain chromium at elevated concentrations.

Petroleum staining, "gasoline" odors, and elevated PID readings were noted during advancement of borings 12-OWA-SB4 and 12-OWA-SB7 at depths of 2 to 10 feet bgs and 7.5 to 10 feet bgs, respectively. A "gasoline" odor and elevated PID readings were also noted during advancement of boring 12-OWA-SB5 at a depth of 2 to 8 feet bgs. A general petroleum odor was also noted during advancement of boring 13-OWA-SB22 at a depth of 2 to 3 feet bgs. A "chemical" odor and elevated PID readings were noted during advancement of boring 12-OWA-SB11 at a depth of 4 to 9.5 feet bgs.

The soil analytical results are summarized on Table 5. Eighteen TCL VOCs (acetone, benzene, MEK, carbon disulfide, chlorobenzene, chloroform, cyclohexane, 1,2-dichlorobenzene, ethylbenzene, isopropylbenzene, methyl acetate, methylcyclohexane, MTBE, methylene chloride, toluene, m,p-xylene, o-xylene, and total xylenes), 22 SVOCs (acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, 1,1'-biphenyl, carbazole, chrysene, dibenzo(a,h)anthracene, dibenzofuran, dimethyl phthalate, bis(2-Ethylhexyl)phthalate, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, naphthalene, phenanthrene, and pyrene), TPH-GRO, TPH-DRO, 1 PCB (aroclor 1260), 7 pesticides (alpha-chlordane, gamma-chlordane, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, heptachlor epoxide, and methoxychlor), 2 herbicides (2,4-D and 2,4,5-TP), and 19 TAL metals (aluminum, arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, silver, sodium, vanadium, and zinc) were detected in the soil samples at concentrations above their RL.

Six TCL SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene) and two metals (arsenic and chromium) and were detected at concentrations above VDEQ and EPA screening levels. Benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene were detected above VDEQ-T3SCRs and EPA-RSL-ISs in surface soil samples ANC-SS-13 and ANC-SS-15. Benzo(a)anthracene and benzo(b)fluoranthene were also detected above VDEQ-T3SCRs and EPA-RSL-ISs in the subsurface soil sample collected from boring 13-OWA-SB21. Benzo(a)pyrene was detected above VDEQ-T3SCRs and EPA-RSL-ISs in the surface soil samples collected from locations ANC-SS-13 and ANC-SS-15, surface soil samples collected from borings 12-OWA-SB12, 12-OWA-SB13, and 12-OWA-SB20, and subsurface soil samples collected from borings 12-OWA-SB2, 12-OWA-SB4, 13-OWA-SB21, and 13-OWA-SB22. Dibenzo(a,h)anthracene was detected above VDEQ-T3SCRs and EPA-RSL-ISs in the surface soil samples collected from locations ANC-SS-13 and ANC-SS-15, surface soil

samples collected from borings 12-OWA-SB12, and 12-OWA-SB13, and subsurface soil samples collected from borings 12-OWA-SB2 and 13-OWA-SB21. The concentrations of the arsenic and chromium detected in the sample were within expected background. Speciation of chromium determined that the type of chromium present in soil was likely chromium III. The concentrations of chromium detected in the samples were below EPA-RSL-ISs for chromium III. Elevated concentrations of TPH-GRO and TPH-DRO in soil (above 100 mg/kg) were detected in several of the surface and subsurface soil samples. TPH-GRO was detected at elevated concentrations in the subsurface soil samples collected from borings 12-OWA-SB4 and 12-OWA-SB11. TPH-GRO concentrations detected in these two samples were 734 and 1,040 mg/kg, respectively. TPH-DRO was detected at elevated concentrations in the surface soil samples collected from locations ANC-SS-13 and ANC-SS-15 and subsurface soil samples collected from borings 12-OWA-SB4, 12-OWA-SB5, and 12-OWA-SB11. TPH-DRO concentrations above 100 mg/kg in these samples ranged from 286 to 1,790 mg/kg.

Current development plans for the OWA include mass grading of the northeastern portion and minimal grading of the remaining portions of the area. Mass grading is expected to entail placement of 4 to 13 feet of fill to achieve site grades. Minimal excavation and grading is proposed for the remaining portions of the area which will be improved with roads, above-grade columbariums, and landscaping. The analytical data collected to date suggest the vast majority of the soil comprising the OWA will be acceptable for beneficial reuse as fill on site (from an environmental standpoint); however, soil containing SVOCs at concentrations above VDEQ and EPA screening levels and TPH at concentrations above 100 mg/kg is proposed for excavation, removal, and transport to a permitted facility for disposal or treatment. The analytical data and field observations suggest the soil containing SVOCs at concentrations above VDEQ and EPA screening levels and TPH at elevated concentrations is limited and localized in extent (to sampling locations ANC-SS-13, ANC-SS-15, 12-OWA-SB2, 12-OWA-SB4, 12-OWA-SB11, 12-OWA-SB12, 12-OWA-SB13, 12-OWA-SB20, 13-OWA-SB21, and 13-OWA-SB22), with excavation not anticipated to exceed 2 to 6 feet bgs. The estimated limits of SVOC and TPH-impacted soil proposed for excavation and removal is depicted on Figures 9 and 12 and represents approximately 2,800 to 3,300 cubic yards (4,200 to 4,950 tons). Based on the type and concentrations of COPCs detected in the samples, the soil is expected to meet criteria for disposal/treatment as a non-hazardous, petroleum-impacted waste.

Fort Meyer Mound (FMM)

The soil gas data collected in 2009 from the FMM did not suggest the presence of COPCs; however, no soil samples were collected from the FMM for laboratory analysis. Further assessment of soil and assessment of groundwater was recommended by the USACE based on the large volume of fill materials that comprise the mound and historical reports of debris of concern (e.g., wagon wheels, drums, tanks, etc.) being buried along with placement of the fill. To further assess soil underlying the FMM, three test borings (borings 13-FMM-SB1, 13-FMM-SB2, and 13-FMM-SB3) were advanced during the EESI. Borings 13-FMM-SB1 and 13-FMM-SB2 were advanced on top of the mound where the fill materials comprising the mound were expected to be the thickest and boring 13-FMM-SB3 was advanced at the topographically-downgradient base of the mound. Surface and subsurface soil samples were collected for laboratory analysis during advancement of the borings. The soil samples were analyzed for some or all of the following: TCL VOCs, TCL SVOCs, TPH-GRO, TPH-DRO, PCBs,

pesticides, and TAL metals. The type of chromium was speciated in one of the samples found to contain chromium at elevated concentrations.

No petroleum or chemical staining were noted during advancement of the borings at the FMM. Elevated PID readings (above background) and an "organic" odor was noted during advancement of borings 12-FMM-SB1 and 12-FMM-SB2 at depths of 8 to 20 feet bgs and 8 to 24.5 feet bgs, respectively. A "sweet" odor was noted during advancement of boring 12-FMM-SB2 at a depth of 24.5 to 27.5 feet bgs.

The soil analytical results are summarized on Table 7. Seven TCL VOCs (acetone, MEK, ethylbenzene, isopropylbenzene, toluene, o-xylenes, and total xylenes), 20 SVOCs (acenaphthalene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, carbozale, chrysene, dibenzo(a,h)anthracene, dimethyl phthalate, bis(2-Ethylhexyl)phthalate, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, naphthalene, phenanthrene, and pyrene), TPH-DRO, one PCB (aroclor 1260), four pesticides (4,4'DDD, 4,4'DDE, 4,4'DDT, and methoxychlor), and 19 TAL metals (aluminum, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, silver, vanadium, and zinc) were detected in the soil samples at concentrations above their RL.

One TCL SVOC (benzo(a)pyrene) and two metals (arsenic and chromium) were detected at concentrations above VDEQ and EPA screening levels. The concentrations of arsenic and chromium were within expected background. Benzo(a)pyrene was detected above VDEQ-T3SCRs and EPA-RSL-ISs in the subsurface soil samples collected from borings 13-FMM-SB1 and 13-FMM-SB2. Elevated concentrations of TPH-DRO in soil (above 100 mg/kg) were detected in the subsurface soil sample collected from location 13-FMM-SB1 and were detected in this sample at a concentration of 581 mg/kg.

Current development plans for the FMM include limited excavation and grading of the area. Excavation and grading is expected to entail excavation and removal of the upper 10 to 15 feet of the top of the mound to construct walkways and associated landscaping. The large volume of debris present within the fill materials comprising the mound and limited analytical data collected to date suggests the vast majority of the soil comprising the FMM will not be suitable for beneficial reuse as fill on site (from a geotechnical and environmental standpoint). Additionally, historical documents suggest other debris of concern (e.g., wagon wheels, drums, tanks, etc.) may have been buried within the fill comprising the mound. The estimated limits of the mound where debris and impacted soil is anticipated to be unearthed are depicted on Figures 10 and 13. Assuming an excavation depth of 10 feet to achieve grade, the estimated volume of debris and material requiring special handling and disposal is 1,000 to 1,500 cubic yards (1,500 to 1,725 tons). Based on the type and concentrations of COPCs detected in the samples, the soil is expected to meet criteria for disposal/treatment as a non-hazardous, petroleum-impacted waste.

Stormwater Diversion/Interceptor Stockpile (SDS)

During the EESI, five test borings (borings 12-SDS-SB1 through 12-SDS-SB5) were advanced at the SDS. Borings 12-SDS-SB1, 12-SDS-SB2, and 12-SDS-SB3 were advanced along the

topographically-downgradient base of the stockpile and borings 12-SDS-SB4 and 12-SDS-SB5 were advanced on top of the stockpile where the fill materials comprising the stockpile were expected to be the thickest. Surface and subsurface soil samples were collected for laboratory analysis during advancement of the borings.

No petroleum or chemical staining and elevated PID readings (above background) were noted during advancement of the borings. A "mulch" odor was noted during advancement of borings 12-SDS-SB3 and 12-SDS-SB4 at depths of 4.5 to 5 feet bgs and 17.5 to 20 feet bgs, respectively. A "chemical" odor was noted during advancement of boring 12-SDS-SB4 at a depth of 6 to 8 feet bgs. The soil samples collected from the borings for laboratory analysis were analyzed for TCL VOCs, TCL SVOCs, TPH-GRO, TPH-DRO, and TAL metals. The type of chromium was speciated in one of the samples found to contain chromium at elevated concentrations.

The soil analytical results are summarized on Table 8. Four TCL VOCs (acetone, MEK, carbon disulfide, and methylene chloride), 14 SVOCs (acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, di-n-butyl phthalate, dimethyl phthalate, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene), TPH-GRO, TPH-DRO, and 18 TAL metals (aluminum, arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, silver, vanadium, and zinc) were detected in the soil samples at concentrations above their RL.

Two metals (arsenic and chromium) were detected at concentrations above VDEQ and EPA screening levels; however, the concentrations of these metals were within expected background. Speciation of chromium determined that the type of chromium present in soil was likely chromium III. The concentrations of chromium detected in the samples were below EPA-RSL-ISs for chromium III.

Current development plans for the SDS include mass excavation and grading of the entire area. Mass excavation and grading is expected to entail excavation and removal of the upper 8 to 30 feet of soil underlying this area. The soil will be removed and graded for traditional casket burial. Only limited grading is proposed on the eastern-most portion of the area. A road will be constructed on this portion of the area. The limited analytical data collected to date suggests the vast majority of the soil comprising the SDS will be acceptable for beneficial reuse as fill on site (from an environmental standpoint). Based on the mass excavation and grading proposed in this area during the expansion of the cemetery, additional soil sampling is being considered to further characterize and profile the fill comprising the SDS.

4.4 Groundwater Quality

Based on recent groundwater measurements obtained from the wells installed during the EESI, the depth to groundwater beneath the SMY, ESMY, and OWA ranged from approximately 2.5 to 9.5 feet bgs. Groundwater flow beneath these AOCs is to the east-southeast, mimicking area topography. A groundwater contour map prepared for the area comprising the SMY, ESMY, and OWA from the well measurement data collected during the EESI is included as Figure 7. The depth to groundwater at the eastern extent of the FMM and SDS was approximately 5 and

23 feet bgs, respectively. Groundwater flow beneath the FMM and SDS is anticipated to be towards the east, mimicking area topography. Groundwater measurements obtained from the wells are summarized on Table 10.

The historical groundwater analytical data was compared to VDEQ screening levels for a commercial use property (VDEQ-T3CGWSLs) and construction worker working in a trench (groundwater not contacted [VDEQ-CWTGNC] and groundwater contacted [VDEQ-CWTGWC]). For the VDEQ-CWTGWC scenario, the dermal contact/incidental ingestion and inhalation values were evaluated. The comparisons are included on analytical summary tables identified in the following sections.

Salvage Metal Yard (SMY)
During the EESI, two temporary wells (designated 12-SMY-SB6 and 12-SMY-SB7) were installed at the ESMY. The wells were installed in the areas where the highest degree of impact was identified during the 2009 soil gas sampling event.

The depth to groundwater at the SMY was approximately 10 feet bgs. No petroleum free product, petroleum or chemical sheens, or petroleum or chemical odors were noted during sampling of the wells 12-SMY-SB6 and 13-SMY-SB7. The samples collected from the wells for laboratory analysis were analyzed for TCL VOCs, TCL SVOCs, TPH-GRO, and TPH-DRO. The groundwater sample collected from well 12-SMY-SB7 was additionally analyzed for total and dissolved metals. The groundwater analytical results are summarized on Table 11.

Two TCL VOCs (chloroform and MTBE) and 11 total and dissolved metals (aluminum, beryllium, calcium, cobalt, iron, magnesium, manganese, nickel, potassium, sodium, and zinc) were detected in the groundwater samples at concentrations above their RL. The TCL VOCs and metals were not detected at concentrations above VDEQ screening levels.

Current development plans for the SMY include mass excavation and grading of the entire area. Mass excavation and grading is expected to entail excavation and removal of the upper 6 to 7 feet of soil underlying this area. Based on the proposed depth of excavation, groundwater will not likely be encountered.

Area East of the Salvage Metal Yard (ESMY)
During the EESI, one temporary well (designated 12-ESMY-SB1) was installed at the ESMY. The well was installed in the area where the highest degree of impact was identified during the 2009 soil gas sampling event.

The depth to groundwater at the ESMY was approximately 7 to 8 feet bgs. No petroleum free product, petroleum or chemical sheens, or petroleum or chemical odors were noted during sampling of well 12-ESMY-SB1. The sample collected from the well for laboratory analysis was analyzed for TCL VOCs, TCL SVOCs, TPH-GRO, TPH-DRO, and total and dissolved metals. The groundwater analytical results are summarized on Table 12.
One TCL VOC (MTBE), six total metals (aluminum, calcium, iron, magnesium, manganese, and sodium), and five dissolved metals (same as total metals with the exception of aluminum) were

detected in the groundwater sample at concentrations above their RL. MTBE and metals were not detected at concentrations above VDEQ screening levels.

Current development plans for the ESMY include mass excavation and grading of the entire area. Mass excavation and grading is expected to entail excavation and removal of the upper 3 to 5 feet of soil underlying this area. Based on the proposed depth of excavation, groundwater will not likely be encountered.

Old Warehouse Area (OWA)

In 2009, three test pits (designated ANC-GW-01, ANC-GW-02, and ANC-GW-03) were excavated at the OWA for the purpose of collecting groundwater samples. The test pits were reportedly excavated to assess past groundwater impacts associated with former leaking USTs. Groundwater samples collected from the test pits for laboratory analysis were analyzed for TPH-GRO and TPH-DRO. During the EESI, seven temporary wells (designated 12-OWA-SB1, 12-OWA-SB3, 12-OWA-SB4, 12-OWA-SB6, 12-OWA-SB7, 12-OWA-SB10, and 12-OWA-SB11) were installed at the OWA. The wells were installed to provide good spatial coverage of the AOC and in locations where USTs were formerly located, impacts were noted during past studies, and locations where site activities would have involved the use, storage, or mixing of petroleum products, raw chemicals, pesticides, and herbicides and generation of waste petroleum and chemicals. Well 12-OWA-SB4 was installed in an area where a leaking UST was formerly located and well 12-OWA-SB7 was located immediately hydraulically downgradient of this area. Well 12-OWA-SB11 was installed beneath a former warehouse where mechanical operations and paint shop was located. The groundwater analytical results are summarized on Table 13.

The depth to groundwater at the OWA during the sampling events ranged from approximately 2.5 to 9 feet bgs. No measurable layers of petroleum free product were noted during sampling of the test pits or temporary wells installed at the OWA. A petroleum sheen and petroleum odors were noted during sampling of wells 12-OWA-SB4 and 12-OWA-SB7 and a chemical odor was noted during sampling of well 12-OWA-SB11. Petroleum odors were noted during excavation of test pit ANC-GW-01.

TPH-GRO, TPH-DRO, 16 TCL VOCs (acetone, benzene, carbon tetrachloride, chloroform, chloromethane, cyclohexane, ethylbenzene, isopropylbenzene, methylclohexane, MTBE, methylene chloride, 1,1,2,2-tetrachloroethane, toluene, m,p-xylene, o-xylene, and total xylenes), 18 SVOCs (acenaphthene, anthracene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, carbazole, chrysene, dibenzofuran, di-n-octyl phthalate, diethyl phthalate, bis(2-ethylhexyl)phthalate, fluoranthene, fluorene, 2-methylnaphthalene, naphthalene, phenanthrene, and pyrene), 17 total metals (aluminum, arsenic, barium, beryllium, calcium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, sodium, vanadium, and zinc), and 12 dissolved metals (same as total metals with the exception of beryllium, chromium, copper, mercury, and vanadium) were detected in the groundwater samples at concentrations above their RL. Detections in groundwater above VDEQ-T3CGWSLs, VDEQ-CWTGNCs, and VDEQ-CWTGCs were experienced at well locations 12-OWA-SB4, 12-OWA-SB7, and 12-OWA-SB11. VDEQ-T3CGWSLs, VDEQ-CWTGNCs, and VDEQ-CWTGCs have not been established for TPH; however, detections

above 1 milligrams per liter (mg/l) are considered detections of note. Detections above the screening levels were as follows:

12-OWA-SB4

- Detections above VDEQ-T3CGWSLs included four TCL VOCs (benzene, ethylbenzene, isopropylbenzene, and methylclohexane).
- Detections above VDEQ-T3CWTGNCs included one TCL VOCs (isopropylbenzene).
- Detections above VDEQ-T3CWTGCs for the inhalation pathway included three TCL VOCs (benzene, ethylbenzene, and m,p-xylene) and one TCL SVOC (naphthalene).
- TPH-GRO and TPH-DRO were detected at concentrations of 3.85 and 13.1 mg/l, respectively.

12-OWA-SB7

- Detections above VDEQ-T3CGWSLs included two TCL VOCs (isopropylbenzene and methylclohexane).
- Detections above VDEQ-T3CWTGCs for the dermal contact and incidental ingestion pathway included one TCL SVOC (benzo(b)fluoranthene) and two total metals (arsenic and chromium). It should be noted that the concentrations of dissolved arsenic and chromium were below this screening level.
- TPH-GRO were detected at a concentrations of 2.49 mg/l.

12-OWA-SB11

- Detections above VDEQ-T3CGWSLs included one TCL VOCs (carbon tetrachloride).
- Detections above VDEQ-T3CWTGCs for the inhalation pathway included one total metal (mercury). It should be noted that the concentration of dissolved mercury was below this screening level.

Current development plans for the OWA include mass grading of the northeastern portion and minimal grading of the remaining portions of the area. Mass grading is expected to entail placement of 4 to 13 feet of fill to achieve site grades. Minimal excavation and grading is proposed for the remaining portions of the area. Based on the proposed depth of excavation, groundwater will not likely be encountered during construction; however, groundwater will be encountered during proposed excavation and removal of SVOC and TPH-impacted soil from the southern portion of the OWA. Treatment of groundwater within the two of the open excavations created during the removal of impacted soil is also proposed for this area. The locations where detections above VDEQ screening levels were experienced are highlighted on Figure 14.

Fort Meyer Mound (FMM)

During the EESI, two temporary wells (designated 13-FMM-SB2 and 13-FMM-SB3) were installed at the FMM. Well 13-FMM-SB2 was installed on the top of the FMM and was found to contain less than 1 foot of water after installation; thus, it was not sampled. Well 13-FMM-SB3 was installed on the hydraulically downgradient base of the mound.

The depth to groundwater at the base of the FMM was approximately 5 feet bgs. No petroleum free product, petroleum or chemical sheens, or petroleum or chemical odors were noted during sampling of the temporary well 13-FMM-SB3. The sample collected for laboratory analysis was analyzed for TCL VOCs, TCL SVOCs, TPH-GRO, TPH-DRO, pesticides, PCBs, and total metals. The groundwater analytical results are summarized on Table 14.

One TCL VOC (chloroform) and 10 total metals (aluminum, calcium, cobalt, iron, lead, magnesium, manganese, nickel, sodium, and zinc) were detected in the groundwater sample at concentrations above their RL. Chloroform and metals were not detected at concentrations above VDEQ screening levels.

Current development plans for the FMM include limited excavation and grading of the area. Excavation and grading is expected to entail excavation and removal of the upper 10 to 15 feet of soil comprising the top of the mound. Based on the proposed depth of excavation, groundwater will not likely be encountered.

Storm Water Diversion/Interceptor Stockpile (SDS)

During the EESI, one temporary well (designated 12-SDS-SB2) was installed at the SDS. The well was installed on the hydraulically downgradient base of the stockpile.

The depth to groundwater at the SDS was approximately 23 feet bgs. No petroleum free product, petroleum or chemical sheens, or petroleum or chemical odors were noted during sampling of well 12-SDS-SB2. The sample collected from the well for laboratory analysis was analyzed for TCL VOCs, TCL SVOCs, TPH-GRO, TPH-DRO, and total and dissolved metals. The groundwater analytical results are summarized on Table 15.

Seven TCL VOCs (carbon tetrachloride, chloroform, 1,2-dichloroethane, cis-1,2-dichloroethene, MTBE, PCE, and TCE), seven total metals (aluminum, barium, calcium, iron, magnesium, manganese, and nickel), and seven dissolved metals (same as total metals with the exception of the absence of aluminum and addition of zinc) were detected in the groundwater sample at concentrations above their RL. Carbon tetrachloride was detected at a concentration above VDEQ-T3CGWSLs and TCE was detected at a concentration above VDEQ-CWTGCs for the inhalation pathway.

Current development plans for the SDS include mass excavation and grading of the entire area. Mass excavation and grading is expected to entail excavation and removal of the upper 8 to 30 feet of soil underlying this area. Only limited grading is proposed on the eastern-most portion of the area (where the elevated detection of VOCs in groundwater was noted). Upon development of the final Millennium Project design, areas where deep excavation is proposed and groundwater may be encountered should be identified and further assessment conducted if warranted. The location where detections above VDEQ screening levels were experienced is highlighted on Figure 15.

4.5 Soil Gas Quality

Limited soil gas quality data was collected during SHAW's 2009 SI. Although elevated detections of COPCs were detected in a few of the SHAW soil gas samples, the soil gas data does not appear to correlate well with soil and groundwater sampling data; thus, general statements concerning soil gas are made in this section.

Salvage Metal Yard (SMY)
Soil and groundwater samples collected from the SMY did not indicate the elevated presence of VOCs in soil and groundwater underlying the area. TPH-impacted soil was identified in the shallow subsurface and is proposed for excavation, removal, and off-site disposal/treatment. AZONE believes that the relatively low detections of VOCs in soil, lack of detection in groundwater, and planned removal of TPH-impacted soil do not indicate soil gas quality will be a concern at the SMY; thus, no further assessment of or remedial actions to address this pathway in this area is proposed.

Area East of the Salvage Metal Yard (ESMY)
Soil and groundwater samples collected from the ESMY did not indicate the elevated presence of VOCs in soil and groundwater underlying the area. SVOC-impacted soil was identified in the shallow subsurface and is proposed for excavation, removal, and off-site disposal/treatment. Based on the relatively low detections of VOCs in soil and groundwater and planned removal of SVOC-impacted soil, AZONE believes that soil gas quality will not be a concern at the ESMY; thus, no further assessment of or remedial actions to address this pathway in this area is proposed.

Old Warehouse Area (OWA)
VOCs were detected in groundwater samples collected from the OWA at concentrations indicating an inhalation risk; however, the vast majority of the TPH, VOC, and SVOC-impacted soil identified in this area is proposed for excavation, removal, and off-site disposal/treatment. Additionally, TPH, VOC, and SVOC-impacted groundwater in this area is proposed for in situ treatment. Based on the planned removal of TPH, VOC, and SVOC-impacted soil and treatment of TPH, VOC, and SVOC-impacted groundwater, AZONE believes that soil gas quality will not be a concern at the OWA; thus, no further assessment of or remedial actions to address this pathway in this area is proposed.

Fort Meyer Mound (FMM)
Soil and groundwater samples collected from the FMM did not indicate the elevated presence of VOCs in soil and groundwater underlying the area. SVOC and TPH-impacted soil was identified within the fill comprising the mound and is proposed for excavation, removal, and off-site disposal/treatment. Based on the relatively low detections of VOCs in soil and groundwater and planned removal of SVOC and TPH-impacted soil, AZONE believes that soil gas quality will not be a concern at the FMM; thus, no further assessment of or remedial actions to address this pathway in this area is proposed.

Storm Water Diversion/Interceptor Stockpile (SDS)
VOCs were detected in a groundwater sample collected from the SDS at a concentration indicating an inhalation risk; however, the elevated detection was not experienced in a location scheduled for mass excavation and grading and groundwater at the location was encountered at a depth greater than 20 feet bgs. Based on the limited excavation and deep depth of groundwater, AZONE believes that soil gas quality will not be a concern at the SDS. If development plans will entail the installation of buildings, structures, subsurface utilities, or other site features susceptible to vapor intrusion in areas identified as impacted and outside the limits of mass excavation and grading, further assessment and corrective actions and engineering controls may be warranted.

4.6 Sensitive Receptors and Human Health Risks

AZONE identified potential human receptors and pathways of exposure to human receptors associated with expansion of the cemetery and development of the Millennium Project property.

4.6.1 *Sensitive Receptors*

Potential human receptors include cemetery construction workers and future site users (workers and visitors). Future site workers refer to ANC employees and maintenance workers and future visitors refers to the general public who are anticipated to have unlimited access to outdoor areas and authorized structures. Potential exposure pathways to these human receptors include direct contact with impacted soil and groundwater, ingestion of impacted soil and groundwater, and inhalation of dust and vapors.

The Millennium Project refers to the proposed expansion of the cemetery. Once developed, the new portions of the cemetery surface will be entirely covered by structures, asphalt and concrete pavement, and clean soil and landscaping limiting the potential for future site users to come into direct contact with and/or ingest impacted soil and the potential for future site users to inhale dust and vapors.

Groundwater is not currently used or proposed for future use at ANC as a potable water or irrigation water supply; thus, the potential for future site users to come into direct contact with and ingest impacted groundwater is minimal. It should be noted that groundwater is not currently used at properties surrounding ANC as a potable water or irrigation water supply. In addition, Arlington restricts groundwater use within the Arlington area for potable or irrigation purposes. Potable water is provided to ANC by the local municipality whose potable water sources are surface water reservoirs.

To prepare the property for development, all remnant structures, features, and surface coverings (asphalt pavement and concrete slabs) will be razed and removed. Mass excavation and grading will be conducted on the vast majority of the property to construct cemetery features. The deepest excavations will occur in areas designated for pre-place crypts. In general, mass excavation and grading will consist of reworking the upper 5 to 18 feet of soil underlying the burial areas. Current plans indicate maximum cut and fill quantities of 16 and 30 plus feet, respectively. The vast majority of the soil generated during excavation and grading is expected

to meet beneficial reuse criteria and will be used at ANC as general backfill. If additional fill is needed to achieve proposed grades, clean imported fill will be used. Utilities proposed at SITE include natural gas lines, electric lines, water lines, storm sewers, and sanitary sewers. Based on groundwater measurement data obtained from ANC and current Millennium Project design, most of the buried cemetery features at the SMY, ESMY, OWA, and SDS will be installed at depths situated above the shallow water table.

During razing of the remnant site features and cemetery construction, construction workers have the potential to come into direct contact with and ingest impacted soil and groundwater and inhale dust and vapors. To date, no impacted media characterized as hazardous waste has been encountered and most of the excavation and grading work is not anticipated to require specialized contractors or personal protective equipment (PPE). Some specialized contractors and use of PPE are anticipated for use in excavating impacted soil, for groundwater treatment, and removal of USTs and other items of environmental concern should they be unearthed during construction. A qualified health and safety professional and/or environmental consultant retained by the Contractor will provide planning support and oversight during implementation of these remedial activities. Exposure risks posed to future site maintenance workers are expected to be similar to or further reduced from those of construction workers.

4.6.2 *Human Health*

The risk to human health during and after construction of the cemetery expansion was evaluated by identifying potential pathways of exposure, comparing the concentrations of detected constituents to applicable VDEQ and EPA screening levels, and evaluating the likelihood that construction workers and future site users (i.e., workers and site visitors) would be exposed to the impacted media.

Soil

Pathways of potential human exposure to impacted soil include direct contact with impacted soil, ingestion of impacted soil, and inhalation of dust. SVOCs were detected at concentrations above applicable VDEQ screening levels in soil. In areas where they were detected at elevated concentrations, the SVOC-impacted soil was recommended for excavation, removal, and off-site disposal/treatment at a permitted facility. The locations where SVOCs were detected at elevated concentrations in soil and where excavation and removal was recommended are depicted on Figures 8, 9, 10, 12, and 13.

In the proposed land use scenario (cemetery), the impacted soil left in place is not expected to represent a risk to future site users and visitors because the cemetery expansion will be covered by site buildings, asphalt and concrete pavement, or landscaping (preventing direct contact with impacted soil, ingestion of impacted soil, and inhalation of dust). Although construction workers and future maintenance workers have the potential to come into direct contact with and ingest impacted soil and inhale dust, the impacted soil is not anticipated to represent an unacceptable risk to these receptors based on the relatively short duration of exposure and low concentrations of COCs detected in soil. Additionally, AZONE assumes that adequate dust control will be implemented during construction as standard practice (e.g., wetting of soil). The vast majority of

the soil generated during grading is expected to meet beneficial reuse criteria and will be used at the site as general backfill to achieve grade for the proposed structures.

Groundwater

Pathways of potential human exposure to impacted groundwater include direct contact with impacted groundwater, ingestion of impacted groundwater, and inhalation of vapors volatilizing from groundwater. COPCs were not detected above VDEQ screening levels in groundwater samples collected from the SMY, ESMY, and FMM. COPCs were detected in groundwater at concentrations indicating a risk may be present at the OWA and SDS. The locations where VOCs were detected in groundwater at elevated concentrations are depicted on Figures 14 and 15.

In the proposed land use scenario (cemetery), the impacted groundwater left in place is not expected to represent a risk to future site users and visitors because the cemetery expansion will be covered by site buildings, asphalt and concrete pavement, or landscaping (preventing direct contact with impacted groundwater, ingestion of impacted groundwater, and inhalation of vapors). The impacted may present a risk to cemetery construction workers and future cemetery maintenance workers should they come into contact with the impacted water. No or limited contact is expected because the impacted groundwater identified at the OWA is not in an area proposed for mass excavation or grading and the impacted groundwater identified at the SDS is situated at depths well below proposed excavation and grading. Although construction workers and future maintenance workers have the potential to come into direct contact with and ingest impacted groundwater and inhale vapors, the impacted groundwater is not anticipated to represent an unacceptable risk to these receptors based on the relatively short duration of exposure expected during construction in the small limited and localized areas of impact.

Groundwater is not currently used or proposed for future use at ANC as a potable water or irrigation water supply; thus, the potential for future site users to come into direct contact with and ingest impacted groundwater is minimal.

An institutional control recommended for ANC is preventing the use of groundwater beneath ANC for any purpose.

Soil Gas

Pathways of potential human exposure to soil gas are limited to inhalation. Potential inhalation risks appear to only be a concern at the OWA and SDS.

In the proposed land use scenario (cemetery), soil gas is not anticipated to represent a human health risk to future site users and visitors, construction workers, or future maintenance workers at the SMY, ESMY, and FMM. This determination is based on the lack of or relatively low concentrations of VOCs detected in soil and groundwater samples collected from these areas and planned removal of SVOC and TPH-impacted soil from these areas. Soil gas may represent a human health risk to future site users and visitors, construction workers, or future maintenance workers at the OWA and SDS. This determination is based on the detection of VOCs above VDEQ screening levels for groundwater for inhalation. The risks at the OWA are expected to be greatly reduced because the vast majority of the impacted soil present at the OWA will be

excavated and removed and impacted groundwater will be treated in situ. The impacted groundwater identified at the SDS is expected to result in a minimal risk because groundwater is situated at depths well below proposed excavation and grading.

Although construction workers and future maintenance workers have the potential to inhale vapors, the risks to these receptors is expected to be minimal based on the size of the area that will be disturbed during excavation and grading, relatively short duration of exposure expected during construction, and small limited and localized areas of impact.

5.0 PROPOSED REMEDIAL ACTIONS, ENGINEERING CONTROLS, AND INSTITUTIONAL CONTROLS

Remedial actions proposed to address impacted soil and groundwater resulting from past ANC and Fort Meyer facility operations include excavation and removal of TPH and SVOC-impacted soil and in situ treatment of TPH and VOC-impacted groundwater. The vast majority of the impacts to soil and groundwater have resulted from releases of petroleum products. Other sources of impact include stockpiling of soil and debris and past storage of materials and maintenance chemicals and supplies. Remedial actions to address unknown USTs or other buried environmental items or features of concern (e.g., drums) should they be encountered during development are also provided. Engineering controls that may be warranted include the incorporation of a vapor barrier into buildings or structures constructed and vapor barrier, clay liner, or chemical-resistant piping/conduit materials used in conjunction with subsurface utility installation over or adjacent to TPH and VOC-impacted soil and groundwater left in place. At this time, no structures or sensitive utilities appear to be proposed in areas where impacted soil or groundwater will be left in place; however, this plan provides general guidance should buildings, structures, or subsurface utilities be constructed over or in close proximity to impacted media. Institutional controls proposed for the Millennium Project include limiting site use to commercial land use and restricting the use of groundwater for any purpose. Both of these controls are already in place at ANC.

A detailed discussion of the proposed remedial actions, engineering controls, and institutional controls is provided in the following sections.

5.1 Worker Health and Safety

Prior to implementation of remedial actions and start of construction, a construction worker APP will be developed by the Contractor and approved for use by the USACE. The APP will address health and safety risks posed to construction workers by the presence of impacted soil and groundwater and include a SSHP and AHAs for each task as attachments. The APP will comply with applicable USACE and OSHA requirements. The APP and RAWP will be required reading for all site workers and a copy of the APP and RAWP will be maintained on the work site at all times.

Based on the type and degree of impacts identified, most of the excavation and grading work is not anticipated to require specialized contractors or PPE; however, a qualified health and safety professional and/or environmental consultant retained by the Contractor will provide planning

support and oversight during the removal of impacted soil. AZONE also recommends that all construction workers be made aware of the potential to unearth impacted media, USTs, and other buried items of environmental concern during construction and procedures to implement upon discovery (e.g., stop work immediately) through awareness training. Specialized and qualified contractors should be used to recover free product from open excavations, apply groundwater treatment chemicals to open excavations, and remove USTs or other buried features of environmental concern should they be encountered.

Upon completion of the cemetery expansion, an APP for maintenance workers will be developed if warranted to address health and safety risks posed to maintenance workers by the presence of impacted soil and groundwater left in place. Maintenance workers represent the only populations that could potentially come into contact with the impacted media left in place after the cemetery expansion. If prepared, the APP will be required reading for all site maintenance workers and a copy of the APP will be maintained at ANC at all times. All maintenance workers conducting subsurface work in areas where impacted media was left in place will be made aware of the potential to unearth impacted media, USTs, and other buried items of environmental concern during maintenance and procedures to implement upon discovery (e.g., stop work immediately) through awareness training.

5.2 Permits and Utility Clearance

Before initiating the proposed remedial actions, the Contractor will obtain all necessary site clearances and permits required by ANC and JBM-HH. As required, the Contractor will call "Miss Utility" at (800) 552-7001 at least 1 week in advance of any subsurface work. The Contractor will also obtain all necessary digging permits from ANC and JBM-HH. Based on AZONE's experience working at the ANC, not all subsurface utilities are known and documented; thus AZONE also recommends that a private utility locator be contracted to assess all areas where intrusive work will be conducted to mark utilities that may be missed or unknown to Miss Utility, ANC, and JBM-HH.

Before performing intrusive work, the Contractor will conduct a thorough visual inspection of the immediate vicinity of the proposed excavations to locate all manholes, curb boxes, fire hydrants, electric or telephone drops into underground conduits, gas pipeline markers, and other utility markers. Using this information, the general direction of (if any) underground utilities can be determined. Work will not be conducted in areas where utility conflicts are noted.

5.3 SVOC and TPH-Impacted Soil Excavation and Removal

Soil that is petroleum stained, exhibits strong petroleum or chemical odors, and/or contains target constituents above VDEQ-T3C and expected background levels will be excavated and removed using a trackhoe or backhoe. Soil meeting these criteria was noted at the SMY, ESMY, OWA, and FMM. Constituents detected above VDEQ and EPA screening levels for a commercial land use were limited to TPH and SVOCs. The estimated limits of the impacted soil requiring excavation and removal are depicted on Figures 8, 9, 10, 12, and 13. The estimated cubic yards/tons of impacted soil proposed for removal at each AOC are provided below:

- **SMY** - 150 to 200 cubic yards (225 to 300 tons) of SVOC-impacted soil assuming excavation depths ranging from 2 to 6 feet. The impacted soil is located on the northeastern corner of the area (depicted on Figures 8 and 12).

- **ESMY** - 40 to 60 cubic yards (60 to 90 tons) of SVOC-impacted soil assuming an excavation depth of 3 feet. The impacted soil is located on the southeastern portion of the area (depicted on Figures 8 and 12).

- **OWA** – 2,800 to 3,300 cubic yards (4,200 to 4,950 tons) of TPH and SVOC-impacted soil assuming excavation depths ranging from 2 to 5 feet. The impacted soil is located in several areas, with the bulk of the impacted soil located on the southern side of Building 108 and southeastern corner of the area (depicted on Figures 9 and 12). Excavation of impacted soil in two areas proposed for in situ groundwater treatment will be conducted until a depth of at least 1 foot below the water table is achieved. This will allow for groundwater treatment to be performed in the open excavations. Groundwater treatment is discussed in Section 5.4.

- **FMM** - 1,000 to 1,500 cubic yards (1,500 to 1,725 tons) of TPH and SVOC-impacted soil assuming an excavation depth of 10 feet to achieve grade. The impacted soil refers to soil comprising the entire mound (depicted on Figures 10 and 13). It should be noted that historical documents suggest other debris of concern (e.g., wagon wheels, drums, tanks, etc.) may have been buried within the fill comprising the mound. If debris or items of environmental concern are unearthed, the protocols outlined in Section 5.5 should be followed.

Based on the type and concentrations of COPCs detected in the samples collected from the SMY, ESMY, OWA, and FMM, the removed impacted soil is expected to meet criteria for disposal/treatment as a non-hazardous, petroleum-impacted waste.

The excavated impacted soil will be directly loaded directly into dump trucks for transport to a permitted disposal/treatment facility. If stockpiling of impacted soil becomes necessary, it will be stockpiled on and covered with plastic sheeting of adequate thickness and will be surrounded by an earthen berm or hay bales. The stockpiled impacted soil will be removed from the work site in a timely manner and stockpiles will be maintained until the impacted soil is removed. All impacted soil leaving the SITE will also be manifested.

The excavation and removal of impacted soil will be performed by qualified and experienced contractors and will be supervised and documented a qualified environmental professional. The actual limits of impacted soil removal will be determined in the field by visual inspection, olfactory inspection, field screening with a PID, and best professional judgment. The successful removal of impacted soil will be confirmed through the collection of soil samples from the excavation bottom and sidewalls for laboratory analysis. The collection of excavation bottom samples is not anticipated in excavations that breach the water table (soil/groundwater interface). At minimum, soil samples will be collected along the excavation walls at 15 foot intervals (spacing between sample points) and 625 square foot intervals from excavation bottoms. The sidewall samples will be collected from a depth corresponding to approximately 1 foot above the

water table surface or depth at which the highest degree of impact to soil is noted based on field observations. The bottom samples will be collected from upper 1 foot of soil comprising te excavation bottoms and will also be biased to locations where the highest degree of impact to soil is noted based on field observations.

All of the post-excavation soil samples will be submitted to a qualified laboratory for analysis of target constituents warranting removal. Anticipated analyses include TPH-DRO and TPH-GRO using EPA Method 8015 and SVOCs using EPA Method 8270C or D.

If required to achieve development grade, the excavations will be backfilled with "clean" soil (soil originating from the Millennium Project deemed acceptable for beneficial reuse or imported from offsite). The excavations will not be backfilled until soil analytical results indicate cleanup endpoints for soil have been achieved and groundwater treatment has been performed. If the analytical results indicate further excavation is warranted, further excavation and removal of impacted soil will be conducted and additional post-excavation soil samples will be collected for laboratory analysis using the criteria discussed above.

5.4 In Situ Groundwater Treatment

In situ groundwater treatment is proposed in two areas at the OWA. The two areas include a small area located in the central portion of the OWA and a relatively large area located near the southeastern corner of the OWA. Both areas are depicted on Figures 9, 12, and 14. Groundwater treatment will be conducted in the open excavations created during excavation and removal of impacted soil. In these areas, a mixture of Regen Ox™ and ORC Advanced® or approved equivalent will be applied across the entire bottom of the open excavation before it is backfilled. RegenOx™ is a chemical oxidizer that chemically destroys petroleum constituents and other VOCs on contact. ORC Advanced® is an oxygen-releasing compound that stimulates aerobic bioremediation of petroleum constituents. Product information for RegenOx™ and ORC Advanced® is included as Attachment 3.

The treatment chemicals will be mixed and applied by qualified and experienced contractors and treatment will be supervised and documented a qualified environmental professional. Treatment is anticipated to require mixing of the chemicals in tanks and application of the chemicals using a pump. Alternatively, the chemicals will be mixed into the excavation bottom using an excavator or backhoe bucket. The volume of Regen Ox™ and ORC Advanced® or approved equivalent needed to treat groundwater and application method will be determined through discussions with the treatment chemical supplier and will be based on the size of area to be treated, degree of impact, and remedial goals (successful treatment of target constituents to levels below VDEQ screening levels for a commercial use property).

The success of groundwater treatment will be evaluated through the collection of groundwater samples for laboratory analysis. The samples will be collected from the excavation just prior to and following treatment of groundwater and from temporary wells installed in strategic locations following backfilling of the excavations. At minimum, one well will be installed immediately hydraulically upgradient, one well will be installed within the approximate center, and two wells will be installed immediately hydraulically downgradient of each excavation where groundwater

treatment is conducted. More wells are anticipated to adequately assess the larger excavation where groundwater treatment will be conducted. The groundwater samples will be submitted to a qualified laboratory for analysis of TPH-DRO and TPH-GRO using EPA Method 8015, VOCs using EPA Method 8260B, and SVOCs using EPA Method 8270C or D.

If petroleum free product is observed to be floating on the groundwater within the excavation, it will be recovered using a vacuum truck before in situ groundwater treatment is performed. Fluid recovery will be performed by qualified and experienced contractors. All recovered fluids will be manifested and transported to a permitted facility for treatment.

5.5 USTs and Other Buried Environmental Items of Concern

Numerous USTs were used at the OWA and debris and other items of environmental concern have been documented to be present in the fill comprising FMM. If USTs or other items of environmental concern are unearthed during construction, all work will cease in the area until the tank or item can be thoroughly assessed and regulatory notification can be made and a permit be obtained if warranted. The USACE will immediately notify the ANC, VDEQ, EPA, or other required regulatory agencies if unknown USTs or items of environmental concern are unearthed during construction.

Upon regulatory notification and receipt of the permit, unearthed USTs and any other items of environmental concern will be removed using adequate equipment (e.g., trackhoe or backhoe). If the tank or item is found to contain petroleum fluids, they will be emptied using a vacuum truck. All associated tank system piping will also be emptied of fluids using a vacuum truck. All recovered fluids will be manifested and transported to a permitted facility for treatment. If the tanks are found to contain fluids other than petroleum products, all work will cease until the fluids can be adequately characterized and proper health and safety protocols can be established. The APP and RAWP will be revised or modified if necessary.

After removing the fluids, the tanks or items will be assessed for vapors and if vapors are noted at elevated levels (levels deemed unsafe to remove the tank/item from the excavation or cut it open for cleaning) it will be vented using dry ice or other approved methods. After proper venting, the UST/item will be removed from its excavation, cut open, cleaned, and recycled. Cutting and cleaning will be conducted on site, on plastic sheeting. All waste fluids and sludge generated during cleaning will be recovered using a vacuum truck. All recovered fluids will be manifested, and transported to a permitted facility for treatment.

If a tank or item is found to contain inert material (e.g., sand, concrete, ash, etc.), the inert material will be removed by cutting open the tank/item (after checking for vapors and proper venting). The removed material will be inspected for evidence of petroleum or other impact by visual inspection, olfactory inspection, field screening with a PID, and best professional judgment. Material determined to be “clean” will be stockpiled on and covered with plastic sheeting pending characterization through laboratory analysis. If found to be clean or meet beneficial reuse criteria, the material will be disposed off site as normal construction debris or reused on site as fill. Material that is determined to be impacted will be properly disposed off site at a permitted disposal/treatment facility.

A minimum of one soil sample will be collected for laboratory analysis from the base of each UST or item excavation. More samples will be collected for larger excavations. Anticipated analyses include TPH-DRO and TPH-GRO using EPA Method 8015, VOCs using EPA Method 8260B, and SVOCs using EPA Method 8270C or D.

The removal of USTs and other buried items of environmental concern will be performed by qualified and experienced contractors and will be supervised and documented a qualified environmental professional.

5.6 Engineering Controls

At this time, the need for engineering controls is not anticipated. The vast majority of impacted soil is proposed for removal and vast majority of impacted groundwater will be treated in situ. The only area where impacted groundwater will be left in place and no treatment is proposed is the SDS. Impacted groundwater is relatively deep in this area (greater than 20 feet below grade) and was identified in an area where a road is proposed.

If development plans will entail the construction of buildings or structures or installation of subsurface utilities or other site features susceptible to vapor intrusion in areas identified as impacted, further assessment and/or engineering controls may be warranted. Applicable engineering controls concerning buildings and structures and based on the COPCs identified may include a vapor barrier incorporated into the building/structure design. Most of the impacts are related to petroleum releases and VOCs and SVOCs. If warranted, the vapor barrier will be resistant to the COPCs and will provide adequate protection from vapors for the building occupants and maintenance workers. Applicable engineering controls concerning subsurface utilities or other site features and based on the COPCs identified may include a vapor barrier, clay liner, or chemical-resistant piping/conduit materials.

If engineering controls become warranted, the RAWP will be amended to include the engineering control design, installation, and maintenance requirements. Engineering controls will be designed and installed by qualified and experienced environmental professionals and contractors.

5.7 Institutional Controls

Two institutional controls are currently in use at the ANC and should provide adequate protections to current and future site users. The institutional controls include limiting site use to commercial land use and restricting the use of groundwater for any purpose.

5.8 Follow-Up Assessment

The USACE may conduct further assessment of impacts noted at the AOCs to better define the limits of impacted soil requiring excavation and removal and/or quality of groundwater. If conducted, the assessment will include advancement of additional test borings or excavation of test pits adjacent to borings where impacted soil requiring removal and groundwater containing COPCs at concentrations above VDEQ and EPA screening levels for commercial land use was

identified. During advancement of the borings and/or excavation of the test pits, soil and groundwater samples will be collected for field screening and laboratory analysis. AOCs where further study may be conducted and basis is as follows:

- **SMY and OWA** - Further assessment of the limits of SVOC and TPH-impacted soil proposed for excavation and removal at the SMY and OWA to better establish the horizontal and vertical limits of impacted soil requiring removal.

- **SDS** - Further assessment of soil and the limits of VOC-impacted groundwater at the SDS to better characterize fill comprising the SDS that will be disturbed during mass grading in this area and further evaluate the need for engineering controls.

Upon successful excavation and removal of SVOC and TPH-impacted soil from the SMY, ESMY, OWA, and FMM the potential risk to future site users will also be evaluated quantitatively to ensure risks to these receptors are acceptable and no further remedial actions are warranted.

6.0 REMEDIAL ACTION SAMPLING

The success of the remedial actions will be verified through the collection of soil and groundwater samples for laboratory analysis. The samples will be collected at specific milestones and are discussed below.

6.1 Soil Sampling

As discussed in Section 5.3, soil samples will be collected for laboratory analysis from the sidewalls and base of the impacted soil excavations to verify successful removal of impacted soil. As discussed in Section 5.5, soil samples will be collected for laboratory analysis from the base of each UST or other item of environmental concern excavation to assess soil quality. At minimum, the soil samples will be submitted to a qualified laboratory for analysis of TPH-DRO and TPH-GRO using EPA Method 8015 and SVOCs using EPA Method 8270C or D. Samples collected from UST and other item excavations will additionally be analyzed for VOCs using EPA Method 8260B. Additional analyses will be performed as warranted.

6.2 Groundwater Sampling

Upon successful removal of the impacted soil and just prior to in situ treatment of groundwater, groundwater samples will be collected from the excavations for laboratory analysis. Groundwater samples will also be collected for laboratory analysis from the excavations immediately following application of the treatment chemicals.

Following treatment, groundwater samples will be collected from strategically placed new temporary groundwater monitoring wells on at least two occasions at least 6 months apart to evaluate the success of groundwater treatment. The wells will be installed within and hydraulically downgradient of the excavations.

The groundwater samples collected from the excavations and wells will be submitted to a qualified laboratory for analysis of TPH-DRO and TPH-GRO using EPA Method 8015, VOCs using EPA Method 8260B, and SVOCs using EPA Method 8270C or D. The proposed well locations and well sampling procedures will be presented in a RAWP Addendum to be prepared following successful removal of the impacted soil.

6.3 Quality Assurance and Control

Quality assurance and control (QA/QC) samples collected and submitted for analysis in association with the soil and groundwater sampling will consist of temperature blanks, trip blanks, equipment blanks, blind field duplicates, and MS/MSDs. The QA/QC samples will be collected to ensure that data of known and acceptable quality are generated. The QA/QC samples will be collected at frequencies recommended by the USACE and EPA.

6.4 Analytical Methods and Data Validation

The soil, groundwater, and associated QA/QC samples will be shipped to a qualified laboratory for analysis. The selected laboratory will be a National Environmental Laboratory Accreditation Commission and Department of Defense Environmental Laboratory Accreditation Program-validated laboratory. The QA/QC samples will be analyzed for the same COPCs, using the same analytical methods, as the primary samples. All of the soil and groundwater samples collected for analysis will be grab samples. All of the groundwater samples will be unfiltered samples. The sampling and analysis will be performed using applicable procedures stipulated in EPA SW-846, *Test Methods for Evaluating Solid Waste*, Final Update III (as amended June 1997). The analytical data will be validated by a third-party, independent validator, with all organic data and inorganic data validated to EPA, Region III Level M3 and IM2, respectively.

7.0 REPORTING

Upon successful completion of the proposed remedial actions and implementation of engineering controls (if warranted), the Contractor will prepare a Post-Remedial Action Report (PRAR). The report will provide a detailed summary of the remedial activities and engineering and institutional controls implemented to address post-development concerns. The report will include analytical summary tables; maps depicting areas where impacted soil, USTs, and other items of environmental concern were removed; areas where groundwater treatment was performed; locations where samples were collected; post-remedial action analytical sampling results; soil, fluid, and tank/item disposal manifests; and laboratory reports of analysis.

The findings of follow-up, post-construction sampling events, if required, will be detailed in a summary reports. The reports will include analytical summary tables; maps depicting sampling points, groundwater flow, and analytical results; and laboratory reports of analysis.

The PRAR and all follow-up reports will be prepared in accordance with applicable USACE and VDEQ guidelines.

8.0 REFERENCES

AZONE. 28 February 2013. *Revised Draft Expanded Environmental Site Investigation Report, Arlington National Cemetery Millennium Project, Arlington, Virginia*.

EPA, 2007. *Office of Solid Waste and Emergency Response Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846), Update IV*.

EPA, Region III. November 2012. *Regional Screening Level Summary Table.*

ROX. 22 January 1998. *Comprehensive Storage Tank Report, Arlington National Cemetery Millennium Project, Arlington, Virginia*.

ROX. 25 January 2002. *Site Characterization Report, Arlington National Cemetery, Old Warehouse Area, Millennium Project, Arlington, Virginia*.

SHAW. April 2011. *Millennium Environmental Support Investigation Report, Arlington National Cemetery Millennium Project, Arlington, Virginia*.

USACE. September 1997. *Arlington National Cemetery Master Plan-Environmental Assessment, Arlington National Cemetery, Arlington, Virginia*.

USACE. December 2005. *Constraints Summary, Arlington National Cemetery Millennium Project, Arlington, Virginia*.

USACE. April 2007. *Final Geotechnical Report, Arlington National Cemetery Millennium Project, Arlington, Virginia*.

USACE. 7 September 2012. *Charrette Report, Arlington National Cemetery Millennium Project, Arlington, Virginia*.

USGS. 26 April 1984. *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States, Professional Paper 1270.*

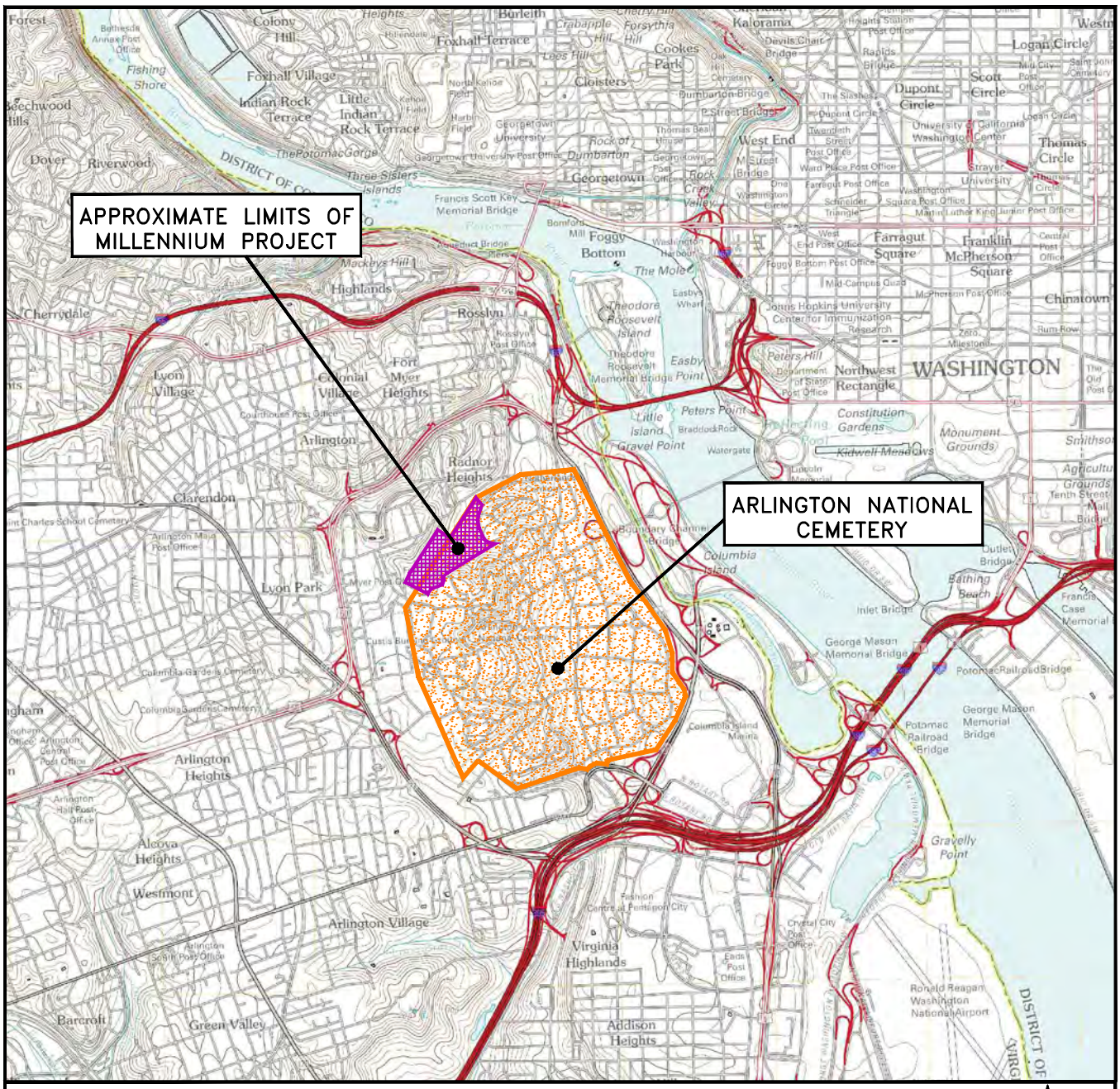
VDEQ. 26 June 2012. *Selection of Contaminants of Concern, Soil: Restricted (Commerical/Industrial), VRP Tier III Screening Concentrations*.

VDEQ. 23 July 2012. *Selection of Contaminants of Concern, Groundwater: Construction Worker in a Trench, Water Table Not Contacted and Water Table Contacted*.

VDEQ. 23 July 2012. *Selection of Contaminants of Concern, Restricted Groundwater Use, Commerical Land Use, Inhalation of Indoor Air, Tier III Groundwater Screening Level*.

c:/reports/AZONE/USACE/ANCMP/ANCMP REVISED DRAFT RAWP (04-22-13).docx

FIGURES



Source:
USGS Topographic Map
WASHINGTON WEST & ALEXANDRIA
Dated 2011

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1988

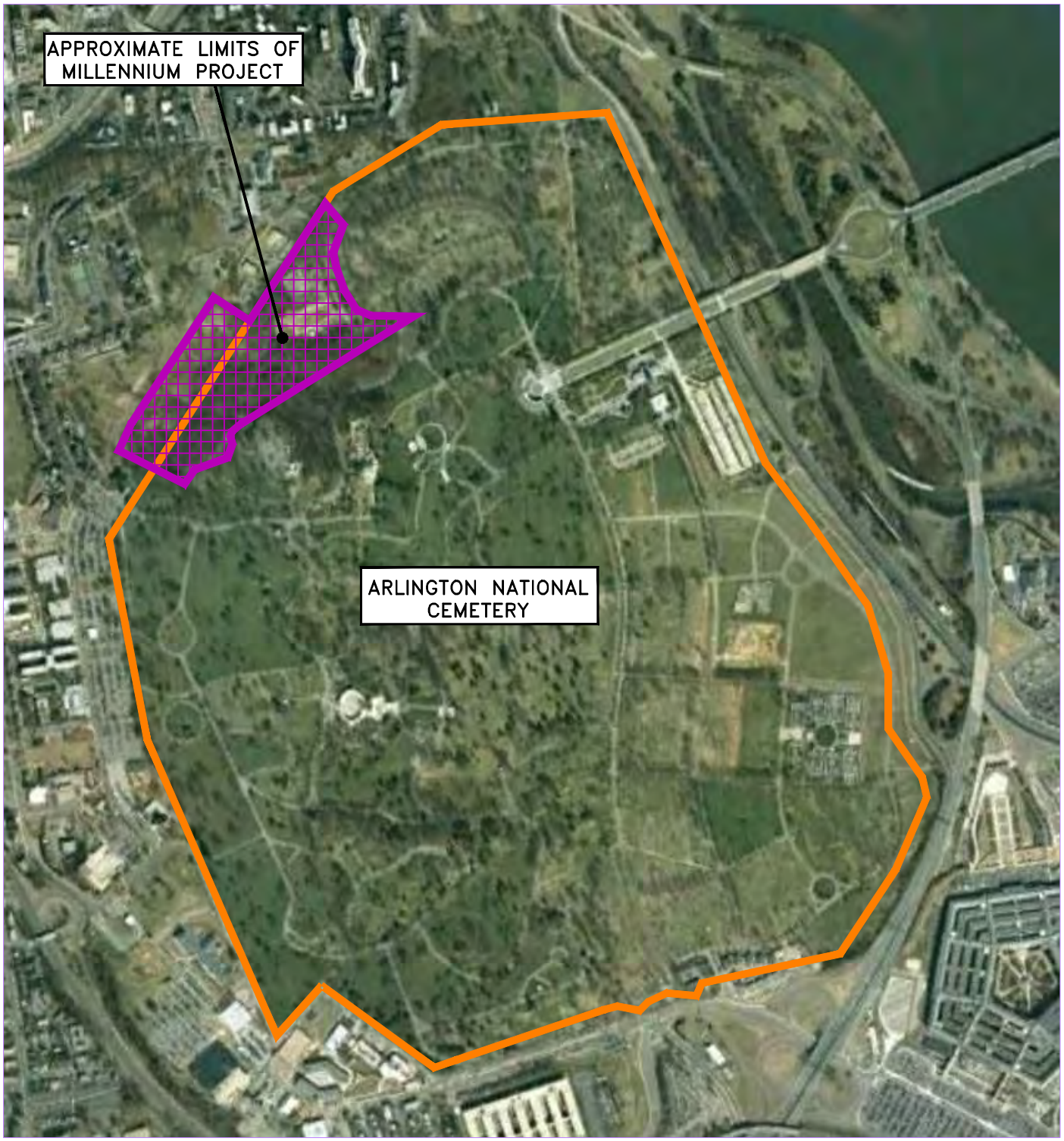
SITE LOCATION MAP

DESIGNED BRUZZESI	DATE 01/22/13
DRAWN STOCKTON	DATE 01/22/13

A-ZONE ENVIRONMENTAL SERVICES
2181 BERRYVILLE PIKE
CHARLES TOWN, WV 25414

ARLINGTON NATIONALCEMETERY
MILLENNIUM PROJECT
ARLINGTON, VA

PROJECT NO. 91236.003	SCALE: AS SHOWN
DRAWING NO.	FIGURE 1



GOOGLE 2012

0 1200 1200 2400

SCALE IN FEET

N

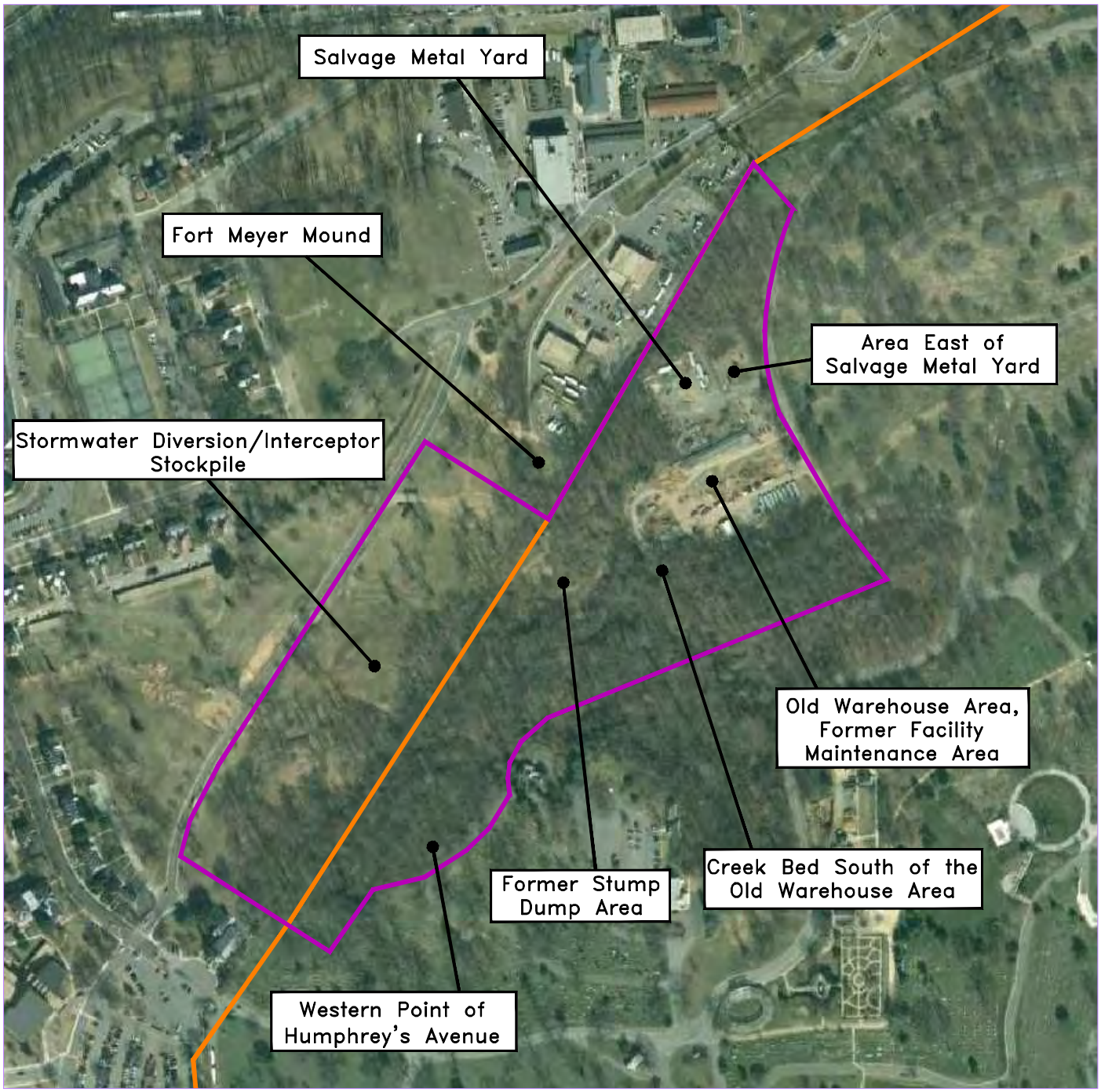
AERIAL PHOTOGRAPH

DESIGNED BRUZZESI	DATE 01/22/13
DRAWN STOCKTON	DATE 01/22/13

A-ZONE ENVIRONMENTAL SERVICES
2181 BERRYVILLE PIKE
CHARLES TOWN, WV 25414

ARLINGTON NATIONALCEMETERY
MILLENNIUM PROJECT
ARLINGTON, VA

PROJECT NO. 91236.003	SCALE: AS SHOWN
DRAWING NO.	FIGURE 2



GOOGLE 2012

0 200 400 800

SCALE IN FEET

LEGEND

- APPROXIMATE LIMITS OF MILLENNIUM PROJECT
- CURRENT ARLINGTON NATIONAL CEMETERY BOUNDARY

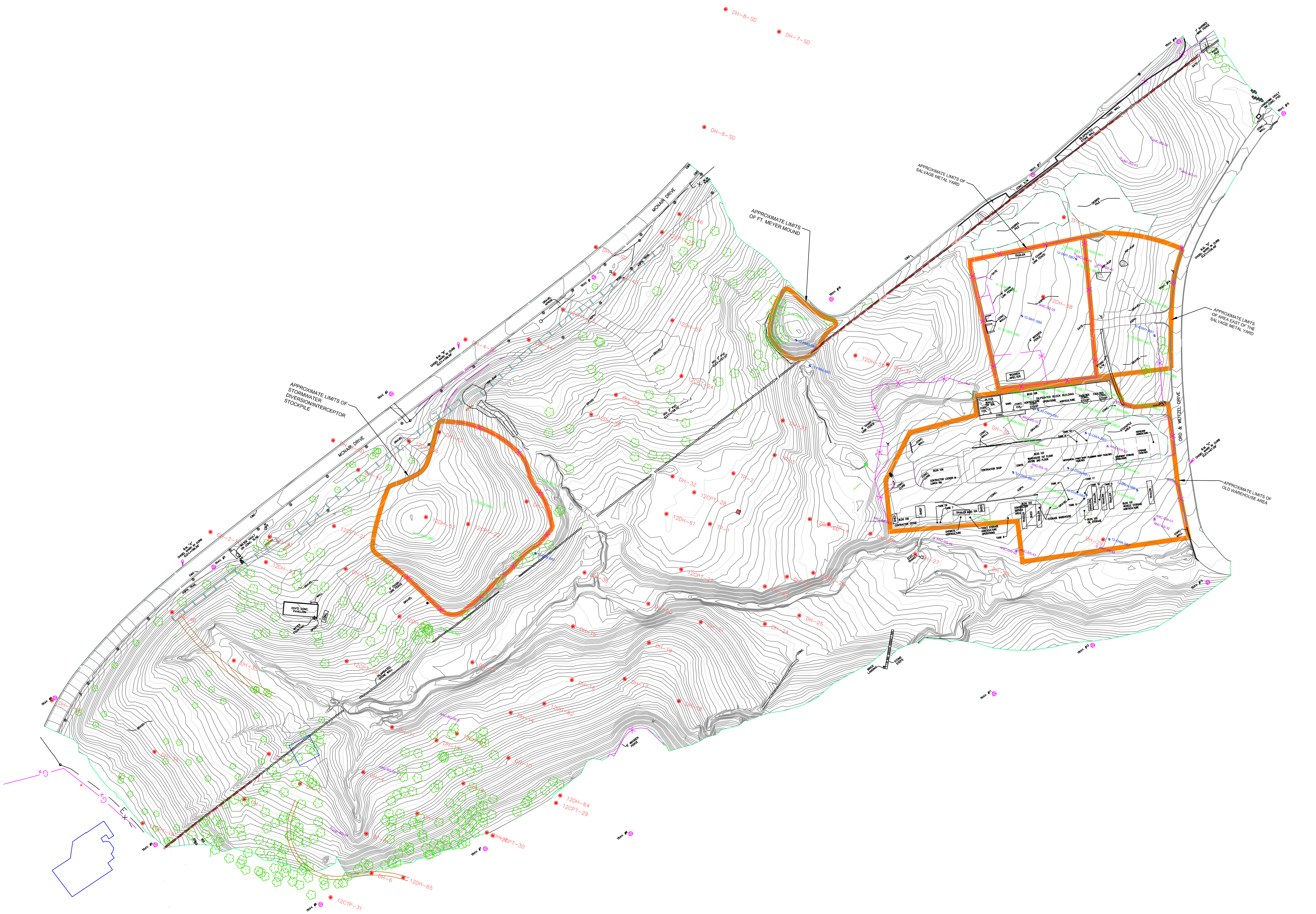
AREAS OF INTEREST

DESIGNED BRUZZESI	DATE 02/23/13
DRAWN STOCKTON	DATE 02/23/13

A-ZONE ENVIRONMENTAL SERVICES
2181 BERRYVILLE PIKE
CHARLES TOWN, WV 25414

ARLINGTON NATIONALCEMETERY
MILLENNIUM PROJECT
ARLINGTON, VA

PROJECT NO. 91236.003	SCALE: AS SHOWN
DRAWING NO.	FIGURE 3

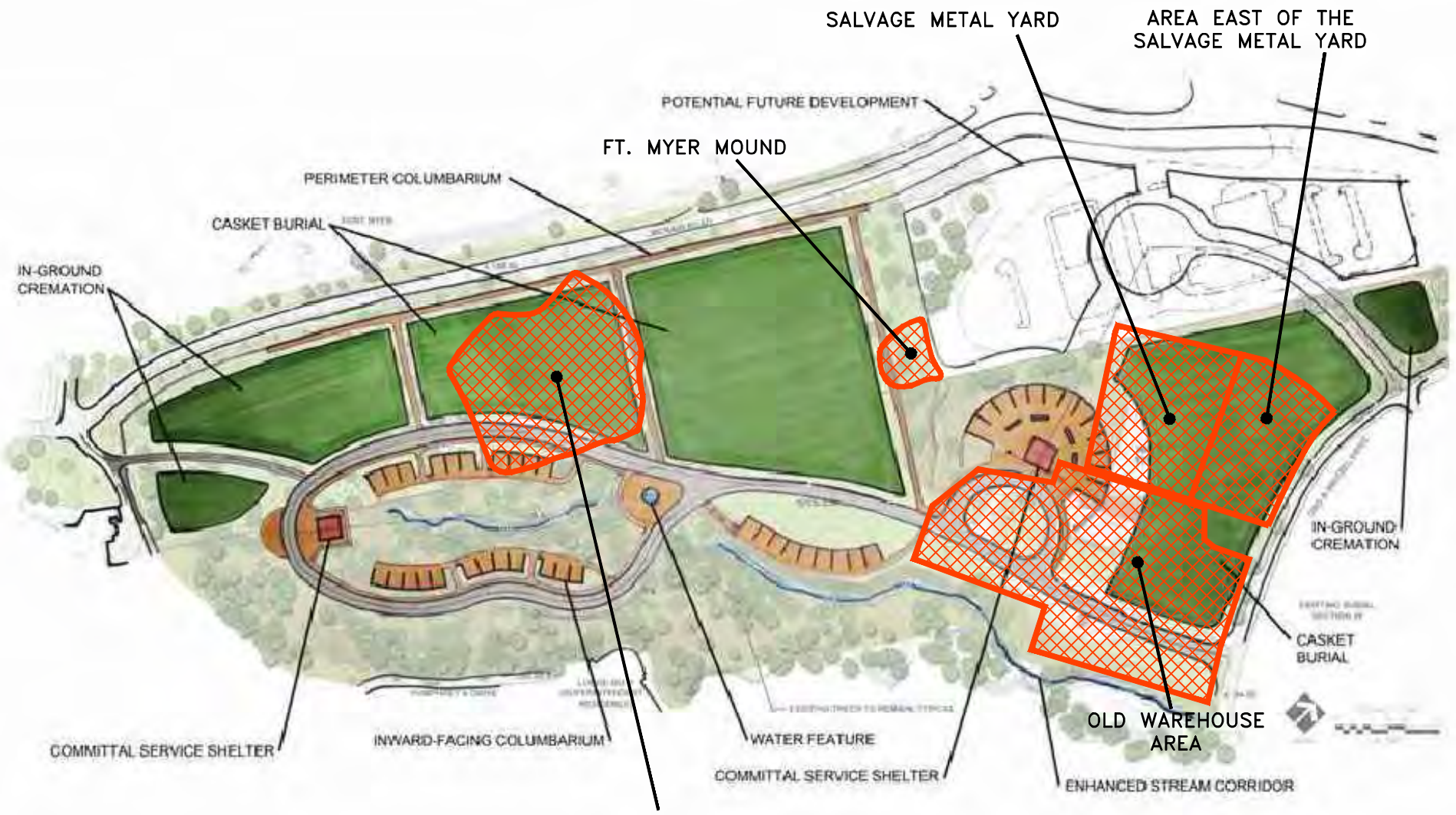


LEGEND

- 2012 & 2013 ENVIRONMENTAL SOIL TEST BORING
- 2012 & 2013 ENVIRONMENTAL SOIL AND GROUNDWATER TEST BORING
- 2009 ENVIRONMENTAL SOIL SAMPLING LOCATION
- 2009 ENVIRONMENTAL GROUNDWATER SAMPLING LOCATION
- GEOTECHNICAL TEST BORING

0 40 80 160
SCALE IN FEET

SITE PLAN (EXISTING CONDITIONS)		
DESIGNED BRUZZESI	DATE 01/22/13	ARLINGTON NATIONALCEMETERY MILLENNIUM PROJECT ARLINGTON, VA
DRAWN STOCKTON	DATE 01/22/13	
A-ZONE ENVIRONMENTAL SERVICES 2181 BERRYVILLE PIKE CHARLES TOWN, WV 25414	PROJECT NO. 91236.003	SCALE: AS SHOWN
	DRAWING NO.	FIGURE 4



GENERALIZED DEVELOPMENT CONCEPT

DESIGNED BRUZZESI	DATE 02/25/13
DRAWN STOCKTON	DATE 02/25/13

A-ZONE ENVIRONMENTAL SERVICES
2181 BERRYVILLE PIKE
CHARLES TOWN, WV 25414

ARLINGTON NATIONALCEMETERY
MILLENNIUM PROJECT
ARLINGTON, VA

PROJECT NO. 91236.003	SCALE: AS SHOWN
DRAWING NO.	FIGURE 5

LEGEND

- 2012 & 2013 ENVIRONMENTAL SOIL TEST BORING
- 2012 & 2013 ENVIRONMENTAL SOIL AND GROUNDWATER TEST BORING
- 2009 ENVIRONMENTAL SOIL SAMPLING LOCATION
- 2009 ENVIRONMENTAL GROUNDWATER SAMPLING LOCATION
- GEOTECHNICAL TEST BORING

0 40 80 160
SCALE IN FEET

DEVELOPMENT CONCEPT		
DESIGNED BRUZZESI	DATE 02/25/13	ARLINGTON NATIONALCEMETERY MILLENNIUM PROJECT ARLINGTON, VA
DRAWN STOCKTON	DATE 02/25/13	
A-ZONE ENVIRONMENTAL SERVICES 2181 BERRYVILLE PIKE CHARLES TOWN, WV 25414	PROJECT NO. 91236.003	SCALE: AS SHOWN
	DRAWING NO.	FIGURE 6

APPROXIMATE LIMITS OF SALVAGE METAL YARD

APPROXIMATE LIMITS OF AREA EAST OF THE SALVAGE METAL YARD

APPROXIMATE LIMITS OF OLD WAREHOUSE AREA

N

TP-5

12DH-58

DH-59

DH-31

DH-30

DH-29

DH-28

DH-27

DH-26

12-SMY-SB1

12-SMY-SB3

12-SMY-SB7

12-SMY-SB2

12-SMY-SB4

12-SMY-SB6
115.72

12-SMY-SB5

ANC-SS-10

ANC-SS-40

ANC-SS-05

12-ESMY-SB2

12-ESMY-SB1
101.70

12-ESMY-SB3

12-ESMY-SB4

12-OWA-SB18

12-OWA-SB19

ANC-SS-15

12-OWA-SB2

12-OWA-SB17

12-OWA-SB16

12-OWA-SB15

12-OWA-SB20

12-OWA-SB14

12-OWA-SB23

12-OWA-SB1
108.33

12-OWA-SB3
104.58

ANC-GW-03

ANC-SS-13

12-OWA-SB21

12-OWA-SB22

12-OWA-SB12

12-OWA-SB11
102.58

ANC-SS-18

12-OWA-SB10
103.38

12-OWA-SB8

12-OWA-SB9

12-OWA-SB6
97.41

12-OWA-SB5

12-OWA-SB4
98.99

ANC-GW-01

ANC-SS-32

12-OWA-SB7
95.10

ANC-SS-42

12-OWA-SB13

ANC-SS-43

ANC-GW-02

ANC-SS-45

ANC-SS-44

B.M. CHISEL MARK ELEV.=101.

B.M. "C" CHISEL MARK IN CURB ELEV.=97.09'

108

113

103

98

TRAILER

6' CHAIN LINK FENCE

GATE

ASPH.

GRAVEL

RIP-RAP

CONC. WALLS

6' WOOD FENCE

STONE S/W

WOODEN SHELTER

BLDG 108

DILAPIDATED BLOCK BUILDING

HORTICULTURE OPERATIONS

FACILITIES CONC. STOOP

BLOCK WALLS TOP SOIL

SAND

CONC. COL.

STORAGE FACILITIES

EQUIPMENT STORAGE OPERATIONS

MECHANICAL PAINT SHOP PLUMBING SHOP FACILITIES

BLDG 107 WAREHOUSE 1ST FLOOR ENTIRE 2ND FLOOR

CONTR. CONTRACTOR SHOP

TANK 4

TANK 6

TANK 10

TANK 9

TANK 16

TANK 17

TANK 5

BLDG 101 VEHICLE STORAGE HORTICULTURE

BLDG 102 OIL STORAGE

BLDG 103 CONTRACTOR SERVICE AREA

SHED

STORAGE WAREHOUSE

BLDG 106 CONTRACTOR LOCKER & LUNCH RM.

CONC. CURB

TANK 19

TANK 7

TANK 8

TRAILER BLDG 104

TOOLS STORAGE HORTICULTURE OPERATIONS

CHEMICAL HORTICULTURE

BLDG 105 CONTRACTOR OFFICE

STOCKPILE AREA

FERTILIZER HORTICULTURE

TRAV. #4

TRAV. #3

ORD & FITZEL DRIVE

LEGEND

- ⊕ 2012 & 2013 ENVIRONMENTAL SOIL TEST BORING
- ◔ 2012 & 2013 ENVIRONMENTAL SOIL AND GROUNDWATER TEST BORING
- ⊕ 2009 ENVIRONMENTAL SOIL SAMPLING LOCATION
- ◬ 2009 ENVIRONMENTAL GROUNDWATER SAMPLING LOCATION
- ◉ GEOTECHNICAL TEST BORING
- 104.58 GROUNDWATER ELEVATION IN FEET
- GROUNDWATER CONTOUR LINE

0 20 40 80

SCALE IN FEET

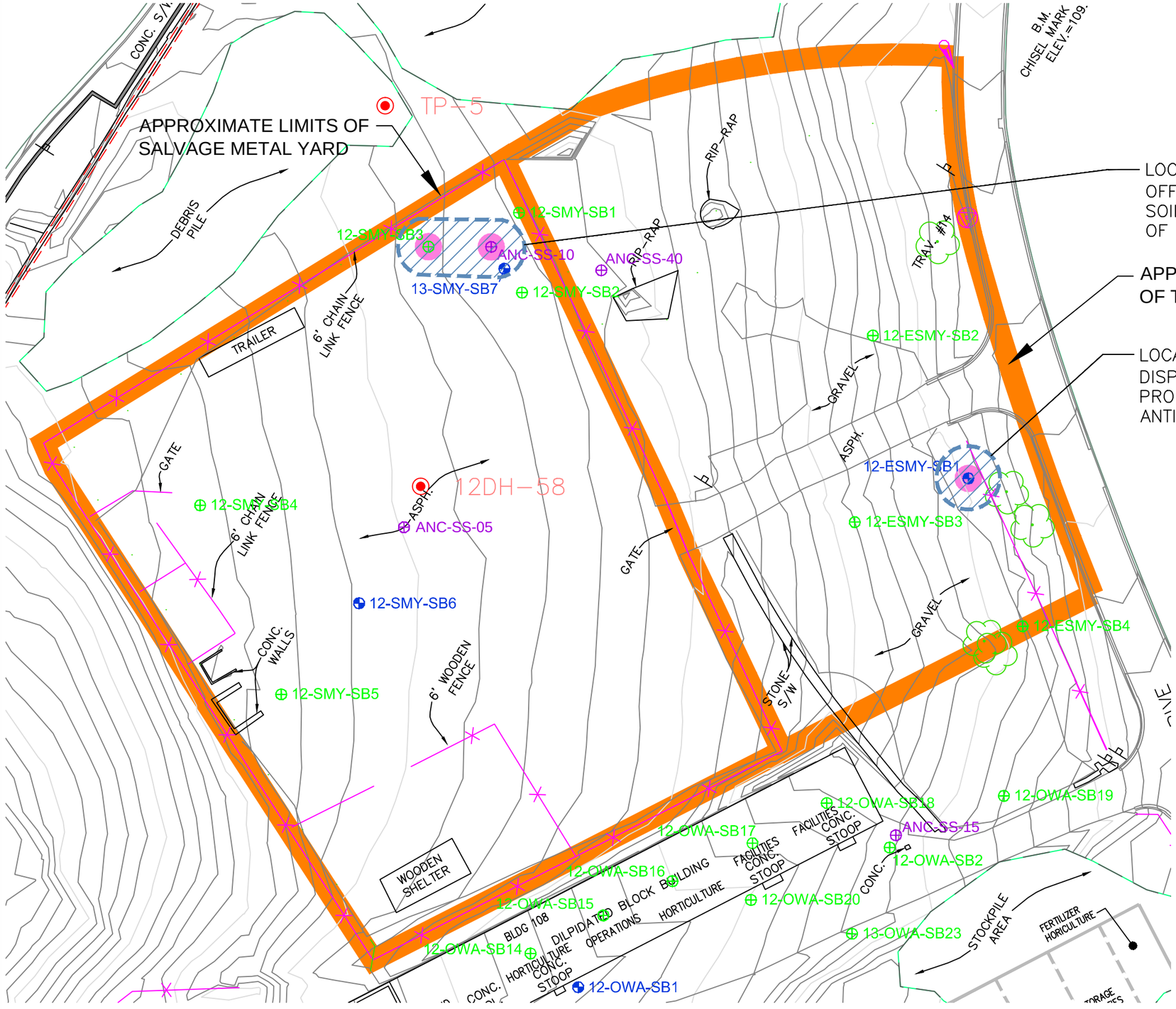
GROUNDWATER CONTOUR MAP

DESIGNED BRUZZESI	DATE 02/25/13
DRAWN STOCKTON	DATE 02/25/13

A-ZONE ENVIRONMENTAL SERVICES
2181 BERRYVILLE PIKE
CHARLES TOWN, WV 25414

ARLINGTON NATIONAL CEMETERY
MILLENNIUM PROJECT
ARLINGTON, VA

PROJECT NO. 91236.003	SCALE: AS SHOWN
DRAWING NO.	FIGURE 7



LOCATION WHERE EXCAVATION, REMOVAL, AND OFF-SITE DISPOSAL/TREATMENT OF TPH-IMPACTED SOIL IS PROPOSED. EXCAVATION OF 2 TO 6 FEET OF SOIL IS ANTICIPATED.

APPROXIMATE LIMITS OF AREA EAST OF THE SALVAGE METAL YARD

LOCATION WHERE EXCAVATION, REMOVAL, AND OFF-SITE DISPOSAL/TREATMENT OF SVOC-IMPACTED SOIL IS PROPOSED. EXCAVATION OF 3 FEET OF SOIL IS ANTICIPATED.

LEGEND

- ⊕ 2012 & 2013 ENVIRONMENTAL SOIL TEST BORING
- ⊕ 2012 & 2013 ENVIRONMENTAL SOIL AND GROUNDWATER TEST BORING
- ⊕ 2009 ENVIRONMENTAL SOIL SAMPLING LOCATION
- ◉ GEOTECHNICAL TEST BORING
- ● DESIGNATES LOCATIONS WHERE TARGET CONSTITUENTS WERE DETECTED ABOVE REGULATED SCREENING LEVELS AND BACKGROUND IN SOIL

0 20 40 80
SCALE IN FEET

SALVAGE METAL YARD (EXISTING CONDITIONS)

DESIGNED BRUZZESI	DATE 04/14/13
DRAWN STOCKTON	DATE 04/14/13

A-ZONE ENVIRONMENTAL SERVICES
2181 BERRYVILLE PIKE
CHARLES TOWN, WV 25414

ARLINGTON NATIONAL CEMETERY
MILLENIUM PROJECT
ARLINGTON, VA

PROJECT NO. 91236.003	SCALE: AS SHOWN
DRAWING NO.	FIGURE 8

LOCATION WHERE EXCAVATION, REMOVAL, AND OFF-SITE DISPOSAL/TREATMENT OF SVOC-IMPACTED SOIL IS PROPOSED. EXCAVATION OF 2 TO 5 FEET OF SOIL IS ANTICIPATED.

APPROXIMATE LIMITS OF OLD WAREHOUSE AREA

LOCATION WHERE EXCAVATION, REMOVAL, AND OFF-SITE DISPOSAL/TREATMENT OF TPH-IMPACTED SOIL AND INSITU TREATMENT OF IMPACTED GROUNDWATER IS PROPOSED. EXCAVATION OF 4 TO 5 FEET OF SOIL IS ANTICIPATED.

LEGEND

- 2012 & 2013 ENVIRONMENTAL SOIL TEST BORING
- 2012 & 2013 ENVIRONMENTAL SOIL AND GROUNDWATER TEST BORING
- 2009 ENVIRONMENTAL SOIL SAMPLING LOCATION
- 2009 ENVIRONMENTAL GROUNDWATER SAMPLING LOCATION
- GEOTECHNICAL TEST BORING
- DESIGNATES LOCATIONS WHERE TARGET CONSTITUENTS WERE DETECTED ABOVE REGULATORY SCREENING LEVELS AND BACKGROUND IN SOIL

0 20 40 80
SCALE IN FEET

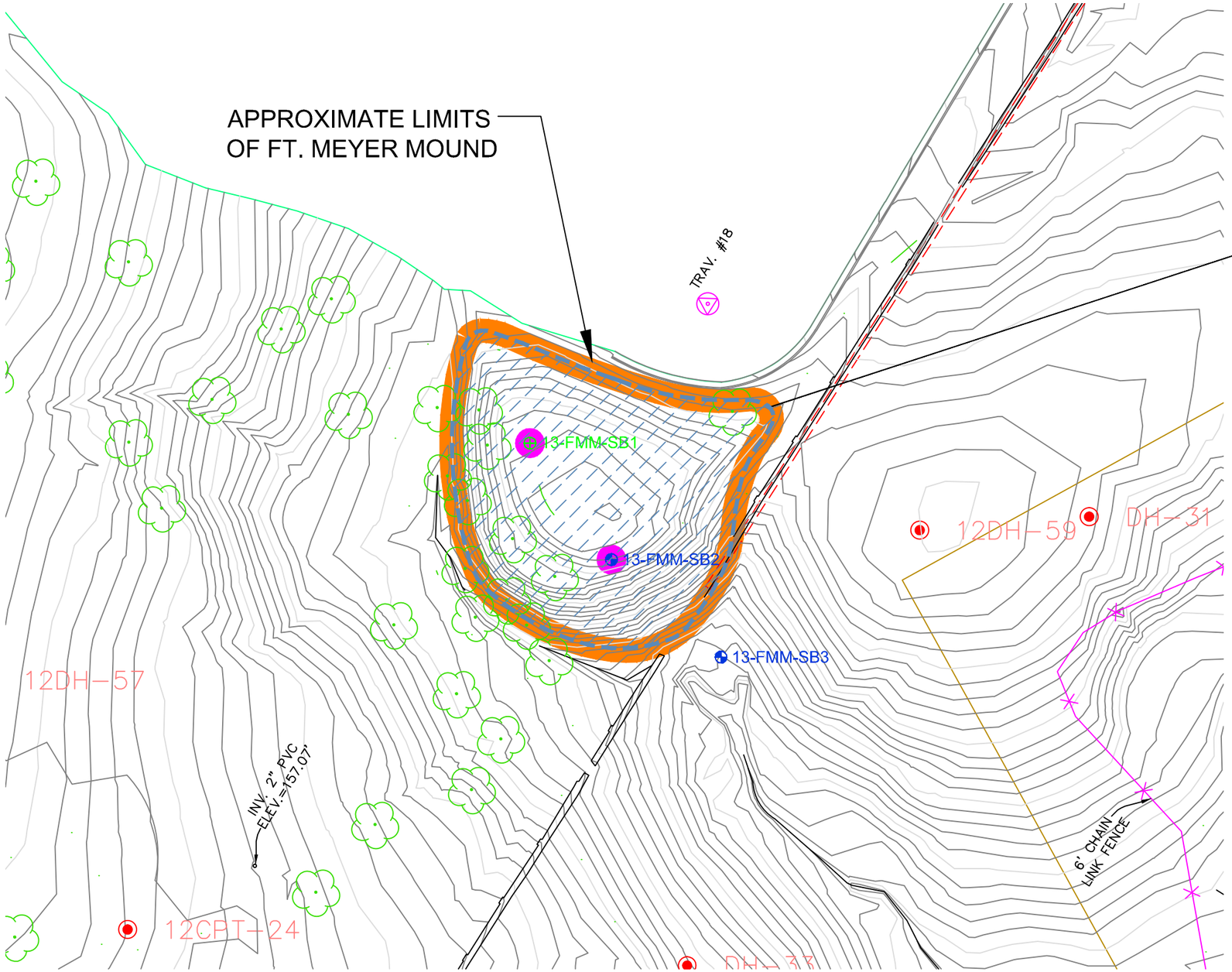
OLD WAREHOUSE AREA (EXISTING CONDITIONS)

DESIGNED BRUZZESI	DATE 04/14/13
DRAWN STOCKTON	DATE 04/14/13

A-ZONE ENVIRONMENTAL SERVICES
2181 BERRYVILLE PIKE
CHARLES TOWN, WV 25414

ARLINGTON NATIONAL CEMETERY
MILLENNIUM PROJECT
ARLINGTON, VA

PROJECT NO. 91236.003	SCALE: AS SHOWN
DRAWING NO.	FIGURE 9



N

ALL FILL COMPRISING MOUND IS PROPOSED FOR EXCAVATION, REMOVAL, AND OFF SITE DISPOSAL/TREATMENT BECAUSE OF PRESENCE OF DEBRIS AND/OR TARGET CONSTITUENTS ABOVE REGULATORY SCREENING VALUES

LEGEND

- ⊕ 2012 & 2013 ENVIRONMENTAL SOIL TEST BORING
- ⊕ 2012 & 2013 ENVIRONMENTAL SOIL AND GROUNDWATER TEST BORING
- ◉ GEOTECHNICAL TEST BORING
- ● DESIGNATES LOCATIONS WHERE TARGET CONSTITUENTS WERE DETECTED ABOVE REGULATORY SCREENING LEVELS

0 20 40 80
SCALE IN FEET

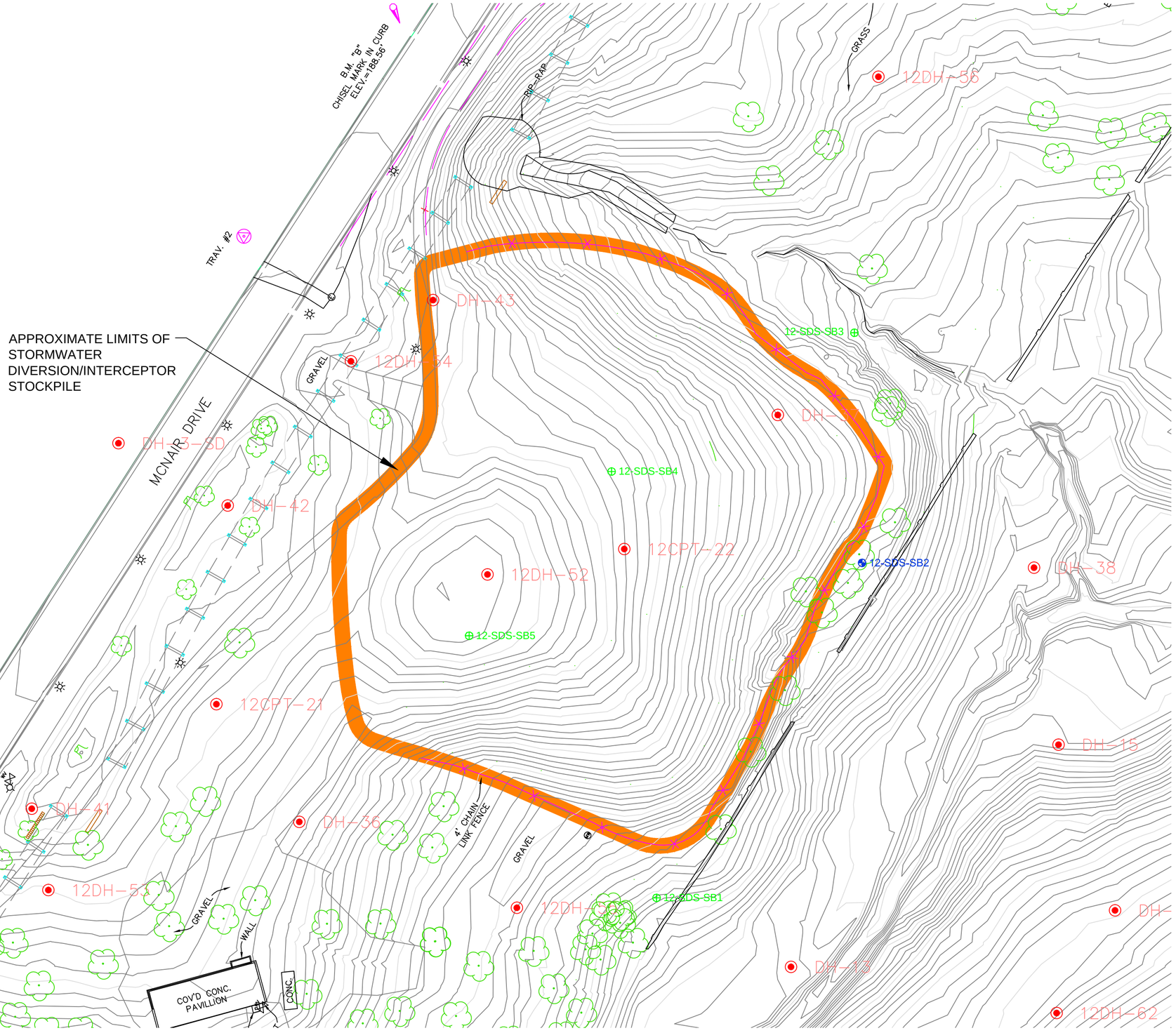
FT. MYER MOUND (EXISTING CONDITIONS)

DESIGNED BRUZZESI	DATE 04/14/13
DRAWN STOCKTON	DATE 04/14/13

A-ZONE ENVIRONMENTAL SERVICES
2181 BERRYVILLE PIKE
CHARLES TOWN, WV 25414

ARLINGTON NATIONAL CEMETERY
MILLENNIUM PROJECT
ARLINGTON, VA

PROJECT NO. 91236.003	SCALE: AS SHOWN
DRAWING NO.	FIGURE 10



N

LEGEND

- 2012 & 2013 ENVIRONMENTAL SOIL TEST BORING
- 2012 & 2013 ENVIRONMENTAL SOIL AND GROUNDWATER TEST BORING
- GEOTECHNICAL TEST BORING

0 20 40 80

SCALE IN FEET

STORMWATER DIVERSION/INTERCEPTOR STOCKPILE (EXISTING CONDITIONS)

DESIGNED BRUZZESI	DATE 02/26/13
DRAWN STOCKTON	DATE 02/26/13

ARLINGTON NATIONAL CEMETERY
MILLENNIUM PROJECT
ARLINGTON, VA

A-ZONE ENVIRONMENTAL SERVICES
2181 BERRYVILLE PIKE
CHARLES TOWN, WV 25414

PROJECT NO. 91236.003	SCALE: AS SHOWN
DRAWING NO.	FIGURE 11

APPROXIMATE LIMITS OF SALVAGE METAL YARD

LOCATION WHERE EXCAVATION, REMOVAL, AND OFF-SITE DISPOSAL/TREATMENT OF TPH-IMPACTED SOIL IS PROPOSED. EXCAVATION OF 2 TO 6 FEET OF SOIL IS ANTICIPATED.

APPROXIMATE LIMITS OF AREA EAST OF THE SALVAGE METAL YARD

PROPOSED PERIMETER COLUMBARIUMS

LOCATION WHERE EXCAVATION, REMOVAL, AND OFF-SITE DISPOSAL/TREATMENT OF SVOC-IMPACTED SOIL IS PROPOSED. EXCAVATION OF 3 FEET OF SOIL IS ANTICIPATED.

PROPOSED CASKET BURIAL

LOCATION WHERE EXCAVATION, REMOVAL, AND OFF-SITE DISPOSAL/TREATMENT OF SVOC-IMPACTED SOIL IS PROPOSED. EXCAVATION OF 2 TO 5 FEET OF SOIL IS ANTICIPATED.

PROPOSED PERIMETER COLUMBARIUMS

PROPOSED COLUMBARIUMS

PROPOSED COMMITTAL SERVICE SHELTER

PROPOSED CASKET BURIAL

PROPOSED LANDSCAPING

PROPOSED ROAD

PROPOSED LANDSCAPING

APPROXIMATE LIMITS OF OLD WAREHOUSE AREA

LOCATION WHERE EXCAVATION, REMOVAL, AND OFF-SITE DISPOSAL/TREATMENT OF TPH-IMPACTED SOIL AND INSITU TREATMENT OF IMPACTED GROUNDWATER IS PROPOSED. EXCAVATION OF 4 TO 5 FEET OF SOIL IS ANTICIPATED.

LEGEND

- 2012 & 2013 ENVIRONMENTAL SOIL TEST BORING
- 2012 & 2013 ENVIRONMENTAL SOIL AND GROUNDWATER TEST BORING
- 2009 ENVIRONMENTAL GROUNDWATER SAMPLING LOCATION
- GEOTECHNICAL TEST BORING
- DESIGNATES LOCATIONS WHERE TARGET CONSTITUENTS WERE DETECTED ABOVE REGULATORY SCREENING LEVELS AND BACKGROUND IN SOIL

0 20 40 80
SCALE IN FEET

LIMITS OF IMPACTED SOIL PROPOSED FOR REMOVAL IN RELATION TO DEVELOPMENT

DESIGNED BRUZZESI	DATE 04/14/13
DRAWN STOCKTON	DATE 04/14/13

A-ZONE ENVIRONMENTAL SERVICES
2181 BERRYVILLE PIKE
CHARLES TOWN, WV 25414

ARLINGTON NATIONAL CEMETERY
MILLENNIUM PROJECT
ARLINGTON, VA

PROJECT NO. 91236.003	SCALE: AS SHOWN
DRAWING NO.	FIGURE 12

PROPOSED PERIMETER COLUMBARIUMS

APPROXIMATE LIMITS OF FT. MEYER MOUND

TRAV. #18

13-FMM-SB1

13-FMM-SB2

13-FMM-SB3

12DH-57

12CPT-24

INV. 2" PVC ELEV.=157.07'

6' CHAIN LINK FENCE

ALL FILL COMPRISING MOUND IS PROPOSED FOR EXCAVATION, REMOVAL, AND OFF SITE DISPOSAL/TREATMENT BECAUSE OF PRESENCE OF DEBRIS AND/OR TARGET CONSTITUENTS ABOVE REGULATORY SCREENING VALUES

PROPOSED COLUMBARIUMS

LEGEND

- 2012 & 2013 ENVIRONMENTAL SOIL TEST BORING
- 2012 & 2013 ENVIRONMENTAL SOIL AND GROUNDWATER TEST BORING
- GEOTECHNICAL TEST BORING
- DESIGNATES LOCATIONS WHERE TARGET CONSTITUENTS WERE DETECTED ABOVE REGULATORY SCREENING LEVELS

0 20 40 80

SCALE IN FEET

LIMITS OF DEBRIS AND IMPACTED SOIL PROPOSED FOR REMOVAL IN RELATION TO DEVELOPMENT OF FMM

DESIGNED BRUZZESI	DATE 04/14/13
DRAWN STOCKTON	DATE 04/14/13

A-ZONE ENVIRONMENTAL SERVICES
2181 BERRYVILLE PIKE
CHARLES TOWN, WV 25414

ARLINGTON NATIONAL CEMETERY
MILLENNIUM PROJECT
ARLINGTON, VA

PROJECT NO. 91236.003	SCALE: AS SHOWN
DRAWING NO.	FIGURE 13

APPROXIMATE LIMITS OF SALVAGE METAL YARD

APPROXIMATE LIMITS OF AREA EAST OF THE SALVAGE METAL YARD

PROPOSED PERIMETER COLUMBARIUMS

PROPOSED CASKET BURIAL

PROPOSED PERIMETER COLUMBARIUMS

PROPOSED COLUMBARIUMS

PROPOSED COMMITTAL SERVICE SHELTER

PROPOSED CASKET BURIAL

PROPOSED ROAD

PROPOSED LANDSCAPING

PROPOSED LANDSCAPING

LOCATION WHERE VOCs AND TOTAL METALS WERE DETECTED ABOVE REGULATORY SCREENING LEVELS IN GROUNDWATER. IN SITU TREATMENT OF GROUNDWATER IS PROPOSED IN THIS AREA FOLLOWING EXCAVATION AND REMOVAL OF IMPACTED SOIL.

AREA WHERE VOCs, SVOCs, AND TOTAL METALS WERE DETECTED ABOVE REGULATORY SCREENING LEVELS IN GROUNDWATER. IN SITU TREATMENT OF GROUNDWATER IS PROPOSED IN THIS AREA FOLLOWING EXCAVATION AND REMOVAL OF IMPACTED SOIL.

APPROXIMATE LIMITS OF OLD WAREHOUSE AREA

LEGEND

- ⊕ 2012 & 2013 ENVIRONMENTAL SOIL TEST BORING
- ◒ 2012 & 2013 ENVIRONMENTAL SOIL AND GROUNDWATER TEST BORING
- ⊕ 2009 ENVIRONMENTAL SOIL SAMPLING LOCATION
- ⧋ 2009 ENVIRONMENTAL GROUNDWATER SAMPLING LOCATION
- ◉ GEOTECHNICAL TEST BORING
- 104.58 GROUNDWATER ELEVATION IN FEET
- GROUNDWATER CONTOUR LINE
- ● DESIGNATES LOCATIONS WHERE TARGET CONSTITUENTS WERE DETECTED ABOVE REGULATORY SCREENING LEVELS IN GROUNDWATER

0 20 40 80
SCALE IN FEET

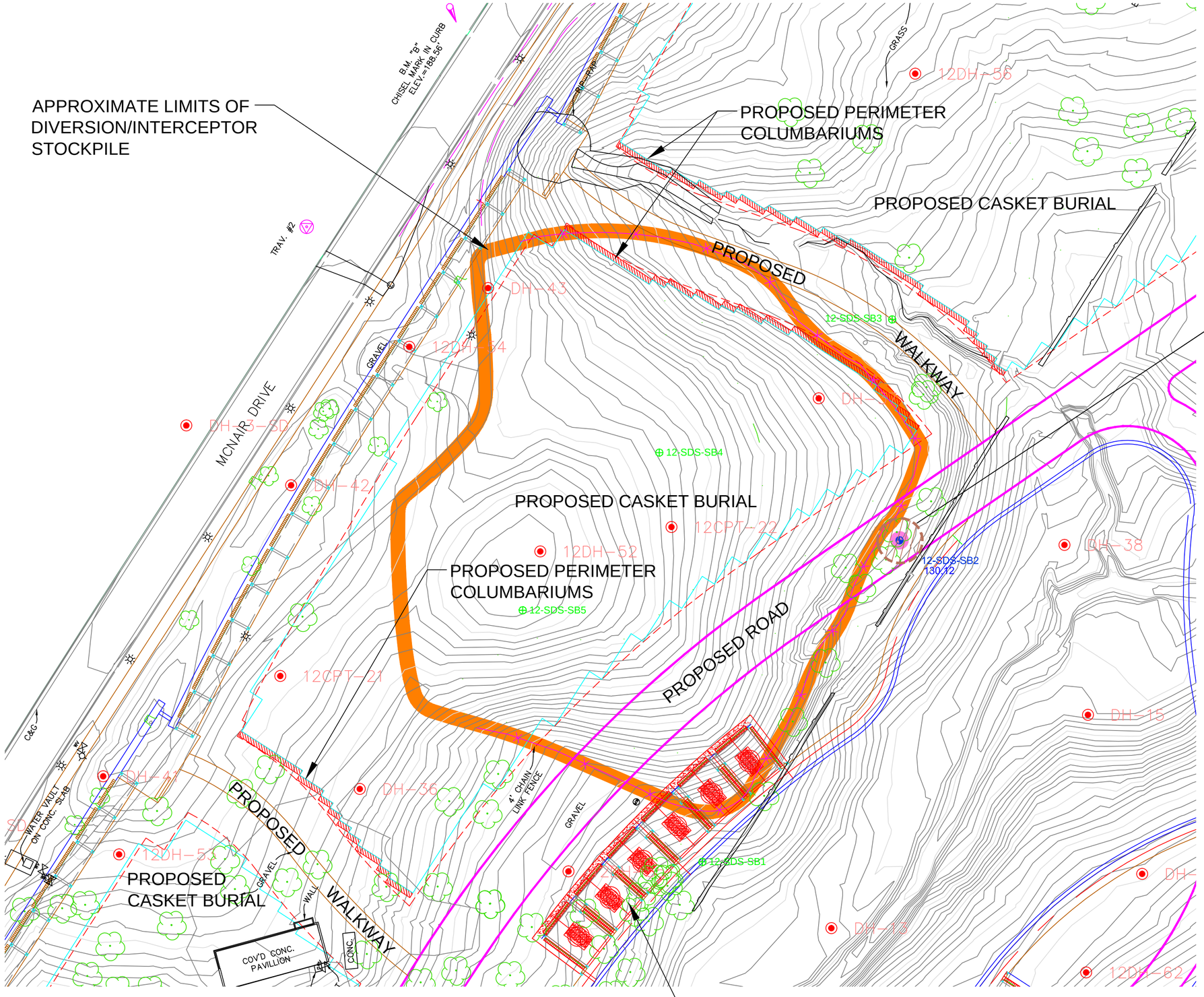
APPROXIMATE LIMITS OF AND PROPOSED AREA FOR IN SITU TREATMENT OF IMPACTED GROUNDWATER IN RELATIONSHIP TO DEVELOPMENT

DESIGNED	BRUZZESI	DATE	04/14/13
DRAWN	STOCKTON	DATE	04/14/13

A-ZONE ENVIRONMENTAL SERVICES
2181 BERRYVILLE PIKE
CHARLES TOWN, WV 25414

ARLINGTON NATIONAL CEMETERY
MILLENNIUM PROJECT
ARLINGTON, VA

PROJECT NO. 91236.003	SCALE: AS SHOWN
DRAWING NO.	FIGURE 14



DESIGNATES LOCATION WHERE VOCs WERE DETECTED ABOVE REGULATORY SCREENING LEVELS IN GROUNDWATER. EXTENT OF IMPACTS UNKNOWN.

LEGEND

- 2012 & 2013 ENVIRONMENTAL SOIL TEST BORING
- 2012 & 2013 ENVIRONMENTAL SOIL AND GROUNDWATER TEST BORING
- GEOTECHNICAL TEST BORING
- 104.58 GROUNDWATER ELEVATION IN FEET
- DESIGNATES LOCATIONS WHERE TARGET CONSTITUENTS WERE DETECTED ABOVE REGULATORY SCREENING LEVELS IN GROUNDWATER

0 20 40 80
SCALE IN FEET

LIMITS OF IMPACTED GROUNDWATER IN RELATION TO PROPOSED DEVELOPMENT OF SDS

DESIGNED BRUZZESI	DATE 02/26/13	ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT ARLINGTON, VA
DRAWN STOCKTON	DATE 02/26/13	
PROJECT NO. 91236.003	SCALE: AS SHOWN	
DRAWNG NO.	FIGURE 15	

A-ZONE ENVIRONMENTAL SERVICES
2181 BERRYVILLE PIKE
CHARLES TOWN, WV 25414

TABLES

TABLE 1. OLD WAREHOUSE AREA (OWA) STORAGE TANK SUMMARY

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Tank ID	Date Installed	Year Removed	Age of Tank (years)	Type of Tank	Construction	Capacity (gallons)	Type of Fuel Stored	Documented Release	VDEQ Case No.	Actions/Status
Tank 4	UKN	1993	UKN	UST	steel	2000	gasoline	No	90-0437/92-1775	Unknown whether or not impacts to soil were noted during tank removal. Soil sampling results did not indicate significant impact to soil underlying the tank. Part of site characterization study conducted in 1993 that assessed groundwater and follow-up groundwater sampling program. Case closed by VDEQ in 1997 based on limited risk. Impacted soil and groundwater left in place.
Tank 5	UKN	1993	UKN	UST	steel	2000	gasoline	No	90-0437/92-1775	Petroleum-impacted soil and petroleum free product floating on groundwater noted during tank removal. Part of site characterization study conducted in 1993 that assessed groundwater and follow-up groundwater sampling program. Case closed by VDEQ in 1997 based on limited risk. Impacted soil and groundwater left in place.
Tank 6	UKN	1993	UKN	UST	steel	2000	gasoline	Yes	90-0437/92-1775	Petroleum-impacted soil and petroleum free product floating on groundwater noted during tank removal. Part of site characterization study conducted in 1993 that assessed groundwater and follow-up groundwater sampling program. Case closed by VDEQ in 1997 based on limited risk. Impacted soil and groundwater left in place.
Tank 7	UKN	1996	UKN	UST	steel	750	diesel fuel	UKN	No	UKN
Tank 8	UKN	1996	UKN	AST	steel	250	heating oil	UKN	No	UKN
Tank 9	UKN	1993	UKN	AST	steel	1000	heating oil	No	No	None.

TABLE 1. OLD WAREHOUSE AREA (OWA) STORAGE TANK SUMMARY

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Tank ID	Date Installed	Year Removed	Age of Tank (years)	Type of Tank	Construction	Capacity (gallons)	Type of Fuel Stored	Documented Release	VDEQ Case No.	Actions/Status
Tank 10	UKN	1993	UKN	UST	steel	2000	heating oil	Yes	90-0437/92-1775	Petroleum-impacted soil and petroleum free product floating on groundwater noted during tank removal. Approximately 60 tons of impacted soil was excavated and removed. Part of site characterization study conducted in 1993 that assessed groundwater and follow-up groundwater sampling program. Case closed by VDEQ in 1997 based on limited risk. Impacted soil and groundwater left in place.
Tank 16	UKN	1993	UKN	UST	steel	1500	diesel fuel	Yes	90-0437/92-1775	Petroleum-impacted soil and petroleum free product floating on groundwater noted during tank removal. Approximately 60 tons of impacted soil was excavated and removed. Part of site characterization study conducted in 1993 that assessed groundwater and follow-up groundwater sampling program. Case closed by VDEQ in 1997 based on limited risk. Impacted soil and groundwater left in place.
Tank 17	UKN	1993	UKN	UST	steel	1000	diesel fuel	Yes	90-0437/92-1775	Petroleum-impacted soil noted during tank removal. Part of site characterization study conducted in 1993 that assessed groundwater and follow-up groundwater sampling program. Case closed by VDEQ in 1997 based on limited risk. Impacted soil and groundwater left in place.
Tank 19	UKN	1996	UKN	AST	steel	1000	used oil	UKN	No	UKN

NOTES:
UKN = unknown
VDEQ = Commonwelath of Virginia Department of Environmental Quality

TABLE 2. ENVIRONMENTAL TEST BORING SUMMARY

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Area of Concern	Test Boring ID	Date Advanced	Northing	Easting	Ground Elevation	Total Boring Depth (feet BSG)	Staining Observed (feet BGS)	Odors Noted (feet BGS)	PID Reading Range (in PPM)	Laboratory Soil Sample Depths and Analyses (feet BSG)		Laboratory Groundwater Sample and Analyses	
										Depth	Analyses	Sample	Analyses
SMY	ANC-SS-05	7/20/2009	7008393.38363	11888702.09020	125.00*	0.5	NA	NA	NA	0.0 - 0.5	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, PCBs, Pesticides, TAL Metals	No	No
	ANC-SS-10	7/20/2009	7008497.59438	11888734.55300	122.00*	0.5	NA	NA	NA	0.0 - 0.5	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, PCBs, Pesticides, TAL Metals	No	No
	12-SMY-SB1	10/23/2012	7008510.267	11888744.872	121.80	10	No	3 - 7 (organic)	0.1 - 0.2	6 - 7	TPH-DRO, **TPH-GRO**, TCL VOCs, **TCL SVOCs**	No	No
	12-SMY-SB2	10/23/2012	7008480.618	11888746.000	122.13	10	No	No	0.0 - 0.4	4 - 5	TPH-DRO, **TPH-GRO**, TCL VOCs, **TCL SVOCs**	No	No
	12-SMY-SB3	10/23/2012	7008497.682	11888711.201	122.78	10	No	No	0.0 - 0.9	4 - 5	TPH-DRO, **TPH-GRO**, TCL VOCs, **TCL SVOCs**	No	No
	12-SMY-SB4	10/23/2012	7008401.342	11888626.293	128.33	10	No	No	0.1 - 0.5	0.5 - 1.5	TPH-DRO, **TPH-GRO**, TAL Metals	No	No
	12-SMY-SB5	10/23/2012	7008331.269	11888656.449	127.36	10	No	No	0.1 - 0.2	1 - 2	TPH-DRO, **TPH-GRO**, TAL Metals, Cr Spec.	No	No
	12-SMY-SB6	10/23/2012	7008365.140	11888685.389	125.80	15	No	No	0.1 - 0.1	1 - 2	TPH-DRO, **TPH-GRO**, TCL VOCs, **TCL SVOCs**, TAL Metals	Yes	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, Total and Dissolved TAL Metals
										7 - 7.5	TCL VOCs		
	13-SMY-SB7	2/12/2013	7008489.4647*	11888739.437*	122.00*	18	No	No	0.0 - 0.1	No	No	Yes	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs

TABLE 2. ENVIRONMENTAL TEST BORING SUMMARY

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Area of Concern	Test Boring ID	Date Advanced	Northing	Easting	Ground Elevation	Total Boring Depth (feet BSG)	Staining Observed (feet BGS)	Odors Noted (feet BGS)	PID Reading Range (in PPM)	Laboratory Soil Sample Depths and Analyses (feet BSG)		Laboratory Groundwater Sample and Analyses	
										Depth	Analyses	Sample	Analyses
ESMY	ANC-SS-40	7/20/2009	7008488.99498	11888775.47750	121.00*	0.5	NA	NA	NA	0.0 - 0.5	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, PCBs, Pesticides, TAL Metals	No	No
	12-ESMY-SB1	10/23/2012	7008411.521	11888911.983	109.53	15	No	No	0.0 - 0.1	1 - 2	TPH-DRO, **TPH-GRO**, TCL VOCs, **TCL SVOCs**, TAL Metals, Cr Spec.	Yes	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs Total and Dissolved TAL Metals
										3 - 4	TCL SVOCs		
	12-ESMY-SB2	11/29/2012	7008464.650*	11888876.470*	112.00*	5	No	No	0.0 - 0.0	1 - 2	TCL SVOCs	No	No
										3 - 4	TCL SVOCs		
	12-ESMY-SB3	11/29/2012	7008395.280*	11888869.760*	114.00*	5	No	No	0.0 - 0.0	1 - 2	TCL SVOCs	No	No
										3 - 4	TCL SVOCs		
	12-ESMY-SB4	11/29/2012	7008356.570*	11888932.180*	109.00*	5	No	No	0.0 - 0.0	1 - 2	TCL SVOCs	No	No
										3 - 4	TCL SVOCs		
OWA	ANC-SS-13	7/20/2009	70082005.75408	11888741.00940	118.00*	0.5	NA	NA	NA	0.0 - 0.5	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, PCBs, Pesticides, TAL Metals	No	No
	ANC-SS-15	7/20/2009	7008278.99901	11888885.02150	111.00*	0.5	NA	NA	NA	0.0 - 0.5	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, PCBs, Pesticides, TAL Metals	No	No
	ANC-SS-18	7/20/2009	7008125.12563	11888790.16280	110.00*	0.5	NA	NA	NA	0.0 - 0.5	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, PCBs, Pesticides, TAL Metals	No	No

TABLE 2. ENVIRONMENTAL TEST BORING SUMMARY

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Area of Concern	Test Boring ID	Date Advanced	Northing	Easting	Ground Elevation	Total Boring Depth (feet BSG)	Staining Observed (feet BGS)	Odors Noted (feet BGS)	PID Reading Range (in PPM)	Laboratory Soil Sample Depths and Analyses (feet BSG)		Laboratory Groundwater Sample and Analyses	
										Depth	Analyses	Sample	Analyses
	ANC-SS-32	7/20/2009	7008114.23786	11889020.34670	97.00*	0.5	NA	NA	NA	0.0 - 0.5	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, PCBs, Pesticides, TAL Metals	No	No
	ANC-SS-42	7/20/2009	7008035.22588	11888942.75630	99.00*	0.5	NA	NA	NA	0.0 - 0.5	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, PCBs, Pesticides, TAL Metals	No	No
	ANC-SS-43	7/20/2009	7007982.06260	11888817.18540	106.00*	0.5	NA	NA	NA	0.0 - 0.5	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, PCBs, Pesticides, TAL Metals	No	No
	ANC-SS-44	7/20/2009	7007952.65419	11888673.68990	106.00*	0.5	NA	NA	NA	0.0 - 0.5	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, PCBs, Pesticides, TAL Metals	No	No
	ANC-SS-45	7/22/2009	7007952.25295	11888595.59270	116.00*	0.5	NA	NA	NA	0.0 - 0.5	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, PCBs, Pesticides, TAL Metals	No	No
	ANC-GW-01	8/3/2009	7008114.23786	11889020.34670	97.00*	11	NA	NA	NA	No	No	Yes	TPH-DRO, TPH-GRO
	ANC-GW-02	8/3/2009	7007982.06260	11888817.18540	106.00*	12	NA	NA	NA	No	No	Yes	TPH-DRO, TPH-GRO
	ANC-GW-03	8/3/2009	7008204.15927	11888901.29940	105.00*	9	NA	NA	NA	No	No	Yes	TPH-DRO, TPH-GRO

TABLE 2. ENVIRONMENTAL TEST BORING SUMMARY

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Area of Concern	Test Boring ID	Date Advanced	Northing	Easting	Ground Elevation	Total Boring Depth (feet BSG)	Staining Observed (feet BGS)	Odors Noted (feet BGS)	PID Reading Range (in PPM)	Laboratory Soil Sample Depths and Analyses (feet BSG)		Laboratory Groundwater Sample and Analyses	
										Depth	Analyses	Sample	Analyses
	12-OWA-SB1	10/23/2012	7008222.788	11888766.901	117.15	15	No	No	0.0 - 0.1	3 - 4	TPH-DRO, **TPH-GRO**, TCL VOCs, **TCL SVOCs**	Yes	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, Pesticides, Herbicides, Total and Dissolved TAL Metals
	12-OWA-SB2	10/23/2012	7008274.143	11888882.706	111.08	10	No	No	0.1 - 0.4	3 - 4	TPH-DRO, **TPH-GRO**, TCL VOCs, **TCL SVOCs**	No	No
										6 - 7	TCL SVOCs		
	12-OWA-SB3	10/23/2012	7008212.214	11888858.019	106.98	10	No	No	0.6 - 0.8	3 - 4	TPH-DRO, **TPH-GRO**, TCL VOCs	Yes	TPH-DRO, **TPH-GRO**, TCL VOCs, TCL SVOCs, Pesticides, Total and Dissolved TAL Metals
	12-OWA-SB4	10/23/2012	7008112.362	11888895.707	104.50	15	2 - 8 (black and gray)	2 - 10 (gasoline)	2.4 - 687	4.5 - 5.5	TPH-DRO, **TPH-GRO**, TCL VOCs, **TCL SVOCs**	Yes	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, Total and Dissolved TAL Metals
	12-OWA-SB5	10/24/2012	7008133.683	11888939.209	102.29	10	No	2 - 8 (gasoline)	1.5 - 130	4 - 5	TPH-DRO, TPH-GRO, **TCL VOCs**	No	No
	12-OWA-SB6	10/24/2012	7008150.142	11888975.188	125.80	10	No	No	0.4 - 1.5	2 - 3	TPH-DRO, TPH-GRO, **TCL VOCs**	Yes	TPH-DRO, **TPH-GRO**, TCL VOCs, TCL SVOCs
	12-OWA-SB7	10/24/2012	7008053.727	11888958.941	98.65	12	8.5 - 10 (black and gray)	7.5 - 10 (gasoline)	0.0 - 0.1	0.25 - 1.25	TAL Metals	Yes	TPH-DRO, **TPH-GRO**, TCL VOCs, TCL SVOCs, Total and Dissolved TAL Metals
										2.5 - 3.5	TPH-DRO, TPH-GRO, **TCL VOCs**		

TABLE 2. ENVIRONMENTAL TEST BORING SUMMARY

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Area of Concern	Test Boring ID	Date Advanced	Northing	Easting	Ground Elevation	Total Boring Depth (feet BSG)	Staining Observed (feet BGS)	Odors Noted (feet BGS)	PID Reading Range (in PPM)	Laboratory Soil Sample Depths and Analyses (feet BSG)		Laboratory Groundwater Sample and Analyses	
										Depth	Analyses	Sample	Analyses
	12-OWA-SB8	10/24/2012	7008096.475	11888860.469	98.99	10	No	No	0.1 - 0.1	1 - 2	TCL-SVOCs, TAL Metals, Pesticides	No	No
										6 - 7	TPH-DRO, TPH-GRO, **TCL VOCs**		
	12-OWA-SB9	10/24/2012	7008075.549	11888820.175	107.83	10	No	No	0.3 - 0.4	0.5 - 1.5	TPH-DRO, TPH-GRO, TCL SVOCs, Pesticides	No	No
	12-OWA-SB10	10/24/2012	7008105.912	11888763.497	111.54	15	No	No	0.1 - 0.6	0.75 - 1.75	TPH-DRO, TPH-GRO, **TCL VOCs**, TCL SVOCs, PCBs, Pesticides, Cr Spec.	Yes	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, Pesticides, Total and Dissolved TAL Metals
										5 - 6	TPH-DRO, TPH-GRO, **TCL VOCs**, TCL SVOCs, PCBs, Pesticides		
	12-OWA-SB11	10/24/2012	7008144.777	11888850.160	107.17	15	No	4 - 9.5 (chemical)	0.6 - 94.6	1 - 2	TAL Metals	Yes	TPH-DRO, **TPH-GRO**, TCL VOCs, TCL SVOCs, Pesticides, Herbicides, Total and Dissolved TAL Metals
										4 - 5	TPH-DRO, TPH-GRO, **TCL VOCs**, TCL SVOCs, PCBs, Pesticides, Herbicides		
	12-OWA-SB12	10/24/2012	7008178.844	11888928.181	103.67	10	No	No	0.0 - 0.0	1 - 2	TPH-DRO, TPH-GRO, **TCL VOCs**, TCL SVOCs, TAL Metals, PCBs, Pesticides, Herbicides	No	No
	12-OWA-SB13	10/24/2012	7008011.674	11888726.358	111.33	10	No	No	0.4 - 1.9	1 - 2	TPH-DRO, TPH-GRO, **TCL VOCs**, TCL SVOCs, TAL Metals, Pesticides, Herbicides	No	No

TABLE 2. ENVIRONMENTAL TEST BORING SUMMARY

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Area of Concern	Test Boring ID	Date Advanced	Northing	Easting	Ground Elevation	Total Boring Depth (feet BSG)	Staining Observed (feet BGS)	Odors Noted (feet BGS)	PID Reading Range (in PPM)	Laboratory Soil Sample Depths and Analyses (feet BSG)		Laboratory Groundwater Sample and Analyses	
										Depth	Analyses	Sample	Analyses
	12-OWA-SB14	10/25/2012	NS	NS	NS	1.33	No	No	1.2 - 2.6	0.33 - 1.33	TCL VOCs, TAL Metals, Pesticides, **Herbicides**	No	No
	12-OWA-SB15	10/25/2012	NS	NS	NS	1.38	No	No	2.5 - 2.9	0.38 - 1.38	TCL VOCs, TAL Metals, Pesticides, **Herbicides**, Cr Spec.	No	No
	12-OWA-SB16	10/25/2012	NS	NS	NS	1.63	No	No	2.3 - 2.5	0.63 - 1.63	TCL VOCs, TAL Metals, Pesticides, **Herbicides**	No	No
	12-OWA-SB17	10/25/2012	NS	NS	NS	1.38	No	No	2.8 - 4.1	0.38 - 1.38	TCL VOCs, TAL Metals, Pesticides, **Herbicides**	No	No
	12-OWA-SB18	10/25/2012	NS	NS	NS	1.29	No	No	1.5 - 1.8	0.29 -1.29	TPH-DRO, TPH-GRO, TCL VOCs, TAL Metals, Pesticides, **Herbicides**	No	No
	12-OWA-SB19	11/29/2012	7008293.540*	11888925.190*	108.00*	5	No	No	0.0 - 0.0	1 - 2	TCL SVOCs	No	No
										3 - 4	TCL SVOCs		
	12-OWA-SB20	11/29/2012	7008254.850*	11888831.120*	108.00*	5	No	No	0.0 - 0.0	1 - 2	TCL SVOCs	No	No
										3 - 4	TCL SVOCs		
	13-OWA-SB21	2/14/2013	7008188.2377*	11888716.2574*	119.00*	3	No	No	0.0 - 0.0	2 - 3	TCL SVOCs	No	No
	13-OWA-SB22	2/14/2013	7008166.711*	11888755.5492*	117.00*	3	No	2 - 3 (petroleum)	0.0 - 3.2	2 - 3	TPH-DRO, TPH-GRO, TCL SVOCs	No	No
	13-OWA-SB23	2/14/2013	7008242.2698*	11888868.7461*	112.00*	3	No	No	0.0 - 0.0	2 - 3	TCL SVOCs	No	No
	13-FMM-SB1	2/14/2013	7008232.1261*	11888305.391*	157.00*	20	No	8 - 20 (organic)	0.0 - 3.3	4 - 5	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, TAL Metals	No	No
										12 - 13	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, PCBs, Pesticides, TAL Metals		

TABLE 2. ENVIRONMENTAL TEST BORING SUMMARY

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Area of Concern	Test Boring ID	Date Advanced	Northing	Easting	Ground Elevation	Total Boring Depth (feet BSG)	Staining Observed (feet BGS)	Odors Noted (feet BGS)	PID Reading Range (in PPM)	Laboratory Soil Sample Depths and Analyses (feet BSG)		Laboratory Groundwater Sample and Analyses	
										Depth	Analyses	Sample	Analyses
	13-FMM-SB2	2/14/2013	7008192.4289*	11888333.1646*	157.00*	27.5	No	8 - 24.5 (organic) 24.5 - 27.5 (sweet odor)	0.2 - 1.3	1 - 2	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, TAL Metals	No	No
										16 - 17	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, TAL Metals		
										24.5 - 25	TCL VOCs		
	13-FMM-SB3	2/14/2013	7008159.1631*	11888370.5437*	132.00*	15	No	No	0.0 - 0.0	0.5 - 1.5	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, TAL Metals	Yes	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, PCBs, Pesticides, Total and Dissolved TAL Metals
SDS	12-SDS-SB1	11/16/2012	7007514.700*	11887926.690*	149.00*	20	No	No	0.0 - 0.0	0.5 - 1.5	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, TAL Metals	No	No
	12-SDS-SB2	11/16/2012	7007692.570*	11888035.770*	153.00*	30	No	No	0.0 - 0.0	0.5 - 1.5	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, TAL Metals	Yes	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, Total and Dissolved TAL Metals
	12-SDS-SB3	11/16/2012	7007814.750*	11888031.730*	146.00*	5	No	4.5 - 5 (mulch)	0.0 - 0.0	0.5 - 1.5	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, TAL Metals, Cr Spec.	No	No

TABLE 2. ENVIRONMENTAL TEST BORING SUMMARY

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Area of Concern	Test Boring ID	Date Advanced	Northing	Easting	Ground Elevation	Total Boring Depth (feet BSG)	Staining Observed (feet BGS)	Odors Noted (feet BGS)	PID Reading Range (in PPM)	Laboratory Soil Sample Depths and Analyses (feet BSG)		Laboratory Groundwater Sample and Analyses	
										Depth	Analyses	Sample	Analyses
	12-SDS-SB4	11/16/2012	7007741.080*	11887902.830*	178.00*	20	No	6 - 8 (organic) 17.5 - 20 (mulch)	0.0 - 0.9	6 - 7	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, TAL Metals	No	No
										17.5 - 18.5	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, TAL Metals		
	12-SDS-SB5	11/16/2012	7007653.850*	11887827.220*	187.00*	20	No	No	0.0 - 0.2	0.5 - 1.5	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, TAL Metals	No	No
										8 - 9	TPH-DRO, TPH-GRO, TCL VOCs, TCL SVOCs, TAL Metals		
BACKGROUND	ANC-BG-01	7/20/2009	7008697.43518	11888855.47210	125.00*	0.5	NA	NA	NA	0.0 - 0.5	TAL Metals	No	No
	ANC-BG-02	7/20/2009	7008730.94398	11888789.80450	131.00*	0.5	NA	NA	NA	0.0 - 0.5	TAL Metals	No	No
	ANC-BG-03	7/20/2009	7008679.86567	11888752.47490	131.00*	0.5	NA	NA	NA	0.0 - 0.5	TAL Metals	No	No
	ANC-BG-04	7/20/2009	7007125.88387	11887866.90150	173.00*	0.5	NA	NA	NA	0.0 - 0.5	TAL Metals	No	No
	ANC-BG-05	7/20/2009	7007254.13886	11887942.30720	163.00*	0.5	NA	NA	NA	0.0 - 0.5	TAL Metals	No	No
	ANC-BG-06	7/20/2009	7007375.68717	11888009.38250	157.00*	0.5	NA	NA	NA	0.0 - 0.5	TAL Metals	No	No

NOTES:
* designates location was not surveyed, coordinates and elevation are estimated
All other survey data obtained from Rice Associates
Horizontal datum is based upon The Virginia Coordinate System of 1983, North Zone (grid)
Vertical datum is based upon The North American Datum of 1988 (NAVD88)
SMY = Salvage Metal Yard
ESMY = East Salvage Metal Yard
OWA = Old Warehouse Area
FMM = Fort Meyer Mound
SDS = Stormwater Diversion/Interceptor Stockpile
BACKGROUND = background sampling locations
BSG = below surface grade
PPM = parts per million
Yellow highlighting indicates evidence of impact observed or noted during advancement of test boring
Red highlighting indicates sample out of hold time for analysis, another sample was collected for analysis
NA = not applicable or not provided in historical reports

TABLE 3. SALVAGE METAL YARD (SMY) SOIL ANALYTICAL RESULTS (DETECTIONS ONLY)

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Field ID:	CAS No.	Units	VDEQ-T3SCR	EPA-RSL-IS	ANC-SS-05(0-0.5)	LQ	VQ	ANC-SS-10(0-0.5)	LQ	VQ	12-SMY-SB1(6-7)	LQ	VQ	12-SMY-SB1(6-7)R	LQ	VQ	12-SMY-SB2(4-5)	LQ	VQ	12-SMY-SB2(4-5)R	LQ	VQ	12-SMY-SB3(4-5)	LQ	VQ	12-SMY-SB3(4-5)R	LQ	VQ	12-SMY-SB4(0.5-1.5)	LQ	VQ	12-SMY-SB4(0.5-1.5)R	LQ	VQ	12-SMY-SB5(1-2)	LQ	VQ	12-SMY-SB5(1-2)R	LQ	VQ
Sampling Date:					7/20/2009			7/20/2009			10/23/2012			11/29/2012			10/23/2012			11/29/2012			10/23/2012			11/29/2012			10/23/2012			11/29/2012			10/23/2012			11/29/2012		
TPH SW846 8015C																																								
TPH-GRO (C6-C10)	None	mg/kg	**100***	**NE**	ND			**0.148**	J	L	ND		R	ND			ND		R	ND			ND		R	ND			ND			NA			ND			NA		
TPH-DRO (C10-C28)	None	mg/kg	**100***	**NE**	ND			**2200**			**12.1**	J		NA			**54.0**			NA			**239**			NA			**14.4**		J	**33.9**			**20.7**		J	**27.7**		
TCL VOCs SW846 8260B																																								
Acetone	67-64-1	ug/kg	**63000000**	**630000000**	ND			**9.37**	J	J	**57.3**		L	NA			**55.8**		L	NA			ND		R	NA			NA			NA			NA			NA		
2-Butanone (MEK)	78-93-3	ug/kg	**20000000**	**200000000**	ND			**4.21**	J	J	**4.0**	J	L	NA			**5.5**	J	L	NA			ND		R	NA			NA			NA			NA			NA		
Ethylbenzene	100-41-4	ug/kg	**27000**	**27000**	ND			ND			ND			NA			ND			NA			**1.0**	J	L	NA			NA			NA			NA			NA		
Isopropylbenzene	98-82-8	ug/kg	**1100000**	**11000000**	ND			ND			ND			NA			ND			NA			**0.49**	J	L	NA			NA			NA			NA			NA		
Methyl Tert Butyl Ether	1634-04-4	ug/kg	**220000**	**220000**	ND			ND			ND			NA			**0.57**	J		NA			ND		R	NA			NA			NA			NA			NA		
Methylene chloride	75-09-2	ug/kg	**960000**	**960000**	**1.3**	J	B	**8.1**	J	J	**10**		B	NA			**8.6**		B	NA			ND		R	NA			NA			NA			NA			NA		
Tetrachloroethene	127-18-4	ug/kg	**110000**	**110000**	ND			ND			ND			NA			ND			NA			**0.81**	J	L	NA			NA			NA			NA			NA		
Toluene	108-88-3	ug/kg	**4500000**	**45000000**	ND			ND			ND			NA			ND			NA			**1.7**		L	NA			NA			NA			NA			NA		
Trichloroethene	79-01-6	ug/kg	**6400**	**6400**	ND			ND			ND			NA			ND			NA			**0.39**	J	L	NA			NA			NA			NA			NA		
m,p-Xylene	108-38-3	ug/kg	**NA**	**2500000**	ND			ND			ND			NA			ND			NA			**2.0**		L	NA			NA			NA			NA			NA		
o-Xylene	95-47-6	ug/kg	**300000**	**3000000**	ND			ND			ND			NA			ND			NA			**0.74**	J	L	NA			NA			NA			NA			NA		
Xylene (total)	1330-20-7	ug/kg	**270000**	**2700000**	ND			**0.93**	J	J	ND			NA			ND			NA			**2.7**		L	NA			NA			NA			NA			NA		
TCL SVOCs SW846 8270D																																								
Benzo(a)anthracene	56-55-3	ug/kg	**2100**	**2100**	ND			ND			ND		UL	ND			ND		UL	ND			**83.0**		L	ND			NA			NA			NA			NA		
Benzo(a)pyrene	50-32-8	ug/kg	**210**	**210**	ND			ND			ND		UL	ND			ND		UL	ND			**69.8**		L	ND			NA			NA			NA			NA		
Benzo(b)fluoranthene	205-99-2	ug/kg	**2100**	**2100**	ND			ND			ND		UL	ND			ND		UL	ND			**78.9**		L	ND			NA			NA			NA			NA		
Benzo(g,h,i)perylene	191-24-2	ug/kg	**1700000**	**NE**	ND			ND			ND		UL	ND			ND		UL	ND			**47.9**	J	L	ND			NA			NA			NA			NA		
Benzo(k)fluoranthene	207-08-9	ug/kg	**21000**	**21000**	ND			ND			ND		UL	ND			ND		UL	ND			**54.1**		J	ND			NA			NA			NA			NA		
Chrysene	218-01-9	ug/kg	**210000**	**210000**	ND			ND			ND		UL	ND			ND		UL	ND			**91.6**		L	ND			NA			NA			NA			NA		
Fluoranthene	206-44-0	ug/kg	**2200000**	**22000000**	ND			ND			ND		UL	ND			ND		UL	ND			**157**		L	ND			NA			NA			NA			NA		
Fluorene	86-73-7	ug/kg	**2200000**	**22000000**	ND			ND			ND		UL	ND			ND		UL	ND			**51.5**		L	ND			NA			NA			NA			NA		
Indeno(1,2,3-cd)pyrene	193-39-5	ug/kg	**2100**	**2100**	ND			ND			ND		UL	ND			ND		UL	ND			**81.2**		L	ND			NA			NA			NA			NA		
Phenanthrene	85-01-8	ug/kg	**1700000**	**NE**	ND			ND			ND		UL	ND			ND		UL	ND			**92.9**		L	ND			NA			NA			NA			NA		
Pyrene	129-00-0	ug/kg	**1700000**	**17000000**	ND			ND			ND		UL	ND			ND		UL	**14.0**	J		**126**		L	ND			NA			NA			NA			NA		
TAL Metals SW846 6010B/7470A																																								
Aluminum	7429-90-5	mg/kg	**99000**	**990000**	**3050**			**4280**			NA			NA			NA			NA			NA			NA			**12700**			NA			**14300**			NA		
Arsenic	7440-38-2	mg/kg	**1.6**	**1.6**	**8.54**			**4.32**			NA			NA			NA			NA			NA			NA			**3.6**			NA			**2.7**			NA		
Barium	7440-39-3	mg/kg	**19000**	**190000**	**32.6**			**37.3**			NA			NA			NA			NA			NA			NA			**51.3**			NA			**70.4**			NA		
Beryllium	7440-41-7	mg/kg	**200**	**2000**	**0.11**	J	J	**0.328**	J	J	NA			NA			NA			NA			NA			NA			**0.70**			NA			**0.95**			NA		
Cadmium	7440-43-9	mg/kg	**80**	**800**	**0.286**	J	J	**0.547**			NA			NA			NA			NA			NA			NA			ND			NA			ND			NA		
Calcium	7789-78 -8	mg/kg	**NE**	**NE**	**9130**			**11200**			NA			NA			NA			NA			NA			NA			**935**			NA			ND			NA		
Chromium	7440-47-3	mg/kg	**5.6****	**5.6**/1500000*****	**16.1**			**18.3**			NA			NA			NA			NA			NA			NA			**17.0**			NA			**21.6**			NA		
Cobalt	7440-48-4	mg/kg	**30**	**300**	**4.46**			**5.16**			NA			NA			NA			NA			NA			NA			**8.1**			NA			**10.1**			NA		
Copper	7440-50-8	mg/kg	**4100**	**410000**	**11.3**			**13.9**			NA			NA			NA			NA			NA			NA			**9.4**			NA			**19.4**			NA		
Iron	7439-89-6	mg/kg	**72000**	**720000**	**6620**	B		**10800**	B		NA			NA			NA			NA			NA			NA			**17100**			NA			**17100**			NA		
Lead	7439-92-1	mg/kg	**800**	**800**	**6.48**			**15.4**			NA			NA			NA			NA			NA			NA			**9.5**			NA			**16.1**			NA		
Magnesium	7439-95-4	mg/kg	**NE**	**NE**	**3790**			**3310**			NA			NA			NA			NA			NA			NA			**956**			NA			**1210**			NA		
Manganese	7439-96-5	mg/kg	**2300**	**23000**	**129**			**179**			NA			NA			NA			NA			NA			NA			**68.7**			NA			**165**			NA		
Mercury	7439-97-6	mg/kg	**4.3**	**43**	ND			**0.02**	J	J	NA			NA			NA			NA			NA			NA			ND			NA			ND			NA		
Nickel	1313-99-1	mg/kg	**2000**	**20000**	**41.8**			**20.3**			NA			NA			NA			NA			NA			NA			**6.6**			NA			**9.4**			NA		
Potassium	7440-09-7	mg/kg	**NE**	**NE**	**358**			**681**			NA			NA			NA			NA			NA			NA			ND			NA			**1270**			NA		
Selenium	7782-49-2	mg/kg	**510**	**5100**	ND			**0.259**			NA			NA			NA			NA			NA			NA			ND			NA			ND			NA		
Sodium	7681-49-4	mg/kg	**NE**	**NE**	**129**			**299**			NA			NA			NA			NA			NA			NA			ND			NA			ND			NA		
Thallium	7440-28-0	mg/kg	**1**	**10**	**0.0415**			**0.0852**			NA			NA			NA			NA			NA			NA			ND			NA			ND			NA		
Vanadium	7440-62-2	mg/kg	**520**	**5200**	**27.4**			**25.7**			NA			NA			NA			NA			NA			NA			**30.3**			NA			**38.8**			NA		
Zinc	7440-66-6	mg/kg	**31000**	**310000**	**25**			**49.8**			NA			NA			NA			NA			NA			NA			**22.6**			NA			**50.9**			NA		
Chromium SW846 6010B																																								
pH	None	su	**NE**	**NE**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			**4.79**		
Redox Potential Vs H2	None	mv	**NE**	**NE**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			**354**		
Chromium, Hexavalent	18540-29-9	mg/kg	**NE**	**5.6**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND		
Chromium, Trivalent	16065-83-1	mg/kg	**NE**	**1500000**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			**11.4**		
Total Chromium	744047-3	mg/kg	**5.6**	**5.6**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			**11.4**		

NOTES:
(0.5-1.25) = designates depth sample was collected below ground surface
TCL = Target Compound List
VOCs = volatile organic compounds
TPH = total petroleum hydrocarbons
TPH-DRO = diesel range TPH
TPH-GRO = gasoline range TPH
SVOCs = semi-VOCs
TAL = Target Analyte List
EPA SW846 8260B = United States Environmental Protection Agency SW-846 analytical method
ug/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ND = not detected above analytical method reporting limit (RL)
NA = not analyzed
Red shading designates location was resampled and sample was reanalyzed
Blue shading designates a blind field duplicate and its associated counterpart sample
LQ = Laboratory Qualifiers
J indicates an estimated value greater or equal to the analytical method detection limit but less than the RL
VQ = Validator Qualifiers
L indicates the reported value may be biased low
J indicates an estimated value
UJ indicates the compound or element was analyzed for but not detected. The sample detection limit is an estimated value
B indicates the compound or element was analyzed for but not detected substantially above the level reported in laboratory or field blanks
R quality control indicates the data is not useable
VDEQ-T3SCR = Commonwelath of Virginia Department of Environmental Quality Tier III screening concentration for restricted use soil (commercial/industrial) (6/26/12)
EPA-RSL-IS = United States Environmental Protection Agency, Region III, regional screening level for industrial use soil (November 2012)
* = represents VDEQ Release Reporting Requirement for TPH (total TPH)
** = chromium VI
*** = chromium III
Bold and right justification designates target compound was detected at a concentration above RL
Yellow shading designates target compound was detected at a concentration above regulatory screening level in at least one sample
NE = not established

TABLE 3. SALVAGE METAL YARD (SMY) SOIL ANALYTICAL RESULTS (DETECTIONS ONLY)

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Field ID:	CAS No.	Units	VDEQ-T3SCR	EPA-RSL-IS	12-SMY-SB6(1-2)	LQ	VQ	12-SMY-SB6(1-2)R	LQ	VQ	12-SMY-SB6(7-7.5)	LQ	VQ
Sampling Date:					10/23/2012			11/29/2012			10/23/2012		
TPH SW846 8015C													
TPH-GRO (C6-C10)	None	mg/kg	**100***	**NE**	ND		R	ND			NA		
TPH-DRO (C10-C28)	None	mg/kg	**100***	**NE**	**8.67**	J		NA			NA		
TCL VOCs SW846 8260B													
Acetone	67-64-1	ug/kg	**63000000**	**630000000**	**53.1**		L	NA			**5.9**	J	L
2-Butanone (MEK)	78-93-3	ug/kg	**20000000**	**200000000**	**6.9**	J	L	NA			ND		R
Ethylbenzene	100-41-4	ug/kg	**27000**	**27000**	ND			NA			ND		
Isopropylbenzene	98-82-8	ug/kg	**1100000**	**11000000**	ND			NA			ND		
Methyl Tert Butyl Ether	1634-04-4	ug/kg	**220000**	**220000**	ND			NA			ND		
Methylene chloride	75-09-2	ug/kg	**960000**	**960000**	**8.2**		B	NA			**6.6**		B
Tetrachloroethene	127-18-4	ug/kg	**110000**	**110000**	ND			NA			ND		
Toluene	108-88-3	ug/kg	**4500000**	**45000000**	ND			NA			ND		
Trichloroethene	79-01-6	ug/kg	**6400**	**6400**	ND			NA			ND		
m,p-Xylene	108-38-3	ug/kg	**NA**	**2500000**	ND			NA			ND		
o-Xylene	95-47-6	ug/kg	**300000**	**3000000**	ND			NA			ND		
Xylene (total)	1330-20-7	ug/kg	**270000**	**2700000**	ND			NA			ND		
TCL SVOCs SW846 8270D													
Benzo(a)anthracene	56-55-3	ug/kg	**2100**	**2100**	ND		UL	ND			NA		
Benzo(a)pyrene	50-32-8	ug/kg	**210**	**210**	ND		UL	ND			NA		
Benzo(b)fluoranthene	205-99-2	ug/kg	**2100**	**2100**	ND		UL	ND			NA		
Benzo(g,h,i)perylene	191-24-2	ug/kg	**1700000**	**NE**	ND		UL	ND			NA		
Benzo(k)fluoranthene	207-08-9	ug/kg	**21000**	**21000**	ND		UL	ND			NA		
Chrysene	218-01-9	ug/kg	**210000**	**210000**	ND		UL	ND			NA		
Fluoranthene	206-44-0	ug/kg	**2200000**	**22000000**	ND		UL	ND			NA		
Fluorene	86-73-7	ug/kg	**2200000**	**22000000**	ND		UL	ND			NA		
Indeno(1,2,3-cd)pyrene	193-39-5	ug/kg	**2100**	**2100**	ND		UL	ND			NA		
Phenanthrene	85-01-8	ug/kg	**1700000**	**NE**	ND		UL	ND			NA		
Pyrene	129-00-0	ug/kg	**1700000**	**17000000**	ND		UL	ND			NA		
TAL Metals SW846 6010B/7470A													
Aluminum	7429-90-5	mg/kg	**99000**	**990000**	**2410**			NA			NA		
Arsenic	7440-38-2	mg/kg	**1.6**	**1.6**	**1.0**			NA			NA		
Barium	7440-39-3	mg/kg	**19000**	**190000**	**10.1**			NA			NA		
Beryllium	7440-41-7	mg/kg	**200**	**2000**	ND			NA			NA		
Cadmium	7440-43-9	mg/kg	**80**	**800**	ND			NA			NA		
Calcium	7789-78 -8	mg/kg	**NE**	**NE**	ND			NA			NA		
Chromium	7440-47-3	mg/kg	**5.6****	**5.6**/1500000***	**2.7**			NA			NA		
Cobalt	7440-48-4	mg/kg	**30**	**300**	ND			NA			NA		
Copper	7440-50-8	mg/kg	**4100**	**410000**	ND			NA			NA		
Iron	7439-89-6	mg/kg	**72000**	**720000**	**2130**			NA			NA		
Lead	7439-92-1	mg/kg	**800**	**800**	**2.0**			NA			NA		
Magnesium	7439-95-4	mg/kg	**NE**	**NE**	ND			NA			NA		
Manganese	7439-96-5	mg/kg	**2300**	**23000**	**20.2**			NA			NA		
Mercury	7439-97-6	mg/kg	**4.3**	**43**	ND			NA			NA		
Nickel	1313-99-1	mg/kg	**2000**	**20000**	ND			NA			NA		
Potassium	7440-09-7	mg/kg	**NE**	**NE**	ND			NA			NA		
Selenium	7782-49-2	mg/kg	**510**	**5100**	ND			NA			NA		
Sodium	7681-49-4	mg/kg	**NE**	**NE**	ND			NA			NA		
Thallium	7440-28-0	mg/kg	**1**	**10**	ND			NA			NA		
Vanadium	7440-62-2	mg/kg	**520**	**5200**	**5.2**			NA			NA		
Zinc	7440-66-6	mg/kg	**31000**	**310000**	**2.3**			NA			NA		
Chromium SW846 6010B													
pH	None	su	**NE**	**NE**	NA			NA			NA		
Redox Potential Vs H2	None	mv	**NE**	**NE**	NA			NA			NA		
Chromium, Hexavalent	18540-29-9	mg/kg	**NE**	**5.6**	NA			NA			NA		
Chromium, Trivalent	16065-83-1	mg/kg	**NE**	**1500000**	NA			NA			NA		
Total Chromium	744047-3	mg/kg	**5.6**	**5.6**	NA			NA			NA		

NOTES:
(0.5-1.25) = designates depth sample was collected below ground surface
TCL = Target Compound List
VOCs = volatile organic compounds
TPH = total petroleum hydrocarbons
TPH-DRO = diesel range TPH
TPH-GRO = gasoline range TPH
SVOCs = semi-VOCs
TAL = Target Analyte List
EPA SW846 8260B = United States Environmental Protection Agency SW-846 analytical method
ug/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ND = not detected above analytical method reporting limit (RL)
NA = not analyzed
Red shading designates location was resampled and sample was reanalyzed
Blue shading designates a blind field duplicate and its associated counterpart sample
LQ = Laboratory Qualifiers
J indicates an estimated value greater or equal to the analytical method detection limit but less than the RL
VQ = Validator Qualifiers
L indicates the reported value may be biased low
J indicates an estimated value
UJ indicates the compound or element was analyzed for but not detected. The sample detection limit is an estimated value
B indicates the compound or element was analyzed for but not detected substantially above the level reported in laboratory or field blanks
R quality control indicates the data is not useable
VDEQ-T3SCR = Commonwelath of Virginia Department of Environmental Quality Tier III screening concentration for restricted use soil (commercial/industrial) (6/26/12)
EPA-RSL-IS = United States Environmental Protection Agency, Region III, regional screening level for industrial use soil (November 2012)
* = represents VDEQ Release Reporting Requirement for TPH (total TPH)
** = chromium VI
*** = chromium III
Bold and right justification designates target compound was detected at a concentration above RL
Yellow shading designates target compound was detected at a concentration above regulatory screening level in at least one sample
NE = not established

TABLE 4. AREA EAST OF SALVAGE METAL YARD (ESMY) SOIL ANALYTICAL RESULTS (DETECTIONS ONLY)

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Field ID:	CAS No.	Units	VDEQ-T3SCR	EPA-RSL-IS	ANC-SS-40(0-0.5)	LQ	VQ	12-ESMY-SB1(1-2)	LQ	VQ	12-ESMY-SB1(1-2)R	LQ	VQ	12-ESMY-SB1(3-4)	LQ	VQ	12-ESMY-SB2(1-2)	LQ	VQ	12-ESMY-SB2(3-4)	LQ	VQ	12-ESMY-SB3(1-2)	LQ	VQ	12-ESMY-SB3(3-4)	LQ	VQ	12-ESMY-SB4(1-2)	LQ	VQ	12-ANCMP-DUP5-SO	LQ	VQ	12-ESMY-SB4(3-4)	LQ	VQ
Sampling Date:					7/20/2009			10/23/2012			11/29/2012			11/29/2012			11/29/2012			11/29/2012			11/29/2012			11/29/2012			11/29/2012			11/29/2012			11/29/2012		
TPH SW846 8015C																																					
TPH-GRO (C6-C10)	None	mg/kg	**100***	**NE**	ND			ND		R	<14			NA			NA			NA			NA			NA			NA			NA			NA		
TPH-DRO (C10-C28)	None	mg/kg	**100***	**NE**	**15.4**	J	J	**65.2**			NA			NA			NA			NA			NA			NA			NA			NA			NA		
TCL VOCs SW846 8260B																																					
Acetone	67-64-1	ug/kg	**63000000**	**630000000**	ND			**8.8**	J		NA			NA			NA			NA			NA			NA			NA			NA			NA		
Methylene chloride	75-09-2	ug/kg	**960000**	**960000**	ND			**24.8**		B	NA			NA			NA			NA			NA			NA			NA			NA			NA		
TCL SVOCs SW846 8270D		ug/kg																																			
Acenaphthylene	208-96-8	ug/kg	**1700000**	**NA**	ND			**44.3**		L	ND			ND			ND			ND			ND			ND			ND			ND			ND		
Anthracene	120-12-7	ug/kg	**17000000**	**170000000**	ND			**60.8**		L	ND			ND			ND			ND			ND			ND			ND			ND			ND		
Benzo(a)anthracene	56-55-3	ug/kg	**2100**	**2100**	ND			**246**		L	ND			ND			**51.7**			**59.3**			ND			ND			ND			ND			ND		
Benzo(a)pyrene	50-32-8	ug/kg	**210**	**210**	ND			**231**		L	ND			ND			**45.2**			**57.4**			ND			ND			ND			ND			ND		
Benzo(b)fluoranthene	205-99-2	ug/kg	**2100**	**2100**	ND			**276**		L	ND			ND			**54.8**			**78.2**			ND			ND			ND			ND			ND		
Benzo(g,h,i)perylene	191-24-2	ug/kg	**1700000**	**NE**	ND			**154**		L	ND			ND			**35.7**			**47.9**			ND			ND			ND			ND			ND		
Benzo(k)fluoranthene	207-08-9	ug/kg	**21000**	**21000**	ND			**127**		J	ND			ND			**35.3**		J	**41.8**		J	ND			ND			ND			ND			ND		
Chrysene	218-01-9	ug/kg	**210000**	**210000**	ND			**238**		L	ND			ND			**56.5**			**73.3**			ND			ND			ND			ND			ND		
Dibenzo(a,h)anthracene	53-70-3	ug/kg	**210**	**210**	ND			**54.5**		J	ND			ND			ND			**15.2**	J		ND			ND			ND			ND			ND		
Fluoranthene	206-44-0	ug/kg	**2200000**	**22000000**	ND			**492**		L	ND			ND			**90.0**			**115**			ND			ND			ND			ND			ND		
Indeno(1,2,3-cd)pyrene	193-39-5	ug/kg	**2100**	**2100**	ND			**152**		L	ND			ND			**30.4**	J		**41.6**			ND			ND			ND			ND			ND		
Phenanthrene	85-01-8	ug/kg	**1700000**	**NE**	ND			**281**		L	ND			ND			**38.8**			**63.9**			ND			ND			ND			ND			ND		
Pyrene	129-00-0	ug/kg	**1700000**	**17000000**	ND			**371**		L	ND			ND			**74.7**			**95.6**			ND			ND			ND			ND			ND		
PCBs SW846 8082A																																					
Aroclor 1260	11096-82-5	ug/kg	**740**	**740**	**10.8**	J	J	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Pesticides SW846 8081B																																					
4,4'-DDD	50-29-3	ug/kg	**7200**	**7200**	**4.25**	J	J	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
4,4'-DDE	50-29-3	ug/kg	**5100**	**5100**	**2.84**	J	J	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
TAL Metals SW846 6010B/7470A																																					
Aluminum	7429-90-5	mg/kg	**99000**	**990000**	**7280**			**5800**			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Antimony	7440-36-0	mg/kg	**41**	**410**	ND			ND			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Arsenic	7440-38-2	mg/kg	**1.6**	**1.6**	**3.22**			**3.3**			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Barium	7440-39-3	mg/kg	**19000**	**190000**	**43.3**			**69.0**			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Beryllium	7440-41-7	mg/kg	**200**	**2000**	**0.489**			**0.58**			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Cadmium	7440-43-9	mg/kg	**80**	**800**	**0.441**			ND			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Calcium	7789-78 -8	mg/kg	**NE**	**NE**	**2100**			**924**			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Chromium	7440-47-3	mg/kg	**5.6****	**5.6**/1500000****	**22.6**			**10.7**			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Cobalt	7440-48-4	mg/kg	**30**	**300**	**3.6**			**5.7**			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Copper	7440-50-8	mg/kg	**4100**	**410000**	**10.2**			**10.5**			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Iron	7439-89-6	mg/kg	**72000**	**720000**	**14600**	B		**7180**			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Lead	7439-92-1	mg/kg	**800**	**800**	**34.5**			**35.6**			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Magnesium	7439-95-4	mg/kg	**NE**	**NE**	**1590**			**726**			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Manganese	7439-96-5	mg/kg	**2300**	**23000**	**163**			**181**			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Mercury	7439-97-6	mg/kg	**4.3**	**43**	**0.0403**	J	J	**0.041**			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Nickel	1313-99-1	mg/kg	**2000**	**20000**	**10.7**			**7.8**			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Potassium	7440-09-7	mg/kg	**NE**	**NE**	**1230**			ND			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Selenium	7782-49-2	mg/kg	**510**	**5100**	**0.335**			ND			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Sodium	7681-49-4	mg/kg	**NE**	**NE**	**74.3**			ND			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Thallium	7440-28-0	mg/kg	**1**	**10**	**0.0695**			ND			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Vanadium	7440-62-2	mg/kg	**520**	**5200**	**26.2**			**18.3**			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Zinc	7440-66-6	mg/kg	**31000**	**310000**	**50**			**28.9**			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Chromium SW846 6010B																																					
pH	None	su	**NE**	**NE**	NA			NA			**7.10**			NA			NA			NA			NA			NA			NA			NA			NA		
Redox Potential Vs H2	None	mv	**NE**	**NE**	NA			NA			**321**			NA			NA			NA			NA			NA			NA			NA			NA		
Chromium, Hexavalent	18540-29-9	mg/kg	**NE**	**5.6**	NA			NA			ND			NA			NA			NA			NA			NA			NA			NA			NA		
Chromium, Trivalent	16065-83-1	mg/kg	**NE**	**1500000**	NA			NA			**10.6**			NA			NA			NA			NA			NA			NA			NA			NA		
Total Chromium	744047-3	mg/kg	**5.6**	**5.6**	NA			NA			**11**			NA			NA			NA			NA			NA			NA			NA			NA		

NOTES:
(0.5-1.25) = designates depth sample was collected below ground surface
TCL = Target Compound List
VOCs = volatile organic compounds
TPH = total petroleum hydrocarbons
TPH-DRO = diesel range TPH
TPH-GRO = gasoline range TPH
SVOCs = semi-VOCs
TAL = Target Analyte List
EPA SW846 8260B = United States Environmental Protection Agency SW-846 analytical method
ug/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ND = not detected above analytical method reporting limit (RL)
NA = not analyzed
Red shading designates location was resampled and sample was reanalyzed
Blue shading designates a blind field duplicate and its associated counterpart sample
LQ = Laboratory Qualifiers
J indicates an estimated value greater or equal to the analytical method detection limit but less than the RL
VQ = Validator Qualifiers
L indicates the reported value may be biased low
J indicates an estimated value
UL indicates the compound or element was analyzed for but not detected. The sample detection limit is probably higher
B indicates the compound or element was analyzed for but not detected substantially above the level reported in the laboratory or field blanks
R quality control indicates the data is not useable
VDEQ-T3SCR = Commonwelath of Virginia Department of Environmental Quality Tier III screening concentration for restricted use soil (commercial/industrial) (6/26/12)
EPA-RSL-IS = United States Environmental Protection Agency, Region III, regional screening level for industrial use soil (November 2012)
* = represents VDEQ Release Reporting Requirement for TPH (total TPH)
** = chromium VI
*** = chromium III
Bold and right justification designates target compound was detected at a concentration above RL

TABLE 5. OLD WAREHOUSE AREA (OWA) SOIL ANALYTICAL RESULTS (DETECTIONS ONLY)

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Field ID:	CAS No.	Units	VDEQ-T3SCR	EPA-RSL-IS	ANC-SS-13	LQ	VQ	ANC-SS-15	LQ	VQ	ANC-SS-18	LQ	VQ	ANC-SS-32	LQ	VQ	ANC-SS-42	LQ	VQ	ANC-SS-42DUP	LQ	VQ	ANC-SS-43	LQ	VQ	ANC-SS-44	LQ	VQ	ANC-SS-45	LQ	VQ	12-OWA-SB1(3-4)	LQ	VQ	12-OWA-SB1(3-4)	LQ	VQ	12-OWA-SB2(3-4)	LQ	VQ	12-OWA-SB2(3-4)	LQ	VQ	12-OWA-SB2(6-7)	LQ	VQ	12-OWA-SB3(3-4)	LQ	VQ	12-OWA-SB3(3-4)	LQ	VQ
Sampling Date:					7/20/2009			7/20/2009			7/20/2009			7/20/2009			7/20/2009			7/20/2009			7/20/2009			7/20/2009			7/22/2009			10/23/2012			11/29/2012			10/23/2012			11/29/2012			11/29/2012			10/23/2012			11/29/2012					
TPH SW846 8015C																																																				
TPH-GRO (C6-C10)	None	mg/kg	**100**	**NE**	ND			ND			ND			ND			ND			ND			ND			ND			NA			ND		R	ND			ND		R	ND			NA			ND		R	ND		
TPH-DRO (C10-C28)	None	mg/kg	**100**	**NE**	**1580**			**675**			**27**	J	J	**18.4**	J	J	**38.5**	J	J	**45.7**	J	J	**9.88**	J	J	**17.5**			NA			ND			NA			ND			NA			NA			NA			**57.4**			NA		
TCL VOCs SW846 8260B																																																				
Acetone	67-64-1	ug/kg	**63000000**	**630000000**	ND			ND			ND			ND			ND			ND			ND			ND			ND			**7.9**	J		NA			**8.6**	J		NA			NA			**137**			NA		
Benzene	71-43-2	ug/kg	**5400**	**5400**	ND			ND			ND			ND			ND			ND			ND			ND			ND			ND			NA			ND			NA			NA			ND			NA		
2-Butanone (MEK)	78-93-3	ug/kg	**20000000**	**200000000**	ND			ND			ND			ND			ND			ND			ND			ND			ND			ND			NA			ND			NA			NA			**35.4**			NA		
Carbon disulfide	75-15-0	ug/kg	**370000**	**3700000**	ND			ND			ND			ND			ND			ND			ND			ND			ND			ND			NA			ND			NA			NA			**0.97**	J		NA		
Chlorobenzene	108-90-7	ug/kg	**140000**	**1400000**	ND			ND			ND			ND			ND			ND			ND			ND			ND			ND			NA			ND			NA			NA			ND			NA		
Chloroform	67-66-3	ug/kg	**1500**	**1500**	ND			ND			ND			ND			ND			ND			ND			ND			ND			ND			NA			ND			NA			NA			ND			NA		
Cyclohexane	557-21-1	ug/kg	**2900000**	**29000000**	ND			ND			ND			ND			ND			ND			ND			ND			ND			ND			NA			ND			NA			NA			ND			NA		
1,2-Dichlorobenzene	95-50-1	ug/kg	**980000**	**9800000**	ND			ND			ND			ND			ND			ND			ND			ND			ND			ND			NA			ND			NA			NA			ND			NA		
Ethylbenzene	100-41-4	ug/kg	**27000**	**27000**	ND			ND			ND			ND			ND			ND			ND			ND			ND			ND			NA			ND			NA			NA			**1.0**	J		NA		
Isopropylbenzene (Cumene)	98-82-8	ug/kg	**1100000**	**11000000**	ND			ND			ND			ND			ND			ND			ND			ND			ND			ND			NA			ND			NA			NA			ND			NA		
Methyl Acetate	79-20-9	ug/kg	**100000000**	**1000000000**	ND			ND			ND			ND			ND			ND			ND			ND			ND			ND			NA			ND			NA			NA			ND			NA		
Methylcyclohexane	108-87- 2	ug/kg	**1400000**	**NA**	ND			ND			ND			ND			ND			ND			ND			ND			ND			ND			NA			ND			NA			NA			ND			NA		
Methyl Tert Butyl Ether	1634-04-4	ug/kg	**220000**	**220000**	ND			ND			ND			ND			ND			ND			ND			ND			ND			ND			NA			ND			NA			NA			ND			NA		
Methylene chloride	75-09-2	ug/kg	**960000**	**960000**	ND			ND			ND			ND			ND			ND			ND			ND			ND			**8.0**	B		NA			**12.2**	B		NA			NA			**12.8**	B		NA		
Toluene	108-88-3	ug/kg	**4500000**	**45000000**	ND			ND			ND			ND			ND			ND			ND			ND			ND			ND			NA			ND			NA			NA			ND			NA		
m,p-Xylene	108-38-3	ug/kg	**NA**	**2500000**	ND			ND			ND			ND			ND			ND			ND			ND			ND			ND			NA			ND			NA			NA			**0.46**	J		NA		
o-Xylene	95-47-6	ug/kg	**300000**	**3000000**	ND			ND			ND			ND			ND			ND			ND			ND			ND			ND			NA			ND			NA			NA			ND			NA		
Xylene (total)	1330-20-7	ug/kg	**270000**	**2700000**	ND			ND			ND			ND			ND			ND			ND			ND			ND			ND			NA			ND			NA			NA			**0.46**	J		NA		
TCL SVOCs SW846 8270D																																																				
Acenaphthene	83-32-9	ug/kg	**3300000**	**33000000**	**8090**			ND			ND			ND			ND			ND			ND			ND			NA			ND	UL		ND			**190**		L	ND			ND			NA			NA		
Acenaphthylene	208-96-8	ug/kg	**170000**	**NA**	**5090**	J		ND			ND			ND			ND			ND			ND			ND			NA			ND	UL		ND			**30.4**	J	L	ND			NA			NA			NA		
Anthracene	120-12-7	ug/kg	**17000000**	**170000000**	**29000**			**4670**	J		ND			ND			ND			ND			ND			ND			NA			ND	UL		ND			**891**		L	**11.2**	J		ND			NA			NA		
Benzo(a)anthracene	56-55-3	ug/kg	**2100**	**2100**	**34100**			**27700**			ND			ND			ND			ND			**118**	J	J	**101**	J	J	NA			ND	UL		**57.7**			**1420**		L	**23.1**	J		ND			NA			NA		
Benzo(a)pyrene	50-32-8	ug/kg	**210**	**210**	**29700**			**35800**			ND			ND			ND			ND			**127**	J	J	**114**	J	J	NA			ND	UL		**59.0**			**1160**		L	**20.6**	J		ND			NA			NA		
Benzo(b)fluoranthene	205-99-2	ug/kg	**2100**	**2100**	**26200**			**33300**			ND			ND			ND			ND			**117**	J	J	**101**	J	J	NA			ND	UL		**62.1**			**1010**		L	**25.5**	J		ND			NA			NA		
Benzo(g,h,i)perylene	191-24-2	ug/kg	**1700000**	**NE**	**6920**			**10800**			ND			ND			ND			ND			ND			ND			NA			ND	UL		**42.6**			**745**		L	**14.2**	J		ND			NA			NA		
Benzo(k)fluoranthene	207-08-9	ug/kg	**21000**	**21000**	**29500**			**43800**			ND			ND			ND			ND			**132**	J	J	**125**	J	J	NA			ND	UL		**44.0**			**814**		J	ND			ND			NA			NA		
1,1'-Biphenyl	92-52-4	ug/kg	**21000**	**210000**	ND			ND			ND			ND			ND			ND			ND			ND			NA			ND	UL		ND			**30.0**	J	L	ND			ND			NA			NA		
Carbazole	86-74-8	ug/kg	**NE**	**NE**	**10300**			ND			ND			ND			ND			ND			ND			ND			NA			ND	UL		ND			**445**		L	ND			ND			NA			NA		
Chrysene	218-01-9	ug/kg	**210000**	**210000**	**29500**			**26800**			ND			ND			ND			ND			**128**	J	J	**113**	J	J	NA			ND	UL		**63.6**			**1280**		L	**19.2**	J		ND			NA			NA		
Dibenzo(a,h)anthracene	53-70-3	ug/kg	**210**	**210**	**3250**	J	J	**4480**	J		ND			ND			ND			ND			ND			ND			NA			ND	UL		**16.7**	J		**271**		J	ND			ND			NA			NA		
Dibenzofuran	132-64-9	ug/kg	**100000**	**1300000**	**17800**			ND			ND			ND			ND			NA			ND			ND			NA			ND	UL		ND			**264**		L	ND			ND			NA			NA		
Dimethyl phthalate	131-11-3	ug/kg	**NE**	**NE**	ND			ND			ND			ND			ND			ND			ND			ND			NA			ND	UL		ND			**39.3**	J	L	ND			ND			NA			NA		
bis(2-Ethylhexyl)phthalate	117-81-7	ug/kg	**120000**	**120000**	ND			ND			ND			ND			ND			ND			ND			ND			NA			ND	UL		ND			**48.8**	J	L	ND			ND			NA			NA		
Fluoranthene	206-44-0	ug/kg	**2200000**	**22000000**	**94600**			**40100**			ND			ND			ND			ND			**260**	J	J	**242**		J	NA			ND	UL		**114**			**3370**		L	**45.2**			ND			NA			NA		
Fluorene	86-73-7	ug/kg	**2200000**	**22000000**	**26600**			ND			ND			ND			ND			ND			ND			ND			NA			ND	UL		ND			**465**		L	ND			ND			NA			NA		
Indeno(1,2,3-cd)pyrene	193-39-5	ug/kg	**2100**	**2100**	**8410**			**12500**			ND			ND			ND			ND			ND			ND			NA			ND	UL		**38.9**			**721**		L	**13.1**	J		ND			NA			NA		
2-Methylnaphthalene	91-57-6	ug/kg	**410000**	**2200000**	**11000**	J		ND			ND			ND			ND			ND			ND			ND			NA			ND	UL		ND			**99.1**		L	ND			ND			NA			NA		
Naphthalene	91-20-3	ug/kg	**1800**	**18000**	**12700**	J		ND			ND			ND			ND			ND			ND			ND			NA			ND	UL		ND			**121**		L	ND			ND			NA			NA		
Phenanthrene	85-01-8	ug/kg	**1700000**	**NE**	**103000**			**11100**			ND			ND			ND			ND			ND			**110**	J	J	NA			ND	UL		**50.3**			**3220**		L	**32.2**			ND			NA			NA		
Pyrene	129-00-0	ug/kg	**1700000**	**17000000**	**637000**			**33200**			ND			ND			ND			ND			**184**	J	J	**167**	J	J	NA			ND	UL		**88.9**			**2550**		L	**33.4**			ND			NA			NA		
PCBs SW846 8082A																																																			
Aroclor 1260	11096-82-5	ug/kg	**740**	**740**	**29.8**			ND			ND			**29.3**			**10.2**	J	J	**13.7**	J	J	ND			ND			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Pesticides SW846 8081B																																																			
alpha-Chlordane	12789-03-6	ug/kg	**6500**	**6500**	ND			ND			**0.58**	J	J	ND			ND			**1.02**	J	J	ND			ND			NA			NA			NA			NA			NA			NA			NA			NA		
gamma-Chlordane	12789-03-6	ug/kg	**6500**	**6500**	ND			ND			ND			ND			ND			ND			ND			ND			NA			NA			NA			NA			NA			NA			NA		
4,4'-DDD	50-29-3	ug/kg	**7200**	**7200**	ND			ND			**2.08**	P	J	**1.51**	J	J	**3.7**	J	J	**2.35**	J	J	ND			**0.839**	J	J	NA			NA			NA			NA			NA			NA			NA			NA		
4,4'-DDE	50-29-3	ug/kg	**5100**	**5100**	ND			ND			**2**			**0.782**	J	J	**3.06**	J	J	**2.22**	J	J	**0.434**	J	J	**0.392**	J	J	NA			NA			NA			NA			NA			NA			NA		
4,4'-DDT	50-29-3	ug/kg	**7000**	**7000**	ND			ND			**1.24**	J	J	**2.9**	J		**13.5**	P	J	**10**	P	J	ND			ND			NA			NA			NA			NA			NA			NA			NA		
Heptachlor epoxide	1024-57-3	ug/kg	**190**	**190**	ND			ND			ND			ND			ND			**2.43**	J	J	ND			ND			NA			NA			NA			NA			NA			NA			NA		
Methoxychlor	72-43-5	ug/kg	**310000**	**3100000**	ND			ND			ND			ND			ND			ND			ND			ND			NA			NA			NA			NA			NA			NA			NA		
Herbicides SW846 8151																																																			
2,4-D	94-75-7	ug/kg	**NE**	**NE**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
2,4,5-TP (Silvex)	93-72-1	ug/kg	**NE**	**4900000**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
TAL Metals SW846 6010B/7470A																																																			
Aluminum	7429-90-5	mg/kg	**99000**	**990000**	**4760**			**2900**			**3770**			**8890**			**7590**			**6910**			**9040**			**9340**			NA			NA			NA			NA			NA			NA			NA			NA		
Antimony	7440-36-0	mg/kg	**41**	**410**	ND			ND			ND			ND			**0.747**	J	B	**0.609**	J	B	ND			ND			NA			NA			NA			NA			NA			NA			NA		
Arsenic	7440-38-2	mg/kg	**1.6**	**1.6**	**12.8**			**11.3**			**7.85**			**2.92**			**3.44**			**3.27**			**3.8**			**2**			NA			NA			NA			NA			NA			NA			NA		
Barium	7440-39-3	mg/kg	**19000**	**190000**	**35.3**			**33.6**			**32.2**			**50.6**			**47.4**			**48.7**			**51**			**37.1**			NA			NA			NA			NA			NA			NA			NA		
Beryllium	7440-41-7	mg/kg	**200**	**2000**	**0.214**	J	J	**0.11**	J	J	**0.305**	J	J	**0.699**			**0.507**			**0.541**			**0.653**			**0.283**	J	J	NA			NA			NA			NA			NA			NA			NA		
Cadmium	7440-43-9	mg/kg	**80**	**800**	**0.418**			**0.371**	J	J	**0.387**			**0.527**			**0.537**			**0.551**			**0.46**			**0.502**			NA			NA			NA			NA			NA			NA			NA		
Calcium	7789-78 -8	mg/kg	**NE**	**NE**	**29300**			**116000**			**3730**			**2610**			**14900**			**4370**			**1710**			**6110**			NA			NA			NA			NA			NA			NA			NA		
Chromium	7440-47-3	mg/kg	**5.6***	**5.6*/1500000****	**24.5**			**6.48**			**22.7**			**24**			**27.7**			**24.9**			**24.5**			**18.2**			NA			NA			NA			NA			NA			NA			NA		
Cobalt	7440-48-4	mg/kg	**30**	**300**	**8.18**			**2.43**			**2.23**			**5.5**			**6.55**			**7.03**			**3.77**			**9.78**			NA			NA			NA			NA			NA			NA			NA		
Copper	7440-50-8	mg/kg	**4100**	**410000**	**9.68**			**4.93**			**15**			**15.3**			**24.9**			**26.4**			**12.6**			**46.7**			NA			NA			NA			NA			NA			NA			NA		
Iron	7439-89-6	mg/kg	**72000**	**720000**	**13200**	B		**6260**	B		**13900**	B		**18600**	B		**18900**	B		**19100**	B		**19500**	B		**23400**	B		NA			NA			NA			NA			NA			NA			NA		
Lead	7439-92-1	mg/kg	**800**	**800**	**30.7**			**37.9**			**38**			**50**			**30.5**			**30.6**			**23.3**			**21.9**			NA			NA			NA			NA			NA			NA			NA		
Magnesium	7439-95-4	mg/kg	**NE**	**NE**	**7540**			**4350**			**1410**			**1750**			**3650**			**4560**			**1620**			**5450**			NA			NA			NA			NA			NA			NA			NA		
Manganese	7439-96-5	mg/kg	**2300**	**23000**	**181**			**76.5**			**103**			**214**			**245**			**234**			**145**			**252**			NA			NA			NA			NA			NA			NA			NA		
Mercury	7439-97-6	mg/kg	**4.3**	**43**	**0.022**	J	J	**0.0359**	J	J	**0.032**	J	J	**0.106**	J	J	**0.025**	J	J	**0.0624**	J	J	**0.0514**	J	J	**0.0266**	J	J	NA			NA			NA			NA			NA			NA			NA		
Nickel	1313-99-1	mg/kg	**2000**	**20000**	**81.3**			**10.3**			**9.83**			**9.92**			**24.7**			**34.9**			**7.5**			**14.8**			NA			NA			NA			NA			NA			NA			NA		
Potassium	7440-09-7	mg/kg	**NE**	**NE**	**404**			**272**			**535**			**1450**			**1190**			**1120**			**1490**			**1130**			NA			NA			NA			NA			NA			NA			NA		
Selenium	7782-49-2	mg/kg	**510**	**5100**	**0.277**			**0.325**			**0.315**			**0.416**			**0.419**			**0.432**			**0.581**			**0.266**			NA			NA			NA			NA			NA			NA			NA		
Silver	7440-22-4	mg/kg	**510**	**5100**	ND			ND			ND			ND			ND			ND			ND			ND			NA			NA			NA			NA			NA			NA			NA		
Sodium	7681-49-4	mg/kg	**NE**	**NE**	**2800**			**63.1**			**395**			**99.9**			**230**			**250**			**32.3**			**111**			NA			NA			NA			NA			NA			NA			NA		
Thallium	7440-28-0	mg/kg	**1**	**10**	**0.0777**			**0.112**			**0.0485**			**0.112**			**0.0955**			**0.0843**			**0.136**			**0.061**			NA			NA			NA			NA			NA			NA			NA		
Vanadium	7440-62-2	mg/kg	**520**	**5200**	**47.2**			**17.3**			**38.4**			**30.7**			**39.4**			**39.7**			**30.9**			**65.6**			NA			NA			NA			NA			NA			NA			NA		
Zinc	7440-66-6	mg/kg	**31000**	**310000**	**23.1**			**18.3**			**35.4**			**53.4**			**57.7**			**56.3**			**38.1**			**62.9**			NA			NA			NA			NA			NA			NA			NA		
Chromium SW846 6010B																																																			
pH		su	**NE**	**NE**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Redox Potential Vs H2		mv	**NE**	**NE**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Chromium, Hexavalent	18540-29-9	mg/kg	**NE**	**5.6**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Chromium, Trivalent	16065-83-1	mg/kg	**NE**	**1500000**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Total Chromium	744047-3	mg/kg	**5.6**	**5.6**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		

NOTES:
(0.5-1.25) = designates depth sample was collected below ground surface
TCL = Target Compound List
VOCs = volatile organic compounds
TPH = total petroleum hydrocarbons
TPH-DRO = diesel range TPH
TPH-GRO = gasoline range TPH
SVOCs = semi-VOCs
PCBs = polychlorinated biphenyls
TAL = Target Analyte List
EPA-SW846 8260B = United States Environmental Protection Agency SW-846 analytical method
c = cancer
n = noncancer
L = user guide on lead
ug/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ND = not detected above analytical method reporting limit (RL)
NA = not analyzed
Blue shading designates a blind field duplicate and its associated counterpart sample
LQ = Laboratory Qualifiers
  J indicates an estimated value greater or equal to the analytical method detection limit but less than the RL
VQ = Validator Qualifiers
  NV indicates data not validated
  J indicates an estimated value
  UJ indicates the compound or element was analyzed for but not detected. The sample detection limit is an estimated value
VDEQ-T3SCR = Commonwelath of Virginia Department of Environmental Quality Tier III screening concentration for restricted use soil (commercial/industrial) (6/26/12)
EPA-RSL-IS = United States Environmental Protection Agency, Region III, regional screening level for industrial use soil (November 2012)
* = represents VDEQ Release Reporting Requirement for TPH (total TPH)
** = chromium VI
*** = chromium III
Bold and right justification designates target compound was detected at a concentration above RL

TABLE 5. OLD WAREHOUSE AREA (OWA) SOIL ANALYTICAL RESULTS (DETECTIONS ONLY)

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Field ID:	CAS No.	Units	VDEQ-T3SCR	EPA-RSL-IS	12-OWA-SB4(4.5-5.5)	LQ	VQ	12-OWA-SB4(4.5-5.5)	LQ	VQ	12-ANCMP-DUP1-SO	LQ	VQ	12-ANCMP-DUP1-SO	LQ	VQ	12-OWA-SB5(4-5)	LQ	VQ	12-OWA-SB5(4-5)	LQ	VQ	12-OWA-SB6(2-3)	LQ	VQ	12-OWA-SB6(2-3)	LQ	VQ	12-OWA-SB7(0.25-1.25)	LQ	VQ	12-OWA-SB7(2.5-3.5)	LQ	VQ	12-OWA-SB7(2.5-3.5)	LQ	VQ	12-OWA-SB8(1-2)	LQ	VQ	12-OWA-SB8(6-7)	LQ	VQ	12-OWA-SB8(6-7)	LQ	VQ	12-OWA-SB9(0.5-1.5)	LQ	VQ
Sampling Date:					10/23/2012			11/30/2012			10/23/2012			11/30/2012			10/24/2012			11/29/2012			10/24/2012			11/29/2012			10/24/2012			10/24/2012			11/30/2012			10/24/2012			10/24/2012			11/30/2012			10/24/2012		
TPH SW846 8015C																																															
TPH-GRO (C6-C10)	None	mg/kg	100	NE	734		J	526			183		J	254			92.4			NA			ND			NA			ND			77.9			NA			NA			ND			NA			ND		
TPH-DRO (C10-C28)	None	mg/kg	100	NE	286			NA			770			NA			1790			NA			47.9			NA			NA			24.9			84.6			NA			11.7			72.0			NA		
TCL VOCs SW846 8260B																																															
Acetone	67-64-1	ug/kg	63000000	630000000	ND		R	NA			ND		R	NA			ND		R	66.9		L	109		L	58.8		L	NA			24.9		L	84.6		J	NA			11.7		L	72.0		L	NA		
Benzene	71-43-2	ug/kg	5400	5400	ND			NA			ND			NA			ND		R	ND			ND		R	ND			NA			ND		R	ND			NA			ND		R	0.38	J		NA		
2-Butanone (MEK)	78-93-3	ug/kg	20000000	200000000	ND			NA			ND			NA			ND		R	3.9	J	L	16.3		L	8.8	J	L	NA			ND		R	ND		R	NA			ND		R	ND			NA		
Carbon disulfide	75-15-0	ug/kg	370000	3700000	ND			NA			ND			NA			ND		R	ND			ND		R	ND			NA			ND		R	ND			NA			ND		R	ND			NA		
Chlorobenzene	108-90-7	ug/kg	140000	1400000	ND			NA			ND			NA			ND		R	ND			ND		R	ND			NA			ND		R	ND			NA			ND		R	ND			NA		
Chloroform	67-66-3	ug/kg	1500	1500	ND			NA			ND			NA			ND		R	ND			ND		R	ND			NA			ND		R	ND			NA			ND		R	ND			NA		
Cyclohexane	557-21-1	ug/kg	2900000	29000000	1350		J	NA			337		J	NA			92.6	J	L	ND			ND		R	0.50	J		NA			ND		R	ND			NA			ND		R	ND			NA		
1,2-Dichlorobenzene	95-50-1	ug/kg	980000	9800000	ND			NA			ND			NA			ND		R	ND			ND		R	ND			NA			ND		R	ND			NA			ND		R	ND			NA		
Ethylbenzene	100-41-4	ug/kg	27000	27000	2290			NA			344			NA			558		L	ND			ND		R	ND			NA			ND		R	ND			NA			ND		R	ND			NA		
Isopropylbenzene (Cumene)	98-82-8	ug/kg	1100000	11000000	1370			NA			379			NA			663		L	3.2	J		ND		R	0.22	J		NA			ND		R	ND			NA			ND		R	ND			NA		
Methyl Acetate	79-20-9	ug/kg	1000000000	1000000000	ND			NA			ND			NA			ND		R	ND			ND		R	ND			NA			ND		R	ND		R	NA			ND		R	9.6		L	NA		
Methylcyclohexane	108-87- 2	ug/kg	1400000	NA	8250		J	NA			2330		J	NA			1260		L	5.7			0.83	J	L	3.4	J		NA			ND		R	ND			NA			ND		R	ND			NA		
Methyl Tert Butyl Ether	1634-04-4	ug/kg	220000	220000	ND			NA			ND			NA			ND		R	ND			ND		R	ND			NA			0.51	J	L	ND			NA			ND		R	ND			NA		
Methylene chloride	75-09-2	ug/kg	960000	960000	ND			NA			ND			NA			ND		R	4.0	J		12.0		L	5.0			NA			5.9		L	ND			NA			30.0		L	2.2	J		NA		
Toluene	108-88-3	ug/kg	4500000	45000000	ND			NA			ND			NA			ND		R	ND			0.72	J	L	0.45	J		NA			ND			0.75	J	J	NA			0.24	J	L	ND			NA		
m,p-Xylene	108-38-3	ug/kg	NA	2500000	166			NA			42.9	J		NA			ND		R	ND			0.49	J	L	0.49	J		NA			0.27	J	L	0.63	J	J	NA			ND		R	ND			NA		
o-Xylene	95-47-6	ug/kg	300000	3000000	56.2			NA			ND			NA			ND		R	ND			0.23	J	L	0.22	J		NA			ND		R	ND			NA			ND		R	ND			NA		
Xylene (total)	1330-20-7	ug/kg	270000	2700000	223			NA			42.9	J		NA			ND		R	ND			0.71	J	L	0.71	J		NA			0.27	J	L	0.63	J	J	NA			ND		R	ND			NA		
TCL SVOCs SW846 8270D																																															
Acenaphthene	83-32-9	ug/kg	3300000	33000000	58.7		L	339			202		L	262			NA			NA			NA			NA			NA			NA			NA			26.3	J		NA			NA			ND		
Acenaphthylene	208-96-8	ug/kg	1700000	NA	ND		UL	ND			ND		UL	ND			NA			NA			NA			NA			NA			NA			NA			41.1			NA			NA			ND		
Anthracene	120-12-7	ug/kg	17000000	170000000	275		L	469			527		L	287			NA			NA			NA			NA			NA			NA			NA			69.6			NA			NA			ND		
Benzo(a)anthracene	56-55-3	ug/kg	2100	2100	354		L	271			539		L	161			NA			NA			NA			NA			NA			NA			NA			189			NA			NA			ND		
Benzo(a)pyrene	50-32-8	ug/kg	210	210	200		L	159			293		L	98.0			NA			NA			NA			NA			NA			NA			NA			208			NA			NA			ND		
Benzo(b)fluoranthene	205-99-2	ug/kg	2100	2100	216		L	162			274		L	76.7			NA			NA			NA			NA			NA			NA			NA			178			NA			NA			ND		
Benzo(g,h,i)perylene	191-24-2	ug/kg	1700000	NE	74.8		L	59.9			98.4		L	37.2			NA			NA			NA			NA			NA			NA			NA			163			NA			NA			ND		
Benzo(k)fluoranthene	207-08-9	ug/kg	21000	21000	117		J	104			194		J	80.5			NA			NA			NA			NA			NA			NA			NA			135			NA			NA			ND		
1,1'-Biphenyl	92-52-4	ug/kg	21000	210000	ND		UL	ND			ND		UL	ND			NA			NA			NA			NA			NA			NA			NA			ND			NA			NA			ND		
Carbazole	86-74-8	ug/kg	NE	NE	ND		UL	ND			ND		UL	ND			NA			NA			NA			NA			NA			NA			NA			48.8	J		NA			NA			ND		
Chrysene	218-01-9	ug/kg	210000	2100000	297		L	221			421		L	138			NA			NA			NA			NA			NA			NA			NA			195			NA			NA			ND		
Dibenz(a,h)anthracene	53-70-3	ug/kg	210	210	ND		UL	25.4	J		45.4		J	16.8	J		NA			NA			NA			NA			NA			NA			NA			38.1			NA			NA			ND		
Dibenzofuran	132-64-9	ug/kg	100000	1300000	ND		UL	399			272		L	301			NA			NA			NA			NA			NA			NA			NA			24.4	J		NA			NA			ND		
Dimethyl phthalate	131-11-3	ug/kg	NE	NE	ND		UL	ND			ND		UL	ND			NA			NA			NA			NA			NA			NA			NA			39.6	J		NA			NA			ND		
bis(2-Ethylhexyl)phthalate	117-81-7	ug/kg	120000	120000	45.3	J	L	ND			50.4	J	L	ND			NA			NA			NA			NA			NA			NA			NA			ND			NA			NA			55.4	J	
Fluoranthene	206-44-0	ug/kg	2200000	22000000	1190		L	988			1680		L	563			NA			NA			NA			NA			NA			NA			NA			376			NA			NA			ND		
Fluorene	86-73-7	ug/kg	2200000	22000000	200		L	991			573		L	762			NA			NA			NA			NA			NA			NA			NA			46.4			NA			NA			ND		
Indeno(1,2,3-cd)pyrene	193-39-5	ug/kg	2100	2100	77.6		L	66.4			110		L	41.2			NA			NA			NA			NA			NA			NA			NA			131			NA			NA			ND		
2-Methylnaphthalene	91-57-6	ug/kg	410000	2200000	345		L	7430			2880		L	6730			NA			NA			NA			NA			NA			NA			NA			24.2	J		NA			NA			ND		
Naphthalene	91-20-3	ug/kg	18000	18000	ND		UL	1260			ND		UL	1120			NA			NA			NA			NA			NA			NA			NA			45.0			NA			NA			ND		
Phenanthrene	85-01-8	ug/kg	1700000	NE	808		L	2430			1970		L	1590			NA			NA			NA			NA			NA			NA			NA			343			NA			NA			ND		
Pyrene	129-00-0	ug/kg	1700000	17000000	868		L	832			1320		L	522			NA			NA			NA			NA			NA			NA			NA			331			NA			NA			NA		
PCBs SW846 8082A																																															
Aroclor 1260	11096-82-5	ug/kg	740	740	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Pesticides SW846 8081B																																															
alpha-Chlordane	12789-03-6	ug/kg	6500	6500	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			NA			NA			ND		
gamma-Chlordane	12789-03-6	ug/kg	6500	6500	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			NA			NA			ND		
4,4'-DDD	50-29-3	ug/kg	7200	7200	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			NA			NA			ND		UJ
4,4'-DDE	50-29-3	ug/kg	5100	5100	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			NA			NA			ND		
4,4'-DDT	50-29-3	ug/kg	7000	7000	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			NA			NA			ND		
Heptachlor epoxide	1024-57-3	ug/kg	190	190	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			NA			NA			ND		
Methoxychlor	72-43-5	ug/kg	310000	3100000	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			NA			NA			ND		UJ
Herbicides SW846 8151																																															
2,4-D	94-75-7	ug/kg	NE	NE	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
2,4,5-TP (Silvex)	93-72-1	ug/kg	NE	4900000	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
TAL Metals SW846 6010B/7470A																																															
Aluminum	7429-90-5	mg/kg	99000	990000	NA			NA			NA			NA			NA			NA			NA			NA			15300			NA			NA			16800			NA			NA			NA		
Antimony	7440-36-0	mg/kg	41	410	NA			NA			NA			NA			NA			NA			NA			NA			<2.3			NA			NA			<2.4			NA			NA			NA		
Arsenic	7440-38-2	mg/kg	1.6	1.6	NA			NA			NA			NA			NA			NA			NA			NA			4.1			NA			NA			4.9			NA			NA			NA		
Barium	7440-39-3	mg/kg	19000	190000	NA			NA			NA			NA			NA			NA			NA			NA			62.5			NA			NA			69.9			NA			NA			NA		
Beryllium	7440-41-7	mg/kg	200	2000	NA			NA			NA			NA			NA			NA			NA			NA			0.83			NA			NA			0.73			NA			NA			NA		
Cadmium	7440-43-9	mg/kg	80	800	NA			NA			NA			NA			NA			NA			NA			NA			<0.58			NA			NA			<0.59			NA			NA			NA		
Calcium	7789-78 -8	mg/kg	NE	NE	NA			NA			NA			NA			NA			NA			NA			NA			1230			NA			NA			2390			NA			NA			NA		
Chromium	7440-47-3	mg/kg	5.6*	5.6*/1500000**	NA			NA			NA			NA			NA			NA			NA			NA			23.3			NA			NA			25.2			NA			NA			NA		
Cobalt	7440-48-4	mg/kg	30	300	NA			NA			NA			NA			NA			NA			NA			NA			7.3			NA			NA			6.9			NA			NA			NA		
Copper	7440-50-8	mg/kg	4100	410000	NA			NA			NA			NA			NA			NA			NA			NA			16.5			NA			NA			16.6			NA			NA			NA		
Iron	7439-89-6	mg/kg	72000	720000	NA			NA			NA			NA			NA			NA			NA			NA			22900			NA			NA			23300			NA			NA			NA		
Lead	7439-92-1	mg/kg	800	800	NA			NA			NA			NA			NA			NA			NA			NA			18.5			NA			NA			92.8			NA			NA			NA		
Magnesium	7439-95-4	mg/kg	NE	NE	NA			NA			NA			NA			NA			NA			NA			NA			2040			NA			NA			1630			NA			NA			NA		
Manganese	7439-96-5	mg/kg	2300	23000	NA			NA			NA			NA			NA			NA			NA			NA			119			NA			NA			285			NA			NA			NA		
Mercury	7439-97-6	mg/kg	4.3	43	NA			NA			NA			NA			NA			NA			NA			NA			<0.039			NA			NA			0.076			NA			NA			NA		
Nickel	1313-99-1	mg/kg	2000	20000	NA			NA			NA			NA			NA			NA			NA			NA			12.3			NA			NA			11.8			NA			NA			NA		
Potassium	7440-09-7	mg/kg	NE	NE	NA			NA			NA			NA			NA			NA			NA			NA			1500			NA			NA			1320			NA			NA			NA		
Selenium	7782-49-2	mg/kg	510	5100	NA			NA			NA			NA			NA			NA			NA			NA			<2.3			NA			NA			<2.4			NA			NA			NA		
Silver	7440-22-4	mg/kg	510	5100	NA			NA			NA			NA			NA			NA			NA			NA			<0.58			NA			NA			<0.59			NA			NA			NA		
Sodium	7681-49-4	mg/kg	NE	NE	NA			NA			NA			NA			NA			NA			NA			NA			<1200			NA			NA			<1200			NA			NA			NA		
Thallium	7440-28-0	mg/kg	1	10	NA			NA			NA			NA			NA			NA			NA			NA			<1.2			NA			NA			<1.2			NA			NA			NA		
Vanadium	7440-62-2	mg/kg	520	5200	NA			NA			NA			NA			NA			NA			NA			NA			36.6			NA			NA			38.8			NA			NA			NA		
Zinc	7440-66-6	mg/kg	31000	310000	NA			NA			NA			NA			NA			NA			NA			NA			41.0			NA			NA			74.3			NA			NA			NA		
Chromium SW846 6010B																																															
pH		su	NE	NE	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Redox Potential Vs H2		mv	NE	NE	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Chromium, Hexavalent	18540-29-9	mg/kg	NE	5.6	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Chromium, Trivalent	16065-83-1	mg/kg	NE	1500000	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Total Chromium	744047-3	mg/kg	5.6	5.6	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		

NOTES:
(0.5-1.25) = designates depth sample was collected below ground surface
TCL = Target Compound List
VOCs = volatile organic compounds
TPH = total petroleum hydrocarbons
TPH-DRO = diesel range TPH
TPH-GRO = gasoline range TPH
SVOCs = semi-VOCs
PCBs = polychlorinated biphenyls
TAL = Target Analyte List
EPA SW846 8260B = United States Environmental Protection Agency SW-846 analytical method
c = cancer
n = noncancer
L = user guide on lead
ug/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ND = not detected above analytical method reporting limit (RL)
NA = not analyzed
Blue shading designates a blind field duplicate and its associated counterpart sample
LQ = Laboratory Qualifiers
  J indicates an estimated value greater or equal to the analytical method detection limit but less than the RL
VQ = Validator Qualifiers
  NV indicates data not validated
  J indicates an estimated value
  UJ indicates the conspound or element was analyzed for but not detected. The sample detection limit is an estimated value
VDEQ-T3SCR = Commonwelath of Virginia Department of Environmental Quality Tier III screening concentration for restricted use soil (commercial/industrial) (6/26/12)
EPA-RSL-IS = United States Environmental Protection Agency, Region III, regional screening level for industrial use soil (November 2012)
* = represents VDEQ Release Reporting Requirement for TPH (total TPH)
** = chromium VI
*** = chromium III
Bold and right justification designates target compound was detected at a concentration above RL

TABLE 5. OLD WAREHOUSE AREA (OWA) SOIL ANALYTICAL RESULTS (DETECTIONS ONLY)

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Field ID:	CAS No.	Units	VDEQ-T3SCR	EPA-RSL-IS	12-OWA-SB10(0.75-1.75)	LQ	VQ	12-OWA-SB10(0.75-1.75)	LQ	VQ	12-ANCMP-DUP2-SO	LQ	VQ	12-ANCMP-DUP2-SO	LQ	VQ	12-OWA-SB10(5-6)	LQ	VQ	12-OWA-SB10(5-6)	LQ	VQ	12-OWA-SB11(1-2)	LQ	VQ	12-OWA-SB11(4-5)	LQ	VQ	12-OWA-SB11(4-5)	LQ	VQ	12-OWA-SB12(1-2)	LQ	VQ	12-OWA-SB12(1-2)	LQ	VQ	12-OWA-SB13(1-2)	LQ	VQ	12-OWA-SB13(1-2)	LQ	VQ
Sampling Date:					10/24/2012			11/30/2012			10/24/2012			11/30/2012			10/24/2012			11/30/2012			10/24/2012			10/24/2012			11/30/2012			10/24/2012			11/30/2012			10/24/2012			11/30/2012		
TPH SW846 8015C																																											
TPH-GRO (C6-C10)	None	mg/kg	**100**	**NE**	ND			NA			ND			NA			ND			NA			NA			**1040**			NA			ND			NA			ND			NA		
TPH-DRO (C10-C28)	None	mg/kg	**100**	**NE**	**27.8**			NA			ND			NA			ND			NA			NA			**503**			NA			**27.4**			NA			**38.3**			NA		
TCL VOCs SW846 8260B																																											
Acetone	67-64-1	ug/kg	**63000000**	**630000000**	**9.0**	J	L	**44.5**		L	**35.3**		L	ND		R	ND		R	ND		R	NA			ND		R	ND			**8.2**	J	L	**12.4**		L	ND		R	ND		R
Benzene	71-43-2	ug/kg	**5400**	**5400**	**0.32**	J	L	**1.1**			**0.38**	J	L	ND			**0.32**	J	L	ND			NA			ND		R	ND			ND		R	**0.35**	J		**0.33**	J	L	ND		
2-Butanone (MEK)	78-93-3	ug/kg	**20000000**	**200000000**	ND		R	ND		R	ND		R	ND		R	ND		R	ND		R	NA			ND		R	ND			ND		R	ND		R	ND		R	ND		R
Carbon disulfide	75-15-0	ug/kg	**370000**	**3700000**	ND		R	ND			ND		R	ND			ND		R	ND			NA			ND		R	ND			ND		R	ND			ND		R	ND		
Chlorobenzene	108-90-7	ug/kg	**140000**	**1400000**	ND		R	ND			ND		R	ND			ND		R	ND			NA			ND		R	ND			ND		R	ND			ND		R	ND		
Chloroform	67-66-3	ug/kg	**1500**	**1500**	ND		R	ND			ND		R	ND			ND		R	ND			NA			ND		R	ND			ND		R	ND			**0.37**	J	L	**0.36**	J	
Cyclohexane	557-21-1	ug/kg	**2900000**	**29000000**	ND		R	**1.7**	J		ND		R	ND			ND		R	ND			NA			ND		R	ND			ND		R	ND			ND		R	**2.0**	J	
1,2-Dichlorobenzene	95-50-1	ug/kg	**980000**	**9800000**	ND		R	ND			ND		R	ND			ND		R	ND			NA			ND		R	ND			ND		R	ND			ND		R	ND		
Ethylbenzene	100-41-4	ug/kg	**27000**	**27000**	ND		R	ND			ND		R	ND			ND		R	ND			NA			ND		R	ND			ND		R	ND			**0.94**		L	ND		
Isopropylbenzene (Cumene)	98-82-8	ug/kg	**1100000**	**11000000**	ND		R	ND			ND		R	ND			ND		R	ND			NA			ND		R	**532**	J		ND		R	ND			**1.1**	J	L	ND		
Methyl Acetate	79-20-9	ug/kg	**1000000000**	**1000000000**	ND		R	ND		R	ND		R	ND		R	ND		R	ND		R	NA			ND		R	ND			ND		R	ND		R	ND		R	ND		R
Methylcyclohexane	108-87- 2	ug/kg	**1400000**	**NA**	ND		R	**2.1**	J		**0.66**	J	L	ND			ND		R	ND			NA			**105**	J	L	**1040**	J		ND		R	ND			**1.3**	J	L	**5.2**		
Methyl Tert Butyl Ether	1634-04-4	ug/kg	**220000**	**220000**	**1.4**		L	ND			ND		L	**1.5**		L	ND		L	ND			NA			ND		R	ND			ND		R	ND			ND		R	ND		
Methylene chloride	75-09-2	ug/kg	**960000**	**960000**	**4.4**	J	L	ND			**9.6**		L	**7.9**		L	ND		R	ND			NA			ND		R	ND			ND		R	ND			ND		R	ND		
Toluene	108-88-3	ug/kg	**4500000**	**45000000**	ND		R	ND			**0.24**	J	L	ND			**0.26**	J	L	ND			NA			ND		R	ND			**0.26**	J	L	**1.9**			ND		R	ND		
m,p-Xylene	108-38-3	ug/kg	**NA**	**2500000**	ND		R	ND			ND		R	ND		R	ND		R	ND			NA			ND		R	ND			**0.34**	J	L	**0.76**	J		**1.1**		L	ND		
o-Xylene	95-47-6	ug/kg	**300000**	**3000000**	ND		R	ND			ND		R	ND		R	ND		R	ND			NA			ND		R	ND			ND		R	ND			**1.8**		L	**0.63**	J	
Xylene (total)	1330-20-7	ug/kg	**270000**	**2700000**	ND		R	ND			**0.24**	J	L	ND			ND		R	ND			NA			ND		R	ND			**0.34**	J	L	**0.76**	J		**2.9**		L	**0.63**	J	
TCL SVOCs SW846 8270D																																											
Acenaphthene	83-32-9	ug/kg	**3300000**	**33000000**	ND			NA			ND			NA			ND			NA			NA			**74.3**			NA			**154**			NA			**110**			NA		
Acenaphthylene	208-96-8	ug/kg	**1700000**	**NA**	ND			NA			ND			NA			ND			NA			NA			ND			NA			**72.9**			NA			**85.5**			NA		
Anthracene	120-12-7	ug/kg	**17000000**	**170000000**	ND			NA			ND			NA			ND			NA			NA			**15.8**	J		NA			**836**			NA			**560**			NA		
Benzo(a)anthracene	56-55-3	ug/kg	**2100**	**2100**	**36.2**	J		NA			ND			NA			ND			NA			NA			ND			NA			**1760**			NA			**1360**			NA		
Benzo(a)pyrene	50-32-8	ug/kg	**210**	**210**	**36.3**	J		NA			ND			NA			ND			NA			NA			ND			NA			**1500**			NA			**1240**			NA		
Benzo(b)fluoranthene	205-99-2	ug/kg	**2100**	**2100**	**50.2**			NA			ND			NA			ND			NA			NA			ND			NA			**1720**			NA			**1160**			NA		
Benzo(g,h,i)perylene	191-24-2	ug/kg	**1700000**	**NE**	**29.6**	J		NA			ND			NA			ND			NA			NA			ND			NA			**931**			NA			**787**			NA		
Benzo(k)fluoranthene	207-08-9	ug/kg	**21000**	**21000**	**16.4**	J		NA			ND			NA			ND			NA			NA			ND			NA			**843**			NA			**880**			NA		
1,1'-Biphenyl	92-52-4	ug/kg	**21000**	**210000**	ND			NA			ND			NA			ND			NA			NA			**21.5**	J		NA			**21.6**	J		NA			ND			NA		
Carbazole	86-74-8	ug/kg	**NA**	**NE**	ND			NA			ND			NA			ND			NA			NA			ND			NA			**246**			NA			**64.8**	J		NA		
Chrysene	218-01-9	ug/kg	**210000**	**210000**	**39.7**			NA			ND			NA			ND			NA			NA			ND			NA			**1600**			NA			**1240**			NA		
Dibenzo(a,h)anthracene	53-70-3	ug/kg	**210**	**210**	ND			NA			ND			NA			ND			NA			NA			ND			NA			**313**			NA			**275**			NA		
Dibenzofuran	132-64-9	ug/kg	**100000**	**1300000**	ND			NA			ND			NA			ND			NA			NA			ND			NA			**221**			NA			**81.2**			NA		
Dimethyl phthalate	131-11-3	ug/kg	**NE**	**NE**	ND			NA			ND			NA			ND			NA			NA			ND			NA			ND			NA			ND			NA		
bis(2-Ethylhexyl)phthalate	117-81-7	ug/kg	**120000**	**120000**	ND			NA			ND			NA			ND			NA			NA			**141**			NA			ND			NA			ND			NA		
Fluoranthene	206-44-0	ug/kg	**2200000**	**22000000**	**58.9**			NA			ND			NA			ND			NA			NA			ND			NA			**6790**			NA			**2740**			NA		
Fluorene	86-73-7	ug/kg	**2200000**	**22000000**	ND			NA			ND			NA			ND			NA			NA			**98.2**			NA			**449**			NA			**173**			NA		
Indeno(1,2,3-cd)pyrene	193-39-5	ug/kg	**2100**	**2100**	**24.0**	J		NA			ND			NA			ND			NA			NA			ND			NA			**920**			NA			**760**			NA		
2-Methylnaphthalene	91-57-6	ug/kg	**410000**	**2200000**	ND			NA			ND			NA			ND			NA			NA			**319**			NA			**34.2**	J		NA			**36.8**	J		NA		
Naphthalene	91-20-3	ug/kg	**18000**	**18000**	ND			NA			ND			NA			ND			NA			NA			**48.6**			NA			**43.1**			NA			**23.7**	J		NA		
Phenanthrene	85-01-8	ug/kg	**1700000**	**NE**	**27.1**	J		NA			ND			NA			ND			NA			NA			**238**			NA			**5650**			NA			**1630**			NA		
Pyrene	129-00-0	ug/kg	**1700000**	**17000000**	**56.9**			NA			ND			NA			ND			NA			NA			**32.0**	J		NA			**3490**			NA			**2140**			NA		
PCBs SW846 8082A																																											
Aroclor 1260	11096-82-5	ug/kg	**740**	**740**	ND			NA			ND			NA			ND			NA			NA			ND			NA			ND			NA			NA			NA		
Pesticides SW846 8081B																																											
alpha-Chlordane	12789-03-6	ug/kg	**6500**	**6500**	NA			NA			NA			NA			NA			NA			NA			ND			NA			ND			NA			ND			NA		
gamma-Chlordane	12789-03-6	ug/kg	**6500**	**6500**	NA			NA			NA			NA			NA			NA			NA			ND			NA			ND			NA			ND			NA		
4,4'-DDD	50-29-3	ug/kg	**7200**	**7200**	NA			NA			NA			NA			NA			NA			NA			**2.8**	J		NA			ND			NA			ND			NA		
4,4'-DDE	50-29-3	ug/kg	**5100**	**5100**	NA			NA			NA			NA			NA			NA			NA			ND			NA			ND			NA			**0.93**		J	NA		
4,4'-DDT	50-29-3	ug/kg	**7000**	**7000**	NA			NA			NA			NA			NA			NA			NA			ND			NA			ND			NA			**1.9**			NA		
Heptachlor epoxide	1024-57-3	ug/kg	**190**	**190**	NA			NA			NA			NA			NA			NA			NA			ND			NA			ND	UJ		NA			ND		UJ	NA		
Methoxychlor	72-43-5	ug/kg	**310000**	**3100000**	NA			NA			NA			NA			NA			NA			NA			ND	UJ		NA			ND	UJ		NA			ND		UJ	NA		
Herbicides SW846 8151																																											
2,4-D	94-75-7	ug/kg	**NE**	**NE**	NA			NA			NA			NA			NA			NA			NA			ND			NA			ND			NA			ND			NA		
2,4,5-TP (Silvex)	93-72-1	ug/kg	**NE**	**4900000**	NA			NA			NA			NA			NA			NA			NA			ND			NA			ND			NA			ND			NA		
TAL Metals SW846 6010B/7470A																																											
Aluminum	7429-90-5	mg/kg	**99000**	**990000**	**19700**			NA			**16900**			NA			**17900**			NA			**17000**			NA			NA			**16500**			NA			**11400**			NA		
Antimony	7440-36-0	mg/kg	**41**	**410**	<2.2			NA			<2.2			NA			<2.3			NA			<2.5			NA			NA			<2.3			NA			<2.2			NA		
Arsenic	7440-38-2	mg/kg	**1.6**	**1.6**	**4.5**			NA			**3.2**			NA			**4.5**			NA			**3.5**			NA			NA			<2.3			NA			**4.7**			NA		
Barium	7440-39-3	mg/kg	**19000**	**190000**	**53.1**			NA			**66.3**			NA			**67.7**			NA			**53.8**			NA			NA			**49.6**			NA			**46.9**			NA		
Beryllium	7440-41-7	mg/kg	**200**	**2000**	**0.66**			NA			**0.51**			NA			**0.67**			NA			**0.53**			NA			NA			**0.39**			NA			**0.44**			NA		
Cadmium	7440-43-9	mg/kg	**80**	**800**	<0.55			NA			<0.54			NA			<0.57			NA			<0.62			NA			NA			<0.57			NA			<0.55			NA		
Calcium	7789-78 -8	mg/kg	**NE**	**NE**	**2320**			NA			**1940**			NA			**1980**			NA			**2120**			NA			NA			**665**			NA			**1880**			NA		
Chromium	7440-47-3	mg/kg	**5.6***	**5.6*/1500000****	**24.0**			NA			**20.8**			NA			**20.6**			NA			**21.1**			NA			NA			**21.7**			NA			**20.4**			NA		
Cobalt	7440-48-4	mg/kg	**30**	**300**	<5.5			NA			<5.4			NA			**6.7**			NA			<6.2			NA			NA			<5.7			NA			**7.8**			NA		
Copper	7440-50-8	mg/kg	**4100**	**410000**	**9.5**			NA			**7.8**			NA			**8.5**			NA			**41.1**			NA			NA			**12.8**			NA			**10.2**			NA		
Iron	7439-89-6	mg/kg	**72000**	**720000**	**23000**			NA			**16900**			NA			**18200**			NA			**19300**			NA			NA			**10800**			NA			**17500**			NA		
Lead	7439-92-1	mg/kg	**800**	**800**	**16.3**			NA			**16.9**			NA			**66.3**			NA			**19.7**			NA			NA			**12.3**			NA			**44.0**			NA		
Magnesium	7439-95-4	mg/kg	**NE**	**NE**	**1230**			NA			**1050**			NA			**1130**			NA			**1140**			NA			NA			**759**			NA			**869**			NA		
Manganese	7439-96-5	mg/kg	**2300**	**23000**	**64.8**			NA			**49.2**			NA			**58.6**			NA			**59.3**			NA			NA			**19.4**			NA			**196**			NA		
Mercury	7439-97-6	mg/kg	**4.3**	**43**	**0.26**			NA			**0.051**			NA			**0.047**			NA			<0.039			NA			NA			<0.037			NA			**0.047**			NA		
Nickel	1313-99-1	mg/kg	**2000**	**20000**	**7.5**			NA			**6.8**			NA			**7.8**			NA			**6.5**			NA			NA			**4.9**			NA			**8.9**			NA		
Potassium	7440-09-7	mg/kg	**NE**	**NE**	**1150**			NA			<1100			NA			<1100			NA			**1420**			NA			NA			<1100			NA			<1100			NA		
Selenium	7782-49-2	mg/kg	**510**	**5100**	<2.2			NA			<2.2			NA			<2.3			NA			<2.5			NA			NA			<2.3			NA			<2.2			NA		
Silver	7440-22-4	mg/kg	**510**	**5100**	<0.55			NA			<0.54			NA			<0.57			NA			<0.62			NA			NA			<0.57			NA			<0.55			NA		
Sodium	7681-49-4	mg/kg	**NE**	**NE**	<1100			NA			<1100			NA			<1100			NA			<1200			NA			NA			<1100			NA			<1100			NA		
Thallium	7440-28-0	mg/kg	**1**	**10**	<1.1			NA			<1.1			NA			<1.1			NA			<1.2			NA			NA			<1.1			NA			<1.1			NA		
Vanadium	7440-62-2	mg/kg	**520**	**5200**	**39.7**			NA			**35.2**			NA			**35.6**			NA			**35.8**			NA			NA			**57.5**			NA			**29.4**			NA		
Zinc	7440-66-6	mg/kg	**31000**	**310000**	**39.0**			NA			**36.1**			NA			**61.9**			NA			**36.2**			NA			NA			**25.7**			NA			**39.5**			NA		
Chromium SW846 6010B																																											
pH		su	**NE**	**NE**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Redox Potential Vs HZ		mv	**NE**	**NE**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Chromium, Hexavalent	18540-29-9	mg/kg	**NE**	**5.6**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Chromium, Trivalent	16065-83-1	mg/kg	**NE**	**1500000**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Total Chromium	744047-3	mg/kg	**5.6**	**5.6**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		

NOTES:
(0.5-1.25) = designates depth sample was collected below ground surface
TCL = Target Compound List
VOCs = volatile organic compounds
TPH = total petroleum hydrocarbons
TPH-DRO = diesel range TPH
TPH-GRO = gasoline range TPH
SVOCs = semi-VOCs
PCBs = polychlorinated biphenyls
TAL = Target Analyte List
EPA SW846 8260B = United States Environmental Protection Agency SW-846 analytical method
c = cancer
n = noncancer
L = user guide on lead
ug/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ND = not detected above analytical method reporting limit (RL)
NA = not analyzed
Blue shading designates a blind field duplicate and its associated counterpart sample
LQ = Laboratory Qualifiers
J indicates an estimated value greater or equal to the analytical method detection limit but less than the RL
VQ = Validator Qualifiers
NV indicates data not validated
J indicates an estimated value
UJ indicates the compound or element was analyzed for but not detected. The sample detection limit is an estimated value
VDEQ-TSCR = Commonwelath of Virginia Department of Environmental Quality Tier III screening concentration for restricted use soil (commercial/industrial) (6/26/12)
EPA-RSL-IS = United States Environmental Protecton Agency, Region III, regional screening level for industrial use soil (November 2012)
* = represents VDEQ Release Reporting Requirement for TPH (total TPH)
** = chromium VI
*** = chromium III
Bold and right justification designates target compound was detected at a concentration above RL

TABLE 5. OLD WAREHOUSE AREA (OWA) SOIL ANALYTICAL RESULTS (DETECTIONS ONLY)

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Field ID:	CAS No.	Units	VDEQ-T3SCR	EPA-RSL-IS	12-OWA-SB14(0.33-1.33)	LQ	VQ	12-OWA-SB14(9.33-1.33)	LQ	VQ	12-OWA-SB15(0.38-1.38)	LQ	VQ	12-OWA-SB15(0.38-1.38)	LQ	VQ	12-OWA-SB16(0.63-1.63)	LQ	VQ	12-OWA-SB16(0.63-1.63)	LQ	VQ	12-ANCMP-DUP2-SO	LQ	VQ	12-ANCMP-DUP2-SO	LQ	VQ	12-OWA-SB17(0.38-1.38)	LQ	VQ	12-OWA-SB17(0.38-1.38)	LQ	VQ	12-OWA-SB18(0.29-1.29)	LQ	VQ	12-OWA-SB18(0.29-1.29)	LQ	VQ	12-OWA-SB19(1-2)	LQ	VQ	12-OWA-SB19(3-4)	LQ	VQ
Sampling Date:					10/25/2012			11/29/2012			10/25/2012			11/29/2012			10/25/2012			11/29/2012			10/25/2012			11/29/2012			10/25/2012			11/29/2012			10/25/2012			11/29/2012			11/29/2012			11/29/2012		
TPH SW846 8015C																																													
TPH-GRO (C6-C10)	None	mg/kg	**100**	**NE**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			NA			NA			NA		
TPH-DRO (C10-C28)	None	mg/kg	**100**	**NE**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			**66.4**			NA			NA			NA		
TCL VOCs SW846 8260B																																													
Acetone	67-64-1	ug/kg	**63000000**	**630000000**	**20.5**			NA			ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			NA			NA		
Benzene	71-43-2	ug/kg	**5400**	**5400**	ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			NA			NA		
2-Butanone (MEK)	78-93-3	ug/kg	**20000000**	**200000000**	ND		R	NA			ND		R	NA			ND		R	NA			ND		R	NA			ND		R	NA			**23.8**		L	NA			NA			NA		
Carbon disulfide	75-15-0	ug/kg	**370000**	**3700000**	**0.72**	J		NA			ND			NA			ND			NA			ND			NA			ND			NA			**10.6**			NA			NA			NA		
Chlorobenzene	108-90-7	ug/kg	**140000**	**1400000**	**0.66**	J		NA			ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			NA			NA		
Chloroform	67-66-3	ug/kg	**1500**	**1500**	ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			NA			NA		
Cyclohexane	557-21-1	ug/kg	**2900000**	**29000000**	ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			NA			NA		
1,2-Dichlorobenzene	95-50-1	ug/kg	**980000**	**9800000**	**0.32**	J		NA			ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			NA			NA		
Ethylbenzene	100-41-4	ug/kg	**27000**	**27000**	ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			**73.8**			NA			NA			NA		
Isopropylbenzene (Cumene)	98-82-8	ug/kg	**1100000**	**11000000**	ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			**1.1**	J		NA			NA			NA		
Methyl Acetate	79-20-9	ug/kg	**100000000**	**1000000000**	ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			NA			NA		
Methylcyclohexane	108-87-2	ug/kg	**1400000**	**NA**	ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			NA			NA		
Methyl Tert Butyl Ether	1634-04-4	ug/kg	**220000**	**220000**	ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			NA			NA		
Methylene chloride	75-09-2	ug/kg	**960000**	**960000**	**15.6**			NA			**12.1**			NA			**6.6**			NA			**7.1**	J		NA			**6.3**			NA			**10.9**			NA			NA			NA		
Toluene	108-88-3	ug/kg	**4500000**	**45000000**	ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			**0.80**	J		NA			NA			NA		
m,p-Xylene	108-38-3	ug/kg	**NA**	**2500000**	ND			NA			ND			NA			ND			NA			**0.62**	J		NA			ND			NA			**293**			NA			NA			NA		
o-Xylene	95-47-6	ug/kg	**300000**	**3000000**	ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			**119**			NA			NA			NA		
Xylene (total)	1330-20-7	ug/kg	**270000**	**2700000**	ND			NA			ND			NA			ND			NA			**0.62**	J		NA			ND			NA			**412**			NA			NA			NA		
TCL SVOCs SW846 8270D																																													
Acenaphthene	83-32-9	ug/kg	**3300000**	**33000000**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
Acenaphthylene	208-96-8	ug/kg	**1700000**	**NA**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
Anthracene	120-12-7	ug/kg	**17000000**	**170000000**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
Benzo(a)anthracene	56-55-3	ug/kg	**2100**	**2100**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
Benzo(a)pyrene	50-32-8	ug/kg	**210**	**210**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
Benzo(b)fluoranthene	205-99-2	ug/kg	**2100**	**2100**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
Benzo(g,h,i)perylene	191-24-2	ug/kg	**1700000**	**NE**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
Benzo(k)fluoranthene	207-08-9	ug/kg	**21000**	**21000**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
1,1'-Biphenyl	92-52-4	ug/kg	**21000**	**210000**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
Carbazole	86-74-8	ug/kg	**NE**	**NE**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
Chrysene	218-01-9	ug/kg	**210000**	**210000**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
Dibenzo(a,h)anthracene	53-70-3	ug/kg	**210**	**210**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
Dibenzofuran	132-64-9	ug/kg	**100000**	**1300000**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
Dimethyl phthalate	131-11-3	ug/kg	**NE**	**NE**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
bis(2-Ethylhexyl)phthalate	117-81-7	ug/kg	**120000**	**120000**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
Fluoranthene	206-44-0	ug/kg	**2200000**	**22000000**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
Fluorene	86-73-7	ug/kg	**2200000**	**22000000**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
Indeno(1,2,3-cd)pyrene	193-39-5	ug/kg	**2100**	**2100**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
2-Methylnaphthalene	91-57-6	ug/kg	**410000**	**2200000**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
Naphthalene	91-20-3	ug/kg	**18000**	**18000**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
Phenanthrene	85-01-8	ug/kg	**1700000**	**NE**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
Pyrene	129-00-0	ug/kg	**1700000**	**17000000**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			ND			ND		
PCBs SW846 8082A																																													
Aroclor 1260	11096-82-5	ug/kg	**740**	**740**	NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Pesticides SW846 8081B																																													
alpha-Chlordane	12789-03-6	ug/kg	**6500**	**6500**	ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			**2.5**	J		NA			NA			NA		
gamma-Chlordane	12789-03-6	ug/kg	**6500**	**6500**	ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			**4.9**	J		NA			NA			NA		
4,4'-DDD	50-29-3	ug/kg	**7200**	**7200**	**3.3**	J		NA			**7.5**			NA			**0.95**	J		NA			**1.2**			NA			ND			NA			**279**			NA			NA			NA		
4,4'-DDE	50-29-3	ug/kg	**5100**	**5100**	**2.1**			NA			**20.2**	J		NA			**2.0**	J		NA			ND			NA			ND			NA			**66.6**	J		NA			NA			NA		
4,4'-DDT	50-29-3	ug/kg	**7000**	**7000**	ND			NA			**183**			NA			**7.2**			NA			**2.2**	J		NA			**12.3**	J		NA			**20.4**			NA			NA			NA		
Heptachlor epoxide	1024-57-3	ug/kg	**190**	**190**	ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			ND			NA			NA			NA		
Methoxychlor	72-43-5	ug/kg	**310000**	**3100000**	ND			NA			ND			NA			**377**			NA			**59.0**			NA			ND			NA			ND			NA			NA			NA		
Herbicides SW846 8151																																													
2,4-D	94-75-7	ug/kg	**NE**	**NE**	ND		UJ	ND			ND		UJ	**82.8**			ND		UJ	ND			ND		UJ	ND			ND		UJ	ND			ND		UJ	ND			NA			NA		
2,4,5-TP (Silvex)	93-72-1	ug/kg	**NE**	**4900000**	ND		UJ	ND			**5.8**		J	**46.7**			**13.3**		J	**22.3**			**9.1**		J	**23.3**			**10.4**		J	**5.9**			**35.7**		J	**40.6**			NA			NA		
TAL Metals SW846 6010B/7470A																																													
Aluminum	7429-90-5	mg/kg	**99000**	**990000**	**5020**		K	NA			**5490**		K	NA			**18900**		K	NA			**16600**		K	NA			**12900**		K	NA			**16000**		K	NA			NA			NA		
Antimony	7440-36-0	mg/kg	**41**	**410**	<2.1		UL	NA			<2.0		UL	NA			<2.6		UL	NA			<2.5		UL	NA			<2.3		UL	NA			<2.3		UL	NA			NA			NA		
Arsenic	7440-38-2	mg/kg	**1.6**	**1.6**	**3.2**			NA			<2.0			NA			**3.8**			NA			**3.7**			NA			**3.5**			NA			**4.5**			NA			NA			NA		
Barium	7440-39-3	mg/kg	**19000**	**190000**	**29.1**			NA			**33.8**			NA			**69.5**			NA			**59.1**			NA			**53.5**			NA			**54.9**			NA			NA			NA		
Beryllium	7440-41-7	mg/kg	**200**	**2000**	**0.34**			NA			**0.32**			NA			**0.78**			NA			**0.64**			NA			**0.50**			NA			**0.63**			NA			NA			NA		
Cadmium	7440-43-9	mg/kg	**80**	**800**	<0.53			NA			<0.51			NA			<0.66			NA			<0.62			NA			<0.59			NA			<0.58			NA			NA			NA		
Calcium	7789-78 -8	mg/kg	**NE**	**NE**	<530			NA			**622**			NA			**1440**			NA			**4020**			NA			**4250**			NA			**2320**			NA			NA			NA		
Chromium	7440-47-3	mg/kg	**5.6***	**5.6*/1500000****	**10.7**			NA			**27.8**			NA			**22.2**			NA			**17.8**			NA			**19.4**			NA			**20.8**			NA			NA			NA		
Cobalt	7440-48-4	mg/kg	**30**	**300**	<5.3			NA			<5.1			NA			**7.7**			NA			**18.0**			NA			<5.9			NA			<5.8			NA			NA			NA		
Copper	7440-50-8	mg/kg	**4100**	**410000**	**3.7**			NA			**4.9**			NA			**13.0**			NA			**23.3**			NA			**9.6**			NA			**10.3**			NA			NA			NA		
Iron	7439-89-6	mg/kg	**72000**	**720000**	**11200**			NA			**8110**			NA			**27600**			NA			**24600**			NA			**14500**			NA			**18100**			NA			NA			NA		
Lead	7439-92-1	mg/kg	**800**	**800**	**16.1**			NA			**40.5**			NA			**102**			NA			**155**			NA			**39.8**			NA			**45.7**			NA			NA			NA		
Magnesium	7439-95-4	mg/kg	**NE**	**NE**	<530			NA			<510			NA			**1180**			NA			**1790**			NA			**1980**			NA			**1460**			NA			NA			NA		
Manganese	7439-96-5	mg/kg	**2300**	**23000**	**58.0**	L		NA			**69.6**	L		NA			**81.5**	L		NA			**107**	L		NA			**69.4**	L		NA			**56.7**			NA			NA			NA		
Mercury	7439-97-6	mg/kg	**4.3**	**43**	<0.036			NA			<0.034			NA			<0.036			NA			**0.069**			NA			<0.038			NA			**0.039**			NA			NA			NA		
Nickel	1313-99-1	mg/kg	**2000**	**20000**	<4.2			NA			**12.3**			NA			**8.9**			NA			**9.6**			NA			**17.2**			NA			**9.3**			NA			NA			NA		
Potassium	7440-09-7	mg/kg	**NE**	**NE**	<1100			NA			<1000			NA			<1300			NA			<1200			NA			<1200			NA			**1280**			NA			NA			NA		
Selenium	7782-49-2	mg/kg	**510**	**5100**	<2.1			NA			<2.0			NA			<2.6			NA			<2.5			NA			<2.3			NA			<2.3			NA			NA			NA		
Silver	7440-22-4	mg/kg	**510**	**5100**	<0.53			NA			<0.51			NA			**1.0**			NA			**1.3**			NA			**0.67**			NA			**0.83**			NA			NA			NA		
Sodium	7681-49-4	mg/kg	**NE**	**NE**	<1100			NA			<1000			NA			**2740**			NA			**2260**			NA			**2490**			NA			<1200			NA			NA			NA		
Thallium	7440-28-0	mg/kg	**1**	**10**	<1.1			NA			<1.0			NA			<1.3			NA			<1.2			NA			<1.2			NA			<1.2			NA			NA			NA		
Vanadium	7440-62-2	mg/kg	**520**	**5200**	**12.8**			NA			**11.7**			NA			**37.7**			NA			**42.5**			NA			**29.1**			NA			**34.0**			NA			NA			NA		
Zinc	7440-66-6	mg/kg	**31000**	**310000**	**12.2**			NA			**18.8**			NA			**42.0**			NA			**47.3**			NA			**35.2**			NA			**49.3**			NA			NA			NA		
Chromium SW846 6010B																																													
pH		su	**NE**	**NE**	NA			NA			NA			**8.08**			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Redox Potential Vs H2		mv	**NE**	**NE**	NA			NA			NA			**318**			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Chromium, Hexavalent	18540-29-9	mg/kg	**NE**	**5.6**	NA			NA			NA			**0.75**			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Chromium, Trivalent	16065-83-1	mg/kg	**NE**	**1500000**	NA			NA			NA			**23.5**			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		
Total Chromium	744047-3	mg/kg	**5.6**	**5.6**	NA			NA			NA			**24.2**			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA		

NOTES:
(0.5-1.25) = designates depth sample was collected below ground surface
TCL = Target Compound List
VOCs = volatile organic compounds
TPH = total petroleum hydrocarbons
TPH-DRO = diesel range TPH
TPH-GRO = gasoline range TPH
SVOCs = semi-VOCs
PCBs = polychlorinated biphenyls
TAL = Target Analyte List
EPA SW846 8260B = United States Environmental Protection Agency SW-846 analytical method
c = cancer
n = noncancer
L = user guide on lead
ug/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ND = not detected above analytical method reporting limit (RL)
NA = not analyzed
Blue shading designates a blind field duplicate and its associated counterpart sample
LQ = Laboratory Qualifiers
  J indicates an estimated value greater or equal to the analytical method detection limit but less than the RL
VQ = Validator Qualifiers
  NV indicates data not validated
  J indicates an estimated value
  UJ indicates the compound or element was analyzed for but not detected. The sample detection limit is an estimated value
VDEQ-T3SCR = Commonwealth of Virginia Department of Environmental Quality Tier III screening concentration for restricted use soil (commercial/industrial) (6/26/12)
EPA-RSL-IS = United States Environmental Protection Agency, Region III, regional screening level for industrial use soil (November 2012)
* = represents VDEQ Release Reporting Requirement for TPH (total TPH)
** = chromium VI
*** = chromium III
Bold and right justification designates target compound was detected at a concentration above RL

TABLE 5. OLD WAREHOUSE AREA (OWA) SOIL ANALYTICAL RESULTS (DETECTIONS ONLY)

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Field ID:	CAS No.	Units	VDEQ-T3SCR	EPA-RSL-IS	12-OWA-SB20(1-2)	LQ	VQ	12-OWA-SB20(3-4)	LQ	VQ	13-OWA-SB21(2-3)	LQ	VQ	13-OWA-SB22(2-3)	LQ	VQ	13-OWA-SB23(2-3)	LQ	VQ
Sampling Date:					11/29/2012			11/29/2012			2/14/2013			2/14/2013			2/14/2013		
TPH SW846 8015C																			
TPH-GRO (C6-C10)	None	mg/kg	**100**	**NE**	NA			NA			NA			ND			NA		
TPH-DRO (C10-C28)	None	mg/kg	**100**	**NE**	NA			NA			NA			**39.8**			NA		
TCL VOCs SW846 8260B																			
Acetone	67-64-1	ug/kg	**63000000**	**630000000**	NA			NA			NA			NA			NA		
Benzene	71-43-2	ug/kg	**5400**	**5400**	NA			NA			NA			NA			NA		
2-Butanone (MEK)	78-93-3	ug/kg	**20000000**	**200000000**	NA			NA			NA			NA			NA		
Carbon disulfide	75-15-0	ug/kg	**370000**	**3700000**	NA			NA			NA			NA			NA		
Chlorobenzene	108-90-7	ug/kg	**140000**	**1400000**	NA			NA			NA			NA			NA		
Chloroform	67-66-3	ug/kg	**1500**	**1500**	NA			NA			NA			NA			NA		
Cyclohexane	557-21-1	ug/kg	**2900000**	**29000000**	NA			NA			NA			NA			NA		
1,2-Dichlorobenzene	95-50-1	ug/kg	**980000**	**9800000**	NA			NA			NA			NA			NA		
Ethylbenzene	100-41-4	ug/kg	**27000**	**27000**	NA			NA			NA			NA			NA		
Isopropylbenzene (Cumene)	98-82-8	ug/kg	**1100000**	**11000000**	NA			NA			NA			NA			NA		
Methyl Acetate	79-20-9	ug/kg	**100000000**	**1000000000**	NA			NA			NA			NA			NA		
Methylcyclohexane	108-87- 2	ug/kg	**1400000**	**NA**	NA			NA			NA			NA			NA		
Methyl Tert Butyl Ether	1634-04-4	ug/kg	**220000**	**220000**	NA			NA			NA			NA			NA		
Methylene chloride	75-09-2	ug/kg	**960000**	**960000**	NA			NA			NA			NA			NA		
Toluene	108-88-3	ug/kg	**4500000**	**45000000**	NA			NA			NA			NA			NA		
m,p-Xylene	108-38-3	ug/kg	**NA**	**2500000**	NA			NA			NA			NA			NA		
o-Xylene	95-47-6	ug/kg	**300000**	**3000000**	NA			NA			NA			NA			NA		
Xylene (total)	1330-20-7	ug/kg	**270000**	**2700000**	NA			NA			NA			NA			NA		
TCL SVOCs SW846 8270D																			
Acenaphthene	83-32-9	ug/kg	**3300000**	**33000000**	**46.4**			ND			**868**			**465**			ND		
Acenaphthylene	208-96-8	ug/kg	**1700000**	**NA**	**31.8**	J		ND			**674**			**152**			ND		
Anthracene	120-12-7	ug/kg	**17000000**	**170000000**	**269**			**15.3**	J		**3370**			**1510**			ND		
Benzo(a)anthracene	56-55-3	ug/kg	**2100**	**2100**	**750**			**37.6**			**3350**			**1330**			ND		
Benzo(a)pyrene	50-32-8	ug/kg	**210**	**210**	**733**			**37.7**			**2540**			**1060**			ND		
Benzo(b)fluoranthene	205-99-2	ug/kg	**2100**	**2100**	**645**			**44.7**			**2360**			**995**			ND		
Benzo(g,h,i)perylene	191-24-2	ug/kg	**1700000**	**NE**	**478**			**34.8**			**1290**			**518**			ND		
Benzo(k)fluoranthene	207-08-9	ug/kg	**21000**	**21000**	**679**		J	**28.2**	J	J	**1830**			**760**			ND		
1,1'-Biphenyl	92-52-4	ug/kg	**21000**	**210000**	ND			ND			**167**			**83.2**			ND		
Carbazole	86-74-8	ug/kg	**NE**	**NE**	**46.1**	J		ND			**955**			**411**			ND		
Chrysene	218-01-9	ug/kg	**210000**	**210000**	**755**			**38.5**			**2990**			**1150**			ND		
Dibenz(a,h)anthracene	53-70-3	ug/kg	**210**	**210**	**186**			**23.1**	J		**420**			**175**			ND		
Dibenzofuran	132-64-9	ug/kg	**100000**	**1300000**	**44.3**	J		ND			**1550**			**628**			ND		
Dimethyl phthalate	131-11-3	ug/kg	**NE**	**NE**	ND			ND			ND			**54.7**	J		ND		
bis(2-Ethylhexyl)phthalate	117-81-7	ug/kg	**120000**	**120000**	ND			ND			ND			ND			ND		
Fluoranthene	206-44-0	ug/kg	**2200000**	**22000000**	**1550**			**59.7**			**14100**			**4050**			ND		
Fluorene	86-73-7	ug/kg	**2200000**	**22000000**	**91.2**			ND			**2620**			**961**			ND		
Indeno(1,2,3-cd)pyrene	193-39-5	ug/kg	**2100**	**2100**	**442**			**27.9**	J		**1270**			**530**			ND		
2-Methylnaphthalene	91-57-6	ug/kg	**410000**	**2200000**	ND			ND			**563**			**229**			ND		
Naphthalene	91-20-3	ug/kg	**18000**	**18000**	ND			ND			**809**			**266**			ND		
Phenanthrene	85-01-8	ug/kg	**1700000**	**NE**	**850**			**45.8**			**16500**			**5080**			ND		
Pyrene	129-00-0	ug/kg	**1700000**	**17000000**	**1220**			**49.9**			**9290**			**2500**			ND		
PCBs SW846 8082A																			
Aroclor 1260	11096-82-5	ug/kg	**740**	**740**	NA			NA			NA			NA			NA		
Pesticides SW846 8081B																			
alpha-Chlordane	12789-03-6	ug/kg	**6500**	**6500**	NA			NA			NA			NA			NA		
gamma-Chlordane	12789-03-6	ug/kg	**6500**	**6500**	NA			NA			NA			NA			NA		
4,4'-DDD	50-29-3	ug/kg	**7200**	**7200**	NA			NA			NA			NA			NA		
4,4'-DDE	50-29-3	ug/kg	**5100**	**5100**	NA			NA			NA			NA			NA		
4,4'-DDT	50-29-3	ug/kg	**7000**	**7000**	NA			NA			NA			NA			NA		
Heptachlor epoxide	1024-57-3	ug/kg	**190**	**190**	NA			NA			NA			NA			NA		
Methoxychlor	72-43-5	ug/kg	**310000**	**3100000**	NA			NA			NA			NA			NA		
Herbicides SW846 8151																			
2,4-D	94-75-7	ug/kg	**NE**	**NE**	NA			NA			NA			NA			NA		
2,4,5-TP (Silvex)	93-72-1	ug/kg	**NE**	**4900000**	NA			NA			NA			NA			NA		
TAL Metals SW846 6010B/7470A																			
Aluminum	7429-90-5	mg/kg	**99000**	**990000**	NA			NA			NA			NA			NA		
Antimony	7440-36-0	mg/kg	**41**	**410**	NA			NA			NA			NA			NA		
Arsenic	7440-38-2	mg/kg	**1.6**	**1.6**	NA			NA			NA			NA			NA		
Barium	7440-39-3	mg/kg	**19000**	**190000**	NA			NA			NA			NA			NA		
Beryllium	7440-41-7	mg/kg	**200**	**2000**	NA			NA			NA			NA			NA		
Cadmium	7440-43-9	mg/kg	**80**	**800**	NA			NA			NA			NA			NA		
Calcium	7789-78 -8	mg/kg	**NE**	**NE**	NA			NA			NA			NA			NA		
Chromium	7440-47-3	mg/kg	**5.6***	**5.6*/1500000****	NA			NA			NA			NA			NA		
Cobalt	7440-48-4	mg/kg	**30**	**300**	NA			NA			NA			NA			NA		
Copper	7440-50-8	mg/kg	**4100**	**41000**	NA			NA			NA			NA			NA		
Iron	7439-89-6	mg/kg	**72000**	**720000**	NA			NA			NA			NA			NA		
Lead	7439-92-1	mg/kg	**800**	**800**	NA			NA			NA			NA			NA		
Magnesium	7439-95-4	mg/kg	**NE**	**NE**	NA			NA			NA			NA			NA		
Manganese	7439-96-5	mg/kg	**2300**	**23000**	NA			NA			NA			NA			NA		
Mercury	7439-97-6	mg/kg	**4.3**	**43**	NA			NA			NA			NA			NA		
Nickel	1313-99-1	mg/kg	**2000**	**20000**	NA			NA			NA			NA			NA		
Potassium	7440-09-7	mg/kg	**NE**	**NE**	NA			NA			NA			NA			NA		
Selenium	7782-49-2	mg/kg	**510**	**5100**	NA			NA			NA			NA			NA		
Silver	7440-22-4	mg/kg	**510**	**5100**	NA			NA			NA			NA			NA		
Sodium	7681-49-4	mg/kg	**NE**	**NE**	NA			NA			NA			NA			NA		
Thallium	7440-28-0	mg/kg	**1**	**10**	NA			NA			NA			NA			NA		
Vanadium	7440-62-2	mg/kg	**520**	**5200**	NA			NA			NA			NA			NA		
Zinc	7440-66-6	mg/kg	**31000**	**310000**	NA			NA			NA			NA			NA		
Chromium SW846 6010B																			
pH		su	**NE**	**NE**	NA			NA			NA			NA			NA		
Redox Potential Vs H2		mv	**NE**	**NE**	NA			NA			NA			NA			NA		
Chromium, Hexavalent	18540-29-9	mg/kg	**NE**	**5.6**	NA			NA			NA			NA			NA		
Chromium, Trivalent	16065-83-1	mg/kg	**NE**	**1500000**	NA			NA			NA			NA			NA		
Total Chromium	744047-3	mg/kg	**5.6**	**5.6**	NA			NA			NA			NA			NA		

NOTES:
(0.5-1.25) = designates depth sample was collected below ground surface
TCL = Target Compound List
VOCs = volatile organic compounds
TPH = total petroleum hydrocarbons
TPH-DRO = diesel range TPH
TPH-GRO = gasoline range TPH
SVOCs = semi-VOCs
PCBs = polychlorinated biphenyls
TAL = Target Analyte List
EPA SW846 8260B = United States Environmental Protection Agency SW-846 analytical method
c = cancer
n = noncancer
L = user guide on lead
ug/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ND = not detected above analytical method reporting limit (RL)
NA = not analyzed
Blue shading designates a blind field duplicate and its associated counterpart sample
LQ = Laboratory Qualifiers
J indicates an estimated value greater or equal to the analytical method detection limit but less than the RL
VQ = Validator Qualifiers
NV indicates data not validated
J indicates an estimated value
UJ indicates the compound or element was analyzed for but not detected. The sample detection limit is an estimated value
VDEQ-T3SCR = Commonwelath of Virginia Department of Environmental Quality Tier III screening concentration for restricted use soil (commercial/industrial) (6/26/12)
EPA-RSL-IS = United States Environmental Protection Agency, Region III, regional screening level for industrial use soil (November 2012)
* = represents VDEQ Release Reporting Requirement for TPH (total TPH)
** = chromium VI
*** = chromium III
Bold and right justification designates target compound was detected at a concentration above RL

TABLE 6. BACKGROUND SOIL ANALYTICAL RESULTS (DETECTIONS ONLY)

EXPANDED ENVIRONMENTAL SITE INVESTIGATION
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Field ID:	CAS No.	Units	VDEQ-T3SCR	EPA-RSL-IS	ANC-BG-01	LQ	LQ	ANC-BG-02	LQ	LQ	ANC-BG-03	LQ	LQ	ANC-BG-04	LQ	LQ	ANC-BG-05	LQ	LQ	ANC-BG-06	LQ	VQ
Sample Depth (feet BSG):					0 - 0.5			0 - 0.5			0 - 0.5			0 - 0.5			0 - 0.5			0 - 0.5		
Sampling Date:					7/20/2009			7/20/2009			7/20/2009			7/20/2009			7/20/2009			7/20/2009		
TAL Metals SW846 6010B/7470A																						
Aluminum	7429-90-5	mg/kg	**99000**	**990000**	**4580**			**3790**			**3200**			**6050**			**8210**			**6080**		
Antimony	7440-36-0	mg/kg	**41**	**410**	**0.618**	J	B	<0.81			**0.435**	J	B	<0.786			<0.843			<0.8		
Arsenic	7440-38-2	mg/kg	**1.6**	**1.6**	**3.77**			**7.23**			**3.36**			**3.09**			**15.3**			**4.25**		
Barium	7440-39-3	mg/kg	**19000**	**190000**	**38.7**			**23.3**			**29.4**			**25.7**			**26.9**			**21.9**		
Beryllium	7440-41-7	mg/kg	**200**	**2000**	**0.197**	J	J	**0.087**	J	J	**0.114**	J	J	**0.257**	J	J	**0.265**	J	J	**0.191**	J	J
Cadmium	7440-43-9	mg/kg	**80**	**800**	**0.275**	J	J	**0.286**	J	J	**0.277**	J	J	**0.302**	J	J	**0.272**	J	J	**0.246**	J	J
Calcium	7789-78 -8	mg/kg	**NE**	**NE**	**706**			**106**			**742**			**3600**			**95.7**			**127**		
Chromium	7440-47-3	mg/kg	**5.6***	**5.6*/1500000****	**8.86**			**9.75**			**6.94**			**9.71**			**18.7**			**11.1**		
Cobalt	7440-48-4	mg/kg	**30**	**300**	**1.45**			**1.17**			**1.01**			**2.15**			**1.74**			**2.04**		
Copper	7440-50-8	mg/kg	**4100**	**410000**	**10.2**			**10.1**			**10.9**			**8.75**			**17.9**			**8.08**		
Iron	7439-89-6	mg/kg	**72000**	**720000**	**6080**	B		**9590**	B		**7240**	B		**11500**	B		**14200**	B		**12700**	B	
Lead	7439-92-1	mg/kg	**800**	**800**	**138**			**105**			**99.2**			**62**			**119**			**65.8**		
Magnesium	7439-95-4	mg/kg	**NE**	**NE**	**342**			**274**			**165**			**500**			**426**			**502**		
Manganese	7439-96-5	mg/kg	**2300**	**23000**	**70.6**			**30.1**			**23.5**			**55.7**			**28.5**			**66.5**		
Mercury	7439-97-6	mg/kg	**4.3**	**43**	**0.167**	J	J	**0.161**	J	J	**0.179**	J	J	**0.0966**	J	J	**0.186**	J	J	**0.0955**	J	J
Nickel	1313-99-1	mg/kg	**2000**	**20000**	**5.43**			**4.04**			**3.36**			**4.51**			**5.57**			**4.37**		
Potassium	7440-09-7	mg/kg	**NE**	**NE**	**330**			**283**			**263**			**364**			**384**			**3.04**		
Selenium	7782-49-2	mg/kg	**510**	**5100**	**1.39**			**1.15**			**0.904**			**0.569**			**1.19**			**0.67**		
Sodium	7681-49-4	mg/kg	**NE**	**NE**	**27.8**			**14.6**	J	J	**10.9**	J	J	**10.6**	J	J	**12**	J	J	**12**	J	J
Thallium	7440-28-0	mg/kg	**1**	**10**	**0.0816**			**0.141**			**0.101**			**0.0847**			**0.135**			**0.121**		
Vanadium	7440-62-2	mg/kg	**520**	**5200**	**34.3**			**51.5**			**36.4**			**27.4**			**44.8**			**35.9**		
Zinc	7440-66-6	mg/kg	**31000**	**310000**	**27.7**			**20.3**			**14.4**			**22.1**			**27.4**			**22.5**		

NOTES:
BGS = below ground surface
TCL = Target Compound List
VOCs = volatile organic compounds
TPH = total petroleum hydrocarbons
TPH-DRO = diesel range TPH
TPH-GRO = gasoline range TPH
SVOCs = semi-VOCs
PCBs = polychlorinated biphenyls
TAL = Target Analyte List
EPA SW846 8260B = United States Environmental Protection Agency SW-846 analytical method
c = cancer
n = noncancer
L = user guide on lead
ug/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
<1.2 = not detected above analytical method reporting limit (RL)
ND = not detected above RL
* = chromium VI
** = chromium III
Blue shading designates a blind field duplicate and its associated counterpart sample
LQ = Laboratory Qualifiers
  J indicates an estimated value greater or equal to the analytical method detection limit but less than the RL
  B indicates blank contamination. Value detected in sample and associated blank.
VQ = Validator Qualifiers
  J indicates an estimated value
VDEQ-T3SCR = Commonwelath of Virginia Department of Environmental Quality Tier III screening concentration for restricted use soil (commercial/industrial) (6/26/12)
EPA-RSL-IS = United States Environmental Protection Agency, Region III, regional screening level for industrial use soil (November 2012)
Bold and right justification designates target compound was detected at a concentration above RL
Yellow shading designates target compound was detected at a concentration above regulatory screening level in at least one sample
NE = not established

TABLE 7. FORT MEYER MOUND (FMM) SOIL ANALYTICAL RESULTS (DETECTIONS ONLY)

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Field ID:	CAS No.	Units	VDEQ-T3SCR	EPA-RSL-IS	13-FMM-SB1(12-13)	LQ	VQ	13-FMM-SB1(4-5)	LQ	VQ	13-FMM-SB2(1-2)	LQ	VQ	13-FMM-SB2(16-17)	LQ	VQ	13-FMM-SB2(24.5-25)	LQ	VQ	13-FMM-SB3(0.5-1.5)	LQ	VQ
Sampling Date:					2/14/2013			2/14/2013			2/14/2013			2/14/2013			2/14/2013			2/14/2013		
TPH SW846 8015C																						
TPH-GRO (C6-C10)	None	mg/kg	**100***	**NE**	ND			ND			ND			ND			NA			ND		
TPH-DRO (C10-C28)	None	mg/kg	**100***	**NE**	**75.6**			**581**			**50.0**			**93.8**			NA			ND		
TCL VOCs SW846 8260B																						
Acetone	67-64-1	ug/kg	**63000000**	**630000000**	**194**			**14.2**			ND			**13.1**			**52.7**			**17.6**		
2-Butanone (MEK)	78-93-3	ug/kg	**20000000**	**200000000**	**49.6**			ND			ND			ND			**12.0**			ND		
Ethylbenzene	100-41-4	ug/kg	**27000**	**27000**	ND			ND			ND			ND			**5.1**			ND		
Isopropylbenzene (Cumene)	98-82-8	ug/kg	**1100000**	**11000000**	**0.71**	J		ND			ND			ND			**2.1**	J		ND		
Toluene	108-88-3	ug/kg	**4500000**	**45000000**	ND			ND			ND			ND			**0.45**	J		ND		
o-Xylene	95-47-6	ug/kg	**300000**	**3000000**	ND			ND			ND			**0.35**	J		ND			ND		
Xylene (total)	1330-20-7	ug/kg	**270000**	**2700000**	ND			ND			ND			**0.35**	J		ND			ND		
TCL SVOCs SW846 8270D																						
Acenaphthene	83-32-9	ug/kg	**3300000**	**33000000**	**17.6**	J		ND			ND			**15.4**	J		NA			ND		
Acenaphthylene	208-96-8	ug/kg	**1700000**	**NA**	ND			ND			ND			**38.5**			NA			ND		
Anthracene	120-12-7	ug/kg	**17000000**	**170000000**	**43.5**			**65.5**			**24.0**	J		**64.7**			NA			ND		
Benzo(a)anthracene	56-55-3	ug/kg	**2100**	**2100**	**130**			**400**			**153**			**291**			NA			ND		
Benzo(a)pyrene	50-32-8	ug/kg	**210**	**210**	**118**			**237**			**118**			**305**			NA			ND		
Benzo(b)fluoranthene	205-99-2	ug/kg	**2100**	**2100**	**126**			**359**			**141**			**253**			NA			ND		
Benzo(g,h,i)perylene	191-24-2	ug/kg	**1700000**	**NE**	**75.2**			**157**			**82.6**			**188**			NA			ND		
Benzo(k)fluoranthene	207-08-9	ug/kg	**21000**	**21000**	**86.5**			**198**			**107**			**255**			NA			ND		
Carbazole	86-74-8	ug/kg	**NE**	**NE**	**19.5**	J		ND			ND			ND			NA			ND		
Chrysene	218-01-9	ug/kg	**210000**	**210000**	**140**			**420**			**159**			**309**			NA			ND		
Dibenzo(a,h)anthracene	53-70-3	ug/kg	**210**	**210**	**29.3**	J		**60.7**	J		**24.8**	J		**67.9**			NA			ND		
Dimethyl phthalate	131-11-3	ug/kg	**NE**	**NE**	**36.3**	J		ND			ND			**74.4**			NA			ND		
bis(2-Ethylhexyl)phthalate	117-81-7	ug/kg	**120000**	**120000**	ND			ND			ND			**36.5**	J		NA			ND		
Fluoranthene	206-44-0	ug/kg	**2200000**	**22000000**	**268**			**926**			**276**			**474**			NA			ND		
Fluorene	86-73-7	ug/kg	**2200000**	**22000000**	**22.7**	J		ND			ND			**23.2**	J		NA			ND		
Indeno(1,2,3-cd)pyrene	193-39-5	ug/kg	**2100**	**2100**	**66.7**			**149**			**71.8**			**161**			NA			ND		
2-Methylnaphthalene	91-57-6	ug/kg	**410000**	**2200000**	ND			ND			ND			**30.9**	J		NA			ND		
Naphthalene	91-20-3	ug/kg	**18000**	**18000**	**22.6**	J		ND			ND			**45.4**			NA			ND		
Phenanthrene	85-01-8	ug/kg	**1700000**	**NE**	**159**			**214**			**84.5**			**220**			NA			ND		
Pyrene	129-00-0	ug/kg	**1700000**	**17000000**	**228**			**792**			**222**			**547**			NA			ND		
PCBs SW846 8082A																						
Aroclor 1260	11096-82-5	ug/kg	**740**	**740**	**55.5**			NA			NA			NA			NA			NA		
Pesticides SW846 8081B																						
4,4'-DDD	50-29-3	ug/kg	**7200**	**7200**	**16.3**			NA			NA			NA			NA			NA		
4,4'-DDE	50-29-3	ug/kg	**5100**	**5100**	**33.4**			NA			NA			NA			NA			NA		
4,4'-DDT	50-29-3	ug/kg	**7000**	**7000**	**5.1**			NA			NA			NA			NA			NA		
Methoxychlor	72-43-5	ug/kg	**310000**	**3100000**	**2.1**			NA			NA			NA			NA			NA		
TAL Metals SW846 6010B/7470A																						
Aluminum	7429-90-5	mg/kg	**99000**	**990000**	**15100**			**17300**			**14000**			**12500**			NA			**10300**		
Arsenic	7440-38-2	mg/kg	**1.6**	**1.6**	**3.8**			**6.0**			**3.9**			**8.1**			NA			ND		
Barium	7440-39-3	mg/kg	**19000**	**190000**	**39.0**			**75.1**			**57.3**			**53.4**			NA			**64.5**		
Beryllium	7440-41-7	mg/kg	**200**	**2000**	ND			**0.47**			**0.53**			**0.37**			NA			**0.32**		
Cadmium	7440-43-9	mg/kg	**80**	**800**	ND			ND			ND			**0.97**			NA			ND		
Calcium	7789-78 -8	mg/kg	**NE**	**NE**	**11200**			**3460**			**3040**			**3380**			NA			**756**		
Chromium	7440-47-3	mg/kg	**5.6****	**5.6**/1500000****	**30.0**			**25.7**			**19.1**			**23.6**			NA			**13.9**		
Cobalt	7440-48-4	mg/kg	**30**	**300**	**17.6**			**6.7**			**6.5**			**5.9**			NA			ND		
Copper	7440-50-8	mg/kg	**4100**	**410000**	**33.7**			**21.0**			**20.8**			**26.4**			NA			**7.3**		
Iron	7439-89-6	mg/kg	**72000**	**720000**	**28700**			**26800**			**20100**			**18100**			NA			**14700**		
Lead	7439-92-1	mg/kg	**800**	**800**	**30.6**			**36.2**			**35.1**			**126**			NA			**8.0**		
Magnesium	7439-95-4	mg/kg	**NE**	**NE**	**9710**			**1390**			**1590**			**1280**			NA			**842**		
Manganese	7439-96-5	mg/kg	**2300**	**23000**	**386**			**226**			**162**			**133**			NA			**72.2**		
Mercury	7439-97-6	mg/kg	**4.3**	**43**	**0.16**			**0.044**			**0.085**			**0.43**			NA			ND		
Nickel	1313-99-1	mg/kg	**2000**	**20000**	**24.5**			**11.3**			**9.4**			**11.9**			NA			**5.2**		
Potassium	7440-09-7	mg/kg	**NE**	**NE**	ND			ND			ND			**1420**			NA			ND		
Silver	7440-22-4	mg/kg	**510**	**5100**	**1.3**			ND			**1.0**			ND			NA			ND		
Vanadium	7440-62-2	mg/kg	**520**	**5200**	**75.6**			**45.6**			**35.2**			**37.6**			NA			**25.3**		
Zinc	7440-66-6	mg/kg	**31000**	**310000**	**408**			**43.1**			**46.8**			**65.2**			NA			**25.3**		
Chromium SW846 6010B																						
pH	None	su	**NE**	**NE**	**8.14**			NA			NA			NA			NA			NA		
Redox Potential Vs H2	None	mv	**NE**	**NE**	**486**			NA			NA			NA			NA			NA		
Chromium, Hexavalent	18540-29-9	mg/kg	**NE**	**5.6**	ND			NA			NA			NA			NA			NA		
Chromium, Trivalent	16065-83-1	mg/kg	**NE**	**1500000**	**30**			NA			NA			NA			NA			NA		
Total Chromium	744047-3	mg/kg	**5.6**	**5.6**	**30**			NA			NA			NA			NA			NA		

NOTES:
(0.5-1.25) = designates depth sample was collected below ground surface
TCL = Target Compound List
VOCs = volatile organic compounds
TPH = total petroleum hydrocarbons
TPH-DRO = diesel range TPH
TPH-GRO = gasoline range TPH
SVOCs = semi-VOCs
PCBs = polychlorinated biphenyls
TAL = Target Analyte List
EPA SW846 8260B = United States Environmental Protection Agency SW-846 analytical method
ug/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ND = not detected above analytical method reporting limit (RL)
NA = not analyzed
Blue shading designates a blind field duplicate and its associated counterpart sample
LQ = Laboratory Qualifiers
J indicates an estimated value greater or equal to the analytical method detection limit but less than the RL
VQ = Validator Qualifiers
VDEQ-TSSCR = Commonwelath of Virginia Department of Environmental Quality Tier III screening concentration for restricted use soil (commercial/industrial) (6/26/12)
EPA-RSL-IS = United States Environmental Protection Agency, Region III, regional screening level for industrial use soil (November 2012)
* = represents VDEQ Release Reporting Requirement for TPH (total TPH)
** = chromium VI
*** = chromium III
Bold and right justification designates target compound was detected at a concentration above RL

TABLE 8. STORMWATER DIVERSION/INTERCEPTOR STOCKPILE (SDS) SOIL ANALYTICAL RESULTS (DETECTIONS ONLY)

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Field ID:	CAS No.	Units	VDEQ-T3SCR	EPA-RSL-IS	12-SDS-SB1(0.5-1.5)	LQ	VQ	12-SDS-SB1(8-9)	LQ	VQ	12-SDS-SB2(0.5-1.5)	LQ	VQ	12-SDS-SB3(0.5-1.5)	LQ	VQ	12-ANCMP-DUP4-SO	LQ	VQ	12-SDS-SB4(17.5-18.5)	LQ	VQ	12-SDS-SB4(6-7)	LQ	VQ	12-SDS-SB5(0.5-1.5)	LQ	VQ
Sampling Date:					11/16/2012			11/16/2012			11/16/2012			11/16/2012			11/16/2012			11/16/2012			11/16/2012			11/16/2012		
TPH SW846 8015C																												
TPH-GRO (C6-C10)	None	mg/kg	**100***	**NE**	**36.1**			ND			ND			ND			ND			ND			ND			ND		
TPH-DRO (C10-C28)	None	mg/kg	**100***	**NE**	ND			ND			ND			ND			ND			ND			**41.9**			**38.0**		
TCL VOCs SW846 8260B																												
Acetone	67-64-1	ug/kg	**63000000**	**630000000**	**34.7**			**11.7**			ND			**25.7**			**16.4**			**12.8**			**22.8**			ND		
2-Butanone (MEK)	78-93-3	ug/kg	**20000000**	**200000000**	**5.0**	J		ND			ND			ND			ND			ND			**3.1**	J		ND		
Carbon disulfide	75-15-0	ug/kg	**370000**	**3700000**	ND			ND			ND			ND			ND			ND			**0.40**	J		ND		
Methylene chloride	75-09-2	ug/kg	**960000**	**960000**	ND			**3.3**	J		ND			ND			**3.2**	J		ND			**3.1**	J		ND		
TCL SVOCs SW846 8270D																												
Acenaphthylene	208-96-8	ug/kg	**1700000**	**NA**	ND			ND			ND			ND			ND			ND			**25.6**	J		ND		
Anthracene	120-12-7	ug/kg	**17000000**	**170000000**	ND			ND			ND			ND			ND			ND			**50.2**			ND		
Benzo(a)anthracene	56-55-3	ug/kg	**2100**	**2100**	ND			ND			ND			ND			ND			ND			**102**			**24.6**	J	
Benzo(a)pyrene	50-32-8	ug/kg	**210**	**210**	ND			ND			ND			ND			ND			ND			**87.5**			**25.4**	J	
Benzo(b)fluoranthene	205-99-2	ug/kg	**2100**	**2100**	ND			ND			ND			ND			ND			ND			**51.3**			ND		
Benzo(g,h,i)perylene	191-24-2	ug/kg	**1700000**	**NE**	ND			ND			ND			ND			ND			ND			**74.3**			**22.2**	J	
Benzo(k)fluoranthene	207-08-9	ug/kg	**21000**	**21000**	ND			ND			ND			ND			ND			ND			**78.2**		J	**30.8**	J	J
Chrysene	218-01-9	ug/kg	**210000**	**210000**	ND			ND			ND			ND			ND			ND			**112**			**27.9**	J	
Di-n-butyl phthalate	84-74-2	ug/kg	**6200000**	**62000000**	ND			ND			ND			**125**			ND			ND			ND			ND		
Dimethyl phthalate	131-11-3	ug/kg	**NE**	**NE**	ND			ND			ND			ND			**39.4**	J		ND			ND			ND		
Fluoranthene	206-44-0	ug/kg	**2200000**	**22000000**	ND			ND			**54.0**			ND			ND			ND			**161**			**35.2**	J	
Indeno(1,2,3-cd)pyrene	193-39-5	ug/kg	**2100**	**2100**	ND			ND			ND			ND			ND			ND			**79.6**			**24.5**	J	
Phenanthrene	85-01-8	ug/kg	**1700000**	**NE**	ND			ND			ND			ND			ND			ND			**109**			**18.3**	J	
Pyrene	129-00-0	ug/kg	**1700000**	**17000000**	ND			ND			**45.3**			ND			ND			ND			**180**			**34.9**	J	
TAL Metals SW846 6010B/7470A																												
Aluminum	7429-90-5	mg/kg	**99000**	**990000**	**15900**			**16400**			**13200**			**19100**			**3600**			**19900**			**11400**			**14000**		
Arsenic	7440-38-2	mg/kg	**1.6**	**1.6**	**3.5**			**3.4**			**3.7**			**7.0**			ND			**4.3**			**2.8**			**3.0**		
Barium	7440-39-3	mg/kg	**19000**	**190000**	**56.6**			**46.6**			**65.8**			**65.1**			ND			**140**			**50.0**			**74.3**		
Beryllium	7440-41-7	mg/kg	**200**	**2000**	**1.1**			**0.58**			**0.67**			**1.6**			**0.22**			**1.2**			**0.84**			**1.2**		
Calcium	7789-78 -8	mg/kg	**NE**	**NE**	**1290**			ND			**688**			**527**			ND			ND			**2420**			**3080**		
Chromium	7440-47-3	mg/kg	**5.6****	**5.6**/1500000***	**30.9**			**22.4**			**23.6**			**99.0**			**16.2**			**30.5**			**21.4**			**21.0**		
Cobalt	7440-48-4	mg/kg	**30**	**300**	**8.2**			ND			**10.0**			**7.4**			ND			ND			**6.6**			**7.9**		
Copper	7440-50-8	mg/kg	**4100**	**410000**	**19.3**			**18.4**			**14.8**			**27.4**			**4.7**			**20.3**			**22.0**			**29.2**		
Iron	7439-89-6	mg/kg	**72000**	**720000**	**29600**			**26100**			**20600**			**59000**			**8990**			**35000**			**22900**			**27000**		
Lead	7439-92-1	mg/kg	**800**	**800**	**15.5**			**11.0**			**23.8**			**12.5**			**2.4**			**10.7**			**17.6**			**24.8**		
Magnesium	7439-95-4	mg/kg	**NE**	**NE**	**934**			**865**			**768**			**1000**			ND			**1960**			**1830**			**3020**		
Manganese	7439-96-5	mg/kg	**2300**	**23000**	**149**			**99.1**			**221**			**299**			**53.8**			**83.4**			**124**			**137**		
Mercury	7439-97-6	mg/kg	**4.3**	**43**	**0.042**			**0.070**			**0.081**			**0.044**			ND			ND			**0.10**			ND		
Nickel	1313-99-1	mg/kg	**2000**	**20000**	**5.3**			**6.7**			**7.1**			**12.7**			ND			**9.6**			**10.5**			**14.8**		
Potassium	7440-09-7	mg/kg	**NE**	**NE**	**1170**			ND			ND			**1010**			ND			**1750**			**1250**			**1830**		
Silver	7440-22-4	mg/kg	**510**	**5100**	ND			ND			ND			**2.6**			ND			ND			ND			ND		
Vanadium	7440-62-2	mg/kg	**520**	**5200**	**61.0**			**51.1**			**39.5**			**95.7**			**14.7**			**63.4**			**46.3**			**54.3**		
Zinc	7440-66-6	mg/kg	**31000**	**310000**	**30.5**			**25.3**			**43.3**			**47.6**			**10.1**			**59.3**			**50.6**			**61.0**		
Chromium SW846 6010B																												
pH	None	su	**NE**	**NE**	NA			NA			NA			**5.09**			NA			NA			NA			NA		
Redox Potential Vs H2	None	mv	**NE**	**NE**	NA			NA			NA			**383**			NA			NA			NA			NA		
Chromium, Hexavalent	18540-29-9	mg/kg	**NE**	**5.6**	NA			NA			NA			**0.74**			NA			NA			NA			NA		
Chromium, Trivalent	16065-83-1	mg/kg	**NE**	**1500000**	NA			NA			NA			**98.3**			NA			NA			NA			NA		
Total Chromium	744047-3	mg/kg	**5.6**	**5.6**	NA			NA			NA			**99.04**			NA			NA			NA			NA		

NOTES:
(0.5-1.25) = designates depth sample was collected below ground surface
TCL = Target Compound List
VOCs = volatile organic compounds
TPH = total petroleum hydrocarbons
TPH-DRO = diesel range TPH
TPH-GRO = gasoline range TPH
SVOCs = semi-VOCs
TAL = Target Analyte List
EPA SW846 8260B = United States Environmental Protection Agency SW-846 analytical method
c = cancer
n = noncancer
L = user guide on lead
ug/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ND = not detected above analytical method reporting limit (RL)
NA = not analyzed
Blue shading designates a blind field duplicate and its associated counterpart sample
LQ = Laboratory Qualifiers
  J indicates an estimated value greater or equal to the analytical method detection limit but less than the RL
VQ = Validator Qualifiers
  J indicates an estimated value
VDEQ-T3SCR = Commonwealth of Virginia Department of Environmental Quality Tier III screening concentration
    for restricted use soil (commercial/industrial) (6/26/12)
EPA-RSL-IS = United States Environmental Protection Agency, Region III, regional screening level for industrial
    use soil (November 2012)
* = represents VDEQ Release Reporting Requirement for TPH (total TPH)
** = chromium VI
*** = chromium III
Bold and right justification designates target compound was detected at a concentration above RL
Yellow shading designates target compound was detected at a concentration above regulatory screening level
    in at least one sample
NE = not established

TABLE 9. GROUNDWATER MONITORING WELL CONSTRUCTION INFORMATION

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Well ID	Date Installed	Construction Material	Inner Diameter (inches)	Total Depth (feet BGS)	Screen Interval (feet BGS)	Top of Casing Elevation (feet)	Ground Elevation (feet)
12-SMY-SB6	10/23/2012	PVC	1.00	15.0	5.0 - 15.0	126.19	125.80
13-SMY-SB7	2/14/2013	PVC	0.75	18.0	8.0 - 18.0	124.25*	122.00*
12-ESMY-SB1	10/23/2012	PVC	1.00	15.0	5.0 - 15.0	110.93	109.53
12-OWA-SB1	10/23/2012	PVC	1.00	14.0	4.0 - 14.0	118.40	117.15
12-OWA-SB3	10/23/2012	PVC	1.00	10.0	2.0 - 10.0	109.95	106.98
12-OWA-SB4	10/23/2012	PVC	1.00	12.0	2.0 - 12.0	105.75	104.50
12-OWA-SB6	10/24/2012	PVC	0.75	8.0	3.0 - 8.0	102.62	100.28
12-OWA-SB7	10/24/2012	PVC	0.75	12.0	2.0 - 12.0	101.36	98.65
12-OWA-SB10	10/24/2012	PVC	0.75	13.5	3.5 - 13.5	113.36	111.54
12-OWA-SB11	10/24/2012	PVC	0.75	15.0	5.0 - 15.0	109.20	107.17
13-FMM-SB2	2/14/2013	PVC	0.75	27.5	17.5 - 27.5	158.38*	157.00*
13-FMM-SB3	2/14/2013	PVC	0.75	13.0	3.0 - 13.0	134.71*	132.00*
12-SDS-SB2	11/16/2012	PVC	0.75	30.0	20.0 - 30.0	154.24*	153.00*

NOTES:
All survey data obtained from Rice Associates
* designates location was not surveyed, coordinates and elevation are estimated
Horizontal datum is based upon The Virginia Coordinate System of 1983, North Zone (grid)
Vertical datum is based upon The North American Datum of 1988 (NAVD88)
TOC = top of casing
BGS = below ground surface
PVC = polyvinyl chloride

TABLE 10. HISTORICAL GROUNDWATER MONITORING WELL MEASUREMENTS

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Well ID	Top of Casing Elevation (feet)	Ground Surface Elevation (feet)	Date	Total Well Depth (feet BGS)	Depth to Petroleum Free Product (feet below top of casing)	Depth to Groundwater (feet below top of casing)	Groundwater Elevation (feet)
12-SMY-SB6	126.19	125.80	10/25/2012	15.0	NO	10.47	115.72
			11/5/2012		NO	10.12	116.07
13-SMY-SB7	124.25*	122.00*	2/15/2013	18.0	NO	14.10	110.15
12-ESMY-SB1	110.93	109.53	10/25/2012	15.0	NO	9.23	101.70
			11/5/2012		NO	8.04	102.89
12-OWA-SB1	118.40	117.15	10/25/2012	14.0	NO	10.07	108.33
			11/5/2012		NO	8.09	110.31
12-OWA-SB3	109.95	106.98	10/25/2012	10.0	NO	5.37	104.58
			10/26/2012		NO	5.38	104.57
12-OWA-SB4	105.75	104.50	10/25/2012	12.0	NO	6.76	98.99
			11/6/2012		NO	6.42	99.33
12-OWA-SB6	102.62	100.28	10/25/2012	8.0	NO	5.21	97.41
			10/26/2012		NO	5.20	97.42
12-OWA-SB7	101.36	98.65	10/25/2012	12.0	NO	6.26	95.10
			10/26/2012		NO	6.25	95.11
12-OWA-SB10	113.36	111.54	10/25/2012	13.5	NO	9.98	103.38
			11/6/2012		NO	DAM	DAM
12-OWA-SB11	109.20	107.17	10/25/2012	15.0	NO	6.62	102.58
			10/26/2012		NO	6.65	102.55
13-FMM-SB2	158.38*	157.00*	2/15/2013	27.5	NO	26.47	131.91
13-FMM-SB3	134.71*	132.00*	2/15/2013	13.0	NO	5.06	129.65
12-SDS-SB2	154.24*	153.00*	11/16/2012	30.0	NO	24.12	130.12

NOTES:
All survey data obtained from Rice Associates
* designates location was not surveyed, coordinates and elevation are estimated
Horizontal datum is based upon The Virginia Coordinate System of 1983, North Zone (grid)
Vertical datum is based upon The North American Datum of 1988 (NAVD88)
NO = not observed
DRY = well dry
BGS = below ground surface
NS = not surveyed
DAM = well damaged, measurement could not be collected

TABLE 11. SALVAGE METAL YARD (SMY) GROUNDWATER ANALYTICAL RESULTS (DETECTIONS ONLY)

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Field ID:	CAS No.	Units	VDEQ-T3CGWSL	VDEQ-CWTGNC	VDEQ-CWTGC		12-SMY-SB6(GW)	LQ	VQ	12-SMY-SB7(GW)	LQ	VQ
					Dermal Contact and Incidental Ingestion	Inhalation						
Sampling Date:							11/5/2012			2/14/2013		
TPH SW846 8015C												
TPH-GRO (C6-C10)	None	mg/l	**NE**	**NE**	**NE**	**NE**	ND			ND		
TPH-DRO (C10-C28)	None	mg/l	**NE**	**NE**	**NE**	**NE**	ND			ND		
TCL VOCs SW846 8260B												
Chloroform	67-66-3	ug/l	**27.3**	**520**	**1580**	**7.08**	ND			**0.41**	J	
Methyl Tert Butyl Ether	1634-04-4	ug/l	**1960**	**292000**	**112000**	**585**	ND			**4.3**		
TCL SVOCs SW846 8270D												
None.		ug/l					ND			ND		
TAL Total Metals SW846 6010B/7470A												
Aluminum	7429-90-5	ug/l	**NE**	**NE**	**620000**	**NE**	**1060**			NA		
Beryllium	7440-41-7	ug/l	**NE**	**NE**	**53.6**	**NE**	**5.4**			NA		
Calcium	7789-78 -8	ug/l	**NE**	**NE**	**NE**	**NE**	**41300**			NA		
Cobalt	7440-48-4	ug/l	**NE**	**NE**	**2430**	**NE**	**158**			NA		
Iron	7439-89-6	ug/l	**NE**	**NE**	**431000**	**NE**	**1900**			NA		
Magnesium	7439-95-4	ug/l	**NE**	**NE**	**NE**	**NE**	**37200**			NA		
Manganese	7439-96-5	ug/l	**NE**	**NE**	**8180**	**NE**	**1100**			NA		
Nickel	1313-99-1	ug/l	**NE**	**NE**	**4750**	**NE**	**67.0**			NA		
Potassium	7440-09-7	ug/l	**NE**	**NE**	**NE**	**NE**	**19500**			NA		
Sodium	7681-49-4	ug/l	**NE**	**NE**	**NE**	**NE**	**115000**			NA		
Zinc	7440-66-6	ug/l	**NE**	**NE**	**220000**	**NE**	**92.7**			NA		
TAL Dissolved Metals SW846 6010B/7470A												
Aluminum	7429-90-5	ug/l	**NE**	**NE**	**620000**	**NE**	**1050**			NA		
Beryllium	7440-41-7	ug/l	**NE**	**NE**	**53.6**	**NE**	**5.5**			NA		
Calcium	7789-78 -8	ug/l	**NE**	**NE**	**NE**	**NE**	**41500**			NA		
Cobalt	7440-48-4	ug/l	**NE**	**NE**	**2430**	**NE**	**162**			NA		
Iron	7439-89-6	ug/l	**NE**	**NE**	**431000**	**NE**	**1890**			NA		
Magnesium	7439-95-4	ug/l	**NE**	**NE**	**NE**	**NE**	**37200**			NA		
Manganese	7439-96-5	ug/l	**NE**	**NE**	**8180**	**NE**	**1080**			NA		
Nickel	1313-99-1	ug/l	**NE**	**NE**	**4750**	**NE**	**70.1**			NA		

TABLE 11. SALVAGE METAL YARD (SMY) GROUNDWATER ANALYTICAL RESULTS (DETECTIONS ONLY)

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Field ID:	CAS No.	Units	VDEQ-T3CGWSL	VDEQ-CWTGNC	VDEQ-CWTGC		12-SMY-SB6(GW)	LQ	VQ	12-SMY-SB7(GW)	LQ	VQ
					Dermal Contact and Incidental Ingestion	Inhalation						
Sampling Date:							11/5/2012			2/14/2013		
Potassium	7440-09-7	ug/l	**NE**	**NE**	**NE**	**NE**	**19500**			NA		
Sodium	7681-49-4	ug/l	**NE**	**NE**	**NE**	**NE**	**114000**			NA		
Zinc	7440-66-6	ug/l	**NE**	**NE**	**220000**	**NE**	**108**			NA		

NOTES:
TCL = Target Compound List
VOCs = volatile organic compounds
TPH = total petroleum hydrocarbons
TPH-DRO = diesel range TPH
TPH-GRO = gasoline range TPH
SVOCs = semi-VOCs
TAL = Target Analyte List
EPA SW846 8260B = United States Environmental Protection Agency SW-846 analytical method
ug/l = micrograms per liter
mg/l = milligrams per liter
ND = not detected above analytical method reporting limit (RL)
NA = not analyzed
* = chromium VI
** = chromium III
LQ = Laboratory Qualifiers
J indicates an estimated value greater or equal to the analytical method detection limit but less than the RL
VQ = Validator Qualifiers
VDEQ = Commonwelath of Virginia Department of Environmental Quality
VDEQ-T3CGWSL = VDEQ Tier III commercial groundwater screening level for restricted groundwater use commercial land use inhalation of indoor air (7/23/12)
VDEQ-CWTGNC = VDEQ Tier III groundwater concentration for construction worker in a trench groundwater not contacted (7/23/12)
VDEQ-CWTGC = VDEQ Tier III groundwater concentration for construction worker in a trench groundwater contacted (7/23/12)
Bold and right justification designates target compound was detected at a concentration above RL
Yellow shading designates target compound was detected at a concentration above regulatory screening level in at least one sample
NE = not established

TABLE 12. AREA EAST OF SALVAGE METAL YARD (ESMY) GROUNDWATER ANALYTICAL RESULTS (DETECTIONS ONLY)

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Field ID:	CAS No.	Units	VDEQ-T3CGWSL	VDEQ-CWTGNC	VDEQ-CWTGC		12-ESMY-SB1(GW)	LQ	VQ
					Dermal Contact and Incidental Ingestion	Inhalation			
Sampling Date:							11/5/2012		
TPH SW846 8015C									
TPH-GRO (C6-C10)	None	mg/l	**NE**	**NE**	**NE**	**NE**	ND		
TPH-DRO (C10-C28)	None	mg/l	**NE**	**NE**	**NE**	**NE**	ND		
TCL VOCs SW846 8260B									
Methyl Tert Butyl Ether	1634-04-4	ug/l	**1960**	**292000**	**112000**	**585**	**0.25**	J	
TCL SVOCs SW846 8270D									
None		ug/l					ND		
TAL Total Metals SW846 6010B/7470A									
Aluminum	7429-90-5	ug/l	**NE**	**NE**	**620000**	**NE**	**499**		
Calcium	7789-78 -8	ug/l	**NE**	**NE**	**NE**	**NE**	**6850**		
Iron	7439-89-6	ug/l	**NE**	**NE**	**431000**	**NE**	**19800**		
Magnesium	7439-95-4	ug/l	**NE**	**NE**	**NE**	**NE**	**6830**		
Manganese	7439-96-5	ug/l	**NE**	**NE**	**8180**	**NE**	**488**		
Sodium	7681-49-4	ug/l	**NE**	**NE**	**NE**	**NE**	**75600**		
TAL Dissolved Metals SW846 6010B/7470A									
Calcium	7789-78 -8	ug/l	**NE**	**NE**	**NE**	**NE**	**7130**		
Iron	7439-89-6	ug/l	**NE**	**NE**	**431000**	**NE**	**21800**		
Magnesium	7439-95-4	ug/l	**NE**	**NE**	**NE**	**NE**	**7260**		
Manganese	7439-96-5	ug/l	**NE**	**NE**	**8180**	**NE**	**530**		
Sodium	7681-49-4	ug/l	**NE**	**NE**	**NE**	**NE**	**78600**		

NOTES:
TCL = Target Compound List
VOCs = volatile organic compounds
TPH = total petroleum hydrocarbons
TPH-DRO = diesel range TPH
TPH-GRO = gasoline range TPH
SVOCs = semi-VOCs
TAL = Target Analyte List
EPA SW846 8260B = United States Environmental Protection Agency SW-846 analytical method
ug/l = micrograms per liter
mg/l = milligrams per liter
ND = not detected above analytical method reporting limit (RL)
NA = not analyzed
* = chromium VI
** = chromium III
LQ = Laboratory Qualifiers
J indicates an estimated value greater or equal to the analytical method detection limit but less than the RL
VQ = Validator Qualifiers
VDEQ = Commonwelath of Virginia Department of Environmental Quality
VDEQ-T3CGWSL = VDEQ Tier III commercial groundwater screening level for restricted groundwater use commercial land use inhalation of indoor air (7/23/12)
VDEQ-CWTGNC = VDEQ Tier III groundwater concentration for construction worker in a trench groundwater not contacted (7/23/12)
VDEQ-CWTGC = VDEQ Tier III groundwater concentration for construction worker in a trench groundwater contacted (7/23/12)
Bold and right justification designates target compound was detected at a concentration above RL
Yellow shading designates target compound was detected at a concentration above regulatory screening level in at least one sample
NE = not established

TABLE 13. OLD WAREHOUSE AREA (OWA) GROUNDWATER ANALYTICAL RESULTS

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Field ID:	CAS No.	Units	VDEQ-T3CGWSL	VDEQ-CWTGNC	VDEQ-CWTGC Dermal Contact and Incidental Ingestion	VDEQ-CWTGC Inhalation	ANC-GW-01	LQ	VQ	ANC-GW-02	LQ	VQ	ANC-GW-03	LQ	VQ	ANC-GW-03DUP	LQ	VQ	12-OWA-SB1(GW)	LQ	VQ	12-ANCMP-DUP3-GW	LQ	VQ	12-OWA-SB3(GW)	LQ	VQ	12-OWA-SB3(GW)	LQ	VQ	12-ANCMP-DUP2(GW)	LQ	VQ	12-OWA-SB4(GW)	LQ	VQ	12-OWA-SB6(GW)	LQ	VQ	12-OWA-SB6(GW)	LQ	VQ	12-ANCMP-DUP1(GW)	LQ	VQ	12-ANCMP-DUP1-GW	LQ	VQ	12-OWA-SB7(GW)	LQ	VQ	12-OWA-SB7(GW)	LQ	VQ
Sampling Date:							8/3/2009			8/3/2009			8/3/2009			8/3/2009			11/5/2012			11/5/2012			10/26/2012			11/30/2012			10/26/2012			11/6/2012			10/26/2012			11/29/2012			10/26/2012			11/29/2012			10/26/2012			11/30/2012		
TPH SW846 8015C																																																				
TPH-GRO (C6-C10)	None	mg/l	**NE**	**NE**	**NE**	**NE**	ND			ND			ND			ND			ND			NA			ND		UJ	ND			NA			**3.85**			ND			UJ	ND			ND		UJ	ND			**2.20**		J	**2.49**		
TPH-DRO (C10-C28)	None	mg/l	**NE**	**NE**	**NE**	**NE**	ND			ND			ND			ND			NA			NA			ND			NA			NA			**13.1**			ND				NA			ND			NA			**0.281**			NA		
TCL VOCs SW846 8260B																																																				
Acetone	67-64-1	ug/l	**8540000**	**42000000**	**666000**	**13200**	NA			NA			NA			NA			ND			NA			ND		R	NA			NA			**25.2**			ND			R	NA			**3.6**	J	L	NA			ND		R	NA		
Benzene	71-43-2	ug/l	**43.9**	**1070**	**871**	**15**	NA			NA			NA			NA			ND			NA			ND			NA			NA			**73.6**			ND				NA			ND			NA			**6.0**			NA		
Carbon tetrachloride	56-23-5	ug/l	**1.64**	**275**	**269**	**26.1**	NA			NA			NA			NA			ND			NA			ND			NA			NA			ND			**0.45**	J		NA			**0.38**	J		NA			ND			NA		
Chloroform	67-66-3	ug/l	**27.3**	**520**	**1580**	**7.08**	NA			NA			NA			NA			**0.58**	J		NA			ND			NA			NA			ND			**0.62**	J		NA			**0.51**	J		NA			ND			NA		
Chloromethane	74-87-3	ug/l	**109**	**528**	**NE**	**13.5**	NA			NA			NA			NA			ND			NA			ND			NA			NA			ND			ND				NA			**0.69**	J		NA			ND			NA		
Cyclohexane	557-21-1	ug/l	**329**	**7170**	**NE**	**3470**	NA			NA			NA			NA			ND			NA			ND			NA			NA			**87.4**			ND				NA			ND			NA			**105**			NA		
Ethylbenzene	100-41-4	ug/l	**27.6**	**3090**	**1440**	**61**	NA			NA			NA			NA			ND			NA			ND			NA			NA			**690**			ND				NA			ND			NA			**0.75**	J		NA		
Isopropylbenzene	98-82-8	ug/l	**3.68**	**34.6**	**6550**	**92**	NA			NA			NA			NA			ND			NA			ND			NA			NA			**64.0**			ND				NA			ND			NA			**28.9**			NA		
Methylcyclohexane	108-87- 2	ug/l	**74.5**	**650**	**NE**	**624**	NA			NA			NA			NA			ND			NA			ND			NA			NA			**153**			ND				NA			ND			NA			**90.9**			NA		
Methyl Tert Butyl Ether	1634-04-4	ug/l	**1960**	**292000**	**112000**	**585**	NA			NA			NA			NA			ND			NA			ND			NA			NA			**2.9**			ND				NA			ND			NA			**1.9**			NA		
Methylene chloride	75-09-2	ug/l	**2930**	**88400**	**16700**	**596**	NA			NA			NA			NA			ND			NA			ND			NA			NA			ND			ND				NA			ND			NA			**7.7**			NA		
1,1,2,2-Tetrachloroethane	79-34-5	ug/l	**15**	**3210**	**475**	**3.79**	NA			NA			NA			NA			ND			NA			ND			NA			NA			ND			ND				NA			ND			NA			**0.54**	J		NA		
Toluene	108-88-3	ug/l	**8050**	**56400**	**35500**	**1020**	NA			NA			NA			NA			ND			NA			ND			NA			NA			**6.4**			ND				NA			ND			NA			**2.8**			NA		
m,p-Xylene	108-38-3	ug/l	**139**	**1100**	**5370**	**21.8**	NA			NA			NA			NA			ND			NA			ND			NA			NA			**29.6**			ND				NA			ND			NA			**6.1**			NA		
o-Xylene	95-47-6	ug/l	**206**	**1440**	**5980**	**21.9**	NA			NA			NA			NA			ND			NA			ND			NA			NA			**12.2**			ND				NA			ND			NA			**2.2**			NA		
Xylene (total)	1330-20-7	ug/l	**206**	**7350**	**11500**	**87.4**	NA			NA			NA			NA			ND			NA			ND			NA			NA			**41.8**			ND				NA			ND			NA			**8.3**			NA		
TCL SVOCs SW846 8270D																																																				
Acenaphthene	83-32-9	ug/l	**NE**	**NE**	**2350**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			NA			**3.8**			ND				NA			ND			NA			**0.34**	J		NA		
Anthracene	120-12-7	ug/l	**NE**	**NE**	**7900**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			NA			**1.2**			ND				NA			ND			NA			**0.52**	J		NA		
Benzo(a)anthracene	56-55-3	ug/l	**814**	**243000**	**1.67**	**33**	NA			NA			NA			NA			**0.40**	J		NA			ND			NA			NA			ND			ND				NA			ND			NA			**1.3**	J		NA		
Benzo(b)fluoranthene	205-99-2	ug/l	**24.5**	**15000**	**0.971**	**3.09**	NA			NA			NA			NA			ND			NA			ND			NA			NA			ND			ND				NA			ND			NA			**1.4**	J		NA		
Benzo(g,h,i)perylene	191-24-2	ug/l	**NE**	**NE**	**252**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			NA			ND			ND				NA			ND			NA			**0.79**	J		NA		
Benzo(k)fluoranthene	207-08-9	ug/l	**3280**	**2000000**	**12.1**	**132**	NA			NA			NA			NA			ND			NA			ND			NA			NA			ND			ND				NA			ND			NA			**0.73**	J		NA		
Carbazole	86-74-8	ug/l	**NE**	**NE**	**NE**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			NA			**2.5**			ND				NA			ND			NA			ND			NA		
Chrysene	218-01-9	ug/l	**290**	**168000**	**167**	**31.1**	NA			NA			NA			NA			ND			NA			ND			NA			NA			ND			ND				NA			ND			NA			**1.4**	J		NA		
Dibenzofuran	132-64-9	ug/l	**NE**	**NE**	**48.4**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			NA			**2.6**	J		ND				NA			ND			NA			ND			NA		
Di-n-octyl phthalate	117-84-0	ug/l	**NE**	**NE**	**NE**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			NA			ND			ND				NA			ND			NA			ND			NA		
Diethyl phthalate	84-66-2	ug/l	**NE**	**NE**	**1420000**	**NE**	NA			NA			NA			NA			ND			NA			**0.34**	J		NA			NA			ND			ND				NA			ND			NA			ND			NA		
bis(2-Ethylhexyl)phthalate	117-81-7	ug/l	**1220000**	**531000000**	**284**	**55900**	NA			NA			NA			NA			ND			NA			ND			NA			NA			ND			ND				NA			ND			NA			ND			NA		
Fluoranthene	206-44-0	ug/l	**NE**	**NE**	**1730**	**NE**	NA			NA			NA			NA			**0.67**	J		NA			ND			NA			NA			**1.6**			ND				NA			ND			NA			**2.9**			NA		
Fluorene	86-73-7	ug/l	**NE**	**NE**	**4380**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			NA			**5.6**			ND				NA			ND			NA			**0.55**	J		NA		
2-Methylnaphthalene	91-57-6	ug/l	**NE**	**NE**	**58.8**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			NA			**27.7**			ND				NA			ND			NA			**6.3**			NA		
Naphthalene	91-20-3	ug/l	**18.2**	**686**	**567**	**0.796**	NA			NA			NA			NA			ND			NA			ND			NA			NA			**9.7**			ND				NA			ND			NA			ND			NA		
Phenanthrene	85-01-8	ug/l	**NE**	**NE**	**2330**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			NA			**3.9**			ND				NA			ND			NA			**1.7**	J		NA		
Pyrene	129-00-0	ug/l	**NE**	**NE**	**1440**	**NE**	NA			NA			NA			NA			**0.44**	J		NA			ND			NA			NA			**2.2**			ND				NA			ND			NA			**2.5**			NA		
PCBs SW846 8082A																																																			
None		ug/l					NA			NA			NA			NA			NA			NA			NA			NA			NA			NA			NA				NA			NA			NA			NA			NA		
Pesticides SW846 8081B																																																			
None		ug/l					NA			NA			NA			NA			ND			NA			ND			NA			ND			NA			NA				NA			NA			NA			NA			NA		
Herbicides SW846 8151																																																			
None		ug/l					NA			NA			NA			NA			ND		UJ	ND		UJ	NA			NA			NA			NA			NA				NA			NA			NA			NA			NA		
TAL Total Metals SW846 6010B/7470A																																																			
Aluminum	7429-90-5	ug/l	**NE**	**NE**	**620000**	**NE**	NA			NA			NA			NA			**279**			NA			**518**			NA			**533**			**1000**			NA				NA			NA			NA			**24900**			NA		
Arsenic	7440-38-2	ug/l	**NE**	**NE**	**185**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			<3.0			**16.4**			NA				NA			NA			NA			**239**			NA		
Barium	7440-39-3	ug/l	**NE**	**NE**	**19600**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			<200			**293**			NA				NA			NA			NA			**439**			NA		
Beryllium	7440-41-7	ug/l	**NE**	**NE**	**53.6**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			<1.0			ND			NA				NA			NA			NA			**2.5**			NA		
Calcium	7789-78 -8	ug/l	**NE**	**NE**	**NE**	**NE**	NA			NA			NA			NA			**12700**			NA			**39900**		L	NA			**41000**		L	**56700**			NA				NA			NA			NA			**52500**		L	NA		
Chromium	7440-47-3	ug/l	**NE**	**NE**	**26.6**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			<10			ND			NA				NA			NA			NA			**90.8**			NA		
Copper	7440-50-8	ug/l	**NE**	**NE**	**24600**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			<10			ND			NA				NA			NA			NA			**81.8**			NA		
Lead	7439-92-1	ug/l	**NE**	**NE**	**NE**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			<3.0			**4.6**			NA				NA			NA			NA			**510**			NA		
Magnesium	7439-95-4	ug/l	**NE**	**NE**	**NE**	**NE**	NA			NA			NA			NA			**6870**			NA			**10300**			NA			**10500**			**19300**			NA				NA			NA			NA			**16400**			NA		
Manganese	7439-96-5	ug/l	**NE**	**NE**	**8180**	**NE**	NA			NA			NA			NA			**182**			NA			**914**			NA			**950**			**879**			NA				NA			NA			NA			**1550**			NA		
Mercury	7439-97-6	ug/l	**0.281**	**2.4**	**NE**	**0.0895**	NA			NA			NA			NA			ND			NA			ND			NA			<0.20			ND			NA				NA			NA			NA			ND			NA		
Nickel	1313-99-1	ug/l	**NE**	**NE**	**4750**	**NE**	NA			NA			NA			NA			**13.5**			NA			ND			NA			<10			**13.3**			NA				NA			NA			NA			**18.8**			NA		
Potassium	7440-09-7	ug/l	**NE**	**NE**	**NE**	**NE**	NA			NA			NA			NA			ND			NA			**24800**			NA			**25700**			ND			NA				NA			NA			NA			ND			NA		
Sodium	7681-49-4	ug/l	**NE**	**NE**	**NE**	**NE**	NA			NA			NA			NA			**85900**			NA			**123000**			NA			**124000**			**189000**			NA				NA			NA			NA			**164000**			NA		
Vanadium	7440-62-2	ug/l	**NE**	**NE**	**194**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			<50			ND			NA				NA			NA			NA			**72.5**			NA		
Zinc	7440-66-6	ug/l	**NE**	**NE**	**220000**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			<20			**33.9**			NA				NA			NA			NA			**288**			NA		
TAL Dissolved Metals SW846 6010B/7470A																																																			
Aluminum	7429-90-5	ug/l	**NE**	**NE**	**620000**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			<200			ND			NA				NA			NA			NA			**906**			NA		
Arsenic	7440-38-2	ug/l	**NE**	**NE**	**185**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			<3.0			**16.1**			NA				NA			NA			NA			**109**			NA		
Barium	7440-39-3	ug/l	**NE**	**NE**	**19600**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			<200			**296**			NA				NA			NA			NA			**319**			NA		
Calcium	7789-78 -8	ug/l	**NE**	**NE**	**NE**	**NE**	NA			NA			NA			NA			**12500**			NA			**40200**			NA			**40400**			**62000**			NA				NA			NA			NA			**61500**			NA		
Iron	7439-89-6	ug/l	**NE**	**NE**	**431000**	**NE**	NA			NA			NA			NA			ND			NA			**20800**			NA			**21200**			**38100**			NA				NA			NA			NA			**85200**			NA		
Lead	7439-92-1	ug/l	**NE**	**NE**	**NE**	**NE**	NA			NA			NA			NA			ND			NA			ND			NA			<3.0			**3.6**			NA				NA			NA			NA			**14.6**			NA		
Magnesium	7439-95-4	ug/l	**NE**	**NE**	**NE**	**NE**	NA			NA			NA			NA			**6730**			NA			**10300**			NA			**10400**			**20400**			NA				NA			NA			NA			**17400**			NA		
Manganese	7439-96-5	ug/l	**NE**	**NE**	**8180**	**NE**	NA			NA			NA			NA			**177**			NA			**918**			NA			**942**			**936**			NA				NA			NA			NA			**1700**			NA		
Nickel	1313-99-1	ug/l	**NE**	**NE**	**4750**	**NE**	NA			NA			NA			NA			**10.4**			NA			ND			NA			ND			**13.3**			NA				NA			NA			NA			ND			NA		
Potassium	7440-09-7	ug/l	**NE**	**NE**	**NE**	**NE**	NA			NA			NA			NA			ND			NA			**24700**			NA			**25100**			ND			NA				NA			NA			NA			ND			NA		
Sodium	7681-49-4	ug/l	**NE**	**NE**	**NE**	**NE**	NA			NA			NA			NA			**80000**			NA			**118000**			NA			**122000**			**210000**			NA				NA			NA			NA			**201000**			NA		
Zinc	7440-66-6	ug/l	**NE**	**NE**	**220000**	**NE**	NA			NA			NA			NA			**26.2**			NA			ND			NA			ND			**35.4**			NA				NA			NA			NA			ND			NA		

NOTES:
TCL = Target Compound List
VOCs = volatile organic compounds
TPH = total petroleum hydrocarbons
TPH-DRO = diesel range TPH
TPH-GRO = gasoline range TPH
SVOCs = semi-VOCs
PCBs = polychlorinated biphenyls
TAL = Target Analyte List
EPA SW846 8260B = United States Environmental Protection Agency SW-846 analytical method
ug/l = micrograms per liter
mg/l = milligrams per liter
ND = not detected above analytical method reporting limit (RL)
NA = not analyzed
* = chromium VI
** = chromium III
LQ = Laboratory Qualifiers
J indicates an estimated value greater or equal to the analytical method detection limit but less than the RL
VQ = Validator Qualifiers
L indicates the reported value may be biased low
UL indicates the compound or element was analyzed for but not detected. The sample detection limit is probably higher
UJ indicates the compound or element was analyzed for but not detected. The sample detection limit is an estimated value
R quality control indicates the data is not useable
VDEQ = Commonwealth of Virginia Department of Environmental Quality
VDEQ-T3CGWSL = VDEQ Tier III commercial groundwater screening level for restricted groundwater use commercial land use inhalation of indoor air (7/23/12)
VDEQ-CWTGNC = VDEQ Tier III groundwater concentration for construction worker in a trench groundwater not contacted (7/23/12)
VDEQ-CWTGC = VDEQ Tier III groundwater concentration for construction worker in a trench groundwater contacted (7/23/12)
Bold and right justification designates target compound was detected at a concentration above RL
Yellow shading designates target compound was detected at a concentration above regulatory screening level in at least one sample
NE = not established
NA = not analyzed

TABLE 13. OLD WAREHOUSE AREA (OWA) GROUNDWATER ANALYTICAL RESULTS

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

			VDEQ-CWTGC													
Field ID:	**CAS No.**	**Units**	**VDEQ-T3CGWSL**	**VDEQ-CWTGNC**	**Dermal Contact and Incidental Ingestion**	**Inhalation**	**12-OWA-SB10(GW)**	**LQ**	**VQ**	**12-OWA-SB11(GW)**	**LQ**	**VQ**	**12-OWA-SB11(GW)**	**LQ**	**VQ**
Sampling Date:							11/5/2012			10/26/2012			11/30/2012		
TPH SW846 8015C															
TPH-GRO (C6-C10)	None	mg/l	**NE**	**NE**	**NE**	**NE**	ND			ND		UJ	ND		
TPH-DRO (C10-C28)	None	mg/l	**NE**	**NE**	**NE**	**NE**	ND			ND			NA		
TCL VOCs SW846 8260B															
Acetone	67-64-1	ug/l	**8540000**	**42000000**	**666000**	**13200**	ND			ND		R	NA		
Benzene	71-43-2	ug/l	**43.9**	**1070**	**871**	**15**	ND			ND			NA		
Carbon tetrachloride	56-23-5	ug/l	**1.64**	**275**	**269**	**26.1**	ND			**3.6**			NA		
Chloroform	67-66-3	ug/l	**27.3**	**520**	**1580**	**7.08**	ND			**2.5**			NA		
Chloromethane	74-87-3	ug/l	**109**	**528**	**NE**	**13.5**	ND			ND			NA		
Cyclohexane	557-21-1	ug/l	**329**	**7170**	**NE**	**3470**	ND			**0.36**	J		NA		
Ethylbenzene	100-41-4	ug/l	**27.6**	**3090**	**1440**	**61**	ND			**0.36**	J		NA		
Isopropylbenzene	98-82-8	ug/l	**3.68**	**34.6**	**6550**	**92**	ND			**0.68**	J		NA		
Methylcyclohexane	108-87- 2	ug/l	**74.5**	**650**	**NE**	**624**	ND			**1.4**	J		NA		
Methyl Tert Butyl Ether	1634-04-4	ug/l	**1960**	**292000**	**112000**	**585**	**0.52**	J		**0.45**	J		NA		
Methylene chloride	75-09-2	ug/l	**2930**	**88400**	**16700**	**596**	ND			ND			NA		
1,1,2,2-Tetrachloroethane	79-34-5	ug/l	**15**	**3210**	**475**	**3.79**	ND			ND			NA		
Toluene	108-88-3	ug/l	**8050**	**56400**	**35500**	**1020**	ND			ND			NA		
m,p-Xylene	108-38-3	ug/l	**139**	**1100**	**5370**	**21.8**	ND			**0.91**	J		NA		
o-Xylene	95-47-6	ug/l	**206**	**1440**	**5980**	**21.9**	ND			**0.24**	J		NA		
Xylene (total)	1330-20-7	ug/l	**206**	**7350**	**11500**	**87.4**	ND			**1.2**			NA		
TCL SVOCs SW846 8270D															
Acenaphthene	83-32-9	ug/l	**NE**	**NE**	**2350**	**NE**	ND			ND			NA		
Anthracene	120-12-7	ug/l	**NE**	**NE**	**7900**	**NE**	ND			ND			NA		
Benzo(a)anthracene	56-55-3	ug/l	**814**	**243000**	**1.67**	**33**	ND			ND			NA		
Benzo(b)fluoranthene	205-99-2	ug/l	**24.5**	**15000**	**0.971**	**3.09**	ND			ND			NA		
Benzo(g,h,i)perylene	191-24-2	ug/l	**NE**	**NE**	**252**	**NE**	ND			ND			NA		
Benzo(k)fluoranthene	207-08-9	ug/l	**3280**	**2000000**	**12.1**	**132**	ND			ND			NA		
Carbazole	86-74-8	ug/l	**NE**	**NE**	**NE**	**NE**	ND			ND			NA		
Chrysene	218-01-9	ug/l	**290**	**168000**	**167**	**31.1**	ND			ND			NA		
Dibenzofuran	132-64-9	ug/l	**NE**	**NE**	**48.4**	**NE**	ND			ND			NA		
Di-n-octyl phthalate	117-84-0	ug/l	**NE**	**NE**	**NE**	**NE**		**9.8**	J	ND			NA		
Diethyl phthalate	84-66-2	ug/l	**NE**	**NE**	**1420000**	**NE**	ND			ND			NA		
bis(2-Ethylhexyl)phthalate	117-81-7	ug/l	**1220000**	**531000000**	**284**	**55900**		**14.7**		ND			NA		
Fluoranthene	206-44-0	ug/l	**NE**	**NE**	**1730**	**NE**	ND			ND			NA		
Fluorene	86-73-7	ug/l	**NE**	**NE**	**4380**	**NE**	ND			ND			NA		
2-Methylnaphthalene	91-57-6	ug/l	**NE**	**NE**	**58.8**	**NE**	ND			**0.74**	J		NA		
Naphthalene	91-20-3	ug/l	**18.2**	**686**	**567**	**0.796**	ND			**1.6**	J		NA		
Phenanthrene	85-01-8	ug/l	**NE**	**NE**	**2330**	**NE**	ND			ND			NA		
Pyrene	129-00-0	ug/l	**NE**	**NE**	**1440**	**NE**	ND			ND			NA		
PCBs SW846 8082A															
None		ug/l					ND			ND			NA		
Pesticides SW846 8081B															
None		ug/l					ND			ND			NA		
Herbicides SW846 8151															
None		ug/l					NA			NA			NA		
TAL Total Metals SW846 6010B/7470A															
Aluminum	7429-90-5	ug/l	**NE**	**NE**	**620000**	**NE**		**354**		**1440**			NA		
Arsenic	7440-38-2	ug/l	**NE**	**NE**	**185**	**NE**	ND			ND			NA		
Barium	7440-39-3	ug/l	**NE**	**NE**	**19600**	**NE**	ND			**405**			NA		
Beryllium	7440-41-7	ug/l	**NE**	**NE**	**53.6**	**NE**	ND			**1.0**			NA		
Calcium	7789-78 -8	ug/l	**NE**	**NE**	**NE**	**NE**		**19900**		**27800**		L	NA		
Chromium	7440-47-3	ug/l	**NE**	**NE**	**26.6**	**NE**	ND			ND			NA		
Copper	7440-50-8	ug/l	**NE**	**NE**	**24600**	**NE**	ND			ND			NA		
Lead	7439-92-1	ug/l	**NE**	**NE**	**NE**	**NE**	ND			ND			NA		
Magnesium	7439-95-4	ug/l	**NE**	**NE**	**NE**	**NE**		**9720**		**16000**			NA		
Manganese	7439-96-5	ug/l	**NE**	**NE**	**8180**	**NE**		**298**		**516**			NA		
Mercury	7439-97-6	ug/l	**0.281**	**2.4**	**NE**	**0.0895**	ND			**0.21**			NA		
Nickel	1313-99-1	ug/l	**NE**	**NE**	**4750**	**NE**		**17.4**		**24.8**			NA		
Potassium	7440-09-7	ug/l	**NE**	**NE**	**NE**	**NE**		**15200**		ND			NA		
Sodium	7681-49-4	ug/l	**NE**	**NE**	**NE**	**NE**		**68000**		**41800**			NA		
Vanadium	7440-62-2	ug/l	**NE**	**NE**	**194**	**NE**	ND			ND			NA		
Zinc	7440-66-6	ug/l	**NE**	**NE**	**220000**	**NE**		**28.7**		**48.3**			NA		
TAL Dissolved Metals SW846 6010B/7470A															
Aluminum	7429-90-5	ug/l	**NE**	**NE**	**620000**	**NE**	ND			ND			NA		
Arsenic	7440-38-2	ug/l	**NE**	**NE**	**185**	**NE**	ND			ND			NA		
Barium	7440-39-3	ug/l	**NE**	**NE**	**19600**	**NE**	ND			**445**			NA		
Calcium	7789-78 -8	ug/l	**NE**	**NE**	**NE**	**NE**		**19900**		**30800**			NA		
Iron	7439-89-6	ug/l	**NE**	**NE**	**431000**	**NE**		**9250**		**1260**			NA		
Lead	7439-92-1	ug/l	**NE**	**NE**	**NE**	**NE**	ND			ND			NA		
Magnesium	7439-95-4	ug/l	**NE**	**NE**	**NE**	**NE**		**9760**		**17600**			NA		
Manganese	7439-96-5	ug/l	**NE**	**NE**	**8180**	**NE**		**297**		**484**			NA		
Nickel	1313-99-1	ug/l	**NE**	**NE**	**4750**	**NE**		**17.2**		**26.6**			NA		
Potassium	7440-09-7	ug/l	**NE**	**NE**	**NE**	**NE**		**15100**		ND			NA		
Sodium	7681-49-4	ug/l	**NE**	**NE**	**NE**	**NE**		**67900**		**46600**			NA		
Zinc	7440-66-6	ug/l	**NE**	**NE**	**220000**	**NE**		**22.5**		**52.0**			NA		

NOTES:
TCL = Target Compound List
VOCs = volatile organic compounds
TPH = total petroleum hydrocarbons
TPH-DRO = diesel range TPH
TPH-GRO = gasoline range TPH
SVOCs = semi-VOCs
PCBs = polychlorinated biphenyls
TAL = Target Analyte List
EPA SW846 8260B = United States Environmental Protection Agency SW-846 analytical method
ug/l = micrograms per liter
mg/l = milligrams per liter
ND = not detected above analytical method reporting limit (RL)
NA = not analyzed
* = chromium VI
** = chromium III
LQ = Laboratory Qualifiers
J indicates an estimated value greater or equal to the analytical method detection limit but less than the RL
VQ = Validator Qualifiers
L indicates the reported value may be biased low
UL indicates the compound or element was analyzed for but not detected. The sample detection limit is probably higher
UJ indicates the compound or element was analyzed for but not detected. The sample detection limit is an estimated value
R quality control indicates the data is not useable
VDEQ = Commonwelath of Virginia Department of Environmental Quality
VDEQ-T3CGWSL = VDEQ Tier III commercial groundwater screening level for restricted groundwater use commercial land use inhalation of indoor air (7/23/12)
VDEQ-CWTGNC = VDEQ Tier III groundwater concentration for construction worker in a trench groundwater not contacted (7/23/12)
VDEQ-CWTGC = VDEQ Tier III groundwater concentration for construction worker in a trench groundwater contacted (7/23/12)
Bold and right justification designates target compound was detected at a concentration above RL
Yellow shading designates target compound was detected at a concentration above regulatory screening level in at least one sample
NE = not established
NA = not analyzed

TABLE 13. FORT MEYER MOUND (FMM) GROUNDWATER ANALYTICAL RESULTS (DETECTIONS ONLY)

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Field ID:	CAS No.	Units	VDEQ-T3CGWSL	VDEQ-CWTGNC	VDEQ-CWTGC		13-FMM-SB3(GW)	LQ	VQ
					Dermal Contact and Incidental Ingestion	Inhalation			
Sampling Date:							2/14/2013		
TPH SW846 8015C									
TPH-GRO (C6-C10)	None	mg/l	**NE**	**NE**	**NE**	**NE**	ND		
TPH-DRO (C10-C28)	None	mg/l	**NE**	**NE**	**NE**	**NE**	ND		
TCL VOCs SW846 8260B									
Chloroform	67-66-3	ug/l	**27.3**	**520**	**1580**	**7.08**	**1.0**		
TCL SVOCs SW846 8270D									
None		ug/l					ND		
Pesticides SW846 8081B									
None		ug/l					ND		
PCBs SW846 8082A									
None		ug/l					ND		
TAL Total Metals SW846 6010B/7470A									
Aluminum	7429-90-5	ug/l	**NE**	**NE**	**620000**	**NE**	**2700**		
Calcium	7789-78 -8	ug/l	**NE**	**NE**	**NE**	**NE**	**30000**		
Cobalt	7440-48-4	ug/l	**NE**	**NE**	**2430**	**NE**	**52.1**		
Iron	7439-89-6	ug/l	**NE**	**NE**	**431000**	**NE**	**8350**		
Lead	7439-92-1	ug/l	**NE**	**NE**	**NE**	**NE**	**6.7**		
Magnesium	7439-95-4	ug/l	**NE**	**NE**	**NE**	**NE**	**12500**		
Manganese	7439-96-5	ug/l	**NE**	**NE**	**8180**	**NE**	**1670**		
Nickel	1313-99-1	ug/l	**NE**	**NE**	**4750**	**NE**	**14.0**		
Sodium	7681-49-4	ug/l	**NE**	**NE**	**NE**	**NE**	**98200**		
Zinc	7440-66-6	ug/l	**NE**	**NE**	**220000**	**NE**	**27.2**		

NOTES:
TCL = Target Compound List
VOCs = volatile organic compounds
TPH = total petroleum hydrocarbons
TPH-DRO = diesel range TPH
TPH-GRO = gasoline range TPH
SVOCs = semi-VOCs
TAL = Target Analyte List
EPA SW846 8260B = United States Environmental Protection Agency SW-846 analytical method
ug/l = micrograms per liter
mg/l = milligrams per liter
ND = not detected above analytical method reporting limit (RL)
NA = not analyzed
* = chromium VI
** = chromium III
LQ = Laboratory Qualifiers
VQ = Validator Qualifiers
VDEQ = Commonwelath of Virginia Department of Environmental Quality
VDEQ-T3CGWSL = VDEQ Tier III commercial groundwater screening level for restricted groundwater use commercial land use inhalation of indoor air (7/23/12)
VDEQ-CWTGNC = VDEQ Tier III groundwater concentration for construction worker in a trench groundwater not contacted (7/23/12)
VDEQ-CWTGC = VDEQ Tier III groundwater concentration for construction worker in a trench groundwater contacted (7/23/12)
Bold and right justification designates target compound was detected at a concentration above RL
Yellow shading designates target compound was detected at a concentration above regulatory screening level in at least one sample
NE = not established
NA = not analyzed

TABLE 15. STORMWATER DIVERSION/INTERCEPTOR STOCKPILE (SDS) GROUNDWATER ANALYTICAL RESULTS (DETECTIONS ONLY)

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT
ARLINGTON, VA

Field ID:	CAS No.	Units	VDEQ-T3CGWSL	VDEQ-CWTGNC	VDEQ-CWTGC		12-STS-SB2(GW)	LQ	VQ
					Dermal Contact and Incidental Ingestion	Inhalation			
Sampling Date:							11/16/2012		
TPH SW846 8015C									
TPH-GRO (C6-C10)	None	mg/l	**NE**	**NE**	**NE**	**NE**	ND		
TPH-DRO (C10-C28)	None	mg/l	**NE**	**NE**	**NE**	**NE**	ND		
TCL VOCs SW846 8260B									
Carbon tetrachloride	56-23-5	ug/l	**1.64**	**275**	**269**	**26.1**	**24.8**		
Chloroform	67-66-3	ug/l	**27.3**	**520**	**1580**	**7.08**	**5.6**		
1,2-Dichloroethane	107-06-2	ug/l	**11.8**	**1720**	**1850**	**5.96**	**0.76**	J	
cis-1,2-Dichloroethene	156-59-2	ug/l	**NE**	**NE**	**2970**	**NE**	**0.53**	J	
Methyl Tert Butyl Ether	1634-04-4	ug/l	**1960**	**292000**	**112000**	**585**	**0.33**	J	
Tetrachloroethene	127-18-4	ug/l	**23.2**	**197**	**199**	**10.8**	**1.1**		
Trichloroethene	79-01-6	ug/l	**2.08**	**16**	**48.6**	**0.484**	**0.51**	J	
TCL SVOCs SW846 8270D									
None		ug/l					ND		
TAL Total Metals SW846 6010B/7470A									
Aluminum	7429-90-5	ug/l	**NE**	**NE**	**620000**	**NE**	**240**		
Barium	7440-39-3	ug/l	**NE**	**NE**	**19600**	**NE**	**246**		
Calcium	7789-78 -8	ug/l	**NE**	**NE**	**NE**	**NE**	**11200**		
Iron	7439-89-6	ug/l	**NE**	**NE**	**431000**	**NE**	**587**		
Magnesium	7439-95-4	ug/l	**NE**	**NE**	**NE**	**NE**	**5920**		
Manganese	7439-96-5	ug/l	**NE**	**NE**	**8180**	**NE**	**206**		
Nickel	1313-99-1	ug/l	**NE**	**NE**	**4750**	**NE**	**11.8**		
TAL Dissolved Metals SW846 6010B/7470A									
Barium	7440-39-3	ug/l	**NE**	**NE**	**19600**	**NE**	**233**		
Calcium	7789-78 -8	ug/l	**NE**	**NE**	**NE**	**NE**	**10600**		
Iron	7439-89-6	ug/l	**NE**	**NE**	**431000**	**NE**	**383**		
Magnesium	7439-95-4	ug/l	**NE**	**NE**	**NE**	**NE**	**5590**		
Manganese	7439-96-5	ug/l	**NE**	**NE**	**8180**	**NE**	**200**		
Nickel	1313-99-1	ug/l	**NE**	**NE**	**4750**	**NE**	**11.3**		
Zinc	7440-66-6	ug/l	**NE**	**NE**	**220000**	**NE**	**22.0**		

NOTES:
TCL = Target Compound List
VOCs = volatile organic compounds
TPH = total petroleum hydrocarbons
TPH-DRO = diesel range TPH
TPH-GRO = gasoline range TPH
SVOCs = semi-VOCs
TAL = Target Analyte List
EPA SW846 8260B = United States Environmental Protection Agency SW-846 analytical method
ug/l = micrograms per liter
mg/l = milligrams per liter
ND = not detected above analytical method reporting limit (RL)
NA = not analyzed
* = chromium VI
** = chromium III
LQ = Laboratory Qualifiers
J indicates an estimated value greater or equal to the analytical method detection limit but less than the RL
VQ = Validator Qualifiers
R quality control indicates the data is not useable
VDEQ = Commonwelath of Virginia Department of Environmental Quality
VDEQ-T3CGWSL = VDEQ Tier III commercial groundwater screening level for restricted groundwater use commercial land use inhalation of indoor air (7/23/12)
VDEQ-CWTGNC = VDEQ Tier III groundwater concentration for construction worker in a trench groundwater not contacted (7/23/12)
VDEQ-CWTGC = VDEQ Tier III groundwater concentration for construction worker in a trench groundwater contacted (7/23/12)
Bold and right justification designates target compound was detected at a concentration above RL
Yellow shading designates target compound was detected at a concentration above regulatory screening level in at least one sample
NE = not established
NA = not analyzed

ATTACHMENT 1

PHOTOGRAPHS

View of SMY looking west (area where removal of impacted soil is proposed is on right side of photo).

View of central portion of OWA looking west (areas where removal of impacted soil is proposed are on left and right side of photo).

View of northeast corner of SMY where removal of impacted soil is proposed.

View of eastern end of warehouse located on northern portion of OWA (areas where removal of impacted soil are proposed are adjacent to warehouse).

View of northeast corner of SMY where removal of impacted soil is proposed.

View of western end of warehouse located on northern portion of OWA (area where removal of impacted soil is proposed is in front of open storage bay).

View of ESMY looking south (area where removal of impacted soil is proposed is on left side of photo).

View of eastern portion of OWA used for storage of wood debris (former location of Building 107, areas where removal of impacted soil are proposed are on left side of photo).

View of southern portion of OWA looking east (former location of Building 104, area where removal of impacted soil is proposed is between trailer and shed).

View of central portion of OWA looking north (former location of Building 107, area where removal of impacted soil is proposed).

View of storage containers stored on southeastern portion of OWA (former location of Building 102, area where removal of impacted soil and groundwater treatment is proposed).

View of stream bounding OWA to the south (area where removal of impacted soil and groundwater treatment is proposed is located on left side of photo).

View of storage containers stored on southern portion of OWA (former location of Building 102, area where removal of impacted soil and groundwater treatment is proposed).

View from base of FMM looking north (fill comprising mound is impacted and is proposed for removal).

View of southeastern portion of OWA(area where removal of impacted soil and groundwater treatment is proposed).

View of top of FMM looking west taken from JBM-HH maintenance facility parking lot (fill comprising mound is impacted and is proposed for removal).

View from base of FMM looking east (fill comprising mound is impacted and is proposed for removal).

View of brick wall at eastern extent of SDS looking north (area where impacted groundwater was identified).

View from top FMM looking east towards JBM-HH maintenance facility.

View of top of SDS looking east.

View of stream located at southern base of FMM.

View of northern side of SDS looking east.

View of southeastern corner of SDS looking north.

View of drainage feature located on northern side of SDS looking east.

ATTACHMENT 2

ELECTRONIC COPY OF RAWP

ATTACHMENT 3

PRODUCT INFORMATION FOR ReGenOX™ AND ORC ADVANCED®

RegenOx™

CHEMICAL OXIDATION REDEFINED...

RegenOx™ is an advanced in situ chemical oxidation technology designed to treat organic contaminants including high concentration source areas in the saturated and vadose zones*

PRODUCT FEATURES:

- Rapid and sustained oxidation of target compounds
- Easily applied with readily available equipment
- Destroys a broad range of contaminants
- More efficient than other solid oxidants
- Enhances subsequent bioremediation
- Avoids detrimental impacts to groundwater aquifers

RegenOx product application

HOW IT WORKS:

RegenOx maximizes in situ performance using a solid alkaline oxidant that employs a sodium percarbonate complex with a multi-part catalytic formula. The product is delivered as two parts that are combined and injected into the subsurface using common drilling or direct-push equipment. Once in the subsurface, the combined product produces an effective oxidation reaction comparable to that of Fenton's Reagent without a violent exothermic reaction. RegenOx safely, effectively and rapidly destroys a wide range of contaminants in both soil and groundwater (Table 1).

ACHIEVES RAPID OXIDATION VIA A NUMBER OF MECHANISMS

RegenOx directly oxidizes contaminants while its unique catalytic complex generates a suite of highly charged, oxidative free radicals that are responsible for the rapid destruction of contaminants. The mechanisms by which RegenOx operates are:

- Surface- Mediated Oxidation: (see Figure 1 and description below)
- Direct Oxidation: $C_2Cl_4 + 2\ Na_2CO_3 \bullet 3\ H_2O_2 + 2\ H_2O \longleftrightarrow 2CO_2 + 4\ NaCl + 4\ H_2O + 2\ H_2CO_3$
- Free Radical Oxidation:
  - Perhydroxyl Radical ($HO_2\bullet$)
  - Hydroxyl Radical ($OH\bullet$)
  - Superoxide Radical ($O_2\bullet$)

Figure 1. RegenOx™ Surface-Mediated Oxidation

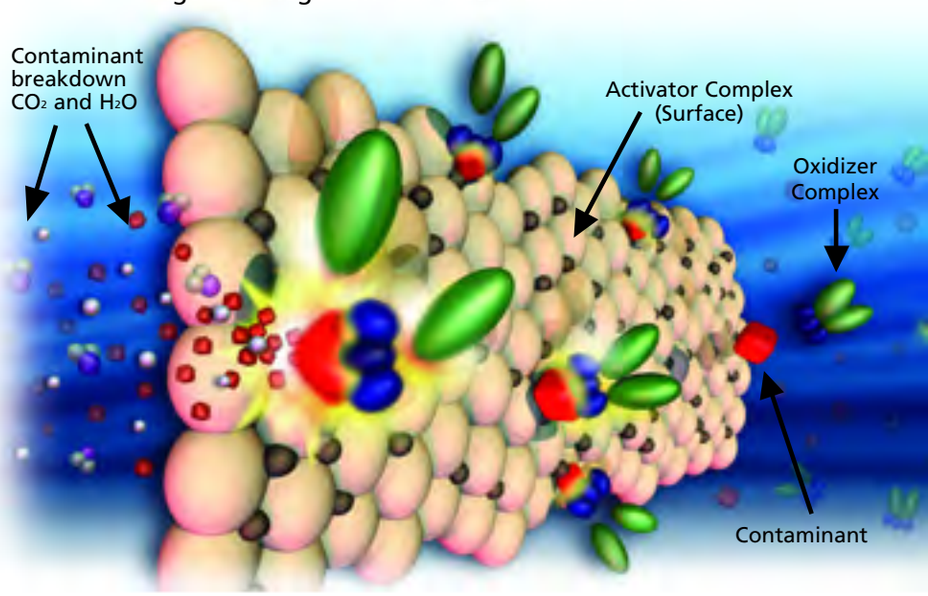


Figure 1. Surface-Mediated Oxidation is responsible for the majority of RegenOx contaminant destruction. This process takes place in two stages. First, the RegenOx activator complex coats the subsurface. Second, the oxidizer complex and contaminant react with the activator complex surface destroying the contaminant.

* Patent applied for

RegenOx™

From Mass Reduction to Bioremediation:

RegenOx™ is an effective and rapid contaminant mass reduction technology. A single injection will remove significant amounts of target contaminants from the subsurface. Strategies employing multiple Regenox injections coupled with follow-on accelerated bioremediation can be used to treat highly contaminated sites to regulatory closure. In fact, RegenOx was designed specifically to allow for a seamless transition to low-cost accelerated bioremediation using any of Regenesis controlled release compounds.

Significant Longevity:

RegenOx has been shown to destroy contaminants for periods of up to one month.

Product Application Made Safe and Easy:

RegenOx produces minimal heat and as with all oxidants proper health and safety procedures must be followed. The necessary safety guidance accompanies all shipments of RegenOx and additional resources are available on request. Through the use of readily available, highly mobile, direct-push equipment and an array of pumps, RegenOx has been designed to be as easy to install as other Regenesis products like ORC® and HRC®.

Effective on a Wide Range of Contaminants:

RegenOx has been rigorously tested in both the laboratory and the field on petroleum hydrocarbons (aliphatics and aromatics), gasoline oxygenates (e.g., MTBE and TAME), polyaromatic hydrocarbons (e.g., naphthalene and phenanthrene) and chlorinated hydrocarbons (e.g., PCE, TCE, TCA).

Oxidant Effectiveness vs. Contaminant Type:

Table 1

Contaminant	RegenOx™	Fenton's Reagent	Permanganate	Persulfate	Activated Persulfate	Ozone
Petroleum Hydrocarbons	**A**	**A**	B	B	B	**A**
Benzene	**A**	**A**	D	B	B	**A**
MTBE	**A**	B	B	C	B	B
Phenols	**A**	**A**	B	C	B	**A**
Chlorinated Ethenes (PCE, TCE, DCE, VC)	**A**	**A**	**A**	B	**A**	**A**
Chlorinated Ethanes (TCA, DCA)	**A**	B	C	D	C	B
Polycyclic Aromatic Hydrocarbons (PAHs)	**A**	**A**	B	B	**A**	**A**
Polychlorinated Biphenyls (PCBs)	B	C	D	D	D	B
Explosives (RDX, HMX)	**A**	**A**	**A**	**A**	**A**	**A**

Based on laboratory kinetic data, thermodynamic calculations, and literature reports.

Oxidant Effectiveness Key:

A = Short half life, low free energy (most energetically favored), most complete
B = Intermediate half life, low free energy, intermediate degree of completion
C = Intermediate half life, intermediate free energy, low degree of completion
D = Long half life, high free energy (least favored), very low degree of completion

REGENESIS
Advanced Technologies for Groundwater Resources
1011 Calle Sombra / San Clemente / California 92673-6244
Tel: 949/366-8000 / Fax: 949/366-8090 / www.regenesis.com

DUST MINIMIZING FORMULATION FOR EXCAVATIONS, TANK PITS AND TRENCHES

DESCRIPTION

ORC Advanced® Pellets (ORC-A Pellets) are a pelletized version of REGENESIS' widely used ORC Advanced and are designed specifically for direct application into excavations, tank pits and trenches. This pelletized, dry application material minimizes airborne dust while eliminating the need for specialized equipment and spray water required for powder-slurry applications. ORC Advanced Pellets are approximately 3-10 mm in size as shown in Figure 1.

FIGURE 1: ORC-A PELLETS ARE APPROXIMATELY 3-10 MM SIZE

FEATURES & BENEFITS

- Optimal for use in excavations, tank pits and trenches where enhanced aerobic bioremediation is appropriate
- Pellet size (3-10 mm) minimizes airborne dust during handling and application of the material
- Dry application form eliminates need for water and equipment required for powder-slurry application types
- Patented technology provides long-term, controlled release oxygen for periods of up to 12 months on a single application
- Unique molecular structure delivers highest amount of active oxygen available, up to 15% by weight
- Contains micro-nutrients including: nitrogen, phosphorus and potassium (N,P,K) which may benefit aerobic microorganisms

FUNCTION

The primary function of ORC-A Pellets is to provide a controlled-release oxygen source for the enhanced aerobic bioremediation of petroleum hydrocarbons or other aerobically degradable compounds. This is achieved through the use of patented processes which embed phosphates into the crystalline structure of solid peroxygen molecules. This feature slows the reaction that releases oxygen upon hydration, producing an optimized, controlled-release of oxygen over a period of up to 12 months. ORC-A Pellets deliver up to 15% active oxygen by weight and contain micro-nutrients such as: nitrogen, phosphorus, and potassium (N,P,K) which may be beneficial to aerobic biodegradation processes.

Note: Due to the size of the pellets this material is not recommended or designed for use in direct-injection or fixed well applications.

REGENESIS

Advanced Technologies for Contaminated Site Remediation

REGENESIS / 1011 Calle Sombra / San Clemente / CA 92673-6244 / USA / T: 949.366.8000 / F: 949.366.8090 / www.regenesis.com

REGENESIS

ORC ADVANCED® OXYGEN RELEASE COMPOUND

Highest amount of active oxygen in a controlled-release, oxygen producing compound

PRODUCT OVERVIEW

ORC Advanced® is the state-of-the-art technology for stimulating aerobic bioremediation. It offers unparalleled, maximum oxygen release for periods up to 12 months on a single injection and is specifically designed to minimize oxygen waste while maximizing contaminated site remediation.

ORC Advanced is a formulation of calcium oxyhydroxide which, upon hydration, releases oxygen and forms simple calcium hydroxide and water.

$$CaO(OH)_2 + H_2O \rightarrow \tfrac{1}{2}O_2 + Ca(OH)_2 + H_2O$$

PRODUCT BENEFITS

PRODUCT BENEFITS

HIGHEST AVAILABLE OXYGEN CONTENT

More active oxygen (17%) plus Regenesis' patented controlled-release technology (CRT™) saves time and money by increasing degradation rates and improving remediation performance by providing more oxygen on a single injection. It is particularly effective at higher demand sites where oxygen may be limited and scavenged by competing carbon sources.

PATENTED CONTROLLED-RELEASE TECHNOLOGY (CRT™)

Based on the same proven technology employed in the industry standard Oxygen Release Compound (ORC®), CRT allows for an efficient, long-term release of oxygen providing the optimal conditions for sustained aerobic biodegradation. This can save time and money by reducing the potential need for multiple applications. Also, oxygen release "lock-up" is avoided – an unfortunate problem experienced with commodity chemicals.

IN SITU APPLICATION

Remediation with ORC Advanced is typically more cost-effective than *ex situ* treatments. With the use of ORC Advanced there is minimal site disturbance with no above-ground piping or mechanical equipment, no operations and maintenance costs and no hazardous materials handling or disposal.

CRT

DEFINING THE SCIENCE BEHIND CONTROLLED-RELEASE TECHNOLOGY (CRT™)

Early on, Regenesis researchers noted that in order to optimally stimulate the natural attenuation of aerobically degradable contaminants, biologically usable oxygen was best supplied in low but constant concentrations. Big bursts of oxygen are wasteful and simply "bubble off", often generating undesirable foaming and producing unwanted preferential flow paths in the subsurface. Regenesis sought to solve this problem by controlling the rate of oxygen release from solid oxygen sources.

The answer was provided by the development of CRT. The CRT process involves intercalating (embedding) phosphates into the crystal structure of solid peroxygen molecules. This patented feature, now available in the ORC Advanced® formulation, slows the reaction that yields oxygen within the crystal, minimizing "bubble off" which can waste the majority of oxygen available in common solid peroxygen chemicals.

CRT provides "balance" – it slows down the rate of oxygen release while at the same time preventing "lock-up". Commodity solid peroxygen chemicals, when in contact with water, will produce an initial rapid and uncontrolled-release of oxygen. Then, as hydroxides form, a significant portion of the oxygen deeper in the crystal is made unavailable or becomes"locked-up." This undesirable effect is inefficient and costly. CRT prevents lock up and controls the rate of oxygen release, representing the state-of-the-art technology in passive oxygen delivery.

FIGURE 1:
FILLING A PUMP WITH ORC ADVANCED SLURRY

1011 Calle Sombra San Clemente California 92673-6244 Telephone: 949.366.8000 Fax: 949.366.8090 www.regenesis.com

REGENESIS

The original controlled-release oxygen compound, since 1994

ORC® OXYGEN RELEASE COMPOUND

PRODUCT OVERVIEW

The original Oxygen Release Compound (ORC®) is a fine, powdery material comprised of a patented formulation of phosphate-intercalated magnesium peroxide. The intercalation or embedding of phosphates within the magnesium peroxide is Regenesis' patented, controlled-release mechanism.

Upon hydration, ORC is designed to produce a controlled-release of oxygen (10% by weight) into the subsurface in accordance with the following reaction:

$$MgO_2 + H_2O \rightarrow \tfrac{1}{2}O_2 + Mg(OH)_2$$

This process can proceed for periods of up to one year depending on site conditions. In the presence of this long-lasting oxygen source, aerobic microbes flourish - accelerating the naturally slow rates of aerobic biodegradation.

BENEFITS

PRODUCT BENEFITS

By enhancing bioremediation using ORC, in situ treatment of contaminants can result in an efficient, simple and cost-effective alternative to traditional technologies. With low capital costs, no operations and maintenance, minimal site disturbance and proven effectiveness, ORC can restore water quality and property values at a reasonable cost.

MATERIAL APPLICATION

Most contaminated sites are treated using ORC slurry which is a prescribed and easily injectable water and ORC mixture (Figure 2). The direct - injection of ORC slurry maximizes ORC and oxygen distribution in the subsurface increasing the range of enhanced biodegradation. ORC is dosed in pounds per vertical foot of material treated. The amount of ORC recommended depends greatly on various factors such as contaminant concentrations, oxygen sinks, groundwater flow rates and subsurface geology. It is recommended that a Regenesis Technical Services Representative be contacted for detailed design information.

ORC treatment approaches or designs may consist of one, or combinations of the following: Source Area Grids, Plume Area Grids or Barriers, Excavations and Biopiles.

SUBSURFACE EMPLACEMENT

PRODUCT APPLICATION

- Direct – Push Injection
- Hollow Stem Augers
- Existing Wells
- Recirculating Wells
- Replaceable Filter Socks (existing wells)
- Excavations
- Trenches

CONTAMINANTS

TREATABLE CONTAMINANTS

ORC can treat a wide range of contaminants and most any aerobically degradable compound including: gasoline and fuel additives (BTEX and MTBE), diesel, kerosene, jet fuel, gas condensates, fuel oils, lubricants, bunker oil, PAHs, certain metals (arsenic), certain pesticides/herbicides and certain industrial solvents (alcohols and ketones).

FIGURE 2: ORC SLURRY

1011 Calle Sombra San Clemente California 92673-6244 Telephone: 949.366.8000 Fax: 949.366.8090 www.regenesis.com

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT, ARLINGTON, VIRGINIA
22 APRIL 2013

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT, ARLINGTON, VIRGINIA
22 APRIL 2013

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT, ARLINGTON, VIRGINIA
22 APRIL 2013

REMEDIAL ACTION WORK PLAN
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT, ARLINGTON, VIRGINIA
22 APRIL 2013

REVISION	DATE	DESCRIPTION	BY

CEMETERY DIVISION
U.S. CASUALTY & MEMORIAL AFFAIRS DIRECTORATE
DEPARTMENT OF THE ARMY

ARLINGTON NATIONAL CEMETERY
ARLINGTON, VIRGINIA
STORM & SANITARY SEWER DRAINS

DRAWN BY	CHECKED BY	APPROVED BY DIRECTION	DATE
TRACED BY	SUBMITTED BY		PLAN NUMBER
	SUPT. A.N.C.	SCALE	SHEET OF

REVISION	DATE	DESCRIPTION	BY

CEMETERY DIVISION
U.S. CASUALTY & MEMORIAL AFFAIRS DIRECTORATE
DEPARTMENT OF THE ARMY

ARLINGTON NATIONAL CEMETERY
ARLINGTON, VIRGINIA
WATER DISTRIBUTION

DRAWN BY	CHECKED BY	APPROVED BY DIRECTION	DATE
TRACED BY	SUBMITTED BY	SUPT. A.N.C.	SCALE

PLAN NUMBER

SHEET OF

SECTION 00 31 46

PERMITS
06/13

PART 1 GENERAL

1.1 SUMMARY

Contractor shall be responsible to comply with requirements of permits for stream restoration in accordance with attached documents:

a. Certificate of Compliance With Army Corps of Engineers Permit, Permit Type NWP 27.

b. Letter dated June 20, 2013 from Department of the Army, Norfolk District.

c. Nationwide Permit 27 Aquatic Habitat Restoration, Establishment and Enhancement Activities dated 3/19/2012.

d. Drawings CS-200, CS-104 and CS-105.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

NOT USED.

-- End of Section --

U.S. Army Corps
Of Engineers
Norfolk District

CERTIFICATE OF COMPLIANCE
WITH
ARMY CORPS OF ENGINEERS PERMIT

Northern Virginia Regulatory Section
NAO 2013-1128 (Unnamed Tributaries to Potomac River)

Mr. Kent Carson
C/o Arlington National Cemetery
1 Memorial Drive, AD Building
Arlington, Virginia 22211

Location: "Arlington National Cemetery Millennium Stream Restoration" project is associated with the proposal to restore 1794 linear feet of unnamed tributaries to the Potomac River in Arlington County, Virginia. In addition, the project as proposed would temporarily impact 69 linear feet of stream channel associated with the restoration plan.

Date of Issuance: June 20
Permit Type: NWP 27

Within 30 days of completion of the activity authorized by this permit and any mitigation required by the permit, sign this certification and return it to the following address:

Regena Bronson
US Army Corps of Engineers
1329 Alum Springs Road, Suite 202
Fredericksburg, Virginia 22401-7001
Regena.d.bronson@usace.army.mil
Phone 540.548.2838

Please note that your permitted activity is subject to a compliance inspection by a U.S. Army Corps of Engineers representative. If you fail to comply with this permit you are subject to permit suspension, modification or revocation.

I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and conditions of the said permit, and required mitigation has been completed in accordance with the nationwide permit conditions.

_____ _____

Signature of Permittee Date

DEPARTMENT OF THE ARMY
NORFOLK DISTRICT CORPS OF ENGINEERS
FORT NORFOLK 803 FRONT STREET
NORFOLK, VIRGINIA 23510-1096

Reply to the Attention of: June 20, 2013

Northern Virginia Regulatory Section
NAO 2013-1128 (Unnamed Tributaries to Potomac River)

Mr. Kent Carson
C/o Arlington National Cemetery
1 Memorial Drive, AD Building
Arlington, Virginia 22211

Dear Mr. Carson:

This letter is regarding the request by Wetland Studies and Solutions, Inc. to perform work in the waters of the United States. The project "Arlington National Cemetery Millennium Stream Restoration" proposes to restore 1794 linear feet of unnamed tributaries to the Potomac River within the Arlington National Cemetery in Arlington County, Virginia. The project as proposed would temporarily impact 69 linear feet of stream channel associated with the restoration plan.

Based on the plans prepared by Wetland Studies and Solutions, Inc., titled "Arlington National Cemetery, Millennium Project Site Expansion Stream Restoration, Overall Plan, Grading and Longitudinal Profile", Sheets CS-200, CG-104 and CG-105 and dated June 3, 2013 has been reviewed and found to satisfy the criteria contained in the Corps Nationwide Permit 27 (attached). The Corps Nationwide Permits were published in the February 21, 2012 Federal Register notice (77 FR 10184) and the regulations governing their use can be found in 33 CFR 330 published in Volume 56, Number 226 of the Federal Register dated November 22, 1991.

In addition, the following conditions are incorporated into the authorization:

1. The stream restoration project as depicted in the plans entitled "Arlington National Cemetery, Millennium Project Site Expansion Stream Restoration, Overall Plan, Grading and Longitudinal Profile", Sheets CS-200, CG-104 and CG-105 and dated June 3, 2013 shall submit monitoring reports as stated within the Preconstruction Notification dated June 3, 2013.

2. Strict sediment and erosion control measures consistent with those contained in the standards and criteria of the Virginia Sediment and Erosion Control handbook shall be used.

3. The approval of this NWP 27 does not allow for the sale of wetland and stream credits unless all approved parties have signed the associated Mitigation Banking Instrument (MBI).

4. Arlington National Cemetery shall adhere to the Memorandum of Agreement (MOA) "MEMORANDUM OF AGREEMENT AMONG ARLINGTON NATIONAL CEMETERY, THE NATIONAL PARK SERVICE—GEORGE WASHINGTON MEMORIAL PARKWAY, AND THE VIRGINIA STATE HISTORIC PRESERVATION OFFICER REGARDING THE MILLENNIUM PROJECT ARLINGTON NATIONAL CEMETERY ARLINGTON COUNTY, VIRGINIA"

The aforementioned conditions are necessary for the verification of the nationwide permit authorization. If these conditions are not acceptable, an individual permit will be required. In addition, the Virginia Department of Environmental Quality has conditionally waived 401 certification for

Nationwide Permit Number 27.

Enclosed is a "compliance certification" form, which must be signed and returned within 30 days of completion of the project, including any required mitigation (see nationwide permit condition number 14). Your signature on this form certifies that you have completed the work in accordance with the nationwide permit terms and conditions.

This verification is valid until the NWP is modified, reissued, or revoked. All of the existing NWPs are scheduled to be modified, reissued, or revoked prior to March 18, 2017. It is incumbent upon you to remain informed of changes to the NWPs. We will issue a public notice when the NWPs are reissued. Furthermore, if you commence or are under contract to commence this activity before the date that the relevant nationwide permit is modified or revoked, you will have twelve (12) months from the date of the modification or revocation of the NWP to complete the activity under the present terms and conditions of this nationwide permit unless discretionary authority has been exercised on a case-by-case basis to modify, suspend, or revoke the authorization in accordance with 33 CFR 330.4(e) and 33 CFR 330.5 (c) or (d). Project specific conditions listed in this letter continue to remain in effect after the NWP verification expires, unless the district engineer removes those conditions. Activities completed under the authorization of an NWP which was in effect at the time the activity was completed continue to be authorized by that NWP.

If you have any questions, please contact Regena Bronson at (540) 548-2838 or regena.d.bronson@usace.army.mil.

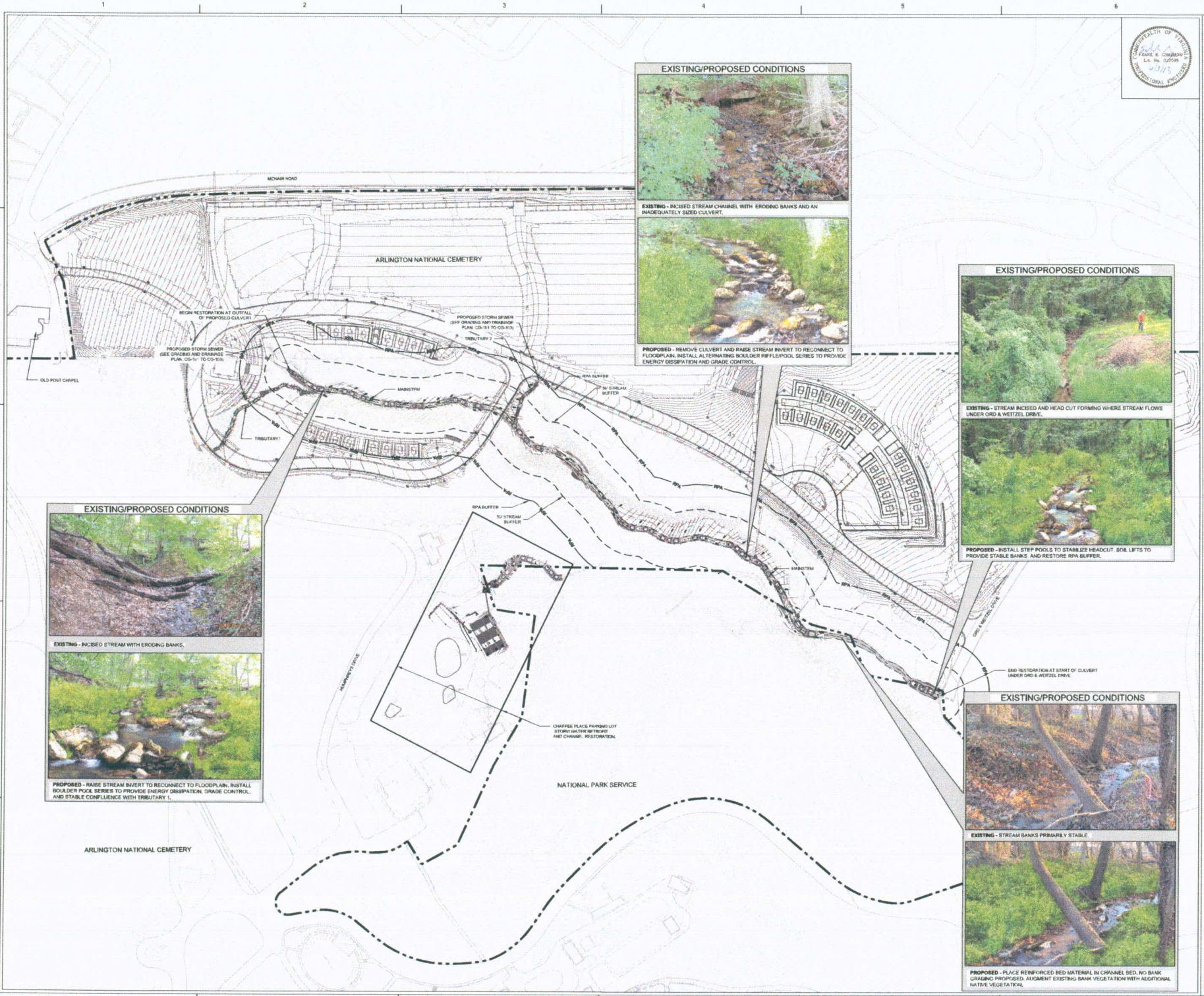
Copies of this verification have been provided to Virginia Department of Environmental Quality, Virginia Marine Resource Commission and Wetland Studies and Solutions, Inc.

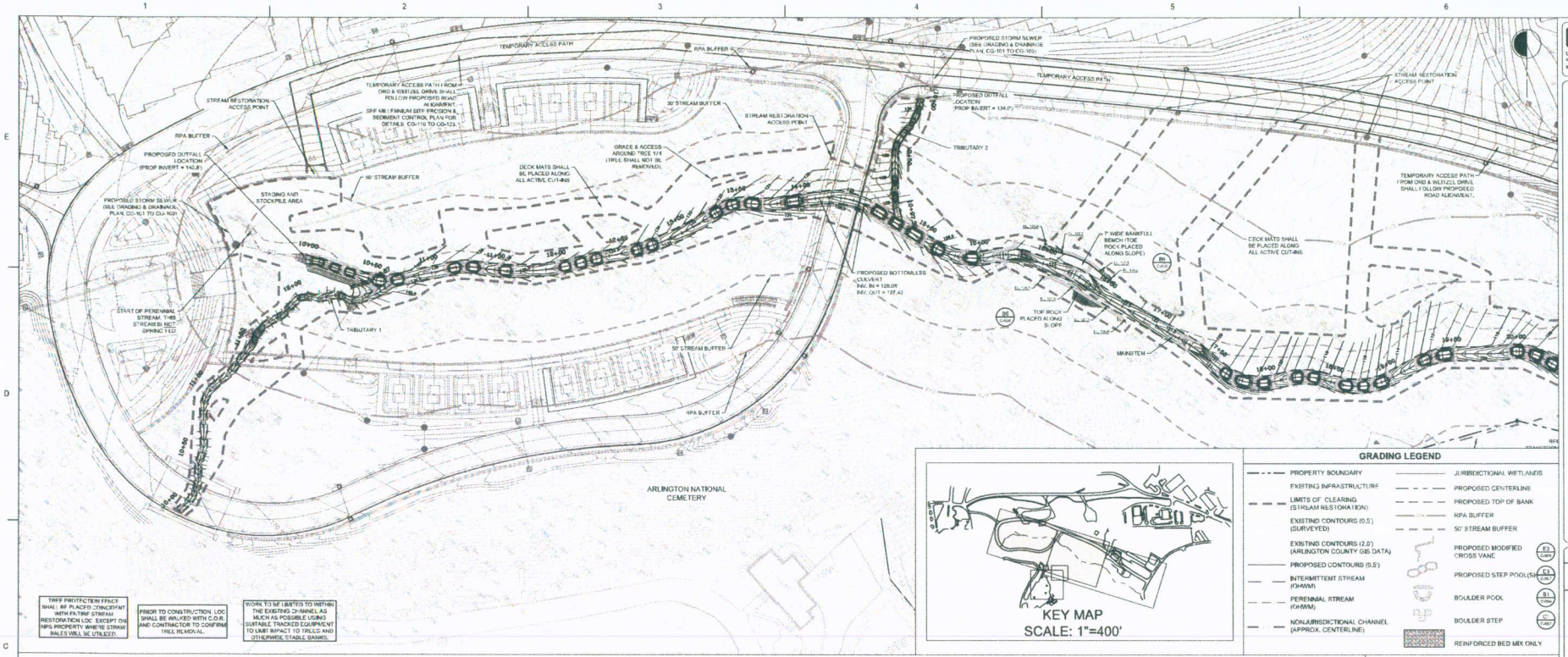
Sincerely,

FOR

Jeanne C. Richardson
Chief, Northern Virginia Regulatory Section

Enclosures


EXISTING/PROPOSED CONDITIONS
EXISTING - INCISED STREAM CHANNEL WITH ERODING BANKS AND AN INADEQUATELY SIZED CULVERT.
PROPOSED - REMOVE CULVERT AND RAISE STREAM INVERT TO RECONNECT TO FLOODPLAIN. INSTALL ALTERNATING BOULDER RIFFLE/POOL SERIES TO PROVIDE ENERGY DISSIPATION AND GRADE CONTROL.
EXISTING/PROPOSED CONDITIONS
EXISTING - STREAM INCISED AND HEAD CUT FORMING WHERE STREAM FLOWS UNDER ORD & WEITZEL DRIVE.
PROPOSED - INSTALL STEP POOLS TO STABILIZE HEADCUT. SOIL LIFTS TO PROVIDE STABLE BANKS AND RESTORE RPA BUFFER.
EXISTING/PROPOSED CONDITIONS
EXISTING - INCISED STREAM WITH ERODING BANKS.
PROPOSED - RAISE STREAM INVERT TO RECONNECT TO FLOODPLAIN. INSTALL BOULDER POOL SERIES TO PROVIDE ENERGY DISSIPATION, GRADE CONTROL, AND STABLE CONFLUENCE WITH TRIBUTARY 1.
EXISTING/PROPOSED CONDITIONS
EXISTING - STREAM BANKS PRIMARILY STABLE.
PROPOSED - PLACE REINFORCED BED MATERIAL IN CHANNEL BED. NO BANK GRADING PROPOSED. AUGMENT EXISTING BANK VEGETATION WITH ADDITIONAL NATIVE VEGETATION.
MCNAIR ROAD
ARLINGTON NATIONAL CEMETERY
BEGIN RESTORATION AT OUTFALL OF PROPOSED CULVERT
PROPOSED STORM SEWER (SEE GRADING AND DRAINAGE PLAN, CS-101 TO CS-103)
PROPOSED STORM SEWER (SEE GRADING AND DRAINAGE PLAN, CS-101 TO CS-103)
TRIBUTARY 2
OLD POST CHAPEL
MAINSTEM
TRIBUTARY 1
RPA BUFFER
50' STREAM BUFFER
RPA
MAINSTEM
ORD & WEITZEL DRIVE
END RESTORATION AT START OF CULVERT UNDER ORD & WEITZEL DRIVE
CHAFFEE PLACE PARKING LOT STORM WATER RETROFIT AND CHANNEL RESTORATION
MEMORIAL AVENUE
NATIONAL PARK SERVICE
ARLINGTON NATIONAL CEMETERY
COMMONWEALTH OF VIRGINIA
FRANK E. CHIARENZA
Lic. No. 027035
PROFESSIONAL ENGINEER
US Army Corps of Engineers
Norfolk District
U.S. ARMY CORPS OF ENGINEERS
NORFOLK DISTRICT
NORFOLK, VIRGINIA
JACOBS/RAMAN/A WHITNEY JV
1100 N. GLEBE ROAD, SUITE 500
ARLINGTON, VA 22201
ARLINGTON NATIONAL CEMETERY
MILLENNIUM PROJECT
SITE, CEMETERY EXPANSION
STREAM RESTORATION
OUTFALL PLAN
SHEET IDENTIFICATION
CS-200



TREE PROTECTION FENCE SHALL BE PLACED CONCURRENT WITH FATRAF STREAM RESTORATION LOC. EXCEPT ON NPS PROPERTY WHERE STRAW BALES WILL BE UTILIZED.

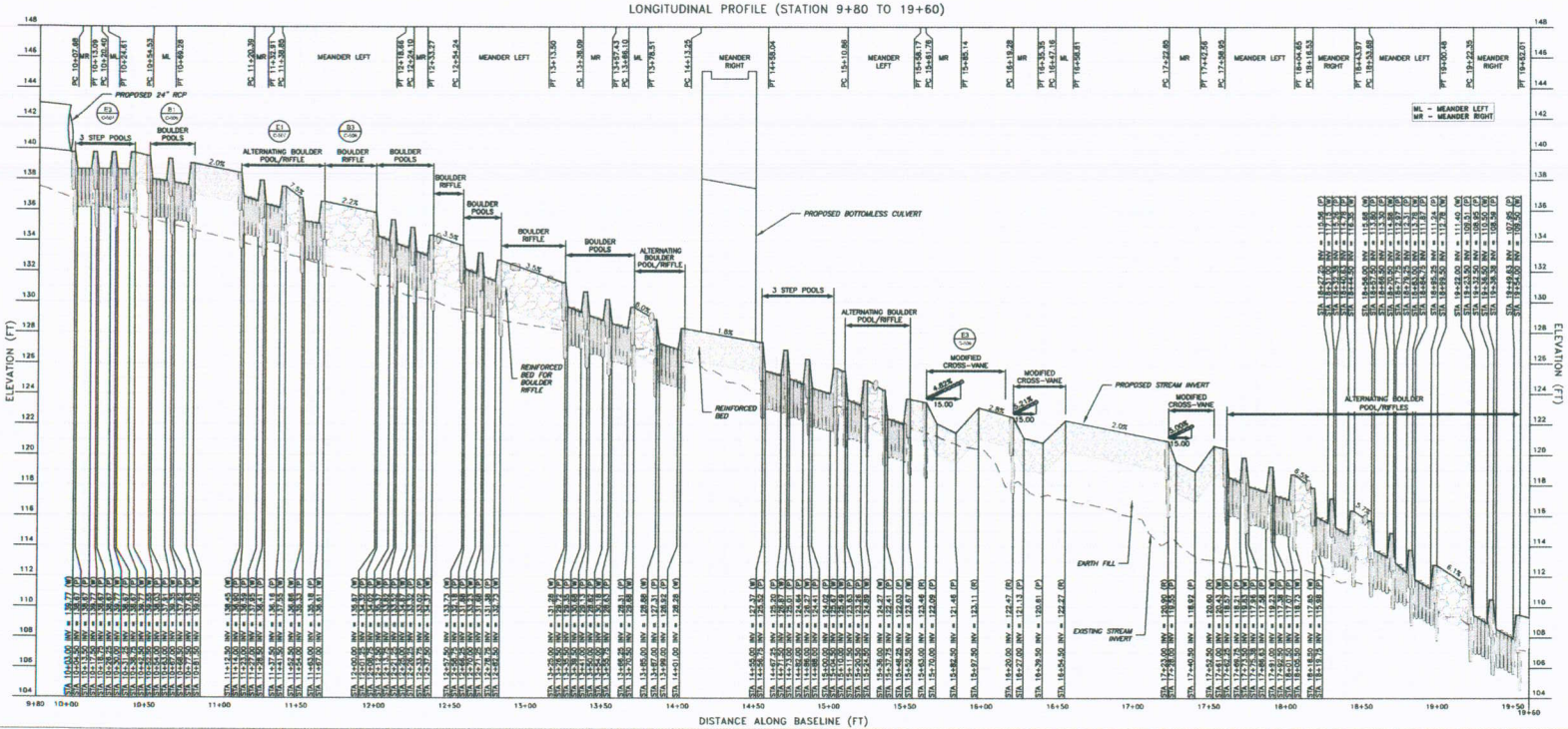
PRIOR TO CONSTRUCTION, LOC SHALL BE WALKED WITH C.O.R. AND CONTRACTOR TO CONFIRM TREE REMOVAL.

WORK TO BE LIMITED TO WITHIN THE EXISTING CHANNEL AS MUCH AS POSSIBLE USING SUITABLE TRACKED EQUIPMENT TO LIMIT IMPACT TO TRILLS AND OTHERWISE, STABLE BANKS.

GRADING LEGEND

- PROPERTY BOUNDARY
- EXISTING INFRASTRUCTURE
- LIMITS OF CLEARING (STREAM RESTORATION)
- EXISTING CONTOURS (0.5') (SURVEYED)
- EXISTING CONTOURS (2.0') (ARLINGTON COUNTY GIS DATA)
- PROPOSED CONTOURS (0.5')
- INTERMITTENT STREAM (OHWM)
- PERENNIAL STREAM (OHWM)
- NONJURISDICTIONAL CHANNEL (APPROX. CENTERLINE)
- JURISDICTIONAL WETLANDS
- PROPOSED CENTERLINE
- PROPOSED TOP OF BANK
- RPA BUFFER
- 50' STREAM BUFFER
- PROPOSED MODIFIED CROSS VANE (E3 CVM)
- PROPOSED STEP POOL(S) (S1 SPL)
- BOULDER POOL (B1 CPL)
- BOULDER STEP (B1 SPL)
- REINFORCED BED MIX ONLY

LONGITUDINAL PROFILE (STATION 9+80 TO 19+60)



REFER TO SHEET C-507 FOR GRADING NOTES AND SEQUENCE OF CONSTRUCTION.

PROFILE LEGEND

- EXISTING STREAM INVERT
- PROPOSED STREAM INVERT
- STRUCTURE ROCKS
- RIFFLE BOULDERS
- REINFORCED BED
- EARTH FILL
- BOULDER RIFFLE
- BOULDER RIFFLE (NO FINES)
- PC & PT LOCATIONS WITH LINE OR CURVE DESIGNATION REFERENCED FROM STAKEOUT DATA

PC = 0+37.99
PT = 2+56.32

LONGITUDINAL PROFILE
SCALE: H: 1" = 30'
V: 1" = 3'

MATCH LINE SHEET CG-105

US Army Corps of Engineers – Norfolk District

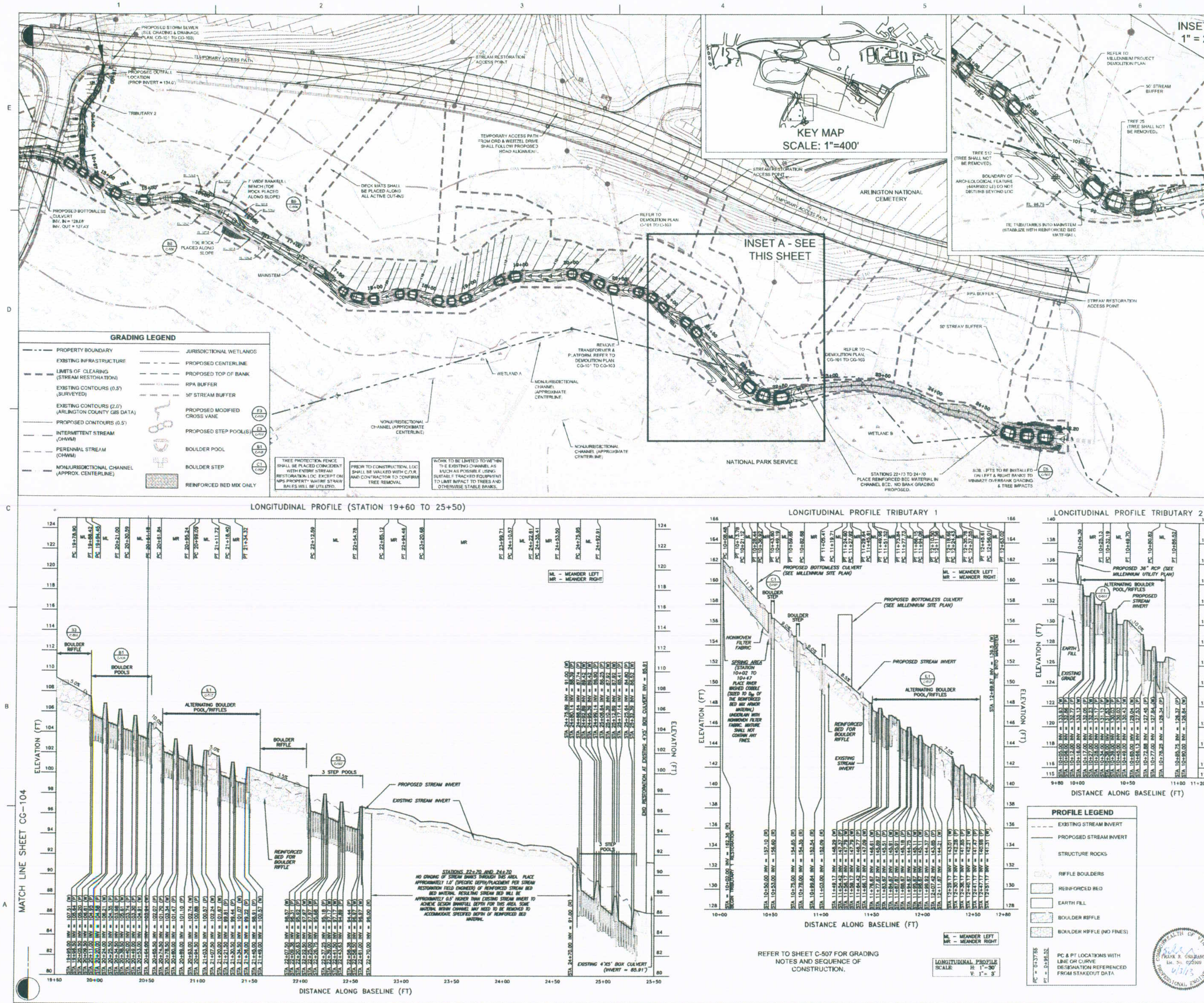
ARLINGTON NATIONAL CEMETERY MILLENNIUM PROJECT SITE CEMETERY EXPANSION ARLINGTON, VA
GRADING PLAN & LONGITUDINAL PROFILE

U.S. ARMY CORPS OF ENGINEERS NORFOLK DISTRICT NORFOLK, VIRGINIA

JACOBS/TAMAKIN & WHITNEY JV 1100 WILSON BLVD., SUITE 900 ARLINGTON, VA 22201

FRANK R. GIANNINO Lic. No. 022269 — COMMONWEALTH OF VIRGINIA — PROFESSIONAL ENGINEER

SHEET IDENTIFICATION
CG-104



KEY MAP
SCALE: 1"=400'
INSET A
1" = 20'
INSET A - SEE THIS SHEET
ARLINGTON NATIONAL CEMETERY
NATIONAL PARK SERVICE
TEMPORARY ACCESS PATH
STREAM RESTORATION ACCESS POINT
TRIBUTARY 2
MAINSTEM
WETLAND A
WETLAND B
50' STREAM BUFFER
RPA BUFFER
GRADING LEGEND
PROPERTY BOUNDARY
EXISTING INFRASTRUCTURE
LIMITS OF CLEARING (STREAM RESTORATION)
EXISTING CONTOURS (0.5') (SURVEYED)
EXISTING CONTOURS (2.0') (ARLINGTON COUNTY GIS DATA)
PROPOSED CONTOURS (0.5')
INTERMITTENT STREAM (OHWM)
PERENNIAL STREAM (OHWM)
NONJURISDICTIONAL CHANNEL (APPROX. CENTERLINE)
JURISDICTIONAL WETLANDS
PROPOSED CENTERLINE
PROPOSED TOP OF BANK
RPA BUFFER
50' STREAM BUFFER
PROPOSED MODIFIED CROSS VANE
PROPOSED STEP POOL(S)
BOULDER POOL
BOULDER STEP
REINFORCED BED MIX ONLY
TREE PROTECTION FENCE SHALL BE PLACED CONCIDENT WITH ENTIRE STREAM RESTORATION LOC EXCEPT ON NPS PROPERTY WHERE STRAW BALES WILL BE UTILIZED.
PRIOR TO CONSTRUCTION, LOC SHALL BE WALKED WITH C.O.R. AND CONTRACTOR TO CONFIRM TREE REMOVAL
WORK TO BE LIMITED TO WITHIN THE EXISTING CHANNEL AS MUCH AS POSSIBLE USING SUITABLE TRACKED EQUIPMENT TO LIMIT IMPACT TO TREES AND OTHERWISE STABLE BANKS.
LONGITUDINAL PROFILE (STATION 19+60 TO 25+50)
LONGITUDINAL PROFILE TRIBUTARY 1
LONGITUDINAL PROFILE TRIBUTARY 2
ELEVATION (FT)
DISTANCE ALONG BASELINE (FT)
MATCH LINE SHEET CG-104
ML - MEANDER LEFT
MR - MEANDER RIGHT
BOULDER RIFFLE
BOULDER POOLS
ALTERNATING BOULDER POOL/RIFFLES
3 STEP POOLS
PROPOSED STREAM INVERT
EXISTING STREAM INVERT
REINFORCED BED FOR BOULDER RIFFLE
END RESTORATION AT EXISTING 4'X5' BOX CULVERT INV = 85.91
EXISTING 4'X5' BOX CULVERT (INVERT = 85.91')
PROPOSED BOTTOMLESS CULVERT (SEE MILLENNIUM SITE PLAN)
PROPOSED 36" RCP (SEE MILLENNIUM UTILITY PLAN)
REFER TO SHEET C-507 FOR GRADING NOTES AND SEQUENCE OF CONSTRUCTION.
LONGITUDINAL PROFILE SCALE: H: 1"=30' V: 1"= 3'
PROFILE LEGEND
EXISTING STREAM INVERT
PROPOSED STREAM INVERT
STRUCTURE ROCKS
RIFFLE BOULDERS
REINFORCED BED
EARTH FILL
BOULDER RIFFLE
BOULDER RIFFLE (NO FINES)
PC & PT LOCATIONS WITH LINE OR CURVE DESIGNATION REFERENCED FROM STAKEOUT DATA

U.S. ARMY CORPS OF ENGINEERS
NORFOLK DISTRICT
NORFOLK, VIRGINIA

JACOBS/AMMANN & WHITNEY JV
1100 N. GLEBE ROAD, SUITE 500
ARLINGTON, VA 22201

ARLINGTON NATIONAL CEMETERY
MILLENNIUM PROJECT
SITE CEMETERY EXPANSION
STREAM RESTORATION
GRADING PLAN & LONGITUDINAL PROFILE (CONT'D)

SHEET IDENTIFICATION
CG-105

Nationwide Permit (27) Aquatic Habitat Restoration, Establishment, and Enhancement Activities (3/19/2012)

Activities in waters of the United States associated with the restoration, enhancement, and establishment of tidal and non-tidal wetlands and riparian areas, the restoration and enhancement of non-tidal streams and other non-tidal open waters, and the rehabilitation or enhancement of tidal streams, tidal wetlands, and tidal open waters, provided those activities result in net increases in aquatic resource functions and services.

To the extent that a Corps permit is required, activities authorized by this NWP include, but are not limited to: the removal of accumulated sediments; the installation, removal, and maintenance of small water control structures, dikes, and berms, as well as discharges of dredged or fill material to restore appropriate stream channel configurations after small water control structures, dikes, and berms, are removed; the installation of current deflectors; the enhancement, restoration, or establishment of riffle and pool stream structure; the placement of in-stream habitat structures; modifications of the stream bed and/or banks to restore or establish stream meanders; the backfilling of artificial channels; the removal of existing drainage structures, such as drain tiles, and the filling, blocking, or reshaping of drainage ditches to restore wetland hydrology; the installation of structures or fills necessary to establish or re-establish wetland or stream hydrology; the construction of small nesting islands; the construction of open water areas; the construction of oyster habitat over unvegetated bottom in tidal waters; shellfish seeding; activities needed to reestablish vegetation, including plowing or discing for seed bed preparation and the planting of appropriate wetland species; re-establishment of submerged aquatic vegetation in areas where those plant communities previously existed; re-establishment of tidal wetlands in tidal waters where those wetlands previously existed; mechanized land clearing to remove non-native invasive, exotic, or nuisance vegetation; and other related activities. Only native plant species should be planted at the site.

This NWP authorizes the relocation of non-tidal waters, including non-tidal wetlands and streams, on the project site provided there are net increases in aquatic resource functions and services.

Except for the relocation of non-tidal waters on the project site, this NWP does not authorize the conversion of a stream or natural wetlands to another aquatic habitat type (e.g., stream to wetland or vice versa) or uplands. Changes in wetland plant communities that occur when wetland hydrology is more fully restored during wetland rehabilitation activities are not considered a conversion to another aquatic habitat type. This NWP does not authorize stream channelization. This NWP does not authorize the relocation of tidal waters or the conversion of tidal waters, including tidal wetlands, to other aquatic uses, such as the conversion of tidal wetlands into open water impoundments.

Compensatory mitigation is not required for activities authorized by this NWP since these activities must result in net increases in aquatic resource functions and services.

Reversion. For enhancement, restoration, and establishment activities conducted:

(1) In accordance with the terms and conditions of a binding stream or wetland enhancement or restoration agreement, or a wetland establishment agreement, between the landowner and the U.S. Fish and Wildlife Service (FWS), the Natural Resources Conservation Service (NRCS), the Farm Service Agency (FSA), the National Marine Fisheries Service (NMFS), the National Ocean Service (NOS), U.S. Forest Service (USFS), or their designated state cooperating agencies;

(2) as voluntary wetland restoration, enhancement, and establishment actions documented by the NRCS or USDA Technical Service Provider pursuant to NRCS Field Office Technical Guide standards; or

(3) on reclaimed surface coal mine lands, in accordance with a Surface Mining Control and Reclamation Act permit issued by the Office of Surface Mining Reclamation and Enforcement (OSMRE) or the applicable state agency, this NWP also authorizes any future discharge of dredged or fill material associated with the reversion of the area to its documented prior condition and use (i.e., prior to the restoration, enhancement, or establishment activities). The reversion must occur within five years after expiration of a limited term wetland restoration or establishment agreement or permit, and is authorized in these circumstances even if the discharge occurs after this NWP expires. The five-year reversion limit does not apply to agreements without time limits reached between the landowner and the FWS, NRCS, FSA, NMFS, NOS, USFS, or an appropriate state cooperating agency. This NWP also authorizes discharges of dredged or fill material in waters of the United States for the reversion of wetlands that were restored, enhanced, or established on prior-converted cropland or on uplands, in accordance with a binding agreement between the landowner and NRCS, FSA, FWS, or their designated state cooperating agencies (even though the restoration, enhancement, or establishment activity did not require a section 404 permit). The prior condition will be documented in the original agreement or permit, and the determination of return to prior conditions will be made by the Federal agency or appropriate state agency executing the agreement or permit. Before conducting any reversion activity the permittee or the appropriate Federal or state agency must notify the district engineer and include the documentation of the prior condition. Once an area has reverted to its prior physical condition, it will be subject to whatever the Corps Regulatory requirements are applicable to that type of land at the time. The requirement that the activity results in a net increase in aquatic resource functions and services does not apply to reversion activities meeting the above conditions. Except for the activities described above, this NWP does not authorize any future discharge of dredged or fill material associated with the reversion of the area to its prior condition. In such cases a separate permit would be required for any reversion.

Reporting. For those activities that do not require pre-construction notification, the permittee must submit to the district engineer a copy of:

(1) The binding stream enhancement or restoration agreement or wetland enhancement, restoration, or establishment agreement, or a project description, including project plans and location map;

(2) the NRCS or USDA Technical Service Provider documentation for the voluntary stream enhancement or restoration action or wetland restoration, enhancement, or establishment action; or

(3) the SMCRA permit issued by OSMRE or the applicable state agency. The report must also include information on baseline ecological conditions on the project site, such as a delineation of wetlands, streams, and/or other aquatic habitats. These documents must be submitted to the district engineer at least 30 days prior to commencing activities in waters of the United States authorized by this NWP.

Notification: The permittee must submit a pre-construction notification to the district engineer prior to commencing any activity (see general condition 31), except for the following activities:

(1) Activities conducted on non-Federal public lands and private lands, in accordance with the terms and conditions of a binding stream enhancement or restoration agreement or wetland enhancement, restoration, or establishment agreement between the landowner and the U.S. FWS, NRCS, FSA, NMFS, NOS, USFS or their designated state cooperating agencies;

(2) Voluntary stream or wetland restoration or enhancement action, or wetland establishment action, documented by the NRCS or USDA Technical Service Provider pursuant to NRCS Field Office Technical Guide standards; or

(3) The reclamation of surface coal mine lands, in accordance with an SMCRA permit issued by the OSMRE or the applicable state agency.

However, the permittee must submit a copy of the appropriate documentation to the district engineer to fulfill the reporting requirement. (Sections 10 and 404)

Note: This NWP can be used to authorize compensatory mitigation projects, including mitigation banks and in-lieu fee projects. However, this NWP does not authorize the reversion of an area used for a compensatory mitigation project to its prior condition, since compensatory mitigation is generally intended to be permanent.

REGIONAL CONDITIONS:

1. **Conditions for Waters Containing Submerged Aquatic Vegetation (SAV) Beds: A pre-construction notification (PCN) is required if work will occur in areas that contain submerged aquatic vegetation (SAVs). Information about SAVs can be found at the Virginia Institute of Marine Science's website: http://www.vims.edu/bio/sav/. Additional avoidance and minimization measures, such as relocating a structure or time-of-year (TOYR) restrictions may be required to reduce impacts to SAVs.**

2. **Conditions for Anadromous Fish Use Areas: To ensure that activities authorized by this Nationwide Permit (NWP) do not impact waterways documented to provide spawning habitat or a migratory pathway for anadromous fish, a check for anadromous fish use areas must be conducted via the Norfolk District's Regulatory GIS (for reporting permits) and/or the Virginia Department of Game and Inland Fisheries (VDGIF) Information System (by applicant for non-reporting permits) at http://vafwis.org/fwis/ . If the project is located in an area documented as an anadromous fish use area (confirmed or potential), a time-of-year restriction (TOYR) prohibiting all in-water work will be required from February 15 to June 30 of any given year or any TOYR specified by VDGIF and/or Virginia Marine Resources Commission (VMRC). For permits requiring a PCN, if the Norfolk District determines that the work is minimal and the TOYR is unnecessary, informal consultation will be conducted with NOAA Fisheries Service (NOAA) to obtain concurrence that the TOYR would not be required for the proposed activity.**

3. **Conditions for Designated Critical Resource Waters, which include National Estuarine Research Reserves: Notification is required for work under this NWP in the Chesapeake Bay National Estuarine Research Reserve in Virginia. This multi-site system along a salinity gradient of the York River includes Sweet Hall Marsh, Taskinas Creek, Catlett Island, and Goodwin Islands. More information can be found at: http://www.vims.edu/cbnerr/.**

4. **Conditions for Federally Listed Species and Designated Critical Habitat: Notification for this NWP will be required for any project that may affect a federally listed threatened or endangered species or designated critical habitat. The U.S. Fish and Wildlife Service (Service) has developed an online system that allows users to find information about sensitive resources that may occur within the vicinity of a proposed project. This system is named "Information, Planning and Conservation System," (IPaC), and is located at: http://ecos.fws.gov/ipac/ This system provides information regarding federally listed and proposed candidate, threatened, and endangered species, designated critical habitats, and Service refuges that may occur in the identified areas, or may be affected by the proposed activities. The applicant may use this system to determine if any federally listed species or designated critical habitat may be affected by their proposed project, ensuring compliance with the Endangered Species Act.**

5. **Conditions Regarding Invasive Species: Plant species listed by the most current *Virginia Department of Conservation and Recreation's Invasive Alien Plant List* shall not be used for re-vegetation for activities authorized by any NWP. The list of invasive plants in Virginia may be found at: http://www.dcr.virginia.gov/natural_heritage/documents/invlist.pdf .**

6. **Conditions Pertaining to Countersinking of Pipes and Culverts in Nontidal Waters:**

   NOTE: COUNTERSINKING IS NOT REQUIRED IN TIDAL WATERS. However, replacement pipes/culverts in tidal waters must be installed with invert elevations no higher than the existing pipe/culvert invert elevation, and a new pipe/culvert must be installed with the invert no higher than the stream bottom elevation.

   a. **Following consultation with the Virginia Department of Game and Inland Fisheries (DGIF), the Norfolk District has determined that fish and other aquatic organisms are most likely present in any stream being crossed, in the absence of site-specific evidence to the contrary. Although prospective permittees have the option of providing such evidence, extensive efforts to collect such information is not encouraged, since countersinking will in most cases be required except as outlined in the conditions below.**
   b. **All pipes: All pipes and culverts placed in streams will be countersunk at both the inlet and outlet ends, unless indicated otherwise by the Norfolk District on a case-by-case basis (see below). Pipes that are 24" or less in diameter shall be countersunk 3" below the natural stream bottom. Pipes that are greater than 24" in diameter shall be countersunk 6" below the natural stream bottom. The countersinking requirement does not apply to bottomless pipes/culverts or pipe arches. All single pipes or culverts (with bottoms) shall be depressed (countersunk) below the natural streambed at both the inlet and outlet of the structure. In sets of multiple pipes or culverts (with bottoms) at least one pipe or culvert shall be depressed (countersunk) at both the inlet and outlet to convey low flows.**
   c. **Exemption for extensions and certain maintenance: The requirement to countersink does not apply to extensions of existing pipes or culverts that are not countersunk, or to maintenance to pipes/culverts that does not involve replacing the pipe/culvert (such as repairing cracks, adding material to prevent/correct scour, etc.).**
   d. **Floodplain pipes: The requirement to countersink does not apply to pipes or culverts that are being placed above ordinary high water, such as those placed to allow for floodplain flows. The placement of pipes above ordinary high water is not jurisdictional (provided no fill is discharged into wetlands).**
   e. **Hydraulic opening: Pipes should be adequately sized to allow for the passage of ordinary high water with the countersinking and invert restrictions taken into account.**
   f. **Pipes on bedrock or above existing utility lines: Different procedures will be followed for pipes or culverts to be placed on bedrock or above existing buried utility lines where it is not practicable to relocate the lines, depending on whether the work is for replacement of an existing pipe/culvert or a new pipe/culvert:**
      i. **Replacement of an existing pipe/culvert: Countersinking is not required provided the elevations of the inlet and outlet ends of the replacement pipe/culvert are no higher above the stream bottom than those of the existing pipe/culvert. Documentation (photographic or other evidence) must be maintained in the permittee's records showing the bedrock condition and the existing inlet and outlet elevations. That documentation will be available to the Norfolk District upon request, but notification or coordination with the Norfolk District is not otherwise required.**
      ii. **A pipe/culvert is being placed in a new location: If the prospective permittee determines that bedrock or an existing buried utility line that is not practicable to relocate prevents countersinking, he/she should evaluate the use of a bottomless pipe/culvert, bottomless utility vault, span (bridge) or other bottomless structure to cross the waterway, and also evaluate alternative locations for the new pipe/culvert that will allow for countersinking. If the prospective permittee determines that neither a bottomless structure nor an alternative location is practicable, then he/she**

must submit a pre-construction notification (PCN) to the Norfolk District in accordance with General Condition 31 of the NWPs. In addition to the information required by General Condition 31, the prospective permittee must provide documentation of measures evaluated to minimize disruption of the movement of aquatic life as well as documentation of the cost, engineering factors, and site conditions that prohibit countersinking the pipe/culvert. Options that must be considered include partial countersinking (such as less than 3" of countersinking, or countersinking of one end of the pipe), and constructing stone step pools, low rock weirs downstream, or other measures to provide for the movement of aquatic organisms. The PCN must also include photographs documenting site conditions. The prospective permittee may find it helpful to contact his/her regional fishery biologist for the Virginia Department of Game and Inland Fisheries (VDGIF), for recommendations about the measures to be taken to allow for fish movements. When seeking advice from VDGIF, the prospective permittee should provide the VDGIF biologist with all available information such as location, flow rates, stream bottom features, description of proposed pipe(s), slopes, etc. Any recommendations from VDGIF should be included in the PCN. The Norfolk District will notify the prospective permittee whether the proposed work qualifies for the nationwide permit within 45 days of receipt of a complete PCN. NOTE: Blasting of stream bottoms through the use of explosives is not acceptable as a means of providing for countersinking of pipes on bedrock.

g. Pipes on steep terrain: Pipes being placed on steep terrain (slope of 5% or greater) must be countersunk in accordance with the conditions above and will in most cases be non-reporting. It is recommended that on slopes greater than 5%, a larger pipe than required be installed to allow for the passage of ordinary high water in order to increase the likelihood that natural velocities can be maintained. There may be situations where countersinking both the inlet and outlet may result in a slope in the pipe that results in flow velocities that cause excessive scour at the outlet and/or prohibit some fish movement. This type of situation could occur on the side of a mountain where falls and drop pools occur along a stream. Should this be the case, or should the prospective permittee not want to countersink the pipe/culvert for other reasons, he/she must submit a Pre-Construction Notification to the Norfolk District in accordance with General Condition 31 of the Nationwide Permits. In addition to the information required by General Condition 31, the prospective permittee must provide documentation of measures evaluated to minimize disruption of the movement of aquatic life as well as documentation of the cost, engineering factors, and site conditions that prohibit countersinking the pipe/culvert. The prospective permittee should design the pipe to be placed at a slope as steep as stream characteristics allow, countersink the inlet 3-6", and implement measures to minimize any disruption of fish movement. These measures can include constructing a stone step/pool structure, preferably using river rock/native stone rather than riprap, constructing low rock weirs to create a pool or pools, or other structures to allow for fish movements in both directions. Stone structures should be designed with sufficient-sized stone to prevent erosion or washout and should include keying-in as appropriate. These structures should be designed both to allow for fish passage and to minimize scour at the outlet. The quantities of fill discharged below ordinary high water necessary to comply with these requirements (i.e., the cubic yards of stone, riprap or other fill placed below the plane of ordinary high water) must be included in project totals. The prospective permittee may find it helpful to contact his/her regional fishery biologist for the Virginia Department of Game and Inland Fisheries (DGIF), for recommendations about the measures to be taken to allow for fish movements. When seeking advice from DGIF, the prospective permittee should provide the DGIF biologist with all available information such as location, flow rates, stream bottom features, description of proposed pipe(s), slopes, etc. Any recommendations from DGIF should be included in the PCN. The Norfolk District will notify the prospective permittee whether the proposed work qualifies for the nationwide permit within 45 days of receipt of a complete PCN.

h. Problems encountered during construction: When a pipe/culvert is being replaced, and the design calls for countersinking at both ends of the pipe/culvert, and during construction it is found that the streambed/banks are on bedrock, then the permittee must stop work and contact the Norfolk District (contact by telephone and/or email is acceptable). The permittee must provide the Norfolk District with specific information concerning site conditions and limitations on countersinking. The Norfolk District will work with the permittee to determine an acceptable plan, taking into consideration the information provided by the permittee, but the permittee should recognize that the Norfolk District could determine that the work will not qualify for a nationwide permit.

i. Emergency pipe replacements: In the case of an emergency situation, such as when a pipe/culvert washes out during a flood, a permittee is encouraged to countersink the replacement pipe at the time of replacement, in accordance with the conditions above. However, if conditions or timeframes do not allow for countersinking, then the pipe can be replaced as it was before the washout, but the permittee will have to come back and replace the pipe/culvert and countersink it in accordance with the guidance above. In other words, the replacement of the washed out pipe is viewed as a temporary repair, and a countersunk replacement should be made at the earliest possible date. The Norfolk District must be notified of all pipes/culverts that are replaced without countersinking at the time that it occurs, even if it is an otherwise non-reporting activity, and must provide the permittee's planned schedule for installing a countersunk replacement (it is acceptable to submit such notification by email). The permittee should anticipate whether bedrock or steep terrain will limit countersinking, and if so, should follow the procedures outlined in (f) and/or (g) above.

7. Conditions for the Repair of Pipes:

NOTE: COUNTERSINKING IS NOT REQUIRED IN TIDAL WATERS. However, replacement pipes/culverts in tidal waters must be installed with invert elevations no higher than the existing pipe/culvert invert elevation, and a new pipe/culvert must be installed with the invert no higher than the stream bottom elevation.

If any discharge of fill material will occur in conjunction with pipe maintenance, such as concrete being pumped over rebar into an existing deteriorated pipe for stabilization, then:

A. If the existing pipe or line of pipes are NOT currently countersunk:
   a. As long as the inlet and outlet invert elevations of at least one pipe located in the low flow channel are not being altered, and provided that no concrete apron is being constructed, then the work may proceed under the NWP for the other pipes, provided it complies with all other NWP General Conditions, including Condition 9 for Management of Water Flows. In such cases, notification to the Norfolk District Commander is not required, unless specified in the NWP Conditions for other reasons, and the permittee may proceed with the work.
   b. Otherwise, the prospective permittee must submit a pre-construction notification (PCN) to the Norfolk District Commander prior to commencing the activity. For all such projects, the following information should be provided:
      1) Photographs of the existing inlet and outlet;
      2) A measurement of the degree to which the work will raise the invert elevations of both the inlet and outlet of the existing pipe;

3) The reasons why other methods of pipe maintenance are not practicable (such as metal sleeves or a countersunk pipe replacement);

4) Depending on the specific case, the Norfolk District may discuss potential fish usage of the waterway with the Virginia Department of Game and Inland Fisheries.

The Norfolk District will assess all such pipe repair proposals in accordance with guidelines that can be found under "Pipe Repair Guidelines" at:
http://www.nao.usace.army.mil/technical%20services/Regulatory%20branch/Guidance/guidance_documents.asp

c. If the Norfolk District determines that the work qualifies for the NWP, additional conditions will be placed on the verification. Those conditions can be found at the web link above (in item ii).

d. If the Norfolk District determines that the work does NOT qualify for the NWP, the applicant will be directed to apply for either an LOP-I permit (applicable only for Virginia Department of Transportation projects) or an individual permit. However, it is anticipated that the applicant will still be required to perform the work such that the waterway is not blocked or restricted to a greater degree than its current conditions.

B. If the existing pipe or at least one pipe in the line of pipes IS countersunk and at least one pipe located in the low flow channel will continue to be countersunk, and no concrete aprons are proposed: No PCN to the Norfolk District is required, unless specified in the NWP Conditions for other reasons, and the permittee may proceed with the work.

C. If the existing pipe or at least one pipe in the line of pipes IS countersunk and no pipe will continue to be countersunk in the low flow channel: This work cannot be performed under the NWPs. The prospective permittee must apply for either a Letter of Permission 1 (LOP-I) permit (applicable only for VDOT projects) or an individual permit. However, it is anticipated that the prospective permittee will still be required to perform the work such that the waterway is not blocked or restricted more so than its current conditions.

D. Emergency situations: In the case of an emergency situation, a prospective permittee is encouraged to follow the above guidelines at the time of repair. However, if conditions or timeframes do not allow for compliance with the procedure outlined herein, then the pipe can be repaired as it was before the washout, but the prospective permittee will have to come back and replace or reconstruct the pipe/culvert in accordance with these guidelines. In other words, the repair of the pipe is viewed as a temporary fix, and an appropriate repair should be made at the earliest possible date. The Norfolk District must be notified of all pipes/culverts that are repaired without compliance with these guidelines at the time that the repair occurs, even if it is an otherwise non-reporting activity, and that notification must provide the prospective permittee's planned schedule for following these procedures and constructing an appropriate repair (it is acceptable to submit such notification by email).

GENERAL CONDITIONS:

Note: To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as applicable, in addition to any regional or case-specific conditions imposed by the division engineer or district engineer. Prospective permittees should contact the appropriate Corps district office to determine if regional conditions have been imposed on an NWP. Prospective permittees should also contact the appropriate Corps district office to determine the status of Clean Water Act Section 401 water quality certification and/or Coastal Zone Management Act consistency for an NWP. Every person who may wish to obtain permit authorization under one or more NWPs, or who is currently relying on an existing or prior permit authorization under one or more NWPs, has been and is on notice that all of the provisions of 33 CFR §§ 330.1 through 330.6 apply to every NWP authorization. Note especially 33 CFR § 330.5 relating to the modification, suspension, or revocation of any NWP authorization.

1. Navigation.
   a) No activity may cause more than a minimal adverse effect on navigation.
   b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.
   c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

2. Aquatic Life Movements. No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species.

3. Spawning Areas. Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

4. Migratory Bird Breeding Areas. Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

5. Shellfish Beds. No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

6. Suitable Material. No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

7. Water Supply Intakes. No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

8. Adverse Effects From Impoundments. If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

9. Management of Water Flows. To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization and storm water management activities, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

10. Fills Within 100-Year Floodplains. The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

11. Equipment. Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

12. Soil Erosion and Sediment Controls. Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow.

13. Removal of Temporary Fills. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

14. Proper Maintenance. Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

15. Single and Complete Project. The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

16. Wild and Scenic Rivers. No activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service).

17. Tribal Rights. No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

18. Endangered Species.
    a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which "may affect" a listed species or critical habitat, unless Section 7 consultation addressing the effects of the proposed activity has been completed.
    b) Federal agencies should follow their own procedures for complying with the requirements of the ESA. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address ESA compliance for the NWP activity, or whether additional ESA consultation is necessary.
    c) Non-federal permittees must submit a pre-construction notification to the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that might be affected by the proposed work or that utilize the designated critical habitat that might be affected by the proposed work. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete pre-construction notification. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have "no effect" on listed species or critical habitat, or until Section 7 consultation has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.
    d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add species-specific regional endangered species conditions to the NWPs.
    e) Authorization of an activity by a NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the U.S. FWS or the NMFS, The Endangered Species Act prohibits any person subject to the jurisdiction of the United States to take a listed species, where "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word "harm" in the definition of "take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.
    f) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the U.S. FWS and NMFS or their world wide web pages at http://www.fws.gov/ or http://www.fws.gov/ipac and http://www.noaa.gov/fisheries.html respectively.

19. Migratory Birds and Bald and Golden Eagles. The permittee is responsible for obtaining any "take" permits required under the U.S. Fish and Wildlife Service's regulations governing compliance with the Migratory Bird Treaty Act or the Bald and Golden Eagle Protection Act. The permittee should contact the appropriate local office of the U.S. Fish and Wildlife Service to determine if such "take" permits are required for a particular activity.

20. Historic Properties.
    a) In cases where the district engineer determines that the activity may affect properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.
    b) Federal permittees should follow their own procedures for complying with the requirements of Section 106 of the National Historic Preservation Act. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address section 106 compliance for the NWP activity, or whether additional section 106 consultation is necessary.
    c) Non-federal permittees must submit a pre-construction notification to the district engineer if the authorized activity may have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties may be affected by the proposed work or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of or potential for the presence of historic resources can be sought from the State Historic Preservation Officer or Tribal Historic Preservation Officer, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of Section 106

of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation, and field survey. Based on the information submitted and these efforts, the district engineer shall determine whether the proposed activity has the potential to cause an effect on the historic properties. Where the non-Federal applicant has identified historic properties on which the activity may have the potential to cause effects and so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects or that consultation under Section 106 of the NHPA has been completed.

d) The district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA Section 106 consultation is required. Section 106 consultation is not required when the Corps determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR §800.3(a)). If NHPA section 106 consultation is required and will occur, the district engineer will notify the non-Federal applicant that he or she cannot begin work until Section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

e) Prospective permittees should be aware that section 110k of the NHPA (16 U.S.C. 470h-2(k)) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of Section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

21. Discovery of Previously Unknown Remains and Artifacts. If you discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by this permit, you must immediately notify the district engineer of what you have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the Federal, Tribal and state coordination required to determine if the items or remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

22. Designated Critical Resource Waters. Critical resource waters include, NOAA-managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment.

a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, and 52 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.

b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with general condition 31, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after it is determined that the impacts to the critical resource waters will be no more than minimal.

23. Mitigation. The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that adverse effects on the aquatic environment are minimal.

a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (i.e., on site).

b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.

c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse effects of the proposed activity are minimal, and provides a project-specific waiver of this requirement. For wetland losses of 1/10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in minimal adverse effects on the aquatic environment. Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332.

(1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in minimal adverse effects on the aquatic environment.

(2) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, wetland restoration should be the first compensatory mitigation option considered.

(3) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2) – (14) must be approved by the district engineer before the permittee begins work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)).

(4) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan only needs to address the baseline conditions at the impact site and the number of credits to be provided.

(5) Compensatory mitigation requirements (e.g., resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan.

d) For losses of streams or other open waters that require pre-construction notification, the district engineer may require compensatory mitigation, such as stream rehabilitation, enhancement, or preservation, to ensure that the activity results in minimal adverse effects on the aquatic environment.

e) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1/2-acre, it cannot be used to authorize any project resulting in the loss of greater than 1/2-acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that a project already meeting the established acreage limits also satisfies the minimal impact requirement associated with the NWPs.

f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the restoration or establishment, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some

cases, riparian areas may be the only compensatory mitigation required. Riparian areas should consist of native species. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. If it is not possible to establish a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or establishing a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

g) Permittees may propose the use of mitigation banks, in-lieu fee programs, or separate permittee-responsible mitigation. For activities resulting in the loss of marine or estuarine resources, permittee-responsible compensatory mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management.

h) Where certain functions and services of waters of the United States are permanently adversely affected, such as the conversion of a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse effects of the project to the minimal level.

24. Safety of Impoundment Structures. To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

25. Water Quality. Where States and authorized Tribes, or EPA where applicable, have not previously certified compliance of an NWP with CWA Section 401, individual 401 Water Quality Certification must be obtained or waived (see 33 CFR 330.4(c)). The district engineer or State or Tribe may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

26. Coastal Zone Management. In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). The district engineer or a State may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

27. Regional and Case-By-Case Conditions. The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

28. Use of Multiple Nationwide Permits. The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the United States authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.

29. Transfer of Nationwide Permit Verifications. If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature:

"When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below."

_____
(Transferee)

_____
(Date)

30. Compliance Certification. Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and any required compensatory mitigation. The success of any required permittee-responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include:
    a) A statement that the authorized work was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions.
    b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(l)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and
    c) The signature of the permittee certifying the completion of the work and mitigation.

31. Pre-Construction Notification.
    a) Timing. Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. The request must specify the information needed to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:
        (1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or
        (2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or in the vicinity of the project, or to notify the Corps pursuant to general condition 20 that the activity may have the potential to cause effects to historic

properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is "no effect" on listed species or "no potential to cause effects" on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or Section 106 of the National Historic Preservation (see 33 CFR 330.4(g)) has been completed. Also, work cannot begin under NWPs 21, 49, or 50 until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).

b) Contents of Pre-Construction Notification: The PCN must be in writing and include the following information:
   (1) Name, address and telephone numbers of the prospective permittee;
   (2) Location of the proposed project;
   (3) A description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause, including the anticipated amount of loss of water of the United States expected to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. The description should be sufficiently detailed to allow the district engineer to determine that the adverse effects of the project will be minimal and to determine the need for compensatory mitigation. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the project and when provided results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans);
   (4) The PCN must include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many waters of the United States. Furthermore, the 45 day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate;
   (5) If the proposed activity will result in the loss of greater than 1/10-acre of wetlands and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse effects are minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.
   (6) If any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, for non-Federal applicants the PCN must include the name(s) of those endangered or threatened species that might be affected by the proposed work or utilize the designated critical habitat that may be affected by the proposed work. Federal applicants must provide documentation demonstrating compliance with the Endangered Species Act; and
   (7) For an activity that may affect a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, for non-Federal applicants the PCN must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property. Federal applicants must provide documentation demonstrating compliance with Section 106 of the National Historic Preservation Act.

c) Form of Pre-Construction Notification: The standard individual permit application form (Form ENG 4345) may be used, but the completed application form must clearly indicate that it is a PCN and must include all of the information required in paragraphs (b)(1) through (7) of this general condition. A letter containing the required information may also be used.

d) Agency Coordination:
   (1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the project's adverse environmental effects to a minimal level.
   (2) For all NWP activities that require pre-construction notification and result in the loss of greater than 1/2-acre of waters of the United States, for NWP 21, 29, 39, 40, 42, 43, 44, 50, 51, and 52 activities that require pre-construction notification and will result in the loss of greater than 300 linear feet of intermittent and ephemeral stream bed, and for all NWP 48 activities that require pre-construction notification, the district engineer will immediately provide (e.g., via e-mail, facsimile transmission, overnight mail, or other expeditious manner) a copy of the complete PCN to the appropriate Federal or state offices (U.S. FWS, state natural resource or water quality agency, EPA, State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Office (THPO), and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will have 10 calendar days from the date the material is transmitted to telephone or fax the district engineer notice that they intend to provide substantive, site-specific comments. The comments must explain why the agency believes the adverse effects will be more than minimal. If so contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the pre-construction notification. The district engineer will fully consider agency comments received within the specified time frame concerning the proposed activity's compliance with the terms and conditions of the NWPs, including the need for mitigation to ensure the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The district engineer will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each pre-construction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.
   (3) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.
   (4) Applicants are encouraged to provide the Corps with either electronic files or multiple copies of pre-construction notifications to expedite agency coordination.

DISTRICT ENGINEER'S DECISION:

1. In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. For a linear project, this determination will include an evaluation of the individual crossings to determine whether they individually satisfy the terms and conditions of the NWP(s), as well as the cumulative effects caused by all of the crossings authorized by NWP. If an applicant requests a waiver of the 300 linear foot limit on impacts to intermittent or ephemeral streams or of an otherwise applicable limit, as provided for in NWPs 13, 21, 29, 36, 39, 40,

42, 43, 44, 50, 51 or 52, the district engineer will only grant the waiver upon a written determination that the NWP activity will result in minimal adverse effects. When making minimal effects determinations the district engineer will consider the direct and indirect effects caused by the NWP activity. The district engineer will also consider site specific factors, such as the environmental setting in the vicinity of the NWP activity, the type of resource that will be affected by the NWP activity, the functions provided by the aquatic resources that will be affected by the NWP activity, the degree or magnitude to which the aquatic resources perform those functions, the extent that aquatic resource functions will be lost as a result of the NWP activity (e.g., partial or complete loss), the duration of the adverse effects (temporary or permanent), the importance of the aquatic resource functions to the region (e.g., watershed or ecoregion), and mitigation required by the district engineer. If an appropriate functional assessment method is available and practicable to use, that assessment method may be used by the district engineer to assist in the minimal adverse effects determination. The district engineer may add case-specific special conditions to the NWP authorization to address site-specific environmental concerns.

2. If the proposed activity requires a PCN and will result in a loss of greater than 1/10-acre of wetlands, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for projects with smaller impacts. The district engineer will consider any proposed compensatory mitigation the applicant has included in the proposal in determining whether the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse effects on the aquatic environment are minimal, after considering mitigation, the district engineer will notify the permittee and include any activity-specific conditions in the NWP verification the district engineer deems necessary. Conditions for compensatory mitigation requirements must comply with the appropriate provisions at 33 CFR 332.3(k). The district engineer must approve the final mitigation plan before the permittee commences work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will expeditiously review the proposed compensatory mitigation plan. The district engineer must review the proposed compensatory mitigation plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure no more than minimal adverse effects on the aquatic environment. If the net adverse effects of the project on the aquatic environment (after consideration of the compensatory mitigation proposal) are determined by the district engineer to be minimal, the district engineer will provide a timely written response to the applicant. The response will state that the project can proceed under the terms and conditions of the NWP, including any activity-specific conditions added to the NWP authorization by the district engineer.

3. If the district engineer determines that the adverse effects of the proposed work are more than minimal, then the district engineer will notify the applicant either: (a) That the project does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit; (b) that the project is authorized under the NWP subject to the applicant's submission of a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level; or (c) that the project is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal adverse effects occur to the aquatic environment, the activity will be authorized within the 45-day PCN period, with activity-specific conditions that state the mitigation requirements. The authorization will include the necessary conceptual or detailed mitigation or a requirement that the applicant submit a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level. When mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan or has determined that prior approval of a final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation.

FURTHER INFORMATION:

1. District Engineers have authority to determine if an activity complies with the terms and conditions of an NWP.
2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.
3. NWPs do not grant any property rights or exclusive privileges.
4. NWPs do not authorize any injury to the property or rights of others.
5. NWPs do not authorize interference with any existing or proposed Federal project.

SECTION 401 WATER QUALITY CERTIFICATION (4/18/12):

The State Water Control Board has provided conditional §401 Water Quality Certification for the following Nationwide Permit as meeting the requirements of the Virginia Water Protection Permit Regulation, which serves as the Commonwealth's §401 Water Quality Certification provided that any compensatory mitigation meets the requirements in the Code of Virginia, Section 62.1-44.15:23 A through C and as detailed below:

NWP 27: *Stream and Wetland Restoration Activities,* provided that:

(1) when used to permit a wetland mitigation bank, compensation for any surface water impacts is debited from the bank credits;
(2) natural stream design shall be used for stream restoration projects;
(3) monitoring for success of these sites shall be conducted including submittal of as-built plans, surveys, and photographs;
(4) Dam removal for those dams meeting the following limits:
   a) less than 25 feet in height with a maximum impoundment capacity of less than 15 acre-feet or
   b) less than six feet in height with a maximum impounding capacity less than 50 acre-feet, or
   c) dams operated primarily for agricultural purposes which are less than 25 feet in height or which create a maximum impoundment capacity smaller than 100 acre-feet

The Commonwealth requests that all pre-construction notifications for any activities that fall into the excepted category be forwarded to the Department of Environmental Quality in order to accomplish their goal of individual review of certain activities.

COASTAL ZONE MANAGEMENT ACT CONSISTENCY DETERMINATION (4/19/12):

Based on the comments submitted by the agencies administering the enforceable policies of the Virginia Coastal Zone Management Program (VCP), the Virginia Department of Environmental Quality (DEQ) concurs that the reissuance of the 2012 NWPs and Virginia Regional Conditions, as proposed, is consistent with the VCP provided that the following conditions, discussed below, are satisfied:

1. Prior to construction, applicants shall obtain all required permits and approvals not yet secured for the activities to be performed that are applicable to the VCP's enforceable policies and that applicants also adhere to all the conditions contained therein.
   - The Virginia Marine Resources Commission's (VMRC) concurrence of consistency with the subaqueous lands management enforceable policy is based on the recognition that prospective permittees may be required to obtain additional state and/or local approvals prior to commencement of work in waters of the United States from the VMRC and/or the local wetlands board. Such approvals must precede implementation of the projects.
   - Similarly, the Department of Conservation and Recreation, Division of Stormwater Management, Local Implementation (formerly the Division of Chesapeake Bay Local Assistance) concurs that the proposed action is consistent with the coastal lands management enforceable policy provided projects are designed and constructed in a manner consistent with all state and local requirements pursuant to the Chesapeake Bay

Preservation Act ("the Act") (Virginia Code §10.1-2100 et seq.) and the Chesapeake Bay Preservation Area Designation and Management Regulations (9 VAC 10-20 et seq.). Applicable projects must receive local approval to be consistent with the coastal lands management enforceable policy.

2. The State Water Control Board has provided §401 Clean Water Act Water Quality Certification for the NWPs and Virginia Regional Conditions. Therefore, the activities that qualify for the NWPs meet the requirements of DEQ's Virginia Water Protection Permit Regulation, provided that the permittee abides by the conditions of the NWP. As to the exceptions for activities that would otherwise qualify for one of these Nationwide Permits, the State will continue to process applications for individual §401 Certification through a Virginia Water Protection General or Individual Permit pursuant to 9 VAC 25-210-10 *et seq.* The Commonwealth requests that the Corps forward to DEQ pre-construction notifications for any activities that fall into an excepted category for individual review of certain activities.

In accordance with the *Federal Consistency Regulations* at 15 CFR Part 930, section 930.4, this conditional concurrence is based on the applicants demonstrating to the Corps that they have obtained, or will obtain, all necessary authorizations prior to implementing a project which qualifies for a NWP. If the requirements of section 930.4, sub-paragraphs (a)(1) through (a)(3) are not met, this conditional concurrence becomes an objection under 15 CFR Part 930, section 940.43.

SECTION 01 11 00

SUMMARY OF WORK
08/11

PART 1 GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

1.1.1 Project Description

The Millennium Project will be developed to increase burial space at Arlington National Cemetery (ANC). Construction includes casket burial sections, in-ground sites for ashes of cremated service members, and both columbarium niche courts and niche walls. The site will include two (2) Committal Service Shelters for service participants. Supporting facilities include water fountains, waterlines, sanitary sewer, storm drainage, underground electrical and communications/information systems, stream restoration, landscaping, retaining walls, perimeter fencing, vehicle and pedestrian access roads and walks, and security systems.

1.1.2 Location

The Millennium project is located on a 27-acre site consisting of Section 29 of the existing ANC and the old picnic grounds of Joint Base Fort Myer / Henderson Hall (JBM-HH). The exact location will be shown by the Contracting Officer.

1.1.3 Permits

Contractor shall obtain digging and access permits from Joint Base Fort Myer/Henderson Hall Public Works and ANC Deputy Engineers Office prior to starting Work.

1.2 OCCUPANCY OF PREMISES

Before work is started, the Contractor shall obtain all required dig and environmental permits, arrange with the Contracting Officer a sequence of procedure, means of access, space for storage of materials and equipment, and use of approaches, corridors, and stairways.

1.3 EXISTING WORK

In addition to "FAR 52.236-9, Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements":

a. Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work which remain.

b. Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as approved by the Contracting Officer. At the completion of operations, existing work shall be in a condition equal to or better than that which existed before new work started.

1.4 LOCATION OF UNDERGROUND UTILITIES

Obtain digging permits prior to start of excavation. Verify elevations

before installing new work closer than nearest manhole or other structure at which an adjustment in grade can be made.

Notify the Contracting Officer at least 48 hours prior to starting excavation work.

1.5 GOVERNMENT-FURNISHED MATERIAL AND EQUIPMENT

Pursuant to Contract Clause "FAR 52.245-2, Government Property (Fixed Price Contracts)", the Government will furnish the following materials for installation by the Contractor:

DESIGNATION NO.	DESCRIPTION	QUANTITY
1	Marble Niche Covers	18,040

Quantities indicated for the above-listed items marked with an asterisk are estimates. It is the intention of the Government to furnish all quantities of the asterisk items required to complete the work as specified and the various quantities will be adjusted when necessary.

Quantities stated for the above items not marked with an asterisk are all that will be furnished by the Government. Contractor shall furnish any additional quantities required.

1.5.1 Delivery Schedule

Contractor shall coordiante the material delivery schedule with Contracting Officer.

1.5.2 Delivery Location

The materials and equipment are located at jobsite.

1.6 SALVAGE MATERIAL AND EQUIPMENT

Refer to Section 31 11 00 CLEARING AND GRUBBING for timber salvage requirements.

Items designated by the Contracting Officer to be salvaged shall remain the property of the Government.

The salvaged property shall be segregated, itemized, delivered, and off-loaded at the Government designated storage area located within 25 miles of the construction site.

Contractor shall maintain property control records for material or equipment designated as salvage. Contractor's system of property control may be used if approved by the Contracting Officer. Contractor shall be responsible for storage and protection of salvaged materials and equipment until disposition by the Contracting Officer.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 14 00

WORK RESTRICTIONS
11/11

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

list of contact personnel

1.2 SPECIAL SCHEDULING REQUIREMENTS

a. Contractor is responsible to ensure that no contract work interferes with any funeral, ceremony, procession, or visitation to be delayed, altered, or otherwise impacted in such a way that the dignity or security of the event is compromised. The Contractor's Site Manager is responsible for staying abreast of all such upcoming events. A list of scheduled ceremonies will be provided each week prior to the event, and a list of scheduled funerals will be provided the day prior to the service. Work with power equipment, within 1,000 feet of funeral or ceremony is not acceptable.

b. All work within 200 feet of a ceremony shall cease during the ceremony.

d. Permission to interrupt Activity, roads, and/or utility service shall be requested in writing a minimum of 15 calendar days prior to the desired date of interruption.

1.3 CONTRACTOR ACCESS AND USE OF PREMISES

1.3.1 Activity Regulations

Ensure that Contractor personnel employed on the Activity become familiar with and obey Activity Regulations including safety, fire, traffic and security regulations. Keep within the limits of the work and avenues of ingress and egress. Wear hard hats in designated areas. Do not enter any restricted areas unless required to do so and until cleared for such entry. The Contractor's equipment shall be conspicuously marked for identification. These site specific regulations will be discussed in more detail at the preconstruction conference. Information is also available upon request through the Contracting Officer's Representative and Owner's Representative.

1.3.1.1 Subcontractors and Personnel Contacts

Furnish a list of contact personnel of the Contractor and subcontractors including addresses and telephone numbers for use in the event of an emergency. As changes occur and additional information becomes available,

correct and change the information contained in previous lists.

1.3.1.2 Identification Badges and Installation Access at ANC

Contractor shall carry passes issued by Arlington National Cemetery for all vehicles entering the Cemetery, whether company-owned or employee's private vehicles. The issued passes should be visibly displayed on the dashboard of the vehicle at all times. All vehicles with passes shall meet Commonwealth of Virginia, State of Maryland, or District of Columbia inspection, safety, licensing, registration, and insurance requirements. The Contractor Site Manager will maintain a list of all vehicles and individuals issued such passes. All Contractor employees shall also keep positive, photographic identification on their persons at all times.

Contractor shall prohibit the use of Government issued passes by any persons other than the Contractor's employees.

Contractor shall maintain an active and accurate daily attendance of all employees working on the job site. Contractor shall provide the Government with a hard copy of the list every time it is updated; remove Contractor employee names not actively working on the site, and add new employees names accordingly. All Contractor employees working on the project not listed will be prohibited from the immediate work area. Government reserves the right to reject contractors from the list at any time and thereby prohibit them from the site.

Contractor shall comply with all security rules, regulations, and restrictions nominally associated with operations of Arlington National Cemetery.

The primary entrance to project site shall be Ord and Weitzel Gate unless otherwise directed by the Contracting Officer's Representative. Contractor shall be provided with a key and shall ensure that personnel are available to man the gate to accommodate deliveries/Contractor personnel access. Routing to project site must be coordinated with the Contracting Officer's Representative.

1.3.1.3 Personnel Entry Approval

Failure to obtain entry approval will not affect the contract price or time of completion. Refer to Section 01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS for employee parking information.

1.3.1.4 No Smoking Policy

Smoking is prohibited within all buildings on installations under the cognizance of Arlington National Cemetery except in designated smoking areas on project site and only as long as Contractor employees comply with appropriate discard of smoking debris. This applies to existing buildings, buildings under construction and buildings under renovation. Discarding tobacco materials other than into designated tobacco receptacles is considered littering and is subject to fines. The Contracting Officer will identify designated smoking areas.

1.3.1.5 Contractor Conduct

Arlington National Cemetery has a zero tolerance policy on the use, sale, and/or distribution of all forms of alcohol and drugs.

Contractor shall maintain a neat and professional appearance throughout its workforce including vehicles, equipment, work sites, staging areas, and employees.

Contractor employees shall behave with appropriate decorum, courtesy, and respect while within the grounds of the Cemetery. Shouting, cursing, angry outbursts, sleeping, intoxification, violence, or criminal acts of any kind will not be tolerated and is cause for immediate and permanent removal from the Cemetery premises. Criminal conduct is further subject to prosecution by the Government.

1.3.2 Working Hours

Working hours for Chaffee Place are as follows:

a. Site Hauling/Delivery Hours: 0600-0800, 1700-2100.

b. Working Hours: 0730-2100

Remainder of the Project Site work hours shall be 0600-2100.

During periods of darkness, the different parts of the work shall be lighted in a manner approved by the Contracting Officer.

1.3.3 Work Outside Regular Hours

Work outside regular working hours requires Contracting Officer approval. Make application 7 calendar days prior to such work to allow arrangements to be made by the Government for inspecting the work in progress, giving the specific dates, hours, location, type of work to be performed, contract number and project title. Based on the justification provided, the Contracting Officer may approve work outside regular hours.

1.3.4 Utility Cutovers and Interruptions

a. Make utility cutovers and interruptions after normal working hours or on Saturdays, Sundays, and Government holidays. Conform to procedures required in the paragraph "Work Outside Regular Hours."

b. Ensure that new utility lines are complete, except for the connection, before interrupting existing service.

c. Interruption to water, sanitary sewer, storm sewer, telephone service, electric service, and natural gas shall be considered utility cutovers pursuant to the paragraph entitled "Work Outside Regular Hours."

d. Operation of Station Utilities: The Contractor shall not operate nor disturb the setting of control devices in the station utilities system, including water, sewer, and electrical services. The Government will operate the control devices as required for normal conduct of the work. The Contractor shall notify the Contracting Officer giving reasonable advance notice when such operation is required.

1.4 SECURITY REQUIREMENTS

Contract Clause "FAR 52.204-2, Security Requirements and Alternate II," "FAC 5252.236-9301, Special Working Conditions and Entry to Work Area," and the following applies:

Contractor shall prohibit the opening of locked areas by Contractor employees to permit entrance of persons other than Contractor employees engaged in the performance of assigned work in those areas, or personnel authorized entrance by the Contracting Officer.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS
11/11

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

View location map
Progress and completion pictures

1.2 VIEW LOCATION MAP

Submit to the Contracting Officer, prior to or with the first digital photograph submittals, a sketch or drawing indicating the required photographic locations. Update as required if the locations are moved.

1.3 PROGRESS AND COMPLETION PICTURES

Photographically document site conditions prior to start of construction operations. Include aerial photographs. Provide monthly, and within one month of the completion of work, digital photographs, 1600x1200x24 bit true color 8MP minimum resolution in JPEG file format showing the sequence and progress of work. Take a minimum of 20 digital photographs each week throughout the entire project from a minimum of ten views from points located by the Contracting Officer. Submit a view location sketch indicating points of view. Submit with the monthly invoice two sets of digital photographs each set on a separate CD-R, cumulative of all photos to date. Indicate photographs demonstrating environmental procedures. Photographs for each month shall be in a separate monthly directory and each file shall be named to indicate its location on the view location sketch. The view location sketch shall also be provided on the CD as digital file. All file names shall include a date designator. Cross reference submittals in the appropriate daily report. Photographs shall be provided for unrestricted use by the Government.

a. Aerial imagery or high-angle imagery taken from crane/man-bucket. Points for images shall be consistent throughout project, once points have been approved by the Contracting Officer.

1.4 MINIMUM INSURANCE REQUIREMENTS

Note that insurance requirements spelled out in this paragraph are not meant to supersede or replace those put forth by FAR, DFAR, and/or the Contracting Officer in Division 00. These requirements merely represent minimum standards set forth by the installation. The Contractor shall be responsible for providing insurance as required in other sections of the contract. Procure and maintain during the entire period of performance

under this contract the following minimum insurance coverage:

a. Comprehensive general liability: $500,000 per occurrence

b. Automobile liability: $200,000 per person, $500,000 per occurrence for bodily injury, $20,000 per occurrence for property damage

c. Workmen's compensation as required by Federal and State workers' compensation and occupational disease laws.

d. Employer's liability coverage of $100,000, except in States where workers compensation may not be written by private carriers,

e. Others as required by Commonwealth of Virginia.

1.5 SUPERVISION

Have at least one qualified supervisor capable of reading, writing, and conversing fluently in the English language on the job site during working hours. In addition, if a Quality Control (QC) representative is required on the contract, then that individual shall also have fluent English communication skills.

1.6 PRECONSTRUCTION CONFERENCE

After award of the contract but prior to commencement of any work at the site, meet with the Contracting Officer to discuss and develop a mutual understanding relative to the administration of the value engineering and safety program, preparation of the schedule of prices or earned value report, shop drawings, and other submittals, scheduling programming, prosecution of the work, and clear expectations of the "Interim DD Form 1354" Submittal. Major subcontractors who will engage in the work shall also attend.

1.7 PERIODIC PROGRESS MEETINGS

Contractor shall be agreeable to post award conferences convened by the Contracting Activity or Contract Administration Office in accordance with Federal Acquisition Regulation Subpart 42.5. The Contracting Officer, COR, and other Government personnel, as appropriate, may meet periodically with the Contractor to review the Contractor's performance. At these meetings the Contracting Officer will apprise the Contractor of how the Government views the Contactor's performance and the Contractor will apprise the Government of problems, if any, being experienced. Appropriate action shall be taken to resolve outstanding issues. These meetings shall be at no additional cost to the Government.

1.8 AVAILABILITY OF CADD DRAWING FILES

After award and upon request, the electronic "Computer-Aided Drafting and Design (CADD)" drawing files will only be made available to the Contractor for use in preparation of construction data related to the referenced contract subject to the following terms and conditions. Request specific drawing numbers of files required; the entire set of drawing files will not be provided.

Data contained on these electronic files shall not be used for any purpose other than as a convenience in the preparation of construction data for the referenced project. Any other use or reuse shall be at the sole risk of

the Contractor and without liability or legal exposure to the Government. The Contractor shall make no claim and waives to the fullest extent permitted by law, any claim or cause of action of any nature against the Government, its agents or sub consultants that may arise out of or in connection with the use of these electronic files. The Contractor shall, to the fullest extent permitted by law, indemnify and hold the Government harmless against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

These electronic CADD drawing files are not construction documents. Differences may exist between the CADD files and the corresponding construction documents. The Government makes no representation regarding the accuracy or completeness of the electronic CADD files, nor does it make representation to the compatibility of these files with the Contractors hardware or software. In the event that a conflict arises between the signed and sealed construction documents prepared by the Government and the furnished CADD files, the signed and sealed construction documents shall govern. The Contractor is responsible for determining if any conflict exists. Use of these CADD files does not relieve the Contractor of duty to fully comply with the contract documents, including and without limitation, the need to check, confirm and coordinate the work of all contractors for the project.

If the Contractor uses, duplicates and/or modifies these electronic CADD files for use in producing construction drawings and data related to this contract, all previous indicia of ownership (seals, logos, signatures, initials and dates) shall be removed.

1.9 ELECTRONIC MAIL (E-MAIL) ADDRESS

The Contractor shall establish and maintain electronic mail (e-mail) capability along with the capability to open various electronic attachments in Microsoft, Adobe Acrobat, and other similar formats. Within 10 days after contract award, the Contractor shall provide the Contracting Officer a single (only one) e-mail address for electronic communications from the Contracting Officer related to this contract including, but not limited to contract documents, invoice information, request for proposals, and other correspondence. The Contracting Officer may also use email to notify the Contractor of base access conditions when emergency conditions warrant, such as hurricanes, terrorist threats, etc. Multiple email address will not allowed.

It is the Contractor's responsibility to make timely distribution of all Contracting Officer initiated e-mail with its own organization including field office(s). The Contractor shall promptly notify the Contracting Officer, in writing, of any changes to this email address.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 32 01.00 10

PROJECT SCHEDULE
08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

ER 1-1-11	(1995) Administration -- Progress, Schedules, and Network Analysis Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Preliminary Project Schedule; G
Initial Project Schedule; G, AE
Periodic Project Schedule Updates; G, AE

1.3 QUALITY ASSURANCE

Designate an authorized representative to be responsible for the preparation of the schedule and all required updating (activity status) and preparation of reports. The authorized representative shall be experienced in scheduling and have previously developed, created, and maintained at least 2 electronic schedules for projects similar in nature and complexity to this project and shall be experienced in the use of the scheduling software that meets the requirements of this specification.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Prepare for approval a Project Schedule, as specified herein, pursuant to the Contract Clause, SCHEDULE FOR CONSTRUCTION CONTRACTS. Show in the schedule the sequence in which the Contractor proposes to perform the work and dates on which the Contractor contemplates starting and completing all schedule activities. The scheduling of the entire project, including the design and construction sequences, is required. The scheduling of construction is the responsibility of the Contractor. Contractor

management personnel shall actively participate in its development. Subcontractors and suppliers working on the project shall also contribute in developing and maintaining an accurate Project Schedule. Provide a schedule that is a forward planning as well as a project monitoring tool.

3.1.1 Approved Project Schedule

Use the approved Project Schedule to measure the progress of the work and to aid in evaluating time extensions. Make the schedule cost loaded and activity coded. The schedule will provide the basis for all progress payments. If the Contractor fails to submit any schedule within the time prescribed, the Contracting Officer may withhold approval of progress payments until the Contractor submits the required schedule.

3.1.2 Schedule Status Reports

Provide a Schedule Status Report on at least a monthly basis. If, in the opinion of the Contracting Officer, the Contractor falls behind the approved schedule, take steps necessary to improve its progress including those that may be required by the Contracting Officer, without additional cost to the Government. In this circumstance, the Contracting Officer may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction plant, and to submit for approval any supplementary schedule or schedules as the Contracting Officer deems necessary to demonstrate how the approved rate of progress will be regained.

3.1.3 Default Terms

Failure of the Contractor to comply with the requirements of the Contracting Officer shall be grounds for a determination, by the Contracting Officer, that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the contract. Upon making this determination, the Contracting Officer may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of the contract.

3.2 BASIS FOR PAYMENT AND COST LOADING

Use the schedule as the basis for determining contract earnings during each update period and therefore the amount of each progress payment. Lack of an approved schedule update, or qualified scheduling personnel, will result in the inability of the Contracting Officer to evaluate contract earned value for the purposes of payment. Failure of the Contractor to provide all required information will result in the disapproval of the preliminary, initial and subsequent schedule updates. In the event schedule revisions are directed by the Contracting Officer and those revisions have not been included in subsequent revisions or updates, the Contracting Officer may hold retainage up to the maximum allowed by contract, each payment period, until such revisions to the Project Schedule have been made. Activity cost loading shall be reasonable, as determined by the Contracting Officer. The aggregate value of all activities coded to a contract CLIN shall equal the value of the CLIN on the Schedule.

3.3 PROJECT SCHEDULE DETAILED REQUIREMENTS

The computer software system utilized to produce and update the Project Schedule shall be capable of meeting all requirements of this specification. Failure of the Contractor to meet the requirements of this

specification will result in the disapproval of the schedule.

3.3.1 Critical Path Method

Use the Critical Path Method (CPM) of network calculation to generate the Project Schedule. Prepare the Project Schedule using the Precedence Diagram Method (PDM).

3.3.2 Level of Detail Required

Develop the Project Schedule to an appropriate level of detail. Failure to develop the Project Schedule to an appropriate level of detail, as determined by the Contracting Officer, will result in its disapproval. The Contracting Officer will consider, but is not limited to, the following characteristics and requirements to determine appropriate level of detail:

3.3.2.1 Activity Durations

Reasonable activity durations are those that allow the progress of ongoing activities to be accurately determined between update periods. Less than 2 percent of all non-procurement activities shall have Original Durations (OD) greater than 20 work days or 30 calendar days. Procurement activities are defined herein.

3.3.2.2 Procurement Activities

The schedule must include activities associated with the submittal, approval, procurement, fabrication and delivery of long lead materials, equipment, fabricated assemblies and supplies. Long lead procurement activities are those with an anticipated procurement sequence of over 90 calendar days. A typical procurement sequence includes the string of activities: submit, approve, procure, fabricate, and deliver.

3.3.2.3 Mandatory Tasks

The following tasks must be included and properly scheduled:

a. Submission, review and acceptance of design packages.

b. Submission of mechanical/electrical/information systems layout drawings.

c. Submission and approval of O & M manuals.

d. Submission and approval of as-built drawings.

e. Submission and approval of 1354 data and installed equipment lists.

f. Other systems testing, if required.

g. Contractor's pre-final inspection.

h. Correction of punchlist from Contractor's pre-final inspection.

i. Government's pre-final inspection.

j. Correction of punch list from Government's pre-final inspection.

k. Final inspection.

3.3.2.4 Government Activities

Show Government and other agency activities that could impact progress. These activities include, but are not limited to: approvals, inspections, utility tie-in, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements.

3.3.2.5 Activity Responsibility Coding (RESP)

Assign responsibility Code for all activities to the Prime Contractor, Subcontractor or Government agency responsible for performing the activity. Activities coded with a Government Responsibility code include, but are not limited to: Government approvals, Government design reviews, environmental permit approvals by State regulators, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements. Code all activities not coded with a Government Responsibility Code to the Prime Contractor or Subcontractor responsible to perform the work. Activities shall not have more than one Responsibility Code. Examples of acceptable activity code values are: DOR (for the designer of record); ELEC (for the electrical subcontractor); MECH (for the mechanical subcontractor); and GOVT (for USACE). Unacceptable code values are abbreviations of the names of subcontractors.

3.3.2.6 Activity Work Area Coding

Assign Work Area code to activities based upon the work area in which the activity occurs. Define work areas based on resource constraints or space constraints that would preclude a resource, such as a particular trade or craft work crew, from working in more than one work area at a time due to restraints on resources or space. Examples of Work Area Coding include different areas within a floor of a building, different floors within a building, and different buildings within a complex of buildings. Activities shall not have more than one Work Area Code. Not all activities are required to be Work Area coded. A lack of Work Area coding will indicate the activity is not resource or space constrained.

3.3.2.7 Contract Changes/Requests for Equitable Adjustment (REA) Coding (MODF)

Assign Activity code to any activity or sequence of activities added to the schedule as a result of a Contract Modification, when approved by the Contracting Officer, with a Contract Changes/REA Code. Key all Code values to the Government's modification numbering system. Any activity or sequence of activities added to the schedule as a result of alleged constructive changes made by the Government may be added to a copy of the current schedule, subject to the approval of the Contracting Officer. Assign Activity codes for these activities with a Contract Changes/REA Code. Key the code values to the Contractor's numbering system. Approval to add these activities does not necessarily mean the Government accepts responsibility and, therefore, liability for such activities and any associated impacts to the schedule, but rather the Government recognizes such activities are appropriately added to the schedule for the purposes of maintaining a realistic and meaningful schedule. Such activities shall not be Responsibility Coded to the Government unless approved. An activity shall not have more than one Contract Changes/REA Code.

3.3.2.8 Contract Line Item (CLIN) Coding (BIDI)

Code all activities to the CLIN on the Contract Line Item Schedule to which

the activity belongs. An activity shall not contain more than one CLIN Item Code. CLIN Item code all activities, even when an activity is not cost loaded.

3.3.2.9 Phase of Work Coding (PHAS)

Assign Phase of Work Code to all activities based upon the phase of work in which the activity occurs. Code activities to a Construction Phase. Code fast track construction phases proposed by the Contractor to allow filtering and organizing the schedule by fast track design and construction packages. If the contract specifies construction phasing with separately defined performance periods, identify a Construction Phase Code to allow filtering and organizing the schedule accordingly. Each activity shall be identified with a single project phase and have only one Phase of Work code.

3.3.2.10 Category of Work Coding (CATW)

Assign Category of Work Code to all Activities based upon the category of work to which the activity belongs. Category of Work Code must include, but is not limited to: construction submittal approvals, Acceptance, Procurement, Fabrication, Delivery, Weather Sensitive Installation, Non-Weather Sensitive Installation, Start-Up, Test and Turnover. Assign a Category of Work Code to each activity. Each activity shall have only one Category of Work Code.

3.3.2.11 Definable Features of Work Coding (FOW1, FOW2, FOW3)

Assign a Definable Feature of Work Code to appropriate activities based on the definable feature of work to which the activity belongs. Definable Feature of Work is defined in Specification Section 01 45 00.00 10 QUALITY CONTROL. An activity shall not have more than one Definable Feature of Work Code. Not all activities are required to be Definable Feature of Work Coded.

3.3.3 Scheduled Project Completion and Activity Calendars

The schedule interval shall extend from NTP date to the required contract completion date. The contract completion activity (End Project) shall finish based on the required contract duration in the accepted contract proposal, as adjusted for any approved contract time extensions. The first scheduled work period shall be the day after NTP is received by the Contractor. Schedule activities on a calendar to which the activity logically belongs. Activities may be assigned to a 7 day calendar when the contract assigns calendar day durations for the activity such as a Government Acceptance activity. If the Contractor intends to perform physical work less than seven days per week, schedule the associated activities on a calendar with non-work periods identified including weekends and holidays. Assign the Category of Work Code - Weather Sensitive Installation to those activities that are weather sensitive. Original durations must account for anticipated normal adverse weather. The Government will interpret all work periods not identified as non-work periods on each calendar as meaning the Contractor intends to perform work during those periods.

3.3.3.1 Project Start Date

The schedule shall start no earlier than the date on which the NTP was acknowledged. Include as the first activity in the project schedule an activity called "Start Project"(or NTP). The "Start Project" activity

shall have an "ES" constraint date equal to the date that the NTP was acknowledged, and a zero day duration.

3.3.3.2 Schedule Constraints and Open Ended Logic

Constrain completion of the last activity in the schedule by the contract completion date. Schedule calculations shall result in a negative float when the calculated early finish date of the last activity is later than the contract completion date. Include as the last activity in the project schedule an activity called "End Project". The "End Project" activity shall have an "LF" constraint date equal to the contract completion date for the project, and with a zero day duration or by using the "project must finish by" date in the scheduling software. The schedule shall have no constrained dates other than those specified in the contract. The use of artificial float constraints such as "zero fee float" or "zero total float" are typically prohibited. There shall only be 2 open ended activities: Start Project (or NTP) with no predecessor logic and End Project with no successor logic.

3.3.3.3 Early Project Completion

In the event the Preliminary or Initial project schedule calculates an early completion date of the last activity prior to the contract completion date, identify those activities that it intends to accelerate and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. The last activity shall have a late finish constraint equal to the contract completion date and the schedule will calculate positive float. The Government will not approve an early completion schedule with zero float on the longest path. The Government is under no obligation to accelerate activities for which it is responsible to support a proposed early contract completion.

3.3.4 Recognized Holidays

The following Government Holidays are recognized and must be reflected in the schedule as non-working days: New Year's day, Martin Luther King Jr's Birthday, President's day, Memorial day, Independence day, Labor day, Columbus day, Veteran's day, Thanksgiving day, and Christmas day.

Permission to work on these days may be granted to the Contractor on a case by case basis by the Contracting Officer. All inquiries from the Contractor must be submitted in writing at least 7 calendar days in advance. The request should include, at a minimum, the desired hours of holiday work, the scope of work to accomplish, and a list of the trades involved.

3.3.5 Interim Completion Dates

Constrain contractually specified interim completion dates to show negative float when the calculated early finish date of the last activity in that phase is later than the specified interim completion date.

3.3.5.1 Start Phase

Include as the first activity for a project phase an activity called "Start Phase X" where "X" refers to the phase of work. The "Start Phase X" activity shall have an "ES" constraint date equal to the date on which the NTP was acknowledged, and a zero day duration.

3.3.5.2 End Phase

Include as the last activity for a project phase an activity called "End Phase X" where "X" refers to the phase of work. The "End Phase X" activity shall have an "LF" constraint date equal to the specified completion date for that phase and a zero day duration.

3.3.5.3 Phase "X" Hammock

Include a hammock type activity for each project phase called "Phase X" where "X" refers to the phase of work. The "Phase X" hammock activity shall be logically tied to the earliest and latest activities in the phase.

3.3.6 Default Progress Data Disallowed

Do not automatically update Actual Start and Finish dates with default mechanisms that may be included in the scheduling software. Activity Actual Start (AS) and Actual Finish (AF) dates assigned during the updating process shall match those dates provided from Contractor Quality Control Reports. Failure of the Contractor to document the AS and AF dates on the Daily Quality Control report for every in-progress or completed activity, and failure to ensure that the data contained on the Daily Quality Control reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's updated schedule and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. Updating of the percent complete and the remaining duration of any activity shall be independent functions. Disable program features which calculate one of these parameters from the other.

3.3.7 Out-of-Sequence Progress

Activities that have progressed before all preceding logic has been satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case basis subject to approval by the Contracting Officer. Propose logic corrections to eliminate all out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project schedule. Correct out of sequence progress that continues for more than two update cycles by logic revision, as approved by the Contracting Officer.

3.3.8 Negative Lags and Start to Finish Relationships

Lag durations contained in the project schedule shall not have a negative value. Do not use Start to Finish (SF) relationships.

3.3.9 Calculation Mode

Schedule calculations shall retain the logic between predecessors and successors even when the successor activity starts and the predecessor activity has not finished. Software features that in effect sever the tie between predecessor and successor activities when the successor has started and the predecessor logic is not satisfied ("progress override") will not be allowed.

3.3.10 Milestones

The schedule must include milestone activities for each significant project event including but not limited to: milestone activities for each fast track design package released for construction; design complete; foundation/substructure construction complete; superstructure construction

complete; building dry-in or enclosure complete to allow the initiation of finish activities; permanent power complete; and building systems commissioning complete.

3.4 PROJECT SCHEDULE SUBMISSIONS

Provide the submissions as described below. The data CD, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS.

3.4.1 Preliminary Project Schedule Submission

Submit the Preliminary Project Schedule, defining the Contractor's planned operations for the first 14 calendar days for approval within 3 calendar days after the NTP is acknowledged. The approved Preliminary Project Schedule will be used for payment purposes not to exceed 14 calendar days after NTP. Completely cost load the Preliminary Project Schedule to balance the contract award CLINS shown on the Price Schedule. Detail it for the first 14 calendar days. It may be summary in nature for the remaining performance period. It must be early start and late finish constrained and logically tied as previously specified. The Preliminary Project Schedule forms the basis for the Initial Project Schedule specified herein and must include all of the required Plan and Program preparations, submissions and approvals identified in the contract (for example, Quality Control Plan, Safety Plan, and Environmental Protection Plan) as well as design activities, the planned submissions of all early design packages, permitting activities, design review conference activities and other non-construction activities intended to occur within the first 14 calendar days. Schedule any construction activities planned for the first 14 calendar days after NTP. Constrain planned construction activities by Government acceptance of the associated design package(s) and all other specified Program and Plan approvals. Activity code any activities that are summary in nature after the first 14 calendar days with Responsibility Code (RESP) and Feature of Work code (FOW1, FOW2, FOW3).

3.4.2 Initial Project Schedule Submission

Submit the Initial Project Schedule for approval within 7 calendar days after NTP. The schedule shall demonstrate a reasonable and realistic sequence of activities which represent all work through the entire contract performance period. The Initial Schedule shall be at a reasonable level of detail as determined by the Contracting Officer.

3.4.3 Periodic Schedule Updates

Based on the result of the meeting, specified in PERIODIC SCHEDULE UPDATE MEETINGS, submit periodic schedule updates. These submissions will enable the Contracting Officer to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgment of the Contracting Officer or authorized representative is necessary for verifying the Contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made.

3.4.4 Standard Activity Coding Dictionary

Use the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER 1-1-11, Appendix A. This exact structure is mandatory, even if some fields are not used. A template SDEF compatible schedule

backup file (sdef.prx) is available on the QCS website: http://rms.usace.army.mil/. The SDEF format is as follows:

SDEF Format			
Field	Activity Code	Length	Description
1	WRKP	3	Workers per Day
2	RESP	4	Responsible Party (e.g. GC, subcontractor, USACE)
3	AREA	4	Area of Work
4	MODF	6	Modification or REA number
5	BIDI	6	Bid Item (CLIN)
6	PHAS	2	Phase of Work
7	CATW	1	Category of Work
8	FOW1	10	Feature of Work (used up to 10 characters in length)
9	FOW2	10	Feature of Work (used up to 20 characters in length)
10	FOW3	10	Feature of Work (used up to 30 characters in length)

3.5 SUBMISSION REQUIREMENTS

Submit the following items for the Preliminary Schedule, Initial Schedule, and every Periodic Schedule Update throughout the life of the project:

3.5.1 Data CD's

Provide two sets of data CD's containing the project schedule in the backup format. Each CD shall also contain all previous update backup files. File medium shall be CD. Label each CD indicating the type of schedule (Preliminary, Initial, Update), full contract number, Data Date and file name. Each schedule shall have a unique file name as determined by the Contractor.

3.5.2 Narrative Report

Provide a Narrative Report with the Preliminary, Initial, and each Periodic Update of the project schedule, as the basis of the progress payment request. The Narrative Report shall include: a description of activities along the 2 most critical paths where the total float is less than or equal to 20 work days, a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions taken or required to be taken. The narrative report is expected to communicate to the Government, the Contractor's thorough analysis of the schedule output and its plans to compensate for any problems, either current or potential, which are revealed through that analysis. Identify and explain why any activities that, based their calculated late dates, should have either started or finished during the update period but did not.

3.5.3 Approved Changes Verification

Include only those project schedule changes in the schedule submission that have been previously approved by the Contracting Officer. The Narrative Report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.

3.5.4 Schedule Reports

The format, filtering, organizing and sorting for each schedule report shall be as directed by the Contracting Officer. Typically reports shall contain: Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float, Actual Start Date, Actual Finish Date, and Percent Complete. The following lists typical reports that will be requested. One or all of these reports may be requested for each schedule submission.

3.5.4.1 Activity Report

A list of all activities sorted according to activity number.

3.5.4.2 Logic Report

A list of detailed predecessor and successor activities for every activity in ascending order by activity number.

3.5.4.3 Total Float Report

A list of all incomplete activities sorted in ascending order of total float. List activities which have the same amount of total float in ascending order of Early Start Dates. Do not show completed activities on this report.

3.5.4.4 Earnings Report by CLIN

A compilation of the Contractor's Total Earnings on the project from the NTP to the data date. This report shall reflect the earnings of specific activities based on the agreements made in the schedule update meeting defined herein. Provided that the Contractor has furnished a complete schedule update, this report shall serve as the basis of determining progress payments. Group activities by CLIN item number and sort by activity number. This report shall: sum all activities coded to a particular CLIN and provide a CLIN item percent earned value; and complete and sum CLIN items to provide a total project percent complete. The printed report shall contain, for each activity: the Activity Number, Activity Description, Original Budgeted Amount, Total Quantity, Quantity to Date, Percent Complete (based on cost), and Earnings to Date.

3.5.5 Network Diagram

The network diagram is required for the Preliminary, Initial and Periodic Updates. The network diagram shall depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.5.5.1 Continuous Flow

Diagrams shall show a continuous flow from left to right with no arrows from right to left. Show the activity number, description, duration, and estimated earned value on the diagram.

3.5.5.2 Project Milestone Dates

Show dates on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

3.5.5.3 Critical Path

Clearly show the critical path.

3.5.5.4 Banding

Organize activities as directed to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

3.5.5.5 S-Curves

Earnings curves showing projected early and late earnings and earnings to date.

3.6 PERIODIC SCHEDULE UPDATE MEETINGS

Conduct periodic schedule update meetings for the purposes of reviewing the Contractor's proposed out of sequence corrections, determining causes for delay, correcting logic, maintaining schedule accuracy and determining earned value. Meetings shall occur at least monthly within five days of the proposed schedule data date and after the Contractor has updated the schedule with Government concurrence respecting actual start dates, actual finish dates, remaining durations and percent complete for each activity it intend to status. Provide a computer with the scheduling software loaded and a projector during the meeting which allows all meeting participants to view the proposed schedule update during the meeting. The meeting and resultant approvable schedule update shall be a condition precedent to a formal submission of the update as described in SUBMISSION REQUIREMENTS and to the submission of an invoice for payment. The meeting will be a working interactive exchange which will allow the Government and the Contractor the opportunity to review the updated schedule on a real time and interactive basis. The Contractor's authorized scheduling representative will organize, sort, filter and schedule the update as requested by the Government. The meeting will last no longer than 8 hours. A rough draft of the proposed activity logic corrections and narrative report shall be provided to the Government 48 hours in advance of the meeting. The Contractor's Project Manager and Authorized Scheduler shall attend the meeting with the Authorized Representative of the Contracting Officer.

3.6.1 Update Submission Following Progress Meeting

Submit a complete update of the project schedule containing all approved progress, revisions, and adjustments, pursuant to paragraph SUBMISSION REQUIREMENTS not later than 4 working days after the periodic schedule update meeting, reflecting only those changes made during the previous update meeting.

3.6.2 Status of Activities

Update information, including Actual Start Dates (AS), Actual Finish Dates (AF), Remaining Durations (RD), and Percent Complete shall be subject to the approval of the Government prior to the meeting. As a minimum, address the following items on an activity by activity basis during each progress meeting.

3.6.2.1 Start and Finish Dates

Accurately show the status of the AS and/or AF dates for each activity currently in-progress or completed since the last update. The Government may allow an AF date to be assigned with the percent complete less than 100% to account for the value of work remaining but not restraining successor activities. Only assign AS dates when actual progress occurs on an activity.

3.6.2.2 Remaining Duration

Update the estimated RD for all incomplete activities independent of Percent Complete. Remaining Durations may exceed the activity OD or may exceed the activity's prior update RD if the Government considers the current OD or RD to be understated based on current progress, insufficient work crews actually manning the job, unrealistic OD or deficiencies that must be corrected that restrain successor activities.

3.6.2.3 Percent Complete

Update the percent complete for each activity started, based on the realistic assessment of earned value. Activities which are complete but for remaining minor punch list work and which do not restrain the initiation of successor activities may be declared 100 percent complete. To allow for proper schedule management, cost load the correction of punch list from Government pre-final inspection activity(ies) not less than 1 percent of the total contract value, which activity(ies) may be declared 100 percent complete upon completion and correction of all punch list work identified during Government pre-final inspection(s).

3.6.2.4 Logic Changes

Specifically identify and discuss all logic changes pertaining to NTP on change orders, change orders to be incorporated into the schedule, Contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, and other changes that have been made pursuant to contract provisions. The Government will only approve logic revisions for the purpose of keeping the schedule valid in terms of its usefulness in calculating a realistic completion date, correcting erroneous logic ties, and accurately sequencing the work.

3.6.2.5 Other Changes

Other changes required due to delays in completion of any activity or group of activities include: 1) delays beyond the Contractor's control, such as strikes and unusual weather. 2) delays encountered due to submittals, Government Activities, deliveries or work stoppages which make re-planning the work necessary. 3) Changes required to correct a schedule that does not represent the actual or planned prosecution and progress of the work.

3.7 REQUESTS FOR TIME EXTENSIONS

In the event the Contractor believes it is entitled to an extension of the contract performance period, completion date, or any interim milestone date, furnish the following for a determination by the Contracting Officer: justification, project schedule data, and supporting evidence as the Contracting Officer may deem necessary. Submission of proof of excusable delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is a condition precedent to any approvals by the Government. In response to each Request For Proposal issued by the Government, submit a schedule impact analysis demonstrating whether or not the change contemplated by the Government impacts the critical path.

3.7.1 Justification of Delay

The project schedule shall clearly display that the Contractor has used, in full, all the float time available for the work involved with this request. The Contracting Officer's determination as to the number of allowable days of contract extension shall be based upon the project schedule updates in effect for the time period in question, and other factual information. Actual delays that are found to be caused by the Contractor's own actions, which result in a calculated schedule delay, will not be a cause for an extension to the performance period, completion date, or any interim milestone date.

3.7.2 Submission Requirements

Submit a justification for each request for a change in the contract completion date of less than 2 weeks based upon the most recent schedule update at the time of the NTP or constructive direction issued for the change. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

a. A list of affected activities, with their associated project schedule activity number.

b. A brief explanation of the causes of the change.

c. An analysis of the overall impact of the changes proposed.

d. A sub-network of the affected area.

Identify activities impacted in each justification for change by a unique activity code contained in the required data file.

3.7.3 Additional Submission Requirements

The Contracting Officer may request an interim update with revised activities for any requested time extension of over 2 weeks. Provide this disk within 4 days of the Contracting Officer's request.

3.8 DIRECTED CHANGES

If the NTP is issued for changes prior to settlement of price and/or time, submit proposed schedule revisions to the Contracting Officer within 2 weeks of the NTP being issued. The Contracting Officer will approve proposed revisions to the schedule prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the

proposed revisions, the Contracting Officer may furnish the Contractor with suggested revisions to the project schedule. Include these revisions in the project schedule until revisions are submitted, and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, advise the Contracting Officer within 2 weeks of receipt of the revisions. Regardless of the objections, continue to update the schedule with the Contracting Officer's revisions until a mutual agreement in the revisions is reached. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the Contracting Officer's proposed revisions, the Contractor will be deemed to have concurred with the Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

3.9 WEEKLY PROGRESS MEETINGS

a. Meet weekly with the Government (or as otherwise mutually agreed to) between the meetings described in paragraph PERIODIC SCHEDULE UPDATE MEETINGS for the purpose of jointly reviewing the actual progress of the project as compared to the as planned progress and to review planned activities for the upcoming two weeks. The then current and approved schedule update shall be used for the purposes of this meeting and for the production and review of reports. The Contractor's Project Manager and the Authorized Representative of the Contracting Officer shall attend. The weekly progress meeting will address the status of RFI's, RFP's and Submittals.

b. Provide a bar chart produced by the scheduling software, organized by Total Float and Sorted by Early Start Date, and a two week "look-ahead" schedule by filtering all schedule activities to show only current ongoing activities and activities schedule to start during the upcoming two weeks, organized by Work Area Code (AREA) and sorted by Early Start Date.

c. The Government and the Contractor shall jointly review the reports. If it appears that activities on the longest path(s) which are currently driving the calculated completion date (driving activities), are not progressing satisfactorily and therefore could jeopardize timely project completion, corrective action must be taken immediately. Corrective action includes but is not limited to: increasing the number of work crews; increasing the number of work shifts; increasing the number of hours worked per shift; and determining if Government responsibility coded activities require Government corrective action.

3.10 OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

3.11 TRANSFER OF SCHEDULE DATA INTO RMS/QCS

Download and upload the schedule data into the Resident Management System (RMS) prior to RMS databases being transferred to the Government and is considered to be additional supporting data in a form and detail required by the Contracting Officer pursuant to FAR 52.232-5 - Payments under Fixed-Price Construction Contracts. The receipt of a proper payment request pursuant to FAR 52.232-27 - Prompt Payment for Construction Contracts is contingent upon the Government receiving both acceptable and approvable hard copies and electronic export from QCS of the application

for progress payment.

-- End of Section --

SECTION 01 33 00

SUBMITTAL PROCEDURES
05/11

PART 1 GENERAL

1.1 SUMMARY

The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections.

Units of weights and measures used on all submittals are to be the same as those used in the contract drawings.

Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements.

Contractor's Quality Control (CQC) System Manager to check and approve all items prior to submittal and stamp, sign, and date indicating action taken. Proposed deviations from the contract requirements are to be clearly identified. Include within submittals items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals.

Submittals requiring Government approval are to be scheduled and made prior to the acquisition of the material or equipment covered thereby. Pick up and dispose of samples not incorporated into the work in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

1.2 DEFINITIONS

1.2.1 Submittal Descriptions (SD)

Submittals requirements are specified in the technical sections. Submittals are identified by Submittal Description (SD) numbers and titles as follows:

SD-01 Preconstruction Submittals

Submittals which are required prior to or the start of the next major phase of the construction on a multi-phase contract, includes schedules, tabular list of data, or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

Certificates of insurance

Surety bonds

List of proposed Subcontractors

List of proposed products

Construction progress schedule

Network Analysis Schedule (NAS)

Submittal register

Schedule of prices

Health and safety plan

Work plan

Quality Control(QC) plan

Environmental protection plan

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

SD-05 Design Data

Design calculations, mix designs, analyses or other data pertaining to a part of work.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within three years of date of contract award for the project.)

Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports.

Daily logs and checklists.

Final acceptance test and operational test procedure.

SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or Subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

Text of posted operating instructions.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and (MSDS)concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be signed by an authorized official of a testing laboratory or agency and must state the test results; and indicate whether the material, product, or system has passed or failed the test.

Factory test reports.

SD-10 Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel, including manufacturer's help and product line documentation necessary to maintain and install equipment. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

This data is intended to be incorporated in an operations and maintenance manual or control system.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Special requirements necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

Interim "DD Form 1354" with cost breakout for all assets 30 days prior to facility turnover.

1.2.2 Approving Authority

Office or designated person authorized to approve submittal.

1.2.3 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, except those SD-01 Pre-Construction Submittals noted above, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with this section.

SD-01 Preconstruction Submittals

Submittal Register; G, AE

1.4 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.4.1 Government Approved (G)

Government approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer.

Within the terms of the Contract Clause entitled, "Specifications and Drawings for Construction," they are considered to be "shop drawings."

1.4.2 Information Only

Submittals not requiring Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

1.5 PREPARATION

1.5.1 Transmittal Form

Use the attached sample transmittal form (ENG Form 4025) for submitting both Government approved and information only submittals in accordance with the instructions on the reverse side of the form. These forms are included in the QCS software that the Contractor is required to use for this contract and may also be obtained from the Contracting Officer or website. Properly complete this form by filling out all the heading blank spaces and identifying each item submitted. Exercise special care to ensure proper listing of the specification paragraph and sheet number of the contract drawings pertinent to the data submitted for each item.

1.6 QUANTITY OF SUBMITTALS

1.6.1 Number of Copies of SD-02 Shop Drawings

Submit six copies of submittals of shop drawings requiring review and approval only by QC organization and seven copies of shop drawings requiring review and approval by Contracting Officer.

1.6.2 Number of Copies of SD-03 Product Data and SD-08 Manufacturer's Instructions

Submit in compliance with quantity requirements specified for shop drawings.

1.6.3 Number of Samples SD-04 Samples

a. Submit two samples, or two sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by approving authority and one will be returned to Contractor.

b. Submit one sample panel or provide one sample installation where directed. Include components listed in technical section or as directed.

c. Submit one sample installation, where directed.

d. Submit one sample of non-solid materials.

1.6.4 Number of Copies SD-05 Design Data and SD-07 Certificates

Submit in compliance with quantity requirements specified for shop drawings.

1.6.5 Number of Copies SD-06 Test Reports and SD-09 Manufacturer's Field Reports

Submit in compliance with quantity and quality requirements specified for shop drawings other than field test results that will be submitted with QC

reports.

1.6.6 Number of Copies of SD-10 Operation and Maintenance Data

Submit three copies of O&M Data to the Contracting Officer for review and approval.

1.6.7 Number of Copies of SD-01 Preconstruction Submittals and SD-11 Closeout Submittals

Unless otherwise specified, submit three sets of administrative submittals.

1.7 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

1.8 VARIATIONS

Variations from contract requirements require both Designer of Record (DOR) and Government approval pursuant to contract Clause FAR 52.236-21 and will be considered where advantageous to Government.

1.8.1 Considering Variations

Discussion with Contracting Officer prior to submission, after consulting with the DOR, will help ensure functional and quality requirements are met and minimize rejections and re-submittals. When contemplating a variation which results in lower cost, consider submission of the variation as a Value Engineering Change Proposal (VECP).

Specifically point out variations from contract requirements in transmittal letters. Failure to point out deviations may result in the Government requiring rejection and removal of such work at no additional cost to the Government.

1.8.2 Proposing Variations

When proposing variation, deliver written request to the Contracting Officer, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to Government, including the DOR's written analysis and approval. If lower cost is a benefit, also include an estimate of the cost savings. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

Check the column "variation" of ENG Form 4025 for submittals which include proposed deviations requested by the Contractor. Set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of

submittals containing unnoted deviations.

1.8.3 Warranting That Variations Are Compatible

When delivering a variation for approval, Contractor, including its Designer(s) of Record, warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.8.4 Review Schedule Is Modified

In addition to normal submittal review period, a period of 10 working days will be allowed for consideration by the Government of submittals with variations.

1.9 SUBMITTAL REGISTER

Prepare and maintain submittal register, as the work progresses. Do not change data which is output in columns (c), (d), (e), and (f) as delivered by Government; retain data which is output in columns (a), (g), (h), and (i) as approved. A submittal register showing items of equipment and materials for which submittals are required by the specifications is provided as an attachment. This list may not be all inclusive and additional submittals may be required. Maintain a submittal register for the project in accordance with Section 01 45 00.10 10 QUALITY CONTROL SYSTEM (QCS). The Government will provide the initial submittal register in electronic format with the following fields completed, to the extent that will be required by the Government during subsequent usage.

Column (c): Lists specification section in which submittal is required.

Column (d): Lists each submittal description (SD No. and type, e.g. SD-02 Shop Drawings) required in each specification section.

Column (e): Lists one principal paragraph in specification section where a material or product is specified. This listing is only to facilitate locating submitted requirements. Do not consider entries in column (e) as limiting project requirements.

Thereafter, the Contractor is to track all submittals by maintaining a complete list, including completion of all data columns, including dates on which submittals are received and returned by the Government.

1.9.1 Use of Submittal Register

Submit submittal register. Submit with QC plan and project schedule. Verify that all submittals required for project are listed and add missing submittals. Coordinate and complete the following fields on the register submitted with the QC plan and the project schedule:

Column (a) Activity Number: Activity number from the project schedule.

Column (g) Contractor Submit Date: Scheduled date for approving authority to receive submittals.

Column (h) Contractor Approval Date: Date Contractor needs approval of submittal.

Column (i) Contractor Material: Date that Contractor needs material delivered to Contractor control.

1.9.2 Contractor Use of Submittal Register

Update the following fields in the Government-furnished submittal register program or equivalent fields in program utilized by Contractor with each submittal throughout contract.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (j) Action Code (k): Date of action used to record Contractor's review when forwarding submittals to QC.

Column (l) List date of submittal transmission.

Column (q) List date approval received.

1.9.3 Approving Authority Use of Submittal Register

Update the following fields in the Government-furnished submittal register program or equivalent fields in program utilized by Contractor.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (l) List date of submittal receipt.

Column (m) through (p) List Date related to review actions.

Column (q) List date returned to Contractor.

1.9.4 Copies Delivered to the Government

Deliver one copy of submittal register updated by Contractor to Government with each invoice request.

1.10 SCHEDULING

Schedule and submit concurrently submittals covering component items forming a system or items that are interrelated. Include certifications to be submitted with the pertinent drawings at the same time. No delay damages or time extensions will be allowed for time lost in late submittals.

a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential resubmittal of requirements.

b. Submittals called for by the contract documents will be listed on the register. If a submittal is called for but does not pertain to the contract work, the Contractor is to include the submittal in the register and annotate it "N/A" with a brief explanation. Approval by the Contracting Officer does not relieve the Contractor of supplying submittals required by the contract documents but which have been omitted from the register or marked "N/A."

c. Re-submit register and annotate monthly by the Contractor with actual submission and approval dates. When all items on the register have been fully approved, no further re-submittal is required.

d. Carefully control procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

1.11 GOVERNMENT APPROVING AUTHORITY

When approving authority is Contracting Officer, the Government will:

a. Note date on which submittal was received.

b. Review submittals for approval within scheduling period specified and only for conformance with project design concepts and compliance with contract documents.

c. Identify returned submittals with one of the actions defined in paragraph entitled, "Review Notations," of this section and with markings appropriate for action indicated.

Upon completion of review of submittals requiring Government approval, stamp and date approved submittals. Three copies of the approved submittal will be retained by the Contracting Officer and two copies of the submittal will be returned to the Contractor. If the Government performs a conformance review of other Designer of Record approved submittals, the submittals will be so identified and returned, as described above.

1.11.1 Review Notations

Contracting Officer review will be completed within 14 calendar days after date of submission. Submittals will be returned to the Contractor with the following notations:

a. Submittals marked "approved" or "accepted" authorize the Contractor to proceed with the work covered.

b. Submittals marked "approved as noted" "or approved except as noted, resubmittal not required," authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections.

c. Submittals marked "not approved" or "disapproved," or "revise and resubmit," indicate noncompliance with the contract requirements or design concept, or that submittal is incomplete. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved.

d. Submittals marked "not reviewed" will indicate submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

1.12 DISAPPROVED OR REJECTED SUBMITTALS

Contractor shall make corrections required by the Contracting Officer. If

the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under the clause entitled, "Changes," is to be given to the Contracting Officer. Contractor is responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Government requiring rejection and removal of such work at the Contractor's expense.

If changes are necessary to submittals, the Contractor shall make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

1.13 APPROVED/ACCEPTED SUBMITTALS

The Contracting Officer's approval or acceptance of submittals is not to be construed as a complete check, and indicates only that the general method of construction, materials, detailing and other information are satisfactory.

Approval or acceptance will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work.

After submittals have been approved or accepted by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.14 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not be construed to change or modify any contract requirements. Before submitting samples, the Contractor to assure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

Match the approved samples for materials and equipment incorporated in the work. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at his expense, upon completion of the contract. Samples not approved will also be returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make of that material. Government reserves the right to disapprove any material or equipment which previously has proved unsatisfactory in service.

Samples of various materials or equipment delivered on the site or in place may be taken by the Contracting Officer for testing. Samples failing to meet contract requirements will automatically void previous approvals. Contractor to replace such materials or equipment to meet contract requirements.

Approval of the Contractor's samples by the Contracting Officer does not

relieve the Contractor of his responsibilities under the contract.

1.15 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

1.16 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements is to be similar to the following:

CONTRACTOR
(Firm Name)
_____ Approved
_____ Approved with corrections as noted on submittal data and/or attached sheets(s)
SIGNATURE: _____
TITLE: _____
DATE: _____

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

ROUTING OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE FOR APPROVAL

For use of this form, see ER 415-1-10; the proponent agency is CECW-CE.

INSTRUCTIONS: Use this form to route ENG Form 4025 with the attached items. This form is not to become a part of the Contractor's record.

1.	TO	FROM	DATE (YYYYMMDD)

CONTRACT NUMBER	CONTRACTOR
TRANSMITTAL NUMBER	PROJECT TITLE AND LOCATION

COMMENTS (*Attach additional sheets if necessary*)

NUMBER OF ENCLOSURES	TYPED NAME AND TITLE	SIGNATURE

2.	TO	FROM	DATE (YYYYMMDD)

COMMENTS (*Attach additional sheets if necessary*)

NUMBER OF ENCLOSURES	TYPED NAME AND TITLE	SIGNATURE

3.	TO	FROM	DATE (YYYYMMDD)

COMMENTS (*Attach additional sheets if necessary*)

NUMBER OF ENCLOSURES	TYPED NAME AND TITLE	SIGNATURE

4.	TO	FROM	DATE (YYYYMMDD)

THE FOLLOWING ACTION CODES ARE GIVEN TO ITEMS LISTED ON ENG FORM 4025.

ACTION CODES

A – Approved as submitted.
B – Approved, except as noted on drawings. Resubmission not required.
C – Approved, except as noted on drawings. Refer to attached sheet. Resubmission required.
D – Will be returned by separate correspondence.
E – Disapproved (see attached or annonations).
F – Receipt acknowledged.
G – Other action required *(specify)*.
K – Government concurs with intermediate design.
R – Design submittal acceptable for release for construction.
X – Receipt acknowledged, does not comply with contract requirements, as noted.

ACTION CODES TO BE INSERTED IN COLUMN G, SECTION I, ENG FORM 4025 *(attach additional sheets, when required)*

ITEM NO. *(Taken from ENG Form 4025)*								
CODE GIVEN								

REMARKS

NUMBER OF ENCLOSURES	TYPED NAME AND TITLE	SIGNATURE

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 14 00	SD-01 Preconstruction Submittals															
			list of contact personnel	1.3.1.1														
		01 30 00	SD-01 Preconstruction Submittals															
			View location map	1.2														
			Progress and completion pictures	1.3														
		01 32 01.00 10	SD-01 Preconstruction Submittals															
			Preliminary Project Schedule	3.4.1	G													
			Initial Project Schedule	3.4.2	G	AE												
			Periodic Project Schedule		G	AE												
			Updates															
		01 33 00	SD-01 Preconstruction Submittals															
			Submittal Register	1.9	G	AE												
		01 35 26	SD-01 Preconstruction Submittals															
			Accident Prevention Plan (APP)	1.6	G													
			Activity Hazard Analysis (AHA)	1.7	G													
			Crane Critical Lift Plan	1.6.1	G													
			Crane Operators	1.5.1.2														
			SD-06 Test Reports															
			Notifications and Reports	1.11														
			Accident Reports	1.11.2	G													
			Crane Reports	1.11.3														
		01 35 29.13	SD-02 Shop Drawings															
			Decontamination Facilities	1.18.1														
			SD-03 Product Data															
			Exposure Monitoring/Air	1.12														
			Sampling Program															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 35 45.00 10	SD-03 Product Data															
			Sampling and Analysis Plan	3.2	G	RO												
			SD-06 Test Reports															
			QA Sample Collection and	1.5.2														
			Analysis															
			Chemistry Data Package	3.3														
			Chemical Data Final Report	3.6														
		01 45 23	SD-06 Test Reports															
			Batch Plant Inspection and	3.1.1														
			Materials Testing-Concrete															
			Field Inspection and Materials															
			Laboratory Tests of Field	3.1.3	G	AE												
			Samples - Concrete															
			Final acceptance test and		G	AE												
			operational test procedure															
			SD-07 Certificates															
			Certificate of Accreditation	1.2.1														
			Scope of Accreditation	1.2.1														
		01 50 00	SD-01 Preconstruction Submittals															
			Construction site plan	1.4	G													
			Traffic control plan	3.3.1	G													
			SD-06 Test Reports															
			Backflow Preventer Tests	2.2.7	G													
			SD-07 Certificates															
			Backflow Tester	1.5.1	G													
			Backflow Preventers	1.5														

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 57 20.00 10	SD-01 Preconstruction Submittals															
			Environmental Protection Plan	1.7	G													
			Archaeologist Qualifications	1.7.2														
			Erosion And Sediment Control	1.7.3	G	AE												
			Plan															
		01 57 23	SD-01 Preconstruction Submittals															
			Storm Water Pollution Prevention	1.3.2	G													
			Plan															
			Storm Water Notice of Intent	1.3.2	G													
			SD-06 Test Reports															
			Registration Statement	1.3.2														
			BMP Inspection Report Template	1.3.2														
			and Notice of Termination															
			Storm Water Inspection Reports	1.3.2	G													
			for General Permit															
			Erosion and Sediment Controls	1.3	G													
			SD-07 Certificates															
			Mill Certificate or Affidavit	2.1.3	G													
		01 58 00	SD-02 Shop Drawings															
			Sign Legend Orders	1.3.1														
		01 74 19	SD-01 Preconstruction Submittals															
			Waste Management Plan	1.5	G													
			SD-11 Closeout Submittals															
			Records	1.6	G													
		01 78 00	SD-03 Product Data															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 78 00	As-Built Record of Equipment	1.3.2	G													
			and Materials															
			Warranty Management Plan	1.6.1	G													
			Warranty Tags	1.6.5	G													
			Spare Parts Data	1.4	G													
			SD-08 Manufacturer's Instructions															
			Preventative Maintenance	1.5														
			Condition Monitoring (Predictive	1.5														
			Testing)															
			Inspection	1.5	G													
			Instructions	1.6.1														
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	1.7	G													
			Manuals															
			SD-11 Closeout Submittals															
			Record Drawings	1.3.1	G													
			Interim Form DD1354	1.9	G													
			Checklist for Form DD1354	1.9	G													
		02 41 00	SD-01 Preconstruction Submittals															
			Existing Conditions	1.9	G													
			SD-07 Certificates															
			Demolition Plan	1.2.1	G													
			SD-11 Closeout Submittals															
			Receipts															
		02 41 19.25	SD-01 Preconstruction Submittals															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		02 41 19.25	Abandonment Plan	1.4.1														
			SD-03 Product Data															
			Plugs	2.1														
			SD-05 Design Data															
			Technical Data	1.4.2														
		02 41 19.28	SD-01 Preconstruction Submittals															
			Abandonment plan	1.4.1														
			SD-03 Product Data															
			Plugs and clamps	2.1														
			SD-05 Design Data															
			Technical Data	1.4.2														
		02 42 91	SD-03 Product Data															
			Work Plan	1.1	G	AE												
		02 61 13	SD-02 Shop Drawings															
			Surveys	3.1	G													
			SD-03 Product Data															
			Work Plan	1.2	G													
			Work Plan	1.2.2	G													
			Closure Report	3.11	G													
			SD-06 Test Reports															
			Backfill	2.3	G													
			Surveys	3.1														
			Confirmation Sampling and	3.5	G													
			Analysis															
			Compaction	3.9.2														
		02 81 00	SD-03 Product Data															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		02 81 00	Notices of Non-Compliance and	3.1														
			Notices of Violation															
			Packaging Notifications	2.1.1														
			SD-06 Test Reports															
			Recordkeeping	3.3														
			Spill Response	3.4														
			Exception Report	3.3	G													
			SD-07 Certificates															
			Certification	1.4.1														
			Security Plan	3.1.4														
			EPA Offsite Policy	3.1.2														
			Certificates of Disposal	3.1.5														
			Shipping Documents and	3.1.3														
			Packagings Certification															
			Waste Minimization	3.2														
		02 82 33.13	SD-01 Preconstruction Submittals															
			Contractor Identification	1.6.1														
			Safety, Health and Accident	1.6.2														
			Prevention Plan															
			Contractor Personnel	1.6.3														
			Medical Surveillance Program	1.6.4														
			Training Program	1.6.5														
			Respiratory Protection Training	1.6.6														
			Program															
			SD-03 Product Data															
			Polyethylene Sheeting	2.1.1														

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		02 82 33.13	FSK Tape	2.1.3														
			High Efficiency Particulate Air	2.1.4														
			(HEPA) Filtered Vacuum															
			HEPA Filtered Ventilation System	2.1.5														
			Wetting Agent	2.1.6														
			Encapsulant	2.1.7														
			Airless Sprayer	2.1.8														
			Respirators	2.1.9														
			Signs and Labels	2.1.10														
			Disposal Bags	2.1.11														
			Air Monitoring Equipment	2.1.12.1														
			SD-07 Certificates															
			Laboratory Qualifications	1.6.7														
			SD-11 Closeout Submittals															
			Waste Manifests	3.6														
			Personal Samples	3.7.1														
			Environmental Monitoring	3.7.2														
		03 30 00	SD-01 Preconstruction Submittals															
			Methods of Construction Report	1.9.3														
			Concrete Placement and	1.6.8.2	G	AE												
			Sequence Plans															
			Concrete Placement and	1.9.1	G	AE												
			Sequence Plans															
			Project Mock-Up	1.9.10	G	AE												
			Plans for Job Mock-Ups	1.9.10.1	G	AE												
			SD-02 Shop Drawings															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		03 30 00	Shop Drawings	1.9.5	G	AE												
			Detail Drawings	1.6.9	G	AE												
			Placement Schedule	1.6.8.3	G	AE												
			Schedules	1.9.5	G	AE												
			Reinforcement Drawings	1.9.5	G	AE												
			Formwork Drawings	1.9.5	G	AE												
			Corrective Work Drawings	3.13.1	G	AE												
			SD-03 Product Data															
			detailed list of concrete materials	1.9.2														
			Concrete Mix Design Data	1.9.4	G	AE												
			Cement	2.1.1														
			Fly Ash	2.1.2														
			Normal Weight Fine Aggregate	2.1.3														
			Normal Weight Fine Aggregate	2.1.4														
			Admixtures	2.1.6	G	AE												
			Polymer Modified Concrete	2.1.7	G	AE												
			Form Materials	2.3														
			Reinforcement and Accessories	2.4														
			Expansion Joint Material	2.5.1														
			Non-shrink Grout	2.5.2														
			Curing Compounds	2.5.5														
			Bonding Agent, Patching Mortar	2.5.6														
			Threaded Inserts	2.5.7														
			Expansion Bolts	2.5.8														
			Epoxy Anchor Bolts	2.5.9														
			Waterstops	2.5.10														

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		03 30 00	Vapor Barrier	2.5.11														
			Electrodes for Welding	2.5.12														
			Epoxy Injection Adhesive	2.5.14														
			SD-04 Samples															
			Panels	1.6.10														
			Project Mock-Up	1.9.10	G	AE												
			Normal Weight Fine Aggregate	2.1.3														
			Normal Weight Fine Aggregate	2.1.4														
			Admixtures	2.1.6	G	AE												
			SD-05 Design Data															
			Concrete Placement and	1.6.8.2														
			Sequence Plans															
			Concrete Placement and	1.9.1														
			Sequence Plans															
			detailed list of concrete materials	1.9.2														
			Concrete Curing and Protection		G	AE												
			Methods															
			Concrete Mixtures	2.2	G	AE												
			mix design															
			SD-06 Test Reports															
			Concrete mix design		G	AE												
			Formwork Shop Drawings	1.6.8.2														
			SD-07 Certificates															
			Concrete Manufacturer's	1.6.1														
			Qualifications															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		03 30 00	Concrete Contractor's	1.6.2														
			Qualifications															
			Testing Agency Qualifications	1.6.3														
			Field Inspector Qualifications	1.6.4														
			Certified Mill Test Reports	1.9.8														
			Certificates of Compliance	1.9.9														
		03 33 00	SD-02 Shop Drawings															
			Detail Drawings	1.5.9	G	AE												
			Formwork Shop Drawings	1.5.8.2	G	AE												
			Concrete Placement and	1.5.8.2	G	AE												
			Sequence Plans															
			Placement Schedule	1.5.8.3	G	AE												
			SD-03 Product Data															
			Design mix	1.5.8.1	G	AE												
			Chamfer Stips															
			Form Joint Tape	2.1.4														
			Form Joint Sealant	2.1.5														
			Sealer	2.1.6														
			Form-Release Agent	2.1.7														
			Steel Reinforcement and	2.2														
			Accessories															
			Admixtures	2.4														
			Curing Materials	2.5														
			Repair Materials	2.6														
			Ready-Mixed Architectural	2.8.1														
			Concrete															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		03 33 00	SD-04 Samples															
			Mockup	1.5.11	G	AE												
			Concrete Materials	2.3														
			Panels	1.5.10	G	AE												
			Form-facing panels	2.1.1	G	AE												
			Form ties	2.1.8														
			Rustication Stips															
			Architectural Concrete Samples	1.5.8.4	G	AE												
			Concrete Mixtures	2.7	G	AE												
			Joint Sealants	2.8.2														
			SD-07 Certificates															
			Concrete Manufacturer's	1.5.1														
			Qualifications															
			Concrete Contractor's	1.5.2														
			Qualifications															
			Testing Agency Qualifications	1.5.3	G	AE												
			Field Inspector Qualifications	1.5.4	G	AE												
			Material Certificates	1.5.8.5														
		03 48 21	SD-02 Shop Drawings															
			Shop Drawings	1.4.6	G	AE												
			SD-03 Product Data															
			Concrete Mix Design of Self	2.2.1	G	AE												
			Consolidate Concrete (SCC)															
			anchorage, angles, and fasteners															
			SD-04 Samples															
			perimeter crypts	1.4.5	G													

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		03 48 21	interior crypt	1.4.5	G													
			dimensions and finishes	1.4.6	G													
			SD-05 Design Data															
			Design Documentation	1.4.7														
			Functional Load Test	1.4.8														
			Design Calculations	2.1.1														
			SD-07 Certificates															
			Manufacturer's Qualifications	1.4.1														
			Installers Qualifications	1.4.3														
			Product Test Reports	2.1.1														
			SD-11 Closeout Submittals															
			As-built Drawings	3.8.1	G													
		03 48 24	SD-02 Shop Drawings															
			Shop Drawings	1.4.6	G	AE												
			Production Drawings	1.4.7														
			fastening systems	1.4.5														
			Stack and Section Markers	2.8.1														
			SD-03 Product Data															
			Manufacturer's Literature and	1.4.8														
			Data															
			fastener systems															
			mounting hardware	1.4.5														
			Adhesive	2.8.2														
			Stencil	2.8.3														
			Paint	2.8.4														
			SD-04 Samples															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		03 48 24	Sample Units	1.4.5	G	AE												
			Color Charts	1.4.8	G	AE												
			Exposed Surface Finishes	1.4.5	G	AE												
			Mock-Up	1.4.9	G	AE												
			SD-05 Design Data															
			Design Documentation	2.1.1														
			SD-07 Certificates															
			Manufacturer's Qualifications	1.4.1														
			Installer Qualifications	1.4.2														
			Precast Concrete Certificates	1.4.4														
		04 01 00.91	SD-01 Preconstruction Submittals															
			Quality Control Plan	1.6.1	G													
			SD-02 Shop Drawings															
			Documentation	1.6.4														
			SD-03 Product Data															
			Repair Materials	2.2	G													
			Structural Upgrades	3.6.1	G													
			Cleaning and Restoration	1.6.5.1	G	AE												
			Methods															
			Cleaning Materials	2.1														
			Qualifications	1.6.2														
			SD-04 Samples															
			Mock-ups	1.6.6	G	AE												
			SD-07 Certificates															
			Repair Materials	2.2	G													
		04 20 00	SD-02 Shop Drawings															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		04 20 00	Detail Drawings	1.4.6	G													
			SD-03 Product Data															
			Cement	2.8														
			Admixtures for Mortar	2.5														
			Cold Weather Installation	1.6.2	G													
			SD-04 Samples															
			Concrete Masonry Units (CMU)	2.2														
			Stone Items	2.3	G	AE												
			Anchors, Ties, and Bar Positioners	2.11														
			Expansion-Joint Materials	2.15														
			Joint Reinforcement	2.12														
			Through Wall Flashing	2.16														
			Mock-ups	1.4.1	G	AE												
			SD-05 Design Data															
			Unit Strength Method	1.2.1.1														
			SD-06 Test Reports															
			Field Testing of Mortar	3.13.1														
			Field Testing of Grout	3.13.2														
			Prism tests	3.13.3														
			Masonry Inspector Qualifications	1.4.5	G													
			SD-07 Certificates															
			Stone Items	2.3														
			Concrete Masonry Units (CMU)	2.2														
			Anchors, Ties, and Bar Positioners	2.11														

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		04 20 00	Expansion-Joint Materials	2.15														
			Joint Reinforcement	2.12														
			Admixtures for Mortar	2.5														
			Admixtures for Grout	2.10.1														
		05 50 13	SD-02 Shop Drawings															
			Access doors and panels	2.3	G													
			Expansion joint covers	3.4	G													
			SD-03 Product Data															
			Access doors and panels	2.3														
			Expansion joints	2.4														
			SD-04 Samples															
			Expansion joint covers	3.4	G													
			Finishes	2.4.1.1	G													
		05 52 00	SD-02 Shop Drawings															
			fabrication and installation	2.1	G	AE												
			drawings															
			SD-03 Product Data															
			Concrete Inserts	1.2.1	G	AE												
			Cold-Drawn Steel Tubing	2.3														
			Steel Railings and Handrails	2.6														
			Stainless Steel Railings and	2.6.2														
			Handrails															
			Anchorage and Fastening	1.2.1	G	AE												
			Systems															
			SD-08 Manufacturer's Instructions															
			Installation Instructions	3.1														

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		06 20 00	SD-02 Shop Drawings															
			Detail Drawings	1.3														
			SD-03 Product Data															
			Clear Heart Western Red Cedar	2.2	G	AE												
			soffit vents	2.3														
			SD-04 Samples															
			Clear Heart Western Red Cedar	2.2	G	AE												
			SD-07 Certificates															
			Certificates of grade	1.4														
			Certificates of compliance	1.4														
		07 11 13	SD-07 Certificates															
			Emulsion-Based Asphalt	2.2														
			Dampproofing															
		07 14 00	SD-03 Product Data															
			Fluid-applied membrane	2.1														
			Flexible Cement Waterproofing	2.1.3														
			Membrane primer	2.2														
			Elastomeric sheet	2.8														
			Flexible foam-backed elastomeric	2.10														
			sheet															
			Solvent	3.3														
			Moisture meter	3.4.1														
			Protection board	2.11														
			Bond breaker	2.7														
			SD-11 Closeout Submittals															
			Warranty	1.6														

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		07 14 00	Information Card	3.6														
			Instructions To Government	3.5														
			Personnel															
		07 21 00	SD-03 Product Data															
			Board insulation	2.1														
			Sprayed insulation	2.2														
			adhesive	2.3.1														
			mechanical fasteners	2.3.2														
			SD-07 Certificates															
			Board Insulation	2.1														
			Sprayed insulation	2.2														
			Adhesive	2.3.1														
		07 92 00	SD-03 Product Data															
			Sealants	2.1														
			Primers	2.2														
			Bond breakers	2.3														
			Backstops	2.4														
			SD-07 Certificates															
			Sealant	3.3.6														
		08 11 13	SD-02 Shop Drawings															
			Doors	2.1	G	AE												
			Doors	2.1	G	AE												
			Frames	2.3	G	AE												
			Frames	2.3	G	AE												
			SD-03 Product Data															
			Doors	2.1	G	AE												

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		08 11 13	Frames	2.3	G	AE												
		08 71 00	SD-02 Shop Drawings															
			Hardware schedule	1.3	G													
			Keying system	2.2.4	G													
			SD-03 Product Data															
			Hardware items	2.2	G	AE												
			SD-08 Manufacturer’s Instructions															
			Installation	3.1														
			SD-10 Operation and Maintenance															
			Data															
			Hardware Schedule	1.3	G	AE												
		08 91 00	SD-02 Shop Drawings															
			Wall louvers	1.4														
			line voltage control	2.3														
			SD-03 Product Data															
			Metal Wall Louvers	2.2														
			SD-04 Samples															
			Colors of finishes	1.5	G	AE												
		09 22 00	SD-02 Shop Drawings															
			Metal support systems	2.1	G													
		09 29 00	SD-03 Product Data															
			Cementitious backer units	2.1.3														
			Impact Resistant Gypsum Board	2.1.2														
			Joint Treatment Materials	2.1.4														
			Accessories	2.1.6														
			SD-07 Certificates															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		09 29 00	Asbestos Free Materials	2.1	G													
		09 30 00	SD-02 Shop Drawings															
			Detail Drawings	1.4	G	AE												
			SD-03 Product Data															
			Tile	2.1														
			Adhesives	2.3														
			Mortar and Grout	2.3														
			Waterproofing	2.5														
			Waterproofing	3.4.3														
			Certification	1.2.2														
			SD-04 Samples															
			Tile	2.1	G	AE												
			Granite Thresholds	2.4	G	AE												
			Grout	2.3	G	AE												
			SD-07 Certificates															
			Tile	2.1														
			Mortar and Grout	2.3														
		09 90 00	SD-02 Shop Drawings															
			Piping identification	3.6														
			stencil	3.6														
			SD-03 Product Data															
			Coating	2.1														
			Manufacturer's Technical Data	2.1														
			Sheets															
			SD-04 Samples															
			Color	1.9	G	AE												

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		10 14 01	SD-02 Shop Drawings															
			Approved Detail Drawings	3.1	G													
			SD-03 Product Data															
			Modular Exterior Signage System	2.1														
			Installation	3.1														
			Exterior Signage	1.2	G													
			Wind Load Requirements	1.2.1														
			SD-04 Samples															
			Exterior Signage	1.2	G													
			SD-10 Operation and Maintenance															
			Data															
			Protection and Cleaning	3.1.2														
		10 28 13	SD-03 Product Data															
			Finishes	2.1.2														
			Accessory Items	2.2														
			SD-04 Samples															
			Finishes	2.1.2	G	AE												
			Accessory Items	2.2	G	AE												
			SD-07 Certificates															
			Accessory Items	2.2														
			SD-10 Operation and Maintenance															
			Data															
			Electric Hand Dryer	2.2.9	G	AE												
		12 93 00	SD-02 Shop Drawings															
			Benches	2.5	G	AE												
			Waste Receptacles	2.6	G	AE												

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		12 93 00	Flower Vase Receptacles	2.6	G	AE												
			Assembly Instruction Drawings	1.3.3														
			SD-03 Product Data															
			Benches	2.5	G	AE												
			Waste Receptacles	2.6	G	AE												
			Flower Vase Receptacles	2.6	G	AE												
			SD-04 Samples															
			Finish	2.3.4	G	AE												
			SD-07 Certificates															
			Primer certificate	1.3.4														
			Powder coatings certificate	1.3.5														
		13 12 13.15	SD-02 Shop Drawings															
			Shop Drawings		G	AE												
			SD-03 Product Data															
			Surface Skimmer	2.2.1														
			Main Pool Drain	2.2.3														
			Wall Niche Overflow	2.2.4														
			Small Sump	2.2.5														
			Anti-Vortex Plate	2.2.6														
			Dual Water Level Sensor	2.2.7														
			SD-04 Samples															
			Surface Skimmer	2.2.1	G													
			Main Pool Drain	2.2.3	G													
			Wall Niche Overflow	2.2.4	G													
			SD-07 Certificates															
			Manufacturer Qualifications	1.4.1														

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		13 12 13.15	Installer Qualifications	1.4.2														
			Engineer Qualifications	1.4.3														
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.7	G													
			Manual															
			SD-11 Closeout Submittals															
			As-built Drawings		G													
			warranty	1.6	G													
		22 00 00	SD-02 Shop Drawings															
			Plumbing System	3.7.1	G	AE												
			SD-03 Product Data															
			Fixtures	2.4														
			Flush valve water closets	2.4.3														
			Flush valve urinals	2.4.4														
			Wall hung lavatories	2.4.5														
			electronic faucet	2.4.2														
			Water heaters	2.10														
			Backflow prevention assemblies	3.7.1.1														
			Water Hammer Arrester	2.1.2														
			Precast Terrazzo Mop Sinks	2.4.6														
			Welding	1.5.1														
			Water meters	2.12														
			Bolts	2.1.1														
			Plumbing System	3.7.1														
			SD-06 Test Reports															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		22 00 00	Tests, Flushing and Disinfection	3.7														
			Test of Backflow Prevention	3.7.1.1														
			Assemblies															
			SD-07 Certificates															
			Materials and Equipment	1.3														
			SD-10 Operation and Maintenance															
			Data															
			Plumbing System	3.7.1														
		22 05 33	SD-02 Shop Drawings															
			Self-Regulating,	2.2	G													
			Parallel-Resistance Heating															
			Cables															
			Thermostats for Freeze	2.3	G													
			Protection															
			SD-03 Product Data															
			Self-Regulating,	2.2														
			Parallel-Resistance Heating															
			Cables															
			Thermostats for Freeze	2.3														
			Protection															
			Accessories	2.4														
			SD-10 Operation and Maintenance															
			Data															
			test and inspection reports	3.5														
			Operation and Maintenance	3.6	G													
			Manual Data															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		22 07 19.00 40	SD-02 Shop Drawings															
			Installation Drawings	1.4	G													
			SD-03 Product Data															
			Adhesives	2.1														
			Coatings	2.1														
			Insulating Cement	2.1														
			Insulation Materials	2.1														
			Jacketing	2.1														
			Tape	2.1														
			SD-07 Certificates															
			Recycled Materials															
			SD-08 Manufacturer’s Instructions															
			Installation Manual	1.4														
			Installation Manual	3.1														
		22 52 00	SD-02 Shop Drawings															
			Shop Drawings	2.1.1	G													
			wiring diagrams	2.1.1	G													
			SD-03 Product Data															
			Filter System	2.2														
			Chemical Feeder	2.3.1														
			Chemicals	2.3.2														
			Ionization	2.3.3														
			Recirculating Pump And Motor	2.4														
			Piping and Fittings	2.5.1														
			Valves	2.5.2														
			Reflecting Pool Control Panel	2.6														

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		22 52 00	SD-07 Certificates															
			Manufacturer Qualifications	1.3.1														
			Installer Qualifications	1.3.2														
			Engineer Qualifications	1.3.3														
			SD-09 Manufacturer's Field															
			Reports															
			test reports	3.4.2														
			SD-10 Operation and Maintenance															
			Data															
			Operating and Maintenance	3.4.2	G													
			Manuals															
			SD-11 Closeout Submittals															
			As-built Drawings		G													
			warranty	1.5														
		23 00 00	SD-02 Shop Drawings															
			Detail Drawings	1.4.3	G													
			SD-03 Product Data															
			Cabinet Exhaust Fans	2.8.1.2	G													
			controls	2.11.1	G													
			test procedures	1.4.4														
			In-Line Centrifugal Fans	2.8.1.1	G													
			Cabinet Unit Heater	2.9.1	G													
			SD-06 Test Reports															
			Performance Tests	3.8	G													
			SD-08 Manufacturer's Instructions															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 00 00	Manufacturer's Installation	3.2														
			Instructions															
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.10.1														
			Manuals															
		23 03 00.00 20	SD-03 Product Data															
			Certification															
		26 20 00	SD-02 Shop Drawings															
			Panelboards	2.10	G													
			marking strips	3.1.6.1														
			SD-03 Product Data															
			Receptacles	2.9														
			Circuit breakers	2.10.3														
			Switches	2.8														
			Motor controllers	2.13														
			Manual motor starters	2.14														
			Surge protective devices	2.21														
			SD-06 Test Reports															
			Ground-fault receptacle test	3.5.2	G													
			SD-10 Operation and Maintenance															
			Data															
			Electrical Systems	1.5.1	G													
		26 51 00	SD-03 Product Data															
			Fluorescent lighting fixtures	2.1														
			Fluorescent electronic ballasts	1.5.1														

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)		(q)	(r)
		26 51 00	Fluorescent lamps	2.1.2															
			Occupancy sensors	2.3															
			Energy Efficiency	1.5.4.3															
			SD-04 Samples																
			Lighting fixtures	1.5.2	G														
			SD-06 Test Reports																
			Operating test	3.3															
		27 10 00	SD-02 Shop Drawings																
			Telecommunications cabling	2.3	G														
			SD-03 Product Data																
			Telecommunications cabling	2.3															
			Telecommunications	2.4															
			outlet/connector assemblies																
			Spare Parts	1.9.2															
			SD-06 Test Reports																
			Telecommunications cabling	3.5.1	G														
			testing																
			SD-07 Certificates																
			Telecommunications Contractor	1.5.2.1															
			Key Personnel	1.5.2.2															
			Manufacturer Qualifications	1.5.2.3															
			Test plan	1.5.3															
			SD-09 Manufacturer's Field																
			Reports																
			Factory reel tests	2.8.1															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		27 10 00	SD-10 Operation and Maintenance															
			Data															
			Telecommunications cabling and	1.9.1	G													
			pathway system															
			SD-11 Closeout Submittals															
			Record Documentation		G													
		31 00 00	SD-01 Preconstruction Submittals															
			Shoring	3.5														
			Dewatering Work Plan	1.4.2	G													
			SD-03 Product Data															
			Utilization of Excavated Materials	3.9	G	AE												
			Opening of Excavation or Borrow	3.4														
			Pit															
			SD-06 Test Reports															
			Testing	3.17	G	AE												
			Borrow Site Testing	2.1	G	AE												
			SD-07 Certificates															
			Testing	3.17														
		31 05 19	SD-03 Product Data															
			Thread	2.1.2	G	AE												
			Manufacturing Quality Control	2.2	G	AE												
			Sampling and Testing															
			SD-04 Samples															
			Quality Assurance Samples and	3.1														
			Tests															
			SD-07 Certificates															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		31 05 19	Geotextile	2.1.1														
		31 11 00	SD-03 Product Data															
			Nonsaleable Materials	3.7.3														
			SD-04 Samples															
			Herbicide	2.1														
			Tree Samples	3.4														
		31 23 00.00 20	SD-01 Preconstruction Submittals															
			Shoring and Sheeting Plan	1.8.1														
			Dewatering work plan	1.8.2														
			SD-06 Test Reports															
			Borrow Site Testing	1.7	G													
			Fill and backfill	3.16.2.1	G	AE												
			Select material	3.16.2.2	G													
			Porous fill	3.16.2.3	G													
			Density tests	3.16.2.4	G													
			Settlement Readings	3.13.1.2	G													
			Moisture Content Tests	3.16.2.5	G													
		31 63 16	SD-02 Shop Drawings															
			Test and Production Piles and		G	AE												
			Load Test Results															
			SD-03 Product Data															
			Equipment															
			Load Test	1.2.3														
			Load Test	1.4														
			Materials	2.1														
			SD-06 Test Reports															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		31 63 16	Grout	2.1.1														
			flow cone	2.1.1														
			Automatic Measurement	3.6														
			Pile records	3.16														
			Pile Integrity	3.17														
			SD-07 Certificates															
			Qualifications	1.3														
		32 01 19	SD-03 Product Data															
			Manufacturer's															
			Recommendations															
			Equipment	1.2														
			SD-04 Samples															
			Materials	1.4.1														
		32 05 33	SD-01 Preconstruction Submittals															
			Integrated Pest Management	2.3	G	AE												
			Plan															
			Invasive Species Removal Plan	1.5	G	AE												
			SD-03 Product Data															
			Mulches Topdressing	2.2	G	AE												
			Organic Mulch Materials	2.2.1	G	AE												
			SD-07 Certificates															
			Plant quantities	3.4.2	G	AE												
			Maintenance Inspection Report	3.4.1	G	AE												
			SD-10 Operation and Maintenance															
			Data															
			Maintenance Plan															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 11 10	SD-03 Product Data															
			Waybills and Delivery Tickets															
			SD-06 Test Reports															
			Sampling and Testing	1.4.1														
			Approval of Materials	1.4.6	G	AE												
			Evaluation	3.2.7														
		32 11 16.16	SD-03 Product Data															
			Materials	2.1	G	AE												
			SD-05 Design Data															
			Gradation curve	2.1														
			SD-06 Test Reports															
			Bearing ratio	2.1														
			Liquid limit	2.1														
			Plasticity index	2.1														
			Dry weight	2.1														
			Percentage of wear	2.1														
			Gradation tests	3.4.2.1														
			Density tests	3.4.2.3														
			SD-07 Certificates															
			Source	2.2														
		32 11 29	SD-03 Product Data															
			Plant, Equipment, Machines, and	1.3.2														
			Tools															
			Mix Design	2.2	G	AE												
			Waybills and Delivery Tickets															
			SD-06 Test Reports															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 11 29	Sampling and Testing	3.5														
			Field Density	3.6.3														
			SD-07 Certificates															
			Bituminous Material	2.1.2														
			Lime	2.1.1														
			Laboratory	2.2														
		32 12 10	SD-03 Product Data															
			Waybills and Delivery Tickets															
			SD-06 Test Reports															
			Sampling and Testing	3.7														
		32 12 16	SD-03 Product Data															
			Mix Design	2.3	G	AE												
			Contractor Quality Control	3.10														
			Material Acceptance	3.11														
			SD-04 Samples															
			Asphalt Cement Binder	2.2														
			Aggregates	2.1														
			SD-06 Test Reports															
			Aggregates	2.1														
			QC Monitoring	3.10.3.10														
			SD-07 Certificates															
			Asphalt Cement Binder	2.2	G	AE												
			Testing Laboratory	3.6														
		32 12 43	SD-03 Product Data															
			asphalt mix	2.1	G	AE												
			stone	2.1.2														

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 12 43	underdrains	2.1.3	G	AE												
			filter fabric	2.1.4	G	AE												
			SD-07 Certificates															
			Installer Qualifications	1.3.1														
		32 13 13.06	SD-03 Product Data															
			Curing materials	2.1.9	G	AE												
			Admixtures	2.1.7														
			Coated Dowel Bars	2.1.8.1														
			SD-04 Samples															
			Field-Constructed Mockup	1.5.5	G	AE												
			SD-05 Design Data															
			mix design	2.3	G	AE												
			SD-06 Test Reports															
			Aggregate	2.1.3														
			Concrete slump tests	3.7.2														
			Air content tests	3.7.4														
			Flexural strength tests	3.7.3														
			Cementitious materials	2.1.1														
			SD-07 Certificates															
			Ready-mixed concrete plant	1.5.1														
			Batch tickets	1.5.4														
			Cementitious materials	2.1.1														
		32 14 40	SD-02 Shop Drawings															
			Fabrication and Installation		G	AE												
			Details															
			SD-03 Product Data															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 14 40	Stone	1.4.5														
			SD-04 Samples															
			Mockups	1.4.4	G	AE												
			Stone	1.4.5	G	AE												
			Mortar Samples	1.4.5	G	AE												
			Grout Color	2.4.2	G	AE												
			SD-06 Test Reports															
			Preconstruction Stone Testing	1.4.3														
			SD-07 Certificates															
			Letter of Certification	1.4.1														
			Installer Qualifications	1.4.2.1														
			Fabricator Qualifications	1.4.2.2														
		32 16 13	SD-03 Product Data															
			Concrete	2.1	G	AE												
			SD-06 Test Reports															
			Field Quality Control	3.8														
		32 17 24.00 10	SD-03 Product Data															
			Equipment	1.2														
			Composition Requirements	2.2.1														
			Qualifications	1.4.1														
			SD-06 Test Reports															
			Sampling and Testing	2.3														
			SD-07 Certificates															
			Volatile Organic Compound	2.2.3														
			(VOC)															
		32 31 11.12	SD-02 Shop Drawings															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 31 11.12	Shop Drawings	1.4.5	G													
			Wiring Diagrams	1.4.5	G													
			SD-03 Product Data															
			Automatic Gate Operators	2.3														
			Emergency Vehicle Access	2.4														
			Key Pad Control	2.5														
			Safety Loops	2.6														
			Gate Safety Edge Sensors	2.7														
			Magnetic Locks	2.8														
			Key Switch Control	2.4														
			Safety Conspicuity Material	2.9.2														
			SD-05 Design Data															
			Design Documentation	1.4.6														
			Operating Data	1.4.7														
			SD-07 Certificates															
			Qualifications	1.4.1														
			Quality Control Certificates	1.4.4														
			SD-10 Operation and Maintenance															
			Data															
			written programming instructions	3.8														
			SD-11 Closeout Submittals															
			Record Drawings	3.10	G													
		32 31 13	SD-02 Shop Drawings															
			Fence Assembly	1.3	G	AE												
			Location of Gate, Corner, End,	3.17.1	G	AE												
			and Pull Posts															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 31 13	Gate Assembly	1.3	G	AE												
			Gate Hardware and Accessories	2.18	G	AE												
			Erection/Installation Drawings	1.3	G	AE												
			SD-03 Product Data															
			Fence Assembly	1.3														
			Gate Assembly	1.3														
			Gate Hardware and Accessories	2.18														
			Recycled Material Content	2.1														
			Zinc Coating	2.2														
			Fabric	2.3														
			Stretcher Bars	2.13														
			Concrete	2.21														
			SD-04 Samples															
			Fabric	2.3	G	AE												
			Posts	2.5	G	AE												
			Braces	2.5	G	AE												
			Line Posts	2.6	G	AE												
			Sleeves	2.8	G	AE												
			Top Rail	2.9	G													
			Tension Wire	2.12	G													
			Stretcher Bars	2.13	G													
			Gate Posts	2.16	G													
			Gate Hardware and Accessories	2.18	G													
			Padlocks	2.23	G													
			Wire Ties	2.20	G													
			SD-07 Certificates															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 31 13	Certificates of Compliance	1.5.2														
			SD-08 Manufacturer's Instructions															
			Fence Assembly	1.3														
			Gate Assembly	1.3														
			Hardware Assembly	1.3														
			Accessories	1.3														
		32 31 19	SD-02 Shop Drawings															
			Ornamental Picket Swing Gates	2.3	G	AE												
			SD-03 Product Data															
			Ornamental Picket Swing Gates	2.3	G	AE												
			Safety Conspicuity Materials	2.3.11														
			SD-04 Samples															
			Finish		G													
			Polyester Powder Coat Finish	2.3.10														
			SD-11 Closeout Submittals															
			As-built Drawings		G													
		32 34 23	SD-02 Shop Drawings															
			Precast Element Dimension and	2.2	G	AE												
			Reinforcement Details															
			SD-05 Design Data															
			Design Calculations	1.5.3														
			Concrete	2.1.1														
			Steel Reinforcement	2.1.2														
			Steel Hardware	2.1.3														
			SD-06 Test Reports															
			Precast Production Reports	1.5.3														

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 34 23	Markings	1.5.7														
			Compression Testing	1.7.1.2														
			Cylinder Tests	1.7.1.3														
			Core Tests	1.7.1.4														
			SD-07 Certificates															
			Certification	1.5.1														
			SD-11 Closeout Submittals															
			Record Drawings	3.5	G													
		32 34 40	SD-02 Shop Drawings															
			Submittal Drawings		G AE													
			Delivery Routes															
			Site Access Points															
			Off-Load Locations															
			Storage Locations															
			Erection Equipment Access															
			Points															
			Erection Equipment Routes															
			On-Site															
			Erection Equipment Locations															
			during Installation															
			Erection Equipment Lift Points															
			and Swing Envelopes															
			SD-05 Design Data															
			Bearing Devices	2.6.1	G AE													
			Design Calculations															
			Fabrication Submittals	3.4	G AE													

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 34 40	Numerical table of joint gap	2.1.2	G	AE												
			widths															
			SD-07 Certificates															
			Qualifications	1.4.1														
			Professional Engineer	2.1.2														
			Painter Qualifications	2.4.2.2														
			SD-11 Closeout Submittals															
			Record Drawings (As-built		G													
			Drawings)															
			Inspection and maintenance	1.5														
			procedures															
		32 84 23	SD-02 Shop Drawings															
			Sprinkler System	3.2	G	AE												
			SD-03 Product Data															
			Framed Instructions	2.6.2.3														
			Framed Instructions	3.3														
			Field Training	3.4														
			Sprinkler System	3.2														
			booster pump assembly	2.5	G													
			Spare Parts	1.6														
			Spare Parts	3.8														
			Design Analysis and Calculations	1.2	G	AE												
			SD-06 Test Reports															
			Field Tests	3.6														
			Record Drawings															
			SD-07 Certificates															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 84 23	Designer Qualifications	1.4.1														
			Equipment Manufacturer's	1.4.2														
			Statement															
			SD-10 Operation and Maintenance															
			Data															
			Sprinkler System	3.2	G AE													
		32 92 19	SD-03 Product Data															
			Fertilizer	2.4														
			SD-06 Test Reports															
			Topsoil composition tests															
			SD-07 Certificates															
			seed	2.1														
		32 93 00	SD-01 Preconstruction Submittals															
			State Landscape Contractor's	1.4.3														
			License															
			Time Restrictions and Planting	1.6														
			Conditions															
			Pesticide Proposal	3.8														
			SD-03 Product Data															
			Root Barriers	2.9	G													
			Pete															
			Gypsum	2.4.7														
			Fertilizer	2.6														
			Mulch	2.7														
			Organic Mulch Materials	2.7.1	G AE													
			Staking Material	2.8.1														

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 93 00	Ground Stakes	2.8.1.2														
			Antidesiccants	2.10														
			Hose	2.11.1														
			SD-06 Test Reports															
			Topsoil composition tests	1.4.1	G	AE												
			SD-07 Certificates															
			Nursery certifications	1.4.2	G	AE												
		33 05 23.15	SD-02 Shop Drawings															
			Jacking	3.3	G	A/E												
			Boring	3.4	G	A/E												
			SD-03 Product Data															
			Steel pipe casings	2.1														
			Carrier Pipe	2.2														
			casing spacers	2.4														
			SD-11 Closeout Submittals															
			As-Built Record Drawings		G	A/E												
		33 11 00	SD-03 Product Data															
			Piping Materials	2.1.1	G	AE												
			Water distribution main	2.1	G	AE												
			Water service line	2.2	G	AE												
			Hydrants	2.1.4.3	G	AE												
			Valve boxes	2.1.4.5	G	AE												
			Valve boxes	2.2.2.4	G	AE												
			SD-06 Test Reports															
			Disinfection	2.2.2.6	G													
			SD-07 Certificates															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		33 11 00	Water distribution main	2.1														
			Water service line	2.2														
			Lining	2.1.1.1														
			hydrants	2.1.4.3														
			SD-08 Manufacturer’s Instructions															
			Delivery, storage, and handling	1.4														
			Installation	3.1.1														
		33 11 23	SD-03 Product Data															
			Valve box	2.4	G	AE												
			Valves		G	AE												
			Warning and identification tape	2.5	G	AE												
			Transition fittings	2.2.2	G	AE												
			SD-07 Certificates															
			PE welder's qualifications	1.4.2														
			Welder's identification symbols	1.4.1														
			SD-08 Manufacturer’s Instructions															
			PE pipe and fittings	2.2.1	G	AE												
		33 30 00	SD-01 Preconstruction Submittals															
			Existing Conditions	1.6														
			SD-02 Shop Drawings															
			Drawings	1.4.2														
			Metal items	2.3.6														
			Frames, covers, and gratings	2.3.6.1	G	AE												
			SD-03 Product Data															
			Pipeline materials	2.1	G	AE												
			SD-06 Test Reports															

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		33 30 00	Reports	2.4														
			SD-07 Certificates															
			Portland Cement	2.2.2														
		33 40 00	SD-07 Certificates															
			Resin Certification	2.1.3														
			Resin Certification	2.1.4														
			Pipeline Testing	3.6														
			Hydrostatic Test on Watertight	2.5	G	AE												
			Joints															
			Determination of Density	3.5.5														
			Frame and Cover for Gratings	2.3.5	G	AE												
			manufacturer's recommendations	3.3														
		33 46 13	SD-07 Certificates															
			Materials	2.1														
		33 46 16	SD-04 Samples															
			Filter Fabric	2.2	G	AE												
			Pipe for Subdrains	2.1	G	AE												
			SD-07 Certificates															
			Filter Fabric	2.2														
			Pipe for Subdrains	2.1														
		33 70 02.00 10	SD-02 Shop Drawings															
			Detail Drawings	1.3.1	G													
			As-Built Drawings	1.3.2	G													
			Installation Requirements	3.2														
			SD-03 Product Data															
			Nameplates	2.2														

SUBMITTAL REGISTER

CONTRACT NO.
W91236-13-R-0012

TITLE AND LOCATION
Arlington National Cemetery - Millennium Project

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		33 70 02.00 10	SD-06 Test Reports															
			Field Testing	3.10														
			Cable Installation	3.3.1.4														
			SD-07 Certificates															
			Material and Equipment	2.1														
			Cable Joints	3.4														
			Installation Engineer															
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance															
			Manuals															
		34 71 14.19	SD-02 Shop Drawings															
			Shop Drawings	1.4.2	G	AE												
			sheet and installation manual	3.1														
			SD-03 Product Data															
			Cable	2.1.1	G	AE												
			Posts	2.1.2	G	AE												
			Cable Hardware	2.1.3	G	AE												
			Locking Hook Bolts	2.1.4	G	AE												
			Delineators	2.1.5	G	AE												
			SD-07 Certificates															
			Installer Qualifications	1.4.1	G	AE												
			Manufacturer Qualifications	1.4.2														

SECTION 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS
02/12

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.32	(2004) Fall Protection
ASSE/SAFE A10.34	(2001; R 2005) Protection of the Public on or Adjacent to Construction Sites
ASSE/SAFE Z359.1	(2007) Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components

ASME INTERNATIONAL (ASME)

ASME B30.22	(2010) Articulating Boom Cranes
ASME B30.3	(2009) Tower Cranes
ASME B30.5	(2011) Mobile and Locomotive Cranes
ASME B30.8	(2010) Floating Cranes and Floating Derricks

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(2010; Errata 2012) Standard for Portable Fire Extinguishers
NFPA 241	(2009) Standard for Safeguarding Construction,Alteration, and Demolition Operations
NFPA 51B	(2009; TIA 09-1) Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70E	(2012; Errata 1) Standard for Electrical Safety in the Workplace

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.146	Permit-required Confined Spaces
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.1400	Cranes & Derricks in Construction
29 CFR 1926.16	Rules of Construction
29 CFR 1926.500	Fall Protection
CPL 2.100	(1995) Application of the Permit-Required Confined Spaces (PRCS) Standards, 29 CFR 1910.146

1.2 DEFINITIONS

a. High Visibility Accident. Any mishap which may generate publicity or high visibility.

b. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.

c. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:

(1) Death, regardless of the time between the injury and death, or the length of the illness;

(2) Days away from work (any time lost after day of injury/illness onset);

(3) Restricted work;

(4) Transfer to another job;

(5) Medical treatment beyond first aid;

(6) Loss of consciousness; or

(7) A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

d. "USACE" property and equipment specified in USACE EM 385-1-1 should be interpreted as Government property and equipment.

e. Weight Handling Equipment (WHE) Accident. A WHE accident occurs when any one or more of the eight elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload; or collision, including unplanned contact between the load, crane, or

other objects. A dropped load, derailment, two-blocking, overload and collision are considered accidents even though no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, bearing failure) is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped load, roll over, etc.) Any mishap meeting the criteria described above shall be documented in both the Contractor Significant Incident Report (CSIR) submitted within five days both as provided by the Contracting Officer.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Government acceptance, as defined in EM 385-1-1, is required for submittals with a "G, A" designation.

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP); G
Activity Hazard Analysis (AHA); G
Crane Critical Lift Plan; G

Proof of qualification for Crane Operators

SD-06 Test Reports

Notifications and Reports

Submit reports as their incidence occurs, in accordance with the requirements of the paragraph, "Notifications and Reports."

Accident Reports; G
Crane Reports

SD-07 Certificates

Confined Space Entry Permit; G
Hot work permit; G
Certificate of Compliance; G

1.4 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this contract, comply with the most recent addition of USACE EM 385-1-1, and the following federal, state, and local laws, ordinances, criteria, rules and regulations . Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern.

1.5 SITE QUALIFICATIONS, DUTIES AND MEETINGS

1.5.1 Personnel Qualifications

1.5.1.1 Site Safety and Health Officer (SSHO)

The SSHO must meet the requirements of EM 385-1-1 section 1 and ensure that the requirements of 29 CFR 1926.16 are met for the project. Provide a Safety oversight team that includes a minimum of one (1) person at each project site to function as the Site Safety and Health Officer (SSHO). The SSHO or an equally-qualified Designated Representative/alternate shall be at the work site at all times to implement and administer the Contractor's safety program and government-accepted Accident Prevention Plan. The SSHO's training, experience, and qualifications shall be as required by EM 385-1-1 paragraph 01.A.17, entitled SITE SAFETY AND HEALTH OFFICER (SSHO), and all associated sub-paragraphs.

A Competent Person shall be provided for all of the hazards identified in the Contractor's Safety and Health Program in accordance with the accepted Accident Prevention Plan, and shall be on-site at all times when the work that presents the hazards associated with their professional expertise is being performed. Provide the credentials of the Competent Persons(s) to the the Contracting Officer for acceptance in consultation with the Safety Office.

1.5.1.1.1 Contractor Quality Control (QC) Person:

The Contractor Quality Control Person can be the SSHO on this project.

1.5.1.2 Crane Operators

Meet the crane operators requirements in USACE EM 385-1-1, Section 16 and Appendix I. In addition, for mobile cranes with Original Equipment Manufacturer (OEM) rated capacitates of 50,000 pounds or greater, designate crane operators as qualified by a source that qualifies crane operators (i.e., union, a government agency, or an organization that tests and qualifies crane operators). Provide proof of current qualification.

1.5.2 Personnel Duties

1.5.2.1 Site Safety and Health Officer (SSHO)

The SSHO shall:

a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Attach safety inspection logs to the Contractors' daily production report.

b. Conduct mishap investigations and complete required reports. Maintain the OSHA Form 300 and Daily Production reports for prime and sub-contractors.

c. Maintain applicable safety reference material on the job site.

d. Attend the pre-construction conference, pre-work meetings including preparatory inspection meeting, and periodic in-progress meetings.

e. Implement and enforce accepted APPS and AHAs.

f. Maintain a safety and health deficiency tracking system that monitors outstanding deficiencies until resolution. Post a list of unresolved safety and health deficiencies on the safety bulletin board.

g. Ensure sub-contractor compliance with safety and health requirements.

h. Maintain a list of hazardous chemicals on site and their material safety data sheets.

Failure to perform the above duties will result in dismissal of the superintendent, QC Manager, and/or SSHO, and a project work stoppage. The project work stoppage will remain in effect pending approval of a suitable replacement.

1.5.3 Meetings

1.5.3.1 Preconstruction Conference

a. Contractor representatives who have a responsibility or significant role in accident prevention on the project shall attend the preconstruction conference. This includes the project superintendent, site safety and health officer, quality control supervisor, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).

b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Contracting Officer's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.

c. Deficiencies in the submitted APP will be brought to the attention of the Contractor at the preconstruction conference, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

1.5.4 Site Safety Meetings

Conduct and document meetings are required by EM 385-1-1. Attach minutes showing contract title, signatures of attendees, and a list of topics discussed to the Contractor's Daily Production Report.

1.6 ACCIDENT PREVENTION PLAN (APP)

Use a qualified person to prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of USACE EM 385-1-1 and as supplemented herein. Cover all paragraph and subparagraph elements in USACE EM 385-1-1, Appendix A, "Minimum Basic Outline for Accident Prevention Plan". Specific requirements for some of the APP elements are described below. The APP shall be job-specific and address any unusual or unique aspects of the project or activity for which it is written. The APP shall interface with the Contractor's overall safety and health program.

Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and made site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP shall be signed by the person and firm (senior person) preparing the APP, the Contractor, the on-site superintendent, the designated site safety and health officer, the Contractor Quality control Manager, and any designated CSP or CIH.

Submit the APP to the Contracting Officer 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP.

Once accepted by the Contracting Officer, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.

Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the Contracting Officer, project superintendent, SSHO and quality control manager. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34,) and the environment.

Copies of the accepted plan will be maintained at the resident engineer's office and at the job site.
Continuously review and ammend the APP, as necessary, throughout the life of the contract. Incorporate unusual or high-hazard activities not identified in the original APP as they are discovered.

1.6.1 EM 385-1-1 Contents

In addition to the requirements outlined in Appendix A of USACE EM 385-1-1, the following is required:

a. Crane Critical Lift Plan.
Prepare and sign weight handling critical lift plans for lifts over 75 percent of the capacity of the crane or hoist (or lifts over 50 percent of the capacity of a barge mounted mobile crane's hoists) at any radius of lift; lifts involving more than one crane or hoist; lifts of personnel; and lifts involving non-routine rigging or operation, sensitive equipment, or unusual safety risks. Submit 15 calendar days prior to on-site work and include the requirements of USACE EM 385-1-1, paragraph 16.H. and the following:

(1) For lifts of personnel, demonstrate compliance with the requirements of 29 CFR 1926.1400.

(2) For barge mounted mobile cranes, barge stability calculations

identifying barge list and trim based on anticipated loading; and load charts based on calculated list and trim. The amount of list and trim shall be within the crane manufacturer's requirements.

b. Site Demolition Plan. The safety and health aspects prepared in accordance with Section 02 41 00 DEMOLITION and referenced sources. Include engineering survey as applicable.

c. Excavation Plan. The safety and health aspects prepared in accordance with Section 31 00 00 EARTHWORK.

1.7 ACTIVITY HAZARD ANALYSIS (AHA)

The Activity Hazard Analysis (AHA) format shall be in accordance with USACE EM 385-1-1, Section 1. Submit the AHA for review at least 15 calendar days prior to the start of each phase. Format subsequent AHAs as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.

Develop the activity hazard analyses using the project schedule as the basis for the activities performed. Any activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier or subcontractor and provided to the prime contractor for submittal to the Contracting Officer.

1.8 DISPLAY OF SAFETY INFORMATION

Within one calendar day(s) after commencement of work, erect a safety bulletin board at the job site. Where size, duration, or logistics of project do not facilitate a bulletin board, an alternative method, acceptable to the Contracting Officer, that is accessible and includes all mandatory information for employee and visitor review, shall be deemed as meeting the requirement for a bulletin board. Include and maintain information on safety bulletin board as required by EM 385-1-1, section 01.A.06. Additional items required to be posted include:

a. Confined space entry permit.

b. Hot work permit.

1.9 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in the article "References." Maintain applicable equipment manufacturer's manuals.

1.10 EMERGENCY MEDICAL TREATMENT

Contractors will arrange for their own emergency medical treatment. Government has no responsibility to provide emergency medical treatment.

1.11 NOTIFICATIONS and REPORTS

1.11.1 Accident Notification

Notify the Contracting Officer as soon as practical, but no more than four hours after any accident meeting the definition of Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than $2,000, or any weight handling equipment accident. Within notification include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted.

1.11.2 Accident Reports

a. Conduct an accident investigation for recordable injuries and illnesses, for Medical Treatment defined in paragraph DEFINITIONS, property damage accidents resulting in at least $20,000 in damages, and near misses as defined in EM 385-1-1, to establish the root cause(s) of the accident. Complete the applicable USACE Accident Report Form 3394, and provide the report to the Contracting Officer within 5 calendar day(s) of the accident. The Contracting Officer will provide copies of any required or special forms.

b. Conduct an accident investigation for any weight handling equipment accident (including rigging gear accidents) to establish the root cause(s) of the accident, complete the WHE Accident Report (Crane and Rigging Gear) form and provide the report to the Contracting Officer within 30 calendar days of the accident. Do not proceed with crane operations until cause is determined and corrective actions have been implemented to the satisfaction of the contracting officer. The Contracting Officer will provide a blank copy of the accident report form.

1.11.3 Crane Reports

Submit crane inspection reports required in accordance with USACE EM 385-1-1, Appendix I and as specified herein with Daily Reports of Inspections.

1.11.4 Certificate of Compliance

Provide a Certificate of Compliance for each crane entering an activity under this contract (see Contracting Officer for a blank certificate). State within the certificate that the crane and rigging gear meet applicable OSHA regulations (with the Contractor citing which OSHA regulations are applicable, e.g., cranes used in construction, demolition, or maintenance comply with 29 CFR 1926 and USACE EM 385-1-1 Section 16 and Appendix I. Certify on the Certificate of Compliance that the crane operator(s) is qualified and trained in the operation of the crane to be used. Also certify that all of its crane operators working on the DOD activity have been trained in the proper use of all safety devices (e.g., anti-two block devices). Post certifications on the crane.

1.12 HOT WORK

Submit and obtain a written permit prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, from the Fire Division. A permit is required from the Explosives Safety Office for work in and around where explosives are processed, stored, or handled. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. Provide at least two (2) twenty (20) pound 4A:20 BC rated extinguishers for normal "Hot Work". All extinguishers shall be current inspection tagged, approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch shall be trained in accordance with NFPA 51B and remain on-site for a minimum of 30 minutes after completion of the task or as specified on the hot work permit.

When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency Fire Division phone number. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED TO THE RESPONSIBLE FIRE DIVISION IMMEDIATELY.

1.13 FACILITY OCCUPANCY CLOSURE

Streets, walks, and other facilities occupied and used by the Government shall not be closed or obstructed without written permission from the Contracting Officer.

1.14 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must:

a. Secure outside equipment and materials and place materials that could be damaged in protected areas.

b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.

c. Ensure that temporary erosion controls are adequate.

1.15 HIGH NOISE LEVEL PROTECTION

Operations performed by Contractor that involve the use of equipment with output of high noise levels (jackhammers, air compressors, pile driving) shall be scheduled for weekends, or after duty working hours during the hours before 7:30AM or after 5:00PM Monday through Friday. Use of such equipment shall be approved in writing by Contracting Officer prior to commencement of Work.

1.16 CONFINED SPACE ENTRY REQUIREMENTS.

Contractors entering and working in confined spaces while performing general industry work are required to follow the requirements of OSHA 29 CFR 1926 and comply with the requirements in Section 34 of EM 385-1-1, OSHA 29 CFR 1910, and OSHA 29 CFR 1910.146.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 CONSTRUCTION AND OTHER WORK

Comply with USACE EM 385-1-1, NFPA 241, the AAP and AHA, Federal and state OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard prevails.

3.1.1 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with USACE EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocynates, lead-based paint are prohibited. The Contracting Officer, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials. Low mercury lamps used within fluorescent lighting fixtures are allowed as an exception without further Contracting Officer approval. Notify the Radiation Safety Officer (RSO) prior to excepted items of radioactive material and devices being brought on base.

3.1.2 Unforeseen Hazardous Material

The design should have identified materials such as PCB, lead paint, and friable and non-friable asbestos and other OSHA regulated chemicals (i.e. 29 CFR Part 1910.1000). If material, not indicated, that may be hazardous to human health upon disturbance during construction operations is encountered, stop that portion of work and notify the Contracting Officer immediately. Within 14 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

3.2 PRE-OUTAGE COORDINATION MEETING

Apply for utility outages at least 7 days in advance. As a minimum, the request should include the location of the outage, utilities being affected, duration of outage and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved, and prior to beginning work on the utility system requiring shut down, attend a pre-outage coordination meeting with the Contracting Officer and the Installation representative to review the scope of work and the lock-out/tag-out procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

3.3 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

Ensure that each employee is familiar with and complies with these procedures and USACE EM 385-1-1, Section 12, Control of Hazardous Energy.

3.4 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

Establish a fall protection and prevention program, for the protection of

all employees exposed to fall hazards. Within the program include company policy, identify responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures.

3.4.1 Training

Institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, provide training for each employee who might be exposed to fall hazards. Provide training by a competent person for fall protection in accordance with USACE EM 385-1-1, Section 21.B.

3.4.2 Fall Protection Equipment and Systems

Enforce use of the fall protection equipment and systems designated for each specific work activity in the Fall Protection and Prevention Plan and/or AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in EM 385-1-1, Section 21. In addition to the required fall protection systems, safety skiff, personal floatation devices, life rings etc., are required when working above or next to water in accordance with USACE EM 385-1-1, Paragraphs 21.N through 21.N.04. Personal fall arrest systems are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall arrest systems are required when operating other equipment such as scissor lifts if the work platform is capable of being positioned outside the wheelbase. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, or travel. Fall protection must comply with 29 CFR 1926.500, Subpart M, USACE EM 385-1-1 and ASSE/SAFE A10.32.

3.4.2.1 Personal Fall Arrest Equipment

Personal fall arrest equipment, systems, subsystems, and components shall meet ASSE/SAFE Z359.1. Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. Body belts may only be used as a positioning device system (for uses such as steel reinforcing assembly and in addition to an approved fall arrest system). Harnesses shall have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Only locking snap hooks and carabiners shall be used. Webbing, straps, and ropes shall be made of synthetic fiber. The maximum free fall distance when using fall arrest equipment shall not exceed 6 feet. The total fall distance and any swinging of the worker (pendulum-like motion) that can occur during a fall shall always be taken into consideration when attaching a person to a fall arrest system.

3.4.3 Fall Protection for Roofing Work

Implement fall protection controls based on the type of roof being constructed and work being performed. Evaluate the roof area to be accessed for its structural integrity including weight-bearing capabilities for the projected loading.

a. Low Sloped Roofs:

(1) For work within 6 feet of an edge, on low-slope roofs, protect personnel from falling by use of personal fall arrest systems,

guardrails, or safety nets.

(2) For work greater than 6 feet from an edge, erect and install warning lines in accordance with 29 CFR 1926.500 and USACE EM 385-1-1.

b. Steep-Sloped Roofs: Work on steep-sloped roofs requires a personal fall arrest system, guardrails with toe-boards, or safety nets. This requirement also includes residential or housing type construction.

3.4.4 Horizontal Lifelines

Design, install, certify and use under the supervision of a qualified person horizontal lifelines for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500).

3.4.5 Guardrails and Safety Nets

Design, install and use guardrails and safety nets in accordance with EM 385-1-1 and 29 CFR 1926 Subpart M.

3.4.6 Rescue and Evacuation Procedures

When personal fall arrest systems are used, ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP).

3.5 EQUIPMENT

3.5.1 Material Handling Equipment

Contractor is responsible for ensuring employees possess required active and valid licenses for operating equipment and vehicles used in the execution of this Contract.

a. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.

b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions.

c. Operators of forklifts or power industrial trucks shall be licensed in accordance with OSHA.

3.5.2 Weight Handling Equipment

a. Equip cranes and derricks as specified in EM 385-1-1, section 16.

b. Comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Perform erection under the supervision of a designated person

(as defined in ASME B30.5). Perform all testing in accordance with the manufacturer's recommended procedures.

c. Comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes, and ASME B30.8 for floating cranes and floating derricks.

d. Under no circumstance shall a Contractor make a lift at or above 90 percent of the cranes rated capacity in any configuration.

e. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and follow the requirements of USACE EM 385-1-1 Section 11 and ASME B30.5 or ASME B30.22 as applicable.

f. Do not crane suspended personnel work platforms (baskets) unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not lift personnel with a line hoist or friction crane.

g. Inspect, maintain, and recharge portable fire extinguishers as specified in NFPA 10, Standard for Portable Fire Extinguishers.

h. All employees must keep clear of loads about to be lifted and of suspended loads.

i. Use cribbing when performing lifts on outriggers.

j. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.

k. A physical barricade must be positioned to prevent personnel from entering the counterweight swing (tail swing) area of the crane.

l. Certification records which include the date of inspection, signature of the person performing the inspection, and the serial number or other identifier of the crane that was inspected shall always be available for review by Contracting Officer personnel.

m. Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available for review by Contracting Officer personnel.

n. Certify that all crane operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

3.5.3 USE OF EXPLOSIVES

Explosives shall not be used.

3.6 EXCAVATIONS

Soil classification must be performed by a competent person in accordance with 29 CFR 1926 and EM 385-1-1.

3.6.1 Utility Locations

Prior to digging, the appropriate digging permit shall be obtained. All underground utilities in the work area must be positively identified by a

third party, independent, private utility locating company in addition to any station locating service and coordinated with the station utility department.

3.6.2 Utility Location Verification

Physically verify underground utility locations, including utility depth, by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system.

3.6.3 Utilities Within and Under Concrete, Bituminous Asphalt, and Other Impervious Surfaces

Utilities located within and under concrete slabs or pier structures, bridges, parking areas, and the like, are extremely difficult to identify. Whenever contract work involves chipping, saw cutting, or core drilling through concrete, bituminous asphalt or other impervious surfaces, the existing utility location must be coordinated with station utility departments in addition to location and depth verification by a third party, independent, private locating company. The third party, independent, private locating company shall locate utility depth by use of Ground Penetrating Radar (GPR), X-ray, bore scope, or ultrasound prior to the start of demolition and construction. Outages to isolate utility systems must be used in circumstances where utilities are unable to be positively identified. The use of historical drawings does not alleviate the contractor from meeting this requirement.

3.7 ELECTRICAL

3.9.1 Portable Extension Cords

Size portable extension cords in accordance with manufacturer ratings for the tool to be powered and protected from damage. Immediately removed from service all damaged extension cords. Portable extension cords shall meet the requirements of EM 385-1-1, NFPA 70E, and OSHA electrical standards.

3.8 WORK IN CONFINED SPACES

Comply with the requirements in Section 34 of USACE EM 385-1-1, OSHA 29 CFR 1910, OSHA 29 CFR 1910.146, OSHA Directive CPL 2.100 and OSHA 29 CFR 1926. Any potential for a hazard in the confined space requires a permit system to be used.

a. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. (See Section 34 of USACE EM 385-1-1 for entry procedures.) All hazards pertaining to the space

shall be reviewed with each employee during review of the AHA.

b. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its' action level.

c. Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.

-- End of Section --

SECTION 01 35 29.13

HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES
01/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN PETROLEUM INSTITUTE (API)

API RP 2219	(2005) Safe Operation of Vacuum Trucks in Petroleum Service

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH 85-115	(1985) Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1904	Recording and Reporting Occupational Injuries and Illnesses
29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.120	Hazardous Waste Operations and Emergency Response
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.65	Hazardous Waste Operations and Emergency Response
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

1.2 DESCRIPTION OF WORK

This section requires Contractors to implement practices and procedures for

working safely and in compliance with OSHA and USACE regulation while performing cleanup activities on uncontrolled hazardous waste sites.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Decontamination Facilities

SD-03 Product Data

Exposure Monitoring/Air Sampling Program

1.4 REGULATORY REQUIREMENTS

Comply with EM 385-1-1, OSHA requirements in 29 CFR 1910 and 29 CFR 1926 with work performed under this contract, especially OSHA's Standards 29 CFR 1926.65 and 29 CFR 1910.120 and state specific OSHA requirements where applicable. Submit to the Contracting Officer for resolution matters of interpretation of standards before starting work. The most stringent requirements apply where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary.

1.5 PRECONSTRUCTION SAFETY CONFERENCE

Conduct a preconstruction safety conference prior to the start of site activities and after submission of the Contractor's APP/SSHP. The objective of the meeting will be to discuss health and safety concerns related to the impending work, discuss project health and safety organization and expectations, review and answer comments and concerns regarding the APP/SSHP or other health and safety concerns the Contractor may have. Ensure that those individuals responsible for health and safety at the project level are available and attend this meeting.

1.6 ACCIDENT PREVENTION PLAN/SITE SAFETY AND HEALTH PLAN (APP/SSHP)

Develop and implement a Site Safety and Health Plan and attach to the Accident Prevention Plan (APP) as an appendix (APP/SSHP). Address all occupational safety and health hazards (traditional construction as well as contaminant-related hazards) associated with cleanup operations within the APP/SSHP. Cover each SSHP element in section 28.A.01 of EM 385-1-1 and each APP element in Appendix A of EM 385-1-1. There are overlapping elements in Section 28.A.01 and Appendix A of EM 385-1-1. SSHP appendix elements that overlap with APP elements need not be duplicated in the APP/SSHP provided each SOH issue receives adequate attention and is documented in the APP/SSHP. The APP/SSHP is a dynamic document, subject to change as project operations/execution change. The APP/SSHP will require modification to address changing and previously unidentified health and safety conditions. It is the Contractor's responsibility to ensure that the APP/SSHP is updated accordingly. Submit amendments to the APP/SSHP to the COR as the APP/SSHP is updated. For long duration projects resubmit the APP/SSHP to the COR annually for review. The APP/SSHP must contain all

updates.

1.6.1 Acceptance and Modifications

Prior to submittal, the APP/SSHP must be signed and dated by the Safety and Health Manager and the Site Superintendent. Submit for review 15 days prior to the Preconstruction Safety Conference. Deficiencies in the APP/SSHP will be discussed at the preconstruction safety conference, and be revised to correct the deficiencies and resubmitted for acceptance. Onsite work must not begin until the plan has been accepted. Maintain a copy of the written APP/SSHP onsite. Changes and modifications to must be made with the knowledge and concurrence of the Safety and Health Manager, the Site Superintendent, and the Contracting Officer. Bring to the attention of the Safety and Health Manager, the Site Superintendent, and the Contracting Officer any unforeseen hazard that becomes evident during the performance of the work, through the Site Safety and Health Officer (SSHO) for resolution as soon as possible. In the interim, take necessary action to re-establish and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public, and the environment. Disregard for the provisions of this specification or the accepted APP/SSHP will be cause for stopping work until the matter has been rectified.

1.6.2 Availability

Make available the APP/SSHP in accordance with 29 CFR 1910.120, (b)(1)(v) and 29 CFR 1926.65, (b)(1)(v).

1.7 SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION

1.7.1 Project/Site Conditions

Refer to the Expanded Environmental Site Investigations report prepared by A-Zone Environmental for the site description and contamination characterization. This report is available electronically on request to the Norfolk District Geo-Environmental Section through coordination with the Contracting Officer. The requestor needs to provide an e-mail address to the Contracting Officer to receive download instructions to obtain the referenced report. Electronic file will be transferred via AMRDEC SAFE Web Application at https://safe.amrdec.army.mil/safe/.

1.8 TASK SPECIFIC HAZARDS, PPE, HAZWOPER MEDICAL SURVEILLANCE AND TRAINING APPLICABILITY

Task specific occupational hazards, task specific HAZWOPER medical surveillance and training applicability and task specific PPE requirements for the project shall be developed by the Contractor and submitted for government approval in the Work Plan required in Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL for work related to the excavation and handling of known contaminated material. Other task specific PPE shall be developed by the Site Safety and Health Manager. A standard template for the Task Hazard and Control Sheets at the end of this section. It is the Contractor's responsibility to reevaluate occupational safety and health hazards as the work progresses and to adjust the PPE and onsite operations, if necessary, so that the work is performed safely and in compliance with occupational safety and health regulations.

1.9 STAFF ORGANIZATION, QUALIFICATION AND RESPONSIBILITIES

1.9.1 Safety and Health Manager

Safety and Health Manager must be a safety professional certified by the Board of Certified Safety Professionals.

1.9.1.1 Additional Qualifications

The Safety and Health Manager must have the following additional qualifications:

a. A minimum of 3 years experience in developing and implementing safety and health programs at construction sites with similar elements of Construction.

b. Documented experience in supervising professional and technician level personnel.

c. Documented experience in developing worker exposure assessment programs and air monitoring programs and techniques.

d. Documented experience in managing personal protective equipment programs and conducting PPE hazard evaluations for the types of activities and hazards likely to be encountered on the project.

e. Working knowledge of state and Federal occupational safety and health regulations.

1.9.1.2 Responsibilities and Duties

The Safety and Health Manager shall:

a. Be responsible for the development, implementation, oversight, and enforcement of the APP/SSHP.

b. Sign and date the APP/SSHP prior to submittal.

c. Conduct initial site-specific training.

d. Be present onsite during the first 3 days of contaminated material excavation and in-situ groundwater treatment activities and at the startup of each new major phase of work.

e. Visit the site as needed and at least once per week for the duration of activities, to audit the effectiveness of the APP/SSHP.

f. Be available for emergencies.

g. Provide onsite consultation as needed to ensure the APP/SSHP is fully implemented.

h. Coordinate any modifications to the APP/SSHP with the Site Superintendent, the SSHO, and the Contracting Officer.

i. Provide continued support for upgrading/downgrading of the level of personal protection.

j. Be responsible for evaluating air monitoring data and recommending

changes to engineering controls, work practices, and PPE.

k. Review accident reports and results of daily inspections.

l. Serve as a member of the Contractor's quality control staff.

1.9.2 Additional Certified Health and Safety Support Personnel

Retain industrial hygiene support from an industrial hygienist certified by the American Board of Industrial Hygiene to develop occupational health practices for the APP/SSHP and visit the site to help implement APP/SSHP requirements.

1.9.3 Site Safety and Health Officer

Designate an individual and one alternate as the Site Safety and Health Officer (SSHO). The name, qualifications (education and training summary and documentation), and include work experience of the Site Safety and Health Officer and alternate in the APP/SSHP.

1.9.3.1 Qualifications

The SSHO shall meet the following qualifications:

a. A minimum of 3 years experience in implementing safety and health programs at underground storage tank removal projects where Level B personal protective equipment was required.

b. Documented experience in construction techniques and construction safety procedures.

c. Working knowledge of Federal and state occupational safety and health regulations.

d. Specific training in personal and respiratory protective equipment, confined space entry and in the proper use of air monitoring instruments and air sampling methods including monitoring for ionizing radiation.

1.9.3.2 Responsibilities and Duties

The Site Safety and Health Officer shall:

a. Assist and represent the Safety and Health Manager in onsite training and the day to day onsite implementation and enforcement of the accepted APP/SSHP.

b. Be assigned to the site on a full time basis for the duration of field activities. The SSHO can have collateral duties in addition to Safety and Health related duties. If operations are performed during more than 1 work shift per day, a site Safety and Health Officer must be present for each shift and when applicable, act as the radiation safety officer (RSO) as defined in paragraph 06.E.02 of EM 385-1-1 on radioactive waste cleanup projects.

c. Have authority to ensure site compliance with specified safety and health requirements, Federal, state and OSHA regulations and all aspects of the APP/SSHP including, but not limited to, activity hazard analyses, air monitoring, monitoring for ionizing radiation, use of

PPE, decontamination, site control, standard operating procedures used to minimize hazards, safe use of engineering controls, the emergency response plan, confined space entry procedures, spill containment program, and preparation of records by performing a daily safety and health inspection and documenting results on the Daily Safety Inspection Log in accordance with 29 CFR 1904.

d. Have authority to stop work if unacceptable health or safety conditions exist, and take necessary action to re-establish and maintain safe working conditions.

e. Consult with and coordinate any modifications to the APP/SSHP with the Safety and Health Manager, the Site Superintendent, and the Contracting Officer.

f. Serve as a member of the Contractor's quality control staff on matters relating to safety and health.

g. Conduct accident investigations and prepare accident reports.

h. Conduct daily safety inspection and document safety and health findings into the Daily Safety Inspection Log. Track noted safety and health deficiencies to ensure that they are corrected.

i. In coordination with site management and the Safety and Health Manager, recommend corrective actions for identified deficiencies and oversee the corrective actions.

1.9.4 Persons Certified in First Aid and CPR

At least two persons who are currently certified in first aid and CPR by the American Red Cross or other approved agency must be onsite at all times during site operations. They must be trained in universal precautions and the use of PPE as described in the Bloodborne Pathogens Standard of 29 CFR 1910, Section .1030. These persons may perform other duties but will be immediately available to render first aid when needed.

1.10 TRAINING

Meet the following requirements in the Contractor's training program for workers performing cleanup operations and who will be exposed to contaminants.

1.10.1 General Hazardous Waste Operations Training

All Personnel performing duties with potential for exposure to onsite contaminants must meet and maintain the following 29 CFR 1910.120/ 29 CFR 1926.65 (e) training requirements:

a. 40 hours of off site hazardous waste instruction.

b. 3 days actual field experience under the direct supervision of a trained, experienced supervisor.

c. 8 hours refresher training annually.

Onsite supervisors must have an additional 8 hours management and supervisor training specified in 29 CFR 1910.120/29 CFR 1926.65 (e) (4).

1.10.2 Pre-entry Briefing

Prior to commencement of onsite field activities, all site employees, including those assigned only to the Support Zone, must attend a site-specific safety and health training session. This session will be conducted by the Safety and Health Manager and the Site Safety and Health Officer to ensure that all personnel are familiar with requirements and responsibilities for maintaining a safe and healthful work environment. Thoroughly discuss procedures and contents of the accepted APP/SSHP and Sections 01.B.02 and 28.D.03 of EM 385-1-1 . Each employee must sign a training log to acknowledge attendance and understanding of the training. Notify the Contracting Officer at least 5 days prior to the initial site-specific training session so government personnel involved in the project may attend.

1.10.3 Periodic Sessions

Conduct periodic onsite training by the SSHO at least weekly for personnel assigned to work at the site during the following week . Address safety and health procedures, work practices, any changes in the APP/SSHP, activity hazard analyses, work tasks, or schedule; results of previous week's air monitoring, review of safety discrepancies and accidents. Convene a meeting prior to implementation of the change must be convened should an operational change affecting onsite field work be made, to explain safety and health procedures. Conduct a site-specific training sessions for new personnel, visitors, and suppliers by the SSHO using the training curriculum outlines developed by the Safety and Health Manager. Each employee must sign a training log to acknowledge attendance and understanding of the training.

1.11 PERSONAL PROTECTIVE EQUIPMENT

1.11.1 Site Specific PPE Program

Provide onsite personnel exposed to contaminants with appropriate personal protective equipment. Components of levels of protection (B, C, D and modifications) must be relevant to site-specific conditions, including heat and cold stress potential and safety hazards. Use only respirators approved by NIOSH. Commercially available PPE, used to protect against chemical agent, must be approved by the director of Army Safety through the Chemical Agent Safety and Health Policy Action Committee (CASHPAC). Keep protective equipment and clothing clean and well maintained. Include site-specific procedures to determine PPE program effectiveness and for onsite fit-testing of respirators, cleaning, maintenance, inspection, and storage of PPE within the PPE section of the APP/SSHP.

1.11.2 Levels of Protection

The Safety and Health Manager must establish and evaluate as the work progresses the levels of protection for each work activity. Also establish action levels for upgrade or downgrade in levels of PPE. Describe in the SSHP the protocols and the communication network for changing the level of protection. Address air monitoring results, potential for exposure, changes in site conditions, work phases, job tasks, weather, temperature extremes, individual medical considerations, etc. within the PPE evaluation protocol.

1.12 EXPOSURE MONITORING/AIR SAMPLING PROGRAM

Prepare and implement by the Safety and Health Manager an exposure monitoring/air sampling program to identify and quantify safety and health hazards and airborne levels of hazardous substances in order to assure proper selection of engineering controls, work practices and personal protective equipment for affected site personnel.

1.13 HEAT STRESS MONITORING AND MANAGEMENT

Document in the APP/SSHP and implement the procedures and practices in section 06.J. in EM 385-1-1 to monitor and manage heat stress.

1.14 SPILL AND DISCHARGE CONTROL

Refer to Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL.

1.15 MATERIALS TRANSFER SAFETY

Remove liquids and residues from the tanks using explosion-proof or air-driven pumps. Bond to the tank and ground pump motors and suction hoses to prevent electrostatic ignition hazards. Use of a hand pump will be permitted to remove the last of the liquid from the bottom of the tanks. If a vacuum truck is used for removal of liquids or residues, the area of operation for the vacuum truck must be vapor free. locate the truck upwind from the tank and outside the path of probable vapor travel. Discharge the vacuum pump exhaust gases through a hose of adequate size and length downwind of the truck and tank area. Vacuum truck operating and safety practices must conform to API RP 2219. Collect tank residues in drums, tanks, or tank trucks labeled according to 49 CFR 171 and 49 CFR 172 and disposed of as specified. Disconnect and drain fittings and lines of their contents after the materials have been transferred and the tanks have been exposed. Do not spill contents into the environment during cutting or disconnecting of tank fittings. Transfer materials drained into DOT-approved drums for storage and/or transportation. Only non-sparking or non-heat producing tools shall be used to disconnect and drain or to cut through tank fittings. Electrical equipment (e.g., pumps, portable hand tools, etc.) used for tank preparation must be explosion-proof. Following cutting or disconnecting of the fittings, plug openings leading to the tanks.

1.16 HOT WORK

Prior to conducting hot work, a hot work permit must be prepared by the person to be conducting the hot work and reviewed and signed off by the Contractor's qualified person. An additional hot work permit may need to be obtained from local authorities or in the case of military or other federal installations, the fire marshal. An example format for a hot work permit must be included in the AAPP/SSHP. Designate an individual at each hot work site as a fire watch. This person's sole responsibility is to monitor the hot work and have immediate access to the fire extinguisher located at each hot work site.

1.17 SITE CONTROL MEASURES

Access to areas of known contaminations shall be limited to Environmental Cleanup Personal. Once known areas of contamination have been addressed to the satisfaction of the Contract Documents and Contracting Officer, restricted access may be removed.

1.18 PERSONAL HYGIENE AND DECONTAMINATION

Personnel entering the contaminated work area who are exposed to hazardous chemical vapors, gases, liquids, or contaminated solids must decontaminate themselves and their equipment prior to exiting the contamination area. Consult Chapter 10.0 of NIOSH 85-115 when preparing decontamination procedures. Submit a detailed discussion of personal hygiene and decontamination facilities and procedures to be followed by site workers as part of the APP/SSHP. Train employees in the procedures and enforce the procedures throughout site operations.

1.18.1 Decontamination Facilities

Submit drawings showing the layout of the personnel and equipment decontamination areas and select appropriate decontamination techniques for personal and equipment.

1.19 EMERGENCY EQUIPMENT AND FIRST AID REQUIREMENTS

Maintain, as a minimum, the following items onsite and available for immediate use:

a. First aid equipment and supplies typical for 50 people.

b. Provide fire extinguishers of sufficient size and type at site facilities and in all vehicles and at any other site locations where flammable or combustible materials present a fire ris.

1.20 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

An Emergency Response Plan, that meets the requirements of 29 CFR 1910.120 (l) and 29 CFR 1926.65 (l), must be developed and implemented as a section of the APP/SSHP. Address, as a minimum, the following elements in the plan:

a. Personnel roles, lines of authority, communications for emergencies.

b. Emergency recognition and prevention.

c. Site topography, layout, and prevailing weather conditions.

d. Criteria and procedures for site evacuation (emergency alerting procedures, employee alarm system, emergency PPE and equipment, safe distances, places of refuge, evacuation routes, site security and control).

e. Specific procedures for medical treatment of injured personnel.

f. Route maps to nearest prenotified medical facility. Site-support vehicles must be equipped with maps. At the beginning of project operations, drivers of the support vehicles must become familiar with the emergency route and the travel time required.

g. Emergency alerting and response procedures including posted instructions and a list of names and telephone numbers of emergency contacts (physician, nearby medical facility, fire and police

departments, ambulance service, Federal, state, and local environmental agencies; as well as Safety and Health Manager, the Site Superintendent, the Contracting Officer and/or their alternates).

h. Procedures for reporting incidents to appropriate government agencies. In the event that an incident such as an explosion or fire, or a spill or release of toxic materials occurs during the course of the project, the appropriate government agencies must be immediately notified. In addition, verbally notify the Contracting Officer and the local district safety office immediately and receive a written notification within 24 hours. Include within the report the following items:

(1) Name, organization, telephone number, and location of the Contractor.

(2) Name and title of the person(s) reporting.

(3) Date and time of the incident.

(4) Location of the incident, i.e., site location, facility name.

(5) Brief summary of the incident giving pertinent details including type of operation ongoing at the time of the incident.

(6) Cause of the incident, if known.

(7) Casualties (fatalities, disabling injuries).

(8) Details of any existing chemical hazard or contamination.

(9) Estimated property damage, if applicable.

(10) Nature of damage, effect on contract schedule.

(11) Action taken to ensure safety and security.

(12) Other damage or injuries sustained, public or private.

i. Procedures for critique of emergency responses and follow-up.

1.21 CERTIFICATE OF WORKER/VISITOR ACKNOWLEDGEMENT

A copy of a Contractor-generated certificate of worker/visitor acknowledgement must be completed and submitted for each visitor allowed to enter the known contamination area.

1.22 INSPECTIONS

Attach to and submit with the Daily Quality Control reports the SSHO's Daily Inspection Logs. Include with each entry the following: date, work area checked, employees present in work area, PPE and work equipment being used in each area, special safety and health issues and notes, and signature of preparer.

1.23 SAFETY AND HEALTH PHASE-OUT REPORT

Submit a Safety and Health Phase-Out Report in conjunction with the project close out report and will be received prior to final acceptance of the

work. Include the following minimum information :

a. Summary of the overall performance of safety and health (accidents or incidents including near misses, unusual events, lessons learned, etc.).

b. Final decontamination documentation including procedures and techniques used to decontaminate equipment, vehicles, and on site facilities.

c. Summary of exposure monitoring and air sampling accomplished during the project.

d. Signatures of Safety and Health Manager and SSHO.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

Task Hazard and Control Requirements Sheet	
Task	
Initial Anticipated Hazards	
Initial PPE	
Initial Controls	
Initial Exposure Monitoring	
(Yes)(No)	HAZWOPER Medical Surveillance Required
(Yes)(No)	HAZWOPER Training Required

-- End of Section --

SECTION 01 35 45.00 10

CHEMICAL DATA QUALITY CONTROL
04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 200-1-1	(1994) Environmental Quality -- Validation of Analytical Chemistry Laboratories
EM 200-1-3	(2001) Engineering and Design -- Requirements for the Preparation of Sampling and Analysis Plans

1.2 ACRONYMS

The definition of acronyms used by the Contractor that pertain to chemical data quality control shall be clearly defined for all contract related products and communications.

1.3 CHEMISTRY REQUIREMENTS

Sample acquisition, chemical analysis and chemical parameter measurements shall be performed so that the resulting data meet and support data use requirements. Details on sample acquisition and chemical analysis are found in Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION. The chemical data shall be acquired, documented, verified and reported to ensure that the specified precision, accuracy, representative, comparability, completeness and sensitivity requirements are achieved.

1.3.1 Site History

Environmental concerns associated with the expansion include the potential to unearth impacted soil and encounter impacted groundwater associated with removed petroleum underground storage tanks (USTs) and current and past facility operations (e.g., maintenance yard operations and storage of pesticides, chemicals, equipment, and scrap metal). Historical documents indicate all of the UST cases within the AOCs have been "closed" by the Commonwealth of Virginia Department of Environmental Quality (VDEQ); however, impacted soil and groundwater was left in place at several of the former UST locations. In areas where impacted soil and groundwater were left in place, closure was granted by the VDEQ based on the minimal risk posed to sensitive receptors by the impacted media and property use at the time of their determination.

Constituents of potential concern (COPCs) at the AOCs include total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), semi-VOCs (SVOCs), polychlorinated biphenyls (PCBs), pesticides, herbicides, and metals. The AOCs selected for further investigation included the Salvage Metal Yard

(SMY), area east of the SMY (ESMY), Old Warehouse Area (OWA), and Ft. Meyer Mound (FMM), which resulted in the Expanded Environmental Site Investigation Report and Remedial Action Plan developed by A-Zone Environmental dated 28 February 2013 and 22 April 2013, respectively.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sampling and Analysis Plan; G, RO

Submit no later than 30 days after receipt of notice to proceed.

SD-06 Test Reports

QA Sample Collection and Analysis
Chemistry Data Package

Chemical Data Final Report

Each report shall be labeled with the contract number, project name and location.

1.5 QUALITY ASSURANCE ELEMENTS

Follow the QA elements necessary to monitor and ensure the quality of chemical data produced.

1.5.1 Laboratory Validation Requirements

Propose the minimum number of laboratories that can attain or have attained U.S. Army Corps of Engineers (USACE) validation in accordance with EM 200-1-1 and consistent with contract required chemical data quality. The Contractor may propose laboratories that shall subsequently be validated by the USACE, or select currently validated USACE laboratories. Identify all proposed project laboratories in the sampling and analysis plan (SAP). If a proposed analytical laboratory cannot meet specified analytical requirements or achieve the required validation, select another laboratory. If not currently validated, the USACE laboratory validation process requires a nominal 120 day process.

1.5.2 QA Sample Collection and Analysis

Collect and transport QA samples to the QA laboratory. Samples for all analyses (except volatiles) shall be taken as splits of homogenized samples. Samples for volatiles shall be collected as discrete duplicates/triplicates. Samples shall be collected at a rate of 5 percent per matrix per analysis per sampling event.

a. Submit the QA Laboratory Advance Notification (QALAN) to the QA laboratory at least 10 business days before the initial shipment of samples. The QALAN shall include a list of laboratory-related DQO.

The DQO shall include, but shall not be limited to, identification of extraction and analysis method numbers, a list of analytes with required limits, estimated number of tests, approximate sampling dates, and requested completion date for QA testing. Notify the Contracting Officer (CO) and the QA laboratory immediately of any changes.

b. Provide all labor and field supplies, including sample containers and shipping coolers, for collecting and shipping samples for QA testing. In the presence of the Contracting Officer, properly collect, label, and package the QA samples, fill out all chain-of-custody forms, and ship the samples by one-day delivery service to the designated QA laboratory for analysis. Notify the laboratory when all sampling is completed and shall clearly mark the chain-of-custody form accompanying the final shipment "FINAL" in 1 inch high lettering.

c. Allow 60 calendar days for laboratory analysis of QA samples, data review, and submission of the Government chemical quality assurance report. The elapsed time shall begin when the Contractor's last sample arrives at the QA laboratory, provided that the Contractor's completed chemistry data package is received within 30 calendar days thereafter. Otherwise, allow 30 calendar days from the date the completed chemistry data package is received at the laboratory. The Contractor may, as an option, continue activities based on initial sampling and QC results, before receipt of QA test results. Where QA results are unacceptable due to Contractor negligence (e.g. improper sample collection and/or handling by the Contractor), or where QA sample results conflict with the Contractor's primary sample results, further sampling and testing shall be performed as directed by the CO. All costs for such additional sampling and testing due to Contractor negligence, including both QC and QA testing and analysis, and for any required remedial actions in the work, shall be borne by the Contractor. USACE acceptance of final disposition of any excavated soil shall not occur until the Contractor's sampling and QC results have been confirmed by QA results. This includes all final stockpiling, wasting, backfilling, and related construction. No payment will be made for laboratory sampling and testing before receipt and acceptance by the Government of the QA samples and the completed Chemical Data Final Report (CDFR), properly formulated according to these specifications.

1.6 QUALIFICATIONS

The Contractor must, at a minimum, designate by name and title personnel with responsibility for data quality. The Contractor must designate personnel with the following qualifications:

1.6.1 Chemical Quality Control Officer

As a minimum, the Contractor's Chemical Quality Control Officer shall have: a Bachelor's or Master's degree in Chemistry; 10 years of experience related to investigations, studies, design and remedial actions at HTRW sites; and 4 field seasons (or one continuous calendar year experience) in calibration and operation of various field monitoring devices as well as standard analytical chemistry methods common for analyzing soil, water, air and other materials for chemical contamination assessment, including hazardous waste manifesting. The Chemical Quality Control Officer shall ensure that all chemistry related objectives including responsibilities for DQO definitions, sampling and analysis, project requirements for data documentation and validation, and final project reports are attained. The Chemical Quality Control officer need not be present onsite during routine

sampling, but shall be available for consultation with Government and Contractor personnel.

1.6.2 Project Chemist

As a minimum, the Contractor's Senior Chemist shall have: a Bachelor's or Master's degree in Chemistry; 5 years of experience related to investigations, studies, design and remedial actions at HTRW sites; 2 field seasons experience in calibrating and operating various field monitoring devices; and 2 years of experience in the operation of an HTRW commercial laboratory with standard analytical chemistry methods common for analyzing soil, water, air and other materials for chemical contamination assessment, including data for hazardous waste manifesting. The project chemist shall ensure that all chemistry related goals of the program are attained. The project chemist shall be onsite during all sampling events and shall also be available for consultation with Government personnel.

1.6.3 Environmental Sampler

As a minimum, the Contractor's Environmental Sampler shall have: a degree in Chemistry, Environmental Science, Engineering, Geology, Hydrology, or a related field;2 years of experience in the development and preparation of SAP and work plans; 2 years of experience in and knowledge of EPA methods for collecting environmental and hazardous waste samples; 2 years of experience in operation of field screening equipment (e.g. PID, FID, infrared spectrometer, immunoassay, etc.); and 4 field seasons of experience with the particular field screening techniques for use on this project. The Environmental Sampler shall collect all onsite samples and perform all field screening tests. The Environmental Sampler shall review the sampling results, and provide recommendations for the Contractor's sampling program. The Environmental Sampler shall be onsite during excavation and stockpiling operations involving contaminated soil or soil to be checked for contamination.

1.7 COORDINATION MEETING

After the preconstruction conference, before any sampling or testing, the Contractor and the Contracting Officer will meet at the construction site to discuss the CQC Plan and the SAP. The coordination meeting will be simultaneous to any CQC coordination meeting required in Section 01 45 00.00 10 QUALITY CONTROL unless otherwise indicated or directed. A list of definable features that involve chemical measurements shall be agreed upon. At a minimum, each matrix (soil, water, air, containerized wastes, radioactive wastes, instrumental chemical parameter measurement, etc.) shall be a definable work feature. Management of the chemical data quality system including project DQO, project submittals, chemical data documentation, chemical data assessment, required sampling and analysis protocols, and minimum data reporting requirements shall be developed by the Contractor and submitted for government approval in the Work Plan required in Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL. The meeting will serve to establish an interrelationship between the Contractor's chemical data quality management and Government chemical quality assurance requirements. Minutes of the meeting will be documented by the Government and shall be signed by both the Contractor and the Contracting Officer. The minutes will include any or all unresolved chemical issues along with the conditions for resolution and will become a part of the contract file.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Provide chemical sample acquisition, sample analysis, instrumental measurements of chemical parameters for chemical data quality control. An effective chemical data quality control system shall be established that meets the requirements for the chemical measurement DQO applicable to the project. The system shall cover chemical measurements pertaining to and required for Contractor and subcontractor produced chemical data. Control field screening, sampling, and testing in conjunction with remedial activities to meet all DQO; minimize the amount of excavated material requiring temporary storage; prevent dilution of contaminated soils with clean soils; and ensure completion of work within the required time.

3.2 SAMPLING AND ANALYSIS PLAN

The SAP shall be prepared in accordance with CDQC requirements and EM 200-1-3. The SAP shall be a single document that contains two distinct elements: FSP and QAPP. Sections of the FSP and QAPP shall be cross referenced. The SAP shall confirm the Contractor's understanding of the contract requirements for chemical data quality control, and shall describe procedures for field sampling and sample submittal for analysis, field chemical parameter measurement, data documentation, data assessment and data reporting requirements. The SAP shall delineate the methods the Contractor intends to use to accomplish the chemical quality control items to assure accurate, precise, representative, complete, legally defensible and comparable data. The SAP shall describe all chemical parameter measurements for all matrices for all phases of the remediation contract. As a single interrelated document, the SAP shall be provided to field and laboratory personnel. The Contractor may propose original/innovative approaches to chemical parameter measurements for cost reduction and remediation efficiency by abbreviated sampling, contingency sampling and/or contingency analysis, indicator or tracer analysis, onsite analytical services, equivalency or screening methods. The SAP shall clearly identify the Contractor obtained laboratories. Furnish copies of the Government approved SAP to all laboratories and the Contractor's field sampling crew. The SAP shall address all levels of the investigation with enough detail to become a document which may be used as an audit guide for field and laboratory work.

3.2.1 Field Sampling Plan

The FSP shall contain necessary technical detail and direction for the field personnel to understand sampling and field measurement requirements. The FSP shall provide a comprehensive description and full detail for personnel to perform all onsite activities required to attain project DQO, including: locations of samples, sampling procedures for onsite and offsite chemical analysis, summaries of analyses to be performed on samples, shipment of samples for offsite analyses, performance of onsite and offsite instrumental parameter measurements, data documentation and reporting requirements.

3.2.2 Quality Assurance Project Plan

The QAPP shall contain necessary technical detail and direction for field and laboratory personnel to understand project sample analysis, quality control and data reporting requirements, analytical methods, required detection limits, QC requirements, and data validation and reporting requirements.

3.3 CHEMISTRY DATA PACKAGE

The chemistry data package shall contain information to demonstrate that the project's DQO have been fulfilled. The QA function will compare QC sample results to corresponding primary sample results, will assess the Contractor's compliance with the FSP and the QAPP, and will recommend corrective action as necessary.

3.4 CONTROL OF CHEMICAL DATA QUALITY

Contractor chemical data quality control shall ensure that a quality control program is in place that assures sampling and analytical activities and the resulting chemical parameter measurement data comply with the DQO and the requirements of the SAP. Utilize the three-phase control system that includes a preparatory, initial and follow-up phase for each definable feature of work. The Contractor's three-phase chemical data control process shall ensure that data reporting requirements are achieved and shall be implemented according to Section 01 45 00.00 10 QUALITY CONTROL. The three-phase chemical data control process shall be combined with that under Section 01 45 00.00 10 QUALITY CONTROL.

3.5 ANALYTICAL TESTING LABORATORIES

The Contractor shall propose the analytical laboratories to be used for the primary samples analyses. Laboratory validation requirements shall be in accordance with paragraph Laboratory Validation Requirements. The Contractor may utilize its own laboratory or utilize subcontract laboratories to achieve the primary required sample analyses.

3.5.1 Laboratory Analytical Requirements

The Contractor shall provide the specified chemical analyses by the Contractor's laboratory. The Contractor shall provide chemical analyses to achieve the project DQO for all parameters specified by the methods.

3.5.2 Laboratory Performance

The Contractor shall provide continued acceptable analytical performance and shall establish a procedure to address data deficiencies noted by review and/or quality assurance sample results. The Contractor shall provide and implement a mechanism for providing analytical labs with the QAPP, for monitoring the lab's performance and for performing corrective action procedures.

3.6 CHEMICAL DATA FINAL REPORT

The CDFR shall be produced including a summary of quality control practices employed and all chemical parameter measurement activities after project completion. As a minimum, the CDFR shall contain the following:

a. Summary of project scope and description.

b. Summary of any deviations from the design chemical parameter measurement specifications.

c. Summary of chemical parameter measurements performed as contingent measurements.

d. Summary discussion of resulting data including achieving data reporting requirements.

e. Summary of achieving project specific DQO.

f. Presentation and evaluation of the data to include an overall assessment on the quality of the data for each method and matrix.

g. Internal QC data generated during the project, including tabular summaries correlating sample identifiers with all blank, matrix spikes, surrogates, duplicates, laboratory control samples, and batch identifiers.

h. A list of the affected sample results for each analyte (indexed by method and matrix) including the appropriate data qualifier flag (J, B, R, etc.), where sample results are negatively impacted by adverse quality control criteria.

i. Summary of field and laboratory oversight activities, providing a discussion of the reliability of the data, QC problems encountered, and a summary of the evaluation of data quality for each analysis and matrix as indicated by the laboratory QC data and any other relevant findings.

j. Conclusions and recommendations.

k. Appendices containing: (1) Chemistry data package, and (2) Results of the Chemical Quality Assurance Report (CQAR). The CQAR is a Government produced document achieved through the inspection and analysis of QA samples and corresponding project sample data. The CQAR will include review of all QC parameters such as holding times, detection limits, method blanks, surrogate recoveries, matrix spikes and duplicates, and inter-laboratory and intra-laboratory data comparisons.

3.7 NOTIFICATION OF NON-COMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. Take immediate corrective action after receipt of such notice.

-- End of Section --

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS
08/10

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization, (e.g. ASTM B564 Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the standards producing organization should be ordered from the source by title rather than by number.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)
38800 Country Club Drive
Farmington Hills, MI 48331
Ph: 248-848-3700
Fax: 248-848-3701
E-mail: bkstore@concrete.org
Internet: http://www.concrete.org

ACOUSTICAL SOCIETY OF AMERICA (ASA)
2 Huntington Quadrangle, Suite 1NO1
Melville, NY 11747-4502
Ph: 516-576-2360
Fax: 516-576-2377
E-mail: asa@aip.org
Internet: http://asa.aip.org

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)
30 West University Drive
Arlington Heights, IL 60004-1893
Ph: 847-394-0150
Fax: 847-253-0088
E-mail: amca@amca.org
Internet: http://www.amca.org

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)
1200 G Street, NW, Suite 500
Washington, D.C. 20005
Ph: 202-628-6380
Fax: 202-393-5453
E-mail: doccenter@atis.org

Internet: http://www.atis.org

ALUMINUM ASSOCIATION (AA)
National Headquarters
1525 Wilson Boulevard, Suite 600
Arlington, VA 22209
Ph: 703-358-2960
Fax: 703-358-2961
Internet: http://www.aluminum.org

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)
1827 Walden Office Square
Suite 550
Schaumburg, IL 60173-5774
Ph: 847-303-5664
Fax: 847-303-5774
E-mail: webmaster@aamanet.org
Internet: http://www.aamanet.org

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
444 North Capital Street, NW, Suite 249
Washington, DC 20001
Ph: 202-624-5800
Fax: 202-624-5806
E-Mail: info@aashto.org
Internet: http://www.aashto.org

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)
1330 Kemper Meadow Drive
Cincinnati, OH 45240
Ph: 513-742-2020 or 513-742-6163
Fax: 513-742-3355
E-mail: mail@acgih.org
Internet: http://www.acgih.org

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
One East Wacker Drive, Suite 700
Chicago, IL 60601-1802
Ph: 312-670-2400
Fax: 312-670-5403
Publications: 800-644-2400
E-mail: pubs@aisc.org
Internet: http://www.aisc.org

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)
P.O. Box 210
Germantown, MD 20875-0210
Ph: 301-972-1700
Fax: 301-540-8004
E-mail: alsc@alsc.org
Internet: http://www.alsc.org

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
1819 L Street, NW, 6th Floor
Washington, DC 20036
Ph: 202-293-8020
Fax: 202-293-9287
E-mail: info@ansi.org

Internet: http://www.ansi.org/

AMERICAN NURSERY & LANDSCAPE ASSOCIATION (ANLA)
1000 Vermont Ave NW
Suite 300
Washington, DC 20005
Ph: 202-789-2900
Fax: 202-789-1893
E-mail: aflynn@anla.org
Internet: http://www.anla.org

AMERICAN PETROLEUM INSTITUTE (API)
1220 L Street, NW
Washington, DC 20005-4070
Ph: 303-397-7993
Fax: 303-397-2740
E-mail: greg.kallio@ihs.com
Internet: http://www.api.org

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)
10003 Derekwood Lane, Suite 210
Lanham, MD 20706
Ph: 301-459-3200
Fax: 301-459-8077
Internet: http://www.arema.org

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)
1791 Tullie Circle, NE
Atlanta, GA 30329
Ph: 800-527-4723 or 404-636-8400
Fax: 404-321-5478
E-mail: ashrae@ashrae.org
Internet: http://www.ashrae.org

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)
1800 East Oakton Street
Des Plaines, IL 60018-2187
Ph: 847-699-2929
Fax: 847-768-3434
E-mail: customerservice@asse.org
Internet: http://www.asse.org

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)
901 Canterbury, Suite A
Westlake, OH 44145
Ph: 440-835-3040
Fax: 440-835-3488
E-mail: info@asse-plumbing.org
Internet: http://www.asse-plumbing.org

AMERICAN WATER WORKS ASSOCIATION (AWWA)
6666 West Quincy Avenue
Denver, CO 80235
Ph: 800-926-7337
Fax: 303-347-0804
E-mail: smorrison@awwa.org
Internet: http://www.awwa.org

AMERICAN WELDING SOCIETY (AWS)
550 N.W. LeJeune Road
Miami, FL 33126
Ph: 800-443-9353 - 305-443-9353
Fax: 305-443-7559
E-mail: info@aws.org or customerservice@awspubs.com
Internet: http://www.aws.org

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)
P.O. Box 361784
Birmingham, AL 35236-1784
Ph: 205-733-4077
Fax: 205-733-4075
E-mail: email@awpa.com
Internet: http://www.awpa.com

APA - THE ENGINEERED WOOD ASSOCIATION (APA)
7011 South 19th St.
Tacoma, WA 98466-5333
Ph: 253-565-6600
Fax: 253-565-7265
E-mail: help@apawood.org
Internet: http://www.apawood.org

ARCHITECTURAL WOODWORK INSTITUTE (AWI)
46179 Westlake Drive, Suite 120
Potomac Falls, VA 20165
Ph: 571-323-3636
Fax: 571-323-3630
E-mail: info@awinet.org
Internet: http://www.awinet.org

ASME INTERNATIONAL (ASME)
Three Park Avenue, M/S 10E
New York, NY 10016-5990
Ph: 800-854-7179 or 800-843-2763
Fax: 212-591-7674
E-mail: infocentral@asme.org
Internet: http://www.asme.org

ASPHALT INSTITUTE (AI)
Research Park Drive
P.O. Box 14052
Lexington, KY 40512-4052
Ph: 859-288-4960
Fax: 859-288-4999
E-mail: info@asphaltinstitute.org
Internet: http://www.asphaltinstitute.org

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)
600 North 18th Street
P.O. Box 2641
Birmingham, AL 35291
Ph: 205-257-2530
Fax: 205-257-2540
E-Mail: aeicdir@bellsouth.net
Internet: http://www.aeic.org

ASTM INTERNATIONAL (ASTM)
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959
Ph: 610-832-9585
Fax: 610-832-9555
E-mail: service@astm.org
Internet: http://www.astm.org

BAY AREA AIR QUALITY MANAGEMENT DISTRICT (Bay Area AQMD)
939 Ellis Street
San Francisco, CA 94109
Ph: 415-771-6000
Fax: 415-928-8560
E-Mail: publicrecords@baaqmd.gov
Internet: http://www.baaqmd.gov/

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)
355 Lexington Avenue
15th Floor
New York, NY 10017
Ph: 212-297-2122
Fax: 212-370-9047
E-mail: assocmgmt@aol.com
Internet: http://www.buildershardware.com

CALIFORNIA ENERGY COMMISSION (CEC)
Media and Public Communications Office
1516 Ninth Street, MS-29
Sacramento, CA 95814-5512
Ph: 916-654-4287
Internet: http://www.energy.ca.gov/

CAST IRON SOIL PIPE INSTITUTE (CISPI)
5959 Shallowford Road, Suite 419
Chattanooga, TN 37421
Ph: 423-892-0137
Fax: 423-892-0817
Internet: http://www.cispi.org

COPPER DEVELOPMENT ASSOCIATION (CDA)
260 Madison Avenue
New York, NY 10016
Ph: 212-251-7200
Fax: 212-251-7234
E-mail: questions@cda.copper.org
Internet: http://www.copper.org

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)
University of South California
Kaprielian Hall 200
Los Angeles, CA 90089-2531
Ph: 213-740-2032 or 866-545-6340
Fax: 213-740-8399
E-mail: fccchr@usc.edu
Internet: http://www.usc.edu/dept/fccchr

GREEN SEAL (GS)
1001 Connecticut Avenue, NW

Suite 827
Washington, DC 20036-5525
Ph: 202-872-6400
Fax: 202-872-4324
E-mail: greenseal@greenseal.org
Internet: http://www.greenseal.org

GREENGUARD ENVIRONMENTAL INSTITUTE (GEI)
2211 Newmarket Parkway, Suite 110
Marietta, GA 30067
Ph: 800-427-9681
Fax: 770-980-0072
E-mail: info@greenguard.org
Internet: http://www.greenguard.org/

GYPSUM ASSOCIATION (GA)
6525 Belcrest Road, Suite 480
Hyattsville, MD 20782
Ph: 301-277-8686
Fax: 301-277-8747
E-mail: info@gypsum.org
Internet: http://www.gypsum.org

HARDWOOD PLYWOOD AND VENEER ASSOCIATION (HPVA)
1825 Michael Faraday Dr.
Reston, VA 20190
Ph: 703-435-2900
Fax: 703-435-2537
E-mail: hpva@hpva.org
Internet: http://www.hpva.org

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IES)
120 Wall Street, 17th Floor
New York, NY 10005
Ph: 212-248-5000
Fax: 212-248-5018
E-mail: IES@IES.org
Internet: http://www.IES.org

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
445 Hoes Lane or 2001 L Street, NW. Suite 700
Piscataway, NJ 08855-1331 or Washington, DC 20036-4910 USA
Ph: 732-981-0060 or 800-701-4333
Fax: 732-562-6380
E-mail: onlinesupport@ieee.org or ieeeusa@ieee.org
Internet: http://www.ieee.org

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)
P.O. Box 1568
Carrollton, GA 30112
Ph: 1 800 447 3352
Fax: 1 303 397 2599
E-mail: global@ihs.com
Internet: http://www.icea.net

INTERNATIONAL CODE COUNCIL (ICC)
5360 Workman Mill Road
Whittier, CA 90601
Ph: 1-888-422-7233

Fax: 562-908-5524
E-mail: webmaster@iccsafe.org
Internet: www.iccsafe.org

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)
3, rue de Varembe, P.O. Box 131
CH-1211 Geneva 20, Switzerland
Ph: 41-22-919-0211
Fax: 41-22-919-0300
E-mail: custserv@iec.ch
Internet: http://www.iec.ch

L.H. BAILEY HORTORIUM (LHBH)
Dept of Plant Biology
c/o Cornell University
412 Mann Library Building
Ithaca, NY 14853
Ph: 607-255-4477(Dr. William L.Crepet)
Internet: http://www.plantbio.cornell.edu/Hort.html

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
127 Park Street, NE
Vienna, VA 22180
Ph: 703-281-6613
Fax: 703-281-6671
E-mail: info@mss-hq.com
Internet: http://www.mss-hq.com

MARBLE INSTITUTE OF AMERICA (MIA)
28901 Clemens Road, Suite 100
Cleveland, OH 44145
Ph: 440-250-9222
Fax: 440-250-9223
E-mail: info@marble-institute.com
Internet: http://www.marble-institute.com

MASTER PAINTERS INSTITUTE (MPI)
2800 Engleton Avenue
Burnaby, BC CANADA V5C 6G7
Ph: 604-298-7578
Fax: 604-298-7571
E-mail: info@paintinfo.com,jody@mpi.net,bgl@mpi.net
Internet: http://www.paintinfo.com/mpi

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)
800 Roosevelt Road, Bldg C, Suite 312
Glen Ellyn, IL 60137
Ph: 630-942-6591
Fax: 630-790-3095
E-mail: wlewis7@cox.net(Vernon Lewis,technical consultant)
Internet: http://www.naamm.org

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)
3 Bethesda Metro Center, Suite 1100
Bethesda, MD 20814
Ph: 301-657-3110
Fax: 301-215-45002
Internet: http://www.necanet.org/

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
1300 North 17th Street, Suite 1752
Rosslyn, VA 22209
Ph: 703-841-3200
Fax: 703-841-5900
Internet: http://www.nema.org/

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
1 Batterymarch Park
Quincy, MA 02169-7471
Ph: 617-770-3000 or 800-344-3555
Fax: 617-770-0700
E-mail: webmaster@nfpa.org
Internet: http://www.nfpa.org

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)
Mail Stop C-34
4676 Columbia Parkway
Cincinnati, OH 45226
Ph: 513-533-8611
Fax: 513-533-8285
E-mail: nioshdocket@cdc.gov
Internet: http://www.cdc.gov/nchs/products.htm

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)
100 Bureau Drive
Stop 1070
Gaithersburg, MD 20899-1070
Ph: 301-975-NIST (6478
E-mail: inquiries@nist.gov
Internet: http://www.nist.gov

NATIONAL PARK SERVICE (NPS)
http://www.nps.gov

NSF INTERNATIONAL (NSF)
789 North Dixboro Road
P.O. Box 130140
Ann Arbor, MI 48113-0140
Ph: 734-769-8010 or 800-NSF-MARK
Fax: 734-769-0109
E-mail: info@nsf.org
Internet: http://www.nsf.org

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)
800 Roosevelt Road, Building C, Suite 312
Glen Ellyn, IL 60137
Ph: 630-858-6540
Fax: 630-790-3095
Internet: http://www.ppfahome.org

PLUMBING AND DRAINAGE INSTITUTE (PDI)
800 Turnpike Street, Suite 300
North Andover, MA 01845
Ph: 978-557-0720 or 800-589-8956
Fax: 978-557-0721
E-Mail: pdi@PDIonline.org

Internet: http://www.pdionline.org

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)
2200 Powell Street, Suite 725
Emeryville, CA 94608
Ph: 510-452-8000
Fax: 510-452-8001
Internet: http://www.scs1.com

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)
400 Commonwealth Drive
Warrendale, PA 15096-0001
Ph: 724-776-4970
Fax: 724-776-0790
E-mail: customerservice@sae.org
Internet: http://www.sae.org

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)
21865 Copley Drive
Diamond Bar, CA 91765
Ph: 909-396-2000
Internet: http://www.aqmd.gov

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)
Publication Distribution Unit
1900 Royal Oaks Dr.
Sacramento, CA 95815-3800
Ph: 916-263-0822 or 916-263-0865
Fax: 916-263-0469
E-mail: publications@dot.ca.gov
Internet: www.//caltrans-opac.ca.gov/publicathtm

STEEL DOOR INSTITUTE (SDI/DOOR)
c/o Steel Door Institute
30200 Detroit Road
Cleveland, OH 44145-1967
Ph: 440-899-0010
Fax: 440-892-1404
E-mail: info@steeldoor.org
Internet: http://www.steeldoor.org

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)
40 24th Street, 6th Floor
Pittsburgh, PA 15222-4656
Ph: 412-281-2331
Fax: 412-281-9992
E-mail: info@sspc.org
Internet: http://www.sspc.org

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)
2500 Wilson Blvd,. Suite 300
Arlington, VA 22201
Ph: 703-907-7700
Fax: 703-907-7727
Internet: http://www.tiaonline.org

TILE COUNCIL OF NORTH AMERICA (TCNA)
100 Clemson Research Boulevard
Anderson, SC 29625

Ph: 864-646-8453
Fax: 864-646-2821
E-mail: literature@tileusa.com
Internet: http://www.tileusa.com

TREE CARE INDUSTRY ASSOCIATION (TCIA)
136 Harvey Road, Suite 101
Londonderry, NH 03053
Ph: 603-314-5380
Fax: 603-314-5386
Internet: http://www.treecareindustry.org

UNDERWRITERS LABORATORIES (UL)
2600 N.W. Lake Road
Camas, WA 98607-8542
Ph: 877-854-3577
Fax: 360-817-6278
E-mail: CEC.us@us.ul.com
Internet: http://www.ul.com/
UL Directories available through IHS at http://www.ihs.com

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)
2711 Villa Creek Drive, Suite 1000
Dallas, TX 75234
Ph: 972-243-3902
Fax: 972-243-3907
E-mail: info@uni-bell.org
Internet: http://www.uni-bell.org

U.S. ARMY (DA)
U.S. Army Publishing Directorate
Ph: 314-592-0910
Fax: 314-592-0923
Internet: http://www.apd.army.mil

U.S. ARMY CORPS OF ENGINEERS (USACE)
Order CRD-C DOCUMENTS from:
U.S. Army Engineer Waterways Experiment Station
ATTN: Technical Report Distribution Section, Services Branch, TIC
3909 Halls Ferry Road
Vicksburg, MS 39180-6199
E-mail: MTC-INFO@erdc.usace.army.mil
Internet:
http://gsl.erdc.usace.army.mil/SL/MTC/handbook/handbook.htm
Order Other Documents from:
USACE Publications Depot
Attn: CEHEC-IM-PD
2803 52nd Avenue
Hyattsville, MD 20781-1102
Ph: 301-394-0081
Fax: 301-394-0084
E-mail: pubs-army@usace.army.mil
Internet: http://www.usace.army.mil/publications
or http://www.hnd.usace.army.mil/techinfo/engpubs.htm

U.S. DEPARTMENT OF AGRICULTURE (USDA)
Order AMS Publications from:
AGRICULTURAL MARKETING SERVICE (AMS)

Seed Regulatory and Testing Branch
801 Summit Crossing Place, Suite C
Gastonia, NC 28054-2193
Ph: 704-810-8871
Fax: 704-852-4189
E-mail: seed.ams@usda.gov
Internet: http://www.ams.usda.gov/lsg/seed.htm
Order Other Publications from:
U.S. Department of Agriculture, Rural Utilities Service
14th and Independence Avenue, SW, Room 4028-S
Washington, DC 20250
Ph: 202-720-2791
Fax: 202-720-2166
Internet: http://www.usda.gov/rus

U.S. DEPARTMENT OF COMMERCE (DOC)
1401 Constitution Avenue, NW
Washington, DC 20230
Ph: 202-482-2000
Fax: 703-605-6900
E-mail: webmaster@doc.gov
Internet: http://www.commerce.gov/
Order Publications From:
National Technical Information Service (NTIS)
5301 Shawnee Road
Alexandria, VA 22312
Ph: 703-605-6050 or 1-888-584-8332
Fax: 703-605-6900
E-mail: info@ntis.gov
Internet: http://www.ntis.gov

U.S. DEPARTMENT OF DEFENSE (DOD)
Order DOD Documents from:
Room 3A750-The Pentagon
1400 Defense Pentagon
Washington, DC 20301-1400
Ph: 703-571-3343
FAX: 215-697-1462
E-mail: pia@hq.afis.asd.mil
Internet: http://www.dod.gov
Obtain Military Specifications, Standards and Related Publications from:
Acquisition Streamlining and Standardization Information System (ASSIST)
Department of Defense Single Stock Point (DODSSP)
Document Automation and Production Service (DAPS)
Building 4/D
700 Robbins Avenue
Philadelphia, PA 19111-5094
Ph: 215-697-6396 - for account/password issues
Internet: http://assist.daps.dla.mil/online/start/; account registration required
Obtain Unified Facilities Criteria (UFC) from:
Whole Building Design Guide (WBDG)
National Institute of Building Sciences (NIBS)
1090 Vermont Avenue NW, Suite 700
Washington, CD 20005
Ph: 202-289-7800
Fax: 202-289-1092

Internet: http://www.wbdg.org/references/docs_refs.php

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, DC 20004
Ph: 202-272-0167
for Fax and E-mail see below
Internet: http://www.epa.gov
--- Some EPA documents are available only from:
National Technical Information Service (NTIS)
5301 Shawnee Road
Alexandria, VA 22312
Ph: 703-605-6050 or 1-688-584-8332
Fax: 703-605-6900
E-mail: info@ntis.gov
Internet: http://www.ntis.gov

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)
Order for sale documents from:
Superintendent of Documents
U.S. Government Printing Office (GPO)
732 North Capitol Street, NW
Washington, DC 20401
Ph: 202-512-1800
Fax: 202-512-2104
E-mail: contactcenter@gpo.gov
Internet: http://www.gpoaccess.gov
Order free documents from:
Federal Aviation Administration
Department of Transportation
800 Independence Avenue, SW
Washington, DC 20591
Ph: 1-866-835-5322
Internet: http://www.faa.gov

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)
445 12th Street SW
Washington, DC 20554
Phone: 888-CALL-FCC
Fax: 866-418-0232
Internet: http://www.fcc.gov
E-mail: fccinfo@fcc.gov
Order Publications From:
Superintendent of Documents
U.S. Government Printing Office (GPO)
732 North Capitol Street, NW
Washington, DC 20401-0001
Ph: 202-512-1800
Fax: 866-418-0232
E-mail: gpoweb@gpo.gov
Internet: http://www.gpoaccess.gov/

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)
FHWA, Office of Safety
1200 New Jersey Ave., SE
Washington, DC 20590-
Ph: 202-366-0411
Fax: 202-366-2249

E-mail: contactcenter@gpo.gov
Internet: http://www.safety.fhwa.dot.gov
Order from:
Superintendent of Documents
U. S. Government Printing Office (GPO)
732 North Capitol Street, NW
Washington, DC 20401
Ph: 202-512-1800
Fax: 202-512-2104
E-mail: contactcenter@gpo.gov
Internet: http://www.gpoaccess.gov

U. S. GREEN BUILDING COUNCIL (USGBC)
2101 L St NW, Suite 500
Washington, D.C. 20037
Fax: 202-828-5110
E-mail: info@usgbc.org
Internet: http://www.usgbc.org

U.S. GENERAL SERVICES ADMINISTRATION (GSA)
General Services Administration
1800 F Street, NW
Washington, DC 20405
Ph: 202-501-0800
Internet: www.GSA.gov
Obtain documents from:
Acquisition Streamlining and Standardization Information System (ASSIST)
Department of Defense Single Stock Point (DODSSP)
Document Automation and Production Service (DAPS)
Building 4/D
700 Robbins Avenue
Philadelphia, PA 19111-5094
Ph: 215-697-6396 - for account/password issues
Internet: http://assist.daps.dla.mil/online/start/; account registration required

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
8601 Adelphi Road
College Park, MD 20740-6001
Ph: 866-272-6272
Fax: 301-837-0483
E-mail: contactcenter@gpo.gov
Internet: http://www.archives.gov
Order documents from:
Superintendent of Documents
U.S.Government Printing Office (GPO)
732 North Capitol Street, NW
Washington, DC 20401
Ph: 202-512-1800
Fax: 202-512-2104
E-mail: contactcenter@gpo.gov
Internet: http://www.gpoaccess.gov

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)
401 N. Michigan Ave., Suite 2200
Chicago, IL 60611
Ph: 312-321-6802
Fax: 312-673-6922

E-mail: wdma@wdma.com
Internet: http://www.wdma.com

WOOD MOULDING AND MILLWORK PRODUCERS ASSOCIATION (WMMPA)
507 First Street
Woodland, CA 95695
Ph: 530-661-9591 or 800-550-7889
Fax: 530-661-9586
E-mail: info@wmmpa.com
Internet: http://www.wmmpa.com

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

-- End of Section --

SECTION 01 45 00.00 10

QUALITY CONTROL
02/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D3740	(2012a) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E329	(2011c) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2009; Errata First Printing) International Building Code

1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program, and all associated costs will be included in the applicable Bid Schedule unit or lump-sum prices.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Establish and maintain an effective quality control (QC) system in compliance with the Contract Clause titled "Inspection of Construction." QC consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. Cover all construction operations, both onsite and offsite, and be keyed to the proposed construction sequence. The project superintendent will be held responsible for the quality of work and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the contract. In this context the highest level manager responsible for the overall construction activities at the site, including quality and production is the project superintendent. The project superintendent must maintain a physical presence at the site at all times and is responsible for all construction and related activities at the site,

except as otherwise acceptable to the Contracting Officer.

3.2 QUALITY CONTROL PLAN

Submit no later than 7 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The Government will consider an interim plan for the first 7 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional work.

3.2.1 Content of the CQC Plan

Include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff will implement the three phase control system for all aspects of the work specified. Include a CQC System Manager who reports to the project superintendent.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. Letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities will be issued by the CQC System Manager. Copies of these letters must be furnished to the Government.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures must be in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities approved by the Contracting Officer must be used.)

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. Establish verification procedures that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

j. Any special inspection requirements as required in accordance with ICC IBC

3.2.2 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.3 Notification of Changes

After acceptance of the CQC Plan, notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, meet with the Contracting Officer or Authorized Representative and discuss the Contractor's quality control system. Submit the CQC Plan a minimum of 3 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details must be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting will be prepared by the Government, signed by both the Contractor and the Contracting Officer and will become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

3.4 QUALITY CONTROL ORGANIZATION

3.4.1 Personnel Requirements

The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel to ensure safety and contract compliance. The Safety and Health Manager must receive direction and authority from the CQC System Manager and serve as a member of the CQC staff. Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization. The Contractor's CQC staff must maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff will be

subject to acceptance by the Contracting Officer. Provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Promptly complete and furnish all letters, material submittals, shop drawing submittals, schedules and all other project documentation to the CQC organization. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

3.4.2 CQC System Manager

Identify as CQC System Manager an individual within the onsite work organization who is responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager must be a graduate engineer, graduate architect, or a graduate of construction management, with a minimum of 5 years construction experience on construction similar to this contract or a construction person with a minimum of 20 years in related work. This CQC System Manager must be on the site at all times during construction and be employed by the prime Contractor. The CQC System Manager must be assigned as System Manager but may have duties as project superintendent in addition to quality control. Identify in the plan an alternate to serve in the event of the CQC System Manager's absence. The requirements for the alternate are the same as the CQC System Manager.

3.4.3 CQC Personnel

In addition to CQC personnel specified elsewhere in the contract, provide as part of the CQC organization specialized personnel to assist the CQC System Manager for the following areas: earthwork, pile inspeciton, concrete work, architectural concrete work, stone masonry, landscaping, concrete, stone, environment, and in-ground water fountain design and installation. These individuals may be employees of the prime or subcontractor; be responsible to the CQC System Manager; be physically present at the construction site during work on their areas of responsibility; have the necessary education and/or experience in accordance with the experience matrix listed herein. These individuals may perform other duties but must be allowed sufficient time to perform their assigned quality control duties as described in the Quality Control Plan. A single person may cover more than one area provided that they are qualified to perform QC activities in each designated and that workload allows.

Experience Matrix	
Area	Qualifications
Civil	Graduate Civil Engineer with Geotechnical track or focus with a minimum of 5 years experience in the type of work being performed on this Project. The CQC person shall be knowledgeable of the local geology (Specifically the Potomac Formation).

Experience Matrix	
Area	Qualifications
Pile Inspector	Graduate Engineer (or technician) with knowledge of and prior experience in inspection and approval of auger cast pile installation.
Mechanical	Graduate Mechanical Engineer with 2 yrs experience or person 5 years of experience supervising mechanical features of work in the field with a construction company
Electrical	Graduate Electrical Engineer with 2 yrs related experience or person 5 years of experience supervising electrical features of work in the field with a construction company
Structural	Graduate Civil Engineer (with Structural Track or Focus) or Construction Manager with 2 yrs experience or person 5 years of experience supervising structural features of work in the field with a construction company
Architectural	Graduate Architect with 2 yrs experience or person with 5 yrs related experience
Environmental	Graduate Environmental Engineer with 3 yrs experience
Submittals	Submittal Clerk with 1 yr experience
Concrete, Pavements and Soils	Materials Technician with 2 yrs experience for the appropriate area
Concrete and Architectural Concrete	Graduate Architect or Engineer or Construction Manager with 2 years experience in the type of work being performed on this Project or technical with 5 years related experience. Knowledge of and experience in inspection of batching, transport, mixing, formwork, reinforcing, placement, curing, and repair of concrete intended to be Architecturally Exposed.

Experience Matrix	
Area	Qualifications
Testing, Adjusting and Balancing (TAB) Personnel	Specialist must be a member of AABC or an experienced technician of the firm certified by the NEBB
Landscaping	Graduate Landscape Architect or Construction Manager with 2 years experience in the type of work being performed on this Project or technician with 5 years related experience.
Cast-In-Place Concrete	Graduate Architect or Engineer or Construction Manager with 2 years experience in the type of work being performed on this Project or technician with 5 years related experience.
Stone	Graduate Architect or Engineer or Construction Manager with 2 years experience in the type of work being performed on this Project or technician with 5 years related experience.
In-Ground Water Fountain	Graduate Architect or Engineer with 2 years experience in the type of work being performed on this Project or technician with 5 years related experience.

3.4.4 Organizational Changes

Maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

3.5 SUBMITTALS AND DELIVERABLES

Submittals, if needed, must comply with the requirements in Section 01 33 00 SUBMITTAL PROCEDURES. The CQC organization is responsible for certifying that all submittals and deliverables are in compliance with the contract requirements.

3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control must be conducted by the CQC System Manager for each definable feature of the construction work as follows:

3.6.1 Preparatory Phase

This phase is performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and

after copies are at the work site. This phase includes:

a. A review of each paragraph of applicable specifications, reference codes, and standards. Make available during the preparatory inspection a copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field. Maintain and make available in the field for use by Government personnel until final acceptance of the work.

b. Review of the contract drawings.

c. Check to assure that all materials and/or equipment have been tested, submitted, and approved.

d. Review of provisions that have been made to provide required control inspection and testing.

e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

f. Examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

g. Review of the appropriate activity hazard analysis to assure safety requirements are met.

h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

i. Check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

j. Discussion of the initial control phase.

k. The Government must be notified at least 36 hours in advance of beginning the preparatory control phase. Include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. Document the results of the preparatory phase actions by separate minutes prepared by the CQC System Manager and attach to the daily CQC report. Instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

3.6.2 Initial Phase

This phase is accomplished at the beginning of a definable feature of work. Accomplish the following:

a. Check work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels

as appropriate.

d. Resolve all differences.

e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

f. The Government must be notified at least 8 hours in advance of beginning the initial phase. Prepare separate minutes of this phase by the CQC System Manager and attach to the daily CQC report. Indicate the exact location of initial phase for future reference and comparison with follow-up phases.

g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3.6.3 Follow-up Phase

Perform daily checks to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. Record the checks in the CQC documentation. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of work which may be affected by the deficient work. Do not build upon nor conceal non-conforming work.

3.6.4 Additional Preparatory and Initial Phases

Conduct additional preparatory and initial phases on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

3.7 TESTS

3.7.1 Testing Procedure

Perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. Procure the services of a Corps of Engineers approved testing laboratory or establish an approved testing laboratory at the project site. Perform the following activities and record and provide the following data:

a. Verify that testing procedures comply with contract requirements.

b. Verify that facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.

d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

e. Record results of all tests taken, both passing and failing on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. Provide an information copy of tests performed by an offsite or commercial test facility directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.7.2 Testing Laboratories

The listing of validated testing laboratories is available at http://gsl.erdc.usace.army.mil/SL/MTC/.

3.7.2.1 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel must meet criteria detailed in ASTM D3740 and ASTM E329.

3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed a charge of $1,200 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

3.7.3 Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.8 COMPLETION INSPECTION

3.8.1 Punch-Out Inspection

Conduct an inspection of the work by the CQC Manager near the end of the work, or any increment of the work established by a time stated in the SPECIAL CONTRACT REQUIREMENTS Clause, "Commencement, Prosecution, and Completion of Work", or by the specifications. Prepare and include in the CQC documentation a punch list of items which do not conform to the approved drawings and specifications, as required by paragraph DOCUMENTATION. Include within the list of deficiencies the estimated date by which the deficiencies will be corrected. Make a second inspection the CQC System Manager or staff to ascertain that all deficiencies have been corrected. Once this is accomplished, notify the Government that the facility is ready for the Government Pre-Final inspection.

3.8.2 Pre-Final Inspection

The Government will perform the pre-final inspection to verify that the

facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. Ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Correct any items noted on the Pre-Final inspection in a timely manner. These inspections and any deficiency corrections required by this paragraph must be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative must be in attendance at the final acceptance inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final inspection. Notify the Contracting Officer at least 14 days prior to the final acceptance inspection and include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause titled "Inspection of Construction".

3.9 DOCUMENTATION

Maintain current records providing factual evidence that required quality control activities and/or tests have been performed. Include in these records the work of subcontractors and suppliers on an acceptable form that includes, as a minimum, the following information:

a. Contractor/subcontractor and their area of responsibility.

b. Operating plant/equipment with hours worked, idle, or down for repair.

c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

d. Test and/or control activities performed with results and references to specifications/drawings requirements. Identify the control phase (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action.

e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

f. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.

g. Offsite surveillance activities, including actions taken.

h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

i. Instructions given/received and conflicts in plans and/or specifications.

j. Contractor's verification statement.

Indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. Cover both conforming and deficient features and include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. Furnish the original and one copy of these records in report form to the Government daily within 48 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, prepare and submit one report for every 7 days of no work and on the last day of a no work period. All calendar days must be accounted for throughout the life of the contract. The first report following a day of no work will be for that day only. Reports must be signed and dated by the CQC System Manager. Include copies of test reports and copies of reports prepared by all subordinate quality control personnel within the CQC System Manager Report.

3.10 SAMPLE FORMS

Sample forms available upon request.

3.11 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. Take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, will be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders will be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

-- End of Section --

SECTION 01 45 00.10 10

QUALITY CONTROL SYSTEM (QCS)
02/10

PART 1 GENERAL

1.1 Contract Administration

The Government will use the Resident Management System for Windows (RMS) to assist in its monitoring and administration of this contract. The Contractor must use the Government-furnished Construction Contractor Module of RMS, referred to as QCS, to record, maintain, and submit various information throughout the contract period. The Contractor module, user manuals, updates, and training information can be downloaded from the RMS web site (www.rmssupport.com).
This joint Government-Contractor use of RMS and QCS will facilitate electronic exchange of information and overall management of the contract. QCS provides the means for the Contractor to input, track, and electronically share information with the Government in the following areas:

Administration
Finances
Quality Control
Submittal Monitoring
Scheduling
Import/Export of Data

1.1.1 Correspondence and Electronic Communications

For ease and speed of communications, both Government and Contractor will, to the maximum extent feasible, exchange correspondence and other documents in electronic format. Correspondence, pay requests and other documents comprising the official contract record will also be provided in paper format, with signatures and dates where necessary. Paper documents will govern, in the event of discrepancy with the electronic version.

1.1.2 Other Factors

Particular attention is directed to Contract Clause, "Schedules for Construction Contracts", Contract Clause, "Payments", Section 01 32 01.00 10 PROJECT SCHEDULE, Section 01 33 00 SUBMITTAL PROCEDURES, and Section 01 45 00.00 10 QUALITY CONTROL, which have a direct relationship to the reporting to be accomplished through QCS. Also, there is no separate payment for establishing and maintaining the QCS database; all costs associated therewith will be included in the contract pricing for the work.

1.2 QCS SOFTWARE

QCS is a Windows-based program that can be run on a stand-alone personal computer or on a network. The Government will make available the QCS software to the Contractor after award of the construction contract. Prior to the Pre-Construction Conference, the Contractor will be responsible to download, install and use the latest version of the QCS software from the Government's RMS Internet Website. Upon specific justification and request by the Contractor, the Government can provide QCS on CD-ROM. Any program updates of QCS will be made available to the Contractor via the Government

RMS Website as they become available.

1.3 SYSTEM REQUIREMENTS

The following is the minimum system configuration that the Contractor must have to run QCS:

QCS and Quality Assurance System (QAS) System

Hardware

IBM-compatible PC with 1000 MHz Pentium or higher processor

256+ MB RAM for workstation / 512+ MB RAM for server

1 GB hard drive disk space for sole use by the QCS system

Compact Disk (CD) Reader 8x speed or higher

SVGA or higher resolution monitor (1024x768, 256 colors)

Mouse or other pointing device

Windows compatible printer. (Laser printer must have 4 MB+ of RAM)

Connection to the Internet, minimum 56k BPS

Software

MS Windows 2000, XP, Vista or Windows 7

QAS-Word Processing software: MS Word 2000 or newer

Latest version of: Netscape Navigator, Microsoft Internet Explorer, or other browser that supports HTML 4.0 or higher

Electronic mail (E-mail) MAPI compatible

Virus protection software that is regularly upgraded with all issued manufacturer's updates

1.4 RELATED INFORMATION

1.4.1 QCS User Guide

After contract award, download instructions for the installation and use of QCS from the Government RMS Internet Website. In case of justifiable difficulties, the Government will provide the Contractor with a CD-ROM containing these instructions.

1.4.2 Contractor Quality Control (CQC) Training

The use of QCS will be discussed with the Contractor's QC System Manager during the mandatory CQC Training class.

1.5 CONTRACT DATABASE

Prior to the pre-construction conference, the Government will provide the Contractor with basic contract award data to use for QCS. The Government

will provide data updates to the Contractor as needed, generally by using the Government's SFTP repository built into QCS import/export function. These updates will generally consist of submittal reviews, correspondence status, QA comments, and other administrative and QA data.

1.6 DATABASE MAINTENANCE

Establish, maintain, and update data in the QCS database throughout the duration of the contract at the Contractor's site office. Submit data updates to the Government (e.g., daily reports, submittals, RFI's, schedule updates, payment requests, etc.) using the Government's SFTP repository built into QCS export function. If permitted by the Contracting Officer, e-mail or CD-ROM may be used instead of E-mail (see Paragraph DATA SUBMISSION VIA CD-ROM). The QCS database typically includes current data on the following items:

1.6.1 Administration

1.6.1.1 Contractor Information

Contain within the database the Contractor's name, address, telephone numbers, management staff, and other required items. Within 14 calendar days of receipt of QCS software from the Government, deliver Contractor administrative data in electronic format.

1.6.1.2 Subcontractor Information

Contain within the database the name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor must be listed separately for each trade to be performed. Assign each subcontractor/trade a unique Responsibility Code, provided in QCS. Within 14 calendar days of receipt of QCS software from the Government, deliver subcontractor administrative data in electronic format.

1.6.1.3 Correspondence

Identify all Contractor correspondence to the Government with a serial number. Prefix correspondence initiated by the Contractor's site office with "S". Prefix letters initiated by the Contractor's home (main) office with "H". Letters must be numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C".

1.6.1.4 Equipment

Contain within the Contractor's QCS database a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

1.6.1.5 Management Reporting

QCS includes a number of reports that Contractor management can use to track the status of the project. The value of these reports is reflective of the quality of the data input, and is maintained in the various sections of QCS. Among these reports are: Progress Payment Request worksheet, QA/QC comments, Submittal Register Status, Three-Phase Control checklists.

1.6.1.6 Request For Information (RFI)

Exchange all Requests For Information (RFI) using the Built-in RFI generator and tracker in QCS.

1.6.2 Finances

1.6.2.1 Pay Activity Data

Include within the QCS database a list of pay activities that the Contractor must develop in conjunction with the construction schedule. The sum of all pay activities must be equal to the total contract amount, including modifications. Group pay activities Contract Line Item Number (CLIN); the sum of the activities must equal the amount of each CLIN. The total of all CLINs equals the Contract Amount.

1.6.2.2 Payment Requests

Prepare all progress payment requests using QCS. Complete the payment request worksheet, prompt payment certification, and payment invoice in QCS. Update the work completed under the contract, measured as percent or as specific quantities, at least monthly. After the update, generate a payment request report using QCS. Submit the payment request, prompt payment certification, and payment invoice with supporting data using the Government's SFTP repository built into QCS export function. If permitted by the Contracting Officer, e-mail or a CD-ROM may be used. A signed paper copy of the approved payment request is also required, which will govern in the event of discrepancy with the electronic version.

1.6.3 Quality Control (QC)

QCS provides a means to track implementation of the 3-phase QC Control System, prepare daily reports, identify and track deficiencies, document progress of work, and support other Contractor QC requirements. Maintain this data on a daily basis. Entered data will automatically output to the QCS generated daily report. Provide the Government a Contractor Quality Control (CQC) Plan within the time required in Section 01 45 00.00 10 QUALITY CONTROL. Within seven calendar days of Government acceptance, submit a QCS update reflecting the information contained in the accepted CQC Plan: schedule, pay activities, features of work, submittal register, QC requirements, and equipment list.

1.6.3.1 Daily Contractor Quality Control (CQC) Reports

QCS includes the means to produce the Daily CQC Report. The Contractor may use other formats to record basic QC data. However, the Daily CQC Report generated by QCS must be the Contractor's official report. Summarize data from any supplemental reports by the Contractor and consolidate onto the QCS-generated Daily CQC Report. Submit daily CQC Reports as required by Section 01 45 00.00 10 QUALITY CONTROL. Electronically submit reports to the Government within 24 hours after the date covered by the report. Also provide the Government a signed, printed copy of the daily CQC report.

1.6.3.2 Deficiency Tracking

Use QCS to track deficiencies. Deficiencies identified by the Contractor will be numerically tracked using QC punch list items. Maintain a current log of its QC punch list items in the QCS database. The Government will log the deficiencies it has identified using its QA punch list items. The

Government's QA punch list items will be included in its export file to the Contractor. Regularly update the correction status of both QC and QA punch list items.

1.6.3.3 QC Requirements

Develop and maintain a complete list of QC testing and required structural and life safety special inspections required by the International Code Council (ICC), transferred and installed property, and user training requirements in QCS. Update all data on these QC requirements as work progresses, and promptly provide this information to the Government via QCS.

1.6.3.4 Three-Phase Control Meetings

Maintain scheduled and actual dates and times of preparatory and initial control meetings in QCS.

1.6.3.5 Labor and Equipment Hours

Log labor and equipment exposure hours on a daily basis. This data will be rolled up into a monthly exposure report.

1.6.3.6 Accident/Safety Reporting

The Government will issue safety comments, directions, or guidance whenever safety deficiencies are observed. The Government's safety comments will be included in its export file to the Contractor. Regularly update the correction status of the safety comments. In addition, utilize QCS to advise the Government of any accidents occurring on the jobsite. This brief supplemental entry is not to be considered as a substitute for completion of mandatory reports, e.g., ENG Form 3394 and OSHA Form 300.

1.6.3.7 Features of Work

Include a complete list of the features of work in the QCS database. A feature of work may be associated with multiple pay activities. However, each pay activity (see subparagraph "Pay Activity Data" of paragraph "Finances") will only be linked to a single feature of work.

1.6.3.8 Hazard Analysis

Use QCS to develop a hazard analysis for each feature of work included in the CQC Plan. Address any hazards, or potential hazards, that may be associated with the work.

1.6.4 Submittal Management

The Government will provide the initial submittal register in electronic format. Thereafter, maintain a complete list of all submittals, including completion of all data columns. Dates on which submittals are received and returned by the Government will be included in its export file to the Contractor. Use QCS to track and transmit all submittals. ENG Form 4025, submittal transmittal form, and the submittal register update must be produced using QCS. QCS and RMS will be used to update, store and exchange submittal registers and transmittals, but will not be used for storage of actual submittals.

1.6.5 Schedule

Develop a construction schedule consisting of pay activities, in accordance with Section 01 32 01.00 10 PROJECT SCHEDULE. Input and maintain in the QCS database this schedule either manually or by using the Standard Data Exchange Format (SDEF) (see Section 01 32 01.00 10 PROJECT SCHEDULE). Include with each pay request the updated schedule.

1.6.6 Import/Export of Data

QCS includes the ability to export Contractor data to the Government and to import submittal register and other Government-provided data from RMS, and schedule data using SDEF.

1.7 IMPLEMENTATION

Contractor use of QCS as described in the preceding paragraphs is mandatory. Ensure that sufficient resources are available to maintain its QCS database, and to provide the Government with regular database updates. QCS shall be an integral part of the Contractor's management of quality control.

1.8 DATA SUBMISSION VIA CD-ROM

The Government-preferred method for Contractor's submission of QCS data is by using the Government's SFTP repository built into QCS export function. Other data should be submitted using E-mail with file attachment(s). For locations where this is not feasible, the Contracting Officer may permit use of CD-ROM for data transfer. Export data onto CDs using the QCS built-in export function. If used, submit CD-ROMs in accordance with the following:

1.8.1 File Medium

Submit in English required data on CD-ROM conforming to industry standards used in the United States.

1.8.2 CD-ROM Labels

Affix a permanent exterior label to each CD-ROM submitted. Indicate on the label in English, the QCS file name, full contract number, contract name, project location, data date, name and telephone number of person responsible for the data.

1.8.3 File Names

The files will be automatically named by the QCS software. The naming convention established by the QCS software must not be altered.

1.9 MONTHLY COORDINATION MEETING

Update the QCS database each workday. At least monthly, generate and submit an export file to the Government with schedule update and progress payment request. As required in Contract Clause "Payments", at least one week prior to submittal, meet with the Government representative to review the planned progress payment data submission for errors and omissions.

Make all required corrections prior to Government acceptance of the export file and progress payment request. Payment requests accompanied by

incomplete or incorrect data submittals will be returned. The Government will not process progress payments until an acceptable QCS export file is received.

1.10 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the requirements of this specification. Take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, will be deemed sufficient for the purpose of notification.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 45 23

TESTING AND INSPECTION SERVICES
01/13

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Batch Plant Inspection and Materials Testing-Concrete
Field Inspection and Materials
Laboratory Tests of Field Samples - Concrete; G, AE
Final acceptance test and operational test procedure; G, AE

SD-07 Certificates

Certificate of Accreditation
Scope of Accreditation

1.2 QUALITY ASSURANCE

This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained and paid for by Contractor.

1.2.1 Accreditation Requirements

Testing Laboratory retained and paid for by Contractor shall be accredited by one or more of the National Voluntary Laboratory Accreditation Program (NVLAP) programs acceptable in the geographic region for the project. Furnish to the Contracting Officer a copy of the Certificate of Accreditation and Scope of Accreditation. For testing laboratories that have not yet obtained accreditation by a NVLAP program, submit an acknowledgement letter from one of the laboratory accreditation authorities indicating that the application for accreditation has been received and the accreditation process has started, and submit to the Contracting Officer for approval, certified statements, signed by an official of the testing laboratory attesting that the proposed laboratory, meets or conforms to the ASTM standards listed below as appropriate to the testing field.

a. Laboratories engaged in testing of construction materials shall meet the requirements of ASTM E329.

b. Laboratories engaged in testing of concrete and concrete aggregates shall meet the requirements of ASTM C1077.

c. Laboratories engaged in testing of bituminous paving materials shall meet the requirements of ASTM D3666.

d. Laboratories engaged in testing of soil and rock, as used in

engineering design and construction, shall meet the requirements of ASTM D3740.

e. Laboratories engaged in inspection and testing of steel, stainless steel, and related alloys will be evaluated according to ASTM A880.

f. Laboratories engaged in non-destructive testing (NDT) shall meet the requirements of ASTM E543.

g. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA.

1.2.2 Inspection and Testing

Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by Contracting Officer. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of Contracting Officer to such failure.

1.2.3 Written Reports

Testing laboratory shall submit test reports to Contracting Officer, Contractor, and AHJ as required within 24 hours after each test is completed unless other arrangements are agreed to in writing.

1.2.4 Verbal Reports

Give verbal notification to Contracting Officer immediately of any irregularity.

1.2.5 Pre-Installation Conference

Specification subparagraph text.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

3.1 CONCRETE

Refer to Section 03 30 00 CAST-IN-PLACE CONCRETE, Part 3 for additional testing requirements.

3.1.1 Batch Plant Inspection and Materials Testing-Concrete

Inspection and testing requirements include but are not limited to the following:

a. Perform continuous batch plant inspection until concrete quality is established to satisfaction of Contracting Officer with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by Contracting Officer.

b. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to Contracting Officer.

c. Sample and test mix ingredients as necessary to insure compliance with specifications.

d. Sample and test aggregates daily and as necessary for moisture content. Test the dry rodded weight of the coarse aggregate whenever a sieve analysis is made, and when it appears there has been a change in the aggregate.

e. Certify, in duplicate, ingredients and proportions and amounts of ingredients in concrete conform to approved trial mixes. When concrete is batched or mixed off immediate building site, certify (by signing, initialing or stamping thereon) on delivery slips (duplicate) that ingredients in truck load mixes conform to proportions of aggregate weight, cement factor, and water cement ratio of approved trial mixes.

3.1.2 Field Inspection and Materials Testing-Concrete

Inspection and testing requirements include but are not limited to the following:

a. Provide a technician at site of placement at all times to perform concrete sampling and testing.

b. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.

c. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least four cylinders for each 50 cubic yards or less of each concrete type, and at least four cylinders for any one day's pour for each concrete type. After good concrete quality control has been established and maintained as determined by Contracting Officer make four cylinders for each 100 cubic yards or less of each concrete type, and at least four cylinders from any one day's pour for each concrete type. Label each cylinder with an identification number. Contracting Officer may require additional cylinders to be molded and cured under job conditions.

d. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.

e. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 25 cubic yards thereafter each day. For concrete not required to be air-entrained, test every 100 cubic yards at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.

f. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.

g. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.

h. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.

i. Verify that specified mixing has been accomplished.

j. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:

1) When ambient air temperature falls below 40 degrees F, record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
2) When ambient air temperature rises above 85 degrees F, record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.

k. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.

l. Observe conveying, placement, and consolidation of concrete for conformance to specifications.

m. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.

n. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.

o. Observe preparations for placement of concrete:

1) Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
2) Inspect preparation of construction, expansion, and isolation joints.

p. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.

q. Observe concrete mixing:

1) Monitor and record amount of water added at project site.
2) Observe minimum and maximum mixing times.

r. Other inspections:

1) Shimming and grouting under precast columbarium units.
2) Shoring of precast columbarium units in preparation for cast-in-place cap casting.

3.1.3 Laboratory Tests of Field Samples - Concrete

Laboratory tests of field samples shall include but not be limited to the following:

a. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and two cylinders at 28 days. Use remaining cylinder as a spare tested as directed by Contracting Officer. Compile laboratory test reports as follows: Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.

b. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.

c. Furnish certified compression test reports to Contracting Officer. In test report, indicate the following information:

1) Cylinder identification number and date cast.
2) Specific location at which test samples were taken.
3) Type of concrete, slump, and percent air.
4) Compressive strength of concrete in psi.
5) Weight of lightweight structural concrete in pounds per cubic feet.
6) Weather conditions during placing.
7) Temperature of concrete in each test cylinder when test cylinder was molded.
8) Maximum and minimum ambient temperature during placing.
9) Ambient temperature when concrete sample in test cylinder was taken.
10) Date delivered to laboratory and date tested.

3.1.4 Architectural Cast-In-Place Concrete Inspection

Inspector shall be able to show acceptable previous experience in the inspection of Architectural Cast-In-Place Concrete for buildings/structures of similar size and complexity to this Project. Resume of proposed inspector shall be submitted for approval. Duties shall include but not be limited to the following:

a. Become familiar with the Project construction documents. Review the project requirements with the Design Architects and Engineers.

b. Attend pre-bid meetings.

c. Attend pre-construction meetings.

d. Observe the construction of Project mockups.

e. Inspect materials used in construction.

f. Provide daily on-site presence to inspect the construction of forms and rebar placement. Provide daily reports.

g. Observe the placement of concrete. Provide daily reports.

h. Observe conditions of forms for suitable reuse after each pour.

Provide daily report.

i. Consult with Contracting Officer, Architect and Engineer on regular basis.

j. Participate in review of completed work pending final approval.

k. Observe concrete repairs if necessary and provide daily report.

3.1.5 Pre-Cast Concrete Structures Inspection

For the precast concrete burial crypts and columbarium units, provide the following additional services:

a. Inspection at Plant: Forms, placement of reinforcing steel, concrete cover, and placement and finishing of concrete.

b. Concrete Testing: Test concrete including materials for concrete as required in other articles of this section, except make two test cylinders for each day's production of each strength of concrete produced.

c. Inspect members to insure specification requirements for curing and finishes have been met.

3.2 REINFORCEMENT

For all concrete reinforcement, the following tests are required:

a. Review mill test reports furnished by concrete supplier or perform sampling at fabricating plant. Take two samples from each 23 t (25 tons) or fraction thereof of each size of reinforcing steel No. 10 thru No. 57 (No. 3 thru No. 18).

b. Make one tensile and one bend test in accordance with ASTM A370 from each pair of samples obtained.

c. Written report shall include, in addition to test results, heat number, manufacturer, type and grade of steel, and bar size.

d. Perform tension tests of mechanical and welded splices in accordance with ASTM A370.

3.3 TYPE OF TEST

Use the following rates and estimated quantities to determine approximate number of tests and man-days of inspection required:

Concrete:

a. Making and Curing Concrete Test Cylinders (ASTM C31): _____.

b. Compressive Strength, Test Cylinders (ASTM C39): _____.

c. Concrete Slump Test (ASTM C143): _____.

d. Concrete Air Content Test (ASTM C173): _____.

e. Unit Weight, Lightweight Concrete (ASTM C567): _____.

Aggregate, Normal Weight: ____.

f. Gradation (ASTM C33): _____.

g. Deleterious Substances (ASTM C33): _____.

h. Soundness (ASTM C33): _____.

i. Abrasion (ASTM C33): _____.

Aggregate, Lightweight: _____.

j. Gradation (ASTM C330): _____.

k. Deleterious Substances (ASTM C330): _____.

l. Unit Weight (ASTM C330): _____.

m. Flatness and Levelness Readings (ASTM E1155) (number of days): _____.

Reinforcing Steel:

a. Tensile Test (ASTM A370): _____.

b. Bend Test (ASTM A370): _____.

c. Mechanical Splice (ASTM A370): _____.

d. Welded Splice Test (ASTM A370): ___.

-- End of Section --

SECTION 01 50 00

TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS
08/09

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component of, each section of the specifications.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C511	(2007) Standard for Reduced-Pressure Principle Backflow Prevention Assembly

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-270-01	(15 March 2001) Asphalt Maintenance and Repair

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR List	(continuously updated) List of Approved Backflow Prevention Assemblies
FCCCHR Manual	(1988e9) Manual of Cross-Connection Control

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241	(2009) Standard for Safeguarding Construction,Alteration, and Demolition Operations
NFPA 70	(2011; Errata 2 2012) National Electrical Code

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(2007; Rev K) Obstruction Marking and Lighting

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

MUTCD	(2009) Manual of Uniform Traffic Control Devices

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT STD	(2011) Virginia Work Area Protection Manual: Standard Guidelines for Temporary Traffic Control

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submitted the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Construction site plan; G
Traffic control plan; G

SD-06 Test Reports

Backflow Preventer Tests; G

SD-07 Certificates

Backflow Tester Certification; G

Backflow Preventers Certificate of Full Approval

1.4 CONSTRUCTION SITE PLAN

Prior to the start of work, submit a site plan showing the locations and dimensions of temporary facilities (including layouts and details, equipment and material storage area (onsite and offsite), and access and haul routes, avenues of ingress/egress to the fenced area and details of the fence installation. Identify any areas which may have to be graveled to prevent the tracking of mud. Indicate if the use of a supplemental or other staging area is desired. Show locations of safety and construction fences, site trailers, construction entrances, trash dumpsters, temporary sanitary facilities, and worker parking areas.

Plan shall also provide the maximum vertical clearance required for all motorized or trailered vehicles/equipment to determine the potential need for possible alternative access routes or tree pruning.

1.5 BACKFLOW PREVENTERS CERTIFICATE

Certificate of Full Approval from FCCCHR List, University of Southern California, attesting that the design, size and make of each backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. Certificate of Provisional Approval will not be acceptable.

1.5.1 Backflow Tester Certificate

Prior to testing, submit to the Contracting Officer certification issued by the State or local regulatory agency attesting that the backflow tester has successfully completed a certification course sponsored by the regulatory agency. Tester must not be affiliated with any company participating in

any other phase of this Contract.

1.5.2 Backflow Prevention Training Certificate

Submit a certificate recognized by the State or local authority that states the Contractor has completed at least 10 hours of training in backflow preventer installations. The certificate must be current.

PART 2 PRODUCTS

2.1 TEMPORARY SIGNAGE

2.1.1 Bulletin Board

Immediately upon beginning of work, provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Contracting Officer. Locate the bulletin board at the project site in a conspicuous place easily accessible to all employees, as approved by the Contracting Officer.

2.1.2 Project and Safety Signs

The requirements for the signs, their content, and location are as specified in Section 01 58 00 PROJECT IDENTIFICATION. Erect signs within 15 days after receipt of the notice to proceed. Correct the data required by the safety sign daily, with light colored metallic or non-metallic numerals.

2.2 TEMPORARY TRAFFIC CONTROL

2.2.1 Construction Access Route

Access of construction vehicles to the Millennium site will be provided through specific private roads and streets within the Arlington National Cemetery and the JBM-HH installations. The primary and alternate construction access routes established for the project are shown on sheet C-002. Because of the increased load and circulation of heavy vehicles associated with the construction activities, the Contractor shall assume that the pavement system for the access route will experience surface cracks, and potential base/sub-base damages. The Contractor shall maintain the construction access routes passable for construction and private vehicles in a manner that does not detract from the aesthetic nature of the cemetery. This includes the repair of any pavement damage caused by the circulation of construction vehicles during construction and the restoration of the surface course for the entire access route after all construction work has been completed. The provisions for dust control shall be made in accordance with standard and specification 3.39 of the Virginia Erosion and Sediment Control Handbook.

The Contractor shall refer to the UFC 3-270-01 (http://www.wbdg.org/ccb/DOD/UFC/ufc_3_270_01.pdf) as the guideline for the maintenance and repair of all paved roads comprising the construction access route for this project. Asphalt and maintenance repair include but is not limited to pothole filling, full depth patching, resurfacing, removal and replacement.

The Contractor shall notify the contracting officer immediately at the first sign of pavement damage and present corrective action plan for his or

her review and approval. Temporary patching such as "cold patch" shall not be permitted. Methods for pavement repair shall be in accordance with the guideline. At the completion of the project, the Contractor shall to remove the first 1-1/2 inch of asphalt and replace it with a new 1-1/2 inch wearing surface of VDOT SM-9.5A. The Contractor shall also be responsible for locating, and protecting, utilities below damaged pavement areas and repairing those damaged as consequence of construction traffic. The Contractor shall document on a report and include digital photographs of the conditions of the construction access road prior to and after construction. The report is to include but not be limited to any visible piping. A copy of said report shall be provided to the contracting officer. Pavement damages and repairs occurring during the time of construction shall be logged in the report and supplied to the contracting office for records. The log shall include date and time when the damage was reported, date and time of the repair, damage description, type of maintenance and/or repair, weather conditions at the time of the repair, and photographs showing before and after the repair conditions.

The primary and alternate construction route will provide ingress/egress of construction vehicles to the ANC Millennium site and consequently constitute part of the project. Therefore, the replacement of pavement surface and repairs shall be in accordance with the contract specifications.

2.2.2 Primary & Alternate Construction Access Routes

2.2.2.1 Temporary Bridge, Ramp, and Spanners

For all culverts or sewer crossings on haul routes, Contractor shall provide a temporary structure capable of dissipating the excess load onto these structures. Culverts also include brick conduits of circular, semi-circular, or arch sections. The temporary structure may be in the form of a portable ramp, spanner, or bridge. The temporary structure shall be rated for H-25 loading and equipped with a skid-resistant surface as specified in Article "Steel Plates". Rails shall be provided on both sides of the temporary structure to safely guide the traffic. Contractor shall be responsible for the erection and disassembly of the temporary structures. The temporary structure shall be installed to allow the free passage of surface drainage and prevent surface runoff accumulation.

2.2.3 Steel Plates

In the event steel plates are used as temporary patching, Contractor shall provide drawings for approval by Contracting Officer. Include method of attachment, surface finish of plate, description for elimination of standing water, and schedule of dates the steel plates will be installed and removed.

a. Approach plate and ending plate shall be attached to the roadway by a minimum of four 12-inch long 7/8-inch diameter low head asphalt anchors with washers pre-drilled into the corners of the plate and drilled 12 inches into the pavement. Asphalt anchors shall be pull and shear rated for 2,500lb force or better. Subsequent plates may be butted to each other. Fine graded asphalt concrete shall be compacted to form ramps, maximum slope 8.5 percent with a minimum 12-inch taper to cover all edges of the steel plates. When steel plates are removed, the dowel holes in the pavement shall be repaired.

b. Steel plates in the traveled portion of the roadway shall have or be combined with a skid-resistant surface, surface pattern, or composite

mat that provides equal or greater surface friction than the existing asphalt surface road. The skid-resistant application on the steel plate shall allow the free passage of surface runoff. Contractor shall install the plates to prevent storm water accumulation on the plates or adjacent areas.

2.2.4 Barricades

Erect and maintain temporary barricades to limit public access to hazardous areas. Whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic barricades will be required. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

2.2.5 Fencing

a. Provide fencing along the construction site at all open excavations and tunnels to control access by unauthorized people. Fencing shall be installed to be able to restrain a force of at least 250 pounds against it. Fence shall have privacy slats; green in color.

2.2.6 Temporary Wiring

Provide temporary wiring in accordance with NFPA 241 and NFPA 70, Article 305-6(b), Assured Equipment Grounding Conductor Program. Include frequent inspection of all equipment and apparatus.

2.2.7 Backflow Preventers

Reduced pressure principle type conforming to the applicable requirements AWWA C511. Provide backflow preventers complete with 150 pound flanged cast iron, mounted gate valve and strainer, 304 stainless steel or bronze, internal parts. The particular make, model/design, and size of backflow preventers to be installed must be included in the latest edition of the List of Approved Backflow Prevention Assemblies issued by the FCCCHR List and be accompanied by a Certificate of Full Approval from FCCCHR List. After installation conduct Backflow Preventer Tests and provide test reports verifying that the installation meets the FCCCHR Manual Standards.

PART 3 EXECUTION

3.1 EMPLOYEE PARKING

Availability for employee parking is minimal; use of local mass transit systems and carpooling to the jobsite are preferable and strongly encouraged. Contractor employees will park privately owned vehicles in an area designated by the Contracting Officer. Contractor employee parking must not interfere with existing and established parking requirements of the government installation.

3.2 AVAILABILITY AND USE OF UTILITY SERVICES

3.2.1 Temporary Utilities

The Contractor shall make provision for temporary utilities required for construction. If reasonable access to temporary utilities is available near the job site the Contractor may use those utilities with the

understanding that they will be used conservatively. The Contractor shall be responsible for operating under conditions that preclude the waste of utilities, which include for example, turning off the water faucets or valves after using the required amount to accomplish cleaning.

Provide temporary utilities required for construction. Materials may be new or used, must be adequate for the required usage, not create unsafe conditions, and not violate applicable codes and standards.

3.2.2 Payment for Utility Services

a. The Government will make all reasonably required utilities available to the Contractor from existing outlets and supplies, without charge and as specified in the contract. Carefully conserve any utilities furnished without charge. If negligent usage of such resources by the Contractor is determined by the Contracting Officer, unless otherwise provided in the contract, the amount of each utility service consumed will be charged to or paid for by the Contractor at prevailing rates charged to the Government or, where the utility is produced by the Government, at reasonable rates determined by the Contracting Officer as specified elsewhere in this Article.

b. Reasonable amounts of the following utilities will be made available to the Contractor without charge.

    1. Electricity.
    2. Potable Water.
    3. Sanitary Sewer.

c. The point at which the Government will deliver such utilities or services and the quantity available is as indicated. Pay all costs incurred in connecting, converting, and transferring the utilities to the work. Make connections, including providing backflow-preventing devices on connections to domestic water lines; providing transformers; and make disconnections. If required by the Contracting Officer, Contractor shall also provide and connect/disconnect metering devices at no additional cost to the Government.

3.2.3 Meters and Temporary Connections

By approval of the Contracting Officer, and at the Contractor's expense and in a manner satisfactory to the Contracting Officer, provide and maintain necessary temporary connections, distribution lines, and meters required to measure the amount of each utility used for the purpose of determining charges. Coordinate with local utility provider for all temporary power, connections, meters, and billing.

3.2.4 Utilities at Special Locations

Under no circumstances will taps to ANC fire hydrants be allowed for obtaining domestic water.

3.2.5 Sanitation

a. Provide and maintain within the construction area minimum field-type sanitary facilities approved by the Contracting Officer and periodically empty wastes into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Obtain approval from the system owner prior to discharge into any

municipal, district, or commercial sanitary sewer system. Any penalties and / or fines associated with improper discharge will be the responsibility of the Contractor. Coordinate with the Contracting Officer and follow station regulations and procedures when discharging into the station sanitary sewer system. Maintain these conveniences at all times without nuisance. Include provisions for pest control and elimination of odors. Government toilet facilities will not be available to Contractor's personnel.

b. Provide temporary sewer and sanitation facilities that are self-contained units with both urinals and stool capabilities. Ventilate the units to control odors and fumes and empty and clean them at least once a week or more often if required by the Contracting Officer. The doors shall be self-closing. The exterior of the unit shall match the base standard color. Locate the facility behind the construction fence or out of the public view.

3.2.6 Telephone

Make arrangements and pay all costs for telephone facilities desired.

3.2.7 Obstruction Lighting of Cranes

Provide a minimum of 2 aviation red or high intensity white obstruction lights on temporary structures (including cranes) over 100 feet above ground level. Light construction and installation must comply with FAA AC 70/7460-1. Lights must be operational during periods of reduced visibility, darkness, and as directed by the Contracting Officer.

3.2.8 Fire Protection

Provide temporary fire protection equipment for the protection of personnel and property during construction. Remove debris and flammable materials daily to minimize potential hazards.

3.2.9 Contractor Parking

There is very limited overall space on the project site for Contractor employee and delivery truck parking. There are a multitude of mass transit services available. Use of these are highly encouraged. More information on these services is available upon request by the Contracting Officer.

3.3 TRAFFIC PROVISIONS

3.3.1 Maintenance of Traffic

a. Conduct operations in a manner that will not close any thoroughfare or interfere in any way with traffic on railways or highways except with written permission of the Contracting Officer at least 15 calendar days prior to the proposed modification date, and provide a Traffic Control Plan detailing the proposed controls to traffic movement for approval. The plan must be in accordance with VDOT STD and the MUTCD, Part VI. Make all notifications and obtain any permits required for modification to traffic movements outside Station's jurisdiction. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the highway authority have been met.

b. Conduct work so as to minimize obstruction of traffic, and maintain traffic on at least half of the roadway width at all times. Obtain

approval from the Contracting Officer prior to starting any activity that will obstruct traffic.

1) There are approximately 30 funerals performed per day at the Arlington National Cemetery. In addition there are a number of ceremonies performed each year on the site. All construction activity, pedestrian, and vehicular traffic shall not interfere, obstruct, or detract from the performance of these services.

c. Provide, erect, and maintain, at Contractor's expense, lights, barriers, signals, passageways, detours, and other items, that may be required by State, County, and local authorities.

3.3.2 Protection of Traffic

Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment the work, and the erection and maintenance of adequate warning, danger, and direction signs, will be as required by the State and local authorities having jurisdiction. Protect the traveling public from damage to person and property. Minimize the interference with public traffic on roads selected for hauling material to and from the site. Investigate the adequacy of existing roads and their allowable load limit. Contractor is responsible for the repair of any damage to roads caused by construction operations.

3.3.3 Rush Hour Restrictions

Do not interfere with the peak traffic flows preceding and during normal operations for Arlington National Cemetery without notification to and approval by the Contracting Officer.

3.3.4 Dust Control

Dust control methods and procedures must be approved by the Contracting Officer. Treat dust abatement on access roads with applications of calcium chloride, water sprinklers, or similar methods or treatment.

3.3.5 Vehicle Washing

Contractor shall clean trucks, cranes, and other equipment prior to exiting the site to prevent dirt, mud, and debris from tracking on new and existing solid surfaces and grassy areas during construction.

3.4 CONTRACTOR'S TEMPORARY FACILITIES

3.4.1 Safety

Protect the integrity of any installed safety systems or personnel safety devices. If entrance into systems serving safety devices is required, the Contractor must obtain prior approval from the Contracting Officer. If it is temporarily necessary to remove or disable personnel safety devices in order to accomplish contract requirements, provide alternative means of protection prior to removing or disabling any permanently installed safety devices or equipment and obtain approval from the Contracting Officer.

3.4.2 Administrative Field Offices

Provide and maintain administrative field office facilities within the construction area at the designated site.

Government office and warehouse facilities will not be available to the Contractor.

3.4.3 Storage Area

Construct a temporary 6 foot high chain link fence around trailers and materials. Include plastic strip inserts, colored green, so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Do not place or store trailers, materials, or equipment outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the Contracting Officer away from the vicinity of the construction site but within the installation boundaries. Trailers, equipment, or materials must not be open to public view with the exception of those items which are in support of ongoing work on any given day. Do not stockpile materials outside the fence in preparation for the next day's work. Park mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment within the fenced area at the end of each work day.

3.4.4 Appearance of Trailers

a. Trailers utilized by the Contractor for administrative or material storage purposes must present a clean and neat exterior appearance and be in a state of good repair. Trailers which, in the opinion of the Contracting Officer, require exterior painting or maintenance will not be allowed on installation property.

b. Paint using suitable paint and maintain the temporary facilities. Failure to do so will be sufficient reason to require their removal.

3.4.5 Maintenance of Storage Area

a. Keep fencing in a state of good repair and proper alignment. Grassed or unpaved areas, which are not established roadways, will be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways, should the Contractor elect to traverse them with construction equipment or other vehicles; gravel gradation will be at the Contractor's discretion. Mow and maintain grass located within the boundaries of the construction site for the duration of the project. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers will be edged or trimmed neatly.

b. Cut grass (or annual weeds) within the construction and storage sites to a maximum 4 inch height at least once a week during the growing season unless the grass area is not visible to the public. Trim the grass around fences at time of grass cutting. Maintain grass or weeds on stockpiled earth as described above.

3.4.6 Security Provisions

3.4.6.1 Security Lighting

Provide temporary security lighting as follows:

a. Provide adequate outside security lighting at the Contractor's temporary facilities. The Contractor will be responsible for the security of its own equipment; in addition, the Contractor will notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

b. Provide adequate outside security lighting for McNair Road and the pedestrian path located along the east side of McNair Road. Provide 0.5 foot-candles average horizontal illumination at the surface for these areas during any time when permanently installed lighting is not operational.

3.4.7 Weather Protection of Temporary Facilities and Stored Materials

Take necessary precautions to ensure that roof openings and other critical openings in the building are monitored carefully. Take immediate actions required to seal off such openings when rain or other detrimental weather is imminent, and at the end of each workday. Ensure that the openings are completely sealed off to protect materials and equipment in the building from damage.

3.4.7.1 Building and Site Storm Protection

When a warning of gale force winds is issued, take precautions to minimize danger to persons, and protect the work and nearby Government property. Precautions must include, but are not limited to, closing openings; removing loose materials, tools and equipment from exposed locations; and removing or securing scaffolding and other temporary work. Close openings in the work when storms of lesser intensity pose a threat to the work or any nearby Government property.

3.4.7.2 Hurricane Condition of Readiness

Unless directed otherwise, comply with:

a. Condition TWO (Sustained winds of 50 knots or greater expected within 24 hours): Curtail or cease routine activities until securing operation is complete. Reinforce or remove form work and scaffolding. Secure machinery, tools, equipment, materials, or remove from the jobsite. Expend every effort to clear all missile hazards and loose equipment from general base areas. Contact Contracting Officer for weather and Condition of Readiness (COR) updates and completion of required actions.

3.5 GOVERNMENT FIELD OFFICE

3.5.1 Government Resident Engineer

Within 10 days after Notice to Proceed (NTP), the Contractor shall provide the Government Resident Engineer with an office to be located on the site as directed by the Contracting Officer. The trailer shall be like new in appearance with at least one operable window in each exterior wall and an entrance landing and steps per 29 OSHA 1910 (OSHA Standards) with two

adjacent parking spaces. Minimum square footage shall be 1440 SF. Space shall include heat, electric power, lighting, plumbing, air conditioning, and high speed broadband internet service from a local cable provider. Office space shall be provided with the following:

a. 7 desks with chairs.

b. 7 three section bookshelves.

c. 3 five section bookshelves.

d. 1 telephone/data jack at each desk.

e. 1 additional jack for a printer.

f. 1 FAX machine.

g. 1 additional telephone jack for the fax machine.

h. 4 four drawer file cabinets or equal.

i. 1 plan table.

j. 1 plan rack.

k. Mini blinds in all windows.

l. Kitchen with wet sink.

m. 1 eighteen CF refrigerator.

n. 1 Microwave oven.

o. Bottled water services with a dispenser that dispenses cold and hot water.

p. Two toilets and lavatories (1 each for male and female gender).

q. Provide a minimum of 16 parking spaces reserved for Government employees.

r. Provide pole-mounted security lighting to illuminate the parking area and front of the trailer.

In addition to the above Resident Engineers Office and within 10 days after the NTP, the Contractor shall assume the lease of an existing 12 by 60 Mobile office trailer located near the intersection of Patton Rd. and Eisenhower Drive, Arlington National Cemetery, Arlington, VA. This trailer consists of two equal size offices with one common area separating the two offices, 1 storage closet, toilet facilities consisting of one lavatory and one water closet, air conditioning, heating, electrical, lighting and power. In addition to the lease costs, the Contractor shall be responsible for assuming and maintaining all existing utilities including, electrical, water, and sewer, internet service, and maintaining all connections (within compliance with local codes).

The Contractor shall be responsible for all costs associated to operate and maintain the following at each location trailer location:

a. Standard Trailer Maintenance for the full rental period.

b. Skirting around the perimeter of the trailer.

c. Entrance steps.

d. high speed broad band internet service.

e. All heat tracing on plumbing piping (heat tracing is required.)

f. Bathroom toilet accessories.

g. All appliances.

h. Fire extinguishers.

i. All windows and blind.

j. All exterior doors.

k. Weekly janitorial services.

l. Trash removal.

m. Weekly lawn maintenance.

n. Office trailer take down, disconnection of utilities, and removal of trailers 60 days after the end of the contract period.

3.6 PLANT COMMUNICATION

Whenever the Contractor has the individual elements of its plant so located that operation by normal voice between these elements is not satisfactory, the Contractor must install a satisfactory means of communication, such as telephone or other suitable devices and made available for use by Government personnel.

3.7 TEMPORARY PROJECT SAFETY FENCING

As soon as practicable, but not later than 15 days after the date established for commencement of work, furnish and erect temporary project safety fencing at the work site. The safety fencing must be a high visibility orange colored, high density polyethylene grid or approved equal, a minimum of 42 inches high, supported and tightly secured to steel posts located on maximum 10 foot centers, constructed at the approved location. Maintain the safety fencing during the life of the contract and, upon completion and acceptance of the work, will become the property of the Contractor and be removed from the work site.

3.8 CLEANUP

Remove construction debris, waste materials, packaging material and the like from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways must be cleaned away. Store within the fenced area described above or at the supplemental storage area any materials resulting from demolition activities which are salvageable. Neatly stacked stored materials not in trailers, whether new or salvaged.

3.9 RESTORATION OF STORAGE AREA

Upon completion of the project remove the bulletinboard, signs, barricades, haulroads, and any other temporary products from the site. After removal of trailers, materials, and equipment from within the fenced area, remove the fence that will become the property of the Contractor. Restore to the original or better condition, areas used by the Contractor for the storage of equipment or material, or other use. Gravel used to traverse grassed areas must be removed and the area restored to its original condition, including top soil and seeding as necessary.

-- End of Section --

SECTION 01 57 20.00 10

ENVIRONMENTAL PROTECTION
04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY (DA)

DA AR 200-1	(2007) Environmental Protection and Enhancement

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011) Safety and Health Requirements Manual
WETLANDS DELINEATION MANUAL	(1987) Corps of Engineers Wetlands Delineation Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

33 CFR 328	Definitions of Waters of the United States
40 CFR 110	Discharge of Oil
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 279	Standards for the Management of Used Oil
40 CFR 302	Designation, Reportable Quantities, and Notification
40 CFR 355	Emergency Planning and Notification
40 CFR 68	Chemical Accident Prevention Provisions
49 CFR 171 - 178	Hazardous Materials Regulations

VIRGINIA DEPARTMENT OF CONSERVATION AND RECREATION (DCR)

DCR	Erosion and Sediment Control Requirements

1.2 DEFINITIONS

1.2.1 Environmental Pollution and Damage

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally and/or historically.

1.2.2 Environmental Protection

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.2.3 Contractor Generated Hazardous Waste

Contractor generated hazardous waste means materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e. methyl ethyl ketone, toluene etc.), waste thinners,excess paints, excess solvents, waste solvents, and excess pesticides, and contaminated pesticide equipment rinse water.

1.2.4 Installation Pest Management Coordinator

Installation Pest Management Coordinator (IPMC) is the individual officially designated by the Installation Commander to oversee the Installation Pest Management Program and the Installation Pest Management Plan.

1.2.5 Project Pesticide Coordinator

The Project Pesticide Coordinator (PPC) is an individual that resides at a Civil Works Project office and that is responsible for oversight of pesticide application on Project grounds.

1.2.6 Land Application for Discharge Water

The term "Land Application" for discharge water implies that the Contractor must discharge water at a rate which allows the water to percolate into the soil. No sheeting action, soil erosion, discharge into storm sewers, discharge into defined drainage areas, or discharge into the "waters of the United States" must occur. Land Application must be in compliance with all applicable Federal, State, and local laws and regulations.

1.2.7 Pesticide

Pesticide is defined as any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, or intended for use as a plant regulator, defoliant or desiccant.

1.2.8 Pests

The term "pests" means arthropods, birds, rodents, nematodes, fungi, bacteria, viruses, algae, snails, marine borers, snakes, weeds and other organisms (except for human or animal disease-causing organisms) that adversely affect readiness, military operations, or the well-being of personnel and animals; attack or damage real property, supplies, equipment, or vegetation; or are otherwise undesirable.

1.2.9 Surface Discharge

The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers,creeks, and/or "waters of the United States" and would require a permit to discharge water from the governing agency.

1.2.10 Waters of the United States

All waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

1.2.11 Wetlands

Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, and bogs. Official determination of whether or not an area is classified as a wetland must be done in accordance with WETLANDS DELINEATION MANUAL.

1.3 GENERAL REQUIREMENTS

Minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work must be protected during the entire duration of this contract. Comply with all applicable environmental Federal, State, and local laws and regulations. Any delays resulting from failure to comply with environmental laws and regulations will be the Contractor's responsibility.

1.4 SUBCONTRACTORS

Ensure compliance with this section by subcontractors.

1.5 PAYMENT

No separate payment will be made for work covered under this section. Payment of fees associated with environmental permits, application, and/or notices obtained by the Contractor, and payment of all fines/fees for violation or non-compliance with Federal, State, Regional and local laws and regulations are the Contractor's responsibility. All costs associated with this section must be included in the contract price.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When

used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Environmental Protection Plan; G
Archaeologist Qualifications
Erosion And Sediment Control Plan; G, AE

1.7 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, submit an Environmental Protection Plan for review and approval by the Contracting Officer. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Issues of concern must be defined within the Environmental Protection Plan as outlined in this section. Address each topic at a level of detail commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified in this section, but are considered necessary, must be identified and discussed after those items formally identified in this section. Prior to submittal of the Environmental Protection Plan, meet with the Contracting Officer for the purpose of discussing the implementation of the initial Environmental Protection Plan; possible subsequent additions and revisions to the plan including any reporting requirements; and methods for administration of the Contractor's Environmental Plans. The Environmental Protection Plan must be current and maintained onsite by the Contractor.

1.7.1 Compliance

No requirement in this Section will relieve the Contractor of any applicable Federal, State, and local environmental protection laws and regulations, including protection of endangered or protected animal species (amphibians and birds) at the Site. During Construction, the Contractor shall be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

1.7.2 Archaeologist Qualifications

Contractor shall provide a qualified archaeologist to conduct continuous on-site monitoring in accordance with requirements of this Project. Archaeologist shall meet the qualifications for prehistoric archaeology and historic archaeology specified in "The Secretary of the Interior's Historic Preservation Professional Qualification Standards" from Federal Register/Vol. 62, No. 119/Friday, June 20, 1997/Notices (pages 33712 through 33713).

1.7.3 Contents

Include in the environmental protection plan, but not limit it to, the following:

a. Name(s) of person(s) within the Contractor's organization who is(are) responsible for ensuring adherence to the Environmental Protection Plan.

b. Name(s) and qualifications of person(s) responsible for manifesting

hazardous waste to be removed from the site, if applicable.

c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.

d. Description of the Contractor's environmental protection personnel training program.

e. An Erosion And Sediment Control Plan developed in accordance with Virginia DCR Erosion and Sediment Control Requirements which identifies the type and location of the erosion and sediment controls to be provided. The plan must include monitoring and reporting requirements to assure that the control measures are in compliance with the erosion and sediment control plan, Federal, State, and local laws and regulations. A Storm Water Pollution Prevention Plan (SWPPP) may be substituted for this plan.

f. Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on the site.

g. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plan shall include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.

h. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.

i. Drawing showing the location of borrow areas.

j. Include in the Spill Control plan the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 110, 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or Local laws and regulations. The Spill Control Plan supplements the requirements of EM 385-1-1. Include in this plan, as a minimum:

(1) The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual will immediately notify the Contracting Officer and Facility Fire Department and Facility Environmental Office in addition to the legally required Federal, State, and local reporting channels (including the National Response Center 1-800-424-8802) if a reportable quantity is released to the environment. Include in the plan a list of the required reporting channels and telephone numbers.

(2) The name and qualifications of the individual who will be responsible for implementing and supervising the containment and cleanup.

(3) Training requirements for Contractor's personnel and methods of accomplishing the training.

(4) A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.

(5) The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.

(6) The methods and procedures to be used for expeditious contaminant cleanup.

k. A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris and schedules for disposal.

(1) Identify any subcontractors responsible for the transportation and disposal of solid waste. Submit licenses or permits for solid waste disposal sites that are not a commercial operating facility.

(2) Evidence of the disposal facility's acceptance of the solid waste must be attached to this plan during the construction. Attach a copy of each of the Non-hazardous Solid Waste Diversion Reports to the disposal plan. Submit the report for the previous quarter on the first working day after the first quarter that non-hazardous solid waste has been disposed and/or diverted (e.g. the first working day of January, April, July, and October).

(3) Indicate in the report the total amount of waste generated and total amount of waste diverted in cubic yards or tons along with the percent that was diverted.

(4) A recycling and solid waste minimization plan with a list of measures to reduce consumption of energy and natural resources. Detail in the plan the Contractor's actions to comply with and to participate in Federal, State, Regional, and local government sponsored recycling programs to reduce the volume of solid waste at the source.

l. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site. Plan shall specifically address provisions to keep concrete dust resulting from jackhammering or sawcutting from becoming airborne.

m. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with Federal, State, and local laws and regulations for storage and handling of these materials. In accordance with EM 385-1-1, a copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be onsite at any given time must be included in the contaminant prevention plan. Update the plan as new hazardous materials are brought onsite or removed from the site.

n. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing

water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines. If a settling/retention pond is required, the plan must include the design of the pond including drawings, removal plan, and testing requirements for possible pollutants. If land application will be the method of disposal for the waste water, the plan must include a sketch showing the location for land application along with a description of the pretreatment methods to be implemented. If surface discharge will be the method of disposal, include a copy of the permit and associated documents as an attachment prior to discharging the waste water. If disposal is to a sanitary sewer, the plan must include documentation that the Waste Water Treatment Plant Operator has approved the flow rate, volume, and type of discharge.

o. A historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on the project site: and/or identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in the area are discovered during construction. Include in the plan methods to assure the protection of known or discovered resources, identifying lines of communication between Contractor personnel and the Contracting Officer.

p. Include and update a pesticide treatment plan, as information becomes available. Include in the plan: sequence of treatment, dates, times, locations, pesticide trade name, EPA registration numbers, authorized uses, chemical composition, formulation, original and applied concentration, application rates of active ingredient (i.e. pounds of active ingredient applied), equipment used for application and calibration of equipment. Federal, State, Regional and Local pest management record keeping and reporting requirements as well as any additional Installation Project Office specific requirements are the Contractor's responsibility in conformance with DA AR 200-1 Chapter 5--Pest Management, Section 5-4 "Program requirements" for data required to be reported to the Installation.

1.7.4 Appendix

Attach to the Environmental Protection Plan, as an appendix, copies of all environmental permits, permit application packages, approvals to construct, notifications, certifications, reports, and termination documents.

1.8 PROTECTION FEATURES

This paragraph supplements the Contract Clause PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS. Prior to start of any onsite construction activities, the Contractor and the Contracting Officer will make a joint condition survey. Immediately following the survey, the Contractor will prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. This survey report will be signed by both the the Contractor and the Contracting Officer upon mutual agreement as to its accuracy and completeness. The Contractor must protect those environmental

features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the work under the contract.

1.8.1 Tree Protection

Tree preservation fencing shall be installed around trees in the work zone. The fencing shall be 6-foot high chain link fence attached to 1-5/8-inch outside diameter pipe with 11 gauge mesh in a 2-inch diamond pattern. The posts shall be driven into the ground a minimum of 2 feet. There shall be two entry points per section on the tree protection zone to allow mowing in these areas. Do not allow stock piling or storage of materials or parking of vehicles under the trees. Root pruning will be conducted by the Arlington National Cemetery (ANC) Urban Forester as needed.

1.9 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Deviations from the drawings, plans, and specifications requested by the Contractor and which may have an environmental impact, will be subject to approval by the Contracting Officer and may require an extended review, processing, and approval time. The Contracting Officer reserves the right to disapprove alternate methods, even if they are more cost effective, if the Contracting Officer determines that the proposed alternate method will have an adverse environmental impact.

1.10 NOTIFICATION

The Contracting Officer will notify the Contractor in writing of any observed noncompliance with Federal, State or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection plan. After receipt of such notice, the Contractor will inform the Contracting Officer of the proposed corrective action and take such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions will be granted or equitable adjustments allowed for any such suspensions. This is in addition to any other actions the Contracting Officer may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 ENVIRONMENTAL PERMITS AND COMMITMENTS

Obtaining and complying with all environmental permits and commitments required by Federal, State, Regional, and local environmental laws and regulations is the Contractor's responsibility.

3.2 LAND RESOURCES

Confine all activities to areas defined by the drawings and specifications. Identify any land resources to be preserved within the work area prior to the beginning of any construction. Contractor shall hire a certified Virginia Professional Wetland Delineator to flag the existing wetland boundaries as shown in the Jurisdictional Determination (COE

#NAO-2011-02220) prior to construction. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval, except in areas indicated on the drawings or specified to be cleared. Ropes, cables, or guys will not be fastened to or attached to any trees for anchorage unless specifically authorized. Provide effective protection for land and vegetation resources at all times, as defined in the following subparagraphs. Remove stone, soil, or other materials displaced into uncleared areas.

3.2.1 Work Area Limits

Mark the areas that need not be disturbed under this contract prior to commencing construction activities. Mark or fence isolated areas within the general work area which are not to be disturbed. Contractor shall hire a certified Virginia Professional Wetland Delineator to flag the existing wetland boundaries as shown in the Jurisdictional Determination (COE #NAO-2011-02220) prior to construction. Protect monuments and markers before construction operations commence. Where construction operations are to be conducted during darkness, any markers must be visible in the dark. The Contractor's personnel must be knowledgeable of the purpose for marking and/or protecting particular objects.

3.2.2 Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved must be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques. Restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

3.2.3 Erosion and Sediment Controls

Providing erosion and sediment control measures in accordance with Federal, State, and local laws and regulations is the Contractor's responsibility. Select and maintain the erosion and sediment controls such that water quality standards are not violated as a result of construction activities. The area of bare soil exposed at any one time by construction operations should be kept to a minimum. Construct or install temporary and permanent erosion and sediment control best management practices (BMPs) as specified in Section 01 57 23 TEMPORARY STORM WATER POLLUTION CONTROL. BMPs may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and outfall protection, diversion channels, and sedimentation basins. Remove any temporary measures after the area has been stabilized.

3.2.4 Contractor Facilities and Work Areas

Place field offices, staging areas, stockpile storage, and temporary buildings in areas designated on the drawings or as directed by the Contracting Officer. Temporary movement or relocation of Contractor facilities will be made only when approved. Erosion and sediment controls must be provided for onsite borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas must be controlled to protect adjacent areas.

3.3 WATER RESOURCES

Monitor all water areas affected by construction activities to prevent

pollution of surface and ground waters. Do not apply toxic or hazardous chemicals to soil or vegetation unless otherwise indicated. For construction activities immediately adjacent to impaired surface waters, the Contractor must be capable of quantifying sediment or pollutant loading to that surface water when required by State or Federally issued Clean Water Act permits.

3.3.1 Stream Crossings

Stream crossings must allow movement of materials or equipment without violating water pollution control standards of the Federal, State, and local governments.

3.3.2 Wetlands

D0 not enter, disturb, destroy, or allow discharge of contaminants into any wetlands

3.4 AIR RESOURCES

Equipment operation, activities, or processes will be in accordance with all Federal and State air emission and performance laws and standards.

3.4.1 Particulates

Dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials, such as from asphaltic batch plants; must be controlled at all times, including weekends, holidays and hours when work is not in progress. Maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates which would cause the Federal, State, and local air pollution standards to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. Provide sufficient, competent equipment available to accomplish these tasks. Perform particulate control as the work proceeds and whenever a particulate nuisance or hazard occurs. Comply with all State and local visibility regulations.

3.4.2 Odors

Odors from construction activities must be controlled at all times. The odors must be in compliance with State regulations and/or local ordinances and may not constitute a health hazard.

3.4.3 Sound Intrusions

Keep construction activities under surveillance and control to minimize environment damage by noise. Comply with the provisions of the Commonwealth of Virginia and Arlington County rules.

3.4.4 Burning

Burning is prohibited on the Government premises.

3.5 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Use of chemicals on site shall meet EPA guidelines for use and Commonwealth of Virginia law for licensed applicator requirements, if applicable, and shall not be used without prior review and consent of the Contracting Officer. Disposal of wastes will be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

3.5.1 Solid Wastes

Place solid wastes (excluding clearing debris) in containers which are emptied on a regular schedule. Handling, storage, and disposal must be conducted to prevent contamination. Employ segregation measures so that no hazardous or toxic waste will become co-mingled with solid waste. Transport solid waste off Government property and dispose of it in compliance with Federal, State, and local requirements for solid waste disposal. A Subtitle D RCRA permitted landfill will be the minimum acceptable offsite solid waste disposal option. Verify that the selected transporters and disposal facilities have the necessary permits and licenses to operate. Comply with Federal, State, and local laws and regulations pertaining to the use of landfill areas.

3.5.2 Chemicals and Chemical Wastes

Dispense chemicals ensuring no spillage to the ground or water. Perform and document periodic inspections of dispensing areas to identify leakage and initiate corrective action. This documentation will be periodically reviewed by the Government. Collect chemical waste in corrosion resistant, compatible containers. Collection drums must be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Wastes will be classified, managed, stored, and disposed of in accordance with Federal, State, and local laws and regulations.

3.5.3 Contractor Generated Hazardous Wastes/Excess Hazardous Materials

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable State and local regulations. Hazardous materials are defined in 49 CFR 171 - 178. At a minimum, manage and store hazardous waste in compliance with 40 CFR 262 in accordance with the Installation hazardous waste management plan. Take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing. Segregate hazardous waste from other materials and wastes, protect it from the weather by placing it in a safe covered location, and take precautionary measures such as berming or other appropriate measures against accidental spillage. Storage, describing, packaging, labeling, marking, and placarding of hazardous waste and hazardous material in accordance with 49 CFR 171 - 178, State, and local laws and regulations is the Contractor's responsibility. Transport Contractor generated hazardous waste off Government property within 60 days in accordance with the Environmental Protection Agency and the Department of Transportation laws and regulations. Dispose of hazardous waste in compliance with Federal, State and local laws and regulations. Spills of hazardous or toxic materials must be immediately reported to the Contracting Officer and the Facility Environmental Office. Cleanup and cleanup costs due to spills are the Contractor's responsibility. The disposition of Contractor generated hazardous waste and excess hazardous materials are the Contractor's responsibility.

3.5.4 Fuel and Lubricants

Storage, fueling and lubrication of equipment and motor vehicles must be conducted in a manner that affords the maximum protection against spill and evaporation. Manage and store fuel, lubricants and oil in accordance with all Federal, State, Regional, and local laws and regulations. Used lubricants and used oil to be discarded must be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations. Storage of fuel on the project site is not allowed. Fuel must be brought to the project site each day that work is performed.

3.5.5 Waste Water

Disposal of waste water will be as specified below.

a. Waste water from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, forms, etc. will not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. Dispose of the construction related waste water off-Government property in accordance with all Federal, State, Regional and Local laws and regulations.

b. For discharge of ground water, the Contractor shall obtain a State or Federal permit specific for pumping and discharging ground water prior to surface discharging. Surface discharge in accordance with all Federal, State, and local laws and regulations.

c. Water generated from the flushing of lines after hydrostatic testing will be land applied in accordance with all Federal, State, and local laws and regulations for land application .

3.6 RECYCLING AND WASTE MINIMIZATION

Participate in State and local government sponsored recycling programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project. .

3.7 NON-HAZARDOUS SOLID WASTE DIVERSION REPORT

Maintain an inventory of non-hazardous solid waste diversion and disposal of construction and demolition debris. Submit a report to Installation through the Contracting Officer on the first working day after each fiscal year quarter, starting the first quarter that non-hazardous solid waste has been generated. Include the following in the report:

a. Construction and Demolition (C&D) Debris Disposed = in cubic yards or tons, as appropriate.

b. Construction and Demolition (C&D) Debris Recycled = in cubic yards or tons, as appropriate.

c. Total C&D Debris Generated = in cubic yards or tons, as appropriate.

d. Waste Sent to Waste-To-Energy Incineration Plant (This amount should not be included in the recycled amount) = in cubic yards

or tons, as appropriate.

3.8 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources will be temporarily suspended. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, immediately notify the Contracting Officer so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. Cease all activities that may result in impact to or the destruction of these resources. Secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

3.8.1 Archaeologist Responsibilities and Duties

Contractor shall provide a qualified archaeologist to conduct continuous on-site monitoring during the following construction activities associated with the Chaffee Place Parking Lot Stormwater Retrofit and Channel restoration:

a. The duration of the channel restoration.

b. Excavation of the underground detention system, associated structures, and inflow and outflow pipes.

c. During the pavement removal.

Similarly, Contractor shall provide a qualified archaeologist to conduct continuous on-site monitoring during the following construction activities associated with the main Millennium Project Site:

a. All excavation activities in the "stump dump" area.

b. All activities in the vicinity of the marker for "Beja".

The qualified archaeologist that monitors the excavation in the vicinity of "Beja" shall be familiar with equine osteology in the event that partial remains are encountered and need to be identified. During all other excavation activities a qualified archaeologist shall be on-call with a four hour (half day) within working hours response time.

3.9 BIOLOGICAL RESOURCES

Minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The protection of threatened and endangered animal and plant species, including their habitat, is the Contractor's responsibility in accordance with Federal, State, Regional, and local laws and regulations.

Threatened and endangered species were not identified in the project area; however, the Environmental Assessment states that special protective measures should be taken for the Northern Two-line Salamanders and other amphibians that may be encountered. Also, the State Threatened Bald Eagle

and other migratory birds may pass through and use areas within the project site. Encounters with these birds should be addressed.

3.10 PREVIOUSLY USED EQUIPMENT

Clean all previously used construction equipment prior to bringing it onto the project site. Ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. Consult with the USDA jurisdictional office for additional cleaning requirements.

3.11 MAINTENANCE OF POLLUTION FACILITIES

Maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

3.12 MILITARY MUNITIONS

In the event military munitions, as defined in 40 CFR 260, are discovered or uncovered, the Contractor will immediately stop work in that area and immediately inform the Contracting Officer.

3.13 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel must be trained in all phases of environmental protection and pollution control. Conduct environmental protection/pollution control meetings for all personnel prior to commencing construction activities. Additional meetings must be conducted for new personnel and when site conditions change. Include in the training and meeting agenda: methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

3.14 POST CONSTRUCTION CLEANUP

The Contractor shall clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up". Unless otherwise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area must be graded, filled and the entire area seeded unless otherwise indicated.

-- End of Section --

SECTION 01 57 23

TEMPORARY STORM WATER POLLUTION CONTROL
04/08

PART 1 GENERAL

1.1 SUMMARY

The work consists of implementing the storm water pollution prevention measures to prevent sediment from entering streams or water bodies as specified in this Section in conformance with the requirements of Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION, and the requirements of the National Pollutant Discharge Elimination System (NPDES).

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D4439	(2011) Geosynthetics
ASTM D4491	(1999a; R 2009) Water Permeability of Geotextiles by Permittivity
ASTM D4533	(2011) Trapezoid Tearing Strength of Geotextiles
ASTM D4632	(2008) Grab Breaking Load and Elongation of Geotextiles
ASTM D4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D4873	(2002; R 2009) Identification, Storage, and Handling of Geosynthetic Rolls and Samples

1.3 EROSION AND SEDIMENT CONTROLS

The controls and measures required of the Contractor are described below.

1.3.1 Stabilization Practices

The stabilization practices to be implemented include temporary seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, erosion control matts, protection of trees, preservation of mature vegetation, etc. On the daily CQC Report, record the dates when the major grading activities occur, (e.g., clearing and grubbing, excavation, embankment, and grading); when construction activities temporarily or permanently cease on a portion of the site; and when stabilization practices are initiated. Except as provided in paragraphs UNSUITABLE CONDITIONS and NO ACTIVITY FOR LESS THAN 21 DAYS, initiate stabilization practices as soon as practicable, but no more than 14 days, in any portion of the site where construction activities

have temporarily or permanently ceased.

1.3.1.1 Unsuitable Conditions

Where the initiation of stabilization measures by the fourteenth day after construction activity temporarily or permanently ceases or is precluded by unsuitable conditions caused by the weather, initiate stabilization practices as soon as practicable after conditions become suitable.

1.3.1.2 Protection of Erodible Soils

Immediately finish the earthwork brought to a final grade, as indicated or specified, and protect the side slopes and back slopes upon completion of rough grading. Plan and conduct earthwork to minimize the duration of exposure of unprotected soils.

1.3.2 Erosion, Sediment and Stormwater Control

a. Submit "Erosion and Sediment Controls" (E&S) (form provided at the pre-construction conference) and Storm Water Inspection Reports for General Permit to the Contracting Officer once every 7 calendar days and within 24 hours of a storm event that produces 0.5 inch or more of rain.

b. Storm Water Notice of Intent for Construction Activities

c. Submit a Storm Water Notice of Intent for NPDES and Virginia Pollutant Discharge Elimination System (VPDES), coverage under the general permit for construction activities and a Storm Water Pollution Prevention Plan (SWPPP) for the project to the Contracting Officer prior to the commencement of work. The SWPPP shall meet the requirements of the Commonwealth of Virginia Department of Environmental Quality (DEQ) general permit for storm water discharges from construction sites. Submit the SWPPP along with any required Notice of Intents, Notice of Termination, and appropriate permit fees, via the Contracting Officer, to the appropriate State agency for approval, a minimum of 14 calendar days prior to the start of any land disturbing activities. Maintain an approved copy of the SWPPP at the construction on-site office, and continually update as regulations require, to reflect current site conditions. Include within the SWPPP:

(1) Identify potential sources of pollution which may be reasonably expected to affect the quality of storm water discharge from the site.

(2) Describe and ensure implementation of practices which will be used to reduce the pollutants in storm water discharge from the site.

(3) Ensure compliance with terms of the Commonwealth of Virginia general permit for storm water discharge.

(4) Select applicable best management practices from EPA 832-R-92-005.

(5) Include a completed copy of the Registration Statement, BMP Inspection Report Template and Notice of Termination except for the effective date.

(6) Storm Water Pollution Prevention Measures and Notice of Intent 40

CFR 122.26, EPA 832-R-92-005. Provide a "Storm Water Pollution Prevention Plan" (SWPPP) for the project. The SWPPP will meet the requirements of the Commonwealth of Virginia general permit for storm water discharges from construction activities. Submit the SWPPP to the Contracting Officer for review, approval and signature a minimum of 15 days prior to the start of any land disturbing activities. Maintain an approved copy of the SWPPP at the construction on-site office, and continually update as regulations require, to reflect current site conditions.

(7) Following SWPPP approval, submit Registration Statement and appropriate permit fees to the Virginia Department of Conservation and Recreation (DCR) before any land disturbing activities begin. Coverage under the permit begins on the day the Registration Statement and fee are: (1) post marked by mail, (2) registered online at the DCR's website, or (3) hand delivered to the DCR office. The Contractor is responsible for all associated fees; contact DCR to determine applicable fees.

(8) Install, inspect, and maintain best management practices (BMPs) as required by the general permit. Prepare and submit to DCR, BMP Inspection Reports as required by the general permit.

(9) Once construction is complete and the site has been stabilized with a final, sustainable cover, submit the Notice of Termination to DCR within 30 days after all land disturbing activities end.

(10) Information on the permit application, SWPPP requirements, Registration Statement, BMP Inspection Reports, and Notice of Termination can be found in the Virginia Permit Regulation 9 VAC 25-180. The Registration Statement, Notice of Termination, and permit fee forms can be found on the DCR website http://www.dcr.state.va.us/sw/vsmp.htm. This website also contains the permit regulations and information on how to obtain coverage online.

(11) Once construction is complete and the site has been stabilized with a final, sustainable cover, submit the Notice of Termination to DCR within 30 days after all land disturbing activities end.

1.3.3 Structural Practices

Implement structural practices to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Implement structural practices in a timely manner, during the construction process, to minimize erosion and sediment runoff. Include the following devices; Location and details of installation and construction are shown on the drawings.

1.3.3.1 Silt Fences

Provide silt fences as a temporary structural practice to minimize erosion and sediment runoff. Properly install silt fences to effectively retain sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g. clearing and grubbing, excavation, embankment, and grading). Install silt fences in the locations indicated on the drawings. Obtain approval from the Contracting Officer prior to final removal of silt fence barriers.

1.3.3.2 Diversion Dikes

Build diversion dikes with a maximum channel slope of 2 percent and adequately compacted to prevent failure. The minimum height measured from the top of the dike to the bottom of the channel shall be 18 inches. The minimum base width shall be 6 feet and the minimum top width shall be 2 feet. Ensure that the diversion dikes are not damaged by construction operations or traffic. Locate diversion dikes where shown on the drawings.

1.3.4 Sediment Basins

Trap sediment in temporary sediment basins. Select a basin size to accommodate the runoff of a local 2-year storm and safely pass the 25-year event. Pump dry and remove the accumulated sediment, after each storm. Use a paved weir or vertical overflow pipe for overflow. Remove collected sediment from the site. Institute effluent quality monitoring programs. Install, inspect, and maintain best management practices (BMPs) as required by the general permit. Prepare BMP Inspection Reports as required by the general permit. If required by the permit, include those inspection reports.

1.3.5 Vegetation and Mulch

a. Provide temporary protection on sides and back slopes as soon as rough grading is completed or sufficient soil is exposed to require erosion protection. Protect slopes by accelerated growth of permanent vegetation, temporary vegetation, mulching, or netting. Stabilize slopes by hydroseeding, anchoring mulch in place, covering with anchored netting, sodding, or such combination of these and other methods necessary for effective erosion control.

b. Seeding: Provide new seeding where ground is disturbed. Include topsoil or nutriment during the seeding operation necessary to establish a suitable stand of grass. The seeding operation will be as specified in Section 32 92 19 SEEDING.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Storm Water Pollution Prevention Plan; G
Storm Water Notice of Intent; G

SD-06 Test Reports

Registration Statement
BMP Inspection Report Template and Notice of Termination
Storm Water Inspection Reports for General Permit; G
Erosion and Sediment Controls; G

SD-07 Certificates

Mill Certificate or Affidavit; G

1.5 DELIVERY, STORAGE, AND HANDLING

Identify, store and handle filter fabric in accordance with ASTM D4873.

PART 2 PRODUCTS

2.1 COMPONENTS FOR SILT FENCES

2.1.1 Filter Fabric

Provide geotextile that complies with the requirements of ASTM D4439, and consists of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. The filament shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of ester, propylene, or amide, and contains stabilizers and/or inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultraviolet and heat exposure. Provide synthetic filter fabric that contains ultraviolet ray inhibitors and stabilizers to assure a minimum of six months of expected usable construction life at a temperature range of 0 to 120 degrees F. The filter fabric shall meet the following requirements:

FILTER FABRIC FOR SILT SCREEN FENCE		
PHYSICAL PROPERTY	TEST PROCEDURE	STRENGTH REQUIREMENT
Grab Tensile Elongation (percent)	ASTM D4632	100 lbs. min. 30 percent max.
Trapezoid Tear	ASTM D4533	55 lbs. min.
Permittivity	ASTM D4491	0.2 sec-1
AOS (U.S. Std Sieve)	ASTM D4751	20-100

2.1.2 Silt Fence Stakes and Posts

Use either wooden stakes or steel posts for fence construction. Wooden stakes utilized for silt fence construction, shall have a minimum cross section of 2 by 2 inches when oak is used and 4 by 4 inches when pine is used, and have a minimum length of 5 feet. Steel posts (standard "U" or "T" section) utilized for silt fence construction, shall have a minimum weight of 1.33 pounds/linear foot and a minimum length of 5 feet.

2.1.3 Mill Certificate or Affidavit

Provide a mill certificate or affidavit attesting that the fabric and factory seams meet chemical, physical, and manufacturing requirements specified above. Specify in the mill certificate or affidavit the actual Minimum Average Roll Values and identify the fabric supplied by roll identification numbers. Submit a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the filter fabric.

PART 3 EXECUTION

3.1 INSTALLATION OF SILT FENCES

Extend silt fences a minimum of 16 inches above the ground surface without exceeding 34 inches above the ground surface. Provide filter fabric from a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, splice together filter fabric at a support post, with a minimum 6 inch overlap, and securely sealed. Excavate trench approximately 4 inches wide and 4 inches deep on the upslope side of the location of the silt fence. The 4 by 4 inch trench shall be backfilled and the soil compacted over the filter fabric. Remove silt fences upon approval by the Contracting Officer.

3.2 FIELD QUALITY CONTROL

Maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures. Use the following procedures to maintain the protective measures.

3.2.1 Silt Fence Maintenance

Inspect the silt fences in accordance with paragraph, titled "Inspections," of this section. Any required repairs shall be made promptly. Pay close attention to the repair of damaged silt fence resulting from end runs and undercutting. Should the fabric on a silt fence decompose or become ineffective, and the barrier is still necessary, replace the fabric promptly. Remove sediment deposits when deposits reach one-third of the height of the barrier. Remove a silt fence when it is no longer required. The immediate area occupied by the fence and any sediment deposits shall be shaped to an acceptable grade. The areas disturbed by this shaping shall receive erosion control and be seeded in accordance with Section 32 05 33 LANDSCAPE ESTABLISHMENT, except that the coverage requirements in paragraph, titled "Establishment" of this section do not apply.

3.2.2 Diversion Dike Maintenance

Inspect diversion dikes in accordance with paragraph, titled "Inspections," of this section. Pay close attention to the repair of damaged diversion dikes and accomplish necessary repairs promptly. When diversion dikes are no longer required, shape to an acceptable grade. Seed the areas disturbed by this shaping in accordance with Section 32 92 19 SEEDING.

3.3 INSPECTIONS

3.3.1 General

Inspect disturbed areas of the construction site, areas that have not been finally stabilized used for storage of materials exposed to precipitation, stabilization practices, structural practices, other controls, and area where vehicles exit the site at least once every seven (7) calendar days and within 24 hours of the end of any storm that produces 0.5 inches or more rainfall at the site. Conduct inspections at least once every month where sites have been finally stabilized.

3.3.2 Inspections Details

Inspect disturbed areas and areas used for material storage that are exposed to precipitation for evidence of, or the potential for, pollutants entering the drainage system. Observe erosion and sediment control measures identified in the Storm Water Pollution Prevention Plan to ensure that they are operating correctly. Inspect discharge locations or points to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Inspect locations where vehicles exit the site for evidence of offsite sediment tracking.

3.3.3 Inspection Reports

For each inspection conducted, prepare a report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the Storm Water Pollution Prevention Plan, maintenance performed, and actions taken. Furnish the report to the Contracting Officer within 24 hours of the inspection as a part of the Contractor's daily CQC Report. A copy of the inspection report shall be maintained on the job site.

3.3.4 Monthly Inspection Report and Certification Form

Complete, sign, and submit the original form, on the first working day of each month, to the Commonwealth of Virginia, Office of Pollution Control (OPC).

In addition, furnish on the first working day of each month one copy of the form submitted to the Contracting Officer as part of the Contractor's daily CQC Report and attach a copy of the completed form to the Plan. Unless otherwise notified, submit the Monthly Inspection Report and Certification Forms for an additional two months after the final completion of all storm water pollution prevention measures required in this contract have been implemented.

-- End of Section --

SECTION 01 58 00

PROJECT IDENTIFICATION
08/09

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EP 310-1-6a	(2006) Sign Standards Manual, VOL 1
EP 310-1-6b	(2006) Sign Standards Manual, VOL 2, Appendices

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Sign Legend Orders

1.3 PROJECT SIGN

1.3.1 Construction Project Signs (USACE)

Furnish the construction project identification sign package, maintain the signs during construction, and remove the signs from the job site upon completion of the project. The construction project sign package consists of two signs: one for project identification and the other to show the on-the-job safety performance of the contractor. The package shall conform to the requirements of EP 310-1-6a and EP 310-1-6b, specifically Section 16. Submit the sign legend orders as described in Section 16 of EP 310-1-6a prior to erecting the signs.

1.3.2 Norfolk District Requirements

Coordinate with the Contracting Officer and the Norfolk District PM for current requirements for producing and placing the Safety and Project signs.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 62 35

RECYCLED / RECOVERED MATERIALS

07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.2 OBJECTIVES

Government procurement policy is to acquire, in a cost effective manner, items containing the highest percentage of recycled and recovered materials practicable consistent with maintaining a satisfactory level of competition without adversely affecting performance requirements or exposing suppliers' employees to undue hazards from the recovered materials. The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. EPA designated products specified in this contract comply with the stated policy and with the EPA guidelines. Make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work.

1.3 EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

Various sections of the specifications contain requirements for materials that have been designated by EPA as being products which are or can be made with recovered or recycled materials. These items, when incorporated into the work under this contract, shall contain at least the specified percentage of recycled or recovered materials unless adequate justification (non-availability) for non-use is provided. When a designated item is specified as an option to a non-designated item, the designated item requirements apply only if the designated item is used in the work.

1.4 EPA PROPOSED ITEMS INCORPORATED IN THE WORK

Products other than those designated by EPA are still being researched and are being considered for future Comprehensive Procurement Guideline (CPG) designation. It is recommended that these items, when incorporated in the work under this contract, contain the highest practicable percentage of recycled or recovered materials, provided specified requirements are also met.

1.5 EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

Many products listed in 40 CFR 247 have been designated or proposed by EPA to include recycled or recovered materials that may be used by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials and that these products be recycled when no longer needed.

PART 2 TITLE

Not Used

PART 3 TITLE

Not Used

-- End of Section --

SECTION 01 74 19

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT
01/07

PART 1 GENERAL

1.1 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse. A minimum of 50 percent by weight of total project solid waste shall be diverted from the landfill.

1.2 MANAGEMENT

Develop and implement a waste management program. Take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor is responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained for salvage, or recycling accrue to the Contractor. Appropriately permit firms and facilities used for recycling, reuse, and disposal for the intended use to the extent required by federal, state, and local regulations. Also, provide on-site instruction of appropriate separation, handling, recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Waste Management Plan; G

SD-11 Closeout Submittals

Records; G

1.4 MEETINGS

Conduct Construction Waste Management meetings. After award of the Contract and prior to commencement of work, schedule and conduct a meeting with the Contracting Officer to discuss the proposed Waste Management Plan and to develop a mutual understanding relative to the details of waste management. The requirements for this meeting may be fulfilled during the coordination and mutual understanding meeting outlined in Section 01 45 00.00 10 QUALITY CONTROL. At a minimum, environmental and waste management goals and issues shall be discussed at the following additional meetings:

a. Pre-bid meeting.

b. Preconstruction meeting.

c. Regular QC meetings.

d. Work safety meetings.

1.5 WASTE MANAGEMENT PLAN

A waste management plan shall be submitted within 15 days after notice to proceed and not less than 10 days before the preconstruction meeting. The plan shall demonstrate how the project waste diversion goal shall be met and shall include the following:

a. Name of individuals on the Contractor's staff responsible for waste prevention and management.

b. Actions that will be taken to reduce solid waste generation, including coordination with subcontractors to ensure awareness and participation.

c. Description of the regular meetings to be held to address waste management.

d. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas on site and equipment to be used for processing, sorting, and temporary storage of wastes.

e. Characterization, including estimated types and quantities, of the waste to be generated.

f. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.

g. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity. Include the name, location, and phone number for each reuse facility to be used, and provide a copy of the permit or license for each facility.

h. List of specific waste materials that will be salvaged for resale, salvaged and reused on the current project, salvaged and stored for reuse on a future project, or recycled. Recycling facilities that will be used shall be identified by name, location, and phone number,

including a copy of the permit or license for each facility.

i. Identification of materials that cannot be recycled/reused with an explanation or justification, to be approved by the Contracting Officer.

j. Description of the means by which any waste materials identified in item (h) above will be protected from contamination.

k. Description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site).

l. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

Revise and resubmit Plan as required by the Contracting Officer. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations or meeting project cumulative waste diversion requirement. Distribute copies of the Waste Management Plan to each subcontractor, the Quality Control Manager, and the Contracting Officer.

1.6 RECORDS

Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Quantities may be measured by weight or by volume, but must be consistent throughout. List each type of waste separately noting the disposal or diversion date. Identify the landfill, recycling center, waste processor, or other organization used to process or receive the solid waste. Provide explanations for any waste not recycled or reused. With each application for payment, submit updated documentation for solid waste disposal and diversion, and submit manifests, weight tickets, receipts, and invoices specifically identifying the project and waste material. The records shall be made available to the Contracting Officer during construction, and a copy of the records shall be delivered to the Contracting Officer upon completion of the construction.

1.7 REPORTS

Provide quarterly reports and a final report to the Contracting Officer. Quarterly and final reports shall include project name, information for waste generated this quarter, and cumulative totals for the project. Each report shall include supporting documentation to include manifests, weight tickets, receipts, and invoices specifically identifying the project and waste material. Include timber harvest and demolition information, if any.

1.8 COLLECTION

Separate, store, protect, and handle at the site identified recyclable and salvageable waste products in a manner that maximizes recyclability and salvagability of identified materials. Provide the necessary containers, bins and storage areas to facilitate effective waste management and clearly and appropriately identify them. Provide materials for barriers and enclosures around recyclable material storage areas which are nonhazardous

and recyclable or reusable. Locate out of the way of construction traffic. Provide adequate space for pick-up and delivery and convenience to subcontractors. Recycling and waste bin areas are to be kept neat and clean, and recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials. Clean contaminated materials prior to placing in collection containers. Use cleaning materials that are nonhazardous and biodegradable. Handle hazardous waste and hazardous materials in accordance with applicable regulations and coordinate with Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION. Separate materials by one of the following methods:

1.8.1 Source Separated Method

Waste products and materials that are recyclable shall be separated from trash and sorted as described below into appropriately marked separate containers and then transported to the respective recycling facility for further processing. Deliver materials in accordance with recycling or reuse facility requirements (e.g., free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process). Separate materials into the following category types as appropriate to the project waste and to the available recycling and reuse programs in the project area:

a. Land clearing debris.

b. Asphalt.

c. Concrete and masonry.

d. Metal (e.g. banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized, stainless steel, aluminum, copper, zinc, lead brass, bronze).

(1) Ferrous.

(2) Non-ferrous.

e. Wood (nails and staples allowed).

f. Debris.

g. Glass (colored glass allowed).

h. Paper.

(1) Bond.

(2) Newsprint.

(3) Cardboard and paper packaging materials.

i. Plastic.

(1) Type 1: Polyethylene Terephthalate (PET, PETE).

(2) Type 2: High Density Polyethylene (HDPE).

(3) Type 3: Vinyl (Polyvinyl Chloride or PVC).

(4) Type 4: Low Density Polyethylene (LDPE).

(5) Type 5: Polypropylene (PP).

(6) Type 6: Polystyrene (PS).

(7) Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

j. Gypsum.

k. Non-hazardous paint and paint cans.

l. Carpet.

m. Ceiling tiles.

n. Insulation.

o. Beverage containers.

1.8.2 Co-Mingled Method

Waste products and recyclable materials shall be placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed.

1.8.3 Other Methods

Other methods proposed by the Contractor may be used when approved by the Contracting Officer.

1.9 DISPOSAL

Control accumulation of waste materials and trash. Recycle or dispose of collected materials off-site at intervals approved by the Contracting Officer and in compliance with waste management procedures. Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

1.9.1 Reuse

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Coordinate reuse with the Contracting Officer. Sale or donation of waste suitable for reuse shall be considered.

1.9.2 Recycle

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling. All fluorescent lamps, HID lamps, and mercury-containing thermostats removed from the site shall be recycled. Arrange for timely pickups from the site or deliveries to recycling facilities in order to prevent contamination of recyclable materials.

1.9.3 Waste

Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

1.9.4 Return

Set aside and protect misdelivered and substandard products and materials and return to supplier for credit.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used. -- End of Section --

SECTION 01 78 00

CLOSEOUT SUBMITTALS
08/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 1-300-08	(2009, with Change 2) Criteria for Transfer and Acceptance of DoD Real Property

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

As-Built Record of Equipment and Materials; G
Warranty Management Plan; G
Warranty Tags; G
Spare Parts Data; G

SD-08 Manufacturer's Instructions

Preventative Maintenance
Condition Monitoring (Predictive Testing)
Inspection; G
Posted Instructions

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

SD-11 Closeout Submittals

Record Drawings; G
Interim Form DD1354; G
Checklist for Form DD1354; G

1.3 PROJECT RECORD DOCUMENTS

1.3.1 Record Drawings

Drawings showing final as-built conditions of the project. This paragraph

covers Record Drawings complete, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working Record Drawings" and "final Record Drawings" refer to Contract Drawings which are revised to be used for final Record Drawings showing as-built conditions. The final CAD Record Drawings must consist of one set of electronic CAD drawing files in the specified format, 2 sets of prints, and one set of the approved working Record Drawings.

1.3.1.1 Government Furnished Materials

One set of electronic CADD files in the specified software and format revised to reflect all bid amendments will be provided by the Government at the preconstruction conference for projects requiring CADD file Record Drawings.

1.3.1.2 Working Record and Final Record Drawings

Revise 2 sets of paper drawings by red-line process to show the as-built conditions during the prosecution of the project. Keep these working as-built marked drawings current on a weekly basis and at least one set available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction must be accurately and neatly recorded as they occur by means of details and notes. Prepare final Record (as-built) Drawings after the completion of each definable feature of work as listed in the Contractor Quality Control Plan (Foundations, Utilities, Structural Steel, etc., as appropriate for the project). The working as-built marked prints and final Record (as-built) Drawings will be jointly reviewed for accuracy and completeness by the Contracting Officer and the Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the working and final Record Drawings as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the Record Drawings. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and the Contractor regarding the accuracy and completeness of updated Drawings. Show on the working and final Record Drawings , but not limited to, the following information:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, show by offset dimensions to two permanently fixed surface features the end of each run including each change in direction on the Record Drawings. Locate valves, splice boxes and similar appurtenances by dimensioning along the utility run from a reference point. Also record the average depth below the surface of each run.

b. The location and dimensions of any changes within the building structure.

c. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

d. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection,

installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

e. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.

f. Changes or modifications which result from the final inspection.

g. Where Contract Drawings or specifications present options, show only the option selected for construction on the final as-built prints.

h. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, furnish a contour map of the final borrow pit/spoil area elevations.

i. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.

j. Modifications (include within change order price the cost to change working and final Record Drawings to reflect modifications) and compliance with the following procedures.

(1) Follow directions in the modification for posting descriptive changes.

(2) Place a Modification Circle at the location of each deletion.

(3) For new details or sections which are added to a drawing, place a Modification Circle by the detail or section title.

(4) For minor changes, place a Modification Circle by the area changed on the drawing (each location).

(5) For major changes to a drawing, place a Modification Delta by the title of the affected plan, section, or detail at each location.

(6) For changes to schedules or drawings, place a Modification Delta either by the schedule heading or by the change in the schedule.

(7) The Modification Circle and Delta size shall be 1/2 inch diameter unless the area where the circle is to be placed is crowded. Smaller size circle shall be used for crowded areas.

1.3.1.3 Drawing Preparation

Modify the Record Drawings as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with approved working as-built prints, and adding such additional drawings as may be necessary. These working as-built marked prints must be neat, legible and accurate. These drawings are part of the permanent records of this project and must be returned to the Contracting Officer after approval by the Government. Any drawings damaged or lost by the Contractor must be satisfactorily replaced by the Contractor at no expense to the Government.

1.3.1.4 Computer Aided Design and Drafting (CADD) Drawings

Only employ personnel proficient in the preparation of CADD drawings to modify the Contract Drawings or prepare additional new drawings. Additions

and corrections to the Contract Drawings must be equal in quality and detail to that of the originals. Line colors, line weights, lettering, layering conventions, and symbols must be the same as the original line colors, line weights, lettering, layering conventions, and symbols. If additional drawings are required, prepare them using the specified electronic file format applying the same graphic standards specified for original drawings. The title block and drawing border to be used for any new final Record Drawings must be identical to that used on the Contract Drawings. Accomplish additions and corrections to the Contract Drawings using CADD files. The Contractor will be furnished "as-designed" drawings in AutoCad Release format compatible with a Windows XP operating system. The electronic files will be supplied on compact disc, read-only memory (CD-ROM). Provide all program files and hardware necessary to prepare final Record Drawings. The Contracting Officer will review final Record Drawings for accuracy and return them to the Contractor for required corrections, changes, additions, and deletions.

a. Provide CADD "base" colors of red, green, and blue. Color code for changes as follows:

(1) Deletions (Red) - Over-strike deleted graphic items (lines), lettering in notes and leaders.

(2) Additions (Green) - Added items, lettering in notes and leaders.

(3) Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes.

b. Rename the Contract Drawing files in a manner related to the contract number (i.e., 98-C-10.DGN) as instructed in the Pre-Construction conference. Use only those renamed files for the Marked-up changes. All changes shall be made on the layer/level as the original item.

c. When final revisions have been completed, show the wording "RECORD DRAWINGS / AS-BUILT CONDITIONS" followed by the name of the Contractor in letters at least 3/16 inch high on the cover sheet drawing. Mark all other Contract Drawings either "Record" drawing denoting no revisions on the sheet or "Revised Record" denoting one or more revisions. Date original Contract Drawings in the revision block.

d. Within 20 days for contracts $5 million and above after Government approval of all of the working Record Drawings for a phase of work, prepare the final CADD Record Drawings for that phase of work and submit two sets of blue-lined prints of these drawings for Government review and approval. The Government will promptly return one set of prints annotated with any necessary corrections. Within 7 days for contracts less than $5 million 10 days for contracts $5 million and above revise the CADD files accordingly at no additional cost and submit one set of final prints for the completed phase of work to the Government. Within 20 days for contracts $5 million and above of substantial completion of all phases of work, submit the final Record drawing package for the entire project. Submit one set of electronic files on compact disc, read-only memory (CD-ROM), one set of mylars, two sets of blue-line prints and one set of the approved working Record Drawings. They must be complete in all details and identical in form and function to the contract drawing files supplied by the Government. Any transactions or adjustments necessary to accomplish this is the responsibility of the Contractor. The Government reserves the right to reject any drawing files it deems incompatible with the customer's CADD

system. Paper prints, drawing files and storage media submitted will become the property of the Government upon final approval. Failure to submit final Record drawing files and marked prints as specified will be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of final Record Drawings must be accomplished before final payment is made to the Contractor.

1.3.1.5 Payment

No separate payment will be made for Record Drawings required under this contract, and all costs accrued in connection with such drawings are considered a subsidiary obligation of the Contractor.

1.3.2 As-Built Record of Equipment and Materials

Furnish one copy of preliminary record of equipment and materials used on the project 15 days prior to final inspection. This preliminary submittal will be reviewed and returned 2 days after final inspection with Government comments. Submit 2 sets of final record of equipment and materials 10 days after final inspection. Key the designations to the related area depicted on the Contract Drawings. List the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA				
Description	Specification Section	Manufacturer and Catalog, Model, and Serial Number	Composition and Size	Where Used

1.3.3 Final Approved Shop Drawings

Furnish final approved project shop drawings 30 days after transfer of the completed facility.

1.3.4 Construction Contract Specifications

Furnish final Record (as-built) construction contract specifications, including modifications thereto, 30 days after transfer of the completed facility.

1.3.5 Real Property Equipment

Furnish a list of installed equipment furnished under this contract. Include all information usually listed on manufacturer's name plate. In the "EQUIPMENT-IN-PLACE LIST" include, as applicable, the following for each piece of equipment installed: description of item, location (by room number), model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. Furnish a draft list at time of transfer. Furnish the final list 30 days after transfer of the completed facility.

1.4 SPARE PARTS DATA

Submit two copies of the Spare Parts Data list.

a. Indicate manufacturer's name, part number, nomenclature, and stock

level required for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

b. Supply one item of each part for spare parts inventory. Provision of spare parts does not relieve the Contractor of responsibilities listed under the contract guarantee provisions.

1.5 PREVENTATIVE MAINTENANCE

Submit Preventative Maintenance, Condition Monitoring (Predictive Testing) and Inspection schedules with instructions that state when systems should be retested.

a. Define the anticipated length of each test, test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements within the schedule. Provide a signoff blank for the Contractor and Contracting Officer for each test feature; e.g., gpm, rpm, psi. Include a remarks column for the testing validation procedure referencing operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventative maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

b. Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

1.6 WARRANTY MANAGEMENT

1.6.1 Warranty Management Plan

Develop a warranty management plan which contains information relevant to the clause Warranty of Construction. At least 30 days before the planned pre-warranty conference, submit two sets of the warranty management plan. Include within the warranty management plan all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan must be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below must include due date and whether item has been submitted or was accomplished. Warranty information made available during the construction phase must be submitted to the Contracting Officer for approval prior to each monthly pay estimate. Assemble approved information in a binder and turn over to the Government upon acceptance of the work. The construction warranty period will begin on the date of project acceptance and continue for the full product warranty period. A joint 4 month and 9 month warranty inspection will be conducted, measured from time of acceptance, by the Contractor, Contracting Officer and the Customer Representative. Include within the warranty management plan , but not limited to, the following:

a. Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the Contractors, subcontractors, manufacturers or suppliers involved.

b. Furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.

c. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and for all commissioned systems such as fire protection and alarm systems, sprinkler systems, lightning protection systems, etc.

d. A list for each warranted equipment, item, feature of construction or system indicating:

(1) Name of item.
(2) Model and serial numbers.
(3) Location where installed.
(4) Name and phone numbers of manufacturers or suppliers.
(5) Names, addresses and telephone numbers of sources of spare parts.
(6) Warranties and terms of warranty. Include one-year overall warranty of construction, including the starting date of warranty of construction. Items which have extended warranties must be indicated with separate warranty expiration dates.
(7) Cross-reference to warranty certificates as applicable.
(8) Starting point and duration of warranty period.
(9) Summary of maintenance procedures required to continue the warranty in force.
(10) Cross-reference to specific pertinent Operation and Maintenance manuals.
(11) Organization, names and phone numbers of persons to call for warranty service.
(12) Typical response time and repair time expected for various warranted equipment.

e. The Contractor's plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.

f. Procedure and status of tagging of all equipment covered by extended warranties.

g. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

1.6.2 Performance Bond

The Contractor's Performance Bond must remain effective throughout the construction period .

a. In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the Contracting Officer will have the work performed by others, and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

b. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the Contractor's expense, the Contracting Officer will have the right to recoup expenses from the bonding company.

c. Following oral or written notification of required construction warranty repair work, respond in a timely manner. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Contracting Officer to proceed against the Contractor.

1.6.3 Pre-Warranty Conference

Prior to contract completion, and at a time designated by the Contracting Officer, meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty will be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warranted construction, be continuously available, and be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this provision.

1.6.4 Contractor's Response to Construction Warranty Service Requirements

Following oral or written notification by the Contracting Officer, respond to construction warranty service requirements in accordance with the "Construction Warranty Service Priority List" and the three categories of priorities listed below. Submit a report on any warranty item that has been repaired during the warranty period. Include within the report the cause of the problem, date reported, corrective action taken, and when the repair was completed. If the Contractor does not perform the construction warranty within the timeframes specified, the Government will perform the work and backcharge the construction warranty payment item established.

a. First Priority Code 1. Perform onsite inspection to evaluate situation, and determine course of action within 4 hours, initiate work within 6 hours and work continuously to completion or relief.

b. Second Priority Code 2. Perform onsite inspection to evaluate situation, and determine course of action within 8 hours, initiate work within 24 hours and work continuously to completion or relief.

c. Third Priority Code 3. All other work to be initiated within 3 work days and work continuously to completion or relief.

d. The "Construction Warranty Service Priority List" is as follows:

Code 1-Life Safety Systems
(1) Fire suppression systems.
(2) Fire alarm system(s) in place in the building.

Code 1-Air Conditioning Systems
(1) Recreational support.
(2) Air conditioning leak in part of building, if causing damage.
(3) Air conditioning system not cooling properly.

Code 1-Doors
(1) Overhead doors not operational, causing a security, fire, or safety problem.
(2) Interior, exterior personnel doors or hardware, not functioning properly, causing a security, fire, or safety problem.

Code 3-Doors
(1) Overhead doors not operational.
(2) Interior/exterior personnel doors or hardware not functioning properly.

Code 1-Electrical
(1) Power failure (entire area or any building operational after 1600 hours).
(2) Security lights
(3) Smoke detectors

Code 2-Electrical
(1) Power failure (no power to a room or part of building).
(2) Receptacle and lights (in a room or part of building).

Code 3-Electrical
Street lights.

Code 1-Gas
(1) Leaks and breaks.
(2) No gas to family housing unit or cantonment area.

Code 1-Heat
(1) Area power failure affecting heat.
(2) Heater in unit not working.

Code 2-Kitchen Equipment
(1) Dishwasher not operating properly.
(2) All other equipment hampering preparation of a meal.

Code 1-Plumbing
(1) Hot water heater failure.
(2) Leaking water supply pipes.

Code 2-Plumbing
(1) Flush valves not operating properly.
(2) Fixture drain, supply line to commode, or any water pipe leaking.
(3) Commode leaking at base.

Code 3 -Plumbing
Leaky faucets.

Code 3-Interior
(1) Floors damaged.
(2) Paint chipping or peeling.
(3) Casework.

Code 1-Roof Leaks
Temporary repairs will be made where major damage to property is occurring.

Code 2-Roof Leaks

Where major damage to property is not occurring, check for location of leak during rain and complete repairs on a Code 2 basis.

Code 2-Water (Exterior)
No water to facility.

Code 2-Water (Hot)
No hot water in portion of building listed.

Code 3-All other work not listed above.

1.6.5 Warranty Tags

At the time of installation, tag each warranted item with a durable, oil and water resistant tag approved by the Contracting Officer. Attach each tag with a copper wire and spray with a silicone waterproof coating. Also, submit two record copies of the warranty tags showing the layout and design. The date of acceptance and the QC signature must remain blank until the project is accepted for beneficial occupancy. Show the following information on the tag.

Type of product/material	
Model number	
Serial number	
Contract number	
Warranty period from/to	
Inspector's signature	
Construction Contractor	
Address	
Telephone number	
Warranty contact	
Address	
Telephone number	
Warranty response time priority code	
WARNING - PROJECT PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE DURING THE WARRANTY PERIOD.	

1.7 OPERATION AND MAINTENANCE MANUALS

Submit 6 copies of the project operation and maintenance manuals 30 calendar days prior to testing the system involved. Update and resubmit data for final approval no later than 30 calendar days prior to contract completion.

1.7.1 Configuration

Operation and Maintenance Manuals must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. Bind information in manual format and grouped by technical sections. Test data must be legible and of good quality. Light-sensitive reproduction techniques are acceptable provided finished pages are clear, legible, and not subject to fading. Pages for vendor data and manuals must have 0.3937-inch holes and be bound in 3-ring, loose-leaf binders. Organize data by separate index and tabbed sheets, in a loose-leaf binder. Binder must lie flat with printed sheets that are easy to read. Caution and warning indications must be clearly labeled.

1.7.2 Training and Instruction

Submit classroom and field instructions for up to 12 Government employees in the operation and maintenance of systems equipment where required by the technical provisions. These services must be directed by the Contractor, using the manufacturer's factory-trained personnel or qualified representatives. Contracting Officer will be given 7 calendar days written notice of scheduled instructional services. Instructional materials belonging to the manufacturer or vendor, such as lists, static exhibits, and visual aids, must be made available to the Contracting Officer.

1.8 CLEANUP

Leave premises "broom clean." Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces. Clean equipment and fixtures to a sanitary condition. Clean filters of operating equipment. Clean debris from roofs, gutters, downspouts and drainage systems. Sweep paved areas and rake clean landscaped areas. Remove waste and surplus materials, rubbish and construction facilities from the site.

1.9 REAL PROPERTY RECORD

Near the completion of Project, but a minimum of 60 days prior to final acceptance of the work, complete, update draft attached to this section, and submit an accounting of all installed property with Interim Form DD1354 "Transfer and Acceptance of Military Real Property." Include any additional assets/improvements/alterations from the Draft DD Form 1354. Contact the Contracting Officer for any project specific information necessary to complete the DD Form 1354. Refer to UFC 1-300-08 for instruction on completing the DD Form 1354. For information purposes, a blank DD Form 1354 (fill-able) in ADOBE (PDF) may be obtained at the following web site:
http://www.dtic.mil/whs/directives/infomgt/forms/eforms/dd1354.pdf

Submit the completed Checklist for Form DD1354 of Installed Building Equipment items. Attach this list to the updated DD Form 1354.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA
07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E1971	(2005; R 2011) Stewardship for the Cleaning of Commercial and Institutional Buildings

1.2 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system, stressing and enhancing the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation. The subcontractors shall compile and prepare data and deliver to the Contractor prior to the training of Government personnel. The Contractor shall compile and prepare aggregate O&M data including clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01 33 00 SUBMITTAL PROCEDURES.

1.2.1 Package Quality

Documents shall be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.2.2 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows.

1.2.3 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Submit changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data within 30 calendar days of the notification of this change requirement.

1.2.4 O&M Database

Develop a database from the O&M manuals that contains the information required to start a preventative maintenance program.

1.3 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.3.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.3.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.3.1.2 Operator Prestart

Include procedures required to install, set up, and prepare each system for use.

1.3.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.3.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment.

1.3.1.5 Emergency Operations

Include Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.3.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

1.3.1.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.3.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance

to minimize corrective maintenance and repair for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.3.2.1 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.3.3 Cleaning Recommendations

Provide environmentally preferable cleaning recommendations in accordance with ASTM E1971.

1.3.4 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs.

1.3.4.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.3.4.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.3.4.3 Maintenance and Repair Procedures

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.3.4.4 Removal and Replacement Instructions

Include step-by-step procedures and a list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.3.4.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote

locations. List spare parts and supplies that have a long lead-time to obtain.

1.3.5 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including requirements by type of craft. Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

1.3.6 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.3.6.1 Product Submittal Data

Provide a copy of all SD-03 Product Data submittals required in the applicable technical sections.

1.3.6.2 Manufacturer's Instructions

Provide a copy of all SD-08 Manufacturer's Instructions submittals required in the applicable technical sections.

1.3.6.3 O&M Submittal Data

Provide a copy of all SD-10 Operation and Maintenance Data submittals required in the applicable technical sections.

1.3.6.4 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog.

1.3.6.5 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

1.3.6.6 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.3.6.7 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.3.6.8 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms.

1.3.6.9 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.4 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M data packages specified in individual technical sections. The required information for each O&M data package is as follows:

1.4.1 Data Package 1

a. Safety precautions

b. Cleaning recommendations

c. Maintenance and repair procedures

d. Warranty information

e. Contractor information

f. Spare parts and supply list

1.4.2 Data Package 2

a. Safety precautions

b. Normal operations

c. Environmental conditions

d. Lubrication data

e. Preventive maintenance plan and schedule

f. Cleaning recommendations

g. Maintenance and repair procedures

h. Removal and replacement instructions

i. Spare parts and supply list

j. Parts identification

k. Warranty information

l. Contractor information

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 02 41 00

DEMOLITION
05/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.6	(2006) Safety Requirements for Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011) Safety and Health Requirements Manual

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(2007; Rev K) Obstruction Marking and Lighting

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 61-SUBPART M	National Emission Standard for Asbestos

VIRGINIA DEPARTMENT OF LABOR AND INDUSTRY

16VAC25-20	(2008)Regulation Concerning Licensed Asbestos Contractor Notification, Asbestos Project Permits, and Permit Fees

1.2 PROJECT DESCRIPTION

1.2.1 Demolition/Deconstruction Plan

Prepare a Demolition Plan and submit proposed demolition, and removal procedures for approval before work is started.. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Coordinate with Waste Management Plan. Include statements affirming Contractor inspection of the existing roof deck and its suitability to perform as a safe working platform or if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work. Provide procedures for safe

conduct of the work in accordance with EM 385-1-1. Plan shall be approved by Contracting Officer prior to work beginning.

1.2.2 General Requirements

Do not begin demolition or deconstruction until authorization is received from the Contracting Officer. Remove rubbish and debris from the project site; do not allow accumulations. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.3 ITEMS TO REMAIN IN PLACE

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract. Do not overload pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition, deconstruction, or removal work. Repairs, reinforcement, or structural replacement require approval by the Contracting Officer prior to performing such work.

1.3.1 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove snow, dust, dirt, and debris from work areas daily.

1.3.2 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas.

1.3.3 Trees

Protect trees within the project site which might be damaged during demolition or deconstruction, and which are indicated to be left in place, by a 6 foot high fence. Erect and secure fence a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Replace any tree designated to remain that is damaged during the work under this contract with like-kind or as approved by the Contracting Officer.

1.3.4 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition and deconstruction operations. Prior to start of work, utilities serving each area of alteration or removal will be shut off by the Government and disconnected and sealed by the Contractor .

1.3.5 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished or deconstructed, unless directed otherwise by the Contracting Officer. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract.

1.4 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted . Where burning is permitted, adhere to federal, state, and local regulations.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Existing Conditions; G

SD-07 Certificates

Demolition Plan; G

SD-11 Closeout Submittals

Receipts

1.6 QUALITY ASSURANCE

Notify the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSE/SAFE A10.6. Comply with the Environmental Protection Agency requirements specified. Use of explosives will not be permitted.

1.6.1 Notification of Abatement or Demolition

Notification of asbestos abatement or demolition shall also be submitted to EPA and Virginia Department of Labor and Industry; 40 CFR 61-SUBPART M and 16VAC25-20.

1.6.2 Dust and Debris Control

Prevent the spread of dust and debris and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Sweep pavements as often as necessary to control the spread of debris that may result in foreign object damage potential to aircraft.

1.7 PROTECTION

1.7.1 Traffic Control Signs

a. Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Anchor barricades in a manner to prevent displacement by wind, jet or prop blast. Notify the Contracting Officer prior to beginning such work.

Provide a minimum of 2 aviation red or high intensity white obstruction lights on temporary structures (including cranes) over 100 feet above ground level. Light construction and installation shall comply with FAA AC 70/7460-1. Lights shall be operational during periods of reduced visibility, darkness, and as directed by the Contracting Officer. Maintain the temporary services during the period of construction and remove only after permanent services have been installed and tested and are in operation.

1.7.2 Protection of Personnel

Before, during and after the demolition work continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the project site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.8 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair or replace items to be relocated which are damaged by the Contractor with new undamaged items as approved by the Contracting Officer.

1.9 EXISTING CONDITIONS

Before beginning any demolition or deconstruction work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 4 inch will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish floor elevations, possible conflicting electrical conduits, plumbing lines, alarms systems, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to before starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document. Submit survey results.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

Inspect and evaluate existing structures onsite for reuse. Existing construction scheduled to be removed for reuse shall be disassembled. Dismantled and removed materials are to be separated, set aside, and prepared as specified, and stored or delivered to a collection point for reuse, remanufacture, recycling, or other disposal, as specified. Materials shall be designated for reuse onsite whenever possible.

3.1.1 Utilities and Related Equipment

3.1.1.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition or deconstruction work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.1.2 Disconnecting Existing Utilities

Remove existing utilities , as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered but are not indicated on the drawings, notify the Contracting Officer prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the Contracting Officer.

3.1.2 Paving and Slabs

Pavement and slabs designated to be recycled and utilized in this project shall be moved, ground and stored as directed by the Contracting Officer. Pavement and slabs not to be used in this project shall be removed from the Installation at Contractor's expense.

3.1.3 Concrete

Saw concrete along straight lines to a depth of a minimum 2 inch. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

3.2 DISPOSITION OF MATERIAL

3.2.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials

or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition and deconstruction, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition, deconstruction, and removal procedures, and authorization by the Contracting Officer to begin demolition and deconstruction. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

3.3 CLEANUP

Remove debris and rubbish from basement and similar excavations. Remove and transport the debris in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.4 DISPOSAL OF REMOVED MATERIALS

3.4.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified off the ANC center in the Waste Management Plan . Storage of removed materials on the project site is prohibited.

3.4.2 Burning on Government Property

Burning of materials removed from demolished and deconstructed structures will not be permitted on Government property .

3.4.3 Removal to Spoil Areas on Government Property

Transport noncombustible materials removed from demolition and deconstruction structures to designated spoil areas on Government property.

3.4.4 Removal from Government Property

Transport waste materials removed from demolished and deconstructed structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

3.5 REUSE OF SALVAGED ITEMS

Recondition salvaged materials and equipment designated for reuse before installation. Replace items damaged during removal and salvage operations or restore them as necessary to usable condition.

-- End of Section --

SECTION 02 41 19.25

SELECTIVE ABANDONMENT OF SEWER MAINS
04/13

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 1107/C 1107M	(2008) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 940	(1998a; R 2003) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory

1.2 SUMMARY

Abandonment in place, by cutting and capping, of existing sewers, junction structures, manholes, service lines, and force mains. Abandonment in place of existing sewers and force mains using flowable fill. Flowable fill will be utilized when abandoning existing sewers and force mains underneath roadways and paved areas and at the direction of the Contracting Officer as field conditions dictate, or as specified on the Drawings.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Abandonment Plan

SD-03 Product Data

Plugs

SD-05 Design Data

Technical Data

1.4 QUALITY ASSURANCE

1.4.1 Abandonment Plan

At least 15 days prior to commencing abandonment activities, submit plan for abandonment, describing proposed grouting sequence, and plugging, if any, and other information pertinent to completion of work.

1.4.2 Technical Data

Provide technical information for equipment and operational procedures including projected slurry injection rate, grout pressure, method of controlling grout pressure, bulkhead and vent design, and number of stages of grout application.

PART 2 PRODUCTS

2.1 PLUGS

Grout Plugs: Cement-based dry-pack grout conforming to ASTM C 1107/C 1107M, Grade B or C.

Manufactured Plug: Commercially available plug or cap specifically designed and manufactured to be used with pipe being abandoned.

2.2 FLOWABLE FILL REQUIREMENTS

Unconfined compressive strength: minimum 75 psi and maximum 150 psi at 56 days as determined based on an average of three tests for same placement. Present at least three acceptable strength tests for proposed mix design in mix design report.

Placement characteristics: self-leveling.

Shrinkage characteristics: non-shrink.

Water bleeding for fill to be placed by grouting method in sewers: not to exceed 2 percent according to ASTM C 940.

Minimum wet density: 90 pounds per cubic foot.

2.3 BALLAST

Ballast Material: Natural rock or concrete pieces with minimum size equal to at least 10 times maximum aggregate size of flowable fill and maximum size of 24 inches. Maximum dimension shall not be more than 20 percent of minimum dimension of space to be filled.

Ballast Composition: Free of regulated waste material.

PART 3 EXECUTION

3.1 DEMOLITION OF SEWER MANHOLES, AND PIPELINE STRUCTURES PRIOR TO ABANDONMENT

Remove manhole frames and covers and castings from other existing pipeline structures.

Demolish and remove precast concrete adjustment rings and corner section,

or brick and mortar corbel and chimney, or other pipeline structure, to minimum depth of 2 feet below finished grade. Structure may be removed to greater depth, but not deeper than 18 inches above crown of abandoned sewer.

Drain manholes and poke holes in manhole floors and walls prior to filling.

When adjacent sewer lines are not to be filled, place temporary plugs in each line connecting to manhole, in preparation for filling manhole.

Excavate overburden from force mains to be abandoned at locations indicated on Drawings, conforming to Section 31 23 00.00 20 EXCAVATION AND FILL.

3.2 CUTTING AND CAPPING OF MAINS

Do not begin cut, plug, and abandonment operations until replacement sewer has been constructed and tested, all service connections have been installed, and main has been approved for use.

Install plug, clamp, and concrete reaction block and make cut at location shown on drawings.

Main to be abandoned shall not be valved off and shall not be cut or plugged other than as shown on drawings.

After main to be abandoned has been cut and capped, check for other sources feeding abandoned sewer main. When sources are found, notify Contracting Officer immediately. Cut and cap abandoned main at point of other feed as directed by Contracting Officer.

Plug or cap ends or opening in abandoned main in manner approved by Contracting Officer. Install concrete around cap and over pipe to ensure its not penetratable by groundwater.

Remove and dispose of surface identifications such as cleanouts. Clean-outs in improved streets, shall be filled with concrete.

Backfill excavations in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL.

Repair steet surfaces in accordance with local base and DPW regulations.

Mark location of abandonend sewer laterals on drawings and provide to Contracting Officer.

3.3 CUTTING AND CAPPING OF SERVICES

Do not begin cut, plug, and abandonment operations until replacement service, if necessary, has been constructed and tested, and all service connections have been installed.

Service lines shall be cut and capped at the cleanout.

Before backfilling of a capped service line is started, the capping must be observed by Contracting Officer.

After service to be abandoned has been cut and capped, check for any other sources feeding abandoned sewer service. When sources are found, notify Contracting Officer immediately. Cut and cap abandoned main at point of other feed as directed by Contracting Officer.

Plug or cap ends or opening in abandoned service in manner approved by Contracting Officer. Install concrete around cap and over pipe to ensure its not penetratable by groundwater.

Remove and dispose of surface identifications such as cleanouts. Cleanouts in improved streets, shall be filled with concrete.

Backfill excavations in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL.

Repair paved surfaces in accordance with local base and DPW regulations.

Mark location of abandonend sewer laterals on drawings and provide to Contracting Officer.

3.4 PREPARATION FOR ABANDONMENT VIA FLOWABLE FILL

Have fill mix design reports and other submittals required by Part 1 of this Section accepted by the Contracting Officer prior to start of placement. Notify the Contracting Officer at least 24 hours in advance of grouting with flowable fill.

Select fill placement equipment and follow procedures with sufficient safety and care to avoid damage to existing underground utilities and structures. Operate equipment at pressure that will not distort or imperil portion of work, new or existing.

Clean sewer lines and video with closed circuit television to identify connections, locate obstructions, and assess condition of pipe. Locate previously unidentified connections, which have not been redirected and reconnected as part of this project, and report them to the Contracting Officer. During placement of fill, compensate for irregularities in sewer pipe, such as obstructions, open joints, or broken pipe to ensure no voids remain unfilled.

Perform demolition work prior to starting fill placement. Clean placement areas of sewers and manholes of debris that may hinder fill placement. Remove excessive amounts of sludge and other substances that may degrade performance of fill. Do not leave sludge or other debris in place if filling more than 2 percent of placement volume.

Remove free water prior to starting fill placement.

3.5 EQUIPMENT FOR FLOWABLE FILL

Mix flowable fill in automated batch plant and deliver it to site in ready-mix trucks. Performance additives may be added at placement site if required by mix design.

Use concrete or grout pumps capable of continuous delivery at planned placement rate.

3.6 INSTALLATION OF FLOWABLE FILL

Abandon existing sewer lines underneath roadways and paved areas by completely filling sewer line with flowable fill. Abandon manholes and other structures by filling with flowable fill, together with ballast as applicable, within depth of structures left in place.

Place flowable fill to fill volume between manholes. Continuously place flowable fill from manhole to manhole with no intermediate pour points, but not exceeding 500 feet in length.

Have filling operation performed by experienced crews with equipment to monitor density of flowable fill and to control pressure.

Temporarily plug sewer lines which are to remain in operation during pouring/pumping to keep lines free of flowable fill.

Pump flowable fill through bulkheads constructed for placement of two 2-inch PVC pipes or use other suitable construction methods to contain flowable fill in lines to be abandoned. These pipes will act as injection points or vents for placement of flowable fill.

Place flowable fill under pressure flow conditions into properly vented open system until flowable fill emerges from vent pipes. Pump flowable fill with sufficient pressure to overcome friction and to fill sewer from downstream end, to discharge at upstream end.

Inject flowable fill through replaced ballast using grouting equipment and series of grout pipes discharging at bottom of placement, allowing fill to rise through ballast effectively filling all voids. Alternatively, sequentially place individual pieces of ballast at same time as flowable fill is placed. Do not fill with ballast more than 50 percent of volume at any level, to prevent nesting and void formation.

Remediate placement of flowable fill which does not fill voids in sewer, in manhole or other structures, or where voids develop due to excessive shrinkage or bleeding of fill, by using pressure grouting either from inside sewer or from surface.

When using grout plug, place temporary plug or bulkhead approximately 12 inches inside pipe. Fill pipe end completely with dry-pack grout mixture.

When using manufactured plug or cap, install fitting as recommended by manufacture's instructions, to form water tight seal.

Backfill to surface, above pipe or structures left in place, with flowable fill in restricted areas, compacted bank run sand in unrestricted areas to be paved or select fill in unrestricted areas outside of pavement. Place and compact backfill, other than flowable fill, in compliance with Section 31 23 00.00 20 EXCAVATION AND FILL.

Collect and dispose of excess flowable fill material and other debris in accordance with Waste Material Disposal or as directed by the Contracting Officer.

3.7 PROTECTION OF PERSONS AND PROPERTY

Provide safe working conditions as requied by OSHA and applicable state and local laws for employees throughout demolition and removal operations. Observe safety requirements for work below grade.

Maintain safe access to adjacent property. Do not obstruct roadways, sidewalks or passageways adjacent to work.

-- End of Section --

SECTION 02 41 19.28

SELECTIVE ABANDONMENT OF WATERMAINS
04/13

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 940	(1998a; R 2003) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 340/1-90/018	(1990) Asbestos/NESHAP Regulated Asbestos Containing Materials Guidance

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61-SUBPART M	National Emission Standard for Asbestos

1.2 SUMMARY

Abandonment in place, by cutting and capping, of existing water mains, hydrants, service lines, and valves. Abandonment in place of water mains using flowable fill. Flowable fill will be utilized when abandoning water mains underneath roadways and paved areas, and at the direction of the Contractng Officer as field conditions dictate, or as shown on the Drawings.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Abandonment plan

SD-03 Product Data

Plugs and clamps

SD-05 Design Data

Technical Data

1.4 QUALITY ASSURANCE

1.4.1 Abandonment Plan

At least 15 days prior to commencing flowable fill abandonment activities, submit plan for abandonment, describing proposed grouting sequence and other information pertinent to completion of work.

1.4.2 Technical Data

Provide technical information for equipment and operational procedures including projected slurry injection rate, grout pressure, method of controlling grout pressure, bulkhead and vent design, and number of stages of grout application.

PART 2 PRODUCTS

2.1 GENERAL MATERIALS

Concrete for reaction blocks: Minimum 3,000 psi concrete conforming to requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE.

Plugs and clamps: Applicable for type of pipe to be plugged.

2.2 FLOWABLE FILL REQUIREMENTS

Unconfined compressive strength: minimum 75 psi and maximum 150 psi at 56 days as determined based on an average of three tests for same placement. Present at least three acceptable strength tests for proposed mix design in mix design report.

Placement characteristics: self-leveling.

Shrinkage characteristics: non-shrink.

Water bleeding for fill to be placed by grouting method in sewers; not to exceed 2 percent according to ASTM C 940.

Minimum wet density: 90 pounds per cubic foot.

2.3 BALLAST

Ballast materials shall be natural rock or concrete pieces with minimum size equal to at least 10 times maximum aggregate size of flowable fill and maximum size of 24 inches. Maximum dimension shall not be more than 20 percent of minimum dimension of space to be filled.

Ballast Composition: Free of regulated waste material.

PART 3 EXECUTION

3.1 DEMOLITION OF FIRE HYDRANTS, VALVES, AND PIPELINE STRUCTURES PRIOR TO ABANDONMENT

Remove all watermain appurtenances, such as hydrants, valves, and valve boxes.

Demolish and remove precast concrete adjustment rings, concrete vault

covers, or other pipeline structure, to minimum depth of 2 feet below finished grade. Structure may be removed to greater depth, but not deeper than 18 inches above crown of abandoned watermain.

Until a fire hydrant is physically removed, any hydrant that becomes non-usable during abandonment procedures shall have a heavy duty cover placed over it and secured and marked “Abandoned” so that fire department personnell know its status.

3.2 CUTTING AND CAPPING OF MAINS

Do not begin cut, plug, and abandonment operations until replacement water main has been constructed and tested, all service connections have been installed, and replacement main is approved for use.

Install plug, clamp, and concrete reaction block and make cut at location shown on drawings.

Main to be abandoned shall not be valved off and shall not be cut or plugged other than as shown on drawings.

After main to be abandoned has been cut and capped, check for other sources feeding abandoned water main. When sources are found, notify Contracting Officer immediately. Cut and cap abandoned main at point of other feed as directed by Contracting Officer.

Plug or cap ends or opening in abandoned main in manner approved by AW Project Manager. Install concrete around cap and over pipe to ensure its not penetratable by groundwater.

Backfill excavations in accordance with Section 31 23 00.00 10 EXCAVATION AND FILL.

Repair steet surfaces.

Mark location of abandonend water service laterals on drawings and provide to Owner.

3.3 CUTTING AND CAPPING OF WATER SERVICES

Do not begin cut, plug, and abandonment operations until replacement service, if necessary, has been constructed and tested, and all service connections have been installed.

Service lines shall be cut and capped at the corp/curb stop.

Before backfilling of a capped service line is started, the capping must be observed by the Government.

After service to be abandoned has been cut and capped, check for any other sources feeding abandoned water service. When sources are found, notify Contracting Officer immediately. Cut and cap abandoned main at point of other feed as directed by Contracting Officer.

Plug or cap ends or opening in abandoned service in manner approved by Contracting Officer. Install concrete around cap and over pipe to ensure its not penetratable by groundwater.

Remove all water service surface identifications and appurtenences such as

valves and valve boxes, meters, and backflow devices. Return appurtenences to AW.

Backfill excavations in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL.

Repair paved surfaces in accordance with local base and DPW regulations.

Mark location of abandonend water services on drawings and provide to Owner.

3.4 PREPARATION FOR ABANDONMENT VIA FLOWABLE FILL

Have fill mix design reports and other submittals required by Part 1 of this Section accepted by the Contracting Officer prior to start of placement. Notify the Contracting Officer at least 24 hours in advance of grouting with flowable fill.

Select fill placement equipment and follow procedures with sufficient safety and care to avoid damage to existing underground utilities and structures. Operate equipment at pressure that will not distort or imperil portion of work, new or existing.

Clean water lines and video with closed circuit television to identify connections, locate obstructions, and assess condition of pipe. Locate previously unidentified connections, which have not been redirected and reconnected as part of this project, and report them to the Contracting Officer. During placement of fill, compensate for irregularities in water pipe, such as obstructions, open joints, or broken pipe to ensure no voids remain unfilled.

Perform demolition work prior to starting fill placement. Clean placement areas of watermains of debris that may hinder fill placement. Remove excessive amounts of tuberculations and other substances that may degrade performance of fill. Do not leave debris in place if filling more than 2 percent of placement volume.

Remove free water prior to starting fill placement.

3.5 EQUIPMENT FOR ABANDONMENT VIA FLOWABLE FILL

Mix flowable fill in automated batch plant and deliver it to site in ready-mix trucks. Performance additives may be added at placement site if required by mix design.

Use concrete or grout pumps capable of continuous delivery at planned placement rate.

3.6 INSTALLATION OF FLOWABLE FILL

Abandon existing water lines underneath roadways and paved areas by completely filling watermains with flowable fill.

Place flowable fill to fill volume between abandonment points. Continuously place flowable fill with no intermediate pour points, but not exceeding 500 feet in length.

Have filling operation performed by experienced crews with equipment to monitor density of flowable fill and to control pressure.

Pump flowable fill through bulkheads constructed for placement of two 2-inch PVC pipes or use other suitable construction methods to contain flowable fill in lines to be abandoned. These pipes will act as injection points or vents for placement of flowable fill.

Place flowable fill under pressure flow conditions into properly vented open system until flowable fill emerges from vent pipes. Pump flowable fill with sufficient pressure to overcome friction and to fill watermain from downstream end, to discharge at upstream end.

Inject flowable fill through replaced ballast using grouting equipment and series of grout pipes discharging at bottom of placement, allowing fill to rise through ballast effectively filling all voids. Alternatively, sequentially place individual pieces of ballast at same time as flowable fill is placed. Do not fill with ballast more than 50 percent of volume at any level, to prevent nesting and void formation.

Remediate placement of flowable fill which does not fill voids in watermain or where voids develop due to excessive shrinkage or bleeding of fill, by using pressure grouting either from inside watermain or from surface.

Plug each end of the water main being abandoned.

Backfill to surface, above pipe left in place. Place and compact backfill in compliance with Section 31 23 00.00 20 EXCAVATION AND FILL.

Collect and dispose of excess flowable fill material and other debris in accordance with Waste Material Disposal or as directed by the Contracting Officer.

3.7 PROTECTION OF PERSONS AND PROPERTY

Provide safe working conditions as requied by OSHA and applicable state and local laws for employees throughout demolition and removal operations. Observe safety requirements for work below grade.

Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to work.

3.8 ASBESTOS CONCRETE PIPE

All work involving or impacting asbestos concrete pipe must be in acordance with the 40 CFR 61-SUBPART M and EPA 340/1-90/018.

-- End of Section --

SECTION 02 42 91

REMOVAL AND SALVAGE OF HISTORIC BUILDING MATERIALS
05/10

PART 1 GENERAL

1.1 PROJECT DESCRIPTION

The work includes removal and salvage of identified historic items and materials, and removal of resulting rubbish and debris. General demolition of non-historic materials and removal of resulting rubbish and debris shall comply with the requirements of Section 02 41 00 DEMOLITION. Materials to be salvaged or recycled shall be stored daily in areas and manner specified by the Contracting Officer. In the interest of conservation, salvage and recycling shall be pursued to the maximum extent possible. Submit a Work Plan including procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, careful removal and disposition of materials specified to be salvaged or recycled, dust control, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations.

1.1.1 Dust Control

The amount of dust resulting from removal, salvage and demolition operations shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water to control dust will not be permitted when it will result in, or create, damage to existing materials and hazardous or objectionable conditions such as ice, flooding, staining and pollution.

1.1.2 Protection

1.1.2.1 Protection of Existing Historic Property

Before beginning any removal, salvage or demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Take necessary precautions to avoid damage to existing historic items that are to remain in place, to be reused, or to remain the property of the Government. Repair or restore items damaged by the Contractor to original condition, or replaced, as approved by the Contracting Officer. Coordinate the work of this section with all other work and shall construct and maintain shoring, bracing and supports, as required. Ensure that structural elements are not overloaded and provide additional supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.1.2.2 Protection From the Weather

Salvaged historic materials shall be stored out of contact on elevated platforms/pallets to prevent direct contact with ground.

1.1.2.3 Unearthed Remains

If horse remains are discovered during construction they are to be properly documented by the archeologist and containerized for transportation and reburial. Contractor shall furnish a suitable plastic-lined box for containing either ashes or decayed remains. Remains shall be turned over to the Contracting Officer.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals marked with "AE", submittal shall be reviewed by the Landscape Architect. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Work Plan; G, AE

1.3 QUALIFICATIONS

Provide qualified workers trained and experienced in removal and salvage of historic materials. Submit documentation of five consecutive years of work of this type with a list of similar projects identifying when, where, and for whom the work was done. A current point-of-contact for identified references shall be provided.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 SALVAGED ITEMS

Salvage items to the maximum extent possible. Prior to any demolition work, historic items to be salvaged shall be removed from the structure. Removal of salvageable items shall be accomplished by hand labor. Care shall be taken to not damage historic portions of the structure to remain or items identified for salvage. Furnishings, equipment, and materials not scheduled for salvage or recycling shall be removed prior to any salvaging procedures. Keep a complete recording of all salvaged materials including the condition of such materials before, and after, salvage operations.

3.1.1 Site Work

The following site items shall be removed intact and salvaged: Seneca Stone Rubble and Bluestone Cap Stones (Copings).

3.2 DISPOSITION OF MATERIALS

Title to materials to be demolished, except Government and using service salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition, loss or damage to such property after notice to proceed.

3.2.1 Items Salvaged for the Government

Salvaged items to remain the property of the Government shall be removed in a manner to prevent damage, crated and isolated in layers with compressible polyethylene sheets to protect the items from damage, or as directed by the Contracting Officer. Items damaged during removal or storage shall be repaired or replaced to match existing items. Crates shall be properly identified as to contents. The following items reserved as property of the Government shall be delivered to the areas designated: Seneca Stone Rubble and Bluestone Cap Stones (Copings).

3.3 CLEAN-UP

Upon completion of the work, portions of structure to remain and adjacent areas and structures shall be cleaned of dust, dirt, and debris caused by salvage and demolition operations. Debris and rubbish shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

-- End of Section --

SECTION 02 61 13

EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL
02/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D5434	(2012) Field Logging of Subsurface Explorations of Soil and Rock

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926	Safety and Health Regulations for Construction
40 CFR 302	Designation, Reportable Quantities, and Notification

1.2 DESCRIPTION OF WORK

The work consists of excavation and temporary storage of approximately 5060 cubic yards of contaminated material and the in-situ oxidation of petroleum constituents in groundwater. Approximate locations of contaminated material are shown on the drawings. Characterization data on the nature and extent of the contaminated material is in the Remedial Action Work Plan prepared by A-Zone Environmental dated 22 April 2013 and is appended to the specifications and reference to propriety products shall be disregarded. Subsurface conditions are shown on the drawings. Submit a Work Plan as specified below. The information presented in the Remedial Action Work Plan is intended to be a guide in developing the Contractor's Work Plan. It should be noted that this effort is meant to remove and replace a known amount of impacted material and not perform a remediation of the site. Notify the Contracting Officer within 24 hours, and before excavation, if contaminated material is discovered that has not been previously identified or if other discrepancies between data provided and actual field conditions are discovered. Backfill material may be available onsite and typically consists of CL and CH soils. It is the Contractors responsibility to provide suitable soils backfill that meets the requirements with Section 31 00 00. Ground water depth varies across the site and approximate levels are shown on the boring logs provided. Required sampling and chemical analysis shall be conducted in accordance with Section 01 35 45.00 10 CHEMICAL DATA QUALITY CONTROL.

1.2.1 Scheduling

Notify the Contracting Officer 15 calendar days prior to the start of excavation of contaminated material. The Contractor shall be responsible for contacting regulatory agencies in accordance with the applicable reporting requirements.

1.2.2 Work Plan

Submit a Work Plan within 30 calendar days after notice to proceed. The Work Plan shall be developed and overseen by an Industrial Hygienist certified by the American Board of Industrial Hygiene who has extensive experience with the design and implementation of contaminated soil excavation and groundwater treatment projects similar to the conditions encountered at the site. No work at the site, with the exception of site inspections and surveys, shall be performed until the Work Plan is approved. Allow 30 calendar days in the schedule for the Government's review. No adjustment for time or money will be made if resubmittals of the Work Plan are required due to deficiencies in the plan. At a minimum, the Work Plan shall include:

a. Schedule of activities.

b. Method of excavation and equipment to be used.

c. Shoring or side-wall slopes proposed.

d. In-Situ Groundwater Treatment.
    1. Treatment Objectives
    2. Selection of Treatment Reagents
    3. Quantities of Treatment Reagents
    4. Equipment
    5. Reagent Delivery Methods and Procedures
    6. Material Handling and Storage
    7. Monitoring Well Installation
    8. Post-Treatment Monitoring
    9. Reporting

e. Storage methods and locations for liquid and solid contaminated material.

f. Borrow sources and haul routes.

g. Decontamination procedures.

h. Spill contingency plan.

i. Field Screening and Verification.

j. Confirmation Sampling.

k. Health and Safety Plan Specific to this task

l. DQO shall include, but shall not be limited to, identification of extraction and analysis method numbers and a list of analytes with required limits.

1.2.3 Other Submittal Requirements

Submit separate cross-sections of each area before and after excavation and after backfilling, test results, and 4 copies of the Closure Report within 14 calendar days of work completion at the site.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Surveys; G

SD-03 Product Data

Work Plan; G
Closure Report; G

SD-06 Test Reports

Backfill; G
Surveys
Confirmation Sampling and Analysis; G
Compaction

1.4 REGULATORY REQUIREMENTS

1.4.1 Permits and Licenses

Obtain required federal, state, and local permits for excavation and storage of contaminated material. Permits shall be obtained at no additional cost to the Government. It is the Contractor's responsibility to comply with all state, local, and federal regulations.

PART 2 PRODUCTS

2.1 SPILL RESPONSE MATERIALS

Provide appropriate spill response materials including, but not limited to the following: containers, adsorbents, shovels, and personal protective equipment. Spill response materials shall be available at all times when contaminated materials/wastes are being handled or transported. Spill response materials shall be compatible with the type of materials and contaminants being handled.

2.2 In-Situ Treatment Reagents

The Contractor shall propose a commercially available product designed specifically for the in situ and/or ex-situ chemical oxidation of the groundwater contaminants including both chlorinated solvents and petroleum hydrocarbons in the Work Plan. The volume of reagent to treat groundwater and application method will be presented in the Work Plan based on the selected treatment chemical supplier.

2.3 BACKFILL

Backfill material and compaction shall be in accordance with Section 31 00 00 EARTHWORK and 31 23 00.00 20 EXCAVATION AND FILL.

PART 3 EXECUTION

3.1 SURVEYS

Surveys shall be performed immediately prior to and after excavation of contaminated material to determine the volume of contaminated material removed. Surveys shall also be performed immediately after backfill of each excavation. Provide cross-sections on 25 foot intervals and at break points for all excavated areas. Locations of confirmation samples shall also be surveyed and shown on the drawings.

3.2 EXISTING STRUCTURES AND UTILITIES

No excavation shall be performed until site utilities have been field located. Take the necessary precautions to ensure no damage occurs to existing structures and utilities. Damage to existing structures and utilities resulting from the Contractor's operations shall be repaired at no additional cost to the Government. Utilities encountered that were not previously shown or otherwise located shall not be disturbed without approval from the Contracting Officer.

3.3 CLEARING

Clearing shall be performed to the limits shown on the drawings in accordance with Section 31 11 00 CLEARING AND GRUBBING.

3.4 CONTAMINATED MATERIAL REMOVAL

3.4.1 Excavation

Areas of contamination shall be excavated to the maximum depth and extent shown on the drawings and not more than 0.2 ft beyond the depth and extent shown on the drawings unless directed by the Contracting Officer. Quantities were based on available sampling information and screening values defined by VDEQ Restricted Soil Use Standard for Commercial Property. Excavation shall be performed in a manner that will limit spills and the potential for contaminated material to be mixed with uncontaminated material. An excavation log describing visible signs of contamination encountered shall be maintained for each area of excavation. Excavation logs shall be prepared in accordance with ASTM D5434.

3.4.2 Shoring

If workers must enter the excavation, it shall be evaluated, shored, sloped or braced as required by EM 385-1-1 and 29 CFR 1926 section 650.

3.4.3 In-Situ Groundwater Treatment

In-Situ Groundwater Treatment shall be in general accordance with the guidelines provided in Technical and Regulatory Guidance for In-Situ Chemical Oxidation of Contaminated Soil and Groundwater Second Edition prepared by The Interstate Technology & Regulatory Council (ITRC).

The treatment chemicals will be mixed and applied by qualified and

experienced contractors and treatment will be supervised and documented a qualified environmental professional. Treatment is anticipated to require mixing of the chemicals in tanks and application of the chemicals using a pump. Alternatively, the chemicals will be mixed into the excavation bottom using an excavator or backhoe bucket. Specific procedures should be documented in the Work Plan.

If petroleum free product is observed to be floating on the groundwater within the excavation, it will be recovered using a vacuum truck before in situ groundwater treatment is performed. Fluid recovery will be performed by qualified and experienced contractors. All recovered fluids will be manifested and transported to a permitted facility for treatment.

Surface water shall be diverted to prevent entry into the excavation. No dewatering shall be performed without prior approval of the Contracting Officer. If dewatering is permitted the Contractor shall be responsible for all required discharge permits.

3.5 CONFIRMATION SAMPLING AND ANALYSIS

The Contracting Officer shall be present to inspect the removal of contaminated material from each site. After all material suspected of being contaminated has been removed, the excavation shall be examined for evidence of contamination. If the excavation appears to be free of contamination, field analysis shall be used to determine the presence of contamination using a real time vapor monitoring instrument or immunoassay field kits and reported to the Contracting Officer. Once directed by the Contracting Officer, confirmation samples shall be collected and analyzed for the following contaminants:

TPH DRO/GRO
benzo (a) pyrene
Dibenzo (a,h) anthracene

Samples shall be collected at a frequency of one per 25 square yards from the bottom and each of the side walls or as directed by the Contracting Officer. A minimum of one sample shall be collected from the bottom and each side wall of the excavation. Confirmation Sampling and Analysis is for reporting purposes only and is not intended for determining limits of excavation. Additional excavation shall be subject to approval by the Contracting Officer. Locations of samples shall be marked in the field and documented on the as-built drawings.

3.6 Groundwater Treatment Sampling

Prior to groundwater treatment, groundwater samples will be collected from the excavation just prior to and following treatment of groundwater and from temporary wells. At minimum, one well will be installed immediately hydraulically upgradient and two wells will be installed immediately hydraulically downgradient of each excavation where groundwater treatment is conducted. Following treatment, groundwater samples will be collected from strategically placed new temporary groundwater monitoring wells on at least two occasions at least 6 months apart to evaluate the success of groundwater treatment. The proposed well locations and well sampling procedures will be presented the Work Plan.

The groundwater samples will be submitted to a qualified laboratory for analysis of TPH-DRO and TPH-GRO using EPA Method 8015, VOCs using EPA Method 8260B, and SVOCs using EPA Method 8270C or D.

Groundwater wells shall be properly abandoned after completion of sampling. Contractor shall protect the wells during construction so that they are not damaged. If the wells are damage, they shall be replaced at no additional expense to the Government.

3.7 CONTAMINATED MATERIAL STORAGE

Material shall be placed in temporary storage immediately after excavation. The following paragraphs describe acceptable methods of material storage. Storage units shall be in good condition and constructed of materials that are compatible with the material or liquid to be stored. If multiple storage units are required, each unit shall be clearly labeled with an identification number and a written log shall be kept to track the source of contaminated material in each temporary storage unit.

3.7.1 Stockpiles

Stockpiles shall be constructed to isolate stored contaminated material from the environment. The maximum stockpile size shall be 50 cubic yards. Stockpiles shall be constructed to include:

a. A chemically resistant geomembrane liner free of holes and other damage. Non-reinforced geomembrane liners shall have a minimum thickness of 20 mils. Scrim reinforced geomembrane liners shall have a minimum weight of 40 lbs/1000 square feet. The ground surface on which the geomembrane is to be placed shall be free of rocks greater than 0.5 inches in diameter and any other object which could damage the membrane.

b. Geomembrane cover free of holes or other damage to prevent precipitation from entering the stockpile. Non-reinforced geomembrane covers shall have a minimum thickness of 10 mils. Scrim reinforced geomembrane covers shall have a minimum weight of 26 lbs/1000 square feet. The cover material shall be extended over the berms and anchored or ballasted to prevent it from being removed or damaged by wind.

c. Berms surrounding the stockpile, a minimum of 12 inches in height. Vehicle access points shall also be bermed.

d. The liner system shall be sloped to allow collection of leachate. Storage and removal of liquid which collects in the stockpile, in accordance with paragraph Liquid Storage.

3.7.2 Roll-Off Units

Roll-off units used to temporarily store contaminated material shall be water tight. A cover shall be placed over the units to prevent precipitation from contacting the stored material. Liquid which collects inside the units shall be removed and stored in accordance with paragraph Liquid Storage.

3.8 SPILLS

In the event of a spill or release of a hazardous substance (as designated in 40 CFR 302), pollutant, contaminant, or oil (as governed by the Oil Pollution Act (OPA), 33 U.S.C. 2701 et seq.), notify the Contracting Officer immediately. Immediate containment actions shall be taken to minimize the effect of any spill or leak. Cleanup shall be in accordance with applicable federal, state, and local regulations. As directed by the

Contracting Officer, additional sampling and testing shall be performed to verify spills have been cleaned up. Spill cleanup and testing shall be done at no additional cost to the Government.

3.9 BACKFILLING

3.9.1 Confirmation Test Results

Excavations shall be backfilled immediately after all contaminated materials have been removed and confirmation test results have been approved. Backfill shall be placed and compacted to the lines and grades shown on the drawings.

3.9.2 Compaction

Compaction shall be performed in accordance with Section 31 00 00 EARTHWORK and Section 31 23 00.00 20 EXCAVATION AND FILL.

3.10 DISPOSAL REQUIREMENTS

Offsite disposal of contaminated material shall be in accordance with Section 02 81 00 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS.

3.11 CLOSURE REPORT

4 copies of a Closure Report shall be prepared and submitted within 14 calendar days of completing work at the site. The report shall be labeled with the contract number, project name, location, date, name of general Contractor, and the Corps of Engineers District contracting for the work. The Closure Report shall include the following information as a minimum:

a. A cover letter signed by a Professional Engineer registered in the Commonwealth of Virginia who is a responsible company official certifying that all services involved have been performed in accordance with the terms and conditions of the contract documents and regulatory requirements.

b. A narrative report including, but not limited to, the following:

(1) site conditions, ground water elevation, and cleanup criteria;

(2) excavation logs;

(3) field screening readings;

(4) quantity of materials removed from each area of contamination;

(5) quantity of water/product removed during dewatering;

(6) sampling locations and sampling methods;

(7) sample collection data such as time of collection and method of preservation;

(8) sample chain-of-custody forms; and

(9) source of backfill.

c. Copies of all chemical and physical test results.

d. Copies of all manifests and land disposal restriction notifications.

e. Copies of all certifications of final disposal signed by the responsible disposal facility official.

f. Waste profile sheets.

g. Scale drawings showing limits of each excavation, limits of contamination, known underground utilities within 50 feet of excavation, sample locations, and sample identification numbers. On-site stockpile, storage, treatment, loading, and disposal areas shall also be shown on the drawings.

h. Progress Photographs. Color photographs shall be used to document progress of the work. A minimum of four views of the site showing the location of the area of contamination, entrance/exit road, and any other notable site conditions shall be taken before work begins. After work has been started, activities at each work location shall be photographically recorded daily. Photographs shall be a minimum of 3 by 5 inches and shall include:

(1) Soil removal and sampling.

(2) Dewatering operations.

(3) Unanticipated events such as spills and the discovery of additional contaminated material.

(4) Contaminated material/water storage, handling, treatment, and transport.

(5) Site or task-specific employee respiratory and personal protection.

(6) Fill placement and grading.

(7) Post-construction photographs. After completion of work at each site, take a minimum of four views of each excavation site.

A digital version of all photos shown in the report shall be included with the Closure Report. Photographs shall be a minimum of 3 inches by 5 inches and shall be mounted back-to-back in double face plastic sleeves punched to fit standard three ring binders. Each print shall have an information box attached. The box shall be typewritten and arranged as follows:

Project Name:	Direction of View:
Location:	Date/Time:
Photograph No.:	Description of View:

-- End of Section --

SECTION 02 81 00

TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS
02/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 266	Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 270	EPA Administered Permit Programs: The Hazardous Waste Permit Program
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
40 CFR 302	Designation, Reportable Quantities, and Notification
49 CFR 107	Hazardous Materials Program Procedures
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 173	Shippers - General Requirements for Shipments and Packagings

49 CFR 178 Specifications for Packagings

1.2 DEFINITIONS

1.2.1 Hazardous Material

A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated pursuant to the Hazardous Materials Transportation Act, 49 U.S.C. Appendix Section 1801 et seq. The term includes materials designated as hazardous materials under the provisions of 49 CFR 172, Sections .101 and .102 and materials which meet the defining criteria for hazard classes and divisions in 49 CFR 173. EPA designated hazardous wastes are also hazardous materials.

1.2.2 Hazardous Waste

A waste which meets criteria established in RCRA or specified by the EPA in 40 CFR 261 or which has been designated as hazardous by a RCRA authorized state program.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Notices of Non-Compliance and Notices of Violation
Packaging Notifications

SD-06 Test Reports

Recordkeeping
Spill Response
Exception Report; G

SD-07 Certificates

Certification
Security Plan
EPA Offsite Policy
Certificates of Disposal
Shipping Documents and Packagings Certification
Waste Minimization

1.4 QUALITY ASSURANCE

1.4.1 Certification

The Contractor and/or subContractors transporting hazardous materials shall possess a current certificate of registration issued by the Research and Special Programs Administration (RSPA), U.S. Department of Transportation, when required by 49 CFR 107, Subpart G. Submit copies of the certificates or written statements certifying exemption from these requirements.

1.4.2 Laws and Regulations Requirements

Work shall meet or exceed the minimum requirements established by Federal, state, and local laws and regulations which are applicable. These requirements are amended frequently and compliance with amendments is required as they become effective. In the event that compliance exceeds the scope of work or conflicts with specific requirements of the contract, notify the Contracting Officer immediately.

PART 2 PRODUCTS

2.1 MATERIALS

Provide all the materials required for the packaging, labeling, marking, placarding and transportation of hazardous wastes and hazardous materials in conformance with Department of Transportation standards. Details in this specification shall not be construed as establishing the limits of the Contractor's responsibility.

2.1.1 Packagings

Provide bulk and non-bulk containers for packaging hazardous materials/wastes consistent with the authorizations referenced in the Hazardous Materials Table in 49 CFR 172, Section .101, Column 8. Bulk and non-bulk packaging shall meet the corresponding specifications in 49 CFR 173 referenced in the Hazardous Materials Table, 49 CFR 172, Section .101. Each packaging shall conform to the general packaging requirements of Subpart B of 49 CFR 173, to the requirements of 49 CFR 178 at the specified packing group performance level, to the requirements of special provisions of column 7 of the Hazardous Materials Table in 49 CFR 172, Section .101, and shall be compatible with the material to be packaged as required by 40 CFR 262. Also provide other packaging related materials such as materials used to cushion or fill voids in overpacked containers, etc. Sorbent materials shall not be capable of reacting dangerously with, being decomposed by, or being ignited by the hazardous materials being packaged. Additionally, sorbents used to treat free liquids to be disposed of in landfills shall be non-biodegradable as specified in 40 CFR 264, Section .314. In addition, packaging notifications will be provided to the Government in accordance with 49 CFR 172, Section .178.2(c) regarding type and dimensions of closures, including gaskets, needed to satisfy performance test requirements.

2.1.2 Markings

Provide markings for each hazardous material/waste package, freight container, and transport vehicle consistent with the requirements of 49 CFR 172. Markings shall be capable of withstanding, without deterioration or substantial color change, a 180 day exposure to conditions reasonably expected to be encountered during container storage and transportation.

2.1.3 Labeling

Provide primary and subsidiary labels for hazardous materials/wastes consistent with the requirements in the Hazardous Materials Table in 49 CFR 172, Section .101, Column 6. Labels shall meet design specifications required by 49 CFR 172, Subpart E including size, shape, color, printing, and symbol requirements. Labels shall be durable and weather resistant and capable of withstanding, without deterioration or

substantial color change, a 180 day exposure to conditions reasonably expected to be encountered during container storage and transportation.

2.1.4 Placards

For each offsite shipment of hazardous material/waste, provide primary and subsidiary placards consistent with the requirements of 49 CFR 172, Subpart F. Placards shall be provided for each side and each end of bulk packaging, freight containers, transport vehicles, and rail cars requiring such placarding. Placards may be plastic, metal, or other material capable of withstanding, without deterioration, a 30 day exposure to open weather conditions and shall meet design requirements specified in 49 CFR 172, Subpart F.

2.1.5 Spill Response Materials

Provide spill response materials including, but not limited to, containers, adsorbent, shovels, and personal protective equipment. Spill response materials shall be available at all times in which hazardous materials/wastes are being handled or transported. Spill response materials shall be compatible with the type of material being handled.

2.2 EQUIPMENT AND TOOLS

Provide miscellaneous equipment and tools necessary to handle hazardous materials and hazardous wastes in a safe and environmentally sound manner.

PART 3 EXECUTION

3.1 OFFSITE HAZARDOUS WASTE MANAGEMENT

Use RCRA Subtitle C permitted facilities which meet the requirements of 40 CFR 264 or facilities operating under interim status which meet the requirements of 40 CFR 265. Offsite treatment, storage, and/or disposal facilities with significant RCRA violations or compliance problems (such as facilities known to be releasing hazardous constituents into ground water, surface water, soil, or air) shall not be used. Submit Notices of Non-Compliance and Notices of Violation by a Federal, state, or local regulatory agency issued to the Contractor in relation to any work performed under this contract. Immediately provide copies of such notices to the Contracting Officer. Also furnish all relevant documents regarding the incident and any information requested by the Contracting Officer, and coordinate its response to the notice with the Contracting Officer or the designated representative prior to submission to the notifying authority. Also furnish a copy to the Contracting Officer of all documents submitted to the regulatory authority, including the final reply to the notice, and all other materials, until the matter is resolved.

3.1.1 Treatment, Storage, and/or Disposal Facility and Transporter

Provide the Contracting Officer with EPA ID numbers, names, locations, and telephone numbers of TSD facilities and transporters. This information shall be contained in the Hazardous Waste Management Plan and shall be approved by the Contracting Officer prior to waste disposal.

3.1.2 Status of the Facility

Facilities receiving hazardous waste shall be permitted in accordance with

40 CFR 270 or operating under interim status in accordance with 40 CFR 265 requirements, or permitted by a state authorized by the Environmental Protection Agency to administer the RCRA permit program. Additionally, prior to using a TSD Facility, contact the EPA Regional Offsite Coordinator specified in 40 CFR 300, Section .440, to determine the facility's status, and document all information necessary to satisfy the requirements of the EPA Offsite policy and submit this information to the Contracting Officer.

3.1.3 Shipping Documents and Packagings Certification

Prior to shipment of any hazardous material offsite and a minimum of 14 days prior to anticipated pickup, the Contractor's TDC shall provide for review written certification to the Contracting Officer that hazardous materials have been properly packaged, labeled, and marked in accordance with Department of Transportation and EPA requirements. Packaging assurances shall be furnished by the designated disposal facility not later than 35 days after acceptance of the shipment. The Contractor's TDC shall also provide written certification regarding waste minimization efforts documenting that efforts have been taken to reduce the volume and toxicity of waste to the degree economically practicable and that the method of treatment, storage, or disposal selected minimizes threats to human health and the environment.

3.1.4 Transportation

Prior to conducting hazardous materials activities, the Contractor responsible for pre-transportation activities shall either certify to the Government that a Security Plan is in place which meets the requirements of 49 CFR 172, Subpart I or in the event that the types or amounts of hazardous materials are excluded from the security planning requirements, a written statement to that effect detailing the basis for the exception. Use manifests for transporting hazardous wastes as required by 40 CFR 263 or any applicable state or local law or regulation. Transportation shall comply with all requirements in the Department of Transportation referenced regulations in the 49 CFR series. Prepare hazardous waste manifests for each shipment of hazardous waste shipped offsite. Manifests shall be completed using instructions in 40 CFR 262, Subpart B and any applicable state or local law or regulation. Submit manifests and waste profiles to Contracting Officer for review and approval. Prepare land disposal restriction notifications as required by 40 CFR 268 or any applicable state or local law or regulation for each shipment of hazardous waste. Submit notifications with the manifest to the Contracting Officer for review and approval.

3.1.5 Treatment and Disposal of Hazardous Wastes

The hazardous waste shall be transported to an approved hazardous waste treatment, storage, or disposal facility within 90 days of the accumulation start date on each container. Ship hazardous wastes only to facilities which are properly permitted to accept the hazardous waste or operating under interim status. Ensure wastes are treated to meet land disposal treatment standards in 40 CFR 268 prior to land disposal. Propose TSD facilities via submission of the Hazardous Waste Management Plan, subject to the approval of the Contracting Officer. Submit Certificates of Disposal documenting the ultimate disposal, destruction or placement of contaminated material days of initial shipment. Receipt of these certificates will be required for final payment.

3.2 WASTE MINIMIZATION

Minimize the generation of hazardous waste to the maximum extent practicable and take all necessary precautions to avoid mixing clean and contaminated wastes. Identify and evaluate recycling and reclamation options as alternatives to land disposal. Requirements of 40 CFR 266 shall apply to: hazardous wastes recycled in a manner constituting disposal; hazardous waste burned for energy recovery; lead-acid battery recycling; and hazardous wastes with economically recoverable precious metals. Submit written certification that waste minimization efforts have been undertaken to reduce the volume and toxicity of waste to the degree economically practicable and that the method of treatment, storage, or disposal selected minimizes threats to human health and the environment.

3.3 RECORDKEEPING

The Contractor is responsible for maintaining adequate records to support information provided to the Contracting Officer regarding exception reports, annual reports, and biennial reports; maintaining asbestos waste shipment records for a minimum of 3 years from the date of shipment or any longer period required by any applicable law or regulation or any other provision of this contract; and maintaining bill of ladings for a minimum of 375 days from the date of shipment or any longer period required by any applicable law or regulation or any other provision of this contract. Submit information necessary to file state annual or EPA biennial reports for all hazardous waste transported, treated, stored, or disposed of under this contract. Do not forward these data directly to the regulatory agency but to the Contracting Officer at the specified time. The submittal shall contain all the information necessary for filing of the formal reports in the form and format required by the governing Federal or state regulatory agency. A cover letter shall accompany the data to include the contract number, Contractor name, and project location. In the events that a manifest copy documenting receipt of hazardous waste at the treatment storage and disposal facility is not received within 35 days of shipment initiation, or that a manifest copy documenting receipt of PCB waste at the designated facility is not received within 35 days of shipment initiation, prepare and submit an exception report to the Contracting Officer within 37 days of shipment initiation.

3.4 SPILL RESPONSE

In the event of a spill or release of a hazardous substance (as designated in 40 CFR 302), or pollutant or contaminant, or oil (as governed by the Oil Pollution Act (OPA), 33 U.S.C. 2701 et seq.), notify the Contracting Officer immediately. Any direction from the Contracting Officer concerning a spill or release shall not be considered a change under the contract. If the spill exceeds a reporting threshold, follow the pre-established procedures for immediate reporting to the Contracting Officer. Comply with all applicable requirements of Federal, state, or local laws or regulations regarding any spill incident.

3.5 EMERGENCY CONTACTS

The Contractor is responsible for complying with the emergency contact provisions in 49 CFR 172, Section 604. Whenever the Contractor ships hazardous materials, provide a 24 hr emergency response contact and phone number of a person knowledgeable about the hazardous materials being shipped and who has comprehensive emergency response and incident mitigation information for that material, or has immediate access to a

person who possesses such knowledge and information. The phone shall be monitored on a 24 hour basis at all times when the hazardous materials are in transportation, including during storage incidental to transportation. Ensure that information regarding this emergency contact and phone number are placed on all hazardous material shipping documents. Designate an emergency coordinator and post the following information at areas in which hazardous wastes are managed:

a. The name of the emergency coordinator.

b. Phone number through which the emergency coordinator can be contacted on a 24 hour basis.

c. The telephone number of the local fire department.

d. The location of fire extinguishers and spill control materials.

-- End of Section --

SECTION 02 82 33.13

REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING UNDERGROUND PIPE
05/13

PART 1 GENERAL

1.1 DEFINITIONS

Only use this paragraph to define terms used in the specification section that are not defined by a commercial or Government standard and to provide a common interpretation of a term for contractual purposes.

a. CIH: An Industrial Hygienist certified in the comprehensive practice of industrial hygiene by the American Board of Industrial Hygiene.

b. Class I Asbestos Work: Activities involving the removal of thermal system insulation (TSI) and surfacing ACM.

c. Class II Asbestos Work: Activities involving the removal of ACM that is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of caulk.

d. Class III Asbestos Work: Repair and maintenance operations where ACM, including TSI and surfacing ACM, is likely to be disturbed. Operations may include drilling, abrading, cutting a hole, cable pulling, crawling through tunnels or attics and spaces above the ceiling, where asbestos or asbestos-containing debris is actively disturbed. Removal of small amounts of ACM that would fit into a single 60 x 60 inch glove bag or disposal bag may be classified as a Class III job.

e. Class IV Asbestos Work: Maintenance and custodial construction activities during which employees contact but do not disturb ACM and activities to clean up dust, waste and debris resulting from Class I, II, and III activities. This may include dusting surfaces where ACM waste and debris and accompanying dust exists and cleaning up loose ACM debris from TSI or surfacing ACM following construction.

f. Competent Person: On all construction work sites, the contractor shall designate a competent person having the qualifications and authority for verifying worker safety and health as required by 29 CFR 1926.20 and for overseeing asbestos-related work as required by 29 CFR 1926.1101. The duties of the competent person include, but are not limited to, the following: establishing the negative pressure enclosure, verifying its integrity, controlling entry into and exit from the enclosure, and verifying workers wear required personal protective equipment and are trained in the use of hygiene facilities, work practices, and decontamination procedures specified in this specification and applicable regulations.

g. COTR: Contracting Officer's Technical Representative

h. Critical Barrier: 2 Layers of 6-mil polyethylene sheeting sealed over the openings in the work area (or other similarly placed physical barrier) sufficient to prevent airborne fibers in the work area from migrating to an adjacent area.

i. Demarcated Area: An area that has been isolated from the remaining portions of the building by installing critical barriers and/or flapped barriers on the doorways/entrances/and other openings to the area, posting the area with OSHA approved warning signage to prevent unauthorized entry, and providing HEPA equipped ventilation equipment to filter the air and provide directed airflow out of the area.

j. Friable ACM: A term as defined in 40 CFR 61, Subpart M and EPA 340/1-90-018 that means any material containing more than one percent asbestos as determined using the method specified in 40 CFR 763, Appendix A, Subpart F, Section 1, Polarized Light Microscopy, that when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

k. High Efficiency Particulate Air (HEPA) Filter: A filter capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometers in diameter.

l. Immediately: When the contractor is on-site, immediately refers actions required to take place within 15 minutes of being notified. When the contractor is off-site, immediately refers to actions required to take place within 2 hours of being notified.

m. Monitoring Contractor (MC): contracted as a third party to the Government, to perform inspections and air monitoring.

n. Presumed Asbestos-Containing Material (PACM): Thermal system insulation and surfacing material found in buildings constructed no later than 1980.

o. Permissible Exposure Limit (PEL): OSHA PELs are worker exposure limits regulating the concentration of a substance in air that shall not be exceeded. (1) An airborne concentration of asbestos of 0.1 fibers per cubic centimeter of air (f/cc) as an eight- (8) hour time weighted average (TWA). (2) An airborne concentration of asbestos of 1.0 f/cc as averaged over thirty- (30) minutes (Excursion Limit).

p. Time-Weighted Average (TWA): The TWA is an 8-hour time weighted average concentration of airborne asbestos fibers (longer than 5 micrometers) per cubic centimeter of air that represents the employee's 8-hour workday as determined by Appendix A of 29 CFR 1926.1101.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z9.2	Fundamentals Governing the Design and Operation of Local Exhaust Systems

ASTM INTERNATIONAL (ASTM)

ASTM D4397	(2010) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E84	(2012c) Standard Test Method for Surface

	Burning Characteristics of Building Materials

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.134	Respiratory Protection
29 CFR 1910.145	Accident Prevention Signs and Tags
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.1101	Asbestos
29 CFR 1926.59	Hazard Communication
29 CFR 1926.62	Lead
40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 763	Asbestos

UNDERWRITERS LABORATORIES (UL)

UL 586	(2009) Standard for High-Efficiency Particulate, Air Filter Units

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT STD	(2007)VDOT Road and Bridge Specifications

1.3 SUMMARY

This specification is being included as part of the bid package to identify and abate the location of asbestos containing materials that may be disturbed during the course of the project.

Asbestos cement pipe buried in the soil is anticipated to be uncovered and will be removed or may need to be connected to new pipe. Asbestos debris in the soil from the cement pipe may be encountered and will be included in this project scope of work.

Observe all existing and expected conditions, drawings, and information presented prior to submitting a bid. Include in the bid, existing conditions and their impact, particularly to cost and health and safety of workers and occupants, and proper function and operation of the facility. Failure to visit the site shall in no way provide relieve from the necessity of furnishing materials or performing any work that may be required to complete the work in accordance with the Contract Documents without additional cost to the owner. All site visits shall be scheduled with the owner.

The following asbestos containing materials have been identified: Asbestos cement pipe is buried in the soil. Reports identifying locations are available from the Government. Also see drawings.

1.4 GENERAL WORK REQUIREMENTS

Comply with the requirements of these Specifications and ANSI Z9.2, 29 CFR 1910.145, 29 CFR 1926.62, 29 CFR 1926.1101 and 40 CFR 61 and 40 CFR 763. The most stringent of codes shall apply.

This project will require removal, connecting, and/or separating the asbestos cement pipe. Local exhaust ventilation or a foam may be used to collect asbestos fiber at the point of generation.

1.4.1 Permits

In the Commonwealth of Virginia, the Virginia Department of Labor and Industry (DOLI) regulates asbestos abatement and removal through enforcement of the Virginia Occupational Safety and Health (VOSH) regulations, enforcement of the Environmental Protection Agency's National Emission Standards for Hazardous Air Pollutants (NESHAPS), and enforcement of the Asbestos Notification regulations found in the Labor Laws of Virginia (§40.1-51.20). The Virginia Department of Professional Occupational Regulation (DPOR) is responsible for all company and individual licensure in Virginia. The Virginia Department of Environmental Quality is responsible for the regulation of landfills in Virginia. The state of Virginia draws a distinction between friable and non-friable asbestos and define friable asbestos as material that can be crumbled through normal hand pressure.

The owner or operator must notify the Virginia DOLI. The notification must be accompanied by a project permit fee. However, this fee is not required for asbestos removal at Federal Government Facilities properties, or military installations.

Notification of the asbestos abatement removal project must be received by the DOLI within 10 days of the start of the project.

Improper notification to the Virginia DOLI of any asbestos and or demolition project as well as failure to amend any revision to the project dates and other required information on the original notification form may result in citation and monetary penalties.

1.4.2 Environmental Monitoring

Environmental monitoring for airborne asbestos fiber concentrations and third party inspections shall be accomplished by the Government's monitoring contractor, who shall be under a separate contract with the Government. This monitoring contractor shall respond directly to the Government.

1.4.3 Wet Removal

ACM shall be removed using an amended water wet removal method as recommended by the EPA 340/1-90-019 Asbestos NESHAP Adequately Wet Guidance Document and OSHA. The Contractor shall provide for the continual prevention of excessive water accumulation throughout the duration of the project.

1.4.4 Removal and/or Connection of Asbestos Cement Pipe

The Contractor is advised that the existing pipe on this project that is scheduled for removal or for connection may contain asbestos. The

Contractor shall assume any pipe designated on the plans as asbestos cement pipe contains asbestos in a quantity sufficient to be a health hazard if found in a friable condition or made friable during removal or connection. Asbestos cement pipe is a "facility component" as defined in 40 CFR 61. The U.S. Environmental Protection Agency and the Virginia Department of Labor and Industry consider asbestos cement pipe to be Category II non-friable asbestos-containing materials. Disposal of asbestos cement is regulated by the Virginia Department of Environmental Quality.

1.4.5 Procedures

This work shall require removal, connecting, and/or separating the asbestos cement pipe. Modifications of, connections to, or removal of ASBESTOS CEMENT pipe that involve breaking, crushing, saw cutting or abrading shall comply with the state requirements.

The pipe designated for removal may be removed by glovebag method, containment areas, or double wrapped with plastic, sealed and remove in whole sections.

This special provision applies to all removal modifications to asbestos cement pipe where the asbestos cement pipe is removed intact by disconnecting at the slip (bell) joint (with no breakage) and where any subsequent connections are made without disturbing the integrity of the existing pipe. If at any time the Contractor determines that the pipe cannot be removed without breakage, abrading, cutting or crushing, the Contractor shall cease work, reassess work methods, and resume operations in accordance with the state requirements.

The Contractor shall spray and saturate pipe joints with amended water prior to disturbing any pipe.

A foam or local exhaust ventilation may be used to collect asbestos fiber at the point of generation.

No "T"-type connections shall be made to existing pipe by internally piercing or breaking existing potable water pipe without pre- and post-connection monitoring for asbestos fibers in water downstream of the connection. Any results that exceed 7 million fibers per liter (7MFL) shall be reported immediately to the Contracting Officer.

The Government at its discretion, may employ an asbestos project monitor to observe and monitor removal operations of intact asbestos cement pipe. If such monitoring determines that asbestos fibers are being released above the applicable action level or the pipe becomes friable, the Contractor shall cease operations on the pipe and take appropriate corrective action to comply with all applicable federal, state, and local regulations.

Removal, connection, hauling, and disposal shall be performed in accordance with 40 CFR 61.140-61.157 (Subpart M-National Emission Standard for Asbestos), with 29 CFR 1926.1101 (Subpart Z-Toxic and Hazardous Substances), and with all state, regional, and local standards.

The Contractor shall ensure that the intact asbestos cement pipe sections remain intact during loading and hauling of the material to the licensed disposal facility. The Contractor shall double bag or wrap asbestos cement pipe in plastic and seal and mark the materials. The Contractor shall only dispose of the material in a permitted landfill that provides daily soil cover and only after the Contractor has provided notification to the

landfill that the material is non-friable/non-regulated ACM.

Within 35 days of the deposit of the waste in the landfill, the Contractor shall submit to the Contracting Officer copy(s) of the certificate of disposal from the landfill.

The Government must receive all acceptable waste manifests/certificates of disposal prior to making payment to the Contractor.

With approval of the Contracting Officer, abandoned portions of asbestos cement pipe may be left in place of origin and backfilled provided that the pipe is not crushed; however, pipe that is scheduled to be abandoned may not be removed and re-deposited. With approval of the Contracting Officer, the Contractor may pump grout into buried lines that are no longer in service to maintain the structural weight bearing capacity of the area. No on-site burial of crushed asbestos cement pipe will be allowed.

1.4.6 Measurement And Payment

Connection to existing asbestos cement pipe will be measured and paid for at the contract unit price per each for each connection. Removal of existing asbestos cement pipe (without disturbing integrity of pipe) will be measured and paid at the contract unit price per linear foot for the length of pipe actually removed (back to the closest joint).

Payment for these items shall include all material, labor, and equipment necessary for excavation, disassembly, tie-ins, backfill, line abandonment including grout, documentation and disposal of asbestos cement pipe.

Payment will be made under:

Pay Item	**Pay Unit**
Connection to Existing Asbestos Cement Pipe	Each
Remove Existing Asbestos Cement Pipe	Linear Foot
Remove Asbestos Debris and Contaiminated Soil	Cubic Foot

1.4.7 Special Requirements for Tapping Asbestos Cement Pipe

The work may include connecting into a transite asbestos cement water main or pipeline by wet tapping method. A qualified Asbestos Inspector must evaluate and sample possible transite asbestos cement water pipeline to determine if the pipe material contains asbestos. Then a qualified Asbestos Designer/Management Planner will evaluate the work needed to make the connection(s) and classify the work in accordance with applicable asbestos regulations. Note: Specific asbestos related worker training, exposure assessment, engineering and work practice controls, and personal protective equipment will be required in accordance with applicable asbestos regulations.

Special precautions shall be taken preparing and tapping transite asbestos cement pipe. The EPA in conjunction with OSHA has established regulations to address asbestos exposure. 29 CFR 1926.1101 addresses asbestos in the construction industry and 29 CFR 1910.134 addresses the use of respirators approved for use working with asbestos products. Any Contractor working

with or around asbestos cement pipe shall be familiar with these regulations. Wet tapping methods may be used.

Any employee working on or around asbestos cement pipe shall have had at a minimum Asbestos training and EPA/OSHA training. Workers performing the tapping operation shall have completed EPA's/OSHA 4 day Asbestos Abatement Worker training. All tapping work shall be supervised by an EPA/OSHA certified asbestos "Competent Person."

Tapping on mains must be approved by Government. Pipe condition, tap size and location shall be reviewed and accepted prior to installation. The following guidelines are required when tapping existing asbestos water mains:

a. Taps shall be located at least eighteen (18) inches from the joint.

b. Tapping procedures shall be in accordance with the manufacturer's published recommendations.

c. Tapping sleeves and valves shall be used on four (4) inch or larger taps.

d. Tapping sleeves shall be subjected to an air test at 35 psi for a duration of five minutes prior to making a tap. The test pressure shall not exceed 40 psi in any case.

e. All two (2) inch taps shall be made using saddles.

f. Only one tap shall be located in a common line parallel to the longitudinal axis.

g. When multiple taps are necessary on the same length of pipe, the tapping sleeves shall be located on slightly different planes and separated by at least three (3) feet.

h. Tapping sleeves shall be supported by a concrete pad, cast in-place, prior to the tap being installed. A concrete thrust block shall also be provided behind the tapping sleeve.

When asbestos cement pipe debris is discovered in soil, it shall be removed by collecting the debris and contaminated soil, then dispose as asbestos waste. A minimum of two (2) inches of additional non-contaminated soil shall be removed at debris locations.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contractor Identification
Safety, Health and Accident Prevention Plan
Contractor Personnel
Medical Surveillance Program
Training Program

Respiratory Protection Training Program

SD-03 Product Data

Polyethylene Sheeting
FSK Tape
High Efficiency Particulate Air (HEPA) Filtered Vacuum
HEPA Filtered Ventilation System
Wetting Agent
Encapsulant
Airless Sprayer
Respirators
Signs and Labels
Disposal Bags
Air Monitoring Equipment

SD-07 Certificates

Laboratory Qualifications

SD-11 Closeout Submittals

Written certification on final completion of the Work that the Work complies with Contract Documents.

Certification that items on punch list issued at substantial completion have been completed or corrected and that tools, construction equipment and surplus materials have been removed from the site.

Copies of Waste Manifests for the project.
Copies of Personal Samples reports.
Copies of Environmental Monitoring reports.

1.6 QUALITY ASSURANCE

1.6.1 Contractor Identification

Contractor shall be licensed by the Commonwealth of Virginia.

a. Company name and address (street and mailing if different).

b. Name of individual supplying information.

c. Name of parent company, if any.

d. State Business License

e. Project Manager Name.

f. Address of office responsible for this project.

g. Telephone number.

h. Certificate of Insurance.

1.6.1.1 Employees

Contractor shall provide the following information for each employee

assigned to this Project:

a. Number of full-time company employees.

b. Names of local office Company Officers.

c. Names of local office full-time field supervisory personnel, and years of asbestos and lead removal experience, include resumes.

d. Names of local office part-time field supervisory personnel, and years of experience.

e. Number of local office full-time foreman and laborers.

f. Number of local office part-time foreman and laborers.

g. Name of employees' union(s), if any.

h. Usual ratio of supervisory to labor personnel used.

1.6.1.2 Experience

Provide the following:

a. Briefly describe company history.

b. Provide evidence verifying the company has a minimum of three (3) years of successful experience working in the State.

c. Provide a representative list (at least three projects) of successful projects working in occupied facilities. List project name, date, size, duration, removal cost, references and telephone numbers for each project.

d. State average yearly dollar volume of work over the past two years.

1.6.1.3 Regulatory Requirements

Provide past 5-year history showing the following. If not applicable, please issue letter stating there are no violations.

a. List and explain warnings or citations received from Federal, State or Local Regulatory Agencies related to asbestos and/or lead abatement activities. Include project name, date and resolution.

b. List assessed penalties, liquidated damages or schedule overruns and resolutions, which occurred. Include contract terminations.

c. List projects where the owner, architect or consultant halted project activities. State project name, date, reason for shutdown and resolutions.

d. List asbestos or lead related legal proceedings/claims in which the company (or employees scheduled to participate in this project) have participated or are currently involved. Include descriptions of role, issue and resolution to date.

1.6.2 Safety, Health and Accident Prevention Plan

Prepare a Safety, Health and Accident Prevention Plan for all work being performed. Incorporate the requirements and procedures of the Asbestos Abatement Contingency Plan into the plan. At a minimum, the plan shall include the following:

a. Emergency procedures shall be in written form and prominently posted on-site. Everyone, prior to entering the work area, shall be required to read and sign these procedures to acknowledge receipt and understanding of work site layout, location of emergency exits and emergency procedures.

b. Emergency planning shall include considerations of fire, explosion, toxic or oxygen deficient atmospheres, electrical hazards, slips, trips and falls, confined spaces and heat/cold related injury. Written procedures shall be developed and employee training in procedures shall be provided.

c. Emergency planning shall include a Hazard Communication Program (HAZCOM). A written HAZCOM program shall be established and implemented according to 29 CFR 1926.59. Copies of Material Data Sheets (MSDS) for chemicals brought on-site by the Contractor shall be attached to the written HAZCOM Program. The Government has the option of disallowing the use of some chemicals due to high toxicity, objectionable odors, and when more suitable substitutes are available.

d. Copy of the company's health and safety program.

1.6.3 Contractor Personnel

Provide number of full-time laborers that shall be assigned to this project. Provide number of crews and shifts for this project. Provide documentation for each employee has received asbestos training.

1.6.4 Medical Requirements

Provide a copy of the company's Medical Surveillance Program.

1.6.5 Training

Provide a copy of the company's training program for supervisors and laborers. The program shall include, but is not limited to, how often training is conducted, who conducts the training, when it is conducted, what the duration of the program is and how documentation of training is accomplished for asbestos and lead.

1.6.6 Respiratory Protection

Provide a copy of the company's respiratory protection training program.

1.6.7 Laboratory Qualifications

Submit documentation that the laboratory(ies) to be used for Personnel Samples on this contract is accredited. For air samples, the laboratory shall be accredited by the American Industrial Hygiene Association (AIHA) and participates in the Environmental Asbestos Laboratory Accreditation Program (EALAP).

1.6.8 Preconstruction Meeting

The Government shall schedule a preconstruction meeting after the Notice to Proceed. The minimum agenda shall consist of the following:

a. Establishing chain of authority.

b. Work schedule.

c. Critical work sequencing.

d. Processing of field decisions.

e. Distribution of Submittal Documents.

f. Review the facility Asbestos Contingency Plan.

g. Submittals: schedules, product data and samples, manufacturer's certifications of products, manpower reports, major equipment deliveries and priorities, procedures for maintaining record documents, use of Government facilities by contractor (access, parking, office area, storage area, and waste load-outs), safety and first aid procedures, security procedures and housekeeping procedures.

1.7 PROJECT CONDITIONS

The work consists of the containment and removal of lead containing coatings. Local, state, Government Orders and federal rules, regulations and laws govern the work.

The Government shall employ an independent Monitoring Contractor (MC) to verify conformance to the Contract Documents.

The Contractor shall cooperate with the Government and the Monitoring Contractor. This cooperation shall include allowing access to the work areas to allow for visual and air monitoring, collecting samples, providing requested data on personnel, equipment, scheduling and facilitating Government monitoring of the work.

Allow access to the work area when authorized by the Government to enter the site of work.

The facility is a 24-hour per day, 7-day per week facility, which is essential to the safe operation of air traffic in the control area. Immediately notify the Government in the event of a breach of any regulated work areas. Coordinate construction and abatement activities with the Government in order to prevent any disruption of Government operations.

a. Disruption of operations for any amount of time could jeopardize the safety of the public.

b. The Government shall occupy the facility during construction activities. Cooperate fully with the Government during construction operations to minimize conflicts and to facilitate Government usage. Perform the work so as not to interfere with Government operations. Provide Government personnel access to equipment remaining in service.

c. The work shall be limited to specific areas of the building and site. Unlimited access is specifically not permitted. Arrangements for

use of the building space, electrical power, water, etc. and site shall be restricted to those areas specifically allowed by Government. Other contractors shall be working at the site. Cooperate with other on-site contractors. Construction planning meetings shall be held once a week to discuss other projects.

1.8 WORK BY GOVERNMENT

Environmental monitoring and sample analysis (by separate contract). The shutdown, lockout/tag out and re-start of mechanical equipment, and all energized source. The shutdown, lockout/tag out and re-start of electrical circuits and equipment.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Prior to bringing material and equipment on site it shall be clean of environmental contamination or debris.

Materials and products shall comply with the requirements of 29 CFR 1910.134, 29 CFR 1926.62 and 29 CFR 1926.1101.

2.1.1 Polyethylene Sheeting

ASTM D4397, 6 mils thick, flame-retardant. Sheeting shall meet flammability requirements of NFPA 701, and flame spread and smoke density requirements of ASTM E84.

2.1.2 Duct Tape

Waterproof, pressure-sensitive adhesive tape, 3 mils (min.) thick by 3 inches wide for criticals, containment seams and repairs, and decon units; 2 inch wide may be used only on disposal bags and personnel clothing.

2.1.3 FSK Tape

Waterproof, pressure-sensitive adhesive tape, 2 mils (min) thick by 3 inches wide for criticals, containment seams, repairs, and decon units.

2.1.4 High Efficiency Particulate Air (HEPA) Filtered Vacuum

Vacuum(s) shall be:

a. Be capable of removing 99.97% of the asbestos particles (0.3 microns or greater in diameter) from the air.

b. Be portable.

c. Be equipped with hoses of sufficient length to reach areas behind pipes, ducts and other obstacles.

d. Have new filters installed at the beginning of the project. The filters shall be changed on a regular basis for the duration of the project.

e. Be removed from the Government property immediately if they are found to be non-conforming.

2.1.5 HEPA Filtered Ventilation System

Portable ventilation system designed to exhaust and clean the air inside the enclosure prior to exhausting to the outside of the building. The units shall have at least three (3) filter stages, including readily accessible pre- and secondary filters, and a final filter, which shall be a High Efficiency Particulate Air (HEPA) filter. The units shall:

a. Be capable of capturing particles having a diameter of 0.3 micrometers or greater in size with an efficiency of 99.97%.

b. Be equipped with the automatic restart feature.

c. Have new filters installed prior to the onset of abatement activities. The filters shall be changed on a regular basis for the duration of the project.

d. Be located as far away from the fresh air intakes as possible.

e. Be removed from the Government property immediately if they are found to be non-conforming.

f. Meet UL 586.

2.1.6 Wetting Agent

Provide water to which a surfactant has been added. Use a mixture of surfactant and water which results in wetting of the asbestos-containing material and in retardation of fiber release during disturbance of the material, equal to or greater than that provided by the use of one ounce of a surfactant consisting of 50 percent polyoxyethylene ester and 50 percent polyoxyethylene ether mixed with five gallons of water.

2.1.7 Encapsulant

Provide an encapsulant/sealant, which shall be compatible with the existing surfaces, and one, which shall act as a suitable substrate for future surface coatings. Taint (or tint) the encapsulant with a contrasting color, to be approved by the Government, so as to identify coverage.

2.1.8 Airless Sprayer

Hand-pump type, pressure-can sprayer fabricated of either metal or plastic, equipped with a wand at the end of a hose capable of delivering a stream or spray of liquid under pressure.

2.1.9 Respirators

Personal protective breathing equipment shall be in accordance with 29 CFR 1926.62 and 29 CFR 1926.1101.

2.1.10 Signs and Labels

Signs and labels shall be provided in accordance with 29 CFR 1926.62, 29 CFR 1926.1101 and 40 CFR 61 subpart M.

2.1.11 Disposal Bags

Leak-tight, 6 mil thick clear polyethylene bags with appropriate hazard

warning, per EPA regulations 40 CFR 61.150 (a) (1) (v), OSHA requirement 29 CFR 1926.1101 and VDOT STD.

2.1.12 Miscellaneous Materials

2.1.12.1 Air Monitoring Equipment

The equipment shall include, but not be limited to:

a. Low-volume, battery powered, body-attachable, portable personal pumps with a power pack capable of sustaining the calibrated flow rate for a minimum of 10 hours.

b. Standard 25-millimeter diameter, 0.8 micron pore size filters and cassettes in accordance with 29 CFR 1926.1101, for asbestos personal air sampling.

c. Standard 35-millimeter diameter, 0.8 micron pore size filters and cassettes in accordance with 29 CFR 1926.62, for lead personal air sampling.

d. A flow calibrator capable of calibration to within plus or minus 2 percent of reading over a temperature range of minus 20 degrees C (minus 4 degrees F) to plus 60 degrees C (140 degrees F) and traceable to a National Institute of Standards and Technology (NIST) primary standard.

PART 3 EXECUTION

3.1 WORK METHODS

Designated boundary limits for the asbestos work shall be established with rope or other continuous barriers and all other requirements for asbestos control areas shall be maintained, including area signage and boundary warning tape.

3.1.1 Wrap and Cut Operation

Removal of the entire pipe may be more protective, easier, and more cost-effective. The wrap and cut procedure consists of 2 distinct operations. The wrap portion requires the removal of small amounts of asbestos from either side of the pipe to be cut; this will be a Class I or III operation depending on the amount of asbestos removed. Once the asbestos is removed and wrapped, the pipe is then cut. OSHA considers the cutting portion of the job as unclassified, as it does not involve asbestos removal. If the wrap and cut operation is conducted in a negative pressure enclosure system, the glovebag step is not required, although recommended.

Prior to cutting pipe, the asbestos-containing insulation shall be wrapped with polyethylene and securely sealed with duct tape to prevent asbestos becoming airborne as a result of the cutting process. The following steps shall be taken: install glovebag, strip back sections to be cut 150 mm 6 inches from point of cut, and cut pipe into manageable sections.

3.1.2 Glovebag Systems

Glovebags shall be used without modification, smoke-tested for leaks, and completely cover the circumference of pipe or other structures where the work is to be done. Glovebags shall be used only once and shall not be

moved. Glovebags shall not be used on surfaces that have temperatures exceeding 66 degrees C 150 degrees F. Prior to disposal, glovebags shall be collapsed using a HEPA vacuum. Before beginning the operation, loose and friable material adjacent to the glovebag operation shall be wrapped and sealed in 2 layers of plastic or otherwise rendered intact. At least 2 persons shall perform glovebag removal. Asbestos regulated work areas shall be established for glovebag abatement.

The box shall be smoke tested for leaks prior to each use.

Attach HEPA vacuum systems to the bag to prevent collapse during removal of ACM.

3.1.3 Mini-Enclosures

Mini-containment (small walk-in enclosure) to accommodate no more than 2 persons, may be used if the disturbance or removal can be completely contained by the enclosure. The mini-enclosure shall be inspected for leaks and smoke tested before each use. Air movement shall be directed away from the employee's breathing zone within the mini-enclosure.

3.1.4 Housekeeping

Essential parts of abatement dust control are housekeeping and clean up procedures. Maintain surfaces of the abatement work area free of accumulations of debris. Give meticulous attention to restricting the spread of dust and debris. Keep waste from being distributed over the general area. The use of compressed air to move waste material or dust is prohibited. Material generated be packaged and removed at the end of each shift and shall not be allowed to accumulate inside the work area. The Government shall inspect the removal area daily for residual debris.

3.2 ABATEMENT SUPERVISORY DUTIES

Contractor shall employ qualified and certified personnel for complete and safe removal of contaminated materials.

3.2.1 Abatement Superintendent

Designate a qualified employee as superintendent. The superintendent shall meet the requirements of a competent person/supervisor in accordance with OSHA and possesses at least 5 years asbestos/lead abatement experience. The competent person shall perform the following:

a. Oversee all abatement personnel performing any abatement related work.

b. Oversee construction of all enclosures.

c. Control entry to and exit from the removal area.

d. Supervise all employee exposure monitoring required by OSHA.

e. Verify the proper use of protective clothing and equipment.

f. Verify that all occupants of the removal area are properly trained and certified.

g. Verify the proper use of hygiene facilities and decontamination

procedures.

h. Verify that all engineering controls are functioning per design.

3.2.2 Contractor Responsibilities

The contractor will maintain radio or telephone communication with the on-site superintendent.

3.2.3 Inspection by the Government

During abatement work, the work shall be subject to on-site inspection by the Government, who may be assisted by the monitoring contractor.

3.2.4 Work Stoppage

The Government may issue a "stop work" order for any of the reasons listed below. No work shall be allowed to resume until the conditions stabilize and upon approval from the Government. Standby time required to identify and resolve the problem shall be at the expense of the Contractor and may include the costs incurred by the extended efforts of the Government's Monitoring Contractor.

a. If visual inspection or air monitoring results indicate the presence of asbestos outside the designated work area to be greater than permissible exposure levels. 0.01 ug/m3.

b. If excessive water accumulations appear or if water leakage or gross contamination is detected in areas adjacent to the removal area.

c. If the work is found to violate specified requirements.

d. If conditions arise that may adversely impact or disrupt the flying operations or working conditions at the facility.

3.3 PERSONAL PROTECTIVE EQUIPMENT (PPE)

The Contractor will provide PPE for their worker's. The contractor's respiratory protection shall comply with 29 CFR 1910.134, 29 CFR 1926.62, and 29 CFR 1926.1101.

3.4 TEMPORARY FACILITIES AND UTILITIES

3.4.1 Field Office

The Contractor shall furnish their temporary office space.

3.4.2 Temporary Electric

The Contractor shall provide and maintain a GFCI electrical power center for the work operations. Connection locations and lockout/tag out shall be as directed by the Government and electric power shall be provided at no charge to the Contractor. Under no circumstances shall Government existing electrical circuits be used by the Contractor for any purpose, without prior authorization from the Government. The Contractor shall provide:

a. Main distribution panel with a capacity of 110-120 volts, single phase or three phase and 60 hertz and of sufficient capacity to service the complete project.

b. Circuit protection for each circuit.

c. Ground fault interruption protection for all circuits.

d. Grounded, UL listed extension cords from power centers to the point of operation.

3.4.3 Temporary Lighting

Contractor shall provide temporary illumination for construction needs, safe working conditions, public safety and security lighting in compliance with the requirements of 29 CFR 1926.26 and subpart D. Supports and ties shall be constructed of non-conductive materials and exposed two wire conductors shall not be allowed. Lamps shall be covered with safety guards or deeply recessed in reflector and lamps shall not be suspended by their electric cords unless cord and fixture is designed for that purpose.

3.4.4 Temporary Water

Contractor shall provide and maintain temporary water service connection throughout the work period. The temporary water shall be equipped with an approved backflow protection device. The contractor shall install valves at tie-in locations that shall be turned off and locked-out and tagged-out when the contractor is not present on-site.

3.4.5 Temporary Sanitary

Contractor shall provide and maintain temporary sanitary service connection throughout the work period.

3.4.6 Existing Systems

Contractor may make written arrangements with the Government to modify, supplement and extend an existing system to meet temporary requirements for the project, subject to approval by the Government. If existing systems are modified, supplemented and/or extended, the Contractor shall not overload the system or interfere with Government's normal use of the system.

3.4.7 Removal of Temporary Systems

Contractor shall remove all temporary services and repair all damage caused by the contractor and restore to original conditions.

3.5 ISOLATION OF THE WORK AREA

Prepare the work areas in accordance with 29 CFR 1926.62 and 29 CFR 1926.1101, and as detailed in this specification for the work areas.

3.5.1 Establishing Negative Pressure

If containments are used by the contractor, establish negative pressure in accordance with the recommendations of 29 CFR 1926.1101 Appendix F.

a. Maintain negative pressure for containments between negative 0.02 and negative 0.10 inches of water gauge. The intent of the design negative pressure is to prevent the contamination of non-abatement areas.

b. Air Filtration Devices shall exhaust to the buildings exterior a minimum distance of thirty feet from the buildings HVAC make-up air.

3.5.2 Work Place Entry and Exit

Enforcement is the responsibility of the Contractor. Entry shall be controlled to prevent unauthorized, accidental access into the containment area.

3.5.3 Maintenance of Enclosure System

Immediately notify Contracting Officer of problems that have developed such as a puncture of the containment system, electrical power loss, GFCI failure, equipment failure, accidental discharge into occupied areas, and partial collapse of the critical barrier (plastic sheet fails to remain in place), etc.

3.6 PROCEDURE FOR DISPOSAL

Asbestos materials being disposed of in a landfill in accordance with local rules and regulations), collect waste, scrap, debris, bags, containers, equipment, and contaminated clothing and place in sealed, impermeable containers. Properly label each container including identification of the type of waste (49 CFR 178) and the date the drum was filled. The labeling shall include the following additional information:

a. Owner Name.

b. Address.

c. Name of Contractor.

The Generator (Government), the Waste Transporter (Contractor), and the Approved Landfill (Disposal Facility) shall sign Waste Manifests. Minimum requirements for information included on the waste manifest include:

a. Contain a unique number.

b. Be signed by generator when shipping.

c. Be signed by transporter when material is picked-up.

d. Be signed by disposal facility when received.

e. Name and address of pick-up site.

f. Estimated quantity of waste.

g. Specific location within the building where waste was generated.

h. Type and number of bags and drums used at each specific location within the building.

i. Name of Transporter.

j. Disposal site name, location and EPA identification number.

k. Copies of the manifest signed by the generator, transporter and disposal site shall be maintained by each entity.

3.7 ABATEMENT AIR MONITORING

3.7.1 Personal Monitoring

Contractor is responsible for Personal Samples required in accordance with OSHA. An independent American Industrial Hygiene Association (AIHA) accredited laboratory shall be used to analyze air samples in accordance with OSHA. Copies of the results of the air samples shall be furnished within 3 days following the day in which they were collected and shall notify monitored employees.

3.7.2 Environmental Monitoring

Environmental monitoring for asbestos shall be under a separate contract to the Government as a third party monitoring contractor.

a. Clearance Monitoring: Final clearance visual inspection will be conducted by the Government's third party Industrial Hygienist after all removal and connection work associated with the designated cement pipe is completed. If damaged cement pipe is discovered, bulk soil samples in the excavation may be collected by a qualified asbestos inspector and analyzed by PLM to verify removal.

b. Clearance Monitoring: After the visual inspection is completed and air monitoring (as applicable) shall be conducted.

If the glove bag or pipe wrap method is used, the worker personal air monitoring results may be used to indicate clearance. If a containment is used, aggressive air sampling techniques as defined in EPA Publication 560/5-85-024, and the EPA TEM Method specified at 40 CFR 763 will be used. NIOSH Method 7400 (PCM) with optional confirmation of results by NIOSH Method 7402 (TEM) may be used for the containments clearance.

For TEM sampling analysis using the EPA Mandatory Method specified in 40 CFR 763, a minimum of 5 samples shall be collected inside the abatement work area. Decontamination of the abated asbestos regulated work area is considered complete when the arithmetic mean concentration of the minimum of 5 inside samples is less than or equal to 70 structures per square millimeter (70 s/mm).

When NIOSH Method 7400 (PCM) is used as the clearance criteria, 1 to 5 samples are collected and each sample must be less than 0.01 f/cc.

-- End of Section --

SECTION 03 30 00

CAST-IN-PLACE CONCRETE
11/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(2005; R 2009) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI/MCP-1	(2012) Manual of Concrete Practice Part 1
ACI/MCP-2	(2012) Manual of Concrete Practice Part 2
ACI/MCP-4	(2012) Manual of Concrete Practice Part 4
ACI 117	(2010) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 301	(2005; Errata 2008) Specifications for Structural Concrete
ACI 302.1R	(2004; Errata 2006; Errata 2007) Guide for Concrete Floor and Slab Construction
ACI 303R	(2004) Guide to Cast-In-Place Architectural Concrete Practice
ACI 305R	(1999; Errata 2006) Specification for Hot Weather Concreting
ACI 306R	(1988; R 2002) Cold Weather Concreting
ACI 308R	(2001; R 2008) Guide to Curing Concrete
ACI 309R	(2005) Guide for Consolidation of Concrete
ACI 318	(2008; Errata 2008; Errata 2009; Errata 2009; Errata 2009; Errata 2009; Errata 2009) Building Code Requirements for Structural Concrete and Commentary

ACI 347	(2004; Errata 2004) Guide to Formwork for Concrete

ASTM INTERNATIONAL (ASTM)

ASTM A 116	(2005) Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
ASTM A185/A185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A193/A193M	(2010a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A615/A615M	(2012) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A775/A775M	(2007b) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM C1059/C1059M	(1999; R 2008) Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C143/C143M	(2010a) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2011) Standard Specification for Portland Cement
ASTM C171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C172/C172M	(2010) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2010b) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C192/C192M	(2007) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C227	(2010) Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
ASTM C231/C231M	(2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C233/C233M	(2011) Standard Test Method for

	Air-Entraining Admixtures for Concrete
ASTM C260/C260M	(2010a) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	(2010) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2011a) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2012) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	(2012) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C494/C494M	(2011) Standard Specification for Chemical Admixtures for Concrete
ASTM C618	(2012) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 88	(2005) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM A 884/A 884M	(2006) Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM C920	(2011) Standard Specification for Elastomeric Joint Sealants
ASTM C94/C94M	(2012) Standard Specification for Ready-Mixed Concrete
ASTM C979	(2005) Pigments for Integrally Colored Concrete
ASTM E 154	(2008a) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM E1745	(2011) Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
ASTM E329	(2011c) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS FF-S-325	(Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)

1.2 SUMMARY OF WORK

Provide products and transportation required to complete cast-in-place concrete work shown on Drawings, as specified herein, or both, including but not limited to items noted below.

a. Furnishing, placing, curing, finishing, and protection of all reinforced cast-in-place concrete above and below grade, including:

1) All site structures including: retaining walls, columbarium walls, beams, columns, pilasters, benches, committal shelters, pools, fountains, toilets.

b. Furnishing and erection of formwork, shoring and removal of same.

c. Furnishing and placing of reinforcing steel and related positioning and securing accessories, including epoxy coating where specified.

d. Furnishing and installation of admixtures, inserts for connections, waterstops, flashing reglets, and similar items in conjunction with concrete work.

e. Installation of anchor bolts.

f. Furnishing and installation of non-shrink grout at locations shown on the drawings.

g. Furnishing and installation of concrete housekeeping pads, inertia blocks, and foundations for mechanical, plumbing, and electrical equipment.

h. Installation of items furnished by other sections (such as anchors, sleeves, bolts, pipes, and plates), and required to be cast into concrete.

i. Make provisions in forms for proper location and installation of pipe sleeves, duct openings, keys, chases, electrical boxes, bolts, anchors, inserts, and similar items, as required by other trades. Notify appropriate trades when items noted are ready for installation.

j. Unless specifically excluded, furnishing and installation of any other items of cast-in-place concrete work indicated on drawings, specified, or obviously needed to make work of this Section complete.

k. Providing sources of testing laboratory to design concrete mixes.

l. Finishing, saw cutting and concrete repairs.

m. Curing concrete.

n. Cleaning concrete.

o. Mock-ups and samples.

1.2.1 Related Sections

Refer to the following Sections for products and other work not listed in this Section including quality control requirements:

a. Section 03 33 00 CAST-IN-PLACE ARCHITECTURAL CONCRETE

b. Section 03 48 24 PRECAST CONCRETE COLUMBARIUM UNITS

c. Section 03 48 21 PRECAST CONCRETE BURIAL CRYPTS

d. Section 31 63 16 AUGER-PLACED GROUT PILES

e. Division 31 Earthwork

f. Division 32 Exterior Improvements for Concrete Pavement, Sidewalks, Curbs and Gutters

1.2.2 Standards Requirements

Material or operation specified by reference to published specifications of manufacturer or published standard shall comply with said specification or standard. In case of conflict between referenced specifications, most stringent requirement shall govern. In case of conflict between referenced specifications and Project Specifications, Project Specifications shall govern.

1.3 DEFINITIONS

a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, ground granulated blast-furnace slag, and silica fume.

b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.

d. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desired work (vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Methods of Construction Report
Concrete Placement and Sequence Plans; G, AE
Project Mock-Up; G, AE
Plans for Job Mock-Ups; G, AE

SD-02 Shop Drawings

Shop Drawings; G, AE
Detail Drawings; G, AE
Placement Schedule; G, AE
Schedules; G, AE
Reinforcement Drawings; G, AE
Formwork Drawings; G, AE
Corrective Work Drawings; G, AE; As Needed

SD-03 Product Data

detailed list of concrete materials
Concrete Mix Design Data; G, AE
Cement
Fly Ash
Normal Weight Fine Aggregate
Admixtures; G, AE
Polymer Modified Concrete; G, AE
Form Materials
Reinforcement and Accessories
Expansion Joint Material
Non-shrink Grout
Curing Compounds
Bonding Agent, Patching Mortar
Threaded Inserts
Expansion Bolts
Epoxy Anchor Bolts
Waterstops
Vapor Barrier
Electrodes for Welding
Epoxy Injection Adhesive

SD-04 Samples

Panels; G, AE
Project Mock-Up; G, AE
Normal Weight Fine Aggregate
Admixtures; G, AE

SD-05 Design Data

Concrete Placement and Sequence Plans
detailed list of concrete materials
Concrete Curing and Protection Methods; G, AE
Concrete Mixtures; G, AE
Concrete mix design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, silica fume, ground slag , and

admixtures; and applicable reference specifications. Provide mix proportion data using at least three different water-cement ratios for each type of mixture, which produce a range of strength encompassing those required for each class and type of concrete required. If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Contracting Officer. Indicate clearly in the submittal where each mix design is used when more than one mix design is submitted. Submit additional data regarding concrete aggregates if the source of aggregate changes. Submit copies of the fly ash, silica fume, and pozzolan test results, in addition. The approval of fly ash, silica fume, and pozzolan test results must be within 6 months of submittal date. Obtain acknowledgement of receipt prior to concrete placement.

SD-06 Test Reports

Concrete mix design; G, AE
Formwork Shop Drawings

SD-07 Certificates

Concrete Manufacturer's Qualifications
Concrete Contractor's Qualifications
Testing Agency Qualifications
Field Inspector Qualifications
Certified Mill Test Reports
Certificates of Compliance

1.5 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.6 QUALITY ASSURANCE

1.6.1 Concrete Manufacturer's Qualifications

A firm experienced in manufacturing and transporting ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

a. Manufacturer certified according to NRMCA's "NRMCA Quality Control Manual - Section 3, Certification of Ready Mixed Concrete Production Facilities."

b. Manufacturer shall also demonstrate successful past performance on projects requiring landmark site-cast architectural concrete in the last 10 years.

1.6.2 Concrete Contractor's Qualifications

A qualified installer who employs on-project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an

ACI-certified Concrete Flatwork Technician.

Concrete construction firm shall be experienced in the framing, reinforcing, placement, finishing, curing, and repair of cast-in-place concrete. Contractor shall demonstrate successful past performance on projects requiring landmark site-cast architectural concrete in the past 10 years.

1.6.3 Testing Agency Qualifications

Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

a. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.

b. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

1.6.4 Field Inspector Qualifications

A field representative, as agreed upon by the Contracting Officer who has acceptable previous experience in the inspection of architectural concrete of equivalent complexity and scope to the Millennium Project. The Field Inspector shall report directly to the Contracting Officer.

1.6.5 Source Limitations

For Cast-in-Place Architectural Concrete, obtain each color, size, type, and variety of concrete material and concrete mixture from a single manufacturer and a single source with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties. Provide certification that sources have sufficient material to supply this project in its entirety.

1.6.6 Reference Standards

Comply with the following ACI publications unless modified by requirements in the Contract Documents:

a. ACI 301, "Specification for Structural Concrete," Sections 1 through 5 and Section 6, "Architectural Concrete."

b. ACI 303.1, "Specification for Cast-in-Place Architectural Concrete."

1.6.7 Concrete Testing Service

Engage a qualified independent testing agency, with qualifications as specified, to perform a Concrete Field Testing Program. See Section 03 30 00 CAST-IN-PLACE CONCRETE for testing scope and requirements.

1.6.8 Submittal Data

1.6.8.1 Design Mix

For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or

other circumstances warrant adjustments.

a. Indicate amounts of mixing water to be withheld for later addition at Project site.

1.6.8.2 Formwork Shop Drawings

Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.

a. Provide Concrete Placement and Sequence Plans in conjunction with other required submittals to Contracting Officer for approval prior to starting work.

1.6.8.3 Placement Schedule

Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.

1.6.8.4 Samples

For each of the following materials:

a. Form-facing panel.

b. Form ties.

c. Coarse- and fine-aggregate gradations.

d. Chamfers and rustications.

Architectural Concrete Samples, cast vertically, approximately 18 by 18 by 4 inches, of finishes, colors, and textures to match design reference sample. Include Sample sets showing the full range of variations expected in these characteristics.

1.6.8.5 Material Certificates

For each of the following:

a. Cementitious materials.

b. Admixtures.

c. Form materials and form-release agents.

d. Repair materials.

e. Course aggregate; include material test reports.

f. Fine aggregate; include material test reports.

1.6.9 Detail Drawings

Submit detail drawings conforming to ACI SP-66 and ACI 318. Detail drawings shall show location of cast-in-place elements in the work, building elevations, formwork fabrication details, reinforcements,

embedments, dimensions, concrete strength, interface with adjacent materials, and special placing instructions, in sufficient detail to cover fabrication, placement, stripping, and finishing.

1.6.10 Panels

Provide sample panels 6 feet long and 4 feet high with the thickness to match building conditions for each type of architectural concrete and finish, located where directed. Panel forms shall include a typical joint between form panels, form tie conditions and finishes. Protect panels from weather, and other damage until acceptance of work. Sample panels shall be used as job standards throughout construction. Submit a sample panel for approval.

After approval of verification sample and before casting architectural concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of panels, cast vertically, approximately 48 by 48 by 6 inches minimum, to demonstrate the expected range of finish, color, and texture variations.

a. Locate panels as indicated or, if not indicated, as directed by Contracting Officer.

b. Demonstrate methods of curing, aggregate exposure, sealers, and coatings, as applicable.

c. In presence of Contracting Officer, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.

d. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.

e. Demolish and remove field sample panels when directed.

1.6.11 Pre-Installation Conference

Conduct conference at Arlington National Cemetery.

Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place architectural concrete to attend, including the following:

a. Contracting Officer.

b. Contractor's field superintendent.

c. Independent testing agency responsible for concrete placement, observation, concrete sampling and testing.

d. Ready-mix concrete supplier.

e. Cast-in-place architectural concrete subcontractor.

Review concrete mix designs, concrete mixes, transportation, and placement. Review concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction joints, forms and form-removal

limitations, reinforcement accessory installation, concrete repair procedures, and protection of cast-in-place architectural concrete.

1.7 DELIVERY, STORAGE, AND HANDLING

Do not deliver concrete until vapor retarder, vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. ACI/MCP-2 for job site storage of materials. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed. Do not store concrete curing compounds or sealers with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store concrete curing compounds or sealers in occupied spaces.

Deliver packaged materials to Project Site in original unopened and undamaged containers plainly labeled with manufacturer's name, product name and designation, expiration period for use, mixing instructions for multicomponent materials, and other pertinent data. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breakage, and other causes.

Product handling shall comply with the applicable requirements of ACI 301, Chapter 2, Paragraph 25. Reinforcing bars and accessories shall be stored above the ground on platforms, skids, or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration.

Damaged or non-conforming materials shall be removed from the Project site and replaced with new materials satisfactory to the Contracting Officer at no additional cost to the Government.

1.7.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

1.8 ENVIRONMENTAL CONDITIONS

1.8.1 Cold Weather Concreting

Comply with ACI 306R.

1.8.2 Hot Weather Concreting

Comply with ACI 305R.

1.8.3 Inclement Weather

Under conditions of rain, the placing of concrete shall not commence unless adequate protection is provided to prevent damage to the surface mortar or damaging flow or wash of the concrete surface. During inclement weather conditions concrete shall be provided with adequate protection to prevent damage.

1.8.4 Project Conditions

1.8.4.1 Protection Against Freezing

Cover completed work with sufficient temporary or permanent cover as required to protect against possibility of freezing and maintain cover for time period as necessary.

1.8.4.2 Protection Against Splatter

Protect adjacent work, construction, and materials against splatter during concrete placement.

1.9 QUALITY ASSURANCE

1.9.1 Pre-Construction Meeting

Adopt a quality control program which will ensure compliance with specified requirements and industry standards. Appoint a person on the construction team to be responsible for quality issues, and prepare a quality control manual which outlines proposed methods for monitoring reinforcing steel placement and concrete placement consolidation and curing.

a. Provide Concrete Placement and Sequence Plans in conjunction with other required submittals to Contracting Officer for approval prior to starting work.

Prior to the start of concrete work, a pre-construction meeting shall be held at which representatives of the Government, Contracting Officer and Testing Agency and key personnel of the Contractor and Subcontractor shall be present. Key personnel shall include persons who will supply and mix special admixtures such as HRWR, integral waterproofing, and integral color conditioning; who will place reinforcing and concrete; who will consolidate and cure the concrete. Attendance at the meeting of all parties is mandatory. Discussions at the meeting shall form the basis for the performance and inspection of concrete work.

Prior to the start of any item of new work, the specifications and drawings shall be reviewed at a formal meeting at which the Contractor's and Subcontractor's key personnel are present. Key personnel shall include persons actually carrying out the work in the field.

1.9.2 Product Data

Concrete product data constituents:

a. Submit to Contracting Officer a detailed list of concrete materials, and corresponding sources, proposed for use in concrete for this project.

b. See Article in Part 2 for submittal of strength information related to mix design.

c. If conveying concrete by pump is intended, submit related data regarding concrete materials, pumping device, and methods to Contracting Officer. Demonstrate understanding of slump loss considering normal weight concrete and no use of High Range Water Reducer.

d. Submit proposed plan to cure above grade Architectural Concrete surfaces per Specification Section 03 33 00, CAST-IN-PLACE ARCHITECTURAL CONCRETE.

e. Tests for approval of concrete mixtures shall be paid for by Contractor.

1.9.3 Methods of Construction Report

Submit prior to starting work, description of construction methods, sequence of construction, and type of equipment proposed for use for performing cast-in-place concrete work. Provide specific details to protect adjacent existing structure. Contracting Officer's review is only for the effects of methods on permanent structure. This submission shall not relieve Contractor of his responsibility for providing structural design for methods and equipment, and the necessary methods, equipment, workmanship, and safety precautions.

1.9.4 Concrete Mix Design Data

Not less than four weeks prior to beginning the work, submit Concrete Mix Design Data for each proposed mix for review and approval. Mix designs shall be calculated and certified by the testing laboratory, and shall indicate the weight of each ingredient of the mixture, aggregate gradation, slump, air content, water-cement ratio and 7-day and 28-day compressive strength test results. Include a complete list of materials, including admixtures and applicable reference specifications. Include statements from concrete supplier(s) that the mix designs will achieve the specified concrete quality as specified in this Section.

1.9.5 Shop Drawings

Submit detailed Shop Drawings, including erection drawings and schedules.

a. Reinforcement Drawings: prepare in accordance with ACI SP-66 Detailing Manual and ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete" and show following: elevations; dimensions of concrete work with specified reinforcement clearances; special reinforcement required for openings in concrete structures; ledges, brackets, openings, sleeves or other items furnished by other Sections, where interference with reinforcement may occur; bending diagrams; assembly diagrams; splices and laps of reinforcement; temperature and shrinkage reinforcement; construction joint reinforcement; and shapes, dimensions, grade designations, and details of reinforcement and accessories. Show dowels with concrete work to be placed first. Shop drawings shall be prepared, signed, and sealed by a licensed Professional Engineer.

b. Formwork Drawings: schedules of placement; construction joints and contraction joints with methods of forming; general arrangement, sizes and grades of lumber and wood panels; alignment and layout of form ties for exposed concrete: location of embedded items and pockets. Submittal is for verification of joint and surface appearance. Comply with ACI 303R Guide to Cast-in-Place Architectural Concrete Practice where exposed concrete or special architectural treatment is required on the Drawings. This submission does not relieve Contractor of his responsibility for providing structural design for formwork and the proper methods, equipment, workmanship and safety precautions. Form work drawings shall be signed and sealed by a licensed Professional

Engineer.

c. Contracting Officer's checking is only a review for conformance with the design concept of the project and compliance with the information given in the contract documents. The Contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating this work with that of all other trades; and performing the work in a safe and satisfactory manner.

d. Do not proceed with fabrication of material or performance of work until corresponding item on Shop Drawing has been reviewed.

1.9.6 Samples

Submit samples and descriptive literature of materials, products, and methods as noted herein, and as otherwise requested by Contracting Officer: concrete constituents including admixtures; form ties and spreaders; accessories for reinforcement; reglets; non-shrink cement grout; inserts; form release agents, and waterstops. Do not proceed with fabrication of material/product or performance of work until Sample has been approved.

1.9.7 Concrete Curing and Protection Methods Proposal

Submit detailed methods proposed for curing and protecting concrete in normal, cold and hot conditions.

1.9.8 Mill Test Certificates

Submit prior to delivery of reinforcing steel or concrete to job site, certified mill test reports of reinforcing steel and cement, (including names and locations of mills and shops, and analyses of chemical and physical properties), properly correlated to concrete to be used in this project. This submittal is for information and file record.

1.9.9 Certificates of Compliance

Submit manufacturer's certificates of compliance for the following materials showing that the named material conforms to the requirements of the Contract Documents. The manufacturer's certifications shall name the appropriate materials, the publication or publications specified as controlling the quality of that item, and shall state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificate of compliance, and having legal authority to bind the manufacturer. Furnishing certificates of compliance shall not provide relief of responsibility for providing materials that conform to the requirements of the Contract Documents.

a. Aggregates.

b. Admixtures.

c. Reinforcement, including epoxy coating certification.

d. Cement.

e. Submit on request by Contracting Officer, manufacturer's or

supplier's or installer's affidavit stating that material or product provided complies with Contract Documents.

1.9.10 Project Mock-Up

1.9.10.1 Plans for Job Mock-Ups

The project site-cast mockup is shown in the construction Documents. Prior to construction of field-constructed job mock-up, submit complete and accurate shop drawings showing the details to be used for construction of the job mock-up. These shop drawings shall be in addition to all other shop drawings required to be submitted for the work. Such drawings shall show in detail all dimensions, kind, type, and quality of all materials, applicable specification references, and such other information as is usual and customary to provide a clear and comprehensive description of the job mock-up construction. Shop drawings for the job mock-up shall be approved by the Contracting Officer before any job mock-up work is performed.

1.9.10.2 Job Mock-Ups

After acceptance of material samples and of color samples, construct project mock-up at the Project Site for review and acceptance by the Contracting Officer. Section shall show color, finish, workmanship, quality of materials, execution, appearance, and aesthetic effects and shall include representative details as shown on the Mock-Up Design Drawing. Build mock-up to comply with the following requirements, using materials proposed for final units of work. Cast, finish, cure, and construct mock-up in same manner as will be employed in production work. Have all material on hand and in place for casting, mixing, forming, finishing, and curing the job mock-up. Job mock-up shall be completely cast, constructed, finished, and cured at least thirty days prior to any production cast-in-place concrete work at the site. Mock-ups shall be produced by the individual workers who will perform the work for the project. Retain samples of cement, sand, aggregate, and color additives used in the mock-up for comparison with materials used in the remaining work. In addition, schedule sufficient time for review of results, correction of deficiencies, reconstruction, and acceptance to prevent delay in the progress of the work. Extensions of Contract Time, additional costs, or other concessions will not be allowed due to delays or expenses caused by or in any way related to job mock-up construction and evaluation. Protect and maintain mock-ups throughout construction period.

1.10 QUALIFICATIONS FOR CONCRETE TESTING SERVICE

Perform concrete testing by an approved laboratory and inspection service experienced in sampling and testing concrete. Testing agency must meet the requirements of ASTM E329.

1.11 CONCRETE SAMPLING AND TESTING

Testing by the Contractor must include sampling and testing concrete materials proposed for use in the work and testing the design mix for each class of concrete. Perform quality control testing during construction.

Sample and test concrete aggregate materials proposed for use in the work in accordance with ASTM C33/C33M.

Sample and test portland cement in accordance with ASTM C150/C150M.

Sample and test air-entraining admixtures in accordance with ASTM C233/C233M.

Testing must be performed by a Grade I Testing Technician.

PART 2 PRODUCTS

2.1 CONCRETE CONSTITUENTS

The above grade cast-in-place concrete for the Arlington National Cemetery Millennium Project, is intended to include a shrinkage compensating constituent. Permissible shrinkage compensating admixtures are listed in Article "Admixtures." The Contractor shall work with the ready mix contractor, the structural engineer, and the Contracting Officer to develop and validate by trial batch and mock-up, a mix design that provides acceptable shrinkage compensating properties.

2.1.1 Cement

Shall be domestic-made Portland Cement, free from water soluble salts or alkalis which will cause efflorescence on exposed surfaces. Portland Cement for all work on the ANC Millennium Project shall be Type I or Type II, conforming to ASTM C150/C150M. Do not use air entraining cements. Use only one brand of cement for each type of cement throughout project. No visual variations in color shall result in exposed concrete. Manufacturer shall certify that no alkali reactivity is produced with the proposed combination of concrete materials when tested in accordance with ASTM C227.

2.1.2 Fly Ash

ASTM C618, Type C or F; fly ash shall not exceed 25 percent of cement content by weight. Blast furnace slag products, if proposed in a concrete mix, shall not exceed 25 percent of the cement content by weight. The combination of these two products, if proposed in a submitted mix design, shall not exceed 25 percent of the mix cement content by weight.

2.1.3 Normal Weight Fine Aggregate

Normal weight fine aggregate shall be washed, inert, natural sand conforming to ASTM C33/C33M and the following additional requirements:

Sieve	Retained Percent
#4	0-5
#16	25-40
#50	70-87
#100	93-97
Fineness Modulus	2.80 (Plus/Minus 0.20)
Ogranic	Plate 2 maximum
Silt	2.0 percent maximum

Sieve	Retained Percent
Mortar Strength	100 percent minimum compression ratio
Soundness	5 percent max. loss, magnesium sulfate, five cycles

In addition to the requirements of ASTM C 88, the sodium sulphate soundness test, provide evidence satisfactory to the Contracting Officer that the fine aggregate has been exposed to natural weathering, either directly or in concrete, for a period of at least 5 years without appreciable disintegration. In the case where new sources are recently developed, at the option of the Contracting Officer, the service requirement may be waived and the aggregate shall be subjected to testing under the provision of AASHTO T-103, "Soundness of Aggregates by Freezing and Thawing". If the weighed percentage of loss at the end of 50 cycles does not exceed 10 percent, the fine aggregate shall be accepted as pertains to soundness requirements.

2.1.4 Normal Weight Fine Aggregate

Normal weight fine aggregate shall be well-graded crushed stone conforming to ASTM C33/C33M. Washed gravel shall not be used. Coarse aggregate shall also meet the following additional requirements:

Designated Size (inches)							
	3	2	1-1/2	1	3/4	1/2	3/8
FM (plus/minus 0.2)	7.95	7.45	7.20	6.95	6.70	6.10	5.80
Organic	Plate 1 maximum.						
Silt	1.0 percent maximum.						
Soundness	5 percent maximum loss, magnesium sulfate, five cycles.						

Maximum designated sizes for normalweight coarse aggregate to be used in concrete sections shall be 3/4-inch for all concrete work.

2.1.5 Water

Provide from approved source, potable, clean and free from oils, acids, alkali, organic matter and other deleterious material.

2.1.6 Admixtures

Water-reducing admixture: Shall comply with ASTM C494/C494M, Type A and contain no more than .05 percent chloride ions.

High-Range Water Reducing (HRWR) admixture (Super Plasticizer) shall not be used for this project.

Use air entrainment admixture for all concrete in accordance with manufacturer's written instructions. See ACI 303R Table 3.4.1 for required air content except that minimum for all sizes of aggregate shall be 6 percent in exterior environment. Air entraining admixture shall comply with ASTM C260/C260M.

Evaporation retarder shall use water-based monomolecular film; use one of the following with flatwork containing corrosion inhibiter or silica fume admixture. The use of this admixture in the concrete mix design shall include due consideration of other admixtures for color and waterproofing. Admixtures shall be included in trial batch mixes of concrete in order to be acceptable for use on the Project.

Water-reducing Set Retarders: Conform with ASTM C494/C494M Type D and may be used when ambient temperatures exceed 80 degrees F. The use of this admixture in the concrete mix design shall include due consideration of other admixtures for color and waterproofing. Admixtures shall be included in trial batch mixes of concrete in order to be acceptable for use on the Project.

Accelerator admixture: Non-chloride and non-corrosive accelerators shall conform to ASTM C494/C494M Type C and may be used when temperatures are below 50 degrees F. The use of this admixture in the concrete mix design shall include due consideration of other admixtures for color and waterproofing. Admixtures shall be included in trial batch mixes of concrete in order to be acceptable for use on the Project.

Prohibited admixtures: Calcium chloride, thiocynanates and admixtures containing more than .05 percent chloride ions are not permitted.

Color Conditioning Admixture:

a. Color admixture as described herein shall be used in concrete for all exposed above grade concrete work.

b. Admixture shall be a single component color admixture, factory formulated and packaged in cubic yard dosage increments. Admixture may also be a packaged iron oxide product without water reducing and set controlling admixtures. The admixture shall comply with ASTM C494/C494M, "Standard Specification for Chemical Admixtures for Concrete".

c. Admixture shall also conform to:

1) ACI A303.1 "Standard Specification for Cast-in-Place architectural Concrete".
2) ASTM C979 "Standard Specification for Pigments for Integrally Colored Concrete.

d. Use integral standard grade pigment of the same color

e. Admixture shall be added to the concrete mix in a dosage (which may range from 2 percent to 10 percent of the cement content) that produces the tan color that has been approved by the Contracting Officer in mock-up samples of concrete.

Integral Waterproofing Admixture: Provide integral waterproofing admixture

which shall be added to the concrete batching operation. This admixture shall be used in all concrete for the new pool and fountain concrete or as required per Drawings.

a. Provide admixture in a dosage of 2 to 3 percent by weight of cementitious concrete materials. Test batches of the design mix with this additive must be produced by the ready mix contractor to assess local plastic and hardened properties to determine optimum mix design.

Shrinkage Compensating Admixtures: Provide admixture in dosages recommended by the manufacturer to achieve compensating properties in the concrete mix. This admixture shall be included in all above grade concrete work. The use of this admixture in the concrete mix design shall include due consideration of other admixtures for color and waterproofing. Admixtures shall be included in trial batch mixes of concrete in order to be acceptable for use on the Project.

2.1.7 Polymer Modified Concrete

Polymer modified concrete, colored to match substrate concrete, shall be used as the repair patch material on any damaged above grade construction. Application of the patch material shall be in accordance with manufacturer's recommendations, and shall also be approved by successful use in the mock-up structure.

2.2 CONCRETE MIXTURES

Following ACI 211.1 recommended practice for selecting proportions for normal weight concrete, proportion concrete on the basis of previous field experiences or laboratory trial batches with the materials to be employed in the work. However, mixtures shall have the limiting quantities or values listed below for each strength concrete with coarse aggregate less than 1-1/2 inches.

Compressive Strength at 28 days PSI	Maximum Allowable Net Water Content		Minimum Cement Factor	
	Gal/Sack	W/C Ratio	Sack s/Cu Yd	Lbs/C u.Yd.
4000	5.07	0.45	6.38	600

Maximum allowable net water content is the total water in the mix at the time of mixing, including free water on aggregate.

Consider any fly ash or silica fume as part of the cement content for purposes of establishing cement factor and w/c ratio.

Use maximum water-cement equal to 0.45 for concrete subject to freezing and thawing, repeated surface wetting or deicers.

Concrete proportions shall be substantiated by trial mixtures made specifically for this project meeting the following restrictions:

a. Use the combination of materials proposed for use in the work. Include all admixtures required for the concrete as described herein (i.e.: air entrainment, concrete color treatment, integral waterproofing, water reducing agents).

b. Make trial mixtures having proportions and consistencies suitable for the proposed work using at least three different water-cement ratios or, for lightweight concrete, cement contents that will produce a range of strengths encompassing those required for the proposed work.

c. Design trial mixtures to produce a slump within 1 inch of the maximum permitted, and for air-entrained concrete, within 0.5 percent of the maximum allowable air content. Report the temperature of freshly mixed concrete in the trial mixtures.

d. For each proposed mixture, make and cure at least three compressive test cylinders for each age in accordance with ASTM C192/C192M. For normal, heavyweight, and mass concrete, each change of water-cement ratio shall be considered a new mixture. Test the cylinders for strength in accordance with ASTM C39/C39M at 28 days or at a specified earlier or later age.

e. From the results of these cylinder tests, plot a curve showing the relationship between compressive strength and the water-cement ratio for normal weight concrete.

f. From this curve, the water-cement ratio for normal concrete to be used in the proposed work, shall be selected to produce an average compressive strength 1200 psi higher than the specified strength. The cement content and mixture proportions to be used shall be such that the selected water-cement ratio or cement content is not exceeded when slump is the maximum permitted. Maintain proper cement content, slump, and air content.

Slump shall be in accordance with Part 3 of this Section.

Normalweight concrete shall have an air dry weight not exceeding 150 lbs. per cubic foot.

a. Design 28 day strengths as shown in the Drawings. Unless otherwise noted, all concrete shall be 4000 psi.

Deviation from approved mix design will not be allowed without written approval of Contracting Officer. Cost of any additional testing by Testing Agency associated therewith shall be paid for by Contractor.

Each proposed mix design must be submitted on separate submittal pages, with each mix clearly labeled with its intended use on the project.

2.3 FORM MATERIALS

2.3.1 Exposed-to-View Surfaces

All Exposed-to-View concrete is considered to be Architectural. Refer to Section 03 33 00 CAST-IN-PLACE ARCHITECTURAL CONCRETE for additional requirements.

a. Approved non-absorptive material. See 03 33 00 CAST-IN-PLACE ARCHITECTURAL CONCRETE.

b. Chamfer Strips: Use 1/2-inch, 45 degree wood strips, nailed six inches on center, and installed in inside corners of all forms, unless otherwise directed by Contracting Officer. Epoxy-Coated Reinforcing Bars: Epoxy coated reinforcement shall conform to ASTM A775/A775M.

2.3.2 Not-Exposed-to-View Surfaces

Use forms of wood, metal, or other material subject to approval of Contracting Officer.

2.3.3 Form Ties and Spreaders

Wire ties shall not be used. Ties for concrete exposed to view shall be as indicated in Section 03 33 00, CAST-IN-PLACE ARCHITECTURAL CONCRETE Ties for foundation walls shall have water seal washers on the earth side.

2.3.4 Form Release Agent

Use a non-staining and non-emulsifiable type. Form release agent shall not impart any stain to concrete nor interfere with adherence of any material to be applied later to concrete surfaces. USDA BioPreferred Products shall be considered wherever possible. See additional requirements for Architectural Concrete in Section 03 33 00 CAST-IN-PLACE ARCHITECTURAL CONCRETE.

2.4 REINFORCEMENT AND ACCESSORIES

2.4.1 Reinforcing Steel Bars

Newly rolled billet steel conforming to ASTM A615/A615M, grade 60. Bars shall be bent cold. All reinforcing bars, chairs and wire ties used in exposed above grade construction shall be epoxy coated; conforming to ASTM A775/A775M, grade 60. Reinforcing in footings, pile caps, and other concrete not exposed to view may be uncoated. Reinforcing in retaining walls which do not contain columbarium units and which are stone-faced are not considered to be architectural concrete and do not require epoxy coated reinforcing.

2.4.2 Welded Wire Fabric

Shall conform to ASTM A185/A185M. All welded wire fabric shall be epoxy coated; conforming to ASTM A 884/A 884M.

2.4.3 Reinforcement Accessories

Reinforcement accessories shall include spacers, chairs, ties, slab bolsters, clips, chair bars, and other devices for properly assembling, placing, spacing, supporting, and fastening reinforcement. Tie wire shall be annealed wire of sufficient strength for intended purpose, but not less than No. 18 gage. Bar supports shall conform to Chapter 3, "Bar Supports" or CRSI Manual of Standard Practice. Supports touching interior formed surfaces exposed to view shall be CRSI Class 1, plastic protected. When epoxy coated reinforcing is used, accessories shall be epoxy coated and tie wire shall be nylon, epoxy or plastic coated

2.5 RELATED MATERIALS

2.5.1 Expansion Joint Material

Joint material shall be high-density open micro-cell polyurethane foam impregnated with a polymer sealing compound with an NSF approved polysulfide facing that meets ASTM C920 and ASTM A 116.

2.5.2 Non-shrink Grout

Use CRD-C 621, factory pre-mixed grout, Type D, non-metallic

2.5.3 Absorptive Cover

Use burlap cloth weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

2.5.4 Moisture-Retaining Cover

Use one of the following, complying with ASTM C171:

a. Waterproof paper.

b. Polyethylene-coated burlap.

2.5.5 Curing Compounds

Verify that products listed below meet regulations of jurisdiction for Volatile Organic Compounds (VOC) emissions. Notify Contracting Officer if listed products do not comply and submit information about equivalent products that do comply. Curing compounds shall not be used for above grade concrete exposed to view (Architectural Concrete). Architectural Concrete shall be moisture cured with water.

a. Curing and Sealing Compound: Use a clear acrylic type conforming to ASTM C309, Type I, Class B. Use one of the following or equivalent where concrete surfaces will remain exposed. Compound must be confirmed to be fully compatible with the color conditioning admixture used in the concrete. It must not adversely affect the color of the concrete as defined by the approved concrete mock-ups.

1) Curing Compound as manufactured by manufacturer of the concrete conditioning admixture.

2.5.6 Bonding Agent, Patching Mortar

Cementitious slurry containing polymer-modified latex admixture.

2.5.7 Threaded Inserts

Use galvanized structural concrete inserts of type shown on the drawings, similar and equivalent to strut and loop inserts with coil-threaded rods, having yield strength Fy = 85,000 psi.

2.5.8 Expansion Bolts

Use hot-dipped galvanized bolt conforming to Federal Spec. FS FF-S-325, Group II, Type 4, Class 1. Allowable pullout and shear values shall be based on ASTM E 488 test methods. See Drawings for diameters, edge

distances, embedments and center-to-center spacings.

2.5.9 Epoxy Anchor Bolts

Two-part epoxy adhesive used in conjunction with project reinforcing bars or anchor rods meeting the requirements of ASTM A193/A193M Grade B7 or AISI 304, or AISI 316 stainless steel. Anchored bolt capacity and installation procedures shall be as specified by the manufacturer.

2.5.10 Waterstops

Provide in all concrete construction joints as shown on drawing details. Material shall be 1 inch by 3/4-inch Bentonite type weighing not less than 0.5l bs per linear foot

2.5.11 Vapor Barrier

A flexible, preformed sheet membrane having a water-vapor permeance rate no greater than 0.012 perms when tested in accordance with ASTM E 154, Section 7 and otherwise conforming to ASTM E1745, Class B or higher. Vapor barrier shall be no less than 10 mils thick in accordance with ACI 302.1R

2.5.12 Electrodes for Welding

E90XX low hydrogen filler rods or equivalent based on welding technique. See Tables 2.2 and 5.1 of AWS D1.4/D1.4M.

2.5.13 Bonding Agent and Reinforcement Protection

ASTM C1059/C1059M, Type II, non redispersible acrylic emulsion or styrene butadiene

2.5.14 Epoxy Injection Adhesive

Two component, 100 percent solids, low viscosity, moisture tolerant epoxy adhesive formulated for grouting and sealing dry and damp cracks.

2.5.15 Extruded Polystyrene Foam Insulation

Used in conjunction with columbarium wall casting as shown on the construction documents. Refer to Section 07 21 00 THERMAL INSULATION

2.5.16 Epoxy Bonding Adhesive

Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.

a. Type V, load bearing, for bonding freshly mixed concrete to hardened concrete.

PART 3 EXECUTION

3.1 INSPECTION

Examine work prepared by other trades to receive work of this Section and

report any defects affecting installation to the Contractor for correction. Commencement of work will be construed as complete acceptance of preparatory work by others.

3.2 FORMS

ACI/MCP-2. Provide forms, shoring, and scaffolding for concrete placement. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch unless otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris. Forms submerged in water must be watertight.

3.2.1 General

Construct forms to conform, within the tolerances specified, to shapes dimensions, lines, elevations, and positions of cast-in-place concrete members as indicated. Forms must be supported, braced, and maintained sufficiently rigid to prevent deformation under load.

3.2.2 Design and Construction of Formwork

Provide formwork design and construction that conforms to ACI/MCP-2, Chapter 4.

Provide forms that are tight to prevent leakage of cement paste during concrete placing.

Support form facing materials by structural members spaced close to prevent deflection of form facing material. Fit forms placed in successive units for continuous surfaces to accurate alignment to ensure a smooth completed surface within the tolerances specified. Where necessary to maintain the tolerances specified, such as long spans where immediate supports are not possible, camber formwork for anticipated deflections in formwork due to weight and pressure of fresh concrete and to construction loads.

Chamfer exposed joints, edges, and external corners a minimum of 3/4 inch by moldings placed in corners of column, beam, and wall forms.

Provide shores and struts with a positive means of adjustment capable of taking up formwork settlement during concrete placing operations. Obtain adjustment with wedges or jacks or a combination thereof. When adequate foundations for shores and struts cannot be secured, provide trussed supports.

Provide temporary openings in wall forms, column forms, and at other points where necessary to permit inspection and to facilitate cleaning.

Provide forms that are readily removable without impact, shock, or damage to concrete.

3.2.3 Coating

Before concrete placement, coat the contact surfaces of forms with a nonstaining mineral oil, nonstaining form coating compound, or two coats of nitrocellulose lacquer. Do not use mineral oil on forms for surfaces to which adhesive, paint, or other finish material is to be applied.

3.2.4 Reshoring

Reshore concrete elements where forms are removed prior to the specified time period. Do not permit elements to deflect or accept loads during form stripping or reshoring. Forms on columns, walls, or other load-bearing members may be stripped after 2 days if loads are not applied to the members. After forms are removed, reshore slabs and beams over 10 feet in span and cantilevers over 4 feet for the remainder of the specified time period in accordance with paragraph entitled "Removal of Forms." Perform reshoring operations to prevent subjecting concrete members to overloads, eccentric loading, or reverse bending. Provide reshoring elements with the same load-carrying capabilities as original shoring and spaced similar to original shoring. Firmly secure and brace reshoring elements to provide solid bearing and support.

3.2.5 Reuse

Reuse forms providing the structural integrity of concrete and the aesthetics of exposed concrete are not compromised.

3.2.6 Forms for Standard Rough Form Finish

Give rough form finish concrete formed surfaces that are to be concealed by other construction, unless otherwise specified.

Form facing material for standard rough form finish must be the specified concrete form plywood or other approved form facing material that produces concrete surfaces equivalent in smoothness and appearance to that produced by new concrete form plywood panels.

For concrete surfaces exposed only to the ground, undressed, square-edge, 1-inch nominal thickness lumber may be used. Provide horizontal joints that are level and vertical joints that are plumb.

3.2.7 Forms for Standard Smooth Form Finish

Give smooth form finish concrete formed surfaces that are to be exposed to view or that are to be covered with coating material applied directly to concrete or with covering material bonded to concrete, such as waterproofing, dampproofing, painting, or other similar coating system.

Form facing material for standard smooth finish must be the specified overlaid concrete form plywood or other approved form facing material that is nonreactive with concrete and that produce concrete surfaces equivalent in smoothness and appearance to that produced by new overlaid concrete form plywood panels.

Maximum deflection of form facing material between supports and maximum deflection of form supports such as studs and wales must not exceed 0.0025 times the span.

Provide arrangement of form facing sheets that are orderly and symmetrical, and sheets that are in sizes as large as practical.

Arrange panels to make a symmetrical pattern of joints. Horizontal and vertical joints must be solidly backed and butted tight to prevent leakage and fins.

3.2.8 Form Ties

Provide ties that are factory fabricated metal, adjustable in length, removable or snap-off type that do allow form deflection or do not spall concrete upon removal. Portion of form ties remaining within concrete after removal of exterior parts must be at least 1-1/2 inches back from concrete surface. Provide form ties that are free of devices that leave a hole larger than 7/8 inch or less than 1/2 inch in diameter in concrete surface. Form ties fabricated at the project site or wire ties of any type are not acceptable.

3.2.9 Tolerances for Form Construction

Construct formwork to ensure that after removal of forms and prior to patching and finishing of formed surfaces, provide concrete surfaces in accordance with tolerances specified in ACI/MCP-1, ACI/MCP-2, and ACI 117.

Parts of construction with additional tolerance requirements are indicated on the Drawings.

3.2.10 Removal of Forms and Supports

After placing concrete, forms must remain in place for the time periods specified in ACI/MCP-4. Do not remove forms and shores (except those used for slabs on grade and slip forms) until the client determines that the concrete has gained sufficient strength to support its weight and superimposed loads. Base such determination on compliance with one of the following:

a. The plans and specifications stipulate conditions for removal of forms and shores, and such conditions have been followed, or

b. The concrete has been properly tested with an appropriate ASTM standard test method designed to indicate the concrete compressive strength, and the test results indicate that the concrete has gained sufficient strength to support its weight and superimposed loads.

Prevent concrete damage during form removal. Clean all forms immediately after removal.

3.2.10.1 Special Requirements for Reduced Time Period

Forms may be removed earlier than specified if ASTM C39/C39M test results of field-cured samples from a representative portion of the structure indicate that the concrete has reached a minimum of 85 percent of the design strength.

3.3 PLACING OF REINFORCEMENT

Place reinforcement in accordance with requirements of CRSI "Placing Reinforcing Bars".

Place reinforcement in accordance with ACI 117 (Tolerances) and with Contract Documents and secure firmly in position by wire ties, chairs, spacers, and hangers, each of type approved by Contracting Officer.

Welding Reinforcement: Comply with AWS D1.4/D1.4M for welding practices. Preheat and interpass temperatures shall comply with Table 5.2 of AWS D1.4/D1.4M. Provide mill reports to Contracting Officer showing carbon

content of reinforcing being welded.

Do not bend, tackweld or cut reinforcement in field in any manner other than as shown on Drawings unless specific approval for each case is given by Contracting Officer.

Continue reinforcement through construction joints unless otherwise indicated on Drawings.

Splice reinforcement only in accordance with requirements of Contract Documents or as otherwise specifically approved by Contracting Officer. Do not splice reinforcement at points of maximum stress unless shown on the Drawings. Welded wire fabric shall be lapped six inches or one and one-half spaces, whichever is larger, and shall be wired together.

At time concrete is placed, reinforcement shall be free of excessive rust, scale, or other coatings that will destroy or reduce bond. Paint reinforcement expected to be exposed to weather for a considerable length of time with a heavy coat of cement grout. Protect stored materials so as not to bend or distort bars in any way. Bars that become damaged will be rejected. Repair damage to coating of epoxy coated rebars in strict accordance with epoxy manufacturer's published instructions.

Before concrete is cast, check all reinforcement after it is placed to insure that reinforcement conforms to Contract Documents and approved Shop Drawings. Such checking shall be done only by qualified experienced personnel. In addition, notify the Contracting Officer at least 36 hours prior to concrete placement so a visit may be made to observe completed reinforcement and formwork before concrete placement.

3.4 JOINTS

Construction joints indicated on Drawings are mandatory and shall not be omitted. Joints not indicated or specified shall be placed to least impair strength of structure and shall be subject to approval of Contracting Officer.

3.5 INSTALLATION OF EMBEDDED ITEMS

Conform to requirements of ACI-318, paragraph 6.3, "Conduits and Pipes Embedded in Concrete", and as specified. Install steel sleeves, furnished by other trades, at locations shown on the drawings.

3.6 MIXING, CONSISTENCY, AND DELIVERY OF CONCRETE

Use ready-mixed concrete produced by plant acceptable to Contracting Officer. Hand or site mixing shall not be done. Batch constituents, including admixtures, at central plant. Admixtures shall be premixed in solution form and dispensed as recommended by manufacturer.

Concrete shall arrive at the job site at a slump of 4 to 6 inches.

a. If high-range water reducing admixture (superplasticizer) is used, it may be added at the job site after verifying that the delivery slump is 4 to 6 inches. Maximum slump after adding HRWR shall be 8 inches.

b. For normalweight concrete, water may be added at the site only to make up water withheld at the plant. Batching plant shall document on the driver's delivery ticket any water withheld at the plant. When

water has not been withheld and slump is too low for proper handling of concrete, use HRWR to bring slump within specified range.

3.6.1 Ready-Mix Concrete

Comply with requirements of ASTM C 94, supplemented and amended as specified herein.

a. Ready-Mix Concrete Delivery Tickets: Before unloading at the site, provide a delivery ticket from concrete supplier with each batch delivered to the site bearing the following information:

1) Name of supplier;
2) Name of batching plant and location;
3) Serial number of ticket:
4) Date;
5) Truck number;
6) Specific job designation;
7) Volume of concrete in cubic yards;
8) Class and type of concrete;
9) Time loaded;
10) Type and brand of cement;
11) Weight of cement;
12) Maximum size of aggregates;
13) Source of aggregates;
14) Type of aggregate;
15) Weight of coarse aggregate;
16) Weight of fine aggregate;
17) Maximum amount of water , and amount, if any, which has been withheld at the plant;
18) Kind and amount of admixtures;
19) Mix design designation; and
20) Signature of a certified plant batcher, or a certified plant concrete technician, or a responsible officer or other authorized employee of the concrete supplier;
21) Time discharged.

Transport ready mixed concrete to site in watertight agitator or mixer trucks loaded not in excess of rated capacities. Discharge at site within one and one-half hours after cement was first introduced into mix. Do not use concrete with a temperature greater than 85 degrees F. Central mixed concrete shall be plant mixed a minimum of five minutes. Agitation shall begin immediately after premixed concrete is placed in truck and shall continue without interruption until discharged. Transit mixed concrete shall be mixed at mixing speed for at least ten minutes immediately after charging truck followed by agitation without interruption until discharged. For Architectural Concrete see additional restrictions in Section 03 33 00, CAST-IN-PLACE ARCHITECTURAL CONCRETE.

Do not retemper (mixing with or without additional cement, aggregates, or water) concrete which has partially hardened.

3.7 PLACING CONCRETE

If concrete pumping is proposed, refer to "Submittals, Concrete Constituents", in this Section for requirements. If lightweight concrete pumping is proposed, use a pipe diameter of 5 inches. Concrete may be placed into the pump at the maximum but not more than the specified slump.

Remove water and foreign matter from forms and excavations and, except in freezing weather or as otherwise directed, thoroughly soak wood forms just prior to placing concrete. Place no concrete on frozen soil and provide adequate protection against frost action during freezing weather.

To secure bond at construction joints, thoroughly clean concrete surfaces with water jet or compressed air. Before new concrete is deposited, saturate joint surface with water.

Do not place concrete having slump outside of allowable slump range. The loss of slump between pump and discharge end of pipeline shall not exceed two inches.

Transport concrete from mixer to place of final deposit as rapidly as practical by methods which prevent separation of ingredients and displacement of reinforcement, and which avoid rehandling. Deposit no partially hardened concrete. When concrete is conveyed by chutes, equipment shall be of such size and U-shaped design as to insure continuous flow in chute. Do not use flat (coal) chutes. Use metal or metal lined chutes with different portions having approximately the same slope. Slope shall not be less than 25 degrees nor more than 45 degrees from horizontal. Use a baffle or spout at the discharge end of the chute to prevent segregation. If discharge end of chute is more than five feet above surface of concrete in forms, use spout with its lower end at surface of deposit. When operation is intermittent, discharge chute into hopper. Do not allow concrete to flow horizontally over distances exceeding five feet.

Place concrete in such manner as to prevent segregation and accumulations of hardened concrete on forms or reinforcement above mass of concrete being placed. To achieve this end, use suitable hoppers, spouts with restricted outlets and tremies as required.

During and immediately after depositing, compact concrete in accordance with ACI 309R by means of internal type mechanical vibrators or other tools to produce required quality of finish. Vibration shall be done by experienced operators under close supervision and shall be carried on only enough to produce homogeneity and optimum consolidation without permitting segregation of constituents or "pumping" of air. Vibrators used for normalweight concrete shall operate at speed of not less than 7,000 rpm and be of suitable capacity. Do not use vibrators to move concrete. Keep at least one vibrator on hand for every 10 cubic yards of concrete placed per hour, plus one spare. Vibrators shall be operable and on site prior to starting placement.

Place vertical lifts not to exceed 18 inches. Vibrate through successive lifts to avoid pour lines. Vibrate first lift thoroughly until top of lift glistens to avoid stone pockets, honeycomb, and segregation.

Deposit concrete continuously, and in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause formation of seams and planes of weakness within section. If section cannot be placed continuously between planned construction joints, as specified, introduce a joint and additional reinforcement so as to preserve structural continuity. Notify Contracting Officer in any such case.

Cold joints, particularly in exposed concrete, including "honeycomb", are unacceptable. If they occur in concrete surfaces exposed to view, Contracting Officer will require that entire section in which blemish

occurs be removed and replaced with new materials at Contractor's expense.

Clean chutes, hoppers, spouts, adjacent work, etc. before and after each run; discharge water and debris outside form.

3.8 CONSTRUCTION FINISHES

3.8.1 Finish of Formed Surfaces

Rough Form Finish: For formed concrete surfaces not exposed-to-view in the finish work. This is the concrete surface imparted by stock form facing material used with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4-inch in height rubbed down or chipped off.

Smooth Form Finish: For formed concrete surfaces above grade and surfaces that are to be covered with a coating material applied directly to concrete, such as waterproofing, dampproofing paint. This is the as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of joints and with a systematic pattern of ties with set-back cones. Grout tie holes; remove and rub smooth fins or other projections. Surfaces remaining exposed-to-view shall have uniform color and texture acceptable to the Contracting Officer.

Related Unformed Surfaces: Unless otherwise noted on the drawings; at tops of walls, horizontal offsets surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces.

3.8.2 Monolithic Slab Finishes

Float Finish:

a. Apply float finish to monolithic slab surfaces that will not be exposed in the completed construction.

b. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to a tolerance not exceeding 5/16-inch in 10 feet when tested with a 10-foot straightedge or to a flatness number for the floor surface (FF) not less than 20. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

Steel Trowel Finish:

a. Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with wood flooring, resilient flooring, carpet, thin-set tile and stone, paint or other thin film finish coating system.

b. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete

surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 3/16" in 10" when tested with a 10' straightedge.

c. A steel trowel finish shall be provided for the:

1) Toilet room and mechanical room slabs;
2) Plinth surfaces on columbarium walls where precast units will be set.

Broom Finish:

a. A light broom finish shall be applied to all exposed sidewalks. Broom lines shall be perpendicular to the direction of the sidewalk.

Sealing and Hardener Finishes:

a. If a wet cure process is not used for curing, apply a coat of the specified Curing and Sealing slabs compound to exposed concrete where compound is indicated on the Drawings. Apply the compound in strict accordance with the directions of the manufacturer.

3.9 CONCRETE CURING AND PROTECTION

Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Start curing before concrete has dried and immediately after placing and finishing. Weather permitting; keep continuously moist for not less than 7 days.

Keep permanent temperature record showing date and outside temperature for concreting operations. Take thermometer readings at start of work in morning, at noon, and again late in afternoon. Record locations of concrete placed during these periods so any effect temperatures may have had on construction can be correlated. Distribute copies of temperature record daily to Contracting Officer.

3.9.1 Curing Methods

Keep concrete surface continuously wet by moist curing, by moisture-retaining cover curing, by curing compound, and by combinations thereof, as herein specified. Moisture curing is required for the Reflecting Pool slab surfaces and for pile supported sidewalks slabs.

Provide moisture curing in accordance with ACI 308R and by covering with water or continuous water-fog spray at Contractor's option:

a. The entire surface of the concrete shall be kept damp by applying water with a nozzle that so atomizes the flow that a mist and not a spray is formed. The moisture from the nozzle shall not be applied under pressure directly upon the concrete and shall not be allowed to accumulate on the concrete in a quantity sufficient to cause a flow or wash the surface.

b. The rate of water application shall be controlled to the maximum rate that can be applied without causing excessive runoff, splattering, splashing, or other water damage. Steps shall be taken to properly protect surrounding work and construction from damage by water or water runoff. The nozzle size, water pressure, sprinkling or wetting equipment, etc., shall be adjusted and regulated so that the optimum

quantity of water is applied to the curing area. Care shall be taken to insure that the overlay of absorptive cover is clean, thoroughly saturated over its entire area, drained of excess water, and remains flat at all times.

c. Curing shall be done so that the concrete is always moist. Improperly cured concrete will be considered defective. Failure to use, or lack of water to adequately provide for curing requirements shall be cause for immediate suspension of concrete placing operations. Placing operations shall not be resumed until proper procedures are used.

d. After moisture curing has been properly completed, sprinkling equipment, wetting lines, connections, and appurtenances shall be removed in a manner acceptable to the Contracting Officer and the work left in a first class and satisfactory condition. Any damage shall be repaired or damaged work replaced as directed by the Contracting Officer at no additional cost to the Government.

e. Cured concrete shall be uniform in color, texture, and finish, with no objectionable form marks or irregularities. Concrete containing plastic shrinkage cracks will be considered defective and shall be repaired or removed and replaced as directed by the Contracting Officer at no additional cost to the Government.

f. Continuous sprinkling coverage shall be complete, shall prevent loss of moisture from the entre concrete surface, and shall prevent early drying shrinkage.

g. Concrete shall not be left exposed for more than 30 minutes during the curing period.

Provide moisture-cover curing as follows:

a. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

b. Moisture Cover Curing shall not be used for the Reflecting Pool slab surfaces or for pile supported sidewalk slabs.

Provide curing compound as follows:

a. Apply specified curing compound to exterior and exposed interior concrete slabs as soon as final finishing operations are complete (within 2 hours) and to formed surfaces immediately after forms are removed.

b. Apply uniformly in two continuous operations at right angles to each other by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

c. Curing compound must be compatible with other admixtures in the concrete mix.

d. Curing compounds shall not be used for exposed to view Architectural Concrete.

3.9.2 Cold Weather Placing

Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306R and as herein specified.

a. When air temperature has fallen to or is expected to fall below 40 degrees F., uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F., and not more than 80 degrees F., at point of placement.

b. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

c. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

d. When the ambient temperature is below 40 degrees F or is expected to drop below 40 in the 12 hours after anticipated placement, concrete shall not be placed unless otherwise directed by the Contracting Officer.

3.9.3 Hot Weather Placing

When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305R and as herein specified.

a. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

b. Wet forms thoroughly before placing concrete. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F. Mixing water may be chilled, or chopped ice may be used to control temperature provided, that when ice is used it shall be added with the water and counted as part of the water-cement ratio.

c. Use water reducing retarding admixture when required by high temperatures, humidity, or other adverse placing conditions, when acceptable to the Contracting Officer.

3.10 REMOVAL OF FORMWORK, SHORING, AND RESHORING

Contractor shall be responsible for proper removal of formwork shoring, and reshoring. Comply with ACI 347 for shoring and reshoring in multi-story construction.

Remove vertical forms as soon as concrete has attained sufficient strength to support its own weight and their removal can be done without damage to the concrete. Apply curing compound immediately after removing forms.

Keep horizontal forms and supports in place for not less than minimum periods of time noted below or until concrete has reached 80 percent of its

specified strength.

a. Soffits of beams or girders shall remain in place until concrete has attained 600 day-degrees.

b. Definition of day-degrees: Total number of days or fractions of days times mean daily air temperature at surfaces of concrete; where concrete surface is protected by insulated blankets or formwork, temperature may be taken under the blankets or formwork. For example, five days at temperature of 60 degrees F. equals 300 day degrees. Days or fractions of days in which temperature is below 50 degrees F. shall not be included in calculation of day-degrees.

When forms are removed, place reshores at same time as stripping operations so that no unshored area is larger than one-fourth of a slab panel. Allow no live load on slab when stripping and shoring are being done.

Field cure test cylinders under same conditions as concrete they represent in order to verify minimum strengths for form removal. Such cylinders and testing shall be at the Contractor's expense.

3.11 ACCEPTANCE AND REPAIRING OF CONCRETE SURFACES

Intent of this Specification is to require forms, mixtures of concrete, and workmanship so that concrete surfaces will require no patching, except for plugging of tie holes.

a. Remove and replace architectural concrete with surface defects exceeding the limitations of ACI 301, Section 13.3.1 or having honeycombs, excessive air voids (bugholes), mismatched coloring, pour lines or sand streaking. The standard of acceptability shall be the surface quality of the approved sample panels and mock-up, where no test panel has been made, the standard of unacceptability shall be ACI 309R-96 "Guide for Consolidation of Concrete".

b. Where patching is acceptable to Contracting Officer, procedure shall comply with ACI 301-96, Chapter 9 and Section 13.6 and as described below.

Clean and dampen tie holes and fill solid with patching mortar immediately after form removal.

Do not patch defective concrete and honeycombed areas unless examined and approval is given by Contracting Officer. If such approval is received by contractor, areas involved shall be chipped down square and at least one inch deep to sound concrete by means of cold chisels or pneumatic chipping hammers. If honeycomb exists around reinforcement, chip to provide clear space at least three-quarter inch wide all around steel to ensure proper bond thereto. Repairs thicker than one and one-half inches shall be built-up on successive days, each layer of one and one-half inches being applied as described in ACI 301-96 Chapter 9. Use specified bonding agent.

Remove and replace patches which become crazed, cracked, or sound hollow upon tapping, at Contractor's expense.

3.11.1 Repair of Concrete Cracks

Over the duration of this project until all concrete has completed 28 days of curing, the contractor shall repair any cracks that may develop in the

pool slab surfaces, the pile supported sidewalks, or the pile supported west plaza. Crack repairs shall be performed on all cracks that have a measurable open dimension. The repair shall be executed using an epoxy injection adhesive.

a. Depending on the size of the crack, the product may be applied by gravity feed or, if necessary, pressure injection. Repairs shall follow the procedure requirements of the product manufacturer for surface preparation, mixing, placement, and curing.

b. All repairs shall be approved in advance by the Contracting Officer. The contractor shall submit proposed marked up plans of all cast surfaces with details for execution. The Contracting Officer shall confirm the scope of crack repairs in any given area via direct field inspection.

3.12 CLEANING

Clean concrete surfaces of objectionable stains as determined by the Contracting Officer. Do not use materials containing acid in any form or methods which will damage "skin" of concrete surfaces.

3.13 CONCRETE REMOVAL AND REPAIR AT DETERIORATED CONCRETE

3.13.1 Corrective Work Drawings

Submit to Contracting Officer drawings showing details of any proposed corrective work prior to performing corrective work.

3.13.2 General

Removal and repair procedures as follows:

a. All concrete in areas designated for removal shall be removed to sound concrete.

b. Patch areas shall be cut or chipped with square edges and corners without overcut. Rectangular patch areas are preferred. Patches with feathered edges are not acceptable.

c. The Contractor shall take all steps necessary to prevent cutting or damaging reinforcing steel or other items embedded in the concrete.

d. All demolition debris and foreign materials shall be carefully removed from the patch areas and legally disposed of off site.

e. If there is less than 12 inches between any two patches, then the affected areas between eh two patches shall be removed.

f. Mechanical Impact:

1) The minimum depth of concrete removal shall be 2 inches.
2) Pneumatic hammers and chipping tools shall not be operated at an angle exceeding 60 degrees relative to the surface of the concrete. Such tools may be started perpendicular to the surface and immediately tilted to a 60 degree angle.

g. After the limits of the concrete removal are determined, chip the perimeter or the patch area to produce a vertical edge cut of

approximately 1/2-inch or less as necessary to avoid cutting the reinforcing bars. Use 4-inch hand-held grinder or other similar methods as necessary to eliminate overcutting at perimeter. Cut 45 degree chamfers at all re-entrant corners.

h. Removal shall start in the middle of the marked areas and proceed outward towards the edges. Take care not to damage concrete beyond the patch area or break the bond of reinforcing steel with the concrete outside of the patch area.

i. If Contractor is required to extend the size of patch areas due to careless shipping damages of sound concrete or the bond of unoxidized reinforcement to the sound concrete, the patch area shall be enlarged until the disturbed concrete is completely removed at the Contractor's expense.

3.13.3 Exposing and Undercutting Reinforcing Steel

Procedures for repairs and replacement for exposed or undercut reinforcing steel:

a. The initial demolition of concrete shall remove all loose and delaminated concrete above oxidized and corroded reinforcing steel.

b. All oxidized and corroded bars shall be undercut a minimum of 3/4-inch or 1/4-inch larger than the largest sized aggregate in the patching concrete, whichever is greater.

c. Exposed bars which are not oxidized or corroded do not need to be undercut if less than 50 percent of the bar's circumference is exposed and the bond between the bar and concrete is intact. If the bond is broken or more than 50 percent of the bar's circumference is exposed, the bar shall be undercut as previously described.

d. Removal of concrete around reinforcing bars shall extend to the point where the bar is well bonded to the concrete and free of corrosion that inhibits the bond. Care shall be taken during undercutting not to damage the bond between the concrete and reinforcing bar in areas beyond the patch.

e. If corroded or heavily oxidized reinforcing bars extend beyond marked repair areas into sound concrete, the Contractor shall extend the limits of the repair area as directed by the Contracting Officer.

3.13.4 Preparation of Reinforcing and Embedments

Procedures are as follows:

a. Cleaning: All exposed reinforcing steel or other metal embedments shall be cleaned to bare metal. It is not necessary to clean the steel to "near white" condition. Cleaning may be performed with a needle gun, grinder, or wire wheel.

b. Corrosion Protection for Steel:

1) The use of a corrosion inhibiting admixture in the patching material is required.

3.13.5 Repair of Reinforcing Steel

Proceed as follows:

a. Conventional Reinforcing:

1) If a reinforcing bar has lost more than 25 percentof its original area (10 percent for full depth repairs), a new bar shall be spliced in place of the old one. Such splicing shall conform to ACI 318.
2) Secure all reinforcing bars in place with plastic tipped steel or high-density plastic supporting and spacing devices and metal tying devices. Reinforcing in concrete members that have one or more surfaces exposed, whether painted or unpainted finish, shall be tied with 14 gage soft annealed galvanized wire. Uncoated tie wire in exposed members will not be accepted.

3.13.6 Miscellaneous Repairs

Coat exposed reinforcing bars with the approved bonding agent. Coat the surface of the concrete to be patched with the same bonding agent if adverse conditions require it and if so directed by the Contracting Officer.

Apply the approved polymer modified repair concrete to cleaned, deteriorated concrete surfaces by hand trowel as recommended by the manufacturer. Cure as directed by the manufacturer.

3.14 INSPECTION AND TESTING

Inspection and testing of cast-in-place concrete work will be performed by an independent Testing Agency, under a separate contract with the Government. Materials and workmanship shall be subjected to inspection and testing in mill, shop and/or field by testing Agency and shall be subjected to periodic observation by the Contracting Officer. Such inspection and testing shall not relieve Contractor of his responsibility to provide his own inspection, testing, and quality control as necessary to furnish materials and workmanship in accordance with requirements of these Contract Documents.

Requirements of this section are generally written for purpose of securing best workmanship and end result. Certain deviations may be desirable under certain project conditions, however, and may be allowed after examination by and upon written approval of Contracting Officer. Any such approved deviation shall not be construed as a waiver of requirements of Specifications.

Notify Contracting Officer and Testing Agency prior to start of any phase of concrete work so as to afford them reasonable opportunity to schedule site visit. Such notification shall be made at least 36 hours in advance.

Facilitate inspection and testing by Testing Agency. Furnish Testing Agency upon request with:

a. Information as to time and place of shipments of materials to plant and project site.

b. Free and safe access and assistance for testing materials and proper facilities for inspection of work in plant and at proper site.

c. Covered box large enough to contain twenty-four standard concrete cylinders. At temperatures below 60 degrees F., box shall be electrically heated to maintain inside temperature of 60 to 80 degrees F. Place cylinders in box immediately after molding and cover with moist burlap until delivery to laboratory, 24 to 72 hours after molding.

d. Copies of mill test reports of shipments of cement and reinforcing steel.

Promptly replace concrete materials or redo work which has been rejected by Contracting Officer and/or Testing Agency, either at plant or at job site, to satisfaction of Contracting Officer and/or Testing Agency and at no expense to the Government.

Correct, or remove and replace concrete work which does not meet requirements of Contract Documents for aesthetic appearance as directed by Contracting Officer. Criteria for acceptance shall be based on a mockup preapproved by the Contracting Officer. Cost of such correction or removal and replacement shall be at Contractor's expense.

Sampling and testing for quality assurance during placement of concrete may include the following, as directed by Contracting Officer. Samples will be made at the point of discharge from the ready-mix truck.

a. Sampling Fresh Concrete: ASTM C172/C172M, except modified for slump to comply with ASTM C94/C94M.

1) Slump: ASTM C143/C143M; one test for each concrete load and one test for each set of compressive strength test specimens.
2) Air Content: ASTM C173/C173M, volumetric method for lightweight or normalweight concrete; ASTM C231/C231M pressure method for normalweight concrete; one for each set of compressive strength test specimens.
3) Concrete Temperature: Test hourly when air temperature is 40 degrees F. (4 degrees C.) and below, and when 80 degrees F. (27 degrees C.) and above; and each time a set of compression test specimens made.
4) Compression Test Specimen: ASTM C31/C31M; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required. One set of cylinders shall be taken for every 50 cubic yards or fraction thereof.

b. Compressive Strength Tests: ASTM C39/C39M; one set for each 50 cu. yds. or fraction thereof, of each concrete class placed in any one day or for each 5,000 sq. ft. of surface area placed; two specimens tested at 7 days, 2 specimens tested at 28 days, and one specimen retained in reserve for later testing if required. Five totals per set.

1) When strength of field-cured cylinders is less than 85% of companion laboratory-cured cylinders, Contracting Officer may direct Contractor to evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete or to redesign the mix. An additional set of field-cured cylinders, taken at the same rate as lab-cured cylinders, will be

required when ambient air temperatures are below 32 degrees F.
2) Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.
3) Test results will be reported in writing to Contracting Officer and Contractor on same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.
4) Additional Tests: The testing agency will make additional tests of in-place concrete when test results show specified concrete strengths and other characteristics have not been attained in the structure, as directed by Contracting Officer.
5) Testing Agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M, or by other methods as directed, including load testing. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

Nondestructive Testing of Welded Reinforcing Steel: The Testing Agency will make tests of welded reinforcing in accordance with AWS D1.4/D1.4M. Butt welded reinforcing shall be tested by radiographic or magnetic particle methods. Parallel-welded reinforcing shall be visually inspected.

-- End of Section --

SECTION 03 33 00

CAST-IN-PLACE ARCHITECTURAL CONCRETE
11/09

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 301	(2010) Specifications for Structural Concrete
ACI 303.1	(1990) Standard Specification for Cast-In-Place Architectural Concrete
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting
ACI 308.1	(1998) Standard Specification for Curing Concrete
ACI 117	(2010) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 318	(2011; Errata 2011) Building Code Requirements for Structural Concrete and Commentary
ACI 347	(2004; Errata 2008) Guide to Formwork for Concrete
ACI 504R	(1990)Guide to Sealing Joints in Concrete Structures
ACI SP-66	(2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM C 1017/C 1017M	(2007) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1059/C 1059M	(1999; R 2008) Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete

ASTM C 1077	(2010c) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 150	(2009) Standard Specification for Portland Cement
ASTM C 171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates
ASTM C 494/C 494M	(2010) Standard Specification for Chemical Admixtures for Concrete
ASTM C 618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 881/C 881M	(2002) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 920	(2010) Standard Specification for Elastomeric Joint Sealants
ASTM C 94/C 94M	(2009a) Standard Specification for Ready-Mixed Concrete
ASTM C 979	(2005) Pigments for Integrally Colored Concrete
ASTM C 989	(2009a) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM E 329	(2009) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 800	(2010) Voluntary Specifications and Test Methods for Sealants

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(2009) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

1.2 SYSTEM DESCRIPTION

All materials, procedures, and requirements specified in Section 03 30 00

CAST-IN-PLACE CONCRETE shall fully apply to cast-in-place architectural concrete, except as otherwise specified.

1.2.1 Concrete Mix Design

Design the concrete mix in accordance with ACI 211.1 including consideration of the finishes required.

1.2.2 Formwork Design

Design formwork conforming to ACI 301 and ACI 347.

1.3 DEFINITIONS

Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structures that require special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance. All concrete on this project which is above grade and exposed to view shall be considered Architectural.

Cementitious Materials: Portland cement alone or in combination with one or more of the following: fly ash and other pozzolans, and ground granulated blast-furnace slag; subject to compliance with requirements.

Design Reference Sample: Sample designated by Contracting Officer in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.

a. References: In addition to references cited in Section 03 30 00 CAST-IN-PLACE CONCRETE:

1) ACI 117 - Tolerances for Concrete Construction
2) ACI 303.1 - Cast-in-Place Architectural Concrete

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G, AE
Formwork Shop Drawings; G, AE
Concrete Placement and Sequence Plans; G, AE
Placement Schedule; G, AE

SD-03 Product Data

Design mix; G, AE
Chamfer Stips
Form Joint Tape
Form Joint Sealant
Sealer
Form-Release Agent
Steel Reinforcement and Accessories
Admixtures

Curing Materials
Repair Materials
Ready-Mixed Architectural Concrete

SD-04 Samples

Mockup; G, AE
Concrete Materials
Panels; G, AE
Form-facing panels; G, AE
Form ties
Rustication Stips
Architectural Concrete Samples; G, AE
Concrete Mixtures; G, AE
Joint Sealants

SD-07 Certificates

Concrete Manufacturer's Qualifications
Concrete Contractor's Qualifications
Testing Agency Qualifications; G, AE
Field Inspector Qualifications; G, AE
Material Certificates

1.5 QUALITY ASSURANCE

1.5.1 Concrete Manufacturer's Qualifications

A firm experienced in manufacturing and transporting ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

a. Manufacturer certified according to NRMCA's "NRMCA Quality Control Manual - Section 3, Certification of Ready Mixed Concrete Production Facilities."

b. Manufacturer shall also demonstrate successful past performance on projects requiring landmark site-cast architectural concrete in the last 10 years.

1.5.2 Concrete Contractor's Qualifications

A qualified installer who employs on-project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

Concrete construction firm shall be experienced in the framing, reinforcing, placement, finishing, curing, and repair of cast-in-place concrete. Contractor shall demonstrate successful past performance on projects requiring landmark site-cast architectural concrete in the past 10 years.

1.5.3 Testing Agency Qualifications

Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

a. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.

b. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

1.5.4 Field Inspector Qualifications

A field representative, as agreed upon by the Contracting Officer who has acceptable previous experience in the inspection of architectural concrete of equivalent complexity and scope to the Millennium Project. The Field Inspector shall report directly to the Contracting Officer.

1.5.5 Source Limitations

For Cast-in-Place Architectural Concrete, obtain each color, size, type, and variety of concrete material and concrete mixture from a single manufacturer and a single source with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties. Provide certification that sources have sufficient material to supply this project in its entirety.

1.5.6 Reference Standards

Comply with the following ACI publications unless modified by requirements in the Contract Documents:

a. ACI 301, "Specification for Structural Concrete," Sections 1 through 5 and Section 6, "Architectural Concrete."

b. ACI 303.1, "Specification for Cast-in-Place Architectural Concrete."

1.5.7 Concrete Testing Service

Engage a qualified independent testing agency, with qualifications as specified, to perform a Concrete Field Testing Program. See Section 03 30 00 CAST-IN-PLACE CONCRETE for testing scope and requirements.

1.5.8 Submittal Data

1.5.8.1 Design Mix

For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

a. Indicate amounts of mixing water to be withheld for later addition at Project site.

1.5.8.2 Formwork Shop Drawings

Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.

a. Provide Concrete Placement and Sequence Plans in conjunction with other required submittals to Contracting Officer for approval prior to

starting work.

1.5.8.3 Placement Schedule

Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.

1.5.8.4 Samples

For each of the following materials:

a. Form-facing panel.

b. Form ties.

c. Coarse- and fine-aggregate gradations.

d. Chamfers and rustications.

Architectural Concrete Samples, cast vertically, approximately 18 by 18 by 4 inches, of finishes, colors, and textures to match design reference sample. Include Sample sets showing the full range of variations expected in these characteristics.

1.5.8.5 Material Certificates

For each of the following:

a. Cementitious materials.

b. Admixtures.

c. Form materials and form-release agents.

d. Repair materials.

e. Course aggregate; include material test reports.

f. Fine aggregate; include material test reports.

1.5.9 Detail Drawings

Submit detail drawings conforming to ACI SP-66 and ACI 318. Detail drawings shall show location of cast-in-place elements in the work, building elevations, formwork fabrication details, reinforcements, embedments, dimensions, concrete strength, interface with adjacent materials, and special placing instructions, in sufficient detail to cover fabrication, placement, stripping, and finishing.

1.5.10 Panels

Provide sample panels 6 feet long and 4 feet high with the thickness to match building conditions for each type of architectural concrete and finish, located where directed. Panel forms shall include a typical joint between form panels, form tie conditions and finishes. Protect panels from weather, and other damage until acceptance of work. Sample panels shall be used as job standards throughout construction. Submit a sample panel for approval.

After approval of verification sample and before casting architectural concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of panels, cast vertically, approximately 48 by 48 by 6 inches minimum, to demonstrate the expected range of finish, color, and texture variations.

a. Locate panels as indicated or, if not indicated, as directed by Contracting Officer.

b. Demonstrate methods of curing, aggregate exposure, sealers, and coatings, as applicable.

c. In presence of Contracting Officer, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.

d. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.

e. Demolish and remove field sample panels when directed.

1.5.11 Mockup

Before casting architectural concrete, build a full size mockup to verify selections made from sample submittals and field sample panels; to demonstrate typical joints, typical features, surface finishes, texture, tolerances, and standard of workmanship. Build mockup to comply with the following requirements, using materials indicated for the completed Work:

a. Build mockups in the location designated by the Client or as directed by Contracting Officer.

b. Build mockups of typical wall, column, beam, and columbarium cap as shown on the project mock-up drawing.

c. Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.

d. In presence of Contracting Officer, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.

e. Obtain Contracting Officer's approval of mockups before casting architectural concrete.

1.5.12 Pre-Installation Conference

Conduct conference at Arlington National Cemetery.

Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place architectural concrete to attend, including the following:

a. Contracting Officer.

b. Contractor's field superintendent.

c. Independent testing agency responsible for concrete placement, observation, concrete sampling and testing.

d. Ready-mix concrete supplier.

e. Cast-in-place architectural concrete subcontractor.

Review concrete mix designs, concrete mixes, transportation, and placement. Review concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction joints, forms and form-removal limitations, reinforcement accessory installation, concrete repair procedures, and protection of cast-in-place architectural concrete.

PART 2 PRODUCTS

2.1 FORM-FACING MATERIALS

Comply with Section 03 30 00 CAST-IN-PLACE CONCRETE for formwork and other form-facing material requirements.

2.1.1 Form-Facing Panels for As-Cast Finishes

Architectural form panels with a non-absorptive surface which will provide continuous, true, and smooth architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints. Aluminum, magnesium, or zinc faced forms shall not be used. Non-absorptive surfaces may be high density overlaid plywood, plastic or metal, subject to specific review and approval by the Contracting Officer.

HDO plywood shall be at least 5 plies with a minimum thickness of 5/8 inch, conforming to USPS P-1-83.

2.1.2 Rustication Strips

Metal, rigid plastic, or dressed wood with sides beveled and back kerfed; nonstaining; in longest practicable lengths.

2.1.3 Chamfer Strips

Metal, rigid plastic, elastomeric rubber, or dressed wood, 3/4 by 3/4 inch, minimum; nonstaining; in longest practicable lengths.

2.1.4 Form Joint Tape

Compressible foam tape; pressure sensitive; AAMA 800, "Specification 810.1, Expanded Cellular Glazing Tape"; minimum 1/4 inch thick.

2.1.5 Form Joint Sealant

Elastomeric sealant complying with ASTM C 920, Type M or Type S, Grade NS, that adheres to form joint substrates.

2.1.6 Sealer

Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.

2.1.7 Form-Release Agent

Commercially formulated, chemically active, colorless form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces. Barrier type release agents shall not be used.

a. Formulate form-release agent with rust inhibitor for steel form-facing materials.

b. Form release agents shall be manufacturer's standard, nonstaining, nonpetroleum based, compatible with surface sealer finish coating.

2.1.8 Form Ties

Factory-fabricated, stainless steel, internally disconnecting ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

a. Furnish internally disconnecting ties that will leave no metal closer than 1-1/2 inches from the architectural concrete surface. Snap-ties shall not be used.

2.2 STEEL REINFORCEMENT AND ACCESSORIES

Comply with Section 03 30 00 CAST-IN-PLACE CONCRETE for steel reinforcement and other requirements for reinforcement accessories. All reinforcement in above grade construction shall be epoxy coated. Exception: Above grade retaining walls without columbarium units and with stone facing on all exposed surfaces are not considered to be architectural concrete and do not require epoxy coated reinforcing.

2.2.1 Bar Supports

Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufacture according to CRSI's "Manual of Standard Practice."

a. Where legs of wire bar supports or other bar spacers contact forms, use white, all-plastic CRSI Class 1, gray, plastic-protected bar supports.

2.2.2 Tie Wire

Shall be epoxy coated where epoxy coated bars are used.

Tie wire shall be soft monel or 18-8 stainless steel.

2.3 CONCRETE MATERIALS

Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

a. Portland Cement: ASTM C 150, Type I or Type II. White cement is expected to be required to achieve the desired color of the concrete mix as indicated below. Cement may be supplemented with the following:

1) Fly Ash: ASTM C 618, Type C or Type F.
2) Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or

Grade 120.

b. A buff concrete color, similar to Indiana limestone is desired. This may be achieved through the use of buff colored cement, through the use of white cement with sand and aggregate of an appropriate color, or through an integral color pigment in a concrete mix with white cement. Color is subject to Architectural review and approval.

Normal-Weight Aggregates: Well graded crushed stone conforming to ASTM C 33/C 33M, Class 5S. Washed gravel shall not be used. Provide aggregates from single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 3/4 inch.

2. Gradation: Uniformly graded.

2.3.1 Normal-Weight Fine Aggregate

ASTM C 33/C 33M manufactured or natural sand, from same source for entire Project.

2.3.2 Water

Potable, complying with ASTM C 94/C 94M except free of wash water from mixer washout operations.

2.4 ADMIXTURES

2.4.1 Air-Entraining Admixture

ASTM C 260.

2.4.2 Chemical Admixtures

Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

2.4.2.1 Water-Reducing Admixture

ASTM C 494/C 494M, Type A.

2.4.2.2 Water-Reducing Admixture

ASTM C 494/C 494M, Type D.

2.4.2.3 High-Range, Water-Reducing Admixture

ASTM C 494/C 494M, Type F and Type G.

2.4.2.4 Plasticizing Admixture

ASTM C 1017/C 1017M, Type II.

2.4.2.5 Shrinkage Compensating Admixture

Provide admixture in dosages recommended by the manufacturer to achieve compensating properties in the concrete mix. This admixture shall be included in all above grade exposed architectural concrete.

2.4.2.6 Integral Waterproofing Admixture

Shall be included in concrete mix for pools and fountains.

2.4.3 Color Pigment

ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

a. Color: Buff as approved in samples and mock-up by the Contracting Officer.

2.5 CURING MATERIALS

Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry, kept continuously wet during the curing period.

Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

Other form of wet curing using water or water-fog spray.

Curing method must be proven through mock-up construction to not create any streaks, marks, or blemishes on the concrete finish.

Curing compounds shall not be used on architectural concrete surfaces.

2.6 REPAIR MATERIALS

Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.

a. Type V, load bearing, for bonding freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXTURES, GENERAL

Prepare design mixtures for each type and strength of cast-in-place architectural concrete proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301 and requirements indicated in Specification Section 03 30 00 CAST-IN-PLACE CONCRETE.

a. Use a qualified independent testing agency for preparing and reporting proposed design mixtures based on laboratory trial mixtures.

Proportion concrete mixtures as follows:

a. Compressive Strength (28 Days): 4000 psi.

b. Maximum Water-Cementitious Materials Ratio: 0.45.

c. Slump Limit: 4 inches to 6 inches.

d. Air Content: 6 percent, plus or minus 1 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

Cementitious Materials: Fly ash and ground granulated blast furnace slag may not replace Portland cement weight by more than 25% combined.

Limit water-soluble, chloride-ion content in hardened concrete to 0.05 percent by weight of cement.

Admixtures: Use admixtures according to manufacturer's written instructions.

Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.8 CONCRETE MIXING

2.8.1 Ready-Mixed Architectural Concrete

Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.

a. Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.

b. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

c. Concrete deliveries which exceed the above time limits are subject to rejection by the Government.

2.8.2 Joint Sealants

As approved for color compatibility by Contracting Officer and conforming to product and application recommendations of ACI 504R.

PART 3 EXECUTION

3.1 FORMWORK ERECTION

Erect formwork in accordance with the detail drawings to ensure that the finished concrete members conform accurately to the indicated dimensions, lines, elevations, and finishes. Deflection shall not exceed 1/360th of each component span or distance between adjacent supports. Deflections and tolerance shall not be cumulative. Install form lines as necessary to provide the required finish. Forms shall be coated with form release agents before reinforcement is placed. Formwork shall conform to ACI 301 and ACI 347.

Limit deflection of form-facing panels to not exceed ACI 303.1 requirements.

In addition to ACI 303.1 limits on form-facing panel deflection, limit cast-in-place architectural concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

a. Class A, 1/8 inch.

Fabricate forms to result in cast-in-place architectural concrete that complies with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials." Parts of construction with additional tolerance requirements are indicated on the Drawings.

Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood rustications, keyways, reglets, recesses, and the like, for easy removal.

a. Seal form joints and penetrations at form ties with form gaskets, form joint tape or form joint sealant to prevent cement paste leakage. Materials including tape must not leave marks on the finished surfaces after finishing with a brush level of sandblasting.

b. Do not use rust-stained steel form-facing material.

c. Use external form ties wherever possible minimizing the use of internal form ties. Internal tie locations must comply with approved type and location shown on shop drawings and as demonstrated in the mockup.

Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

Chamfer exterior corners andners and edges of cast-in-place architectural concrete 1/2-inch to 3/4-inch as approved in the mockup or as otherwise shown on the mockup drawing.

Coat contact surfaces of wood rustications and chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.

Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 REINFORCEMENT AND INSERTS

Comply with Section 03 30 00 CAST-IN-PLACE CONCRETE for fabricating and

installing steel reinforcement. Securely fasten steel reinforcement and wire ties against shifting during concrete placement.

Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

Reinforcement for all exposed above grade construction shall be epoxy coated.

Concrete cover for reinforcing bars in architectural concrete shall be 1-1/2 inches.

3.3 REMOVING AND REUSING FORMS

Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours (50 degree days minimum) after placing concrete if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

a. Schedule form removal to maintain surface appearance that matches approved mockups.

b. Cut off and grind glass-fiber-reinforced plastic form ties, if approved for work, flush with surface of concrete.

Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 75 percent of 28-day design compressive strength. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

Clean and repair surfaces of forms to be reused in the Work. Do not use split, frayed, delaminated, or otherwise damaged form-facing material. Apply new form-release agent.

When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for cast-in-place architectural concrete surfaces.

3.4 JOINTS

3.4.1 Construction Joints

Install construction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by Contracting Officer. The intended location of construction joints shall be be shown on the formwork drawings. All joints shall be located at intended rustication features of each wall as shown on the construction documents and as demonstrated in the project mockup .

a. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.

b. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete. Align construction joint within rustications attached to form-facing material.

c. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection. Intended construction joint locations must also be approved by the Contracting Officer and Engineer. Joint locations will also be dictated by design rustication features where they are shown on the construction documents and the mockup drawing.

d. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

e. Space all joints in walls as indicated on approved shop drawings. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

f. Construction joints shall not be spaced more than 40 feet apart.

g. Use bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

3.4.2 Contraction Joints

Form weakened-plane contraction joints true to line with faces perpendicular to surface plane of cast-in-place architectural concrete so strength and appearance of concrete are not impaired, at locations indicated, or approved shop drawings, or as approved by Contracting Officer.

3.5 CONCRETE PLACEMENT

Before placing concrete, verify that installation of formwork, form-release agent, reinforcement, and embedded items is complete and that required inspections have been performed.

Do not add water to concrete during delivery, at Project site, or during placement unless approved by Contracting Officer. Water addition at the site is not permitted in conjunction with the use if a High Range Water Reducing admixture is going to be used.

Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

a. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.

a. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

b. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303.1.

c. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to

lose plasticity. Do not permit vibrators to contact forms. Do not specifically vibrate forms.

3.5.1 Cold-Weather Placement

Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

a. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.

b. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

c. Do not use calcium chloride, salt, or other materials containing antifreeze agents.

d. Do not use chemical accelerators unless otherwise specified and approved in design mixtures.

3.5.2 Hot-Weather Placement

Comply with ACI 301 and as follows:

a. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

b. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.6 CONCRETE FINISHES

Maintain uniformity of special finishes over construction joints unless otherwise indicated.

3.6.1 Architectural Concrete Finish

Match Contracting Officer's approved design reference sample and approved mock-up, identified and described as indicated, to satisfaction of Contracting Officer.

3.6.2 Related Unformed Surfaces

At tops of walls, beams, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Tops of beams, sloped tops of columbarium roofs, sloped tops of mechanical room and toilet room roofs, and sloped top surfaces of the committal roof structures shall have a steel trowel finish, compatible with the finish resulting from the formed architectural surfaces. These surfaces are to receive the same brush blast sandblasted finish as the exposed vertical surfaces in order to create a uniform finish.Maintain a surface plane tolerance of at least 3/16 inch in

10 ft when tested with a 10 ft straight edge.

a. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.7 AS-CAST FORMED FINISHES

Sandblasted Finish: All architecturally exposed concrete shall receive a sandblasted finish as approved in the mock-up structure. See also Article 3.8.

3.8 SAND BLASTED FINISHES

3.8.1 Abrasive-Blast Finish

Perform abrasive blasting after compressive strength of concrete exceeds 2000 psi. Coordinate with formwork removal to ensure that surfaces to be abrasive blasted are treated at same age for uniform results.

a. Surface Continuity: Perform abrasive-blast finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work. Maintain required patterns or variances in depths of blast to match design reference sample and mockup.

b. Abrasive Blasting: Abrasive blast corners and edges of patterns carefully, using backup boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure, and blasting techniques required to match design reference sample or mockup.

c. Depth of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surfaces to match design reference sample or mockup, as follows:

1) Brush: Remove cement matrix to dull surface sheen and expose face of fine aggregate; with no significant reveal. Brush blast is intended to create a surface appearance as similar to that of Indiana Limestone as possible. Acceptance of finish will be determined through the mockup approval process.

3.9 CONCRETE PROTECTING AND CURING

General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 for hot-weather protection during curing.

Begin curing cast-in-place architectural concrete immediately after removing forms from concrete. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:

a. Moisture Curing: Keep exposed surfaces of cast-in-place architectural concrete continuously moist for no fewer than seven days with the following materials:

1) Water.
2) Continuous water-fog spray.
3) Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent

absorptive covers.

b. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for no fewer than seven days. Immediately repair any holes or tears during curing period; use cover material and waterproof tape.

3.10 FIELD QUALITY CONTROL

Comply with field quality-control requirements in Section 03 30 00 CAST-IN-PLACE CONCRETE.

Refer also to Division 01 specifications for Quality Control and Testing.

3.11 REPAIRS, PROTECTION, AND CLEANING

Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by Contracting Officer. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.

a. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to Contracting Officer's approval.

b. Patch all holes created by form ties. Color and material used in this process must be approved by the Contracting Officer.

Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.

Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.

Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.

Wash and rinse surfaces according to concrete finish applicator's written instructions. Protect other Work from staining or damage due to cleaning operations.

a. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

-- End of Section --

SECTION 03 48 21

PRECAST CONCRETE BURIAL CRYPTS
11/12

PART 1 GENERAL

1.1 SUMMARY

The Work of this Section includes fabrication, handling, delivery to the site, storage and installation of precast concrete burial crypts, hereafter referred to as units or crypts; subbase foundation and drainage; placement of the units; backfilling, grading, fine grading and turf establishment; and other, all as shown on the Drawings or Specified herein. In addition Contractor to provide:

a. Crypt Lid Lifting Apparatus: 3.

b. Extra Concrete Crypt Lids: 10 percent of total number of crypts installed.

c. Devices To Retrieve And Lower The Inside Shelf Without Entering The Crypt: 3.

The design of the units are as described in this Section and their installation layout as illustrated on the plans. All perimeter crypts shall be structurally designed for overhead and lateral soil pressure plus live loads specified hereafter. All designs require that the manufacturer provide fabrication drawings stamped by a Professional Engineer indicating that the design meets or exceeds the structural requirements contained herein. The Contractor may propose alternative designs of the corresponding components if all the following requirements are met.

a. Any proposed alternative design shall comply with the design criteria and the functional tests of this specification.

b. All provisions of this specification shall apply to any proposed alternative design.

c. The Government may accept or reject part or all of any proposed alternative design. The Contractor will pay for all cost for alternate designs, submittals, and reviews.

1.1.1 Related Sections

Refer to Section 31 00 00 EARTHWORK, Section 31 23 00.00 20 EXCAVATION AND FILL, and Section 33 46 16 SUBDRAINAGE SYSTEM.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 99	(2010) Moisture-Density Relations of Soils Using a 2.5-kg (5.5 lb) Rammer and a 305-mm (12-inch) Drop.

ACI INTERNATIONAL (ACI)

ACI 318	(2008; Errata 2008; Errata 2009; Errata 2009; Errata 2009; Errata 2009; Errata 2009) Building Code Requirements for Structural Concrete and Commentary
ACI/MCP	(2012) Manual of Concrete Practice

ASTM INTERNATIONAL (ASTM)

ASTM A 153/A 153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 185/A 185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 36/A 36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A 615/A 615M	(2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 82/A 82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM C 1017/C 1017M	(2007) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1116/C 1116M	(2010) Standard Specification for Fiber-Reinforced Concrete
ASTM C 1157/C 1157M	(2010) Standard Specification for Hydraulic Cement
ASTM C1399 / C1399M	(2010) Standard Test Method for Obtaining Average Residual-Strength of Fiber-Reinforced Concrete
ASTM C 150/C 150M	(2009) Standard Specification for Portland Cement
ASTM C 1602/C 1602M	(2006) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C 172	(2008) Standard Practice for Sampling Freshly Mixed Concrete

ASTM C 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 31/C 31M	(2009) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates
ASTM C 39/C 39M	(2009a) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 494/C 494M	(2010) Standard Specification for Chemical Admixtures for Concrete
ASTM C 595/C 595M	(2010) Standard Specification for Blended Hydraulic Cements
ASTM C 78	(2009) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G, AE for Crypts; Gravesite Grid Monuments and Markers.

SD-03 Product Data

Concrete Mix Design of Self Consolidate Concrete (SCC); G, AE
anchorage, angles, and fasteners

SD-04 Samples

perimeter crypts; G
interior crypt; G
dimensions and finishes; G

SD-05 Design Data

Design Documentation
Functional Load Test
Design Calculations

SD-07 Certificates

Manufacturer's Qualifications
Installers Qualifications
Product Test Reports

SD-11 Closeout Submittals

As-built Drawings; G

1.4 QUALITY ASSURANCE

1.4.1 Manufacturer's Qualifications

Contractor shall submit documentation regarding the manufacturer of the units. Contractor shall provide evidence that manufacturer has a minimum of three years experience with pre-casting units of similar type, and provide evidence that the manufacturer plant(s) used are certified by the National Precast Concrete Association (NPCA).

1.4.2 Precast Concrete Manufacturer

Provide a licensed Structural Engineer to certify that the units conform to specified requirements.

1.4.3 Installers Qualifications

Regularly engaged for at least three years in installation of pre-cast concrete similar to this project.

1.4.4 Size

Fabricate crypts to the interior dimensions described below. Replace or repair units that do not comply with the individual dimensions and tolerances.

1.4.5 Mock-Up

Prior to or in the initial stage of crypt production, furnish at the site, two perimeter crypts and a single interior crypt to demonstrate quality of construction of crypts and conduct on-site buried crypt load testing. Commence production of crypts only after submittal approval and on-site load testing has been scheduled for witnessing by the USACE Crypt Specialist.

1.4.6 Shop Drawings

Provide shop drawings for approval. Include the following with the Shop Drawings:

a. Erection Narrative:

1) Method of transportation.
2) Method of handling and placement.

b. Production Drawings:

1) Elevation view of each unit.
2) Plan view of unit.

c. Sections and details to show quantities, sizes and position of reinforcing steel, inserts, and essential embedded hardware for fabrication, handling, transportation and installation.

d. Section and details of lid lifting system.

e. Dimensions and finishes.

1.4.7 Design Criteria (Double Depth Crypt)

The units shall be of the following type, style, and size:

a. Type: Precast concrete.

b. Style: One-piece box with separate outer lid, and a removable one-piece inside shelf.

c. Crypt Interior Size: Interior minimum dimensions are as follows: 30-inch minimum width at the inside bottom floor and for the full height of the crypt; 86-inch minimum length along the inside bottom floor and for the full height of the crypt; 25-inch minimum clear height from the highest part of the inside shelf to the underside of the lid and; 25 inches minimum clear height from the lowest part of the inside shelf to the top of the casket risers and; 3/4-inch minimum height casket risers from the crypt floor spaced 20 inches from crypt centerline to eliminate pinching of the lowering straps during removal. Four risers required.

d. Crypt Height and Wall Thickness: Exterior maximum height dimension shall be 60 inches including the lid. Crypt wall thickness shall be 2 inches plus or minus 1/2-inch. Perimeter crypts may exceed wall thickness dimension. Crypt wall sections at support slots for the inside shelf may be of lesser thickness.

e. Layout: Crypts shall fit in a 3-foot by 8-foot plot or a lesser plot size as noted on the plans. The lesser plot size shall govern. If the Contractor's layout or crypt size dimensions differ, the Contractor at no cost to the Contracting Officer shall submit a Layout/Size Plan for approval by the Contracting Officer.

f. Quad crypts are not permitted.

Units shall be designed for a burial depth with soil cover as indicated on the plans, and be capable of structurally withstanding a center point load of 6,000 lbs prior to burial, passage of a wheel axle load of 12,000 lbs after burial, and a 3-foot tall pile of excavated material on top of or adjacent to buried crypts.

Contractor shall submit to the USACE inspector for approval five sets of design documentation showing structural design of the units. Contractor to provide one set to USACE Crypt Specialist. This documentation shall include dimensions, methods of construction, and calculations. All design calculations and drawings shall be signed and sealed by qualified licensed Structural Engineer.

The concrete lid shall be designed to be removable and replaceable. Lid lifting shall be from the chamfered lid edges. The Contractor shall furnish the Cemetery with three (3) OSHA approved lifting devices for removing the lid.

Inside shelf will be one piece rigid construction, fully conceal the lower casket with a rigid barrier, weigh 40 lbs. or less, allow for easy casket lowering belt removal, and capable of holding 400 lbs indefinitely. The

entire inside shelf should be rigid, non-brittle and non-deteriorating. Provide three (3) tools that Contracting Officer can easily retrieve and install the shelf from ground level without entering the crypt.

The concrete lid shall be beveled along the entire top perimeter. Chamfer top edge of lid with a 1:1 chamfer beginning 1/2-inch down from top.

The design of casket risers shall allow the casket to rest 3/4-inch above the inside floor of the crypt and above the top of the inside shelf in order aid in casket lowering straps removal. In addition, rests location shall not exceed 21 inches from crypt centerline.

There shall be a minimum of two 1-inch diameter drain holes in the bottom at opposite ends of each crypt to allow for complete water drainage.

The crypt lifting wire/cable shall be designed for transport and installation along with provisions for removal/abandonment of crypt lifting wire/cable once crypt has been installed.

1.4.8 Functional Load Test

A functional on-site load test will be made at the Contractor's expense to insure the units are capable of supporting loads stated. The functional test will consist of following loading conditions:

a. Confined Loading: An interior unit between two perimeter units shall be placed in a hole dug in the ground on site and covered with 24 inches of soil or covered to the maximum depth as shown on the plans, whichever is greater. The soil will be compacted to Standard Proctor (AASHTO T 99) a density along the sides of 95 percent and reduced density over the lid, both as shown on the plans. An axle load of 12,000 lbs. will then be passed over the covered crypts for a minimum of 10 times in repetition, in a manner that causes maximum lateral pressure due to wheel load on the sides of the crypts. The crypts shall then be fully excavated, exposed and the lids removed to allow careful examination inside and outside. The crypts must not show any signs of stress or cracking.

b. Concurrent with Confined Loading, the inside shelve of the interior crypt shall be loaded with one worker with a minimum weight of 200 lbs. Worker shall walk on individual supports to confirm structural integrity and load bearing capability. Worker shall adhere to all safety regulations while performing test. Upon uncovering and load removal, without entering the crypt the inside shelf shall be retrieved for inspection and lowered back into place by the removal tool device to be provided to the Cemetery by Contractor. The inside shelf must not show any signs of stress, cracking or excessive deflection during load testing and retrieve/return procedures.

1.5 ALLOWABLE TOLERANCES

Tolerances of individual units shall be as follows:

a. Variation in overall crypt outside dimensions of unit (height, length and width): 1/8-inch plus or minus. There is zero tolerance for any lesser crypt inside minimum clear dimensions.

b. Variation in thickness of precast panels and elements: 1/16-inch plus or minus.

c. Maximum height differential in final placement in the ground: 1/4-inch above or below design grade.

d. Cracks greater than 0.030 inch in width are cause for crypt rejection by the NCA inspector. With evidence of fiber or steel reinforcement, cracking 0.030 or lesser width that does not extend through wall is acceptable. Cracking 0.016-inch or lesser that extends through wall is acceptable. All other cracks are cause for rejecting crytps that shall be repaired or removed and replaced at no cost to Government.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery and Handling

Units shall be transported, stored and handled so as to prevent damage to surfaces, edges and corners and to prevent development of stresses and cracks. The Contractor shall provide temporary bracing protection devices and measures as necessary to prevent damage to the units during handling, transportation and storage. Contractor is responsible for transportation, storage and handling of units such that any negligence on the Contractor's part shall be corrected at the Contractor's expense. Use the designed crypt lifting cable to transport crypts. On the job site, forklift handling of crypts may be approved by the Contracting Officer upon demonstration that no crypt damage will be incurred.

1.6.2 Storage

Units may be stored at designated locations(s) on site.

1.6.3 Markings and Identifications

Markings, including logos, trademarks and proprietary information are prohibited on surfaces of crypts. Date of manufacture (month, day, year) shall be written on the box and lid with permanent ink or an equivalent marking.

1.7 WARRANTY

After erection, completed Work will be subject to terms of Article "Warranty of Construction" FAR Clause 52.246-21, except warranty period is extended to five years.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Design Requirements

Structural adequacy calculations of units (crypts), performed by a licensed Structural Engineer.

Loadings for Design Calculations:

a. Initial handling and erection stresses.

b. Dead and live loads specified.

c. Other loads specified for units as applicable.

d. Deflection of precast members.

e. Product test reports:

1) The concrete shall be tested for the compressive strength and beam flexural strength as specified herein. An approved independent, commercial testing laboratory shall perform tests. Certified copies of test reports, including test data and results shall be submitted to the Contracting Officer (USACE inspector) immediately after the strength tests have been completed. The tests shall be as specified herein.

2) Prior to backfilling over crypts and at Contractor expense, the USACE inspector may pick a single crypt for coring another bottom slab drainage hole by an independent lab with said core being analyzed (petrography testing) and results submitted verifying evidence of fly ash or other pozzalons as specified.

3) Based on failed testing, the USACE inspector may request more frequent testing to ensure quality of the product and pozzalons content is present, again at Contractor expense.

2.2 MATERIALS

2.2.1 Concrete Mixes

Submit a detailed Concrete Mix Design of Self Consolidate Concrete (SCC) with a minimum 15 percent requirement of a cement substitute of fly ash or other pozzolons.

2.2.2 Precast Concrete

All crypts shall be of concrete with a minimum 28 days compressive strength of 5,000 psi, be Self Consolidated Concrete (SCC) containing structural fiber with an inverted slump between 22 inches and 28 inches; and shall contain a minimum of 15 percent cement substitute of fly ash and/or other pozzalons. Fiber is not required for crypt lids. All to be in conformance to the following requirements:

a. Hydraulic Cement: ASTM C 150/C 150M or ASTM C 1157/C 1157M or ASTM C 595/C 595M.

b. Normal Weight Aggregates: ASTM C 33/C 33M.

c. Water: ASTM C 1602/C 1602M.

d. Chemical Admixtures:

1) Water reducers, accelerating and retarding: ASTM C 494/C 494M.

2) Air Entraining: ASTM C 260.

3) Admixtures for flowing concrete: ASTM C 1017/C 1017M.

4) Admixtures with no standard designation shall be used only with approval of Contracting Officer.

e. Prohibited Admixtures: Calcium Chloride thyocyanates or admixtures containing more than 0.1 percent chloride ions.

2.2.3 Reinforcement

Provide the following reinforcement materials:

a. Welded Steel Wire Fabric: ASTM A 185/A 185M.

b. Steel Wire Reinforcement: ASTM A 82/A 82M, cold drawn.

c. Steel Reinforcement: ASTM A 615/A 615M Grade 60, deformed.

d. Inserts, Anchors, Dowels and Accessories: Steel, ASTM A 36/A 36M, zinc coated ASTM A 153/A 153M hot-dipped galvanized finish G90.

e. Fiber: Macrofiber complying with ASTM C 1116/C 1116M

2.2.4 Form Coatings

Use commercial formulation form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces.

2.2.5 Paint

Use commercial Concrete and Garage Floor Epoxy Acrylic Paint for crypt concrete lid and inside wall surface numbering. Paint as manufactured by BEHR Deep Base #930 or approved equal. Provide sample of stencils for applying numbering system.

2.3 MANUFACTURED UNITS

Units shall be fabricated in accordance with the minimum interior dimensions and tolerances indicated herein, with concrete surfaces that are smooth and free of irregularities.

2.3.1 Finishes

Finishes shall comply with the following requirements:

a. Surface holes (1/4-inch and smaller) caused by air bubbles, normal color variations, normal form joint marks, small chips (1/4-inch and smaller) and spalling (no more than one square foot total per unit) are permitted.

b. Exposed steel reinforcing, honeycomb, bugholes, and cracks not within tolerances are not permitted.

c. Concrete shall have no evidence of segregation of materials.

2.3.2 Reinforcement

Provide steel and fiber reinforcing as required for casting, handling, erection loads, lateral and overhead fill, and equipment live loads. Reinforcing steel shall be free of dirt, mill scale, rust, oil, grease, ice, snow, water and placed within approved tolerances in accordance with ACI 318. Careful placement of reinforcing is required to avoid overlapping at thin points of the units.

2.3.3 Concrete Placement

Porosity, strength, weight and gradation of coarse aggregate shall be as required to produce specified characteristics. Units shall be cast in steel forms designed to suit shape and finish required. Each element of the unit shall be cast as an integral piece free of joints and seams.

2.3.4 Curing

Ninety percent of specified concrete compressive strength shall be attained before transportation of units to the Cemetery or storage site. Units shall be cured as required to develop specified structural characteristics and shall be stored in a manner that will permit all surfaces to cure equally. Units shall be properly cured in accordance with the applicable provisions of the current ACI/MCP-Manual of Concrete Practice.

2.3.5 Surface Treatment and Corrective Work

Units that have minor chipping of edges and corners shall be repaired by a method approved by the USACE Inspector. Cracked/damaged units deemed unacceptable by the USACE Inspector shall be removed by the Contractor at no cost to the Government.

2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

Contractor is responsible for the performance of all inspection requirements including the removal of lids, number painting inside crypts, and replacement of the lids for inspection by the Contracting Officer. The USACE inspector reserves the right to perform any of the inspections set forth in the specification when deemed necessary to assure that the units conform to prescribed requirements.

PART 3 EXECUTION

3.1 LAYOUT CONTROL

A professional registered Land Surveyor shall establish and control horizontal and vertical alignment of units.

3.2 PREPARATION

Before beginning installation, inspect Work of other trades insofar as it affects the Work of this Section. Commencing installation of units will be construed as accepting as suitable the Work of other trades.

Verify by survey, grading of subgrade and aggregate base for proper installation of units.

Verify by testing, compaction of prepared subgrade and subbase to meet Standard Proctor (AASHTO T 99).

Verify by survey locations and elevations of units relative to control points indicated on plans. Submit new control point layout if a crypt size other than specified is used.

3.3 HANDLING, INSTALLATION, AND PAINTING

3.3.1 Handling

Comply with the following requirements:

a. Units shall be handled in a vertical plane at all times and stacked vertically on wood supports of adequate strength, until erected. On the job site, use the designed lifting cable to transport crypts from the truck to storage to the final installation.

b. Lift units with suitable lifting devices at points provided by manufacturer.

c. Provide temporary wood bracing to comply with manufacturer's recommendations to keep crypt bottom off ground during storage.

3.3.2 Installation

Install as follows:

a. Install units by competent erector crews trained and certified as competent by manufacturer.

b. Use all means necessary to protect units from being damaged in transport and during and after installation. Lids that show damage from bouncing during transport shall be replaced by the Contractor at no cost to the Government.

c. Accurately install by aligning and leveling units in accordance with plans. Assure that crypts are in straight horizontal alignment.

d. After crypt installation and prior to backfill, the Contractor shall remove lids with the specified lifting apparatus for crypt inspection and inspection of numbering by the USACE inspector.

3.3.3 Painting

Numbers furnished by USACE shall be painted by the Contractor on the outside of the crypt lids and on the upper inside crypt short wall, both at the headstone end. Numbers shall be permanent paint as specified and twelve inches high. Crypt lid number painting must be applied to a clean, dust-free surface requiring paint application within seconds of surface cleaning.

3.3.4 Completion

After completion of inspection and marking, the Contractor shall replace the lids. Any damage to lids or crypts will be the responsibility of the Contractor.

3.4 PROTECTION OF WORK

Use all means necessary to protect units from being damaged during and after installation.

3.5 REPAIR AND REPLACEMENT

Remove and replace units that the Contracting Officer has determined are

damaged, cracked, broken, improperly fabricated, or otherwise defective and are structurally unsound and unacceptable.

Units having minor defects not affecting serviceability or appearance may be repaired when approved by Contracting Officer.

Repair work shall be sound, permanent, and flush with adjacent surfaces.

Replacements and repairs shall be done at no additional cost to the Government.

3.6 BACKFILLING AND MATERIAL STORAGE

Protect installed crypt units during backfill operations.

Install approved backfill against outside walls of all units, insuring no voids are remaining. Approved backfill shall contain no material that will cause a concentrated point load. The perimeter wall backfill shall be compacted to a Standard Proctor (AASHTO T 99) to 95 percent density to the level equal to the top of the crypts.

Install approved flowable rock fill per gradation in Section 31 23 00.00 20 EXCAVATION AND FILL into gaps between crypts leaving no voids. Use rodding to assure no bridging occurs and void areas are eliminated. No sand allowed. At USACE's discretion, a cut aggregate substitute of same gradation may be approved with demonstration that filling gaps between crytps leaves no voids.

Install backfill on top of units and compact. Backfill shall be as shown on plans. In absence of plan detail, backfill on top of units working from bottom up consists of 2 inches of identification sand, soil to specified level, and 4 inches of topsoil as the final layer. The entire backfill atop the units shall be compacted to a Standard Proctor (AASHTO T 99) of 95% density.

No equipment over the crypts should exceed crypt design loads as specified herein (12,000 lbs axle), which includes compacting equipment. No vibratory compaction equipment over the crypts unless impact loads are shown not to exceed crypt design loads.

Immediately during crypts installation, Contractor shall mark the crypt field edges with temporary driven 5-foot tall lathes and signage for easy identification by vehicles carrying fill, topsoil, compost, sod, water or other. Signage shall state "12,000-lb axle load maximum." Lathes and signage to be maintained in-place during backfilling thru final acceptance of the crypt field.

Finish grading and prepare topsoil as indicated on plans.

Contractor shall not store or stockpile any stone, sand, backfill or any other material within ten (10) yards of or on top of installed crypts. All costs to inspect affected crypts for possible damages will be at Contractor's expense.

3.7 FIELD QUALITY CONTROL

3.7.1 Tests

Contractor shall procure an independent qualified testing agency to perform

concrete tests during crypt production and prepare test reports.

a. Concrete Cylinder testing for compressive strength: Three cylinders per day of crypt production to be taken in accordance to ASTM C 172 as applicable to SCC. Strength to exceed 5000 psi after 28 days curing in accordance to ASTM C 31/C 31M and ASTM C 39/C 39M. Test inverted slump when cylinders are made.

b. Beam testing to confirm design flexure strength: Once at the beginning of crypt production, a minimum of three beams with fiber shall be taken for testing of Flexural Performance of Fiber-Reinforced Concrete in accordance with ASTM C 78 and ASTM C1399 / C1399M. All beams' flexural strength shall exceed the crypt design flexural strength requirements and residual strength of fiber reinforced concrete, and shall exceed capacity of conventionally reinforced concrete wall design as submitted by the Structural Engineer and approved by USACE. Fiber Manufacturer shall verify type and dosage rate of the test beams are identical in crypt production.

c. A single verification test of fly ash in the crypt concrete mix required at the discretion of the USACE inspector.

3.8 INSPECTION AND ACCEPTANCE

Final inspection and acceptance will be performed by Contracting Officer and USACE Inspector.

3.8.1 Record Documents

Provide As-built Drawings to Government indicating location of Work. As-built drawings shall be provided in format indicated in the Contract in compliance with Division 01 requirements.

-- End of Section --

SECTION 03 48 24

PRECAST CONCRETE COLUMBARIUM UNITS
11/12

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 533.3R	(1970) Fabrication, Handling and Erection of Precast Concrete Wall Panels

ASTM INTERNATIONAL (ASTM)

ASTM A 185/A 185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 36/A 36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A240/A240M	(2012a) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A 615/A 615M	(2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 82/A 82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM C 150	(2009) Standard Specification for Portland Cement
ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates

1.2 SUMMARY

This Section includes the manufacture and installation of precast concrete columbarium units, as shown on the Drawings and specified, including but not limited to the following:

a. Steel reinforcement.

b. Steel embedment plates.

c. Required sleeves.

d. Finished exposed surfaces.

e. Preparation of setting surface.

f. Adhesive.

g. Columbarium fasteners.

h. Niche cover anchor clip assemblies.

Acceptable designs of the columbarium units components are provided as shown on the Drawings. Contractor may use this design for this Work or may propose alternate designs of the corresponding components as follows:

a. Design for alternate columbarium units shall comply with the design criteria per this Section, if required by the Contractor, shall comply with the functional tests as required in this Section.

b. Unless indicated otherwise, all provisions of this Specification shall apply to the Contractor proposed design.

Government may accept or reject part or all of any design proposed by the Contractor.

This section includes finishing and staining/coating of exposed faces of the columbarium units as indicated on drawings or described herein.

This Section includes installation of niche covers, one for each niche of the new columbarium units. Refer to Section 04 73 01 COLUMBARIUM NICHE COVERS, MARBLE (GFCI).

1.2.1 Related Sections

Refer to Section 03 30 00 CAST-IN-PLACE CONCRETE for cast-in-place concrete work, Section 04 73 01 COLUMBARIUM NICHE COVERS, MARBLE (GFCI), Section 07 92 00 JOINT SEALANTS, for materials and workmanship for sealant application and Section 31 00 00 EARTHWORK.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G, AE
Production Drawings
fastening systems
Stack and Section Markers

SD-03 Product Data

Manufacturer's Literature and Data
fastener systems
mounting hardware
Adhesive
Stencil

Paint

SD-04 Samples

Sample Units; G, AE
Color Charts; G, AE
Exposed Surface Finishes; G, AE
Mock-Up; G, AE

SD-05 Design Data

Design Documentation

SD-07 Certificates

Manufacturer's Qualifications
Installer Qualifications
Precast Concrete Certificates

1.4 QUALITY ASSURANCE

1.4.1 Manufacturer's Qualifications

Prior to commencement of work, Contractor shall submit documentation regarding the experience of his precast concrete supplier in the design and manufacture of Precast Concrete structures and custom units.

Precast concrete manufacturer's qualified Registered Professional Structural Engineer to certify that precast reinforced concrete conforms to specified requirements.

Precast concrete columbarium units shall be product of manufacturer who has a minimum of 3 years experience in fabrication and erection of the precast concrete columbarium units similar in material design and extent to that indicated on the drawings and specified herein.

1.4.2 Installer Qualifications

Supply and Installation of fastener system shall be by a product installer, both whom have had a minimum of 3 years experience in installation of similar design as indicated on the Drawing.

Installation of niche fronts will be performed by those companies who have had 3 years experience in installation of similar design as indicated in the drawings and specified herein.

1.4.3 Regulatory Requirements

Codes and regulations of the Federal, State and County authorities shall apply.

1.4.4 Precast Concrete Certificates

Manufacturers certificate indicating precast concrete columbarium units meet the requirements of ACI 533.3R and as specified.

1.4.5 Sample Units

Before starting production of precast concrete Columbarium Units, furnish

at the site, two complete Precast Concrete Columbarium Units, to demonstrate quality of construction. Commence production of Columbarium Units only after written approval has been obtained from the Contractor.

a. Fabricate to dimensions shown or approved from Sample Units. Replace or correct Columbarium Units that do not comply with the individual dimensions and tolerances.

Submit sample of all fastening systems, mounting hardware and exposed surface finishes including, but not limited to, the following:

a. Stainless Steel Angle.

b. Stainless Steel Bolt, Nut and Washers.

c. Tamper Proof Stainless Steel Bolt.

d. Stainless Steel Rosette.

e. Stainless Steel Expansion Anchors, Bolts and pins.

f. Stainless Steel Ferrule loop insert.

g. Non-Metalic Shims.

h. Exposed front of columbarium with coating applied to show finish (If coating is required).

i. Adhesives and grouts.

1.4.6 Shop Drawings

Complete shop and erection drawings of all precast concrete columbarium units, showing all dimensions and details of construction, installation and relation to adjoining work, reinforcements, anchorage, attachments, inserts, location of all pre-drilled sleeves and other items to be installed in the work of other trades, joint treatment, joint alignment coordinated with cap stone joints, and other work required for a complete installation. Provide evidence that the Contractor to be installing the cast in place concrete foundations for the columbarium and pier units has been contacted prior to any work relating to the footings for the columbarium construction, and that the construction of the concrete support (foundations) work has been coordinated with the precast columbarium unit manufacturer and installer. Government will review and approve proposed deviations from unit segments/joints shown on the Plan.

1.4.7 Production Drawings

Include the following:

a. Elevation view of each structural element.

b. Planametric view of unit.

c. Sections and details to show quantities and position of reinforcing steel, anchors, inserts, and essential embedded and non-embedded hardware for fabrication, handling, transportation and installation.

d. Lifting and erection inserts.

e. Dimensions and finishes.

f. Method of transportation.

g. Method of erection and handling.

1.4.8 Manufacturer's Literature and Data

Include the following information:

a. Each type of Concrete Fastener, including adhesive and anchor devices.

b. Instructions for final cleaning.

c. Concrete stain/coating, including color charts of manufacturers standard color palette (If applicable for this project.)

1.4.9 Mock-Up

Build mockup to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Include joint details.

1.5 DELIVERY, STORAGE, AND HANDLING

Ship precast concrete columbarium units to site with adequate protection to prevent chipping, breaking and other damage. Materials shall be marked giving proper identifications and location. Store materials in protected areas to prevent damage, injurious effects of weather and inclusion of foreign matter.

1.6 COORDINATION

Coordinate the manufacture and erection of precast concrete columbarium units with related work of other sections of the Specifications. Provide templates for inserts and other devices for anchoring precast concrete columbarium units to the work of other trades, in sufficient time to be built into adjoining construction. Perform cutting, fitting and other related work in connection with erection of precast concrete columbarium unit work.

1.7 WARRANTY

Provide warranty that precast concrete columbarium unit work, including anchorage, joint treatment and related components to be free from all defects in materials and workmanship, including cracking and spalling, and after erection, completed work for period is one year.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Design Requirements

The Columbarium Units shall be of the following type, style, and size:

a. Type: Precast concrete, reinforced.

b. Size: Interior and exterior dimensions as indicated on plans.

c. Units shall be cast, shall be no smaller than 2 unit (columns) wide, and no wider than 8 units (columns).

Columbarium top shall be capable of structurally supporting imposed service live load of no less than 50 lb./ sq. ft, and dead loads based on stone veneer thickness and heights, including material composition and element section properties, mortar and grout, and dead loads based on concrete top element sectional properties.

Contractor shall submit to the Contracting Officer for review and approval 5 sets of design documentation showing structural design of the complete Columbarium. This documentation shall include dimensions, methods of construction, and calculations. All design calculations and drawings shall be signed and sealed by qualified Professional Structural Engineer.

2.1.2 Functional Load Tests

If required by the Contracting Officer, a functional load test will be made at the Contractor's expense to insure that the columbarium proposed by the Contractor, as furnished, will be capable of supporting loads stated in Article "Design Requirements." The functional test will consist of two loading conditions.

2.1.2.1 Unconfined Loading

The columbarium will be placed on a flat surface with no support against the sides. The entire top of the columbarium will be subjected to a simulated uniform load of live load of 50 lb./sq. ft and required dead load simulating stone veneer, mortar, and grout as they will be installed. The load will be maintained for no less than 72 hours. At end of the loading period, the maximum deflection of the Columbarium top elements shall be no more than 1/8-inch. Upon removal of the load from the unit the residual deflection shall be no more than 1/16-inch and concrete elements shall be free of all structural distress.

2.1.3 Allowable Tolerances

In addition to tolerances of individual elements required by American Concrete Institute Publication ACI 533.3R, erection tolerances shall be as follows:

a. Variation of anchors and fasteners from dimensions specified: 1/8-inch.

b. Variation in overall dimensions of precast element (height and width): 1/8-inch.

c. Maximum differential between adjacent units in erected position: 1/4-inch.

d. Variation in thickness of precast panels and elements: 1/8-inch.

e. Maximum vertical differential between adjacent columbarium units in installed position: 1/8-inch.

2.2 MATERIALS

2.2.1 Coarse Aggregate

Hard durable aggregate carefully graded from coarse to fine in proportions required to match approved samples.

2.2.2 Aggregate for Back-Up Mix

Fine and coarse aggregate lightweight. ASTM C 33/C 33M. Limit gradation as required to produce the specified appearance and quality of concrete.

2.2.3 Portland Cement

ASTM C 150, Type I and Type II; Color as required.

2.2.4 Structural Steel

ASTM A 36/A 36M.

2.2.5 Steel Fabric Reinforcement

ASTM A 185/A 185M, galvanized.

2.2.6 Steel Wire Reinforcement

ASTM A 82/A 82M, cold drawn.

2.2.7 Reinforcing Steel

ASTM A 615/A 615M, deformed, Grade 60.

2.2.8 Color and Finish

Portland cement color and finish of the niche units shall match Tan Buff per Section 03 33 00 CAST-IN-PLACE ARCHITECTURAL CONCRETE and approved samples and mock-up by the Contracting Officer.

2.2.9 Miscellaneous Galvanized Steel Items

Bolts, nuts, washers, anchors, inserts, and the like for handling, erection, or use by other trades.

2.3 MARBLE NICHE COVERS

Marble niche covers are specified in Section 04 73 01 COLUMBARIUM NICHE COVERS, MARBLE (GFCI). Contractor shall inspect the niche covers upon delivery to the site. The general quantity and condition shall be observed and an adequate count to cover all the installed columbarium units, plus required spares shall be verified, once the niche covers are accepted at the site, they shall become the Contractors responsibility until installed and the installation is accepted by the Contracting Officer.

2.3.1 Niche Cover Attachment Hardware

Arlington National Cemetery Standard stainless steel rosette, mounting brackets, and bolts for complete attachment of the niche covers to the precast columbarium units.

2.4 BACK-UP MATERIAL

Closed cell neoprene, butyl, polyurethane, vinyl or polyethylene foam rod, diameter approximately 1-1/3 times the joint width.

2.5 BOND BREAKERS

Type and material recommended by sealant manufacturer.

2.6 SEALING COMPOUND

ASTM C 920/C 920M, Type S, Grade NS, Class 25.

2.7 FABRICATION

Precast concrete columbarium units shall NOT be fabricated, delivered or incorporated in the work until samples have been approved. Precast concrete shall comply with ACI 533.3R, except as modified herein.

a. Concrete for precast columbarium units shall have minimum compressive strength of 5,000 psi at 28 days.

b. Provide additional steel reinforcing as required for casting, handling and erection loads.

c. Back-up Mix: Porosity, strength, weight and gradation of coarse aggregate shall be as required to produce specified characteristics.

d. Columbarium units shall be cast in steel forms designed to suit shape and finish required and to withstand high frequency vibration. Concrete shall be deposited in oiled forms. Form oil shall be non-staining type. Vibrations, where required, shall be continuous during process of casting to attain through compaction, complete embedment of reinforcement and to assure concrete of uniform and maximum density without segregation of mix and full thickness of precast element is attained.

1) Anchors, lifting devices, provisions for cutouts and openings, dovetail slots, notches, reglets, inserts and similar items required for the work of other trades shall be accurately positioned in forms before casting elements.

2) All fastener location holes, including those for anchoring of units and attachment of niche covers, shall be cast into units. Drilling to precast concrete columbarium units, after fabrication, shall not be acceptable.

e. Cement, aggregate and water shall be obtained from single sources for facing mix of precast concrete work in order to assure regularity of appearance and uniformity of color.

2.7.1 Finish

Concrete exposed-to-view shall have an Architectural finish, smooth and uniform in color, free of bugholes, cracks, chips, and stains. The face of the units shall be processed by the manufacturer, following removal from the forms to insure that the discoloration and blemishes on the niche faces are removed before shipping to the site. Exposed-to-view is defined as faces and inside of niche

2.7.2 Curing

Precast concrete shall be cured as required to develop specified structural characteristics and shall be stored in a manner that will permit all surfaces to cure equally and minimize warping, without staining the exposed faces.

2.8 ACCESSORIES

Attachment hardware shall be Arlington National Cemetery standard stainless steel rosette, mounting brackets, and bolts for complete attachment of the niche covers to the precast columbarium units.

2.8.1 Stack and Section Markers

ASTM A240/A240M Type 304 stainless steel matching markers, rosettes, and hardware at other ANC Columbarium units in type, color, and finish. Contact information of supplier:

a. Name: Joseph Bunton.

b. Phone Number:703-607-8204.

Each vertical stack of niches within a Section shall be identified by identification disks with Arabic indicators centered on the corresponding stacks. Stack indicator disks within each section shall begin with the number one (1) starting on the left (when facing the stacks) and proceed in ascending order to the right. Individual niches shall be identified by an Arabic indictor beginning with number one (1) for the bottom row and proceeding up in ascending order. Each niche shall have an identifying number painted on the rear wall of the niche. An example of the painted number would be R-5-4 or Section R, Stack 5, 4th niche up from the bottom.

2.8.2 Adhesive

Epoxy compatible with finishes of the surface for attaching; Fed Spec MMM-A-187. Two-part, epoxy resin based, general purpose paste form adhesive manufactured for non structural bonding of metals, porcelain, ceramics, leather, wood and various porous, and non porous materials to themselves and each other.

2.8.3 Stencil

Provide in either cardboard or metal form.

2.8.4 Paint

Latex-based exterior grade suitable for masonry.

2.8.5 Rosettes, Niche Hardware, and Attachment Devices

Rosettes, niche hardware, and attachment devices shall be as specified in Section 03 48 21 PRECAST CONCRETE BURIAL CRYPTS.

PART 3 EXECUTION

3.1 EXAMINATION

Before beginning installation, inspect work of other trades in-so-far as it effects the work of this Section. Commencing installation of precast concrete columbarium units will be construed as acceptance, as suitable, of such work of other trades. Concrete base for the columbarium units shall be inspected and modified as required, grinding off high spots, to become an acceptable base upon which to install the units. Columbarium units shall be handled in a nearly vertical plane at all times and stacked vertically on wood supports of adequate strength, until erected. Cover and protect precast concrete columbarium units against staining and other damage. Reinstall, realign and otherwise correct improper installed units.

a. Accurately place and securely anchor precast concrete columbarium units to adjoining construction in accordance with approved shop and erection drawings.

b. Installed niche units shall meet alignment unit. Alignment shall be demonstrated using a 10-foot steel straight edge. Within each precast unit, the niche face of niche face shall not deviate more than 1/16-inch using a 5-foot metal straight edge in any direction.

3.2 SETTING

Where shown, joints shall be filled with sealant. Surfaces and other joints for precast concrete columbarium units shall be cleaned of all dust, dirt and other foreign matter. Exposed surfaces of units shall either be protected by anti-graffiti coating at the manufacturer, or shall be protected until accepted by the USACE following installation. Units that have been damaged on exposed surfaces by graffiti, when not coated in advance shall be rejected and removed from the site. Each precast element shall be set level and true to line with uniform joints. Joints required to have sealants shall be kept free of dirt and other contaminants for their full depth. Precautions shall be taken to protect precast concrete work from being damaged and soiled during and after installation. Wedges, spacers or other appliances which are likely to cause staining shall be removed from joints.

3.3 SEALING JOINTS

Where shown or where required to make the work watertight, joints between precast concrete columbarium units and between other precast elements and adjoining masonry, concrete and other materials shall be filled with back-up material for depth extending as required to form joint of depth as shown or recommended by sealant manufacturer. Provide bond breakers, at base of sealant where space for back-up does not exist and to prevent sealant from bonding to material at base of joint.

3.4 CLEANING

After erection is complete, clean precast columbarium units using materials, equipment and methods recommended by manufacturer.

3.5 REPLACEMENT AND REPAIR

Precast concrete columbarium units which are damaged, cracked, stained,

improperly fabricated or otherwise defective shall be removed and be replaced. Precast units having minor defects not affecting serviceability or appearance may be repaired when approved by the Owners Designated Representative. Repaired work shall be sound, permanent, flush with adjacent surfaces and of color and texture matching similar adjoining surfaces and shall show no line of demarcation between original and patched surfaces.

Replacement and repairs shall be done at no additional cost to the Government.

3.6 INSTALLATION OF NICHE COVERS

Refer to Section 04 73 01 COLUMBARIUM NICHE COVERS, MARBLE (GFCI) for niche covers.

Install niche covers plumb and level as shown so that exposed faces of niche covers lie in the same plane and that rows of niche covers align both horizontally and vertically. Tighten fasteners to achieve snug fit but do not over tighten to the point where they may crack or break niche covers. Due to the manufacturing tolerances in the niche covers and the allowable deviations from the nominal dimensions, it will be impossible to install the niche covers perfectly and each cover will need to be individually adjusted to meet the requirements. Niche face on all margins, in complete alighment with the covers to the top and bottom and on either side. Niche covers shall sit flush against the niche face on all margins, in complete alignment with the covers to the top and bottom and on either side. The allowable tolerance is a 1/16-inch gap. Coordinate the installation procedures with the Contracting Officer and establish the critical visual line for which the best alignment is to be established.

-- End of Section --

SECTION 04 01 00.91

RESTORATION AND CLEANING OF MASONRY IN HISTORIC STRUCTURES
05/12

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

It is the intent of this specification to protect historic structures to the greatest extent possible. Use the gentlest means to perform the work and take the greatest of care to ensure that the historic materials are not damaged in the process of the work. In addition to requirements in this section, comply with NPS Hist Prop.

Masonry is stone masonry for most or all work on this project. Exposed bond patterns range from random ashlar to rubble patterns. Reinstalled or reconstructed exposed masonry shall be built as approved to match or blend in to the aesthetic of the existing masonry to remain as determined by the Government.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100	(2001; Supplements 2002-2008) Documentation of the Threshold Limit Values and Biological Exposure Indices

ASTM INTERNATIONAL (ASTM)

ASTM C1324	(2010) Standard Test Method for Examination and Analysis of Hardened Masonry Mortar
ASTM C144	(2011) Standard Specification for Aggregate for Masonry Mortar
ASTM C1489	(2001; E 2008; R 2008) Standard Specification for Lime Putty for Structural Purposes
ASTM C170/C170M	(2009) Standard Test Method for Compressive Strength of Dimension Stone
ASTM C207	(2006; R 2011) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C881/C881M	(2010) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM E11	(2009; E 2010) Wire Cloth and Sieves for

	Testing Purposes
ASTM E2659	(2009; E 2010) Standard Practice for Certificate Programs
ASTM E96/E96M	(2010) Standard Test Methods for Water Vapor Transmission of Materials

NATIONAL PARK SERVICE (NPS)

NPS Hist Prop	(1995) National Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings
NPS TPS Brief 1	(2000) Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings
NPS TPS Brief 2	(1998) Repointing Mortar Joints in Historic Masonry Buildings

1.3 DEFINITIONS

Terms are defined below as applicable to this project.

1.3.1 Aggregates

The sand component of mortar.

1.3.2 Biocides

A chemical treatment meant to eliminate organic growth on the masonry units and mortar and prohibit re-growth.

1.3.3 Binder

The component of mortar that binds together the aggregate particles into a cohesive material.

1.3.4 Dispersed Lime Crack Injection

A repair method in which dispersed lime material is injected into small hairline cracks by use of needle or syringe.

1.3.5 Dutchman

A repair method in which deteriorated stone is removed in part and replaced with salvaged, harvested or new stone to make a seamless patch.

1.3.6 Insitu

A term referencing a repair procedure in which the masonry units and mortar remain in place and are repaired without removal from the wall system

1.3.7 Joint Sealant

A flexible, chemical product that is used to create a weather-tight seal at

the boundary of masonry units with other units or dissimilar materials.

1.3.8 Lime Wash

A protective surface treatment comprised of calcium hydroxide particles in suspension in water, along with small amounts of calcium carbonate, silica particles and other minerals.

1.3.9 Mockup

Specific area on the building approved by Contracting Officer to demonstrate the contractor's ability to apply, match and install specified materials.

1.3.10 Mortar

A mixture of binders, aggregates, and pigments used for reconstruction, repointing or stucco applications.

1.3.11 New Elements

New, non-historic materials added to masonry structures to aid in their ability to resist loads (typically seismic) or to resist water infiltration.

1.3.12 Patch

The use of substitute repair materials to treat damaged or deteriorated masonry units insitu.

1.3.13 Remediate

The practice of restoring a historic masonry structure and its component materials with the intent to maintain the original fabric to the greatest extent possible.

1.3.14 Remove

Specifically for historic masonry materials, the term means to detach an item from existing construction to the limits indicated.

1.3.15 Replace

To reinstall an item in its original position (or where indicated) after remedial treatment, or to duplicate and reinstall an entire item with new material; with the original item serving as the pattern for creating the duplicate.

1.3.16 Repoint

To remove existing mortar joints to the specified depth and replace with a mortar that matches in color, texture, and performance with maximum breathability, bond, and flexibility to accommodate movement.

1.3.17 Retool

A repair method in which a chisel is used to re-create the surrounding stone texture finish by removing loose pieces of stone.

1.3.18 Test Panel

Specific area on the building approved by the Contracting Officer to demonstrate individual applicator competency in workmanship proficiency.

1.3.19 Tuckpointing

Often called skim-coating, an American practice of surface repairing mortar joints without the required removal of existing deteriorated mortar beneath. This practice is not recommended for mortar joint repair work on historic masonry. There is also an acceptable British form of tuckpointing practice that involves careful thin penciling of smaller joints within larger ones to give the wall the appearance of an ashlar finish.

1.3.20 Wall System

A term used to address the fact that masonry structures are comprised of different materials but function holistically, requiring that all restoration and cleaning process take into account the implications of the treatment to the adjacent materials and the site as a whole.

1.3.21 Masonry Treatment Requirement (MTR)

Defined treatments that are required by the specification (contract) documents for project specific repairs to masonry.

1.3.22 Saturated Surface Dry (SSD)

Defined as a condition of the wall surface after water has been applied and allowed to dry to a point with no standing water visible.

1.4 PRE-CONSTRUCTION CONFERENCE

Prior to beginning the work of this Section, convene a meeting with the Contracting Officer's Representative(s) to review the requirements of the Quality Control Plan, Project Training Program, installation procedures, location of required mockup areas, and all job conditions and processes. All subcontracting firms involved with this work shall participate in this meeting.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals marked with "AE" shall be reviewed by the Landscape Architect. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Plan; G

SD-02 Shop Drawings; G

Documentation

SD-03 Product Data

Repair Materials; G
Structural Upgrades; G
Cleaning and Restoration Methods; G, AE
Cleaning Materials
Qualifications

SD-04 Samples

Mock-ups; G, AE

SD-07 Certificates

Repair Materials; G

1.6 QUALITY CONTROL

Submit resumes for all historic masonry workers, demonstrating the minimum experience required. Product manufacturers, vendors, distributors, or suppliers of materials will not be permitted to offer on-site project training certificates or historic masonry consultation services.

1.6.1 Quality Control Plan

Prior to beginning restoration and cleaning work, submit a written Quality Control Plan. Include a separate section in the overall project Quality Control Plan specifically addressing this restoration and cleaning work. Do not proceed without written approval of the plan. At a minimum, include the items in the Quality Control Plan

a. Describe methods of dust containment during the work specific to the restoration and cleaning work.

b. Describe the methods of protecting surrounding construction, memorial and cemetery markers, columbariums, surrounding landscape, and adjacent bases and properties. Provide drawings of protection.

c. Describe the work procedures, materials, and tools the contractor proposes to use for each MTR specified.

d. Describe the sequence of each MTR.

e. Describe how the sequence of MTR and the construction schedule changes as it relates to climate changes and protection of completed work.

f. Describe the methods for surveying original layout and collecting datum points and plumb lines for rebuilding masonry.

g. Describe the methods for shoring and providing a safe working environment.

h. Describe the methods for select deconstruction of individual masonry units and tools for cleaning the masonry for reuse.

i. Describe the method and approach to mortar joint removal.

j. Describe the method and approach to cleaning mortar coating smears and old patching materials from the masonry surfaces.

k. Describe, in detail, the procedures relating to techniques and tools

proposed for masonry matching.

l. Describe the complete masonry removal and matching procedures; include equipment, approach, length of time the masonry will be out of the wall, documentation on mapping the location, and where (on-site or in shop) the masonry units will be repaired.

m. Describe the procedure for matching of different colors at different locations.

n. Describe the procedure for mixing and matching of substitute repair materials.

o. Describe the methods and system by which the use of reclaimed (salvaged) masonry units can be utilized.

p. Describe the methods for setting masonry back into its original position and maintaining the original bond patterns and joint widths and profiles.

q. Describe the methods of transition points where replacement /preservation work will meet the original historic work.

1.6.2 Qualifications

1.6.2.1 Historic Masonry Consultant

Secure the services of a historic masonry consultant with a minimum of 10 years experience applying NPS Hist Prop as they relate to the work in this section. Submit five relevant projects within that period that include how NPS Hist Prop was applied to the work of similar scope and scale and what jurisdiction or agency was involved in approving the work. The consultant's services include; investigating the condition of the masonry materials and mortar, arranging for material analysis in the laboratory, recommending appropriate cleaning methods and materials, recommending restoration options, providing project specific specifications, providing a training program and providing quality control services during construction.

1.6.2.2 Masonry Firm

The firm performing the masonry work shall have a minimum of five years experience on similar projects. The firm shall have completed work similar in material, design, and extent to that indicated for this Project and shall demonstrate a record of successful in-service performance. Proven implementation of NPS Hist Prop and related Preservation Briefs are required.

1.6.2.3 Field Supervision

Retain an experienced full-time supervisor on the project site at all times when masonry restoration is in progress. A single individual shall be responsible for supervising the historic masonry restoration work throughout the duration of the project.

1.6.2.4 Masonry Applicator

Employ craftspeople who are experienced with and specialize in restoration work of the types they will be performing. All masonry restoration treatments must be performed by a craftsperson that is familiar with

historic masonry construction and has worked on historic masonry projects for at least five years. Only skilled journeyman masons who are familiar and experienced with the materials and methods specified may be used.

1.6.3 Project Training Definition and Use

In addition to five years demonstrable experience on masonry restoration projects, offer workers project training certificate(s) within the framework of ASTM E2659. Project training certificates are earned by individual workers and issued with the understanding that they are for limited time use, enforceable only to this specific project and for a specific MTR. It is not necessary, nor a requirement of this specification, that all restoration workers obtain all project training certificates offered. Rather it is desirable that workers be trained for each project specific task they will perform to ensure the highest quality results from the cleaning and restoration program.

1.6.4 Documentation

Submit digital photographic documentation of the all phases of masonry restoration, including prior to the start of restoration work. Provide thorough photo documentation of the project and project details and targeted areas.

1.6.5 Cleaning and Restoration Mock-ups

1.6.5.1 Cleaning and Restoration Methods

Submit the cleaning and restoration methods, and materials selected for a specific structure for approval before work starts. Take into account the total construction system of the structure to be worked upon, including different masonry and mortar materials, as well as non-masonry elements which may be affected by the work. Utilize mockups to identify the appropriate cleaning and restoration treatment and materials and set the standard for each project task. Demonstrate the correct execution of the approved cleaning and restoration methods and materials during the workmanship training program within the framework of ASTM E2659.

1.6.5.2 Cleaning Products and Procedures

Establish cleaning products and procedures during the mockup process; proposing the least aggressive method used to achieve the desired level of clean. Where chemical products are proposed for cleaning, use them in accordance with the manufacturer's instructions and the environmental restrictions for the project.

1.6.6 Masonry Mock-ups

Submit mock-ups of each treatment proposed for use in the work. No masonry or mortar shall be used in the work until the mock-ups and the represented material and workmanship have been approved by the Contracting Officer. Materials shall be submitted and approved prior to the creation of mock-ups. The location for placement, size, and location of mock-ups will be as directed.

Mock-ups shall demonstrate the methods and quality of workmanship to be performed in each masonry treatment requirement (MTR). Provide a mockup for each MTR indicated and included in related specification Sections.

a. Prepare mock-ups on existing walls under the same weather conditions expected during the remainder of the work.

b. Throughout restoration, retain approved mock-up panels in undisturbed condition, suitably marked, as a standard for judging completed work.

c. Review manufacturer's product data sheets to determine suitability of each product for each surface.

d. Apply products using manufacturer-approved application methods, determining actual requirements for application.

e. Obtain approval as to the preservation treatment approach, design, and workmanship to include, but not limited to the verification of all material applications and finishes as specified to the requirements of color, texture, profiles, and finishes before proceeding with work.

f. Mock-ups: May be performed on inconspicuous sections of actual construction

(1) Location and number as directed.

(2) Size: 2 feet by 3 feet or as appropriate for the repair specified

(3) Repair unacceptable work.

1.6.6.1 Repointing

Repoint mortar joints, minimum acceptable mock up dimensions: twelve feet in length - 2/3 horizontal joints and 1/3 vertical joints. Demonstrate method for cutting out mortar joints, preparing wall for repointing, mixing mortar, installing mortar and curing the mortar. Prepare and place repointing mortar in accordance with NPS TPS Brief 2 and in compliance with NPS Hist Prop.

1.6.6.2 Retooling Stone Masonry Insitu

Demonstrate treatment technique and methods to retool three deteriorated stone faces insitu in all known historic profile textures identified. Finishes include, but are not limited to honed, rough dressed, and rock faces finishes.

1.6.6.3 Masonry Removal and Replacement

Fully remove masonry and replace to specified dimensions and texture. Select size of masonry units representing typical conditions. Return one masonry unit to same location, set to surrounding profile joint width and bond pattern. Set masonry unit using specified mortar. Confirm with Contracting Officer's Representative that the replacement masonry units meet specification requirements for matching and that sufficient quantity required for the work have been identified. Leave one stone dry-set into opening set on wood shims for evaluation and approval of preparation conditions.

1.6.6.4 Substitute Repair Materials

a. Patching - Apply substitute repair material on at least two masonry units for repair. Include one masonry unit on which to demonstrate proficiency in removing previous patching material and repairing with

new substitute repair material.

b. Dutchman - Undertake dutchman repairs in two locations, including one that is only cut and prepared for application. Demonstrate the quality of the stone insert, as well as the workmanship and techniques to be performed in the dutchman repairs. Do not proceed with other dutchman repairs until the technique has been approved.

1.6.6.5 Crack Repair

Repair one crack, 2 feet in length, using mortar. Repair one crack, 2 feet in length, using dispersed hydrated lime injection technique with appropriate substitute repair material.

1.6.6.6 New Masonry Elements

Install new accessories in a manner demonstrating their final installation on the structure.

1.7 DELIVERY, STORAGE, AND HANDLING

Furnish cement in suitable bags used for packaging cements. Labeling of packages shall clearly define contents, manufacturer, and batch identification. Detergents, masonry cleaners, paint removers, solvents, epoxies and other chemicals used for masonry cleaning shall be in sealed containers that legibly show the designated name, formula or specification number, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name of manufacturer. Store materials in weathertight structures which will exclude moisture and contaminants. Accessories shall be stored avoiding contamination and deterioration. Admixtures which have been in storage onsite for six months or longer, or which have been subjected to freezing, shall not be used unless retested and proven to meet the specified requirements.

1.8 FIELD CONDITIONS

1.8.1 General Ambient Conditions

Masonry, mortar, and epoxy adhesives shall not be placed when weather conditions detrimentally affect the quality of the finished product. No masonry or mortar shall be placed when the air temperature is below 40 degrees F in the shade. When air temperature is likely to exceed 90 degrees F masonry and mortar shall have a temperature not exceeding 90 degrees F when deposited. Materials to be used in the work shall be neither produced nor placed during periods of rain or other precipitation. Stop material placements, and protect all in-place material from exposure, during periods of rain or other precipitation. Masonry surfaces shall be cleaned only when air temperatures are above 40 degrees F and will remain so until masonry has dried out, but for not less than 7 days after completion of the work.

1.8.2 Masonry Installation Conditions

Do not perform any masonry repointing unless air temperatures are between 40 degrees F and 95 degrees F and will remain so for at least 48 hours after completion of work. Phase repointing during hot weather by completing process on the shady side of the building or schedule installation of materials during cooler evening hours to prevent premature

evaporation of the water from the mortar. Do not use frozen materials or materials mixed or coated with ice or frost. Do not lower the freezing point of mortar by the use of admixtures or anti-freeze agents. Do not add chlorides to the mortar. Prevent repointing mortar from staining the face of the masonry or other exposed surfaces. Immediately remove all repointing mortar that comes in contact with such surfaces. Cover partially completed work when work is not in progress. Protect ledges and projections from mortar droppings. If the Contractor fails to protect against damage as a result of work of this Section, such damage shall be the Contractor's responsibility. The Contractor shall restore damaged areas to the complete satisfaction of the Owner at no expense to the Owner. Do not apply products under conditions outside manufacturer's requirements, which include:

a. Surfaces that are frozen; allow complete thawing prior to installation.

b. Surface and air temperatures below 40 degrees F.

c. Surface and air temperatures above 95 degrees F.

d. When surface or air temperature is not expected to remain above 40 degrees F for at least 48 hours after application.

e. Wind conditions that may blow materials onto surfaces not intended to be treated.

1.9 WARRANTIES

1.9.1 Cleaning Warranty

Warrant cleaning procedures for a period of two years against harm to substrate (masonry and mortar) or to adjacent materials including, but not limited to, discoloration of substrate from improper procedures or usage, chemical damage from inadequate rinse procedures, and abrasive damage from improper procedures.

1.9.2 Repair Warranty

Warrant repair procedures, including repointing, for a period of two years against: discoloration or mismatch of new mortar to adjacent original historic mortar, discoloration or damage to masonry from improper mortar clean-up, loss of bond between masonry and mortar, fracturing of masonry edges from improper mortar joint preparation procedures or improper mortar formulation, and occurrence of efflorescence.

PART 2 PRODUCTS

2.1 CLEANING MATERIALS

Selection of appropriate cleaning products requires a clear understanding of the masonry materials to be cleaned, a rationale for the cleaning, and an understanding of the anticipated level of cleanliness expected from the cleaning program. Caution against over-cleaning of surfaces which may be detrimental, and which may remove desirable historic surface details or patinas. For example, if cleaning reveals unexpected conditions; suspend the cleaning action, protect the exposed area and notify the Contracting Officer. Research has determined that overly aggressive cleaning methods and materials can cause subtle, long-term damage to masonry units. Use products that have a minimum 5 year performance record on similar

projects. Selection of the products shall be predicated on long-term negative effects to the masonry rather than current level of cleanliness of the comparable structure.

2.1.1 Paint Removers

a. Provide chemical paint removers which are manufacturer's water soluble, low toxicity products, effective for removal of paint on masonry without altering, damaging, or discoloring the masonry surface.

b. Provide commercially available poulticing materials designed to adhere to and peel off paint without damaging the underlying masonry or project specific mixtures that include absorbent materials and cleaning solutions which can be demonstrated to do no harm to the masonry.

2.1.2 Biocides

Use biocides that are chemical treatments designed to remove organic growth from masonry. The manufacturer's literature for all biocides shall contain information on the product as well as the expected service life of the material and any detrimental effects it may have on the masonry or mortar.

2.1.3 Liquid Strippable Masking Agent

Liquid strippable masking agent shall be manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, and polished stone surfaces from the damaging effect of approved masonry cleaners.

2.1.4 Cleaning Implements

Furnish brushes that contain natural or nylon fiber bristles only. Do not use wire brushes. Scrapers and application paddles shall be made of wood with rounded edges. Metallic tools are not permitted.

2.1.5 Water

Obtain potable water from a local source. Filter to remove minerals resulting in a neutral pH, prior to application.

2.2 REPAIR MATERIALS

Use materials, physical and chemical properties, and composition of masonry and mortar in renovation work that match the original existing masonry and mortar to be repaired, unless samples and testing determine that existing mixtures and materials are faulty or non-performing. Masonry materials used for repair and renovation shall match the original existing historic materials as closely as possible in composition, color, texture, strength, size, finishing and porosity. Substitute repair materials for each condition shall be of one type and from one source, when used in repair treatments exposed to view.

2.2.1 Mortar

The replacement mortar shall coexist with the old in a sympathetic, supportive and, if necessary, sacrificial capacity. The replacement mortar shall have greater vapor permeability and be softer (measured in compressive strength) than the masonry units. The replacement mortar shall be as vapor permeable, and as soft, or softer, (measured in compressive

strength) than the existing historic mortar. Measure water vapor transmission in accordance with ASTM E96/E96M.

2.2.1.1 Matching

Take test specimens of existing mortar from a sound and intact representative portion of the structure, at locations indicatedby the Contracting Officer's Representative. The replacement mortar shall match the original existing material in color, texture and tooling. The sand shall match the sand in the original existing mortar by color, shape and particle size distribution as defined using ASTM C144; ASTM E11 sieves. Use of admixtures is subject to approval.

2.2.1.2 Binder Content of Historic Mortar

Historic mortars can represent four different binder types, or combination of them, depending on the time period of construction. A building constructed in the early 1800s is likely built with a straight lime putty binder type because the discovery of natural cement binder types had not occurred until the early 1820s. A building constructed in 1940 might be built with portland cement (1871) and hydrated lime (1930s). The historic binder types include: non-hydraulic lime (fat lime, lime putty or hydrated lime); hydraulic lime (feebly, NHL 2, moderately, NHL 3.5, and imminently, NHL 5.0); natural cement; and portland cement. The binder types are all derived from limestone. Each successive type is fired at higher temperatures in a kiln to the point of vitrification or liquid phase (2200-2800F) when Portland cement is developed. Lime can be slaked into a hydrate powder or putty form by adding water due to the lower firing temperatures (1650-2000F), while cement products must be crushed mechanically into a powder form before use. Each binder type has its own unique performance properties in relation to historic masonry units and the building wall design. A mortar formula made from lime putty (low compressive strength) will accommodate building movement in load-bearing masonry much more effectively than a portland cement formula of much higher compressive strength. Identify performance characteristics of the replacement mortar carefully based upon evaluation of the existing historic mortar. Each binder type or mixture of mortar shall have a cement, lime, or combination thereof consistent with the original existing mortar content in order to provide uniform durability, weathering characteristics, and the same, or better, life-cycle performance expectations.

2.2.1.3 Crack Injection

Comply with the dispersed hydrated lime manufacturer's written instructions. Inject cracks that are no greater than 1/8 inch in width and masonry is soundly bonded but cracked. Unless specifically instructed inject the full length of the cracks.

2.2.2 Replacement Masonry Materials

2.2.2.1 Replacement Stone

Replacement stone shall match in type, color, shape, size, texture and finish-profile the appearance of the existing historic stone units. Test replacement stone in comparison to the existing historic stone using ASTM C170/C170M. Where possible, stone salvaged from this site shall be used for repair of existing masonry walls.

2.2.3 Masonry Elements

2.2.3.1 Epoxy Anchor Adhesives

Use an epoxy-resin grout to bond stainless steel anchors to masonry. The grout shall be a 100 percent solids, moisture insensitive, low creep, structural adhesive. The epoxy shall conform to ASTM C881/C881M, Type IV; Grade and Class selected to conform to the manufacturer's recommendations for the application.

2.2.3.2 Metal attachments

Anchors for spall repairs shall be threaded or helical stainless steel, size as indicated.

2.3 EQUIPMENT

2.3.1 Cleaning Equipment

Cleaning equipment shall not cause staining, erosion, marring, or other damage or changes in the appearance of the surfaces to be cleaned.

2.3.1.1 Sandblasting

Sandblasting equipment is not allowed for cleaning masonry surfaces.

2.3.1.2 Water Blasting

Provide water blasting equipment including a trailer-mounted water tank, pumps, high-pressure hose, wand with safety release cutoff control, nozzle, and auxiliary water re-supply equipment. Do not operate the equipment at a pressure which will cause etching or other damage to the masonry surface or mortar joints. Operate the equipment at a discharge capacity of 55 to 400 psi and 2.5 to 3 gpm for general surface cleaning operations. The water tank and auxiliary re-supply equipment shall be of sufficient capacity to permit continuous operations. Provide protective covers and barriers as required to prevent over-spray onto adjacent surfaces.

2.3.2 Spray Equipment

Spray equipment for chemical cleaners shall be low-pressure tanks or chemical pumps suitable for chemical cleaner indicated, and shall be equipped with stainless steel, cone-shaped spray-tip. Spray equipment for water shall disperse water through a fan-shaped spray tip at an angle of not less than 15 degrees. Spray equipment shall deliver water at a pressure not greater than 400 psi and at a volume between 2.5 and 3 gpm. Spray equipment for heated water shall be capable of maintaining temperature, at flow rates indicated, between 140 and 180 degrees F. Keep the spray-tip at a 10-inch minimum distance from the wall surface during operations.

2.3.3 Alternative Blasting Methods

Alternative blasting methods require equipment designed to discharge sponges, walnut shells, ice, soda and other friable materials. These are specially designed systems that must be operated in accordance with manufacturer's recommendations and maintained in good working order. Do not operate the equipment at a pressure which will cause etching or other damage to the masonry surface or mortar joints. Determine the discharge

capacity on a case by case basis during the mockup test panel demonstration and approval process. Provide protective covers and barriers as required to prevent over-spray onto adjacent surfaces.

2.3.4 Drilling Equipment

Use standard handheld masonry drills, commonly used for drilling small holes in concrete and masonry to drill holes in masonry for patch anchors and other applications. The drill shall be a small, powered, handheld type, using rotary drilling mode only. Impact and rotary impact type drills will not be allowed.

2.3.5 Compressed Air Supplies

Compressed air equipment shall deliver clean, oil and moisture free compressed air at the surface to be cleaned. The compressed air line shall have at least two in-line air filters to remove oil and moisture from the air supply. Test the compressed air supply during each shift for the presence of oil and moisture.

PART 3 EXECUTION

3.1 EVALUATION AND ANALYSIS

Undertake masonry renovation only after complete evaluation and analysis of the areas to be repaired are completed, including sampling and testing of the existing mortar to determine its composition and qualities. No repair work shall be undertaken until conditions that have caused masonry deterioration have been identified. Correct such conditions, if possible, prior to start of the work.

3.1.1 Mortar Analysis

Analyze existing original historic mortar before repointing in order to provide a match with the new repointing mortar. Historic mortars are usually softer than newer mortars, often using lime as a binder rather than cement. Lime for repointing mortar shall conform to ASTM C207, Type S, or ASTM C1489 unless otherwise specified. Full laboratory analysis of the existing mortar shall conform to ASTM C1324, and include methods for precise determination of the binder constituents. Field analysis of the existing mortar shall be as specified below.

3.1.2 Field (Insitu) Mortar Analysis

a. Analyze the mortar composition and detect cracks, degradation and de-bonding from the surrounding masonry. Also determine previous surface coating treatments that may be contributing to the current conditions.

b. Compare the bedding mortar with the pointing mortar and determine the cross-sectional characteristics of the wall.

c. Determine the level of moisture movement in the insitu mortar, and if the mortar or masonry units are handling the brunt of the water movement through the wall.

d. Assess the physical characteristics of the mortar and determine indirect compressive strength. Gather data on insitu mortar joint shear strength.

3.1.3 Taking and Preparation of Samples

Take and analyze samples of unweathered original historic mortar and different type of mortar in the structure in order to match the new mortar to be used for repointing. Remove three or four samples of each type of mortar to be matched with a hand chisel from several locations on the building. Set aside the largest sample for comparison with the repointing mortar. Place the remaining samples in labeled, sealed sample bags for transport to the laboratory.

3.1.3.1 Laboratory Mortar Analysis Equipment

Equipment for evaluating historic mortar in the lab includes physical preparation and analysis equipment such as scales, ovens, compression machines, sieves, sieve shakers and the like. All lab equipment should be calibrated and in good working condition. To accurately determine the binder constituents and proportions requires additional equipment such as high magnification microscopes to perform petrography, specialized ovens to perform Differential Thermal Analysis and specialized equipment to perform X-Ray diffraction analysis. This specialized equipment should be operated and the results analyzed only by trained, experienced personnel.

3.1.3.2 Laboratory Masonry Unit Evaluation Equipment

Equipment for evaluating masonry units in the lab includes physical preparation and analysis equipment such as scales, ovens, compression machines, freeze-thaw equipment, soaking chambers and the like. All lab equipment should be calibrated and in good working condition.

3.1.4 Binder Analysis

Subject a part of the historic mortar sample to Differential Thermal Analysis or X-ray Diffraction to determine the binder components.

3.1.5 Aggregate Analysis

Separate aggregate of the mortar sample from the binder by taking the crushed mortar sample and either gently blowing away the fine binder material, placing the crushed sample in a centrifuge, or chemically separating the aggregate from the binder. The separated aggregate shall be rinsed clean with water and dried. Examine the aggregate with a magnifying glass, and record the component materials as to range of materials, sizes, colors, as well as the presence of other materials. Perform sand analysis using a sieve analysis of the aggregate as part of the ASTM C1324 process.

3.2 PREPARATION

3.2.1 Material Handling and Associated Equipment

3.2.1.1 Mixing, Transporting, and Placing Job Materials

Provide equipment used for mixing, transporting, placing, and confining masonry and mortar placements capable of satisfactorily mixing material and supporting uninterrupted placement operations. Equipment used for mixing, conveying, and placing of materials shall be clean, free of old materials and contaminants, and shall conform to the material manufacturer's recommendations.

3.2.1.2 Associated Equipment

Provide associated equipment, such as mixer timing equipment, valves, pressure gauges, pressure hoses, other hardware, and tools, as required to ensure a continuous supply of material and operation control.

3.2.2 Protection

Protect persons, motor vehicles, adjacent surfaces, surrounding site features or buildings, equipment, and landscape materials from chemicals used and runoff from cleaning and paint removal operations. Erect temporary protection covers, which will remain in operation during the course of the work, over pedestrian walkways and at personnel and vehicular points of entrance and exit.

3.2.2.1 Worker Exposures

Exposure of workers to chemical substances shall not exceed the limits established by ACGIH 0100, or those required by a more stringent applicable regulation.

3.3 EQUIPMENT AND TECHNIQUES DEMONSTRATION

Demonstrate equipment and techniques of operation in an approved location. Dependable and sufficient equipment, appropriate and adequate to accomplish the work specified, shall be assembled at the work site in sufficient lead time before the start of the work to permit inspection, calibration of weighing and measuring devices, adjustment of parts, and the making of any repairs that may be required. Maintain the equipment in good working condition throughout the project.

3.4 MASONRY CLEANING

Historic materials shall not be damaged or marred in the process of cleaning. Cleaning shall conform to NPS TPS Brief 1. Protect open joints to prevent water and cleaner intrusion into the interior of the structure from pressure spraying. Protect non-masonry materials and severely deteriorated masonry by approved methods prior to initiation of cleaning operations. Masonry cleaning shall remove all organic and inorganic contaminants from the surface and pores of the substrate, without causing any short or long-term negative consequences. Surfaces shall be evenly cleaned with no evidence of streaking or bleaching. The cleaning process shall not affect the density, porosity, or color of the masonry or mortar. Cleaned masonry shall have a neutral pH. Use the gentlest methods possible for cleaning historic masonry to achieve the desired results. Make test patches to determine a satisfactory cleaning result. Cleaning shall proceed in an orderly manner, working from top to bottom of each scaffold width and from one end of each elevation to the other. Perform cleaning in a manner which results in uniform coverage of all surfaces, including corners, moldings, interstices and which produces an even effect without streaking or damage to masonry. The cleaning materials, equipment, and methods shall not result in staining, erosion, marring, or other damage to the surfaces of the structure. Following an initial inspection and evaluation of the structure and surfaces, give the structure a surface cleaning which shall be completed prior to start of repair work, and sampling and testing of mortars. The work shall provide for the complete cleaning of all exposed masonry surfaces of the structures, removing all traces of moss, dirt, and other contaminants to allow determination of the masonry's color and shades, finish and texture, and other properties.

Following completion of the surface cleaning of the structure (or side of structure) the masonry shall be dried prior to the start of any repair work. The following sequence of methods shall be used to determine the least aggressive, effective cleaning method:

1. Water with brushes
2. Water with mild soap
3. Water with stronger soap
4. Water with stronger soap plus ammonia
5. Water with stronger soap plus vinegar (but not on calcareous masonry)

3.4.1 Test Patches

Demonstrate the materials, equipment, and methods to be used in cleaning in a test section approximately 3 feet by 3 feet. The location of the test section, and the completed test section is subject to approval. Adjust the cleaning process as required and the test section rerun until an acceptable process is obtained. Locate test patches in inconspicuous areas of the structures. The areas tested shall exhibit soiling characteristics representative of those larger areas to be cleaned. Also conduct tests on areas to be stripped of paint. Allow tested areas to dry before a determination is made on the effectiveness of a particular treatment.

3.4.2 Water Cleaning

3.4.2.1 Pressure Spraying

Spray apply water to masonry surfaces to comply with requirements indicated by test patches for location, purpose, water temperature, pressure, volume, and equipment. Unless otherwise indicated, the surface washing shall be done with clean, low pressure water (pressure of less than 55 psi and 2.5 to 3 gpm discharge) and the spray nozzle shall not be held less than 12 inches from surface of masonry. Water shall be applied side to side in overlapping bands to produce uniform coverage.

3.4.2.2 Hand Scrubbing

Scrub surfaces to be cleaned to remove surface contaminants. Pre-wet surfaces and use hand-held natural bristle or nylon brushes. Do not use wire brushes.

3.4.2.3 Rinsing

Rinse scrubbed surfaces clean of all contaminants and cleaning solutions with water in a low-to-moderate pressure spray, working upwards from bottom to top of each treated area. The rinsing cycle shall remove all traces of contaminants and cleaning solutions.

3.4.3 Chemical Cleaning

Chemical cleaning of historic masonry shall use the gentlest means possible to achieve the desired result as determined by test patches. Chemical cleaning is the use of any product in addition to water, including detergents, ammonia, and vinegar. Proceed in an orderly manner, working from top to bottom of each scaffold width and from one end of each elevation to the other. Cleaning shall result in uniform coverage of all surfaces, including corners, moldings, interstices and produce an even effect without streaking or damage to masonry. Do not apply chemical cleaners to the same masonry surfaces more than twice.

3.4.3.1 Surface Prewetting

Wet masonry surfaces to be cleaned with chemical cleaners with water using a low pressure spray before application of any cleaner.

3.4.3.2 pH Testing

Determine the pH of masonry surfaces which have been chemically cleaned using pH monitoring pencils or papers. Rinse chemically cleaned masonry of all chemical residues until a neutral pH (7) reading is obtained from the masonry surface.

3.5 MASONRY REPAIR

Match repaired surfaces with adjacent existing surfaces in all respects. Proceed with masonry repair only after the cause of deterioration has been identified and corrected. Demonstrate the materials, methods and equipment proposed for use in the repair work in test panels. The location, number, size and completed test panels is subject to approval. Use products in accordance with the manufacturer's instructions.

3.5.1 Deterioration Investitgation

Perform a field investigation, conducted by the historic masonry consultant, to determine the causes and extent of degradation. To facilitate the investigation utilize the following techniques.

a. Employ a field microscope to closely assess the conditions at the surface of the mortar and masonry units. Determine the mortar composition, detect cracks and assess for degradation and debonding from the surrounding masonry. Detect previous surface coating treatments on the mortar and masonry that may be contributing to the current conditions. Employ a boroscope to examine mortar deeper in the joint. Compare the bedding mortar with the pointing mortar and ascertain the cross-sectional characteristics of the wall.

b. Employ moisture meters to determine the level of moisture in the mortar and masonry, and if the mortar or masonry units are handling the brunt of the water movement through the wall. Infrared thermography, employed by a trained investigator, can provide additional information on the moisture conditions. Employ rilem tubes to determine the rate of water uptake into the masonry. To access the physical characteristics of hard mortar, use a spring loaded impact device to determine indirect compressive strength. For evaluating softer mortars, mortar integrity deeper in the wall, and the condition of the masonry units, a drill resistance tool shall be employed by an experienced consultant.

3.5.2 Repointing Masonry

Repoint masonry in accordance with NPS TPS Brief 2.

3.5.2.1 Wall Preparation

Remove old caulking, grout, or non-original mortar from previously repaired joints to a minimum depth of 2.5 times the width of the joint. Cut all joints (unless otherwise noted) back to sound, solid, back up material. Leave a clean, square face at the back of the joint to provide for maximum

contact of repointing mortar.

a. Shallow or feather edging is not permitted. Remove loose particles from joints. Clean joints, followed by blowing with filtered, dry, compressed air or vacuum.

b. Existing joints shall not be cut out using power tools. All joints must be removed by hand using a hammer and chisel.

c. Remove existing mortar using only small-headed chisels that are no wider than half the width of the existing masonry joints.

d. Do not widen the existing masonry joints. The surrounding masonry edges shall not be spalled or chipped in the process of mortar removal. Damage to surrounding masonry units is not permitted. Replace all masonry units damaged during mortar removal with replacement units that match the original.

e. Do not permit applicators to be trained at the project site in this masonry treatment requirement.

3.5.2.2 Mixing and Installation

Repointing mortar shall be pre-blended in single containers in a factory-controlled environment; Type L, Type O and Type K. Ensure appropriate material proportions as regards to the affect of moisture content on the individual components (cement, sand and lime. Batch materials using volumetric measurement devices (not shovels) and consistently consolidate the material in these devices to ensure the uniformity of the mortar.

a. Batching

(1) Utilize a calibrated measuring device for batching portland cement.

(2) Utilize a calibrated measuring device for batching hydrated lime or lime putty.

(3) Utilize a calibrated measuring devices for batching the sand.

b. Cement and Lime Proportions: Fill the measuring device with portland cement, hydrated lime or lime putty.

(1) Briskly strike the bottom of the measuring device against the ground a minimum of ten times and then strike the top flush.

(2) For dry hydrate lime, fill the measuring device using a minimum of 3 lifts, strike the bottom of the measuring device against the ground a minimum of ten times and then strike the top flush. Dry hydrate lime experiences a significant volumetric loss when converted to a wet paste during mixing; therefore, add additional 25 percent dry hydrate lime to the formulation.

(3) For lime putty briskly strike the bottom of the measuring device against the ground a minimum of ten times and then strike the top flush. No additional lime is required when measuring from putty.

c. Sand Proportions

(1) Proportion sand when the sand is in saturated surface dry (SSD), loose damp condition.

(2) Proportion the sand by filling a measuring device using a minimum of 3 lifts, striking the sides a minimum of ten times, and then striking the top flush.

3.5.3 Presoaking Masonry / Mortar Consistency / Lifts

Use the same mortar as the repointing mortar for setting the replacement masonry. Soak exposed surfaces of historic masonry adjacent to joint with water prior to repointing. Allow time for excess water to run off and evaporate prior to repointing. Joint surfaces shall be damp but free from standing water. Maintain a water sprayer on site at all times during the repointing process. The mortar material shall resemble the consistency of brown sugar during installation. This drier consistency enables the material to be tightly packed into the joint, allows for cleaner work, and prevents shrinkage cracks as the mortar cures. Point joints in layers or "lifts" where the joints are deeper than 1-1/4 inch. Apply in layers not less than 1/2 the depth but not more than 1-1/4 inch or until a uniform depth is formed.

3.5.4 Compression / Joint Finish / Curing

a. Compress each layer thoroughly and allow it to become thumbprint hard before applying the next layer.

b. When mortar is thumbprint hard at the surface of the wall, finish the joints to match the original historic joint profile. Allow water evaporation from the freshly repointed walls in order to initiate the carbonation process in high lime content mortars. The carbonation of lime mortar initially requires wet-and-dry cycles, which can be created by water misting the joints after the mortar application when dry weather conditions prevail. Finish the joint profile before these cycles are started. Depending on the environmental conditions (temperature and humidity), carry out water misting until a full nine alternating wet-and-dry cycles are completed.

c. Adjust curing methods to ensure that the repointing mortar is damp without eroding the surface of the mortar.

3.5.5 Protection

Keep the mortar from drying out too quickly or from becoming too wet Protect it from direct sun and high winds for the first 72 hours after installation or from driving rain for the first 24 hours, using plastic sheeting if necessary. Be careful not to create a greenhouse effect by sealing off air movement in an attempt to protect the wall with plastic. Allow for air circulation to facilitate the carbonation process.

3.5.6 Retooling Stone Masonry Insitu

Scale off all loose pieces of original stone from masonry intended to remain in place, including surface material in powder or granular form and detachments of planer elements, spalls and chips. Sound all stone on building by using the "ring test method" in order to distinguish fully intact stone from those in which delamination may be hidden or pieces of unstable material may not be immediately visible. Any stone that is designated for retooling insitu can became a candidate for removal if,

after chiseling is completed, the solid stone substrate is no longer in plane or plumb with the surrounding stone masonry surfaces.

3.5.7 Masonry Removal and Replacement

Before removing any deteriorated masonry units, establish bonding patterns, levels and coursings. Remove masonry that has deteriorated or is damaged beyond repair, as determined through investigation and evaluation. Carefully demolish or remove entire units from joint to joint, without damaging surrounding units in a manner that permits replacement with full-size units. Support and protect remaining masonry work that surrounds removal area. Maintain adjoining construction in an undamaged condition. Notify Contracting Officer of unforeseen detrimental conditions including voids, cracks, bulges, and loose masonry units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items. Remove as many whole masonry units as possible without damage.

a. Remove mortar, loose particles, and soil from masonry by cleaning with hand chisels, brushes, and water.

b. Remove sealants by cutting close to masonry units with utility knife and cleaning with solvents. Clean surrounding masonry areas by removing mortar, dust, and loose particles in preparation for replacement.

c. Replace removed masonry with harvested masonry units, where possible, or with new masonry units matching the existing units. Butter vertical joints for full width before setting and set units in full bed of mortar, unless otherwise indicated. Remove mortar used for laying/setting masonry units before mortar sets to the repointing depth of the surrounding area. Repoint new mortar joints in repaired area to comply with requirements for repointing existing masonry units.

d. If a few isolated masonry units are to be replaced, remove each without disturbing the surrounding masonry. Remove deteriorated masonry units and mortar requiring replacement by hand chiseling. Do not damage adjoining masonry units during the removal of deteriorated units and mortar.

e. Test the new element for fitting into its space without mortar. If wedges are used to support and align the new unit, cover them with at least 1-1/2 inches of mortar when pointing is complete.

f. Cover the four sides and back of the space with sufficient mortar to ensure that there will be no air spaces when the new unit is set. Line up and set the new unit by tapping it into place with a wooden or rubber mallet. Align the face of new unit with that of existing masonry.

g. Repoint joints to match the rest of the wall after new units have been properly installed and adjusted.

h. Clean replacement areas with a non-metallic brush and water to remove excess mortar.

3.5.8 Substitute Material Repair

Repair or replace original historic masonry materials only if surfaces are extensively deteriorated (surface missing to a depth of 4 inches or more)

or are threatening the safety of the structure or individuals. Deteriorated surfaces shall be removed and repaired or replaced only upon approval. Repairs and replacements shall match the materials, colors, and finish of the existing historic masonry as closely as possible. Use material salvaged from the site when and where possible.

3.5.8.1 Areas To Be Removed

Remove unsound, weak, or damaged masonry and mortar in areas as indicated. Loose particles, laitance, spalling, cracked, or debonded masonry and mortar and foreign materials shall be removed with hand tools unless otherwise noted. Surfaces prepared for repair shall be cleaned free of dust, dirt, masonry chips, oil or other contaminants, rinsed with water, and dried before repair work is begun. Protect surfaces of the structure, and surfaces adjacent to the work area from damage which may result from removal, cleaning, and repair operations.

3.5.8.2 Application of Substitute Repair Materials

Place substitute repair materials to rebuild spalled or damaged areas to match the original surface finish, level, texture, bonding patterns, color and porosity. Match the finished appearance of the substitute repair material patch with the adjacent existing surface. Apply samples to the masonry units insitu.

a. Substitute repair material shall not be installed in thicknesses exceeding 2 inches. Masonry repairs in excess of 2 inches thick shall utilize a Dutchman repair approach or replacement unit.

b. Remove all loose mortar and masonry prior to installation of the substitute repair material. "Sound" the masonry with a hammer to verify its integrity. If necessary, cut away an additional 1/2 inch of the masonry substrate to ensure the surface to be repaired is solid and stable.

c. Remove any sealant residue. Cut out used anchors, threaded rod anchors and/or dowels within the damaged masonry area. Any anchors that are free of rust, solidly embedded, and do not project beyond the solid masonry surface may remain.

d. Using clean water and a scrub brush, clean all dust from surface and pores of the substrate.

e. Pre-wet the substrate with water prior to the application of the repair material to prevent the substrate from drawing out the moisture too quickly. Re-wet the surface with water again immediately before applying the repair material. Use approved methods to deliver the substitute repair work as demonstrated.

f. Follow manufacturers' instructions pertaining to the placement of materials. If the manufacturer requires that installers of a specified product be trained, provide this documentation to the Contracting Officer. Training certificates previously issued by product companies for the application of specified products cannot be substituted for the Project Training "Substitute Repair Material Certificate" on this project.

3.5.8.3 Masonry and Substitute Material Repair Finishes and Color

Match the exposed surfaces of masonry and substitute material repair finish, color, texture, and surface detail with the original surface. Mechanical finishing and texturing may be required to produce the required finish and appearance. The finishing and texturing shall conceal bond lines between the repaired area and adjacent surfaces. The texturing shall provide replication of all surface details, including tooling and machine marks. Use low-impact energy type equipment in finishing and texturing, which will not weaken the patch or damage the patch bond and the adjacent masonry.

3.5.8.4 Patch Anchors

Provide patch anchors to ensure that the patch is tied to the existing masonry structure at a frequency of at least one patch anchor per 4 square inches of patch plan surface area; specific locations for patch anchors shall be as indicated. Use small handheld, low-speed rotary masonry drills to produce holes in the existing masonry, within the limits for the patch anchor installation.

3.5.8.5 Holes

Drill holes into the existing substrate material of the masonry using rotary (non-hammer) drills. Holes shall have a diameter of 1/8 inch larger than the anchor diameter. The holes shall be drilled to a depth of 4 inches, except as otherwise indicated or directed. Drill holes shall not penetrate completely through the masonry, and shall provide at least 1 inch of cover around the drill hole. Holes shall be cleaned by water blasting to remove drill dust and other debris and then blown dry with filtered, dry, compressed air. Drill holes shall be conditioned in accordance with the epoxy adhesive manufacturer's recommendations.

3.5.8.6 Anchor Installation

Clean anchors to remove all contaminants which may hinder epoxy bond. Epoxy adhesive shall be pressure injected into the back of the drilled holes. The epoxy shall fill the holes without spilling excess epoxy when the anchors are inserted. Insert anchors immediately into the holes. The anchors shall be set back from the exterior face at least 1 inch. Install anchors without breaking or chipping the exposed masonry surface. Where voids exist in the masonry units or between the wythes, use socks to contain the epoxy.

3.5.8.7 Cleanup

Remove excess epoxy and spills from the surface of the masonry. Leave the surface of the masonry in a clean and uncontaminated condition. Remove spills on adjacent surfaces and repair surfaces as required.

3.5.8.8 Dutchman Repairs

Select stone for Dutchman repairs from the following three sources listed in order of priority: 1) stone harvested from the same elevation and stone type; 2) approved salvaged stone; 3) new stone made from a similar stone type. Fit the new piece into place with tolerances of no more than plus or minus 1/16-inch. Provide supporting rods of stainless steel as necessary for the extent of the repair and the location. Closely blend repairs in with the surrounding original materials.

3.5.9 Crack Injection

3.5.9.1 Application of Dispersed Hydrated Lime (DHL)

Notify the Contracting Officer as to when and where the installation will occur at least 48 hours prior to start. Provide samples to the Government representative from the dispenser during the course of the injection. Apply in accordance with the manufacturer's instructions.

a. Drill 1/8-inch diameter, downward-sloping injection holes. For transverse cracks less than 3/8 inch wide, drill holes through center of crack at 1 to 1.5 inches on center.

b. Clean out drill holes and cracks with compressed air and distilled water. Remove dirt and organic matter, loose material, sealants, and failed crack repair materials.

c. Inject Dispersed Hydrated Lime through holes sequentially, beginning at one end of area and working to opposite end. Where possible begin at lower end of injection area and work upward. Inject Dispersed Hydrated Lime until it extrudes from adjacent holes. After Dispersed Hydrated Lime has set, remove excess material and patch injection holes and surface of cracks with appropriate surface treatment.

3.5.9.2 Tools and Equipment

Do not use tools and equipment in the work that have not been cleaned of set dispersed hydrated lime.

3.6 NEW ELEMENTS

Evaluate new materials and components for both functional and aesthetic impacts on historic structures.

3.6.1 Structural Upgrades

Mechanical anchors used to reinforce masonry structures shall be designed by a registered professional structural engineer. It is critical that such strengthening measures take into account the current loads and stresses in the structure and the nature in which the structure has historically managed thermal and other environmental changes or cycles. Submit manufacturers literature, design analysis and detail drawings for the proposed additional materials.

3.7 FINAL CLEANING

No sooner than 72 hours after completion of the repair work and after joints are sealed, faces and other exposed surfaces of masonry shall be washed down with water applied with a soft bristle brush, then rinsed with clean water. Discolorations which cannot be removed by these procedures, shall be considered defective work. Perform cleaning work when temperature and humidity conditions allow the surfaces to dry rapidly. Protect adjacent surfaces from damage during cleaning operations.

3.8 PROTECTION OF WORK

Protect work against damage from subsequent operations.

3.9 DEFECTIVE WORK

Defective work shall be repaired or replaced, as directed, using approved procedures.

3.10 FINAL INSPECTION

Following completion of the work, inspect the structure for damage, staining, and other distresses. The patches shall be inspected for cracking, crazing, delamination, unsoundness, staining and other defects. The finish, texture, color and shade, and surface tolerances of the patches shall be inspected to verify that all requirements have been met. Repair surfaces exhibiting defects as directed.

-- End of Section --

SECTION 04 20 00

MASONRY
02/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 530/530.1	(2011; Errata 2011) Building Code Requirements and Specification for Masonry Structures and Related Commentaries
ACI SP-66	(2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A167	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A615/A615M	(2012) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A641/A641M	(2009a) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A82/A82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM B633	(2011) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C1019	(2011) Standard Test Method for Sampling and Testing Grout
ASTM C144	(2011) Standard Specification for Aggregate for Masonry Mortar
ASTM C150/C150M	(2012) Standard Specification for Portland Cement
ASTM C207	(2006; R 2011) Standard Specification for Hydrated Lime for Masonry Purposes

ASTM C270	(2012a) Standard Specification for Mortar for Unit Masonry
ASTM C476	(2010) Standard Specification for Grout for Masonry
ASTM C494/C494M	(2012) Standard Specification for Chemical Admixtures for Concrete
ASTM C593	(2006; R 2011) Fly Ash and Other Pozzolans for Use with Lime for Soil Stabilization
ASTM C780	(2012) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C90	(2012) Loadbearing Concrete Masonry Units
ASTM C94/C94M	(2012) Standard Specification for Ready-Mixed Concrete
ASTM D2240	(2005; R 2010) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D2287	(2011) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds

1.2 SYSTEM DESCRIPTION

1.2.1 Design Requirements

1.2.1.1 Unit Strength Method

Compute compressive strength of masonry system "Unit Strength Method", ACI 530/530.1. Submit calculations and certifications of unit and mortar strength.

1.2.1.2 Masonry Strength

Determine masonry strength in accordance with ACI 530/530.1; submit test reports on three prisms as specified in ACI 530/530.1. The cost of testing shall be paid by the Contractor.

1.2.2 Additional Requirements

a. Maintain at least one spare vibrator on site at all times.

b. Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by local code.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals marked with "AE" shall be reviewed by Landscape Architect. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Cement
Admixtures for Mortar
Cold Weather Installation; G

SD-04 Samples

Concrete Masonry Units (CMU)
Stone Items; G, AE
Anchors, Ties, and Bar Positioners
Expansion-Joint Materials
Joint Reinforcement
Through Wall Flashing
Mock-ups; G, AE

SD-05 Design Data

Unit Strength Method

SD-06 Test Reports

Field Testing of Mortar
Field Testing of Grout
Prism tests;
Masonry Inspector Qualifications; G

SD-07 Certificates

Stone Items
Concrete Masonry Units (CMU)
Anchors, Ties, and Bar Positioners
Expansion-Joint Materials
Joint Reinforcement
Admixtures for Mortar
Admixtures for Grout

1.4 QUALITY ASSURANCE

1.4.1 Mock-Ups

Construct full depth mock ups walls representing each type of stone masonry scheduled including new, salvaged, and refurbished stone masonry. Provide all materials, reinforcement, and accessories scheduled for use. Mock ups for walls with new or salvaged and reused masonry stone shall be free standing and are to be removed near the end of the project as and when directed by the Government. Mock ups of rehabilitated masonry stone walls shall be part of existing stone walls to be refurbished and may remain in place if approved by the Government. Refurbishment of existing stone walls shall not damage existing stone units. Size of mock ups is as indicated, or if not indicated as directed by the Government.

1.4.2 Composition

Mock-ups shall show full color range, texture, and bond pattern of the masonry work. The Contractor's method for mortar joint tooling; grouting of reinforced vertical cores, collar joints; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement; and cleaning of masonry work shall be demonstrated during the construction of the mock-ups. Installation or application procedures for anchors, wall ties, CMU control joints, random ashlar and rubble stone control joints, flashing, shall be shown in the sample mock-ups. Panels that represent reinforced masonry shall contain corners and control joints. Required reinforcing shall be provided.

1.4.3 Construction Method

Where anchored veneer walls are required, demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with appropriate ties placed within the specified tolerances across the filled cavity. At grouting, demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells and collar joints using the requirements specified herein. Mock-ups shall be built on a properly designed concrete foundation.

1.4.4 Usage

The completed panels shall be used as the standard of workmanship for the type of masonry represented. Masonry work shall not commence until the sample panel for that type of masonry construction has been completed and approved. Panels shall be protected from the weather and construction operations until the masonry work has been completed and approved. After completion of the work, the sample panels, including all foundation concrete, shall become the property of the Contractor and shall be removed from the construction site.

1.4.5 Masonry Inspector Qualifications

A qualified masonry inspector approved by the Contracting Officer shall perform inspection of the masonry work. Minimum qualifications for the masonry inspector shall be 5 years of reinforced masonry inspection experience or acceptance by a State, municipality, or other governmental body having a program of examining and certifying inspectors for reinforced masonry construction. The masonry inspector shall be present during preparation of masonry prisms, sampling and placing of masonry units, placement of reinforcement (including placement of dowels in footings and foundation walls), inspection of grout space, immediately prior to closing of cleanouts, and during grouting operations. The masonry inspector shall assure compliance with the drawings and specifications. The masonry inspector shall keep a complete record of all inspections and shall submit daily written reports to the Quality Control Supervisory Representative reporting the quality of masonry construction. Submit copies of masonry inspector reports.

1.4.6 Detail Drawings

Submit detail drawings showing bar splice locations. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall pilasters shall be shown. No approval will be given to the shop drawings until the Contractor

certifies that all conditions, are shown. If, during construction, additional masonry conditions are required, the approved shop drawings shall be resubmitted with the additional conditions shown along with the proposed changes. Location of these additional conditions shall be clearly highlighted. The minimum scale for wall elevations shall be 1/4 inch per foot. Reinforcement bending details shall conform to the requirements of ACI SP-66. Submit drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners, wall intersections, and pilasters; offsets; tops, bottoms, and ends of walls; and masonry expansion (control) joints.

1.5 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered, stored, handled, and protected to avoid chipping, breakage, and contact with soil or contaminating material. Store and prepare materials in already disturbed areas to minimize project site disturbance and size of project site.

1.5.1 Masonry Units

Cover and protect moisture-controlled concrete masonry units and cementitious materials from precipitation. Conform to all handling and storage requirements of ASTM C90. Mark prefabricated lintels on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.5.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars shall be free of loose mill scale and rust.

1.5.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Store sand and aggregates in a manner to prevent contamination or segregation.

1.6 PROJECT/SITE CONDITIONS

Conform to ACI 530/530.1 for hot and cold weather masonry erection.

1.6.1 Hot Weather Installation

Take the following precautions if masonry is erected when the ambient air temperature is more than 99 degrees F in the shade and the relative humidity is less than 50 percent or the ambient air temperature exceeds 90 degrees F and the wind velocity is more than 8 mph. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

1.6.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 40 degrees F or temperature of masonry units is below 40 degrees F, submit a written statement of proposed cold weather construction procedures for approval.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval. Submit sample of colored mortar. Units shall show the full range of color and texture. Submit test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project. Submit certificates of compliance stating that the materials meet the specified requirements.

2.2 CONCRETE MASONRY UNITS (CMU)

Submit samples and certificates as specified. Cement shall have a low alkali content and be of one brand. Units shall be of modular dimensions and air, water, or steam cured.

a. Hollow Load-Bearing Units: ASTM C90, made with normal weight aggregate.

b. Solid Load-Bearing Units: ASTM C90, normal weight units. Provide solid units as required or indicated.

2.2.1 Kinds and Shapes

Units shall be modular in size and shall include special shapes and sizes to complete the work as indicated. Nominal 16-inch long units 6-inch and greater thickness shall have two-cells and where bond beams are required provide bond units complying with as-cast three reduced-height webs.

2.3 STONE ITEMS

Submit samples as specified. Stone for veneer, trim, sills, copings, and cap stones shall be sandstone, bluestone, quartzite, and granite as required and shall be fabricated to suit the design shown and as required to match existing installations. Reuse salvaged stone from Government sources on site such as stockpiles and existing walls to be removed before proposing new materials to match. New materials shall match salvaged materials for reuse as approved by the Government.

Seneca Stone: Brownish red random rubble bond dense sandstone fabricated with finish, rockface, clefting, and tool marks matching the blended range of salvaged Seneca Stone. Use stone salvaged from the site as indicated. Provide new matching stone as approved by the Government where indicated or required.

Bluestone: Grayish blue dense sandstone/limestone used for capstones, copings, and pavers. Use stone salvaged from the site as indicated. Confirm dimensions of cap stone prior to constructing walls to assure nominal overhang indicated is provided.

Carderock: Brownish blue quartzite blend matching rock stone including finish, clefting, and tool marks matching in-situ regional Carderock random ashlar installations. Use stone salvaged from the site as indicated. Provide new stone as approved by the Government.

Granite: Good commercial grade building granite of medium or moderately coarse grain with a thermal finish on exposed faces and bush-hammered finish where indicated on vertical faces. Type and color of granite shall match and blend with salvaged bluestone color ranges. Provide new stone as approved by the Government.

2.4 MORTAR

ASTM C270, Type S. Strength (f'm) as indicated. Test in accordance with ASTM C780. Use Type I portland cement. Do not use admixtures containing chlorides. When structural reinforcement is incorporated, maximum air-content shall be 12 percent in cement-lime mortar. Use up to 40 percent Class F fly ash with type IP cement in cement-lime mortar. Fly ash shall comply with ASTM C593.

2.5 Admixtures for Mortar

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C494/C494M, Type C. Submit the required certifications.

2.6 Colored Mortar

Inorganic mortar coloring shall be added to the mortar used for exposed masonry surfaces to produce a uniform color matching approved mock-ups. Quantity of pigment to cementitious content of the masonry cement shall not exceed 5 by weight; carbon black shall not exceed 1 percent by weight. Quantity of pigment to cementitious content of cement-lime mix shall not exceed 10 percent by weight, carbon black no more than 2 percent by weight. Mortar coloring shall be chemically inert, of finely ground limeproof pigment, and furnished in accurately pre-measured and packaged units that can be added to a measured amount of cement. Compressive strength of colored mortar shall equal uncolored mortar.

2.7 Hydrated Lime and Alternates

Hydrated lime shall conform to ASTM C207, Type S.

2.8 Cement

Portland cement shall conform to ASTM C150/C150M, Type IA. Containers shall bear complete instructions for proportioning and mixing to obtain the required types of mortar. Incorporate to the maximum extent, without conflicting with other requirements of this section, up to 40 percent fly ash, up to 70 percent slag, up to 10 percent cenospheres, and up to 10 percent silica fume. When masonry cement is used, submit the manufacturer's printed instructions on proportions of water and aggregates and on mixing to obtain the type of mortar required. Additives shall conform to requirements in Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.9 Sand and Water

Sand shall conform to ASTM C144. Water shall be clean, potable, and free from substances which could adversely affect the mortar.

For work exposed to view when complete, provide sand in colors required to match existing exposed mortars where inorganic mortar coloring is insufficient to match approved mockups. Where width of mortar exceeds standard aspect ratios or widths, provide pea gravel or other approved aggregate to enhance performance at such joint configurations and widths.

2.10 GROUT AND READY-MIXED GROUT

Grout shall conform to ASTM C476, fine. Cement used in grout shall have a low alkali content. Grout slump shall be between 8 and 10 inches. Minimum grout strength shall be 2000 psi in 28 days, as tested by ASTM C1019. Use grout subject to the limitations of Table III. Do not change proportions and do not use materials with different physical or chemical characteristics in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. Ready-Mixed grout shall conform to ASTM C94/C94M.

2.10.1 Admixtures for Grout

In cold weather, a non-chloride based accelerating admixture may be used subject to approval; accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C494/C494M, Type C. In general, air-entrainment, anti-freeze or chloride admixtures shall not be used except as approved by the Contracting Officer. Submit required certifications.

2.11 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A153/A153M, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A82/A82M. Wire ties or anchors shall conform to ASTM A641/A641M. Joint reinforcement shall conform to ASTM A641/A641M; coordinate with paragraph JOINT REINFORCEMENT below. Anchors and ties shall be sized to provide a minimum of 5/8 inch mortar cover from either face. Ties at rubble and random ashlar stone veneer shall provide 1 inch mortar cover from exterior face. Submit two anchors, ties and bar positioners of each type used, as samples.

2.11.1 Wall Ties

Fixed Corrugated Metal Ties: Metal strips not less than 1.25 inch wide with corrugations having a wavelength of 0.385 to 0.50 inch and an amplitude of 0.06 to 0.10 inch made from 0.060 inch thick, steel sheet, galvanized after fabrication. Punched end to receive fixed anchor to backup wall. Length of ties to suit conditions and terminate 1-inch from exterior face of mortar.

Adjustable Corrugated Metal Ties: Metal strips not less than 1.25 inch wide with corrugations having a wavelength of 0.385 to 0.50 inch and an amplitude of 0.06 to 0.10 inch made from 0.075 inch-thick, steel sheet, galvanized after fabrication. Keyed shape to interlock with vertical adjustable anchorage means of dovetail imbeds or anchored slot channels suiting conditions.

2.11.2 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell. Telescoping bar positioner shall be manufactured from AISI 1065 spring steel and coated in accordance with ASTM B633.

2.12 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A82/A82M, welded construction. Wire shall have zinc coating conforming to ASTM A153/A153M, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 5/8 inch cover from either face. The distance between crosswires shall not exceed 16 inches. Joint reinforcement for straight runs shall be furnished in flat sections not less than 10 feet long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features. Submit one piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

2.13 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A615/A615M, Grade 60.

2.14 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of polyvinyl chloride conforming to ASTM D2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 5/8 inch thick and 3/8 inch thick flanges, with a tolerance of plus or minus 1/16 inch. The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 30 degrees F after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D2240.

2.15 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam or polyurethane foam as recommended by the sealant manufacturer. Sealant shall conform to Section 07 92 00 JOINT SEALANTS. Submit one piece of each type of material used.

2.16 THROUGH WALL FLASHING

Stainless Steel Flashing: ASTM A167, Type 304 0.018 inch thick, No. 2D finish. Provide with factory-fabricated deformations that mechanically bond flashing against horizontal movement in all directions. Deformations shall consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations.

PART 3 EXECUTION

3.1 PREPARATION

Prior to start of work, masonry inspector shall verify the applicable conditions as set forth in ACI 530/530.1, inspection. The Contracting Officer will serve as inspector or will select a masonry inspector.

3.1.1 Protection

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

a. Air Temperature 40 to 32 Degrees F. Sand or mixing water shall be heated to produce mortar temperatures between 40 and 120 degrees F

b. Air Temperature 32 to 25 Degrees F. Sand and mixing water shall be heated to produce mortar temperatures between 40 and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing.

c. Air Temperature 25 to 20 Degrees F. Sand and mixing water shall be heated to provide mortar temperatures between 40 and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 15 mph.

d. Air Temperature 20 Degrees F and below. Sand and mixing water shall be heated to provide mortar temperatures between 40 and 120 degrees F. Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees F. Temperature of units when laid shall not be less than 20 degrees F.

3.1.2 Completed Masonry and Masonry Not Being Worked On

a. Mean daily air temperature 40 to 32 degrees F. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.

b. Mean daily air temperature 32 to 25 degrees F. Masonry shall be completely covered with weather-resistant membrane for 24 hours.

c. Mean Daily Air Temperature 25 to 20 degrees F. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.

d. Mean Daily Temperature 20 degrees F and Below. Masonry temperature shall be maintained above 32 degrees F for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

3.1.3 Stains

Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

3.1.4 Loads

Do not apply uniform loads for at least 24 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

3.1.5 Surfaces

Clean surfaces on which masonry is to be placed of laitance, dust, dirt, oil, organic matter, or other foreign materials and slightly roughen to provide a surface texture with a depth of at least 1/8 inch. Sandblast, if necessary, to remove laitance from pores and to expose the aggregate.

3.2 LAYING MASONRY UNITS

a. Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. CMU shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 1/2 inch. Each unit shall be adjusted to its final position while mortar is still soft and plastic.

b. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Vertical CMU joints shall be kept plumb.

c. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of masonry, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below.

d. In double wythe construction, collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 8 inches.

3.2.1 Forms and Shores

Provide bracing and scaffolding as required. Design bracing to resist wind pressure as required by local codes. Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

3.2.2 Reinforced Concrete Masonry Units Walls

Where vertical reinforcement occurs, fill cores solid with grout. Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Embed the adjacent webs in mortar to prevent leakage of grout. Remove mortar fins protruding from joints before placing

grout. Minimum clear dimensions of vertical cores shall be 2 by 3 inches. Position reinforcing accurately as indicated before placing grout. As masonry work progresses, secure vertical reinforcing in place at vertical intervals not to exceed 160 bar diameters. Use puddling rod or vibrator to consolidate the grout. Minimum clear distance between masonry and vertical reinforcement shall be not less than 1/2 inch. Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together.

3.2.3 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved. Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

3.2.4 Tolerances

Lay masonry plumb, true to line, with courses level. Keep bond pattern plumb throughout. Square corners unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, lay masonry within the following tolerances (plus or minus unless otherwise noted):

TABLE II TOLERANCES	
Variation from the plumb in the lines and surfaces of columns, walls and arises	
In adjacent masonry units	1/8 inch
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch
Variations from the plumb for external corners, expansion joints, and other conspicuous lines	
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch
Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	

TABLE II TOLERANCES	
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch
Variation from level for bed joints and top surfaces of bearing walls	
In 10 feet	1/4 inch
In 40 feet or more	1/2 inch
Variations from horizontal lines	
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch
Variations in cross sectional dimensions of columns and in thickness of walls	
Minus	1/4 inch
Plus	1/2 inch

3.2.5 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

3.2.6 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

3.2.6.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall. Joints in unparged masonry walls below grade shall be pointed tight. Flush joints for architectural units, such as fluted units, shall completely fill both the head and bed joints.

3.2.6.2 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

3.2.6.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch.

3.2.7 Joint Widths

Joint widths shall be as follows:

3.2.7.1 Concrete Masonry Units

Concrete masonry units shall have 3/8 inch joints.

3.2.7.1.1 Veneer Stone Masonry

Match width and concave profile of joints on approved mock-up for random ashlar bond at Carderock stone.

Match width, raked depth, and bead or grapevine profiles of joints on approved mock-up for rubble bond at Seneca stone.

3.2.8 Embedded Items

Fill spaces around built-in items with mortar. Point openings around flush-mount electrical outlet boxes in wet locations with mortar. Embed anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in as the masonry work progresses. Fully embed anchors, ties and joint reinforcement in the mortar. Fill cells receiving anchor bolts and cells of the first course below bearing plates with grout.

3.2.9 Unfinished Work

Step back unfinished work for joining with new work. Toothing may be resorted to only when specifically approved. Remove loose mortar and thoroughly clean the exposed joints before laying new work.

3.2.10 Masonry Wall Intersections

Masonry bond each course at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

3.2.11 Partitions

Partitions shall be continuous from floor to underside of floor or roof deck where shown. Openings in firewalls around joists or other structural members shall be filled as indicated or approved. Where suspended ceilings

on both sides of partitions are indicated, the partitions other than those shown to be continuous may be stopped approximately 4 inches above the ceiling level. An isolation joint shall be placed in the intersection between partitions and structural or exterior walls as shown. Interior partitions having 4 inch nominal thick units shall be tied to intersecting partitions of 4 inch units, 5 inches into partitions of 6 inch units, and 7 inches into partitions of 8 inch or thicker units. Cells within vertical plane of ties shall be filled solid with grout for full height of partition or solid masonry units may be used. Interior partitions having masonry walls over 4 inches thick shall be tied together with joint reinforcement. Partitions containing joint reinforcement shall be provided with prefabricated pieces at corners and intersections or partitions.

3.3 ANCHORED VENEER CONSTRUCTION

Completely separate the inner and outer wythes by a continuous airspace as indicated. Lay up both the inner and the outer wythes together except when adjustable joint reinforcement assemblies are approved for use. When both wythes are not brought up together, through-wall flashings shall be protected from damage until they are fully enclosed in the wall. The airspace between the wythes shall be kept clear and free of mortar droppings by temporary wood strips laid on the wall ties and carefully lifted out before placing the next row of ties. A coarse gravel or drainage material shall be placed behind the weep holes in the cavity to a minimum depth of 4 inches of coarse aggregate or 10 inches of drainage material to keep mortar droppings from plugging the weep holes.

3.4 MORTAR MIX

Mix mortar in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measure ingredients for mortar by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Mix water with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Retemper mortar that has stiffened because of loss of water through evaporation by adding water to restore the proper consistency and workability. Discard mortar that has reached its initial set or that has not been used within 2.5 hours after mixing. Remove installed mortar and provide new mortar when installed mortar does not match approved dry mortar color for each location.

3.5 REINFORCING STEEL

Clean reinforcement of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 2 inches of tops of walls.

3.5.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in

position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

3.5.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement unless otherwise indicated. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

3.6 JOINT REINFORCEMENT INSTALLATION

Joint reinforcement shall be installed at 16 inches on center or as indicated. Reinforcement shall be lapped not less than 6 inches. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be placed to provide not less than 5/8 inch cover to either face of the unit.

3.7 PLACING GROUT

Fill cells containing reinforcing bars with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

3.7.1 Vertical Grout Barriers for Fully Grouted Walls

Provide grout barriers not more than 30 feet apart, or as required, to limit the horizontal flow of grout for each pour. Take all necessary precautions to prevent filling control joints and expansion joints with cementitious material or debris.

3.7.2 Grout Holes and Cleanouts

3.7.2.1 Grout Holes

Provide grouting holes in slabs, spandrel beams, and other in-place overhead construction. Locate holes over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Provide additional openings spaced not more than 16 inches on centers where grouting of all hollow unit masonry is indicated. Openings shall not be less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, plug and finish grouting holes to match surrounding surfaces.

3.7.2.2 Cleanouts for Hollow Unit Masonry Construction

Provide cleanout holes at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet. Where all cells are to be grouted, construct cleanout courses using bond beam units in an inverted position to permit cleaning of all cells.

Provide cleanout holes at a maximum spacing of 32 inches where all cells are to be filled with grout. Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 3 by 4 inch openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner to match surrounding masonry.

3.7.2.3 Cleanouts for Solid Unit Masonry Construction

Provide cleanouts for construction of walls consisting of a grout filled cavity between solid masonry wythes at the bottom of every pour by omitting every other masonry unit from one wythe. Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Do not plug cleanout holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner to match surrounding masonry.

3.7.3 Grouting Equipment

3.7.3.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Operate pumps to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, remove waste materials and debris from the equipment, and dispose of outside the masonry.

3.7.3.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. Maintain at least one spare vibrator at the site at all times. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation.

3.7.4 Grout Placement

Lay masonry to the top of a pour before placing grout. Do no place grout in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 5 feet in height. High-lift grout methods shall be used on pours exceeding 5 feet in height.

3.7.4.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 1/2 inch into the grout space shall be removed before beginning the

grouting operation. Grout pours 12 inches or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 12 inches in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

3.7.4.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 1/4 inch into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 4 feet in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 12 to 18 inches into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III
POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

			Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells in inches (1,2)	
Maximum Grout Pour Height feet (4)	Grout Type	Grouting Procedure	Multiwythe Masonry (3)	Hollow-unit Masonry
1	Fine	Low Lift	3/4	1-1/2 x 2
5	Fine	Low Lift	2	2 x 3
8	Fine	High Lift	2	2 x 3

TABLE III
POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

			Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells in inches (1,2)	
Maximum Grout Pour Height feet (4)	Grout Type	Grouting Procedure	Multiwythe Masonry (3)	Hollow-unit Masonry
12	Fine	High Lift	2-1/2	2-1/2 x 3
24	Fine	High Lift	3	3 x 3
1	Coarse	Low Lift	1-1/2	1-1/2 x 3
5	Coarse	Low Lift	2	2-1/2 x 3
8	Coarse	High Lift	2	3 x 3
12	Coarse	High Lift	2-1/2	3 x 3
24	Coarse	High Lift	3	3 x 4

Notes:

(1) The actual grout space or cell dimension shall be larger than the sum of the following items:

(a) The required minimum dimensions of total clear areas given in the table above;

(b) The width of any mortar projections within the space;

(c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.

(2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 3/4 inch or greater in width.

(3) For grouting spaces between masonry wythes.

(4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

3.8 CONTROL JOINTS

Control (vertical masonry expansion and contraction joints) joints shall be provided as indicated and required and shall be constructed in accordance with the details shown on the drawings and the project requirements. Use sash jamb units at CMU with a 3/4 by 3/4 inch groove near the center at end of each unit. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. At CMU this shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in CMU courses containing continuous bond beam steel. The exterior control joints shall be installed with backer rod and textured sealant in accordance with

Section 07 92 00 JOINT SEALANTS.

Continuation of control joints through exposed random ashlar or rubble stone veneer shall include conforming joints to stone layout to create a blended random interlocking appearance in the manner approved through the mock-ups and test panels.

Fill control joints and varying offset collar joint between CMU or concrete backup and stone veneer with approved compressible material.

3.9 ANCHORAGE TO CONCRETE AND STRUCTURAL STEEL

3.9.1 Anchorage to Concrete

Anchorage of masonry to the face of concrete columns, beams, or walls shall be with dovetail anchors spaced not over 16 inches on centers vertically and 18 inches on center horizontally.

3.10 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, completely remove mortar and grout daubs or splashings from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.10.1 Dry-Brushing

Exposed masonry shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.11 PROTECTION

Protect facing materials against staining. Cover top of walls with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 2 feet down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

3.12 WASTE MANAGEMENT

Manage waste according to the Waste Management Plan and as follows. Minimize water used to wash mixing equipment. Use trigger operated spray nozzles for water hoses. Place materials defined as hazardous or toxic waste in designated containers.

3.13 TEST REPORTS

3.13.1 Field Testing of Mortar

Take at least three specimens of mortar each day. Spread a layer of mortar 1/2 to 5/8 inch thick on the masonry units and allowed to stand for one minute. Prepare and test the specimens for compressive strength in accordance with ASTM C780. Submit test results.

3.13.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 2000 psi at 28 days. Submit test results.

3.13.3 Prism Tests

Perform at least one prism test sample for each 5,000 square feet of wall but not less than three such samples shall be made for any building. Three prisms will be used in each sample. Prisms shall be tested in accordance with ACI 530/530.1. Seven-day tests may be used provided the relationship between the 7- and 28-day strengths of the masonry is established by the tests of the materials used. Compressive strength shall be 1,500 psi at 28 days. If the compressive strength of any prism falls below the specified value by more than 500 psi, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. If the likelihood of low-strength masonry is confirmed and computations indicate that the load-carrying capacity may have been significantly reduced, tests of cores drilled, or prisms sawed, from the area in question may be required. In such case, three specimens shall be taken for each prism test more than 500 psi below the specified value. Masonry in the area in question shall be considered structurally adequate if the average compressive strength of three specimens is equal to at least 85 percent of the specified value, and if the compressive strength of no single specimen is less than 75 percent of the specified value. Additional testing of specimens extracted from locations represented by erratic core or prism strength test results will be permitted. Submit test results.

-- End of Section --

SECTION 04 73 01

COLUMBARIUM NICHE COVERS, MARBLE (GFCI)
11/12

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

MARBLE INSTITUTE OF AMERICA (MIA)

MIA Design Manual (2003) Dimension Stone Design Manual

1.2 SUMMARY

This Section specifies installation by Contractor of blank columbarium niche covers provided by Government made from white marble. This Work includes all labor and materials to install the maximum quantity of niche covers indicated on the drawings, one per constructed precast niche opening, plus storing a quantity of spare niche covers meeting all of the acceptance criteria, in the quantity of 10 percent of the total identified on the Drawings. 18,040 approved white marble columbarium niche covers shall be delivered to the Arlington National Cemetery as part of the work provided by the U.S. Army Corps of Engineers(USACE) Norfolk District.

1.2.1 Related Sections

Refer to Section 03 48 24 PRECAST CONCRETE COLUMBARIUM UNITS for niche cover installation.

1.3 QUALITY ASSURANCE

1.3.1 Regulatory Requirements

Requirements for columbarium niche covers provided by the Government shall comply with standards established by Arlington National Cemetery. Marble shall comply with standards of MIA Design Manual.

1.3.2 On-Site Samples

Maintain and protect on site a minimum of two accepted blank white marble niche cover samples for reference 15-3/4 inches by 11-1/4 inches by 3/4-inch representative of the stone to be used, the finish to be attained, the placement and diameter of the holes to be drilled and testing results. The samples shall be marked clearly on the back with indelible marker, showing contractor name, project number, quarry source of stone and name of stone. Any covers which arrive damaged shall be set aside and the Contracting Officer notified of the total.

These samples will be the basis for comparison of all blank niche covers furnished by Government under this contract.

1.4 DELIVERY, STORAGE, AND HANDLING

Niche covers are Government-Furnished and Contractor-installed. Government will inspect, approve, and sign-off on accepted niche covers prior to Contractor receipt and installation. Government will deliver niche covers to the Contractor to offload, store, and protect throughout installation.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Source of Supply

All stone furnished by the Government shall be obtained from quarries within the United States of America, having adequate capacity and facilities to meet the specified requirements. Cutting and finishing shall be done by a manufacturer equipped to process the material promptly, in order and in strict accordance with these specifications.

2.1.2 Marble Material

Marble shall be white American monumental marble which shall be sound and compact, free from cracks, spalls, chips, holes, calcite lines more than two inches in length, open seams, pits, or other defects that would impair its strength, durability or appearance.

2.1.3 Marble Color

The overall whiteness of the marble exclusive of allowable coloration shall be no less than standard number N8 of the Munsell Neutral Value Scale, 31 Step Scale. Variations in coloration shall blend gradually with the white background. Blotches of color, or clouding and veining which is in sharp contrast with the background whiteness, which would inhibit ease of legibility of the inscription, or which presents an objectionable appearance shall be cause for rejection and shall not be installed.

2.2 MANUFACTURED UNITS

2.2.1 Dimension Tolerances

Niche covers shall conform to the dimensions shown on details in the Drawings.

Each surface shall be parallel to its counterpart and perpendicular within 0.5 degree to its contiguous surfaces. Dimension tolerances are:

a. Width: Plus or minus 1/16 inch.

b. Height: Plus or minus 1/16 inch.

c. Thickness: Plus or minus 1/16 inch.

d. Surface Deviation From A True Plane: Plus or minus 1/16 inch.

e. Hole Placement: The location of the holes shall be perpendicular to the adjoining holes, with the center to center spacing 8-3/4 inch width and 12-1/2 inch height. The center of the holes shall be no more than 1/32-inch in any direction away from the corners of the identified

8-3/4 inch by 12-1/2 inch rectangle.

2.2.2 Finish

The face of each niche cover shall be machine 80 grit honed with a finishing stone to produce a smooth satin finish, free of scratches, saw marks, rust spots and skips. The back face of the niche covers can be sawn finished or better. All edges, of the front, back and corners shall be smooth sawn and finished with a clean 1/16 inch to 1/8 inch aris (eased edge). Four holes are to be core drilled in each cover as shown in detail on Drawings. The holes shall be perpendicular to the face of the cover. The holes shall have smooth side walls, with one centerline and no visible change in the side wall from drilling the hole from opposite faces.

2.2.2.1 Workmanship

Each niche cover shall be free from defects in workmanship. Spalls, chips, cracks, open seams, or abraded edges, will not be permitted and the repair or patching of any such defects is prohibited and will be cause for rejection. The covers shall be free of ink, oil, crayon marks, dirt, coatings, sealers and stone dust. Workmanship quality shall be in accordance with industry standards and practices. Do not install damaged covers.

PART 3 EXECUTION

3.1 EXAMINATION

All materials will be inspected by the Government prior to installation to insure compliance with the contract documents and to insure there is no damage. Should conditions be different from those indicated on the contract documents, or approved covers show damage the Contractor shall assist the Government in inspection of covers by sorting, separating, protecting, and tracking approved and rejected covers. Contractor shall re-crate rejected covers and store will away from accepted covers. Contractor shall protect approved covers during storage, handling, and installation. Contractor shall immediately notify the Contracting Officer of status of covers which are not acceptable.

3.2 INSTALLATION

Refer to Section 03 48 24 PRECAST CONCRETE COLUMBARIUM UNITS for installation requirements. Turn over and set aside 1,640 Blank Marble Niche Covers to the Contracting Officer for future use as part of this Contract.

3.2.1 Installation of ID Disks

Drill holes where indicated in stone cladding and stone edging to receive identification disks. Set disk studs in full bed of adhesive. Remove excess adhesive.

3.3 ID PAINTING

Paint niche identification numbers centered on rear walls of each niche using stencils.

3.4 PROTECTION DURING CLEANING

Protect all installed identification disks and hardware from damage when

the stonework is cleaned. Damaged identificaiton disks and hardware shall be replaced with new at no additional cost to the Government.

3.5 CLEANUP

Clean up area of excess material and debris. Clean visible portions of all covers.

-- End of Section --

SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS
05/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF45	(2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	(2010) Code of Standard Practice for Steel Buildings and Bridges

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.3	(2006) Operations - Safety Requirements for Powder Actuated Fastening Systems

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(2010) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2010) Standard for Square and Hex Nuts
ASME B18.21.1	(2009) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
ASME B18.6.2	(1998; R 2010) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series
ASME B18.6.3	(2010) Machine Screws, Tapping Screws, and Machine Drive Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2012) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2010) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile

	Strength
ASTM A36/A36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A47/A47M	(1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A500/A500M	(2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A653/A653M	(2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A924/A924M	(2010a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B108/B108M	(2012; E 2012) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B209	(2010) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2012) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B26/B26M	(2012) Standard Specification for Aluminum-Alloy Sand Castings
ASTM C510	(2011) Standard Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants
ASTM C518	(2010) Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C661	(2006) Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer
ASTM C1513	(2012) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections

ASTM D1187/D1187M	(1997; E 2011; R 2011) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM E283	(2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E331	(2000; R 2009) Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM G26	(1996) Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	(Oct 2009) Alkyd Anti-Corrosive Metal Primer

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Access doors and panels, installation drawings; G
Expansion joint covers, installation drawings; G

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

SD-03 Product Data

Access doors and panels
Expansion joints

SD-04 Samples

Expansion joint covers; G
Finishes for expansion joints; G

Provide full size samples, taken from manufacturer's stock, and be complete as required for installation in the structure. Samples may be installed in the work, provided each sample is clearly identified and its location recorded.

1.3 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Carbon Steel

ASTM A36/A36M.

2.1.2 Structural Tubing

ASTM A500/A500M.

2.1.3 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B.

2.1.4 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A47/A47M.

2.1.5 Anchor Bolts

ASTM A307. Where exposed, shall be of the same material, color, and finish as the metal to which applied.

2.1.5.1 Lag Screws and Bolts

ASME B18.2.1, type and grade best suited for the purpose.

2.1.5.2 Toggle Bolts

ASME B18.2.1.

2.1.5.3 Bolts, Nuts, Studs and Rivets

ASME B18.2.2 or ASTM A307.

2.1.5.4 Powder Actuated Fasteners

Follow safety provisions of ASSE/SAFE A10.3.

2.1.5.5 Screws

ASME B18.2.1, ASME B18.6.2, ASME B18.6.3 and ASTM C1513.

2.1.5.6 Washers

Provide plain washers to conform to ASME B18.21.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ASME B18.21.1.

2.1.6 Aluminum Alloy Products

Conform to ASTM B209 for sheet plate, ASTM B221 for extrusions and ASTM B26/B26M or ASTM B108/B108M for castings, as applicable. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, G90, as applicable.

2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints, but coat with rust preventative applied in the shop.

2.2.4.2 Pretreatment, Priming and Painting

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.

2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.6 Aluminum Surfaces

2.2.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.2.6.2 Aluminum Finishes

Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA DAF45. Unless otherwise specified, provide all other aluminum items with a standard mill finish. Provide a coating thickness not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF45. Provide a polished satin finish on items to be anodized.

2.3 ACCESS DOORS AND PANELS

Provide flush type access doors and panels unless otherwise indicated. Fabricate frames for access doors of steel not lighter than 16 gage with welded joints and anchorage for securing into construction. Provide access doors with a minimum of 24 by 24 inches and of not lighter than 16 gage steel, with stiffened edges and welded attachments. Provide access doors hinged to frame and with a flush-face, screwdriver operated cam latch. Provide exposed metal surface with a baked enamel finish. Provide frames with 0.25-inch mounting holes.

2.4 EXPANSION JOINTS

Provide expansion joints constructed of extruded aluminum with standard mill finish for floor covers and exterior covers. Furnish plates, backup angles, expansion filler strip and anchors as indicated.

2.4.1 Watertight, Deck to Wall Joints (EJ-1)

Provide expansion joint consisting of heavy-duty extruded aluminum retainer rails, synthetic rubber side flashing sheets, a thermo-plastic rubber sealing insert, and stainless steel restrainer caps. Rails shall be bolted to the structural slab; flashing sheets are integrated in a sandwich with the deck waterproofing system.

2.4.1.1 Finishes

Match adjacent surface color.

2.4.2 Watertight Joint System for Deck-to-Wall in Concrete (EJ-2)

Precompressed, silicone-and-impregnated-foam hybrid installed into field applied epoxy adhesive on the joint faces; with the silicone bellows locked to the joint faces with a field-injected silicone sealant band supplied by manufacturer. Seal shall be odorless, clean handling, UV stable in compliance with ASTM G155; non-staining, and features low temperature flexibility.

2.4.2.1 Finishes

Bellows shall be color gray.

2.4.3 Seismic Control (EJ-3)

Watertight, thermal insulation, 100 percent movement capability, UV stable and color coordinated with substrate (stone). Factory-applied, low-modulus silicone, with an open-cell polyurethane foam infused with a water-based, non-drying acrylic dispersion. The silicone external color facing shall be factory applied with the foam is partially precompressed to a width greater than maximum anticipated joint extension and cured before final compression. When fully compressed, a bellows is created in the coating. Bellows folds and unfolds during movement, virtually free of tensile stresses. Sealing against the substrate is achieved through a combination of the pressure-sensitive adhesive acrylic in the foam, the back-pressure of the expanding foam and the field installation of a corner bead of silicone at the substrate-to-bellows interface.

Typical physical properties for EJ-3:

a. Durometer Hardness: Silicone coating not to exceed 25 pts, Shore A according to ASTM C661.

b. Weatherometer: Xenon Arc Weatherometer 2000 hours - no visible deterioration according to ASTM C510 and ASTM G26 respectively.

c. Primary Surface Weathering: Atlas Weatherometer, 6000 hours minimal hardness change according to ASTM G26.

d. Bleeding/Staining: Materials shall not bleed or stain when tested according to ASTM C510.

e. R-Value: 2.15 per 1-inch depth; ASTM C518.

f. Air Permeability: ABAA Compliant ASTM E283.

g. Water Penetration: No water penetration for 15 minute duration at 500 Pa in accordance with ASTM E331.

2.4.3.1 Color

Bellows color shall be as selected by Contracting Officer.

2.4.4 Pedestrian Bridge Joint Cover (EJ-4)

Provide expansion joint cover, waterproof design; wing seals shall be attached with elastomeric concrete header. Design shall have maximum opening of 2-1/2 inches. Silicone seals shall be in color selected. Joint cover shall be constructed of metal (aluminum, stainless steel or bronze) and silicone seals for floor systems.

a. Extruded Aluminum: Alloy 6063-T5.

b. Plate Aluminum: Alloy 6061-T6.

c. Bronze: Alloy 280 Muntz Metal.

d. Stainless Steel: Alloy 304.

e. Zinc Chromate: All surfaces in contact with wet cement.

f. UV and mildew resistant.

g. Color of Seal: Natural Stone (color selection based on Architectural Art Manufacturing, Division of Pittcon Architectural Metals, LLC.)

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners shall be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Form joints exposed to the weather shall be formed to exclude water. Items listed below require additional procedures.

3.2 WORKMANSHIP

Provide miscellaneous metalwork that is well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections of work in place and ground smooth. Provide a smooth finish on exposed surfaces of work in place and unless otherwise approved, flush exposed riveting. Mill joints where tight fits are required. Corner joints shall be coped or mitered, well formed, and in true alignment. Accurately set work to established lines and elevations and securely fastened in place. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.4 EXPANSION JOINT COVERS

3.4.1 Watertight, Deck to Wall Joints

The sealing insert shall be installed over the upper end of the flashing sheets and held in compression by the stainless-steel retainer caps. The system shall integrate the structural slab, deck waterproofing and expansion joint system which is essentially independent of the wear-course

components (pavers, concrete topping, etc.) while ensuring that movement is properly accommodated.

3.4.2 Watertight Joint System for Decks

Follow instructions written by the manufacturer and job-specific requirements. Ensure material nominal size matches joint size. Mix epoxy and trowel a thin layer onto the joint faces to at least the depth of the DSM foam. Apply thin layer of epoxy to both sides of the joint face. Insert material into joint with at least a 1/4-inch recess. Join lengths by pushing silicone coated ends firmly together. Wipe silicone facing using clean, lint-free rag made damp with solvent. Before epoxy cures, force the tip of the sealant tube between the foam and the substrate and inject a silicone sealant band. Tool overflow sealant into a cove bead between the top of the silicone bellows and the substrate. Tool silicone between joined lengths so that bellows is not restrained by excess silicone.

3.4.3 Seismic Joint Covers

Follow instructions written by the manufacturer and job-specific requirements. Ensure material nominal size matches joint size. Wipe factory-applied release agent off silicone facing using damp, clean lint-free rag. Apply think bead of silicone sealant along edge of bellows at end where the material will join with next length. Insert material into joint with at least 1/4-inch recess and adhere to one joint face. Allow material to expand against other joint face. Blend silicone at joins into the silicone bellows to create a consistent finished appearance being sure not to restrict the folds of the bellows. Once material has equalized its expansion across the joint, gun and tool fillet beat of the supplied liquid silicone at the substrate-to-bellows interface.

3.4.4 Pedestrian Bridge Joint Cover

Verify the joint is clean and will provide an appropriate surface for the joint sealant. Apply a 1/16 inch to 1/8 inch coating of epoxy mixture to both sides of the joint to a depth of the sealant material plus 1/2-inch. Remove wrapping material and stick material to one side of joint opening. Material will self expand and seal to opposite side. Follow technical data and installation instructions provided by the manufacturers.

3.5 FINISHES

3.5.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D1187/D1187M, asphalt-base emulsion.

3.5.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, shall be free of rust, grease, dirt and other foreign matter.

3.5.3 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy

weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer.

3.6 ACCESS PANELS

Install a removable access panel not less than 12 by 12 inches directly below each valve, flow indicator, damper, or air splitter that is located above the ceiling, other than an acoustical ceiling, and that would otherwise not be accessible.

3.7 CONTROL-JOINT COVER INSTALLATION

Provide covers over control-joints and fasten on one side only with fasteners spaced to give positive contact with wall surfaces on both sides of joint throughout the entire length of cover.

-- End of Section --

SECTION 05 52 00

METAL RAILINGS
02/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010; Errata 2010) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A 240/A 240M	(2010) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A 312/A 312M	(2009) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A 554	(2010) Standard Specification for Welded Stainless Steel Mechanical Tubing
ASTM A 666	(2003) Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM A 743/A 743M	(2006) Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
ASTM A500/A500M	(2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A512	(2006) Standard Specification for Cold-Drawn Buttweld Carbon Steel Mechanical Tubing
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM C109	(2012) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens)

ASTM C469	(2010) Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression
ASTM C496	(2011) Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
ASTM C78	(2010e1) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 521	(2001) Pipe Railing Manual

1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Pre-Installation Meetings

Within 30 days of Contract Award, submit fabrication drawings to the Contracting Officer for the following items:

a. Steel Shapes, Plates, Bars and Strips

b. Steel Railings and Handrails

c. Anchorage and fastening systems

Submit manufacturer's catalog data, including two copies of manufacturers specifications, load tables, dimension diagrams, and anchor details for the following items:

a. Concrete inserts

b. Anchorage and fastening systems

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

fabrication and installation drawings; G, AE

SD-03 Product Data

Concrete Inserts; G, AE
Cold-Drawn Steel Tubing
Steel Railings and Handrails
Stainless Steel Railings and Handrails
Anchorage and Fastening Systems; G, AE

SD-08 Manufacturer's Instructions

Installation Instructions

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide complete, detailed fabrication and installation drawings for all hardware, and for all steel shapes, plates, bars and strips used in accordance with the design specifications referenced in this section.

Pre-assemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

For the fabrication of work exposed to view, use only materials that are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and application of surface finishes, including zinc coatings.

2.2 GENERAL FABRICATION

Provide railings and handrails detail plans and elevations at not less than 1 inch to 1 foot. Provide details of sections and connections at not less than 3 inches to 1 foot. Also detail setting drawings, diagrams, templates for installation of anchorages, including concrete inserts, anchor bolts, and miscellaneous metal items having integral anchors.

Use materials of size and thicknesses indicated or, if not indicated, of required size and thickness to produce adequate strength and durability in finished product for intended use. Work materials to dimensions indicated on approved detail drawings, using proven details of fabrication and support. Use type of materials indicated or specified for the various components of work.

Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ensure all exposed edges are eased to a radius of approximately 1/32 inch. Bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

Weld corners and seams continuously and in accordance with the recommendations of AWS D1.1/D1.1M. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

Form exposed connections with hairline joints that are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type indicated or, if not indicated, use Phillips flathead (countersunk) screws or bolts.

Provide anchorage of the type indicated and coordinated with the supporting structure. Fabricate anchoring devices and space as indicated and as required to provide adequate support for the intended use of the work.

2.3 COLD-DRAWN STEEL TUBING

Provide tubing conforming to ASTM A512, sunk drawn, butt-welded, cold-finished, and stress-relieved.

2.4 STEEL PIPE

Provide pipe conforming to ASTM A53/A53M, type as selected, Grade B; primed finish, unless galvanizing is required; standard weight (Schedule 40).

2.5 FASTENERS

stainless steel fasteners used for exterior applications or where built into exterior walls or floor systems. Select fasteners for the type, grade, and class required for the installation of railing system.

2.6 STEEL RAILINGS AND HANDRAILS

Design handrails to resist a concentrated load of 250 lbs in any direction at any point of the top of the rail or 20 lbs per foot applied horizontally to top of the rail, whichever is more severe. NAAMM AMP 521, provide the same size rail and post. Provide pipe collars of the same material and finish as the handrail and posts. Provide series 300 stainless steel pipe collars.

2.6.1 Steel Handrails

Provide steel handrails, including inserts in concrete, steel pipe conforming to ASTM A53/A53M or structural tubing conforming to ASTM A500/A500M, Grade A or B of equivalent strength. Provide steel railings of 2 inches nominal size,.

a. Fabrication: Joint posts, rail, and corners by one of the following methods:

(1) Flush-type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8 inch hexagonal-recessed-head setscrews.

(2) Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Butt railing splices and reinforce them by a tight fitting interior sleeve not less than 6 inches long.

(3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

2.6.2 Stainless Steel Railings and Handrails

Tubing: ASTM A 554, Grade MT 316L.

Pipe: ASTM A 312/A 312M, Grade TP 316L.

Castings: ASTM A 743/A 743M, Grade CF 8M or CF 3M.

Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, Type 316L.

Do not use exposed fasteners for connecting railing system. Provide fasteners manufactured or recommended by railing system manufacturer.

2.6.2.1 Stainless Steel Finishes

Remove tool and die marks and stretch lines, or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece. Provide the following finishe as approved by Contracting Officer:

a. Directional Satin Finish: No. 4.

When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.6.3 Braided Stainless Steel Cable

Provide 3/16-inch braided stainless steel cable and fittings installed to 300 pound tension.

2.6.4 Pourable High Strength Grout

Provide a form and pour mortar specially designed for structural support of the stainless steel handrails and guardrails. Performance properties shall be as follows, minimum:

a. Comprehensive Strength: After 28 days, greater than 8500 psi per ASTM C109.

b. Flexural Strength: after 28 days, 1100 psi per ASTM C78.

c. Splitting Tensile: After 28 days, 675 psi per ASTM C496.

d. Modulus of Elasticity: 2.5 by 10-6 psi per ASTM C469.

PART 3 EXECUTION

3.1 INSTALLATION INSTRUCTIONS

Submit manufacturer's installation instructions for the following products to be used in the fabrication of hand rail work:

a. Steel railings and handrails.

b. Anchorage and fastening systems.

3.2 PREPARATION

Adjust railings and handrails prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length. Space posts not more than 8 feet on center. Plumb posts in each direction.

Anchor posts in concrete by means of pipe sleeves set and anchored into concrete. Provide sleeves stainless steel pipe, not less than 6 inches long, and having an inside diameter not less than 1/2-inch greater than the outside diameter of the inserted pipe post. After posts have been inserted into sleeves, fill the annular space between post and sleeve with a quick-setting hydraulic cement. Cover anchorage joint with a round steel flange welded to the post.

3.3 STEEL HANDRAIL

Install according to approved Shop Drawings and manufacturer's recommended installation method. Secure rail ends by steel pipe flanges

-- End of Section --

SECTION 06 20 00

FINISH CARPENTRY
02/12

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)

ALSC PS 20	(2010) American Softwood Lumber Standard

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C20	(2003) Structural Lumber Fire-Retardant Treatment by Pressure Processes
AWPA C27	(2002) Plywood - Fire-Retardant Treatment by Pressure Processes
AWPA M2	(2007) Standard for Inspection of Treated Wood Products
AWPA M4	(2002) Standard for the Care of Preservative-Treated Wood Products
AWPA P5	(2009) Standard for Waterborne Preservatives

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA L870	(2010) Voluntary Product Standard, PS 1-09, Structural Plywood

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI AWS	(2009) Architectural Woodwork Standards

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(2010) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2010) Standard for Square and Hex Nuts
ASME B18.6.1	(1981; R 2008) Wood Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM D2898	(2010) Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing

HARDWOOD PLYWOOD AND VENEER ASSOCIATION (HPVA)

HPVA HP-1	(2009) American National Standard for Hardwood and Decorative Plywood

U.S. DEPARTMENT OF COMMERCE (DOC)

DOC/NIST PS58	(1973) Basic Hardboard (ANSI A135.4)

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S. 4	(2009) Preservative Treatment for Millwork

WOOD MOULDING AND MILLWORK PRODUCERS ASSOCIATION (WMMPA)

WMMPA WM 6	(1987) Industry Standard for Non-Pressure Treating of Wood Millwork

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

SD-03 Product Data

Clear Heart Western Red Cedar; G, AE
soffit vents

Manufacturer's printed data indicating the usage of engineered or recycled wood products, and environmentally safe preservatives.

SD-04 Samples

Clear Heart Western Red Cedar; G, AE

Samples shall be of sufficient size to show patterns, color ranges, and types, as applicable, of the material proposed to be used.

SD-07 Certificates

Certificates of grade
Certificates of compliance

1.3 DETAIL DRAWINGS

The Contractor shall submit detail drawings showing fabricated items and special mill and woodwork items. Drawings shall indicate materials and details of construction, methods of fastening, erection, and installation.

1.4 CERTIFICATES

Provide certificates of grade from the grading agency on graded but unmarked lumber or plywood attesting that materials meet the grade requirements specified herein.

Provide certificates of compliance unless materials bear certification markings or statements.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver lumber, plywood, trim, and millwork to job site in an undamaged condition. Stack materials to ensure ventilation and drainage. Protect against dampness before and after delivery. Store materials under cover in a well-ventilated enclosure and protect against extreme changes in temperature and humidity. Do not store products in building until wet trade materials are dry.

1.6 QUALITY ASSURANCE

1.6.1 Lumber

Identify each piece or each bundle of lumber, millwork, and trim by the grade mark of a recognized association or independent inspection agency that is certified by the Board of Review, American Lumber Standards Committee, to grade the species.

1.6.2 Plywood

Each sheet of plywood shall bear the mark of a recognized association or independent inspection agency that maintains continuing control over quality of the plywood. Mark shall identify plywood by species group or span rating, and shall show exposure durability classification, grade, and compliance with APA L870.

1.6.3 Hardboard

Materials shall bear a marking or statement identifying the producer and the applicable standard.

1.6.4 Nonpressure-Treated Woodwork and Millwork

Mark, stamp, or label, indicating compliance with WDMA I.S. 4.

1.6.5 Fire-Retardant Treated Lumber

Each piece to bear Underwriters Laboratories label or the label of another nationally recognized independent testing laboratory.

PART 2 PRODUCTS

2.1 WOOD

2.1.1 Sizes and Patterns of Wood Products

Yard and board lumber sizes shall conform to ALSC PS 20. Provide shaped lumber and millwork in the patterns indicated and standard patterns of the association covering the species. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within

manufacturing tolerances allowed by the applicable standard.

2.1.2 Trim, Finish, and Frames

Provide species and grades listed for materials to be paint finished. Provide materials that are to be stain, natural, or transparent finished one grade higher than that listed. Provide species indicated for materials to be transparent finished. Run trim, except window stools and aprons with hollow backs.

2.1.3 Hardwood Plywood

HPVA HP-1, Type I (Exterior) , Premium (A) Grade, lumber core construction of thickness indicated.

2.1.4 Hardboard

DOC/NIST PS58, standard type, 1/4 inch thick.

2.2 CLEAR HEART WESTERN RED CEDAR

Provide clear heart western red cedar, grade NLGA 200a or grade WCLIB 102-b; highest grade that includes only pieces with heartwood on the exposed face. Semi-transparent stain shall be oil-based.

2.2.1 Tongue and Groove Products

Provide tongue and groove red western cedar for Committal Shelter ceiling. Joints between adjoining pieces shall be v-shaped fut flush, "reveal."

2.2.2 Trim Boards

Provide clear grade western red cedar trim.

2.3 SOFFIT VENTS

Provide soffit vents with vent slots 1/8-inch wide and 1-inch long configured at 1-1/2-inch on center lengthwise and 1/2-inch on center laterally. Each row of vent slots lengthwise shall provide approximately one-square inch of vented are per lineal foot. Vents shall be aluminum; baked-on powder coated finish in color indicated or approved by Contracting Officer.

2.4 PRESERVATIVE TREATMENT OF WOOD PRODUCTS

2.4.1 Nonpressure Treatment

Treat woodwork and millwork, such as exterior trim, door trim, and window trim, in accordance with WDMA I.S. 4, with either 2 percent copper napthenate, 3 percent zinc napthenate, or 1.8 percent copper-8-quinolinolate. Provide a liberal brushcoat of preservative treatment to field cuts and holes.

2.4.2 Pressure Treatment

Lumber and plywood used on the exterior of buildings or in contact with masonry or concrete shall be treated with water-borne preservative listed in AWPA P5 as applicable, and inspected in accordance with AWPA M2. Identify treatment on each piece of material by the quality mark of an

agency accredited by the Board of Review of the American Lumber Standards Committee. Plywood shall be treated to a reflection level as follows:

Exterior wood molding and millwork within 18 inches of soil, in contact with water or concrete shall be preservative-treated in accordance with WMMPA WM 6. Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWPA M4. Items of all-heart material of cedar, cypress, or redwood will not require preservative treatment, except when in direct contact with soil.

2.5 FIRE-RETARDANT TREATMENT

2.5.1 Wood Products

Fire-retardant treated lumber shall be pressure treated in accordance with AWPA C20. Fire-retardant treated plywood shall be pressure treated in accordance with AWPA C27. Material use shall be defined in AWPA C20 and AWPA C27 for Interior Type A and B and Exterior Type. Treatment and performance inspection shall be by a qualified independent testing agency that establishes performance ratings. Each piece or bundle of treated material shall bear identification of the testing agency to indicate performance with such rating. Treated materials to be exposed to rain wetting shall be subjected to an accelerated weathering technique in accordance with ASTM D2898, Method A, prior to being tested for compliance with AWPA C20 or AWPA C27.

2.6 HARDWARE

Provide sizes, types, and spacings of manufactured building materials recommended by the product manufacturer except as otherwise indicated or specified.

2.6.1 Wood Screws

ASME B18.6.1.

2.6.2 Bolts, Nuts, Lag Screws, and Studs

ASME B18.2.1 and ASME B18.2.2.

2.7 FABRICATION

2.7.1 Quality Standards (QS)

The terms "Premium," "Custom," and "Economy" refer to the quality grades defined in AWI AWS. Items not specified to be of a specific grade shall be Custom grade. The AWI QS is superseded by all contract document requirements indicated or stated herein.

PART 3 EXECUTION

3.1 FINISH WORK

Provide sizes, materials, and designs as indicated and as specified. Apply primer to finish work before installing. Where practicable, shop assemble and finish items of built-up millwork. Joints shall be tight and constructed in a manner to conceal shrinkage. Miter trim and moldings at exterior angles and cope at interior angles and at returns. Material shall show no warp after installation. Install millwork and trim in maximum

practical lengths. Fasten finish work with finish nails. Provide blind nailing where practicable. Set face nails for putty stopping.

3.1.1 Exterior Finish Work

Machine-sand exposed flat members and square edges. Machine-finish semi-exposed surfaces. Construct joints to exclude water. In addition to nailing, glue joints of built-up items with waterproof glue as necessary for weather-resistant construction. Provide well distributed end joints in built-up members. Provide shoulder joints in flat work. Hold backs of wide-faced miters together with metal rings and waterproof glue. Fascias and other flat members, unless otherwise indicated, shall be 3/4 inch thick. Provide door and window trim in single lengths. Provide braced, blocked, and rigidly anchored cornices for support and protection of vertical joints. Install soffits in largest practical size. Joints of plywood shall occur over center lines of supports. Fasten soffits with aluminum or stainless steel nails. Back prime all concealed surfaces of exterior trim.

3.2 SOFFIT VENT INSTALLATION

Attach vents to the framing with screws. All vents shall be cut accurately and installed with tight, neat joints. All nailing flanges shall be covered with lath and all but joints shall be sealed. Use carbide tip blade along with lubricant when cutting aluminum trim.

-- End of Section --

SECTION 07 11 13

BITUMINOUS DAMPPROOFING
08/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D1187/D1187M	(1997; E 2011; R 2011) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM D1227	(1995; R 2007) Emulsified Asphalt Used as a Protective Coating for Roofing
ASTM D41/D41M	(2011) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D4263	(1983; R 2012) Indicating Moisture in Concrete by the Plastic Sheet Method

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates

Emulsion-Based Asphalt Dampproofing

1.3 DELIVERY AND STORAGE

Deliver materials in sealed containers bearing manufacturer's original labels. Labels shall include date of manufacture, contents of each container, performance standards that apply to the contents and recommended shelf life.

PART 2 PRODUCTS

2.1 ASPHALT PRIMER

ASTM D41/D41M.

2.2 EMULSION-BASED ASPHALT DAMPPROOFING

2.2.1 Fibrated Emulsion-Based Asphalt

Fibrated emulsion-based asphalt dampproofing shall be cold-applied type

conforming to ASTM D1227 Type II, Class 1, asbestos-free, manufactured of refined asphalt, emulsifiers and selected clay, fibrated with mineral fibers. For spray or brush application, emulsion shall contain a minimum of 59 percent solids by weight, 56 percent solids by volume. For trowel application, emulsion shall contain a minimum of 58 percent solids by weight, 55 percent solids by volume.

2.2.2 Non-Fibrated Emulsion-Based Asphalt

Non-fibrated emulsion-based asphalt dampproofing shall be cold-applied type conforming to ASTM D1187/D1187M Type II or ASTM D1227 Type III, manufactured of refined asphalt, emulsifiers and selected clay. Asphalt shall contain a minimum 58 percent solids by weight, 55 percent solids by volume.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean concrete and masonry surfaces to receive dampproofing of foreign matter and loose particles. Apply dampproofing to clean dry surfaces. Moisture test in accordance with ASTM D4263. If test indicates moisture, allow a minimum of 7 additional days after test completion for curing. If moisture still exists, redo test until substrate is dry.

3.1.1 Metal Surfaces

Metal surfaces shall be dry and be free of rust, scale, loose paint, oil, grease, dirt, frost and debris.

3.2 Protection of Surrounding Areas

Before starting the dampproofing work, the surrounding areas and surfaces shall be protected from spillage and migration of dampproofing material onto other work. Drains and conductors shall be protected from clogging with dampproofing material.

3.3 APPLICATION

Use either hot-application or cold-application method. Use cold-application method in confined spaces where hot bitumen would be hazardous. Prime surfaces to receive fibrous asphaltic dampproofing unless recommended otherwise by dampproofing materials manufacturer. Apply dampproofing after priming coat is dry, but prior to any deterioration of primed surface, and when ambient temperature is above 40 degrees F.

3.3.1 Surface Priming

Prime surfaces to receive asphalt or fibrous asphalt dampproofing with asphalt primer. Apply primer when ambient temperature is above 40 degrees F and at rate of approximately one gallon per 100 square feet, fully covering entire surface to be dampproofed.

3.3.2 Hot-Application Method

Apply two mop coats of hot coal-tar pitch or two mop coats of hot asphalt to surfaces. Apply mop coats uniformly using not less than 25 pounds of coal-tar pitch or 20 pounds of asphalt per 100 square feet for each coat. Do not heat asphalt above 450 degrees F. Do not heat coal tar pitch above

400 degrees F. Have kettlemen in attendance at all times during heating to ensure that maximum temperature specified is not exceeded. Apply hot asphalt bitumen or coal tar pitch and fully bond to primed surface. Provide finished surface that is smooth, lustrous, and impervious to moisture. Recoat dull or porous spots.

3.3.3 Cold-Application Method

3.3.3.1 Emulsion-Based Asphalt

Emulsion-based asphalt dampproofing work shall not be performed in temperatures below 40 degrees F. Emulsions shall have a smooth and uniform consistency at time of application. Dampproofing materials shall be applied in accordance with manufacturer's published instructions to produce a smooth uniform dry film of not less than 12 mils thick without voids or defects. Dull or porous spots shall be recoated. Dampproofing materials shall seal tightly around pipes and other items projecting through dampproofing. Rates of application shall be as follows:

a. Primer: 1/2 gallon per 100 square feet, cold-applied.

b. Fibrated Dampproofing: 2 gallons per 100 square feet, cold-applied with spray, brush or trowel.

c. Non-fibrated Dampproofing: 2 gallons per 100 square feet, cold-applied with spray, brush or trowel.

-- End of Section --

SECTION 07 14 00

FLUID-APPLIED WATERPROOFING
02/12

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C33/C33M	(2011a) Standard Specification for Concrete Aggregates
ASTM C321	(2012) Standard Test Method for Bond Strength of Chemical-Resistant Mortars
ASTM C578	(2011be1) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C836/C836M	(2012) High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use With Separate Wearing Course
ASTM D1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1751	(2004; R 2008) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2004a; R 2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fluid-applied membrane
Flexible Cement Waterproofing
Membrane primer
Elastomeric sheet

Flexible foam-backed elastomeric sheet
Solvent
Moisture meter
Protection board
Bond breaker

Submit material description and physical properties, application details, and recommendations regarding shelf life, application procedures, and precautions on flammability and toxicity.

SD-11 Closeout Submittals

Warranty
Information Card
Instructions To Government Personnel

Include copies of Material Safety Data Sheets for maintenance/repair materials.

1.3 PREWATERPROOFING CONFERENCE

Prior to starting application of waterproofing system, arrange and attend a prewaterproofing conference to ensure a clear understanding of drawings and specifications. Give the Contracting Officer 7 days advance written notice of the time and place of meeting. Ensure that the mechanical and electrical subcontractor, flashing and sheetmetal subcontractor, and other trades that may perform other types of work on or over the membrane after installation, attend this conference.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver waterproofing materials in manufacturer's original, unopened containers, with labels intact and legible. Containers of materials covered by a referenced specification number shall bear the specification number, type, and class of the contents. Deliver materials in sufficient quantity to continue work without interruption. Store and protect materials in accordance with manufacturer's instructions, and use within their indicated shelf life. When hazardous materials are involved, adhere to special precautions of the manufacturer, unless precautions conflict with local, state, and federal regulations. Promptly remove from the site materials or incomplete work adversely affected by exposure to moisture or freezing. Store materials on pallets and cover from top to bottom with canvas tarpaulins.

1.5 ENVIRONMENTAL CONDITIONS

Apply materials when ambient temperature is 40 degrees F or above for a period of 24 hours prior to the application and when there is no ice, frost, surface moisture, or visible dampness on the substrate surface. Apply materials when air temperature is expected to remain above 40 degrees F during the cure period recommended by the manufacturer. Moisture test for substrate is specified under paragraph entitled "Moisture Test." Work may be performed within heated enclosures, provided the surface temperature of the substrate is maintained at a minimum of 40 degrees F for 24 hours prior to the application of the waterproofing, and remains above that temperature during the cure period recommended by the manufacturer.

1.6 WARRANTY

Provide roof system material and workmanship warranties meeting specified requirements. Provide revisions or amendment to standard membrane manufacturer warranty to comply with the specified requirements. Minimum manufacturer warranty shall have no dollar limit, cover full system water-tightness, and shall have a minimum duration of 20 years.

1.6.1 Roof Membrane Manufacturer Warranty

Furnish the roof membrane manufacturer's 20-year no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation, and accessories necessary for a watertight roof system construction. Write the warranty directly to the Government commencing at time of Government's acceptance of the roof work. Provide the the following statements for such warranty:

a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, blisters, splits, tears, cracks, delaminates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship are the responsibility of the roof membrane manufacturer. All cost associated with the repair or replacement work are the responsibility of the roof membrane manufacturer.

b. The warranty must remain in full force and effect, including emergency temporary repairs performed by others, when the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification.

1.6.2 Roofing System Installer Warranty

The roof system installer must warrant for a minimum period of two years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Write the warranty directly to the Government. The roof system installer is responsible for correction of defective workmanship and replacement of damaged or affected materials. The roof system installer is responsible for all costs associated with the repair or replacement work.

1.6.3 Continuance of Warranty

Approve repair or replacement work that becomes necessary within the warranty period and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the roof membrane manufacturer warranty for the remainder of the manufacturer warranty period.

PART 2 PRODUCTS

2.1 FLUID-APPLIED MEMBRANE

2.1.1 Polyurethane Waterproofing

Two-component reinforced, unmodified polyurethane waterproofing; ASTM C836/C836M.

2.1.2 Polyester Waterproofing

Multicomponent, reinforced, unsaturated polyester waterproofing; ASTM C836/C836M.

2.1.3 Flexible Cement Waterproofing

Acrylic latex modified cement waterproofing for reflecting pool waterproofing. Provide cemetitious, two-component, acrylic emulsion based, highly flexible, crack bridging waterproof membrane barrier against positive water pressure, with the following characteristics:

a. Color: Black.

b. Shore A Hardness: Greater than 90.

c. Bond/Adhesion: 215 psi per ASTM C321.

d. Tear Resistance: 190 psi at 68 deg. F.

e. Elongation: 60 percent.

f. Elongation: 40 mils.

2.2 MEMBRANE PRIMER

As recommended by the fluid-applied membrane manufacturer unless specifically prohibited by the manufacturer of the fluid-applied membrane.

2.3 SEALANT

As specified in Section 07 92 00 JOINT SEALANTS.

2.4 SEALANT PRIMER

As specified in Section 07 92 00 JOINT SEALANTS.

2.5 BACKING MATERIAL

Premolded, closed-cell, polyethylene, or polyurethane foam rod having a diameter 25 percent larger than joint width before being compressed into joint. Provide bond breaker of polyethylene film or other suitable material between backing material and sealant.

2.6 JOINT FILLER

As specified in Section 03 30 00 CAST-IN-PLACE CONCRETE, ASTM D1751 or ASTM D1752.

2.7 BOND BREAKER

As recommended by the fluid-applied membrane manufacturer. Bond breaker shall not interfere with the curing process or other performance properties of the fluid-applied membrane.

2.8 ELASTOMERIC SHEET

Preformed; as recommended by the fluid-applied membrane manufacturer. Bond strength between the fluid-applied membrane and the preformed elastomeric sheet shall be a minimum of one psi when tested in accordance with ASTM C836/C836M.

2.9 ELASTOMERIC SHEET ADHESIVE

As recommended by the elastomeric sheet manufacturer.

2.10 FLEXIBLE FOAM-BACKED ELASTOMERIC SHEET

Flexible foam-backed elastomeric sheet for protection over preformed elastomeric sheet at expansion joints shall be 1/2 inch thick, minimum, closed cell foam conforming to ASTM D1056, Type 2, Class B, Grades 2 or 3, factory-bonded to 1/16 inch thick, minimum, preformed elastomeric sheet.

2.11 PROTECTION BOARD

Premolded bitumen composition board, 1/8 inch minimum thickness or other composition board compatible with the fluid-applied membrane.

2.12 DRAINAGE COURSE AGGREGATE

ASTM C33/C33M, size No. 8.

2.13 INSULATION

Polystyrene foam conforming to ASTM C578, Class IV, thickness as required by indicated R-value.

PART 3 EXECUTION

3.1 PREPARATION

Coordinate work with that of other trades to ensure that components to be incorporated into the waterproofing system are available when needed. Inspect and approve surfaces immediately before application of waterproofing materials. Remove laitance, loose aggregate, sharp projections, grease, oil, dirt, curing compounds, and other contaminants which could adversely affect the complete bonding of the fluid-applied membrane to the concrete surface.

3.1.1 Flashings

Make penetrations through sleeves in concrete slab watertight before application of waterproofing. After flashing is completed, cover elastomeric sheet with fluid-applied waterproofing during waterproofing application.

3.1.1.1 Drains

Make drain flanges flush with surface of structural slab. Apply a full elastomeric sheet around the drain, with edges fully adhered to drain flange and to structural slab. Do not adhere elastomeric sheet over joint between drain and concrete slab. Do not plug drainage or weep holes. Cover elastomeric sheet with fluid-applied waterproofing during waterproofing application. Lap elastomeric sheet a minimum of 4 inches onto concrete slab.

3.1.1.2 Penetrations and Projections

Flash penetrations and projections through structural slab with an elastomeric sheet adhered to the concrete slab and the penetration. Leave elastomeric sheet unadhered for one inch over joint between penetration and concrete slab. Adhere elastomeric sheet a minimum of 4 inches onto horizontal deck.

3.1.1.3 Walls and Vertical Surfaces

Flash wall intersections which are not of monolithic pour or constructed with reinforced concrete joints with an elastomeric sheet adhered to both vertical wall surfaces and concrete slab. Flash intersections which are monolithically poured or constructed with reinforced concrete joints with either an elastomeric sheet or a vertical grade of fluid-applied waterproofing adhered to vertical wall surfaces and concrete slab. Leave sheet unadhered for a distance of one inch from the corner on both vertical and horizontal surfaces.

3.1.2 Cracks and Joints

Prepare visible cracks and joints in substrate to receive fluid-applied waterproofing membrane by placing a bond breaker and an elastomeric slip sheet between membrane and substrate. Cracks that show movement shall receive a 2 inch bond breaker followed by an elastomeric sheet adhered to the deck. Nonmoving cracks shall be double coated with fluid-applied waterproofing.

3.1.3 Priming

Prime surfaces to receive fluid-applied waterproofing membrane. Apply primer as required by membrane manufacturer's printed instructions.

3.2 SPECIAL PRECAUTIONS

Protect waterproofing materials during transport and application. Do not dilute primers and other materials, unless specifically recommended by materials manufacturer. Keep containers closed except when removing contents. Do not mix remains of unlike materials. Thoroughly remove residual materials before using application equipment for mixing and transporting materials. Do not permit equipment on the project site that has residue of materials used on previous projects. Use cleaners only for cleaning, not for thinning primers or membrane materials. Ensure that workers and others who walk on cured membrane wear clean, soft-soled shoes to avoid damaging the waterproofing materials.

3.3 APPLICATION

Over primed surfaces, provide a uniform, wet, monolithic coating of

fluid-applied membrane, 60 mils thick, plus or minus 5 mils by following manufacturer's printed instructions. Apply material by trowel, squeegee, roller, brush, spray apparatus, or other method recommended by membrane manufacturer. Check wet film thickness as specified in paragraph entitled "Film Thickness" and adjust application rate as necessary to provide a uniform coating of the thickness specified. Where possible, mark off surface to be coated in equal units to facilitate proper coverage. At expansion joints, control joints, prepared cracks, flashing, and terminations, carry membrane over preformed elastomeric sheet in a uniform 60 mil thick, plus or minus 5 mils, wet thickness to provide a monolithic coating. If membrane cures before next application, wipe previously applied membrane with a solvent to remove dirt and dust that could inhibit adhesion of overlapping membrane coat. Use solvent recommended by the membrane manufacturer, as approved.

3.3.1 Work Sequence

Perform work so that protection board is installed prior to using the waterproofed surface. Do not permanently install protection board until the membrane has passed the flood test specified under paragraph entitled "Flood Test." Move material storage areas as work progresses to prevent abuse of membrane and overloading of structural deck.

3.3.2 Protection Board

Protect fluid-applied membrane by placing protection board over membrane at a time recommended by the membrane manufacturer. Protect membrane application when protection board is not placed immediately. Butt protection boards together and do not overlap.

3.3.3 Drainage Course

Place drainage course where shown after flood tests are completed and concrete protection slab or wearing course is ready to be installed.

3.3.4 Insulation

Place insulation of thickness indicated, on top of drainage course just prior to placement of concrete protection slab.

3.4 FIELD QUALITY CONTROL

3.4.1 Moisture Test

Prior to application of fluid-applied waterproofing, measure moisture content of substrate with a moisture meter in the presence of the Contracting Officer. An acceptable device is the Delmhorst Moisture Meter, Model BD7/2E/CS, Type 21 E. Similar meters by other manufacturers, which are suitable for the purpose, may be used as approved by the Contracting Officer. Do not begin application until meter reading indicates "dry" range.

3.4.2 Film Thickness

Measure wet film thickness every 100 square feetduring application by placing flat metal plates on the substrate or using a mil-thickness gage especially manufactured for the purpose.

3.4.3 Flood Test

After application and curing is complete, plug drains and fill waterproofed area with water to a depth of 2 inches. A minimum 48 hour cure time, or longer cure time if recommended by the membrane manufacturer, shall be required prior to flood testing. Allow water to stand 24 hours. Test watertightness by measuring water level at beginning and end of the 24 hour period. If water level falls, drain water, allow installation to dry, and inspect. Make repairs or replace as required and repeat the test. Work shall not proceed before approval of repairs or replacement.

3.5 INSTRUCTIONS TO GOVERNMENT PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the roof membrane manufacturer and include a minimum of 4 hours on maintenance and emergency repair of the membrane. Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations.

3.6 INFORMATION CARD

For each roof application, furnish a minimum 8-1/2 inch by 11 inch information card for facility records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 0.032 inch thick aluminum card for exterior display. Identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarder; date of completion; installing contractor identification and contract information; membrane manufacturer warranty expiration, warranty reference number, and contact information. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

FORM 1
FLUID-APPLIED WATERPROOFING SYSTEM COMPONENTS
1. Contract Number
2. Date Work Completed
3. Project Specification Designation
4. Substrate Material
5. Slope of Substrate
6. Drains Type/Manufacturer
7. Waterproofing
a. Membrane
b. Sealant
c. Elastomeric Sheet
d. Materials Manufacturer(s)
8. Protection Board
a. Type
b. Thickness
c. Manufacturer's Name
9. Drainage Course Material Graduation
10. Insulation
a. Type
b. Thickness
c. Manufacturer's Name
11. Protection Slab
a. Material
b. Thickness
c. Support
d. Joint System

FORM 1	
FLUID-APPLIED WATERPROOFING SYSTEM COMPONENTS	
12. Wearing Course	
a. Type	
b. Slope	
c. Joint System	
d. Sealant/Gasket Type	
13. Wearing Surface Type	
Manufacturer's Name	
14. Warranty	
a. Manufacturer warranty expiration	
b. Warranty reference number	
15. Statement of Compliance or Exception	
Contractor's Signature	Date Signed
Inspector's Signature	Date Signed

-- End of Section --

SECTION 07 21 00

THERMAL INSULATION
01/13

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C203	(2005a; R 2012) Breaking Load and Flexural Properties of Block-Type Thermal Insulation
ASTM C272/C272M	(2012) Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions
ASTM C578	(2011be1) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C930	(2005) Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM D1621	(2010) Compressive Properties of Rigid Cellular Plastics
ASTM E136	(2011) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
ASTM E84	(2012a) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	(2010) Standard Test Methods for Water Vapor Transmission of Materials

GREENGUARD ENVIRONMENTAL INSTITUTE (GEI)

GEI	Greenguard Standards for Low Emitting Products

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.134 Respiratory Protection

1.2 SEQUENCING AND SCHEDULING

Specification subparagraph text.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Board insulation
Sprayed insulation
adhesive
mechanical fasteners

SD-07 Certificates

Board Insulation
Sprayed insulation
Adhesive

1.4 SUSTAINABLE DESIGN CERTIFICATION

Product shall be third party certified by GEI Greenguard Indoor Air Quality Certified, SCS Scientific Certification Systems Indoor Advantage or equal. Certification shall be performed annually and shall be current.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials to the site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.5.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

1.6 SAFETY PRECAUTIONS

1.6.1 Respirators

If recommended by insulation manufacturer, provide installers with dust/mist respirators, training in their use, and protective clothing, all

approved by National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) in accordance with 29 CFR 1910.134.

1.6.2 Other Safety Considerations

Consider safety concerns and measures as outlined in ASTM C930.

1.6.3 Qualifications

Installer of sprayed insulation must have been trained by manufacturer of the sprayed insulation in its safe processing and installation, including disposal of waste material.

PART 2 PRODUCTS

2.1 BOARD INSULATION

Provide only thermal insulating materials recommended by manufacturer for type of application indicated. Provide board or block thermal insulation conforming to the following standards and the physical properties listed below:

a. Extruded Preformed Cellular Polystyrene: ASTM C578

2.1.1 Thermal Resistance

Slab Edge R-7.5.

2.1.2 Fire Protection Requirement

a. Flame spread index of 25 or less when tested in accordance with ASTM E84.

b. Smoke developed index of 450 or less when tested in accordance with ASTM E84.

2.1.3 Other Material Properties

Provide thermal insulating materials with the following properties:

a. Rigid cellular plastics: Compressive Resistance at Yield: Not less than 40 pounds per square inch (psi) when measured according to ASTM D1621.

b. Flexural strength: Not less than 60 psi when measured according to ASTM C203.

c. Water Vapor Permeance: Not more than 1.0 Perms or less when measured according to ASTM E96/E96M, desiccant method, in the thickness required to provide the specified thermal resistance, including facings, if any.

d. Water Absorption: Not more than 0.3 percent by total immersion, by volume, when measured according to ASTM C272/C272M.

2.1.4 Prohibited Materials

Do not provide materials containing asbestos.

2.2 SPRAYED INSULATION

2.2.1 Closed-Cell Polyurethane Foam Insulation

ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

Minimum density of 2.0 lb/cu. ft. per ASTM D1622, thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F per ASTM C518.

Compressive strength: Minimum 24 psi per ASTM D1621.

Tensile strength: Minimum 28 psi per ASTM D1623, Type C.

Closed cell content: Greater than 90 percent per ASTM D6226.

Dimensional stability (percent volume change): plus 6 to plus 11 percent when dry aged at 158 deg F for 28 days, per ASTM D2126.

2.2.2 Blowing Agent

Provide two-component system. Use only blowing agents that have zero ozone-depleting potential and do not exceed carbon dioxide in greenhouse gas potential.

2.3 ACCESSORIES

2.3.1 Adhesive

As recommended by insulation manufacturer.

2.3.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, ensure that all areas that will be in contact with the insulation are dry and free of projections which could cause voids. If installing perimeter or under slab insulation, check that the fill is flat, smooth, dry, and well tamped. If moisture or other conditions are found that do not allow the proper installation of the insulation, do not proceed but notify the Contracting Officer of such conditions.

3.2 PREPARATION

3.2.1 Blocking Around Heat Producing Devices

Unless using insulation board that passes ASTM E136 in addition to the requirements in Part 2, install non-combustible blocking around heat producing devices to provide the following clearances:

a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless certified for installation surrounded by insulation: 3 inches from outside face of fixtures and devices or as required by NFPA 70and, if insulation is to be placed above fixture or device, 24 inches above fixture.

3.3 INSTALLATION

3.3.1 Insulation Board

Install and handle insulation in accordance with the manufacturer's installation instructions. Keep material dry and free of extraneous materials. Observe safe work practices.

3.3.2 Continuity of Insulation

Butt tightly against adjoining boards. Provide continuity and integrity of insulation at corners. Avoid creating any thermal bridges or voids.

3.4 INSTALLATION OF SPRAYED INSULATION ON WALLS

3.4.1 Installation on Concrete Walls and Roof Slabs

Apply sprayed insulation directly to concrete walls and roof slabs, using application equipment supplied or recommended by manufacturer. Do not apply more than the manufacturer's recommended maximum thickness. If design requires additional thickness, allow first layer to cure as recommended prior to adding second layer.

Properly dispose of waste material as recommended by manufacturer to avoid creating fire hazard.

3.5 PERIMETER SLAB INSULATION

Install perimeter thermal insulation where heated spaces are adjacent to exterior walls or slab edges in slab-on-grade construction.

3.5.1 Manufacturer's Instructions

Install, attach, and tape edges as recommended in manufacturer's instructions.

3.5.2 Insulation on Vertical Surfaces

Install thermal insulation on edges of slabs on grade. Fasten insulation with adhesive or mechanical fasteners.

-- End of Section --

SECTION 07 92 00

JOINT SEALANTS
01/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C1311	(2010) Standard Specification for Solvent Release Agents
ASTM C509	(2006; R 2011) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C834	(2010) Latex Sealants
ASTM C920	(2011) Standard Specification for Elastomeric Joint Sealants
ASTM D1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1667	(2005; R 2011) Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sealants
Primers
Bond breakers
Backstops

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). Provide a copy of the Material Safety Data Sheet for each solvent, primer or sealant material.

SD-07 Certificates

Sealant

Certificates of compliance stating that the materials conform to

the specified requirements.

1.3 ENVIRONMENTAL CONDITIONS

Apply sealant when the ambient temperature is between 40 and 90 degrees F.

1.4 DELIVERY AND STORAGE

Deliver materials to the job site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, color, and material designation clearly marked thereon. Label elastomeric sealant containers to identify type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 90 degrees F or less than 0 degrees F.

1.5 QUALITY ASSURANCE

1.5.1 Compatibility with Substrate

Verify that each of the sealants are compatible for use with joint substrates.

1.5.2 Joint Tolerance

Provide joint tolerances in accordance with manufacturer's printed instructions.

1.5.3 Mock-Up

Project personnel is responsible for installing sealants in mock-up, using materials and techniques approved for use on the project.

1.6 SPECIAL WARRANTY

Guarantee sealant joint against failure of sealant and against water penetration through each sealed joint for five years.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it will be applied.

2.1.1 Interior Sealant

Provide ASTM C834 and ASTM C920, Type S, Grade NS, Class 50, Use NT. Locations and colors of sealant for the following:

LOCATION	COLOR
a. Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface-mounted equipment and fixtures, and similar items.	Latex, paintable

LOCATION	COLOR
b. Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	Latex, paintable
c. Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.	Latex, paintable
d. Joints between edge members for acoustical tile and adjoining vertical surfaces.	Latex, paintable
e. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	Latex, paintable
f. Joints between bathtubs and ceramic tile; joints between shower receptors and ceramic tile; joints formed where nonplaner tile surfaces meet.	Sanitary mildew-resistar silicone, white
g. Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change.	Sanitary mildew-resistar silicone, white
h. Behind escutcheon plates at valve pipe penetrations and showerheads in showers.	Sanitary mildew-resistar white

2.1.2 Exterior Sealant

For joints in vertical surfaces, provide ASTM C920, Type S or M, Grade NS, Class 50, Use NT. For joints in horizontal surfaces, provide ASTM C920, Type S or M, Grade P, Class 25, Use T. Sealants must be nonstaining to porous substrates in accordance with ASTM C-1248. Custom colors are required. Sealants for joints in vertical surfaces require grout-like texture. Provide locations and colors of sealant as follows:

LOCATION	COLOR
a. Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	Silicone; m atch adjacent surface color

LOCATION	COLOR
b. Joints between new and existing exterior concrete walls.	Silicone; match adjacent surface color
c. Concrete joints.	Silicone; match adjacent surface color
d. Joints in wash surfaces of stonework.	Silicone; match adjacent surface color
e. Expansion and control joints.	Silicone; match adjacent surface color
f. Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.	Silicone; match adjacent surface color
g. Voids where items pass through exterior walls.	Silicone; match adjacent surface color
h. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.	Silicone; match adjacent surface color
i. Metal-to-metal joints where sealant is indicated or specified.	Silicone; match adjacent surface color
j. Joints between ends of gravel stops, fascias, copings, and adjacent walls.	Silicone;match adjacent surface color

2.1.3 Floor Joint Sealant

ASTM C920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows:

LOCATION	COLOR
a. Seats of metal thresholds for exterior doors.	Silicone; match adjacent surface color

LOCATION	COLOR
b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.	Silicone; match adjacent surface color

2.1.4 Preformed Sealant

Provide preformed sealant of polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealant capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 30 to plus 160 degrees F, the sealant must be non-bleeding and no loss of adhesion.

2.1.4.1 Foam Strip

Provide foam strip of polyurethane foam; with cross-section dimensions indicated on Drawings or verified in the field. Provide foam strip capable of sealing out moisture, air, and dust when installed and compressed as recommended by the manufacturer. Service temperature must beminus 40 to plus 275 degrees F. Furnish untreated strips with adhesive to hold them in place. Do not allow adhesive to stain or bleed into adjacent finishes. Saturate treated strips with butylene waterproofing or impregnated with asphalt.

2.2 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

2.3 BOND BREAKERS

Provide the type and consistency recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.4 BACKSTOPS

Provide glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized backing for closed cell and 40 to 50 percent oversized backing for open cell material, unless otherwise indicated. Make backstop material compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

2.4.1 PVC

Conform to ASTM D1667, Grade VO 12, open-cell foam, round cross section for Polyvinyl chloride (PVC) backing.

2.4.2 Synthetic Rubber

Conform to ASTM C509, Option I, Type I preformed rods or tubes for Synthetic rubber backing.

2.4.3 Neoprene

Conform to ASTM D1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2 for Neoprene backing.

2.4.4 Butyl Rubber Based

Provide Butyl Rubber Based Sealants of single component, solvent release, conforming to ASTM C1311.

2.4.5 Silicone Rubber Base

Provide Silicone Rubber Based Sealants of single or multiple component, custom colors, conforming to ASTM C920, Non-sag and self-leveling, Types, Grades, and Classes as indicated. Comply with local VOC requirements for all sealants.

2.5 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean surfaces from dirt frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Remove oil and grease with solvent. Surfaces must be wiped dry with clean cloths. When resealing an existing joint, remove existing sealant prior to applying new sealant. For surface types not listed below, contact sealant manufacturer for specific recommendations.

3.1.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue-free solvent.

3.1.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. For removing protective coatings and final cleaning, use nonstaining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.1.3 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing. Remove laitance, efflorescence and loose mortar from the joint cavity.

3.1.4 Wood Surfaces

Keep wood surfaces to be in contact with sealants free of splinters and sawdust or other loose particles.

3.2 SEALANT PREPARATION

Do not add liquids, solvents, or powders to the sealant. Mix multicomponent elastomeric sealants in accordance with manufacturer's instructions.

3.3 APPLICATION

3.3.1 Joint Width-To-Depth Ratios

a. Acceptable Ratios:

JOINT WIDTH	JOINT DEPTH	
	Minimum	Maximum
For metal, glass, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For wood, concrete, masonry, or stone:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
over 1/2 inch to 2 inch	1/2 inch	5/8 inch
Over 2 inch	As recommended by sealant manufacturer	

b. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding is not required on metal surfaces.

3.3.2 Masking Tape

Place masking tape on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Remove masking tape within 10 minutes after joint has been filled and tooled.

3.3.3 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

a. Where indicated.

b. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios".

3.3.4 Primer

Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

3.3.5 Bond Breaker

Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

3.3.6 Sealants

Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Make sealant uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified. Apply sealer over the sealant when and as specified by the sealant manufacturer.

3.4 PROTECTION AND CLEANING

3.4.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

3.4.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

a. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.

b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent-moistened cloth.

-- End of Section --

SECTION 08 11 13

STEEL DOORS AND FRAMES
02/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010; Errata 2010) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M	(2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A879/A879M	(2012) Standard Specification for Steel Sheet, zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
ASTM A924/A924M	(2010a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C612	(2010) Mineral Fiber Block and Board Thermal Insulation

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.115	(2006) Hardware Preparation in Steel Doors and Steel Frames

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR 111	(2009) Recommended Selection and Usage Guide for Standard Steel Doors, Frames and Accessories
SDI/DOOR 113	(2001; R2006) Standard Practice for Determining the Steady State Thermal Transmittance of Steel Door and Frame Assemblies
SDI/DOOR A250.11	(2001) Recommended Erection Instructions for Steel Frames
SDI/DOOR A250.6	(2003; R2009) Recommended Practice for

	Hardware Reinforcing on Standard Steel Doors and Frames
SDI/DOOR A250.8	(2003; R2008) Recommended Specifications for Standard Steel Doors and Frames

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors; G, AE
Frames; G, AE

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of doors; G, AE
Schedule of frames; G, AE

Submit door and frame locations.

SD-03 Product Data

Doors; G, AE
Frames; G, AE

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to SDI/DOOR A250.8 requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

SDI/DOOR A250.8, except as specified otherwise. Prepare doors to receive door hardware as specified in Section 08 71 00. Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 1-3/4 inch thick, unless otherwise indicated.

2.1.1 Classification - Level, Performance, Model

2.1.1.1 Extra Heavy Duty Doors

SDI/DOOR A250.8, Level 3, physical performance Level A, Model 2 with core construction as required by the manufacturer for indicated exterior doors, of size(s) and design(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners shall be filled with mineral board insulation..

2.2 INSULATION CORES

Insulated cores shall be of type specified, and provide an apparent U-factor of .48 in accordance with SDI/DOOR 113 and shall conform to:

a. Mineral board: ASTM C612, Type I.

2.3 STANDARD STEEL FRAMES

SDI/DOOR A250.8, Level 4, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors unless otherwise indicated.

2.3.1 Welded Frames

Continuously weld frame faces at corner joints. Continuously weld stops and rabbets. Grind welds smooth.

Weld frames in accordance with the recommended practice of the Structural Welding Code Sections 1 through 6, AWS D1.1/D1.1M and in accordance with the practice specified by the producer of the metal being welded.

2.3.2 Stops and Beads

Form stops and beads from 20 gage steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inch on center. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.3.3 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated, not lighter than 18 gage.

2.3.3.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

a. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI/DOOR 111; and

2.3.3.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each

jamb member.

2.4 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in SDI/DOOR A250.6. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI/DOOR A250.8 and SDI/DOOR A250.6. For additional requirements refer to ANSI/BHMA A156.115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of SDI/DOOR A250.8, as applicable. Punch door frames, with the exception of frames that will have weatherstripping gasketing, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.5 FINISHES

2.5.1 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A924/A924Mand ASTM A653/A653M. The coating weight shall meet or exceed the minimum requirements for coatings having 0.4 ounces per square foot, total both sides, i.e., A40. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in SDI/DOOR A250.8.

2.5.2 Electrolytic Zinc-Coated Anchors and Accessories

Provide electrolytically deposited zinc-coated steel in accordance with ASTM A879/A879M, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces as specified in SDI/DOOR A250.8.

2.6 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. Design frames in exposed concrete walls or partitions to allow sufficient space between the inside back of trim and concrete to receive caulking compound.

2.6.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI/DOOR A250.11. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. Backfill frames with mortar. Coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

3.1.2 Doors

Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection and glazing, clean and adjust hardware.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

-- End of Section --

SECTION 08 71 00

DOOR HARDWARE
08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E283	(2004; R 2012) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1	(2006) Butts and Hinges
ANSI/BHMA A156.13	(2012) Mortise Locks & Latches Series 1000
ANSI/BHMA A156.18	(2006) Materials and Finishes
ANSI/BHMA A156.21	(2009) Thresholds
ANSI/BHMA A156.4	(2008) Door Controls - Closers
ANSI/BHMA A156.6	(2010) Architectural Door Trim
ANSI/BHMA A156.7	(2003; R 2009) Template Hinge Dimensions
BHMA A156.22	(2011) Door Gasketing and Edge Seal Systems

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR A250.8	(2003; R2008) Recommended Specifications for Standard Steel Doors and Frames

1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-02 Shop Drawings

Hardware schedule; G
Keying system; G

SD-03 Product Data

Hardware items; G, AE

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package 1; G, AE

Submit data package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.3 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publi-cation Type No.	Finish	Mfr Name and Catalog No.	Key Control Symbols	UL Mark (If fire rated and listed	BHMA Finish Desig-nation

1.4 QUALITY ASSURANCE

1.4.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.4.2 Key Shop Drawings Coordination Meeting

Prior to the submission of the key shop drawing, the Contracting Officer, Contractor, Door Hardware subcontractor, using Activity and Base Locksmith shall meet to discuss key requirements for the facility.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Deliver permanent keys and removable cores to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Provide hardware to be applied to metal manufactured to template. Promptly furnish template information or templates to door and frame manufacturers. Conform to ANSI/BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE ITEMS

Clearly and permanently mark with the manufacturer's name or trademark, hinges, pivots, locks, latches, exit devices, bolts and closers where the identifying mark will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

2.2.1 Hinges

ANSI/BHMA A156.1, 5 by 5 inch by 0.180 inch thick unless otherwise indicated. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed. Other antifriction bearing hinges may be provided in lieu of ball-bearing hinges.

2.2.1.1 Protection Devices

Provide full height hand and finger protection device at the hinge-side area opening of doors and gates. Hinge-side protection device shall be provided on both sides of the doors and gates, covering hinges and space between door and frame when doors are in the open position. The installed device shall push hand and/or fingers out of the opening and away from a crushing hazard.

2.2.2 Locks and Latches

2.2.2.1 Mortise Locks and Latches

ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 1. Provide mortise locks with escutcheons not less than 7 by 2-1/4 inch with a bushing at least 1/4 inch long. Cut escutcheons to suit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Install knobs and roses of mortise locks with screwless shanks and no exposed screws.

2.2.3 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Provide cylinders and cores with six pin tumblers. Provide cylinders from products of one manufacturer, and provide cores from the products of one manufacturer.

2.2.4 Keying System

Provide a master keying system. Provide construction interchangeable cores.

2.2.5 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.2.5.1 Lever Handles

Provide lever handles in lieu of knobs. Conform to the minimum requirements of ANSI/BHMA A156.13 for mortise locks of lever handles for exit devices. Provide lever handle locks with a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when force in excess of that specified in ANSI/BHMA A156.13 is applied to the lever handle. Provide lever handles return to within 1/2 inch of the door face.

2.2.6 Keys

Furnish one file key, one duplicate key, and one working key for each key change and for each master keying system. Furnish one additional working key for each lock of each keyed-alike group. Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Do not place room number on keys.

2.2.7 Closers

ANSI/BHMA A156.4, Series C02000, Grade 1, with PT 4C, powder coat finish, cushion stop, vandal-resistant drop forged arm, and no hold-open function. Provide with brackets, arms, mounting devices, fasteners, full size covers, and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

2.2.7.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.

2.2.8 Door Protection Plates

ANSI/BHMA A156.6.

2.2.8.1 Sizes of Kick Plates

2 inch less than door width for single doors; one inch less than door width for pairs of doors. Provide 12 inch kick plates for flush doors.

2.2.9 Thresholds

ANSI/BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

2.2.10 Weather Stripping Gasketing

BHMA A156.22. Provide the type and function designation where specified in paragraph entitled "Hardware Schedule". Provide a set to include head and jamb seals and sweep strips. Air leakage of weather stripped doors not to exceed 0.5 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E283. Provide weather stripping with one of the following:

2.2.10.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 0.050 inch wall thickness with neoprene, silicone rubber, or polyurethane inserts. Provide bronze anodized aluminum.

2.2.10.2 Interlocking Type

Zinc or bronze not less than 0.018 inch thick.

2.2.10.3 Spring Tension Type

Spring bronze or stainless steel not less than 0.008 inch thick.

2.2.11 Rain Drips

Extruded aluminum, not less than 0.08 inch thick, bronze anodized. Set drips in sealant and fasten with stainless steel screws.

2.2.11.1 Overhead Rain Drips

Approximately 1-1/2 inch high by 2-1/2 inch projection, with length equal to overall width of door frame. Align bottom with door frame rabbet.

2.2.12 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.3 FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Provide stainless steel or nonferrous metal fasteners that are exposed to weather. Provide fasteners of type necessary to accomplish a permanent installation.

2.4 FINISHES

ANSI/BHMA A156.18. Provide hardware in BHMA 630 finish (satin stainless steel), unless specified otherwise.Provide mortise sets in BHMA 613 finish (dark oxidized bronze. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except aluminum paint finish for surface door closers. Provide hinges for exterior doors in stainless steel with BHMA 630 finish. Match exposed parts of concealed closers to lock and door trim.

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed installation instructions. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weather Stripping Installation

Handle and install weather stripping to prevent damage. Provide full contact, weather-tight seals. Operate doors without binding.

3.1.1.1 Stop-Applied Weather Stripping

Fasten in place with color-matched sheet metal screws not more than 9 inch on center after doors and frames have been finish painted.

3.1.1.2 Interlocking Type Weather Stripping

Provide interlocking, self-adjusting type on heads and jambs and flexible hook type at sills. Nail weather stripping to door 1 inch on center and to

heads and jambs at 4 inch on center

3.1.1.3 Spring Tension Type Weather Stripping

Provide spring tension type on heads and jambs. Provide bronze nails with bronze, stainless steel nails with stainless steel. Space nails not more than 1-1/2 inch on center.

3.1.2 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves.

3.2 HARDWARE LOCATIONS

SDI/DOOR A250.8, unless indicated or specified otherwise.

a. Kick Plates: Push side of single-acting doors.

3.3 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

-- End of Section --

SECTION 08 91 00

METAL WALL LOUVERS
05/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 500-D	(2012) Laboratory Methods of Testing Dampers for Rating
AMCA 511	(2010) Certified Ratings Program for Air Control Devices

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2605	(2005) Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels

ASTM INTERNATIONAL (ASTM)

ASTM B209	(2010) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2012) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Wall louvers
line voltage control

SD-03 Product Data

Metal Wall Louvers

SD-04 Samples

Colors of finishes; G, AE

1.3 DELIVERY, STORAGE, AND PROTECTION

Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Louvers shall be free from nicks, scratches, and blemishes. Replace defective or damaged materials with new.

1.4 DETAIL DRAWINGS

Show all information necessary for fabrication and installation of wall louvers. Indicate materials, sizes, thicknesses, fastenings, and profiles.

1.5 COLOR SAMPLES

Colors of finishes for wall louvers shall closely approximate colors indicated. Where color is not indicated, submit the manufacturer's standard colors to the Contracting Officer for selection.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum Sheet

ASTM B209, alloy 3003 or 5005 with temper as required for forming.

2.1.2 Extruded Aluminum

ASTM B221, alloy 6063-T5 or -T52.

2.2 METAL WALL LOUVERS

Weather resistant type, with bird screens and made to withstand a wind load of not less than 30 pounds per square foot. Wall louvers shall bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-D and AMCA 511. The rating shall show a water penetration of 0.20 or less ounce per square foot of free area at a free velocity of 800 feet per minute.

2.2.1 Extruded Aluminum Louvers

Fabricated of extruded 6063-T5 or -T52 aluminum with a wall thickness of not less than 0.063 inch.

2.2.2 Mullions and Mullion Covers

Same material and finish as louvers. Provide mullions where indicated Provide mullions covers on both faces of joints between louvers.

2.2.3 Screens and Frames

For aluminum louvers, provide 1/2 inch square mesh, 14 or 16 gage aluminum or 1/4 inch square mesh, 16 gage aluminum bird screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

2.3 CONTROLS

Provide line voltage control, voltage range 120 to 277 VAC. Stainless steel sensing elements for corrosive conditions; NEMA 4X enclosure suitable for

locations that are wet or mildly corrosive with high humidity or airborne contaminants.

a. Switch Type: SPDT.

b. Switch Action: Open/Close on rise.

c. Control Range: 40 to 110 degrees F.

d. Sensor Type: Stainless Steel, hydraulic cap.

e. Display: Analog.

f. Compliance with UL and NEC.

2.4 FASTENERS AND ACCESSORIES

Provide stainless steel screws and fasteners for aluminum louvers. Provide other accessories as required for complete and proper installation.

2.5 FINISHES

2.5.1 Aluminum

Exposed aluminum surfaces shall be factory finished with an organic coating. Louvers shall have the same finish.

2.5.1.1 Organic Coating

Clean and prime exposed aluminum surfaces. Provide a high-performance finish in accordance with AAMA 2605 with total dry film thickness of not less than 1.2 mil, color as selected by Contracting Officer from manufacturer's full range.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wall Louvers

Install using stops or moldings, flanges, strap anchors, or jamb fasteners as appropriate for the wall construction and in accordance with manufacturer's recommendations.

3.1.2 Screens and Frames

Attach frames to louvers with screws or bolts.

3.2 PROTECTION FROM CONTACT OF DISSIMILAR MATERIALS

3.2.1 Aluminum

Where aluminum contacts metal other than zinc, paint the dissimilar metal with a primer and two coats of aluminum paint.

3.2.2 Metal

Paint metal in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

-- End of Section --

SECTION 09 22 00

SUPPORTS FOR PLASTER AND GYPSUM BOARD
02/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 341	(2010) Seismic Provisions for Structural Steel Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A463/A463M	(2010) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A653/A653M	(2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C645	(2011a) Nonstructural Steel Framing Members
ASTM C754	(2011) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Metal support systems; G

Submit for the erection of metal framing and ceiling suspension systems. Indicate materials, sizes, thicknesses, and fastenings.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the job site and store in ventilated dry locations. Storage area shall permit easy access for inspection and handling. If materials are stored outdoors, stack materials off the ground, supported on a level platform, and fully protected from the weather. Handle materials carefully to prevent damage. Remove damaged items and provide new items.

PART 2 PRODUCTS

2.1 MATERIALS

Provide steel materials for metal support systems with galvanized coating ASTM A653/A653M, G-60; aluminum coating ASTM A463/A463M, T1-25; or a 55-percent aluminum-zinc coating. Provide support systems and attachments per AISC 341 in seismic zones.

2.1.1 Materials for Attachment of Gypsum Wallboard

2.1.1.1 Self-supporting Ceiling Systems

ASTM C645.

2.1.1.2 Nonload-Bearing Wall Framing

ASTM C645, but not thinner than 0.0179 inch thickness, with 0.0329 inch minimum thickness supporting wall hung items such as cabinetwork, equipment and fixtures.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Systems for Attachment of Gypsum Wallboard

3.1.1.1 Self-supporting Ceiling Systems

ASTM C754, except provide framing members 16 inches o.c. unless indicated otherwise.

3.1.1.2 Non-loadbearing Wall Framing

ASTM C754, except as indicated otherwise.

3.2 ERECTION TOLERANCES

Provide framing members that will be covered by finish materials, such as wallboard or ceramic tile set in a mortar setting bed, within the following limits:

a. Layout of walls and partitions: 1/4 inch from intended position;

b. Plates and runners: 1/4 inch in 8 feet from a straight line;

c. Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and

d. Face of framing members: 1/4 inch in 8 feet from a true plane.

Provide framing members that will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive within the following limits:

a. Layout of walls and partitions: 1/4 inch from intended position;

b. Plates and runners: 1/8 inch in 8 feet from a straight line;

c. Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and

d. Face of framing members: 1/8 inch in 8 feet from a true plane.

-- End of Section --

SECTION 09 29 00

GYPSUM BOARD
05/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.11	(1992; Reaffirmed 2005) Specifications for Interior Installation of Cementitious Backer Units

ASTM INTERNATIONAL (ASTM)

ASTM C1002	(2007) Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
ASTM C1047	(2010a) Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C1396/C1396M	(2011) Standard Specification for Gypsum Board
ASTM C1629/C1629M	(2006; R 2011) Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels
ASTM C475/C475M	(2002; R 2007) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C840	(2011) Application and Finishing of Gypsum Board
ASTM C954	(2011) Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
ASTM D1037	(2012) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM D226/D226M	(2009) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

ASTM D2394	(2005; R 2011) Simulated Service Testing of Wood and Wood-Base Finish Flooring
ASTM D5420	(2010) Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Strike Impacted by a Falling Weight (Gardner Impact)
ASTM E695	(2003; R 2009) Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading
ASTM E84	(2012a) Standard Test Method for Surface Burning Characteristics of Building Materials

GYPSUM ASSOCIATION (GA)

GA 214	(2010) Recommended Levels of Gypsum Board Finish
GA 216	(2010) Application and Finishing of Gypsum Panel Products

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Cementitious backer units
Impact Resistant Gypsum Board
Joint Treatment Materials
Accessories

Submit for each type of gypsum board and for cementitious backer units.

SD-07 Certificates

Asbestos Free Materials; G

Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.3.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation. Store per manufacturer's recommendations for allowable temperature and humidity range. Do not store panels near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.3.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.4 ENVIRONMENTAL CONDITIONS

1.4.1 Temperature

Maintain a uniform temperature of not less than 50 degrees F in the structure for at least 48 hours prior to, during, and following the application of gypsum board, cementitious backer units, and joint treatment materials, or the bonding of adhesives.

1.4.2 Exposure to Weather

Protect gypsum board and cementitious backer unit products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

1.5 QUALIFICATIONS

Furnish type of gypsum board work specialized by the installer with a minimum of 3 years of documented successful experience.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to specifications, standards and requirements specified. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only.

2.1.1 Gypsum Board

ASTM C1396/C1396M. Paper facings shall contain 100 percent post-consumer recycled paper content. Gypsum cores shall contain a minimum of 95 percent post-industrial recycled gypsum content.

2.1.2 Impact Resistant Gypsum Board

48 inchwide, 5/8 inch thick, tapered edges.
Reinforced gypsum panel with imbedded fiber mesh or lexan backing testing in accordance with the following tests. Hard body impact test must attain a Level 2 performance in accordance with ASTM C1629/C1629M. Provide fasteners that meet manufacturer requirements and specifications stated within this section. Impact resistant gypsum board, when tested in accordance with ASTM E84, have a flame spread rating of 25 or less and a smoke developed rating of 50 or less.

2.1.2.1 Structural Failure Test

ASTM E695 or ASTM D2394 for structural failure (drop penetration). ASTM E695 using a 60 lb sand filled leather bag, resisting no less than 300 ft. lb. cumulative impact energy before failure or ASTM D2394 using 5.5 inch hemispherical projectile resisting no less than 264 ft. lb. before failure. Provide test specimen stud spacing a minimum 16 inch on center.

2.1.2.2 Indentation Test

ASTM D5420 or ASTM D1037 for indentation resistance. ASTM D5420 using a 32 oz weight with a 5/8 inch hemispherical impacting head dropped once 3 feet creating not more than 0.137 inch indentation or ASTM D1037 using no less than 470 lb weight applied to the 0.438 inch diameter ball to create not more than a 0.0197 inch indentation depth.

2.1.3 Cementitious Backer Units

In accordance with the Tile Council of America (TCA) Handbook.

2.1.4 Joint Treatment Materials

ASTM C475/C475M. Provide materials specifically recommended by manufacturers of cement board and abuse-resistant board.

2.1.4.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.4.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.4.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.4.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.4.5 Joint Tape

Use cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.5 Fasteners

2.1.5.1 Screws

ASTM C1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board and steel framing members less than 0.033 inch thick. ASTM C954 steel drill screws for fastening gypsum board to steel framing members 0.033 to 0.112 inch thick. Provide cementitious backer unit screws with a polymer coating.

2.1.6 Accessories

ASTM C1047. Fabricate from corrosion protected steel or plastic designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges shall be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide prefinished materials.

2.1.7 Asphalt Impregnated Building Felt

Provide a 15 lb asphalt moisture barrier over gypsum sheathing. Conforming to ASTM D226/D226M Type 1 (No. 15) for asphalt impregnated building felt.

2.1.8 Water

Provide clean, fresh, and potable water.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board and cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive grab bars and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board and cementitious backer units.

3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing and furring members in accordance with ASTM C840 or GA 216 and the requirements specified. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length; select panel sizes to minimize waste. Cut out gypsum board to make neat, close, and tight joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Lay out panels to minimize waste; reuse cutoffs whenever feasible. Surfaces of gypsum board and substrate members may not be bonded together with an adhesive. Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Provide type of gypsum board for use in each system specified herein as indicated.

3.2.1 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with ASTM C840, System VIII or GA 216.

3.2.2 Arches and Bending Radii

Apply gypsum board in accordance with ASTM C840, System IX or GA 216.

3.2.3 Control Joints

Install expansion and contraction joints in ceilings and walls in accordance with ASTM C840, System XIII or GA 216.

3.2.4 Application of Impact Resistant Gypsum Board

Apply in accordance with applicable system of ASTM C840 as specified or GA 216. Follow manufacturers written instructions on how to cut, drill and attach board.

3.3 APPLICATION OF CEMENTITIOUS BACKER UNITS

3.3.1 Application

In wet areas (tubs, shower enclosures, saunas, steam rooms, gang shower rooms), apply cementitious backer units in accordance with ANSI A108.11. Place a 15 lb asphalt impregnated, continuous felt paper membrane behind cementitious backer units, between backer units and studs. Place membrane with a minimum 6 inch overlap of sheets laid shingle style.

3.3.2 Joint Treatment

ANSI A108.11.

3.4 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C840, GA 214 and GA 216. Finish plenum areas above ceilings to Level 1 in accordance with GA 214. Finish walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings to Level 4 in accordance with GA 214. Unless otherwise specified, finish all gypsum board walls, partitions and ceilings to Level 5 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Tool joints as smoothly as possible to minimize sanding and dust. Do not use fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer. Protect workers, building occupants, and HVAC systems from gypsum dust.

3.4.1 Uniform Surface

Wherever gypsum board is to receive eggshell, semigloss or gloss paint finish, or where severe, up or down lighting conditions occur, finish gypsum wall surface in accordance to GA 214 Level 5. In accordance with GA 214 Level 5, apply a thin skim coat of joint compound to the entire gypsum board surface, after the two-coat joint and fastener treatment is complete and dry.

3.5 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07 92 00 JOINT SEALANTS Apply material with exposed surface flush with gypsum board or cementitious backer units.

3.6 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes.

-- End of Section --

SECTION 09 30 00

CERAMIC TILE, QUARRY TILE, AND PAVER TILE
08/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108/A118/A136.1	(2009) American National Standards for the Installation of Ceramic Tile

ASTM INTERNATIONAL (ASTM)

ASTM C 241/C 241M	(2009) Standard Specification for Abrasion Resistance of Stone Subjected to Foot Traffic
ASTM C 97/C 97M	(2009) Absorption and Bulk Specific Gravity of Dimension Stone
ASTM C1026	(2010) Standard Test Method for Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling
ASTM C1027	(2009) Standard Test Method for Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C1028	(2007e1) Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
ASTM C373	(1988; R 2006) Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products
ASTM C482	(2002; R 2009) Bond Strength of Ceramic Tile to Portland Cement
ASTM C501	(1984; R 2009) Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser
ASTM C648	(2004; R 2009) Breaking Strength of Ceramic Tile

BAY AREA AIR QUALITY MANAGEMENT DISTRICT (Bay Area AQMD)

Bay Area AQMD Rule 8-51	(1992; R 2001) Adhesive and Sealant Products

GREENGUARD ENVIRONMENTAL INSTITUTE (GEI)

GEI	Greenguard Standards for Low Emitting Products

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(1989; R 2005) Adhesive and Sealant Applications

TILE COUNCIL OF NORTH AMERICA (TCNA)

TCA Hdbk	(2010) Handbook for Ceramic Tile Installation

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED GBDC	(2009) LEED Reference Guide for Green Building Design and Construction

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

For materials like Tile, Accessories, and marble Thresholds submit Samples of sufficient size to show color range, pattern, type and joints.

1.2.2 Sustainable Design Certification

Product shall be third party certified by GEI Greenguard Indoor Air Quality Certified, SCS Scientific Certification Systems Indoor Advantage or equal. Certification shall be performed annually and shall be current.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G, AE

SD-03 Product Data

Tile
Adhesives
Mortar and Grout
Waterproofing
Certification

SD-04 Samples

Tile; G, AE
Granite Thresholds; G, AE
Grout; G, AE

SD-07 Certificates

Tile
Mortar and Grout

1.4 QUALITY ASSURANCE

Dimension and draw detail drawings at a minimum scale of 1/4 inch equals 1 foot. Include drawings of pattern at inside corners, outside corners, termination points and location of all equipment items such as thermostats, switch plates, mirrors and toilet accessories mounted on surface. Submit drawings showing ceramic tile pattern elevations and floor plans.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Protect materials from weather, and store them under cover in accordance with manufacturer's printed instructions.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not perform ceramic tile work unless the substrate and ambient temperature is at least 50 degrees F and rising. Maintain temperature above 50 degrees F while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used, ventilate the area to the outside to avoid carbon dioxide damage to new tilework.

1.7 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period.

1.8 EXTRA MATERIALS

Supply an extra two percent of each type tile used in clean and marked cartons.

PART 2 PRODUCTS

2.1 TILE

Conform to TCA Hdbk for standard grade tile. Provide grade sealed containers. Mark seals with the marks on the signed master grade certificate. Provide an impact resistant tile with a minimum floor breaking strength for wall tile of 90 pound and for floor tile of 250 pound in accordance with ASTM C648. The manufacturer will provide a frost resistant rating for tile used in cold climate projects as determined by ASTM C1026. Provide a 0.50 maximum percent water absorption in accordance with ASTM C373. Provide a minimum coefficient of friction of 0.60 wet and dry in accordance with ASTM C1028. Identify floor tile as Class III-Medium Heavy Traffic, durability classification as rated by the manufacturer when tested in accordance with ASTM C1027 for abrasion resistance as related to foot traffic. Contracting Officer will select colors from manufacturer's full range. Submit manufacturer's catalog data and preprinted installation and cleaning instructions plus a master grade certificate for tile..

2.1.1 Mosaic Tile

Furnish unglazed porcelain, unpolished, with sharply formed face. Provide tile size 2 by 2 inch. Contracting Officer will select colors from manufacturer's full range.

2.1.2 Porcelain Tile

Furnish an unglazed mosaic porcelain tile and trim with the color extending uniformly through the body of the tile. Criteria for tile to meet or exceed is as follows: Abrasive wear in accordance with ASTM C501 and bonding strength in accordance with ASTM C482. Comply with 36 CFR 1191 for coefficient of friction for interior tiled floors.

2.1.3 Glazed Wall Tile

Provide glazed wall tile with cushioned edges and trim edged with lead-free bright finish. Provide tile sizes as shown on drawings. Tile face dimensions and thickness shall coordinate with mosaic field tile such that entire installation is the same thickness and all grout joints are the same width. Contracting Officer will select colors from manufacturer's full range.

2.2 WATER

Provide potable water.

2.3 MORTAR AND GROUT

Submit certificates indicating conformance with specified requirements. Submit LEED documentation relative to low-emitting materials in accordance with LEED GBDC. Include in LEED Documentation Notebook. Interior adhesives, sealants, primers and sealants used as filler must meet the requirements of LEED low emitting materials. Conform to SCAQMD Rule 1168 and Bay Area AQMD Rule 8-51, and to the following for mortar, grout, adhesive, and sealant:

2.3.1 Latex-Portland Cement Mortar

TCA Hdbk.

2.3.1.1 Minimum 28 Day Porcelain Tile Shear Strength

200 psi per ANSI A108/A118/A136.1.

2.3.1.2 Open Time

Minimum 40 minutes.

2.3.1.3 Pot Life

Minimum 2 hours.

2.3.1.4 Time to Heavy Traffic

Maximum 24 hours.

2.3.2 Ceramic Tile Grout

TCA Hdbk; petroleum-free and plastic-free unsanded latex-portland cement grout.

2.3.2.1 Minimum Flexural Strength

400 psi per ANSI A108/A118/A136.1.

2.3.2.2 Maximum Linear Shrinkage

0.1 percent after 7 days.

2.3.3 Sealants

Comply with applicable regulations regarding toxic and hazardous materials and as specified.

2.3.4 Cementitious Backer Board

Provide cementitious backer units, for use as tile substrate over wood sub-floors, in accordance with TCA Hdbk. Furnish 1/2inch thick cementitious backer units.

2.4 GRANITE THRESHOLDS

Provide granite thresholds of size required by drawings or conditions. Provide a honed finish in color as selected by the Contracting Officer. Provide double bevel to comply with accessibility requirements. Minimum thickness 3/8 inch.

2.4.1 Maximum Absorption by Weight

0.40 percent in accordance with ASTM C 97/C 97M

2.4.2 Minimum Density

160 pcf in accordance with ASTM C 97/C 97M

2.4.3 Minimum Modulus of Rupture

1,500 psi

2.4.4 Minimum Compressive Strength

19,000 psi

2.4.5 Minimum Abrasion Resistance

Ha equals 25.0 in accordance with ASTM C 241/C 241M

2.4.6 Minimum Flexural Strength

1,200 psi

2.5 WATERPROOFING

General: Manufacturer's standard product, liquid-applied bonded waterproofing coved at walls and taken up 4 inches on walls, that complies with ANSI A108/A118/A136.1 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

2.5.1 Fabric-Reinforced, Fluid-Applied Membrane

System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.

2.5.2 Fluid-Applied Membrane

Liquid-latex rubber or elastomeric polymer

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Inspect surface to receive tile in conformance to the requirements of TCA Hdbk for surface conditions for the type setting bed specified and for workmanship. Provide variations of tiled surfaces that fall within maximum values shown below:

TYPE	WALLS	FLOORS
Latex Portland Cement Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.

3.2 GENERAL INSTALLATION REQUIREMENTS

Do not start tile work until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Do not start floor tile installation in spaces requiring wall tile until after wall tile has been installed. Apply tile in colors and patterns indicated in the area shown on the drawings. Install tile with the respective surfaces in true even

planes to the elevations and grades shown. Slope to floor drain. Provide special shapes as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Solidly back tile bases and coves with mortar.

3.3 INSTALLATION OF WALL TILE

Install wall tile in accordance with the TCA Hdbk, thinset mortar over cement board method.

3.3.1 Latex-Portland Cement Mortar

Use Latex-Portland Cement to install tile in accordance with TCA Hdbk.

3.4 INSTALLATION OF FLOOR TILE

Install floor tile in accordance with TCA Hdbkthinset mortar over bonded waterproofing membrane on concrete slab on grade method.

3.4.1 Latex-Portland Cement

Use Latex-Portland cement mortar to install tile directly over properly cured, plane, clean waterproofed concrete slabs in accordance with TCA Hdbk.

3.4.2 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with TCA Hdbk.

3.4.3 Waterproofing

Install in accordance with manufacturer's instructions and allow to cure before installing tile.

3.5 INSTALLATION OF GRANITE THRESHOLDS

Install thresholds where indicated, in a manner similar to that of the ceramic tile floor. Provide thresholds full width of the opening. Install head joints at ends not exceeding 1/4 inch in width and grouted full.

3.6 EXPANSION JOINTS

Form and seal joints as specified in Section 07 92 00 JOINT SEALANTS.

3.6.1 Walls

Provide expansion joints at control joints in backing material. Wherever backing material changes, install an expansion joint to separate the different materials.

3.6.2 Floors

Provide expansion joints over construction joints, control joints, and expansion joints in concrete slabs. Provide expansion joints where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 24 to 36 feet each way in large interior floor areas and 12 to 16 feet each way in large exterior areas or areas exposed to direct sunlight or moisture. Extend expansion joints through setting-beds and fill.

3.7 CLEANING AND PROTECTING

Upon completion, thoroughly clean tile surfaces in accordance with manufacturer's approved cleaning instructions. Do not use acid for cleaning glazed tile. Clean floor tile with resinous grout or with factory mixed grout in accordance with printed instructions of the grout manufacturer. After the grout has set, provide a protective coat of a noncorrosive soap or other approved method of protection for tile wall surfaces. Cover tiled floor areas with building paper before foot traffic is permitted over the finished tile floors. Provide board walkways on tiled floors that are to be continuously used as passageways by workmen. Replace damaged or defective tiles.

3.8 WASTE MANAGEMENT

Separate waste, including metal and cardboard, in accordance with the Waste Management Plan and recycle or reuse. Place materials defined as hazardous or toxic waste, including used sealant tubes and containers, in designated containers and areas. Close and seal tightly partly used sealant containers and store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste, including used sealant tubes and containers, in designated containers and areas and dispose of properly.

-- End of Section --

SECTION 09 90 00

PAINTS AND COATINGS
05/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100	(2001; Supplements 2002-2008) Documentation of the Threshold Limit Values and Biological Exposure Indices

ASME INTERNATIONAL (ASME)

ASME A13.1	(2007) Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM D523	(2008) Standard Test Method for Specular Gloss
ASTM D6386	(2010) Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting

MASTER PAINTERS INSTITUTE (MPI)

MPI 107	(Oct 2009) Rust Inhibitive Primer (Water-Based)
MPI 134	(Oct 2009) Galvanized Primer (Waterbased)
MPI 147	(Oct 2009) Institutional Low Odor / VOC Interior Latex, Semi-Gloss, MPI Gloss Level 5
MPI 163	(Oct 2009) Exterior W.B. Light Industrial Coating, Semi-Gloss, MPI Gloss Level 5
MPI 50	(Oct 2009) Interior Latex Primer Sealer
MPI 79	(Oct 2009) Alkyd Anti-Corrosive Metal Primer

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2000; E 2004) Shop, Field, and Maintenance Painting of Steel

SSPC PA Guide 3	(1982; E 1995) A Guide to Safety in Paint Application
SSPC SP 1	(1982; E 2004) Solvent Cleaning
SSPC SP 12/NACE No.5	(2002) Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA Method 24	(2000) Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-313	(Rev D; Notice 1) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

SD-02 Shop Drawings

Piping identification

Submit color stencil codes

SD-03 Product Data

Coating
Manufacturer's Technical Data Sheets

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

SD-04 Samples

Color; G, AE

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

1.3 APPLICATOR'S QUALIFICATIONS

1.3.1 Contractor Qualification

Submit the name, address, telephone number, FAX number, and e-mail address of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on a minimum of three similar projects within the past three years. List information by individual and include the following:

a. Name of individual and proposed position for this work.

b. Information about each previous assignment including:

Position or responsibility

Employer (if other than the Contractor)

Name of facility owner

Mailing address, telephone number, and telex number (if non-US) of facility owner

Name of individual in facility owner's organization who can be contacted as a reference

Location, size and description of structure

Dates work was carried out

Description of work carried out on structure

1.4 QUALITY ASSURANCE

1.4.1 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph "Sampling Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products which do not conform, shall be removed from the job site and replaced with new products that conform to the referenced specification. Testing of replacement products that failed initial testing shall be at no cost to the Government.

1.4.1.1 Sampling Procedure

The Contracting Officer will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor

shall provide one quart samples of the selected paint materials. The samples shall be taken in the presence of the Contracting Officer, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.

1.4.1.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.5 REGULATORY REQUIREMENTS

1.5.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.

1.5.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.5.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.5.4 Asbestos Content

Materials shall not contain asbestos.

1.5.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.5.6 Silica

Abrasive blast media shall not contain free crystalline silica.

1.5.7 Human Carcinogens

Materials shall not contain ACGIH 0100 confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.6 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F.

1.7 SAFETY AND HEALTH

1.7.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA Guide 3.

1.7.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.

=1.8 ENVIRONMENTAL CONDITIONS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation.

1.8.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 5 degrees F above dew point;

b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.

1.9 COLOR SELECTION

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the Contracting Officer. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

Color, texture, and pattern of wall coating systems shall be as indicated .

1.10 LOCATION AND SURFACE TYPE TO BE PAINTED

1.10.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.10.1.1 Exterior Painting

Includes new surfaces of the building and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

1.10.1.2 Interior Painting

Includes new surfaces of the building and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

1.10.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.

c. Steel to be embedded in concrete.

d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

e. Hardware, fittings, and other factory finished items.

1.10.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

(1) Exposed piping, conduit, and ductwork;

(2) Supports, hangers, air grilles, and registers;

(3) Miscellaneous metalwork and insulation coverings.

b. Do not paint the following, unless indicated otherwise:

(1) New zinc-coated, aluminum, and copper surfaces under insulation

(2) New aluminum jacket on piping

(3) New interior ferrous piping under insulation.

1.10.4 Definitions and Abbreviations

1.10.4.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.10.4.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing shall only be accomplished by MPI testing lab.

1.10.4.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendaring, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

1.10.4.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.10.4.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

1.10.4.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.10.4.7 EXT

MPI short term designation for an exterior coating system.

1.10.4.8 INT

MPI short term designation for an interior coating system.

1.10.4.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.10.4.10 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.10.4.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.10.4.12 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units at 60 degrees	Units at 85 degrees
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.10.4.13 MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

1.10.4.14 Paint

See Coating definition.

1.10.4.15 REX

MPI short term designation for an exterior coating system used in

repainting projects or over existing coating systems.

1.10.4.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents. Comply with applicable regulations regarding toxic and hazardous materials.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.3 PREPARATION OF METAL SURFACES

3.3.1 Galvanized Surfaces

a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with steam, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized" If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D6386, Appendix X2, and remove by one of the methods described therein.

b. Galvanized with Slight Coating Deterioration or with Little or No Rusting: Water jetting to SSPC SP 12/NACE No.5 WJ3 to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended

by the coating manufacturer to prevent rusting.

3.4 APPLICATION

3.4.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Use trigger operated spray nozzles for water hoses. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats.

a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.

c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

3.4.2 3.8.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

3.4.3 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table

Division 5. Exterior Metal, Ferrous and Non-Ferrous Paint Table

Division 5. Interior Metal, Ferrous and Non-Ferrous Paint Table

Division 9: Interior Plaster, Gypsum Board, Textured Surfaces Paint Table

b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.

c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:

(1) One coat of primer.

(2) One coat of undercoat or intermediate coat.

(3) One topcoat to match adjacent surfaces.

e. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.5 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.

b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings

to protect from rusting prior to applying field primer.

d. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 1.5 mils DFT immediately prior to application of epoxy or urethane coatings.

e. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

f. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.6 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with ASME A13.1. Place stenciling in clearly visible locations. On piping not covered by ASME A13.1, stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inches high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

3.7 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.8 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows. Do not use kerosene or any such organic solvents to clean up water based paints. Properly dispose of paints or solvents in designated containers. Close and seal partially used containers of paint to maintain quality as necessary for reuse. Store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste in designated containers.

3.9 PAINT TABLES

All DFT's are minimum values. Use only materials with a GPS green check mark having a minimum MPI "Environmentally Friendly" rating based on VOC (EPA Method 24) content levels. Acceptable products are listed in the MPI Green Approved Products List, available at http://www.specifygreen.com/APL/ProductIdxByMPInum.asp.

3.9.1 EXTERIOR PAINT TABLES

DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

STEEL / FERROUS SURFACES

EXTERIOR GALVANIZED SURFACES

A. New Galvanized surfaces:

EXTERIOR GALVANIZED SURFACES

1. Waterborne Primer / Waterborne Light Industrial Coating
   MPI EXT 5.3J-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 134 MPI 163 MPI 163
   System DFT: 4.5 mils

J. Surfaces adjacent to painted surfaces; miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

1. MPI EXT 5.1C-G5(Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 79 MPI 163 MPI 163
   System DFT: 5 mils

3.9.2 INTERIOR PAINT TABLES

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. Metal Surfaces adjacent to painted surfaces (Match surrounding finish)and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

B. Miscellaneous non-ferrous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

A. New Wallboard not otherwise specified:

1. Institutional Low Odor / Low VOC Latex

   New; MPI INT 9.2M-G5 (Semigloss) / Existing; MPI RIN 9.2M-G5 (Semigloss)
   Primer: Intermediate: Topcoat:
   MPI 50 MPI 147 MPI 147
   System DFT: 4 mils

-- End of Section --

SECTION 10 14 01

EXTERIOR SIGNAGE
04/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS C1.1M/C1.1	(2012) Recommended Practices for Resistance Welding
AWS D1.1/D1.1M	(2012; Errata 2011) Structural Welding Code - Steel
AWS D1.2/D1.2M	(2008) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A1011/A1011M	(2012) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability and Ultra-High Strength
ASTM A123/A123M	(2012) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A36/A36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A653/A653M	(2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A924/A924M	(2010a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B108/B108M	(2012; E 2012) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B209	(2010) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2012) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

ASTM B26/B26M	(2012) Standard Specification for Aluminum-Alloy Sand Castings
ASTM E84	(2012b) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500	(2006) Metal Finishes Manual

1.2 GENERAL REQUIREMENTS

All exterior signage shall be provided by a single manufacturer. Exterior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Submit exterior signage schedule in electronic media with spread sheet format. Spread sheet shall include sign location, sign type, and message. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Each sample shall consist of a complete sign panel with letters and symbols. Samples may be installed in the work, provided each sample is identified and location recorded. Submit color samples for each material requiring color and 12 inch square sample of sign face color sample.

1.2.1 Wind Load Requirements

Exterior signage shall be designed to withstand 90 mph windload. Submit design analysis and supporting calculations performed in support of specified signage.

1.2.2 Character Proportions and Heights

Letters and numbers on indicated signs for handicapped-accessible buildings shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G

SD-03 Product Data

Modular Exterior Signage System
Installation
Exterior Signage; G
Wind Load Requirements

SD-04 Samples

Exterior Signage; G

SD-10 Operation and Maintenance Data

Protection and Cleaning

1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.5 DELIVERY AND STORAGE

Materials shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area in accordance with manufacturer's instructions.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

PART 2 PRODUCTS

2.1 MODULAR EXTERIOR SIGNAGE SYSTEM

Exterior signage shall consist of a system of coordinated directional, identification, and regulatory type signs located where shown. Dimensions, details, materials, message content, and design of signage shall be as shown. Submit manufacturer's descriptive data and catalog cuts.

2.1.1 Panel And Post/Panel Type Signs

2.1.1.1 Posts

One-piece aluminum or galvanized steel posts shall be provided with minimum 0.125 inch wall thickness. Posts shall be designed to accept panel framing system described. The post shall be designed to permit attachment of panel framing system without exposed fasteners. Caps shall be provided for each post.

2.1.1.2 Panel Framing System

Panel framing consisting of aluminum sections and interlocking track components shall be designed to interlock with posts with concealed fasteners.

2.1.1.3 Panels

Modular message panels shall be provided in sizes shown on drawings. Panels shall be fabricated a minimum of 0.125 inch aluminum. Panels shall be designed to be interchangeable.

2.1.1.4 Finishes

Post finish shall be two-component acrylic polyurethane.

2.1.1.5 Mounting

Permanent mounting shall be provided by embedding posts in concrete foundation as shown.

2.2 GRAPHICS FOR EXTERIOR SIGNAGE SYSTEMS

2.2.1 Graphics

Signage graphics shall conform to the following:

a. Custom fabricated aluminum letters, 1/4 inch thick shall be provided and fastened to the message panel with concealed fasteners. Letters shall not project from face of panel.

b. Precision computer cut vinyl lettering as specified in the Drawings. Vinyl letting shall be 5 to 6 year premium type.

c. Pressure sensitive retroflective sheet vinyl, digitally printed with UV stable inks. Vinyl sheeting shall be 5 to 6 year premium type.

d. Graphic shall be engraved in UV stable, phenolic plastic laminate. Graphic shall be core color or paint filled multiple colors.

2.2.2 Messages

Refer to LS-511 through LS-516 for message content. Refer to LS-514 for project typefaces. Type size is as indicated.

2.3 METAL PLAQUES

Design and location of plaques shall be as shown.

2.3.1 Cast Metal Plaques

2.3.1.1 Fabrication

Cast metal plaques shall have the logo, emblem and artwork cast in the flat relief technique. Plaques shall be fabricated from prime aluminum.

2.3.1.2 Size

Plaque size shall be as shown.

2.3.1.3 Border

Border shall be custom ornamental as shown.

2.3.1.4 Background

Background texture shall be leather.

2.3.1.5 Mounting

Mounting shall be concealed.

2.3.1.6 Finish

Finishes shall consist of Gloss Black painted fields, returns and reverse with Gloss White painted faces of borders and graphics/copy.

2.4 DIMENSIONAL BUILDING LETTERS

2.4.1 Fabrication

Letters shall be fabricated from 1/4-inch cast brass. CNC routed or waterjet cut process only. Letters shall be packaged for proteciton until installed.

2.4.2 Typeface

Typeface shall be as indicated.

2.4.3 Size

Letter size shall be as indicated.

2.4.4 Finish

Polished bronze with clear coat finish shall be provided.

2.4.5 Mounting

Threaded studs of number and size as recommended by manufacturer, shall be used for concealed anchorage. Letters which project from the building line shall have stud spacer sleeves. Letters, studs, and sleeves shall be of the same material. Templates for mounting shall be supplied.

2.5 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products shall conform to ASTM B209 for sheet or plate, ASTM B221 for extrusions and ASTM B26/B26M or ASTM B108/B108M for castings. Aluminum extrusions shall be provided at least 1/8 inch thick and aluminum plate or sheet at least 16 gauge thick. Welding for aluminum products shall conform to AWS C1.1M/C1.1.

2.6 ORGANIC COATING

Surfaces shall be cleaned, primed, and given a two-component acrylic polyurethane finish in accordance with NAAMM AMP 500, AMP 505, with total dry film thickness not less than 1.2 mils.

2.7 STEEL PRODUCTS

Structural steel products shall conform to ASTM A36/A36M. Sheet and strip steel products shall conform to ASTM A1011/A1011M. Welding for steel products shall conform to AWS D1.2/D1.2M.

2.8 VINYL SHEETING FOR GRAPHICS

Vinyl sheeting shall be 5 to 7 year premium type and shall be in accordance

with the flammability requirements of ASTM E84 and shall be a minimum 0.003 inch film thickness. Film shall include a precoated pressure sensitive adhesive backing, Class 1, or positionable pressure sensitive adhesive backing, Class 3.

2.9 ANCHORS AND FASTENERS

Exposed anchor and fastener materials shall be compatible with metal to which applied and shall match in color and finish and shall be non-rusting, non-corroding, and non-staining. Exposed fasteners shall be tamper-proof.

2.10 SHOP FABRICATION AND MANUFACTURE

2.10.1 Factory Workmanship

Work shall be assembled in the shop, as far as practical, ready for installation at the site. Work that cannot be shop assembled shall be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Welding to or on structural steel shall be in accordance with AWS D1.1/D1.1M. Welding shall be continuous along the entire area of contact. Exposed welds shall be ground smooth. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practical. Items specified to be galvanized shall be by hot-dip process after fabrication if practical. Galvanization shall be in accordance with ASTM A123/A123M and ASTM A653/A653M, as applicable. Other metallic coatings of steel sheet shall be in accordance with ASTM A924/A924M. Joints exposed to the weather shall be formed to exclude water. Drainage and weep holes shall be included as required to prevent condensation buildup.

2.10.2 Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

2.10.3 Shop Painting

Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, shall be given one coat of zinc-molybdate primer or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Surfaces of items to be embedded in concrete shall not be painted. Upon completion of work, damaged surfaces shall be recoated.

2.11 COLOR, FINISH, AND CONTRAST

Color shall be as indicated on the drawings. For buildings required to be handicapped-accessible, the characters and background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast with their background - either light characters on a dark background or dark characters on a light background.

PART 3 EXECUTION

3.1 INSTALLATION

Signs, plaques, or dimensional letters shall be installed in accordance with approved manufacturer's instructions at locations shown on the approved detail drawings; submit drawings showing elevations of each type of sign; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction. A schedule showing the location, each sign type, and message shall be included. Circuits installed underground shall conform to the requirements of Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Steel conduits installed underground and illuminated signage mounted directly on buildings shall be in conformance with the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces shall not be installed until finishes on such surfaces have been completed. Submit manufacturer's installation instructions and cleaning instructions.

3.1.1 Anchorage

Anchorage and fastener materials shall be in accordance with approved manufacturer's instructions for the indicated substrate. Anchorage not otherwise specified or indicated shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned in accordance with manufacturer's instructions. After signs are completed and inspected, Cover all project identification, directional, and other signs which may mislead the public. Covering shall be maintained until instructed to be removed by the Contracting Officer or until the facility is to be opened for business. Submit six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The instructions shall include simplified diagrams for the equipment as installed. Signs shall be cleaned, as required, at time of cover removal.

3.2 FIELD PAINTED FINISH

Miscellaneous metals and frames shall be field painted in accordance with Section 09 90 00 PAINTS AND COATINGS. Anodized metals, masonry, and glass shall be protected from paint. Finish shall be free of scratches or other blemishes.

-- End of Section --

SECTION 10 28 13

TOILET ACCESSORIES
07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E84	(2012c) Standard Test Method for Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Finishes
Accessory Items

SD-04 Samples

Finishes; G, AE
Accessory Items; G, AE

SD-07 Certificates

Accessory Items

SD-10 Operation and Maintenance Data

Electric Hand Dryer; G, AE

1.3 DELIVERY, STORAGE, AND HANDLING

Wrap toilet accessories for shipment and storage, then deliver to the jobsite in manufacturer's original packaging, and store in a clean, dry area protected from construction damage and vandalism.

1.4 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

Provide toilet accessories where indicated in accordance with paragraph SCHEDULE. Porcelain type, tile-wall accessories are specified in Section 09 30 00 CERAMIC TILE QUARRY TILE, AND PAVER TILE. Provide each accessory item complete with the necessary mounting plates of sturdy construction with corrosion resistant surface.

2.1.1 Anchors and Fasteners

Provide anchors and fasteners capable of developing a restraining force commensurate with the strength of the accessory to be mounted and suited for use with the supporting construction. Provide tamperproof design exposed fasteners with finish to match the accessory.

2.1.2 Finishes

Except where noted otherwise, provide the following finishes on metal:

Metal	Finish
Stainless steel	No. 4 satin finish

2.2 ACCESSORY ITEMS

Conform to the requirements for accessory items specified below. Submit fasteners proposed for use for each type of wall construction, mounting, operation, and cleaning instructions and one sample of each other accessory proposed for use. Incorporate approved samples into the finished work, provided they are identified and their locations noted. Submit certificate for each type of accessory specified, attesting that the items meet the specified requirements.

2.2.1 Grab Bar (GB)

Provide an 18 gauge, 1-1/4 inch grab bar OD Type 304 stainless steel. Provide form and length for grab bar as indicated. Provide concealed mounting flange. Provide grab with satin finish . Furnish installed bars capable of withstanding a 500 pound vertical load without coming loose from the fastenings and without obvious permanent deformation. Allow 1-1/2 inch space between wall and grab bar.

2.2.2 Mirror, Metal (MM)

Provide a brightly polished stainless steel metal mirror of 0.037 inch minimum thickness, edges turned back 1/4 inch and recess fitted with tempered hardboard backing, and theft-proof fasteners. Provide size in accordance with paragraph SCHEDULE.

2.2.3 Sanitary Napkin Disposer (SND)

Construct a Type 304 stainless steel sanitary napkin disposal with removable leak-proof receptacle for disposable liners. Provide fifty disposable liners of the type standard with the manufacturer. Retain receptacle in cabinet by tumbler lock. Provide disposer with a door for

inserting disposed napkins, surface mounted.

2.2.4 Soap Dispenser (SD)

Provide soap dispenser surface mounted, liquid type consisting of a vertical Type 304 stainless steel tank with holding capacity of 40 fluid ounces with a corrosion-resistant all-purpose valve that dispenses liquid soaps, lotions, detergents and antiseptic soaps.

2.2.5 Shelf, Metal, Light Duty (SMLD)

Support light duty metal shelf between brackets or on brackets. Purpose of brackets is to prevent lateral movement of the shelf. Furnish 24 inch long shelf. Provide stainless steel shelf and brackets.

2.2.6 Toilet Tissue Dispenser, Jumbo (TTDJ)

Provide surface mounted toilet tissue dispenser with 2 rolls of jumbo tissue. Fabricate cabinet of Type 304, 18 gauge stainless steel with Type 304, 20 gauge stainless steel door. Provide cover with key lock.

2.2.7 Waste Receptacle (WR)

Provide Type 304 stainless steel waste receptacle, designed for surface mounting. Provide reusable liner, of the type standard with the receptacle manufacturer. Provide receptacles with push doors and doors for access to the waste compartment with continuous hinges. Furnish tumbler key lock locking mechanism.

2.2.8 Toilet Seat Cover Dispenser (TSCD)

Provide Type 304 stainless steel with surface mounted toilet seat cover dispensers. Provide dispenser with a minimum capacity of 500 seat covers.

2.2.9 Electric Hand Dryer (EHD)

Provide wall mount and electric hand dryer designed to operate at 110/125 volts, 60 cycle, single phase alternating current with a heating element core rating of a maximum 2100 watts. Provide dryer housing of single piece construction and of baked electrostatically applied epoxy . Submit complete copies of maintenance instructions listing routine maintenance procedures and possible breakdowns. Include repair instructions for simplified wiring and control diagrams and other information necessary for unit maintenance.

2.2.10 Mop and Broom Holder (MH)

Stainless steel with grip jaw cam mechanism securing 3 mop or broom handles. Also includes storage shelf.

2.2.11 Under-Lavatory Covers

Provide 1/8-inch pliable PVC shell finish with fusion-welded seams pipe covers; anti-microbial, UV-inhibited and anti-fungal. Shield shall include a hook and loop fastening system for attachment to piping under restroom sink. Cover shall comply with ASTM E84 for flame spread and smoke index. Color shall be white.

PART 3 EXECUTION

3.1 INSTALLATION

Provide the same finish for the surfaces of fastening devices exposed after installation as the attached accessory. Provide oval exposed screw heads. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses. Use sealants for brackets, plates, anchoring devices and similar items in showers (a silicone or polysulfide sealant) as they are set to provide a watertight installation. After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

3.1.1 Recessed Accessories

Fasten accessories with wood screws to studs, blocking or rough frame in wood construction. Set anchors in mortar in masonry construction. Fasten to metal studs or framing with sheet metal screws in metal construction.

3.1.2 Surface Mounted Accessories

Mount on concealed backplates, unless specified otherwise. Conceal fasteners on accessories without backplates. Install accessories with sheet metal screws or wood screws in lead-lined braided jute, PTFE or neoprene sleeves, or lead expansion shields, or with toggle bolts or other approved fasteners as required by the construction. Install backplates in the same manner, or provide with lugs or anchors set in mortar, as required by the construction. Fasten accessories mounted on gypsum board and plaster walls without solid backing into the metal or wood studs or to solid wood blocking secured between wood studs, or to metal backplates secured to metal studs.

3.2 CLEANING

Clean material in accordance with manufacturer's recommendations. Do mot use alkaline or abrasive agents. Take precautions to avoid scratching or marring exposed surfaces.

-- End of Section --

SECTION 12 93 00

SITE FURNISHINGS
02/09

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	(2010) Code of Standard Practice for Steel Buildings and Bridges

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.3	(2006) Operations - Safety Requirements for Powder Actuated Fastening Systems

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010; Errata 2010) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(2010) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2010) Standard for Square and Hex Nuts
ASME B18.21.1	(2009) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
ASME B18.6.2	(1998; R 2010) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series
ASME B18.6.3	(2010) Machine Screws, Tapping Screws, and Machine Drive Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2012) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2010) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile

	Strength
ASTM A36/A36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A47/A47M	(1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A48/A48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM A500/A500M	(2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A501	(2007) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A653/A653M	(2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B108/B108M	(2012e1) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B209	(2010) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2012) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B26/B26M	(2012) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B62	(2009) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM D3451	(2006; R 2012) Testing Coating Powders and Powder Coatings

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 25	(1997; E 2004) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1925	(Rev A; Notice 2) Shield Expansion (Nail Anchors)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals identified with "AE" shall be reviewed by the Landscape Architect. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Benches; G, AE
Waste Receptacles; G, AE
Flower Vase Receptacles; G, AE
Assembly Instruction Drawings

SD-03 Product Data

Benches; G, AE
Waste Receptacles; G, AE
Flower Vase Receptacles; G, AE

SD-04 Samples

Finish; G, AE

SD-07 Certificates

Primer certificate
Powder coatings certificate

1.3 QUALITY ASSURANCE

Qualify welders in accordance with AWS D1.1/D1.1M using procedures, materials, and equipment of the type required for the work.

1.3.1 Fabrication Drawings

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

11.3.2 Installation Drawings

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation.

1.3.3 Assembly Instruction Drawings

Submit assembly instruction drawings showing layout(s), connections, bolting and anchoring details in accordance with manufacturer's standards. Submit drawings showing scaled details of proposed site furnishings, elevations for each type of site furnishing; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction.

1.3.4 Primer Certificate

Submit a certificate from the manufacturer stating that the primer conforms

to requirements of SSPC Paint 25.

1.3.5 Powder Coatings Certificate

Submit a certificate from the manufacturer stating that the powder coat conforms to ASTM D3451.

1.4 DELIVERY, STORAGE, AND HANDLING

Ship items knocked-down (KD) ready for site assembly. Packaged components shall be complete including all accessories and hardware. Materials shall be delivered, handled, and stored in accordance with the manufacturer's recommendations. Site furnishings shall be inspected upon arrival at the job site for conformity to specifications and quality in accordance with paragraph MATERIALS. Protect from corrosion, staining, and other types of damage. Store items in designated area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

Provide materials which are the standard products of a manufacturer regularly engaged in the manufacture of such products. The materials provided shall be of a type with proven satisfactory usage for at least 2 years.

2.1.1 Metals

Metallic materials and products shall conform to Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS. Furnish metal components with factory drilled holes and free of excess weld and spatter. Metal components with holes that will not be filled by hardware or hidden by other components will be rejected. Structural steel products shall conform to ASTM A36/A36M, ASTM A500/A500M and ASTM A501.

2.1.2 Structural Tubing

ASTM A500/A500M.

2.1.3 Steel Pipe and Fittings

Steel pipe shall conform to ASTM A53/A53M, Type E or S, Grade B; standard malleable iron fittings shall conform to ASTM A47/A47M.

2.1.4 Gray Cast Iron

Gray cast iron shall conform to ASTM A48/A48M Class 35 or better. Provide castings manufactured true to pattern and component parts that fit together in a satisfactory manner. Castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects. Smooth castings shall be well-cleaned by sand or shot blasting.

2.1.5 Cast Aluminum

Cast aluminum shall conform to ASTM B26/B26M and ASTM B108/B108M. Provide castings manufactured true to pattern and component parts that fit together in a satisfactory manner. Provide castings of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects.

Smooth castings shall be well-cleaned by sand or shot blasting.

2.1.6 Aluminum Alloy Products

Conform to ASTM B209 for sheet plate, ASTM B221 for extrusions and ASTM B26/B26M or ASTM B108/B108M for castings, as applicable. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

2.1.7 Anchors and Hardware

Provide anchors, where necessary, for fastening site furnishings securely in place and in accordance with approved manufacturer's instructions. Anchoring devices that may be used, when no anchors are otherwise specified or indicated, include anchor bolts, slotted inserts, expansion shields for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; and lag bolts and screws for wood. Anchor bolts shall conform to ASTM A307. Hardware shall be stainless steel in accordance with ASTM A153/A153M and compatible with the material to which applied. All exposed hardware shall match in color and finish. Mounting hardware shall be concealed, recessed, and plugged.

2.1.7.1 Threaded Inserts and Expansion Anchors

Expansion shields shall conform to CID A-A-1925, group II, type 4, class 1. Provide embedment required by manufacturer.

2.1.7.2 Lag Screws and Bolts

ASME B18.2.1, type and grade best suited for the purpose.

2.1.7.3 Toggle Bolts

ASME B18.2.1.

2.1.7.4 Bolts, Nuts, Studs and Rivets

ASME B18.2.2 or ASTM A307.

2.1.7.5 Power Driven Fasteners

Follow safety provisions of ASSE/SAFE A10.3.

2.1.7.6 Screws

ASME B18.2.1, ASME B18.6.2, and ASME B18.6.3.

2.1.7.7 Washers

Provide plain washers to conform to ASME B18.21.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ASME B18.21.1.

2.1.8 Ounce Metals

Bronze, copper, and other ounce metals shall conform to ASTM B62.

2.2 PRETREATMENT, PRIMING AND PAINTING

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.

2.2.1 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.2 Aluminum Surfaces

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.3 COATINGS AND FINISHES

2.3.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing shall conform to ASTM A123/A123M, ASTM A153/A153M or ASTM A653/A653M, as applicable. Tailings and sharp protrusions formed as a result of the hot-dip process shall be removed and exposed edges burnished. Galvanize anchor bolts, grating fasteners, washers and parts or devices necessary for proper installation, unless otherwise indicated.

2.3.2 Polyester Powder

Powder-coated surfaces shall receive electrostatic zinc coating prior to painting. Powder coating shall be electrostatically applied and oven cured. Polyester powder coating shall be resistant to ultraviolet (UV) light.

2.3.3 Polyvinyl-Chloride (PVC)

PVC coating shall be primed with a clear acrylic thermosetting solution. The primed parts shall be preheated prior to dipping. The liquid polyvinyl chloride shall be ultraviolet (UV) stabilized and mold-resistant. The coated parts shall be cured. The coating shall be a minimum 2/25 inches thick plus or minus 0.020 inches and shall have an 85 durometer hardness with a slip-resistant finish.

2.3.4 Finish

Finish shall be as specified by the manufacturer or as indicated. Exposed surfaces and edges shall be rounded, polished, or sanded. Finish shall be non-toxic, non-glare, and resistant to corrosion. Exposed surfaces shall be smooth exposed surfaces. Submit two sets of color data for each furnishing displaying manufacturer's color selections and finishes, and identifying those colors and finishes proposed for use.

2.3.4.1 Paint

Paint shall be factory applied with a minimum of 2 coats. Paint shall be weather-resistant and resistant to cracking, peeling and fading.

2.4 SITE STANDARDS

Site furnishings shall be furnished with the dimensions and requirements indicated.

2.5 BENCHES

Furnish benches with no sharp edges or protruding hardware. Benches shall be solid granite cut to dimensions shown on Drawings. Color shall be Iridian Gray as defined by Cold Spring Granite Color samples, or acceptable color substitution; Honed Finish.

a. Height: The height above finished grade or specified surface shall be between 18-20 inches and level, as shown on the Drawings.

b. Seat: The seat surface shall be pitched or slotted to shed water; the seat shall be pitched down at the back at a 0-5 degree angle, and shall overhang the support base by a minimum of 4 inches for heel space and to facilitate rising from a seating position.

2.5.1 Accessories

Provide manufacturer's standard materials and accessories as required for assembly of units and as indicated on the assembly drawings. Provide unexposed aluminum, stainless steel or steel plates, angles and supports as required for complete assembly. Separate dissimilar materials to prevent electrolytic action.

2.5.2 Fasteners

Provide concealed fasteners except where specifically approved; types as required for specific usage.

2.5.3 Anchoring Brackets

Provide 1/4 inch zinc plated steel angle anchoring brackets, 1-7/8 inch wide by 2 inches deep by 2-1/2 inches high , pre-drilled for bolting benches to substrate.

2.6 WASTE RECEPTACLES AND FLOWER VASE RECEPTACLES

Provide for waste receptacles 36 gallon litter receptacle with raised domed lid. Furnish with 36 gallon liner. Color shall be black. Provide decals with word "Trash" repeated around band as indicated.

Provide flower vase receptacle 36 gallon litter receptacle with hinged solid lid cover with stainless steel handle. Lid hinge shall be placed at 1/3 chord position on lid. Hinge shall be stainless steel piano style. Lid shall be prepped and powder-coated following drilling of holes for handle and hinge hardware. Color shall be Black. Provide decals with the words "Flower Vases" repeated around band as indicated.

a. Height: Trash and litter deposit openings shall be between 30-40 inches above the ground.

b. Liners: Trash and litter receptacles shall be furnished with removable/reusable inner containers. Self-dumping type designs to include hinged bottom, top or sides will be rejected.

c. Anchors: Trash and litter receptacles that can be anchored to resist overturning by typical use, high winds, or animals shall be furnished and anchored in accordance with the manufacturer's recommendations.

d. Openings: Openings for trash and flower vase insertion shall be a minimum of 4 inches in diameter. Edges of the openings shall be crimped, rounded and smoothed.

2.6.1 Metal Waste Receptacle and Vase Receptacles

Provide metal waste receptacles and flower vase receptacles as indicated; powder coat finish, color as selected.

a. Metal thickness, width, and configuration shall be manufacturer's standard. Chemically clean and phosphate coat prior to final powdercoat.

PART 3 EXECUTION

3.1 INSTALLATION

Verify that finished grades and other operations affecting mounting surfaces have been completed prior to the installation of site furnishings. Site furnishings shall be installed plumb and true, at locations indicated,in accordance with the approved manufacturer's instructions.

3.2 RESTORATION AND CLEAN UP

When the installation has been completed, clean up and protect the site. Existing areas that have been damaged from the installation operation shall be restored to original condition at Contractor's expense.

3.2.1 Clean Up

The site shall be cleaned of all materials associated with the installation. Site furnishing surfaces shall be cleaned of dirt, stains, filings, and other blemishes occurring from shipment and installation. Cleaning methods and agents shall be according to manufacturer's instructions or as indicated.

3.2.2 Protection

The area shall be protected as required or directed by providing barricades and signage. Signage shall be in accordance with Section 10 14 01 EXTERIOR SIGNAGE.

3.2.3 Disposal of Materials

Excess and waste material shall be removed and disposed off Government property.

3.3 RE-INSTALLATION

Where re-installation is required, the following shall be accomplished:

a. Re-install the product as specified. Material acquisition of

replacement parts is the responsibility of the Contractor. Provide replacement materials that are new and supplied by the original manufacturer to match.

b. Damage caused by the failed installation shall be repaired.

-- End of Section --

SECTION 13 12 13.15

REFLECTING POOL
03/13

PART 1 GENERAL

1.1 SUMMARY

The general, supplementary, and special conditions as well as the general requirements form a part of this section as if written herein. The intention of these specifications is to ensure that a single fountain equipment manufacturer provides a system with single source responsibility for the components in the fountain system.

1.2 RELATED SECTIONS

Coordinate the Work in this Section with the following Sections:

a. Section 03 30 00 CAST-IN-PLACE CONCRETE for concrete.

b. Section 32 14 40 STONE PAVERING for granite used in and around fountain and paver support system.

c. Section 07 14 00 FLUID APPLIED WATERPROOFING for waterproofing pool.

d. Section 07 92 00 JOINT SEALANTS for sealants used for pool.

e. Section 22 52 00 REFLECTING POOL PLUMBING SYSTEMS for plumbing system dedicated to the fountains.

f. Division 26 for electrical requirements.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G, AE

Submit shop drawings for each product and accessory required. Include information not fully detailed in manufacturer's standard product data. Submit shop drawings which have been signed and sealed by a professional engineer licensed to practice in the State in which the Project is located.

SD-03 Product Data

Surface Skimmer
Main Pool Drain
Wall Niche Overflow
Small Sump
Anti-Vortex Plate

Dual Water Level Sensor

SD-04 Samples

Surface Skimmer; G
Main Pool Drain; G
Wall Niche Overflow; G

Submit finish samples for initial color selection. Submit samples of each specified finish. Submit samples in form of manufacturer's color charts showing full range of colors and finishes available. Where finishes involve normal color variations, include samples showing the full, range of variations expected. Submit samples for verification purposes. Additional samples may be required to show fabrication techniques and workmanship.

SD-07 Certificates

Manufacturer Qualifications
Installer Qualifications
Engineer Qualifications

Submit qualification data for firms and persons specified in Quality Assurance Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names of architects and Governments, and other information specified.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manual; G

SD-11 Closeout Submittals

As-built Drawings; G
warranty; G

1.4 QUALITY ASSURANCE

1.4.1 Manufacturer Qualifications

Manufacturer shall be a firm engaged in the manufacture of fountains of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of five years.

a. All fountain equipment required by the specifications and/or the drawings shall be supplied by a single source fountain equipment manufacturer/supplier unless otherwise specified herein.

b. The fountain equipment supplier must currently be in business of supplying fountain equipment, similar to size and complexity. The equipment supplier shall provide written documentation of supplying fountain equipment and expertise, similar in size and complexity for a minimum of five (5) years.

1.4.2 Installer Qualifications

Installer shall be a firm that shall have a minimum of five years of

successful installation experience with projects utilizing fountains similar in type and scope to that required for this Project, and shall be approved by the manufacturer.

1.4.3 Engineer Qualifications

The engineer shall be a professional engineer legally authorized to practice in the jurisdiction where the Project is located and experienced in providing engineering services of the kind indicated that have resulted in the installation of products similar to this Project in material, design, and extent, and that have a record of successful in-service performance.

1.4.4 Regulatory Requirements

Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.

1.4.5 Pre-Installation Conference

At the start of the installation, periodically as work progresses, and after completion, furnish the services of the manufacturer's authorized field representative at the job site as necessary to advise on every phase of the work. Provide technical assistance to the Installer as may be required.

1.5 DELIVERY, STORAGE AND HANDLING

Deliver materials to the Project site in suppliers or manufacturer's original wrappings and containers, labeled with suppliers or manufacturer's name, material or product brand name, and lot number, if any.

The fountain installer shall inspect the fountain basin equipment and all other equipment in the shipment upon arrival to ascertain any damage incurred of repair or replacement of equipment if necessary.

Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.6 WARRANTY

Contractor shall provide warranty of the work of this Section to be in accordance with the Contract Documents and free from defects in materials and workmanship for a period of one year.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

The fountain equipment and the material specified in this Section shall be installed by fountain contractor (installer) in accordance with the fountain manufacturer's recommendation to form two completely separate, identical, mirror image, reflecting pools with complete operating fountain pumping systems in order to produce the desired effects in the design statement written and shown on the Drawings.

Each fountain basin shall consist of a recessed, approximately 30-feet long

by 13-feet rectangular pool. The water will be introduced into the pool through eyeball fittings that will be installed equally under a raised open joint paver system. The water will enter through the Eyeball fittings and through the open joints so as to not create any water disturbances on the surface of the upper pool. The water will recirculate in the pool before being returned to the pump through the skimmer and floor Sump suction fittings.

2.1.1 Plumbing System Requirements

The pumping system for the reflecting pool will be installed on Fibergrate pumping skids and located in the pump room as shown on the drawings. The reflecting pool basin effect for the fountain requires 2 Horsepower pump at 120 gallons per minute at 50 feet of head. The filter is sized at 150 square feet which will filter the entire volume of water in the system once about every 30 minutes hours. In order to maintain water clarity, an ionization and bromine units are included with the pumping system. Refer to Section 22 52 00 REFLECTING POOL PLUMBING SYSTEMS.

A minimum 1-inch incoming cold water supply line at 50 PSI maximum will need to be brought to the pump room equipment station. The power supply for the pumping room is 120 volt, single phase, 100 amps.

The pump room shall be equipped with a minimum 4 inch floor drain, lighting and ventilation so as to turn over the entire volume of air in the room once every 2 to 4 minutes. The pump room doors shall be 6 feet wide, double doors for access.

The two reflecting pool pumping systems will operate independently from one another but will be controlled from a single control panel mounted in the pump room.

2.1.2 Electrical Requirements

The electrical control panel supplied shall be no less than a UL Listed assembly with industrial application rating, NEMA 4 enclosure construction, containing all required disconnects, starters, relays, timing devices, control switches and all indicating pilot lights for local and/or remote automatic operation, pre-wired to field terminals. The UL Listed assembly shall contain all additionally required protection per 2013 NEC section 680.

2.2 POOL BASIN FOUNTAIN EQUIPMENT

2.2.1 Surface Skimmer

High-impact plastic body; plastic flap weir; removable plastic basket; brass faceplate with brass screws; 1-1/2 inch female N.P.T. connection.

2.2.2 Eyeball Fitting

Cast brass body with water stop flange; Brass or CPB 1-inch orifice eyeball, insert, lock ring and guide bushing; bonding screw; Brass or CPB companion flange; 2-inch female N.P.S. connection. PVC is not acceptable.

2.2.3 Main Pool Drain

Cast bronze and brass; adjustable base with lock ring; bonding screw; plug made of brass with male threads, neoprene O-ring and cross handle; 4-inch N.P.T. female connection. PVC is not acceptable.

2.2.4 Wall Niche Overflow

Cast brass body; brass slotted grate with 5 sq. in. open area; 3-inch by 6-inch rectangular face; bonding screw; 2-inch female N.P.T. connection. PVC is not acceptable.

2.2.5 Small Sump

High-impact cycolac plastic body; 8-inch diameter anti-vortex plate; 2-inch N.P.T. female bottom connections; 1-1/2-inch N.P.T. female side connections.

2.2.6 Anti-Vortex Plate

Twelve by 12-inch stainless steel anti-vortex plate.

2.2.7 Dual Water Level Sensor

Cast bronze, copper, brass, and stainless steel construction; stainless steel cover plate; perma-magnet activated reed switch sensors; adjustability after installation; 12 VAC, 0.5 amp, non-inductive; 3/4-inch NPT bottom connection.

2.3 WATERPROOFING SYSTEM

2.3.1 Cemetitious Crystalline Penetrating Waterproofing

Prepackaged, colored proprietary blend of portland cement, specially treated sand, and active chemicals that, when mixed with water and applied, penetrates into concrete and concrete unit masonry and reacts chemically with the byproducts of cement hydration in the presence of water to develop crystalline growth within substrate capillaries to produce an impervious, dense, waterproof substrate; with properties complying with or exceeding the criteria specified below.

a. Water Permeability: Maximum zero for water at 30 feet when tested according to COE CRD-C 48.

b. Compressive Strength: Minimum 4000 psi at 28 days when tested according to ASTM C 109/C 109M.

c. Color: Black.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verification of Conditions

Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Government and the Architect, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

a. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

3.2 EXCAVATION, TRENCHING AND BACKFILLING

Excavate to permit the pipes to be laid at the intended elevations and to permit work space for installing connections and fittings.

Minimum cover (distance from top of pipe or electrical conduit to finish grade) of 12 inches over fountain pipe and over electrical conduit.

Backfill shall be free from rubbish, vegetable matter, and stones larger than two inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe shall be free of sharp objects which may damage the pipe.

Backfill un-sleeved pipe in either of the following manners:

a. Backfill and puddle the lower half of the trench. Allow to dry 24 hours. Backfill the remainder of the trench in 6-inch layers. Compact to 95 percent density.

b. Backfill the trench by depositing the backfill material equally on both sides of the pipe in 6-inch layers and compacting to 95 percent density.

Dress backfilled areas to original grade. Incorporate excess backfill into existing site grades.

Where utilities interfere with trenching and pipe work, contact the Government's Representative for trench depth adjustments.

3.3 INSTALLATION

Construct entire Fountain assembly in accordance with the drawings and specifications, including but not limited to foundations, reinforced concrete slabs, walls, and benches, waterproofing, cut stone finishes, loose stone in basins, and all other materials necessary for a complete, waterproof and functional fountain assembly.

Install fountain equipment in accordance with the manufacturer's written installation instructions, reviewed product data, and final shop drawings.

3.4 WATERPROOFING SYSTEM APPLICATION

Comply with waterproofing manufacturer's written instructions for application and curing.

a. Saturate surface with water for several hours and maintain damp condition until applying waterproofing. Remove standing water.

b. Apply waterproofing to surfaces, and extend waterproofing onto adjacent surfaces as follows:

1) Onto every substrate in areas indicated for treatment, including pipe trenches, pipe chases, pits, sumps, and similar offsets and features.

c. Number of Coats: Number required for specified water permeability.

d. Application Method: Apply to ensure that each coat fills voids and is in full contact with substrate or previous coat.

e. Dampen surface between coats.

3.4.1 Finishing

Final Coat Finish: Smooth.

Curing: Moist-cure waterproofing for three days immediately after final coat has set, followed by air drying, unless otherwise recommended in writing by manufacturer.

3.5 SYSTEM STARTUP

Fountain equipment manufacturer shall be present for the initial startup of the fountain system.

Contractor shall adjust fountain water system for volume and water flow characteristics to reflect design intent as approved by Contracting Officer.

Contractor shall have the following conditions satisfied prior to departure of personnel from factory.

a. All electrical connections shall be made and tested.

b. Pump and filter motors shall be power tested to insure proper impeller rotation at specified voltage.

c. Electronic water level control and/or low water cut-off control shall be installed and wired for operation.

d. All hydraulic lines and fittings shall be pressure tested for leaks, repaired as necessary, and flushed clean. Basket strainers shall be checked and cleaned as required.

e. All eyeball return fittings, manifolds, headers shall be installed properly and flushed of debris as required. Final eyeball adjustment for position and throttling to achieved specified performance for all display discharge points to be performed by installing contractor.

f. Pump skids, when supplied by manufacturer shall be thoroughly cleaned of debris, tested for electrical integrity and pressure tested for leaks.

g. Chemical feed system, when supplied, shall be filled to proper level with required dosage of chemicals.

h. The fountain basin shall be thoroughly cleaned and filled to proper water level with clean, fresh water.

i. Contractor shall make available to factory personnel a plumber and electrician who have first-hand knowledge of the fountain installation, at contractors own expense.

j. Contractor will perform any manual labor or provide any tools for adjustment and start-up.

3.6 ADJUSTING AND CLEANING

Adjust the fountain equipment for proper operation.

3.7 DEMONSTRATION

Engage a factory-authorized service representative to provide start-up services to demonstrate and train the Government's maintenance personnel as described below.

a. Test and adjust controls and safeties. Replaced damaged and malfunctioning controls and equipment.

b. Train the Government's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, service and preventative maintenance.

c. Review data in the operation and maintenance manual.

d. Schedule training with the Government, through the Contracting Officer, with at least seven days advance notice.

-- End of Section --

SECTION 22 00 00

PLUMBING, GENERAL PURPOSE
11/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22/CSA 4.4	(1999; Addenda A 2000, Addenda B 2001; R 2004) Relief Valves for Hot Water Supply Systems

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP	(2010; INT 1 2011; Errata 2011, Errata 2011; Errata 2011, INT 2-12 2011, Errata 2011; Addenda A, B, C, G, H, J, K, O, P, S, Y, Z, BZ, CG, CI, AND DS 2012; INT 13 2012; Errata 2012, Errata 2012, Errata 2012, Errata 2012) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(2008) Performance Requirements for Atmospheric Type Vacuum Breakers (ANSI approved 2009)
ASSE 1010	(2004) Performance Requirements for Water Hammer Arresters (ANSI approved 2004)
ASSE 1011	(2004; Errata 2004) Performance Requirements for Hose Connection Vacuum Breakers (ANSI approved 2004)
ASSE 1012	(2009) Performance Requirements for Backflow Preventer with an Intermediate Atmospheric Vent - (ANSI approved 2009)
ASSE 1013	(2009) Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers - (ANSI approved 2010)
ASSE 1018	(2001) Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied (ANSI Approved 2002

ASSE 1020	(2004; Errata 2004; Errata 2004) Performance Requirements for Pressure Vacuum Breaker Assembly (ANSI Approved 2004)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA 10084	(2005) Standard Methods for the Examination of Water and Wastewater
AWWA C606	(2011) Grooved and Shouldered Joints
AWWA C651	(2005; Errata 2005) Standard for Disinfecting Water Mains
AWWA C652	(2011) Disinfection of Water-Storage Facilities
AWWA C700	(2009) Standard for Cold Water Meters - Displacement Type, Bronze Main Case
AWWA C701	(2007) Standard for Cold-Water Meters - Turbine Type for Customer Service

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2011) Specification for Filler Metals for Brazing and Braze Welding
AWS B2.2/B2.2M	(2010) Specification for Brazing Procedure and Performance Qualification

ASME INTERNATIONAL (ASME)

ASME A112.1.2	(2012) Standard for Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)
ASME A112.14.1	(2003; R 2008) Backwater Valves
ASME A112.19.2/CSA B45.1	(2008; Update 1 2009; Update 2 2011) Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals
ASME A112.19.3/CSA B45.4	(2008; Update 1 2009; Update 2 2011) Stainless Steel Plumbing Fixtures
ASME A112.36.2M	(1991; R 2008) Cleanouts
ASME A112.6.1M	(1997; R 2008) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.6.3	(2001; R 2007) Standard for Floor and Trench Drains
ASME B1.20.1	(1983; R 2006) Pipe Threads, General Purpose (Inch)

ASME B16.18	(2012) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(2011) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2001; R 2010) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(2011) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.29	(2007) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.5	(2009) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.50	(2001; R 2008) Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings
ASME B31.1	(2010) Power Piping
ASME B31.5	(2010) Refrigeration Piping and Heat Transfer Components
ASME B40.100	(2005; R 2010) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	(2010) BPVC Section IX-Welding and Brazing Qualifications

ASTM INTERNATIONAL (ASTM)

ASTM A105/A105M	(2011a) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A183	(2003; R 2009) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A193/A193M	(2012) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A515/A515M	(2010) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A516/A516M	(2010) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A74	(2009) Standard Specification for Cast Iron Soil Pipe and Fittings

ASTM A888	(2011) Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B117	(2011) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B32	(2008) Standard Specification for Solder Metal
ASTM B370	(2011e1) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B42	(2010) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B43	(2009) Standard Specification for Seamless Red Brass Pipe, Standard Sizes
ASTM B813	(2010) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B88	(2009) Standard Specification for Seamless Copper Water Tube
ASTM C564	(2011) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C920	(2011) Standard Specification for Elastomeric Joint Sealants
ASTM D2000	(2012) Standard Classification System for Rubber Products in Automotive Applications
ASTM D2822/D2822M	(2005e1; R 2011) Asphalt Roof Cement
ASTM D3139	(1998; R 2011) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3212	(2007) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3311	(2011) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM E1	(2007) Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM F409	(2002; R 2008) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F477	(2010) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(2009) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(2011) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015	(1994; R 1995) Copper Tube Handbook

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1	(2009) Accessible and Usable Buildings and Facilities
ICC IPC	(2009) International Plumbing Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110	(2010) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-25	(2008) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(2009) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-69	(2003) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)
MSS SP-70	(2011) Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(2011) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	(2010a) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-80	(2008) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2012) Standard for the Installation of Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF/ANSI 61	(2011; Addenda 2012) Drinking Water System Components - Health Effects

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA Fire Man	(2010) Firestopping: Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201	(2010) Water Hammer Arresters Standard

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508	(2009) Hose Clamp Specifications

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

PL 93-523	(1974; A 1999) Safe Drinking Water Act

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 141.80	National Primary Drinking Water Regulations; Control of Lead and Copper; General Requirements
PL 109-58	Energy Policy Act of 2005 (EPAct05)

UNDERWRITERS LABORATORIES (UL)

UL 499	(2005; Reprint Apr 2012) Electric Heating Appliances

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Plumbing System; G, AE

Detail drawings consisting of schedules, performance charts, instructions, diagrams, and other information to illustrate the requirements and operations of systems that are not covered by the Plumbing Code. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

SD-03 Product Data

Fixtures

List of installed fixtures with manufacturer, model, and flow rate.

Flush valve water closets
Flush valve urinals
Wall hung lavatories
electronic faucet

Water heaters
Backflow prevention assemblies
Water Hammer Arrester
Precast Terrazzo Mop Sinks
Welding
Water meters
Bolts

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Plumbing System

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

SD-06 Test Reports

Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Test of Backflow Prevention Assemblies.

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Materials and Equipment

SD-10 Operation and Maintenance Data

Plumbing System

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.1 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.4 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Welding

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record.

1.6 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC. Energy consuming products and systems shall be in accordance with PL 109-58 and ASHRAE 90.1 - IP

1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.8 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the

equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.9 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 Materials

Materials for various services shall be in accordance with TABLES I and II. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead shall not be used in any potable water system. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF/ANSI 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Plastic pipe shall not be installed.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Solder containing lead shall not be used with copper pipe. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A74, AWWA C606. For hubless type: CISPI 310

b. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.

c. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.

d. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.

e. Solder Material: Solder metal shall conform to ASTM B32.

f. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.

g. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.

h. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C564.

i. Rubber Gaskets for Grooved Pipe: ASTM D2000, maximum temperature 230 degrees F.

j. Flexible Elastomeric Seals: ASTM D3139, ASTM D3212 or ASTM F477.

k. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A183.

l. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A105/A105M. Blind flange material shall conform to ASTM A516/A516M cold service and ASTM A515/A515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A193/A193M.

m. Copper tubing shall conform to ASTM B88, Type K, L or M.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Water Hammer Arrester: PDI WH 201. Water hammer arrester shall be piston type.

b. Copper, Sheet and Strip for Building Construction: ASTM B370.

c. Asphalt Roof Cement: ASTM D2822/D2822M.

d. Hose Clamps: SAE J1508.

e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

f. Metallic Cleanouts: ASME A112.36.2M.

g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

h. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.

i. Thermometers: ASTM E1. Mercury shall not be used in thermometers.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Backwater Valves	ASME A112.14.1
Vacuum Relief Valves	ANSI Z21.22/CSA 4.4
Trap Seal Primer Valves	ASSE 1018

2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with ICC IPC. Fixtures for use by the physically handicapped shall be in accordance with ICC A117.1. ASME A112.19.3/CSA B45.4 302 stainless steel , nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other

flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains shall be copper alloy with all visible surfaces chrome plated. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature.

2.4.1 Lavatories

Vitreous china lavatories shall be provided with two cast-iron or steel brackets secured to the underside of the apron and drilled for bolting to the wall in a manner similar to the hanger plate. Exposed brackets shall be porcelain enameled. Vitreous china lavatories shall be provided with two integral molded lugs on the back-underside of the fixture and drilled for bolting to the wall in a manner similar to the hanger plate.

2.4.2 Electronic Faucet

Provide electronic faucet with proximity operation for hand-free operation; vandal-resistant solid brass construction with single post mounting. Hardwired AC permanent power.

2.4.3 Flush Valve Water Closets

ASME A112.19.2/CSA B45.1, white vitreous china, siphon jet, elongated bowl, wall mounted, wall outlet. Top of toilet seat height above floor shall be 14 to 15 inches, except 17 to 19 inches for wheelchair water closets. Provide wax bowl ring including plastic sleeve. Provide white solid plastic elongated open-front seat.

Water flushing volume of the water closet and flush valve combination shall not exceed 1.6 gallons per flush. Provide a 1.28 gpf water closet.

Provide electronic-sensored flush valve for hand-free operation. Sensor shall be hardwired, UL approved hardwired AC transformer. Fully mechanical manual override, allows for valve to flush during a power failure.

Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Mounted height of flush valve shall not interfere with the hand rail in ADA stalls.

2.4.4 Flush Valve Urinals

ASME A112.19.2/CSA B45.1, white vitreous china, wall-mounted, wall outlet, siphon jet, integral trap, and extended side shields. Provide urinal with the rim 24 inches above the floor. Water flushing volume of the urinal and flush valve combination shall not exceed 0.5 gallons per flush. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe

supports. Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.

2.4.5 Wall Hung Lavatories

ASME A112.19.2/CSA B45.1, white vitreous china, straight back type, minimum dimensions of 19 inches, wide by 17 inches front to rear, with supply openings for use with top mounted centerset faucets, and openings for concealed arm carrier installation. Provide aerator with faucet. Water flow rate shall not exceed 0.5 gpm when measured at a flowing water pressure of 60 psi. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports and concealed arms for the lavatory. Mount lavatory with the front rim 34 inches above floor and with 29 inches minimum clearance from bottom of the front rim to floor. Provide top mounted washerless centerset lavatory faucets.

2.4.6 Precast Terrazzo Mop Sinks

Terrazzo shall be made of marble chips cast in white portland cement to produce 3000 psi minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers.

2.5 BACKFLOW PREVENTERS

Backflow prevention devices must be approved by the State or local regulatory agencies. If there is no State or local regulatory agency requirements, the backflow prevention devices must be listed by the Foundation for Cross-Connection Control & Hydraulic Research, or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention devices and assemblies.

Reduced pressure principle assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be meet the above requirements.

Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.6 DRAINS

2.6.1 Floor Drains

Floor drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor

thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor drains shall conform to ASME A112.6.3. Provide drain with trap primer connection, trap primer, and connection piping. Primer shall meet ASSE 1018.

2.7 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F409 or copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be withouta cleanout. Provide traps with removable access panels for easy clean-out at sinks and lavatories. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.8 AUTOMATIC TRAP PRIMER VALVE

Provide automatic trap primer shall be 1/2-inch inlet by 1/2-inch outlet, which activates with a 10 psig pressure drop. Water release shall be factory set. Large port opening and a non-corrosive brass finish shall be UPC/IAPMO listed, ASSE Certified to the ASSE 1018 standard.

2.9 PRESSURE REDUCING VALVES

Pressure-reducing valve shall maintain a constant downstream pressure, plus or minus 2 psi, regardless of changing inlet pressure. All flow conditions from zero flow to full flow shall be handled in a stable manner. The valve shall be designed for a maximum working inlet pressure of 350 psi. The reduced pressure spring range shall be either 7-29, 29-87, or 80-145 psi, as indicated on Drawings. Valve shall close drop tight when the downstream pressure rises to the set point of the spring setting. No pressure "creep" or leakage will be tolerated. Valve shall be of high capacity, balanced, single seat design. Valve body and cover shall be constructed of bronze material; valve trim shall be of type 416 stainless steel.

The self-contained pressure-reducing valve shall include a permaphragm assembly, all internal seals, spring, spring guide, adjustment nut, stem, and a floating stainless steel seat. The permaphragm assembly shall be fully guided above and below the molded, reinforced synthetic rubber permaphragm. Design of the permaphragm shall be such that any stem travel will not cause any stretching or fatigue. The perimeter of the permaphragm shall be molded to form a bead ring which will enable highly reliable

attachment between the cover and the permaphragm retainer without the requirement of high compression of the bead ring (outer perimeter) of the permaphragm. Flat, die-cut diaphragms will not be permitted.

Valve shall be constructed with union tailpieces at both the inlet and the outlet ends. Dual body tappings shall make it possible to install a pressure gauge on either side of the valve to monitor the downstream pressure. Valve shall be a standard production model and the manufacturer shall have a proven history of reliable and satisfactory products for a period of not less than 10 years.

2.10 WATER HEATERS

2.10.1 Electric Instantaneous Water Heaters (Tankless)

UL 499 and UL listed flow switch activated, tankless electric instantaneous water heater for wall mounting below sink or lavatory.

2.11 STORM WATER PIPING, ABOVE GRADE

2.11.1 Cast Iron Pipe

Cast iron pipe CISPI; ASTM A 888, service weight, hubless. Fittings shall be cast iron, ASTM A 888. Joints ASTM C 564, rubber gasket and stainless steel clamp and shield assemblies. Unions for pipe 2-inches and smaller:

a. Copper Piping: Class 150, bronze unions with soldered brazed joints.

b. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

Flanges for pipe 2-1/2 inches and larger:

a. Copper Piping: Class 150, slip-on bronze flanges.

b. Gaskets: 1/16-inch thick, preformed neoprene gaskets.

2.11.2 Downspout Nozzle

All nickel bronze body, with removable stainless steel screen.

2.12 DOMESTIC WATER SERVICE METER

Cold water meters 2-inches and smaller shall be positive displacement type conforming to AWWA C700. Cold water meters 2-1/2 inches and larger shall be turbine type conforming to AWWA C701. Meter register may be round or straight reading type. Advance water meter (smart meter) shall have BACnet communication interface capability. Meter shall be provided with a pulse generator, remote readout register, and all necessary wiring and accessories.

2.13 MISCELLANEOUS PIPING ITEMS

2.13.1 Roof Drain

Coated cast iron roof drain, large polypropylene locking dome, non-punch ring clamp with integral gravel stop, large sump with wide roof flange and bottom outlet.

2.13.2 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated on copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

2.13.3 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor.

2.13.3.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.13.4 Pipe Hangers (Supports)

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.13.5 Nameplates

Provide 0.125 inch thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 0.25 inch high normal block lettering into the white core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA Fire Man. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A ball valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior

service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the average local frost depth or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the

pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

3.1.1.7 Thrust Restraint

Plugs, caps, tees, valves and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 4 inches in diameter or larger shall be provided with thrust blocks, where indicated, to prevent movement. Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms. The area of bearing will be as shown. Blocking shall be placed so that the joints of the fitting are accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.1.8 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

3.1.2 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching

of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.2.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.2.2 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

3.1.2.3 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.2.4 Copper Tube and Pipe

a. Brazed. Brazed joints shall be made in conformance with AWS B2.2/B2.2M, ASME B16.50, and CDA A4015 with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015. Soldered joints shall not be used in compressed air piping between the air compressor and the receiver.

3.1.2.5 Other Joint Methods

3.1.3 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.4 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.4.1 Sleeve Requirements

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.

A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.

Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor.

Unless otherwise indicated, sleeves shall be of a size to provide a minimum of one inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic.

Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C920 and with a primer, backstop material and surface preparation as specified in Section 07 92 00 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated.

Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and concrete wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant.

3.1.5 Supports

3.1.5.1 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

e. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.5.2 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

3.1.6 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.7 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks

in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron.

3.2 WATER HEATERS

3.2.1 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 39 inches above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 30 inches above the floor and arranged to avoid interference with grab bars. In addition, for water closets intended for handicap use, the flush valve handle shall be installed on the wide side of the enclosure.

3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 42 inches above floor. Wall-hung service sinks shall be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with ICC A117.1.

3.3.4 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.3.4.1 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.3.4.2 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

3.3.5 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with IPC at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3.6 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced,

maintained, or replaced. Access panels shall be as specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

3.3.7 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D3311. Traps for acid-resisting waste shall be of the same material as the pipe.

3.4 IDENTIFICATION SYSTEMS

3.4.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.4.2 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves, dampers, switches, linkages and thermostats. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 3/8 inch in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the approximate dimensions of 3 foot width, 30 inches height, and 1/2 inch thickness. The board shall be made of wood fiberboard and framed under glass or 1/16 inch transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters.

3.5 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.6 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in

concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTS AND COATINGS.

3.6.1 Painting of New Equipment

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.6.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

3.6.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.

b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

3.7 TESTS, FLUSHING AND DISINFECTION

3.7.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with IPC, except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure to the Contracting Officer for approval.

a. Drainage and Vent Systems Test. The final test shall include a smoke test.

b. Building Sewers Tests.

c. Water Supply Systems Tests.

3.7.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies.

Backflow prevention assembly test gauges shall be tested annually for accuracy in accordance with the requirements of State or local regulatory agencies. If there is no State or local regulatory agency requirements, gauges shall be tested annually for accuracy in accordance with the requirements of University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14), or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention assembly test gauges. Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.7.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be

repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.7.3 System Flushing

3.7.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with hot potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF/ANSI 61, Section 9, shall be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.

3.7.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions. Comply with ASHRAE 90.1 - IP for minimum efficiency requirements. Unless more stringent local requirements exist, lead levels shall not exceed limits established by 40 CFR 141.80 (c)(1). The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.7.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

b. Water pressures at the most remote and the highest fixtures.

c. Operation of each fixture and fixture trim.

d. Operation of each valve, hydrant, and faucet.

e. Temperature of each domestic hot-water supply.

f. Operation of each floor and roof drain by flooding with water.

g. Operation of each vacuum breaker and backflow preventer.

3.7.5 Disinfection

After all system components are provided and operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. Before introducing disinfecting chlorination material, entire system shall be flushed with potable water until any entrained dirt and other foreign materials have been removed.

Water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652 as modified and supplemented by this specification. The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). Feed a properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or inject liquid chlorine into the system through a solution-feed chlorinator .

Test the chlorine residual level in the water at 6 hour intervals for a continuous period of 24 hours. If at the end of a 6 hour interval, the chlorine residual has dropped to less than 25 ppm, flush the piping including tanks with potable water, and repeat the above chlorination procedures. During the chlorination period, each valve and faucet shall be opened and closed several times.

After the second 24 hour period, verify that no less than 25 ppm chlorine residual remains in the treated system. The 24 hour chlorination procedure must be repeated until no less than 25 ppm chlorine residual remains in the treated system.

Upon the specified verification, the system including tanks shall then be flushed with potable water until the residual chlorine level is reduced to less than one part per million. During the flushing period, each valve and faucet shall be opened and closed several times.

Take addition samples of water in disinfected containers, for bacterial examination, at locations specified by the Contracting Officer Test these samples for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10084. The testing method used shall be EPA approved for drinking water systems and shall comply with applicable local and state requirements.

Disinfection shall be repeated until bacterial tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.8 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.9 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, minimum overall efficiency.

ET = Minimum thermal efficiency with 70 degrees F delta T.

SL = Standby loss is maximum (Btu/h) based on a 70 degrees F temperature difference between stored water and ambient requirements.

V = Rated volume in gallons

Q = Nameplate input rate in kW (Btu/h)

3.9.1 Storage Water Heaters

3.10 TABLES

TABLE I

PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A74 with compression gaskets. Pipe and fittings shall be marked with the CISPI trademark.	X	X	X		X	

TABLE I

PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A888 Pipe and fittings shall be marked with the CISPI trademark.		X		X	X	
3	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X	X	
4	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X	X	

SERVICE:
A - Underground Building Soil, Waste and Storm Drain
B - Aboveground Soil, Waste, Drain In Buildings
C - Underground Vent
D - Aboveground Vent
E - Interior Rainwater Conductors Aboveground
F - Corrosive Waste And Vent Above And Belowground
* - Hard Temper

TABLE II

PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C
	Malleable-iron threaded fittings:			

TABLE II

PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C
1	Seamless red brass pipe, ASTM B43	X	X	X
2	Seamless Copper Pipe, ASTM B42	X	X	X
3	Seamless copper water tube, ASTM B88/B88M	X**	X**	X**
4	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22	X	X	X
5	Cast copper alloy solder-joint pressure fittings, ASME B16.18	X	X	X
	Press Fittings: A - Cold Water Service Aboveground B - Hot and Cold Water Distribution 180 degrees F Maximum Aboveground C - Cold Water Service Belowground Indicated types are minimum wall thicknesses. ** - Type L - Hard *** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors **** - In or under slab floors only brazed joints			

-- End of Section --

SECTION 22 05 33

HEAT TRACING FOR PLUMBING PIPING
05/13

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 515	(2004) Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011) National Electrical Code

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Self-Regulating, Parallel-Resistance Heating Cables; G
Thermostats for Freeze Protection; G

Include plans, elevations, sections, and attachment details. Include diagrams for power, signal, and control wiring.

SD-03 Product Data

Self-Regulating, Parallel-Resistance Heating Cables
Thermostats for Freeze Protection
Accessories

Include rated capacities, operating characteristics, and furnished specialties and accessories. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.

SD-10 Operation and Maintenance Data

test and inspection reports
Operation and Maintenance Manual Data; G

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Plumbing piping heat tracing for freeze prevention with the following electric heating cables:

a. Self-regulating, parallel resistance.

2.2 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

Comply with IEEE 515.1.

2.2.1 Heating Element

Pair of parallel No. 16 AWG, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

2.2.2 Electrical Insulating Jacket

Flame-retardant thermoplastic rubber.

2.2.3 Cable Cover

Tinned-copper braid TPR overcoat.

2.2.4 Maximum Operating Temperature (Power On)

100 deg F.

2.2.5 Maximum Exposure Temperature (Power Off)

185 deg F.

2.2.6 Electrical Components, Devices, and Accessories

Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2.7 Capacities and Characteristics

a. Maximum Heat Output: 8 W/ft.

b. Piping Diameter: 2-1/2 NPS.

c. Spiral Wrap Pitch: Determined in field by installer.

d. Electrical Characteristics for Single-Circuit Connection:

1) Volts: 120.
2) Phase: Single.
3) Hertz: 60.

2.3 CONTROLS

Pipe-Mounted Thermostats for Freeze Protection:

a. Remote bulb unit with adjustable temperature range from 30 to 50 deg F.

b. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.

c. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.

d. Corrosion-resistant, waterproof control enclosure.

2.4 ACCESSORIES

Cable installation accessories include fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

2.4.1 Warning Tape

Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.

a. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.

PART 3 EXECUTION

3.1 EXAMINATION

Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.

a. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.

Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

Install the following types of electric heating cable for the applications described:

a. Freeze protection.

3.3 INSTALLATION

Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.

Electric Heating-Cable Installation for Freeze Protection for Piping:

a. Install electric heating cables after piping has been tested and before insulation is installed.

b. Install electric heating cables according to IEEE 515.1.

c. Install insulation over piping with electric cables according to Section 22 07 19.00 40 PLUMBING PIPING INSULATION.

d. Install warning tape on piping insulation where piping is equipped with electric heating cables.

3.4 CONNECTIONS

Ground equipment according to manufacturers instructions.

Connect wiring according to Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.5 FIELD QUALITY CONTROL

Perform the following tests and inspections:

a. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.

b. Test cables for electrical continuity and insulation integrity before energizing.

c. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.

Cables will be considered defective if they do not pass tests and inspections.

Prepare test and inspection reports.

3.6 OPERATION AND MAINTENANCE MANUALS

Provide Operation and Maintenance Manual Data written by the manufacturer.

3.7 PROTECTION

Protect installed heating cables, including nonheating leads, from damage during construction. Remove and replace damaged heat-tracing cables.

-- End of Section --

SECTION 22 07 19.00 40

PLUMBING PIPING INSULATION
02/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B209	(2010) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C1136	(2010) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C195	(2007) Standard Specification for Mineral Fiber Thermal Insulating Cement
ASTM C449	(2007) Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C547	(2012) Standard Specification for Mineral Fiber Pipe Insulation
ASTM C795	(2008) Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C916	(1985; R 2007) Standard Specification for Adhesives for Duct Thermal Insulation
ASTM C920	(2011) Standard Specification for Elastomeric Joint Sealants
ASTM C921	(2010) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM D579	(2010) Standard Specification for Greige Woven Glass Fabrics
ASTM E96/E96M	(2010) Standard Test Methods for Water Vapor Transmission of Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 220	(2012) Standard on Types of Building Construction
NFPA 255	(2006) Standard Method of Test of Surface

Burning Characteristics of Building Materials

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS 3779 (1990; Rev A; R 1994) Tape Adhesive, Pressure Sensitive Thermal Radiation Resistant, Aluminum Foil/Glass Cloth

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595 (Rev C; Notice 1) Colors Used in Government Procurement

1.2 PERFORMANCE REQUIREMENTS

Provide noncombustible thermal-insulation system materials, as defined by NFPA 220. Provide adhesives, coatings, sealants, facings, jackets, and thermal-insulation materials with a flame-spread classification (FSC) of 25 or less , and a smoke-developed classification (SDC) of 50 or less . Determine these maximum values in accordance with NFPA 255. Provide coatings and sealants that are nonflammable in their wet state.

Provide adhesives, coatings, and sealants with published or certified temperature ratings suitable for the entire range of working temperatures normal for the surfaces to which they are to be applied.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings; G

SD-03 Product Data

Adhesives
Coatings
Insulating Cement
Insulation Materials
Jacketing
Tape

SD-07 Certificates

Recycled Materials

SD-08 Manufacturer's Instructions

Installation Manual

1.4 PRE-INSTALLATION REQUIREMENTS

Within 30 days of Contract Award, submit installation drawings for pipe

insulation, conforming with the adhesive manufacturer's written instructions for installation. Submit installation manual clearly stating the manufacturer's instructions for insulation materials

PART 2 PRODUCTS

2.1 INSULATION PRODUCTS AND ACCESSORIES

Provide manufacturer's catalog data for all materials provided under this Section:

a. Adhesives

b. Coatings

c. Insulating Cement

d. Insulation Materials

e. Jacketing

f. Tape

Provide compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state. Meet ASTM C795 requirements for materials to be used on stainless steel surfaces. Provide materials that are asbestos free and conform to the following.

2.2 INSULATION MATERIALS

Provide materials with maximum value conductances as tested at any point, not an average. Replace or augment insulation conductance found by test to exceed the specified maximum by an additional thickness to bring it to the required maximum conductance and a complete finishing system.

2.2.1 Fiberglass Insulation

Conform to ASTM C547. Ensure the apparent thermal conductivity does not exceed 0.54 Btu-inch per hour per square foot per degree F at 200 degrees F mean.

Fiber glass pipe insulation having an insulating efficiency not less than that of the specified thickness of mineral fiber pipe insulation may be provided in lieu of mineral fiber pipe insulation for aboveground piping.

2.3 ADHESIVES

2.3.1 Cloth Adhesives

Provide adhesives for adhering, sizing, and finishing lagging cloth, canvas, and open-weave glass cloth with a pigmented polyvinyl acetate emulsion conforming to the requirements of ASTM C916, Type I.

2.3.2 Vapor-Barrier Material Adhesives

Provide adhesives for attaching laps of vapor-barrier materials and presized glass cloth for attaching insulation to itself, to metal, and to various other substrates, of nonflammable solvent-base, synthetic-rubber

type conforming to the requirements of ASTM C916, Type I, for attaching fibrous-glass insulation to metal surfaces.

2.4 INSULATING CEMENT

2.4.1 General Purpose Insulating Cement

Provide general purpose insulating cement, mineral fiber,conforming to ASTM C195. Ensure composite is rated for 1800 degrees F service, with a thermal-conductivity maximum of 0.85 Btu by inch per hour per square foot for each degree F temperature differential at 200 degrees F mean temperature for 1 inch thickness.

2.4.2 Finishing Insulating Cement

Provide finishing insulating cement of a mineral-fiber, hydraulic-setting type conforming to ASTM C449.

2.5 caulking

Provide elastomeric joint sealant for caulking specified insulation materials in accordance with ASTM C920, Type S, Grade NS, Class 25, Use A.

2.6 CORNER ANGLES

Provide nominal 0.016 inch aluminum 1 by 1 inch corner angle piping insulation with factory applied kraft backing. Ensure aluminum conforms to ASTM B209.

2.7 JACKETING

2.7.1 Aluminum Jacket

Provide aluminum jackets conforming to ASTM B209, Temper H14, minimum thickness of 0.016 inch, with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside diameters less than 8 inches. Provide corrugated surface jackets for jacket outside diameters 8 inches and larger. Provide stainless steel bands, minimum width of 0.5 inch. Provide factory prefabricated aluminum covers for insulation on fittings, valves, and flanges. Provide aboveground jackets and bands with factory-applied baked-on semigloss brown color conforming to Federal Standard FED-STD-595, "Colors," color chip number 20062.

2.7.2 PVC Jacket

Provide 0.010 inch thick, factory-premolded, one-piece fitting polyvinylchloride that is self-extinguishing, high-impact strength, moderate chemical resistance with a permeability rating of 0.01 grain per hour per square foot per inch of mercury pressure difference, determined in accordance with ASTM E96/E96M. Provide manufacturer's standard solvent-weld type vapor-barrier joint adhesive.

Conform to ASTM C1136 for, Type I, low-vapor transmission, high-puncture resistance vapor barrier for use on insulation for piping, ducts, and equipment.

2.8 COATINGS

2.8.1 Outdoor Vapor-Barrier Finishing

For coatings for outdoor vapor-barrier finishing of insulation surfaces, such as fittings and elbows, provide a nonasphaltic, hydrocarbon polymer, solvent-base mastic containing a blend of nonflammable solvents. Conform to the requirements of ASTM C1136 and ASTM C921 for coatings.

2.8.2 Indoor Vapor-Barrier Finishing

Provide pigmented resin and solvent compound coatings for indoor vapor-barrier finishing of insulation surfaces conforming to ASTM C1136, Type II.

2.8.3 Outdoor and Indoor Nonvapor-Barrier Finishing (NBF)

Provide pigmented polymer-emulsion type NBF recommended by the insulation material manufacturer for outdoor and indoor NBF coating of insulation surfaces for the surface to be coated and applied to specified dry-film thickness.

2.8.4 Coating Color

Provide white for the coating color.

2.9 TAPE

Provide a knitted elastic cloth glass lagging specifically suitable for continuous spiral wrapping of insulated pipe bends and fittings and produce a smooth, tight, wrinkle-free surface. Conform to requirements of SAE AMS 3779, SAE AMS 3779, ASTM D579, and ASTM C921 for tape, weighing not less than 10 ounces per square yard.

PART 3 EXECUTION

3.1 INSTALLATION OF INSULATION SYSTEMS

Install smooth and continuous contours on exposed work. Smoothly and securely paste down cemented laps, flaps, bands, and tapes. Apply adhesives on a full-coverage basis.

Apply insulation only to system or component surfaces that have been tested and approved.

Install insulation lengths tightly butted against each other at joints. Where lengths are cut, provide smooth and square and without breakage of end surfaces. Where insulation terminates, neatly taper and effectively seal ends, or finish as specified. Direct longitudinal seams of exposed insulation away from normal view.

Apply materials in conformance with the recommendations of the manufacturer.

Clean surfaces free of oil and grease before insulation adhesives or mastics are applied. Provide solvent cleaning required to bring metal surfaces to such condition.

Submit installation drawings for pipe insulation, conforming with the adhesive manufacturer's written instructions for installation. Submit

installation manual clearly stating the manufacturer's instructions for insulation materials.

3.2 SYSTEM TYPES

3.2.1 Type T-6, Mineral Fiber with Aluminum Jacket

Cover piping with mineral-fiber pipe insulation with factory-attached or field-applied aluminum jacketing.

Cover fittings and valve bodies with preformed mineral-fiber pipe-fitting insulation of the same thickness as the pipe-barrel insulation. Temporarily secure fitting insulation in place with light cord ties. Apply a 60-mil coating of vapor-barrier mastic, and while still tacky, wrapped with glass lagging tape.

Apply additional mastic as needed and rubber-gloved to smooth fillets or contours. Build up on-the-job fabricated insulation for special configurations from mineral fiber and a mixture of insulating cement and lagging adhesive diluted with 3 parts water. Only where standard aluminum jacketing cannot be used, make the surfaces vapor-tight by using mastic and glass lagging cloth or tape as specified above with an added finish coat of mastic.

Insulate hot-water, cold-water and condensate drain pipes to the extent shown with nominal 1-inch thick, fire-retardant fiberglass insulation.

Set pipe insulation into outdoor vapor-barrier coating for a minimum of 6 inches at maximum 12-foot spacing. Seal ends of the insulation to the jacketing with the same material to provide effective vapor barrier stops.

Install continuous vapor barrier over all surfaces, including areas inside pipe sleeves, hangers, and other concealment.

Apply piping insulation to both sides of pipe hangers. Insulate junctions with a special mastic mixture, glass cloth mesh tape, and mastic as previously specified.

Securely cement jacket laps, flaps, and bands in place with aluminum jacket sealant. Provide 6 inch wide minimum jacketing bands for butt joints.

Lap joints, wherever possible, against the weather so that the water will run off the lower edge and in accordance with the pipe drainage pitch. Locate longitudinal laps on horizontal lines 45 degrees below the horizontal centerline and alternately staggered 1 inch. Lap jacketing material a minimum of 2 inches, circumferentially sealed with mastic, and strapped to provide a waterproof covering throughout. Locate straps 8 inches on center and pull up tight to hold jacketing securely in place. Use screws in addition to straps when necessary to obtain a waterproof covering. Place extra straps on each side of supporting devices and at openings. Where flanging access occurs, strap a chamfer sheet to the pipe at jacketing.

Stiffen exposed longitudinal edges of aluminum jacketing by bending a 1 inch hem on one edge.

Provide expansion joints for maximum and minimum dimensional fluctuations.

To prevent corrosion, do not allow the aluminum jacketing to come in direct

contact with other types of metal.

At openings in jacket, apply an outdoor vapor-barrier coating for 2 inches in all directions. Apply jacketing while waterproofing is tacky.

Use screws at each corner of each sheet, at fitting jackets, and as necessary for the service. Place number 7, 3/8 inch long, binding-head aluminum sheet metal screws through the mastic seal.

3.3 ACCEPTANCE

Final acceptance is dependent upon providing construction (Record Drawings) details to the Contracting Officer. Include construction details, by building area, the insulation material type, amount, and installation method. An illustration or map of the duct routing locations may serve this purpose. With data, provide a cover letter/sheet clearly marked with the system name, date, and the words "Record Drawings insulation/material." Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --

SECTION 22 52 00

REFLECTING POOL PLUMBING SYSTEMS
01/13

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

UNDERWRITERS LABORATORIES (UL)

UL 508	(1999; R 1999 - R 2010) Industrial Control Equipment

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G
wiring diagrams; G

SD-03 Product Data

Filter System
Chemical Feeder
Chemicals
Ionization
Recirculating Pump And Motor
Piping and Fittings
Valves
Reflecting Pool Control Panel

SD-07 Certificates

Manufacturer Qualifications
Installer Qualifications
Engineer Qualifications

SD-09 Manufacturer's Field Reports

test reports

SD-10 Operation and Maintenance Data

Operating and Maintenance Manuals; G

SD-11 Closeout Submittals

As-built Drawings; G
warranty

1.3 QUALITY ASSURANCE

Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.

1.3.1 Manufacturer Qualifications

Manufacturer shall be a firm engaged in the manufacture of reflecting pools of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of five years.

a. All reflecting pool equipment required by the specifications and/or the drawings shall be supplied by a single source reflecting pool equipment manufacturer/supplier unless otherwise specified herein.

b. The reflecting pool equipment supplier must currently be in business of supplying reflecting pool equipment, similar to size and complexity. The equipment supplier shall provide written documentation of supplying reflecting pool equipment and expertise, similar in size and complexity for a minimum of five (5) years.

1.3.2 Installer Qualifications

Installer shall be a firm that shall have a minimum of five years of successful installation experience with projects utilizing reflecting pools similar in type and scope to that required for this Project, and shall be approved by the manufacturer.

1.3.3 Engineer Qualifications

The engineer shall be a professional engineer legally authorized to practice in the jurisdiction where the Project is located and experienced in providing engineering services of the kind indicated that have resulted in the installation of products similar to this Project in material, design, and extent, and that have a record of successful in-service performance.

1.3.4 Pre-Installation Conference

Using approved shop drawing, review the site with Installer to determine if pool is ready to receive the reflecting pool plumbing system.

1.4 DELIVERY, STORAGE AND HANDLING

Deliver materials to the Project site in suppliers or manufacturer's original wrappings and containers, labeled with suppliers or manufacturer's name, material or product brand name, and lot number, if any.

The reflecting pool contractor shall inspect the reflecting pool basin equipment and all other equipment in the shipment upon arrival to ascertain any damage incurred of repair or replacement of equipment if necessary.

Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.5 WARRANTY

Work of this Section shall be free from defects in workmanship and materials for a period of one year from date of Substantial Completion unless otherwise noted in this Section. Provide warranty to Government.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

All materials and equipment shall be new, free from defects, of first quality and entirely suitable for the intended service. Materials and equipment sued in this work which are subject to approval by such agencies as UL, AGA, ASME, NSF, etc. shall bear the appropriate label or stamp of approval.

2.1.1 Design Requirements

Submit shop drawings and wiring diagrams showing complete design of reflecting pool, component parts, attachments, devices, filtration filter, size, turn-over capacity, and supporting calculations. Include electrical schematic.

Include with product data, performance curves indicating GPM and TDH for pumps, maximum amperage draw, and current characteristics and service factor of motor.

2.1.2 Performance Requirements

The reflecting pool equipment and the material specified in this section shall be installed by the reflecting pool contractor (installer) in accordance with the reflecting pool manufacturer's recommendation to form two completely separate, identical, mirror image, reflecting pools with complete operating reflecting pool pumping systems in order to produce the desired effects in the design statement written and shown on the drawings.

Refer to Section 13 12 13.15 REFLECTING POOL for performance requirements associated with physical pool design and electrical requirements.

2.2 FILTER SYSTEM

2.2.1 Cartridge Filters

Provide separate filter systems for each reflecting pool. Maximum filter flow rate shall not exceed 0.375 GPM per square foot of filter area.

a. Cartridge type; made of fiberglass reinforced polypropylene tank.

b. Automatic air relief purge.

c. Integrated continuous High Flow internal air relief valve

d. Lock ring with spring-loaded safety latches

e. Coreless cartridge for easy cleaning

f. High flow manual air relief valve

g. One inch drain and wash out

h. Pressure gauge

i. NSF listed

j. With (1) 150 sq.ft. replacement cartridge filter element

2.2.1.1 Filter Media

Polyester with an effective size microns; minimum 10 microns.

2.3 WATER TREATMENT SYSTEMS

2.3.1 Chemical Feeder

Provide one chemical feeder for each reflecting pool. Chemical feeder shall include the following features:

a. Automatic dial chemcial feed.

b. In-line, corrosion resistant themoplastic body.

c. NSF Listed

d. 50 PSI maximum operating pressure.

e. Complete enclosed system with no escaping gases.

f. For use with bromine sticks or tablets.

2.3.2 Chemicals

Provide appropriate chlorine solution in stick or tablet form compatible with the chemical feeder.

2.3.3 Ionization

Provide separate ionization systems for each reflecting pool. Ionization units shall include the following:

a. NEMA 4X Waterproof equipment enclosure, gasket sealed clear acrylic view cover.
b. Anodes consisting of copper, silver and zinc.
c. Three inch diameter Ion Tee chamber.
d. UL and NSF Listed.
e. Ion test kit.
f. Self-cleaning anode feature.
g. Lifetime equipment warranty.

2.4 RECIRCULATING PUMP AND MOTOR

2.4.1 Pumps

Provide separate pumping systems for each reflecting pool. Pumps shall be capable of delivering the designated GPM at the designated head pressure during the filtering operation without overloading along the full length of the pump curve.

a. Heavy duty thermoplastic durable corrosion proof construction.

b. Integral basket strainer with see thru lexan cover.

c. Oversized basket strainer.

d. Heavy threaded connections for suction and discharge.

e. UL and NSF Listed.

2.4.2 Motor

Provide motor with horsepower and electrical requirements to meet design requirements and those recommended by the pump manufacturer.

a. Durable, commercial grade motor never needs lubrication.

Pumping systems for each reflecting pool. Pumps shall be capable of delivering the designated GPM at the designated head pressure during the filtering operation without overloading along the full length of the pump curve.

2.5 PIPING AND VALVES

2.5.1 Piping and Fittings

Provide piping and fittings as follows:

a. Piping manifolds included in the system. Above 3-inch in diameter, the manifold shall be constructed out of Schedule 80 PVC. Connections, threaded and flanged, shall be welded or glued into the manifold to provide the appropriate discharge arrangements. The manifold shall be pressure tested, and all leaks shall be repaired as necessary. The manifold shall be finished, corrosion free and painted.

b. Pipe and fitting materials shall conform to the following criteria:

1) All suction lines and discharge piping 4-inch and under shall be type "L" copper or Schedule 40 PVC.
2) Discharge piping 6-inch and above shall be Schedule 80 PVC.
3) All suction and discharge fittings 4-inch and under shall be wrought copper, cast brass or Schedule 40 PVC.
4) Discharge fittings 6-inch and above shall be Schedule 80 PVC.
5) Flexible electrical conduit shall be liquid tight copper with a PVC coating.
6) Rigid electrical conduit shall be schedule 40 PVC.
7) Reducers on the suction side of the pump shall be eccentric. Above 4 inches, they shall be of cast iron 125# flanged construction.
8) Reducers on the discharge side of the pump shall be concentric. Above 4 inches they shall be of cast iron 125# flanged construction.

(a) PVC slip connections shall be made using the manufacturer's recommendations and using the industry's standards.
(b) Flanged connections shall be made using stainless steel bolts or studs

2.5.2 Valves

Valves shall be installed as follows

a. Valve Selection:

1) Throttling operation: 2-inch and under shall be ball valves, 150# cast bronze body, neoprene seats and seals, infinite position vinyl covered handle.
2) Throttling operation: 3-inch and over shall be butterfly valves; 150# cast bronze construction; infinite position.
3) On-off operation: 3-inch and under shall be gate valves, 150# cast bronze construction.
4) On-Off operation: 4-inch and over shall be butterfly valves; 150# cast bronze construction; 10 position.
5) Check Valves: Spring or swing check valves shall be made of cast bronze construction; bronze discs, neoprene seats.
6) Solenoid Valves: 1-inch and under shall be 150# cast iron constructed body; pilot controls and molded epoxy coils rated at 115 V., 50 cycles. Solenoid Valves: 1-inch and under shall be 150# cast iron constructed body; pilot controls and molded epoxy coils rated at 115 V., 60 cycles.
7) Electrically Operated Solenoid Valve: Single seated, hydraulically-operated pilot controlled diaphragm-type; pressure reducing CRD controls; solenoid shut-off valves, 120 volt, 1 phase; single pressure adjustment screw; cast iron body and cover; bronze, brass and stainless steel trim; bronze pilot control; stainless steel pilot control.

2.6 REFLECTING POOL CONTROL PANEL

The control panel shall consist of an enclosure, control devices, circuit breakers, switches, relays, terminal strips, and inter-connecting wiring as necessary.

The ENTIRE control panel assembly shall be U.L. Listed (per UL 508).

The enclosure shall be NEMA 4 rated steel construction. Sized for the application and shall include gasket hinge mounted door.

Main Disconnect Switch shall be provided and installed integral to the enclosure. The disconnect switch shall be door mounted interlocking red handle; padlock capable device. The disconnect switch shall be UL Listed, (I.E.C. IP55).

Hands Off Automatic (HOA) selector switch shall be provided and installed integral to the enclosure. The HOA switch shall be horsepower rated non-teasing heavy duty cam switches with the required number of contacts. These HOA switches shall be UL Listed, (I.E.C. IP55).

Pilot lights shall be full voltage, UL Listed, (I.E.C IP55).

Combination motor starters shall consist of the following:

a. The motor disconnect shall have three adjustable magnetic short circuit protection trips and one adjustable overload (the adjustment sets three individual bi-metallic overloads) and trip indicating handle. Short circuit rating will be as required, up to 42,000 ARMS at 600 Volts (AC).

b. Contactors shall be horsepower rated as per international electric codes (I.E.C.) with a minimum of two normally open and two normally closed auxiliary contacts. Contactors shall have a guaranteed technical life span of one million operations or more as per I.E.C.

All control relays shall be horsepower rated and have contacts that are rated at 20 amps continuous operation and shall have a minimum of two normally open and two normally closed contacts.

Control voltage to external pilot devices and solenoid valves shall be 120VAC isolated.

All control components shall be pre-wired to a master terminal located at the top or bottom of the control panel.

Daily start/stop timing functions shall be provided by programmable (manual or digital) timing devices.

Water level monitor shall be a solid state module and sensor with no moving parts. The module shall have 2 miniature relays rated for 1/4 HP at 120 volt, with two normally open and two normally closed contacts. The sensor voltage of the module shall meet Article 680, National Electric Code (N.E.C.) requirements and shall have an isolated transformer with a metal ground barrier between the primary and secondary windings. The module shall be equipped with green and red light emitting diodes to indicate water level status. The sensor voltage shall be rated at less than 15 volts (DC).

The following controls and pilot lights shall be mounted on front of the control panel enclosure and shall indicate and perform specified operations.

a. Recalculating display pump HOA switch has a blue pilot light.

1) Hand position; power to pump, pilot light illuminated, timing devices over ridden.
2) Auto position; pump operation and pilot light interlocked with time devices.
3) Off position; pump shall not operate.

b. Water level monitor module pilot lights (one red and green light for each operation model).

1) Water Level control mode:

(a) Green pilot light illuminated; normal operating.
(b) Red pilot light illuminated; low water operating.

2) Low water protection mode:

(a) Green pilot light illuminated; normal operating.
(b) Red pilot light illuminated; low operating water.

24VDC 10 amp regulated power supply system.

Control Panel internal wiring color code shall be:

a. Load wiring: black (neutral - white)

b. AC control wiring: red (neutral - white)

c. DC control wiring: blue

d. Wire type: Machine assembly per NEC.

e. Solenoid field terminals: Fusible disconnect type.

2.7 BACKFLOW PREVENTER

Bronze body; minimum 1-inch, reduced pressure zone. Refer to Section 22 00 00 PLUMBING, GENERAL PURPOSE for additional backflow preventer requirements for this Project.

2.8 ACCESSORIES

Provide electric solenoid valve for water make up.

PART 3 EXECUTION

3.1 INSTALLATION

Connection of the two reflecting pools shall be by municipal water brought into the pump room with a maximum 1 inch, 50 PSI maximum connection. Pumping skids shall be located inside the pump room as indicated on the drawings. Pool fittings, piping and conduits shall run from the pumping system to the various sumps, skimmers, eyeballs and water level sensor fittings as shown on the drawings. Please refer to section 13 12 13.15 REFLECTING POOL. Inspect prior to installation of work in this Section. If work of the reflecting pools is not satisfactory, notify the contracting officer and do not proceed until the pools are ready.

Connect to the waterline provided by work in other sections. Connect to the water line in the equipment room and provide and install all items required for disposal of reflecting pool water.

Provide all pool plumbing associated with the reflecting pool recirculating and water treatment equipment.

Install filtration equipment necessary for proper reflecting pool operation, including all the necessary valves and fittings. Refer to Section 13 12 13.15 REFLECTING POOL for the filtration fittings located in the reflecting pool basins.

Waste water discharge is the responsibility of the contractor prior to installion of piping and equipment of this section. Refer to Section 13 12 13.15 REFLECTING POOL for the overflow and drain fittings located in the reflecting pool basins.

3.2 SYSTEM STARTUP

reflecting pool equipment manufacturer shall be present for the initial startup of the reflecting pool system.

Contractor shall adjust reflecting pool water system for volume and water flow characteristics to reflect design intent as approved by Contracting Officer.

Contractor shall have the following conditions satisfied prior to departure of personnel from factory.

a. All electrical connections shall be made and tested.

b. Pump and filter motors shall be power tested to insure proper impeller rotation at specified voltage.

c. Electronic water level control and/or low water cut-off control shall be installed and wired for operation.

d. All hydraulic lines and fittings shall be pressure tested for leaks, repaired as necessary, and flushed clean. Basket strainers shall be checked and cleaned as required.

e. All eyeball return fittings, manifolds, headers shall be installed properly and flushed of debris as required. Final eyeball adjustment for position and throttling to achieved specified performance for all display discharge points to be performed by installing contractor.

f. Pump skids, when supplied by manufacturer shall be thoroughly cleaned of debris, tested for electrical integrity and pressure tested for leaks.

g. Chemical feed system, when supplied, shall be filled to proper level with required dosage of chemicals.

h. The reflecting pool basin shall be thoroughly cleaned and filled to proper water level with clean, fresh water.

i. Contractor shall make available to factory personnel a plumber and electrician who have first-hand knowledge of the reflecting pool installation, at contractors own expense.

j. Contractor will perform any manual labor or provide any tools for adjustment and start-up.

3.3 ADJUSTING AND CLEANING

Adjust the reflecting pool equipment for proper operation.

3.4 CLOSEOUT ACTIVITIES

3.4.1 Demonstration

Engage a factory-authorized service representative to provide start-up services to demonstrate and train the Government's maintenance personnel as described below.

a. Test and adjust controls and safeties. Replaced damaged and malfunctioning controls and equipment.

b. Train the Government's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, service and preventative maintenance.

c. Review data in the operation and maintenance manual. Refer to Section 017800 "Closeout Submittals."

d. Schedule training with the Government, through the Contracting Officer, with at least seven days advance notice.

3.4.2 Operation and Maintenance Manuals

Provide operating and maintenance manuals to the Government. Include the installers information and list of scheduled maintenance necessary for correct operation. Include the following data:

a. Operating instructions for the reflecting pools, to include how to drain, how to fill, how to filter, how to clean, how to troubleshoot and a list of replacement parts and components.

b. Equipment literature with parts list of all equipment.

c. Chemical and ionization replacement procedures.

d. Suggested safety procedures.

e. Repainting/Refinishing procedures.

f. Copies of manufacturer's warranties.

g. Test reports from Manufacturer's Representative that system is operating as designed.

-- End of Section --

SECTION 23 00 00

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS
08/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S12.51	(20127) Acoustics Determination of Sound Power Levels of Noise Sources using Sound Pressure Precision Method for Reverberation Rooms

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 201	(2002; R 2011) Fans and Systems
AMCA 210	(2007) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 300	(2008) Reverberant Room Method for Sound Testing of Fans
AMCA 301	(2006; INT 2007; Errata 2008) Methods for Calculating Fan Sound Ratings from Laboratory Test Data
AMCA 500-D	(2012) Laboratory Methods of Testing Dampers for Rating

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP	(2010; INT 1 2011; Errata 2011, Errata 2011; Errata 2011, INT 2-12 2011, Errata 2011; Addenda A, B, C, G, H, J, K, O, P, S, Y, Z, BZ, CG, CI, AND DS 2012; INT 13 2012; Errata 2012, Errata 2012, Errata 2012, Errata 2012) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated,

	Welded and Seamless
ASTM A924/A924M	(2010a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B117	(2011) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B766	(1986; R 2008) Standard Specification for Electrodeposited Coatings of Cadmium
ASTM C553	(2011) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM D1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D3359	(2009e2) Measuring Adhesion by Tape Test
ASTM D520	(2000; R 2011) Zinc Dust Pigment

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2011) Motors and Generators
NEMA MG 11	(1977; R 2007) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code
NFPA 701	(2010) Standard Methods of Fire Tests for Flame Propagation of Textiles and Films

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-010-01	(2012) DoD Minimum Antiterrorism Standards for Buildings

UNDERWRITERS LABORATORIES (UL)

UL 6	(2007; reprint Nov 2010) Electrical Rigid Metal Conduit-Steel
UL 705	(2004; Reprint Mar 2012) Standard for Power Ventilators
UL Bld Mat Dir	(2012) Building Materials Directory

1.2 SYSTEM DESCRIPTION

Furnish ductwork, piping offsets, fittings, and accessories as required to provide a complete installation. Coordinate the work of the different trades to avoid interference between piping, equipment, structural, and

electrical work. Provide complete, in place, all necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work as indicated and specified.

1.2.1 Service Labeling

Label equipment, including fans, air handlers, terminal units, etc. with labels made of self-sticking, plastic film designed for permanent installation. Labels shall be in accordance with the typical examples below:

SERVICE	LABEL AND TAG DESIGNATION
Exhaust Fan Number	EF - 1
Cabinet Unit Heater	CU - 1

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Cabinet Exhaust Fans; G
controls; G
test procedures
In-Line Centrifugal Fans; G
Cabinet Unit Heater; G

SD-06 Test Reports

Performance Tests; G

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

1.4 QUALITY ASSURANCE

Except as otherwise specified, approval of materials and equipment is based on manufacturer's published data.

a. Where materials and equipment are specified to conform to the standards

of the Underwriters Laboratories, the label of or listing with reexamination in UL Bld Mat Dir, and UL 6 is acceptable as sufficient evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, submit a written certificate from any nationally recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Outline methods of testing used by the specified agencies.

b. Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the ASTM International (ASTM), the ASME International (ASME), or other standards, a manufacturer's certificate of compliance of each item is acceptable as proof of compliance.

c. Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.

1.4.1 Prevention of Corrosion

Protect metallic materials against corrosion. Manufacturer shall provide rust-inhibiting treatment and standard finish for the equipment enclosures. Do not use aluminum in contact with earth, and where connected to dissimilar metal. Protect aluminum by approved fittings, barrier material, or treatment. Ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials shall be hot-dip galvanized in accordance with ASTM A123/A123M for exterior locations and cadmium-plated in conformance with ASTM B766 for interior locations.

1.4.2 Asbestos Prohibition

Do not use asbestos and asbestos-containing products.

1.4.3 Detail Drawings

Submit detail drawings showing equipment layout, including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications. Include any information required to demonstrate that the system has been coordinated and functions properly as a unit on the drawings and show equipment relationship to other parts of the work, including clearances required for operation and maintenance. Submit drawings showing bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Submit function designation of the equipment and any other requirements specified throughout this Section with the shop drawings.

1.4.4 Test Procedures

Submit proposed test procedures and test schedules for the ductwork leak test, and performance tests of systems, at least 2 weeks prior to the start of related testing.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored equipment at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all pipes until installed.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide components and equipment that are "standard products" of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. "Standard products" is defined as being in satisfactory commercial or industrial use for 2 years before bid opening, including applications of components and equipment under similar circumstances and of similar size, satisfactorily completed by a product that is sold on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record are acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Provide equipment items that are supported by a service organization. Where applicable, provide equipment that is an ENERGY STAR Qualified product or a Federal Energy Management Program (FEMP) designated product.

2.2 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, provide engraved laminated phenolic identification plates for each piece of mechanical equipment. Identification plates are to designate the function of the equipment. Submit designation with the shop drawings. Identification plates shall be three layers, black-white-black, engraved to show white letters on black background. Letters shall be upper case. Identification plates 1-1/2-inches high and smaller shall be 1/16-inch thick, with engraved lettering 1/8-inch high; identification plates larger than 1-1/2-inches high shall be 1/8-inch thick, with engraved lettering of suitable height. Identification plates 1-1/2-inches high and larger shall have beveled edges. Install identification plates using a compatible adhesive.

2.3 EQUIPMENT GUARDS AND ACCESS

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact according to OSHA requirements. Properly guard or cover with insulation of a type specified, high temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard.

2.4 ELECTRICAL WORK

a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown. For packaged equipment, include manufacturer provided controllers with the required monitors and timed restart.

b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11. Integral size motors shall be the premium efficiency type in accordance with NEMA MG 1.

c. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Provide motors rated for continuous duty with the enclosure specified. Provide motor duty that allows for maximum frequency start-stop operation and minimum encountered interval between start and stop. Provide motor torque capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Fit motor bearings with grease supply fittings and grease relief to outside of the enclosure.

2.5 ANCHOR BOLTS

Provide anchor bolts for equipment placed on concrete equipment pads or on concrete slabs. Bolts to be of the size and number recommended by the equipment manufacturer and located by means of suitable templates. Installation of anchor bolts shall not degrade the surrounding concrete.

2.6 PAINTING

Paint equipment units in accordance with approved equipment manufacturer's standards unless specified otherwise. Field retouch only if approved. Otherwise, return equipment to the factory for refinishing.

2.7 DUCT SYSTEMS

2.7.1 Metal Ductwork

2.7.1.1 General Service Duct Connectors

Provide a flexible duct connector approximately 6 inches in width where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, secure the flexible material by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, install the flexible material locked to metal collars using normal duct construction methods. Provide a composite connector system that complies with NFPA 701 and is classified as "flame-retardent fabrics" in UL Bld Mat Dir.

2.7.2 Air Supply And Exhaust Air Dampers

Where motorized outdoor air supply and exhaust air dampers are required they shall have a maximum leakage rate when tested in accordance with AMCA 500-D as required by ASHRAE 90.1 - IP or UFC 4-010-01, including maximum Damper Leakage.

2.7.3 Fabric Backdraft Damper

Frame shall be constructed of 18 gage galvanized steel. Blades shall be double coated neoprene fabric. Performance shall be tested in accordance with AMCA 500-D.

2.7.4 Louvers

Refer to Section 08 91 00 METAL WALL LOUVERS.

2.8 AIR SYSTEMS EQUIPMENT

2.8.1 Fans

Test and rate fans according to AMCA 210. Calculate system effect on air moving devices in accordance with AMCA 201 where installed ductwork differs from that indicated on drawings. Install air moving devices to minimize fan system effect. Where system effect is unavoidable, determine the most effective way to accommodate the inefficiencies caused by system effect on the installed air moving device. The sound power level of the fans shall not exceed 85 dBA when tested according to AMCA 300 and rated in accordance with AMCA 301. Provide all fans with an AMCA seal. Connect fans to the motors directly. Provide fans with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Provide fan and motor assemblies with vibration-isolation supports or mountings as indicated. Use vibration-isolation units that are standard products with published loading ratings. Select each fan to produce the capacity required at the fan static pressure indicated. Provide sound power level as indicated. Obtain the sound power level values according to AMCA 300. Provide standard AMCA arrangement, rotation, and discharge as indicated. Provide power ventilators that conform to UL 705 and have a UL label.

2.8.1.1 In-Line Centrifugal Fans

Duct mounted supply, exhaust, or return fans shall be of the centrifugal, direct driven, inline type. Fan housing shall be of a square design constructed of heavy-gage galvanized steel or aluminum and shall include square duct mounting collars. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels shall be of sufficient size to permit easy access to all interior components. Fan wheel shall be centrifugal, backward inclined, constructed of aluminum, and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced. Motors shall be permanently lubricated and carefully matched to the fan loads. Motors shall be readily accessible for maintenance. A NEMA-1 disconnect switch shall be provided as standard. All fans shall bear the AMCA Certified Ratings Seal for Sound and Air performance.

2.8.1.2 Cabinet Exhaust Fans

Provide centrifugal type, direct driven suspended cabinet-type exhaust fans. Provide fans with acoustically insulated housing. Provide chatter-proof backdraft damper. Provide egg-crate design or louver design integral face grille. Mount fan motors on vibration isolators. Furnish unit with mounting flange for hanging unit from ceiling or wall. Provide U.L. listed fans.

2.9 TERMINAL UNITS

2.9.1 Cabinet Unit Heater

Provide base unit that includes air-discharge nozzles, air discharge grilles, recirculation grilles, electric coil, plus an enclosure for

cabinet models and casing for concealed models. Make each unit capable of producing not less than the capacity indicated without exceeding the indicated static pressure. Provide a sound power level as indicated with power level data or values for these units based on tests conducted according to ASA S12.51. Sound power values apply to units provided with factory fabricated cabinet enclosures and standard grilles. The values obtained for the standard cabinet models are acceptable for concealed models without separate tests, provided there is no variation between models as to coil configuration, air discharge nozzles, air balancing dampers, or relative arrangement of parts. Provide controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. Secure each unit to the building structure. Provide units with capacity indicated.

2.9.1.1 Enclosures

Fabricate enclosures from not lighter than 18 gauge steel, reinforced and braced. Provide a removable front panel of enclosure and insulate when required acoustically and to prevent condensation. Provide discharge grilles that are adjustable and properly distribute air throughout the conditioned space. Plastic discharge and return grilles are not acceptable. Provide access doors for all control compartments.

2.9.1.2 Fans

Provide galvanized steel or aluminum, multiblade, centrifugal type fans, dynamically and statically balanced. Equip fan housings with resilient mounted, self-aligning permanently lubricated ball bearings, sleeve bearings, or combination ball and sleeve bearings, capable of not less than 2000 hours of operation on one oiling. Provide direct-connected fans.

2.9.2 Electric Resistance Coils

Provide electric resistance coils consisting of a nickel-chromium resister mounted on refractory materials and a steel or aluminum frame for attachment to ductwork. Electric resistance coils that meets the requirements of Underwriters Laboratories and NFPA 70 and is provided with a built-in or surface mounted high-limit thermostat.

2.9.2.1 Plate Fin Element

Steel fins shall be copper brazed to low watt density, steel-sheathed tubular heating elements (80/20 NiCh resistance wire). Element shall be finished with aluminized paint for corrosion resistance. Fins and elements shall be arranged in a uniform grid pattern and fit closely into the discharge area to assure that all outgoing air passes through the heating element.

2.10 FACTORY PAINTING

Factory paint new equipment, which are not of galvanized construction. Paint with a corrosion resisting paint finish according to ASTM A123/A123M or ASTM A924/A924M. Clean, phosphatize and coat internal and external ferrous metal surfaces with a paint finish which has been tested according to ASTM B117, ASTM D1654, and ASTM D3359. Submit evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors. Provide rating of failure at the scribe mark that is not less than 6, average creepage not greater than 1/8 inch. Provide rating of the inscribed area that is not

less than 10, no failure. On units constructed of galvanized steel that have been welded, provide a final shop docket of zinc-rich protective paint on exterior surfaces of welds or welds that have burned through from the interior according to ASTM D520 Type I.

2.11 SUPPLEMENTAL COMPONENTS

2.11.1 Controls

Provide controls with the following characteristics and as recommended by the cabinet ventilator fan (Future F-1):

a. Control with occupancy sensor.

Provide controls with the following characteristics and as recommended by the cabinet ventilator fan (F-2):

a. Control with occupancy sensor.

Provide controls with the following characteristics and as recommended by the inline cabinet fan (F-3):

a. Fan is intended to run continuously.

b. An air pressure switch is interlocked with the vehicle charging receptacles. Should the fan fail, power to the charging receptacle shall be interrupted.

Provide controls with the following characteristics and as recommended by the inline cabinet fan (F-4):

a. Control with wall mounted thermostat located in space. Thermostat shall be set to operate fan at 80 degrees F.

b. Interlock fan operation with motorized dampers D-3 and D-4.

Provide controls with the following characteristics and as recommended by the cabinet unit heater (Future CU-1 and CU-2):

a. Provide an integral 2-stage thermostat. Provide a summer fan switch option to allow the fan to operate during summer months without energizing the heating coil.

Provide controls with the following characteristics and as recommended by the cabinet unit heater (CU-3):

a. Provide an integral 2-stage thermostat.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

a. Install materials and equipment in accordance with the requirements of

the contract drawings and approved manufacturer's installation instructions. Accomplish installation by workers skilled in this type of work. Perform installation so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.

b. No installation is permitted to block or otherwise impede access to any existing machine or system. Install all hinged doors to swing open a minimum of 120 degrees. Provide an area in front of all access doors that clears a minimum of 3 feet. In front of all access doors to electrical circuits, clear the area the minimum distance to energized circuits as specified in OSHA Standards, part 1910.333 (Electrical-Safety Related work practices)and an additional 3 feet.

c. Except as otherwise indicated, install emergency switches and alarms in conspicuous locations. Mount all indicators, to include gauges, meters, and alarms in order to be easily visible by people in the area.

3.2.1 Equipment and Installation

Provide frames and supports for fans, coils, dampers, and other similar items requiring supports. Floor mount or ceiling hang air handling units as indicated. Anchor and fasten as detailed.

3.2.2 Access Panels

Install access panels for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance of sufficient size, and locate them so that the concealed items are easily serviced and maintained or completely removed and replaced. Provide access panels as specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

3.2.3 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, perform temporary dust control protection. Protect the distribution system (supply and return) with temporary seal-offs at all inlets and outlets at the end of each day's work. Keep temporary protection in place until system is ready for startup.

3.2.4 Power Transmission Components Adjustment

Test V-belts and sheaves for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Uniformly load belts on drive side to prevent bouncing. Make alignment of direct driven couplings to within 50 percent of manufacturer's maximum allowable range of misalignment.

3.3 CUTTING AND PATCHING

Install work in such a manner and at such time that a minimum of cutting and patching of the building structure is required. Make holes in exposed locations, in or through existing floors, by drilling and smooth by sanding. Make holes through masonry walls to accommodate sleeves with an iron pipe masonry core saw.

3.4 CLEANING

Thoroughly clean surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction

before such surfaces are prepared for final finish painting or are enclosed within the building structure. Before final acceptance, clean mechanical equipment, including piping, ducting, and fixtures, and free from dirt, grease, and finger marks.

3.5 PENETRATIONS

Provide sleeves and prepared openings for duct mains, branches, and other penetrating items, and install during the construction of the surface to be penetrated. Cut sleeves flush with each surface. Place sleeves for round duct 15 inches and smaller. Build framed, prepared openings for round duct larger than 15 inches and square, rectangular or oval ducts. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Provide one inch clearance between penetrating and penetrated surfaces except at grilles, registers, and diffusers. Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber conforming with ASTM C553, Type 1, Class B-2.

a. Sleeves: Fabricate sleeves, except as otherwise specified or indicated, from 20 gauge thick mill galvanized sheet metal. Where sleeves are installed in bearing walls or partitions, provide black steel pipe conforming with ASTM A53/A53M, Schedule 20.

b. Framed Prepared Openings: Fabricate framed prepared openings from 20 gauge galvanized steel, unless otherwise indicated.

3.6 FIELD PAINTING OF MECHANICAL EQUIPMENT

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except clean to bare metal on metal surfaces subject to temperatures in excess of 120 degrees F. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Provide aluminum or light gray finish coat.

a. Temperatures less than 120 degrees F: Immediately after cleaning, apply one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat to metal surfaces subject to temperatures less than 120 degrees F.

3.6.1 Finish Painting

The requirements for finish painting of items only primed at the factory, and surfaces not specifically noted otherwise, are specified in Section 09 90 00 PAINTS AND COATINGS.

3.7 TESTING, ADJUSTING, AND BALANCING

After verifying all ventilation fans operate as indicated by sequence of controls, verify operating capacity of EF-1, EF-2, EF-3, and EF-4 meets or exceeds the scheduled value. Verification method may require testing prior to installation of duct insulation. Notify Contracting Officer if capacity does not meet or exceed scheduled value.

3.8 PERFORMANCE TESTS

Test each system as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Record the testing during the applicable season. Make corrections and adjustments as necessary to produce the conditions indicated or specified.

3.9 CLEANING AND ADJUSTING

Inside of cabinet unit heater, thoroughly clean ducts, plenums, and casing of debris and blow free of small particles of rubbish and dust and then vacuum clean before installing outlet faces. Wipe equipment clean, with no traces of oil, dust, dirt, or paint spots. Provide temporary filters prior to startup of all fans that are operated during construction, and install new filters after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. Maintain system in this clean condition until final acceptance. Properly lubricate bearings with oil or grease as recommended by the manufacturer. Tighten belts to proper tension. Adjust control valves and other miscellaneous equipment requiring adjustment to setting indicated or directed. Adjust fans to the speed indicated by the manufacturer to meet specified conditions. Maintain all equipment installed under the contract until close out documentation is received, the project is completed and the building has been documented as beneficially occupied.

3.10 OPERATION AND MAINTENANCE

3.10.1 Operation and Maintenance Manuals

Submit six manuals at least 2 weeks prior to field training. Submit data complying with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA. Submit Data Package 3 for the items/units listed under SD-10 Operation and Maintenance Data

-- End of Section --

SECTION 23 03 00.00 20

BASIC MECHANICAL MATERIALS AND METHODS
08/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B117	(2011) Standard Practice for Operating Salt Spray (Fog) Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2012; Errata 2012; INT 1 2012; INT 2 2012) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 11	(1977; R 2007) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Certification

1.3 QUALITY ASSURANCE

1.3.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.2 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.3 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.4 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.5 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.5.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.5.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace

damaged or defective items.

1.5 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors shall conform to and have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and shall have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

1.6 ELECTRICAL INSTALLATION REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.6.1 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters , control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, and the electrical power circuits shall be provided under Division 26, except internal wiring for components of package equipment shall be provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

1.6.2 High Efficiency Motors

1.6.2.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

1.7 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for

regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.8 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

3.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of 1 mil; and two coats of enamel applied to a minimum dry film thickness of 1 mil per coat.

b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

-- End of Section --

SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS
07/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D709	(2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2012; Errata 2012; INT 1 2012; INT 2 2012) National Electrical Safety Code
IEEE C57.12.28	(2005; INT 3 2011) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2005) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 13, SPECIAL CONSTRUCTION, Divisions 22 and 23, PLUMBING and HEATING VENTILATING AND AIR CONDITIONING. This section applies to all sections of Division 26 and 33, ELECTRICAL and UTILITIES, of this project specification unless specified otherwise in the individual sections. This section has been incorporated into, and thus, does not apply to, and is not referenced in the following sections.

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM

Section 26 51 00 INTERIOR LIGHTING

Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.3 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 13.75 kV primary, 30, 4W,60 Hz, and 120/240 volts secondary, single phase, three wire. Final connections to the power distribution system at the existing Vista SF-6 switch will be made by Dominion Virginia Power Company (DVP).

1.4 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.4.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.4.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.5 QUALITY ASSURANCE

1.5.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year

period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.5.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.7 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.8 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.9 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.10 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

1.11 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.12 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section.

PART 2 PRODUCTS

2.1 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test and the additional requirements specified in the technical sections.

PART 3 EXECUTION

3.1 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in the section specifying the associated electrical equipment.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

-- End of Section --

SECTION 26 20 00

INTERIOR DISTRIBUTION SYSTEM
08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D709	(2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE C2	(2012; Errata 2012; INT 1 2012; INT 2 2012) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C80.1	(2005) American National Standard for Electrical Rigid Steel Conduit (ERSC)
ANSI C80.3	(2005) American National Standard for Electrical Metallic Tubing (EMT)
NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2000; R 2005; R 2008) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2011) Enclosures
NEMA KS 1	(2001; R 2006) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
NEMA MG 1	(2011) Motors and Generators
NEMA MG 11	(1977; R 2007) Energy Management Guide for

	Selection and Use of Single Phase Motors
NEMA RN 1	(2005) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2003) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2004) Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA WD 1	(1999; R 2005; R 2010) Standard for General Color Requirements for Wiring Devices
NEMA WD 6	(2002; R 2008) Wiring Devices Dimensions Specifications
NEMA Z535.4	(2011) American National Standard for Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code
NFPA 70E	(2012) Standard for Electrical Safety in the Workplace
NFPA 780	(2011) Standard for the Installation of Lightning Protection Systems

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA J-STD-607	(2002a) Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
TIA-569	(2012c) Commercial Building Standard for Telecommunications Pathways and Spaces

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)

UNDERWRITERS LABORATORIES (UL)

UL 1	(2005; Reprint Jul 2007) Standard for Flexible Metal Conduit
UL 1449	(2006; Reprint Feb 2011) Surge Protective Devices
UL 20	(2010) General-Use Snap Switches
UL 360	(2009; Reprint Jun 2009) Liquid-Tight

	Flexible Steel Conduit
UL 467	(2007) Grounding and Bonding Equipment
UL 486A-486B	(2003; Reprint Feb 2010) Wire Connectors
UL 486C	(2004; Reprint Feb 2010) Splicing Wire Connectors
UL 489	(2009; Reprint Jun 2011) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498	(2012) Attachment Plugs and Receptacles
UL 50	(2007; Reprint Apr 2012) Enclosures for Electrical Equipment, Non-environmental Considerations
UL 508	(1999; Reprint Apr 2010) Industrial Control Equipment
UL 510	(2005; Reprint Apr 2008) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	(2004; Reprint Apr 2010) Metallic Outlet Boxes
UL 514B	(2004; Reprint Nov 2009) Conduit, Tubing and Cable Fittings
UL 514C	(1996; Reprint Novy 2011) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 6	(2007; reprint Nov 2010) Electrical Rigid Metal Conduit-Steel
UL 651	(2011; Reprint Mar 2012) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 67	(2009; Reprint Sep 2010) Standard for Panelboards
UL 797	(2007) Electrical Metallic Tubing -- Steel
UL 817	(2001; Reprint Nov 2011) Standard for Cord Sets and Power-Supply Cords
UL 83	(2008) Thermoplastic-Insulated Wires and Cables
UL 869A	(2006) Reference Standard for Service Equipment
UL 943	(2006; Reprint May 2010) Ground-Fault Circuit-Interrupters

UL 984 (1996; Reprint Sep 2005) Hermetic Refrigerant Motor-Compressors

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Panelboards; G
marking strips

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

SD-03 Product Data

Receptacles
Circuit breakers
Switches
Motor controllers
Manual motor starters
Surge protective devices

Submittals shall include performance and characteristic curves.

SD-06 Test Reports

Ground-fault receptacle test; G

SD-10 Operation and Maintenance Data

Electrical Systems, Data Package 2; G

Submit operation and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein.

1.4 QUALITY ASSURANCE

1.4.1 Fuses

Submit coordination data as specified in paragraph, FUSES of this section.

1.4.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.4.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.5 MAINTENANCE

1.5.1 Electrical Systems

Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. This shall include:

a. Single line diagram of the "as-built" building electrical system.

b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).

c. Manufacturers' operating and maintenance manuals on active electrical equipment.

1.6 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

2.2 CONDUIT AND FITTINGS

Shall conform to the following:

2.2.1 Rigid Metallic Conduit

2.2.1.1 Rigid, Threaded Zinc-Coated Steel Conduit

ANSI C80.1, UL 6.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40 in accordance with NEMA TC 2,UL 651.

2.2.3 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797, ANSI C80.3.

2.2.4 Plastic-Coated Rigid Steel Conduit

NEMA RN 1, Type 40(40 mils thick).

2.2.5 Flexible Metal Conduit

UL 1.

2.2.5.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.2.6 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.

2.2.6.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.6.2 Fittings for EMT

Steel compression type.

2.2.7 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3 for PVC, and UL 514B.

2.3 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal. UL 514C, if nonmetallic.

2.4 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

2.5 WIRES AND CABLES

Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.5.1 Conductors

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and capacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.5.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements.

2.5.1.2 Minimum Conductor Sizes

Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG; and for Class 3 low-energy, remote-control, alarm and signal circuits, No. 22 AWG.

2.5.2 Color Coding

Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutrals shall be white with a different colored (not green) stripe for each.

2.5.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN/THHN conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C)

conductors, provide only conductors with 90-degree C insulation or better.

2.5.4 Cord Sets and Power-Supply Cords

UL 817.

2.6 SPLICES AND TERMINATION COMPONENTS

UL 486A-486B for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A-486B or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.7 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets to suit the devices installed. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges. For nonmetallic boxes and fittings, other suitable plates may be provided. Plates on finished walls shall be satin finish stainless steel or brushed-finish aluminum, minimum 0.03 inch thick. Screws shall be machine-type with countersunk heads in color to match finish of plate. Sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations."

2.8 SWITCHES

2.8.1 Toggle Switches

NEMA WD 1, UL 20, single pole, totally enclosed with bodies of thermoplastic or thermoset plastic and mounting strap with grounding screw. Handles shall be white thermoplastic. Wiring terminals shall be screw-type, side-wired or of the solderless pressure type having suitable conductor-release arrangement. Contacts shall be silver-cadmium and contact arm shall be one-piece copper alloy. Switches shall be rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.8.2 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Fused switches shall utilize Class R fuseholders and fuses, unless indicated otherwise. Switches serving as motor-disconnect means shall be horsepower rated. Provide switches in NEMA 1 , enclosure per NEMA ICS 6.

2.9 RECEPTACLES

UL 498, hard use, heavy-duty, grounding-type. Ratings and configurations shall be as indicated. Bodies shall be of white as per NEMA WD 1. Face and body shall be thermoplastic supported on a metal mounting strap. Dimensional requirements shall be per NEMA WD 6. Provide screw-type, side-wired wiring terminals. Connect grounding pole to mounting strap. The receptacle shall contain triple-wipe power contacts and double or triple-wipe ground contacts.

2.9.1 Weatherproof Receptacles

Provide in cast metal box with gasketed, weatherproof, cast-metal cover

plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Receptacle shall be UL listed for use in "wet locations with plug in use."

2.9.2 Ground-Fault Circuit Interrupter Receptacles

UL 943, duplex type for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A GFCI devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads.

2.10 PANELBOARDS

UL 67 and UL 50 having a short-circuit current rating as indicated. Panelboards for use as service disconnecting means shall additionally conform to UL 869A. Panelboards shall be circuit breaker-equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings. Use of "Subfeed Breakers" is not acceptable unless specifically indicated otherwise. Main breaker shall be "separately" mounted "above" or "below" branch breakers. Where "space only" is indicated, make provisions for future installation of breakers. Directories shall indicate load served by each circuit in panelboard. Directories shall also indicate source of service to panelboard (e.g., Panel PA served from Panel MDP). Type directories and mount in holder behind transparent protective covering. Panelboards shall be listed and labeled for their intended use. Panelboard shall have nameplates in accordance with paragraph FIELD FABRICATED NAMEPLATES.

2.10.1 Enclosure

Enclosures shall meet the requirements of UL 50. All cabinets shall be fabricated from sheet steel of not less than No. 12 gauge if surface-mounted indoors, with full seam-welded box ends. Cabinets shall be painted in accordance with paragraph PAINTING. Front edges of cabinets shall be form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front. All cabinets shall be so fabricated that no part of any surface on the finished cabinet shall deviate from a true plane by more than 1/8 inch. Holes shall be provided in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a 1/2 inch clear space between the back of the cabinet and the wall surface. Flush doors shall be mounted on hinges that expose only the hinge roll to view when the door is closed. Each door shall be fitted with a combined catch and lock, except that doors over 24 inches long shall be provided with a three-point latch having a knob with a T-handle, and a cylinder lock. Two keys shall be provided with each lock, and all locks shall be keyed alike. Finished-head cap screws shall be provided for mounting the panelboard fronts on the cabinets.

2.10.2 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate

ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet.

2.10.3 Circuit Breakers

UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker shall be mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.10.3.1 Multipole Breakers

Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.10.3.2 Circuit Breaker With GFCI

UL 943 and NFPA 70. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of 6 milliamperes or greater per requirements of UL 943 for Class A GFCI devices, for personnel protection, and 20 milliamperes or greater per requirements of UL 943 for Class B GFCI per equipment protection.

2.10.3.3 Circuit Breakers for HVAC Equipment

Circuit breakers for HVAC equipment having motors (group or individual) shall be marked for use with HACR type and UL listed as HACR type.

2.11 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

Motor short-circuit protectors, also called motor circuit protectors (MCPs); shall conform to UL 508 and UL 489 and shall be provided as shown. MSCPs shall consist of an adjustable instantaneous trip circuit breaker used only in conjunction with a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection. MSCPs shall be rated in accordance with the requirements of NFPA 70.

2.12 MOTORS

NEMA MG 1 FIRE PUMPS; hermetic-type sealed motor compressors shall also comply with UL 984. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors for operation on 240-volt, single -phase circuits shall have terminal voltage rating of 220 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating. Unless otherwise indicated, motors rated 1 HP and above shall be continuous duty type.

Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated.

2.12.1 High Efficiency Single-Phase Motors

Single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11. In exception, for motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.12.2 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

2.12.3 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment as specified herein. Power wiring and conduit shall conform to the requirements specified herein. Control wiring shall be provided under, and conform to the requirements of the section specifying the associated equipment.

2.13 MOTOR CONTROLLERS

UL 508, NEMA ICS 1, and NEMA ICS 2. Controllers shall have thermal overload protection in each phase and shall have one spare normally open and one spare normally closed auxiliary contact. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay. Magnetic-type motor controllers shall have undervoltage protection when used with momentary-contact pushbutton stations or switches and shall have undervoltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or maintained-contact switch, controller shall have hand/off/automatic selector switch. Connections to selector switch shall be such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in motor control circuit in "hand" and "automatic" positions. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with indicated or manufacturer's approved wiring diagram. Selector switch shall have means for locking in any position. For each motor not in sight of controller or where controller disconnecting means is not in sight of motor location and driven machinery location, controller disconnecting means shall be capable of being locked in open position. As an alternative, provide a manually operated, lockable, nonfused switch which disconnects motor from supply source within sight of motor. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller

case. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position. Minimum short circuit withstand rating of combination motor controller shall be as shown on Drawings.

2.13.1 Enclosures for Motor Controllers

NEMA ICS 6.

2.13.2 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations shall be heavy duty, oil-tight design.

2.13.3 Pilot and Indicating Lights

Provide LED cluster lamps.

2.14 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

Single or double pole designed for surface mounting with overload protection.

2.15 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 23, "Mechanical."

2.16 TELECOMMUNICATIONS SYSTEM

Provide system of telecommunications wire-supporting structures (pathway), including: outlet boxes, conduits with pull wires and other accessories for telecommunications outlets and pathway in accordance with TIA-569 and as specified herein. Additional telecommunications requirements are specified in Section 27 10 00, BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.17 GROUNDING AND BONDING EQUIPMENT

2.17.1 Ground Rods

UL 467. Ground rods shall be copper-clad steel, with minimum diameter of 3/4 inch and minimum length of 10 feet.

2.18 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.19 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when

applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

2.20 WARNING SIGNS

Provide warning signs for flash protection in accordance with NFPA 70E and NEMA Z535.4 for switchboards, panelboards, industrial control panels, and motor control centers that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized. Provide field installed signs to warn qualified persons of potential electric arc flash hazards when warning signs are not provided by the manufacturer. The marking shall be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

2.21 SURGE PROTECTIVE DEVICES

Provide parallel type surge protective devices which comply with UL 1449 at the service entrance and panelboards. Provide surge protectors in a NEMA 1 enclosure per NEMA ICS 6. Provide the following modes of protection:

FOR SINGLE PHASE AND THREE PHASE WYE CONNECTED SYSTEMS-

a. Each phase to neutral (L-N)
b. Neutral to ground (N-G)
c. Phase to ground (L-G)

Surge protective devices at the panelboard shall have a minimum surge current rating of 40,000 amperes per mode minimum. The maximum line to neutral (L-N) Suppressed Voltage Rating (SVR) shall be:

a. 500V for 120/240V, single phase system

The minimum MCOV (Maximum Continuous Operating Voltage) rating shall be:

a. 300/150V for 120/240V, single phase system

EMI/RFI filtering shall be provided for each mode with the capability to attenuate high frequency noise. Minimum attenuation shall be 20db.

2.22 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test and the additional requirements as specified herein. Interior and exterior steel surfaces of equipment enclosures shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Exterior surfaces shall be free from holes, seams, dents, weld marks, loose scale or other imperfections. Interior surfaces shall receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish. Equipment located indoors shall be ANSI Light Gray,. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations, including weatherproof and hazardous locations and ducts, plenums and other air-handling spaces, shall conform to requirements of NFPA 70 and IEEE C2 and to requirements specified herein.

3.1.1 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures shall be labeled and identified as such.

3.1.1.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph FIELD FABRICATED NAMEPLATES. Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure, shall be provided only as permitted by NFPA 70.

3.1.2 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Shared neutral, or multi-wire branch circuits, are not permitted with arc-fault circuit interrupters. Minimum conduit size shall be 1/2 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings shall be made with metal conduit in fire-rated shafts. Metal conduit shall extend through shafts for minimum distance of 6 inches. Conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors shall be firestopped.

3.1.2.1 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 200-pound force tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.3 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.

3.1.3.1 Restrictions Applicable to EMT

a. Do not install underground.

b. Do not encase in concrete, mortar, grout, or other cementitious materials.

c. Do not use in areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.

d. Do not use in hazardous areas.

e. Do not use outdoors.

f. Do not use in fire pump rooms.

g. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.3.2 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph FLEXIBLE CONNECTIONS. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.3.3 Underground Conduit Other Than Service Entrance

Convert nonmetallic conduit, other than PVC Schedule 40 or 80, to plastic-coated rigid, steel conduit before rising through floor slab. Plastic coating shall extend minimum 6 inches above floor.

3.1.3.4 Conduit Installed Under Floor Slabs

Conduit run under floor slab shall be located a minimum of 12 inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.1.3.5 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finished slab.

3.1.3.6 Conduit Installed in Concrete Floor Slabs

Rigid steel unless indicated otherwise. Locate so as not to adversely affect structural strength of slabs. Install conduit within middle one-third of concrete slab. Do not stack conduits. Space conduits horizontally not closer than three diameters, except at cabinet locations. Curved portions of bends shall not be visible above finish slab. Increase slab thickness as necessary to provide minimum one inch cover over conduit. Where embedded conduits cross building and/or expansion joints, provide suitable watertight expansion/deflection fittings and bonding jumpers. Expansion/deflection fittings shall allow horizontal and vertical movement of raceway. Conduit larger than one inch trade size shall be parallel with or at right angles to main reinforcement; when at right angles to reinforcement, conduit shall be close to one of supports of slab.

3.1.3.7 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.3.8 Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Installation shall be coordinated with mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations.

3.1.3.9 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.3.10 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.3.11 Flexible Connections

Provide flexible steel conduit between 3 and 6 feet in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 3/4 inch diameter. Provide liquidtight flexible conduit in wet and damp locations for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.1.4 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling

of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when surface mounted on interior walls exposed up to 7 feet above floors and walkways, and when specifically indicated. Boxes in other locations shall be sheet steel, and nonmetallic boxes may be used with nonmetallic conduit system. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. Threaded studs driven in by powder charge and provided with lockwashers and nuts or nail-type nylon anchors may be used in lieu of wood screws, expansion shields, or machine screws. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.4.1 Boxes

Boxes for use with raceway systems shall be minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet. Telecommunications outlets shall be a minimum of 4 inches square by 2 1/8 inches deep. Mount outlet boxes flush in finished walls.

3.1.4.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge galvanized sheet steel, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.5 Mounting Heights

Mount panelboards, motor controller and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor. Mount lighting switches. Mount receptacles and telecommunications outlets 18 inches above finished floor, unless otherwise indicated. Wall-mounted telecommunications outlets shall be mounted at height 60 inches above finished floor. Mount other devices as indicated. Measure mounting heights of wiring devices and outletsto center of device or outlet.

3.1.6 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Provide telecommunications system conductor identification as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEMS.

3.1.6.1 Marking Strips

White or other light-colored plastic marking strips, fastened by screws to each terminal block, shall be provided for wire designations. The wire numbers shall be made with permanent ink. The marking strips shall be reversible to permit marking both sides, or two marking strips shall be furnished with each block. Marking strips shall accommodate the two sets of wire numbers. Each device to which a connection is made shall be assigned a device designation in accordance with NEMA ICS 1 and each device terminal to which a connection is made shall be marked with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, additional wire and cable designations for identification of remote (external) circuits shall be provided for the Government's wire designations. Prints of the marking strips drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

3.1.7 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.8 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.9 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings.

3.1.10 Grounding and Bonding

Provide In accordance with NFPA 70 and NFPA 780. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telecommunications system grounds, grounding conductor of nonmetallic

sheathed cables, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70. Make ground connection to driven ground rods on exterior of building. Interconnect all grounding media in or on the structure to provide a common ground potential. This shall include lightning protection, electrical service, telecommunications system grounds, as well as underground metallic piping systems. Interconnection to the gas line shall be made on the customer's side of the meter. Use main size lightning conductors for interconnecting these grounding systems to the lightning protection system. In addition to the requirements specified herein, provide telecommunications grounding in accordance with TIA J-STD-607. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.10.1 Ground Rods

Provide cone pointed ground rods. The resistance to ground shall be measured using the fall-of-potential method described in IEEE 81. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, additional rods not less than 6 feet on centers, or if sectional type rods are used, additional sections may be coupled and driven with the first rod. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, notify the Contracting Officer who will decide on the number of ground rods to add.

3.1.10.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, excepting specifically those connections for which access for periodic testing is required, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.10.3 Ground Bus

A copper ground bus shall be provided in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of equipment shall be effectively grounded by bonding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 4 inches above the floor. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment.

3.1.10.4 Resistance

Maximum resistance-to-ground of grounding system shall not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer for further instructions.

3.1.11 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

3.1.12 Surge Protective Devices

Connect the surge protective devices in parallel to the power source, keeping the conductors as short and straight as practically possible.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side. Space the signs in accordance with NFPA 70E.

3.4 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.Where field painting of enclosures for panelboards, load centers or the like is specified to match adjacent surfaces, to correct damage to the manufacturer's factory applied coatings, or to meet the indicated or specified safety criteria, provide manufacturer's recommended coatings and apply in accordance to manufacturer's instructions.

3.5 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 5 working days notice prior to each test.

3.5.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.5.2 Ground-Fault Receptacle Test

Test ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

3.5.3 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

-- End of Section --

SECTION 26 51 00

INTERIOR LIGHTING
07/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

CALIFORNIA ENERGY COMMISSION (CEC)

CEC Title 24	(1978; R 2005) California's Energy Efficiency Standards for Residential and Nonresidential Buildings

GREEN SEAL (GS)

GC-12	(1997) Occupancy Sensors

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IES)

IES HB-10	(2011) IES Lighting Handbook

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2012; Errata 2012; INT 1 2012; INT 2 2012) National Electrical Safety Code
IEEE C62.41.1	(2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ANSLG C82.11	(2011) Lamp Ballasts - High-Frequency Fluorescent Lamp Ballasts

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System

UNDERWRITERS LABORATORIES (UL)

UL 1598	(2008; Reprint Jan 2010) Luminaires
UL 935	(2001; Reprint Nov 2011) Standard for Fluorescent-Lamp Ballasts

1.2 RELATED REQUIREMENTS

Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in this section.

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. Average life is the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

c. Total harmonic distortion (THD) is the root mean square (RMS) of all the harmonic components divided by the total fundamental current.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Data, drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES HB-10, as applicable, for the lighting system specified.

SD-03 Product Data

Fluorescent lighting fixtures
Fluorescent electronic ballasts
Fluorescent lamps
Occupancy sensors
Energy Efficiency

SD-04 Samples

Lighting fixtures, complete with lamps and ballasts; G

SD-06 Test Reports

Operating test

Submit test results as stated in paragraph entitled "Field Quality Control."

1.5 QUALITY ASSURANCE

1.5.1 Fluorescent Electronic Ballasts

Submit ballast catalog data as required in the paragraph entitled "Fluorescent Lamp Electronic Ballasts" contained herein. As an option, submit the fluorescent fixture manufacturer's electronic ballast specification information in lieu of the actual ballast manufacturer's catalog data. This information shall include published specifications and sketches, which covers the information required by the paragraph entitled "Fluorescent Lamp Electronic Ballasts" herein. This information may be supplemented by catalog data if required, and shall contain a list of vendors with vendor part numbers.

1.5.2 Lighting Fixtures, Complete With Lamps and Ballasts

Submit one sample of each fixture type for inspection, review, and approval. The sample shall be retained for comparison against the remainder of the fixtures. The sample may be used in the final fixture installation.

1.5.3 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.4 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.5.4.3 Energy Efficiency

Comply with National Energy Policy Act and Energy Star requirements for lighting products. Submit data indicating lumens per watt efficiency and color rendition index of light source.

1.6 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.6.1 Electronic Ballast Warranty

Furnish the electronic ballast manufacturer's warranty. The warranty period shall not be less than 5 years from the date of manufacture of the electronic ballast. Ballast assembly in the lighting fixture, transportation, and on-site storage shall not exceed 12 months, thereby permitting 4 years of the ballast 5 year warranty to be in service and energized. The warranty shall state that the malfunctioning ballast shall be exchanged by the manufacturer and promptly shipped to the using Government facility. The replacement ballast shall be identical to, or an improvement upon, the original design of the malfunctioning ballast.

1.7 SUSTAINABLE DESIGN REQUIREMENTS

1.7.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources.

PART 2 PRODUCTS

2.1 FLUORESCENT LIGHTING FIXTURES

UL 1598. Fluorescent fixtures shall have electronic ballasts unless specifically indicated otherwise.

2.1.1 Fluorescent Lamp Electronic Ballasts

The electronic ballast shall as a minimum meet the following characteristics:

a. Ballast shall comply with UL 935, NEMA ANSLG C82.11, NFPA 70, and CEC Title 24 unless specified otherwise. Ballast shall be 100 percent electronic high frequency type with no magnetic core and coil components. Ballast shall provide transient immunity as recommended by IEEE C62.41.1 and IEEE C62.41.2. Ballast shall be designed for the wattage of the lamps used in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.

b. Power factor shall be 0.95 (minimum).

c. Ballast shall operate at a frequency of 20,000 Hertz (minimum). Ballast shall be compatible with and not cause interference with the operation of occupancy sensors or other infrared control systems. Provide ballasts operating at or above 40,000 Hertz where available.

d. Ballast shall have light regulation of plus or minus 10 percent lumen output with a plus or minus 10 percent input voltage regulation. Ballast shall have 10 percent flicker (maximum) using any compatible lamp.

e. Ballast factor shall be between 0.85 (minimum) and 1.00 (maximum). Current crest factor shall be 1.7 (maximum).

f. Ballast shall be UL listed Class P with a sound rating of "A."

g. Ballast shall have circuit diagrams and lamp connections displayed on the ballast.

h. Ballasts shall be instant start unless otherwise indicated. Ballasts shall be programmed start where indicated. Instant start ballasts shall operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed. Programmed start ballasts may operate lamps in a series circuit configuration. Provide series/parallel wiring for programmed start ballasts where available.

i. Ballasts for compact fluorescent fixtures shall be programmed start.

j. Ballast shall be capable of starting and maintaining operation at a minimum of 0 degrees F unless otherwise indicated.

k. Electronic ballast shall have a full replacement warranty of 5 years from date of manufacture as specified in paragraph entitled "Electronic Ballast Warranty" herein.

2.1.1.1 T-8 Lamp Ballast

a. Total harmonic distortion (THD): Shall be 10 percent (maximum).

b. Input wattage.

1. 32 watts (maximum) when operating one F32T8 lamp

2. 62 watts (maximum) when operating two F32T8 lamps

3. 92 watts (maximum) when operating three F32T8 lamps

4. 114 watts (maximum) when operating four F32T8 lamps

2.1.1.2 F17T8 Lamp Ballast

a. Total harmonic distortion (THD): Shall be 25 percent (maximum).

b. Input wattage:

1. 34 watts (maximum) when operating two F17T8 lamps.

2.1.1.3 T-8 Lamp Ballast

Input wattage, for indicated lamp quantity shall be:

a. 35 watts (maximum) when operating one F32T8 lamp.

b. 70 watts (maximum) when operating two F32T8 lamps.

c. 104 watts (maximum) when operating three F32T8 lamps.

2.1.2 Fluorescent Lamps

a. T-8 instant start lamp, 59 watts (maximum), nominal length of 96 inches, minimum CRI of 75, 5700 initial lumens, color temperature of 3500 K, and average rated life of 15,000 hours.

b. T-5, long twin tube fluorescent lamp, 40 watts (maximum), 3500 K, 22.6 inches maximum length, 20,000 hours average rated life, 3150 initial lumens, CRI of 80 (minimum), 2G11 Type base, 90 to 100 lumens/watt depending on wattage.

c. T-8, U shaped fluorescent lamp, 31 watts maximum, 2600 initial lumens (minimum), 3500 K, 75 CRI (minimum), 20,000 hours average rated life, 1.625 inch leg spacing.

d. Compact fluorescent lamps shall be: CRI 80, minimum, 3500 K, 10,000 hours average rated life, and as follows:

Average rated life is based on 3 hours operating per start.

2.1.3 Compact Fluorescent Fixtures

Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballasts integral to the fixture. Providing assemblies designed to retrofit incandescent fixtures is prohibited except when specifically indicated for renovation of existing fixtures. Fixtures shall use lamps as indicated, with a minimum CRI of 80.

2.2 SWITCHES

2.2.1 Toggle Switches

Provide toggle switches as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.3 OCCUPANCY SENSORS

UL listed. Comply with GC-12. Occupancy sensors and power packs shall be designed to operate on the voltage indicated. Sensors and power packs shall have circuitry that only allows load switching at or near zero current crossing of supply voltage. Occupancy sensor mounting as indicated. Sensor shall have an LED occupant detection indicator. Sensor shall have adjustable sensitivity and adjustable delayed-off time range of 5 minutes to 15 minutes. Wall mounted sensors shall be white.

2.4 EQUIPMENT IDENTIFICATION

2.4.1 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.4.2 Labels

Provide labeled luminaires in accordance with UL 1598 requirements. All luminaires shall be clearly marked for operation of specific lamps and ballasts according to proper lamp type. The following lamp characteristics shall be noted in the format "Use Only _____":

a. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.

b. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.

c. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.

d. ANSI ballast type (M98, M57, etc.) for HID luminaires.

e. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.

All markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Ballasts shall have clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

2.5 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

3.1.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed just prior to project completion. Lamps installed and used for working light during construction shall be replaced prior to turnover to the Government if more than 15 percent of their rated life has been used. Lamps shall be tested for proper operation prior to turn-over and shall be replaced if necessary with new lamps from the original manufacturer. Provide 10 percent spare lamps of each type from the original manufacturer.

3.1.2 Lighting Fixtures

Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved drawings. Installation shall meet requirements of NFPA 70. Mounting heights specified or indicated shall be to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed.

3.1.3 Occupancy Sensor

Provide quantity of sensor units indicated as a minimum. Provide additional units to give full coverage over controlled area. Full coverage shall provide hand and arm motion detection for office and administration type areas and walking motion for industrial areas, warehouses, storage rooms and hallways. Locate the sensor(s) as indicated and in accordance with the manufacturer's recommendations to maximize energy savings and to avoid nuisance activation and deactivation due to sudden temperature or airflow changes and usage. Set sensor "on" duration to 15 minutes.

3.1.4 Light Level Sensor

Locate light level sensor as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for 50 footcandles or for the indicated light level at the typical work plane for that area.

3.2 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.3 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test to show that equipment operates in accordance with requirements of this section.

3.3.1 Occupancy Sensor

Test sensors for proper operation. Observe for light control over entire area being covered.

-- End of Section --

SECTION 27 10 00

BUILDING TELECOMMUNICATIONS CABLING SYSTEM
08/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D709	(2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-83-596	(2011) Indoor Optical Fiber Cables
ICEA S-90-661	(2008) Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cables for Use in General Purpose and LAN Communications Wiring Systems Technical Requirements

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)

NECA/BICSI 568	(2006) Standard for Installing Building Telecommunications Cabling

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA WC 66	(2001; Errata 2003) Performance Standard for Category 6 and Category 7 100 Ohm Shielded and Unshielded Twisted Pairs

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA J-STD-607	(2002a) Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
TIA-1152	(2009) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling

TIA-455-21	(1988; R 2012) FOTP-21 - Mating Durability of Fiber Optic Interconnecting Devices
TIA-526-14	(2010b) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
TIA-526-7	(2002; R 2008) OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
TIA-568-C.0	(2009; Add 1 2010) Generic Telecommunications Cabling for Customer Premises
TIA-568-C.1	(2009; Add 2 2011; Add 1 2012) Commercial Building Telecommunications Cabling Standard
TIA-568-C.2	(2009; Errata 2010) Balanced Twisted-Pair Telecommunications Cabling and Components Standards
TIA-568-C.3	(2008; Corrections 2008) Optical Fiber Cabling Components Standard
TIA-569	(2012c) Commercial Building Standard for Telecommunications Pathways and Spaces
TIA/EIA-606	(2002a; Errata 2007; R 2007; Adm 1 2008) Administration Standard for the Telecommunications Infrastructure

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 68	Connection of Terminal Equipment to the Telephone Network (47 CFR 68)

UNDERWRITERS LABORATORIES (UL)

UL 1286	(2008; Reprint Sep 2011) Office Furnishings
UL 1863	(2004; Reprint Aug 2008) Communication Circuit Accessories
UL 444	(2008; Reprint Apr 2010) Communications Cables
UL 467	(2007) Grounding and Bonding Equipment
UL 514C	(1996; Reprint Novy 2011) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 969	(1995; Reprint Nov 2008) Standard for Marking and Labeling Systems

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in TIA-568-C.1, TIA-568-C.2, TIA-568-C.3, TIA-569, TIA/EIA-606 and IEEE 100 and herein.

1.2.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect (MC).)

1.2.2 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect (IC).)

1.2.3 Floor Distributor (FD)

A distributor used to connect horizontal cable and cabling subsystems or equipment. (International expression for horizontal cross-connect (HC).)

1.2.4 Telecommunications Room (TR)

An enclosed space for housing telecommunications equipment, cable, terminations, and cross-connects. The room is the recognized cross-connect between the backbone cable and the horizontal cabling.

1.2.5 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service cables (including wireless) including the entrance point at the building wall and continuing to the equipment room.

1.2.6 Equipment Room (ER) (Telecommunications)

An environmentally controlled centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.2.7 Open Cable

Cabling that is not run in a raceway as defined by NFPA 70. This refers to cabling that is "open" to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with that space.

1.2.8 Open Office

A floor space division provided by furniture, moveable partitions, or other means instead of by building walls.

1.2.9 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.3 SYSTEM DESCRIPTION

The building telecommunications cabling and pathway system shall include permanently installed horizontal cabling, horizontal pathways, work area pathways, telecommunications outlet assemblies, conduit, raceway, and hardware for splicing, terminating, and interconnecting cabling necessary to transport telephone and data (including LAN) between equipment items in a building. The horizontal system shall be wired in a star topology from the telecommunications work area to the floor distributor or campus distributor at the center or hub of the star. The backbone cabling and pathway system includes intrabuilding and interbuilding interconnecting cabling, pathway, and terminal hardware. The intrabuilding backbone provides connectivity from the floor distributors to the building distributors or to the campus distributor and from the building distributors to the campus distributor as required. The backbone system shall be wired in a star topology with the campus distributor at the center or hub of the star. Provide telecommunications pathway systems referenced herein as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telecommunications cabling; G

SD-03 Product Data

Telecommunications cabling (backbone and horizontal)
Telecommunications outlet/connector assemblies
Spare Parts

Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Include performance and characteristic curves. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-06 Test Reports

Telecommunications cabling testing; G

SD-07 Certificates

Telecommunications Contractor Qualifications
Key Personnel Qualifications
Manufacturer Qualifications
Test plan

SD-09 Manufacturer's Field Reports

Factory reel tests

SD-10 Operation and Maintenance Data

Telecommunications cabling and pathway system Data Package 2; G

SD-11 Closeout Submittals

Record Documentation; G

1.5 QUALITY ASSURANCE

1.5.1 Shop Drawings

In exception to Section 01 33 00 SUBMITTAL PROCEDURES, submitted plan drawings shall be a minimum of 11 by 17 inches in size using a minimum scale of 1/8 inch per foot, except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.5.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, and the supervisor (if different from the installer). A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.5.2.1 Telecommunications Contractor

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years of similar scope and size. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor.

1.5.2.2 Key Personnel

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel.

In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications systems and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The Contracting Officer.

1.5.2.3 Minimum Manufacturer Qualifications

Cabling, equipment and hardware manufacturers shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with TIA-568-C.1, TIA-568-C.2 and TIA-568-C.3.

1.5.3 Test Plan

Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the components and accessories for each cable type specified, 60 days prior to the proposed test date. Include procedures for certification, validation, and testing.

1.5.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.5.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.5.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site shall not be used, unless specified otherwise.

1.6 DELIVERY AND STORAGE

Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage.

1.7 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, noncondensing.

1.8 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.9 MAINTENANCE

1.9.1 Operation and Maintenance Manuals

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications cabling and pathway system, Data Package 5. Submit operations and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data Package 5, include the requirements of paragraphs TELECOMMUNICATIONS DRAWINGS, TELECOMMUNICATIONS SPACE DRAWINGS, and RECORD DOCUMENTATION. Ensure that these drawings and documents depict the as-built configuration.

1.9.2 Spare Parts

In addition to the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA, provide a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

PART 2 PRODUCTS

2.1 COMPONENTS

Components shall be UL or third party certified. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard. Provide a complete system of telecommunications cabling and pathway components using star topology. Provide support structures and pathways, complete with outlets, cables, connecting hardware and telecommunications cabinets/racks. Cabling and interconnecting hardware and components for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70 and conform to the requirements specified herein.

2.2 TELECOMMUNICATIONS PATHWAY

Provide telecommunications pathways in accordance with TIA-569 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide system furniture pathways in accordance with UL 1286.

2.3 TELECOMMUNICATIONS CABLING

Cabling shall be UL listed for the application and shall comply with TIA-568-C.0, TIA-568-C.1, TIA-568-C.2, TIA-568-C.3 and NFPA 70. Provide a labeling system for cabling as required by TIA/EIA-606 and UL 969. Ship cable on reels or in boxes bearing manufacture date for for unshielded twisted pair (UTP) in accordance with ICEA S-90-661 and optical fiber cables in accordance with ICEA S-83-596 for all cable used on this project. Cabling manufactured more than 12 months prior to date of

installation shall not be used.

2.3.1 Horizontal Cabling

Provide horizontal cable in compliance with NFPA 70 and performance characteristics in accordance with TIA-568-C.1.

2.3.1.1 Horizontal Copper

Provide horizontal copper cable, UTP, 100 ohm in accordance with TIA-568-C.2, UL 444, ANSI/NEMA WC 66, ICEA S-90-661 . Provide four each individually twisted pair, minimum size 24 AWG conductors, Category 6, with a blue thermoplastic jacket. Cable shall be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) and length marking at regular intervals in accordance with ICEA S-90-661. Provide plenum (CMP), riser (CMR), or general purpose (CM or CMG) communications rated cabling in accordance with NFPA 70. Substitution of a higher rated cable shall be permitted in accordance with NFPA 70. Cables installed in conduit within and under slabs shall be UL listed and labeled for wet locations in accordance with NFPA 70.

2.4 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES

2.4.1 Outlet/Connector Copper

Outlet/connectors shall comply with FCC Part 68, TIA-568-C.1, and TIA-568-C.2. UTP outlet/connectors shall be UL 1863 listed, non-keyed, 8-pin modular, constructed of high impact rated thermoplastic housing and shall be third party verified and shall comply with TIA-568-C.2 Category 6 requirements. Outlet/connectors provided for UTP cabling shall meet or exceed the requirements for the cable provided. Outlet/connectors shall be terminated using a Type 110 IDC PC board connector, color-coded for both T568A and T568B wiring. Each outlet/connector shall be wired T568A or T568B. UTP outlet/connectors shall comply with TIA-568-C.2 for 200 mating cycles.

2.4.2 Optical Fiber Connectors

Provide in accordance with TIA-455-21. Optical fiber connectors shall be compatible with 62.5/125, 50/125 multimode8/125 single-mode fiber. The connectors shall provide a maximum attenuation of 0.3 dB at 1300 nm with less than a 0.2 dB change after 500 mating cycles.

2.4.3 Cover Plates

Telecommunications cover plates shall comply with UL 514C, and TIA-568-C.1, TIA-568-C.2, TIA-568-C.3; oversized design constructed of 302 stainless material. Provide labeling in accordance with the paragraph LABELING in this section.

2.5 GROUNDING AND BONDING PRODUCTS

Provide in accordance with UL 467, TIA J-STD-607, and NFPA 70. Components shall be identified as required by TIA/EIA-606. Provide ground rods, bonding conductors, and grounding busbars as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.6 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.7 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inches thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inches high normal block style.

2.8 TESTS, INSPECTIONS, AND VERIFICATIONS

2.8.1 Factory Reel Tests

Provide documentation of the testing and verification actions taken by manufacturer to confirm compliance with TIA-568-C.1, TIA-568-C.2, TIA-568-C.3, TIA-526-7 for single mode optical fiber , and TIA-526-14 for multimode optical fiber cables.

PART 3 EXECUTION

3.1 INSTALLATION

Install telecommunications cabling and pathway systems, including the horizontal and backbone cable, pathway systems, telecommunications outlet/connector assemblies, and associated hardware in accordance with NECA/BICSI 568, TIA-568-C.1, TIA-568-C.2, TIA-568-C.3, TIA-569, NFPA 70, and UL standards as applicable. Provide cabling in a star topology network. Pathways and outlet boxes shall be installed as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Install telecommunications cabling with copper media in accordance with the following criteria to avoid potential electromagnetic interference between power and telecommunications equipment. The interference ceiling shall not exceed 3.0 volts per meter measured over the usable bandwidth of the telecommunications cabling.

3.1.1 Cabling

Install UTP, and optical fiber telecommunications cabling system as detailed in TIA-568-C.1, TIA-568-C.2, and TIA-568-C.3. Screw terminals shall not be used except where specifically indicated on plans. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations. Do not exceed manufacturers' cable pull tensions for copper and optical fiber cables. Provide a device to monitor cable pull tensions. Do not exceed 25 pounds pull tension for four pair copper cables. Do not chafe or damage outer jacket materials. Use only lubricants approved by cable manufacturer. Do not over cinch cables, or crush cables with staples. For UTP cable, bend radii shall not be less than four times the cable diameter. Cables shall be terminated; no cable shall contain unterminated elements. Cables shall not be spliced. Label cabling in accordance with paragraph LABELING in this section.

3.1.1.1 Open Cable

Use only where specifically indicated on plans for use in cable trays, or below raised floors. Install in accordance with TIA-568-C.1, TIA-568-C.2 and TIA-568-C.3. Do not exceed cable pull tensions recommended by the manufacturer. Copper cable not in a wireway or pathway shall be suspended a minimum of 8 inches above ceilings by cable supports no greater than 60 inches apart. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 12 inches shall be maintained when such placement cannot be avoided.

3.1.1.2 Backbone Cable

a. Optical fiber Backbone Cable. Install intrabuilding backbone optical fiber in indicated pathways. Do not exceed manufacturer's recommended bending radii and pull tension. Prepare cable for pulling by cutting outer jacket 10 inches leaving strength members exposed for approximately 10 inches. Twist strength members together and attach to pulling eye. Vertical cable support intervals shall be in accordance with manufacturer's recommendations.

3.1.2 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings.

3.1.3 Grounding and Bonding

Provide in accordance with TIA J-STD-607, NFPA 70 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.2 LABELING

3.2.1 Labels

Provide labeling in accordance with TIA/EIA-606. Handwritten labeling is unacceptable. Stenciled lettering for voice and data circuits shall be provided using thermal ink transfer process.

3.2.2 Cable

Cables shall be labeled using color labels on both ends with identifiers in accordance with TIA/EIA-606.

3.2.3 Termination Hardware

Workstation outlets and patch panel connections shall be labeled using color coded labels with identifiers in accordance with TIA/EIA-606.

3.3 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 TESTING

3.5.1 Telecommunications Cabling Testing

Perform telecommunications cabling inspection, verification, and performance tests in accordance with TIA-568-C.1, TIA-568-C.2, TIA-568-C.3. Test equipment shall conform to TIA-1152. Perform optical fiber field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.

3.5.1.1 Inspection

Visually inspect UTP and optical fiber jacket materials for UL or third party certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for T568A or T568B pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1, TIA-568-C.2, TIA-568-C.3, . Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.

3.5.1.2 Verification Tests

UTP backbone copper cabling shall be tested for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has overall shield. Test operation of shorting bars in connection blocks. Test cables after termination but prior to being cross-connected.

For multimode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568-C.3 and TIA-526-14 using Method A, Optical Power Meter and Light Source Method B, OTDR for multimode optical fiber. For single-mode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568-C.3 and TIA-526-7 using Method A, Optical Power Meter and Light Source Method B, OTDR for single-mode optical fiber. Perform verification acceptance tests.

3.5.1.3 Final Verification Tests

Perform verification tests for UTP and optical fiber systems after the complete telecommunications cabling and workstation outlet/connectors are installed.

a. Data Tests. These tests assume the Information Technology Staff has a network installed and are available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

-- End of Section --

SECTION 31 00 00

EARTHWORK
08/08

PART 1 GENERAL

1.1 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

c. Ground water elevations indicated by the boring logs were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction. Refer to sheets B-100 through B-210 of the Plans.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2010) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 224	(2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(2010) Installation of Ductile-Iron Water Mains and Their Appurtenances

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010; Errata 2010) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A139/A139M	(2004; R 2010) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
ASTM A252	(2010) Standard Specification for Welded and Seamless Steel Pipe Piles

ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D 1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2009) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D 6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D1140	(2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D1557	(2009) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D2487	(2011) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D4318	(2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D698	(2007e1) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes
EPA SW-846.3-3	(1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT	(2007) Virginia Department of Transportation Road and Bridge Specifications

1.3 DEFINITIONS

1.3.1 Satisfactory Materials

Satisfactory materials comprise any materials classified by ASTM D2487 as GW, GM, GC, SW, SP, SM, SC, CL, ML, CH, MH or combination thereof. Satisfactory materials for grading located more than 2 feet below finished grade shall be comprised of stones less than 8 inches in diameter. Satisfactory materials located within 2 feet of finished grade or fill material for pavements shall be comprised of stones less than 3 inches in diameter.

1.3.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the Contracting Officer when encountering any contaminated materials.

1.3.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with ASTM D4318, ASTM C136, ASTM D422, and ASTM D1140.

1.3.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557 abbreviated as a percent of laboratory maximum density. Since ASTM D1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve as a percentage of the maximum density in accordance with AASHTO T 180 and corrected with AASHTO T 224. To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in AASHTO T 180.

1.3.5 Topsoil

Material suitable for topsoils obtained from offsite areas or excavations is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

1.3.6 Unstable Material

Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.3.7 Select Granular Material

1.3.7.1 General Requirements

Select granular material consist of non-expansive materials and classified as GW, GC, GM, SW, SM, or combination thereof by ASTM D2487 where indicated. The liquid limit of such material must not exceed 30 percent when tested in accordance with ASTM D4318. The plasticity index must not be greater than 10 percent when tested in accordance with ASTM D4318.

Soils classified as SC and GC shall not have more than 15 percent by weight be finer than the No. 200 sieve when tested in accordance with ASTM D1140. The other materials listed shall not have more than 20 percent by weight be finer than the No. 200 sieve when tested in accordance with ASTM D1140.

1.3.7.2 Controlled Structural Fill

Fill placed beneath buildings, structures, and under roadways which will raise the site to the finished subgrade shall be compacted structural fill. Controlled structural fill material under buildings and the roadways shall be non-expansive and free of organic matter, debris, and particles larger than 2-inches in size. Proposed fill materials shall be subjected to laboratory tests consisting of, but not necessarily limited to, moisture density determinations, Atterberg limits, and sieve analysis. Compacted controlled fill shall extend at least 10 feet beyond the building limits or to a distance equal to the height of the fill. Areas to receive fill which are sloped surfaces, steeper than one foot vertical and four feet horizontal (1V to 4H) shall be plowed, stepped, and benched so that the fill material will bond with the existing materials. Steps or benches shall be 1 foot vertical to 2 feet horizontal (1V to 2H). Controlled Structural Fill under buildings and structures should classify per USCS as SW, SP, SP-SM, or SM with a maximum of 20 percent fines passing the No. 200 sieve. Controlled Structural Fill under roadways shall include all materials suitable under buildings and structures and include material classified per USCS as SC, ML, or CL with a maximum liquid limit of 45 and a plasticity index of greater than 15.

1.3.8 Initial Backfill Material

Initial backfill consists of select granular material or satisfactory materials free from rocks 3 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, free the initial backfill material of stones larger than 2 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

1.3.9 Expansive Soils

Expansive soils are defined on Page 21 of the Geotechnical Report as:

a. Expansive Soils: Expansive Soils such as "marine clays" of the Potomac Formation are not permitted as structural fill for building pads, foundaiton backfill, backfill around structure, or behind retaining walls.

b. Expansive Soil is defined by the Internal Building Code as "Soils meeting all four of the following provisions shall be considered expansive, except that tests to show compliance with Items 1, 2, and 3 shall not be required if the test prescribed in Item 4 is conducted:

1. Placticity Index (PI) of 15 greater, determined in accordance with ASTM D 4318.
2. More than 10 percent of the soil particles pass a No. 200 sieve, determined in accordance with ASTM D 422.
3. More than 10 percent of the soil particles are less than 5 micrometers in size, determined in accordance with ASTM D 422.
5. Expansion Index greater than 20, determined in accordance with ASTM D 4829.

c. If the PI of soil is 20 or less, the Plasticity Index Corrected (PIcor) or the Expansion Index Corrected (EIcor) may be substituted in the above definition of expansive soils. PIcor and EIcor are defined as follows:

$$\frac{PI \times (\%\ \text{Passing No. 40 Sieve})}{100} \quad \text{and} \quad EIcor = \frac{EI\ X\ (\%\ \text{Passing No. 4 Sieve})}{100}$$

1.3.10 Nonfrost Susceptible (NFS) Material

Nonfrost susceptible material are a uniformly graded washed sand with a maximum particle size of 3 inch and less than 5 percent passing the No. 200 size sieve, and with not more than 3 percent by weight finer than 0.02 mm grain size.

1.4 SYSTEM DESCRIPTION

Subsurface soil boring logs are shown on the drawings. The subsoil investigation report and samples of materials taken from subsurface investigations may be examined; request for this data should be amde through the Contracting Officer. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.4.1 Classification of Excavation

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.4.1.1 Common Excavation

Include common excavation with the satisfactory removal and disposal of all materials not classified as rock excavation.

1.4.2 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals identified with "AE" shall also be reviewed by Landscape Architect in addition to the Engineer. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shoring
Dewatering Work Plan; G

SD-03 Product Data

Utilization of Excavated Materials; G, AE
Opening of Excavation or Borrow Pit

SD-06 Test Reports

Testing; G, AE
Borrow Site Testing; G, AE

SD-07 Certificates

Testing

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS

Test offsite soils brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity and reactivity. Backfill shall contain a maximum of 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and a maximum of 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall pass the TCPL test. Determine TPH concentrations by using EPA 600/4-79/020 Method 418.1. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5030/8020. Perform TCLP in accordance with EPA SW-846.3-3 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Within 24 hours of conclusion of physical tests, submit 5 copies of test results, including calibration curves and results of calibration tests. Do not bring material onsite until tests have been approved by the Contracting Officer.

2.2 BURIED WARNING AND IDENTIFICATION TAPE

Provide polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inches minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

Warning Tape Color Codes

Red:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems

Warning Tape Color Codes

2.2.1 Warning Tape for Metallic Piping

Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.003 inch and a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.2.2 Detectable Warning Tape for Non-Metallic Piping

Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.004 inch, and a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.3 MATERIAL FOR RIP-RAP

Provide Bedding material Filter fabric and rock conforming to the Virginia Department of Transportation (VDOT) Standards for construction indicated.

2.4 PIPE CASING

2.4.1 Casing Pipe

ASTM A139/A139M, Grade B, or ASTM A252, Grade 2, smooth wall pipe. Match casing size to the outside diameter and wall thickness as indicated on Drawing Sheet No. C-504. Protective coating is not required on casing pipe.

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, strip topsoil to a maximum depth of 10 inches. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Remove from the site any surplus of topsoil from excavations and gradings.

3.2 GENERAL EXCAVATION

Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Perform the grading in accordance with the typical sections shown and the tolerances specified in paragraph FINISHING. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory

excavated material not required for fill or embankment in areas approved for surplus material storage or designated waste areas. Dispose unsatisfactory excavated material in designated waste or spoil areas. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times. Excavate material required for fill or embankment in excess of that produced by excavation within the grading limits from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

In areas to receive fill, where existing slopes are 1V:4H or steeper, the ground surface shall be benched back prior to filling activities.

3.2.1 Ditches, Gutters, and Channel Changes

Finish excavation of ditches, gutters, and channel changes by cutting accurately to the cross sections, grades, and elevations shown. Do not excavate ditches and gutters below grades shown. Backfill the excessive open ditch or gutter excavation with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Dispose excavated material as shown or as directed, except in no case allow material be deposited a maximum 4 feet from edge of a ditch. Maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Do not disturb the bottom of the excavation when concrete or masonry is to be placed in an excavated area. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

3.2.3 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

3.2.4 Dewatering

Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Do not permit French drains, sumps, ditches or trenches within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation

area have been made. Take control measures by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, maintain the water level continuously, at least 3 feet below the working level. Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly.

3.2.5 Trench Excavation Requirements

Excavate the trench as recommended by the manufacturer of the pipe to be installed. Slope trench walls below the top of the pipe, or make vertical, and of such width as recommended in the manufacturer's printed installation manual. Provide vertical trench walls where no manufacturer's printed installation manual is available. Shore trench walls more than 5 feet high, cut back to a stable slope, or provide with equivalent means of protection for employees who may be exposed to moving ground or cave in. Shore vertical trench walls more than 5 feet high. Excavate trench walls which are cut back to at least the angle of repose of the soil. Give special attention to slopes which may be adversely affected by weather or moisture content. Do not exceed the trench width below the pipe top of 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter, and do not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, provide redesign, stronger pipe, or special installation procedures by the Contractor. The Contractor is responsible for the cost of redesign, stronger pipe, or special installation procedures without any additional cost to the Government.

3.2.5.1 Bottom Preparation

Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones of 3 inch or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, to avoid point bearing.

3.2.5.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, remove such material 4 inch below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.2.5.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the Government.

3.2.5.4 Excavation for Appurtenances

Provide excavation for manholes, catch-basins, inlets, or similar structures sufficient to leave at least 12 inches clear between the outer structure surfaces and the face of the excavation or support members Clean rock or loose debris and cut to a firm surface either level, stepped, or

serrated, as shown or as directed. Remove thin strata. Specify removal of unstable material. When concrete or masonry is to be placed in an excavated area, take special care not to disturb the bottom of the excavation. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

3.2.5.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, provide excavation by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.2.6 Underground Utilities

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. Perform work adjacent to non-Government utilities as indicated in accordance with procedures outlined by utility company. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

3.2.7 Structural Excavation

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement.

3.3 SELECTION OF BORROW MATERIAL

Select borrow material to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Obtain borrow material from the borrow areas within the limits of the project site, selected by the Contractor or from approved private sources. Unless otherwise provided in the contract, the Contractor is responsible for obtaining the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling from the owners. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, do not obtain borrow within the limits of the project site without prior written approval. Consider necessary clearing, grubbing, and satisfactory drainage and the disposal of debris thereon related operations to the borrow excavation.

3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

CONTRACTOR IS NOT ALLOWED TO OPEN A BORROW PIT ON ARLINGTON NATIONAL CEMETERY PROPERTY.

Notify the Contracting Officer sufficiently in advance of the opening of excavation or borrow pit or borrow areas to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, excavate borrow pits and other excavation areas

providing adequate drainage. Transport overburden and other spoil material to designated spoil areas or otherwise dispose of as directed. Provide neatly trimmed and drained borrow pits after the excavation is completed. Ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.5 SHORING

3.5.1 General Requirements

Submit a Shoring and Sheeting plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheeting as excavations are backfilled, in a manner to prevent caving.

3.5.2 Geotechnical Engineer

Hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer is responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer is responsible for updating the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and submit an updated plan if necessary. Submit a monthly written report, informing the Contractor and Contracting Officer of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Contracting Officer is responsible for arranging meetings with the Geotechnical Engineer at any time throughout the contract duration.

3.6 GRADING AREAS

Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Do not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Place and grade stockpiles of satisfactory as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

3.7 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Do not excavate to final grade until just before concrete is to be placed. Only use excavation methods that will leave the foundation rock in a solid and unshattered condition. Roughen the level surfaces, and cut the sloped surfaces, as indicated, into rough steps or benches to provide a satisfactory bond. Protect shales from slaking and all surfaces from erosion resulting from ponding or water flow.

3.8 GROUND SURFACE PREPARATION

3.8.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the Contracting Officer, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 6 inches before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 6 inches, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inches and compact it as specified for the adjacent fill.

3.8.2 Frozen Material

Do not place material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary to plus or minus 2 percent of optimum moisture.

3.9 UTILIZATION OF EXCAVATED MATERIALS

Dispose unsatisfactory materials removing from excavations into designated waste disposal or spoil areas. Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. Submit procedure and location for disposal of unused satisfactory material. Submit proposed source of borrow material. Do not waste any satisfactory excavated material without specific written authorization. Dispose of satisfactory material, authorized to be wasted, in designated areas approved for surplus material storage or designated waste areas as directed. Clear and grub newly designated waste areas on Government-controlled land before disposal of waste material thereon. Stockpile and use coarse rock from excavations for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. Do not dispose excavated material to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.10 BURIED TAPE AND DETECTION WIRE

3.10.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.10.2 Buried Detection Wire

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. Extend the wire continuously and unbroken, from manhole to manhole. Terminate the ends of the wire inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. Furnish insulated wire over

it's entire length. Install wires at manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, terminate the wire in the valve pit at the pump station end of the pipe.

3.11 BACKFILLING AND COMPACTION

Place backfill adjacent to any and all types of structures, and compact to at least at least 95 percent laboratory maximum density in accordance with ASTM D1557, Procedure C, to prevent wedging action or eccentric loading upon or against the structure. Prepare ground surface on which backfill is to be placed and provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs GROUND SURFACE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.11.1 Trench Backfill

Backfill trenches to the grade shown. Do not backfill the trench until all specified tests are performed.

3.11.1.1 Replacement of Unyielding Material

Replace unyielding material removed from the bottom of the trench with select granular material or initial backfill material.

3.11.1.2 Replacement of Unstable Material

Replace unstable material removed from the bottom of the trench or excavation with select granular material placed in layers not exceeding 6 inches loose thickness.

3.11.1.3 Bedding and Initial Backfill

Provide bedding of the type and thickness shown. Place initial backfill material and compact it with approved tampers to a height of at least one foot above the utility pipe or conduit. Bring up the backfill evenly on both sides of the pipe for the full length of the pipe. Take care to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Compact backfill to top of pipe to 95 percent of ASTM D698 maximum density. Provide plastic piping with bedding to spring line of pipe. Provide materials as follows:

a. Class I: Angular, 0.25 to 1.5 inch, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inch, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D2487.

3.11.1.4 Backfill for Stream Restoration

Placement of satisfactory earth fill and/or the reinforced bed material as

part of the stream restoration project shall be compacted by several passes of the tracked equipment, or by other means subject to the approval of the Contracting Officer. Achieving maximum density is not required.

3.11.1.5 Final Backfill

Fill the remainder of the trench, except for special materials for roadways, and other structural areas, with satisfactory material. Place backfill material and compact as follows:

a. Roadways, and Other Structural Areas: Place backfill up to the required elevation as specified. Do not permit water flooding or jetting methods of compaction. Compact to 95 percent based on ASTM D1557.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Deposit backfill in layers of a maximum of 12 inches loose thickness, and compact it to 90 percent maximum density in accordance with ASTM D1557. Do not permit compaction by water flooding or jetting. Apply this requirement to all other areas not specifically designated above.

3.11.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 28 days, place backfill in such a manner that the structure is not be damaged by the shock of falling earth. Deposit the backfill material, compact it as specified for final backfill, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.12 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.12.1 Gas Distribution

Excavate trenches to a depth that will provide a minimum 18 inches of cover in rock excavation and a minimum 24 inch of cover in other excavation.

3.12.2 Water Lines

Excavate trenches to a depth that provides a minimum cover of 4 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.12.3 Electrical Distribution System

Provide a minimum cover of 24 inches from the finished grade to direct burial cable and conduit or duct line, unless otherwise indicated.

3.12.4 Pipeline Casing

Provide new smooth wall steel pipeline casing under existing pavement by the boring and jacking method of installation unless otherwise indicated by the geotechnical engineer and after submittal has been approved.. Provide each new pipeline casing, where indicated and to the lengths and dimensions shown, complete and suitable for use with the new piped utility as indicated. Install pipeline casing by dry boring and jacking method as follows:

3.12.4.1 Bore Holes

Mechanically bore holes and case through the soil with a cutting head on a continuous auger mounted inside the casing pipe. Weld lengths of pipe together in accordance with AWS D1.1/D1.1M. Do not use water or other fluids in connection with the boring operation.

3.12.4.2 Cleaning

Clean inside of the pipeline casing of dirt, weld splatters, and other foreign matter which would interfere with insertion of the piped utilities by attaching a pipe cleaning plug to the boring rig and passing it through the pipe.

3.12.4.3 End Seals

After installation of piped utilities in pipeline casing, provide watertight end seals at each end of pipeline casing between pipeline casing and piping utilities. Provide watertight segmented elastomeric end seals.

3.12.5 Rip-Rap Construction

Construct rip-rap on filter fabric in accordance with Virginia Department of Transportation (VDOT) Standards in the areas indicated. Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 0.1 foot.

3.12.5.1 Bedding Placement

Spread filter fabric bedding material uniformly to a thickness of at least 3 inches on prepared subgrade as indicated. Compaction of bedding is not required. Finish bedding to present even surface free from mounds and windrows.

3.12.5.2 Stone Placement

Place rock for rip-rap on prepared bedding material to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip-rap throughout the entire mass and eliminate "pockets" of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above.

3.12.6 Stream Restoration

Rock materials used as part of the stream restoration project (reinforced bed material, structure rocks, and toe protection) shall be placed as specified in the construction documents.

3.12.6.1 Reinforced Bed Material

Reinforced bed material shall be pre-mixed in accordance with the specifications contained in the construction documents. The source and mixing of the reinforced bed material in the proper proportions (as specified in the construction documents) shall be confirmed and approved by the Contracting Officer. Observed changes in the composition of the reinforced bed material will result in additional inspections of the mixing

operation by the Contracting Officer. to ensure the proper material and proportions are being utilized.

3.13 EMBANKMENTS

3.13.1 Earth Embankments

Construct earth embankments from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. Place the material in successive horizontal layers of loose material not more than 12 inches in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise brake up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 95 percent laboratory maximum density in accordance with ASTM D1557, Procedure C. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph SUBGRADE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.14 SUBGRADE PREPARATION

3.14.1 Proof Rolling

The natural fine subgrade soils are noted to be above the optimum moisture needed for compaction, based on laboratory testing; therefore, the subgrade soils will require drying by aerating or disking before being compacted to develop a suitable subgrade for areas to receive compacted control fill, pavement or concrete slab-on-grade. Subgrade shall be properly prepared and protected during construction to minimize the degradation of these soils.

Finish proof rolling on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade with six passes of a 15 ton, pneumatic-tired roller. Operate the roller in a systematic manner to ensure the number of passes over all areas, and at speeds between 2-1/2 to 3-1/2 mph. When proof rolling, provide one-half of the passes made with the roller in a direction perpendicular to the other passes. Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Perform proof rolling in the presence of the Contracting Officer. Undercut rutting or pumping of material as directed by the Contracting Officer and replace with fill and backfill or select material.

The areas identified as "Old Stump Dump" and "Old Warehouse Area" on sheets C-101 through C-103 consist of surficial material that is unsuitable for construction. Areas shall be over excavated down to natural material and replaced with controlled structural fill for support of columbarium niche structures, manholes, and pavements. The undercut and replacement may be in excess of 10 feet, however, replacement under pavement may be limited to 3 feet.

3.14.2 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or

otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Excavate rock encountered in the cut section to a depth of 6 inches below finished grade for the subgrade. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified. After rolling, the surface of the subgrade for roadways shall not show deviations greater than 1/2 inch when tested with a 12-foot straightedge applied both parallel and at right angles to the centerline of the area. Do not vary the elevation of the finish subgrade more than 0.05 foot from the established grade and cross section.

3.14.3 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. The following are the minimum compaction requirements:

a. Structures, Foundations, and Concrete Slabs: Compact top 12 inches of subgrade and subsequent lifts to 95 percent of the laboratory maximum dry density in accordance with ASTM D 1557, procedure C.

b. Roads, Parking Areas, Crypt Burial Area, and Retaining Walls: Compact top 12-inches of subgrade and subsequent lifts to 95 percent of the laboratory maximum dry density in accordance with ASTM D 1557, Procedure C.

c. Green Areas: Compact to 85 percent of the laboratory maximum dry density in accordance with ASTM D 1557, Procedure C.

3.14.3.1 Subgrade for Pavements

The near surface soils contain high amounts of fines (silts and clays); the top 12 inches of subgrade shall be lime stabilized in accordance with Section 32 11 29 LIME-STABILIZED SUBGRADE.

Compact subgrade for pavements to at least 95 percentage laboratory maximum density in accordance with ASTM D 1557 for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, thoroughly blend, reshape, and compact the top 6 inch of subgrade.

3.15 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.15.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained.

Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

3.15.2 Grading Around Structures

Construct areas within 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

3.16 PLACING TOPSOIL

On areas to receive topsoil, prepare the compacted subgrade soil to a 2 inches depth for bonding of topsoil with subsoil. Spread topsoil evenly to a thickness of 6 inch and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from offsite areas.

3.17 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. Submit qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the Contracting Officer.

a. Determine field in-place density in accordance with ASTM D 6938. When ASTM D 6938 is used, check the calibration curves and adjust using only the sand cone method as described in ASTM D 1556. ASTM D 6938 results in a wet unit weight of soil in determining the moisture content of the soil when using this method.

b. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D 6938; check the calibration of both the density and moisture gauges at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, remove the material, replace, and recompact to meet specification requirements.

c. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.17.1 Fill and Backfill Material Gradation

One test per 500 cubic yards stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with ASTM D 422.

3.17.2 In-Place Densities

a. One test per 2,500 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 500 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

c. One test per 500 linear feet, or fraction thereof, of each lift of embankment or backfill for roads.

3.17.3 Moisture Contents

In the stockpile, excavation, or borrow areas, perform a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, perform tests as dictated by local conditions and approved by the Contracting Officer.

3.17.4 Optimum Moisture and Laboratory Maximum Density

Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 500 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.17.5 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

3.17.6 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to the finished grade surface, inspect the pipe to determine whether significant displacement has occurred. Conduct this inspection in the presence of the Contracting Officer. Inspect pipe sizes larger than 36 inches, while inspecting smaller diameter pipe by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgment of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, replace or repair the defects as directed at no additional cost to the Government.

3.17.7 Topsoil in Reinforced Bed Material

Topsoil meeting the specifications contained in the construction documents shall be used in the reinforced bed material. Alternative topsoil material can be used, subject to the approval of the Contracting Officer. Alternative topsoil material may require testing to confirm its classification and to verify it contains 3-5 percent organic matter.

3.18 DISPOSITION OF SURPLUS MATERIAL

Provide surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber as removed from Government property as directed by the Contracting Officer.

-- End of Section --

SECTION 31 05 19

GEOTEXTILE
08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D4354	(1999; R 2009) Sampling of Geosynthetics for Testing
ASTM D4355	(2007) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D4491	(1999a; R 2009) Water Permeability of Geotextiles by Permittivity
ASTM D4533	(2011) Trapezoid Tearing Strength of Geotextiles
ASTM D4632	(2008) Grab Breaking Load and Elongation of Geotextiles
ASTM D4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D4759	(2011) Determining the Specification Conformance of Geosynthetics
ASTM D4833	(2007) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D4873	(2002; R 2009) Identification, Storage, and Handling of Geosynthetic Rolls and Samples
ASTM D3786/D3786M	(2009) Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
ASTM D6241	(2009) Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 288	(2006) Standard Specification for Geotextile Specification for Highway Applications

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Thread; G, AE
Manufacturing Quality Control Sampling and Testing; G, AE

SD-04 Samples

Quality Assurance Samples and Tests

SD-07 Certificates

Geotextile

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver, store, and handle geotextile in accordance with ASTM D4873.

1.3.1 Delivery

Notify the Contracting Officer a minimum of 24 hours prior to delivery and unloading of geotextile rolls packaged in an opaque, waterproof, protective plastic wrapping. The plastic wrapping shall not be removed until deployment. If quality assurance samples are collected, immediately rewrap rolls with the plastic wrapping. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed. Label each roll with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, gross weight), and date manufactured.

1.3.2 Storage

Protect rolls of geotextile from construction equipment, chemicals, sparks and flames, temperatures in excess of 160 degrees F, or any other environmental condition that may damage the physical properties of the geotextile. To protect geotextile from becoming saturated, either elevate rolls off the ground or place them on a sacrificial sheet of plastic in an area where water will not accumulate.

1.3.3 Handling

Handle and unload geotextile rolls with load carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 PRODUCTS

2.1 RAW MATERIALS

A minimum of 7 days prior to scheduled use, submit manufacturer's certificate of compliance stating that the geotextile meets the requirements of this section. For needle punched geotextiles, the manufacturer shall also certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could damage other geosynthetic layers. The certificate of compliance shall be attested to by a person having legal authority to bind the geotextile manufacturer.

2.1.1 Geotextile

Provide geotextile that is a nonwoven pervious sheet of polymeric material consisting of long-chain synthetic polymers composed of at least 95 percent by weight polyolefins, polyesters, or polyamides. The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) will not be allowed. Add stabilizers and/or inhibitors to the base polymer, as needed, to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure. Regrind material, which consists of edge trimmings and other scraps that have never reached the consumer, may be used to produce the geotextile. Post-consumer recycled material may also be used. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. Geotextiles shall meet the requirements specified in Table 1. Where applicable, Table 1 property values represent minimum average roll values (MARV) in the weakest principal direction. Values for AOS represent maximum average roll values.

TABLE 1
MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE

PROPERTY	UNITS	ACCEPTABLE VALUES	TEST METHOD
GRAB STRENGTH	LBS	160	ASTM D4632
SEAM STRENGTH	LBS	142	ASTM D4632
PUNCTURE	LBS	55	ASTM D4833
TRAPEZOID TEAR	LBS	55	ASTM D4533
APPARENT OPENING SIZE	U.S. SIEVE	No. 60	ASTM D4751
PERMITTIVITY	SEC -1	0.2	ASTM D4491
ULTRAVIOLET DEGRADATION	PERCENT	50 AT 500 HRS	ASTM D4355

2.1.2 Thread

A minimum of 7 days prior to scheduled use, submit proposed thread type for sewn seams along with data sheets showing the physical properties of the thread. Construct sewn seams with high-strength polyester, nylon, or other approved thread type. Thread shall have ultraviolet light stability equivalent to the geotextile and the color shall contrast with the geotextile.

2.1.3 Stabilization and Separation Geotextile Fabric

Stabilization and separation geotextile fabric shall meet the requirements of AASHTO M 288 Class 1/FHWA FP-03 Type III (A).

Property	Units	Acceptable Values	Test Method
Grab Tensile Strength	LBS	250	ASTM D4632
Grab Elongation	Percent	50	ASTM D4632
Puncture Strength	LBS	150	ASTM D4833
CBR Puncture	LBS	525	ASTM D6241
Mullen Burst	PSI	450	ASTM D3786/D3786M
Trapezoidal Tear	LB	80	ASTM D4533
Apparent Opening Size (AOS)	US Sieve	100	ASTM D4751
Permittivity	SEC-1	1.2	ASTM D4491
UV Resistance	% Retained @ 500 HRS	70	ASTM D4355

2.2 MANUFACTURING QUALITY CONTROL SAMPLING AND TESTING

The Manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. A minimum of 7 days prior to scheduled use, submit manufacturer's quality control manual. Documentation describing the quality control program shall be made available upon request. Perform manufacturing quality control sampling and testing in accordance with the manufacturer's approved quality control manual. As a minimum, geotextiles shall be randomly sampled for testing in accordance with ASTM D4354, Procedure A. Acceptance of geotextile shall be in accordance with ASTM D4759. Tests not meeting the specified requirements will result in the rejection of applicable rolls.

PART 3 EXECUTION

3.1 QUALITY ASSURANCE SAMPLES AND TESTS

3.1.1 Quality Assurance Samples

Provide assistance to the Contracting Officer in the collection of quality

assurance samples for quality assurance testing; assign 7 days in the schedule to allow for testing. Collect samples upon delivery to the site in accordance with ASTM D4354, Procedure B. Lot size for quality assurance sampling shall be considered to be the shipment quantity of the product or a truckload of the product, whichever is smaller. The unit size shall be considered one roll of geotextile. . Identify samples with a waterproof marker by manufacturer's name, product identification, lot number, roll number, and machine direction. The date and a unique sample number shall also be noted on the sample. Discard the outer layer of the geotextile roll prior to sampling a roll. Samples shall then be collected by cutting the full-width of the geotextile sheet a minimum of 3 feet long in the machine direction. Rolls which are sampled shall be immediately resealed in their protective covering.

3.1.2 Quality Assurance Tests

The Contractor shall provide quality assurance samples to an Independent Laboratory. Samples will be tested to verify that geotextile meets the requirements specified in Table 1. Test method ASTM D4355 shall not be performed on the collected samples. Geotextile product acceptance shall be based on ASTM D4759. Tests not meeting the specified requirements will result in the rejection of applicable rolls.

3.2 INSTALLATION

3.2.1 Subgrade Preparation

The surface underlying the geotextile shall be smooth and free of ruts or protrusions which could damage the geotextile. Subgrade materials and compaction requirements shall be in accordance with Section 31 00 00 EARTHWORK.

3.2.2 Placement

Notify the Contracting Officer a minimum of 24 hours prior to installation of geotextile. Geotextile rolls which are damaged or contain imperfections shall be repaired or replaced as directed. The geotextile shall be laid flat and smooth so that it is in direct contact with the subgrade. The geotextile shall also be free of tensile stresses, folds, and wrinkles. On slopes steeper than 10 horizontal on 1 vertical, lay the geotextile with the machine direction of the fabric parallel to the slope direction.

3.3 SEAMS

3.3.1 Overlap Seams

Continuously overlap geotextile panels a minimum of 12 inches at all longitudinal and transverse joints. Where seams must be oriented across the slope, lap the upper panel over the lower panel. If approved, sewn seams may be used instead of overlapped seams.

3.3.2 Sewn Seams

Factory and field seams shall be continuously sewn on all slopes steeper than 1 vertical on 4 horizontal The stitch type used shall be a 401 locking chain stitch or as recommended by the manufacturer. For field and factory seams which are sewn, provide at least a 2-meter sample of sewn seam before the geotextile is installed. For seams that are field sewn, the seams shall be sewn using the same equipment and procedures as will be used for

the production seams. If seams are sewn in both the machine and cross machine direction, provide samples of seams from both directions. Provide Quality Assurance seam samples to the Government at the request of the Contracting Officer. Seam strength shall meet the minimum requirements specified in Table 1. The thread at the end of each seam run shall be tied off to prevent unraveling. Skipped stitches or discontinuities shall be sewn with an extra line of stitching with a minimum of 18 inches of overlap.

3.4 PROTECTION

Protect the geotextile during installation from clogging, tears, and other damage. Damaged geotextile shall be repaired or replaced as directed. Use adequate ballast (e.g. sand bags) to prevent uplift by wind. The geotextile shall not be left uncovered for more than 14 days after installation.

3.5 REPAIRS

Repair torn or damaged geotextile. Clogged areas of geotextile shall be removed. Perform repairs by placing a patch of the same type of geotextile over the damaged area. The patch shall extend a minimum of 12 inches beyond the edge of the damaged area. Patches shall be continuously fastened using approved methods. The machine direction of the patch shall be aligned with the machine direction of the geotextile being repaired. Remove and replace geotextile rolls which cannot be repaired. Repairs shall be performed at no additional cost to the Government

3.6 PENETRATIONS

Construct engineered penetrations of the geotextile by methods recommended by the geotextile manufacturer.

3.7 COVERING

Do not cover geotextile prior to inspection and approval by the Contracting Officer. Place cover soil in a manner that prevents soil from entering the geotextile overlap zone, prevents tensile stress from being mobilized in the geotextile, and prevents wrinkles from folding over onto themselves. On side slopes, soil backfill shall be placed from the bottom of the slope upward. Cover soil shall not be dropped onto the geotextile from a height greater than 3 feet. No equipment shall be operated directly on top of the geotextile without approval of the Contracting Officer. Use equipment with ground pressures less than 7 psi to place the first lift over the geotextile. A minimum of 12 inches of soil shall be maintained between full-scale construction equipment and the geotextile. Cover soil material type, compaction, and testing requirements are described in Section 31 00 00 EARTHWORK. Equipment placing cover soil shall not stop abruptly, make sharp turns, spin their wheels, or travel at speeds exceeding 5 mph.

-- End of Section --

SECTION 31 11 00

CLEARING AND GRUBBING
08/08

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Nonsaleable Materials

SD-04 Samples

Herbicide
Tree Samples

1.2 DELIVERY, STORAGE, AND HANDLING

Deliver materials to store at the site, and handle in a manner which will maintain the materials in their original manufactured or fabricated condition until ready for use.

PART 2 PRODUCTS

2.1 HERBICIDE

Comply with Federal Insecticide, Fungicide, and Rodenticide Act (Title 7 U.S.C. Section 136) for requirements on Contractor's licensing, certification and record keeping. Contact the command Pest Control Coordinator prior to starting work. Submit samples in cans with manufacturer's label.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Roads and Walks

Keep roads and walks free of dirt and debris at all times.

3.1.2 Trees, Shrubs, and Existing Facilities

Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.1.3 Utility Lines

Protect existing utility lines that are indicated to remain from damage.

Notify the Contracting Officer immediately of damage to or an encounter with an unknown existing utility line. The Contractor is responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, notify the Contracting Officer in ample time to minimize interruption of the service. Refer to Section 01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS for additional utility protection.

3.2 CLEARING

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches below 12 feet from ground. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Tree roots exposed by this work shall be neatly pruned and covered with soil.

3.3 TREE REMOVAL

Where directed by Contracting Officer, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.4 Tree Samples

Contractor shall harvest and provide to the Contracting Officer two 6-inch thick "cookies" or slices from each of the following trees, identified by tag numbers: 1024, 1063, 1258, and 2027.

Sample shall be harvested at approximately 48-inches above ground surface in coordination with the Arlington National Cemetery (ANC) Horticulture Department. Slices shall be cut with suitable equipment to provide a uniform surface.

3.5 PRUNING

Trim trees designated to be left standing within the cleared areas of dead branches 1 1/2 inches or more in diameter. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Tree pruning shall only be undertaken by a certified arborist. No tree pruning shall be undertaken without prior approval on-site by Contracting Officer.

3.6 GRUBBING

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing

areas. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.7 DISPOSAL OF MATERIALS

3.7.1 Removal of Designated Timber

Within 30 days after the Notice to Proceed is issued, the Contractor shall submit a certified check in the amount of $11,000.00 payable to "FAO, U. S. Army Corps of Engineers" for the fair market value of the timber designated for removal on the site, per the plans and specifications. The check shall be mailed/delivered to David B. Parson, Norfolk District Corps of Engineers, 803 Front Street, Norfolk VA 23510-1096. The Contractor shall have 180 days from the date that the Notice to Proceed is issued to remove the designated timber from the construction site. Ownership of timber transfers from the Government to the Contractor upon cutting. Title to the timber cut hereunder shall vest in the Contractor as and when the Contractor cuts the timber; however, the Cemetery reserves title to those slices, or "cookies," of trees as indicated at Article 3.4 of this Section in accordance with certain mitigation measures stipulated in the Memorandum of Agreement with the Virginia Department of Historic Resources. The risk of loss shall transfer from the Government to the Contractor upon vesting of title. All trees not cut will remain property of the Government.

The transfer and vesting of title to timber harvested from the Millennium Project site is conditioned upon a covenant by the Contractor, manifested by signing its price proposal to this Solicitation, that the use and/or disposition of the harvested timber will be in keeping with the dignity of Arlington National Cemetery ("ANC"). Therefore, the Contractor, or its successors, heirs, or assigns, will be strictly precluded from using, advertising for sale, or otherwise marketing the harvested timber in any manner that references directly or indirectly that the timber was harvested from Arlington National Cemetery. If Contractor intends to use the timber in a manner that makes reference to the fact that the timber was harvested from ANC and is in keeping with the dignity of the Cemetery, the Contractor must submit a detailed written plan for the intended use for approval by the Executive Director of ANC. The Executive Director hereby retains discretion to establish the requirements for the written submittal. In no way may the Contractor's use, sale, or other disposition of the harvested timber under any circumstances impact the execution of the Work subject to this contract.

3.7.2 Saleable Timber

All timber on the project site noted for clearing and grubbing shall become the property of the Contractor, and shall be removed from the project site and disposed of off stations.

3.7.3 Nonsaleable Materials

Written permission to dispose of such products on private property shall be filed with the Contracting Officer. Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except

for salable timber, shall be disposed of outside the limits of Government-controlled land at the Contractor's responsibility , except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed. Burning of nonsaleable materials shall not be permitted on Government property.

-- End of Section --

SECTION 31 23 00.00 20

EXCAVATION AND FILL
02/11

PART 1 GENERAL

1.1 SUMMARY

This Section includes requirements for excavation. If buried remains of horses are found, the Contracting Officer shall be notified immediately. Refer to Section 02 42 91 REMOVAL AND SALVAGE OF HISTORIC BUILDING MATERIALS for procedures for unearthing horse remains at this Site.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(2010) Installation of Ductile-Iron Water Mains and Their Appurtenances

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010; Errata 2010) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A139/A139M	(2004; R 2010) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
ASTM A252	(2010) Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C33/C33M	(2011a) Standard Specification for Concrete Aggregates
ASTM D1140	(2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	(2009) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D2216	(2010) Laboratory Determination of Water

	(Moisture) Content of Soil and Rock by Mass
ASTM D2321	(2011) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2487	(2011) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D4318	(2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D698	(2007e1) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011) Safety and Health Requirements Manual

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 530/F-93/004	(1993; Rev O; Updates I, II, IIA, IIB, and III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II) (SW-846)
EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT	(2007) Virginia Department of Transporation Road and Bridge Specifications

1.3 DEFINITIONS

1.3.1 Capillary Water Barrier

A layer of clean, poorly graded crushed rock, stone, or natural sand or gravel having a high porosity which is placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below a slab.

1.3.2 Degree of Compaction

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557, for general soil

types, abbreviated as percent laboratory maximum density.

1.3.3 Hard Materials

Dense consolidated deposits which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.1.3.4 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals identified with "AE" shall be reviewed by Landscape Architect. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shoring and Sheeting Plan
Dewatering work plan

Submit 15 days prior to starting work.

SD-06 Test Reports

Borrow Site Testing; G
Fill and backfill test; G, AE
Select material test; G
Porous fill test for capillary water barrier; G
Density tests; G
Settlement Readings; G
Moisture Content Tests; G

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

1.5 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.6 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.

e. Material character is indicated by the boring logs.

f. Hard materials will be encountered at 10 feet below existing surface elevations.

g. Blasting will not be permitted. Remove material in an approved manner.

1.7 REQUIREMENTS FOR OFF SITE SOIL

Soils brought in from off site for use as backfill shall be tested for TPH, BTEX and full TCLP including ignitability, corrosivity and reactivity. Backfill shall contain less than 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCPL test. TPH concentrations shall be determined by using EPA 600/4-79/020 Method 418.1. BTEX concentrations shall be determined by using EPA 530/F-93/004 Method 5030/8020. TCLP shall be performed in accordance with EPA 530/F-93/004 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Material shall not be brought on site until tests have been approved by the Contracting Officer.

1.8 QUALITY ASSURANCE

1.8.1 Shoring and Sheeting Plan

Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Drawings shall include material sizes and types, arrangement of members, and the sequence and method of installation and removal. Calculations shall include data and references used.

The Contractor is required to hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer shall be responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer shall update the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and shall submit an updated plan if necessary. A written report shall be submitted, at least monthly, informing the Contractor and Contracting Officer of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Geotechnical Engineer shall be available to meet with the Contracting Officer at any time throughout the contract duration.

1.8.2 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.

1.8.3 Utilities

Movement of construction machinery and equipment over pipes, utilities, and inplace crypts during construction shall be at the Contractor's risk. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation

until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

2.1.1 Satisfactory Materials for Common Fill

Any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC, SP-SM, SP-SC, CL, CL-ML, CH, free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, andfrozen, deleterious, expansive or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 3 inches. The Contracting Officer shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic (plasticity index equals zero). Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

2.1.4 Expansive Soils

Expansive Soils such as "marine clays" of the Potomac Formation are not permitted as structural fill for building pads, foundation backfill, backfill around structure, or behind retaining walls. Expansive Soil is defined as:

Soils meeting all four of the following provisions shall be considered expansive, except that tests to show compliance with Items a, b and c shall not be required if the test prescribed in Item d is conducted:

a. Plasticity Index (PI) of 15 or greater, determined in accordance with ASTM D4318.

b. More than 10 percent of the soil particles pass a No. 200 sieve, determined in accordance with ASTM D422.

c. More than 10 percent of the soil particles are less than 5 micrometers in size, determined in accordance with ASTM D422.

d. Expansion Index greater than 20, determined in accordance with ASTM D4829.

If the PI of the soil is 20 or less (e.g., PI < 20) and the LL is 45 or less (e.g., LL < 45), the Plasticity Index Corrected (PIcor) or the Expansion Index Corrected (EIcor) may be substituted in the above definition of expansive soils. PIcor and EIcor are defined as:

a. PIcor = PI x (% Passing No. 40 Sieve)/100 and EIcor = EI x (% Passing No. 4 Sieve)/100

2.1.5 Common Fill

Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location.

2.1.6 Backfill and Fill Material

ASTM D2487, classification GW, GP, GM, GC, SW, SP, SM, SC with a maximum ASTM D4318 liquid limit of 35, maximum ASTM D4318 plasticity index of 12, and a maximum of 25 percent by weight passing ASTM D1140, No. 200 sieve.

2.1.7 Select Material

Fill placed beneath buildings, structures, and under roadways which will raise the site to the finished subgrade shall be compacted structural fill. Controlled structural fill material under buildings and the roadways should be non-expansive and free of organic matter, debris, and particles larger than 2-inches in size. Controlled fill shall extend at least 10 feet beyond the building limits or to a distance equal to the height of the fill. Areas to receive fill which are sloped surfaces, steeper than one foot vertical and four feet horizontal (1V to 4H) shall be plowed, stepped and benched so that the fill material will bond with the existing materials. Steps or benches shall be 1 foot vertical to 2 feet horizontal (1V to 2H). Controlled Structural Fill under buildings and structures should classify per USCS as SW, SP, SP-SM, or SM by ASTM D2487 with a maximum of 20 percent fines passing the No. 200 sieve when tested in accordance with ASTM D1140. Controlled Structural Fill under roadways shall include all materials suitable under building and structures and include material classified per USCS as SC, ML, or CL with a maximum liquid limit of 45 and a plasticity index of greater than 15 when tested in accordance with ASTM D4318.

2.1.8 Topsoil

Provide as specified in Section 32 92 19 SEEDING.

2.1.9 Settlement Plates

The settlement plates shall be fabricated of materials as indicated on the contract drawings.

2.2 POROUS FILL FOR CAPILLARY WATER BARRIER

ASTM C33/C33M fine aggregate grading with a maximum of 3 percent by weight passing ASTM D1140, No. 200 sieve, or coarse aggregate Size 57, 67, or 77 and conforming to the general soil material requirements specified in paragraph entitled "Satisfactory Materials."

2.3 UTILITY BEDDING MATERIAL

Except as specified otherwise in the individual piping section, provide

bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide ASTM D2321 materials as follows:

a. Class I: Angular, 0.25 to 1.5 inches, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inches, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D2487.

2.4 BORROW

Obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property.

2.5 BACKFILL FOR UNDERDRAINAGE SYSTEMS

Clean sand, crushed rock, or gravel meeting the following requirements:

a. Perforated or Slotted-Wall Pipe: Backfill meeting requirements of Type I material as specified in Table 1.

b. Open Joint Pipe: Type III backfill consisting of both Type I and Type II materials as specified in Table 1.

c. Blind or French Drains: Backfill consisting of Type I or Type III material as specified in Table 1.

d. Any Type Drain Used With Filter Fabric: Clean gravel or crushed stone or gravel conforming to ASTM C33/C33M coarse aggregate grading size 57, 67, or 7.

TABLE 1

	Type I	Type II	Type III
ASTM D422 Sieve Size	Percent Passing	Percent Passing	Percent Passing
1.5 inches	100	100	100
1 inch	95-100	100	96-100
3/4 inch	82-82	52-100	70-83
1/2 inch	62-80	---	44-70

TABLE 1

	Type I	Type II	Type III
ASTM D422 Sieve Size	Percent Passing	Percent Passing	Percent Passing
3/8 inch	59-73	36-65	38-59
No. 4	40-55	8-40	24-33
No. 8	5-20	---	20-29
No. 16	0-5	0-12	12-21
No. 50	---	---	2-8
No. 100	---	---	0-3
No. 200	---	0-5	---

Note: As a guide, a 50/50 blend of No. 57 and No 9 coarse aggregate will fall within the Type I gradation. Pennsylvania Department of Transportation OGS Gradation (Section 703.2) will fall within gradation band No. II. A 75/25 blend of No. 57 coarse aggregate and C33 sand will Type III.

2.6 BACKFILL BEHIND RETAINING WALLS

Shall be done according to Detail 4 on Sheet S-522 of the Drawings.

2.7 BACKFILL FOR CRYPTS

2.7.1 Flowable Rock Fill

Washed pea stone or gravel, natural stone; free of shale, clay, friable material, debris, or other deleterious substances, self-consolidating, in the following gradation:

Sieve Size	Percent Passing
1 inch	100
3/4 inch	90-100
3/8 inch	40-100
No. 4	25-40

Sieve Size	Percent Passing
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

Rock shall have a durability index of not less than 40. Flowable rock fill to be used between crypts and over top of crypt lids as indicated on the Contract Drawings.

2.7.2 Crushed Aggregate Drainage Fill

Washed, narrowly graded mixture of crushed stone or crushed or uncrushed gravel; free of shale, clay, friable material, debris, or other deleterious substances; conforming to ASTM D448; coarse-aggregate grading Size 57:

Sieve Size	Percent Passing
1-1/2 inch	100
1 inch	95-100
1/2 inch	25-60
No. 4	0-10
No. 8	0-5

Crushed aggregate drainage fill to be used beneath crypts as indicated on the Contract Drawings.

2.8 FILTER FABRIC

See Section 31 05 19.

2.9 MATERIAL FOR PIPE CASING

2.9.1 Casing Pipe

ASTM A139/A139M, Grade B, or ASTM A252, Grade 2, smooth wall pipe. Casing size shall be of the outside diameter and wall thickness as indicated. Protective coating is not required on casing pipe.

2.10 MATERIAL FOR RIP-RAP

Filter fabric and rock conforming to the Virginia Erosion and Sediment Control Handbook, Third Edition 1992 for construction indicated.

2.10.1 Bedding Material

Consisting of sand, gravel, or crushed rock, well graded, with a maximum particle size of 2 inches. Material shall be composed of tough, durable particles. Fines passing the No. 200 standard sieve shall have a plasticity index less than six.

2.11 BURIED WARNING AND IDENTIFICATION TAPE

Refer to Section 31 00 00 EARTHWORK.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Shoring and Sheeting

Provide shoring, bracing, cribbing, and sheeting where required. In addition to Section 25 A and B of EM 385-1-1 , include provisions in the shoring and sheeting plan that will accomplish the following:

a. Prevent undermining of pavements, foundations and slabs.

b. Prevent slippage or movement in banks or slopes adjacent to the excavation. Shoring shall anticipate vehicle traffic, construction activities, and any other foreseeable forces that will affect design..

c. Allow for the abandonment of shoring and sheeting materials in place in critical areas as the work is completed. In these areas, backfill the excavation to within 3 feet of the finished grade and remove the remaining exposed portion of the shoring before completing the backfill.

3.1.2 Drainage and Dewatering

Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.1.2.1 Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. The Contractor shall establish/construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

3.1.2.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 2 feet below the working level.

3.1.3 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. The Contractor shall contact JBMHH Public Works Department, Miss Utility, ANC, and higher a private utility locator for assistance in locating existing utilities. The Contractor shall scan the construction site with electromagnetic and sonic equipment and mark the surface of the ground where existing underground utilities are discovered.

3.1.4 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged.

3.2 SURFACE PREPARATION

3.2.1 Clearing and Grubbing

See Section 31 11 00.

3.2.2 Stripping

Strip suitable soil from the site where excavation or grading is indicated and stockpile separately from other excavated material. Material unsuitable for use as topsoil shall be wasted. Locate topsoil so that the material can be used readily for the finished grading. Where sufficient existing topsoil conforming to the material requirements is not available on site, provide borrow materials suitable for use as topsoil. Protect topsoil and keep in segregated piles until needed.

3.2.3 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils

softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed. Refill with approved fill for the intended use and compact to 95 percent of ASTM D1557 maximum density. Satisfactory material removed below the depths indicated, without specific direction of the Contracting Officer, shall be replaced with satisfactory materials to the indicated excavation grade; except as specified for spread footings. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.3.1 Structures With Spread Footings

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Fill over excavations with concrete during foundation placement.

3.3.2 Pile Cap Excavation and Backfilling

Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the Contracting Officer. Backfill and compact overexcavations and changes in grade due to pile driving operations to 95 percent of ASTM D698 maximum density.

3.3.3 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement. Tamp if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 6 inches below the bottom of the pipe.

3.3.4 Excavated Materials

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Paragraph "DISPOSITION OF SURPLUS MATERIAL."

3.3.5 Final Grade of Surfaces to Support Concrete

Excavation to final grade shall not be made until just before concrete is to be placed. For pile foundations, the excavation shall be stopped at an elevation 6 to 12 inches above the bottom of the footing before driving piles. After pile driving has been completed, the remainder of the excavation shall be completed to the elevations shown. Only excavation methods that will leave the foundation rock in a solid and unshattered condition shall be used. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond. Shales shall be protected from slaking and all surfaces shall be protected from erosion resulting from ponding or flow of water.

3.4 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Contracting Officer. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to plus or minus 2 percent of optimum moisture to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified herein.

3.4.1 Proof Rolling

Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. Proof roll the existing subgrade that will see development with six passes of a dump truck loaded with 212 cubic feet of soil. Operate the truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 2 1/2 to 3 1/2 miles per hour. When proof rolling under buildings, the building subgrade shall be considered to extend 5 feet beyond the building lines, and one-half of the passes made with the roller shall be in a direction perpendicular to the other passes. Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Contracting Officer. Rutting or pumping of material shall be undercut as directed by the Contracting Officer.

3.5 FILLING AND BACKFILLING

Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.

3.5.1 Common Fill Placement

Provide for general site and under pile-supported structures. Place in 12 inch lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Finish to a smooth surface by blading, rolling with a smooth roller, or both.

3.5.2 Backfill and Fill Material Placement

Provide for paved areas and under concrete slabs, except where select material is provided. Place in 6 inch lifts. Do not place over wet or frozen areas. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against the structure.

3.5.3 Select Material Placement

Provide under structures not pile supported. Place in 12 inch lifts. Do not place over wet or frozen areas. Backfill adjacent to structures shall be placed as structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against structure.

3.5.4 Backfill and Fill Material Placement Over Pipes and at Walls

Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade . Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than 1 inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.

3.5.5 Porous Fill Placement

Provide under floor and area-way slabs on a compacted subgrade. Place in 4 inch lifts with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.5.6 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact backfill under structures and paved areas in 6 inch lifts to top of trench and in 6 inch lifts to one foot over pipe outside structures and paved areas.

3.6 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved borrow materials shall be obtained as specified herein.

3.7 BURIED WARNING AND IDENTIFICATION TAPE

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.8 BURIED DETECTION WIRE

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall

terminate inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over it's entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

3.9 COMPACTION

Determine in-place density of existing subgrade; if required density exists, no compaction of existing subgrade will be required. Density requirements specified herein are for cohesionless materials. When cohesive materials are encountered or used, density requirements may be reduced by 5 percent.

3.9.1 General Site

Compact underneath areas designated for vegetation and areas outside the 5 foot line of the paved area or structure to 90 percent of ASTM D1557.

3.9.2 Structures, Spread Footings, and Concrete Slabs

Compact top 12 inches of subgrades to 95 percent of ASTM D1557. Compact select material to 95 percent of ASTM D1557.

3.9.3 Adjacent Area

Compact areas within 5 feet of structures to 90 percent of ASTM D1557.

3.9.4 Paved Areas

Compact top 12 inches of subgrades to 95 percent of ASTM D1557. Compact fill and backfill materials to 95 percent of ASTM D1557.

3.10 PIPELINE CASING UNDER PAVEMENT

Provide new smooth wall steel pipeline casing under existing pavement by the boring and jacking method of installation. Provide each new pipeline casing, where indicated and to the lengths and dimensions shown, complete and suitable for use with the new piped utility as indicated.

3.10.1 Earthwork for Pipeline Casings

Provide excavation, sheet piling, shoring, dewatering, and backfilling for pipeline casings under this section.

3.10.2 Steel Cased Pipelines

Install pipeline casing by dry boring and jacking method as follows:

3.10.2.1 Hole for Pipeline Casing

Mechanically bore holes and case through the soil with a cutting head on a continuous auger mounted inside the casing pipe. Weld lengths of pipe together in accordance with AWS D1.1/D1.1M. Do not use water or other fluids in connection with the boring operation.

3.10.2.2 Cleaning

Clean inside of the pipeline casing of dirt, weld splatters, and other foreign matter which would interfere with insertion of the piped utilities by attaching a pipe cleaning plug to the boring rig and passing it through the pipe.

3.10.2.3 Piped Utilities

Provide in casing using wood supports adjusted to obtained grades and elevations indicated.

3.10.2.4 End Seals

After installation of piped utilities in pipeline casing, provide watertight end seals at each end of pipeline casing between pipeline casing and piping utilities according to detail shown on Drawings. Provide watertight segmented elastomeric end seals.

3.11 SPECIAL EARTHWORK REQUIREMENTS FOR SUBSURFACE DRAINS

Excavate to dimensions indicated. Provide a bedding surface of no more than one inch of sand and place on compacted native soil as indicated. Backfill around and over the pipes after pipe installation has been approved. Place special granular filter material in 6 inch lifts and compact with mechanical, vibrating plate tampers or rammers until no further consolidation can be achieved. Compact backfill overlying the special granular filter material as specified for adjacent or overlying work.

3.11.1 Granular Backfill Using Filter Fabric

3.11.1.1 Perforated or Slotted Wall Pipes

Wrap one layer of filter fabric around pipe in such a manner that longitudinal overlaps are in unperforated or unslotted quadrants of the pipe. Overlap fabric a minimum of 2 inches. Secure fabric to pipe so that backfill material does not infiltrate through overlaps. Place granular material and extend it for one pipe diameter, minimum of 6 inches on each side of and 18 inches above top of pipe. Place a layer of filter fabric on top of granular filter before continuing with backfill.

3.11.1.2 Open-Joint Pipe

Wrap one layer of filter fabric around pipe joints overlapping a minimum of 2 inches in the longitudinal direction and extending at least 6 inches on both sides of the joint. Secure fabric to pipe so that backfill material does not infiltrate through overlaps. Place granular material specified and extend it for a minimum of one pipe diameter on each side of and 18 inches above top of pipe. Place a layer of filter fabric on top of granular filter before continuing with backfill.

3.11.1.3 Blind or French Drains

Install filter cloth in trenches with smoothly graded sides and bottom, free of cavities or projecting rocks. Lay the cloth flat but not stretched and secure with anchor pins. Place filter cloth so that drain water must pass through the cloth into the specified granular filter material. Overlap ends at least of 12 inches. Place backfill on filter cloth in the direction of overlaps. Where fabric is damaged, place a new piece of

filter cloth over damaged area and overlap at least of 12 inches in every direction.

3.12 RIP-RAP CONSTRUCTION

Construct rip-rap on bedding material or on filter fabric as indicated on Drawings and in accordance with VDOT Road and Bridge Specifications, 414 "Riprap" in the areas indicated.

3.12.1 Preparation

Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 0.1 foot.

3.12.2 Bedding Placement

Spread filter fabric or bedding material uniformly to a thickness of at least 4 inches on prepared subgrade as indicated. Finish bedding to present even surface free from mounds and windrows.

3.12.3 Stone Placement

Place rock for rip-rap on prepared bedding material to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip-rap throughout the entire mass and eliminate "pockets" of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above.

3.13 SETTLEMENT PLATES

The settlement plates shall be installed following completion of stripping operations and prior to placement of any fill. The foundation surface for each plates shall be well compacted and graded smooth and level. Care shall be exercised to ensure the riser pipe is installed and maintained plumb. the locations of the settlement plates shall be determined by scaling from structural features on the contract drawings. The locations of the settlement plates shall be adjusted to avoid utilities.

A protective mound of fill shall be placed over the base of the settlement plate and maintained around the riser pipe above the working surface of the fill as it is constructed. Fill material placed in the protective mound shall be compacted by hand-operated compactors to the same density as the contiguous mass fill. Care shall be exercised in placing and compacting fill around the settlement plates to avoid damage to or misalignment of the riser pipe. Details of the protective mound are shown on the drawings.

Contractor shall conduct the mass fill placement operations so as to avoid any disturbance or damage to the settlement plates. Any settlement plate rendered unusable by disturbance or damage shall be immediately repaired or replaced, as directed by the Contracting Officer, all at the Contractor's expense.

When a settlement plate is no longer needed, the riser pipe shall be cut off a minimum of 18 inches below finish grade.

3.13.1 Monitoring Of Instrumentation

3.13.1.1 Survey Accuracy

The elevations of the tops of the settlement plate risers shall be determined by level surveys to the nearest 0.01 foot. The surveys shall be performed at second-order accuracy. Sight distances shall be limited to 200 feet, foresight and backsight readings shall be balanced, and the level rod shall be equipped with a level bubble. The elevations shall be based on a benchmark founded in natural in situ soil and located, as approved by the Contracting Officer, away from the construction area where it will not be disturbed. The survey circuit shall be closed on the benchmark and the apparent closing error distributed among the points as appropriate. The surveying shall be performed by or under the direct supervision of a Registered Professional Land Surveyor.

3.13.1.2 Settlement Readings

Readings shall begin immediately after installation of each settlement plate and the placement of a protective earth fill mound around the settlement plates.

The settlement plates shall be read twice weekly during placement of the fill, twice weekly for 1 month following completion of the fill to required elevation in the vicinity of the settlement plates, and bi-weekly thereafter for 1 month, unless discontinuation is ordered in writing by the Contracting Officer before the end of the second month.

Additionally, each time a settlement plate is surveyed, the elevation of the "working surface" of the fill, not the protective mound, in the vicinity of the settlement plate shall be determined and recorded with that of the riser pipe.

3.14 FINISH OPERATIONS

3.14.1 Grading

Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. Maintain areas free of trash and debris. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.14.2 Protection of Surfaces

Protect newly backfilled, graded, and topsoiled areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.15 DISPOSITION OF SURPLUS MATERIAL

Remove from Government property surplus or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber.

3.16 FIELD QUALITY CONTROL

3.16.1 Sampling

Take the number and size of samples required to perform the following tests.

3.16.2 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

3.16.2.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C136 for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D4318 for liquid limit and for plastic limit; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

3.16.2.2 Select Material Testing

Test select material in accordance with ASTM C136 for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

3.16.2.3 Porous Fill Testing

Test porous fill in accordance with ASTM C136 for conformance to gradation specified in ASTM C33/C33M.

3.16.2.4 Density Tests

Test density in accordance with ASTM D1556, or ASTM D6938. When ASTM D6938 density tests are used, verify density test results by performing an ASTM D1556 density test at a location already ASTM D6938 tested as specified herein. Perform an ASTM D1556 density test at the start of the job, and for every 10 ASTM D6938 density tests thereafter. Test each lift at randomly selected locations every 2000 square feet of existing grade in fills for structures and concrete slabs, and every 2500 square feet for other fill areas and every 2000 square feet of subgrade in cut. Include density test results in daily report.

Bedding and backfill in trenches: One test per 50 linear feet in each lift.

3.16.2.5 Moisture Content Tests

In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of materials being placed is required during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions and approved moisture content shall be tested in accordance with ASTM D2216. Include moisture content test results in daily report.

-- End of Section --

SECTION 31 63 16

AUGER-PLACED GROUT PILES
11/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only and represent the latest edition in force when this contract is awarded.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 33	Concrete Aggregates
ASTM C 109/C 109M	Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C 150	Portland Cement
ASTM C 469	Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression
ASTM C 618	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 937	Grout Fluidifier for Preplaced-Aggregate Concrete
ASTM C 939	Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
ASTM C 989	Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1090	Standard Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout
ASTM C 1260	(1994) Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM D 1143	Piles Under Static Axial Compressive Load

1.2 UNIT PRICE BASIS FOR BIDS AND PAYMENTS

1.2.1 General

Piles shall be 14-inches in diameter and have capacity as noted on the Drawings.

This Section applies to Auger-Placed Grout Piles. When otherwise noted on the Drawings as Auger-Cast Grout Piles, all requirements stipulated herein shall apply.

1.2.1.1 Presence of Contracting Officer

All measurements shall be made in the presence of the Contracting Officer.

1.2.1.2 Protection of Records

The Contractor shall preserve all work in good condition until final measurement and until the records have been examined and accepted.

1.2.1.3 Payment

The contract unit prices for each of the various items of work covered under this section shall constitute full compensation for furnishing all plant, labor, equipment, materials, and supplies, and performing all operations specified herein, shown on the drawings, directed by the Contracting Officer, or as otherwise required to satisfactorily complete each item of work. All costs required to complete the work in this section which are not otherwise specified for separate payment shall be considered incidental to and included in the contract prices for the various items of work in the Unit Price Schedule.

1.2.2 Pile Lengths

From the results of data obtained from the placing and loading of the test pile specified herein, the Contracting Officer will determine the "calculated" pile tip elevation. The Contracting Officer shall have the right to increase or decrease the linear footage of piles to be furnished and installed by changing the pile locations or elevations, requiring the installation of additional piles, or directing the omission of piles from the requirements shown or specified. Pile length will be measured for payment on the basis of the total linear footage of piles, exclusive of any load test reaction piles, satisfactorily installed in place from cut-off elevations to final tip elevations as directed by the Contracting Officer. All fractional lengths shall be measured to the nearest foot. No payment will be made for withdrawn, damaged, or rejected piles; for any portion of a pile remaining above the cut-off elevation; for cutting off piles; nor for any cut-off lengths of piles. Payment will be made for satisfactorily installed pile lengths at the contract unit price per linear foot for Item 004, "Auger-Placed ProductionGrout Piles, Pile Lengths," of the Unit Price Schedule, which shall include payment for all costs of furnishing all necessary equipment, tools, materials, labor, mobilization, demobilization, and supervision for augering, pile cut-offs, reinforcing, grout, testing, and casings for pile installation, and all other work incidental thereto.

1.2.3 Axial Compressive Test Program

Measurement for payment will be based on a test pile program satisfactorily completed in accordance with the requirements in paragraph TEST PILE. The Contractor shall pay particular attention to the test pile overload requirement and the minimum 300-ton jack and test pile load frame requirements in paragraph Load Test, all of which shall be considered an integral part of the axial compressive test program payment item. The Contracting Officer reserves the right to increase or decrease the number of axial compressive test programs. Payment will be made for each satisfactorily completed axial compressive test program at the contract

unit price per axial compressive test program for Item 004 Auger Placed Test Pile of the Unit Price Schedule. Each axial compressive test program shall include installation of a test pile of hereinafter specified length and necessary reaction piles, auger withdrawals of 2 reaction piles per load test, and the furnishing, delivering, handling, and/or installing, as applicable, all labor, materials, equipment and instrumentation, as well as survey and professional engineer services necessary to meet contract requirements applicable to conducting, monitoring and recording data for the axial compressive load test to 250-tons or pile failure. No payment will be made for test programs which were unsatisfactorily performed, as determined by the Contracting Officer.

1.3 DESCRIPTION AND DESIGN INTENT

Auger-placed grout piles are formed by the rotation of a continuous flight hollow-shaft auger into the ground to the tip elevation established by the requirements specified elsewhere in this section. Grout is then injected through the auger shaft as the auger is being withdrawn in such a way as to exert removing pressure on the withdrawing earth-filled auger as well as lateral pressure on the soil surrounding the grout-filled pile hole. It is the intent of the pile design to bear in the more dense sand and clay layers locatged approximately 35 to 40 feet below finish grade. Reference subsurface exploration logs provided in the Project Geotechnical Report, provided as a supplement to the Contract Documents. As indicated in paragraph TEST PILE, axial compressive load tests will be conducted on ten (10) separate test piles of anticipated pile length of 35 to 40 feet; however, the exact lengths may vary depending upon the subsurface conditions encountered and will be directed by the Contracting Officer during installation. The ten (10) test piles will be loaded to 140 tons with an overload test requirement to 200 tons as hereinafter specified in paragraph TEST PILE.

1.3 QUALIFICATIONS

1.4 Specialty Subcontractor

The work shall be performed by a Specialty Subcontractor specializing in the specified foundation system and having experience installing the specified foundation system under similar subsurface conditions. The foundation system contractor shall furnish evidence that he has been engaged in the successful installation of auger-placed grout piles for at least 5 years.

1.4.2 Geotechnical Inspection

An independent licensed Professional Engineer with expertise in Geotechnical Engineering, referred to as the Geotechnical Engineer, shall be paid for by the Contractor and shall be provided for auger-placed grout pile inspection and to oversee the recording and monitoring of all auger-placed grout pile construction (test piles and production piles) and load test. Each auger-placed grout pile shall be checked by the Geotechnical Engineer to ensure that it meets the requirements herein and supplementary guidance provided by the Contracting Officer. The Geotechnical Engineer shall have at least 5 years experience in auger-placed grout pile construction and conducting and evaluating axial compressive load tests. A field technician under the supervision of the Geotechnical Engineer for recording and monitoring data shall have at least 5 years experience in auger-placed grout pile installation; provide qualifications to the Contracting Officer. The Geotechnical Engineer must

be on-site at all times to oversee the pile load testing. The Geotechnical Engineer or field Technician must be on-site at all times during pile installation.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Test and Production Piles and Load Test Results; G, AE

A complete and accurate Pile Record of all auger-placed grout piles (both test piles and production piles) and of the load test results shall be furnished by an independent registered Geotechnical Engineer paid for by the Contractor. Installation test pile information shall be submitted for approval prior to production piling as discussed herein. Prior to pile installation, Contractor shall submit 5 drawings indicating proposed pile locations and designation for each pile for use in maintaining proper pile installation records. Upon completion of all pile installation, the Contractor shall submit a drawing signed and sealed by a registered surveyor indicating the actual in-place pile locations. This drawing must be submitted and approved prior to beginning any pile cap/grade beam installation.

SD-03 Product Data

Equipment

Manufacturer's data to demonstrate compliance of augering, mixing and pumping equipment, Automatic Measurement and Recording Equipment, and Pile Integrity Testing equipment. Information shall be submitted for approval at least 30 days prior to the planned start pile work.

Load Test

The Contractor shall submit for review 30 days prior to installation of the test piles or reaction piles a plan detailing the load test set-up and increments of loading for each axial compressive load test. In addition, jack and load cell calibration data and vibrating wire rebar strain meter calibration data shall be submitted for review 30 days prior to the installation of the load test piles. The Contractor shall submit a complete report on the load tests, within 7 days of completion of each load test, including but not limited to, reaction and test pile locations, reaction pile withdrawl information, complete test data, analysis of test data, and other observations made during testing plus any other items required in ASTM D 1143 as applicable. The report shall be prepared by or under the direct supervision of a registered professional engineer experienced in pile load testing and load test analysis, and shall bear the stamp and signature of the Engineer.

Materials

Information on the components of the grout mix showing that they meet the specified requirements. Mix design for the grout and substantiating lab test results. Strength development versus time information when GGBF or other pozzolanic materials are used. Modulus of elasticity test results for the grout mix design. Shop drawing showing specifics of reinforcing cage. Information shall be submitted for approval at least 30 days prior to the planned start pile work.

SD-06 Test Reports

Grout Specimens for Laboratory Tests
flow cone results
Automatic Measurement
Pile records
Pile Integrity

SD-07 Certificates

Qualifications

Evidence to the Contracting Officer that the Contractor has been engaged in the successful installation of auger-placed grout piles for at least 5 years. Documentation that the Geotechnical engineer is registered, has at least 5 years experience in auger-placed grout pile construction and has supervised a minimum of 5 auger-placed grout pile test programs. Documentation that the PIT testing technician has at least three years experience in integrity testing and that the engineer conducting the PIT interpretation records is a licensed professional engineer in the state of Virginia with at least five years experience in integrity testing interpretation. Information shall be submitted for approval at least 30 days prior to the planned start pile work.

1.6 DESCRIPTION

Auger-placed grout piles are formed by the rotation of a continuous flight hollow-shaft auger into the ground to the tip elevation established by the requirements specified elsewhere in this section. Grout is then injected through the auger shaft as the auger is being withdrawn in such a way as to exert removing pressure on the withdrawing earth-filled auger as well as lateral pressure on the soil surrounding the grout-filled pile hole.

1.7 SUBSURFACE DATA, EXCAVATION AND EXCAVATION EQUIPMENT REQUIREMENTS

1.7.1 Subsurface Data

Subsurface exploration drill logs are provided in the Construction Documents. The contractor should anticipate that concrete, bricks, cinders, wood, boulders, and other miscellaneous fill materials may be encountered in any excavation across the site.

1.7.2 Excavation Equipment

The Contractor shall be responsible to provide all equipment and excavation tools necessary to auger to the pile tip elevations determined from the test pile program. The drilling machine used for auger-placed grout pile

excavation shall have a minimum continuous downward thrust (crowd) of 10,000 pounds and a minimum continuous torque of 25,000 foot-pounds. The auger flights shall be continuous from the top of the auger to the bottom tip of the cutting face of the auger, with no gaps or other breaks. Gaps in the flighting are allowed only where auger sections are joined and may not exceed 1 inch. The length of any auger brought to the project site shall be such that the auger is capable of installing a pile to a depth that is a minimum of 30 percent greater than the depth of the pile illustrated in paragraph "TEST PILE". The auger flighting shall be uniform in diameter throughout its length, and the outside diameter of the auger shall be at least 97 percent of the design diameter of the pile. Only single helix augers shall be used. The hollow stem of the auger shall be maintained in a clean condition throughout the construction operation. In order to facilitate inspection, the leads shall be clearly marked every 1 foot along its length so that such marks are visible to the unaided eye from the ground.

The bottom of the auger flights and the cutting teeth attached thereto shall be constructed geometrically so that the bottom of the pile will be as flat as feasible. The grout or concrete injection port shall be fitted with a means of sealing it against ingress of water and soil during drilling.

The auger shall be guided at the ground surface by a guide connected to the leads of the piling rig. If the auger is over 40 feet long, it shall also be guided by a guide to be located approximately half the length of the auger above the ground-surface guide. Where piles are installed with hydraulic, fixed mast installation platforms, and the stem to which the auger is fixed has an outside diameter 10 inches or greater, a guide above the ground surface is not required. The leads that carry the rotary unit that power the auger should be restrained against rotation by an appropriate mechanism.

The piling rig shall be capable of penetrating the ground without drawing surrounding soils laterally into the pile bore, as is described in paragraph "DRILLING". It shall be capable of installing a pile to a depth at least 30 percent greater than the depth of the piles shown in paragraph "TEST PILE".

1.7.3 Basis for Excavation

All excavation shall be done on an unclassified basis. No consideration will be given to the nature of the materials encountered except as specified hereinafter for obstructions. Obstruction of the pile installation shall be defined as the depth at which refusal of approved equipment occurs; i.e, where less than 6 inches of penetration is achieved over a 5-minute period with the approved equipment operating at the hereinbefore specified minimum torque and crowd.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Grout

Grout shall consist of a mixture of portland cement, pozzolanic material or Ground Granulated Blast-Furnace (GGBF) Slag when approved, fluidifier, sand, and water proportioned and mixed to produce a grout capable of being

pumped with an ultimate compressive strength of 5000 psi at 28 days. Other admixtures shall not be used. The Contractor shall include strength development versus time information with the submitted grout mix when GGBF or other pozzolanic materials are used. The quantity of water used shall be such as to produce a grout having a consistency of between 15 and 25 seconds when tested with a flow cone in accordance with the with ASTM C 939 except that the flow cone outlet shall be modified from 1/2 inch diameter outlet to 3/4 inch diameter outlet. The grout shall not exhibit shrinkage in excess of 0.15 percent in the vertical direction, as tested in accordance with ASTM C 1090, and shall be housed in a 100 percent humidity room at a temperature of 68 to 74 degrees F.

2.1.1.1 Portland Cement

Portland cement shall conform to ASTM C 150 Type II (low alkali if available). When low alkali cement is OR is not available, tests shall be completed in accordance with ASTM C 1260 as described below in paragraph "Aggregates". The government reserves the right to confirm the test results and to adjust the percentage of pozzolan or GGBF slag in the combination to suit other requirements.

2.1.1.2 Pozzolan

ASTM C 618 F with the optional requirements for multiple factor, drying shrinkage, and uniformity from Table 2A of ASTM C 618. Requirement for maximum alkalies from Table 1A of ASTM C 618 shall apply. If pozzolan is used, it shall never be less than 15 percent nor more than 25 percent by weight of the total cementitious material. Fly ash shall conform to EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS.

2.1.1.3 Ground Granulated Blast-Furnace (GGBF) Slag

ASTM C 989, Grade 120. If GGBF is used, it shall not exceed more than 25 percent by weight of the total cementitious material. The combination of pozzolan and the GGBF together shall not exceed 25 percent by weight of the total cementitious material.

2.1.1.4 Grout Fluidifier

Grout fluidifier shall conform to ASTM C 937, except that expansion shall not exceed 4 percent. The fluidifier shall be a compound possessing characteristics which will increase the flowability of the mixture, assist in the dispersal of cement grains, and neutralize the setting shrinkage of the high-strength cement mortar.

2.1.1.5 Water

Water shall be fresh, clean, and free from sewage, oil, acid, alkali, salts, or organic matter.

2.1.1.6 Aggregates

Aggregates to be used in the grout (concrete) shall be evaluated and tested by the Contractor for alkali-aggregate reactivity in accordance with ASTM C 1260. Test results shall have a measured expansion equal to or less than 0.10 percent at 16 days after casting. Should the test data indicate an expansion greater than 0.10 percent, the aggregate(s) shall be rejected, or additional testing, using a modified version of ASTM C 1260, shall be

performed by the Contractor as described below. ASTM C 1260 shall be modified as follows to include one of the following options:

a. Utilize the Contractor's proposed low alkali portland cement and Class F fly ash in combination for the test proportioning. Class F fly ash shall contain less than 8 percent Calcium Oxide (CaO) and shall be used in the range of 15 to 25 percent of the total cementitious material by mass. The quantity shall be determined that will meet all the requirements of these specifications and which will lower the expansion equal to or less than 0.10 percent at 16 days after casting.

b. Utilize the Contractor's proposed low alkali portland cement and ground granulated blast furnace (GGBF) slag in combination for the test proportioning. GGBF slag shall be used up to 25 percent of the total cementitious material by mass. The quantity shall be determined that will meet all the requirements of these specifications and which will lower the expansion equal to or less than 0.10 percent at 16 days after casting.

If any of the above options does not lower the expansion equal to or less than 0.10 percent at 16 days after casting, the aggregate(s) shall be rejected and the Contractor shall submit new aggregate sources for retesting. The results of the testing shall be submitted to the Contracting Officer for evaluation and acceptance.

2.1.1.7 Fine Aggregate

Fine aggregate shall meet the requirements of ASTM C 33. The sand shall consist of hard, dense, durable, uncoated rock particles and be free from injurious amounts of silt, loam, lumps, soft or flaky particles, shale, alkali, organic matter, mica, and other deleterious substances. If washed, a washing method shall be used that will not remove desirable fines, and the sand shall subsequently be permitted to drain until the residual-free moisture is reasonably uniform and stable. The sand shall be well-graded from fine to coarse, with fineness modulus between 1.30 and 3.40. The fineness modulus is defined as the total divided by 100 of the cumulative percentages retained on U.S. Standard Sieve Numbers 16, 30, 50, and 100.

2.1.2 Reinforcement

Materials, assembly, and placement of reinforcement shall conform to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE. The sizes of the vertical bars and ties shall conform to the details shown on the drawings. To assist in the insertion of the reinforcing cage into the grouted hole, the bottom three ties may be deleted and the cage bars brought to a point subject to the approval of the Contracting Officer. To insure proper centering of the reinforcing cage within the pile, the Contractor shall use a centering device and shall submit "centralizer" details to the Contracting Officer as part of the shop drawings for approval.

PART 3 EXECUTION

3.1 GENERAL

The ground surface at each pile location at the time of augering and grouting shall be at least 12 inches higher than the required pile cut-off elevation but no higher than the top of pile cap/grade beam, and the augered hole shall be completely filled with grout. Except where auger

withdrawal is required or directed by the Contracting Officer, each pile hole shall be drilled and filled with grout in an uninterrupted operation. The minimum inside diameter of the hollow shaft of the auger flight shall be 2-1/4 inches. Grout injection equipment shall be provided with a grout pressure gage in clear view of the equipment operator. Rate of grout injection and rate of auger withdrawal from the soil shall be so coordinated as to maintain at all times a positive pressure on this gage which will, in turn, indicate the existence of a "removing pressure" on the bottom of the auger flight. Automated monitoring equipment providing "real time" measurements is required per paragraph "AUTOMATIC MEASUREMENT AND RECORDING EQUIPMENT". Although the grout head to be maintained during pile installation will be established during the installation test pile program, a minimum grout head of 10 feet is required. In determining grout head on the auger flights only, clean grout of the design consistency will be used to figure grout head; no consideration will be given to diluted or soil contaminated grout. The auger hoisting equipment shall be capable of withdrawing the auger smoothly and at a constant rate. If the auger jumps upward during withdrawal, it shall be reinserted to the original tip elevation and the rate of withdrawal decreased to prevent further jumping. If grout injection is interrupted or the injection rate varies from the rate determined from the installation test pile program, the auger shall be reinserted to a depth a minimum of 5 feet below the depth where the problem started and the grouting resumed at the approved rate. If the grouting rate still varies from the approved rate or the grouting is again interrupted, the auger shall be reinserted to the original tip elevation, the pile shall be cleaned out before the grout reaches its initial set, and the grouting problem shall be resolved before resuming the injection of grout into the hole. Material excavated by augering shall be disposed of in accordance with the requirements for excavated materials given in section 31 00 00 Earthwork. No pile shall be left partially completed overnight, but must be completely grouted and protected at the termination of each day's operation.

3.2 Auger Cast Pile Installation in Fill

Where auger cast piles are planned to be constructed through more than 10 feet of fill placed to achieve the planned elevation, the Contractor shall phase construction so that a waiting period of 30 days between fill placement and installation of test and production piles can occur. The contractor shall monitor fill placement through the use of settlement plates placed on the existing subgrade prior to fill placement. The contractor shall submit proposed locations for settlement plates to the government for approval. Monitoring of settlement plates shall be in accordance with Section 31 23 00 paragraph 3.13.1.

3.3 PILE LOCATION SURVEY CONTROL

The location of piles shall be surveyed under the supervision of a registered professional surveyor. The maximum number of piles that can be laid out in advance shall be limited to that amount that can be installed in five working days. The staked pile locations shall be re-confirmed by the surveyor the day before pile installation is to occur. Upon completion of all pile installation, the Contractor shall survey the actual in-place pile locations. A drawing signed and sealed by a registered surveyor indicating actual pile locations must be submitted prior to beginning any pile cap/grade beam installation.

3.4 DRILLING

The Pile Contractor shall perform the drilling required for the piling, through whatever materials are encountered, to the dimensions and elevations illustrated hereinafter and as determined by the test program per paragraph "TEST PILE". Drilling shall not commence until sufficient supply of grout is present on the project site to complete the pile. The drilling parameters (auger rotation speed, penetration rates, crowd, torque, etc.) for the production piles shall be within the ranges established during installation of the test piles. The same procedures used to install the test piles shall be used to install production piles.

The auger shall not be extracted from the ground at any time during the construction of a pile in such a way that would result in an open unsupported borehole or inflow of water into the pile borehole. If it should become necessary to raise the auger and subsequently re-insert the auger during the pile construction process, the depth of the pile shall be increased and/or other additional measures shall be required as directed by the Engineer.

The auger shall be advanced into the ground at a continuous rate and at a rate of rotation that prevents excess spoil (exceeding theorectical values) from being transported to the ground surface. The rate of penetration shall be established as a part of the test pile program. Automated monitoring equipment shall be used to verify this target rate of penetration is maintained during construction of production piles.

3.5 GROUT

3.5.1 General

All oil, rust inhibitors, residual drilling slurries and similar foreign materials shall be removed from holding tanks/hoppers, stirring devices, pumps and lines, and all other equipment in contact with the grout before use.

All grout used shall be batched at a Virginia or Maryland state approved facility, and delivered to the project site. The addition of water at the project site is permitted only with prior approval by the Contracting Officer and only to the extent that the water-cementitious material ratio does not exceed the ratio of the approved design mix.

If agitated continuously, the grout may be held in the ready mix truck for up to 2.5 hours if the air temperature is not greater than 68° F, or up to 2 hours if the air temperature is between 68° and 100° F if other than Type III Portland cement is used. Grout shall not be placed if the air temperature exceeds 100° F or is less than 39° F unless approved procedures for hot (over 100° F) or cold weather (less than 39° F) placement are submitted by the Contractor and approved by the Contracting Officer. Grout designed with retarders or GGBF slag to extend the holding time or placement temperature range shall be placed in accordance with the mix design parameters and approved by the Contrating Officer.

3.5.2 Grout Pump

The grout pump shall be a positive displacement pump with a known volume per stroke that is capable of developing peak pressures of at least 350 psi (2,400 kPa) at the pump. The pump shall be sized appropriately to the pile size such that a smooth, continuous delivery of grout or concrete can be

maintained while limiting the pressure variations (particularly the pressure drop) felt by the pile due to the pump strokes. The Contractor shall provide the Contracting Officer with the value of the volume of grout or concrete delivered by each stroke of the pump and shall demonstrate to the Contracting Officer prior to any grout operating operations that the actual volume delivered by each stroke of the pump is within 3 percent of the value provided. The grout pump shall be calibrated each day prior to the start of pile installation. The volume per stroke shall be recalibrated when the Contracting Officer suspects that the grout delivery performance has changed.

Automatic measurements shall be made and recorded during the pile construction process as described in paragraph "AUTOMATIC MEASUREMENT AND RECORDING EQUIPMENT". All inspection records shall be made as described in paragraph "PILE RECORDS". The minimum value of grout pressure at the pump outlet or at the top of the auger that is required based upon the results of test pile installation shall be maintained for all grout placement operations throughout the project.

A screen with a mesh with openings no larger than 3/4-inch. shall be used between the delivery point from a ready mix truck and the pump, to remove large particles or cement clumps that can clog the grout injection system.

3.5.3 Placement of Grout

The placement of grout shall commence within 5 minutes after the auger has achieved the planned depth. Grout shall be pumped through the hollow-stem auger with sufficient pressure (as measured at the top of the auger) as the auger is withdrawn to completely form the pile and fill any soft or porous zones surrounding the pile.

At the beginning of grout placement the sealing device (plug, or bottom cover plate at the tip of the auger) shall be removed by the application of grout pressure. As pumping begins, the auger shall be lifted from 6 to 12 inches to facilitate removal of the sealing device. Care shall be taken to ensure that the auger is lifted only within this specified range to initiate the flow of grout and that water inflow and soil movement at or near the base of the auger are minimized. After withdrawing the auger to initiate the flow of grout or concrete, the tip of the auger should be re-inserted to at least the original depth.

The technique and equipment used to initiate and maintain the grout flow shall be such that a pile of the full design cross-section is obtained from the maximum depth of boring to the final pile cut-off level. The grout shall be supplied to the pile at a rate during auger withdrawal that ensures that a continuous monolithic shaft of at least the full specified cross-section is formed, and is free from soil inclusions or any grout or concrete segregation.

The auger shall be extracted at a smooth, steady rate while continuously pumping. If rotation of the auger occurs during auger extraction, it shall be positive, i.e. in the same direction as during drilling.

Satisfactory coordination of auger withdrawal with pumping is indicated by maintaining a positive pressure in the grout at the auger tip, and a sufficient volume or pressure of grout to fill the pile (with a small oversupply of volume). Satisfactory coordination shall be verified using automated monitoring equipment.

The volume of grout placed as a function of depth shall be measured and recorded at intervals not exceeding 2 feet using automated monitoring equipment. The magnitude of minimum oversupply (or grout volume factor) appropriate for the site conditions shall be established during the test pile program and maintained during production pile construction. Inadequate volume pumped over a depth interval of 5 ft (1.5 m) is a basis for rejection of the pile. (In general, typical grout volume factors range from 1.15 to 1.2 (i.e., 15 percent to 20 percent oversupply). Grout factors greater than 1.5 suggest that soil mining or other undesirable installation effects may be occurring.) The volume of grout per linear foot of pile shall be not less than the volume of grout per foot of the approved installation test piles. All volume measurements shall be made in the presence of the Contracting Officer or his representative.

If placement of grout or concrete is suspended for any reason, such as equipment failure, the pile will need to be re-drilled. The pile may be re-drilled in the same location if the grout or concrete is still fluid enough for the drill rig to penetrate. If the concrete or grout has set, the pile will need to be re-drilled in a new location as directed by the Contracting Officer at the Contractors cost and responsibility.

Piles shall be periodically checked by the Contractor to determine if the grout in the top of the piles has settled. To maintain the proper top of pile grade, additional fresh grout shall be added to the top of the pile before the grout in the pile has reached its initial set. If the grout in the pile is allowed to settle more than 2 feet before additional grout is added, the top portion of the pile will be purged, and additional fresh grout added to bring the top of the pile back up to 12 inches higher than the required pile cut-off elevation.

If 6 inches or more of water is found on top of the grout, the water shall be purged out of the pile by placing a hose or pipe at least 3 feet below the grout elevation and pumping in additional fresh grout in accordance with the direction of the Contracting Officer.

3.6 AUTOMATIC MEASUREMENT AND RECORDING EQUIPMENT

The Contractor shall provide Automated Monitoring Equipment to provide automatic measurements during the pile construction process for test piles, reaction piles, and production piles as described below. The Contractor shall provide printouts on daily basis. As a minimum the following automatic measurements shall be made and recorded during the drilling operation:

a. Auger rotation;

b. Depth of the Auger injection Point;

c. Auger torque, rotation, crowd and drilling rate;

All measurements shall referenced to or plotted against the depth of the auger injection point. This shall be accomplished with a rotational position indicator on the auger head system and an electronic position indicator on the crane line or boom holding the auger. Torque and thrust load cells shall be positioned on the auger head system.

As a minimum, the following automatic measurements shall be made and recorded during the grouting operation:

a. Volume of grout (pumped versus depth, total actual versus theoretical volumes);

b. Maximum and minimum grout pressure;

c. Auger rotation if augered;

d. Depth of injection point;

e. Withdrawal rate.

All measurements shall be referenced to or plotted against the depth of the auger injection point. This shall be accomplished with electronic flowmeters and electronic pressure transducers placed in the grout line, an electronic position indicator on the crane line or boom holding the auger, and a rotational position indicator on the auger system.

Calibration shall be made on all measuring and recording equipment at the beginning of the project that will demonstrate that the values indicated by the measuring and recording equipment are within 3 percent of the values indicated. Calibrations shall be performed in accordance with the equipment manufacturers specifications. All measuring and recording equipment shall also be recalibrated when the Contracting Officer suspects that the drilling and grouting performance has changed.

3.7 PILE HEAD FINISHING AND PROTECTION

Immediately upon completion of placement of the fluid grout, the Contractor shall remove all excess grout and spoil from the vicinity of the top of the excavation and place a suitable temporary device within the top of the excavation, extending both above and below the ground surface by at least 1 foot to keep surface spoil from entering the grout column before it sets. Immediately upon placement of this temporary device, the Contractor shall remove any and all loose soil that has fallen into the grout column by approved methods, and before the grout begins its initial set. The temporary device shall be removed without disturbing the natural soil surrounding the top of the pile once the grout has set.

3.8 REINFORCING STEEL PLACEMENT

Any required reinforcing steel shall be placed as shown on the plans by lowering the steel into the grout column while it is in a fluid state. The reinforcing steel shall be free of oil, soil, excessive rust or other deleterious material. The reinforcing steel shall be centered in the excavation by means of plastic or cementitious spacers placed at sufficient intervals along the pile and at sufficient intervals around the steel to keep the steel centered. Metallic spacers shall not be permitted. Centralizer types and spacing are subject to approval by the Contracting Officer. If cages of reinforcing steel are required, the longitudinal bars and lateral reinforcement (spiral or horizontal ties) shall be completely assembled and placed as a unit. Where spiral reinforcement is used, it shall be tied to the longitudinal bars at a spacing not to exceed 1 foot unless otherwise shown on the plans.

The reinforcing steel shall not be spliced except at locations that are shown on the plans, and the reinforcing steel shall be free of any permanent distortion, such as bars bent by improper pickup. If a pile is required by the Contracting Officer to be lengthened after the steel has

been cut and cages have been assembled, the schedule of reinforcing steel (both longitudinal and lateral) shall be extended to the required depth by splicing. Splices should be as close to the bottom of the reinforcing cage as possible. Splicing by welding shall not be permitted unless weldable reinforcing steel is specified as part of the approved design.

The reinforcing steel shall be placed in the grout column before the grout begins to set. The steel may be lowered into the grout by gravity or pushed gently to final position by hand. The reinforcing steel shall not be vibrated, driven, or otherwise guided into position by mechanical means. The reinforcing steel shall be held in position at the ground surface within the fluid grout column by supports appropriate for the reinforcement used, which shall remain in place until the grout reaches its initial set, or 24 hours, whichever is longer.

3.9 PILE CUT-OFF

The Contractor shall cut off the tops of piles and square with the pile axis at the elevations indicated on the Contract Drawings, by removing fresh grout or concrete from the top of the pile or by cutting off hardened grout or concrete down to the final cutoff point at any time after initial set has occurred. The finished top of pile shall be no more than 1 inch below or 1 inch above the elevation shown on the Contract Drawings.

3.10 PROTECTION OF PILES

The sequence of pile installation shall be such that adjacent piles show no evidence of disturbance. This evidence would actually appear as a drop in the grout surface. The load applied to the soil by the drilling equipment shall be far enough away from the pile being drilled to avoid compressing or shearing of the soil which may in turn displace or squeeze-off the grout column. No piles shall be placed within six diameters, center to center, of adjacent piles until the grout in the piles has sufficiently set by reaching a minimum compressive strength of 1500 psi (30 percent of the 28 day compressive strength) such that the integrity of the existing pile will not be compromised if drilling the new pile causes mining of soil away from the existing pile. The time for the grout to reach 1500 psi may exceed the typical 3 days and may take as long 10 days (or longer) depending upon the percent of Ground Granulated Blast-Furnace (GGBF) Slag contained into the grout mix as required to meet ASR requirements as specified in paragraph "Aggregates". The Contractor shall include strength development versus time information with the submitted grout mix.

3.11 TEST PILE

3.11.1 Placement

The test piles shall be of the type and shall be placed in the manner specified elsewhere in this section for all piling. The Government will use the installation records and load test data in combination with known subsurface condition information to provide the contractor with the "calculated" pile tip elevation criteria. The results of the installation and testing will also be used to establish target drilling penetration rate for the subsurface conditions and establish pressure/volume relations during placement of grout. Payment for installation test piles shall be the same as for production piles and shall be made in accordance with the unit price payment items included herein. The contractor shall conduct flow cone tests and take grout cube samples for each pile and perform

strength tests and modulus of elasticity tests as discussed herein. Test loads shall not be applied until the grout has obtained a minimum strength of 5000 psi. Test and reaction piles shall be cut off a minimum of 6 feet below final grade upon completion of the load tests and the area restored as specified for final construction in these areas.

3.11.2 Test Pile Locations and Depths

Eleven (11) axial compressive load tests shall be conducted at the locations and for the anticipated pile embedment as follows:

12CPT20 / 35' embedment
12CPT-23 / 35' embedment
12DH-53 / 40' embedment
12DH-54 / 40' embedment
12DH-55 / 40' embedment
12DH-61 / 40' embedment.
12DH-62 / 40' embedment.
DH-4 / 40' embedment.
DH-15 / 40' embedment
DH-30 / 40' embedment
DH-38 / 35' embedment

Pile embedment shall be from the planned pile cut-off for closest structure. Reaction piles shall be installed prior to test piles. For Reaction piles, the auger shall be withdrawn after reaching the directed tip elevation and before grout is pumped to verify the subsurface conditions. The Contracting Officer shall be present to check the soil conditions and shall have the right to increase the test pile length if soil conditions warrant. In such cases, the Contracting Officer may require additional auger withdrawals after drilling to a higher or lower tip elevation. The pile hole shall not be filled with grout until the Contracting Officer has approved the final tip elevation.

3.11.3 Axial Compressive Load Test

Load test shall be in accordance with ASTM D 1143; except as otherwise noted below. The load test shall consist of the "Quick Load Test Method For Individual Piles" up to a total test load of 140 tons, followed by the "Loading In Excess of Standard Test Load" up to 200 tons, or until failure of the test pile occurs. Load application shall be in increments of 10 percent of the design service load. Time interval between load increments shall be 15 minutes. The full test load shall be maintained for one hour. The Contractor shall provide a load frame and test jack capable of applying a minimum 300-ton axial load to the test piles. Reaction auger-placed piles shall be used in lieu of other reaction frame methods; and these reaction piles, as well as the reference and testing apparatus, shall be independently monitored for movement. A minimum of four dial gauges mounted 90 degrees apart is required; along with two sets of parallel wires, mirrors, and scales, to monitor the movement of the top of the test piles. An additional single set of wires, mirrors, and scales will be required to monitor the top of each reaction pile for movement. All movement data shall be recorded. A calibrated load cell shall be used to measure the load application on the pile. The load cell shall have an accuracy of ± 1 percent. A spherical bearing shall be placed between the ram and the reaction beam to reduce eccentric loading. The Contractor shall provide a weather-proof covering over the load test setup to protect the equipment and personnel from the weather. Loading, testing, and recording of data shall be done by the Contractor under the direct

supervision of a registered professional engineer paid for by the Contractor as indicated in paragraph "Geotechnical Inspection". Prior to this project, the Geotechnical engineer shall have supervised a minimum of five auger-placed grout pile load test programs. The analysis of the load test data shall be completed by the Geotechnical Engineer and submitted to the Government. The Contractor shall give his full cooperation in the performance of the testing and shall allow at least 14 calendar days from the Government's receipt of each set of load test data provided by the Contractor, for the evaluation of the load test results by the Government. The installation of production piles shall not proceed until a satisfactory load test has been performed and the evaluation of the load test data has been completed. Government will use the installation records and load test data in combination with known subsurface condition information to provide the contractor with the "calculated" pile tip elevation criteria. All production piles will be required to bear a minimum of 5 feet into the dense sand and gravel layer and at a minimum pile length as determined from the load test program, whichever is greater. The pile deign service load is 70 tons.

Each test pile shall be instrumented with pairs of vibrating wire strain gauges located at two different levels; (1) bottom of the clay layer (i.e. top of bearing layer) and (2) bottom of the bearing sand layer (i.e. tip of pile) to obtain information about the shaft friction developed within the different subsoil strata. The exact depths of these gauges will be determined based upon the soil profile observed from withdrawals of adjacent reaction piles. These strain gauges shall be "Vibrating Wire Rebar Strain Meters" (Sister bars). Two strain gauges shall be installed at each depth mounted 180 degrees apart.

If the axial compressive load test program for the selected test piles is unsuccessful, additional test piles and load tests shall be required by the Contracting Officer. The locations of any additional test piles and load tests will be determined by the Contracting Officer.

3.11.4 Acceptance

The safe design service load capacity of a test pile as determined from the results of the axial compressive load tests shall be one half of the ultimate load capacity as determined by Davisson's failure criteria.

3.12 TOLERANCES

Piles shall be located as shown on drawings or as otherwise directed by the Contracting Officer. Piles shall be installed from the ground surface existing after general excavation work has been completed. The maximum variation of the center of any pile from the required location shall be 3 inches at the ground surface, and no pile shall be out of plumb more than 2 percent. Piles damaged, mislocated, or out of alignment beyond the maximum tolerance will be abandoned and additional piles shall be placed as directed. No payment will be provided for such unsatisfactorily installed piles unless these problems were the result of obstructions as hereinbefore defined.

3.13 FLOW CONE TEST

The quantity of water used shall be such as to produce a grout having a consistency of between 15 and 25 seconds seconds when tested with a flow cone in accordance with ASTM C 939 except that the flow cone outlet shall be modified from 1/2 inch diameter outlet to 3/4 inch diameter outlet.

Flow cone tests and temperature shall be conducted for every truck prior to discharging grout into the pump hopper.

3.14 GROUT TEST SPECIMENS

Grout tests shall be conducted in accordance with ASTM C 109/C 109M in a laboratory, approved by the Contracting Officer. Test specimens shall be prepared by pouring grout into 2-inch by 2-inch by 2-inch cube molds. Not less than six cubes shall be cast during each 8-hour shift. Two cubes shall be tested at 7 days and two at 28 days. The additional two cubes will require testing only if the 28 day test results show inadequate strength. Further detail will be provided by the Contracting Officer if testing of these samples is required.

3.15 MODULUS OF ELASTICITY

Grout modulus of elasticity shall be determined in accordance with ASTM C 469.

3.16 PILE RECORDS

An accurate record shall be kept by the Contractor of each production and test pile as installed. Records shall identify the pile as indicated on the drawings. The Contractor shall furnish detailed records in an approved form for each pile on a daily basis within 24 hours of the completion of the pile. Upon completion of the pile work, the Contractor shall provide a record of as-excavated centerline locations based on the survey of the registered surveyor or engineer provided by the Contractor. In addition, corrective measures shall be similarly recorded. A complete tabulation of all records pertaining to approved piles shall be delivered to the Contracting Officer in the form of a "final Report" once all of the piles are installed. Records shall be signed by the inspector and the Contractor's superintendent. The presence of a Government inspector or the keeping of separate records by the Contracting Officer shall not relieve the Contractor of the responsibility for the work specified in this paragraph. Data collected by automated measuring and recording equipment shall be provided in numerical or graphical form. Any unusual conditions encountered during pile installation and/or load testing shall be reported immediately to the Contracting Officer. These records shall include as a minimum:

1. Pile location;

2. Ground surface elevation (reference grade for pile length);

3. Pile toe (bottom) depth and elevation;

4. Elevation of top of grout;

5. Pile length;

6. Auger diameter;

7. Details of the reinforcing steel (number, size, and grade of longitudinal bars, size and spacing of transverse steel; outside diameter and length of cage);

8. Theoretical volume of drilled hole (theoretical diameter = diameter of auger);

9. Depth to which reinforcing steel was placed;

10. Date/Time of beginning of drilling;

11. Date/Time of completion of drilling;

12. Daily Pump Calibration;

13. Date/Time grout was mixed;

14. Date/Time ready-mix grout truck arrived at project site, and copies of all grout batch tickets used for the pile construction;

15. Date/Time of beginning of grout pumping;

16. Date/Time of completion of grout pumping;

17. Grout head;

18. Loss of grout head and at what depth the loss occurred;

19. Jacking (lifting) of auger;

20. Number of grout strokes at bottom of pile, strokes per foot during auger withdrawal, total number of strokes per pile, quantity of grout actually pumped in each pile hole;

21. Weather conditions, including air temperature, at time of grout placement;

22. Identification of all grout samples taken from the pile and results of strength tests;

23. All other pertinent data relative to the pile installation;

3.17 PILE INTEGRITY TESTING (PIT)

3.17.1 General

Pile Integrity Testing (PIT) shall be used to inspect the actual installed piles in order to determine the overall integrity. The results shall be analyzed by a Pile Integrity Testing (PIT) Consultant as indicated in paragraph "PIT Consultant" using an approved commercial software package designed by the PIT manufacturer , Pile Dynamics, Inc. or approved equivalent. PIT testing is a Non-Destructive integrity test method for foundation piles. It is a "Low Strain" Method (since it requires the impact of only a small hand-held hammer). The evaluation of PIT records is conducted either according to the Pulse-Echo (or Sonic Echo - a time domain analysis) or the Transient Response (frequency domain analysis) Procedure. In general, the test requires the impact of a small hand held hammer on the shaft top and the measurement of the shaft top motion (acceleration or velocity). The input compression wave from the hammer is reflected from pile toe (or a defect) and returns to the pile top at a time related to the speed of travel of the wave in the pile material.

3.17.2 Test Equipment

Pile integrity tests shall be performed using digital data acquisition equipment. The signal conditioning and power supply must have very high signal-to-noise ratios since the reflected signals for long piles (and/or piles in high friction soils) are often very weak. The analog to digital resolution shall be at least 16 bits, and the sampling frequency at least 40,000 Hz. Data should be stored such that additional processing or further wave analysis is possible. The data must be displayed in the field for evaluations of preliminary data quality and interpretation.

3.17.3 PIT Consultant

The Pile integrity testing consultant shall consist of personnel independent of the Auger Cast Pile Contractor and Prime Contractor, paid for by the Contractor. The field testing shall be performed by a technician with at least three years experience in pile integrity testing. The interpretation of the records shall be completed by a professional engineer licensed in the state of Virginia with at least five years experience in integrity testing interpretation.

3.17.4 Testing

Integrity testing shall not be performed until the concrete has cured for a minimum of seven (7) days and obtained a minimum of 3000 psi compressive strength, whichever is greater. The pile head shall be free from water, dirt or other debris. The concrete at the pile top surface must be relatively smooth with sufficient space for both attachment of the motion sensing device and hammer impact area.

100 percent of the first 20 piles shall be integrity tested. Integrity testing shall proceed concurrent with pile installation operations to verify the installation techniques and to ensure that the piers installed are not defective. Should any of the tested piles prove defective, as determined by the Contracting Officer, the Contractor shall identify the cause(s) and make appropriate adjustments to his construction techniques to prevent a similar occurrence. Where defective piles are found in the testing of the first 20 piles, the Contractor, at his expense, shall continue to test each pile on the project until he can show that his methods are producing satisfactory defect free results. Providing the first 20 piles tested are determined to be satisfactory by the Contracting Officer, the Contractor, at his expense, shall test 1 per each group of 20 piles completed for the remainder of the project, at locations determined by the Contracting Officer, so long as the test results remain satisfactory. Should the continued testing reveal any defective piles, testing shall revert to 100 percent until satisfactory results are achieved as determined by the Contracting Officer. The contractor shall ensure that no construction obstructing access to the piles occurs until after testing is completed and then evaluated by the Contracting Officer.

3.17.5 Result Presentation

PIT records shall be submitted within 24 hours of performing the field test and shall include test results and integrity evaluation. For each pile tested, the averaged, amplified velocity versus time record shall be included in the report, with a table summarizing results and conclusions. In addition, a final report to include the testing of all piles shall be submitted with 14 days after all testing is completed.

3.17.6 Acceptance and Rejection

Piles with no significant reflections from locations above the pile toe and with a clear pile toe reflection may be accepted. Where no clear toe reflection is apparent, the experienced test engineer shall state to which shaft depth the test appears to be conclusive. Where reflections from locations with significant reductions above the pile toe are observed, the pile has a serious defect. If the record is complex, the results may be deemed inconclusive. Construction records (concrete usage, grout pressure records, soil borings) may be valuable in result interpretations or additional numerical analysis modeling may be used to quantify the record. The decision to reject and replace, or repair, any defective shaft is at the sole responsibility of the Contracting Officer.

3.17.7 Remedial Action

Rejected or questionable piles shall be replaced at no additional cost to the Government. Questionable or rejected piles may also be subjected to further testing, e.g., static load testing, dynamic load testing, core drilling, ultra-sonic logging, etc. as approved by the Contracting Officer. If the pile top appears questionable, further pile top cut-off and retesting may be advisable. If a majority of piles diagnose as "inconclusive", partial or even complete pile excavation or another test method may be necessary for pile acceptance as approved by the Contracting Officer at no additional cost to the Government.

3.18 Unacceptable Piles

Unacceptable piles are defined as piles that do not meet the project specifications. Unacceptable piles shall be replaced or repaired at the Contractor's expense and responsibility, as directed by the Contracting Officer. The following items constitute construction conditions which would be considered a basis for pile rejection:

1. Piles that are tested using post-installation integrity testing methods and are judged by the Contracting Officer to be unacceptable.

2. Piles for which the data from the automated measuring and recording equipment, other recording methods, or the Inspector's records indicate that a defective pile has been installed due to an inadequate penetration rates, grout/concrete volume factors or pressures, or other pile installation parameters that do not meet the criteria established by the pre-production test program.

3. Piles out of position at the ground surface or not within the plumbness limits.

4. Piles in which the top of pile elevation is outside the limits shown on the Contract Drawings.

5. Piles in which the grout strength is less than specified.

6. Piles in which the reinforcing steel was not inserted as designed.

7. Piles that exhibit any visual evidence of grout contamination, excessive settlement of grout, or structural damage.

8. Lateral communication between piles.

-- End of Section --

SECTION 32 01 19

FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS
08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 509	(2006) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM D 5893	(2004) Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements
ASTM D 6690	(2007) Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM D 789	(2007) Determination of Relative Viscosity and Moisture Content of Polyamide (PA)

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 525	(1989) Test Method for Evaluation of Hot-Applied Joint Sealants for Bubbling Due to Heating

1.2 SYSTEM DESCRIPTION

Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started maintained in satisfactory condition at all times.

1.2.1 Sealing Equipment

1.2.1.1 Cold-Applied, Single-Component Sealing Equipment

The equipment for installing ASTM D 5893 single component joint sealants shall consist of an extrusion pump, air compressor, following plate, hoses, and nozzle for transferring the sealant from the storage container into the joint opening. The dimension of the nozzle shall be such that the tip of the nozzle will extend into the joint to allow sealing from the bottom of the joint to the top. Maintain the initially approved equipment in good working condition, serviced in accordance with the supplier's instructions, and unaltered in any way without obtaining prior approval. Small hand-held air-powered equipment (i.e., caulking guns) may be used for small applications.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturer's Recommendations

Printed copies of manufacturer's recommendations, 14 days prior to use on the project, where installation procedures, or any part thereof, are required to be in accordance with those recommendations. Installation of the material will not be allowed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

Equipment

List of proposed equipment to be used in performance of construction work including descriptive data, 14 days prior to use on the project.

SD-04 Samples

Materials

Samples of the materials (sealant, primer if required, and backup material), in sufficient quantity for testing and approval 14 days prior to the beginning of work. No material will be allowed to be used until it has been approved.

1.4 QUALITY ASSURANCE

1.4.1 Test Requirements

Test the joint sealant and backup or separating material for conformance with the referenced applicable material specification. The materials will be tested by the Government. No material shall be used at the project prior to receipt of written notice that the materials meet the laboratory requirements. The cost of the first test of samples will be borne by the Government. If the samples fail to meet specification requirements, replace the materials represented by the sample and test the new materials at the Contractor's expense. Conformance with the requirements of the laboratory tests specified will not constitute final acceptance of the materials. Final acceptance will be based on the performance of the in-place materials.

1.4.2 Trial Joint Sealant Installation

Prior to the cleaning and sealing of the joints for the entire project, prepare a test section at least 200 feet long using the specified materials and approved equipment, so as to demonstrate the proposed joint preparation and sealing of all types of joints in the project. Following the completion of the test section and before any other joint is sealed, inspect the test section to determine that the materials and installation meet the requirements specified. If it is determined that the materials or

installation do not meet the requirements, remove the materials, and reclean and reseal the joints at no cost to the Government. When the test section meets the requirements, it may be incorporated into the permanent work and paid for at the contract unit price per linear foot for sealing items scheduled. Prepare and seal all other joints in the manner approved for sealing the test section.

1.5 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the job site for defects, unload, and store them with a minimum of handling to avoid damage. Provide storage facilities at the job site for maintaining materials at the temperatures and conditions recommended by the manufacturer.

1.6 ENVIRONMENTAL REQUIREMENTS

The ambient air temperature and the pavement temperature within the joint wall shall be a minimum of 50 degrees F and rising at the time of application of the materials. Do not apply sealant if moisture is observed in the joint.

PART 2 PRODUCTS

2.1 SEALANTS

Materials for sealing cracks in the various paved areas indicated on the drawings shall be as follows:

Sealing Material
ASTM D 6690, Type II and COE CRD-C 525
ASTM D 6690, Type III and COE CRD-C 525

2.2 PRIMERS

When primers are recommended by the manufacturer of the sealant, use them in accordance with the recommendation of the manufacturer.

2.3 BACKUP MATERIALS

Provide backup material that is a compressible, nonshrinking, nonstaining, nonabsorbing material, nonreactive with the joint sealant. The material shall have a melting point at least 5 degrees F greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D 789. The material shall have a water absorption of not more than 5 percent of the sample weight when tested in accordance with ASTM C 509. The backup material shall be 25 plus or minus 5 percent larger in diameter than the nominal width of the crack.

2.4 BOND BREAKING TAPES

Provide a bond breaking tape or separating material that is a flexible, nonshrinkable, nonabsorbing, nonstaining, and nonreacting adhesive-backed tape. The material shall have a melting point at least 5 degrees F greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D 789. The bond breaker tape shall be approximately 1/8 inch wider than the nominal width of the joint and shall not bond to the joint sealant.

PART 3 EXECUTION

3.1 PREPARATION OF JOINTS

Immediately before the installation of the sealant, thoroughly clean the joints to remove all laitance, curing compound, filler, protrusions of hardened concrete, and old sealant from the sides and upper edges of the joint space to be sealed.

3.1.1 Back-Up Material

When the joint opening is of a greater depth than indicated for the sealant depth, plug or seal off the lower portion of the joint opening using a back-up material to prevent the entrance of the sealant below the specified depth. Take care to ensure that the backup material is placed at the specified depth and is not stretched or twisted during installation.

3.1.2 Bond Breaking Tape

Where inserts or filler materials contain bitumen, or the depth of the joint opening does not allow for the use of a backup material, insert a bond breaker separating tape to prevent incompatibility with the filler materials and three-sided adhesion of the sealant. Securely bond the tape to the bottom of the joint opening so it will not float up into the new sealant.

3.1.3 Rate of Progress of Joint Preparation

Limit the stages of joint preparation, which include sandblasting, air pressure cleaning and placing of the back-up material to only that lineal footage that can be sealed during the same day.

3.2 PREPARATION OF SEALANT

3.2.1 Single-Component, Cold-Applied Sealants

Inspect the ASTM D 5893 sealant and containers prior to use. Reject any materials that contain water, hard caking of any separated constituents, nonreversible jell, or materials that are otherwise unsatisfactory. Settlement of constituents in a soft mass that can be readily and uniformly remixed in the field with simple tools will not be cause for rejection.

3.3 INSTALLATION OF SEALANT

3.3.1 Time of Application

Seal joints immediately following final cleaning of the joint walls and following the placement of the separating or backup material. Open joints, that cannot be sealed under the conditions specified, or when rain interrupts sealing operations shall be recleaned and allowed to dry prior to installing the sealant.

3.3.2 Sealing Joints

Immediately preceding, but not more than 50 feet ahead of the joint sealing operations, perform a final cleaning with compressed air. Fill the joints from the bottom up to 1/4 inch plus or minus 1/16 inch below the pavement surface. Remove and discard excess or spilled sealant from the pavement by

approved methods. Install the sealant in such a manner as to prevent the formation of voids and entrapped air. In no case shall gravity methods or pouring pots be used to install the sealant material. Traffic shall not be permitted over newly sealed pavement until authorized by the Contracting Officer. When a primer is recommended by the manufacturer, apply it evenly to the joint faces in accordance with the manufacturer's instructions. Check the joints frequently to ensure that the newly installed sealant is cured to a tack-free condition within the time specified.

3.4 INSPECTION

3.4.1 Joint Sealant Application Equipment

Inspect the application equipment to ensure conformance to temperature requirements, proper proportioning and mixing (if two-component sealant) and proper installation. Evidences of bubbling, improper installation, failure to cure or set will be cause to suspend operations until causes of the deficiencies are determined and corrected.

3.4.2 Joint Sealant

Inspect the joint sealant for proper rate of cure and set, bonding to the joint walls, cohesive separation within the sealant, reversion to liquid, entrapped air and voids. Sealants exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed from the joint, wasted, and replaced as specified herein at no additional cost to the Government.

3.5 CLEAN-UP

Upon completion of the project, remove all unused materials from the site and leave the pavement in a clean condition.

-- End of Section --

SECTION 32 05 33

LANDSCAPE ESTABLISHMENT
02/10

PART 1 GENERAL

1.1 SUMMARY

This Section includes landscape maintenance and warranty. Refer to other Division 32 Sections for products and installation procedures.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

TREE CARE INDUSTRY ASSOCIATION (TCIA)

TCIA Z133.1	(2006) American National Standard for Arboricultural Operations - Pruning, Repairing, Maintaining, and Removing Trees, and Cutting Brush - Safety Requirements

1.3 DEFINITIONS

1.3.1 Pesticide

Any substance or mixture of substances, including biological control agents, that may prevent, destroy, repel, or mitigate pests and are specifically labeled for use by the U.S. Environmental Protection Agency (EPA). Also, any substance used as a plant regulator, defoliant, disinfectant, or biocide. Examples of pesticides include fumigants, herbicides, insecticides, fungicides, nematicides, molluscicides and rodenticides.

1.3.2 Planter Beds

A planter bed is defined as an area containing one or a combination of the following plant types: trees, shrubs, and groundcover.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals identified with "AE" shall be reviewed by Landscape Architect. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Integrated Pest Management Plan; G, AE
Invasive Species Removal Plan; G, AE

SD-03 Product Data

Mulches Topdressing; G, AE
Organic Mulch Materials; G, AE

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

SD-07 Certificates

Plant quantities; G, AE
Maintenance Inspection Report; G, AE

SD-10 Operation and Maintenance Data

Maintenance Plan

1.5 QUALITY CONTROL

Provide Invasive Species Removal Plan to Contracting Officer for approval prior to start of Work.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Delivery

Deliver fertilizer, mulch to the site in original containers bearing manufacturer's chemical analysis, name, trade name, or trademark, and indication of conformance to state and federal laws. Instead of containers, mulch may be furnished in bulk with a certificate indicating the above information.

1.6.2 Storage

1.6.2.1 Mulch Storage

Material shall be stored in designated areas.

1.6.3 Handling

Do not drop or dump materials from vehicles.

PART 2 PRODUCTS

2.1 WATER

Source of water shall be approved by the Contracting Officer, and be of suitable quality for irrigation.

2.2 MULCHES TOPDRESSING

Free from noxious weeds, mold, or other deleterious materials.

2.2.1 Organic Mulch Materials

shredded hardwood from site when available. Biobased content shall be a

minimum of 100 percent. Wood cellulose fiber shall be processed to contain no growth or germination-inhibiting factors, dyed with non-toxic, biodegradable dye to an appropriate color to facilitate visual metering of materials application. Paper-based hydraulic mulch shall contain a minimum of 100 percent post-consumer recycled content. Wood-based hydraulic mulch shall contain a minimum of 100 percent recycled material.

2.3 PESTICIDES

Submit an Integrated Pest Management Plan to Contracting Officer, including weed and pest management strategies to comply with Arlington National Cemetery's Pesticide Use Proposal (PUP). Use biological pest controls as approved in the Plan.

PART 3 EXECUTION

3.1 EXTENT OF WORK

Provide landscape construction maintenance to include watering, weeding, stake and guy adjusting, and straightening for all newly installed landscape trees and shrubs. Seedling areas shall be weeded and straightened. Contractor shall provide maintenance and invasive species removal for one-year from date of Substantial Completion.

3.1.1 Policing

The Contractor shall police all landscaped areas. Policing includes removal of leaves, branches and limbs regardless of length or diameter, dead vegetation, paper, trash, cigarette butts, garbage, rocks exceeding 4 inches in diameter, or other debris. Collected debris shall be promptly removed and legallydisposed of at an approved disposal site off ANC property.

3.2 IRRIGATION ESTABLISHMENT PERIOD

3.2.1 Water Restrictions

The Contractor shall abide by state, local or other water conservation regulations in force during the establishment period. Automatic controller shall be adjusted to comply with the water conservation regulations schedule.

3.2.2 Fire Hydrants

To use a fire hydrant for irrigation, the Contractor shall obtain prior clearance from the Contracting Officer and provide the tools and connections approved for use on fire hydrants. If a fire hydrant is used, Contractor shall provide a reduced pressure backflow preventer for each connection between hose and fire hydrant. Backflow preventer used shall be tested once per month by a certified backflow preventer tester.

3.3 PLANT ESTABLISHMENT PERIOD

The plant establishment period will commence on the date that inspection by the Contracting Officer shows that the new plants furnished under this contract have been satisfactorily installed and shall continue for a period of 365 days.

3.3.1 Maintenance and Policing

Begin maintenance immediately after plants have been installed. Inspect plants at least once a week and once every two weeks for seedlings during the installation and establishment period and perform needed maintenance within 72 hours. Police as described in Article 3.1.1.

3.3.2 Promotion of Plant Growth and Vigor

Water, prune, fertilize, mulch, adjust stakes, guys and turnbuckles, eradicate weeds and perform other operations necessary to promote plant growth, and vigor.

3.3.3 Planting Bed Maintenance

Planting beds shall be weeded, fertilized, irrigated, kept pest free, turf free, pruned, and mulch levels maintained. Planting beds will not be allowed to encroach into turf areas. A definite break shall be maintained between turf areas and planting beds.

3.3.3.1 Shrub Selective Maintenance

In addition to the above requirements, shrubs shall be selectively pruned, and shaped for health and safety when the following conditions exist: Remove growth in front of windows, over entrance ways or walks, and any growth which will obstruct vision at street intersections or of security personnel; Remove dead, damaged or diseased branches or limbs; where shrub growth obstructs pedestrian walkways; where shrub growth is found growing against or over structures; where shrub growth permits concealment of unauthorized persons. All pruning debris shall be disposed of in a proper manner off ANC property.

3.3.3.2 Tree Maintenance

Tree maintenance shall include adjustment of stakes, ties, guy supports and turnbuckles, watering, fertilizing, pest control, mulching, pruning for health and safety. Stakes, ties, guy supports and turnbuckles shall be inspected and adjusted to avoid girdling and promote natural development. All trees within the project boundaries, regardless of caliper, shall be selectively pruned for safety and health reasons. These include but are not limited to removal of dead and broken branches and correction of structural defects. Prune trees according to their natural growth characteristics leaving trees well shaped and balanced. Pruning of all trees including palm trees shall be accomplished by or in the presence of a certified member of the International Society of Arboriculture and in accordance with TCIA Z133.1. All pruning debris generated shall be disposed of in a proper manner.

3.3.4 Removal of Dying or Dead Plants

Remove dead and dying plants and provide new plants immediately upon commencement of the specified planting season, and replace stakes, guys, and mulch. No additional plant establishment period will be required for replacement plants beyond the original warranty period. A tree shall be considered dying or dead when the main leader has died back, or a minimum of 20 percent of the crown has died. A shrub or ground cover shall be considered dying or dead when a minimum of 20 percent of the plant has died. This condition shall be determined by scraping on a branch an area 1/16 inch square, maximum, to determine the cause for dying plant material

and shall provide recommendations for replacement. The Contractor shall determine the cause for dying plant material and consult with the Contracting Officer regarding replacement.

3.3.5 Tracking of Unhealthy Plants

Note plants not in healthy growing condition, as determined by the Contracting Officer, and as soon as seasonal conditions permit, remove and replace with plants of the same species and sizes as originally specified. Install replacement plantings in accordance with Section 32 93 00 EXTERIOR PLANTS.

3.3.6 Final Inspection

Final inspection will be made upon written request from the Contractor at least 10 days prior to the last day of the establishment period. Final inspection will be based upon satisfactory health and growth of plants and on the following:

3.3.6.1 Mulching and Weeding

Planting beds and earth mound water basins are properly mulched and free of weeds.

3.3.6.2 Tree Supports

Stakes, guys and turnbuckles are in good condition.

3.3.6.3 Remedial Work

Remedial measures directed by the Contracting Officer to ensure plant material survival and promote healthy growth have been completed.

3.4 FIELD QUALITY CONTROL

3.4.1 Maintenance Inspection Report

Provide maintenance inspection report to assure that landscape maintenance is being performed in accordance with the specifications and in the best interest of plant growth and survivability. Site observations shall be documented at the start of the establishment period, then quarterly following the start, and at the end of establishment period. Results of site observation visits shall be submitted to the Contracting Officer within 7 calendar days of each site observation visit.

3.4.2 Plant Quantities

The Contractor shall provide Contracting Officer with the number of plant quantities. In addition, provide total exterior area of hardscape and landscaping such as turf and total number of shrubs.

3.4.3 Tree Staking and Guying Removal

The Contractor shall provide a certified letter that all stakes and guys are removed from all project trees at the end of the establishment period.

-- End of Section --

SECTION 32 11 10

DRAINAGE LAYER
08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	(2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C29/C29M	(2009) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C88	(2005) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM D2487	(2011) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D4791	(2010) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D75/D75M	(2009) Standard Practice for Sampling Aggregates

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST IR 91-4756	(1991) Laboratory Accreditation Activities in the United States

1.2 SYSTEM DESCRIPTION

Build a drainage layer under the pavements, as indicated on drawings, consisting of Rapid Draining Material (RDM).

1.2.1 Equipment

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times.

1.2.2 Placement Equipment

Use an asphalt paving machine to place drainage layer material. Alternate methods may be used if it can be demonstrated in the test section that these methods obtain the specified results.

1.2.3 Compaction Equipment

Use a dual or single smooth 10 2000 lb- tons (min.) vibratory drum roller, which provides a maximum compactive effort without crushing the drainage layer aggregate, to compact drainage layer material.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Waybills and Delivery Tickets

SD-06 Test Reports

Sampling and Testing
Approval of Materials; G, AE
Evaluation

1.4 QUALITY ASSURANCE

1.4.1 Sampling and Testing

Submit copies of field test results within 24 hours of completion of tests. Sampling and testing are the responsibility of the Contractor to be performed by an approved commercial testing laboratory, or by the Contractor subject to approval. If the Contractor elects to establish testing facilities of its own, approval of such facilities will be based on compliance with NIST IR 91-4756, and no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved. The first inspection of the facilities will be at the expense of the Government and any subsequent inspections required because of failure of the first inspection shall be at the expense of the Contractor. Such costs will be deducted from the total amount due the Contractor. Test drainage layer materials to establish compliance with the specified requirements.

1.4.2 Sampling

Take aggregate samples in accordance with ASTM D75/D75M.

1.4.3 Test Methods

1.4.3.1 Sieve Analyses

Make sieve analyses in accordance with ASTM C117 and ASTM C136.

1.4.3.2 Density Tests

Perform field density tests for RDM drainage layers in accordance with ASTM D6938 by Direct Transmission Method for the full depth of the lift, use ASTM D6938 to determine the moisture content of the aggregate drainage layer material. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D6938. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph "Calibration" of ASTM D6938, on each different type of material being tested at the beginning of a job and at intervals as directed by the Contracting Officer.

1.4.3.3 Soundness Test

Perform soundness tests in accordance with ASTM C88.

1.4.3.4 Los Angeles Abrasion Test

Perform Los Angeles abrasion tests in accordance with ASTM C131.

1.4.3.5 Flat or Elongated Particles Tests

Perform flat and/or elongated particles tests in accordance with ASTM D4791.

1.4.3.6 Fractured Faces Tests

When aggregates are supplied from crushed gravel, use approved test methods to ensure the aggregate meets the requirements for fractured faces in paragraph AGGREGATES.

1.4.4 Initial Tests

Perform one of each of the following tests on the proposed material, prior to commencing construction, to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, complete the following tests for each source.

a. Sieve Analysis including 0.02mm size material.

b. Flat and/or elongated particles

c. Fractured Faces

d. Los Angeles abrasion.

e. Soundness.

1.4.5 Testing Frequency

1.4.5.1 Aggregate Layer

Perform field density and moisture content tests at a rate of at least one test for every 2000 square yards of completed area and not less than one test for each day's production. Sieve analyses shall be performed at a rate of at least one test for every 6000 square yards of completed area. Perform soundness tests, Los Angeles abrasion tests, fractured faces tests and flat and/or elongated particles tests at the rate of one test for every 12,000 square yards of production.

1.4.6 Approval of Materials

Submit material sources and material test results prior to field use.

1.4.6.1 Aggregate

Select the aggregate source at least 60 days prior to field use in the test section. Tentative approval of the source will be based on certified test results to verify that materials proposed for use meet the contract requirements. Final approval of both the source and the material will be based on test section performance and tests for gradation, soundness, Los Angeles abrasion, flat and/or elongated particles tests and fractured faces tests. For aggregate drainage layer materials, perform these tests on samples taken from the completed and compacted drainage layer course within the test section.

1.5 ENVIRONMENTAL REQUIREMENTS

Place drainage layer material when the atmospheric temperature is above 35 degrees F. Correct areas of completed drainage layer or underlying courses that are damaged by freezing, rainfall, or other weather conditions or by contamination from sediments, dust, dirt, or foreign material to meet specified requirements.

PART 2 PRODUCTS

2.1 AGGREGATES

Provide aggregates consisting of clean, sound, hard, durable, angular particles of crushed stone, crushed slag, or crushed gravel which meet the specification requirements. Slag shall be an air-cooled, blast-furnace product having a dry weight of not less than 65 pcf determined by ASTM C29/C29M. Provide aggregates free of silt and clay as defined by ASTM D2487, vegetable matter, and other objectionable materials or coatings.

2.1.1 Aggregate Quality

The aggregate shall have a soundness loss not greater than 18 percent weighted averaged at 5 cycles when tested in magnesium sulfate in accordance with ASTM C88 and a percentage of loss on abrasion not to exceed 40 after 500 revolutions as determined by ASTM C131. Determine the percentage of flat and/or elongated particles by ASTM D4791 with the following modifications: 1) The aggregates shall be separated into 2 size fractions, particles greater than 1/2 inch sieve and particles passing the 1/2 inch sieve and retained on the No. 4 sieve. 2) The percentage of flat and/or elongated particles in either fraction shall not exceed 20. 3) A flat particle is one having a ratio of width to thickness greater than 3;

an elongated particle is one having a ratio of length to width greater than 3. 4) When the aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements. When the aggregate is supplied from crushed gravel it shall be manufactured from gravel particles, 90 percent of which by weight are retained on the maximum-size sieve listed in TABLE I. In the portion retained on each sieve specified, the crushed gravel shall contain at least 90 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the face. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as 2 fractured faces.

2.1.2 Gradation Requirements

Drainage layer aggregates shall be well graded within the limits specified in TABLE I of Section 31 23 00.00 20 EXCAVATION AND FILL.

PART 3 EXECUTION

3.1 STOCKPILING AGGREGATES

Stockpile aggregates at locations designated by the Contracting Officer. Clear and level stockpile areas prior to stockpiling aggregates to prevent segregation and contamination. Aggregates obtained from different sources shall be stockpiled separately.

3.2 TEST SECTION

3.2.1 Data

Construct a test section to evaluate the ability to carry traffic, including placement of overlaying material and the constructability of the drainage layer including required mixing, placement, and compaction procedures. Test section data will be used by the Contracting Officer to validate the required number of compaction passes given in paragraph Compaction Requirements and the field dry density requirements for full scale production.

3.2.2 Schedule/Evaluation

Construct the test section a minimum of 30 days prior to the start of full scale production to provide sufficient time for an evaluation of the proposed materials, equipment and procedures including Government QA testing.

3.2.3 Location and Size

Place the test section outside production paving limits in an area with similar subgrade and subbase conditions approved by the Contracting Officer. The underlying courses and subgrade preparation, required for the pavement section, shall be completed, inspected and approved in the test section prior to constructing the drainage layer. The test section shall be a minimum of 100 feet long and two full paving lanes wide side by side.

3.2.4 Initial Testing

Provide certified test results, approved by the Contracting Officer prior to the start of the test section, to verify that the materials proposed for

use in the test section meet the contract requirements.

3.2.5 Mixing, Placement, and Compaction

Accomplish mixing, placement, and compaction using equipment meeting the requirements of paragraph EQUIPMENT. Compaction equipment speed shall be no greater than 1.5 mph. Start compaction from the outside edges of the paving lane and proceed to the centerline of the lift being placed. The roller shall stay a minimum of one half the roller width from the outside edge of the drainage layer being placed until the desired density is obtained. The outside edge shall then be rolled.

3.2.6 Procedure

3.2.6.1 RDM Aggregate Drainage Layer Tests

Construct the test section with aggregate in a wet state so as to establish a correlation between number of roller passes and dry density achievable during field production. Designate three separate areas within the test section, test each area for density, moisture, and gradation. Complete all testing in the middle third of the test section being placed. Conduct density and moisture content tests in accordance with ASTM D6938. Conduct sieve analysis tests on samples, taken adjacent to the density test locations. Take one set of tests (i.e. density, moisture, and sieve analysis) before the third compaction pass and after each subsequent compaction pass at three separate locations as directed by the Contracting Officer. Define a pass as the movement of a roller over the drainage layer area for one direction only. Compaction for the RDM shall consist of a maximum of 5 passes in the vibrating state and one final pass in the static state. Continue compaction passes and density readings until the difference between the average dry densities of any two consecutive passes is less than or equal to 1.0 pcf.

3.2.7 Evaluation

Within 10 days of completion of the test section, submit to the Contracting Officer a Test Section Construction Report complete with all required test data and correlations. The Contracting Officer will evaluate the data and validate the required number of passes of the roller, the need for a final static pass of the roller, and provide the dry density for field density control during construction.

3.3 PREPARATION OF UNDERLYING COURSE

Prior to constructing the drainage layer, clean the underlying course of all foreign materials. During construction, the underlying course shall contain no frozen material. The underlying course shall conform to Section 32 11 16.16 BASE COURSE FOR RIGID PAVEMENT AND SUBBASE COURSE FOR FLEXIBLE PAVING. Correct ruts or soft yielding spots in the underlying courses having inadequate compaction and deviations of the surface from the requirements set forth herein by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line, and grade, and recompacting to specified density. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until the drainage layer is placed.

3.4 TRANSPORTING MATERIAL

3.4.1 Aggregate Drainage Layer Material

Transport aggregate drainage layer material to the site in a manner which prevents segregation and contamination of materials.

3.5 PLACING

3.5.1 General Requisites

Place drainage layer material on the underlying course in lifts of uniform thickness using equipment meeting the requirements of paragraph EQUIPMENT. When a compacted layer 6 inches or less in thickness is required, place the material in a single lift. When a compacted layer in excess of 6 inches is required, place the material in lifts of equal thickness. No lift shall exceed 6 inches or be less than 3 inches when compacted. The lifts when compacted after placement shall be true to the grades or levels required with the least possible surface disturbance. Where the drainage layer is placed in more than one lift, clean the previously constructed lift of loose and foreign material. Such adjustments in placing procedures or equipment shall be made to obtain true grades and minimize segregation and degradation of the drainage layer material.

3.5.2 Hand Spreading

Spread by hand drainage layer material in areas where machine spreading is impractical. The material shall be spread uniformly in a loose layer to prevent segregation. The material shall conform to the required grade and thickness after compaction.

3.6 COMPACTION REQUIREMENTS

3.6.1 Field Compaction

Base field compaction requirements on the results of the test section, using the materials, methods, and equipment proposed for use in the work.

3.6.2 Number of Passes

Accomplish compaction using rollers meeting the requirements of paragraph EQUIPMENT and operating at a rolling speed of no greater than 1.5 miles per hour. Compact each lift of drainage material, including shoulders when specified under the shoulders, with the number of passes of the roller as follows: for RDM material use 4 passes in the vibratory state and one in the static. The Contracting Officer will validate the number of roller passes after the test section is evaluated and before production starts.

3.6.3 Dry Density

In addition, maintain a minimum field dry density as specified by the Contracting Officer. If the required field dry density is not obtained, adjust the number of roller passes in accordance with paragraph DEFICIENCIES. Compact aggregate in a moisture state as determined in the test section. Excessive rolling resulting in crushing of aggregate particles shall be avoided. In all places not accessible to the rollers, compact the drainage layer material with mechanical hand operated tampers.

3.7 FINISHING

Finish the top surface of the drainage layer after final compaction, as determined from the test section. Make adjustments in rolling and finishing procedures to obtain grades and minimize segregation and degradation of the drainage layer material.

3.8 EDGES OF DRAINAGE LAYER

Place shoulder material along the edges of the drainage layer course in a quantity that will compact to the thickness of the layer being constructed. At least 3 feet width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each lift of the drainage layer.

3.9 SMOOTHNESS TEST

The surface of the top lift shall not deviate more than 3/8 inch when tested with either a10 or 12 foot straightedge applied parallel with and at right angles to the centerline of the area to be paved. Correct deviations exceeding 3/8 inch in accordance with paragraph DEFICIENCIES.

3.10 THICKNESS CONTROL

The completed thickness of the drainage layer shall be within 1/2 inch of the thickness indicated. Measure thickness at intervals providing at least one measurement for each 500 square yards of drainage layer. Make measurements in test holes at least 3 inches in diameter unless the Contractor can demonstrate, for COR approval, that a steel rod pushed through the drainage layer clearly stops at the material interface. Where the measured thickness is more than 1/2 inch deficient, such areas shall be corrected in accordance with paragraph DEFICIENCIES. Where the measured thickness is 1/2 inch more than indicated, it will be considered as conforming to the requirements plus 1/2 inch, provided the surface of the drainage layer is within 1/2 inch of established grade. The average job thickness shall be the average of all job measurements as specified above but within 1/4 inch of the thickness shown on the drawings.

3.11 DEFICIENCIES

3.11.1 Grade and Thickness

Correct deficiencies in grade and thickness so that both grade and thickness tolerances are met. Thin layers of material shall not be added to the top surface of the drainage layer to meet grade or increase thickness. If the elevation of the top of the drainage layer is more than 1/2 inch above the plan grade it shall be trimmed to grade and finished in accordance with paragraph FINISHING. If the elevation of the top surface of the drainage layer is 1/2 inch or more below the required grade, the surface of the drainage layer shall be scarified to a depth of at least 3 inches, new material shall be added, and the layer shall be blended and recompacted to bring it to grade. Where the measured thickness of the drainage layer is more than 1/2 inch deficient, such areas shall be corrected by excavating to the required depth and replaced with new material to obtain a compacted lift thickness of at least 3 inches. The depth of required excavation shall be controlled to keep the final surface elevation within grade requirements and to preserve layer thicknesses of materials below the drainage layer.

3.11.2 Density

Density will be considered deficient if the field dry density test results are below the dry density specified by the Contracting Officer. If the densities are deficient, the layer shall be rolled with 2 additional passes of the specified roller. If the dry density is still deficient, work will be stopped until the cause of the low dry densities can be determined and reported to the Contracting Officer.

3.11.3 Smoothness

Correct deficiencies in smoothness as if they are deficiencies in grade or thickness. All tolerances for grade and thickness shall be maintained while correcting smoothness deficiencies.

-- End of Section --

SECTION 32 11 16.16

BASE COURSE FOR RIGID AND SUBBASE COURSE FOR FLEXIBLE PAVING
11/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	(2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C29/C29M	(2009) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM D1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	(2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D1883	(2007e2) CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D2940/D2940M	(2009) Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports
ASTM D4318	(2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D6270	(2008e1) Use of Scrap Tires in Civil Engineering Applications
ASTM D6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D698	(2012) Laboratory Compaction

	Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
ASTM D75/D75M	(2009) Standard Practice for Sampling Aggregates

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Materials; G, AE

Documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

SD-05 Design Data

Gradation curve

SD-06 Test Reports

Bearing ratio
Liquid limit
Plasticity index
Dry weight of slag
Percentage of wear
Gradation tests
Density tests

SD-07 Certificates

Source

1.3 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site and store aggregates in a manner that will prevent segregation and contamination.

1.4 CONSTRUCTION EQUIPMENT

Subject to approval of the Contracting Officer, special equipment as dictated by local conditions may be used. Calibrated equipment, such as scales, batching equipment, spreaders, and other similar equipment, shall have been calibrated by a state calibration laboratory within 12 months of commencing work.

1.5 ENVIRONMENTAL REQUIREMENTS

Do not construct course when atmospheric temperature is below 35 degrees F or when weather conditions could detrimentally affect quality of finished

course. When temperature falls below 35 degrees F, protect areas of completed course against freezing.

PART 2 PRODUCTS

2.1 MATERIALS

ASTM D2940/D2940M, except as modified herein. Material shall consist of natural, rock, gravel, stone, slag, chert, caliche, limerock, coral; shell; sand; or screenings; and soil or other similar binding or filler material. Material shall be free-draining. Obtain materials from sources approved by the Contracting Officer. Preliminary approval of pits shall not mean that material found in the deposit will be acceptable. Maximum dimensions of material particles shall not be greater than two-thirds the compacted thickness of the layer in which it is to be placed. Coarse aggregate shall have a percentage of wear of not more than 40 as determined by ASTM C131. Material shall have a bearing ratio of at least 80 as determined by laboratory test on a four day soaked specimen in accordance with ASTM D1883; compact the specimen in accordance with ASTM D1557, Method B, C, or D. Material passing the No. 40 sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than 5 in accordance with ASTM D4318. Slag shall be an air-cooled blast furnace product having a dry weight not less than 65 pounds per cubic foot when tested in accordance with ASTM C29/C29M and consisting of angular fragments uniform in density and quality and reasonably free from thin and elongated pieces, dirt, or other objectionable material. Gradation of the final composite mixture shall conform to the following size and shall be the basis of the gradation curve:

Sieve Size (Square Openings)	Design Range (Percent Passing)
2 inch	100
1 1/2 inch	90-100
1 inch	94-100
3/8 inch	63-72
No. 4	30-60
No. 10	32-41
No. 40	14-24
No. 200	6-12

2.2 SOURCE QUALITY CONTROL

Prior to production and delivery of aggregates, take at least one initial sample in accordance with ASTM D75/D75M. Collect each sample by taking three incremental samples at random from source material to make a composite sample of not less than 50 pounds. Repeat sampling procedure when source of material is changed or when deficiencies or variations from specified grading of materials are found in testing.

PART 3 EXECUTION

3.1 GRADE CONTROL

Provide line and grade stakes for control. Place grade stakes in lanes parallel to centerline of areas to be paved and space for string lining or other control methods.

3.2 PLACING AND MIXING

Clean underlying surface of foreign substances and ensure proper compaction and smoothness before placement of course. Verify subsoils have a permeability between 0.5 and 3.0 inches per hour. Recondition, reshape, and recompact areas damaged by freezing, rainfall, or other weather conditions. Mix and place materials to obtain a uniform course for the water content and gradation specified. Construct course in one or more layers. Make each layer between 3 and 8 inches in compacted thickness. Tire shall be installed in accordance with ASTM D6270.

3.3 COMPACTING AND FINISHING

Compact each layer to at least 100 percent of the maximum laboratory density determined in accordance with ASTM D1557 for areas subject to heavy vehicular traffic. Compact each layer to at least 95 percent Standard Proctor Density per ASTM D698 for pedestrian areas. Compact material inaccessible to rolling equipment by mechanical tamping. Finish surface of the layer by blading and rolling. Blade, roll, and tamp until surface is smooth and free from waves and irregularities. Aerate material excessively moistened by rain during construction. Aerate using blade graders, harrows, or other equipment until the moisture content is that needed to obtain specified density. Place and compact earth at edges of course for at least one foot of the shoulder.

3.4 FIELD QUALITY CONTROL

3.4.1 Sampling During Construction

Take one random sample of each 1000 tons of material placed, but not less than one random sample per day's run. Take samples in accordance with ASTM D75/D75M.

3.4.2 Testing

3.4.2.1 Material

Make gradation tests from each sample in accordance with ASTM C136. Determine material passing the No. 200 sieve in accordance with ASTM C117.

3.4.2.2 Smoothness Test

Test with a 10 foot straightedge applied parallel with and at right angles to centerline of the rolled area. Correct surface deviations in excess of 3/8 inch by loosening, adding or removing material, reshaping, watering, and compacting. When course is constructed in more than one layer, smoothness requirements apply only to the top layer.

3.4.2.3 Field Density Tests

ASTM D1556 or ASTM D6938. Take one field density test for each 500 square

yards of each layer of course. When using ASTM D6938 to test field compaction densities, verify the results of the tests by performing one test per day using ASTM D1556 at locations previously tested by ASTM D6938 and one additional test using ASTM D1556 for every ten tests performed at locations previously tested by ASTM D6938.

3.4.2.4 Laboratory Density Tests

ASTM D1557, Method B, C, or D, for all material.

3.4.2.5 Thickness Test

Determine thickness of course from test holes not less than 3 inches in diameter. Obtain a thickness test for each 500 square yards of course. Where course deficiency is more than 1/2 inch, correct by scarifying, adding mixture of proper gradation, reblading, and recompacting. Where the measured thickness exceeds the indicated thickness by more than 1/2 inch, consider the measured thickness as the indicated or specified thickness plus 1/2 inch for determining the average. The average thickness shall be the average of the depth measurements and shall not underrun the thickness shown by more than 1/4 inch.

3.5 MAINTENANCE

After construction is completed, protect and maintain all areas of course against detrimental effects. Maintenance includes drainage, rolling, shaping, watering, or other action required to maintain course in proper condition. Maintain sufficient moisture by light sprinkling with water at the surface to prevent a dusty condition.

-- End of Section --

SECTION 32 11 29

LIME-STABILIZED SUBGRADE
11/09

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 208	(2001; R 2009) Standard Specification for Cationic Emulsified Asphalt
AASHTO T 135	(1997; R 2009) Standard Method of Test for Wetting-and-Drying Test of Compacted Soil-Cement Mixtures
AASHTO T 136	(1997; R 2009) Standard Method of Test for Freezing-and-Thawing Tests of Compacted Soil-Cement Mixtures

ASTM INTERNATIONAL (ASTM)

ASTM C 207	(2006) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C1602/C1602M	(2012) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C25	(2011) Standard Test Method for Chemical Analysis of Limestone, Quicklime, and Hydrated Lime
ASTM C50/C50M	(2012) Sampling, Sample Preparation, Packaging, and Marking of Lime and Limestone Products
ASTM D1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	(2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D1632	(2007) Making and Curing Soil-Cement Compression and Flexure Test Specimens in

	the Laboratory
ASTM D3551	(2008) Laboratory Preparation of Soil-Lime Mixtures Using a Mechanical Mixer
ASTM D3740	(2012a) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D4318	(2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D5102	(2009) Standard Test Method for Unconfined Compressive Strength of Compacted Soil-Lime Mixtures
ASTM D6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D75/D75M	(2009) Standard Practice for Sampling Aggregates
ASTM E11	(2009; E 2010) Wire Cloth and Sieves for Testing Purposes

1.2 DEFINITIONS

1.2.1 Lime-Stabilized Course

Lime-stabilized course, as used in this specification, is a mixture of lime and in-place or borrow material uniformly blended, wetted, and thoroughly compacted to produce a pavement course which meets the criteria set forth in the plans and this specification.

1.2.2 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557abbreviated as percent laboratory maximum density.

1.3 SYSTEM DESCRIPTION

The work specified consists of the construction of a lime-stabilized subgrade course. Perform the work in accordance with this specification conforming to the lines, grades, notes, and typical sections shown in the drawings. Select sources of materials well in advance of the time when materials will be required in the work.

1.3.1 Stockpiling Materials

Stockpile borrow material, including approved material available from excavation and grading, in the manner and at the locations designated. Before stockpiling material, storage sites shall be cleared and sloped to

drain. Stockpile separately materials obtained from different sources.

1.3.2 Plant, Equipment, Machines, and Tools

Submit list of proposed equipment to be used in performance of construction work including descriptive data.

1.3.2.1 General Requisites

Plant, equipment, machines, and tools used in the work shall be subject to approval and maintained in satisfactory working condition at all times. Other compacting equipment may be used in lieu of that specified, where it can be demonstrated that the results are equivalent. Provide protective equipment, apparel, and barriers to protect the eyes, respiratory system, and the skin of workers exposed to contact with lime dust or slurry.

1.3.2.2 Steel-Wheeled Rollers

Steel wheeled rollers shall be the self propelled type. Unless otherwise provided, non-vibratory steel-wheel rollers shall be of the tandem or 3-wheel self-propelled type or steel-wheel trailer type weighing not less than 5 tons. When drive rolls or trailer type rolls produce a compressive force of not less than 200 pounds per linear inch of contact area, a roller weighing less than 5 tons may be used. Equip wheels of the rollers with adjustable scrapers. The use of vibratory rollers is optional.

1.3.2.3 Pneumatic-Tired Rollers

Pneumatic-tired rollers shall have 4 or more tires, inflated to a minimum pressure of 90 psi. The loading shall be equally distributed to all wheels, and the tires shall be uniformly inflated. Also provide pneumatic-tired towing equipment.

1.3.2.4 Tamping-Type Roller

The tamping type roller, under working conditions, shall have a minimum weight of 90 pounds per linear inch of length of drum and a minimum load on each sheeps-foot of 100 pounds per square inch of cross sectional area of the sheeps-foot in contact with the ground. Maximum area of the face of each sheeps-foot shall not be more than 12 square inches. The feet on the sheeps-foot roller shall project not less than 7 inches from the face of the drum, and the roller shall be equipped with teeth-cleaning devices. Space the feet in adjacent rows so that the distance from center to center of adjacent parallel rows is not less than 6 inches nor more than 11 inches. Individual drums of the roller shall not exceed 5 feet in width and shall oscillate independently. Roller and tractor for pulling shall travel at a speed of approximately 3 to 6 mph.

1.3.2.5 Mechanical Spreader

Mechanical spreader shall be self-propelled or attached to a propelling unit capable of moving the spreader and material truck. The device shall be steerable and shall have variable speeds forward and reverse. The spreader and propelling unit shall be carried on tracks, rubber tires, or drum-type steel rollers that will not disturb the underlying material. Provide a spreader containing a hopper, an adjustable screed, and outboard bumper rolls; designed to have a uniform, steady flow of material from the hopper; and capable of laying material without segregation, across the full width of the lane, to a uniform thickness and to a uniform loose density so

that when compacted, the layer or layers conform to thickness and grade requirements indicated. The Contracting Officer may require a demonstration of the spreader prior to approving use in performance of the work.

1.3.2.6 Pulvimixer

The pulverizing and mixing equipment shall be self-propelled, four-wheel drive, and capable of pulverizing the soil in a single pass for the full depth to be stabilized. The mixing action shall be capable of uniformly blending and mixing the required lime content with the subgrade soil. The rotor shall be capable of up or down cutting.

1.3.2.7 Slurry Mixer/Distributor

Mix the lime with water in trucks with approved distributors and applied as a thin water suspension or slurry. Apply commercial lime slurry with a lime percentage not less than that applicable for the grade used. Attain the distribution of lime by successive passes over a measured section of subgrade until the proper amount of lime has been spread. The amount of lime spread shall be the amount required for mixing to the specified depth that will result in the percentage determined in the job mix formula. The distributor truck shall continually agitate the slurry to keep the mixture uniform.

1.3.2.8 Central Mixing Plant

A lime-slurry central mixing plant shall consist of a lime storage silo, water supply tank, lime and water metering devices, and a lime-water mixer. Provide storage tanks for lime-water slurry with mechanical agitation to maintain the lime-water slurry in suspension.

1.3.2.9 Sprinkling Equipment

Provide sprinkling equipment consisting of tank trucks, pressure distributors, or other approved equipment designed to apply controlled quantities of water uniformly over variable widths of surface.

1.3.2.10 Tampers

Provide tampers of an approved mechanical type, having sufficient weight and striking power to produce the compaction required.

1.3.2.11 Straightedge

Furnish and maintain at the site, in good condition, one 12 foot straightedge for use in the testing of the finished surface. Straightedge shall be made available for Government use. Straightedges shall be constructed of aluminum or other lightweight metal with blades of box or box-girder cross section with flat bottom reinforced to insure rigidity and accuracy. Straightedges shall have handles to facilitate movement on pavement.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in

accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, Machines, and Tools
Mix Design; G, AE
Waybills and Delivery Tickets

SD-06 Test Reports

Sampling and Testing
Field Density

SD-07 Certificates

Bituminous Material.
Lime
Laboratory

1.5 ENVIRONMENTAL REQUIREMENTS

Do not work during freezing temperatures. When the temperature is below 40 degrees F, protect the completed stabilized materials against freezing by a sufficient covering of straw, or by other approved methods, until the course has dried out. Any areas of completed stabilized materials that are damaged by freezing, rainfall, or other weather conditions shall be brought to a satisfactory condition without additional cost to the Government. Do not apply lime when the atmospheric temperature is less than 40 degrees F or to soils that are frozen or contain frost, or when the underlying material is frozen. If the temperature falls below 35 degrees F completed lime-treated areas shall be protected against any detrimental effects of freezing.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Lime

Submit copies of certified test data. Lime shall be a standard brand of hydrated lime conforming to ASTM C 207, Type N, and the following physical and chemical requirements. Sample lime in accordance with ASTM C50/C50M.

a. Lime shall be of such gradation that 97 percent passes a No. 30 sieve and a minimum of 75 percent passes a No. 200 sieve.

b. Calcium oxide shall be not less than 93 percent.

c. Hydrated Lime shall not exceed 5 percent Carbon Dioxide or 2 percent free moisture (taken at the point of manufacture).

2.1.2 Bituminous Material

Submit copies of certified test data. Material shall conform to one of the following:

2.1.2.1 Emulsified Asphalt

AASHTO M 208, Type CRS-1.

2.1.3 Material to be Stabilized

Material to be stabilized shall consist of in situ, borrow, or compacted fill material. Provide material free of deleterious substances such as sticks, debris, organic matter, and stones greater than 3 inches in any dimension. At least 10 percent of the material shall pass the No. 40 sieve. Plasticity index shall be greater than 15.

2.1.4 Water

Water shall be clean, fresh, and free from injurious amounts of oil, acid, salt, alkali, organic matter, and other substances deleterious to the lime or soil-lime mixture, and shall be subject to approval. Water shall be tested and conform to the requirements of ASTM C1602/C1602M including the optional requirements of Table 2. Potable water sources may be used without testing.

2.2 MIX DESIGN

Submit certification of testing laboratory compliance. Develop and submit for approval a proposed mix design for each material type to be stabilized at least 14 days before it is to be used. Obtain approval of the proposed mix designs prior to starting the work. Mix designs shall be developed by an approved commercial laboratory which meets the requirements of ASTM D3740 . Develop the mix design using representative samples of each soil to be stabilized and using the proposed project lime. Conduct three trials for each mix design tested. Prepare samples in accordance with ASTM D3551. Allow the prepared samples to mellow for 48 hours for stabilized materials before any testing is performed. For soil stabilization, vary the lime content to produce a maximum plasticity index of 10 when tested in accordance with ASTM D4318. Provide the results in a graph of plasticity index versus lime content. Determine the maximum dry density and optimum moisture content for the proposed lime-soil mixture in accordance with ASTM D1557. Cure samples at a constant moisture content and temperature for 7 days. The soil stabilization mix design shall be capable of producing a unconfined compressive strength of 200 psi at 28-days age (average of three specimens) when compacted to the design percent of laboratory maximum density and tested in accordance with ASTM D5102, Method A. Prepare three specimens per test evaluation for durability testing for each mix design tested. Samples shall not exceed loss indicated in Table 2 after 12 cycles of the wet-dry test in accordance with AASHTO T 135. Conduct freeze thaw tests in accordance with AASHTO T 136 (but omitting wire brushing) for projects susceptible to freeze/thaw conditions. The mix design submittal information shall include the following:

a. Material type
b. Material classification including plasticity test data
c. Laboratory maximum density
d. Percent of lime and rate of application
e. Optimum water content during mixing, curing, and compaction
f. Gradation of material before and after treatment
g. Compressive strength
h. Durability Wet-Dry and Freeze/Thawtest data
i. Mixing or equipment requirements
j. Mellowing time requirements
k. Water quality test data, if non-potable source used

Table 2	
Type of Soil Stabilized	Maximum Allowable Weight Loss After 12 Wet-Dry or Freeze-Thaw Cycles Percent of Initial Specimen Weight
Silt	8
Clays	6

The in situ soil or compacted fill shall be modified with lime at a rate of 4 percent to 6 percent per dry unit weight of soil.

PART 3 EXECUTION

3.1 LIME STABILIZATION MIXTURE

The subgrade material to be stabilized shall be thoroughly pulverized and, the mix shall be thoroughly blended at a moisture content below optimum. After blending is completed, the proportions of the mixture shall be in accordance with the approved mix design. After blending, water shall be added into the dry mix in amounts necessary to bring the moisture content to a minimum of 3 percent above optimum. Control field moisture content within plus 2 or minus 1 percent of optimum. When the stabilized course is constructed in more than one layer, clean the previously constructed layer of loose and foreign matter by sweeping with power sweeper or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Provide adequate drainage during the entire construction period to prevent water from collecting or standing on the area to be stabilized or on pulverized, mixed, or partially mixed material. Provide line and grade stakes as necessary for control. Place grade stakes in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.2 OPERATION OF BORROW PITS

Borrow pits shall be cleared, stripped and excavated in a manner that exposes vertical faces of the deposit for suitable working depths. Strata of unsuitable materials overlying or occurring in the deposit shall be wasted. Methods of operating pits and the processing and blending of materials may be changed or modified if necessary to obtain material conforming to the specified requirements. Upon completion of the work, pits shall be conditioned to drain readily, and be left in a satisfactory condition as determined by the Government.

3.3 PREPARATION OF AREA TO BE STABILIZED

Clean the area of debris, roots, thrash, organic and other deleterious materials. The area will be inspected for adequate compaction and shall be capable of withstanding, without displacement, the compaction specified for the soil-lime mixture. Debris and removed unsatisfactory in-place material shall be disposed of as specified.

3.3.1 In-Place Material to be Stabilized

Grade the entire area to conform to the lines, grades, and cross sections shown in the drawings prior to being processed. Soft or yielding subgrade areas shall be made stable before construction is begun. Unsatisfactory material shall be removed and replaced as directed by the Government.

3.3.2 In-Place Material to Receive Stabilized Course

Correct soft, yielding areas and ruts or other irregularities in the surface. The material in the affected areas shall be loosened and unsatisfactory material removed. Add approved material where directed. The area shall then be shaped to line, grade, and cross section, and shall be compacted to the specified density. Subgrade shall conform to Section 31 00 00 EARTHWORK.

3.3.3 Grade Control

Excavate underlying material to sufficient depth for the required stabilized -course thickness so that the finished stabilized course with the subsequent surface course will meet the fixed grade. Finished and completed stabilized area shall conform to the lines, grades, cross section, and dimensions indicated.

3.4 INSTALLATION

3.4.1 Mixed In-Place Method

3.4.1.1 Scarifying and Pulverizing of Soil

Prior to application of lime, the soil shall be scarified and pulverized to a depth of 12 inches. Scarification shall be controlled so that the layer beneath the layer to be treated is not disturbed. Depth of pulverizing shall not exceed the depth of scarification.

3.4.1.2 Application of Lime

Shape pulverized material to approximately the cross section indicated. Apply lime so that when uniformly mixed with the soil, the specified lime content is obtained, and a sufficient quantity of lime-treated soil is produced to construct a compacted lime-treated course conforming to the lines, grades, and cross section indicated. Lime shall be spread only on areas where the mixing operations can be completed during the same work shift or day. Use mechanical spreaders in applying bulk lime. Apply lime as a slurry, and use distributors in applying slurry. If lime is spread by hand, the bags shall be spotted accurately on the area being stabilized so that when the bags are opened the lime will be dumped and spread uniformly on the area being processed. Limit hand spreading to areas inaccessible to mechanical spreaders. No equipment, except that used in spreading and mixing, shall pass over the freshly applied lime.

3.4.1.3 Initial Mixing

Mix the lime and soil immediately after the lime has been distributed. Initial mixing shall be sufficient to alleviate any dusting or wetting of the lime that might occur in the event of wind or rainstorms. This may be accomplished several days in advance of the final application and mixing.

3.4.1.4 Water Application and Moist Mixing

Determine moisture content of the mixture in preparation for final mixing. Moisture in the mixture following final mixing shall not be less than the water content determined to be optimum based on dry weight of soil and shall not exceed the optimum water content by more than 2 percentage points. Water may be added in increments as large as the equipment will permit; however, such increment of water shall be partially incorporated in the mix to avoid concentration of water near the surface. After the last increment of water has been added, continue mixing until the water is uniformly distributed throughout the full depth of the mixture, including satisfactory moisture distribution along the edges of the section. Soil shall be mixed in two stages, allowing for an intervening 24 to 48 hour mellowing period. The stabilized mixture should mellow sufficiently to allow the chemical reaction to alter (break down) the material. The duration of this mellowing period shall be identified in the mix design and should be based on soil type. After mellowing, the soil shall be remixed before compaction.

3.4.1.5 Confined Areas

In areas inaccessible to machinery, excavate soils to be stabilized and move to an area where machine mixing may be performed, processed, and placed back in the original location. Place material in its final location within 24 hours of initial mixing, and prior to final mixing and compaction.

3.4.2 Edges of Stabilized Course

Place approved material along the edges of the stabilized course in a quantity that will compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple-layer course, allowing at least a 1 foot width of the shoulder to be rolled and compacted simultaneously with the rolling and compacting of each layer of the stabilized course.

3.4.3 Central-Plant Method

Provide a plant capable of producing a uniform lime-treated mixture at the specified lime and moisture contents. Haul the mixture to the job in trucks equipped with protective covers. Underlying course shall be thoroughly moistened and the mixture then placed on the prepared area in a uniform layer with mechanical spreaders. The layer shall be uniform in thickness and surface contour; and the completed layer, after compaction, shall conform to the required grade and cross section.

3.4.4 Traveling-Plant Method

Traveling plant shall move at a uniform rate of speed and shall accomplish thorough mixing of the materials in one pass. Deliver water and lime from supply trucks or bins at a predetermined rate. Windrows of prepared soil-lime mixture shall cover a predetermined width to the indicated compacted thickness.

3.4.5 Layer Thickness

Compacted thickness of the stabilized course shall be 12 inches. No layer shall be more than 8 inches or less than 3 inches in compacted thickness.

3.4.6 Compaction

Before compaction operations are started and as a continuation of the mixing operation, the mixture shall be thoroughly loosened and pulverized to the full depth. Start compaction immediately after final mixing is completed. During final compaction moisten the surface, if necessary, and shape it to the required lines, grades, and cross section. Density of compacted mixture shall be at least 90 percent of laboratory maximum density. Begin rolling at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Make alternate trips of the roller slightly different lengths. At all times, the speed of the roller shall not cause displacement of the mixture to occur. Compact areas inaccessible to the rollers with mechanical tampers; shape and finish the areas by hand methods.

3.4.7 Finishing

Finish the surface of the top layer to the grade and cross section shown. The surface shall be of uniform texture. Light blading during rolling may be necessary for the finished surface to conform to the lines, grades, and cross sections. If for any reason the surface becomes rough, corrugated, uneven in texture, or traffic-marked prior to completion, the unsatisfactory portions shall be scarified, reworked, relaid, or replaced as directed. If any portion of the course, when laid, becomes watersoaked for any reason, that portion shall be removed immediately, and the mix placed in a windrow and aerated until a moisture content within the limits specified is obtained; and then spread, shaped, and rolled as specified above.

3.4.8 Construction Joints

At the end of each phase of construction, form a straight transverse construction joint by cutting back into the completed work to form a true vertical face free of loose or shattered material. Material along construction joints not properly compacted shall be removed and replaced with soil-lime mixture that is mixed, moistened, and compacted as specified.

3.4.9 Curing and Protection

Immediately after the soil-lime area has been finished as specified above, the surface shall be protected against rapid drying for 7 days by the application of a bituminous material.

Uniformly apply bituminous material by means of a bituminous distributor within a temperature range of 75 to 130 degrees F. Bituminous material shall be applied in quantities of not less than 0.1 gallon/square yard nor more than 0.25 gallon/square yard. Areas inaccessible to or missed by the distributor shall be properly treated using the manually operated hose attachment. Apply bituminous material only to the top layer. At the time the bituminous material is applied, the surface of the area shall be free of loose or foreign matter and shall contain sufficient moisture to prevent excessive penetration of the bituminous material. When necessary, sprinkle the area immediately before the bituminous material is applied. Treated surface shall be sanded to prevent the bituminous material from being picked up by traffic.

3.5 SAMPLING AND TESTING

Submit calibration curves and related test results prior to using the

device or equipment being calibrated. Furnish copies of field test results within 24 hours after the tests are performed. Submit certified copies of test results of materials and sources not less than 30 days before material is required for the work.

3.5.1 General Requirements

Perform sampling and testing using an approved commercial testing laboratory or facilities furnished by the Contractor. Work requiring testing will not be permitted until the facilities have been inspected and approved. The first inspection will be at the expense of the Contractor. Cost incurred for any subsequent inspection required because of failure of the facilities to pass the first inspection will be charged to the Contractor. Perform tests in sufficient numbers and at the locations and times directed to ensure that materials and compaction meet specified requirements. Furnish certified copies of the test results to the Contracting Officer within 24 hours of completion.

3.5.2 Results

Results shall verify that the material complies with the specification. When the source of materials is changed or deficiencies are found, repeat the initial analysis including mix design studies if the material source is changed, and retest the material already placed to determine the extent of unacceptable material. Replace all in-place unacceptable material.

3.5.3 Sampling

Take all aggregate samples for laboratory testing in accordance with ASTM D75/D75M. Take samples of lime in accordance with ASTM C50/C50M. Prepare specimens for the unconfined compression tests in accordance with ASTM D1632.

3.5.4 Sieve Analysis

Before starting work, test one sample of material to be stabilized in accordance with ASTM C136 and ASTM D422 on sieves conforming to ASTM E11. After the initial test, perform a minimum of one analysis for each 1000 tons of material placed, with a minimum of three analyses for each day's run until the course is completed.

3.5.5 Liquid Limit and Plasticity Index

Perform one liquid limit and plasticity index for each sieve analysis. Liquid limit and plasticity index shall be in accordance with ASTM D4318.

3.5.6 Chemical Analysis

Test lime for the specified chemical requirements in accordance with ASTM C25.

3.6 FIELD QUALITY CONTROL

Provide a moisture-density relationship for the lime-soil mixture from the tests. Results of field quality control testing shall verify that materials comply with this specification. When a material source is changed, test the new material for compliance . When deficiencies are found, the initial analysis shall be repeated and the material already placed shall be retested to determine the extent of unacceptable material.

All in-place unacceptable material shall be replaced or repaired, as directed by the Contracting Officer, at no additional cost to the Government.

3.6.1 Treatment Depth Checks

The depth of stabilization shall be measured at a frequency intervals for each of 250 square yards of stabilized course. Measurements shall be made in test holes soil by spraying with a pH indicator such as phenolphthalein. Phenolphthalein changes from clear to red between pH 8.3 and 10. The color change indicates the location of the bottom of the mixing zone. Other pH indicators can measure higher pH levels if there is reason to suspect that inadequate lime has been mixed into the soil.

3.6.2 Thickness Control

Completed thicknesses of the stabilized course shall be within 1/2 inch of the thickness indicated. Where the measured thickness of the stabilized course is more than 1/2 inch deficient, correct such areas by scarifying, adding mixture of proper gradation, reblading, and recompacting as directed. Where the measured thickness of the stabilized course is more than 1/2 inch thicker than indicated, it shall be considered as conforming to the specified thickness requirement. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 1/4 inch of the thickness indicated. Thickness of the stabilized course shall be measured at intervals which ensure one measurement for each 250 square yards of stabilized course. Measurements shall be made in 3 inch diameter test holes penetrating the stabilized course.

3.6.3 Field Density

Determine field in-place density in accordance with ASTM D6938. When ASTM D6938 is used, the calibration curves shall be checked, and adjusted if necessary, using the sand cone method as described in paragraph Calibration of the ASTM publication. ASTM D6938 may be used to determine both the wet unit weight and the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D6938. If ASTM D6938 is used, in-place densities shall be checked by ASTM D1556 at least once per lift and at a frequency not to exceed one test under ASTM D1556 per 8 tests performed under ASTM D6938. Furnish calibration curves and calibration tests results to the Contracting Officer within 24 hours of conclusion of the tests. Perform at least one field density test for each 250 square yards of each layer of stabilized material.

3.6.4 Smoothness Test

The surface of a stabilized layer shall show no deviations in excess of 1/2 inch when tested with the 10- foot straightedge. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting, as directed. Take measurements for deviation from grade and cross section shown in successive positions parallel to the pavement centerline with a 10- foot straightedge. Measurements shall also be taken perpendicular to the pavement centerline at 50- foot intervals.

3.7 TRAFFIC

Completed portions of the lime-treated soil area may be opened to light

traffic after a period of 3 days if cured with a bituminous material provided the curing is not damaged. After the curing period has elapsed, completed areas may be opened to all traffic, provided the stabilized course has hardened sufficiently to prevent marring or distorting of the surface by equipment or traffic. Heavy equipment is not permitted on the area during the curing period. Lime and water may be hauled over the completed area with pneumatic-tired equipment if approved. Protect finished portions of lime-stabilized soil, that are traveled on by equipment used in constructing an adjoining section, in a manner to prevent equipment from marring or damaging completed work.

3.8 MAINTENANCE

Maintain stabilized area in a satisfactory condition until the completed work is accepted. Maintenance shall include immediate repairs of any defects and shall be repeated as often as necessary to keep the area intact. Correct defects as specified herein.

3.9 DISPOSAL OF UNSATISFACTORY MATERIALS

Removed in-place materials that are unsuitable for stabilization, material that is removed for the required correction of defective areas, waste material, and debris shall be disposed of as directed .

-- End of Section --

SECTION 32 12 10

BITUMINOUS TACK AND PRIME COATS
08/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 208	(2001; R 2009) Standard Specification for Cationic Emulsified Asphalt
AASHTO T 40	(2002; R 2006) Sampling Bituminous Materials

ASTM INTERNATIONAL (ASTM)

ASTM D140/D140M	(2009) Standard Practice for Sampling Bituminous Materials
ASTM D2995	(1999; R 2009) Determining Application Rate of Bituminous Distributors

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT	(2007) Virginia Department of Transportation Road and Bridge Specifications

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Plant, equipment, machines and tools used in the work are subject to approval and shall be maintained in a satisfactory working condition at all times. Calibrated equipment such as asphalt distributors, scales, batching equipment, spreaders and similar equipment, should have been recalibrated by a calibration laboratory within 12 months prior to commencing work .

1.2.2 Bituminous Distributor

Provide a distributor with pneumatic tires of such size and number that the load produced on the base surface does not exceed 650 psi of tire width to prevent rutting, shoving or otherwise damaging the base surface or other layers in the pavement structure. Design and equip the distributor to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, with a pressure range of 25 to 75 psi and with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Include with the distributor equipment

a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. Equip the distributor to circulate and agitate the bituminous material during the heating process.

1.2.3 Heating Equipment for Storage Tanks

The equipment for heating the bituminous material shall be steam, electric, or hot oil heaters. Provide steam heaters consisting of steam coils and equipment for producing steam, so designed that the steam cannot get into the material. Fix an armored thermometer to the tank with a temperature range from 40 to 400 degrees F so that the temperature of the bituminous material may be determined at all times.

1.2.4 Power Brooms and Power Blowers

Use power brooms and power blowers suitable for cleaning the surfaces to which the bituminous coat is to be applied.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Waybills and Delivery Tickets

SD-06 Test Reports

Sampling and Testing

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect the materials delivered to the site for contamination and damage. Unload and store the materials with a minimum of handling.

1.5 ENVIRONMENTAL REQUIREMENTS

Apply bituminous coat only when the surface to receive the bituminous coat is dry. Apply bituminous coat only when the atmospheric temperature in the shade is 50 degrees F or above and when the temperature has not been below 35 degrees F for the 12 hours prior to application, unless otherwise directed.

PART 2 PRODUCTS

2.1 PRIME COAT

2.1.1 Emulsified Asphalt

Provide emulsified asphalt conforming to AASHTO M 208, Type 1 in accordance with Section 210 of the Virginia Department of Transportation (VDOT) 2007

Road and Bridge Specifications.

2.2 TACK COAT

2.2.1 Emulsified Asphalt

Provide emulsified asphalt conforming to AASHTO M 208, Type 1 in accordance with Section 210 of the Virginia Department of Transportation (VDOT) 2007 Road and Bridge Specifications.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Immediately before applying the bituminous coat, remove all loose material, dirt, clay, or other objectionable material from the surface to be treated by means of a power broom or blower supplemented with hand brooms. The surface shall be dry and clean at the time of treatment.

3.2 APPLICATION RATE

The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.

3.2.1 Tack Coat

Apply bituminous material for the tack coat in quantities of not less than 0.05 gallon nor more than 0.15 gallon per square yard of pavement surface.

3.2.2 Prime Coat

Apply bituminous material for the prime coat in quantities of not less than 0.18 gallon nor more than 0.35 gallon per square yard of pavement surface.

3.3 APPLICATION TEMPERATURE

3.3.1 Viscosity Relationship

Asphalt application temperature shall provide an application viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 centistokes, kinematic. Furnish the temperature viscosity relation to the Contracting Officer.

3.3.2 Temperature Ranges

The viscosity requirements determine the application temperature to be used. The following is a normal range of application temperatures:

Liquid Asphalts

SC-70	120-225 degrees F
SC-250	165-270 degrees F
MC-30	85-190 degrees F
MC-70	120-225 degrees F
MC-250	165-270 degrees F
RC-70	120-200 degrees F*
RC-250	165-250 degrees F*

Paving Grade Asphalts

Penetration Grades

200-300	plus 265 degrees F
120-150	plus 270 degrees F
85-100	plus 280 degrees F

Viscosity Grades

AC 2.5	plus 270 degrees F
AC 5	plus 280 degrees F
AC 10	plus 280 degrees F
AR 1000	plus 275 degrees F
AR 2000	plus 285 degrees F
AR 4000	plus 290 degrees F

Emulsions

RS-1	70-140 degrees F
MS-1	70-160 degrees F
HFMS-1	70-160 degrees F
SS-1	70-160 degrees F
SS-1h	70-160 degrees F
CRS-1	125-175 degrees F
CSS-1	70-160 degrees F
CSS-1h	70-160 degrees F

These temperature ranges exceed the flash point of the material and care should be taken in their heating.

3.4 APPLICATION

3.4.1 General

Following preparation and subsequent inspection of the surface, apply the bituminous prime or tack coat with the Bituminous Distributor at the specified rate with uniform distribution over the surface to be treated. Properly treat all areas and spots missed by the distributor with the hand spray. Until the succeeding layer of pavement is placed, maintain the surface by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, spread clean dry sand to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment are permitted within 25 feet of heating, distributing, and transferring operations of bituminous material other than bituminous emulsions. Prevent all traffic, except for paving equipment used in constructing the surfacing, from using the underlying material, whether primed or not, until the surfacing is completed. The bituminous coat shall conform to all requirements as described herein.

3.4.2 Prime Coat

Apply a prime coat at locations shown on the Drawings. Apply prime coat in accordance with VDOT, Section 311.03.

3.4.3 Tack Coat

Apply tack coat at the locations shown on the drawings. Apply the tack coat in accordance with VDOT, Section 310.03.

3.5 CURING PERIOD

Following application of the bituminous material and prior to application of the succeeding layer of pavement, allow the bituminous coat to cure and to obtain evaporation of any volatiles or moisture. Maintain the coated surface until the succeeding layer of pavement is placed, by protecting the surface against damage and by repairing and recoating deficient areas. Allow the prime coat to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course. Furnish and spread enough sand to effectively blot up and cure excess bituminous material.

3.6 FIELD QUALITY CONTROL

Samples of the bituminous material shall be tested for compliance with the applicable specified requirements. A sample shall be obtained and tested by the Contractor for every 100 gallons of bituminous material used .

3.7 SAMPLING AND TESTING

Submit copies of all test results for emulsified asphalt, and bituminous materials, within 24 hours of completion of tests. Furnish certified copies of the manufacturer's test reports indicating temperature viscosity relationship for cutback asphalt, compliance with applicable specified requirements, not less than 30 days before the material is required in the work. Perform sampling and testing by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved.

3.7.1 Sampling

The samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D140/D140M or AASHTO T 40. Sources from which bituminous materials are to be obtained shall be selected and notification furnished the Contracting Officer within 15 days after the award of the contract.

3.7.2 Calibration Test

Furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibration shall be made with the approved job material and prior to applying the bituminous coat material to the prepared surface. Calibrate the bituminous distributor in accordance with ASTM D2995.

3.7.3 Trial Applications

Before providing the complete bituminous coat, apply three lengths of at least 100 feet for the full width of the distributor bar to evaluate the amount of bituminous material that can be satisfactorily applied.

3.7.3.1 Tack Coat Trial Application Rate

Unless otherwise authorized, apply the trial application rate of bituminous tack coat materials in the amount of 0.05 gallons per square yard. Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.7.3.2 Prime Coat Trial Application Rate

Unless otherwise authorized, apply the trial application rate of bituminous materials in the amount of 0.25 gallon per square yard. Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.7.4 Sampling and Testing During Construction

Perform quality control sampling and testing as required in paragraph FIELD QUALITY CONTROL.

3.8 TRAFFIC CONTROLS

Keep traffic off surfaces freshly treated with bituminous material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces.

-- End of Section --

SECTION 32 12 16

HOT-MIX ASPHALT (HMA) FOR ROADS
08/09

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 156	(1997: R 2009) Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
AASHTO M 320	(2010) Standard Specification for Performance-Graded Asphalt Binder
AASHTO T 283	(2007) Standard Method of Test for Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage

ASPHALT INSTITUTE (AI)

AI MS-2	(1997 6th Ed) Mix Design Methods
AI SP-2	(2001; 3rd Ed) Superpave Mix Design

ASTM INTERNATIONAL (ASTM)

ASTM C117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C127	(2012) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C128	(2012) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C566	(1997; R 2004) Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM D140/D140M	(2009) Standard Practice for Sampling Bituminous Materials

ASTM D1461	(2011) Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D2172/D2172M	(2011) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D2489/D2489M	(2008) Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D2950/D2950M	(2011) Density of Bituminous Concrete in Place by Nuclear Methods
ASTM D3665	(2012) Random Sampling of Construction Materials
ASTM D3666	(2011) Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D4125/D4125M	(2010) Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D5444	(2008) Mechanical Size Analysis of Extracted Aggregate
ASTM D6307	(2010) Asphalt Content of Hot Mix Asphalt by Ignition Method
ASTM D6925	(2009) Standard Test Method for Preparation and Determination of the Relative Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
ASTM D6926	(2010) Standard Practice for Preparation of Bituminous Specimens Using Marshall Apparatus
ASTM D6927	(2006) Standard Test Method for Marshall Stability and Flow of Bituminous Mixtures

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)

CTM 526	(2002) Operation of California Profilograph and Evaluation of Profiles

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT	(2007) Virginia Department of Transportation Road and Bridge Specifications

1.2 SYSTEM DESCRIPTION

Perform the work consisting of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. HMA designed and constructed in accordance with this section shall conform to the lines, grades,

thicknesses, and typical cross sections shown on the drawings. Construct each course to the depth, section, or elevation required by the drawings and roll, finish, and approve it before the placement of the next course.

1.2.1 Asphalt Mixing Plant

Plants used for the preparation of hot-mix asphalt shall conform to the requirements of AASHTO M 156 with the following changes:

a. Truck Scales. Weigh the asphalt mixture on approved, certified scales at the Contractor's expense. Inspect and seal scales at least annually by an approved calibration laboratory.

b. Testing Facilities. Provide laboratory facilities at the plant for the use of the Government's acceptance testing and the Contractor's quality control testing.

c. Inspection of Plant. Provide the Contracting Officer with access at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant; verifying weights, proportions, and material properties; checking the temperatures maintained in the preparation of the mixtures and for taking samples. Provide assistance as requested, for the Government to procure any desired samples.

d. Storage Bins. Use of storage bins for temporary storage of hot-mix asphalt will be permitted as follows:

(1) The asphalt mixture may be stored in non-insulated storage bins for a period of time not exceeding 3 hours.

(2) The asphalt mixture may be stored in insulated storage bins for a period of time not exceeding 8 hours. The mix drawn from bins shall meet the same requirements as mix loaded directly into trucks.

1.2.2 Hauling Equipment

Provide trucks for hauling hot-mix asphalt having tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Petroleum based products shall not be used as a release agent. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers (tarps) shall be securely fastened.

1.2.3 Asphalt Pavers

Provide asphalt pavers which are self-propelled, with an activated screed, heated as necessary, and capable of spreading and finishing courses of hot-mix asphalt which will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.

1.2.3.1 Receiving Hopper

Provide paver with a receiving hopper of sufficient capacity to permit a

uniform spreading operation and equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

1.2.3.2 Automatic Grade Controls

Equip the paver with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. A transverse slope controller shall not be used to control grade. Provide controls capable of working in conjunction with any of the following attachments:

a. Ski-type device of not less than 30 feet in length.

b. Taut stringline set to grade.

c. Short ski or shoe for joint matching.

d. Laser control.

1.2.4 Rollers

Rollers shall be in good condition and shall be operated at slow speeds to avoid displacement of the asphalt mixture. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Do not use equipment which causes excessive crushing of the aggregate.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mix Design; G, AE
Contractor Quality Control
Material Acceptance

SD-04 Samples

Asphalt Cement Binder
Aggregates

SD-06 Test Reports

Aggregates
QC Monitoring

SD-07 Certificates

Asphalt Cement Binder; G, AE
Testing Laboratory

1.4 ENVIRONMENTAL REQUIREMENTS

Do not place the hot-mix asphalt upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 3. The temperature requirements may be waived by the Contracting Officer, if requested; however, all other requirements, including compaction, shall be met.

Table 3. Surface Temperature Limitations of Underlying Course

Mat Thickness, inches	Degrees F
3 or greater	40
Less than 3	45

PART 2 PRODUCTS

2.1 AGGREGATES

Provide aggregates consisting of crushed stone, crushed gravel, crushed slag, screenings, natural sand and mineral filler, as required. Submit sufficient materials to produce 200 lb of blended mixture for mix design verification. The portion of material retained on the No. 4 sieve is coarse aggregate. The portion of material passing the No. 4 sieve and retained on the No. 200 sieve is fine aggregate. The portion passing the No. 200 sieve is defined as mineral filler. Submit all aggregate test results and samples to the Contracting Officer at least 14 days prior to start of construction.

2.1.1 Coarse Aggregate

Provide coarse aggregate consisting of sound, tough, durable particles, free from films of material that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances. All individual coarse aggregate sources shall be in accordance with Section 203 of VDOT.

2.1.2 Fine Aggregate

Fine aggregate shall consist of clean, sound, tough, durable particles free from coatings of clay, silt, or any objectionable material and containing no clay balls. Fine aggregate shall be in accordance with Section 202 of VDOT.

2.1.3 Mineral Filler

Mineral filler shall be nonplastic material meeting the requirements of Section 201 of VDOT.

2.1.4 Aggregate Gradation

The combined aggregate gradation shall conform to gradations specified in Table 4, when tested in accordance with ASTM C136 and ASTM C117, and shall not vary from the low limit on one sieve to the high limit on the adjacent

sieve or vice versa, but grade uniformly from coarse to fine.

Table 4. Aggregate Gradations

Sieve Size, inch	Gradation 1 Percent Passing by Mass	Gradation 2 Percent Passing
1-1/2	--	100
1	--	90-100
3/4	--	90 Max
1/2	100	---
3/8	90-100	---
No. 4	80 Max	---
No. 8	38-67	19-38
No. 30	--	---
No. 50	--	---
No. 200	2-10	1-7

2.2 ASPHALT CEMENT BINDER

Submit a 5 gallon sample for mix design verification. Asphalt cement binder shall conform to AASHTO M 320 Performance Grade (PG) 64-22. Test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Submit copies of these certifications to the Contracting Officer. The supplier is defined as the last source of any modification to the binder. The Contracting Officer may sample and test the binder at the mix plant at any time before or during mix production. Obtain samples for this verification testing in accordance with ASTM D140/D140M and in the presence of the Contracting Officer. Furnish these samples to the Contracting Officer for the verification testing, which shall be at no cost to the Contractor. Submit samples of the asphalt cement specified for approval not less than 14 days before start of the test section. Submit copies of certified test data, amount, type and description of any modifiers blended into the asphalt cement binder.

2.3 MIX DESIGN

a. Develop the mix design. The asphalt mix shall be composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF). Submit proposed JMF; do not produce hot-mix asphalt for payment until a JMF has been approved. The hot-mix asphalt shall be designed in accordance with Superpave (SP-2) procedures and the criteria shown in Table 5. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by AASHTO T 283 is less than 0.80, the aggregates shall be rejected or the asphalt mixture treated with an approved anti-stripping agent. The amount of anti-stripping agent added shall be sufficient to produce a TSR of not less than 0.80. Provide an antistrip agent, if required, at no additional cost. Sufficient materials to produce 200 pound of blended mixture shall be provided to the Contracting Officer for verification of mix design at least 14 days prior to construction of test section.

b. Utilize a Commonwealth of Virginia DOT Superpave hot mix may be used in

lieu of developing a Marshall hot mix design as described herein. Design the Superpave volumetric mix in accordance with AI SP-2 and ASTM D6925. The nominal maximum aggregate size (NMAS) for the surface mixture and base mixture shall be 3/8-inch and 1-inch respectively.

c. Design Superpave mixes with the number of gyrations specified in Table 5, unless the DOT option is chosen.

2.3.1 JMF Requirements

Submit in writing the job mix formula for approval at least 14 days prior to the start of the test section including as a minimum:

a. Percent passing each sieve size.

b. Percent of asphalt cement.

c. Percent of each aggregate and mineral filler to be used.

d. Asphalt performance grade.

e. Number of gyrations of Superpave gyratory compactor, (NA for Marshall mix design)

f. Laboratory mixing temperature.

g. Lab compaction temperature.

h. Temperature-viscosity relationship of the asphalt cement.

i. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.

j. Graphical plots of air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-2.

k. Specific gravity and absorption of each aggregate.

l. Percent natural sand.

m. Percent particles with 2 or more fractured faces (in coarse aggregate).

n. Fine aggregate angularity.

o. Percent flat or elongated particles (in coarse aggregate).

p. Tensile Strength Ratio(TSR).

q. Antistrip agent (if required) and amount.

r. List of all modifiers and amount.

Table 5. Mix Design Criteria

Test Property	65 Gyrations
Air voids, percent	4

Table 5. Mix Design Criteria

Test Property	65 Gyrations
Percent Voids in mineral aggregate VMA, (minimum)	
Surface Mixture	15.0
Base Mixture	12.0
Gradation 3	15.0
TSR, minimum percent	80

* This is a minimum requirement. The average during construction shall be significantly higher than this number to ensure compliance with the specifications.

** Calculate VMA in accordance with AI MS-2, based on ASTM C127 and ASTM C128 bulk specific gravity for the aggregate.

2.3.2 Adjustments to Field JMF

Keep the Laboratory JMF for each mixture in effect until a new formula is approved in writing by the Contracting Officer. Should a change in sources of any materials be made, perform a new laboratory jmf design and a new JMF approved before the new material is used. The Contractor will be allowed to adjust the Laboratory JMF within the limits specified in Section 211.08 of VDOT mix volumetric properties with the approval of the Contracting Officer. Adjustments to the Laboratory JMF shall be applied to the field (plant) established JMF and limited to those values as shown. Adjustments shall be targeted to produce or nearly produce 4 percent voids total mix (VTM).

If adjustments are needed that exceed these limits, develop a new mix design. Tolerances given above may permit the aggregate grading to be outside the limits shown in Table 4; while not desirable, this is acceptable, except for the No. 200 sieve, which shall remain within the aggregate grading of Table 4.

PART 3 EXECUTION

3.1 PREPARATION OF ASPHALT BINDER MATERIAL

Heat the asphalt cement material avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 325 degrees F when added to the aggregates. Performance-Graded (PG) asphalts shall be within the temperature range of 265-320 degrees F when added to the aggregate.

3.2 PREPARATION OF MINERAL AGGREGATE

Heat and dry the aggregate for the mixture prior to mixing. No damage shall occur to the aggregates due to the maximum temperature and rate of heating used. The temperature of the aggregate and mineral filler shall

not exceed 350 degrees F when the asphalt cement is added. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

3.3 PREPARATION OF HOT-MIX ASPHALT MIXTURE

The aggregates and the asphalt cement shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. Mix the combined materials until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but no less than 25 seconds for batch plants. Establish the wet mixing time for all plants based on the procedure for determining the percentage of coated particles described in ASTM D2489/D2489M, for each individual plant and for each type of aggregate used. The wet mixing time will be set to at least achieve 95 percent of coated particles. The moisture content of all hot-mix asphalt upon discharge from the plant shall not exceed 0.5 percent by total weight of mixture as measured by ASTM D1461.

3.4 PREPARATION OF THE UNDERLYING SURFACE

Immediately before placing the hot mix asphalt, clean the underlying course of dust and debris. Apply a prime coat and/or tack coat in accordance with the contract specifications.

3.5 TEST SECTION

Prior to full production, place a test section for each JMF used. Construct a test section 250 - 500 feet long and two paver passes wide placed for two lanes, with a longitudinal cold joint. The test section shall be of the same thickness as the course which it represents. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment and personnel used in construction of the test section shall be the same equipment to be used on the remainder of the course represented by the test section. Place the test section as part of the project pavement, as approved by the Contracting Officer.

3.5.1 Sampling and Testing for Test Section

Take one random sample at the plant, triplicate specimens compacted, and tested for stability, flow, and laboratory air voids. Test a portion of the same sample for theoretical maximum density (TMD), aggregate gradation and asphalt content. Take four randomly selected cores from the finished pavement mat, and four from the longitudinal joint, and tested for density. Random sampling shall be in accordance with procedures contained in ASTM D3665. The test results shall be within the tolerances shown in Table 7 for work to continue. If all test results meet the specified requirements, the test section shall remain as part of the project pavement. If test results exceed the tolerances shown, the test section shall be removed and replaced at no cost to the Government and another test section shall be constructed. The test section shall be paid for with the first lot of paving

Table 7. Test Section Requirements for Material and Mixture Properties

Property	Specification Limit
Aggregate Gradation-Percent Passing (Individual Test Result)	
No. 8 and larger	JMF plus or minus 8
No. 16 and No. 30	JMF plus or minus 6
No. 50	JMF plus of minus 5.0
No. 100 and No. 200	JMF plus or minus 2.0
Asphalt Content, Percent (Individual Test Result)	JMF plus or minus 0.60
Laboratory Air Voids, Percent (Average of 3 specimens)	JMF plus or minus 1.0
Mat Density, Percent of TMD (Average of 4 Random Cores)	92.0 - 96.0
Joint Density, Percent of TMD (Average of 4 Random Cores)	90.5 - 92.5

3.5.2 Additional Test Sections

If the initial test section should prove to be unacceptable, make the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures and place a second test section. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Full production shall not begin until an acceptable section has been constructed and accepted.

3.6 TESTING LABORATORY

Submit certification of compliance and Plant Scale Calibration Certification. Use a laboratory to develop the JMF that meets the requirements of ASTM D3666. The Government will inspect the laboratory equipment and test procedures prior to the start of hot mix operations for conformance to ASTM D3666. The laboratory shall maintain the Corps certification for the duration of the project. A statement signed by the manager of the laboratory stating that it meets these requirements or clearly listing all deficiencies shall be submitted to the Contracting Officer prior to the start of construction. The statement shall contain as a minimum:

a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.

b. A listing of equipment to be used in developing the job mix.

c. A copy of the laboratory's quality control system.

d. Evidence of participation in the AASHTO Materials Reference Laboratory

(AMRL) program.

3.7 TRANSPORTING AND PLACING

3.7.1 Transporting

Transport the hot-mix asphalt from the mixing plant to the site in clean, tight vehicles. Schedule deliveries so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Provide adequate artificial lighting for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to 140 degrees F. To deliver mix to the paver, use a material transfer vehicle operated to produce continuous forward motion of the paver.

3.7.2 Placing

Place and compact the mix at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, place the mixture to the full width by an asphalt paver; it shall be struck off in a uniform layer of such depth that, when the work is completed, it will have the required thickness and conform to the grade and contour indicated. Regulate the speed of the paver to eliminate pulling and tearing of the asphalt mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. Place the mixture in consecutive adjacent strips having a minimum width of 10 feet. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 1 foot; however, the joint in the surface course shall be at the centerline of the pavement. Transverse joints in one course shall be offset by at least 10 feet from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools.

3.8 COMPACTION OF MIXTURE

After placing, the mixture shall be thoroughly and uniformly compacted by rolling. Compact the surface as soon as possible without causing displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once. Furnish sufficient rollers to handle the output of the plant. Continue rolling until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, keep the wheels properly moistened but excessive water will not be permitted. In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand tampers. Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective shall be removed full depth, replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching will not be allowed.

3.9 JOINTS

The formation of joints shall be performed ensuring a continuous bond between the courses and to obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

3.9.1 Transverse Joints

Do not pass the roller over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing material at the joint. Remove the cutback material from the project. In both methods, all contact surfaces shall be given a light tack coat of asphalt material before placing any fresh mixture against the joint.

3.9.2 Longitudinal Joints

Longitudinal joints which are irregular, damaged, uncompacted, cold (less than 175 degrees F at the time of placing adjacent lanes), or otherwise defective, shall be cut back a maximum of 3 inches from the top of the course with a cutting wheel to expose a clean, sound vertical surface for the full depth of the course. All cutback material shall be removed from the project. All contact surfaces shall be given a light tack coat of asphalt material prior to placing any fresh mixture against the joint. The Contractor will be allowed to use an alternate method if it can be demonstrated that density, smoothness, and texture can be met.

3.10 CONTRACTOR QUALITY CONTROL

3.10.1 General Quality Control Requirements

Develop and submit an approved Quality Control Plan. Submit aggregate and QC test results. Do not produce hot-mix asphalt for payment until the quality control plan has been approved addressing all elements which affect the quality of the pavement including, but not limited to:

a. Mix Design

b. Aggregate Grading

c. Quality of Materials

d. Stockpile Management

e. Proportioning

f. Mixing and Transportation

g. Mixture Volumetrics

h. Moisture Content of Mixtures

i. Placing and Finishing

j. Joints

k. Compaction

l. Surface Smoothness

3.10.2 Testing Laboratory

Provide a fully equipped asphalt laboratory located at the plant or job site and meeting the pertinent requirements in ASTM D3666. Laboratory facilities shall be kept clean and all equipment maintained in proper working condition. The Contracting Officer shall be permitted unrestricted access to inspect the Contractor's laboratory facility, to witness quality control activities, and to perform any check testing desired. The Contracting Officer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are corrected.

3.10.3 Quality Control Testing

Perform all quality control tests applicable to these specifications and as set forth in the Quality Control Program. The testing program shall include, but shall not be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, moisture in the asphalt mixture, laboratory air voids, in-place density, grade and smoothness. Develop a Quality Control Testing Plan as part of the Quality Control Program.

3.10.3.1 Asphalt Content

A minimum of two tests to determine asphalt content will be performed per lot (a lot is defined in paragraph MATERIAL ACCEPTANCE and PERCENT PAYMENT) by one of the following methods: the extraction method in accordance with ASTM D2172/D2172M, Method A or B, the ignition method in accordance with ASTM D6307, or the nuclear method in accordance with ASTM D4125/D4125M. Calibrate the ignition oven or the nuclear gauge for the specific mix being used. For the extraction method, determine the weight of ash, as described in ASTM D2172/D2172M, as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture.

3.10.3.2 Gradation

Determine aggregate gradations a minimum of twice per lot from mechanical analysis of recovered aggregate in accordance with ASTM D5444. When asphalt content is determined by the ignition oven or nuclear method, aggregate gradation shall be determined from hot bin samples on batch plants, or from the cold feed on drum mix plants. For batch plants, test aggregates in accordance with ASTM C136 using actual batch weights to determine the combined aggregate gradation of the mixture.

3.10.3.3 Temperatures

Check temperatures at least four times per lot, at necessary locations, to determine the temperature at the dryer, the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job

site.

3.10.3.4 Aggregate Moisture

Determine the moisture content of aggregate used for production a minimum of once per lot in accordance with ASTM C566.

3.10.3.5 Moisture Content of Mixture

Determine the moisture content of the mixture at least once per lot in accordance with ASTM D1461 or an approved alternate procedure.

3.10.3.6 Laboratory Air Voids

Take mixture samples at least four times per lot compacted into specimens compacted to 75 gyrations in accordance with ASTM D6925. Hot-mix provided under the VDOT Superpave option shall be compacted in accordance with the VDOT requirements. After compaction, determine the laboratory air voids of each specimen. Stability and flow shall be determined for the Marshall-compacted specimens, in accordance with ASTM D6927.

3.10.3.7 In-Place Density

Conduct any necessary testing to ensure the specified density is achieved. A nuclear gauge may be used to monitor pavement density in accordance with ASTM D2950/D2950M.

3.10.3.8 Grade and Smoothness

Conduct the necessary checks to ensure the grade and smoothness requirements are met in accordance with paragraphs MATERIAL ACCEPTANCE and PERCENT PAYMENT.

3.10.3.9 Additional Testing

Any additional testing, which the Contractor deems necessary to control the process, may be performed at the Contractor's option.

3.10.3.10 QC Monitoring

Submit all QC test results to the Contracting Officer on a daily basis as the tests are performed. The Contracting Officer reserves the right to monitor any of the Contractor's quality control testing and to perform duplicate testing as a check to the Contractor's quality control testing.

3.10.4 Sampling

When directed by the Contracting Officer, sample and test any material which appears inconsistent with similar material being produced, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

3.10.5 Control Charts

For process control, establish and maintain linear control charts on both individual samples and the running average of last four samples for the parameters listed in Table 8, as a minimum. These control charts shall be posted as directed by the Contracting Officer and kept current at all

times. The control charts shall identify the project number, the test parameter being plotted, the individual sample numbers, the Action and Suspension Limits listed in Table 8 applicable to the test parameter being plotted, and the Contractor's test results. Target values from the JMF shall also be shown on the control charts as indicators of central tendency for the cumulative percent passing, asphalt content, and laboratory air voids parameters. When the test results exceed either applicable Action Limit, take immediate steps to bring the process back in control. When the test results exceed either applicable Suspension Limit, halt production until the problem is solved. Use the control charts as part of the process control system for identifying trends so that potential problems can be corrected before they occur. Make decisions concerning mix modifications based on analysis of the results provided in the control charts. The Quality Control Plan shall indicate the appropriate action to be taken to bring the process into control when certain parameters exceed their Action Limits.

Table 8. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

	Individual Samples		Running Average of Last Four Samples	
Parameter to be Plotted	Action Limit	Suspension Limit	Action Limit	Suspension Limit
No. 4 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	6	8	4	5
No. 30 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	4	6	3	4
No. 200 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	1.4	2.0	1.1	1.5
Asphalt content, % deviation from JMF target; plus or minus value	0.4	0.5	0.2	0.3
Laboratory Air Voids, % deviation from JMF target value	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Mat Density, % of TMD	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Joint Density, % of TMD	No specific action and suspension limits set since this parameter is used to determine percent payment			

3.11 MATERIAL ACCEPTANCE

Testing for acceptability of work will be performed by an independent laboratory hired by the Contractor. Forward test results and payment calculations daily to the Contracting Officer. Acceptance of the plant produced mix and in-place requirements will be on a lot to lot basis. A standard lot for all requirements will be equal to 8 hours of production. Where appropriate, adjustment in payment for individual lots of hot-mix asphalt will be made based on in-place density, laboratory air voids, grade and smoothness in accordance with the following paragraphs. Grade and surface smoothness determinations will be made on the lot as a whole. Exceptions or adjustments to this will be made in situations where the mix within one lot is placed as part of both the intermediate and surface courses, thus grade and smoothness measurements for the entire lot cannot be made. In order to evaluate laboratory air voids and in-place (field) density, each lot will be divided into four equal sublots.

3.11.1 Sublot Sampling

One random mixture sample for determining laboratory air voids, theoretical

maximum density, and for any additional testing the Contracting Officer desires, will be taken from a loaded truck delivering mixture to each sublot, or other appropriate location for each sublot. All samples will be selected randomly, using commonly recognized methods of assuring randomness conforming to ASTM D3665 and employing tables of random numbers or computer programs. Laboratory air voids will be determined from three laboratory compacted specimens of each sublot sample in accordance with ASTM D6926. The specimens will be compacted within 2 hours of the time the mixture was loaded into trucks at the asphalt plant. Samples will not be reheated prior to compaction and insulated containers will be used as necessary to maintain the temperature.

3.11.2 Additional Sampling and Testing

The Contracting Officer reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. The cost of any additional testing will be paid for by the Government. Testing in these areas will be in addition to the lot testing, and the requirements for these areas will be the same as those for a lot.

3.11.3 Grade

The final wearing surface of pavement shall conform to the elevations and cross sections shown and shall vary not more than 0.05 foot from the plan grade established and approved at site of work. Finished surfaces at juncture with other pavements shall coincide with finished surfaces of abutting pavements. Deviation from the plan elevation will not be permitted in areas of pavements where closer conformance with planned elevation is required for the proper functioning of drainage and other appurtenant structures involved. The grade will be determined by running lines of levels at intervals of 25 feet, or less, longitudinally and transversely, to determine the elevation of the completed pavement surface. Within 5 working days, after the completion of a particular lot incorporating the final wearing surface, test the final wearing surface of the pavement for conformance with the specified plan grade. Diamond grinding may be used to remove high spots to meet grade requirements. Skin patching for correcting low areas or planing or milling for correcting high areas will not be permitted.

3.11.4 Surface Smoothness

Use one of the following methods to test and evaluate surface smoothness of the pavement. Perform all testing in the presence of the Contracting Officer. Keep detailed notes of the results of the testing and furnish a copy to the Government immediately after each day's testing. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the Contracting Officer.

3.11.4.1 Smoothness Requirements

a. Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of 1/4 inch or more, and all pavements shall be within the tolerances of 1/4 inch in both the longitudinal and transverse directions, when tested with an approved 12 feet straightedge.

b. Profilograph Testing: The finished surfaces of the pavements shall have no abrupt change of 1/8 inch or more, and each 0.1 mile segment of

each pavement lot shall have a Profile Index not greater than 9 inches/mile when tested with an approved California-type profilograph. If the extent of the pavement in either direction is less than 200 feet, that direction shall be tested by the straightedge method and shall meet requirements specified above.

3.11.4.2 Testing Method

After the final rolling, but not later than 24 hours after placement, test the surface of the pavement in each entire lot in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. Separate testing of individual sublots is not required. If any pavement areas are ground, these areas shall be retested immediately after grinding. Test each lot of the pavement in both a longitudinal and a transverse direction on parallel lines. Set the transverse lines 15 feet or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane for lanes less than 20 feet wide and at the third points for lanes 20 feet or wider. Also test other areas having obvious deviations. Longitudinal testing lines shall be continuous across all joints.

a. Straightedge Testing. Hold the straightedge in contact with the surface and move it ahead one-half the length of the straightedge for each successive measurement. Determine the amount of surface irregularity by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

b. Profilograph Testing. Perform profilograph testing using approved equipment and procedures described in CTM 526. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must-grind" bumps and the Profile Index for each 0.1 mile segment of each pavement lot. Grade breaks on parking lots shall be accommodated by breaking the profile segment into shorter sections and repositioning the blanking band on each segment. The "blanking band" shall be 0.2 inches wide and the "bump template" shall span 1 inch with an offset of 0.3 inch. Compute the Profile Index for each pass of the profilograph in each 0.1 mile segment. The Profile Index for each segment shall be the average of the Profile Indices for each pass in each segment. The profilograph shall be operated by a DOT approved operator. Furnish a copy of the reduced tapes to the Government at the end of each day's testing.

-- End of Section --

SECTION 32 12 43

POROUS FLEXIBLE PAVING
05/13

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS(AASHTO)

AASHTO MP1	(2000) Standard Specification for Performance Graded Asphalt Binder
AASHTO M252	(2009) Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M294	(2009)Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter

ASTM INTERNATIONAL (ASTM)

ASTM D4632	(2008) Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D3786/D3786M	(2013) Standard Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method
ASTM D4355	(2007) Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
ASTM D4491	(2009) Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4751	(2012) Standard Test Method for Determining Apparent Opening Size of a Geotextile
ASTM F758	(2007)e1 Standard Specification for Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
ASTM F949	(2010) Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT (2007) Road and Bridge Specifications

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

asphalt mix; G, AE
stone
underdrains; G, AE
filter fabric; G, AE

SD-07 Certificates

Installer Qualifications

1.3 QUALITY ASSURANCE

1.3.1 Installer Qualifications

Flexible Porous Paving installer shall be currently certified by the Manufacturer and have successfully installed a minimum of 10,000 square feet within the Mid-Atlantic region within the last year.

Flexible Porous Paving installer shall employ no less than two Manufacturer-certified Flexible Porous Paving technicians on staff who directly oversee or perform the installations during all Flexible Porous Paving placement, unless otherwise specified.

a. Provide a list of successfully installed Flexible Porous Paving projects, as required herein, including the address, square footage, and photographs for each project.

b. Manufacturer's Certifications.

1.4 SITE CONDITIONS

Schedule placements to minimize exposure to wind and heat before curing materials are applied.

Avoid placing porous paving if rain, snow, or frost is forecast within 24 hours unless measures are taken as described later. Always protect fresh paving from moisture and freezing.

1.4.1 Traffic Control

Maintain access for pedestrian traffic as required for other construction activities.

PART 2 PRODUCTS

2.1 POROUS ASPHALT

Porous asphalt pavement shall be a minimum of 3 inches thick and conform to VDOT Road and Bridge Specifications for Asphalt Materials (Section 210) and Asphalt Cement (Section 211) except for aggregate gradation. The asphalt mix shall be 5.75 percent to 6.0 percent of dry aggregate by weight. The asphalt binder shall be modified with an elastomeric polymer to produce a binder meeting the requirements of PG 76-22 (AASHTO MP1) and applied at a rate of 3.0 percent by total weight of the binder. Drain down of the asphalt binder shall be no greater than 0.3 percent (ASTM D 6390). The aggregate gradation shall be as specified in Table below. Porous asphalt pavement shall have a minimum connected void space of 18 percent.

AGGREGATE GRADATION	
U.S. Standard Sieve Size	Percent Passing
1/2 inch	100
3/8 inch	92-98
#4	34-40
#8	14-20
#16	7-13
#30	0-4
#200	0-2

2.1.1 Bedding Course

The bedding course for open jointed pavement blocks shall consist of 3 inches of washed VDOT #8, #8P, or #9 stone. VDOT #8 stone is recommended. VDOT #8P or #9 stone may used to match the stone used in the joint openings. The bedding course for porous asphalt pavement shall consist of 2 inches of washed VDOT #57 stone. All stone shall be washed with less than 1 percent passing a #200 sieve.

2.1.2 Aggregate Base

The aggregate base course shall consist of washed VDOT #57 stone. The thickness of the base course shall be 4 inches. VDOT #2 or #3 stone may be substituted as the base course material provided an adequate choker course of VDOT #57 stone is provided between the aggregate base course and the bedding course. All stone shall be washed with less than 1 percent passing a #200 sieve.

2.1.3 Underdrains

Underdrains shall be PVC pipe conforming to the requirements of ASTM F758, Type PS 28 or ASTM F949; HDPE pipe conforming to the requirements

AASHTO M252 or AASHTO M294, Type S; or other approved rigid plastic pipe with a smooth interior. Underdrains shall be perforated with four rows of 3/8-inch holes with a hole spacing of 3.25 ± 0.25 inches or a combination of hole size and spacing that provides a minimum inlet area 1.76 square inches per linear foot of pipe or be perforated with slots 0.125 inch in width that provides a minimum inlet area 1.5 square inches per linear foot of pipe.

2.1.4 Filter Fabric

Filter fabric shall be a needled, non-woven, polypropylene geotextile meeting the requirements listed in Table below. Heat-set or heat-calendared fabrics are not permitted.

Filter Fabric Specifications	
Grab Tensile Strength Per ASTM D4632	120 lbs
Mullen Burst Strengh Per ASTM D3786/D3786M	225 lbs/sq in
UV Resistance Per ASTM D4355	70% strength after 500 hours
Flow Rate Per ASTM D4491	125 gal/min/sq ft
Apparent Opening Size Per ASTM D4751	US #70 or #80 Sieve
Permittivity Per ASTM D4491	1.5

2.1.5 Subgrade

Sub-grade shall be compacted to the project's specifications.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

Prepare subgrade as specified by VDOT Road and Bridge Specifications. Construct subgrade to ensure that the required paving thickness is obtained in all locations.

Keep all traffic off of the subgrade during construction to the maximum extent practical. Regrade subgrade disturbed by delivery vehicles or other construction traffic, as needed.

3.2 SUBBASE

Prepare subbase in accordance with contract documents. Install the layer of subbase over a geotextile.

3.3 SETTING FORMWORK

Set, align, and brace forms so that the hardened paving meets the tolerances specified herein.

Apply form release agent to the form face which will be in contact with porous paving, immediately before placing paving.

The vertical face of previously placed concrete may be used as a form.

a. Protect previously placed paving from damage.

b. Do not apply form release agent to previously placed concrete.

c. Apply liquid urethane bonding agent to face of surfaces when adhesion is desired.

d. Placement width shall be as specified in Contract Documents.

3.4 BATCHING, MIXING, AND DELIVERY

Batch and mix on site in compliance with Manufacturer's written specifications, except that discharge shall be completed within 5 minutes of the introduction of urethane to the dry products.

3.5 PLACING AND FINISHING PAVING

Do not place porous paving on frozen or wet subgrade or subbase.

Deposit porous paving either directly onto the subgrade or subbase by wheelbarrow or by material handler onto the subgrade or subbase, unless otherwise specified.

Deposit porous paving between the forms to an approximately uniform height.

Spread the porous paving using a come-along, short-handle, square-ended shovel or rake.

Use steel trowels to finish to the elevations and thickness specified in Contract Documents.

3.6 FINAL SURFACE TEXTURE

Final surface of porous paving shall be smoothed with bull float and magnesium trowels.

3.7 EDGING

When forms are not used, bevel the edge of the top surface to a 45-degree slope.

3.8 CURING

Begin curing within 20 minutes of paving discharge, unless longer working time is accepted by the Manufacturer. Completely cover the paving surface with a minimum 4 mil thick polyethylene sheet only if rain or sprinklers are imminent within 20 minutes. Cut sheeting to a minimum of a full placement width.

a. Cover all exposed edges of paving with polyethylene sheet.

b. Secure curing cover material without using dirt.

Cure paving for a minimum of 24 uninterrupted hours, unless otherwise specified.

3.9 HOT AND COLD WEATHER CONSTRUCTION

When hot weather is anticipated up to 95 degrees Fahrenheit, no special procedures are necessary. In cold weather when temperatures may fall below freezing just after an installation, utilize a fan to maintain airflow over porous paving during the curing process.

3.10 OPENING TO TRAFFIC

Do not open the paving to light vehicular traffic until the porous paving has cured for at least 24 hours during warm weather, and 48 hours during very cold temperatures at or near freezing and not until the porous paving is accepted by the Owner for opening to traffic. Paving should be checked and verified to be sufficiently hardened after the curing period as relative humidity can alter the curing time in some regions.

-- End of Section --

SECTION 32 13 13.06

PORTLAND CEMENT CONCRETE PAVEMENT FOR ROADS AND SITE FACILITIES
11/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 212.3R	(2010) Chemical Admixtures for Concrete
ACI 301	(2010) Specifications for Structural Concrete
ACI 305R	(2010) Guide to Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C215	(2004; R 2010) Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines

ASTM INTERNATIONAL (ASTM)

ASTM A615/A615M	(2012) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A775/A775M	(2007b) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A966/A966M	(2008; R 2012) Standard Test Method for Magnetic Particle Examination of Steel Forgings Using Alternating Current
ASTM C1077	(2011c) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C1157/C1157M	(2011) Standard Specification for Hydraulic Cement
ASTM C1260	(2007) Standard Test Method for Potential Alkali Reactivity of Aggregates

	(Mortar-Bar Method)
ASTM C143/C143M	(2010a) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2011) Standard Specification for Portland Cement
ASTM C1567	(2011) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602/C1602M	(2012) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C172/C172M	(2010) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231/C231M	(2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	(2010) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2011a) Standard Specification for Concrete Aggregates
ASTM C494/C494M	(2011) Standard Specification for Chemical Admixtures for Concrete
ASTM C595/C595M	(2011) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2012) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C78/C78M	(2010) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C94/C94M	(2012) Standard Specification for Ready-Mixed Concrete
ASTM C989/C989M	(2011) Standard Specification for Slag Cement for Use in Concrete and Mortars

1.2 RELATED SECTIONS

Portland cement concrete pavement shall use Section 32 11 16.16 BASE COURSE FOR RIGID AND SUBBASE COURSE FOR FLEXIBLE PAVING, in addition to this section.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Curing materials; G AE
Admixtures
Coated Dowel Bars

Submit a complete list of materials including type, brand and applicable reference specifications.

SD-04 Samples

Field-Constructed Mockup; G AE

SD-05 Design Data

Concrete mix design; G, AE

Thirty days minimum prior to concrete placement, submit a mix design, with applicable tests, for each strength and type of concrete for approval. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, slag, and admixtures; and applicable reference specifications. Provide mix proportion data using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required. Submittal shall clearly indicate where each mix design will be used when more than one mix design is submitted. Obtain acknowledgement of approvals prior to concrete placement. Submit a new mix design for each material source change.

SD-06 Test Reports

Aggregate tests
Concrete slump tests
Air content tests
Flexural strength tests
Cementitious materials

SD-07 Certificates

Ready-mixed concrete plant
Batch tickets
Cementitious materials

1.4 DELIVERY, STORAGE, AND HANDLING

ASTM C94/C94M.

1.5 QUALITY ASSURANCE

1.5.1 Ready-mixed Concrete Plant Certification

Unless otherwise approved by the Contracting Officer, ready mixed concrete shall be produced and provided by a National Ready-Mix Concrete Association (NRMCA) certified plant.

1.5.2 Contractor Qualifications

Unless waived by the Contracting Officer, the Contractor shall meet one of the following criteria:

a. Contractor shall have at least one National Ready Mixed Concrete Association (NMRCA) certified concrete craftsman on site, overseeing each placement crew during all concrete placement.

b. Contractor shall have no less than three NRMCA certified concrete installers, who shall be on site working as members of each placement crew during all concrete placement.

1.5.3 Required Information

Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix will be suitable for the job conditions. The laboratory test reports shall include mill test and all other test for cementitious materials, aggregates, and admixtures. Provide maximum nominal aggregate size, combined aggregate gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Test reports shall be submitted along with the concrete mix design. Sampling and testing of materials, concrete mix design, sampling and testing in the field shall be performed by a commercial testing laboratory which conforms to ASTM C1077. The laboratory shall be approved in writing by the Government.

1.5.4 Batch Tickets

ASTM C94/C94M. Submit mandatory batch ticket information for each load of ready-mixed concrete.

1.5.5 Field-Constructed Mockup

Install a minimum 400 square feet to demonstrate typical joints, surface finish, texture, color, thickness, and standard of workmanship. Test panels shall be placed using the mixture proportions, materials, and equipment as proposed for the project. Test mock up panels in accordance with requirements in FIELD QUALITY CONTROL.

When a test panel is does not meet one or more of the requirements, the test panel shall be rejected, removed, and replaced at the Contractor's expense. If the test panels are acceptable, they may be incorporated into the project with the approval of the Contracting Officer.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cementitious Materials

Cementitious materials in concrete mix shall be 20 to 50 percent non-portland cement pozzolanic materials by weight. Provide test data demonstrating compatibility and performance of concrete satisfactory to Contracting Officer.

2.1.1.1 Cement

ASTM C150/C150M, Type I or II or ASTM C595/C595M, Type IS, IP, or P or ASTM C1157/C1157M MS.

2.1.1.2 Fly Ash and Pozzolan

ASTM C618, Type C, F, or N. Fly ash certificates shall include test results in accordance with ASTM C618.

2.1.1.2 Slag

ASTM C989/C989M, Slag Cement (formerly Ground Granulated Blast Furnace Slag) Grade 100 or 120. Certificates shall include test results in accordance with ASTM C989/C989M.

2.1.2 Water

Water shall conform to ASTM C1602/C1602M. Hot water shall not be used unless approved by the Contracting Officer.

2.1.3 Aggregate

Coarse aggregate shall consist of crushed or uncrushed gravel, crushed stone, or a combination thereof. Aggregates, as delivered to the mixers, shall consist of clean, hard, uncoated particles. Coarse aggregate shall be washed. Washing shall be sufficient to remove dust and other coatings. Fine aggregate shall consist of natural sand, manufactured sand, or a combination of the two, and shall be composed of clean, hard, durable particles. Both coarse and fine aggregates shall meet the requirements of ASTM C33/C33M.

2.1.4 Alkali Reactivity Test

Aggregates to be used in all concrete in projects over 50,000 SF in size shall be evaluated and tested by the Contractor for alkali-aggregate reactivity in accordance with ASTM C1260. The types of aggregates shall be evaluated in a combination which matches the contractors' proposed mix design (including Class F fly ash or GGBF slag), utilizing ASTM C1567. Test results of the combination shall have a measured expansion of less than 0.08 percent at 28 days. Should the test data indicate an expansion of greater than 0.08%, the aggregate(s) shall be rejected and the contractor shall submit new aggregate sources for retesting or may submit additional test results incorporating Lithium Nitrate for consideration.

ASTM C1260 shall be modified as follows to include one of the following options:

a. Utilize the contractor's proposed low alkali Portland cement and Class F fly ash in combination for the test proportioning. The laboratory shall use the contractor's proposed percentage of cement and fly ash.

b. Utilize the contractor's proposed low alkali Portland cement and ground granulated blast furnace (GGBF) slag in combination for the test proportioning. The laboratory shall use the contractor's proposed percentage of cement and GGBF.

c. Utilize the contractor's proposed low alkali Portland cement and Class F fly ash and ground granulated blast furnace (GGBF) slag in combination for the test proportioning. The laboratory shall use the contractor's proposed percentage of cement, fly ash and GGBF.

2.1.5 Fine Aggregates

ASTM C33/C33M.

2.1.6 Coarse Aggregates

ASTM C33/C33M.

2.1.7 Admixtures

ASTM C494/C494M: Type A, water reducing; Type B, retarding; Type C, accelerating; Type D, water-reducing and retarding; and Type E, water-reducing and accelerating admixture. Do not use calcium chloride admixtures. Where not shown or specified, the use of admixtures is subject to written approval of the Contracting Officer.

ASTM C260/C260M: Air-entraining.

ACI 212.3R (Chapter 15): Crystalline Integral Concrete Waterproofing Admixture.

2.1.8 Reinforcement

2.1.8.1 Coated Dowel Bars

Bars shall conform to ASTM A615/A615M, Grade 60 for plain billet-steel bars of the size and length indicated. Remove all burrs and projections from the bars. Coating system shall conform to AWWA C215, Type 2. Coat the bars with a double coat system or an epoxy coating system for resistance to penetration of oil and salt solutions. The systems shall be in accordance with manufacturer's recommendation for coating which are not bondable to concrete. Bond the coating to the dowel bar to resist laps or folds during movement of the joint. Coating thickness shall be 7 mils minimum and 20 mils maximum.

2.1.8.2 Tie Bars

Bars shall be billet or axle steel deformed bars and conform to ASTM A615/A615M or ASTM A966/A966M Grade 60. Epoxy coated in accordance with ASTM A775/A775M.

2.1.8.3 Reinforcement

Bar reinforcement shall conform to ASTM A615/A615M, Grade 60.

2.1.8.4 Setting Slab Reinforcement

Reinforcement shall be positioned on suitable chairs prior to concrete placement. At expansion, contraction, and construction joints, place the reinforcement as indicated. reinforcement, when place din concrete, shall be free of mud, oil, scale, or other foreign materials. Place reinforcement accurately and wire securely. The laps at splices shall be 12 inches minimum and the distances from ends and sides of slabs and joints shall be as indicated.

2.1.9 Curing Materials

2.1.9.1 White-Burlap-Polyethylene Sheet

ASTM C171, 0.004 inch thick white opaque polyethylene bonded to 10 oz/linear yard (40 inch) wide burlap.

2.1.9.2 Liquid Membrane-Forming Compound

ASTM C309, white pigmented, Type 2, Class B, free of paraffin or petroleum.

2.1.9.3 Liquid Chemical Sealer-Hardener Compound

Compound shall be magnesium fluosilicate which when mixed with water seals and hardens the surface of the concrete. Do not use on exterior slabs exposed to freezing conditions. Compound shall not reduce the adhesion of resilient flooring, tile, paint, roofing, waterproofing, or other material applied to concrete.

2.1.10 Joint Fillers and Sealants

Provide as specified in Section 07 92 00 JOINT SEALANTS and Section 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAYMENTS.

2.2 CONCRETE PAVEMENT

2.2.1 Joint Layout Drawings

If jointing requirements on the project drawings are not compatible with the contractor's placement sequence, the contractor shall submit a joint layout plan shop drawing to the Contracting Officer for approval. No work shall be allowed to start until the joint layout plan is approved. The joint layout plan shall indicate and describe in the detail the proposed jointing plan for contraction joints, expansion joints, and construction joints, in accordance with the following:

a. Indicate locations of contraction joints, construction joints, and expansion joints. Spacing between contraction joints shall not exceed 15 feet unless noted otherwise or approved by the Contracting Officer.

b. The larger dimension of a panel shall not be greater than 125% of the smaller dimension.

c. The minimum angle between two intersecting joints shall be 80 degrees, unless noted otherwise or approved by the Contracting Officer.

d. Joints shall intersect pavement-free edges at a 90 degree angle the pavement edge and shall extend straight for a minimum of 1.5 feet from the pavement edge, where possible.

e. Align joints of adjacent panels.

f. Align joints in attached curbs with joints in pavement when possible.

g. Ensure joint depth, widths, and dimensions are specified.

h. Minimum contraction joint depth shall be 1/4 of the pavement thickness. The minimum joint width shall be 1/8 inch.

i. Use expansion joints only where pavement abuts buildings, foundations, manholes, and other fixed objects.

2.3 CONTRACTOR-FURNISHED MIX DESIGN

Contractor-furnished mix design concrete shall be designed in accordance with ACI 211.1 except as modified herein, and the mix design shall be as specified herein under paragraph entitled "Submittals." The concrete shall have a minimum flexural strength of 650 pounds per square inch at 28 days. The concrete may be air entrained. If air entrainment is used the air content shall be 5.0 plus or minus 1.5 percent. Maximum size aggregate for slip forming shall be 1.5 inches. The minimum cementitious factor is 564 lbs per cubic yard and slump shall be 1 to 3 inches (or less when slip form is used).

If the cementitious material is not sufficient to produce concrete of the flexural strength required it shall be increased as necessary, without additional compensation under the contract. The cementitious factor shall be calculated using cement, Class F fly ash, and or GGBF slag. The mix shall use a cement replacement (by weight) of 25 percent - 35 percent Class F fly ash, or 40 percent - 50 percent GGBF slag, or a combination of the two. In the combination, each 5 percent of Class F fly ash shall be replaced by 8 percent GGBF slag.

PART 3 EXECUTION

3.1 FORMS

3.1.1 Construction

Construct forms to be removable without damaging the concrete.

3.1.2 Coating

Before placing the concrete, coat the contact surfaces of forms except existing pavement sections where bonding is required, with a non-staining mineral oil, non-staining form coating compound, or two coats of nitro-cellulose lacquer.

3.1.3 Grade and Alignment

Check and correct grade elevations and alignment of the forms immediately before placing the concrete.

3.2 REINFORCEMENT

3.2.1 Coated Dowel Bars

Install bars accurately aligned, vertically and horizontally, at indicated

locations and to the dimensions and tolerances indicated. Reject coatings which are perforated, cracked, or otherwise damaged. While handling, avoid scuffing or gouging of the coating.

3.2.2 Tie Bars

Install bars, accurately aligned horizontally and vertically, at indicated locations.

3.3 MEASURING, MIXING, CONVEYING, AND PLACING CONCRETE

3.3.1 Measuring

ASTM C94/C94M.

3.3.2 Mixing

ASTM C94/C94M, except as modified herein. Begin mixing within 30 minutes after cement has been added to aggregates. When the air temperature is greater than 85 degrees F, place concrete within 60 minutes. With the approval of the Contracting Officer, a hydration stabilizer admixture meeting the requirements of ASTM C494/C494M Type D, may be used to extend the placement time to 90 minutes. Additional water may be added to bring slump within required limits as specified in Section 11.7 of ASTM C94/C94M, provided that the specified water-cement ratio is not exceeded.

3.3.3 Conveying

ASTM C94/C94M.

3.3.4 Placing

Follow guidance of ACI 301, except as modified herein. Do not exceed a free vertical drop of 5 feet from the point of discharge. Deposit concrete either directly from the transporting equipment or by conveyor on to the pre-wetted subgrade or subbase, unless otherwise specified. Do not place concrete on frozen subgrade or subbase. Deposit the concrete between the forms to an approximately uniform height. Place concrete continuously at a uniform rate, with minimum amount of segregation, without damage to the grade and without unscheduled stops except for equipment failure or other emergencies. If this occurs within 10 feet of a previously placed expansion joint, remove concrete back to joint, repair any damage to grade, install a construction joint and continue placing concrete only after cause of the stop has been corrected.

3.3.5 Vibration

Immediately after spreading concrete, consolidate concrete with internal type vibrating equipment along the boundaries of all slabs regardless of slab thickness, and interior of all concrete slabs 6 inches or more in thickness. Limit duration of vibration to that necessary to produce consolidation of concrete. Excessive vibration will not be permitted. Vibrators shall not be operated in concrete at one location for more than 15 seconds. At the option of the Contractor, vibrating equipment of a type approved by the Contracting Officer may be used to consolidate concrete in unreinforced pavement slabs less than 6 inches thick.

3.3.5.1 Vibrating Equipment

Operate equipment, except hand-manipulated equipment, ahead of the finishing machine. Select the number of vibrating units and power of each unit to properly consolidate the concrete. Mount units on a frame that is capable of vertical movement and, when necessary, radial movement, so vibrators may be operated at any desired depth within the slab or be completely withdrawn from the concrete. Clear distance between frame-mounted vibrating units that have spuds that extend into the slab at intervals across the paving lane shall not exceed 30 inches. Distance between end of vibrating tube and side form shall not exceed 2 inches. For pavements less than 10 inches thick, operate vibrators at mid-depth parallel with or at a slight angle to the subbase. For thicker pavements, angle vibrators toward the vertical, with vibrator tip preferably about 2 inches from subbase, and top of vibrator a few inches below pavement surface. Vibrators may be pneumatic, gas driven, or electric, and shall be operated at frequencies within the concrete of not less than 8,000 vibrations per minute. Amplitude of vibration shall be such that noticeable vibrations occur at 1.5 foot radius when the vibrator is inserted in the concrete to the depth specified.

3.3.6 Cold Weather

Except with authorization, do not place concrete when ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. When authorized, when concrete is likely to be subjected to freezing within 24 hours after placing, heat concrete materials so that temperature of concrete when deposited is between 65 and 80 degrees F. Methods of heating materials are subject to approval of the Contracting Officer. Do not heat mixing water above 165 degrees F. Remove lumps of frozen material and ice from aggregates before placing aggregates in mixer. Follow practices found in ACI 306.1.

3.3.7 Hot Weather

Maintain required concrete temperature in accordance with Figure 2.1.5 in ACI 305R to prevent evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. After placement, use fog spray, apply monomolecular film, or use other suitable means to reduce the evaporation rate. Start curing when surface of fresh concrete is sufficiently hard to permit curing without damage. Cool underlying material by sprinkling lightly with water before placing concrete. Follow practices found in ACI 305R.

3.4 PAVING

Pavement shall be constructed with paving and finishing equipment utilizing fixed forms or slipforms.

3.4.1 Consolidation

The paver vibrators shall be inserted into the concrete not closer to the underlying material than 2 inches. The vibrators or any tamping units in front of the paver shall be automatically controlled so that they shall be stopped immediately as forward motion ceases. Excessive vibration shall not be permitted. Concrete in small, odd-shaped slabs or in locations inaccessible to the paver mounted vibration equipment shall be vibrated

with a hand-operated immersion vibrator. Vibrators shall not be used to transport or spread the concrete.

3.4.2 Operation

When the paver is operated between or adjacent to previously constructed pavement (fill-in lanes), provisions shall be made to prevent damage to the previously constructed pavement, including keeping the existing pavement surface free of any debris, and placing rubber mats beneath the paver tracks. Transversely oscillating screeds and extrusion plates shall overlap the existing pavement the minimum possible, but in no case more than 8 inches.

3.4.3 Required Results

The paver-finisher shall be operated to produce a thoroughly consolidated slab throughout, true to line and grade within specified tolerances. The paver-finishing operation shall produce a surface finish free of irregularities, tears, voids of any kind, and any other discontinuities. It shall produce only a very minimum of paste at the surface. Multiple passes of the paver-finisher shall not be permitted. The equipment and its operation shall produce a finished surface requiring no hand finishing, other than the use of cutting straightedges, except in very infrequent instances. No water, other than true fog sprays (mist), shall be applied to the concrete surface during paving and finishing.

3.4.4 Fixed Form Paving

Forms shall be steel, except that wood forms may be used for curves having a radius of 150 feet or less, and for fillets. Forms may be built up with metal or wood, added only to the base, to provide an increase in depth of not more than 25 percent. The base width of the form shall be not less than eight-tenths of the vertical height of the form, except that forms 8 inches or less in vertical height shall have a base width not less than the vertical height of the form. Wood forms for curves and fillets shall be adequate in strength and rigidly braced. Forms shall be set on firm material cut true to grade so that each form section when placed will be firmly in contact with the underlying layer for its entire base. Forms shall not be set on blocks or on built-up spots of underlying material. Forms shall remain in place at least 12 hours after the concrete has been placed. Forms shall be removed without injuring the concrete.

3.4.5 Placing Dowels and Tie Bars

Dowels shall be installed with alignment not greater than 1/8 inch per ft. Except as otherwise specified below, location of dowels shall be within a horizontal tolerance of plus or minus 5/8 inch and a vertical tolerance of plus or minus 3/16 inch. The portion of each dowel intended to move within the concrete or expansion cap shall be painted with one coat of rust inhibiting primer paint, and then oiled just prior to placement. Dowels and tie bars in joints shall be omitted when the center of the dowel or tie bar is located within a horizontal distance from an intersecting joint equal to or less than one-fourth of the slab thickness.

3.4.5.1 Contraction Joints

Dowels and tie bars in longitudinal and transverse contraction joints within the paving lane shall be held securely in place by means of rigid metal basket assemblies. The dowels and tie bars shall be welded to the

assembly or held firmly by mechanical locking arrangements that will prevent them from becoming distorted during paving operations. The basket assemblies shall be held securely in the proper location by means of suitable anchors.

3.4.5.2 Construction Joints-Fixed Form Paving

Installation of dowels and tie bars shall be by the bonded-in-place method, supported by means of devices fastened to the forms. Installation by removing and replacing in preformed holes will not be permitted.

3.4.5.3 Dowels Installed in Hardened Concrete

Installation shall be by bonding the dowels into holes drilled into the hardened concrete. Holes approximately 1/8 inch greater in diameter than the dowels shall be drilled into the hardened concrete. Dowels shall be bonded in the drilled holes using epoxy resin injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel shall not be permitted. The dowels shall be held in alignment at the collar of the hole, after insertion and before the grout hardens, by means of a suitable metal or plastic collar fitted around the dowel. The vertical alignment of the dowels shall be checked by placing the straightedge on the surface of the pavement over the top of the dowel and measuring the vertical distance between the straightedge and the beginning and ending point of the exposed part of the dowel.

3.4.5.4 Expansion Joints

Dowels in expansion joints shall be installed by the bonded-in-place method or by bonding into holes drilled in hardened concrete, using procedures specified above.

3.5 FINISHING CONCRETE

Start finishing operations immediately after placement of concrete. Use finishing machine, except hand finishing may be used in emergencies and for concrete slabs in inaccessible locations or of such shapes or sizes that machine finishing is impracticable. Finish pavement surface on both sides of a joint to the same grade. Finish formed joints from a securely supported transverse bridge. Provide hand finishing equipment for use at all times. Transverse and longitudinal surface tolerances shall be 1/4 inch in 10 feet.

3.5.1 Side Form Finishing

3.5.1.1 Joint Finish

Before concrete is hardened, correct edge slump of pavement, exclusive of edge rounding, in excess of 0.02 foot. Finish concrete surface on each side of construction joints to the same plane, and correct deviations before newly placed concrete has hardened.

3.5.1.2 Hand Finishing

Strike-off and screed surface of concrete to elevations slightly above finish grade so that when concrete is consolidated and finished pavement surface is at the indicated elevation. Vibrate entire surface until

required compaction and reduction of surface voids is secured with a strike-off template.

3.5.1.3 Longitudinal Floating

After initial finishing, further smooth and consolidate concrete by means of hand-operated longitudinal floats. Use floats that are not less than 12 feet long and 6 inches wide and stiffened to prevent flexing and warping.

3.5.2 Texturing

Before the surface sheen has disappeared and before the concrete hardens, the surface of the pavement shall be given a texture as described herein. Following initial texturing on the first day of placement, the Placing Foreman, Contracting Officer representative, and a representative of the Using Agency shall inspect the texturing for compliance with design requirements. After curing is complete, all textured surfaces shall be thoroughly power broomed to remove all debris. Any type of transverse texturing shall produce grooves in straight lines across each lane within a tolerance of plus or minus 1/2 inch of a true line. The concrete in areas of recesses for tie-down anchors, lighting fixtures, and other outlets in the pavement shall be finished to provide a surface of the same texture as the surrounding area.

3.5.2.1 Brooming

Finish the surface of the slab by brooming the surface with a new wire broom at least 18 inches wide. Gently pull the broom over the surface of the pavement from edge to edge just before the concrete becomes non-plastic. Slightly overlap adjacent strokes of the broom. Broom perpendicular to centerline of pavement so that corrugations produced will be uniform in character and width, and not more than 1/16 inch in depth. Broomed surface shall be free from porous spots, irregularities, depressions, and small pockets or rough spots such as may be caused by accidentally disturbing particles of coarse aggregate embedded near the surface.

3.5.3 Edging

At the time the concrete has attained a degree of hardness suitable for edging, carefully finish slab edges, including edges at formed joints, with an edge having a maximum radius of one-eighth inch. When brooming is specified for the final surface finish, edge transverse joints before starting brooming, then operate broom to obliterate as much as possible the mark left by the edging tool without disturbing the rounded corner left by the edger. Clean by removing loose fragments and soupy mortar from corners or edges of slabs which have crumbled and areas which lack sufficient mortar for proper finishing. Refill voids solidly with a mixture of suitable proportions and consistency and refinish. Remove unnecessary tool marks and edges. Remaining edges shall be smooth and true to line.

3.5.4 Repair of Surface Defects

Follow guidance of ACI 301.

3.6 CURING AND PROTECTION

Protect concrete adequately from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks and oil stains, and do not

allow it to dry out from the time it is placed until the expiration of the minimum curing periods specified herein. Use White-Burlap-Polyethylene Sheet or liquid membrane-forming compound, except as specified otherwise herein. Do not use membrane-forming compound on surfaces where its appearance would be objectionable, on surfaces to be painted, where coverings are to be bonded to concrete, or on concrete to which other concrete is to be bonded. Maintain temperature of air next to concrete above 40 degrees F for the full curing periods.

3.6.1 White-Burlap-Polyethylene Sheet

Wet entire exposed surface thoroughly with a fine spray of water, saturate burlap but do not have excessive water dripping off the burlap and then cover concrete with White-Burlap-Polyethylene Sheet, burlap side down. Lay sheets directly on concrete surface and overlap 12 inches. Make sheeting not less than 18 inches wider than concrete surface to be cured, and weight down on the edges and over the transverse laps to form closed joints. Repair or replace sheets when damaged during curing. Check daily to assure burlap has not lost all moisture. If moisture evaporates, resaturate burlap and re-place on pavement (re-saturation and re-placing shall take no longer than 10 minutes per sheet). Leave sheeting on concrete surface to be cured for at least 7 days.

3.6.2 Liquid Membrane-Forming Compound Curing

Apply compound immediately after surface loses its water sheen and has a dull appearance and before joints are sawed. Agitate curing compound thoroughly by mechanical means during use and apply uniformly in a two-coat continuous operation by suitable power-spraying equipment. Total coverage for the two coats shall be at least one gallon of undiluted compound per 200 square feet. Compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. Apply an additional coat of compound immediately to areas where film is defective. Respray concrete surfaces that are subject to heavy rainfall within 3 hours after curing compound has been applied in the same manner.

3.6.2.1 Protection of Treated Surfaces

Keep concrete surfaces to which liquid membrane-forming compounds have been applied free from vehicular traffic and other sources of abrasion for not less than 72 hours. Foot traffic is allowed after 24 hours for inspection purposes. Maintain continuity of coating for entire curing period and repair damage to coating immediately.

3.7 FIELD QUALITY CONTROL

3.7.1 Sampling

The Contractor's approved laboratory shall collect samples of fresh concrete in accordance with ASTM C172/C172M during each working day as required to perform tests specified herein. Make test specimens in accordance with ASTM C31/C31M.

3.7.2 Consistency Tests

The Contractor's approved laboratory shall perform concrete slump tests in accordance with ASTM C143/C143M. Take samples for slump determination from concrete during placement. Perform tests at the beginning of a concrete

placement operation and and for each batch (minimum) or every 20 cubic yards (maximum) of concrete to ensure that specification requirements are met. In addition, perform tests each time test beams and cylinders are made.

3.7.3 Flexural Strength Tests

The Contractor's approved laboratory shall test for flexural strength in accordance with ASTM C78/C78M. Make four test specimens for each set of tests. Test two specimens at 7 days, and the other two at 28 days. Concrete strength will be considered satisfactory when the minimum of the 28 -day test results equals or exceeds the specified 28-day flexural strength, and no individual strength test is less than 550 pounds per square inch. If the ratio of the 7-day strength test to the specified 28-day strength is less than 65 percent, make necessary adjustments for conformance. Frequency of flexural tests on concrete beams shall be not less than four test beams for each 50 cubic yards of concrete, or fraction thereof, placed. Concrete which is determined to be defective, based on the strength acceptance criteria therein, shall be removed and replaced with acceptable concrete.

3.7.4 Air Content Tests

Test air-entrained concrete for air content at the same frequency as specified for slump tests. Determine percentage of air in accordance with ASTM C231/C231M on samples taken during placement of concrete in forms.

3.7.5 Surface Testing

Surface testing for surface smoothness , edge slump and plan grade shall be performed as indicated below by the Testing Laboratory. The measurements shall be properly referenced in accordance with paving lane identification and stationing, and a report given to the Government within 24 hours after measurement is made. A final report of surface testing, signed by a Registered Engineer, containing all surface measurements and a description of all actions taken to correct deficiencies, shall be provided to the Government upon conclusion of surface testing.

3.7.5.1 Surface Smoothness Requirements

The finished surfaces of the pavements shall have no abrupt change of 1/8 inch or more, and all pavements shall be within the tolerances specified when checked with a 12 foot straightedge: 1/5 inch longitudinal and 1/4 inch transverse directions for roads and streets and 1/4 inch for both directions for other concrete surfaces, such as parking areas.

3.7.5.2 Surface Smoothness Testing Method

The surface of the pavement shall be tested with the straightedge to identify all surface irregularities exceeding the tolerances specified above. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines approximately 15 feet apart. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length and measuring the maximum gap between the straightedge and the pavement surface, in the area between these two high points.

3.7.6 Plan Grade Testing and Conformance

The surfaces shall vary not more than 0.06 foot above or below the plan grade line or elevation indicated. Each pavement category shall be checked by the Contractor for conformance with plan grade requirements by running lines of levels at intervals to determine the elevation at each joint intersection.

3.7.7 Test for Pavement Thickness

Measure during concrete placement to determine in-place thickness of concrete pavement.

3.7.8 Reinforcement

Inspect reinforcement prior to installation to assure it is free of loose flaky rust, loose scale, oil, mud, or other objectionable material.

3.7.9 Dowels

Inspect dowel placement prior to placing concrete to assure that dowels are of the size indicated, and are spaced, aligned and painted and oiled as specified. Dowels shall not deviate from vertical or horizontal alignment after concrete has been placed by more than 1/8 inch per foot.

3.8 WASTE MANAGEMENT

In accordance with the Waste Management Plan.

-- End of Section --

SECTION 32 14 40

STONE PAVING
04/13

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 530/530.1	(2008; Errata 2008; Errata 2009) Building Code Requirements and Specification for Masonry Structures and Related Commentaries

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A118.4	(2012) American National Standard Specifications for Modified Dry-Set Cement Mortar
ANSI A118.7	(2010) American National Standard Specifications for High Performance Cement Grouts for Tile Installation

ASTM INTERNATIONAL (ASTM)

ASTM C 144	(2004) Standard Specification for Aggregate for Masonry Mortar
ASTM C 150	(2009) Standard Specification for Portland Cement
ASTM C 207	(2006) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C880/C880M	(2009) Standard Test Method for Flexural Strength of Dimension Stone
ASTM D 1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1238	(2010) Melt Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D 648	(2007) Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
ASTM D 792	(2008) Density and Specific Gravity (Relative Density) of Plastics by Displacement

1.2 SUMMARY

Section includes exterior paving, reflecting pool surface and coping edge, and exterior stone stairs.

Refer to Section 07 92 00 JOINT SEALANTS for sealing joints in stone.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals identified with "AE" shall be reviewed by Landscape Architect. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication and Installation Details; G, AE

Include dimensions and profiles of stone units.

SD-03 Product Data

Stone

SD-04 Samples

Mockups; G, AE
Stone; G, AE
Mortar Samples; G, AE
Grout Color; G, AE

SD-06 Test Reports

Preconstruction Stone Testing for each stone type

SD-07 Certificates

Letter of Certification
Installer Qualifications
Fabricator Qualifications

1.4 QUALITY ASSURANCE

1.4.1 Certificate from Stone Fabricator

Submit a Letter of Certification from the stone fabricator, stating the material being furnished is the specified material and there are sufficient reserves available to supply the project and furnish replacements if needed.

Source Limitations for Stone: Obtain each stone variety from a single quarry. Make quarried blocks available for examination by Contracting Officer.

1.4.2 Certificates

1.4.2.1 Installer Qualifications

Engage experienced installer that has completed stone installation similar in material, design, and extent to that indicated for the project.

1.4.2.2 Fabricator Qualifications

Engage experienced fabricator that has completed stone fabrication similar in material, design, and extent to that indicated for the project.

1.4.3 Preconstruction Stone Testing

Engage an independent testing agency to perform the following testing for each stone variety:

a. Furnish test specimens that are representative of materials.

b. Physical Property Tests: ASTM standards specified for stone type.

c. Flexural Strength Tests: ASTM C880/C880M.

1.4.4 Mockups

Mockups: Build mockup of typical areas as shown on Drawings.

a. Size: 96 inches by 96 inches.

b. Color consistency: demonstrate color consistency with mockup; color range shall not exceed range of color established by samples.

c. Include sealant joints installed as required by Section 07 92 00 JOINT SEALANTS.

d. Mockups may become part of the completed Work if approved at time of Substantial Completion.

1.4.5 Samples

Submit samples for each stone type required, exhibiting the full range of color characteristics expected.

a. Submit a minimum of 2 each, 12 inches by 12 inches in size, in each color and finish specified.

b. In the case of more variegated stones, color photos shall be submitted in addition to the number of samples to show the full range of color and markings to be expected.

c. Mortar Samples: Full range of exposed color and texture.

1.5 DELIVERY, STORAGE, AND HANDLING

Store and handle materials to prevent deterioration or damage.

a. Stone shall be carefully packed and loaded for shipment using reasonable care and customary precautions against damage in transit. Material, which may cause staining or discoloration shall not be used

for blocking or packing.

b. The stone shall be stacked on timber or platforms at least 4 inches above the ground. Care shall be taken to prevent staining or discoloration during storage.

c. If storage is to be for a prolonged period, polyethylene or other suitable plastic film shall be placed between wood and finished surfaces of completely dry stone.

Properly store cementitious materials. Do not use damp cementitious materials.

1.6 PROJECT CONDITIONS

Cold-Weather Requirements for Exterior Stone Paving: ACI 530/530.1/ASCE 6/TMS 602.

Hot-Weather Requirements for Exterior Stone Paving: ACI 530/530.1/ASCE 6/TMS 602.

PART 2 PRODUCTS

2.1 STONE PAVERS

Granite Pavers: Rectangular paving slabs made from granite complying with ASTM C 615. Pavers shall be installed in columbarium courts and walkways, plaza aras, stair landings, and reflecting pools as indicated on Drawings.

a. Color and Grain: Iridian Gray, Charcoal Gray, Carnelian (brownish-red) and Mesabi (Black).

b. Finish: Thermal.

d. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

e. Thickness: Not less than 2 inches for paving areas and reflecting pools surface. Not less than 3 inches for copings and border around reflecting pool.

f. Face Size: As indicated.

2.1.1 Bluestone Pavers

Refer to Section 04 20 00 MASONRY, "Stone Items" paragraph for bluestone pavers used in this Project.

2.2 STONE STAIRS

Granite Stairs: Rectangular stair slabs made from granite complying with ASTM C 615. Stairs shall be installed as indicated on Drawings.

a. Color and Grain: Iridian Gray (light gray); medium grain.

b. Finish: Thermal.

d. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

e. Thickness: As indicated on Drawings. Stair treads shall have 1/4-inch per foot wash on tread.

f. Face: 16-inch tread surface.

g. Length: As indicated on Drawings

2.3 MORTAR MATERIALS

2.3.1 Portland Cement

ASTM C 150, Type I or Type II, except Type III may be used for cold-weather construction.

2.3.2 Hydrated Lime

ASTM C 207.

2.3.3 Portland Cement-Lime Mix

ASTM C 150, Type I or Type III, and ASTM C 207.

2.3.4 Colored Portland Cement-Lime Mix

ASTM C 150, Type I or Type III; ASTM C 207; and mortar pigments.

2.3.5 Aggregate

ASTM C 144.

2.3.6 Mortar Pigments

Natural and synthetic iron oxides. Use only pigments with a record of satisfactory performance in mortar and containing no carbon black.

2.3.7 Latex Additive

Acrylic-resin water emulsion recommended by additive manufacturer for use with field-mixed portland cement mortar bed.

2.3.8 Thin-Set Mortar

Latex-portland cement mortar; ANSI A118.4.

2.4 GROUT

2.4.1 Polymer Modified Cement Grout

ANSI A118.7. Polymer Type: Acrylic resin in liquid-latex form for addition to prepackaged dry-grout mix.

2.4.2 Grout Color

As selected by Architect from manufacturer's full range.

2.5 ACCESSORIES

2.5.1 Compressible Foam Filler

Preformed strips complying with ASTM D 1056, Grade 2A1.

2.6 ADJUSTABLE PAVER SUPPORTS

Provide supports designed to support loads up to a minimum 1,250 pound weight bearing capacity FS:3 and contains built in slope compensation from 0 to 1/2 inch per foot slope with adjustable system height range from 2-1/4 inches to 36 inches. Supports shall be impervious to water, mold and freeze/thaw. Pedestal shall have a broad footprint to provide stability.

2.6.1 Materials

Paver supports shall be manufactured from plastics and manufactured product shall meet requirements of ASTM D 1238, ASTM D 792, and ASTM D 648.

PART 3 EXECUTION

3.1 EXAMINATION

Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

Where pavers are to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.

Proceed with installation only after unsatisfactory conditions have been corrected and waterproofing protection is in place.

3.2 PREPARATION

Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

Sweep concrete substrates to remove dirt, dust, debris, and loose particles.

Proof-roll prepared subgrade according to requirements in Section 31 00 00 EARTHWORD to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive base course for unit pavers.

3.3 INSTALLATION, GENERAL

Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.

Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible.

Hammer cutting is not acceptable.

a. For concrete pavers, a block splitter may be used.

Handle protective-coated brick pavers to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.

Joint Pattern: As indicated.

Pavers over Waterproofing: Exercise care in placing pavers and setting materials over waterproofing so protection materials are not displaced and waterproofing is not punctured or otherwise damaged. Carefully replace protection materials that become displaced and arrange for repair of damaged waterproofing before covering with paving.

a. Provide joint filler at waterproofing that is turned up on vertical surfaces.

Tolerances: Do not exceed 1/16-inch unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches and 1/4 inch in 10 feet from level, or indicated slope, for finished surface of paving.

Expansion and Control Joints: Provide for sealant-filled joints at locations and of widths indicated. Provide compressible foam filler as backing for sealant-filled joints. Install joint filler before setting pavers. Sealant materials and installation are specified in Section 07 92 00 JOINT SEALANTS.

Provide solid stone stair treads made of granite as indicated. Install stair treads before installing adjacent pavers in landings and adjacent walkways.

3.4 REPAIRING, POINTING, AND CLEANING

Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.

Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.

a. Remove temporary protective coating as recommended by coating manufacturer and as acceptable to paver and grout manufacturers.

b. Do not allow protective coating to enter floor drains. Trap, collect, and remove coating material.

-- End of Section --

SECTION 32 16 13

CONCRETE SIDEWALKS AND CURBS AND GUTTERS
04/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(2005; R 2009) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

ASTM INTERNATIONAL (ASTM)

ASTM A185/A185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A615/A615M	(2012) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C143/C143M	(2010a) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C172/C172M	(2010) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2010b) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C231/C231M	(2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	(2010) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C920	(2011) Standard Specification for Elastomeric Joint Sealants

ASTM D1751	(2004; R 2008) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2004a; R 2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D5893/D5893M	(2010) Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Provide plant, equipment, machines, and tools used in the work subject to approval and maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.2.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Concrete; G, AE

SD-06 Test Reports

Field Quality Control

1.4 ENVIRONMENTAL REQUIREMENTS

1.4.1 Placing During Cold Weather

Do not place concrete when the air temperature reaches 40 degrees F and is falling, or is already below that point. Placement may begin when the air temperature reaches 35 degrees F and is rising, or is already above 40 degrees F. Make provisions to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the

temperature of the air, aggregates, or water is below 35 degrees F, placement and protection shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.4.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed95 degrees F at any time.

PART 2 PRODUCTS

2.1 CONCRETE

Provide concrete conforming to the applicable requirements of 32 13 13.06 PORTLAND CEMENT CONCRETE PAVEMENT FOR ROADS AND SITE FACILITIES except as otherwise specified. Concrete shall have a minimum compressive strength of 4,000 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inches. Submit copies of certified delivery tickets for all concrete used in the construction.

2.1.1 Air Content

Mixtures shall have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

The concrete slump shall be 2 inches plus or minus 1 inch where determined in accordance with ASTM C143/C143M.

2.1.3 Reinforcement Steel
Reinforcement bars shall conform to ASTM A615/A615M. Wire mesh reinforcement shall conform to ASTM A185/A185M.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C171, type optional, except that polyethylene film, if used, shall be white opaque.

2.2.2 Burlap

Burlap shall conform to AASHTO M 182.

2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to ASTM C309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.4.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D1751 or ASTM D1752, 1/2 inch thick, unless otherwise indicated.

2.5 JOINT SEALANTS

Joint sealant, cold-applied shall conform to ASTM C920 or ASTM D5893/D5893M.

2.6 FORM WORK

Design and construct form work to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 10 feet. Radius bends may be formed with 3/4 inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 10 feet with a minimum of 3 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

2.6.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside

form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted in accordance with Section 31 00 00 EARTHWORK.

3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Set forms to the indicated alignment, grade and dimensions. Hold forms rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Set forms for sidewalks with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10 foot long section. After forms are set, grade and alignment shall be checked with a 10 foot straightedge. Forms shall have a transverse slope as indicated with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after

finishing has been completed.

3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Place concrete in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated by tamping and spading or with an approved vibrator, and the surface shall be finished to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, finish the surface with a wood or magnesium float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of 3/8 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

3.4.4 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction/control joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. Expansion joints are not required between sidewalks and curb that abut the sidewalk longitudinally.

3.5.1 Sidewalk Contraction/Control Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Tooled joints shall be constructed using a tool with 3/8-inch radius edges, to the depth indicated, unless otherwise approved.

3.5.2 Sidewalk Expansion Joints

Expansion joints shall be formed with 1/2 inch joint filler strips. Provide expansion joint at a minimum of 20-feet o.c. or as shown on Drawings. In paving areas that have granite pavers mortared to the concrete base, expansion joints in the concrete slab shall coincide with expansion joints shown in the Drawings with the granite paver areas. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to ASTM D1752 or building paper. Joint filler shall be held in place with steel pins or

other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 3/8 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with cold-applied joint sealant. Joint sealant shall be gray or match granite pavers in color. Joints shall be sealed as specified in Section 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS.

3.5.3 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

3.6 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length.

a. Contraction joints (except for slip forming) shall be constructed by means of 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

b. When slip forming is used, the contraction joints shall be cut in the top portion of the gutter/curb hardened concrete in a continuous cut across the curb and gutter, using a power-driven saw. The depth of cut shall be at least one-fourth of the gutter/curb depth and 1/8 inch in width.

3.6.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 1/2 inch in width shall be provided at intervals not less than 30 feet nor greater than 120 feet. Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Joints shall be sealed as specified in Section 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Protect concrete against loss of moisture and rapid temperature changes for

at least 7 days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

The entire exposed surface shall be covered with 2 or more layers of burlap. Mats shall overlap each other at least 6 inches. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.7.1.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. The curing medium shall not be less than 18-inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

3.7.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet/gallon for the total of both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the jobsite for use in the event of mechanical failure of the

spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Completed concrete shall be protected from damage until accepted. Repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.7.4 Protective Coating

Protective coating, of linseed oil mixture, shall be applied to the exposed-to-view concrete surface after the curing period, if concrete will be exposed to de-icing chemicals within 6 weeks after placement. Concrete to receive a protective coating shall be moist cured.

3.7.4.1 Application

Curing and backfilling operation shall be completed prior to applying two coats of protective coating. Concrete shall be surface dry and clean before each application. Coverage shall be by spray application at not more than 50 square yards/gallon for first application and not more than 70 square yards/gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at ambient or material temperatures lower than 50 degrees F.

3.8 FIELD QUALITY CONTROL

Submit copies of all test reports within 24 hours of completion of the test.

3.8.1 General Requirements

Perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, take the action and submit

reports as required below, and any additional tests to insure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

Provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 250 cubic yards of concrete. The samples for strength tests shall be taken in accordance with ASTM C172/C172M. Cylinders for acceptance shall be molded in conformance with ASTM C31/C31M by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

3.8.2.2 Air Content

Determine air content in accordance with ASTM C173/C173M or ASTM C231/C231M. ASTM C231/C231M shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

-- End of Section --

SECTION 32 17 24.00 10

PAVEMENT MARKINGS
04/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D792	(2008) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM E28	(1999; R 2009) Softening Point of Resins Derived from Naval Stores by Ring and Ball Apparatus

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT	(2007) Virginia Department of Transportation Road and Bridge Specifications

1.2 SYSTEM DESCRIPTION

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition. Submit lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation. Equipment operating on roads and runways shall display low speed traffic markings and traffic warning lights.

1.2.1 Paint Application Equipment

1.2.1.1 Self-Propelled or Mobile-Drawn Pneumatic Spraying Machines

The equipment to apply paint to pavements shall be a self-propelled or mobile-drawn pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. The machine shall have a speed during application not less than 5 mph, and shall be capable of applying the stripe widths indicated, at the paint coverage rate specified in paragraph APPLICATION, and of even uniform thickness with clear-cut edges. Equipment used for marking streets and highways shall be capable of placing the prescribed number of lines at a single pass as solid lines, intermittent lines or a combination of solid and intermittent lines using a maximum of two different colors of paint as specified. . The paint applicator shall have paint reservoirs or tanks of sufficient capacity and suitable gauges to apply paint in accordance with

requirements specified. Tanks shall be equipped with suitable air-driven mechanical agitators. The spray mechanism shall be equipped with quick-action valves conveniently located, and shall include necessary pressure regulators and gauges in full view and reach of the operator. Paint strainers shall be installed in paint supply lines to ensure freedom from residue and foreign matter that may cause malfunction of the spray guns. The paint applicator shall be readily adaptable for attachment of an air-actuated dispenser for the reflective media approved for use. Pneumatic spray guns shall be provided for hand application of paint in areas where the mobile paint applicator cannot be used.

1.2.1.2 Hand-Operated, Push-Type Machines

All machines, tools, and equipment used in performance of the work shall be approved and maintained in satisfactory operating condition. Hand-operated push-type machines of a type commonly used for application of paint to pavement surfaces will be acceptable for marking small streets and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Sandblasting equipment shall be provided as required for cleaning surfaces to be painted. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.

1.2.2 Thermoplastic Application Equipment

1.2.2.1 Thermoplastic Material

Thermoplastic material shall be applied to the primed pavement surface by spray techniques or by the extrusion method, wherein one side of the shaping die is the pavement and the other three sides are contained by, or are part of, suitable equipment for heating and controlling the flow of material. By either method, the markings shall be applied with equipment that is capable of providing continuous uniformity in the dimensions of the stripe.

1.2.2.2 Application Equipment

a. Application equipment shall provide continuous mixing and agitation of the material. Conveying parts of the equipment between the main material reservoir and the extrusion shoe or spray gun shall prevent accumulation and clogging. All parts of the equipment which come into contact with the material shall be easily accessible and exposable for cleaning and maintenance. All mixing and conveying parts up to and including the extrusion shoes and spray guns shall maintain the material at the required temperature with heat-transfer oil or electrical-element-controlled heat.

b. The application equipment shall be constructed to ensure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off stripe ends squarely and shall provide a method of applying "skiplines". The equipment shall be capable of applying varying widths of traffic markings.

c. The applicator shall be equipped with a drop-on type bead dispenser capable of uniformly dispensing reflective glass spheres at controlled rates of flow. The bead dispenser shall be automatically operated and shall begin flow prior to the flow of composition to assure that the strip is fully reflectorized.

1.2.2.3 Mobile and Maneuverable

Application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. The equipment used for the placement of thermoplastic pavement markings shall be of two general types: mobile applicator and portable applicator.

a. Mobile Application Equipment: The mobile applicator shall be defined as a truck-mounted, self-contained pavement marking machine that is capable of hot applying thermoplastic by either the extrusion or spray method. The unit shall be equipped to apply the thermoplastic marking material at temperatures exceeding 375 degrees F, at widths varying from 3 to 12 inches and in thicknesses varying from 0.020 to 0.190 inch and shall have an automatic drop-on bead system. The mobile unit shall be capable of operating continuously and of installing a minimum of 20,000 lineal feet of longitudinal markings in an 8-hour day.

   (1) The mobile unit shall be equipped with a melting kettle which holds a minimum of 6000 pounds of molten thermoplastic material. The kettle shall be capable of heating the thermoplastic composition to temperatures of 375 to 425 degrees F. A thermostatically controlled heat transfer liquid shall be used. Heating of the composition by direct flame will not be allowed. Oil and material temperature gauges shall be visible at both ends of the kettle. The mobile unit shall be equipped with a spray gun system. The spray system shall consist of a minimum of four spray guns, located two on each side of the truck, and shall be capable of marking simultaneous edgeline and centerline stripes. The spray system shall be surrounded (jacketed) with heating oil to maintain the molten thermoplastic at a temperature of 375 to 425 degrees F; and shall be capable of spraying a stripe of 3 to 12 inches in width, and in thicknesses varying from 0.055 inch to 0.095 inch, and of generally uniform cross section.

   (2) The mobile unit shall be equipped with an electronic programmable line pattern control system. The control system shall be capable of applying skip or solid lines in any sequence, through any and all of the extrusion shoes, or the spray guns, and in programmable cycle lengths. In addition, the mobile unit shall be equipped with an automatic counting mechanism capable of recording the number of lineal feet of thermoplastic markings applied to the pavement surface with an accuracy of 0.5 percent.

b. Portable Application Equipment: The portable applicator shall be defined as hand-operated equipment, specifically designed for placing special markings such as crosswalks, stopbars, legends, arrows, and short lengths of lane, edge and centerlines. The portable applicator shall be capable of applying thermoplastic pavement markings by the extrusion method. The portable applicator shall be loaded with hot thermoplastic composition from the melting kettles on the mobile applicator. The portable applicator shall be equipped with all the necessary components, including a materials storage reservoir, bead dispenser, extrusion shoe, and heating accessories, so as to be capable of holding the molten thermoplastic at a temperature of 375 to 425 degrees F, of extruding a line of 3 to 12 inches in width, and in thicknesses of not less than 0.125 inch nor more than 0.190 inch and of generally uniform cross section.

1.2.3 Surface Preparation Equipment

1.2.3.1 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall be capable of furnishing not less than 150 cfm of air at a pressure of not less than 90 psi at each nozzle used, and shall be equipped with traps that will maintain the compressed air free of oil and water.

1.2.3.2 Waterblast Equipment

The water pressure shall be specified at 2600 psi at 140 degrees F in order to adequately clean the surfaces to be marked.

1.2.4 Marking Removal Equipment

Equipment shall be mounted on rubber tires and shall be capable of removing markings from the pavement without damaging the pavement surface or joint sealant. Waterblasting equipment shall be capable of producing an adjustable, pressurized stream of water. Sandblasting equipment shall include an air compressor, hoses, and nozzles. The compressor shall be equipped with traps to maintain the air free of oil and water.

1.2.4.1 Shotblasting Equipment

Shotblasting equipment shall be capable of producing an adjustable depth of removal of marking and pavement. Each unit shall be self-cleaning and self-contained, shall be able to confine dust and debris from the operation, and shall be capable of recycling the abrasive for reuse.

1.2.4.2 Chemical Equipment

Chemical equipment shall be capable of application and removal of chemicals from the pavement surface, and shall leave only non-toxic biodegradable residue.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment
Composition Requirements
Qualifications

SD-06 Test Reports

Sampling and Testing

SD-07 Certificates

Volatile Organic Compound (VOC)

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Submit documentation certifying that pertinent personnel are qualified for equipment operation and handling of chemicals.

1.4.2 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

1.4.3 Maintenance of Traffic

1.4.3.1 Roads, Streets, and Parking Areas

When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, flagpersons, and related equipment for the safe passage of vehicles shall be provided.

1.5 DELIVERY, STORAGE, AND HANDLING

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

1.6 ENVIRONMENTAL REQUIREMENTS

Pavement surface shall be free of snow, ice, or slush. Surface temperature shall be at least 40 degrees F and rising at the beginning of operations, except those involving shot or sand blasting. Operation shall cease during thunderstorms. Operation shall cease during rainfall, except for waterblasting and removal of previously applied chemicals. Waterblasting shall cease where surface water accumulation alters the effectiveness of material removal.

PART 2 PRODUCTS

2.1 PAINT

The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months. Pavement marking paints shall comply with Section 246 of the Virginia (VDOT) 2007 Road and Bridge Specifications and local laws enacted to ensure compliance with Federal Clean Air Standards. Paint materials shall conform to the restrictions of the local Air Pollution Control District.

2.2 THERMOPLASTIC COMPOUNDS

The thermoplastic reflectorized pavement marking compound shall be extruded or sprayed in a molten state onto a primed pavement surface. Following a

surface application of glass beads and upon cooling to normal pavement temperatures, the marking shall be an adherent reflectorized strip of the specified thickness and width that is capable of resisting deformation by traffic.

2.2.1 Composition Requirements

Submit Manufacturer's current printed product description and Material Safety Data Sheets (MSDS) for each type paint/color proposed for use. The binder component shall be formulated as a hydrocarbon resin. The pigment, beads and filler shall be uniformly dispersed in the binder resin. The thermoplastic composition shall be free from all skins, dirt, and foreign objects and shall comply with the following requirements:

Component	Percent by Weight	
	White	Yellow
Binder	17 min.	17 min.
Titanium dioxide	10 min.	-
Glass beads	20 min.	20 min.
Calcium carbonate and inert fillers	49 max.	*
Yellow pigments	-	*
*Amount and type of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, providing the other composition requirements of this specification are met.		

2.2.2 Physical Properties

2.2.2.1 Color

The color shall be as indicated.

2.2.2.2 Drying Time

When installed at 70 degrees F and in thicknesses between 1/8 and 3/16 inch, after curing 15 minutes.

2.2.2.3 Softening Point

The composition shall have a softening point of not less than 194 degrees F when tested in accordance with ASTM E28.

2.2.2.4 Specific Gravity

The specific gravity of the composition shall be between 1.9 and 2.2 as determined in accordance with ASTM D792.

2.2.3 Asphalt Concrete Primer

The primer for asphalt concrete pavements shall be a thermosetting adhesive with a solids content of pigment reinforced synthetic rubber and synthetic

plastic resin dissolved and/or dispersed in a volatile organic compound (VOC). Submit certificate stating that the proposed pavement marking paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located. Solids content shall not be less than 10 percent by weight at 70 degrees F and 60 percent relative humidity. A wet film thickness of 0.005 inch plus or minus 0.001 inch, shall dry to a tack-free condition in less than 5 minutes.

2.2.4 Portland Cement Concrete Primer

The primer for Portland cement concrete pavements shall be an epoxy resin primer. The primer shall be of the type recommended by the manufacturer of the thermoplastic composition. Epoxy primers recommended by the manufacturer shall be approved by the Contracting Officer prior to use. Requests for approval shall be accompanied with technical data, instructions for use, and a 1 quart sample of the primer material.

2.3 SAMPLING AND TESTING

Materials proposed for use shall be stored on the project site in sealed and labeled containers, or segregated at source of supply, sufficiently in advance of needs to allow 60 days for testing. Submit certified copies of the test reports, prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory. Upon notification by the Contractor that the material is at the site or source of supply, a sample shall be taken by random selection from sealed containers in the presence of the Contracting Officer. Samples shall be clearly identified by designated name, specification number, batch number, manufacturer's formulation number, project contract number, intended use, and quantity involved. Testing shall be performed in an approved independent laboratory. If materials are approved based on reports furnished by the Contractor, samples will be retained by the Government for possible future testing should the material appear defective during or after application.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Thoroughly clean surfaces to be marked before application of the pavement marking material. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking. Surfaces shall be recleaned, when work has been stopped due to rain.

3.1.1 Pretreatment for Early Painting

Where early painting is required on rigid pavements, apply a pretreatment with an aqueous solution, containing 3 percent phosphoric acid and 2

percent zinc chloride, to prepared pavement areas prior to painting.

3.1.2 Cleaning Existing Pavement Markings

In general, markings shall not be placed over existing pavement marking patterns. Remove existing pavement markings, which are in good condition but interfere or conflict with the newly applied marking patterns. Deteriorated or obscured markings that are not misleading or confusing or interfere with the adhesion of the new marking material do not require removal. New preformed and thermoplastic pavement markings shall not be applied over existing preformed or thermoplastic markings. Whenever grinding, scraping, sandblasting or other operations are performed the work must be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that is misleading or confusing. When these operations are completed the pavement surface shall be blown off with compressed air to remove residue and debris resulting from the cleaning work.

3.1.3 Cleaning Concrete Curing Compounds

On new portland cement concrete pavements, cleaning operations shall not begin until a minimum of 30 days after the placement of concrete. All new concrete pavements shall be cleaned by either sandblasting or water blasting. When water blasting is performed, thermoplastic and preformed markings shall be applied no sooner than 24 hours after the blasting has been completed. The extent of the blasting work shall be to clean and prepare the concrete surface as follows:

a. There is no visible evidence of curing compound on the peaks of the textured concrete surface.

b. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.

c. All remaining curing compound is intact; all loose and flaking material is removed.

d. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.

e. The surface to be marked is dry.

3.2 APPLICATION

All pavement markings and patterns shall be placed as shown on the plans.

3.2.1 Paint

Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Paint temperature shall be maintained within these same limits. New asphalt pavement surfaces and new Portland concrete cement shall be allowed to cure for a period of not less than 30 days before applications of paint. Paint shall be applied pneumatically with approved equipment at rate of coverage specified. Provide guide lines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined.

3.2.1.1 Rate of Application

a. Reflective Markings: Pigmented binder shall be applied evenly to the pavement area to be coated at a rate of 105 plus or minus 5 square feet/gallon. Glass spheres shall be applied uniformly to the wet paint on road and street pavement at a rate of 6 plus or minus 0.5 pounds of glass spheres per gallon of paint.

b. Nonreflective Markings: Paint shall be applied evenly to the pavement surface to be coated at a rate of 105 plus or minus 5 square feet/gallon.

3.2.1.2 Drying

The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a delay in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.

3.2.2 Thermoplastic Compounds

Thermoplastic pavement markings shall be placed upon dry pavement; surface dry only will not be considered an acceptable condition. At the time of installation, the pavement surface temperature shall be a minimum of 40 degrees F and rising. Thermoplastics, as placed, shall be free from dirt or tint.

3.2.2.1 Longitudinal Markings

All centerline, skipline, edgeline, and other longitudinal type markings shall be applied with a mobile applicator. All special markings, crosswalks, stop bars, legends, arrows, and similar patterns shall be placed with a portable applicator, using the extrusion method.

3.2.2.2 Primer

After surface preparation has been completed the asphalt and/or concrete pavement surface shall be primed. The primer shall be applied with spray equipment. Primer materials shall be allowed to "set-up" prior to applying the thermoplastic composition. The asphalt concrete primer shall be allowed to dry to a tack-free condition, usually occurring in less than 10 minutes. The Portland cement concrete primer shall be allowed to dry in accordance with the thermoplastic manufacturer's recommendations. To shorten the curing time of the epoxy resins an infrared heating device may be used on the concrete primer.

a. Asphalt Concrete Primer: Primer shall be applied to all asphalt concrete pavements at a wet film thickness of 0.005 inch, plus or minus 0.001 inch (265-400 square feet/gallon).

b. Portland Cement Concrete Primer: Primer shall be applied to all concrete pavements (including concrete bridge decks) at a wet film thickness of between 0.04 to 0.05 inch (320-400 square feet/gallon).

3.2.2.3 Markings

After the primer has "set-up", the thermoplastic shall be applied at temperatures no lower than 375 degrees F nor higher than 425 degrees F at the point of deposition. Immediately after installation of the marking,

drop-on glass spheres shall be mechanically applied so that the spheres are held by and imbedded in the surface of the molten material.

a. Extruded Markings: All extruded thermoplastic markings shall be applied at the specified width and at a thickness of not less than 0.125 inch nor more than 0.190 inch.

b. Sprayed Markings: All sprayed thermoplastic markings shall be applied at the specified width and the thicknesses designated in the contract plans. If the plans do not specify a thickness, centerline markings shall be applied at a wet thickness of 0.090 inch, plus or minus 0.005 inch, and edgeline markings at a wet thickness of 0.060 inch plus or minus 0.005 inch.

c. Reflective Glass Spheres: Immediately following application, reflective glass spheres shall be dropped onto the molten thermoplastic marking at the rate of 1 pound/20 square feet of compound.

3.3 MARKING REMOVAL

Pavement marking, shall be removed in the areas shown on the drawings. Removal of marking shall be as complete as possible without damage to the surface. Aggregate shall not be exposed by the removal process. After the markings are removed, the cleaned pavement surfaces shall exhibit adequate texture for remarking as specified in paragraph SURFACE PREPARATION. Demonstrate removal of pavement marking in an area designated by the Contracting Officer. The demonstration area will become the standard for the remainder of the work.

3.3.1 Equipment Operation

Equipment shall be controlled and operated to remove markings from the pavement surface, prevent dilution or removal of binder from underlying pavement, and prevent emission of blue smoke from asphalt or tar surfaces.

3.3.2 Cleanup and Waste Disposal

The worksite shall be kept clean of debris and waste from the removal operations. Cleanup shall immediately follow removal operations in areas subject to air traffic. Debris shall be disposed of at approved sites.

-- End of Section --

SECTION 32 31 11.12

GATE OPERATORS AND CONTROLS
04/13

PART 1 GENERAL

1.1 SUMMARY

The Work of this Section includes fabrication, handling, delivery to the site, storage and installation and programming of a self contained automatic swing gate operating system complete with programmable controller and inputs hereafter referred to as gate operators; motor foundation and pad; loop conduit and wiring placement and connection of the operators; and other components, all as shown on the Drawings or specified. Section includes:

a. Automatic Entry Gate Actuators.

b. Vehicle Detectors.

c. Entry Gate Control Programmable Units.

d. Weater rated, exterior grade key switches.

e. Digital keypad interfaces and inputs.

1.1.1 Related Sections

Other Sections related to this Section includes:

a. Section 32 31 19 INDUSTRIAL ORNAMENTAL SWING GATES.

b. Section 03 30 00 CAST IN PLACE CONCRETE.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B 3	(2001; R 2007) Standard Specification for Soft or Annealed Copper Wire
ASTM B 8	(2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 325	(2002; R 2007; R 2009; R 2009; R 2009; R

	2010) Door, Drapery, Gate, Louver, and Window Operators and Systems
UL 493	Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G
Wiring Diagrams; G

SD-03 Product Data

Automatic Gate Operators
Emergency Vehicle Access
Key Pad Control
Safety Loops
Gate Safety Edge Sensors
Magnetic Locks
Key Switch Control
Safety Conspicuity Material

Description of entry gate control equipment material and accessories to be provided. Provide data on operating equipment, characteristics and limitations, and operating temperature ranges.

SD-05 Design Data

Design Documentation
Operating Data

SD-07 Certificates

Qualifications
Quality Control Certificates

SD-10 Operation and Maintenance Data

written programming instructions

SD-11 Closeout Submittals

Record Drawings; G

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Approval by Contracting Officer is required of products or service of proposed manufacturer, suppliers, and installers, and will be based upon submission by Contractor of certification that:

a. Installer: Approved by manufacturer of materials and has technical qualifications, experience, trained personnel and facilities to install specified items.

b. Manufacturer's product submitted has been in satisfactory operation, on three installations similar and equivalent in size to this project for three years. Submit list of installations.

1.4.2 Maintenance Proximity

Installer shall maintain a place of business with maintenance facilities not more than 2-hour normal travel time from project site.

1.4.3 Regulatory Compliance

Provide internal electrical components required as part of entry gate control equipment that are listed by UL and comply with applicable NEMA standards.

Conform to all applicable local code requirements for fire/ambulance emergency vehicle access.

1.4.4 Single-Source Responsibility

Obtain entry gate control equipment from one source. Provide Quality Control Certificates from manufacturer that products have been tested to comply with requirements of this Section and in accordance with Drawings. Provide only accessories that have demonstrated compatibility with the primary system components.

1.4.5 Shop Drawings

Indicate plan layout of equipment, existing features such as gate columns and steel plates for hinges, access lanes, concrete curbing; mounting bolt dimensions, conduit and outlet locations, power requirements, and all in conformation to building code electrical requirements. Note which features are existing.

Wiring Diagrams: Detailing wiring for entry gate control equipment operator, signal, and control systems differentiating clearly between manufacturer-installed wiring and field-installed wiring.

Show locations of connections to electrical service provided as a unit of work under other Divisions.

1.4.6 Design Documentation

For entry gate control equipment components for inclusion in Operating and Maintenance Manuals, include the following.

a. Maintenance Instructions: Provide manufacturer's instructions for maintenance of entry control equipment.

b. Include recommended methods and frequency for maintaining equipment in optimum operating condition under anticipated traffic and use conditions.

c. Include precautions against materials and methods that may be

detrimental to finishes and performance.

d. Lubrication Schedule and Information: Provide lubrication and periodic maintenance requirement schedules including parts list and parts numbers.

1.4.7 Operating Data

Provide operating data for operating equipment, including clock timer, security access keys, strobe emergency access, radio transmitter/receivers, magnetic locks, and any other pertinent information required for Government operation.

1.5 PROJECT CONDITIONS

Arrange and pay for a locate service to locate any existing conduits, accessories, and wiring indicated in construction drawings. Install additional conduit, accessories, and power wiring to operating equipment. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.6 DELIVERY, STORAGE AND HANDLING

Deliver materials to site in original sealed packages or containers; labeled for identification with manufacturer's name and brand. Store materials in weather tight and dry storage facility. Protect from damage due to handling, weather, and construction operations before, during and after installation.

1.7 WARRANTY

Submit manufacturer's written guaranty for five (5) years for materials and workmanship. Final Acceptance: Requirement for final acceptance shall be continued acceptable use of entry/exit gate control equipment without a breakdown or stoppage for a period of fifteen (15) calendar days after final acceptance by Government.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Entry-Exit Gate Operation

Manual open - timed closed gate operation is activated by pedestal mounted key pads located on both sides of gate, and by a keyed switch co-located with keypad. Once the code is entered on the key pad, the magnetic lock disengages, the entry gate operator motor is activated, the gate segments open in unison to their full open position and remain in that position until the vehicle has cleared the loops on either side. The built in adjustable timer will begin to close the gate once the vehicle has passed the last vehicle detector and no other vehicles are detected anywhere in the exit path reversing loops or in the shadow loop. When closing via the timer or by remote control, the gate operator will sense and initiate the reverse of the gate within two seconds of contact with a solid object. This will serve as the primary type of entrapment protection. In the absence of an obstruction the gates will close and the magnetic locks will re-engage. The program shall require key pad code entry for passage from either side. There is to be no automatic operation of the gates without a code or activation of a key switch.

2.1.2 Manual Open - Manual Close

The gate may be opened and set in a remain open position by entering a separate dedicated code until a second single number or symbol is entered at which point the gate closes and the magnetic locks engage.

2.1.3 Magnetic Lock System

Incorporated into automatic control system, able to withstand forces up to 1,300 pounds.

2.1.4 Emergency Access

The gate operators may also be activated to achieve a Manual Open and Manual Close operation through a Key Switch. The secure box contains a switch that can only be operated by a controlled security key that is held by Joint Base Security, Medical and Fire Personnel.

2.1.5 Access Gate

Twenty-four-hour programmable clock with key pad and emergency vehicle access via secure key switch, for double leaf swing gate entrance.

2.2 MANUFACTURED UNITS

System design is based on commercially available with integral controller and on exterior-rated key pad interfaces that are currently used by security personnel. System shall open and close swinging gates, providing convenience and security. Model shall be adaptable to function with most available gate accessories including: radio controls, single and three button control stations, digital keypads, coded cards, sensing loops, telephone entry systems, warning lights, and revenue control equipment. Control voltage 24 Volt DC.

a. Conforms to Class II, when tested in accordance with UL 325

b. Electrical Components: Self-contained, plug-in, replaceable components. Include wiring for control units, grounded convenience outlet, switch for automatic or manual operation, switch to disconnect power unit, thermostatically controlled heater with control switch and preset thermostat, and thermal protection disconnect for motors.

Note: Facility employs the use of a Linear Corporation, Linear Access AK-11 Keypad elsewhere on the facility.

2.3 AUTOMATIC GATE OPERATORS

2.3.1 Operator Enclosure

Fully enclosed, NEMA 3R, weather-resistant and vandal resistant, hinged, lockable, 14-gauge steel enclosure with baked-on high durability powdercoat finish over a 7 gauge steel frame, tamper proof hardware, weather tight gaskets, master keyed locks; furnish two (2) keys for each cabinet, keyed alike. Conceal mounting bolts inside units.

Color of enclosure and all visible mounting supports and hardware shall match gate finish color.

2.3.2 Operator Motor

Provide minimum 1/2-HP motor with built-in overload protection in 230 VAC single phase operation for gates up to 700 lbs to 120 degree opening arc. Drive System: 20:1 gear reduction using worm-gear reduction in synthetic oil bath with a solenoid-activated brake system that prevents back-driving.

2.3.3 Open and Close Limit Settings

Limit switches are modular and fully adjustable.

2.3.4 Controller

Solid state logic controller built-in diagnostic L.E.D. indicators, left or right hand operation option, auto-close timer, optional run/prestart alarm, maximum run timer, stagger mode option, auxiliary relay accessory output, adjustable reverse delay time, adjustable brake delay time, constant pressure control station option, shadow loop open prevention option, integral cycle counter, programmable maintenance alert indicator, mid-travel stop option, integral radio control receiver option, integral entrapment sensing contact and radio obstacle inputs.

Additional required controls:

a. Inherent obstruction sensing providing separate, single force adjustments for both open and closed directions, allowing a closing gate to reverse to the opposite limit and stop when encountering an obstruction.

b. External obstruction sensing providing separate open and close cycle input connections for external contact and non-contact sensors.

c. Maglock control relay to activate and deactivate an optional magnetic lock for securing the gate in its closed position.

d. UL 325-compliant entrapment warning alarm system providing ability to offer a warning tone which begins 3-seconds prior to gate movement and continues during gate operation. Alarm volume shall be adjustable and have the ability to be silenced through programming.

e. Loop detector inputs allowing for the connection of exit, shadow, and interrupt loop detectors.

f. Timer-to-close providing adjustable timer settings between 1 and 180 seconds which resets upon receiving any additional open commands.

g. Maximum run timer to protect gate and operator from damage by limiting run time to 120 seconds.

h. Emergency Stop: Stop button in a weather-tight outdoor enclosure to halt operation of the operator in an emergency situation. Two locations will be approved by the Contracting Officer.

i. Accessory Power: 24 VAC connections for operator accessories, including magnetic locks, shadow and reverse loop detectors, reversing edge contact sensor assemblies as required.

j. Dual Gate capable via programmable selection. Provide three-wire twisted pair shielded cable required for this feature.

2.3.5 Wiring Terminations

Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

2.3.6 Disconnect Switch

Factory mount disconnect switch in control panel.

2.3.7 Battery Back-Up

Rechargeable back-up battery for power outages or brown outs.

2.3.8 Miscellaneous Accessories

Gates will require special length articulating arms and brackets to accommodate a larger swing operating arc.

Provide yellow warning strobes on top of each operator and program to illuminate during gate operation and 5-seconds before.

2.4 EMERGENCY VEHICLE ACCESS

Provide exterior grade key switch control unit to activate gates. Co-locate and mount unit with keypads in goose neck pedestals in locations approved by JB HHFM and the Contracting Officer.

2.4.1 Control Unit

To activate automatic gate operator by insertion of key and turning to open and turn to close. Unit shall be weather-proof/rated for exterior use.

Co-locate with key pad on gooseneck arms located on both sides of gate.

2.5 KEY PAD CONTROL

Provide goose neck pedestal mounted illuminated digital key pad control unit to activate gates. Locate on both sides of entry gates in locations approved by ANC and JBHHFM and as shown on the plans.

2.5.1 Control Unit

To activate gate motors by entry of access code onto digital key pad.

2.5.2 Cabinet Housing

Cast aluminum; thermally insulated to permit heater to maintain cabinet temperature to equipment operating minimum, flush access doors and panels, tamper proof flush mounted lock hardware and two (2) keys master keyed to operate access panel, weather tight gaskets.

a. Mount cabinet housing on a 4-inch square structural steel tube pedestal with a curved top to receive housing ("gooseneck"), and a trim plate to cover anchor bolts. Secure structural steel tube to mounting bolts in 48 inches deep by 12 inches diameter concrete footing that tapers to a 18 inches by 18 inches square cap that is sloped to shed water away from tube and anchor plate cover. Conduit for wiring to be

concealed in concrete footing. Surface mounting of conduit and wiring is not permitted. Finish exterior of steel tube with 5-mil power coating over prepared surface. Color to match ornamental steel entry gate color (black).

b. Provide space and frame support to locate Emergency Vehicle Access key switch adjacent to key pad.

c. Finish interior and exterior of cabinet with manufacturer's standard baked enamel finish over primer. Color: Black.

2.5.3 Key Pad

Mount 42-inches above vehicle pavement surface, illuminate and protect with projecting weather shield.

2.6 INTERRUPT AND REVERSE DETECTION (SAFETY LOOPS)

2.6.1 Vehicle Detection

For use in temperature range of -40 deg. F to 160-deg F to consist of detector unit in conjunction with safety sensing loop to interrupt gate operation when vehicle approaches exit gate area while gate is in closing process. Loop layout and size shall be determined by manufacturer to suit the project requirements and eliminate loop to loop interference.

2.6.2 Loop Wire

14 AWG gage, XHWN or THWN copper; loop size: size per application and manufacturers recommendations. Loop wire to meets UL 493 standard for direct burial. Pre-phased at factory for field installation.

a. Conductors: Solid (per ASTM B 3) or stranded soft annealed uncoated copper (per ASTM B 8)

b. Insulation: Polyvinyl chloride (PVC) compound to thickness required by Underwriters Laboratories for Type THHN 90 degree C rated

c. Color Code:

1) 2 Conductors: Black, White.
2) 3 Conductors: Black, White, Red.
3) Conductor Jacket: Heat stabilized nylon.
4) Grounding Conductor: Un-insulated, soft annealed solid.
5) Assembly: Individual Type THHN/THWN conductors are laid parallel with (or without) a grounding conductor it is placed in the web between insulated conductors.
6) Temperature: 60 degree C wet or dry.
7) Rating: 600V.

2.6.3 Loop Groove Fill

Manufacturer's recommendations and to properly match material and color that is sawn.

2.6.4 Accessories

Provide watertight transitions, junction boxes and connections specific to the conditions indicated by the systems manufacturer. Junction boxes in

lawn or pavement areas shall be traffic rated.

2.7 GATE SAFETY EDGE SENSORS

Provide UL listed three sided sensor on all gates operated by automatic gate operators. Control board/detector unit to be integral with gate operator control system.

2.8 MAGNETIC LOCKS

Electrically operated magnetic lock and strike with minimum 1,300 lbs. holding force. Protects gate and operator from damage. Bracket and systems designed for swing gate configuration. Includes all required junction boxes, brackets, welding, transformer, and wiring.

2.9 FINISHES

2.9.1 Cabinets and Pedestals

Baked enamel color on steel, stainless steel or integral color on high impact resistant plastic. Color: Black.

2.9.2 Safety Conspicuity Material

Provide 3M Scotchlite Black reflective striping tape widths as required for placement on sides of Key Pad housings and as 2 inches wide rings on protection posts mounted 6 inches from top of post.

PART 3 EXECUTION

3.1 EXAMINATION

Clean surfaces thoroughly prior to installation

Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions

Verify that electric power is available and of correct characteristics.

3.2 COORDINATION

Coordinate entry gate control equipment installation with installation of industrial ornamental swing gates. See Section 32 31 19 INDUSTRIAL ORNAMENTAL SWING GATES.

3.3 PREPARATION

Provide templates for anchor bolts and other items encased in concrete or below finished surfaces in sufficient time so as not to delay work.

Coordinate sawcut in new paving as required to install loop wiring. All installations and paving repairs shall be subject to review and approval by the Contracting Officer.

3.4 INSTALLATION

Install entry gate control system and components in accordance with manufacturer's instructions and placement drawings.

Mount pedestal post directly to concrete pad, firmly secured, plumb, and level.

Install schedule 40 protection posts as indicated.

Mount key pad and Emergency Vehicle Access key switch to mounting pedestal posts; provide base plate.

Wire in accordance with National Electric Code. All power and control wiring shall be in conduit. Conduits shall be concealed.

Enclose all splices in easily accessible junction boxes or on terminal boards.

Tag and identify all cable runs in all junction boxes

Cut grooves in pavement surface, install vehicle detection loops and lead-in wires, and fill grooves with loop filler. Loop fill material color to match material sawn. Mask surface as required. Remove and clean excess filler.

Install internal electrical wiring, conduit, junction boxes, transformers, circuit breakers, and all auxiliary components required.

The installer shall install all provided warning signs securely within view of both sides of the gate, as required by the manufacturer. Apply conspicuity tape as described. Apply finishes and tough UPS as required.

3.5 ADJUSTING

Prior to final acceptance of project adjust system components for smooth operation of entry gates. Fit or adjust hardware for ease of operations.

a. Lubricate hardware and other moving parts per manufacturer's printed instructions.

b. Re-adjust entry gate control system and components at completion of project.

3.6 CLEANING

Clean metal surfaces promptly after installation, exercising care to avoid damage to coatings. Touch up damaged shop-applied finishes as required to restore damaged areas.

Follow recommendations of manufacturer in selection of cleaning agents. Do not use cleaning agents containing ammonia or other compounds that might damage finished metal surfaces.

3.7 FIELD QUALITY CONTROL

3.7.1 Tests

Test operating functions in accordance with manufacturer's printed checklist. Correct defects revealed by tests. Retest corrected areas until functions are operating properly.

3.8 DEMONSTRATIONS, TESTING, AND ACCEPTANCE

Instruct Government personnel in proper operation, programming, and maintenance of entry gate control equipment. Train personnel in procedures to follow in event of operational failures or malfunctions.

a. Contracting Officer shall arrange for a minimum of 2 security personnel responsible for the management and programming of access control systems at ANC.

b. Provide written programming instructions to Security Personnel that have been identified in writing as the recipients by the Contracting Officer. This personnel shall receive the code used during the demonstration exercise and will be responsible for successfully reprogramming the access codes immediately upon receipt of the code. Contractor will demonstrate that all prior codes have been eliminated.

c. Contractor shall turn over key pad box access keys to the Contracting Officer.

3.8.1 Acceptance

At completion of project, and as a condition of acceptance, entry gate control equipment and systems shall be automatically operated for a period of 30 consecutive calendar days without breakdown.

3.9 PROTECTION

Protect entry gate control equipment finished surfaces from damage during delivery, storage, erection, and after completion of work until final inspection and acceptance.

3.10 RECORD DRAWINGS

Provide Record Drawings (As-Builts) recording actual locations of concealed conduit and vehicle detection activators.

-- End of Section --

SECTION 32 31 13

CHAIN LINK FENCES AND GATES
08/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A116	(2011) Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
ASTM A153/A153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A702	(1989; R 2006) Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought
ASTM A780/A780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A90/A90M	(2011) Standard Test Method for Weight of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM C94/C94M	(2012) Standard Specification for Ready-Mixed Concrete
ASTM F1043	(2011a) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F1083	(2010) Standard Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures
ASTM F567	(2011a) Standard Practice for Installation of Chain Link Fence
ASTM F626	(2008) Standard Specification for Fence Fittings
ASTM F883	(2009) Padlocks

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-F-191	(Rev K) Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and

	Accessories)
FS RR-F-191/1	(Rev F) Fencing, Wire and Post, Metal (Chain-Link Fence Fabric)
FS RR-F-191/2	(Rev E) Fencing, Wire and Post, Metal (Chain-Link Fence Gates)
FS RR-F-191/3	(Rev E; Am 1) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fence Assembly; G, AE
Location of Gate, Corner, End, and Pull Posts; G, AE
Gate Assembly; G, AE
Gate Hardware and Accessories; G, AE
Erection/Installation Drawings; G, AE

SD-03 Product Data

Fence Assembly
Gate Assembly
Gate Hardware and Accessories
Recycled Material Content
Zinc Coating
Fabric
Stretcher Bars
Concrete

SD-04 Samples

Fabric; G, AE
Posts; G, AE
Braces; G, AE
Line Posts; G, AE
Sleeves; G, AE
Top Rail; G
Tension Wire; G
Stretcher Bars; G
Gate Posts; G
Gate Hardware and Accessories; G
Padlocks; G
Wire Ties; G

SD-07 Certificates

Certificates of Compliance

SD-08 Manufacturer's Instructions

Fence Assembly
Gate Assembly
Hardware Assembly
Accessories

1.3 ASSEMBLY AND INSTALLATION INSTRUCTIONS

Submit manufacturer's erection/installation drawings and instructions that detail proper assembly and materials in the design for fence, gate, hardware and accessories.

Submit erection/installation drawings along with manufacturer's catalog data for complete fence assembly, gate assembly, hardware assembly and accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

1.5 QUALITY ASSURANCE

1.5.1 Required Report Data

Submit reports of listing of chain-link fencing and accessories regarding weight in ounces for zinc coating.

1.5.2 Certificates of Compliance

Submit certificates of compliance in accordance with the applicable reference standards and descriptions of this section for the following:

a. Zinc coating

b. Fabric

c. Stretcher bars

d. Gate hardware and accessories

e. Concrete

PART 2 PRODUCTS

2.1 GENERAL

Provide fencing materials conforming to the requirements of ASTM A116, ASTM A702, ASTM F626, and as specified.

Submit manufacturer's data indicating percentage of recycled material content in protective fence materials, including chain link fence, fabric, and gates to verify affirmative procurement compliance.

2.2 ZINC COATING

Provide hot-dip galvanized (after fabrication) ferrous-metal components and accessories, except as otherwise specified.

Provide zinc coating of weight not less than 1.94 ounces per square foot, as determined from the average result of two specimens, when tested in accordance with ASTM A90/A90M.

Provide zinc coating conforming to the requirements of the following:

a. Pipe: FS RR-F-191/3 Class 1 Grade A in accordance with ASTM F1083.

b. Hardware and accessories: ASTM A153/A153M, Table 1

c. Surface: ASTM F1043

d. External: Type B-B surface zinc with organic coating, 0.97 ounce per square foot minimum thickness of acrylated polymer.

e. Internal: Surface zinc coating of 0.97 ounce per square foot minimum.

Provide galvanizing repair material that is cold-applied zinc-rich coating conforming to ASTM A780/A780M.

2.3 FABRIC

FS RR-F-191 and detailed specifications as referenced and other requirements as specified.

FS RR-F-191/1; Type I, zinc-coated steel, 9 gage. Mesh size, 2 inches. Provide selvage knuckled at one selvage and twisted and barbed at the other and knuckled at both selvages. Height of fabric, as indicated.

Provide fabric consisting of No. 9-gage wires woven into a 2-inch diamond mesh, with dimensions of fabric and wire conforming to ASTM A116, ASTM A702 and ASTM F626, with 2.0 ounces per square foot zinc galvanizing.

Provide one-piece fabric widths for fence heights up to 12 feet.

2.4 TOP AND BOTTOM SELVAGES

Provide knuckled selvages at top and bottom for fabric with 2 inch mesh and up to 60 inches high, and if over 60 inches high, provide twisted and barbed top selvage and knuckled bottom selvage.

Knuckle top and bottom selvages for 1-3/4-inch and 1-inch mesh fabric.

2.5 POSTS, TOP RAILS, AND BRACES

FS RR-F-191/3 line posts; Class 1, steel pipe, Grade A. End, corner, and pull posts; Class 1, steel pipe, Grade A. Braces and rails; Class 1, steel pipe, Grade A or in minimum sizes listed in FS RR-F-191/3 for each class and grade.

2.6 LINE POSTS

Minimum acceptable line posts are as follows:

Up to 6-feet high:

Grade A: 1.900 inch O.D. pipe weighing 2.72 pounds per linear foot.

Over 6-feet high:

2.0 inch O.D. pipe weighing 3.65 pounds per linear foot.

2.7 END, CORNER, AND PULL POSTS

Provide minimally acceptable end, corner, and pull posts as follows:

Up to 6 feet high:

Grade A: 2.375 inch O.D. pipe weighing 3.65 pounds per linear foot.

Over 6 feet high:

Grade A: 2.875 inch O.D. pipe weighing 5.79 pounds per linear foot.

2.8 SLEEVES

Provide sleeves for setting into concrete construction of the same material as post sections, sized 1-inch greater than the diameter or dimension of the post. Weld flat plates to each sleeve base to provide anchorage and prevent intrusion of concrete.

2.9 TOP RAIL

Provide a minimum of 1.660 inches O.D. pipe rails. Provide expansion couplings 6-inches long at each joint in top rails.

2.10 CENTER RAILS BETWEEN LINE POSTS

For fencing over 6-feet high, provide 1.660 inches O.D. pipe center rails,

2.11 POST-BRACE ASSEMBLY

Provide bracing consisting of 1.660 inches O.D. pipe and 3/8 inch adjustable truss rods and turnbuckles.

2.12 TENSION WIRE

Provide galvanized wire, No. 7-gage, coiled spring wire, provided at the bottom of the fabric only. Provide zinc coating that weighs not less than 2.0 ounces per square foot.

2.13 STRETCHER BARS

Provide bars that have one-piece lengths equal to the full height of the fabric with a minimum cross section of 3/16 by 3/4 inch, in accordance with ASTM A116, ASTM A702 and ASTM F626.

2.14 POST TOPS

Provide tops that are steel, wrought iron, or malleable iron designed as a weathertight closure cap. Provide one cap for each post, unless equal protection is provided by a combination post-cap and barbed-wire supporting arm. Provide caps with an opening to permit through passage of the top rail.

2.15 STRETCHER BAR BANDS

Provide bar bands for securing stretcher bars to posts that are steel,

wrought iron, or malleable iron spaced not over 15 inches on center. Bands may also be used in conjunction with special fittings for securing rails to posts. Provide bands with projecting edges chamfered or eased.

2.16 GATE POSTS

Provide a gate post for supporting each gate leaf as follows:

Up to 6-feet wide:

2.875 inch O.D. pipe Grade A weighing 5.79 pounds per linear foot.

Over 6 feet wide and up to 13 feet wide:

2.875 inch O.D. pipe Grade A weighing 5.79 pounds per linear foot.

2.17 GATES

FS RR-F-191/2; Type II, double swing. Shape and size of gate frame, as indicated. Framing and bracing members, round of steel alloy. Steel member finish, zinc-coated. Provide gate frames and braces of minimum sizes listed in FS RR-F-191/3 for each Class and Grade, except that steel pipe frames are a minimum of 1.90 inches o.d., 0.120 inches minimum wall thickness and aluminum pipe frames and intermediate braces are 1.869 inches o.d. minimum, 0.940 lb/ft of length. Gate fabric, is as specified for fencing fabric. Coating for steel latches, stops, hinges, keepers, and accessories, galvanized Provide plunger bar type gate latches. Provide intermediate members as necessary for gate leaves more than 8 feet wide, to provide rigid construction, free from sag or twist. Provide truss rods or intermediate braces for gate leaves less than 8 feet wide. Attach gate fabric to gate frame in accordance with manufacturer's standards, except that welding is not permitted. Arrange padlocking latches to be accessible from both sides of gate, regardless of latching arrangement.

For gate leaves up to 6-feet high or 6-feet wide, provide perimeter gate frames of 1.66 inch O.D. pipe Grade A weighing 2.27 pounds per linear foot.

For gate leaves over 6 feet high or 6 feet wide, provide perimeter gate frames of 1.90 inch O.D. pipe Grade A weighing 2.72 pounds per linear foot.

Provide gate frame assembly that is welded or assembled with special malleable or pressed-steel fittings and rivets to provide rigid connections. Install fabric with stretcher bars at vertical edges; stretcher bars may also be used at top and bottom edges. Attach stretcher bars and fabric to gate frames on all sides at intervals not exceeding 15 inches. Attach hardware with rivets or by other means which provides equal security against breakage or removal.

Provide diagonal cross-bracing, consisting of 3/8-inch diameter adjustable-length truss rods on welded gate frames, where necessary to obtain frame rigidity without sag or twist. Provide nonwelded gate frames with diagonal bracing.

2.18 GATE HARDWARE AND ACCESSORIES

Provide gate hardware and accessories that conforms to ASTM A116, ASTM A702, ASTM F626, and be as specified:

Provide malleable iron hinges to suit gate size, non-lift-off type, offset to permit 180-degree opening.

Provide latch that permits operation from either side of the gate, with a padlock eye provided as an integral part of the latch.

Provide stops and holders of malleable iron for vehicular gates. Provide stops that automatically engage the gate and hold it in the open position until manually released.

Provide double gates with a cane bolt and ground-set keeper, with latch or locking device and padlock eye designed as an integral part.

2.19 MISCELLANEOUS HARDWARE

Provide miscellaneous hot-dip galvanized hardware as required.

2.20 WIRE TIES

Provide 16-gage galvanized steel wire for tying fabric to line posts,spaced 12 inches on center. For tying fabric to rails and braces, space wire ties 24 inches on center. For tying fabric to tension wire, space 0.105-inch hog rings 24 inches on center.

Manufacturer's standard procedure will be accepted if of equal strength and durability.

Provide wire ties constructed of the same material as the fencing fabric.

2.21 CONCRETE

Provide concrete conforming to ASTM C94/C94M, and obtaining a minimum 28-day compressive strength of 3,000 psi.

2.22 GROUT

Provide grout of proportions one part portland cement to three parts clean, well-graded sand and a minimum amount of water to produce a workable mix.

2.23 PADLOCKS

Provide padlocks conforming to ASTM F883, with chain.

PART 3 EXECUTION

Provide complete installation conforming to ASTM F567.

3.1 GENERAL

Ensure final grading and established elevations are complete prior to commencing fence installation.

3.2 EXCAVATION

Provide excavations for post footings which are drilled holes in virgin or compacted soil, of minimum sizes as indicated.

Space footings for line posts 10 feet on center maximum and at closer intervals when indicated, with bottoms of the holes approximately 3-inches

below the bottoms of the posts. Set bottom of each post not less than 36-inches below finished grade when in firm, undisturbed soil. Set posts deeper, as required, in soft and problem soils and for heavy, lateral loads.

Uniformly spread soil from excavations adjacent to the fence line or on areas of Government property, as directed. When solid rock is encountered near the surface, drill into the rock at least 12 inches for line posts and at least 18 inches for end, pull, corner, and gate posts. Drill holes at least 1 inch greater in diameter than the largest dimension of the placed post.

If solid rock is below the soil overburden, drill to the full depth required except that penetration into rock need not exceed the minimum depths specified above.

3.3 SETTING POSTS

Remove loose and foreign materials from holes and the soil moistened prior to placing concrete.

Provide tops of footings that are trowel finished and sloped or domed to shed water away from posts. Set hold-open devices, sleeves, and other accessories in concrete.

Keep exposed concrete moist for at least 7 calendar days after placement or cured with a membrane curing material, as approved.

Grout all posts set into sleeved holes in concrete with an approved grouting material.

Maintain vertical alignment of posts set in concrete construction until concrete has set.

3.3.1 Earth and Bedrock

Provide concrete bases of dimensions indicated. Compact concrete to eliminate voids, and finish to a dome shape.

3.3.2 Bracing

Brace gate, corner, end, and pull posts to nearest post with a horizontal brace used as a compression member, placed at least 12 inches below top of fence, and a diagonal tension rod.

3.4 CONCRETE STRENGTH

Provide concrete that has attained at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than 7 calendar days after placement, before rails, tension wire, or fabric are installed. Do not stretch fabric and wires or hang gates until the concrete has attained its full design strength.

Take samples and test concrete to determine strength as specified.

3.5 TOP RAILS

Provide top rails that run continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by the fencing manufacturer.

3.6 CENTER RAILS

Provide single piece center rails between posts set flush with posts on the fabric side, using special offset fittings where necessary.

3.7 BRACE ASSEMBLY

Provide bracing assemblies at end and gate posts and at both sides of corner and pull posts, with the horizontal brace located at midheight of the fabric.

Install brace assemblies so posts are plumb when the diagonal rod is under proper tension.

Provide two complete brace assemblies at corner and pull posts where required for stiffness and as indicated.

3.8 TENSION WIRE INSTALLATION

Install tension wire by weaving them through the fabric and tying them to each post with not less than 7-gage galvanized wire or by securing the wire to the fabric with 10-gage ties or clips spaced 24 inches on center.

3.9 FABRIC INSTALLATION

Provide fabric in single lengths between stretch bars with bottom barbs placed approximately 1-1/2-inches above the ground line. Pull fabric taut and tied to posts, rails, and tension wire with wire ties and bands.

Install fabric on the security side of fence, unless otherwise directed.

Ensure fabric remains under tension after the pulling force is released.

3.10 STRETCHER BAR INSTALLATION

Thread stretcher bars through or clamped to fabric 4 inches on center and secured to posts with metal bands spaced 15 inches on center.

3.11 GATE INSTALLATION

Install gates plumb, level, and secure, with full opening without interference. Install ground set items in concrete for anchorage as recommended by the fence manufacturer. Adjust hardware for smooth operation and lubricated where necessary.

3.12 TIE WIRES

Provide tie wires that are U-shaped to the pipe diameters to which attached. Twist ends of tie wires not less than two full turns and bent so as not to present a hazard.

3.13 FASTENERS

Install nuts for tension bands and hardware on the side of the fence opposite the fabric side. Peen ends of bolts to prevent removal of nuts.

3.14 ZINC-COATING REPAIR

Clean and repair galvanized surfaces damaged by welding or abrasion, and cut ends of fabric, or other cut sections with specified galvanizing repair material applied in strict conformance with the manufacturer's printed instructions.

3.15 TOLERANCES

Provide posts that are straight and plumb within a vertical tolerance of 1/4 inch after the fabric has been stretched. Provide fencing and gates that are true to line with no more than 1/2 inch deviation from the established centerline between line posts. Repair defects as directed.

3.16 SITE PREPARATION

3.16.1 Clearing and Grading

Clear fence line of trees, brush, and other obstacles to install fencing. Establish a graded, compacted fence line prior to fencing installation.

3.17 FENCE INSTALLATION

Install fence on prepared surfaces to line and grade indicated. Secure fastening and hinge hardware in place to fence framework by peening or welding. Allow for proper operation of components. Coat peened or welded areas with a repair coating matching original coating. Install fence in accordance with fence manufacturer's written installation instructions except as modified herein.

3.17.1 Post Spacing

Provide line posts spaced equidistantly apart, not exceeding 10 feeton center. Provide gate posts spaced as necessary for size of gate openings. Do not exceed 500 feet on straight runs between braced posts. Provide corner or pull posts, with bracing in both directions, for changes in direction of 15 degrees or more, or for abrupt changes in grade. Provide drawings showing location of gate, corner, end, and pull posts.

3.17.2 Top and Bottom Tension Wire

Install bottom tension wires before installing chain-link fabric, and pull wires taut. Place top and bottom tension wires within 8 inches of respective fabric line.

3.18 ACCESSORIES INSTALLATION

3.18.1 Post Caps

Install post caps as recommended by the manufacturer.

3.18.2 Padlocks

Provide padlocks for gate openings and provide chains that are securely attached to gate or gate posts. Provide padlocks keyed alike, and provide two keys for each padlock.

3.19 CLEANUP

Remove waste fencing materials and other debris from the work site.

-- End of Section --

SECTION 32 31 19

INDUSTRIAL ORNAMENTAL SWING GATES
04/13

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M	(2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A787/A787M	(2009)Standard Specification for Electric-Resistance-Welded Metallic-Coated Carbon Steel Mechanical Tubing
ASTM B 117	(2009) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM D 1654	(2008) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244	(2009b) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2794	(1993; R 2004) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(2009; E 2010) Measuring Adhesion by Tape Test
ASTM D 523	(2008) Standard Test Method for Specular Gloss
ASTM D 714	(2002; R 2009) Evaluating Degree of Blistering of Paints
ASTM D 822	(2001; R 2006) Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings

1.2 SUMMARY

Install a total industrial ornamental steel fence system of their published design. The system shall include all components (i.e., pickets, rails, posts, gates and hardware) required to provide the free opening as indicated on the Drawings.

1.2.1 Related Sections

Refer to Section 03 30 00 CAST-IN-PLACE-CONCRETE and Section 32 31 11.12 AUTOMATIC GATE OPERATORS AND CONTROLS.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Ornamental Picket Swing Gates; G, AE

SD-03 Product Data

Ornamental Picket Swing Gates; G, AE
Safety Conspicuity Materials

SD-04 Samples

Finish; G
Polyester Powder Coat Finish on sample segment of fabricated unit

SD-11 Closeout Submittals

As-built Drawings; G

1.4 QUALITY ASSURANCE

Contractor shall provide installers who are thoroughly skilled and familiar with the type of construction, systems, components, and techniques specified.

1.5 WARRANTY

All structural fence components shall be warranted within specified limitations by the manufacturer for a period of 10 years from date of original purchase. Warranty shall cover defects in material finish, including cracking, peeling, chipping, blistering, or corroding. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufacturer warranty shall be guaranteed for 5 years from date of original purchase.

1.6 DELIVERY, STORAGE, AND HANDLING

Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

PART 2 PRODUCTS

2.1 MANUFACTURER

The industrial ornamental tubular steel gate system shall be from manufacturer that is experienced in the manufacture of welded ornamental steel gate products and conforming with the specifications as indicated or as approved equivalent. The design for the gate and components shown on the Construction Documents is based upon commercially available products.

2.2 MATERIALS

Steel material for gate framework (i.e. tubular pickets, rails and posts), shall be galvanized prior to forming in accordance with the requirements of ASTM A653/A653M, with minimum yield strength of 45,000 psi. The steel shall be hot-dip galvanized to meet the requirements of ASTM A653/A653M with a minimum zinc coating weight of 0.90 oz/ft2, Coating Designation G-90.

Material for pickets shall be 1 inch square, 14 gage. tubing. The cross-sectional shape of the rails shall conform to double wall design with outside cross-section dimensions of 1.75 inch square and a minimum thickness of 14 gage. Gate frame ends shall be 2-inch square 11 gage steel. Gate leaves that exceed 6 feet in length shall have a 1.75 inch square 14 gage steel intermediate upright. Picket holes in the top and bottom rail shall be spaced to accommodate open spacing between pickets of 3.75 inch. Gate posts shall meet the minimum size requirements required by the manufacturer, but in no case shall be less than a 6 inch by 6 inch square steel tube with a 3/16-inch wall thickness.

2.3 ORNAMENTAL PICKET SWING GATES

Provide indicated items required to complete gate system. Galvanize each ferrous metal item in accordance with ASTM A 653/A 653M and provide finishes as specified.

2.3.1 Pickets

Galvanized square steel tubular members manufactured per ASTM A787/A787M, having a 45,000 psi yield strength and G90 zinc coating, 0.90 oz/ft2. Minimum size pickets: 1-inch. Space pickets 3.75 inch maximum face to face.

2.3.2 Post Caps

Formed steel, cast of malleable iron, weathertight closure cap. Provide post cap for each post. Fully weld to post, grind weld smooth, clean, prepare and apply ouch up finish in accordance with Manufacturer's instructions for field touch up to fulfill underlying warranty and guarantee requirements

2.3.3 Gate Frames

Fabricate ornamental picket swing gate using galvanized steel members, ASTM A787/A787M, structural quality steel, 45,000 psi tensile strength, with galvanized G90 coating. Frame members welded using stainless steel welded to form rigid one-piece unit (no substitution). Minimum size vertical uprights, 2-inch square 11 gage wall thickness.

2.3.4 Bracing

Provide diagonal adjustable length truss rods on gates to prevent sag. Bracing and associated hardware shall receive same color and finish as gate.

2.3.5 Hardware Materials

Galvanized steel or malleable iron shapes to suit gate size.

2.3.6 Hinges

Structurally capable of supporting gate leaf and allow opening and closing without binding. Weld on non-lift-off box type hinge design shall permit gate to swing 120° from a closed position. Hinges shall permit gate to swing 240° stop to stop. Provide integral offsets as needed. All offsets and brackets to be shop fabricated and installed prior to preparation and application of finish. Provide quantity of hinges to meet operational requirements.

2.3.7 Double Gates

Gate open and closed positions are held by automatic gate operators and a magnetic lock that is controlled by a gate actuator controller housed in the primary/master unit. Refer to Section 32 31 11.12 GATE OPERATORS AND CONTROLLERS.

2.3.8 Magnetic Lock Mounting Brackets

Size, fabricate, and attach bracket to gate leafs prior to preparation and application of finish.

2.3.9 Gate Posts

Square members, ASTM A787/A787M, structural quality steel 45,000 psi tensile strength, with galvanized G90 coating. Coat inside and outside member. Posts galvanized outside and painted inside is unacceptable. Minimum post size 6 inches by 6 inches having 3/16-inch wall thickness.

2.3.10 Polyester Powder Coat Finish

After all components have been galvanized to provide maximum corrosion resistance, pretreat, clean, and prepare galvanized surface to assure complete adhesion of base and finish coats.

a. Color: Black. All exposed components to receive black finish as described.

2.3.11 Safety Conspicuity Materials

3M Scotchlite Black reflective striping tape widths as required for placement in 12 inches long segments, 36 inches on center along top and bottom rails, uprights. Omit in areas of contact sensors. Place 12 inch long strip on every third picket starting from the non-hinged end of each leaf. Mount the center of the vertical strip at 2 feet below the top of the top rail. Apply material to both sides of gate.

2.4 POST SETTING MATERIAL

Concrete shall be minimum 28 day compressive strength of 3,000 psi.

2.5 FABRICATION

Pickets, rails and posts shall be precut to specified lengths. Top and bottom "U" rails shall be prepunched to accept pickets. Picket tops shall be closed with PVC insert of matching finish color specifically intended for this use.

The manufactured galvanized framework shall be subjected to a thermal stratification coating process (high-temperature, in-line, multi-stage, multi-layer) including, as a minimum, a six-stage pretreatment/wash (with zinc phosphate), an electrostatic spray application of an epoxy base, and a separate electrostatic spray application of a polyester finish. The base coat shall be a thermosetting epoxy powder coating (gray in color) with a minimum thickness of 2 mils (0.0508mm). The topcoat shall be a "no-mar" TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color shall be black. The stratification-coated framework shall be capable of meeting the performance requirements for each quality characteristic shown.

Coating Performance Requirements

Quality Characteristics	**ASTM Test Method**
Adhesion	ASTM D 3359 Method B
Corrosion Resistance	ASTM B 117, ASTM D 714, ASTM D 1654
Impact Resistance	ASTM D 2794
Weathering Resistance	ASTM D 822, ASTM D 2244, ASTM D 523 (60 ft method)

Completed gate and frame shall be capable of supporting a 600 lb. load applied at midspan without permanent deformation. Panels shall be biasable to a 25% change in grade.

Swing gates shall be fabricated using 1.75" x 14 gage double channel "U" rail, 2-inch square by 11 gage gate ends, and 1-inch square by 14 gage pickets. Gates that exceed 6' in width will have a 1.75" sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding.

PART 3 EXECUTION

3.1 PREPARATION

All new installations shall be laid out by the Contractor in accordance with the construction plans.

Verify areas to receive fencing are completed to final grades and elevations

Ensure property lines and legal boundaries of Work are clearly established.

Coordinate with Security personnel during construction.

a. Gate opening is to be secured at all times.

b. Once gate is installed but are not connected to the operators, the Contractor shall provide acceptable means of securing the gate in the closed position without damage to the gate or gate finish. "Secure" in this instance means only the authorized contractor and government security may have means of opening the gate.

3.2 GATE INSTALLATION

Install gates plumb, level and secure for full opening without interference. Attach hardware by means which will prevent unauthorized removal. Adjust hardware for smooth operation. Install post caps and other accessories to complete fence. Coordinate connection and operation with installation of automatic gate operators.

3.3 INSTALLATION MAINTENANCE

When cutting/drilling rails or posts adhere to the following steps to seal the exposed surfaces:

a. Remove all metal shavings from cut area.

b. Apply custom finish paint matching fence color. Failure to seal exposed surfaces as specified in this section will negate warranty. Manufacturer's spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of parts or components, other than those from the gate manufacturer, will negate the manufacturer's warranty.

3.4 GATE INSTALLATION

Gate posts shall be spaced as indicated on the Construction Documents, according to the manufacturer's gate drawings, approved during submittal processing, allowing the proper fit with gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based upon the application; weight, height, and number of gate cycles. The gate manufacturer' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacturer of the gate and shall be installed per manufacturer's recommendations.

3.5 CLEANING

Contractor shall clean the jobsite of excess materials; post-hole excavations shall be cleaned, and debris removed or scattered uniformly away from posts, so as to not disturb the adjoining topsoil and turf growth.

3.6 PROTECTION

Contractor shall protect gate and finishes throughout project until Final Acceptance and turnover. Contractor may be required to provide access through the gates to the Government or other parties and shall implement measures and techniques to protect gate and finish.

-- End of Section --

SECTION 32 34 23

FABRICATED ROADWAY BRIDGES
04/13

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 292M/M 292	(2006)Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
AASHTO M 270M/M 270	Standard Specification for Structural Steel for Bridges
AASHTO M 111M/M 111	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
AASHTO T 99	Moisture-Density Relations Of Soils

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM B 695	(2009) Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C 150	(2009) Standard Specification for Portland Cement
ASTM C 173/C 173M	(2010a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	(2009b) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 31/C 31M	(2009) Standard Practice for Making and Curing Concrete Test Specimens in the Field

ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates
ASTM C 39/C 39M	(2009a) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(2010) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 497	(2005) Concrete Pipe, Manhole Sections, or Tile

1.2 SUMMARY

1.2.1 Type

This work shall consist of furnishing and constructing a precast concrete arch span bridge system in accordance with these specifications and in reasonably close conformity with the lines, grades, design and dimensions shown on the Construction Documents or as established by the Contracting Officer.

1.2.2 Designation

Precast reinforced concrete arch span bridge units conforming to this specification shall be designated by span and rise. Precast reinforced concrete wingwalls and headwalls in accordance with this specification shall be designated by length, height, and deflection angle.

1.2.3 Design

The precast elements shall be designed in accordance with the "Standard Specifications for Highway Bridges" 17th Edition, adopted by the American Association of State Highway and Transportation Officials, 2002. A minimum of one and one-half feet of cover above the crown of the bridge units is required in the installed condition. (Unless noted otherwise on the shop drawings and designed accordingly.)

Additional design information is provided on the Construction Drawings.

1.2.4 Foundations

Contractor shall design all foundations for precast concrete arch spans and associated wing walls and headwalls. Foundation elements shall be supported by auger cast pile with a 70 ton capacity and as further described in Section 31 63 16 AUGER-PLACED GROUT PILES. Additional design information as shown on the Construction Drawings.

1.2.5 Basis-of-Design

BEBO Arch Systems, and precast retaining wall systems as manufactured by ConTech Engineering Solutions, Inc.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When

used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Precast Element Dimension and Reinforcement Details; G, AE

SD-05 Design Data

Design Calculations
Concrete
Steel Reinforcement
Steel Hardware

SD-06 Test Reports

Precast Production Reports
Markings
Compression Testing
Cylinder Tests
Core Tests

SD-07 Certificates

Certification

SD-11 Closeout Submittals

Record Drawings (As-Builts); G

1.4 STORAGE, HANDLING & DELIVERY

1.4.1 Storage

Precast concrete bridge elements shall be lifted and stored in “as-cast” position. Precast concrete headwall and wingwall units are cast, stored and shipped in a flat position. The precast elements shall be stored in such a manner to prevent cracking or damage. Store elements using timber supports as appropriate. The units shall not be moved until the concrete compressive strength has reached a minimum of 2500 psi, and they shall not be stored in an upright position.

1.4.2 Handling

Handling devices shall be permitted in each precast element for the purpose of handling and setting. Spreader beams may be required for the lifting of precast concrete bridge elements to preclude damage from bending or torsion forces. The contractor must provide a double-drum crane with equal capacity on each drum for the installation of the precast elements.

1.4.3 Delivery

Precast concrete elements must not be shipped until the concrete has attained the specified design compressive strength, or as directed by the design Engineer. Precast concrete elements may be unloaded and placed on the ground at the site until installed. Store elements using timber supports as appropriate.

1.5 QUALITY ASSURANCE

The Precaster shall demonstrate adherence to the standards set forth in the NPCA Quality Control Manual. The Precaster shall meet either Section 4.7.1 or 4.7.2

1.5.1 Certification

Precaster shall be certified by the Precast/Prestressed Concrete Institute Plant Certification Program or the National Precast Concrete Association's Plant Certification Program prior to and during production of the products covered by this specification.

1.5.2 Qualifications, Testing and Inspection

The Precaster shall have been in the business of producing precast concrete products similar to those specified for a minimum of three years. He shall maintain a permanent quality control department or retain an independent testing agency on a continuing basis. The agency shall issue a report, certified by a licensed engineer, detailing the ability of the Precaster to produce quality products consistent with industry standards.

The Precaster shall show that the following tests are performed in accordance with the ASTM standards indicated. Tests shall be performed as indicated in this Section.

a. Air Content: ASTM C 231 or ASTM C 173/C 173M.

b. Compressive Strength: ASTM C 31/C 31M, ASTM C 39/C 39M, ASTM C 497.

The Precaster shall provide documentation demonstrating compliance with this section to CONTECH® Bridge Solutions at regular intervals or upon request. Tests shall be included in Design Submittals to the Government

The Government may place an inspector in the plant when the products covered by this specification are being manufactured.

1.5.3 Documentation

Precaster shall submit Precast Production Reports and Design Calculations to CONTECH® Bridge Solutions as required. Reports shall be included in Design Submittals to the Government.

1.5.4 Workmanship/Finish

The bridge units, wingwalls, and headwalls shall be substantially free of fractures. The ends of the bridge units shall be normal to the walls and centerline of the bridge section, within the limits of the variations specified, except where beveled ends are specified. The faces of the wingwalls and headwalls shall be parallel to each other, within the limits of variations specified. The surface of the precast elements shall be a smooth steel form or troweled surface. Trapped air pockets causing surface defects shall be considered as part of a smooth, steel form finish.

1.5.5 Repairs

Precast elements may be repaired, if necessary, because of imperfections in manufacture or handling damage and will be acceptable if, in the opinion of

the Government, the repairs are sound, properly finished and cured, and the repaired section conforms to the requirements of this specification.

1.5.6 Rejection

The precast elements shall be subject to rejection on account of any of the specification requirements. Individual precast elements may be rejected because of any of the following:

a. Fractures or cracks passing through the wall, except for a single end crack that does not exceed one half the thickness of the wall.

b. Defects that indicate proportioning, mixing, and molding not in compliance with these specifications.

c. Honeycombed or open texture.

d. Damaged ends, where such damage would prevent making a satisfactory joint.

1.5.7 Markings

Each bridge unit shall be clearly marked by waterproof paint. Marks shall not be placed on surfaces which will be exposed in the completed construction. The following shall be shown on the inside of the vertical leg of the bridge section:

a. Bridge Span X Bridge Rise.

b. Date of Manufacture.

c. Name or trademark of the manufacturer.

1.6 PERMISSIBLE VARIATIONS

1.6.1 Bridge Units

1.6.1.1 Internal Dimensions

The internal dimension shall vary not more than 1 percent from the design dimensions nor more than 1-1/2 inches whichever is less.

1.6.1.2 Slab and Wall Thickness

The slab and wall thickness shall not be less than that shown in the design by more than 1/4 inch. A thickness more than that required in the design shall not be cause for rejection.

1.6.1.3 Length of Opposite Surfaces

Variations in laying lengths of two opposite surfaces of the bridge unit shall not be more than 1/2 inch in any section, except where beveled ends for laying of curves are specified by the purchaser.

1.6.1.4 Length of Section

The underrun in length of a section shall not be more than 1/2 inch in any bridge unit.

1.6.1.5 Position of Reinforcement

The maximum variation in position of the reinforcement shall be plus or minus 1/2 inch. In no case shall the cover over the reinforcement be less than 1 1/2 inches for the outside circumferential steel or be less than 1 inch for the inside circumferential steel as measured to the external or internal surface of the bridge. These tolerances or cover requirements do not apply to mating surfaces of the joints.

1.6.1.6 Area of Reinforcement

The areas of steel reinforcement shall be the design steel areas as shown in the manufacturer's shop drawings. Steel areas greater than those required shall not be cause for rejection. The permissible variation in diameter of any reinforcement shall conform to the tolerances prescribed in the ASTM Specification for that type of reinforcement.

1.6.2 Wingwalls & Headwalls

1.6.2.1 Wall Thickness

The wall thickness shall not vary from that shown in the design by more than 1/2 inch.

1.6.2.2 Length/ Height of Wall Section

The length and height of the wall shall not vary from that shown in the design by more than 1/2 inch.

1.6.2.3 Position of Reinforcement

The maximum variation in the position of the reinforcement shall be plus or minus 1/2 inch. In no case shall the cover over the reinforcement be less than 1 1/2 inches.

1.6.2.4 Size of Reinforcement

The permissible variation in diameter of any reinforcing shall conform to the tolerances prescribed in the ASTM Specification for that type of reinforcing. Steel area greater than that required shall not be cause for rejection.

1.7 TESTING/INSPECTION

1.7.1 Testing

1.7.1.1 Type of Test Specimen

Concrete compressive strength shall be determined from compression tests made on cylinders or cores. For cylinder testing, a minimum of 2 cylinders shall be taken for each bridge element or core testing, core shall be cut from each of 3 precast elements selected at random from each group of 15 or fewer elements made using a single concrete mix in the same day’s production. Each lot shall be considered separately for the purpose of testing and acceptance.

1.7.1.2 Compression Testing

Cylinders shall be made and tested as prescribed by the ASTM C 39/C 39M

Specification. Cores shall be obtained and tested for compressive strength in accordance with the provisions of the ASTM C 42/C 42M Specification.

1.7.1.3 Acceptability of Cylinder Tests

When the average compressive strength of all cylinders tested is equal to or greater than the design compressive strength, and not more than 10 percent of the cylinders tested have a compressive strength less than the design concrete strength, and no cylinder tested has a compressive strength less than 80 percent of the design compressive strength, then the lot shall be accepted. When the compressive strength of the cylinders tested does not conform to these acceptance criteria, the acceptability of the lot may be determined as described in this Section.

1.7.1.4 Acceptability of Core Tests

The compressive strength of the concrete in a lot is acceptable when the average core test strength is equal to or greater than the design concrete strength. When the compressive strength of a core tested is less than the design concrete strength, the precast element from which that core was taken may be re-cored. When the compressive strength of the re-core is equal to or greater than the design concrete strength, the compressive strength of the concrete in that lot is acceptable.

a. When the compressive strength of any recore is less than the design concrete strength, the precast element from which that core was taken shall be rejected. Two precast elements from the remainder of the lot shall be selected at random and one core shall be taken from each. If the compressive strength of both cores is equal to or greater than the design concrete strength, the compressive strength of the remainder of that group is acceptable. If the compressive strength of either of the two cores tested is less than the design concrete strength, the remainder of the group shall be rejected or, at the option of the manufacturer, each precast element of the remainder of the group shall be cored and accepted individually, and any of these elements that have cores with less than the design concrete strength shall be rejected.

b. Plugging Core Holes - The core holes shall be plugged and sealed by the manufacturer in a manner such that the elements will meet all of the test requirements of this specification. Precast elements so sealed shall be considered satisfactory for use.

c. Test Equipment - Every manufacturer furnishing precast elements under this specification shall furnish all facilities and personnel necessary to carryout the test required.

1.7.2 Inspection

The quality of materials, the process of manufacture, and the finished precast elements shall be subject to inspection by the Government.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Concrete

The concrete for the precast elements shall be air-entrained composed of Portland cement, fine and coarse aggregates, admixtures and water.

Air-entrained concrete shall contain 6 plus or minus 2 percent air. The air-entraining admixture shall conform to AASHT0 M 154. The minimum concrete compressive strength shall be as shown on the shop drawings.

2.1.1.1 Portland Cement

Shall conform to the requirements of ASTM C 150-Type I, Type II, or Type lIl cement.

2.1.1.2 Coarse Aggregate

Shall consist of stone having a maximum size of 1 inch. Aggregate shall meet requirements for ASTM C 33/C 33M.

2.1.1.3 Water Reducing Admixture

The manufacturer may submit, for approval by the Contracting Officer, a water-reducing admixture for the purpose of increasing workability and reducing the water requirement for the concrete.

2.1.1.4 Calcium Chloride

The addition to the mix of calcium chloride or admixtures containing calcium chloride will not be permitted.

2.1.1.5 Mixture

The aggregates, cement and water shall be proportioned and mixed in a batch mixer to produce a homogeneous concrete meeting a 28 compressive of 5000 psi strength. The proportion of portland cement in the mixture shall not be less than 650 pounds (7 sacks) per cubic yard of concrete. The maximum allowable water/cement ratio shall be 0.40.

2.1.2 Steel Reinforcement

The minimum steel yield strength shall be 60,000 psi, unless otherwise noted on the shop drawings.

All reinforcing steel for the precast elements shall be fabricated and placed in accordance with the detailed shop drawings submitted by the manufacturer.

Reinforcement shall consist of welded wire fabric conforming to ASTM A 185/ A 185M or ASTM A 497, or deformed billet steel bars conforming to ASTM A 615/ A 615M, Grade 60. Longitudinal distribution reinforcement may consist of welded wire fabric or deformed billet-steel bars.

2.1.3 Steel Hardware

Bolts and threaded rods for wingwall connections shall conform to ASTM A 307. Nuts shall conform to AASHTO M 292M/M 292 (ASTM A 194/ A 194M) Grade 2H. All bolts, threaded rods and nuts used in wingwall connections shall be mechanically zinc coated in accordance with ASTM B 695 Class 50.

Structural Steel for wingwall connection plates and plate washers shall conform to AASHTO M 270M/M 270 (ASTM A 709/ A 709M) Grade 36 and shall be hot dip galvanized as per AASHTO M 111M/M 111 (ASTM A 123/A 123M).

Inserts for wingwalls shall be 1 inch diameter Two-Bolt Preset Wingwall

Anchors as manufactured by Dayton/Richmond Concrete Accessories, Miamisburg, Ohio, (800) 745-3700.

Ferrule Loop Inserts shall be F-64 Ferrule Loop Inserts as manufactured by Dayton/Richmond Concrete Accessories, Miamisburg, Ohio, (800) 745-3700.

Hook Bolts used in attached headwall connections shall be ASTM A 307.

Inserts for detached headwall connections shall be AISI Type 304 stainless steel, F-58 Expanded Coil inserts as manufactured by Dayton/Richmond Concrete Accessories, Miamisburg, Ohio, (800) 745-3700. Coil rods and nuts used in headwall connections shall be AISI Type 304 stainless steel. Washers used in headwall connections shall be either AISI Type 304 stainless steel plate washers or AASHTO M 270M/M 270 (ASTM A 709/ A 709M) Grade 36 plate washers hot dip galvanized as per AASHTO M 111M/M 111 (ASTM A 123/A 123M).

Reinforcing bar splices shall be made using the Dowel Bar Splicer System as manufactured by Dayton/Richmond Concrete Accessories, Miamisburg, Ohio, (800) 745-3700, and shall consist of the Dowel Bar Splicer (DB-SAE) and Dowel-In (DI).

2.2 MANUFACTURE OF PRECAST ELEMENTS

Subject to the provisions of this Section, the precast element dimension and reinforcement details shall be as prescribed in the plan and shop drawings provided by the manufacturer.

2.2.1 Forms

Forms used in manufacture shall be sufficiently rigid and accurate to maintain the required precast element dimensions within the permissible variations given in Section 5 of these specifications. All casting surfaces shall be of a smooth material.

2.2.2 Placement of Reinforcement

Placement of Reinforcement in Precast Bridge Units - The cover of concrete over the outside circumferential reinforcement shall be 2 inches minimum. The cover of concrete over the inside circumferential reinforcement shall be 1 1/2 inches minimum, unless otherwise noted on the shop drawings. The clear distance of the end circumferential wires shall not be less than one inch nor more than two inches from the ends of each section. Reinforcement shall be assembled utilizing single or multiple layers of welded wire fabric (not to exceed 3 layers), supplemented with a single layer of deformed billet-steel bars, when necessary. Welded wire fabric shall be composed of circumferential and longitudinal wires meeting the spacing requirements of this Section, and shall contain sufficient longitudinal wires extending through the bridge unit to maintain the shape and position of the reinforcement. Longitudinal distribution reinforcement may be welded wire fabric or deformed billet-steel bars and shall meet the spacing requirements of this Section. The ends of the longitudinal distribution reinforcement shall be not more than 3 inches and not less than 1 1/2 inches from the ends of the bridge unit.

2.2.3 Placement of Reinforcement for Precast Wingwalls and Headwalls

The cover of concrete over the longitudinal and transverse reinforcement shall be 2 inches minimum. The clear distance from the end of each precast

element to the end of reinforcing steel shall not be less than 1/2 inch nor more than 3 inches. Reinforcement shall be assembled utilizing a single layer of welded wire fabric, or a single layer of deformed billet-steel bars. Welded wire fabric shall be composed of transverse and longitudinal wires meeting the spacing requirements of this Section, and shall contain sufficient longitudinal wires extending through the element to maintain the shape and position of the reinforcement. Longitudinal reinforcement may be welded wire fabric or deformed billet-steel bars and shall meet the spacing requirements of this Section.

2.2.4 Laps, Welds, Spacing

2.2.4.1 Laps, Welds, and Spacing for Precast Bridge Units

Tension splices in the circumferential reinforcement shall be made by lapping. Laps may be tack welded together for assembly purposes. For smooth welded wire fabric, the overlap shall meet the requirements of AASHTO 8.30.2 and AASHTO 8.32.6. For deformed welded wire fabric, the overlap shall meet the requirements of AASHTO 8.30.1 and AASHTO 8.32.5. The overlap of welded wire fabric shall be measured between the outer-most longitudinal wires of each fabric sheet. For deformed billet-steel bars, the overlap shall meet the requirements of AASHTO 8.25. For splices other than tension splices, the overlap shall be a minimum of 12 inches for welded wire fabric or deformed billet-steel bars. The spacing center to center of the circumferential wires in a wire fabric sheet shall be not less than 2 inches nor more than 4 inches. The spacing center to center of the longitudinal wires shall not be more than 8 inches. The spacing center to center of the longitudinal distribution steel for either line of reinforcing in the top slab shall be not more than 16 inches.

2.2.5 Curing

The precast concrete elements shall be cured for a sufficient length of time so that the concrete will develop the specified compressive strength in 28 days or less. Any one of the following methods of curing or combinations thereof shall be used:

a. Steam Curing - The precast elements may be low-pressure steam cured by a system that will maintain a moist atmosphere.

b. Water Curing - The precast elements may be water cured by any method that will keep the sections moist.

c. Membrane Curing - A sealing membrane conforming to the requirements of ASTM Specification C 309 may be applied and shall be left intact until the required concrete compressive strength is attained. The concrete temperature at the time of application shall be within plus or minus 10 degrees F of the atmospheric temperature. All surfaces shall be kept moist prior to the application of the compounds and shall be damp when the compound is applied.

2.3 JOINTS

The bridge units shall be produced with flat butt ends. The ends of the bridge units shall be such that when the sections are laid together they will make a continuous line with a smooth interior free of appreciable irregularities, all compatible with the permissible variations in this Section. The joint width between adjacent precast units shall not exceed 3/4 inches.

PART 3 EXECUTION

3.1 INSTALLATION PREPARATION

To ensure correct installation of the precast concrete bridge system, care and caution must be exercised in forming the support areas for bridge units, headwall, and wingwall elements. Exercising special care will facilitate the rapid installation of the precast components.

3.1.1 Pile Supported Foundation Elements

Do not over excavate foundations unless directed by site soil engineer to remove unsuitable soil.

The Project Geotechnical Engineer or his designated representative shall certify that the pile installer and pile capacity meets or exceeds the Project design requirements, prior to the contractor pouring of the pile caps. A copy of the report shall be submitted to Contractor prior to shipment of precast concrete elements.

The bridge units and wingwalls shall be installed on either precast or cast-in-place concrete footings. The size and elevation of the footings shall be as designed by the Contractor's Engineer. A keyway shall be formed in the top surface of the bridge footing as specified on the plans. No keyway is required in the wingwall footings, unless otherwise specified on the plans.

The pile caps shall be given a smooth float finish and shall reach a compressive strength of 4,000 psi before placement of the bridge and wingwall elements. Backfilling shall not begin until the pile cap has reached the full design compressive strength without written approval from the Contractor.

The pile caps surface shall be constructed in accordance with grades shown on the plans. When tested with a 10-foot straight edge, the surface shall not vary more than 1/4 inch in 10 feet.

If a precast concrete footing is used, the contractor shall prepare a 4-inch thick base layer of compacted granular material the full width of the footing prior to placing the precast footing.

The foundations for precast concrete bridge elements and wingwalls must be connected by reinforcement to form one monolithic body. Expansion joints shall not be used.

The contractor shall be responsible for the construction of the foundations per the signed and sealed Engineering Submittals.

Refer to Section 31 63 16 AUGER CAST PILE for additional design and construction information on piles.

3.2 INSTALLATION

The installation of the precast concrete elements shall be as laid out in the project’s Preconstruction Notes.

3.2.1 Lifting

It is the responsibility of the contractor to ensure that a crane of the correct lifting capacity is available to handle the precast concrete units. This can be accomplished by using the weights given for the precast concrete components and by determining the lifting reach for each crane unit. Site conditions must be checked well in advance of shipping to ensure proper crane location and to avoid any lifting restrictions. The lift anchors or holes provided in each unit are the only means to be used to lift the elements. The precast concrete elements must not be supported or raised by other means than those given in the manuals and drawings without written approval from the Contractor.

3.2.2 Construction Equipment Weight Restrictions

In no case shall equipment operating in excess of the design load (HS20 or HS25) be permitted over the bridge units unless approved by the Contractor.

In the immediate area of the bridge unit, the following restrictions for the use of heavy construction machinery during backfilling operations apply:

a. No construction equipment shall cross the bare precast concrete bridge unit.

b. After the compacted fill level has reached a minimum of 4 inches over the crown of the bridge, construction equipment with a weight of less than 10 tons may cross the bridge.

c. After the compacted fill level has reached a minimum of 1 foot over the crown of the bridge, construction equipment with a weight of less than 30 tons may cross the bridge.

d. After the compacted fill level has reached the design cover, or 2 feet, minimum, over the crown of the precast concrete bridge, construction equipment within the design load limits for the road may cross the precast concrete bridge.

3.2.3 Leveling Pad/Shims

The bridge units and wingwalls shall be set on masonite or steel shims measuring 6" x 6", minimum, unless shown otherwise on the plans. A minimum gap of 1/2 inch shall be provided between the footing and the bottom of the bridge's vertical legs or the bottom of the wingwall.

3.2.4 Placement of Bridge Units

The bridge units shall be placed as shown on the signed and sealed plan drawings submitted by the Contractor. Special care shall be taken in setting the elements to the true line and grade. The joint width between adjacent precast units shall not exceed 3/4 inches.

It is imperative that any lateral spreading of the bridge elements be avoided during and after their placement. Therefore, a sufficient quantity of hardwood wedges must be available and on site. The hardwood wedges are placed in the key and smaller shims and wedges added before complete release of the precast concrete bridge element from the crane. Also, a supply of 1/4- 1/2-inch and 1/8-thick steel or masonite shims for various shimming purposes should be on site.

3.2.5 Placement of Wingwalls & Headwalls

The wingwalls and headwalls shall be placed as shown on the plan drawings. Special care shall be taken in setting the elements to the true line and grade.

3.2.6 Waterproofing/ Joint protection and Subsurface Drainage

3.2.6.1 External Protection of Joints

The butt joint made by two adjoining bridge units shall be covered with a 7/8-inch by 1-3/8-inch preformed bituminous joint sealant and a minimum of a 9-inch wide joint wrap. The surface shall be free of dirt before applying the joint material. A primer compatible with the joint wrap to be used shall be applied for a minimum width of nine inches on each side of the joint. The external wrap shall be either EZ-WRAP RUBBER by PRESS-SEAL GASKET CORPORATION, SEAL WRAP by MAR MAC MANUFACTURING CO. INC. or approved equal. The joint shall be covered continuously from the bottom of one bridge section leg, across the top of the bridge and to the opposite bridge section leg. Any laps that result in the joint wrap shall be a minimum of six inches long with the overlap running downhill.

In addition to the joints between bridge units, the joint between the end bridge unit and the headwall shall also be sealed as described above. If precast wingwalls are used, the joint between the end bridge unit and the wingwall shall be sealed with a 2'-0" strip of filter fabric. Also, if lift holes are formed in the bridge units, they shall be primed and covered with a 9-inch by 9-inch square of joint wrap.

During the backfilling operation, care shall be taken to keep the joint wrap in its proper location over the joint.

Subsoil drainage shall be as coordinated by the Contractor.

3.3 GROUTING

Grouting shall not be performed when temperatures are expected to go below 35 degrees for a period of 72 hours.

Fill the bridge-foundation keyway with cement grout (Portland cement and water or cement mortar composed of Portland cement, sand and water) with a minimum 28-day compressive strength of the following unless otherwise indicated on the installation drawings.

a. 3000 psi for spans 48 feet,

b. 5000 psi for spans > 48 feet,

Vibrate as required to ensure that the entire key around the bridge element is completely filled.

All grout shall have a maximum aggregate size of 1/4 inch. Lifting and erection anchor recesses shall be filled with grout.

3.4 BACKFILL

Do not perform backfilling during wet or freezing weather.

No backfill shall be placed against any structural elements until they

have been approved by the Engineer.

Backfill shall be considered as all replaced excavation and new embankment adjacent to the precast concrete elements. The project construction and material specifications, which include the specifications for excavation for structures and roadway excavation and embankment construction, shall apply except as modified in this section.

Backfill Zones:

a. Non-Expansive In-situ soil. Only Non-Expansive In-situ soil shall be used as backfill behind retaining walls.

b. Zone A: constructed embankment or overfill.

c. Zone B: fill that is directly associated with precast concrete bridge installation.

d. Zone C: road structure.

3.4.1 In-situ Soil

Natural ground is to be sufficiently stable to allow effective support to the precast concrete bridge units. As a guide, the existing natural ground should be of similar quality and density to Zone B material for minimum lateral dimension of one bridge span outside of the bridge footing.

3.4.2 Zone A

Zone A requires fill material with specifications and compacting procedures equal to that for normal road embankments.

3.4.3 Zone B

Generally, soils shall be reasonably free of organic matter, and, near concrete surfaces, free of stones larger than 3 inches in diameter. See Project Geotechnical Report for detailed descriptions of acceptable soils.

3.4.4 Zone C

Zone C is the road section of gravel, asphalt or concrete built in compliance with local engineering practices.

3.4.5 Placing and Compacting Backfill

Dumping for backfilling is not allowed any nearer than 3 ft to a vertical plane through the bridge key.

The fill must be placed and compacted in layers not exceeding 8 inches. The maximum difference in the surface levels of the fill on opposite sides of the bridge must not exceed 2 feet.

The fill behind wingwalls must be placed at the same time as that of the bridge fill. It must be placed in progressively placed horizontal layers not exceeding 8 inches per layer.

The backfill of Zone B shall be compacted to a minimum density of 95 percent of Standard Proctor as required by AASHTO T 99.

Soil within 1 foot of concrete surfaces should be hand-compacted. Elsewhere, use of rollers is acceptable. If vibrating roller-compactors are used, they should not be started or stopped within Zone B and the vibration frequency should be at least 30 revolutions per second.

The backfill material and compacting behind wingwalls should satisfy the criteria for the bridge backfill, Zone 'B'.

Backfill against a waterproofed surface shall be placed carefully to avoid damage to the waterproofing material.

3.4.6 Bridge Units

For fill heights over 12 feet, no backfilling may begin until a backfill compaction testing plan has been coordinated with and approved by the Contractor. Cost of the backfill compaction testing shall be included in the cost of the precast units. This included cost applies only to projects with fill heights over 12 feet (as measured from top crown of bridge to finished grade).

3.4.7 Wingwalls

Backfill in front of wingwalls shall be carried to ground lines shown in the approved Designated Design plans.

3.4.8 Monitoring

The contractor shall check settlements and horizontal displacement of foundation to ensure that they are within the allowable limit provided by the engineer. These measurements should give an indication of the settlements and deformations along the length of the foundations.

The first measurement row should take place after the erection of all precast bridge system elements, a second after completion of backfilling, and a third before opening of the bridge to traffic. Further measurements may be made according to local conditions.

The maximum difference in vertical displacements 'v' should not exceed 1 inch along the length of one foundation.

3.5 CLOSEOUT

Provide Record Drawings to the Contracting Officer in approved format.

-- End of Section --

SECTION 32 34 40

FABRICATED STEEL TRUSS BRIDGES
05/13

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 318	(2008; Errata 2008; Errata 2009; Errata 2009; Errata 2009; Errata 2009; Errata 2009) Building Code Requirements for Structural Concrete and Commentary

ASTM INTERNATIONAL (ASTM)

ASTM A 588/A 588M	(2005) Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A 653/A 653M	(2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 847 / A 847M	(2012) Standard Specification for Cold-Formed Welded and Seamless High-Strength, Low-Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance

AMERICAN WELDING SOCIETY (AWS)

AWS A5.28/A5.28M	(2005) Specification for Low-Alloy Steel Electrodes and Rods for Gas Shielded Arc Welding (With 2007 errata)
AWS D1.1/D1.1M	(2010) Structural Welding Code - Steel

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595	(Rev C; Notice 1) Colors Used in Government Procurement

1.2 SUMMARY

1.2.1 Type

This work shall consist of furnishing and constructing a fabricated steel truss bridge system in accordance with these specifications and in reasonably close conformity with the lines, grades, design and dimensions

shown on the Construction Documents or as established by the Contracting Officer.

1.2.2 Designation

Fabricated steel truss bridge units conforming to this specification shall be designated by span and height.

1.2.3 Related Sections

Refer to Section 03 33 00 CAST-IN-PLACE ARCHITECTURAL CONCRETE and 32 16 13 CONCRETE SIDEWALKS AND CURBS AND GUTTERS.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submittal Drawings; G, AE

Refer to Approval Checklist shown in the Appendix of this Section.

Delivery Routes
Site Access Points
Off-Load Locations
Storage Locations
Erection Equipment Access Points
Erection Equipment Routes On-Site
Erection Equipment Locations during Installation
Erection Equipment Lift Points and Swing Envelopes

Provide drawings, maps, narrative, etc. for Contractor's and Installers plans for delivery and erection proceedures above.

SD-05 Design Data

Bearing Devices; G, AE
Design Calculations
Fabrication Submittals; G, AE
Numerical table of joint gap widths; G, AE

Refer to Approval Checklist shown in the Appendix of this Section.

SD-07 Certificates

Qualifications
Professional Engineer
Painter Qualifications

SD-11 Closeout Submittals

Record Drawings (As-built Drawings); G

Inspection and maintenance procedures

1.4 QUALITY ASSURANCE

Provide information to Contracting Officer for approval in submittal format.

1.4.1 Qualifications

Qualified suppliers must have at least 5 years experience fabricating these type structures.

1.4.2 Governing Design Codes/References

Structural members shall be designed in accordance with recognized engineering practices and principles as follows:

a. Structural Steel Design:

1) American Association of State Highway and Transportation Officials (AASHTO).

2) LRFD latest Pedestrian Guide Specifications for Pedestrian Bridges.

b. Welded Tubular Connections:

1) American National Standards Institute / American Welding Society (ANSI/AWS) and the Canadian Institute of Steel Construction (CISC).

2) Welder certifications in compliance with AWS standard qualification tests.

3) All welded tubular connections shall be checked, when within applicable limits, for the limiting failure modes outlined in the AWS D1.1/D1.1M/D1.1M Structural Welding Code or in accordance with the "Design Guide for Hollow Structural Section Connections" as published by the Canadian Institute of Steel Construction (CISC).

4) When outside the "validity range" defined in these design guidelines, the following limit states or failure modes must be checked:

a) Chord face plastification.
b) Punching shear (through main member face).
c) Material failure: Tension failure of the web member and local buckling of a compression web member.
d) Weld failure: Allowable stress based on "effective lengths" and "Ultimate" capacity.
e) Local buckling of a main member face.
f) Main member failure: Web or sidewall yielding, Web or sidewall crippling, Web or sidewall buckling, and Overall shear failure.

5) All tubular joints shall be plain unstiffened joints (made without the use of reinforcing plates) except as follows:

a) Floor beams hung beneath the lower chord of the structure may be constructed with or without stiffener (or gusset) plates, as

required by design.
b) Floor beams which frame directly into the truss verticals (H-Section bridges) may be designed with or without end stiffening plates as required by design.
c) Where chords, end floor beams and in high profiles the top end struts weld to the end verticals, the end verticals (or connections) may require stiffening to transfer the forces from these members into the end vertical.
d) Truss vertical to chord connections.

NOTE: The effects of fabrication tolerances shall be accounted for in the design of the structure. Special attention shall be given to the actual fit-up gap at welded truss joints.

c. Concrete

1) American Concrete Institute (ACI).

2) Reinforced concrete shall be designed in accordance with the "Building Code Requirements for Structural Concrete" (ACI 318).

d. Top Chord Stability

1) Structural Stability Research Council (SSRC), formerly Column Research Council.

1.4.3 Pre-Installation Conference

Contractor and installer shall hold pre-installation conference with the Contracting Officer.

1.5 DELIVERY AND ERECTION

Erection and other vehicles and equipment shall not be placed within 10 feet of bridge abutments. Coordinate delivery procedures with fabricator of the bridges. All trucks delivering bridge materials shall be unloaded at the time of arrival.

The manufacturer shall provide detailed, written instruction in the proper lifting procedures and splicing procedures (if required). The method and sequence of erection shall be the responsibility of Contractor.

The bridge manufacturer shall provide written inspection and maintenance procedures to be followed by the Government.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Bridge span shall be as shown on the Drawings.

Structural design of the bridge structure(s) shall be performed by or under the direct supervision of a licensed professional engineer and done in accordance with recognized engineering practices and principles. The engineer shall be licensed to practice in Virginia.

2.1.1 Shop Drawings

Schematic drawings and diagrams shall be submitted for review within two

weeks of Award of Contract. Submittal drawings shall be unique drawings, prepared to illustrate the specific portion of the work to be done. All relative design information such as member sizes, bridge reactions, and general notes shall be clearly specified on the drawings. Drawings shall have cross referenced details and sheet numbers. All drawings shall be signed and sealed by a Professional Engineer who is licensed in Commonwealth of Virginia.

2.1.2 Structural Calculations

Complete structural calculations for the bridge superstructure shall be submitted, within two weeks of Award of Contract, by the bridge manufacturer and reviewed by the approving engineer. All calculations shall be signed and sealed by a Professional Engineer who is licensed in the Commonwealth of Virginia. The calculations shall include all design information necessary to determine the structural adequacy of the bridge. The calculations shall include the following:

a. All AASHTO allowable stress checks for axial, bending and shear forces in the critical member of each truss member type (i.e. top chord, bottom chord, floor beam, vertical, etc.).

b. Checks for the critical connection failure modes for each truss member type (i.e. vertical, diagonal, floor beam, etc.). Special attention shall be given to all welded tube on tube connections.

c. All bolted splice connections.

d. Main truss deflection checks.

e. Deck design.

f. Bridge manufacturer shall develop a numerical table of joint gap widths that reflect gap adjustments and associated ambient temperatures. Submit the table with bridge design calculations. Contractor shall ensure that the constructed joint cap width is adjusted in accordance with the numerical table.

NOTE: The analysis and design of triangulated truss bridges shall account for moments induced in members due to joint fixity where applicable. Moments due to both truss deflection and joint eccentricity shall be considered.

2.1.3 Design Requirements

Bridge(s) shall be designed as a truss that has one (1) diagonal per panel and plumb end vertical members. Interior vertical members shall be plumb to the chord faces. Concrete deck to be placed on the top of the top chords shall be as shown in the drawings. Maximum truss depth is 4'-6". Bridge to be designed for a future stainless steel railing system at 50plf per railing to be attached to the concrete deck by the Contractor in the field.

2.1.3.1 Design Loads

In considering design and fabrication issues, this structure shall be assumed to be statically loaded. No dynamic analysis shall be required nor shall fabrication issues typically considered for dynamically loaded structures be considered for this bridge.

2.1.3.2 Dead Load

The bridge structure design shall consider its own dead load (superstructure and original decking), as well as the additional loads listed below for uniform live load.

2.1.3.3 Pedestrian Live Load

Main Members: Main supporting members, including girders, trusses and arches shall be designed for a pedestrian live load of 85 pounds per square foot of bridge walkway area. The pedestrian live load shall be applied to those areas of the walkway so as to produce maximum stress in the member being designed.

Secondary Members: Bridge decks and supporting floor systems, including secondary stringers, floor beams and their connections to main supporting members shall be designed for a live load of 85 pounds per square foot, with no reduction allowed.

2.1.3.4 Wind Load

Horizontal Forces:

a. The bridge shall be designed for a wind load of 35 pounds per square foot on the full vertical projected area of the bridge as if enclosed. The wind load shall be applied horizontally at right angles to the longitudinal axis of the structure.

b. The wind loading shall be considered both in the design of the lateral load bracing system and in the design of the truss vertical members, floor beams and their connections.

Overturning Forces:

a. The effect of forces tending to overturn structures shall be calculated assuming that the wind direction is at right angles to the longitudinal axis of the structure. In addition, an upward force shall be applied at the windward quarter point of the transverse superstructure width. This force shall be 20 pounds per square foot of deck.

2.1.3.5 Top Chord

The top chord, truss verticals, and floor beams shall be designed for lateral wind loads and for any loads required to provide top chord stability.

2.1.3.6 Load Combinations

The loads listed herein shall be considered to act in the following combinations, whichever produce the most unfavorable effects on the bridge superstructure or structural member concerned.

a. DL=Dead Load; LL = Live Load; WL = Wind Load.

1) DL + LL
2) DL+WL
3) DL+LL+.3WL

NOTE: For service load design, the percentage of the basic unit stress used for each combination shall be in accordance with table 3.22.1A of the AASHTO "Standard Specifications for Highway Bridges".

2.1.4 Design Limitations

2.1.4.1 Deflection

Vertical Deflection:

a. The vertical deflection of the main trusses due to service pedestrian live load shall not exceed 1/500 of the span.

b. The vertical deflection of cantilever spans of the structure due to service pedestrian live load shall not exceed 1/300 of the cantilever arm length.

c. The deflection of the floor system members (floor beams and stringers) due to service pedestrian live load shall not exceed 1/360 of their respective spans.

d. The service pedestrian live load shall be 85 PSF.

Horizontal Deflection:

a. The horizontal deflection of the structure due to lateral wind loads shall not exceed 1/500 of the span under an 85 MPH (25 PSF) wind load.

2.1.4.2 Minimum Thickness of Metal

The minimum thickness of all structural steel members shall be 1/4" nominal and be in accordance with the AISC Manual of Steel Constructions' "Standard Mill Practice Guidelines". For ASTM A 847 / A 847M tubing, the section properties used for design shall be per the Steel Tube Institute of North America's Hollow Structural Sections "Dimensions and Section Properties".

2.1.5 Member Components

All members of the vertical trusses (top and bottom chords, verticals, and diagonals) shall be fabricated from square and/or rectangular structural steel tubing. Other structural members and bracing shall be fabricated from structural steel shapes or square and rectangular structural steel tubing.

Unless the floor and fastenings are specifically designed to provide adequate lateral support to the top flange of open shape stringers (w-shapes or channels), a minimum of one stiffener shall be provided in each stringer at every floor beam location.

2.1.6 Camber

The bridge shall have a vertical camber dimension at midspan equal to 100% of the full dead load deflection.

2.1.7 Elevation Difference

The bridge abutments shall be constructed at the elevation difference shown on the drawings.

2.2 MATERIALS

2.2.1 Painted Steel

All blast cleaning shall be done in a dedicated OSHA approved indoor facility owned and operated by the bridge fabricator. Blast operations shall use Best Management Practices and exercise environmentally friendly blast media recovery systems.

Bridges which are to be painted shall be fabricated using high strength, low alloy, atmospheric corrosion resistant ASTM A 847 / A 847M cold-formed welded square and rectangular tubing (Fy = 50,000 psi) and/or ASTM A 588/A 588M. Plate, structural steel shapes, and splice plates, if required, shall be ASTM A 588/A 588M. All painted bridges shall be painted in a dedicated indoor OSHA approved paint facility that is owned and operated by the bridge fabricator. The fabricator must hold a "Sophisticated Paint Endorsement" as set forth by AISC.

2.2.2 Concrete Decking

Concrete for the bridge deck shall conform to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE as ammended by this Section and by the following requirements:

a. Concrete finishing shall conform to the appropriate subsection of Section 32 16 13 CONCRETE SIDEWALKS, CURBS, AND GUTTERS.

b. Integral water proofing admixture shall be used.

The bridge shall be furnished with a stay-in-place galvanized steel form deck suitable for pouring a reinforced concrete slab. The form deck shall be designed to carry the dead load of the wet concrete, weight of the form decking, plus a construction load of 20 PSF uniform load or a 150 pound concentrated load on a 1-foot-0-inch wide section of deck. When edge supports are used, deflection is limited to 1/180 of the span or 3/4 , whichever is less. Without edge supports, deflection shall be limited to 1/180 of the span or 3/8 , whichever is less. The bridge manufacturer supplied form decking shall only span between and cover the truss members. The Contractor shall provide removable forming for the edge of the deck with a drip recess to prevent the deck water from running onto the steel members.

The form deck shall be either smooth or composite. The form deck material shall be supplied in accordance with ASTM A 653/A 653M and galvanized to a minimum G90 coating weight. The deck slab shall be constructed using concrete with a minimum 28-day strength of 4000 PSI.

Concrete deck design shall be performed by the bridge manufacturer.

2.3 FABRICATION

2.3.1 Drain Holes

When the collection of water inside a structural tube is a possibility, either during construction or during service, the tube shall be provided with a drain hole at its lowest point to let water out.

2.3.2 Welds

Special attention shall be given to developing sufficient weld throats on tubular members. Fillet weld details shall be in accordance with AWS D1.1/D1.1M, Section 3.9 (See AWS Figure 3.2). Unless determined otherwise by testing, the loss factor "Z" for heel welds shall be in accordance with AWS Table 2.8. Fillet welds which run onto the radius of a tube shall be built up to obtain the full throat thickness. The maximum root openings of fillet welds shall not exceed 3/16 inch in conformance with AWS D1.1, Section 5.22. Weld size or effective throat dimensions shall be increased in accordance with this same section when applicable (i.e. fit-up gaps> 1/16-inch).

The fabricator shall have verified that the throat thickness of partial joint penetration groove welds (primarily matched edge welds or the flare-bevel-groove welds on underhung floor beams) shall be obtainable with their fit-up and weld procedures. Matched edge welds shall be "flushed" out when required to obtain the full throat or branch member wall thickness.

For full penetration butt welds of tubular members, the backing material shall be fabricated prior to installation in the tube so as to be continuous around the full tube perimeter, including corners. Backing may be of four types:

a. A "box" welded up from 4 plates.

b. Two "channel" sections, bent to fit the inside radius of the tube, welded together with full penetration welds.

c. A smaller tube section which slides inside the spliced tube.

d. A solid plate cut to fit the inside radius of the tube.

Corners of the "box" backing, made from four plates, shall be welded and ground to match the inside corner radii of the chords. The solid plate option shall require a weep hole either in the chord wall above the "high side" of the plate or in the plate itself. In all types of backing, the minimum fit-up tolerances for backing must be maintained at the corners of the tubes as well as across the "flats".

2.3.3 Sealing and Caulking

To prevent rust runs on painted structures, open ends of all tubes shall be capped and seal welded. Wherever practical, member end connections and steel on steel contact surfaces, such as stringer to floor beam connections, shall be welded all around. Long seams between members or any seam which cannot be practically welded shall be caulked.

2.3.4 Paint Clearance

To provide adequate clearance for initial painting and future recoating, a minimum of a 1-1/2 gap shall be provided between any two opposing painted surfaces. If this gap cannot be maintained, member sizes shall be increased or filler plates added to bring the opposing surfaces in contact for seal welding.

2.4 FINISHING

2.4.1 Blast Cleaning Painted Steel

All exposed surfaces of steel to be painted shall be blast cleaned in accordance with the appropriate section of the Steel Structures Painting Council Surface Preparation Specifications as recommended by the paint manufacturer.

2.4.2 Painting

All exposed steel surfaces shall receive shop applied primer and finish coats. The paint system shall consist of the following:

a. Primer: Epoxy Primer.

b. Top Coat: Aliphatic urethane.

c. System DFT: 5 mils, unless otherwise specified or recommended by the paint manufacturer.

The primer and top coat shall be applied in accordance with and to the paint manufacturer's recommendations. The top coat paint color shall be brown, FED-STD-595 - 20059; semigloss.

a. Unless specified otherwise, connection faying surfaces and the interior surfaces of all structural tubing shall not be coated.

2.4.2.1 Touch-up Paint

A nominal quantity of touch-up paint will be provided to repair marred surfaces. Touch-up painting includes any and all painting required after the structure reaches the site, and is the responsibility of others. This painting shall include, but not be limited to, the following areas:

a. Any areas damaged due to shipping, handling, and erection of the bridge and components.

b. Bolt heads and exposed area of bolts and nuts as applicable.

c. Non-galvanized attachments or anchor bolts if not made of corrosion resistant steel.

d. If applicable, small areas (0 to 2 each side) around bolted field splices, designed as "slip critical", where one or all paint coats may be required to be left off the faying surfaces.

2.4.2.2 Painter Qualifications

All painters shall be certified by the appropriate paint manufacturer for proper handling, mixing, thinning (if required) and application of the paint system in accordance with the manufacturer's instructions. The painters shall also be certified by the Department of Transportation in the state in which the bridge is manufactured.

2.5 QUALITY CERTIFICATION

Bridge shall be fabricated by a fabricator who is currently certified by the American Institute of Steel Construction to have the personnel,

organization, experience, capability, and commitment to produce fabricated structural steel for the category "Major Steel Bridges" as set forth in the AISC Certification Program with Fracture Critical Endorsement. Quality control shall be in accordance with procedures outlined for AISC certification. For painted structures, the fabricator must hold a "Sophisticated Paint Endorsement" as set forth in the AISC certification program. Furthermore, the bridge shall be fabricated in a facility owned and/or leased by the corporate owner of the manufacturer, and fully dedicated to bridge manufacturing.

2.6 BEARINGS

2.6.1 Bearing Devices

Bridge bearings shall consist of a steel setting or slide plate placed on the abutment or grout pad. The bridge bearing plate which is welded to the bridge structure shall bear on this setting plate. One end of the bridge will be fixed by fully tightening the nuts on the anchor bolts at that end. The opposite end will have finger tight only nuts to allow movement under thermal expansion or contraction.

Bridges shall have teflon on teflon or stainless steel on teflon slide bearings placed between the bridge bearing plate and the setting plate. The top slide plate shall be large enough to cover the lower teflon slide surface at both temperature extremes.

Bridge bearings shall sit on the concrete abutment as shown on the Drawings. The step height (from bottom of bearing to top of deck) shall be determined by the bridge manufacturer and provided to the Contractor to establish the surface elevation of the concrete bridge bearing cap.

2.7 FOUNDATIONS

The bridge manufacturer shall determine the number, diameter, minimum concrete embedment, minimum grade and finish of all anchor bolts. The anchor bolts shall be designed to resist all horizontal and uplift forces to be transferred by the superstructure to the supporting foundations. Contractor shall provide all materials for (including anchor bolts) and construction of the bridge supporting foundations. The contractor shall install the anchor bolts in accordance with the manufacturer's anchor bolt spacing dimensions.

Information as to bridge support reactions and anchor bolt locations shall be furnished by the bridge manufacturer after receipt of order and after the bridge design is complete.

PART 3 EXECUTION

3.1 INSTALLATION PREPARATION

To ensure correct installation of the steel truss bridge system, care and caution must be exercised in forming the support areas for bridge units, abutments, and wingwall elements. Exercising special care will facilitate the rapid installation of the steel components.

3.2 INSTALLATION

The installation of the steel truss elements shall be as laid out in the project’s Preconstruction Notes.

3.2.1 Lifting

It is the responsibility of the contractor to ensure that a crane of the correct lifting capacity is available to handle the steel units. This can be accomplished by using the weights given for the steel components and by determining the lifting reach for each crane unit. Site conditions must be checked well in advance of shipping to ensure proper crane location and to avoid any lifting restrictions. The steel elements must not be supported or raised by other means than those given in the manuals and drawings without written approval from the manufacturer.

3.2.2 Construction Equipment Weight Restrictions

In no case shall equipment operating in excess of the design load (85 psf) be permitted over the bridge units unless approved by the manufacturer.

In the immediate area of the bridge unit, the following restrictions for the use of heavy construction machinery during backfilling operations apply:

a. No construction equipment shall cross the bare steel bridge unit.

3.2.3 Placement of Bridge Units

The bridge units shall be placed as shown on the signed and sealed plan drawings submitted by the manufacturer. Special care shall be taken in setting the elements to the true line and grade.

3.3 WELDING

Welding and weld procedure qualification tests shall conform to the provisions of AWS D1.1/D1.1M/D1.1M. Filler metal shall be in accordance with the applicable AWS Filler Metal Specification (i.e. AWS A5.28/A5.28M for the GMAW Process). For exposed, bare, unpainted applications of corrosion resistant steels (i.e. ASTM A 588/A 588M and ASTM A 847 / A 847M), the filler metal shall be in accordance with AWS D1.1/D1.1M, Section 3.7.3.

Welders shall be properly accredited operators, each of whom shall submit certification of satisfactorily passing AWS standard qualification tests for all positions with unlimited thickness of base metal, have a minimum of 6 months experience in welding tubular structures and have demonstrated the ability to make uniform sound welds of the type required.

3.4 CLOSEOUT

Provide Record Drawings to the Contracting Officer in approved format.

APPROVAL CHECKLIST

The following checklist shall be used in the evaluation of all submittals to assure compliance with the Specifications for Fabricated Steel Truss Bridge. This checklist is considered the minimum acceptable requirements for compliance with these specifications. Any deviations from this checklist shall be considered grounds for rejection of the submittal. Any costs associated with delays caused by the rejection of the submittal, due to non-compliance with this checklist, shall be fully borne by the Contractor and bridge manufacturer.

SHOP DRAWINGS

Data Required to be Shown:

- Bridge Elevation
- Bridge Cross Section
- All Member Sizes
- All Vertical Truss Members are Square or Rectangular Tubing
- Bridge Reactions
- General Notes Indicating:
  - AASHTO Stress Conformance
  - Material Specifications to be Followed
  - Design Live Load
  - Design Wind Load
  - Other Specified Design Loads
  - Welding Process
  - Blast Cleaning
  - Paint System to be Used
- Paint Color Chart
- Detailed Bolted Splices
- Bolted Splice Location (If applicable)
- Signature and Seal of Professional Engineer, licensed in Accordance with Article 2.1.2.

DESIGN CALCULATIONS

Data Required to be Shown:

- Deck Joint Width Adjustments
- Data Input for 3-D Analysis of Bridge
  - Joint Coordinates & Member Incidences
  - Joint and Member Loads
  - Member Properties
  - Load Combinations
- AASHTO Member Stress Checks for Each Member Type
- Critical Connection Failure Mode Checks For Each Member Type
  - Chord Face Plastification Checks
  - Punching Shear Checks
  - Material Failure Checks (Truss Webs)
  - Weld Failure Checks (Effective Length)
  - Weld Failure Checks (Ultimate)

Local Buckling of the Main Member Face Checks
Main Member Yielding Failure Checks
Main Member Crippling Failure Checks

Main Member Buckling Failure Checks
Main Member Shear Failure Checks
All Bolted Splice Checks (if applicable)
Main Truss Deflection Checks
Decking Material Checks

Consideration of Individual Member Moments Due to Truss Deflection, Joint Fixity and Joint Eccentricity

FABRICATION SUBMITTALS

Data Required to be Shown:

**Written Installation Instructions
**Written Splicing Instructions
**Written Maintenance and Inspection Instructions
**Welder Certifications
**Welding Procedures
Material Certifications

Structural Steel
Decking
Structural Bolts (if applicable)
**Quality Control Sections of AISC Certification Manual (if applicable)
**Painter Certifications (if applicable)
Weld Testing Reports (if applicable)

**NOTE: These items are required to be submitted along with Submittal Drawings and Design Calculations. Those Fabrication Submittal Items not marked are to be submitted prior to shipment of the bridge.)

-- End of Section --

SECTION 32 84 23

UNDERGROUND SPRINKLER SYSTEMS
04/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1012	(2009) Performance Requirements for Backflow Preventer with an Intermediate Atmospheric Vent - (ANSI approved 2009)
ASSE 1013	(2011) Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers - (ANSI approved 2010)

ASME INTERNATIONAL (ASME)

ASME B1.2	(1983; Errata 1992; R 2007) Gages and Gaging for Unified Inch Screw Threads
ASME B16.18	(2012) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	(2001; R 2010) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ASTM INTERNATIONAL (ASTM)

ASTM B32	(2008) Standard Specification for Solder Metal
ASTM B88	(2009) Standard Specification for Seamless Copper Water Tube
ASTM D1785	(2012) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	(2009) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2464	(2006) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

ASTM D2466	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2564	(2004; R 2009e1) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2774	(2012) Underground Installation of Thermoplastic Pressure Piping
ASTM D2855	(1996; R 2010) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM F441/F441M	(2009) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR Manual	(1988e9) Manual of Cross-Connection Control

INTERNATIONAL ELECTROTECHNICAL COMMISSION(IEC)

IEC 60068-2-27	(2008) Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock
IEC 61131-3	(2013) Programmable Controllers - Part 3: Programming Languages
IEC 62061	(2005)Safety Of Machinery - Functional Safety of Safety-Related Electrical, Electronic and Programmable Electronic Control Systems

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(2008) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2011) Enclosures
NEMA 250	(2011) Enclosures for Electrical Equipment (1000V max)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-51145	(Rev D; Notice 1) Flux, Soldering, Non-Electronic, Paste and Liquid
MIL STD 202G	(2002) Test Method Standard Electronic And Electrical Component Parts

UNDERWRITERS LABORATORIES (UL)

UL 508	Industrial Control Equipment

1.2 SYSTEM DESCRIPTION

Provide a system that operates given the pressure and flow available at the point of connection. Drawings show locations of mainline pipe, major equipment and zones which are designated for specific types of irrigation. The Drawings do not show control valves, lateral pipe or irrigations heads and emitters. Contractor shall submit a full irrigation design that incorporates the design on the Drawings, and adds all heads, lateral pipe, valves, and any other necessary components and equipment to complete the design. Show locations, sizes, manufacturers and models of all components. Design shall achieve the precipitation rates and coverage as shown on the Drawings. Pressure of the last head in each zone shall be as shown on the contract Drawings. Submit Design Analysis and Calculations verifying that system will provide the irrigation requirements.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals identified with "AE" shall be reviewed by Landscape Architect. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Sprinkler System; G, AE

Detail drawings for valves, sprinkler heads, backflow preventers. Include a complete list of equipment and materials, and manufacturer's descriptive and technical literature, performance charts, and curves, catalog cuts, and installation instructions. Also show complete wiring and schematic diagrams and other details required to demonstrate that the system has been coordinate and will function as a unit. Show proposed system layout, type and umber of heads, zone valves, drain pockets, backflow devices, controllers, and mounting details of controllers. Include as-built drawings which provide current factual information showing locations of mains, heads, valves, and controllers including deviations from the amendments to the drawings and changes in the work.

SD-03 Product Data

Framed Instructions
Field Training

Sprinkler System
booster pump assembly; G

Provide detailed procedures defining the provisions for accident prevent, health protection, and other safety precautions for the Work to be done.

Spare Parts
Design Analysis and Calculations; G, AE

SD-06 Test Reports

Field Tests
Record Drawings

SD-07 Certificates

Designer Qualifications
Equipment Manufacturer's Statement

SD-10 Operation and Maintenance Data

Sprinkler System Operating Manual; G, AE

1.4 QUALITY CONTROL

1.4.1 Designer Qualifications

Irrigation sprinkler system drawings shall be prepared by a licensed, registered, or certified Landscape Architect or Irrigation Specialist with minimum 5 years experience. Provide qualifications to Government.

1.4.2 Equipment Manufacturer's Statement

Provide material supplier's or equipment manufacturer's statement that the supplied materials or equipment meet specified requirements. Each certificate shall be signed by an official authorized to certify on behalf of material supplier or product manufacturer and shall identify quantity and date or dates of shipment or delivery to which the certification applies.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, excessive humidity, and temperature variation; direct sunlight (in the case of plastic or rubber materials); and dirt, dust, or other contaminants.

1.6 EXTRA MATERIALS

Submit spare parts data for each different item of material and equipment specified, after approval of the related submittals and not later than the start of the field tests. Include with the data a complete list of parts and supplies, with current unit prices and source of supply.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Standard Products

Provide materials and equipment which are the standard products of a manufacturer who has produced similar systems that have performed well for a minimum period of 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.1.2 Nameplates

Each item of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.1.3 Additional Stock

Provide the following extra stock: Two sprinkler heads of each size and type, two valve keys for operating manual valves, two wrenches for removing and installing each type of head, two quick coupler keys and hose swivels, and four irrigation controller housing keys.

2.2 PIPING MATERIALS

2.2.1 Copper Tubing and Associated Fittings

Tubing shall conform to requirements of ASTM B88, Type K. Fittings shall conform to ASME B16.22 and ASME B16.18, solder joint. Solder shall conform to ASTM B32 95-5 tin-antimony. Flux shall conform to CID A-A-51145, Type I.

2.2.2 Polyvinyl Chloride (PVC) Pipe, Fittings and Solvent Cement

2.2.2.1 PVC Pipe

Pipe shall conform to the requirements of ASTM D1785, PVC 1120 Schedule 80 or 80; or ASTM D2241, PVC 1120 SDR 21, Class 200.

2.2.2.2 PVC Fittings

Solvent welded socket type fittings shall conform to requirements of ASTM D2466, Schedule 40. Threaded type fittings shall conform to requirements of ASTM D2464, Schedule 80.

2.2.2.3 Solvent Cement

Solvent cement shall conform to the requirements of ASTM D2564.

2.2.3 Dielectric Fittings

Dielectric fittings shall conform to ASTM F441/F441M, Schedule 80, CPVC threaded pipe nipples, 4 inch minimum length.

2.3 SPRINKLER HEADS

2.3.1 Pop-Up Spray Heads

2.3.1.1 General Requirements

Pop-up spray heads lay flush with housing, then pop up when water pressure is activated in system. The rising member supporting the nozzle shall be identical on full, half, third or quarter pattern sprinklers so that nozzles will be interchangeable. The sprinkler head shall be designed to be adjustable for coverage and flow. The nozzle shall be removable so head does not have to be removed for flushing or cleaning. Nozzle rises a minimum of 4 inches above the body in turf areas; 12 inches in shrub areas. The body shall be constructed with a 1/2 inch female thread for installation in a fixed underground pipe system.

2.3.2 Rotary Pop-Up Sprinklers

Sprinklers shall be as listed in irrigation equipment schedule on the contract drawings. Construction shall be high impact molded plastic with filter screen, reducible watering radius, and choice of nozzles and have adjustable radius capabilities.

2.4 VALVES

2.4.1 Gate Valves, Less than 3 Inches

Gate valves shall conform to the requirements of MSS SP-80, Type 1, Class 150, threaded or soldered ends.

2.4.2 Quick Coupling Valves

Quick coupling valves shall have brass parts and shall be two-piece unit consisting of a coupler water seal valve assembly and a removable upper body to allow spring and key track to be serviced without shutdown of main. Lids shall be lockable vinyl with spring for positive closure on key removal.

2.4.3 Remote Control Valves, Electrical

Remote control valves shall be solenoid actuated globe valves of 3/4 to 3 inch size, suitable for 24 volts, 60 cycle, and designed to provide for shut-off in event of power failure. Valve shall be brass or plastic housing suitable for service at 150 psi operating pressure with external flow control adjustment for shut-off capability, external plug at diaphragm chamber to enable manual operation, filter in control chamber to prevent valve body clogging with debris, durable diaphragm, and accessibility to internal parts without removing valve from system.

2.4.4 Backflow Preventers

Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR Manual. Backflow preventers with intermediate atmospheric vent shall be in accordance with ASSE 1012. Reduced pressure principle backflow preventers shall be in accordance with ASSE 1013.

2.4.4.1 Reduced Pressure Type Backflow Preventers

Backflow preventers shall be 150 pound flanged cast iron or , bronze mounted gate valve and strainer, 304 stainless steel or bronze, internal parts. Total pressure drop through complete assembly shall be a maximum of 12 psi at rated flow. Strainers shall be bronze or brass construction with gasket caps. Units shall have 200-mesh stainless steel screen elements. Provide unions at both ends of backflow.

2.5 BOOSTER PUMP

This item shall consist of furnishing and installing a booster pump assembly in conformance with these special provisions and the manufacturer's specifications.

Electrical supply to power the booster pump assembly shall be provided by the Contractor. 240 VAC, single phase, 2-pole, 60A circuit breaker.

Conditions: Maximum flow: 50- GPM with 50-PSI boost: Electrical service 240VAC, single-phase: 24VAC-pump start assembled and mounted above ground in a weatherproof enclosure.

All work shall meet applicable federal, state, and local building codes, including permits as required. Design and install booster pump with electrical supply including permits and applicable fees. Motor and pump sizing according to specifications.

Pump control panel to be UL 508 listed, mounted in NEMA 3R or NEMA 4 according to NEMA 250 for above ground, outdoors; blown and filtered enclosure with main circuit breaker door interlocked handle, VFD only with DC link choke, drive display on the door, fused 110-volt control, 150VA control transformer, one fault light on door, three control relays, optional output terminal for external fan.

Booster Pump shall have three years warranty. Contractor to provide authorized approval from manufacturer.

a. With shielded cable.

b. Custom temperature switch with red fault light and reset on panel door.

c. Liquid filled gauges mounted on intake and discharge manifold.

d. Butterfly valves with grooved connection line size for bypass and applicable line size for pump suction.

e. Check Valve to be located on the pump discharge.

f. Galvanized plumbing within unit are grooved connections and fittings for 2 inches and larger, painted dark green.

g. Above ground galvanized drop pipes with grooved connections. Underground PVC connections and adaptors.

h. Booster pump assembly to be mounted on a level concrete pad 4-inch thick with a 3-inch wide apron all around including a minimum of three conduits for power and control wires.

The operating ambient temperature range shall be 0*C to 50*C (32* to 122*F). Storage temperatures shall be between -40*C to 50*C (-40* to 122*F).

The relative humidity range shall be 5-95 percent non-condensing.

The variable frequency drives have been vibration tested in accordance with MIL STD 202G.

The variable frequency drives have been mechanical shock tested in accordance with IEC 60068-2-27.

The variable frequency drives electromagnetic immunity is in compliance with IEC 6100-4-6, with built in filter.

Standards:

a. The panel is UL 508 listed.

b. The panel is designed in accordance with applicable portions of NEMA standards.

c. The panel is compatible with the installation requirements of interpretive codes such as National Electric Code (NEC) and Occupational Safety & Health Act (OSHA).

d. Standard enclosure sizes are 1Hp to 10Hp 200 to 230Volts or 1Hp to 20Hp 480Volts is 24 inches by 15 inches by 14 inches, 15Hp 200 to 230Volts 24 inches by 20 inches by 14 inches, 20Hp to 30Hp 200 to 230Volts or 480Volt is 30 inches by 24 inches by 14 inches.

Input Power:

a. The panel is to operate on 200 to 240Volts +/-10 percent, 380 to 480Volts +/-10 percent three-phase.

b. The frequency is to be 60Hz +/-5 percent.

c. The MOV voltage of the drive 160 Joules, 1400VDC clamping.

Output Power:

a. The drive shall be capable of horsepower ratings for 1Hp to 2300Hp and output frequencies up to 3,000Hz. It shall also have an energy save feature with the capability of selecting a V/Hz automatic control function that will modify the V/Hz curve based on light load characteristics that will minimize power consumption.

b. The drive output voltage shall vary with frequency to maintain constant volts/hertz ratio up to base speed (60Hertz) output. Constant or linear voltage output shall be supplied at frequencies greater than base speed (60Hertz).

c. The drive one minute overload current rating shall be 110 percent of rated current for normal duty loads and 150 percent torque for heavy duty loads.

I/O Specification:

a. Seven programmable digital inputs.

b. Digital inputs can be programmed for positive or negative logic.

c. Three analog inputs (Analog 1 0-10VDC, Analog 2 and 3 programmable for 0-10VDC, 0-20Ma, 4-20Ma, 20-0Ma, 20-4Ma, or thermistor input).

d. Two programmable analog outputs (programmable for 0-10VDC, 0-20Ma, or 4-20Ma).

e. Secure Disable input meets IEC 62061 cat 3.

f. One programmable dry contact rated 240VAC 2A resistive.

g. 24VDC external input for backup power supply.

Features:

a. V/Hz standard default mode or can be programmed in open loop vector or rotor flux control mode.

b. Three zero space solution module slots for field bus and additional I/O.

c. Smartcard for simple setup and cloning of drive parameters.

d. External 24VDC backup control supply connection.

e. PLC functionality built in with IEC 61131-3 programming language.

f. Built in EMC filter.

g. Built in dynamic brake transistor.

Protective Features:

a. Under Voltage DC Bus 175/350/435VDC, Under voltage trip (approximately 124/247/307VAC line voltage).

b. Over Voltage DC Bus 415/830/990VDC, Over voltage trip (approximately 293/587/700VAC line voltage).

c. MOV voltage 160 Joules, 1400VDC clamping.

d. Transient protection line to line and line to ground.

e. Drive overload trip programmable for normal duty or heavy duty operation.

f. Instantaneous over current trip is 225 percent of drive rating.

g. Phase loss trip due to DC bus ripple exceeded.

h. Over temperature trips; drive heatsink, control board, and option module monitoring.

i. Protects against phase to phase faults.

j. Protects against phase to ground faults.

k. Electronically protects the motor from overheating due to load conditions.

l. No flow shutdown with programmable auto restart attempts.

Booster Pump Enclosure:

a. Standard enclosure size 48-inches by 36 inches by 44 inches, uni-constructed two-piece with pivoting top and no hinges. Louvers on two sides for ventilation. Exhaust fan rated for 117 CFM, 115-volt, with finger guard for safety, external single muffin fan hood to shield from exposure. Pump and electrical panel mounted for easy service access. Powder coated dark green exterior and interior, all steel brackets and hardware for supports.

1. Pumps equipped with mechanical shaft seals, back pull out designs with ample access to junction box.

2. Requires recertification for system testing with documentation twelve months following turnover.

3. Three year warranty following final acceptance on all equipment by Owner's representative.

4. Contractor to provide Operation & Maintenance manuals and special tools. (2 sets)

5. Contractor to provide as-built for electrical and pumping system after acceptance. (2 sets)

6. Contractor to provide equipment and assembly submittals prior to proceeding with work. (3 sets)

7. Contractor to contact Contracting Officer for inspection of in ground plumbing before backfill.

2.6 ACCESSORIES AND APPURTENANCES

2.6.1 Valve Keys for Manually Operated Valves

Valve keys shall be 1/2 inch diameter by 3 feet long, tee handles and keyed to fit valves.

2.6.2 Valve Boxes and Concrete Pads

2.6.2.1 Valve Vaults

Valve boxes shall be cast iron, plastic lockable, or precast concrete for each gate valve, manual control valve and remote control valve. Vault sizes shall be adjustable for valve used. Cast the word "IRRIGATION" on the cover. Shaft diameter of vault shall be minimum 5-1/4 inches. Cast iron vault shall have bituminous coating.

2.6.2.2 Concrete Pads

Concrete pads shall be precast or cast-in-place reinforced concrete construction for reduced pressure type backflow preventers.

2.6.2.3 Framed Instructions

Provide labels, sisns, and templates of operating instructions that are required to be mounted or installed on or near the product for normal, safe operation.

2.7 AUTOMATIC CONTROLLERS, ELECTRICAL

Controller shall conform to the requirements of NEMA ICS 2 with 120 -volt single phase service, operating with indicated stations, and grounded chassis. Enclosure shall conform to NEMA ICS 6 Type 3R, with locking hinged cover, wall-mounted. Controller shall be programmed for various schedules by setting switches and dials equipped with the following features: A switch for each day of week for three schedules, allowing each station to be scheduled individually as to days of watering; a minute switch for each station with a positive increment range of 3 to 60 minutes , set time within one percent; a switch allowing selected schedules to be repeated after each completion of initial watering schedule and allowing each operation to be scheduled throughout a 24-hour day; a circuit breaker for surge protection; and circuit for a 9-volt rechargeable NiCad battery.

2.8 ELECTRICAL WORK

Wiring and rigid conduit for electrical power shall be in accordance with NFPA 70, and Section 33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

2.9 CONCRETE MATERIALS

Concrete shall have a compressive strength of 2500 psi at 28 days as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.10 WATER SUPPLY MAIN MATERIALS

Tapping sleeves, service cut off valves, and connections to water supply mains shall be in accordance with Section 33 11 00 WATER DISTRIBUTION.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work verify all dimensions in the field and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

Install Sprinkler System after site grading has been completed. Perform excavation, trenching, and backfilling for sprinkler system in accordance with the applicable provisions of Section 31 00 00 EARTHWORK, except as modified herein.

a. Submit detail drawings for valves, sprinkler heads, backflow preventers, automatic controllers, emitter heads, and water hammer arresters. Include on the drawings a complete list of equipment and materials, and manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Also show on the drawings complete wiring and schematic diagrams and any other details required to demonstrate that the system

has been coordinated and will function as a unit. Show on the drawings proposed system layout, type and number of heads and emitters, zone valves, drain pockets, backflow devices, controllers, and mounting details of controllers.

b. Submit detailed procedures defining the Contractor's provisions for accident prevention, health protection, and other safety precautions for the work to be done. Submit the material supplier's or equipment manufacturer's statement that the supplied material or equipment meets specified requirements. Each certificate shall be signed by an official authorized to certify in behalf of material supplier or product manufacturer and shall identify quantity and date or dates of shipment or delivery to which the certificates apply. Include As-built Drawings which provide current factual information showing locations of mains, heads, valves, and controllers including deviations from and amendments to the drawings and changes in the work.

c. Submit 6 copies of operation and 6 copies of maintenance manuals for the equipment furnished. One complete set prior to field testing and the remainder upon acceptance. Manuals shall be approved prior to the field training course. Operating manuals shall detail the step-by-step procedures required for system startup, operation, and shutdown. Operating manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features.

d. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout, simplified wiring and control diagrams of the system as installed, and system programming schedule.

3.2.1 Trenching

Hand excavate trench around roots to pipe grade when roots of 2 inches diameter or greater are encountered. Trench width shall be 4 inches minimum or 1.5 times diameter of pipe, whichever is wider. Backfill shall be hand tamped over excavation. When rock is encountered, trench shall be excavated 4 inchesdeeper and backfilled with silty sand (SM) or well-graded sand (SW) to pipe grade. Trenches shall be kept free of obstructions and debris that would damage pipe. Subsoil shall not be mixed with topsoil. Existing concrete walks, drives and other obstacles shall be bored at a depth conforming to bottom of adjacent trenches. Pipe sleeves for bored pipe shall be two pipe diameters larger than sprinkler pipe.

3.2.2 Piping System

3.2.2.1 Cover

Underground piping shall be installed to meet the minimum depth of backfill cover specified.

3.2.2.2 Clearances

Minimum horizontal clearances between lines shall be 4 inches for pipe 2 inches and less; 12 inches for 2-1/2 inches and larger. Minimum vertical clearances between lines shall be 1 inch.

3.2.3 Piping Installation

3.2.3.1 Polyvinyl Chloride (PVC) Pipe

a. Solvent-cemented joints shall conform to the requirements of ASTM D2855.

b. Threaded joints shall be full cut with a maximum of three threads remaining exposed on pipe and nipples. Threaded joints shall be made tight without recourse to wicks or fillers, other than polytetrafluoroethylene thread tape.

c. Piping shall be joined to conform with requirements of ASTM D2774 or ASTM D2855, and pipe manufacturer's instructions. Pipe shall be installed in a serpentine (snaked) manner to allow for expansion and contraction in trench before backfilling. Pipes shall be installed at temperatures over 40 degrees F.

3.2.3.2 Soldered Copper Tubing

Pipe shall be reamed and burrs removed. Contact surfaces of joint shall be cleaned and polished. Flux shall be applied to male and female ends. End of tube shall be inserted into fittings full depth of socket. After soldering, a solder bead shall show continuously around entire joint circumference. Excess acid flux shall be removed from tubings and fittings.

3.2.3.3 Threaded Brass or Galvanized Steel Pipe

Prior to installation, pipe shall be reamed. Threads shall be cut in conformance with ASME B1.2. Pipe joint compound shall be applied to male end only.

3.2.3.4 Insulating Joints

Insulating and dielectric fittings shall be provided where pipes of dissimilar metal are joined and at connections to water supply mains as shown. Installation shall be in accordance with Section 33 11 00 WATER DISTRIBUTION.

3.2.4 Installation of Valves

3.2.4.1 Automatic Valves

Valve shall be set plumb in a valve box extending from grade to below valve body, with minimum of 4 inch cover measured from grade to top of valve. Automatic valves shall be installed beside sprinkler heads with a valve box.

3.2.5 Sprinklers and Quick Coupling Valves

Sprinklers and valves shall be installed plumb and level with terrain.

3.2.6 Backflow Preventers

Backflow preventer shall be installed in new connection to existing water distribution system, between connection and control valves.

3.2.6.1 Reduced Pressure Type

Pipe lines shall be flushed prior to installing reduced pressure device;

device shall be protected by a strainer located upstream. Device shall not be installed in pits or where any part of device could become submerged in standing water.

3.2.7 Control Wire and Conduit

3.2.7.1 Wires

Low voltage wires may be buried beside pipe in same trench. Rigid conduit shall be provided where wires run under paving. Wires shall be number tagged at key locations along main to facilitate service. One control circuit shall be provided for each zone and a circuit to control sprinkler system.

3.2.7.2 Loops

A 12 inch loop of wire shall be provided at each valve where controls are connected.

3.2.7.3 Expansion and Contraction

Multiple tubes or wires shall be bundled and taped together at 20 foot intervals with 12 inch loop for expansion and contraction.

3.2.7.4 Splices

Electrical splices shall be waterproof.

3.2.8 Automatic Controller

Exact field location of controllers shall be determined before installation. Coordinate the electrical service to these locations. Install in accordance with manufacturer's recommendations and NFPA 70.

3.2.9 Backfill

3.2.9.1 Minimum Cover

Depth of cover shall be 36 inches for pressure mainline; 24 inches for non-pressure lateral (except within columbaria, refer to note on Drawings), and 36 inches for pipes under traffic loads, farm operations, and freezing temperatures; and 36 inches for low-voltage wires. Remainder of trench or pipe cover shall be filled to within 3 inches of top with excavated soil, and compact soil with plate hand-held compactors to same density as undisturbed adjacent soil.

3.2.9.2 Restoration

Top 3 inches shall be filled with topsoil and compacted with same density as surrounding soil. Lawns and plants shall be restored in accordance with Sections 32 92 19 SEEDING.

3.2.10 Adjustment

After grading, seeding, and rolling of planted areas, sprinkler heads shall be adjusted flush with finished grade. Adjustments shall be made by providing new nipples of proper length or by use of heads having an approved device, integral with head, which will permit adjustment in height of head without changing piping.

3.2.11 Disinfection

Sprinkler system fed from a potable water system shall be disinfected upstream of backflow preventer in accordance with Section 33 11 00 WATER DISTRIBUTION.

3.2.12 Cleaning of Piping

Prior to the hydrostatic and operation tests, the interior of the pipe shall be flushed with clean water until pipe is free of all foreign materials. Flushing and cleaning out of system pipe, valves, and components shall not be considered completed until witnessed and accepted by Contracting Officer.

3.3 FRAMED INSTRUCTIONS

Post framed instructions, containing wiring and control diagrams under glass or in laminated plastic, where directed. Condensed operating instructions, prepared in typed form, shall be framed as specified above and posted beside the diagrams. Post the framed instructions before acceptance testing of the system. Submit labels, signs, and templates of operating instructions that are required to be mounted or installed on or near the product for normal, safe operation. After as-built drawings are approved by Contracting Officer, prepare controller charts and programming schedule. One chart for each controller shall be supplied. Chart shall be a reduced drawing of actual as-built system that will fit the maximum dimensions inside controller housing. Black line print for chart and a different pastel or transparent color shall indicate each station area of coverage. After chart is completed and approved for final acceptance, chart shall be sealed between two 20 mil pieces of clear plastic.

3.4 FIELD TRAINING

Provide a field training course for designated operating and maintenance staff members for a total period of 8 hours of normal working time and starting after the system is functionally complete but prior to final acceptance tests. Submit information describing training to be provided, training aids to be used, samples of training materials to be provided, and schedules and notification of training. Field training shall cover all of the items contained in the operating and maintenance manuals.

3.5 OPERATION AND MAINTENANCE

Provide 6 copies of operation and maintenance manuals for equipment furnished. One complete set prior to field testing and the remainder upon acceptance. Manuals shall be approved prior to the field training course. Operating manuals shall detail the step-by-step procedures required for system startup, operation, and shutdown. Operating manuals shall include the manufacturer's name, model numbers, parts list, and brief description of all equipment and their basic operating features. Maintenance manual shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout, simplified wiring and control diagrams of the system as installed, and system programming schedule.

3.6 FIELD TESTS

Provide all instruments, equipment, facilities, and labor required to conduct the tests. Submit performance test reports, in booklet form, showing all field tests performed to adjust each component; and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Indicate in each test report the final position of control valves.

3.6.1 Hydrostatic Pressure Test

Mainline piping shall be tested hydrostatically before backfilling and proved tight at a hydrostatic pressure of 100 psi without pumping for a period of one hour with an allowable pressure drop of 5 psi. If hydrostatic pressure cannot be held for a minimum of 4 hours, make adjustments or replacements and repeat the tests until satisfactory results are achieved and accepted by the Contracting Officer.

3.6.2 Leakage Tests

Leakage tests for service main shall be in accordance with Section 33 11 00 WATER DISTRIBUTION.

3.6.3 Operation Test

At conclusion of pressure test, sprinkler heads or emitter heads, quick coupling assemblies, and hose valves shall be installed and entire system tested for operation under normal operating pressure. Operation test consists of the system operating through at least one complete programmed cycle for all areas to be sprinkled.

3.7 CLEANUP

Upon completion of installation of system, all debris and surplus materials resulting from the work shall be removed.

3.8 SPARE PARTS

Provide spare parts data for each different item of material and equipment specified, after approval of the related submittals and not later than the start of the field tests. The data shall include a complete list of parts and supplies with current unit prices and source of supply.

-- End of Section --

SECTION 32 92 19

SEEDING
10/06

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 602 (2007) Agricultural Liming Materials

ASTM D 4427 (2007) Peat Samples by Laboratory Testing

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act (1940; R 1988; R 1998) Federal Seed Act

1.2 DEFINITIONS

1.2.1 Stand of Turf

95 percent ground cover of the established species.

1.3 RELATED REQUIREMENTS

Section 31 00 00 EARTHWORK, applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fertilizer

Include physical characteristics, and recommendations.

SD-06 Test Reports

Topsoil composition tests

(Reports and Recommendations)

SD-07 Certificates

State certification and approval for seed

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Seed Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.5.1.2 Fertilizer and Lime Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer and lime may be furnished in bulk with certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Seed, Fertilizer and Lime Storage

Store in cool, dry locations away from contaminants.

1.5.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.5.2.3 Handling

Do not drop or dump materials from vehicles.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Restrictions

Do not plant when the ground is frozen, snow covered, muddy, or when air temperature exceeds 90 degrees Fahrenheit.

1.7 TIME LIMITATIONS

1.7.1 Seed

Apply seed within twenty four hours after seed bed preparation.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Classification

Provide State-certified seed of the latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weedseed content, and inert material. Label in conformance with AMS Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected. Field mixes will be acceptable when field mix is performed on site in the presence of the Contracting Officer .

All seed varieties shall be from either the Maryland State approved list for certified sod production or Virginia Cooperative Extension's list of recommended varieties. All seed varieties shall be from either the Maryland State approved list for certified sod production or Virginia Cooperative Extension's list or recommended varieties.

2.1.2 Planting Dates

Planting Season	Planting Dates
Spring	Feb 15 to April 15
Fall	Aug 15 to Oct 15

Temporary Seeding: Per Virginia Erosion and Sediment Control Handbook Requirements for "Temporary Seeding."

2.1.3 Seed Purity

Botanical Name	Common Name	Min. Percent Pure Seed	Min. Percent Germination and Hard Seed	Max. Percent Weed Seed
All		85%	95%	0.5%

2.1.4 Seed Mixture by Weight

Shade Areas:

a. 80% Tall Fescue (two or more varieties, no dwarfs).

b. 10% Kentucky Bluegrass.

c. 10% Perennial Rye.

Wetland Seed Mix: Seasonally Flooded Area Annual/Prennial Mix

Upland Seed Mix:

a. Native Upland Wildflower Folage and Cover Meadow Mix: Ernmx 123 by Ernst Seed Company or equivelant.

Proportion seed mixtures by weight. The same requirements of turf establishment for Spring and Fall apply for temporary seeding.

2.2 TOPSOIL

2.2.1 On-Site Topsoil

Surface soil tested, stripped, and stockpiled on site and modified as necessary to meet the requirements specified for topsoil in paragraph entitled "Composition." When available topsoil shall be existing surface soil stripped and stockpiled on-site in accordance with Section 31 00 00 EARTHWORK.

2.2.2 Off-Site Topsoil

Conform to requirements specified in paragraph entitled "Composition." Additional topsoil shall be furnished by the Contractor .

2.3 SOIL CONDITIONERS

Add conditioners to topsoil as required to bring into compliance with "composition" standard for topsoil as specified herein.

2.3.1 Lime

Commercial grade hydrate limestone containing a calcium carbonate equivalent (C.C.E.) as specified in ASTM C 602 in order to obtain the required compaction.

2.3.2 Aluminum Sulfate

Commercial grade.

2.3.3 Sulfur

100 percent elemental

2.3.4 Iron

100 percent elemental

2.3.5 Peat

Natural product of peat moss derived from a freshwater site and conforming to ASTM D 4427. Shred and granulate peat to pass a 1/2 inch mesh screen and condition in storage pile for minimum 6 months after excavation.

2.3.6 Sand

Clean and free of materials harmful to plants.

2.3.7 Perlite

Horticultural grade.

2.3.8 Gypsum

Coarsely ground gypsum comprised of calcium sulfate dihydrate 61 percent, calcium 22 percent, sulfur 17 percent; minimum 96 percent passing through 20 mesh screen, 100 percent passing thru 16 mesh screen.

2.3.9 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to a minimum temperature of 1200 degrees F. Gradation: A minimum 90 percent shall pass a No. 8 sieve; a minimum 99 percent shall be retained on a No. 60 sieve; and a maximum 2 percent shall pass a No. 100 sieve. Bulk density: A maximum 40 pounds per cubic foot.

2.4 FERTILIZER

2.4.1 Granular Fertilizer

Organic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

1 pound per 1000 square feet available nitrogen
4 percent available phosphorus
2 percent available potassium

2.5 MULCH

Mulch shall be free from noxious weeds, mold, and other deleterious materials.

2.5.1 Wood Cellulose Fiber Mulch

Use recovered materials of either paper-based (100 percent) or wood-based (100 percent) hydraulic mulch. Processed to contain no growth or germination-inhibiting factors and dyed an appropriate color to facilitate visual metering of materials application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 5.5 to 8.2. Use with hydraulic application of grass seed and fertilizer.

2.6 WATER

Source of water shall be approved by Contracting Officer and of suitable quality for irrigation, containing no elements toxic to plant life.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 EXTENT OF WORK

Provide soil preparation (including soil conditioners as required), fertilizing, seeding, and surface topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.1.1.1 Topsoil

Provide 4 inches of on-site topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer, pH adjusters, and soil conditioners into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Contracting Officer. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.1.1.2 Soil Conditioner Application Rates

Apply soil conditioners at rates as determined by laboratory soil analysis of the soils at the job site.

3.1.1.3 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site.

3.2 SEEDING

3.2.1 Seed Application Seasons and Conditions

Immediately before seeding, restore soil to proper grade. Do not seed when ground is muddy frozen, snow covered or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the Contracting Officer stating the special conditions and proposed variance.

3.2.2 Seed Application Method

Seeding method shall be hydroseeded.

Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application. Application shall be one of the following or as approved by the Contracting Officer.

a. Mix slurry with fiber-mulch tackifier.

b. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.

c. Spray-apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre.

3.2.3 Mulching

3.2.3.1 Hydroseed Mulching

Mulch shall be composed of minimum 70 percent wood fiber and maximum 30 percent cellulose products with no growth or germination inhibiting substances, and shall be manufactured in such a manner that when thoroughly mixed with seed, fertilizer, organic stabilizer, and water, in the proportions specified, will form homogeneous slurry which is capable of being sprayed to form a porous mat. The fibrous mulch in its air-dry state shall contain no more than 15 percent by weight of water. The fiber shall have a temporary green dye and shall be accompanied by a certificate of compliance stating that the fiber conforms to these specifications.

3.2.3.2 Mechanical Anchor

Mechanical anchor shall be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

3.2.3.3 Asphalt Adhesive Tackifier

Asphalt adhesive tackifier shall be sprayed at a rate between 10 to 13 gallons per 1000 square feet. Sunlight shall not be completely excluded from penetrating to the ground surface.

3.2.3.4 Non-Asphaltic Tackifier

Hydrophilic colloid shall be applied at the rate recommended by the manufacturer, using hydraulic equipment suitable for thoroughly mixing with water. A uniform mixture shall be applied over the area.

3.2.3.5 Asphalt Adhesive Coated Mulch

Hay or straw mulch may be spread simultaneously with asphalt adhesive applied at a rate between 10 to 13 gallons per 1000 square feet, using power mulch equipment which shall be equipped with suitable asphalt pump and nozzle. The adhesive-coated mulch shall be applied evenly over the surface. Sunlight shall not be completely excluded from penetrating to the ground surface.

3.2.4 Rolling

Immediately after seeding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width.

3.2.5 Erosion Control Material

Install in accordance with manufacturer's instructions, where indicated or as directed by the Contracting Officer.

3.2.6 Watering

Start watering areas seeded as required by temperature and wind conditions. Apply water at a rate sufficient to insure thorough wetting of soil to a depth of 2 inches without run off. During the germination process, seed is to be kept actively growing and not allowed to dry out.

3.3 PROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

3.4 RESTORATION

Restore to original condition existing turf areas which have been damaged during turf installation operations at the Contractor's expense. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work in adjacent areas is complete.

-- End of Section --

SECTION 32 93 00

EXTERIOR PLANTS
02/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NURSERY & LANDSCAPE ASSOCIATION (ANLA)

ANSI/ANLA Z60.1	(1996; R 2004) American Standard for Nursery Stock

ASTM INTERNATIONAL (ASTM)

ASTM A580/A580M	(2012a) Standard Specification for Stainless Steel Wire
ASTM C602	(2007) Agricultural Liming Materials
ASTM D4427	(2007) Peat Samples by Laboratory Testing
ASTM D4972	(2001; R 2007) pH of Soils
ASTM D5268	(2007) Topsoil Used for Landscaping Purposes

L.H. BAILEY HORTORIUM (LHBH)

LHBH	(1976) Hortus Third

TREE CARE INDUSTRY ASSOCIATION (TCIA)

TCIA A300P1	(2008) ANSI A300 Part1: Tree Care Operations - Trees, Shrubs and Other Woody Plant Maintenance Standard Practices - Pruning
TCIA Z133.1	(2006) American National Standard for Arboricultural Operations - Pruning, Repairing, Maintaining, and Removing Trees, and Cutting Brush - Safety Requirements

U.S. DEPARTMENT OF AGRICULTURE (USDA)

DOA SSIR 42	(1996) Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 3.0

VIRGINIA DEPARTMENT OF CONSERVATION AND RECREATION (DCR)

DCR	(2011)Stormwater Design Specification No.

4 Soil Compost Amendment

1.2 RELATED REQUIREMENTS

Section 31 00 00 EARTHWORK, Section 32 92 19 SEEDING, and Section 32 05 33 LANDSCAPE ESTABLISHMENT applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein; and in accordance with DCR where applicable.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals identified with "AE" shall be reviewed by Landscape Architect. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

State Landscape Contractor's License
Time Restrictions and Planting Conditions
Pesticide Proposal

Indicate anticipated dates and locations for each type of planting.

SD-03 Product Data

Root Barriers; G
Pete
Gypsum
Fertilizer
Mulch
Organic Mulch Materials; G, AE
Staking Material
Ground Stakes
Antidesiccants
Hose

SD-06 Test Reports

Topsoil composition tests; G, AE

SD-07 Certificates

Nursery certifications; G, AE

Indicate names of plants in accordance with the LHBH, including type, quality, and size.

1.4 QUALITY ASSURANCE

1.4.1 Topsoil Composition Tests

Commercial test from an independent testing laboratory including basic soil groups (moisture and saturation percentages, Nitrogen-Phosphorus-Potassium (N-P-K) ratio, pH (ASTM D4972), soil salinity), secondary nutrient groups (calcium, magnesium, sodium, Sodium Absorption Ratio (SAR)), micronutrients

(zinc, manganese, iron, copper), toxic soil elements (boron, chloride, sulfate), cation exchange and base saturation percentages, and soil amendment and fertilizer recommendations with quantities for plant material being transplanted. Soil required for each test shall include a maximum depth of 18 inches of approximately 1 quart volume for each test. Areas sampled should not be larger than 1 acre and should contain at least 6-8 cores for each sample area and be thoroughly mixed. Problem areas should be sampled separately and compared with samples taken from adjacent non-problem areas. The location of the sample areas should be noted and marked on a parcel or planting map for future reference.

1.4.2 Nursery Certifications

a. Indicate on nursery letterhead the name of plants in accordance with the LHBH, including botanical common names, quality, and size.

b. Inspection certificate.

c. Mycorrhizal fungi inoculum for plant material treated

1.4.3 State Landscape Contractor's License

Construction company shall hold a landscape contractors license in the state where the work is performed and have a minimum of five years landscape construction experience. Submit copy of license and three references for similar work completed in the last five years.

1.4.4 Tree Tagging

Tree tagging shall be administered by the Contracting Officer in coordination with ANC Horticultural Staff and Landscape Contractor.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Branched Plant Delivery

Deliver with branches tied and exposed branches covered with material which allows air circulation. Prevent damage to branches, trunks, root systems, and root balls and desiccation of leaves.

1.5.1.2 Soil Amendment Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, or trademark, and indication of conformance to state and federal laws. Instead of containers, gypsum, and lime may be furnished in bulk with a certificate indicating the above information. Store in dry locations away from contaminates.

1.5.1.3 Plant Labels

Deliver plants with durable waterproof labels in weather-resistant ink. Provide labels stating the correct botanical and common plant name and variety as applicable and size as specified in the list of required plants. Attach to plants, bundles, and containers of plants. Groups of plants may be labeled by tagging one plant. Labels shall be legible for a minimum of 60 days after delivery to the planting site.

1.5.2 Storage

1.5.2.1 Plant Storage and Protection

Store and protect plants not planted on the day of arrival at the site as follows:

a. Shade and protect plants in outside storage areas from the wind and direct sunlight until planted.

b. Heel-in bare root plants.

c. Protect balled and burlapped plants from freezing or drying out by covering the balls or roots with moist burlap, sawdust, wood chips, shredded bark, peat moss, or other approved material. Provide covering which allows air circulation.

d. Keep plants in a moist condition until planted by watering with a fine mist spray.

e. Do not store plant material directly on concrete or bituminous surfaces.

1.5.2.2 Fertilizer, and Mulch Storage

Store in dry locations away from contaminants.

1.5.2.3 Topsoil and Compost

Prior to stockpiling topsoil, eradicate on site undesirable growing vegetation. Clear and grub existing vegetation three to four weeks prior to stockpiling existing topsoil.

1.5.3 Handling

Do not drop or dump plants from vehicles. Avoid damaging plants being moved from nursery or storage area to planting site. Handle balled and burlapped balled and potted and container plants carefully to avoid damaging or breaking the earth ball or root structure. Do not handle plants by the trunk or stem. Remove damaged plants from the site.

1.5.4 TIME LIMITATION

Except for container-grown plant material, the time limitation from digging to installing plant material shall be a maximum of 90 days. The time limitation between installing the plant material and placing the mulch shall be a maximum of 24 hours.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Planting Dates

1.6.1.1 Deciduous Material

Deciduous material: April 15 to June 15.

All Willow Oaks and Red Oaks shall be dug between 15 February and 30 April.

1.6.1.2 Evergreen Material

Evergreen material: September 15 to November 15, except as noted below.

No evergreen trees or shrubs shall be planted 1 December to 15 March.

1.7 GUARANTEE

All plants shall be guaranteed for one year beginning on the date of inspection by the Contracting Officer to commence the plant establishment period, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by the Government or by weather conditions unusual for the warranty period.

Remove and replace dead planting materials immediately unless required to plant in the succeeding planting season. At end of warranty period, replace planting materials that die or have 25 percent or more of their branches that die during the construction operations or the guarantee period.

PART 2 PRODUCTS

2.1 PLANTS

2.1.1 Regulations and Varieties

Furnish nursery stock in accordance with ANSI/ANLA Z60.1, except as otherwise specified or indicated. Each plant or group of planting shall have a "key" number indicated on the nursery certifications of the plant schedule. Furnish plants, including turf grass, grown under climatic conditions similar to those in the locality of the project. Spray plants budding into leaf or having soft growth with an antidesiccant before digging. Plants of the same specified size shall be of uniform size and character of growth. All plants shall comply with all Federal and State Laws requiring inspection for plant diseases and infestation.

2.1.2 Shape and Condition

Well-branched, well-formed, sound, vigorous, healthy planting stock free from disease, sunscald, windburn, abrasion, and harmful insects or insect eggs and having a healthy, normal, and undamaged root system.

2.1.2.1 Deciduous Trees and Shrubs

Symmetrically developed and of uniform habit of growth, with straight boles or stems, and free from objectionable disfigurements.

2.1.2.2 Evergreen Trees and Shrubs

Well developed symmetrical tops with typical spread of branches for each particular species or variety.

2.1.2.3 Seedlings

Well shaped and grown, vigorous, healthy plants having healthy and well-balanced root systems.

2.1.3 Plant Size

Minimum sizes measured after pruning and with branches in normal position, shall conform to measurements indicated, based on the average width or height of the plant for the species as specified in ANSI/ANLA Z60.1. Plants larger in size than specified may be provided with approval of the Contracting Officer. When larger plants are provided, increase the ball of earth or spread of roots in accordance with ANSI/ANLA Z60.1.

2.1.3.1 Seedling Size

Seedlings shall be 2-0 stock or better.

2.1.4 Root Ball Size

All box-grown, field potted, field boxed, collected, plantation grown, bare root, balled and burlapped, container grown, processed-balled, and in-ground fabric bag-grown root balls shall conform to ANSI/ANLA Z60.1. All wrappings and ties shall be biodegradable. Root growth in container grown plants shall be sufficient to hold earth intact when removed from containers. Root bound plants will not be accepted.

2.1.5 Growth of Trunk and Crown

2.1.5.1 Deciduous Trees

A height to caliper relationship shall be provided in accordance with ANSI/ANLA Z60.1. Height of branching shall bear a relationship to the size and species of tree specified and with the crown in good balance with the trunk. The trees shall not be "poled" or the leader removed.

a. Single stem: The trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.

b. Multi-stem: All countable stems, in aggregate, shall average the size specified. To be considered a stem, there shall be no division of the trunk which branches more than 6 inches from ground level.

2.1.5.2 Deciduous Shrubs

Deciduous shrubs shall have the height and number of primary stems recommended by ANSI/ANLA Z60.1. Acceptable plant material shall be well shaped, with sufficient well-spaced side branches, and recognized by the trade as typical for the species grown in the region of the project.

2.1.5.3 Coniferous Evergreen Plant Material

Coniferous Evergreen plant material shall have the height-to-spread ratio recommended by ANSI/ANLA Z60.1. The coniferous evergreen trees shall not be "poled" or the leader removed. Acceptable plant material shall be exceptionally heavy, well shaped and trimmed to form a symmetrical and tightly knit plant. The form of growth desired shall be as indicated.

2.1.5.4 Broadleaf Evergreen Plant Material

Broadleaf evergreen plant material shall have the height-to-spread ratio recommended by ANSI/ANLA Z60.1. Acceptable plant material shall be well shaped and recognized by the trade as typical for the variety grown in the region of the project.

2.2 TOPSOIL

2.2.1 Existing Soil

Modify to conform to requirements specified in paragraph entitled "Composition." All topsoil shall have compost amendment tilled-in.

2.2.2 Off-Site Topsoil

Conform to requirements specified in paragraph entitled "Composition." Additional topsoil shall be furnished by the Contractor .

2.2.3 Composition

Evaluate soil for use as topsoil in accordance with ASTM D5268. From 5 to 10 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR 42. Maximum particle size, 3/4 inch, with maximum 3 percent retained on 1/4 inch screen. The pH shall be tested in accordance with ASTM D4972. Topsoil shall be free of sticks, stones, roots, plants, and other debris and objectionable materials. Other components shall conform to the following limits:

Silt	25-50 percent
Clay	20-35 percent
Sand	10-30 percent
pH	5.5 to 7.0
Soluble Salts	600 ppm maximum

2.3 BIO-RETENTION SOIL FILTER MEDIA

Sand	85 to 88 percent
Soil Fines	8 to 12 percent
Compost	3 to 5 percent

2.4 SOIL CONDITIONERS

Provide singly or in combination as required to meet specified requirements for topsoil. Soil conditioners shall be nontoxic to plants.

2.4.1 Lime

Commercial grade hydrated limestone containing a calcium carbonate equivalent (C.C.E.) as specified in ASTM C602 of not less than 80 percent.

2.4.2 Aluminum Sulfate

Commercial grade.

2.4.3 Sulfur

100 percent elemental

2.4.4 Iron

100 percent elemental

2.4.5 Peat

Natural product of peat moss derived from a freshwater site and conforming to ASTM D4427 as modified herein. Shred and granulate peat to pass a 1/2 inch mesh screen and condition in storage pile for minimum 6 months after excavation. Biobased content shall be a minimum of 100 percent. Peat shall not contain invasive species, including seeds.

2.4.6 Sand

Clean and free of materials harmful to plants.

2.4.7 Gypsum

Coarsely ground gypsum comprised of calcium sulfate dihydrate 91 percent, calcium 22 percent, sulfur 17 percent; minimum 96 percent passing through 20 mesh screen, 100 percent passing thru 16 mesh screen.

2.4.8 Compost

Compost shall be derived from plant material and provided by a member of the U.S. Composting Seal of Testing Assurance (STA) Program. Refer to www.composting council.org for a list of local providers.

The compost shall be the result of the biological degradation and transformation of plant-derived materials under conditions that promote anaerobic decomposition. The material shall be well composted, free of viable weed seeds, and stable with regard to oxygen consumption and carbon dioxide generation. The compost shall have a moisture content that has no visible free water or dust produced when handling the material. It shall meet the following criteria, as reported by the U.S. Composting Council STAA Compost Technical Data Sheet provided by the vendor:

a. 100 percent of the material must pass through a half-inch screen.

b. the pH of the material shall be between 6 and 8.

c. Manufactured inert material (plastic, concrete, ceramics, metal) shall be less than 1.0 percent by weight.

d. The organic matter content shall be between 35 and 65 percent.

e. Soluble salt content shall be less than 6.0 mmhos/cm.

f. Maturity shall be greater than 80 percent.

g. Stability shall be 7 or less.

h. Carbon/nitrogen ratio shall be less than 25:1.

i. Trace metal test results shall be "pass."

j. The compost shall have a dry bulk density ranging from 40 to 50 lbs/cu ft.

2.5 PLANTING SOIL MIXTURES

100 percent topsoil as specified herein.

2.6 FERTILIZER

2.6.1 Granular Fertilizer

Organic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

2.7 MULCH

Free from noxious weeds, mold, pesticides, or other deleterious materials.

2.7.1 Organic Mulch Materials

shredded hardwood bark peelings from site when available. Biobased content shall be a minimum of 100 percent. Wood cellulose fiber shall be processed to contain no growth or germination-inhibiting factors, dyed with non-toxic, biodegradable dye to an appropriate color to facilitate visual metering of materials application. Paper-based hydraulic mulch shall contain a minimum of 100 percent post-consumer recycled content. Wood-based hydraulic mulch shall contain a minimum of 100 percent recycled material.

2.8 STAKING AND GUYING MATERIAL

2.8.1 Staking Material

2.8.1.1 Tree Support Stakes

Rough sawn hard wood free of knots, rot, cross grain, bark, long slivers, or other defects that impair strength. Stakes shall be minimum 2 inches square or 2 1/2 inch diameter by 8 feet long, pointed at one end. .

2.8.1.2 Ground Stakes

100 percent post-consumer recycled content plastic, 2 inches square are by 3 feet long, pointed at one end.

2.8.2 Guying Material

2.8.2.1 Guying Wire

12 gauge annealed galvanized steel, ASTM A580/A580M.

2.8.2.2 Guying Cable

Minimum five-strand, 3/16 inch diameter galvanized steel cable plastic coated.

2.8.3 Hose Chafing Guards

New or used 2 ply 3/4 inch diameter reinforced rubber or plastic hose, black or dark green, all of same color.

2.8.4 Turnbuckles

Galvanized or cadmium-plated steel with minimum 3 inch long openings fitted with screw eyes. Eye bolts shall be galvanized or cadmium-plated steel with one inch diameter eyes and screw length 1 1/2 inches, minimum.

2.9 ROOT BARRIERS

Black, molded, 12-inches width modular panels manufactured with 50 percent recycled polyethylene plastic with ultraviolet inhibitors, 85 mils thick, with vertical root deflecting ribs protruding 3/4-inch out from panel. Depth of panel as indicated on Drawings.

2.10 ANTIDESICCANTS

Sprayable, water insoluble vinyl-vinledine complex which produce a moisture retarding barrier not removable by rain or snow. Film shall form at temperatures commonly encountered out of doors during planting season and have a moisture vapor transmission rate (MVT) of the resultant film of maximum 10 grams per 24 hours at 70 percent humidity.

2.11 WATER

Source of water to be approved by Contracting Officer and suitable quality for irrigation and shall not contain elements toxic to plant life.

2.11.1 Hose

Hoses used for watering shall be a minimum of 60 percent post-consumer rubber or plastic.

2.12 SOURCE QUALITY CONTROL

The Contracting Officer will inspect plant materials at the project site and approve them. Tag plant materials for size and quality.

PART 3 EXECUTION

3.1 EXTENT OF WORK

Provide soil preparation, soil amendments, planting materials, and planting, planting installation of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

Coordinate with ANC Urban Forester and Landscape Contractor who will provide tree tagging service on this Project.

3.2 PREPARATION

3.2.1 Protection

Protect existing and proposed landscape features, elements, and sites from damage or contamination. Protect trees, vegetation, and other designated

features by erecting high-visibility, reusable construction fencing. Locate fence no closer to trees than the drip line. Plan equipment and vehicle access to minimize and confine soil disturbance and compaction to areas indicated on Drawings.

3.2.2 Layout

Stake out approved plant material locations and planter bed outlines on the project site before digging plant pits or beds. The Contracting Officer reserves the right to adjust plant material locations to meet field conditions. Locate as shown on Drawings.

For seedling areas, define limits of overall seedling planting area.

3.2.3 Soil Preparation

3.2.3.1 pH Adjuster Application Rates

Apply pH adjuster at rates as determined by laboratory soil analysis of the soils at the job site.

3.2.3.2 Soil Conditioner Application Rates

Apply soil conditioners at rates as determined by laboratory soil analysis of the soils at the job site.

3.2.3.3 Compost Incorporation

Apply compost over graded topsoil to a depth of 4 inches. Till compost into soil to a depth of 10 inches distributing evenly through soil profile.

3.2.3.4 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site.

3.3 PLANT BED PREPARATION

Verify location of underground utilities prior to excavation. Protect existing adjacent turf before excavations are made. Where planting beds occur in existing turf areas, remove turf to a depth that will ensure removal of entire root system. Measure depth of plant pits from finished grade. Depth of plant pit excavation shall be as indicated and provide proper relation between top of root ball and finished grade. Install plant material as specified in paragraph entitled "Plant Installation." Do not install trees within 10 feet of any utility lines or walls.

3.4 SEEDLING ESTABLISHMENT

3.4.1 Planting Procedures

3.4.1.1 Setting Plants

Plants shall be set plumb and held in position until sufficient soil has been firmly placed around roots. Plants shall be set in relation to surrounding grade so that they are even with the depth at which they were grown in the nursery or plantation.

3.4.1.2 Bare-Root Plants

Bare-root plants shall be installed by arranging the roots in a natural position. Damaged roots shall be removed with a clean cut. Plants shall be back-filled with soil to minimize air pockets and exposed roots.

3.4.1.3 Random Planting Pattern

For deciduous seeding planting areas, Contractor shall begin planting near the center of the designated site to ensure irregular pattern is established throughout the site as shown on Plans. Plants shall be placed randomly at the following rate:

a. 300 seedlings/acre for Canopy Trees.

Plant species will be alternated to ensure mixture of species required for each area and to avoid monocultures.

3.5 PLANT INSTALLATION

3.5.1 Individual Plant Pit Excavation

Excavate pits at least twice as large in diameter as the size of ball or container to depth shown.

3.5.2 Plant Beds with Multiple Plants

Excavate plant beds continuously throughout entire bed as outlined to depth shown.

3.5.3 Handling and Setting

Move plant materials only by supporting the root ball. Set plants on hand compacted layer of prepared backfill soil mixture 6 inches thick. Set plants on native soil and hold plumb in the center of the pit until soil has been tamped firmly around root ball. Set plant materials, in relation to surrounding finish grade, one to 2 to inches above depth at which they were grown in the nursery, collecting field or container. Replace plant material whose root balls are cracked or damaged either before or during the planting process.

Plant material shall be set in plant beds according to the drawings. Backfill soil mixture shall be placed on previously scarified subsoil to completely surround the root balls, and shall be brought to a smooth and even surface, blending to existing areas.

3.5.3.1 Balled and Burlapped Stock

Backfill with prepared soil mixture to approximately half the depth of ball and then tamp and water. Carefully remove or fold back excess burlap and tying materials from the top a minimum 1/3 depth from the top of the rootball. Tamp and complete backfill, place mulch topdressing, and water. Remove wires and non-biodegradable materials from plant pit prior to backfill operations.

3.5.3.2 Container Grown Stock

Remove from container and prevent damage to plant or root system.

3.5.4 Earth Mounded Watering Basin for Individual Plant Pits

Form with topsoil around each plant by replacing a mound of topsoil around the edge of each plant pit. Watering basins shall be 6 inches deep for trees and 4 inches deep for shrubs. Eliminate basins around plants in plant beds containing multiple plants.

3.5.5 Mulch Topdressing

Provide mulch topdressing over entire planter bed surfaces and individual plant surfaces including earth mound watering basin around plants to a depth of 2 to 3 inches after completion of plant installation and before watering. Keep mulch out of the crowns of shrubs. Place mulch a minimum 2 to 3 inches away from trunk of shrub or tree.

3.5.6 Staking and Guying

3.5.6.1 Staking

Stake plants with the number of stakes indicated complete with double strand of 12 gage guy wire as detailed. Attach guy wire half the tree height but not more than 5 feet high. Drive stakes to a depth of 2 1/2 to 3 feet into the ground outside the plant pit. Do not injure the root ball. Use hose chafer guards where guy wire comes in contact with tree trunk.

3.5.6.2 Guying

Guy plants as indicated. Attach two strands of guying wire around the tree trunk at an angle of 45 degrees at approximately 1/2 of the trunk height . Protect tree trunks with chafing guards where guying wire contacts the tree trunk. Anchor guys to wood ground stakes. Fasten flags to each guying wire approximately 2/3 of the distance up from ground level. Provide turnbuckles as indicated.

3.5.6.3 Chafing Guards

Use hose chafing guards, as specified where guy wire will contact the plant.

3.5.6.4 Wood Ground Stakes

Drive wood ground stakes into firm ground outside of plant pit with top of stake flush with ground. Place equal distance from tree trunk and around the plant pit.

3.5.6.5 Iron Anchors

Drive malleable iron anchors into firm ground outside of plant pit a minimum 30 inches below finish grade. Place equal distance from tree trunk and around the plant pit.

3.5.6.6 Steel Screw Anchors

Insert steel screw anchors as recommended in manufacturer's data. Place equal distance from tree trunk and around the plant pit.

3.5.7 Pruning

Prune in accordance with safety requirement of TCIA Z133.1.

3.5.7.1 Trees and Shrubs

Remove dead and broken branches. Prune to correct structural defects only. Retain typical growth shape of individual plants with as much height and spread as practical. Do not cut central leader on trees. Make cuts with sharp instruments. Do not flush cut with trunk or adjacent branches. Collars shall remain in place. Pruning shall be accomplished by trained and experienced personnel and shall be accordance with TCIA A300P1.

3.5.7.2 Wound Dressing

Do not apply tree wound dressing to cuts.

3.6 ROOT BARRIER INSTALLATION

Install root barrier where shown on the Landscape Plans, in general where trees are planted within 60 inches of paving or other hardscape elements, such as walls, curbs, and walkways unless otherwise shown on Drawings. Install root barrier in interior planting areas and edges of burial sections as indicated on the plans.

Align root barrier vertically and run it linearly along and adjacent to the paving or other hardscape elements to be protected from invasive roots.

Install root barrier continuously for a distance of 120 inches in each direction from the tree trunk, for a total distance of 20 feet per tree. If trees are spaced closer, use a single continuous piece of root barrier. Within and adjacent to in-ground crypt burial section, provide root barrier continuously along perimeter of interior tree planting areas adjacent to crypt boxes as indicated on Drawings.

a. Position top of root barrier 4 inches below finish grade.

b. Overlap root barrier a minimum of 12 inches at joints.

c. Do not distort or bend root barrier during construction activities.

d. Do not install root barrier surrounding the root ball of tree.

3.7 RESTORATION AND CLEAN UP

3.7.1 Restoration

Turf areas, pavements and facilities that have been damaged from the planting operation shall be restored to original condition at the Contractor's expense.

3.7.2 Clean Up

Remove excess and waste material from installed area and shall be dispose offsite at an approved landfill, recycling center, or composting center. Separate and recycle or reuse the following landscape waste materials: wire, ball wrap, and wood stakes. Clear adjacent paved areas.

3.8 MAINTENANCE DURING INSTALLATION

Contractor shall provide a written Pesticide Proposal to Pest Management Coordinator for approval prior to any pesticide application. Maintenance

shall begin immediately following installation. Conduct maintenance per Section 32 05 33 LANDSCAPE ESTABLISHMENT.

-- End of Section --

SECTION 33 05 23.15

JACKING AND BORING PIPE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 26	(1979) Standard Method of Test for Quality of Water to Be Used in Concrete

ASTM INTERNATIONAL (ASTM)

ASTM A 139/A 139M	(2004) Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
ASTM A 666	(2003) Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM C 144	(2004) Standard Specification for Aggregate for Masonry Mortar
ASTM C 150	(2012) Standard Specification for Portland Cement
ASTM C 404	(2007) Standard Specification for Aggregates for Masonry Grout

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA C200	(2005) Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C203	(2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C206	(2003) Field Welding of Steel Water Pipe

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT Specs	(2007) Virginia Department of Transporation Specifications and Regulations

1.2 SUMMARY

This section provides for furnishing and installing pipe by means of jacking and boring as shown on the Construction Plans and described in this

specification.

a. The Work of this Section includes all labor, machinery, construction equipment and appliances required to perform in a good workmanlike manner all boring and jacking of pipeline casings and installation of pipe therein.

b. The overall work scope shall include, but not be limited to, boring and jacking pits and equipment, sheeting, steel casing pipe, skid, steel straps, coatings, location signs as required, installation of the carrier pipe within the casings, miscellaneous appurtenances to complete the entire work as shown on the Construction Drawings, and restoration. Boring and jacking operations shall be performed within the limits shown on the Construction Drawings.

c. The equipment used in boring and jacking casings shall be of adequate commercial size and satisfactory working condition for safe operation, and may be subject to approval by Contracting Officer. Such approval, however, shall not relieve the Contractor of the responsibility for making a satisfactory installation meeting the criteria set forth herein. Only workmen experienced in boring and jacking operations shall be used in performing the Work.

d. Provide all structures, safety equipment, and professional services required to provide for the health and safety of the general public and of personnel involved in pipe boring and jacking work in accordance with the requirements of the regulatory agencies having jurisdiction.

e. Take all measures necessary to protect surrounding public and private property, buildings, roads, drives, sidewalks, drains, sewers, utilities, trees, structures, and appurtenances from damage due to pipe boring and jacking work. Responsibility and payment for correction of such damage, including additional engineering and/or inspection costs incurred by Contracting Officer, shall be the sole responsibility of the Contractor.

1.3 SUBMITTALS

SD-02 Shop Drawings

Jacking Locations and Details; Methods; G, A/E
Boring Locations and Details; Methods; G, A/E

SD-03 Product Data

Steel pipe casings
Carrier Pipe
casing spacers

SD-11 Closeout Submittals

As-Built Record Drawings; G, A/E

PART 2 PRODUCTS

2.1 PIPE CASING

Steel pipe casings shall conform to the requirements of AWWA C200 and ASTM A 139/A 139M (straight seam pipe only), Grade "B" with a minimum yield

strength of 36,000 psi and Standard ASTM 1100 be of a thickness equal to or exceeding the minimum gauge indicated on the Contract Drawings, and equal to or exceeding the requirements of the applicable governing agency. Pipe casing to be placed by jacking methods shall be of sufficient thickness and axial strength to withstand the forces to be encountered during the jacking process. The pipe shall be coated externally with coal-tar primer followed by hot coal-tar enamel in accordance with AWWA C203. The casing shall be shop cut with ends square with centerline, leveled and welded so that the entire length of the casing shall be straight and true.

Field and shop welds of the casing pipes shall conform to the American Welding Society (AWS) standard specifications and shall be performed by qualified welders. Field welds shall be complete penetration (butt welded), single-bevel groove type joints in accordance with the requirements of AWWA C206. Welds shall be airtight, continuous over the entire circumference of the pipe, and shall not increase the outside pipe diameter by more than 3/4-inch. Nor shall there be intrusion of the weld metal into the bore of the casing. It shall be the Contractor's responsibility to provide stress transfer across the joints which is capable of resisting the jacking forces involved.

2.2 CARRIER PIPE

The carrier pipe material shall be in accordance with the Construction Drawings and specifications and will be restrained with manufacturer's restrained joints.

2.3 AUGERING FLUIDS

Augering fluids shall use a mixture of bentonite clay, or other approved stabilizing agent, mixed with potable water with a minimum pH of 6.0 to create the drilling fluid for lubrication and stabilization, as necessary. Vary the fluid viscosity to best fit the soil conditions encountered. Do not use other chemicals or polymer surfactant in the drilling fluid without written consent of the Engineer. Certify in writing to the Engineer that any chemicals to be added are environmentally safe and not harmful or corrosive to the facility. Identify the source of water for mixing the drilling fluid. Approvals and permits are required for obtaining water from such sources as streams, rivers, ponds, or fire hydrants. Any water source used other than potable water shall require a pH test.

2.4 CASING SPACERS

Fusion bond assembled carbon steel bands, risers, and studs with PVC or Epoxy 14 to 20 mils thick.

Treat and coat stainless steel metal surfaces and welds in order to reduce chemical reactivity of its surface.

Bands and Risers.

Minimum 2 pieces, stainless steel plate: ASTM A 666 Type 304, or hot rolled, pickled carbon steel with minimum yield strength of 30,000 psi and coat as specified herein.

Band: Minimum thickness: 14 gage for carrier pipes up to 12 inches diameter and 12 gage for more than 12 inches.

Runners:

a. High density molecular polyethylene or polymer reinforced fiberglass with DURO Hardness A of 80 and minimum dielectric strength of 500 volts per mil with sufficient compressive and shear strengths.

b. Attach to risers with bolts or welded studs.

c. Fill bolt holes with silicone caulk.

d. Spacer Band: Line with minimum 0.090 inch thick ribbed PVC liner of DURO Hardness A of 80 and minimum dielectric strength of 450 volts per mil.

e. Approved Manufacturers:

1) Pipeline Seal and Insulator Inc.
2) Cascade Waterworks Manufacturing Company.
3) Advanced Products and Systems, Inc. (APS)
4) Or equal (Minimum 5 years of fabricating casing spacers in the United States).

Casing End Seals:

a. Approved Manufacturers:

1) Advance Products & Systems, Model AC.
2) Pipeline Seal & Insulator, Inc., Model S or C.
3) Maloney Technical Products, MUL TIFLEX End Seal.
4) Advanced Products and Systems, Inc. (APS)
5) Or equal.

Grout:

a. Cement: ASTM C 150, Type I or Type II.

b. Water: Clean, fresh, and free from injurious substances. If water has questionable quality it shall meet limits of comparison tests with distilled water following AASHTO T 26.

c. Sand: ASTM C 404, Size No.1.

d. Voids Between Casing and Existing Ground: Minimum compressive strength of 100 psi, attained within 24 hours, and sufficiently fluid to inject through lining and fill voids, with prompt setting to control grout flow.

e. For Carrier Pipe Bedding and Filling Annular Space Between Tunnel Liner and Carrier Pipe: 3 parts ASTM C 144 sand, to 1 part ASTM C 150 cement.

Concrete for Cradle or Filling Void between Casing and Carrier Pipe: Conform to VDOT Specs, Section 217 for Class A3.

Flowable Fill for Filling Void between Casing and Carrier Pipe: Conform to VDOT Specs, Section 217 for Class A3.

Subsurface Settlement Indicator Fabrication: Refer to details on Sheet C-505.

Dielectric Material:

a. Thermoplastic; Minimum strength of 400 volts for each mil, and water absorption less than 0.02 percent (24-hour period).

Surface Settlement Markers:

a. Within Bituminous Concrete Paved Areas: "p.k." nails.

b. Within nonpaved Areas: Wooden hubs.

c. On Concrete Surfaces: Paint

PART 3 EXECUTION

3.1 GENERAL

Suitable pits or trenches shall be excavated for jacking, boring or tunneling operations. Dewater all excavations as required to provide a safe and stable work area and suitable foundation for all pipe. Pipe installed by jacking or boring or tunneling under highways, streets or other facilities shall not interfere in any way with the normal operation of the highway, street or facility. Pipe installed by jacking or boring or tunneling under highways, streets or other facilities shall not weaken or damage any part of the highway, street or facility.

a. Furnish and maintain traffic control devices as required during jacking, boring and tunneling operations.

b. Remove traffic control devices upon completion of jacking, boring and tunneling operations.

Remove and replace without additional cost, any pipe damaged during jacking or boring operations. The final position of the pipe may vary only 1 inch in 40 feet, laterally or vertically and such variation must be regular and in only one direction. The final grade of the flow line must be in the direction indicated by the Construction Plans. Over-excavation in excess of 1-in. shall be pressure grouted the entire length of the installation. The pits or trenches excavated to install pipe by jacking or boring shall be backfilled immediately after the installation of the pipe has been completed.

The installation of pipeline casing under road (as shown on Drawings) shall be in accordance with VDOT Specs, Section 302, Item 302.03(a)1 "Jack and Bore Methods."

3.2 EXCAVATION

A two-inch auger pilot hole shall first be attempted to determine if rock will prevent the installation of the casing. If the pilot hole is successfully made, the casing shall be installed.

The leading section of casing shall be equipped with a jacking head securely anchored thereto to prevent any wobble or variation in alignment during the jacking operation.

Excavation shall be performed entirely within the jacking head and no excavation in advance thereof shall be permitted. Every effort shall be made to avoid any loss of earth outside the jacking head.

Excavated material shall be removed from the casing as excavation progresses, and no accumulation of such material within the casing will be permitted.

3.3 JACKING

Provide heavy duty jacks suitable for forcing the pipe through the embankment. Apply even operating pressure to all jacks used. Provide a suitable jacking head and suitable bracing between jacks and jacking head to assure that pressure will be applied to the pipe uniformly around the ring of the pipe. Provide a suitable jacking frame or back stop. Set the pipe to be jacked on guides properly braced together to support the pipe section and direct it in the proper line and grade. Line up the jacking assembly with the direction and grade of the pipe. Excavate embankment material just ahead of the pipe, remove excavated material through the pipe and force the pipe through the embankment with jacks into the space provided. Excavate beneath the pipe to conform to contour and grade for at least one-third of its circumference. A 2-inch maximum clearance above the pipe shall taper to zero at the point where the excavation conforms to the contour of the pipe. The distance the excavation extends beyond the end of the pipe depends upon the character of the material, but shall not exceed 2 feet. Jack the pipe from the low or downstream end. A cutting edge of steel plate may be installed around the head end of the pipe.

a. The cutting edge may extend a short distance beyond the end of the pipe.

b. Angles or lugs are permitted inside the cutting edge to prevent its slipping back onto the pipe.

Once jacking is begun, the operation must continue without interruption, insofar as practicable, to prevent the pipe from becoming firmly set in the embankment.

3.4 BORING

Pilot Hole Method

a. Bore a 2-inch pilot hole the entire length of the crossing.

b. From the opposite end, check it for line and grade.

c. Use pilot hole as centerline for the larger diameter hole to be bored.

Auger Method:

a. Provide proper diameter steel encasement pipe equipped with a cutter head to mechanically perform the excavation.

b. Augers shall be of sufficient diameter to convey the excavated material to the work pit.

Use water or other fluids in boring only to lubricate cuttings; jetting will not be permitted. In unconsolidated formations, use a gel-forming colloidal drilling fluid containing at least 10 percent of high-grade, carefully processed bentonite to consolidate the cuttings of the bit, seal

the hole walls, and furnish lubrication for subsequent removal of cuttings and immediate installation of the pipe.

3.5 BORING AND JACKING

The boring and jacking operations shall be done simultaneously with correct line and grade carefully maintained for the casing. Holes for casing shall be bored with an auger mounted inside the pipe with the auger extending a short distance beyond the lead end of the pipe to preclude caving.

Excavation for jacking pits or shafts shall be in accordance with applicable sections of these specifications.

Carrier pipes shall have manufacturer's restrained joints and shall be supported to prevent damages to either carrier pipe or casing pipe. The ends of the casing pipe shall be sealed with elastomeric end seals fastened with stainless steel bands installed at each end of casing after installation of the utility pipe. For water and sewer, refer to end of tunnel detail on drawings.

The top of the casing shall maintain a minimum of 36-inch clearance under the roadway surface, or as indicated on the Construction Drawings.

The invert elevation of the steel casing for the individual roadway crossings shall be set in the field by the Contractor and shall be based on the minimum vertical clearance between the top of the carrier pipe, unless otherwise indicated on the Construction Drawings, and the existing utilities on either side of the crossing site unless otherwise noted on the Construction Drawings.

Casing invert elevations which are proposed by the Contractor shall be submitted to the Engineer for approval prior to starting work.

3.6 GROUTING

After jacking is completed, the Contractor shall drill holes in the casing at the locations of ground loss and elsewhere where voids are suspected and shall force grout in to fill voids to refusal at satisfactory pressures, but not to exceed 50 psi. This shall be done only in casings with large enough diameter to provide adequate working room.

3.7 PIPE SIZES

Pipe size and class shall be as indicated on Drawings.

Contractor shall submit calculations and details for sheeting, shoring and bracing for protection of roadbed and equipment. Contractor shall not proceed with pipe installation until the plan has been reviewed by the Contracting Officer.

In cases where circumstances such as utility conflicts will not allow crossing by bore and jack method, the Government may consider approving other methods of crossing with additional requirements to minimize pavement failure and maintenance problems.

3.8 LOSS OF GROUND

Should appreciable loss of ground occur during the jacking operation, the voids shall be backpacked promptly to the extent practicable with soil

cement consisting of a slightly moistened mixture of 1 part cement to 5 parts granular material. Where the soil is not suitable for this purpose, the Contractor shall provide suitable material at his expense.

The soil cement shall be thoroughly mixed and rammed into place as soon as possible after the loss of ground.

3.9 TOLERANCES

Extreme care shall be exercised by the Contractor to maintain line and grade during jacking operation, and the Contractor may be required to modify the manner in which he is conducting his jacking operation to correct any deviation when deemed necessary by the Contracting Officer.

3.10 RESPONSIBILITY

Contractor shall be fully responsible for the placement of the casing. The details shown on the Construction Drawings are to be considered minimum only.

3.11 INSTALLATION OF PIPE

The pipe shall be installed in the casing using approved manufactured casing spacer centered on pipe length.

The pressure of sliding carrier pipe into the casing shall not be applied directly to carrier pipe. A plank, timber, or other material acceptable to the Contracting Officer shall be placed over the pipe end, during pushing, to protect it from damage.

Adjust the pipe grade as required by changing the thickness of the spacers to compensate for any grade variations of the casing.

If the alignment of the casing is such that the pipe grade cannot be met, the grade of the pipe shall be adjusted, if required by the Contracting Officer. If realignment is not deemed feasible, another casing meeting the required grade shall be installed. The abandoned casing shall be filled with sand and the ends plugged with 12-inch thick masonry plugs. Realignment or replacement work shall in no way result in extra cost to the Government.

Ends of casing pipe shall be sealed with elastomeric end seals fastened with stainless steel bands shall be installed at each end of casing. For water and sewer, refer to end of tunnel detail on Drawings.

3.12 SUCCESSFUL COMPLETION

Contractor shall be considered as having completed the requirements of any one boring or jacking when he has successfully completed the work to the satisfaction of the Contracting Officer.

The locations of any second or third attempts shall have the concurrence of the Contracting Officer. If, after three attempts, the Contractor is not able to complete a boring or jacking, he may request authorization to use a trench. If such authorization is granted, the installation of the pipe and restoration of the surface shall be at no additional cost except that the Contractor shall be reimbursed for any casing abandoned in place at the unit price set forth in the Unit Price Schedule for Change Orders. If such authorization is not granted and the Contractor is required to utilize

other methods approved by the Contracting Officer, it shall be considered additional work. However, appropriate credit shall be given for not having performed the borings or trenching.

-- End of Section --

SECTION 33 11 00

WATER DISTRIBUTION
02/11

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ARLINGTON COUNTY DEPARTMENT OF ENVIRONMENTAL SERVICES (DES)

DES STDS	Construction Standards and Specifications

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2008; Errata 2010) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105/A21.5	(2010) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110/A21.10	(2012) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2007) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151/A21.51	(2009) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C153/A21.53	(2011) Ductile-Iron Compact Fittings for Water Service
AWWA C203	(2008) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C500	(2009) Metal-Seated Gate Valves for Water Supply Service
AWWA C502	(2005) Dry-Barrel Fire Hydrants
AWWA C509	(2009) Resilient-Seated Gate Valves for Water Supply Service
AWWA C550	(2005) Protective Epoxy Interior Coatings for Valves and Hydrants
AWWA C600	(2010) Installation of Ductile-Iron Water Mains and Their Appurtenances

ASME INTERNATIONAL (ASME)

ASME B16.15	(2011) Cast Bronze Alloy Threaded Fittings Classes 125 and 250
ASME B16.18	(2012) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	(2001; R 2010) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2011) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B18.2.2	(2010) Standard for Square and Hex Nuts
ASME B18.5.2.1M	(2006; R 2011) Metric Round Head Short Square Neck Bolts
ASME B18.5.2.2M	(1982; R 2010) Metric Round Head Square Neck Bolts

ASTM INTERNATIONAL (ASTM)

ASTM A126	(2009) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A240	(2012) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A242	(2009) Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A307	(2010) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A47/A47M	(1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A48/A48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM A536	(1984; R 2009) Standard Specification for Ductile Iron Castings
ASTM A563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM B42	(2010) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B88	(2009) Standard Specification for Seamless Copper Water Tube

ASTM C94/C94M	(2012) Standard Specification for Ready-Mixed Concrete

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1963	(2009; Errata 09-1) Standard for Fire Hose Connections
NFPA 291	(2013) Recommended Practice for Fire Flow Testing and Marking of Hydrants

UNDERWRITERS LABORATORIES (UL)

UL 262	(2004; Reprint Oct 2011) Gate Valves for Fire-Protection Service

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ)

12 VAC5-590	Waterworks Regulations

1.2 DESIGN REQUIREMENTS

1.2.1 Water Distribution Mains

Provide water distribution mains indicated as 4 to 14 inch lines of ductile-iron pipe. Provide water main accessories, gate valves and check valves as specified and where indicated.

1.2.2 Water Service Lines

Provide water service lines indicated as 4 to 12 inch lines from water distribution main to building service at a point approximately 5 feet from building . Water service lines shall be ductile-iron. Ductile-iron pipe appurtenances, and valves as specified for water mains may also be used for service lines. Provide water service line appurtenances as specified and where indicated. Submit design calculations of water piping.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Piping Materials; G, AE
Water distribution main piping, fittings, joints, valves, and coupling; G, AE
Water service line piping, fittings, joints, valves, and coupling; G, AE
Hydrants; G, AE
Valve boxes; G, AE

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on joints. Include information concerning gaskets with submittal for joints and couplings.

SD-06 Test Reports

Bacteriological Disinfection; G.

Test results from commercial laboratory verifying disinfection

SD-07 Certificates

Water distribution main piping, fittings, joints, valves, and coupling
Water service line piping, fittings, joints, valves, and coupling
Lining
Fire hydrants

Certificates shall attest that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the intervals or frequency specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

SD-08 Manufacturer's Instructions

Delivery, storage, and handling
Installation procedures for water piping

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves and hydrants free of dirt and debris.

1.4.2 Handling

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Do not place any other material or pipe inside a pipe or fitting after the coating has been applied. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Store rubber gaskets that are not to be installed immediately, under cover out of direct sunlight.

1.4.2.1 Coated and Wrapped Steel Pipe

Handle steel pipe with coal-tar enamel coating in accordance with the provisions of AWWA C203.

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS

All materials shall be suitable for 250 pounds per square inch (psi) working pressure unless otherwise indicated. Pipe of the same size and material shall be furnished by the same manufacturer. Each pipe length and fitting shall be clearly marked with the manufacturer's name, trademark and class of pipe. Materials shall be recently manufactured and unused. Only previously approved manufacturers items may be furnished.

2.1.1 Piping Materials

2.1.1.1 Ductile-Iron Piping

a. Pipe and Fittings: Unless otherwise specified on the Drawings, pipe, AWWA C151/A21.51, Pressure Class 53 minimum for 6-inch pipe and smaller; Class 52 for 8-inch and larger. Fittings, AWWA C110/A21.10 or AWWA C153/A21.53; fittings with push-on joint ends conforming to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have singlecement-mortar lining, AWWA C104/A21.4, twice the standard thickness.

b. Joints and Jointing Material:

(1) Joints: Joints for pipe and fittings shall be mechanical joints unless otherwise indicated. Provide mechanical joints where indicated. Provide mechanically coupled type joints using a sleeve-type mechanical coupling where indicated.

(2) Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets, AWWA C111/A21.11.

2.1.2 Iron Pipe

Unless otherwise specified on the Drawigns, iron pipe shall be ductile iron conforming to AWWA C151/A21.51, class 53 minimum for 6-inch pipe and class 52 minimum for 8-inch and larger pipe. Pipe shall be single cement lined conforming to AWWA C104/A21.4 and shall have mechanical or push-on joints utilizing rubber gasket rings, conforming to AWWA C111/A21.11. Coatings shall be bituminous 1.0 mil. thick.

Fittings shall be mechanical joint ductile iron conforming to AWWA C110/A21.10
with a minimum pressure rating of 250 psi, or ductile iron compact grade conforming to AWWA C153/A21.53 with a minimum pressure rating of 350 psi. Fittings shall be cement lined conforming to AWWA C104/A21.4.

Polyethylene encasement with a minimum thickness of 8-mils shall be applied to all underground ductile pipe installations and shall comply with the

installation and material requirements of AWWA C105/A21.5. All pipes, fittings, valves, hydrants and branch connections shall be encased as shown on approved plans. All holes and openings of any size shall be repaired in accordance with the manufacturer's recommendations.

2.1.3 Tie Rods and Accessories for Anchorage and Mechanical Joint Restraints

Tie rods, tie bolts and accessories shall be manufactured of corrosion resistant steel, ASTM A242.

Mechanical joint restraints shall be used with all water main appurtenances as directed or as approved by the engineer. Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Restraining devices shall be manufactured of ductile iron. Torque limiting twist off nuts shall be used to insure proper installation of the restraining device. The minimum working pressure shall be at least 250 psi.

2.1.4 Valves, Hydrants, and Other Water Main Accessories

2.1.4.1 Gate Valves

Gate valves, 4-inch through 12-inch, for buried installation shall be iron body, bronze mounted, resilient seated, O-ring sealed, non-rising stem, fitted with a 2-inch operating nut opening left, with mechanical joint and/or flanged ends, asindicated on the drawings. Valves shall conform to AWWA C509 requirements. Provide buried valves with valve boxes. Provide extension stems extended within two feet of finished grade if required for valve depth.

Gate valves 14 inches and larger shall be iron body with fusion epoxy coating conforming to AWWA C550 bronze mounted, double disc, resilient wedge, O-ring sealed, non-rising stem, fitted with a 2-inch operating nut opening left, with mechanical joint and/or flanged ends as indicated on the drawings. 14 inch gate valves may be installed in vaults or buried with valve boxes and extension stems placed within two feet of finished grade if required for valve depth.

Gate valves 3 inches to 8 inches for water meter and/or fire line vault or interior installation shall be iron body, bronze mounted, resilient wedge, bolted bonnet, 250 psig maximum working pressure class 125 psi, outside screw and yoke, rising stem with hand wheel, opening left, with flanged ends.

Gate valves 2 inches and smaller shall be bronze body, solid disc, union bonnet, class 150 psi minimum, non-rising stem with hand wheel, opening left, with inside threaded ends.

2.1.4.2 Vacuum and Air Relief Valves

Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow.

Air release valves shall be constructed of cast iron body and cover

conforming to ASTM A126.GR.B requirements. The float shall be stainless steel conforming to ASTM A240 requirements.

2.1.4.3 Fire Hydrants

Fire hydrants shall be painted nutmeg brown with a reflective finish. Caps shall indicate tested water pressure. Follow NFPA 291 for hydrant classification color accent band painted on the bonnet indicating the rated capacity. Hydrant number shall be stenciled on per NFPA 291.

a. Dry-Barrel Type Fire Hydrants: Fire hydrants shall be dry top, dry barrel compression type, with a valve opening of 5-1/4 inches, double 0-ring seals and safety flange, and shall conform to AWWA C502 requirements. Hydrants shall be provided with two 2-1/2 inch hose nozzles and one 4-inch pumper nozzle with threading conforming to NFPA 1963 requirements for National Standard Fire Hose Company Screw Threads, 6-inch mechanical joint inlet connection, National Standard 1-1/2 inch pentagon operating nut, outlet nozzle cap nuts, chains on outlet nozzle caps, and harnessed lugs. Hydrants shall open left and counterclockwise.

b. Flush-Type Fire Hydrants: Hydrants shall conform to the applicable requirements of AWWA C502, except that they shall be of a design that will permit placement of hydrant below surface of pavement. Hydrants shall have 6 inch inlet, 4 1/4 inch minimum valve opening, one 4 1/2 inch pumper connection, and one 2 1/2 inch hose connection. Hose and pumper connections and operating nuts shall be readily accessible, and enclosed in a cast iron box with top flush with pavement and having cast-iron cover with flush lifting handle. Inlet shall have mechanical-joint. Size and shape of operating nut and cap nuts and threads on hose and pumper connections shall be as specified in AWWA C502.

2.1.4.4 Watering Station Pedestal

Flower watering station shall be cast iron post/pedestal with integral plumbing to allow for connection of water service and installation of faucet in the field. Provide reducers and adapters for connection to mainline.

Faucet/Pedestal assembly shall have laminar flow and 3-feet depth of bury. Color shall be black.

Plumbing and fittings shall comply with ASTM B88, Type L, annealed. Fittings, ASME B16.22, wrought copper. Provide full solder cup for all fittings. Capped or plugged outlets shall be schedule 40 screwed brass.

2.1.4.5 Valve Boxes

Provide a valve box for each gate valve on buried piping . Valve boxes shall be of cast iron of a size suitable for the valve on which it is to be used and shall be adjustable. Cast-iron boxes shall have a minimum cover and wall thickness of 3/16 inch. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 5 1/4 inches. Cast-iron box shall have a heavy coat of bituminous paint.

2.1.4.6 Valve Pits

Valve pits shall be constructed at locations indicated or as required above

and in accordance with the details shown.

2.1.4.7 Sleeve-Type Mechanical Couplings

Couplings shall be designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling shall consist of one middle ring flared or beveled at each end to provide a gasket seat; two follower rings; two resilient tapered rubber gaskets; and bolts and nuts to draw the follower rings toward each other to compress the gaskets. The middle ring and the follower rings shall be true circular sections free from irregularities, flat spots, and surface defects; the design shall provide for confinement and compression of the gaskets. For ductile iron pipe, the middle ring shall be of cast-iron. Cast iron, ASTM A48/A48M not less than Class 25. Malleable and ductile iron shall, conform to ASTM A47/A47M and ASTM A536, respectively. Gaskets shall be designed for resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in AWWA C111/A21.11. Bolts shall be track-head type, ASTM A307, Grade A, with nuts, ASTM A563, Grade A; or round-head square-neck type bolts, ASME B18.5.2.1M and ASME B18.5.2.2M with hex nuts, ASME B18.2.2. Bolts shall be 5/8 inch in diameter; minimum number of bolts for each coupling shall be for 4 inch pipe, 6 for 6 inch pipe, and for 8 10 inch pipe. Bolt holes in follower rings shall be of a shape to hold fast the necks of the bolts used. Mechanically coupled joints using a sleeve-type mechanical coupling shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint. Mechanical couplings shall provide a tight flexible joint under all reasonable conditions, such as pipe movements caused by expansion, contraction, slight setting or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Couplings shall be of strength not less than the adjoining pipeline.

2.1.4.8 Tracer Wire for Nonmetallic Piping

Provide bare copper or aluminum wire not less than 0.10 inch in diameter in sufficient length to be continuous over each separate run of nonmetallic pipe.

2.2 WATER SERVICE LINE MATERIALS

2.2.1 Piping Materials

2.2.1.1 Copper Pipe and Associated Fittings

Pipe, ASTM B42, regular, threaded ends. Fittings shall be brass or bronze, ASME B16.15, 125 pound.

2.2.1.2 Copper Tubing and Associated Fittings

Tubing, ASTM B88, Type K. Fittings for solder-type joint, ASME B16.18 or ASME B16.22; fittings for compression-type joint, ASME B16.26, flared tube type.

2.2.1.3 Ductile-Iron Piping

Comply with "Ductile-Iron Piping" subparagraph under paragraph "Water Distribution Main Materials."

2.2.1.4 Insulating Joints

Joints between pipe of dissimilar metals shall have a rubber-gasketed or other suitable approved type of insulating joint or dielectric coupling which will effectively prevent metal-to-metal contact between adjacent sections of piping.

2.2.2 Water Service Line Appurtenances

2.2.2.1 Check Valves

Check valves shall be designed for a minimum working pressure of 200 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, or trademark shall be cast on the body of each valve. Valves 2 inches and larger shall be outside lever and weight type.

2.2.2.2 Gate Valves 3 Inch Size and Larger on Buried Piping

Gate valves 3 inch size and larger on buried piping AWWA C500 or UL 262 and of one manufacturer. Valves, AWWA C500, nonrising stem type with double-disc gates. Valves, UL 262, inside-screw type with operating nut, split wedge or double disc type gate, and designed for a hydraulic working pressure of 250 psi. Materials for UL 262 valves conforming to the reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have 0-ring stem seals and shall be bolted and constructed so as to permit easy removal of parts for repair. Valves shall have ends suitable for joining to the pipe used; mechanical-joint ends for joining to ductile-iron pipe; gaskets and pipe ends, AWWA C111/A21.11.

2.2.2.3 Pressure Regulation (Reducing) Valves

Range of 30 to 50 psi. Shall be set at 40 psi. Inline.

2.2.2.4 Valve Boxes

Provide a valve box for each gate valve on buried piping. Valve boxes shall be of cast iron of a size suitable for the valve on which it is to be used and shall be adjustable. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 5 1/4 inches. Cast-iron box shall have a heavy coat of bituminous paint.

2.2.2.5 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be ductile, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 200 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as

specified, pretorqued to 50 foot-pound.

2.2.2.6 Disinfection

Chlorinating materials shall conform to 12 VAC5-590.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Location of Water Lines

Terminate the work covered by this section at a point approximately 5 feet from the building , unless otherwise indicated. Where the location of the water line is not clearly defined by dimensions on the drawings, do not lay water line closer horizontally than 10 feet from any sewer line. Where water lines cross under gravity sewer lines, encase sewer line fully in concrete for a distance of at least 10 feet on each side of the crossing, unless sewer line is made of pressure pipe with rubber-gasketed joints and no joint is located within 3 feet horizontally of the crossing. Lay water lines which cross sewer force mains and inverted siphons at least 2 feet above these sewer lines; when joints in the sewer line are closer than 3 feet horizontally from the water line, encase these joints in concrete. Do not lay water lines in the same trench with gas lines fuel lines or electric wiring. Copper tubing shall not be installed in the same trench with ferrous piping materials.Where nonferrous metallic pipe, e.g. copper tubing, cross any ferrous piping, provide a minimum vertical separation of 12 inches between pipes.

Where water piping is required to be installed within 3 feet of existing structures, the water pipe shall be sleeved as required in Paragraph "Casting Pipe". The Contractor shall install the water pipe and sleeve ensuring that there will be no damage to the structures and no settlement or movement of foundations or footings.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK.

3.1.1.3 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe in a neat workmanlike manner accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at proper

elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports where indicated and where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation. Depth of cover over top of pipe shall not be less than 3 1/2 feet.

3.1.1.4 Installation of Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.1.1.5 Connections to Existing Water Lines

Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped as indicated , except as otherwise specified.

3.1.1.6 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.1.7 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.2 Special Requirements for Installation of Water Mains

3.1.2.1 Installation of Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

a. Jointing: Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer.

b. Allowable Deflection: The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of

the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

c. Pipe Anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Thrust blocks shall be in accordance with the requirements of AWWA C600 for thrust restraint, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C94/C94M, having a minimum compressive strength of 3,000 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

d. Exterior Protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet, using Class C (Black) polyethylene film, in accordance with AWWA C105/A21.5.

3.1.2.2 Installation of Valves and Hydrants

a. Installation of Valves: Install gate valves, AWWA C500 and UL 262, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500. Install gate valves, AWWA C509, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509. Make and assemble joints to gate valves and check valves as specified for making and assembling the same type joints between pipe and fittings.

b. Installation of Hydrants: Install hydrants in accordance with AWWA C600 for hydrant installation and as indicated. Make and assemble joints as specified for making and assembling the same type joints between pipe and fittings. Install hydrants with the 4 1/2 inch connections facing the adjacent paved surface. If there are two paved adjacent surfaces, contact the Contracting Officer for further instructions.

3.1.2.3 Installation of Valves and Flower Watering Stations

Set valves on solid bearing. Provide a drainage pit 12 inches square by 36 inches deep filled with flowable rock fill under drip line of faucet. Extend crypt underdrainage to connect to drainage pit. When crypt underdrain is not available to connect, construct drainage pit 60 inches deep with drainage fill with filter fabric envelope as shown on Drawings.

a. Center and plumb valve box over valve. Set box cover flush with finish grade.

b. Set watering station pedestals plumb; locate faucet perpendicular and facing roadway and as shown on Drawings.

c. Set watering station pedestals to grade, with spigots at elevation indicated.

d. Connect watering station pedestals to water service. Provide pressure regulator and set to 40 psi. Locate PRV in valve box.

e. Locate control valve and concrete valve box as shown.

f. Install faucet to obtain a leak-free connection.

3.1.3 Disinfection

3.1.3.1 Disinfection of Water Mains

When each pipe length has been placed and shut off, disinfect each section of the water main. Provide all labor, materials and equipment to perform the disinfection operations in compliance with all state and local regulations. Disinfection shall conform to AWWA C601 requirements.

Water for disinfection, flushing and testing will be furnished to the Contractor from the existing water system at no charge to the Contractor. Schedule water usage with the Engineer to result in a minimum interference to water service throughout the existing water system. Temporary connections to the existing water system shall be provided and removed by the Contractor and shall include approved means to prevent backflow and possible contamination of the existing water system. Temporary taps for removing air and flushing the main shall be provided by the Contractor as necessary.

Disinfection of the water main shall be accomplished in the following manner:

a. Preliminary Flushing of Mains: All mains shall be flushed prior to disinfection except when the tablet method of disinfection is used. The mains shall be flushed at a minimum velocity of 2.5 feet per second and all points in the main shall receive a minimum of five (5) consecutive minutes of flushing at this velocity, until the water runs clear.

b. Form of Chlorine to be Used: Liquid chlorine, calcium hypochlorite or sodium hypochlorite may be used for disinfection. Liquid chlorine shall be used only when approved by the Engineer. Calcium hypochlorite and sodium hypochlorite shall be added to water to form a chlorine water solution before being used.

c. Methods of Application: The chlorine shall be applied by continuous feed method or by the tablet method only (slug method shall not be used). The application shall be performed as follows:

1) Continuous Feed Method: Potable water shall be introduced into the pipe line at a constant flow rate. Chlorine shall be added at a constant rate to this flow so that the chlorine concentration in the water in the pipe is at least 50 mg/L. The chlorinated water shall remain in the pipe at least 24 hours, after which, the chlorine concentration in the water shall be at least 10 mg/L.

2) Tablet Method: Tablet method shall not be used if trench water or foreign material has entered the main or if the water is below 5 deg. C (41 deg. F). Tablets are placed in each section of pipe and also in hydrant branches and other appurtenances. A sufficient number of tablets shall be used to ensure that a chlorine concentration in the water in the pipe is at least 25 mg/L. The tablets shall be attached by an adhesive to the top of the pipe sections and crushed or rubbed in all appurtenances. The adhesive shall be acceptable to the Virginia Department of Health

(VDH). When installation has been completed, the main shall be filled with water at a velocity of less than one foot per second. The water shall then remain in contact with the pipe for at least 24 hours.

d. Contact Period: The chlorinated water shall be retained in the main for at least 24 hours during which time all valves and hydrants, in the section treated, shall be operated in order to disinfect the appurtenances. The tests for chlorine residual shall be made by the Engineer. The Contractor shall install corporation cocks and copper tubing for the tests at the locations indicated by the Engineer.

e. Flushing and Discharge: After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system or less than 1 mg/l. Chlorine residual determination shall be made by the Engineer. The Contractor shall assume full responsibility for the lawful disposal of chlorinated water. Any damage to property vegetation, trees, streams or ponds caused by the discharge of heavily chlorinated water or injury to customers resulting from the discharge of disinfected water into the system shall be the responsibility of the Contractor and shall be remedied at the Contractor's expense. Hydrostatic testing shall not be performed until the requirements of this section have been completed successfully.

3.1.3.2 Hydrostatic Testing

Pressure tests shall conform with Section 4 of AWWA C600.

The water mains shall be tested for leakage by the Contractor at his own expense in the presence of the Engineer. All tests will be conducted in a manner to minimize any interference with the Contractor's work or progress. A maximum of 2,000 linear feet of water main may be tested at one time.

Contractor shall notify the Engineer when the work is ready for hydrostatic testing and tests shall be taken soon thereafter as practicable under the direction of the Engineer. Personnel for reading meters, gauges or other measuring devices will be furnished by the Engineer, but all other labor, equipment, water and materials, excluding meters and gauges, shall be furnished by the Contractor.

The water mains, including all appurtenances, shall be tested as a whole or in sections, valved or bulkhead at the ends. Test piping under a hydrostatic pressure of 200 psig unless shown otherwise on the approved plans. Testing shall not be conducted against existing valves. Apply pressure to the piping after it has been purged of air. Maintain water pressure for a minimum of two hours. The test pressure shall not vary by more than 5 psi during the test. Testing procedures shall be in accordance with AWWA Standard C600 with the exception that in no case shall the measured leakage exceed 10 gallons/ inch of diameter/mile/day.

3.1.3.3 Final Flushing

All water mains shall be flushed after the acceptance of the hydrostatic test and before bacteriologic testing. The water mains shall be flushed at the highest flow possible through hydrants and/or blow-offs. The operation of any valves on the existing water system shall be done only by DES STDS.

3.1.3.4 Bacteriologic Test

After chlorination, hydrostatic testing and final flushing, and before the water main is placed in service, samples shall be collected from the main and tested for enteric bacterial contamination and shall show the absence of coliform organisms. At least two (2) sets of consecutive satisfactory bacteriological samples 24 hours apart shall be obtained from the distribution system before the system can be placed into service. Samples shall be collected at all accessible locations not exceeding 2,000 feet apart in the line downstream from where the pipe was filled with water. Samples shall be taken through the use of sample tap consisting of a corporation cock and copper tube or through other accessible appurtenances on the main. Samples shall be collected by a representative of the testing laboratory.

All bacteriological sampling and testing shall be conducted by a state certified laboratory. If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained. After each group of samples is taken, the Contractor shall submit in writing to the Engineer a copy of the report stating the results of the tests.

3.1.3.5 Repairs

Cleaning, disinfecting, flushing, testing, or similar operational actions shall be in accordance with the most current version of AWWA C601.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

Prior to hydrostatic testing, obtain Contracting Officer approval of the proposed method for disposal of waste water from hydrostatic testing. The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing . The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications. Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete.

3.2.2 Testing Procedure

Test water mains and water service lines in accordance with the applicable specified standard, except for the special testing requirements given in paragraph entitled "Special Testing Requirements." Test ductile-iron water mains in accordance with the requirements of AWWA C600 for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints or push-on joints shall not exceed the amounts given in AWWA C600; no leakage will be allowed at joints made by any other method. Test water service lines in accordance with applicable requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed.

3.2.3 Special Testing Requirements

For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 2 inches in diameter, hydrostatic

test pressure shall be not less than 200 psi. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

3.3 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

SECTION 33 11 23

NATURAL GAS AND LIQUID PETROLEUM PIPING
11/09

PART 1 GENERAL

1.1 SUMMARY

This Section includes Natural Gas Piping requirements.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME B16.40	(2008) Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems
ASME B31.8	(2010; Supplement 2010) Gas Transmission and Distribution Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM D2513	(2012a) Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
ASTM D2683	(2010) Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(2012) National Fuel Gas Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

49 CFR 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Valve box; G, AE

Valves; G, AE
Warning and identification tape; G, AE
Transition fittings; G, AE

SD-07 Certificates

PE welder's qualifications
Welder's identification symbols

SD-08 Manufacturer's Instructions

PE pipe and fittings; G, AE

Submit manufacturer's installation instructions and manufacturer's visual joint appearance chart.

1.4 QUALITY ASSURANCE

1.4.1 Welder's Qualifications

Comply with ASME B31.8. The PE welder shall have a certificate from a PE pipe manufacturer's sponsored training course. Contractor shall also conduct a qualification test. Submit each welder's identification symbols, assigned number, or letter, used to identify work of the welder. Affix symbols immediately upon completion of welds. Welders making defective welds after passing a qualification test shall be given a requalification test and, upon failing to pass this test, shall not be permitted to work this contract. The PE Welder shall be an approved contractor of Washington Gas in order to work on this Contract.

1.4.2 PE Welder's Qualifications

Prior to installation, Contractor shall have supervising and installing personnel trained by a PE pipe manufacturer's sponsored course of not less than one week duration, or present proof satisfactory to the Contracting Officer that personnel are currently working in the installation of PE gas distribution lines. The PE welder shall be an approved contractor of Washington Gas in order to work on this Contract.

1.4.3 Safety Standards

49 CFR 192.

1.5 DELIVERY, STORAGE, AND HANDLING

Handle, transport, and store plastic pipe and fittings carefully. Plug or cap pipe ends during transportation or storage to minimize dirt and moisture entry. Do not subject to abrasion or concentrated external loads. Discard PE pipe sections and fittings that have been damaged.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Conform to NFPA 54 and with requirements specified herein.

2.2 PIPE AND FITTINGS

2.2.1 Underground Polyethylene (PE)

PE pipe and fittings are as follows:

a. Pipe: ASTM D2513, 100 psig working pressure, Standard Dimension Ratio (SDR), the ratio of pipe diameter to wall thickness, 11.5 maximum.

b. Socket Fittings: ASTM D2683.

c. Butt-Fusion Fittings: ASTM D2513, molded in accordance with Section 5276 Plastic Joining Methods of the Washington Gas Engineering and Operating Standards.

2.2.2 Transition Fittings

a. Steel to Plastic (PE): Use swaged gas-tight construction with O-ring seals, metal insert, and protective sleeve steel-to-plastic with tapping tee or sleeve. Coat or wrap exposed steel pipe with heavy plastic coating.

b. Plastic to Plastic: Manufacturer's standard bolt-on (PVC to PE) plastic tapping saddle tee, UL listed for gas service, rated for 100 psig, and O-ring seals. Manufacturer's standard slip-on PE mechanical coupling, molded, with stainless-steel ring support, O-ring seals, and rated for 150 psig gas service. Manufacturer's standard fused tapping (PE-to-PE) tee assembly with shut-off feature.

2.3 SHUTOFF VALVES, BELOW GROUND

2.3.1 PE Ball or Plug Valves

ASME B16.40 and ASTM D2513, Class C materials (PE 2306 or PE 3406), strength rating of Class 4 location with class factor of 0.20, and SDR matching PE pipe dimensions and working pressure.

2.4 VALVE BOX

Provide street valve box with cast-iron cover and two-piece 5 1/4 inch shaft-slip valve box extension . Cast the word "Gas" into the box cover. Use valve box for areas as follows:

a. Roads and Traffic Areas: Heavy duty, cast iron cover.

b. Other Areas: Standard duty, concrete cover.

2.5 BURIED UTILITY WARNING AND IDENTIFICATION TAPE

Provide detectable aluminum-foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 3 inch minimum width, color-coded yellow for natural gas, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be "Danger Gas Line Buried Below - Stop Digging - Call Washington Gas - 703-750-1000". Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.5.1 Soft-Drawn Locator Wire

Install #12 gauge soft-drawn solid copper polyethylene-coated locator wire over the entire length of PE pipe. Install locator wire with a separation of no more than 6 inches from the plastic pipe.

PART 3 EXECUTION

3.1 INSTALLATION

Install distribution piping in accordance with ASME B31.8 and the Engineering and Operating Standards of Washington Gas.

3.1.1 Excavating and Backfilling

Perform excavating and backfilling of pipe trenches as specified in Section 31 00 00 EARTHWORK and in accordance with Section 5288 of the Washington Gas Engineering and Operations Standards. Coordinate provision of utility warning and identification tape with backfill operation. Bury utility warning and identification tape with printed side up at 12 to 18 inches above the pipe during backfilling.

3.1.2 Piping

3.1.2.1 Cleanliness

Clean inside of pipe and fittings before installation. Blow lines clear using 80 to 100 psig clean dry compressed air. Cap or plug pipe ends to maintain cleanliness throughout installation.

3.1.2.2 Buried Plastic Lines

Provide totally PE piping. Prior to installation, obtain printed instructions and technical assistance in proper installation techniques from pipe manufacturer. Install new PE pipe to existing pipe line, in accordance with Sections 4240 "tie-ins" and 4241 "Stop-Off Operations" of the Washington Gas Engineering and Operating Standards.

a. PE Piping: Prior to installation, Contractor shall have supervising and installing personnel, certified in accordance with paragraph entitled "Welder's Qualifications" and approved by Washington Gas for installation of gas line. Provide fusion-welded joints except where transitions have been specified. Use electrically heated tools, thermostatically controlled and equipped with temperature indication. (Where connection must be made to existing plastic pipe, contractor shall be responsible for determination of compatibility of materials and procedural changes in fusion process necessary to attain maximum integrity of bond.)

b. Laying PE Pipe: Bury pipe minimum 36 inches below finish grade. Lay in accordance with manufacturer's printed instructions.

3.1.2.3 Connections to Existing Pipeline

When making connections to live gas mains, use pressure tight installation equipment operated by workmen trained and experienced and approved by Washington Gas in making hot taps. For connections to existing underground

pipeline or service branch, use transition fittings for dissimilar materials.

3.1.2.4 Wrapping

Where connection to existing steel line is made underground, tape wrap new steel transition fittings and exposed existing pipe having damaged coating. Clean pipe to bare metal. Initially stretch first layer of tape to conform to the surface while spirally half-lapping. Apply a second layer, half-lapped and spiraled as the first layer, but with spirals perpendicular to first wrapping. Use 10 mil minimum thick polyethylene tape. In lieu of tape wrap, heat shrinkable 10 mil minimum thick polyethylene sleeve may be used.

3.1.3 Valves

Install valves approximately at locations indicated. Orient stems vertically, with operators on top, or horizontally. Provide support for valves to resist operating torque applied to PE pipes.

3.1.3.1 Stop Valve and Shutoff Valve

Provide stop valve on service branch at connection to main.

3.2 FIELD QUALITY CONTROL

3.2.1 PE Fusion Welding Inspection

Visually inspect butt joints by comparing with, manufacturer's visual joint appearance chart. Inspect fusion joints for proper fused connection. Replace defective joints by cutting out defective joints or replacing fittings. Inspect 100 percent of all joints and reinspect all corrections. Arrange with the pipe manufacturer's representative in the presence of the Contracting Officer to make first time inspection.

3.2.2 Pressure Tests

Pressure test gas line in accordance with Sections 4210 "Pressure Testing-Overview" and 4211 "Pressure Testing Distribution and High Pressure Pipelines" of the Washington Gas Engineering and Operating Standards.

3.2.3 System Purging

After completing pressure tests, and before testing a gas contaminated line, purge line in accordance with Sections 4230 "Purging Overview" and 4231 "Purging to Place Pipelines into Service" of the Washington Gas Engineering and Operating Standards.

-CAUTION-
Failure to purge may result in explosion within line when air-to-gas is at correct mixture.

-- End of Section --

SECTION 33 30 00

SANITARY SEWERS
04/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Arlington County Department of Environmental Services (DES)

DES Stds	Construction Standards and Specifications

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C105/A21.5	(2010) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C111/A21.11	(2007) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151/A21.51	(2009) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C600	(2010) Installation of Ductile-Iron Water Mains and Their Appurtenances

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM C150/C150M	(2011) Standard Specification for Portland Cement
ASTM C443	(2011) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C923	(2008) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C924	(2002; R 2009) Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C94/C94M	(2012) Standard Specification for Ready-Mixed Concrete
ASTM C969	(2002; R 2009) Standard Practice for Infiltration and Exfiltration Acceptance

	Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C972	(2000; R 2011) Compression-Recovery of Tape Sealant
ASTM C990	(2009) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D2321	(2011) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2412	(2011) Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D3034	(2008) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D4101	(2011) Standard Specification for Polypropylene Injection and Extrusion Materials
ASTM D412	(2006ae2) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D624	(2000; R 2012) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM F949	(2010) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.27	Fixed Ladders

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1998) Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ)

9VAC25-790	Sewage Collection and Treatment Regulations

1.2 SYSTEM DESCRIPTION

1.2.1 Sanitary Sewer Gravity Pipeline

Provide mains and laterals of polyvinyl chloride (PVC) plastic pipe and ductile iron pipe.

1.2.2 USACE Project

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 5 feet outside the building to which the sewer system is to be connected. Replace damaged material and redo unacceptable work at no additional cost to the Government. Backfilling shall be accomplished after inspection by the Contracting Officer. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Existing Conditions

SD-02 Shop Drawings

Drawings
Metal items
Frames, covers, and gratings; G, AE

SD-03 Product Data

Pipeline materials; G, AE

SD-06 Test Reports

Reports

SD-07 Certificates

Portland Cement

1.4 QUALITY ASSURANCE

1.4.1 Installer Qualifications

Install specified materials by a licensed underground utility Contractor licensed for such work in the state where the work is to be performed. Installing Contractor's License shall be current and be state certified or state registered.

1.4.2 Drawings

a. Submit As-Built Drawings for the complete sanitary sewer system showing complete detail with all dimensions, both above and below grade, including invert elevation.

b. Sign and seal As-Built Drawings by a Professional Surveyor and Mapper. Include the following statement: "All potable water lines crossed by sanitary hazard mains are in accordance with the permitted utility separation requirements."

1.4.3 Compliance Requirements

Contractor shall comply with applicable requirements of 9VAC25-790 and DES Stds.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

1.5.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.5.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.5.1.3 Cement, Aggregate, and Reinforcement

As specified in Section 03 30 00 CAST-IN-PLACE CONCRETE .

1.5.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Carry, do not drag, pipe to trench.

1.6 PROJECT/SITE CONDITIONS

Submit drawings of existing conditions, after a thorough inspection of the area in the presence of the Contracting Officer. Details shall include the environmental conditions of the site and adjacent areas. Submit copies of the records for verification before starting work.

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS

Pipe shall conform to the respective specifications and other requirements specified below. Submit manufacturer's standard drawings or catalog cuts.

2.1.1 Ductile Iron Gravity Sewer Pipe and Associated Fittings

2.1.1.1 Ductile Iron Pipe(DIP)

Ductile iron pipe shall conform to AWWA C151/A21.51 minimum class 54. Pipe lining shall be corrosion resistant to sewer gas, sewpercoat, protecto 401 or approved equal and shall have push-on joints utilizing rubber gasket rings conforming to AWWA C111/A21.11.

2.1.2 PVC Plastic Gravity Sewer Piping

2.1.2.1 PVC Plastic Gravity Pipe and Fittings

ASTM D3034, SDR 35, or ASTM F949 with ends suitable for elastomeric gasket joints.

2.1.2.2 Polyvinyl Chloride Pipe (PVC)

PVC pipe and fittings, 4-inch through 15-inch maximum diameter, shall meet requirements of ASTM D 3034, wall thickness classification SDR-35 and shall be colored green for in-ground identification as sewer pipe

PVC pipe shall be furnished in lengths of not less than 12 feet. PVC pipe and fittings shall be legibly marked in accordance with ASTM D 3034, and in addition shall have the following markings:

a. Manufacturer's lot number.

b. Date of manufacturer.

c. Point of origin.

Pipe not marked as indicated will be rejected. Date of manufacturer shall not be more than 6 months prior to date of installation. Pipe and fittings shall have integral bell gasket joint. Joints shall meet the requirements of ASTM D 3212, and gasket shall meet requirements of ASTM F 477.

2.2 CONCRETE MATERIALS

2.2.1 Cement Mortar

Mortar used in the repair of existing concrete block structures shall be one part portland cement conforming to ASTM C 150, Type II, and two parts sand conforming to ASTM C 144, with enough water added to produce mortar of the proper consistency for the type of joint.

2.2.2 Portland Cement

Submit certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes. Portland cement shall conform to ASTM C150/C150M, Type II for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking.

2.2.3 Portland Cement Concrete

Portland cement concrete shall conform to ASTM C94/C94M, compressive strength of 4000 psi at 28 days, except for concrete cradle and encasement

or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 2500 psi minimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

2.2.4 Quick Setting Grout

Quick-setting non-shrink grout shall conform to Corps of Engineers CRD-588, Octocrete, Speedcrete, or equal.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Precast Concrete Manholes

Precast concrete manhole bases, risers, and cones shall conform to the requirements of ASTM C 478 with configurations as shown in the Drawings. Cones shall be eccentric. Manhole sections for sanitary sewers shall be a male and female end type with a preformed groove provided in the male end for placement of a round rubber gasket ring. Rubber gasket rings shall meet the requirements of ASTM C 361 or ASTM C443.

Each precast section shall be clearly marked on the inside near the top with the following information where applicable:

a. ASTM designation.

b. Standard detail or drawing number.

c. Station location and designation.

d. Date of manufacturer and name or trademark of manufacturer.

2.3.2 Manhole Neck Adjustments

Adjustments to manhole necks shall be limited to 2 inches of concrete. Concrete adjustment rings shall be used for adjustments in excess of 2 inches, but not to exceed 12 inches. Nonshrink grout shall be used between adjustment rings.

2.3.3 Precast Concrete Blocks

Precast concrete blocks, as approved for use by the Arlington County Department of Environmental Services (DES Stds), shall conform to ASTM C 139. Blocks shall not be less than 5-inches by 8-inches and of proper radius and shape for sealing with mortar.

2.3.4 Gaskets and Connectors

Gaskets for joints between manhole sections shall conform to ASTM C443. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C923 or ASTM C990.

2.3.5 External Preformed Rubber Joint Seals

An external preformed rubber joint seal shall be an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" shall be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal shall be multi-section with a

neoprene rubber top section and all lower sections made of Ethylene Propylene Diene Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit shall consist of a top and bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be a non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections shall cover up to two more adjusting rings. Properties and values are listed in the following tables:

Properties, Test Methods and Minimum Values for Rubber used in Preformed Joint Seals

Physical Properties	Test Methods	EPDM	Neoprene	Butyl mastic
Tensile, psi	ASTM D412	1840	2195	-
Elongation percent	ASTM D412	553	295	350
Tear Resistance, ppi	ASTM D624 (Die B)	280	160	-
Rebound, percent, 5 minutes	ASTM C972 (mod.)	-	-	11
Rebound, percent, 2 hours	ASTM C972	-	-	12

2.3.6 Metal Items

2.3.6.1 Frames, Covers, and Gratings for Manholes

Frames, cover, and grating for manholes shall be as indicated on Drawings.

Manhole frames and covers shall be constructed of gray or ductile iron conforming to ASTM A 48 and ASTM A 536. Frames and covers shall have machined bearing surfaces to prevent rocking and rattling under traffic. Manhole covers shall be as shown on the standard details as as indicated on the approved plan. The word "Sanitary Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.6.2 Flexible Plastic Gasket

Flexible plastic gaskets between bolted manhole cover and manhole frame seat shall be extruded rope Type B, conforming to AASHTO M-198, butyl based, 3/4 inch diameter minimum.

2.3.6.3 Manhole Pipe Sleeves or Boots

All sanitary sewer main connections to existing manholes shall be made by coring the manhole wall above the existing bench. Sewer pipe shall be connected to manhole by approved flexible boot. Flexible connection of sewer pipe to manhole shall provide a positive, watertight compression joint allowing for 10 omni-directional deflection. Manhole boots or sleeves shall be manufactured of 3/8-inch flexible neoprene rubber conforming to ASTM C443 specifications or 3/16-inch flexible ethylene propylene rubber conforming to ASTM C923. Sleeves shall utilize a stainless steel clamp to secure pipe and shall be the flexible rubber foot of the “Kor 'N' Seal” system as manufactured by an approved manufacturer.

2.3.6.4 Manhole Steps

as indicated conforming to 29 CFR 1910.27. Plastic or rubber coating pressure-molded to the steel shall be used. Plastic coating shall conform to ASTM D4101, copolymer polypropylene. Rubber shall conform to ASTM C443, except shore A durometer hardness shall be 70 plus or minus 5. Aluminum steps or rungs will not be permitted.

2.3.6.5 Manhole Ladders

A steel ladder shall be provided where the depth of a manhole exceeds 12 feet. The ladder shall not be less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A123/A123M.

2.4 REPORTS

Submit Test Reports. Compaction and density test shall be in accordance with Section 31 00 00 EARTHWORK. Submit Inspection Reports for daily activities during the installation of the sanitary system. Information in the report shall be detailed enough to describe location of work and amount of pipe laid in place, measured in linear feet.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

These general requirements apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.1.1.1 Location

The work covered by this section shall terminate at a point approximately 5 feet from the building , unless otherwise indicated. Where the location of the sewer is not clearly defined by dimensions on the drawings, do not lay sewer line closer horizontally than 10 feet to a water main or service line. Where sanitary sewer lines pass above water lines, encase sewer in concrete for a distance of 10 feet on each side of the crossing, or substitute rubber-gasketed pressure pipe for the pipe being used for the same distance. Where sanitary sewer lines pass below water lines, lay pipe so that no joint in the sewer line will be closer than 3 feet, horizontal distance, to the water line.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK.

3.1.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay nonpressure pipe with the bell ends in the upgrade direction. Adjust spigots in bells to give a uniform space all around. Blocking or wedging between bells and spigots will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint

material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose. Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for PVC pipe shall conform to Table 4 of ASTM D3034.

3.1.2 Special Requirements

3.1.2.1 Installation of Ductile Iron Gravity Sewer Pipe

Unless otherwise specified, install pipe and associated fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of AWWA C600 for pipe installation and joint assembly.

a. Make push-on joints with the gaskets and lubricant specified for this type joint and assemble in accordance with the applicable requirements of AWWA C600 for joint assembly.

b. Exterior protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet in accordance with AWWA C105/A21.5, using Class C polyethylene film.

3.1.2.2 Installation of PVC Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM D2321 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble in accordance with the requirements of ASTM D2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.1.3 Concrete Work

Cast-in-place concrete is included in Section 03 30 00 CAST-IN-PLACE CONCRETE. The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.1.4 Sewer Service Connections

Sanitary sewer connections are privately owned and maintained from the sewer main up to and including the building served. Pipe and fittings for sewer service connections shall conform to the requirements of Arlington County Plumbing Code and Plumbing Code adopted by the Commonwealth of Virginia.

Taps to existing sanitary sewer mains shall use approved tapping saddles. Where the existing pipe is HDPE eltrofusion saddles shall be used. Only approved manufactured tee or wye fittings shall be used for any lateral connections to new sanitary sewer mains. No taps shall be allowed in the installation of new sanitary sewer mains.

3.1.5 Miscellaneous Construction and Installation

3.1.5.1 Connecting to Existing Manholes

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.1.5.2 Metal Work

a. Workmanship and finish: Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.

b. Field painting: After installation, clean cast-iron frames, covers, gratings, and steps not buried in concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.2 SANITARY SEWER DESIGN CRITERIA

Sanitary sewers shall be installed within street right of way and shall follow the street centerline wherever possible. The sewer shall extend a minimum of 10 feet along the property frontage of the last house being served. Sewers shall not be located longitudinally under walks. Sewers shall be installed within recorded easements on private property when locations in public right of way are not possible. Such easements, of the width detailed below, shall be recorded prior to final approval and issuance of building permits.

a. Ten feet from center line of sewer mains less than 15 inches in diameter and 10 feet or less in depth.

b. Fifteen feet from center line of sewer mains greater than 15 inches in diameter or any size sanitary sewer main greater than 10-foot in depth.

c. The above standards and specifications may be modified in instances where proposed development, site restrictions, and other unusual circumstances present unusual hardships and provisions are made to provide permanent sheeting shoring protection for the pipe.

The minimum clear horizontal separation between sanitary sewer mains or sewer manholes and water mains shall be 10 feet. When local conditions prevent a minimum separation of 10 feet, a closer separation may be allowed provided that:

a. Sanitary sewer manholes shall be of watertight construction and tested in place.

b. The top (crown) of the sanitary sewer main shall be a minimum of 18 inches below the bottom (invert) of the water main. The sewer main and water main shall be kept in separated trenches. Where minimum vertical separation cannot be obtained, the sanitary sewer shall be constructed of ductile iron pipe and pressure tested in place without leakage prior to backfilling.

Sewer mains crossing under water mains shall be laid to provide a minimum vertical separation of 18 inches between the top of the sewer and bottom of the water main. If local conditions prevent this, the water main shall be relocated to provide the separation directed by the Engineer, or the sewer shall be constructed of ductile iron pipe, pressure tested in place without leakage before backfill, and with no joint of the sewer closer than 8 feet of the water main.

Sanitary sewer mains crossing over water mains shall maintain a minimum vertical separation of 18 inches between the top of the water main and the bottom of the sewer. The sanitary sewer shall be constructed of ductile iron pipe, pressure tested in place without leakage before backfill. Provide adequate structural support for the sewer to prevent excessive joint deflection and the settling on and breakage of the water main.

The minimum clear horizontal separation between sanitary sewer and utilities other than water main shall be 5 feet.

The minimum vertical clearance between sanitary sewer and utilities other than water main shall be 1.0 foot, unless provisions to prevent damage to the underlying utility are detailed for approval by DES Stds.

The minimum clear horizontal separation between sanitary sewer and buildings or other structures shall be as follows:

a. Ten feet for sanitary sewer mains less than 15 inches in diameter and 10 feet or less in depth.

b. Fifteen feet for sanitary sewer mains 15 inches and larger in diameter or any sanitary sewer in excess of 10 feet in depth.

All plans and specifications for construction of proposed sanitary sewer facilities must be approved by DES. No sanitary sewer facilities shall be constructed without approved plans, shop drawings and construction cut sheets.

3.3 LAYING PIPE

Temporarily support, protect and maintain all underground and surface structures and utilities encountered in the process of the work. Where the grade or alignment of the pipe is obstructed by existing utilities, such as conduits, pipes or drains, the obstruction shall be permanently relocated and supported by the Contractor in cooperation with the owners of said utilities.

Use the proper tools for the safe handling and laying of pipe. Unload pipe by hand, skidways or hoists in such a manner so that material is not dropped or damaged. Distribute pipe at site of installation near area where it is to be laid. Protect machined ends of pipe from damage and keep pipe

free from dirt and debris.

Install piping in such a manner as to obtain sufficient flexibility and to prevent excessive stresses in materials and excessive bending moments at joints. Conduct work in strict conformance with the procedures established by the manufacturers of the various types of pipe.

Use full lengths of pipe wherever possible. Do not use short lengths of pipe with couplings without approval of the Engineer. Cut pipe to exact measurement and install without forcing or springing.

Bring any conflict, during the installation of piping, to the attention of the Engineer. Do not improvise or make field changes without the approval of the Engineer.

Lay pipe to a true uniform line and grade from elevations indicated on the drawings with continuous bearing of barrel on cradle or bedding material.

Lay pipe upgrade with the bell end pointing in the upstream direction and the spigot end pointing in the downstream direction. Lay each section of pipe in such a manner as to form a close concentric joint with the adjoining section and to prevent any sudden offsets in the flow line.

Ensure that pipe is well bedded on a solid foundation. Only Class A, B, or C bedding and AWWA class shall be permitted. Correct any defects due to settlement. Excavate bell holes sufficiently large, to ensure making of proper joints. Exercise precautions to include the furnishing and placing of bedding to prevent any pipe from resting directly on rock. Upon ensuring that the joint of pipe is on proper line and grade, the pipe must be held in place while stone is hand chocked under the haunches for the full length of the pipe. Verify grade and alignment before placing enough stone to adequately cover pipe and prevent movement. Check grade and alignment once again. Special attention should be given to the area of bedding between the end of the pipe trench and manhole connection. Refer to Section 02200 - Backfill for Pipelines for additional requirements and Standard Drawing S-4.0 for pipe and bedding details.

As the work progresses, clear the interior of the pipe of all dirt and superfluous materials of every description. Utilize a suitable swab or drag in small diameter pipes and pull forward past each joint immediately after the joining has been completed.

Keep trenches and excavations free of water during construction and until final inspection. Do not lay pipe in water or in a frozen bedding condition. Prevent flotation and re-lay pipe that has floated.

When work is not in progress, securely close open ends of pipe to prevent trench water, earth or other substances from entering the pipe.

Prevent pipe lining and coating from being damaged. Carefully inspect all materials for defects before lowering into trench.

Provide temporary service to customers in the area of construction, by providing bypass pumping, unless specified otherwise on the approved plans.

When abandoning existing manholes and/or sewer lines, plug all pipes at all open ends. Excavate within the manhole to a point 2-feet below finished grade, fill the manhole with sand or #57 VDOT aggregate material and deliver the frame and cover to the Arlington County Department of

Environmental Services, Water/Sewer/Streets Division.

Ventilation of gravity sewer systems shall be provided where continuous watertight sections (including manholes with watertight covers) greater than 1,000 feet in length are incurred conforms to Virginia Department of Health Sewerage Regulation VR 355-17106.07(G).

Sanitary sewer lines constructed in fill areas shall be continuous ductile iron (CL-50)run from manhole to manhole. Fill material beneath the pipe shall be select material compacted to 95 percent density at optimum moisture (ASTM Proctor Test). Refer to 3.4C for manholes in fill areas.

3.4 MANHOLE CONSTRUCTION

Construct manholes of precast concrete in accordance with Standard Details and the plans, unless directed otherwise. Provide monolithic base of precast construction and make water-tight connections between base and risers, unless modifications to the existing system are being performed. Manhole wall and bottom construction shall be such as to ensure water tightness. If directed by DES, the entire wall exterior shall be painted with waterproof coating. Place axis of manholes directly over the center lines of the pipes unless otherwise shown. The manhole foundation shall be adequately designed to support the manhole and any superimposed loads that may occur.

Manholes shall be minimum 4 feet inside diameter with a minimum clear opening in the manhole frame of 24 inches. Manholes shall be a maximum 16 feet deep and shall be installed at all changes in sewer size, material, alignment or grade and at terminal end of sewer. Manholes deeper than 16 feet shall only be considered for approval by DES in extreme cases with justification provided by the Engineer. Maximum spacing of manholes shall be 350 feet. Crown of inlet sewers shall not be lower than crown of outlet sewer.

Drop connections should be avoided and will be allowed only upon approval by DES when normal connections are not practical. Drop connections shall provide a minimum drop in a manhole of two feet measured from the invert of the incoming pipe to the manhole invert (refer to Standard Drawing S-2.3). Inside drop connections shall only be allowed in 5 foot inside diameter manholes and shall only be used under special circumstances such as high water table, utility conflicts and excessive depths.

Construct appropriate flow channels in the bottom of manholes as shown on the Standard Details and plans. Cast-in-place concrete shall be a minimum 4 inches thick, non-reinforced, 3000 psi concrete with smooth form troweled finish. Flow channel construction shall provide a smooth transition between adjacent sewer sections to reduce turbulence. Benches shall be sloped to the channel to prevent accumulation of solids. Provide a positive means of bonding channel to manhole base.

The minimum invert drop from inlet to outlet of a manhole shall be 0.10 foot.

Manholes in fill areas shall have a foundation extending a minimum depth of 18 inches into undisturbed earth and shall be designed only with prior approval of DES.

All manholes subject to infiltration of ponded surface water those with top elevations lower than the 25-year flood elevations shall be provided with

watertight manhole frame and bolted cover (refer to Standard Drawings S-3.1 and S-3.2).

Cut all pipes flush with the inside wall of the manhole structure. In all diameter sewer manholes, provide flexible rubber gasket between manhole wall and the incoming pipe. Provide field sleeve where required to assure a tight fit.

Firmly anchor manhole steps to wall according to manufacturer's recommendations. Steps shall be installed in accordance with Standard Drawing M-2.0.

Install manhole frames and covers, as indicated on the plans. Adjust the frame and cover to finished grade by concrete adjusting ring. Provide flexible plastic gasket between the cover of manholes to be bolted and the manhole frame. Cement the rubber gasket to the frame with a water-resistant material (such as 3M Super Weather Strip Adhesive, part 8001).

3.5 SEWER SERVICE CONNECTIONS

Sewer service connections to the sanitary sewer main shall be made only by a licensed plumber and in accordance with the Plumbing Code adopted by the State of Virginia and the Arlington County Plumbing Code. No sewer service connections shall be made within 2 feet of any joint in the sanitary main or within 5 feet along the pipe leading from a terminal manhole. The minimum allowable distance between sewer service connections at the sewer main shall be 3 feet. No house service lateral shall be connected to an existing manhole without the special approval of DES.

3.6 FIELD QUALITY CONTROL

3.6.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. Perform field tests and provide labor, equipment, and incidentals required for testing. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.6.2 Tests for Nonpressure Lines

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line. When pressure piping is used in a nonpressure line for nonpressure use, test this piping as specified for nonpressure pipe.

3.6.2.1 Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration tests, or by low-pressure air tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

a. Infiltration tests and exfiltration tests: Perform these tests for

sewer lines made of the specified materials, not only concrete, in accordance with ASTM C969. Make calculations in accordance with the Appendix to ASTM C969.

b. Low-pressure air tests: Perform tests as follows:

(1) Ductile-iron pipelines: Test in accordance with the applicable requirements of ASTM C924. Allowable pressure drop shall be as given in ASTM C924. Make calculations in accordance with the Appendix to ASTM C924.

(2) PVC plastic pipelines: Test in accordance with UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

3.6.2.2 Sanitary Sewer Acceptance Tests

Acceptance tests (air tests) shall be specified for all new sanitary sewer main construction. Acceptance shall not be made until all sanitary sewer pipes, manholes, and required building spurs have been installed, and the pipe trenches are backfilled to the finished grade and compacted. Prior to backfilling sanitary sewer sections, Contractor may perform preliminary tests at his own discretions without the presence of the Contracting Officer. Contractor shall schedule the final acceptance tests with the Contracting Officer at least 48 hours in advance. final acceptance tests shall be performed in the presence of the Contracting Officer or his duly authorized representative. All materials, equipment, and labor required shall be provided by Contractor. Sewer pipes shall be tested from manhole to manhole or from manhole to terminus. Sections passing the acceptance tests shall continue to be maintained by the Contractor until a satisfactory final inspection of the entire sewer system is completed.

a. Low Pressure Air Tests: Sanitary sewer sections of one diameter only and above the ground water table shall be tested using low air pressures after completion of backfill and before hookup of house connections. Temporarily cap all laterals and secure brace for the test. Inspect sewers and manholes prior to testing and remove all soil and debris by thoroughly flushing the lines. Dispose of soil and debris without using the existing sewer system. Provide and securely brace test plugs at each manhole. After all personnel are removed from manholes, add air slowly to the portion of the pipe being tested until internal air pressure is held at a test pressure of 4.0 pounds per square inch (psi) for a minimum of 2 minutes. Pressure gauges used in the air test procedure shall be calibrated in divisions of 0.10 psi.

If in the Contracting Officer's opinion, there is any indication of leakage at the test plug, relieve the internal pressure before taking steps to eliminate the leak. After the 2-minute holding period at 4.0 psi, disconnect hose and compressor from the pipe section being tested. If pressure decreases to 3.5 psi, observe and record the time required for the pressure to drop 1.0 psi from 3.5 to 2.5 psi. Pipes failing to maintain minimum acceptable holding times in accordance with ASTM C 828 will not be accepted. Make repairs or replacement as required at no cost to the Government and retest as specified above.

b. Mandrel Testing: All PVC sewer lines shall require mandrel testing in addition to air test acceptance to determine if they are within the allowable deflection tolerance. Contractor shall perform the deflection test by utilizing an approved go/no go multi-arm mandrel which meets

ASTM D 3043 dimensions for 7.5 percent deflection limit.

c. Manhole Testing: manholes may be tested for leakage at the same time that gravity sewer lines are being tested for leakage. Manhole inverts shall be completed before testing is performed.

Vacuum testing shall include vacuum pump, certified vacuum gauge with a range of 0 to 30 inch mercury (Hg), sealing element with manhole support brace and air pressure to monitor the inflatable sealing ring. Evacuate the manhole to 10 inches Hg for the specified test period using the chart provided. If the vacuum drops less than 1 in mercury within the test time the manhole is considered acceptable. If the manhole fails and leaks, repairs shall be made or replacement at no cost to the Government and retest as specified.

When exfiltration testing is used, the allowable leakage shall not exceed one-half gallons per hour. This equates to 0.25 or 1/4-inch per four hour test period. The inflatable plugs or stoppers shall be positioned in the lines far enough from the manhole to ensure testing of those portions of the lines not air tested. The manhole shall then be filled with water to the top of the manhole rim. A 24-hour soak shall be allowed prior to testing. After test completion the water shall be pumped from the manholes and disposed of properly.

Under no circumstances shall water be allowed to enter the existing sanitary sewer system. If water drop in manhole exceeds the allowable leakage during the test period, Contractor shall make repairs or replacement at no cost to the Government and retest as specified above.

VACUUM TEST TABLE

Specified test period for vacuum to drop less than 1-inch mercury.

Manhole Depth In Feet	4-Foot Inside Diameter (Seconds)	5-Foot Inside Diameter (Seconds)	6-Foot Inside Diameter (Seconds)
8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	65
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97

Manhole Depth In Feet	4-Foot Inside Diameter (Seconds)	5-Foot Inside Diameter (Seconds)	6-Foot Inside Diameter (Seconds)
26	64	85	105
28	69	91	113
30	74	98	121

If air testing of gravity sewer lines is performed, the manholes shall normally be tested by exfiltration. Inflatable stoppers shall be used to plug all lines in to and out of the manhole being tested. The stoppers shall be positioned in the lines far enough from the manhole to ensure testing of those portions of the lines not air tested. The manhole shall then be filled with water to the top of the rim. A 12-hour soak shall be allowed prior to testing. Leakage during testing shall not exceed 0.25 gallon per hour. Water shall be pumped from manholes and disposed of properly upon completion of tests. Under no circumstances shall water be allowed to enter the existing sanitary sewer system. If testing or vacuum testing of manholes for leakage may be considered on a case-by-case basis. It is important that the entire manhole from the invert to the top of the rim be tested. Existing manholes shall be tested for leakage by an acceptable method after the proposed sewer line has been connected to it. Acceptable methods include exfiltration, infiltration, or vacuum testing.

AIR TEST TABLE

Based on Equations from ASTM C 828.

Specification Time (Min:Sec) Required for Pressure Drop from 3-1/2 to 2-1/2 psig when testing one pipe diameter only.

Pipe Length (feet)	Pipe Diameter (inches)								
	4	6	8	10	12	15	18	21	24
25	0:04	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55
100	0:18	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34
125	0:22	0:50	1:28	2:18	3:18	5:09	7:26	9:55	1:20
150	0:26	9:59	1:46	2:45	3:58	6:11	8:30		
175	0:31	1:09	2:03	3:13	4:37	7:05			
200	0:35	1:19	2:21	3:40	5:17				

Pipe Length (feet)	Pipe Diameter (inches)								
225	0:40	1:29	2:38	4:08	5:40				
250	0:44	1:39	2:56	4:35					
275	0:48	1:49	3:14	4:43					
300	0:53	1:59	3:31						
350	1:02	2:19	3:47						
400	1:10	2:38							
450	1:19	2:50							
500	1:28	2:50	3:47	4:42	5:40	7:05	8:30	9:55	11:20

d. Infiltration Tests: In addition to passing air test requirements, sanitary sewer sections below the ground water table shall be tested using the following infiltration test procedure if requested by the Contracting Officer. Contractor shall provide all material, labor, and equipment for the infiltration tests.

Plug upper section of pipe system after flushing and cleaning section in conformance with specifications above in this sub-article. Place a weir in the downstream invert of pipe in a plumb and level position. Read the infiltration after an elapsed time of 30 minutes with the line of sight level to the weir line. Flow rates shall not exceed 100 gal/day/inch of diameter/mile. Readings that exceed 100 gal/day but are below 1,500 gal/day shall be re-measured using a weir with spout.

e. Sanitary sewer force mains shall be hydrostatically tested, as described in this Section at 150 percent of working pressure, 50 psig minimum.

f. Other Conditions: Sewer sections containing a large amount of lateral volume or sewer sections partially submerged, shall be air-testing using the appropriate criteria stipulated in ASTM C 828 to ensure accuracy of the test procedure.

g. T.V. Inspection: All new sanitary sewer main installations shall be required to pass a T.V. inspection prior to final acceptance. The following items shall be completed before a T.V. inspection is scheduled with Department of Sanitation:

1) All manholes adjusted to finished grade.
2) Final paving completed.
3) All manholes are accessible to T.V. equipment.
4) All manholes and sanitary mains are free of dirt and debris.
5) All manhole inverts have been properly constructed to ensure smooth flow and positive drainage.
6) All lateral connections have been completed and accepted.

3.6.2.3 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads determined in accordance with ASTM D2412. Deflection of pipe in the installed pipeline under external loads shall not exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

a. Pull-through device: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided the device meets the applicable requirements specified in this paragraph, including those for diameter of the device, and that the mandrel has a minimum of 9 arms. Ball, cylinder, or circular sections shall conform to the following:

   (1) A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.

   (2) Homogeneous material throughout, shall have a density greater than 1.0 as related to water at 39.2 degrees F, and shall have a surface Brinell hardness of not less than 150.

   (3) Center bored and through-bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of not less than 70,000 psi, with eyes or loops at each end for attaching pulling cables.

   (4) Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

b. Deflection measuring device: Sensitive to 1.0 percent of the diameter of the pipe being tested and shall be accurate to 1.0 percent of the indicated dimension. Deflection measuring device shall be approved prior to use.

c. Pull-through device procedure: Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions.

d. Deflection measuring device procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, replace pipe which has excessive deflection and completely retest in same manner and under same conditions.

3.6.3 Field Tests for Concrete

Field testing requirements are covered in Section 03 30 00 CAST-IN-PLACE CONCRETE

3.7 PROTECTION OF WATER SUPPLIES

There shall be no cross connection between a drinking water supply and any sewer, or appurtenances thereto.

3.8 MINIMUM REQUIREMENT FOR RECORD DRAWINGS

Upon completion of the construction of a sanitary sewer main project, one set of Record Drawings (As-Built Drawings). Record Drawings shall include the following:

a. Invert elevation changes.

b. Manhole top elevations.

c. Change in percent of grade between manholes.

d. Change in horizontal distance between manholes.

e. Material changes.

f. Location of connection to existing system from closest existing manhole.

g. Location of sewer service connection from the closest manhole.

h. Show actual location, depth or elevation, type, and size of all utility crossings.

-- End of Section --

SECTION 33 40 00

STORM DRAINAGE UTILITIES
02/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 294	(2011) Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Eng Man	(2010) Manual for Railway Engineering

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM A536	(1984; R 2009) Standard Specification for Ductile Iron Castings
ASTM A746	(2009) Standard Specification for Ductile Iron Gravity Sewer Pipe
ASTM B26/B26M	(2011) Standard Specification for Aluminum-Alloy Sand Castings
ASTM C1103	(2003; R 2009) Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C139	(2011) Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C270	(2012) Standard Specification for Mortar for Unit Masonry
ASTM C425	(2004; R 2009) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C443	(2011) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

ASTM C478	(2012) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C877	(2008) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C923	(2008) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C990	(2009) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1171	(1999; R 2007) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D1557	(2009) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D1751	(2004; R 2008) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2004a; R 2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D1784	(2011) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D2167	(2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2321	(2011) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2729	(2011) Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3034	(2008) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

ASTM D3212	(2007) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3350	(2012) Polyethylene Plastics Pipe and Fittings Materials
ASTM D6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM F1417	(2011a) Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air
ASTM F477	(2010) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F679	(2008) Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F714	(2010) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F794	(2003; R 2009) Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F894	(2007) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F949	(2010) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2008; Errata 2010) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C111/A21.11	(2012) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT Specs	(2007) Virginia Department of Transportation Road and Bridge Specifications

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office

that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates

Resin Certification
Pipeline Testing
Hydrostatic Test on Watertight Joints; G, AE
Determination of Density
Frame and Cover for Gratings; G, AE
manufacturer's recommendations for placing pipe

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Ductile Iron Gravity Sewer Pipe

Ductile iron pipe shall conform to ASTM A746, Thickness Class 54. Ends of pipe shall be suitable for the joints specified hereinafter. Pipe shall have double cement-mortar lining conforming to AWWA C104/A21.4, standard thickness.

2.1.1.1 Ductile Iron Gravity Joints and Jointing Materials

Pipe shall have push-on joints, except as otherwise specified. Push-on joint pipe ends, gaskets, and lubricant for joint assembly shall conform to AWWA C111/A21.11.

a. Push-on joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly shall conform to AWWA C111/A21.11.

2.1.2 Perforated Piping

2.1.2.1 PVC Pipe

ASTM D2729.

2.1.3 PVC Pipe

Submit the pipe manufacturer's resin certification, indicating the cell classification of PVC used to manufacture the pipe, prior to installation of the pipe.

2.1.3.1 Type PSM PVC Pipe

ASTM D3034, Type PSM, maximum SDR 35, produced from PVC certified by the compounder as meeting the requirements of ASTM D1784, minimum cell class 12454-B.

2.1.3.2 Profile PVC Pipe

ASTM F794, Series 46, produced from PVC certified by the compounder as meeting the requirements of ASTM D1784, minimum cell class 12454-B.

2.1.3.3 Smooth Wall PVC Pipe

ASTM F679 produced from PVC certified by the compounder as meeting the requirements of ASTM D1784, minimum cell class 12454-B.

2.1.3.4 Corrugated PVC Pipe

ASTM F949 produced from PVC certified by the compounder as meeting the requirements of ASTM D1784, minimum cell class 12454-B.

2.1.4 PE Pipe

Submit the pipe manufacturer's resin certification, indicating the cell classification of PE used to manufacture the pipe, prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D3350.

2.1.4.1 Smooth Wall PE Pipe

ASTM F714, maximum DR of 21 for pipes 3 to 24 inches in diameter and maximum DR of 26 for pipes 26 to 48 inches in diameter. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.

2.1.4.2 Corrugated PE Pipe

AASHTO M 294, Type S or C. For slow crack growth resistance, acceptance of resins shall be determined by using the notched constant ligament-stress (NCLS) test meeting the requirements of AASHTO M 294. Pipe walls shall have the following properties:

Nominal Size (in.)	Minimum Wall Area (square in/ft)	Minimum Moment of Inertia of Wall Section (in to the 4th/in)
12	1.50	0.024
15	1.91	0.053
18	2.34	0.062
24	3.14	0.116
30	3.92	0.163
36	4.50	0.222
42	4.69	0.543
48	5.15	0.543
54	5.67	0.800
60	6.45	0.800

2.1.4.3 Profile Wall PE Pipe

ASTM F894, RSC 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 334433C. Pipe walls shall have the following properties:

Nominal Size (in.)	Minimum Wall Area (square in/ft)	Minimum Moment Of Inertia of Wall Section (in to the 4th/in)	
		Cell Class 334433C	Cell Class 335434C
18	2.96	0.052	0.038
21	4.15	0.070	0.051
24	4.66	0.081	0.059
27	5.91	0.125	0.091
30	5.91	0.125	0.091
33	6.99	0.161	0.132
36	8.08	0.202	0.165
42	7.81	0.277	0.227
48	8.82	0.338	0.277

2.2 DRAINAGE STRUCTURES

2.2.1 Flared End Sections

Sections shall be of a standard design according to VDOT Std.

2.2.2 Precast Reinforced Concrete Box

Manufactured in accordance with VDOT Std (A3).

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 3000 psi concrete under Section 217 "Hydraulic Cement Concrete" of VDOT Specs. The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D1751, or ASTM D1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D1752.

2.3.2 Mortar

Hydraulic cement mortar and grout shall meet VDOT Std, Section 218. Minimum mortar requirements are as follows: Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but in no case shall exceed 6 gallons of water per sack of cement. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 Precast Concrete Segmental Blocks

Precast concrete segmental block shall conform to ASTM C139, not more than 8 inches thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

2.3.4 Precast Reinforced Concrete Manholes and Drainage Structures

All precast reinforced concrete manholes and drainage structures shall conform to Section 302 of the VDOT Specs. As a minimum requirement, precast reinforced concrete manholes shall conform to ASTM C478. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.5 Frame and Cover for Gratings

Frame and cover shall meet the requirements of VDOT Specs, Section 224 "Castings." Submit certification on the ability of frame and cover or gratings to carry the imposed live load. Frame and cover for gratings shall be cast gray iron, ASTM A48/A48M, Class 35B; cast ductile iron, ASTM A536, Grade 65-45-12; or cast aluminum, ASTM B26/B26M, Alloy 356.OT6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans. The word "Storm Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.6 Joints

2.3.6.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or

rubber-type gaskets for concrete pipe. The design of joints and the physical requirements for preformed flexible joint sealants shall conform to ASTM C990, and rubber-type gaskets shall conform to ASTM C443. Factory-fabricated resilient joint materials shall conform to ASTM C425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.

b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C443. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.6.2 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C877.

2.3.6.3 Flexible Watertight, Gasketed Joints

a. Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately 7 inches wide and approximately 3/8 inch thick, meeting the requirements of ASTM D1056, Type 2 A1 , and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D1171. Rubber O-ring gaskets shall be 13/16 inch in diameter for pipe diameters of 36 inches or smaller and 7/8 inch in diameter for larger pipe having 1/2 inch deep end corrugation. Rubber O-ring gaskets shall be 1-3/8 inches in diameter for pipe having 1 inch deep end corrugations. O-rings shall meet the requirements of ASTM C990 or ASTM C443. Preformed flexible joint sealants shall conform to ASTM C990, Type B.

b. Connecting Bands: Connecting bands shall be of the type, size and sheet thickness of band, and the size of angles, bolts, rods and lugs as indicated or where not indicated as specified in the applicable standards or specifications for the pipe. Exterior rivet heads in the longitudinal seam under the connecting band shall be countersunk or the rivets shall be omitted and the seam welded. Watertight joints shall be tested and shall meet the test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS.

2.3.6.4 PVC Plastic Pipes

Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

2.3.6.5 Smooth Wall PE Plastic Pipe

Pipe shall be joined using butt fusion method as recommended by the pipe manufacturer.

2.3.6.6 Corrugated PE Plastic Pipe

Pipe joints shall be water tight and shall conform to the requirements in AASHTO M 294. Water tight joints shall be made using a PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477.

2.3.6.7 Profile Wall PE Plastic Pipe

Joints shall be gasketed or thermal weld type with integral bell in accordance with ASTM F894.

2.4 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C923.

2.5 HYDROSTATIC TEST ON WATERTIGHT JOINTS

2.5.1 PVC and PE Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to ASTM C990 or ASTM C443. Test requirements for joints in clay pipe shall conform to ASTM C425. Test requirements for joints in PVC and PE plastic pipe shall conform to ASTM D3212.

2.6 EROSION CONTROL RIPRAP

Provide nonerodible rock not exceeding 15 inches in its greatest dimension and choked with sufficient small rocks to provide a dense mass with a minimum thickness of as indicated. Riprap shall meet VDOT Specs for standard size criteria.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 31 00 00 EARTHWORK and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 12 inches for pipes 36-inches in diameter or less and 18 inches for pipes larger than 36-inches in diameter to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified, without any overexcavation. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional

cost to the Government.

3.1.2 Removal of Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 8 inches or 1/2 inch for each foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe. Rock excavation shall be as specified and defined in Section 31 00 00 EARTHWORK.

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Plastic Pipe

Bedding for PVC and PE pipe shall meet the requirements of ASTM D2321. Bedding, haunching, and initial backfill shall be either Class IB or II material.

3.3 PLACING PIPE

Submit printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed flexible pipe shall not exceed the following limits:

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (%)
Plastic (PVC & HDPE)	5

Note post installation requirements of paragraph 'Deflection Testing' in PART 3 of this specification for all pipe products including deflection testing requirements for flexible pipe.

3.3.1 Concrete, Clay, PVC, Ribbed PVC, Ductile Iron and Cast-Iron Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.2 Corrugated PE Pipe

Laying shall be with the separate sections joined firmly on a bed shaped to line and grade and shall follow manufacturer's recommendations.

3.3.3 Multiple Culverts

Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 3 feet apart, whichever is less.

3.3.4 Jacking Pipe Through Fills

Methods of operation and installation for jacking pipe through fills shall conform to requirements specified in Volume 1, Chapter 1, Part 4 of AREMA Eng Man.

3.4 DRAINAGE STRUCTURES

3.4.1 Manholes and Inlets

Construction shall be of precast reinforced concrete; complete with frames and covers or gratings;Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.4.2 Walls and Headwalls

Construction shall be as indicated.

3.5 BACKFILLING

3.5.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation equal to the midpoint (spring line) of RCP or has reached an elevation of at least 12 inches above the top of the pipe for flexible pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 8 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.5.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 6 inches. Use select granular material for this entire region of backfill for flexible pipe installations.

3.5.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.5.4 Compaction

3.5.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.5.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

a. Under paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.5.5 Determination of Density

Testing is the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D2167 or ASTM D6938. When ASTM D6938 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D6938 results in a wet unit weight of soil and ASTM D6938 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D6938. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.6 PIPELINE TESTING

3.6.1 Leakage Tests

Lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate. Low pressure air testing for plastic pipe shall conform to ASTM F1417. Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C1103. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 250 gallons per inch in diameter per mile of pipeline per day . When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished.

3.6.2 Deflection Testing

No sooner than 30 days after completion of installation and final backfill, an initial post installation inspection shall be accomplished. Clean or flush all lines prior to inspection. Perform a deflection test on entire length of installed flexible pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads. Deflection of pipe in the installed pipeline under external loads shall not exceed limits in paragraph PLACING PIPE above as percent of the average inside

diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a laser profiler or mandrel.

a. Laser Profiler Inspection: If deflection readings in excess of the allowable deflection of average inside diameter of pipe are obtained, remove pipe which has excessive deflection, and replace with new pipe. Initial post installation inspections of the pipe interior with laser profiling equipment shall utilize low barrel distortion video equipment for pipe sizes 48 inches or less. Use a camera with lighting suitable to allow a clear picture of the entire periphery of the pipe interior. Center the camera in the pipe both vertically and horizontally and be able to pan and tilt to a 90 degree angle with the axis of the pipe rotating 360 degrees. Use equipment to move the camera through the pipe that will not obstruct the camera's view or interfere with proper documentation of the pipe's condition. The video image shall be clear, focused, and relatively free from roll static or other image distortion qualities that would prevent the reviewer from evaluating the condition of the pipe. For initial post installation inspections for pipe sizes larger than 48 inches, visual inspection shall be completed of the pipe interior.

b. Pull-Through Device Inspection: Pass the pull-through device through each run of pipe by pulling it by hand. If deflection readings in excess of the allowable deflection of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show excess allowable deflections of the average inside diameter of pipe, remove pipe which has excessive deflection, replace with new pipe, and completely retest in same manner and under same conditions. Pull-through device: The mandrel shall be rigid, nonadjustable having a minimum of 9 fins, including pulling rings at each end, engraved with the nominal pipe size and mandrel outside diameter. The mandrel shall be 5 percent less than the certified-actual pipe diameter for Plastic Pipe, 5 percent less than the certified-actual pipe diameter for Corrugated Steel and Aluminum Alloy, 3 percent less than the certified-actual pipe diameter for Concrete-Lined Corrugated Steel and Ductile Iron Culvert provided by manufacturer. When mandrels are utilized to verify deflection of flexible pipe products, the Government will verify the mandrel OD through the use of proving rings that are manufactured with an opening that is certified to be as shown above.

c. Deflection measuring device: Shall be approved by the Contracting Officer prior to use.

d. Warranty period test: Pipe found to have a deflection of greater than allowable deflection in paragraph PLACING PIPE above, just prior to end of one-year warranty period shall be replaced with new pipe and tested as specified for leakage and deflection. Inspect 100 percent of all pipe systems under the travel lanes, including curb and gutter. Random inspections of the remaining pipe system outside of the travel lanes shall represent at least 10 percent of the total pipe footage of each pipe size. Inspections shall be made, depending on the pipe size, with video camera or visual observations. In addition, for flexible pipe installations, perform deflection testing on 100 percent of all pipes under the travel lanes, including curb and gutter, with either a laser profiler or 9-fin mandrel. For flexible pipe, random deflection inspections of the pipe system outside of the travel lanes shall represent at least 10 percent of the total pipe footage of each pipe size. When mandrels are utilized to verify deflection of flexible pipe

products during the final post installation inspection, the Government will verify the mandrel OD through the use of proving rings.

3.6.3 Post-Installation Inspection

One hundred percent of all reinforced concrete pipe installations shall be checked for joint separations, soil migration through the joint, cracks greater than 0.01 inches, settlement and alignment. One hundred percent of all flexible pipes (HDPE, PVC, CMP) shall be checked for rips, tears, joint separations, soil migration through the joint, cracks, localized bucking, bulges, settlement and alignment.

a. Replace pipes having cracks greater than 0.1 inches in width or deflection greater than 5 percent deflection. An engineer shall evaluate all pipes with cracks greater than 0.01 inches but less than 0.10 inches to determine if any remediation or repair is required. RCP with crack width less than 0.10 inches and located in a non-corrosive environment (pH 5.5) are generally acceptable. Repair or replace any pipe with crack exhibiting displacement across the crack, exhibiting bulges, creases, tears, spalls, or delamination.

b. Reports: The deflection results and finial post installation inspection report shall include: a copy of all video taken, pipe location identification, equipment used for inspection, inspector name, deviation from design, grade, deviation from line, deflection and deformation of flexible pipe systems, inspector notes, condition of joints, condition of pipe wall (e.g. distress, cracking, wall damage dents, bulges, creases, tears, holes, etc.).

-- End of Section --

SECTION 33 46 13

FOUNDATION DRAINAGE SYSTEM
04/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 252	(2009) Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M 294	(2011) Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter

ASTM INTERNATIONAL (ASTM)

ASTM D2751	(2005) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D3034	(2008) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3212	(2007) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F405	(2005) Corrugated Polyethylene (PE) Tubing and Fittings
ASTM F667	(2012) Large Diameter Corrugated Polyethylene Pipe and Fittings
ASTM F758	(1995; R 2007e1) Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
ASTM F949	(2010) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

1.2 SYSTEM DESCRIPTION

1.2.1 Extent

Furnish and install foundation drainage as a complete system to 5 feet beyond the building .

1.2.2 Outlet Connections

Foundation pipe shall be connected to the storm drainage system as shown and specified in Section 33 40 00 STORM DRAINAGE .

1.2.3 Drainage Lines

Construct drainage lines of drain tile, perforated pipe, or porous pipe.

1.2.4 Outlet Lines

Construct outlet lines of closed-joint nonperforated, nonporous pipe.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates

Materials

1.4 DELIVERY, STORAGE, AND HANDLING

Protect materials placed in storage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Do not expose plastic pipe to direct sunlight for more than 6 months from time of manufacturer to installation.

PART 2 PRODUCTS

2.1 MATERIALS

Pipe for foundation drainage system shall be of the type and size indicated. Appropriate transitions, adapters, or joint details shall be used where pipes of different types or materials are connected. Submit two randomly selected samples of each type of pipe and fitting, prior to delivery of materials to the site, and certifications from the manufacturers attesting that materials meet specification requirements.

2.1.1 Plastic Pipe

Plastic pipe shall contain ultraviolet inhibitor to provide protection from exposure to direct sunlight.

2.1.1.1 Corrugated High Density Polyethylene (HDPE) Drainage Pipe

Furnish ASTM F405 heavy duty for pipe 3 to 6 inches in diameter inclusive, ASTM F667 for pipe 8 to 24 inches in diameter; or AASHTO M 252 for pipe 3 to 10 inches in diameter or AASHTO M 294 for pipe 12 to 24 inches in diameter. Fittings shall be pipe manufacturer's standard type and shall conform to the indicated specification.

2.1.1.2 Acrylonitrile-Butadiene-Styrene (ABS) Pipe

ASTM D2751, with a maximum SDR of 35.

2.1.1.3 Polyvinyl Chloride (PVC) Pipe

ASTM F758, Type PS 46, ASTM D3034, or ASTM F949 with a minimum pipe stiffness of46 psi.

2.1.1.4 Circular Perforations in PVC Plastic Pipe

Circular holes shall be cleanly cut, not more than 5/16 inch or less than 3/16 inch in diameter, and arranged in rows parallel to the longitudinal axis of the pipe. Perforations shall be approximately 3 inches apart, center-to-center, along rows. The rows shall be approximately 1-1/2 inches apart and arranged in a staggered pattern so that all perforations lie at the midpoint between perforations in adjacent rows. The rows shall be spaced over not more than 155 degrees of circumference. The spigot or tongue end of the pipe shall not be perforated for a length equal to the depth of the socket and perforations shall continue at uniform spacing over the entire length of the pipe. Manufacturer's standard perforated pipe which essentially meets these requirements may be used with prior approval of the Contracting Officer.

2.1.1.5 Slotted Perforations in HDPE Plastic Pipe

Circumferential slots shall be cleanly cut so as not to restrict the inflow of water and uniformly spaced along the length and circumference of the tubing. Width of slots shall not exceed 1/8 inch or be less than 1/32 inch. The length of individual slots shall not exceed 1-1/4 inches on 3 inch diameter tubing; 10 percent of the tubing inside nominal circumference on 4 to 8 inch diameter tubing; and 2-1/2 inches on 10 inch diameter tubing. Rows of slots shall be symmetrically spaced so that they are fully contained in quadrants of the pipe. Slots shall be centered in the valleys of the corrugations of profile wall pipe. The water inlet area shall be a minimum of 0.5 square inch/linear foot of tubing. Manufacturer's standard perforated pipe which essentially meets these requirements may be used with prior approval of the Contracting Officer.

2.1.2 Fittings

Fittings shall be of compatible materials for pipe, of corresponding weight and quality, and as specified herein.

2.1.3 Cleanouts and Piping Through Walls

Cleanout pipe and fittings and piping through walls and footings shall be cast-iron soil pipe. Each cleanout shall have a brass ferrule and a cast-brass screw-jointed plug with socket or raised head for wrench.

2.1.4 Cover and Wrapping Materials for Open Joints in Drain Tile

Cover material may be tar paper, roofing paper, reinforced building paper, glass fiber fabric, or other similar type material. Wrapping material shall be 18-14 mesh, 0.01 inch diameter nonferrous wire cloth.

2.1.5 Bedding and Pervious Backfill for Foundation Drains

Bedding and pervious backfill shall be in accordance with Section 31 00 00

EARTHWORK .

2.1.6 Protective Covering for Pervious Backfill

Protective covering shall be fiberglass mat of lime borosilicate glass fibers. Fibers shall be 8 to 12 microns in average diameter, 2 to 4 inches in length, and bonded with phenol formaldehyde resin. Mat shall be roll type, nonperforated, water permeable, with thickness between 1/4 and 1/2 inch and density of 3/4 pcf .

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Trenching and Excavation

Perform required trenching and excavation in accordance with Section 31 00 00 EARTHWORK. Keep trenches dry during installation of drainage system. Changes in direction of drain lines shall be made with 1/8 bends. Use wye fittings at intersections.

3.1.2 Bedding

Place graded bedding, minimum 6 inches in depth, in the bottom of trench for its full width and length compacted as specified prior to laying of foundation drain pipe. Each section shall rest firmly upon the bedding, through the entire length, with recesses formed for bell joints. Except for recesses for bell joints, the bedding shall fully support the lower quadrant of the pipe.

3.1.3 Pipe Laying

Lay drain lines to true grades and alignment with a continuous fall in the direction of flow. Bells of pipe sections shall face upgrade. Clean interior of pipe thoroughly before being laid. When drain lines are left open for connection to discharge lines, the open ends shall be temporarily closed and the location marked with wooden stakes. Perforated pipe shall be laid with perforations facing down. Any length that has had its grade or joints disturbed shall be removed and relaid at no additional cost to the Government. Perforated corrugated polyethylene drainage tubing and plastic piping shall be installed in accordance with manufacturer's specifications and as specified herein. Tubing and piping with physical imperfections shall not be installed.

3.1.4 Jointing

3.1.4.1 Perforated and Porous Pipes

Perforated and porous types of drain pipes shall be laid with closed joints.

3.1.4.2 Nonperforated Drain Tile

Nonperforated and plain-end drain tile shall be laid with 1/8 to 1/4 inch open joints. Open joints shall be covered or wrapped. Covered joints shall have one thickness of the cover material placed over the joint. Material shall overlap the joint not less than 4 inches on each side and cover the tile for not less than the upper half or more than the upper two-thirds of the circumference of the tile. Strips of wire cloth wrapping material3 inches wide shall be used for wrapped joints, with ends fastened

together.

3.1.4.3 PVC Pipe

PVC pipe joints shall be in accordance with ASTM D3034, ASTM D3212, or ASTM F949.

3.1.4.4 Corrugated Polyethylene

Corrugated polyethylene (PE) pipe joints shall be in accordance with ASTM F405 or ASTM F667.

3.1.5 Outlet Lines

The outlet end of drain lines connecting with an open gutter or outfall shall be covered with a removable wire basket of 16-mesh copper or bronze wire cloth fastened with brass or wire straps .

3.1.6 Cleanouts

Provide cleanouts in locations indicated. Cleanouts in unpaved areas shall be set in concrete blocks as shown on Drawings.

3.2 Backfilling

After joints and connections have been inspected and approved, place the specified pervious backfill material for the full width of the trench and full width between pipe and adjacent walls and 12 inches above the top of the pipe. Place the backfill preventing displacement of or injury to the pipe or tile. Place a protective covering, as specified, over the pervious backfill for the full width of the trench before regular backfill is placed. Compact backfill as specified in Section 31 00 00 EARTHWORK.

-- End of Section --

SECTION 33 46 16

SUBDRAINAGE SYSTEM
04/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 288	(2006) Standard Specification for Geotextile Specification for Highway Applications

ASTM INTERNATIONAL (ASTM)

ASTM A27/A27M	(2010) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A47/A47M	(1999; R 2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A48/A48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM C33/C33M	(2011a) Standard Specification for Concrete Aggregates
ASTM C4	(2004; R 2009) Standard Specification for Clay Drain Tile and Perforated Clay Drain Tile
ASTM C412	(2011) Concrete Drain Tile
ASTM C478	(2012) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM D1751	(2004; R 2008) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2004a; R 2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D3034	(2008) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

ASTM D3212	(2007) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D4491	(1999a; R 2009) Water Permeability of Geotextiles by Permittivity
ASTM D4752	(2010) Standard Practice for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub
ASTM F405	(2005) Corrugated Polyethylene (PE) Tubing and Fittings
ASTM F2648	(2013) Standard Specification for 2 to 60 inch Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications
ASTM F667	(2012) Large Diameter Corrugated Polyethylene Pipe and Fittings
ASTM F949	(2010) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT Specs	(2007) Virginia Department of Transportation Road and Bridge Specifications
VDOT Std	(2008) Virginia Department of Transporation Road and Bridge Standards

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-04 Samples

Filter Fabric; G, AE
Pipe for Subdrains; G, AE

SD-07 Certificates

Filter Fabric
Pipe for Subdrains

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Inspect materials delivered to site for damage; unload, and store with minimum handling. Do not store materials directly on the ground. The inside of pipes and fittings shall be free of dirt and debris. Keep, during shipment and storage, filter fabric wrapped in burlap or similar heavy duty protective covering. The storage area shall protect the fabric from mud, soil, dust, and debris. Filter fabric materials that are not to be installed immediately shall not be stored in direct sunlight. Install plastic pipe within 6 months from the date of manufacture unless otherwise approved.

1.3.2 Handling

Handle materials in such a manner as to ensure delivery to the trench in sound undamaged condition. Pipe shall be carried and not dragged to the trench.

PART 2 PRODUCTS

2.1 PIPE FOR SUBDRAINS

Submit samples of pipe, and pipe fittings, before starting the work. Pipe for subdrains shall be of the types and sizes indicated. Submit certifications from the manufacturers attesting that materials meet specification requirements. Certificates are required for drain pipe, drain tile, and fittings.

2.1.1 Drain Tile

Clay drain tile shall conform to ASTM C4 standard, extra quality or heavy duty as indicated. Concrete drain tile shall conform to ASTM C412 standard, extra, heavy duty extra, or special quality as indicated.

2.1.2 Plastic

Plastic pipe shall contain ultraviolet inhibitor to provide protection from exposure to direct sunlight.

2.1.2.1 Polyvinyl Chloride (PVC) and Fittings

Polyvinyl chloride (PVC) pipe and fittings shall conform to ASTM D3034.

2.1.2.2 Corrugated Polyethylene (PE) and Fittings

Use ASTM F405 for pipes 3 to 6 inches in diameter, inclusive, ASTM F667 for pipes 8 to 24 inches in diameter . Fittings shall be manufacturer's standard type and shall conform to the indicated specification.

2.1.2.3 Pipe Perforations

Water inlet area shall be a minimum of 0.5 square inch per linear foot. Manufacturer's standard perforated pipe which essentially meets these requirements may be substituted with prior approval of the Contracting Officer.

a. Circular Perforations in Plastic Pipe: Circular holes shall be

cleanly cut not more than 3/8 inch or less than 3/16 inch in diameter and arranged in rows parallel to the longitudinal axis of the pipe. Perforations shall be approximately 3 inches center-to-center along rows. The rows shall be approximately 1-1/2 inches apart and arranged in a staggered pattern so that all perforations lie at the midpoint between perforations in adjacent rows. The rows shall be spaced over not more than 155 degrees of circumference. The spigot or tongue end of the pipe shall not be perforated for a length equal to the depth of the socket, and perforations shall continue at uniform spacing over the entire length of the pipe.

b. Slotted Perforations in Plastic Pipe: Circumferential slots shall be cleanly cut so as not to restrict the inflow of water and uniformly spaced along the length and circumference of the tubing. Width of slots shall not exceed 1/8 inch nor be less than 1/32 inch. The length of individual slots shall not exceed 1-1/4 inches on 3 inch diameter tubing, 10 percent of the tubing inside nominal circumference on 4 to 8 inch diameter tubing, and 2-1/2 inches on 10 inch diameter tubing. Rows of slots shall be symmetrically spaced so that they are fully contained in 2 quadrants of the pipe. Slots shall be centered in the valleys of the corrugations of profile wall pipe.

2.1.2.4 Dual Wall Corrugated High-Density Polyethylene (PE) and Fittings

Dual wall high-density polyethylene drainage pipe with smooth interior and annular exterior corrugations, per ASTM F2648. Pipe shall be joined using bell and spigot joint meeting ASTM F2648. The joint shall be soil-tight and gaskets meeting requirements of ASTM F477. A joint lubricant supplied by the manufacturer shall be used on the gasket and bell during assembly. Fittings shall conform to ASTM F 2306. Bell and spigot connections shall utilize a spun-on or welded bell and valley or saddle gasket meeting the soil-tight joint performance requirements of ASTM F 2306.

a. Where perforated pipe is indicated, perforations shall be AASHTO Class II Perforation.

b. Dual Wall Corrugated High-Density Polyethylene (PE) and Fittings to be used beneath crypts at columbarium niche wall toe drain, and within columbarium courts as indicated on the Contract Drawings.

2.2 FILTER FABRIC

Submit samples of filter fabric, and certifications from the manufacturers attesting that filter fabric meets specification requirements. Provide geotextile that is a woven pervious sheet of polymeric material consisting of long-chain synthetic polymers composed of at least 95 percent by weight polypropylene (PP) or polyester (PET). The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) will not be allowed. Add stabilizers and/or inhibitors to the base polymer, as needed, to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure. The filter fabric shall provide be nonwoven and clog resistant, suitable for subsurface application and thermally and biologically stable. The geotextiles shall retain at least 75 percent of its ultimate strength when subjected to substances having a pH of a minimum of 3 and a maximum of 12 for a period of 24 hours. Permittivity shall be minimum 0.5 seconds when tested according to ASTM D4491 and apparent opening size (AOS) maximum number 50 sieve when tested according to ASTM D4752. Geotextile shall comply with AASHTO M 288 for strength requirements Table 1, Class 3, for grab strength.

AOS is defined as the number of the US Standard sieve having openings closest in size to the filter fabric openings.

2.3 SUBDRAIN FILTER AND BEDDING MATERIAL

Subdrain filter and bedding material shall be washed sand, sand and gravel, crushed stone, crushed stone screenings, or slag composed of hard, tough, durable particles free from adherent coatings. Filter material shall not contain corrosive agents, organic matter, or soft, friable, thin, or elongated particles and shall be evenly graded between the limits specified in TABLE I. TABLE II shows values that can be used to complete TABLE I. Gradation curves will exhibit no abrupt changes in slope denoting skip or gap grading. Filter materials shall be clean and free from soil and foreign materials. Filter blankets found to be dirty or otherwise contaminated shall be removed and replaced with material meeting the specific requirements, at no additional cost to the Government.

TABLE I. FILTER GRADATION

Sieve Designation	Percent by Weight Passing		
	Gradation A	Gradation B	Gradation C

TABLE II

ASTM D422 Sieve Size	Type I Gradation E 11 ASTM C33/C33M Percent Passing	Type II Gradation 57 ASTM C33/C33M Percent Passing	Gradation
1.5 inches	--	100	
1 inch	--	90 - 100	
3/8 inch	100	25 - 60	
No. 4	95 - 100	5 - 40	
No. 8	--	0 - 20	
No. 16	45 - 80	--	
No. 50	10 - 30	--	
No. 100	0 - 10	--	

2.4 DRAINAGE STRUCTURES

2.4.1 Concrete

Except for precast concrete, reinforcement shall conform to the requirements for 3,000 psi (A3) concrete in Section 217 "Hydraulic Cement Concrete" of the VDOT Specs. The concrete covering over steel reinforcing shall be not less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall be at least 3 inches thick between the steel and the ground. Expansion-joint filler material shall conform to ASTM D1751 or ASTM D1752. Exposed concrete surfaces, such as drainage structures that form a continuation of concrete curbs and gutters, shall be given a protective coating of linseed oil as specified in Section 32 16 13 CONCRETE SIDEWALKS AND CURBS AND GUTTERS.

2.4.2 Mortar

Hydraulic Cement Mortar and Grout shall meet VDOT Std, Section 218 "Hydraulic Cement Mortar and Grout." Minimun mortar requirements as as follows: Mortar for pipe joints and connections to other drainage structures shall be composed of one part by volume of portland cement and two parts of sand. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of injurious acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes from the time the ingredients are mixed with water.

2.4.3 Manholes and Appurtenances

2.4.3.1 Precast Reinforced Concrete Manhole Risers and Tops

All precast reinforced manholes and appurtenances shall conform to Section 302 "Drainage Structures" of VDOT Specs. As a minimum requirement, precast reinforced concrete manholes and appurtenances shall conform to ASTM C478.

2.4.3.2 Precast Concrete Segmental Blocks

Precast concrete segmental blocks shall conform to the same requirements as for precast reinforced concrete manholes and appurtenances and shall be not more than 8 inches thick, not less than 8 inches long, and of such shape that the joints can be effectively sealed and bonded with cement mortar.

2.4.3.3 Precast Concrete Manhole Bases

If precast concrete manhole bases are used, the bases shall conform to ASTM C478 and shall be of such a design as to effect suitable connection with influent and effluent lines and to provide a suitable base structure for riser sections.

2.4.3.4 Frames and Covers or Gratings

Frames and gratings, or frames and covers, except as otherwise permitted, shall be of either cast iron with tensile strength test not less than ASTM A48/A48M Class 25 or steel conforming to ASTM A27/A27M, Class 65-35. Weight, shape, and size shall be as indicated. Frames and covers not subjected to vehicular traffic or storage may be of malleable iron where indicated. The malleable-iron frames and covers shall conform to ASTM A47/A47M and shall be of the weight, shape, and size indicated.

PART 3 EXECUTION

3.1 EXCAVATION AND BEDDING FOR SUBDRAIN SYSTEMS

Trenching and excavation, including the removal of rock and unstable material, shall be in accordance with Section 31 00 00 EARTHWORK. Bedding material shall be placed in the trench as indicated or as required as replacement materials used in those areas where unstable materials were removed. Compaction of the bedding material shall be as specified for cohesionless material in Section 31 00 00 EARTHWORK.

3.2 MANHOLES AND FLUSHING AND OBSERVATION RISERS

3.2.1 Manholes

Manholes shall be installed complete with frames and covers or gratings at the locations and within the limits and sizes indicated. Manholes shall be constructed of one of the materials specified for manholes in paragraph DRAINAGE STRUCTURES. Joints shall be completely filled and shall be smooth and free of surplus mortar or mastic on the inside of the structure. Brick manholes shall be plastered with 1/2 inch of mortar over the entire outside surface of the walls. Brick for square or rectangular structures shall be laid in stretcher courses with a header course every sixth course. Brick for round structures shall be laid radially with every sixth course laid as a stretcher course. Ladders shall be installed in manholes as indicated. Base for manholes shall be either precast or cast-in-place concrete.

3.2.2 Flushing and Observation Risers

Flushing and observation riser pipes with frames and covers shall be installed at the locations indicated. Risers shall be constructed of precast concrete. Joining of riser pipes to the subdrain system shall be as indicated.

3.3 INSTALLATION OF FILTER FABRIC AND PIPE FOR SUBDRAINS

3.3.1 Installation of Filter Fabric

3.3.1.1 Overlaps on Perforated or Slotted Pipes

One layer of filter fabric shall be wrapped around perforated or slotted collector pipes in such a manner that longitudinal overlaps of fabric are in unperforated or unslotted quadrants of the pipes. The overlap shall be at least 2 inches. The fabric shall be secured to the pipe in such a manner that backfill material will not infiltrate through any fabric overlaps.

3.3.1.2 Installation on Open-Joint Pipe

One layer of filter fabric shall be wrapped around open joints. The overlap should be at least 2 inches. The fabric shall be secured to the pipe in such a manner that backfill material will not infiltrate through the overlap or the edges of the fabric to either side of the open joint.

3.3.1.3 Trench Lining and Overlaps

Trenches to be lined with filter fabric shall be graded to obtain smooth side and bottom surfaces so that the fabric will not bridge cavities in the soil or be damaged by projecting rock. The fabric shall be laid flat but not stretched on the soil, and it shall be secured with anchor pins. Overlaps shall be at least 12 inches, and anchor pins shall be used along the overlaps.

3.3.2 Installation of Pipe for Subdrains

3.3.2.1 Pipelaying

Each pipe shall be carefully inspected before it is laid. Any defective or damaged pipe shall be rejected. No pipe shall be laid when the trench conditions or weather is unsuitable for such work. Water shall be removed

from trenches by sump pumping or other approved methods. The pipe shall be laid to the grades and alignment as indicated. The pipe shall be bedded to the established gradeline. Perforations shall be centered on the bottom of the pipe. Pipes of either the bell-and-spigot type or the tongue-and-groove type shall be laid with the bell or groove ends upstream. All pipes in place shall be approved before backfilling.

3.3.2.2 Jointings

a. Nonperforated Concrete Pipe: Pipe shall be laid with 1/8 to 1/4 inch opening between the ends of the pipe or as required by spacing lugs constructed in the pipe. Mortar shall be placed in the joint at three points and pressed firmly into place to hold the pipe securely in line. The mortar shall be the full depth of the bell or groove and approximately 1 inch in width, and shall be located at the third points around the joint with the top point at the center of the pipe. The inside of the pipe shall be free of excess mortar.

b. Drain Tile: Drain tile shall be bedded as provided for bell-and-spigot or tongue-and-groove types of pipe and laid with open joints of approximately 1/8 inch width but not over 1/4 inch width. Drain tile shall be protected against the entrance of filter material into the line by the use of filter fabric.

c. Polyvinyl Chloride (PVC) Pipe: Joints shall be in accordance with the requirements of ASTM D3034, ASTM D3212, or ASTM F949.

d. Perforated Corrugated Polyethylene Pipe: Perforated corrugated polyethylene drainage pipe shall be installed in accordance with the manufacturer's specifications and as specified herein. A pipe with physical imperfections shall not be installed. No more than 5 percent stretch in a section will be permitted.

3.4 INSTALLATION OF AND BACKFILLING FOR BLIND OR FRENCH DRAINS

Filter material shall be placed as indicated and compacted as specified for cohesionless materials in Section 31 00 00 EARTHWORK. Filter material shall extend to a suitable outlet or to an outlet through a pipeline as indicated. Overlying backfill material shall be placed and compacted as specified in Section 31 00 00 EARTHWORK.

3.5 INSTALLATION OF FILTER MATERIAL AND BACKFILLING FOR SUBDRAINS

After pipe for subdrains has been laid, inspected, and approved, filter material shall be placed around and over the pipe to the depth indicated. The filter material shall be placed in layers not to exceed 8 inches thick, and each layer shall be thoroughly compacted by mechanical tampers or rammers to obtain the required density. Compaction of filter material and the placement and compaction of overlying backfill material shall be in accordance with the applicable provisions specified in Section 31 00 00 EARTHWORK.

3.6 TESTS

3.6.1 Pipe Test

Strength tests of pipe shall conform to field service test requirements of the Federal Specification, ASTM specification, or AASHTO specification covering the product (paragraph PIPE FOR SUBDRAINS).

-- End of Section --

SECTION 33 70 02.00 10

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND
11/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALLIANCE FOR TELECOMMUNICATIONS INDUSTRY SOLUTIONS (ATIS)

ATIS ANSI O5.1	(2008) Wood Poles -- Specifications & Dimensions

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC C8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV
AEIC CS8	(2000) Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M	(2003; R 2008) Standard Specification for Gray Iron Castings
ASTM B231/B231M	(2012) Standard Specification for Concentric-Lay-Stranded Aluminum 1350 Conductors
ASTM B400	(2008) Standard Specification for Compact Round Concentric-Lay-Stranded Aluminum 1350 Conductor
ASTM B609/B609M	(2012) Standard Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical purposes
ASTM B8	(2011) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM C478	(2012a) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C478M	(2012a) Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 404	(2012) Standard for Extruded and Laminated

	Dielectric Shielded Cable Joints Rated 2500 V to 500,000 V
IEEE 48	(2009) Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV
IEEE 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE C2	(2012; Errata 2012; INT 1 2012; INT 2 2012; INT 3 2012) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C119.1	(2011) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts
NEMA TC 6 & 8	(2003) Standard for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2011; Errata 2 2012) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 467	(2007) Grounding and Bonding Equipment
UL 486A-486B	(2003; Reprint Feb 2010) Wire Connectors
UL 651	(2011; Reprint Mar 2012) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G
As-Built Drawings; G
Installation Requirements

SD-03 Product Data

Nameplates

SD-06 Test Reports

Field Testing
Cable Installation

SD-07 Certificates

Material and Equipment
Cable Joints
Installation Engineer

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

1.3 QUALITY ASSURANCE

1.3.1 Detail Drawings

Submit detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

a. If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

b. Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

(1) Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.

(2) External wiring connections shall be clearly identified.

(3) Detail drawings shall as a minimum depict the installation of the following items:

(a) Medium-voltage cables and accessories including cable installation plan.

(b) Transformers.

1.3.2 As-Built Drawings

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. Correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

1.4 DELIVERY, STORAGE, AND HANDLING

Visually inspect devices and equipment when received and prior to acceptance from conveyance. Protect stored items from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Store oil filled transformers and switches in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ATIS ANSI O5.1. Handle wood poles in accordance with ATIS ANSI O5.1, except that pointed tools capable of producing indentations more than 1 inch in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

1.5 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Provide material and equipment which are the standard product of a manufacturer regularly engaged in the manufacture of the product and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

a. Submit a complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

b. Where materials or equipment are specified to conform to the

standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms.

c. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

2.2 NAMEPLATES

Submit catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. Sectionalizer switch nameplates shall have a schematic with all switch positions shown and labeled. As a minimum, nameplates shall be provided for transformers, circuit breakers, meters, switches, and switchgear.

2.3 CABLES

Cables shall be single conductor type unless otherwise indicated.

2.3.1 Medium-Voltage Cables

2.3.1.1 General

Cable construction shall be concentric neutral underground distribution cable conforming to AEIC C8 . Cables shall be manufactured for use in duct applications .

2.3.1.2 Ratings

Cables shall be rated for a circuit voltage of 35 kV.

2.3.1.3 Conductor Material

Underground cables shall be aluminum alloy 1350, 3/4 hard minimum complying

with ASTM B609/B609M and ASTM B231/B231M for regular concentric and compressed stranding or ASTM B400 for compacted stranding.

2.3.1.4 Insulation

Cable insulation shall be 345 milcross-linked thermosetting polyethylene (XLP) insulation conforming to the requirements of AEIC C8 . A 133 percent insulation level shall be used on 5 kV, 15 kV and 25 kV rated cables. Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS.

2.3.1.5 Shielding

Cables rated for 2 kV and above shall have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper shield for each phase.

2.3.1.6 Neutrals

Concentric neutrals conductors shall be tinned copper, having a combined ampacity equal to the phase conductor ampacity rating.

2.3.1.7 Jackets

Cables shall be provided with a PVC jacket. Direct buried cables shall be rated for direct burial.

2.3.2 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70, and must be UL listed for the application or meet the applicable section of NEMA standards, THHN/THWN.

2.3.2.1 In Duct

Cables shall be single-conductor cable, in accordance with NFPA 70.

2.4 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

2.4.1 Medium-Voltage Cable Joints

Medium-voltage cable joints shall comply with IEEE 404. Medium-voltage cable terminations shall comply with IEEE 48. Joints shall be the standard products of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Joints shall have ratings not less than the ratings of the cables on which they are installed. Splice kits may be of the premolded splice and connector type, the conventional taped type, or the resin pressure-filled overcast taped type for voltages up to 35 kV. Joints used in manholes, handholes, vaults and pull boxes shall be certified by the manufacturer for waterproof, submersible applications.

2.4.2 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A-486B. Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type

connector, conforming to the applicable requirements of UL 486A-486B. Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

2.4.3 Terminations

Terminations shall be in accordance with IEEE 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

2.4.3.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level. Leakage distances shall comply with wet withstand voltage test requirements of IEEE 48 for the next higher Basic Insulation Level (BIL) level. Anti-tracking tape shall be applied over exposed insulation of preformed molded elastomer terminations.

2.5 CONDUIT AND DUCTS

Ducts shall be single, round-bore type, with wall thickness and fittings suitable for the application. Duct lines shall be nonencased direct-burial, thick-wall type.

2.5.1 Nonmetallic Ducts

2.5.1.1 Direct Burial

UL 651 Schedule 40, or NEMA TC 6 & 8 Type DB.

2.5.2 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

2.6 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast-concrete manholes shall have the required strength established by ASTM C478, ASTM C478M. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A48/A48M, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be fabricated from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 10,000 psi and a flexural strength of at least 5,000 psi. Pullbox and handhole covers in sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

2.7 GROUNDING AND BONDING

2.7.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length. Sectional type rods may be used.

2.7.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.8 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

3.2 INSTALLATION REQUIREMENTS

As a minimum, submit installation procedures for transformers, substations, switchgear, and splices. Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment. Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 31 00 00 EARTHWORK. Concrete work shall have minimum 3000 psi

compressive strength and conform to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.2.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

3.3 CABLE AND BUSWAY INSTALLATION

Obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc. And then prepare a checklist of significant requirements perform pulling calculations and prepare a pulling plan which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS.

3.3.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

3.3.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

3.3.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 1/4 inch less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 8 cubic inches of debris is expelled from the duct.

3.3.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

3.3.1.4 Cable Installation

Provide a cable feeding truck and a cable pulling winch as required. Provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manila rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. Do not allow cables to cross over while

cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 50 degrees F temperature for at least 24 hours before installation. Submit 6 copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.

d. The dates of cable pulls, time of day, and ambient temperature.

e. The length of cable pull and calculated cable pulling tensions.

f. The actual cable pulling tensions encountered during pull.

3.3.1.5 Cable Installation Plan

Submit a cable installation plan for all cable pulls in accordance with the detail drawings portion of paragraph SUBMITTALS. Cable installation plan shall include:

a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.

b. List of cable installation equipment.

c. Lubricant manufacturer's application instructions.

d. Procedure for resealing cable ends to prevent moisture from entering cable.

e. Cable pulling tension calculations of all cable pulls.

f. Cable percentage conduit fill.

g. Cable sidewall thrust pressure.

h. Cable minimum bend radius and minimum diameter of pulling wheels used.

i. Cable jam ratio.

j. Maximum allowable pulling tension on each different type and size of conductor.

k. Maximum allowable pulling tension on pulling device.

3.3.2 Duct Line

Cables shall be installed in duct lines where indicated. Cable splices or joints shall be made in manholes and handholes only, except as otherwise noted. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.3.3 Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with IEEE C2.

3.4 CABLE JOINTS

Medium-voltage cable joints shall be made by qualified cable splicers only. Qualifications of cable splicers shall be submitted with a certification that contains the names of people recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. The certification shall indicate that any person recommended to perform actual splicing and terminations has been adequately trained in the proper techniques and have had at least three recent years of experience in splicing and terminating the same or similar types of cables approved for installation. In addition, any person recommended by the Contractor may be required to perform a practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. If that additional requirement is imposed, provide short sections of the approved types of cables along with the approved type of splice and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types.. Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint or in accordance with manufacturer's recommended practice. Cable joints shall provide insulation and jacket equivalent to that of the associated cable. Armored cable joints shall be enclosed in compound-filled, cast-iron or alloy, splice boxes equipped with stuffing boxes and armor clamps of a suitable type and size for the cable being installed.

3.5 DUCT LINES

3.5.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

3.5.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer

shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.5.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70. The separation between adjacent electric power and communication ducts shall conform to IEEE C2. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. Submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph SUBMITTALS. At any point, tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 6 inches vertically.

3.5.4 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

3.5.4.1 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

3.5.5 Duct Line Markers

A 5 mil brightly colored plastic tape, not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion-resistant 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels of such lines.

3.6 MANHOLES, HANDHOLES, AND PULLBOXES

3.6.1 General

Manholes, handholes and pullboxes shall be constructed approximately where shown. The exact location of each manhole, handhole, and pullboxe shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes, handholes, and pullboxes shall be the type noted on the drawings and shall be constructed in accordance with the applicable

details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may, as an option, utilize monolithically constructed precast-concrete manholes, handholes having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for manhole and handhole, handholes and pullboxes entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 1/2 inch above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes and handholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole and handhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

3.6.2 Electric Manholes

Cables shall be securely supported from walls by stainless steel, hot-dip galvanized or fiberglass cable racks with a plastic coating over the galvanizing or stainless steel and equipped with adjustable hooks and insulators. The number of cable racks indicated shall be installed in each manhole and not less than 2 spare hooks shall be installed on each cable rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required on spare hooks.

3.6.3 Handholes

Handholes shall be located approximately as shown. Handholes shall be of the type noted on the drawings and shall be constructed in accordance with the details shown.

3.6.4 Pullboxes

Pullbox tops shall be flush with sidewalks or curbs or placed 1/2 inch above surrounding grades when remote from curbed roadways or sidewalks. Covers shall be marked "Low-Voltage" and provided with 2 lifting eyes and 2 hold-down bolts. Each box shall have a suitable opening for a ground rod. Conduit, cable, ground rod entrances, and unused openings shall be sealed with mortar.

3.6.5 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 4 inches of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

3.7 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation, surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose.

3.7.1 Concrete Pads

3.7.1.1 Construction

Concrete pads for pad-mounted electrical equipment may be either pre-fabricated or poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 4 inches above finished grade and sloped to drain. Edges of concrete pads shall have 3/4 inch chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

3.7.1.2 Concrete and Reinforcement

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.7.1.3 Sealing

When the installation is complete, seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.8 CONNECTIONS TO BUILDINGS

Cables shall be extended into the various buildings as indicated, and shall be connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be at conduit stubouts terminating 5 feet outside of a building and 2 feet below finished grade as specified and provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

3.9 GROUNDING

A ground ring consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed around pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths

and armor, and metallic conduit shall be grounded. At least 2 driven rods shall be provided for a transformer pad. Metallic frames and covers of handholes and pull boxes shall be grounded by use of a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.9.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be driven into the earth until the tops of the rods are approximately 1 foot below finished grade.

b. Ground ring - A ground ring shall be installed as shown consisting of bare copper conductors installed not less than 30 inches below finished top of soil grade. Ground ring conductors shall be No. 2 AWG, minimum.

c. Additional electrodes - When the required ground resistance is not met, additional electrodes shall be provided as indicated to achieve the specified ground resistance. The additional electrodes will be 10 feet apart, a single extension-type rod, 3/4 inch diameter, up to 30 feet long driven perpendicular to grade. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

3.9.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process.

3.9.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

3.9.4 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in manholes, handholes, or concrete pullboxes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 2 inches above and 6 inches below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

3.9.5 Metal Splice Case Grounding

Metal splice cases for medium-voltage cable shall be grounded by connection to a driven ground rod located within 2 feet of each splice box using a grounding electrode conductor having a current-carrying capacity of at least 20 percent of the individual phase conductors in the associated splice box, but not less than No. 6 AWG.

3.10 FIELD TESTING

Submit a proposed field test plan, 20 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

3.10.1 General

Field testing shall be performed in the presence of the Contracting Officer. Notify the Contracting Officer 5 days prior to conducting tests. Furnish all materials, labor, and equipment necessary to conduct field tests. Perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. Maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field test reports shall be signed and dated by the Contractor.

3.10.2 Safety

Provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. Replace any devices or equipment which are damaged due to improper test procedures or handling.

3.10.3 Ground-Resistance Tests

The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

a. Rod electrode - 25 ohms.

3.10.4 Medium-Voltage Cable Test

After installation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and

terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be for the particular type of cable installed, except that 28 kV and 35 kV insulation test voltages shall be in accordance with either AEIC C8 or AEIC CS8 as applicable, and shall not exceed the recommendations of IEEE 404 for cable joints and IEEE 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.10.5 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

3.10.6 Liquid-Filled Transformer Tests

The following field tests shall be performed on all liquid-filled transformers . Pass-fail criteria shall be in accordance with transformer manufacturer's specifications.

a. Insulation resistance test phase-to-ground.

b. Turns ratio test.

c. Correct phase sequence.

d. Correct operation of tap changer.

3.11 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SECTION 34 71 14.19

HIGH-TENSION CABLE BARRIER
05/13

PART 1 GENERAL

1.1 SUMMARY

Section includes NCHRP 350 tested high-tension cable barrier system approved for use in roadway medians and on roadway shoulders.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 103	(2006) Standard Specification for Steel Castings, Carbon, for General Application

ASTM INTERNATIONAL (ASTM)

ASTM A1	(2010) Standard Specification for Carbon Steel Tee Rails
ASTM A123	(2012) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2012) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
ASTM A47	(2009) Standard Specification for Ferritic Malleable Iron Castings
ASTM A563	(2007) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A741	(2011) Standard Specification for Metallic-Coated Steel Wire Rope and Fittings for Highway Guardrail

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM (NCHRP)

NCHRP 350	Recommended Procedures for the Safety Performance Evaluation of Highway Features Transportation Research

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G, AE
Manufacturer's most recent sheet and installation manual

SD-03 Product Data

Cable; G, AE
Posts; G, AE
Cable Hardware; G, AE
Locking Hook Bolts; G, AE
Delineators; G, AE

SD-07 Certificates

Installer Qualifications; G, AE
Manufacturer Qualifications

1.4 QUALITY CONTROL

1.4.1 Installer Qualifications

Provide installer qualifications including project completed over the past 5 years for the products specified. Installer shall have experience in the Commonwealth of Virginia and VDOT regulations. An authorized representative who is trained and approved by manufacturer.

1.4.2 Manufacturer Qualifications

Provide equipment and products from manufacturer who is regularly engaged in the manufacturer of product specified. Manufacturer shall have in-house design capabilities, shall be able to provide complete shop drawings and installation inspection for high tension cable barriers.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall be as described on the manufacturer's standard and as follows:

2.1.1 Cable

The cable shall be 3/4 inch 3 by 7 steel cable manufactured in accordance with ASTM A741, AASHTO M30, Type I, Class A coating.

2.1.2 Posts

U-channel cable line posts shall conform to the physical properties of ASTM A499, and the chemical properties of ASTM A1. In addition they shall have a minimum yield of strength of 80,000psi and tensile strength of 100,000psi.

All posts shall be galvanized per ASTM A123.

2.1.3 Cable Hardware

All fittings shall be designed to develop 25,000 lbs. tensile strength. Wedge type cable socket fittings shall be of the open end type and shall permit visual inspection of the cable end and wedge after installation. Malleable iron fittings shall conform to the requirements of ASTM A47. Cast steel fittings shall conform to the requirements of AASHTO M 103, grade 70-36.

2.1.4 Locking Hook Bolts

Special locking hook bolts shall be manufactured from ASTM A307 Grade C carbon steel. Nuts shall be ASTM A563 Grade A Heavy Hex. Special locking hook bolts and nuts shall be galvanized per ASTM A153.

2.1.5 Delineators

Delineators shall be 3M Type III / IV High Intensity Prismatic adhesive reflective sheeting. Delineators shall be installed with 3M Primer 94 Adhesive.

2.1.6 Installation Accessories

Provide all other installation products, accessories, tools, and equipment for complete, safe installation.

2.2 CONCRETE

Concrete shall be 3000 psi minimum. Concrete is to be reinforced according to plan details. Refer to Section 03 30 00 CAST IN PLACE CONCRETE.

2.3 SOIL CONDITIONS

NCHRP 350 Strong Soil (S1) is required for use with 6 foot direct driven line posts, 30 inch socketed line post foundations, or 5 foot concrete CRP post foundations. If the soil is of lesser strength than NCRHP 350 Strong Soil (S1) but stronger than NCHRP 350 Weak Soil (S2) an 8 foot direct driven line post, 36 inch socketed line post foundation, or 8 foot concrete CRP post foundation should be used. If soil is NCHRP 350 Weak (S2) soil or weaker contact manufacturer for appropriate foundation sizing.

PART 3 EXECUTION

3.1 INSTALLATION

High Tension Cable Barrier System shall be installed according to the manufacturer's latest standard sheet and installation manual and approved shop drawings.

3.2 FIELD QUALITY CONTROL

Adjust the tension of the wire ropes to ensure that they share load equally. Submit the proposed method field tensioning in the work plan. After "break-in/testing" the ropes shall be tested to determine if they share load equally, and if not, they shall be re-tensioned.

-- End of Section --