

PHASE 1 GEOTECHNICAL DATA REPORT

Alexandria Waterfront Flood Mitigation Alexandria, Virginia

Schnabel Reference: 16C12012
October 26, 2016



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1956 - 2016

October 26, 2016

Mr. Jeffrey Lohr, PE
Stantec
4500 Daly Drive, Suite 100 Fairfax
Chantilly, VA 20151

**Subject: Project 16C12012, Alexandria Waterfront Flood Mitigation
Phase 1 Geotechnical Data Report, Alexandria, Virginia**

Dear Mr. Lohr:

SCHNABEL ENGINEERING, LLC (Schnabel) is pleased to submit our Phase 1 Geotechnical Data report for this project. This report includes tables, figures, and appendices with relevant data collected for this study. This study was performed in accordance with our proposal dated March 22, 2016, as authorized by the Subconsultant Agreement effective February 16, 2016.

We appreciate the opportunity to be of service for this project. Please call us if you have any questions regarding this report.

Sincerely,

SCHNABEL ENGINEERING, LLC

A handwritten signature in blue ink, appearing to read "Nancy A. Straub".

Nancy A. Straub, PE, ENV SP, LEED AP
Associate

A handwritten signature in blue ink, appearing to read "Hamid M. Riahi".

Hamid M. Riahi, PE
Senior Associate

A handwritten signature in blue ink, appearing to read "Qamar A. O. Kazmi".

Qamar A. O. Kazmi, PE
Principal

RTH:BB:NS:nv

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**PHASE 1 GEOTECHNICAL DATA REPORT
ALEXANDRIA WATERFRONT FLOOD MITIGATION
ALEXANDRIA, VIRGINIA**

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1.0 INTRODUCTION

1.1 Project Overview

In 2012, the City of Alexandria, Virginia approved the Alexandria Waterfront Small Area Plan (Waterfront Plan), which provides a 20 to 30 year vision for development of the Alexandria waterfront. The Waterfront Plan includes a framework for revitalizing Alexandria's waterfront by incorporating Alexandria's history, expanding and enhancing public open spaces, improving public access and connectivity, promoting the waterfront as an arts and cultural destination, and ensuring compatible development. The area of the proposed Waterfront Plan extends from Wilkes Street on the south to Canal Center Plaza on the north, and between the Potomac River to the east and Union Street (from Wilkes Street to Pendleton Street) and North Lee Street (from Pendleton Street to Canal Center Plaza) on the west.

Phase I of the planned waterfront development will include construction of a promenade, a bulkhead, and a flood mitigation system in the "Core Area" of the Waterfront Plan. The Core Area of the proposed development, bounded by the Potomac River to the east, Queen Street to the north, Union Street to the west, and Duke Street to the south, is shown on Figure 1, Site Vicinity Map.

1.2 Purpose of Report

The purpose of this report is to present the data from Phase 1 of our geotechnical investigation for the Phase I flood mitigation system and Potomac River shoreline improvements. The data presented in this report will be used to advance the concept-level design. A Phase 2 geotechnical investigation will be performed in the future to collect additional information for design.

2.0 SCOPE OF SERVICES

Our proposal dated March 22, 2016 and our contract with Stantec Consulting Services, Inc. (Stantec) dated February 16, 2016, defines the scope of services for this project. The scope of services includes the following:

- Task 1 – Project Management and Coordination
- Task 2 – Information Gathering
- Task 4 – Civic Engagement
- Task 6 – Landscape and Flood Mitigation Construction Documents

This Geotechnical Data Report has been prepared as part of Task 2 listed above.

3.0 DESCRIPTION OF SITE AND PROPOSED CONSTRUCTION

3.1 Site Description

The subject site is located within the City of Alexandria, Virginia (City). The City is a municipality with a population of approximately 140,000, located on the west bank of the Potomac River, near Washington, D.C. The subject site is located in the Old Town area of the City near the waterfront on reclaimed land as shown in Figure 2. Phase I of the Waterfront Plan project extends from South Union Street on the west to the Potomac River on the east and from Queen Street on the north to Duke Street on the south. The subject site is generally level and highly developed with a variety of buildings, roadways, parks, piers, and other structures.

We obtained this site information from a site plan dated May 2016, prepared by Stantec, and through our site visits.

3.2 Proposed Construction

We understand that the following improvements will be performed as part of the Phase I flood mitigation system and Potomac River shoreline improvements project:

- A new riverfront promenade 20 ft to 25 ft in width adjacent to the new structural bulkhead. The promenade includes a paved landside component; a riverside, over-water boardwalk constructed on pilings; and areas with a stepped bulkhead, or grand steps, into the water.
- A new structural bulkhead will be installed to at least EL 6.0 along the Potomac River within the project area. The proposed bulkhead will be generally located east of the existing shoreline and in some portion east of the U.S. Army Corps of Engineers bulkhead line.
- Two proposed pump stations, including screens, wet wells, pumps, backup generators, backup fuel sources, discharge piping, mechanical equipment, controls, and all related infrastructure. Each pump station site will include a pair of park pavilion buildings to elevate the pump station equipment above the flood plain, as well as incorporate related park uses including storage, restrooms, and service areas.
- A storm sewer network to convey upstream runoff directly to the river, bypassing the pump stations. The proposed bypass storm sewer network should help decrease the size of drainage area serviced by the pump stations.
- A new storm sewer inlet and pipe network to collect and convey runoff from the proposed development area to the proposed pump station wet wells.

The locations, extents, and elevations of these improvements are currently conceptual and will be developed during future design phases.

4.0 SUBSURFACE EXPLORATION PROGRAM

We performed a geotechnical exploration program consisting of test borings to explore the subsurface conditions underlying the site and to evaluate the geotechnical properties of the materials encountered. Exploration methods used are discussed below. The appendices to this report contain the results of our exploration.

4.1 Subsurface Exploration and Field Testing

4.1.1 Test Borings

Our subcontractor, Free-State Drilling of Frederick, Maryland, drilled seven (7) test borings under our observation between August 8, 2016 and August 22, 2016. The borings were advanced using either hollow stem augers (HSA) or mud rotary drilling techniques. HSA were used in shallower borings where the soils were anticipated to be at least medium dense to medium stiff. Mud rotary techniques were used in borings BH-2A, RCP-1, and SW-1 due to the anticipated very soft soils below the groundwater table and the potential for encountering wood or other debris. A decontamination pad was set up in the drum staging area at 910 South Payne Street.

During the drilling of BH-2, significant wood debris was encountered in the upper 15 ft which caused the lead HSA to shear off. The damaged auger was recovered from the borehole, and the borehole was abandoned using bentonite grout. The boring was resumed in an adjacent offset hole, BH-2A, using a tri-cone roller bit and rotary drilling methods. As the boring was advanced, a casing was installed to maintain borehole stability when potentially collapsible layers were encountered.

In both methods of drilling, the Standard Penetration Test (SPT) was performed at selected depths in the borings. Split spoon samples were obtained during the SPT using a hydraulically driven automatic trip hammer (ATH). Most correlations with SPT data are based on N-values collected with a safety hammer. The energy applied to the split-spoon sampler using the ATH is about 33 percent greater than that applied using the safety hammer, resulting in lower N-values. The hammer blows shown on the boring logs are uncorrected for the higher energy.

As the borings were advanced, an archaeologist provided by Stantec observed the soil samples and soil cuttings to determine if any historical artifacts were present. In addition, a representative from GeoConcepts was on-site during drilling to screen the samples for potential environmental contamination using a Photoionization Detector (PID). Representative sample(s) were collected from the test borings by GeoConcepts to be submitted for environmental laboratory testing. The results of their testing will be provided by GeoConcepts under separate report cover.

As the borings were advanced and SPT samples obtained, the split spoon sampler was decontaminated by scrubbing it with water and a non-toxic soap between each sample. Upon completion of each test boring, the equipment was decontaminated in the drum staging area. The equipment was cleaned using a non-toxic soap and the decontamination wash water was placed in drums for disposal.

During the drilling of each test boring, the soil cuttings, drilling fluid, decontamination wash water, and disposable sampling equipment were collected and placed in clean, clearly labeled, 55-gal drums and

transported to a drum staging area for temporary storage until final disposal. At the conclusion of the subsurface investigation, the drums were collected and disposed of at a licensed disposal facility by the certified soil disposal contractor, AEG Environmental Products & Services. Borings completed in pavement were backfilled with bentonite chips to just below the surface of the pavement. The pavement was patched with quick-setting concrete or cold-patch asphalt, as appropriate. Borings performed in non-paved areas were backfilled with a cement-bentonite grout.

Appendix A includes specific observations, remarks, and logs for the borings, classification criteria, drilling methods, and sampling protocols. Figures 3A through 3F, included at the end of this report, indicate the test boring locations. Soil samples collected in the field, excluding those taken for environmental testing, were taken to Schnabel's offices for further review and testing. We will retain soil samples up to 45 days beyond the issuance of this report, unless you request other disposition.

4.2 Previous Explorations by Others

URS previously performed a preliminary subsurface exploration on this site near the proposed locations for the two pump stations (one near each pump station). Test logs for the two test borings performed as part of that exploration are included in Appendix B.

These data were developed by others and we were not present during collection of this information. We have reviewed the data for reasonableness, but we assume no responsibility for the completeness and accuracy of this information.

5.0 LABORATORY TESTING

Selected samples obtained during the subsurface exploration were submitted to our laboratory, GeoTesting Express and Microbac Laboratories for testing. The testing aided in the classification of materials encountered during the subsurface exploration. Results of the moisture content and index testing are shown on the boring logs in Appendix A. The remainder of the test results are presented in the Summary of Laboratory Tests in Appendix C and are summarized in Section 6.0.

5.1 Current Laboratory Testing Program

5.1.1 Index Testing

We performed natural moisture content, Atterberg Limit, and gradation tests on 44 jar and two Shelby tube samples of soils representing Strata A, B, C, and D. The testing was performed to confirm the field soil classifications and to provide parameters for use in estimation of soil properties based on published correlations.

5.1.2 Strength Testing

Our subcontractor, GeoTesting Express, performed one unconsolidated-undrained (UU) triaxial shear test on a tube sample collected from boring BH-1 at a depth of 60.5 ft below ground surface (bgs) representing Stratum D to evaluate the shear strength of these materials.

5.1.3 Corrosivity Testing

We performed tests for pH, sulfides, redox potential, and resistivity testing on 10 samples representing Strata A, B, and D. In addition, Microbac Laboratories, performed chloride and sulfate testing on the same 10 samples.

5.2 Previous Testing

URS performed soil laboratory tests on selected samples obtained from the site. Testing included moisture content, grain size analysis, Atterberg Limits, and environmental contamination. Previous test results are presented in Appendix D.

These data were developed by others and we were not present during the performance of these tests. We have reviewed these data for reasonableness, but we assume no responsibility for the completeness and accuracy of this information.

6.0 GEOLOGY AND SUBSURFACE CONDITIONS

6.1 Regional Geology

Based on published geologic information (Fleming 2015), the project site is located within the Atlantic Coastal Plain Physiographic Province. Fill was placed along much of the shoreline of the Potomac River to reclaim the land and raise the grade to allow for the expansion of the waterfront. Below the fill, Quaternary-period alluvial deposits (Qa) consisting of boulders, gravel, sand, and mud, often containing mica, are present along the floodways of streams and rivers. These recent alluvial deposits taper out to the west of the Potomac River. Below the recent alluvium, the Old Town Terrace Deposits, described as repetitive sequences of sand, gravel, and silty clay with organic layers, were deposited approximately 150,000 to 15,000 years ago. Due to the thick layers of existing fill, recent alluvium and The Old Town Terrace deposits, the specific subsurface stratigraphy below the Old Town Terrace depositions is uncertain. Fleming depicts early Cretaceous-age sediments of the Potomac Group, including the Arell Clay member (K_{pa}), the Cameron Valley Sands (K_{pcv}) and Chinaquapin Hollow fine sandy clays (K_{pch}). The regional bedrock formation is anticipated to be the metamorphosed mafic to felsic volcanic rocks and sediments of the Chopawamsic Formation. Bedrock is estimated to be approximately 350 ft to 500 ft below sea level and dipping eastward.

6.2 Site Geology

The existing fill soils of Stratum A are believed to be a combination of sand, gravel, clay, topsoil, and construction debris placed sometime after 1749 as the wharves and the waterfront were developed. Below the existing fill, recent alluvial deposits consisting of boulders, gravel, sand, and mud are encountered. The Old Town Terrace Deposit generally consists of repetitive sequences of coarse to fine sediments, gravelly in their lower parts, grading up through sand and muddy sand into mud, which are separated by significant organic layers. At about 60-ft to 75-ft depth below the ground surface, Fleming anticipates the soils to transition to the gray to blue-gray, very stiff to hard, lacustrine clays of the Arell member. The Arell clays are reported to contain abundant fractures and a high content of expandable-lattice clay minerals.

6.3 Generalized Subsurface Stratigraphy

Based on the test boring data and laboratory test results presented herein, we interpret that the following generalized strata underlie the site to the depths explored at the boring locations. The following strata designations do not imply continuity of the materials described, but give general descriptions and characteristics of the materials at the project site. In addition, the strata designations may be revised after additional explorations are completed.

Stratum	Where Present	Description
Stratum A: (Fill)	Below the asphalt and concrete to depth of up to approximately 43.5 ft-bgs. Present in all seven borings	Gray to dark gray/black, light brown to brown, and red FILL, sampled as Gravel (GW, GC, GP-GC), Sand (SC, SP-SM, SP), Silt (MH), and Clay (CL, CH) with varying amounts of sand, gravel, silt,

and clay. Also present in varying amounts: mica, shells, and other debris including ceramic, metal, wood fragments, wood fibers, glass, and brick; soft to stiff (N = Weight of Hammer (WOH) to 12) where fine-grained and very loose to very dense (N = 2 to 52) where coarse-grained. Pocket penetrometer (PP) test results (estimated unconfined compressive strength) recorded for the fine-grained soils ranged from 0.0 to 2.5 tsf.

Stratum B: Recent Alluvium	Below Stratum A, where present, and above Stratum C	Light to dark gray and grayish brown Silt (ML, MH), Clay (CL, CH), Organic Clay (OH), and Sand (SC) with varying amounts of gravel, sand, silt, and clay. Also present was varying amounts of wood, wood fibers, and mica; very soft to medium stiff (N=WOH to 7 bpf). PP test results recorded for the fine-grained soils ranged from 0.0 to 0.5 tsf.
Stratum C: Old Town Terrace	Below Stratum A or Stratum B (where present)	Gray Sand (SM, SP, SP-SC) and Silt (ML) with varying amounts of gravel, silt, and sand. Also present was gravel and mica; very loose to loose (N=WOH to 11 bpf).
Stratum D: (Potomac Group)	Below Stratum B (where present), and below Stratum C	Gray to dark gray, bluish gray, brown, and reddish brown Elastic Silt (MH) and Clay (CH, CL) with varying amounts of gravel, sand, and mica; medium stiff to hard (N=5 to 35). PP test results recorded for the fine-grained soils ranged from 2.0 to 4.5 tsf.

6.4 Laboratory Test Results

Selected soil samples recovered from the soil borings were tested for water content, grain size distribution, Atterberg limits, presence of organics, undrained shear strength, and corrosion potential in general conformance with applicable ASTM and AWWA standards. The results of the above testing are summarized by stratum in Table 1 below and the test results are included in Appendix C.

One unconsolidated-undrained (UU) triaxial shear test was performed on a sample of elastic silt (MH) of Stratum D collected from boring BH-1 at a depth of 60.5 ft bgs. The test resulted in an undrained shear strength of 1,524 psf.

Table 1: Summary of Index Test Results by Stratum

Stratum	Moisture Content (%)	Fines Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Oven-Dried Liquid Limit	Specific Gravity	Bulk Density (pcf)
A	9.1 - 94.3	2 – 95.7	26 – 54	18 - 31	8 – 23	-	2.67 – 2.73	98.01
B	24.6 – 69.7	41.4 – 98.6	44 – 74	28 – 32	16 – 42	36 – 42	2.61 – 2.69	-
C	20 – 23.5	10.3 - 33.8	20	17	3	-	-	-
D	28.7 - 37.7	90.4 – 99.1	59 - 90	24 - 31	28 - 61	-	2.63 - 2.87	118.7

- (1) “-” denotes that the laboratory test was not performed
- (2) If the ratio of the oven-dried liquid limit to the air-dried liquid limit is less than 0.75, the soil is classified as “organic”

6.5 Groundwater

We observed groundwater during drilling in all seven borings at depths ranging from 3 ft to 13.5 ft bgs, which corresponds to about EL 0.5 to EL -9.0 ft. The test boring logs in Appendix A include groundwater level measurements obtained during our subsurface exploration. These data include depths to groundwater encountered during drilling, upon drilling completion, and following completion of the boring. For borings drilled with mud rotary techniques (BH-2A, RCP-1, and SW-1), the use of water during the drilling process makes groundwater level observations unreliable.

We did not obtain long-term water level readings since test borings were backfilled upon completion for safety reasons.

The groundwater levels on the logs indicate our estimate of the water table at the time of our subsurface exploration. The final design should anticipate the fluctuation of the hydrostatic level depending on variations in precipitation, surface runoff, pumping, tidal action, leaking utilities, and similar factors. Table 2 below gives a summary of the groundwater observations made during the subsurface investigation.

Table 2: Summary of Groundwater Observations

Boring	Boring Elevation (ft)	Depth of Boring (ft)	Depth Encountered (ft)	Depth at Completion (ft)	Depth when Casing Pulled (ft)
BH-1	3.47	100	4	14	-
BH-2	3.42	15.5	3.0	10.5	-
BH-2A ⁽²⁾	3.42	100	3.0	12 ²	-
PS-1	3.81	15	8	8.5	4
RCP-1 ⁽²⁾	3.94	65	9	7.5 ²	-
SS-1	4.05	40	6.5	25.5	8.5
SS-2	4.42	25	Dry	Dry	13.5
SW-1 ⁽²⁾	4.07	35	6	5 ²	-

(1) "-" denotes a reading was not recorded

(2) These groundwater measurements are not considered reliable because of the addition of water during drilling and should not be considered representative of actual conditions

6.6 Soil Corrosivity Potential

Corrosion potential testing, consisting of resistivity, oxidation-reduction potential, chlorides, sulfates, sulfides and pH testing, was performed on selected samples of soil from across the site. We recommend the results of our corrosion potential testing be provided to the project corrosion consultant to evaluate the corrosion potential of the on-site soils and provide recommendations. Table 3 below summarizes the results of the corrosion potential testing with full details provided in Appendix C.

Table 3: Summary of Corrosion Potential Series Test Results

Test	Stratum			
	A	B	C	D
pH	6.5 to 12.0	6.3 to 6.4	-	4.1 to 5.4
Oxidation Reduction Potential (mV)	-243 to 33	35 to 38	-	77 to 135
Resistivity (ohm-cm)	1800 to 6100	2000 to 2400	-	800 to 900
Sulfides (presence)	Negative	Negative	-	Negative
Chlorides (mg/kg)	19 to 160	18 to 50	-	ND
Sulfates (mg/kg)	12 to 790	43 to 150	-	15 to 18
AWWA Ranking	8 to 14	8 to 11	-	11 to 15.5
AASHTO Sulfate Rating	Low to Moderate Exposure	Low to Moderate Exposure	-	Low Exposure
AASHTO Chlorides Rating	Low Potential	Low Potential	-	Low Potential
ACI Sulfate Exposure Rating	Low to Moderate Exposure	Low to Moderate Exposure	-	Low Exposure

(1) "-" denotes the laboratory test was not performed

(2) "ND" denotes that analyte not detected at or above reporting limit

Table 3 presents the corrosion potential for the various strata per American Water Works Association (AWWA) Specification C105. AWWA Specification C105 includes a procedure for ranking soils on a 10-point scale to evaluate whether the soils are potentially corrosive to cast iron. This standard also includes recommendations for providing corrosion protection of cast iron pipes that are installed in soils that have a ranking of 10 or greater. Although the specification is specific for ductile iron pipes, the AWWA ranking system is widely used to evaluate the corrosion potential in other ferrous metals based on the similar behavior of cast iron and steel when exposed to corrosive environments.

We also tested selected samples for chloride and sulfates, which can cause significant deterioration of buried concrete structures and reinforcing steel over time. AASHTO uses a chloride threshold of 500 ppm in assessing potential pipe corrosion. If the results of the chloride testing are above 500 mg/kg (ppm), then the test is indicative of potential pipe corrosion. The potential exposure to chlorides and sulfates per AASHTO based on this criterion is provided in Table 3.

Guidance provided in the American Concrete Institute (ACI) Publication 318, Section 4.3 (as designated in Section 1904.3 of the IBC 2009 manual) indicate that sulfate exposure is considered low if the results are less than 150 mg/kg (ppm). If the results are greater than or equal to 150 mg/kg (ppm), but less than 1,500 mg/kg (ppm), the sulfate exposure is considered moderate. If the results are greater than 1,500 mg/kg (ppm), but less than 10,000 mg/kg (ppm), then the sulfate exposure is severe. If the results are greater than 10,000 mg/kg (ppm) then the sulfate exposure is very severe. The corrosion potential rating per AASHTO based on this criterion is provided in Table 3.

7.0 LIMITATIONS

The subsurface conditions described in this data report were developed based on the information revealed by our exploration and our review of data provided to us by others.

This report has been prepared to aid in the evaluation of this site and to assist in the design of the project. It is intended for use concerning this specific project.

We have endeavored to complete the services identified herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project. No other representation, express or implied, is included or intended, and no warranty or guarantee is included or intended in this report, or other instrument of service.

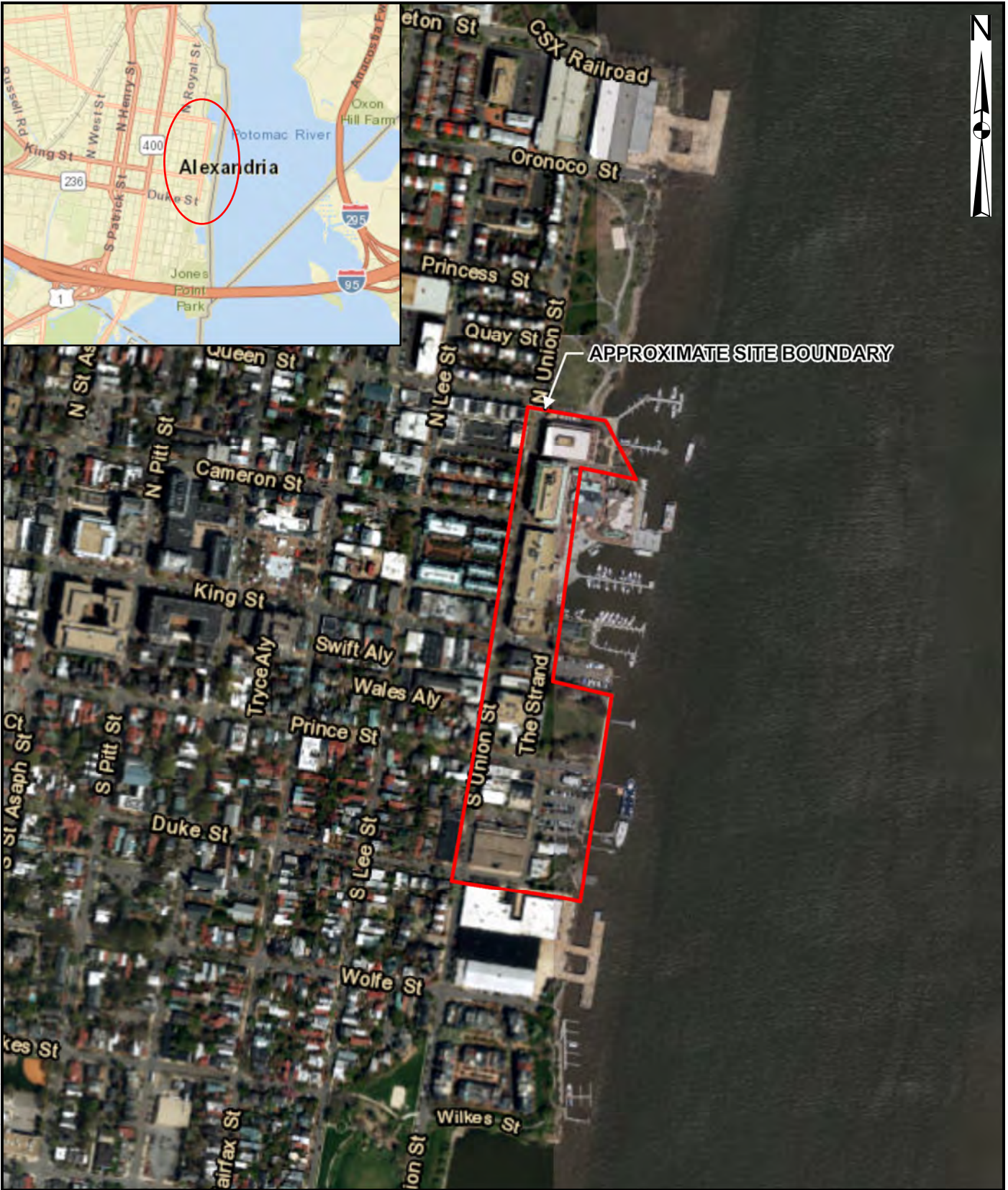
8.0 REFERENCES

Drake, A.A., Jr., and Froelich, A.J., (1986). "Geologic Map of the Annandale Quadrangle, Fairfax County, Virginia." U.S. Geological Survey Geologic Quadrangle Map GQ-1601. Scale 1:24,000.

Fleming, A.H. (2015). "Geologic Atlas of the City of Alexandria, Virginia, and Vicinity," City of Alexandria, Virginia.

FIGURES

Figure 1: Site Vicinity Map
Figure 2: Alexandria Historic Shoreline
Figure 3A through F: Boring Location Plan



Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
 Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS,

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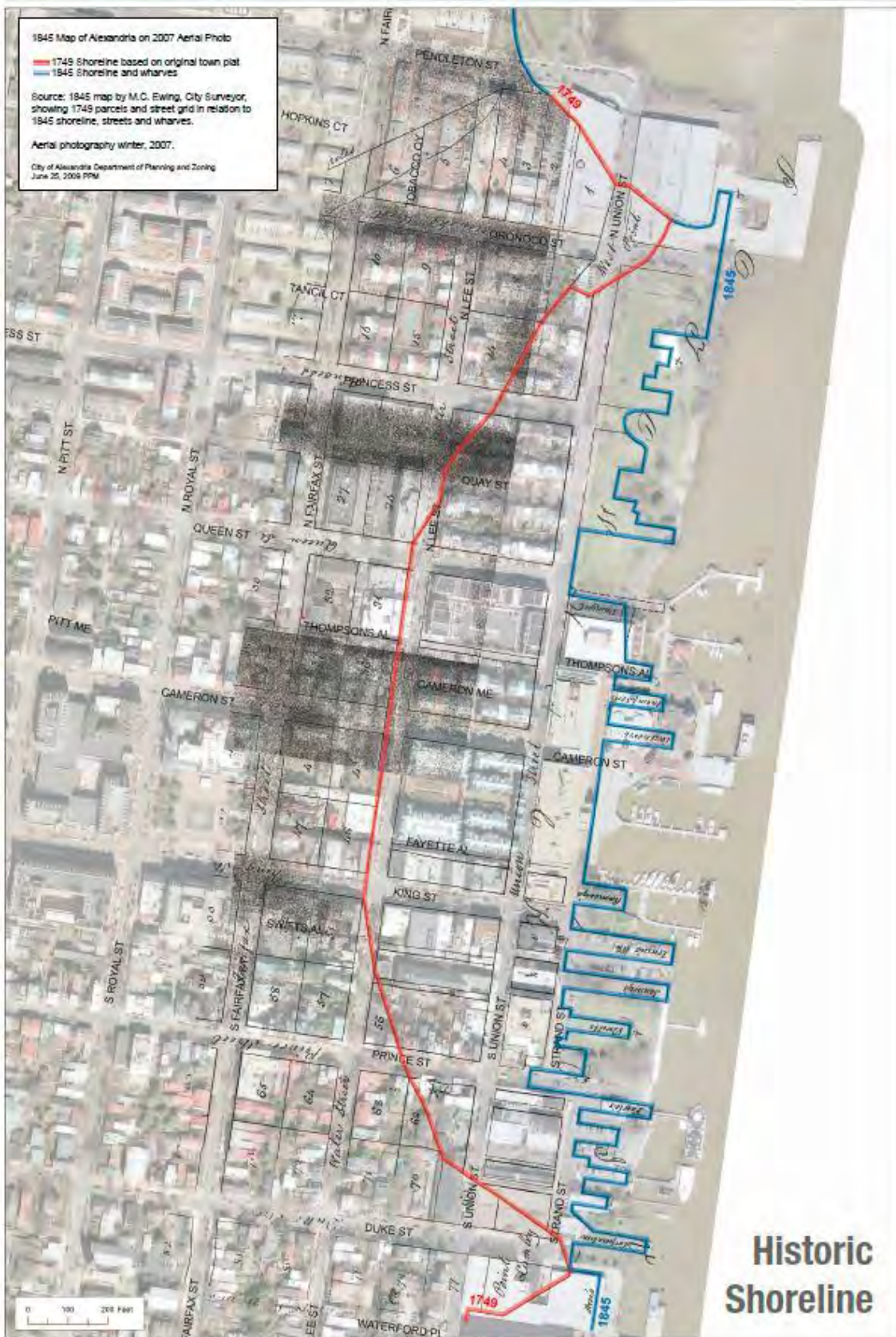


WATERFRONT FLOOD MITIGATION IMPLEMENTATION
 ALEXANDRIA, VIRGINIA

SITE VICINITY
 MAP

PROJECT NO. 16c12012.00

FIGURE 1



SOURCE: CITY OF ALEXANDRIA DEPARTMENT OF PLANING AND ZONING JUNE 25, 2009

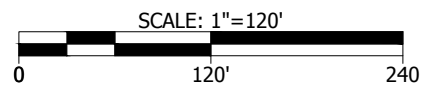
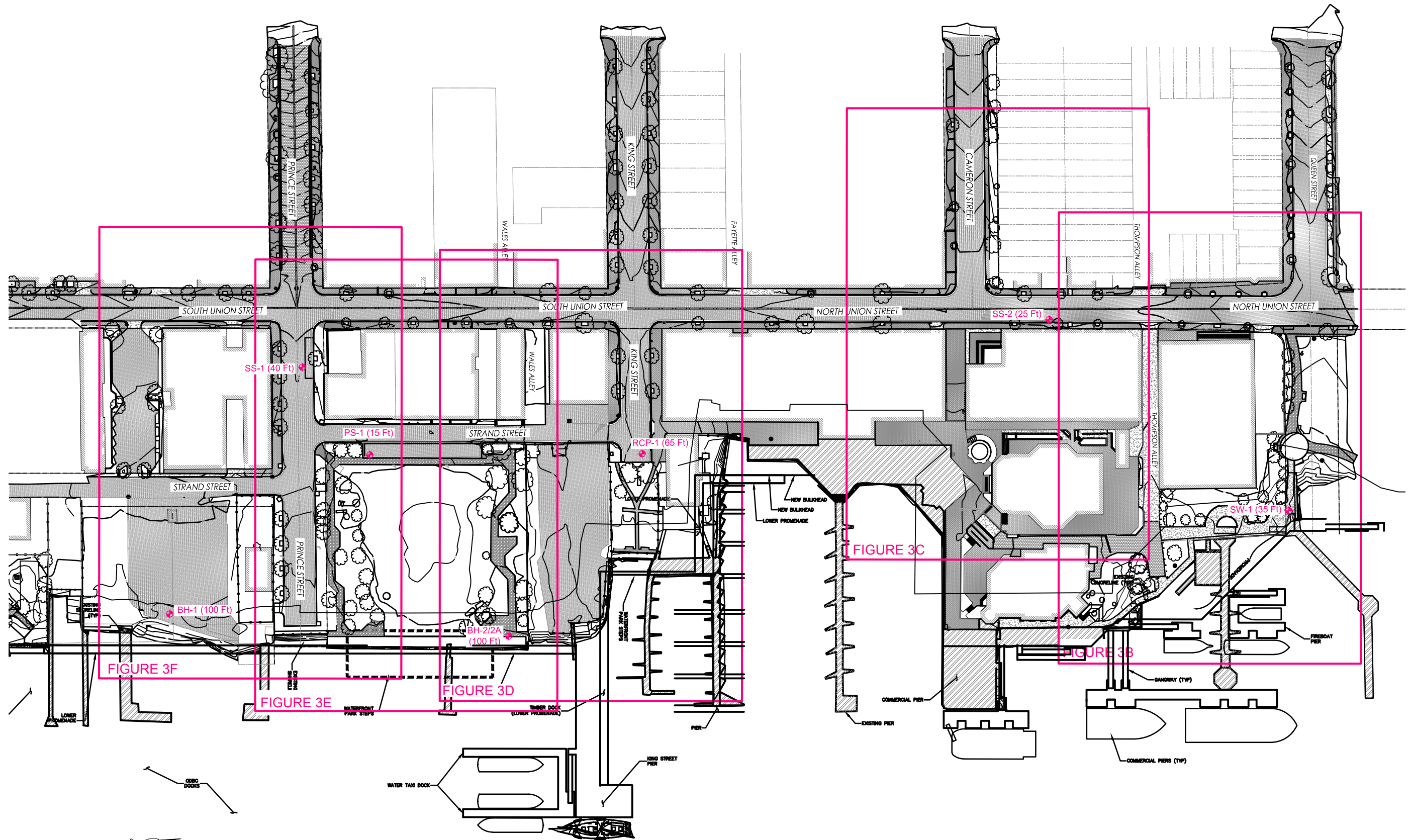
10/3/2016



**WATERFRONT FLOOD MITIGATION
IMPLEMENTATION
ALEXANDRIA, VIRGINIA
PROJECT NO. 16C12012.00**

**ALEXANDRIA HISTORIC
SHORELINE**

FIGURE 2



NOTE
 Drawing adapted from a base plan titled "2029041842-_base_topo.dwg", dated June 6, 2016 and prepared by Stantec.

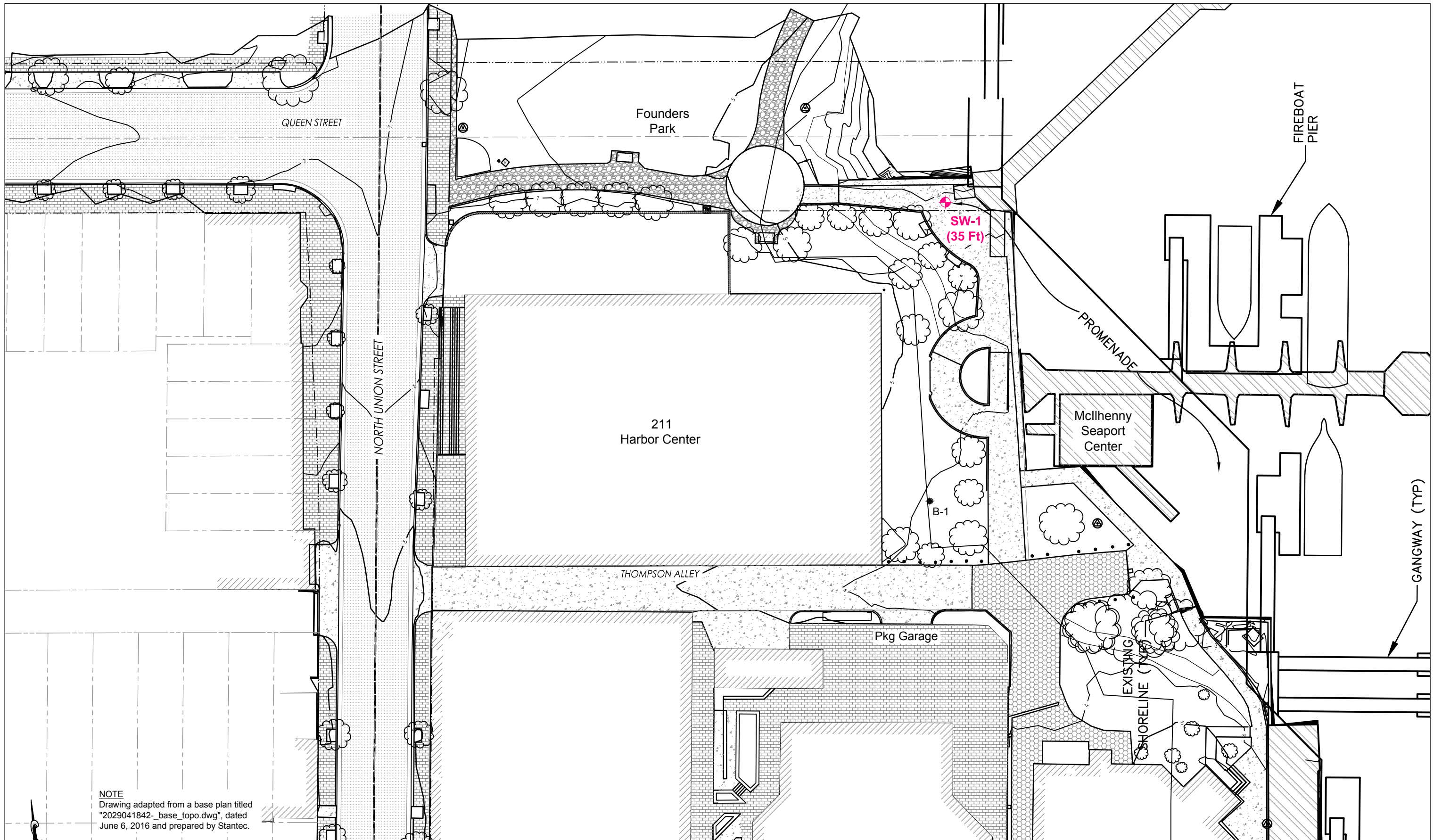
LEGEND
 ◆ As-Drilled Boring Location (Depth Ft)



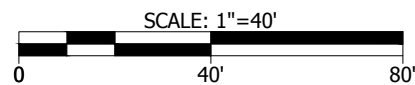
**WATERFRONT FLOOD
 MITIGATION IMPLEMENTATION
 CITY OF ALEXANDRIA, VIRGINIA
 PROJECT NO. 16C12012.00**

**BORING
 LOCATION PLAN**

FIGURE 3A



NOTE
 Drawing adapted from a base plan titled
 "2029041842_base_topo.dwg", dated
 June 6, 2016 and prepared by Stantec.



NOTES

Note 1: Reference Virginia Work Area
 Protection Manual dated January 2015.
 Note 2: 350 ft or maximum available sight
 distance if less than 350 ft.

LEGEND

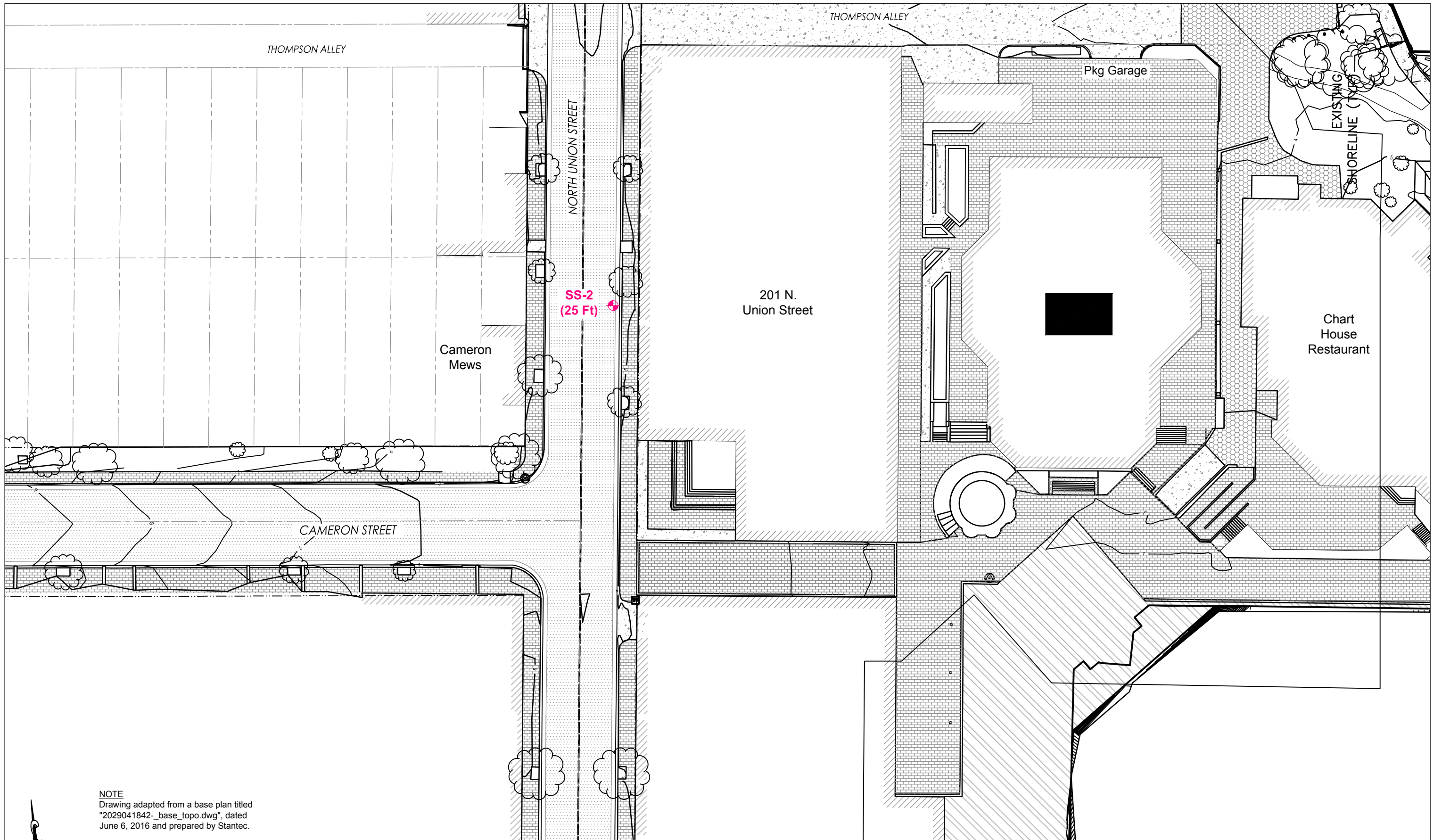
- ◆ As-Drilled Boring Location (Depth Ft)
- ◆ B-1 URS Boring (2014)



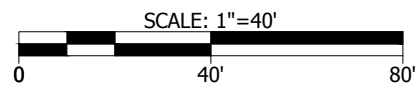
**WATERFRONT FLOOD
 MITIGATION IMPLEMENTATION
 CITY OF ALEXANDRIA, VIRGINIA
 PROJECT NO. 16C12012.00**

**BORING
 LOCATION PLAN**

FIGURE 3B



NOTE
 Drawing adapted from a base plan titled
 "2029041842_base_topo.dwg", dated
 June 6, 2016 and prepared by Stantec.



NOTES

Note 1: Reference Virginia Work Area
 Protection Manual dated January 2015.
 Note 2: 350 ft or maximum available sight
 distance if less than 350 ft.

LEGEND

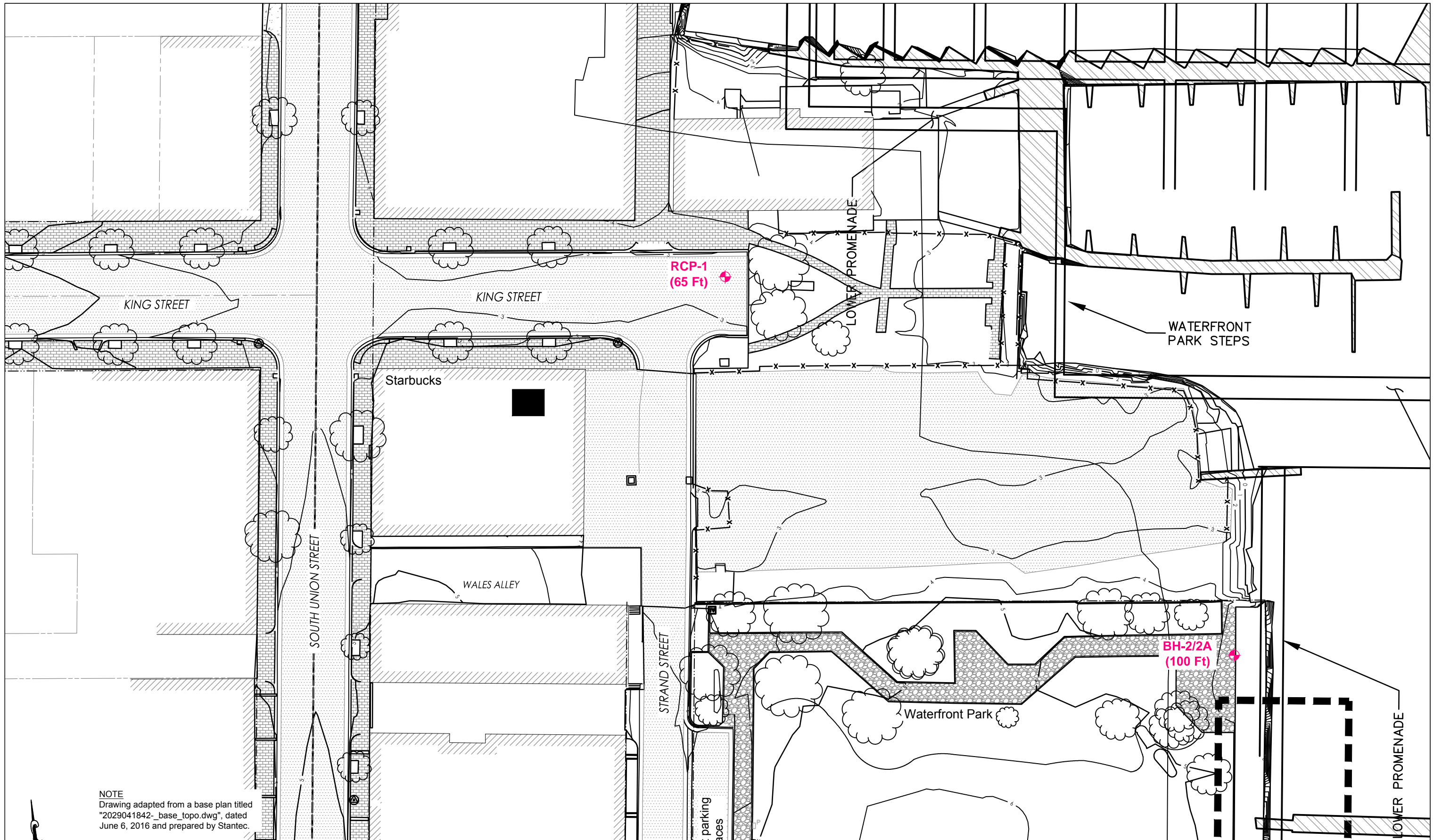
- ◆ As-Drilled Boring Location (Depth Ft)
- ◆ B-1 URS Boring (2014)



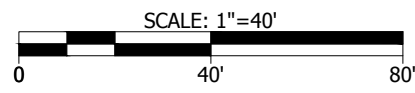
WATERFRONT FLOOD
 MITIGATION IMPLEMENTATION
 CITY OF ALEXANDRIA, VIRGINIA
 PROJECT NO. 16C12012.00

BORING
 LOCATION PLAN

FIGURE 3C



NOTE
 Drawing adapted from a base plan titled
 "2029041842_base_topo.dwg", dated
 June 6, 2016 and prepared by Stantec.



NOTES
 Note 1: Reference Virginia Work Area
 Protection Manual dated January 2015.
 Note 2: 350 ft or maximum available sight
 distance if less than 350 ft.

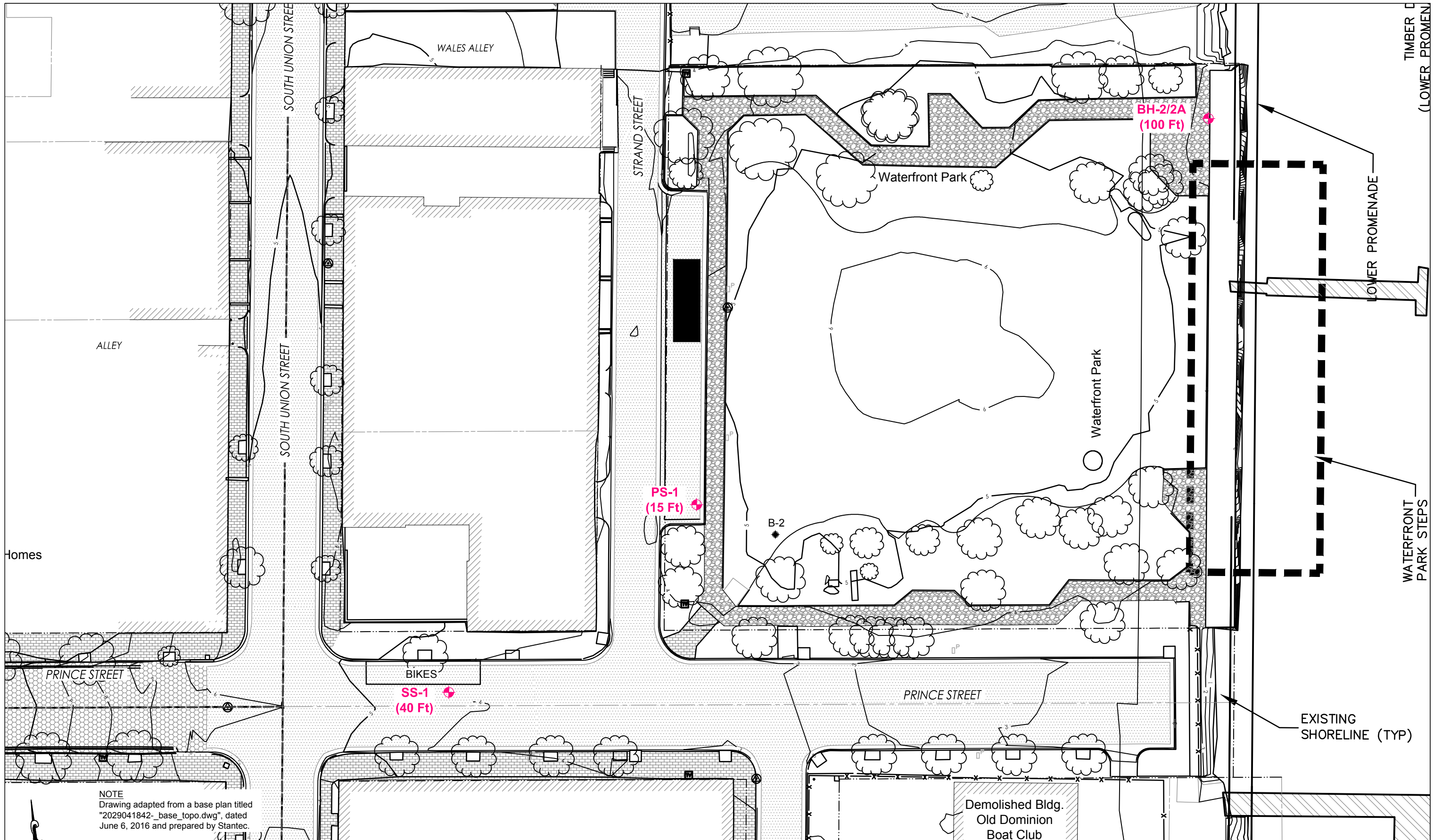
LEGEND
 ◆ As-Drilled Boring Location (Depth Ft)
 ◆ B-1 URS Boring (2014)



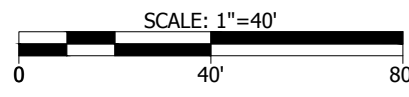
WATERFRONT FLOOD
 MITIGATION IMPLEMENTATION
 CITY OF ALEXANDRIA, VIRGINIA
 PROJECT NO. 16C12012.00

BORING
 LOCATION PLAN

FIGURE 3D



NOTE
 Drawing adapted from a base plan titled
 "2029041842_base_topo.dwg", dated
 June 6, 2016 and prepared by Stantec.



NOTES
 Note 1: Reference Virginia Work Area
 Protection Manual dated January 2015.
 Note 2: 350 ft or maximum available sight
 distance if less than 350 ft.

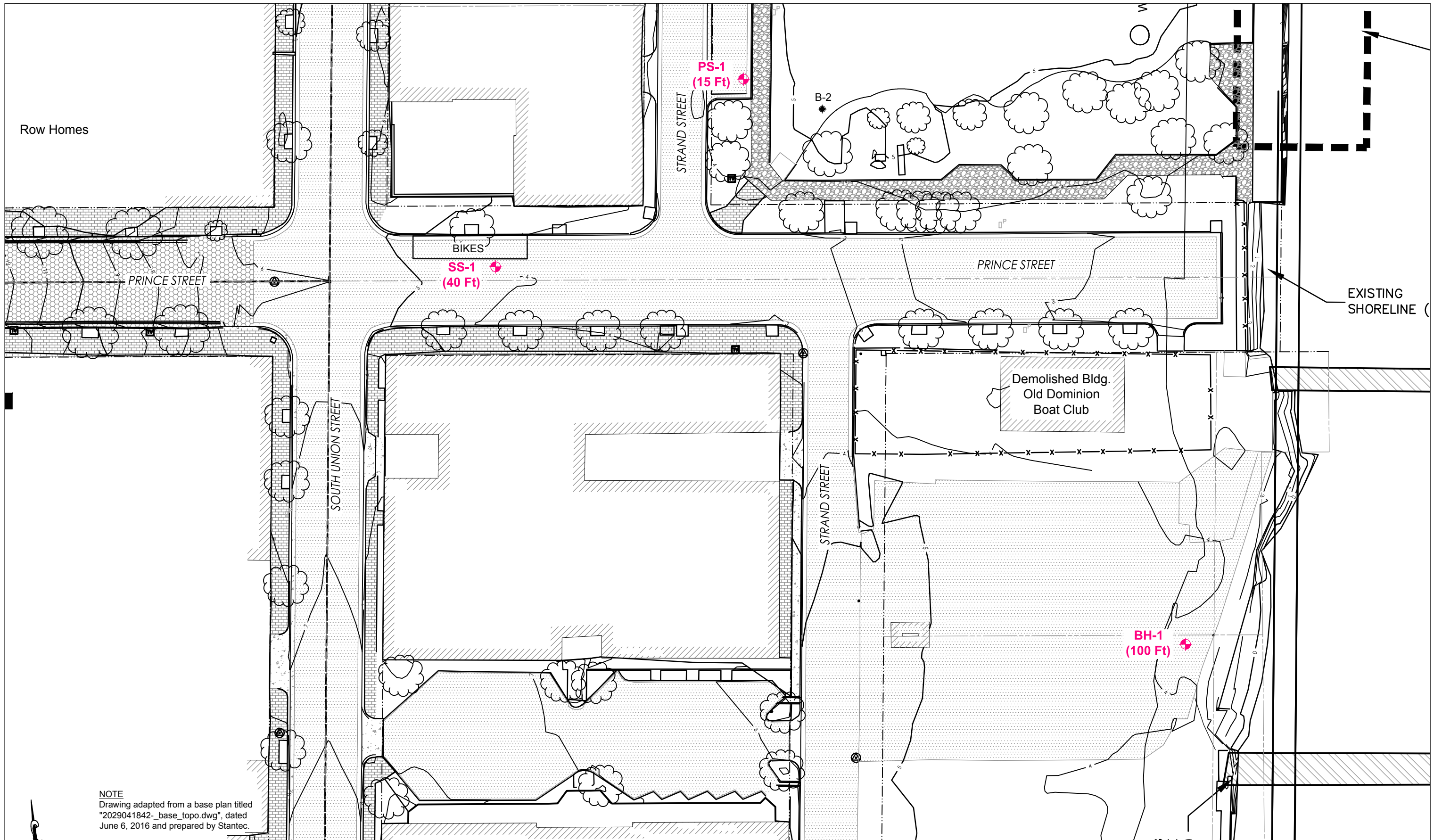
LEGEND
 ◆ As-Drilled Boring Location (Depth Ft)
 ◆ B-1 URS Boring (2014)



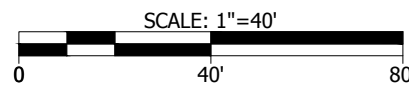
WATERFRONT FLOOD
 MITIGATION IMPLEMENTATION
 CITY OF ALEXANDRIA, VIRGINIA
 PROJECT NO. 16C12012.00

BORING
 LOCATION PLAN

FIGURE 3E



NOTE
 Drawing adapted from a base plan titled
 "2029041842_base_topo.dwg", dated
 June 6, 2016 and prepared by Stantec.



NOTES
 Note 1: Reference Virginia Work Area
 Protection Manual dated January 2015.
 Note 2: 350 ft or maximum available sight
 distance if less than 350 ft.

LEGEND
 ◆ As-Drilled Boring Location (Depth Ft)
 ◆ B-1 URS Boring (2014)



WATERFRONT FLOOD
 MITIGATION IMPLEMENTATION
 CITY OF ALEXANDRIA, VIRGINIA
 PROJECT NO. 16C12012.00

BORING
 LOCATION PLAN

FIGURE 3F

APPENDIX A

SUBSURFACE EXPLORATION DATA

Subsurface Exploration Procedures

General Notes for Subsurface Exploration Logs

Identification of Soil

Boring Logs, BH-1, BH-2, BH-2A, PS-1, RCP-1, SS-1, SS-2, SW-1

SUBSURFACE EXPLORATION PROCEDURES

Test Borings – Hollow Stem Augers

The borings are advanced by turning an auger with a center opening of 3¼ or 4¼ inches. A plug device blocks off the center opening while augers are advanced. Cuttings are brought to the surface by the auger flights. Sampling is performed through the center opening in the hollow stem auger by standard methods after removal of the plug. Usually, no water is introduced into the boring using this procedure.

Test Borings – Mud Rotary

Drillers advanced the borings using mud rotary drilling techniques. The boring is advanced with a drill string consisting of a 3⅞-inch diameter tri-cone roller bit attached to A-sized drilled rods. Drilling fluid such as water or a bentonite clay water slurry is pumped through the drill rods to flush cuttings to the surface. The borehole remains full of drilling fluid to maintain the sides of the borehole. At the designated depth, the drillers removed the drill string and collect a sample using standard methods. When necessary, casing is installed to a depth necessary to prevent caving of the boring sidewalls. Water level data is indicated on the logs.

Standard Penetration Test Results

The Standard Penetration Test (SPT) is performed in the borings at regular depth intervals to collect soil samples. The numbers in the Sampling Data column of the boring logs represent SPT results. Each number represents the blows needed to drive a 2-inch O.D., 1⅝-inch I.D. split-spoon sampler 6 inches, using a 140-pound hammer falling 30 inches. The sampler is typically driven a total of 18 or 24 inches. The first 6 inches are considered a seating interval. The total of the number of blows for the second and third 6-inch intervals is the SPT “N value.” The Standard Penetration Test is performed according to ASTM D1586.

The SPT samples were obtained using a hydraulically driven automatic trip hammer (ATH). Most correlations with SPT data are based on N-values collected with a safety hammer. The energy applied to the split-spoon sampler using the ATH is about 33 percent greater than that applied using the safety hammer, resulting in lower N-values. The hammer blows shown on the boring logs are uncorrected for the higher energy. However, we correct SPT N values for the higher energy when using N values in our analyses.

Soil Classification Criteria

The group symbols on the logs represent the Unified Soil Classification System Group Symbols (ASTM D2487) based on visual observation and limited laboratory testing of the samples. Criteria for visual identification of soil samples are included in this appendix. Some variation can be expected between samples visually classified and samples classified in the laboratory.

Disintegrated rock is defined as residual material with SPT N values between 60 blows per foot and refusal. Refusal is defined as an N value of 50 blows for a penetration of one inch or less.

Partially weathered rock (PWR) is defined as residual material with SPT N values between 100 blows per foot and refusal. Refusal is defined as an N value of 50 blows for a penetration of one inch or less.

Pocket Penetrometer Results

The values following "PP=" in the sampling data column of the logs represent pocket penetrometer readings. Pocket penetrometer readings provide an estimate of the unconfined compressive strength of fine-grained soils.

Boring Locations and Elevations

The surveyed locations and elevations of the as-drilled boring locations were provided to by Stantec. Surveyed boring locations were provided in the Virginia State Plane as shown on Figures 3A through 3F. Ground surface elevations at the boring locations are indicated on the boring logs. Locations and elevations should be considered no more accurate than the methods used to determine them. We understand that the elevations are provided using the NAVD88 vertical datum.

GENERAL NOTES FOR SUBSURFACE EXPLORATION LOGS

1. Numbers in sampling data column next to Standard Penetration Test (SPT) symbols indicate blows required to drive a 2-inch O.D., 1½-inch I.D. sampling spoon 6 inches using a 140 pound hammer falling 30 inches. The Standard Penetration Test (SPT) N value is the number of blows required to drive the sampler 12 inches, after a 6-inch seating interval. The Standard Penetration Test is performed in general accordance with ASTM D1586.
2. Visual classification of soil is in accordance with terminology set forth in "Identification of Soil." The ASTM D2487 group symbols (e.g., CL) shown in the classification column are based on visual observations.
3. Estimated water levels indicated on the logs are only estimates from available data and may vary with precipitation, porosity of the soil, site topography, and other factors.
4. Refusal at the surface of rock, boulder, or other obstruction is defined as an SPT resistance of 50 blows for 1 inch or less of penetration.
5. The logs and related information depict subsurface conditions only at the specific locations and at the particular time when drilled or excavated. Soil conditions at other locations may differ from conditions occurring at these locations. Also, the passage of time may result in a change in the subsurface soil and water level conditions at the subsurface exploration location.
6. The stratification lines represent the approximate boundary between soil and rock types as obtained from the subsurface exploration. Some variation may also be expected vertically between samples taken. The soil profile, water level observations and penetration resistances presented on these logs have been made with reasonable care and accuracy and must be considered only an approximate representation of subsurface conditions to be encountered at the particular location.
7. Key to symbols and abbreviations:



S-1, SPT
5+10+1

Sample No., Standard Penetration Test
Number of blows in each 6-inch increment



SH-1, SH
Rec=24", 100%

Sample No., 2" or 3" Shelby Tube Sample
Recovery in inches, Percent Recovery

LL

Liquid Limit

MC

Moisture Content (percent)

PL

Plastic Limit

PP

Pocket Penetrometer Reading (tsf)

%Passing#200

Percent by weight passing a No. 200 Sieve

IDENTIFICATION OF SOIL

I. DEFINITION OF SOIL GROUP NAMES (ASTM D2487)

SYMBOL GROUP NAME

Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels – More than 50% of coarse fraction retained on No. 4 sieve Coarse, ¾" to 3" Fine, No. 4 to ¾"	Clean Gravels Less than 5% fines	GW	WELL GRADED GRAVEL
			GP	POORLY GRADED GRAVEL
		Gravels with fines More than 12% fines	GM	SILTY GRAVEL
	Sands – 50% or more of coarse Fraction passes No. 4 sieve Coarse, No. 10 to No. 4 Medium, No. 40 to No. 10 Fine, No. 200 to No. 40	Clean Sands Less than 5% fines	SW	WELL GRADED SAND
			SP	POORLY GRADED SAND
		Sands with fines More than 12% fines	SM	SILTY SAND
SC			CLAYEY SAND	
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays – Liquid Limit less than 50 Low to medium plasticity	Inorganic	CL	LEAN CLAY
			ML	SILT
		Organic	OL	ORGANIC CLAY
			ORGANIC SILT	
	Silts and Clays – Liquid Limit 50 or more Medium to high plasticity	Inorganic	CH	FAT CLAY
			MH	ELASTIC SILT
Organic		OH	ORGANIC CLAY	
		ORGANIC SILT		
Highly Organic Soils	Primarily organic matter, dark in color and organic odor		PT	PEAT

II. DEFINITION OF SOIL COMPONENT PROPORTIONS (ASTM D2487)

Examples

Adjective Form	GRAVELLY SANDY	>30% to <50% coarse grained component in a fine-grained soil	GRAVELLY LEAN CLAY
	CLAYEY SILTY	>12% to <50% fine grained component in a coarse-grained soil	SILTY SAND
"With"	WITH GRAVEL WITH SAND	>15% to <30% coarse grained component in a fine-grained soil	FAT CLAY WITH GRAVEL
	WITH GRAVEL WITH SAND	>15% to <50% coarse grained component in a coarse-grained soil	POORLY GRADED GRAVEL WITH SAND
	WITH SILT WITH CLAY	>5% to <12% fine grained component in a coarse-grained soil	POORLY GRADED SAND WITH SILT

III. GLOSSARY OF MISCELLANEOUS TERMS

- SYMBOLS** Unified Soil Classification Symbols are shown above as group symbols. A dual symbol “-” indicates the soil belongs to two groups. A borderline symbol “/” indicates the soil belongs to two possible groups.
- FILL** Man-made deposit containing soil, rock and often foreign matter.
- PROBABLE FILL** Soils which contain no visually detected foreign matter but which are suspect with regard to origin.
- DISINTEGRATED ROCK (DR)** Residual materials with a standard penetration resistance (SPT) between 60 blows per foot and refusal. Refusal is defined as an SPT of 100 blows for 2" or less penetration.
- PARTIALLY WEATHERED ROCK (PWR)** Residual materials with a standard penetration resistance (SPT) between 100 blows per foot and refusal. Refusal is defined as an SPT of 100 blows for 2" or less penetration.
- BOULDERS & COBBLES** Boulders are considered rounded pieces of rock larger than 12 inches, while cobbles range from 3 to 12-inch size.
- LENSES** 0 to ½-inch seam within a material in a test pit.
- LAYERS** ½ to 12-inch seam within a material in a test pit.
- POCKET** Discontinuous body within a material in a test pit.
- MOISTURE CONDITIONS** Wet, moist or dry to indicate visual appearance of specimen.
- COLOR** Overall color, with modifiers such as light to dark or variation in coloration.



Project: Alexandria Waterfront Flood Mitigation

Boring Number: **BH-1**
 Contract Number: 16C12012
 Sheet: 1 of 3

Contractor: Free State Drilling, Inc.
 Frederick, Maryland
 Contractor Foreman: R. Stidham
 Schnabel Representative: J. Spencer
 Equipment: CME-55 (Truck)
 Method: 4-1/4" I.D. Hollow Stem Auger

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ∇	8/16	---	4.0'	4.0'	---
Completion \blacktriangledown	8/17	---	14.0'	60.5'	---

Hammer Type: Auto Hammer (140 lb)
 Dates Started: 8/16/16 Finished: 8/17/16
 North: 0 ft East: 30 ft
 Coordinate System: VA State Plane (N)
 Ground Surface Elevation: 3.5 (ft) Total Depth: 100.0 ft

TEST BORING LOG; P-DRAFT LOGS 2015_02_16.GPJ; D.: L-GINT LIBRARY_2015_02_16 (NCO).GLB; Print: 10/6/16

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.0 - 8.0	FILL, sampled as silty sand with gravel, fine to coarse grained sand; moist, gray, contains wood fragments 2.0 ft: Change: wet, brown and gray, contains root hairs 4.0 ft: Change: gray 6.0 ft: Change: no root hairs	FILL	-4.5	A	5	S-1, SS 7+10+6+5 REC=14", 58% S-2, SS 4+2+2+18 REC=15", 63% S-3, SS 8+3+3+4 REC=14", 58% S-4, SS 9+6+7+7 REC=13", 54%	MC = 15.5% Resistivity = 6100 Ohms-cm Redox = -178 mv pH = 10.67	
8.0 - 10.0	FILL, sampled as sandy lean clay; moist, dark gray, contains gravel, and mica 10.0 ft: Change: contains rock fragments	FILL	-11.5		10	S-5, SS 3+3+3+2 REC=13", 54% S-6, SS 2+1+1/12" REC=10", 42%	PP = 0.00 tsf PP = 0.00 tsf	
15.0 - 18.5	FILL, sampled as silt; moist, gray, contains brick fragments	FILL	-15.0		15	S-7, SS 1+1+1/12" REC=16", 67%	PP = 0.00 tsf	
18.5 - 20.0	SILT; moist, gray	ML		B	20	S-8, SS WOH/12"+1 REC=18", 100%	LL = 44 PI = 16 MC = 52.3% PP = 0.00 tsf	
20.0 - 25.0					25	S-9, SS WOH/18" REC=18", 100%	PP = 0.00 tsf	

(continued)

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS	
					DEPTH	DATA			
28.5	28.5 - 43.5 ft: ELASTIC SILT; moist, gray, contains wood	ML	-25.0	B	30	S-10, SS WOH/18" REC=18", 100%	LL = 50 PI = 20 MC = 54.3% % Passing #200 = 98.6 PP = 0.00 tsf		
		MH			35	S-11, SS WOH/18" REC=18", 100%			MC = 57.2% PP = 0.00 tsf Resistivity = 2400 Ohms-cm Redox = 36 mv pH = 6.37
					40	S-12, SS WOH/18" REC=18", 100%			PP = 0.00 tsf
43.5		43.5 - 48.5 ft: CLAYEY SAND, fine to coarse grained sand; moist, dark gray, contains mica	SC		-40.0	45			S-13, SS WOH+1+1 REC=18", 100%
48.5	48.5 - 53.5 ft: SANDY LEAN CLAY; moist, gray, contains wood fragments, contains mica	CL	-45.0		50	S-14, SS WOH/18" REC=18", 100%	PP = 0.50 tsf		
53.5	53.5 - 58.5 ft: CLAYEY SAND, fine to medium grained sand; moist, gray, probable ALLUVIAL material, contains fine rounded gravel and mica	SC	-50.0		55	S-15, SS WOH/12"+2 REC=18", 100%			
58.5	58.5 - 60.5 ft: CLAYEY SAND, fine to medium grained sand; moist, gray and brown, contains organics	SC	-55.0		60	S-16, SS 3+3+4 REC=15", 83%			
60.5	60.5 - 63.0 ft: ELASTIC SILT; moist, reddish brown, contains, contains approximately 10% sand	MH	-57.0	D		UD-1, SH REC=21", 88%	LL = 59 PI = 28 MC = 32.5% % Passing #200 = 90.5 PP = 2.00 tsf		
63.0	63.0 - 68.5 ft: SANDY LEAN CLAY; moist, gray and reddish brown, contains mica	CL	-59.5			S-17, SS 3+6+7 REC=15", 83%			

(continued)

TEST BORING LOG; P-DRAFT LOGS 2015_02_16.GPJ; D:\GINT LIBRARY_2015_02_16 (NCO).GLB; Print: 10/6/16

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
65		CL						
68.5	68.5 - 73.5 ft: SANDY LEAN CLAY WITH GRAVEL; moist, gray and reddish brown, contains mica	CL	-65.0		70	S-18, SS 2+2+3 REC=18", 100%	MC = 37.7% PP = 2.50 tsf Resistivity = 900 Ohms-cm Redox = 77 mv pH = 5.4	
73.5	73.5 - 83.5 ft: SANDY LEAN CLAY; moist, gray and reddish brown, contains mica	CL	-70.0		75	S-19, SS 5+8+4 REC=18", 100%	PP = 2.50 tsf	
		CL			80	S-20, SS 5+6+11 REC=15", 83%	PP = 4.00 tsf	
83.5	83.5 - 88.5 ft: FAT CLAY; gray and reddish brown, contains mica	CH	-80.0	D	85	S-21, SS 5+10+11 REC=15", 83%	LL = 90 PI = 61 MC = 37.4% % Passing #200 = 96.1 PP = 4.50 tsf	
88.5	88.5 - 100.0 ft: SANDY FAT CLAY; moist, bluish gray and brown, contains mica	CH	-85.0		90	S-22, SS 11+12+14 REC=18", 100%	PP = 4.50 tsf	
		CH			95	S-23, SS 5+9+12 REC=16", 89%	PP = 4.50 tsf	
100.0			-96.5		100	S-24, SS 10+15+20 REC=18", 100%	PP = 4.50 tsf	

Bottom of Boring at 100.0 ft.

Boring terminated at selected depth. Boring backfilled with grout upon completion.

TEST BORING LOG; P-DRAFT LOGS 2015_02_16.GPJ; D.: L-GINT LIBRARY_2015_02_16 (NCO).GLB; Print: 10/6/16



Project: Alexandria Waterfront Flood Mitigation

Boring Number: **BH-2**
 Contract Number: 16C12012
 Sheet: 1 of 1

Contractor: Free State Drilling, Inc.
 Frederick, Maryland
 Contractor Foreman: R. Stidham
 Schnabel Representative: J. Spencer
 Equipment: CME-55 (Truck)
 Method: 4-1/4" I.D. Hollow Stem Auger

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ∇	8/8	---	3.0'	2.0'	---
Completion ∇	8/8	---	10.5'	14.0'	---
After Drilling ∇	8/11	---	2.5'	---	---

Hammer Type: Auto Hammer (140 lb)
 Dates Started: 8/8/16 Finished: 8/8/16

Coordinate System: VA State Plane (N)

Ground Surface Elevation: 3.4 (ft) Total Depth: 15.5 ft

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.0 - 2.0	FILL, sampled as sandy lean clay with gravel; moist, light brown, 3 inch crushed stone walking path	FILL				S-1, SS 3+6+6+5 REC=16", 67%		
2.0	2.0 - 4.0 ft: FILL, sampled as poorly graded sand with gravel; moist, gray	FILL	1.4			S-2, SS 3+5+47 REC=13", 72%	MC = 11.3%	2.0 ft: Wood in tip of the spoon
4.0	4.0 - 6.0 ft: FILL, sampled as poorly graded sand with silt and gravel; moist, gray, wood	FILL	-0.6			S-3, SS 10+16+12+12 REC=20", 83%	MC = 12.4% % Passing #200 = 10.4	
6.0	6.0 - 10.0 ft: FILL, sampled as poorly graded sand with gravel; moist, dark gray	FILL	-2.6	A	5	S-4, SS 4+4+4+7 REC=5", 21%		
						S-5, SS 3+3+21+6 REC=5", 21%		8.0 - 10.0 ft: Wood in spoon
10.0	10.0 - 14.0 ft: FILL, sampled as poorly graded sand; wet, dark gray	FILL	-6.6		10	S-6, SS 6+3+2+2 REC=5", 21%	MC = 23.3%	
14.0	14.0 - 15.5 ft: FILL, sampled as elastic silt with sand; wet, dark gray, contains gravel	FILL	-10.6		15	S-7, SS 1+1+1 REC=5", 250%	LL = 51 PI = 22 MC = 53.0%	
15.5			-12.1					

Bottom of Boring at 15.5 ft.
 Auger refusal at 14.0 ft.
 Boring backfilled with bentonite upon completion.
 Lead auger sheared off in borehole. Top of the auger is approximately 5 ft below ground surface. Auger abandoned in borehole.

TEST BORING LOG; P-DRAFT LOGS 2015_02_16.GPJ; D:\GINT LIBRARY_2015_02_16 (NCO).GLB; Print: 10/16/16



Project: Alexandria Waterfront Flood Mitigation

Boring Number: **BH-2A**
 Contract Number: 16C12012
 Sheet: 1 of 4

Contractor: Free State Drilling, Inc.
 Frederick, Maryland
Contractor Foreman: R. Stidham
Schnabel Representative: J. Spencer
Equipment: CME-55 (Truck)
Method: Mud Rotary

Hammer Type: Auto Hammer (140 lb)
Dates Started: 8/11/16 **Finished:** 8/15/16
North: 0 ft **East:** 240 ft
Coordinate System: VA State Plane (N)
Ground Surface Elevation: 3.4 (ft) **Total Depth:** 100.0 ft

Groundwater Observations						
	Date	Time	Depth	Casing	Caved	
Encountered	8/8	---	3.0'	2.0'	---	
Completion	8/15	10:45 AM	12.0'	60.0'	---	

TEST BORING LOG; P-DRAFT LOGS 2015_02_16.GPJ; D:\GINT LIBRARY_2015_02_16 (NCO).GLB; Print: 10/6/16

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
0.0 - 15.0	Auger probe, refer to BH-2 for material description							0.0 - 15.0 ft: No sample
15.0 - 18.5	FILL, sampled as sandy fat clay; moist, gray, contains wood fragments		-11.6	A	15	S-8, SS WOH/24" REC=8", 33%	MC = 46.1% Resistivity = 1800 Ohms-cm Redox = 33 mv pH = 6.48	
18.5 - 23.5	FILL, sampled as elastic silt; moist, gray, contains wood fragments		-15.1		20	S-9, SS WOH/18" REC=18", 100%	LL = 50 PI = 21 MC = 60.0%	
23.5 - 25.0	contains brick fragments							

(continued)



DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
25.0			-21.6		25	S-10, SS WOH/12"+1 REC=8", 44%	PP = 0.00 tsf	28.5 ft: Empty jar
					30	S-11, SS WOH/18" REC=0", 0%		
	30.5 - 33.0 ft: contains wood fibers	FILL				S-12, SS WOH/18" REC=18", 100%		
33.0	33.0 - 38.5 ft: wet, grayish brown		-29.6	A	35	UD-1, SH Pushed 24 inches REC=23.5", 98%	LL = 54 PI = 23 MC = 57.6% % Passing #200 = 95.7	
	37.0 ft: Change: contains brick					S-13, SS WOH/18" REC=18", 100%		
38.5	38.5 - 43.5 ft: FILL, sampled as lean clay; moist, grayish brown, contains wood fiber and brick	FILL	-35.1		40	S-14, SS WOH/18" REC=12", 67%		
						S-15, SS WOH/18" REC=8", 44%	MC = 60.1%	
43.5	43.5 - 53.5 ft: LEAN CLAY; moist, grayish brown, contains wood fiber		-40.1		45			
	47.0 ft: Change: no wood fiber	CL				S-16, SS WOH/18"+1 REC=16", 67%		
				B	50			
53.5	53.5 - 58.5 ft: SANDY ORGANIC CLAY; moist, grayish brown, contains wood fibers, shells	OH	-50.1		55	S-17, SS WOH+1+2+2 REC=24", 100%	LL = 52 PI = 24 MC = 50.5% % Passing #200 = 52.9 PP = 0.50 tsf	

TEST BORING LOG: P-DRAFT LOGS 2015_02_16.GPJ; D.: L-GINT LIBRARY_2015_02_16 (NCO).GLB; Print: 10/6/16

(continued)



DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
58.5	58.5 - 63.5 ft: LEAN CLAY WITH SAND; moist, grayish brown, contains wood fibers	OH	-55.1	B	60	S-18, SS WOH/18"+1 REC=24", 100%	PP = 0.50 tsf	
		CL						
63.5	63.5 - 68.5 ft: POORLY GRADED SAND WITH CLAY; wet, gray with speckles of black, trace gravel rounds	SP-SC	-60.1	C	65	S-19, SS 4+5+6+9 REC=18", 75%	MC = 20.0% % Passing #200 = 10.3	
68.5	68.5 - 73.5 ft: FAT CLAY; moist, red and gray	CH	-65.1	D	70	S-20, SS 3+5+10 REC=15", 83%	LL = 75 PI = 51 MC = 29.9% % Passing #200 = 90.4 PP = 2.50 tsf	
73.5	73.5 - 83.5 ft: SANDY LEAN CLAY; moist, gray	CL	-70.1	D	75	S-21, SS 7+8+13 REC=12", 67%	MC = 31.5% PP = 3.00 tsf Resistivity = 800 Ohms-cm Redox = 135 mv pH = 4.1	
83.5	83.5 - 100.0 ft: FAT CLAY; moist, gray and red, contains sand	CH	-80.1	D	85	S-23, SS 8+12+16 REC=18", 100%	PP = 4.25 tsf	

TEST BORING LOG; P-DRAFT LOGS 2015_02_16.GPJ; D.: L-GINT LIBRARY_2015_02_16 (NCO).GLB; Print: 10/6/16

(continued)

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
88.5	Change: bluish gray and brown, contains sand, and mica	CH	-96.6	D	90	S-24, SS 8+12+18 REC=18", 100%	LL = 76 PI = 51 MC = 28.7% % Passing #200 = 99.1 PP = 4.00 tsf	
	95				S-25, SS 8+10+12 REC=14", 78%	PP = 4.25 tsf		
100.0					100	S-26, SS 6+12+16 REC=16", 89%	PP = 4.00 tsf	

Bottom of Boring at 100.0 ft.

Borings backfilled with grout upon completion.

1. Boring offset 2 ft south of BH-2 (see BH-2 for samples S-1 to S-7).

2. Boring advanced utilizing tricone roller bit and 4-inch diameter casing. A total of 6 ft of casing installed.



Project: Alexandria Waterfront Flood Mitigation

Boring Number: **PS-1**
 Contract Number: 16C12012
 Sheet: 1 of 1

Contractor: Free State Drilling, Inc.
 Frederick, Maryland
 Contractor Foreman: R. Stidham
 Schnabel Representative: J. Spencer
 Equipment: CME-55 (Truck)
 Method: 3-1/4" I.D. Hollow Stem Auger

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ▽	8/18	---	8.0'	8.0'	---
Completion ▼	8/18	---	8.5'	13.5'	---
Casing Pulled ▼	8/18	---	4.0'	---	8.5'

Hammer Type: Auto Hammer (140 lb)
 Dates Started: 8/18/16 Finished: 8/18/16
 North: 0 ft East: 150 ft
 Coordinate System: VA State Plane (N)
 Ground Surface Elevation: 3.8 (ft) Total Depth: 15.0 ft

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS	
					DEPTH	DATA			
0.4	0.0 - 0.4 ft: FILL, sampled as asphalt; 4 inches of asphalt	FILL	3.4	A	5	S-1, SS 19+25+7 REC=15", 83%	MC = 9.1% Resistivity = 4200 Ohms-cm Redox = -243 mv pH = 12.03		
2.0	0.4 - 2.0 ft: FILL, sampled as silty sand with gravel, medium to coarse grained sand; moist, gray	FILL	1.8			S-2, SS 8+9+10+4 REC=14", 58%			
4.0	2.0 - 4.0 ft: FILL, sampled as clayey sand with gravel, fine to coarse grained sand; moist, gray, contains concrete fragments	FILL	-0.2			S-3, SS 1+1+4+3 REC=8", 33%			
6.0	4.0 - 6.0 ft: FILL, sampled as sandy fat clay; moist, black and red, contains brick fragments	FILL	-2.2			S-4, SS 6+4+6+5 REC=7", 29%			
8.0	6.0 - 8.0 ft: FILL, sampled as clayey sand, fine to coarse grained sand; gray and light brown, contains brick fragments, fine gravel, chemical odor	FILL	-4.2			S-5, SS 1+1+1+1 REC=24", 100%			LL = 28 PI = 10 MC = 23.1% % Passing #200 = 71.5 PP = 0.00 tsf
10.0	8.0 - 10.0 ft: FILL, sampled as lean clay with sand; moist, light gray, contains gravel	FILL	-6.2			S-6, SS 3+9+5+9 REC=24", 100%			
13.5	10.0 - 13.5 ft: FILL, sampled as poorly graded gravel with clay and sand; wet, gray, fine to coarse gravel	FILL	-9.7			S-7, SS 1+1+1 REC=18", 100%			MC = 24.2% % Passing #200 = 2.0
15.0	13.5 - 15.0 ft: FILL, sampled as poorly graded sand, fine to coarse grained sand; wet, gray, contains shell fragments, gravel, chemical odor	FILL	-11.2	15					

Bottom of Boring at 15.0 ft.
 Boring terminated at selected depth. Boring backfilled with grout upon completion.

TEST BORING LOG; P-DRAFT LOGS 2015_02_16.GPJ; D: L-GINT LIBRARY; 2015_02_16 (NCO).GLB; Print: 10/16/16



Project: Alexandria Waterfront Flood Mitigation

Boring Number: **RCP-1**
 Contract Number: 16C12012
 Sheet: 1 of 3

Contractor: Free State Drilling, Inc.
 Frederick, Maryland

Contractor Foreman: R. Stidham

Schnabel Representative: J. Smith

Equipment: CME-55 (Truck)

Method: Mud Rotary

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/19/16 Finished: 8/19/16

North: 0 ft East: 330 ft

Coordinate System: VA State Plane (N)

Ground Surface Elevation: 3.9 (ft) Total Depth: 65.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ∇	8/19	---	9.0'	15.0'	---
Completion ∇	8/19	---	7.5'	25.0'	---

TEST BORING LOG; P-DRAFT LOGS 2015_02_16.GPJ; D-L:GINT LIBRARY_2015_02_16 (NCO).GLB; Print: 10/16/16

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.5	0.0 - 0.5 ft: FILL, sampled as asphalt; 5 inches of asphalt	FILL	3.4			S-1, SS 7+2+27 REC=8", 44%		2.0 ft: Possible concrete or cobble stopping split spoon
0.5 - 4.0	0.5 - 4.0 ft: FILL, sampled as silty sand with gravel, fine to medium grained sand; moist, dark gray	FILL				S-2, SS 50/0" REC=0", 0%		
4.0	4.0 - 6.0 ft: FILL, sampled as sandy lean clay; moist, dark gray, contains gravel, contains organics	FILL	-0.1		5	S-3, SS 4+1+1+1 REC=6", 25%		
6.0	6.0 - 8.0 ft: FILL, sampled as clayey sand with gravel; wet, black, contains brick fragments	FILL	-2.1			S-4, SS 1/12"+1/12" REC=4", 17%	MC = 21.2%	
8.0	8.0 - 10.0 ft: FILL, sampled as clayey sand with gravel; wet, black, contains brick fragments, contains metal, wood, and ceramic fragments	FILL	-4.1	A		S-5, SS 1/12"+1+2 REC=12", 50%	MC = 44.8%	
10.0	10.0 - 18.5 ft: FILL, sampled as silty sand, fine to medium grained sand; moist, black, contains wood, brick fragments, mica	FILL	-6.1		10	S-6, SS 1+1+1+1 REC=15", 63%		
					15	S-7, SS 2+8+8 REC=8", 44%	MC = 94.3% % Passing #200 = 25.3	
18.5	18.5 - 33.5 ft: ELASTIC SILT; moist, dark gray, contains wood	MH	-14.6	B	20	S-8, SS WOH/12"+1 REC=18", 100%	MC = 69.7% PP = 0.75 tsf Resistivity = 2000 Ohms-cm Redox = 38 mv pH = 6.38	
	23.5 ft: Change: contains wood, contains mica				25	S-9, SS WOH/12"+1 REC=18", 100%	PP = 0.00 tsf	

(continued)

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
		MH			30	S-10, SS WOH/18" REC=8", 44%	PP = 0.00 tsf	
33.5	33.5 - 43.5 ft: FAT CLAY; moist, dark gray, contains wood and mica	CH	-29.6	B	35	S-11, SS WOR/18" REC=18", 100%	LL = 55 PI = 26 MC = 69.5% % Passing #200 = 92.6 PP = 0.00 tsf	
					40	S-12, SS WOH/18" REC=18", 100%	PP = 0.00 tsf	
43.5	43.5 - 48.5 ft: LEAN CLAY; moist, gray, contains mica	CL	-39.6		45	S-13, SS WOR/18" REC=18", 100%	PP = 0.00 tsf	
48.5	48.5 - 53.5 ft: POORLY GRADED SAND; moist, gray, probable ALLUVIAL material, contains very fine gravel and mica	SP	-44.6		50	S-14, SS 3+5+5 REC=12", 67%		
53.5	53.5 - 58.5 ft: SILTY SAND, fine to coarse grained sand; wet, gray, probable ALLUVIAL material	SM	-49.6	C	55	S-15, SS WOH/18" REC=18", 100%	MC = 20.0% % Passing #200 = 33.3	
58.5	58.5 - 63.5 ft: SANDY SILT; wet, gray, probable ALLUVIAL material, contains fine gravel and mica	ML	-54.6		60	S-16, SS 2+4+1 REC=18", 100%	LL = 20 PI = 3 MC = 23.5% PP = 0.50 tsf	

TEST BORING LOG; P-DRAFT LOGS 2015_02_16.GPJ; D.: L-GINT LIBRARY_2015_02_16 (NCO).GLB; Print: 10/6/16

(continued)



Schnabel TEST BORING LOG
ENGINEERING

Project: Alexandria Waterfront Flood Mitigation

Boring Number: **RCP-1**

Contract Number: 16C12012

Sheet: 3 of 3

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
63.5	63.5 - 65.0 ft: SILTY SAND, fine to coarse grained sand; wet, gray, contains mica, probable ALLUVIAL material	SM	-59.6	C	65	S-17, SS 3+3+3 REC=18", 100%	MC = 20.3% % Passing #200 = 33.8 PP = 0.50 tsf	
65.0			-61.1					

Bottom of Boring at 65.0 ft.
Boring terminated at selected depth. Boring backfilled with grout upon completion.



Project: Alexandria Waterfront Flood Mitigation

Boring Number: **SS-1**
 Contract Number: 16C12012
 Sheet: 1 of 2

Contractor: Free State Drilling, Inc.
 Frederick, Maryland
 Contractor Foreman: R. Stidham
 Schnabel Representative: J. Smith
 Equipment: CME-55 (Truck)
 Method: 3-1/4" I.D. Hollow Stem Auger

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ▽	8/22	---	6.5'	4.5'	---
Completion ▼	8/22	---	25.5'	38.5'	---
Casing Pulled ▼	8/22	---	8.5'	---	31.0'

Hammer Type: Auto Hammer (140 lb)
 Dates Started: 8/22/16 Finished: 8/22/16

Coordinate System: VA State Plane (N)
 Ground Surface Elevation: 4.1 (ft) Total Depth: 40.0 ft

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS	
					DEPTH	DATA			
1.0	0.0 - 1.0 ft: FILL, sampled as asphalt; 10 inches of asphalt	FILL	3.1	A		S-1, SS 5+7+6 REC=6", 33%	MC = 30.1% PP = 0.00 tsf		
2.5	1.0 - 2.5 ft: FILL, sampled as poorly graded sand with gravel, fine to medium grained sand; moist, brown	FILL	1.6			S-2, SS 1+7+7+5 REC=12", 50%			
4.5	2.5 - 4.5 ft: FILL, sampled as clayey sand with gravel, fine to medium grained sand; moist, black and gray	FILL	-0.5		5	S-3, SS 1+2+2+4 REC=16", 67%			
	4.5 - 8.5 ft: FILL, sampled as clayey sand, fine to coarse grained sand; wet, dark gray, contains gravel, shells, brick fragments	FILL				S-4, SS 3+1+1+1 REC=3", 13%			
8.5	6.5 ft: Change: SANDY LEAN CLAY, fine to coarse grained sand; wet, dark gray, contains gravel, shells, brick fragments	FILL	-4.5			S-5, SS 1/12"+1/12" REC=18", 75%			
10.5	8.5 - 10.5 ft: FILL, sampled as sandy lean clay, fine to medium grained sand; wet, gray, contains shells	FILL	-6.5		10	S-6, SS WOH+2/18" REC=24", 100%			MC = 47.4% PP = 0.00 tsf
13.5	10.5 - 13.5 ft: FILL, sampled as sandy lean clay; wet, gray, contains shells, wood fragments, glass	FILL	-9.5			S-7, SS 1+1+1 REC=16", 89%			MC = 55.9% PP = 0.50 tsf Resistivity = 2500 Ohms-cm Redox = 27 mv pH = 6.58
	13.5 - 23.5 ft: FILL, sampled as lean clay; moist, gray, fine grained sand, contains mica, wood	FILL			15	S-8, SS 2/18" REC=18", 100%			PP = 0.00 tsf
23.5	18.5 ft: Change: wet	FILL			20	S-9, SS WOH/18" REC=18", 100%			PP = 0.25 tsf
	23.5 - 28.5 ft: FILL, sampled as sandy lean clay; moist, gray, contains mica, wood fragments, metal	FILL	-19.5						

TEST BORING LOG: P-DRAFT LOGS 2015_02_16.GPJ; D.: L-GINT LIBRARY_2015_02_16 (NCO).GLB; Print: 10/16/16

(continued)



DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
		FILL		A				
28.5	28.5 - 33.5 ft: ORGANIC CLAY; moist, dark gray, contains mica, wood fragments	OH	-24.5		30	S-10, SS WOH/18" REC=18", 100%	LL = 74 PI = 42 MC = 59.7% PP = 0.00 tsf	
33.5	33.5 - 40.0 ft: CLAYEY SAND, fine to medium grained sand; moist, gray, contains mica, probable ALLUVIAL material, wood fibers	SC	-29.5	B	35	S-11, SS WOH+2+2 REC=18", 100%		
40.0	38.5 ft: Change: dark gray, contains mica		-36.0		40	S-12, SS 1+1+2 REC=18", 100%	MC = 24.6% % Passing #200 = 41.4	

Bottom of Boring at 40.0 ft.
Boring terminated at selected depth. Boring backfilled with grout upon completion.



Project: Alexandria Waterfront Flood Mitigation

Boring Number: **SS-2**
 Contract Number: 16C12012
 Sheet: 1 of 1

Contractor: Free State Drilling, Inc.
 Frederick, Maryland
 Contractor Foreman: R. Stidham
 Schnabel Representative: J. Spencer
 Equipment: CME-55 (Truck)
 Method: 3-1/4" I.D. Hollow Stem Auger

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ▽	8/18	10:44 AM	Dry	23.5'	---
Completion ▼	8/18	---	Dry	23.5'	---
Casing Pulled ▼	8/18	---	13.5'	---	14.0'

Hammer Type: Auto Hammer (140 lb)
 Dates Started: 8/18/16 Finished: 8/18/16

Coordinate System: VA State Plane (N)
 Ground Surface Elevation: 4.4 (ft) Total Depth: 25.0 ft

TEST BORING LOG; P-DRAFT LOGS 2015_02_16.GPJ; D: L-GINT LIBRARY_2015_02_16 (NCO).GLB; Print: 10/6/16

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.5	0.0 - 0.5 ft: FILL, sampled as asphalt; 5 inches of asphalt	FILL	3.9			S-1, SS 6+23+14 REC=15", 83%		
2.0	0.5 - 2.0 ft: FILL, sampled as well graded gravel with sand; moist, light gray, fine to coarse gravel, contains wood fragments	FILL	2.4			S-2, SS 5+10+8+6 REC=18", 75%		
	2.0 - 6.0 ft: FILL, sampled as clayey sand, fine to medium grained sand; moist, dark gray, contains gravel, brick fragments	FILL			5	S-3, SS 4+8+7+6 REC=21", 88%	MC = 16.5% % Passing #200 = 49.8	
6.0	4.0 ft: Change: gray							
	6.0 - 13.5 ft: FILL, sampled as lean clay with sand; moist, light gray	FILL	-1.6	A		S-4, SS 4+6+5+5 REC=20", 83%	MC = 21.7% Resistivity = 1900 Ohms-cm Redox = -2 mv pH = 7.14	
	8.0 ft: Change: gray brown, contains fine gravel				10	S-5, SS 2+1+1+1 REC=22", 92%		
	10.0 ft: Change: no gravel					S-6, SS 1+1+1+2 REC=14", 58%	LL = 26 PI = 8 MC = 21.1% % Passing #200 = 77.7 PP = 2.50 tsf	
13.5	13.5 - 18.5 ft: FAT CLAY; moist, gray, contains mica	CH	-9.1		15	S-7, SS 1/12"+1 REC=18", 100%	PP = 0.50 tsf	
18.5	18.5 - 25.0 ft: SANDY FAT CLAY; dark gray, very fine gravel, contains wood fiber	CH	-14.1	B	20	S-8, SS WOH/12"+1 REC=18", 100%	MC = 55.8% PP = 0.00 tsf	
25.0			-20.6		25	S-9, SS WOH/12"+1 REC=18", 100%	PP = 0.50 tsf	

Bottom of Boring at 25.0 ft.
 Boring terminated at selected depth. Boring backfilled with grout upon completion.



Project: Alexandria Waterfront Flood Mitigation

Boring Number: **SW-1**
 Contract Number: 16C12012
 Sheet: 1 of 2

Contractor: Free State Drilling, Inc.
 Frederick, Maryland

Contractor Foreman: R. Stidham

Schnabel Representative: J. Smith

Equipment: CME-55 (Truck)

Method: Mud Rotary

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/22/16 Finished: 8/22/16

North: 0 ft East: 732 ft

Coordinate System: VA State Plane (N)

Ground Surface Elevation: 4.1 (ft) Total Depth: 35.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ∇	8/22	---	6.0'	6.0'	---
Completion ∇	8/22	---	5.0'	25.0'	---

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.5	0.0 - 0.5 ft: FILL, sampled as concrete; 4 inches concrete	FILL	3.6	A		S-1, SS 11+14+20 REC=5", 28%		
2.0	0.5 - 2.0 ft: FILL, sampled as silty sand with gravel, fine to medium grained sand; moist, tan gray, contains wood fragments, contains quartz fragments	FILL	2.1			S-2, SS 5+2+2+2 REC=8", 33%		
4.0	2.0 - 4.0 ft: FILL, sampled as clayey gravel with sand; wet, black, fine gravel	FILL	0.1			S-3, SS 2+2+1+2 REC=6", 25%		
6.0	4.0 - 6.0 ft: FILL, sampled as clayey gravel with sand, fine to coarse grained sand; black, contains gravel, organic odor	FILL	-1.9			S-4, SS 2+17+5+1 REC=8", 33%		
8.0	6.0 - 8.0 ft: FILL, sampled as sandy clay; wet, gray, contains wood, (sampled through a tree root)	FILL	-3.9			S-5, SS 1/24" REC=13", 54%	MC = 72.6% PP = 0.00 tsf	
10.0	8.0 - 10.0 ft: FILL, sampled as elastic silt with sand; wet, gray, chemical odor	FILL	-5.9			S-6, SS WOR/24" REC=24", 100%	LL = 48 PI = 20 MC = 53.1% % Passing #200 = 89.3	
	10.0 - 18.5 ft: SILT; moist, gray, contains sand and gravel	ML		B		S-7, SS 1/18" REC=0", 0%		13.5 - 18.5 ft: No recovery
18.5	18.5 - 33.5 ft: ELASTIC SILT; moist, gray, contains wood fibers	MH	-14.4			S-8, SS WOR/18" REC=18", 100%	LL = 52 PI = 22 MC = 59.1% PP = 0.00 tsf	
						S-9, SS WOR/18" REC=18", 100%	PP = 0.00 tsf	

TEST BORING LOG; P-DRAFT LOGS 2015_02_16.GPJ; D-L:GINT LIBRARY_2015_02_16 (NCO).GLB; Print:10/16/16

(continued)

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
		MH		B	30	S-10, SS WOR/18" REC=18", 100%	MC = 57.9% PP = 0.00 tsf Resistivity = 2400 Ohms-cm Redox = 35 mv pH = 6.25	
33.5	33.5 - 35.0 ft: SANDY ELASTIC SILT; moist, gray, contains wood fibers	MH	-29.4			S-11, SS WOH/12"+1 REC=18", 100%	PP = 0.25 tsf	
35.0			-30.9		35			

Bottom of Boring at 35.0 ft.
 Boring terminated at selected depth. Boring backfilled with grout upon completion.

APPENDIX B

SUBSURFACE EXPLORATION DATA BY OTHERS



Log of Boring B-1

PROJECT: **Waterfront Small Area**

PROJECT LOCATION: **Alexandria, VA** COORD. SYS./DATUM: /

PROJECT NUMBER: **15303359** COORDINATES: **N E**

DATE STARTED: **4/14/2014**
 DATE COMPLETED: **4/16/2014**
 LOGGED BY: **M Gravina**
 CHECKED BY:
 DRILLING CONTRACTOR: **Connelly & Asso**
 DRILL RIG: **T-2 Track Rig**
 DRILLER: **Zac**

DRILL METHOD: **3-1/4" I.D. Hollow Stem Auger**
 HAMMER TYPE/WEIGHT: **Auto Hammer/140lbs**
 CASING TYPE: **HSA**
 CASING SIZE: **3-1/4"**
 BIT TYPE/SIZE: **NA/NA**
 BOREHOLE DEPTH: **70.0 FT**
 SURFACE ELEVATION: **4 FT +/-**

Groundwater Observations

	Date	Time	Depth (ft)	Cave in Depth (ft)
Encountered ∇	04-16-2014		8.5	
Completion ∇	04-16-2014		4.9	17.5

DEPTH (FT)	ELEV. (FT)	DESCRIPTION	USCS GRAPHIC LOG	SAMPLES			WELL	MOISTURE CONTENT		Pocket Pen. (tsf)	Torvane (tsf)	REMARKS AND TESTS
				NUMBER	TYPE	BLOWS		REC (IN.) (%)	ATTERBERG			
0		5 inches of top soil		S-1	X	1-17-15	16" (89%)					
5		Moist, very loose to medium dense, dark brown and black, nonplastic, SILTY SAND WITH GRAVEL AND CONCRETE FRAGMENTS (FILL),		S-2	X	4-6-6	14" (78%)					
		Strong petroleum odor between 2.5 feet and 13.5 feet.		S-3	X	7-5-5	9" (50%)					
				S-4	X	2-1-1	9" (50%)					
				S-5	X	1-2-4	5" (28%)					
				S-6	X	1-1-3	8" (44%)					
		Wet, very soft, dark brown, medium plasticity, LEAN CLAY WITH SAND	CL									
				S-7	X	13-25-20	16" (89%)					
		Wet, medium dense, dark gray, nonplastic, SILTY GRAVEL WITH SAND,										
		with wood (possible wood log) between 23.5 feet and 28.5.										
		Auger refused at 23 feet. Boring was off set 6 feet south.	GM	S-8	X	21-7-5	14" (78%)					
				S-9	X	11-4-3	6" (33%)					
		Moist, very soft to medium stiff, dark gray, low plasticity, SANDY SILT WITH GRAVEL	ML									
				S-10	X	1-WOH-2	18"					

25.0': High blow counts are likely due to testing on wood/wood log

URS TEMPLATE SOIL-ROCK 2-10-12 WATERFRONT SMALL AREA BORINGS.GPJ MHNC LOGS.GPJ 5/13/14 REV-0

URS CORPORATION
 12420 Milestone Center Drive, Suite 150
 Germantown, MD 20876
 Phone: 301.820.3000 Fax: 301.820.3009

B = Bulk Sample S = Split Spoon Sample D = Denison Sample
 G = Geoprobe T = Shelby Tube Sample RC = Rock Core
 PS = Piston Sample P = Pitcher Sample SC = Sonic Core



Log of Boring B-1

PROJECT: **Waterfront Small Area**
 PROJECT LOCATION: **Alexandria, VA**
 PROJECT NUMBER: **15303359**

DEPTH (FT)	ELEV. (FT)	DESCRIPTION	USCS GRAPHIC LOG	SAMPLES			WELL	MOISTURE CONTENT			Pocket Pen. (tsf)	Tonvane (tsf)	REMARKS AND TESTS
				NUMBER	TYPE	BLOWS		REC (IN.) (%)	ATTERBERG				
		Moist, very soft to medium stiff, dark gray, low plasticity, SANDY SILT WITH GRAVEL (continued)	ML										
45	-40			S-11	WOH-WOH-2	0" (NR)							
50	-45			S-12	WOH-WOH-3	18" (100%)							
55	-50			S-13		3-2-3	13" (72%)						
60	-55			S-14		2-2-2	18" (100%)						
65	-60	Moist, medium dense to dense, dark gray and brown, medium plasticity, CLAYEY SAND, (Potomac Soils)	SC	S-15		13-19-20	18" (100%)						
70	-65			S-16		5-8-10	12" (67%)						
BORING AT 70.0 FT ON 4/16/2041 AT 9:30 AM HOURS.													

URS TEMPLATE SOIL-ROCK 2-10-12 WATERFRONT SMALL AREA BORINGS.GPJ MHNC LOGS.GPJ 5/13/14 REV-0



Log of Boring B-2

PROJECT: **Waterfront Small Area**

PROJECT LOCATION: **Alexandria, VA** COORD. SYS./DATUM: /

PROJECT NUMBER: **15303359** COORDINATES: **N E**

DATE STARTED: **4/16/2014**
 DATE COMPLETED: **4/16/2014**
 LOGGED BY: **M Gravina**
 CHECKED BY:
 DRILLING CONTRACTOR: **Connelly & Asso**
 DRILL RIG: **T-2 Track Rig**
 DRILLER: **Ian**

DRILL METHOD: **3-1/4" I.D. Hollow Stem Auger**
 HAMMER TYPE/WEIGHT: **Auto Hammer/140lbs**
 CASING TYPE: **HSA**
 CASING SIZE: **3-1/4"**
 BIT TYPE/SIZE: **NA/NA**
 BOREHOLE DEPTH: **70.0 FT**
 SURFACE ELEVATION: **5 FT +/-**

Groundwater Observations

	Date	Time	Depth (ft)	Cave in Depth (ft)
Encountered ∇	04-14-2013		5.0	
Completion ∇	04-14-2014		4.5	7.2
After Drilling ∇	04-16-2014		3.9	6.3

DEPTH (FT)	ELEV. (FT)	DESCRIPTION	USCS GRAPHIC LOG	SAMPLES			WELL	MOISTURE CONTENT		Pocket Pen. (tsf)	Torvane (tsf)	REMARKS AND TESTS
				NUMBER	TYPE	BLOWS		REC (IN.) (%)	ATTERBERG			
5	0	5 inches of top soil Wet, very loose to medium dense, dark brown and black, low plasticity, CLAYEY SAND WITH GRAVEL AND CONCRETE FRAGMENTS (FILL), Strong petroleum odor between 2.5 feet and 13.5 feet.	[Cross-hatched pattern]	S-1	X	3-4-12	16" (89%)					4.0': Concrete at 4 feet. Auger refusal. Boring was offset 5 feet east.
				S-2	X	6-30-50/1"	10" (77%)					
				S-3	X	4-4-28	8" (44%)					
				S-4	X	4-3-1	14" (78%)					
15	-10	Moist, very soft, dark brown, medium plasticity, SILT WITH GRAVEL AND ORGANICS	ML	S-5	X	2-2-1	18" (100%)	△				
20	-15			S-6	X	2-1-1	18" (100%)		○			
25	-20	Moist, very soft, dark gray, high plasticity, ELASTIC SILT	MH	S-7	X	WOH-WOH-2	18" (100%)	△	○	□		
30	-25			S-8	X	2-2-1	16" (89%)		○			
35	-30			S-9	X	WOH-WOH-WOH	18" (100%)		○			
40	-35			S-10	X	WOH-WOH-WOH	18" (100%)		○			

URS TEMPLATE SOIL-ROCK 2-10-12 WATERFRONT SMALL AREA BORINGS.GPJ MHNC LOGS.GPJ 5/13/14 REV-0

URS CORPORATION
 12420 Milestone Center Drive, Suite 150
 Germantown, MD 20876
 Phone: 301.820.3000 Fax: 301.820.3009

B = Bulk Sample S = Split Spoon Sample D = Denison Sample
 G = Geoprobe T = Shelby Tube Sample RC = Rock Core
 PS = Piston Sample P = Pitcher Sample SC = Sonic Core



Log of Boring B-2

PROJECT: **Waterfront Small Area**
 PROJECT LOCATION: **Alexandria, VA**
 PROJECT NUMBER: **15303359**

DEPTH (FT)	ELEV. (FT)	DESCRIPTION	USCS	GRAPHIC LOG	SAMPLES			WELL	MOISTURE CONTENT		Pocket Pen. (tsf)	Tonvane (tsf)	REMARKS AND TESTS
					NUMBER	TYPE	BLOWS		REC (IN.) (%)	ATTERBERG			
45	-40	Moist, very soft, dark gray, high plasticity, ELASTIC SILT <i>(continued)</i>	MH		S-11	WOH-WOH-WOH	18"	(100%)					
50	-45	Wet, very loose to medium dense, light gray, nonplastic, SILTY SAND	SM		S-12		5-3-1	18"	(100%)				
55	-50		SM		S-13		4-8-11	8"	(44%)				
60	-55	Moist, medium dense, dark gray and brown, medium plasticity, CLAYEY SAND, (Potomac Soils)	SC		S-14		6-8-11	7"	(39%)				
65	-60		SC		S-15		4-11-14	17"	(94%)				
70	-65	Moist, very stiff, gray, high plasticity, FAT CLAY WITH SAND	CH		S-16		5-7-11	13"	(72%)				

BORING AT 70.0 FT ON 4/16/2041 AT 5:30 PM HOURS.

URS TEMPLATE SOIL-ROCK 2-10-12 WATERFRONT SMALL AREA BORINGS.GPJ MHNC LOGS.GPJ 5/13/14 REV-0

URS CORPORATION
 12420 Milestone Center Drive, Suite 150
 Germantown, MD 20876
 Phone: 301.820.3000 Fax: 301.820.3009

B = Bulk Sample S = Split Spoon Sample D = Denison Sample
 G = Geoprobe T = Shelby Tube Sample RC = Rock Core
 PS = Piston Sample P = Pitcher Sample SC = Sonic Core

APPENDIX C

SOIL LABORATORY TEST DATA

Summary of Laboratory Tests

Gradation Curves

Atterberg Limits

Corrosion Potential Series

Chloride and Sulfate Tests

Moisture Content Tests

Density of Soil Tests

Specific Gravity Tests

Grain Size Distribution

Atterberg Limits

Unconsolidated-Undrained (UU) Triaxial Shear Test Results

Appendix B: Summary of Laboratory Tests

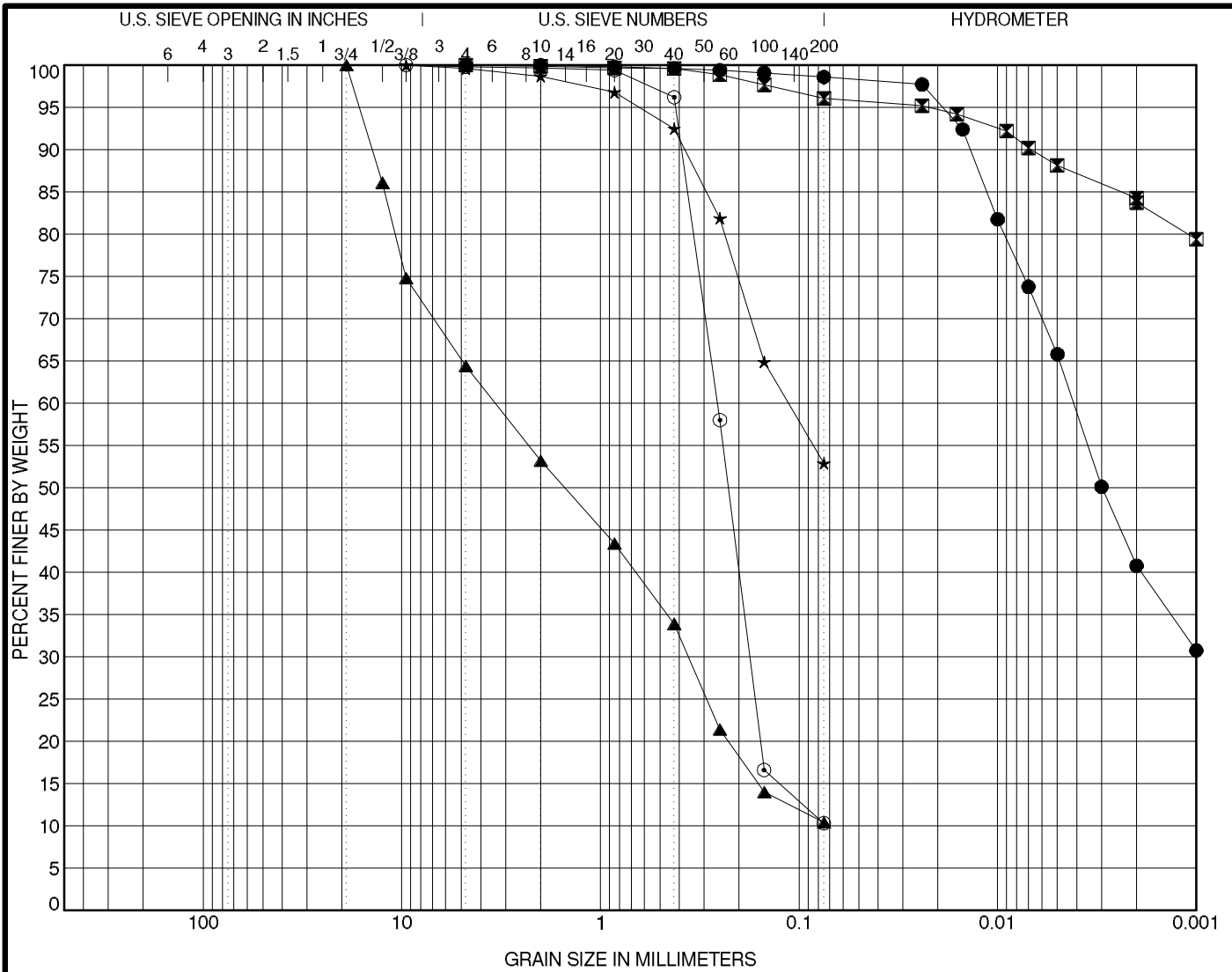
Boring	Depth (ft)	USCS	Stratum	Moisture Content (%)	Fines Content (%)	Atterberg Limits				Specific Gravity	Bulk Density (pcf)	Corrosion Testings					
						Liquid Limits (%)	Plastic Limit (%)	Plasticity Index (%)	Oven-Dried Liquid Limit (%)			pH	Oxidation Reduction Potential (mV)	Resistivity (ohm-cm)	Sulfides (presence)	Chlorides (mg/kg)	Sulfates (mg/kg)
SS-2	18.5-20	CH	B	55.8	-	-	-	-	-	-	-	-	-	-	-	-	-
SW-1	10-12	ML	B	53.1	89.3	48	28	20	-	2.61	-	-	-	-	-	-	-
SW-1	18.5-20	MH	B	59.1	-	52	30	22	-	-	-	-	-	-	-	-	-
SW-1	28.5-35	MH	B	57.9	-	-	-	-	-	-	-	6.3	35	2400	Negative	24	69
			Min	24.6	41.4	44	28	16	36	2.61	-	6.3	35	2000		18	43
			Max	69.7	98.6	74	32	42	42	2.69	-	6.4	38	2400		50	150

Boring	Depth (ft)	USCS	Stratum	Moisture Content (%)	Fines Content (%)	Atterberg Limits				Specific Gravity	Bulk Density (pcf)	Corrosion Testings					
						Liquid Limits (%)	Plastic Limit (%)	Plasticity Index	Oven-Dried Liquid Limit (%)			pH	Oxidation Reduction Potential (mV)	Resistivity (ohm-cm)	Sulfides (presence)	Chlorides (mg/kg)	Sulfates (mg/kg)
BH-2A	63.5-65.5	SP-SC	C	20	10.3	-	-	-	-	-	-	-	-	-	-	-	-
RCP-1	53.5-55	SM	C	20	33.3	-	-	-	-	-	-	-	-	-	-	-	-
RCP-1	58.5-60	ML	C	23.5	-	20	17	3	-	-	-	-	-	-	-	-	-
RCP-1	63.5-65	SM	C	20.3	33.8	-	-	-	-	-	-	-	-	-	-	-	-
			Min	20	10.3	-	-	-	-	-	-	-	-	-	-	-	-
			Max	23.5	33.8	-	-	-	-	-	-	-	-	-	-	-	-

Boring	Depth (ft)	USCS	Stratum	Moisture Content (%)	Fines Content (%)	Atterberg Limits				Specific Gravity	Bulk Density (pcf)	Corrosion Testings					
						Liquid Limits (%)	Plastic Limit (%)	Plasticity Index	Oven-Dried Liquid Limit (%)			pH	Oxidation Reduction Potential (mV)	Resistivity (ohm-cm)	Sulfides (presence)	Chlorides (mg/kg)	Sulfates (mg/kg)
BH-1	60.5-62.5	MH	D	32.5	90.5	59	31	28	-	2.63	118.7	-	-	-	-	-	-
BH-1	63-64.5	CL	D	34.3	-	-	-	-	-	-	-	-	-	-	-	-	-
BH-1	68.5-75	CL	D	37.7	-	-	-	-	-	-	-	5.4	77	900	Negative	ND	18
BH-1	83.5-85	CH	D	37.4	96.1	90	29	61	-	2.87	-	-	-	-	-	-	-
BH-2A	68.5-70	CH	D	29.9	90.4	75	24	51	-	-	-	-	-	-	-	-	-
BH-2A	73.5-80	CL	D	31.5	-	-	-	-	-	-	-	4.1	135	800	Negative	ND	15
BH-2A	88.5-90	CH	D	28.7	99.1	76	25	51	-	2.81	-	-	-	-	-	-	-
			Min	28.7	90.4	59	24	28	-	2.63	118.7	4.1	77	800			15
			Max	37.7	99.1	90	31	61	-	2.87	118.7	5.4	135	900			18

Notes:

- (1) Soil tests in general accordance with ASTM standards.
- (2) Soil classifications are in general accordance with ASTM D2487 (as applicable), based on testing indicated or visual classification
- (3) "ND" denotes that analyte not detected at or above the reporting limit
- (4) "-" denotes the laboratory test was not performed



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen	Sample Description	LL	PL	PI
● BH-1 28.5 ft	ELASTIC SILT (MH)	50	30	20
☒ BH-1 83.5 ft	FAT CLAY (CH)	90	29	61
▲ BH-2 4.0 ft	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)	--	--	--
★ BH-2A 53.5 ft	SANDY ORGANIC CLAY (OH)	52	28	24
⊙ BH-2A 63.5 ft	POORLY GRADED SAND with CLAY (SP-SC)	--	--	--

Specimen	Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● BH-1 28.5 ft	ASTM D422	2	0.004			0.0	1.4	57.8	40.8
☒ BH-1 83.5 ft	ASTM D422	4.75				0.0	3.9	12.4	83.7
▲ BH-2 4.0 ft	ASTM D422	19	3.382	0.36		35.6	54.0		10.4
★ BH-2A 53.5 ft	ASTM D422	9.5	0.113			0.4	46.7		52.9
⊙ BH-2A 63.5 ft	ASTM D422	9.5	0.257	0.177		0.2	89.5		10.3

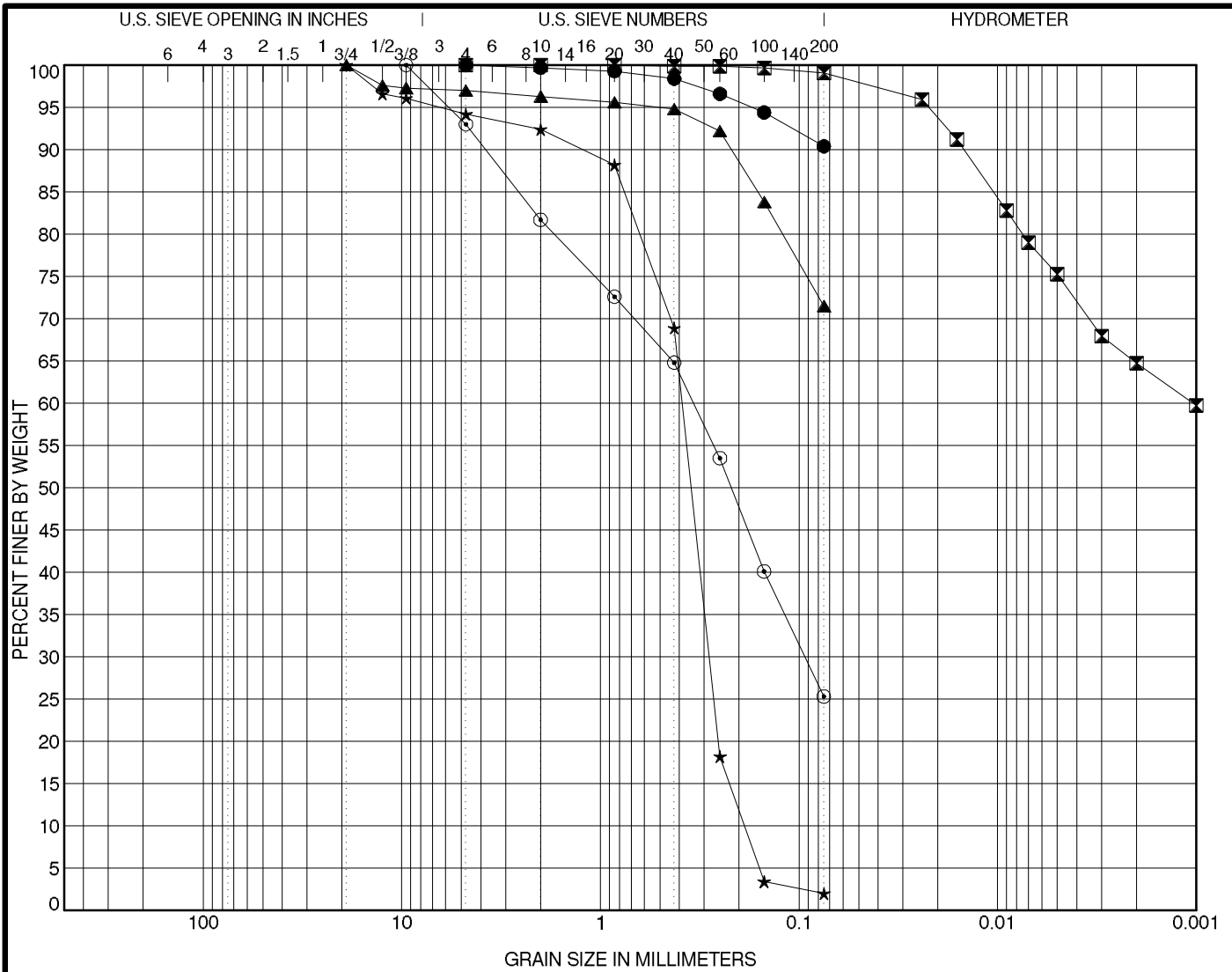


GRADATION CURVES

Project: City of Alexandria Waterfront Flood Mitigation
Alexandria Waterfront
Alexandria, VA

Contract: 16C12012.00

SIEVE 5 SHEET 16C12012.GPJ SCHNABEL DATA TEMPLATE 2008_04 22.GDT 9/14/16



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

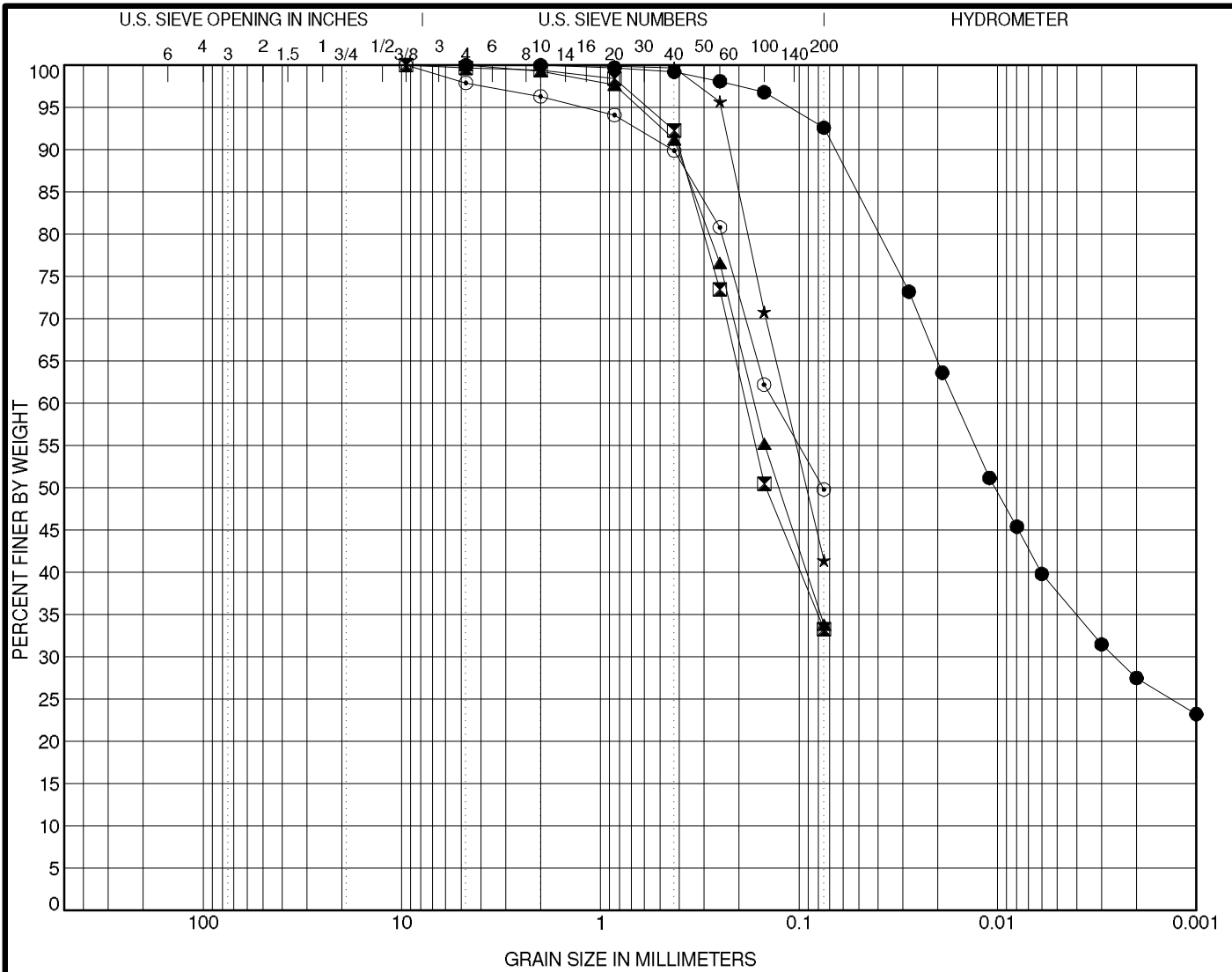
Specimen	Sample Description	LL	PL	PI
● BH-2A 68.5 ft	FAT CLAY (CH)	75	24	51
☒ BH-2A 88.5 ft	FAT CLAY (CH)	76	25	51
▲ PS-1 8.0 ft	LEAN CLAY with SAND (CL)	28	18	10
★ PS-1 13.5 ft	POORLY GRADED SAND (SP)	--	--	--
⊙ RCP-1 13.5 ft	SILTY SAND (SM)	--	--	--

Specimen	Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● BH-2A 68.5 ft	ASTM D422	4.75				0.0	9.6	90.4	
☒ BH-2A 88.5 ft	ASTM D422	0.85	0.001			0.0	0.9	34.4	64.7
▲ PS-1 8.0 ft	ASTM D422	19				3.0	25.5	71.5	
★ PS-1 13.5 ft	ASTM D422	19	0.387	0.283	0.188	5.8	92.2	2.0	
⊙ RCP-1 13.5 ft	ASTM D422	9.5	0.339	0.093		7.0	67.7	25.3	



GRADATION CURVES
Project: City of Alexandria Waterfront Flood Mitigation
 Alexandria Waterfront
 Alexandria, VA
Contract: 16C12012.00

SIEVE 5 SHEET 16C12012.GPJ SCHNABEL DATA TEMPLATE 2008_04 22.GDT 9/14/16



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

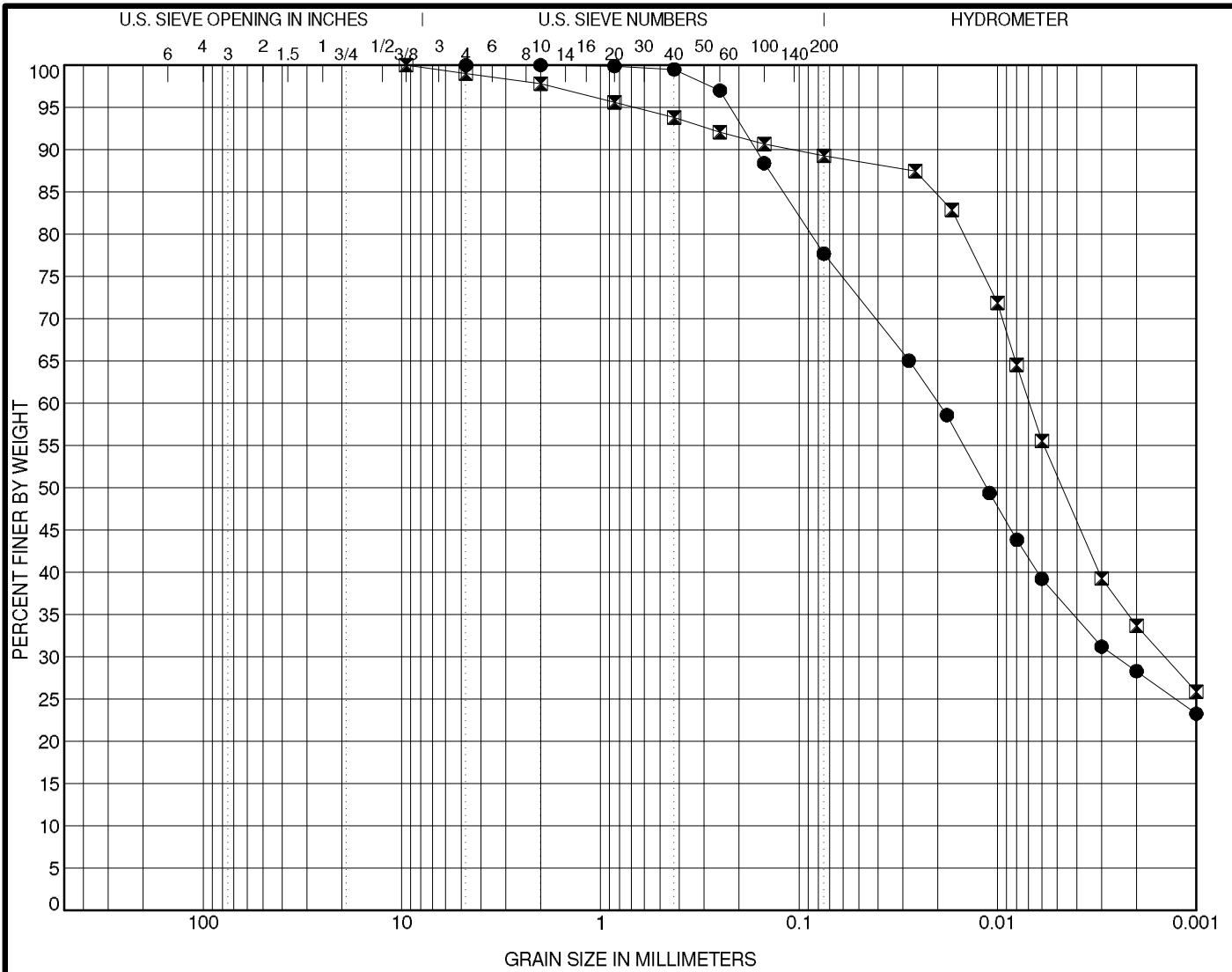
Specimen	Sample Description	LL	PL	PI
● RCP-1 33.5 ft	FAT CLAY (CH)	55	29	26
☒ RCP-1 53.5 ft	SILTY SAND (SM)	--	--	--
▲ RCP-1 63.5 ft	SILTY SAND (SM)	--	--	--
★ SS-1 38.5 ft	CLAYEY SAND (SC)	--	--	--
◎ SS-2 4.0 ft	CLAYEY SAND (SC)	--	--	--

Specimen	Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● RCP-1 33.5 ft	ASTM D422	2	0.016	0.003		0.0	7.4	65.1	27.5
☒ RCP-1 53.5 ft	ASTM D422	9.5	0.185			0.3	66.4	33.3	
▲ RCP-1 63.5 ft	ASTM D422	4.75	0.168			0.0	66.2	33.8	
★ SS-1 38.5 ft	ASTM D422	2	0.116			0.0	58.6	41.4	
◎ SS-2 4.0 ft	ASTM D422	9.5	0.133			2.1	48.1	49.8	



GRADATION CURVES
Project: City of Alexandria Waterfront Flood Mitigation
 Alexandria Waterfront
 Alexandria, VA
Contract: 16C12012.00

SIEVE 5 SHEET 16C12012.GPJ SCHNABEL DATA TEMPLATE 2008_04 22.GDT 9/14/16



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

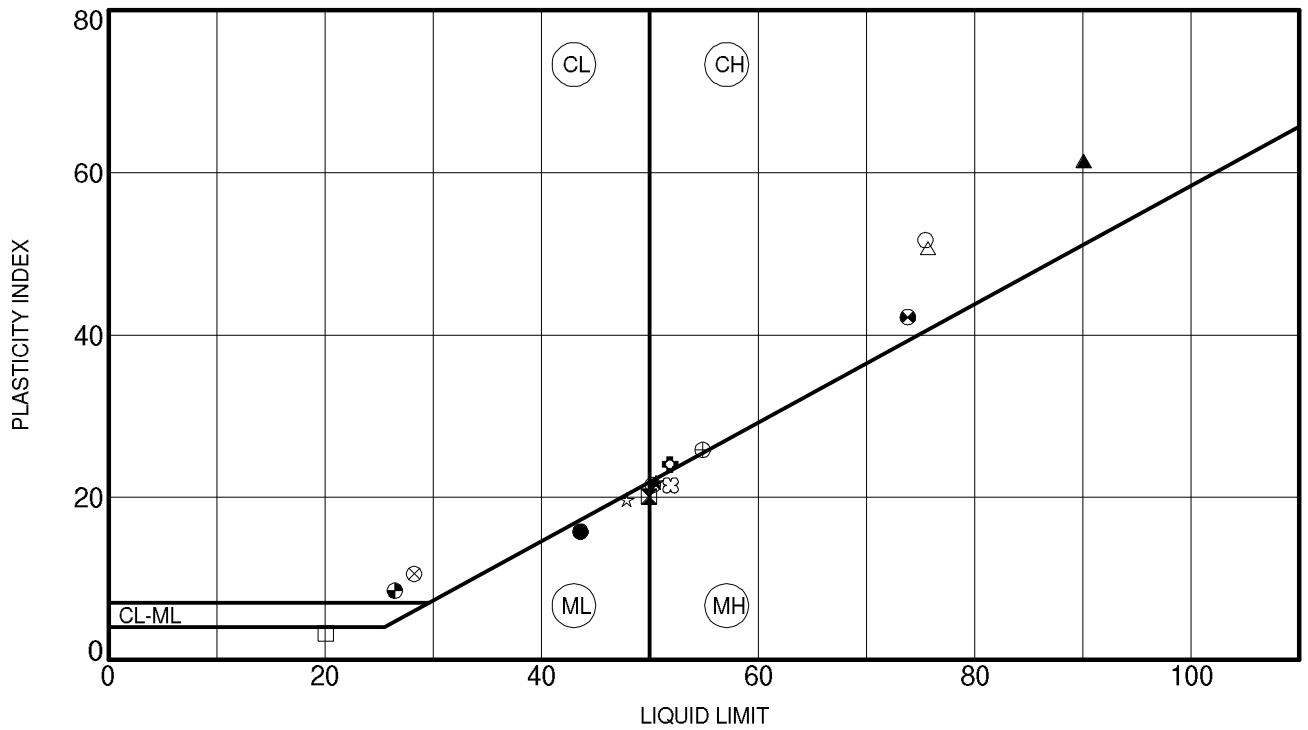
Specimen	Sample Description	LL	PL	PI
● SS-2 10.0 ft	LEAN CLAY with SAND (CL)	26	18	8
☒ SW-1 10.0 ft	SILT (ML)	48	28	20

Specimen	Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● SS-2 10.0 ft	ASTM D422	2	0.02	0.003		0.0	22.3	49.4	28.3
☒ SW-1 10.0 ft	ASTM D422	9.5	0.007	0.001		1.0	9.7	55.7	33.6



GRADATION CURVES

Project: City of Alexandria Waterfront Flood Mitigation
 Alexandria Waterfront
 Alexandria, VA
Contract: 16C12012.00



PLOTTED DATA REPRESENTS SOIL PASSING NO. 40 SIEVE

Specimen	LL	PL	PI	Fines	Oven Dry, Liquid Limit	Description
● BH-1	18.5 ft	44	28	16		SILT (ML)
⊗ BH-1	28.5 ft	50	30	20	99	ELASTIC SILT (MH)
▲ BH-1	83.5 ft	90	29	61	96	FAT CLAY (CH)
★ BH-2	14.0 ft	51	29	22		ELASTIC SILT with SAND (MH)
⊙ BH-2A	18.5 ft	50	29	21		ELASTIC SILT (MH)
⊕ BH-2A	53.5 ft	52	28	24	53	36.0 SANDY ORGANIC CLAY (OH)
○ BH-2A	68.5 ft	75	24	51	90	FAT CLAY (CH)
△ BH-2A	88.5 ft	76	25	51	99	FAT CLAY (CH)
⊗ PS-1	8.0 ft	28	18	10	72	LEAN CLAY with SAND (CL)
⊕ RCP-1	33.5 ft	55	29	26	93	FAT CLAY (CH)
□ RCP-1	58.5 ft	20	17	3		SANDY SILT (ML)
⊕ SS-1	28.5 ft	74	32	42	42.0	ORGANIC CLAY (OH)
● SS-2	10.0 ft	26	18	8	78	LEAN CLAY with SAND (CL)
★ SW-1	10.0 ft	48	28	20	89	SILT (ML)
⊗ SW-1	18.5 ft	52	30	22		ELASTIC SILT (MH)

NOTE: An organic clay or silt is a soil that would be classified as a clay or silt, respectively, except that its oven dried liquid limit is less than 75% of its liquid limit value.



ATTERBERG LIMITS

Project: City of Alexandria Waterfront Flood Mitigation
 Alexandria Waterfront
 Alexandria, VA
Contract: 16C12012.00

ATTERBERG LIMITS 16C12012.GPJ SCHNABEL DATA TEMPLATE 2008 04 22.GDT 9/14/16



SOIL MECHANICS LABORATORY
CORROSION POTENTIAL SERIES
AWWA-C105

Project Name: Alexandria Waterfront

Project No: 16C12012

Sample No: SS-1, S-7/S-8
Depth: 13.5-20 ft
Classification: SILT (ML)

As received moisture

Test	Unit	Readings	Points
Resistivity	ohm-cm	2,500	2
pH	--	6.58	0
Redox	mV	27	4
Sulfide	presence	Negative	0
Moisture	condition	Wet	2
Total Points			8

Tare No.	dolt
Ww + Wt	43.6
Wd + Wt	33.28
Wt	14.81
Ww	10.32
Wd	18.47
% MC	55.9

Sample No: BH-1, S-2/S-3
Depth: 2-6 ft
Classification: SILTY SAND with GRAVEL (SM)

As received moisture

Test	Unit	Readings	Points
Resistivity	ohm-cm	6,100	0
pH	--	10.67	3
Redox	mV	-178	5
Sulfide	presence	Negative	0
Moisture	condition	Wet	2
Total Points			10

Tare No.	smd
Ww + Wt	88.86
Wd + Wt	78.9
Wt	14.72
Ww	9.96
Wd	64.18
% MC	15.5

NOTE: See Table A.1 attached for point system information and data interpretation

REMARKS:

Tested By: L. Geake
 Date: 8/31/16

Checked By: E. Gibson
 Date: 9/15/16



SOIL MECHANICS LABORATORY
CORROSION POTENTIAL SERIES
AWWA-C105

Project Name: Alexandria Waterfront

Project No: 16C12012

Sample No: BH-1, S-11/S-12
Depth: 33.5-40 ft
Classification: SILT (ML)

As received moisture

Test	Unit	Readings	Points
Resistivity	ohm-cm	2,400	2
pH	--	6.37	0
Redox	mV	36	4
Sulfide	presence	Negative	0
Moisture	condition	Wet	2
Total Points			8

Tare No.	race
Ww + Wt	67.85
Wd + Wt	48.50
Wt	14.68
Ww	19.35
Wd	33.82
% MC	57.2

Sample No: BH-1, S-18/S-19
Depth: 68.5-75 ft
Classification: SANDY LEAN CLAY with GRAVEL (CL)

As received moisture

Test	Unit	Readings	Points
Resistivity	ohm-cm	900	10
pH	--	5.40	0
Redox	mV	77	3.5
Sulfide	presence	Negative	0
Moisture	condition	Wet	2
Total Points			15.5

Tare No.	whu
Ww + Wt	49.82
Wd + Wt	39.81
Wt	13.27
Ww	10.01
Wd	26.54
% MC	37.7

NOTE: See Table A.1 attached for point system information and data interpretation

REMARKS:

Tested By: L. Geake
 Date: 8/31/16

Checked By: E. Gibson
 Date: 9/15/16



SOIL MECHANICS LABORATORY
CORROSION POTENTIAL SERIES
AWWA-C105

Project Name: Alexandria Waterfront

Project No: 16C12012

Sample No: BH-2A, S-21/S-22
Depth: 73.5-80 ft
Classification: LEAN CLAY with SAND (CL)

As received moisture

Test	Unit	Readings	Points
Resistivity	ohm-cm	800	10
pH	--	4.10	0
Redox	mV	135	0
Sulfide	presence	Negative	0
Moisture	condition	Moist	1
Total Points			11

Tare No.	c3p
Ww + Wt	49.17
Wd + Wt	40.61
Wt	13.42
Ww	8.56
Wd	27.19
% MC	31.5

Sample No: BH-2A, S-8/S-9/S-10
Depth: 15-25 ft
Classification: SANDY FAT CLAY (CH)

As received moisture

Test	Unit	Readings	Points
Resistivity	ohm-cm	1,800	8
pH	--	6.48	0
Redox	mV	33	4
Sulfide	presence	Negative	0
Moisture	condition	Wet	2
Total Points			14

Tare No.	jaw
Ww + Wt	49.29
Wd + Wt	38.47
Wt	14.98
Ww	10.82
Wd	23.49
% MC	46.1

NOTE: See Table A.1 attached for point system information and data interpretation

REMARKS:

Tested By: L. Geake
 Date: 8/31/16

Checked By: E. Gibson
 Date: 9/15/16



SOIL MECHANICS LABORATORY
CORROSION POTENTIAL SERIES
AWWA-C105

Project Name: Alexandria Waterfront

Project No: 16C12012.00

Sample No: SS-2, S-4/S-5
Depth: 6-10 ft
Classification: LEAN CLAY with SAND (CL)

As received moisture

Test	Unit	Readings	Points
Resistivity	ohm-cm	1,900	5
pH	--	7.14	0
Redox	mV	-2	5
Sulfide	presence	Negative	0
Moisture	condition	Wet	2
Total Points			12

Tare No.	doc
Ww + Wt	64.92
Wd + Wt	55.94
Wt	14.52
Ww	8.98
Wd	41.42
% MC	21.7

Sample No: PS-1, S-1/S-2
Depth: 0-4 ft
Classification: SILTY SAND with GRAVEL (SM)

As received moisture

Test	Unit	Readings	Points
Resistivity	ohm-cm	4,200	0
pH	--	12.03	3
Redox	mV	-243	5
Sulfide	presence	Negative	0
Moisture	condition	Moist	1
Total Points			9

Tare No.	tk9
Ww + Wt	68.54
Wd + Wt	64.09
Wt	15.21
Ww	4.45
Wd	48.88
% MC	9.1

NOTE: See Table A.1 attached for point system information and data interpretation

REMARKS:

Tested By: LG
 Date: 9/7/16

Checked By: E. Gibson
 Date: 9/15/16



SOIL MECHANICS LABORATORY
CORROSION POTENTIAL SERIES
AWWA-C105

Project Name: Alexandria Waterfront

Project No: 16C12012.00

Sample No: SW-1, S-9/S-11
Depth: 28.5-35 ft
Classification: ELASTIC SILT (MH)

As received moisture

Test	Unit	Readings	Points
Resistivity	ohm-cm	2,400	2
pH	--	6.45	0
Redox	mV	35	4
Sulfide	presence	Negative	0
Moisture	condition	Wet	2
Total Points			8

Tare No.	a
Ww + Wt	45.61
Wd + Wt	33.79
Wt	13.37
Ww	11.82
Wd	20.42
% MC	57.9

Sample No: RCP-1, S-8/S-9
Depth: 18.5-25 ft
Classification: ELASTIC SILT (MH)

As received moisture

Test	Unit	Readings	Points
Resistivity	ohm-cm	2,000	5
pH	--	6.38	0
Redox	mV	38	4
Sulfide	presence	Negative	0
Moisture	condition	Wet	2
Total Points			11

Tare No.	gem
Ww + Wt	63.03
Wd + Wt	43.09
Wt	14.47
Ww	19.94
Wd	28.62
% MC	69.7

NOTE: See Table A.1 attached for point system information and data interpretation

REMARKS:

Tested By: LG
 Date: 9/7/16

Checked By: E. Gibson
 Date: 9/15/16

Table A.1 Soil-test evaluation

Soil Characteristics Based on Samples Taken Down to Pipe Depth	Points [*]
Resistivity—ohm-cm (based on water-saturated soil box):	
<1,500.....	10
≥1,500–1,800	8
>1,800–2,100.....	5
>2,100–2,500.....	2
>2,500–3,000.....	1
>3,000.....	0
pH:	
0–2.....	5
2–4.....	3
4–6.5.....	0
6.5–7.5.....	0 [†]
7.5–8.5.....	0
>8.5.....	3
Redox potential:	
> +100 mV	0
+50 to +100 mV.....	3.5
0 to +50 mV	4
Negative.....	5
Sulfides:	
Positive.....	3.5
Trace	2
Negative	0
Moisture:	
Poor drainage, continuously wet	2
Fair drainage, generally moist.....	1
Good drainage, generally dry	0

*Ten points indicates that soil is corrosive to ductile-iron pipe; protection is needed.

†If sulfides are present and low or negative redox-potential results are obtained, add three points for this range.



Client:	Schnabel Engineering, LLC		
Project:	Alexandria Waterfront Flood Mitigation		
Location:	Alexandria, VA	Project No:	GTX-305292
Boring ID:	---	Sample Type:	---
Sample ID:	---	Test Date:	09/21/16
Depth :	---	Test Id:	390020
		Tested By:	jbr
		Checked By:	emm

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content, %
BH-1	UD- 1	60.5-62.5	Moist, reddish brown silt	32.5
BH-2A	UD- 1	33-35	Wet, grayish brown silt	57.6

Notes: Temperature of Drying : 110° Celsius



Client:	Schnabel Engineering, LLC		
Project:	Alexandria Waterfront Flood Mitigation		
Location:	Alexandria, VA	Project No:	GTX-305292
Boring ID:	---	Sample Type:	---
Sample ID:	---	Test Date:	09/23/16
Depth :	---	Test Id:	390018
		Tested By:	md
		Checked By:	emm

**Laboratory Determination of Density (Unit Weight)
of Soil Specimens by ASTM D7263**

Boring ID	Sample ID	Depth	Visual Description	Bulk Density pcf	Moisture Content %	Dry Density pcf	*
BH-1	UD- 1	60.5-62.5	Moist, reddish brown silt	118.7	32.52	89.54	(1)
BH-2A	UD- 1	33-35	Wet, grayish brown silt	98.01	57.64	62.17	(2)

* Sample Comments

- (1): Method B-Cylinder, Intact
- (2): Method B-Cylinder, Intact

Notes: Moisture Content determined by ASTM D2216.



Client:	Schnabel Engineering, LLC		
Project:	Alexandria Waterfront Flood Mitigation		
Location:	Alexandria, VA	Project No:	GTX-305292
Boring ID:	---	Sample Type:	---
Sample ID:	---	Test Date:	09/22/16
Depth :	---	Test Id:	390023
		Tested By:	jbr
		Checked By:	emm

Specific Gravity of Soils by ASTM D854

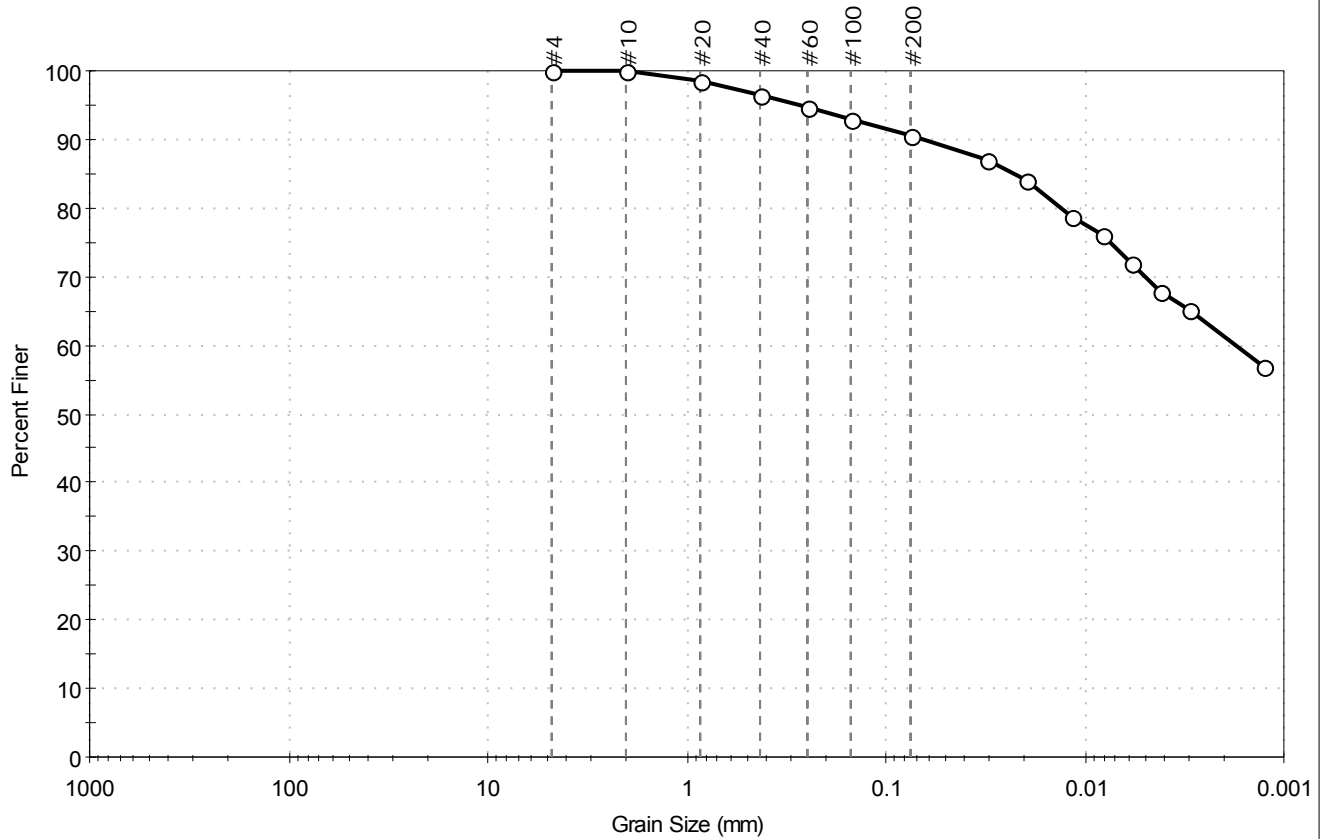
Boring ID	Sample ID	Depth	Visual Description	Specific Gravity	Comment
BH-1	UD- 1	60.5-62.5	Moist, reddish brown silt	2.63	
BH-2A	UD- 1	33-35	Wet, grayish brown silt	2.67	

Notes: Specific Gravity performed by using method B (oven dried specimens) of ASTM D854
Moisture Content determined by ASTM D2216.



Client:	Schnabel Engineering, LLC		
Project:	Alexandria Waterfront Flood Mitigation		
Location:	Alexandria, VA	Project No:	GTX-305292
Boring ID:	BH-1	Sample Type:	tube
Sample ID:	UD-1	Test Date:	09/26/16
Depth:	60.5-62.5	Test Id:	390021
Test Comment:	---		
Visual Description:	Moist, reddish brown silt		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	9.5	90.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	96		
#60	0.25	95		
#100	0.15	93		
#200	0.075	90		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0311	87		
---	0.0198	84		
---	0.0118	79		
---	0.0085	76		
---	0.0060	72		
---	0.00425	68		
---	0.0030	65		
---	0.0015	57		

<u>Coefficients</u>	
D ₈₅ = 0.0226 mm	D ₃₀ = N/A
D ₆₀ = 0.0017 mm	D ₁₅ = N/A
D ₅₀ = N/A	D ₁₀ = N/A
C _u = N/A	C _c = N/A

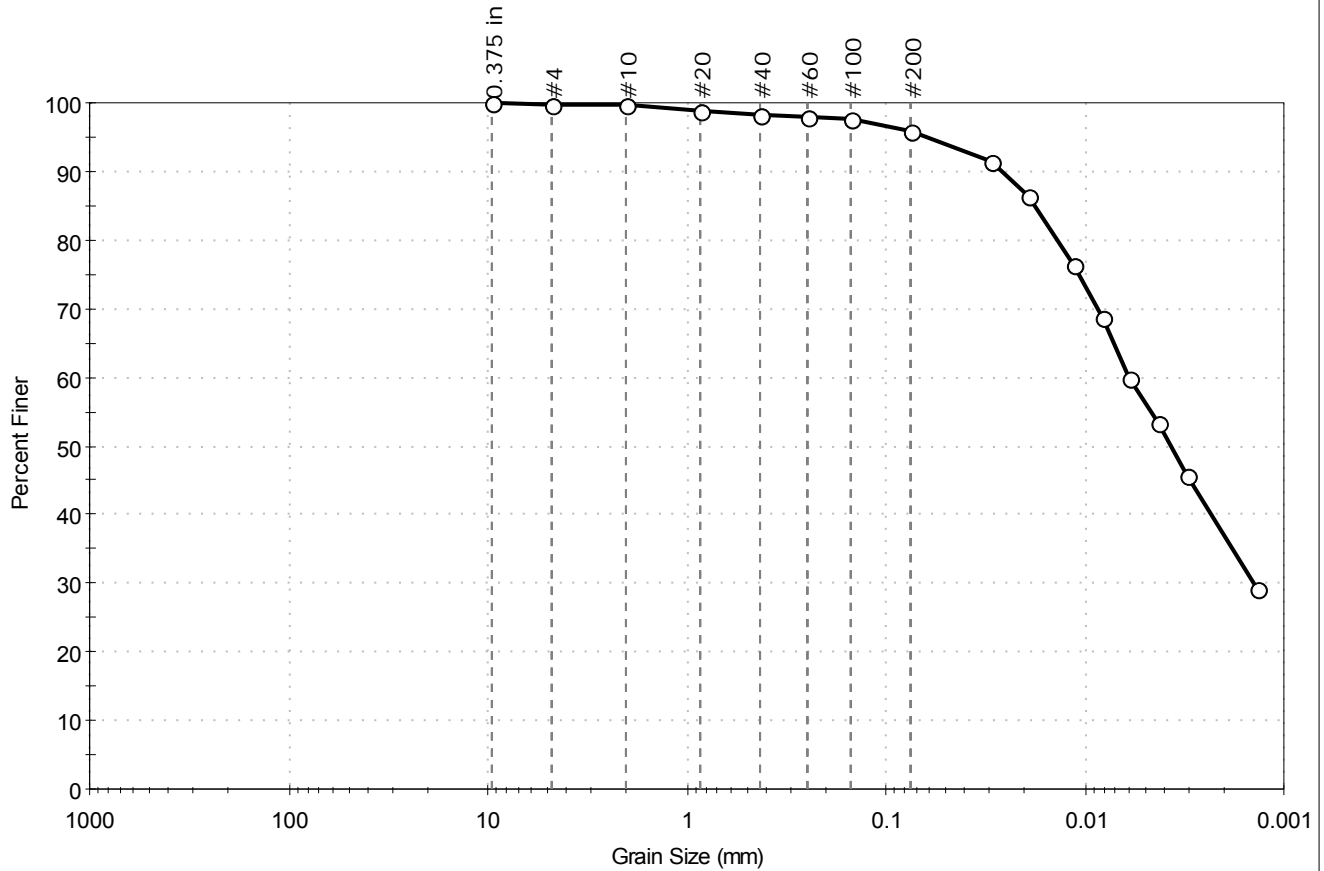
<u>Classification</u>	
<u>ASTM</u>	Elastic silt (MH)
<u>AASHTO</u>	Clayey Soils (A-7-5 (30))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Specific Gravity : 2.632
Separation of Sample: #200 Sieve



Client:	Schnabel Engineering, LLC		
Project:	Alexandria Waterfront Flood Mitigation		
Location:	Alexandria, VA	Project No:	GTX-305292
Boring ID:	BH-2A	Sample Type:	tube
Sample ID:	UD-1	Test Date:	09/22/16
Depth :	33-35	Test Id:	390022
Test Comment:	---		
Visual Description:	Wet, grayish brown silt		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.2	4.1	95.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	98		
#60	0.25	98		
#100	0.15	98		
#200	0.075	96		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0295	92		
---	0.0192	86		
---	0.0114	76		
---	0.0083	69		
---	0.0060	60		
---	0.0043	53		
---	0.0031	46		
---	0.0014	29		

<u>Coefficients</u>	
D ₈₅ = 0.0178 mm	D ₃₀ = 0.0014 mm
D ₆₀ = 0.0060 mm	D ₁₅ = N/A
D ₅₀ = 0.0037 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

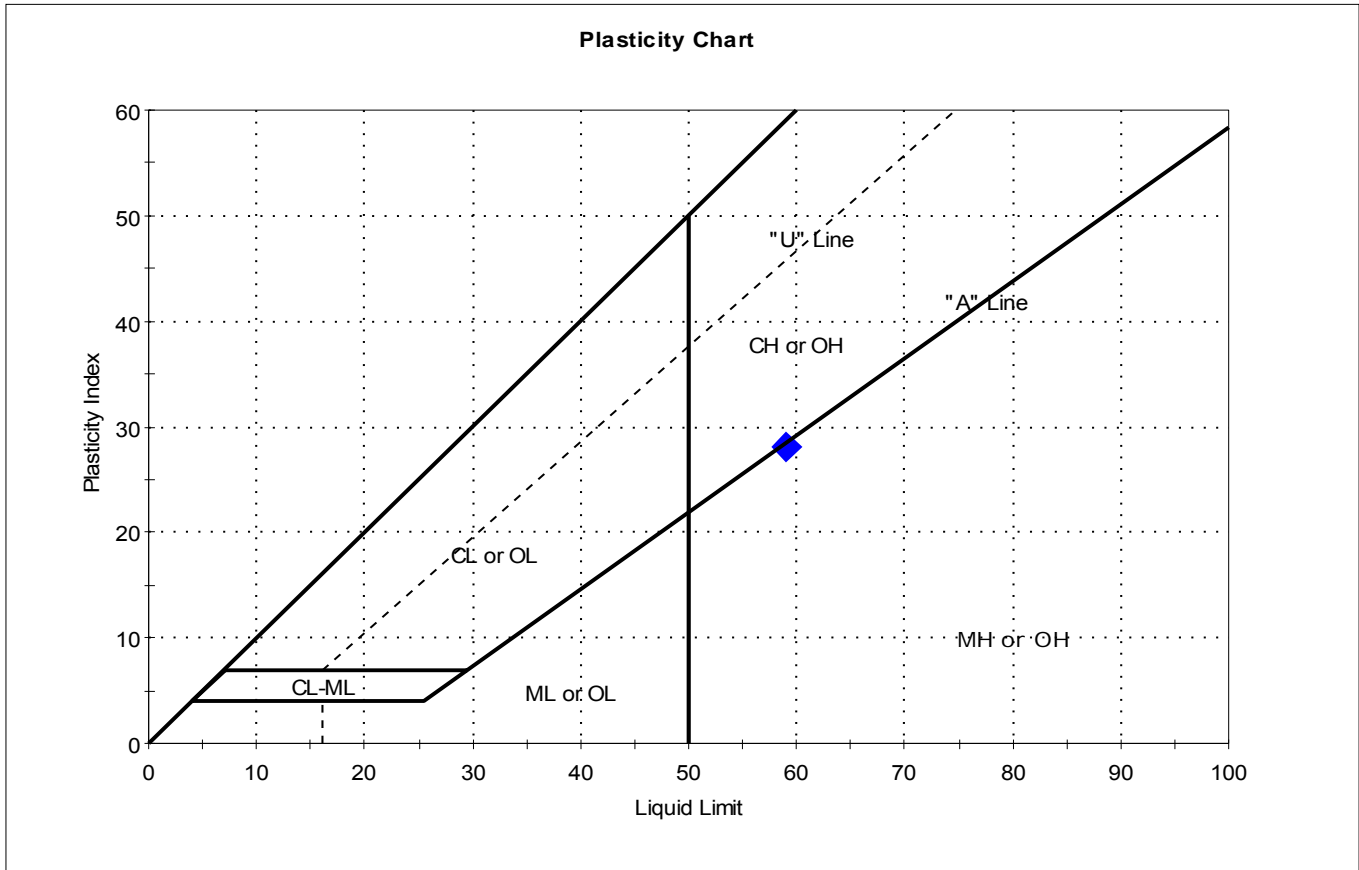
<u>Classification</u>	
<u>ASTM</u>	Elastic silt (MH)
<u>AASHTO</u>	Clayey Soils (A-7-5 (27))

<u>Sample/Test Description</u>	
Sand/Gravel Particle Shape : ---	
Sand/Gravel Hardness : ---	
Dispersion Device : Apparatus A - Mech Mixer	
Dispersion Period : 1 minute	
Specific Gravity : 2.671	
Separation of Sample: #200 Sieve	



Client:	Schnabel Engineering, LLC		Project No:	GTX-305292	
Project:	Alexandria Waterfront Flood Mitigation		Tested By:	cam	
Location:	Alexandria, VA	Sample Type:	tube	Checked By:	emm
Boring ID:	BH-1	Test Date:	09/23/16	Test Id:	390015
Sample ID:	UD-1				
Depth :	60.5-62.5				
Test Comment:	---				
Visual Description:	Moist, reddish brown silt				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



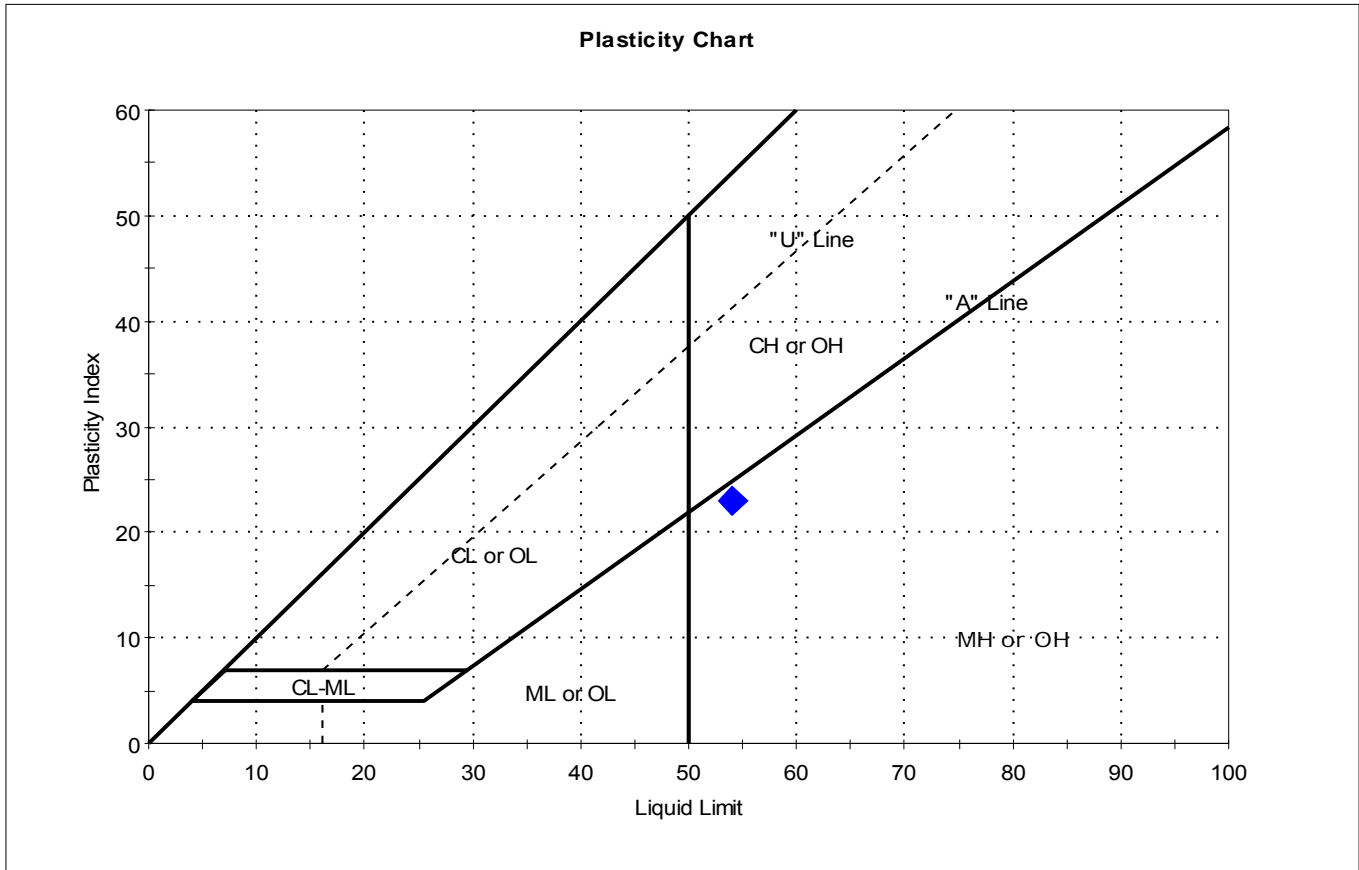
Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	UD-1	BH-1	60.5-62.5	33	59	31	28	0.1	Elastic silt (MH)

Sample Prepared using the WET method
 4% Retained on #40 Sieve
 Dry Strength: HIGH
 Dilatancy: SLOW
 Toughness: LOW



Client:	Schnabel Engineering, LLC		Project No:	GTX-305292	
Project:	Alexandria Waterfront Flood Mitigation				
Location:	Alexandria, VA	Sample Type:	tube	Tested By:	cam
Boring ID:	BH-2A	Test Date:	09/21/16	Checked By:	emm
Sample ID:	UD-1	Test Id:	390016		
Depth :	33-35				
Test Comment:	---				
Visual Description:	Wet, grayish brown silt				
Sample Comment:	---				

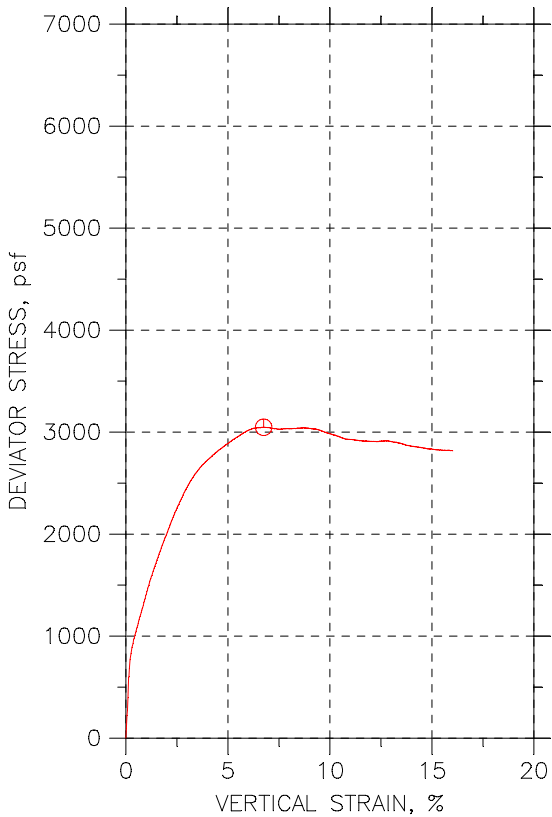
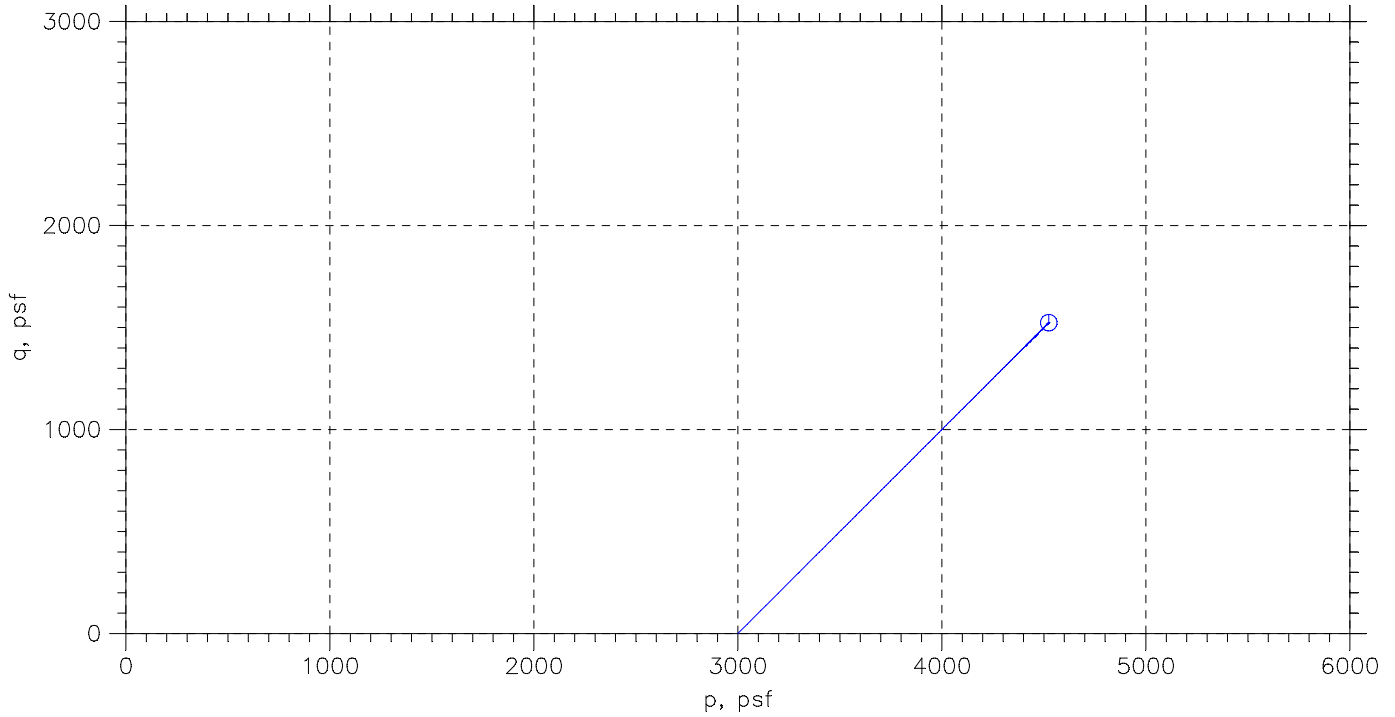
Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	UD-1	BH-2A	33-35	58	54	31	23	1.2	Elastic silt (MH)

Sample Prepared using the WET method
 2% Retained on #40 Sieve
 Dry Strength: VERY HIGH
 Dilatancy: SLOW
 Toughness: LOW

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D2850



Symbol	⊕			
Sample No.	UD-1			
Test No.	UU-1			
Depth	60.5-62.5			
Tested by	md			
Test Date	9/15/16			
Checked by	njh			
Check Date	9/23/16			
Diameter, in	2.85			
Height, in	6.1			
Water Content, %	30.8			
Dry Density, pcf	90.72			
Saturation, %	100.0			
Void Ratio	0.81			
Confining Stress, psf	3000			
Undrained Strength, psf	1524			
Max. Dev. Stress, psf	3048			
Strain at Failure, %	6.75			
Strain Rate, %/min	1			
Measured Specific Gravity	2.63			
Liquid Limit	59			
Plastic Limit	31			
Plasticity Index	28			



Project: Alexandria Waterfront	
Location: Alexandria, VA	
Project No.: GTX-305292	
Boring No.: BH-1	
Sample Type: intact	
Description: Moist, reddish brown silt	
Remarks: System W	

Phase calculations based on start and end of test.



Microbac Laboratories, Inc.

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COVER LETTER

Luke Geake
Schnabel Engineering
1380 Wilmington Pike, Suite 100
West Chester, PA 19382

September 16, 2016
Report No.: 16I0498

RE: Soil Analysis

The report of analyses contains test results for samples received at Microbac Laboratories, Inc., Baltimore Division on 09/08/2016 10:00.

The enclosed results were obtained from and applicable to the sample(s) as received at the laboratory. All sample results are reported on an "as received" basis unless otherwise noted.

All data included in this report has been reviewed and meet the applicable project and certification specific requirements, unless otherwise noted.

This report has been paginated in its entirety and shall not be reproduced except in full, without the written approval of Microbac Laboratories, Inc.

We appreciate the opportunity to service your analytical needs. If you have any questions, please feel free to contact us.

This Data Package contains the following:

- This Cover Page
- Sample Summary
- Test Results
- Certifications/Notes and Definitions
- Cooler Receipt Log
- Chain of Custody

9/16/2016

Final report reviewed by:

Michael M. Gallion/Project Manager

Report issue date

All samples received in proper condition and results conform to ISO 17025 and TNI NELAC standards unless otherwise noted.

If we have not met or exceeded your expectations, please contact Michael M. Gallion/Project Manager at 410-633-1800. You may also contact Trevor Boyce, President at trevor.boyce@microbac.com



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Baltimore Division

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CERTIFICATE OF ANALYSIS

Schnabel Engineering 1380 Wilmington Pike, Suite 100 West Chester, PA 19382	Project: Soil Analysis Project Number: 16C12012.00, Alexandria Waterfront, Virginia Project Manager: Luke Geake	Report: 16I0498 Reported: 09/16/2016 16:26
---	---	---

SAMPLE SUMMARY

Sample ID	Laboratory ID	Matrix	Type	Date Sampled	Date Received
SS-2, S-4&5, 6-10 ft	16I0498-01	Solid	Not Specified	09/07/2016 00:00	09/08/2016 10:00
PS-1, S-1&2, 0-4 ft	16I0498-02	Solid	Not Specified	09/07/2016 00:00	09/08/2016 10:00
SW-1, S-9&11, 28.5-35 ft	16I0498-03	Solid	Not Specified	09/07/2016 00:00	09/08/2016 10:00
RCP-1, S-8&9, 18.5-25 ft	16I0498-04	Solid	Not Specified	09/07/2016 00:00	09/08/2016 10:00
BH-2A, S-8,9&10, 15-25 ft	16I0498-05	Solid	Not Specified	09/07/2016 00:00	09/08/2016 10:00

CERTIFICATE OF ANALYSIS

Schnabel Engineering 1380 Wilmington Pike, Suite 100 West Chester, PA 19382	Project: Soil Analysis Project Number: 16C12012.00, Alexandria Waterfront, Virginia Project Manager: Luke Geake	Report: 16I0498 Reported: 09/16/2016 16:26
---	---	---

SS-2, S-4&5, 6-10 ft

16I0498-01 (Solid) Sampled: 09/07/2016 00:00; Type: Not Specified

Analyte	Result	Reporting Limit	Units	Limits	Prepared	Analyzed	Analyst	Method	Notes
---------	--------	-----------------	-------	--------	----------	----------	---------	--------	-------

Microbac Laboratories, Inc. - Baltimore

Wet Chemistry

% Solids	83.76	0.05	% by Weight		091316 1600	091416 1110	RLD	SM 2540 G-11	
Chloride	100	12	mg/kg dry		091216 1436	091316 2124	PPM	SW-846 9056A	
Sulfate as SO4	12	12	mg/kg dry		091216 1436	091316 2124	PPM	SW-846 9056A	





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CERTIFICATE OF ANALYSIS

Schnabel Engineering 1380 Wilmington Pike, Suite 100 West Chester, PA 19382	Project: Soil Analysis Project Number: 16C12012.00, Alexandria Waterfront, Virginia Project Manager: Luke Geake	Report: 16I0498 Reported: 09/16/2016 16:26
---	---	---

PS-1, S-1&2, 0-4 ft

16I0498-02 (Solid) Sampled: 09/07/2016 00:00; Type: Not Specified

Analyte	Result	Reporting Limit	Units	Limits	Prepared	Analyzed	Analyst	Method	Notes
---------	--------	-----------------	-------	--------	----------	----------	---------	--------	-------

Microbac Laboratories, Inc. - Baltimore

Wet Chemistry

% Solids	88.68	0.05	% by Weight		091316 1600	091416 1110	RLD	SM 2540 G-11	
Chloride	160	11	mg/kg dry		091216 1436	091316 2136	PPM	SW-846 9056A	
Sulfate as SO4	790	11	mg/kg dry		091216 1436	091316 2136	PPM	SW-846 9056A	

Microbac Laboratories, Inc. - Baltimore

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Michael M. Gallion, Project Manager

Original Report

Page 4 of 12

CERTIFICATE OF ANALYSIS

Schnabel Engineering 1380 Wilmington Pike, Suite 100 West Chester, PA 19382	Project: Soil Analysis Project Number: 16C12012.00, Alexandria Waterfront, Virginia Project Manager: Luke Geake	Report: 16I0498 Reported: 09/16/2016 16:26
---	---	---

SW-1, S-9&11, 28.5-35 ft

16I0498-03 (Solid) Sampled: 09/07/2016 00:00; Type: Not Specified

Analyte	Result	Reporting Limit	Units	Limits	Prepared	Analyzed	Analyst	Method	Notes
---------	--------	-----------------	-------	--------	----------	----------	---------	--------	-------

Microbac Laboratories, Inc. - Baltimore

Wet Chemistry

% Solids	63.97	0.05	% by Weight		091316 1600	091416 1110	RLD	SM 2540 G-11	
Chloride	24	16	mg/kg dry		091216 1436	091316 2148	PPM	SW-846 9056A	
Sulfate as SO4	69	16	mg/kg dry		091216 1436	091316 2148	PPM	SW-846 9056A	



CERTIFICATE OF ANALYSIS

Schnabel Engineering 1380 Wilmington Pike, Suite 100 West Chester, PA 19382	Project: Soil Analysis Project Number: 16C12012.00, Alexandria Waterfront, Virginia Project Manager: Luke Geake	Report: 16I0498 Reported: 09/16/2016 16:26
---	---	---

RCP-1, S-8&9, 18.5-25 ft

16I0498-04 (Solid) Sampled: 09/07/2016 00:00; Type: Not Specified

Analyte	Result	Reporting Limit	Units	Limits	Prepared	Analyzed	Analyst	Method	Notes
---------	--------	-----------------	-------	--------	----------	----------	---------	--------	-------

Microbac Laboratories, Inc. - Baltimore

Wet Chemistry

% Solids	60.83	0.05	% by Weight		091316 1600	091416 1110	RLD	SM 2540 G-11	
Chloride	50	16	mg/kg dry		091216 1436	091316 2201	PPM	SW-846 9056A	
Sulfate as SO4	150	16	mg/kg dry		091216 1436	091316 2201	PPM	SW-846 9056A	





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CERTIFICATE OF ANALYSIS

Schnabel Engineering 1380 Wilmington Pike, Suite 100 West Chester, PA 19382	Project: Soil Analysis Project Number: 16C12012.00, Alexandria Waterfront, Virginia Project Manager: Luke Geake	Report: 16I0498 Reported: 09/16/2016 16:26
---	---	---

BH-2A, S-8,9&10, 15-25 ft

16I0498-05 (Solid) Sampled: 09/07/2016 00:00; Type: Not Specified

Analyte	Result	Reporting Limit	Units	Limits	Prepared	Analyzed	Analyst	Method	Notes
---------	--------	-----------------	-------	--------	----------	----------	---------	--------	-------

Microbac Laboratories, Inc. - Baltimore

Wet Chemistry

% Solids	68.13	0.05	% by Weight		091316 1600	091416 1110	RLD	SM 2540 G-11	
Chloride	19	15	mg/kg dry		091216 1436	091316 2213	PPM	SW-846 9056A	R1
Sulfate as SO4	310	15	mg/kg dry		091216 1436	091316 2213	PPM	SW-846 9056A	R1

Microbac Laboratories, Inc. - Baltimore

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Michael M. Gallion, Project Manager

Original Report

Page 7 of 12

CERTIFICATE OF ANALYSIS

Schnabel Engineering 1380 Wilmington Pike, Suite 100 West Chester, PA 19382	Project: Soil Analysis Project Number: 16C12012.00, Alexandria Waterfront, Virginia Project Manager: Luke Geake	Report: 16I0498 Reported: 09/16/2016 16:26
---	---	---

Project Requested Certification(s):

A2LA (Environmental)

Analyte Certification Exception Summary

No certification exceptions

All analysis performed were analyzed under the required certification unless otherwise noted in the above summary.

Certification List

Below is a list of certifications maintained by Microbac Laboratories, Inc. All data included in this report has been reviewed for and meets all project specific and quality control requirements of the applicable accreditation, unless otherwise noted. A complete list of individual analytes pursuant to each certification below is available upon request.

Code	Description	Certification Number	Expires
Microbac Laboratories, Inc. - Baltimore			
A2LA1	A2LA (Biology)	410.02	04/30/2017
A2LA2	A2LA (Environmental)	410.01	04/30/2017
VA-B	Commonwealth of Virginia (NELAC) - Baltimore	460285	03/14/2017
CPSC	CPSC Testing of Childrens Products and Jewelry	1115	04/30/2017
Pb	Environmental Lead (ELLAP)	410.01	04/30/2017
MD	State of Maryland (Drinking Water)	109	06/30/2017
WV	West Virginia	054	08/31/2017
Microbac Laboratories, Inc. - Richmond			
VA-R	Commonwealth of Virginia (NELAC) - Richmond	460022	06/14/2017





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CERTIFICATE OF ANALYSIS

Schnabel Engineering
1380 Wilmington Pike, Suite 100
West Chester, PA 19382

Project: Soil Analysis
Project Number: 16C12012.00, Alexandria Waterfront, Virginia
Project Manager: Luke Geake

Report: 16I0498
Reported: 09/16/2016 16:26

Qualifiers/Notes and Definitions

General Definitions:

DET Analyte DETECTED
ND Analyte NOT DETECTED at or above the reporting limit
dry Sample results reported on a dry weight basis
RPD Relative Percent Difference

Analysis Qualifiers/Notes:

Microbac Laboratories, Inc. - Baltimore

R1 Sample Duplicate RPD was out of acceptance limits.



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Cooler Receipt Log

Cooler ID: Default Cooler	Cooler Temp: 27.00°C	Work Order: 1610498
Custody Seals Intact: Yes	COC/Containers Agree: Yes	
Containers Intact: Yes	Correct Preservation: Yes	
Received On Ice: No	Correct Number of Containers Received: Yes	
Radiation Scan Acceptable: Yes	Sufficient Sample Volume for Testing: Yes	
COC Present: Yes	Samples Received in Proper Condition: Yes	

Comments:



*ADDITIONAL SAMPLES

CHAIN OF CUSTODY

1380 Wilmington Pike, Suite 100
 West Chester, Pennsylvania 19382
 610-696-6066 Phone
 610-696-7771 Fax



1610498

Project Number: 16C12012.00		Schnabel Engineering, LLC		1380 Wilmington Pike, Suite 100 West Chester, PA 19382		Contact: Luke Geake E-mail: lgeake@schnabel-eng.com Phone Number: 610-696-6066 Fax Number: 610-696-7771		Project Name: Alexandria Waterfront Project Number: 16C12012.00 Project Location: Alexandria, VA		Analysis	
Sample Identification	Container Size	Type	Sampling Date	Sample Type	Sample Type	Container Type	1. Soil	2. Geosynthetic	3. Rock	4. Concrete	5. Other
SS-2, S-4&5, 6-10 ft	1Qt	2		1	X	1. Bucket					
PS-1, S-1&2, 0-4 ft	1Qt	2		1	X	2. Bag					
SW-1, S-9&11, 28.5-35 ft	1Qt	2		1	X	3. Jar					
RCP-1, S-8&9, 18.5-25 ft	1Qt	2		1	X	4. Tube					
BH-2A, S-8,9&10, 15-25 ft	1Qt	2		1	X	5. Roll					
Received By: <i>Andrew Smith</i> Date: 9/8/16 Time: 10:00 AM Received By: Date: Time: Received By: Date: Time:											
Relinquished By: <i>Jake Smith</i> FEDEX Date: Time: Relinquished By: Date: Time: Relinquished By: Date: Time: SHIPPED VIA: FedEx											
Comments: Analysis per client MMG 9/8/16											

Cooler Receipt Form / Sample Acceptance & Noncompliance Form

Microbac Laboratories, Inc., Baltimore Division
 Control # 606-03
 Effective Date: 07/11/2016
 Page 1 of 1

Number of Coolers Received: 1
 Client: Schnabel Engineering, LLC
 Form Completed By: Anthony Smith
 Shipper:
 Custody Tape Intact:
 Containers Intact:
 Sample Received on Ice or refrigerated:

 Radiation Scan:
 Chain of Custody Present with shipment:
 Sample Bottle IDs agree with COC:
 Preservation requirements met:
 Correct Number of Containers / Sample Volume:
 Headspace in container:
 Type of Sample:

Receipt Date / Time: 9/8/16 10:00 AM
 Work Order # 16J0498

Microbac Client UPS FedEx
~~YES~~ / NO / NA

~~YES~~ / NO

YES / ~~NO~~ / NA

Infrared (IR) Temperature: 27.0 °C

Negative or _____ mR/hr

~~YES~~ / NO

~~YES~~ / NO

~~YES~~ / NO / Not Checked

~~YES~~ / NO (If No, contact client immediately)

YES / NO / ~~NA~~

Water Soil Wipes Oil Filter Solid
 Sludge Food Swab Other

Container Type / Quantity:

A -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid:	If preserved pH <2, pH >10
B -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
C -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
D -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
E -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
H -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
K -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
L -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
M -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
P -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
W -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
V -	Unpreserved	HCl	HCl / Ascorbic Acid	HCl / NaTHIO	(Checked at time of Analysis)		
F -	Unpreserved	NaTHIO (Checked at time of Analysis)					
S -	Unpreserved	NaTHIO (Checked at time of Analysis)					
SN -	Unpreserved	NaTHIO	NaTHIO/EDTA	(Checked at time of Analysis)			
	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10

Describe preservation requirements not met:

All Acid preserved <2 pH *NaOH preserved >12 pH* *All others >2 and <10 (usually 4-8)*
 Sample ID: _____ H₂SO₄ HNO₃ NaOH _____ mls added
 Sample ID: _____ H₂SO₄ HNO₃ NaOH _____ mls added
 Sample ID: _____ H₂SO₄ HNO₃ NaOH _____ mls added
 Sample ID: _____ H₂SO₄ HNO₃ NaOH _____ mls added

H₂SO₄ - Sulfuric Acid, HNO₃ - Nitric Acid, NaOH - Sodium Hydroxide, ASC - Ascorbic Acid, NaTHIO - Sodium Thiosulfate

Describe Anomalies: 5 zip-loc bags of soil.

Contact information / Summary of Actions:

Date / Time: _____ Contact: _____ Contact By: _____
 Comments: _____



Microbac Laboratories, Inc.

Baltimore Division
2101 Van Deman Street • Baltimore, MD 21224

Phone: 410-633-1800
Fax: 410-633-6553
www.microbac.com

COVER LETTER

Luke Geake
Schnabel Engineering
1380 Wilmington Pike, Suite 100
West Chester, PA 19382

September 16, 2016
Report No.: 16I0191

RE: Soil Analysis

The report of analyses contains test results for samples received at Microbac Laboratories, Inc., Baltimore Division on 09/01/2016 10:50.

The enclosed results were obtained from and applicable to the sample(s) as received at the laboratory. All sample results are reported on an "as received" basis unless otherwise noted.

All data included in this report has been reviewed and meet the applicable project and certification specific requirements, unless otherwise noted.

This report has been paginated in its entirety and shall not be reproduced except in full, without the written approval of Microbac Laboratories, Inc.

We appreciate the opportunity to service your analytical needs. If you have any questions, please feel free to contact us.

This Data Package contains the following:

- This Cover Page
- Sample Summary
- Test Results
- Certifications/Notes and Definitions
- Cooler Receipt Log
- Chain of Custody

9/16/2016

Final report reviewed by:

Michael M. Gallion/Project Manager

Report issue date

All samples received in proper condition and results conform to ISO 17025 and TNI NELAC standards unless otherwise noted.

If we have not met or exceeded your expectations, please contact Michael M. Gallion/Project Manager at 410-633-1800. You may also contact Trevor Boyce, President at trevor.boyce@microbac.com

CERTIFICATE OF ANALYSIS

Schnabel Engineering 1380 Wilmington Pike, Suite 100 West Chester, PA 19382	Project: Soil Analysis Project Number: Alexandria Waterfront Project Manager: Luke Geake	Report: 16I0191 Reported: 09/16/2016 16:27
---	--	---

SAMPLE SUMMARY

Sample ID	Laboratory ID	Matrix	Type	Date Sampled	Date Received
SS-1, S-7 & 8, 13.5-20'	16I0191-01	Solid	Composite	08/31/2016 00:00	09/01/2016 10:50
BH-1, S-2 & 3, 2-6'	16I0191-02	Solid	Composite	08/31/2016 00:00	09/01/2016 10:50
BH-1, S-11 & 12, 33.5-40'	16I0191-03	Solid	Composite	08/31/2016 00:00	09/01/2016 10:50
BH-1, S-18 & 19, 68.5-75'	16I0191-04	Solid	Composite	08/31/2016 00:00	09/01/2016 10:50
BH-2A, S-21 & 22, 73.5-80'	16I0191-05	Solid	Composite	08/31/2016 00:00	09/01/2016 10:50





Microbac Laboratories, Inc.
Baltimore Division

2101 Van Deman Street • Baltimore, MD 21224

Phone: 410-633-1800
Fax: 410-633-6553
www.microbac.com

CERTIFICATE OF ANALYSIS

Schnabel Engineering 1380 Wilmington Pike, Suite 100 West Chester, PA 19382	Project: Soil Analysis Project Number: Alexandria Waterfront Project Manager: Luke Geake	Report: 16I0191 Reported: 09/16/2016 16:27
---	--	---

SS-1, S-7 & 8, 13.5-20'

16I0191-01 (Solid) Sampled: 08/31/2016 00:00; Type: Composite

Analyte	Result	Reporting Limit	Units	Limits	Prepared	Analyzed	Analyst	Method	Notes
---------	--------	-----------------	-------	--------	----------	----------	---------	--------	-------

Microbac Laboratories, Inc. - Baltimore

Wet Chemistry

% Solids	65.53	0.05	% by Weight		090716 1340	090916 1350	RLD	SM 2540 G-11	
Chloride	48	15	mg/kg dry		090616 1200	090616 1758	PPM	SW-846 9056A	
Sulfate as SO4	57	15	mg/kg dry		090616 1200	090616 1758	PPM	SW-846 9056A	

Microbac Laboratories, Inc. - Baltimore

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Michael M. Gallion, Project Manager

Original Report

Page 3 of 12

CERTIFICATE OF ANALYSIS

Schnabel Engineering
1380 Wilmington Pike, Suite 100
West Chester, PA 19382

Project: Soil Analysis
Project Number: Alexandria Waterfront
Project Manager: Luke Geake

Report: 16I0191
Reported: 09/16/2016 16:27

BH-1, S-2 & 3, 2-6'

16I0191-02 (Solid) Sampled: 08/31/2016 00:00; Type: Composite

Analyte	Result	Reporting Limit	Units	Limits	Prepared	Analyzed	Analyst	Method	Notes
---------	--------	-----------------	-------	--------	----------	----------	---------	--------	-------

Microbac Laboratories, Inc. - Baltimore

Wet Chemistry

% Solids	83.68	0.05	% by Weight		090716 1340	090916 1350	RLD	SM 2540 G-11	
Chloride	61	12	mg/kg dry		090616 1200	090616 1823	PPM	SW-846 9056A	
Sulfate as SO4	390	12	mg/kg dry		090616 1200	090616 1823	PPM	SW-846 9056A	



CERTIFICATE OF ANALYSIS

Schnabel Engineering 1380 Wilmington Pike, Suite 100 West Chester, PA 19382	Project: Soil Analysis Project Number: Alexandria Waterfront Project Manager: Luke Geake	Report: 16I0191 Reported: 09/16/2016 16:27
---	--	---

BH-1, S-11 & 12, 33.5-40'

16I0191-03 (Solid) Sampled: 08/31/2016 00:00; Type: Composite

Analyte	Result	Reporting Limit	Units	Limits	Prepared	Analyzed	Analyst	Method	Notes
---------	--------	-----------------	-------	--------	----------	----------	---------	--------	-------

Microbac Laboratories, Inc. - Baltimore

Wet Chemistry

% Solids	64.04	0.05	% by Weight		090716 1340	090916 1350	RLD	SM 2540 G-11	
Chloride	18	15	mg/kg dry		090616 1200	090616 1848	PPM	SW-846 9056A	
Sulfate as SO4	43	15	mg/kg dry		090616 1200	090616 1848	PPM	SW-846 9056A	



CERTIFICATE OF ANALYSIS

Schnabel Engineering
1380 Wilmington Pike, Suite 100
West Chester, PA 19382

Project: Soil Analysis
Project Number: Alexandria Waterfront
Project Manager: Luke Geake

Report: 16I0191
Reported: 09/16/2016 16:27

BH-1, S-18 & 19, 68.5-75'

16I0191-04 (Solid) Sampled: 08/31/2016 00:00; Type: Composite

Analyte	Result	Reporting Limit	Units	Limits	Prepared	Analyzed	Analyst	Method	Notes
---------	--------	-----------------	-------	--------	----------	----------	---------	--------	-------

Microbac Laboratories, Inc. - Baltimore

Wet Chemistry

% Solids	74.83	0.05	% by Weight		090716 1340	090916 1350	RLD	SM 2540 G-11	
Chloride	ND	13	mg/kg dry		090616 1200	090616 1912	PPM	SW-846 9056A	
Sulfate as SO4	18	13	mg/kg dry		090616 1200	090616 1912	PPM	SW-846 9056A	





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 Baltimore Division

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CERTIFICATE OF ANALYSIS

Schnabel Engineering 1380 Wilmington Pike, Suite 100 West Chester, PA 19382	Project: Soil Analysis Project Number: Alexandria Waterfront Project Manager: Luke Geake	Report: 16I0191 Reported: 09/16/2016 16:27
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BH-2A, S-21 & 22, 73.5-80'

16I0191-05 (Solid) Sampled: 08/31/2016 00:00; Type: Composite

Analyte	Result	Reporting Limit	Units	Limits	Prepared	Analyzed	Analyst	Method	Notes
---------	--------	-----------------	-------	--------	----------	----------	---------	--------	-------

Microbac Laboratories, Inc. - Baltimore

Wet Chemistry

% Solids	79.70	0.05	% by Weight		090716 1340	090916 1350	RLD	SM 2540 G-11	
Chloride	ND	12	mg/kg dry		090616 1200	090616 1937	PPM	SW-846 9056A	
Sulfate as SO4	15	12	mg/kg dry		090616 1200	090616 1937	PPM	SW-846 9056A	

Microbac Laboratories, Inc. - Baltimore

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Michael M. Gallion, Project Manager

Original Report

Page 7 of 12

CERTIFICATE OF ANALYSIS

Schnabel Engineering 1380 Wilmington Pike, Suite 100 West Chester, PA 19382	Project: Soil Analysis Project Number: Alexandria Waterfront Project Manager: Luke Geake	Report: 16I0191 Reported: 09/16/2016 16:27
---	--	---

Project Requested Certification(s):

A2LA (Environmental)

Analyte Certification Exception Summary

No certification exceptions

All analysis performed were analyzed under the required certification unless otherwise noted in the above summary.

Certification List

Below is a list of certifications maintained by Microbac Laboratories, Inc. All data included in this report has been reviewed for and meets all project specific and quality control requirements of the applicable accreditation, unless otherwise noted. A complete list of individual analytes pursuant to each certification below is available upon request.

Code	Description	Certification Number	Expires
Microbac Laboratories, Inc. - Baltimore			
A2LA1	A2LA (Biology)	410.02	04/30/2017
A2LA2	A2LA (Environmental)	410.01	04/30/2017
VA-B	Commonwealth of Virginia (NELAC) - Baltimore	460285	03/14/2017
CPSC	CPSC Testing of Childrens Products and Jewelry	1115	04/30/2017
Pb	Environmental Lead (ELLAP)	410.01	04/30/2017
MD	State of Maryland (Drinking Water)	109	06/30/2017
WV	West Virginia	054	08/31/2017
Microbac Laboratories, Inc. - Richmond			
VA-R	Commonwealth of Virginia (NELAC) - Richmond	460022	06/14/2017





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Baltimore Division

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Fax: 410-633-6553

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CERTIFICATE OF ANALYSIS

Schnabel Engineering
1380 Wilmington Pike, Suite 100
West Chester, PA 19382

Project: Soil Analysis
Project Number: Alexandria Waterfront
Project Manager: Luke Geake

Report: 16I0191
Reported: 09/16/2016 16:27

Qualifiers/Notes and Definitions

General Definitions:

DET Analyte DETECTED
ND Analyte NOT DETECTED at or above the reporting limit
dry Sample results reported on a dry weight basis
RPD Relative Percent Difference



Microbac Laboratories, Inc.

Baltimore Division
2101 Van Deman Street • Baltimore, MD 21224

Phone: 410-633-1800
Fax: 410-633-6553
www.microbac.com

Cooler Receipt Log

Cooler ID: Default Cooler	Cooler Temp: 21.60°C	Work Order: 1610191
Custody Seals Intact: Yes	COC/Containers Agree: Yes	
Containers Intact: Yes	Correct Preservation: Yes	
Received On Ice: Yes	Correct Number of Containers Received: Yes	
Radiation Scan Acceptable: Yes	Sufficient Sample Volume for Testing: Yes	
COC Present: Yes	Samples Received in Proper Condition: Yes	

Comments:



Schnabel
ENGINEERING

CHAIN OF CUSTODY

1380 Wilmington Pike, Suite 100
West Chester, Pennsylvania 19382
610-696-6066 Phone
610-696-7771 Fax

Project Number: 16C12012.00				Analysis																																																																																													
Schnabel Engineering, LLC																																																																																																	
1380 Wilmington Pike, Suite 100 West Chester, PA 19382				<table border="1"> <tr> <td>Sample Type</td> <td>Container Type</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>1. Soil</td> <td>1. Bucket</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2. Geosynthetic</td> <td>2. Bag</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3. Rock</td> <td>3. Jar</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>4. Concrete</td> <td>4. Tube</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>5. Other</td> <td>5. Roll</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>										Sample Type	Container Type													1. Soil	1. Bucket													2. Geosynthetic	2. Bag													3. Rock	3. Jar													4. Concrete	4. Tube													5. Other	5. Roll												
Sample Type	Container Type																																																																																																
1. Soil	1. Bucket																																																																																																
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4. Concrete	4. Tube																																																																																																
5. Other	5. Roll																																																																																																
Contact: Luke Geake E-mail: lgeake@schnabel-eng.com Phone Number: 610-696-6066 Fax Number: 610-696-7771				<i>Chlorides + Sulfates</i>																																																																																													
Project Name: Alexandria Waterfront Project Number: 16C12012.00 Project Location: Alexandria, VA																																																																																																	
Sample Identification		Container Size	Container Type	Sampling Date	Sampling Time	Sample Type																																																																																											
SS-1, S-7&8, 13.5-20 ft		1Qt	2			1	X																																																																																										
BH-1, S-2&3, 2-6 ft		1Qt	2			1	X																																																																																										
BH-1, S-11&12, 33.5-40 ft		1Qt	2			1	X																																																																																										
BH-1, S-18&19, 68.5-75 ft		1Qt	2			1	X																																																																																										
BH-2A, S-21&22, 73.5-80 ft		1Qt	2			1	X																																																																																										
Relinquished By: <i>Luke Geake</i>				Date: <i>8/21/16</i>		Received By: <i>Anthony Smith</i>				Date: <i>9/1/16</i>		Turn Around Time Requested:																																																																																					
Relinquished By:				Time:		Received By:				Time: <i>10:50 AM</i>		No. of Business Days: <i>8</i>																																																																																					
Relinquished By:				Date:		Received By:				Date:		ASAP																																																																																					
Relinquished By:				Time:		Received By:				Time:		Special Instructions:																																																																																					
SHIPPED VIA: FedEx																																																																																																	



Cooler Receipt Form / Sample Acceptance & Noncompliance Form

Microbac Laboratories, Inc., Baltimore Division
Control # 606-03
Effective Date: 07/11/2016
Page 1 of 1

Number of Coolers Received: 1

Receipt Date / Time: 9/1/16 10:50 AM

Client: Schnabel Engineering, LLC

Work Order # _____

Form Completed By: _____

Shipper:

Microbac Client UPS FedEx

Custody Tape Intact:

YES / NO / NA

Containers Intact:

YES / NO

Sample Received on Ice or refrigerated:

YES / NO / NA

Radiation Scan:

Infrared (IR) Temperature: 21.6 °C

Chain of Custody Present with shipment:

Negative or _____ mR/hr

Sample Bottle IDs agree with COC:

YES / NO

Preservation requirements met:

YES / NO

Correct Number of Containers / Sample Volume:

YES / NO / Not Checked

Headspace in container:

YES / NO (If No, contact client immediately)

Type of Sample:

YES / NO / NA

Water Soil Wipes Oil Filter Solid
Sludge Food Swab Other

Container Type / Quantity:

A -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid:	If preserved pH <2, pH >10
B -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
C -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
D -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
E -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
H -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
K -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
L -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
M -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
P -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
W -	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
V -	Unpreserved	HCl	HCl / Ascorbic Acid	HCl / NaTHIO	(Checked at time of Analysis)		
F -	Unpreserved	NaTHIO (Checked at time of Analysis)					
S -	Unpreserved	NaTHIO (Checked at time of Analysis)					
SN -	Unpreserved	NaTHIO NaTHIO/EDTA (Checked at time of Analysis)					
	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10
	Unpreserved	H2SO4	HNO3	HCl	NaOH	NaOH/Ascorbic Acid	If preserved pH <2, pH >10

Describe preservation requirements not met:

All Acid preserved <2 pH NaOH preserved >12 pH All others >2 and <10 (usually 4-8)

Sample ID: _____ H₂SO₄ HNO₃ NaOH _____ mls added
 Sample ID: _____ H₂SO₄ HNO₃ NaOH _____ mls added
 Sample ID: _____ H₂SO₄ HNO₃ NaOH _____ mls added
 Sample ID: _____ H₂SO₄ HNO₃ NaOH _____ mls added

H₂SO₄ – Sulfuric Acid, HNO₃ – Nitric Acid, NaOH – Sodium Hydroxide, ASC – Ascorbic Acid, NaTHIO – Sodium Thiosulfate

Describe Anomalies: Samples in 5 zip-loc bags:

Contact information / Summary of Actions:

Date / Time: _____ Contact: _____ Contact By: _____

Comments: _____

APPENDIX D

LABORATORY TEST DATA BY OTHERS

SUMMARY OF LABORATORY TESTING
WATERFRONT SMALL AREA

PROJECT #: 15303359
 SAMPLES: 17
 REPORT: 04/29/14

SAMPLED: -
 LOCATION: -
 REMARKS: -

JAY KAY TESTING
 5233 Lehman Road, Suite 110
 Spring Grove, PA 17362
 Phone: (410) 259-5101

BORING	SAMPLE	DEPTH	MC %	OM %	LL	PL	PI	% FINES	USCS
B-1	S-4	8.5-10.0	33.6	-	-	-	-	-	-
B-1	S-5	13.5-15.0	35.4	-	NP	NP	NP	12.8	SM
B-1	S-6	18.5-20.0	26.9	-	-	-	-	-	-
B-1	S-7	23.5-25.0	46.5	-	-	-	-	-	-
B-1	S-8	28.5-30.0	24.4	-	31	NP	NP	15.4	GM
B-1	S-10	38.5-40.0	82.7	-	-	-	-	-	-
B-1	S-13	53.5-55.0	49.3	-	-	-	-	-	-
B-1	S-15	63.5-65.0	33.5	-	-	-	-	-	-
B-2	S-5	13.5-15.0	35.9	-	43	29	14	50.2	ML
B-2	S-6	18.5-20.0	71.3	-	-	-	-	-	-
B-2	S-7	23.5-25.0	59.6	-	79	39	40	90.9	MH
B-2	S-8	28.5-30.0	51.1	-	-	-	-	-	-
B-2	S-9	33.5-35.0	53.9	-	-	-	-	-	-
B-2	S-10	38.5-40.0	59.7	-	-	-	-	-	-
B-2	S-11	43.5-45.0	54.0	-	-	-	-	-	-
B-2	S-12	48.5-50.0	17.2	-	-	-	-	-	-
B-2	S-15	63.5-65.0	19.5	-	-	-	-	-	-

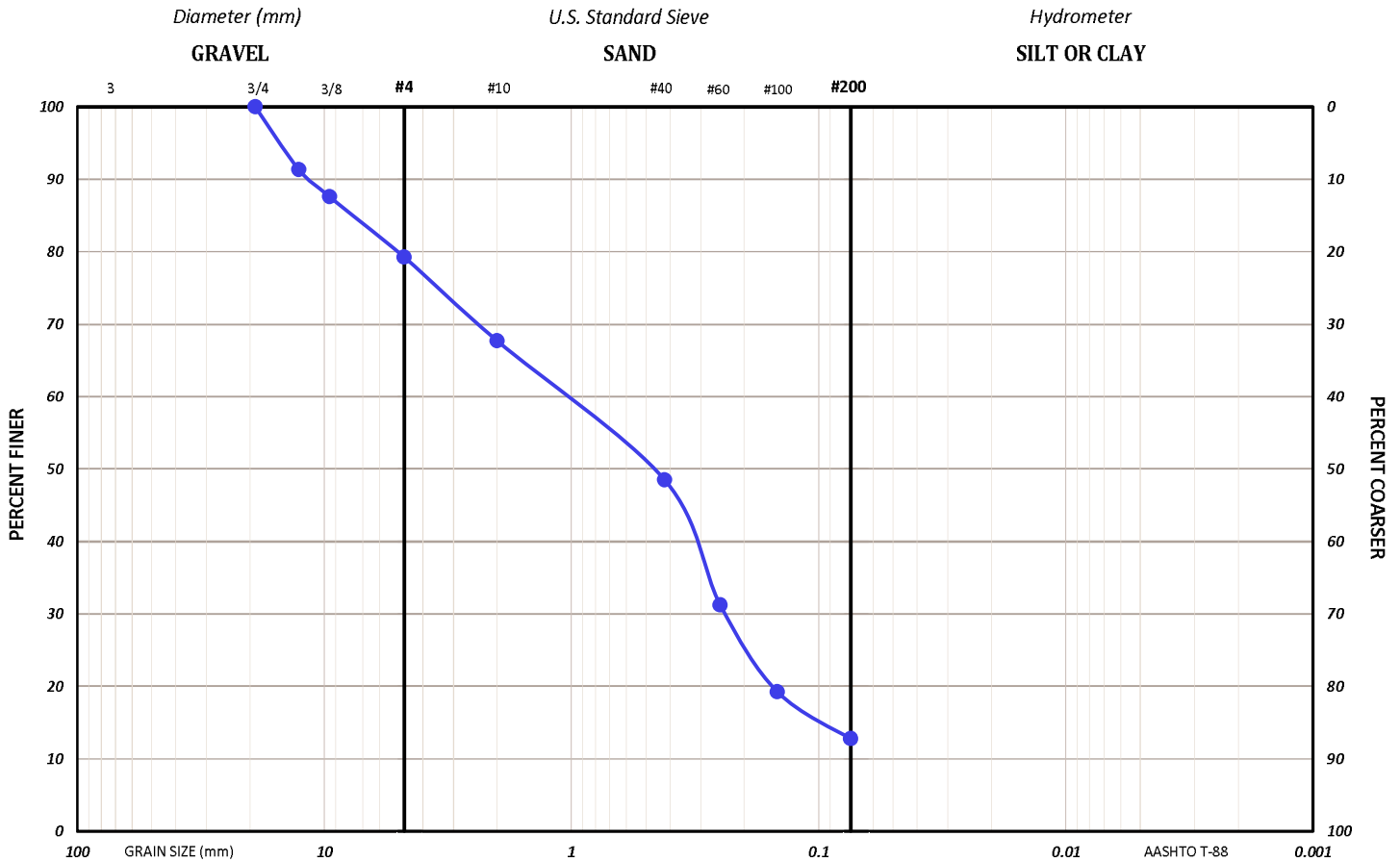
Jay Kay Testing (AASHTO-Accredited)

WATERFRONT SMALL AREA

BORING: B-1
 SAMPLE: S-5
 DEPTH: 13.5-15.0'

PROJECT #: 15303359
 SAMPLED: -
 LOCATION: -

JAY KAY TESTING
 5233 Lehman Road, Suite 110
 Spring Grove, PA 17362
 Phone: (410) 259-5101



GRAIN SIZE ANALYSIS

Diameter	75.0	50.8	37.5	25.4	19.0	12.7	9.51	4.76	2.0	0.42	0.25	0.147	0.074
Sieve Size	3"	2"	1.5"	1"	3/4"	1/2"	3/8"	#4	#10	#40	#60	#100	#200
% Passing	-	-	-	-	100.0	91.3	87.6	79.2	67.7	48.5	31.2	19.2	12.8

% GRAVEL	% SAND	Coarse Gravel	Fine Gravel	Coarse Sand	Medium Sand	Fine Sand	CC	CU
20.8	66.4	-	20.8	11.5	19.2	35.7	-	-

Moisture Content	35.4	Organic Content	-
pH	-	Other	-

ATTERBERG LIMITS

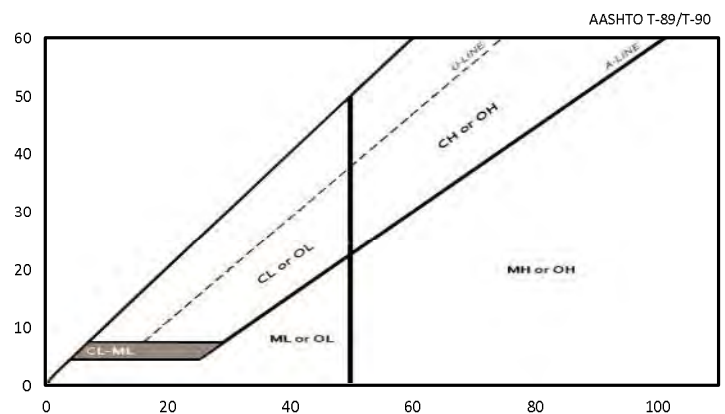
Liquid Limit	NP
Plastic Limit	NP
Plasticity Index	NP

CLASSIFICATION

AASHTO	A-1-b
USCS	SM

SOIL DESCRIPTION

Dark gray silty SAND with gravel (and bark)

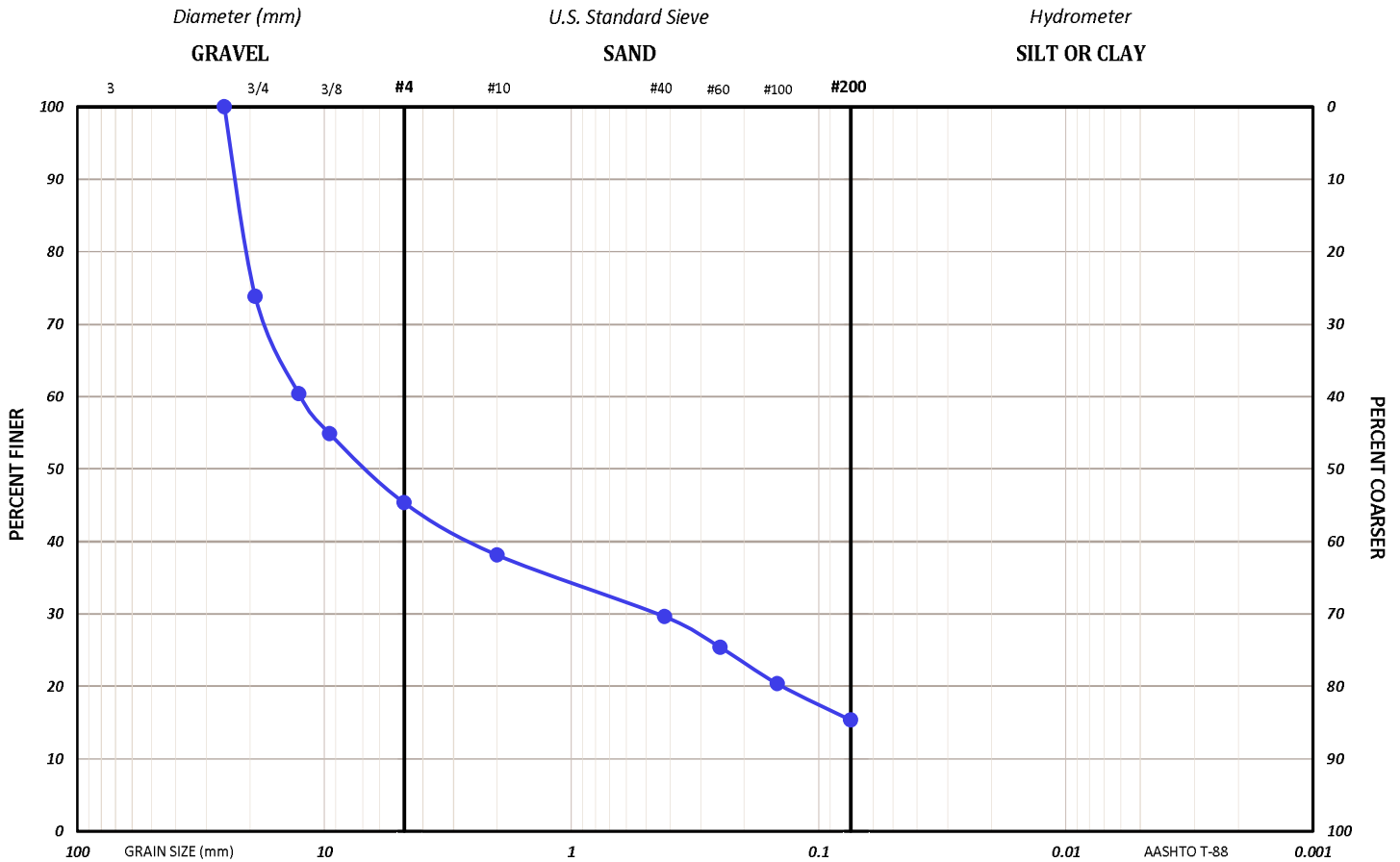


WATERFRONT SMALL AREA

BORING: B-1
 SAMPLE: S-8
 DEPTH: 28.5-30.0'

PROJECT #: 15303359
 SAMPLED: -
 LOCATION: -

JAY KAY TESTING
 5233 Lehman Road, Suite 110
 Spring Grove, PA 17362
 Phone: (410) 259-5101



GRAIN SIZE ANALYSIS

Diameter	75.0	50.8	37.5	25.4	19.0	12.7	9.51	4.76	2.0	0.42	0.25	0.147	0.074
Sieve Size	3"	2"	1.5"	1"	3/4"	1/2"	3/8"	#4	#10	#40	#60	#100	#200
% Passing	-	-	-	100.0	73.8	60.4	54.9	45.3	38.2	29.6	25.4	20.4	15.4

% GRAVEL	% SAND	Coarse Gravel	Fine Gravel	Coarse Sand	Medium Sand	Fine Sand	CC	CU
54.7	29.9	26.2	28.5	7.1	8.6	14.2	-	-

Moisture Content: 24.4
 pH: -
 Organic Content: -
 Other: -

ATTERBERG LIMITS

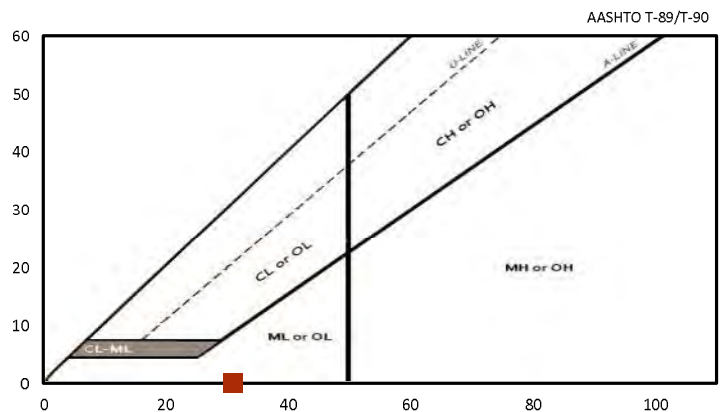
Liquid Limit: 31
 Plastic Limit: NP
 Plasticity Index: NP

CLASSIFICATION

AASHTO: A-1-b
 USCS: GM

SOIL DESCRIPTION

Dark gray silty GRAVEL with sand (and bark)

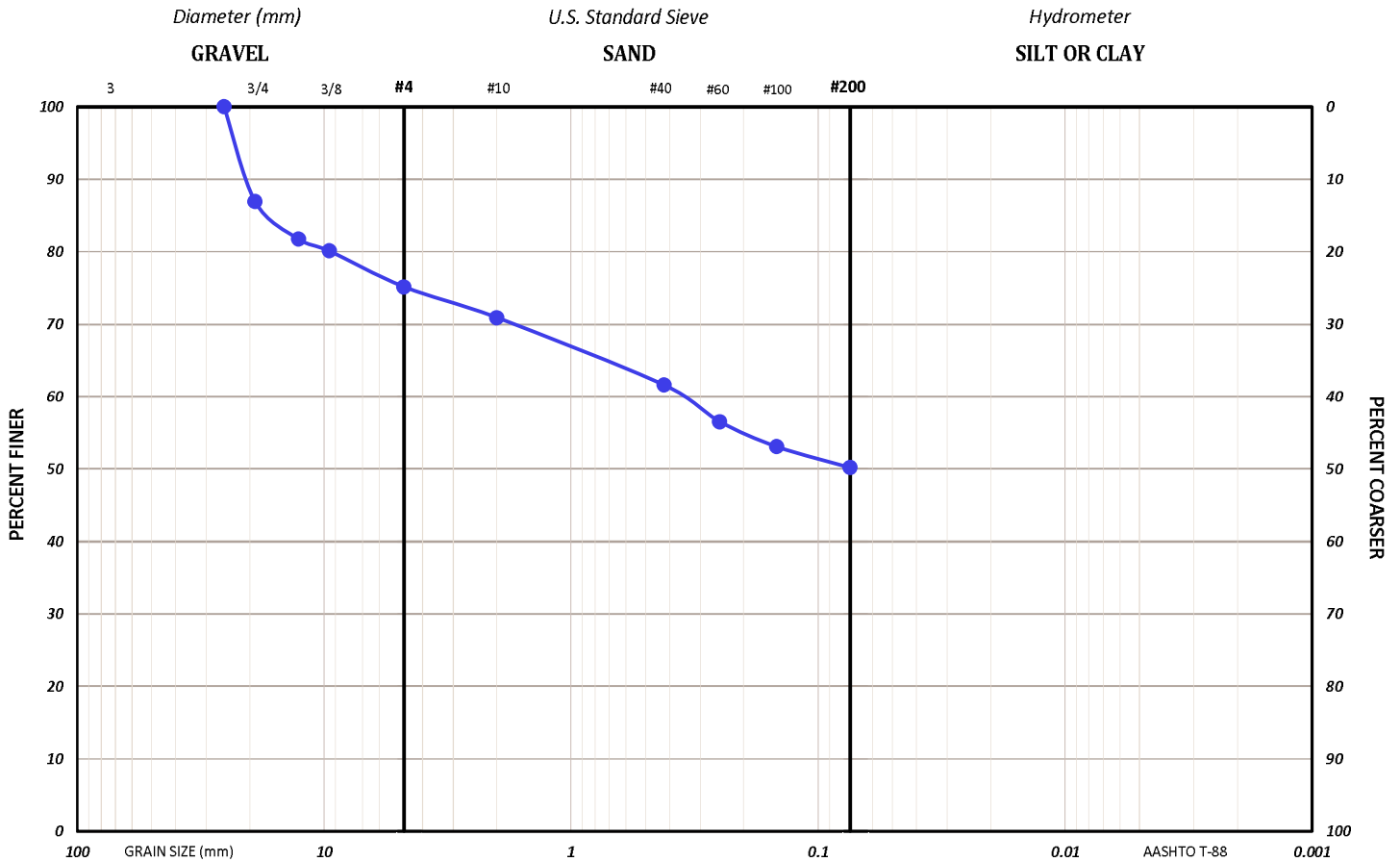


WATERFRONT SMALL AREA

BORING: B-2
 SAMPLE: S-5
 DEPTH: 13.5-15.0'

PROJECT #: 15303359
 SAMPLED: -
 LOCATION: -

JAY KAY TESTING
 5233 Lehman Road, Suite 110
 Spring Grove, PA 17362
 Phone: (410) 259-5101



GRAIN SIZE ANALYSIS

Diameter	75.0	50.8	37.5	25.4	19.0	12.7	9.51	4.76	2.0	0.42	0.25	0.147	0.074
Sieve Size	3"	2"	1.5"	1"	3/4"	1/2"	3/8"	#4	#10	#40	#60	#100	#200
% Passing	-	-	-	100.0	86.9	81.8	80.1	75.2	70.9	61.6	56.5	53.1	50.2

% GRAVEL	% SAND	Coarse Gravel	Fine Gravel	Coarse Sand	Medium Sand	Fine Sand	CC	CU
24.8	25.0	13.1	11.7	4.3	9.3	11.4	-	-

Moisture Content	35.9	Organic Content	-
pH	-	Other	-

ATTERBERG LIMITS

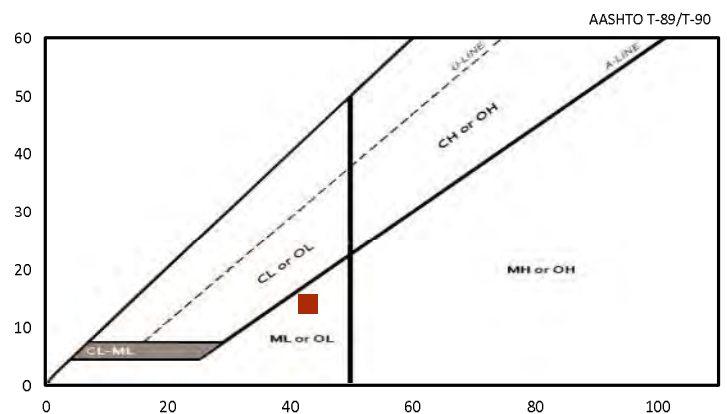
Liquid Limit	43
Plastic Limit	29
Plasticity Index	14

CLASSIFICATION

AASHTO	A-7-6
USCS	ML

SOIL DESCRIPTION

Dark gray sandy SILT with gravel

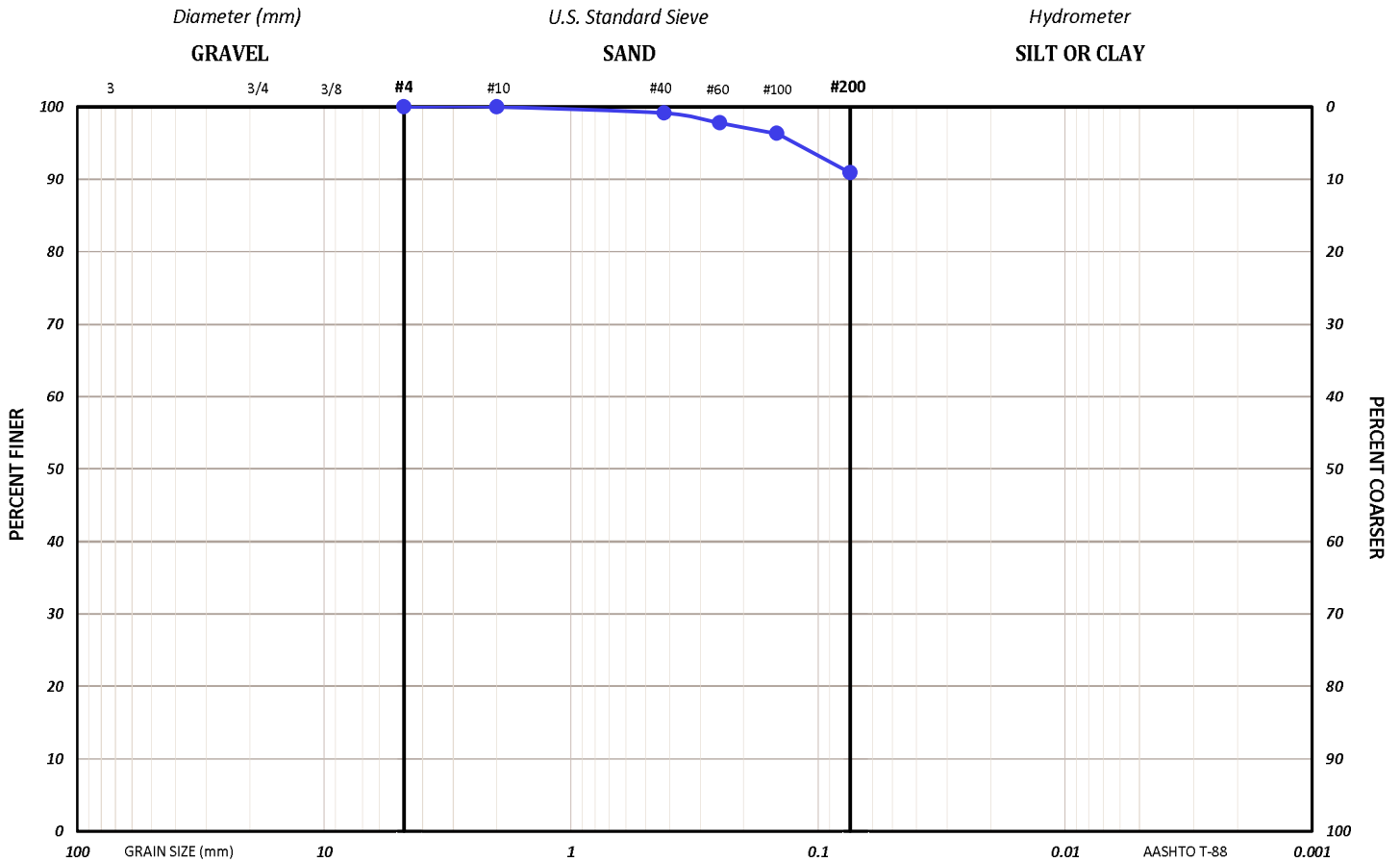


WATERFRONT SMALL AREA

BORING: B-2
 SAMPLE: S-7
 DEPTH: 23.5-25.0'

PROJECT #: 15303359
 SAMPLED: -
 LOCATION: -

JAY KAY TESTING
 5233 Lehman Road, Suite 110
 Spring Grove, PA 17362
 Phone: (410) 259-5101



GRAIN SIZE ANALYSIS

Diameter	75.0	50.8	37.5	25.4	19.0	12.7	9.51	4.76	2.0	0.42	0.25	0.147	0.074
Sieve Size	3"	2"	1.5"	1"	3/4"	1/2"	3/8"	#4	#10	#40	#60	#100	#200
% Passing	-	-	-	-	-	-	-	100.0	99.9	99.1	97.8	96.3	90.9

% GRAVEL	% SAND	Coarse Gravel	Fine Gravel	Coarse Sand	Medium Sand	Fine Sand	CC	CU
-	9.1	-	-	0.1	0.8	8.2	-	-

Moisture Content	59.6	Organic Content	-
pH	-	Other	-

ATTERBERG LIMITS		CLASSIFICATION	
Liquid Limit	79	AASHTO	A-7-5
Plastic Limit	39	USCS	MH
Plasticity Index	40		

SOIL DESCRIPTION
 Dark brown elastic SILT

