COMMONWEALTH of VIRGINIA

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November 2, 2017

Mr. Michael Liberati
DuPont Corporate Remediation Group
Chestnut Run Plaza 715-236
Wilmington, DE 19805

VIA ELECTRONIC MAIL

Re: Revised Final Design Submittal for the Waste Water Treatment Plant Bank Management Areas
Former DuPont Waynesboro Plant, Area of Concern 4
Waynesboro, Virginia
EPA ID# VAD003114832

Dear Mr. Liberati:

This letter acknowledges the receipt and review of the Revised Final Design Submittal for the Waste Water Treatment Plant Bank Management Areas, submitted to the Virginia Department of Environmental Quality, Office of Remediation Programs (Department) by Anchor QEA, LLC on behalf of the E.I du Pont de Nemours and Company (DuPont).

The Department approves the design with no further comment at this time.

If you have any questions, you may contact me at 703-583-3825 or by email at Kurt.Kochan@deq.virginia.gov.

Sincerely,

Kurt W. Kochan
Corrective Action Project Manager
Office of Remediation Programs

cc: DuPont Waynesboro Correspondence File
Brett Fisher, Calvin Jordan, VDEQ-CO
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BASIS OF DESIGN REPORT
PHASE 1A BANK MANAGEMENT AREAS
SOUTH RIVER AREA OF CONCERN 4

Prepared for

Virginia Department of Environmental Quality

City of Waynesboro

Prepared by

Anchor QEA, LLC

AECOM

E. I. du Pont de Nemours and Company

REVISIONS				
REV	DATE	BY	APPD	DESCRIPTION
1	9/22/2016	SFH	WJD	REVISED FINAL DESIGN REPORT SUBMITTAL
2	7/24/2017	SFH	WJD	REVISED FOR WWTP A/B FINAL DESIGN SUBMITTAL

July 2017

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LIST OF ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
BMA	bank management area
BMP	best management practice
BODR	Basis of Design Report
City	City of Waynesboro, Virginia
cm/s	centimeters per second
cy	cubic yards
DGIF	Department of Game and Inland Fisheries
DGPS	differential global positioning system
DSR	DuPont Site Representative
DuPont	former E.I. du Pont de Nemours and Company
Ecological Study	*Ecological Study of the South River and a Segment of the South Fork Shenandoah River, Virginia*
EPA	U.S. Environmental Protection Agency
FGCM	fine-grained channel margin
H:V	horizontal to vertical
g/cm^3	grams per cubic centimeters
HASP	Health and Safety Plan
HDPE	high density polyethylene
IHg	inorganic mercury
IMWP	*Interim Measures Design, Implementation, and Monitoring Work Plan*
kg/mile-year	kilograms per mile per year
LiDAR	Light Detection and Ranging
LWA	length-weighted average
mg/kg	milligram per kilogram
mg/L	milligram per liter
MPA	mass per unit area
NRDC	Natural Resources Defense Council

Permit	Final Hazardous Waste Permit for Corrective Action-Renewal EPA ID No. VAD003114832
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RRM	relative river mile; miles downstream of former DuPont Waynesboro facility footbridge
SFS	South Fork of the Shenandoah
SRST	South River Science Team
STMP	*Final AOC 4 Short-Term Monitoring Plan – Relative River Mile 0-2 of the South River, Virginia*
TCLP	toxicity characteristic leaching procedure
THg	total mercury
USACE	U.S. Army Corps of Engineers
VADEQ	Virginia Department of Environmental Quality
VDOT	Virginia Department of Transportation
WWTP	wastewater treatment plant

1 INTRODUCTION

This Basis of Design Report (BODR) describes key design elements for remediation of mercury-impacted banks downstream of the former E.I. du Pont de Nemours and Company (DuPont) facility in the City of Waynesboro, Virginia (City). The remediation measures discussed herein were conceptually developed in the Remediation Proposal submitted to the Natural Resources Defense Council (NRDC; Anchor QEA et al. 2013), and were subsequently refined in the *Interim Measures Design, Implementation, and Monitoring Work Plan* (IMWP; Anchor QEA et al. 2015) approved by the Virginia Department of Environmental Quality (VADEQ) in March 2015. Design and implementation of the remediation measures described in this BODR are being performed as an interim measure under the regulatory authority of the Resource Conservation and Recovery Act (RCRA) within the South River Area of Concern (AOC) 4 under RCRA Permit No. VAD003114832. The map in Figure 1-1 shows the approximate area of AOC 4, consistent with the RCRA Permit.

Consistent with the IMWP, corrective actions in the South River will generally be performed in an upstream-to-downstream sequence within an adaptive management framework. As discussed in more detail in Section 2.3, the first phase of remediation in the South River (termed Phase 1) addresses banks within the first 2 river miles downstream of the former DuPont Waynesboro facility (i.e., relative river miles [RRMs] 0 to 2; see Figure 2-2). Phase 1 is part of a larger remedial strategy designed to address inorganic mercury (IHg), historically released from the former DuPont Waynesboro facility to the South River and a portion of the South Fork of the Shenandoah (SFS) River. As described in more detail in this BODR, Phase 1 interim measures target bank management areas (BMAs) within RRMs 0 to 2 that contribute disproportionately to IHg loading to the South River. A subset of those Phase 1 BMAs located on land owned by DuPont and the City will be addressed first (Phase 1A), followed by the remaining City-owned BMAs and non-City-owned BMAs in RRMs 0 to 2 (Phase 1B). This BODR describes design elements for Phase 1A BMAs.

Subsequent sections of this BODR are organized as follows:

- Section 2 – Site Overview
- Section 3 – Remedial Measures

- Section 4 – Implementation Plan
- Section 5 – Schedule and Sequencing of Activities
- Section 6 – Quality Assurance/Quality Control
- Section 7 – Documentation and Reporting
- Section 8 – Monitoring and Maintenance
- Section 9 – References

The following appendices are attached to this BODR:

- Appendix A – Geotechnical Investigation Report
- Appendix B – Supplemental Bank Coring Report
- Appendix C – Bathymetric Survey Data
- Appendix D – Geophysical Survey Report
- Appendix E – Bank Loading Model Refinements
- Appendix F – Biochar Amendment Supporting Information
- Appendix G – Geotechnical Calculations
- Appendix H – Toe Armor Stone Sizing Calculations
- Appendix I – Hydraulic Modeling Report
- Appendix J – Preliminary Tree Survey
- Appendix K – Final Design Plans
- Appendix L – Technical Specifications
- Appendix M –Maintenance Plan
- Appendix N – Project-specific Waste Management Plan for Interim Measures Design and Implementation – Area of Concern (AOC) 4
- Appendix OMemorandum – Phase 1A Bank Stabilization, Slope Stability Analysis of Berm Improvements Outside of Bank Management Area

2 SITE OVERVIEW

2.1 Site History

From 1929 to 1950, DuPont used mercury compounds (e.g., mercuric sulfate) in the production of acetate flake and yarn at the former DuPont Waynesboro facility. This process generated mercury-containing sludge that was conveyed to an on-site retort facility where the majority of the mercury was recovered. During that period, IHg was released to both the upland facility and the South River. Storm sewers that drain the former mercury management areas at the upland facility are currently being addressed by DuPont, VADEQ, and the U.S. Environmental Protection Agency (EPA) under a separate RCRA action. Upland control measures associated with storm sewers at the former DuPont Waynesboro facility are mostly complete, and remaining proposed activities are currently anticipated to be completed in spring 2017.

The Commonwealth of Virginia instituted a fish consumption advisory on the South River and SFS River in 1977, which is still in effect (VDH 2014). Comparisons of fish tissue data collected in summer and fall of 1999, with results from the 1980s and earlier, indicated that total mercury (THg) concentrations in tissue from a number of fish species remained steady or may have increased over time (URS 2012). This finding prompted discussions between DuPont and VADEQ in 2000 on the need to reassess the legacy mercury issue in the South River and SFS River; these discussions led to the formation of the South River Science Team (SRST) in 2001 and initiation of a detailed ecological study of the river system.

In September 2012, DuPont prepared and submitted to the NRDC the *Ecological Study of the South River and a Segment of the South Fork Shenandoah River, Virginia* (Ecological Study; URS 2012), which summarized comprehensive data on South River geophysical, chemical, and biological mechanisms and pathways of mercury exposure. The Ecological Study identified bank erosion as the primary mechanism for ongoing IHg release and transport to the South River and SFS River. Mass loading estimates and assumptions supporting the estimates are described in detail in the Ecological Study (Appendix K in URS 2012). Following completion of the Ecological Study, DuPont prepared a Remediation Proposal (Anchor QEA et al. 2013) detailing the framework for undertaking remedial measures in the South River and a segment of the SFS River. The completion of the Ecological Study in 2012, and acceptance of the Remediation Proposal by NRDC/Sierra Club in 2013, allowed the remedial efforts to be incorporated into the RCRA program in 2014, with oversight by the VADEQ. The Remediation Proposal included initial details on approaches to reduce or eliminate loading of mercury to the South River and associated environments, as well as monitoring to determine remedial effectiveness and integrity.

Interim measures and corrective actions at the former DuPont Waynesboro facility are being conducted by DuPont in accordance with the requirements set forth in a RCRA Corrective Action Permit (Final Hazardous Waste Permit for Corrective Action-Renewal EPA ID No. VAD003114832; Permit). In February 2014, VADEQ amended the Permit to incorporate AOC 4, which includes aquatic and riparian/floodplain areas extending from South River RRMs 0 to 24, continuing through a portion of the SFS River (Figure 1-1). As discussed previously, the IMWP (Anchor QEA et al. 2015), which was approved under the Permit by VADEQ in March 2015, outlines remediation plans for BMAs in the first 2 river miles of AOC 4.

2.2 Remedial Action Objectives

As discussed in the IMWP (Anchor QEA et al. 2015), overall remedial action objectives for Phase 1A interim measures are as follows:

- Reduce mercury loading to the South River from bank erosion
- Reduce mercury loading to the South River from leaching of bank soils, as practicable
- Decrease the impact of shear stress on banks with high erosion potential

Upon review of conceptual Phase 1A Interim Measure designs, the City and Virginia Department of Game and Inland Fisheries (DGIF) raised concerns regarding potential impacts to riparian and upland habitats (e.g., mature trees). The final designs strike a balance between the remedial objectives of the RCRA Corrective Action stated above and stakeholder objectives of maintaining riparian and near-bank aquatic habitat functions, improving access to the river for recreational activities, and minimizing disruption.

Based on the outcome of collaborative design discussions with DuPont, the City, VADEQ, DGIF, and the SRST, the design elements described in this BODR were developed to optimize and balance all of the objectives listed above. Section 3 provides additional detail on how each of these objectives are achieved by the Phase 1A interim measures.

2.3 Phase 1A Bank Management Areas

The Remediation Proposal (Anchor QEA et al. 2013) developed a bank erosion THg loading model for RRMs 0 to 2 using multiple lines of evidence, including bank soil THg concentrations, measured bank erosion rates, hydrodynamic modeling, and other information. The model was refined in the IMWP (Anchor QEA et al. 2015), and has been further refined in this BODR, incorporating additional pre-design investigation sampling and analysis data (Appendix B). Based on the updated bank erosion THg loading model (Appendix E), Phase 1 BMAs were identified as those banks that collectively contribute approximately 90% of the THg loading from bank erosion in RRMs 0 to 2 (Figure 2-1). In general, the BMAs identified by the updated bank erosion THg loading model are the same as those identified in the earlier version of the model presented in the IMWP. Only a few of the banks previously identified as BMAs with the earlier version of the model were replaced by banks that were not previously identified as BMAs, and these were all from the lower end of the loading distribution (i.e., contributing less than 0.1% of the total THg load in RRMs 0 to 2). These differences are considered to be within the uncertainty of the original model.

For this BODR, Phase 1 BMAs were further divided into Primary and Secondary BMAs to differentiate those banks that contribute disproportionately to THg loading in RRMs 0 to 2. Phase 1 Primary BMAs are those banks with relatively high unit THg loading rates (greater than approximately 20 kilograms per mile per year [kg/mile-year]) that collectively contribute approximately 50% of the THg loading from bank erosion in RRMs 0 to 2 (Figure 2-1). The combined Primary and Secondary BMAs contribute roughly 90% of the THg loading from bank erosion in RRMs 0 to 2, and represent approximately 25% of the total bank length in RRMs 0 to 2. Phase 1 Primary BMAs represent approximately 5% of the total bank length in RRMs 0 to 2 (approximately 0.16 miles). Phase 1 Secondary BMAs contribute an additional 40% of the THg loading from bank erosion and represent approximately 20% of the total bank length (approximately 0.84 miles) in RRMs 0 to 2.

Phase 1 Primary and Secondary BMAs were further divided into Phase 1A and 1B based on land ownership and landowner preferences regarding which BMAs to advance first (Figure 2-2). Phase 1A BMAs include the DuPont-owned Primary and Secondary BMAs at Constitution Park and the City-owned Primary and Secondary BMAs at the Waynesboro Wastewater Treatment Plant (WWTP). Phase 1B BMAs include the remaining City-owned Primary and Secondary BMAs, as well as all non-City-owned Primary and Secondary BMAs in RRMs 0 to 2. This BODR describes design elements for Phase 1A BMAs. Phase 1B BMAs will be addressed as part of follow-on Phase 1B corrective measures.

Based on the outcome of collaborative design discussions between DuPont, the City, VADEQ, DGIF, and the SRST, optimization and balancing of the objectives listed in Section 2.2 can be best achieved by focused bank soil removal actions in the relatively localized Phase 1A Primary BMAs (Figures 2-1 and 2-2). As described in Section 3, less invasive enhanced vegetative stabilization designs have been developed for the Phase 1A Secondary BMAs. The following sections briefly identify each of the Phase 1A Primary BMAs. More detailed discussions of the key design elements applied to each of these BMAs are presented in Section 3; existing conditions at these BMAs are summarized in sheets EC-1 through EC-3 provided in Appendix K.

2.3.1 Constitution Park

The Constitution Park Phase 1A BMAs (Primary and Secondary) occupy a portion of the river bank in Constitution Park, which is on the left descending bank between Short Street and Virginia State Route 340 (Main Street), from RRMs 0.18 to 0.25. The Primary BMA in this area extends from RRMs 0.19 to 0.21 (Figure 2-2), and is characterized by a relatively high unit THg loading rate of approximately 70 kg/mile-year.

2.3.2 Wastewater Treatment Plant

There are two individual Primary BMAs on the banks located adjacent to the City's WWTP, which are designated as WWTP A and B. The WWTP A Primary BMA is situated directly adjacent to the City's vehicle maintenance area immediately downstream of the 2nd Street Bridge. It extends from RRM 1.34 to RRM 1.38 (Figure 2-2) and has a unit THg loading of approximately 62 kg/mile-year. The WWTP B Primary BMA occupies the banks adjacent to the settling basins and other treatment tanks and extends from RRM 1.48 to RRM 1.50 (Figure 2-2). WWTP B has an uncharacterized unit THg loading rate, primarily due to uncertainties in the bank erosion rate in this area. However, based on visible evidence of bank erosion, as well as elevated near-surface bank soil THg concentrations, this area has been included as a Primary BMA.

2.4 Pre-Design Investigations

As outlined in the IMWP (Anchor QEA et al. 2015), a series of pre-design investigations were performed to support detailed designs. Table 2-1 summarizes the Phase 1A BMA pre-design investigations, which are presented in more detail in appendices to this BODR.

Table 2-1
Phase 1A BMA Pre-Design Investigations

Investigation	Description
Geotechnical Investigation	Geotechnical investigations were performed in November 2014. Geotechnical soil borings were advanced in each of the Phase 1A BMAs. The results of the investigation are summarized in Appendix A.
Supplemental Bank Coring	Soil borings to further characterize mercury concentrations in prospective Primary Phase 1A BMAs were collected in spring 2015. Results of this investigation are summarized in Appendix B.
WWTP A Bank Face Sampling	Bank face samples were collected in February 2016 along the bank face in the WWTP A secondary BMA to confirm bank face concentrations along steeper portions of the bank. Results of this investigation are summarized in Appendix B.
Hydrodynamic Modeling	Hydrodynamic modeling was performed in support of the bank erosion mercury loading used to identify Phase 1 BMAs (see Appendix C of the IMWP [Anchor QEA et al. 2015]). Water surface elevations and velocities predicted by the model under different flow events are used herein to inform the design.
Topographic Surveys	Topographic data from various sources were combined to support design, including flyover LiDAR data collected in 2005 (Surdex Corporation 2005) and 2011 (USGS 2011) and land-based LiDAR surveys of the riverbanks (see Appendix A of the IMWP [Anchor QEA et al. 2015]). In late 2015/early 2016, a topographic survey was conducted by EGS & Associates to confirm bank profiles and elevations within the Phase 1A BMAs.
Bathymetric Survey	A bathymetric survey was conducted in November 2014 to obtain elevation data below the waterline in the Phase 1 area. The bathymetry data generated by this survey are summarized in Appendix C.

Investigation	Description
Utility Survey	Buried utilities within the Phase 1A BMA areas were marked by Miss Utility of Virginia, and the markings were surveyed by a Virginia-licensed surveyor. In addition, a geophysical survey was conducted in the Phase 1A BMAs to further identify the presence of buried utilities and/or debris. Locations of utilities identified during the geophysical survey were obtained with a DGPS. The geophysical survey is summarized in Appendix D.
Tree Survey	The position, size, and species of trees within the Phase 1A areas were collected during a survey in May 2015. Position data were obtained with a DGPS. The positions of trees within the Secondary BMAs and along the boundaries of the Primary BMAs were surveyed by EGS & Associates. Further detail on the tree survey is provided in Appendix J. Data obtained during the tree survey are shown in the plan sheets provided in Appendix K. Multiple tree evaluations and consultations were held among stakeholders, including the City of Waynesboro, the Department of Game and Inland Fisheries, the SRST, and the Virginia Department of Environmental Quality. The information from the surveys and consultations has been incorporated into the final design.
Ordinary High Water Mark and Low Water Mark Surveys	Indicators of the ordinary high water mark, including the position of the lowest elevation of woody vegetation on the bank, changes in bank elevation or angle, and changes in soil characteristics were utilized to establish the ordinary high water elevation. The surveyed low-flow water surface elevation corresponds to a river flow of approximately 30 cubic feet per second.

Notes:
BMA = bank management area
DGPS = differential global positioning system
IMWP = Interim Measures Design, Implementation, and Monitoring Work Plan
LiDAR = Light Detection and Ranging
SRST = South River Science Team
WWTP = wastewater treatment plant

3 REMEDIAL MEASURES

The following section summarizes the basis for design of Phase 1A interim measures. Subsequent sections of this BODR summarize the Implementation Plan (Section 4), Schedule and Sequencing of Activities (Section 5), Quality Assurance/Quality Control (Section 6), Documentation and Reporting (Section 7), and Monitoring and Maintenance (Section 8). Final design plans are presented in Appendix K.

3.1 Bank Soil Removal and Off-site Disposal

As discussed in the IMWP (Anchor QEA et al. 2015) and summarized in Section 2.2, the primary objective for the design of Phase 1A interim measures is to reduce THg loading to the South River from bank erosion. Removal of bank soils from Phase 1A Primary BMAs is projected to reduce loading of THg to RRMs 0 to 2 because ongoing erosion of such bank soils accounts for approximately 14% of the bank erosion THg loading in this upper reach of the South River. Removal of additional bank soils from Primary BMAs during subsequent interim measures is expected to reduce loading from bank erosion by an additional 36%. Removal of bank soils in Phase 1A Primary BMAs that contain relatively higher concentrations of THg is also projected to reduce THg loads from bank soil leaching by removing a primary source of leached mercury.

Fine-grained channel margin (FGCM) deposits can serve as areas of THg storage and sources of release to the river water column through resuspension and diffusion (URS 2012). THg concentrations are highly variable in FGCM deposits, ranging from approximately 0.1 to 880 milligrams per kilogram (mg/kg). Figure 2-2 depicts the approximate extent of the FGCM deposits in the vicinity of the Phase 1A BMAs. These FGCM deposits are limited in extent and therefore not targeted for removal.

Phase 1A Primary BMAs were identified using the bank erosion loading model developed for the IMWP (Anchor QEA et al. 2015) and refined in this BODR (Appendix E). To design BMA excavation prisms, THg mass within each Phase 1A Primary BMA was refined and delineated using supplemental bank coring data (Appendix B)[1]. The vertical and horizontal limits of the excavation prisms were established to target removal of approximately 90% (or more) of the THg mass within each of the Phase 1A Primary BMAs. Figures 3-1, 3-2, and 3-3 show the excavation cut lines along cross-sections that were used to design the removal prisms for each Phase 1A Primary BMA.

The bank soil removal designs are based on the overarching objective of completing the excavations and backfilling in these areas as quickly as practicable to minimize risks of potential impacts (for example, from short-term river stage fluctuations). Detailed pre-design core sampling was performed in each of the Phase 1A Primary BMAs (Appendix B) to set reliable limits of removal with a high degree of confidence and support a protective design that obviates the need for post-excavation verification sampling. Post-excavation sampling will be performed to document conditions at the base of each excavation area, and reliable sample results will be available shortly after completion of each Phase 1A BMA action for inclusion in construction completion reports; the results of this post excavation sampling will not be used to adjust removal limits in the field.

The stable slope for excavation cuts was determined using limit equilibrium analyses and appropriate soil parameters as outlined in Appendix G. Slope inclinations of 1.5 horizontal to 1 vertical (1.5H:1V) and 2H:1V were evaluated for short-term construction stability in each Phase 1A Primary BMA using site-specific soil information from environmental and geotechnical explorations located in and near each BMA. Once the maximum stable inclination was determined, the Phase 1A Primary BMA removal prism was further refined by extending the stable inclination from the base of the limit of the excavation to the surrounding existing grade.

The excavation slopes presented in this BODR were developed to optimize excavation designs at each Phase 1A Primary BMA, considering the distribution of THg mass within the

[1] Supplemental bank coring data were used to obtain length-weighted average (LWA) THg concentrations for each core collected within a BMA. THg mass within the BMA was then calculated by converting LWA THg concentrations at each core to a mass per unit area (MPA) using a nominal soil density of 1.2 g/cm^3, and assigning the core-specific MPA to the area surrounding each core, distributing the BMA area approximately equally between each core location.

deposit; available area and associated constraints, such as minimizing impacts to habitat (e.g., tree removal); and achieving temporary construction slopes with a minimum safety factor of 1.3 (based on the geotechnical analysis in Appendix G). During development of remedial action work plans with the selected contractor, these removal designs will be refined to ensure slopes are excavated in a safe manner. The following subsections summarize how removal prism designs were developed in each Phase 1A Primary BMA.

3.1.1 Constitution Park

Design plans for excavation of the Constitution Park Primary BMA are shown in plan view on Plan Sheet C-1 (Appendix K) and . Figure 3-1 shows cross-sectional views of the planned excavation along the cross-section lines shown in Plan Sheet C-1. The excavation prism was extended 5 feet upstream of Cross-section 1A to maintain a minimum 10-foot offset from a buried water main and gas line that cross the Constitution Park BMA at the upstream end of the removal area.

Construction slopes of 1.5H:1V were determined to be stable in this area (Appendix G) and were used in the removal prism design to transition between elevations within the excavation area to existing grade at the limits of the excavation. Mid-slope benches were established at Cross-sections 1A and 1B to ensure removal of soils with the greatest THg mass, including those at depth (Figure 3-1). Consistent with Virginia Department of Transportation (VDOT) guidance for minimum bench widths, these mid-slope benches are designed to be a minimum of 6 feet in width.

3.1.2 Wastewater Treatment Plant A

The excavation design of the WWTP A Primary BMA is shown in plan view on Plan Sheet C-2 (Appendix K) and as cross-sections in Figure 3-2. Construction slopes of 2H:1V were determined to be stable in this area and were used to transition back to existing grade at the top of the bank. A stormwater drain passes through the WWTP A excavation area. The selected contractor will be required to develop a plan subject to approval by DuPont and the City for either temporarily rerouting the drain during excavation and replacing in kind before backfilling or stabilizing the drain in place.

3.1.3 Wastewater Treatment Plant B

The excavation design of the WWTP B Primary BMA is shown in Sheet C-3 (Appendix K) and Figure 3-3. Construction slopes of 2H:1V were determined to be stable in this area (Appendix G) and were used to transition between the base of the excavation and benches and back to existing grade at the top of the bank. Mid-slope benches were established at the middle of the bank to optimize removal of bank soils with elevated THg concentrations. Consistent with VDOT guidance, these benches were designed to a minimum of 6 feet in width.

3.2 Bank Soil Leaching Treatment Control

As outlined in the IMWP (Anchor QEA et al. 2015) and summarized in Section 2.2, reducing mercury loading to the South River is a primary remedial action objective for Phase 1A interim measures. Removal of bank soils from Phase 1A Primary BMAs and in situ stabilization of Phase 1A Secondary BMAs are the primary measures to achieve the objective of reducing THg loading, primarily from bank erosion. Removal of bank soils in Phase 1A Primary BMAs that contain relatively higher concentrations of THg contaminated soils is projected to reduce THg loads from bank soil leaching by removing primary deposits that provide a source of leached mercury. In addition, further control of bank leaching will be provided by placing suitable bank soil treatment amendments (i.e., biochar[2]), as practicable, within both Primary and Secondary BMAs as follows:

- **Primary BMAs**. Immediately following excavation and prior to backfilling with subgrade fill and/or toe armor rock, a layer of biochar, mixed with subgrade fill, will be placed within a 6-inch high density polyethylene (HDPE) geocell. The material specification (see Specification Section 31 23 00 Earthwork and Fill for details, Appendix L) is designed to achieve a hydraulic conductivity of 10^{-3} centimeters per second (cm/s) that creates a free draining layer to prevent buildup of hydrostatic pressure behind the fill. The geocell will provide structure so the biochar mixture remains in place and will extend from the base of the excavation up to the 2-year water surface elevation, as hydraulic modeling (Attachment 1 of Appendix F) shows relatively little groundwater flux to the South River above the 2-year water surface

[2] Biochar is an alkaline, carbon-rich organic material that has large surface area and high capacity to adsorb metals and other chemicals, providing in situ treatment.

elevation. The left panel in Figure 3-4 shows an example of how the finished Primary BMA will look in cross-section and shows the 6-inch layer of biochar extending from the base of the cut to the 2-year flood elevation.

- **Secondary BMAs**. As shown in the right panel of Figure 3-4, a 6-inch layer of biochar, mixed with subgrade fill, will also be placed within a 12-inch HDPE geocell on the bank surface, as practicable, up to the 2-year water surface elevation, but without prior excavation. This will be topped with a 6-inch lift of topsoil to fill the geocell. 12-inches of topsoil will be placed in the geocell on the bank above the 2-year water surface elevation, without biochar. The material specification for the biochar layer within the Secondary BMAs was designed to provide a hydraulic conductivity that will promote retention of moisture to promote healthy growth of plantings.

In both Primary and Secondary BMA applications, biochar is a secondary element in the design intended to further reduce bioavailable mercury loading, as practicable. The primary remedial action objective for Phase 1A interim measures is to reduce mercury loading to the South River from bank erosion, including removing THg mass from bank deposits and stabilizing banks to reduce erosion.

The remainder of this section reviews the updated conceptual site model of bank soil leaching as a source of THg loading to the South River and summarizes the preliminary design of bank soil amendments. Supplemental technical and other design information is provided in Appendix F.

3.2.1 Updated Conceptual Site Model

As discussed in the Ecological Study (URS 2012), various lines of evidence suggest that bank leaching accounts for up to approximately 15% of the current THg load to the South River. Bank leaching includes the release of filter-passing (dissolved and colloidal) THg from the near-channel alluvial bank soil following a flood event due to sudden changes in geochemical conditions (e.g., pH, redox potential, and conductivity) caused by mixing of anoxic alluvial groundwater and oxic surface water (i.e., stream water and precipitation). During storm events, a rapid rise in stream level causes water to move from the stream channel into the banks—a process known as bank storage. If the river remains below bank-full conditions, most of the local bank storage water will drain downward by gravity to the permeable basal gravel/sand layer and back to the river channel over several days to several weeks. However, if the stream runs bank full and inundates the floodplain, widespread recharge to groundwater will occur over weeks to months because of the much lengthier groundwater flow paths.

As part of ongoing SRST evaluations, Aquanty Inc. constructed a numerical model to develop estimates of surface water-groundwater interactions, bank drainage, and groundwater flux, including during and following storm events (Attachment 1 of Appendix F). Simulations were conducted with varying hydraulic parameters (e.g., hydraulic conductivity and horizontal-to-vertical anisotropy) to bracket the anticipated bank storage volume, volumetric groundwater flux, and drainage time for a characteristic South River bank. Among other conclusions, these modeling evaluations revealed that the majority of surface water that infiltrates the bank face and near-bank floodplain surface during a storm event re-enters the South River through the relatively permeable basal gravel/sand layer that underlies the bank soils, above bedrock.

Various SRST investigations conducted by the University of Delaware, University of Waterloo, and Texas Tech University have sampled and analyzed alluvial groundwater in the near-bank floodplain, as well as saturated bank soil porewater under baseline and storm conditions, using a range of different methods (Appendix F). Based on these limited data, groundwater that discharges predominantly through the basal gravel/sand layer into the South River between RRMs 0 to 2 (and for at least several miles downstream) likely has an average THg concentration of roughly 1,000 nanograms per liter. Multiplying this average groundwater concentration by the average discharge from the Aquanty Inc. model results in an updated THg loading estimate from the bank leaching/groundwater pathway that is approximately 10 to 20% of the current THg load to the South River, similar to the estimate in the Ecological Study (URS 2012).

3.2.2 Biochar Amendment Design

The designs developed for this project include placement of biochar either at the bottom of the soil excavations (in Primary BMAs) or on the existing soil surface (in Secondary BMAs), extending from the base of the BMA up to the 2-year flood elevation. Numerous studies were conducted by DuPont and academic researchers on biochar to ensure its efficacy to bind mercury while also having little adverse impacts on plants, earthworms, and other organisms. To facilitate placement, biochar mixed with subgrade fill will be applied within a geocell layer. Depending on the specific application, biochar will be mixed with up to 50% subgrade fill to achieve a hydraulic conductivity of 10^{-3} cm/s, which is similar to or slightly greater than the adjacent bank soils when applied at the base of excavations to allow free drainage (Appendix F).

As depicted in the example cross-section shown in Figure 3-5, in many of the Primary BMAs, bank soil excavations may not extend through the basal gravel/sand layer to contact the underlying bedrock. Removal prisms were primarily designed to efficiently remove THg mass at Primary BMAs (which is the primary remedial measure); additional removal to extend through the basal gravel/sand layer to contact the underlying bedrock is not planned. The overall design optimizes THg mass removal while limiting impacts to bank habitat. Thus, in at least some of the Primary BMAs, as well as all of the Secondary BMAs, biochar amendments will not extend deep enough to attenuate that portion of the THg bank leaching/groundwater load that discharges through the basal gravel/sand layer. Nevertheless, biochar application will provide some added control of THg leaching from bank soils, as practicable. As discussed in Appendix F, although groundwater discharge to the river is primarily transmitted through the basal gravel/sand layer, THg leaching and associated loading can occur from mid- to upper-bank soils, as well as through the basal gravel/sand layer. Although THg loading rates from leaching along different portions of the bank are uncertain, the updated conceptual site model suggests that a relatively smaller amount of THg loading is attributable to leaching processes, compared to bank erosion (Section 3.2.1).

As discussed in more detail in Appendix F, a 6-inch thickness of biochar mixed with 50% subgrade fill is anticipated to provide decades of added control of THg that may leach through the banks. All of the amendment designs developed for this BODR include a nominal 6 inches of biochar mixed with up to 50% subgrade fill as appropriate.

3.3 Backfilling and Riverside Access

As outlined in the IMWP (Anchor QEA et al. 2015) and summarized in Section 2.2, additional remedial action objectives for Phase 1A interim measures include reducing the impact of shear stress on banks with high erosion potential, maintaining habitat function, and improving river access for recreation. The backfilling designs for Primary BMAs were developed for this BODR to address and optimize all of these objectives, as practicable, incorporating the outcome of collaborative design discussions between DuPont, the City, VADEQ, and the SRST.

After placement of the biochar amendment layer, bank slopes in Primary BMAs will be reconstructed by placing compacted clean backfill material at a stable slope configuration. The finished slope grade will be constructed to a maximum slope of 2H:1V (Appendix G), which is less steep and more stable than many of the existing Primary BMA slopes. The reconstructed slope also provides opportunities to improve access to the river for recreational activities in Constitution Park and provides river access to City staff at WWTP A. Outside of access paths, 12 inches of topsoil material will be placed on the finished slope to provide an appropriate substrate for habitat restoration (see Section 3.5).

The slope reconstruction designs are shown in plan sheets R-7 through R-16 (Appendix J), and will be more stable than current slopes in these BMAs. The stability of an inclined soil mass is determined by the soil mass internal angle of friction (resisting force) divided by the inclination of the soil slope (driving force; Appendix G). Thus, decreasing the soil slope inclination will decrease the driving force, and replacing in situ soils with compacted backfill will increase the internal friction angle and thus increase the resisting force. These two factors work to increase long-term stability of the reconstructed BMA slopes. Fill will be added so that the reconstructed bank height is consistent with the height of the bank section prior to removal. The reconstructed banks have also been designed with additional fill so the reconstructed bank face will closely match the bank faces at the upstream and downstream ends of the removal areas. This approach reduces erosive eddying actions that could occur at abrupt transitions in the bank face alignment. The reconstructed bank face will be graded to blend into the adjoining banks as far as practicable and maintain the maximum 2H:1V slope.

Subgrade backfill materials will be imported from DuPont's Jones Hollow Property located off of Delphine Avenue. Test pits have been advanced in the Jones Hollow Property, and soils have been tested to check that borrow material is appropriate for use as embankment fill and contains background THg concentrations (see Specification Section 00 31 32). For use as topsoil, Jones Hollow Property borrow material will be amended so that its composition is appropriate for providing a planting base for the planned plant species (Section 3.5.2). At Secondary BMAs, above the 2-year flood elevation, topsoil will be installed in a 12-inch HDPE geocell; below the 2-year flood elevation, a 6-inch lift of topsoil will be installed above 6 inches of biochar (see Section 3.2), all within a 12-inch HDPE geocell. In all cases, topsoil will be covered with biodegradable erosion-control fabrics to provide temporary protection from erosion while vegetation becomes established. Excavated bank soils will not be re-used as fill.

Reconstructed slopes in Constitution Park and WWTP A Primary BMAs will be augmented with footpaths providing access to the river for recreation and maintenance of City utilities (primarily stormwater drains). Footpath locations and layouts are shown on plan sheets CM-1 and CM-3 (Appendix K). Footpaths will improve access to the river for residents, visitors, and City staff and will be constructed to specifications detailed in Specification Section 04 40 00 – Stone Assemblies for Public Access.

3.4 Structural Stabilization

The following structural stabilization elements have been incorporated into preliminary designs of the Primary BMAs:

- Armoring the toe of the bank to protect against bank erosion
- Placing suitable salvaged logs at the toe of the bank to improve habitat function

Each of these design elements is described in the following subsections.

3.4.1 Stone Toe Protection

Based on the outcome of collaborative design discussions between DuPont, the City, DGIF, VADEQ, and the SRST, localized stone toe protection elements have been incorporated into designs of reconstructed Primary BMAs and in portions of the WWTP A Secondary BMA.

Reconstructed Primary BMAs will be inclined at a more stable slope than their original configuration, but will still be subject to potential erosional forces from near-bank shear stress and ice that could potentially undercut the reconstructed bank. To help protect against potential future erosion of these BMAs, a stone toe will be installed at the base of the reconstructed Primary BMAs. In the WWTP A BMA, the stone toe will be extended 145 feet downstream of the Primary BMA to protect an area of the adjacent Secondary BMA where the natural inclination of the toe is too steep for vegetative stabilization to be effective (i.e., it is steeper than 70 degrees in inclination). In all cases, the stone toe has been designed to limit erosion from bank undercutting.

Stone toe placement designs are shown on sheets CM-1 through CM-11. As shown on the example cross-section in Figure 3-4, the armor stone will be placed from the base of the slope or low water elevation up to approximately halfway to the modeled 2-year recurrence flood elevation, as predicted by the hydrodynamic model (Appendix C of Anchor QEA et al. 2015). This stone placement boundary balances the structural stabilization benefits obtained through stone armoring of the bank with opportunities to reconstruct the riparian habitat on the bank. Because this stone toe placement is high enough on the bank to armor against probable flow events in the near term, vegetation will have the opportunity to become established upland of the armor layer, improving long-term stability of the bank (Section 3.5). In the WWTP A Secondary BMA, the stone is placed so it covers the steeper section at the toe of the bank where vegetative stabilization will not be used. In this area, the armor stone will be placed against the existing grade from the base.

A launchable section of stone will be placed at the toe of the rock to provide added protection from potential future undermining of the channel. That is, in the event that the toe is undermined by possible future channel down-cutting, "launched" armor stones would settle into the scour hole and limit further erosion. This toe design and configuration improves bank stability without requiring excavation into the riverbed.

Appropriate armor stone sizes for the toe protection were designed using methods outlined in *Armor Layer Design Guidance for In-Situ Capping of Contaminated Sediment* (Maynord 1998). Calculations were performed for the 1-, 2-, 5-, 10-, 25-, 50-, and 100-year recurrence interval floods using estimated velocities and water depths provided by the hydrodynamic model in the river channel model grid cells immediately adjacent to the Primary BMAs. A safety factor of 1.5 was incorporated into the stone size calculation to address design uncertainties and improve stability.

Stable stone sizes necessary to resist potential ice forces within the South River channel were computed using guidance developed by the U.S. Army Corps of Engineers (USACE) (White 2004; Sodhi et al. 1996). This calculation requires an estimate of ice thickness as the primary input parameter. Temperature data collected at the Waynesboro WWTP (National Climatic Data Center Station USC00448941) for the past 15 winters was used to compute the maximum ice thickness observed over that time period, providing an estimate of the 10-year recurrence ice thickness.

Table 3-1 summarizes the results of the armor toe stone size calculations for the Phase 1A BMAs, which were similar between these BMAs. As is frequently the case, protection from higher flood flows requires larger armor stones, but larger stone tends to limit the development and functional attributes of riparian and aquatic habitat, and depending on the final design, could potentially limit public access and recreational activities. Preliminary armor stone sizes (i.e., D_{50}) for each Phase 1A BMA were assigned using the maximum of the stable particle size computed to resist the 10-year flood and ice loading at each Primary BMA. The 10-year flood event was selected over larger events to strike an appropriate balance between providing an adequate level of protection while limiting the impact to available bank habitat and recreation activities. To simplify construction, a consistent median armor stone size of 16 inches for all of the Phase 1A BMAs was assigned. This stone size was selected because it is the maximum of armor stone size calculated to protect against a 10-year flow or ice scour event in the Phase 1A BMAs. Table 3-2 provides a detailed gradation for the armor stone based on the Automated Coastal Engineering Software technical reference manual (USACE 1992). VDOT Class II riprap has been specified for the project because it is readily available and meets or exceeds this gradation.

Table 3-1
Design Median Armor Stone Size for Toe Protection (inches)

Primary BMA	Recurrence Flood Interval							Ice Scour
	1-year	2-year	5-year	10-year	25-year	50-year	100-year	
Constitution Park	4	5	10	9	7	6	3	14
WWTP A	4	4	12	16	13	12	10	14
WWTP B	2	3	7	12	17	19	13	14

Notes:
BMA = bank management area
WWTP = wastewater treatment plant

Table 3-2
Design Armor Stone Gradation

Percent Passing	Weight (pounds)	Size (inches)
100	819	26
85	401	21
50	205	16
15	82	12
0	26	8

The dimensions of the launchable section of armored toe were designed using guidance developed by Lagasse et al. (2006) and the bend scour estimation method from Maynord (1996). The average computed scour depth from Maynord (1996) is 5 feet; however, the site conditions are at the lower limit of validity for the Maynord method and are considered very conservative in this case. Previous South River bank stabilization designs by Inter-Fluve, Inc. (2012) used 1.5 feet of scour depth protection along the banks. To balance the needs of bank protection with bank habitat and recreation access, a scour protection depth of 2.5 feet was selected. Detailed example calculations for armor stone sizing and toe dimensions are provided in Appendix H.

The stone toe will be tapered back into the existing bank at a 4H:1V transition angle while maintaining the stone revetment at a maximum of 1.5H:1V slope inclination upstream and downstream of the Primary BMAs. This approach will smooth transitions between the armored and unarmored areas and limit the formation and strength of eddies that could cause further bank erosion at the transitions between the Primary and Secondary BMAs. Additional details for the stone toe design are provided in Specification Section 31 37 00 – Stone Toe Protection.

3.4.2 Stone Toe Habitat Improvements

To improve habitat functions within the armored toe of the Primary BMAs, salvaged trees will be placed at the foot of the launchable toe. As shown on plan sheets CM-1 through CM-11 (Appendix K), select trees removed from the Primary BMA areas during clearing will be salvaged and anchored to large stones placed at the lower portion of the launchable toe. The salvaged trees will provide hydraulic refuge, complexity, and cover along the margins of the river channel, allowing fish to escape or rest, as well as providing cover and structural diversity for aquatic macroinvertebrates and periphyton.

Salvaged trees will be selected using the requirements shown in Table 3-3. Limbs of salvaged trees will be trimmed to a maximum length of 12 inches. Large stones will be used to anchor salvaged trees, obviating the need to excavate the channel and key the trees into the existing riverbanks. During high flows, anchored wood in the riverbed will be subjected to buoyancy forces, drag forces, and, possibly, impact forces. Proper anchoring is required to resist these forces and firmly hold the salvaged trees in place. In general, salvaged trees will be placed with the rootwad or broader portion upstream and angled at approximately 0 to 15 degrees from the bank line to limit drag forces on the structure during high-flow events. It is intended that the logs be placed at the direction of the DuPont Site Representative to adapt each placement to site-specific conditions.

Table 3-3
Salvaged Tree Placement Specifications

Design Variable	Value
Salvaged tree diameter at breast height	Less than 18 inches
Salvaged tree trunk length	Less than 35 feet
Salvaged tree rootwad cone diameter	Less than 54 inches
Individual rock dry weight	Greater than or equal to 2,000 pounds
Number of anchor rocks per tree	4

Consistent with the design approach for sizing the toe armor stone, a 10-year flow was used to establish preliminary specifications for the salvaged tree anchors. The hydrodynamic model predicts that the maximum 10-year flow design velocity in the South River adjacent to where salvaged trees are to be installed is approximately 11 feet per second. Calculations of the buoyancy and drag forces that could be expected at the Primary BMAs under this peak flow condition, using the assumed configuration and parameters identified in large wood design guidance (USBR 2014), are provided in Appendix H. Based on the calculations, a minimum of four anchor stones weighing a minimum of 2,000 pounds each will be used for each salvaged tree. Anchor stones of this weight will be approximately 2.5 to 3.0 feet in diameter and will provide additional structure to the channel to support habitat functions.

3.5 Enhanced Vegetative Stabilization

In addition to the removal, treatment, backfill, and structural stabilization elements outlined in the previous sections, enhanced vegetative stabilization is another key element that has been integrated into the interim measures designs of both Primary and Secondary BMAs, consistent with interim measures objectives summarized in Section 2.2. In Primary BMAs, the vegetative cover will provide habitat functions along the reconstructed bank faces, and will concomitantly decrease near bank shear stress during high flow events. Within Secondary BMAs, enhanced vegetative stabilization is the primary remedial technology that will be applied to reduce THg loading, primarily by sequestering contaminated bank soils beneath a stabilized vegetative cover.

3.5.1 Planting Preparation in Secondary Bank Management Areas

Examples of the enhanced vegetative stabilization components of the interim measures design are shown in cross-section on Figure 3-4. Plan sheets CM-1 through CM-12 and L-1 to L-6 (Appendix K) show the stabilization components, planting plans and details. In Secondary BMAs, the enhanced vegetative cover will be placed directly on the bank without removal of the existing bank soils, though there may need to be minor reshaping/grading following selective clearing and grubbing to fill voids. To protect the plantings from erosive forces during the period between construction and when they become fully established, a system of temporary biodegradable and permanent synthetic products will be used to stabilize bank soils. These materials include HDPE geocells, coir logs, and coir fabrics as discussed in more detail in the following paragraphs.

Although focused clearing of ground vegetation will be necessary within Secondary BMAs to facilitate construction, several of these BMAs have existing vegetation in the riparian zone that would be beneficial to retain. This vegetation consists primarily of larger, healthy trees or native shrubs. Trees to be preserved and/or areas to be avoided have been identified on plan sheets D-1 through D-3 (Appendix K) and will be protected by the contractor during construction; final determination of which trees/shrubs can remain will be made in the field in consultation with the City and the VADEQ prior to the start of construction in each BMA. Additional plantings within these areas and removal of invasive vegetation adjacent to the areas will occur to provide ecological uplift of the entire plant community on the project sites. Geotextiles (HDPE geocells) and coir erosion-control fabrics placed on the bank to control erosion will be worked around the existing vegetation to remain. Select clearing of vegetation will also occur to allow more light to penetrate to the understory so new plantings have sufficient sunlight to grow quickly. Clearing will include ground cover, and select shrubs and trees as needed. Additional details of the selective clearing and grubbing and the preservation of existing vegetation that will occur in the secondary BMAs are provided in Specification Section 31 12 00 – Selective Clearing.

A 12-inch HDPE geocell system will be used as appropriate to secure topsoil and biochar in Secondary BMAs. As shown in Figure 3-4, 12 inches of topsoil material will be placed within the 12-inch geocell. Below the 2-year flood elevation, the geocell will contain a 6-inch lift of biochar topped with a 6-inch lift of topsoil instead of a single 12-inch lift of topsoil, as discussed in Section 3.2. The topsoil (i.e., top 6 inches below the 2-year flood elevation and 12 inches above the 2-year flood) will be an appropriate substrate for planting and will be prepared by amending Jones Hollow Property borrow material in accordance with Specification Section 32 90 00 – Planting and Habitat Restoration. A coir fabric cover will be installed over the topsoil to provide further protection from erosion. Coir fabric will ultimately biodegrade and is intended to provide erosion protection from normal flood events long enough to allow vegetation to become established. The geocell and fabric installation approach are discussed in greater detail in Specification Section 31 35 00 – Slope Protection.

To provide further temporary stabilization, two to three layers of coir logs will be placed at the foot of each Secondary BMA depending on bank slope. The coir logs will provide a buffer to lessen energy on the shore. Similar to the other coir fabric used in this design, this material is biodegradable and intended to be a temporary stabilization measure until vegetation becomes fully established. Natural logs with a minimum diameter of 2 feet may be used in lieu of coir logs at locations where a steep toe requires additional protection, as approved by the DuPont Site Representative. In locations where exposed bedrock is present or trees to remain exist at the shoreline, neither coir logs nor natural logs will be installed because the bedrock and tree roots will provide sufficient erosion protection.

3.5.2 Planting and Seeding

Planting of a variety of native species is the primary component of the vegetative stabilization technique and is aimed at improving habitat functions and stabilizing the banks by providing natural protection from erosion. The various planting types detailed below are intended to address the different site-specific vegetation conditions on the banks.

Additionally, the specific species planted in a Primary or Secondary BMA will be determined based on the proximity to the waterline, with plants more adapted to inundation and saturated root zones planted on the lower half of the riverbank below the elevation of the 2-year flood, and plants less adapted to saturation and inundation planted on the upper half of the riverbank. Tables 3-4 and 3-5 list the species of plants that are planned for areas below and above the 2-year flood elevation, respectively.

Table 3-4
Vegetation Plantings below the 2-year Flood Elevation

Shrub Species	
Silky dogwood (*Cornus amomum*)	Container Class #1
Nannyberry (*Viburnum lentago*)	Container Class #1
Southern arrow-wood (*Viburnum dentatum*)	Container Class #1
Black elderberry (*Sambucus canadenis*)	Container Class #1
Bladdernut (*Staphylea trifolia*)	Container Class #1
Southern arrow-wood (*Viburnum dentatum*)	Live cutting/stake
Silky dogwood (*Cornus amomum*)	Live cutting/stake

Shrub Species	
Black willow (*Salix nigra*)	Live cutting/stake

Table 3-5

Vegetation Plantings above the 2-year Flood Elevation

Shrub Species	
Black chokecherry (*Aronia melanocarpa*)	Container Class #1
Hazel alder (*Alnus serrulata*)	Container Class #1
Spicebush (*Lindera benzoin*)	Container Class #1
Ninebark (*Physocarpus opulifolius*)	Container Class #1
Smooth hydrangea (*Hydrangea arborescens*)	Container Class #1
Silky willow (*Salix sericea*)	Container Class #1
Staghorn sumac (*Rhus typhina*)	Container Class #1
Hawthorn (*Crataegus crusgalli*)	Container Class #1
Silky dogwood (*Cornus amomum*)	Container Class #1
Witch hazel (*Hamamelis virginiana*)	Container Class #1
Tree Species	
Pawpaw (*Asimina triloba*)	Container Class #2
Pignut hickory (*Carya glabra*)	Container Class #2
Eastern cottonwood (*Populus deltoides*)	Container Class #2
Eastern hophornbean (*Ostrya virginiana*)	Container Class #2
Black cherry (Prunus serotina)	Container Class #2
Sassafrass (*Sassafras albidum*)	Container Class #2
Northern red oak (*Quercus rubra*)	Container Class #2, #20
White pine (*Pinus strobus*)	Container Class #2
Eastern red cedar (*Juniperus virginiana*)	Container Class #2
American sycamore (*Platanus occidentalis*)	Container Class #2, #20

All plants will consist of native species. Trees and shrubs will be 1- to 5-gallon sizes to provide a range of plant sizes that can be installed by hand without the need for larger equipment. Trees and shrubs will be planted on 5- to 15-foot centers (based on size) and interspersed to provide a multi-layer canopy as the plants develop. The number of trees and shrubs planted at Primary BMAs will be much greater than that at Secondary BMAs due to the preservation of vegetation at the latter sites. In addition to the containerized trees and shrubs, live stakes will be installed on the lower portion of the bank. Tubelings may be substituted for live stakes if bank restoration work is finished prior to the dormant season.

Seeds will be placed by hydroseeding and/or hand-broadcasting. A native seed mix will be spread over all disturbed areas following the installation of trees and shrubs. If bank restoration work does not occur until fall, a cover crop of annual rye and oats will be applied as overwinter cover, and the native seed mix will be applied the following spring. Additional details on the seed mixes and application rates are provided in Specification 32 90 00 – Planting and Habitat Restoration.

3.5.2.1 Supporting Techniques for Planting

The following provides details on additional elements of the planting plan:

- **Preservation of Existing Native Vegetation**. Existing vegetation consisting of larger trees or areas of native shrubs will be preserved to the extent practicable. The trees to be preserved are shown on the plans (Appendix K), and will not be disturbed during construction. Additional plantings within these areas and removal of invasive vegetation adjacent to the areas will occur to provide ecological uplift of the plant community within and adjacent to the BMAs. Clearing and grubbing and the preservation of existing vegetation are discussed in greater detail in the specifications.
- **Invasive Vegetation Control**. Invasive vegetation control measures will be conducted where needed for up to 3 years following construction to reduce the potential for invasive plants (primarily Japanese knotweed [*Fallopia japonica*]) to dominate the plant community. In replanted areas, active invasive species control may be discontinued before 3 years if native plants take hold quickly. Invasive species control will be accomplished by two general methods—mechanical and chemical. Mechanical removal will be implemented at the Primary BMAs during clearing and grubbing. Chemical treatments will be used in Secondary BMAs and immediately adjacent to Primary and Secondary BMAs to provide a buffer. Invasive vegetation control is discussed in greater detail in the specifications (Appendix L) and Maintenance Plan (Appendix M).
- **Erosion-control Measures**. Erosion-control measures will be used at all planting locations to retain topsoil and will consist of erosion-control blankets (e.g., coir)

placed over disturbed areas. Erosion-control blankets will be placed and anchored on with biodegradable stakes to prevent topsoil from becoming mobilized. Biodegradable erosion-control blankets that allow plant growth through the material will be used.

- **Care of Plantings**. Care of the plantings will begin immediately after each planting is installed and consists of keeping the plants in a healthy growing condition by watering, weeding, cultivating, pruning, placing additional mulch, and other operations, as necessary. All plantings will be watered once per week during the months of May through September for the first year. Long-term monitoring and maintenance of the plantings are discussed in Section 8 and in the Maintenance Plan (Appendix M).

3.6 Adaptive Management Measures

As discussed in the IMWP (Anchor QEA et al. 2015), an adaptive management approach will be used for implementing corrective measures in AOC 4. The overall adaptive management objective is to develop a flexible decision-making process that can be adjusted as remediation action outcomes are better understood and as landowner and other stakeholder preferences are identified and possibly change over time. Careful monitoring of the outcome of implemented Phase 1A actions will advance understanding and help adjust future remedy decisions as part of an iterative learning process. Developed with considerable SRST input, VADEQ approved short- and long-term monitoring plans for AOC 4, which were incorporated into the IMWP. DuPont plans to complete baseline monitoring prior to initiation of Phase 1A interim measures in late summer 2016.

Adaptive management is particularly well suited to AOC 4, in part because interim measures and corrective actions will be implemented sequentially over the next 5 to 10 years or more, starting with implementation of Phase 1A. This will provide an opportunity to effectively integrate lessons learned. Where Phase 1 actions do not result in measureable improvements, changes in approaches, technologies, and/or applications may be required in subsequent phases, potentially including revisiting the Phase 1 actions. Implementation of corrective actions in the South River will also require landowner acceptance and flexibility to consider other stakeholder needs.

Use of the adaptive management learning approach, along with relative risk modeling currently being performed by the SRST (see Anchor QEA et al. 2013), is expected to provide quantitative feedback on net environmental improvements resulting from implementation of corrective measures, which will provide benefits to the South River. The USACE Engineer Research and Development Center is assisting DuPont in developing an enhanced adaptive management plan for AOC 4 that is expected to provide semi-quantitative feedback on net environmental improvements resulting from remediation actions. The adaptive management and relative risk models will serve as tools for refinement of corrective action approaches throughout AOC 4 based on effectiveness, implementability (including stakeholder preferences), ecological effects, and cost.

A Monitoring Task Team, working under the SRST, will evaluate the results of the short- and long-term monitoring programs to understand changes resulting from the Phase 1A interim measures. Where necessary, changes to the monitoring program will be implemented to help ensure measurements relevant to corrective action performance are obtained during Phase 1 and future efforts.

4 IMPLEMENTATION PLAN

This section summarizes the implementation approach to construct the remedy described in Section 3 and in the plans (Appendix K). It should be noted that some elements of the implementation plan will be defined by the contractor as part of the bidding process. Bidders for the construction contract will be required to provide a general description of their proposed site layout, equipment, and procedures, so significant proposed modifications can be discussed and evaluated prior to the award of the contract. In addition, before starting the work, the contractor will be required to provide a detailed work plan that will lay out the specifics of their means and methods for the remediation and restoration activities.

4.1 Site Development

Prior to commencement of work in a particular BMA, temporary erosion and sediment controls will be erected. A temporary security fence will be erected in the Constitution Park BMA to secure the site from the public. Temporary closure of public access to the banks, the adjacent Greenway Trail, and other impacted park areas will be necessary during construction for public safety. The WWTP A and B sites will be barricaded with snow fencing for safety; however, security fencing is not anticipated to secure these BMAs because they are not accessible by the public. Erosion and sediment controls will be maintained throughout BMA construction and restoration activities to minimize release of THg-containing solids and other adverse impacts to the environment during the performance of the work. The contractor will prepare a Stormwater Pollution Prevention Plan outlining the specific best management practices (BMPs) to be employed, such as wetting down disturbed areas for dust control and properly operating and maintaining construction vehicles and equipment.

Staging areas for equipment and stockpiling materials, as well as access roads to the BMAs, will be necessary for construction of the Phase 1A project. DuPont's Jones Hollow Property at 790 South Delphine Avenue in Waynesboro, Virginia, will be used for a staging area based on right of access, contiguous space available, location relative to the Phase 1A BMA construction areas, and other factors. Access points to the BMAs have been identified based on the proximity to roadways, sufficient width and length free of obstruction (other than trees and vegetation), discussions with the City, and other factors. The following subsections provide additional details of staging area requirements and BMA access routes.

4.1.1 Staging, Processing, and Construction Support Area Requirements

DuPont's Jones Hollow Property has been designated as the primary staging, processing, and support area for construction material laydown, equipment storage, and project support (e.g.., trailers and employee sanitary facilities). The Jones Hollow Property is readily securable and provides sufficient open, level space for stockpiling and laydown. However, the Jones Hollow Property will not be used for stockpiling material excavated from the BMAs; handling of excavated material is discussed further in Section 4.2.

Figure 4-1a through Figure 4-1c depicts the primary staging area and planned routes to and from the BMAs. The Jones Hollow Property is currently owned by DuPont and is located in the City. The Jones Hollow Property meets the requirements for the project staging, processing, and construction support area discussed above. This area consists of approximately 74,000 square feet of open space, which is sufficient area for the project requirements. This area is also readily accessible from main roads that can be used to bring and stockpile material into the staging area and from the staging area to the individual BMAs. Although the Jones Hollow Property staging area appears sufficient for this project, other potential staging areas may be identified during the bidding process and would be subject to DuPont and City approval.

4.1.2 Bank Management Area Construction Access Considerations

Figure 4-1a shows the planned routes from the Jones Hollow Property staging area to the Phase 1A BMA sites. In general, access to the individual BMAs will be obtained using City roads to access the entry points of the BMA sites. Routes were identified to minimize travel distance and impact to residential areas. Roads that allow construction vehicle traffic and have vertical and horizontal clearances sufficient for the construction vehicles to be used on the project were selected. Routes through the City's operations maintenance yard and WWTP shown on Figure 4-1c are the result of discussions with the City regarding access to the WWTP A and B BMAs through the City operations areas. Consideration was given to staff safety, minimizing interference with City operations, and efficiency of construction operations in developing the access route plans. The contractor will submit a traffic control plan to the DuPont Site Representative (DSR) for review and approval before the start of construction. This plan will generally follow the plan provided herein and will also account for any additional traffic controls, oversized load permits, and weight restrictions.

Temporary haul roads may be constructed within the BMA project boundaries if proposed by the contractor and approved by DuPont and the City. Temporary haul roads will be designed to accommodate the equipment required to construct the remediation/restoration project. Specific access considerations for the individual BMAs are discussed in the following subsections.

4.1.2.1 Constitution Park

As shown in Figure 4-1b, access to the Constitution Park BMA will be obtained from Short Street. As shown in plan sheet ES-1 (Appendix K), a stabilized construction entrance and tire wash will be constructed so equipment and material exiting the site will not track soil onto Short Street. During soil removal activities, trucks and other equipment leaving the site will undergo wet decontamination on a designated decontamination pad. This will remove any impacted soils from the vehicles before they approach the construction entrance entering Short Street.

4.1.2.2 WWTP A and B

Figure 4-1c shows the access routes to the WWTPs A and B BMAs. Access will be obtained from Essex Avenue through the City's operations maintenance yard and WWTP. As shown in Figure 4-1c, a temporary staging and laydown area of approximately 11,000 square feet will be made available to the contractor within the WWTP. Construction vehicles will access this area using the WWTP maintenance roads as shown in Figure 4-1c.

Construction vehicles will approach the WWTP A Primary BMA around the south side of the City's vehicle parking structure. To the extent practicable, trucks transporting excavated material will stay on the paved area directly adjacent to the WWTP A Primary BMA; however, they will still undergo wet decontamination and tire washing to avoid tracking soils outside of the site. As shown in Figure 4-1c and on Plan Sheet ES-2 (Appendix K), a second access point from the WWTP maintenance road is planned adjacent to the WWTP A Secondary BMA for delivery and positioning of geocells and coir fabrics that will be installed from the top of the bank. Vehicles accessing this entrance will stay on the stabilized construction road in this area. Access to the WWTP A Secondary BMA may also be obtained from the river within the dewatered area behind the cofferdam. Access to the WWTP B BMA will be obtained from the road within the City's WWTP.

Access through the operations maintenance yard and the WWTP will be coordinated with the City to minimize interference with City operations.

4.2 Removal, Transportation, and Disposal of Soils

As discussed in Section 3.1, the excavation slopes presented in this BODR were developed to optimize excavation designs at each Phase 1A Primary BMA, considering the distribution of THg mass within the deposit; available area and associated constraints, such as minimizing impacts to habitat; and achieving stable temporary construction slopes. The remedial action work plans developed by the selected contractor will contain specification of measures to ensure slopes are excavated in a safe manner.

It is anticipated that bank soil removal will be conducted from the top of the bank, though alternate plans presented during the bid process will be considered. Excavations have been designed to remain above the typical summer low-flow elevation. In all Primary and part of some Secondary BMAs, temporary cofferdams (e.g., Portadam or similar) will be erected around the base of the Primary BMAs. The temporary cofferdams will protect the upland excavation areas from rising river water in case a storm event occurs during excavation. Water will be pumped out of the protected areas so that excavation of the banks can be conducted in the dry. In WWTP A, the cofferdam is planned to extend throughout the Secondary BMA area to allow access to the WWTP A Secondary BMA from the water because available space is limited at the top of the bank. Work will be sequenced so that only one of the WWTP BMA cofferdams is in place at a time, minimizing the impact of the temporary cofferdams on the river cross-section in this area, which could result in an increased flood risk. The temporary cofferdam specification is provided in Specification Section 31 52 00 – Temporary Cofferdams.

Stabilized construction entrances will be provided at each of the Primary BMAs for egress to prevent the tracking of soil onto the access routes and public roads. A vehicle wheel wash/decontamination pad will be installed to remove and collect contaminated soil that adheres to truck tires prior to the truck leaving the site; soil collected on the decontamination pad will be removed on a daily basis or as required to prevent sediment buildup within the pad. The vehicle decontamination pad will also be washed down at the completion of each day of work, or more often if necessary, with water removed using a vacuum truck or similar method as approved by the DSR, and sediment separated and removed. A detailed specification for removal equipment decontamination is provided in Specification Section 02 51 00 – Equipment Decontamination and Screening.

The following sections discuss design considerations for implementing the removal, including removal equipment considerations, anticipated removal volumes, staging and processing plans, and disposal alternatives.

4.2.1 Bank Soil Removal Equipment Considerations

Bank soil removal will be conducted mechanically using excavators, front loaders, or similar equipment, and will be conducted in the dry to the extent practicable. Soil will be excavated and loaded directly into dump truck or similar equipment and hauled directly to the disposal facility. Alternatively, the contractor may elect to stockpile excavated soils on site, subject to DSR and City approval. All excavated material stockpiles will be contained with HDPE liners and constructed berms with adequate erosion and sediment controls placed around their perimeter. Stockpiling of excavated material at the Jones Hollow Property staging area will not be permitted. In either case (i.e., direct load of excavated soil to trucks or management in stockpiles), excavated soil will be characterized for THg concentration and for leachable mercury by the RCRA toxicity characteristic leaching procedure (TCLP). Additional waste characterization analyses may be performed if required by the disposal facility.

Trucks will be lined with durable plastic sheeting and covered during transport to avoid any potential releases due to dewatering of saturated soils and fugitive dust. If visible moisture is observed in excavated soils, then the excavated material will have to pass a paint filter test before it can be loaded into the truck. No free liquids shall be loaded into trucks that are not completely enclosed and water-tight to prevent leakage or overtopping of the container. The specific equipment used in excavation and excavated material transport will be proposed by bidders for the construction contract.

4.2.2 Waste Management Approach

The primary contaminant of concern for waste from this project is mercury associated with bank soils. Based on a review of the historical manufacturing processes, waste management practices, and spill history at the former DuPont Waynesboro facility, federal- or state-listed waste codes do not apply to the wastes impacted from industrial activity at the facility. Therefore, the waste determination for hazardous or non-hazardous remediation waste will be based on analytical results of samples collected from either BMA test pits, which will be collected immediately after clearing and grubbing and before excavation in the Primary BMAs, or from stockpiles of excavated soils. Samples will be analyzed for THg and by RCRA TCLP for mercury and other analytes as required by the disposal facility. Extensive data collection within the BMAs has not identified any free mercury; hence, inspection for free mercury is not warranted.

Soil remediation efforts at the Phase 1A BMAs will be performed by managing three types of waste streams containing different mercury concentrations:

1. Soils with TCLP concentrations that do not exceed RCRA hazardous waste criteria for mercury, and thus, may be managed locally as RCRA non-hazardous waste
2. Soils with elevated TCLP concentrations that exceed RCRA hazardous waste criteria and can be disposed of in a hazardous waste (i.e., Subtitle-C) landfill
3. Soils with elevated TCLP and THg concentrations that exceed RCRA hazardous waste criteria and land disposal restrictions, thus requiring retorting for treatment

Waste management options for these three possible scenarios are summarized in Table 4-1.

Table 4-1
Waste Management Matrix

Scenario	RCRA Classification	Disposal Facility
TCLP Hg < 0.2 mg/L	RCRA Non-Hazardous	Waste Management Amelia Landfill in Jettersville, VA
THg < 260 mg/kg TCLP Hg ≥ 0.2 mg/L	RCRA Hazardous	U.S. Ecology Subtitle-C Landfill in Belleville, MI
THg ≥ 260 mg/kg TCLP Hg ≥ 0.2 mg/L	RCRA Hazardous	Bethlehem Apparatus (Retorting Facility) in Bethlehem, PA

Notes:
Hg = mercury
mg/kg = milligram per kilogram
mg/L = milligram per liter
RCRA = Resource Conservation and Recovery Act
TCLP = toxicity characteristic leaching procedure
THg = total mercury

4.2.3 Processing and Transportation of Excavated Materials

Excavated bank soils will be trucked from the Phase 1A Primary BMAs directly to the ultimate disposal facility. Immediately after clearing and grubbing in each of the Primary BMAs, test pits will be advanced along the bank face so material is characterized per 500 cubic yards (cy) of excavated soil. The soil excavated from the test pits will be sampled and characterized to properly identify its waste classification profile and treatment requirements. Alternatively, the contractor may elect to stockpile excavated soils onsite, subject to DSR and City approval. If soils are stockpiled prior to transport to final disposal facility, waste characterization samples will be collected directly from the stockpiles, and in situ classification via test pits will not be necessary. As generally summarized in Table 4-1, the results of analytical testing of waste characterization samples will be used to determine if disposal in a Subtitle-C landfill or retort facility is required.

Excavated soils that are determined to be non-hazardous will be transported via allowable truck routes to a suitable facility. Hazardous waste soils will be transported to a suitable hazardous waste landfill or retort facility by truck or rail. Potential hazardous and non-hazardous facilities are summarized in Table 4-1. Final waste transport plans will be developed by the selected contactor.

4.2.4 Bank Soil Removal Volumes and Concentration Estimates

Prospective THg concentrations within the bank soils were estimated using an approximate volume-weighted average of the sampling data available within each BMA removal prism. Bank soil removal volumes were estimated from the preliminary excavation prism designs shown in the plans (Appendix K).

Estimated bank soil removal volumes and THg concentrations in the prospective excavated material are summarized in Table 4-2. Although TCLP mercury levels in the WWTP Primary BMAs are anticipated to be well below 0.2 milligram per liter (mg/L), bank soils exceeding this hazardous waste criterion could be encountered within portions of the Constitution Park Primary BMA.

Table 4-2
Prospective Removal Volumes and Mercury Concentrations

	Non-Hazardous		Hazardous	
Primary BMA	**Volume (cy)**	**Average THg Concentration (mg/kg)**	**Volume (cy)**	**Average THg Concentration (mg/kg)**
Constitution Park	100	18	200	640
WWTP A	1,240	37	-	-
WWTP B	560	140	-	-

Notes:
cy = cubic yards
mg/kg = milligram per kilogram
THg = total mercury
WWTP = wastewater treatment plant

Estimates of excavated bank soil THg concentration in Constitution Park were further refined to more precisely estimate the volume of soil removed from this area that may need to be managed at a suitable Subtitle-C landfill or retort facility. Bank soils with the highest concentrations in the removal prism exist at the middle and bottom of the bank, covering roughly two-thirds of the removal prism (see Figure 3-1). To obtain a refined estimate of the volumes of hazardous/retort versus non-hazardous waste bank soils in Constitution Park, average THg concentrations and removal volumes were recalculated for the lower two-thirds of the bank and the upper third of the bank separately.

Based on these calculations, approximately 200 cy of bank soil excavated from portions of the Constitution Park Primary BMA may have TCLP mercury concentrations that exceed 0.2 mg/L, and thus could require management at a suitable Subtitle-C landfill or retort facility (see Tables 4-1 and 4-2). The remaining approximately 1,900 cy of bank soil excavated from Constitution Park and the WWTP BMAs is anticipated to have TCLP mercury levels below 0.2 mg/L. Pending verification of relatively low TCLP in samples that characterize these areas, such soils will likely be suitable for disposal at a local Subtitle-D landfill.

4.3 Installation of Design Elements

The following sections summarize key construction details for the Phase 1A interim measures.

4.3.1 Biochar

As discussed in Section 3.2, 6 inches of biochar mixed with 50% subgrade fill, will be placed at the base of the excavations in Primary BMAs. The biochar layer will be installed within a 6-inch HDPE geocell to help it remain in place on the slope prior to backfilling. Geocells will be secured from the top of the slope according to manufacturer's recommendations to avoid puncturing the woven geotextile filter, which will be installed beneath the biochar in some locations (See Section 4.3.3). Details of biochar installation can be found in Specification Section 31 23 00 – Earthwork and Fill and Section 31 05 19 – Geosynthetics.

4.3.2 Backfilling

Backfill will be installed after biochar application using mechanical excavators. Above the upper elevation of biochar application, it is likely that "benching" of the excavated slope cut will be required so interlocking can form between the native subgrade and the backfill soils. General backfill will be placed in loose lifts and compacted to a minimum of 90% relative density for long-term stability. Details of backfill installation are further discussed in Specification Section 31 23 00 – Earthwork and Fill.

4.3.3 Structural Stabilization Features

Prior to installation of toe armor, a woven geotextile filter (with a minimum tensile strength of 150 pounds per foot) will be installed over the native substrate exposed at the base of the cut or bank face to cover the area where armor stone is to be installed. This fabric will prevent winnowing of the native material beneath the armor stone. The geotextile will be secured using stakes. Surfaces where the launchable toe rock will be installed will not be covered with the geotextile to allow rock in these areas to "launch" into scour holes in the event of bed scour at the toe of the bank. Armor stone will be installed over the geotextile (and over biochar where applicable) using excavators or a crane with clamshell buckets or similar mechanical means recommended by the selected contractor. Details of stone toe installation are provided in Specification Section 31 37 00 – Stone Toe Protection and include discussion of the appropriate installation techniques required to prevent damage of the underlying geotextile during installation.

Salvaged trees will be connected to anchor stones using chains, connecting links, and eye bolts secured into the stones with mechanical anchors or adhesive. Assembly of the trees and anchor stones may be performed before installation and placed using cranes or other means recommended by the contractor. All soil will be removed from the rootwads of the salvaged trees before they are connected to the anchor stones. The soil removed from the rootwads and wash water will be handled according to the waste management protocols for the project.

4.3.4 Enhanced Vegetative Stabilization

Enhanced vegetative stabilization will be implemented by seeding and planting.

4.3.4.1 Installation Techniques

Seeds will be placed by hydroseeding and hand-broadcasting. Hydroseeding will include a mixture of seeds and a tackifier sprayed onto the site following placement of topsoil. Native seeds will also be hand-broadcast over disturbed areas following installation of trees and shrubs.

Trees and shrubs will be installed by hand. Planting pits will be dug by hand and be of a minimum diameter and depth recommended by the nursery based on the size of the container. The planting pits will be created in the topsoil placed at the site so the need for additional soil amendments is not anticipated. Larger trees shall be supported by a 2-inch by

2-inch stake installed on the upwind side of the tree. Animal exclusion methods may also be used to reduce browsing by deer, geese, and other animals. Five-foot-tall tree tubes will be installed with each tree and shrub species, at the time of planting. The tubes will be staked into the ground with a 6-foot-tall wooden stake. Bird netting will also be included on the top of each tree tube. Geese exclusion will include staking, string, and flagging. Additional details are provided in the specifications.

4.3.4.2 Equipment Considerations

With the exception of the hydroseeding equipment, all planting and seeding is anticipated to be completed with hand-held tools to prevent soil compaction at the site and potential damage to preserved trees and shrubs. For hydroseeding, the mixer and generator will remain at the top of bank outside of the planting zone, and the seed/tackifier mixture will be applied using a hand-held spray hose.

5 SCHEDULE AND SEQUENCING OF ACTIVITIES

Depending on permitting and easement timelines, as well as weather conditions, construction of Phase 1A interim measures is anticipated to begin in September 2016, with completion by late 2016, generally coinciding with the normal period of low flow in the South River. Construction is expected to proceed in an upstream-to-downstream sequence beginning with development of the primary staging area and construction at the Constitution Park BMA, though alternate sequencing proposed by the selected contractor may be considered. Depending on the contractor's progress, construction may potentially be temporarily suspended during the winter after completion of the Constitution Park BMA, with construction of the WWTP BMAs occurring in the late spring/early summer of 2017.

Within a BMA, work will begin with general site development, including construction of temporary access roads and installation of erosion-control measures and temporary cofferdams. After general site development, clearing and grubbing of the Primary BMA and selective clearing in the Secondary BMA will commence. Waste characterization test pits will be advanced after clearing of the Primary BMA is complete. Samples will be analyzed on an expedited turnaround so excavation of the Primary BMA can begin as soon as possible after clearing and grubbing. It is anticipated that construction of slope stabilization measures in Secondary BMAs (i.e., installation of coir logs, geocells with biochar and topsoil, and erosion-control fabric) will begin in parallel with Primary BMA excavation so geocells and erosion-control fabrics can be keyed and staked into the limit of excavation prior to backfilling. After excavation is complete, geotextile will be installed along the base of the cut in the armored toe area, followed by placement of the biochar layer, which in turn will be followed by armor toe construction and backfilling. Once grading of the finished slope is complete, topsoil (and geocell if necessary) will be applied, followed by habitat restoration (salvaged tree installation and planting) and closeout.

The contractor will develop a more detailed implementation schedule as part of the bidding process.

6 QUALITY ASSURANCE/QUALITY CONTROL

The Phase 1A interim measures design includes a number of construction performance standards to help ensure the remedy is successful and executed safely. As discussed in the following sections, construction performance standards include environmental protection, health and safety, materials testing and construction verification procedures, as well as BMPs and other appropriate quality assurance (QA)/quality control (QC) procedures. Environmental protection, health and safety, and construction performance standards are provided in further detail in the project specifications (Appendix L), and will also be detailed by the contractor in a project-specific construction health and safety and QA/QC plans.

6.1 Health, Safety, and Environmental Protection

Before the start of construction, the contractor will submit a project-specific Health and Safety Plan (HASP) detailing the hazards present in the each work activity, personnel protective equipment levels specific for each work activity, and other safe work practice plans, as necessary, based on the contractor's proposed means and methods to complete the project. The contractor will have a Site Safety and Health Officer who will be assigned to the project site fulltime and be responsible ensure each aspect of the contractor's HASP is followed. All site staff will be required to have OSHA 29 CFR 1910.120 HAZWOPER training and certification.

In addition to erosion and sediment control BMPs discussed in Section 4, the contractor will also be required to take measures necessary to control noise, dust, pests, and other pollutants during construction. These measures will include storing volatile liquids in closed containers, using environmentally safe hydraulic fluid, preventing ponding of stagnant water on site, properly maintaining equipment, and providing dust control and air monitoring. The contractor will also prepare spill response procedures that will be followed in the event that pollutants are spilled during construction.

During construction, the DSR will perform daily oversite of the project and will have responsibility of enforcing the HASP and environmental protection measures. Oversite will include conducting daily tailgate meetings to discuss the planned work and anticipated hazards for the day and generally inspecting construction activity to ensure all safety and environmental controls are in place and are being followed. A full health and safety audit will be performed weekly to check that all aspects of the job are being performed safely. Further details of the health and safety and environmental protection requirements for the project can be found in the Technical Specification (Appendix L) in Sections 01 31 00 - Project Management and Coordination, 01 35 29 - Health, Safety, and Emergency Response Procedures, and 01 35 43 - Environmental Protection Procedures.

6.2 Materials Testing

Borrow soils from the Jones Hollow Property have been tested for geotechnical properties and mercury content (see Specification Section 00 31 32 – Geotechnical Data). This testing has shown that the borrow soils from this site have geotechnical properties that are acceptable for use on the project. Mercury analysis of the same samples used to determine the geotechnical properties of the Jones Hollow Property soil show that THg concentrations at the Jones Hollow Property are at background levels. Other materials imported to the site will be tested at the beginning of the construction project to ensure they meet the project specifications (Appendix L). Waste characterization testing will be performed in situ before excavation. Materials testing and documentation will be the responsibility of the selected contractor. Tests to be performed and required testing frequency are identified in the construction specifications and include the following:

- Compaction testing for backfill materials
- Grain size testing of the biochar blends for subgrade and bank face applications
- Topsoil quality tests prior to placement and planting
- Inspection and integrity testing of geotextile (synthetic and coir), geocell, and coir logs before installation
- Inspection and testing of hardware used for attaching anchor stones to salvaged trees
- Purity and germination testing for plant seed imported to the site
- Quality inspections of live plants imported to the site
- Quality and purity testing of mulch imported to the site

6.3 Construction Verification

Excavation control points are shown on plan sheets C-1 through C-3. Finished grade control points and maximum allowable bank slopes are shown on the plan sheets CM-1 through

CM-5. Control elevations for stone toe and riparian planting limits are shown on plan sheets CM-1 through CM-10 and L-1 through L-5. The contractor will use these control points, elevations, and the allowable slopes shown on the plans to stake out construction and rebuild the banks to the design elevations and slope inclinations. Verification of excavation cutline elevations, finished grade elevations, topsoil thickness, rock toe dimensions, and plantings will be verified by a licensed land surveyor with vertical accuracies of 0.1 foot and horizontal accuracies of 0.5 foot. Backfill placement and compaction QC testing will be completed in each BMA. Elevation tolerances for excavation and finished grading and compaction tolerances are documented in Specification Section 31 23 00 – Earthwork and Fill.

To minimize the potential for erosion of bank soil during construction, installation of filter fabric, biochar, armor toe, and backfill layers will occur as quickly as practicable following verification of excavation cutline elevations. Exposed slopes will be temporarily covered with plastic liners anchored by sand bags during periods of inactivity or when storm events are expected. Soil samples will be collected from the base of the excavation to document conditions at the base of each excavation area before backfilling; however, the results of chemical analysis of these samples will not be used to verify the extent of excavation in Primary BMAs, and backfilling will commence immediately after the characterization samples have been collected. Based on detailed bank soil sampling data collected to date in these BMAs (Appendix B), the excavation plans have been developed to remove the majority of the near-surface THg mass present in these BMAs (Appendix J). Lower level residual THg mass anticipated to remain in these bank soils will be managed by placement of the overlying fabric, biochar, armor toe, and backfill layers.

Installation of geotextiles (synthetic and coir), geocells, and coir logs will be inspected the DuPont Site Representative prior to cover. Salvaged logs will be placed at the direction of the Project Engineer. Plantings will be inspected by the DuPont Site Representative.

7 DOCUMENTATION AND REPORTING

7.1 Real Estate, Easements, and Permit Requirements

No real estate purchase is required for implementation of the Phase 1A interim measures.

DuPont currently owns the Constitution Park BMA property, but easements from the City will likely be required for the temporary access and laydown at this BMA. Construction easements will be required from the City for access to BMAs at the WWTP. DuPont is currently discussing with the City the terms for these easements. DuPont currently owns the Jones Hollow Property, and easements are not required for access to property for construction staging.

Anticipated permits and approvals required for the Phase 1A interim measures are discussed in Section 5.6 of the IMWP (Anchor QEA et al. 2015). A pre-application meeting with USACE, VADEQ, and the City was held in November 2015 to confirm specific permitting requirements. Permit applications were submitted in May 2016, and permits are anticipated to be obtained by July 2016.

7.2 Contracting Strategy

A contractor will be selected by competitive bid solicitation procedures consistent with DuPont's guidelines for procurement of construction contracts.

The detailed engineering plans (Appendix K) and specifications (Appendix L) for the project have been developed to support the bidding process and identify project tasks and activities required for implementation of the remedy. Permit conditions and other associated requirements will be incorporated into the bidding documents. Qualified bidders will be identified using such factors as acceptable safety rating, experience in the local area, demonstrated past performance with DuPont and others on projects of similar nature, demonstrated financial soundness, and experience with claims and lawsuits on previous projects, as appropriate.

A mandatory pre-bid meeting will be held with potential contractors and subcontractors to discuss site conditions, project requirements, and contractual issues. Questions from potential contractors will be addressed in addenda to the contract. These clarifications or modifications to the project will become part of the project contract. Following receipt of bids, responding qualified potential contractors considered to be in the competitive range will be considered for further evaluation. DuPont will perform a structured evaluation that includes a detailed review of the bidder's written proposal relative to the bidder's strategy to accomplish the work. DuPont will evaluate the bidder's exceptions to the bid documents if the bid is qualified, and how these exceptions compare with the engineer's estimate and the other bidders. This evaluation process allows the narrowing of the selection field and focuses on the best overall value relative to bid price and the bidder's proposed approach to accomplishing the work. The evaluation process identifies differences between bids that need to be qualified or clarified so bidders are evaluated on an equal basis. Bidders in the competitive range are then selected for a follow-up round of discussions and given the opportunity to clarify or answer questions.

The following criteria will be assessed by DuPont in its evaluation process prior to contract services award:

- Health and safety performance and safety statistics
- Contractor's work implementation strategy, including sequence, proposed methods, means, and technical approach
- Schedule and realistic ability to meet the schedule based on approach and resources
- Cost and individual cost elements (cost realism)
- Experience, including financial health and legal history
- References
- Proposed construction innovations and/or value engineering proposals
- Compliance with or exceptions to contract terms and conditions
- Compliance with or exceptions to the scope of work, drawings and specifications, site conditions, or working limitations
- Performance risks

Upon acceptance of the bid, the contractor will receive a Notice of Award, at which time the contractor will obtain and submit required bonds and proof of insurance, and the signed contract. After the Notice of Award and prior to issuance of the contract, a pre-construction meeting will be held to conduct a site walkover. Items that will be discussed include submittals, safety, payrolls, labor relations, environmental protection, progress schedules, payment, procurement of materials, communications, and documentation. The principal features of work will also be reviewed, and questions regarding the contract and the work site will be addressed.

After the contract is issued, but prior to mobilization to the site, a pre-work meeting will be held to define the contractor's QC system, thoroughly review the work plan, and develop a mutual understanding of the specific requirements established by the contract. The specifics of the contractor's HASP will be discussed so the emergency and safety requirements are understood by all of those directly related to the site work. The schedule of work will also be discussed. Questions concerning the administrative requirements outlined during the pre-construction conference, or any other aspect of the project, may also be addressed.

7.3 Specifications

Detailed specifications are attached as Appendix L.

8 MONITORING AND MAINTENANCE

The effectiveness of the Phase 1A interim measures will be monitored as described in the *Final AOC 4 Short-Term Monitoring Plan – Relative River Mile 0-2 of the South River, Virginia* (STMP; URS 2015), incorporated into the VADEQ-approved IMWP (Anchor QEA et al. 2015). The STMP, which may be amended from time to time by VADEQ as part of the adaptive management process, includes routine inspections of remediated areas to monitor the performance of the remedy. A Long-Term Monitoring Plan, which was incorporated into the IMWP, is concurrently being implemented to assess the overall effectiveness of the remedy over longer timeframes and larger spatial scales.

The STMP incorporates an adaptive management approach to identify potential concerns that can be corrected with maintenance activities on a case-by-case basis. Consistent with the application of adaptive management in the overall remedial program for the South River, the results of the short-term and long-term monitoring will be reviewed with VADEQ, the SRST, and other stakeholders so remedial effectiveness, as judged by the monitoring results, is communicated in a timely and transparent manner.

A Maintenance Plan has also been developed for the Phase 1A BMAs (Appendix M) to complement the STMP. The Maintenance Plan outlines planned monitoring and maintenance of the slope stabilization (i.e., rock toe, geocell, erosion-control fabrics, and coir logs) and enhanced vegetative stabilization features of the Phase 1A designs.

The following subsections outline specific components of the monitoring and maintenance plan.

8.1 Vegetation

By the end of the first full growing season, areas where herbaceous vegetation are not fully established may need to be reseeded. Trees and/or shrubs will be replanted as needed to meet a 90% survival goal. For the large trees (3-gallon size), all individuals that do not survive the first year will be replaced. Trees and shrubs that do not survive the first year will be replaced with species performing well at the site. The specific replanting location may also be adjusted based on field conditions. Site conditions will also be evaluated to determine if additional measures, such as herbivory control, are warranted. Any replanting required will occur in the next appropriate planting window, which may occur in the same year as the observation.

All planted and seeded areas will be irrigated three time a week for the first 2 weeks after installation, and weekly thereafter during the first full growing season, using water obtained from the South River. A submersible pump, with a hose connection, will be placed in the river and the planted areas will be watered until the surface soils are saturated. Gator bags will also be installed around larger planted trees to provide continuous irrigation during a longer period.

Invasive species will be monitored and controlled in the Phase 1A BMAs as necessary for up to 3 years following implementation of the Phase 1 interim measures. During the first two growing seasons after construction, spot treatments with chemical herbicides (e.g., Rodeo) will be applied where invasive species are observed with coverage of 10% or greater, especially Japanese knotweed. For the remaining year of invasive species control, chemical herbicides will be applied to invasive species if percent cover of invasive species exceeds 10% or establishing patches are observed within the project boundaries during the field surveys. Alternative control measures will be recommended, if needed, based on the species identified in the field.

8.2 Bank Slope/Toe

Where bank slope failure has occurred and structural integrity is needed to support infrastructure, bank stabilization measures will be implemented, including placement of armor stone at the toe or vegetated material, to stabilize riverbanks where necessary and/or return them to grade. The preferred bank stabilization measure will be to place armor stone material. Placement of natural or manufactured (bio) logs, cobble, gravel, and plant material will be considered where practicable.

8.3 Erosion-Control Products

Areas where erosion-control products (e.g., geocells and coir fabric) have been placed will be visually inspected. Areas that have become dislodged or loosened will be re-anchored to the bank and any exposed erosion-control product will be covered with topsoil, seeded, and covered by mulch and/or tackifier.

9 REFERENCES

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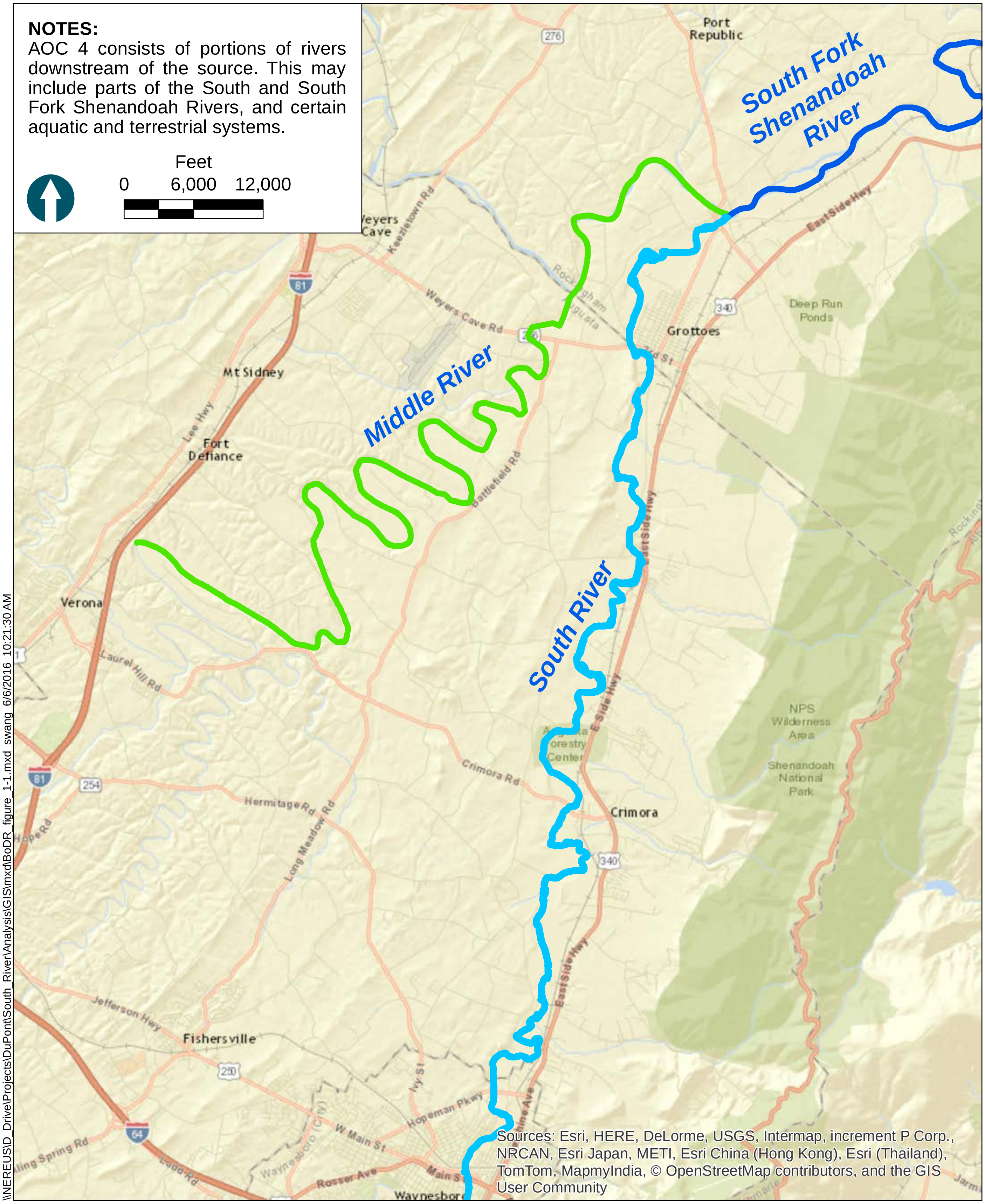
FIGURES



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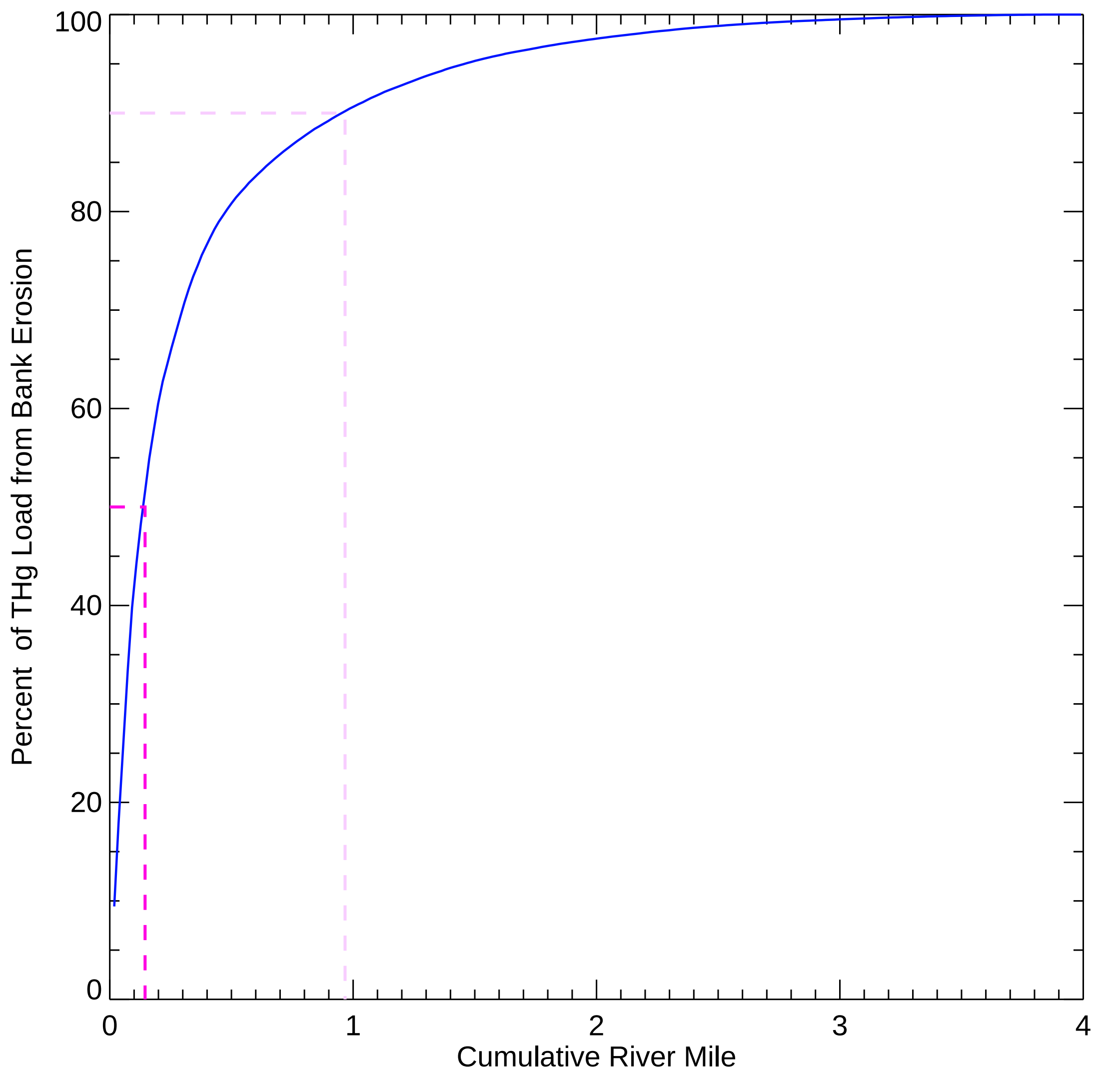
ANCHOR QEA

Figure 1-1
South River and a Portion of the South Fork Shenandoah River: AOC 4
Basis of Design Report - Phase 1A Bank Management Areas
South River Area of Concern 4



Primary BMAs (50% of Total THg Loading)
Secondary BMAs (90% of Total THg Loading)

NOTES:
BMA = bank management area
THg = total mercury

Figure 2-1
Cumulative Bank THg Loading: RRMs 0 to 2
Basis of Design Report - Phase 1A Bank Management Areas
South River Area of Concern 4

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NOTES:
Aerial image provided by ESRI.
BMA = bank management area
RRMs = relative river miles

Feet
0 500 1,000

Figure 2-2
Bank Management Areas: RRMs 0 to 2
Basis of Design Report - Phase 1A Bank Management Areas
South River Area of Concern 4

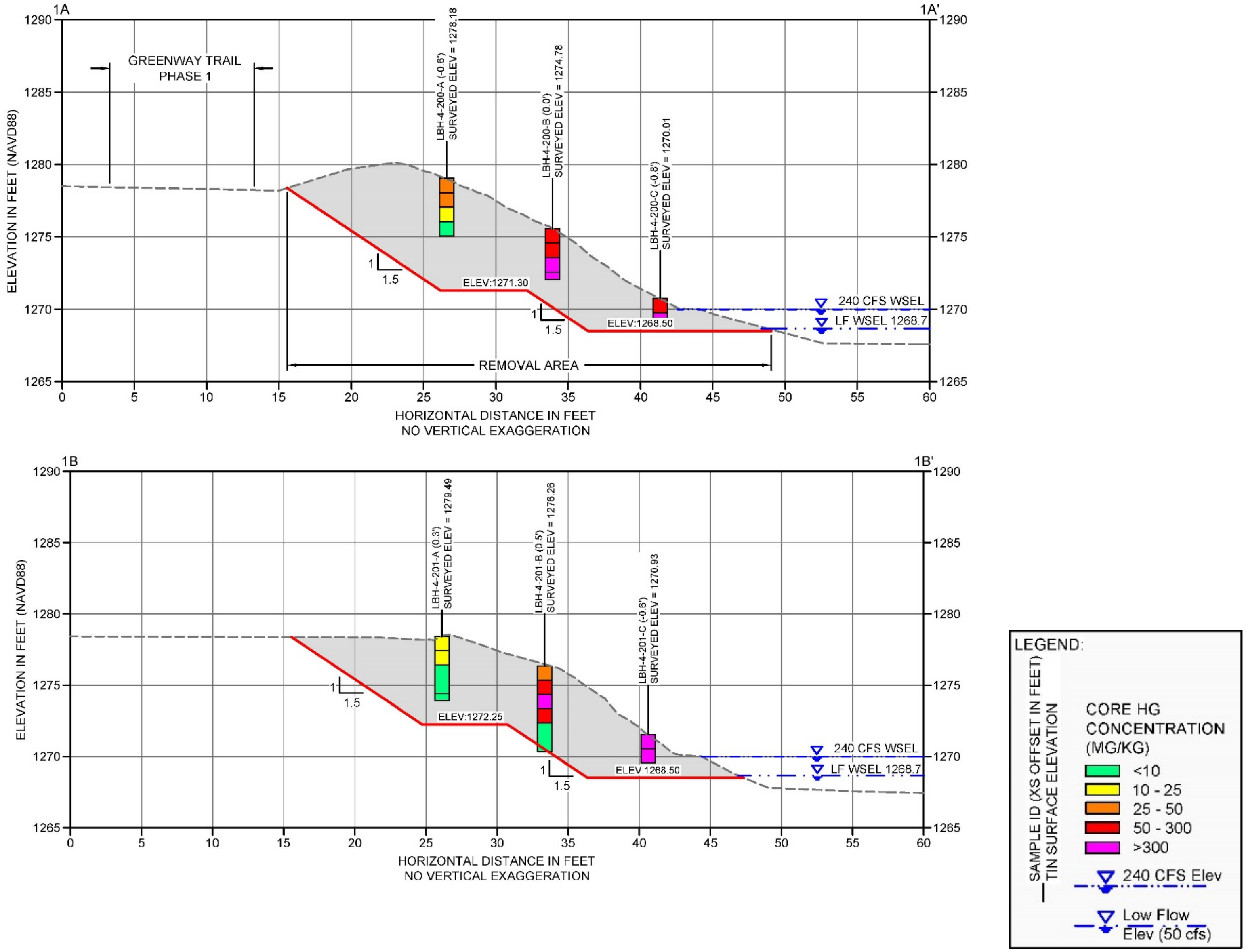

Figure 3-1
Constitution Park Primary BMA Removal Cross-sections
Basis of Design Report - Phase 1A Bank Management Areas
South River Area of Concern 4

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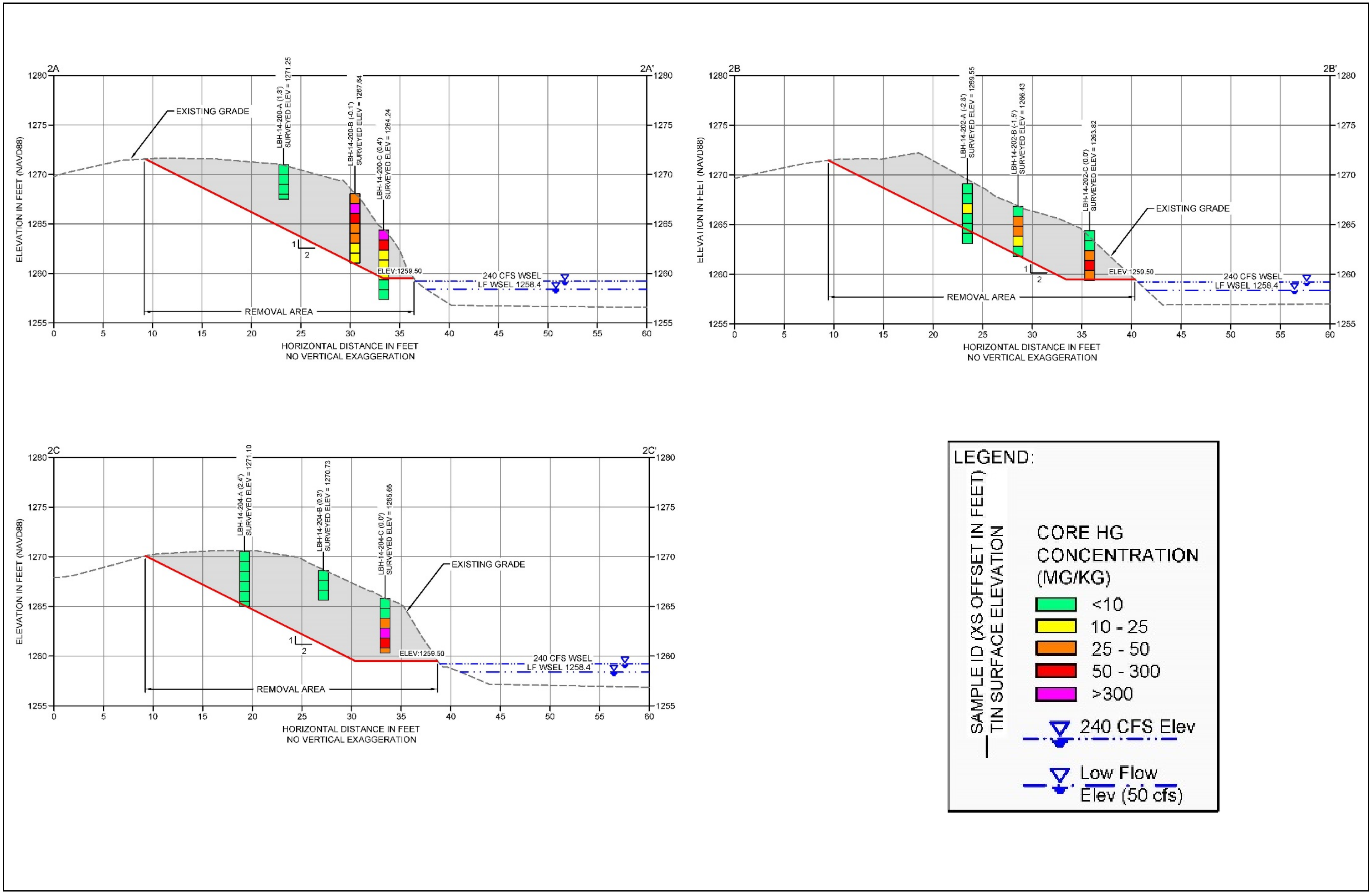


Figure 3-2
WWTP A Primary BMA Removal Cross-sections
Basis of Design Report - Phase 1A Bank Management Areas
South River Area of Concern 4

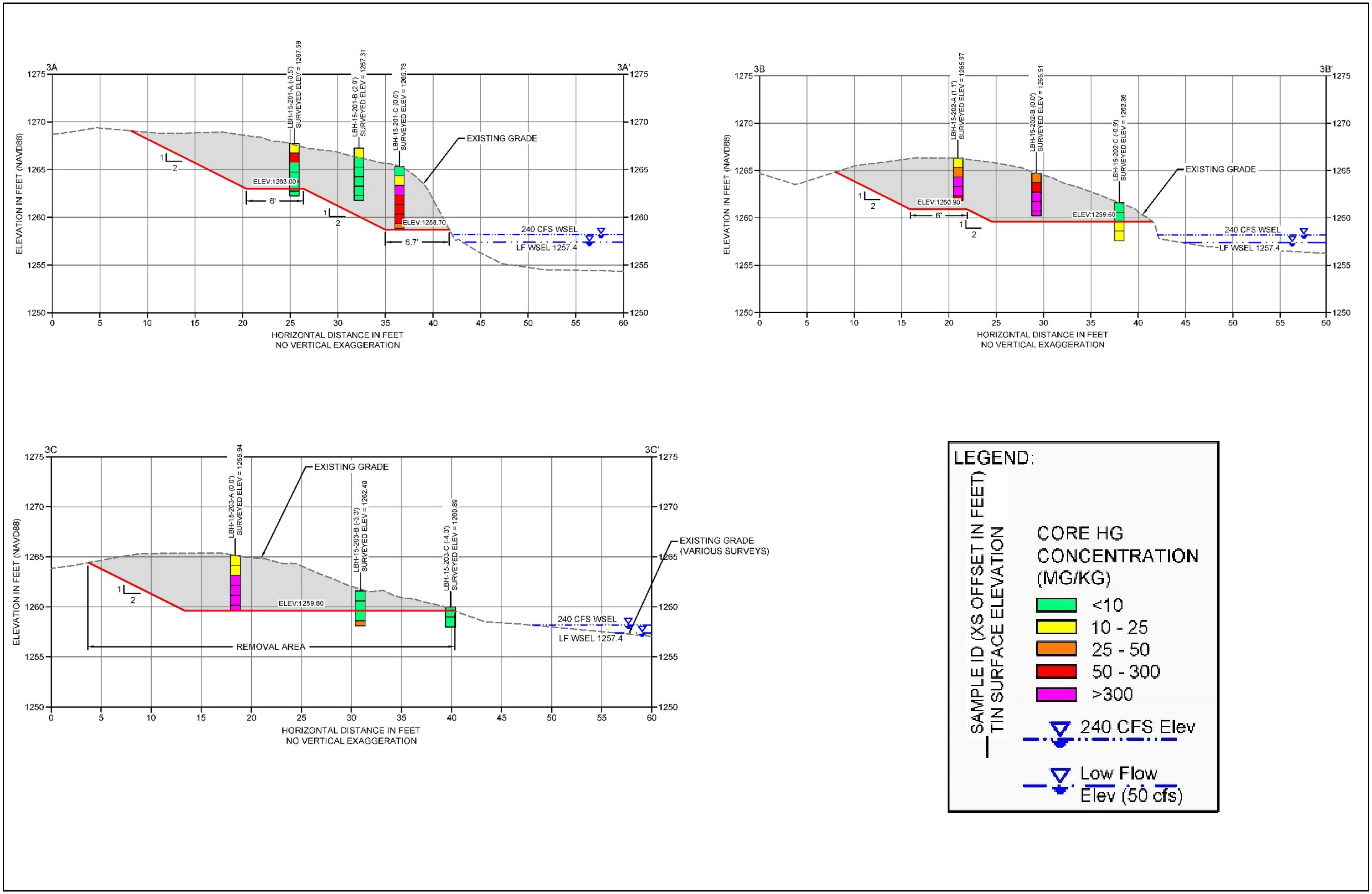
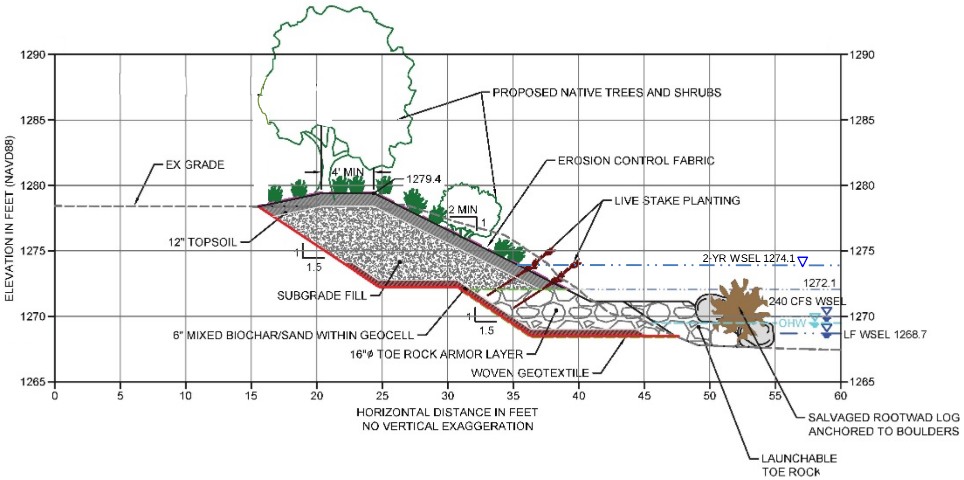


Figure 3-3
WWTP B Primary BMA Removal Cross-sections
Basis of Design Report - Phase 1A Bank Management Areas
South River Area of Concern 4

Finished Primary BMA Example Cross-section



Finished Secondary BMA Example Cross-section

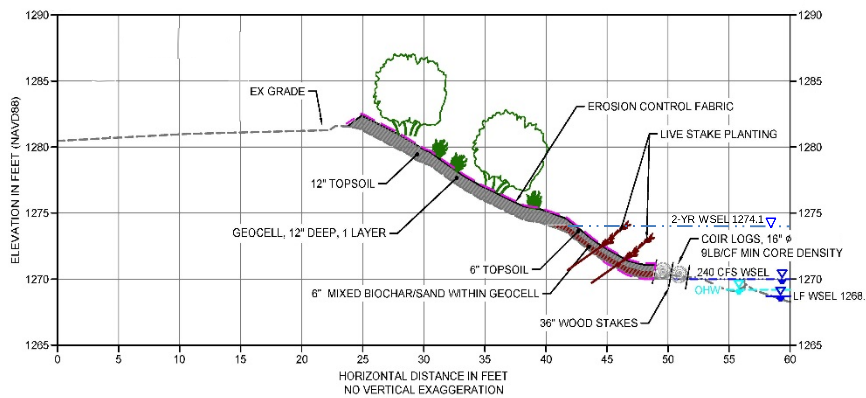


Figure 3-4
Finished BMA Example Cross-sections
Basis of Design Report - Phase 1A Bank Management Areas
South River Area of Concern 4

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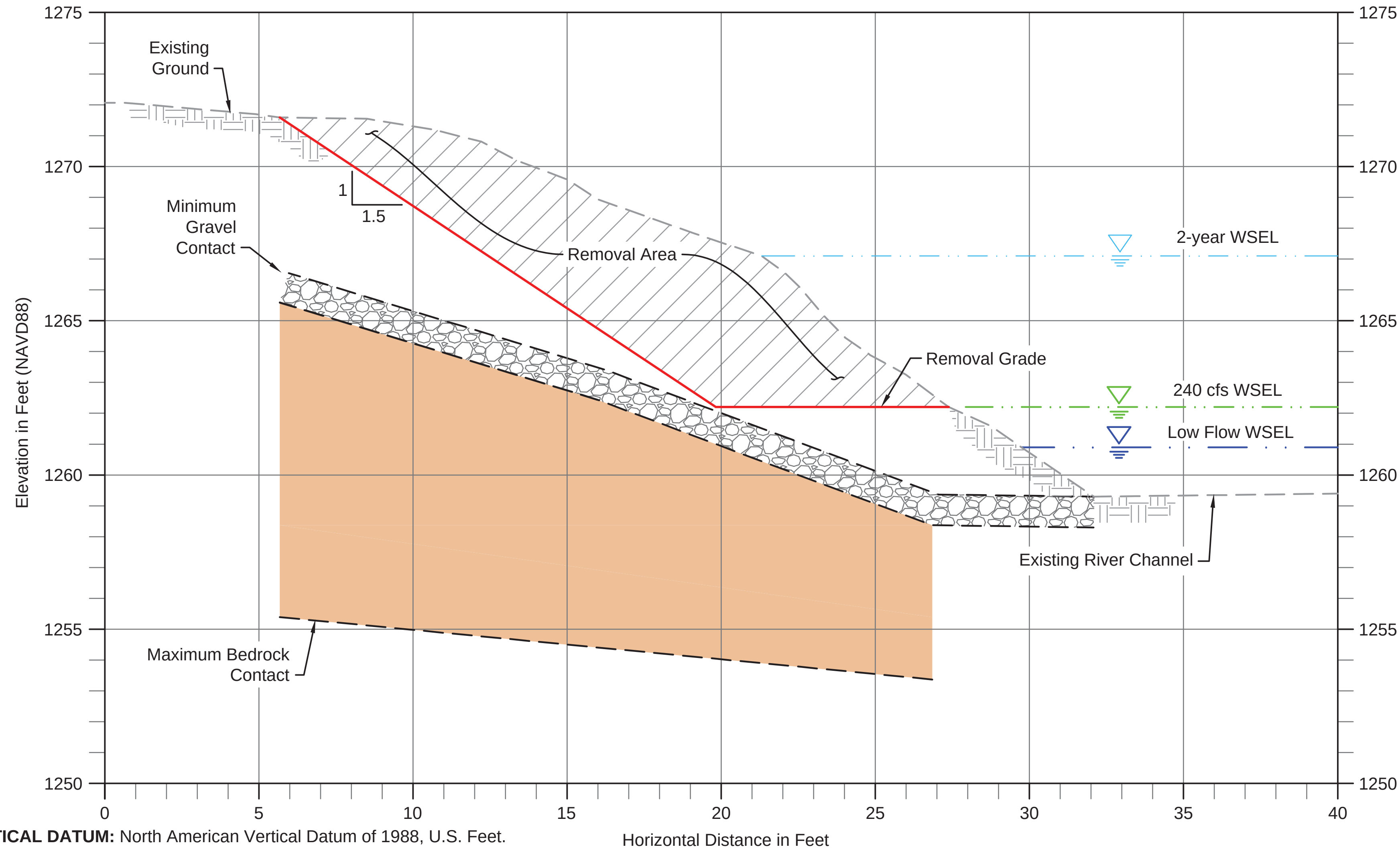

VERTICAL DATUM: North American Vertical Datum of 1988, U.S. Feet.

NOTES:

1. Depth to basal gravel and sand layer and depth to bedrock shown in cross-section are typical and based on a range of contacts collected from field surveys in the Area of Concern.
2. cfs=cubic feet per second
3. WSEL=water surface elevation

1 / -

Typical Removal Section
SCALE:1" = 5'

LEGEND:

- Existing Grade
- Removal Grade
- 2-year Water Surface Elevation
- 240 cfs Water Surface Elevation
- Low Flow Water Surface Elevation
- Removal Area
- Typical Depth of Bedrock
- Typical Depth of Basal Gravel/Sand Layer

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Figure 3-5
Conceptual Site Model of
Typical Bank Soils: RRM 0 to 2
Basis of Design Report -
Phase 1A Bank Management Areas
South River Area of Concern 4

Figure 4-1a
Truck Route Overview
Basis of Design Report – Phase 1A Bank Management Areas
South River Area of Concern 4

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Figure 4-1b
Truck Route at Constitution Park
Basis of Design Report – Phase 1A Bank Management Areas
South River Area of Concern 4

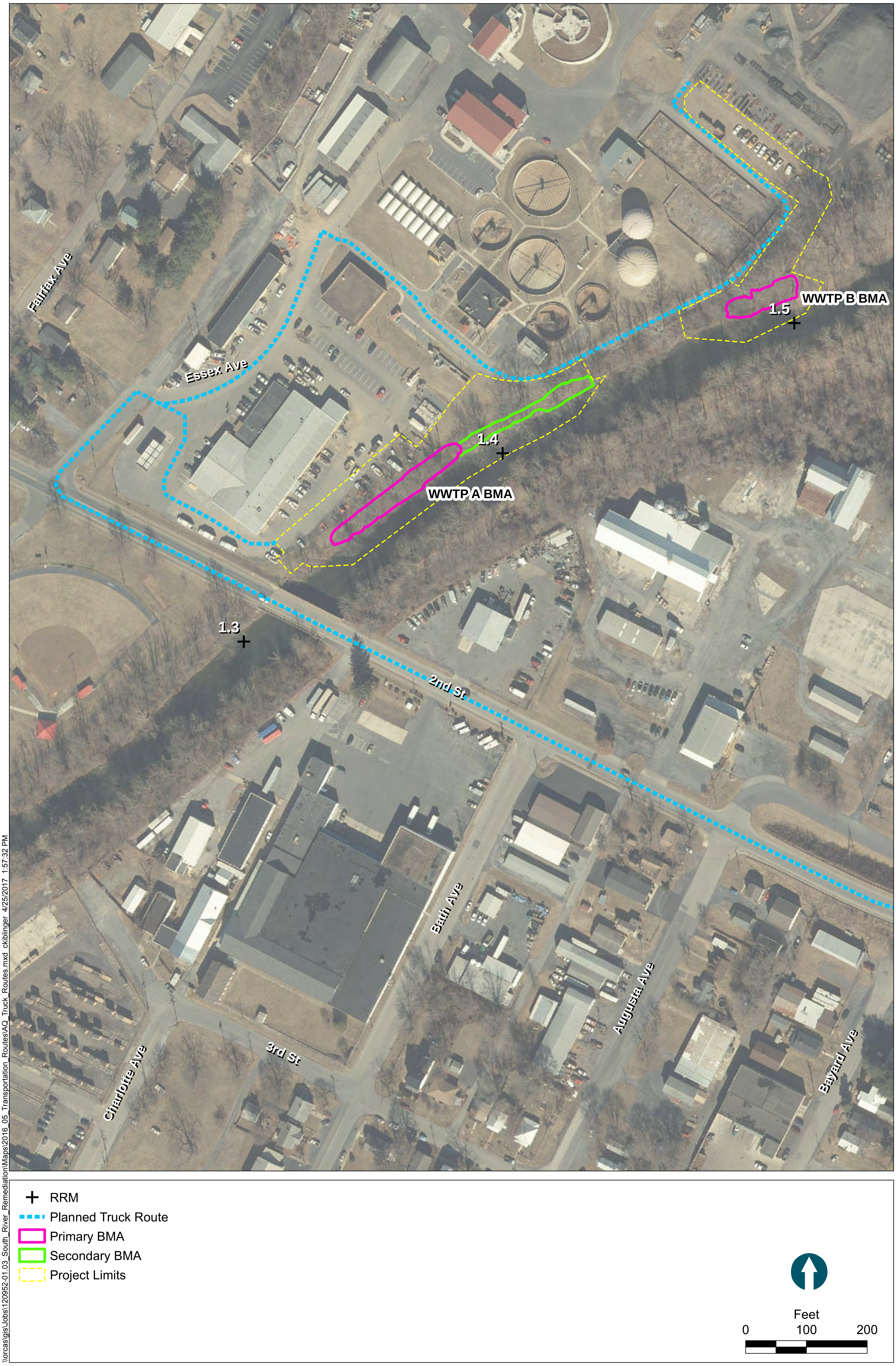

Figure 4-1c
Truck Route at Waste Water Treatment Plant
Basis of Design Report – Phase 1A Bank Management Areas
South River Area of Concern 4

APPENDIX A
GEOTECHNICAL INVESTIGATION REPORT

AREA OF CONCERN 4 GEOTECHNICAL DATA SUMMARY REPORT
SOUTH RIVER REMEDIATION
WAYNESBORO, VIRGINIA

Prepared for

E. I. du Pont de Nemours and Company

Prepared by

Anchor QEA, LLC
10400 Little Patuxent Parkway, Suite 220
Columbia, MD 21044

February 2015

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LIST OF ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
ASTM	ASTM International
bgs	below ground surface
BMA	Bank Management Area
DGPS	differential global positioning system
DuPont	E.I du Pont de Nemours and Company
site	South River site downstream of DuPont facility in Waynesboro, Virginia
SPT	standard penetration testing
USCS	Unified Soil Classification System

1 INTRODUCTION

This report summarizes and presents the findings of the geotechnical investigation performed in November 2014 as part of the Area of Concern (AOC) 4 Bank Management Area Phase 1A Interim Measures Design detailed in the AOC 4 Phase 1 Work Plan (Anchor QEA, URS, and DuPont 2014). The investigation was conducted in support of remediation design of mercury-contaminated riverbanks downstream of the former E.I du Pont de Nemours and Company (DuPont) facility in Waynesboro, Virginia (the site). The investigation focused on characterizing physical (geotechnical) properties of upland soil and riverbank sediment within AOC 4 (also referred to herein as the Bank Management Areas [BMAs]) shown in Figures 1 through 6. Characterization of the upland soil and sediments within the BMAs will inform design elements of remedial measures as well as disposal options. Details of the explorations as well as laboratory test results are tabulated at the end of the report. Boring logs and laboratory reports from the testing labs are included as Appendices A and B, respectively.

The 2.0-mile section of the South River investigated lies within the city limits of Waynesboro, Virginia, and work performed for Phase 1A was limited to BMAs within City of Waynesboro property. The explorations performed in the BMAs consisted of 10 hollow stem auger soil borings ranging from 6.2 to 23.5 feet below ground surface (bgs) with standard penetration testing (SPT; ASTM 1586) performed in 2.5-foot intervals. All borings were terminated at or in bedrock. A total of 46 soil samples were collected and submitted for laboratory testing.

2 FIELD SAMPLING SUMMARY

The field sampling performed at the site consisted of 10 upland boring performed along the riverbank of the South River between river miles 0.0 and 2.0. All explorations, in situ testing, and sampling were performed by Total Depth Drilling of Knoxville, Tennessee. Borehole logging, sample collection and labeling, and oversight of the investigation were performed by an Anchor QEA geotechnical engineer. Work was performed from November 6 to November 7, 2014, and samples were shipped to GeoTesting Express in Anton, Massachusetts for laboratory testing on November 8, 2014. Boring locations were first selected based on proximity to the mapped BMAs and were adjusted in the field as necessary due to access limitations and utilities. Location AQSR-05 was moved approximately 90 feet due to the presence of utilities. All other locations were moved fewer than 10 feet for access purposes.

Navigation and recording of exploration, sample, and testing locations were performed using a Trimble Geo6000XH differential global positioning system (DGPS). The horizontal datum used was Virginia State Plane North 1983. Coordinates of the locations are presented in U.S. Survey feet in Table 1. Figures 1 through 6 present the actual exploration, sampling, and testing locations performed during the Phase 1A geotechnical investigation.

2.1 Soil Borings

Hollow-stem augers were utilized for soil borings. SPT was performed through the hollow-stem augers, which allowed for collection of soil and sediment samples. The borings were performed to total depths of 6.2 and 23.5 feet bgs. Boring depth was limited by refusal from bedrock, which was encountered in all borings.

2.2 Soil and Sediment Sampling

Soil and sediment samples were obtained using both disturbed and undisturbed sampling methods. Disturbed sampling was performed using a split-spoon, standard penetration sampler (i.e., 18-inch length, 1.375-inch inside diameter, and 2.0-inch outside diameter). Sample recovery length was recorded and the soil units were classified and logged in accordance with the Unified Soil Classification System (USCS; ASTM D2487) and were logged at each location shown in Figures 1 through 6. Disturbed samples were labeled, stored, and sealed in water-tight plastic bags to minimize moisture loss. Samples were shipped to the testing laboratory in a sealed 5-gallon bucket and held in a moisture-controlled environment until testing was performed. A total of 47 disturbed samples were submitted to the testing laboratory, 28 for analysis and 19 for archiving. These samples were tested for index properties, including moisture content, organic matter, grain size distribution, specific gravity, and Atterberg limits. Testing results for disturbed samples are presented in Table 2.

Undisturbed sampling was performed by advancing a 3-inch outside diameter, thin-walled Shelby tube into cohesive soil units using constant hydraulic pressure (ASTM 1587). Only one undisturbed sample was successfully retrieved. Upon retrieval, the sample was characterized by visual observation of both the top and bottom of the Shelby tube, then moisture-sealed using wax. The ends were additionally sealed with plastic caps. The undisturbed sample was wrapped with bubble wrap and shipped in a Schedule 40 PVC tube with PVC end-caps to the testing laboratory. The sample was stored in a moisture-controlled room until tested. This sample was tested for compressibility and strength properties using one-dimensional consolidation and direct shear testing, respectively. Testing results for undisturbed samples are presented in Table 3.

2.3 Work Plan Deviations

The following deviations from the Work Plan occurred:

- Location AQSR-05 was moved 94 feet to the southeast and parallel to the river for purposes of avoiding underground utilities.
- Strength testing of the undisturbed sample utilized the direct shear test (ASTM D3080) rather than the tri-axial compression test (ASTM D2850). The direct shear test was chosen because it required less material per test and therefore enabled more tests results to be obtained.

3 INVESTIGATION RESULTS

A discussion of the findings and testing results performed for the geotechnical investigation is presented in this section. Soil boring logs are included in Appendix A.

3.1 Subsurface Conditions

Characterization of subsurface conditions was performed during soil borings through observations of samples obtained from regular intervals from the ground surface to the final boring depth (i.e., bedrock surface). Three principal soil units were identified during the investigation. All soil borings were terminated at bedrock surface. Soil units are described in order from the ground surface downward, as follows.

Topsoil/Silty SAND (SM)

The near-surface soils consisted primarily of top soil, fill, and/or recently deposited river sediments. This unit consisted of a loose to medium dense, dry to moist, dark brown to yellow-brown, fine silty sand with non- to slightly plastic fines, occasional gravel and rock fragments, and varying amounts of organic matter. This unit varied in thickness from 2.0 to 13.5 feet, with an average thickness of 6.9 feet. This unit was observed at all sampling locations.

Alluvium (SM/GM)

Underlying the near-surface soils was a predominately granular alluvium. This unit was loose to medium dense, damp to wet, brown/yellow-brown to olive-gray, fine to coarse silty sand and silty gravel with frequent large gravel and cobbles that are sub-rounded to sub-angular in shape. This unit was typically observed immediately beneath the topsoil/silty sand unit and ranged in thickness from 2.5 to 5.0 feet, with an average thickness of 3.8 feet. This unit was not observed in soil borings AQSR-04, AQSR-05, and AQSR-07.

SILT/CLAY (ML/MH/CL)

Cohesive soil units were observed at five of the ten soil boring locations: AQSR-01, AQSR-03, AQSR-04, AQSR-05, and AQSR-06. This unit was highly variable and ranged from a stiff, moist, brown to dark brown, non-plastic very fine sandy silt/clay to a very soft, moist/wet, orange-brown silt with medium to high plasticity. Moisture content of the cohesive units ranged from 11.9% to 99.1%. Thickness of this unit ranged from 2.0 to 9.5 feet, with an average thickness of 4.8 feet.

At AQSR-01 and AQSR-06, where cohesive units were observed to be very soft to soft, the units were immediately above bedrock and exhibited a blocky fracture when intact pieces were broken apart. The material appeared to be very highly weathered bedrock, such as limestone, that exhibits a clay-like behavior when disturbed and remolded. An undisturbed sample was successfully collected at AQSR-01, while all other sampling used disturbed methods. Four other undisturbed sampling attempts were performed unsuccessfully in the cohesive unit.

Bedrock

Bedrock outcrops were frequently observed at various locations of the site. Bedrock was encountered in all boring logs and was the contacted at the bottom of each boring. For boring logs AQSR-01 and AQSR-06, soil borings were terminated in weathered bedrock. The soil overburden thickness and zones of weathered bedrock are expected be variable throughout the site.

Groundwater

Groundwater was observed in all soil borings except AQSR-04, where shallow bedrock was encountered. Depth to groundwater ranged from 5.0 to 19.0 feet bgs, as shown in Table 1.

3.2 Geotechnical Laboratory Testing

Testing performed as part of the geotechnical investigation consisted of laboratory and in situ testing. Laboratory testing included the following tests:

- Moisture Content (ASTM D2216)
- Organic Content (ASTM D2974)
- Atterberg limits (ASTM D4318)
- Dry Density (ASTM D2937)
- Specific Gravity (ASTM D854)
- Grain Size (ASTM D422)
- One-Dimension Consolidation (ASTM D2435)

- Direct Shear (ASTM D3080)

All testing was performed by GeoTesting Express. Results of the laboratory testing for index testing and strength testing are presented in Tables 2 and 3, respectively. Results of consolidation testing are presented in Appendix B.

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ASTM Standard D2487, 2011. *Standard Practice for Classification of Sediments for Engineering Purposes (Unified Soil Classification System)*. ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D2850, 2007. *Standard Test Methods for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils*. ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D2937, 2010. *Standard Test Methods for Density of Soil in Place by the Drive-Cylinder Method*. ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D2974, 2014. *Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils*. West Conshohocken, PA, www.astm.org.

ASTM Standard D3080, 2011. *Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions*. ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D4318, 2010. *Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Sediments*. ASTM International, West Conshohocken, PA, www.astm.org.

TABLES

Table 1
Summary of Explorations

Exploration ID	Easting (x)[1]	Northing (y)[1]	Type of Exploration	Date of Exploration[2]	Depth to groundwater (feet)	Termination Depth[3] (feet)
AQSB-01	11372203.92	6707572.17	Soil Boring	11/6/2014	10.9	21.5
AQSB-02	11371910.44	6709143.97	Soil Boring	11/6/2014	5.0	6.6
AQSB-03	11372825.57	6710897.65	Soil Boring	11/7/2014	10.0	11.2
AQSB-04	11373219.19	6711330.99	Soil Boring	11/7/2014	---	9.7
AQSB-05	11374051.98	6711620.90	Soil Boring	11/7/2014	15.3	16.1
AQSB-06	11374380.48	6711781.40	Soil Boring	11/6/2014	19.0	24.1
AQSB-07	11374716.77	6711891.29	Soil Boring	11/7/2014	6.0	6.2
AQSB-08	11374869.93	6712194.14	Soil Boring	11/6/2014	13.3	14.3
AQSB-09	11375102.30	6712314.58	Soil Boring	11/6/2014	14.0	16.1
AQSB-10	11374916.48	6713802.35	Soil Boring	11/7/2014	9.4	11.0

Notes:

[1] Horizontal datum is North American Datum of 1983 Virginia State Plane North, U.S. Survey feet.

[2] Depth to groundwater refers to the groundwater depth below ground surface at the time of drilling.

[3] Termination depth is relative to the ground surface.

Table 2
Index Test Results

		In Situ Sample Depth (feet)[1]						Atterberg Limits			Particle Size Summary			
Boring ID	Sample ID[2]	Top	Bottom	Recovery (inches)	Moisture Content (%)	Organic Matter (%)	Specific Gravity	Liquid Limit	Plastic Limit	Plasticity Index	Gravel (%)	Sand (%)	Fines (%)	USCS Symbol
AQSB-01	SS02	3.5	5.0	12.0	12.1	3.0	2.63	---	---	---	10.4	58.1	31.5	SM
AQSB-01	SS04	8.5	10.0	8.0	6.4	---	2.71	---	---	---	42	50.2	7.8	SP-SM
AQSB-01	SS06	13.5	15.0	14.0	36.4	---	2.81	47	32	15	---	---	---	ML
AQSB-01	ST01	18.0	20.0	24.0	52.6	---	2.75	NP	NP	NP	28.2	28.6	43.2	SM
AQSB-02	SS01	1.0	2.5	12.0	18.5	2.5	2.66	---	---	---	6.0	48.0	46.0	SM
AQSB-03	SS01	1.0	2.5	12.0	9.4	1.0	2.68	---	---	---	4.8	63.1	32.1	SM
AQSB-03	SS03	6.0	7.5	18.0	19.4	---	2.61	29	17	12	---	---	---	CL
AQSB-03	SS04	9.5	11.0	12.0	15.3	---	---	---	---	---	40.5	46.2	13.3	SM
AQSB-04	SS01	1.0	2.5	6.0	9.4	1.6	2.72	---	---	---	19.7	56.2	25.1	SM
AQSB-04	SS02	3.5	5.0	11.0	15.7	---	---	---	---	---	3.7	27.6	68.7	ML
AQSB-05	SS02	3.5	5.0	16.0	7.0	---	2.63	---	---	---	5.8	66.1	28.1	SM
AQSB-05	SS03	6.0	7.5	18.0	11.9	---	---	---	---	---	0.0	45.8	54.2	ML
AQSB-06	SS04	8.5	10.0	4.0	11.2	---	---	---	---	---	10.8	56.1	33.1	SM
AQSB-06	SS05	11.0	12.5	12.0	16.0	---	2.68	---	---	---	0.0	51.2	48.8	SM
AQSB-06	SS06	13.5	15.0	18.0	43.5	---	2.60	38	22	16	---	---	---	CL
AQSB-06	SS08	18.5	20.0	18.0	20.9	---	---	---	---	---	31.1	36.4	32.5	SM
AQSB-06	SS09	21.0	22.5	18.0	99.1	---	2.74	89	43	46	---	---	---	MH
AQSB-07	SS01	1.0	2.5	18.0	9.8	2.2	2.64	---	---	---	19.1	43.8	37.1	SM
AQSB-08	SS01	1.0	2.5	11.0	8.8	0.8	2.72	---	---	---	43.4	29.3	27.3	GM
AQSB-08	SS03	6.0	7.5	13.0	6.6	---	---	---	---	---	2.1	66.3	31.6	SM
AQSB-08	SS04	8.5	10.0	12.0	6.7	---	2.72	---	---	---	38.5	47.0	14.5	SM
AQSB-08	SS05	11.0	12.5	10.0	6.4	---	---	---	---	---	47.8	44.2	8.0	GP-GM
AQSB-09	SS02	3.5	5.0	18.0	8.3	2.2	2.68	---	---	---	0.0	57.7	42.3	SM
AQSB-09	SS04	8.5	10.0	18.0	4.6	---	2.71	---	---	---	38.1	53.0	8.9	SP-SM
AQSB-09	SS06	13.5	15.0	11.0	13.1	---	2.82	---	---	---	45.2	42.2	12.6	GP-GM
AQSB-10	SS01	1.0	2.5	8.0	17.3	2.9	2.68	---	---	---	0.5	54.4	45.1	SM
AQSB-10	SS03	6.0	7.5	15.0	29.9	---	2.69	43	26	17	0.0	53.6	46.4	SC

Notes:

[1] In situ depth refers to the depth below the surface at the time of sampling.

[2] SS = Split-spoon; ST = Shelby tube

USCS = Unified Soil Classification System

Table 3
Direct Shear Test Results

Boring ID	Sample ID	Test ID	In Situ Depth[1] (feet) Top	In Situ Depth[1] (feet) Bottom	Initial Moisture Content (%)	Specific Gravity	Initial Void Ratio	Normal Shear Stess (psf)	Maximum Shear Stess (psf)	Apparent Cohesion (psf)	Friction Angle (degrees)	Description (USCS Symbol)
AQSB-01	ST01	DS-1	19.0	19.5	29.8	2.75	0.83	450	582	440	36.3	Silty SAND (SM) with gravel
AQSB-01	ST01	DS-2	19.5	20.0	23.7	2.75	0.78	900	1320			Silty SAND (SM) with gravel
AQSB-01	ST01	DS-3[2]	20.0	20.5	---	---	---	---	---			Silty SAND (SM) with gravel
AQSB-01	ST01	DS-4	20.5	21.0	63.6	2.75	1.81	3600	3050			Silty SAND (SM) with gravel

Notes:

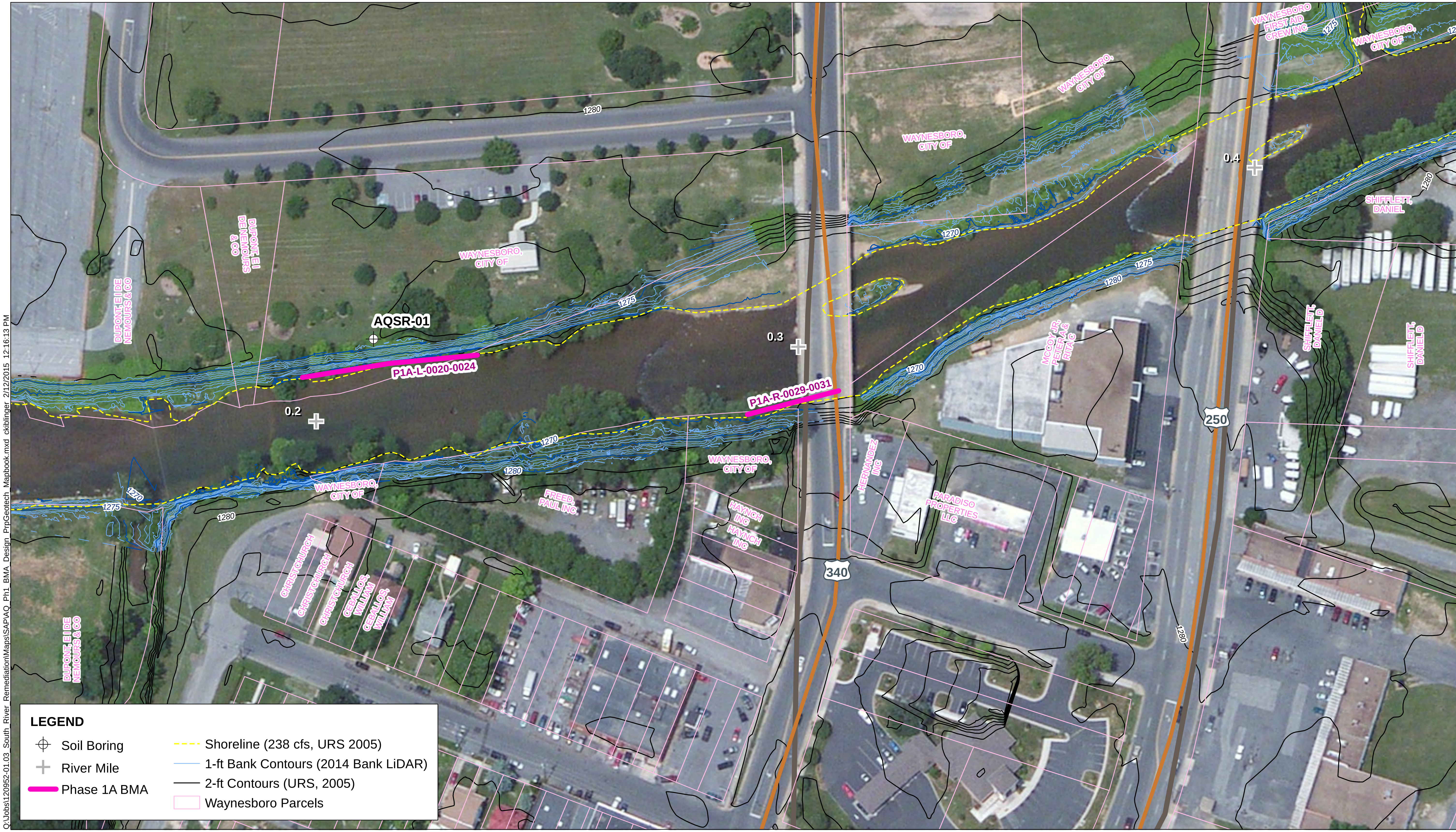
[1] In situ depth is referenced from ground surface for AQSB-01.

[2] Testing was not preformed due to high sample disturbance during sample preparation.

psf = pounds per square foot

USCS = Unified Soil Classification System

FIGURES



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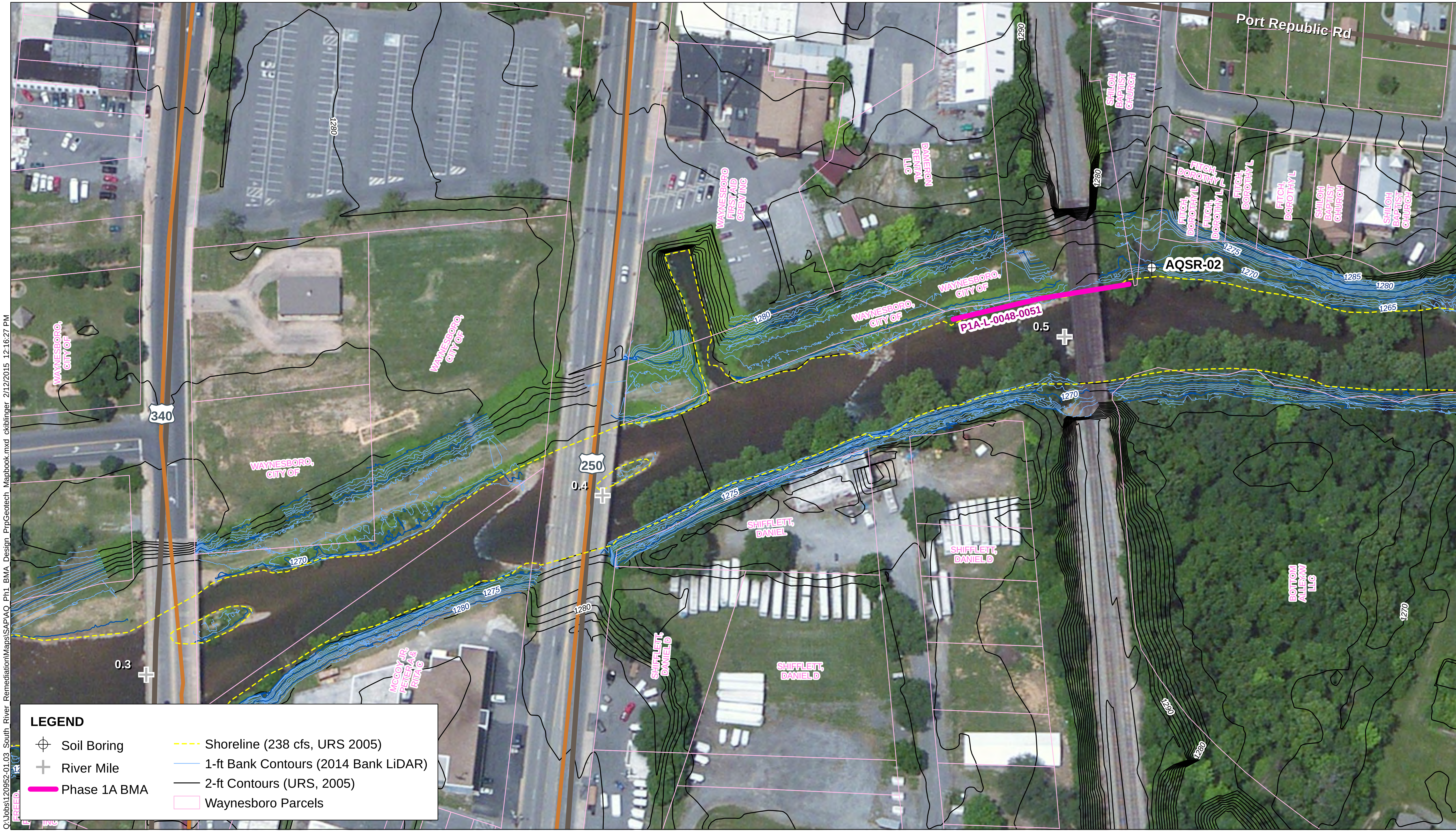
ANCHOR QEA

NOTE:
Aerial Imagery: ESRI (20110509).

Feet
0 100 200

Figure 1
Geotechnical Data Report
River Mile 0.1 - 0.4
AOC 4 Phase 1A - South River



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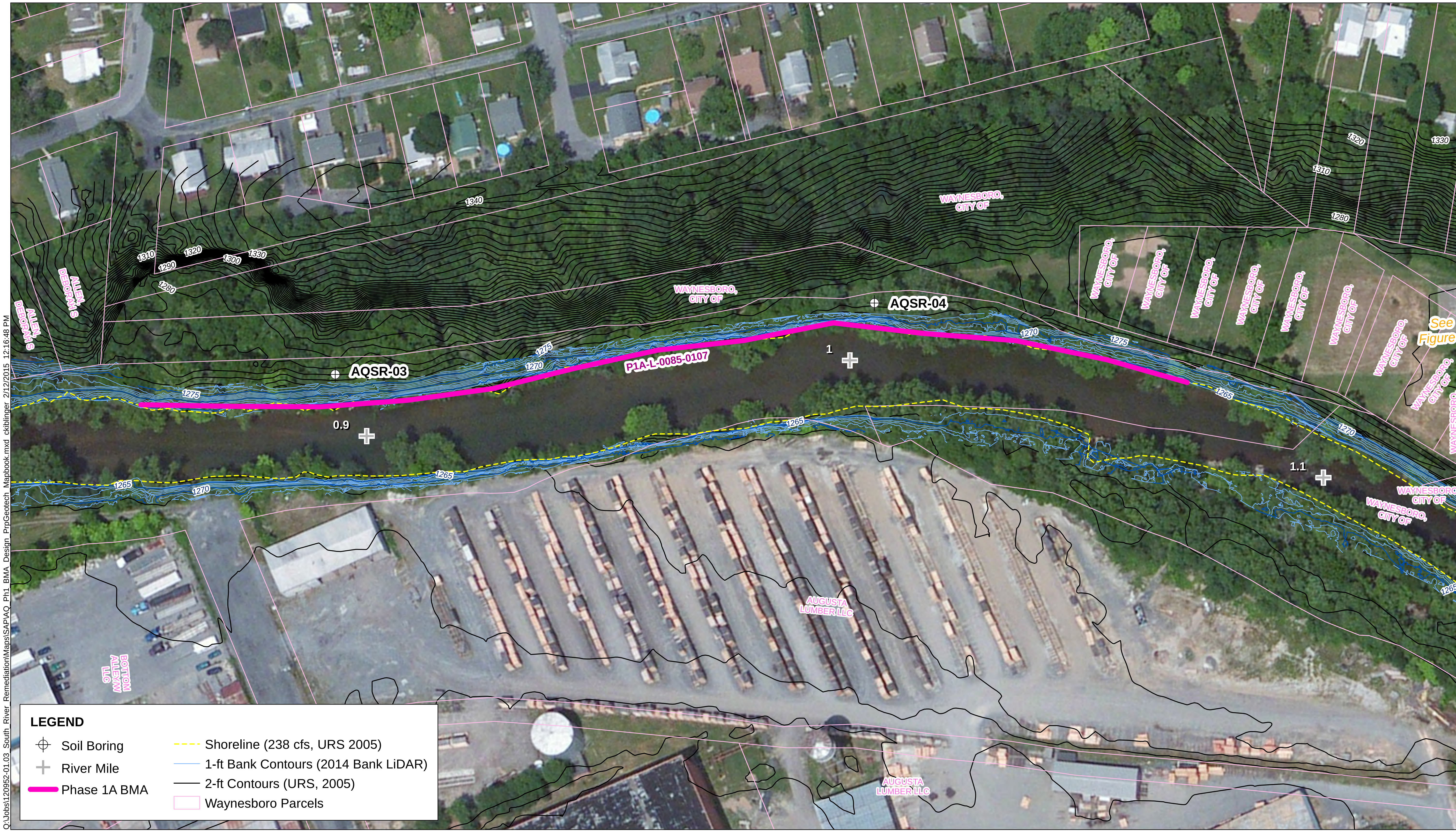
ANCHOR QEA

NOTE:
Aerial Imagery: ESRI (20110509).

Feet
0 100 200

Figure 2
Geotechnical Data Report
River Mile 0.3 - 0.5
AOC 4 Phase 1A - South River

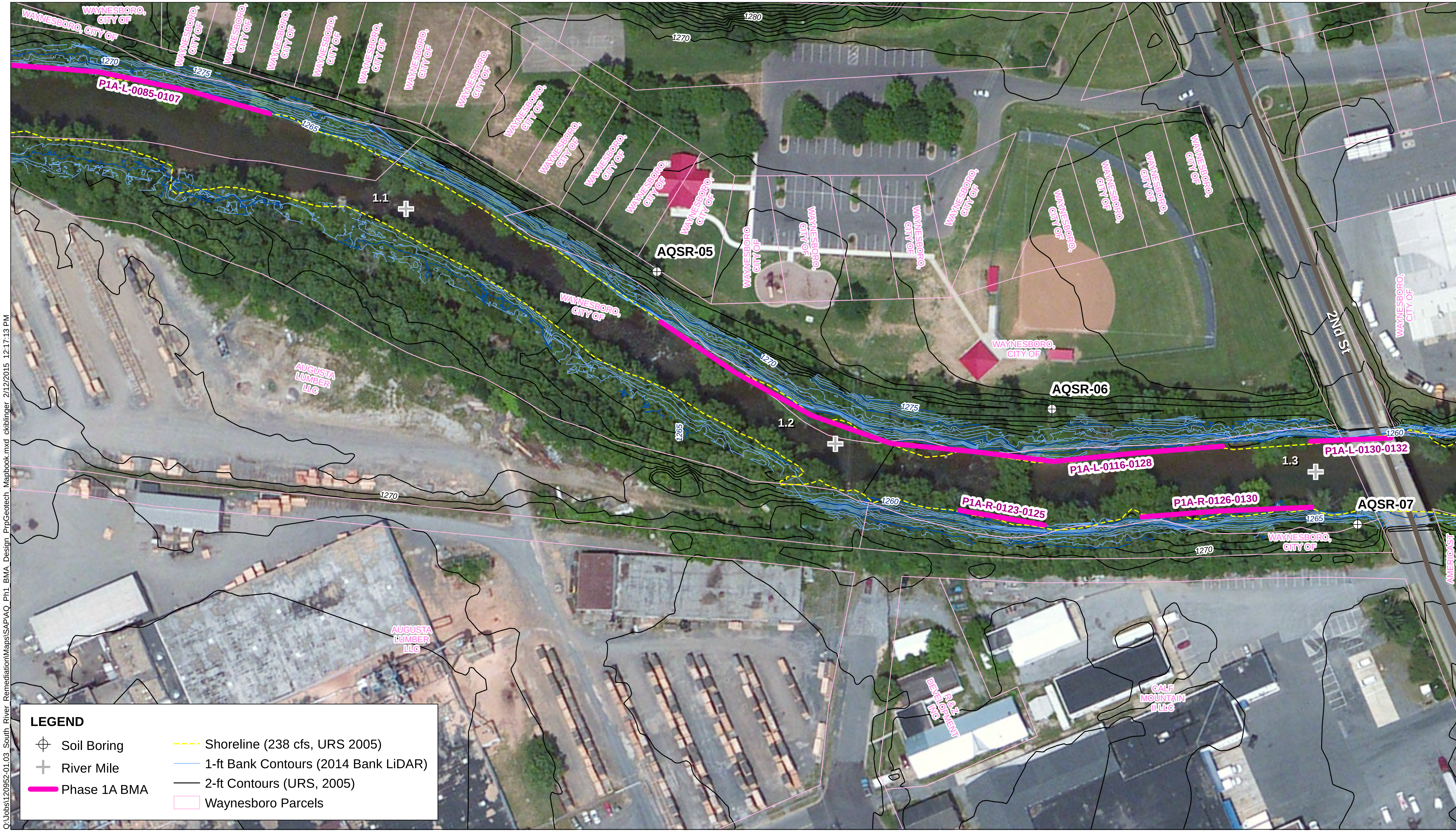


ANCHOR QEA

NOTE:
Aerial Imagery: ESRI (20110509).

Feet
0 100 200

Figure 3
Geotechnical Data Report
River Mile 0.8 - 1.1
AOC 4 Phase 1A - South River



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NOTE:
Aerial Imagery: ESRI (20110509).

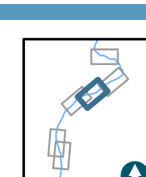
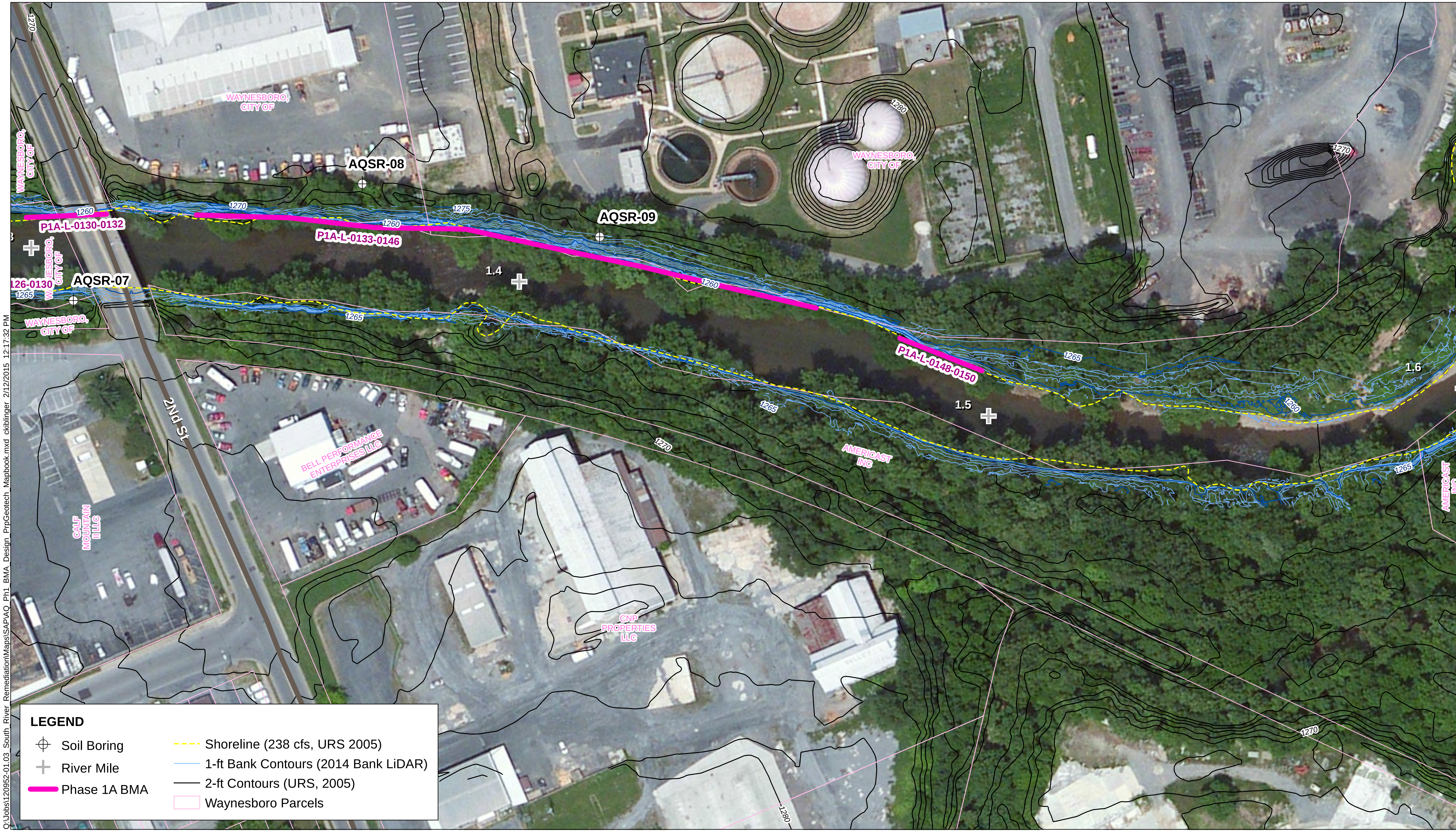


Figure 4
Geotechnical Data Report
River Mile 1.0 - 1.3
AOC 4 Phase 1A - South River



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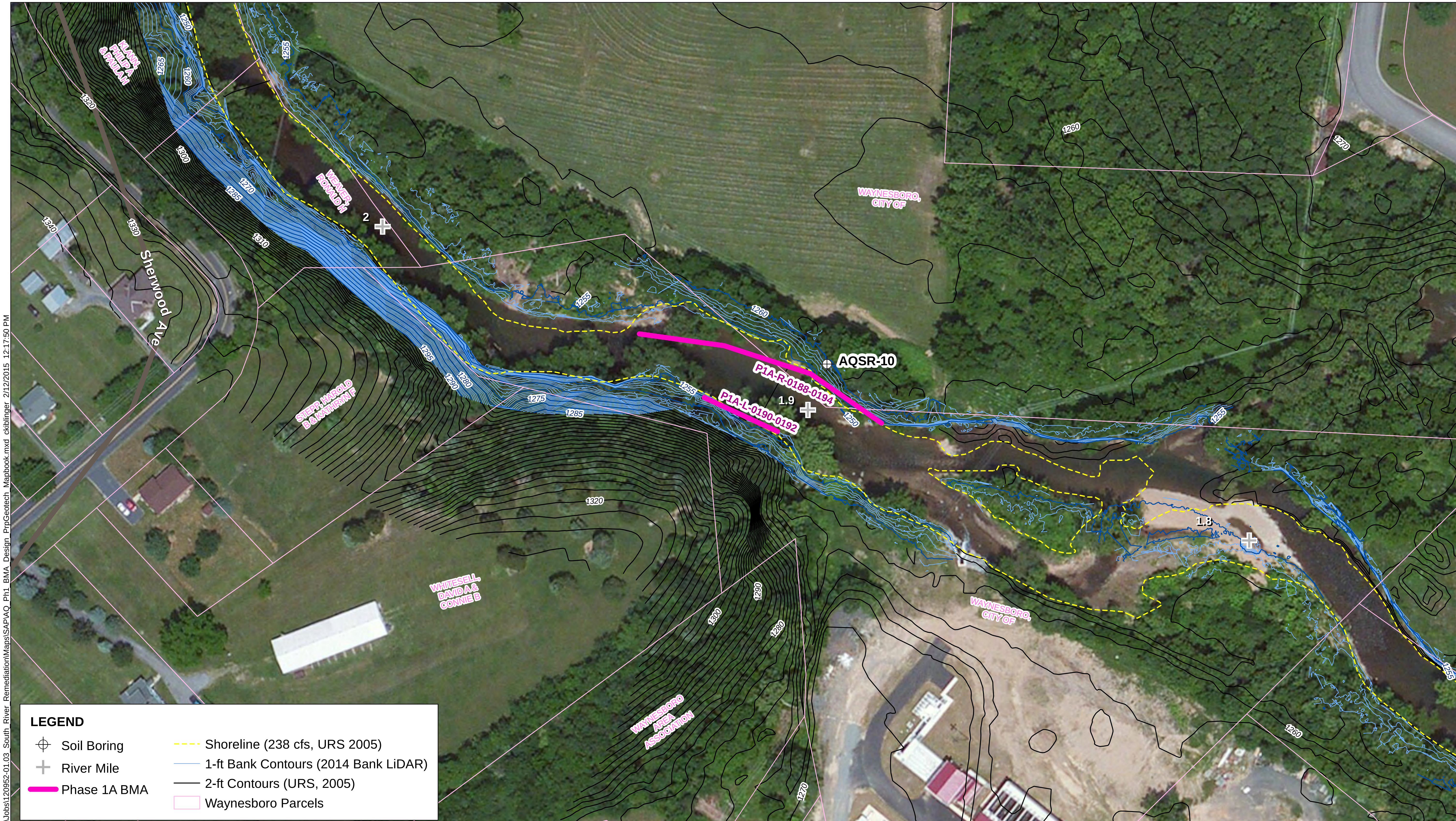
ANCHOR QEA

NOTE:
Aerial Imagery: ESRI (20110509).

Figure 5
Geotechnical Data Report
River Mile 1.3 - 1.5
AOC 4 Phase 1A - South River



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NOTE:
Aerial Imagery: ESRI (20110509).

Feet
0 100 200

Figure 6
Geotechnical Data Report
River Mile 1.8 - 2.0
AOC 4 Phase 1A - South River

APPENDIX A
SOIL BORING LOGS

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits is estimated based on visual observation and is presented parenthetically on the test pit logs.

Density SAND or GRAVEL	Standard Penetration Resistance (N) in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance (N) in Blows/Foot	Approximate Shear Strength in TSF
Very loose	0 - 4	Very soft	0 - 2	<0.125
Loose	4 - 10	Soft	2 - 4	0.125 - 0.25
Medium dense	10 - 30	Medium stiff	4 - 8	0.25 - 0.5
Dense	30 - 50	Stiff	8 - 15	0.5 - 1.0
Very dense	>50	Very stiff	15 - 30	1.0 - 2.0
		Hard	>30	>2.0

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible moisture, probably above optimum

Minor Constituents

Minor Constituents	Estimated Percentage
Not identified in description	0 - 5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Legends

Sampling Test Symbols

BORING SAMPLES

- ⊠ Split Spoon
- ⧅ Shelby Tube
- ⧓ CAL-MOD Split-Spoon
- ∗ CAL-MOD Adjusted SPT Resistance

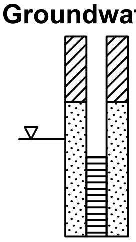
TEST PIT SAMPLES

- ⊠ Grab (Jar)
- ⧄ Bag

Test Symbols

AL	Atterberg Limits
Arc	Archive Sample
Consol	One-dimension consolidation
DD	Dry Density
DS	Direct Shear
GS	Grain Size
MC	Moisture Content
OC	Organic Content
SG	Specific Gravity
WOR	Weight of Rods

Groundwater Observations



Groundwater Level on Date (ATD) At Time of Drilling

Groundwater Seepage (Test Pits)

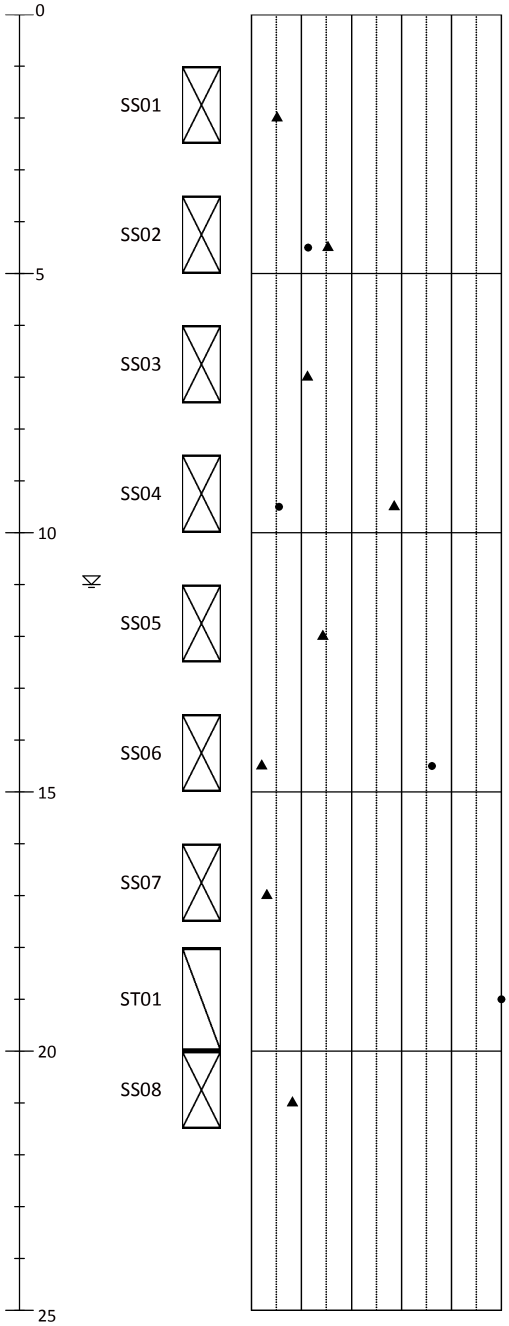
\\bellingham2\bell2\Staff Folders\Darci\LOGPLOT\South River\KEY TO EXPLORATION LOGS_SouthRiver.pdf

Soil Boring Log

AQSR-01

Project: **South River Phase 1 Interim Remedial Measure**	Location: **River Mile 0.0 to 2.0 of South River near Waynesboro, VA**	Method: **Hollow Stem Auger**
Project #: **120592-01.05**	N/LAT: **6707572.17** E/LONG: **11372203.92**	Total Depth (ft): **21.5**
Client: **DuPont**	Horiz. Datum: **Virginia State Plane North, NAD1983, US Feet**	Observed GW (bgs): **11.0**
Collection Date: **11/06/2014**	Vert. Datum: **NAVD88**	Mudline Elevation (ft):
Contractor: **Total Depth Drilling**	Sampler(s): **2in O.D./1.375in I.D. Split - Spoon** **3in O.D. Shelby Tube**	Hammer: **140 lbs w/ 30 inch drop**
Logged By: **Zac Koehn**		Hammer Efficiency: **84%**

Depth (ft)	Water Level	Samples	Uncorrected Standard Penetration Resistance (blows per foot) and Water Content (%)	Values Greater than 50	Soil Description	Lab Test



Soil Description
Samples and descriptions are in recovered depths.
Classification scheme: USCS

Silty SAND (SM): Loose, damp, dark brown with orange mottling, fine to medium silty SAND (SM), occasional gravel and trace organics.

No recovery.

SAND with silt (SP-SM): Medium dense, moist, light orange-brown, fine to coarse SAND with silt (SP-SM) with trace silt and occasional gravel and rock fragments (alluvium).
Heavy drill chatter.

Rock at end of sampler of SS04.

Increasing gravel content.

SILT (ML): Soft, moist to wet, reddish orange with olive gray mottling, fine sandy SILT (ML) with low to medium plasticity.

Material feels stiffer than indicated by blow counts.

Bottom of boring @ 21.5 feet below ground surface. Completed on 11/06/2014.

Sample	Lab Test
SS01	Arc
SS02	MC, GS, SG, OC
SS03	
SS04	MC, GS, SG
SS05	Arc
SS06	MC, AL. SG
SS07	Arc
ST01	MC, AL, SG, Consol, DS, DD
SS08	

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▲ SPT N-Value
● Water Content (%)

Notes:
1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

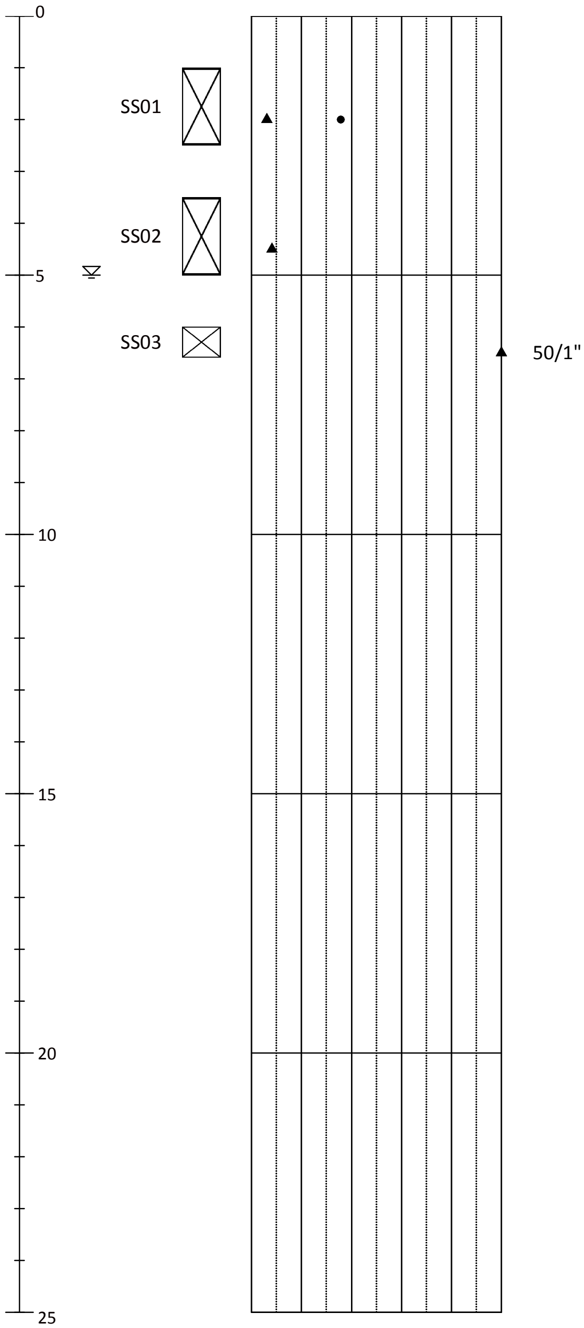
Soil Boring Log

AQSR-02

Sheet 1 of 1

Project: **South River Phase 1 Interim Remedial Measure**	Location: **River Mile 0.0 to 2.0 of South River near Waynesboro, VA**	Method: **Hollow Stem Auger**
Project #: **120592-01.05**	N/LAT: **6709143.973** E/LONG: **11371910.44**	Total Depth (ft): **6.6**
Client: **DuPont**	Horiz. Datum: **Virginia State Plane North, NAD1983, US Feet**	Observed GW (bgs): **5.0**
Collection Date: **11/06/2014**	Vert. Datum: **NAVD88**	Mudline Elevation (ft):
Contractor: **Total Depth Drilling**	Sampler(s): **2in O.D./1.375in I.D. Split - Spoon** **3in O.D. Shelby Tube**	Hammer: **140 lbs w/ 30 inch drop**
Logged By: **Zac Koehn**		Hammer Efficiency: **84%**

Depth (ft)	Water Level	Samples	Uncorrected Standard Penetration Resistance (blows per foot) and Water Content (%) 0 10 20 30 40 50	Values Greater than 50	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test



Silty SAND (SM): Loose, moist, dark brown to reddish brown, fine to medium silty SAND (SM), slighly plastic fines with trace gravel and occasional hair-like roots (sediment). — Lab Test: MC, GS, SG, OC

Silty SAND (SM): Loose, moist, brown to olive-gray, fine to coarse silty SAND (SM) with gravel-sized rock fragment (alluvium).
Low recovery due to large rock fragment plugging the sampler for SS02. — Lab Test: Arc

Thin silt seam (~2 inch thick) @ 4.5 feet. — Lab Test: Arc

0.5 feet zone of weathered bedrock (white to gray rock fragment) over bedrock, refusal at 6.6 feet.

Bottom of boring @ 6.6 feet below ground surface. Completed on 11/06/2014.

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▲ SPT N-Value
● Water Content (%)

Notes:

1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

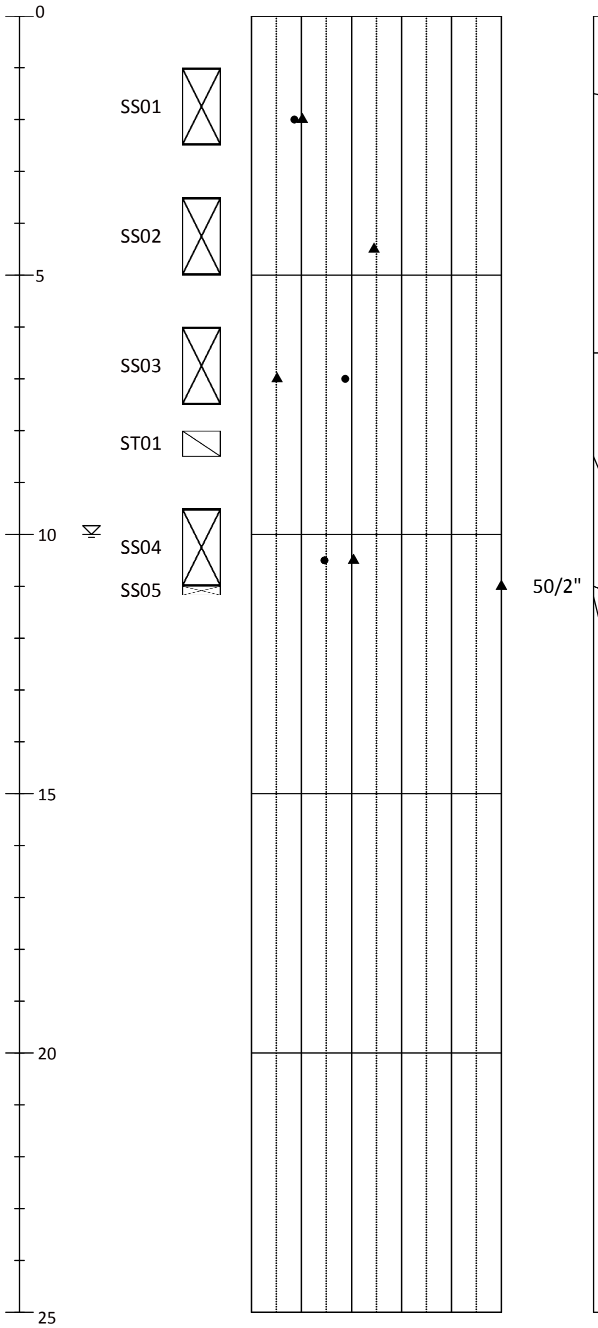
Soil Boring Log

AQSR-03

Sheet 1 of 1

Project: South River Phase 1 Interim Remedial Measure	Location: River Mile 0.0 to 2.0 of South River near Waynesboro, VA	Method: Hollow Stem Auger
Project #: 120592-01.05	N/LAT: 6710897.646 E/LONG: 11372825.57	Total Depth (ft): 11.2
Client: DuPont	Horiz. Datum: Virginia State Plane North, NAD1983, US Feet	Observed GW (bgs): 10.0
Collection Date: 11/07/2014	Vert. Datum: NAVD88	Mudline Elevation (ft):
Contractor: Total Depth Drilling	Sampler(s): 2in O.D./1.375in I.D. Split - Spoon 3in O.D. Shelby Tube	Hammer: 140 lbs w/ 30 inch drop
Logged By: Zac Koehn		Hammer Efficiency: 84%

Depth (ft)	Water Level	Samples	Uncorrected Standard Penetration Resistance (blows per foot) and Water Content (%)	Values Greater than 50	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test



Soil Description	Lab Test
Silty SAND (SM): Loose, damp, brown to dark brown, fine to medium silty SAND (SM) with organics (topsoil).	
Silty SAND (SM): Loose to medium dense, dry to damp, reddish brown, fine silty SAND (SM) with non-plastic fines and occasional gravel.	MC,GS, SG, OC
No recovery.	
CLAY (CL): Soft, damp to moist, orange-brown with dark gray-brown mottling, fine sandy silty CLAY (CL) with low to moderate plasticity. Transitions to silty SAND (SM). Refusal of shelby tube, sample not retained.	MC, AL, SG MC, GS
Silty SAND (SM): Loose to medium dense, moist, orange-brown to gray-brown, fine to medium silty SAND (SM) with non-plastic to low plastic fines (alluvium).	
Bedrock	
Bottom of boring @ 11.2 feet below ground surface. Completed on 11/07/2014.	

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▲ SPT N-Value
● Water Content (%)

Notes:
1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

Soil Boring Log

Sheet 1 of 1

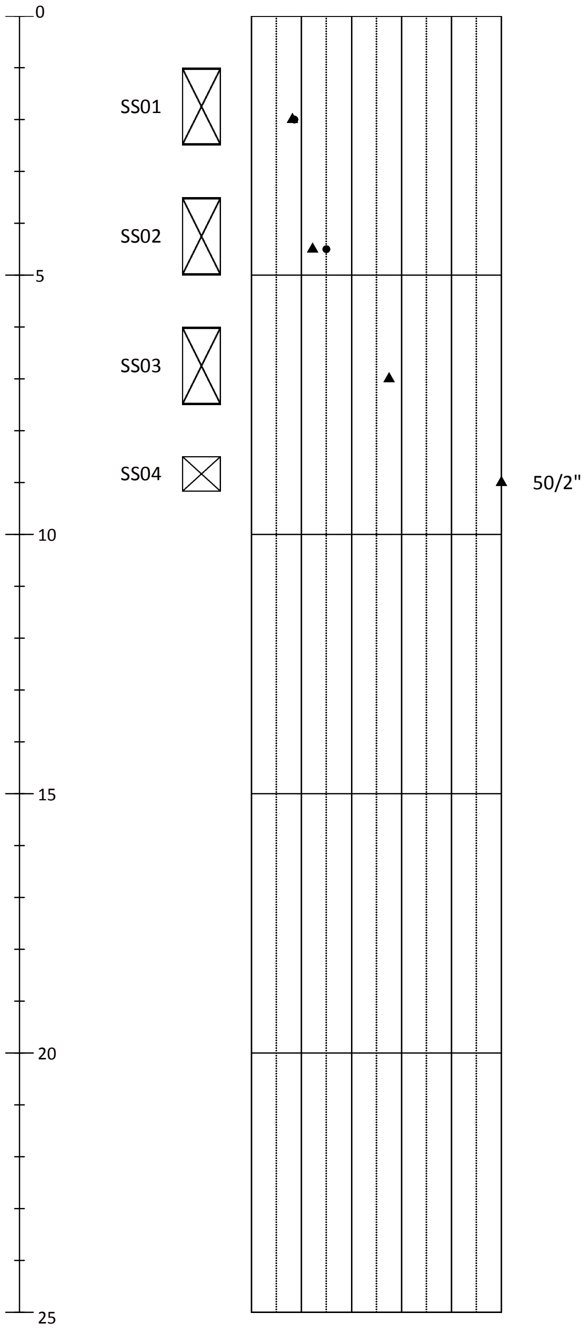
AQSR-04

Project: **South River Phase 1 Interim Remedial Measure**	Location: **River Mile 0.0 to 2.0 of South River near Waynesboro, VA**	Method: **Hollow Stem Auger**
Project #: **120592-01.05**	N/LAT: **6711330.986** E/LONG: **11373219.19**	Total Depth (ft): **9.7**
Client: **DuPont**	Horiz. Datum: **Virginia State Plane North, NAD1983, US Feet**	Observed GW (bgs): **N/A**
Collection Date: **11/07/2014**	Vert. Datum: **NAVD88**	Mudline Elevation (ft):
Contractor: **Total Depth Drilling**	Sampler(s): **2in O.D./1.375in I.D. Split - Spoon** **3in O.D. Shelby Tube**	Hammer: **140 lbs w/ 30 inch drop**
Logged By: **Zac Koehn**		Hammer Efficiency: **84%**

Depth (ft) | Water Level | Samples | Uncorrected Standard Penetration Resistance (blows per foot) and Water Content (%) 0 10 20 30 40 50 | Values Greater than 50

Soil Description
Samples and descriptions are in recovered depths.
Classification scheme: USCS

Lab Test



Samples	Soil Description	Lab Test
SS01	Silty SAND (SM): Loose, damp, dark brown, fine to medium silty SAND (SM) with abundant organics (topsoil). Low recovery due to large rock fragment plugging the sampler for SS01.	MC, GS, OC
SS02	SILT (ML): Soft to medium stiff, dry to damp, dark reddish brown with white chalk-like particles, fine sandy SILT (ML), low to medium plastic fines and trace gravel.	MC,GS, SG
SS03		Arc
SS04 (50/2")	Weathered bedrock, appears to be limestone.	
	Bedrock	
	Bottom of boring @ 9.7 feet below ground surface. Completed on 11/07/2014.	

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▲ SPT N-Value
● Water Content (%)

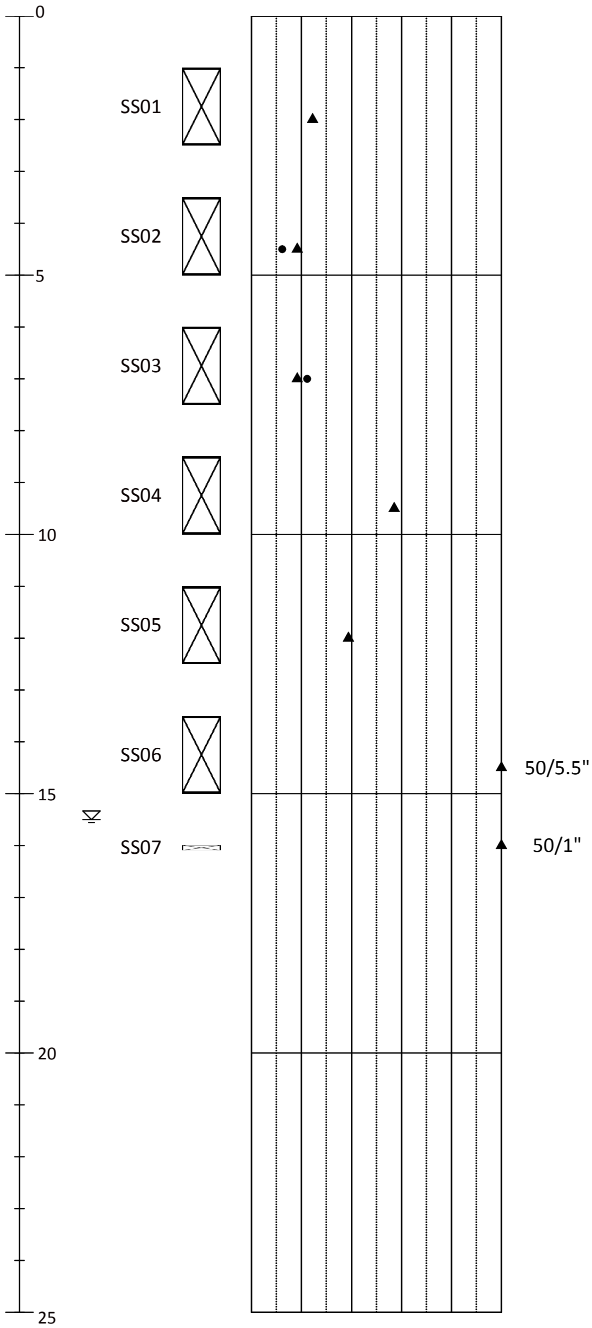
Notes:
1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

Soil Boring Log

AQSR-05

Project: South River Phase 1 Interim Remedial Measure	Location: River Mile 0.0 to 2.0 of South River near Waynesboro, VA	Method: Hollow Stem Auger
Project #: 120592-01.05	N/LAT: 6711620.898 E/LONG: 11374051.98	Total Depth (ft): 16.1
Client: DuPont	Horiz. Datum: Virginia State Plane North, NAD1983, US Feet	Observed GW (bgs): 15.5
Collection Date: 11/07/2014	Vert. Datum: NAVD88	Mudline Elevation (ft):
Contractor: Total Depth Drilling	Sampler(s): 2in O.D./1.375in I.D. Split - Spoon 3in O.D. Shelby Tube	Hammer: 140 lbs w/ 30 inch drop
Logged By: Zac Koehn		Hammer Efficiency: 84%

Depth (ft)	Water Level	Samples	Uncorrected Standard Penetration Resistance (blows per foot) and Water Content (%) 0 10 20 30 40 50	Values Greater than 50	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test



Silty SAND (SM): Loose, damp, dark brown, fine to medium silty SAND (SM) with abundant organics (topsoil).

Silty SAND (SM): Loose to medium dense, dry to damp, dark reddish brown with white chalk-like particles, fine silty SAND (SM), low to medium plastic fines and trace gravel.

Transitions to very fine sandy SILT (ML). Fades from reddish brown to brown.

Transitions back to fine silty SAND (SM) and becomes medium dense with some limestone rock fragment.

Low recovery due to large rock fragment plugging the sampler for SS05.

Soft contact @ 12.3 feet.

Weathered bedrock, appears to be limestone.

Bedrock

Bottom of boring @ 16.1 feet below ground surface. Completed on 11/07/2014.

Sample	Lab Test
SS01	Arc
SS02	MC, GS, SG, OC
SS03	MC, GS
SS04	Arc
SS06	Arc

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▲ SPT N-Value
● Water Content (%)

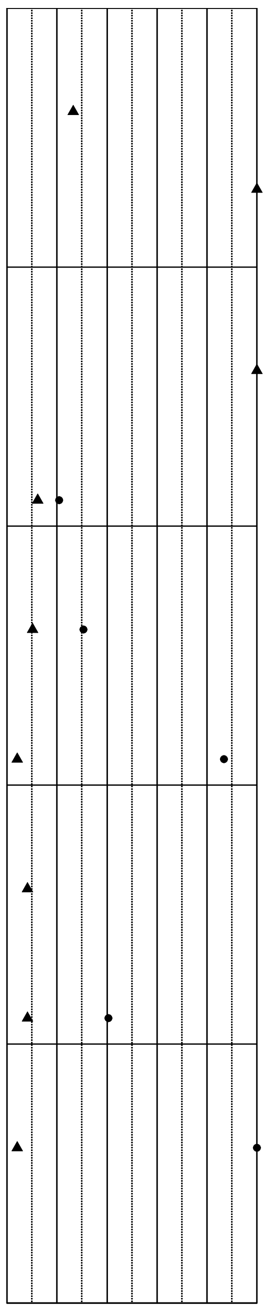
Notes:
1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

Soil Boring Log

AQSR-06

Project: **South River Phase 1 Interim Remedial Measure**	Location: **River Mile 0.0 to 2.0 of South River near Waynesboro, VA**	Method: **Hollow Stem Auger**
Project #: **120592-01.05**	N/LAT: **6711781.398** E/LONG: **11374380.48**	Total Depth (ft): **24.1**
Client: **DuPont**	Horiz. Datum: **Virginia State Plane North, NAD1983, US Feet**	Observed GW (bgs): **19**
Collection Date: **11/07/2014**	Vert. Datum: **NAVD88**	Mudline Elevation (ft):
Contractor: **Total Depth Drilling**	Sampler(s): **2in O.D./1.375in I.D. Split - Spoon** **3in O.D. Shelby Tube**	Hammer: **140 lbs w/ 30 inch drop**
Logged By: **Zac Koehn**		Hammer Efficiency: **84%**

Uncorrected Standard Penetration Resistance (blows per foot) and Water Content (%): 0 10 20 30 40 50



Depth (ft)	Water Level	Samples	Values Greater than 50	Soil Description (Samples and descriptions are in recovered depths. Classification scheme: USCS)	Lab Test
0		SS01		Silty SAND (SM): Loose to medium dense, brown with some pinkish rock fragment, fine to medium silty SAND (SM) with trace organics.	Arc
		SS02	50/3"	No recovery, refusal from obstruction. Hard drilling. No recovery.	
5		SS03	60		
		SS04		Low recovery due to large rock fragment plugging the sampler.	MC, GS
10		SS05		Silty SAND (SM): Loose, damp, dark brown, fine silty SAND (SM), non-plastic fines with uniform sand grain size.	MC, GS, SG
		SS06		Increasing silt content. Soft, damp, dark gray-brown, fine sandy SILT (ML), low plastic fines. Wood debris @ 14.8 feet.	MC, AL, SG
15		SS07		Silty SAND (SM): Loose, wet, orange-brown, fine to coarse gravelly silty SAND (SM) with cream colored rock fragments (alluvium).	Arc
	∇	SS08		SILT (MH): Very soft, wet, orange-brown, SILT (MH) with medium plasticity.	MC, GS
20		SS09	99.1%		MC, AL, SG
		ST01		Bottom of boring @ 23.5 feet below ground surface. Completed on 11/06/2014.	
25					

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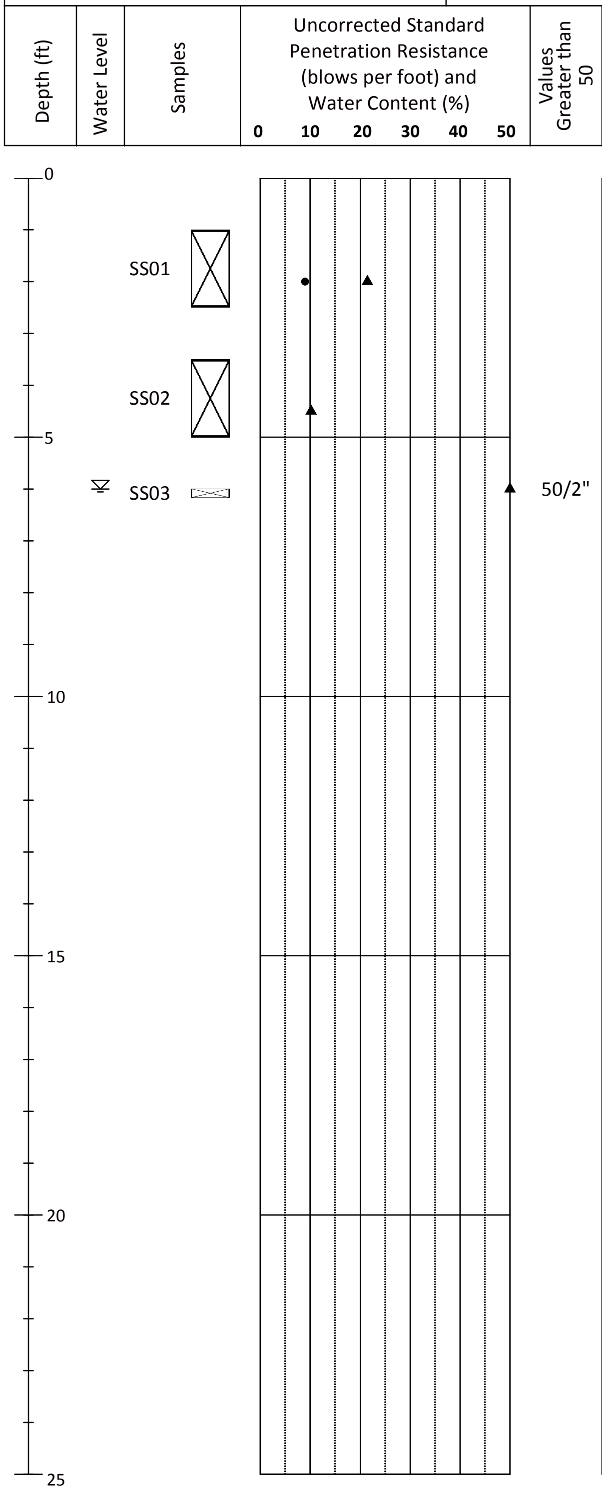
▲ SPT N-Value
● Water Content (%)

Notes:
1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

Soil Boring Log

AQSR-07

Project: South River Phase 1 Interim Remedial Measure	Location: River Mile 0.0 to 2.0 of South River near Waynesboro, VA	Method: Hollow Stem Auger
Project #: 120592-01.05	N/LAT: 6711891.292 E/LONG: 11374716.77	Total Depth (ft): 6.2
Client: DuPont	Horiz. Datum: Virginia State Plane North, NAD1983, US Feet	Observed GW (bgs): 6.0
Collection Date: 11/07/2014	Vert. Datum: NAVD88	Mudline Elevation (ft):
Contractor: Total Depth Drilling	Sampler(s): 2in O.D./1.375in I.D. Split - Spoon 3in O.D. Shelby Tube	Hammer: 140 lbs w/ 30 inch drop
Logged By: Zac Koehn		Hammer Efficiency: 84%



Soil Description

Samples and descriptions are in recovered depths.
Classification scheme: USCS

Soil Description	Lab Test
Silty SAND (SM): Loose, damp, dark brown, fine to medium silty SAND (SM) with abundant organics (topsoil).	
Silty SAND (SM): Loose to medium dense, dry to damp, dark reddish brown with orange mottling, fine silty SAND (SM) with occasional gravel.	MC, GS, SG, OC Arc
Refusal due to bedrock.	
Bottom of boring @ 6.2 feet below ground surface.	

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▲ SPT N-Value
● Water Content (%)

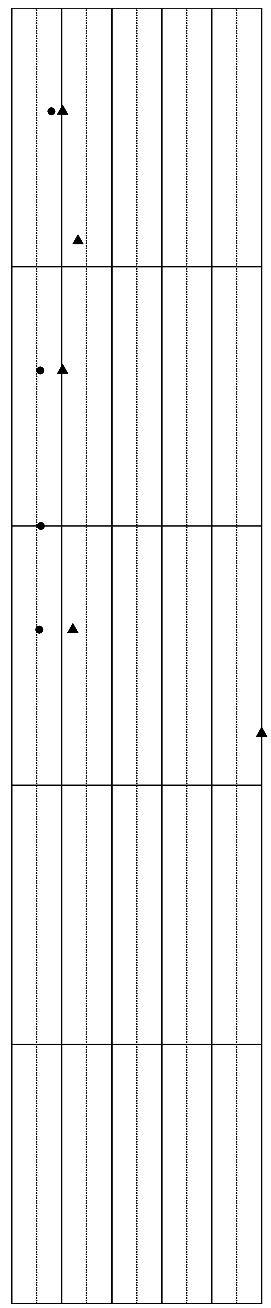
Notes:
1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

Soil Boring Log

AQSR-08

Project: South River Phase 1 Interim Remedial Measure	Location: River Mile 0.0 to 2.0 of South River near Waynesboro, VA	Method: Hollow Stem Auger
Project #: 120592-01.05	N/LAT: 6712194.137 E/LONG: 11374869.93	Total Depth (ft): 14.3
Client: DuPont	Horiz. Datum: Virginia State Plane North, NAD1983, US Feet	Observed GW (bgs): 13.3
Collection Date: 11/07/2014	Vert. Datum: NAVD88	Mudline Elevation (ft):
Contractor: Total Depth Drilling	Sampler(s): 2in O.D./1.375in I.D. Split - Spoon 3in O.D. Shelby Tube	Hammer: 140 lbs w/ 30 inch drop
Logged By: Zac Koehn		Hammer Efficiency: 84%

Depth (ft)	Water Level	Samples	Uncorrected Standard Penetration Resistance (blows per foot) and Water Content (%) 0 10 20 30 40 50	Values Greater than 50	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
0					Silty GRAVEL (GM): Loose to medium dense, dry, reddish brown to yellow-brown, fine to medium silty sandy GRAVEL (GM) with non-plastic fines, occasional rock fragments.	
		SS01				MC, GS, SG, OC
		SS02				Arc
5					Low recovery due to large rock fragment plugging the sampler.	
		SS03				MC, GS
					GRAVEL with silt (GP-GM): Medium dense, damp, reddish yellow-brown with brick and colored rock fragment, fine to coarse sandy GRAVEL with silt (GP-GM), non-plastic fines and frequent rock fragments.	
		SS04				MC, GS, SG
10						
		SS05			Large rock fragment at end of sampler of SS05.	MC, GS
	▽					
		SS06		50/0"	Weathered Shale, 6 inch in 1 blow then weight of rods for 4 inches followed by refusal.	
15					Bottom of boring @ 14.3 feet below ground surface. Completed on 11/06/2014.	
20						
25						



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▲ SPT N-Value
● Water Content (%)

Notes:

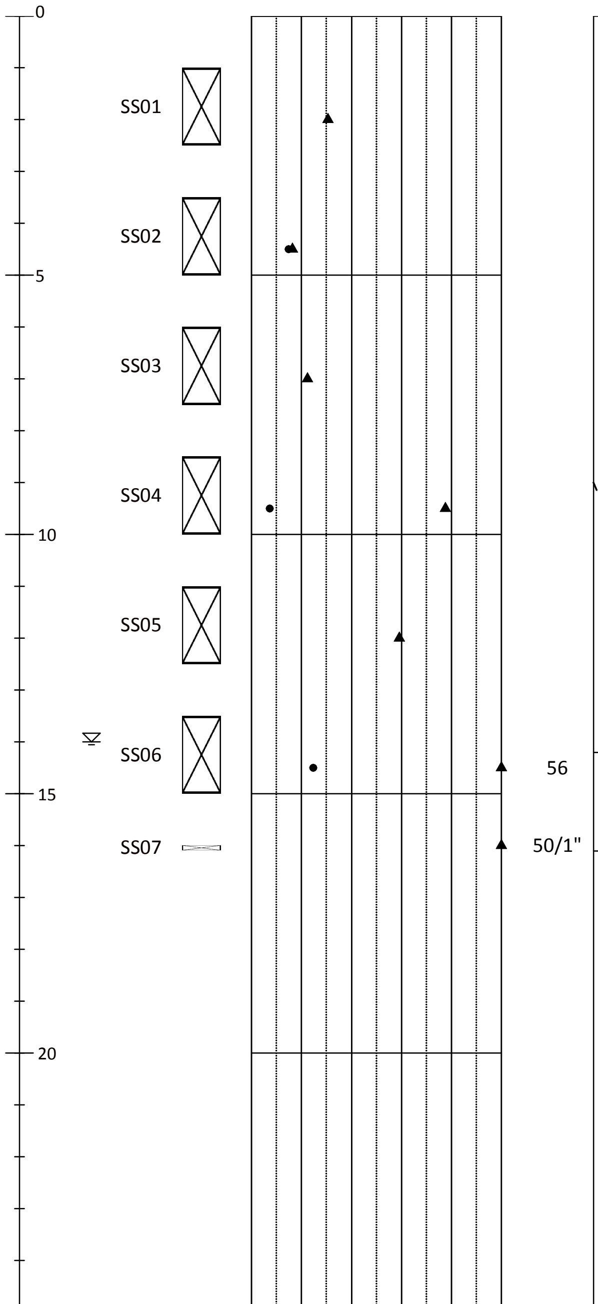
1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

Soil Boring Log

AQSR-09

Project: South River Phase 1 Interim Remedial Measure	Location: River Mile 0.0 to 2.0 of South River near Waynesboro, VA	Method: Hollow Stem Auger
Project #: 120592-01.05	N/LAT: 6712314.576 E/LONG: 11375102.3	Total Depth (ft): 16.1
Client: DuPont	Horiz. Datum: Virginia State Plane North, NAD1983, US Feet	Observed GW (bgs): 14.0
Collection Date: 11/07/2014	Vert. Datum: NAVD88	Mudline Elevation (ft):
Contractor: Total Depth Drilling	Sampler(s): 2in O.D./1.375in I.D. Split - Spoon 3in O.D. Shelby Tube	Hammer: 140 lbs w/ 30 inch drop
Logged By: Zac Koehn		Hammer Efficiency: 84%

Depth (ft)	Water Level	Samples	Uncorrected Standard Penetration Resistance (blows per foot) and Water Content (%) 0 10 20 30 40 50	Values Greater than 50	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test



Silty SAND (SM): Medium dense, dry to damp, reddish brown, fine to medium silty SAND (SM) with non-plastic fines and occasional gravel and wood debris.

@2 feet, transitions to yellow-brown.

Increasing density.

SAND with silt (SP-SM): Medium dense, dry to damp, reddish to yellow-brown with cream colored fragments, gravelly SAND with silt (SP-SM) with angular rock fragments (alluvium).
Hard drilling at 10 to 11 feet. Increasing gravel content, transitions to GRAVEL with silt (GP-GM).

Weathered bedrock, limestone.

Bottom of boring @ 16.1 feet below ground surface. Completed on 11/07/2014.

Sample	Lab Test
SS01	Arc
SS02	MC, GS, SG, OC
SS03	Arc
SS04	MC, GS, SG
SS05	Arc
SS06	MC, GS, SG

ANCHOR QEA
720 Olive Way, Suite 1900
Seattle, WA 98101
206-287-9130

▲ SPT N-Value
● Water Content (%)

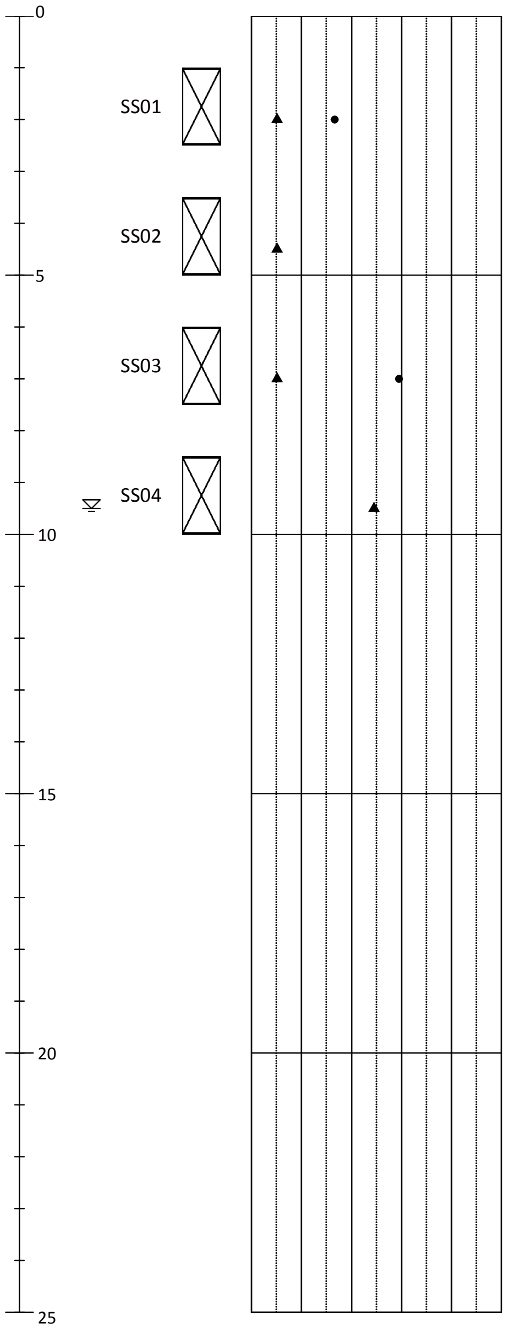
Notes:
1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

Soil Boring Log

AQSR-10

Project: **South River Phase 1 Interim Remedial Measure**	Location: **River Mile 0.0 to 2.0 of South River near Waynesboro, VA**	Method: **Hollow Stem Auger**
Project #: **120592-01.05**	N/LAT: **6713802.346** E/LONG: **11374916.48**	Total Depth (ft): **11.0**
Client: **DuPont**	Horiz. Datum: **Virginia State Plane North, NAD1983, US Feet**	Observed GW (bgs): **9.5**
Collection Date: **11/07/2014**	Vert. Datum: **NAVD88**	Mudline Elevation (ft):
Contractor: **Total Depth Drilling**	Sampler(s): **2in O.D./1.375in I.D. Split - Spoon** **3in O.D. Shelby Tube**	Hammer: **140 lbs w/ 30 inch drop**
Logged By: **Zac Koehn**		Hammer Efficiency: **84%**

Depth (ft)	Water Level	Samples	Uncorrected Standard Penetration Resistance (blows per foot) and Water Content (%) 0 10 20 30 40 50	Values Greater than 50	**Soil Description** Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test



Soil Description	Lab Test
Silty SAND (SM): Loose, dry to damp, reddish brown, fine silty SAND (SM) with non-plastic to low plastic fines, trace gravel and some hair-like roots.	MC, GS, SG, OC
	Arc
Increasing fines content, dark brown-gray, fine silty clayey SAND (SC).	MC, AI, GS, SG
SAND with silt (SP-SM): Medium dense, wet, light yellow-brown, fine to coarse gravelly SAND with silt (SP-SM), subangular to angular particles (alluvium).	Arc
Bottom of boring @ 11.0 feet below ground surface. Completed on 11/07/2014.	

ANCHOR QEA
720 Olive Way, Suite 1900
Seattle, WA 98101
206-287-9130

▲ SPT N-Value
● Water Content (%)

Notes:

1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

APPENDIX B
GEOTECHNICAL LABORATORY REPORTS

Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	---	Sample Type:	---	Tested By:	jek
Sample ID:	---	Test Date:	12/03/14	Checked By:	jdt
Depth :	---	Test Id:	315483		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content, %
AQSB-01	SS02	---	Moist, dark brown silty sand	12.1
AQSB-01	SS04	---	Moist, yellowish brown sand with silt and gravel	6.4
AQSB-01	SS06	---	Moist, brownish yellow silt	36.4
AQSB-01	ST01	---	Moist, yellowish brown silty sand with gravel	52.6
AQSB-02	SS01	---	Moist, brown silty sand	18.5
AQSB-03	SS01	---	Moist, brown silty sand	9.4
AQSB-03	SS03	---	Moist, brown clay	19.4
AQSB-03	SS04	---	Wet, brownish yellow silty sand with gravel	15.3
AQSB-04	SS01	---	Moist, dark grayish brown silty sand with gravel	9.4
AQSB-04	SS02	---	Moist, brown sandy silt	15.7

Notes: Temperature of Drying : 110° Celsius

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content, %
AQSB-05	SS02	---	Moist, brown silty sand	7.0
AQSB-05	SS03	---	Moist, brown sandy silt	11.9
AQSB-06	SS04	---	Moist, brown silty sand	11.2
AQSB-06	SS05	---	Moist, brown silty sand	16.0
AQSB-06	SS06	---	Moist, dark grayish brown clay	43.5
AQSB-06	SS08	---	Moist, brownish yellow clayey sand with gravel	20.9
AQSB-06	SS09	---	Moist, brownish yellow silt	99.1
AQSB-07	SS01	---	Moist, brown silty sand with gravel	9.8

Notes: Temperature of Drying : 110° Celsius

Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	---	Sample Type:	---	Tested By:	jek
Sample ID:	---	Test Date:	12/03/14	Checked By:	jdt
Depth :	---	Test Id:	315500		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content, %
AQSB-08	SS01	---	Moist, light yellowish brown silty gravel with sand	8.8
AQSB-08	SS03	---	Moist, brown silty sand	6.6
AQSB-08	SS04	---	Moist, brown silty sand with gravel	6.7
AQSB-08	SS05	---	Moist, brown gravel with silt and sand	6.4
AQSB-09	SS02	---	Moist, brown silty sand	8.3
AQSB-09	SS04	---	Moist, brown sand with silt and gravel	4.6
AQSB-09	SS06	---	Wet, olive silty gravel with sand	13.1
AQSB-10	SS01	---	Moist, brown silty sand	17.3
AQSB-10	SS03	---	Moist, brown clayey sand	29.9

Notes: Temperature of Drying : 110º Celsius

Client:	Anchor QEA, LLC			
Project:	South River			
Location:	---		Project No:	GTX-302574
Boring ID: ---		Sample Type: ---	Tested By:	jek
Sample ID: ---		Test Date: 12/03/14	Checked By:	jdt
Depth :	---	Test Id: 315538		

Moisture, Ash, and Organic Matter - ASTM D2974

Boring ID	Sample ID	Depth	Description	Moisture Content, %	Ash Content, %	Organic Matter, %
AQSB-01	SS02	---	Moist, dark brown silty sand	12	97.0	3.0
AQSB-02	SS01	---	Moist, brown silty sand	18	97.5	2.5
AQSB-03	SS01	---	Moist, brown silty sand	9	99.0	1.0
AQSB-04	SS01	---	Moist, dark grayish brown silty sand with gravel	9	98.4	1.6
AQSB-05	SS02	---	Moist, brown silty sand	7	97.9	2.1
AQSB-07	SS01	---	Moist, brown silty sand with gravel	10	97.8	2.2
AQSB-08	SS01	---	Moist, light yellowish brown silty gravel with sand	9	99.2	.8
AQSB-09	SS02	---	Moist, brown silty sand	8	97.8	2.2
AQSB-10	SS01	---	Moist, brown silty sand	17	97.1	2.9

Notes: Moisture content determined by Method A and reported as a percentage of oven-dried mass;
dried to a constant mass at temperature of 105º C
Ash content and organic matter determined by Method C; dried to constant mass at temperature 440º C

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Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID: ---	Sample Type: ---	Tested By:	jek
Sample ID: ---	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315547		

Specific Gravity of Soils by ASTM D854

Boring ID	Sample ID	Depth	Visual Description	Specific Gravity	Comment
AQSB-01	SS02	---	Moist, dark brown silty sand	2.63	
AQSB-01	SS04	---	Moist, yellowish brown sand with silt and gravel	2.71	
AQSB-01	SS06	---	Moist, brownish yellow silt	2.81	
AQSB-01	ST01	---	Moist, yellowish brown silty sand with gravel	2.75	
AQSB-02	SS01	---	Moist, brown silty sand	2.66	
AQSB-03	SS01	---	Moist, brown silty sand	2.68	
AQSB-03	SS03	---	Moist, brown clay	2.61	
AQSB-04	SS02	---	Moist, brown sandy silt	2.72	
AQSB-05	SS02	---	Moist, brown silty sand	2.63	

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

Client:	Anchor QEA, LLC			
Project:	South River			
Location:	---		Project No:	GTX-302574
Boring ID:	---	Sample Type: ---	Tested By:	jek
Sample ID:	---	Test Date: 12/02/14	Checked By:	jdt
Depth :	---	Test Id: 315556		

Specific Gravity of Soils by ASTM D854

Boring ID	Sample ID	Depth	Visual Description	Specific Gravity	Comment
AQSB-06	SS05	---	Moist, brown silty sand	2.68	
AQSB-06	SS06	---	Moist, dark grayish brown clay	2.60	
AQSB-06	SS09	---	Moist, brownish yellow silt	2.74	
AQSB-07	SS01	---	Moist, brown silty sand with gravel	2.64	
AQSB-08	SS01	---	Moist, light yellowish brown silty gravel with sand	2.72	
AQSB-08	SS04	---	Moist, brown silty sand with gravel	2.72	
AQSB-09	SS02	---	Moist, brown silty sand	2.68	
AQSB-09	SS04	---	Moist, brown sand with silt and gravel	2.71	
AQSB-09	SS06	---	Wet, olive silty gravel with sand	2.82	

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

Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	---	Sample Type:	---	Tested By:	jek
Sample ID:	---	Test Date:	11/26/14	Checked By:	jdt
Depth :	---	Test Id:	315558		

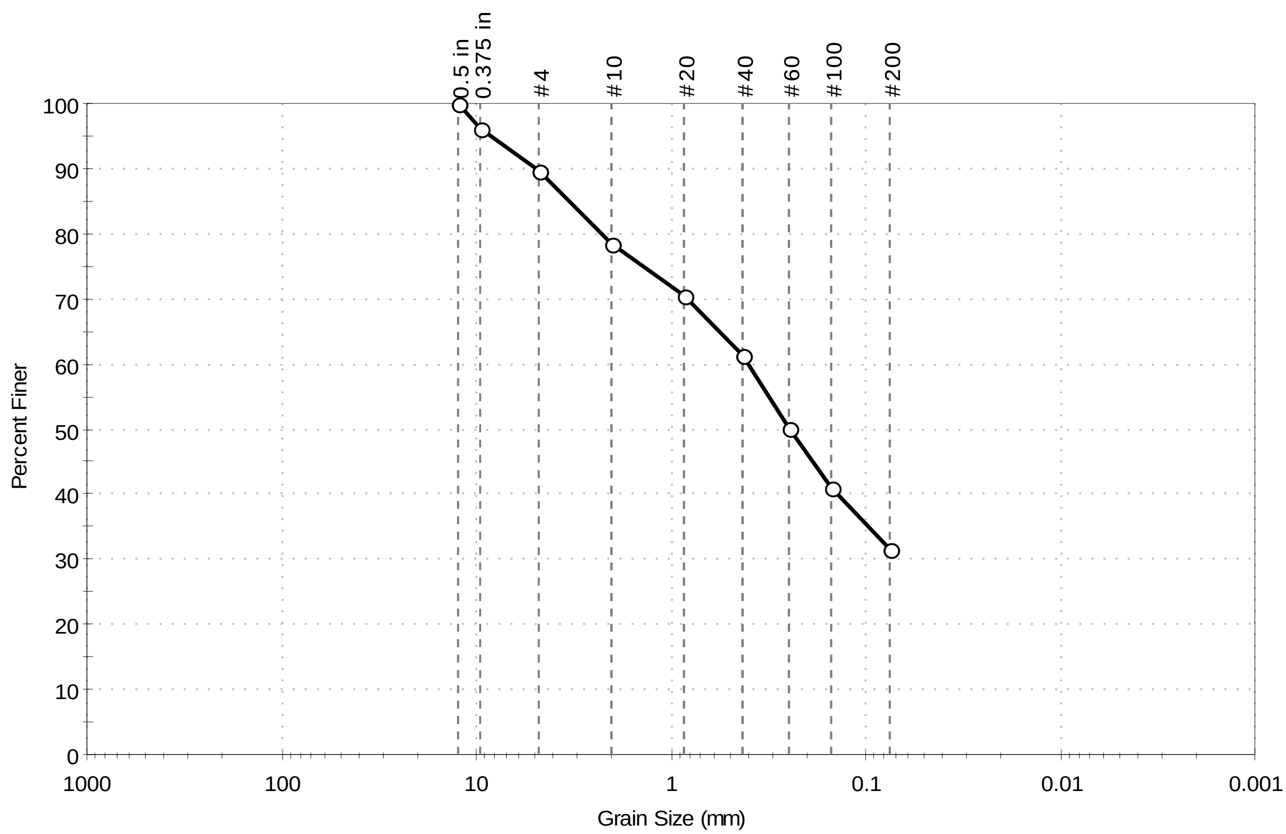
Specific Gravity of Soils by ASTM D854

Boring ID	Sample ID	Depth	Visual Description	Specific Gravity	Comment
AQSB-10	SS01	---	Moist, brown silty sand	2.68	
AQSB-10	SS03	---	Moist, brown clayey sand	2.69	

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

Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID: AQSB-01	Sample Type: bag	Tested By:	jbr
Sample ID: SS02	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315501		
Test Comment:	---		
Sample Description:	Moist, dark brown silty sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	10.4	58.1	31.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	96		
#4	4.75	90		
#10	2.00	78		
#20	0.85	71		
#40	0.42	61		
#60	0.25	50		
#100	0.15	41		
#200	0.075	31		

Coefficients

D_{85} = 3.3366 mm | D_{30} = N/A
D_{60} = 0.3984 mm | D_{15} = N/A
D_{50} = 0.2459 mm | D_{10} = N/A
C_u = N/A | C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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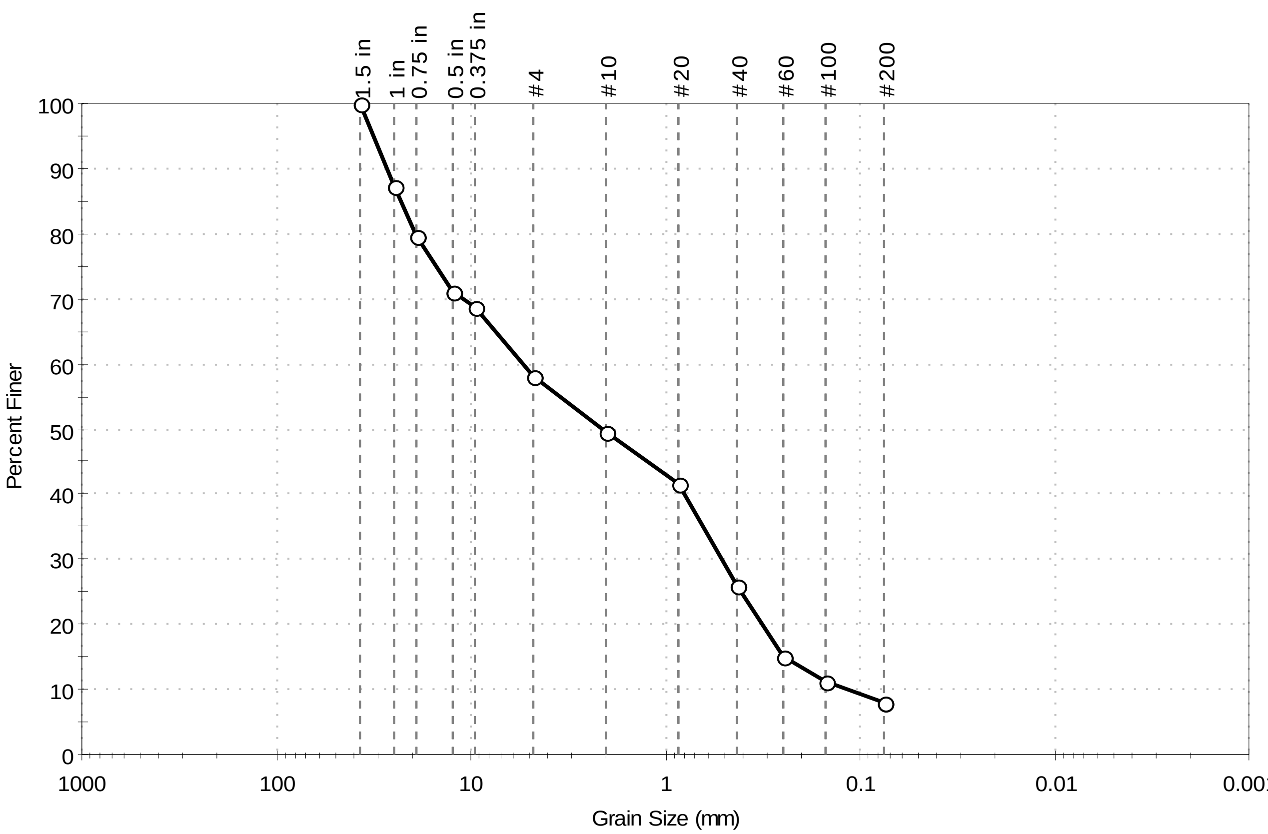
Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID: AQSB-01	Sample Type: bag	Tested By:	jbr
Sample ID: SS04	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315502		
Test Comment:	---		
Sample Description:	Moist, yellowish brown sand with silt and gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	42.0	50.2	7.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	87		
0.75 in	19.00	80		
0.5 in	12.50	71		
0.375 in	9.50	69		
#4	4.75	58		
#10	2.00	50		
#20	0.85	42		
#40	0.42	26		
#60	0.25	15		
#100	0.15	11		
#200	0.075	7.8		

Coefficients

D_{85} = 23.0722 mm | D_{30} = 0.5107 mm
D_{60} = 5.3764 mm | D_{15} = 0.2461 mm
D_{50} = 2.0733 mm | D_{10} = 0.1192 mm
C_u = 45.104 | C_c = 0.407

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-a (1))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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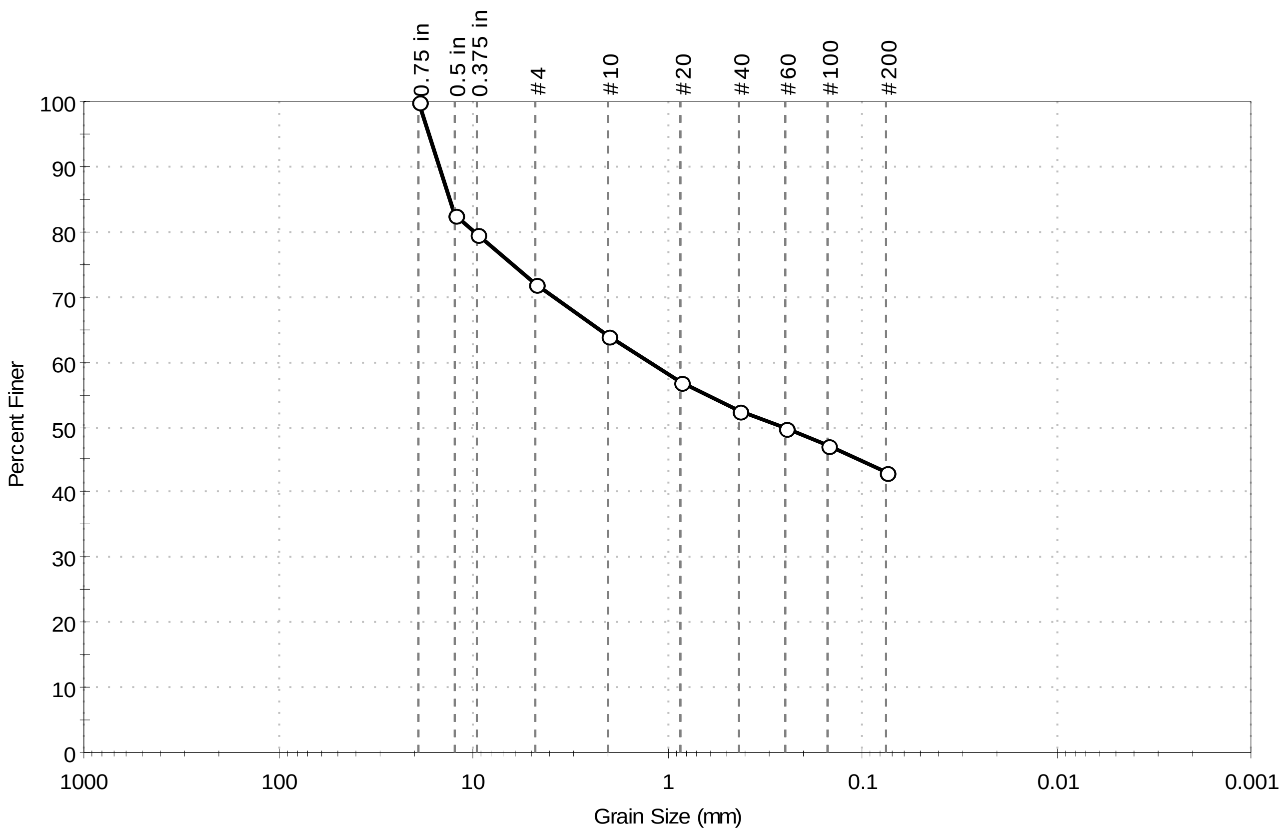
GeoTesting EXPRESS

Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-01	Sample Type: tube	Tested By:	jbr
Sample ID: ST01	Test Date: 12/08/14	Checked By:	jdt
Depth : ---	Test Id: 315503		

Test Comment: ---
Sample Description: Moist, yellowish brown silty sand with gravel
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	28.2	28.6	43.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	83		
0.375 in	9.50	80		
#4	4.75	72		
#10	2.00	64		
#20	0.85	57		
#40	0.42	53		
#60	0.25	50		
#100	0.15	47		
#200	0.075	43		

Coefficients

D_{85} = 13.2131 mm	D_{30} = N/A
D_{60} = 1.2340 mm	D_{15} = N/A
D_{50} = 0.2549 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM Silty sand with gravel (SM)

AASHTO Silty Soils (A-4 (0))

Sample / Test Description

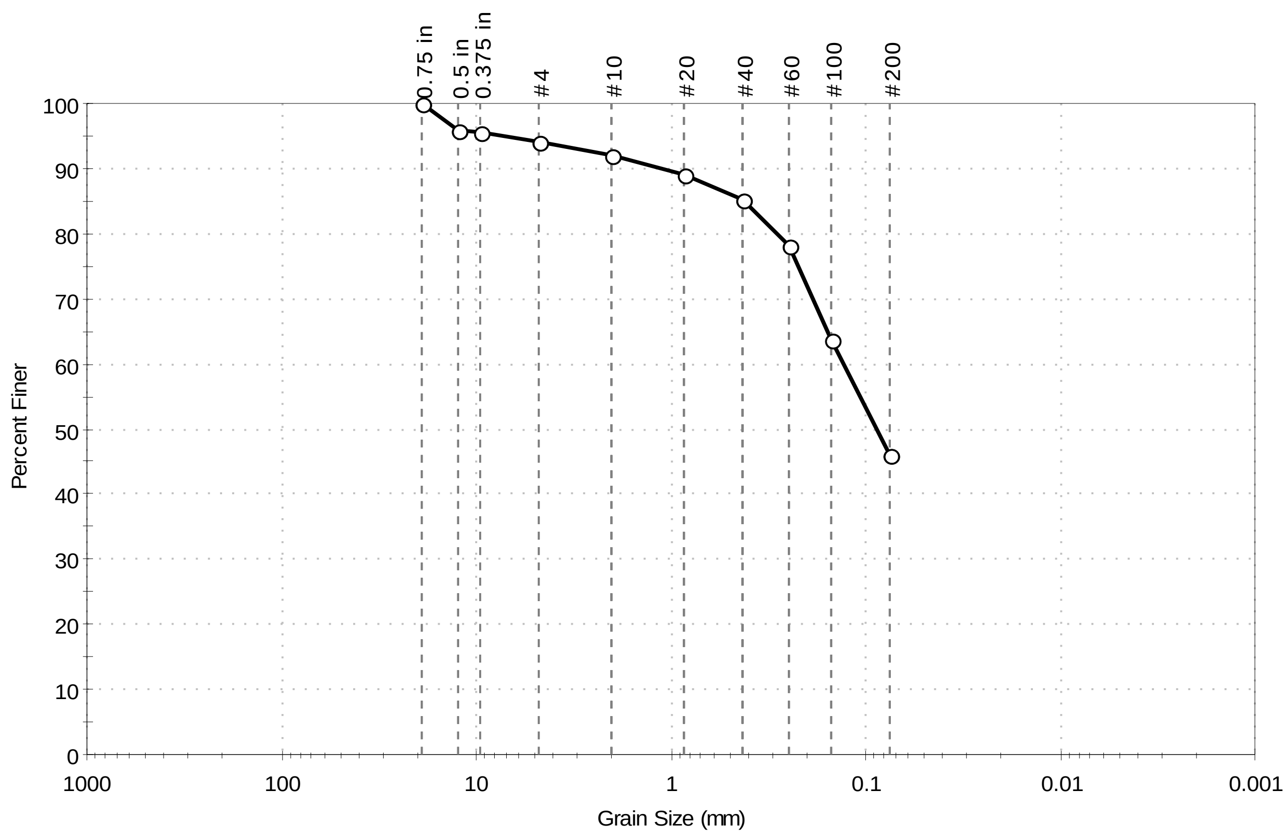
Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : SOFT

Client:	Anchor QEA, LLC			
Project:	South River			
Location:	---		Project No:	GTX-302574
Boring ID:	AQSB-02	Sample Type: bag	Tested By:	jbr
Sample ID:	SS01	Test Date: 12/01/14	Checked By:	jdt
Depth :	---	Test Id: 315504		

Test Comment: ---
Sample Description: Moist, brown silty sand
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	6.0	48.0	46.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	96		
0.375 in	9.50	95		
#4	4.75	94		
#10	2.00	92		
#20	0.85	89		
#40	0.42	85		
#60	0.25	78		
#100	0.15	64		
#200	0.075	46		

Coefficients

D_{85} = 0.4202 mm D_{30} = N/A
D_{60} = 0.1294 mm D_{15} = N/A
D_{50} = 0.0876 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM   N/A

AASHTO   Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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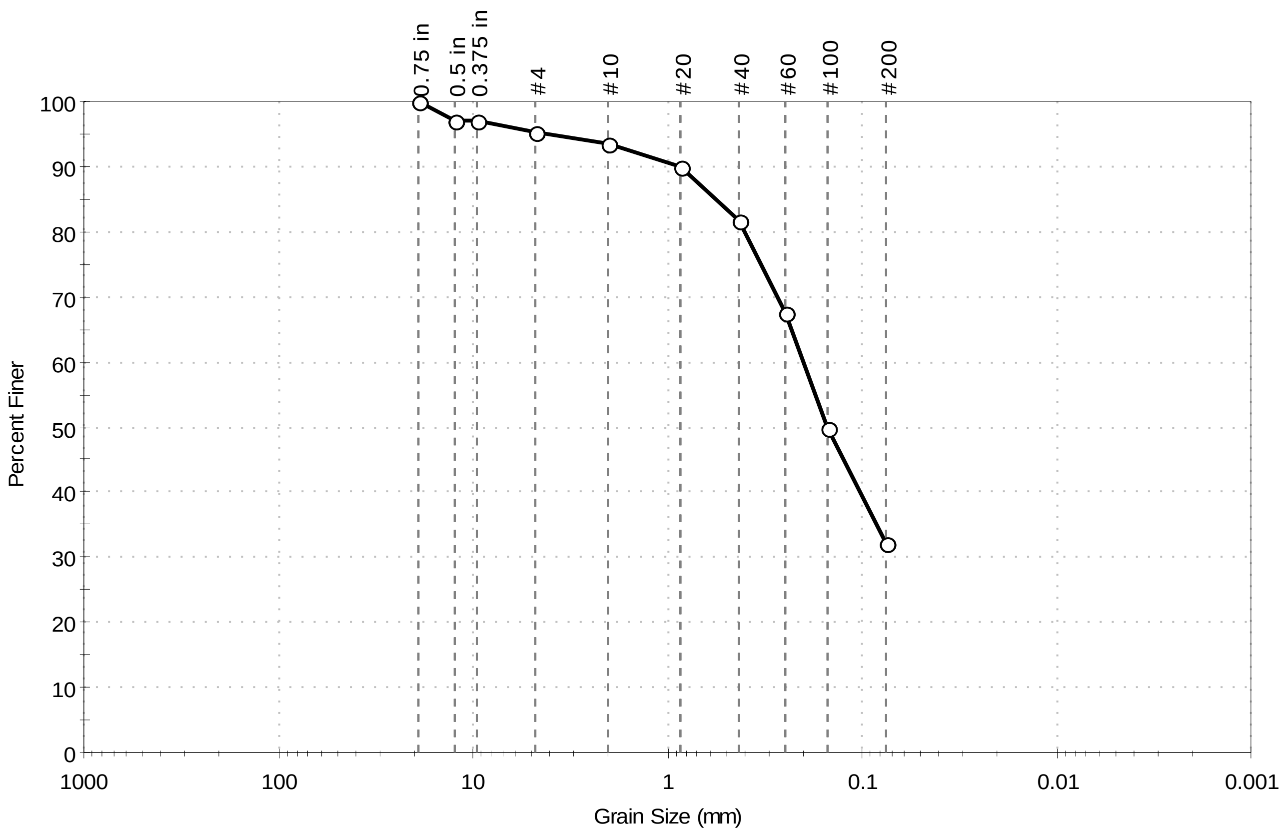
Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID: AQSB-03	Sample Type: bag	Tested By:	jbr
Sample ID: SS01	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315505		
Test Comment:	---		
Sample Description:	Moist, brown silty sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	4.8	63.1	32.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	97		
0.375 in	9.50	97		
#4	4.75	95		
#10	2.00	93		
#20	0.85	90		
#40	0.42	82		
#60	0.25	68		
#100	0.15	50		
#200	0.075	32		

Coefficients

D_{85} = 0.5609 mm	D_{30} = N/A
D_{60} = 0.2009 mm	D_{15} = N/A
D_{50} = 0.1504 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

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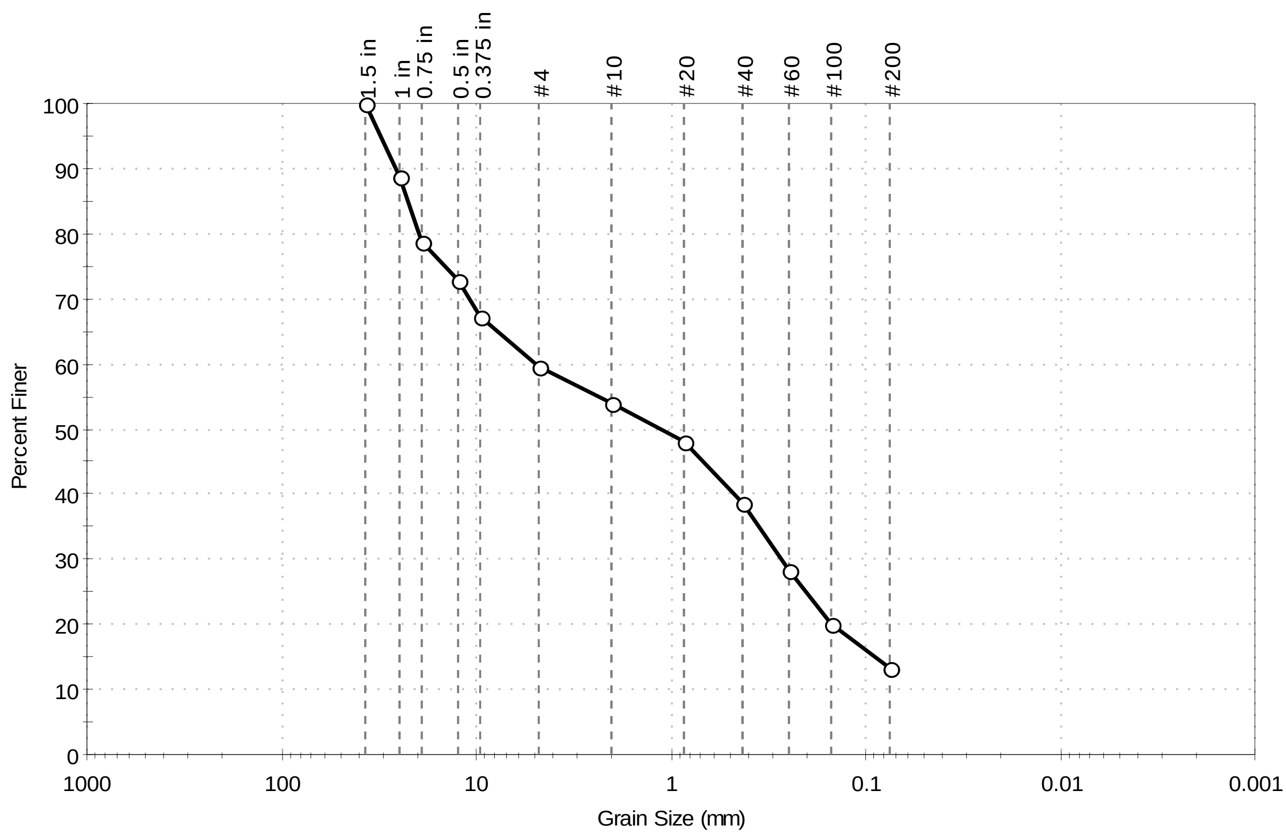
Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	AQSB-03	Sample Type:	bag	Tested By:	jbr
Sample ID:	SS04	Test Date:	12/02/14	Checked By:	jdt
Depth :	---	Test Id:	315506		

Test Comment: ---
Sample Description: Wet, brownish yellow silty sand with gravel
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	40.5	46.2	13.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	89		
0.75 in	19.00	79		
0.5 in	12.50	73		
0.375 in	9.50	67		
#4	4.75	60		
#10	2.00	54		
#20	0.85	48		
#40	0.42	39		
#60	0.25	28		
#100	0.15	20		
#200	0.075	13		

Coefficients

D_{85} = 22.6240 mm D_{30} = 0.2731 mm
D_{60} = 4.9556 mm D_{15} = 0.0891 mm
D_{50} = 1.1165 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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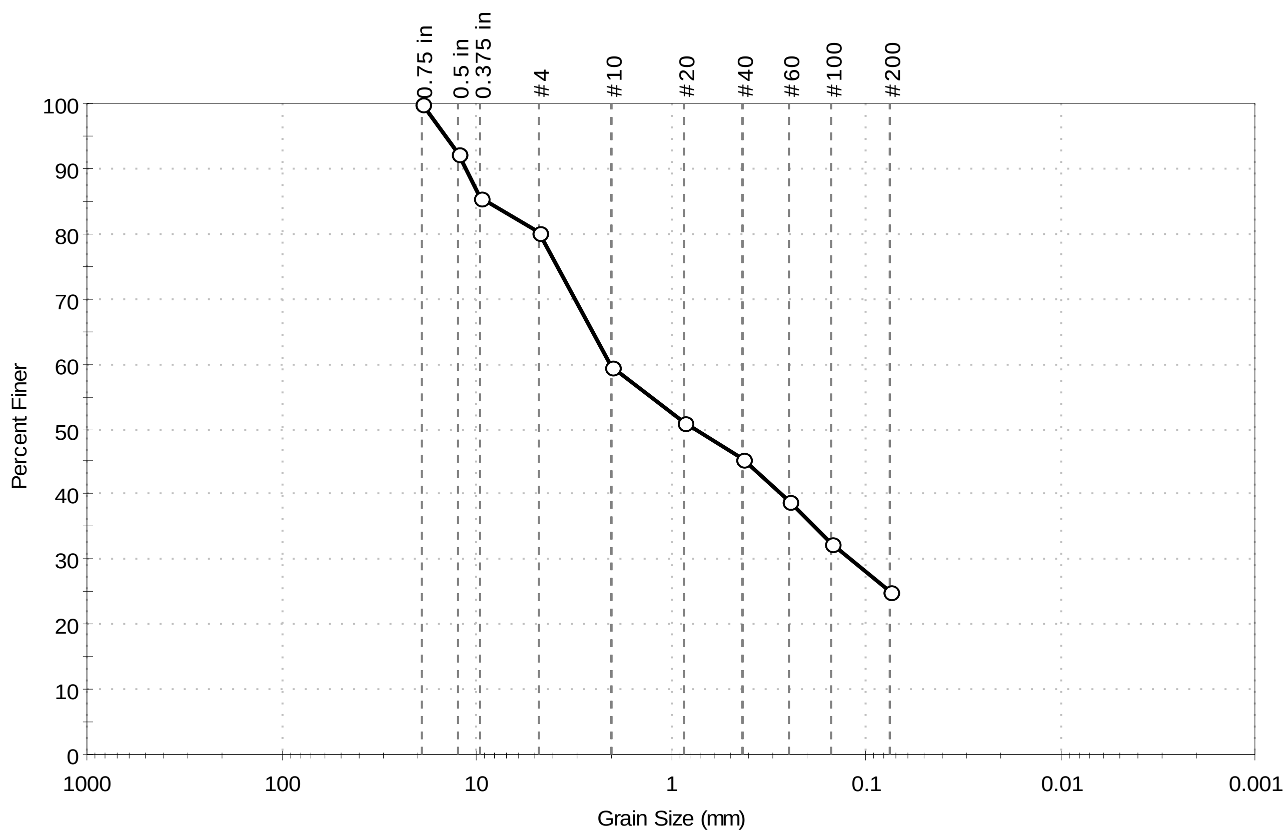
Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID:	AQSB-04	Sample Type: bag	Tested By: jbr
Sample ID:	SS01	Test Date: 12/01/14	Checked By: jdt
Depth :	---	Test Id: 315507	

Test Comment: ---
Sample Description: Moist, dark grayish brown silty sand with gravel
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	19.7	55.2	25.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	92		
0.375 in	9.50	85		
#4	4.75	80		
#10	2.00	60		
#20	0.85	51		
#40	0.42	45		
#60	0.25	39		
#100	0.15	32		
#200	0.075	25		

Coefficients

D_{85} = 8.9966 mm　　D_{30} = 0.1191 mm
D_{60} = 2.0246 mm　　D_{15} = N/A
D_{50} = 0.7534 mm　　D_{10} = N/A
C_u = N/A　　C_c = N/A

Classification

ASTM　N/A

AASHTO　Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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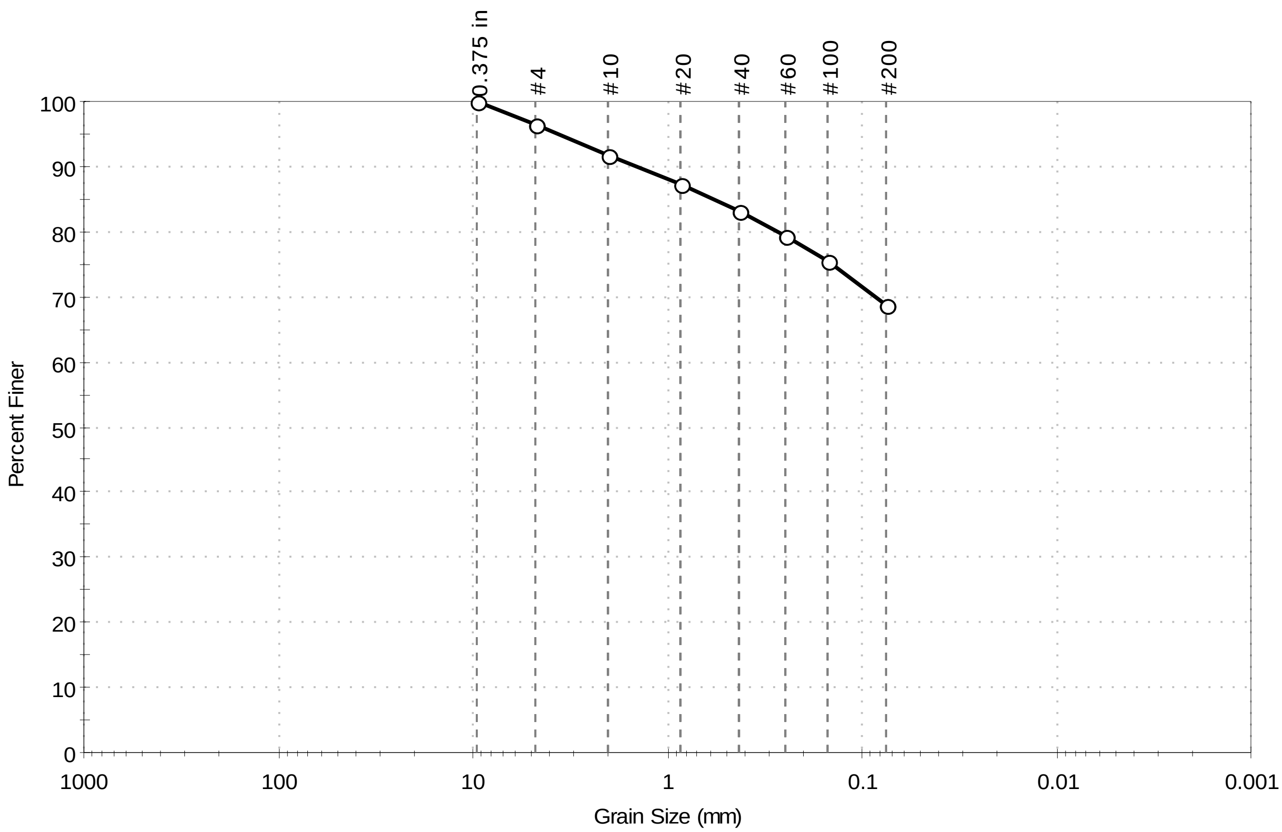
Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID: AQSB-04	Sample Type: bag	Tested By:	jbr
Sample ID: SS02	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315508		
Test Comment:	---		
Sample Description:	Moist, brown sandy silt		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	3.7	27.6	68.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	96		
#10	2.00	92		
#20	0.85	87		
#40	0.42	83		
#60	0.25	79		
#100	0.15	76		
#200	0.075	69		

Coefficients

D_{85} = 0.5842 mm

D_{30} = N/A

D_{60} = N/A

D_{15} = N/A

D_{50} = N/A

D_{10} = N/A

C_u = N/A

C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

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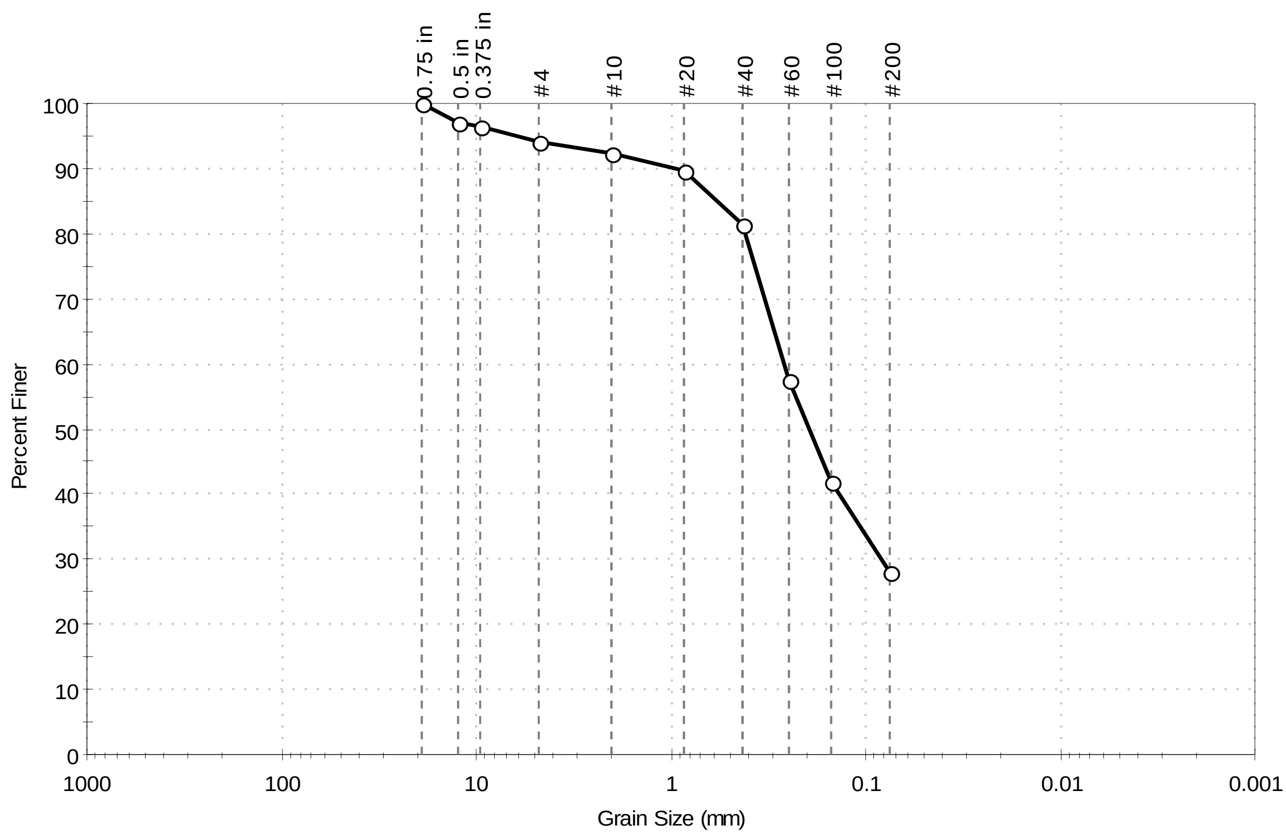
Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-05	Sample Type: bag	Tested By:	jbr
Sample ID: SS02	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315509		
Test Comment: ---			
Sample Description: Moist, brown silty sand			
Sample Comment: ---			

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	5.8	66.1	28.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	97		
0.375 in	9.50	96		
#4	4.75	94		
#10	2.00	92		
#20	0.85	90		
#40	0.42	81		
#60	0.25	58		
#100	0.15	42		
#200	0.075	28		

Coefficients

D_{85} = 0.5756 mm	D_{30} = 0.0827 mm
D_{60} = 0.2635 mm	D_{15} = N/A
D_{50} = 0.1952 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

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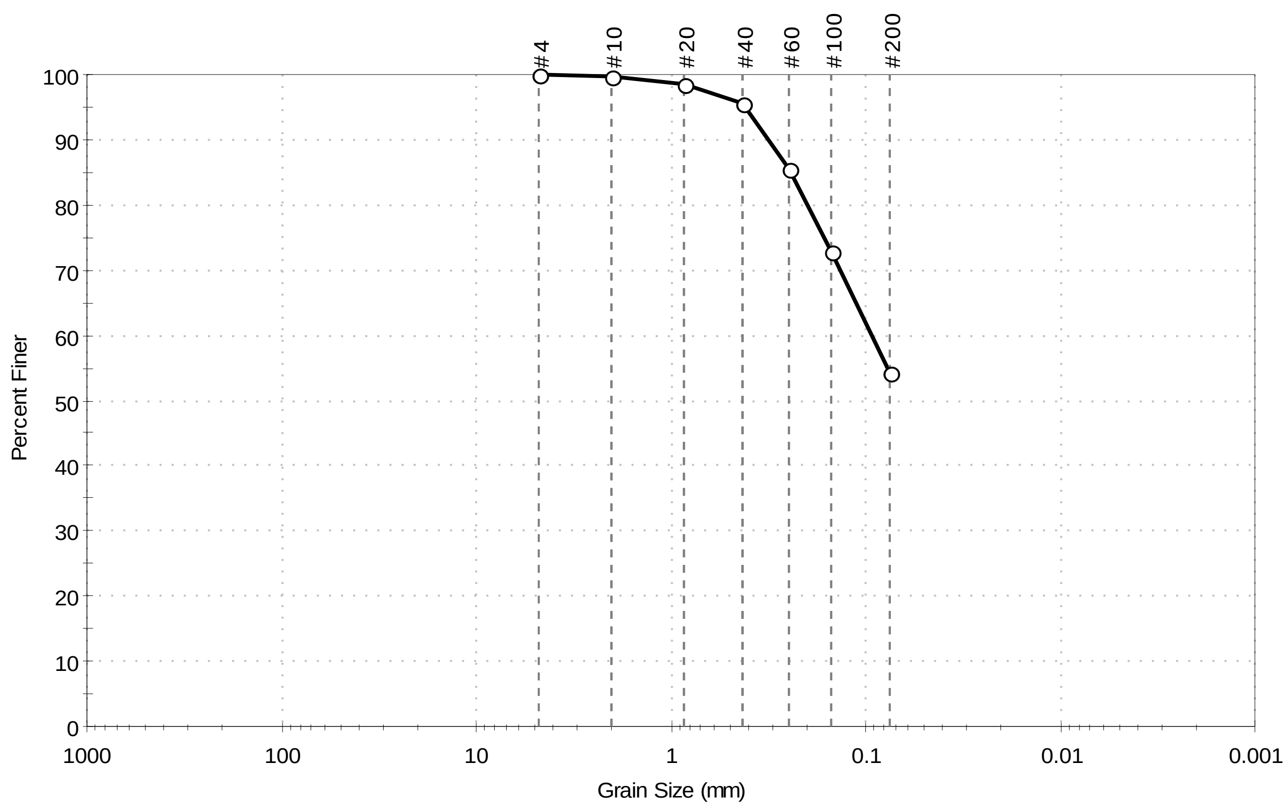
Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	AQSB-05	Sample Type:	bag	Tested By:	jbr
Sample ID:	SS03	Test Date:	12/01/14	Checked By:	jdt
Depth :	---	Test Id:	315510		
Test Comment:	---				
Sample Description:	Moist, brown sandy silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	45.8	54.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	98		
#40	0.42	96		
#60	0.25	86		
#100	0.15	73		
#200	0.075	54		

Coefficients

D_{85} = 0.2446 mm	D_{30} = N/A
D_{60} = 0.0931 mm	D_{15} = N/A
D_{50} = N/A	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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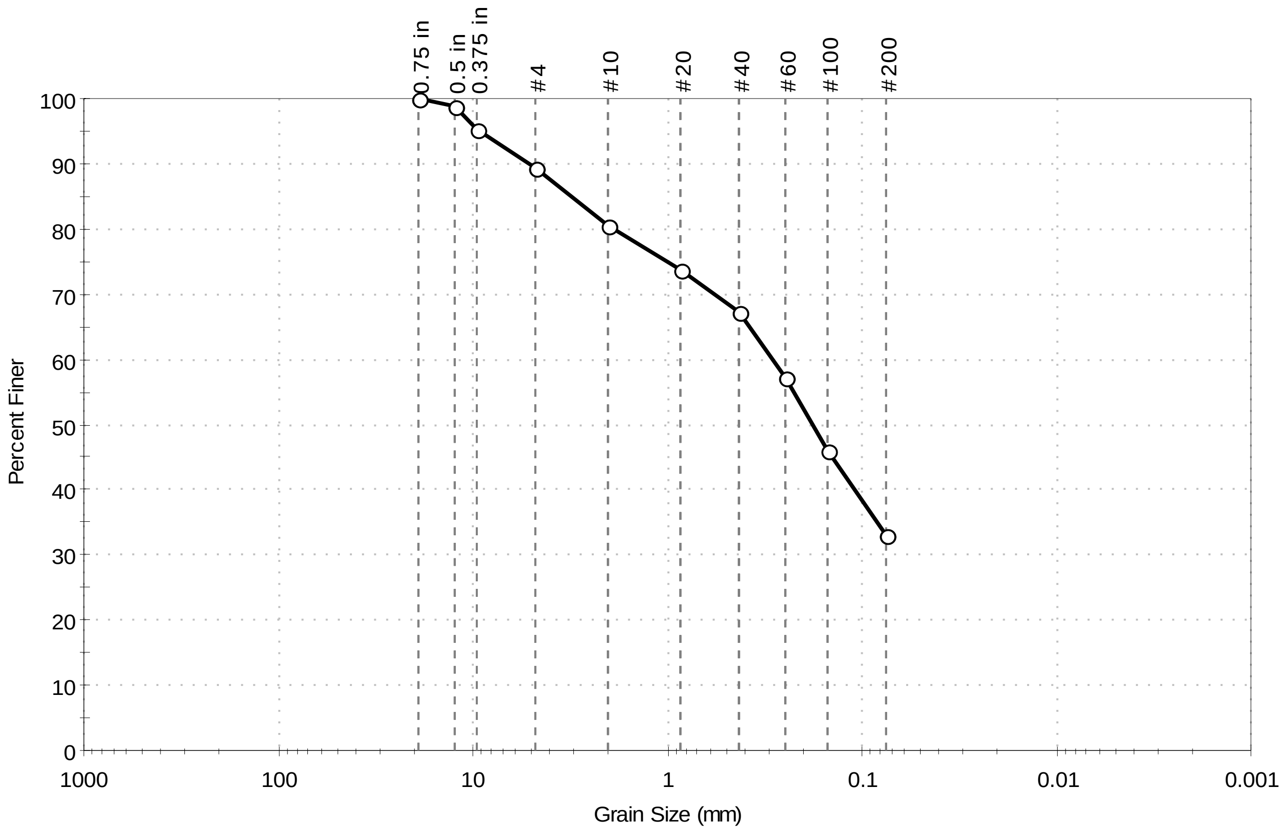
GeoTesting EXPRESS

Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-06	Sample Type: bag	Tested By:	jbr
Sample ID: SS04	Test Date: 12/02/14	Checked By:	jdt
Depth : ---	Test Id: 315511		
Test Comment: ---			
Sample Description: Moist, brown silty sand			
Sample Comment: ---			

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	10.8	56.1	33.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	99		
0.375 in	9.50	95		
#4	4.75	89		
#10	2.00	80		
#20	0.85	74		
#40	0.42	67		
#60	0.25	57		
#100	0.15	46		
#200	0.075	33		

Coefficients

D_{85} = 3.1354 mm D_{30} = N/A

D_{60} = 0.2883 mm D_{15} = N/A

D_{50} = 0.1793 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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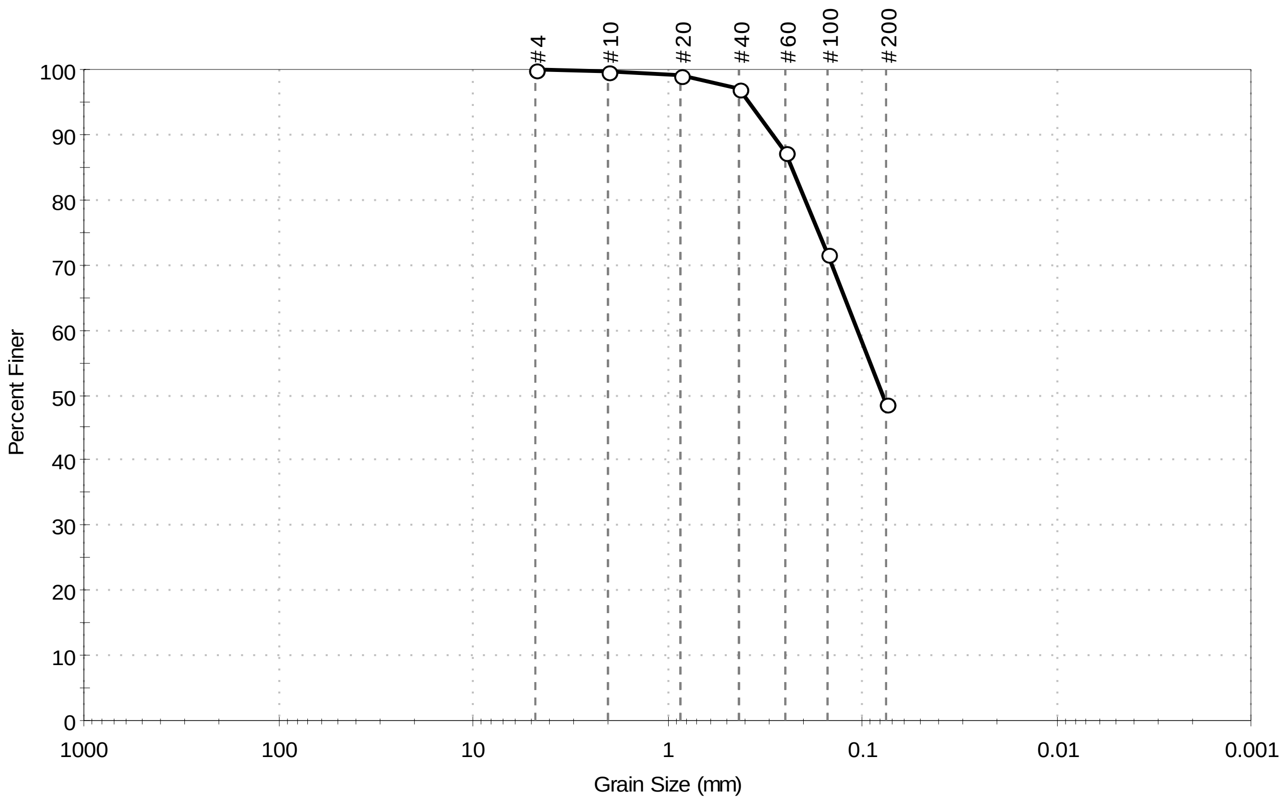
Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-06	Sample Type: bag	Tested By:	jbr
Sample ID: SS05	Test Date: 12/02/14	Checked By:	jdt
Depth : ---	Test Id: 315512		
Test Comment: ---			
Sample Description: Moist, brown silty sand			
Sample Comment: ---			

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	51.2	48.8

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	97		
#60	0.25	87		
#100	0.15	72		
#200	0.075	49		

Coefficients

D_{85} = 0.2323 mm D_{30} = N/A

D_{60} = 0.1052 mm D_{15} = N/A

D_{50} = 0.0778 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM   N/A

AASHTO   Silty Soils (A-4 (0))

Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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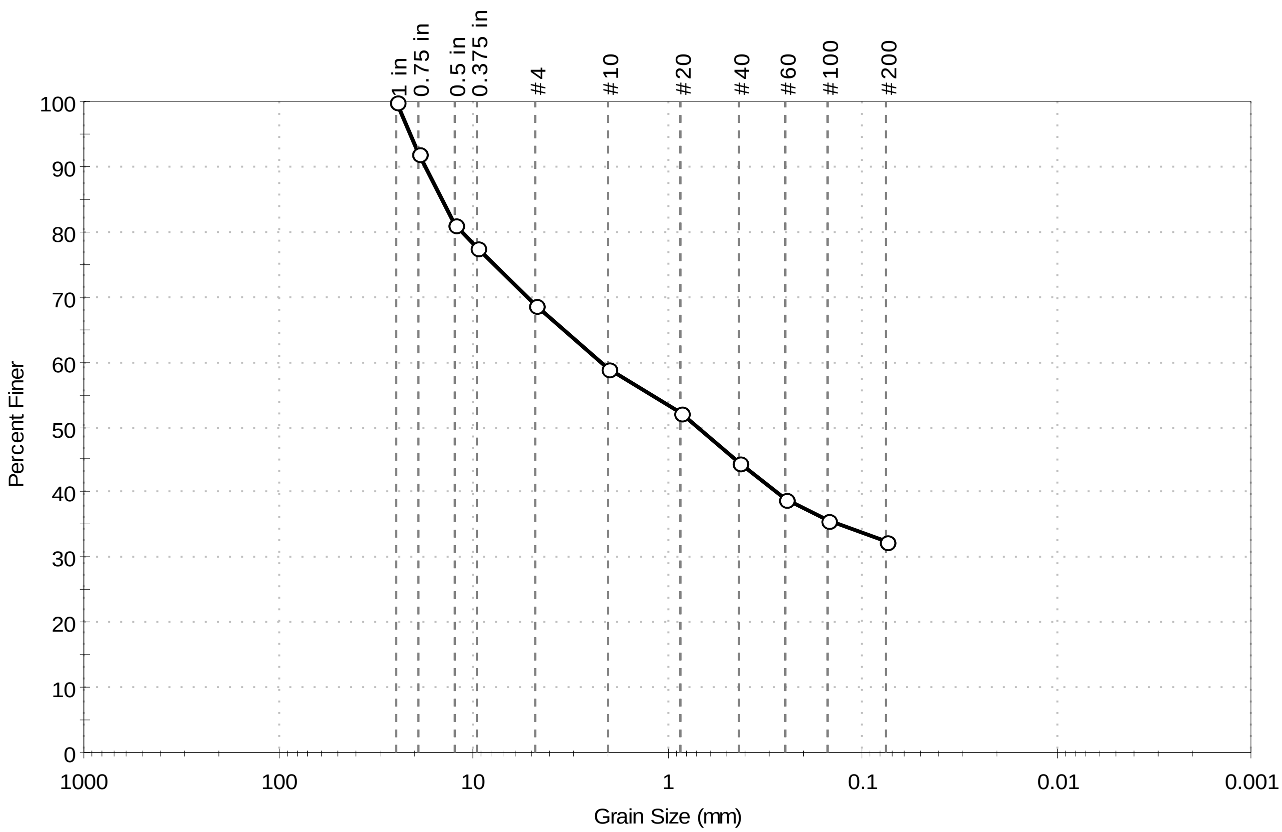
Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-06	Sample Type: bag	Tested By:	jbr
Sample ID: SS08	Test Date: 12/02/14	Checked By:	jdt
Depth : ---	Test Id: 315513		
Test Comment: ---			
Sample Description: Moist, brownish yellow clayey sand with gravel			
Sample Comment: ---			

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	31.1	36.4	32.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	92		
0.5 in	12.50	81		
0.375 in	9.50	78		
#4	4.75	69		
#10	2.00	59		
#20	0.85	52		
#40	0.42	45		
#60	0.25	39		
#100	0.15	36		
#200	0.075	32		

Coefficients

D_{85} = 14.4499 mm | D_{30} = N/A

D_{60} = 2.1754 mm | D_{15} = N/A

D_{50} = 0.6982 mm | D_{10} = N/A

C_u = N/A | C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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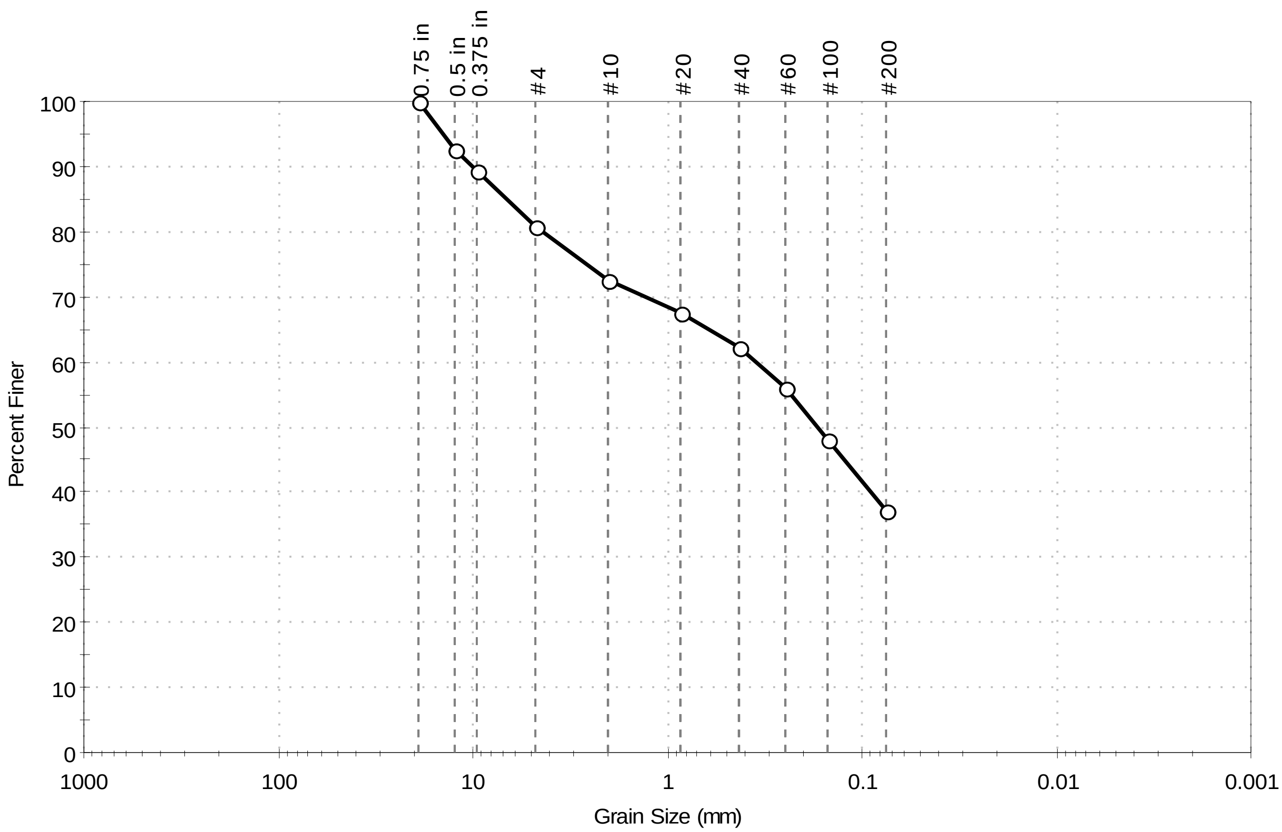
Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID: AQSB-07	Sample Type: bag	Tested By:	jbr
Sample ID: SS01	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315514		
Test Comment:	---		
Sample Description:	Moist, brown silty sand with gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	19.1	43.8	37.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	92		
0.375 in	9.50	89		
#4	4.75	81		
#10	2.00	73		
#20	0.85	68		
#40	0.42	62		
#60	0.25	56		
#100	0.15	48		
#200	0.075	37		

Coefficients

D_{85} = 6.6544 mm	D_{30} = N/A
D_{60} = 0.3506 mm	D_{15} = N/A
D_{50} = 0.1688 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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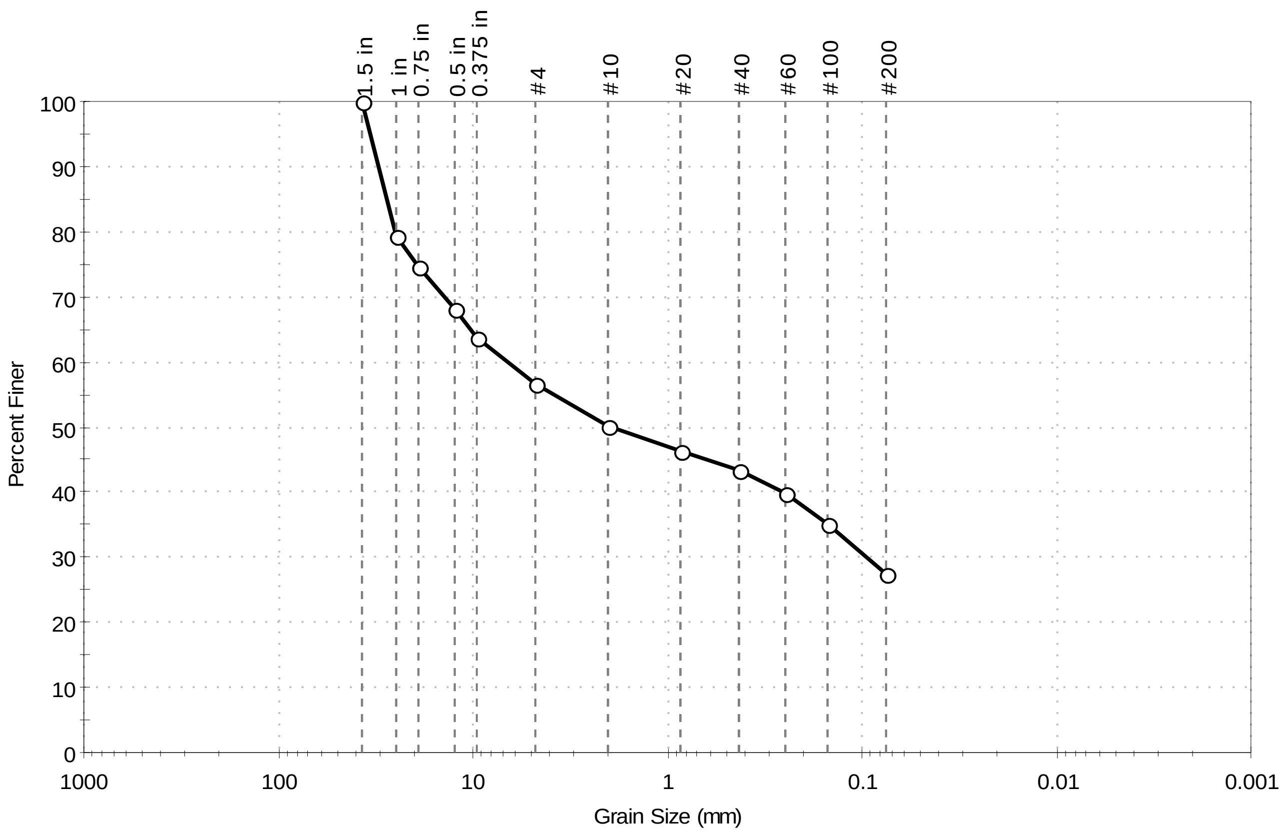
Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	AQSB-08	Sample Type:	bag	Tested By:	jbr
Sample ID:	SS01	Test Date:	12/01/14	Checked By:	jdt
Depth :	---	Test Id:	315515		
Test Comment:	---				
Sample Description:	Moist, light yellowish brown silty gravel with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	43.4	29.3	27.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	79		
0.75 in	19.00	75		
0.5 in	12.50	68		
0.375 in	9.50	64		
#4	4.75	57		
#10	2.00	50		
#20	0.85	46		
#40	0.42	43		
#60	0.25	40		
#100	0.15	35		
#200	0.075	27		

Coefficients

D_{85} = 27.8977 mm　　D_{30} = 0.0955 mm

D_{60} = 6.6315 mm　　D_{15} = N/A

D_{50} = 1.9680 mm　　D_{10} = N/A

C_u = N/A　　C_c = N/A

Classification

ASTM　N/A

AASHTO　Silty Gravel and Sand (A-2-4 (0))

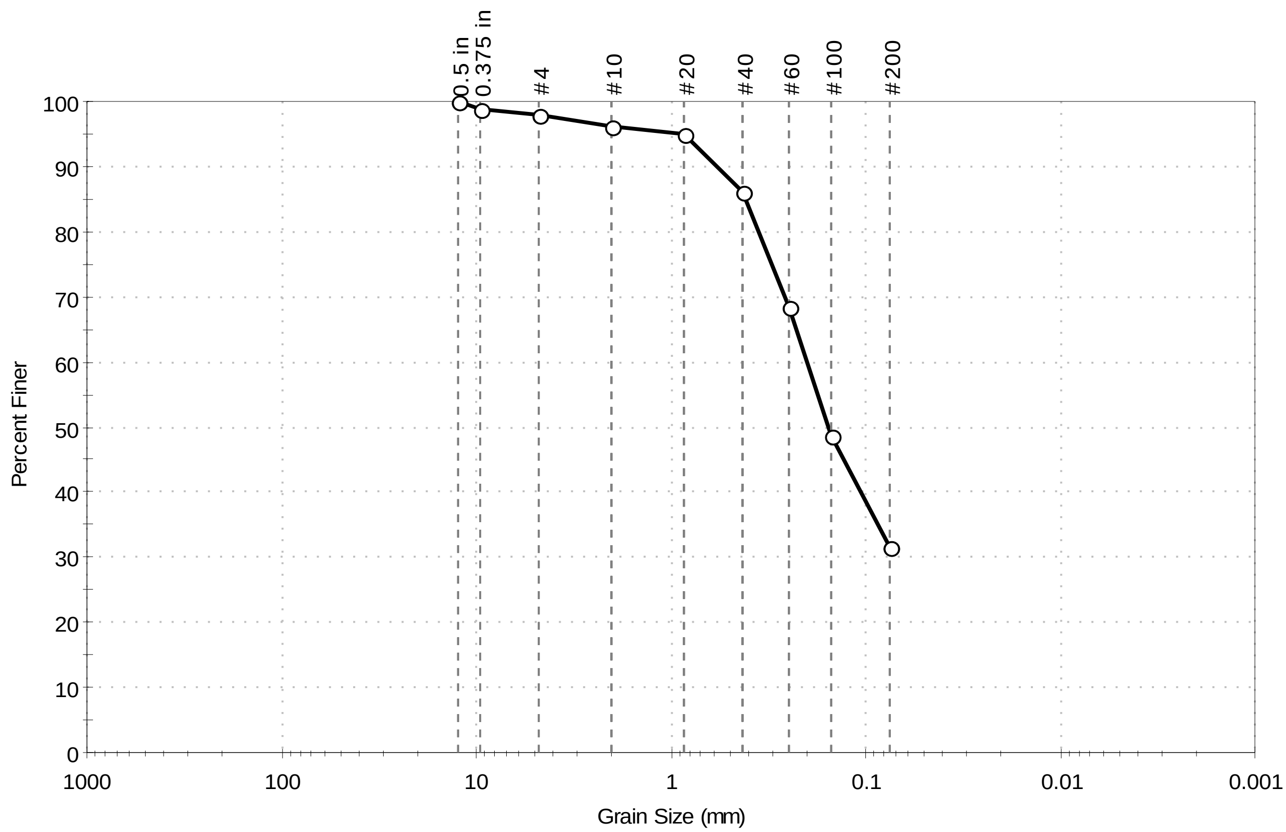
Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-08	Sample Type: bag	Tested By:	jbr
Sample ID: SS03	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315516		
Test Comment: ---			
Sample Description: Moist, brown silty sand			
Sample Comment: ---			

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	2.1	66.3	31.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	99		
#4	4.75	98		
#10	2.00	96		
#20	0.85	95		
#40	0.42	86		
#60	0.25	68		
#100	0.15	49		
#200	0.075	32		

Coefficients

D_{85} = 0.4111 mm　　D_{30} = N/A

D_{60} = 0.2012 mm　　D_{15} = N/A

D_{50} = 0.1549 mm　　D_{10} = N/A

C_u = N/A　　C_c = N/A

Classification

ASTM　N/A

AASHTO　Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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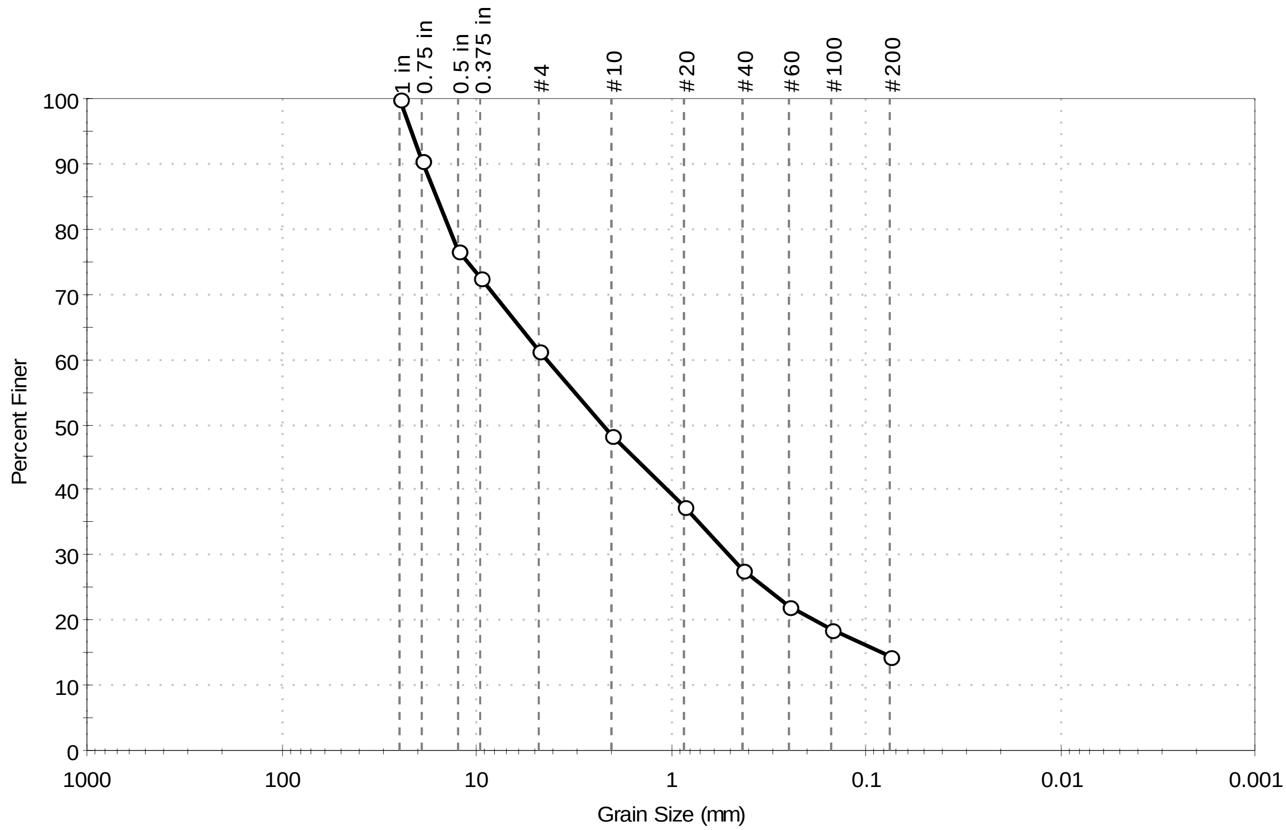
Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID: AQSB-08	Sample Type: bag	Tested By:	jbr
Sample ID: SS04	Test Date: 12/02/14	Checked By:	jdt
Depth : ---	Test Id: 315517		
Test Comment:	---		
Sample Description:	Moist, brown silty sand with gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	38.5	47.0	14.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	91		
0.5 in	12.50	77		
0.375 in	9.50	73		
#4	4.75	61		
#10	2.00	48		
#20	0.85	37		
#40	0.42	28		
#60	0.25	22		
#100	0.15	19		
#200	0.075	14		

Coefficients

D_{85} = 16.0455 mm | D_{30} = 0.4975 mm

D_{60} = 4.2995 mm | D_{15} = 0.0819 mm

D_{50} = 2.2122 mm | D_{10} = N/A

C_u = N/A | C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-a (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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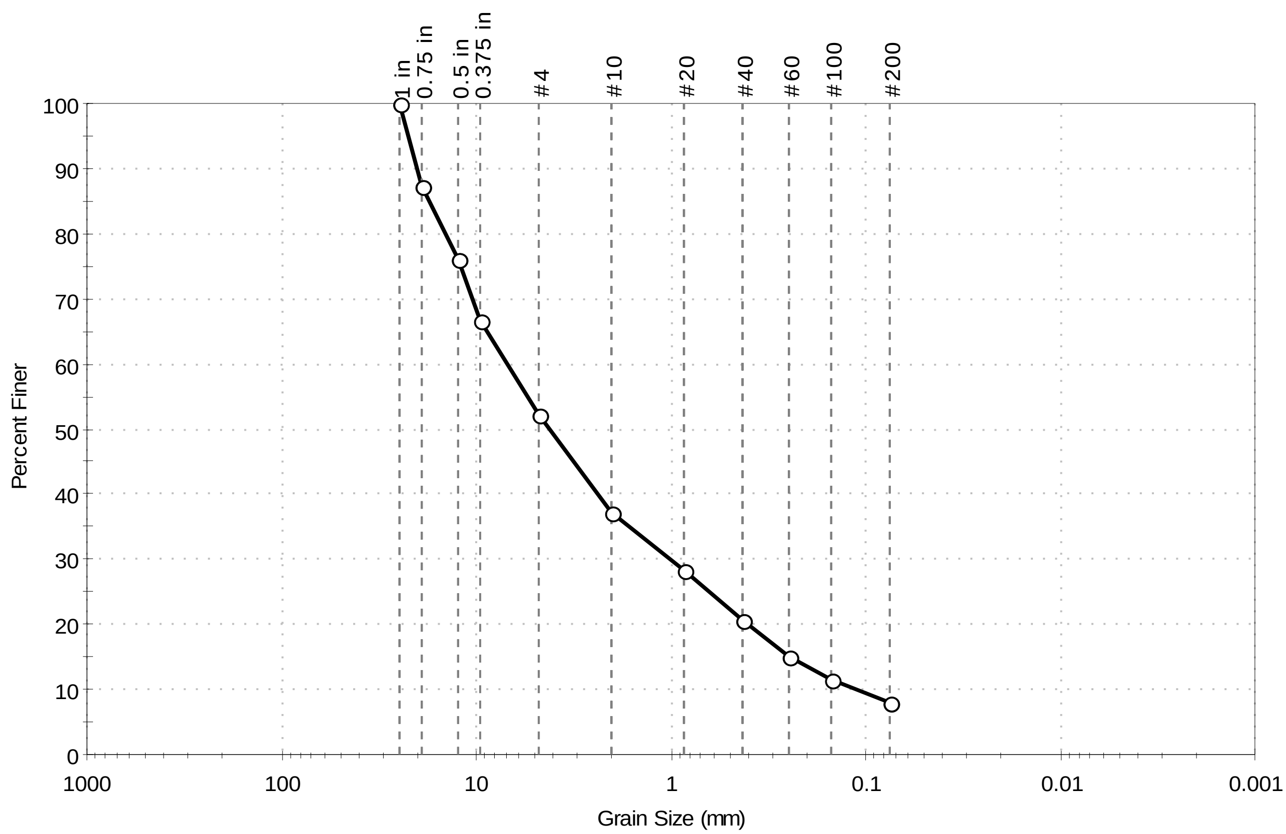
Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	AQSB-08	Sample Type:	bag	Tested By:	jbr
Sample ID:	SS05	Test Date:	12/02/14	Checked By:	jdt
Depth :	---	Test Id:	315518		

Test Comment: ---

Sample Description: Moist, brown gravel with silt and sand

Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	47.8	44.2	8.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	87		
0.5 in	12.50	76		
0.375 in	9.50	67		
#4	4.75	52		
#10	2.00	37		
#20	0.85	28		
#40	0.42	21		
#60	0.25	15		
#100	0.15	11		
#200	0.075	8.0		

Coefficients

D_{85} = 17.3739 mm | D_{30} = 0.9957 mm

D_{60} = 6.8864 mm | D_{15} = 0.2452 mm

D_{50} = 4.1927 mm | D_{10} = 0.1130 mm

C_u = 60.942 | C_c = 1.274

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-a (1))

Sample / Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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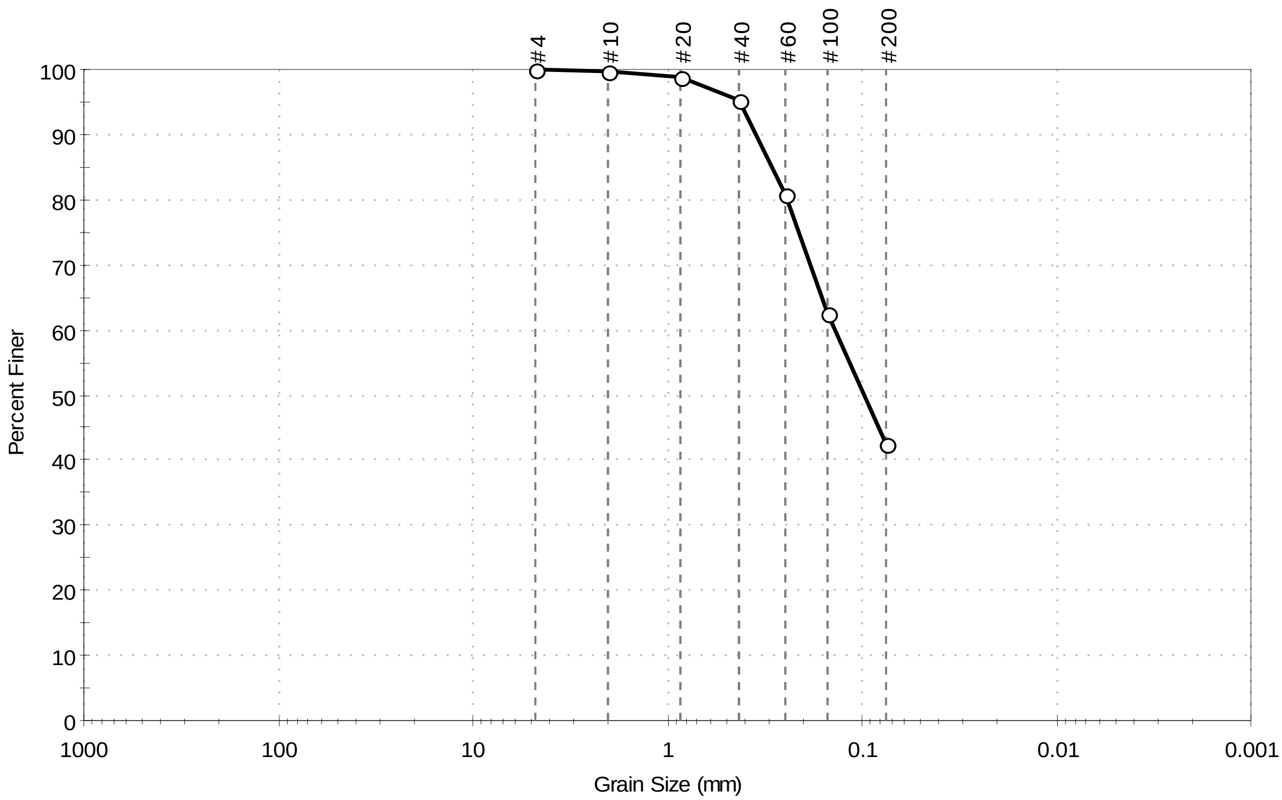
Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID: AQSB-09	Sample Type: bag	Tested By:	jbr
Sample ID: SS02	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315519		
Test Comment:	---		
Sample Description:	Moist, brown silty sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	57.7	42.3

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	95		
#60	0.25	81		
#100	0.15	62		
#200	0.075	42		

Coefficients

D_{85} = 0.2921 mm D_{30} = N/A

D_{60} = 0.1380 mm D_{15} = N/A

D_{50} = 0.0977 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM   N/A

AASHTO   Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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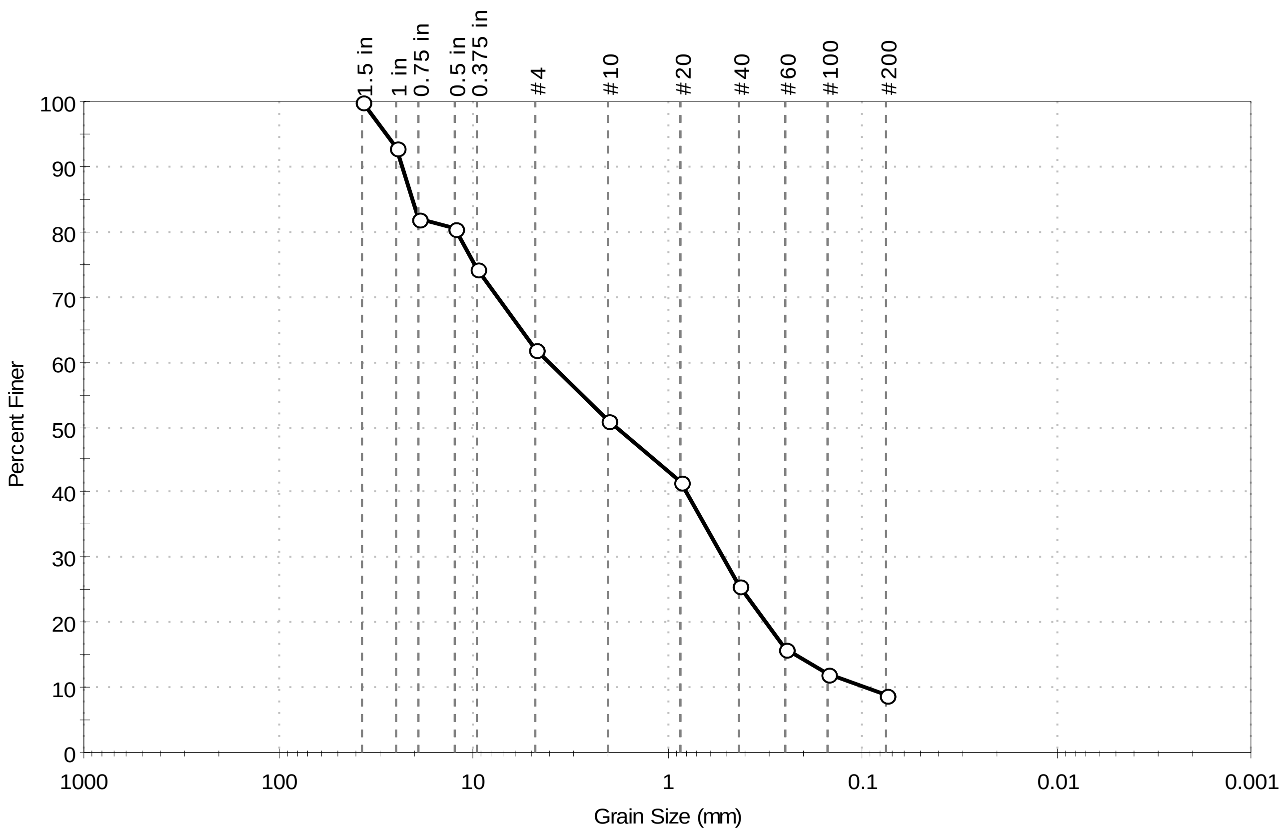
Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-09	Sample Type: bag	Tested By:	jbr
Sample ID: SS04	Test Date: 12/02/14	Checked By:	jdt
Depth : ---	Test Id: 315520		
Test Comment: ---			
Sample Description: Moist, brown sand with silt and gravel			
Sample Comment: ---			

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	38.1	53.0	8.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	93		
0.75 in	19.00	82		
0.5 in	12.50	81		
0.375 in	9.50	74		
#4	4.75	62		
#10	2.00	51		
#20	0.85	42		
#40	0.42	26		
#60	0.25	16		
#100	0.15	12		
#200	0.075	8.9		

Coefficients

D_{85} = 20.4706 mm
D_{30} = 0.5138 mm
D_{60} = 4.0896 mm
D_{15} = 0.2202 mm
D_{50} = 1.8063 mm
D_{10} = 0.0966 mm
C_u = 42.335
C_c = 0.668

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (1))

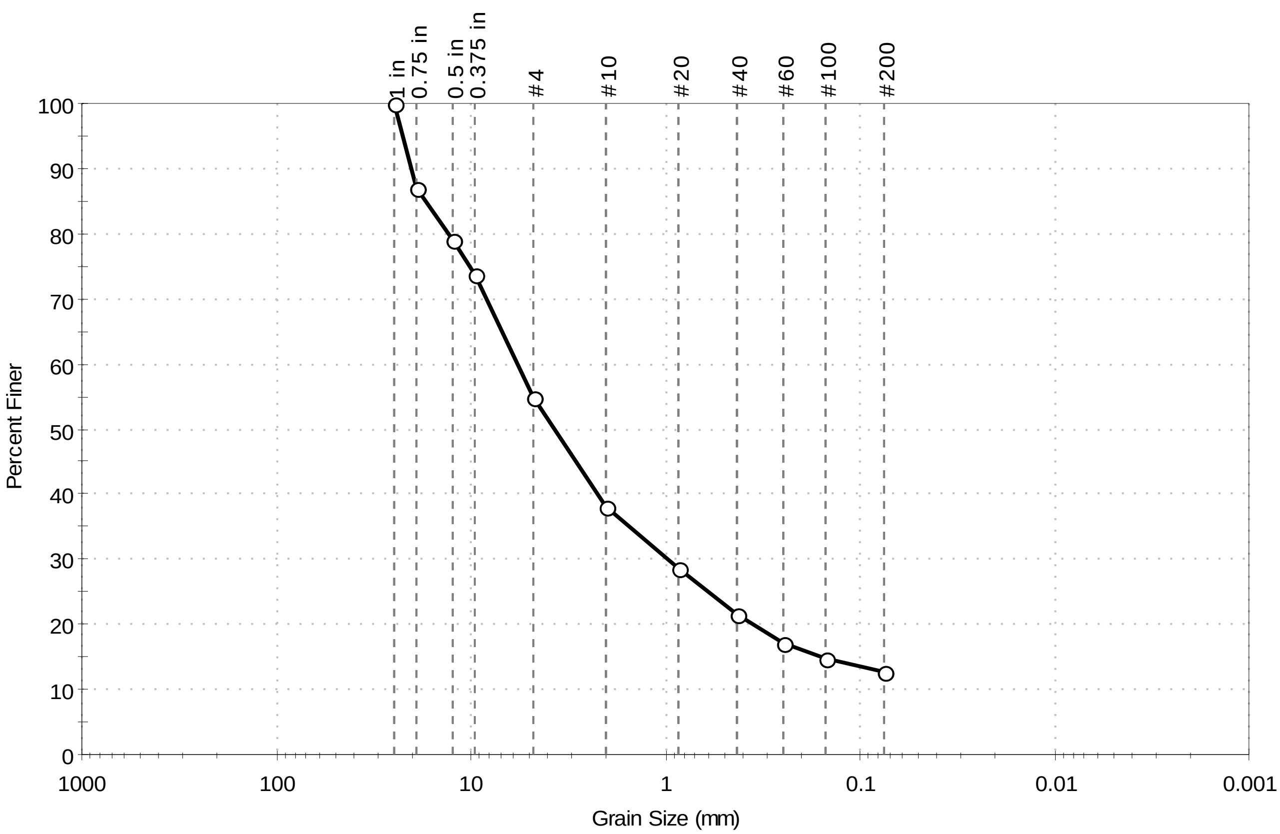
Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID: AQSB-09	Sample Type: bag	Tested By:	jbr
Sample ID: SS06	Test Date: 12/02/14	Checked By:	jdt
Depth : ---	Test Id: 315521		
Test Comment:	---		
Sample Description:	Wet, olive silty gravel with sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	45.2	42.2	12.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	87		
0.5 in	12.50	79		
0.375 in	9.50	74		
#4	4.75	55		
#10	2.00	38		
#20	0.85	29		
#40	0.42	21		
#60	0.25	17		
#100	0.15	15		
#200	0.075	13		

Coefficients

D_{85} = 17.0003 mm D_{30} = 0.9697 mm

D_{60} = 5.7447 mm D_{15} = 0.1561 mm

D_{50} = 3.7186 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-a (0))

Sample / Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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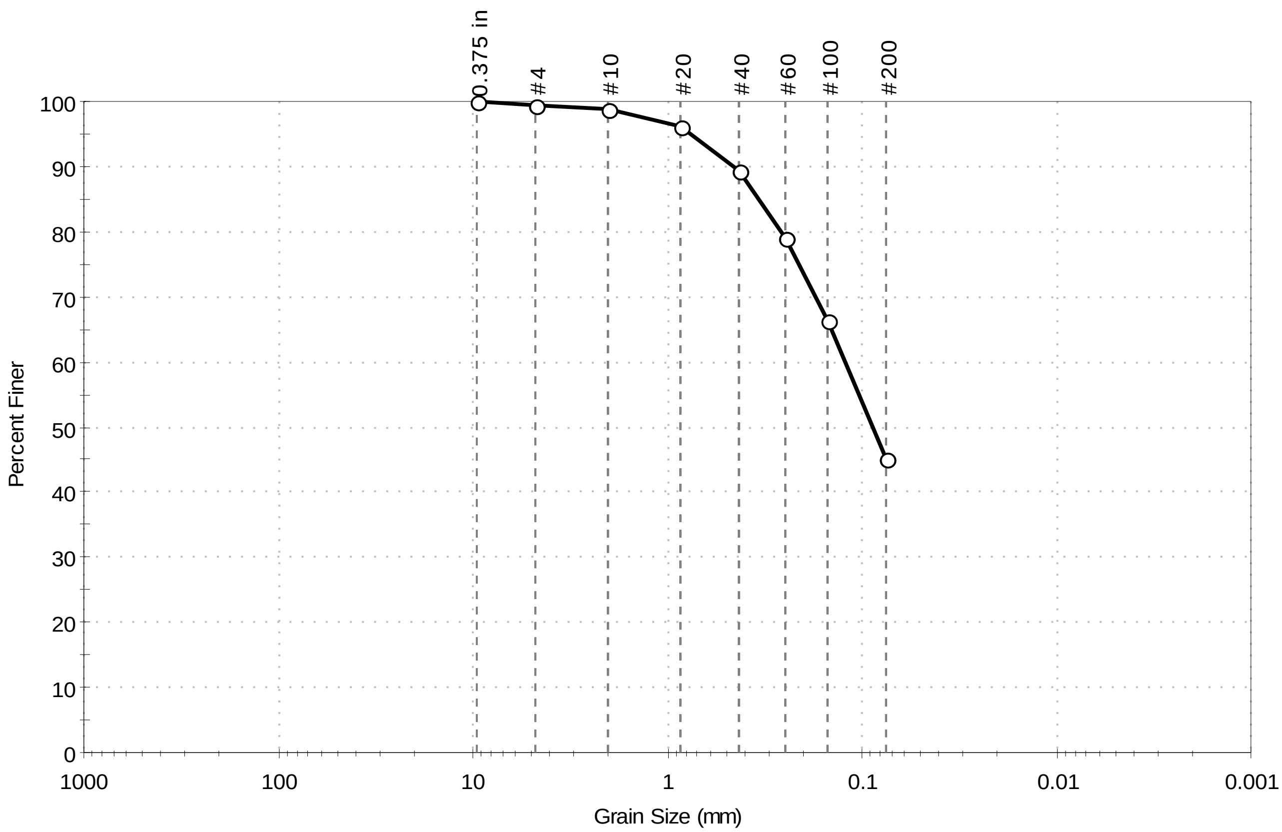
Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID: AQSB-10	Sample Type: bag	Tested By:	jbr
Sample ID: SS01	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315522		
Test Comment:	---		
Sample Description:	Moist, brown silty sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.5	54.4	45.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	99		
#20	0.85	96		
#40	0.42	89		
#60	0.25	79		
#100	0.15	66		
#200	0.075	45		

Coefficients

D_{85} = 0.3399 mm D_{30} = N/A

D_{60} = 0.1219 mm D_{15} = N/A

D_{50} = 0.0881 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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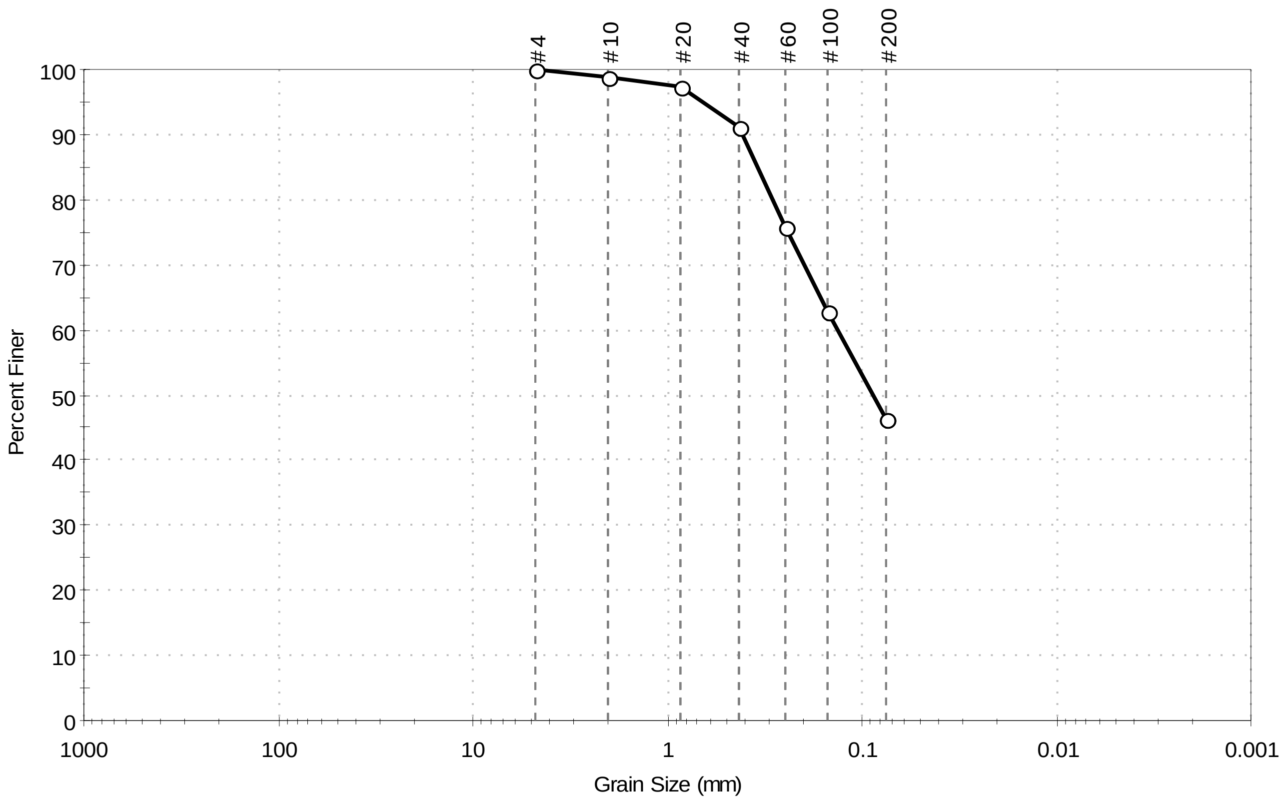
Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-10	Sample Type: bag	Tested By:	jbr
Sample ID: SS03	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315523		
Test Comment: ---			
Sample Description: Moist, brown clayey sand			
Sample Comment: ---			

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	53.6	46.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	99		
#20	0.85	97		
#40	0.42	91		
#60	0.25	76		
#100	0.15	63		
#200	0.075	46		

Coefficients

D_{85} = 0.3423 mm　　D_{30} = N/A
D_{60} = 0.1328 mm　　D_{15} = N/A
D_{50} = 0.0873 mm　　D_{10} = N/A
C_u = N/A　　C_c = N/A

Classification

ASTM　Clayey sand (SC)

AASHTO　Clayey Soils (A-7-6 (5))

Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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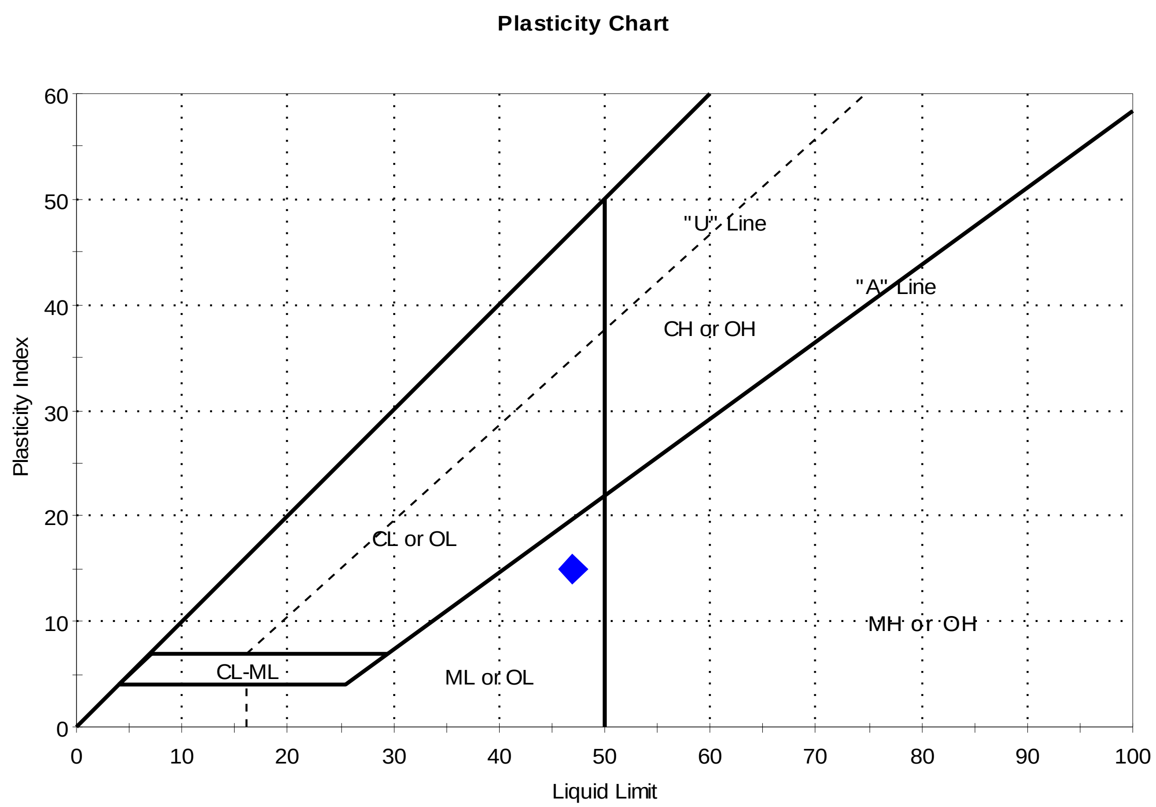
GeoTesting EXPRESS

Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	AQSB-01	Sample Type:	bag	Tested By:	cam
Sample ID:	SS06	Test Date:	12/05/14	Checked By:	jdt
Depth :	---	Test Id:	315524		

Test Comment: ---
Sample Description: Moist, brownish yellow 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
◆	SS06	AQSB-01	---	36	47	32	15	0.3	

Sample Prepared using the WET method

Dry Strength: HIGH
Dilatancy: SLOW
Toughness: LOW

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Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	AQSB-01	Sample Type:	tube	Tested By:	cam
Sample ID:	ST01	Test Date:	12/10/14	Checked By:	jdt
Depth :	---	Test Id:	315525		

Test Comment: ---

Sample Description: Moist, yellowish brown silty sand with gravel

Sample Comment: ---

Atterberg Limits - ASTM D4318

Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	ST01	AQSB-01	---	53	n/a	n/a	n/a	n/a	Silty sand with gravel (SM)

47% Retained on #40 Sieve

Dry Strength: LOW

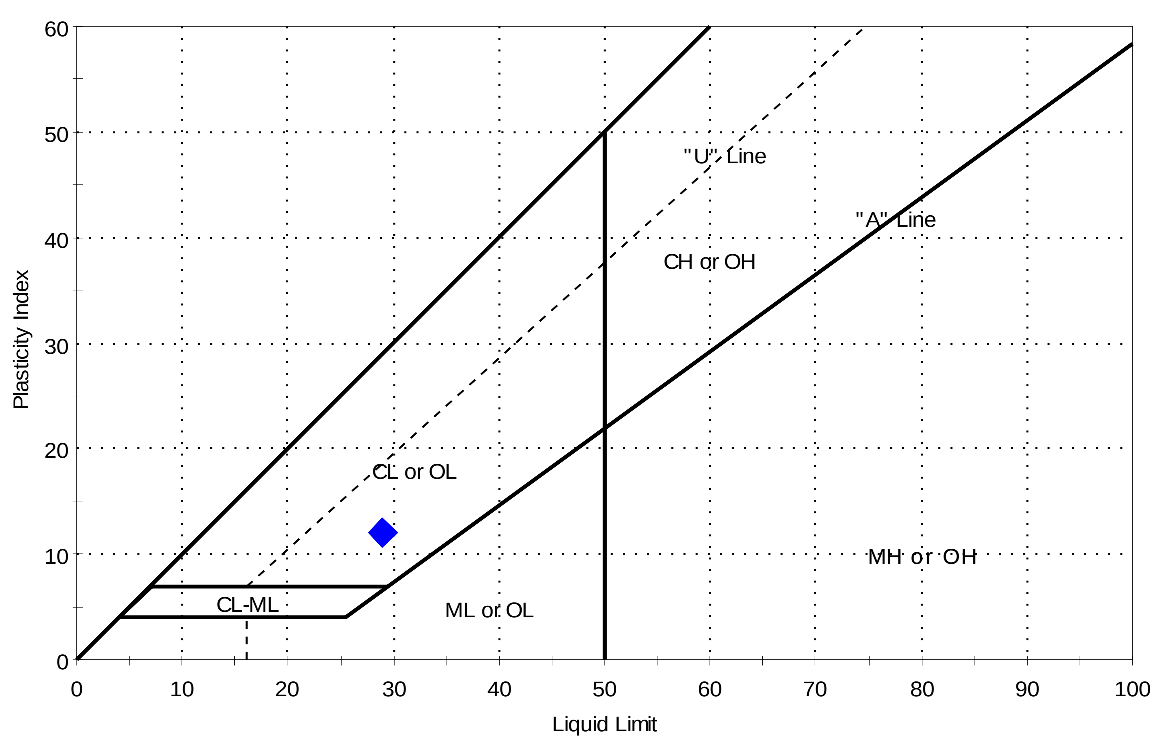
Dilatancy: RAPID

Toughness: n/a

The sample was determined to be Non-Plastic

Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-03	Sample Type: bag	Tested By:	cam
Sample ID: SS03	Test Date: 12/10/14	Checked By:	jdt
Depth : ---	Test Id: 315526		
Test Comment: ---			
Sample Description: Moist, brown clay			
Sample Comment: ---			

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS03	AQSB-03	---	19	29	17	12	0.2	

Sample Prepared using the WET method

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

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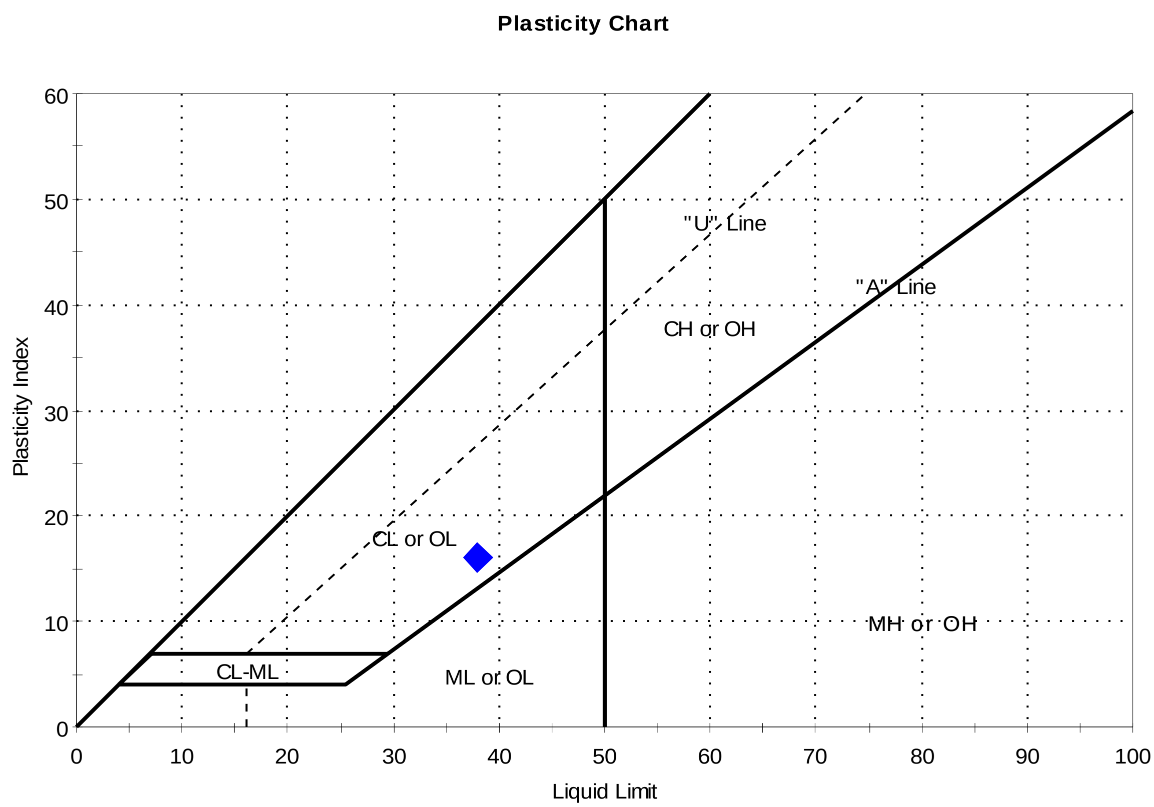
Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID: AQSB-06	Sample Type: bag	Tested By:	cam
Sample ID: SS06	Test Date: 12/09/14	Checked By:	jdt
Depth : ---	Test Id: 315527		
Test Comment: ---			
Sample Description: Moist, dark grayish brown clay			
Sample Comment: ---			

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS06	AQSB-06	---	43	38	22	16	1.3	

Sample Prepared using the WET method

Dry Strength: HIGH

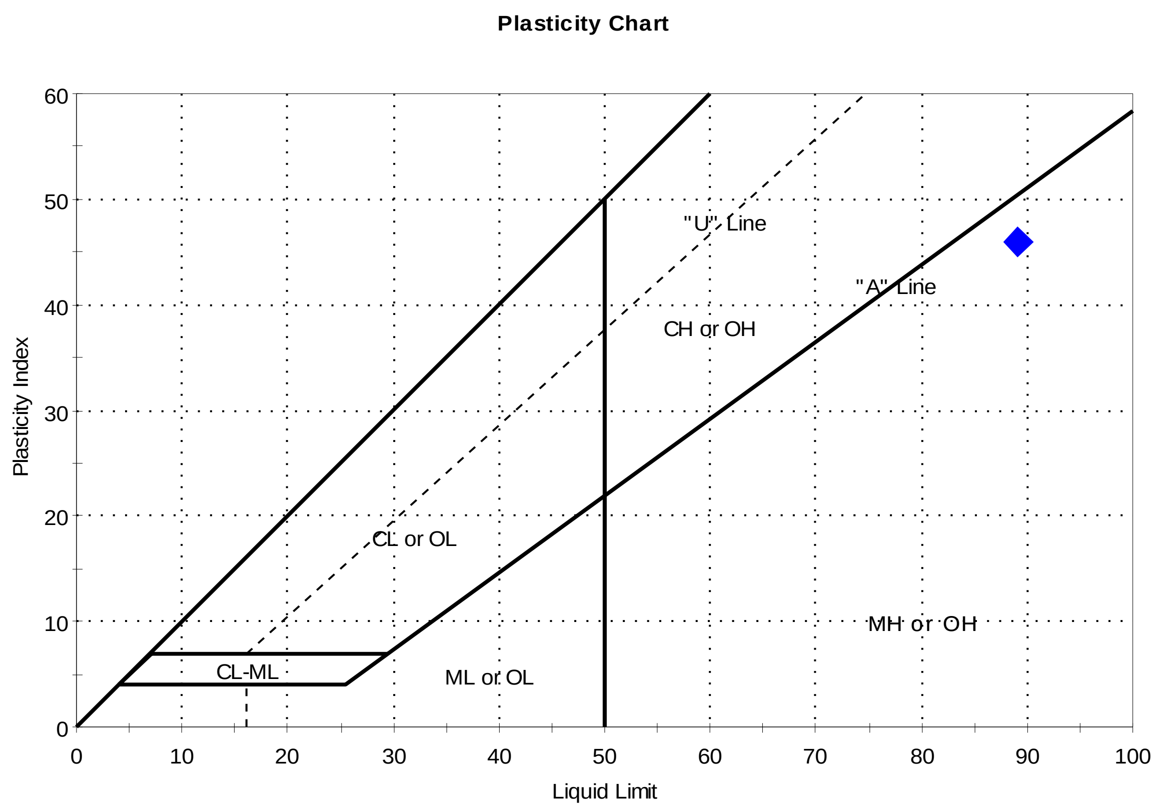
Dilatancy: SLOW

Toughness: LOW

Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-06	Sample Type: bag	Tested By:	cam
Sample ID: SS09	Test Date: 12/05/14	Checked By:	jdt
Depth : ---	Test Id: 315528		

Test Comment: ---
Sample Description: Moist, brownish yellow 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
◆	SS09	AQSB-06	---	99	89	43	46	1.2	

Sample Prepared using the WET method

Dry Strength: MEDIUM
Dilatancy: SLOW
Toughness: LOW

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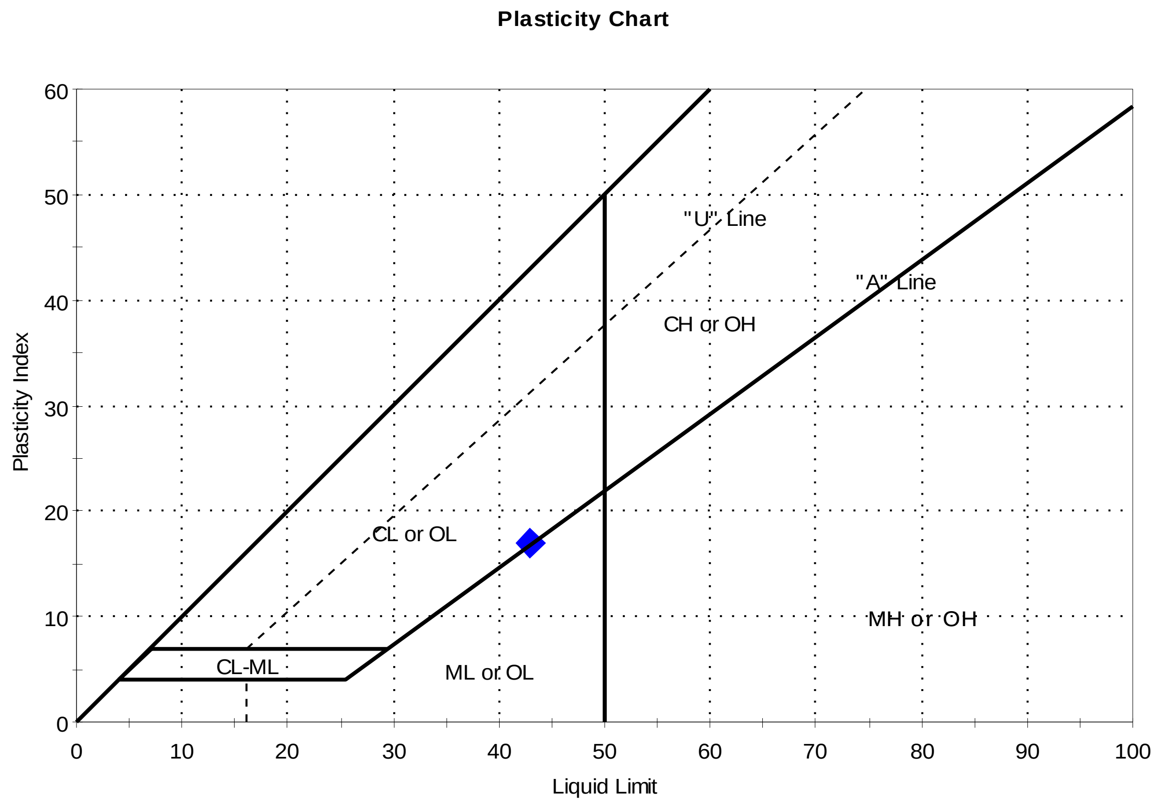
Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-10	Sample Type: bag	Tested By:	cam
Sample ID: SS03	Test Date: 12/08/14	Checked By:	jdt
Depth : ---	Test Id: 315529		
Test Comment: ---			
Sample Description: Moist, brown clayey sand			
Sample Comment: ---			

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS03	AQSB-10	---	30	43	26	17	0.2	Clayey sand (SC)

Sample Prepared using the WET method

9% Retained on #40 Sieve

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

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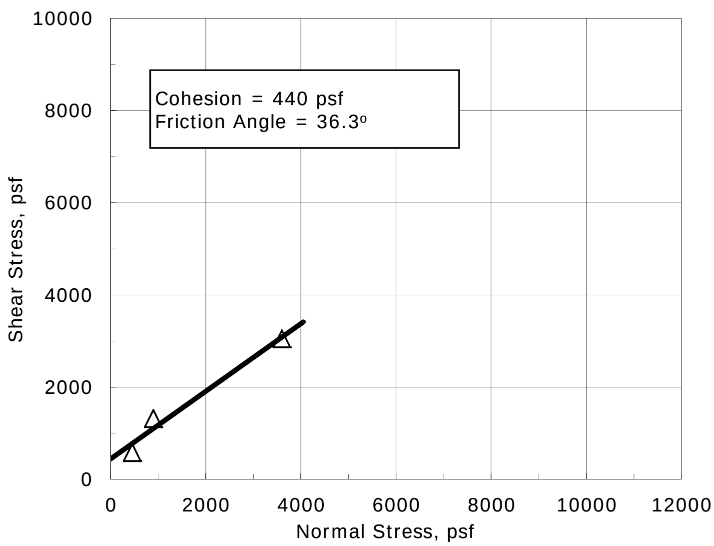
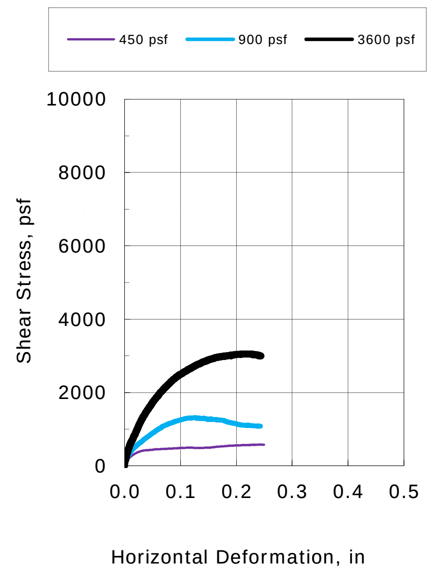
Client:	Anchor QEA, LLC
Project Name:	South River
Project Location:	---
GTX #:	302574
Test Date:	12/8/2014
Tested By:	md
Checked By:	jdt
Boring ID:	AQSB-01
Sample ID:	ST01
Depth, ft:	---
Visual Description:	Moist, yellowish brown silty sand with gravel

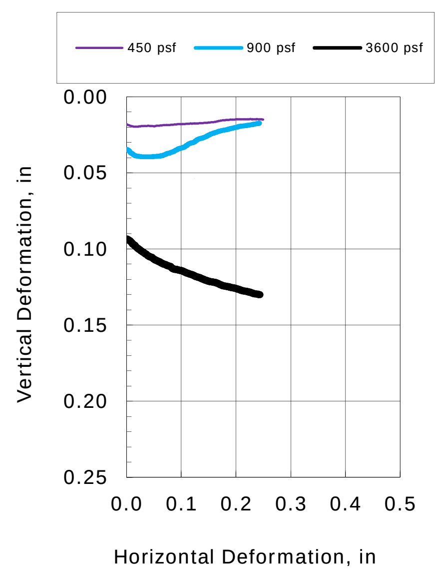
Direct Shear Test of Soils Under Consolidated Drained Conditions by ASTM D3080





Test No.:	DS-1	DS-2	DS-4
Initial Diameter, in:	2.5	2.5	2.5
Initial Height, in:	1.0	1.0	1.0
Initial Mass, grams:	158.9	153.6	121.6
Initial Dry Density, pcf:	93.8	96.4	61.1
Initial Moisture Content, %:	29.8	23.7	63.6
Initial Bulk Density, pcf:	122	119	100
Initial Degree of Saturation:	98.7	83.4	96.7
Initial Void Ratio:	0.83	0.78	1.81
Final Dry Density, pcf:	95.2	98.1	70.2
Final Moisture Content, %:	21.4	35.5	46.8
Final Bulk Density, pcf:	116	133	103
Normal Stress, psf:	450	900	3600
Maximum Shear Stress, psf:	582	1320	3050
Shear Rate, in/min:	0.0004	0.0004	0.0004

Sample Type:	intact
Measured Specific Gravity:	2.75
Liquid Limit:	Non-Plastic
Plastic Limit:	Non-Plastic
Plasticity Index:	Non-Plastic
% Passing #200 sieve:	43.2
Soil Classification:	Silty Sand with Gravel
Group Symbol:	SM

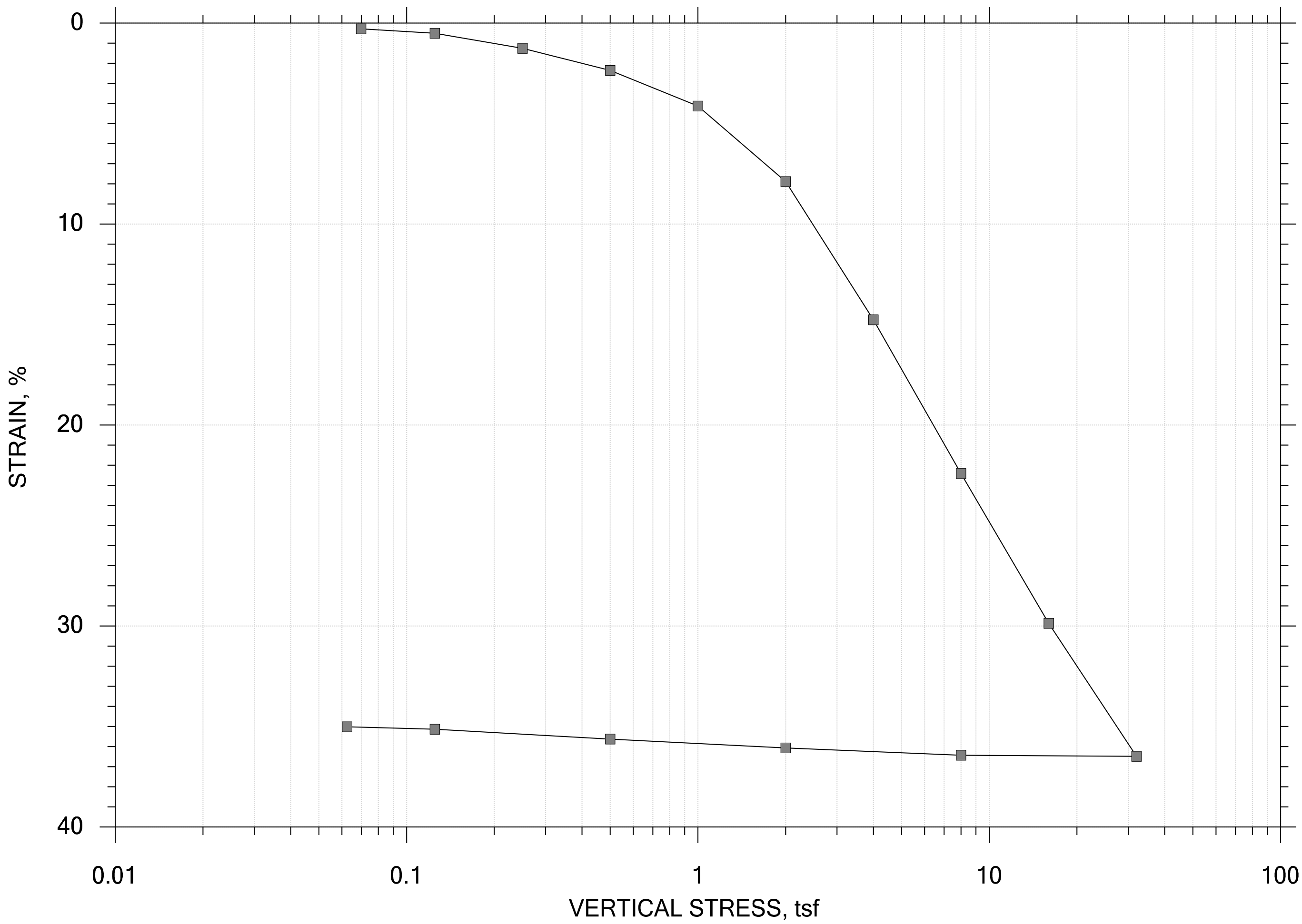


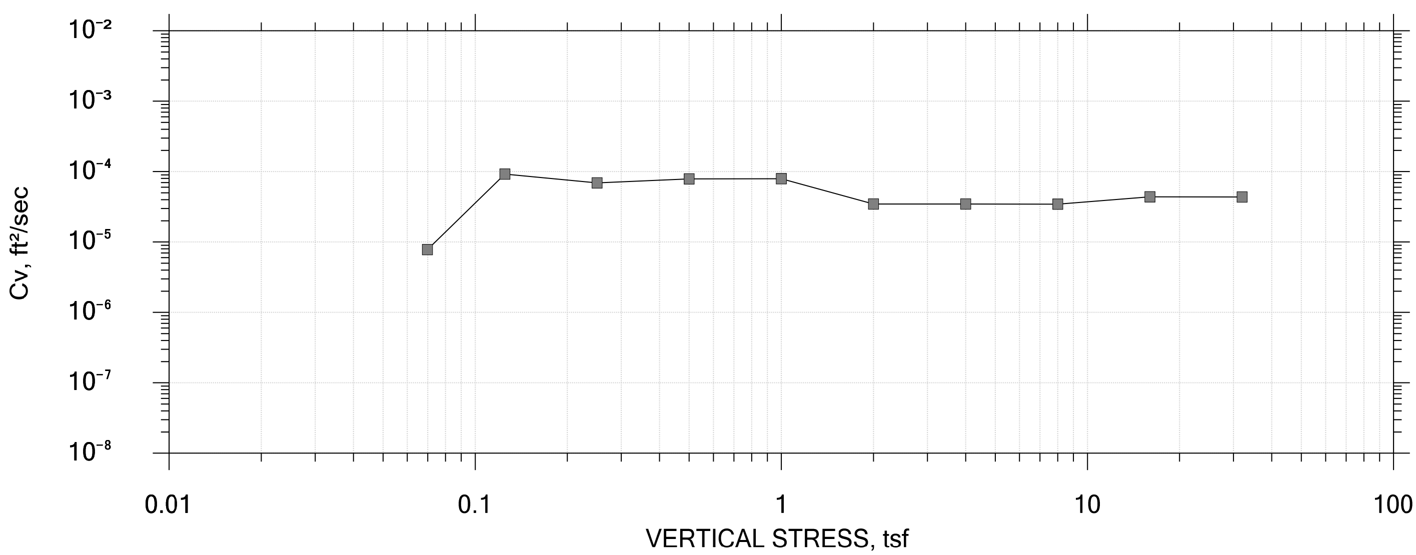
Notes: Moisture content obtained before shear from sample trimmings
Moisture Content determined by ASTM D2216
Specific Gravity determined by ASTM D854
Atterberg Limits determined by ASTM D4318
% Passing #200 Sieve determined by ASTM D422

Values for cohesion and friction angle determined from best-fit straight line to the data for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site-specific conditions.
"---" indicates testing required to determine these values was not requested.

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

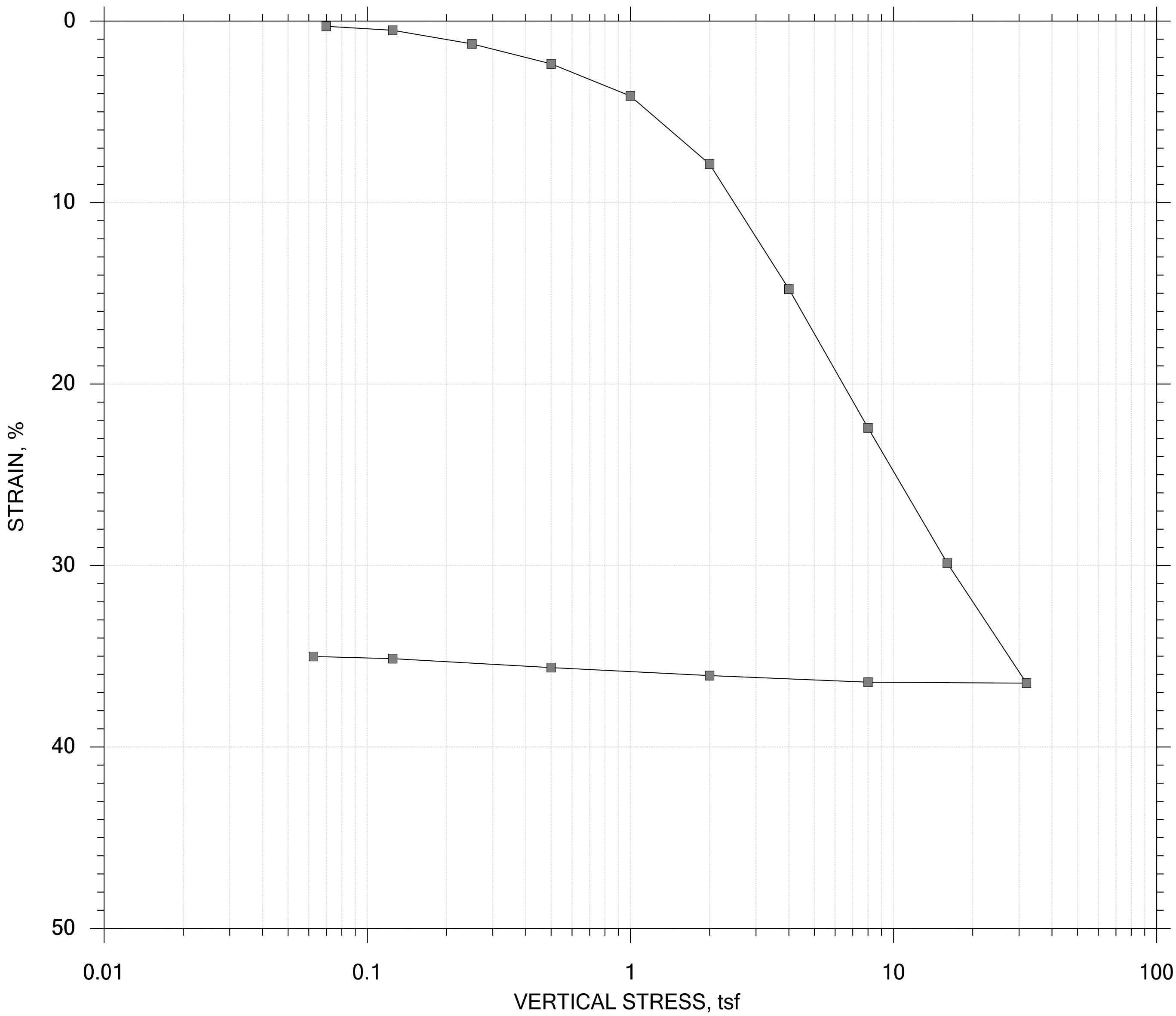




GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT



					Before Test	After Test
Current Vertical Effective Stress: ---				Water Content, %	79.06	40.81
Preconsolidation Stress: ---				Dry Unit Weight, pcf	51.769	80.889
Compression Ratio: ---				Saturation, %	93.86	100.00
Diameter: 2.5 in		Height: 1 in		Void Ratio	2.32	1.12
LL: NP	PL: NP	PI: NP	GS: 2.75			

GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: South River
Location: ---
Project No.: GTX-302574
Boring No.: AQSB-01
Tested By: md
Checked By: jdt
Sample No.: ST01
Test Date: 12/01/14
Depth: ---
Test No.: IP-1
Sample Type: intact
Elevation: ---

Soil Description: Moist, yellowish brown silty sand with gravel
Remarks: System O, Swell Pressure = 0.0698 tsf

Measured Specific Gravity: 2.75
Liquid Limit: NP
Specimen Diameter: 2.50 in
Initial Void Ratio: 2.32
Plastic Limit: NP
Initial Height: 1.00 in
Final Void Ratio: 1.12
Plasticity Index: NP
Final Height: 0.64 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	14752	RING		15308
Wt. Container + Wet Soil, gm	55.800	228.27	202.76	103.85
Wt. Container + Dry Soil, gm	38.370	175.54	175.54	76.240
Wt. Container, gm	9.1000	108.83	108.83	8.5900
Wt. Dry Soil, gm	29.270	66.705	66.705	67.650
Water Content, %	59.55	79.06	40.81	40.81
Void Ratio	---	2.32	1.12	---
Degree of Saturation, %	---	93.86	100.00	---
Dry Unit Weight, pcf	---	51.769	80.889	---

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: South River
Boring No.: AQSB-01
Sample No.: ST01
Test No.: IP-1

Location: ---
Tested By: md
Test Date: 12/01/14
Sample Type: intact

Project No.: GTX-302574
Checked By: jdt
Depth: ---
Elevation: ---

Soil Description: Moist, yellowish brown silty sand with gravel
Remarks: System O, Swell Pressure = 0.0698 tsf

Displacement at End of Increment

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft²/sec	Mv 1/tsf	k ft/day
1	0.0698	0.002825	2.31	0.283	6.002	4.08e-006	4.05e-002	4.45e-004
2	0.125	0.005031	2.30	0.503	0.395	6.16e-005	4.00e-002	6.65e-003
3	0.250	0.01256	2.27	1.26	0.488	4.94e-005	6.03e-002	8.03e-003
4	0.500	0.02355	2.24	2.36	0.425	5.57e-005	4.40e-002	6.60e-003
5	1.00	0.04122	2.18	4.12	0.408	5.64e-005	3.53e-002	5.37e-003
6	2.00	0.07882	2.05	7.88	0.929	2.33e-005	3.76e-002	2.37e-003
7	4.00	0.1476	1.83	14.8	0.532	3.62e-005	3.44e-002	3.36e-003
8	8.00	0.2241	1.57	22.4	0.467	3.48e-005	1.91e-002	1.79e-003
9	16.0	0.2987	1.33	29.9	0.414	3.23e-005	9.32e-003	8.12e-004
10	32.0	0.3648	1.11	36.5	0.388	2.83e-005	4.13e-003	3.15e-004
11	8.00	0.3643	1.11	36.4	0.396	2.50e-005	2.19e-005	1.48e-006
12	2.00	0.3607	1.12	36.1	0.355	2.81e-005	6.02e-004	4.56e-005
13	0.500	0.3563	1.13	35.6	0.377	2.68e-005	2.93e-003	2.12e-004
14	0.125	0.3513	1.15	35.1	0.986	1.04e-005	1.32e-002	3.71e-004
15	0.0625	0.3501	1.16	35.0	22.429	4.61e-007	1.85e-002	2.30e-005

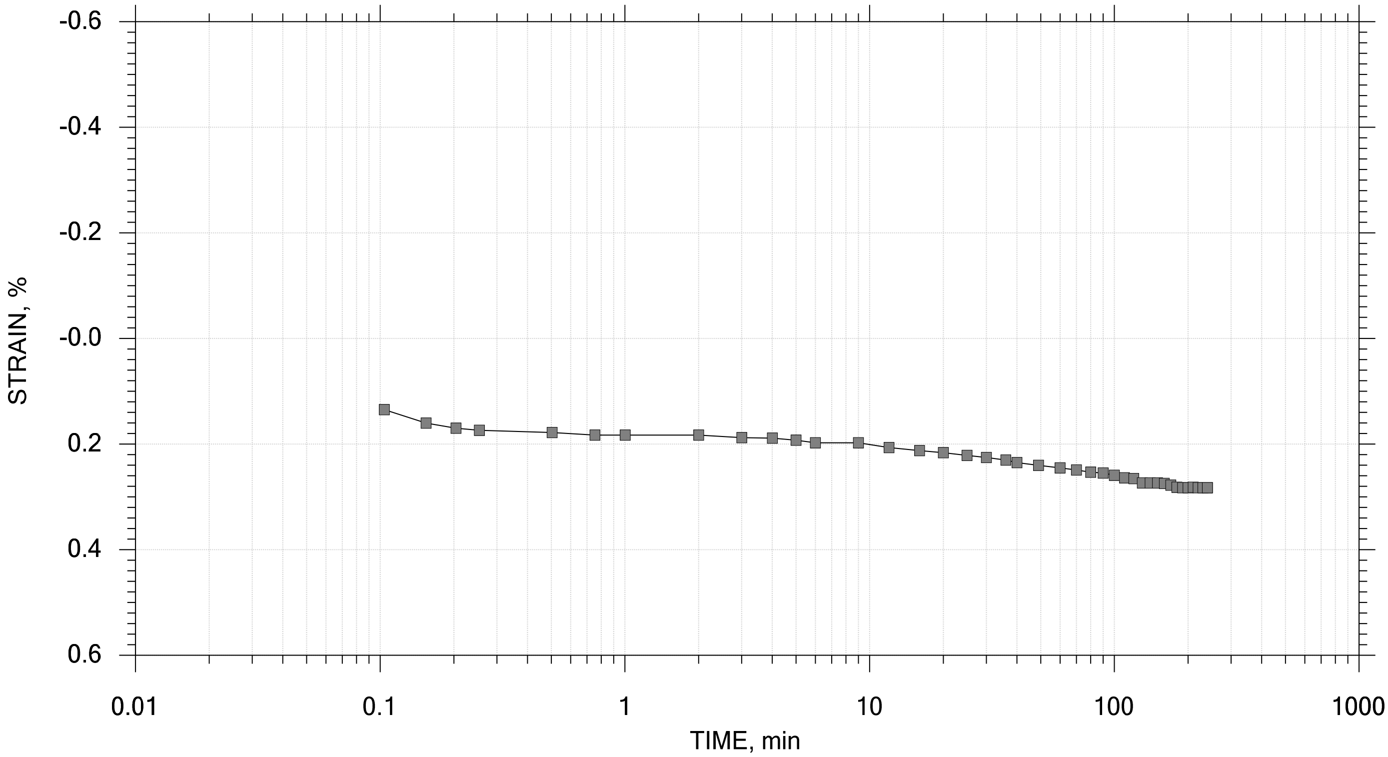
	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/sec	Mv 1/tsf	k ft/day	Ca %
1	0.0698	0.002825	2.31	0.283	0.000	0.00e+000	4.05e-002	0.00e+000	0.00e+000
2	0.125	0.005031	2.30	0.503	0.000	0.00e+000	4.00e-002	0.00e+000	0.00e+000
3	0.250	0.01256	2.27	1.26	0.000	0.00e+000	6.03e-002	0.00e+000	0.00e+000
4	0.500	0.02355	2.24	2.36	0.000	0.00e+000	4.40e-002	0.00e+000	0.00e+000
5	1.00	0.04122	2.18	4.12	0.000	0.00e+000	3.53e-002	0.00e+000	0.00e+000
6	2.00	0.07882	2.05	7.88	0.106	4.76e-005	3.76e-002	4.83e-003	0.00e+000
7	4.00	0.1476	1.83	14.8	0.135	3.32e-005	3.44e-002	3.08e-003	0.00e+000
8	8.00	0.2241	1.57	22.4	0.118	3.21e-005	1.91e-002	1.65e-003	0.00e+000
9	16.0	0.2987	1.33	29.9	0.000	0.00e+000	9.32e-003	0.00e+000	0.00e+000
10	32.0	0.3648	1.11	36.5	0.000	0.00e+000	4.13e-003	0.00e+000	0.00e+000
11	8.00	0.3643	1.11	36.4	0.000	0.00e+000	2.19e-005	0.00e+000	0.00e+000
12	2.00	0.3607	1.12	36.1	0.000	0.00e+000	6.02e-004	0.00e+000	0.00e+000
13	0.500	0.3563	1.13	35.6	0.000	0.00e+000	2.93e-003	0.00e+000	0.00e+000
14	0.125	0.3513	1.15	35.1	0.000	0.00e+000	1.32e-002	0.00e+000	0.00e+000
15	0.0625	0.3501	1.16	35.0	0.000	0.00e+000	1.85e-002	0.00e+000	0.00e+000

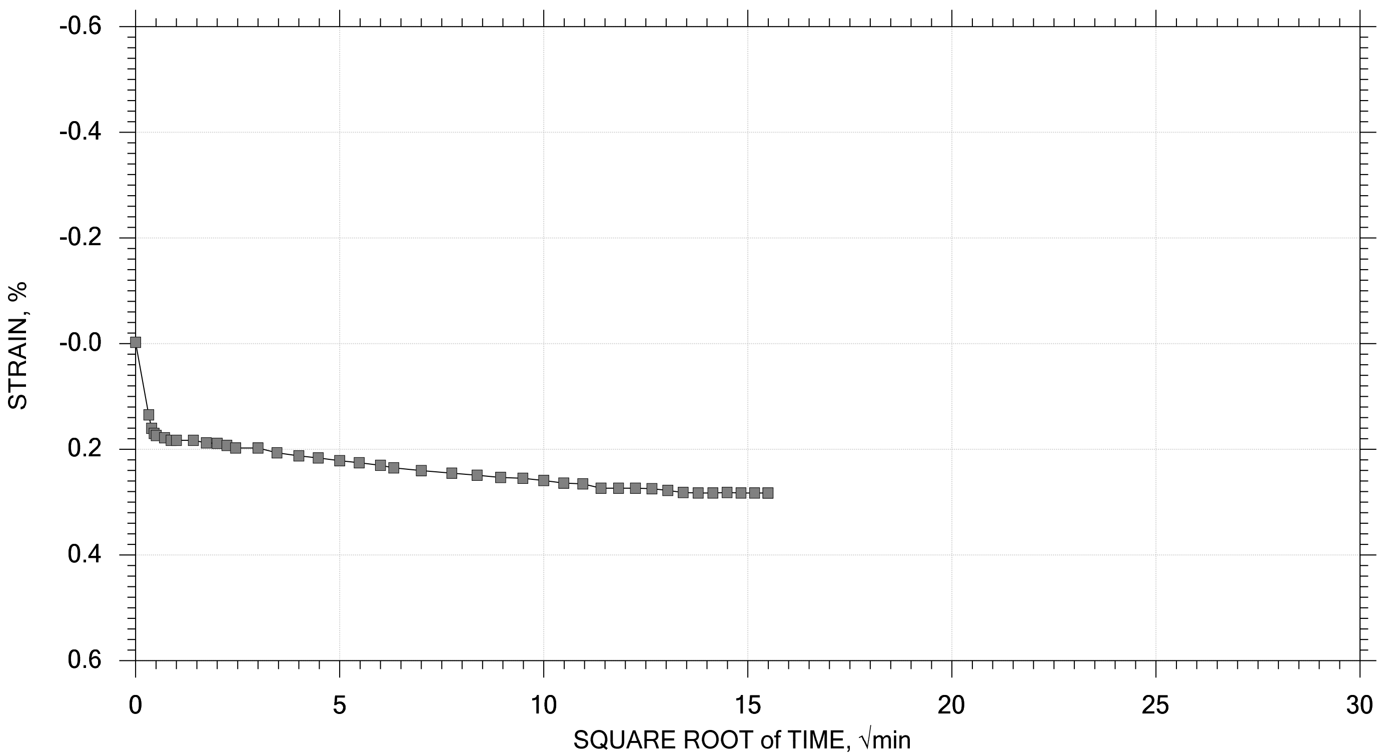
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Volume Step 1 of 15

Stress: 0.069818 tsf





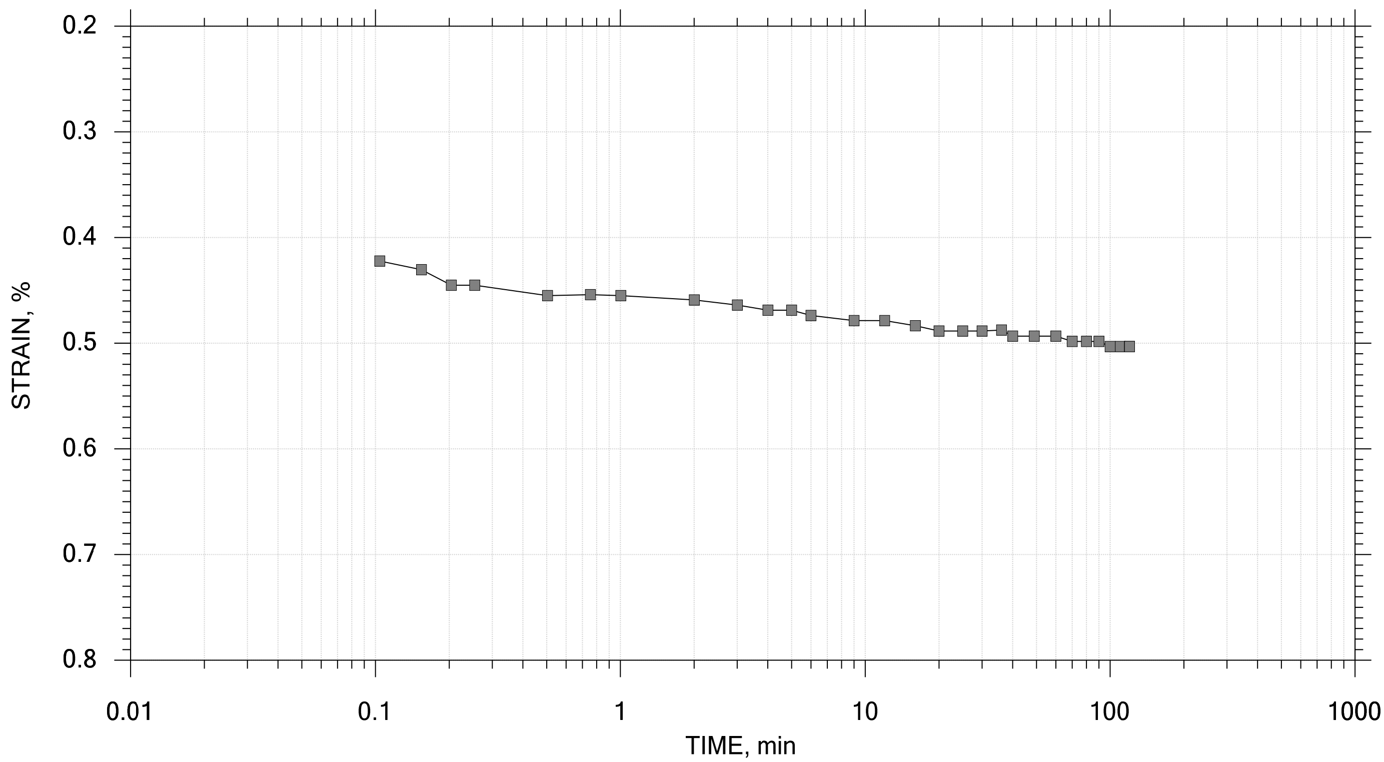
GeoTesting EXPRESS			
	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

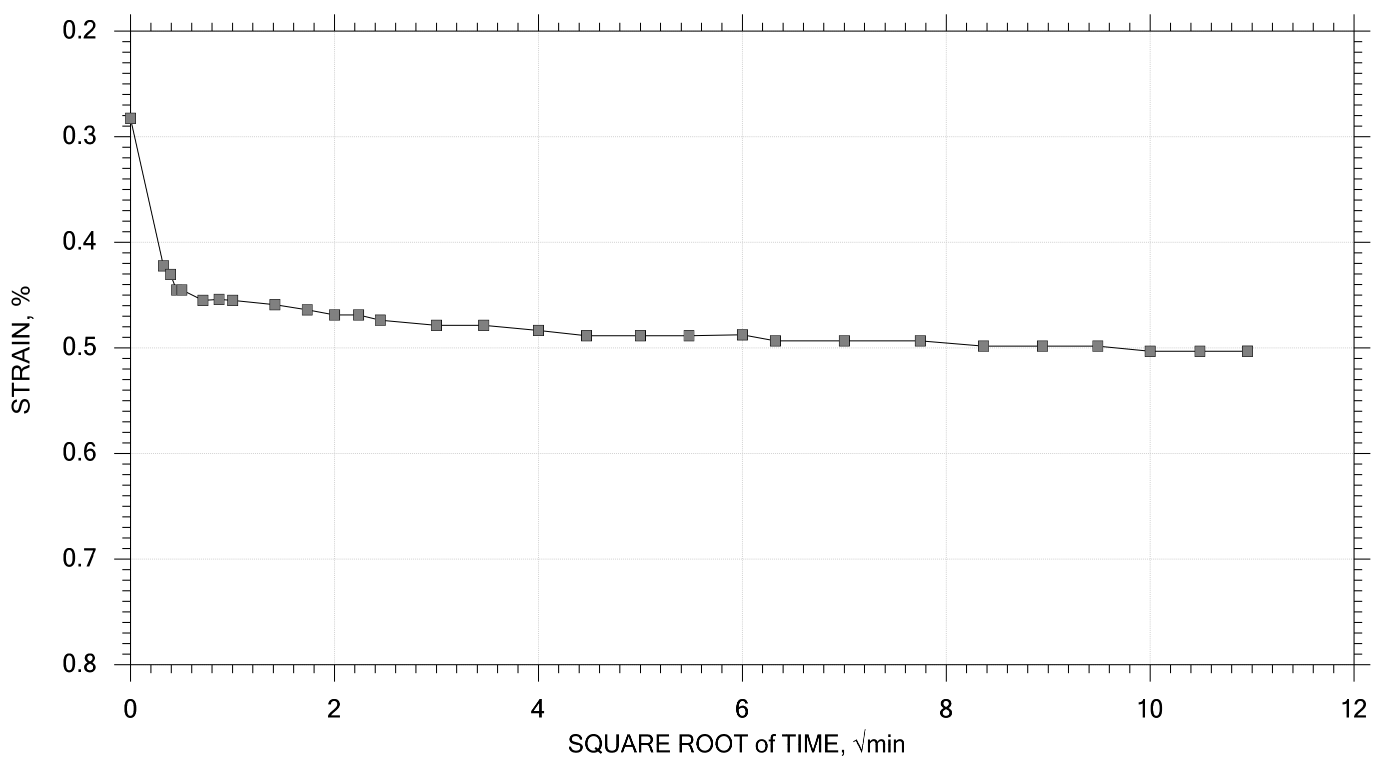
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 2 of 15

Stress: 0.125 tsf





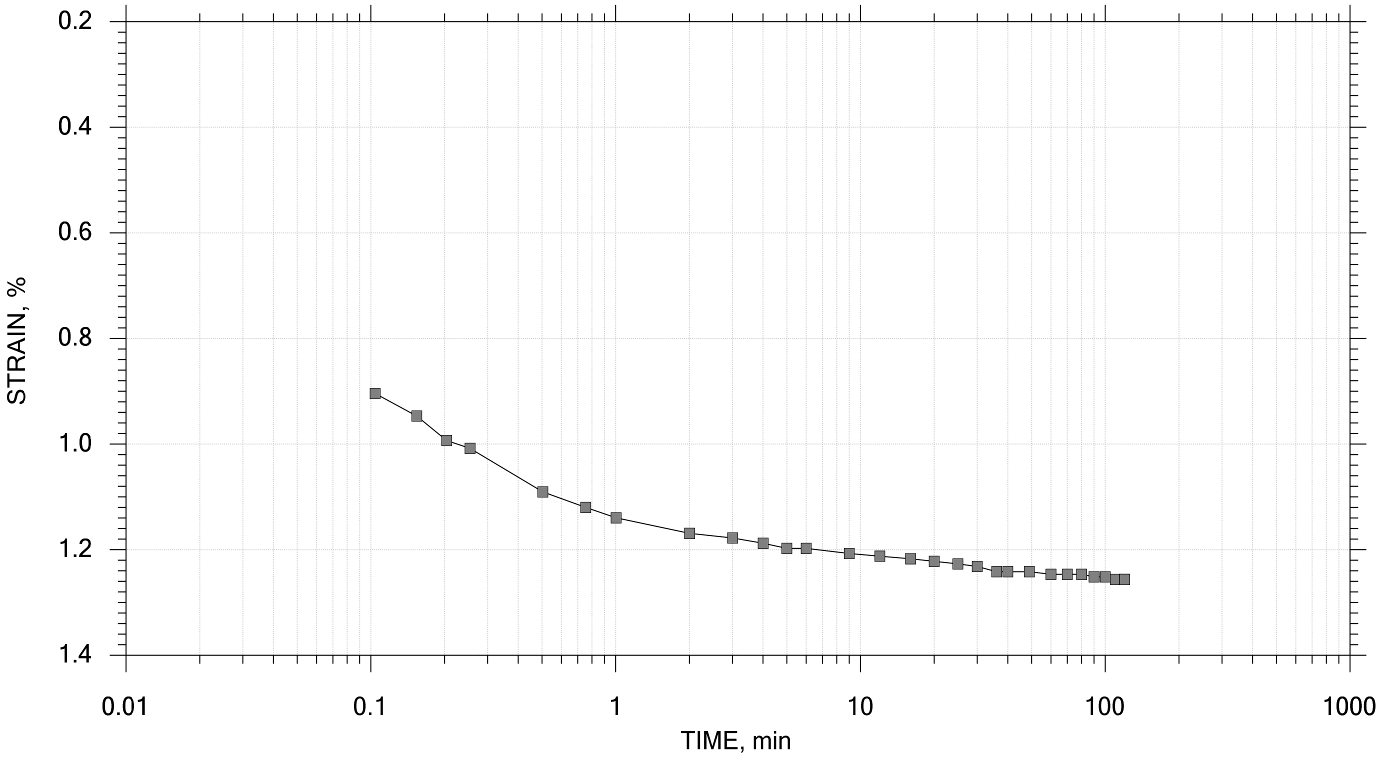
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

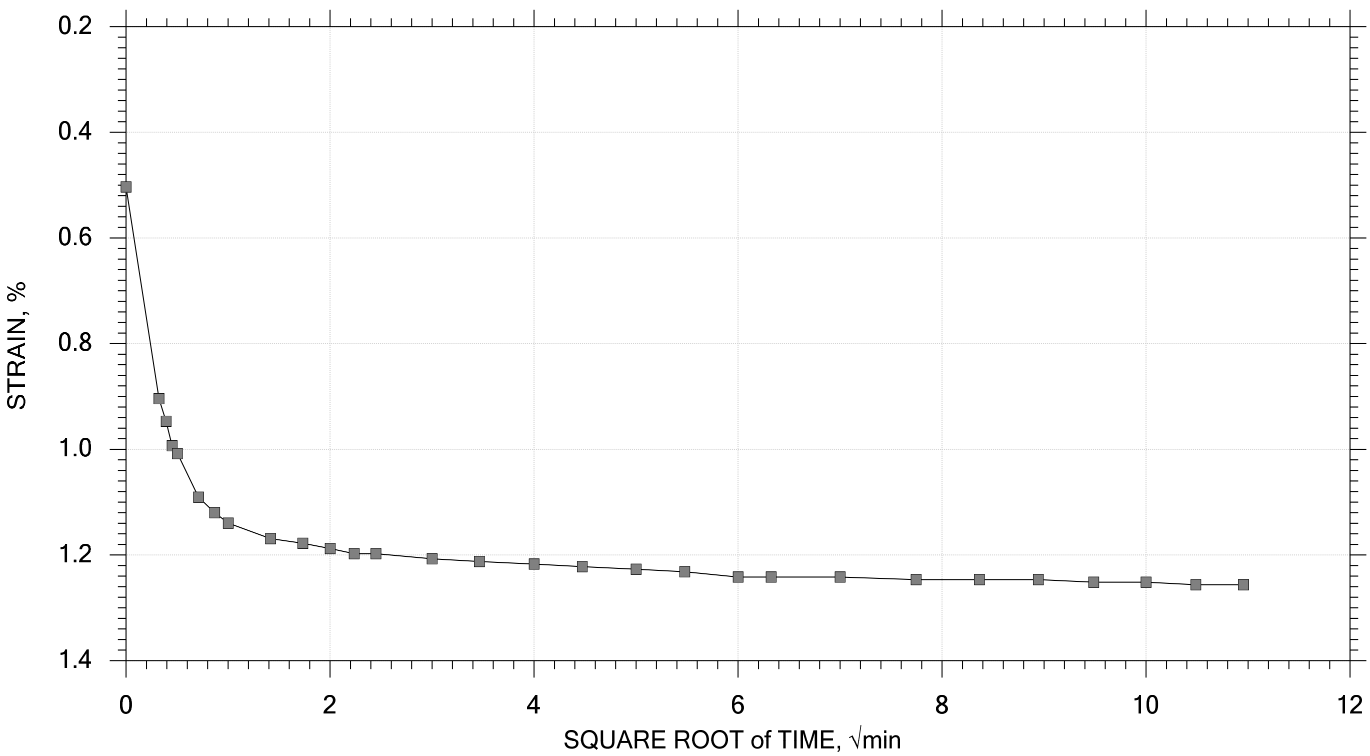
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 3 of 15

Stress: 0.25 tsf





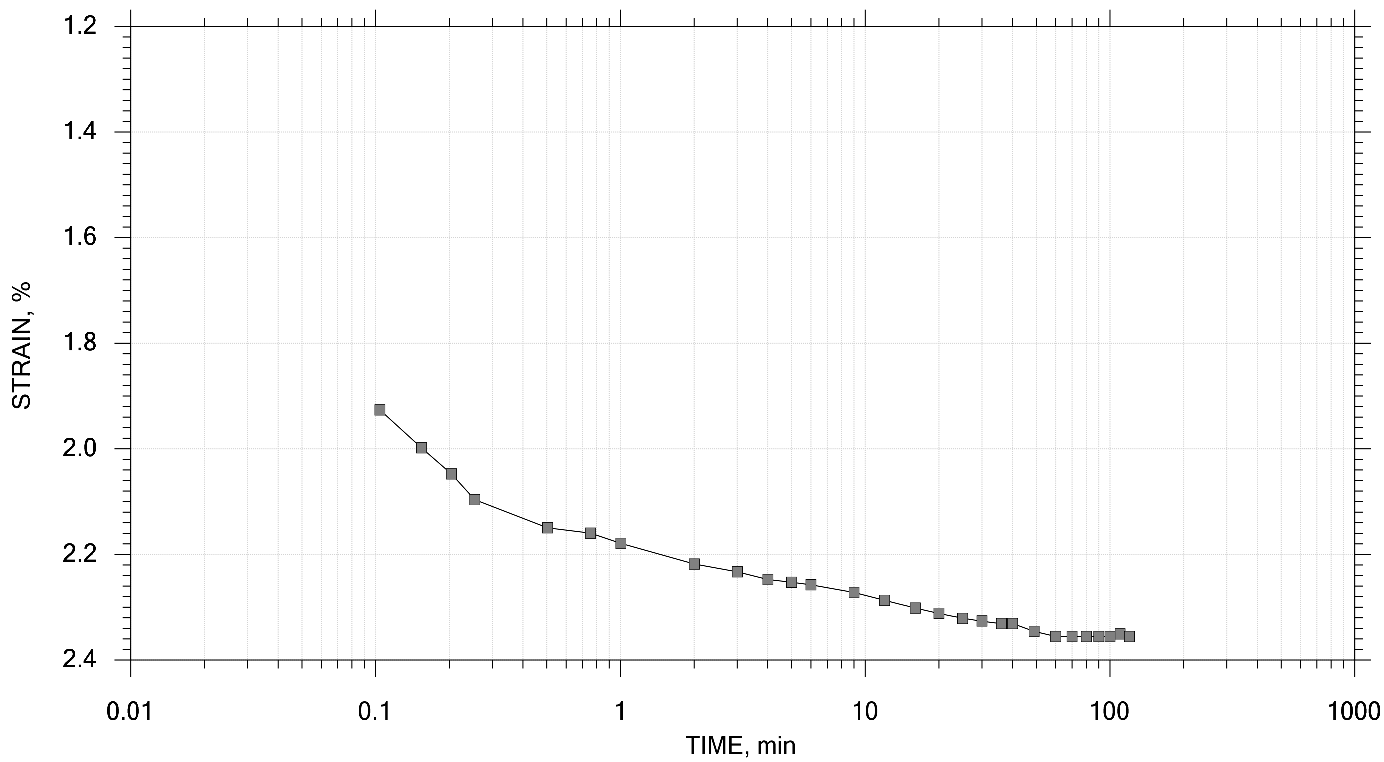
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

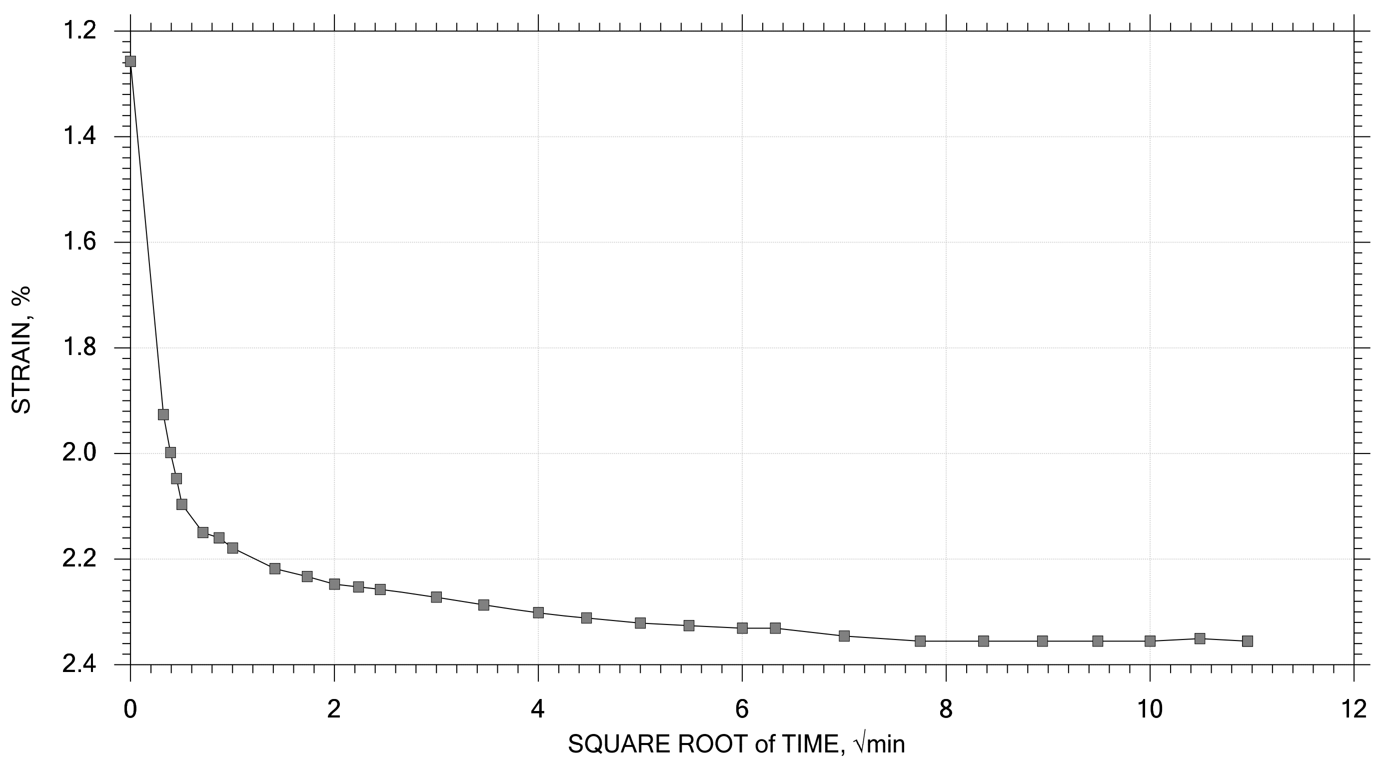
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 4 of 15

Stress: 0.5 tsf





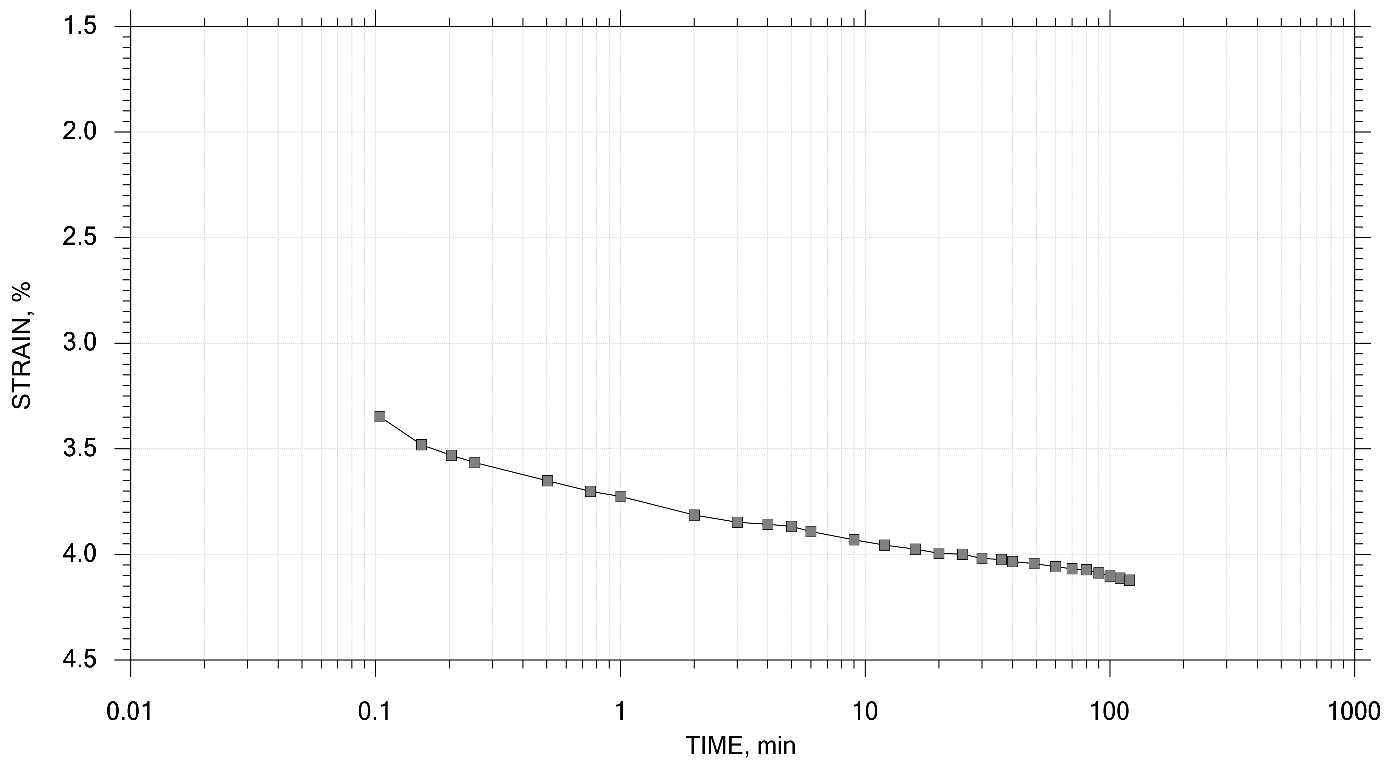
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

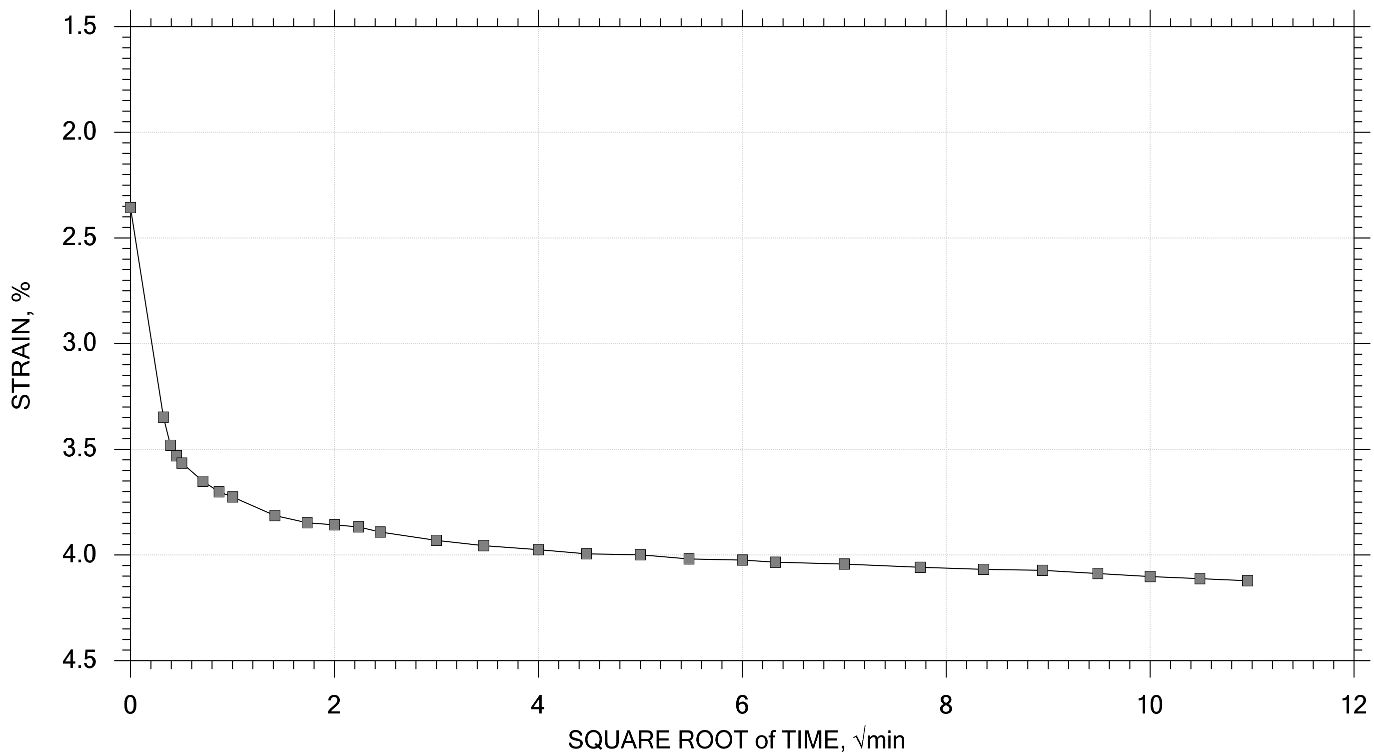
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 15

Stress: 1 tsf





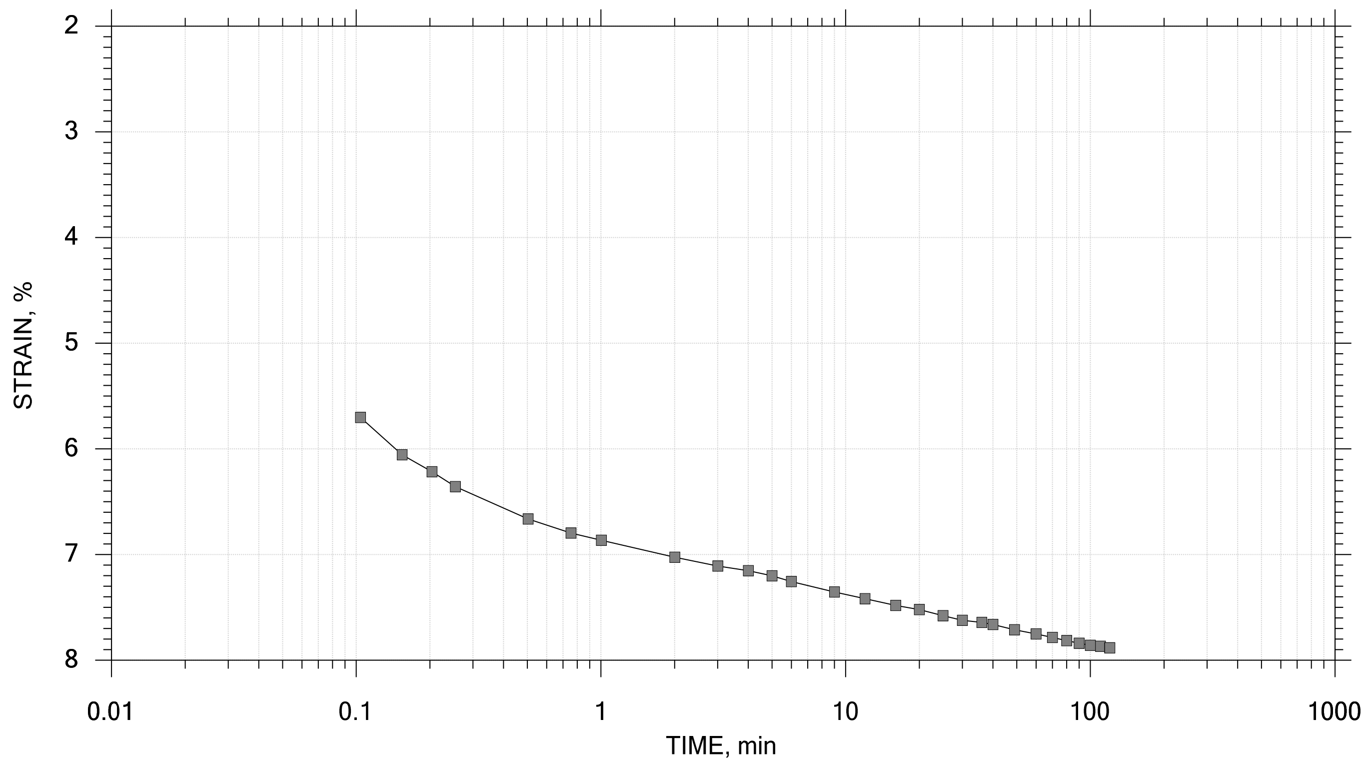
GeoTesting EXPRESS			
	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

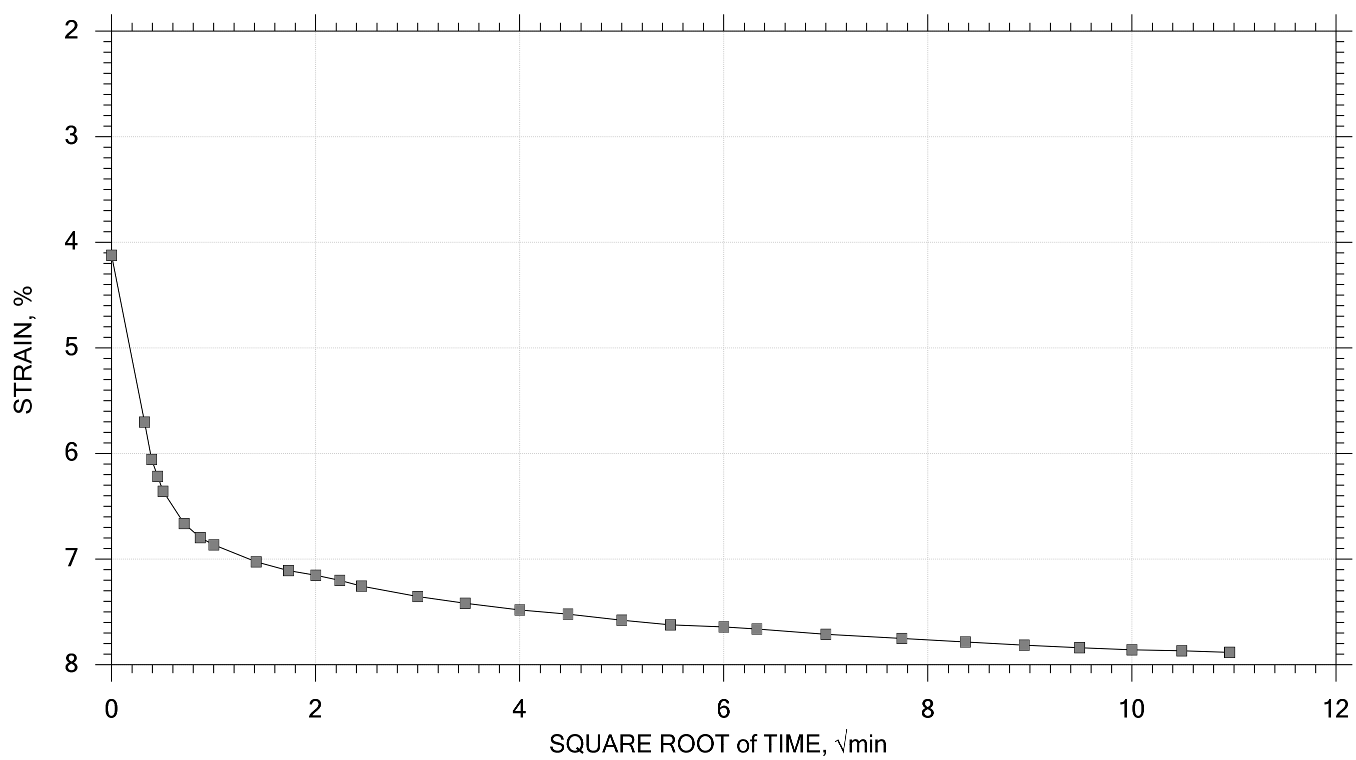
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 6 of 15

Stress: 2 tsf





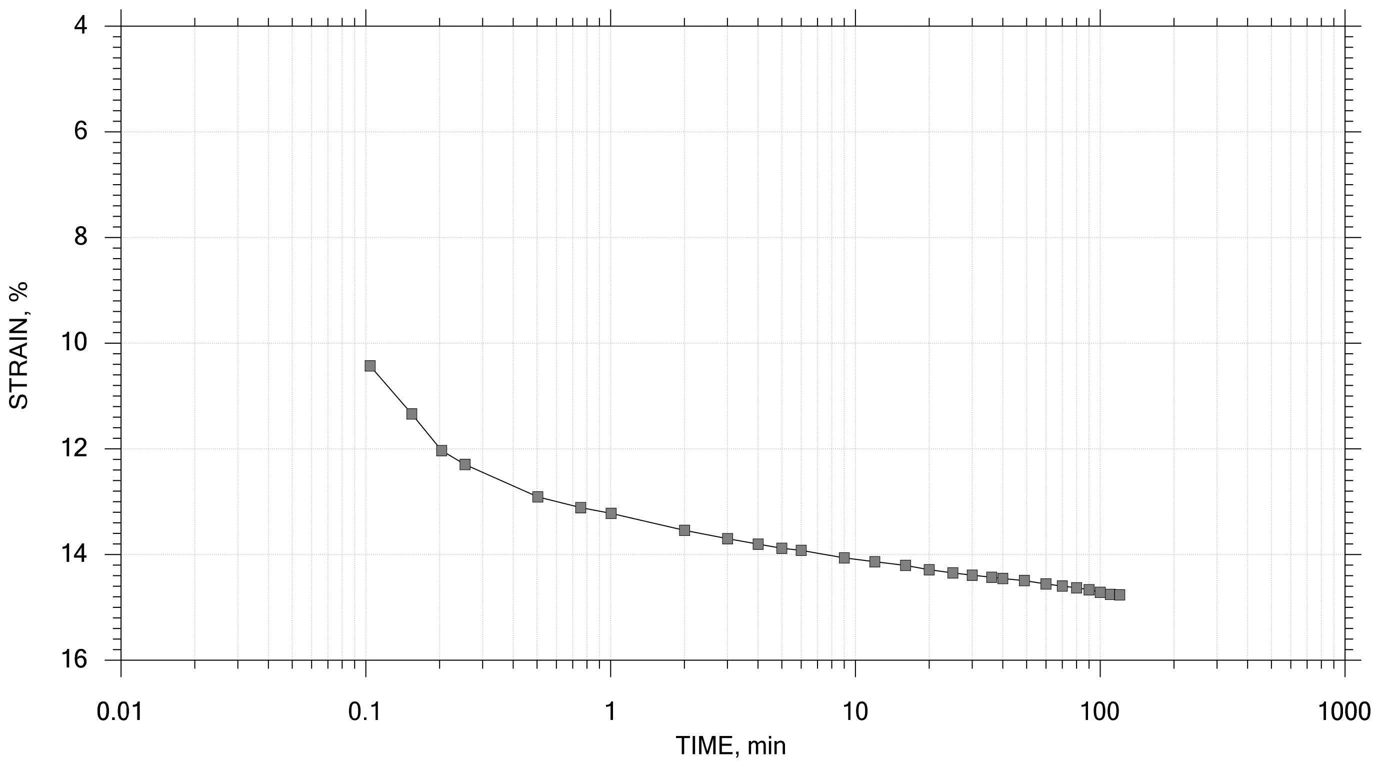
GeoTesting EXPRESS			
	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

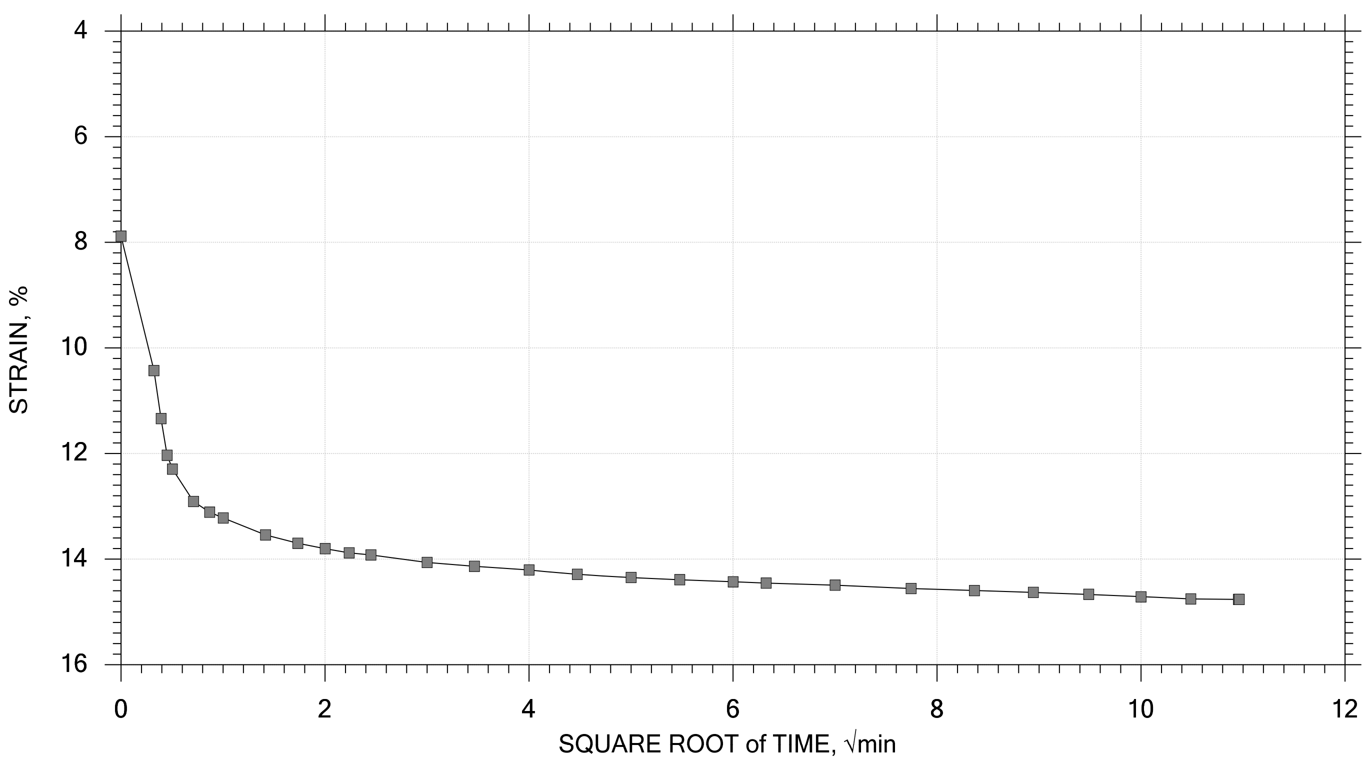
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 15

Stress: 4 tsf





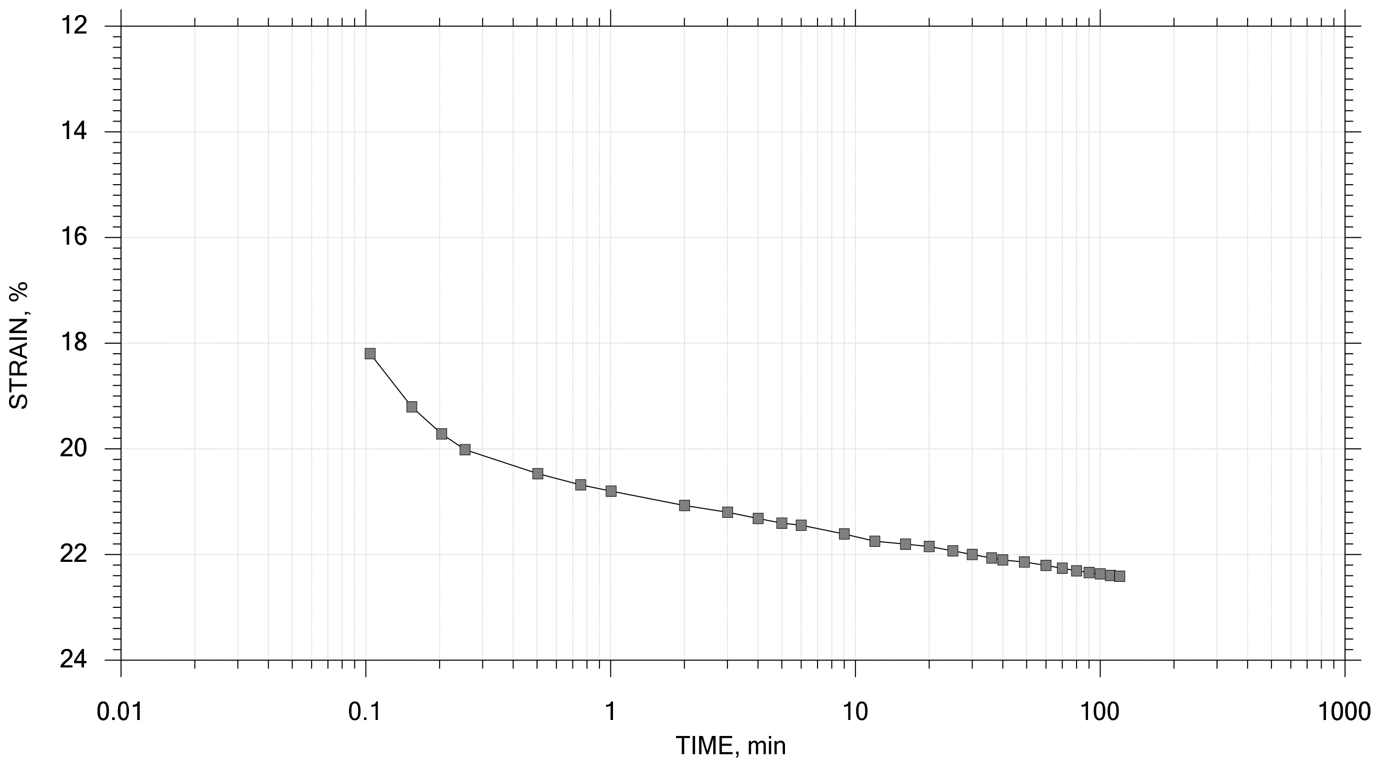
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

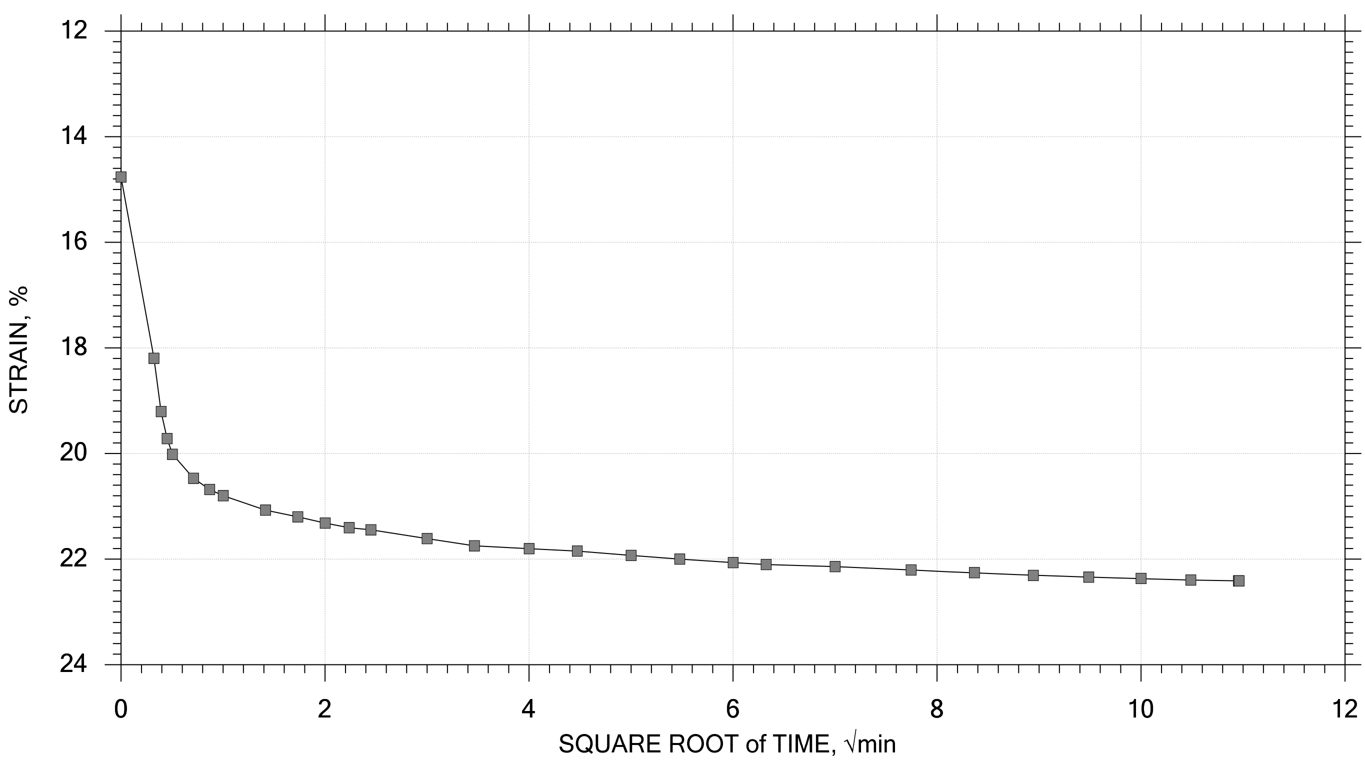
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 15

Stress: 8 tsf





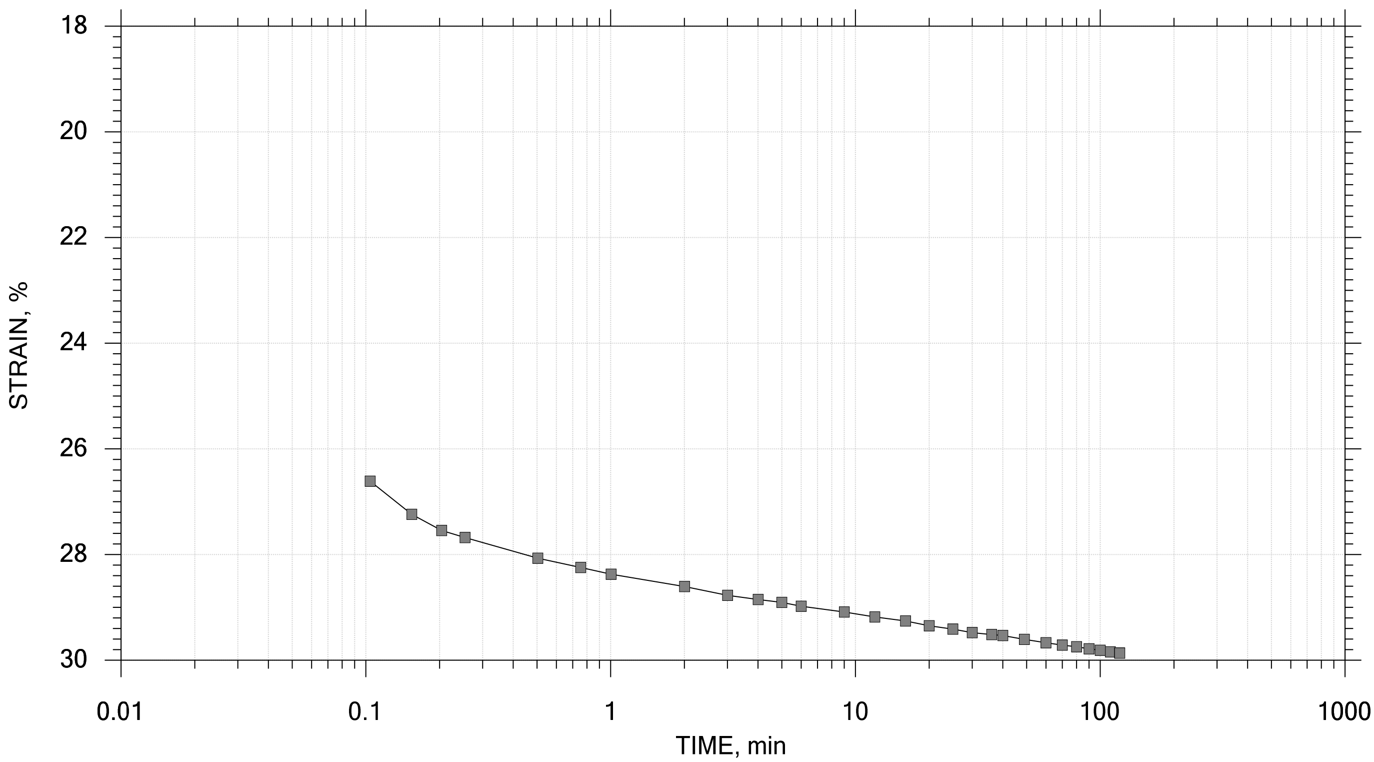
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

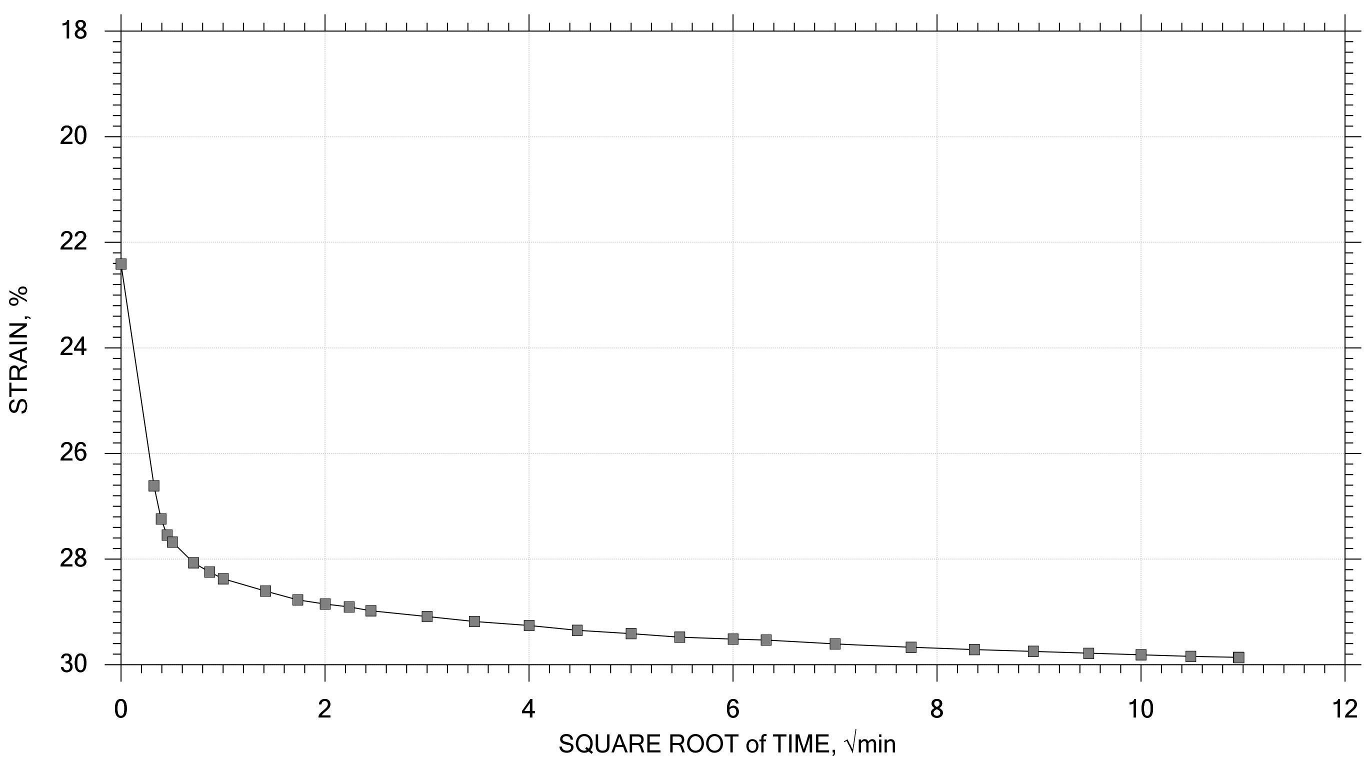
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 9 of 15

Stress: 16 tsf





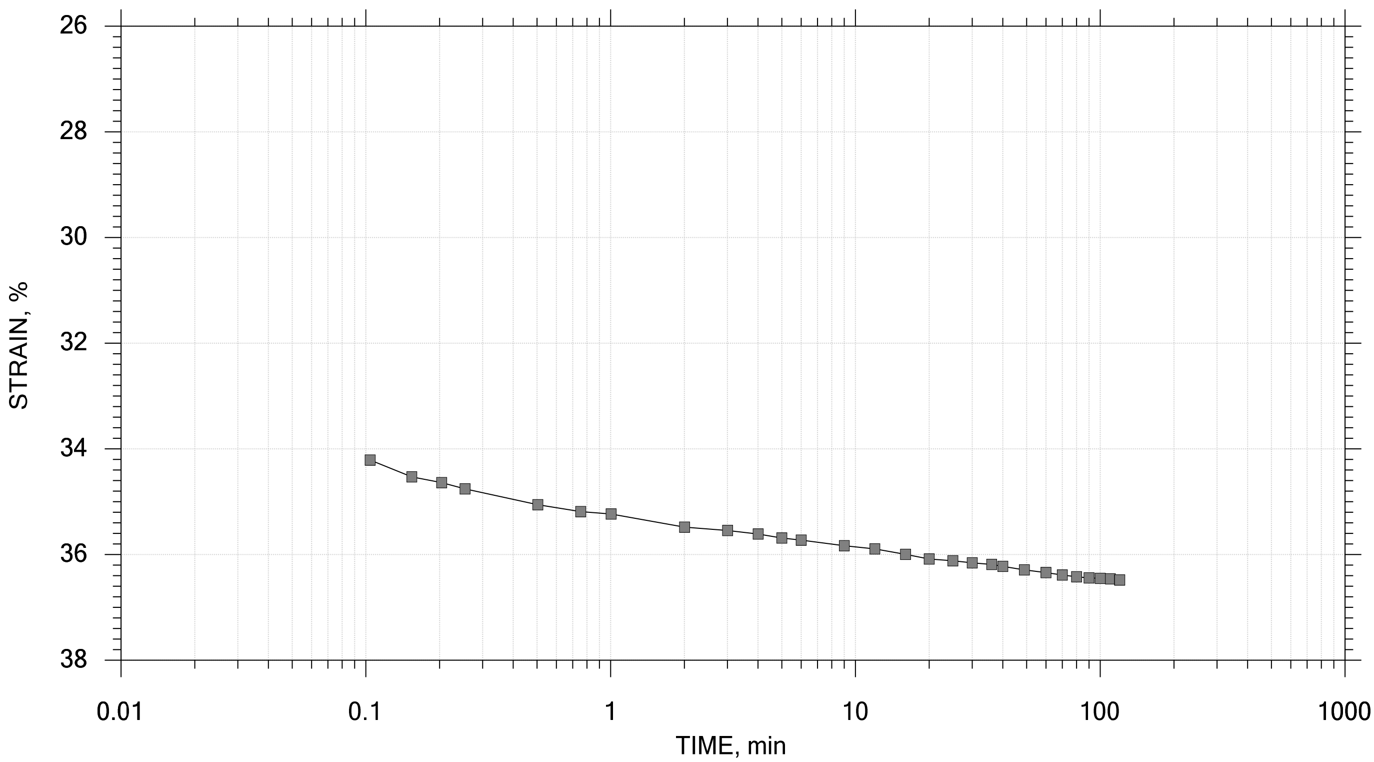
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

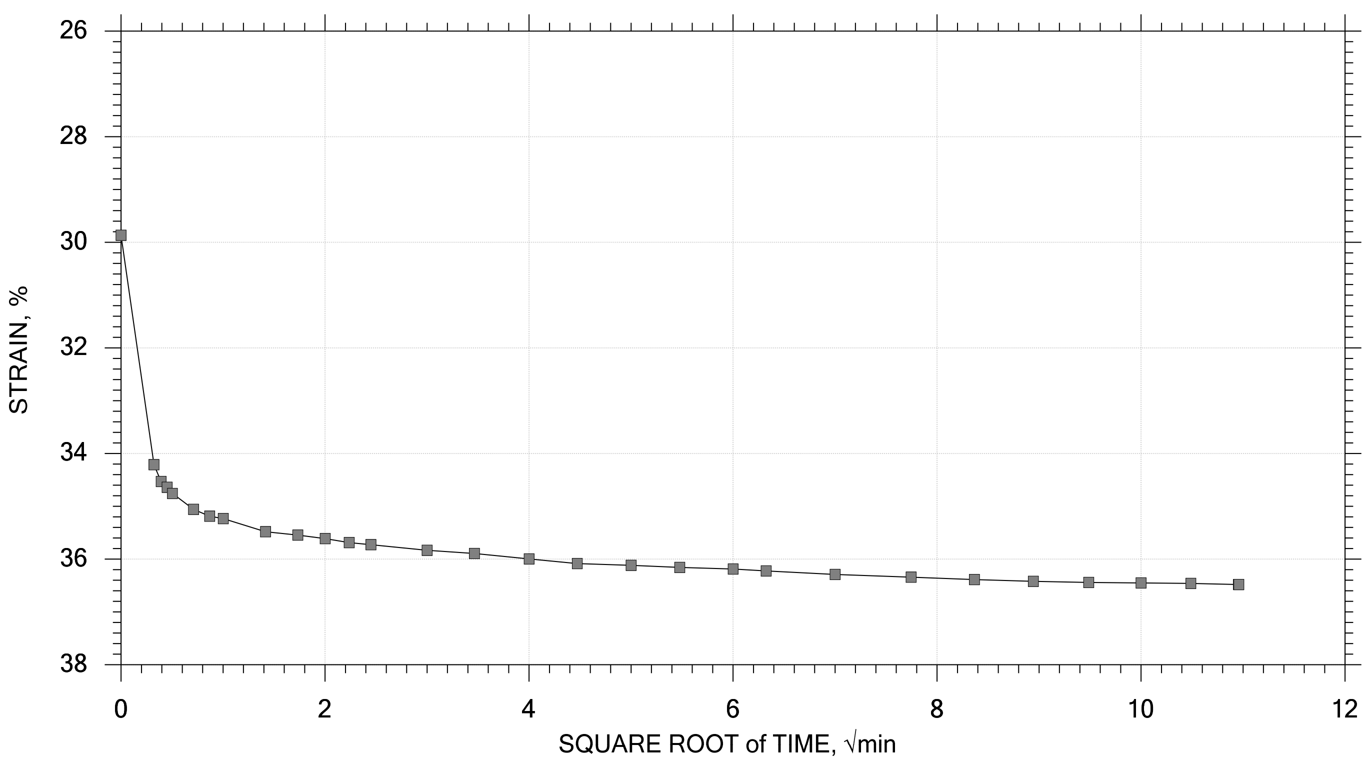
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 10 of 15

Stress: 32 tsf





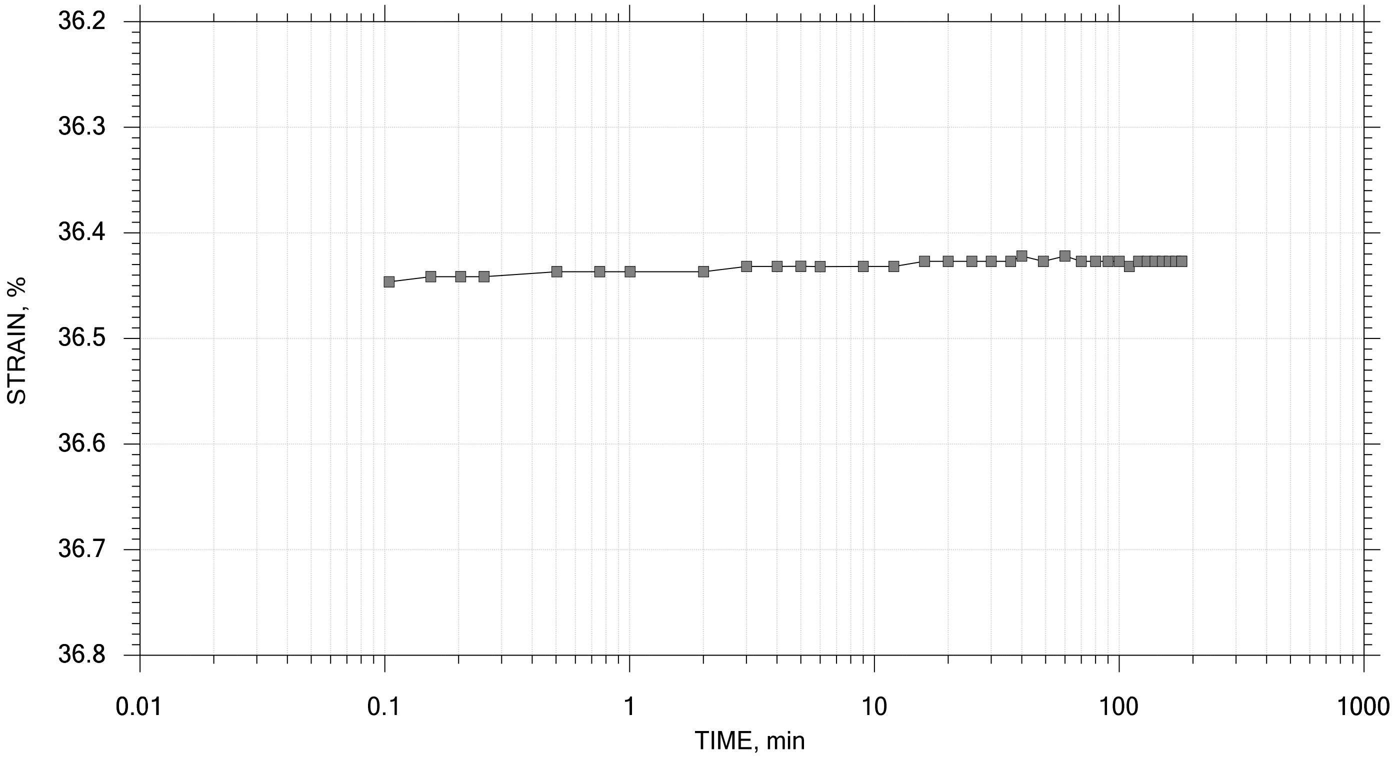
GeoTesting EXPRESS			
	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

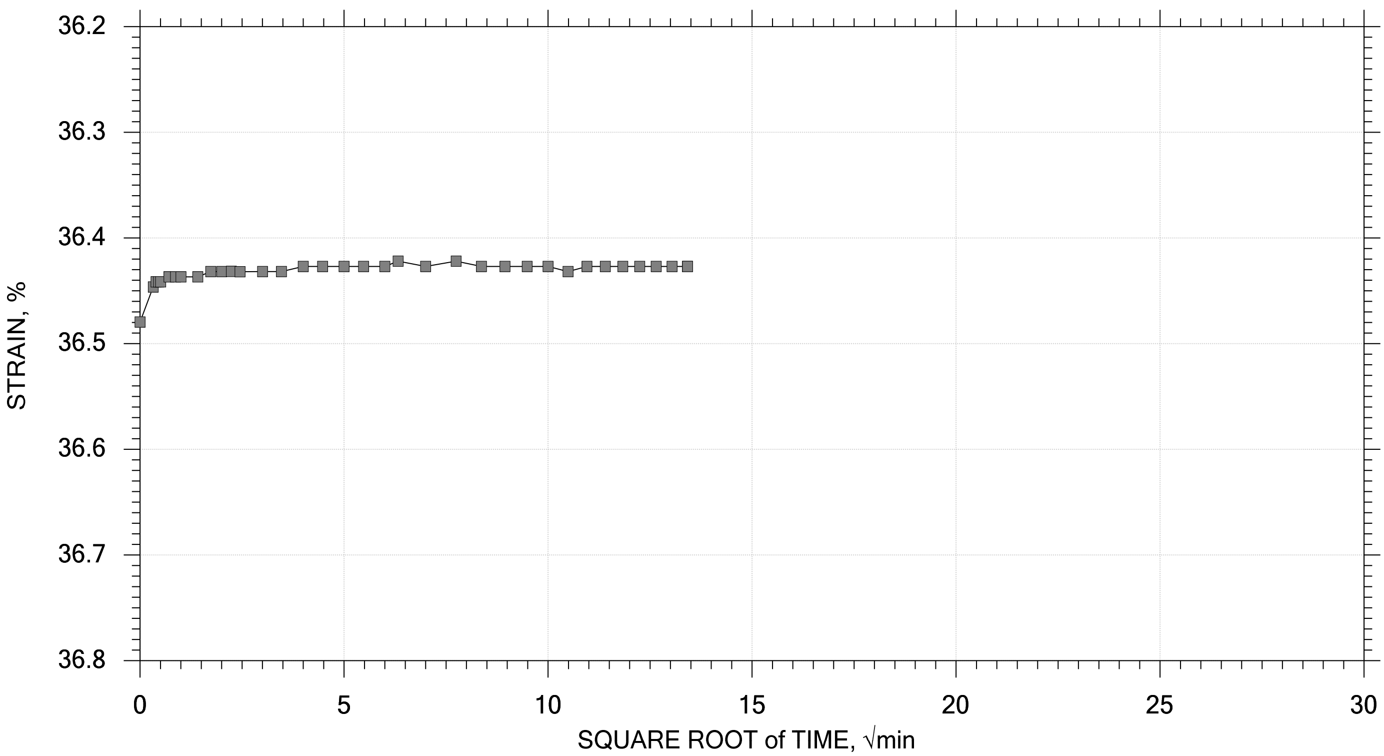
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 11 of 15

Stress: 8 tsf





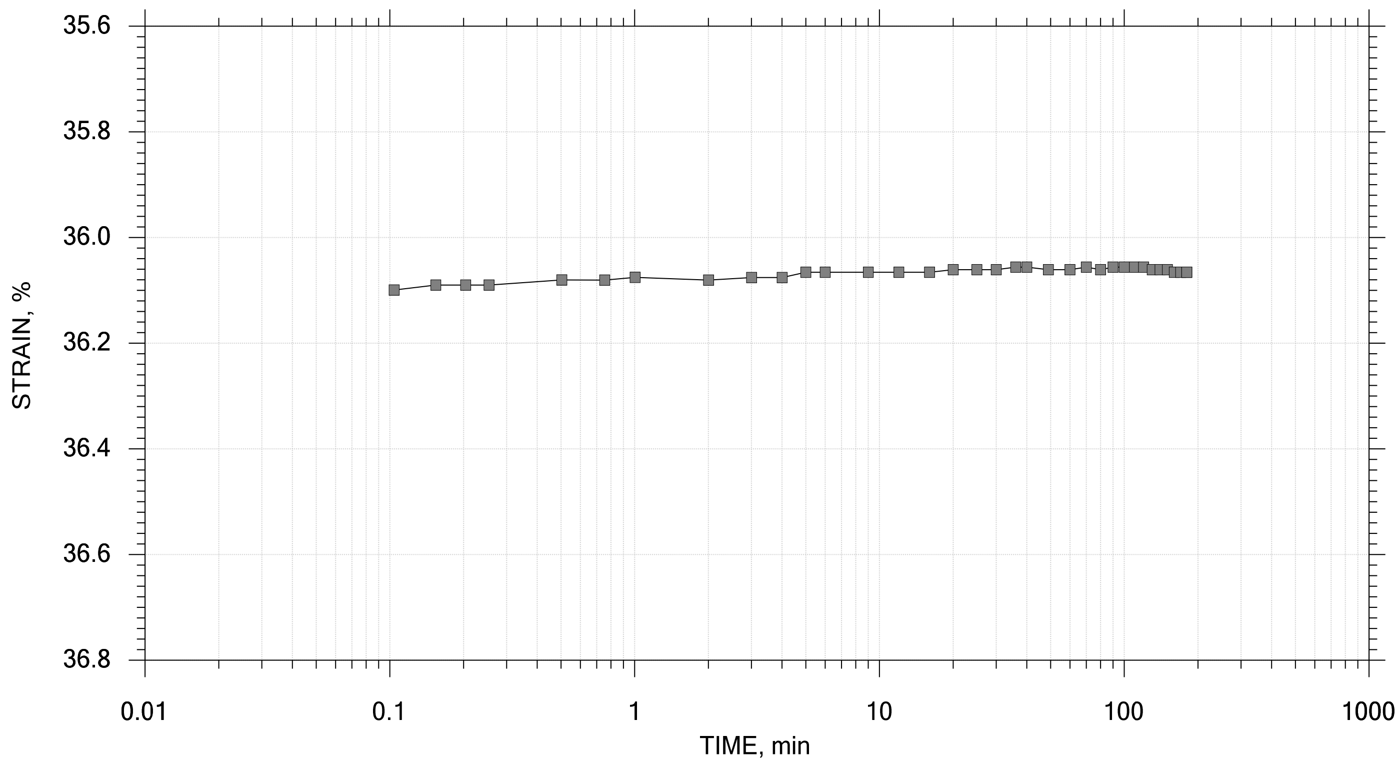
	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
GeoTesting EXPRESS	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

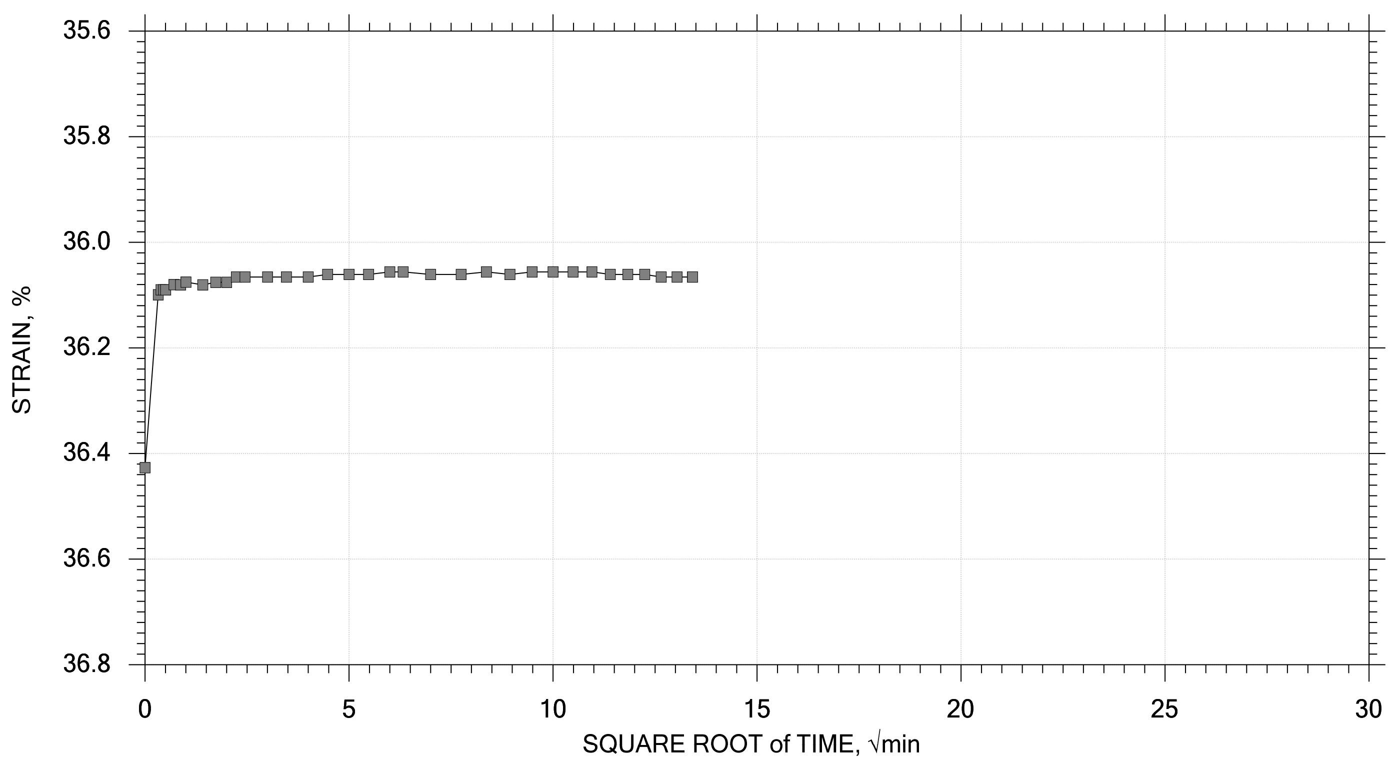
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 12 of 15

Stress: 2 tsf





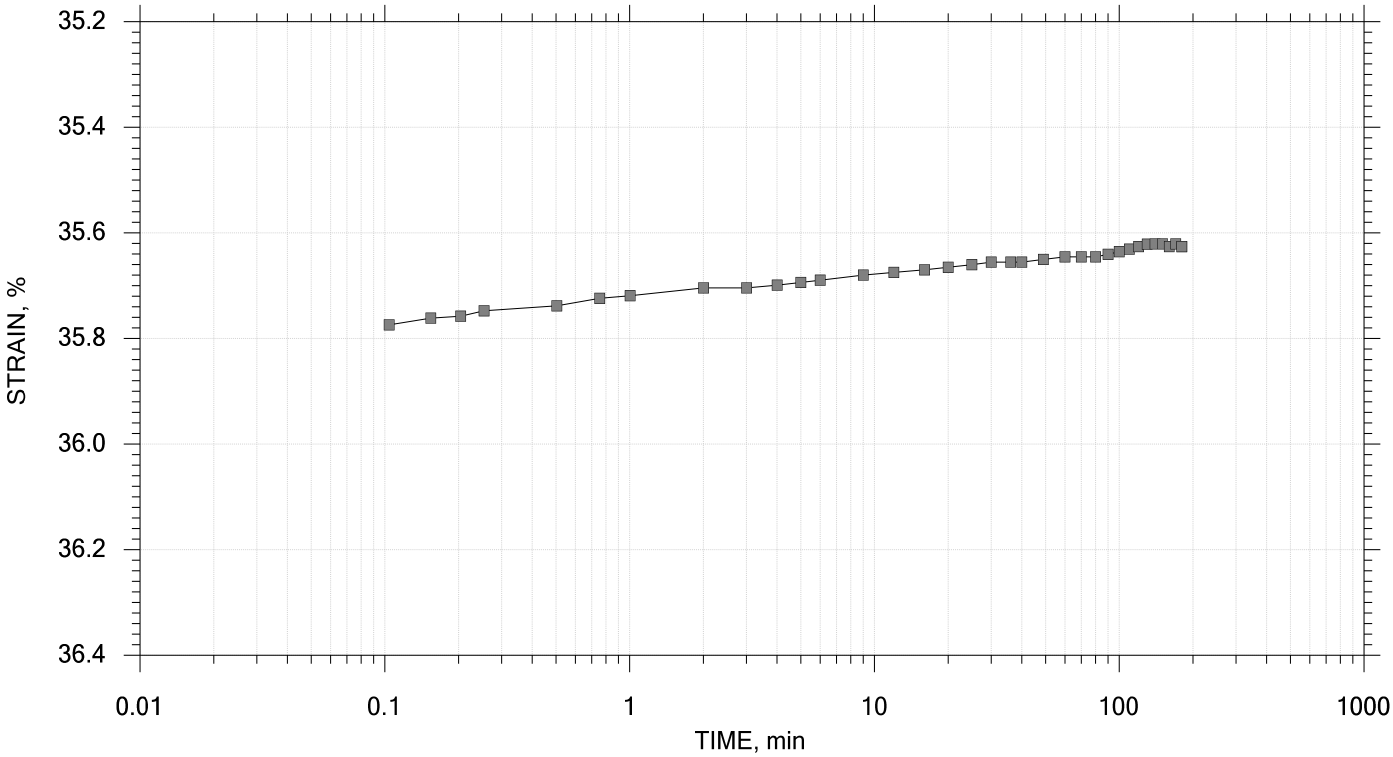
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

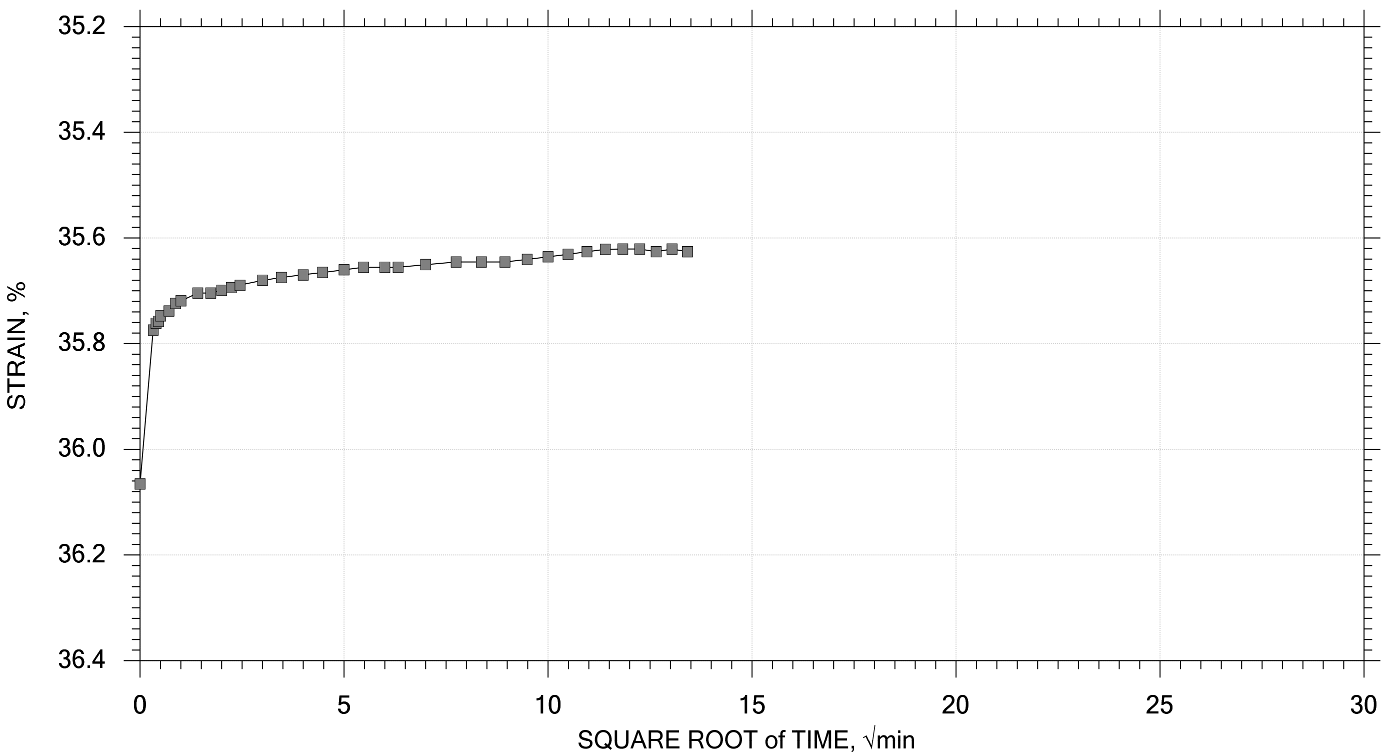
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 13 of 15

Stress: 0.5 tsf





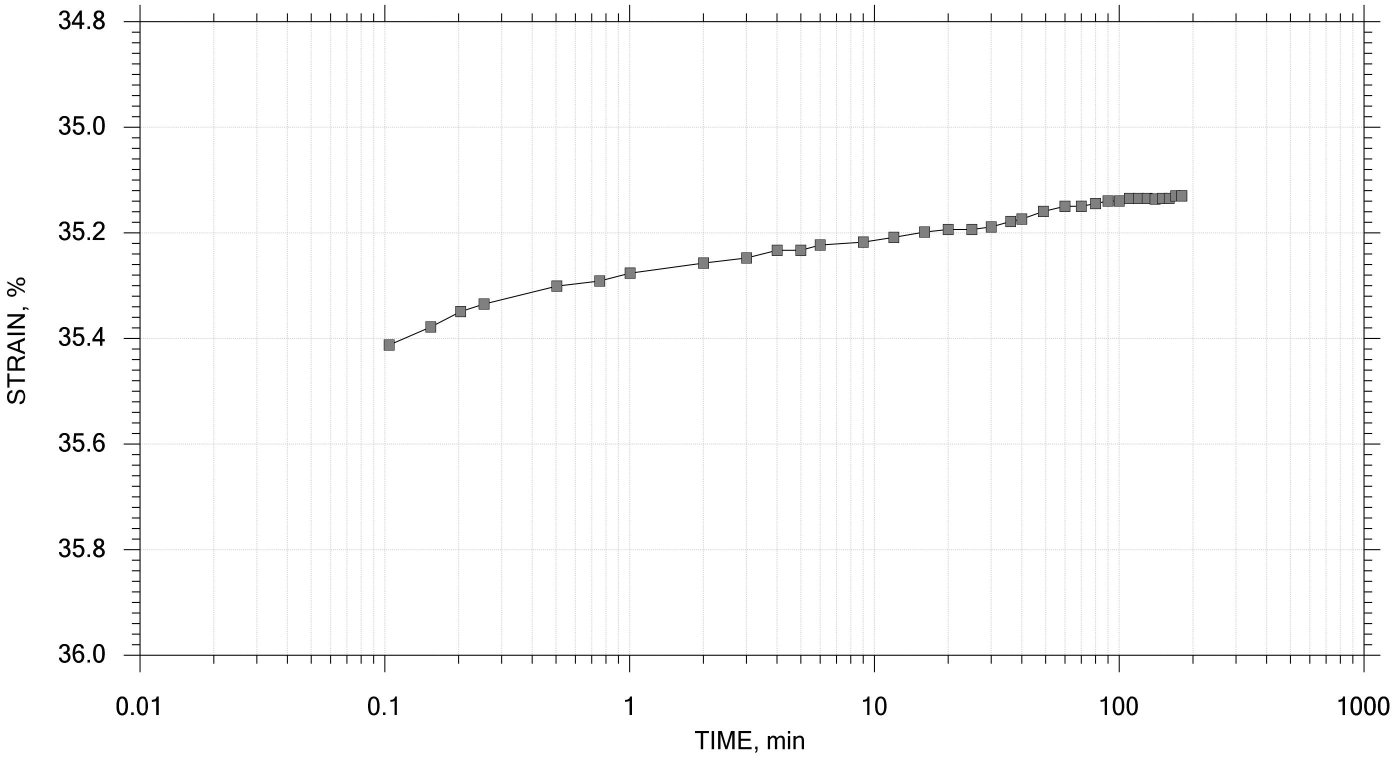
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

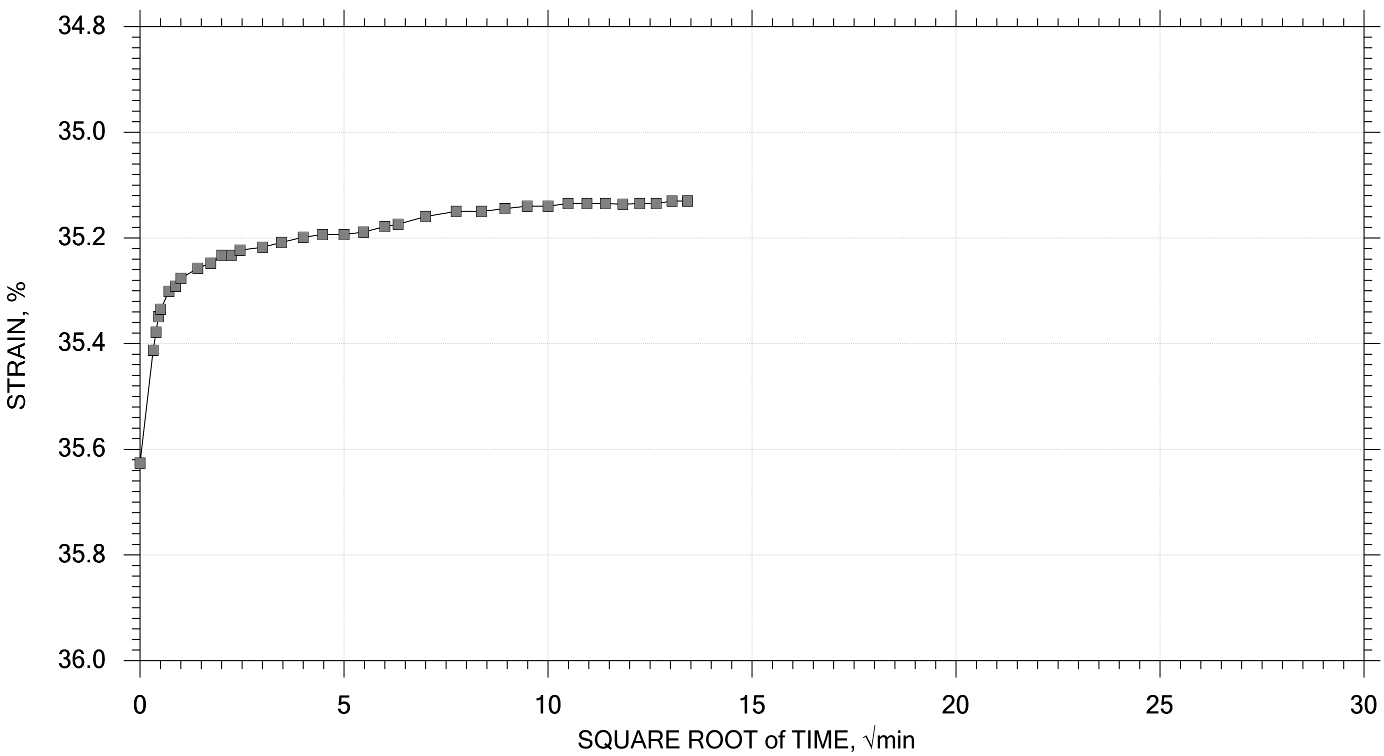
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 14 of 15

Stress: 0.125 tsf





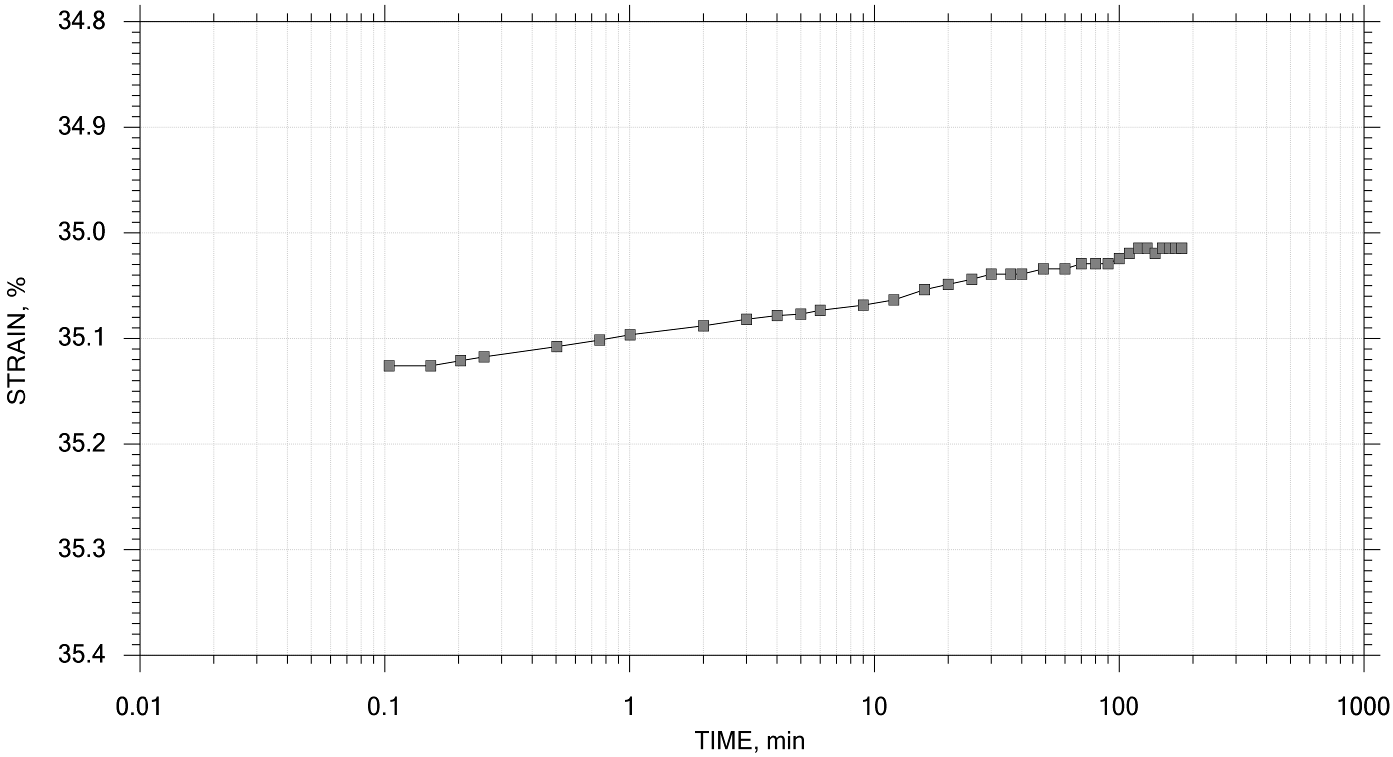
GeoTesting EXPRESS			
	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

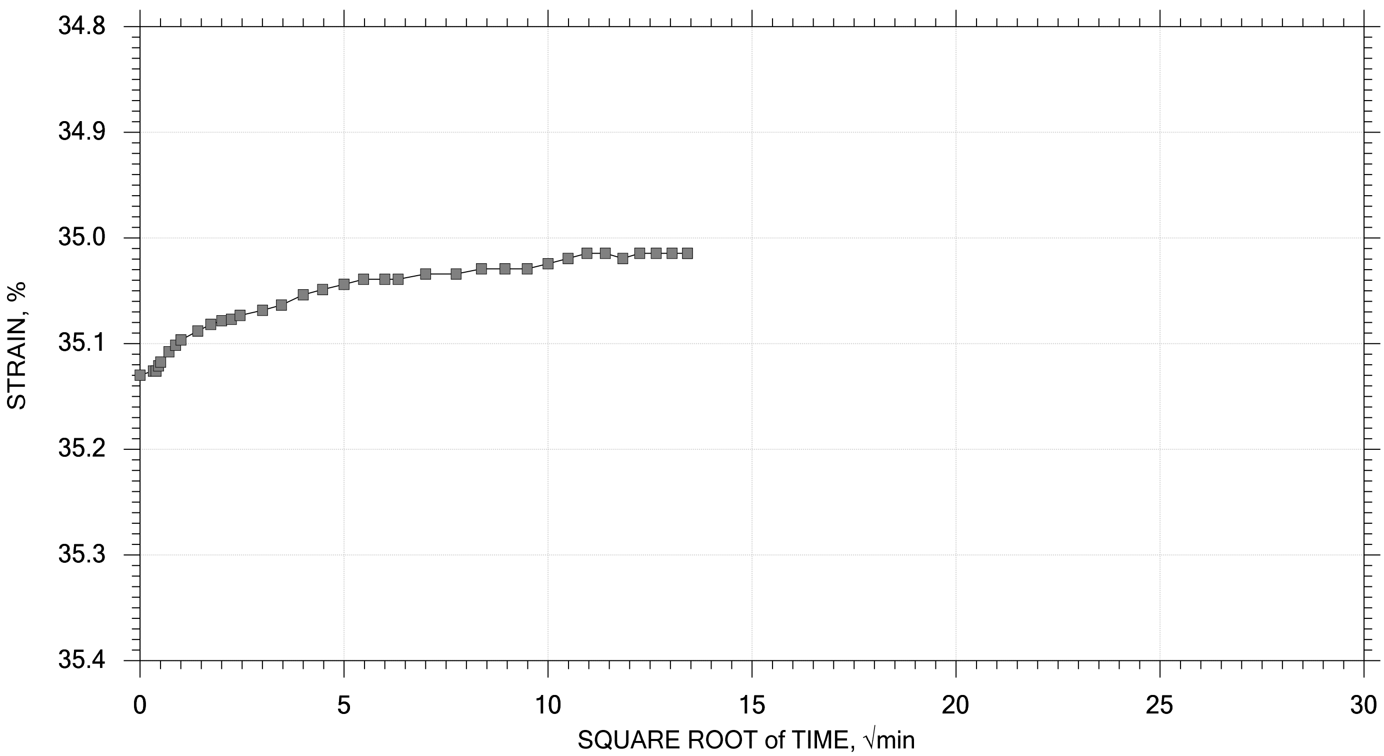
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 15 of 15

Stress: 0.0625 tsf

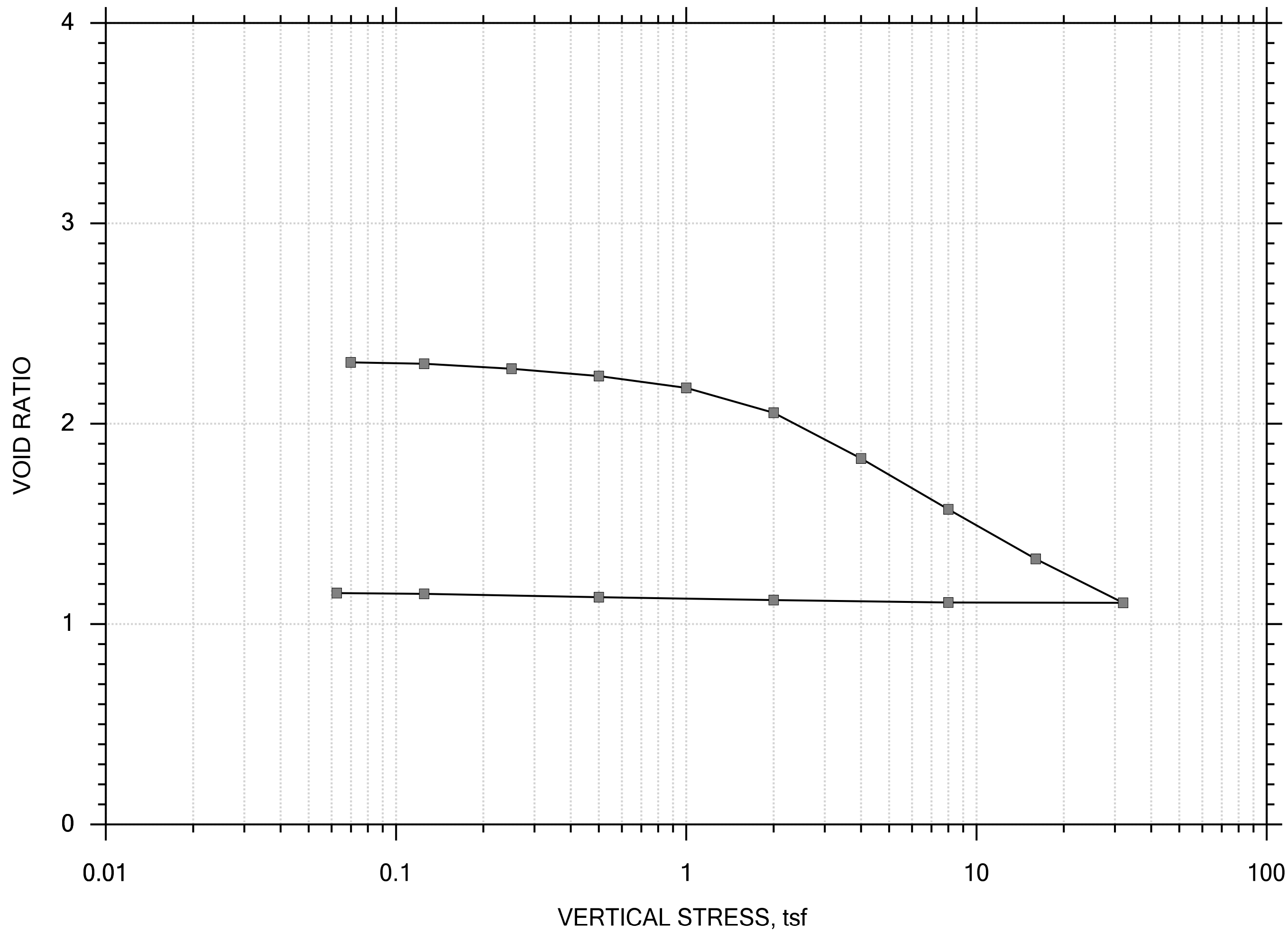


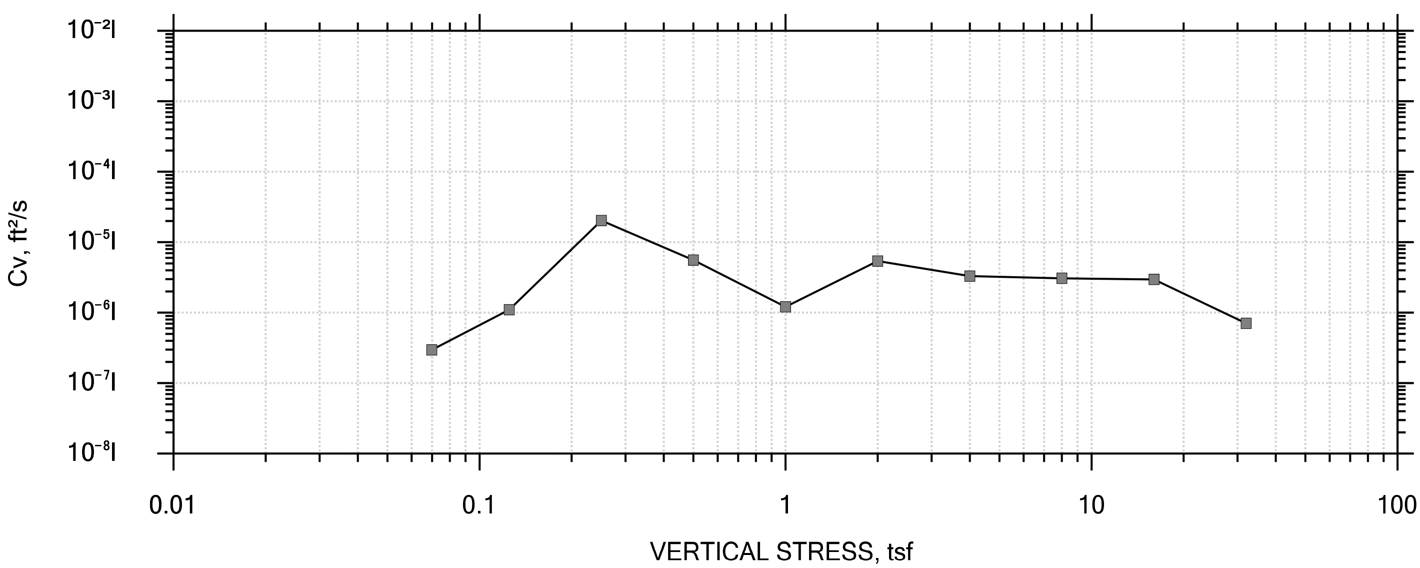


GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

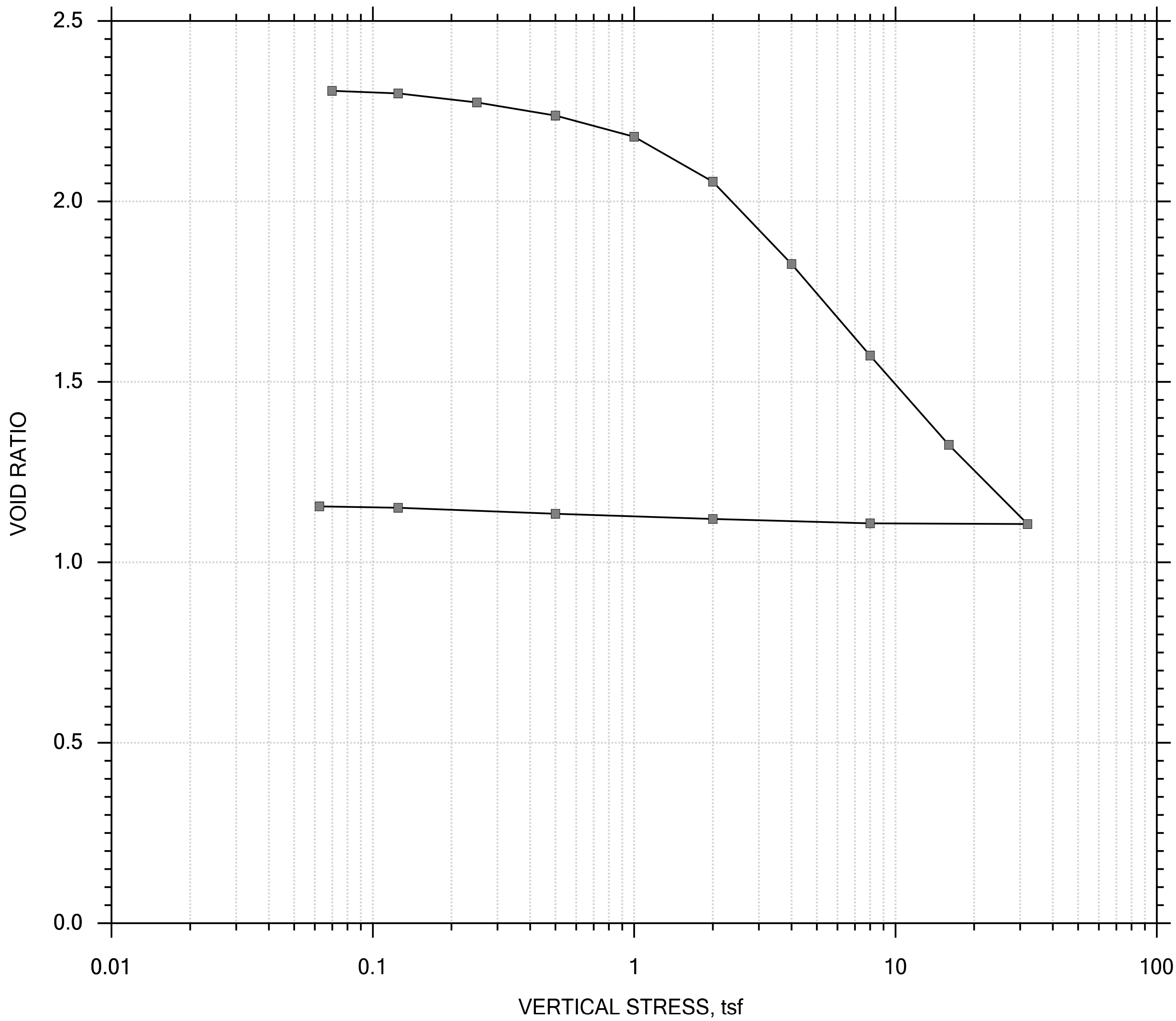




Project: South River	Location: ---	Project No.: GTX-302574
Boring No.: AQSB-01	Tested By: md	Checked By: jdt
Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
Depth: ---	Sample Type: intact	Elevation: ---
Description: Moist, yellowish brown silty sand with gravel		
Remarks: System O, Swell Pressure = 0.0698 tsf		
Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT



					Before Test	After Test
Current Vertical Effective Stress: ---				Water Content, %	79.06	40.81
Preconsolidation Stress: ---				Dry Unit Weight, pcf	51.769	80.889
Compression Ratio: ---				Saturation, %	93.86	100.00
Diameter: 2.5 in		Height: 1 in		Void Ratio	2.32	1.12
LL: NP	PL: NP	PI: NP	GS: 2.75			

GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: South River	Location: ---	Project No.: GTX-302574
Boring No.: AQSB-01	Tested By: md	Checked By: jdt
Sample No.: ST01	Test Date: 12/01/14	Depth: ---
Test No.: IP-1	Sample Type: intact	Elevation: ---

Soil Description: Moist, yellowish brown silty sand with gravel
Remarks: System O, Swell Pressure = 0.0698 tsf

Measured Specific Gravity: 2.75	Liquid Limit: NP	Specimen Diameter: 2.50 in
Initial Void Ratio: 2.32	Plastic Limit: NP	Initial Height: 1.00 in
Final Void Ratio: 1.12	Plasticity Index: NP	Final Height: 0.64 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	14752	RING		15308
Wt. Container + Wet Soil, gm	55.800	228.27	202.76	103.85
Wt. Container + Dry Soil, gm	38.370	175.54	175.54	76.240
Wt. Container, gm	9.1000	108.83	108.83	8.5900
Wt. Dry Soil, gm	29.270	66.705	66.705	67.650
Water Content, %	59.55	79.06	40.81	40.81
Void Ratio	---	2.32	1.12	---
Degree of Saturation, %	---	93.86	100.00	---
Dry Unit Weight, pcf	---	51.769	80.889	---

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: South River
Boring No.: AQSB-01
Sample No.: ST01
Test No.: IP-1

Location: ---
Tested By: md
Test Date: 12/01/14
Sample Type: intact

Project No.: GTX-302574
Checked By: jdt
Depth: ---
Elevation: ---

Soil Description: Moist, yellowish brown silty sand with gravel
Remarks: System O, Swell Pressure = 0.0698 tsf

Displacement at End of Increment

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft²/s	Mv 1/tsf	k ft/day
1	0.0698	0.002842	2.31	0.284	79.906	3.06e-07	4.07e-02	3.36e-05
2	0.125	0.005047	2.30	0.505	19.886	1.22e-06	4.00e-02	1.32e-04
3	0.250	0.01259	2.27	1.26	1.194	2.02e-05	6.03e-02	3.28e-03
4	0.500	0.02358	2.24	2.36	4.588	5.16e-06	4.40e-02	6.11e-04
5	1.00	0.04124	2.18	4.12	18.502	1.24e-06	3.53e-02	1.18e-04
6	2.00	0.07885	2.05	7.88	5.171	4.19e-06	3.76e-02	4.25e-04
7	4.00	0.1477	1.83	14.8	6.016	3.21e-06	3.44e-02	2.98e-04
8	8.00	0.2241	1.57	22.4	5.611	2.90e-06	1.91e-02	1.49e-04
9	16.0	0.2987	1.33	29.9	4.816	2.78e-06	9.32e-03	6.99e-05
10	32.0	0.3648	1.11	36.5	15.318	7.15e-07	4.13e-03	7.97e-06
11	8.00	0.3643	1.11	36.4	35.909	2.76e-07	2.19e-05	1.63e-08
12	2.00	0.3607	1.12	36.1	4.910	2.03e-06	6.02e-04	3.30e-06
13	0.500	0.3563	1.13	35.6	17.233	5.86e-07	2.93e-03	4.63e-06
14	0.125	0.3513	1.15	35.1	17.485	5.86e-07	1.32e-02	2.09e-05
15	0.0625	0.3502	1.15	35.0	23.147	4.47e-07	1.85e-02	2.22e-05

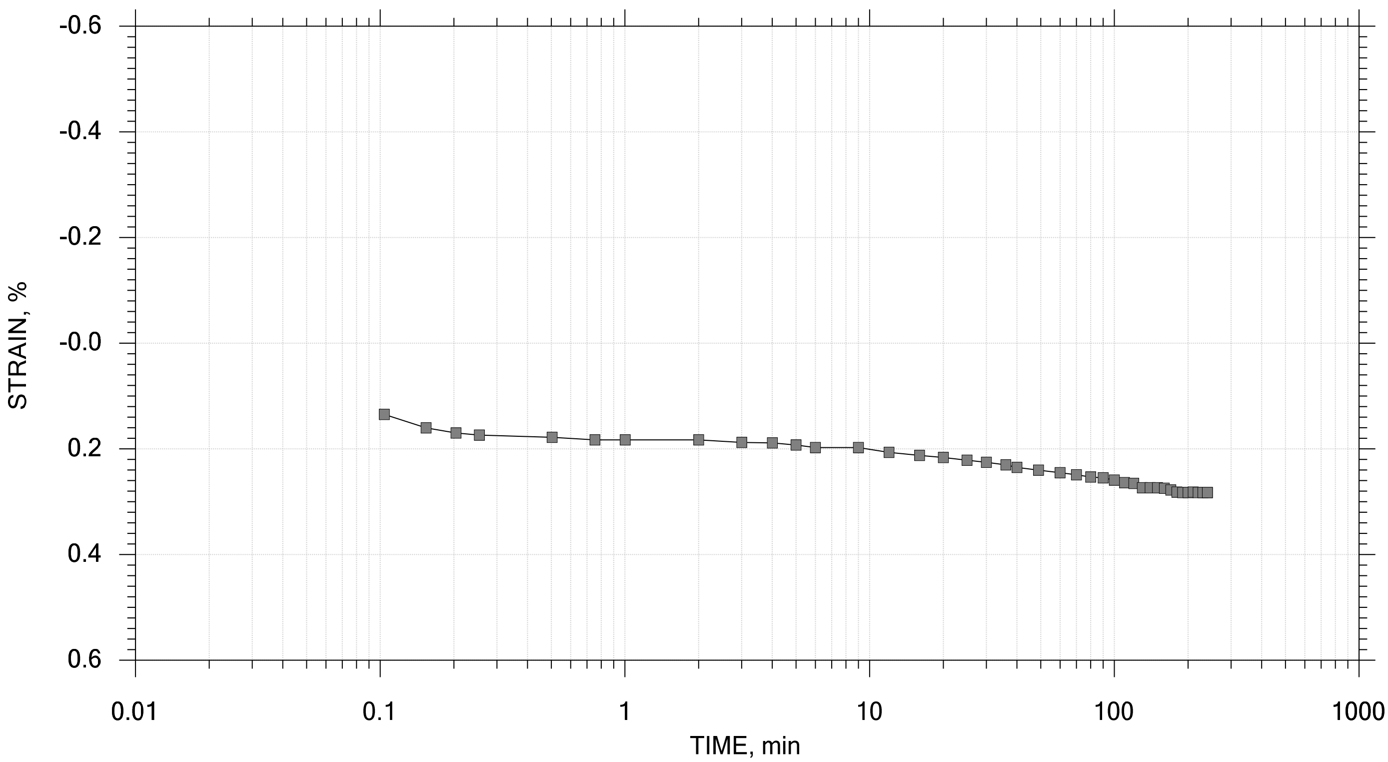
	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/s	Mv 1/tsf	k ft/day	Ca %
1	0.0698	0.002842	2.31	0.284	0.000	0.00e+00	4.07e-02	0.00e+00	0.00e+00
2	0.125	0.005047	2.30	0.505	0.000	0.00e+00	4.00e-02	0.00e+00	0.00e+00
3	0.250	0.01259	2.27	1.26	0.284	1.97e-05	6.03e-02	3.20e-03	0.00e+00
4	0.500	0.02358	2.24	2.36	0.000	0.00e+00	4.40e-02	0.00e+00	0.00e+00
5	1.00	0.04124	2.18	4.12	0.000	0.00e+00	3.53e-02	0.00e+00	0.00e+00
6	2.00	0.07885	2.05	7.88	0.715	7.04e-06	3.76e-02	7.14e-04	0.00e+00
7	4.00	0.1477	1.83	14.8	0.000	0.00e+00	3.44e-02	0.00e+00	0.00e+00
8	8.00	0.2241	1.57	22.4	0.000	0.00e+00	1.91e-02	0.00e+00	0.00e+00
9	16.0	0.2987	1.33	29.9	0.000	0.00e+00	9.32e-03	0.00e+00	0.00e+00
10	32.0	0.3648	1.11	36.5	0.000	0.00e+00	4.13e-03	0.00e+00	0.00e+00
11	8.00	0.3643	1.11	36.4	0.000	0.00e+00	2.19e-05	0.00e+00	0.00e+00
12	2.00	0.3607	1.12	36.1	0.000	0.00e+00	6.02e-04	0.00e+00	0.00e+00
13	0.500	0.3563	1.13	35.6	0.000	0.00e+00	2.93e-03	0.00e+00	0.00e+00
14	0.125	0.3513	1.15	35.1	0.000	0.00e+00	1.32e-02	0.00e+00	0.00e+00
15	0.0625	0.3502	1.15	35.0	0.000	0.00e+00	1.85e-02	0.00e+00	0.00e+00

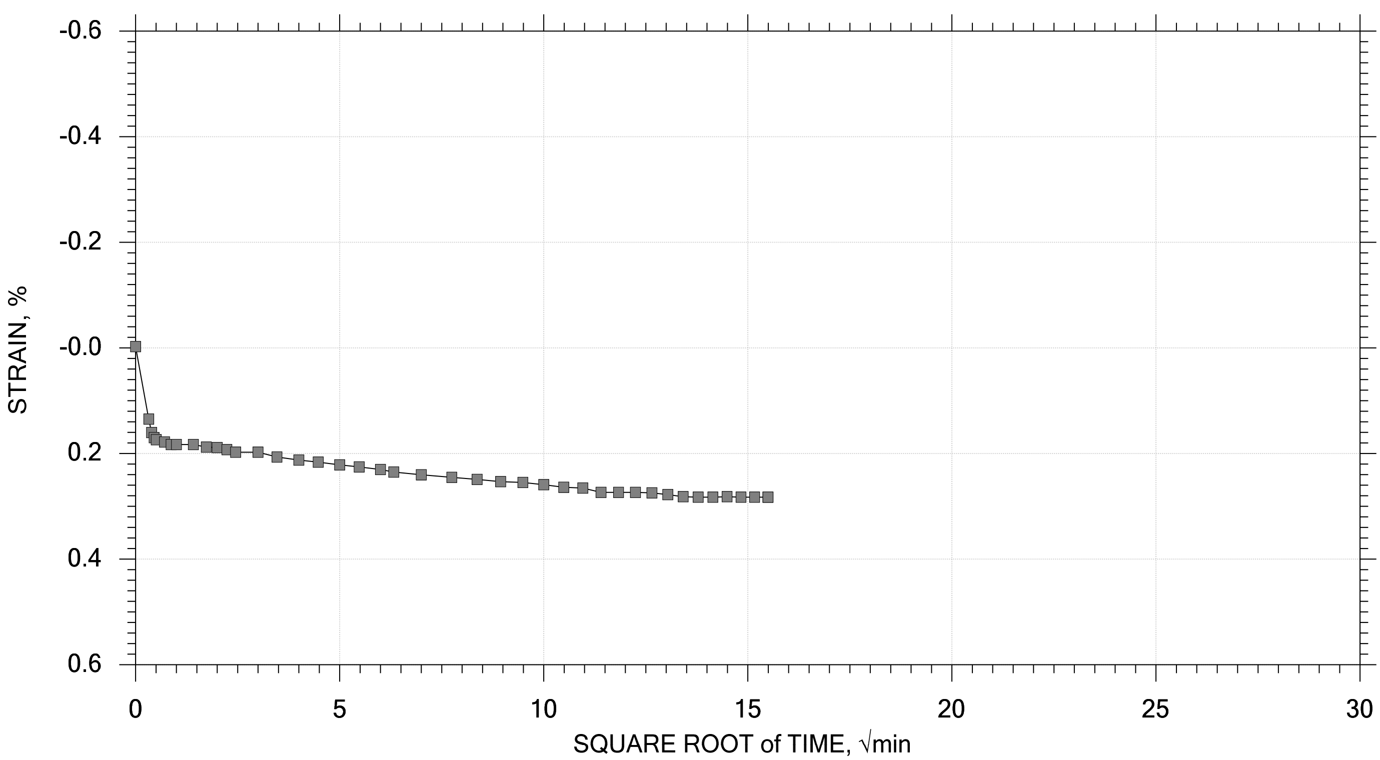
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Volume Step 1 of 15

Stress: 0.069818 tsf

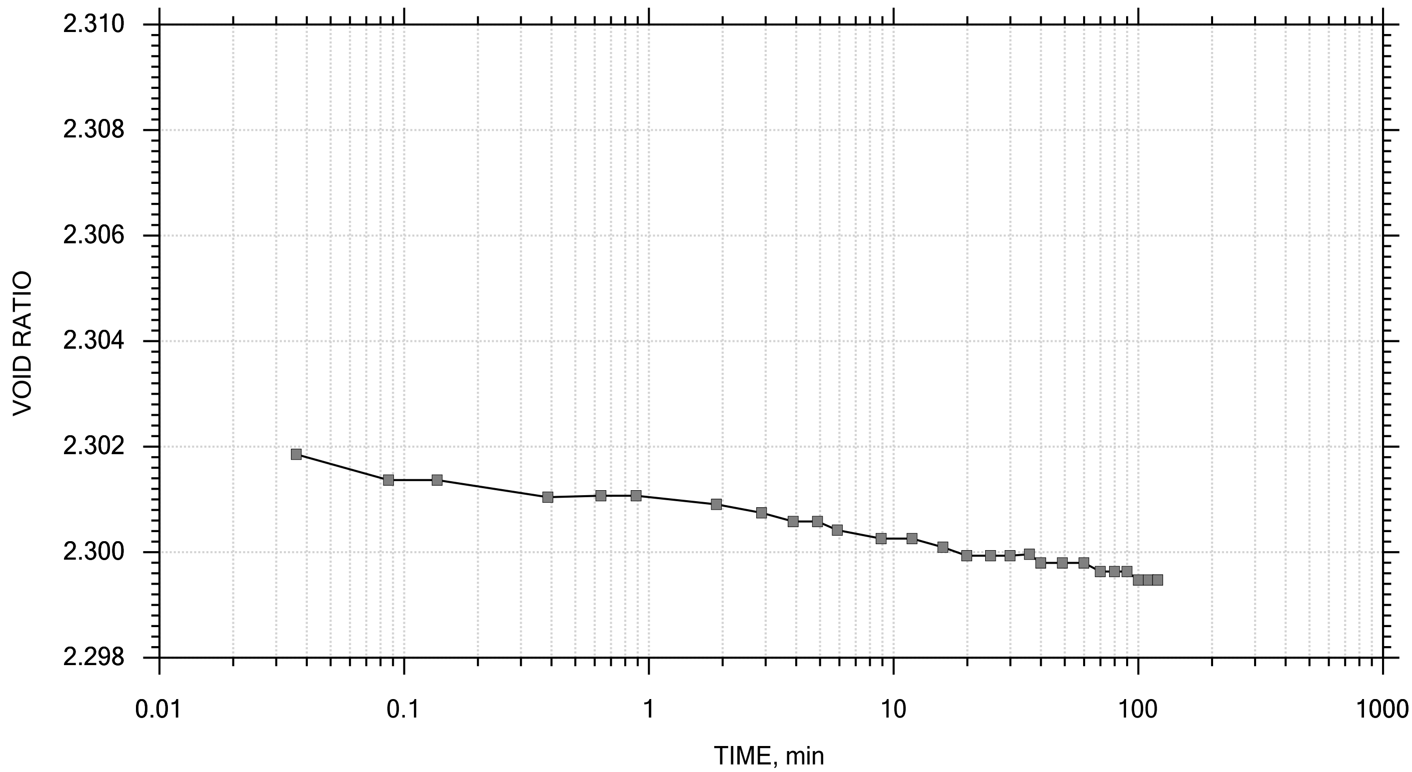


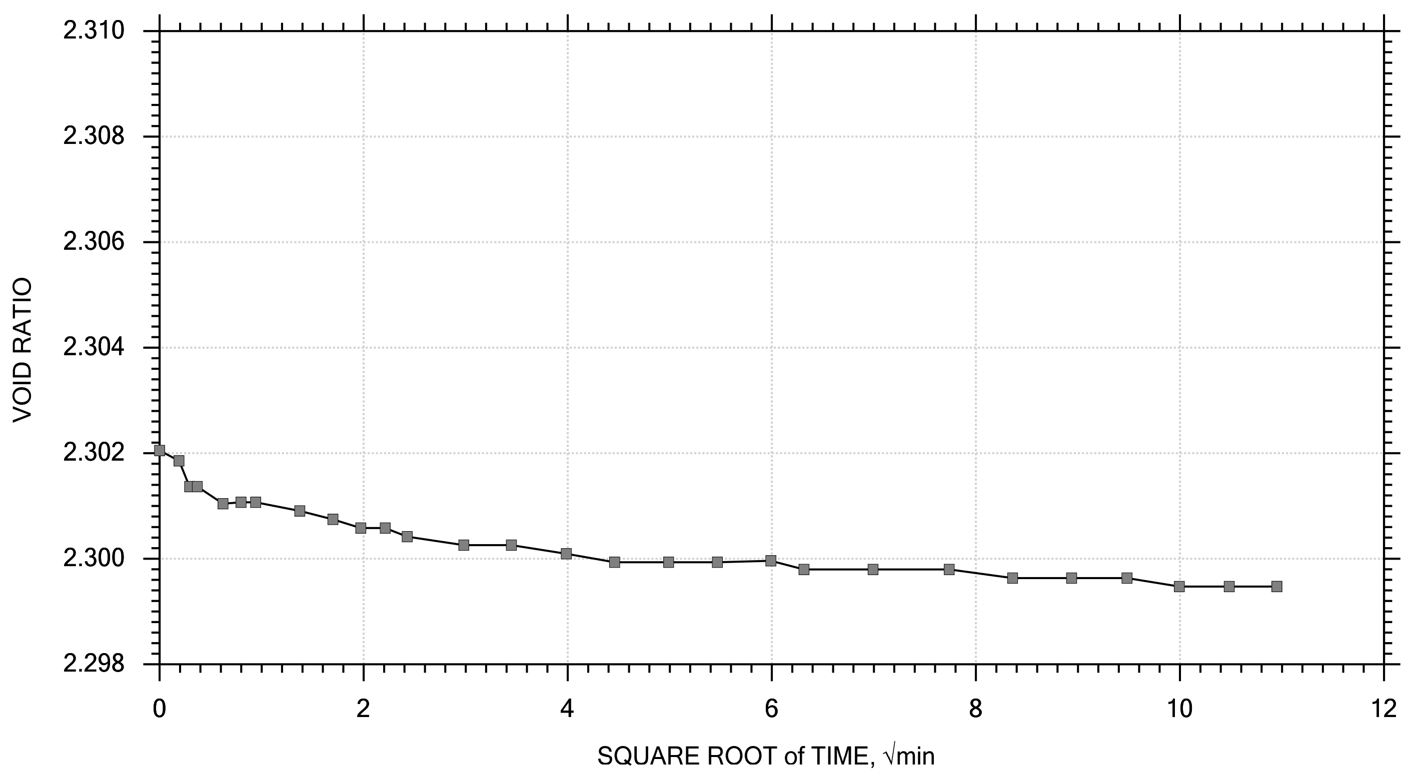


GeoTesting EXPRESS			
	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 2 of 15
Stress: 0.125 tsf

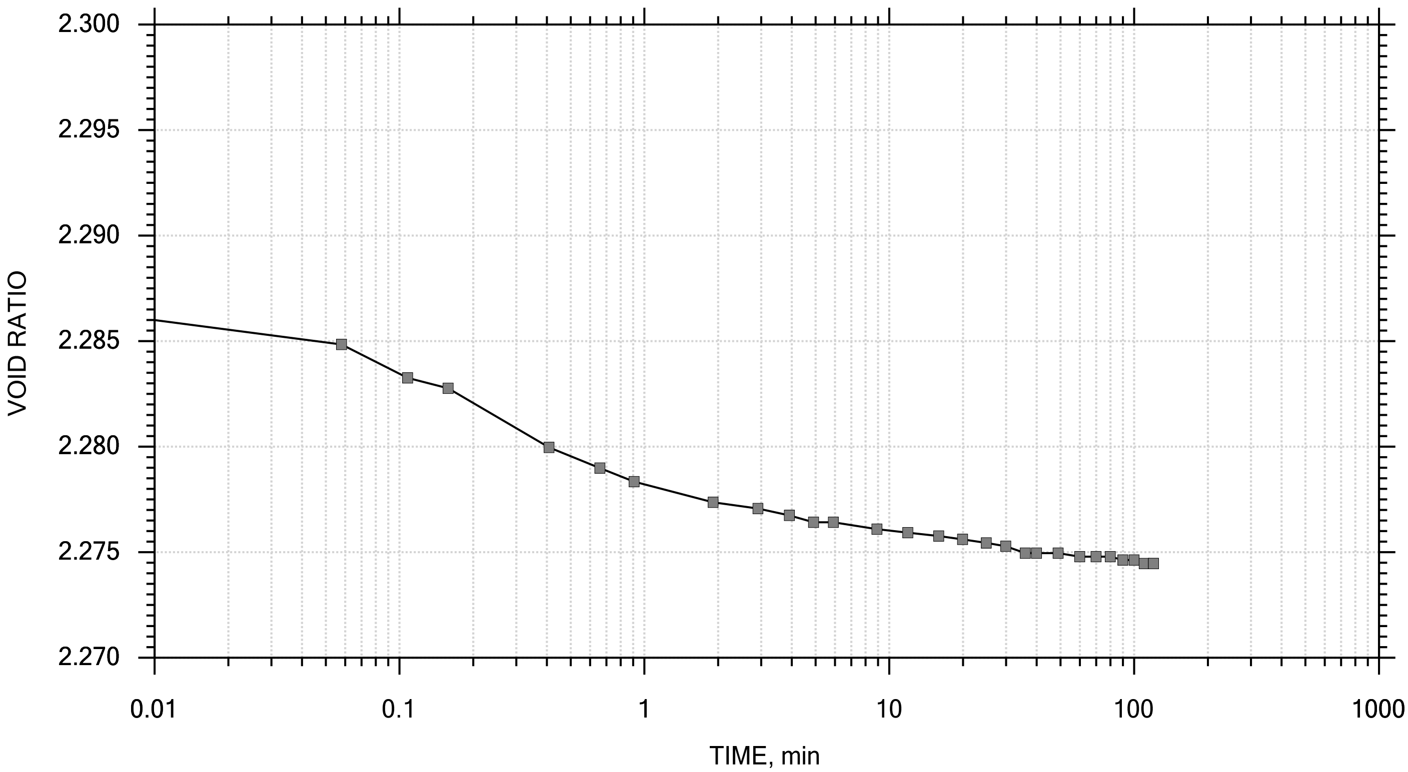


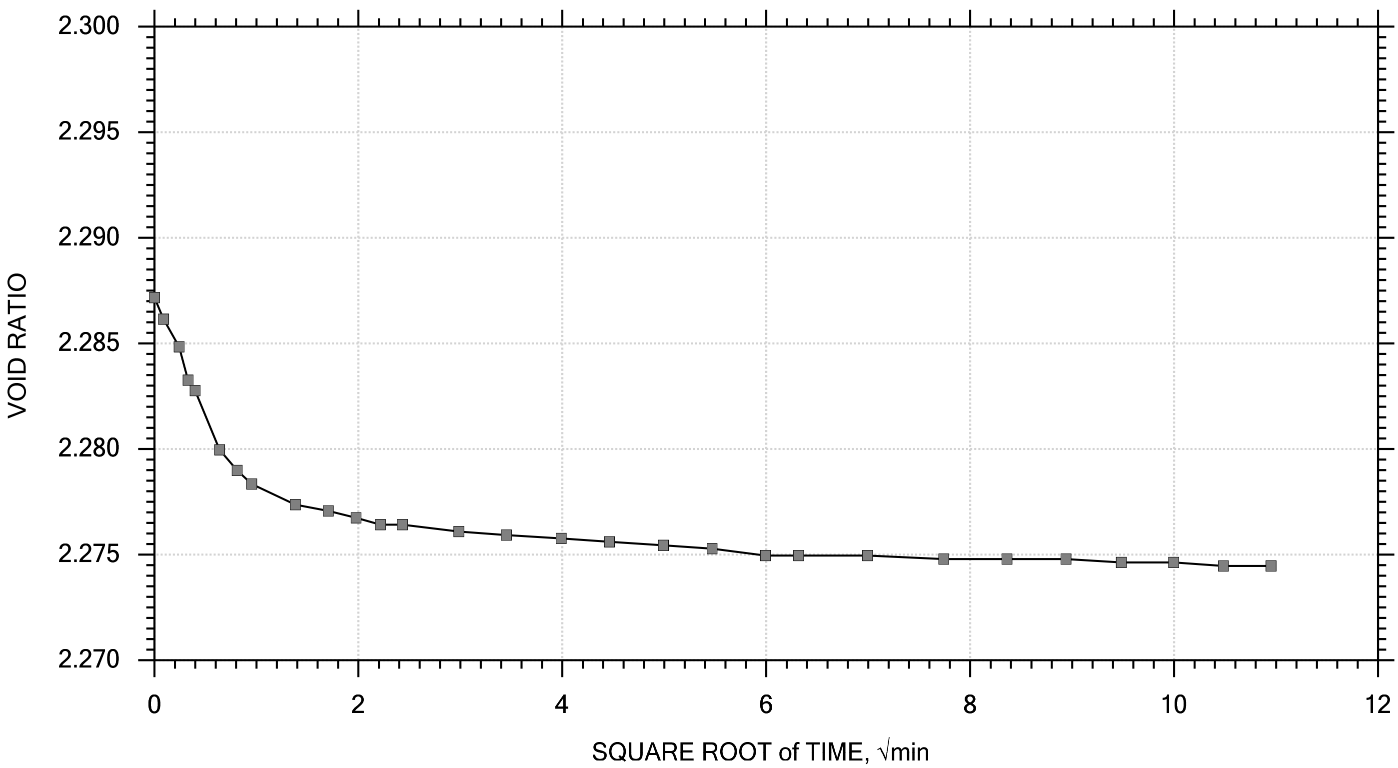


GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 3 of 15
Stress: 0.25 tsf

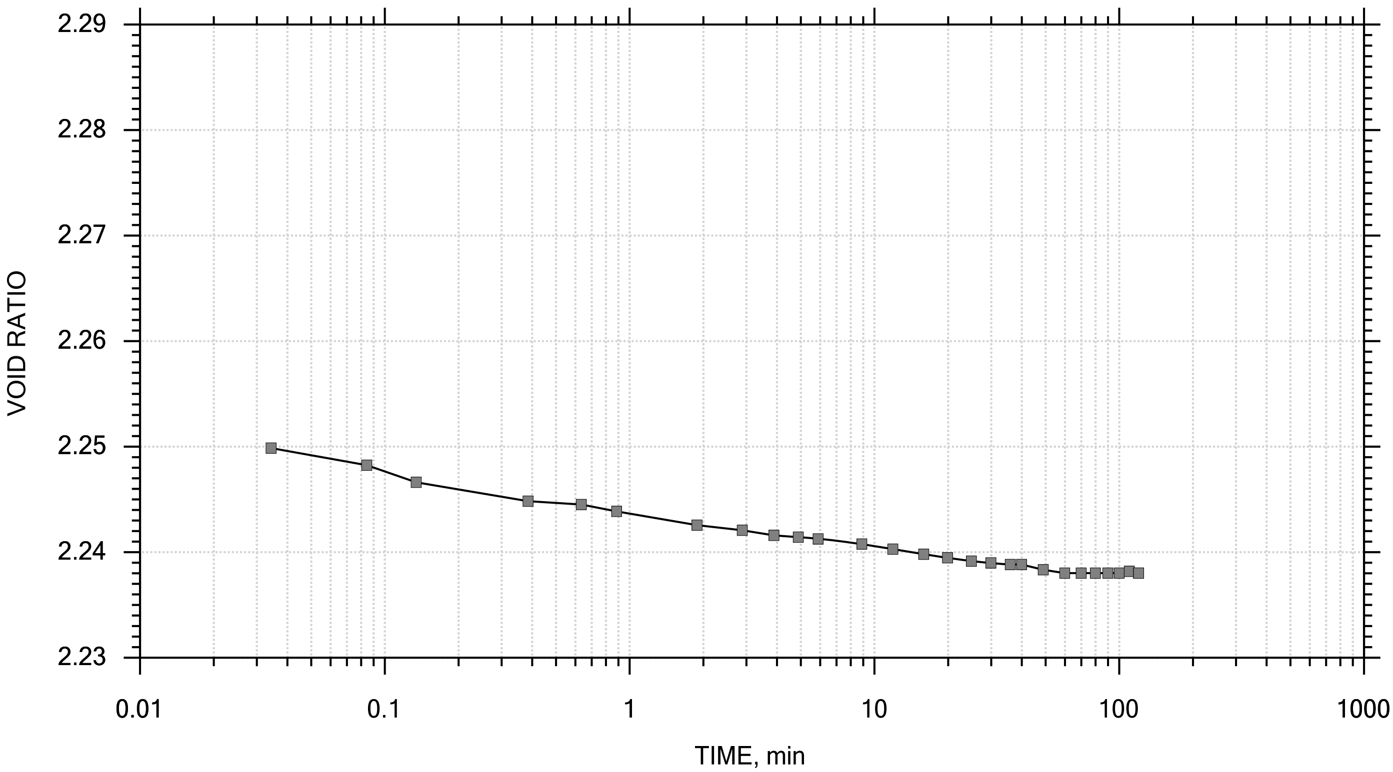


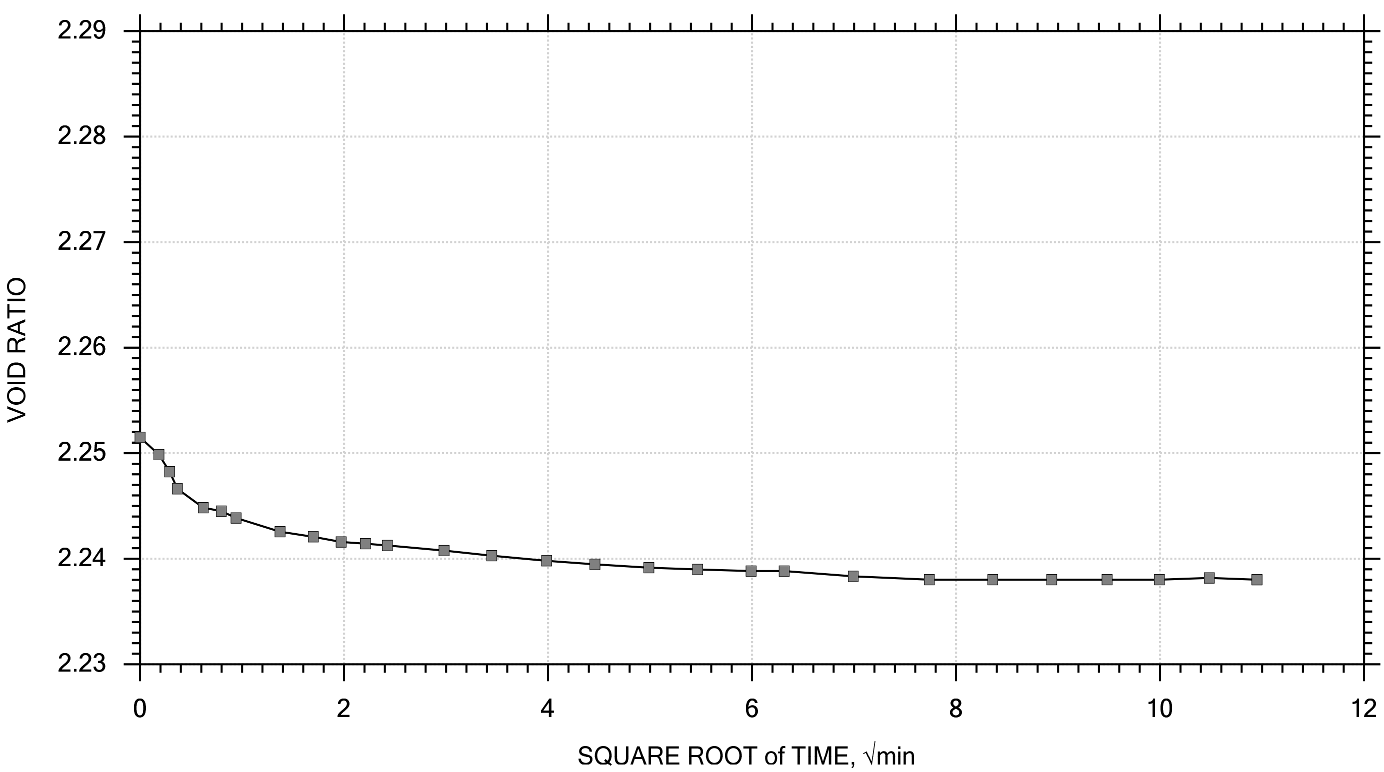


GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 4 of 15
Stress: 0.5 tsf

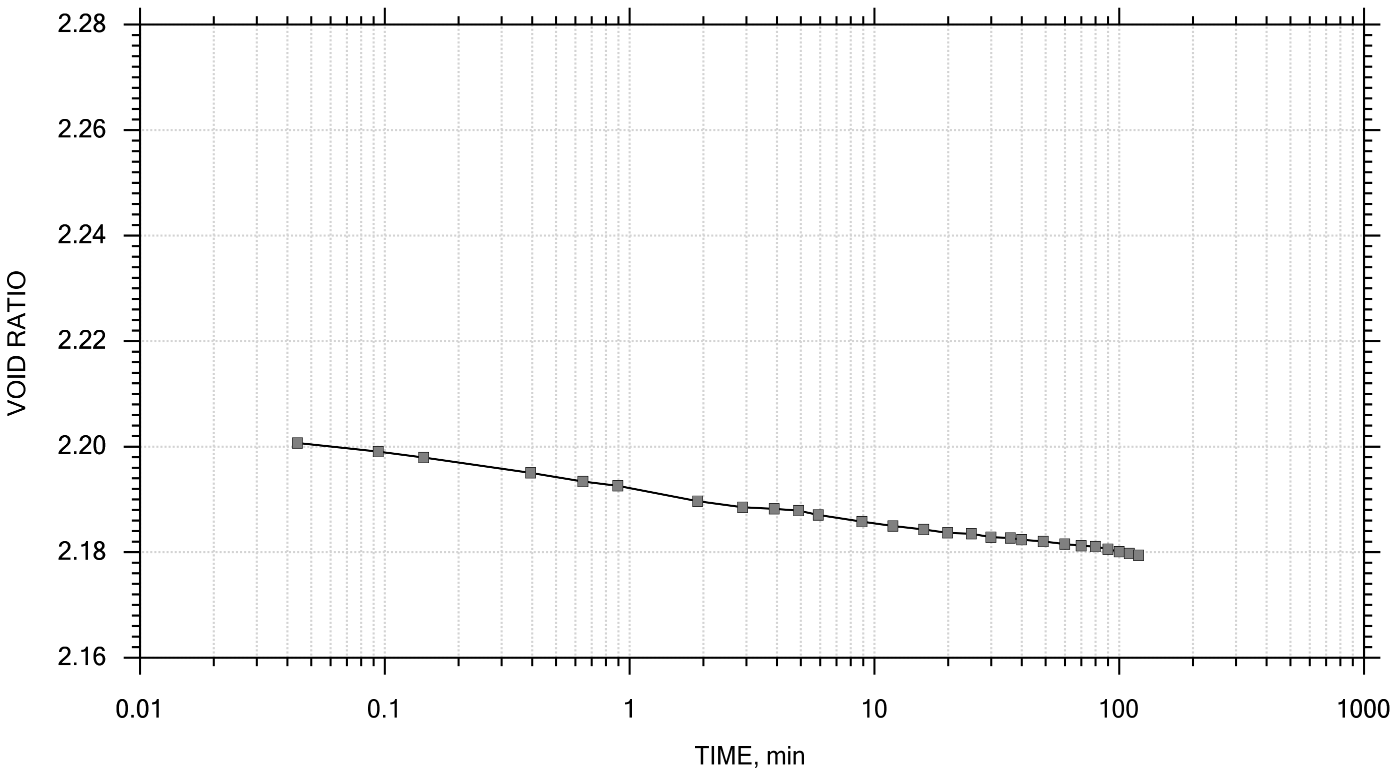


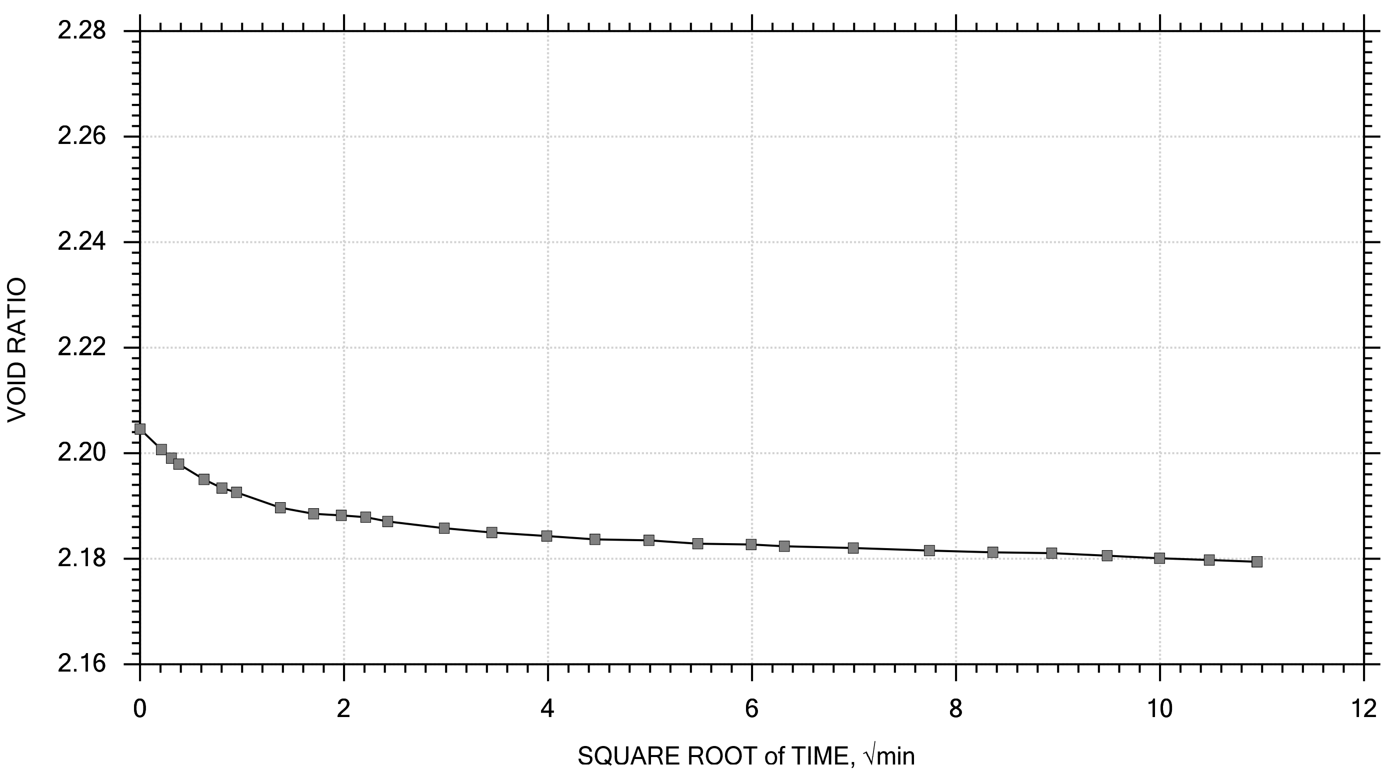


GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 5 of 15
Stress: 1 tsf





GeoTesting EXPRESS			
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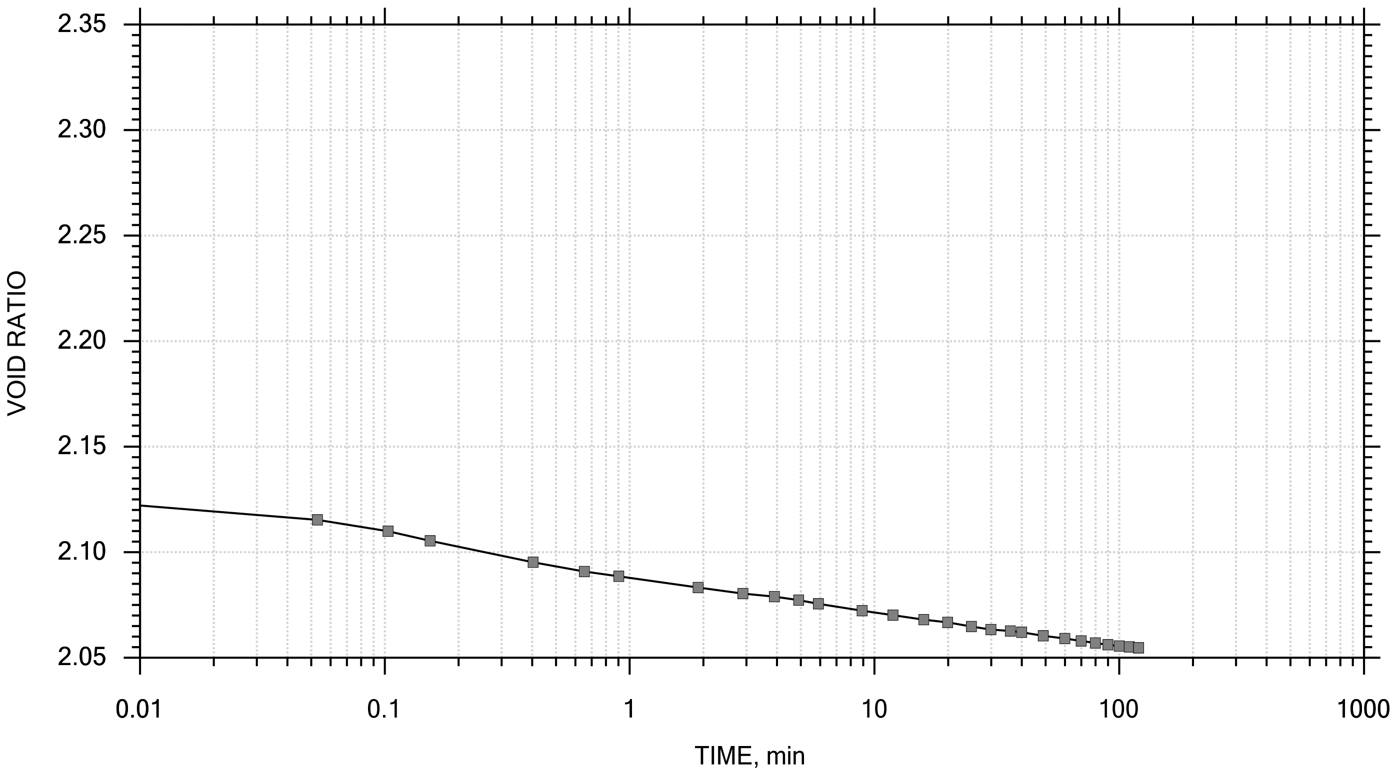
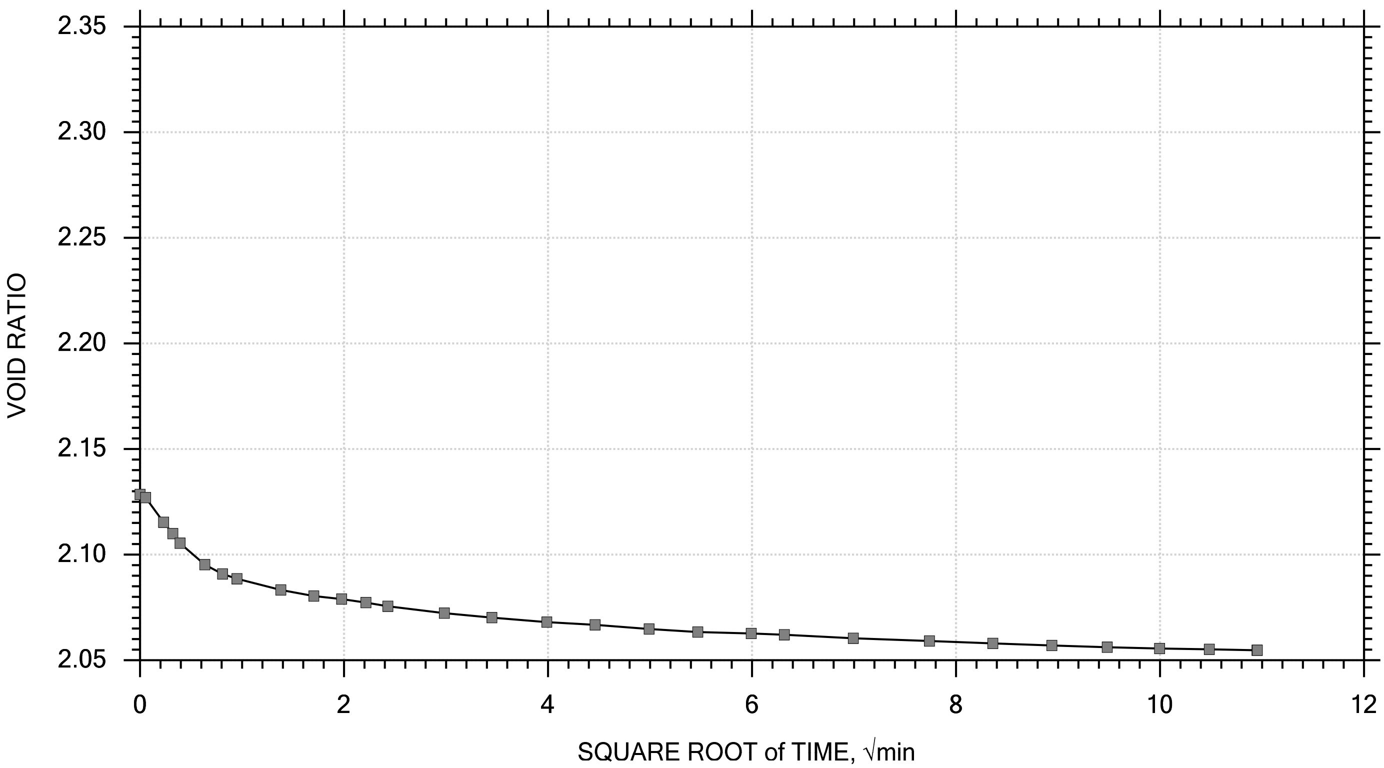
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 6 of 15
Stress: 2 tsf

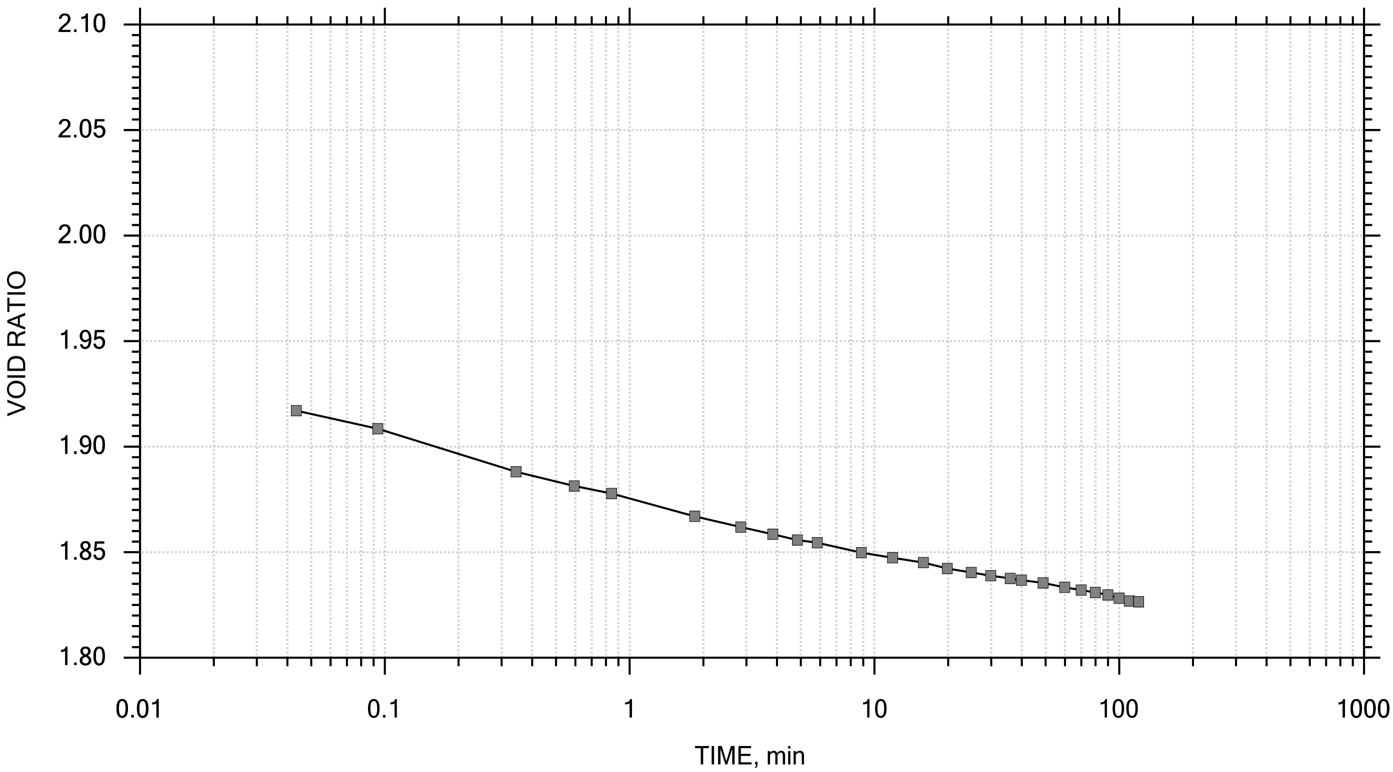


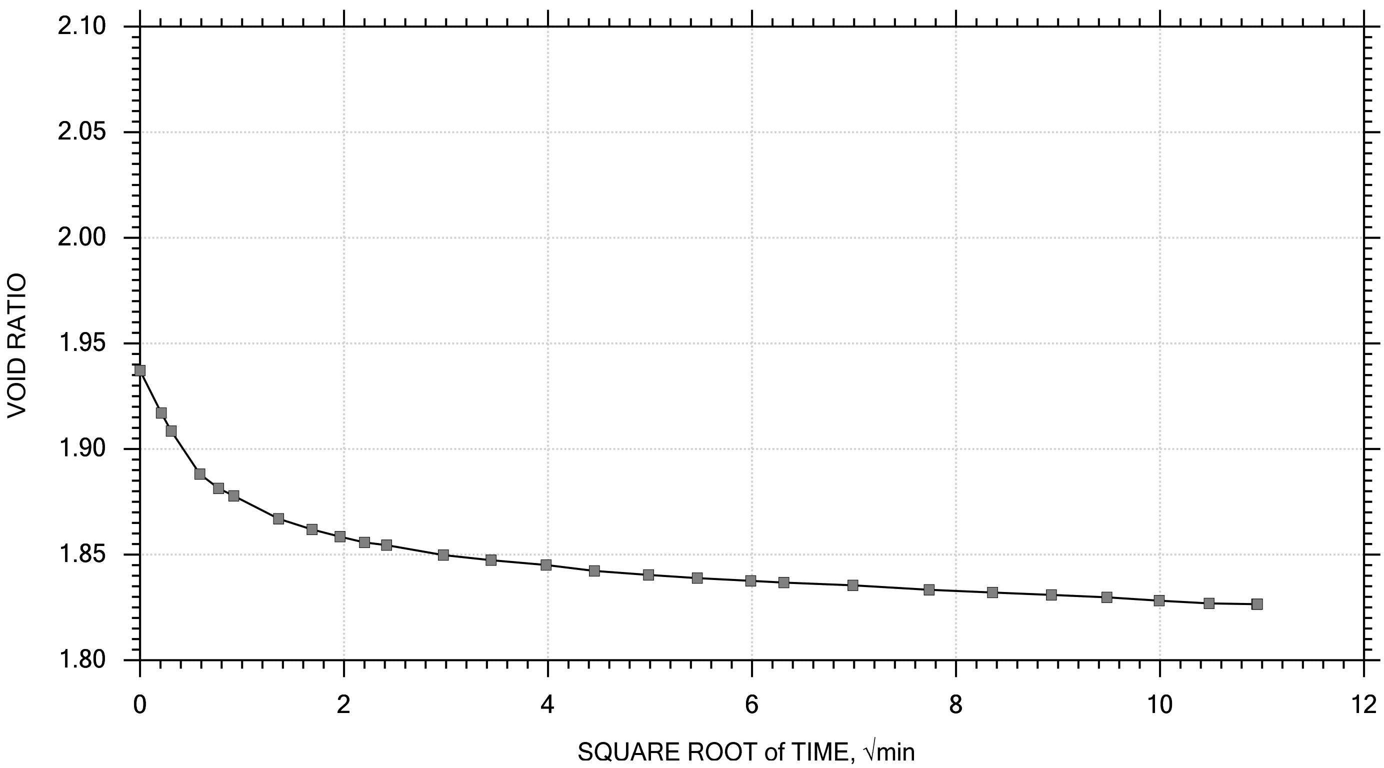


Project: South River	Location: ---	Project No.: GTX-302574
Boring No.: AQSB-01	Tested By: md	Checked By: jdt
Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
Depth: ---	Sample Type: intact	Elevation: ---
Description: Moist, yellowish brown silty sand with gravel		
Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 7 of 15
Stress: 4 tsf





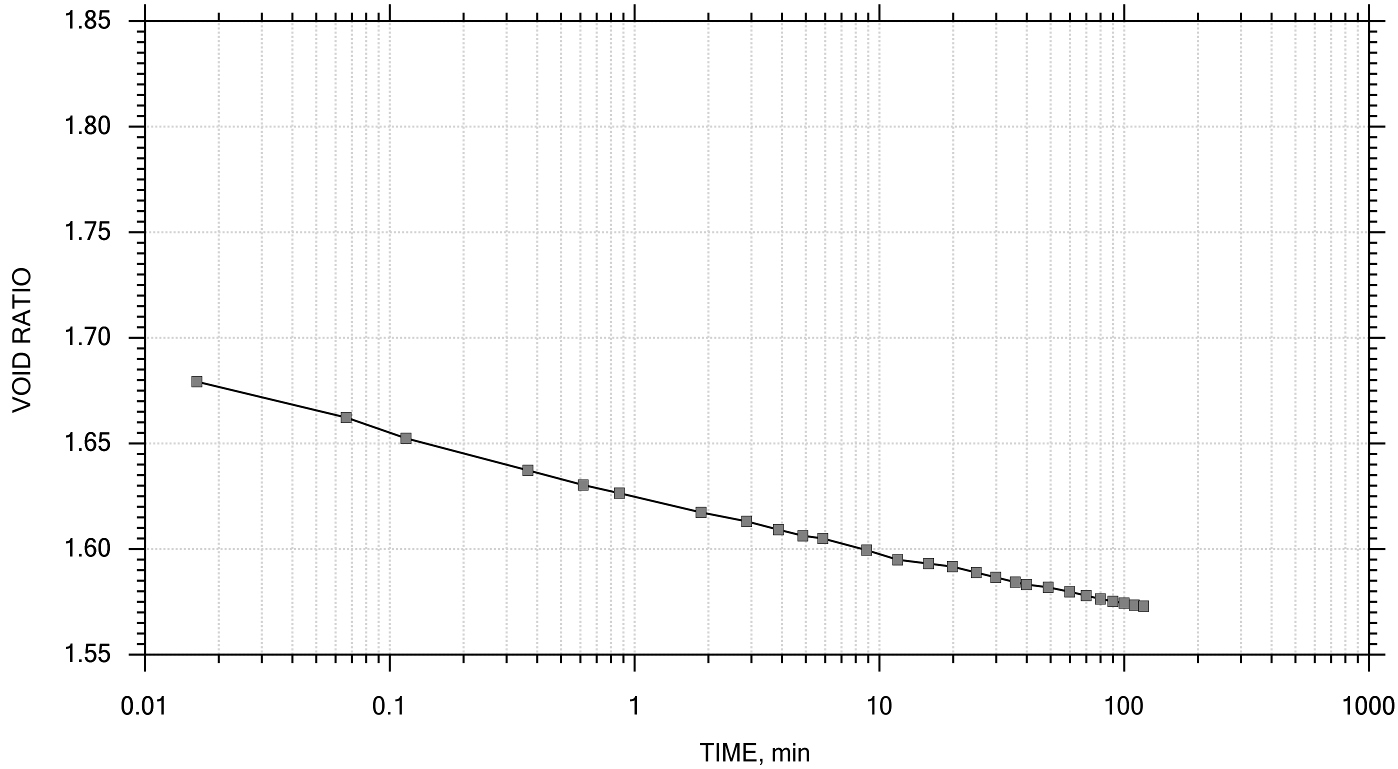
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

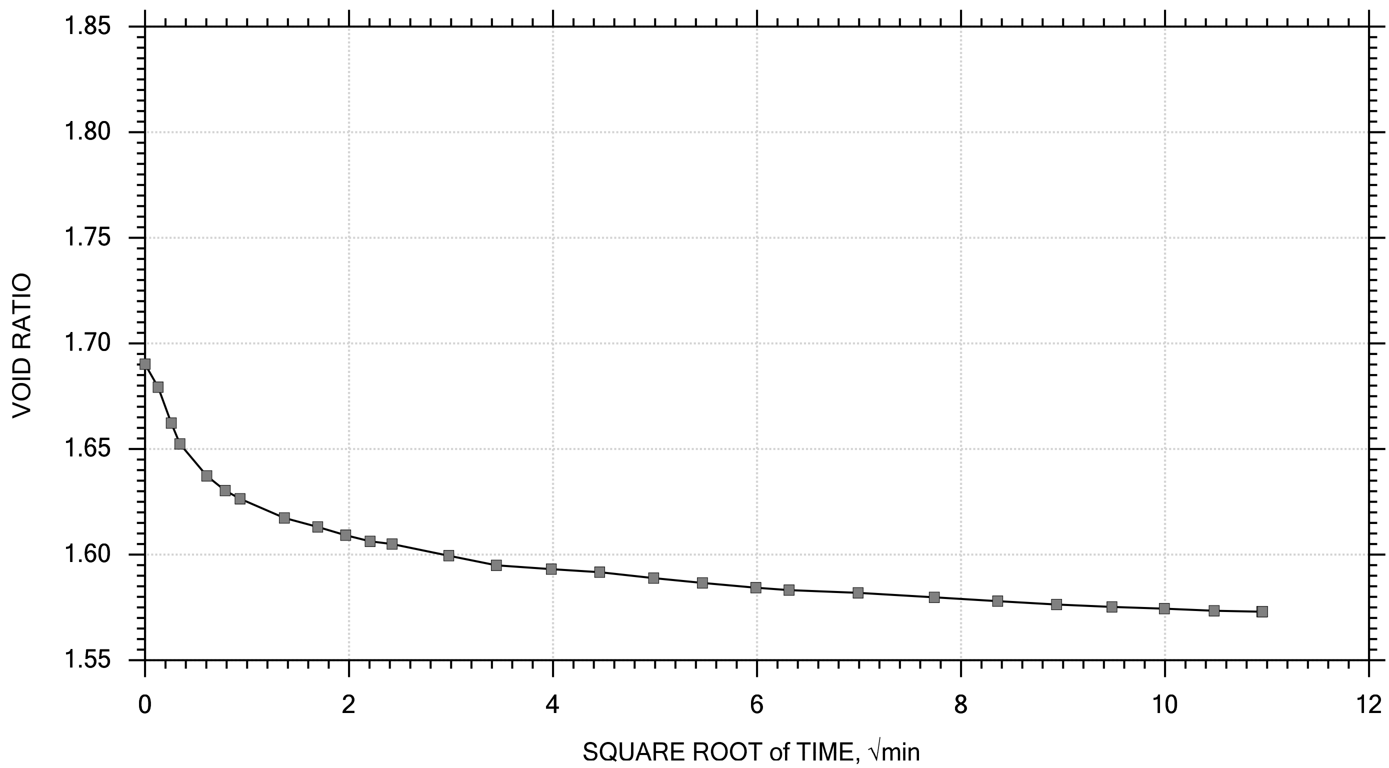
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 15

Stress: 8 tsf

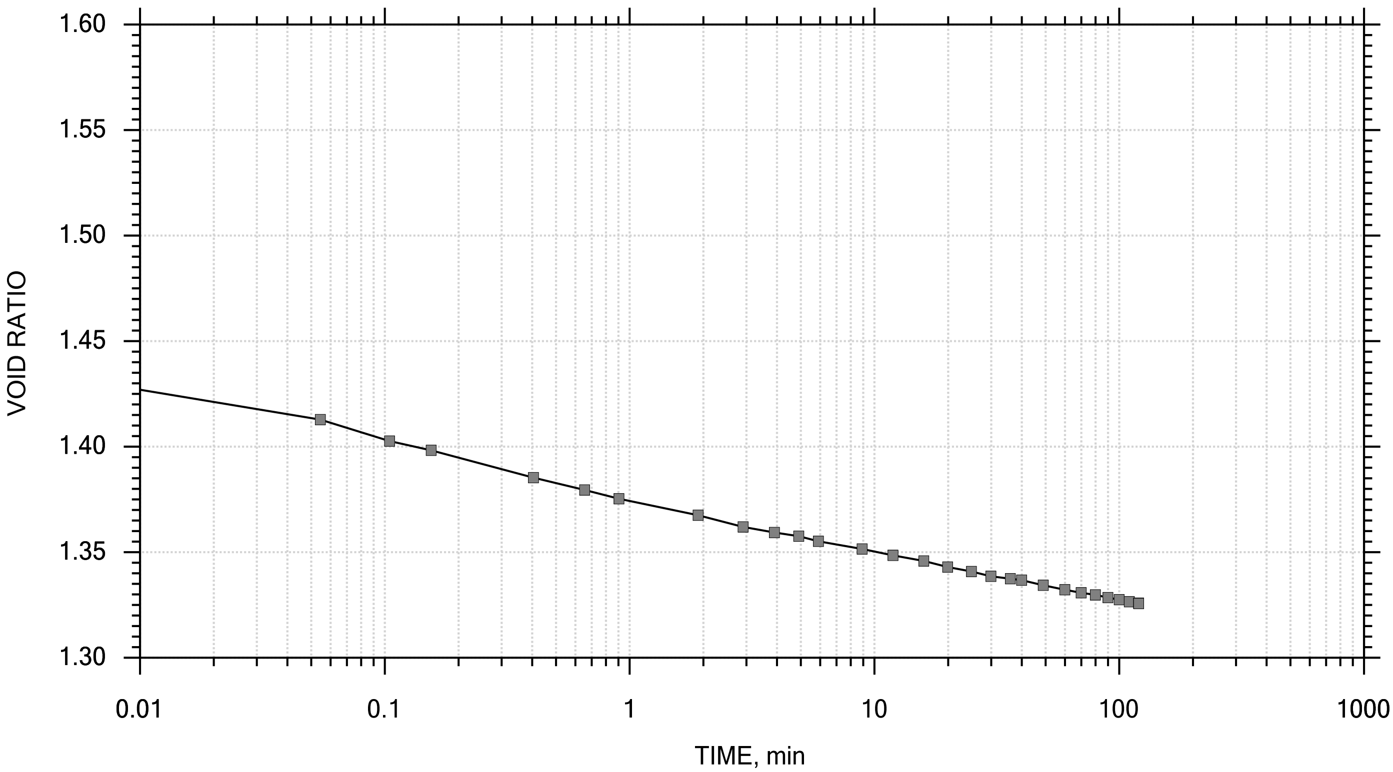


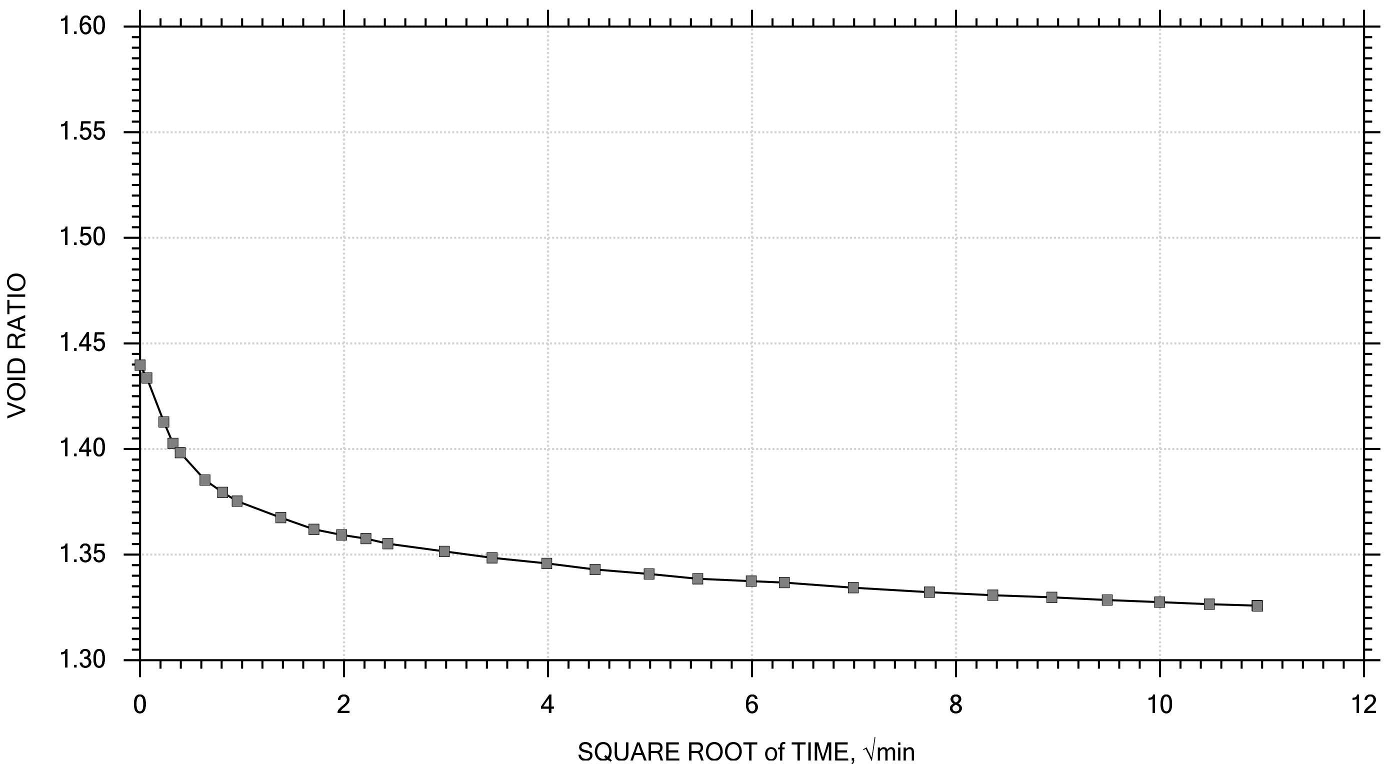


GeoTesting EXPRESS			
	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 9 of 15
Stress: 16 tsf





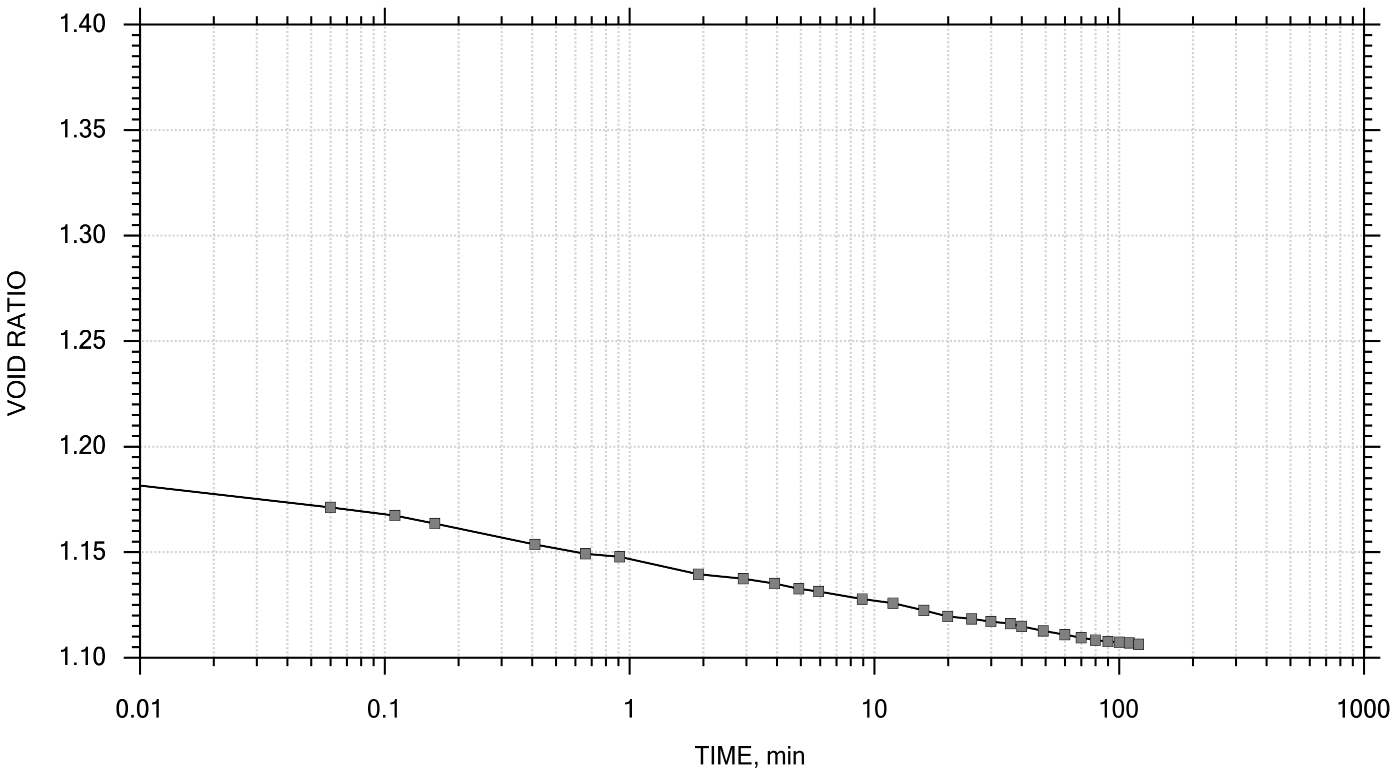
Project: South River	Location: ---	Project No.: GTX-302574
Boring No.: AQSB-01	Tested By: md	Checked By: jdt
Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
Depth: ---	Sample Type: intact	Elevation: ---
Description: Moist, yellowish brown silty sand with gravel		
Remarks: System O, Swell Pressure = 0.0698 tsf		

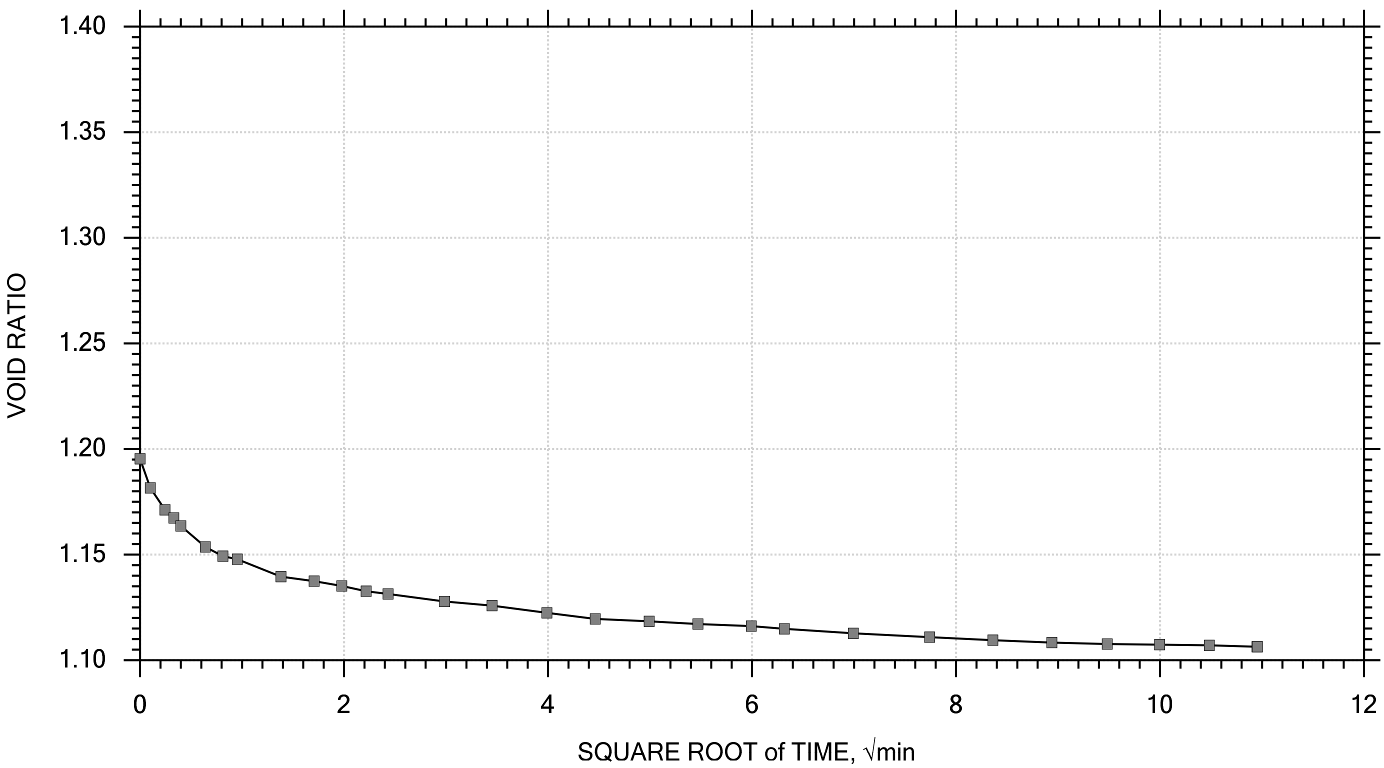
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 10 of 15

Stress: 32 tsf

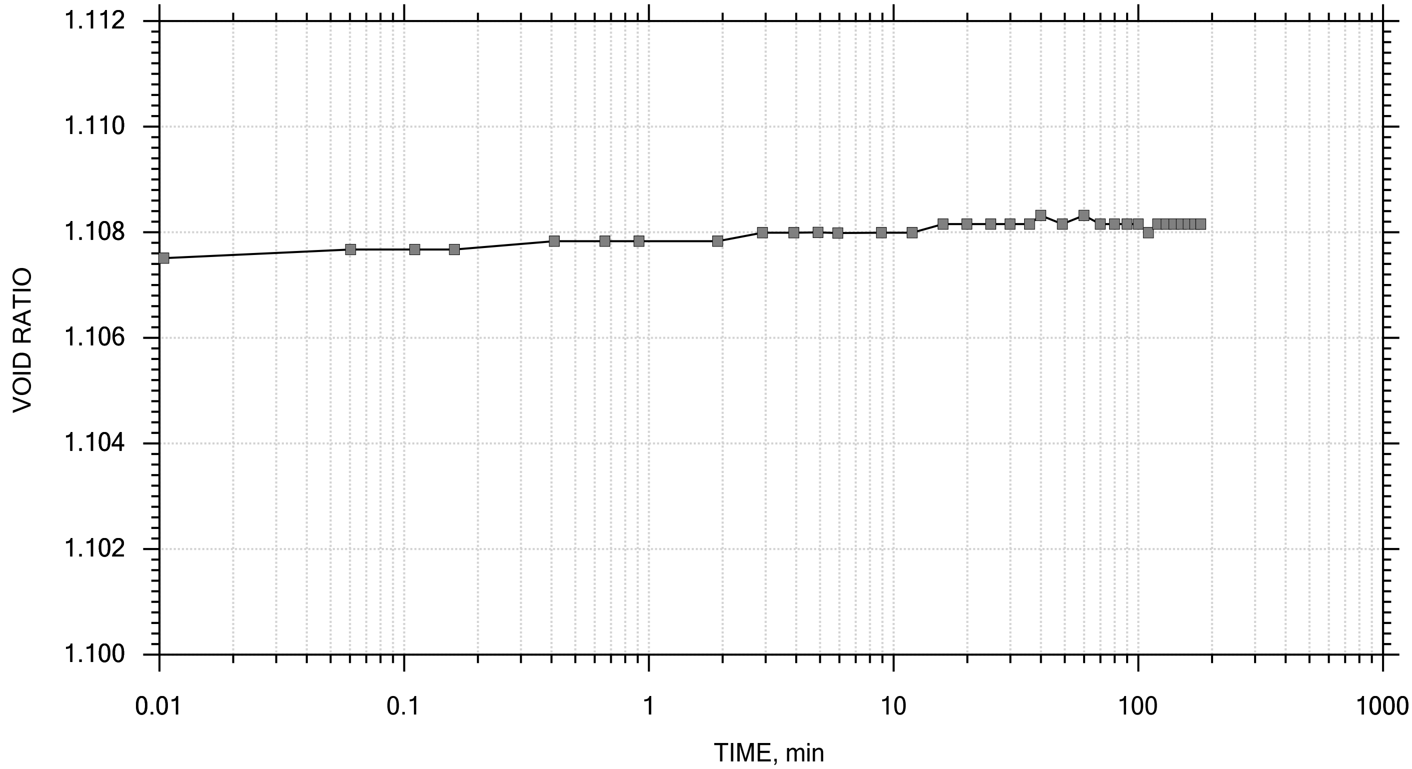


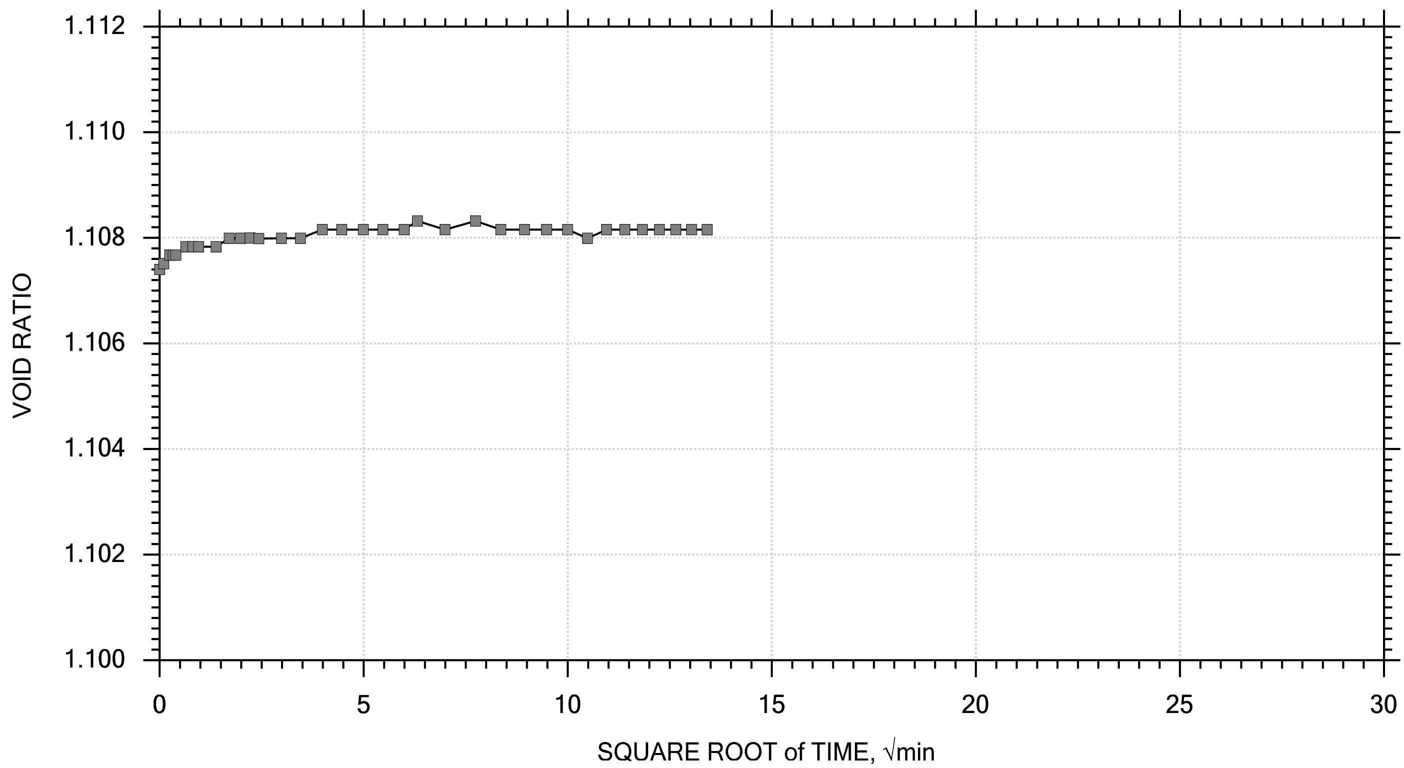


GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 11 of 15
Stress: 8 tsf

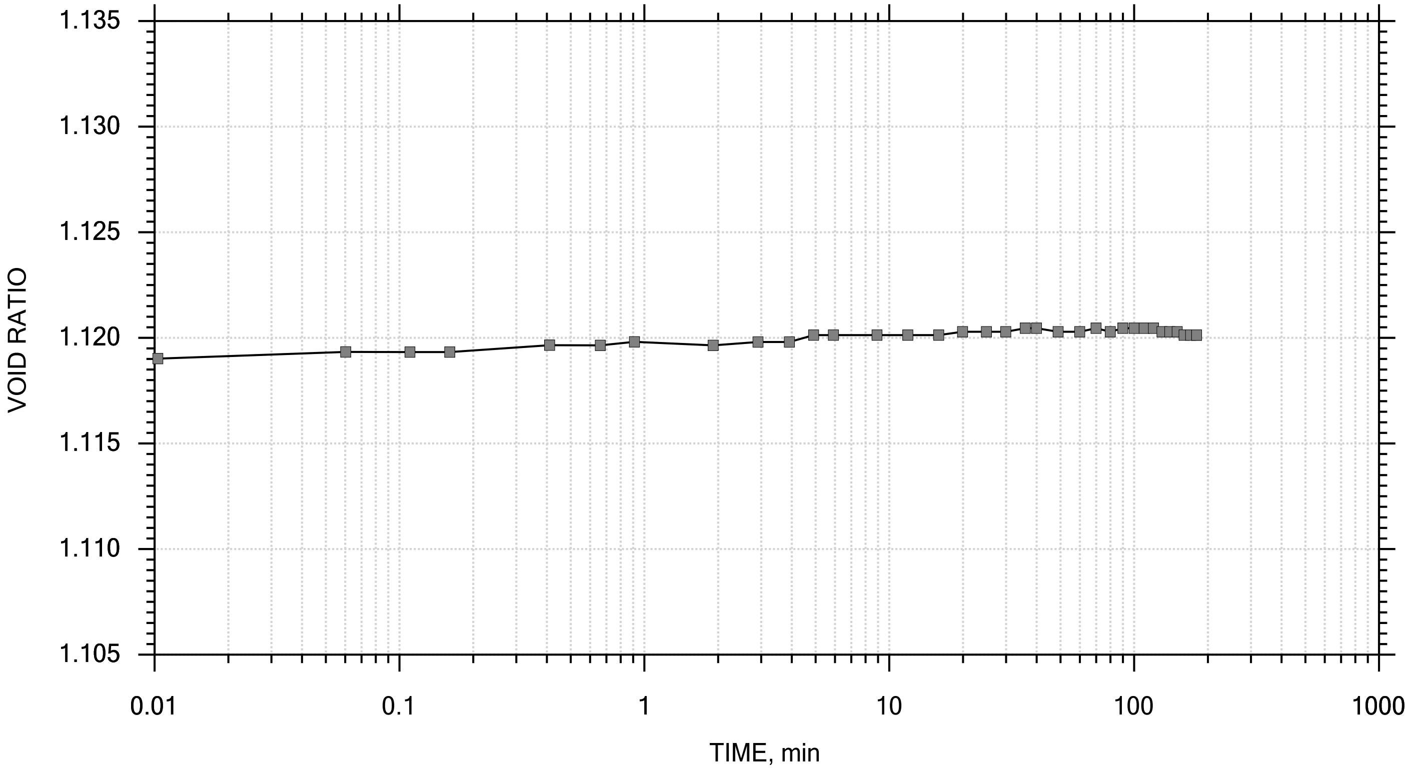


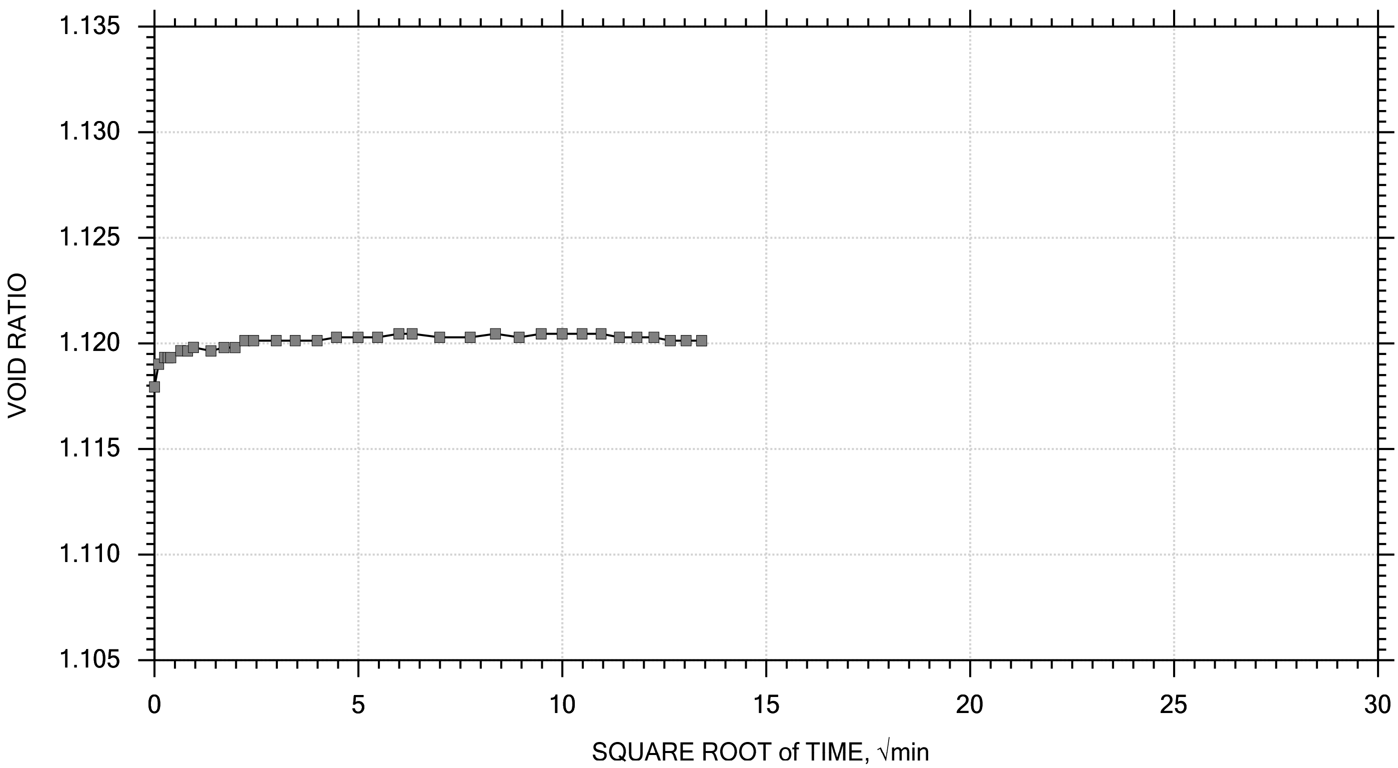


GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 12 of 15
Stress: 2 tsf





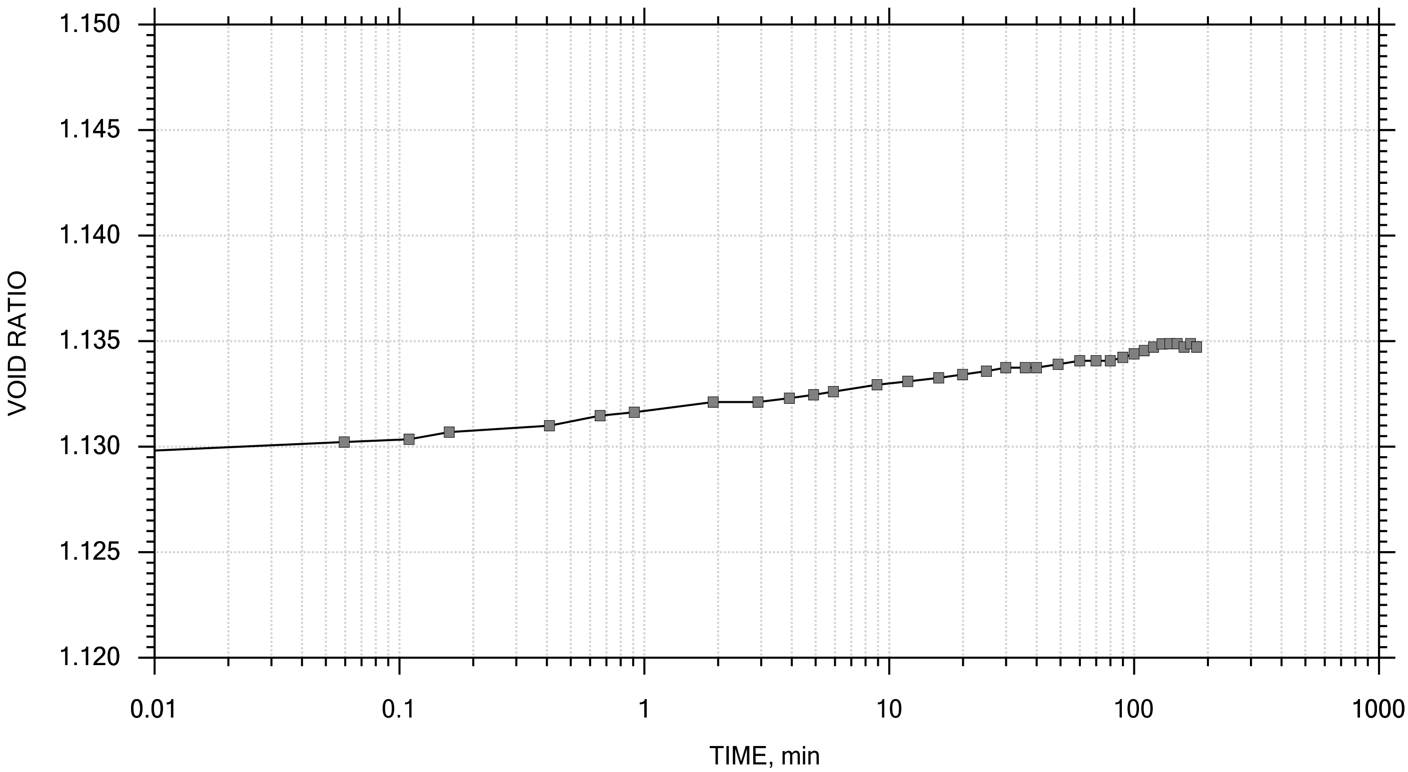
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

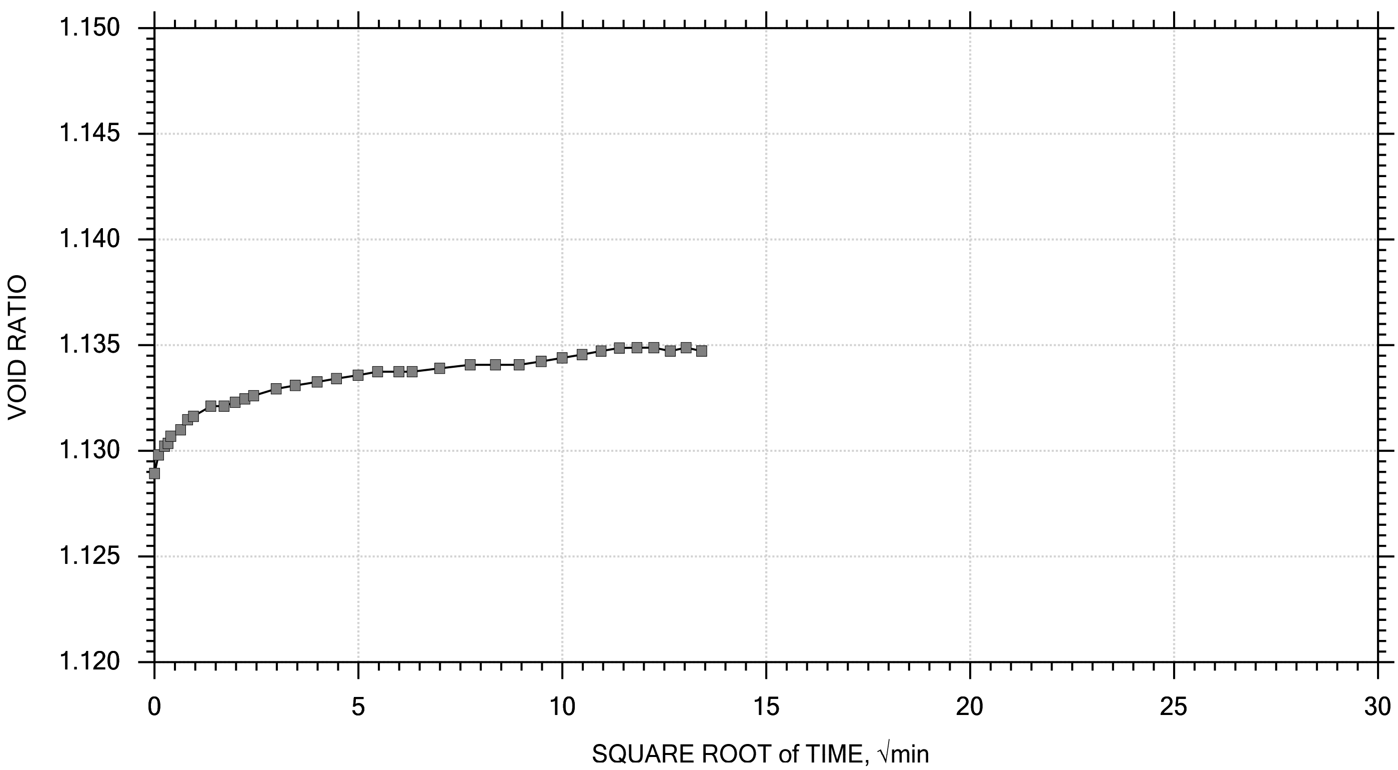
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 13 of 15

Stress: 0.5 tsf

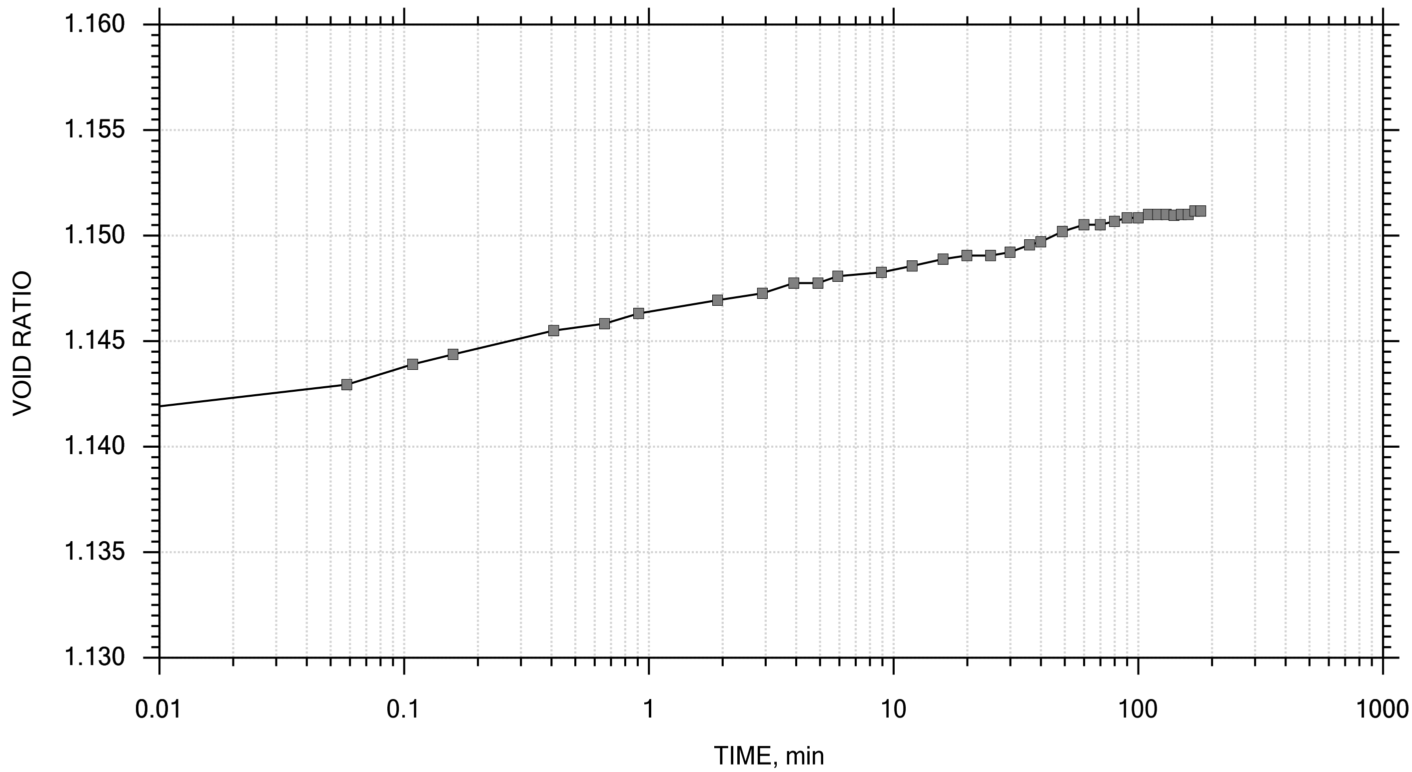


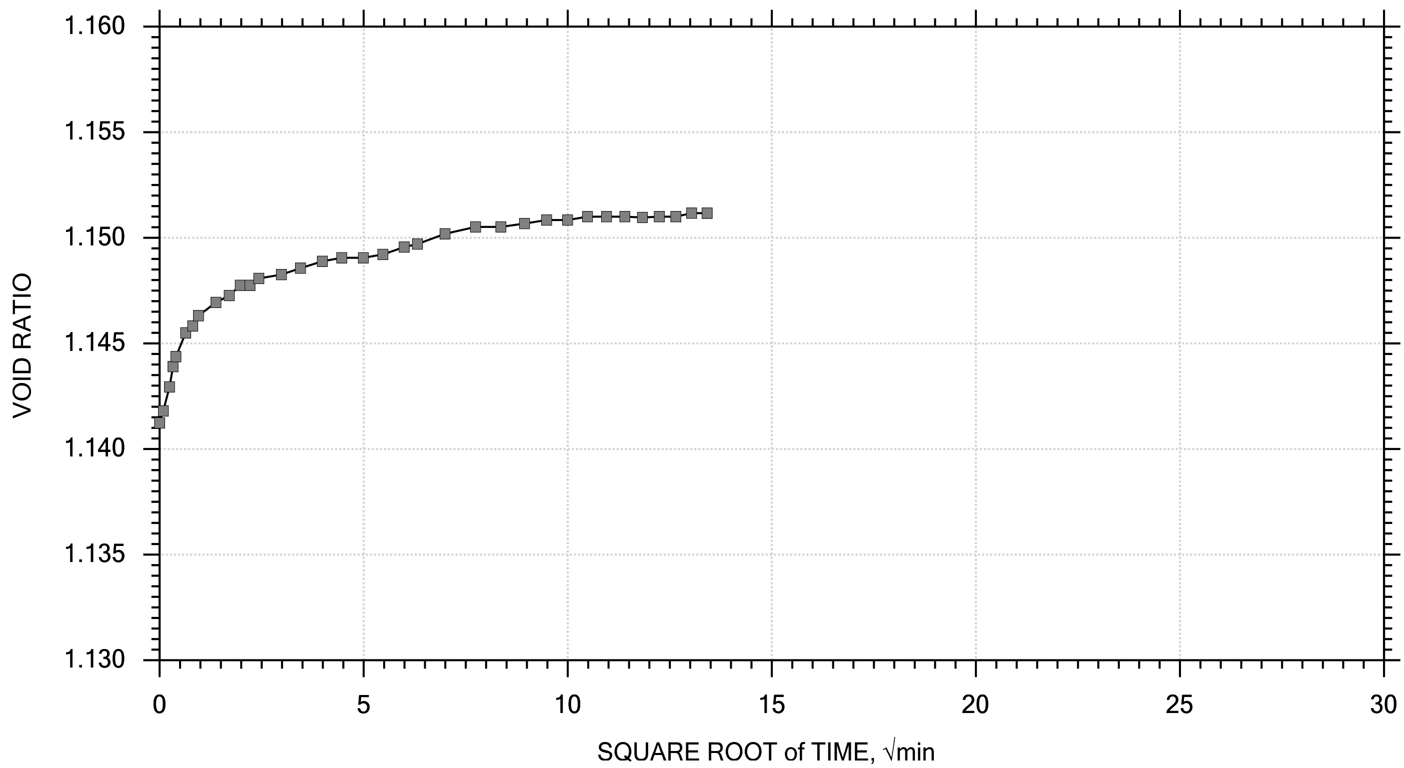


GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 14 of 15
Stress: 0.125 tsf

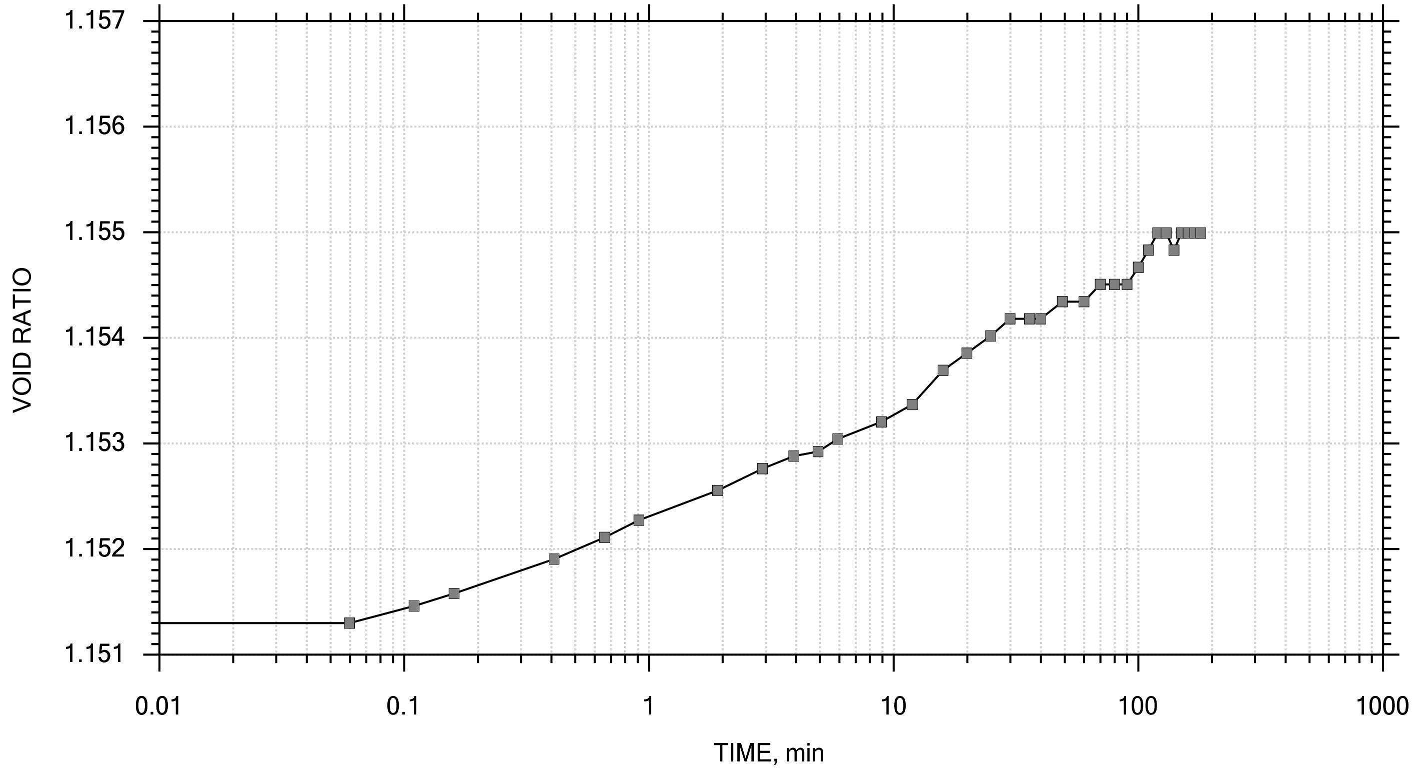


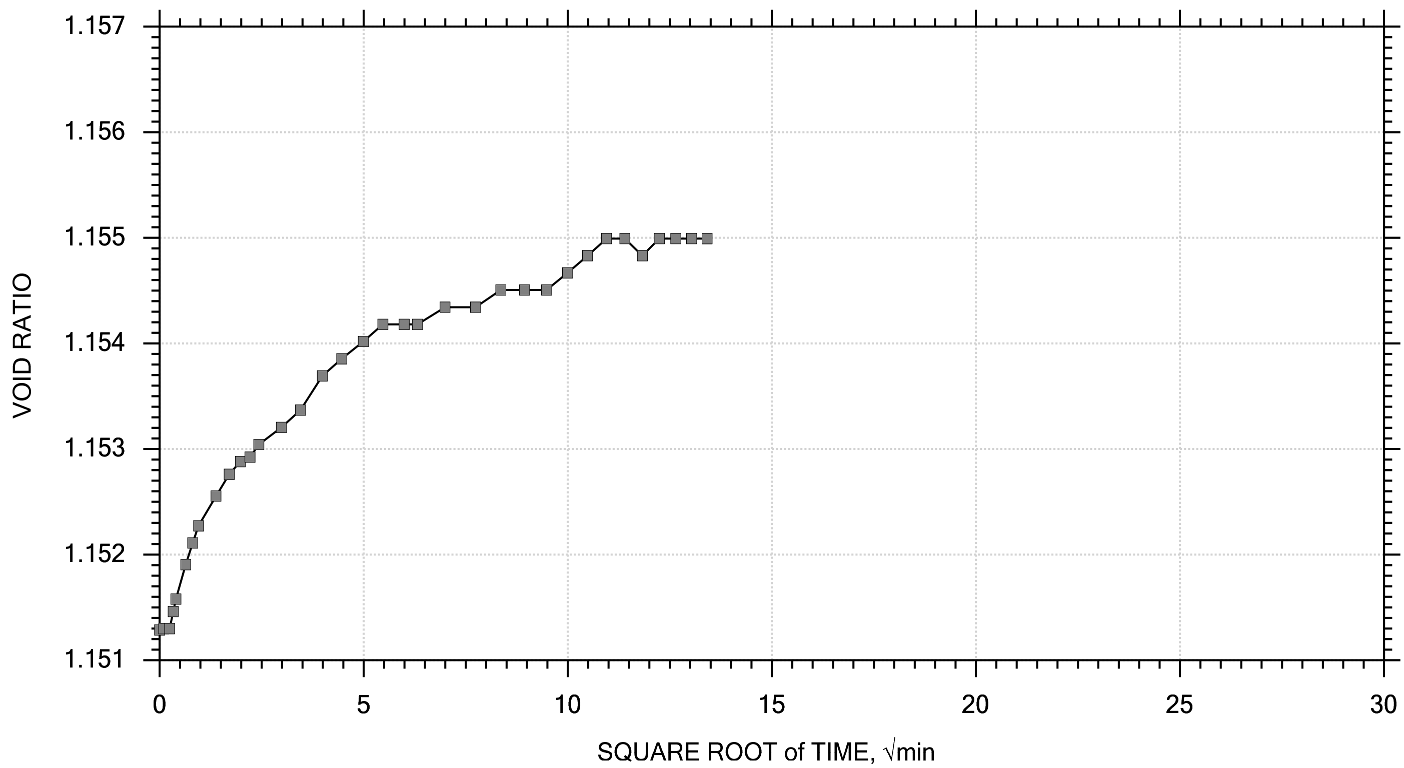


GeoTesting EXPRESS			
	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 15 of 15
Stress: 0.0625 tsf





GeoTesting EXPRESS			
	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

APPENDIX B
SUPPLEMENTAL BANK CORING REPORT

AECOM
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Telephone: (610)-832-2500
Facsimile: (610) 832-3501

MEMORANDUM

TO: Nancy Grosso, DuPont

DATE: May 17, 2016

CC: Michael Liberati, DuPont

FROM: Joshua Collins, AECOM
Cecilia Mancini, AECOM

SUBJECT: PHASE 1A – BANK MANAGEMENT AREAS - SUPPLEMENTAL BANK SOIL SAMPLING
DUPONT FORMER WAYNESBORO SITE, AREA OF CONCERN 4

Background

This memorandum provides a summary of supplemental soil sampling activities performed by AECOM during the spring/summer 2015 and March 2016, in support of the Phase 1A Interim Measures remedial design for Area of Concern 4 (AOC 4) of the former DuPont Waynesboro facility located in Waynesboro, Virginia. The objective of the soil sampling efforts was to collect additional data to further characterize distribution of bank soil mercury concentrations in bank management areas (BMAs) where relatively high and low surface and/or subsurface mercury concentrations were documented in previous sampling events.

Upon review of conceptual Phase 1A Interim Measure designs, the City of Waynesboro (City) and Virginia Department of Game and Inland Fisheries (VDGIF) raised concerns regarding potential impacts to upland habitats (e.g., mature trees). To address these concerns, AECOM conducted a preliminary vegetative community survey at representative Phase 1A BMAs, concurrent with the soil coring efforts. The primary objective of the vegetative community survey was to provide necessary data to refine the Phase IA Interim Measures designs to balance remedial objectives and habitat preservation, consistent with the City and VDGIF's preferences. The approach and results of the preliminary vegetative community survey and the more intensive Tree Survey are provided in the AOC 4 Phase 1A Bank Management Area Vegetation Community and Tree Survey Memorandum (AECOM, 2015a).

Approach

Soil samples were collected at three Phase 1A BMAs (i.e., Constitution Park, North Park[1] and the Waynesboro Wastewater Treatment Plant) where relatively high surface and/or subsurface mercury concentrations have been documented. In 2015, a combination of soil borings and test pits were conducted at 35 transects, located at approximately 50-foot intervals aligned with and between historical sampling locations (Figure 1 and Figure 2). Three discrete borings/test pits were conducted at each transect; one each from the top, middle and bottom third of the bank. Discrete soil samples were collected at one-foot intervals from the bank surface to refusal.

A second sampling event was conducted in March 2016 to further evaluate mercury concentrations at the Waynesboro Wastewater Treatment Plant (Figure 2). As part of this effort, four additional surficial soil transects were sampled using methods consistent previous surficial soil sampling events (URS, 2014).

Specific details regarding soil collection procedures are provided in the Phase 1 – Bank Management Area Supplemental Bank Coring Work Plan (AECOM, 2015b) and the Phase 1B Bank Management Areas - 2016 Pre-Remedy Design – Bank Soil Sampling Work Plan (AECOM, 2016).

Results

The results of the 2015 supplemental bank coring are consistent with data collected in similar previous efforts within the first two river miles (Anchor QEA et al., 2015; URS, 2012). Average total mercury (THg) concentrations for

[1] Soil data collected at North Park has not been included in this memorandum as the North Park BMAs are not part of the first phase of interim measures. Data will be included with the Basis of Design Report for North Park at a later date.

borings ranged from 0.16 mg/kg to 636 mg/kg (Table 1), comparable to historical data. However, compared to historical data, discrete sample maximum concentrations were much higher, with a maximum detected concentration of 3,610 mg/kg at Transect LBH04-200 (Table 1). The highest detected THg concentrations were typically encountered at depths greater than 2-3 feet, and were confined to a relatively small area (i.e. one to two borings at the same or adjacent transects).

Mercury concentrations in surficial soil samples collected in March 2016 at the Waynesboro Wastewater Treatment Plant secondary BMA were consistent with previous findings. Average THg concentrations for surficial soil transects ranged from 7.74 to 14.13 mg/kg (Table 1) with discrete sample maximum concentrations ranging from 10.9 to 24.5 mg/kg. Table 1 below presents a summary of THg data summarized by sampling area; complete analytical results are provided in Appendix A.

Discussion

Elevated THg concentrations (e.g., > 50 mg/kg) were documented at all Phase 1A BMAs sampled as part of the 2015 sampling efforts, which is consistent with previous data in the area. Data collected during the 2016 sampling event, confirmed lower concentrations of THg within the secondary WWTP-A BMA. Data have been integrated with hydrodynamic and loading models to revise loading estimates for each of the BMAs included in these efforts. Complete details of the loading analysis are provided in the Final Basis of Design report.

References

AECOM. 2016. Phase 1B Bank Management Areas - 2016 Pre-Remedy Design Bank Soil Sampling Work Plan: Former DuPont Waynesboro Site Area of Concern 4. Waynesboro, Virginia

AECOM. 2015a. AOC 4 Phase 1A Bank Management Area Vegetation Community and Tree Survey Memorandum. Submitted September, 2015.

AECOM. 2015b. Phase I Bank Management Areas Supplemental Bank Coring Work Plan. Waynesboro, Virginia.

Anchor QEA, AECOM and DuPont. 2015. Final Interim Measures Design Implementation, and Monitoring Work Plan: Phase 1 South River Area of Concern. Waynesboro, Virginia.

URS. 2014. Bank Soil Sampling Work Plan: 2014 - Preliminary Bank Management Area Characterization: South River Project. Waynesboro, Virginia.

URS. 2012. Final Report: Ecological Study of the South River and a Segment of the South Fork Shenandoah River, Virginia. Waynesboro, Virginia.

Tables

Table 1
Summary of Total Mercury in Supplemental Soil Samples
Phase 1A Supplemental Bank Core Sampling
Former DuPont Waynesboro Site – AOC 4

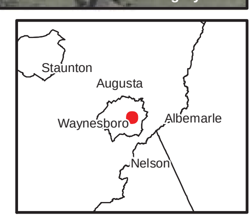
Transect	Number of Samples	Minimum THg (mg/kg)	Maximum THg (mg/kg)	Average THg (mg/kg)	Geometric Mean THg (mg/kg)
Constitution Park					
LBH04-200	10	2.28	3610	636	121
LBH04-201	13	0.92	1820	219	22.2
LBH04-202	7	0.86	47.1	26.1	17.4
LBH04-203	10	0.51	53.8	18.3	8.19
LBH04-204	10	0.76	92.3	20.3	7.04
LBH04-205	8	2.98	12.8	8.3	7.47
Wastewater Treatment Plant A					
LBH14-200	18	0.22	495	81.8	15
LBH14-201	15	0.35	38	10.6	5.34
LBH14-202	16	0.47	254	28.2	8.15
LBH14-203	13	0.27	185	36.7	9.81
LBH14-204	15	0.03	407	36.7	1.98
LBH14-205	10	0.54	13.2	3.81	2.56
LBH14-300	5	4.98	12.6	7.80	7.25
LBH14-301	5	3.97	10.9	7.74	7.31
LBH14-302	5	8.19	24.3	12.90	11.79
LBH14-303	5	6.48	24.5	14.13	12.38
Wastewater Treatment Plant B					
LBH15-200	24	0.02	0.76	0.16	0.1
LBH15-201	18	0.22	347	61.9	8.98
LBH15-202	14	6.57	1200	306	85.5
LBH15-203	12	3.67	1600	241	38.3

Notes: THg, Total mercury

Figures

Legend

Mapped Substrate Type	Supplemental Soil Samples: Avg. THg (mg/kg)	Historic Surface: Avg. THg (mg/kg)	Historic Cores: Avg. THg (mg/kg)
1.) Clays and Silts	0.133 - 1	0.0778 - 1	0.0117 - 1
2.) Fine Sands	1.1 - 2.5	1.1 - 2.5	1.1 - 2.5
	2.51 - 10	2.51 - 10	2.51 - 10
	10.1 - 50	10.1 - 50	10.1 - 50
	50.1 - 360	50.1 - 268	50.1 - 360



AECOM

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0 25 50 100 Feet

Job: 60390328

Prepared by: VP/PJL

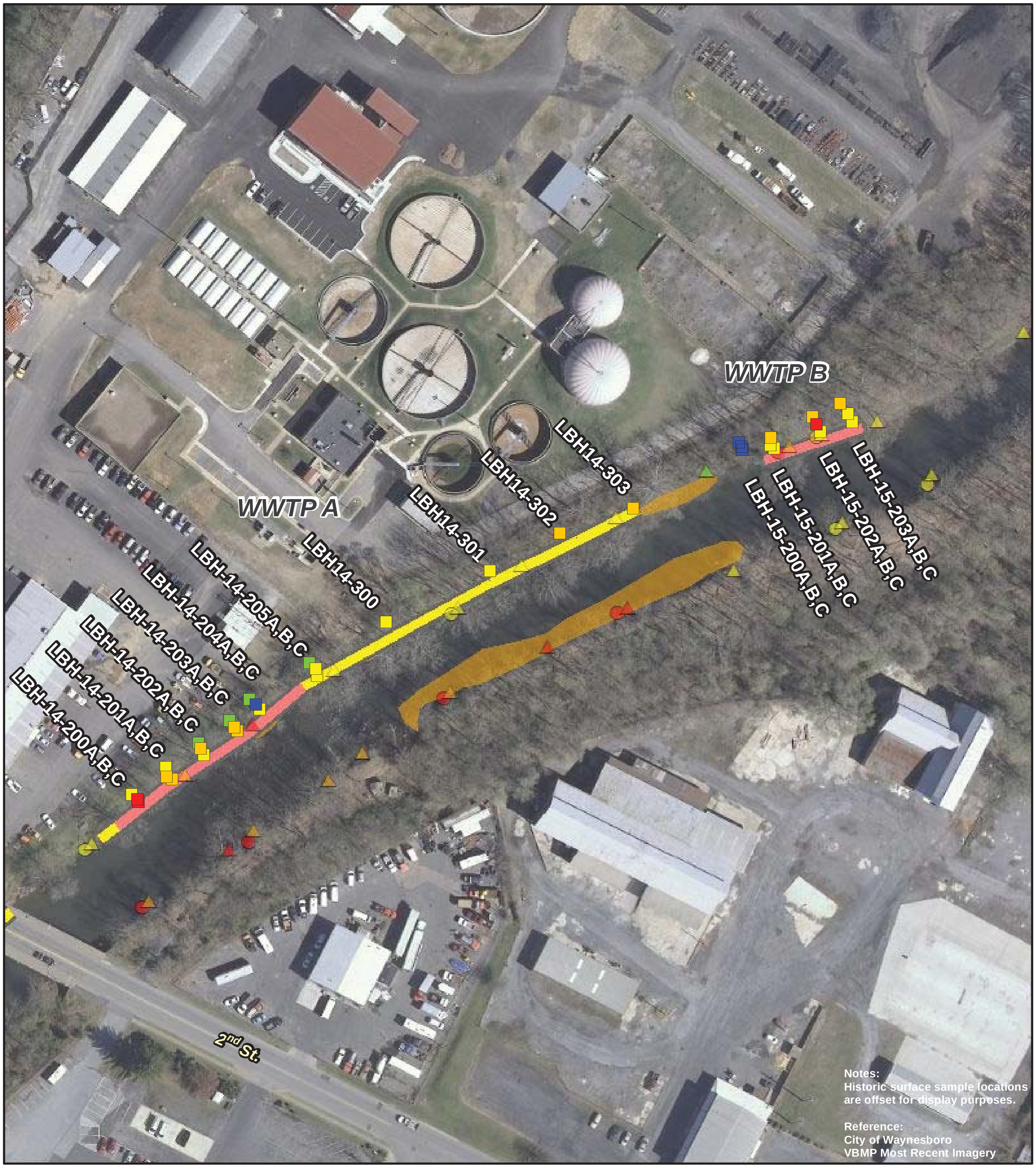
Checked by: JC

Date: 5/17/2016

Figure 1
Supplemental Soil Sample Locations
Constitution Park
Former DuPont Waynesboro Site, AOC 4

Waynesboro, Virginia

S:\Projects\IMS\DUPONT\STHRIVER\Projects\BankConcAndLoading\2015PhI-A-BMA-SupplBankCoring\Final BODR\Figure 1 Sample Locations Constitution Former Waynesboro Site AOC4.mxd



Legend

Supplemental Soil Samples: Avg. THg (mg/kg)	Historic Surface: Avg. THg (mg/kg)	Historic Cores: Avg. THg (mg/kg)
0.133 - 1	0.0778 - 1	0.0117 - 1
1.1 - 2.5	1.1 - 2.5	1.1 - 2.5
2.51 - 10	2.51 - 10	2.51 - 10
10.1 - 50	10.1 - 50	10.1 - 50
50.1 - 360	50.1 - 268	50.1 - 360

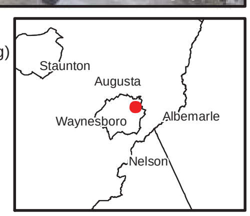
Phase 1A Primary BMA

Phase 1A Secondary BMA

Mapped Substrate Type

1.) Clays and Silts

2.) Fine Sands



AECOM

0 25 50 100 Feet

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Job: 60390328

Prepared by: VP/PJL

Checked by: JC

Date: 5/17/2016

Figure 2
Supplemental Soil Sample Locations
Wastewater Treatment Plant
Former DuPont Waynesboro Site, AOC 4

Waynesboro, Virginia

S:\Projects\IMS\DUPONT\STHRIVER\Projects\BankConcAndLoading\2015PhI-A-BMA-SupplBankCoring\Final BODR\Figure 2 Sample Locations Wastewater Treatment Plant Former Waynesboro Site AOC4.mxd

Appendix A:
Supplemental Soil Data

Transect	Boring	Sample ID	Depth/Sampling Interval (ft.)	THg (mg/kg)
LBH04-200	A	SC040315-LBH04-200A-(0-1)	0-1	48.5
		SC040315-LBH04-200A-(1-2)	1-2	34.4
		SC040315-LBH04-200A-(2-3)	2-3	17.1
		SC040315-LBH04-200A-(3-4)	3-4	2.28
	B	SC040315-LBH04-200B-(0-1)	0-1	81.5
		SC040315-LBH04-200B-(1-2)	1-2	154
		SC040315-LBH04-200B-(2-3)	2-3	1,580
		SC040315-LBH04-200B-(3-3.5)	3-3.5	3,610
	C	SC040315-LBH04-200C-(0-1)	0-1	252
		SC040315-LBH04-200C-(1-1.5)	1-1.5	581
LBH04-201	A	SC040315-LBH04-201A-(0-1)	0-1	22
		SC040315-LBH04-201A-(1-2)	1-2	20.2
		SC040315-LBH04-201A-(2-3)	2-3	1.73
		SC040315-LBH04-201A-(3-4)	3-4	1.3
		SC040315-LBH04-201A-(4-4.5)	4-4.5	0.915
	B	SC040315-LBH04-201B-(0-1)	0-1	39.6
		SC040315-LBH04-201B-(1-2)	1-2	51.6
		SC040315-LBH04-201B-(2-3)	2-3	464
		SC040315-LBH04-201B-(3-4)	3-4	84
		SC040315-LBH04-201B-(4-5)	4-5	1.25
		SC040315-LBH04-201B-(5-6)	5-6	5.65
	C	SC040315-LBH04-201C-(0-1)	0-1	1,820
		SC040315-LBH04-201C-(1-2)	1-2	332
LBH04-202	A	SC040215-LBH04-202A-(0-1)	0-1	23.9
		SC040215-LBH04-202A-(1-2)	1-2	0.857
	B	SC040215-LBH04-202B-(0-1)	0-1	40.9
		SC040215-LBH04-202B-(1-2)	1-2	19.2
		SC040215-LBH04-202B-(2-3)	2-3	29.5
	C	SC040215-LBH04-202C-(0-1)	0-1	47.1
		SC040215-LBH04-202C-(1-2)	1-2	21.2
LBH04-203	A	SC040215-LBH04-203A-(0-1)	0-1	23.5
		SC040215-LBH04-203A-(1-2)	1-2	0.508
		SC040215-LBH04-203A-(2-3)	2-3	0.931
		SC040215-LBH04-203A-(3-4)	3-4	4.99
		SC040215-LBH04-203A-(4-5)	4-5	3.8
	B	SC040215-LBH04-203B-(0-1)	0-1	38.5
		SC040215-LBH04-203B-(1-2)	1-2	53.8
		SC040215-LBH04-203B-(2-3)	2-3	7.59
	C	SC040215-LBH04-203C-(0-1)	0-1	38.6
		SC040215-LBH04-203C-(1.5-2.5	1.5-2.5	10.6
LBH04-204	A	SC040215-LBH04-204A-(0-1)	0-1	21.1
		SC040215-LBH04-204A-(1-2)	1-2	4.41
		SC040215-LBH04-204A-(2-2.5)	2-2.5	62.8
	B	SC040215-LBH04-204B-(0-1)	0-1	8.89
		SC040215-LBH04-204B-(1-2)	1-2	2.23
		SC040215-LBH04-204B-(2-3)	2-3	1.75
	C	SC040215-LBH04-204C-(0-1)	0-1	5.02
		SC040215-LBH04-204C-(1-2)	1-2	0.759
		SC040215-LBH04-204C-(2-3)	2-3	4.18
		SC040215-LBH04-204C-(3-3.5)	3-3.5	92.3
LBH04-205	A	SC040215-LBH04-205A-(0-1)	0-1	4.2
		SC040215-LBH04-205A-(1-2)	1-2	7.74
		SC040215-LBH04-205A-(2-2.5)	2-2.5	2.98
	B	SC040215-LBH04-205B-(0-1)	0-1	7
		SC040215-LBH04-205B-(1-2)	1-2	8.27
		SC040215-LBH04-205B-(2-3)	2-3	12
	C	SC040215-LBH04-205C-(0-1)	0-1	11.3
		SC040215-LBH04-205C-(1-2)	1-2	12.8

Transect	Boring	Sample ID	Depth/Sampling Interval (ft.)	THg (mg/kg)
LBH14-200	A	SC040615-LBH14-200A-(0-1)	0-1	4.42
		SC040615-LBH14-200A-(1-2)	1-2	0.65
		SC040615-LBH14-200A-(2-3)	2-3	0.985
		SC040615-LBH14-200A-(3-3.5)	3-3.5	0.219
	B	SC040615-LBH14-200B-(0-1)	0-1	48.3
		SC040615-LBH14-200B-(1-2)	1-2	482
		SC040615-LBH14-200B-(2-3)	2-3	197
		SC040615-LBH14-200B-(3-4)	3-4	38.2
		SC040615-LBH14-200B-(4-5)	4-5	36.5
		SC040615-LBH14-200B-(5-6)	5-6	18.9
		SC040615-LBH14-200B-(6-7)	6-7	10.7
	C	SC040615-LBH14-200C-(0-1)	0-1	495
		SC040615-LBH14-200C-(1-2)	1-2	79.2
		SC040615-LBH14-200C-(2-3)	2-3	21.5
		SC040615-LBH14-200C-(3-4)	3-4	15
		SC040615-LBH14-200C-(4-5)	4-5	14.9
		SC040615-LBH14-200C-(5-6)	5-6	6.73
		SC040615-LBH14-200C-(6-7)	6-7	1.51
LBH14-201	A	SC040615-LBH14-201A-(0-1)	0-1	14.6
		SC040615-LBH14-201A-(1-2)	1-2	2.41
		SC040615-LBH14-201A-(2-3)	2-3	2.28
	B	SC040615-LBH14-201B-(0-1)	0-1	14
		SC040615-LBH14-201B-(1-2)	1-2	38
		SC040615-LBH14-201B-(2-3)	2-3	14.7
		SC040615-LBH14-201B-(3-4)	3-4	1.68
		SC040615-LBH14-201B-(4-5)	4-5	3.61
		SC040615-LBH14-201B-(5-6)	5-6	0.353
	C	SC040615-LBH14-201C-(0-1)	0-1	23.9
		SC040615-LBH14-201C-(1-2)	1-2	31.4
		SC040615-LBH14-201C-(2-3)	2-3	2.08
		SC040615-LBH14-201C-(3-4)	3-4	4.26
		SC040615-LBH14-201C-(4-5)	4-5	3.13
		SC040615-LBH14-201C-(5-6)	5-6	2.94
LBH14-202	A	SC040715-LBH14-202A-(0-1)	0-1	1.92
		SC040715-LBH14-202A-(1-2)	1-2	1.25
		SC040715-LBH14-202A-(2-3)	2-3	13.2
		SC040715-LBH14-202A-(3-4)	3-4	3.05
		SC040715-LBH14-202A-(4-5)	4-5	2.32
		SC040715-LBH14-202A-(5-6)	5-6	0.47
	B	SC040715-LBH14-202B-(0-1)	0-1	6.47
		SC040715-LBH14-202B-(1-2)	1-2	29.5
		SC040715-LBH14-202B-(2-3)	2-3	30.6
		SC040715-LBH14-202B-(3-4)	3-4	11.3
		SC040715-LBH14-202B-(4-5)	4-5	2.59
	C	SC040715-LBH14-202C-(0-1)	0-1	8.14
		SC040715-LBH14-202C-(1-2)	1-2	6.34
		SC040715-LBH14-202C-(2-3)	2-3	40.8
		SC040715-LBH14-202C-(3-4)	3-4	254
		SC040715-LBH14-202C-(4-5)	4-5	39.5
LBH14-203	A	SC040715-LBH14-203A-(0-1)	0-1	1.93
		SC040715-LBH14-203A-(1-2)	1-2	0.446
		SC040715-LBH14-203A-(2-3)	2-3	0.266
	B	SC040715-LBH14-203B-(0-1)	0-1	3.71
		SC040715-LBH14-203B-(1-2)	1-2	19.7
		SC040715-LBH14-203B-(2-3)	2-3	185
		SC040715-LBH14-203B-(3-4)	3-4	5.66
		SC040715-LBH14-203B-(4-4.5)	4-4.5	14.5
	C	SC040715-LBH14-203C-(0-1)	0-1	10.8
		SC040715-LBH14-203C-(1-2)	1-2	78.2
		SC040715-LBH14-203C-(2-3)	2-3	107
		SC040715-LBH14-203C-(3-4)	3-4	42.2
		SC040715-LBH14-203C-(4-5)	4-5	8.02

Transect	Boring	Sample ID	Depth/Sampling Interval (ft.)	THg (mg/kg)
LBH14-204	A	SC040715-LBH14-204A-(0-1)	0-1	2.71
		SC040715-LBH14-204A-(1-2)	1-2	0.226
		SC040715-LBH14-204A-(2-3)	2-3	0.156
		SC040715-LBH14-204A-(3-4)	3-4	0.181
		SC040715-LBH14-204A-(4-5)	4-5	0.189
		SC040715-LBH14-204A-(5-5.5)	5-5.5	0.033 J
	B	SC040715-LBH14-204B-(0-1)	0-1	0.814
		SC040715-LBH14-204B-(1-2)	1-2	0.282
		SC040715-LBH14-204B-(2-3)	2-3	1.78
	C	SC040715-LBH14-204C-(0-1)	0-1	2.97
		SC040715-LBH14-204C-(1-2)	1-2	7.15
		SC040715-LBH14-204C-(2-3)	2-3	35.9
		SC040715-LBH14-204C-(3-4)	3-4	407
		SC040715-LBH14-204C-(4-5)	4-5	52.5
		SC040715-LBH14-204C-(5-5.5)	5-5.5	38.9
LBH14-205	A	SC040715-LBH14-205A-(0-1)	0-1	1.03
		SC040715-LBH14-205A-(1.2)	1-2	1.29
		SC040715-LBH14-205A-(2-3)	2-3	1.44
	B	SC040715-LBH14-205B-(0-1)	0-1	4.97
		SC040715-LBH14-205B-(1-2)	1-2	3.08
		SC040715-LBH14-205B-(2-3)	2-3	2.24
		SC040715-LBH14-205B-(3-4)	3-4	0.54
	C	SC040715-LBH14-205C-(0-1)	0-1	5.82
		SC040715-LBH14-205C-(1-2)	1-2	4.52
		SC040715-LBH14-205C-(2-2.5)	2-2.5	13.2
LBH14-300	SS	SS030716-LBH14-300-(0-1.2)	0-1.2	5.8
		SS030716-LBH14-300-(1.2-2.4)	1.2-2.4	10.2
		SS030716-LBH14-300-(2.4-3.6)	2.4-3.6	12.6
		SS030716-LBH14-300-(3.6-4.8)	3.6-4.8	5.0
		SS030716-LBH14-300-(4.8-6.0)	4.8-6	5.5
LBH14-301	SS	SS030716-LBH14-301-(0-2)	0-2	4.0
		SS030716-LBH14-301-(2-4)	2-4	6.3
		SS030716-LBH14-301-(4-6)	4-6	10.9
		SS030716-LBH14-301-(6-8)	6-8	8.1
		SS030716-LBH14-301-(8-10)	8-10	9.5
LBH14-302	SS	SS030716-LBH14-302-(0-2)	0-2	13.7
		SS030716-LBH14-302-(2-4)	2-4	24.3
		SS030716-LBH14-302-(4-6)	4-6	9.2
		SS030716-LBH14-302-(6-8)	6-8	8.2
		SS030716-LBH14-302-(8-10)	8-10	9.1
LBH14-303	SS	SS030716-LBH14-303-(0-2)	0-2	6.5
		SS030716-LBH14-303-(2-4)	2-4	24.5
		SS030716-LBH14-303-(4-6)	4-6	20.8
		SS030716-LBH14-303-(6-8)	6-8	10.3
		SS030716-LBH14-303-(8-10)	8-10	8.56
LBH15-200	A	SC040115-LBH15-200A-(0-1)	0-1	0.239
		SC040115-LBH15-200A-(1-2)	1-2	0.168
		SC040115-LBH15-200A-(2-3)	2-3	0.546
		SC040115-LBH15-200A-(3-4)	3-4	0.392
		SC040115-LBH15-200A-(4-5)	4-5	0.112
		SC040115-LBH15-200A-(5-6)	5-6	0.095 J
		SC040115-LBH15-200A-(6-7)	6-7	0.0412 J
		SC040115-LBH15-200A-(7-8)	7-8	0.0338 J
	B	SC040115-LBH15-200B-(0-1)	0-1	0.155
		SC040115-LBH15-200B-(1-2)	1-2	0.161
		SC040115-LBH15-200B-(2-3)	2-3	0.76
		SC040115-LBH15-200B-(3-4)	3-4	0.147
		SC040115-LBH15-200B-(4-5)	4-5	0.0492 J
		SC040115-LBH15-200B-(5-6)	5-6	0.0402 J
		SC040115-LBH15-200B-(6-7)	6-7	0.0860 J
		SC040115-LBH15-200B-(7-8)	7-8	0.0897 J
	C	SC040115-LBH15-200C-(0-1)	0-1	0.153
		SC040115-LBH15-200C-(1-2)	1-2	0.113 J
		SC040115-LBH15-200C-(2-3)	2-3	0.333
		SC040115-LBH15-200C-(3-4)	3-4	0.0511 J
		SC040115-LBH15-200C-(4-5)	4-5	0.0858 J
		SC040115-LBH15-200C-(5-6)	5-6	0.0297 J
		SC040115-LBH15-200C-(6-7)	6-7	0.0274 J
		SC040115-LBH15-200C-(7-8)	7-8	0.0187 J

Transect	Boring	Sample ID	Depth/Sampling Interval (ft.)	THg (mg/kg)
LBH15-201	A	SC040115-LBH15-201A-(0-1)	0-1	12.9
		SC040115-LBH15-201A-(1-2)	1-2	78.5
		SC040115-LBH15-201A-(2-3)	2-3	2.47
		SC040115-LBH15-201A-(3-4)	3-4	3.73
		SC040115-LBH15-201A-(4-5)	4-5	3.22
		SC040115-LBH15-201A-(5-5.5)	5-5.5	2.76
	B	SC040115-LBH15-201B-(0-1)	0-1	15.2
		SC040115-LBH15-201B-(1-2)	1-2	3.91
		SC040115-LBH15-201B-(2-3)	2-3	0.293
		SC040115-LBH15-201B-(3-4)	3-4	0.833
		SC040115-LBH15-201B-(4-5)	4-5	0.217
	C	SC040115-LBH15-201C-(0-1)	0-1	0.399
		SC040115-LBH15-201C-(1-2)	1-2	18.4
		SC040115-LBH15-201C-(2-3)	2-3	347
		SC040115-LBH15-201C-(3-4)	3-4	233
		SC040115-LBH15-201C-(4-5)	4-5	257
		SC040115-LBH15-201C-(5-6)	5-6	96.5
		SC040115-LBH15-201C-(6-6.5)	6-6.5	37.4
LBH15-202	A	SC040115-LBH15-202A-(0-1)	0-1	13.6
		SC040115-LBH15-202A-(1-2)	1-2	29
		SC040115-LBH15-202A-(2-3)	2-3	456
		SC040115-LBH15-202A-(3-4)	3-4	1,070
		SC040115-LBH15-202A-(4-4.5)	4-4.5	194
	B	SC040115-LBH15-202B-(0-1)	0-1	44.2
		SC040115-LBH15-202B-(1-2)	1-2	199
		SC040115-LBH15-202B-(2-3)	2-3	630
		SC040115-LBH15-202B-(3-4)	3-4	407
		SC040115-LBH15-202B-(4-4.5)	4-4.5	1,200
	C	SC040115-LBH15-202C-(0-1)	0-1	6.57
		SC040115-LBH15-202C-(1-2)	1-2	8.29
		SC040115-LBH15-202C-(2-3)	2-3	15.5
		SC040115-LBH15-202C-(3-4)	3-4	13.1
LBH15-203	A	SC040115-LBH15-203A-(0-1)	0-1	16.2
		SC040115-LBH15-203A-(1-2)	1-2	18.9
		SC040115-LBH15-203A-(2-3)	2-3	413
		SC040115-LBH15-203A-(3-4)	3-4	328
		SC040115-LBH15-203A-(4-5)	4-5	458
		SC040115-LBH15-203A-(5-5.5)	5-5.5	1,600
	B	SC040115-LBH15-203B-(0-1)	0-1	3.67
		SC040115-LBH15-203B-(1-2)	1-2	6.11
		SC040115-LBH15-203B-(2-3)	2-3	9.77
		SC040115-LBH15-203B-(3-3.5)	3-3.5	25.3
	C	SC040115-LBH15-203C-(0-1)	0-1	7.75
		SC040115-LBH15-203C-(1-2)	1-2	7.63

Notes:

J= Analyte present. Reported value may not be accurate or precise, THg = Total mercury, SS = Surficial soil

APPENDIX C
BATHYMETRIC SURVEY DATA

1 SURVEY DESCRIPTION

This appendix documents the hydrographic survey that was performed from November 3 through November 7, 2014, to obtain bathymetry along the first 2 miles of the South River, Virginia, beginning at the former DuPont Waynesboro facility at relative river mile (RRM) 0 and extending through RRM 2. River bed elevation data obtained during this survey are shown in Figures C-1 through C-3.

The river bed survey was performed using electronic survey techniques for horizontal and vertical data acquisition. River bed elevations were obtained using total station methods with a minimum of 25-foot spacing. Elevations were collected along transect lines spaced at 100-foot intervals running perpendicular to the river centerline, with tie-lines oriented parallel to the direction of flow at approximately one-third and two-thirds of the channel width. In addition to collecting bed elevation as described above, the position, length, and width of any bridge piers within the target survey area were also obtained.

FIGURES

B:\Projects\Dupont\South River\CAD\0952-BODR-001-CHANNEL SURVEY.dwg FIGURE C-1

Sep 21, 2015 2:19pm epipkin

SOURCE: Drawing prepared from survey provided by Spicer Group, Inc. Survey conducted November 2014.
HORIZONTAL DATUM: Virginia State Plane North Zone, North American Datum of 1983, U.S. feet
VERTICAL DATUM: North American Vertical Datum of 1988, U.S. feet
NOTES:
1. Aerial image is Google Earth (October 4, 2012). Acquired from Google Earth Pro (v.7.1.1.1888) on April 23, 2014.
2. RRM = relative river mile

LEGEND:

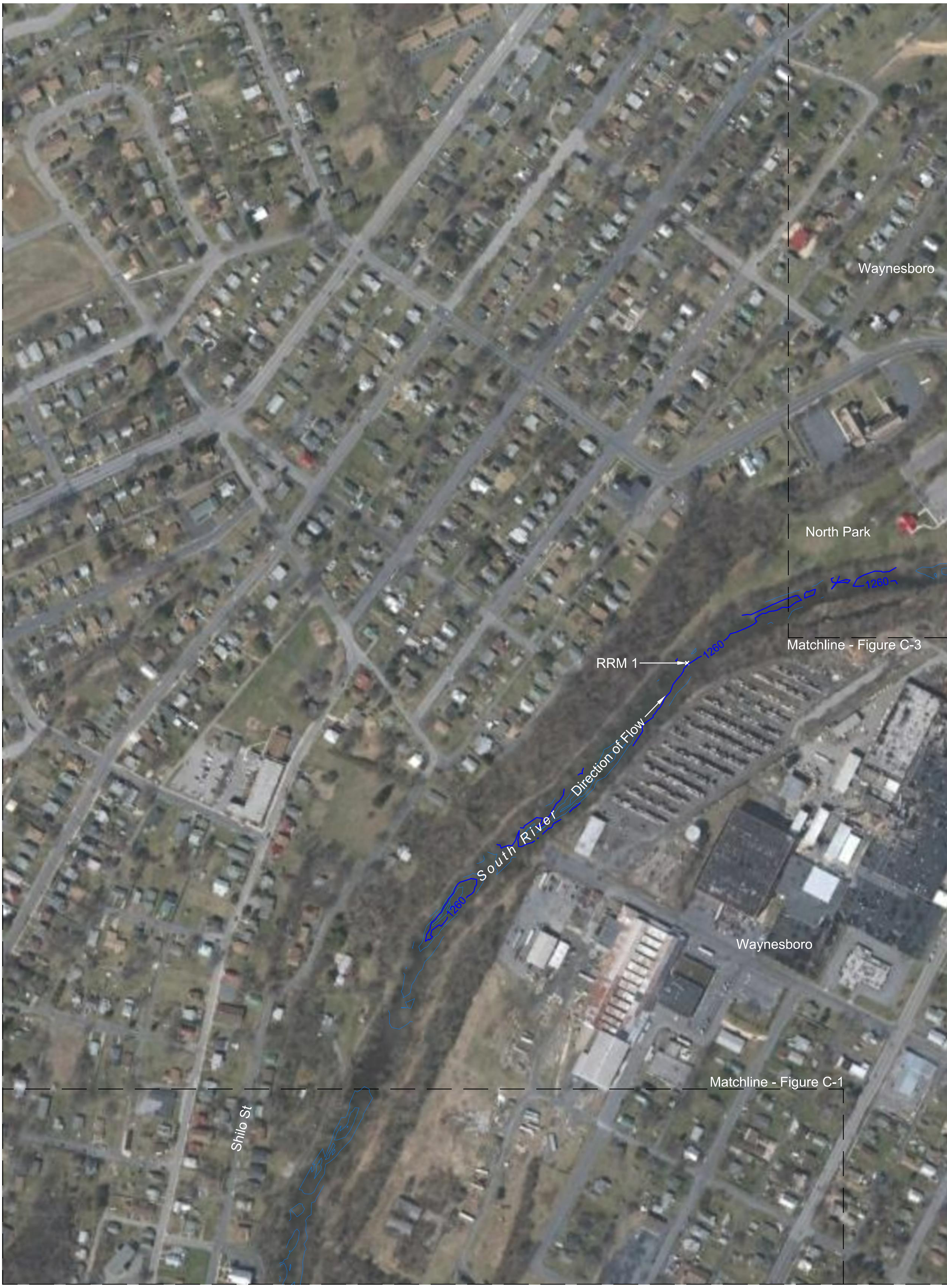
Major Contour (5-foot interval)

Minor Contour (1-foot interval)

0 Feet 300

ANCHOR QEA

Figure C-1
2014 Channel Survey RRMs 0 through 0.68
Basis of Design Report - Phase 1A Bank Management Areas
South River Area of Concern 4



B:\Projects\Dupont\South River\CAD\0952-BODR-001-CHANNEL SURVEY.dwg FIGURE C-2

Sep 21, 2015 2:19pm epipkin

SOURCE: Drawing prepared from survey provided by Spicer Group, Inc. Survey conducted November 2014.
HORIZONTAL DATUM: Virginia State Plane North Zone, North American Datum of 1983, U.S. feet
VERTICAL DATUM: North American Vertical Datum of 1988, U.S. feet
NOTES:
1. Aerial image is Google Earth (October 4, 2012). Acquired from Google Earth Pro (v.7.1.1.1888) on April 23, 2014.
2. RRM = relative river mile

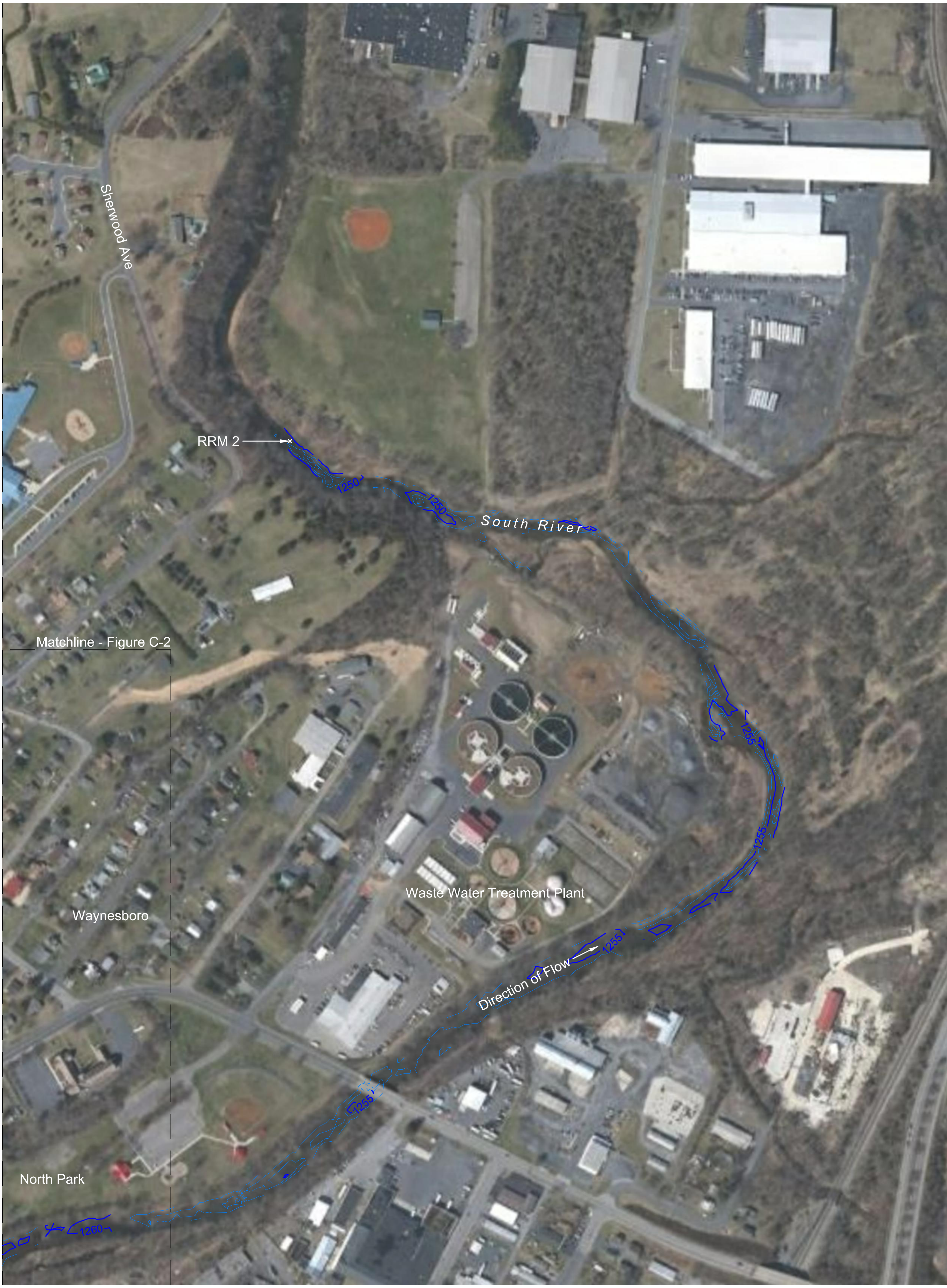
LEGEND:

Major Contour (5-foot interval)

Minor Contour (1-foot interval)

0 Feet 300

Figure C-2
2014 Channel Survey RRMs 0.57 through 1.16
Basis of Design Report - Phase 1A Bank Management Areas
South River Area of Concern 4



B:\Projects\Dupont\South River\CAD\0952-BODR-001-CHANNEL SURVEY.dwg FIGURE C-3

Sep 21, 2015 2:19pm epipkin

SOURCE: Drawing prepared from survey provided by Spicer Group, Inc. Survey conducted November 2014.
HORIZONTAL DATUM: Virginia State Plane North Zone, North American Datum of 1983, U.S. feet
VERTICAL DATUM: North American Vertical Datum of 1988, U.S. feet
NOTES:
1. Aerial image is Google Earth (October 4, 2012). Acquired from Google Earth Pro (v.7.1.1.1888) on April 23, 2014.
2. RRM = relative river mile

LEGEND:

Major Contour (5-foot interval)

Minor Contour (1-foot interval)

0 Feet 300

ANCHOR QEA

Figure C-3
2014 Channel Survey RRMs 1.07 through 2.0
Basis of Design Report - Phase 1A Bank Management Areas
South River Area of Concern 4

APPENDIX D
GEOPHYSICAL SURVEY REPORT

URS

January 6, 2015

Via Email
Mr. Michael Liberati
DuPont Corporate Remediation Group
133 Blakiston Lane
Warwick, MD 21912

Subject: Geophysical Investigation Report
Subsurface Utility Location Survey
AOC 4 Interim Measures – Phase 1A BMAs
Waynesboro, Virginia

Dear Mr. Liberati:

In accordance with our proposal dated November 3, 2014, URS Corporation (URS) Geophysical Services group is pleased to present this report on the findings of a geophysical investigation conducted within Area of Concern 4 (AOC 4) near the former DuPont Waynesboro Plant in Waynesboro, Virginia. The objective of the geophysical survey was to locate and map potential underground utilities and obstructions in advance of planned intrusive work within the Phase 1A Bank Management Areas (BMAs).

Project and Site Description

Geophysical surveying for underground utilities was performed along portions of the eastern and western banks of South River, as shown on the attached Figures 1 through 10. The boring locations, as well as locations of the Phase 1A BMAs, are also presented on Figures 1 through 10. Suspected underground utilities within the survey area include active electric, fire protection, storm and sanitary sewer, gas, and unknown lines. Ground surface conditions generally consisted of moderately sloping and densely vegetated river banks. Table 1 provides a more detailed characterization of conditions encountered during surveying at each of the BMAs.

Geophysical Survey Methodology

The geophysical investigation was conducted using a combination of pipe and cable locating and tracing and ground-penetrating radar (GPR). Descriptions of the geophysical methods are provided below.

Pipe and Cable Locators and Tracers

Pipe and cable locators and tracers allow for inductive or conductive tracing of accessible utility lines. Tracing utilities with these instruments may require access to the utility, either via a manhole, an exposed portion of the utility, a standpipe or a valve stem. Cast iron or steel utility lines can be traced by transmitting a signal into the line via a multi-frequency high-power transmitter and using a receiver at the surface to track the signal. The signal can be transmitted to the utility either by placing the transmitter on the ground surface above the suspected utility location or by applying a signal directly to an exposed section of the utility.

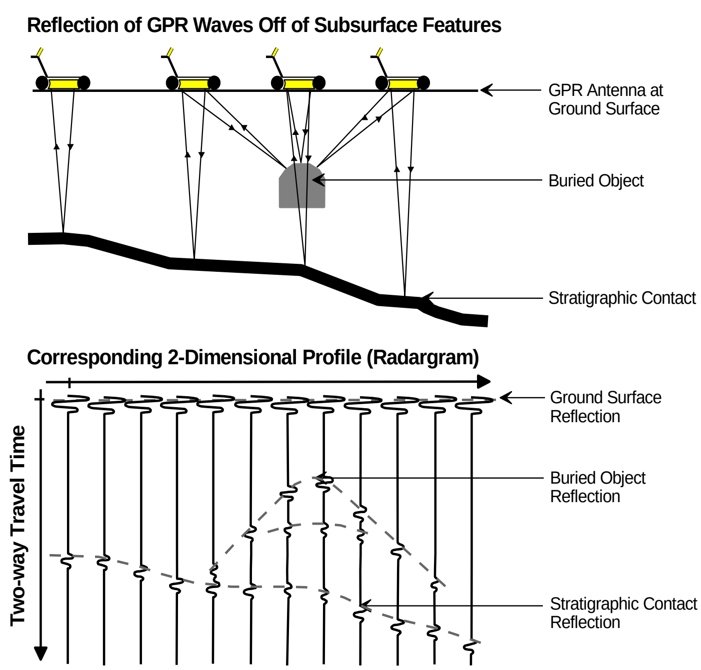
URS Corporation
12420 Milestone Center Dr., Ste. 150
Germantown, MD 20876
Tel: 301.820-3000
www.urscorp.com

Pipe and cable locating/tracing was performed using the Radiodetection Cable Avoidance Tool (C.A.T.) and the Radiodetection RD7000 receiver with a multi-frequency transmitter. Both instruments allow detection of radio signals that can be broadcast by metal utilities or inactive conduits. This feature allows for reliable tracing of utilities that have no access points, and is useful for conducting broad scans for subsurface utility lines. In addition, both instruments allow for detection of 60 Hz electric lines. A Schonstedt magnetic locator was also used to assist in locating and delineating metallic utilities.

Ground Penetrating Radar (GPR)

The GPR survey was completed using the Noggin SmartCart manufactured by Sensors and Software Inc., equipped with a 250 mHz antenna. The GPR method is widely used in subsurface utility studies. GPR provides an effective technology for detecting and delineating the extent of a variety of buried features of importance in these studies including metallic and non-metallic utility lines, buried building foundations, and backfilled trenches. The GPR method involves transmitting high-frequency electromagnetic pulses into the ground using a portable transducer antenna placed on the ground surface. The radar pulses are reflected by a variety of subsurface interfaces or buried objects. The reflected pulses are sensed by a receiver antenna located adjacent to the transmitter antenna.

As the transmitter and receiver are moved along a survey line, the reflected electromagnetic signals are displayed versus either travel times or relative depths on a graphic recorder or computer. In certain types of surveys the data can be stored and subsequently analyzed using specialized computer software. With the Noggin SmartCart and similar GPR instruments the transmitter and receiver are collocated in the same antenna housing.



The effectiveness of GPR surveying at a given site is directly related to the dielectric properties of the subsurface materials. The effective depth of exploration provided by the method can be limited by subsurface materials characterized by high conductivity and dielectric constants, including clay, metal and metallic minerals, or reinforced pavement which absorb radar energy thereby diminishing the responses associated with reflected waves associated with the features of interest. In general, the depth of investigation at a given site is inversely proportional to antenna frequency and the degree of feature resolution is proportional to antenna frequency. A relatively smooth ground surface is essential to collection of high quality data so that coherent signals are not muted by spurious signals associated with poor coupling of the antenna to the ground surface.

The GPR antenna is linked to a control/display unit by a wire or fiber optic connection. The control unit provides the operator a set of interactive data acquisition parameters, a display screen and file management and downloading capabilities via a computer interface. GPR data is typically collected continuously by moving a self-contained transmitter/ receiver antenna unit along linear transects. As the antenna is towed along the transect line, the reflected radar signals are displayed on a video screen which depicts an approximation of the subsurface interfaces in cross-section.

Field Investigation

The field investigation was completed between November 5 and 7, 2014, by two URS Geophysicists. URS field staff coordinated with Joshua Collins of URS, and Zachary Koehn of Anchor QEA to arrange site access, confirm the survey areas and coordinate with the drillers.

URS conducted a broad scan survey across the accessible extents of the 10 boring locations and 12 BMAs presented on Figures 1 through 10 using the pipe and cable locators and the GPR. The lateral extents of identified suspected subsurface utilities and obstructions were marked in the field using semi-permanent marking paint and flags. Utility depths below ground surface (bgs) were noted where determined.

URS acquired positional data using a Trimble differential global positioning system (DGPS) to record the positions of identified utilities and obstructions. Utility Avoidance Field Sketches were created to reference the locations of relevant site features and marked suspected utilities for nine of the ten proposed boring locations and included as Attachment A. A sketch was not created for AQSR-01 as drilling was being performed at the time URS arrived onsite to mark utilities at that location.

Access to significant portions of the BMAs was limited by steep slopes and/or dense vegetation. In most locations vegetation and moderately to steeply sloped banks prevented the performance of surveying along portions of the river banks within each of the 12 BMAs. In areas where 100 percent coverage was not achievable, the following three steps were taken:

1) Utilities were scanned for along transects running roughly parallel to the river banks across the accessible portions of the banks where vegetation and slope allowed access.
2) Utilities were scanned for along transects running roughly perpendicular to the river banks along accessible portions of the survey area. In several instances surveying was

performed in accessible areas as far as 100 feet away from the river's edge to scan for utilities running perpendicular to the river and entering the BMAs.

3) Visual inspection of the densely vegetated and steeply sloped sections of BMAs, where fully effective surveying with the entire suite of tools could not be completed. This also included the survey crew wading in the river along the entire length of each of the BMAs to visually scan the banks for features previously unidentified by geophysical surveying on shore.

Boring ID	BMA ID	Surface Conditions	Survey Methods Implemented
AQSR-01	P1A-L-0020-0024	Flat, grass and paved surfaces transitioning to moderately to steeply sloping and densely vegetated river bank	GPR / CAT / RD-7000 / Schonstedt / Visual Inspection
	P1A-R-0029-0031	Moderately to steeply sloping densely vegetated river bank	CAT / Schonstedt / Visual Inspection
AQSR-02	P1A-L-0048-0051	Flat, grass surfaces	GPR / CAT / RD-7000 / Schonstedt / Visual Inspection
AQSR-03	P1A-L-0085-0107	Primarily moderately to steeply sloping densely vegetated river bank. Parellel hard-packed access road existed	GPR / CAT / RD-7000 / Schonstedt / Visual Inspection
AQSR-04			
AQSR-05	P1A-L-0116-0128	Moderately to steeply sloping densely vegetated river bank	GPR / CAT / RD-7000 / Schonstedt / Visual Inspection
AQSR-06			
	P1A-L-0130-0132	Moderately to steeply sloping densely vegetated river bank / 2nd Street Bridge	CAT / Schonstedt / Visual Inspection
	P1A-R-0123-0125	Moderately to steeply sloping densely vegetated river bank	CAT / Schonstedt / Visual Inspection
AQSR-07	P1A-R-0126-0130		CAT / RD-7000 / Schonstedt / Visual Inspection
AQSR-08	P1A-L-0133-0146	Moderately to steeply sloping densely vegetated river bank	GPR / CAT / RD-7000 / Schonstedt / Visual Inspection
AQSR-09	P1A-L-0148-0150		
AQSR-10	P1A-R-0188-0194	Gently to moderately sloping densely vegetated river bank	GPR / CAT / RD-7000 / Schonstedt / Visual Inspection
	P1A-L-0190-0192	Steeply sloping densely vegetated river bank	Visual Inspection

Table 1: Conditions encountered at each BMA and boring location

Investigation Results

The results of the utility mapping are presented as Figures 1 through 10. Composite maps displaying the lateral extents of the designated survey areas (BMAs), the locations of the borings and the locations of identified linear anomalies and suspected subsurface utilities are provided as Figures 1 through 10. The displayed survey areas are based on the boundaries indicated on the available site plan. It should be noted that the features presented on the attached figures are limited to utilities or linear anomalies that were detected by URS during the field investigation. Not all utilities identified on the available applicable site drawings that were not verified during the utility mapping field investigation have been included.

Preexisting utility maps were reviewed by the survey crew at the City of Waynesboro's waste water treatment facility. Review confirmed the locations of the sanitary sewer river crossing points as displayed on the attached figures by a dashed yellow line. Storm water drains, as well as other utilities, were not indicated on the available utility maps. Several unknown linear features are presented on the attached figures as green lines. The identity of these suspected utilities could not be determined in the field based on geophysical surveying.

Limitations

This geophysical investigation was conducted in accordance with reasonable and accepted engineering geophysics practices, and the interpretations and conclusions are rendered in a manner consistent with other consultants in our profession. However, all geophysical techniques have some level of uncertainty and limitations. No other representations to the client are expressed or implied, and no warrant or guarantee is included or intended.

We greatly appreciated the opportunity to provide you with these services. Please feel free to contact us at (301) 820-3000 if you have any questions.

Very truly yours,

URS Corporation

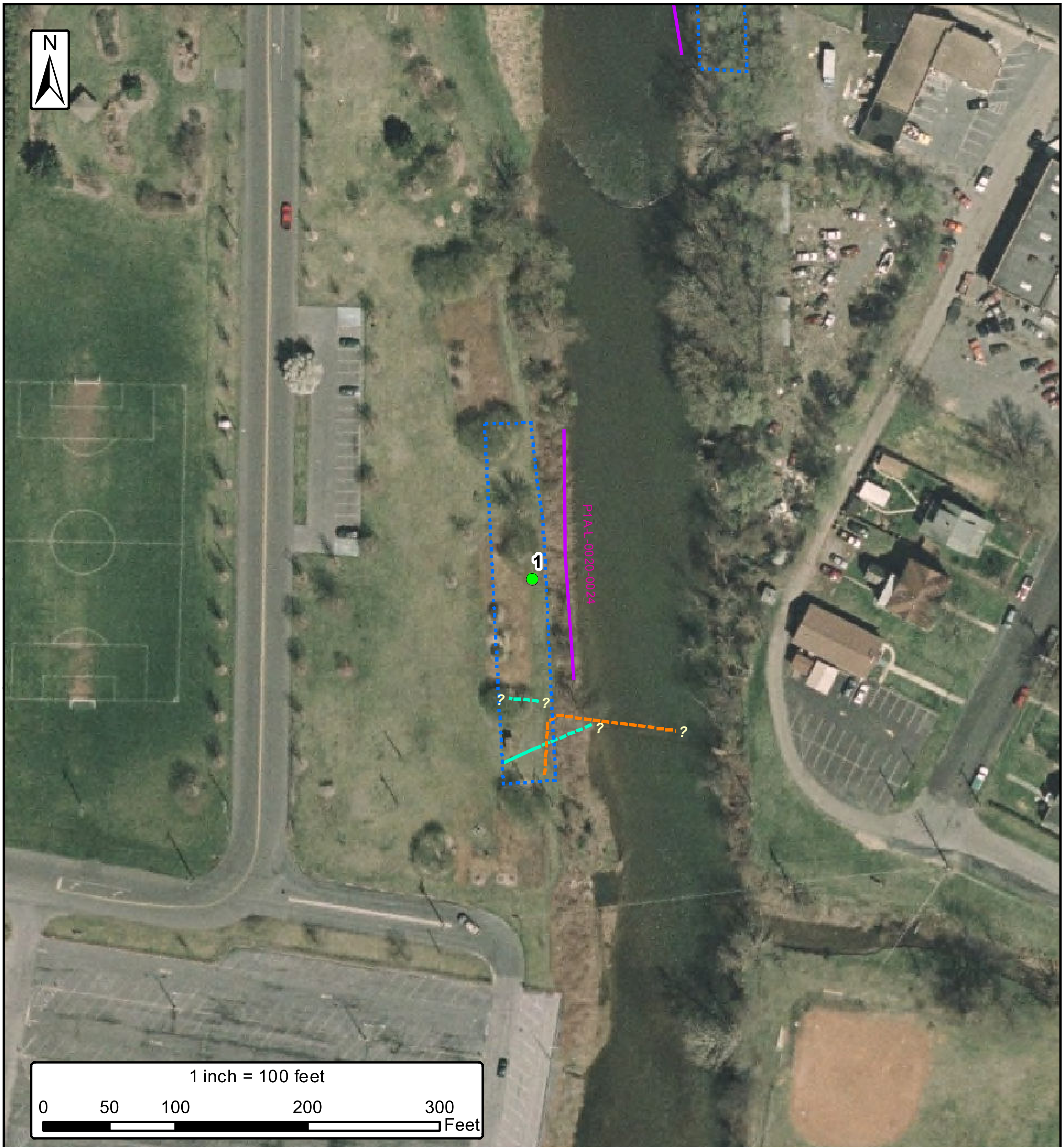
Steven J. Husted
Geophysicist

Timothy J. King, P.G.
Principal Geologist

Cc: Ceil Mancini, URS Program Manager

Attachments: Figures 1 through 10 – Bank Management Area Utility Maps
Attachment A – Utility Avoidance Field Sketches

FIGURES



Legend

- RRM Intervals Whole Mile
- Boring
- Phase 1BMA's
- Unknown Termination
- Sanitary Manhole
- Storm Manhole
- Water Valve
- 3' Interpreted Utility Depth
- Gas
- Sanitary
- Sanitary (Interpreted)
- Storm
- Storm (Interpreted)
- Electric
- Water
- Water (Interpreted)
- Unkown Linear Anomaly
- Geophysical Investigation Limits

Reference:
VBMP 2007 Aerial Imagery

NAD 1983 StatePlane Virginia North
Projection: Transverse Mercator
Linear Unit: Foot US

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Job: 18986308

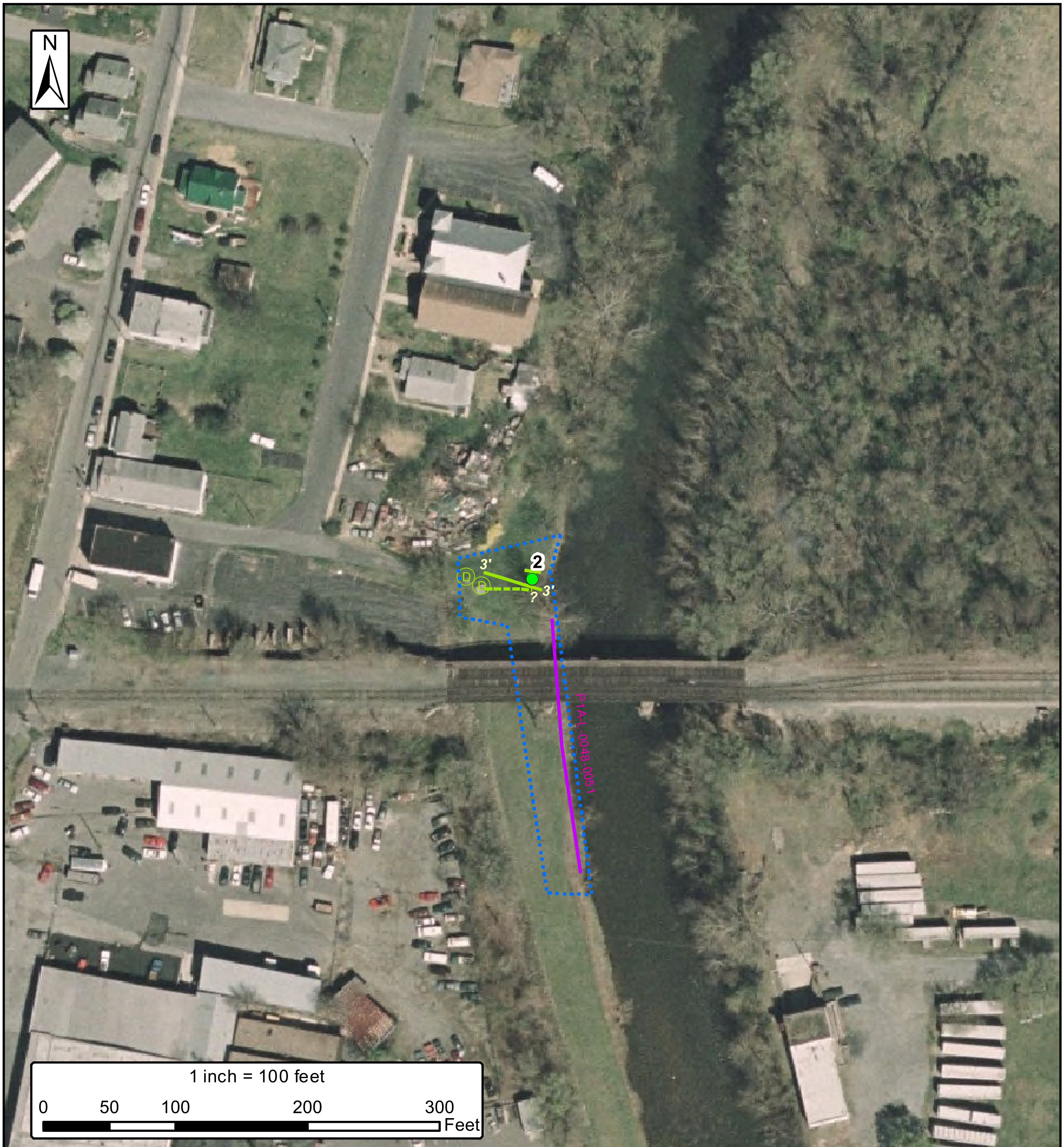
Prepared by: RRM III

Checked by: SH

Date: 1/9/2015

Figure 1
Bank Management Areas
Phase 1 Surveyed Utilities at Boring Locations
Former Dupont Waynesboro Plant
Waynesboro, Virginia

Q:\Projects\ENG\Geophysics\DuPont\DuPont-Invista Waynesboro\Utility-Avoidance-2014\F_Data\GIS\MXDs\Figure 2 BMA Utility Survey_REV2.mxd



Legend

RRM Intervals Whole Mile	Sanitary Manhole	Gas	Storm	Water
Boring	Storm Manhole	Sanitary	Storm (Interpreted)	Water (Interpreted)
Phase 1BMA's	Water Valve	Sanitary (Interpreted)	Electric	Unkown Linear Anomaly
Unknown Termination	Interpreted Utility Depth			Geophysical Investigation Limits

Reference:
VBMP 2007 Aerial Imagery

NAD 1983 StatePlane Virginia North
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Figure 2
Bank Management Areas
Phase 1 Surveyed Utilities at Boring Locations
Former Dupont Waynesboro Plant
Waynesboro, Virginia

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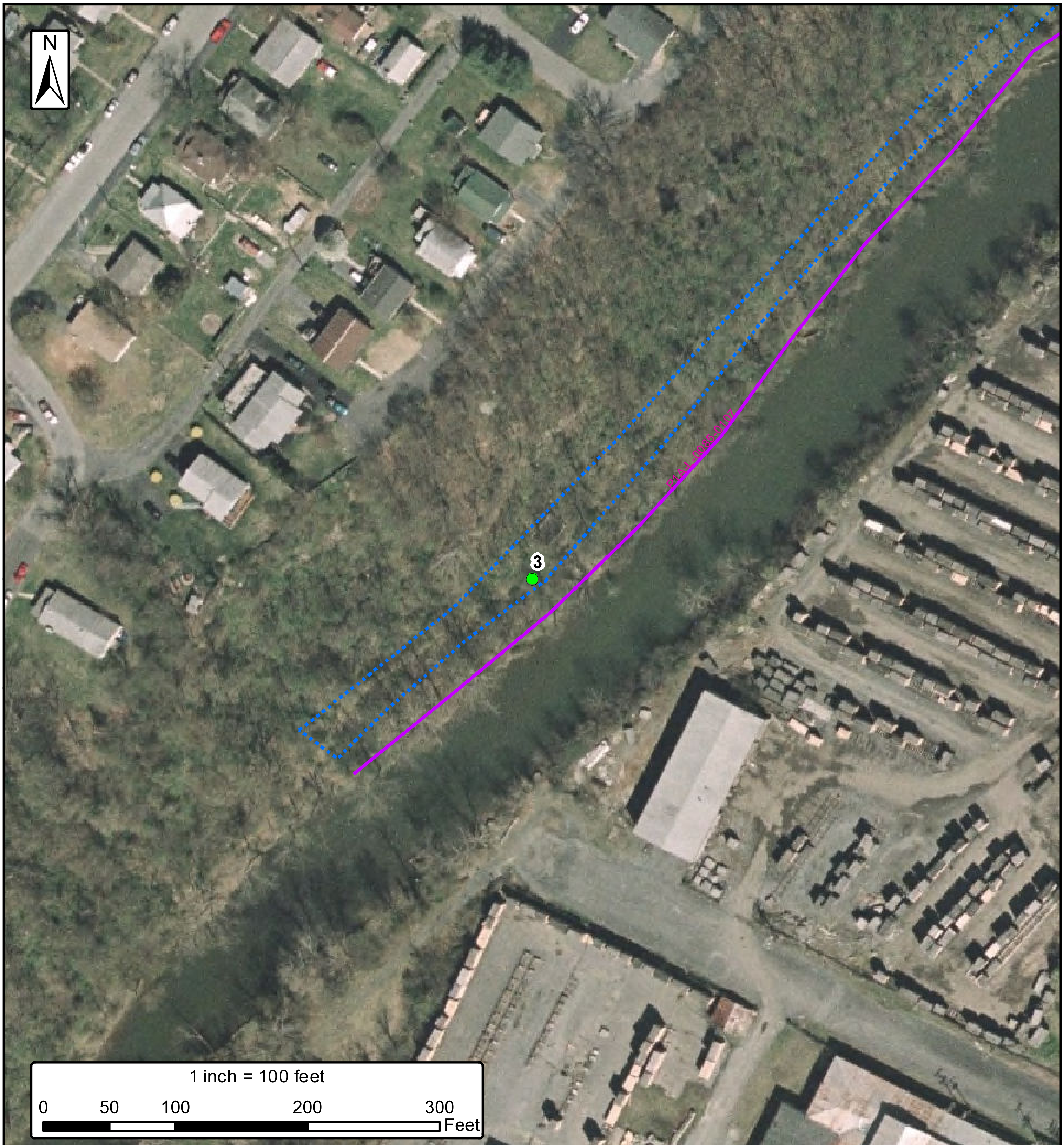

Legend

- RRM Intervals Whole Mile
- Boring
- Phase 1BMA's
- Unknown Termination
- Sanitary Manhole
- Storm Manhole
- Water Valve
- 3' Interpreted Utility Depth
- Gas
- Sanitary
- Sanitary (Interpreted)
- Storm
- Storm (Interpreted)
- Electric
- Water
- Water (Interpreted)
- Unkown Linear Anomaly
- Geophysical Investigation Limits

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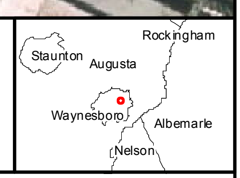
Linear Unit: Foot US



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Checked by: SH	
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Figure 3
Bank Management Areas
Phase 1 Surveyed Utilities at Boring Locations

Former Dupont Waynesboro Plant
Waynesboro, Virginia

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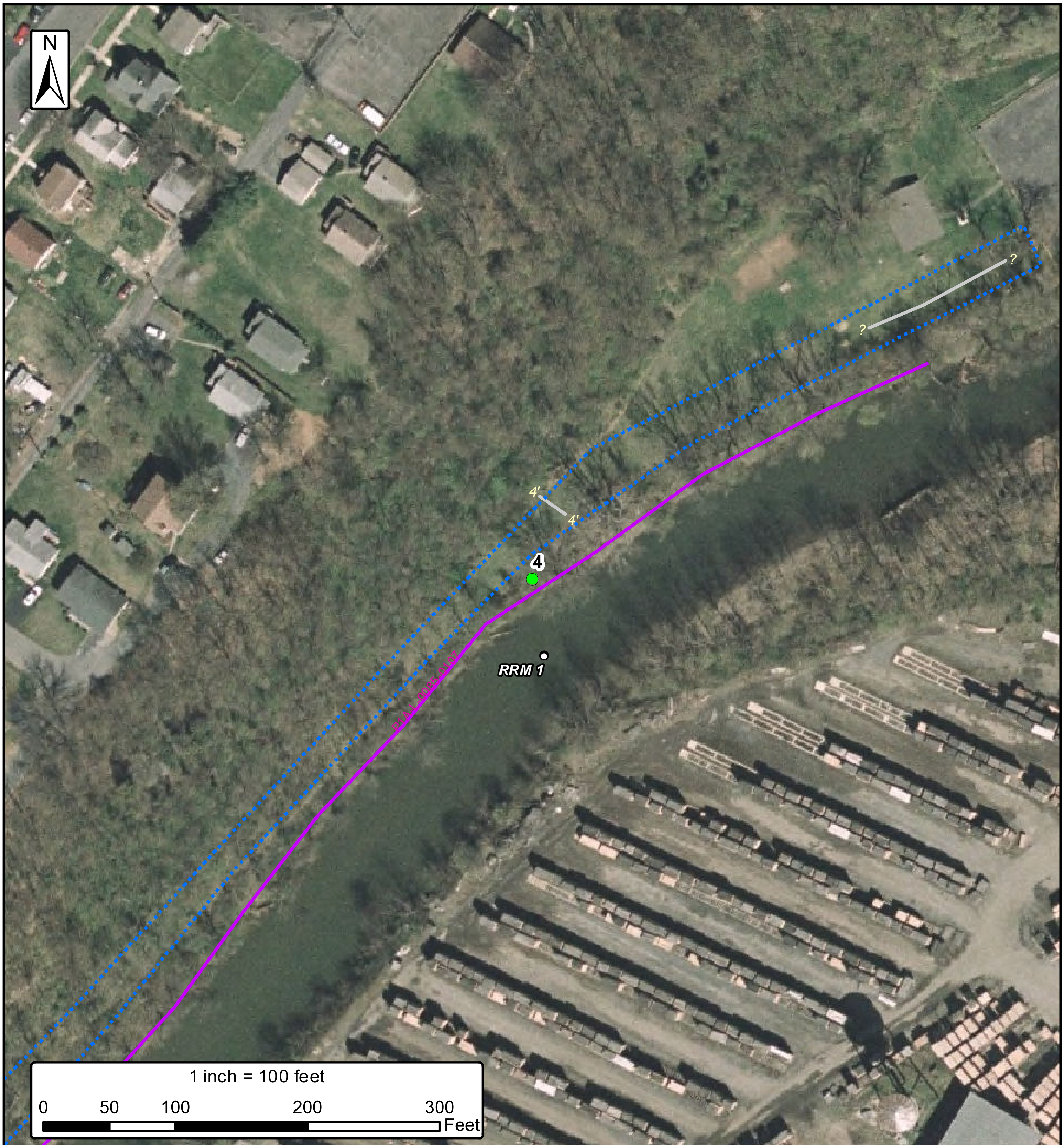

Legend

- RRM Intervals Whole Mile
- Boring
- Phase 1BMA's
- ? Unknown Termination
- WW Sanitary Manhole
- D Storm Manhole
- Water Valve
- 3' Interpreted Utility Depth
- Gas
- Sanitary
- Sanitary (Interpreted)
- Storm
- Storm (Interpreted)
- Electric
- Water
- Water (Interpreted)
- Unkown Linear Anomaly
- Geophysical Investigation Limits

Reference:
VBMP 2007 Aerial Imagery

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Projection: Transverse Mercator
Linear Unit: Foot US

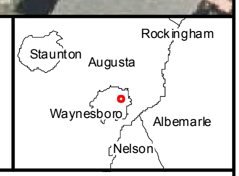

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Figure 4
Bank Management Areas
Phase 1 Surveyed Utilities at Boring Locations
Former Dupont Waynesboro Plant
Waynesboro, Virginia

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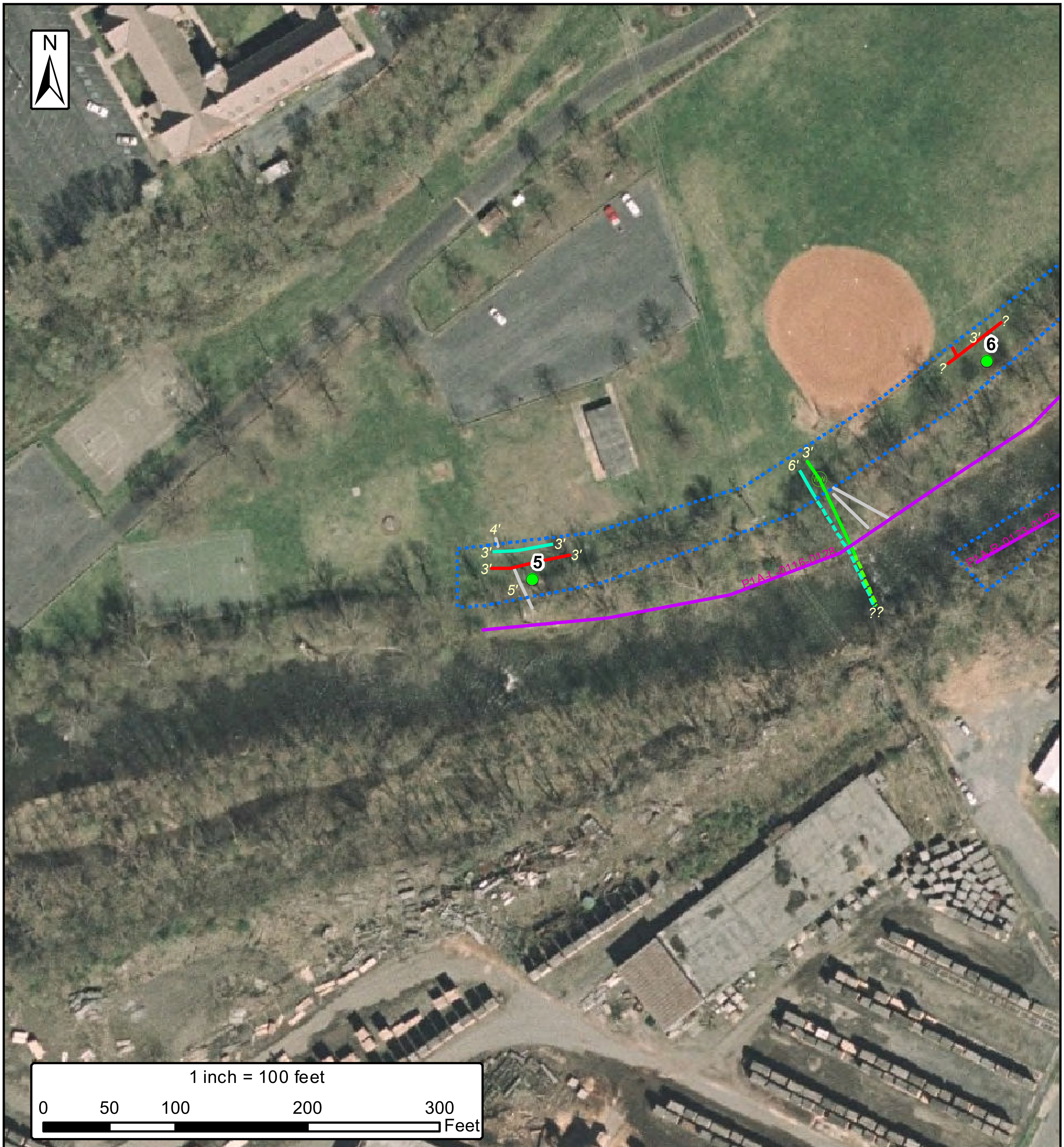

Legend

- RRM Intervals Whole Mile
- Boring
- Phase 1BMA's
- ? Unknown Termination
- WW Sanitary Manhole
- D Storm Manhole
- Water Valve
- 3' Interpreted Utility Depth
- Gas
- Sanitary
- Sanitary (Interpreted)
- Storm
- Storm (Interpreted)
- Electric
- Water
- Water (Interpreted)
- Unkown Linear Anomaly
- Geophysical Investigation Limits

Reference:
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NAD 1983 StatePlane Virginia North
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Linear Unit: Foot US

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Date: 1/9/2015

Figure 5
Bank Management Areas
Phase 1 Surveyed Utilities at Boring Locations

Former Dupont Waynesboro Plant
Waynesboro, Virginia

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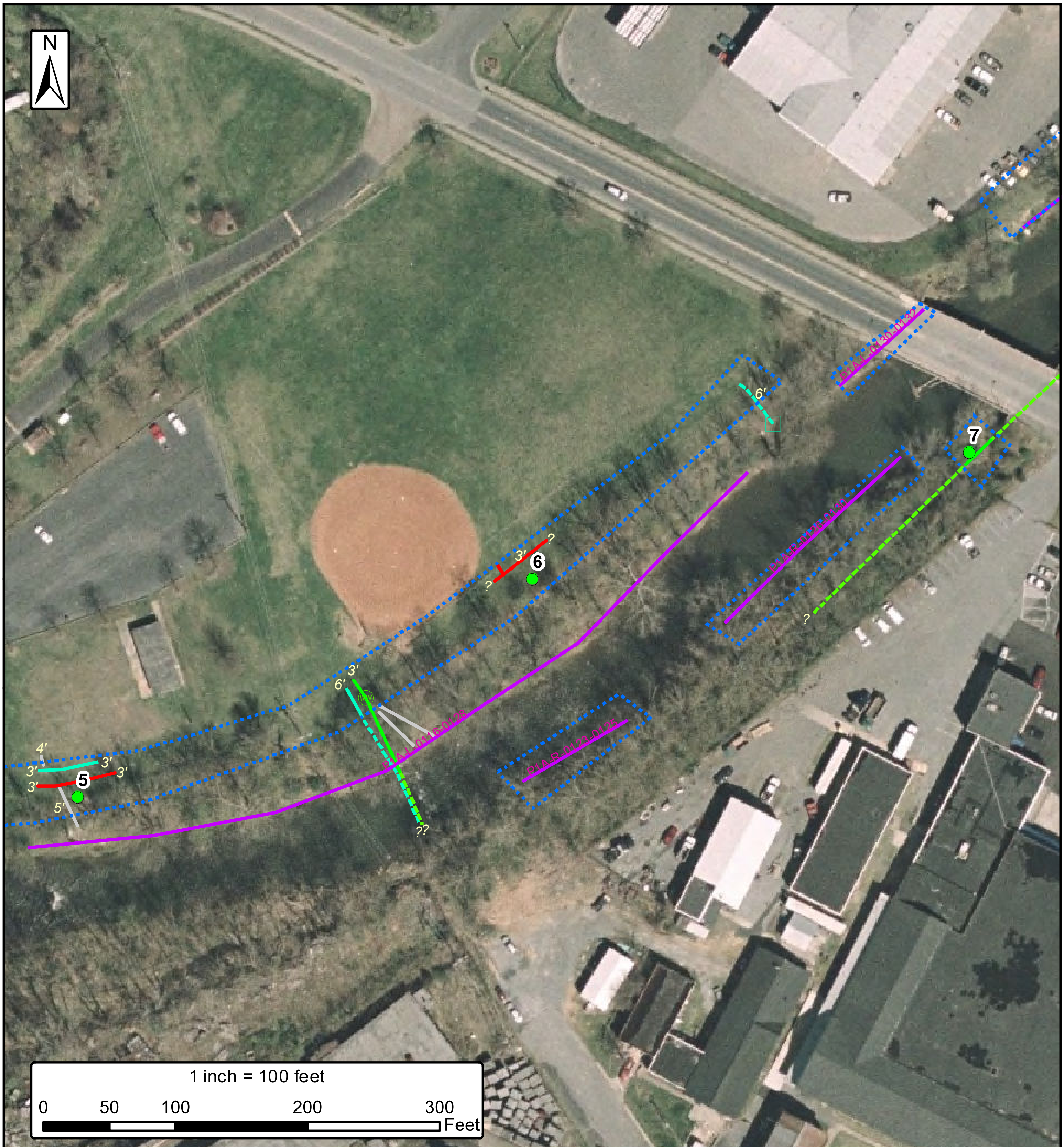

Legend

- RRM Intervals Whole Mile
- Boring
- Phase 1BMA's
- ? Unknown Termination
- Sanitary Manhole
- Storm Manhole
- Water Valve
- 3' Interpreted Utility Depth
- Gas
- Sanitary
- Sanitary (Interpreted)
- Storm
- Storm (Interpreted)
- Electric
- Water
- Water (Interpreted)
- Unkown Linear Anomaly
- Geophysical Investigation Limits

Reference:
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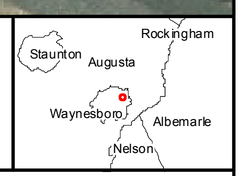
NAD 1983 StatePlane Virginia North
Projection: Transverse Mercator
Linear Unit: Foot US



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Date: 1/9/2015

Figure 6
Bank Management Areas
Phase 1 Surveyed Utilities at Boring Locations

Former Dupont Waynesboro Plant
Waynesboro, Virginia

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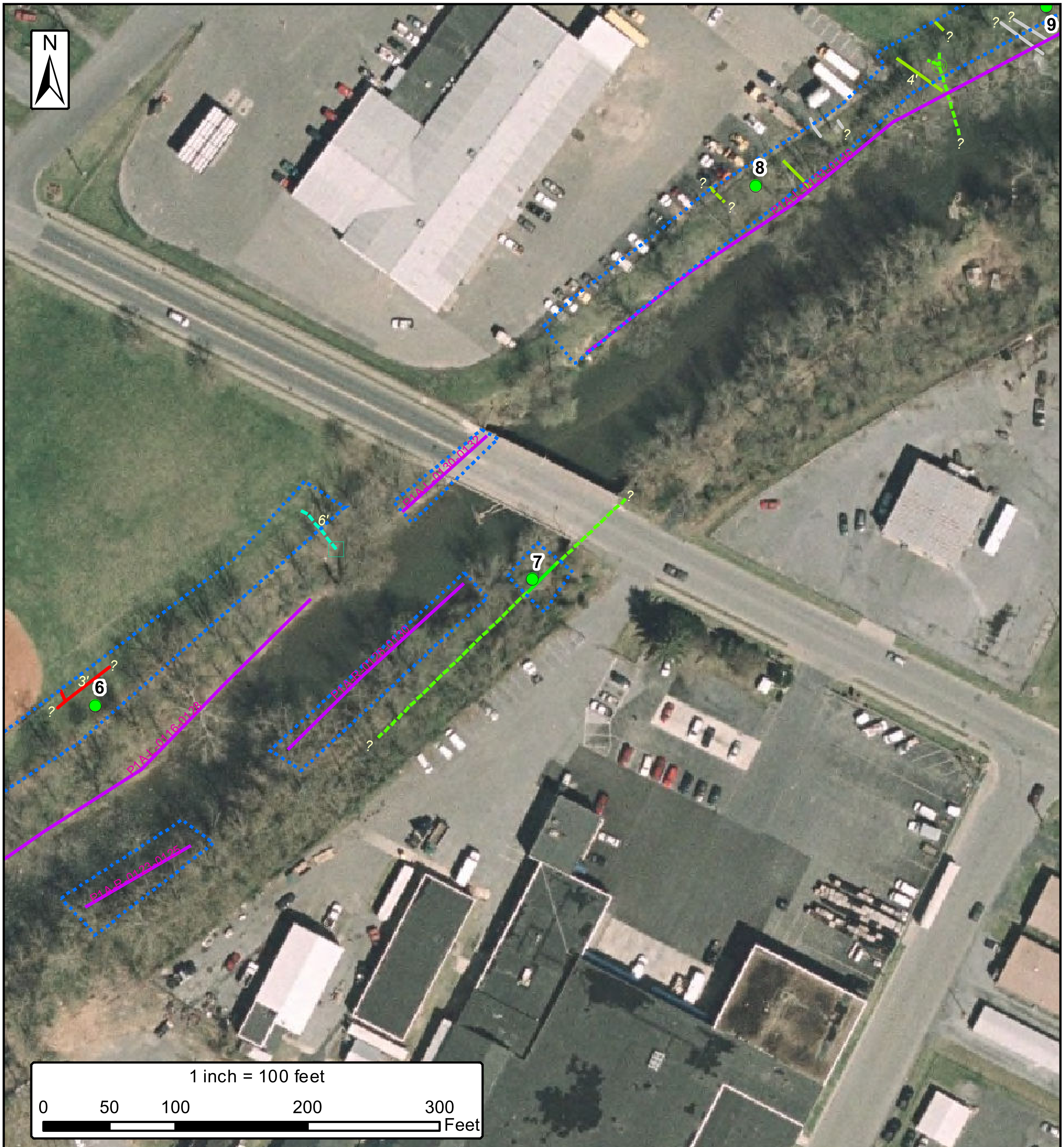

Legend

RRM Intervals Whole Mile	Sanitary Manhole	Gas	Storm	Water
Boring	Storm Manhole	Sanitary	Storm (Interpreted)	Water (Interpreted)
Phase 1BMA's	Water Valve	Sanitary (Interpreted)	Electric	Unkown Linear Anomaly
Unknown Termination	3' Interpreted Utility Depth			Geophysical Investigation Limits

Reference:
VBMP 2007 Aerial Imagery

NAD 1983 StatePlane Virginia North
Projection: Transverse Mercator
Linear Unit: Foot US

Rockingham
Staunton
Augusta
Waynesboro
Albemarle
Nelson

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Figure 7
Bank Management Areas
Phase 1 Surveyed Utilities at Boring Locations
Former Dupont Waynesboro Plant
Waynesboro, Virginia

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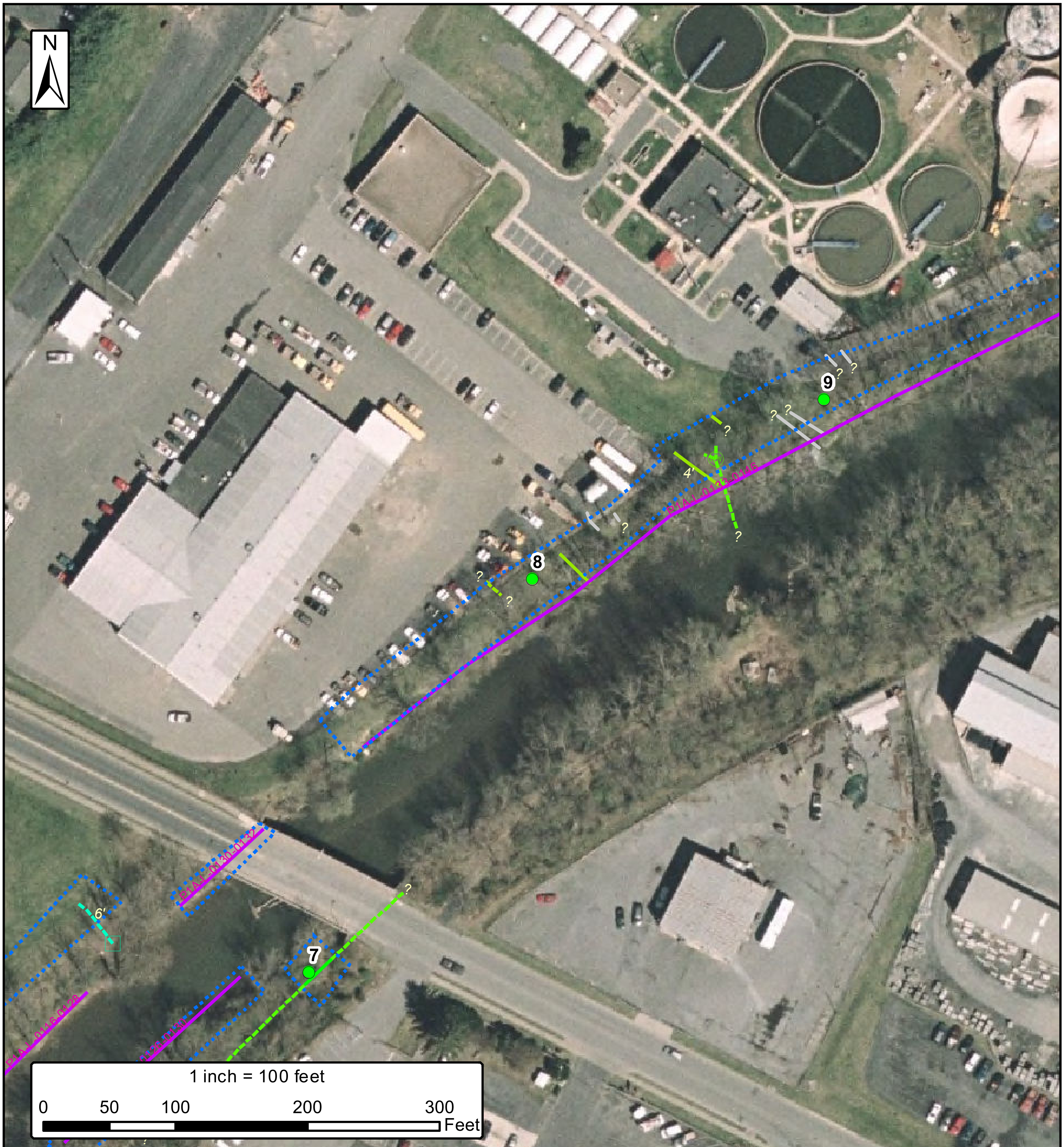

Legend

- RRM Intervals Whole Mile
- Boring
- Phase 1BMA's
- Unknown Termination
- Sanitary Manhole
- Storm Manhole
- Water Valve
- 3' Interpreted Utility Depth
- Gas
- Sanitary
- Sanitary (Interpreted)
- Storm
- Storm (Interpreted)
- Electric
- Water
- Water (Interpreted)
- Unkown Linear Anomaly
- Geophysical Investigation Limits

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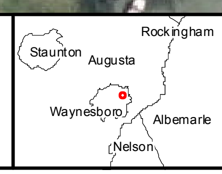
Linear Unit: Foot US



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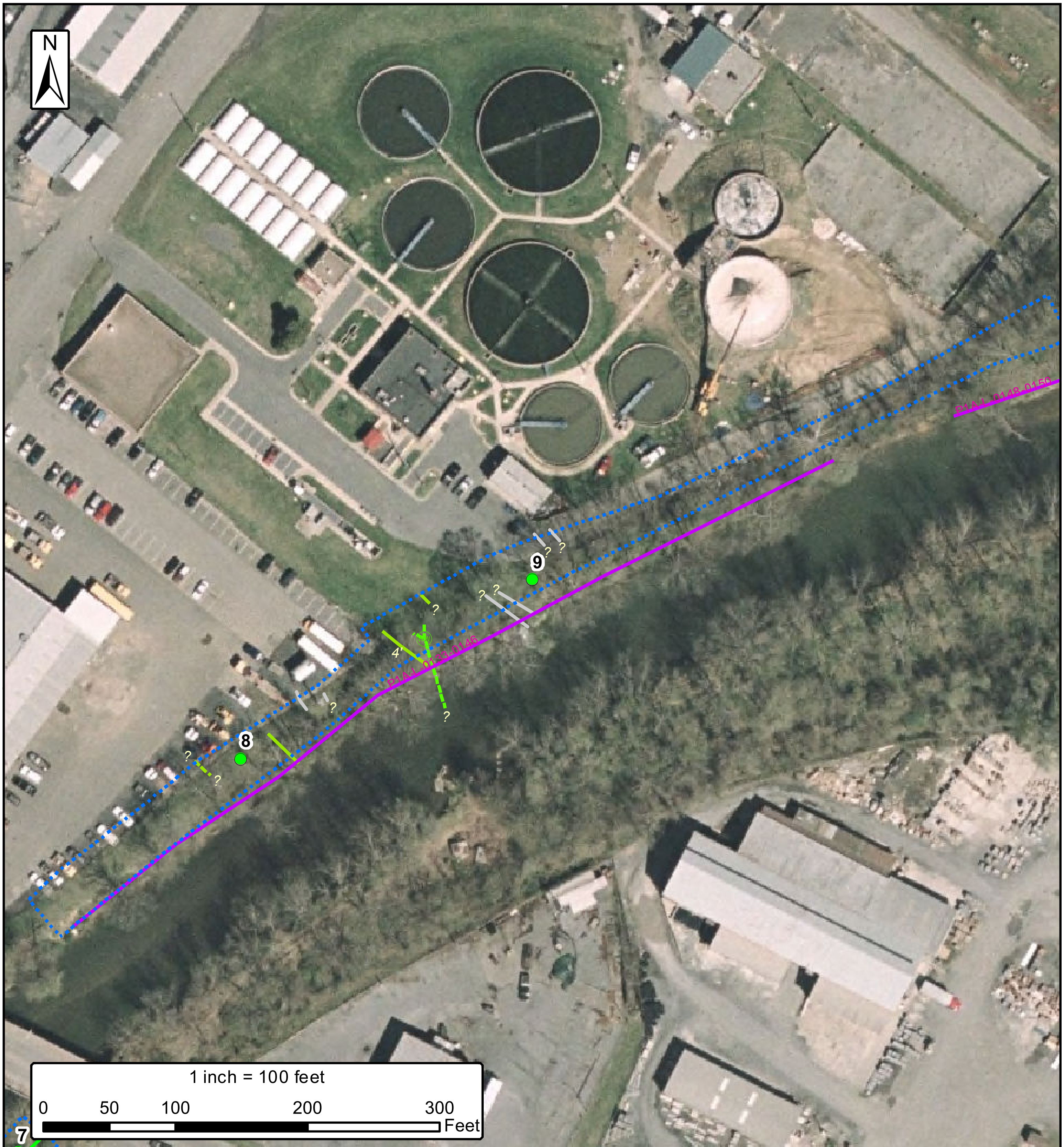
Date: 1/9/2015

Figure 8
Bank Management Areas
Phase 1 Surveyed Utilities at Boring Locations
Former Dupont Waynesboro Plant
Waynesboro, Virginia



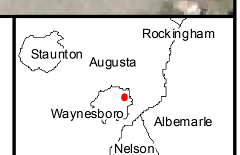
Legend

RRM Intervals Whole Mile	Sanitary Manhole	Gas
Boring	Storm Manhole	Sanitary
Phase 1BMA's	Water Valve	Sanitary (Interpreted)
? Unknown Termination	3' Interpreted Utility Depth	

Storm	Water
Storm (Interpreted)	Water (Interpreted)
Electric	Unkown Linear Anomaly
	Geophysical Investigation Limits

Reference:
VBMP 2007 Aerial Imagery

NAD 1983 StatePlane Virginia North
Projection: Transverse Mercator
Linear Unit: Foot US



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Job: 18986308

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Checked by: SH

Date: 1/9/2015

Figure 9
Bank Management Areas
Phase 1 Surveyed Utilities at Boring Locations

Former Dupont Waynesboro Plant
Waynesboro, Virginia

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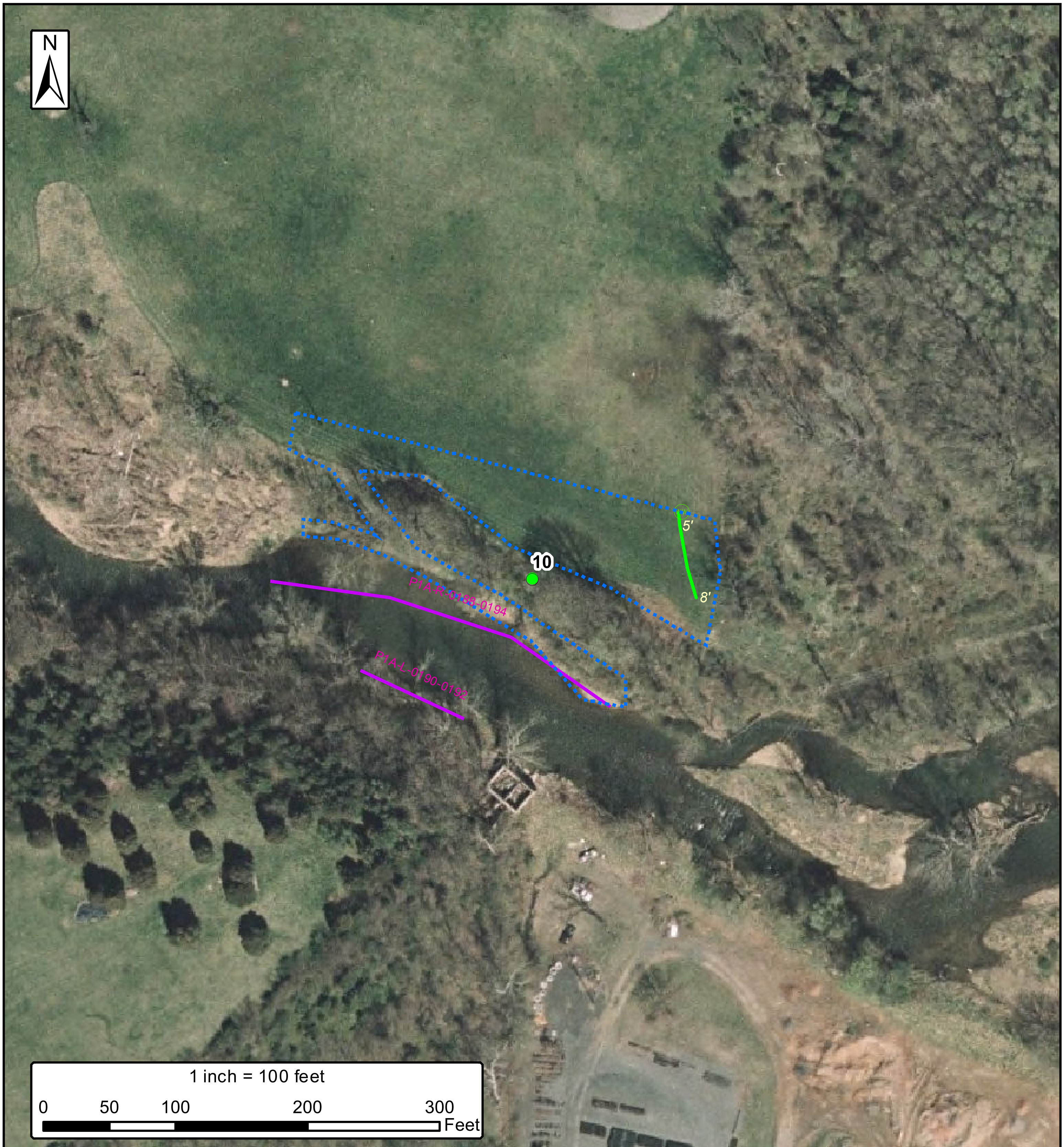

Legend

RRM Intervals Whole Mile	Sanitary Manhole	Gas	Storm	Water
Boring	Storm Manhole	Sanitary	Storm (Interpreted)	Water (Interpreted)
Phase 1BMA's	Water Valve	Sanitary (Interpreted)	Electric	Unkown Linear Anomaly
Unknown Termination	Interpreted Utility Depth			Geophysical Investigation Limits

Reference:
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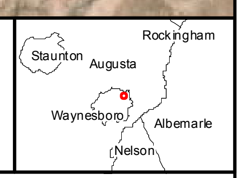
NAD 1983 StatePlane Virginia North
Projection: Transverse Mercator
Linear Unit: Foot US



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Job: 18986308

Prepared by: RRM III

Checked by: SH

Date: 1/9/2015

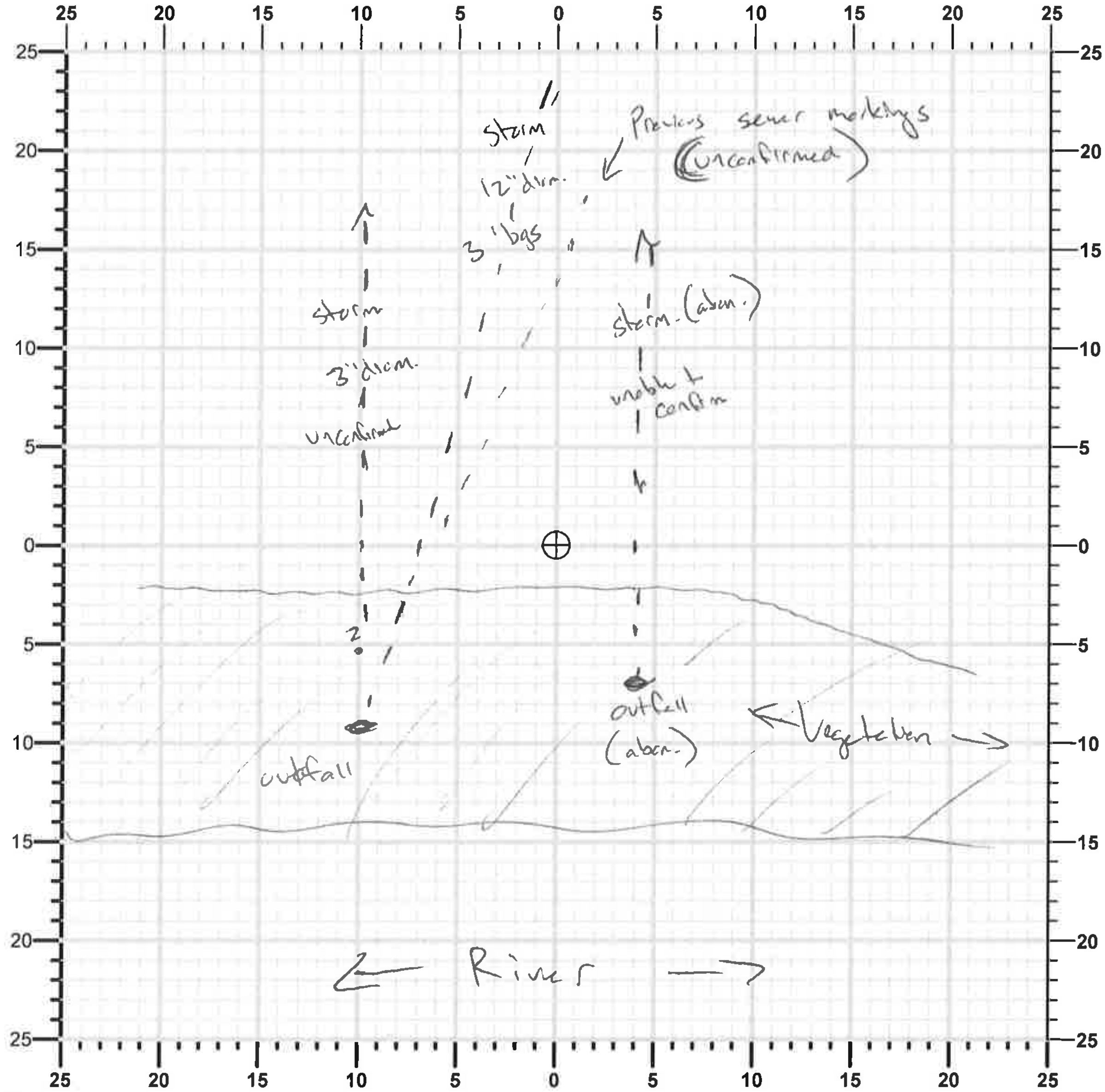
Figure 10
Bank Management Areas
Phase 1 Surveyed Utilities at Boring Locations

Former Dupont Waynesboro Plant
Waynesboro, Virginia

Q:\Projects\ENG\Geophysics\DuPont\DuPont-Invista Waynesboro\Utility-Avoidance-2014\F_Data\GIS\MXDs\Figure 2 BMA Utility Survey_REV2.mxd

Attachment A
Utility Avoidance Sketches

Date: 11-6-14	**Boring Number:** AQSR-02	**Orientation** N ⟶
Project Number: 18986308		
Project Name: BMA Utility Location		
Site Location: Waynesboro, VA		**GPS Coordinates (if known)**
Compiled By: S. Husted	**Cleared Radius:** 20'	N: 6709150.5 E: 11371902.9
Comments:	**Sketch Units: (Circle One)** Feet Meters	**Sheet** 1 **of** 1



Notes:
1. Utilities are located in accordance with reasonable and accepted engineering geophysics practices. Interpretations are rendered in a manner consistent with other consultants in our profession. However, all geophysical techniques have some level of uncertainty and limitations. No other representations to the client are expressed or implied, and no warranty or guarantee is included or intended.
2. Sketch does not satisfy state or local Miss Utility / One-Call (or equivalent) service requirements.

Survey Equipment			
CAT:	Y N	MAC-51B:	Y N
7000 ~~RD-4000~~:	Y N	EM-61:	Y N
GEMINI-3:	Y N	GPR:	Y N

Utility Avoidance Field Sketch

URS

Geophysical Services

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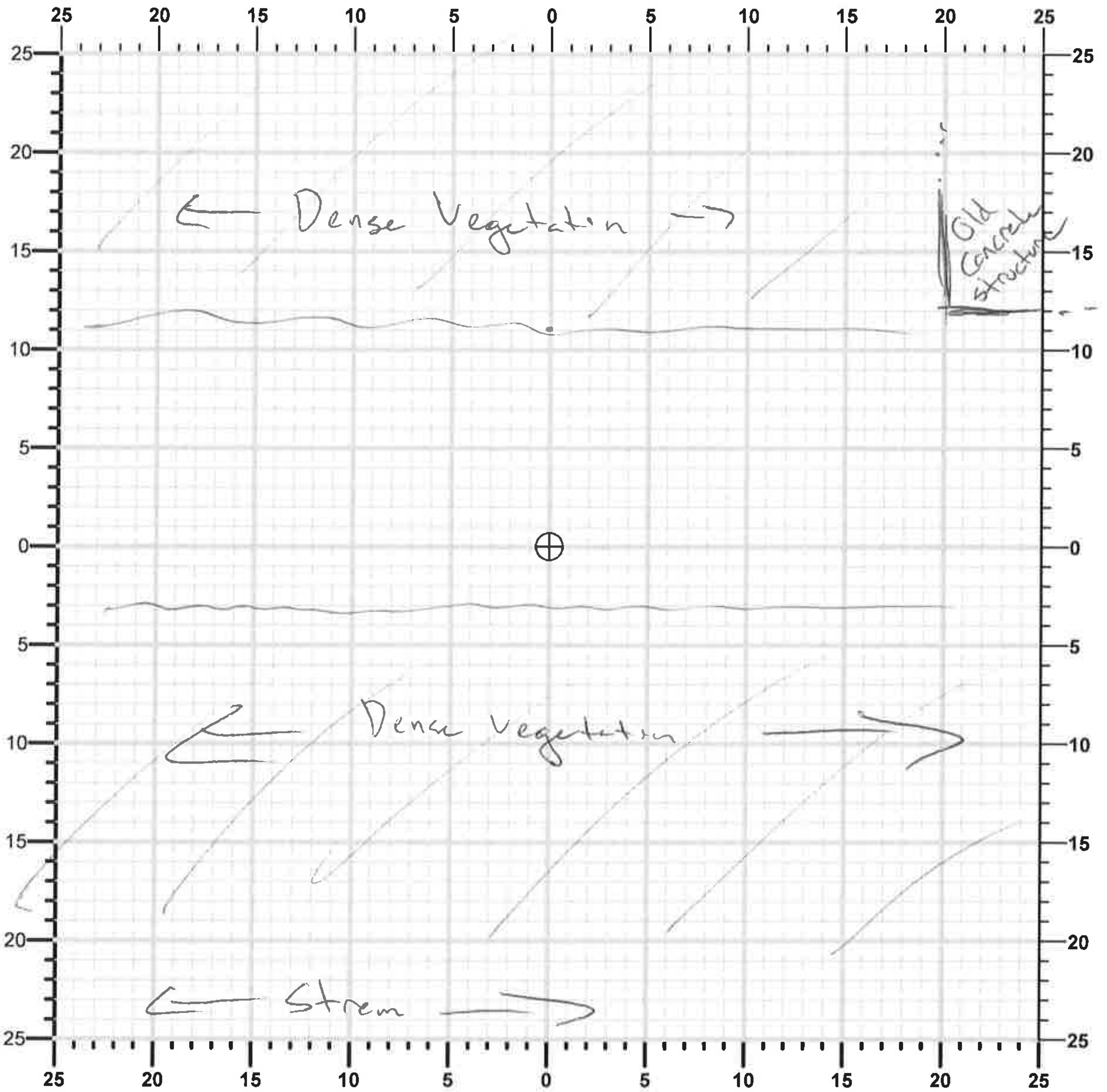
Germantown, MD 20876
Phone: (301) 820-3000
Fax: (301) 820-3009

625 W. Ridge Pike, Ste. E-100
Conshohocken, PA 19428
Phone: (610) 832-6137
Fax: (610) 832-3501

Date: 11-7-14	**Boring Number:** AGSR-03	**Orientation** N
Project Number: 18986308		
Project Name: BMA Utility Location		
Site Location: Waynesboro, VA		**GPS Coordinates (if known)**
Compiled By: S. Husted	**Cleared Radius:** 20'	**N:** 6710896.78
Comments: No fractures identified	**Sketch Units: (Circle One)** Feet Meters	**E:** 11372813.2[illegible]
		Sheet 1 **of** 1



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2. Sketch does not satisfy state or local Miss Utility / One-Call (or equivalent) service requirements.

Survey Equipment

CAT:	Y N	MAC-51B:	Y N
~~RD-4000~~ 7000:	Y N	EM-61:	Y N
GEMINI-3:	Y N	GPR:	Y N

Utility Avoidance Field Sketch

URS

Geophysical Services

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Date: 11-7-14	**Boring Number:** AQSR-04	**Orientation**
Project Number: 18986308		N
Project Name: BMA Utility Location		
Site Location: Waynesboro, VA		**GPS Coordinates (if known)**
Compiled By: S. Husted	**Cleared Radius:** 20'	N: 671329.44
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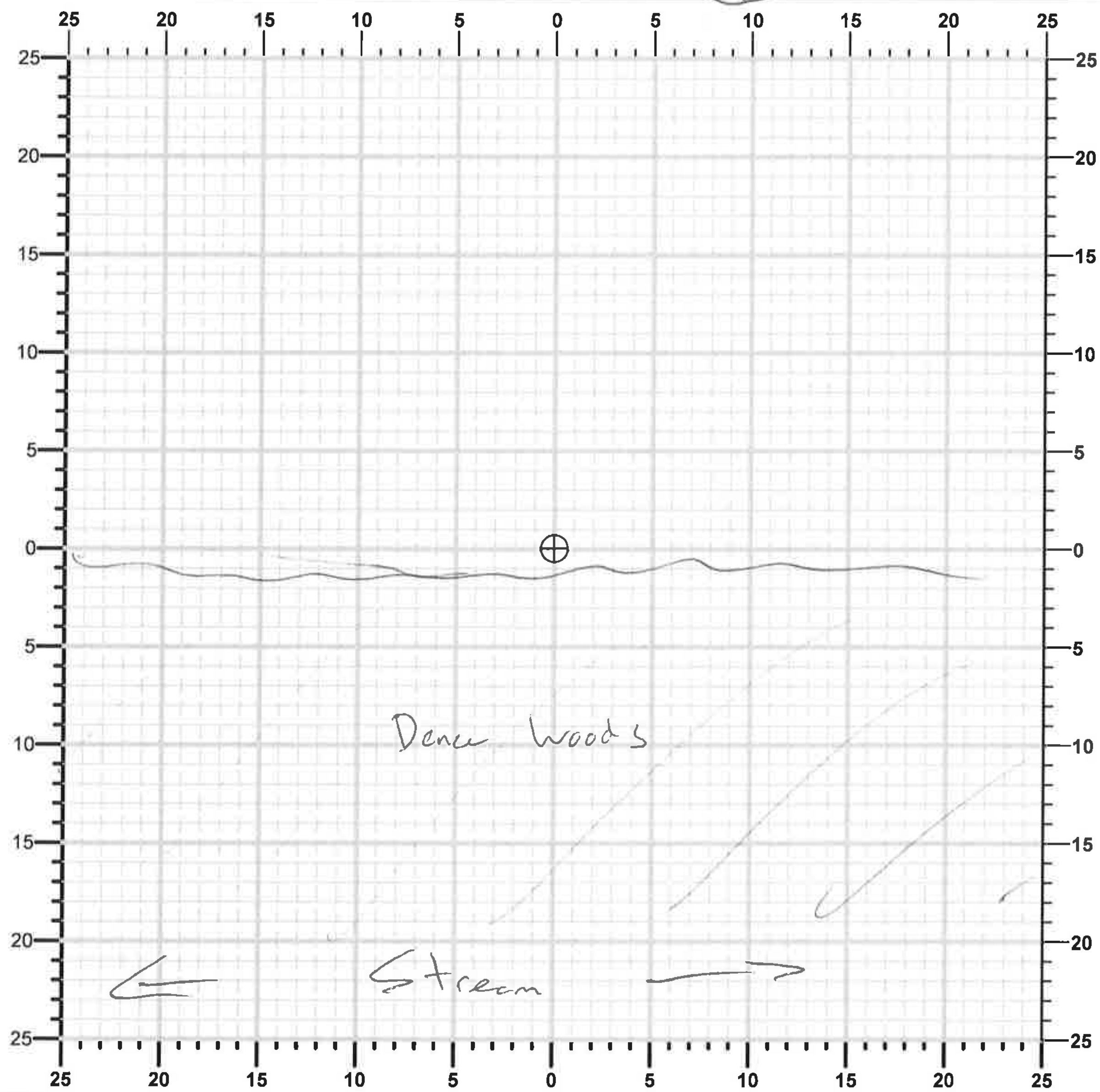

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Survey Equipment			
CAT:	Y N	MAC-51B:	Y N
RD-~~4000~~ 7000:	Y N	EM-61:	Y N
GEMINI-3:	Y N	GPR:	Y N

Utility Avoidance Field Sketch

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Date: 11-5-14	**Boring Number:** AQSR-05	**Orientation** N ↗
Project Number: 18986308		
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Site Location: Waynesboro, VA		**GPS Coordinates (if known)**
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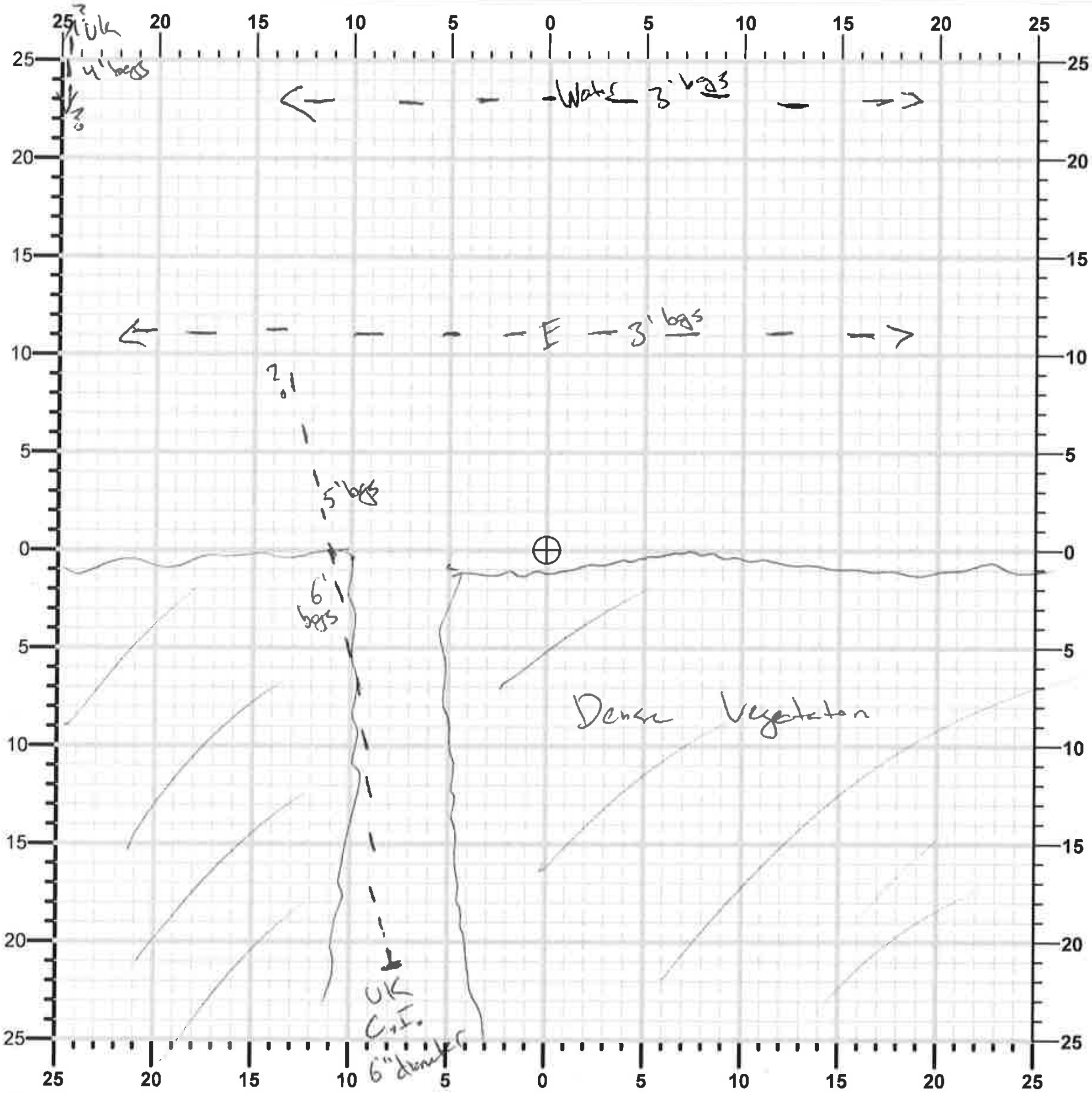

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GEMINI-3:	Y	N	GPR:	Y	N

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Date: 11-5-14	**Boring Number:** AQSR-06	**Orientation** N
Project Number: 18986306		
Project Name: BMA Utility Location		
Site Location: Waynesboro, VA		**GPS Coordinates (if known)**
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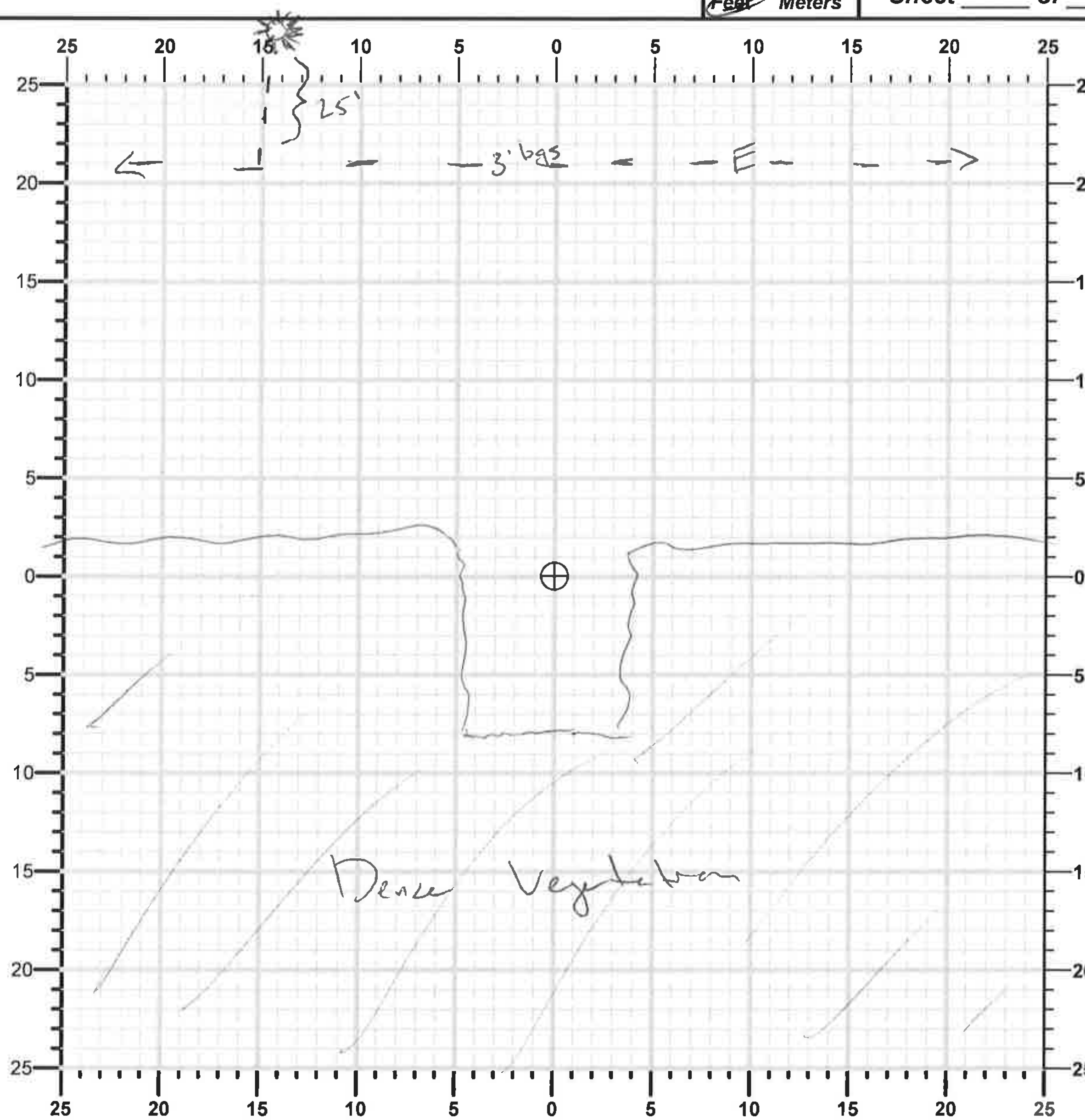

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GEMINI-3:	Y N	GPR:	Y N

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Date: 11-7-14	**Boring Number:** AQSR-07	**Orientation** N
Project Number: 18986308		
Project Name: BMA Utility Location		
Site Location: Waynesboro, VA		**GPS Coordinates (if known)**
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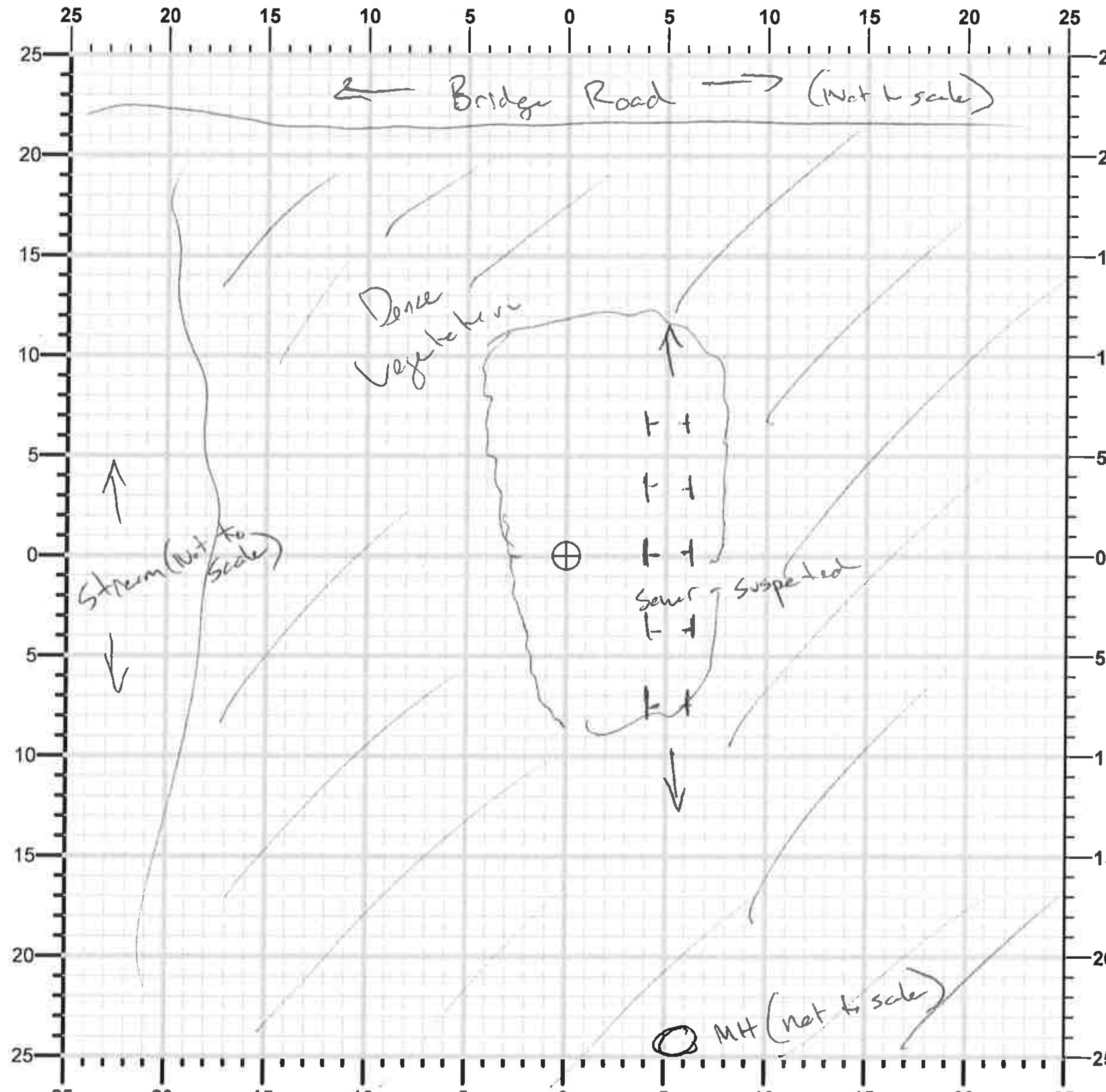

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GEMINI-3:	Y N	GPR:	Y N

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Date: 11-5-14	**Boring Number:** AQSR-08	**Orientation** ↗ N
Project Number: 18986308		
Project Name: BMA Utility Location		
Site Location: Waynesboro, VA		**GPS Coordinates (if known)**
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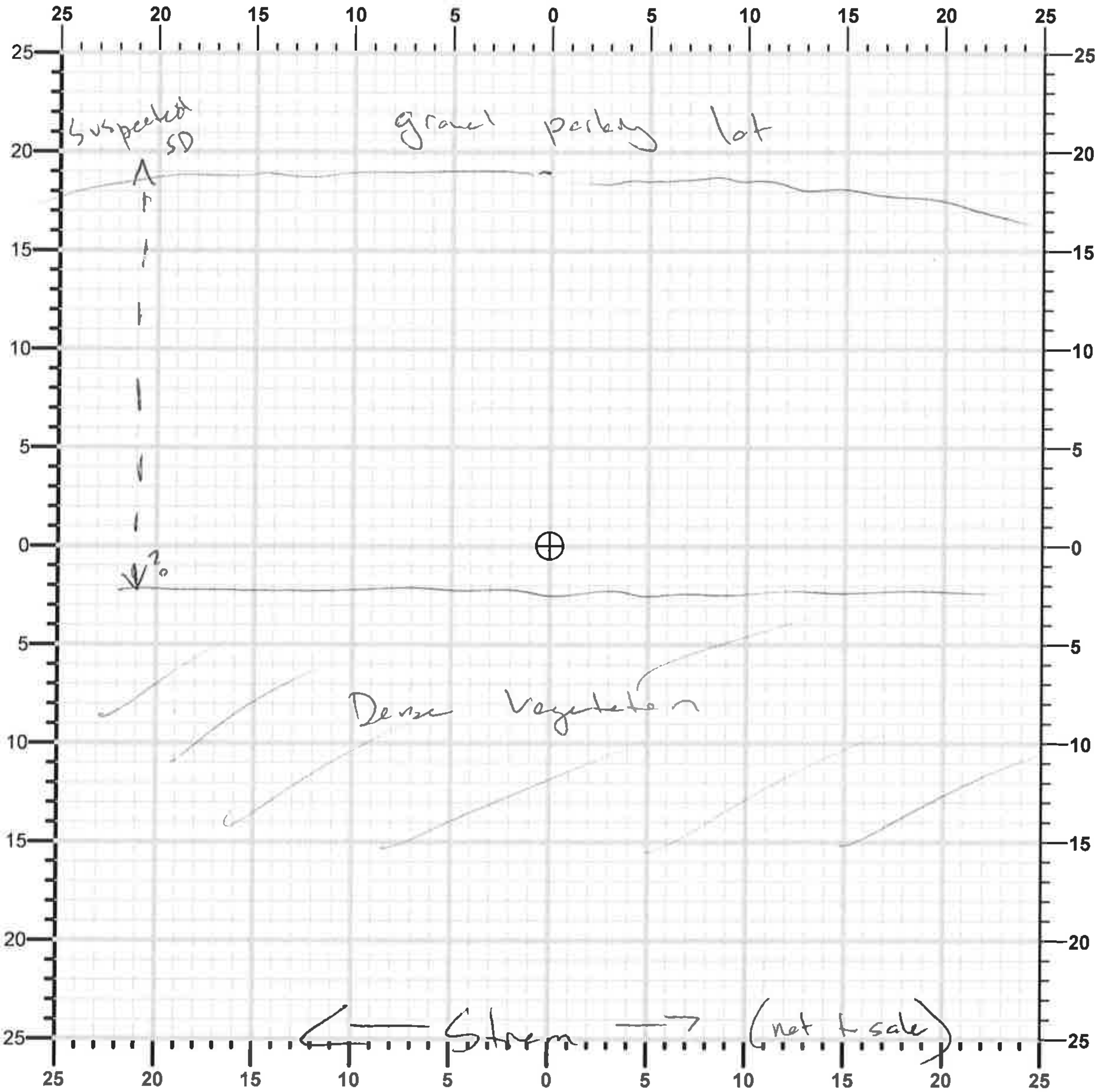

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GEMINI-3:	Y N	GPR:	Y N

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Date: 11-5-14	**Boring Number:** AQSR-09	**Orientation**
Project Number: 18986308		N
Project Name: BMA Utility Location		
Site Location: Waynesboro, VA		**GPS Coordinates (if known)**
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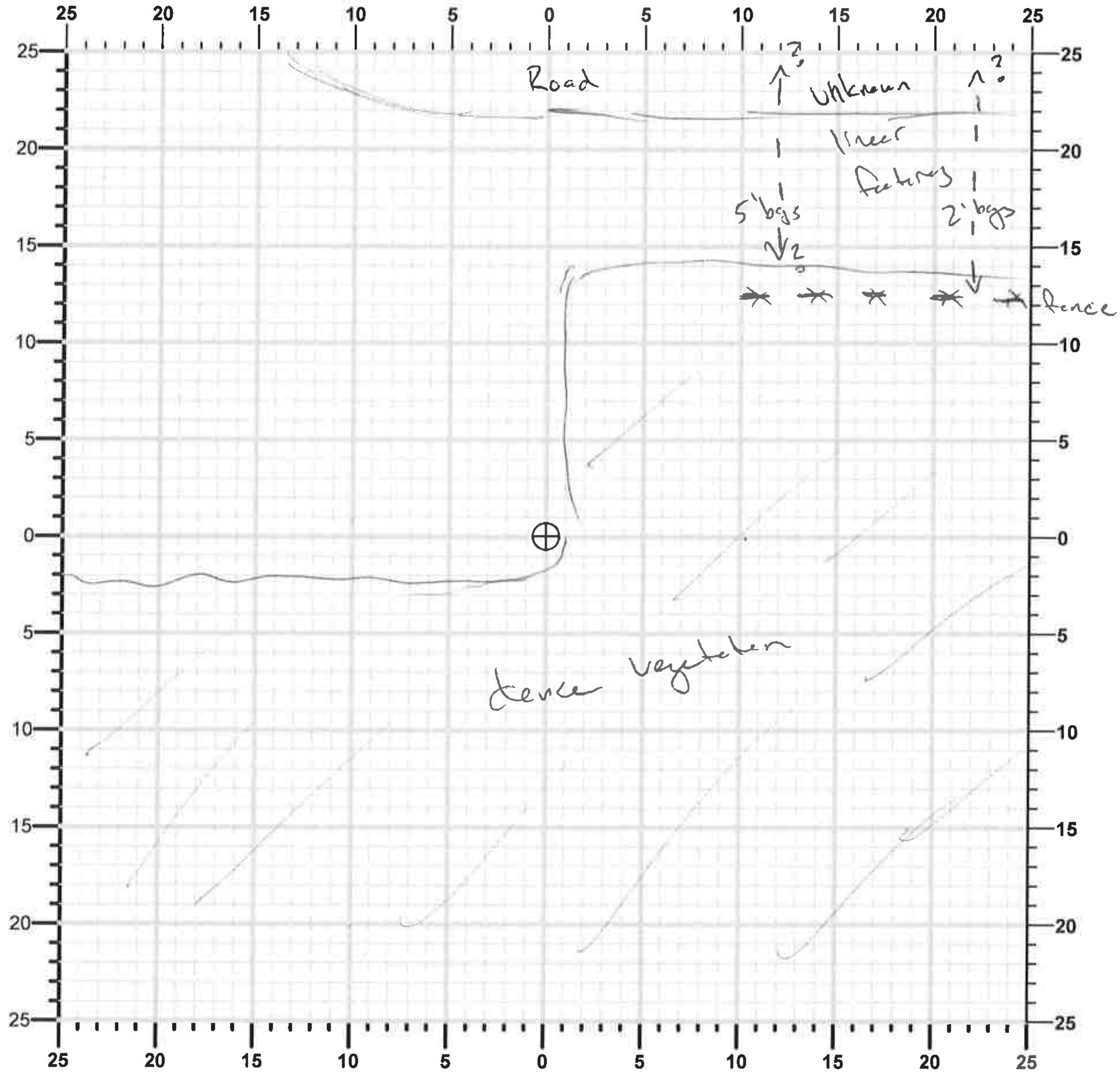

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RD-~~4000~~ 7000:	Y N	EM-61:	Y N
GEMINI-3:	Y N	GPR:	Y N

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Date: 11-6-14	**Boring Number:** AQSR-10	**Orientation** N ↑
Project Number: 18986308		
Project Name: BMA Utility Location		
Site Location: Waynesboro, VA		**GPS Coordinates (if known)**
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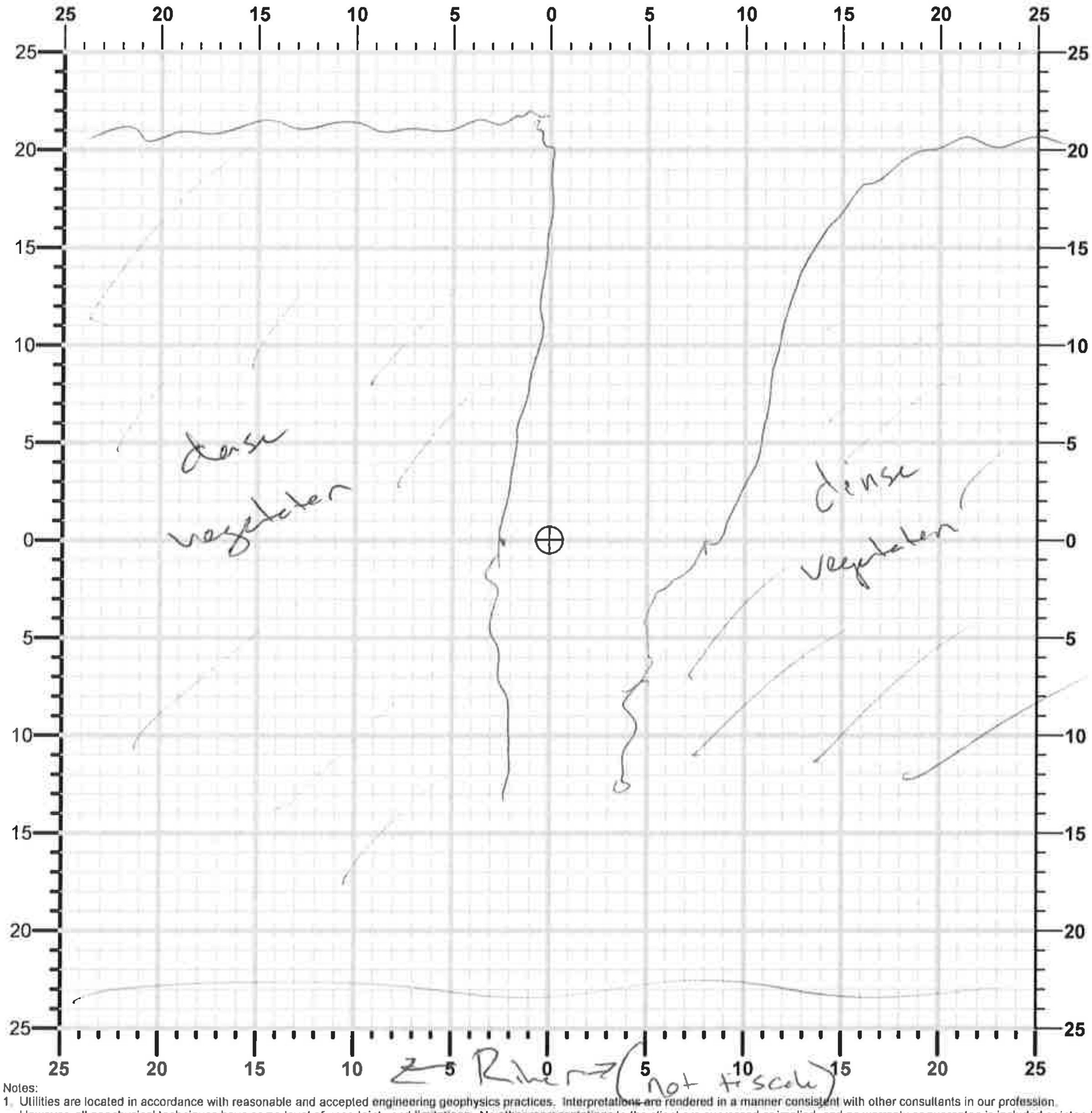

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Survey Equipment

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RD-4000:	Y N	EM-61:	Y N
GEMINI-3:	Y N	GPR:	Y N

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APPENDIX E
BANK LOADING MODEL REFINEMENTS

This technical appendix describes refinements made to the South River bank erosion total mercury (THg) loading model. These refinements were made in support of the remediation design of the Phase 1A Bank Management Areas (BMAs) of the South River Area of Concern 4. This appendix is a component of the Basis of Design Report (BODR) for the Phase 1A BMAs.

The bank erosion THg loading model was originally presented in the *Interim Measures Design, Implementation, and Monitoring Work Plan for Phase 1 of the South River Area of Concern 4* (IMWP; Anchor QEA et al. 2015). This model was used to select the Phase 1 BMAs by identifying those banks that contribute disproportionally to bank erosion THg loads in the first 2 river miles downstream of the former DuPont Waynesboro facility (i.e., relative river mile [RRM] 0 to 2). The inputs to this model are bank face soil THg concentrations, measured bank heights, and the 2-year flood near-bank shear stress predicted with a hydrodynamic model (Appendix C of the IMWP). The model divides the river banks in the South River into segments defined by hydrodynamic model grid. At each bank segment, the one-dimensional (length/time) bank erosion rate is predicted by using the near-bank shear stress predicted by the hydrodynamic model. Combining this predicted erosion rate with the measured bank height, and bank face THg concentrations available at each bank segment, a segment-specific THg bank erosion loading estimate was calculated (Equation 1). Phase 1 BMAs were identified as those bank segments that collectively contribute approximately 90% of the THg loading from bank erosion in RRM 0 to 2.

$$W_{THg} = C_{Hg} \times BH \times BE \times \frac{0.0328\,ft}{cm} \times D_{bulk} \times \frac{5280\,ft}{mile} \times \frac{kg}{10^6 mg} \qquad \text{(Equation 1)}$$

where:

W_{THg}	=	the bank segment THg loading (kilograms per mile per year)
C_{Hg}	=	average bank face mercury concentration at each bank segment (milligrams per kilogram)
BH	=	average bank height at each bank segment (feet)
BE	=	predicted bank erosion rate at each bank segment (centimeters per year)
D_{bulk}	=	bulk density of sediment (assumed to be 34 kilograms per cubic foot)

Pre-design investigations conducted in support of the remedial design included supplemental bank coring to further characterize THg concentrations (see Appendix B of the BODR). The THg concentrations from the supplemental bank cores were used to update THg loadings.

THg concentrations in the surface segments of the supplemental bank soil cores were used to update C_{Hg} in Equation 1. THg concentrations in the surface samples of the supplemental bank soil cores were averaged by sampling transect (e.g., THg concentrations from the surface segment of cores LBH-4-200-A, LBH-4-200-B, and LBH-4-200-C were averaged to achieve an average surface THg concentration for sampling transect LBH-4-200). The average THg concentrations at supplemental bank coring transects were then combined with bank face surface soil THg concentrations from earlier investigations within the same bank segment to update the THg concentration of the segment (i.e., C_{Hg}).

The updated primary BMA bank segments are tabulated in Table E-1. The bank erosion THg loading model was rerun with these updated bank segment THg concentrations to calculate the updated loadings from these banks segments. The updated THg loadings are shown in Figure E-1.

Reference

Anchor QEA (Anchor QEA, LLC), URS, and DuPont, 2015. *Interim Measures Design, Implementation, and Monitoring Work Plan, Phase 1 – South River Area of Concern 4.* August 2015.

Table E-1

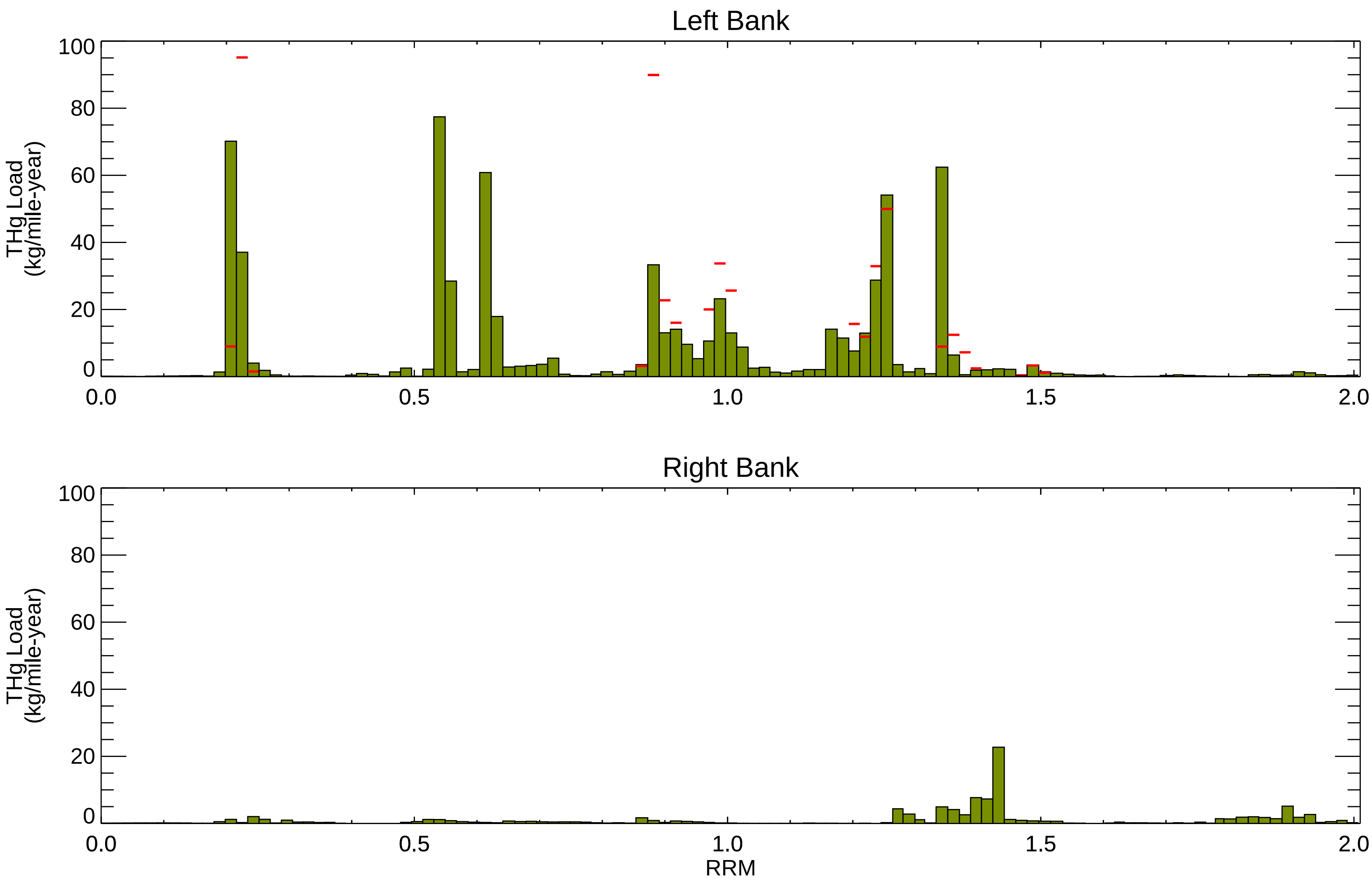
BMA Hg Concentration and THg Loadings Comparison

RRM Start	RRM End	Supplemental Bank Core Transect	Bank Height (feet)	Erosion Rate (cm/year)	Previous THg (mg/kg)	Current THg (mg/kg)	Previous THg Loading (kg/mile-year)	Current THg Loading (kg/mile-year)
0.1981	0.2160	LBH-4-200, LBH-4-201, LBH-4-202	10.05	5.80	26.23	204.52	9.00	70.17
0.2160	0.2340	LBH-4-203, LBH-4-204	9.84	6.14	267.56	104.26	95.13	37.07
0.2340	0.2521	LBH-4-205	10.24	6.20	4.08	10.77	1.52	4.03
0.8538	0.8726	LBH-11-001	12.31	5.65	7.74	8.72	3.17	3.57
0.8726	0.8909	LBH-11-002, LBH-11-003, LBH-11-004	13.77	6.18	179.42	66.52	89.92	33.33
0.8909	0.9088	LBH-11-005	13.34	6.90	42.01	24.11	22.75	13.05
0.9088	0.9267	LBH-11-006	14.08	7.47	25.93	22.81	16.05	14.12
0.9619	0.9789	LBH-11-200	9.02	7.15	52.73	27.93	20.01	10.60
0.9789	0.9969	LBH-11-201, LBH-11-202	8.88	7.00	92.12	63.35	33.74	23.20
0.9969	1.0146	LBH-11-203, LBH-11-204, LBH-11-205	7.91	6.90	79.78	40.50	25.64	13.02
1.1935	1.2110	LBH-12-200, LBH-12-201	9.36	8.43	33.79	16.42	15.70	7.63
1.2110	1.2281	LBH-12-202	12.22	8.88	18.58	20.29	11.87	12.96
1.2281	1.2451	LBH-12-203, LBH-12-204	8.75	9.10	70.25	61.39	32.92	28.76
1.2451	1.2637	LBH-13-200, LBH-13-201	8.66	8.04	121.92	131.99	49.98	54.11
1.3330	1.3516	LBH-14-200	10.87	5.35	26.19	182.57	8.95	62.43
1.3516	1.3702	LBH-14-201, LBH-14-202, LBH-14-203	9.51	4.55	48.93	25.27	12.45	6.43
1.3702	1.3880	LBH-14-204	11.19	3.91	28.10	2.16	7.24	0.56
1.3880	1.4054	LBH-14-205	14.16	4.03	7.26	5.60	2.44	1.88

RRM Start	RRM End	Supplemental Bank Core Transect	Bank Height (feet)	Erosion Rate (cm/year)	Previous THg (mg/kg)	Current THg (mg/kg)	Previous THg Loading (kg/mile-year)	Current THg Loading (kg/mile-year)
1.4602	1.4781	LBH-15-200	12.16	4.69	1.13	0.65	0.38	0.22
1.4781	1.4968	LBH-15-201, LBH-15-202	7.80	4.94	14.66	15.07	3.33	3.42
1.4968	1.5158	LBH-15-203	6.07	5.04	6.55	8.10	1.18	1.46

Notes:
BMA = Bank Management Area
cm/year = centimeters per year
Hg = mercury
kg/mile-year = kilograms per mile per year
mg/kg = milligrams per year
RRM = relative river mile
THg = total mercury

FIGURE



Previous THg Loading (kg/mile-year)

Current THg Loading (kg/mile-year)

NOTES:
RRM = relative river mile
THg = total mercury

Figure E-1

Updated South River Bank Erosion Total Mercury Loadings
Basis of Design Report - Phase 1A Bank Management Areas
South River Area of Concern 4

ANCHOR QEA

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APPENDIX F
BIOCHAR AMENDMENT SUPPORTING INFORMATION

INTRODUCTION

The abiotic portion of the conceptual site model (CSM) for mercury (Hg) on the South River (published in 2012 and shown in Figure 1) identifies the inorganic sources of Hg that are methylated and ultimately bioaccumulate as methylmercury (MeHg) in smallmouth bass.

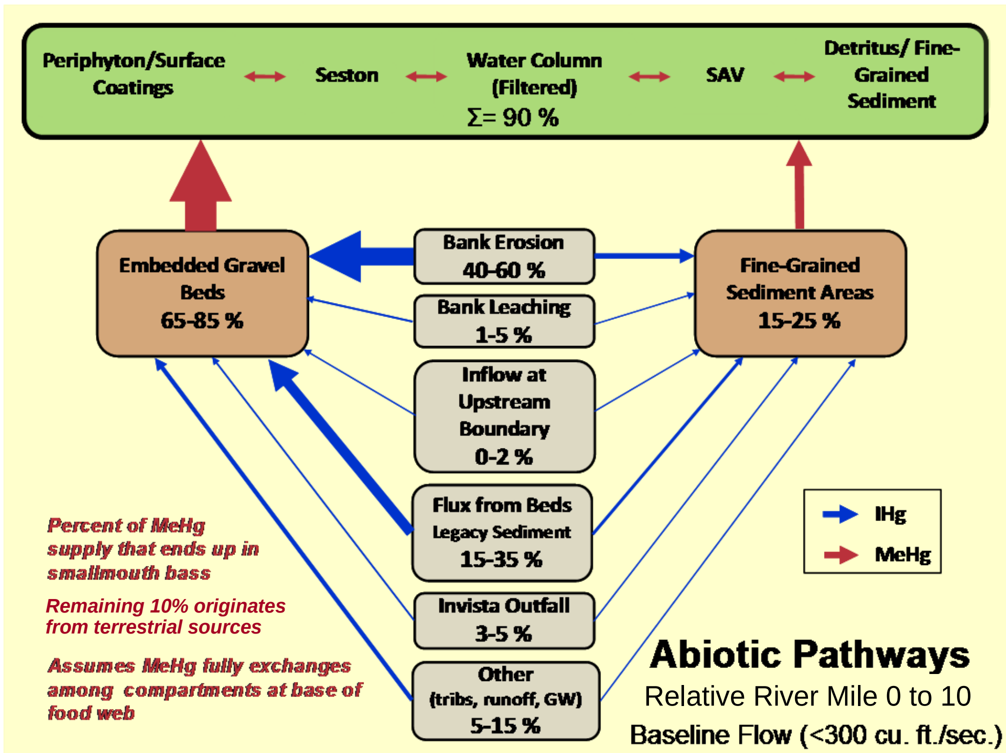


Figure 1. Hg sources and abiotic pathways leading to MeHg bioaccumulation in smallmouth bass in the South River under baseline conditions for relative river mile (RRM) 0 to 10.

Values are the percent of MeHg supply to smallmouth bass. The green box represents compartments at the base of the ecosystem that are primary connections to MeHg in the food web.

In the South River CSM, bank leaching refers specifically to Hg loading to the river following a storm/flood event where the Hg expresses itself locally through the near-channel alluvial bank soil. This is in contrast to other inorganic Hg loads originating more than 30 to 50 feet inland from the banks that express themselves following a precipitation event via tributaries, floodplain surface run-off, and bulk alluvial floodplain groundwater.

In 2012, existing lines of evidence suggested that bank leaching accounts for up to 5% of the inorganic Hg load that ultimately ends up as MeHg in smallmouth bass. The two largest uncertainties in this estimate were the volumetric water (hydraulic) flux emanating from the bank face and the concentration of Hg in the groundwater-diluted leachate as it enters the water column, mostly near the base of the bank. Subsequent laboratory and field studies at relative river mile (RRM) 3.5 by the University of Delaware, University of Waterloo, and Texas Tech from 2013 to 2015, coupled with the development of a fully integrated groundwater-surface water hydrodynamic model by Aquanty, aimed to reduce these uncertainties. These studies now suggest the contribution of bank leaching to inorganic Hg load could be up to 15%.

Bank leaching includes the release of filter-passing (dissolved and colloidal) Hg from near-channel alluvial bank soil following a flood event due to sudden changes in geochemical conditions (e.g., pH, redox potential, conductivity) caused by mixing of anoxic near-channel groundwater and oxic stream water. During storm events, a rapid rise in stream level (stage), attributable to floodplain runoff and tributary drainage upstream, causes stream water to move from the channel into the banks—a process known as bank storage. If the stream remains below bank-full conditions, most of the local bank storage water will drain downward by gravity to the permeable basal gravel/sand layer (BG/SL) and back to the river channel throughout several days to several weeks. However, if the stream runs bank-full and inundates the floodplain, widespread recharge to groundwater will occur throughout weeks to months because of the much lengthier groundwater flow paths. For this reason, the contribution of bank leaching to inorganic Hg load in the South River was evaluated for storm (rapid Hg release case) and baseline (slow-drainage case) conditions.

OBJECTIVE

Estimate the thickness of a 100% biochar bed required to remove Hg from bank storage water that drains through the BG/SL back to the South River after storm events.

VOLUMETRIC WATER FLUX

Aquanty Inc. (Waterloo, Ontario, Canada) utilized HydroGeoSphere—a fully-integrated, rigorous 2D/3D groundwater-surface water model—to better quantify surface water-groundwater interaction, bank drainage, and groundwater flux following a storm event. In contrast to empirical or statistical relationships employed by simpler models, HydroGeoSphere uses the underlying physics as a foundation to describe water movement throughout the bank and floodplain areas. Aquanty conducted HydroGeoSphere simulations at four different flood stages (1.5, 3, 6, and 12 feet above base flow) for eight sensitivity analysis cases with varying hydraulic and hydrogeologic parameters (specifically, hydraulic conductivity, K_h, and horizontal-to-vertical anisotropy ratio, K_h/K_v) to bracket the anticipated bank storage volume, volumetric groundwater flux, and drainage time for a characteristic South River bank. Detailed results of the simulations can be found in Aquanty's draft summary report *HydroGeoSphere Modeling for a Representative Reach of the South River*, April 2015.

For most simulation cases, regardless of flood stage, the majority of the precipitation and stream water that infiltrates the bank face and near-bank floodplain surface during a storm event re-enters the stream via the more permeable BG/SL (bank exchange zone #5). The relevant model output from HydroGeoSphere, therefore, is the cumulative volume of bank storage water (liters per meter bank width) that drains through Zone #5 throughout a 7- to 30-day period (30 days was the maximum simulation time). In addition, because the target lifetime of the biochar layer will be on the order of decades, the relevant simulation case will be one that represents the spatial and long-term temporal average, which in this situation is Case #1 (mid-range K_h and K_h/K_v for alluvial bank soil and BG/SL). Table 1 summarizes the model input and output parameters for Case #1 that served as the basis for determining the required biochar bed thickness.

Table 1
HydroGeoSphere Parameters Used as Basis for Calculating Basal Gravel/Sand Layer Biochar Treatment Bed Thickness.

Parameter	Layer(s)	Value	Units
Horizontal Hydraulic Conductivity (K_h)	ABS	1	feet/day
	BG/SL	50	feet/day
Horizontal-to-Vertical Anisotropy Ratio, K_h/K_v	ABS and BG/SL	6	unitless
Effective Porosity	ABS and BG/SL	25	%
Drainage Layer Height	BG/SL	3	feet
Flood Stage (feet)	**Return Frequency (events/year)**	**Leachate Volume (Liters/foot bank width)**	
1.5	18	49	
3	3.5	102	
6	1	260	

Notes:
ABS = alluvial bank soil
BG/SL = basal gravel/sand layer

TOTAL INORGANIC HG LOADING

A THg concentration profile for alluvial groundwater in the BG/SL that spans the full life cycle of a storm event (up to 30 days or more) is not available for a representative South River bank. As a result, the cumulative total Hg load per storm event cannot be determined directly by estimating the area under the loading-time curve. However, two alternative sources of THg concentration data are available to serve as a reasonable basis for sizing the biochar bed.

As part of University of Delaware's bank geochemistry study at RRM 3.5, alluvial groundwater samples were collected from four piezometer wells installed in the BG/SL of the near-bank floodplain area during five sampling events from July 2013 to July 2014, and analyzed at University of Waterloo for 0.45-micron filter-passing total Hg (THg). Measured THg concentrations in the alluvial groundwater were generally less than 250 nanograms per liter (ng/L), although two samples exceeded 500 ng/L and one sample exceeded 1400 ng/L. Each sample of the BG/SL represents a single point in time, and where each sample is positioned temporally in the fill/drainage lifecycle of a bank following a storm is not well understood.

Measurements of porewater taken by Texas Tech from saturated bank soils at RRM 3.5 (under baseline and storm conditions using DGT probes and in situ peeper technology) suggest that THg concentrations in undiluted porewater range from 10,000 to more than 70,000 ng/L. HydroGeoSphere results for Case #1 indicate an approximately 65:1 dilution of alluvial bank soil (ABS) bank storage water by alluvial groundwater as the ABS drains into the BG/SL. Diluting DGT porewater concentrations by 65:1 yields THg concentrations ranging from 150 to 1,100 ng/L.

Based on the above two lines of evidence, a conservative median concentration of 1,000 ng THg/L was assumed for estimating the long-term average THg load on the biochar treatment bed.

BIOCHAR BED THICKNESS

The following assumptions were made in estimating a preliminary bed thickness for a biochar treatment layer for the BG/SL:

- Based on University of Waterloo saturated biochar treatment column experiments with South River bank soil/sediment leachate, the depth of THg penetration into the biochar column is very short (less than 1 inch after several hundred pore volumes). In addition, X-ray Absorption Fine Structure Spectroscopy (XAFS) studies at Argonne National Laboratory and sequential extraction tests have shown Hg is strongly bound to the surface and within the interstices of biochar particles. There is also XAFS evidence for the formation of low-solubility HgS-like species within the biochar pore structure.
- For the majority of storm events, the drainage velocity of groundwater-diluted leachate will be relatively low because it occurs throughout 7 to 30 days or more.
- The above observations support a conservative assumption of equilibrium loading on biochar at the feed or inlet concentration, as well as good utilization of the full thickness of the biochar bed (short mass transfer zone equals steep Hg breakthrough curve).

- Based on the University of Waterloo studies, equilibrium partition coefficients (K_d) for inorganic Hg for South River soils and sediments range from 1,000 liters per kilogram (L/kg) to more than 100,000 L/kg. Literature values of K_d for Hg range from 10,000 L/kg to 1,000,000 L/kg depending on soil/sediment type, pH, and redox state. A conservative value of 10,000 L/kg was used.
- Summary of Design Parameters
  - THg inlet concentration: 1,000 ng/L
  - Desired sorbent lifetime: Up to 100 years
  - Equilibrium Partition Coefficient: 10,000 L/kg
  - Assumed Height of BG/SL: 3 feet
  - Bulk Density Biochar: 23 pounds per feet^3

Table 2 summarizes the calculation results for the treatment bed thickness using the assumptions and calculation basis outlined above. The results suggest a minimum bed thickness of 6 inches, assuming a 50/50 volume/volume (v/v) biochar and sand mix. A bed thickness of more than 6 inches will provide additional protection because of the large uncertainties involved in the bank leaching model.

Table 2
Biochar Treatment Bed Thickness Calculation for Basal Gravel/Sand Layer Using HydroGeoSphere Case #1 Leachate Volumes

Flood Stage (ft)	Leachate Volume (L/ft bank width)	Return Frequency (events/yr)	Annual THg Load by flood stage (mg/yr/ft bank width)	Annual THg Load for all storms (mg/yr/ft bank width)	mg THg/kg biochar at breakthrough	Annual Biochar Required (ft^3/yr/ft bank)	50/50 v/v Biochar/Sand Bed Thickness (in)
1.5	49	18	0.88	1.5	10	0.0143	6 to 12
3	102	3.5	0.36				
6	260	1	0.26				

Notes:
ft = feet
ft^3 = cubic feet
in = inch
kg = kilograms
L/ft = liters per feet
mg = milligrams
THg = total mercury
yr = year

ATTACHMENT F-1

LABORATORY STUDY UPDATE

Laboratory Study Update

Texas Tech University

Presented on 8/14/2015

Updated Slides

RRM 3.5 Reactive Capping Study

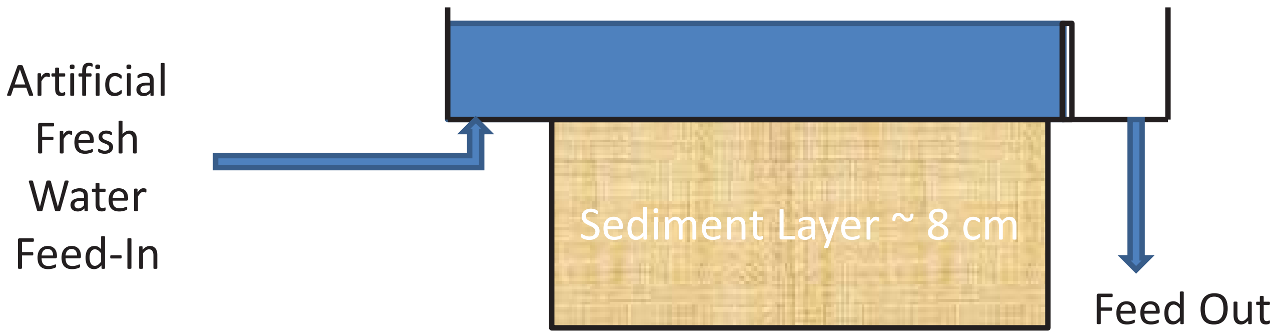
Baseline sampling: November 2014 – indicates sediment layer flushed with oxic waters
Capping: December 2014
Post-capping 1st sampling: Jan 2015 – indicates behavior during redox transition
Post-capping 2nd sampling: May 2015- T-cells dismantled for Hg and MeHg coring
Indicates behavior of continually saturated capped sediments such as base of bank

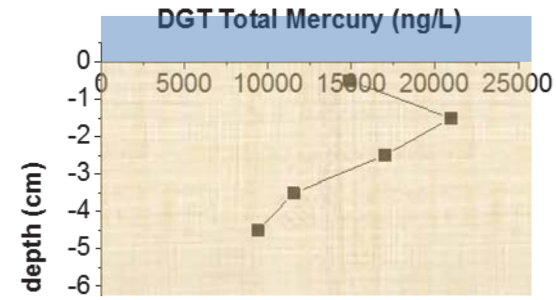
Designation	Sediment Source	Sediment Type/ TOC	THg Conc. (mg/kg)	Cap Type (All 3 cm thick)	Amendment Description
3.5-G-C1	Off channel	Gravel/fines; TOC = 1.3 ± 0.2 %	30±10	Sand w/biochar	1 lb/ft^2mixed in 3 cm layer
3.5-G-S2	Off channel	Gravel/fines; TOC = 1.3 ± 0.2 %	30±10	Not Capped	
3.5-B-C1	Base of bank	Fines/gravel; TOC= 2.3 ± 0.2 %	150±21	Sand w/AC	AC applied as in 3.5-G-C1
3.5-B-S1	Base of bank	Fines/gravel TOC= 2.3 ± 0.2 %	150±21	Sand	
3.5-B-S2	Base of bank	Fines/gravel TOC= 2.3 ± 0.2 %	150±21	Sand w/biochar	As applied in 3.5-G-C1

T-cell & Depth Profile Configuration

Baseline

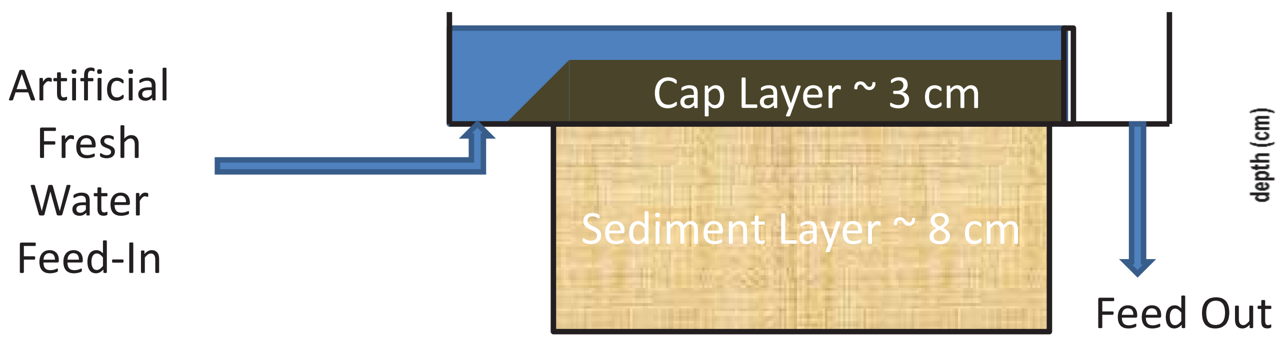
Hg profile

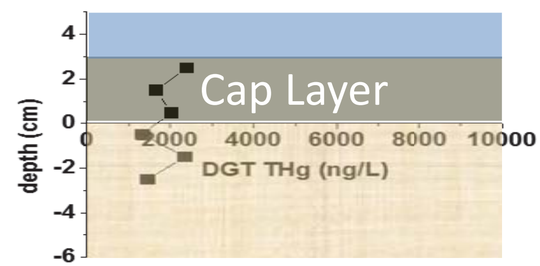




At least ~ 1 month to develop stable redox profile before DGT sampling for baseline

Capped





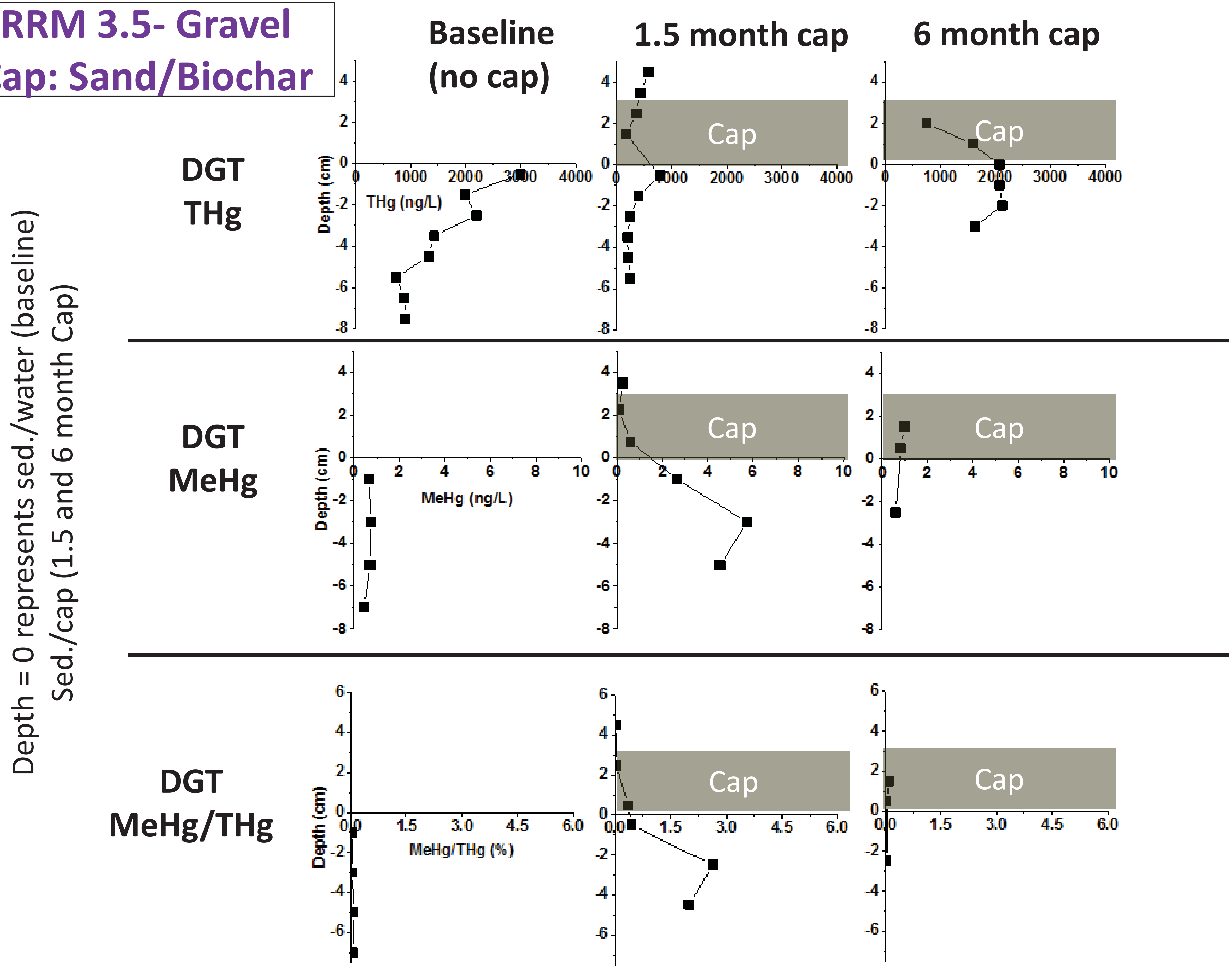
~ 1.5 month post cap DGT THg & MeHg sampled

~ 6 month post cap Voltammetry, and DGTs sampled first and afterwards sediment coring done for total sediment Hg and MeHg

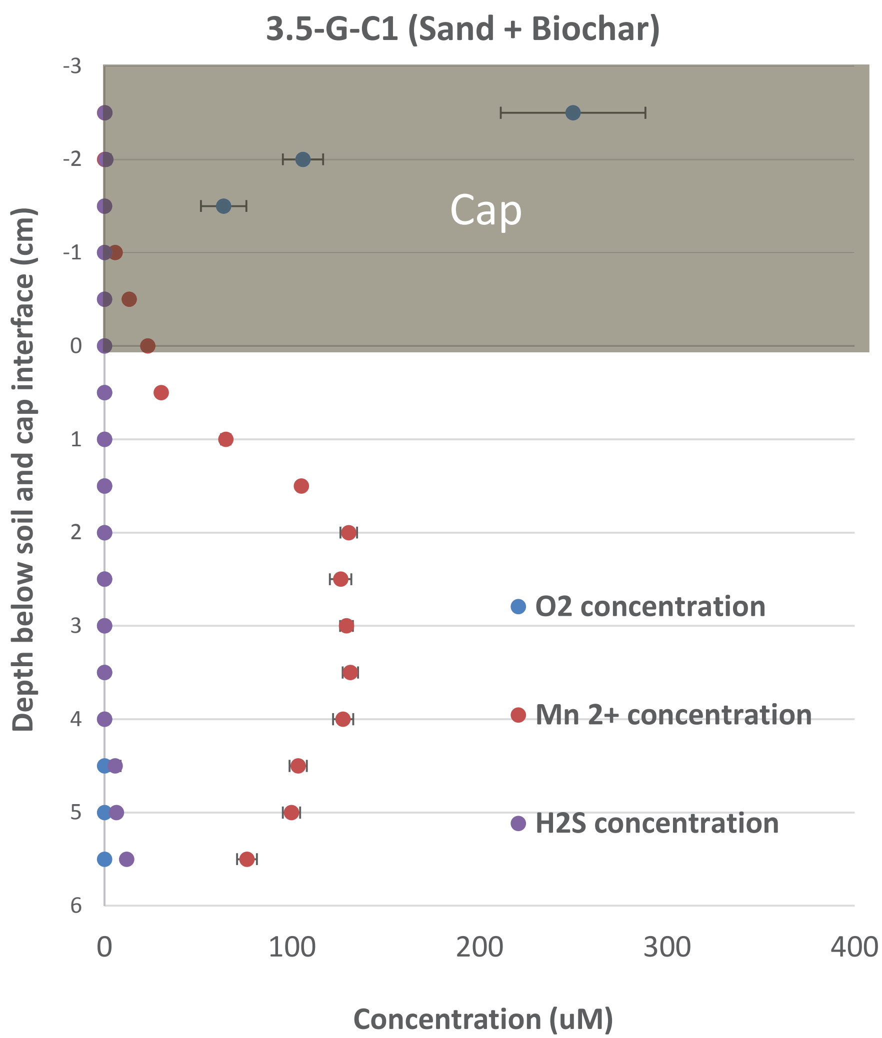
Gravel Mesocosms RRM 3.5

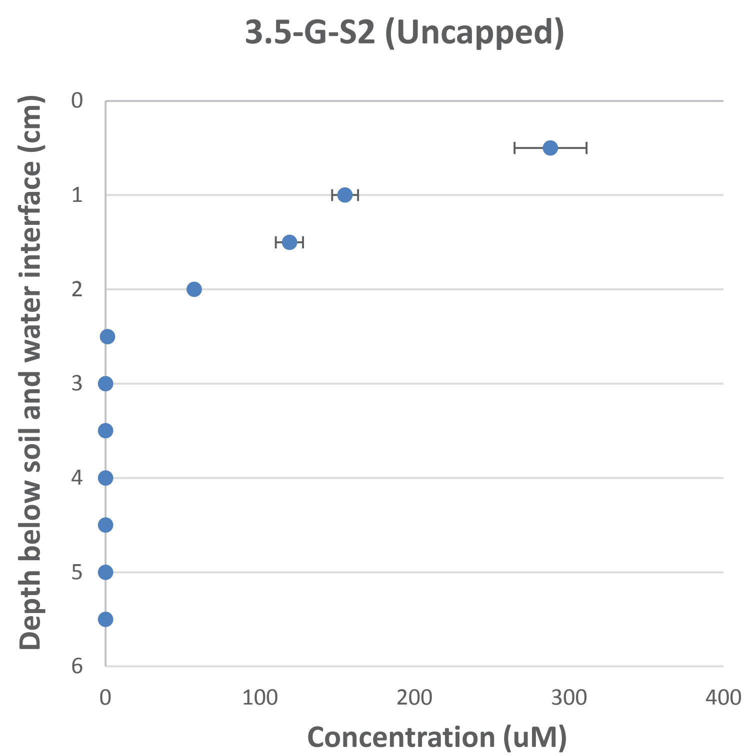
- Simulating river bed and release from sand and gravel layer at base of bank
  - Sand, gravel intermixed with fines
  - Continuously saturated with water
  - Hg 30±10 mg/kg

RRM 3.5- Gravel Cap: Sand/Biochar

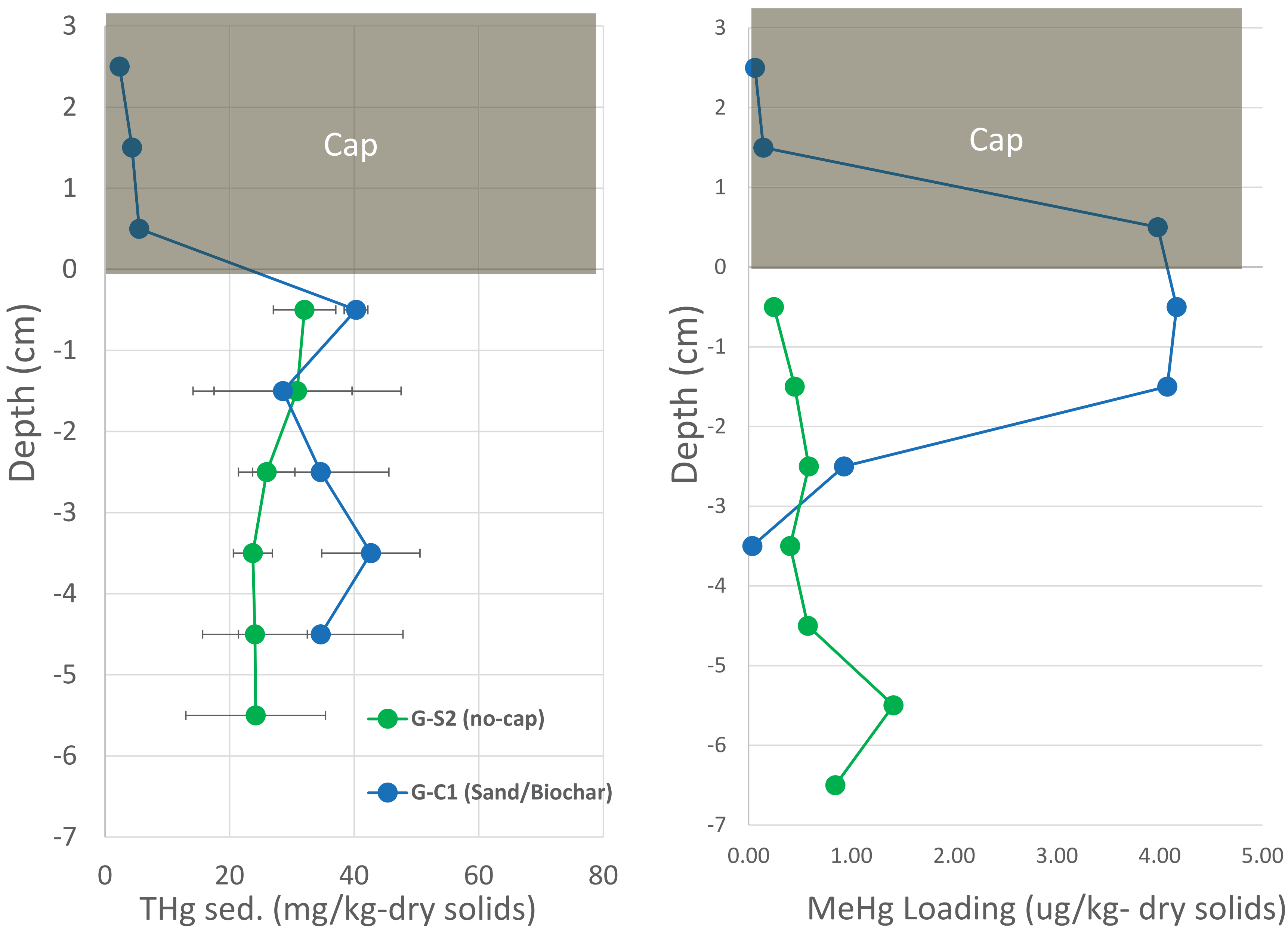


Voltammetry- Gravel-6 months Cap





Gravel- Sed. THg & MeHg



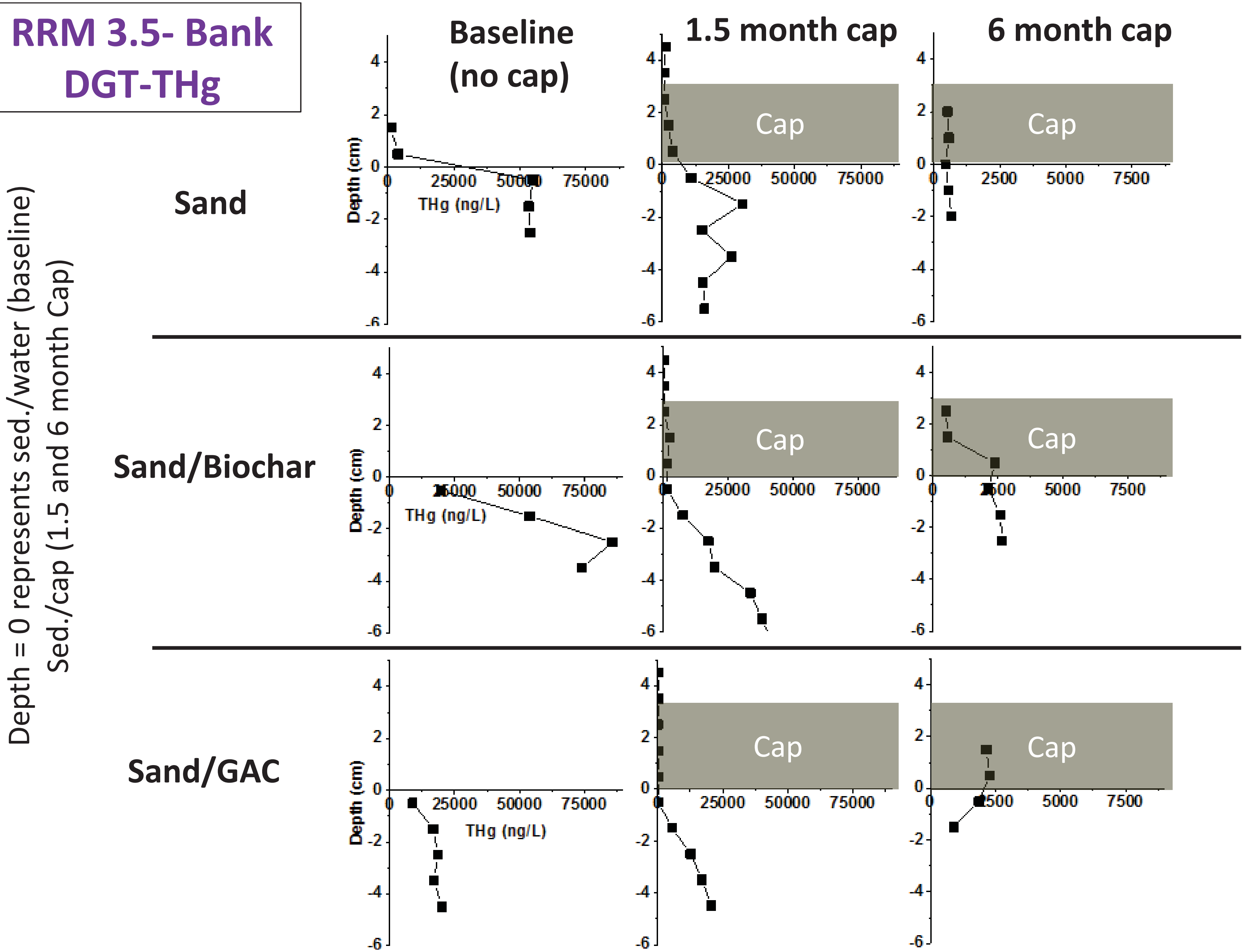
Key Conclusions - Gravel

- Relatively low Hg in porewater
- Minimal changes in Hg Kd beneath a cap
  - Remains relatively oxic
  - Little evidence of reduced Hg phases forming
- Increased methylation (transient) due to the reduction that does occur
  - Greater increases in methylation with biochar
    - Not observed in bank sediments (missed transient ?)
    - Negligible effect after 6 months
- Minimal migration into caps

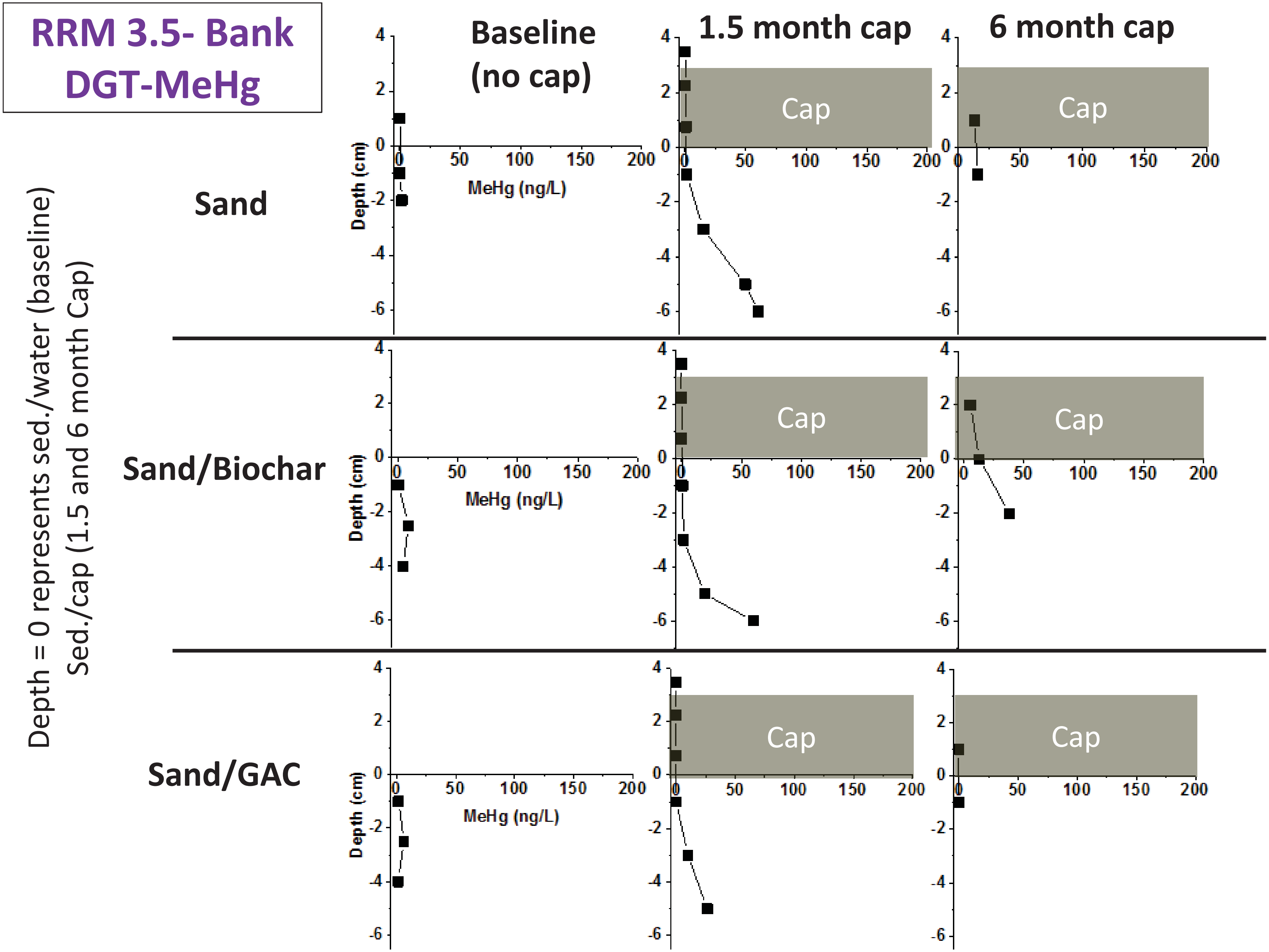
Base of Bank Mesocosm

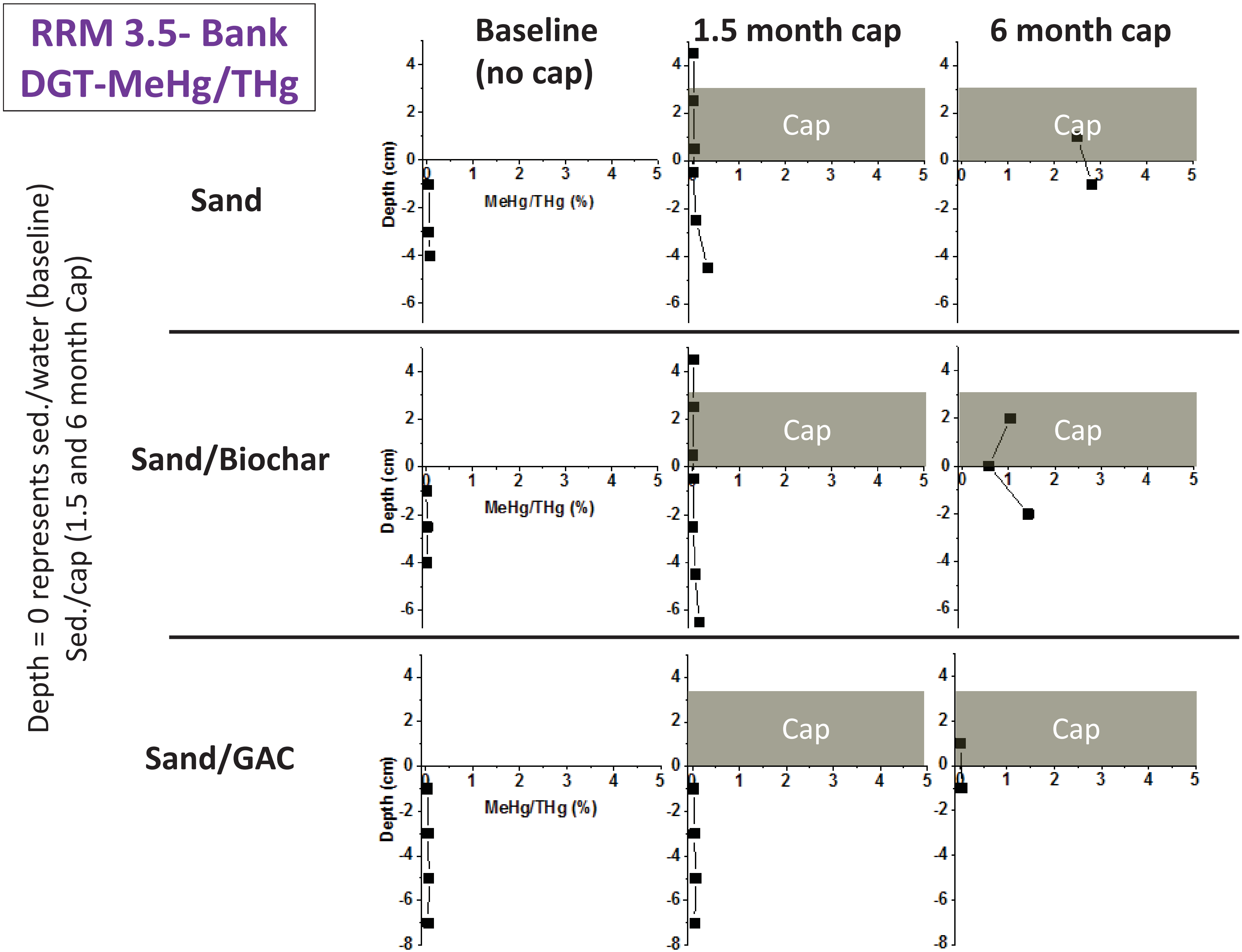
- Simulating cap layer at base of bank
  - Continuously saturated
  - Fine grained silt with some sand/gravel
  - Hg 150 ± 21 mg/kg
- Baseline sampling indicates behavior under oxic conditions
  - e.g. as a result of flushing of unsaturated zone with oxic waters during a flood event

RRM 3.5- Bank DGT-THg

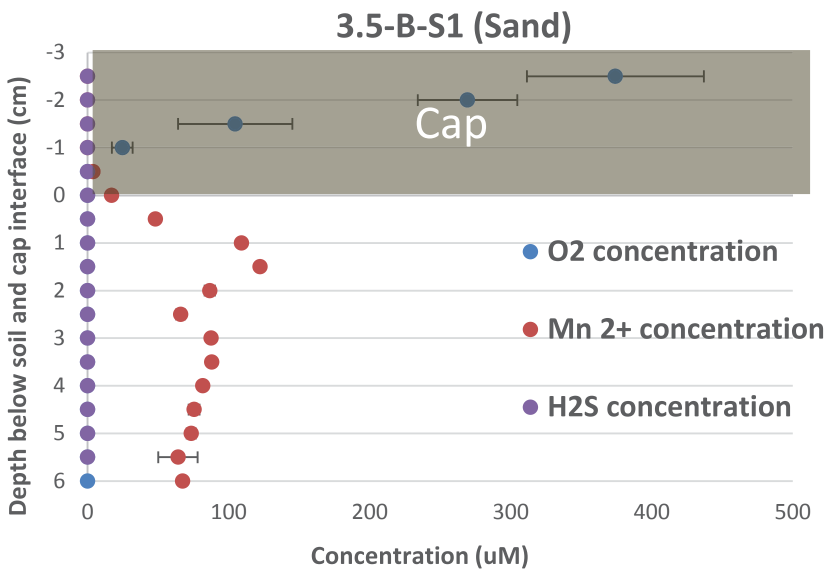


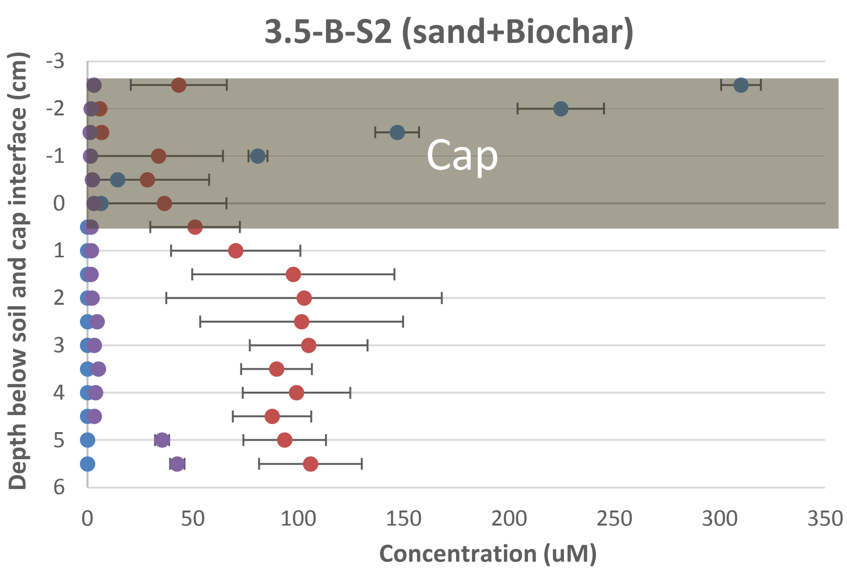
RRM 3.5- Bank DGT-MeHg

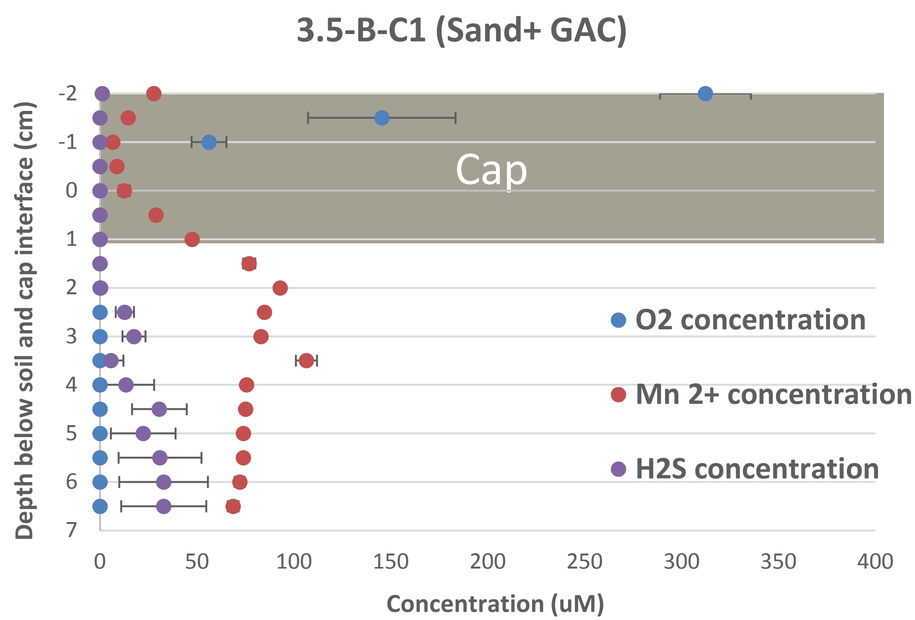



RRM 3.5- Bank
DGT-MeHg/THg
Baseline (no cap)
1.5 month cap
6 month cap
Sand
Sand/Biochar
Sand/GAC
Depth = 0 represents sed./water (baseline)
Sed./cap (1.5 and 6 month Cap)
Depth (cm)
MeHg/THg (%)
Cap

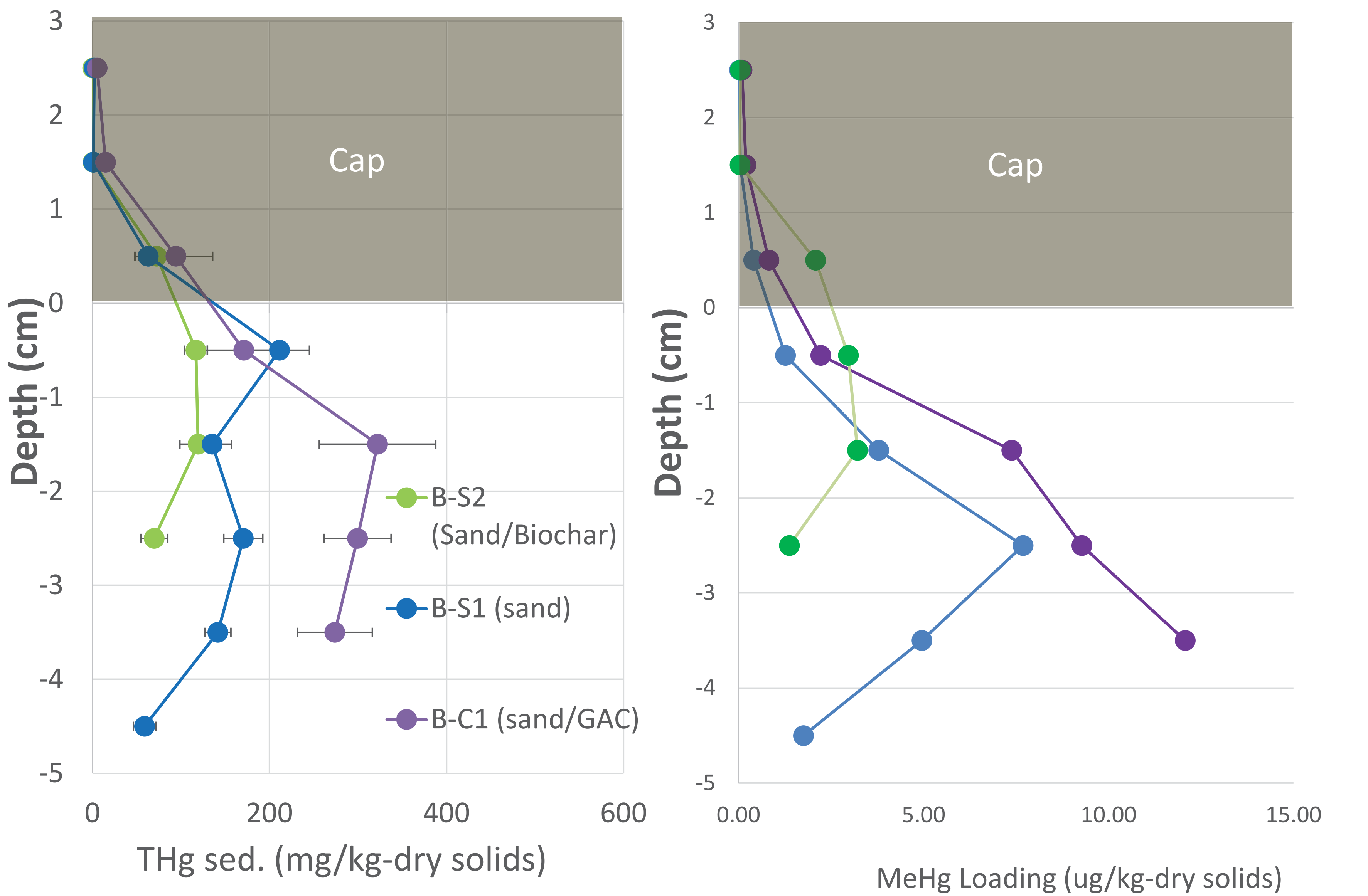
Voltammetry- Bank-6 months Cap







Bank-Sed. THg & MeHg



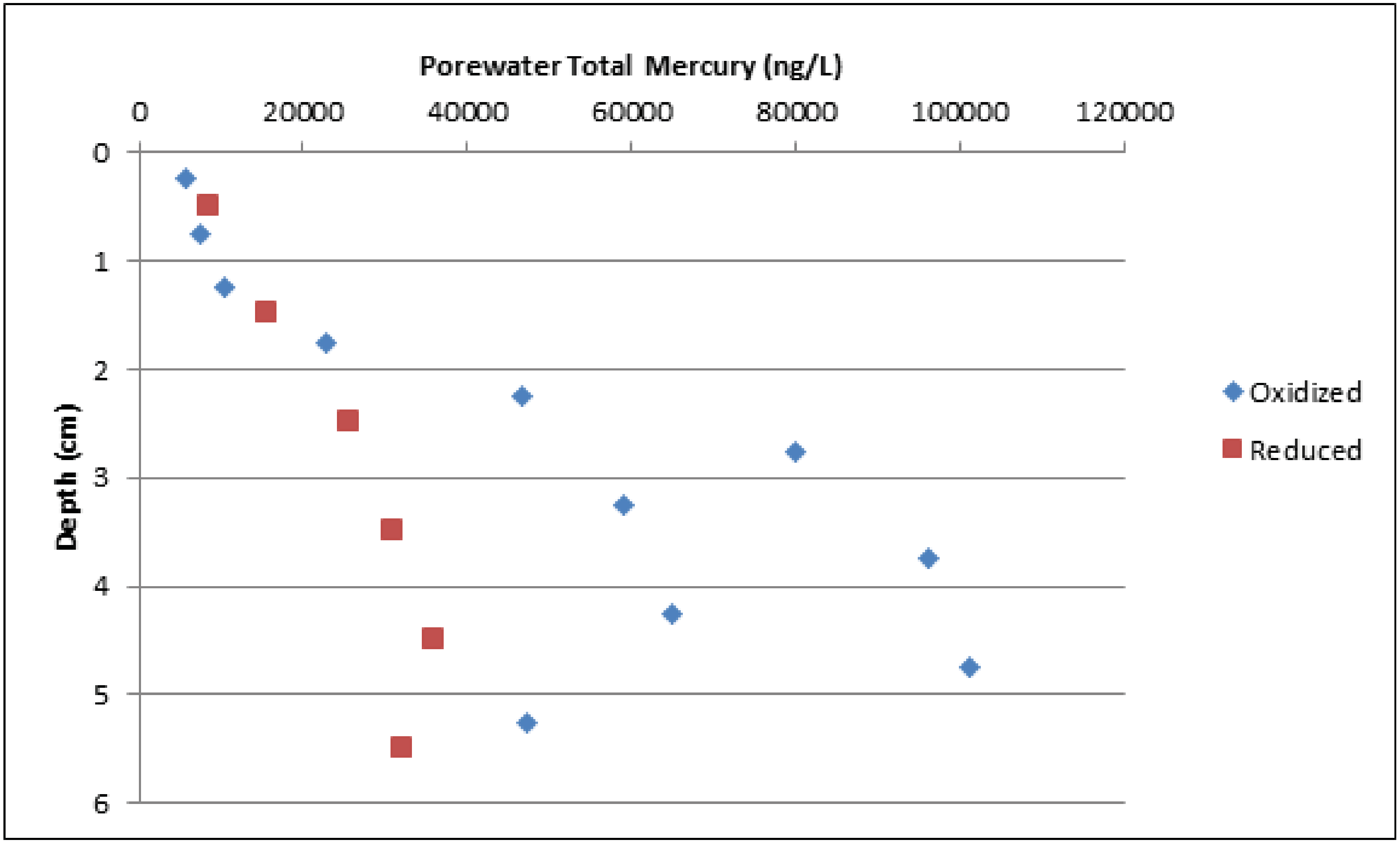
Key Conclusions- Bank Sediment

- Primary effect of cap beneath water table is driving previously exposed sediment more anaerobic and increasing precipitation of reduced Hg phases
  - Kd exposed sediment 3000-7500L/kg
  - Kd sediment 6 months post cap 75000 L/kg
  - Results at 1.5 months show mixed results due to dynamics
- Minor increases in MeHg with reduction
- Migration into cap minimal - sand or amended cap
  - Measured Hg only at 0-1 cm into cap
    - Intermixing or migration?
  - Increased Kd below cap (saturated reduced conditions) reduces mobile Hg
  - Diffusion only mechanism in laboratory microcosms
    - Greater migration under groundwater flow/seepage conditions

On-going T-cell status

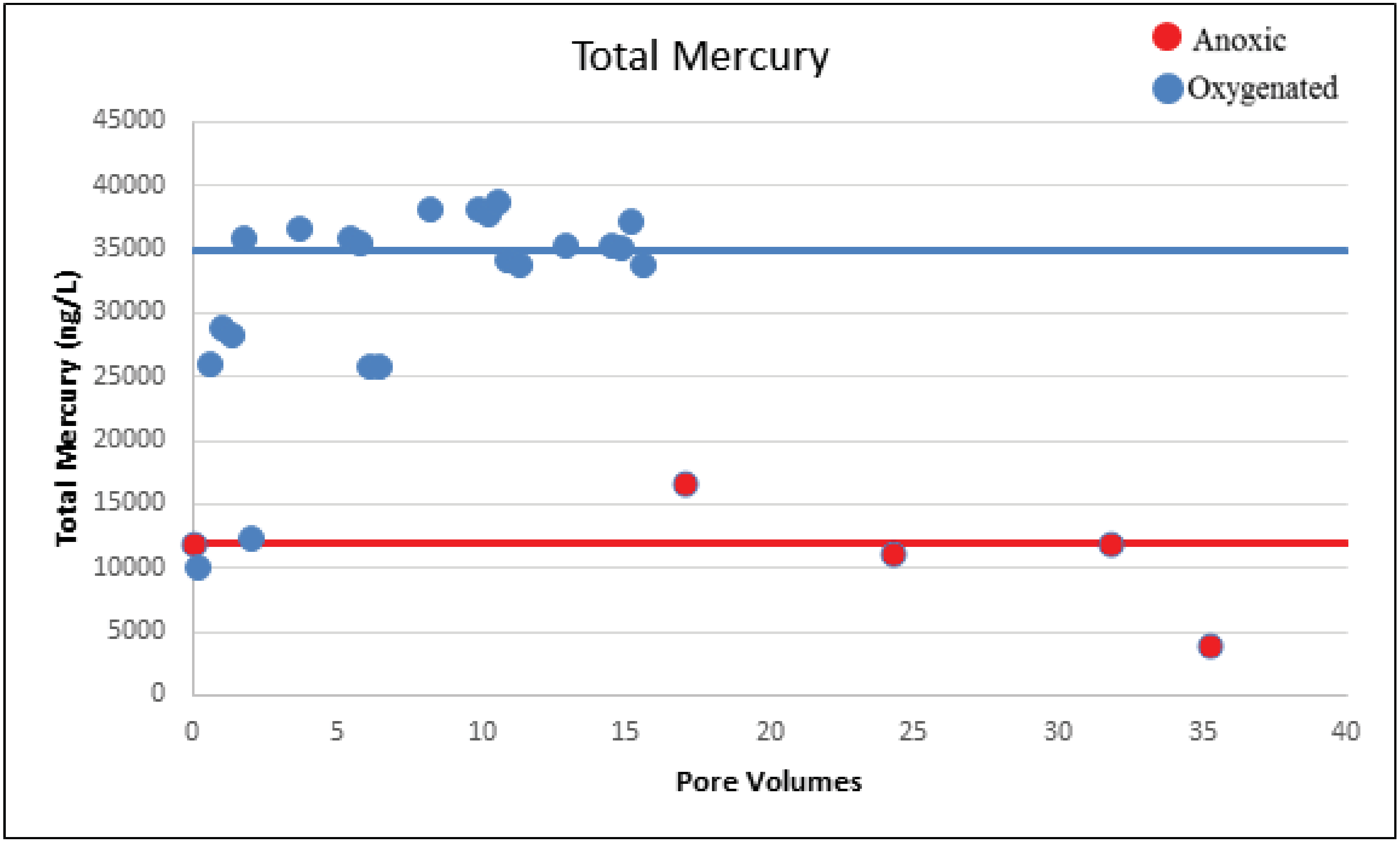
Designation	Sediment Source	Type	THg Conc. (mg/kg)	Cap Type (All 3 cm thick)	Amendment Description	T-cell Status	Status
3.5-BS-1	Bank soil	Fines	151±25	No Cap	NA	For Paul's Thesis- Drainage studies	For Paul's Thesis- Drainage studies
3.5-BS-2	Bank soil	Fines	151±25	Jones Hollow soil; THg= 0.078±0.013 mg/kg		Capped; Baseline data being compiled	Baseline DGT MeHg, THg, Volt (done)
3.5-BS-3	Bank soil	Fines	151±25	Sand w/AC	1 lb/ft^2 mixed in 3 cm	Same as above	Same as above
CP-BS-1	Bank soil	Fines	4.2±0.97	Jones Hollow soil		Capped; baseline data being compiled	Same as above
CP-BS-2	Bank soil	Fines	4.2±0.97	Sand w/AC	Same as BS-3	Same as above	Same as above
CP-BS-3	Bank soil	Fines	4.2±0.97	Sand w/Biochar	Same as 3.5-G-C1	Same as above	Same as above
CP-BS-4	Bank soil	Fines	4.2±0.97	No cap		NA	Same as above
CP-BS-5	Bank soil	Fines	4.2±0.97	No cap		NA	Same as above

Mesocosms -Drainage/Wetting Cycle



Mesocosm initially reduced (red), drained and then flooded with oxic waters (blue)

Bank Drainage



Key Conclusions – Wetting/Drainage

- Total Hg rapidly undergoes shifts between
  - anoxic (low total Hg in porewater <10,000ng/L) to
  - oxic (higher total Hg >30-50,000 ng/L)
  - Some variations due to local heterogeneity and likely some phases that do not shift rapidly
- Oxic conditions represent worst case for drainage from a bank saturated during a flood event
- Anoxic conditions only likely to occur in continuously saturated zones
  - MeHg also likely to be significant only in those zones

In-Situ Management

“Cap” layers?

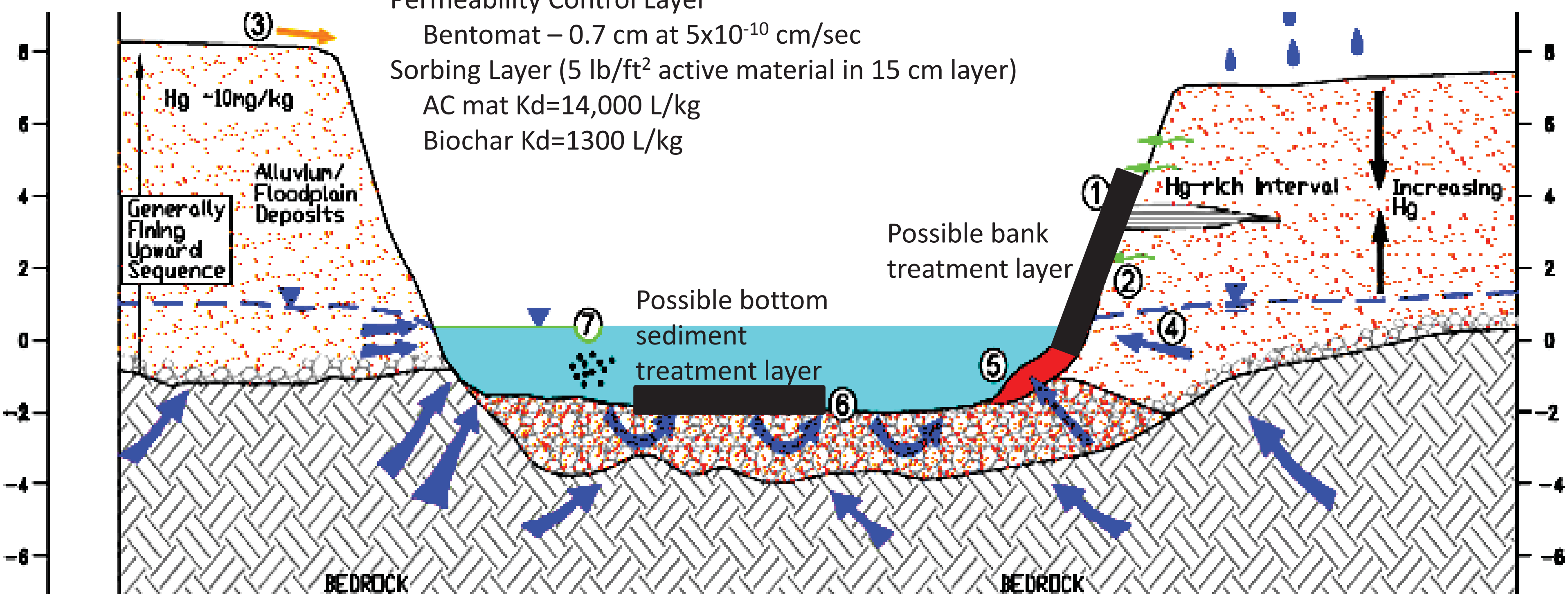
Permeability Control Layer

Bentomat – 0.7 cm at 5x10^{-10} cm/sec

Sorbing Layer (5 lb/ft^2 active material in 15 cm layer)

AC mat Kd=14,000 L/kg

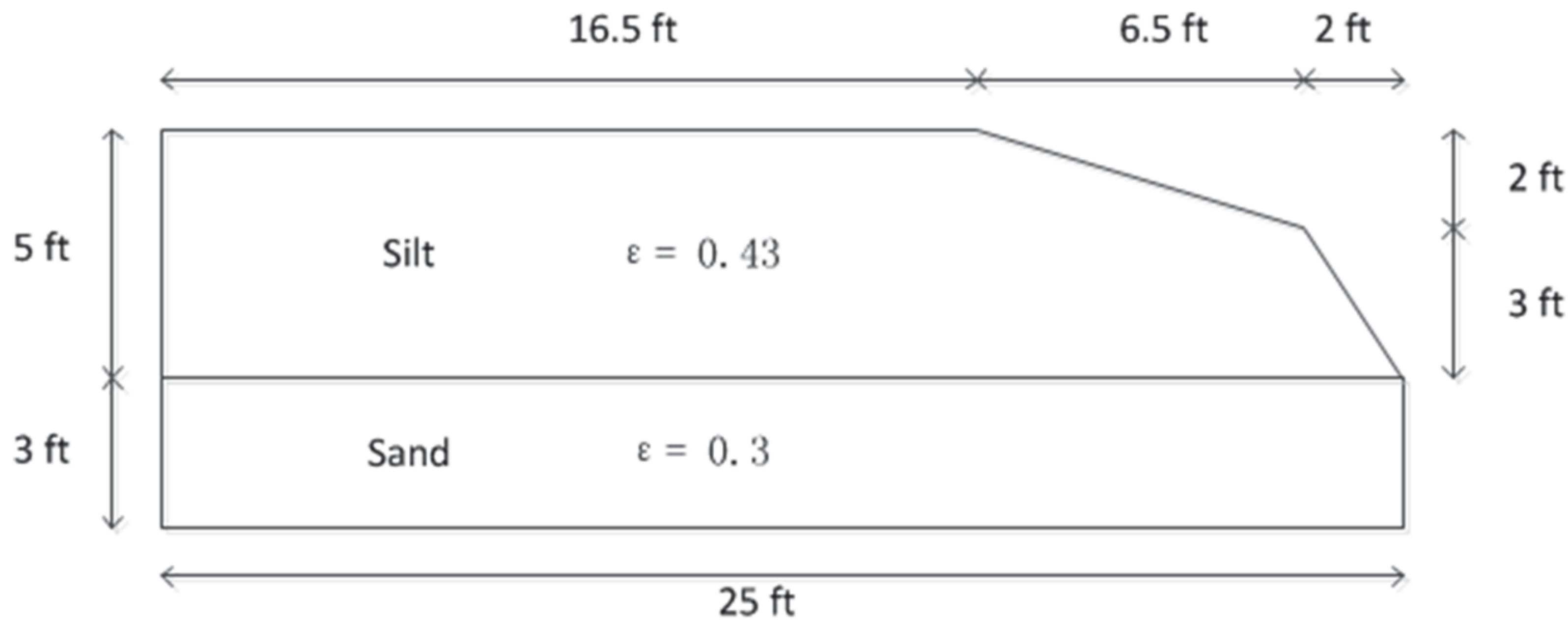
Biochar Kd=1300 L/kg



Amended Layers to Manage Bank Drainage

- Focus on partially saturated oxic bank inundated by flood event and then draining back to river over time
- Assumptions
  - Major flood event once monthly
  - Flood event completely saturates bank then completely drains over time (model as oscillating flow with one month time period)
  - No other significant groundwater exchange
  - Draining water remains oxic (50,000 ng/L total Hg) with minimal methylation
  - Significant Hg only in seepage from fine grained bank material (bulk of drainage is through relatively clean sand/gravel layer)
  - Sand and/or sand-amended layer (biochar or activated carbon) placed along drainage path from bank

Estimating drainage from contaminated silt layer vs underlying sand



Ksilt/Ksand	From sand	From silt
0.11	99.78%	0.22%
0.22	99.09%	0.91%
0.45	97.76%	2.24%
0.89	94.43%	5.57%
1.79	86.46%	13.54%
width	From sand	From silt
10ft	99.19%	0.81%
25ft	99.78%	0.22%
50ft	99.70%	0.30%

Assuming drainage from 5 ft inundation of entire bank

Note boundary condition modified to allow free exchange from sand layer

Screening of potential amendment materials – Freshwater sorption of THg

pore volumes sorbent can manage (pure amendment) ~ K_d

		Matrix
Material Type	Sorbent	Freshwater
		K_d [L/kg]
Carbon based material	GAC	14300*
	Biochar-wood	1310*
	Biochar-Rice Husk	190
organophilic clay based materials	PM199 granular	460
Natural materials	Kaolinite	1490
	Sand	6

*Does not include precipitation processes, e.g. cinnabar formation

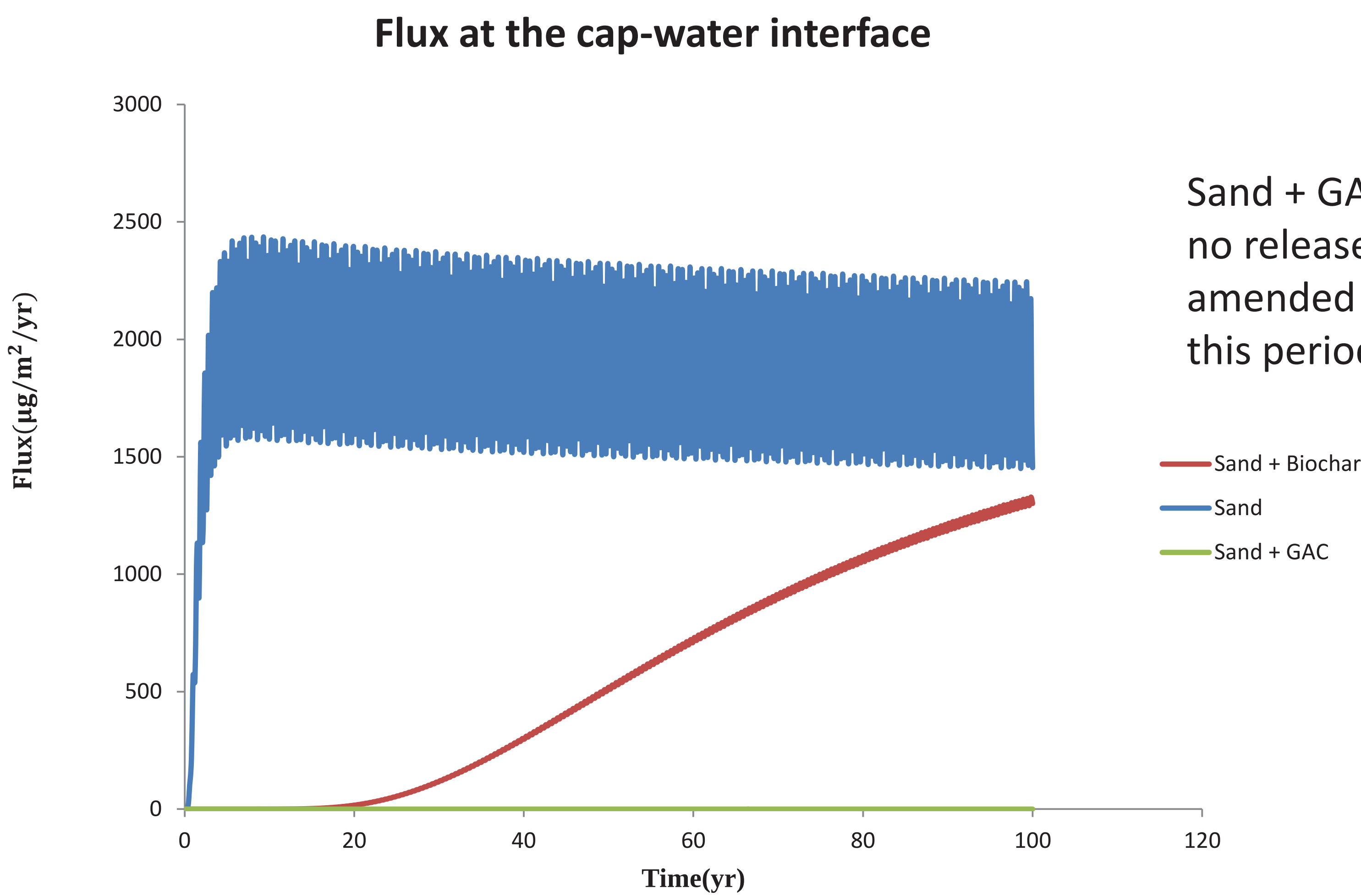
Screening in laboratory waters, not site porewaters

Note DOM is a major factor in effectiveness of sorbents.
<100 mg/L DOM relatively small effect
>1000 mg/L DOM little or no sorption of Hg observed (limited data and not expected to be relevant to South River

Cap/Amendment Assumptions

- Amendment Layer
  - <u>15 cm containing sand or sand with 5 lb/ft^2 of AC or biochar</u>
    - 40% AC or 32.5% biochar (by volume)
    - Equivalent to a 5-6 cm layer of pure materials
  - <u>Consider only seepage from silty layer</u>
    - $U[cm/yr] = 26.5\sin\left(\frac{2\pi t[day]}{30}\right)$
  - <u>Consider only inundation and drainage as primary transport mechanism</u>
    - 50,000 ng/L THg in silt seepage
    - Neglect Hg concentration in gravel layer

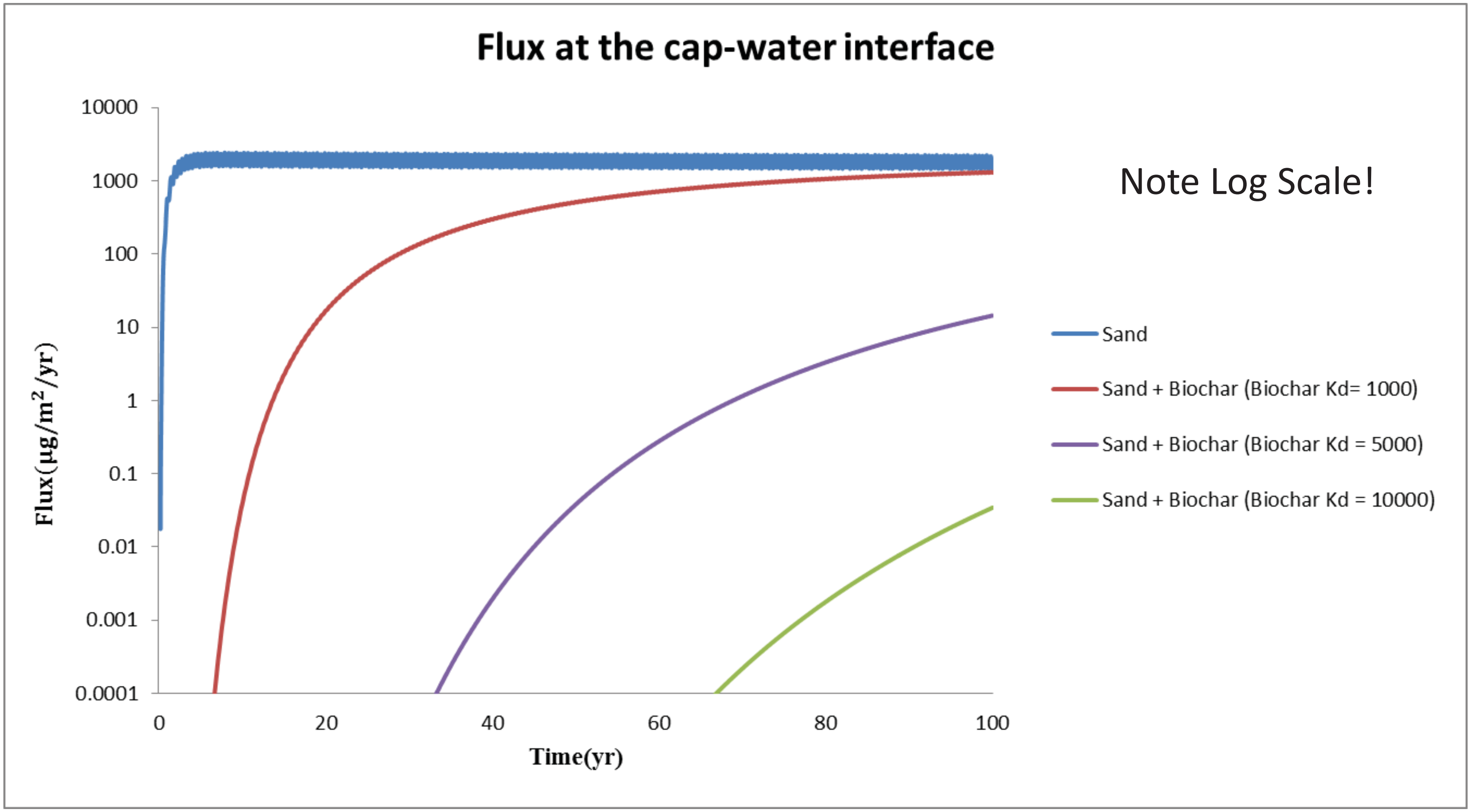
Hg flux for different capping materials



Sand + GAC effectively no release through the amended cap layer in this period

Neglects any net groundwater flow to river and assumes inundation and drainage equal
Neglects any changes in Hg porewater concentration due to reduction beneath a saturated cap

Hg flux- Effect of Biochar K_D



Neglects any net groundwater flow to river and assumes inundation and drainage equal
Neglects any changes in Hg porewater concentration due to reduction beneath a saturated cap

Key Conclusions

- Below water table in river and at base of bank
  - Cap layer can isolate sediments and encourage reduction
  - Increases Hg partition coefficient and reduces porewater Hg
  - Potential for at least transient modest increases in MeHg
  - Amended caps aid containment but may not be necessary unless there is substantial groundwater exchange
- Unsaturated bank soils
  - Flood related inundation will release water with total Hg at higher concentrations due to oxic conditions
  - Minimal MeHg due to oxic conditions
  - Amended caps, including biochar, can retain Hg for long periods (decades or longer) if inundation and drainage and resulting sorption onto amendment reversible

ATTACHMENT F-2

HYDROGEOSPHERE MODELING FOR A REPRESENTATIVE REACH OF THE SOUTH RIVER

HydroGeoSphere Modeling for a Representative Reach of the South River

Prepared by:

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Report Submitted to:

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September 2015

Project Number: 00210001

Distribution:
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TABLE OF CONTENTS

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FIGURES

TABLES

APPENDICES

1.0 INTRODUCTION

1.1 Project Background

In 2015, E.I. du Pont de Nemours and Company (DuPont) retained Aquanty Inc. (Aquanty) to conduct a numerical modeling study entitled: HydroGeoSphere Modeling for a Representative Reach of the South River. The primary goal of this study was to improve the conceptual understanding of surface water/groundwater interaction, bank drainage, and groundwater flux following storm events with respect to mercury loading of the South River, Virginia.

This project was designed to answer the following questions posed by DuPont:

1)
    a. How quickly and to what extent does a river flood wave infiltrate and advance into alluvial bank soils following a significant rain event?
    b. What are the water flow vectors and how do stream water, rain water, and groundwater mix?

2)
    a. How quickly and to what extent does bank storage water drain on the falling limb of the hydrograph?
    b. What are the water flow vectors and how do stream water, rain water, and groundwater mix?

3) Sensitivity Analysis
    a. What are the critical hydraulic and hydrogeologic parameters that influence the groundwater flow vectors? At what parameter values?

4) What is the likely range of volumetric groundwater flux from the banks given the range of hydraulic aquifer properties observed in the system?

5) What is the range of seepage discharge velocities?

6) Recommended future investigation approach/design – What type of field investigation approach is recommended in order to create a site-specific calibrated model?

1.2 Numerical Model Selection

The appropriate numerical model for any problem is that which physically represents the key processes governing the system. For this modeling project, representing the interaction of surface water and groundwater using a strong scientific basis during flood events is of first-order importance, and, as such, requires the use of a fully-integrated groundwater-surface water model. Fully-integrated models are unique in their approach to simulating water movement because they are designed to seamlessly track the movement of water between surface water and groundwater systems, with a physics-based numerical approach. By utilizing the underlying physics to describe water movement, as oppose to empirical or statistical relationships commonly used by simpler modeling approaches, fully-integrated models are not restricted by any form of process simplification.

Among the available fully-integrated groundwater-surface water models, *HydroGeoSphere* (*HGS*) is recognized as the most comprehensive model, and most appropriate for this project. The *HGS* model (Aquanty Inc., 2015) is a three-dimensional control volume finite element simulator that is designed to simulate the entire terrestrial portion of the hydrologic cycle. It uses a globally-implicit approach to simultaneously solve the 2D diffusion-wave equation in the surface domain, and 3D form of Richards' equation in the subsurface domain. It also dynamically integrates key components of the hydrologic cycle such as evaporation from bare soil and water bodies, vegetation-dependent transpiration with root uptake, snowmelt and soil freeze/thaw. As with the solution of the coupled water flow equations, *HGS* solves the contaminant transport and energy transport equations over the land surface and in the subsurface, for both multispecies inorganic and organic contaminants including nonaqueous phase liquid dissolution and degradation processes, thus allowing for surface/subsurface interactions for not only flow, but also transport. The *HGS* platform uses a robust and efficient nonlinear solver, and has been parallelized to utilize high performance computing facilities to address large-scale problems.

HGS has been successfully applied to a number of real-world river cross-section modeling problems, including: hillslope models to quantify the origins of water entering a stream (Park et al., 2011); simulation of solute transport and tracer hydrograph separation (Liggett et al., 2014); and the role of groundwater recharge from overbank floods (Doble et al., 2012).

See **Appendix A** for a more detailed description of HydroGeoSphere.

1.3 Report Organization

This report is organized into 8 chapters, including this introduction. Chapter 2 presents the conceptual model which forms the basis for the numerical model construction and parameterization presented in Chapter 3; Chapter 4 presents a model sensitivity analysis; Chapter 5 presents simulation results for selected Cases and return periods; Chapter 6 contains recommendations for future field investigations; Chapter 7 contains report references; and, Chapter 8 describes the limitations and uses of this report.

1.4 Supplementary Video Summary

Since it is very difficult portray the highly transient nature of the scenarios considered as part of this study with static images, a video library has been provided to assist the reader's interpretation of the simulations. The following index lists the file path and videos associated with each section of the report.

Table 1. Supplementary Video Summary. Section Reference, Folder Path, and Video File Name.

Section	Folder Path	Video File Name
4.1.1	Video_Summary\01_K_Sensitivity	K_Sensitivity_6ft_with_precipitation.avi
4.1.2	Video_Summary\01_K_Sensitivity	K_Sensitivity_6ft_no_precipitation.avi
4.1.3	Video_Summary\02_Ss_Sensitivity	Ss_sensitivity.avi
4.1.4	Video_Summary\03_Water_Retention	CF_Case2.avi CF_Case7.avi
4.1.5	Video_Summary\04_Antecedent_Moisture	Case1_10day_ant_moist.avi
5.2.1	Video_Summary\05_WaterTable_Saturation	Case1\Case1_SW_WT_1-5.avi Case1\Case1_SW_WT_3ft.avi Case1\Case1_SW_WT_6ft.avi Case1\Case1_SW_WT_12ft_2d_drain.avi Case2\Case2_SW_WT_1-5.avi Case2\Case2_SW_WT_3ft.avi Case2\Case2_SW_WT_6ft.avi Case2\Case2_SW_WT_12ft_2d_drain.avi Case4\Case4_SW_WT_1-5.avi Case4\Case4_SW_WT_3ft.avi Case4\Case4_SW_WT_6ft.avi Case4\Case4_SW_WT_12ft_2d_drain.avi Case7\Case7_SW_WT_1-5.avi Case7\Case7_SW_WT_3ft.avi Case7\Case7_SW_WT_6ft.avi Case7\Case7_SW_WT_12ft_2d_drain.avi
5.2.2	Video_Summary\06_SoluteTransport	Case1\4_waters_animation_Case1_1_5ft.avi Case1\4_waters_animation_Case1_3ft.avi Case1\4_waters_animation_Case1_6ft.avi Case1\4_waters_animation_Case1_12ft_2d_drain.avi Case2\4_waters_animation_Case2_1_5ft.avi Case2\4_waters_animation_Case2_3ft.avi Case2\4_waters_animation_Case2_6ft.avi Case2\4_waters_animation_Case2_12ft_2d_drain.avi Case4\4_waters_animation_Case4_1_5ft.avi Case4\4_waters_animation_Case4_3ft.avi

		Case4\4_waters_animation_Case4_6ft.avi Case4\4_waters_animation_Case4_12ft_2d_drain.avi Case7\4_waters_animation_Case7_1_5ft.avi Case7\4_waters_animation_Case7_3ft.avi Case7\4_waters_animation_Case7_6ft.avi Case7\4_waters_animation_Case7_12ft_2d_drain.avi
5.2.3	Video_Summary\07_Velocity	Case1\Case1_V_1-5ft.avi Case1\Case1_V_3ft.avi Case1\Case1_V_6ft.avi Case1\Case1_V_12ft_2d_drain.avi Case2\Case2_V_1-5ft.avi Case2\Case2_V_3ft.avi Case2\Case2_V_6ft.avi Case2\Case2_V_12ft_2d_drain.avi Case4\Case4_V_1-5ft.avi Case4\Case4_V_3ft.avi Case4\Case4_V_6ft.avi Case4\Case4_V_12ft_2d_drain.avi Case7\Case7_V_1-5ft.avi Case7\Case7_V_3ft.avi Case7\Case7_V_6ft.avi Case7\Case7_V_12ft_2d_drain.avi

2.0 CONCEPTUAL MODEL

A 2 dimensional (2D) conceptual model was constructed for a representative reach along the South River, VA. using Leapfrog Hydro (www.leapfrog3d.com). The conceptual model included: geometry, material distributions and properties, and information on stressors to the system. This conceptual model forms the basis of the numerical model presented in Section 3.0. While the *HGS* model is a 3D simulator, it was agreed with DuPont to first explore a number of key issues that could be best accommodated in a 2D framework as a starting point.

2.1 Outer Geometry

The upper surface of the 2D conceptual model, assembled by AnchorQEA (2015), was created by combining three separate topographic data sets for a representative reach of the South River:

- Channel bathymetry based on the channel survey results completed by Spicer Group in 2014. Provided by Anchor QEA (2015);
- LiDAR collect by Spicer Group in 2014 to define bank elevations. Provided by Anchor QEA (2015); and,
- Topographic Lidar to define the floodplain topography (USGS, 2011).

Gaps between the data sets were interpolated by AnchorQEA (2015).

For the purposes of this modeling study, the bedrock underlying the channel sediments is assumed to be impervious and will serve as a bottom boundary for the model. An estimate of the upper surface of the bedrock underlying the channel sediments was provided by DuPont. The lateral extent of the conceptual model is defined as the location where bedrock intercepts ground surface (Figure 1). The lateral extent of the model is approximately 2,600 ft, and contains the 100 yr FEMA floodplain extents at 310 ft and 2,720 ft along the cross-section.

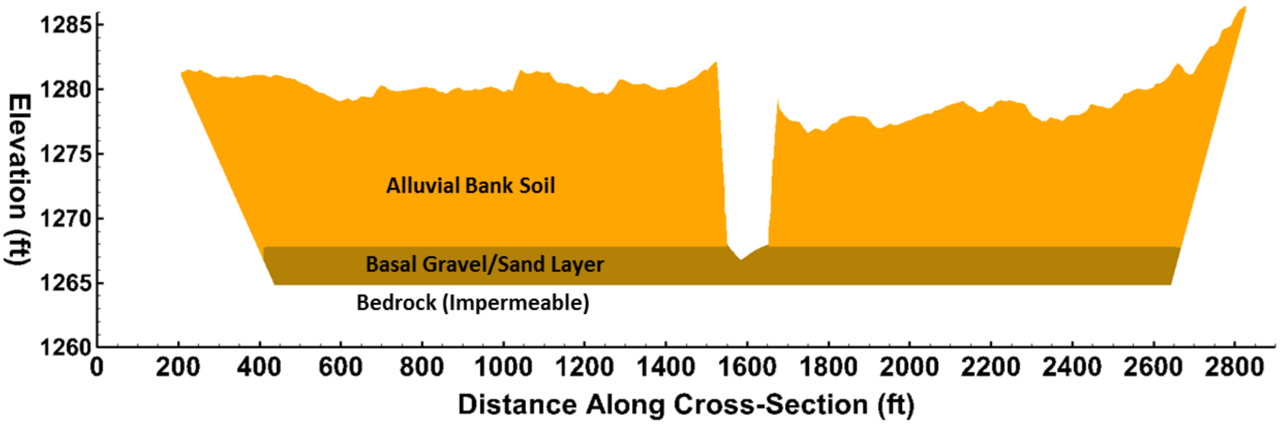

Figure 1. Conceptual model for a representative reach (RRM 0.22) along the South River, Virginia.

2.2 Subsurface Domain

The modified form of Richards' equation describing 3D transient subsurface flow under variably-saturated conditions is given by:

$$\nabla \cdot k_r \mathbf{K} \cdot \nabla h \pm Q + \Gamma = \frac{\partial}{\partial t}\left(\theta_s S_w\right) \tag{1}$$

where k_r is the relative permeability of the medium as a function of the water saturation S_w or the pressure head ψ, $\mathbf{K}$ is the hydraulic conductivity tensor, h is the total head as $\psi + z$ where z is the elevation, θ_s is the saturated water content, Q is an externally applied source or sink of water. The fluid exchange between the surface and subsurface is represented by Γ. The storage term can be expanded to account for both the change in storage in the saturated zone through compressibility effects and a change in saturation in the unsaturated zone (Cooley, 1971; Neuman, 1973):

$$\frac{\partial}{\partial t}\left(\theta_s S_w\right) \approx S_w S_s \frac{\partial h}{\partial t} + \theta_s \frac{\partial S_w}{\partial t} \tag{2}$$

where S_s is the specific storage coefficient. The governing groundwater flow equation is highly nonlinear due to the nature of the constitutive relations between hydraulic head (h), saturation (S_w), and relative permeability (k_r), which is commonly described through expressions such as the van Genuchten (1980) or Brooks and Corey (1964) relations.

2.2.1 Material Distribution

The conceptual model consists of two distinct materials; Alluvial Bank Soil (ABS) underlain by a Basal Gravel/Sand Layer (BG/SL). The BG/SL is assumed to have a constant thickness of 3 ft across the bottom portion of the domain (Figure 1).

2.2.2 Parameterization

2.2.2.1 Hydraulic Conductivity

The horizontal hydraulic conductivity (K_h) of the ABS is expected to be between 0.1 and 10 ft/day, with a horizontal-to-vertical anisotropy (K_h/K_v) ratio between 3 and 10. The K_h of the BG/SL is expected to be between 10 and 100 ft/day with K_h/K_v ratio between 3 and 10. A detailed K sensitivity analysis is presented in Section 4.0.

2.2.2.2 Porosity

Both the ABS and BG/SL are estimated to have an effective porosity (n_e) of 0.25.

2.2.2.3 Specific Storage

The specific storage (S_s) of the ABS and BG/SL is unknown; however, based on literature values, S_s is expected to range between 3.1 x 10^{-4} ft^{-1} (loose sand) to 3.9 x 10^{-5} ft^{-1} (dense sandy gravel) (Duffield, 2007).

2.2.2.4 Soil Water Retention Curves

Because no information from the site was available to describe the soil water retention characteristics of the system, representative curves from the literature were used. For the ABS unit, the soil water retention curve for a medium fine sand from Canadian Forces Base Borden was applied (Abdul, 1985), and for the BG/SL soil water retention curves for coarse sand and gravel described by Mace et al., (1998) were used. Figure 2 shows the soil water retention curves assigned to both units.

Note: for simulations in this study, both the base flow stage height and the watertable in the bank remain above the BG/SL, which means that the simulations will be insensitive to the soil water retention curves assigned to this unit.

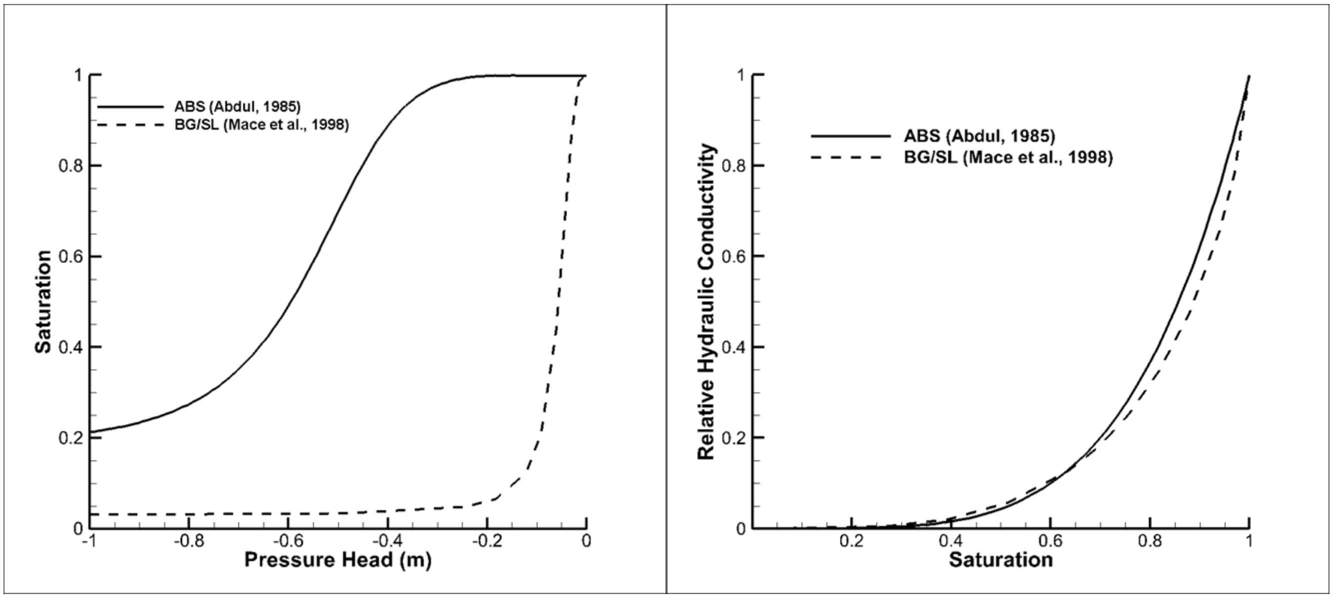

Figure 2. Soil Water Retention Curves for the ABS and BG/SL. Pressure head - saturation relationship (left panel); and, Relative Hydraulic Conductivity – Saturation relationship (right panel).

2.3 Surface Domain

In the *HGS* model, areal overland flow is represented by a 2D depth-integrated flow equation that is the diffusion-wave approximation of the Saint Venant equation for surface water flow:

$$\nabla \cdot d_o K_o \cdot \nabla h_o \pm Q_o + \Gamma_o = \frac{\partial h_o}{\partial t} \quad (3)$$

where d_o is the depth of flow, h_o is the water surface elevation ($= d_0 + z$), and K_o is the surface conductances that are changed with the friction slopes of the surface and is approximated by the Manning's equation in *x*- and *y*- directions as:

$$K_{ox} = \frac{d_o^{2/3}}{n_x} \frac{1}{\left[\partial h_o / \partial s\right]^{1/2}}; \quad K_{oy} = \frac{d_o^{2/3}}{n_y} \frac{1}{\left[\partial h_o / \partial s\right]^{1/2}} \quad (4)$$

where n_x and n_y are the Manning's n values and s is the direction of maximum surface-water slope. The surface conductances K_{ox} and K_{oy} are complex functions of the dependent variables d_0 or h_0 ($= d_0 + z$), making the governing equation highly nonlinear.

2.3.1 Parameterization

2.3.1.1 Manning's n-Value

The Manning's n-Value represents resistance to surface water flow, and is normally used as a calibration parameter. However, for the 2D conceptualization used in this study, the stage-discharge relation will be controlled by boundary conditions, and the model will be insensitive to the value of the Manning's n-Value. A Manning n-Value of 0.04 was assigned to the surface domain, which is representative of a clean, meandering channel (Chow, 1959).

2.3.1.2 Rill Storage Height

Within *HGS*, rill storage, or depression storage, represents the amount of storage that must be filled by sub-grid scale depressions before any lateral surface flow can occur. Rill storage is a means of accounting for micro topographic relief that cannot be captured by the discretization of finite elements in the grid. Rill storage heights of 0.17 ft and 0.001 ft were assigned to the floodplain and main channel, respectively.

2.3.1.3 Coupling Length

The variably-saturated subsurface and surface flow equations are explicitly coupled in *HGS* by assuming that the two domains are separated by a thin boundary layer. Thus, Γ_o in the governing flow equation represents a first-order exchange between subsurface and surface domains as follows, based on the equivalent of a discrete form of Darcy's law:

$$\Gamma_o = (k_r)_{exch} K_{exch} (h - h_o) / l_{exch} \tag{5}$$

$$\int_V \Gamma dV = -\int_{A_{\text{interf}}} \Gamma_o dA_{\text{interf}} \tag{6}$$

where $(k_r)_{exch}$ is the relative permeability for fluid exchange, K_{exch} is the surface/subsurface conductance, and l_{exch} is the thickness of the interface layer between surface and subsurface domains (coupling length). In the coupling equation, a positive Γ_0 indicates movement from the subsurface to the surface domain through the interface (A_{interf}).

A value of 0.1 m, which is commonly used for site scale models, was assigned for this study (Ebel et al., 2009).

2.4 Stressors to the System

Two primary system stressors are expected to significantly affect the movement of hydraulic pressure and water within the bank soils; 1) river stage; and, 2) precipitation.

2.4.1 River Stage

A total of four different flood stages were simulated as part of this study (1.5', 3', 6' and 12' above base flow). To ensure consistency between each flood event, a representative hydrograph was selected from the historic data at USGS Station Number: 01626000 at Waynesboro Va. The criteria for selection were; the flood hydrograph was a single isolated event, started near base flow, and, returned to base flow with no additional events in the curve. The selected event occurred in November 1992 and represented a 7ft flood stage. This representative hydrograph was normalized, allowing it to be scaled for each flood stage of interest (e.g., 1.5', 3' 6' and 12')

Base flow for this representative reach is approximately 30 cubic feet per second (cfs) with a stage height of 1,269.2 ft. For each flood stage the flow (cfs) was estimated from the USGS rating curve for the South River near Waynesboro Va. (USGS Station Number: 01626000). Figure 3 shows the normalized flood hydrograph used for this study.

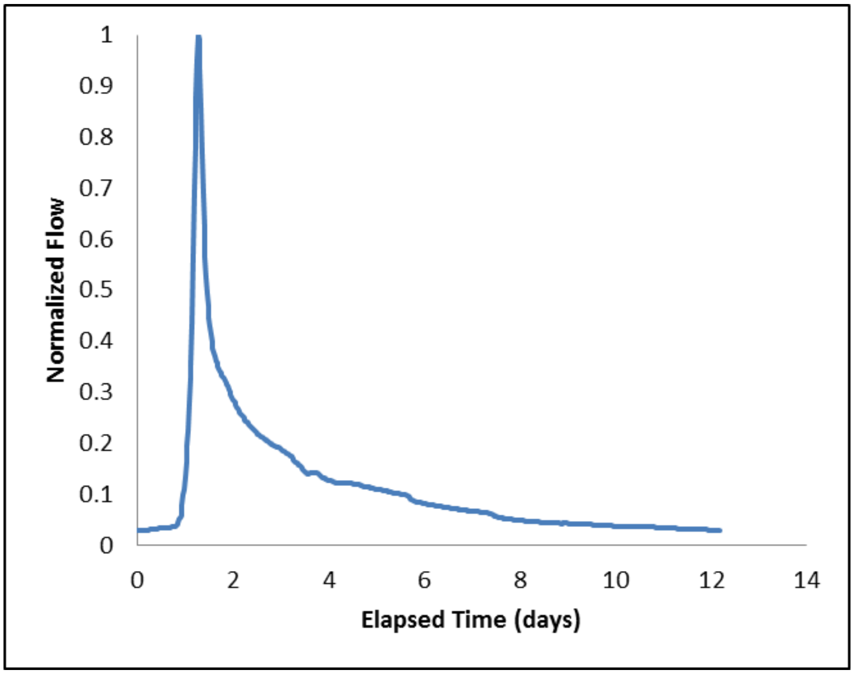

Figure 3. Normalized hydrograph for a representative flood event on the South River near Waynesboro Va.

2.4.2 Precipitation

The precipitation associated with each flood stage was approximated by associating the estimated return period for each flood event (Pizzuto, [date unknown]) to the intensity-frequency-duration data from the National Weather Service (NWS) for Waynesboro Va. (http://hdsc.nws.noaa.gov/hdsc/pfds). The precipitation period was assumed to be 12 hours in duration; starting at t = 0.75 days and ending at peak stage height (approximately t = 1.25 days). Since the intensity-frequency-duration data from NWS is only for return periods greater than 1 year, an exponential relation was fitted to the 12 hour intensity-frequency data to estimate the precipitation rate for returns periods less than 1 year. See Figure 4 and Table 2 for a complete summary of the stage heights and the 12 hour precipitation for each flood stage of interest.

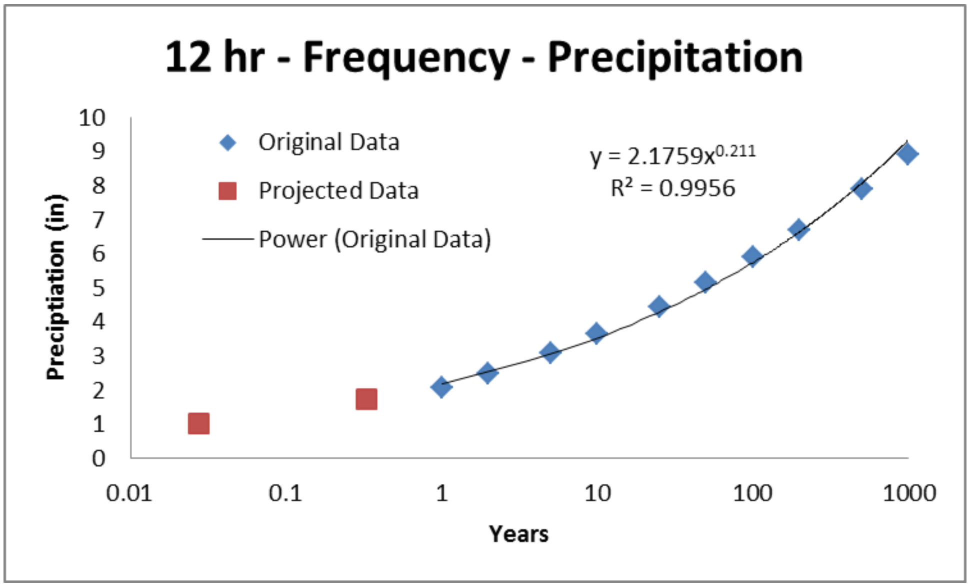

Figure 4. 12 hr – Frequency – Precipitation Graph for Waynesboro Va. The red squares are projected based on an exponential fit to the original data (blue).

Table 2. Stage, discharge, and precipitation data used to define the stressors for the conceptual model.

	Stage (ft)	Stage (ft asl)	Flow (cfs)	Approximate Return Period	12 hr Precipitation (in)
Base Flow	2.4	1,269.2	30		0
1.5 ft Rise	3.9	1,270.7	447	10-30 day	1.02
3 ft Rise	5.4	1,272.2	1,170	90 – 120 day	1.72
6 ft Rise	8.4	1,275.2	3,630	2 – 5 yr	2.47
12 ft Rise	14.4	1,281.2	10,000	10 yr	3.65

2.5 Expected System Behaviour

The expected behaviour of the system to the simulated flood events can be separated into two stages; the rising and falling limbs of the hydrograph.

2.5.1 Rising Limb

During the rising limb of the hydrograph, water flows from the channel into the bank soils. Since *K* of the BG/SL is estimated to be 2 to 3 orders of magnitude greater than the ABS, it is expected that surface water will preferentially flow laterally into the BG/SL where it will displace the resident water into the ABS. In addition to the dynamic near bank response, precipitation on the floodplain will cause the near surface portion of the ABS to become active (Figure 5). The extent to which flow in the upper portion of the ABS occurs will depend on the intensity of the precipitation, the *K* of the ABS, and the antecedent moisture condition of the bank soils.

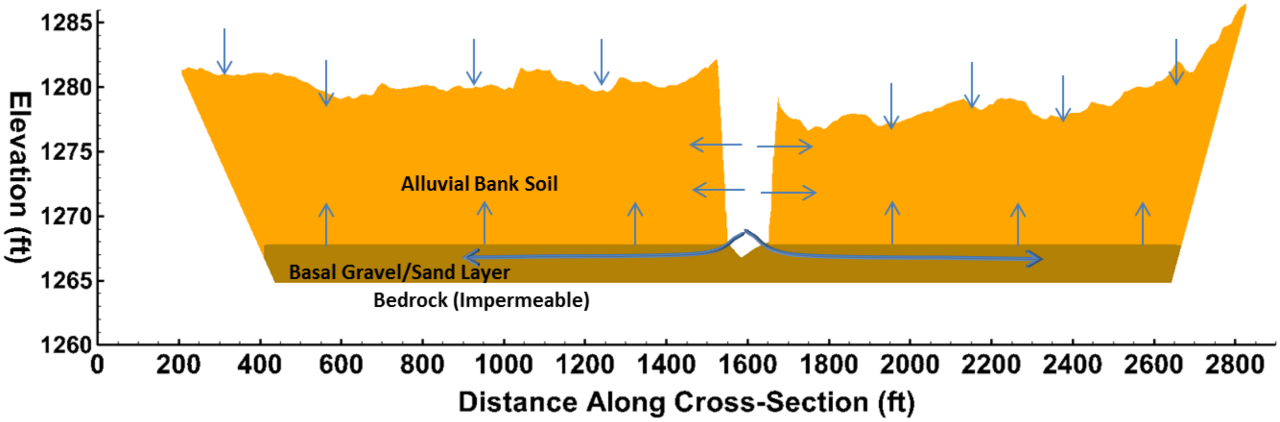

Figure 5. Expected response of the system to the rising limb of a flood hydrograph.

2.5.2 Falling Limb

During the falling limb portion of the hydrograph, groundwater flow is expected to reverse direction and flow back to the channel when the stage height drops below the watertable in the bank. The timing of this reversal is difficult to predict and will depend on the hydraulic properties of the bank soils, and the rate at which the flood wave recedes. Due to the contrast in *K*, return flow is expected to predominantly occur through the BG/SL (Figure 6).

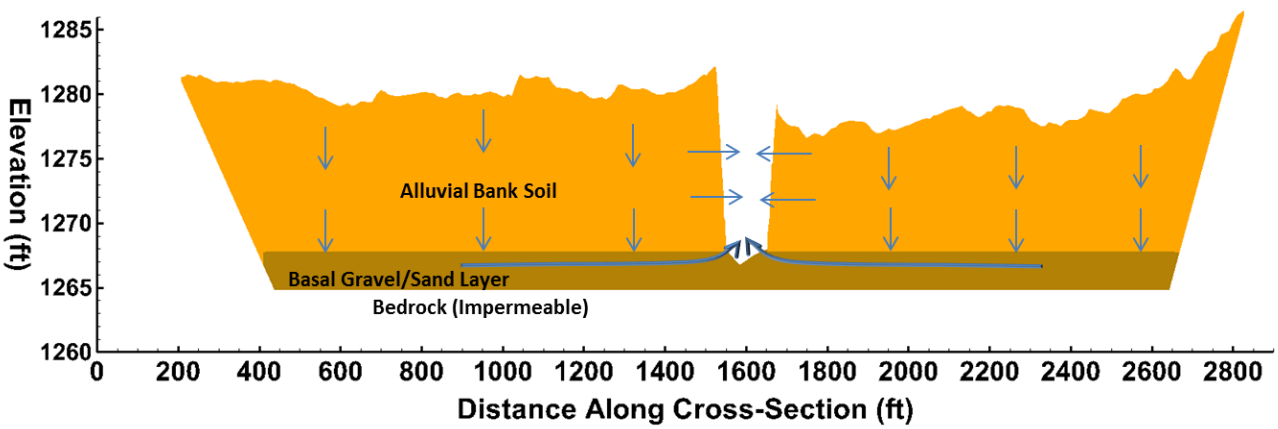

Figure 6. Expected response of the system to the falling limb of the flood hydrograph.

3.0 NUMERICAL MODEL

3.1 Finite Element Mesh

A 2D triangular finite element mesh containing 45,723 nodes and 84,514 elements was generated using Leapfrog Hydro (www.leapfrog3d.com). The 3D triangular prism finite element mesh comprises a total of 137,169 nodes, and 169,028 elements, including the rectangular elements covering the land surface flow domain that are connected to the subsurface flow regime. Figure 7 shows a close up view of the finite element mesh for the right bank of the model domain.

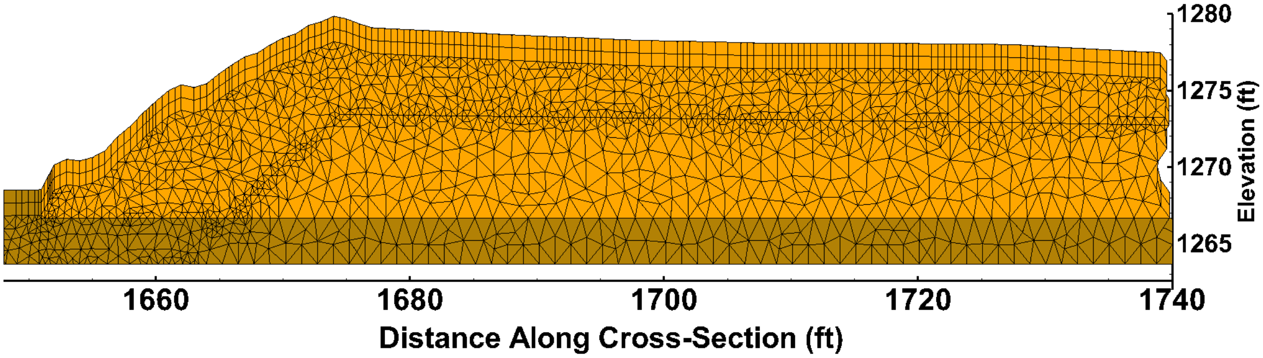

Figure 7. Close-up of the 3D finite element mesh along the right bank (3D perspective view).

3.2 Model Parameterization

3.2.1 Subsurface

Table 3 summarizes the subsurface parameterization assigned to the numerical model. Note: K and S_s, were subject to sensitivity analyses and are discussed in greater detail in Sections 4.1.1 and 4.1.3, respectively.

Table 3. Summary of Subsurface Parameters

	ABS	BG/SL
Hydraulic Conductivity	0.1 – 10 ft/day	10 – 100 ft/day
Porosity	0.25	0.25
Specific Storage	3.9 x 10^{-5} ft^{-1} to 1.5 x 10^{-4} ft^{-1}	3.9 x 10^{-5} ft^{-1} to 1.5 x 10^{-4} ft^{-1}

[1]See Section 4.1.1. for hydraulic conductivity values used for each case

[1]See Section 4.1.3. for specific storage values used for each case

3.2.2 Surface

Table 4 summarizes the surface parameterization assigned to the numerical model.

Table 4. Summary of Surface Parameters

	In-Channel	Floodplain
Manning's n-Value	0.04	0.04
Rill Storage Height	0.001 ft	0.17 ft
Coupling Length	0.33 ft	0.33 ft

3.3 Boundary Conditions

3.3.1 Subsurface Boundary Conditions

All subsurface boundary conditions are no-flow boundary conditions; meaning, water can only enter or leave the subsurface domain through the surface domain (e.g., infiltration/exfiltration).

3.3.2 Surface Boundary Conditions

Four different boundary conditions were applied to the surface domain (Figure 8):

- **Specified Flux** – The nodes along the bottom of the channel, on the inflow side (upstream side) of the model, were assigned a time-varying specified flux boundary condition. This boundary condition was used to add water to the channel as specified by the stage-discharge relation for the different hydrograph scenarios;

- **Specified Head** – The nodes along the entire channel (excluding the floodplain), on the outflow side (downstream side) of the model, were assigned as a modified time-varying specified head boundary. This modification allows the specified head nodes to become unconstrained should the specified head become less than the elevation of the node (e.g., negative pressure head). This boundary condition will let water flow out of the system while maintaining the appropriate stage height within the channel;

- **Precipitation (specified flux)** – The floodplain portion of the surface domain was assigned as a precipitation (specified flux) boundary condition; and,

- **Critical Depth Boundary Condition –** For the 12` hydrograph scenario (See Section 5.1.3), a critical depth boundary condition was applied to the floodplain for a short period of time, from 2-2.5 days after the start of the simulation (equivalent to 0.75 to 1.25 days after precipitation finishes). This critical depth boundary condition is used to drain any standing water still in the floodplain at that time (e.g., emulating return flow from the floodplain to the channel after a flood event).

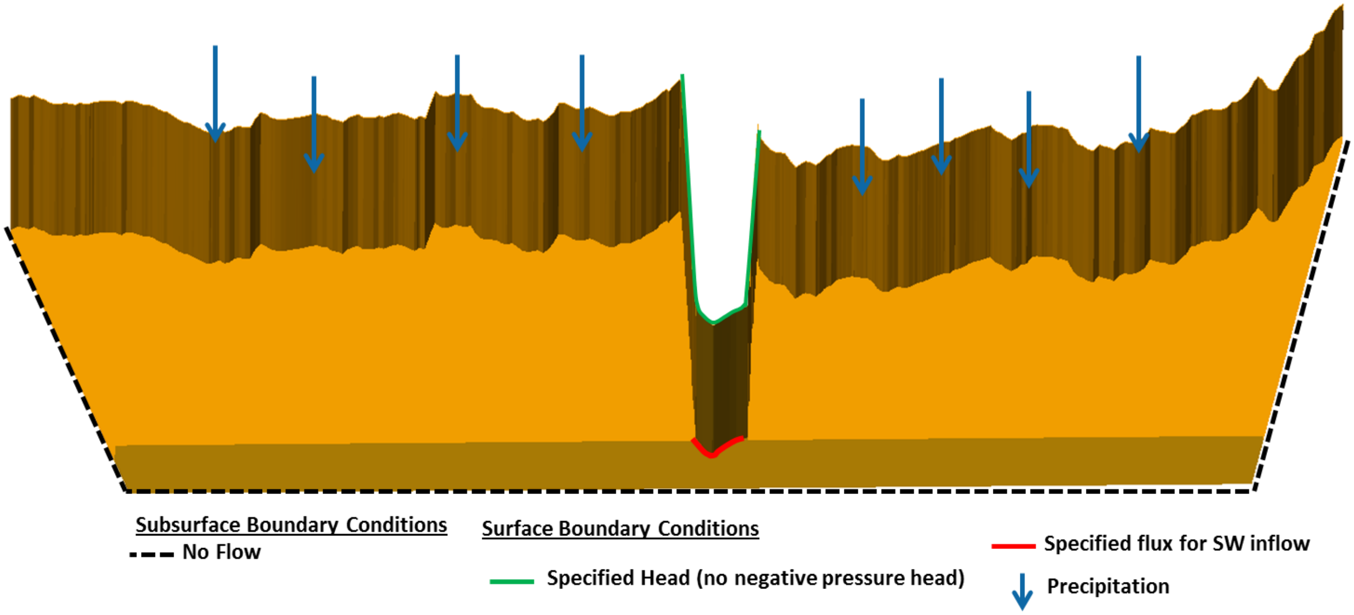

Figure 8. Boundary conditions assigned to the model domain.

4.0 SENSITIVITY ANALYSIS

4.1 Sensitivity Simulations

To help focus future field investigations, a sensitivity analysis was performed to identify the most important parameters for creating a robust and representative numerical model. The sensitivity analysis explored both the physical characteristics of the system, and the impact of different stressors/scenarios:

- Physical Characteristics
  - Hydraulic conductivity of the ABS and BG/SL;
  - Specific storage of ABS and BS/SL; and,
  - ABS soil water retention characteristics.
- Stressors/Scenarios
  - Precipitation vs. no precipitation during the flood event; and,
  - The impact of antecedent moisture in the soil profile.

Due to the large number of cases and scenarios evaluated as part of the sensitivity analysis, the watertable response was selected as a simple way to compare the system response to changes in either parameterization, or scenario.

4.1.1 Hydraulic Conductivity

The sensitivity of the system to the K of the ABS and BG/SL was assessed by simulating the 8 different cases presented in Table 5. The values of K for the ABS and BG/SL, as well as the horizontal-to-vertical anisotropy ratio (K_h:K_z), were selected based on the ranges provided by DuPont. K_h of the ABS is expected to be between 0.1 and 10 ft/day, with K_h/K_v between 3 and 10. K_h of the BG/SL is expected to be between 10 and 100 ft/day with K_h/K_v ratio between 3 and 10.

Some notable cases include:

- Case 1 – mid-range case with K values that are approximately half-way between the extremes;
- Case 2 - lowest K of all cases for both the ABS and the BG/SL;
- Cases 3 and 4 - are nearly homogenous; and
- Case 7 – highest K of all cases for both the ABS and the BG/SL.

For all 8 cases, a flood hydrograph with a stage height 6’ above base flow, and a precipitation of 2.47” in a 12-hr period, were used to drive the simulation. These simulations were assigned a specific storage (S_s) value of 1.5 x 10^{-4} ft^{-1}. The sensitivity of the system to S_s is assessed in Section 4.1.3.

Table 5. Summary of *K* values for sensitivity analysis (Cases 1 – 8).

Case	Alluvial Bank Soil (ABS)		Basal Gravel/Sand Layer (BG/SL)		Comment
	K_h (ft/day)	K_h/K_v (ft/day)	K_h (ft/day)	K_h/K_v (ft/day)	
1	1	6	50	6	Base Case - mid-range ***K*** for all units
2	**0.1**	**10**	**10**	**10**	Lowest ***K*** for all units
3	**10**	10	10	10	Increase ABS $\boldsymbol{K_h}$
4	10	**3**	10	10	Increase ABS $\boldsymbol{K_v}$
5	0.1	10	**100**	10	Low K ABS, High $\boldsymbol{K_h}$ BG/SL
6	0.1	10	100	**3**	Increase BG/SL $\boldsymbol{K_v}$
7	**10**	**3**	100	3	Highest ***K*** for all units
8	10	**10**	100	**10**	Increase $\boldsymbol{K_h/K_v}$ for both units

10 Values are **bold and underlined** to indicated changes from the preceding case.

Figure 9 and Figure 10 show the position of the watertable for each of the 8 cases at t = 1.3 days, and t = 1.7 days, respectively. This timing corresponds with the approximately the peak stage height of the 6' flood hydrograph (t = 1.3 days) and, 0.4 days following peak stage height (t = 1.7 days). The watertable positions shown in Figure 9 and Figure 10, highlights the significant impact different *K* configurations have on the response of the system. Four different groupings of response are evident:

1. Cases 4 and 7 show the largest response to increasing stage height in the channel at t = 1.3 days;
2. Cases 2, 5 and 6 respond the least;
3. Case 1 shows a mid-range response; and,
4. At t = 1.7 days, Cases 3 and 4, and Cases 7 and 8, form two distinct groupings.

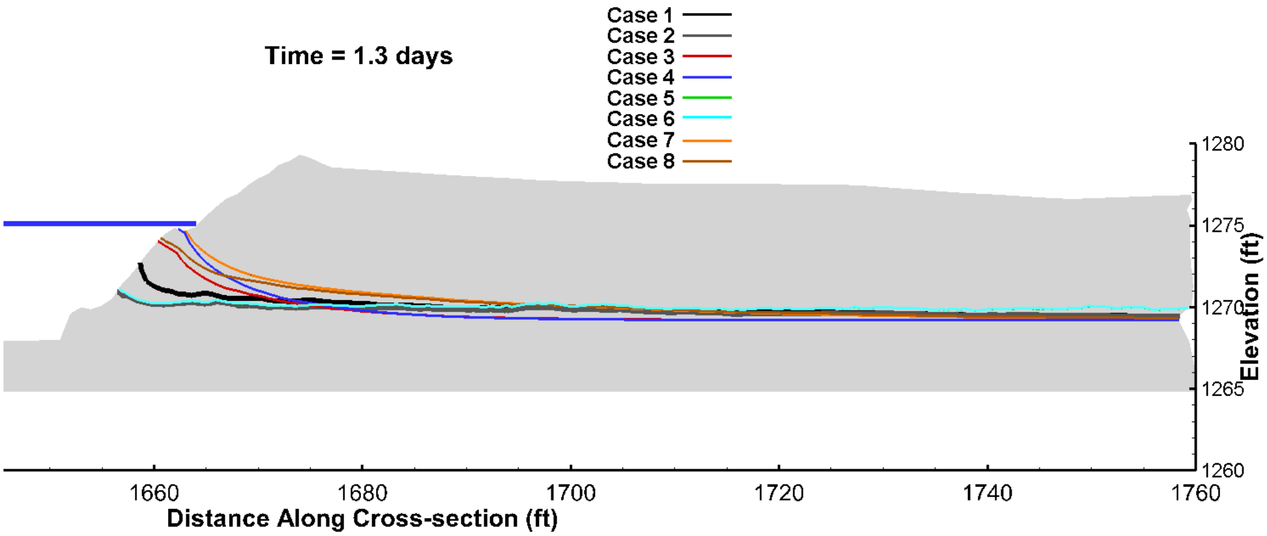

Figure 9. Watertable (solid lines) position for Cases 1 – 8 at the peak stage height (t = 1.3 days) for the 6' flood hydrograph with precipitation. The solid blue line in the channel shows the stage height.

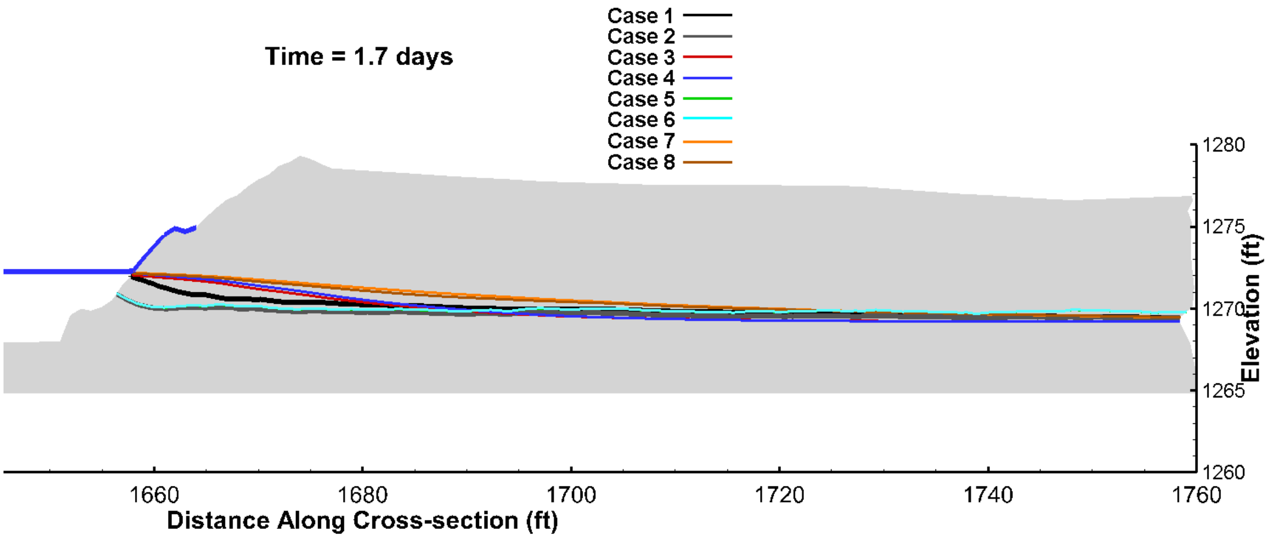

Figure 10. Watertable (solid lines) position for Cases 1 – 8 at the peak stage height (t = 1.7 days) for the 6' flood hydrograph with precipitation. The solid blue line in the channel shows the stage height.

These results demonstrate that water table response is highly sensitive to the hydraulic conductivity values of both the ABS and BG/SL.

An animation of the results shown in Figure 9 and Figure 10 can be found in the Supplementary Video Summary at the following file path:

(*Video_Summary\01_K_Sensitivity\K_Sensitivity_6ft_with_precipitation.avi*)

4.1.2 Without Precipitation

The 8 cases presented in Section 4.1.1, were repeated without precipitation in order to assess sensitivity of the system to precipitation on the floodplain. Figure 11 and Figure 12 show the watertable position for all 8 cases at t = 1.3 days and t = 1.7 days, respectively. The response of the system at these times is virtually identical to the scenario with precipitation (Figure 9 and Figure 10). An animation of the results shown in Figure 11 and Figure 12 is provided in the Supplementary Video Summary at the following file path:

(*Video_Summary\01_K_Sensitivity\K_Sensitivity_6ft_no_precipitation.avi*).

Subtle late time differences are evident between the two scenarios; however, these are not expected to significantly influence the near-bank processes which are the primary focus of this study. The reader may compare the late time responses by viewing the videos for both scenarios (*Video_Summary\01_K_Sensitivity*).

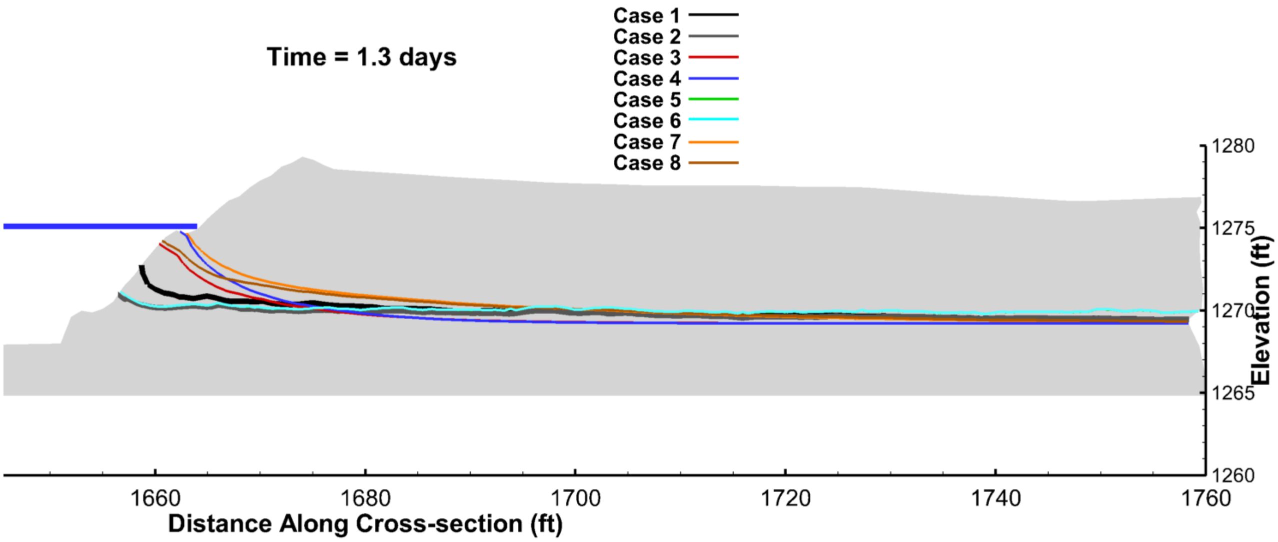

Figure 11. Watertable position (solid lines) for Cases 1 – 8 at the peak stage height (t = 1.3 days) for the 6' flood hydrograph without precipitation. The solid blue line in the channel shows the stage height.

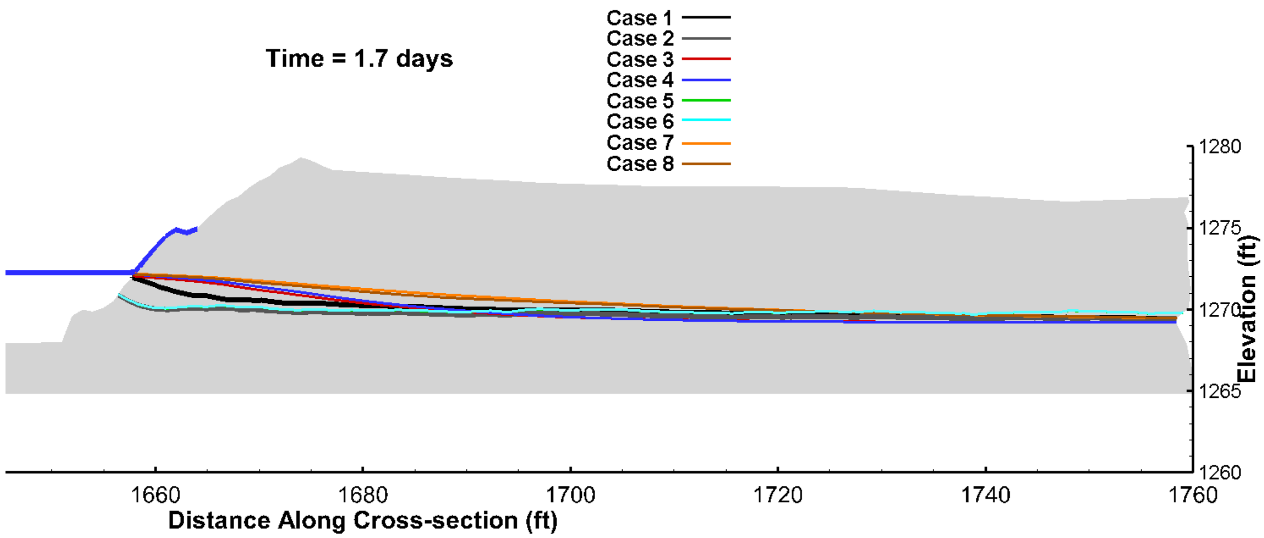

Figure 12. Watertable position (solid lines) for Cases 1 – 8 at the peak stage height (t = 1.7 days) for the 6' flood hydrograph without precipitation. The solid blue line in the channel shows the stage height.

4.1.3 Specific Storage

The sensitivity of the system to S_s, was investigated by adjusting the S_s value of both the ABS and BG/SL up and down within literature reported ranges (Duffield, 2007). Note: S_s is only relevant for the saturated portion of the model domain.

For this sensitivity analysis, Case 1 was used as a base case from which the S_s value was increased (Case 9), and decreased (Case 10). The *K* values used for all three cases are identical to those for Case 1 (See Table 5).

- Case 1: S_s = 1.5 x 10^{-4} ft^{-1} (typical of loose sand)
- Case 9: S_s = 3.1 x 10^{-4} ft^{-1} (high end for loose sand)
- Case 10: S_s = 3.9 x 10^{-5} ft^{-1} (typical of dense sandy gravel)

Figure 13 shows the watertable position for Cases 1, 9 and 10 during peak stage height at t = 1.3 days. These results show that the model is insensitive to S_s within the literature reported ranges for the material types present at the site. For the remainder of the simulations in this study, an S_s value of 1.5 x 10^{-4} ft^{-1} is used.

The reader may assess the sensitivity of the system to S_s by viewing the videos for Figure 13 at the following file path: (`Video_Summary\02_Ss_Sensitivity\`).

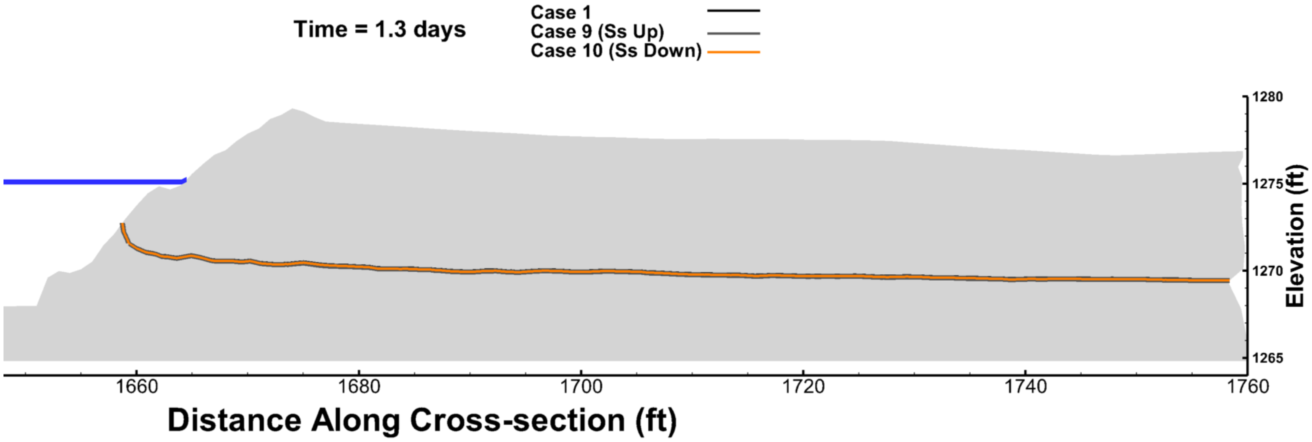

Figure 13. Watertable position (solid lines) for Cases 1, 9 and 10 at the peak stage height (t = 1.3 days) for the 6` flood hydrograph. The solid blue line in the channel shows the stage height.

4.1.4 Soil Water Retention Curve

Because no information from the site was available to describe the soil water retention characteristics of the system, representative literature curves were used (See Figure 2). The sensitivity of the system to the selection of soil water retention curves assigned to the ABS (Abdul, 1985) was investigated by shifting the pressure-saturation profile by 30 cm (approximately 1 ft) of pressure head; effectively increasing the capillary fringe height by 30 cm. No adjustments were made to the BG/SL as it remains full saturated for all scenarios, and is insensitive to the soil water retention curve. Figure 14 shows the original and adjusted saturation-pressure head curve used for this sensitivity analysis.

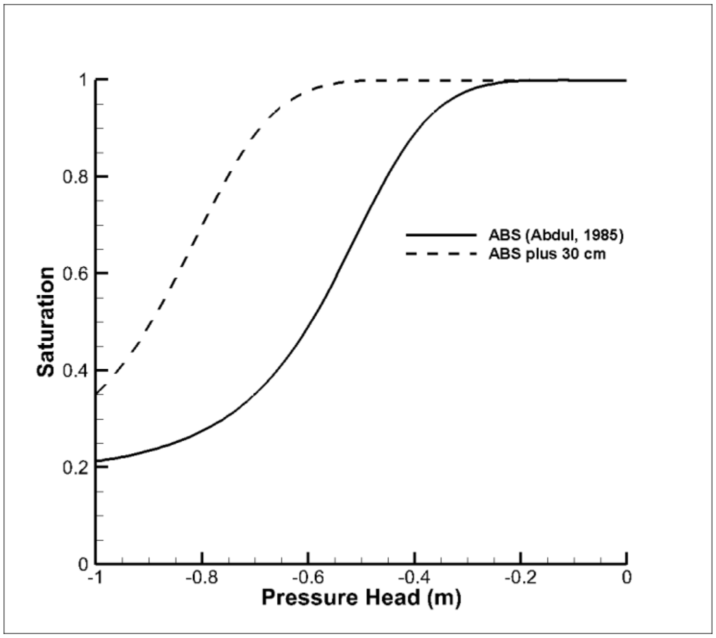

Figure 14. Original (solid line) and modified pressure head-saturation relation.

It was suspected that different *K* configurations (Cases) might respond differently to the adjusted pressure-saturation curve. Thus, the highest *K* case (Case 7) and lowest *K* case (Case 2) were selected as end members to assess the model sensitivity. For both cases the 6` flood hydrograph was used to drive the simulation.

The results for Case 2 and Case 7, at peak stage height (t = 1.3 days) are presented on Figure 15 and Figure 16, respectively. Case 2 shows a small change in watertable position as a result of the adjusted pressure-saturation curve; and, Case 7 shows very little difference as a result of the adjusted pressure-saturation curve.

The difference for Case 2 is less than 1 ft, and the difference is almost indistinguishable for Case 7. Based on the simulation results for these extreme *K* cases, the pressure-saturation curve is unlikely to significantly impact the simulation results. As such, the original ABS curves (Abdul, 1985) will be used for the remainder of the simulations presented in this study.

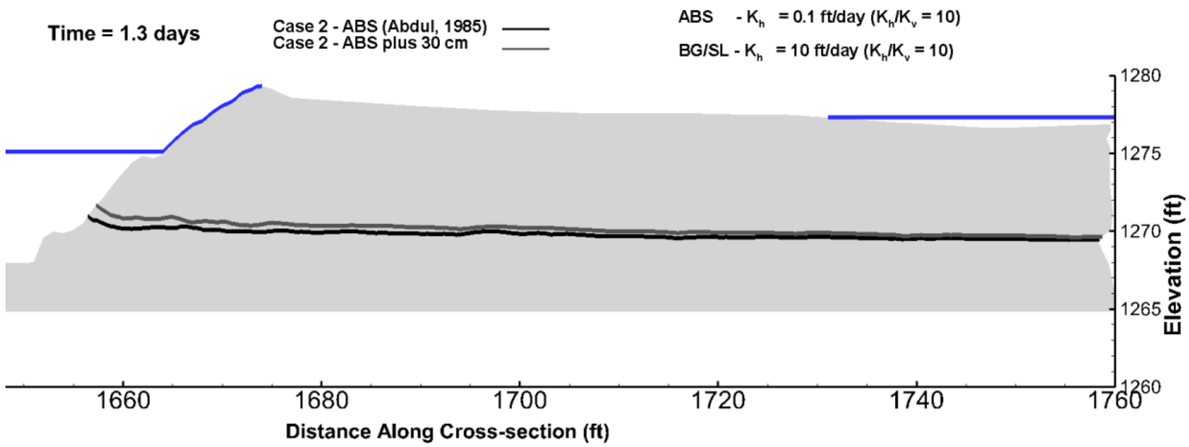

Figure 15. Watertable position (solid lines) for Case 2 with the original and adjusted press-saturation curves at peak stage height (t = 1.3 days). The solid blue line in the channel, and on the right side of the domain indicates surface water elevation.

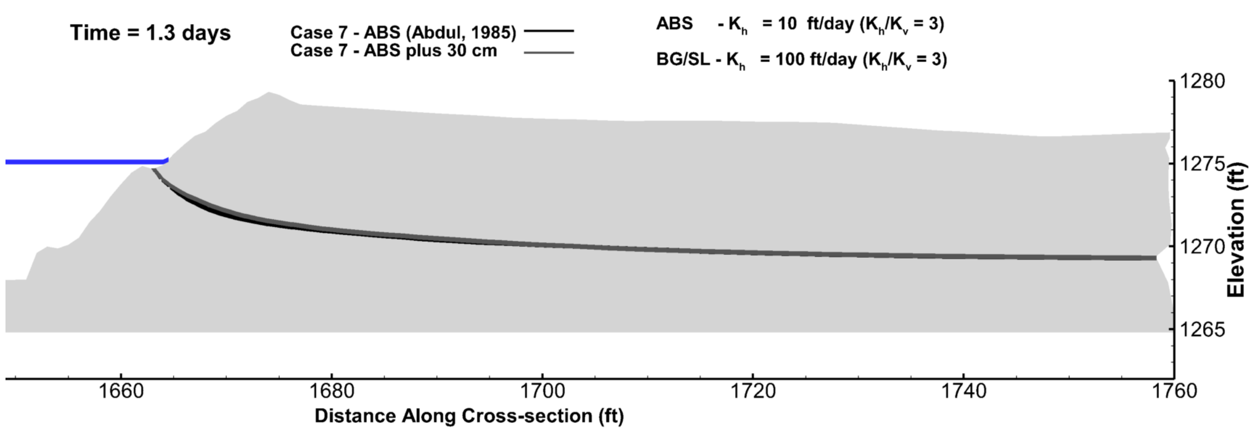

Figure 16. Watertable position (solid lines) for Case 7 with the original and adjusted press-saturation curves at peak stage height (t = 1.3 days). The solid blue line in the channel, and on the right side of the domain indicates surface water elevation.

The reader may assess the sensitivity of the system to the ABS pressure-saturation curve by viewing the videos for Figure 15 and Figure 16 at the following file path. (`Video_Summary\03_Water_Retention\`).

4.1.5 Antecedent Moisture

All of the simulations previously presented ignore the hydraulic history of the system and start with an initial estimate of surface water stage height, and watertable elevation; both equivalent to base flow elevation. In reality, this system is subject to periodic precipitation and flood events that may result in initial conditions different than those assumed so far in this study. The sensitivity of the system to antecedent moisture in the soil column from previous events was investigated by repeating a flood simulation 10 days after the initial event (see Figure 17 and Figure 18). A small, but noticeable difference is evident in the watertable profiles shown in Figure 17 and Figure 18. Since the difference in watertable position is small relative to the response of the watertable to the actual flood event, future simulations will be simulated assuming an arbitrary initial condition (i.e. base flow elevation).

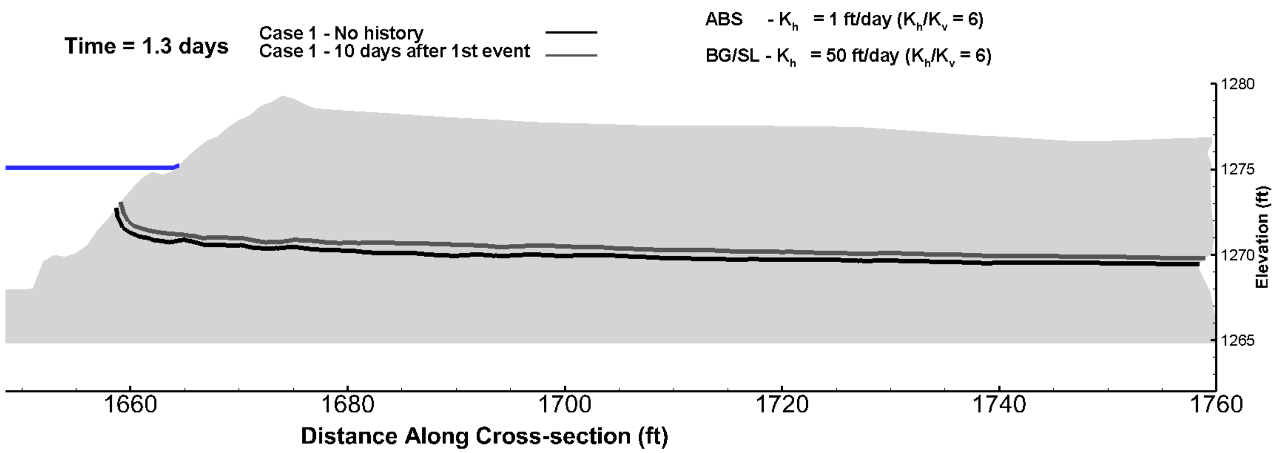

Figure 17. Watertable position for Case 1 with a 6' flood hydrograph at peak stage height (t = 1.3 days). The solid black line shows the watertable without any history in the system, and the solid grey line shows the watertable position when the flood event was repeated 10 days after the initial event.

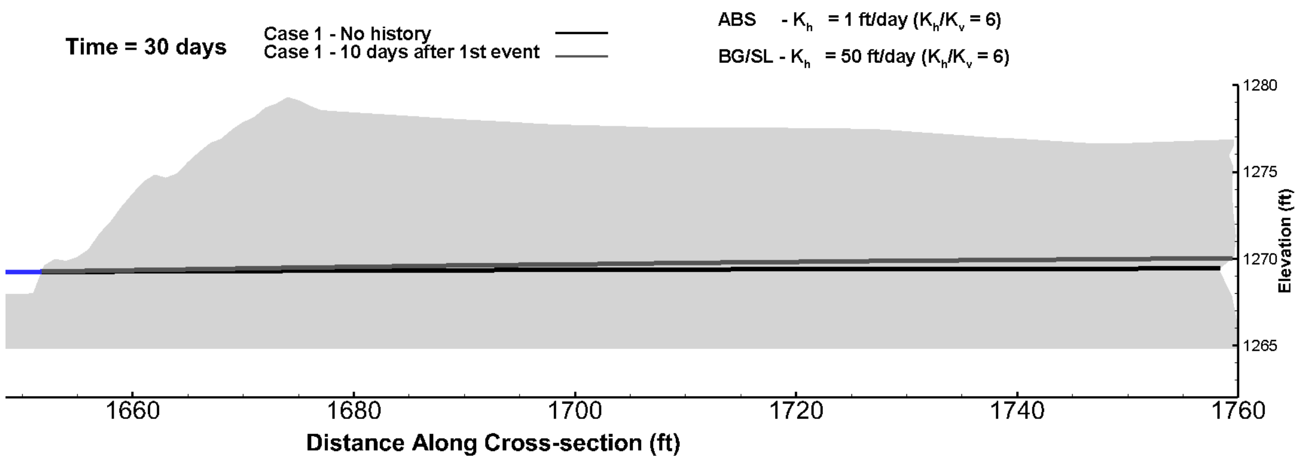

Figure 18. Watertable position for Case 1 with a 6' flood hydrograph at t = 30 days. The solid black line shows the watertable without any history in the system, and the solid grey line shows the watertable position when the flood event was repeated 10 days after the initial event.

The reader may assess the sensitivity of the system to antecedent moisture in the soil profile by viewing the video for Figure 17 and Figure 18 at the following file path. (`Video_Summary\04_Antecedent_Moisture`).

4.2 Scenarios Selected for Further Analysis

Based on the results of the sensitivity analysis, the following 4 cases were selected for further analysis under different flood hydrograph stages:

- Case 1 – mid range or average behaviour;
- Case 2 – minimum inundation;
- Case 4 – mid-to-high range of inundation (near homogeneous); and,
- Case 7 – maximum inundation.

See Table 5 for details of the *K* values assigned to these cases.

5.0 RETURN PERIOD SIMULATIONS

5.1 Description of Scenarios

For each of the 4 selected cases (i.e., Cases 1, 2, 4, and 7), further analysis was completed by simulating 4 different flood events with peak stage heights of 1.5', 3', 6' and 12'. During these simulations, the movement of 4 different waters were tracked by applying a conservative species to each. The tracked waters were: surface water, rain water, ABS groundwater, and, BG/SL groundwater.

5.1.1 Assignment of Tracers

Similar to the method used by Vanderkwaak (1999) and Jones et al. (2006), each water type of interest (e.g., surface water, precipitation, etc.,) was tracked during the simulations by using a different conservative species for each water type.

For hydrograph heights of 1.5', 3' and 6', four different waters were tracked as follows:

- ***Surface water*** – the inflow nodes at the channel were assigned as specified concentration nodes; thus, causing any surface water entering the system to be tagged as surface water (i.e., $C_{SW} = 1$);
- ***Precipitation*** – rain water on the floodplain was assigned a specified concentration, $C_{rain} = 1$;
- ***Groundwater (ABS)*** – The groundwater in the ABS unit at the start of the simulation was assigned an initial concentration, $C_{ABS} = 1$; and,
- ***Groundwater (BG/SL)*** - The groundwater in the BG/SL unit at the start of the simulation was assigned an initial concentration, $C_{BG/SL} = 1$.

For the 12' hydrograph simulation, precipitation was not included as the floodplain response is dominated by surface water spilling the bank and infiltrating into the ABS.

Figure 19 shows the assignment of tracers to the groundwater system at the start of the simulation. Figure 19a shows the location of groundwater tagged with C_{ABS}, and Figure 19b shows the location of groundwater tagged with $C_{BG/SL}$. A concentration of 1 at a particular location indicates that the water at that location is completely composed of a single water type. For example, the red areas in Figure 19, indicates that the water is predominately ABS (a) or BG/SL (b). The apparent early time mixing evident at the contact between the ABS and BG/SL units is a function of mesh refinement.

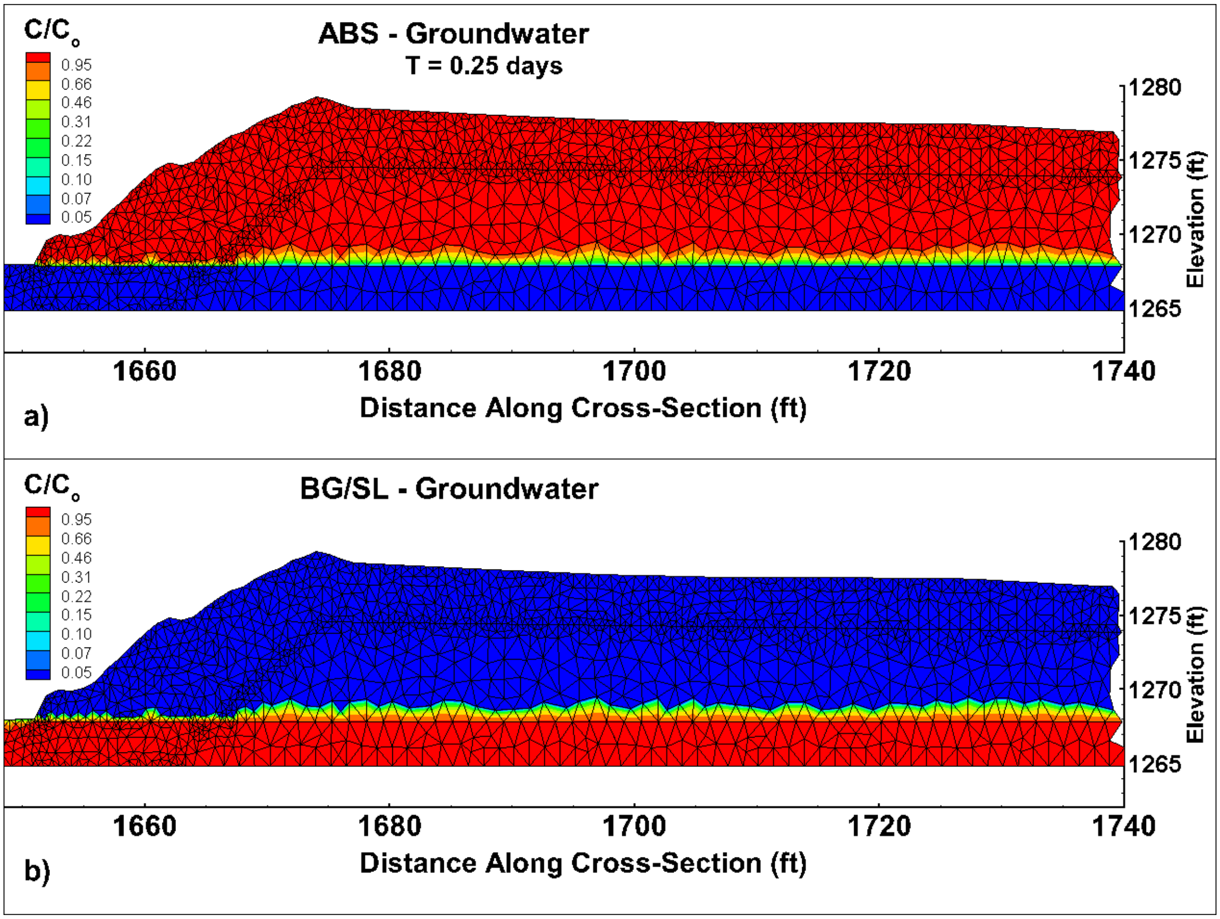

Figure 19. Initial Distribution of groundwater tagged with tracers in the a) ABS unit; and, b) BG/SL unit.

5.1.2 Post-processing of Concentration Data

To account for numerical errors that may occur in the simulated concentrations; particularly, for low saturation and low water depth conditions, a concentration normalization scheme, similar to that used by Vanderkwaak (1999) was employed; where:

$$C_{ABS_{Norm}} = \frac{c_{ABS}}{\left(c_{ABS}+c_{BG/SL}+c_{SW}+c_{Rain}\right)} \tag{7}$$

$$C_{BG/SL_{Norm}} = \frac{c_{BG/SL}}{\left(c_{ABS}+c_{BG/SL}+c_{SW}+c_{Rain}\right)} \tag{8}$$

$$C_{SW_{Norm}} = \frac{c_{SW}}{\left(c_{ABS}+c_{\frac{BG}{SL}}+c_{SW}+c_{Rain}\right)} \tag{9}$$

$$C_{Rain_{Norm}} = \frac{C_{Rain}}{(C_{ABS}+C_{BG/SL}+C_{SW}+C_{Rain})} \quad (10)$$

And:

$$C_{ABS\_Norm} + C_{BG/SL_{Norm}} + C_{SW\_Norm} + C_{Rain\_Norm} = 1 \quad (11)$$

Because the sum of all normalized concentrations at a given point in the model domain equals unity, the concentration of the solute can be used to determine the composition of the water at a given point in space. For example: if $C_{ABS\_Norm} = 0.5$, this means that 50% of the water at that particular point was located in the ABS zone at the beginning of the simulation. Figure 20, shows an example of the simulation results for Case 1, at 2.75 days, with a 6' peak hydrograph. A more comprehensive discussion of the results from the tracer simulation is presented in Section 5.2.2.

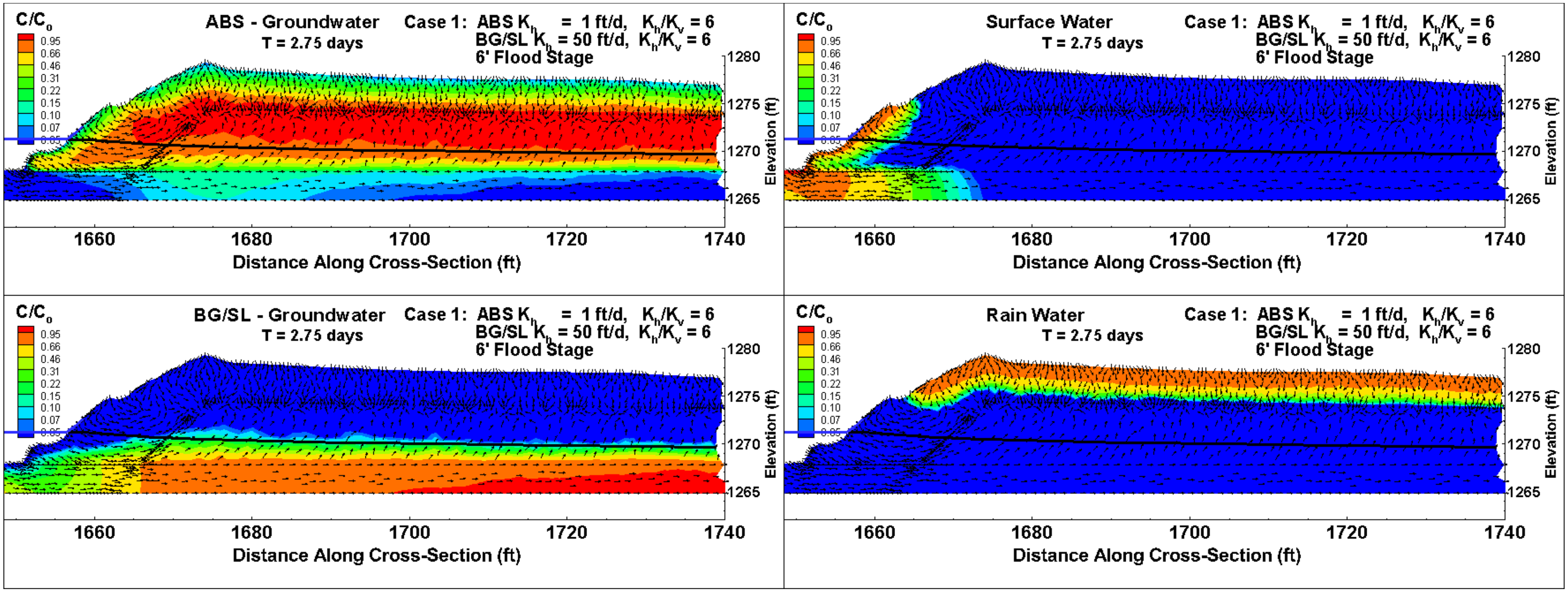

Figure 20. Sample illustration of the distribution of different water species in the simulation domain for Case 1, at t = 2.75 days, with a 6ft peak hydrograph.

5.1.3 Conceptualization of Floodplain Events (12' Stage Height)

For the 12' stage events, the flood wave crests the right bank and spills into the floodplain. Due to the limitations of the 2D model conceptualization used in this preliminary study, the only way for the water in the floodplain to leave the model domain is back through the main channel. However, the topography is such that the water in the floodplain becomes disconnected from the main channel as the hydrograph recedes. This means that the water that spills into the floodplain during peak stage height is trapped and can only return to the channel by infiltrating into the subsurface. Figure 21 illustrates the disconnection between water in the floodplain and the main channel at t = 1.5 days.

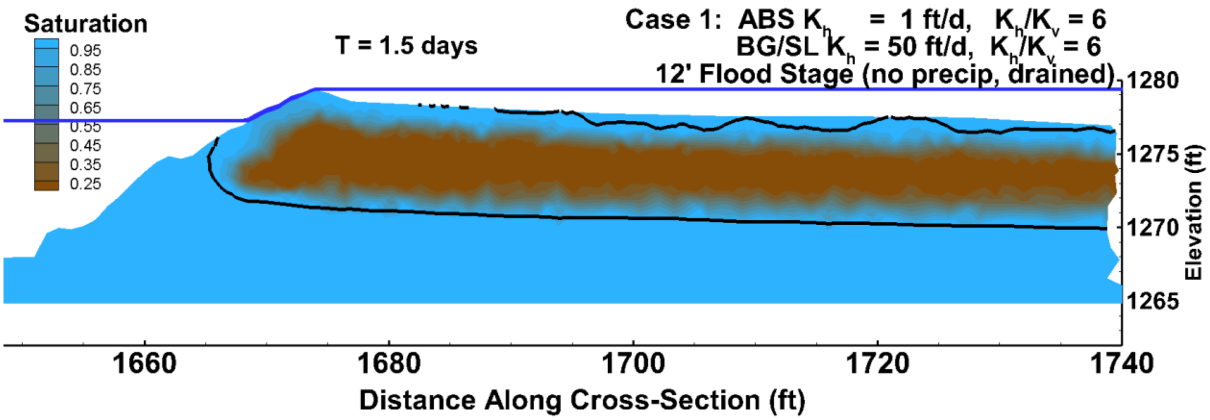

Figure 21. Position of surface water in the channel and floodplain (solid blue line) immediately after the flood hydrograph starts to recede at t = 1.5 days. The contouring shows the distribution of soil saturation and the solid black line shows the position of the watertable.

In the real system, the water in the floodplain would be able return back to the main channel through small streams and tributaries shortly after the peak of the flood event. To approximate the return of surface water to the channel, a critical depth boundary condition was applied at several locations within the floodplain at t = 2 days to allow the standing water to drain. Figure 22 shows the system at t = 2.25 days, shortly after the standing water in the floodplain was drained. A fully 3D surface/subsurface analysis over a reach of the river system, including the floodplain, would not require this approximation.

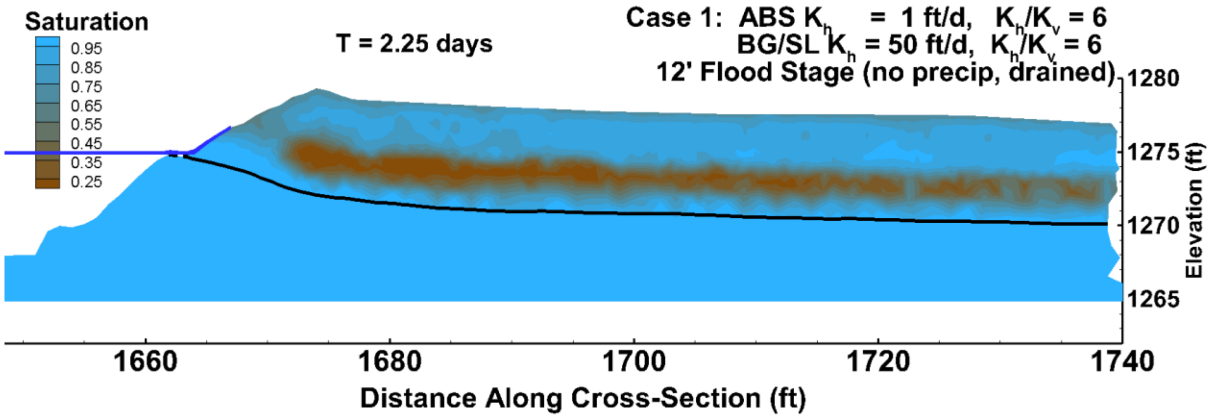

Figure 22. Position of surface water in the channel (solid blue line) at t = 2.25 days shortly after the floodplain was drained. The contouring shows the distribution of soil saturation and the solid blank line shows the watertable position.

The floodplain for all 12' hydrograph scenarios simulated as part of this study were drained at t = 2 days.

5.2 General Conclusions and Observations

Due to the number of scenarios simulated, and their highly transient nature, it is prohibitive to review all of them in detail as part of this report. Rather, this section highlights the key findings and general conclusions/observations from these simulations. The reader is referred to the video summary (Section 1.4) to view all simulation scenarios/cases.

The scenarios tend to fall into 2 groups based on the behaviour of the system: 1) all of the in-channel flood events (i.e., stage height increases of 1.5', 3' and 6') behave in a very similar fashion, with the degree to which the system responds being related to the maximum stage height; and, 2) floodplain events (i.e., stage height increase of 12'), where significant amounts of surface water are able to enter the ABS unit through infiltration from the floodplain.

For discussion purposes in the report, the 6' event is selected as representative of the in-channel events, and the 12' event will be used to illustrate the floodplain events. The 1.5' and 3' events will not be presented in detail here, however, animations of these events are available in the video summary (Section 1.4) at the following file path (*Video_Summary\05_WaterTable_Saturation*).

The discussion of the results is organized into three sections:

- 5.2.1 Watertable and Saturation;
- 5.2.2 Movement of Solute Tracer
- 5.2.3 Groundwater Velocity

5.2.1 Watertable and Saturation

Figure 23 shows the watertable position and soil saturation distribution for Cases 1, 2, 4, and 7 during peak stage height (t = 1.3 days) with the 6' flood hydrograph.

- Case 1: This average *K* case shows a moderate near channel watertable response and some infiltration of rain water on the floodplain (Figure 23a);
- Case 2: Due to the low *K* of the ABS and BG/SL, the watertable response is minimal. Additionally, very little infiltration of rain water occurs on the floodplain. Rather the water flows overland and ponds, as indicated by the solid blue line at ground surface in Figure 23b from 1730 ft to 1740 ft along the cross-section; and,
- Cases 4 and 7: The *K* of the ABS for both of these cases is identical, resulting in a very similar watertable and saturation response to this scenario. The primary difference is that the watertable response is greater further into the bank for Case 7 as a result of the higher *K* of the BG/SL unit (See Figure 23c and Figure 23d for Cases 4 and 7, respectively).

Figure 24 shows the watertable position and soil saturation distribution for Cases 1, 2, 4, and 7 at t = 3 days for the 12' flood hydrograph. In contrast to the previous scenario, the 12' scenario is a floodplain event, where the river stage overtops the bank from approximately t = 1.2 to t = 1.5 days. As the river stage recedes, the water in the floodplain becomes disconnected from the main channel. To simulate return flow to the channel, the standing water in the floodplain is drained at t = 2 days. The snapshots in Figure 24 are taken at t = 3 days; or 1 day after the water in the floodplain was drained. For all cases, except Case 2 which has a very low *K*, there are significant differences in the watertable position and saturation profile, relative to the 6' event (Figure 23). While some of the additional water for the 12' scenario comes from additional bank infiltration, a significant portion comes from infiltration of standing water in the floodplain.

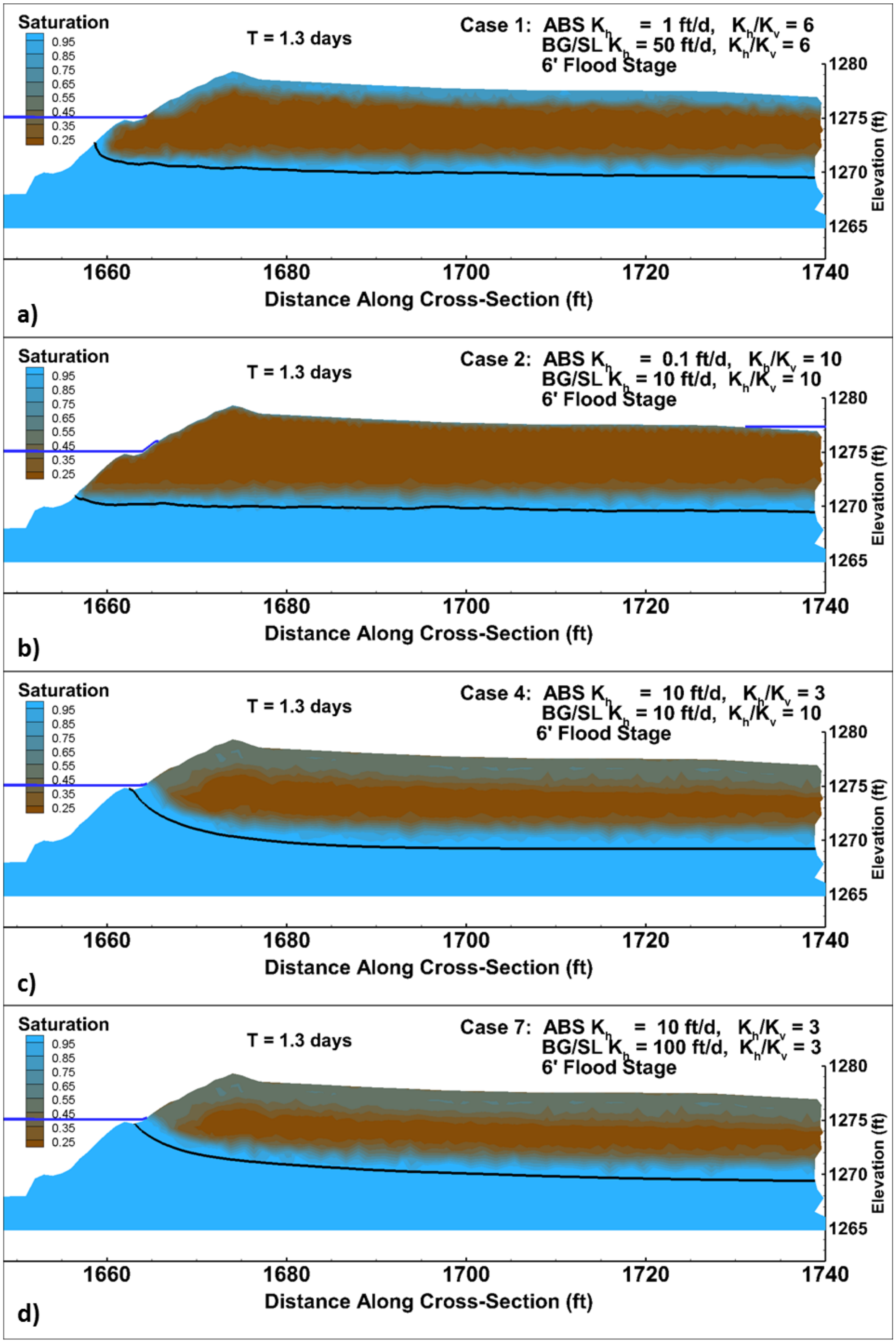

Figure 23. Saturation distribution and watertable position during peak stage height (t = 1.3 days) for the 6' hydrograph event for a) Case 1; b) Case 2; c) Case 4; and d) Case 7.

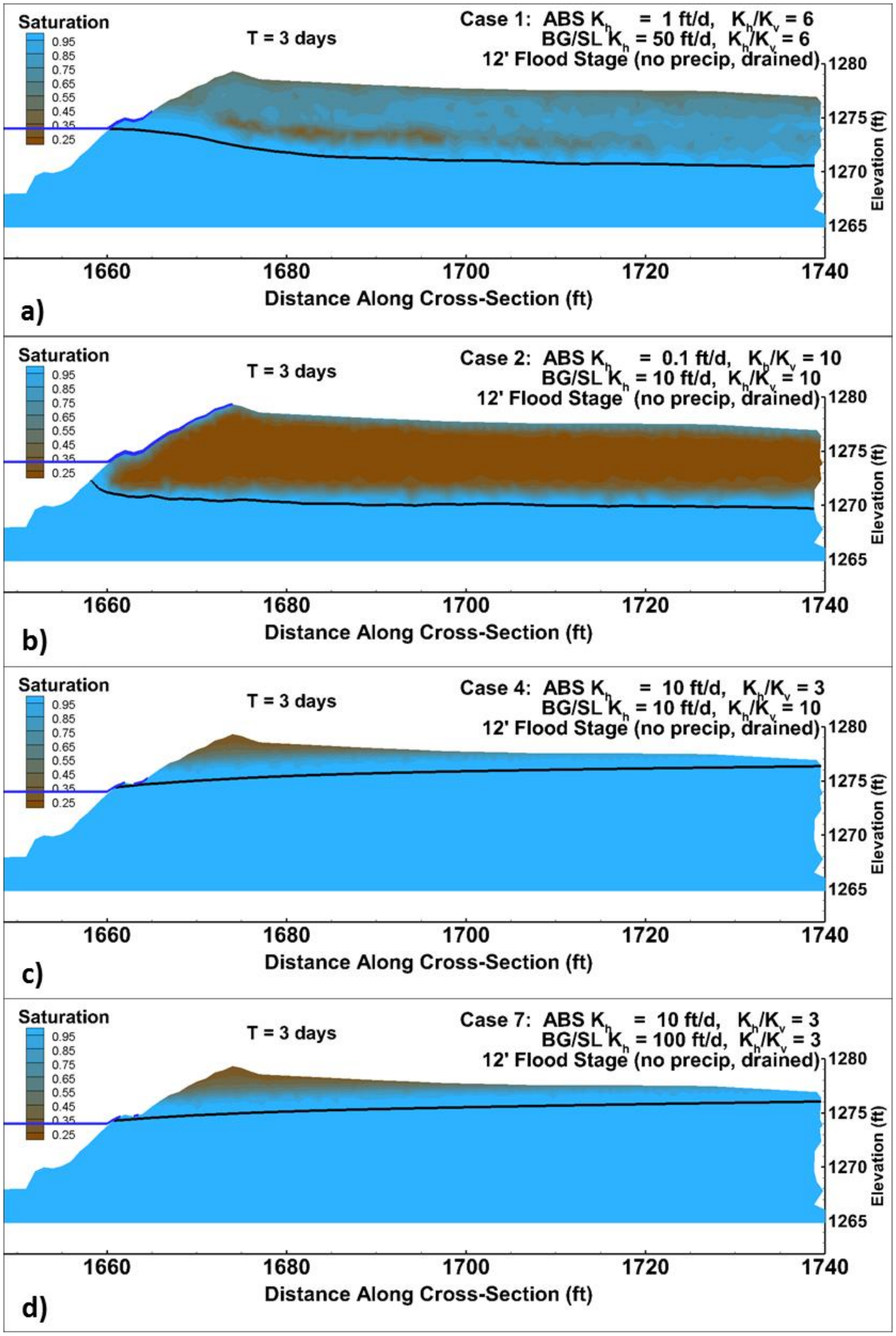

Figure 24. Saturation distribution and watertable position at t = 3 days; or 1 day after the floodplain water was drained for the 12' hydrograph event for a) Case 1; b) Case 2; c) Case 4; and d) Case 7.

5.2.2 Movement of Solute Tracer

Figure 25 through Figure 28 shows the distribution of the conservative species used to track the movement of surface water, precipitation water, and groundwater at t = 0 (e.g., ABS and BG/SL). For each of these figures the contouring depicts the normalized concentration, and the vectors indicate groundwater flow direction. Consistent with previous figures, the solid black line is the watertable position and the solid blue line in the channel is surface water elevation. For the purposes of discussion, two scenarios will be consider; the 6' flood hydrograph, and the 12' flood hydrograph.

Animations corresponding to the simulations shown in the following figures are available in the video summary (Section 1.4) at the following file path (`Video_Summary\06_SoluteTransport`).

Tracking the movement of the different water types within the system provides additional insight into the response of the system that watertable position and saturation distributions alone cannot provide. For example, Figure 25 shows the distribution of surface water within the system for a) Case 1; b) Case 2; c) Case 4; and, d) Case 7, with a 6' flood hydrograph. The snapshots for Figure 25 were timed to coincide with the maximum inundation of surface water. Maximum inundation distance and timing is closely related to the *K* of the system. For example, Case 2 (Figure 25b) has the lowest *K,* and has the least surface water inundation (approximately 10 ft) at the latest time (t = 10.5 days); whereas Case 7 (Figure 25d) has the highest *K*, and the most surface water inundation (approximately 40ft) at a much earlier time (t = 4.75 days). To summarize, surface water inundation distance is positively correlated to *K;* and, the timing of the maximum inundation distance is negatively correlated to *K*.

Figure 26 shows the late time (t = 30 days) distribution of ABS Groundwater (Figure 26a), Surface Water (Figure 26b), BG/SL Groundwater (Figure 26c), and, Rain Water (Figure 26d) for Case 1 with a 6' flood hydrograph. At late time (t = 30 days), rain water remains in the upper portion of the ABS, surface water remains entrained in the bank, and the ABS water has flushed down into the BG/SL.

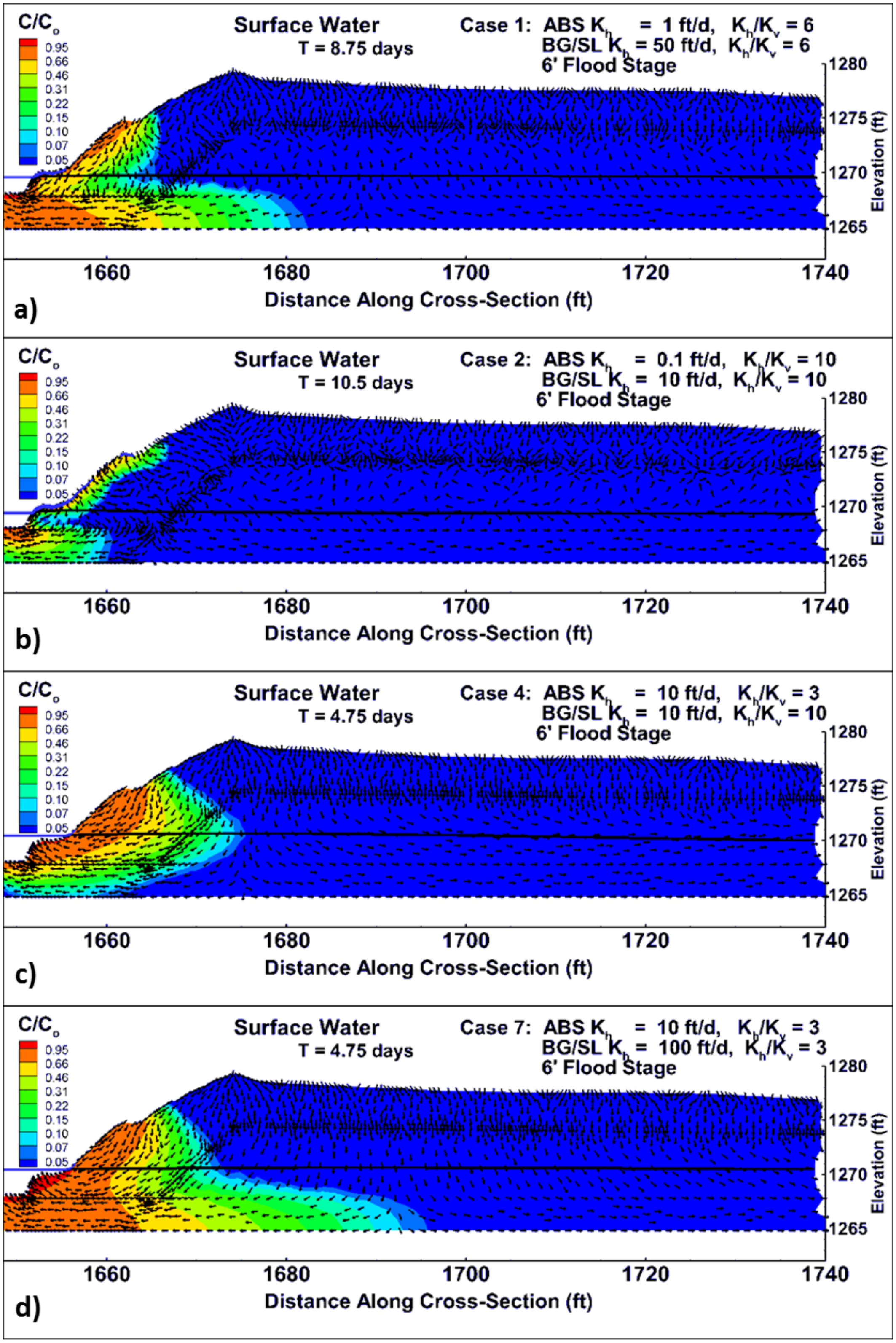

Figure 25. Snapshot of maximum surface water inundation into the bank for each case. a) Case 1 at t = 8.75 days; b) Case 2 at t = 10.5 days; c) Case 4 at t = 4.75 days; and, d) Case 7 at t = 4.75 days.

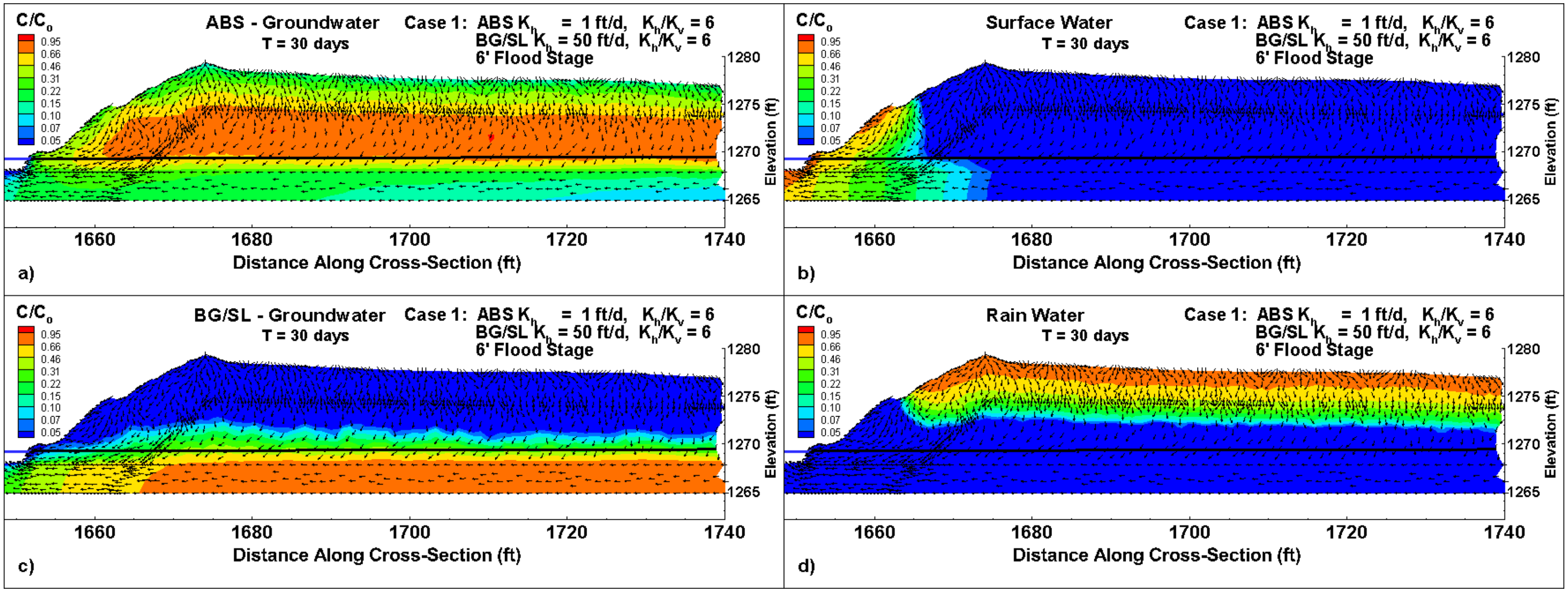

Figure 26. Distribution of a) ABS; b) Surface Water; c) BG/SL; and d) Rain Water at t = 30 days for Case 1 with a 6' flood hydrograph.

Figure 27 shows the late time (t = 30 days) distribution of surface water within the system for: a) Case 1; b) Case 2; c) Case 4; and, d) Case 7, with a 12' flood hydrograph. Due to the overtopping of the bank, the distribution of surface water within the bank is quite different than for an in-channel event (e.g., Figure 26b). Most notably, the majority of the surface water remaining in the system at t = 30 days is in the ABS unit, which entered the system a result of infiltration from the floodplain.

Figure 28 shows the late time (t = 30 days) distribution of ABS Groundwater (Figure 28a), Surface Water (Figure 28b), BG/SL Groundwater (Figure 28c), and, Rain Water (Figure 28d) for Case 1 with a 12' flood hydrograph (in contrast to Figure 26 which shows the same snapshot for a 6' flood hydrograph). (Note: for the 12`event no precipitation was applied to the floodplain).

The key differences between Figure 26 and Figure 28 are:

- Considerably more flushing of the ABS groundwater occurs with the 12` flood hydrograph because of the infiltration of surface water from the floodplain;
- Significantly more Surface Water is stored in the ABS unit at late time (t = 30 days) for the 12' flood hydrograph, however, less surface water is stored in the BG/SL at late time. This is attributed to the fact that the with the 12' event there is stronger return flow in the BG/SL caused by the additional water which infiltrated from the floodplain; and,
- More mixing of the BG/SL groundwater up into the ABS unit occurs with the 12' event due to a stronger gradient from the channel into the BG/SL.

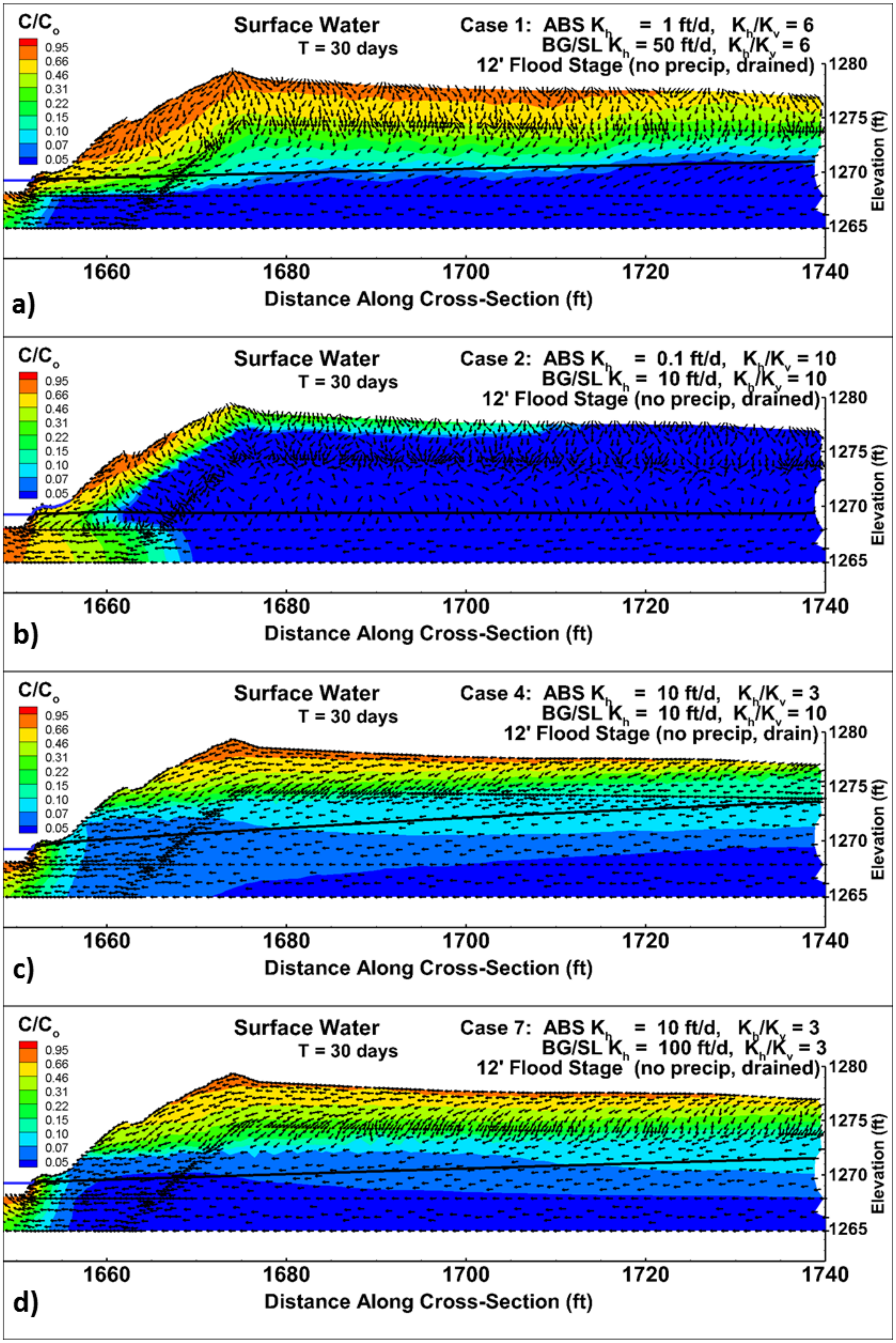

Figure 27. Distribution of surface within the subsurface domain at t = 30 days for the 12’ flood stage for 4 different cases: a) Case 1; b) Case 2; c) Case 4; and, d) Case 7.

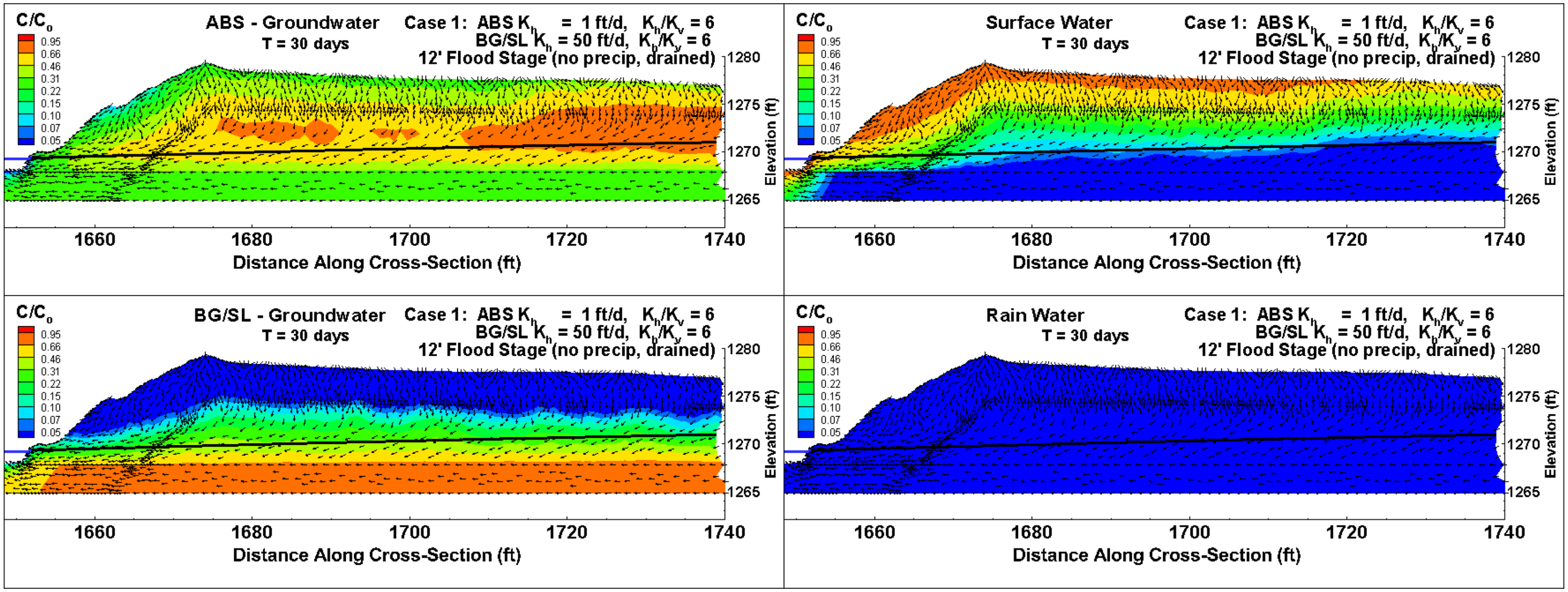

Figure 28. Distribution of a) ABS; b) Surface Water; c) BG/SL; and d) Rain Water at day 30 for Case 1 with a 12’ flood hydrograph.

5.2.3 Groundwater Velocity

Figure 29 through Figure 32 shows the distribution of groundwater velocity in the right bank of the system. The contour depicts the magnitude of groundwater velocity and the vectors indicate groundwater flow direction.

Figure 29 shows the peak groundwater velocity distribution and direction for: a) Case 1; b) Case 2; c) Case 4; and, d) Case 7, with a 6' flood hydrograph at t = 1.3 days. For cases with a strong contrast in *K* between the ABS and BG/SL, peak velocities occur in the BG/SL layer and coincide with maximum stage height (i.e., when the gradient between the river and the groundwater system are greatest). The groundwater flow vectors show that at early time groundwater flow is away from the channel and into the bank, both through the ABS and BG/SL. However, because the ABS has a higher *K*, it can transmit water further from the channel where it pushes up into the ABS. This is evident in the groundwater vector patterns shown in Figure 29. Peak groundwater velocities ranged from less than 5 ft/day for Case 2, to greater than 30 ft/day for Case 7.

Similar to the solute transport figures (Section 5.2.2), where the timing of maximum inundation was related to the *K* of the system, so too is the timing of the reversal of groundwater flow from into the bank, to out of the bank. Figure 30 shows a snapshot for all four Cases immediately before groundwater flow switches from infiltration at the bank face to exfiltration. The timing ranges from t = 3 days for Case 4 (Figure 30c) and Case 7 (Figure 30d), to t = 9.25 days for Case 2 (Figure 30b). The reason for the earlier reversal with higher *K* is because the watertable responds much more quickly to the change in stage height; thus, as stage height decreases, gradients towards the channel develop earlier because the watertable in the bank is at a higher elevation.

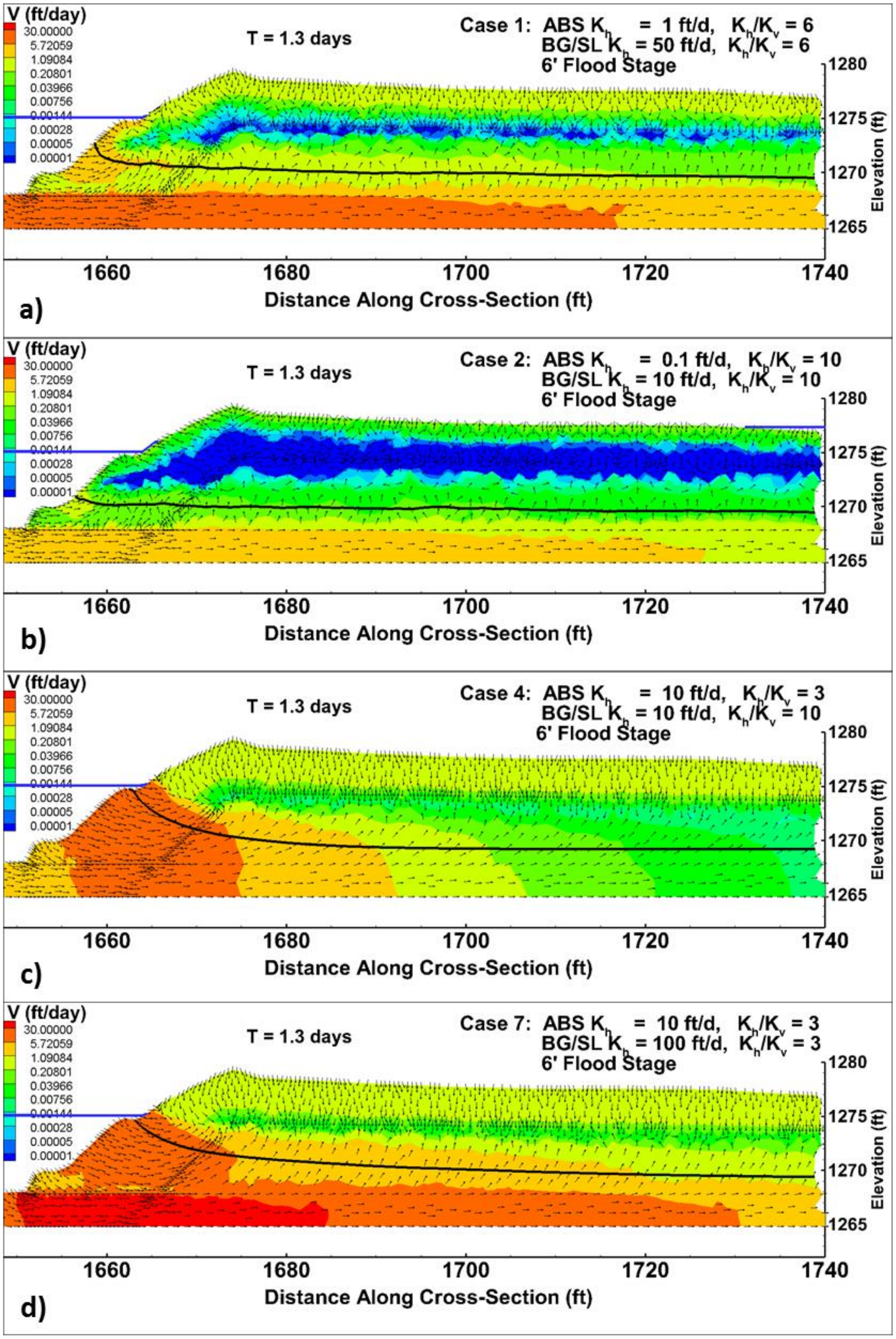

Figure 29. Distribution of groundwater velocity within the system at peak stage height for the 6' hydrograph event for: a) Case 1; b) Case 2; c) Case 4; and, d) Case 7.

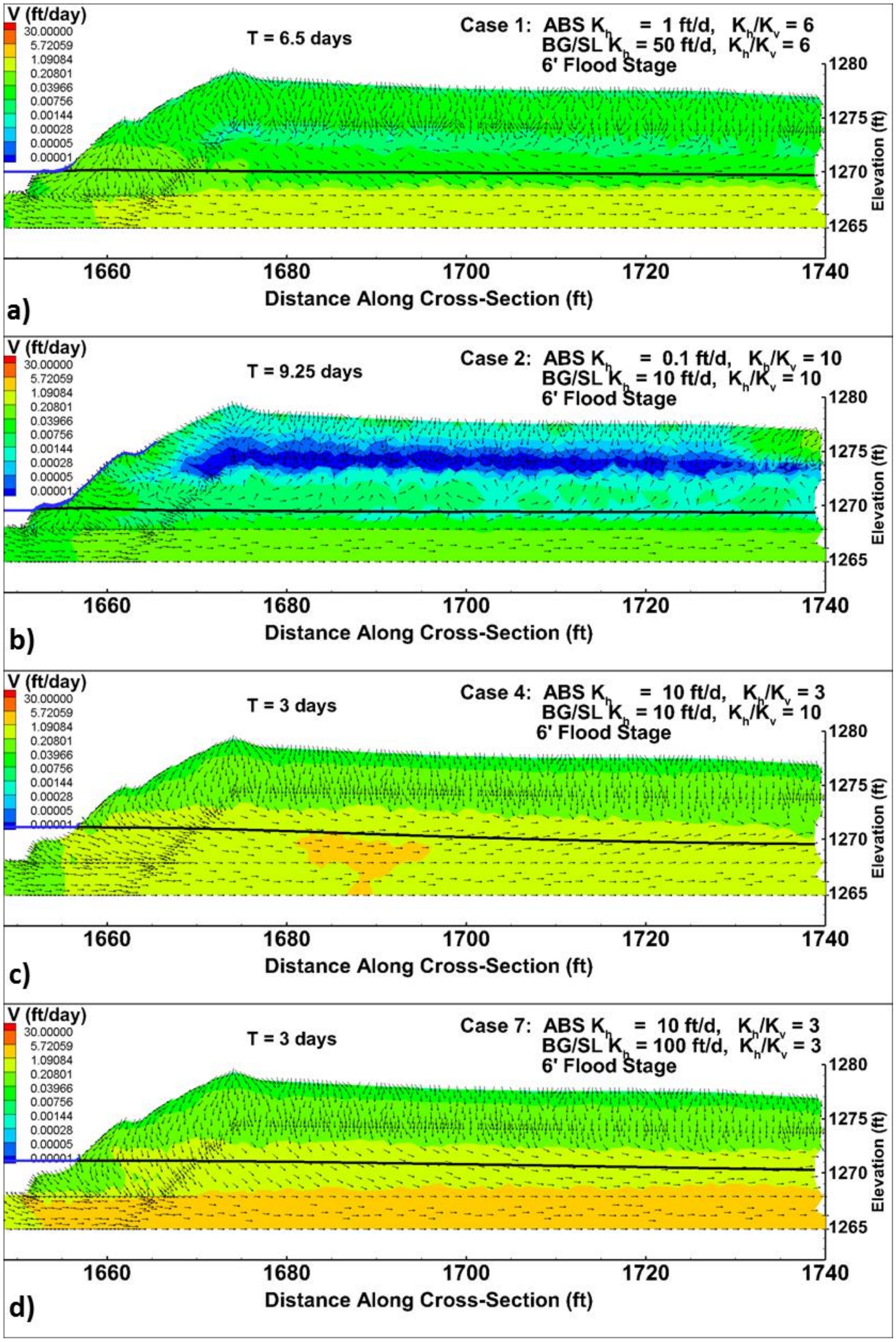

Figure 30. Snapshot of the velocity field immediately before groundwater flow reverses and starts to flow back to the channel. a) Case 1: t = 6.5 days; a) Case 2: t = 9.25 days; a) Case 4: t = 3 days; a) Case 7: t = 3 days.

Figure 31 shows the late time (t = 30 days) groundwater velocity distribution with a 6' flood hydrograph. For all cases, the highest velocities occur in the lower BG/SL layer with flow towards the channel, and the lowest velocities are present in the ABS unit, above the watertable where flow is vertically downwards.

Figure 32 shows the late time (t = 30 days) groundwater velocity distribution with a 12' flood hydrograph. While the overall pattern is similar to that for the 6' flood hydrograph (Figure 31), the magnitude is considerably greater. This suggests that for floodplain events significant return flow in the BG/SL layer may occur for up to 30 days after the original event.

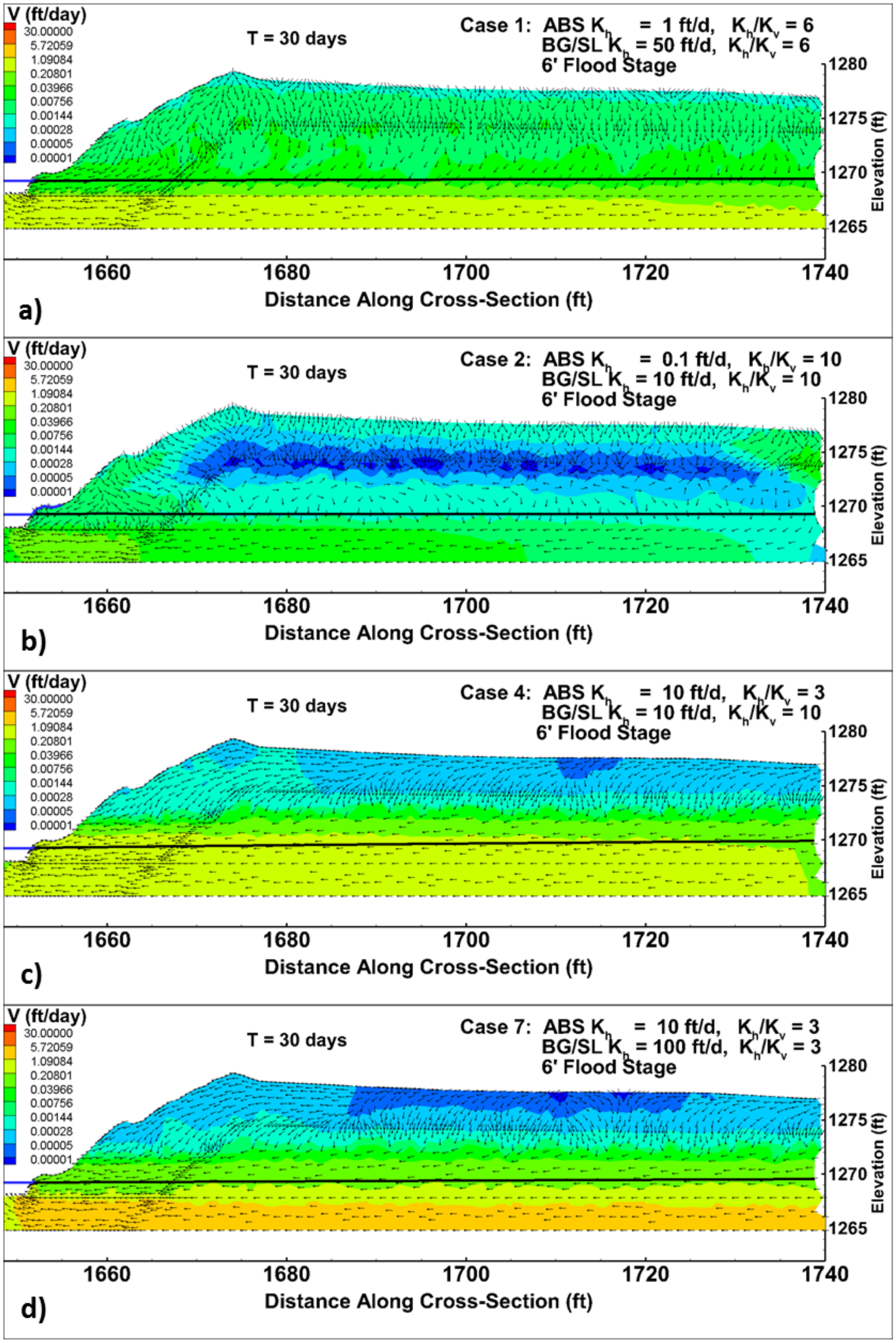

Figure 31. Late time (t = 30 days) velocity distribution for all 4 cases with a 6' flood hydrograph: a) Case 1; b) Case 2; c) Case 4; and, d) Case 7.

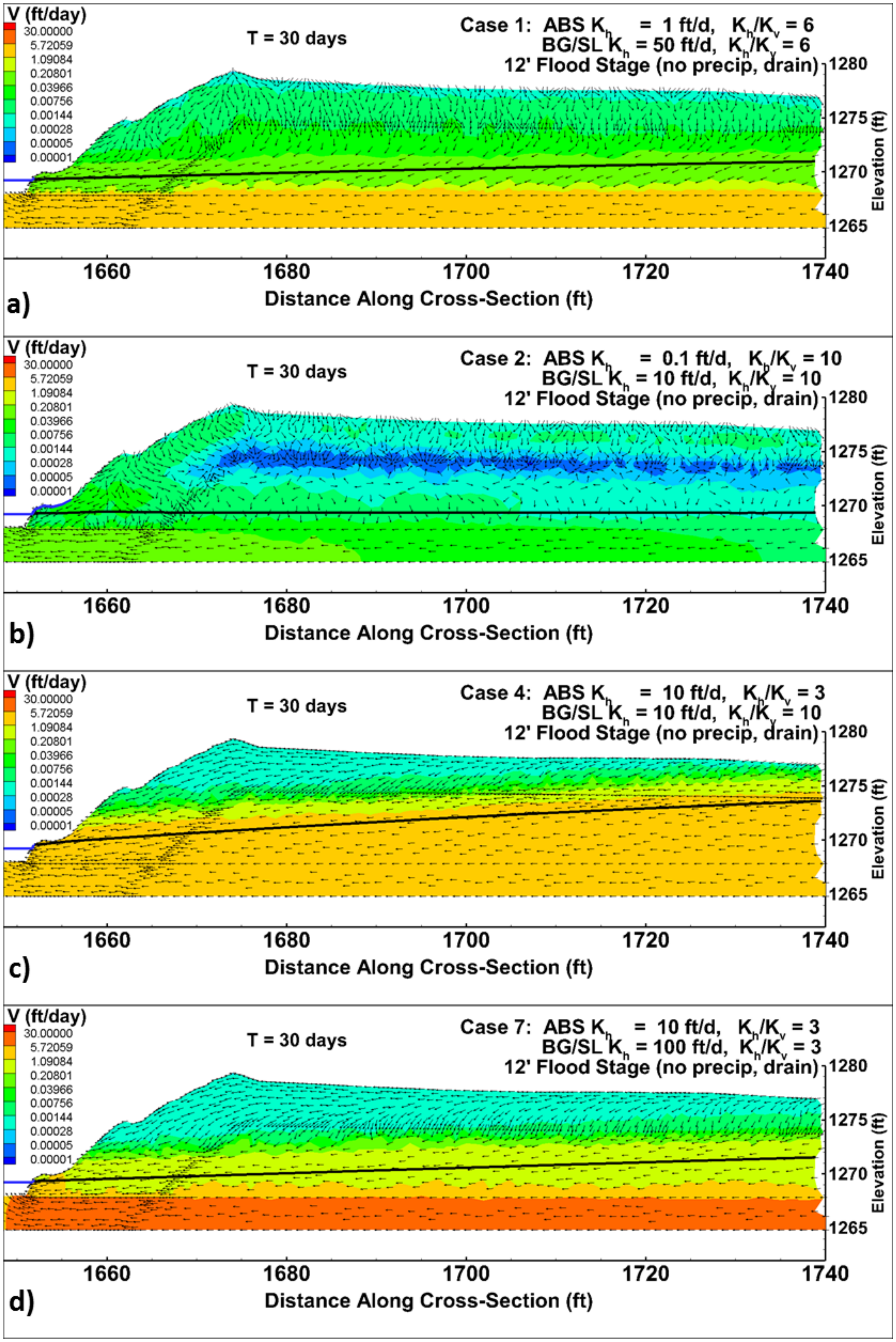

Figure 32. Late time (t = 30 days) velocity distribution for all 4 cases with a 12' flood hydrograph: a) Case 1; b) Case 2; c) Case 4; and, d) Case 7.

5.2.4 Estimation of Flux Out of the Bank

To better understand the interaction of surface water and groundwater during a flood event, a subset of simulations were selected for detailed tracking of exchange flux for discrete zones along the bank face. Figure 33 shows the location and extent of each zone. Note: Zones 3 through 15 are of interest for this investigation. Zones 1 and 2 cover regions of the model domain outside the zone of interest and will not be discussed as part of this analysis.

Zones 3, 4, and 5 represent the base of the South River near the right bank and coincide with the upper surface of the BG/SL layer. Zone 6 and most of Zone 7 are below the base flow level of the South River. Zones 8 through 15 represent sequentially higher elevations along the bank face, with Zone 15 representing the upper most interval.

The three in-channel events for Case 1 (1.5', 3', and 6') were further analyzed by repeating the simulations while tracking the exchange of fluid between the surface and subsurface domains of the model over these intervals.

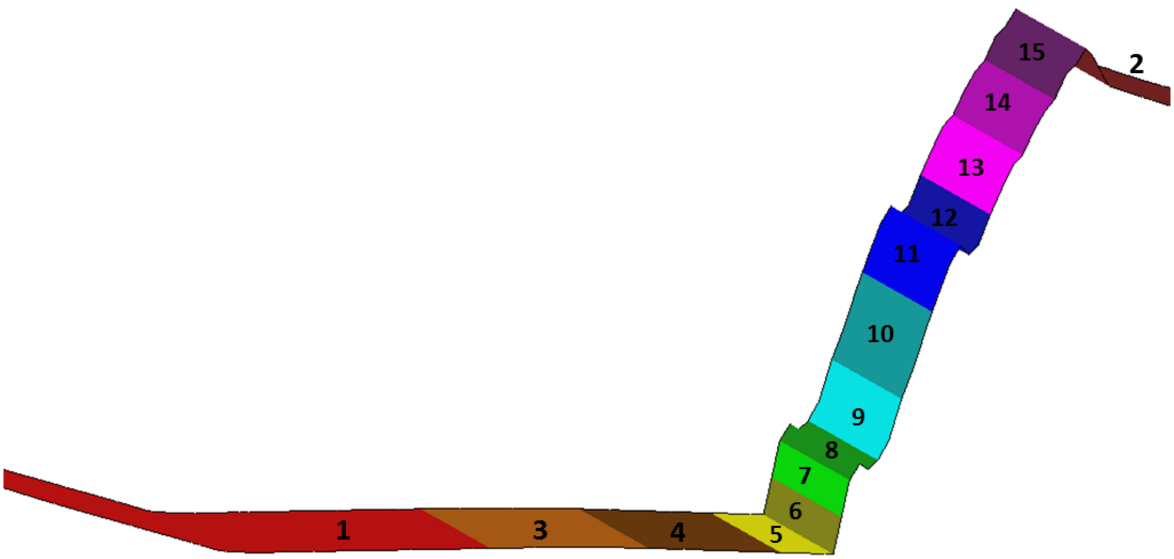

Figure 33. Zones for for tracking exchange flux between surface and subsurface domains during the flood wave simulations along the right bank of the channel.

5.2.4.1 Total Flux by Zone

For each simulation the total flux of water; and the flux of each individual species was recorded at every simulation time step. Of particular interest for understanding the movement of water and bank flow processes are the zones below peak stage height (e.g., for the 3' event this includes Zones 6 – 10); and the zones along the base of the channel near the bank (e.g., Zones 3 – 5). Figure 34 shows the exchange flux across each zone for the entire simulation duration for Case 1 with a 3' flood event. Note: only those zones affected by the flood wave are shown.

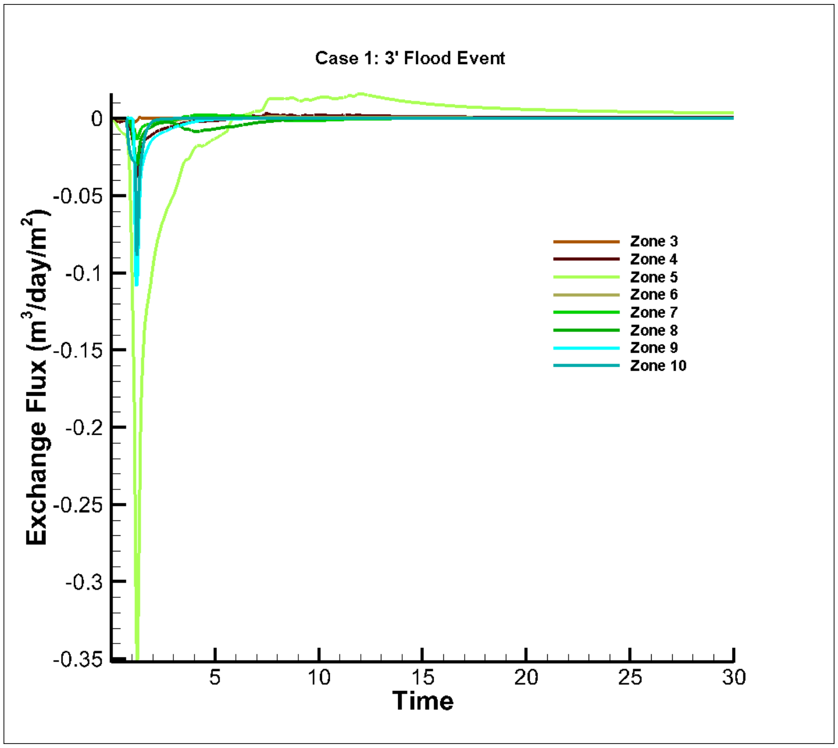

Figure 34. Total exchange flux between the surface and subsurface domain for Case 1 with a 3' flood hydrograph. Negative values indicate infiltration, and positive values indicate exfiltration.

Figure 35 is a close up of Figure 34 focused on the early time period of the simulation. This figure shows that during the flood event the majority of water enters the bank soils through Zone 5, which is situated as the base of the channel adjacent to bank. Moving up the bank, Zones 6 and 7 become active, however, to a lesser degree than Zone 5. It is suspected that the limited infiltration into Zones 6 and 7 is because these soils are in contact with the ABS which has a lower *K* than the BG/SL; and, this soil is already saturated, thus decreasing the available storage capacity. As the flood wave rises, surface water starts infiltrates into Zones 8, 9, and 10. These zones experience more infiltration than Zones 6 and 7 because they are only partially saturated and thus have a greater ability to take up more water. Some of the exchange flux seen at Zone 4 may eventually make its way into the bank; however, as it is located further from the bank from Zone 5, it is expected to play a relatively minor role. Peak infiltration rates, which occur during maximum stage height, are approximately:

- Zone 5: 0.35 m^3/day/m^2
- Zone 6: 0.01 m^3/day/m^2
- Zone 7: 0.01 m^3/day/m^2
- Zone 8: 0.03 m^3/day/m^2
- Zone 9: 0.1 m^3/day/m^2
- Zone 10: 0.08 m^3/day/m^2

Note: the relatively early response of Zone 10 is due to precipitation within this zone.

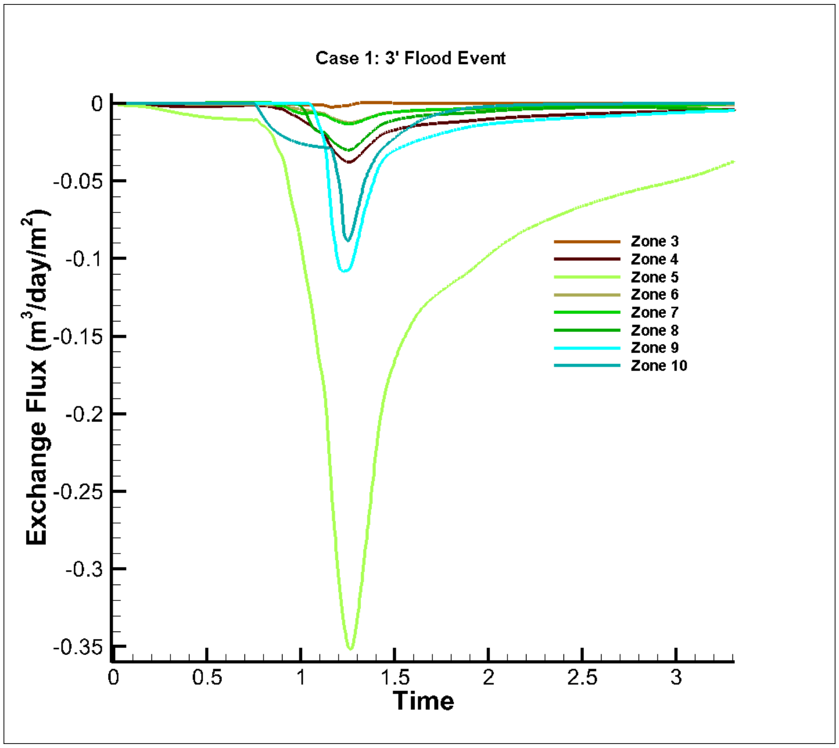

Figure 35. Total exchange flux between the surface and subsurface domain for Case 1 with a 3' event up to from t = 0 days to t = 3.5 days.

Figure 35 shows the total exchange flux of water between the surface and subsurface domains from t = 3.5 days to t = 30 days for Case 1 with a 3' flood hydrograph. Similar to the early time infiltration phase, the late time exfiltration phase is dominated by discharge in Zone 5 with a peak exfiltration rate of approximately 0.015 $m^3/day/m^2$. Minor exfiltration is also evident from Zones 4 and 6.

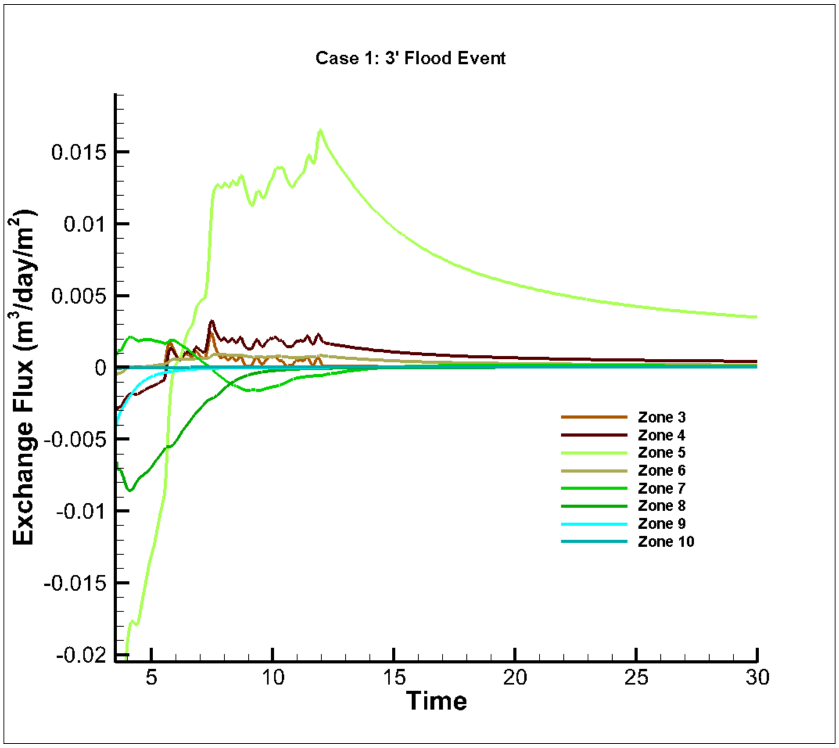

Figure 36. Total exchange flux between the surface and subsurface domain for Case 1 with a 3' event up from t = 3.5 days to t = 30 days.

5.2.4.2 Zone 5 Exchange Flux Composition

The figures in Section 5.2.4.1 indicate that the exchange of water between the river and the bank soils is largely dominated by the movement of water through Zone 5, which represents flux through the BG/SL at the toe of the bank. The movement of water through Zone 5 can be further examined by analyzing the individual water components (e.g., surface water, rain water, ABS groundwater, and BG/SL groundwater). Figure 37 shows the exchange flux for each species of water for the entire simulation. At early time dispersive mixing between the surface water and groundwater causes a net discharge of BG/SL water in the surface domain (red spike at early time). At early time, the infiltration into the bank through Zone 5 is predominantly surface water, as seen by the large negative green spike. Figure 38 shows a close up of Figure 37 from t = 0 days to t = 3.5 days.

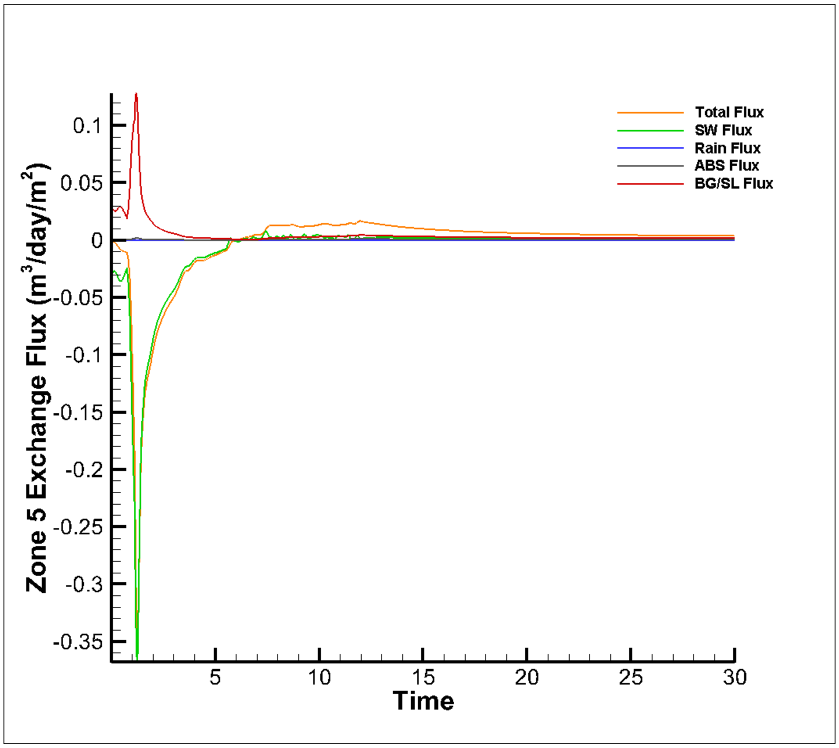

Figure 37. Exchange flux by species through Zone 5 for Case 1 with a 3' flood hydrograph.

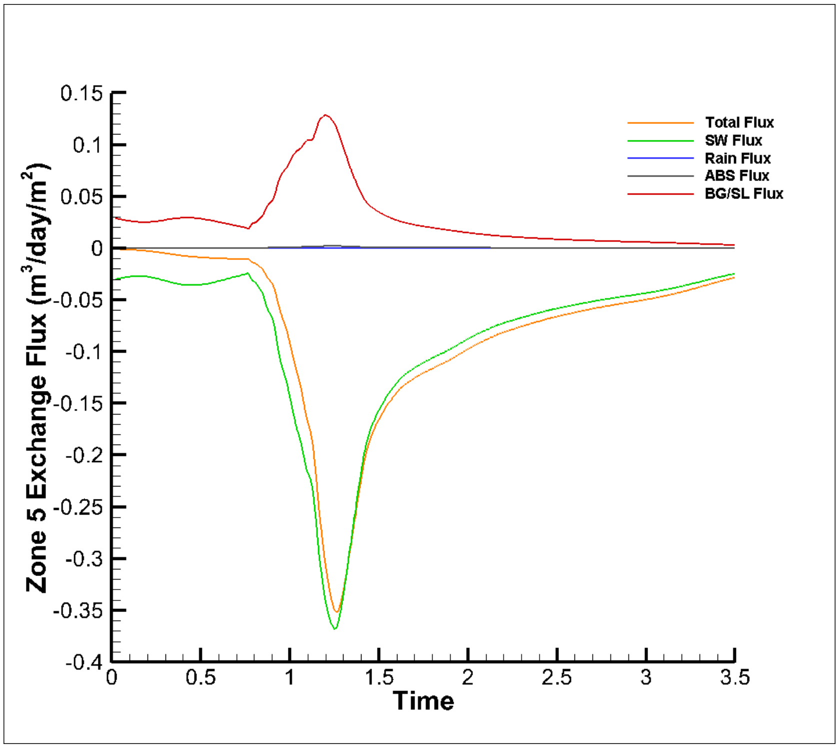

Figure 38. Zone 5 exchange flux for Case 1 with a 3` hydrograph from t = 0 to t = 3.5 days.

Figure 39 shows the late time exchange flux for Zone 5. As the flood wave recedes, infiltration ceases and water starts to discharge through Zone 5. Figure 39 shows that the discharging water through Zone 5 is a mixture of infiltrated BG/SL water, surface water, and ABS water.

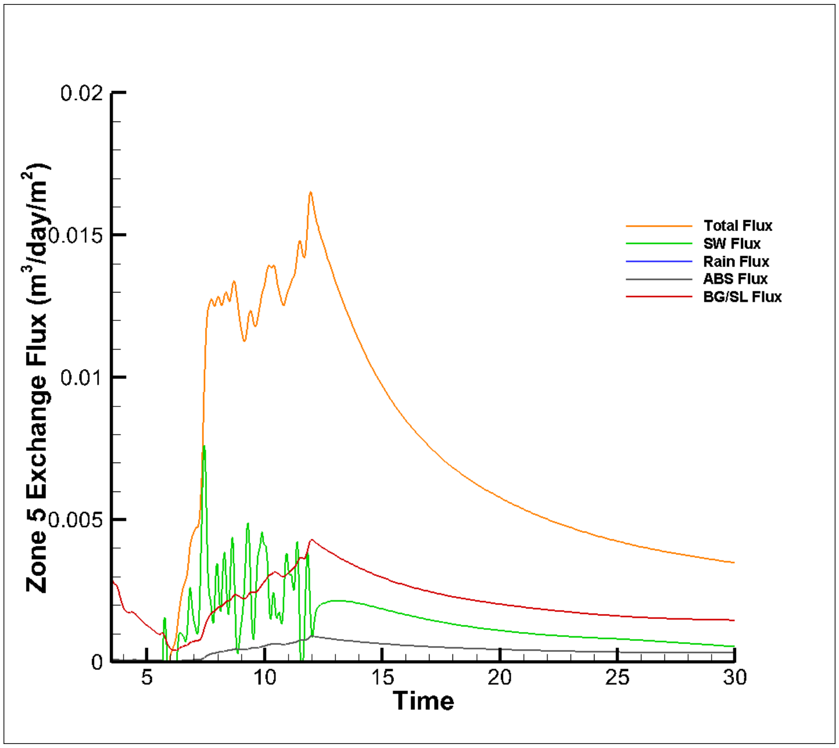

Figure 39. Zone 5 exchange flux for Case 1 with a 3`hydrograph from t = 3.5 to t = 30 days.

5.2.4.3 Comparison to Other Stage Heights

Exchange flux figures for the 1.5ft and 6ft hydrographs are presented in **Appendix B**. Consistent with the 3ft hydrograph, Zone 5 is the most active zone and dominates the river-bank soil interaction. As the stage height increases the rate of exchange flux (both infiltration and exfiltration) through Zone 5 increase in a near linear fashion (see Table 6). Additionally, with greater stage height, more zones along the bank experience surface water infiltration.

Table 6. Peak infiltration and exfiltration rates through Zone 5 for Case 1 with stage heights of 1.5', 3', and 6'.

	Peak Infiltration Rate ($m^3/d/m^2$) (*Approximate*)	Peak Exfiltration Rate ($m^3/d/m^2$) (*Approximate*)
Case 1 - 1.5 ft event	0.18	0.009
Case 1 - 3 ft event	0.36	0.017
Case 1 - 6 ft event	0.65	0.04

In addition to differences in peak exchange flux, the composition of the returning water differs depending on the size of the flood event. For the 1.5' hydrograph the returning water predominantly originated in the simulation as BG/SLwater, however, for the 6' hydrograph the returning water predominantly originate in the simulation as surface water. This proportional increase in surface water exfiltration with increasing stage height may be a result of additional surface water entering the bank soils through the higher elevation zones, flowing vertically downward, and subsequently discharging through Zone 5.

The analysis presented in Section 5.2.4 was repeated for Cases 4 and 7. The figures for these cases are presented in **Appendix C**.

By integrating under the flux curves an estimate of the total amount of water flowing into, or out of the bank for each zone was estimated. The results for Cases 1, 4, and 7 are included as Tables D1 through D6 in **Appendix D.**

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

A conceptual and numerical model was developed to improve the conceptual understanding of surface water/groundwater interaction, bank drainage, and groundwater flux following storm events with respect to mercury loading of the South River, Virginia. This study consisted of a sensitivity analysis to identify the most important parameters controlling the response of the system; and, simulating flood events of different magnitudes while tracking the movement of different water types within the system.

Based on the results of the numerical modeling simulations conducted using *HGS*, the questions posed by DuPont in Section 1.1 (and repeated below) are addressed:

1)

  a. ***How quickly and to what extent does a river flood wave infiltrate and advance into alluvial bank soils following a significant rain event?***

  b. ***What are the water flow vectors and how do stream water, rain water, and groundwater mix?***

  The infiltration rate, extent of the river flood wave into the alluvial bank soils, and degree of mixing is highly dependent on the *K* configuration of the bank soils and the flood event scenario. For example, for a 6' hydrograph the minimum and maximum inundation are:

  - Case 2: Lowest *K* Case. Maximum surface water inundation of approximately 10' at t = 10.5 days (See Figure 25b);
  - Case 7: Highest *K* Case. Maximum surface water inundation of approximately 40' at t = 4.75 days.

  The reader is referred to the supplementary animations (`Video_Summary\06_SoluteTransport`) for a comprehensive overview how the river flood wave infiltrates into the alluvial bank soils, and how the different waters mix, under different hydraulic parameter configurations and different flood events.

2)

  a. **How quickly and to what extent does bank storage water drain on the falling limb of the hydrograph?**
  b. **What are the water flow vectors and how do stream water, rain water, and groundwater mix?**

  The timing and rate of the drainage of stored bank water is highly dependent on; the *K* configuration of the banks soils, and the flood event scenario. For example, for a 6' hydrograph, the timing of the earliest and latest reversals are:

- Case 7: Highest *K* Case. Reversal at t = 3 days (See Figure 30d); and
- Case 2: Lowest *K* Case. Reversal at t = 9.25 days (See Figure 30b)

Additionally, the return velocities are significantly less than the infiltration velocities. The reader is referred to the supplementary animations (`Video_Summary\07_Velocity`) for a comprehensive overview how the river flood wave infiltrates and drains from the alluvial bank soils.

3) Sensitivity Analysis

a. What are the critical hydraulic and hydrogeologic parameters that influence the groundwater flow vectors? At what parameter values?

Based on the sensitivity analysis presented in Section 4.0, the single most important parameter controlling the response of the system to a give flood wave is hydraulic conductivity. Hydraulic conductivity controls the extent to which a river flood wave infiltrates into the bank, as well as the timing of reversal when the infiltrated water begins to discharge back to the river.

4) What is the likely range of volumetric groundwater flux from the banks given the range of hydraulic aquifer properties observed in the system?

The timing and range of volumetric groundwater flux from the banks of the South River following a flood event depends on the magnitude of the event, the hydraulic properties of the bank soils, and the portion of the bank investigated.

The comprehensive analysis for Case 1, presented in Section 5.2.4, shows that the timing and rate of flux is highly dependent on location:

- Zone 5 is the most active zone during an event because the BG/SL layer is in direct contact with river and is able to carry large amounts of water away from the channel;
- Zones 6 and 7 are less active because they are in contact with the relatively low *K* ABS, and are unable to rapidly transmit water away from the channel; and
- Zones 8+ represent areas above the low water stage of the channel that are in contact with the ABS. Due to the fact that the ABS soils in these zones are initially dry, they have a large storage capacity and actually allow more surface water to infiltrate than zones 6 and 7.

The rate of infiltration and exfiltration through Zone 5, which represents flux through the BG/SL at the toe of the bank, is directly related to the change in river stage (see Table 6). The composition of the water returning through Zone 5 is dependent on the size of the flood event; with larger events having a greater percentage of surface water.

A tabulated summary of fluxes through each zone for Cases 1, 4, and 7 is provided in **Appendix D**.

5) ***What is the range of seepage discharge velocities?***

Maximum groundwater seepage velocities occurred in the BG/SL layer and were highly dependent on hydraulic conductivity and stage height, with maximum velocities coinciding with maximum stage heights (e.g., period of strongest gradients).

Peak velocities in the BG/SL ranged from <5 ft/d for Case 2 to >30 ft/day for Case 7.

6) ***Recommended future investigation approach/design – What type of field investigation approach do you recommend in order to create a site-specific calibrated model?***

The follow section (Section 6.2) provides recommendations for further field investigations to support the development of a site-specific calibrated model.

The reader is reminded that this numerical model is conceptual in nature, and is meant to be representative of the general flow processes that may occur along the South River, VA. Additionally, the 2D nature of the model means that it is unable to account for 3D processes that may occur in the real system. None of the results or conclusions presented herein should be considered to accurately represent the true behaviour of the system for any given location.

6.2 Recommendations for Field Investigation to Calibrate the Numerical Model

The calibration of the right bank of the numerical model requires the collection of hydraulic data in both the ABS and BG/SL units at multiple distances away from the bank. Additionally, hydraulic data should be collected at multiple depths within the ABS unit. Figure 40 shows the location of the surface water and subsurface pressure transducers required to calibrate the model.

Because the preliminary model is 2D in nature, the stressor to the system should act along the profile of the cross-section. This eliminates the need for pumping tests which act radially and would violate this requirement. The best source for model calibration is subsurface hydraulic data collected during a flood event, or multiple flood events, as the pressure from the flood wave propagates perpendicular to the channel. The monitoring network shown in Figure 40 is designed to record the flood wave as well as the bank soils response to it.

Because accessing the banks of the South River may be difficult it is recommended that the pressure transducers be installed using drive-point piezometers. The clusters should be positioned to approximately target the 3', 6', and 9' foot events.

The cluster closest to the banks consists of 3 pressure transducers, and the other two clusters consist of 4 pressure transducers. The deepest transducer at each location should target the BG/SL layer. The second deepest should be situated within the ABS, below the low watertable elevation. The remaining transducers at each location should split the remaining distance between the watertable and ground surface.

At a minimum these pressure transducers should record pressure; however, the collection of temperature and electrical conductivity may also prove insightful for gaining a better understanding of the system.

Following the development of these drive-point piezometers, it is recommended that slug tests be performed at each location to gauge the local heterogeneity of the system, and provide initial values for the model calibration.

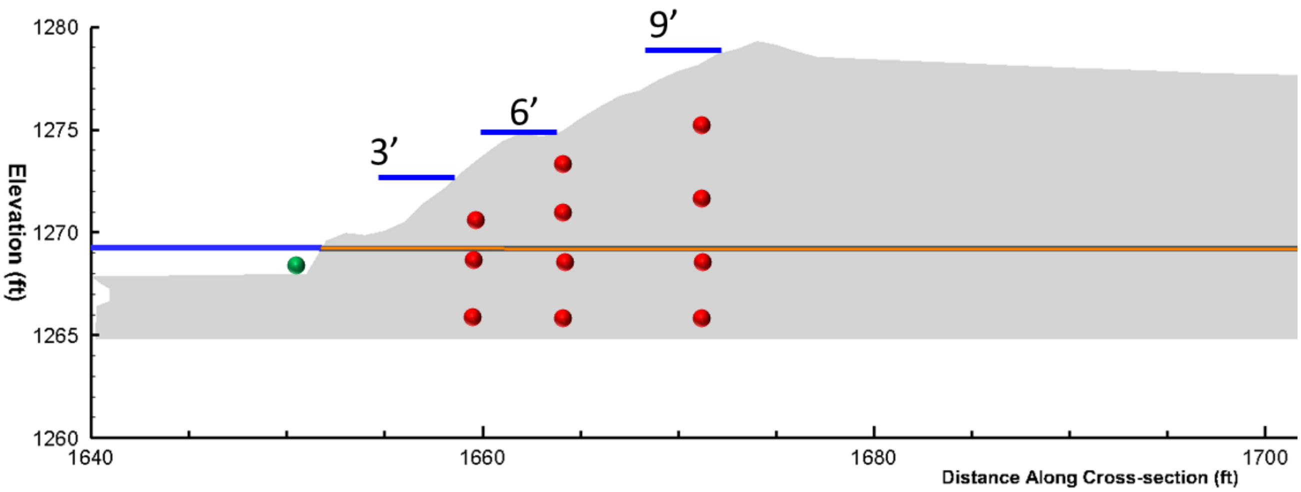

Figure 40. Recommended locations for pressure transducer installation. The solid green circle represents a surface water location, and the solid red circles represent subsurface installations.

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8.0 LIMITATIONS

SCOPE OF REPORT

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APPENDIX A

HydroGeoSphere: A Three-Dimensional Integrated Surface and Subsurface Flow, Solute, and Thermal Energy Transport Simulator

Integrated Hydrologic Approaches and *HydroGeoSphere* (*HGS*)

A diverse group of problems exists that requires quantification of the entire hydrologic cycle by integrated simulation of water flow and contaminant migration in the surface and subsurface regimes. Increased demand on limited resources for potable water and other purposes has driven the development of innovative management practices including water recycling, drainage water reuse for salt-tolerant crops, conjunctive use of surface and subsurface water resources, and artificial recharge of subsurface aquifers during wet periods. A quantification of available water within the hydrologic system and the impacts of withdrawals is essential for addressing these complex water supply issues. The complex cycle of irrigation; evaporation; infiltration; discharge to nearby lakes, rivers, and streams, and pumping needs to be quantified in these cases to resolve supply and demand issues. Concerns over drying and restoration of wetlands or the effects of subsurface water withdrawals on surface water features (which may fluctuate across land surface or layering features in an unsaturated zone) also require an integrated, fully-coupled analysis of the various flow regimes. Ecosystems of lakes, rivers, and bays depend on certain minimum flows as do hydropower generation, recreational use, and downstream water districts, states, and countries for their water needs. Regulating water use in hydraulically connected watershed and surficial aquifer systems necessitates an understanding of surface/subsurface water interactions and overall seasonal hydrologic cycle behavior.

Since the early 1970s, there has been an evolution of hydrologic models for single-event and continuous simulations of rainfall-runoff processes. Earlier models quantify various hydrologic components using simplified procedures (including a unit hydrograph method, empirical formulas, system lumping, and analytical equations) that are incapable of describing flow physics and contaminant transport in any detail. In the past, numerical models based on complex multi-dimensional governing equations have not received much attention because of their computational, distributed input and parameter estimation requirements. Today, with the availability of powerful personal computers, efficient computational methods, and sophisticated GIS, remote sensing and advanced visualization tools, the hydrologic community is realizing the tremendous potential and utility of physically-based numerical simulators.

The *HydroGeoSphere* (*HGS*) model (Aquanty, Inc., 2015) is a three-dimensional control volume finite element simulator which is designed to simulate the entire terrestrial portion of the hydrologic cycle. It uses a globally-implicit approach to simultaneously solve the 2D diffusion wave equation and 3D form of Richards' equation. It also dynamically integrates key components of the hydrologic cycle such as evaporation from bare soil and water bodies, vegetation-dependent transpiration with root uptake, snowmelt and soil freeze/thaw. As with the solution of the coupled water flow equations, *HGS* solves the contaminant transport and energy transport equations over the land surface and in the subsurface, thus allowing for surface/subsurface interactions. The *HGS* platform uses a robust and efficient nonlinear solver, and has been parallelized to utilize high performance computing facilities to address large-scale problems.

2. Key Features and Formulations

Overland Flow

In the *HGS* model, areal overland flow is represented by a two-dimensional depth-integrated flow equation which is the diffusion-wave approximation of the Saint Venant equation for surface water flow:

$$\nabla \cdot d_o K_o \cdot \nabla h_o \pm Q_o + \Gamma_o = \frac{\partial h_o}{\partial t}$$

where d_o is the depth of flow, h_o is the water surface elevation ($= d_0 + z$), and K_o is the surface conductances that are changed with the friction slopes of the surface and is approximated by the Manning's equation in *x*- and *y*- directions as:

$$K_{ox} = \frac{d_o^{2/3}}{n_x} \frac{1}{\left[\partial h_o / \partial s\right]^{1/2}} \; ; \qquad K_{oy} = \frac{d_o^{2/3}}{n_y} \frac{1}{\left[\partial h_o / \partial s\right]^{1/2}}$$

where n_x and n_y are the Manning's roughness coefficients and s is the direction of maximum surface-water slope. The surface conductances K_{ox} and K_{oy} are complex functions of the dependent variables d_0 or h_0 ($= d_0 + z$), and the complex relationship makes the governing equation highly nonlinear.

Groundwater Flow

The modified form of Richards' equation describing three-dimensional transient subsurface flow under variably-saturated conditions is given by:

$$\nabla \cdot k_r \mathbf{K} \cdot \nabla h \pm Q + \Gamma = \frac{\partial}{\partial t}\left(\theta_s S_w\right)$$

where k_r is the relative permeability of the medium as a function of the water saturation S_w or the pressure head ψ, $\mathbf{K}$ is the hydraulic conductivity tensor, h is the total head as $\psi + z$ where z is the elevation, θ_s is the saturated water content, Q is an externally applied source or sink of water. The fluid exchange between the surface and subsurface is represented by Γ. The storage term can be expanded to account for both the change in storage in the saturated zone through compressibility effects and a change in saturation in the unsaturated zone (Cooley, 1971; Neuman, 1973):

$$\frac{\partial}{\partial t}\left(\theta_s S_w\right) \approx S_w S_s \frac{\partial h}{\partial t} + \theta_s \frac{\partial S_w}{\partial t}$$

where S_s is the specific storage coefficient. The governing groundwater flow equation is highly nonlinear due to the nature of the constitutive relations between hydraulic head (h), saturation (S_w), and relative permeability (k_r), which is commonly described through expressions such as the van Genuchten (1980) or Brooks and Corey (1964) relations.

Surface Water and Groundwater Interaction

Separate surface and subsurface flow models can be combined by explicitly coupling the variably-saturated flow and the surface flow equations. In *HGS*, it is assumed that the two domains are separated by a thin boundary layer. Thus, Γ_o in the governing flow equation represents a first-order exchange between subsurface and surface domains as follows:

$$\Gamma_o = (k_r)_{exch} K_{exch} (h - h_o) / l_{exch}$$

$$\int_V \Gamma dV = -\int_{A_{\mathrm{interf}}} \Gamma_o dA_{\mathrm{interf}}$$

where $(k_r)_{exch}$ is the relative permeability for fluid exchange, K_{exch} is the surface/subsurface conductance, and l_{exch} is the thickness of the interface layer between surface and subsurface domains. In the coupling equation, a positive Γ_0 indicates movement from the subsurface to the surface domain through the interface (A_{interf}). Note that the *HGS* model is referred to as a fully-integrated globally-implicit model, opposed to linked or iteratively coupled simulators because the governing equations are solved simultaneously with the above coupling equation.

Canopy Interception and Evapotranspiration

The *HGS* model simulates interception and evapotranspiration as mechanistic processes governed by plant and climate conditions as noted by Kristensen and Jensen (1975) and Wigmosta et al. (1994). Interception is the process involving retention of a certain amount of precipitation on the leaves, branches, and stems of vegetation or on buildings and structures in urban areas. The interception process is simulated by the bucket model, wherein precipitation in excess of interception storage and evaporation from interception reaches the ground surface. The interception storage varies between zero and S_{int}^{Max}, the interception storage capacity such that

$$S_{\mathrm{int}}^{Max} = c_{\mathrm{int}} LAI$$

where *LAI* is the dimensionless leaf area index and c_{int} is the canopy storage parameter. Note that *LAI* represents the cover of leaves over a unit area of ground surface, and may be prescribed in a time-dependent manner.

Evapotranspiration is rigorously modeled as a combination of plant transpiration and evaporation, and affects both surface and subsurface flow domains. Transpiration from vegetation occurs within the root zone of the subsurface which may be above or below the watertable. The rate of transpiration (T_p) is estimated using the following relationship that distributes the net capacity for transpiration among various factors (Kristensen and Jensen, 1975).

$$T_p = f_1(LAI)\, f_2(\theta) RDF[E_p - E_{can}]$$

where $f_1(LAI)$ is a function of leaf area index, $f_2(\theta)$ is a function of nodal water content, *RDF* is the root distribution function, E_p is the potential evapotranspiration, and E_{can} is the canopy evaporation. The vegetation term is expressed as

$$f_1(LAI) = \max\{0, \min[1, (C_2 + C_1 LAI)]\}$$

and the moisture content dependence term is expressed as

$$f_2(\theta) = \begin{cases} 0 & \text{for } 0 \le \theta \le \theta_{wp} \\ f_3 & \text{for } \theta_{wp} \le \theta \le \theta_{fc} \\ 1 & \text{for } \theta_{fc} \le \theta \le \theta_o \\ f_4 & \text{for } \theta_o \le \theta \le \theta_{an} \\ 0 & \text{for } \theta_{an} \le \theta \end{cases}$$

where:

$$f_3 = 1 - \left[\frac{\theta_{fc} - \theta}{\theta_{fc} - \theta_{wp}}\right]^{C_3/E_p} \quad \text{and} \quad f_4 = 1 - \left[\frac{\theta_{an} - \theta}{\theta_{an} - \theta_o}\right]^{C_3/E_p}$$

where C_1, C_2, and C_3 / E_p are dimensionless fitting parameters, θ_{fc} is the moisture content at field capacity, θ_{wp} is the moisture content at the wilting point, θ_o is the moisture content at the oxic limit, θ_{an} is the moisture content at the anoxic.

The evaporation mode used in *HGS* assumes that evaporation occurs along with transpiration, resulting from energy that penetrates the vegetation cover and is expressed as

$$E_s = \alpha^* (E_p - E_{can})[1 - f_1(LAI)]EDF$$

where α^* is a wetness factor given by

$$\alpha^* = \begin{cases} \frac{\theta-\theta_{e2}}{\theta_{e1}-\theta_{e2}} & \text{for } \theta_{e2} \le \theta \le \theta_{e1} \\ 1 & \text{for } \theta > \theta_{e1} \\ 0 & \text{for } \theta < \theta_{e2} \end{cases}$$

where θ_{e1} is the moisture content at the end of the energy limiting stage (above which full evaporation can occur) and θ_{e2} is the limiting moisture content below unity which evaporation is zero. The equation expresses the moisture availability term for the subsurface domain. For the overland flow domain, α^* is calculated as varying between unity when the elevation of flow is at or above depression storage and zero for a flow elevation at the land surface, thus representing the reduced evaporative area of available water in the overland flow domain within the depressions. The term *EDF* is the evaporation distribution function that includes the overland and subsurface flow domains. It is assumed that the capacity for evaporation decreases with depth below the surface due to the reduction of energy penetration in the soil.

Snowmelt and Porewater Freezing and Thawing

In order to consider both solid and liquid phases of water in the surface flow domain, the governing overland flow equation needs to be expanded to include both water and snow mass ($\rho_w d_w$ and $\rho_{snow} d_{snow}$). The solid phase snow is assumed to be immobile and the mass balance of the total water is formulated as the following:

$$\frac{\partial}{\partial t}(\rho_w d_w + \rho_{snow} d_{snow}) = \frac{\partial}{\partial x}\left(\rho_w k_m d_w K_{ox} \frac{\partial h_o}{\partial x}\right) + \frac{\partial}{\partial y}\left(\rho_w k_m d_w K_{oy} \frac{\partial h_o}{\partial y}\right) - \rho_w \Gamma_{ex} + \rho_w Q_o + \rho_{snow}(Q_{snow} - \mu)$$

where Q_{snow} and μ represent the rates of snow precipitation and sublimation per unit surface area. The depth of snow is determined by the rates of snow precipitation, sublimation, and melting (always sink) which is caused by temperature change.

$$\frac{\partial}{\partial t}(\rho_{snow} d_{snow}) = \rho_{snow} Q_{snow} - \eta(T_{air} - T_{threshold}) - \mu$$

where the depth of snow is always positive and the rate of melting is assumed to be proportional to a melting constant (η) and the difference between air temperature (T_{air}) and threshold temperature ($T_{threshold}$) when $T_{air} > T_{threshold}$.

By combining the total water balance equation with the snow balance equation, *HGS* solves the balance equation for the liquid phase water.

$$\frac{\partial}{\partial t}(\rho_w d_w) = \frac{\partial}{\partial x}\left(\rho_w k_m d_w K_{ox} \frac{\partial h_o}{\partial x}\right) + \frac{\partial}{\partial y}\left(\rho_w k_m d_w K_{oy} \frac{\partial h_o}{\partial y}\right) - \rho_w \Gamma_{ex} + \rho_w Q_o + \rho_{snow} Q_{melt}$$

When the liquid phase of porewater can be transformed into the solid phase ice (freezing) or vice versa (melting), the total mass of water in the subsurface system is $\rho_w \theta_s S_w + \rho_{ice} \theta_s S_{ice}$ where the subscript ice represents the solid phase ice. The ice is assumed to be immobile and thus, the balance of the total water mass can be described by the following equation:

$$\frac{\partial}{\partial t}(\rho_w \theta_s S_w + \rho_{ice} \theta_s S_{ice}) = -\nabla \cdot \rho_w \mathbf{q} + \rho_w Q_w$$

The partitioning of water between solid and liquid phases is assumed to be determined by the temperature (which is a function of time at a given point) such that

$$\frac{\rho_{ice} S_{ice}}{\rho_w S_w + \rho_{ice} S_{ice}} = \left(\frac{T_f - T_{pm}}{T_f - T_m} \right)^{\beta} \text{ when } T_m < T_{pm} < T_f$$

where T_m and T_f are the melting and freezing temperatures. A simple one-dimensional analytical model is employed in *HGS* to determine the vertical temperature distribution of bulk porous medium

$$\frac{\partial}{\partial t}(T_{pm} - T_b) = \frac{\partial}{\partial z}\left(\frac{k_{pm}}{c_{pm}} \frac{\partial (T_{pm} - T_b)}{\partial z} \right)$$

where k_{pm} and c_{pm} are the bulk thermal conductivity and heat capacity, respectively and it is assumed that the temperature at depth is given as T_b and the surface temperature is same as the atmospheric temperature (T_{atm}). The analytical solution of the equation is given as follows:

$$T_{pm}(z,t) = T_b + \frac{z}{\sqrt{4\pi\kappa}} \int_{\tau=0}^{t} \frac{\partial T_{atm}(\tau)}{\partial \tau} erfc\left[\frac{z}{\sqrt{4\kappa(t-\tau)}}\right] d\tau$$

where the thermal diffusivity of bulk porous medium κ is defined as k_{pm} / c_{pm}.

Solute Transport

In *HGS*, three-dimensional transport of solutes in a variably-saturated porous matrix is described by the following advection-dispersion equation:

$$-\nabla \cdot w_m (\mathbf{q}C - \theta_o S_w \mathbf{D} \nabla C) + [w_m \theta_o S_w R \lambda C]_{par} + \sum \Omega_{ex} \pm Q_c = w_m \left[\frac{\partial}{\partial t}(\theta_o S_w R C) + \theta_o S_w R \lambda C \right]$$

where *C* is the solute concentration of the current species amongst possibly multiple species and λ is a first-order decay constant. The subscript *par* designates parent species for the case of a decay chain. For the case of a straight decay chain, there is only one parent species, as might be the case for a radioactive decay chain; however, for degrading organic species, a particular species may have several parent sources through a complex degradation process. Solute exchange with the outside of the simulation domain, as specified from boundary conditions, is represented by Q_c which represents a source (positive) or a sink (negative) to the system. The dimensionless retardation factor, *R*, is given as:

$$R = 1 + \frac{\rho_b}{\theta_s S_w} K'$$

where ρ_b is the bulk density of the porous medium and *K'* is the equilibrium distribution coefficient describing a linear Freundlich adsorption isotherm. Note that for variably-saturated conditions, the water saturation appears in the definition of *R*. Ω_{ex} represents the mass exchange rate of solutes per unit volume between the subsurface domain and all other types of domains supported by the model. Currently, these additional domains are surface, wells, tile drains, discrete fractures, immobile second continuum and mobile dual continuum.

The equation for two-dimensional transport of solutes along the surface domain is written as

$$-\bar{\nabla}(\mathbf{q}_o C_o - \mathbf{D}_o \phi_o d_o \bar{\nabla} C_o) + [\phi_o d_o R_o \lambda C_o]_{par} - \phi_o d_o \Omega_o = \frac{\partial}{\partial t}(\phi_o d_o R_o C_o) + \phi_o d_o R_o \lambda C_o$$

where C_o is the concentration in water on the surface domain, $\mathbf{D}_o$ is the hydrodynamic dispersion tensor of the surface flow domain and $\bar{\nabla}$ is the vertically integrated two-dimensional gradient operator. An expression similar to the equation used for a two-dimensional fracture is used to represent the dispersion coefficient $\mathbf{D}_o$ and the retardation factor R_o.

Solute exchange between surface and subsurface $d_o \Omega_o$ is calculated by advective-dispersive equation:

$$\left(d_o \Omega_o\right)_{total} = \left(d_o \Omega_o\right)_{adv} + \left(d_o \Omega_o\right)_{disp}$$

Advective solute exchange flux is computed from fluid exchange flux and upstream concentration and dispersive flux is accounted for by one-dimensional mechanical dispersion and diffusion.

$$\left(d_o \Omega_o\right)_{adv} = \left(d_o \Gamma_o\right) C_{up}$$

where:

$$C_{up} = \begin{cases} C_o & \text{for } h_o > h \\ C & \text{for } h_o \le h \end{cases} \text{ and } \left(d_o\Omega_o\right)_{disp} = \left|(d_o\Gamma_o)\right|\alpha_{ex} + \frac{D_{free}\theta_{ex}S_{ex}\tau}{l_{ex}}(C - C_o)$$

where α_{ex} is the exchange dispersivity, θ_{ex} and S_{ex} are the geometric mean for surface and subsurface porosities and saturations, respectively, τ is the subsurface tortuosity, and l_{ex} is the effective mass transfer scale which represents the dimension of an interface layer. In *HGS*, dispersive flux can be optionally neglected if it is considered to be much smaller than advective flux.

Thermal Energy Transport

The equation describing thermal energy transport in the unsaturated zone is similar to that for the saturated zone, with the inclusion of a saturation term in the bulk transport parameters. The general equation for variably-saturated subsurface thermal energy transport following Molson et al. [1992] is given by:

$$\left[\frac{\delta\rho_b c_b T}{\delta t}\right] = -\nabla[q\rho_w c_w T - (k_b + c_b\rho_b D)\nabla T] \pm Q_T + \Omega_\mathrm{o}$$

where ρ is the density, c is the heat capacity, T is the temperature, t is time, q is the Darcy flux in the subsurface, k_b is the bulk thermal conductivity term, D is the dispersion term, Q_T is a source sink and Ω_o is the surface/subsurface interaction term, which will be discussed in a following section. The subscript b denotes a bulk term, whereas w represents the aqueous phase.

The surface water thermal energy transport equation is similar to the surface water contaminant transport equation. The equation used for surface water thermal transport is given by:

$$\frac{\delta\rho_w c_w h_o T_o}{\delta t} = -\nabla[q_o\rho_w c_w T_o - (k_b + D_o\rho_w c_w d_o)\nabla T_o] \pm Q_{T_o} - d_o\Omega_o + E_{atm}$$

where h is the elevation of the surface water, d is the depth of flow, and the subscript o denotes overland flow. The inclusion of atmospheric thermal inputs (E_{atm}) is necessary to properly simulate the surface and subsurface thermal regimes. Currently the atmospheric inputs from CLASS (Verseghy, 1991) are used to determine the surface heat fluxes in HydroGeoSphere. The atmospheric input included in HydroGeoSphere has four components, shortwave radiation (K*), longwave radiation (L*), sensible heat flux (QH) and latent heat flux (QE). The sum of these components represents the atmospheric input to the surface thermal energy system.

$$\mathrm{E_{atm}} = \mathrm{K}_* + \mathrm{L}_* + \mathrm{Q_H} + \mathrm{Q_E}$$

The coupling of the surface and subsurface thermal continua is similar to that used for advective-dispersive contaminant transport in HydroGeoSphere. There are two methods of coupling the surface and subsurface continua, the common node and the dual node approach. The common node approach is based on superposition where continuity of thermal energy is assumed between the two domains concerned, which correspond to instantaneous equilibrium between the two domains. The dual node approach does not assume continuity of thermal energy between two domains but uses a first-order flux relation to transfer heat from one domain to the other. The equation for the dual-node coupling of the surface and subsurface thermal equations is given by:

$$\Omega_o = \rho_w c_w T_{ups} \Gamma_o + \alpha_o \rho_w c_w (T - T_o)$$

Where Γo represents the aqueous exchange flux between the surface and subsurface (the amount of water flowing between the two regimes), and α is an energy transfer coefficient.

3. Numerical Methods

Control Volume Finite Element Method

The control volume finite element (CVFE) method is based on the concept of combining the finite element and finite difference methods. Specifically, the CVFE method takes advantage of the finite element method, which is computationally efficient and geometrically flexible, and the cell-centered finite difference method, which has continuous interfacial fluxes across the element interfaces and thus, the fluid mass in each single local element is conserved. For the discretization of the variably-saturated flow equation, the finite element method uses a weighted residual method combined with a trial solution ($\hat{h}$ and $\hat{S}_w$) to solve for unknown nodal values of head and saturation within a domain V. The final form of discretized equation for surface and subsurface flow is as follows:

$$\frac{a_{oi}}{\Delta t}\left(h_{oi}^{t+\Delta t} - h_{oi}^{t}\right) = \sum_{oj \in \eta_{oi}} (\lambda)_{oioj+1/2}^{t+\Delta t} \; \gamma_{oioj} \; \left(h_{oj}^{t+\Delta t} - h_{oi}^{t+\Delta t}\right) \pm Q_{oi}^{t+\Delta t} + \Gamma_{oi}^{t+\Delta t}$$

$$\frac{v_i (S_w)_i^{t+\Delta t} S_s}{\Delta t}\left(h_i^{t+\Delta t} - h_i^{t}\right) + \frac{v_i \theta_s}{\Delta t}\left((S_w)_i^{t+\Delta t} - (S_w)_i^{t}\right) = \sum_{j \in \eta_i} \lambda_{ij+1/2}^{t+\Delta t} \; \gamma_{ij} \; \left(h_j^{t+\Delta t} - h_i^{t+\Delta t}\right) \pm Q_i^{t+\Delta t} + \Gamma_i^{t+\Delta t}$$

where the control area and control volume associated with surface node *oi* and subsurface node *i* is defined as

$$a_{oi} = \int N_{oi} dA \text{ and } v_i = \int N_i dv$$

and $(\lambda)_{oioj+1/2}^{t+\Delta t} \; \gamma_{oioj} \; \left(h_{oj}^{t+\Delta t} - h_{oi}^{t+\Delta t}\right)$ and $(\lambda)_{ij+1/2}^{L+1} \gamma_{ij} (h_j^{L+1} - h_i^{L+1})$ represent the surface and subsurface flux from node *oj* to *oi* and from *j* to *i*, respectively. The fluid exchange terms $\Gamma_{oi}^{t+\Delta t}$ and $-\Gamma_i^{t+\Delta t}$ are given as

$$a_{oi}(k_r)_{exch}K_{exch,oi}(h_i^{t+\Delta t} - h_{oi}^{t+\Delta t})/l_{exch,oi}$$

where the dual nodes *oi* and *i* represent surface and subsurface nodes, respectively.

The discretized equation presented above is independent of the choice of element type. Of the numerous types of three-dimensional elements that can be used to discretize the porous blocks, both 8-node rectangular block elements (Huyakorn et al., 1986) and 6-node prism elements are implemented here. The user also has the option of subdividing rectangular block or prism elements into 4-node tetrahedral elements, which permits the discretization of highly irregular domains. The two-dimensional fracture planes and the surface flow are discretized using either rectangular or triangular elements (Huyakorn et al., 1984). This choice of simple elements allows use of the influence coefficient technique (Huyakorn et al., 1984) to analytically evaluate the integrals appearing in finite element discretization in an efficient manner.

Newton-Raphson Successive Linearization

One of the challenges of simulating integrated surface-subsurface flow is to solve the nonlinear discrete equations. Specifically, the discrete mass balance equations for surface-subsurface flow become nonlinear because the terms $(S_w)_i^{t+\Delta t}$ and $\lambda_{ij+\frac{1}{2}}^{t+\Delta t}\gamma_{ij}$ for subsurface flow and h_o and $(\lambda_o)_{ij+\frac{1}{2}}^{t+\Delta t}\gamma_{oij}$ for surface flow are nonlinear functions of the dependent variables h and h_o, respectively. To linearize the discrete equations, the HGS model applies the Newton-Raphson (NR) iterative method. In the NR procedure for subsurface flow, the residual value at each NR iteration level *L* can be defined as:

$$\begin{aligned} R_i^L(h_{i,j\in\eta_i}^{t+\Delta t,L}, h_{oi}^{t+\Delta t,L}) = {} & \frac{v_i(S_w)_i^{t+\Delta t,L}S_s}{\Delta t}\left(h_i^{t+\Delta t,L} - h_i^t\right) + \frac{v_i\theta_s}{\Delta t}\left((S_w)_i^{t+\Delta t,L} - (S_w)_i^t\right) \\ & - \sum_{j\in\eta_i}(\lambda_{ij+1/2}^{t+\Delta t}\ \gamma_{ij})^L\ \left(h_j^{t+\Delta t,L} - h_i^{t+\Delta t,L}\right) \mp Q_i - \Gamma_i^L(h_i^{t+\Delta t,L}, h_{oi}^{t+\Delta t,L}) \end{aligned}$$

where R_i^L represents the residual for node *i* at the iteration level *L*. To minimize the residual for a given $h_{i,j\in\eta_i}^{t+\Delta t}$, a Taylor expansion technique is used such that

$$\begin{aligned} & R_i^L(h_{i,j\in\eta_i}^{t+\Delta t,L} + \Delta h_{i,j\in\eta_i}^{t+\Delta t,L}, h_{oi}^{t+\Delta t,L} + \Delta h_{oi}^{t+\Delta t,L}) = \\ & R_i^L(h_{i,j\in\eta_i}^{t+\Delta t,L}, h_{oi}^{t+\Delta t,L}) + \frac{\partial R_i^L(h_{i,j\in\eta_i}^{t+\Delta t,L}, h_{oi}^{t+\Delta t,L})}{\partial h_{i,j\in\eta_i}^{t+\Delta t,L}}\Delta h_{i,j\in\eta_i}^{t+\Delta t,L} + \frac{\partial R_i^L(h_{i,j\in\eta_i}^{t+\Delta t,L}, h_{oi}^{t+\Delta t,L})}{\partial h_{oi}^{t+\Delta t,L}}\Delta h_{oi}^{t+\Delta t,L} = 0 \end{aligned}$$

HGS uses numerical differentiation to construct the Jacobian matrix [*Forsyth and Simpson, 1991*]. With a Jacobian matrix being defined as

$$J_{ij}^L = \partial R_i^L(h_{i,j\in\eta_i}^{t+\Delta t,L}) \big/ \partial h_{i,j\in\eta_i}^{t+\Delta t,L} \text{ and } J_{ioi}^L = \partial R_i^L(h_{i,j\in\eta_i}^{t+\Delta t,L}, h_{oi}^{t+\Delta t,L}) \big/ \partial h_{oi}^{t+\Delta t,L}$$

a set of linearized discrete equations can be obtained to update the dependent variables such that

$$J_{ij}^{L}\Delta h_{i,j\in\eta_i}^{t+\Delta t,L} + J_{ioi}^{L}\Delta h_{oi}^{t+\Delta t,L} = -R_i^L$$

$$\Delta h_{i,j\in\eta_i}^{t+\Delta t,L} = h_{i,j\in\eta_i}^{t+\Delta t,L+1} - h_{i,j\in\eta_i}^{t+\Delta t,L} \text{ and } \Delta h_{oi}^{t+\Delta t,L} = h_{oi}^{t+\Delta t,L+1} - h_{oi}^{t+\Delta t,L}$$

A similar procedure can be applied to linearize the surface flow equation, with the residual for a surface node *oi* given as

$$\begin{aligned} R_{oi}^{L}(h_{oi,oj\in\eta_{oi}}^{t+\Delta t,L}, h_i^{t+\Delta t,L}) &= \frac{a_{oi}}{\Delta t}\left(h_{oi}^{t+\Delta t,L} - h_{oi}^{t}\right) \\ &\quad - \sum_{oj\in\eta_{oi}} ((\lambda)_{oioj+1/2}^{t+\Delta t}\ \gamma_{oioj})^{L}\ \left(h_{oj}^{t+\Delta t,L} - h_{oi}^{t+\Delta t,L}\right) - \Gamma_{oi}{}^{L} - Q_{oi} \end{aligned}$$

Convergence is assumed to be achieved when either $\max_i \left|R_i^{L+1}\right|$ or $\max_i \left|\Delta h_i^{t+\Delta t,L}\right|$ becomes smaller than pre-specified convergence criteria.

Adaptive Time Stepping/Sub-Time Stepping

For transient integrated surface and subsurface simulations, *HGS* uses an adaptive time stepping strategy to optimize the computational cost for a given tolerance controlling the simulation accuracy. In this adaptive time stepping approach, the time step size is determined by the maximum nodal change in the hydraulic head, saturation, water depth, and/or concentration from the previous time step such that

$$\Delta t^{L+1} = \frac{\Delta h_{allowed}}{\max_j(\Delta h_j^L)} \cdot \Delta t^L$$

where Δt^L and Δt^{L+1} are the time step sizes used in the previous and current time marching levels, $\Delta t_{allowed}$ is a given tolerance in head (saturation, depth, concentration, or the number of NR iterations), and $\max_j(\Delta h_j^L)$ is the maximum nodal change in the previous time step with given Δt^L.

Sub-time stepping in HGS is a fully-implicit numerical strategy that applies different time step sizes to one or more sub-domains with each having different accuracy requirements. By applying smaller sub-time steps to the sub-domains with relatively rapid responses and utilizing larger time steps in the remainder of the domain, the accuracy requirement is satisfied in the entire domain with minimal temporal over-discretization. This approach is most suitable for problems where the system response is high in only a small portion of the computational domain such as in integrated surface and subsurface simulations. In an implicit sub-time stepping procedure, the global time step size (Δt^{L+1}), the number of sub-timed nodes (n_s), and the number of sub-time steps (M) can be determined from the previous time step results such that

$$z\ \Delta t^{L+1} = \frac{\Delta h_{allowed}^{\Delta t}}{\max\limits_{j}(\Delta h_j^L)} \cdot \Delta t^L$$

$$M = \min\left[M_{\max}, \frac{\max\limits_{j}(\Delta h_j^L)}{\Delta h_{allowed}^{\Delta t_s}} \right] \text{ and } \Delta h_{allowed}^{\Delta t_s} < M_{\max} \Delta h_{allowed}^{\Delta t_s}$$

where $\Delta h_{allowed}^{\Delta t}$ and $\Delta h_{allowed}^{\Delta t_s}$ are prescribed accuracy tolerance that are defined as the maximum allowed nodal change during a global time step Δt and sub-time step Δt_s, $M_{\max}$ is the maximum number of sub-time steps, and a node *j* is sub-timed when $\Delta h_j \geq \Delta h_{allowed}^{\Delta t_s}$. Sub-time stepping becomes most efficient when $n_s(M-1)$ is small compared to the number of nodes and thus a larger $M_{\max}$ does not necessarily guarantee higher efficiency.

Parallel High Performance Computing using OpenMP

The main numerical tasks for the integrated surface-subsurface flow and transport simulators can be divided into initialization, simulation time looping, and finalization. For initialization, it reads the discretization information and the initial and boundary conditions and initializes the simulation variables and time loops. During time looping, the model repeatedly solves water flow, solute and heat transport at each current time step based on the results from the previous time step until it reaches the final target time. Analysis of computational cost in integrated hydrologic simulations indicates that more than 90 % of the total computing time is consumed by the tasks that deal with a system of linear equations (matrix assembly and matrix solution) for most of the cases.

When the Jacobian matrix is assembled in parallel, communications among threads are not required and each thread can work independently. However, an appropriate scheduling is necessary because the parallel matrix assembly can cause data racing conditions. Specifically, the racing conditions in matrix assembly occur when values computed by threads are simultaneously updated to one matrix entry that is shared by two or more threads. Thus, a static scheduling that avoids the conditions is applied to HGS.

The matrix solver used in *HGS* (BiCGSTAB) consists of four operational components: forward and backward substitutions (or LUs), dot products (DPs), and matrix-vector (MVs) and scalar-vector (SVs) multiplications: LU solve takes more than 50 % of total solver computing time and thus the efficiency of parallel matrix solver is highly dependent on the efficiency of parallel LU solution and the other operations (DPs, MVs, and SVs) are straightforward to be parallelized due to the data independency. The parallelization of preconditioned BiCGSTAB uses two schemes: a multiblocking scheme with coordinate nested dissection and a privatization scheme. For the multiblocking scheme, nodes consisting of a simulation domain are reordered for dissecting a simulation domain with the number of CPUs applied. In the multiblocking method, each of the computing processors can perform computational tasks for each of the smaller sub-domains. The privatization scheme was implemented for reducing competitions among CPUs when CPUs access to shared memory locations. The process of privatization scheme is to chop the matrix and arrays used in the matrix solving to fit with the computing for each CPU and to designate all the variables as private in the parallel loop.

APPENDIX B

Exchange Flux Graphs for Case 1 with 1.5ft and 3ft Flood Events

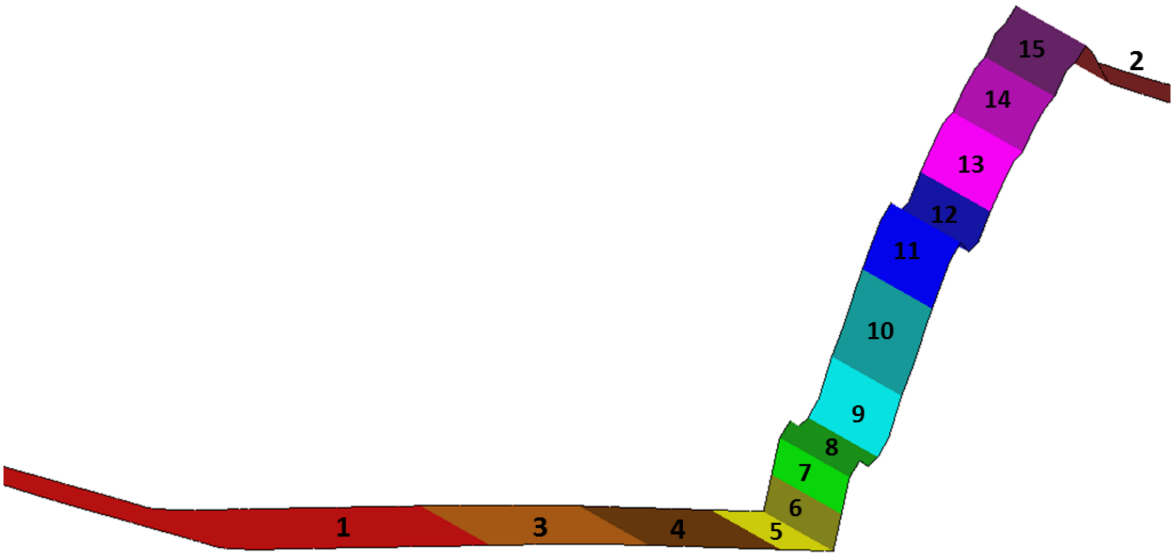

Figure B1. Zones for for tracking exchange flux between surface and subsurface domains during the flood wave simulations along the right bank of the channel.

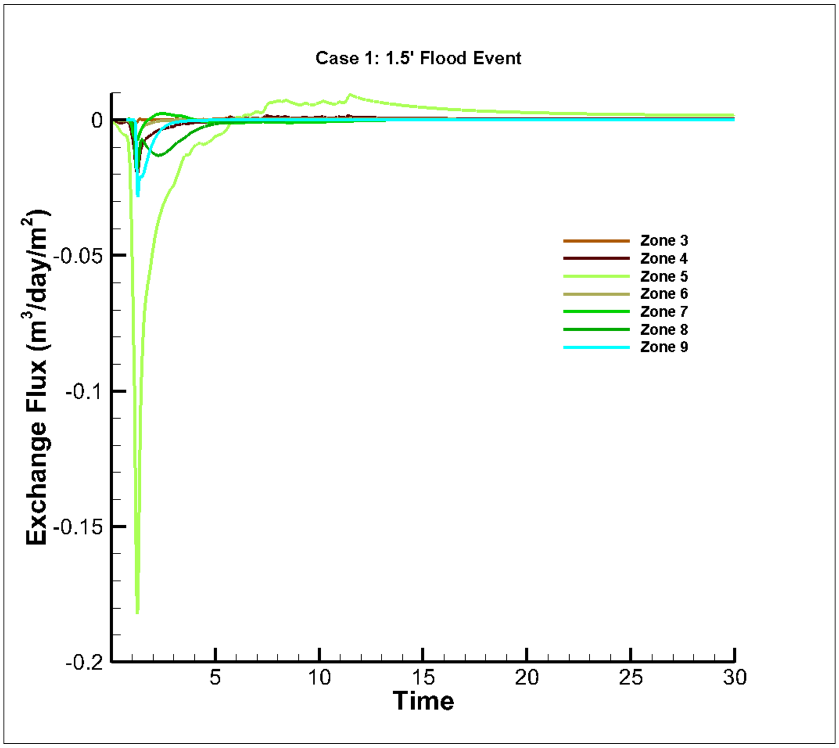

Figure B2. Total exchange flux between the surface and subsurface domain for Case 1 with a 1.5’ flood hydrograph. Negative values indicate infiltration, and positive values indicate exfiltration.

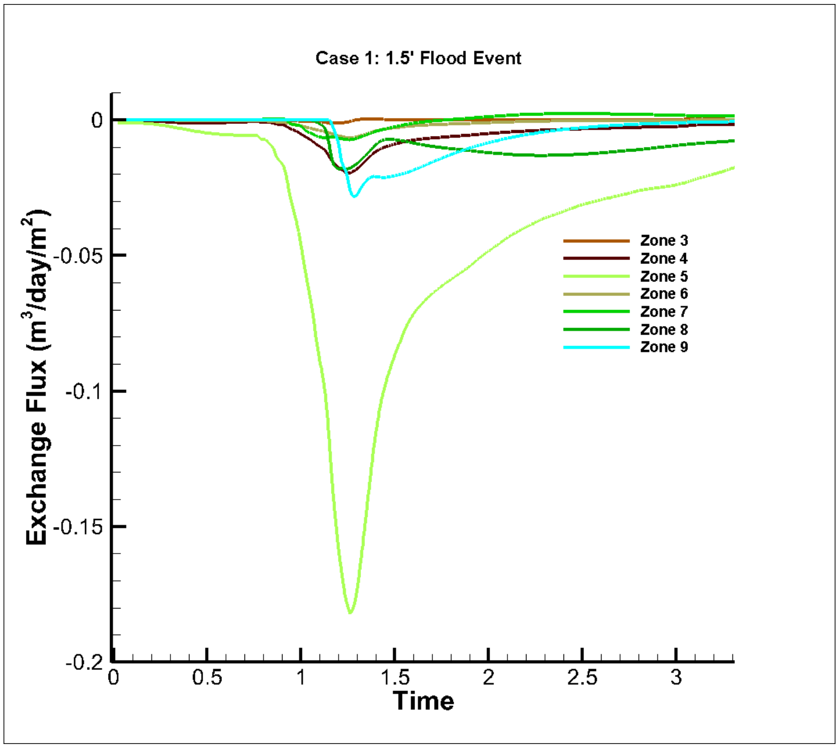

Figure B3. Total exchange flux between the surface and subsurface domain for Case 1 with a 1.5`event up to t = 3.5 days.

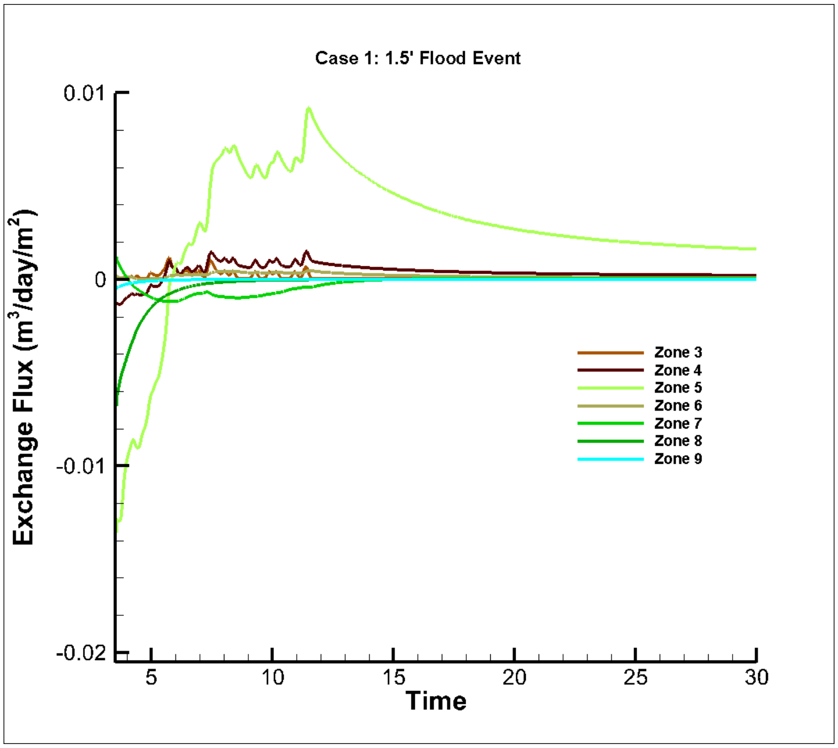

Figure B4. Total exchange flux between the surface and subsurface domain for Case 1 with a 1.5` event up from t = 3.5 days to t = 30 days.

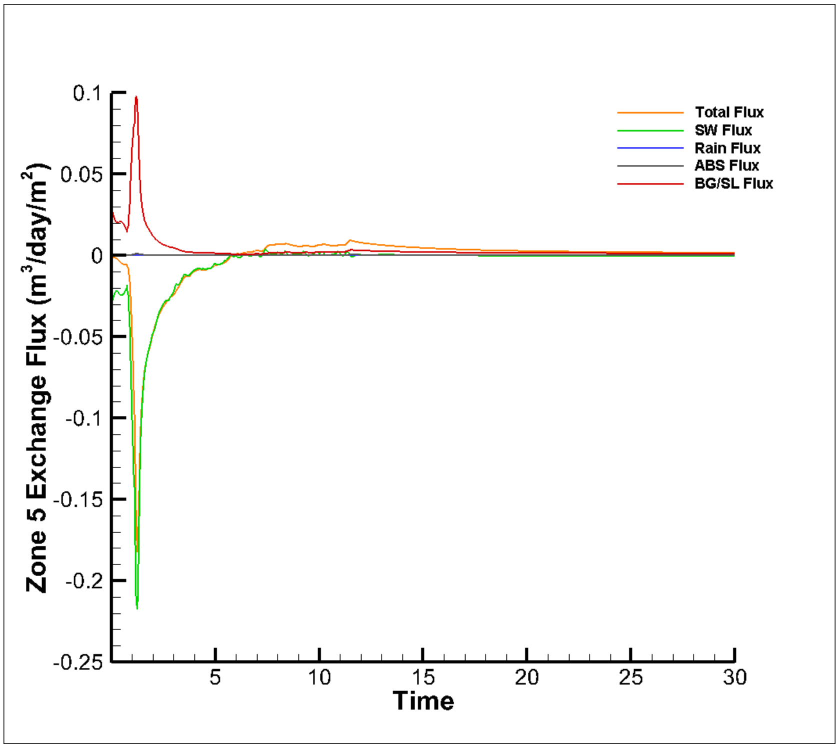

Figure B5. Exchange flux by species through Zone 5 for Case 1 with a 1.5’ flood hydrograph.

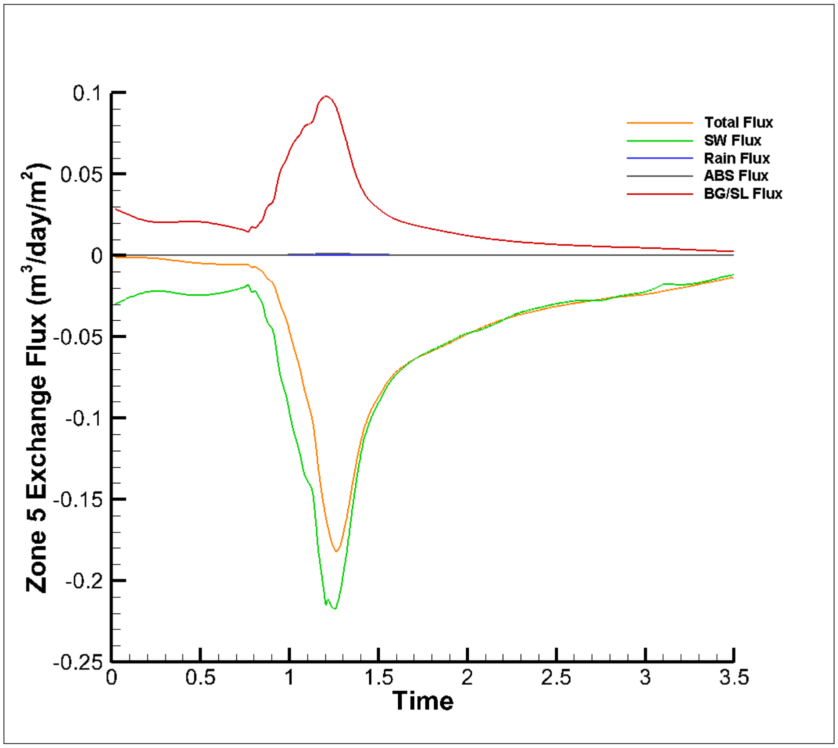

Figure B6. Zone 5 exchange flux for Case 1 with a 1.5` hydrograph from t = 0 to t = 3.5 days.

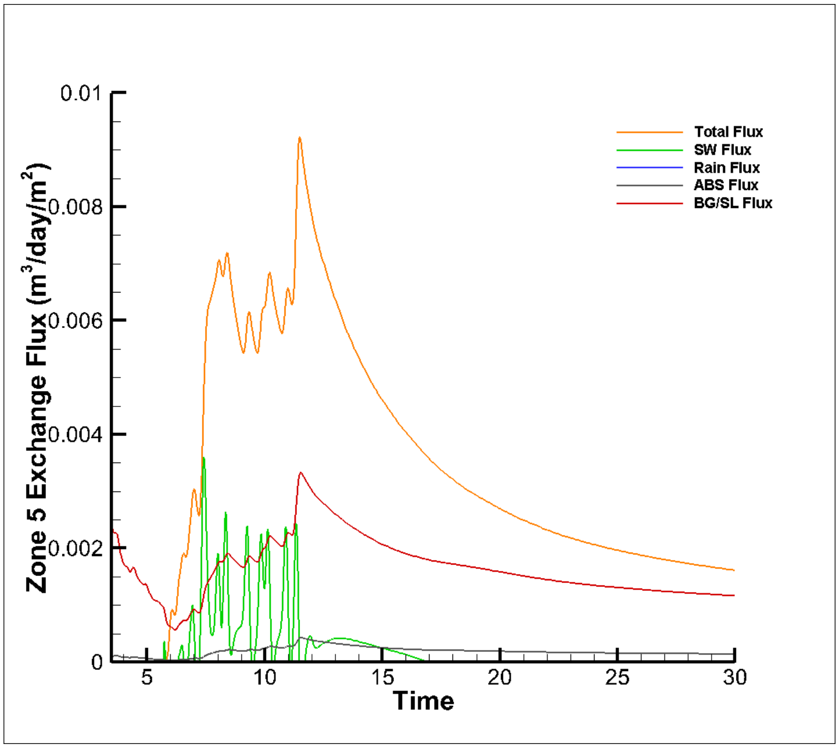

Figure B7. Zone 5 exchange flux for Case 1 with a 1.5`hydrograph from t = 3.5 to t = 30 days.

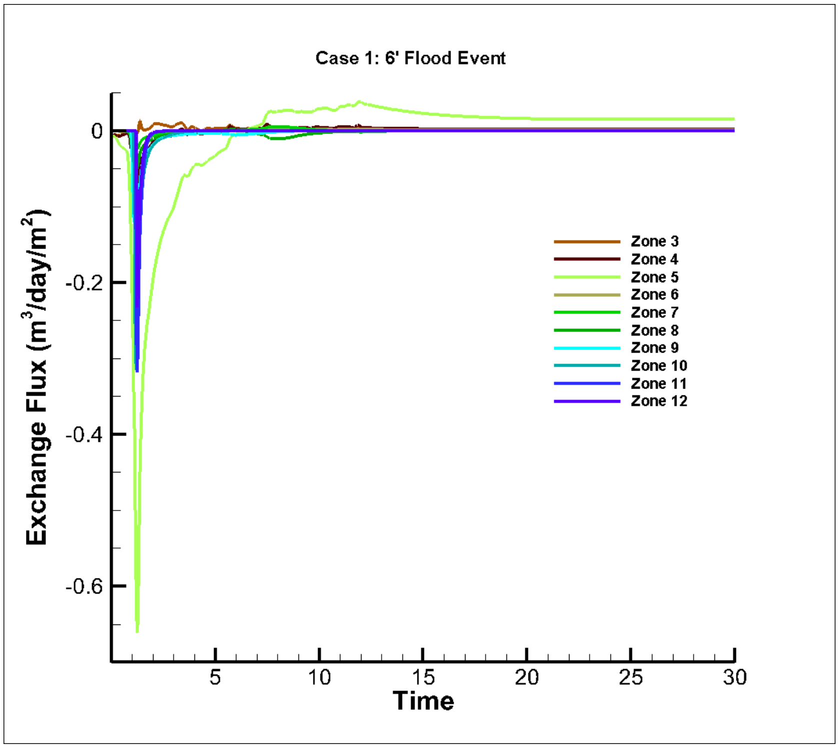

Figure B8. Total exchange flux between the surface and subsurface domain for Case 1 with a 6' flood hydrograph. Negative values indicate infiltration, and positive values indicate exfiltration.

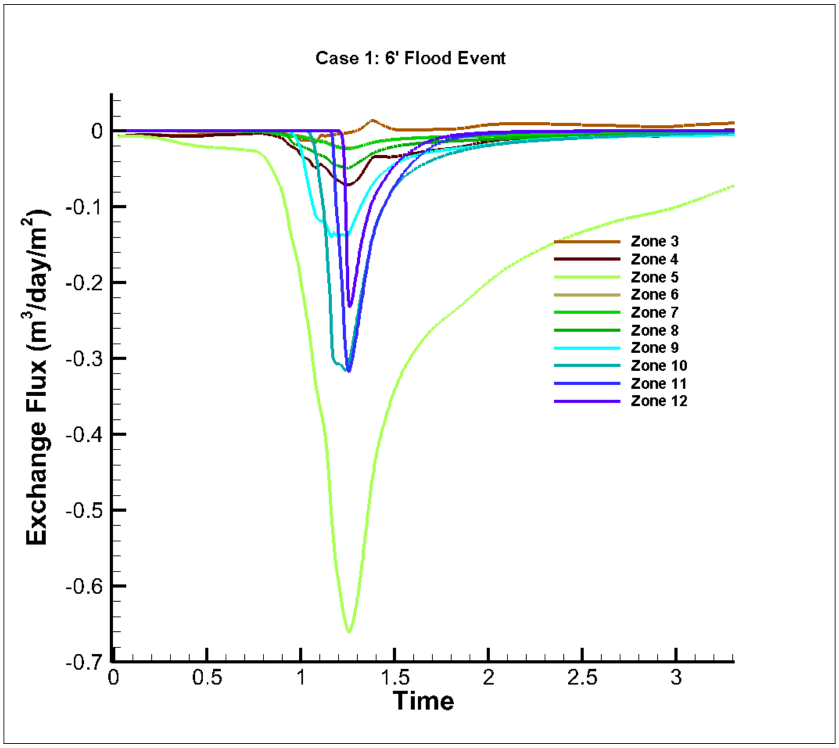

Figure B9. Total exchange flux between the surface and subsurface domain for Case 1 with a 6` event up to t = 3.5 days.

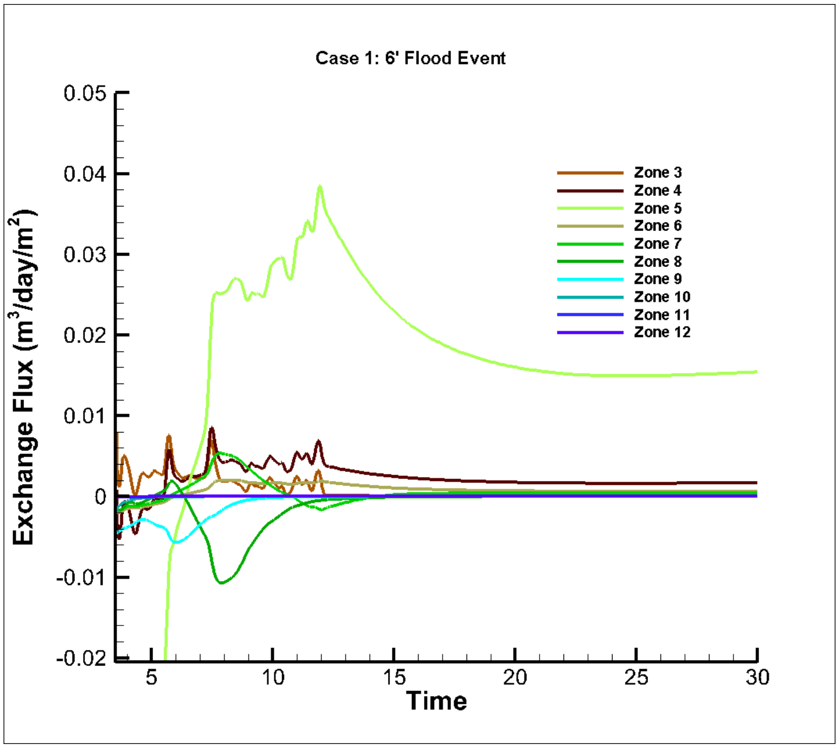

Figure B10. Total exchange flux between the surface and subsurface domain for Case 1 with a 6` event up from t = 3.5 days to t = 30 days.

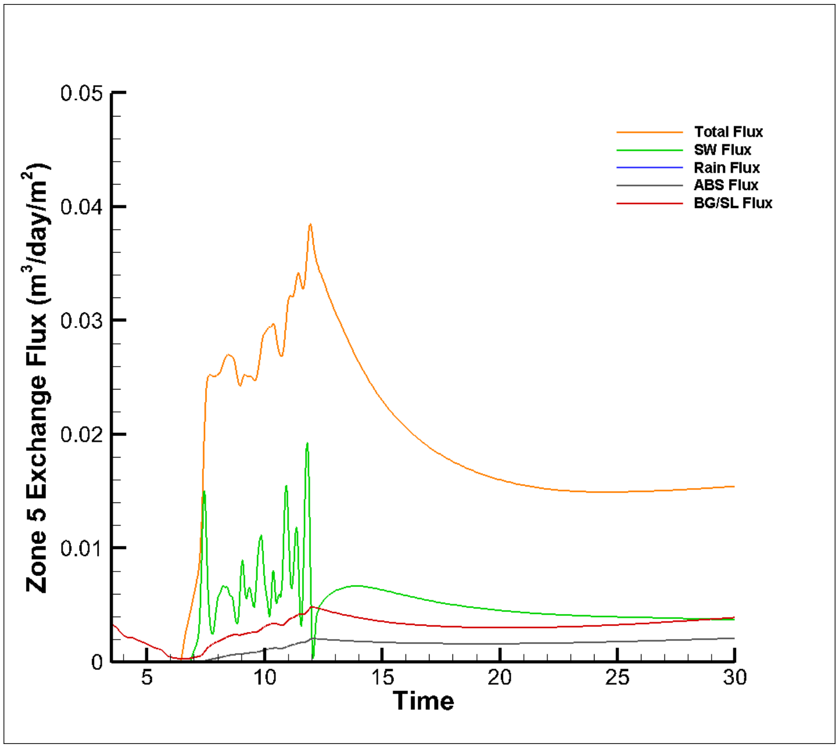

Figure B11. Exchange flux by species through Zone 5 for Case 1 with a 6' flood hydrograph.

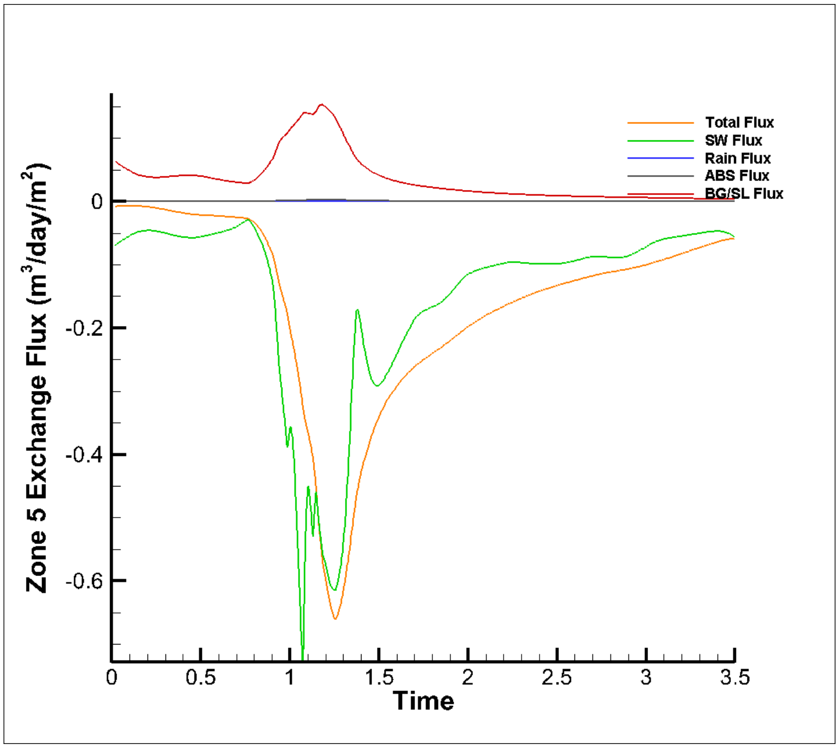

Figure B12. Zone 5 exchange flux for Case 1 with a 6` hydrograph from t = 0 to t = 3.5 days.

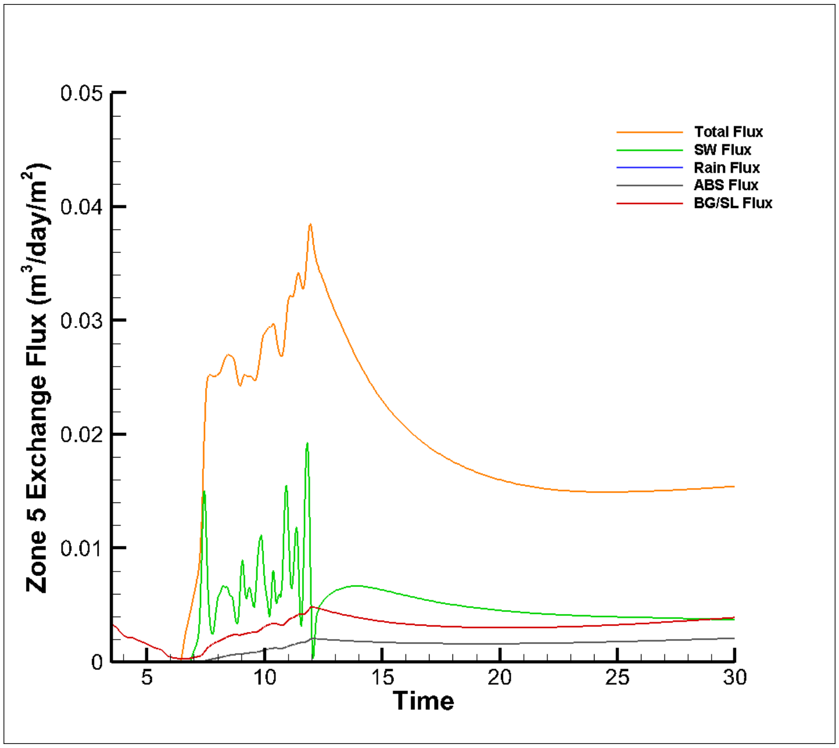

Figure B13. Zone 5 exchange flux for Case 1 with a 6` hydrograph from t = 3.5 to t = 30 days.

APPENDIX C

Exchange Flux Graphs for Cases 4 and 7

1.5ft, 3ft, and 6 ft Flood Events

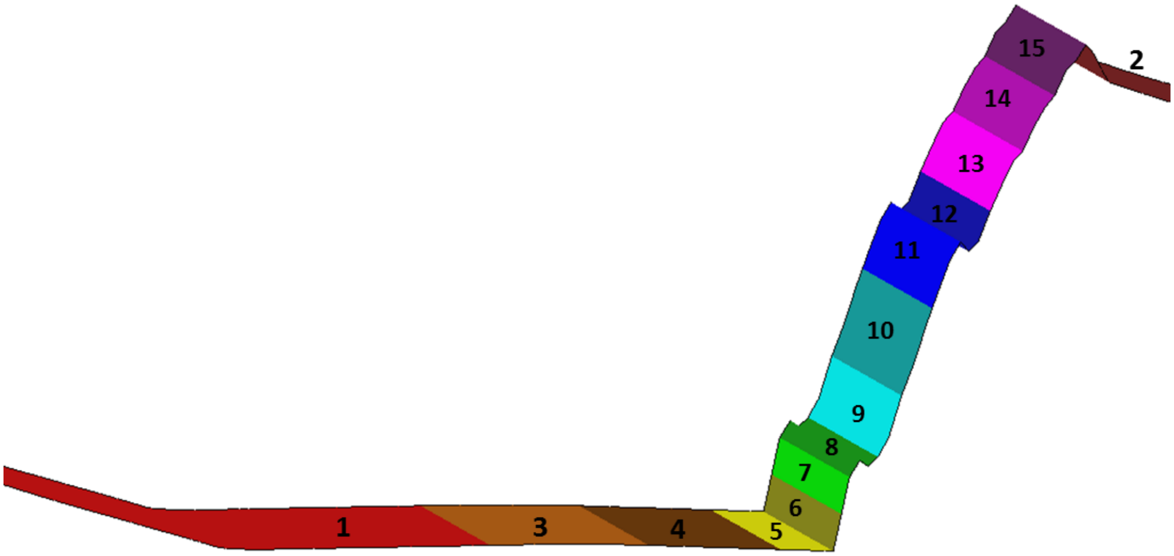

Figure C1. Zones for for tracking exchange flux between surface and subsurface domains during the flood wave simulations along the right bank of the channel.

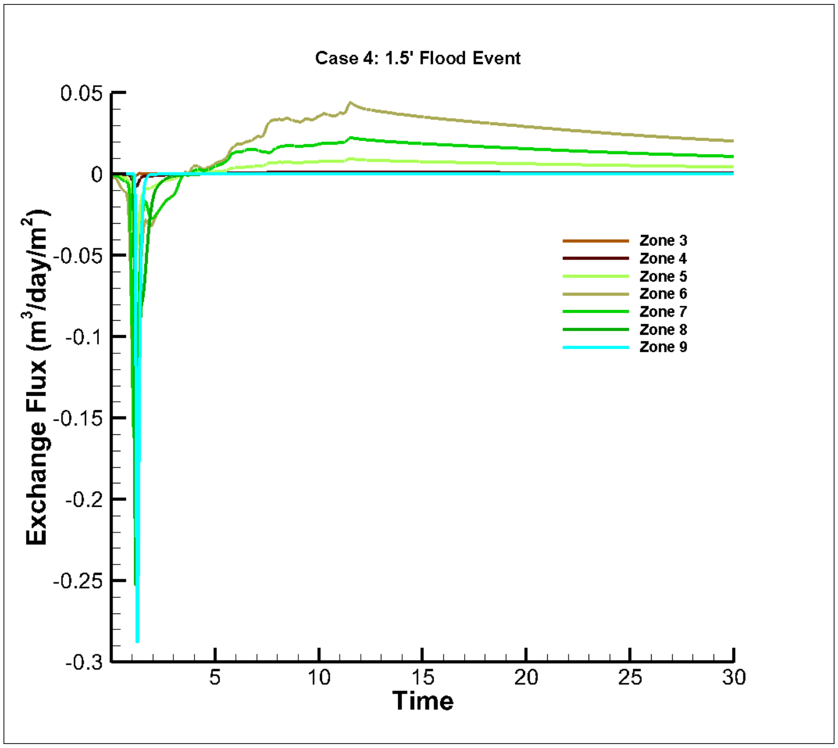

Figure C2. Total exchange flux between the surface and subsurface domain for Case 4 with a 1.5' flood hydrograph. Negative values indicate infiltration, and positive values indicate exfiltration.

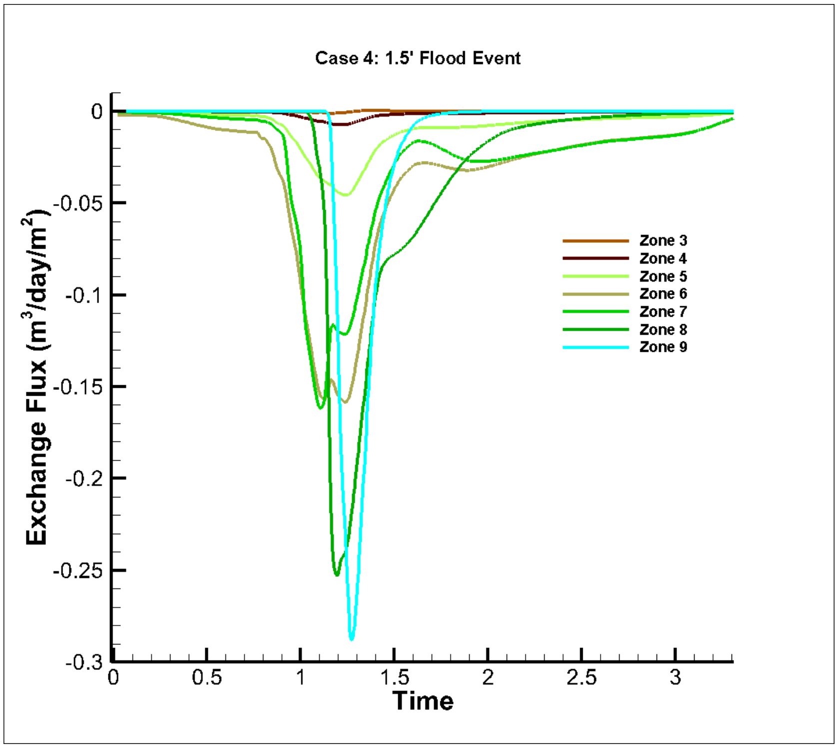

Figure C3. Total exchange flux between the surface and subsurface domain for Case 4 with a 1.5`event up to t = 3.5 days.

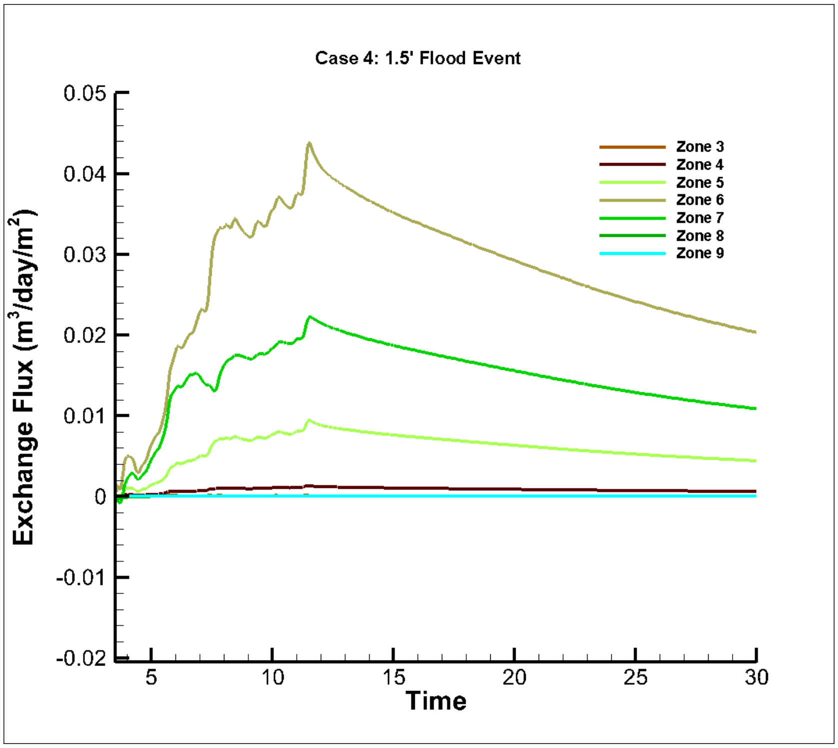

Figure C4. Total exchange flux between the surface and subsurface domain for Case 4 with a 1.5` event up from t = 3.5 days to t = 30 days.

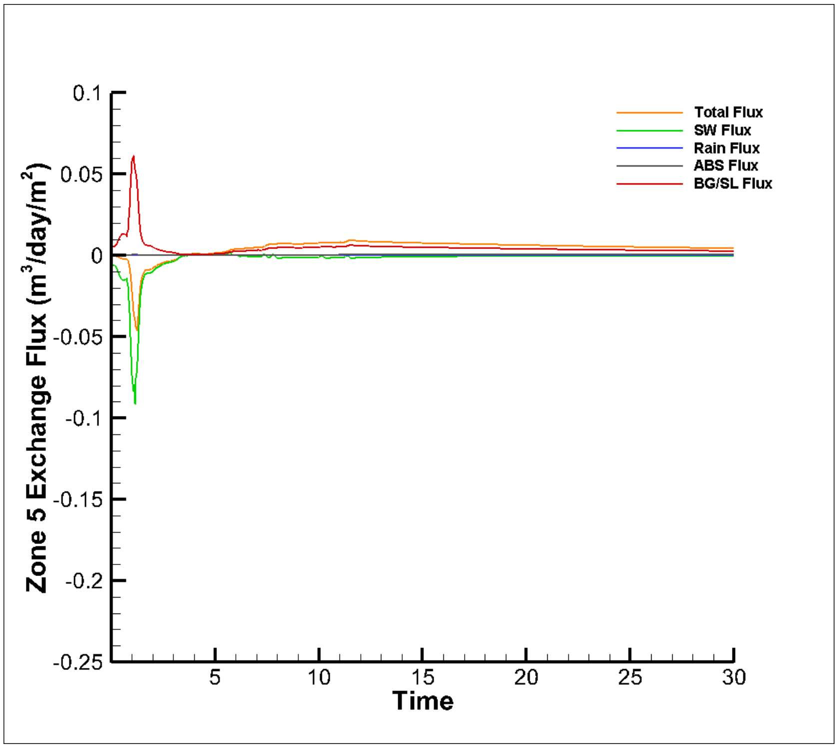

Figure C5. Exchange flux by species through Zone 5 for Case 4 with a 1.5’ flood hydrograph.

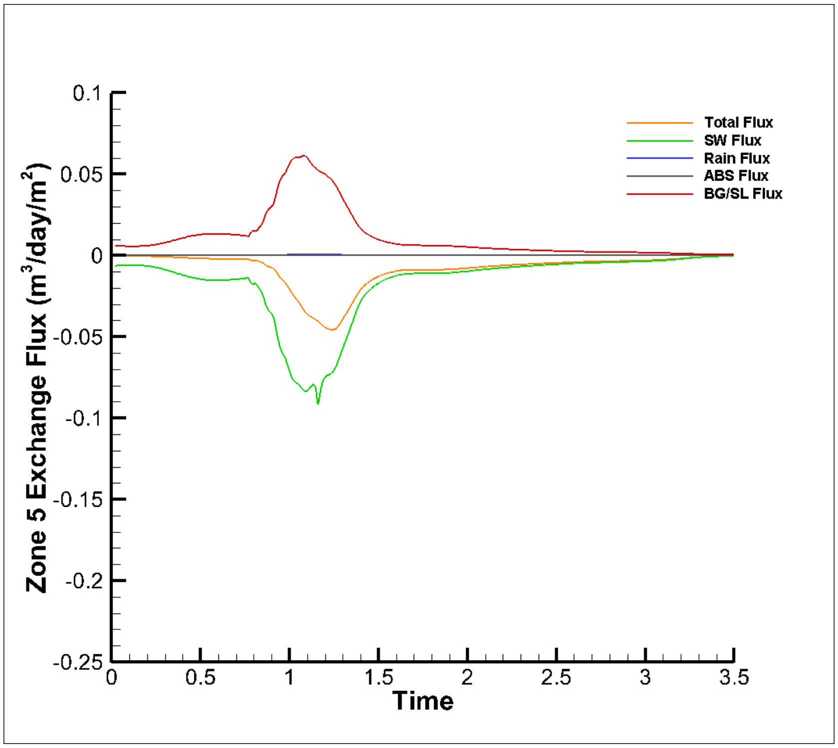

Figure C6. Zone 5 exchange flux for Case 4 with a 1.5` hydrograph from t = 0 to t = 3.5 days.

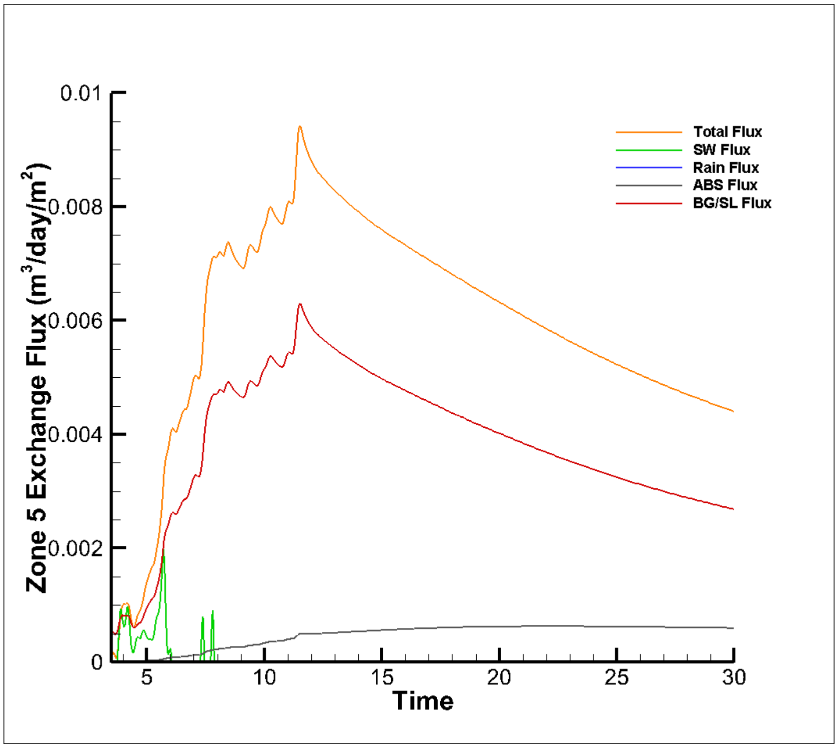

Figure C7. Zone 5 exchange flux for Case 4 with a 1.5`hydrograph from t = 3.5 to t = 30 days.

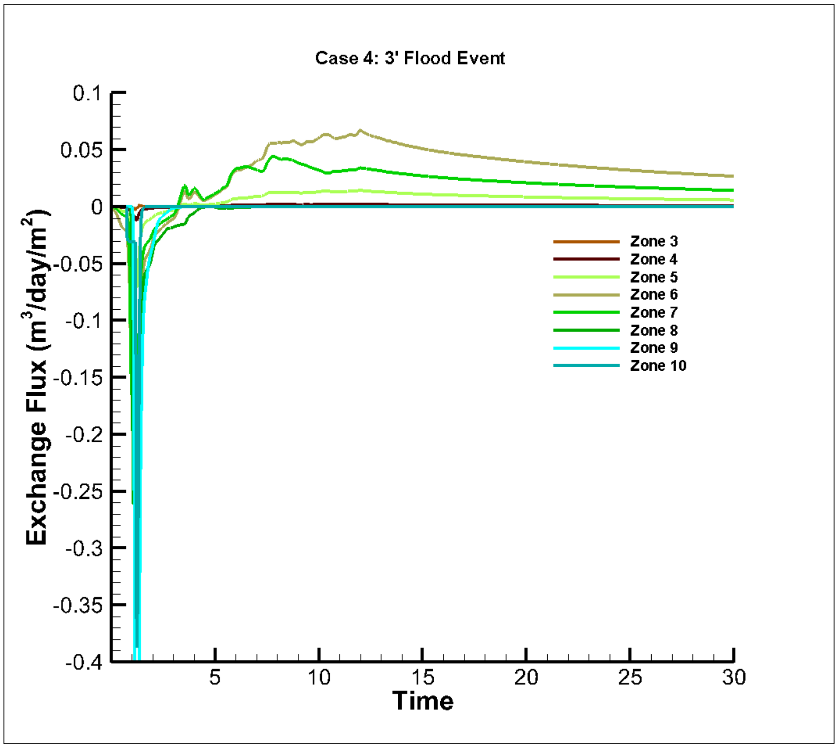

Figure C8. Total exchange flux between the surface and subsurface domain for Case 4 with a 3' flood hydrograph. Negative values indicate infiltration, and positive values indicate exfiltration.

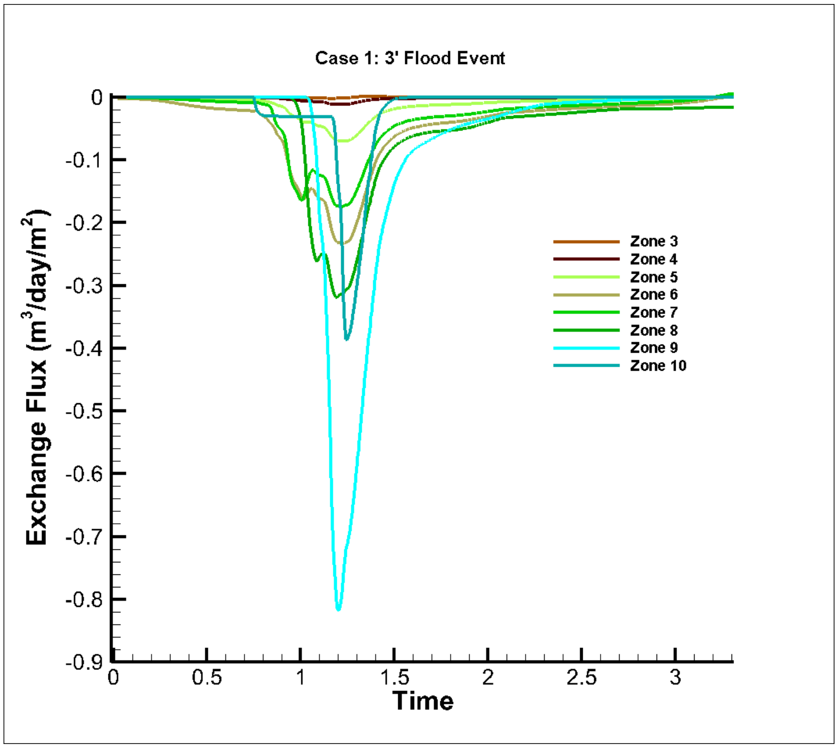

Figure C9. Total exchange flux between the surface and subsurface domain for Case 4 with a 3`event up to t = 3.5 days.

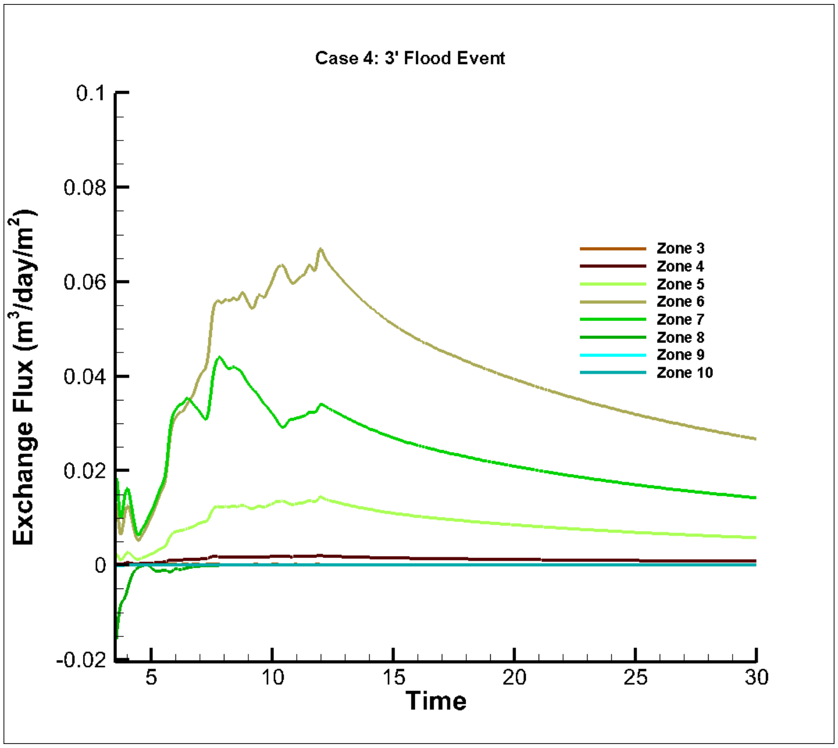

Figure C10. Total exchange flux between the surface and subsurface domain for Case 4 with a 3` event up from t = 3.5 days to t = 30 days.

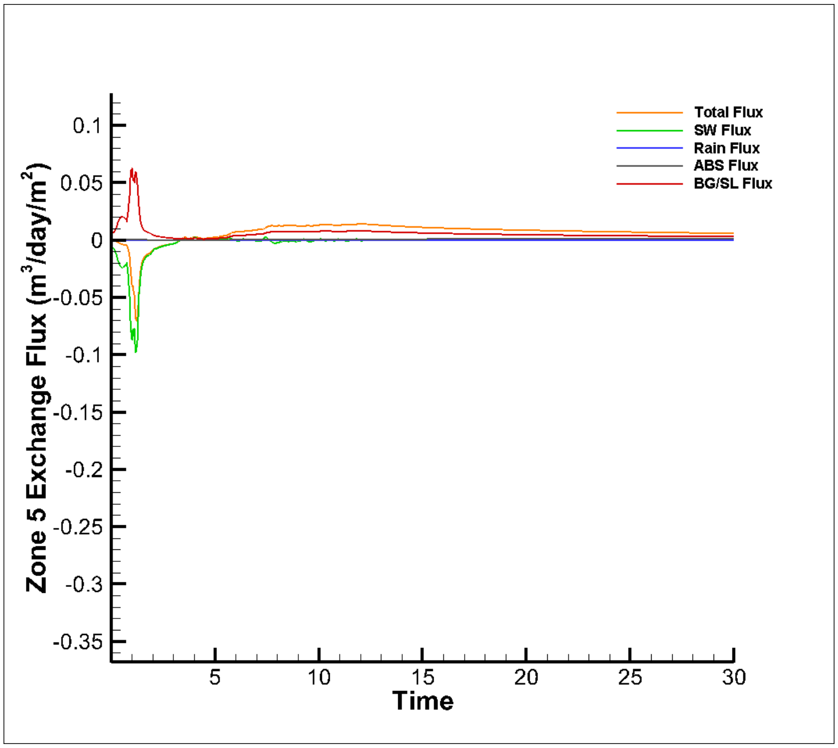

Figure C11. Exchange flux by species through Zone 5 for Case 4 with a 3' flood hydrograph.

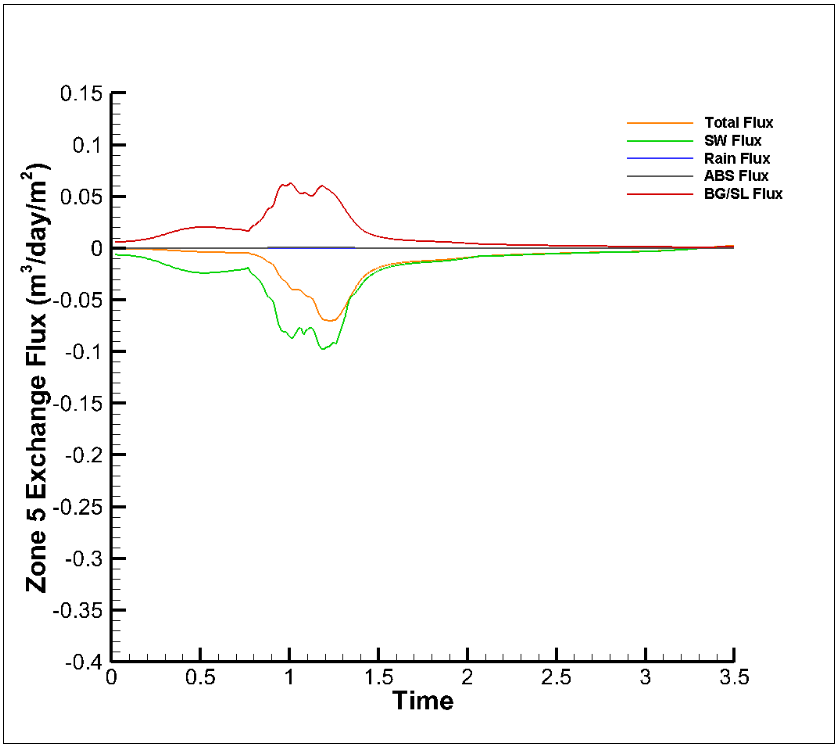

Figure C12. Zone 5 exchange flux for Case 4 with a 3` hydrograph from t = 0 to t = 3.5 days.

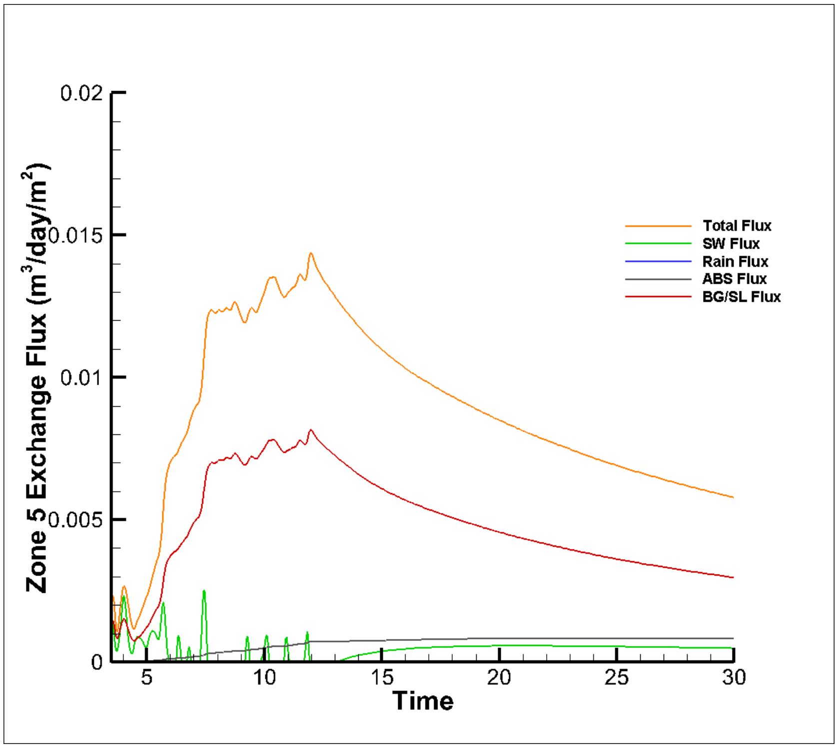

Figure C13. Zone 5 exchange flux for Case 4 with a 3`hydrograph from t = 3.5 to t = 30 days.

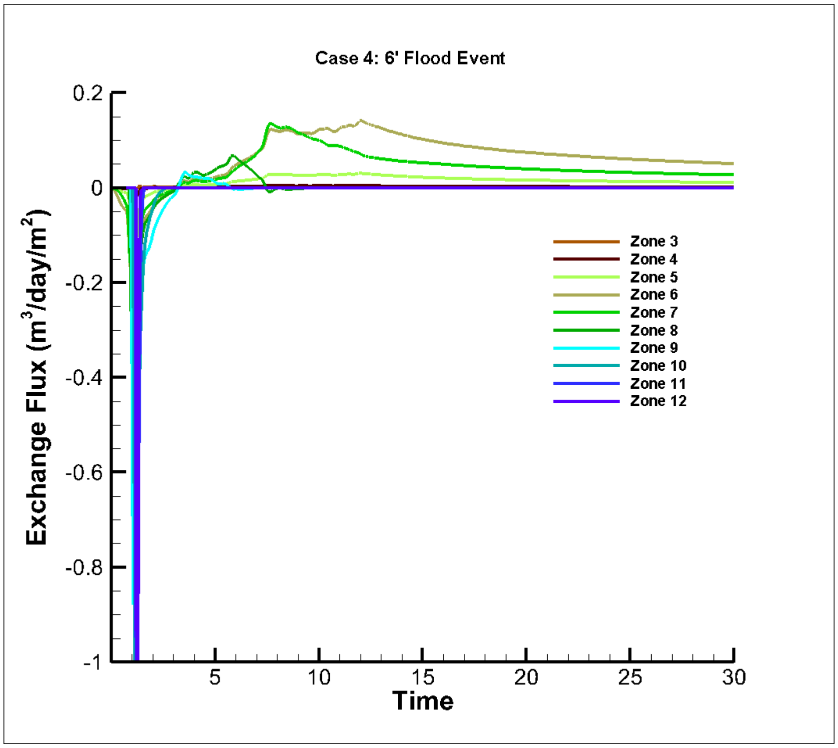

Figure C14. Total exchange flux between the surface and subsurface domain for Case 4 with a 6' flood hydrograph. Negative values indicate infiltration, and positive values indicate exfiltration.

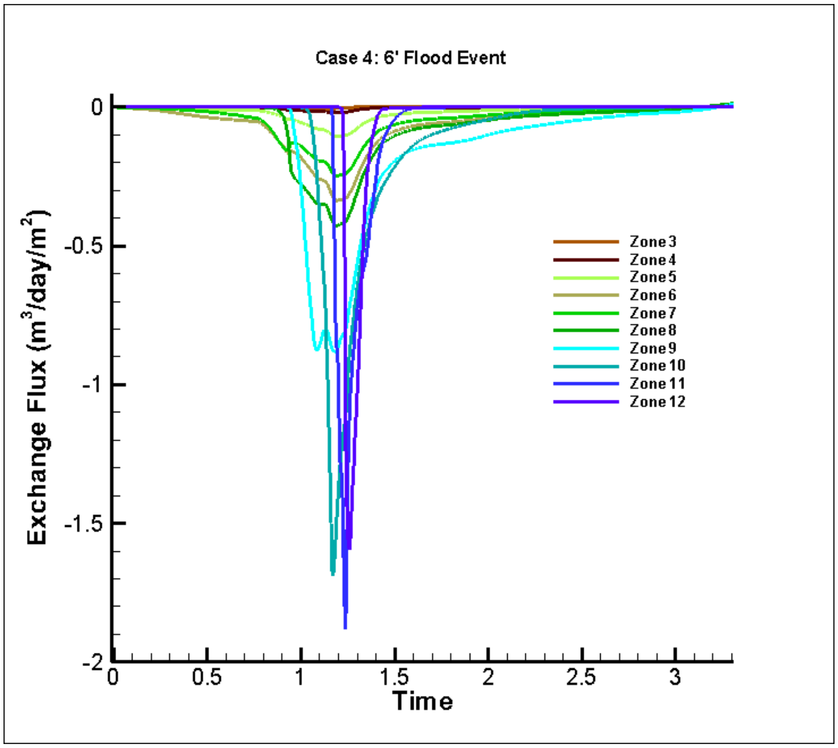

Figure C15. Total exchange flux between the surface and subsurface domain for Case 4 with a 6`event up to t = 3.5 days.

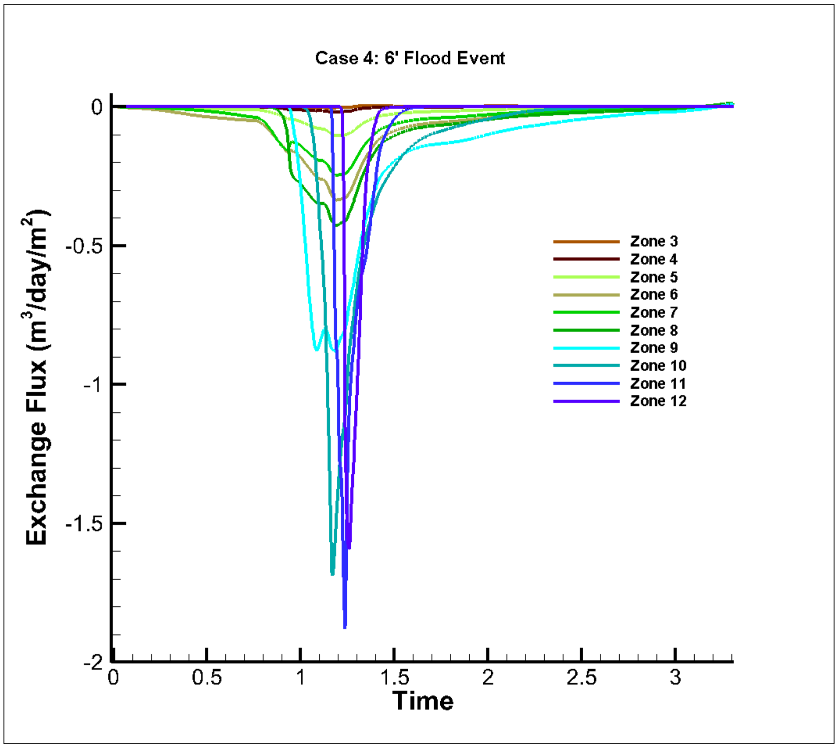

Figure C16. Total exchange flux between the surface and subsurface domain for Case 4 with a 6` event up from t = 3.5 days to t = 30 days.

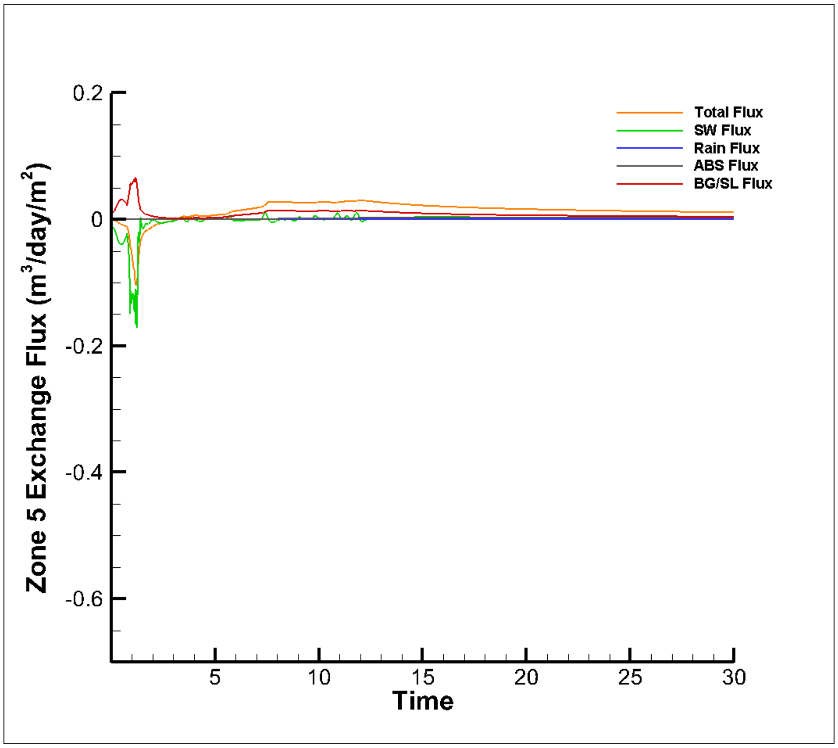

Figure C17. Exchange flux by species through Zone 5 for Case 4 with a 6' flood hydrograph.

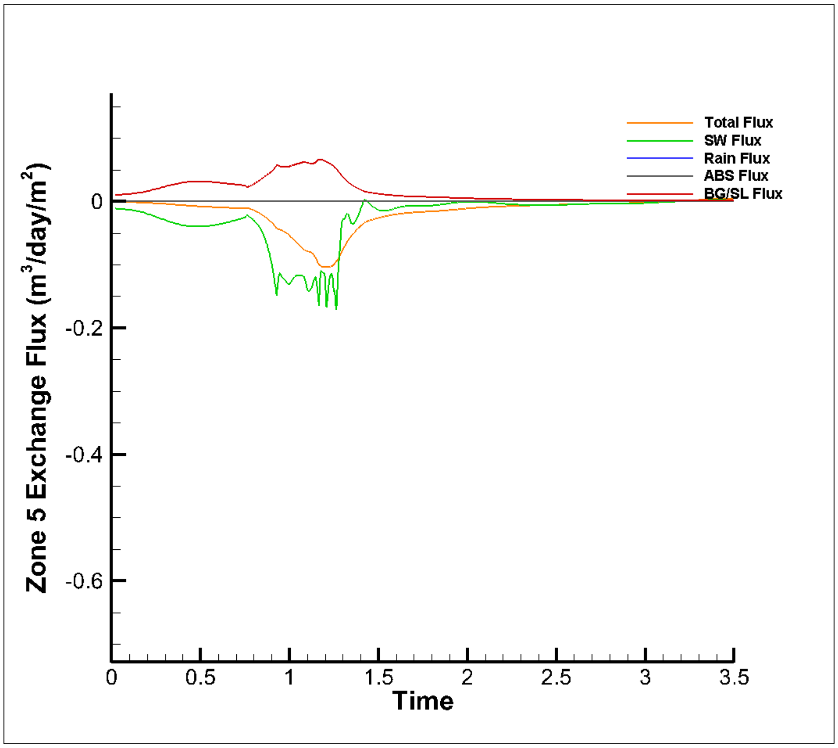

Figure C18. Zone 5 exchange flux for Case 4 with a 6` hydrograph from t = 0 to t = 3.5 days.

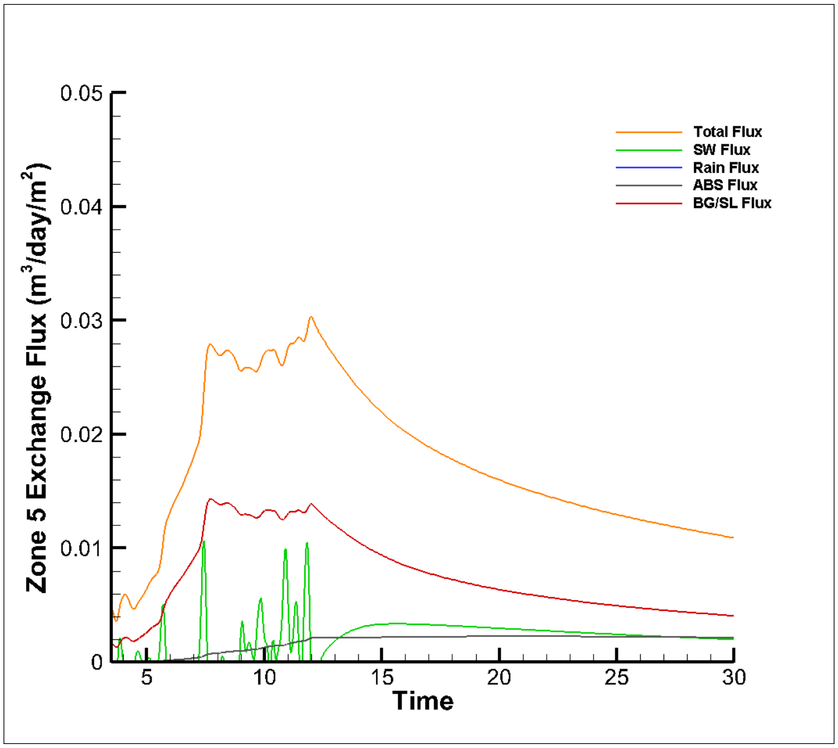

Figure C19. Zone 5 exchange flux for Case 4 with a 6`hydrograph from t = 3.5 to t = 30 days.

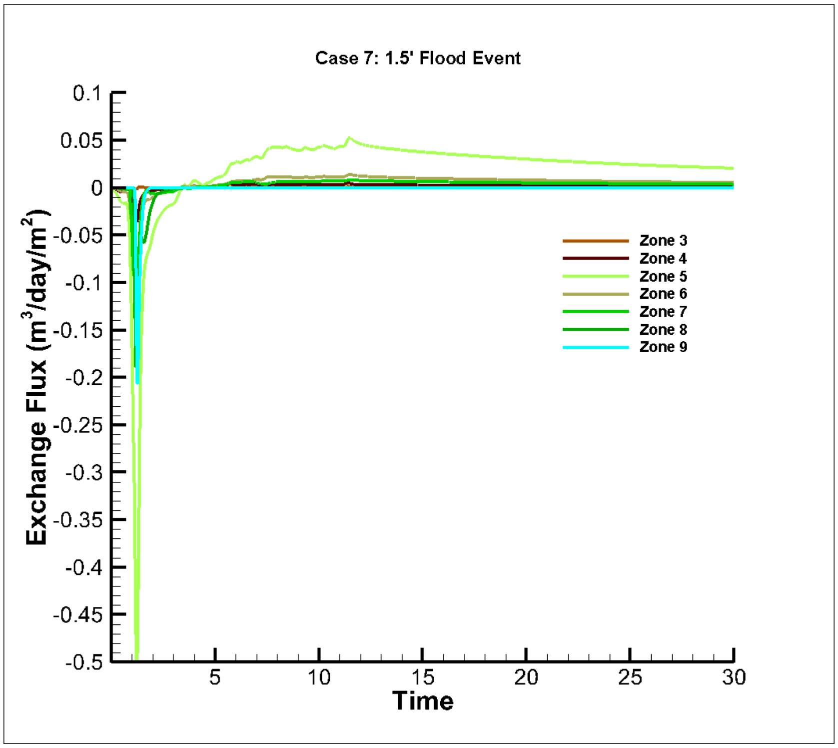

Figure C20. Total exchange flux between the surface and subsurface domain for Case 7 with a 1.5' flood hydrograph. Negative values indicate infiltration, and positive values indicate exfiltration.

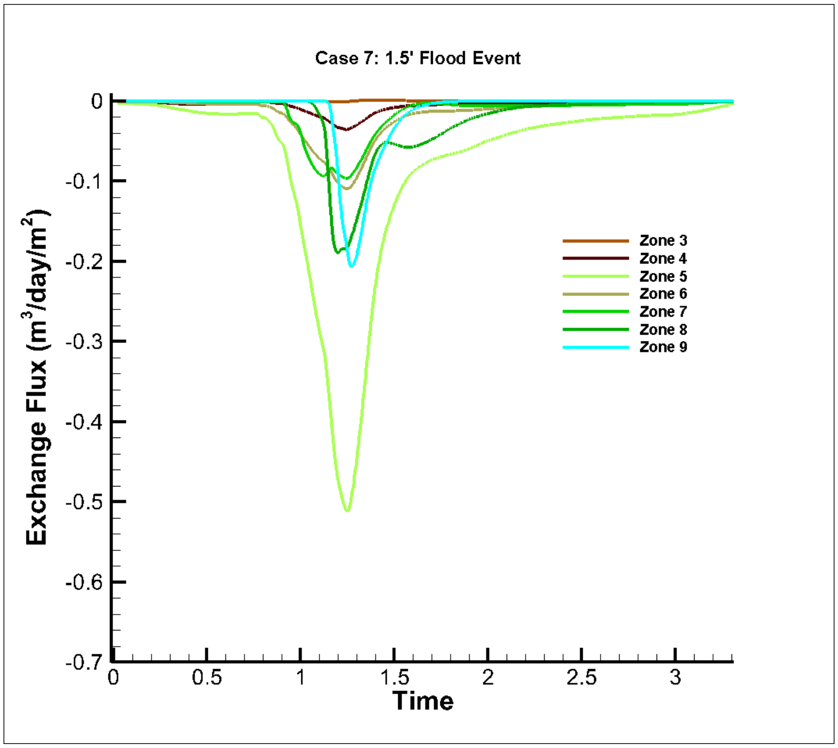

Figure C21. Total exchange flux between the surface and subsurface domain for Case 7 with a 1.5`event up to t = 3.5 days.

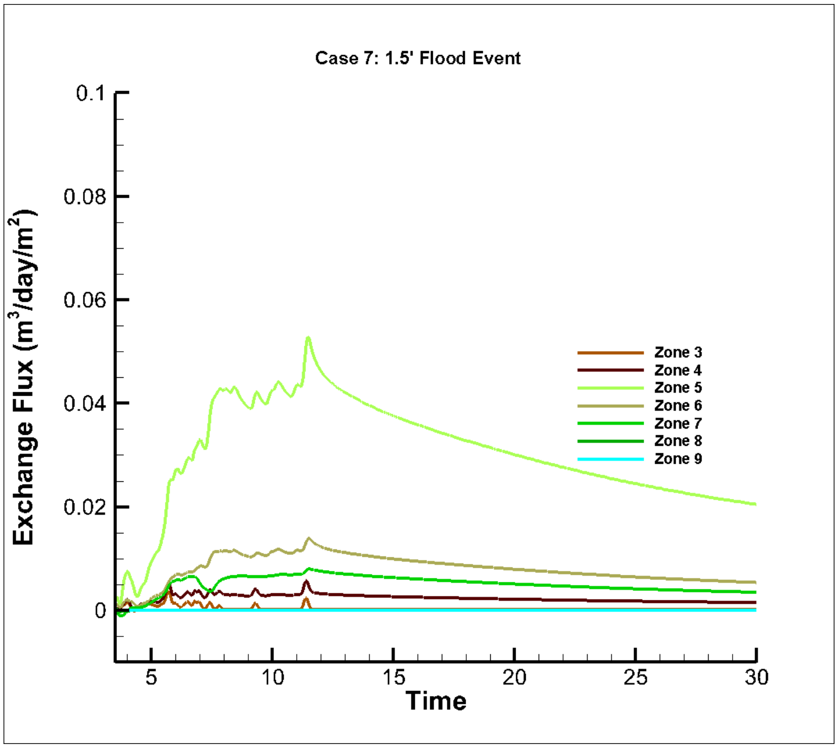

Figure C22. Total exchange flux between the surface and subsurface domain for Case 7 with a 1.5` event up from t = 3.5 days to t = 30 days.

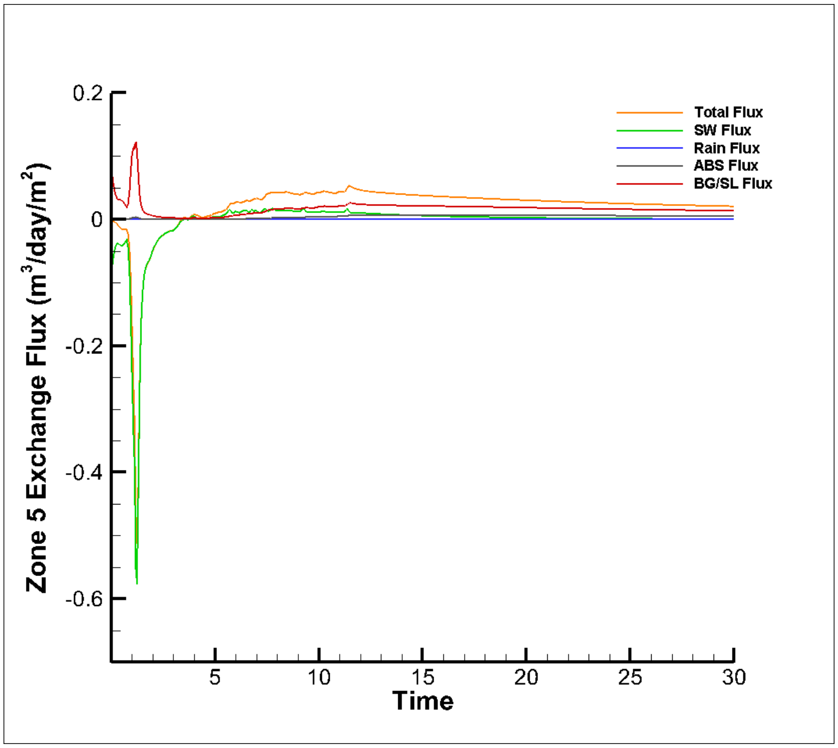

Figure C23. Exchange flux by species through Zone 5 for Case 7 with a 1.5' flood hydrograph.

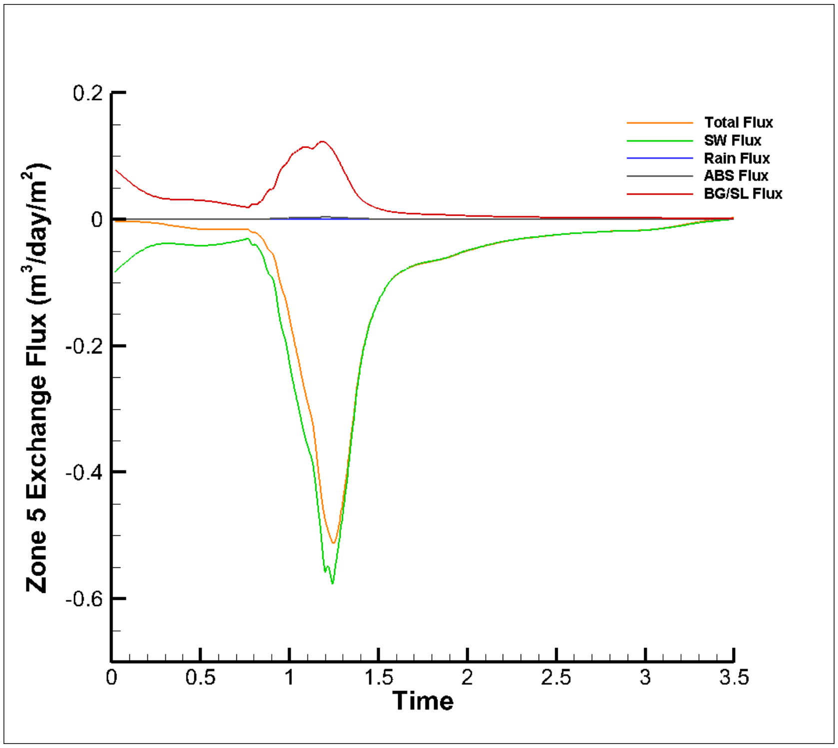

Figure C24. Zone 5 exchange flux for Case 7 with a 1.5` hydrograph from t = 0 to t = 3.5 days.

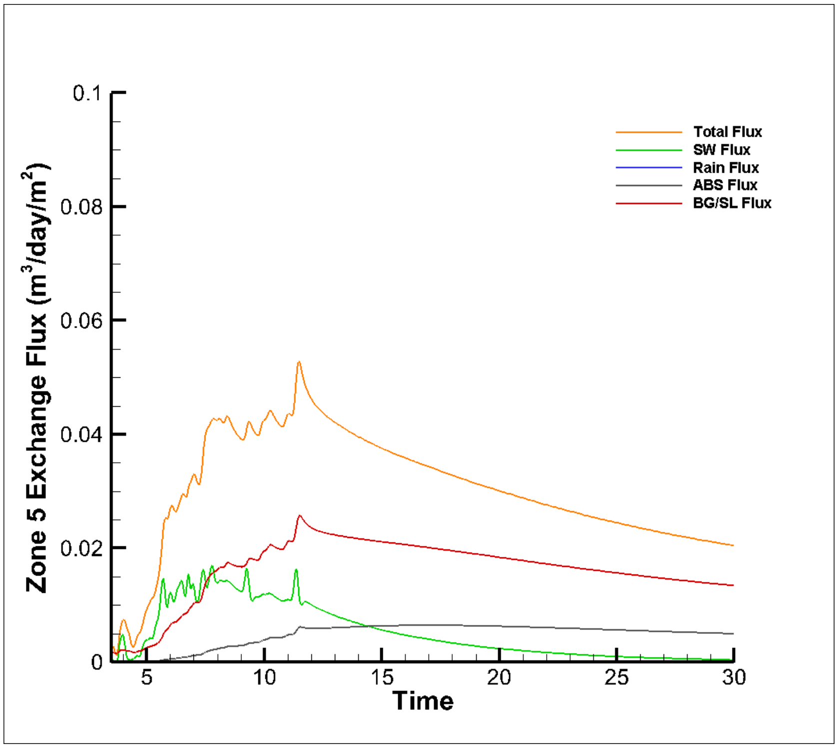

Figure C25. Zone 5 exchange flux for Case 7 with a 1.5`hydrograph from t = 3.5 to t = 30 days.

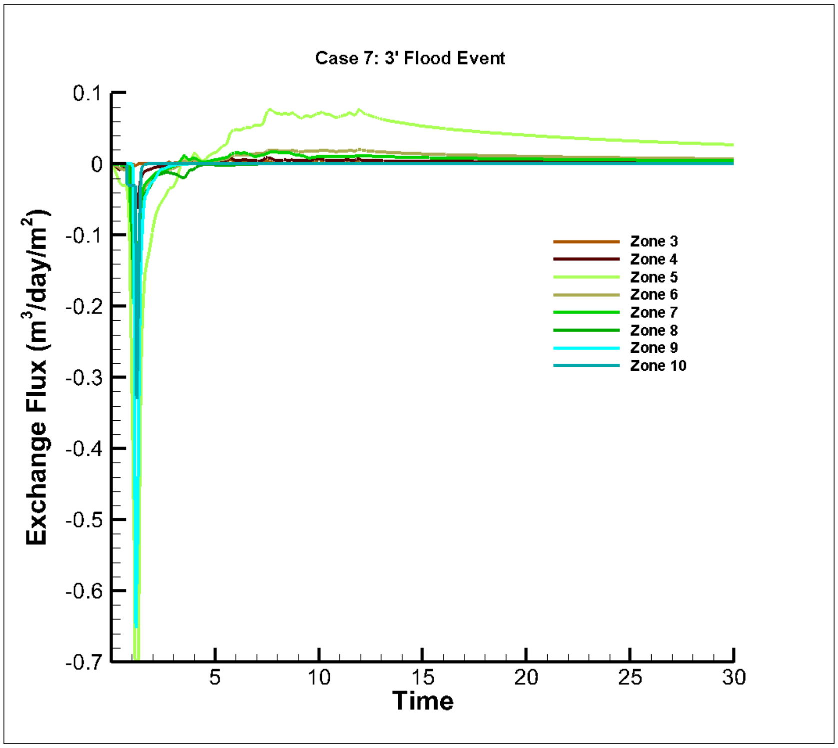

Figure C26. Total exchange flux between the surface and subsurface domain for Case 7 with a 3’ flood hydrograph. Negative values indicate infiltration, and positive values indicate exfiltration.

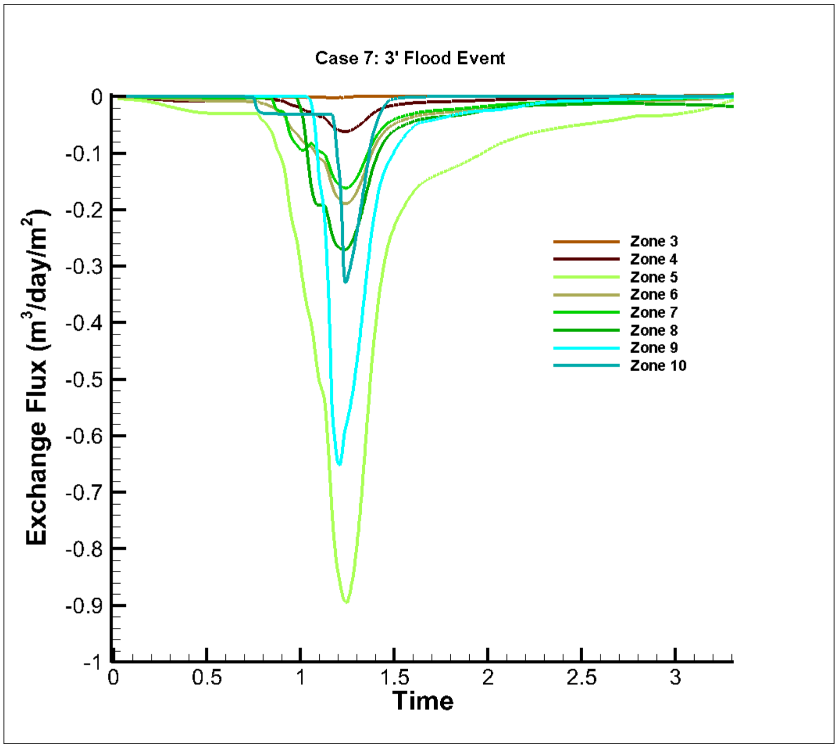

Figure C27. Total exchange flux between the surface and subsurface domain for Case 7 with a 3`event up to t = 3.5 days.

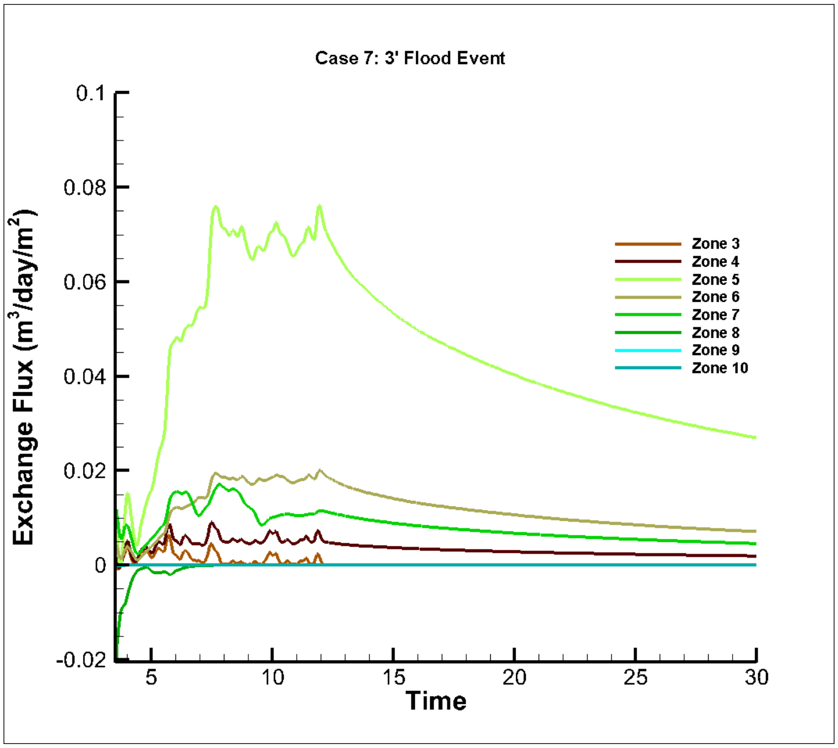

Figure C28. Total exchange flux between the surface and subsurface domain for Case 7 with a 3` event up from t = 3.5 days to t = 30 days.

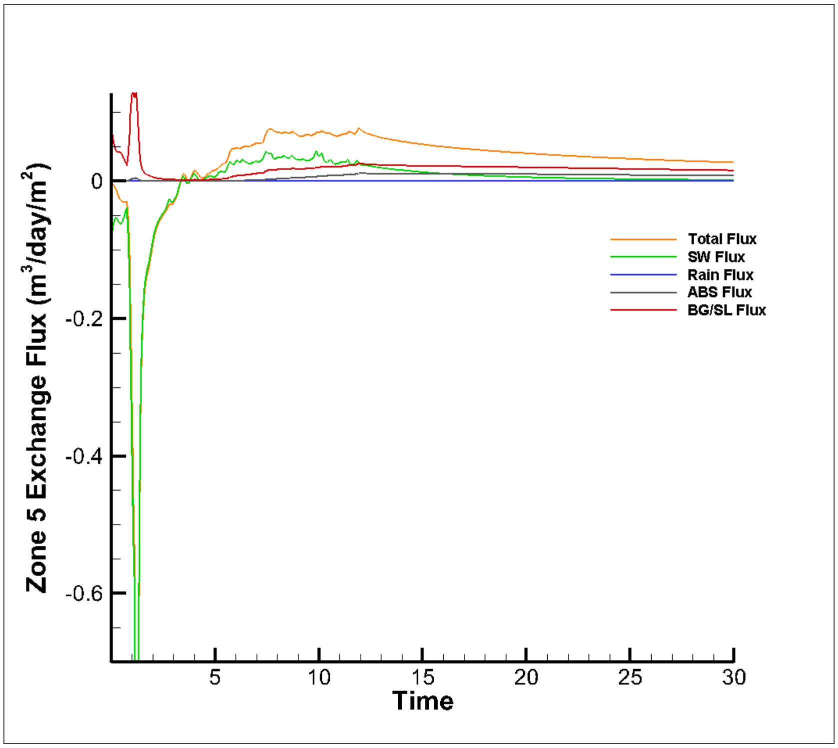

Figure C29. Exchange flux by species through Zone 5 for Case 7 with a 3' flood hydrograph.

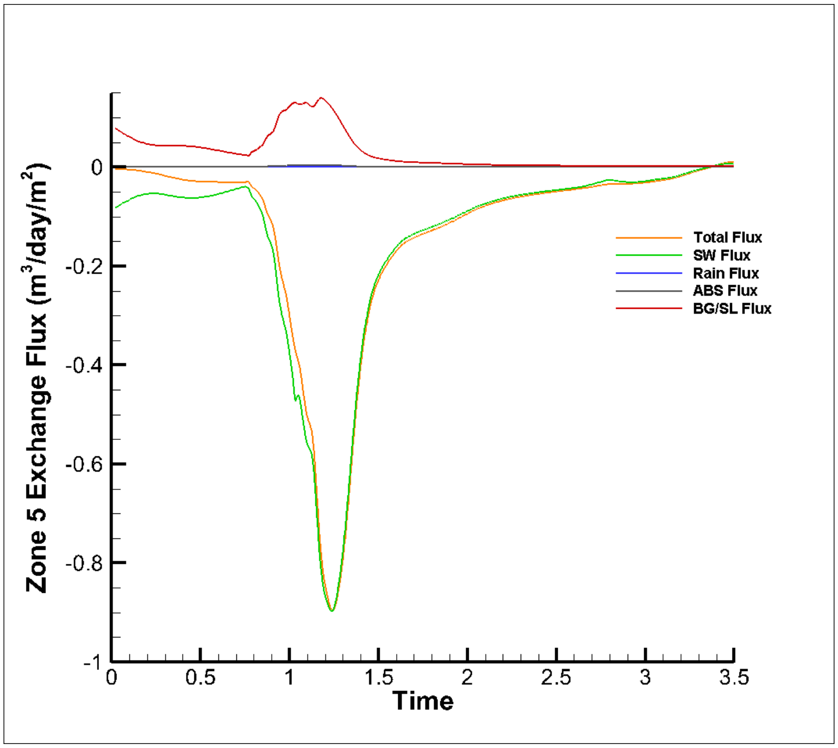

Figure C30. Zone 5 exchange flux for Case 7 with a 3` hydrograph from t = 0 to t = 3.5 days.

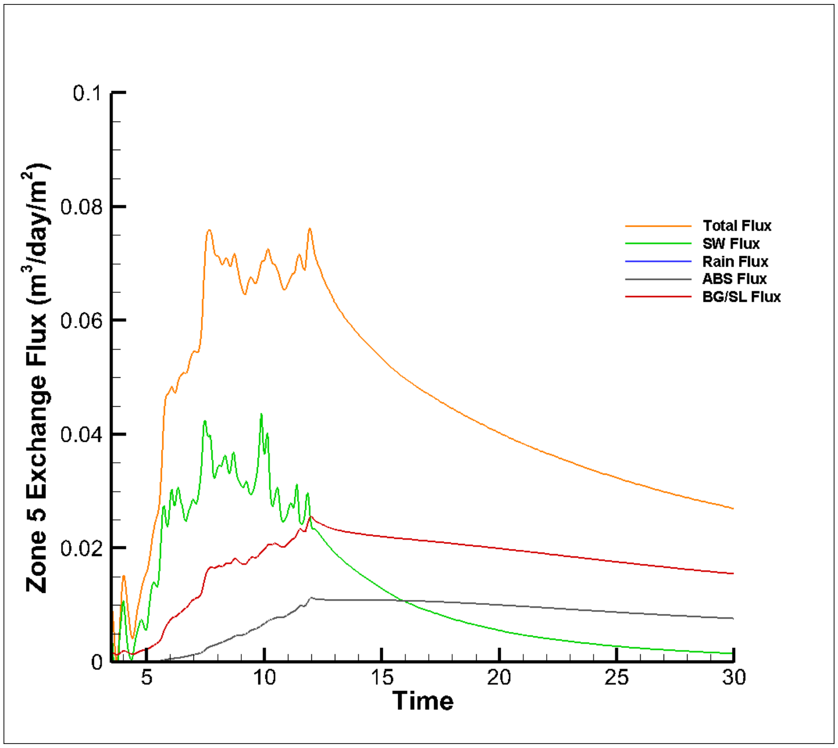

Figure C31. Zone 5 exchange flux for Case 7 with a 3` hydrograph from t = 3.5 to t = 30 days.

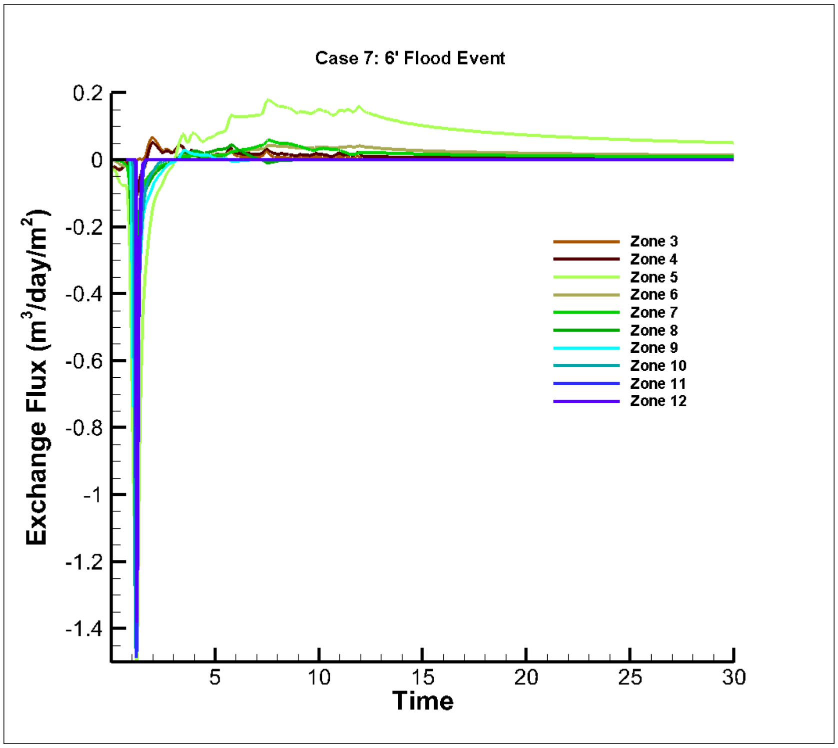

Figure C32. Total exchange flux between the surface and subsurface domain for Case 7 with a 6' flood hydrograph. Negative values indicate infiltration, and positive values indicate exfiltration.

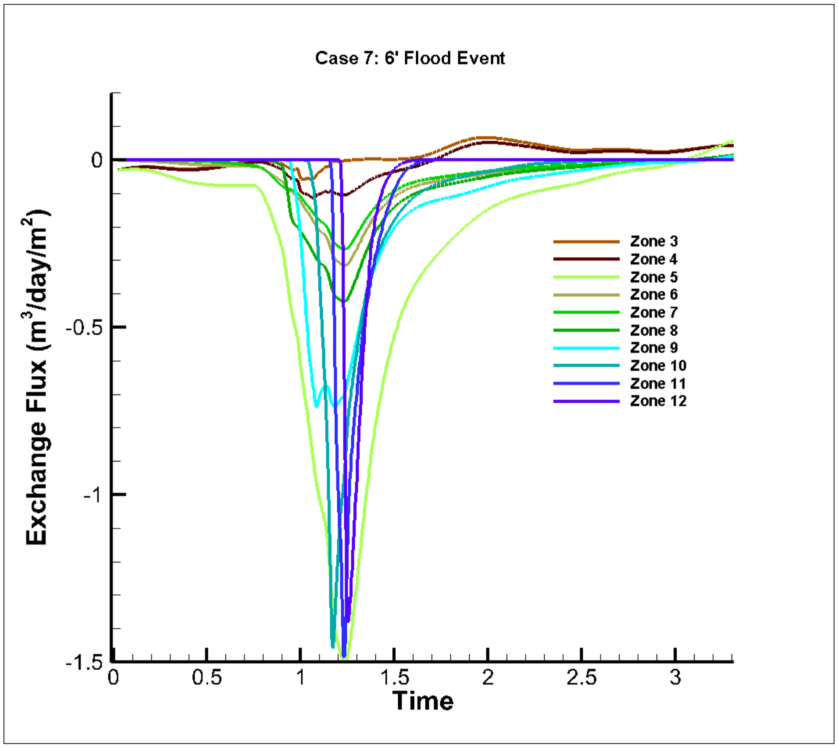

Figure C33. Total exchange flux between the surface and subsurface domain for Case 7 with a 6`event up to t = 3.5 days.

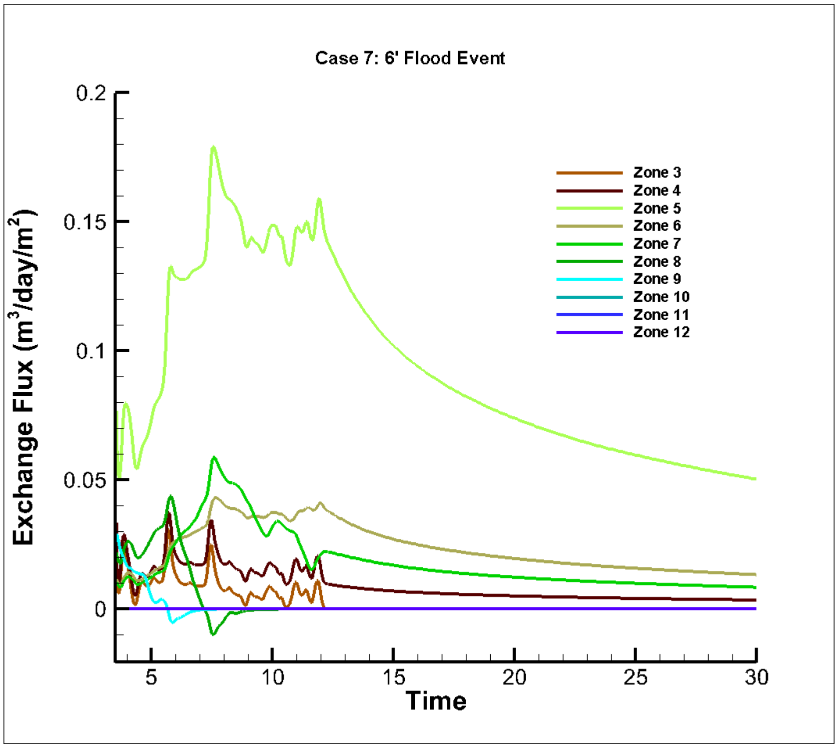

Figure C34. Total exchange flux between the surface and subsurface domain for Case 7 with a 6` event up from t = 3.5 days to t = 30 days.

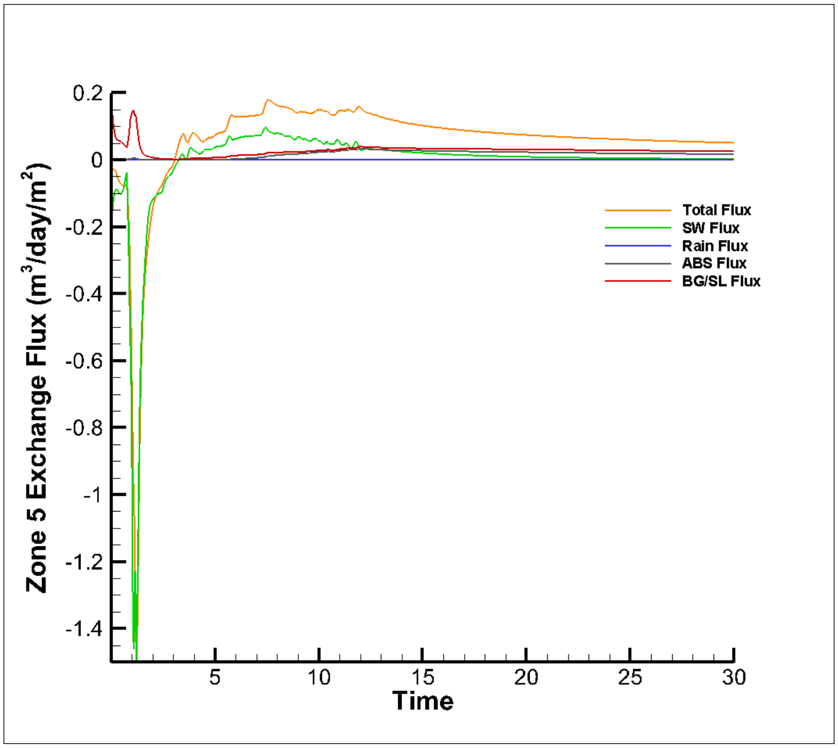

Figure C35. Exchange flux by species through Zone 5 for Case 7 with a 6' flood hydrograph.

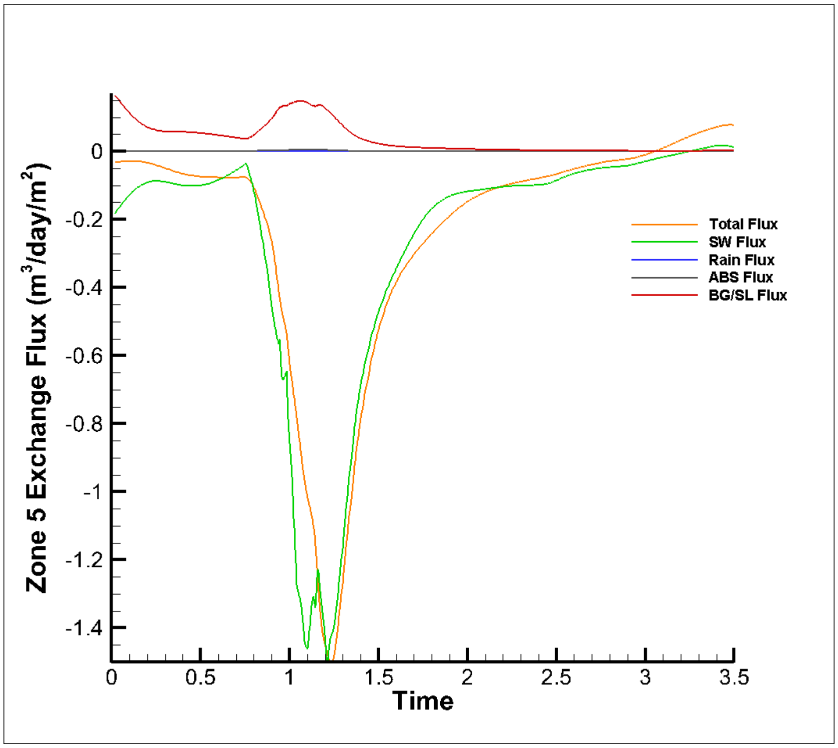

Figure C36. Zone 5 exchange flux for Case 7 with a 6` hydrograph from t = 0 to t = 3.5 days.

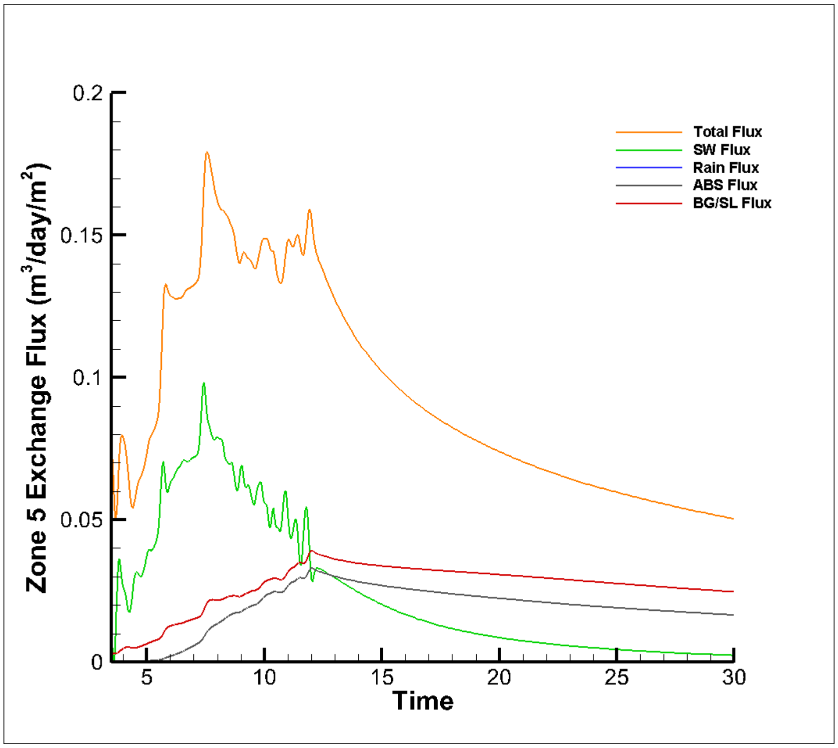

Figure C37. Zone 5 exchange flux for Case 7 with a 6` hydrograph from t = 3.5 to t = 30 days.

APPENDIX D

Estimate of Total Flux in and Out of the Bank by Zone, For Cases 1, 4, and 7

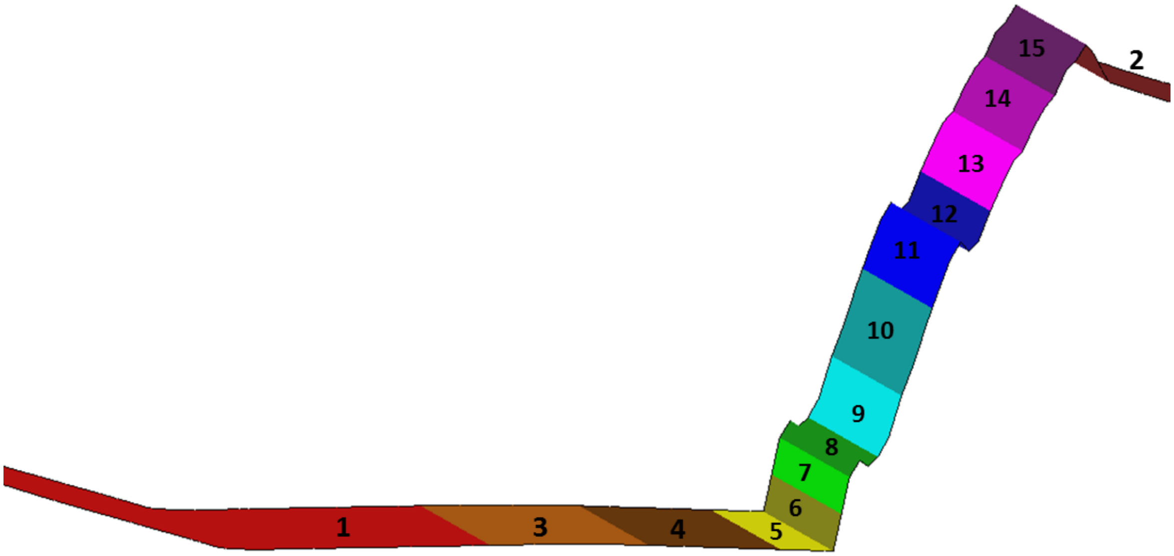

Figure D1. Zones for for tracking exchange flux between surface and subsurface domains during the flood wave simulations along the right bank of the channel.

Table D1. Case 1: Total Flux into the Bank (L/m width)

	1.5 ft	3 ft	6 ft
Zone 3	-3.34	-6.69	-35.32
Zone 4	-75.95	-155.03	-258.34
Zone 5	-290.20	-578.79	-1199.06
Zone 6	-1.12	-2.88	-6.61
Zone 7	-2.85	-4.29	-7.10
Zone 8	-31.19	-41.68	-58.89
Zone 9	-13.65	-38.75	-69.70
Zone 10	-11.90	-29.21	-106.25
Zone 11	-19.83	-25.11	-61.73
Zone 12	-23.80	-30.14	-38.95
Zone 13	-23.80	-30.15	-49.13
Zone 14	-23.81	-30.16	-58.93
Zone 15	-23.81	-30.16	-58.93

Table D2. Case 1: Total Flux Out of the Bank (L/m width)

	1.5 ft	3 ft	6 ft
Zone 3	17.30	29.29	196.82
Zone 4	54.72	108.78	286.14
Zone 5	162.12	333.62	852.04
Zone 6	1.39	2.89	6.69

Zone 7	1.14	2.19	5.30
Zone 8	0.00	0.00	1.07
Zone 9	0.00	0.00	0.00
Zone 10	0.00	0.00	0.00
Zone 11	0.00	0.00	0.00
Zone 12	0.00	0.00	0.00
Zone 13	0.00	0.00	0.00
Zone 14	0.00	0.00	0.00
Zone 15	0.00	0.00	0.00

Table D3. Case 4: Total Flux into the Bank (L/m width)

	1.5 ft	3 ft	6 ft
Zone 3	-1.74	-3.25	-11.43
Zone 4	-19.50	-28.90	-39.46
Zone 5	-53.10	-76.14	-110.36
Zone 6	-32.13	-42.80	-60.79
Zone 7	-26.35	-31.87	-44.30
Zone 8	-85.33	-164.78	-214.17
Zone 9	-38.82	-171.96	-313.59
Zone 10	-12.02	-62.52	-340.57
Zone 11	-20.07	-25.11	-183.13
Zone 12	-24.11	-30.15	-129.92
Zone 13	-24.14	-30.17	-48.98
Zone 14	-24.17	-30.19	-58.80
Zone 15	-24.19	-30.21	-58.84

Table D4. Case 4: Total Flux out of the Bank (L/m width)

	1.5 ft	3 ft	6 ft
Zone 3	6.68	10.87	44.90
Zone 4	98.99	146.88	305.19
Zone 5	286.95	425.16	852.39
Zone 6	210.06	310.78	609.92
Zone 7	112.87	182.72	388.01
Zone 8	0.00	0.00	144.98

Zone 9	0.00	0.00	32.30
Zone 10	0.00	0.00	0.00
Zone 11	0.00	0.00	0.00
Zone 12	0.00	0.00	0.00
Zone 13	0.00	0.00	0.00
Zone 14	0.00	0.00	0.00
Zone 15	0.00	0.00	0.00

Table D5. Case 7: Total Flux into the Bank (L/m width)

	1.5 ft	3 ft	6 ft
Zone 3	-9.13	-17.66	-144.22
Zone 4	-82.01	-148.97	-321.78
Zone 5	-456.11	-832.22	-1519.22
Zone 6	-15.96	-28.64	-53.05
Zone 7	-13.45	-24.16	-44.53
Zone 8	-65.95	-130.10	-219.79
Zone 9	-30.87	-131.59	-271.44
Zone 10	-12.13	-54.67	-288.35
Zone 11	-20.27	-25.34	-173.47
Zone 12	-24.36	-30.42	-138.00
Zone 13	-24.41	-30.45	-53.01
Zone 14	-24.45	-30.47	-63.57
Zone 15	-24.49	-30.48	-63.59

Table D6. Case 7: Total Flux Out of the Bank (L/m width)

	1.5 ft	3 ft	6 ft
Zone 3	39.85	91.04	843.10
Zone 4	279.87	430.29	1368.62
Zone 5	1467.81	2157.87	4557.65
Zone 6	61.13	89.84	180.99
Zone 7	38.38	63.21	138.86
Zone 8	0.00	0.00	87.40
Zone 9	0.00	0.00	23.21
Zone 10	0.00	0.00	0.00
Zone 11	0.00	0.00	0.00
Zone 12	0.00	0.00	0.00
Zone 13	0.00	0.00	0.00
Zone 14	0.00	0.00	0.00
Zone 15	0.00	0.00	0.00

APPENDIX G
GEOTECHNICAL CALCULATIONS

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1 INTRODUCTION

This technical appendix describes geotechnical engineering evaluations performed in support of the remediation design of the Phase 1A Bank Management Areas (BMAs) of the South River Area of Concern 4. The project is located in the City of Waynesboro, Virginia.

The appendix is a component of the Basis of Design Report (BODR) for the project, and describes analyses that are based on project elements described in the BODR. Analyses are based on geologic information generated during the environmental sample collection investigation, as well as geotechnical sample investigations conducted in support of the Phase 1A BMA preliminary design. A summary report on the geotechnical investigation is attached to the BODR as Appendix A.

The following evaluations are described in this appendix:

- Geologic background
- Short-term (construction) stability of excavated slopes
- Long-term stability of restored slopes

2 GEOTECHNICAL ENGINEERING EVALUATIONS

This section provides the details and conclusions of the geotechnical engineering evaluations conducted in support of the Phase 1A BMA design. The Phase 1A preliminary design discussed in the BODR targets certain banks that contribute disproportionally to the total mercury loading within the first 2 river miles downstream of the former DuPont Waynesboro facility (i.e., relative river (RR) mile 0 to 2). The following two general Phase 1A BMA groups have been identified in the BODR:

- Constitution Park
- Wastewater Treatment Plant (WWTP): Areas A and B

The remedy for these areas will be, in part, excavation of contaminated soils and replacement with backfill, along with enhanced vegetative stabilization. The remedy is anticipated to be implemented in late summer and fall of 2016.

2.1 Geologic Background

The generalized soil conditions, as observed in the ten upland geotechnical borings (AQSR-01 through AQSR-10) are described in more detail in Appendix A. A brief summary is as follows (from the existing ground surface down):

- **Topsoil/silty sand** is loose to medium dense topsoil, granular fill, and recently deposited river sediments. Occasional gravel and rock fragments and varying amounts of organic matter were also noted. The topsoil/silty sand layer ranges in thickness from 2.0 to 13.5 feet in the locations sampled.
- **Alluvium (sands and silts overlying clays, silts, and gravel)** is loose to medium dense and very soft to medium stiff alluvial deposits with large gravel and cobbles noted. An upper alluvial layer of predominantly sand and silt was encountered beneath the topsoil/silty sand unit and ranged in thickness from 2.5 to 5.0 feet. Another deeper alluvial layer made up of variable clay, silt, and gravel was encountered and ranged in thickness from 2 to 9.5 feet. The presence of these layers was not consistent in all borings. AQSR-10 terminated in alluvium.
- **Bedrock (weathered and intact)** – Weathered bedrock tends to be very soft to soft and exhibits clay-like behavior when disturbed and remolded. Weathered bedrock was encountered in seven of the ten borings, at depths ranging from 6 to 19 feet below ground surface (bgs). The thickness of this layer differs across the site, and three borings did not encounter the unit at all (AQSR-03, AQSR-07, and AQSR-10), whereas AQSR-01 and AQSR-06 terminated in weathered bedrock. Intact bedrock (sedimentary rock) was very dense/hard and sampling within this unit was unsuccessful. Intact bedrock was encountered in seven of the ten locations at depths ranging from 6.2 to 16 feet bgs. With the exception of AQSR-01, AQSR-06, and AQSR-10, the remaining explorations terminated in this unit.

The project area is underlain by the Waynesboro Formation, which consists of sedimentary dolostone and limestone with interbedded layers of mudrock, sandstone, and dolostone. Mapped areas of karstic topography have been noted within the Waynesboro Formation (Gathright et al. 1977). Karstic topography are features (such as sinkholes) indicative of dissolution of soluble rocks from sinks, ravines, or underground water streams.

Groundwater was observed in all soil borings except AQSR-04, where shallow bedrock was encountered. Depth to groundwater ranged from 5 to 19 feet bgs.

2.2 Stability of Excavated Slopes

Excavation depths range from about 5 to 12.5 feet depending on the proposed target elevation in each BMA. Geologic cross-sections were developed for each BMA to evaluate global stability under short-term (construction) conditions as noted in Figures G-1 to G-3. Subsurface conditions in the river channel shown in the figures are inferred and may need to be field-verified if excavations or other construction activities are performed in the channel. The static groundwater and river-level elevations were assumed to be at the low-flow (50 cubic feet per second) river water surface elevation as predicted by the hydrodynamic model (see Appendix C of the *Interim Measures Design, Implementation, and Monitoring Work Plan, Phase 1 – South River Area of Concern 4* [Anchor QEA et al. 2015]). However, it was assumed that groundwater would be dewatered at the base of the excavations during construction.

Input parameters for the soils are listed in Table G-1. These soil parameters were developed based on subsurface data described in Appendix A of the BODR, typical soil correlations, and experience with similar materials. The slopes of the excavations (back cuts) were analyzed at both 2 horizontal to 1 vertical (2H:1V) and 1.5H:1V for each Phase 1A BMA. Slopes were modeled using limit equilibrium methods implemented in the Slide 7.0 software package by Rocscience, Inc.

Table G-1
Slope Stability Soil Parameters

Generalized Soil Description	Unit Weight (pounds per cubic feet)	Friction Angle (degrees)	Cohesion (pounds per square foot)
Topsoil and sandy fill	130	30	0
Sandy alluvium	130	33	0
Deep sandy alluvium	130	30 to 35	0
Silt and clay alluvium (undrained)	115	0	400
Silt and clay alluvium (drained)	115	30	0
Subgrade Backfill	130	33	0
Riprap and Launchable Toe	145	45	0
Weathered bedrock	130	33	0
Bedrock	150	45	0

The failure surface searches were restricted to surfaces greater than 1 foot thick; for limit equilibrium analyses that assume zero cohesion (a simplifying modeling assumption that does not necessarily represent typical soil behavior), critical slip surfaces are as shallow as the model will allow, and restricting surface depths prevents the model from reporting unrealistically low Factors of Safety (FOSs) that occur at infinitesimally small scales. Some surficial sloughing is likely to occur; however, temporary erosion and sediment control (TESC) measures will be implemented to intercept any sloughed material before it migrates into the river.

Based on the U.S. Army Corps of Engineers (USACE 2003) and Duncan, Wright and Brandon (2014) guidelines, a FOS of 1.3 or greater is targeted for short-term (construction) evaluation. WWTP B had a short-term FOS less than 1.3, however, the slip surface depth is a little over 1-foot which would likely manifest as sloughing or some slumping at the edge of the excavation. It is recommended that the contractor monitor the excavation and provide additional TESC or other measures to prevent soil migration. The failure surfaces immediately following the low FOS all resulted in values of 1.3 and greater.

Stockpiles and heavy equipment will be maintained at a minimum setback of either 5 feet from the edge of the excavation or minimum distance required by governing state or federal Occupational Safety and Health Administration guidelines, whichever is furthest from the top of the excavated slope. Based on the results, we recommend a back cut of 1.5H:1V for Constitution Park and 2H:1V for WWTP A and B. Table G-2 is a summary of the short-term and long-term slope stability analyses for the BMAs.

Table G-2
Slope Stability Evaluation Results

Bank Management Area	Short-Term FOS	Long-Term FOS
Constitution Park	1.34	1.42
WWTP A	1.31	1.25
WWTP B	1.05*	1.30

*failure surface is a little deeper than 1-foot

2.3 Stability of Restored Slopes

The backfilled areas of the primary BMAs will serve as the construction base on which the enhanced vegetative stabilization and recreational access features of the design will be placed. An evaluation of the restored slopes was performed to determine stability prior to plant establishment (see Figures G-4 through G-6).

Additionally, infinite slope analyses as outlined by Duncan, Wright, and Brandon (2014) were also used to evaluate surficial stability of the restored slopes. The infinite slope analysis methodology for cohesionless soils (cohesion and effective cohesion = 0) was used. For cohesionless soils, the FOS is independent of depth and the general equation reduces to the following:

$$\mathrm{FOS} = \frac{\tan \varphi'}{\tan \beta}$$

where:

φ' = angle of internal friction in terms of effective stress ($\varphi' = \varphi$ for granular soil)

β = slope angle

For the restored slopes, we recommend that the finished slope face be no steeper than 2H:1V. This inclination resulted in FOS values of approximately 1.3. Although this is below general guidelines for embankments (USACE 2003), it is within the typical range of 1.25 to 1.3 for long-term stability of non-critical embankments as noted by Virginia Department of Transportation (VDOT, 2012) and other state transportation agencies [e.g. California (Caltrans), Texas (TxDOT), and Washington (WSDOT)] (Caltrans, 2014; TxDOT, 2012; WSDOT, 2015). Once the vegetation is established, the root systems will provide additional strength to the restored slope soil mass and thus increase the FOS over time.

3 REFERENCES

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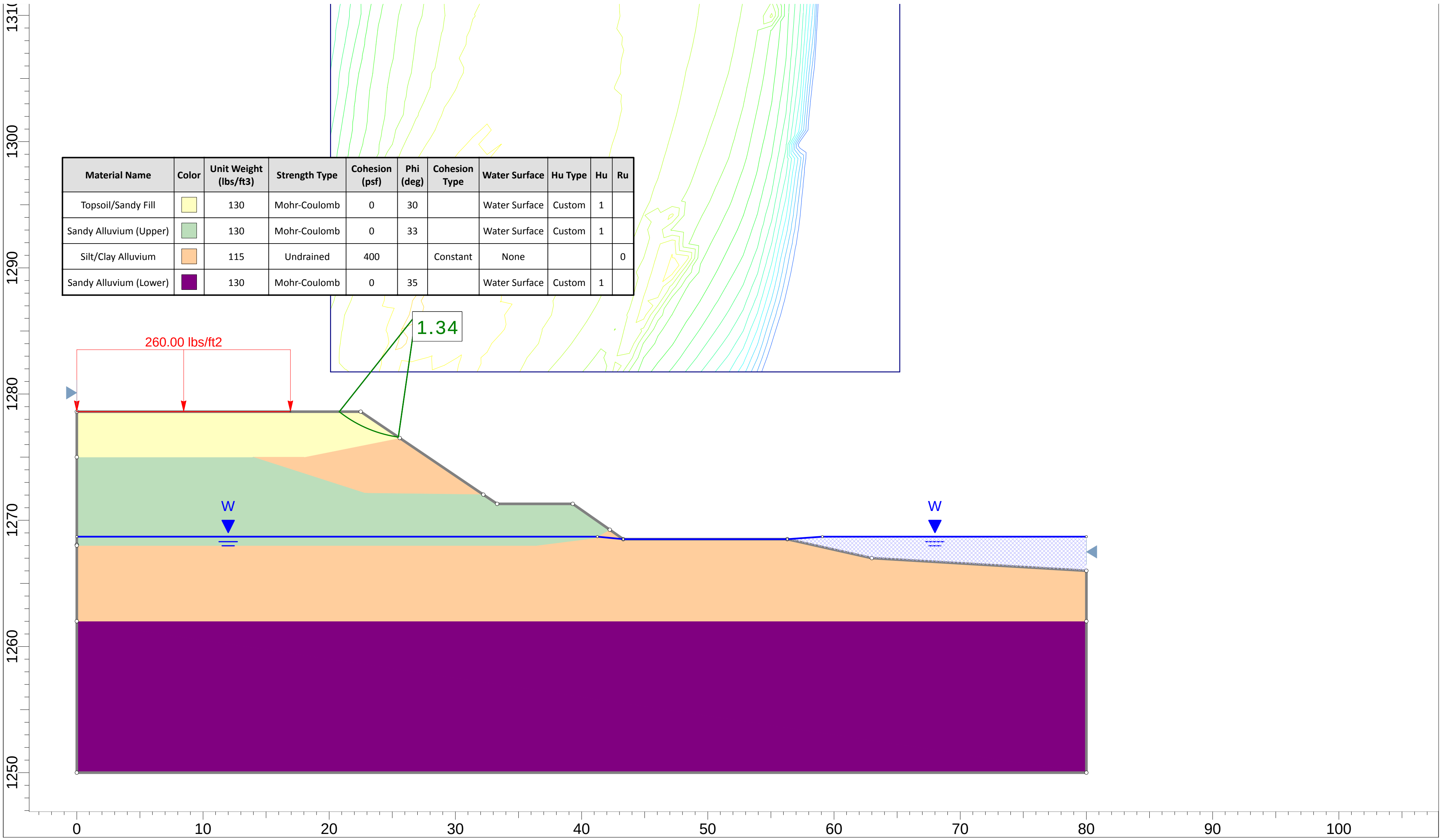
FIGURES



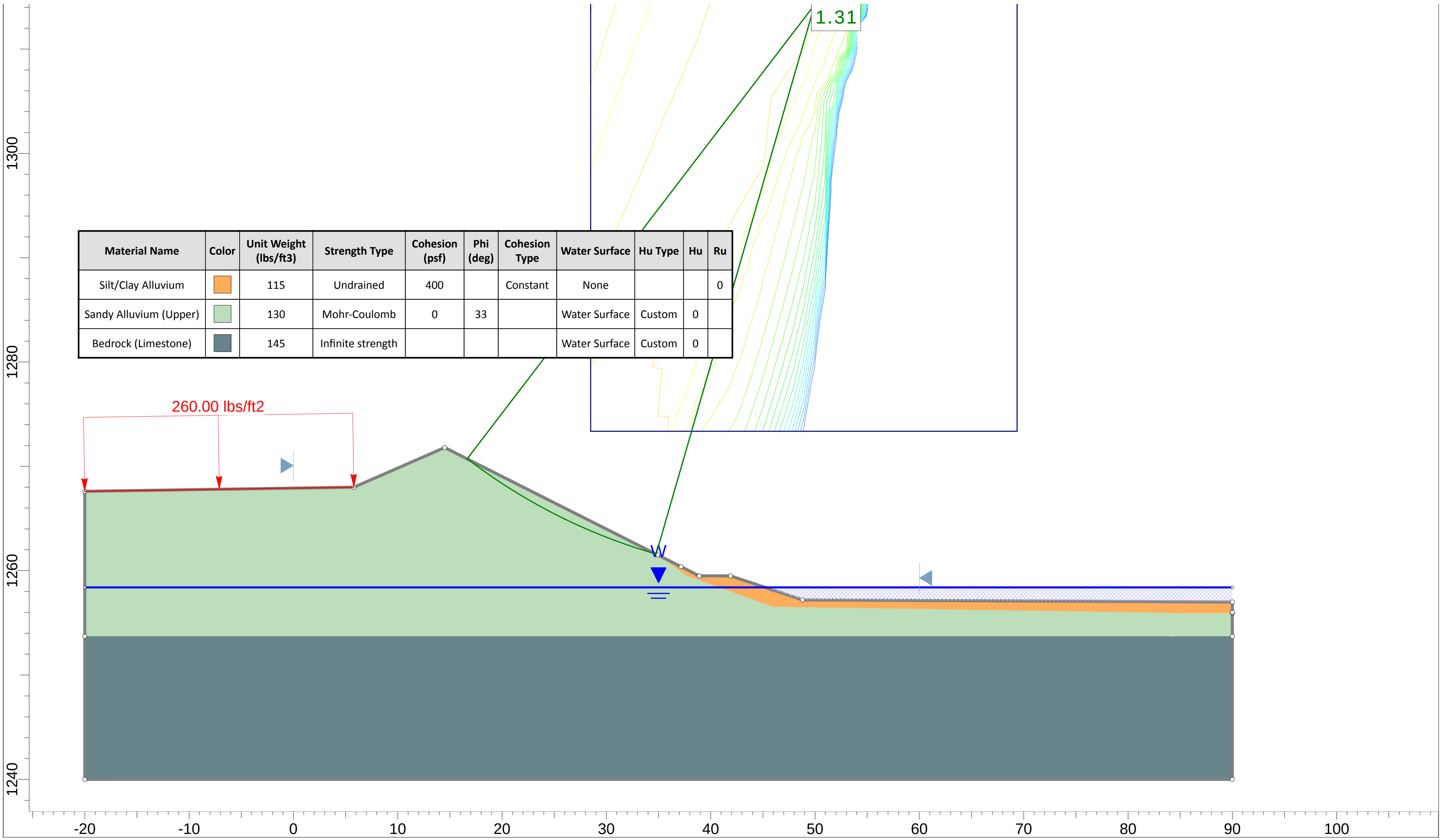
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Water Surface	Hu Type	Hu	Ru
Topsoil/Sandy Fill		130	Mohr-Coulomb	0	30		Water Surface	Custom	1	
Sandy Alluvium (Upper)		130	Mohr-Coulomb	0	33		Water Surface	Custom	1	
Silt/Clay Alluvium		115	Undrained	400		Constant	None			0
Sandy Alluvium (Lower)		130	Mohr-Coulomb	0	35		Water Surface	Custom	1	

Figure G-1

Constitution Park Construction Slope Stability

Basis of Design Report - Phase 1A Bank Management Areas

South River Area of Concern 4



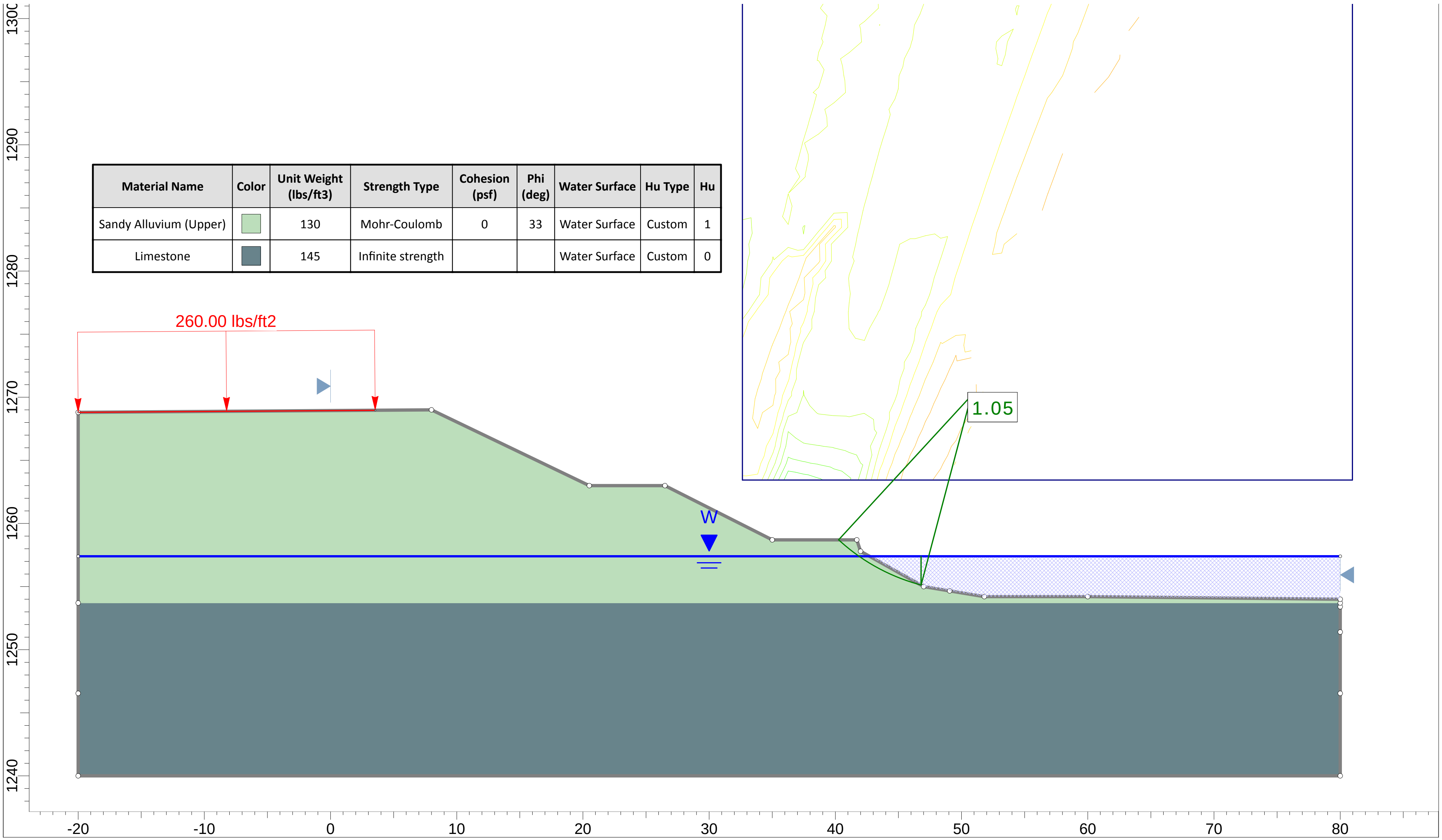
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Water Surface	Hu Type	Hu	Ru
Silt/Clay Alluvium		115	Undrained	400		Constant	None			0
Sandy Alluvium (Upper)		130	Mohr-Coulomb	0	33		Water Surface	Custom	0	
Bedrock (Limestone)		145	Infinite strength				Water Surface	Custom	0	

Figure G-2

WWTP A Construction Slope Stability

Basis of Design Report - Phase 1A Bank Management Areas

South River Area of Concern 4



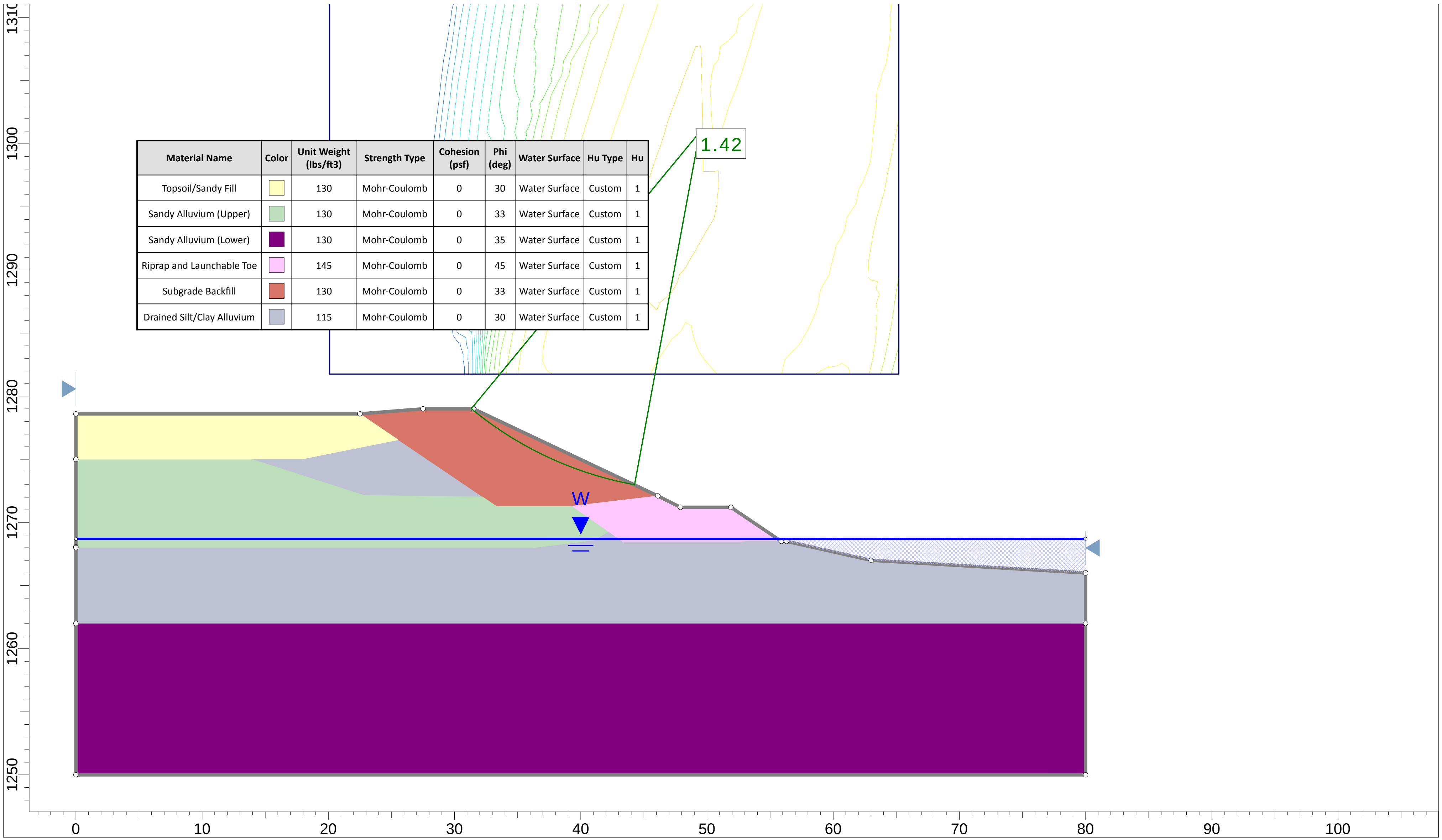
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Sandy Alluvium (Upper)		130	Mohr-Coulomb	0	33	Water Surface	Custom	1
Limestone		145	Infinite strength			Water Surface	Custom	0

Figure G-3

WWTP B Construction Slope Stability

Basis of Design Report - Phase 1A Bank Management Areas

South River Area of Concern 4



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Topsoil/Sandy Fill		130	Mohr-Coulomb	0	30	Water Surface	Custom	1
Sandy Alluvium (Upper)		130	Mohr-Coulomb	0	33	Water Surface	Custom	1
Sandy Alluvium (Lower)		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
Riprap and Launchable Toe		145	Mohr-Coulomb	0	45	Water Surface	Custom	1
Subgrade Backfill		130	Mohr-Coulomb	0	33	Water Surface	Custom	1
Drained Silt/Clay Alluvium		115	Mohr-Coulomb	0	30	Water Surface	Custom	1

ANCHOR QEA

Figure G-4

Constitution Park Restored Slope Stability

Basis of Design Report - Phase 1A Bank Management Areas

South River Area of Concern 4

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Sandy Alluvium (Upper)		130	Mohr-Coulomb	0	33	Water Surface	Custom	0
Bedrock (Limestone)		145	Infinite strength			Water Surface	Custom	0
Riprap and Launchable Toe		145	Mohr-Coulomb	0	45	Water Surface	Custom	1
Silt/Clay Alluvium (Drained)		115	Mohr-Coulomb	0	30	Water Surface	Custom	1
Subgrade Backfill		130	Mohr-Coulomb	0	33	Water Surface	Custom	1

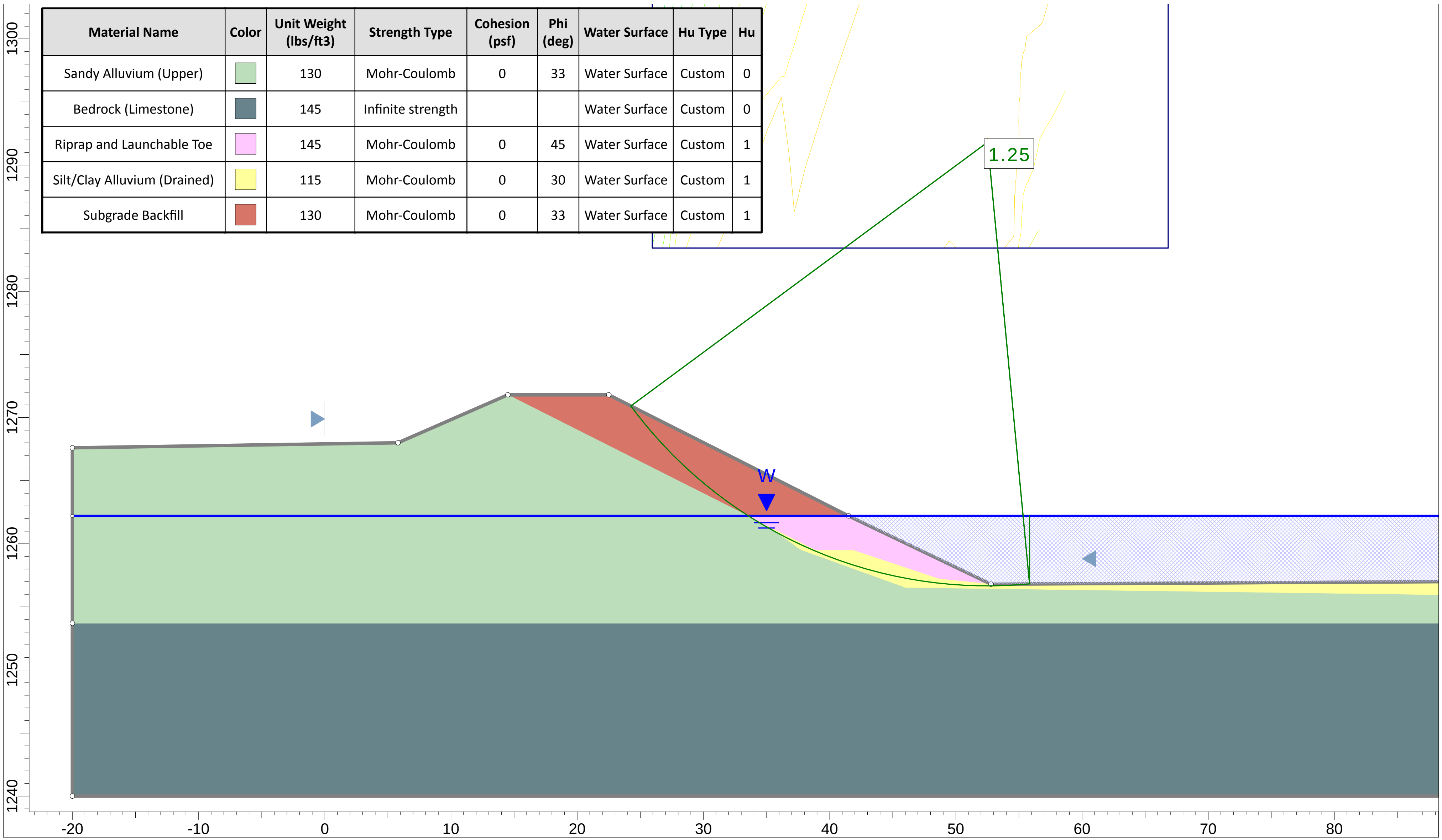
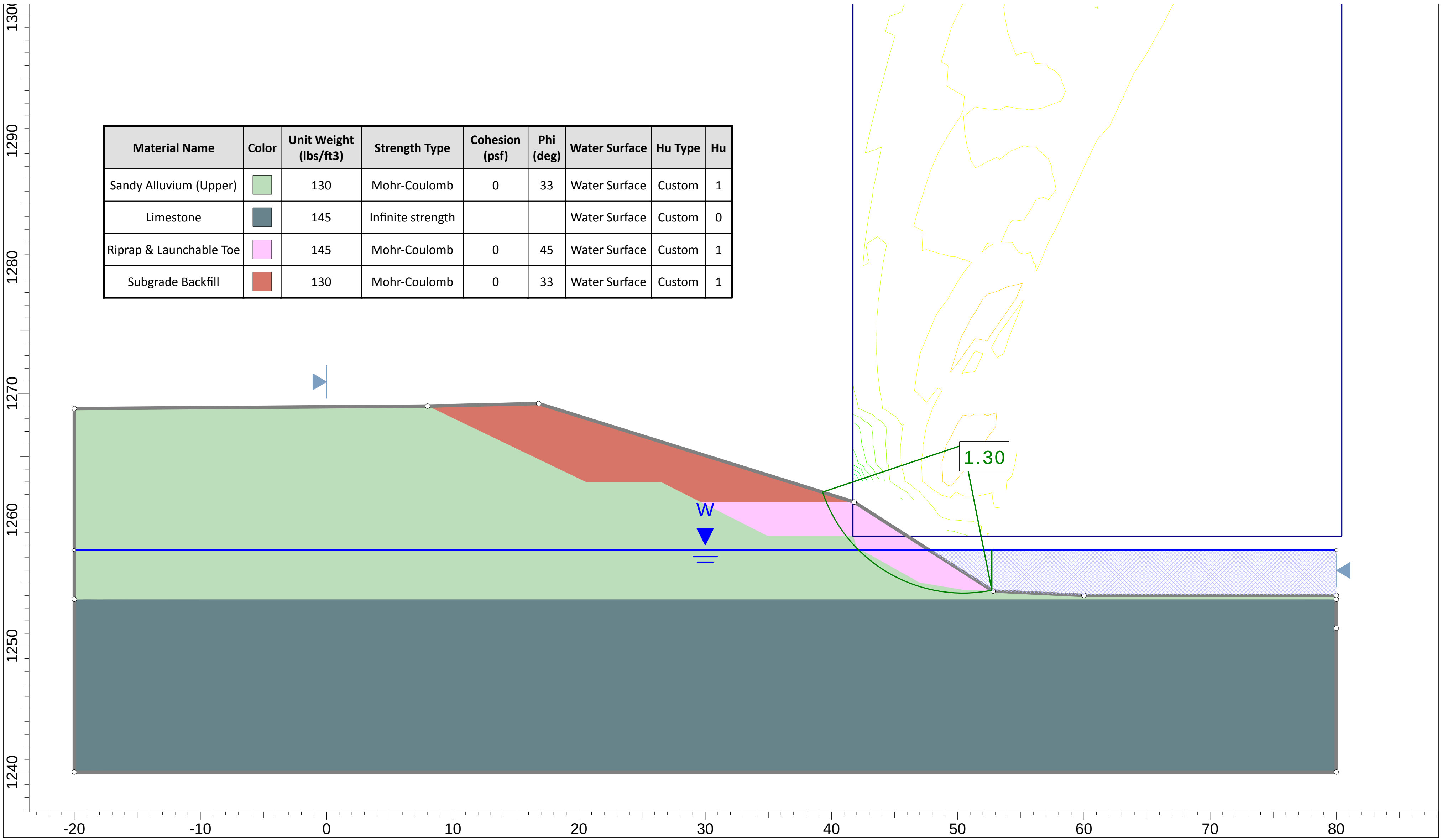


Figure G-5

WWTP A Restored Slope Stability

Basis of Design Report - Phase 1A Bank Management Areas

South River Area of Concern 4



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Sandy Alluvium (Upper)		130	Mohr-Coulomb	0	33	Water Surface	Custom	1
Limestone		145	Infinite strength			Water Surface	Custom	0
Riprap & Launchable Toe		145	Mohr-Coulomb	0	45	Water Surface	Custom	1
Subgrade Backfill		130	Mohr-Coulomb	0	33	Water Surface	Custom	1

Figure G-6

WWTP B Restored Slope Stability

Basis of Design Report - Phase 1A Bank Management Areas

South River Area of Concern 4

APPENDIX H
TOE ARMOR STONE SIZING CALCULATIONS

Objective: To determine the particle size necessary to prevent erosion of bank scour protection due to the 10-year flood flows and ice loading in the South River. This document presents an example calculation for Constitution Park.

References:

Anchor QEA (Anchor QEA, LLC), URS (URS Corporation), and DuPont (E. I. du Pont de Nemours and Company), 2015. *Interim Measures Design, Implementation, and Monitoring Work Plan, Phase 1 – South River Area of Concern 4.* August 2015.

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White, K., 2004. *Method to Estimate River Ice Thickness Based on Meteorological Data.* ERDC/CRREL Technical Note 04-3. June 2004.

Computation of 10-year flood flows, ice thickness, and resultant particle size(s): The following presents a detailed summary and example calculation for the South River stone-size analysis. The numbered list below outlines the general approach used for the calculation and defines specific parameters used in the calculations. The sections illustrate a step-by-step calculation for the example case of Constitution Park.

1. Predict near-bank velocities and water depths using the U.S. Environmental Protection Agency's (EPA's) Environmental Fluid Dynamics Code (EFDC) Hydrodynamic Model.

   The velocity fields generated by the 10-year flow in the South River were modeled using the EPA's hydrodynamic model (i.e., EFDC). The EFDC model is a 2-dimensional, depth-averaged (i.e., the model computes lateral, not vertical variations in flows), hydrodynamic numerical model used by the EPA for hydrodynamic studies. A detailed description of the model input parameters is provided in Appendix C of the *Interim Measures Design, Implementation, and Monitoring Work Plan* (IMWP; Anchor QEA 2015).

   Current velocities and water depths along the banks were extracted from the model and used for determination of stable particle size. Table H-1 presents the computed velocities and water depths along the bank of each Phase 1A Bank Management Area (BMA).

Table H-1
Predicted 10-year Velocities and Water Depths along Phase 1A Bank Management Areas

Bank Management Area	Maximum Predicted Depth-averaged Velocity along Bank (fps)	Maximum Predicted Water Depth along Bank (ft)
Constitution Park	7.6	11.2
North Park A	9.2	11.8
North Park B	6.6	12.8
North Park C	10.9	12.3
WWTP A	9.5	8.5
WWTP B	8.5	9.7

Notes:
fps = feet per second
ft = feet
WWTP = wastewater treatment plant

2. Compute the stable sediment size along the bank at Constitution Park to resist the 10-year flow.

The stable sediment size for maximum current velocities was estimated using the method outlined in *Appendix A – Armor Layer Design from the Guidance for In-Situ Subaqueous Capping of Contaminated Sediments* (Maynord 1998).

Equation 2 from Maynord (1998) requires specification of water depth 20% up the bank slope and the local depth-averaged current velocity. For the calculation, predicted water depths from Table H-1 were multiplied by 80% while using depth-averaged velocities along the bank. Using Equation 2 for a current velocity of 7.6 feet per second (fps) at a water depth of 9.0 feet (11.2 feet x 0.8), the D_{50} is computed to be 8.3 inches:

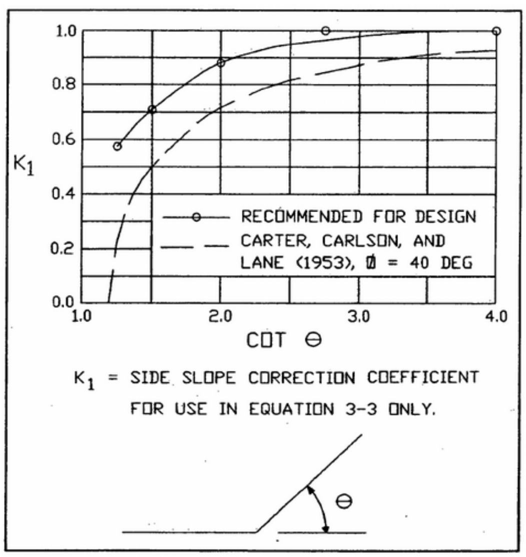
$$D_{50} = S_f C_s C_v C_T C_G d \left[\left(\frac{\gamma_w}{\gamma_s - \gamma_w} \right)^{1/2} \frac{V}{\sqrt{K_1 g d}} \right]$$

$$D_{50} = 1.5 * 0.3 * 1 * 1 * 1.52 * 9.0\, ft \left[\left(\frac{62.4 \frac{ft}{s^3}}{165 \frac{ft}{s^3} - 62.4 \frac{ft}{s^3}} \right)^{\frac{1}{2}} \frac{7.6 \frac{ft}{s}}{\sqrt{0.7 * 32.2 \frac{ft}{s^2} * 9.0\, ft}} \right]^{2.5}$$

$$D_{50} = 0.7\ ft = 8.3\, inches$$

Where:
S_f = safety factor = 1.5
C_s = stability coefficient for incipient failure = 0.3 for angular rock
C_V = velocity distribution coefficient = 1.0 for an approximately straight channel in vicinity of BMAs
C_T = blanket thickness coefficient (typically 1 for flood flows)
C_G = gradation coefficient = $(D_{85}/D_{15})^{1/3}$
D_{85}/D_{15} = gradation uniformity coefficient (typical range = 1.8 to 3.5) = 3.5
d = depth = 9.0 feet
γ_s = unit weight of stone = 165 pounds/feet^3
γ_w = unit weight of water = 62.4 pounds/feet^3
V = maximum depth-averaged velocity = 7.6 fps
cot θ = 1.5 (side slope of BMAs)
K_1 = side slope correction factor = 0.7 (for side slope of 1.5H:1V; see Figure H-1. Plate B-39 from USACE 1994)
g = 32.2 feet/second^2

Figure H-1. Plate B-39 Correction for Side Slope Angle (from USACE 1994)



3. Compute ice thickness from average daily air temperature.

USACE Cold Regions Research and Engineering Laboratory (CRREL; White 2004) provides guidance on estimating ice thickness from average daily air temperature and accumulated freezing degree days (AFDD) for each winter season. Freezing degree days (FDD) are first calculated for each day of the winter season using the following equation from White (2004):

$$FDD = 32 - T_a$$

Where:
T_a = average daily air temperature in degrees Fahrenheit

A negative FDD value represents a temperature warmer than freezing, while a positive FDD represents temperatures below freezing. The FDD values for each day of the winter are summed to determine the net AFDD each day (White 2004).

Average daily air temperature data was obtained from the National Climatic Data Center at the Waynesboro wastewater treatment plant (Station ID: USC00448941) for the years 2000 to 2015. The maximum AFDD was determined for each winter season (assumed to be November through March). Figure H-2 presents an example plot of the average daily air temperature and the net AFDD for the 2000 to 2001 winter season.

The ice thickness was computed for each season by the following equation from White (2004):

$$t_i = C(AFDD)^{0.5} = 5.1\,inches$$

Where:
C = 0.41 (constant for sheltered small rivers (from White 2004)
AFDD = maximum accumulated freezing degree days = 153 (2000 to 2001 winter season)

Table H-2 provides a summary of the maximum AFDD and ice thickness computed for each winter season.

Table H-2
Maximum AFDD and Maximum Ice Thickness from 2000 to 2014

Winter Season Start Year (November to March)	Maximum Accumulated Freezing Degree Days	Maximum Ice Thickness (inches)
2000	153	5.1
2001	77	3.6
2002	93	4
2003	23	2
2004	49	2.9
2005	5	1
2006	0	0.4
2007	17	1.7
2008	19	1.8
2009	297	7.1
2010	60	3.2
2011	2	0.6
2012	0	0
2013	0	0
2014	18	1.8

4. Compute median armor stone to resist ice forces.

Additional guidance from CRREL (Sodhi et al. 1996) states that, to sustain no damage, the maximum armor stone size (D_{100}) should be three times the ice thickness for slopes of 1.5H:1V. Using the maximum ice thickness computed from the AFDD (7.1 inches), the maximum stable armor stone size (D_{100}) is computed to be 21.3 inches.

The *ACES Software Technical Reference Manual* (USACE 1992) shows a median stone size for a well-graded riprap can be computed from the D_{100} by the following relationships:

$$W_{100} = 4W_{50}$$

$$D_x = \left(\frac{W_x}{\omega_r}\right)^{\frac{1}{3}}$$

Where:
x = percentage of the weight of the total gradation contributed by stones of lesser weight
ω_r = unit weight of armor stone = 165 pounds/feet^3

Using the above relationships, a median armor stone size to resist ice loading is calculated to be 13.4 inches.

5. Compare results of 10-year flood and ice-loading stability to assign armor stone size.

   Based on the above analysis, it is determined that ice forces should govern design in this case. A median armor stone size of 14 inches is recommended for the Constitution Park Phase 1A BMA.

RECORD OF REVISIONS

NO.	REASON FOR REVISION	BY	CHECKED	APPROVED/ ACCEPTED	DATE

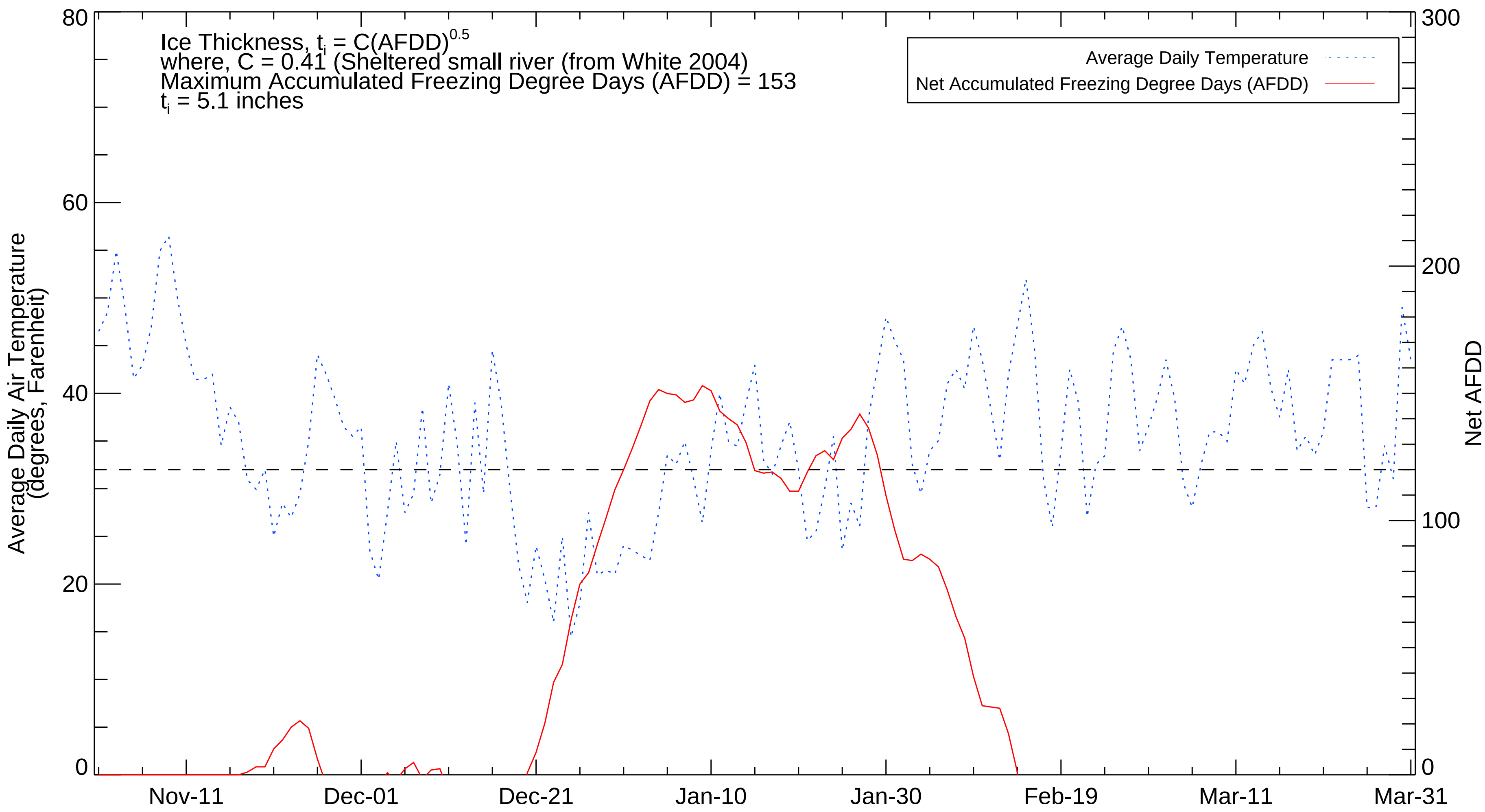


Figure H-2

Average Daily Air Temperature at Waynesboro WWTP, November 2000 to March 2001

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Note: Average daily temperature taken as average of minimum and maximum daily temperature.
Net AFDD and ice thickness computed according to guidance in ERDC/CRREL Technical Note 04-3 (2004).
Temperature data from NCDC Station USC00448941 (Waynesboro WWTP).

BTR - B:\Staff\Brandon\Projects\South_River\Design\Armor_Stability\Ice\south_river_ice_analysis.pro Mon Sep 21 16:17:47 2015

CALCULATION COVER SHEET

PROJECT: Phase 1A Bank Management Areas, South River AOC 4	**CALC NO. 2**	**SHEET** 1 of 7
SUBJECT: Appendix H – Armored Toe and Salvaged Tree Anchor Stone Design – Example Calculations		

Objective: To determine the total weight and quantity of anchor stones required to properly ballast salvaged trees for a 10-year flood event on the South River. This document presents an example calculation for a general case adjacent to where salvaged trees are proposed to be installed.

References:

Drury, T. A. 1999. *Stability and pool scour of engineered log jams in the North Fork Stillaguamish River, Washington.*

Julien, P. Y. 2010. *Erosion and sedimentation*. Cambridge University Press. Cambridge, New York.

Okiishi, M. Y., B. Munson, D. Young, and A.P. Rothmayer. (2006). *Fundamentals of Fluid Mechanics*. John Wiley & Sons, Inc.

Thevenet, A., A. Citterio, and H. Piegay, 1998. *A new methodology for the assessment of large woody debris accumulations on highly modified rivers (example of two French piedmont rivers).* Regulated Rivers: research & management, 14(6), 467-483.

USBR (U.S. Bureau of Reclamation), 2014. *Large Wood National Manual: Guidelines for Planning, Design, Placement, and Maintenance of Large Wood in Fluvial Ecosystems: Restoring Process, Function and Structure*. U.S. Bureau of Reclamation and the U.S. Army Corps of Engineers. Technical Review Draft. January 2014.

USDA (U.S. Department of Agriculture) and USFS (U.S. Forest Service), 2009. *Specific Gravity and Other Properties of Wood and Bark for 156 Tree Species Found in North America.* Research Note NRS-38.

Computation of rootwad log properties, anchor stone properties, and salvaged tree ballast requirements: The following presents a detailed summary and example calculation for the South River salvaged tree ballast requirements analysis. The numbered list below outlines the general approach used for the calculation and defines specific parameters used in the calculations. The sections illustrate a step-by-step calculation for the example case.

1. Salvaged tree geometry, volume, and specific weight calculations

   To compute geometric properties for a salvaged tree, the large woody material was assumed to be a rootwad log with a bole diameter of 1.50 feet and bole length of 35.0 feet (maximum salvaged tree size). The rootwad and log were each geometrically simplified as separate conical frustums to account for natural shape and taper (Drury 1999). Dimension variables used in calculations are defined in the calculations below and presented in Figure H-3.

   The rootwad volume ($V_{Rootwad}$) was calculated using the equation for a conical frustum as a function of bole diameter, rootwad diameter, and rootwad length. Assumptions were made about how the rootwad geometry relates to the bole diameter based on past field observation.

$$V_{Rootwad} = \frac{1}{3}\pi L_r\left[\left(\frac{1}{2}D_r\right)^2 + \frac{1}{4}D_r D_b + \left(\frac{1}{2}D_b\right)^2\right]$$

$$V_{Rootwad} = \frac{1}{3}\pi * 3.0\,ft\left[\left(\frac{1}{2} * 4.5\,ft\right)^2 + \frac{1}{4} * 4.5\,ft * 1.5\,ft + \left(\frac{1}{2} * 1.5\,ft\right)^2\right] = 22.97\,ft^3$$

Where:

D_b = bole diameter = 1.5 feet
D_r = rootwad diameter = 4.5 feet = 3 D_{BH}
L_r = rootwad length = 3.0 ft = 2/3 D_r

The bole volume (V_{Bole}) was calculated using the equation for a conical frustum as a function of bole diameter, bole length, and bole diameter reduction.

$$V_{Bole} = \frac{1}{3}\pi L_b\left[\left(\frac{1}{2}D_b\right)^2 + \frac{1}{4}D_b D_b DR + \left(\frac{1}{2}D_b DR\right)^2\right]$$

$$V_{Bole} = \frac{1}{3}\pi * 35\,ft * \left[\left(\frac{1}{2} * 1.5\,ft\right)^2 + \frac{1}{4} * 1.5\,ft * 1.5\,ft * 0.8 + \left(\frac{1}{2} * 1.5\,ft * 0.8\right)^2\right] = 50.30\,ft^3$$

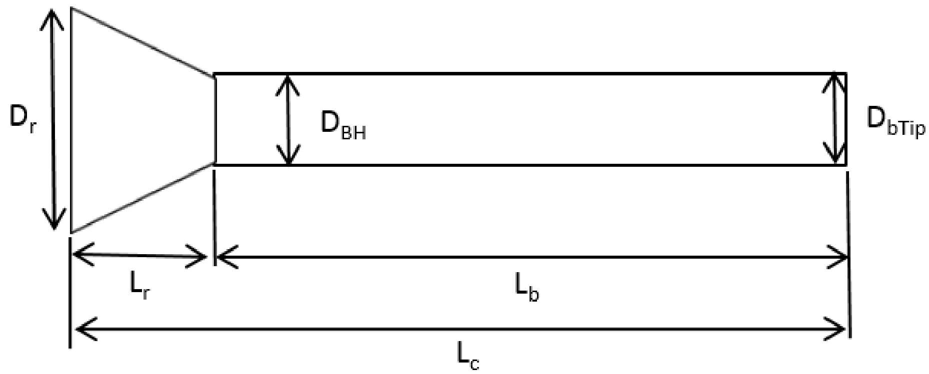
Where:

D_b = bole diameter = 1.5 feet
L_b = bole length = 35 feet
DR = bole diameter reduction = 0.8
D_{bTip} = bole tip diameter = 1.2 ft = D_{BH}DR
L_c = composite rootwad log length = 38.0 ft = L_r + L_b

The composite rootwad log volume (V_c) has been calculated as the summation of the rootwad and bole volumes.

$$V_c = V_{Rootwad} + V_{Bole} = 73.27\,ft^3$$

Figure H-3. Rootwad Log Dimension Diagram



The rootwad log's dry specific weight γ_{DWood} has been determined using a value for trees commonly available in the Mid-Atlantic Region of the United States (USDA and USFS 2009). Dry specific weight is used as a conservative assumption for stability calculations. However, logs below the water table will quickly saturate and have been known to increase their unit weight by more than 100% in 24 hours (Thevenet et al. 1998).

$$\gamma_{DWood} = 44\, lb/ft^3$$

2. Anchor stone geometric, volume and specific weight computations

To compute geometric properties for an anchor stone used for ballast, the stone was assumed to be a spherical boulder with a diameter of 2.95 feet. The boulder volume ($V_{Boulder}$) has been calculated using the equation for a sphere as a function of boulder diameter.

$$V_{Boulder} = \frac{4}{3}\pi\left(\frac{1}{2}D_b\right)^3$$

$$V_{Boulder} = \frac{4}{3}\pi\left(\frac{1}{2}*2.95\,ft\right)^3 = 13.44\,ft^3$$

Where:

D_b = diameter of boulder = 2.95 ft

The boulder specific weight γ_B has been calculated using an assumed specific gravity of 2.4, based on materials available for the project.

$$\gamma_{Boulder} = G_{Boulder}\gamma_w$$

$$\gamma_{Boulder} = 2.40 * 62.4\, {}^{lb}\!/_{ft^3} = 150.0\, {}^{lb}\!/_{ft^3}$$

Where:

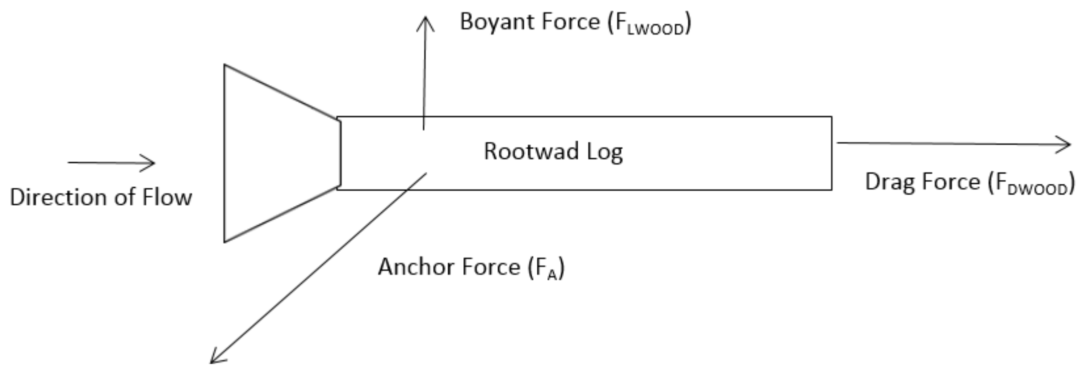
$G_{Boulder}$ = specific gravity of boulder = 2.40
γ_w = specific weight of water = $62.4\, {}^{lb}\!/_{ft^3}$

3. Net force principles

Both a horizontal drag force F_{DWood}, and a vertical buoyant force F_{LWood}, will act on the salvaged tree placed in a riverine environment. Each of these components will be counteracted by a horizontal anchor force $F_{DBallast}$, and a vertical anchor force $F_{LBallast}$. The resultant of these two force components is defined as the designed anchor force F_A. Figure H-4 defines the forces acting on the rootwad log based on a log alignment parallel to flow.

$$F_A = \sqrt{F_{LBallast}{}^2 + F_{DBallast}{}^2}$$

Figure H-4. Rootwad Log Net Force Diagram



Where:

F_{DWood} = the drag force acting on the rootwad log
F_{LWood} = the buoyant force acting on the rootwad log
F_A = the designed anchor force

The example calculations below illustrate the computed factors of safety for each force acting on the rootwad log. A value of **4 boulders per rootwad log** was designed iteratively using a spreadsheet solution to achieve acceptable factors of safety at the 10-year flood event in the horizontal and vertical directions. The boulders are assumed to act as one combined mass for stability calculations and defined as the boulder ballast.

4. Buoyant force calculations

To calculate the stability of the salvaged tree relative to buoyant and vertical anchor forces, the submerged force of the boulder ballast $F_{LBallast}$ (vertical component of Anchor Force F_A), was compared to the submerged force of the rootwad log F_{LWood}, to define a factor of safety against uplift FS_L.

$$F_{LBallast} = N_{Boulder}\left(\gamma_w V_{Boulder} - \gamma_{Boulder} V_{Boulder}\right)$$

$$F_{LBallast} = 4 * \left(62.4\, {}^{lb}\!/_{ft^3} * 13.44\, ft^3 - 150.0\, {}^{lb}\!/_{ft^3} * 13.44\, ft^3\right) = -4{,}709.4 lb$$

Where:

$N_{Boulder}$ = designed number of boulders = 4

γ_w = specific weight of water = $62.4\, {}^{lb}\!/_{ft^3}$

$\gamma_{Boulder}$ = specific weight of boulder = $150.0\, {}^{lb}\!/_{ft^3}$

$V_{Boulder}$ = volume of boulder = $13.44\, ft^3$

$$F_{LWood} = \gamma_w V_{Wood} - \gamma_{DWood} V_{Wood}$$

$$F_{LWood} = 62.4\, {}^{lb}\!/_{ft^3} * 73.27\, ft^3 - 44.0\, {}^{lb}\!/_{ft^3} * 73.27\, ft^3 = 1{,}348.2 lb$$

Where:

γ_w = specific weight of water = $62.4\, {}^{lb}\!/_{ft^3}$

γ_{DWood} = specific weight of dry wood = $44.00\, {}^{lb}\!/_{ft^3}$

V_{Wood} = volume of wood = $73.27\, ft^3$

$$FS_L = \left|\frac{F_{LBallast}}{F_{LWood}}\right| = \left|\frac{-4{,}709.4 lb}{1{,}348.2 lb}\right| = \mathbf{3.49}$$

5. Drag Force Calculations

To calculate the stability of the salvaged tree relative to drag and horizontal anchor forces, the submerged horizontal force of the boulder ballast $F_{DBallast}$ (horizontal component of Anchor Force F_A) was compared to the drag forces acting on the rootwad log F_{DWood}. This ratio defines a factor of safety against sliding FS_D.

The horizontal anchor force of the boulder ballast resisting sliding was calculated by multiplying the summation of normal forces from the ballast and wood by an assumed friction factor for a stream bed of medium gravel (Julien 2010).

$$F_{DBallast} = \tan(\phi)(F_{LBallast} + F_{LWood})$$

$$F_{DBallast} = 0.75 * (-4{,}709.4lb + 1{,}348.2lb) = -2520.9lb$$

Where:

$F_{LBallast}$ = Submerged force of ballast = $-4{,}709.4lb$
F_{LWood} = Submerged force of rootwad log = $1{,}348.2lb$
$\tan(\phi)$ = bed friction coefficient = 0.75

A resultant drag forces acting on the rootwad log was calculated using a general equation for the drag force acting on an object moving through a fluid at a relatively high velocity (Okiishi 2006). The drag coefficients have been calibrated for S.I. units, thus the parameters were input into the equation in S.I. units and converted back to Imperial. The coefficient of drag for the rootwad log was selected as an intermediate value from a range of coefficients (USBR 2014). The rootwad face was assumed to be circular in shape and impervious, thus the Drury number was set equal to 1.0. The design velocity (V) was defined as 11.0 feet/second based on maximum predicted velocities at the 10-year flood event from the Environmental Fluid Dynamics Code model (Table H-1). The area normal to flow A, was calculated as the area of the rootwad using the rootwad diameter D_r.

$$F_{DWood} = C_{DWood} C_A \left(\frac{1}{2} \rho_w V^2 A \right) = C_{DWood} C_A \left(\frac{1}{2} \rho_w V^2 \pi \left(\frac{1}{2} D_r \right)^2 \right)$$

$$F_{DWood} = 1.2 * 1.0 * \left(\frac{1}{2} * 999.9kg/m^3 * (3.35m/s)^2 * \pi \left(\frac{1}{2} * 1.37m \right)^2 \right) = 9{,}925.0N = 2{,}231.2lb$$

Where:

C_{DWood} = Drag coefficient for wood = 1.2
C_A = Coefficient of non-uniformity (Drury Number) = 1.0

ρ_w = Density of water = $999.9 kg/m^3$

V = 10-year flood event design velocity = $11.0\,ft/s$ = $3.35 m/s$

A = Area normal to flow

D_r = rootwad diameter = 4.5 feet = 1.37 meters

$$FS_D = \left|\frac{F_{DBallast}}{F_{DWood}}\right| = \left|\frac{-2{,}520.9lb}{2{,}231.2lb}\right| = \mathbf{1.13}$$

RECORD OF REVISIONS

NO.	REASON FOR REVISION	BY	CHECKED	APPROVED/ ACCEPTED	DATE

APPENDIX I
HYDRAULIC MONITORING REPORT

HYDRAULIC MODELING REPORT
PHASE 1A BANK MANAGEMENT AREAS
SOUTH RIVER AREA OF CONCERN 4

Prepared for

Virginia Department of Environmental Quality

City of Waynesboro

Prepared by

Anchor QEA, LLC

10320 Little Patuxent Parkway, Suite 1140

Columbia, Maryland 21044

April 2017

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LIST OF ACRONYMS AND ABBREVIATIONS

BMA	bank management area
BODR	Basis of Design Report
City	City of Waynesboro, Virginia
cy	cubic yards
DuPont	former E.I. du Pont de Nemours and Company
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
HEC-RAS	Hydrologic Engineering Centers River Analysis System
IHg	inorganic mercury
LiDAR	Light Detection and Ranging
NAVD 88	North American Vertical Datum of 1988
RRM	relative river mile; miles downstream of former DuPont Waynesboro facility footbridge

1 INTRODUCTION

Phase 1 of the South River Area of Concern 4 Interim Measures addresses banks within the first 2 river miles downstream of the former DuPont Waynesboro facility (i.e., relative river miles [RRMs] 0 to 2; see Figure 2-2 from the Basis of Design Report (BODR). Phase 1 is part of a larger remedial strategy designed to address inorganic mercury (IHg) historically released from the former DuPont Waynesboro facility to the South River and a portion of the South Fork of the Shenandoah River. As described in more detail in the BODR, Phase 1 interim measures target bank management areas (BMAs) within RRMs 0 to 2 that contribute disproportionately to IHg loading to the South River. A subset of those Phase 1 BMAs located on land owned by the City of Waynesboro, Virginia (City), will be addressed first (Phase 1A), followed by the remaining City-owned BMAs and the non-City-owned BMAs in RRMs 0 to 2 (Phase 1B). The BODR describes design elements for Phase 1A BMAs.

A hydraulic analysis was performed to evaluate the impacts on the 100-year flood elevation from planned bank remediation and reconstruction (i.e., removal, rock toe construction, backfill and restoration, and berm improvements) in the Phase 1A BMAs. This report documents the hydraulic analysis for the Phase 1A remedies.

2 APPROACH

Two simulations using the Hydrologic Engineering Centers River Analysis System (HEC-RAS) model were performed using flow rates consistent with the 100-year flood event to evaluate: 1) existing conditions in the river; and 2) the planned conditions, including reshaping (i.e., bank removal and reconstruction) and stone toe construction in the Phase 1A BMAs, as well as improvement of a berm along the left bank adjacent to the Wastewater Treatment Plan A (WWTP A) BMA. The model domain extends from 0.15 miles upstream of the confluence with Rockfish Run (RRM 0.17) to 0.34 miles downstream of the Hopeman Parkway Bridge (RRM 2.68) and extends laterally to the limits of the 100-year floodplain. The 100-year water surface elevations along the modeled reach predicted by the two simulations were compared to evaluate the 100-year flood elevation change projected to be caused by the Phase 1A Interim Measures project.

2.1 Model Inputs

2.1.1 Topography and Bathymetry

Topographic and bathymetric data from multiple sources were merged to form a digital elevation map of the 100-year floodplain. The data were prioritized to determine which source should take precedence where there was overlap between the dataset coverages. The sources of topographic and bathymetric data included the following, in order of decreasing precedence:

- Bank survey by EGS & Associates in March 2016 (EGS 2016)
- Bank survey by Spicer Group on March 2014 (Spicer 2014a)
- Bathymetric river survey by Spicer Group on November 2014 (Spicer 2014b)
- Upland LiDAR survey by Surdex Corporation dated April 7, 2005 (Surdex 2005)
- Upland LiDAR survey by the U.S. Geological Survey dated April 7, 2011 (USGS 2011)

The model cross-sections were placed at intervals between 1,000 to 2,000 feet. Additionally, five cross-sections were placed near each Phase 1A BMA at intervals between 50 and 100 feet.

Data from the existing elevation surface were extracted along each model cross-section to create the existing conditions geometry. The planned conditions geometry was created by adjusting the cross-section geometry to reflect the planned condition after the Phase 1A project completion.

The Phase 1A designs include toe protection with a launchable section of stone placed at the toe of the revetments protecting the bank. The launchable section provides added protection from potential future undermining of the channel due to scour at the toe. That is, in the event that the toe is potentially undermined by channel down-cutting, launched armor stones would settle into the scour hole and limit further erosion. For the planned conditions HEC-RAS model geometry, all launchable rock sections were assumed to have settled to their corresponding design depth scour holes.

The Phase 1A designs also include approximately 400 feet of berm improvements at the top of the WWTP A banks downstream of the 2nd Street Bridge. The berm improvement consists of raising the crest height to 1,272 feet North American Vertical Datum of 1988. The berm crown width is 4 feet, with side slopes to a proposed restoration grade of 2 horizontal to 1 vertical.

2.1.2 Flow Rate and Water Surface Elevation

The 100-year return interval flow rates in the river were obtained from the Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) for Augusta County (Volume 1 of 2; FEMA 2015). These flow rates include 17,690 cubic feet per second at the upstream boundary and three additional flow increases applied at intermediate points within the model to account for inflow to the river. These flow rates and their corresponding locations, as described in the Augusta County FIS (FEMA 2015), are summarized in Table 1.

Table 1
100-year Flow Rates in South River (FEMA 2015)

Location Description	Flow Rate (cubic feet per second)
Approximately 1.29 miles downstream of confluence with Pratt's Run (upstream boundary)	17,690
At confluence with Jones Hollow Property (i.e., Rockfish Run)	18,390
Approximately 0.51 mile upstream of confluence with Steele's Run	18,590
Approximately 0.24 mile upstream of Waynesboro corporate limits	19,080

The downstream boundary was set to the 100-year water surface elevation of 1,259.6 feet North American Vertical Datum of 1988 (NAVD 88). This elevation was obtained from the South River flood profile included in Augusta County FIS (Volume 2 of 2; FEMA 2010).

2.1.3 Model Coefficients

Manning's roughness coefficients used in the model simulations were selected from values published in Chow (1959), based on varying land cover type along the cross-sections. The Manning's roughness ranged between 0.06 to 0.08 in the floodplain, and between 0.03 and 0.035 in the channel. The Manning's roughness for the constructed stone toe in the BMAs was set to 0.06.

Where transitions between cross-sections were gradual, the contraction and expansion coefficients were set to 0.1 and 0.3, respectively. Where transitions between cross-sections were more abrupt, contraction and expansion coefficients were set to 0.3 and 0.5, respectively.

2.1.4 Additional Inputs

The following five bridges cross the South River within the model domain:

- Main Street (Route 340)
- Broad Street
- CSXT Railroad
- 2nd Street
- Hopeman Parkway

Bridge geometry and ineffective flow areas around the bridges were based on previous modeling efforts (DuPont 2007). The geometry of the Main Street Bridge was updated to reflect the configuration of the new bridge to be completed in 2017 (VDOT 2015). Based on a review of the 100-year flood elevations in FEMA (2010), the lower chord of the 2nd Street Bridge and the Main Street Bridges are submerged during the 100-year flood, so these bridges were modeled using a pressure flow computation method. A discharge coefficient of 0.8 was specified for the pressure flow method at both bridges. The remaining bridges were modeled using the standard step method.

2.2 Comparison to FEMA

Water surface elevations reported in FEMA (2010) were compared to the results of the existing condition simulation to check that the model reasonably simulates the current condition flood elevations as reported by FEMA. The results of the comparison are listed in in Table 2. Differences between the FEMA FIS flood elevations and those predicted by the baseline conditions simulation are likely due to the different spatial resolutions used in the FEMA study and this investigation. Considering these minor differences, the comparison shows that the baseline condition HEC-RAS model is a reliable assessment tool to evaluate changes in water surface elevations resulting from the planned changes to the Phase 1A BMAs.

Table 2
Comparison of FEMA 100-year Flood Elevations to Existing Conditions HEC-RAS Model

Location		100-year Water Surface Elevation (feet, NAVD 88)		Difference (feet)
		FEMA	HEC-RAS	
Main Street Bridge	Upstream	1282.7	1283.0	0.3
	Downstream	1282.0	1282.8	0.8
Broad Street Bridge	Upstream	1281.5	1281.0	-0.5
	Downstream	1280.5	1280.9	0.4
Railroad Bridge	Upstream	1280.4	1280.8	0.4
	Downstream	1279.1	1279.0	-0.1
2nd Street Bridge	Upstream	1272.9	1273.4	0.5
	Downstream	1272.1	1273.1	1.0
Hopeman Parkway Bridge	Upstream	1263.2	1263.6	0.4
	Downstream	1261.3	1261.1	-0.2

3 RESULTS

Figure 1 presents a comparison of the 100-year flood profiles predicted by the HEC-RAS model for the existing and planned conditions. In the top panel of Figure 1, both profiles are shown along with the channel bottom elevation. The bottom panel shows the difference between the two models. As shown, changes in flood elevation throughout the City area are predicted to be less than 0.1 feet in all project locations.

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FIGURE

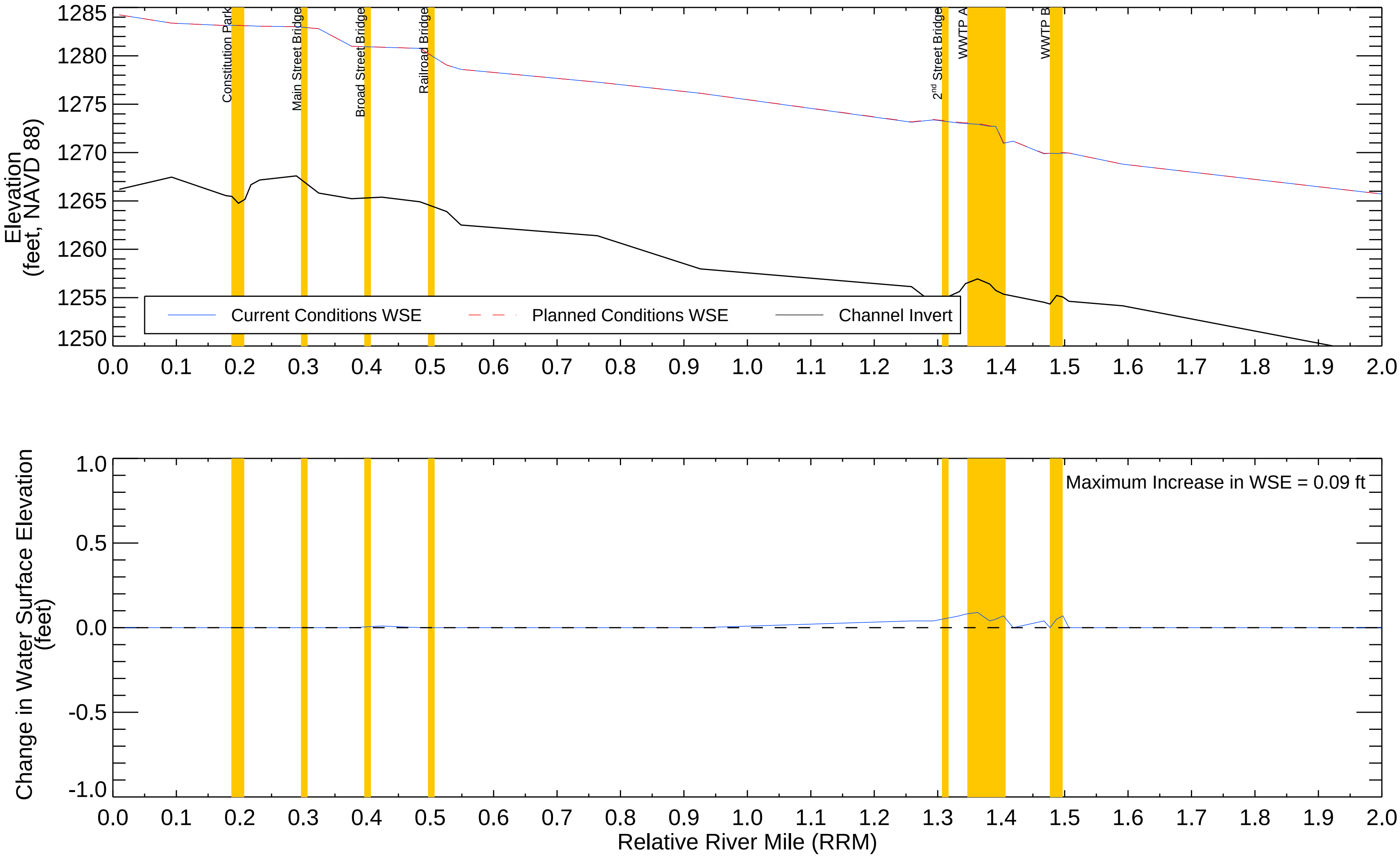


Figure 1

Predicted 100-year Water Surface Elevations of Existing and Planned Conditions
Appendix I – Hydraulic Modeling Report
Draft Basis of Design Report – Phase 1A Bank Management Areas
South River Area of Concern 4

ANCHOR QEA

BTR - W:\South_River\HEC-RAS\Analysis\Profiles\sr_bma_hecras_wse_plot.pro Fri Apr 28 13:03:47 2017

APPENDIX J
PRELIMINARY TREE SURVEY

AECOM
625 West Ridge Pike, Suite E-100
Conshohocken, PA 19428
Telephone: (610)-832-2500
Facsimile: (610) 832-3501

MEMORANDUM

TO: Nancy Grosso, DuPont

DATE: September 22, 2015

CC: Michael Liberati, DuPont

FROM: Kristy Hoffman, AECOM
Cecilia Mancini, AECOM

SUBJECT: AOC 4 PHASE 1A BANK MANAGEMENT AREA VEGETATION COMMUNITY AND TREE SURVEY MEMORANDUM
DUPONT FORMER WAYNESBORO SITE, AREA OF CONCERN 4

Background

AECOM conducted a tree survey on behalf of DuPont during June 2015, along designated Area of Concern (AOC 4) Phase 1A Bank Management Areas (BMAs), South River, Waynesboro, Virginia. The purpose of the survey was to address City of Waynesboro (City) and Virginia Department of Game and Inland Fisheries (VDGIF) concerns about the potential for the Phase 1A Interim Measures to result in disturbance to riparian habitat. The primary objective of the survey was to provide necessary data to refine the Phase IA Interim Measures designs to balance remedial objectives and habitat preservation, consistent with the City and VDGIF's preferences.

Approach

The tree survey was conducted along the following five reaches:

- Constitution Park from Relative River Mile (RRM) 0.18 to 0.28;
- North Park from RRM 0.86 to 1.09 and 1.12 to 1.32;
- Bank Across from North Park from RRM 1.23 to 1.32;
- Wastewater Treatment Plant from RRM 1.33 to 1.47, 1.49-1.5, and 1.86 to 1.95; and
- Basic Park from RRM 1.88 to 1.94.

At each reach, trees with a minimum diameter at breast height (dbh) (as measured using a 24-inch caliper) of eight inches were surveyed. Each surveyed tree was marked with a numbered plastic or aluminum tag; orange flagging was also wrapped around the tree. The Critical Root Zone (CRZ) was estimated using the assumption that one inch of dbh is equal to 1.25 feet of root zone. The tree tag number was recorded with the tree species, the dbh, the estimated tree height, and the CRZ. A GeoXH GPS device was used to record the tree location. Some trees with a dbh of less than eight inches were also surveyed to provide supplemental data.

Results

Constitution Park (RRM 0.18 to 0.28)

Twenty-eight trees consisting of eight species were identified along Constitution Park. Black locust (*Robinia pseudoacacia*) and northern catalpa (*Catalpa speciosa*) were dominant species. One of the surveyed trees appeared dead and two were multi-stemmed. Table 1 summarizes the survey results for this location.

Table 1. Summary of Tree Survey Results for Constitution Park

Species		Quantity			Diameter at Breast Height (Inches)	Estimated Height (Feet)
Common Name	*Scientific Name*	Surveyed	Dead Trees	Multi-stemmed Trees		
Black Locust	*Robinia pseudoacacia*	11	0	0	6.5 - 20	40 - 65
Northern Catalpa	*Catalpa speciosa*	7	0	0	6 - 20.2	20 - 60
Ash-Leaf Maple	*Acer negundo*	2	0	1	5 - 72.1	30 - 60
Black Walnut	*Juglans nigra*	2	1	0	13.3 - 16	25 - 60
American Sycamore	*Platanus occidentalis*	2	0	0	11.7 - 23	35 - 70
Black Willow	*Salix nigra*	2	0	1	10.4 - 20.3	30 - 30
Tree-of-Heaven	*Ailanthus altissima*	1	0	0	7.5	35
Sour Cherry	*Prunus cerasus*	1	0	0	20.2	20
TOTAL	**8**	**28**	**1**	**2**	**5 - 72.1**	**20 - 70**

North Park (RRM 0.86 – 1.09 and 1.12 – 1.32)

One hundred and ninety-eight trees consisting of 11 species were identified along North Park. Black walnut (*Juglans nigra*) and silver maple (*Acer saccharinum*) were dominant species. Ten of the surveyed trees appeared dead trees and 23 were multi-stemmed. Table 2 summarizes the results at this location.

Table 2. Summary of Tree Survey Results for North Park

Species		Quantity			Diameter at Breast Height (Inches)	Estimated Height (Feet)
Common Name	*Scientific Name*	Surveyed	Dead Trees	Multi-stemmed Trees		
Black Walnut	*Juglans nigra*	85	2	1	7 - 22.5	20 - 80
Silver Maple	*Acer saccharinum*	34	2	13	9 - 116.4	25 - 80
Black Locust	*Robinia pseudoacacia*	23	0	2	8 - 25.5	30 - 80
American Sycamore	*Platanus occidentalis*	22	1	4	7 - 81.5	15 - 80
Ash-Leaf Maple	*Acer negundo*	20	3	1	7.8 - 25	15 - 70
Northern Catalpa	*Catalpa speciosa*	3	0	0	7.6 - 19.7	40 - 60
American Basswood	*Tilia americana*	3	0	0	8 - 14	30 - 50
Norway Maple	*Acer platanoides*	2	0	0	9.6 - 16	50 - 50
Tree-of-Heaven	*Ailanthus altissima*	2	0	0	8 - 8.8	30 - 40
Unknown (Dead)		2	2	0	8 - 9.6	15 - 20
Honeysuckle sp.	*Lonicera morrowii*	1	0	1	16.7	15
Black Willow	*Salix nigra*	1	0	1	40.0	50
TOTAL	**11**	**198**	**10**	**23**	**7 - 116.4**	**15 - 80**

Bank Across from North Park (RRM 1.23 – 1.32)

Thirty-two trees consisting of four species were identified along the bank across from North Park. Silver maple and American sycamore (*Platanus occidentalis*) were dominant species. One of the surveyed trees appeared dead and 11 were multi-stemmed. Table 3 summarizes the survey results for this location.

Table 3. Summary of Tree Survey Results for Bank Across from North Park

Species		Quantity			Diameter at Breast Height (Inches)	Estimated Height (Feet)
Common Name	*Scientific Name*	Surveyed	Dead Trees	Multi-stemmed Trees		
Silver Maple	*Acer saccharinum*	12	1	5	9.9 - 83.8	35 - 80
American Sycamore	*Platanus occidentalis*	11	0	5	8.3 - 51.3	40 - 60
Black Locust	*Robinia pseudoacacia*	7	0	1	7.5 - 17.7	30 - 55
Black Walnut	*Juglans nigra*	2	0	0	7.3 - 14.4	50 - 50
TOTAL	**4**	**32**	**1**	**11**	**7.3 - 83.8**	**30 - 80**

Wastewater Treatment Plant (RRM 1.33 – 1.47, 1.49-1.5, and 1.86 – 1.95)

One hundred and forty trees consisting of 13 species were identified along the wastewater treatment plant. Silver maple, American sycamore, and black locust were dominant species. Six of the surveyed trees appeared dead and 25 were multi-stemmed. Table 4 summarizes the survey results from this location.

Table 4. Summary of Tree Survey Results for the Wastewater Treatment Plant

Species		Quantity			Diameter at Breast Height (Inches)	Estimated Height (Feet)
Common Name	*Scientific Name*	Surveyed	Dead Trees	Multi-stemmed Trees		
Silver Maple	*Acer saccharinum*	42	0	12	7.2 - 58.1	25 - 80
American Sycamore	*Platanus occidentalis*	25	0	6	7.5 - 41	40 - 80
Black Locust	*Robinia pseudoacacia*	21	1	0	6.3 - 17.4	30 - 65
Black Cherry	*Prunus serotina*	17	1	5	7 - 40.5	25 - 60
Common Hackberry	*Celtis occidentalis*	7	1	0	8 - 25	20 - 60
Slippery Elm	*Ulmus rubra*	7	0	1	7.6 - 25	30 - 70
Ash-Leaf Maple	*Acer negundo*	6	1	1	8 - 32.2	20 - 50
Sweet Cherry	*Prunus avium*	5	1	0	7.8 - 14.4	40 - 60
Black Walnut	*Juglans nigra*	4	1	0	12.9 - 21.8	50 - 70
Norway Maple	*Acer platanoides*	2	0	0	8.7 - 13.4	45 - 50
Bitter-Nut Hickory	*Carya cordiformis*	2	0	0	10.4 - 18.7	50 - 65
Northern Catalpa	*Catalpa speciosa*	1	0	0	13.2	55
Eastern Hop-Hornbeam	*Ostrya virginiana*	1	0	0	10.8	40
TOTAL	**13**	**140**	**6**	**25**	**6.3 - 58.1**	**20 - 80**

Basic Park (RRM 1.88 – 1.94)

Thirty-five trees consisting of 10 species were identified along Basic Park. Black walnut was the dominant species. Two of the surveyed trees appeared dead and two were multi-stemmed. Table 4 summarizes the results at this location.

Table 5. Summary of Tree Survey Results for Basic Park

Species		Quantity			Diameter at Breast Height (Inches)	Estimated Height (Feet)
Common Name	***Scientific Name***	**Surveyed**	**Dead Trees**	**Multi-stemmed Trees**		
Black Walnut	*Juglans nigra*	15	0	0	7.3 - 34	40 - 70
Shell-Bark Hickory	*Carya laciniosa*	4	0	0	12.5 - 26.5	50 - 80
American Sycamore	*Platanus occidentalis*	4	0	1	5.5 - 25.7	25 - 70
Ash-Leaf Maple	*Acer negundo*	3	0	1	14.5 - 16	35 - 60
Common Hackberry	*Celtis occidentalis*	2	0	0	31 - 34.5	75 - 80
Black Locust	*Robinia pseudoacacia*	2	2	0	17.7 - 20.6	25 - 25
Black Willow	*Salix nigra*	2	0	0	8.1 - 23	20 - 20
Tree-of-Heaven	*Ailanthus altissima*	1	0	0	12.5	50
Northern Catalpa	*Catalpa speciosa*	1	0	0	7.0	15
Slippery Elm	*Ulmus rubra*	1	0	0	17.5	60
TOTAL	**10**	**35**	**2**	**2**	**5.5 - 34.5**	**15 - 80**

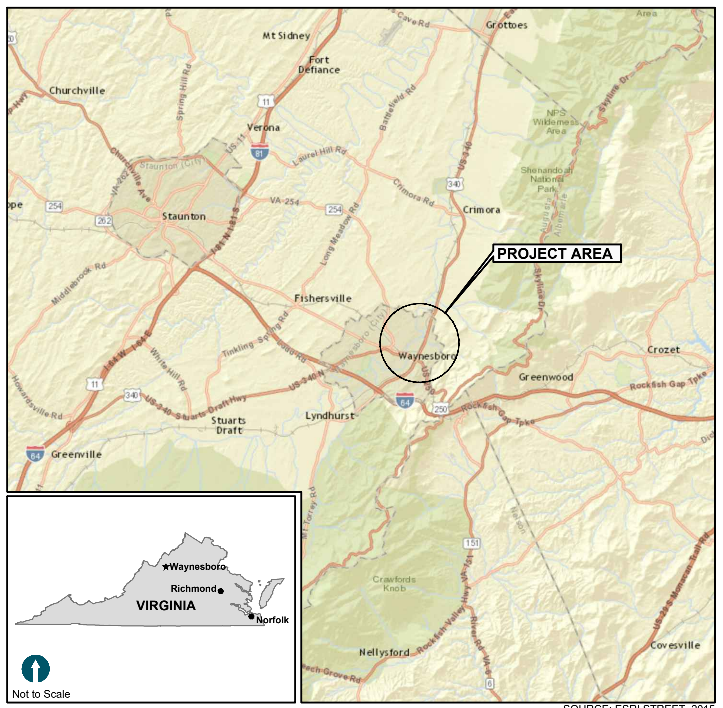
Summary

A total of 433 trees consisting of 19 species were surveyed at the five reaches. Black walnut, silver maple, American sycamore, and black locust were the dominant species. Twenty (5%) of the surveyed trees appeared dead and 63 (15%) were multi-stemmed. These data have been considered in the design of the BMAs incorporating avoidance and design strategies to minimize potential disturbance, and balance remedial and habitat goals.

APPENDIX K
FINAL DESIGN PLANS

SOUTH RIVER AREA OF CONCERN 4 (AOC 4) FINAL DESIGN
PHASE 1A BANK STABILIZATION PLANS

VICINITY MAP



SOURCE: ESRI STREET, 2015

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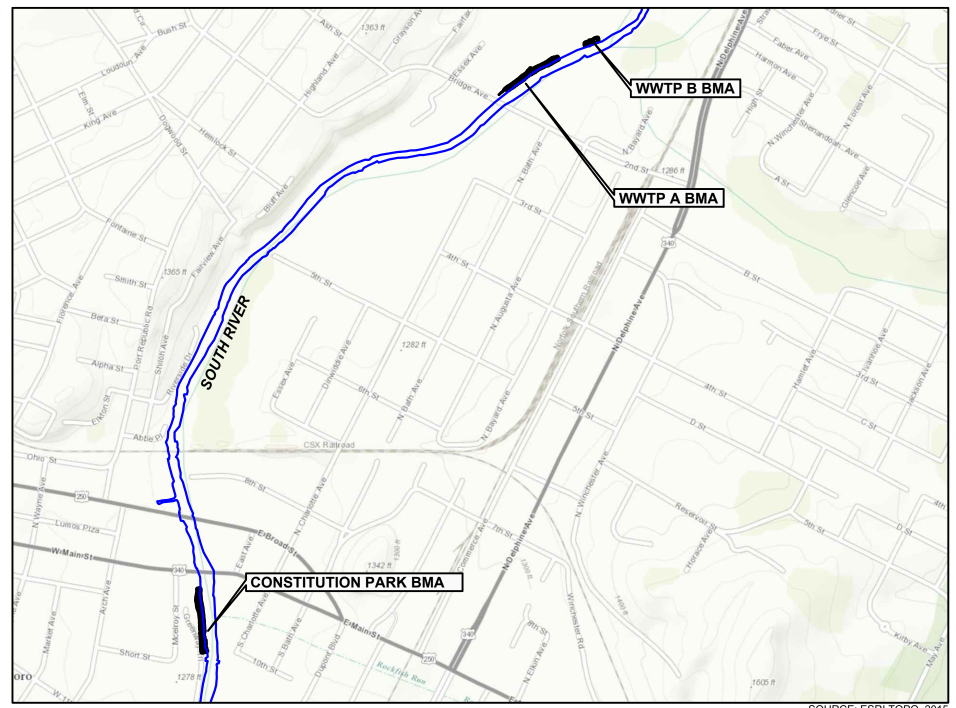
SCALE IN MILES

LOCATION MAP



SOURCE: ESRI TOPO, 2015

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SCALE IN FEET

DRAWING INDEX		
SHT NO.	DWG NO.	TITLE
1	G-1	COVER SHEET
2	G-2	LEGENDS, ABBREVIATIONS AND GENERAL NOTES
3	G-3	SHEET LAYOUT
4	EC-1	EXISTING CONDITIONS PLAN - CONSTITUTION PARK BMA
5	EC-2	EXISTING CONDITIONS PLAN - WWTP A BMA
6	EC-3	EXISTING CONDITIONS PLAN - WWTP B BMA
7	ES-1	TESC AND CARE OF WATER PLAN - CONSTITUTION PARK BMA
8	ES-2	TESC AND CARE OF WATER PLAN - WWTP A BMA
9	ES-3	TESC AND CARE OF WATER PLAN - WWTP B BMA
10	ES-4	TESC DETAILS
11	ES-5	TESC DETAILS
12	ES-6	TESC NOTES
13	ES-7	TESC NOTES
14	D-1	CLEARING PLAN - CONSTITUTION PARK BMA
15	D-2	CLEARING PLAN - WWTP A BMA
16	D-3	CLEARING PLAN - WWTP B BMA
17	C-1	EXCAVATION PLAN - CONSTITUTION PARK BMA
18	C-2	EXCAVATION PLAN - WWTP A BMA
19	C-3	EXCAVATION PLAN - WWTP B BMA
20	C-4	EXCAVATION CROSS SECTIONS - CONSTITUTION PARK BMA
21	C-5	EXCAVATION CROSS SECTIONS - WWTP A BMA
22	C-6	EXCAVATION CROSS SECTIONS - WWTP B BMA
23	CM-1	CONSTRUCTION MATERIALS PLAN - CONSTITUTION PARK BMA - SHEET 1
24	CM-2	CONSTRUCTION MATERIALS PLAN - CONSTITUTION PARK BMA - SHEET 2
25	CM-3	CONSTRUCTION MATERIALS PLAN - WWTP A BMA - SHEET 1
26	CM-4	CONSTRUCTION MATERIALS PLAN - WWTP A BMA - SHEET 2
27	CM-5	CONSTRUCTION MATERIALS PLAN - WWTP B BMA
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2

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

ANCHOR QEA

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COMMONWEALTH OF VIRGINIA
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7/14/17

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1
2	7/14/17	TPG	WJD	REVISION TO ADDRESS PERMIT COMMENTS

DESIGNED BY: S. HAFFEY
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

COVER SHEET

G-1

SHEET NO. 1 OF 42

2

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Jul 25, 2017 9:52am tgriga

SURVEY NOTES:

1. HORIZONTAL DATUM: VIRGINIA STATE PLANE, NORTH ZONE, NAD 83, U.S. FEET.
2. VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM (NAVD 88).
3. UTILITY LOCATIONS OBTAINED THROUGH GEOPHYSICAL SURVEY METHODS (SEE APPENDIX D OF THE BODR), MISS UTILITY OF VIRGINIA, AND THE CITY OF WAYNESBORO. UTILITY MARKINGS, POLES, INLETS, MANHOLES, AND OUTFALLS, WERE SURVEYED BY EGS & ASSOCIATES IN AUGUST 2015, MARCH 2016 AND MARCH 2017.
4. BURIED LINEAR FEATURES WERE IDENTIFIED BY A GEOPHYSICAL SURVEY (DOCUMENTED IN APPENDIX D OF THE BODR FOR THE PHASE 1A PROJECT). THESE LINEAR FEATURES WERE NOT IDENTIFIED AS ACTIVE UTILITIES BY MISS UTILITY OF VIRGINIA OR THE CITY OF WAYNESBORO AND THE POSITIONS WERE NOT SURVEYED. THE POSITIONS SHOWN ON THE PLANS WERE OBTAINED USING DGPS AND SHOULD BE CONSIDERED APPROXIMATE.
5. TOPOGRAPHY IN THE OVERBANK REGION OBTAINED BY FLYOVER LIDAR PERFORMED BY SURDEX CORPORATION ON APRIL 10, 2005 (USED FOR CONSTITUTION PARK) AND USGS ON APRIL 7, 2011 (USED FOR WWTP A AND B)
6. BANK TOPOGRAPHY OBTAINED BY LAND BASED LIDAR PERFORMED BY THE SPICER GROUP IN MARCH 2014.
7. BATHYMETRY OBTAINED BY TOTAL STATION SURVEY PERFORMED BY SPICER GROUP IN NOVEMBER 2014
8. TOPOGRAPHY UPSTREAM OF THE REMOVAL AREA AND ALONG THE TOP OF BANK WITHIN THE REMOVAL AREA AT WWTP A SURVEYED BY EGS & ASSOCIATES MARCH 2017.
9. TOPOGRAPHIC AND BATHYMETRIC SURVEY DATA OBTAINED FROM THE ABOVE SURVEYS (NOTES 5 THROUGH 8) WERE MERGED BY ANCHOR QEA TO PROVIDE THE ELEVATION CONTOURS SHOWN ON THE PLANS.
10. OHW WAS IDENTIFIED IN THE FIELD USING BANK CHARACTERISTICS AND WAS STAKED AT INTERVALS WITHIN A BMA. STAKE POSITIONS WERE SURVEYED BY EGS & ASSOCIATES IN AUGUST 2015. THE OHW LINE SHOWN ON THE PLAN DRAWINGS IS AN INTERPOLATION OF THE STAKED POSITIONS AND SHOULD BE CONSIDERED APPROXIMATE
11. INITIAL TREE SURVEY PERFORMED BY AECOM USING DGPS IN JUNE 2015 TO OBTAIN APPROXIMATE POSITIONS, DBH, CRZ, AND SPECIES. TREE POSITIONS OF TREES OUTSIDE OF THE BANK REMOVAL AREAS WERE SURVEYED BY EGS & ASSOCIATES IN MARCH 2016. TREE SYMBOLS SHOWN ON THE PLANS ARE SCALED TO SHOW APPROXIMATE CRZ.
12. EGS SURVEY BENCHMARKS ARE LISTED IN THE TABLE BELOW. HORIZONTAL AND VERTICAL DATUM WAS ESTABLISHED BY STATIC GPS OBSERVATIONS WITH OPUS SOLUTIONS.

	Point	Northing	Easting	Elevation	Description
CONSTITUTION PARK	4001	6707532.89	11372174.19	1279.5	GPS 5 SPIKE SET FLUSH WITH GROUND
	4002	6707442.12	11372089.50	1279.5	GPS 6 SPIKE SET FLUSH WITH GROUND
	4005	6707755.30	11372146.03	1281.2	BM MARK ON CORNER OF PAVILLION SLAB
WWTP A & B	2001	6712038.92	11374614.89	1273.5	GPS 4 IRON ROD SET FLUSH WITH GROUND
	2002	6712306.86	11374982.35	1270.5	GPS 3 IRON ROD SET FLUSH WITH GROUND
	2236	6712408.96	11375198.73	1268.5	BM MAG NAIL SET IN PAVED ROAD
	2269	6712524.43	11375409.32	1270.8	BM MARK ON TOP CORNER OF RETAINING WALL
	2337	6712750.5	11375469.96	1270.4	GPS TREATMENT IRON ROD SET FLUSH WITH GROUND
	2650	6712276.71	11374987.79	1269.4	BM MARK ON TOP CENTER OF RETAINING WALL

UTILITY NOTES

1. THE LOCATIONS OF EXISTING UTILITIES SHOWN ON THESE DRAWINGS ARE APPROXIMATE AND ARE BASED ON SURVEY INFORMATION AND AS-BUILT INFORMATION PROVIDED BY THE CITY OF WAYNESBORO. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD LOCATING ALL UTILITIES PRIOR TO CONSTRUCTION. THE CONTRACTOR MUST CALL MISS UTILITY OF VIRGINIA AT 1-800-552-7001 (OR 811) FOR UTILITY LOCATIONS AND ALLOW THE REQUIRED TIME FOR MARKING BEFORE THE SCHEDULED DATE FOR EXCAVATION OR EARTHWORK THAT MAY IMPACT EXISTING UTILITIES.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE CONDITION OF ALL ABANDONED UTILITIES THAT INTERFERE WITH THE WORK PRIOR TO DISTURBANCE OR MODIFICATION.THE CONTRACTOR SHALL WORK WITH THE UTILITY OWNER TO CONFIRM THAT UTILITIES HAVE BEEN ABANDONED AND TO DETERMINE WHAT ACTION SHOULD BE TAKEN.
3. THE SIZE AND TYPE OF BURIED UTILITIES EXPOSED OR MODIFIED BY THE CONTRACTOR SHALL BE ACCURATELY NOTED AND SHOWN ON THE CONTRACTOR'S FIELD DOCUMENTATION.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE INTEGRITY OF ALL EXISITING UTILITIES THROUGHOUT CONSTRUCTION.
5. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO PROMPTLY NOTIFY THE DSR OF ANY CONFLICT WITH EXISITING UTILITIES.
6. ALL EXISTING FACILITIES, LANDSCAPE IMPROVEMENTS, AND UTILITIES NOT SPECIFICALLY IDENTIFIED FOR REMOVAL SHALL BE PROTECTED THROUGHOUT CONSTRUCTION OR RESTORED AT COMPLETION OF THE WORK.

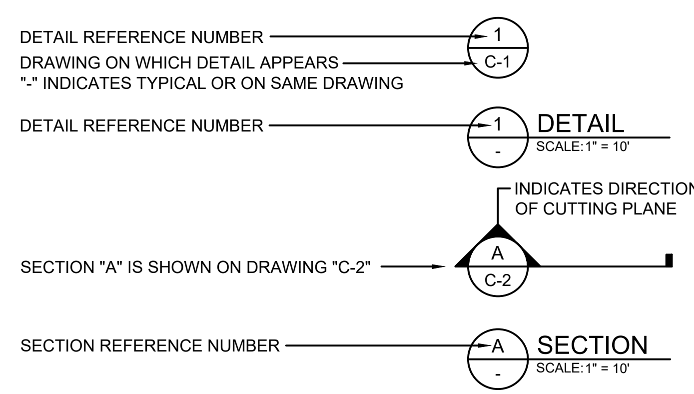
CONSTRUCTION ACCESS/TRAFFIC CONTROL

1. THE CONTRACTOR SHALL PROVIDE A TRAFFIC CONTROL PLAN TO THE DSR FOR REVIEW. CONSTRUCTION SHALL NOT COMMENCE UNTIL THE DSR HAS APPROVED THE TRAFFIC CONTROL PLAN. UPON APPROVAL THE CONTRACTOR IS SOLELY RESPONSIBLE FOR IMPLEMENTING REQUIRED TRAFFIC CONTROL AS REVIEWED AND APPROVED BY THE DSR.
2. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR PROVIDING ANY REQUIRED TRAFFIC CONTROL INCLUDING, BUT NOT LIMITED TO, SIGNAGE AND FLAGGERS.
3. WORK IN THE CONSTITUTION PARK BMA MAY COINCIDE WITH ONGOING CONSTRUCTION BY THE VDOT AT THE MAIN STREET BRIDGE AND BY CITY OF WAYNESBORO IN CONSTITUTION PARK. THE CONTRACTOR WILL BE RESPONSIBLE FOR COORDINATING WORK WITH VDOT AND CITY OF WAYNESBORO TO MINIMIZE INTERFERENCE WITH THESE ONGOING PROJECTS.
4. WORK IN THE WWTP BMAS WILL COINCIDE WITH DAILY MAINTENANCE ACTIVITIES CONDUCTED BY THE CITY OF WAYNESBORO IN THESE AREAS. THE CONTRACTOR WILL BE RESPONSIBLE FOR COORDINATING WORK WITH THE CITY OF WAYNESBORO TO MINIMIZE INTERFERENCE WITH ONGOING MAINTENANCE ACTIVITIES.
5. ALL EQUIPMENT, MATERIALS AND PERSONNEL SHALL REMAIN WITHIN THE PROJECT LIMITS.
6. ALL AFFECTED AREAS INCLUDING ROADS AND ACCESS ROUTES SHALL BE RESTORED TO ORIGINAL CONDITION . ALL DISTURBED AREAS OUTSIDE THE LIMITS OF DISTURBANCE SHALL BE RESTORED TO ORIGINAL CONDITION AT NO COST TO THE OWNER.
7. THE CONTRACTOR SHALL COORDINATE WITH THE THE CITY'S GREENWAY CONTRACTOR FOR WORK WITHIN THE CONSTITUTION PARK AREA TO AVOID CONFLICTS THAT MAY BE CAUSED BY WORKING IN THE SAME AREA.

GENERAL NOTES:

1. ALL WORK SHALL BE IN CONFORMANCE WITH EXISTING LABOR LAWS, SAFETY REQUIREMENTS, PERMIT CONDITIONS, AND OTHER REGULATIONS, AS REQUIRED BY THE CITY OF WAYNESBORO, THE STATE OF VIRGINIA, THE FEDERAL GOVERNMENT. THE CONTRACTOR SHOULD ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION, INCLUDING THE SAFTEY OF ALL PERSONS AND PROPERTY. THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND IS NOT LIMITED TO NORMAL WORKING HOURS. THE CONTRACTOR SHALL PROVIDE ADEQUATE SAFEGUARDS, SAFETY DEVICES, PROTECTIVE EQUIPMENT, FLAGGERS, AND ANY OTHER PRACTICES NEEDED TO PROTECT THE LIFE, HEALTH, AND SAFETY OF THE PUBLIC, AND TO PROTECT PROPERTY IN CONNECTION WITH THE PERFORMANCE OF THE WORK COVERED BY THE CONTRACT.
2. EXCEPT AS OTHERWISE NOTED HEREIN, ALL MATERIAL AND WORK SHALL BE ACCOMPLISHED IN ACCORDANCE WITH THE CONTRACT DOCUMENTS,CITY OF WAYNESBORO STANDARDS,THE VDOT "ROAD AND BRIDGE SPECIFICATIONS"(LATEST EDITION), OTHER APPLICABLE STANDARDS, AND ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.
3. THE CONTRACTOR SHALL HAVE COPIES OF THE APPROVED CONTRACT DOCUMENTS, PERMITS, AND THE VDOT "ROAD AND BRIDGE SPECIFICATIONS" (LATEST EDITION) ON THE JOB SITE AT ALL TIMES.
4. THE CONTRACTOR SHALL VISIT THE JOB SITE PRIOR TO CONSTRUCTION AND SHALL BE RESPONSIBLE FOR VERIFYING FIELD CONDITIONS AND DIMENSIONS AND CONFIRMING THAT THE WORK CAN BE ACCOMPLISHED AS SHOWN ON THESE DRAWINGS. ANY DISCREPANCIES BETWEEN THE EXISTING FIELD CONDITIONS AND DIMENSIONS SHOWN ON THE CONTRACT DOCUMENTS AND THOSE OBSERVED BY THE CONTRACTOR SHALL BE BROUGHT TO THE ATTENTION OF THE DSR PRIOR TO PROCEEDING WITH CONSTRUCTION.
5. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR ALL CONSTRUCTION MEANS, METHODS, TECHNIQUES, SEQUENCES, AND PROCEDURES AND FOR COORDINATING ALL PORTIONS OF THE WORK INCLUDED IN THE CONTRACT DOCUMENTS.
6. A PRE-CONSTRUCTION MEETING BETWEEN THE CONTRACTOR, DSR, AND THE CITY'S REPRESENTATIVE SHALL BE REQUIRED PRIOR TO ANY ON-SITE WORK.
7. THE CONTRACTOR SHALL MAKE ALL NECESSARY PROVISIONS TO PROTECT EXISTING IMPROVEMENTS, ROADWAYS, DRAINAGE WAYS, CULVERTS, AND VEGETATION UNTIL SUCH ITEMS ARE TO BE DISTURBED OR REMOVED AS INDICATED ON THE CONTRACT DOCUMENTS.
8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REPAIR OF PROPERTY IN AND AROUND THE PROJECT AREA. ITEMS AFFECTED BY CONSTRUCTION ACTIVITIES SHALL BE REPAIRED OR REPLACED FOLLOWING CONSTRUCTION.
9. THE CONTRACTOR SHALL RECEIVE, IN WRITING FROM DUPONT, AUTHORIZATION TO PROCEED BEFORE STARTING WORK ON ANY ITEM NOT CLEARLY DEFINED OR IDENTIFIED BY THE CONTRACT DOCUMENTS.
10. THE NOTES, DETAILS, AND SPECIFICATIONS ON THE CONTRACT DOCUMENTS SHALL TAKE PRECEDENCE OVER THESE GENERAL NOTES.
11. DIMENSION CALL-OUTS SHALL TAKE PRECEDENCE OVER SCALES SHOWN ON THE DRAWINGS.
12. THE CONTRACTOR SHALL MAINTAIN HAND DRAWN RED LINES, FIELD NOTES AND PHOTOGRAPHS ("FIELD DOCUMENTATION") OF ALL IMPROVEMENTS OR VARIATIONS AS THE WORK PROGRESSES. THE CONTRACTOR'S FIELD DOCUMENTATION SHALL BE MAINTAINED ON-SITE AND SHALL BE AVAILABLE FOR REVIEW BY THE DSR AT ALL TIMES.
13. THE PROJECT SHALL BE CONSTRUCTED TO MEET ALL PROVISIONS OF APPLICABLE PERMITS.
14. THE CONTRACTOR SHALL PROVIDE TEMPORARY CUT SLOPES AND TEMPORARY SHORING AS NECESSARY TO COMPLETE THE WORK. THE STABILITY OF ALL TEMPORARY SLOPES AND SHORING IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR.
15. THE CONTRACTOR SHALL KEEP THE WORK AREAS IN A CLEAN AND NEAT CONDITION FREE OF DEBRIS AND CLUTTER FOR THE DURATION OF THE PROJECT.
16. WWTP A BERM ELEVATION AT 1272.0 WHICH IS EQUIVALENT TO THE FEMA 100-YEAR FLOOD ELEVATION AS PER FEMA FLOOD INSURANCE STUDY AUGUSTA COUNTY VIRGINIA AND INCORPORATED AREAS, VOL. 2, 2010.

DETAIL AND SECTION REFERENCING:



EXISTING UTILITIES LEGEND

- GAS — HIGH PRESSURE GAS LINE
- OH — OVERHEAD POWER LINE
- SS — SANITARY SEWER LINE
- ST — STORM DRAIN
- W — WATER LINE
- - - - - UNKNOWN BURIED LINEAR FEATURE

COMMON NAME TREE ABBREVIATIONS

ABBREVIATION	COMMON TREE NAME
AB	American Basswood
AM	Ash-Leaf Maple
AS	American Sycamore
BC	Black Cherry
BH	Bitter-Nut Hickory
BL	Black Locust
BW	Black Walnut
BWi	Black Willow
CH	Common Hackberry
EH	Eastern Hop-Hornbeam
HS	Honeysuckle sp.
NC	Northern Catalpa
NM	Norway Maple
SC	Sweet Cherry
SE	Slippery Elm
SH	Shell-Bark Hickory
SM	Silver Maple
TH	Tree-of-Heaven
UKN	Unknown

TABLE 1. PROPOSED DISTURBANCE IN REGULATED AREAS

BANK MANAGEMENT AREA (BMA)	PLAN SHEET NUMBER	LINEAR FEET BELOW OHW	AREA OF DISTURBANCE BELOW ORDINARY HIGH WATER (ACRES)		NET FILL BELOW ORDINARY HIGH WATER (CUBIC YARDS)	
			PERMANENT	TEMPORARY	PERMANENT	TEMPORARY
WWTP A	25-26	520	0.12	0.31	365	0
WWTP B	27	115	0.02	0.10	67	0
TOTAL		635	0.14	0.41	432	0

NOTE: THE PROPOSED PROJECT WILL NOT RESULT IN DISTURBANCE TO WETLANDS.

ABBREVIATIONS

ABBRV	ABBREVIATION
AQ	ANCHOR QEA
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
BLDG	BUILDING
BMA	BANK MANAGEMENT AREA
BODR	BASIS OF DESIGN REPORT
CB	CATCH BASIN
CONC	CONCRETE
CONT	CONTINUED OR CONTINUOUS
CMP	CORRUGATED METAL PIPE
CP	CONTROL POINT (SURVEYED)
CPE	CORRUGATED POLYETHYLENE
CRZ	CROWN ROOT ZONE
CY	CUBIC YARD
DBH	DIAMETER BREAST HEIGHT
DGPS	DIFFERENTIAL GLOBAL POSITIONING SYSTEM
DI	DUCTILE IRON
DIA	DIAMETER
DSR	DUPONT SITE REPRESENTATIVE
DWG	DRAWING
E	EAST
EA	EACH
EAA	EARLY ACTION AREA
EL, ELEV	ELEVATION
EX	EXISTING
FT	FOOT OR FEET
FS	FINISHED SURFACE
FTG	FOOTING
IE	INVERT ELEVATION
IN	INCH OR INCHES
LS	LUMP SUM
LWA	LENGTH-WEIGHTED AVERAGE
MAX	MAXIMUM
MH	MANHOLE, MAINTENANCE HOLE
MIN	MINIMUM
MISC	MISCELLANEOUS
MHHW	MEAN HIGHER HIGH WATER
MLLW	MEAN LOWER LOW WATER
N	NORTH
NAD	NORTH AMERICAN DATUM
NAVD	NORTH AMERICAN VERTICAL DATUM
NPDES	NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
OC	ON CENTER
OHWM	ORDINARY HIGH WATER MARK
PE	PROFESSIONAL ENGINEER, POLYETHYLENE
PVC	POLYVINYL CHLORIDE
RCP	REINFORCED CONCRETE PIPE
ROW	RIGHT OF WAY
S	SOUTH
SD	STORM DRAIN
SF	SQUARE FOOT OR FEET
SHT	SHEET
SPEC	SPECIFICATION
STA	STATION
STD	STANDARD
STRUCT	STRUCTURE, STRUCTURAL
TESC	TEMPORARY EROSION AND SEDIMENT CONTROL
TYP	TYPICAL
UBLF	UNKNOWN BURIED LINEAR FEATURE (SURVEY NOTE 4)
VDOT	VIRGINIA DEPARTMENT OF TRANSPORTATION
W	WEST
WSEL	WATER SURVEY ELEVATION
WWTP	WASTE WATER TREATMENT PLANT

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APPROVED CONSTRUCTION PLAN SET

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ANCHOR QEA

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REVISIONS

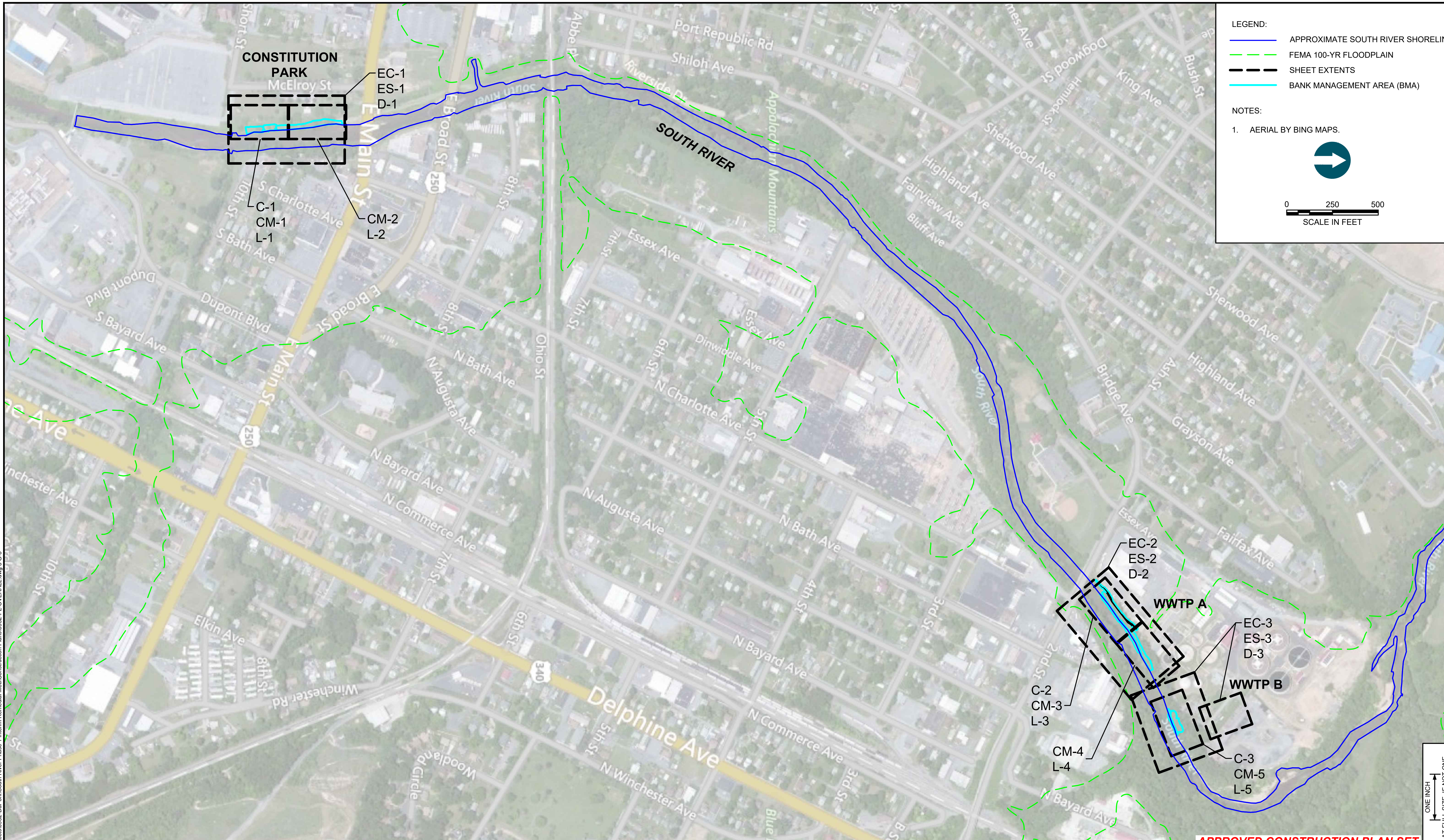
REV	DATE	BY	APP'D	DESCRIPTION
1	5/26/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1
2	10/19/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #2

DESIGNED BY: S. HAFFEY
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

LEGENDS, ABBREVIATIONS AND GENERAL NOTES

G-2



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7/14/17

REVISIONS

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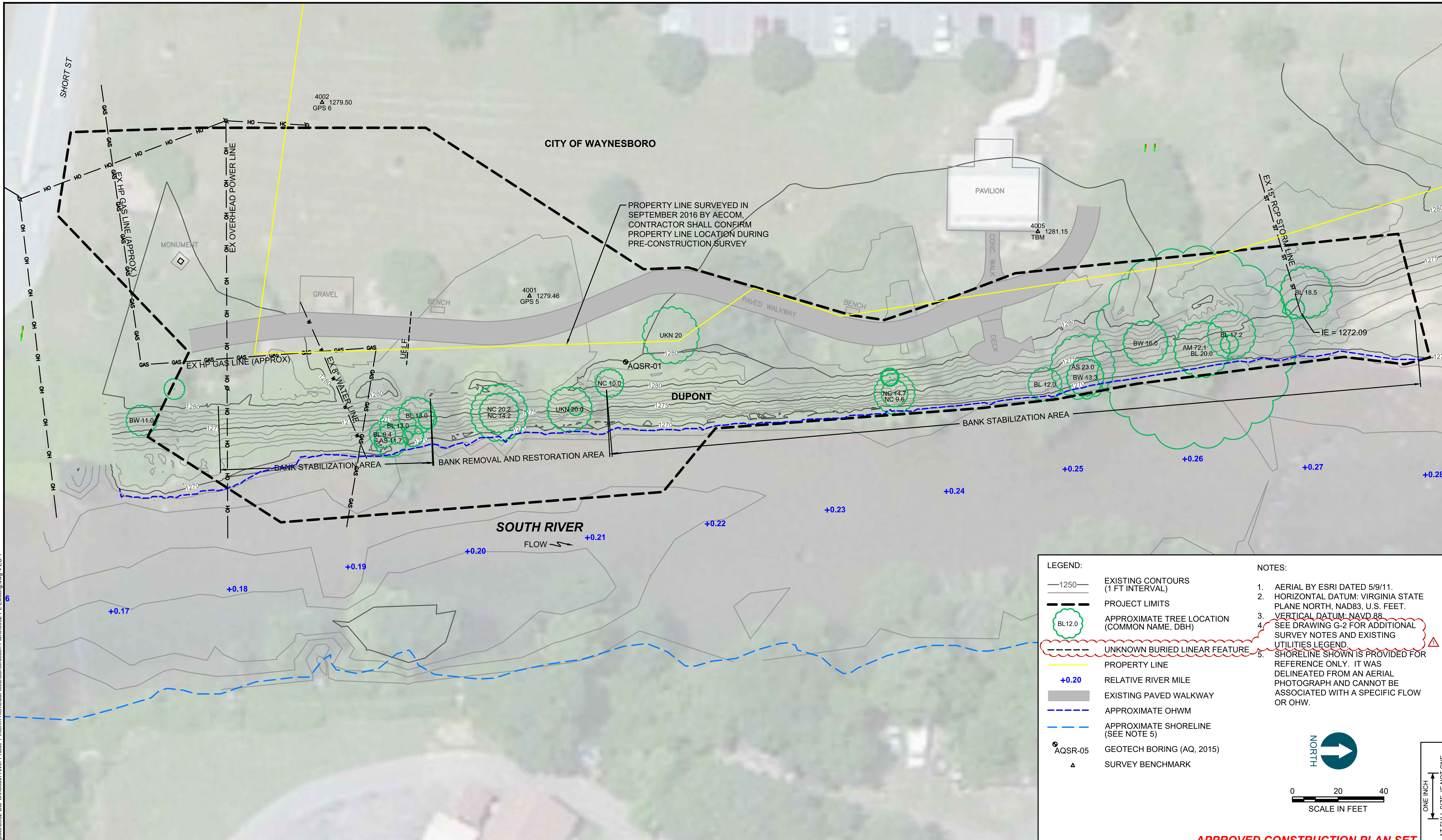
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

SHEET LAYOUT

G-3

SHEET NO. 3 OF 42



LEGEND:

—1250—	EXISTING CONTOURS (1 FT INTERVAL)
	PROJECT LIMITS
BL12.0	APPROXIMATE TREE LOCATION (COMMON NAME, DBH)
	UNKNOWN BURIED LINEAR FEATURE
	PROPERTY LINE
+0.20	RELATIVE RIVER MILE
	EXISTING PAVED WALKWAY
	APPROXIMATE OHWM
	APPROXIMATE SHORELINE (SEE NOTE 5)
AQSR-05	GEOTECH BORING (AQ, 2015)
	SURVEY BENCHMARK

NOTES:

1. AERIAL BY ESRI DATED 5/9/11.
2. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
3. VERTICAL DATUM: NAVD 88.
4. SEE DRAWING G-2 FOR ADDITIONAL SURVEY NOTES AND EXISTING UTILITIES LEGEND.
5. SHORELINE SHOWN IS PROVIDED FOR REFERENCE ONLY. IT WAS DELINEATED FROM AN AERIAL PHOTOGRAPH AND CANNOT BE ASSOCIATED WITH A SPECIFIC FLOW OR OHW.

NORTH

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SCALE IN FEET

ONE INCH AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

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DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
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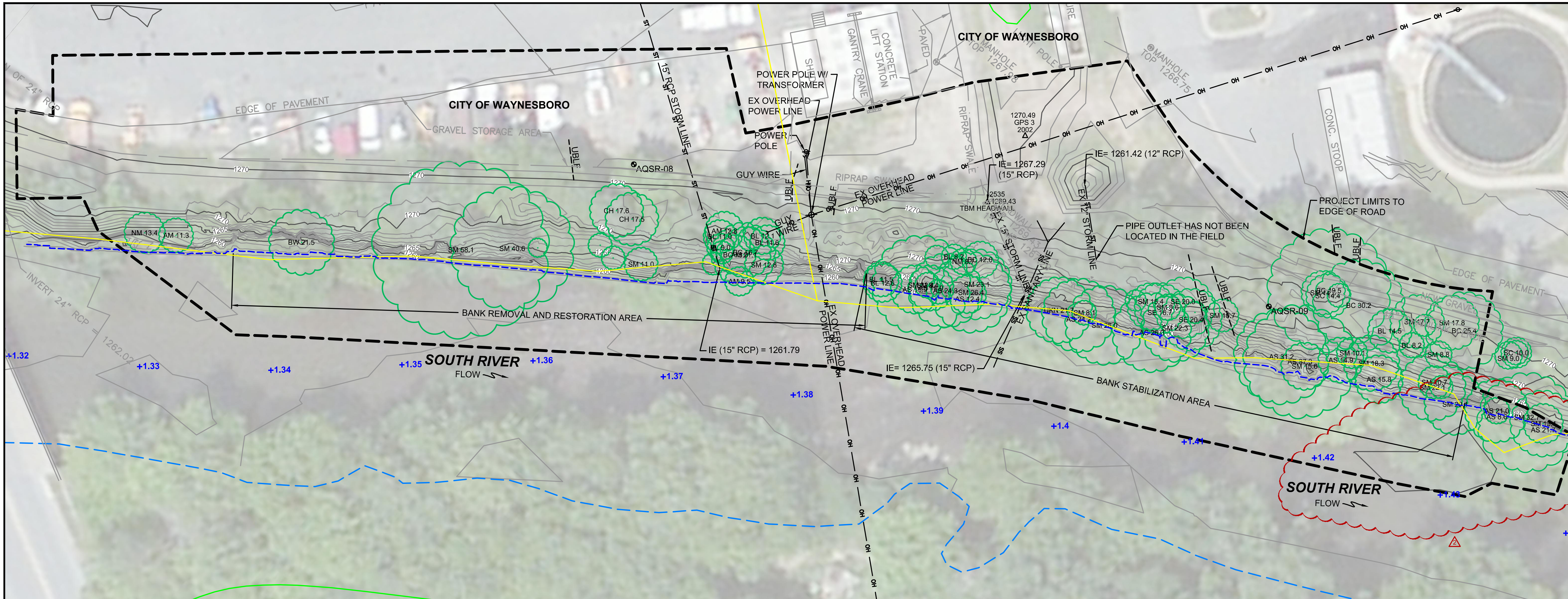
SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

EXISTING CONDITIONS PLAN -
CONSTITUTION PARK BMA

EC-1

SHEET NO. 4 OF 42



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APPROVED CONSTRUCTION PLAN SET

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Nov 16, 2017 12:15pm tgriga

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10/19/17

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APPROVED BY: W. DINICOLA
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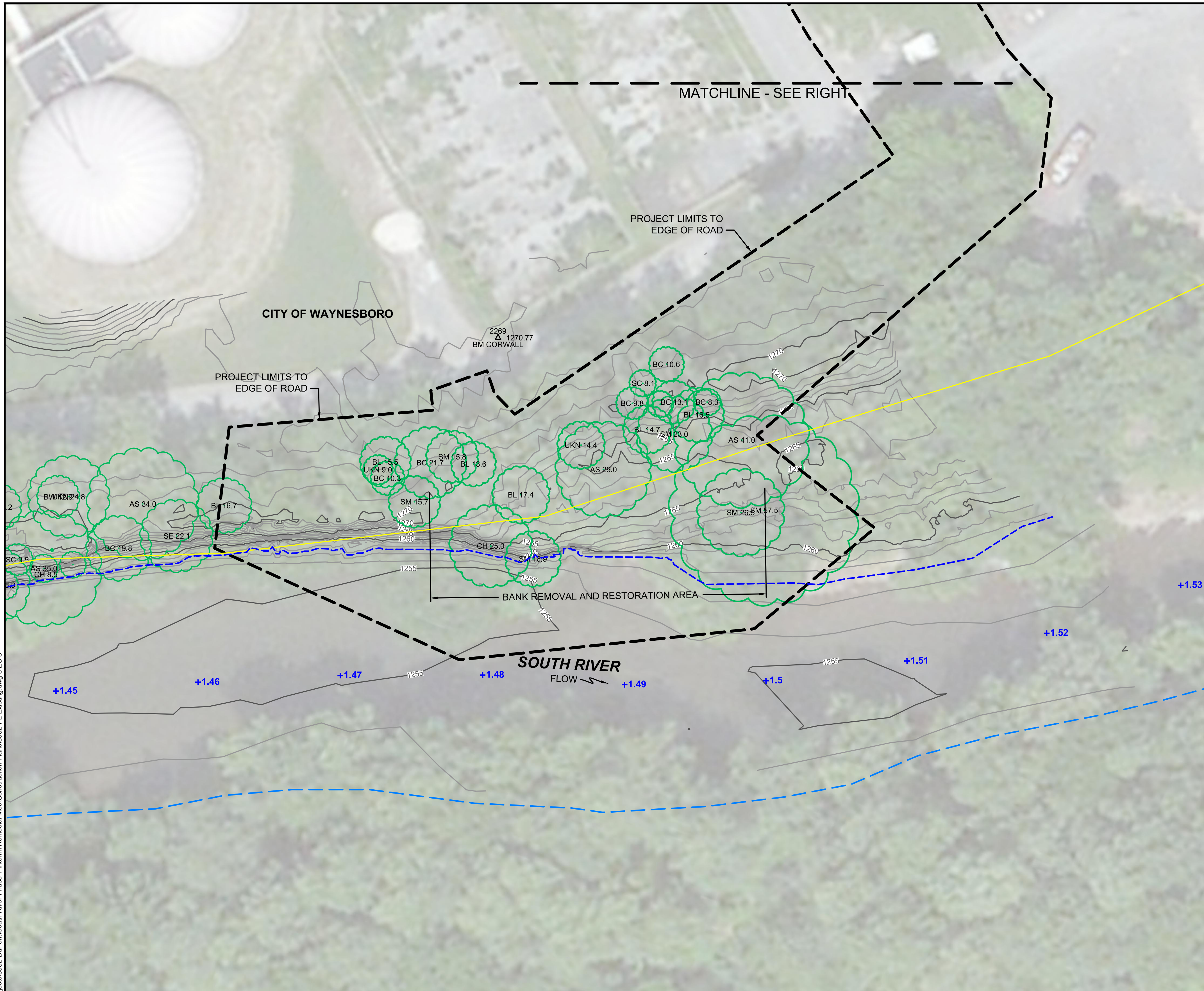
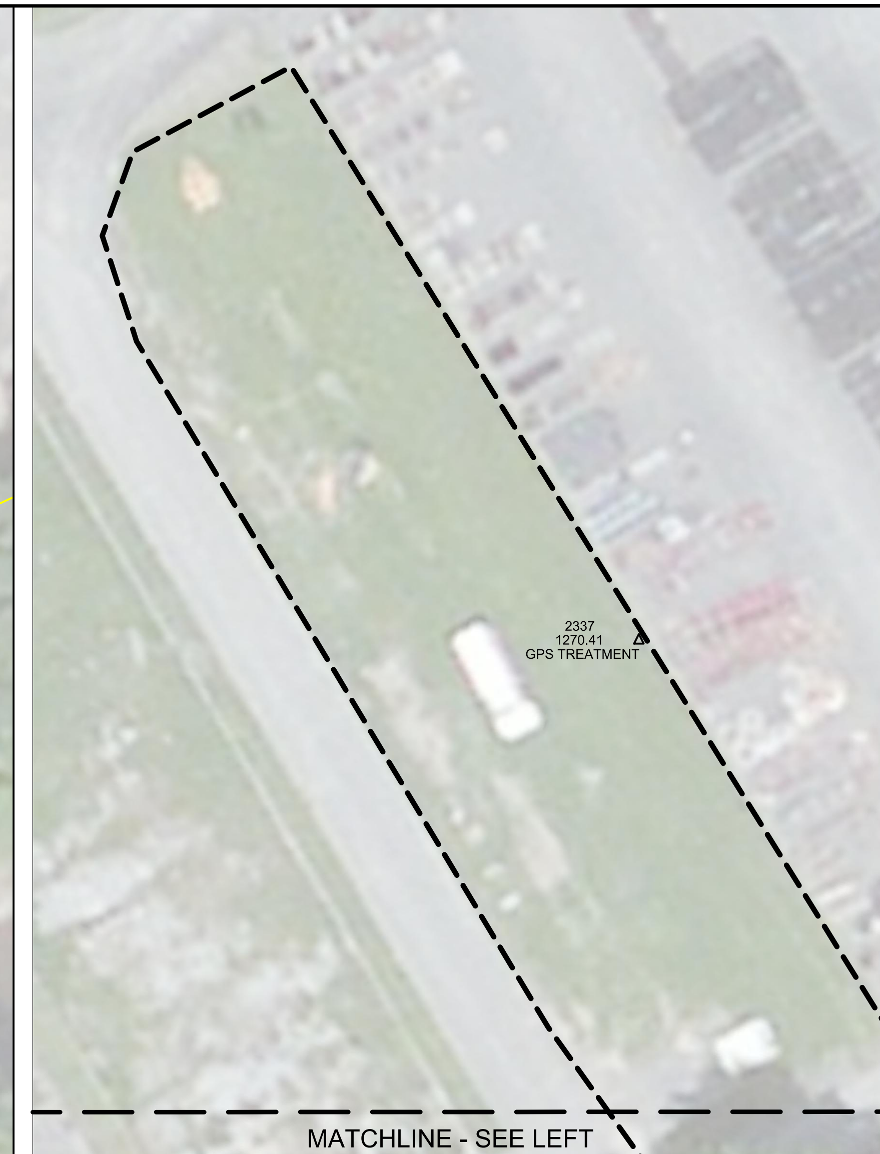
SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

EXISTING CONDITIONS PLAN -
WWTP A BMA

EC-2

SHEET NO. 5 OF 42





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0 20 40
SCALE IN FEET

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

K:\Projects\0952-DuPont\South River Phase 1 Interim Remedial Mea\Construction Plans\0952-PL-Existing.dwg 6 EC-3
Jul 25, 2017 9:54am tgriga

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1

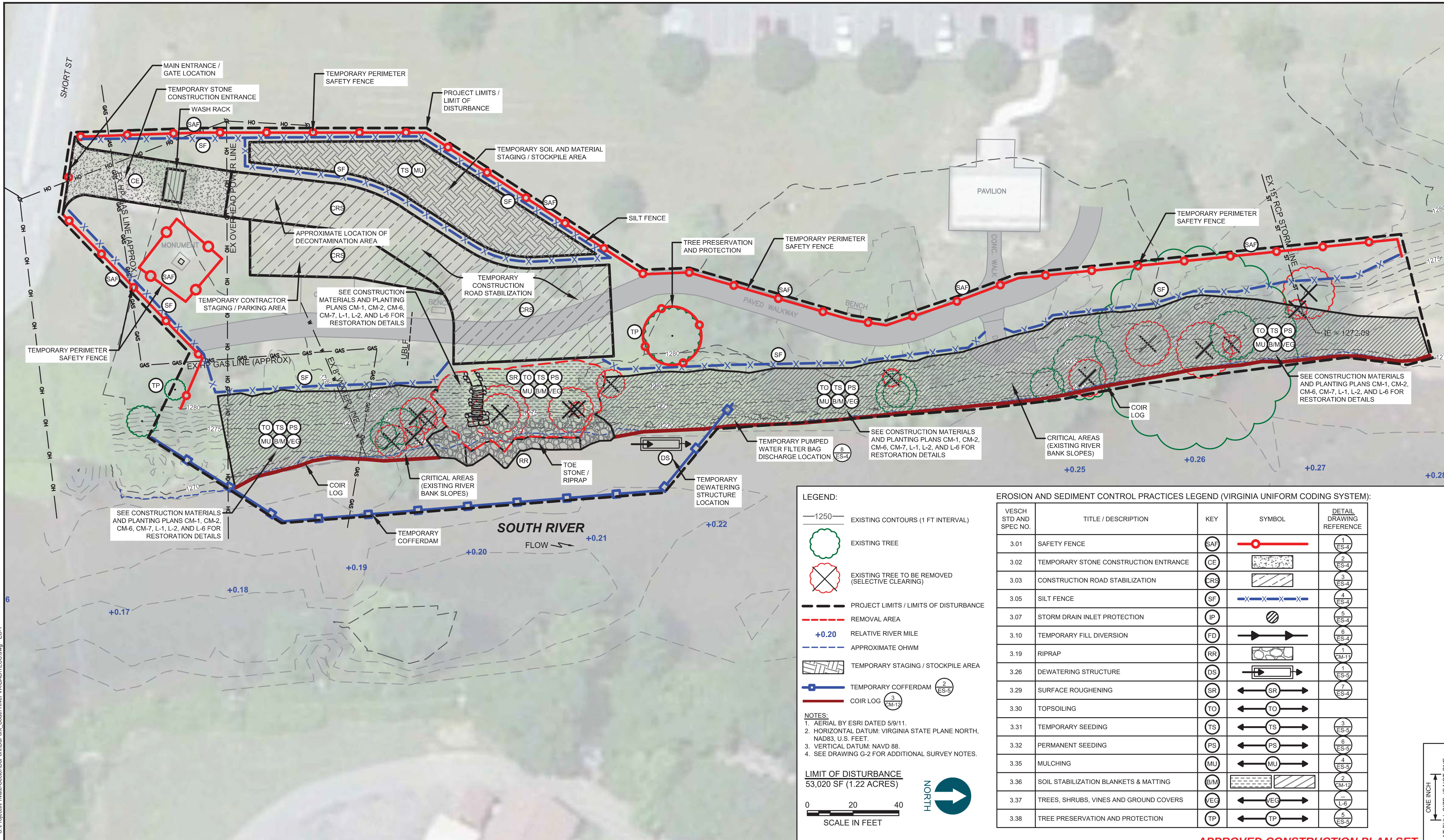
DESIGNED BY: S. HAFFEY
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

EXISTING CONDITIONS PLAN -
WWTP B BMA

EC-3

SHEET NO. 6 OF 42



LEGEND:

- 1250 — EXISTING CONTOURS (1 FT INTERVAL)
- EXISTING TREE
- EXISTING TREE TO BE REMOVED (SELECTIVE CLEARING)
- PROJECT LIMITS / LIMITS OF DISTURBANCE
- REMOVAL AREA
- +0.20 RELATIVE RIVER MILE
- APPROXIMATE OHWM
- TEMPORARY STAGING / STOCKPILE AREA
- TEMPORARY COFFERDAM (2/ES-5)
- COIR LOG (3/CM-12)

NOTES:

1. AERIAL BY ESRI DATED 5/9/11.
2. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
3. VERTICAL DATUM: NAVD 88.
4. SEE DRAWING G-2 FOR ADDITIONAL SURVEY NOTES.

LIMIT OF DISTURBANCE
53,020 SF (1.22 ACRES)

0 20 40
SCALE IN FEET

NORTH

EROSION AND SEDIMENT CONTROL PRACTICES LEGEND (VIRGINIA UNIFORM CODING SYSTEM):

VESCH STD AND SPEC NO.	TITLE / DESCRIPTION	KEY	SYMBOL	DETAIL DRAWING REFERENCE
3.01	SAFETY FENCE	SAF		1/ES-4
3.02	TEMPORARY STONE CONSTRUCTION ENTRANCE	CE		2/ES-4
3.03	CONSTRUCTION ROAD STABILIZATION	CRS		3/ES-4
3.05	SILT FENCE	SF		4/ES-4
3.07	STORM DRAIN INLET PROTECTION	IP		5/ES-4
3.10	TEMPORARY FILL DIVERSION	FD		6/ES-4
3.19	RIPRAP	RR		1/CM-11
3.26	DEWATERING STRUCTURE	DS		1/ES-5
3.29	SURFACE ROUGHENING	SR	SR	7/ES-4
3.30	TOPSOILING	TO	TO	
3.31	TEMPORARY SEEDING	TS	TS	3/ES-5
3.32	PERMANENT SEEDING	PS	PS	6/ES-5
3.35	MULCHING	MU	MU	4/ES-5
3.36	SOIL STABILIZATION BLANKETS & MATTING	B/M		2/CM-12
3.37	TREES, SHRUBS, VINES AND GROUND COVERS	VEG	VEG	—/L-6
3.38	TREE PRESERVATION AND PROTECTION	TP	TP	5/ES-5

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

ANCHOR QEA
AECOM

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
DONALD FRANKLIN MAYER, III
No. 029879
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. JERRYTONE
DRAWN BY: J. JERRYTONE
CHECKED BY: D. MAYER
APPROVED BY: D. MAYER
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

TESC AND CARE OF WATER PLAN -
CONSTITUTION PARK BMA

ES-1

SHEET NO. 7 OF 42

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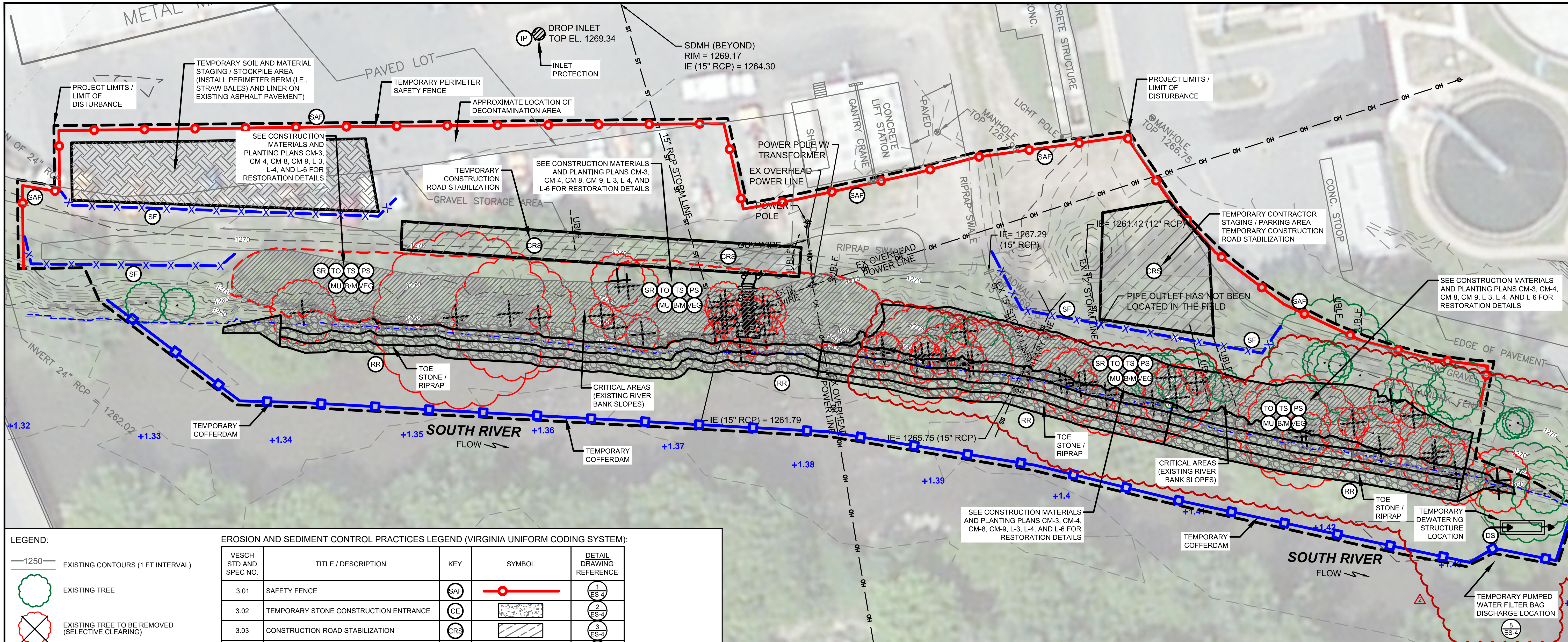
Jul 25, 2017 1:32pm jason.jerrytone



LEGEND:

- 1250 EXISTING CONTOURS (1 FT INTERVAL)
- EXISTING TREE
- EXISTING TREE TO BE REMOVED (SELECTIVE CLEARING)
- PROJECT LIMITS / LIMITS OF DISTURBANCE
- REMOVAL AREA
- +0.20 RELATIVE RIVER MILE
- APPROXIMATE OHWM
- TEMPORARY STAGING / STOCKPILE AREA
- TEMPORARY COFFERDAM (2 / ES-5)
- COIR LOG (3 / CM-12)

NOTES:
1. AERIAL BY ESRI DATED 5/9/11.
2. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
3. VERTICAL DATUM: NAVD 88.
4. SEE DRAWING G-2 FOR ADDITIONAL SURVEY NOTES.

LIMIT OF DISTURBANCE
64,092 SF (1.47 ACRES) 2

0 20 40
SCALE IN FEET

NORTH

EROSION AND SEDIMENT CONTROL PRACTICES LEGEND (VIRGINIA UNIFORM CODING SYSTEM):

VESCH STD AND SPEC NO.	TITLE / DESCRIPTION	KEY	SYMBOL	DETAIL DRAWING REFERENCE
3.01	SAFETY FENCE	SAF		1 / ES-4
3.02	TEMPORARY STONE CONSTRUCTION ENTRANCE	CE		2 / ES-4
3.03	CONSTRUCTION ROAD STABILIZATION	CRS		3 / ES-4
3.05	SILT FENCE	SF		4 / ES-4
3.07	STORM DRAIN INLET PROTECTION	IP		5 / ES-4
3.10	TEMPORARY FILL DIVERSION	FD		6 / ES-4
3.19	RIPRAP	RR		1 / CM-11
3.26	DEWATERING STRUCTURE	DS		1 / ES-5
3.29	SURFACE ROUGHENING	SR	SR	7 / ES-4
3.30	TOPSOILING	TO	TO	
3.31	TEMPORARY SEEDING	TS	TS	3 / ES-5
3.32	PERMANENT SEEDING	PS	PS	6 / ES-5
3.35	MULCHING	MU	MU	4 / ES-5
3.36	SOIL STABILIZATION BLANKETS □ MATTING	B/M		2 / CM-12
3.37	TREES, SHRUBS, VINES AND GROUND COVERS	VEG	VEG	-- / L-6
3.38	TREE PRESERVATION AND PROTECTION	TP	TP	5 / ES-5

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

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Oct 19, 2017 2:36pm jason jerr□tone

ANCHOR QEA
AECOM

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
DONALD FRANKLIN MAYER, III
No. 029879
PROFESSIONAL ENGINEER
10/19/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	JRJ	DFM	REVISED WWTP FINAL DESIGN SET #1
2	10/19/17	JRJ	DFM	REVISED WWTP FINAL DESIGN SET #2

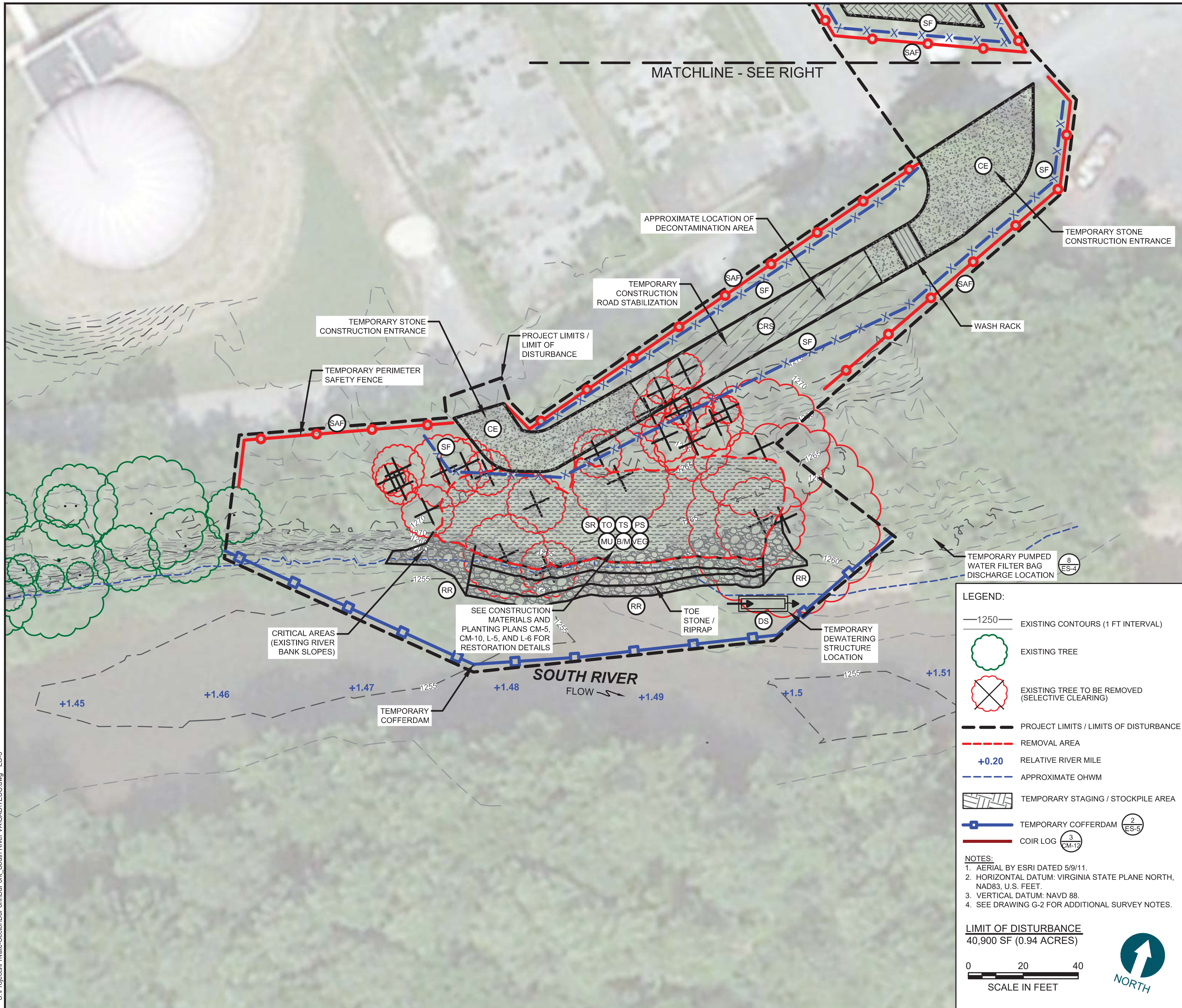
DESIGNED BY: J. JERRYTONE
DRAWN BY: J. JERRYTONE
CHECKED BY: D. MAYER
APPROVED BY: D. MAYER
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

TESC AND CARE OF WATER PLAN
- WWTP A BMA

ES-2

SHEET NO. 8 OF 42



LEGEND:

- 1250 — EXISTING CONTOURS (1 FT INTERVAL)
- EXISTING TREE
- EXISTING TREE TO BE REMOVED (SELECTIVE CLEARING)
- PROJECT LIMITS / LIMITS OF DISTURBANCE
- REMOVAL AREA
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NOTES:

1. AERIAL BY ESRI DATED 5/9/11.
2. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
3. VERTICAL DATUM: NAVD 88.
4. SEE DRAWING G-2 FOR ADDITIONAL SURVEY NOTES.

LIMIT OF DISTURBANCE
40,900 SF (0.94 ACRES)

0 20 40
SCALE IN FEET

NORTH

EROSION AND SEDIMENT CONTROL PRACTICES LEGEND (VIRGINIA UNIFORM CODING SYSTEM):

VESCH STD AND SPEC NO.	TITLE / DESCRIPTION	KEY	SYMBOL	DETAIL DRAWING REFERENCE
3.01	SAFETY FENCE	SAF		1 / ES-4
3.02	TEMPORARY STONE CONSTRUCTION ENTRANCE	CE		2 / ES-4
3.03	CONSTRUCTION ROAD STABILIZATION	CRS		3 / ES-4
3.05	SILT FENCE	SF		4 / ES-4
3.07	STORM DRAIN INLET PROTECTION	IP		5 / ES-4
3.10	TEMPORARY FILL DIVERSION	FD		6 / ES-4
3.19	RIPRAP	RR		1 / CM-11
3.26	DEWATERING STRUCTURE	DS		1 / ES-5
3.29	SURFACE ROUGHENING	SR	SR	7 / ES-4
3.30	TOPSOILING	TO	TO	
3.31	TEMPORARY SEEDING	TS	TS	3 / ES-5
3.32	PERMANENT SEEDING	PS	PS	6 / ES-5
3.35	MULCHING	MU	MU	4 / ES-5
3.36	SOIL STABILIZATION BLANKETS & MATTING	B/M		2 / CM-12
3.37	TREES, SHRUBS, VINES AND GROUND COVERS	VEG	VEG	— / L-6
3.38	TREE PRESERVATION AND PROTECTION	TP	TP	5 / ES-5

APPROVED CONSTRUCTION PLAN SET

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA
AECOM

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
DONALD FRANKLIN MAYER, III
No. 029879
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. JERRYTONE
DRAWN BY: J. JERRYTONE
CHECKED BY: D. MAYER
APPROVED BY: D. MAYER
SCALE: AS NOTED
DATE: AUGUST 2016

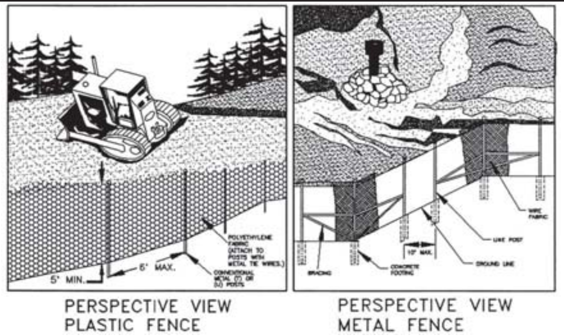
SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

TESC AND CARE OF WATER PLAN
- WWTP B BMA

ES-3

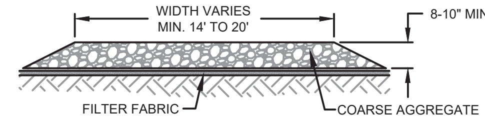
SHEET NO. 9 OF 42

Jul 25, 2017 1:36pm jason jerrytone S:\Projects\Private-Sector\DuPont\DuPont_South River VA\CAD\TESC.dwg ES-3



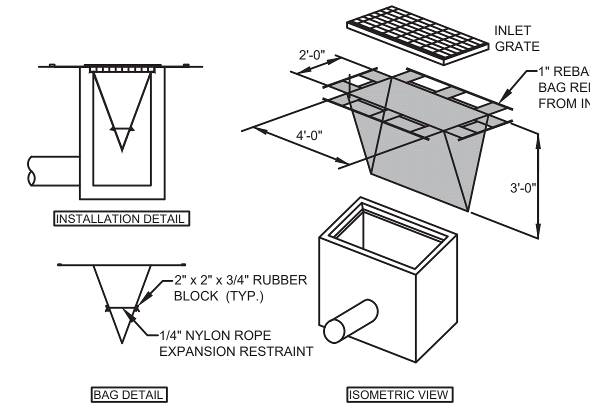
NOTES:
1. SAFETY FENCES SHALL BE LOCATED TO CREATE A FORMIDABLE BARRIER TO UNDESIRED ACCESS, WHILE ALLOWING FOR THE CONTINUATION OF CONSTRUCTION ACTIVITIES.
2. WORK AREA / HAZARD SIGNS SHALL BE POSTED IMMEDIATELY UPON INSTALLATION OF SAFETY FENCE.
3. SAFETY FENCES SHALL BE INSTALLED PRIOR TO E&SC MEASURES BECOMING ACCESSIBLE.
4. PLASTIC FENCE
   A. HEIGHT SHALL BE MINIMUM FIVE (5) FEET.
   B. PHYSICAL PROPERTIES INCLUDE (SOURCE: CONWED PLASTICS):
      - RECOMMENDED COLOR: "INTERNATIONAL" ORANGE
      - TENSILE YIELD (ASTM D638): AVERAGE 2000 LBS. / 4 FOOT WIDTH
      - ULTIMATE TENSILE STRENGTH (ASTM D638): AVERAGE 2900 LBS. / 4 FOOT WIDTH
      - ELONGATION AT BREAK (%) (ASTM D638): GREATER THAN 1000%
      - CHEMICAL RESISTANCE: INERT TO MOST CHEMICALS AND ACIDS
   C. POLYETHYLENE WEB SHALL BE SECURED TO A CONVENTIONAL METAL "T" OR "U" POST DRIVEN INTO THE GROUND A MINIMUM DEPTH OF 18 INCHES; POSTS SPACED T 6-FOOT CENTERS OR OTHER APPROVED METHOD.
5. METAL FENCE
   A. LINE POSTS SHALL BE PLACED AT 10 FOOT INTERVALS.
   B. POSTS SHALL BE SET IN CONCRETE AND BACKFILLED OR ANCHORED BY OTHER ACCEPTABLE MEANS.
   C. ALL CORNER POSTS, END POSTS, GATE POSTS, AND PULL POSTS SHALL BE EMBEDDED, BRACED, AND TRUSSED.
   D. FOR CONCRETE FOOTINGS, FABRIC SHALL NOT BE STRETCHED UNTIL AT LEAST 14 DAYS AFTER POSTS ARE SET INTO CONCRETE.
   E. FABRIC SHALL BE STRETCHED TAUT AND SECURELY FASTENED BY MEANS OF TIE CLIPS TO THE POSTS AT INTERVALS NO EXCEEDING 15 INCHES AND TO THE TOP RAILS OR TENSION WIRES AT INTERVALS NOT EXCEEDING 2 FEET.

1 SAFETY FENCE (SAF)
\- SCALE: NTS VESCH STD & SPEC 3.01



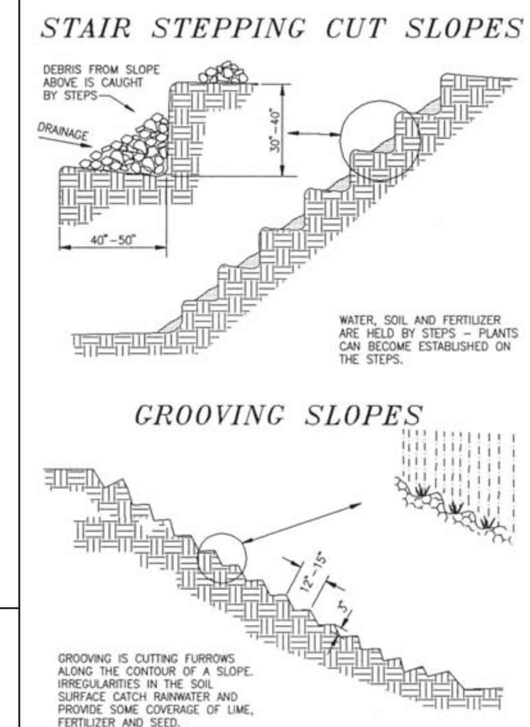
NOTES:
1. TEMPORARY ROADS SHALL FOLLOW THE CONTOUR OF THE NATURAL TERRAIN TO THE EXTENT POSSIBLE. SLOPES SHALL NOT EXCEED 10 PERCENT.
2. TEMPORARY PARKING / STAGING AREAS SHALL BE LOCATED ON NATURALLY FLAT AREAS TO MINIMIZE GRADING. GRADES SHALL BE SUFFICIENT TO PROVIDE DRAINAGE BUT SHOULD NOT EXCEED 4 PERCENT.
3. ROADBEDS SHALL BE AT LEAST 14 FEET WIDE FOR ONE-WAY TRAVEL AND 20 FEET WIDE FOR TWO-WAY TRAFFIC.
4. ALL CUTS SHALL BE 2:1 OR FLATTER TO THE EXTENT POSSIBLE.
5. AN 8 TO 10-INCH COARSE OF VDOT #1 COARSE AGGREGATE SHALL BE PLACED ON TOP OF A FILTER FABRIC. SEE CONSTRUCTION ENTRANCE DETAILS REGARDING FILTER FABRIC SPECIFICATIONS.

3 CONSTRUCTION ROAD STABILIZATION (CRS)
\- SCALE: NTS VESCH STD & SPEC 3.03



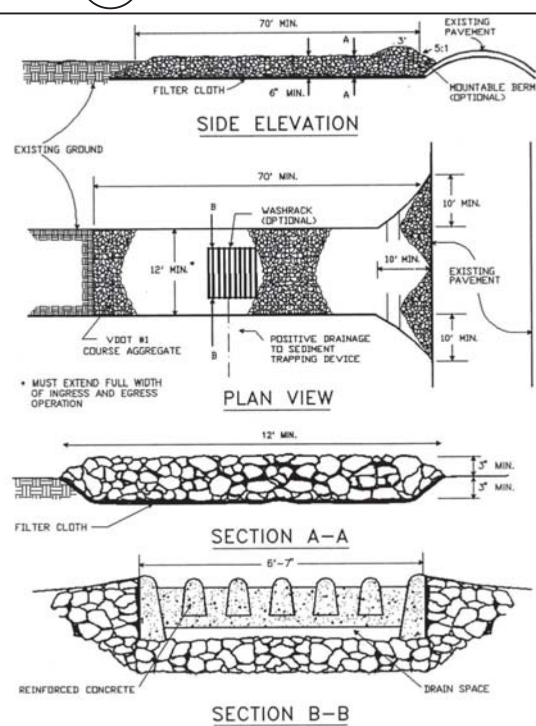
NOTES:
1. THE PROTECTION DEVICE WILL CAPTURE OR FILTER RUNOFF FROM THE 1 YEAR, 24 HOUR STORM EVENT.
2. THE CONTRACTOR SHALL CLEAN THE INLET FILTER AFTER EVERY STORM EVENT.
3. INSPECTIONS SHALL BE FREQUENT, MAINTENANCE, REPAIR AND REPLACEMENT SHALL BE MADE PROMPTLY, AS NEEDED. THE INLET PROTECTION SHALL BE REMOVED WHEN THE AREA DRAINING TOWARDS THE INLETS HAS BEEN STABILIZED.

5 STORM DRAIN INLET PROTECTION (IP)
\- SCALE: NTS VESCH STD & SPEC 3.07



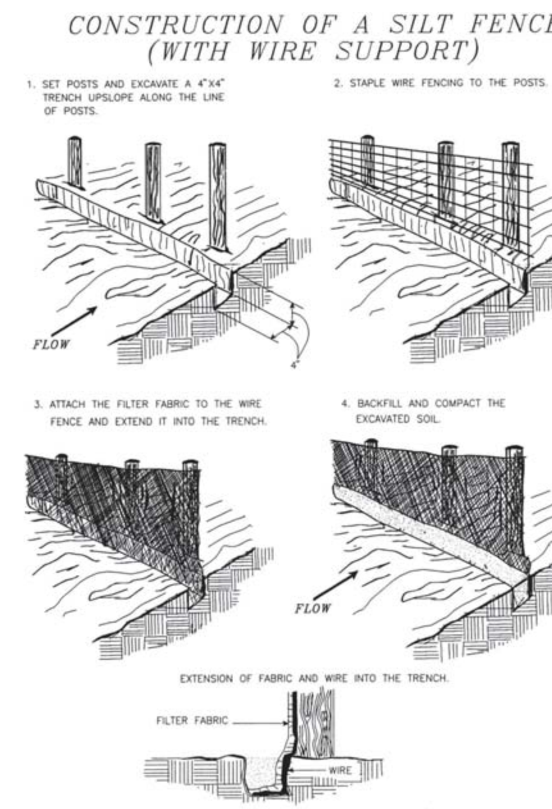
NOTES:
1. CUT OR GRADED SLOPES WHERE GEOCELL WILL BE INSTALLED SHOULD NOT BE ROUGHENED. CUT SLOPES STEEPER THAN 3H:1V ABOVE THE LIMIT OF GEOCELL INSTALLATION REQUIRE SURFACE ROUGHENING WITH EITHER STAIR-STEP GRADING OR FURROWING.
2. RESTORED SLOPES IN BANK REMOVAL AND RESTORATION AREAS SHOULD HAVE SOIL SURFACE LIGHTLY ROUGHENED AND LOOSE TO A DEPTH OF 2 TO 4 INCHES PRIOR TO SEEDING.
3. AREAS WHICH HAVE BEEN GRADED AND WILL NOT BE STABILIZED IMMEDIATELY MAY BE ROUGHENED TO REDUCE RUNOFF VELOCITY UNTIL SEEDING AND OTHER STABILIZATION PRODUCTS ARE INSTALLED.
4. SLOPES WITH EXISTING STABLE ROCK FACES (ROCK OUTCROPS) DO NOT REQUIRE ROUGHENING.

7 SURFACE ROUGHENING
\- SCALE: NTS VESCH STD & SPEC 3.29



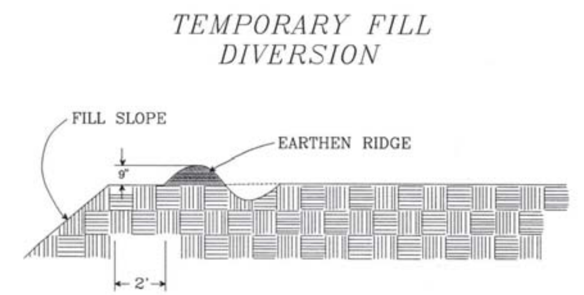
NOTES:
1. AGGREGATE: VDOT #1 COARSE AGGREGATE (2 TO 3 INCH) SHALL BE USED. AGGREGATE LAYER SHALL BE MINIMUM 6-INCHES THICK; A MINIMUM OF 3-INCHES OF AGGREGATE SHALL BE PLACED IN A CUT SECTION TO GIVE THE ENTRANCE ADDED STABILITY AND TO SECURE THE FILTER CLOTH SEPARATOR. AGGREGATE SHALL EXTEND THE FULL WIDTH OF THE VEHICULAR INGRESS AND EGRESS AREA(S) AND SHALL HAVE A MINIMUM 12-FOOT WIDTH.
2. THE LENGTH OF THE ENTRANCE SHALL BE A MINIMUM 70 FEET IF PROJECT LIMITS PERMIT. TRUCK TIRES WILL ALSO BE WASHED WITHIN CONTAINED DECONTAMINATION / WASH PAD AREAS AND REMAIN ON TEMPORARY, STABILIZED CONSTRUCTION ACCESS ROADS AND/OR EXISTING PAVED DRIVEWAYS TO THE EXTENT POSSIBLE.
3. FILTER FABRIC LINER SHALL BE WOVEN OR NONWOVEN FABRIC AND SHALL BE PLACED THE FULL WIDTH AND LENGTH OF THE ENTRANCE. FILTER FABRICS MAY INCLUDE TREVIRA SPUNBOND 1135, MIRAFI 600X, OR EQUIVALENT. CONSTRUCTION SPECIFICATIONS FOR FILTER FABRIC LINER INCLUDE:
   A. GRAB TENSILE STRENGTH: 220 LBS (ASTM D1682)
   B. ELONGATION AT FAILURE: 220% (ASTM D1682)
   C. MULLEN BURST STRENGTH: 430 LBS (ASTM D3786)
   D. PUNCTURE STRENGTH: 125 LBS (ASTM D751 MODIFIED)
   E. EQUIVALENT OPENING SIZE: 40-80 mm (U.S. STANDARD SIEVE CW-02215)

2 TEMPORARY STONE CONSTRUCTION ENTRANCE (CE)
\- SCALE: NTS VESCH STD & SPEC 3.02



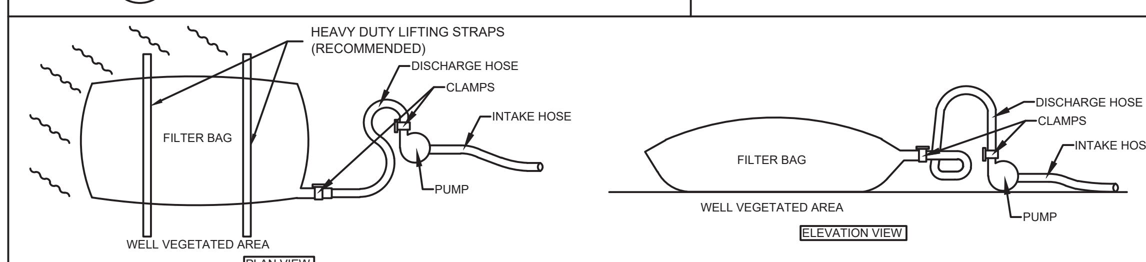
NOTES:
1. SYNTHETIC FILTER FABRIC SHALL BE A PERVIOUS SHEET OF PROPYLENE, NYLON, POLYESTER, OR ETHYLENE YARN AND SHALL BE CERTIFIED BY THE MANUFACTURER OR SUPPLIER FOR THE FOLLOWING:
   A. FILTERING EFFICIENCY: 75% MINIMUM (ASTM 5141)
   B. TENSILE STRENGTH AT 20% (MAXIMUM) ELONGATION: EXTRA STRENGTH - 50 LBS / LINEAR INCH (MINIMUM) (TEST METHOD VTM-52)
   C. FLOW RATE: 0.2 GAL / SF-MIN (MINIMUM) (ASTM 5141)
   D. ULTRAVIOLET RADIATION STABILITY %: 90% (MINIMUM) (ASTM G26)
2. WOODEN STAKES SHALL HAVE A DIAMETER OF 2 INCHES WHEN OAK IS USED AND 4 INCHES WHEN PINE IS USED. WOODEN STAKES SHALL HAVE A MINIMUM LENGTH OF 5 FEET.
3. STEEL POSTS (STANDARD "U" OR "T" SECTION) SHALL HAVE A MINIMUM WEIGHT OF 1.33 POUNDS PER LINEAR FOOT AND SHALL HAVE A MINIMUM LENGTH OF 5 FEET.
4. WIRE FENCE REINFORCEMENT USING STANDARD-STRENGTH FILTER CLOTH SHALL BE A MINIMUM OF 14 GAUGE AND SHALL HAVE A MAXIMUM MESH SPACING OF 6 INCHES.
5. HEIGHT OF SILT FENCE SHALL BE A MINIMUM OF 16-INCHES ABOVE THE ORIGINAL GROUND SURFACE AND SHALL NOT EXCEED 34-INCHES ABOVE GROUND ELEVATION.
6. FILTER FABRIC SHALL BE A CONTINUOUS ROLL CUT TO THE LENGTH OF THE BARRIER TO AVOID THE USE OF JOINTS. WHERE JOINTS ARE UNAVOIDABLE, FILTER CLOTH SHALL BE SPLICED TOGETHER ONLY AT A SUPPORT POST, WITH A MINIMUM OF 6-INCH OVERLAP, AND SECURELY SEALED.
7. TRENCH SHALL BE EXCAVATED APPROXIMATELY 4-INCHES WIDE AND 4-INCHES DEEP ON THE UPSLOPE SIDE OF THE PROPOSED LOCATION OF THE MEASURE.
8. POSTS SHALL BE PLACED A MAXIMUM OF 10 FEET APART.
9. WIRE MESH FENCE SHALL BE FASTENED SECURELY TO THE UPSLOPE SIDE OF THE POSTS USING HEAVY DUTY WIRE STAPLES AT LEAST ONE INCH LONG, TIRE WIRES OR HOG RINGS. WIRE SHALL EXTEND INTO THE TRENCH A MINIMUM OF 2 INCHES AND SHALL NOT EXTEND MORE THAN 34 INCHES ABOVE THE ORIGINAL GROUND SURFACE.
10. STANDARD-STRENGTH FABRIC SHALL BE STAPLED OR WIRED TO THE WIRE FENCE AND 8 INCHES OF THE FABRIC SHALL BE EXTENDED INTO THE TRENCH. FABRIC SHALL NOT BE STAPLED TO EXISTING TREES.
11. THE 4-INCH BY 4-INCH TRENCH SHALL BE BACKFILLED AND THE SOIL COMPACTED OVER THE FILTER CLOTH.
12. SILT FENCE SHALL BE REMOVED WHEN IT HAS SERVED ITS USEFUL PURPOSE, BUT NOT BEFORE THE UPSLOPE AREAS HAVE BEEN PERMANENTLY STABILIZED.

4 SILT FENCE (SF)
\- SCALE: NTS VESCH STD & SPEC 3.05



NOTES:
1. AS NEEDED, A TEMPORARY FILL DIVERSION SHALL BE CONSTRUCTED AT THE TOP OF THE FILL AT THE END OF EACH WORK DAY TO PROTECT FILL SLOPES.
2. THE MINIMUM HEIGHT OF THE SUPPORTING RIDGE SHALL BE 9 INCHES. THE SUPPORTING RIDGE SHALL BE CONSTRUCTED WITH A UNIFORM HEIGHT ALONG ITS ENTIRE LENGTH TO AVOID BREACHING.
3. THE DIVERSION SHALL BE LOCATED AT LEASE 2 FEET INSIDE THE TOP EDGE OF THE FILL.
4. CHANNELS SHALL HAVE A POSITIVE GRADE TO A STABILIZED OUTLET.

6 TEMPORARY FILL DIVERSION (FD)
\- SCALE: NTS VESCH STD & SPEC 3.10



NOTES:
1. FILTER BAGS SHALL BE MADE FROM NONWOVEN GEOTEXTILE MATERIAL SEWN WITH HIGH STRENGTH, DOUBLE STITCHED "J" TYPE SEAMS. THEY SHALL BE CAPABLE OF TRAPPING PARTICLES LARGER THAN 150 MICRONS.
2. A SUITABLE MEANS OF ACCESSING THE BAG WITH MACHINERY REQUIRED FOR DISPOSAL PURPOSES MUST BE PROVIDED. FILTER BAGS SHALL BE REPLACED WHEN THEY BECOME 1/2 FULL. SPARE BAGS SHALL BE KEPT AVAILABLE FOR REPLACEMENT OF THOSE THAT HAVE FAILED OR ARE FILLED.
3. BAGS SHALL BE LOCATED IN WELL-VEGETATED (GRASSY) OR STABILIZED AREAS WITHIN SOUTH RIVER AND DOWNSTREAM OF COFFERDAM AREAS, AND DISCHARGE ONTO STABLE, EROSION RESISTANT AREAS. WHERE THIS IS NOT POSSIBLE, A GEOTEXTILE FLOW PATH SHALL BE PROVIDED. BAGS SHALL NOT BE PLACED ON SLOPES GREATER THAN 5%.
4. THE PUMP DISCHARGE HOSE SHALL BE INSERTED INTO THE BAGS IN THE MANUFACTURER SPECIFIED BY THE MANUFACTURER AND SECURELY CLAMPED.
5. THE PUMPING RATE SHALL BE NO GREATER THAN 750 GPM OR 1/2 THE MAXIMUM SPECIFIED BY THE MANUFACTURER, WHICHEVER IS LESS. PUMP INTAKES SHOULD BE FLOATING AND SCREENED.

8 PUMPED WATER FILTER BAG
\- SCALE: NTS

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

S:\Projects\Private-Sector\DuPont\DuPont_South River VA\CAD\Details & Notes.dwg Details 1
Jul 25, 2017 1:37pm jason.jerrytone

ANCHOR QEA
AECOM

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
DONALD FRANKLIN MAYER, III
No. 029879
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

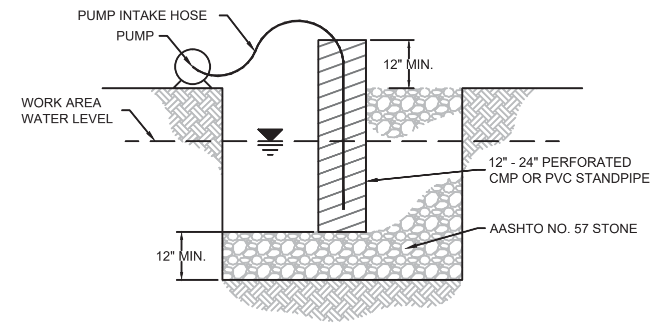
DESIGNED BY: J. JERRYTONE
DRAWN BY: J. JERRYTONE
CHECKED BY: D. MAYER
APPROVED BY: D. MAYER
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

TESC DETAILS

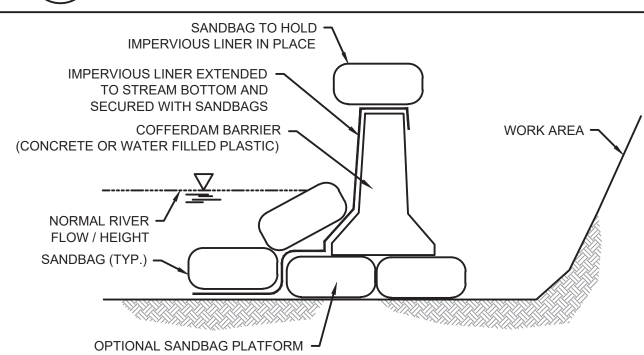
ES-4

SHEET NO. 10 OF 42



NOTES:
1. THE CONTRACTOR SHALL DETERMINE THE NUMBER, LOCATION, AND SIZE OF DEWATERING SUMPS AS REQUIRED TO PERFORM THE WORK IN ACCORDANCE WITH THE CONTRACTOR'S PROPOSED MEANS AND METHODS.
2. LOCATE DEWATERING SUMPS AT LOW POINTS IN WORK AREAS AND OUTSIDE OF ACTIVE CONSTRUCTION ACTIVITY WHENEVER POSSIBLE.
3. MINIMUM DIAMETER OF PIT BOTTOM SHALL BE 24" LARGER THAN THE STANDPIPE DIAMETER. MINIMUM DEPTH OF PIT SHALL BE 24" BELOW THE WATER LEVEL WITHIN THE WORK AREA (INCLUDING THE AASHTO NO. 57 STONE).
4. VOID SPACE AROUND THE PIPE SHALL BE FILLED WITH AASHTO NO. 57 STONE. PIPE TO EXTEND MINIMUM 12" ABOVE THE TOP OF STONE AND/OR WATER BEING PUMPED FROM THE WORK AREA.
5. SET PUMP INTAKE INSIDE STANDPIPE. DISCHARGE FROM PUMP SHALL BE THROUGH A PUMPED WATER FILTER BAG OR OTHER SEDIMENT FILTER / REMOVAL DEVICE TO A STABLE AREA BELOW DISTURBANCES FROM THE WORK AREA.

1 / -
TEMPORARY DEWATERING STRUCTURE (DS)
SCALE: NTS VESCH STD & SPEC 3.26



NOTES:
1. THE CONTRACTOR SHALL DETERMINE THE TYPE, NUMBER, LOCATION, AND SIZE OF THE TEMPORARY COFFERDAM BARRIERS AS REQUIRED TO PERFORM THE WORK IN ACCORDANCE WITH THE CONTRACTOR'S PROPOSED MEANS AND METHODS.
2. ALTERNATES TO THE COFFERDAM BARRIER SHOWN MAY INCLUDE PRE-ENGINEERED STEEL SUPPORT FRAMES (PORTADAM) OR EARTH-FILLED BULK BAGS.
3. THE NORMAL STREAM FLOW / HEIGHT SHALL NOT EXTEND ABOVE HALF THE COFFERDAM BARRIER HEIGHT.

2 / -
TEMPORARY COFFERDAM
SCALE: NTS

1. TEMPORARY SEEDING SHALL BE APPLIED TO STABILIZE DISTURBED AREAS THAT WILL NOT BE BROUGHT TO FINAL GRADE FOR A PERIOD OF MORE THAN 14 DAYS.
2. A PERMANENT VEGETATIVE COVER SHALL BE APPLIED TO AREAS THAT WILL BE LEFT DORMANT FOR A PERIOD OF MORE THAN 1 YEAR.
3. LIMING REQUIREMENTS:
   - pH TEST BELOW 4.2 - 3 TONS PER ACRE
   - pH TEST 4.2 TO 5.2 - 2 TONS PER ACRE
   - pH TEST 5.2 TO 6 - 1 TON PER ACRE
4. FERTILIZER SHALL BE APPLIED AT 600 LBS / ACRE OR 10-20-10 (14 LBS / 1,000 SF) OR EQUIVALENT NUTRIENTS.
5. LIME AND FERTILIZER SHALL BE INCORPORATED INTO THE TOP 2 TO 4 INCHES OF THE SOIL.
6. WHEN THE AREA IS COMPACTED, CRUSTED, OR HARDENED, THE SOIL SURFACE SHALL BE LOOSENED BY DISCING, RAKING, HARROWING, OR OTHER ACCEPTABLE MEANS.
7. SEED SHALL BE EVENLY APPLIED WITH A BROADCAST SEEDER, DRILL, CULTIPACKER SEEDER, OR HYDROSEEDER. SMALL GRAINS SHALL BE PLANTED NO MORE THAN 1.5 INCHES DEEP. SMALL SEEDS SHALL BE PLANTED NO MORE THAN 0.25 INCH DEEP. OTHER GRASSES AND LEGUMES SHALL BE PLANTED FROM 0.25 TO 0.5 INCH DEEP.
8. SEEDINGS MADE IN FALL FOR WINTER COVER AND DURING HOT AND DRY SUMMER MONTHS SHALL BE MULCHED, EXCEPT THAT HYDROMULCHES (FIBER MULCH) WILL NOT BE CONSIDERED ADEQUATE. STRAW MULCH SHALL BE USED DURING THESE PERIODS.
9. TEMPORARY SEEDINGS MADE UNDER FAVORABLE SOIL AND SITE CONDITIONS DURING OPTIMUM SPRING AND FALL SEEDING DATES MAY NOT REQUIRE MULCH.
10. AREAS WITH NO ESTABLISHED VEGETATIVE COVER ADEQUATE TO PREVENT RILL EROSION SHALL BE RE-SEEDED AS SOON AS SUCH AREAS ARE IDENTIFIED.
11. TEMPORARY SEEDING APPLICATIONS:
   - SEPTEMBER 1 - FEBRUARY 15: DORMANT SEEDING WITH PERMANENT SEED MIX AND COVER CROP OF GRAIN RYE AT 30 LBS / ACRE. AREAS TO BE COVERED BY COIR FABRIC (BLANKETS / MATTING) FOLLOWING SEEDING.
   - FEBRUARY 16 - APRIL 30: ERNST SEEDS, ERNMX-101 FOR DISTURBED SITES AND STEEP SLOPES AT 50 LBS / ACRE (http://www.ernstseeds.com/) OR APPROVED EQUAL MEETING THE VESCH SEEDING REQUIREMENTS.
   - MAY 1 - AUGUST 31: ERNST SEEDS, ERNMX-101 FOR DISTURBED SITES AND STEEP SLOPES AT 50 LBS / ACRE (http://www.ernstseeds.com/) OR APPROVED EQUAL MEETING THE VESCH SEEDING REQUIREMENTS.

3 / -
TEMPORARY SEEDING (TS)
SCALE: NTS VESCH STD & SPEC 3.31

TABLE 3.35-A

ORGANIC MULCH MATERIALS AND APPLICATION RATES

MULCHES:	RATES: Per Acre	RATES: Per 1000 sq. ft.	NOTES:
Straw or Hay	1½ - 2 tons (Minimum 2 tons for winter cover)	70 - 90 lbs.	Free from weeds and coarse matter. Must be anchored. Spread with mulch blower or by hand.
Fiber Mulch	Minimum 1500 lbs.	35 lbs.	Do not use as mulch for winter cover or during hot, dry periods.* Apply as slurry.
Corn Stalks	4 - 6 tons	185 - 275 lbs.	Cut or shredded in 4-6" lengths. Air-dried. Do not use in fine turf areas. Apply with mulch blower or by hand.
Wood Chips	4 - 6 tons	185 - 275 lbs.	Free of coarse matter. Air-dried. Treat with 12 lbs nitrogen per ton. Do not use in fine turf areas. Apply with mulch blower, chip handler, or by hand.
Bark Chips or Shredded Bark	50 - 70 cu. yds.	1-2 cu. yds.	Free of coarse matter. Air-dried. Do not use in fine turf areas. Apply with mulch blower, chip handler, or by hand.

* When fiber mulch is the only available mulch during periods when straw should be used, apply at a minimum rate of 2000 lbs./ac. or 45 lbs./1000 sq. ft.

NOTES:
1. MULCH MATERIALS SHALL BE SPREAD UNIFORMLY BY HAND OR MACHINE. WHEN SPREADING STRAW MULCH BY HAND, DIVIDE THE AREA TO BE MULCHED INTO APPROXIMATELY 1,000 SF SECTIONS AND PLACE 70-90 LBS (1 1/2 TO 2 BALES) OF STRAW IN EACH SECTION TO FACILITATE UNIFORM DISTRIBUTION.
2. STRAW MULCH MUST BE ANCHORED IMMEDIATELY AFTER SPREADING TO PREVENT DISPLACEMENT. OTHER ORGANIC MULCHES LISTED IN TABLE 3.35-A TO NOT REQUIRE ANCHORING. THE FOLLOWING METHODS OF ANCHORING MAY BE USED: MULCH ANCHORING TOOL (OFTEN REFERRED TO AS A KRIMPER OR KRIMPER TOOL), FIBER MULCH, LIQUID MULCH BINDERS, MULCH NETTINGS, OR PEG AND TWINE.

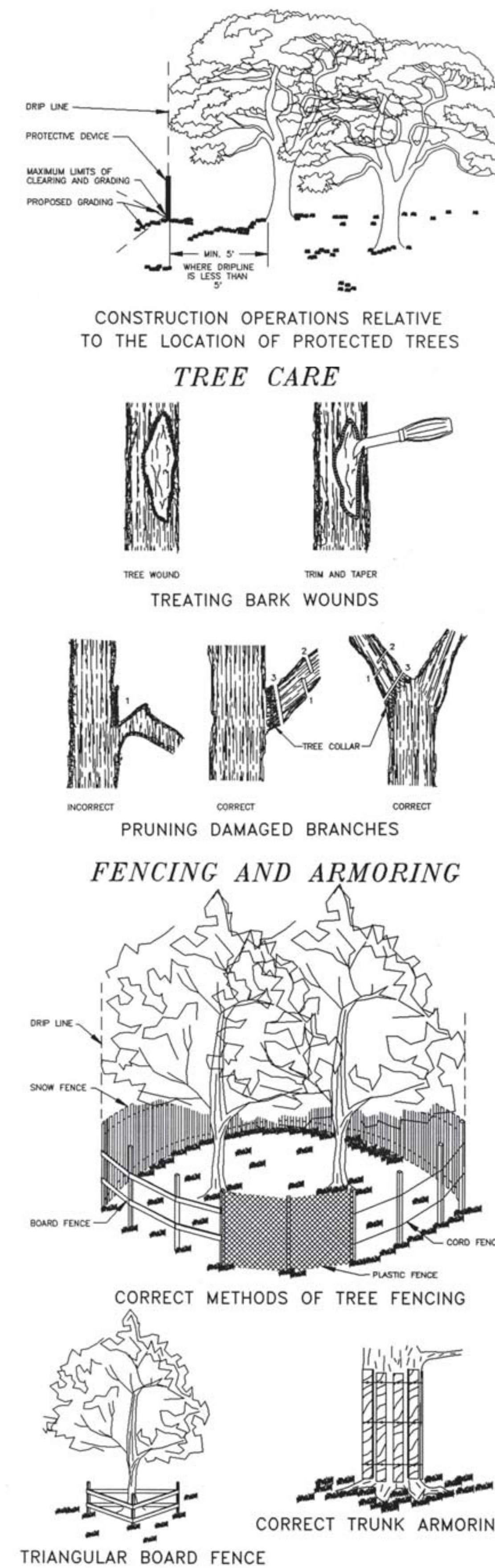
4 / -
MULCHING (MU)
SCALE: NTS VESCH STD & SPEC 3.35

1. PERMANENT SEEDING SHALL BE APPLIED TO STABILIZE DISTURBED AREAS THAT ARE BROUGHT TO FINAL GRADE OR AREAS TO BE LEFT DORMANT FOR A PERIOD OF MORE THAN 1 YEAR.
2. LIMING AND FERTILIZER REQUIREMENTS SHALL BE BASED UPON SOIL TESTING PERFORMED BY THE CONTRACTOR.
3. WHEN THE AREA IS COMPACTED, CRUSTED, OR HARDENED, THE SOIL SURFACE SHALL BE LOOSENED BY DISCING, RAKING, HARROWING, OR OTHER ACCEPTABLE MEANS.
4. SEED SHALL BE EVENLY APPLIED WITH A BROADCAST SEEDER, DRILL, CULTIPACKER SEEDER, OR HYDROSEEDER. SMALL GRAINS SHALL BE PLANTED NO MORE THAN 1.5 INCHES DEEP. SMALL SEEDS SHALL BE PLANTED NO MORE THAN 0.25 INCH DEEP. OTHER GRASSES AND LEGUMES SHALL BE PLANTED FROM 0.25 TO 0.5 INCH DEEP.
5. SEEDINGS MADE IN FALL FOR WINTER COVER AND DURING HOT AND DRY SUMMER MONTHS SHALL BE MULCHED OR COVERED WITH COIR FABRIC (BLANKETS / MATTING), EXCEPT THAT HYDROMULCHES (FIBER MULCH) WILL NOT BE CONSIDERED ADEQUATE. STRAW MULCH SHALL BE USED DURING THESE PERIODS.
6. AREAS WITH NO ESTABLISHED VEGETATIVE COVER ADEQUATE TO PREVENT RILL EROSION SHALL BE RE-SEEDED AS SOON AS SUCH AREAS ARE IDENTIFIED.
7. PERMANENT SEEDING APPLICATIONS:
   - ERNMX-822 (VA SOUTHERN RIDGE & VALLEY RIPARIAN MIX) FOR RIPARIAN SITES AT 20 LBS / ACRE (http://www.ernstseeds.com/). AREAS TO BE COVERED BY COIR FABRIC (BLANKETS / MATTING) FOLLOWING SEEDING.
   - AN APPROVED EQUAL MAY BE UTILIZED BY THE CONTRACTOR IF IT MEETS THE VESCH SEEDING REQUIREMENTS.

WATERING SCHEDULE:

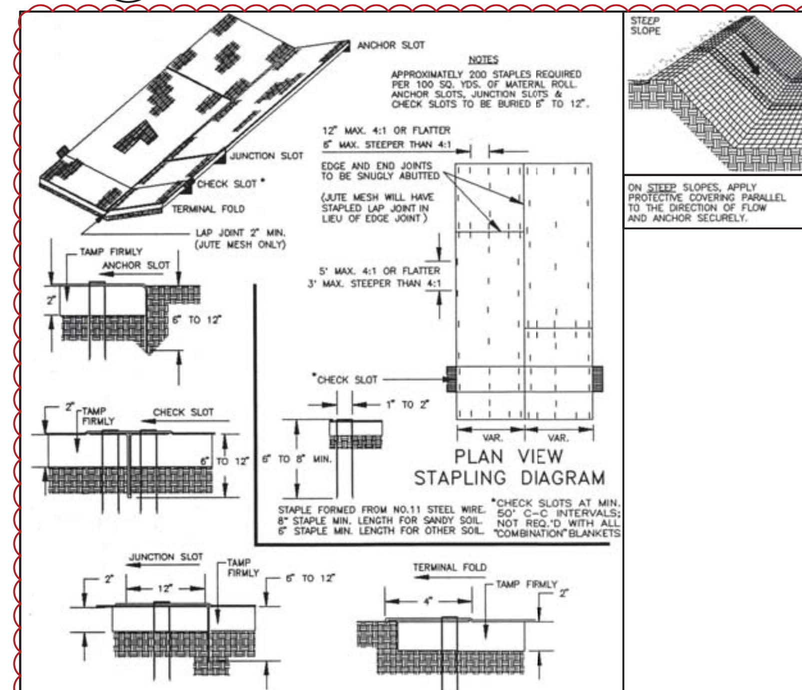
1. WATER TREES, SHRUBS, AND LIVESTAKES WITHIN THE FIRST 24 HOURS OF INITIAL PLANTING, AND NOT LESS THAN TWICE PER WEEK (INCLUDING RAIN) FOR ONE YEAR AFTER PLANTING AND SEEDING.

6 / -
PERMANENT SEEDING (PS)
SCALE: NTS VESCH STD & SPEC 3.32



NOTES:
1. TREE FENCING DETAILS ARE ONLY APPLICABLE TO THOSE TREES SHOWN ON D-1 THROUGH D-3 SHOWN TO HAVE PROTECTIVE FENCING. TREES THAT DO NOT HAVE FENCING SHALL BE ARMORED WITH BURLAP WRAPPING AND 2-INCH STUDS WIRED VERTICALLY NO MORE THAN 2 INCHES APART TO A HEIGHT OF 5 FEET ENCIRCLING THE TRUNK. IF THIS ALTERNATIVE IS USED, THE ROOT ZONE WITHIN THE DRIP LINE WILL STILL REQUIRE PROTECTION. NOTHING SHOULD EVER BE NAILED TO A TREE.
2. GROUPS OF TREES AND INDIVIDUAL TREES SELECTED FOR RETENTION SHALL BE ACCURATELY LOCATED ON THE CONTRACT DRAWINGS AND DESIGNATED AS "TREE(S) TO BE SAVED" IN THE FIELD.
3. THE LIMITS OF CLEARING SHALL BE LOCATED OUTSIDE THE DRIP LINE OF ANY TREE TO BE RETAINED AND, IN NO CASE, CLOSER THAN 5 FEET TO THE TRUNK OF ANY TREE.
4. PRIOR TO CONSTRUCTION AND BEFORE THE PRECONSTRUCTION CONFERENCE, INDIVIDUAL TREES AND STANDS OF TREES TO BE RETAINED WITHIN THE LIMITS OF CLEARING SHALL BE MARKED AT A HEIGHT VISIBLE TO EQUIPMENT OPERATORS.
5. HEAVY EQUIPMENT, VEHICULAR TRAFFIC, OR STOCKPILES OF ANY CONSTRUCTION MATERIALS (INCLUDING PLANTING SUBSTRATE) SHALL NOT BE PERMITTED WITHIN THE DRIP LINE OF ANY TREE TO BE RETAINED. TREES BEING REMOVED SHALL NOT BE FELLED, PUSHED, OR PULLED INTO TREES BEING RETAINED. OPERATORS SHALL NOT CLEAN ANY PART OF THEIR EQUIPMENT BY SLAMMING AGAINST THE TRUNKS OF TREES TO BE RETAINED.
6. NO TOXIC MATERIALS SHALL BE STORED CLOSER THAN 100 FEET TO THE DRIP LINE OF ANY TREES TO BE RETAINED.
7. STANDARD 40-INCH HIGH SNOW FENCE SHALL BE PLACED AT THE LIMITS OF CLEARING ON STANDARD "T" OR "U" POSTS DRIVEN TO A MINIMUM DEPTH OF 18 INCHES AND SET 6 FEET APART.
8. FENCING AND ARMORING DEVICES SHALL BE IN PLACE BEFORE ANY EXCAVATION OR GRADING ACTIVITIES HAVE BEGUN, SHALL BE KEPT IN GOOD REPAIR FOR THE DURATION OF CONSTRUCTION ACTIVITIES, AND SHALL BE THE LAST ITEMS REMOVED DURING THE FINAL CLEANUP AFTER THE COMPLETION OF THE PROJECT.
9. ANY DAMAGE TO THE CROWN, TRUNK, OR ROOT SYSTEM OF ANY TREE RETAINED SHALL BE REPAIRED / ADDRESSED IMMEDIATELY.
10. WHENEVER MAJOR ROOT OR BARK DAMAGE OCCURS, REMOVE SOME FOLIAGE TO REDUCE THE DEMAND FOR WATER AND NUTRIENTS.
11. DAMAGED ROOTS SHALL IMMEDIATELY BE CUT OFF CLEANLY INSIDE THE EXPOSED OR DAMAGED AREA. CUT SURFACES SHALL BE PAINTED WITH APPROVED TREE PAINT, AND MOIST PEAT MOSS, BURLAP, OR PLANTING SUBSTRATE SHALL BE SPREAD OVER THE EXPOSED AREA.
12. TO TREAT BARK DAMAGE, CAREFULLY CUT AWAY ALL LOOSENED BARK BACK INTO THE UNDAMAGED AREA, TAPER THE CUT AT THE TOP AND BOTTOM, AND PROVIDE DRAINAGE AT THE BASE OF THE WOUND.
13. ALL TREE LIMBS DAMAGED DURING CONSTRUCTION OR REMOVED FOR ANY OTHER REASON SHALL BE CUT OFF ABOVE THE COLLAR AT THE PRECEDING BRANCH JUNCTION.
14. CARE FOR SERIOUS INJURIES SHALL BE PRESCRIBED BY A FORESTER OR A TREE SPECIALIST.

5 / -
TREE PRESERVATION AND PROTECTION (TP)
SCALE: NTS VESCH STD & SPEC 3.38



NOTES:
1. PROTECTIVE BLANKETS & MATTING SHALL BE LAID ON A FRIABLE SEEDBED FREE FROM CLODS, ROCKS, ROOTS, ETC. THAT MIGHT IMPEDE GOOD CONTACT.
2. LAY BLANKETS & MATTING FROM THE TOP OF SLOP AND UNROLL DOWN-GRADE.
3. ALLOW BLANKETS & MATTING TO LAY LOOSELY ON THE SOIL - DO NOT STRETCH.
4. UPSLOPE ENDS OF THE BLANKETS & MATTING SHALL BE BURIED IN AN ANCHOR TRENCH/SLOT NO LESS THAN 6-INCHES DEEP. TAMP THE EARTH FIRMLY OVER THE MATERIAL. STAPLE THE MATERIAL AT A MINIMUM OF EVERY 12 INCHES ACROSS THE TOP END.
5. EDGES OF THE MATERIAL SHALL BE STAPLED EVERY 3 FEET. WHERE MULTIPLE WIDTHS ARE LAID SIDE BY SIDE, THE ADJACENT EDGE SHALL BE OVERLAPPED A MINIMUM OF 12 INCHES AND STAPLED TOGETHER.
6. STAPLES SHALL BE PLACED DOWN THE CENTER, STAGGERED WITH THE EDGES AT 3 FOOT INTERVALS.
7. AT THE POINT AT WHICH THE MATERIAL IS DISCONTINUED, OR AT WHICH TIME THE PROTECTIVE COVERING MEETS A STRUCTURE OF SOME TYPE, FOLD 4 INCHES OF THE MATERIAL UNDERNEATH AND STAPLE EVERY 12 INCHES (MINIMUM).
8. AT THE BOTTOM OF SLOPES, LEAD THE PROTECTIVE COVERING OUT ONTO A LEVEL AREA BEFORE ANCHORING. TURN ENDS UNDER 4 INCHES, AND STAPLE ACROSS EVERY 12 INCHES.

⚠ 7 / -
SOIL STABILIZATION BLANKETS & MATTING
SCALE: NTS VESCH STD & SPEC 3.36

APPROVED CONSTRUCTION PLAN SET

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

S:\Projects\Private-Sector\DuPont\DuPont_South River VA\CAD\Details & Notes.dwg Details 2
Jul 25, 2017 1:37pm jason.jerrytone

ANCHOR QEA
AECOM

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
DONALD FRANKLIN MAYER, III
No. 029879
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
⚠	7/14/17	JRJ	DFM	REVISION TO ADDRESS PERMIT COMMENTS

DESIGNED BY: J. JERRYTONE
DRAWN BY: J. JERRYTONE
CHECKED BY: D. MAYER
APPROVED BY: D. MAYER
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

TESC DETAILS

ES-5

SHEET NO. 11 OF 42

GENERAL EROSION AND SEDIMENT CONTROL NOTES
TABLE 6-1, VIRGINIA EROSION AND SEDIMENT CONTROL HANDBOOK, THIRD EDITION,1992 (VESCH)

ES-1: UNLESS OTHERWISE INDICATED, ALL VEGETATIVE AND STRUCTURAL EROSION AND SEDIMENT CONTROL PRACTICES WILL BE CONSTRUCTED AND MAINTAINED ACCORDING TO MINIMUM STANDARDS AND SPECIFICATIONS OF THE VIRGINIA EROSION AND SEDIMENT CONTROL HANDBOOK AND VIRGINIA REGULATIONS 4VAC50-30 (9VAC25-840) EROSION AND SEDIMENT CONTROL REGULATIONS.

ES-2: THE PLAN APPROVING AUTHORITY MUST BE NOTIFIED ONE WEEK PRIOR TO THE PRE-CONSTRUCTION CONFERENCE, ONE WEEK PRIOR TO THE COMMENCEMENT OF LAND DISTURBING ACTIVITY, AND ONE WEEK PRIOR TO THE FINAL INSPECTION.

ES-3: ALL EROSION AND SEDIMENT CONTROL MEASURES ARE TO BE PLACED PRIOR TO OR AS THE FIRST STEP IN CLEARING.

ES-4: A COPY OF THE APPROVED EROSION AND SEDIMENT CONTROL PLAN SHALL BE MAINTAINED ON THE SITE AT ALL TIMES.

ES-5: PRIOR TO COMMENCING LAND DISTURBING ACTIVITIES IN AREAS OTHER THAN INDICATED ON THESE PLANS (INCLUDING, BUT NOT LIMITED TO, OFF-SITE BORROW OR WASTE AREAS), THE CONTRACTOR SHALL SUBMIT A SUPPLEMENTARY EROSION CONTROL PLAN TO THE OWNER (DSR) FOR REVIEW AND APPROVAL BY THE PLAN APPROVING AUTHORITY.

ES-6: THE CONTRACTOR IS RESPONSIBLE FOR INSTALLATION OF ANY ADDITIONAL EROSION CONTROL MEASURES NECESSARY TO PREVENT EROSION AND SEDIMENTATION AS DETERMINED BY THE PLAN APPROVING AUTHORITY.

ES-7: ALL DISTURBED AREAS ARE TO DRAIN TO APPROVED SEDIMENT CONTROL MEASURES AT ALL TIMES DURING LAND DISTURBING ACTIVITIES AND DURING SITE DEVELOPMENT UNTIL FINAL STABILIZATION IS ACHIEVED.

ES-8: DURING DEWATERING OPERATIONS, WATER WILL BE PUMPED INTO AN APPROVED FILTERING DEVICE.

ES-9: THE CONTRACTOR SHALL INSPECT ALL EROSION CONTROL MEASURES PERIODICALLY AND AFTER EACH RUNOFF-PRODUCING RAINFALL EVENT. ANY NECESSARY REPAIRS OR CLEANUP TO MAINTAIN THE EFFECTIVENESS OF THE EROSION CONTROL DEVICES SHALL BE MADE IMMEDIATELY.

EROSION AND SEDIMENT CONTROL NARRATIVE

A. INTRODUCTION
THIS NARRATIVE DESCRIBES THE EROSION AND SEDIMENT CONTROL (E&SC) MEASURES FOR THE SOUTH RIVER AREA OF CONCERN 4 (AOC 4) PHASE 1A BANK STABILIZATION PROJECT (PROJECT) AND WERE DEVELOPED TO COMPLY WITH THE REQUIREMENTS CONTAINED IN CHAPTER 30, ARTICLE II OF THE CODE OF THE CITY OF WAYNESBORO WHICH CITES THE VIRGINIA EROSION AND SEDIMENT CONTROL LAW (CODE OF VIRGINIA TITLE 10.1, CHAPTER 5). THE VIRGINIA EROSION AND SEDIMENT CONTROL HANDBOOK, THIRD EDITION, 1992 (VESCH) AND THE VIRGINIA STREAM RESTORATION AND STABILIZATION BEST MANAGEMENT PRACTICES GUIDE, 2004 WERE USED AS REFERENCES FOR DESIGN AND SELECTION OF EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES (BMPs).

B. PROJECT DESCRIPTION
THE PROJECT INVOLVES THE REMEDIATION OF MERCURY-IMPACTED BANKS DOWNSTREAM OF THE FORMER E.I. DU PONT DE NEMOURS AND COMPANY (DUPONT) FACILITY IN THE CITY OF WAYNESBORO, VIRGINIA (CITY). THE REMEDIATION MEASURES WERE DEVELOPED IN THE REMEDIATION PROPOSAL SUBMITTED TO THE NATURAL RESOURCES DEFENSE COUNCIL (NRDC; ANCHOR QEA ET AL. 2013), AND WERE SUBSEQUENTLY REFINED IN THE *INTERIM MEASURES DESIGN, IMPLEMENTATION, AND MONITORING WORK PLAN* (IMWP; ANCHOR QEA ET AL. 2015) APPROVED BY THE VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY (VDEQ) IN MARCH 2015. IMPLEMENTATION OF THE REMEDIATION MEASURES ARE BEING PERFORMED AS AN INTERIM MEASURE UNDER THE REGULATORY AUTHORITY OF THE RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) WITHIN THE SOUTH RIVER AOC 4 UNDER RCRA PERMIT NO. VAD003114832.

CONSISTENT WITH THE IMWP, CORRECTIVE ACTIONS IN THE SOUTH RIVER WILL GENERALLY BE PERFORMED IN AN UPSTREAM-TO-DOWNSTREAM SEQUENCE WITHIN AN ADAPTIVE MANAGEMENT FRAMEWORK. THE FIRST PHASE OF REMEDIATION (TERMED PHASE 1) ADDRESSES BANK MANAGEMENT AREAS (BMAs) WITHIN THE FIRST 2 RIVER MILES DOWNSTREAM OF THE FORMER DUPONT WAYNESBORO FACILITY (I.E., RELATIVE RIVER MILES [RRMs] 0 TO 2). PHASE 1 BMAs ARE DIVIDED INTO "BANK REMOVAL AND RESTORATION" AND "BANK STABILIZATION" BMAs TO DIFFERENTIATE BANKS THAT CONTRIBUTE DISPROPORTIONATELY TO TOTAL MERCURY (THg) LOADING IN RRMs 0 TO 2 AND ARE DESCRIBED AS FOLLOWS:

1. PHASE 1 "BANK REMOVAL AND RESTORATION" BMAs ARE THOSE BANKS WITH RELATIVELY HIGH UNIT THg LOADING RATES (GREATER THAN APPROXIMATELY 20 KILOGRAMS PER MILE PER YEAR (KG/MILE-YEAR) THAT COLLECTIVELY CONTRIBUTE APPROXIMATELY 50% OF THE THg LOADING FROM BANK EROSION IN RRMs 0 TO 2). PHASE 1 "BANK REMOVAL AND RESTORATION" BMAs REPRESENT APPROXIMATELY 5% OF THE TOTAL BANK LENGTH IN RRMs 0 TO 2 (APPROXIMATELY 0.16 MILES).

2. PHASE 1 "BANK STABILIZATION" BMAs CONTRIBUTE AN ADDITIONAL 40% OF THE THg LOADING FROM BANK EROSION AND REPRESENT APPROXIMATELY 20% OF THE TOTAL BANK LENGTH (APPROXIMATELY 0.84 MILES) IN RRMs 0 TO 2.

PHASE 1 BMAs ARE FURTHER DIVIDED INTO PHASE 1A AND 1B BASED ON LAND OWNERSHIP AND LANDOWNER PREFERENCES REGARDING WHICH BMAs TO ADVANCE FIRST. PHASE 1A BMAs INCLUDE CITY-OWNED "BANK REMOVAL AND RESTORATION" BMAs AT CONSTITUTION PARK AND THE WAYNESBORO WASTEWATER TREATMENT PLANT (WWTP), AS WELL AS CITY-OWNED "BANK STABILIZATION" BMAs THAT ARE LOCATED IMMEDIATELY ADJACENT TO THESE "BANK REMOVAL AND RESTORATION" BMAs. PHASE 1B BMAs INCLUDE THE REMAINING CITY-OWNED BMAs, AS WELL AS ALL NON-CITY-OWNED BMAs IN RRMs 0 TO 2.

THE SCOPE OF THIS PROJECT INCLUDES PHASE 1A BMAs DESCRIBED AS FOLLOWS:

1. CONSTITUTION PARK: THE CONSTITUTION PARK PHASE 1A BMAs OCCUPY A PORTION OF THE RIVER BANK IN CONSTITUTION PARK, WHICH IS ON THE LEFT DESCENDING BANK BETWEEN SHORT STREET AND VIRGINIA STATE ROUTE 340 (MAIN STREET), FROM RRMs 0.18 TO 0.25. THE "BANK REMOVAL AND RESTORATION" BMA IN THIS AREA EXTENDS FROM RRMs 0.19 TO 0.21 AND IS CHARACTERIZED BY A RELATIVELY HIGH UNIT THg LOADING RATE OF APPROXIMATELY 70 KG/MILE-YEAR.

2. WASTEWATER TREATMENT PLANT (WWTP): THE WWTP INCLUDES TWO INDIVIDUAL "BANK REMOVAL AND RESTORATION" BMAs LOCATED ADJACENT TO THE CITY'S WWTP FACILITY WHICH ARE DESIGNATED AS WWTP A AND B. THE WWTP A "BANK REMOVAL AND RESTORATION" BMA IS SITUATED DIRECTLY ADJACENT TO THE CITY'S VEHICLE MAINTENANCE AREA IMMEDIATELY DOWNSTREAM OF THE 2ND STREET BRIDGE. IT EXTENDS FROM RRM 1.34 TO 1.38 AND HAS A UNIT THg LOADING OF APPROXIMATELY 62 KG/MILE-YEAR. THE WWTP B "BANK REMOVAL AND RESTORATION" BMA OCCUPIES THE BANKS ADJACENT TO THE SETTLING BASINS AND OTHER TREATMENT TANKS AND EXTENDS FROM RRM 1.48 TO 1.50 AND HAS AN UNCHARACTERIZED UNIT THg LOADING RATE, PRIMARILY DUE TO UNCERTAINTIES IN THE BANK EROSION RATE IN THIS AREA. BASED UPON VISIBLE EVIDENCE OF BANK EROSION AND ELEVATED NEAR-SURFACE BANK SOIL THg CONCENTRATIONS, WWTP B WAS INCLUDED AS A "BANK REMOVAL AND RESTORATION" BMA.

THE INTENT OF THIS PROJECT IS TO MEET THE FOLLOWING OVERALL REMEDIAL ACTION OBJECTIVES:

- REDUCE MERCURY LOADING TO THE SOUTH RIVER FROM BANK EROSION;
- REDUCE MERCURY LOADING TO THE SOUTH RIVER FROM LEACHING OF BANK SOILS, AS PRACTICABLE; AND
- DECREASE THE IMPACT OF SHEAR STRESS ON BANKS WITH HIGH EROSION POTENTIAL.

IN ORDER TO ACHIEVE THESE OBJECTIVES, THE FOLLOWING MAJOR WORK ITEMS ARE PROPOSED AND DETAILED WITHIN THE *BASIS OF DESIGN REPORT* (BODR, ANCHOR QEA ET AL. 2016) WHICH INCLUDES SUPPORTING INVESTIGATION REPORTS, MODELS, CALCULATIONS, CONTRACT DRAWINGS, TECHNICAL SPECIFICATIONS, AND OTHER PROJECT-SPECIFIC PLANS AND APPLICATIONS:

1. SITE PREPARATION
   - CONSTRUCTION, MANAGEMENT, AND PROTECTION OF TRAFFIC CONTROL MEASURES (PEDESTRIAN / VEHICULAR).
   - DEMARCATION OF THE THE PROJECT LIMITS, LIMITS OF CLEARING, AND LIMITS OF WORK.
   - IDENTIFICATION, LOCATION, AND PROTECTION OF EXISTING UTILITIES.
   - CONSTRUCTION OF TEMPORARY EROSION AND SEDIMENT CONTROL AND STORMWATER MANAGEMENT MEASURES.
   - SELECTIVE CLEARING AND GRUBBING OF EXISTING TREES AND VEGETATION WITHIN THE LIMITS OF DISTURBANCE.
   - CONSTRUCTION OF TEMPORARY ACCESS ROADS, LAYDOWN / STAGING / STOCKPILE AREAS, AND DECONTAMINATION AREAS.

2. BANK SOIL REMOVAL AND OFF-SITE DISPOSAL
   - EXCAVATION OF MATERIALS FROM THE DESIGNATED "BANK REMOVAL AND RESTORATION AREAS". THE VERTICAL AND HORIZONTAL LIMITS OF EXCAVATION PRISMS ARE SHOWN ON THE CONTRACT DRAWINGS.
   - CONSOLIDATION, LOADING, AND TRANSPORTATION OF CONTAMINATED MATERIALS FOR OFF-SITE DISPOSAL AT A LICENSED FACILITY.

EROSION AND SEDIMENT CONTROL NARRATIVE (CONTINUED)

B. PROJECT DESCRIPTION (CONTINUED)

3. IN SITU STABILIZATION (BIOCHAR AMENDMENT APPLICATION)
   - SURFACE ROUGHENING WITHIN "BANK REMOVAL AND RESTORATION AREAS" PRIOR TO PLACEMENT OF CLEAN FILL MATERIALS TO THE EXTENT PRACTICAL.
   - PLACEMENT OF BIOCHAR EITHER AT THE BOTTOM OF EXCAVATIONS WITHIN THE "BANK REMOVAL AND RESTORATION AREAS" OR ON THE EXISTING SOIL SURFACE ("BANK STABILIZATION AREAS"). BIOCHAR APPLICATION WILL PROVIDE SOME ADDED CONTROL OF THg LEACHING FROM BANK SOILS. BIOCHAR WILL BE MIXED WITH SUBGRADE FILL OR PLANTING SUBSTRATE (DEPENDING UPON THE APPLICATION) AND APPLIED WITHIN A GEOSYNTHETIC GEOCELL LAYER.

4. BACKFILLING
   - PLACEMENT OF COMPACTED CLEAN BACKFILL MATERIAL. SUBGRADE BACKFILL MATERIALS ARE ANTICIPATED TO BE IMPORTED FROM THE DUPONT JONES HOLLOW PROPERTY WHICH WILL BE PERMITTED SEPARATELY. FOR USE AS PLANTING SUBSTRATE, THE DUPONT JONES HOLLOW PROPERTY BORROW MATERIAL WILL ALSO BE AMENDED TO MEET THE COMPOSITION REQUIREMENTS FOR THE PLANNED PERMANENT VEGETATIVE STABILIZATION.
   - WITHIN "BANK REMOVAL AND RESTORATION AREAS", 12 INCHES OF PLANTING SUBSTRATE MATERIAL WILL BE PLACED TO MEET FINISHED GRADES.
   - WITHIN "BANK STABILIZATION AREAS", PLANTING SUBSTRATE WILL BE PLACED IN A 12-INCH GEOSYNTHETIC GEOCELL LAYER OR A 6-INCH LAYER OF PLANTING SUBSTRATE WILL BE PLACED ABOVE A 6-INCH BIOCHAR AMENDMENT LAYER DEPENDING UPON THE STABILIZATION LOCATION ALONG THE BANK.

5. RIVERSIDE ACCESS
   - CONSTRUCTION OF FOOTPATHS WITHIN RECONSTRUCTED SLOPES IN CONSTITUTION PARK AND WWTP A BMAs TO PROVIDE ACCESS TO THE RIVER FOR RECREATION AND MAINTENANCE OF CITY UTILITIES (PRIMARILY STORMWATER DRAINS).

6. STABILIZATION
   - STRUCTURAL: WITHIN THE "BANK REMOVAL AND RESTORATION AREAS", STRUCTURAL STABILIZATION ELEMENTS WILL INCLUDE STONE TOE ARMOR TO PROTECT AGAINST BANK EROSION AND PLACEMENT OF SUITABLE SALVAGED LOGS AT THE TOE OF THE BANK TO IMPROVE HABITAT FUNCTION. A LAUNCHABLE SECTION OF STONE WILL BE PLACED AT THE TOE OF THE STONE ARMOR TO PROVIDE ADDED PROTECTION FROM POTENTIAL FUTURE UNDERMINING OF THE CHANNEL. WITHIN THE "BANK REMOVAL AND RESTORATION" BMAs, SALVAGED TREES WILL ALSO BE PLACED AT THE FOOT OF THE LAUNCHABLE TOE. THE SALVAGED TREES WILL PROVIDE HYDRAULIC REFUGE, COMPLEXITY, AND COVER ALONG THE MARGINS OF THE RIVER CHANNEL.
   - VEGETATIVE: A SYSTEM OF TEMPORARY BIODEGRADABLE AND/OR PERMANENT GEOSYNTHETIC PRODUCTS WILL BE USED TO STABILIZE BANK SOILS INCLUDING GEOCELL SYSTEMS, COIR LOGS, AND COIR FABRICS. PLANTING OF VARIETY OF NATIVE SPECIES IS THE PRIMARY COMPONENT OF THE VEGETATIVE STABILIZATION TECHNIQUE. SEEDING WILL BE PERFORMED TO STABILIZE ALL DISTURBED AREAS WITHIN THE PROJECT LIMITS / LIMITS OF DISTURBANCE UNLESS STABILIZED WITH STONE OR OTHER PAVED PATHWAYS.

ANTICIPATED PROJECT SCHEDULE : THE WORK AT CONSTITUTION PARK IS ANTICIPATED TO START IN OCTOBER 2016 AND FINISH IN DECEMBER 2016 CONTINGENT UPON REGULATORY APPROVALS AND REQUIREMENTS, WEATHER CONDITIONS, PRODUCT AVAILABILITY, AND THE CONTRACTOR'S MEANS AND METHODS. THE WORK AT WWTP IS ANTICIPATED TO BEGIN IN JUNE 2017 AND FINISH IN OCTOBER 2017.

PROJECT AREA: THE TOTAL PROJECT AREA FOR CONSTITUTION PARK IS 1.22 ACRES AND THE TOTAL PROJECT AREA FOR WWTP IS 2.32 ACRES.

TOTAL DISTURBANCE: THE TOTAL LIMIT OF DISTURBANCE FOR EACH PHASE 1A BMA IS AS FOLLOWS:
1. CONSTITUTION PARK - 53,020 SQUARE FEET (1.22 ACRES)
2. WWTP A - 60,180 SQUARE FEET (1.38 ACRES)
3. WWTP B - 40,900 SQUARE FEET (0.94 ACRES)

THE TOTAL PHASE 1A BMA PROJECT LIMIT OF DISTURBANCE IS 154,100 SQUARE FEET (3.54 ACRES).

C. EXISTING SITE CONDITIONS
THE EXISTING SITE GRADES AT CONSTITUTION PARK ARE RELATIVELY FLAT WITH GROUND ELEVATIONS RANGING FROM 1278 TO 1280 WITH AN APPROXIMATE 1-2% SLOPE EASTERLY TOWARDS SOUTH RIVER. THE SOUTH RIVER BANKS NEAR CONSTITUTION PARK ARE APPROXIMATELY 2H:1V. THE EXISTING SITE GRADES AT WWTP ARE RELATIVELY FLAT OR MILDLY SLOPING TO THE SOUTH WITH GROUND ELEVATIONS RANGING FROM 1265 TO 1272. THE SOUTH RIVER BANKS NEAR WWTP A ARE APPROXIMATELY 1.5 TO 2H:1V, AND THE SOUTH RIVER BANKS NEAR WWTP B RANGE BETWEEN 1.5H:1V OR STEEPER TO 3H:1V. THE GROUND COVER AT CONSTITUTION PARK AND WWTP A AND B IS PREDOMINANTLY GRASS WITH TREES AND SHRUBS ALONG THE RIVER BANKS. WHERE POSSIBLE, THE GRASSED AREAS AND TREES WILL BE LEFT IN PLACE TO REDUCE EROSION. EXISTING TREES TO REMAIN WILL BE MARKED WITH PAINT, HIGH-VISIBILITY TAPE, OR OTHER VISUAL MEANS AND PROTECTED. TEMPORARY STAGING AND STOCKPILE AREAS OF CONTAMINATED MATERIALS (IF NECESSARY) WILL BE LOCATED OUTSIDE THE RIVER BANK CORRIDOR AND WITHIN CONTAINED / DIKED AREAS IN THE NEAR VICINITY OF THE REMEDIATION ACTIVITIES. THE EXISTING RIVER BANK SLOPES ARE TYPICALLY AT A GRADE OF APPROXIMATELY 30-50% WITH EXCEPTION OF WWTP B WHICH HAS SOME STEEPER SLOPES. THERE ARE NO ONSITE DRAINAGE CHANNELS. ALL DISTURBED AREAS WILL BE RESTORED TO APPROXIMATE ORIGINAL GRADES AND CONDITIONS UNLESS RIPRAP ARMOR IS NECESSARY TO STABILIZE STEEPER SLOPES.

D. ADJACENT AREAS
E&SC BMP MEASURES WILL BE INSTALLED TO MITIGATE THE POTENTIAL FOR SEDIMENT-LADEN STORMWATER RUNOFF FROM FLOWING TO OFFSITE AREAS. THE PROJECT BMAs, ALONG WITH ADJACENT AREAS, ARE LOCATED WITHIN THE FEDERAL EMERGENCY MANAGEMENT AGENCY'S (FEMA) 100-YEAR FLOODPLAIN. NO WETLANDS ARE NEAR THE PROJECT SITE. THE PROJECT SITE IS NEAR PUBLIC ROADS AND THE CITY'S WWTP AND STORMWATER RUNOFF AND DUST CONTROL SHALL BE ADDRESSED DURING CONSTRUCTION ACTIVITIES.

E. OFF-SITE AREAS
OFF-SITE LAND DISTURBANCE WILL BE LIMITED TO THE DUPONT JONES HOLLOW PROPERTY TO OBTAIN BORROW SOURCE MATERIALS FOR SUBGRADE FILL AND PLANTING SUBSTRATE. OFF-SITE LAND DISTURBANCE WILL BE PERMITTED SEPARATELY. THE LIMIT OF DISTURBANCE ASSOCIATED WITH THE OFF-SITE BORROW SOURCE IS 42,610 SQUARE FEET (0.98 ACRES). THE CONTRACTOR SHALL BE RESPONSIBLE FOR FINAL STABILIZATION AND MAINTENANCE OF THE OFF-SITE BORROW SOURCE.

F. SOILS
NO SOILS INFORMATION IS AVAILABLE FOR THE PROJECT BMAs ACCORDING TO THE "SOIL SURVEY OF AUGUSTA COUNTY, VIRGINIA (1977)" OR THE NATURAL RESOURCE CONSERVATION SERVICE WEB SOIL SURVEY. A GEOTECHNICAL INVESTIGATION WAS PERFORMED IN NOVEMBER 2014 (*AREA OF CONCERN 4 GEOTECHNICAL DATA SUMMARY REPORT*, ANCHOR QEA, FEBRUARY 2015) THAT INCLUDED A CHARACTERIZATION OF UPLAND SOILS AND SEDIMENTS WITHIN THE BMAs. THE SOIL UNITS IDENTIFIED DURING THIS INVESTIGATION INCLUDED THE FOLLOWING:

1. TOPSOIL / SILTY SAND (SM) - NEAR-SURFACE SOILS CONSISTED PRIMARILY OF TOPSOIL, FILL, AND/OR RECENTLY DEPOSITED RIVER SEDIMENTS. THIS UNIT CONSISTED OF LOOSE TO MEDIUM DENSE, DRY TO MOIST, DARK BROWN TO YELLOW-BROWN, FINE SILTY SAND WITH NON- TO SLIGHTLY PLASTIC FINES, OCCASIONAL GRAVEL AND ROCK FRAGMENTS, AND VARYING AMOUNTS OF ORGANIC MATTER. THIS UNIT VARIED IN THICKNESS FROM 2 TO 13.5 FEET, WITH AN AVERAGE THICKNESS OF 6.9 FEET.

2. ALLUVIUM (SM / GM) - UNDERLYING NEAR-SURFACE SOILS WERE PREDOMINANTLY GRANULAR ALLUVIUM. THIS UNIT WAS LOOSE TO MEDIUM DENSE, DAMP TO WET, BROWN / YELLOW-BROWN TO OLIVE-GRAY, FINE TO COARSE SILTY SAND AND SILTY GRAVEL WITH FREQUENT LARGE GRAVEL AND COBBLES THAT WERE SUB-ROUNDED TO SUB-ANGULAR IN SHAPE. THIS UNIT WAS TYPICALLY OBSERVED IMMEDIATELY BENEATH THE TOPSOIL / SILTY SAND UNIT AND RANGED IN THICKNESS FROM 2.5 TO 5 FEET, WITH AN AVERAGE THICKNESS OF 3.8 FEET.

3. SILT / CLAY (ML / MH / CL) - THIS UNIT IS HIGHLY VARIABLE AND RANGED FROM A STIFF, MOIST, BROWN TO DARK BROWN, NON-PLASTIC VERY FINE SANDY SILT / CLAY TO A VERY SOFT, MOIST / WET, ORANGE-BROWN SILT WITH MEDIUM TO HIGH PLASTICITY. THICKNESS RANGED FROM 2 TO 9.5 FEET, WITH AN AVERAGE THICKNESS OF 4.8 FEET.

4. BEDROCK - BEDROCK OUTCROPS WERE FREQUENT. BEDROCK WAS ENCOUNTERED AT DEPTHS RANGING FROM 6.2 TO 24.1 FEET BELOW EXISTING GRADE.

SOIL TYPES THAT WERE AVAILABLE FROM PREVIOUS SOUTH RIVER PROJECTS INCLUDED ALLEGHENY-COTACO COBBLY FINE SANDY LOAMS AND CHAVIES FINE SANDY LOAM. PERMEABILITY OF THESE SOILS IS TYPICALLY MODERATE WITH RUNOFF POTENTIAL AND HAZARD OF EROSION HIGHLY VARIABLE.

EROSION AND SEDIMENT CONTROL NARRATIVE (CONTINUED)

G. CRITICAL AREAS
THE EXISTING SOUTH RIVER BANK SLOPES ARE AT AN APPROXIMATE GRADE OF 30% OR STEEPER. CONTRACTORS WILL BE MADE AWARE OF THESE CRITICAL AREAS AND WILL BE INSTRUCTED TO MINIMIZE PERSONNEL AND LIGHT VEHICLE ACTIVITY NEAR AND ON THE SLOPES. SOUTH RIVER IS ALSO CONSIDERED A CRITICAL AREA. TO THE EXTENT PRACTICAL, REMEDIATION AND RESTORATION / STABILIZATION ACTIVITIES WILL BE COMPLETED BY HEAVY EQUIPMENT OPERATING FROM FLAT OR MILDLY SLOPING AREAS ABOVE THE RIVER BANKS. WITHIN COFFERDAM SECTIONS OF THE RIVER BANKS, EQUIPMENT MAY ACCESS THE LOWER SECTIONS OF SOUTH RIVER BY EITHER UTILIZING EXISTING, FLATTER SLOPE SECTIONS, CONSTRUCTED STABILIZED RAMPED SECTIONS, AND/OR CONSTRUCTED TERRACED / BENCHED SECTIONS TO ACCOMMODATE EQUIPMENT ACCESS AND OPERATIONS NEAR AND AT THE TOE OF SLOPE.

H. EROSION AND SEDIMENT CONTROL MEASURES
ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL MEET OR EXCEED THE MINIMUM STANDARDS AS SPECIFIED BY THE EROSION AND SEDIMENT CONTROL LAW AND REGULATIONS (4VAC50-30-40 / 9VAC25-840-40). THE VESCH WAS USED AS THE PRIMARY REFERENCE FOR BMP SELECTION. THE FOLLOWING BMPs SHALL BE UTILIZED DURING THIS PROJECT:

1. SAFETY FENCE - SAF (VESCH 3.01) - TEMPORARY SAFETY FENCING (METAL FOR CONSTITUTION PARK AND PLASTIC FOR WWTP A AND B BMAs) SHALL BE CONSTRUCTED ALONG THE PERIMETER OF THE PROJECT LIMITS (WITHIN UPLAND AREAS OUTSIDE OF THE RIVER BANK / CORRIDOR AND TERMINATING AT THE TOP OF THE RIVER BANK) TO CREATE A FORMIDABLE BARRIER BETWEEN THE PUBLIC AND THE PROJECT WORK AREAS. SIGNS NOTING POTENTIAL HAZARDS SHALL ALSO BE POSTED AND EASILY SEEN BY ANYONE APPROACHING THE PROTECTED PROJECT WORK AREAS IMMEDIATELY UPON INSTALLATION OF THE SAFETY FENCE.

2. TEMPORARY STONE CONSTRUCTION ENTRANCE - CE (VESCH 3.02) - TEMPORARY STONE CONSTRUCTION ENTRANCES SHALL BE INSTALLED AT THE JUNCTION BETWEEN TEMPORARY ACCESS ROADS AND EXISTING PAVED DRIVEWAYS / STREETS. CONSTRUCTION ENTRANCES WILL LIMIT THE POTENTIAL FOR SOIL TO BE TRANSPORTED ONTO NEARBY PAVED AREAS BY CONSTRUCTION VEHICLES. THE CONSTRUCTION ENTRANCE SHALL BE CONSTRUCTED WITH COARSE AGGREGATE UNDERLAIN BY A FILTER FABRIC LINER. THE CONSTRUCTION ENTRANCE SHALL ALSO BE FITTED WITH A WASH RACK OR OTHER DECONTAMINATION / WASH PAD CONTAINMENT AREA, WHERE SITE SOILS WILL BE REMOVED FROM THE TIRES OF VEHICLES PRIOR TO LEAVING THE SITE. A CONSTRUCTION ENTRANCE IS NOT PROPOSED FOR WWTP A AS ALL VEHICULAR TRAFFIC IS ANTICIPATED TO REMAIN ON EXISTING PAVED SURFACES.

3. CONSTRUCTION ROAD STABILIZATION - CRS (VESCH 3.03) - TEMPORARY ACCESS ROADS WILL EXTEND FROM THE CONSTRUCTION ENTRANCES TO THE BMAs. TEMPORARY ACCESS ROADS SHALL FOLLOW THE CONTOUR OF NATURAL TERRAIN TO THE EXTENT POSSIBLE AND BE CONSTRUCTED WITH COARSE AGGREGATE UNDERLAIN BY A FILTER FABRIC LINER. WHEN CROSSING UTILITIES, THE CONTRACTOR SHALL ADHERE TO THE UTILITY OWNER'S REQUIREMENTS FOR UTILITY CROSSINGS. AT A MINIMUM, TEMPORARY ACCESS ROADS THAT CROSS EXISTING UTILITIES SHALL ALSO BE OUTFITTED WITH STEEL ROAD PLATES ON TOP OF THE COARSE AGGREGATE.

4. SILT FENCE - SF (VESCH 3.05) - SILT FENCE SHALL BE INSTALLED ALONG DOWNGRADIENT PERIMETER SECTIONS OF THE PROJECT SITE TO LIMIT THE POTENTIAL FOR OFF-SITE MIGRATION OF SEDIMENT FROM UPLAND DISTURBED AREAS AND ANY TEMPORARY STAGING / STOCKPILE AREAS. SILT FENCE SECTIONS SHALL BE CONSTRUCTED OF SYNTHETIC MATERIAL WITH A WIRE MESH SUPPORT.

5. STORM DRAIN INLET PROTECTION - IP (VESCH 3.07) - STORM DRAIN INLET PROTECTION SHALL BE INSTALLED WITHIN EXISTING STORM INLETS NEAR THE CONSTRUCTION ENTRANCES AND WITHIN EXISTING WWTP ROADWAYS AS A PRECAUTIONARY MEASURE TO FILTER STORMWATER FLOWING FROM OR NEAR THE PROJECT SITE AND PREVENTING SEDIMENT AND DEBRIS FROM ENTERING THE STORM DRAIN SYSTEM.

6. TEMPORARY FILL DIVERSION - FD (VESCH 3.10) - AS NECESSARY, TEMPORARY FILL DIVERSIONS SHALL BE CONSTRUCTED AT THE TOP OF FILL SLOPES AT THE END OF EACH WORK DAY TO PREVENT WASHOUT OF NEWLY CONSTRUCTED RIVER BANK SUBGRADES OR FINISHED GRADES.

7. RIPRAP - RR (VESCH 3.19) - A ROCK TOE SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE CONTRACT DRAWINGS. RIPRAP SHALL PROTECT UNDERLYING SOILS FROM EROSIVE FORCES OF THE SOUTH RIVER DURING HIGH FLOW CONDITIONS. VIRGINIA DEPARTMENT OF TRANSPORTATION CLASS II RIPRAP SHALL BE UTILIZED FOR THE ROCK TOE AND ANY FINISHED BANK ARMORING. GEOTEXTILE FILTER FABRIC SHALL BE PLACED BETWEEN THE RIPRAP AND THE UNDERLYING SOIL SURFACE TO PREVENT SOIL MOVEMENT INTO OR THROUGH THE RIPRAP.

8. DEWATERING STRUCTURE - DS (VESCH 3.26) - A TEMPORARY PUMPING AND FILTERING/SETTLING DEVICE SHALL BE INSTALLED TO REMOVE SEDIMENT-LADEN WATER FROM A CONSTRUCTION AREA.

9. SURFACE ROUGHENING - SR (VESCH 3.29) - TO THE EXTENT PRACTICAL, SURFACE ROUGHENING SHALL BE PERFORMED TO PROMOTE INTERMIXING OF EXISTING SUBGRADE SOILS WITH IMPORTED FILL SOILS AND PLANTING SUBSTRATE. SURFACE ROUGHENING WILL ALSO AID IN THE ESTABLISHMENT OF VEGETATIVE COVER WITH SEED, REDUCE RUNOFF VELOCITY, INCREASE INFILTRATION, REDUCE EROSION, AND PROVIDE FOR SEDIMENT TRAPPING. SUBGRADE SOILS SHALL BE ROUGHENED WITHIN "BANK REMOVAL AND RESTORATION" BMAs, AND PLANTING SUBSTRATE (NOT PLACED WITHIN THE GEOCELL SYSTEM LAYER) SHALL ALSO BE ROUGHENED (GROOVED, FURROWED, TRACKED) TO PROMOTE SEED GERMINATION.

10. TOPSOILING - TO (VESCH 3.30) - DISTURBED BANK SLOPES WILL RECEIVE A 6-INCH OR 12-INCH PLANTING SUBSTRATE LAYER BASED UPON THE BMA STABILIZATION TYPE.

11. TEMPORARY SEEDING - TS (VESCH 3.31) - TEMPORARY SEEDING SHALL BE UTILIZED TO STABILIZE DISTURBED AREAS THAT WILL NOT BE BROUGHT TO FINAL GRADE FOR A PERIOD OF MORE THAN 14 DAYS. TEMPORARY SEEDING SHALL ALSO BE APPLIED TO SOIL STOCKPILES THAT ARE TO BE UNUSED FOR MORE THAN 14 DAYS.

12. PERMANENT SEEDING - PS (VESCH 3.32) - ALL DISTURBED AREAS SHALL BE PERMANENTLY SEEDED, LIMED, AND FERTILIZED ACCORDING TO THE CONTRACT DRAWINGS.

13. MULCHING - MU (VESCH 3.35) - ALL DISTURBED AREAS THAT RECEIVE TEMPORARY OR PERMANENT SEEDING SHALL BE MULCHED UNLESS A SOIL STABILIZATION BLANKET / MATTING IS UTILIZED DUE TO STEEP SLOPES.

14. SOIL STABILIZATION BLANKETS AND MATTING - B/M (VESCH 3.36) - A PROTECTIVE COVERING (BLANKET) SHALL BE INSTALLED ON ALL BANK SLOPES THAT ARE 3H:1V OR STEEPER IN ACCORDANCE WITH THE CONTRACT DRAWINGS.

15. TREES, SHRUBS, VINES, AND GROUND COVERS - VEG (VESCH 3.37) - ALL DISTURBED RIVER BANKS SHALL BE PERMANENTLY VEGETATED WITH NATIVE TREES, SHRUBS, AND HERBACEOUS PLANTINGS ACCORDING TO THE CONTRACT DRAWINGS.

16. TREE PRESERVATION AND PROTECTION - TP (VESCH 3.38) - TREES SHALL BE SELECTIVELY CLEARED AND SALVAGED TO THE EXTENT PRACTICAL. PRIOR TO CONSTRUCTION AND BEFORE THE PRECONSTRUCTION CONFERENCE, INDIVIDUAL TREES AND STANDS OF TREES TO BE RETAINED WITHIN THE LIMITS OF CLEARING SHALL BE MARKED AT A HEIGHT VISIBLE TO EQUIPMENT OPERATORS. A DIAGONAL SLASH OF BRIGHTLY COLORED PAINT, SURVEYOR'S RIBBON, AND/OR SAFETY FENCING SHALL BE PLACED AROUND THE TREES TO BE RETAINED.

17. DUST CONTROL - DC (VESCH 3.39) - THROUGHOUT CONSTRUCTION, AIR MOVEMENT OF DUST DURING LAND DISTURBING, DEMOLITION, AND CONSTRUCTION ACTIVITIES SHALL BE MINIMIZED. DUST CONTROL MAY INCLUDE VEGETATIVE COVER, MULCH, TILLAGE, IRRIGATION, SPRAY-ON ADHESIVES, STONE, OR OTHER PROTECTIVE BARRIERS (FABRICS / LINERS).

18. COFFERDAMS - PRIOR TO BANK REMEDIATION AND RESTORATION / STABILIZATION ACTIVITIES, A COFFERDAM SHALL BE CONSTRUCTED WITHIN SOUTH RIVER. THE COFFERDAM MAY BE COMPRISED OF ANY OF THE FOLLOWING: PORTADAM PRE-ENGINEERED WATER DIVERSION STRUCTURE, CONCRETE BARRIERS, OR EARTH-FILLED BULK BAGS THAT SHALL BE LOWERED INTO THE WATER BY AN EXCAVATOR OR SIMILAR MATERIAL HANDLING / LIFTING EQUIPMENT, POSITIONED ON FLAT AREAS WITHIN THE LIMIT OF DISTURBANCE. A GEOSYNTHETIC IMPERMEABLE LINER SHALL BE WRAPPED OR ANCHORED TO THE PRE-ENGINEERED / PREFABRICATED COFFERDAM STRUCTURES. THE COFFERDAM SHALL ACT TO ISOLATE THE DISTURBED BANKS AND OTHER AREAS FROM ACTIVE RIVER FLOWS. THE COFFERDAM MAY BE REMOVED AFTER TOE STABILIZATION AND ARMORING MEASURES ARE INSTALLED AND THE PROPOSED BANK HAS BEEN CONSTRUCTED ABOVE THE ORDINARY HIGH WATER ELEVATION.

19. FILTER FABRICS - AFTER GRADING OF THE BANK IS COMPLETED, FILTER FABRIC SHALL BE PLACED ATOP THE SUBSOILS. THE FILTER FABRIC SHALL REDUCE THE POTENTIAL FOR EROSION OF THE TEMPORARILY UNSTABILIZED BANK DURING INSTALLATION OF OTHER STABILIZATION MEASURES.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

S:\Projects\Private-Sector\DuPont\DuPont_South River VA\CAD\Details & Notes.dwg Notes 1
Jul 25, 2017 1:38pm jason.jerrytone

ANCHOR QEA
AECOM

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
DONALD FRANKLIN MAYER, III
No. 029879
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. JERRYTONE
DRAWN BY: J. JERRYTONE
CHECKED BY: D. MAYER
APPROVED BY: D. MAYER
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

TESC NOTES

ES-6

SHEET NO. 12 OF 42

EROSION AND SEDIMENT CONTROL NARRATIVE (CONTINUED)

H. EROSION AND SEDIMENT CONTROL MEASURES (CONTINUED)

20. PUMPED WATER FILTER BAG - A FILTER BAG SHALL BE USED TO FILTER ANY WATER PUMPED FROM DISTURBED EXCAVATION AREAS AND/OR CONTAINED WITHIN COFFERDAM SECTIONS ALONG THE RIVER BANK PRIOR TO DISCHARGING TO ADJACENT AREAS.

21. GEOSYNTHETIC GEOCELL SYSTEM - A PRE-ENGINEERED CELLULAR CONFINEMENT SYSTEM FOR FILL MATERIALS THAT FUNCTIONS AS A SERIES OF CHECK DAMS PREVENTING THE FORMATION OF RILLS AND GULLIES ALONG SLOPES AND PROMOTES THE ESTABLISHMENT OF VEGETATION ON STEEPER SLOPES SHALL BE INSTALLED IN ACCORDANCE WITH THE CONTRACT DRAWINGS.

I. MANAGEMENT STRATEGIES / SEQUENCE OF CONSTRUCTION
ALL E□SC BMPs SHALL BE INSTALLED AND INSPECTED AS REQUIRED BY CHAPTER 30-29(m) OF THE CITY OF WAYNESBORO CODE PRIOR TO ANY BANK REMOVAL AND RESTORATION / STABILIZATION WORK.

THE PROJECT IS ANTICIPATED TO BE PERFORMED WITHIN A FOUR (4) MONTH TIMEFRAME. THE OVERALL PROJECT SCHEDULE AND SEQUENCE OF WORK ACTIVITIES MAY VARY BASED UPON REGULATORY REQUIREMENTS AND PERMIT, SITE, AND/OR WEATHER CONDITIONS. WORK ACTIVITIES MAY BE PERFORMED CONCURRENTLY OR BEFORE/AFTER OTHERS PROVIDED ADEQUATE MEANS OF EROSION AND SEDIMENT CONTROL ARE IMPLEMENTED PRIOR TO PERFORMANCE OF SUCH ACTIVITIES.

THE ANTICIPATED SEQUENCE OF CONSTRUCTION AND INSTALLATION OF BMP MEASURES IS AS FOLLOWS:

1. OBTAIN EROSION AND SEDIMENT CONTROL PLAN APPROVAL AND OTHER APPLICABLE PERMITS BY REGULATORY AGENCIES FOR THE WORK. PERFORM REGULATORY NOTIFICATIONS IN ACCORDANCE WITH THE PERMIT CONDITIONS AND AS REQUIRED BY LAW.
2. PERFORM A PRECONSTRUCTION CONFERENCE, INCLUDING ATTENDANCE BY THE CITY, CONTRACTOR, AND REGULATORY AGENCIES, AS REQUIRED.
3. COORDINATE WITH PROPERTY OWNERS FOR PROTECTION / REMOVAL OF PRIVATE AMENITIES.
4. DEMARCATE THE PROJECT LIMITS, LIMITS OF CLEARING (SELECTIVE TREES), AND LIMITS OF WORK.
5. PERFORM PRE-CONSTRUCTION UTILITY MARK-OUTS AND ASSESSMENTS. CONTACT MISS UTILITY OF VIRGINIA (811 OR 800-552-7001) PRIOR TO PERFORMING ANY EARTH DISTURBANCE ACTIVITIES. THE CONTRACTOR SHALL VERIFY AND COORDINATE UTILITY MARK-OUTS AND REQUEST AN UPDATE BY MISS UTILITY OF VIRGINIA IF THERE IS A REASON TO UPDATE SUCH AS A MISS MARK, NO MARK, ETC. COORDINATE MANAGEMENT AND PROTECTION OF EXISTING UTILITIES WITH UTILITY OWNERS.
6. MOBILIZE EQUIPMENT, PERSONNEL, AND MATERIALS TO THE SITE.
7. INSTALL, OPERATE, AND MAINTAIN ENVIRONMENTAL, HEALTH, AND SAFETY (EH□S) MONITORING EQUIPMENT AND TEMPORARY CONTROL / MITIGATION FACILITIES (E.G., AIR, WATER, ETC.).
8. INSTALL, OPERATE, AND MAINTAIN TRAFFIC CONTROL AND SITE ACCESS MEASURES (E.G., SAFETY FENCE, GATES, VISUAL SCREENS, SIGNAGE, ETC.).
9. INSTALL TEMPORARY UPLAND E□SC MEASURES: STONE CONSTRUCTION ENTRANCES, STORM DRAIN INLET PROTECTION, SILT FENCE, CONSTRUCTION ROAD STABILIZATION, AND TEMPORARY STAGING / STOCKPILING AND DECONTAMINATION / WASH PAD AREAS.
10. PERFORM DEMOLITION ACTIVITIES IN ACCORDANCE WITH THE CONTRACT DRAWINGS.
11. PERFORM SELECTIVE CLEARING AND GRUBBING (E.G., CUTTING / CHIPPING OF WOODY DEBRIS, SALVAGING OF SUITABLE TREES, SOD REMOVAL, ETC.).
12. INSTALL COFFERDAM AND WATER MANAGEMENT (STORM, SURFACE, AND GROUND WATER) CONTROL MEASURES. INSTALL PUMPED WATER FILTER BAG.
13. APPLY BIOCHAR AMENDMENT, INCLUDING INSTALLATION OF GEOSYNTHETIC GEOCELL LAYER.
14. EXCAVATE "SOIL REMOVAL AND RESTORATION" BMAs. CONSOLIDATE AND LOAD CONTAMINATED SOILS / MATERIALS INTO TRUCKS FOR OFF-SITE DISPOSAL AT A LICENSED FACILITY.
15. INSTALL FILTER FABRICS AND ROCK TOE AND RIPRAP ARMORING.
16. PLACE AND COMPACT BACKFILL MATERIALS AND PLANTING SUBSTRATE.
17. STABILIZE BANK SLOPES WITH SEED, FERTILIZER, VEGETATION, MULCH, AND SOIL STABILIZATION BLANKETS / MATTING.
18. REMOVE COFFERDAM AND TEMPORARY E□SC MEASURES AFTER SITE INSPECTION AND APPROVAL BY THE CITY AND REGULATORY AGENCIES, AS REQUIRED.
19. DEMOBILIZE ALL EQUIPMENT, PERSONNEL, AND EXCESS / WASTE MATERIALS OFF-SITE.

J. PERMANENT STABILIZATION
THE PROJECT SITE UNDER POST-STABILIZATION ACTIVITIES SHALL BE PERMANENTLY STABILIZED WITH PERMANENT SEEDING AND VEGETATIVE AND STRUCTURAL BANK STABILIZATION MEASURES AS PRESENTED ON THE CONTRACT DRAWINGS.

K. MAINTENANCE OF EROSION AND SEDIMENT CONTROL MEASURES
TEMPORARY E□SC CONTROL MEASURES SHALL BE INSPECTED DAILY AND AFTER ANY RAIN EVENT. DAMAGED BMPs SHALL BE REPAIRED IMMEDIATELY UPON THEIR DISCOVERY. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTENANCE OF EROSION AND SEDIMENT CONTROL MEASURES DURING CONSTRUCTION.

1. STONE CONSTRUCTION ENTRANCE - ANY SINKHOLES OR RUTS SHALL BE REPAIRED BY ADDING STONE TO BRING THE CONSTRUCTION ENTRANCE TO ITS SPECIFIED DIMENSIONS. A STOCKPILE OF EXTRA STONE SHALL BE AVAILABLE ONSITE FOR SUCH REPAIRS. THE WASH RACK OR OTHER DECONTAMINATION / WASH PAD SHALL BE CLEARED OF SEDIMENT DAILY. SEDIMENT SHALL BE COLLECTED AND DISPOSED OF PROPERTY OFF-SITE OR DISTRIBUTED ON-SITE IF DETERMINED TO BE CLEAN. SEDIMENT ON PUBLIC ROADWAYS SHALL BE SWEPT BACK ON-SITE AND SHALL NOT BE WASHED AWAY WITH WATER.
2. CONSTRUCTION ROAD STABILIZATION - ANY SINKHOLES OR RUTS SHALL BE REPAIRED BY ADDING STONE TO BRING THE CONSTRUCTION ENTRANCE TO ITS SPECIFIED DIMENSIONS. A STOCKPILE OF EXTRA STONE SHALL BE AVAILABLE ONSITE FOR SUCH REPAIRS.
3. SILT FENCE - SEDIMENT DEPOSITS SHALL BE REMOVED WHERE ACCUMULATIONS REACH 1/2 OF THE HEIGHT OF THE FENCE. ALL UNDERCUTTING OR EROSION OF THE TOE ANCHOR SHALL BE IMMEDIATELY REPAIRED WITH COMPACTED BACKFILL MATERIALS. ANY SILT FENCE THAT HAS BEEN UNDERMINED OR TOPPED SHALL BE PROMPTLY REPLACED. SEDIMENT DEPOSITS SHALL BE SPREAD ACROSS THE SITE AS FILL, WHEN SUITABLE, OR OTHERWISE CONTAINED AND DISPOSED OF OFF-SITE.
4. COFFERDAM - THE COFFERDAM SHALL BE INSPECTED DAILY FROM THE RIVER BANK TO DETECT ANY POSSIBLE BREACHES. IF A POSSIBLE BREACH IS DETECTED, A CLOSER INSPECTION SHALL BE COMPLETED. CONFIRMED BREACHES SHALL BE REPAIRED IMMEDIATELY.
5. FILTER FABRIC AND GEOSYNTHETIC GEOCELL LAYER - FILTER FABRICS AND GEOCELL MATERIALS COVERING SUBSOILS SHALL BE INSPECTED DAILY DURING CONSTRUCTION. ANY MAJOR HOLES OR TEARS IN THE MATERIALS SHALL BE REPAIRED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS. THE CONTRACTOR SHALL BE ADVISED TO LIMIT TRAFFIC AND STAGING OF EQUIPMENT ON GEOSYNTHETIC MATERIALS TO WHAT IS NECESSARY FOR INSTALLATION AND SLOPE STABILIZATION.
6. STONE TOE AND RIPRAP ARMOR - STONE TOE AND RIPRAP LOCATIONS SHALL BE INSPECTED PERIODICALLY TO ASSESS WHETHER HIGH FLOWS HAVE CAUSED SCOUR BENEATH THE STONE / RIPRAP OR SECTIONS OF FILTER FABRIC / GEOCELL OR DISLODGED ANY OF THE STONE MATERIALS. ANY REQUIRED REPAIRS, INCLUDING THE ADDITION OF STONE TO BRING THE TOE BACK UP TO PROPOSED FINISHED GRADES SHALL BE COMPLETED IMMEDIATELY.

EROSION AND SEDIMENT CONTROL NARRATIVE (CONTINUED)

K. MAINTENANCE OF EROSION AND SEDIMENT CONTROL MEASURES (CONTINUED)

7. VEGETATED STREAMBANK STABILIZATION - STABILIZED BANKS SHALL BE INSPECTED ONCE A WEEK (MINIMUM) AND AFTER EVERY HIGH-WATER EVENT FROM THE TIME OF FINAL STABILIZATION UNTIL THE END OF THE NEXT DORMANT SEASON AND SEMIANNUALLY THEREAFTER. GAPS IN VEGETATIVE COVER SHALL BE FIXED WITH NEW PLANTS (OR FRESH CUTTINGS FROM ADJACENT PLANTS) IMMEDIATELY AND MULCHED / BLANKETED AS NECESSARY.
8. TEMPORARY SEEDING - AREAS WHICH FAIL TO ESTABLISH TEMPORARY VEGETATIVE COVER ADEQUATE TO MITIGATE EROSION SHALL BE RE-SEEDED AS SOON AS SUCH AREAS ARE IDENTIFIED.
9. PERMANENT SOIL STABILIZATION - IF PERMANENT SOIL STABILIZATION MEASURES (SEEDED AREAS OR TREES / SHRUBS) HAVE BEEN DETERMINED TO HAVE NOT GERMINATED OR DIED, THE AREA SHALL BE RE-SEEDED (OR REPLANTED). THE REASON FOR THE FAILURE SHALL BE DETERMINED AND CORRECTIVE ACTION SHALL BE IMPLEMENTED PRIOR TO RE-SEEDING (OR REPLANTING).
10. SOIL STABILIZATION BLANKETS / MATTING - BLANKETS / MATTING SHALL BE INSPECTED ONCE A WEEK AND AFTER EVERY HIGH-WATER EVENT FROM THE TIME OF FINAL STABILIZATION UNTIL THE END OF THE NEXT DORMANT PERIOD. EROSION, UNDERMINING, DISLOCATION, OR ANY OTHER FAILURE SHALL BE REPAIRED IMMEDIATELY. IF WASHOUT OR BREAKAGE OCCURS, THE BLANKET / MATTING MATERIAL SHALL BE REINSTALLED AFTER THE DAMAGED BANK SLOPES ARE REPAIRED.
11. SAFETY FENCE - SAFETY FENCE SHALL BE CHECKED REGULARLY FOR WEATHER-RELATED OR OTHER DAMAGE. ANY NECESSARY REPAIRS SHALL BE MADE IMMEDIATELY. CARE SHALL BE TAKEN TO SECURE ALL ACCESS POINTS (GATES) AT THE END OF EACH WORKING DAY. ALL LOCKING DEVICES SHALL BE REPAIRED OR REPLACED AS NECESSARY.

IF A LARGE RAIN EVENT IS EXPECTED, ALL E□SC BMPs SHALL BE INSPECTED BEFORE AND IMMEDIATELY AFTER THE RAIN EVENT TO VERIFY THAT EACH BMP IS IN ADEQUATE OPERATIONAL CONDITION. REPAIRS SHALL BE MADE AS NECESSARY.

L. CALCULATIONS FOR TEMPORARY EROSION AND SEDIMENT CONTROL
THE TEMPORARY E□SC BMP MEASURES DESCRIBED AND REFERENCED WITHIN THE STANDARDS AND SPECIFICATIONS OF THE VESCH DO NOT REQUIRE CALCULATIONS. STORMWATER RUNOFF OCCURRING DURING STABILIZATION ACTIVITIES SHALL BE MANAGED ONSITE THROUGH THE USE OF THE E□SC BMPs DESCRIBED. STRUCTURES SUCH AS SILT FENCE AND COFFERDAMS SHALL MITIGATE THE POTENTIAL FOR SEDIMENT-LADEN STORMWATER FROM LEAVING THE SITE.

M. STORMWATER RUNOFF CONSIDERATIONS AND MAINTENANCE
STORMWATER RUNOFF DURING STABILIZATION ACTIVITIES SHALL BE MANAGED ONSITE THROUGH THE USE OF THE E□SC BMPs DESCRIBED. STRUCTURES SUCH AS SILT FENCES AND COFFERDAMS SHALL MITIGATE THE POTENTIAL FOR SEDIMENT-LADEN STORMWATER FROM LEAVING THE SITE. THE SITE SHALL BE GENERALLY RESTORED TO SIMILAR COVER TYPES THAT WERE PRESENT PRIOR TO BANK REMOVAL AND RESTORATION / STABILIZATION ACTIVITIES. INCREASES IN STORMWATER RUNOFF PEAK RATES OR VOLUMES UNDER POST-STABILIZATION ACTIVITIES WILL BE CONSIDERED MINIMAL (FROM NEWLY CONSTRUCTED ACCESS FOOTPATHS). THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE MAINTENANCE OF PERMANENT EROSION AND SEDIMENT CONTROLS STARTING FROM THE CONCLUSION OF FINAL BANK STABILIZATION ACTIVITIES THROUGH THE NEXT DORMANT SEASON (1 YEAR FOLLOWING PROJECT COMPLETION).

N. WATER QUALITY AND OTHER STATE REQUIREMENTS
THIS PROJECT IS IN COMPLIANCE WITH THE WATER QUALITY CRITERIA PRESENTED IN 4VAC50-60-60 (9VAC25-870) OF THE CODE OF VIRGINIA. THE PROPOSED IMPROVEMENTS SHALL NOT INCREASE THE TOTAL PERCENT IMPERVIOUS COVER AT THE SITE. NO POLLUTANT LOAD EVALUATION IS NECESSARY.

THIS PROJECT IS IN COMPLIANCE WITH THE STREAM CHANNEL EROSION AND FLOODING CRITERIA PRESENTED IN 4VAC50-60-70, 80 (9VAC25-870) OF THE CODE OF VIRGINIA. ALL DOWNSTREAM AREAS OF THE SITE SHALL BE PROTECTED DURING BANK STABILIZATION ACTIVITIES THROUGH THE USE OF SILT FENCES AND COFFERDAMS. AFTER BANK STABILIZATION ACTIVITIES, BANKS SHALL BE STABILIZED WITH PERMANENT STRUCTURAL AND VEGETATIVE COVER, INCLUDING TOE ROCK, SEEDING, TREE / SHRUB PLANTING, AND SLOPE AND VEGETATED STREAMBANK STABILIZATION MEASURES. THE PERCENT IMPERVIOUS COVER UNDER POST-STABILIZATION CONDITIONS SHALL NOT BE GREATER THAN UNDER PRE-STABILIZATION CONDITIONS. DOWNSTREAM AREAS SHALL NOT EXPERIENCE EROSION DAMAGE DUE TO CHANGES IN RUNOFF RATE OR VOLUME, VELOCITY, FREQUENCY, DURATION, OR PEAK FLOW RATE OF STORMWATER AS A RESULT OF BANK RESTORATION / STABILIZATION ACTIVITIES.

VESCH EROSION □ SEDIMENT CONTROL MINIMUM STANDARDS (MS1-19) - 9VAC25-840-40

MS-1: PERMANENT OR TEMPORARY SOIL STABILIZATION SHALL BE APPLIED TO DENUDED AREAS WITHIN SEVEN DAYS AFTER FINAL GRADE IS REACHED ON ANY PORTION OF THE SITE. TEMPORARY SOIL STABILIZATION SHALL BE APPLIED WITHIN SEVEN DAYS TO DENUDED AREAS THAT MAY NOT BE AT FINAL GRADE BUT WILL REMAIN DORMANT FOR LONGER THAN 14 DAYS. PERMANENT STABILIZATION SHALL BE APPLIED TO AREAS THAT ARE TO BE LEFT DORMANT FOR MORE THAN ONE YEAR.

MS-2: DURING CONSTRUCTION OF THE PROJECT, SOIL STOCK PILES AND BORROW AREAS SHALL BE STABILIZED OR PROTECTED WITH SEDIMENT TRAPPING MEASURES. THE APPLICANT IS RESPONSIBLE FOR THE TEMPORARY PROTECTION AND PERMANENT STABILIZATION OF ALL SOIL STOCKPILES ON SITE AS WELL AS BORROW AREAS AND SOIL INTENTIONALLY TRANSPORTED FROM THE PROJECT SITE.

MS-3: A PERMANENT VEGETATIVE COVER SHALL BE ESTABLISHED ON DENUDED AREAS NOT OTHERWISE PERMANENTLY STABILIZED. PERMANENT VEGETATION SHALL NOT BE CONSIDERED ESTABLISHED UNTIL A GROUND COVER IS ACHIEVED THAT IS UNIFORM, MATURE ENOUGH TO SURVIVE AND WILL INHIBIT EROSION.

MS-4: SEDIMENT BASINS AND TRAPS, PERIMETER DIKES, SEDIMENT BARRIERS AND OTHER MEASURES INTENDED TO TRAP SEDIMENT SHALL BE CONSTRUCTED AS A FIRST STEP IN ANY LAND-DISTURBING ACTIVITY AND SHALL BE MADE FUNCTIONAL BEFORE UPSLOPE LAND DISTURBANCE TAKES PLACE.

MS-5: STABILIZATION MEASURES SHALL BE APPLIED TO EARTHEN STRUCTURES SUCH AS DAMS, DIKES AND DIVERSIONS IMMEDIATELY AFTER INSTALLATION.

MS-6: SEDIMENT TRAPS AND SEDIMENT BASINS SHALL BE DESIGNED AND CONSTRUCTED BASED UPON THE TOTAL DRAINAGE AREA TO BE SERVED BY THE TRAP OR BASIN. (A) THE MINIMUM STORAGE CAPACITY OF A SEDIMENT TRAP SHALL BE 134 CUBIC YARDS PER ACRE OF DRAINAGE AREA AND THE TRAP SHALL ONLY CONTROL DRAINAGE AREAS LESS THAN THREE ACRES. (B) SURFACE RUNOFF FROM DISTURBED AREAS THAT IS COMPRISED OF FLOW FROM DRAINAGE AREAS GREATER THAN OR EQUAL TO THREE ACRES SHALL BE CONTROLLED BY A SEDIMENT BASIN. THE MINIMUM STORAGE CAPACITY OF A SEDIMENT BASIN SHALL BE 134 CUBIC YARDS PER ACRE OF DRAINAGE AREA. THE OUTFALL SYSTEM SHALL, AT A MINIMUM, MAINTAIN THE STRUCTURAL INTEGRITY OF THE BASIN DURING A 25-YEAR STORM OF 24-HOUR DURATION. RUNOFF COEFFICIENTS USED IN RUNOFF CALCULATIONS SHALL CORRESPOND TO A BARE EARTH CONDITION OR THOSE CONDITIONS EXPECTED TO EXIST WHILE THE SEDIMENT BASIN IS UTILIZED.

MS-7: CUT AND FILL SLOPES SHALL BE DESIGNED AND CONSTRUCTED IN A MANNER THAT WILL MINIMIZE EROSION. SLOPES THAT ARE FOUND TO BE ERODING EXCESSIVELY WITHIN ONE YEAR OF PERMANENT STABILIZATION SHALL BE PROVIDED WITH ADDITIONAL SLOPE STABILIZING MEASURES UNTIL THE PROBLEM IS CORRECTED.

MS-8: CONCENTRATED RUNOFF SHALL NOT FLOW DOWN CUT OR FILL SLOPES UNLESS CONTAINED WITHIN AN ADEQUATE TEMPORARY OR PERMANENT CHANNEL, FLUME OR SLOPE DRAIN STRUCTURE.

MS-9: WHENEVER WATER SEEPS FROM A SLOPE FACE, ADEQUATE DRAINAGE OR OTHER PROTECTION SHALL BE PROVIDED.

MS-10: ALL STORM SEWER INLETS THAT ARE MADE OPERABLE DURING CONSTRUCTION SHALL BE PROTECTED SO THAT SEDIMENT-LADEN WATER CANNOT ENTER THE CONVEYANCE SYSTEM WITHOUT FIRST BEING FILTERED OR OTHERWISE TREATED OR REMOVE SEDIMENT.

MS-11: BEFORE NEWLY CONSTRUCTED STORMWATER CONVEYANCE CHANNELS OR PIPES ARE MADE OPERATIONAL, ADEQUATE OUTLET PROTECTION AND ANY REQUIRED TEMPORARY OR PERMANENT CHANNEL LINING SHALL BE INSTALLED IN BOTH THE CONVEYANCE CHANNEL AND RECEIVING CHANNEL.

MS-12: WHEN WORK IN A LIVE WATERCOURSE IS PERFORMED, PRECAUTIONS SHALL BE TAKEN TO MINIMIZE ENCROACHMENT, CONTROL SEDIMENT TRANSPORT AND STABILIZE THE WORK AREA TO THE GREATEST EXTENT POSSIBLE DURING CONSTRUCTION. NON-ERODIBLE MATERIAL SHALL BE USED FOR THE CONSTRUCTION OF CAUSEWAYS AND COFFERDAMS. EARTHEN FILL MAY BE USED FOR THESE STRUCTURES IF ARMORED BY NON-ERODIBLE COVER MATERIALS.

VESCH EROSION □ SEDIMENT CONTROL MINIMUM STANDARDS (MS1-19) - 9VAC25-840-40 (CONTINUED)

MS-13: WHEN A LIVE WATERCOURSE MUST BE CROSSED BY CONSTRUCTION VEHICLES MORE THAN TWICE IN ANY SIX-MONTH PERIOD, A TEMPORARY VEHICULAR STREAM CROSSING CONSTRUCTED OF NON-ERODIBLE MATERIAL SHALL BE PROVIDED.

MS-14: ALL APPLICABLE FEDERAL, STATE AND LOCAL REQUIREMENTS PERTAINING TO WORKING IN OR CROSSING LIVE WATERCOURSES SHALL BE MET.

MS-15: THE BED AND BANKS OF A WATERCOURSE SHALL BE STABILIZED IMMEDIATELY AFTER WORK IN THE WATERCOURSE IS COMPLETED.

MS-16: UNDERGROUND UTILITY LINES SHALL BE INSTALLED IN ACCORDANCE WITH THE FOLLOWING STANDARDS IN ADDITION TO OTHER APPLICABLE CRITERIA:
A. NO MORE THAN 500 LINEAR FEET OF TRENCH MAY BE OPENED AT ONE TIME.
B. EXCAVATED MATERIAL SHALL BE PLACED ON THE UPHILL SIDE OF TRENCHES.
C. EFFLUENT FROM DEWATERING OPERATIONS SHALL BE FILTERED OR PASSED THROUGH AN APPROVED SEDIMENT TRAPPING DEVICES (OR BOTH), BEFORE BEING DISCHARGED IN A MANNER THAT DOES NOT ADVERSELY AFFECT FLOWING STREAMS OR OFF-SITE PROPERTY.
D. MATERIAL USED FOR BACKFILLING TRENCHES SHALL BE PROPERLY COMPACTED IN ORDER TO MINIMIZE EROSION AND PROMOTE STABILIZATION.
E. RE-STABILIZATION SHALL BE ACCOMPLISHED IN ACCORDANCE WITH THIS CHAPTER (9VAC28-840).
F. APPLICABLE SAFETY REQUIREMENTS SHALL BE COMPLIED WITH.

MS-17: WHERE CONSTRUCTION VEHICLE ACCESS ROUTES INTERSECT PAVED OR PUBLIC ROADS, PROVISIONS SHALL BE MADE TO MINIMIZE THE TRANSPORT OF SEDIMENT BY VEHICULAR TRACKING ONTO THE PAVED SURFACE. WHERE SEDIMENT IS TRANSPORTED ONTO A PAVED OR PUBLIC ROAD SURFACE, THE ROAD SURFACE SHALL BE CLEANED THOROUGHLY AT THE END OF EACH DAY. SEDIMENT SHALL BE REMOVED FROM THE ROADS BY SHOVELING OR SWEEPING AND TRANSPORTED TO A SEDIMENT CONTROL DISPOSAL AREA. STREET WASHING SHALL BE ALLOWED ONLY AFTER SEDIMENT IS REMOVED IN THIS MANNER. THIS PROVISION SHALL APPLY TO INDIVIDUAL DEVELOPMENT LOTS AS WELL AS TO LARGER LAND-DISTURBING ACTIVITIES.

MS-18: ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE REMOVED WITHIN 30 DAYS AFTER FINAL SITE STABILIZATION OR AFTER THE TEMPORARY MEASURES ARE NO LONGER NEEDED, UNLESS OTHERWISE AUTHORIZED BY THE VESCP AUTHORITY. TRAPPED SEDIMENT AND THE DISTURBED SOIL AREAS RESULTING FROM THE DISPOSITION OF TEMPORARY MEASURES SHALL BE PERMANENTLY STABILIZED TO PREVENT FURTHER EROSION AND SEDIMENTATION.

MS-19: PROPERTIES AND WATERWAYS DOWNSTREAM FROM DEVELOPMENT SITES SHALL BE PROTECTED FROM SEDIMENT DISPOSITION, EROSION AND DAMAGE DUE TO INCREASES IN VOLUME, VELOCITY AND PEAK FLOW RATE OF STORMWATER RUNOFF FOR THE STATED FREQUENCY STORM OF 24-HOUR DURATION IN ACCORDANCE WITH THE FOLLOWING STANDARDS AND CRITERIA. STREAM RESTORATION AND RELOCATION PROJECTS THAT INCORPORATE NATURAL CHANNEL DESIGN CONCEPTS ARE NOT MAN-MADE CHANNELS AND SHALL BE EXEMPT FROM ANY FLOW RATE CAPACITY AND VELOCITY REQUIREMENTS FOR NATURAL OR MAN-MADE CHANNELS.

Erosion and Sediment Control Checklist

Project Name: _____

Applicant: _____
Submittal No. _____
Date: _____

Site Area: _____
Disturbed Area: _____

Yes	No	NA	
X			**Attached Erosion and Sediment Control checklist completed by plan preparer.**
			VESC Handbook Minimum Standards: Erosion and Sediment Control plan shall satisfy applicable minimum standards.
X			MS-1 Have all denuded areas requiring temporary or permanent stabilization been stabilized? Seeded? yes/no Mulched? yes/no Graveled? yes/no
X			MS-2 Are soil stockpiles adequately stabilized with seeding and/or sediment trapping measures?
X			MS-3 Does permanent vegetation provide adequate stabilization?
X			MS-4 Have sediment trapping facilities been constructed as a first step in the land disturbing activity?
		X	MS-5 For perimeter trapping facilities, are earthen structures stabilized immediately after stabilization?
		X	MS-6 Are sediment traps and/or basins installed where needed?
X			MS-7 Are finished cut and fill slopes adequately stabilized?
		X	MS-8 Is concentrated runoff downslopes contained within an adequate channel?
		X	MS-9 Is adequate drainage or other protection provided for water seeps from slope faces?
X			MS-10 Do all operational storm sewer inlets have adequate inlet protection?
		X	MS-11 Are all storm water conveyance channels adequately stabilized with channel line and/or outlet protection?
X			MS-12 Is in-stream construction conducted using measures to minimize channel damage?
		X	MS-13 Are temporary stream crossings of non-erodible material installed where applicable?
X			MS-14 Are all federal, state and local permits obtained before working in or crossing a live watercourse?
X			MS-15 Are the banks and the bed of a watercourse stabilized immediately after work in watercourse is complete?
		X	MS-16 Are utility trenches stabilized properly?
X			MS-17 Are soil and mud kept off roadways at intersections with site access roads?
X			MS-18 Have all temporary control structures that are no longer needed been removed and have all control structure repairs and sediment removal been performed and areas stabilized?
X			MS-19 Are properties and waterways downstream from development adequately protected from erosion and sediment deposition due to increase in peak storm water runoff?

Review Signatures: ________________________________

____

____

APPROVED CONSTRUCTION PLAN SET

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

ANCHOR QEA
AECOM

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
DONALD FRANKLIN MAYER, III
No. 029879
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: J. JERRYTONE
DRAWN BY: J. JERRYTONE
CHECKED BY: D. MAYER
APPROVED BY: D. MAYER
SCALE: AS NOTED
DATE: AUGUST 2016

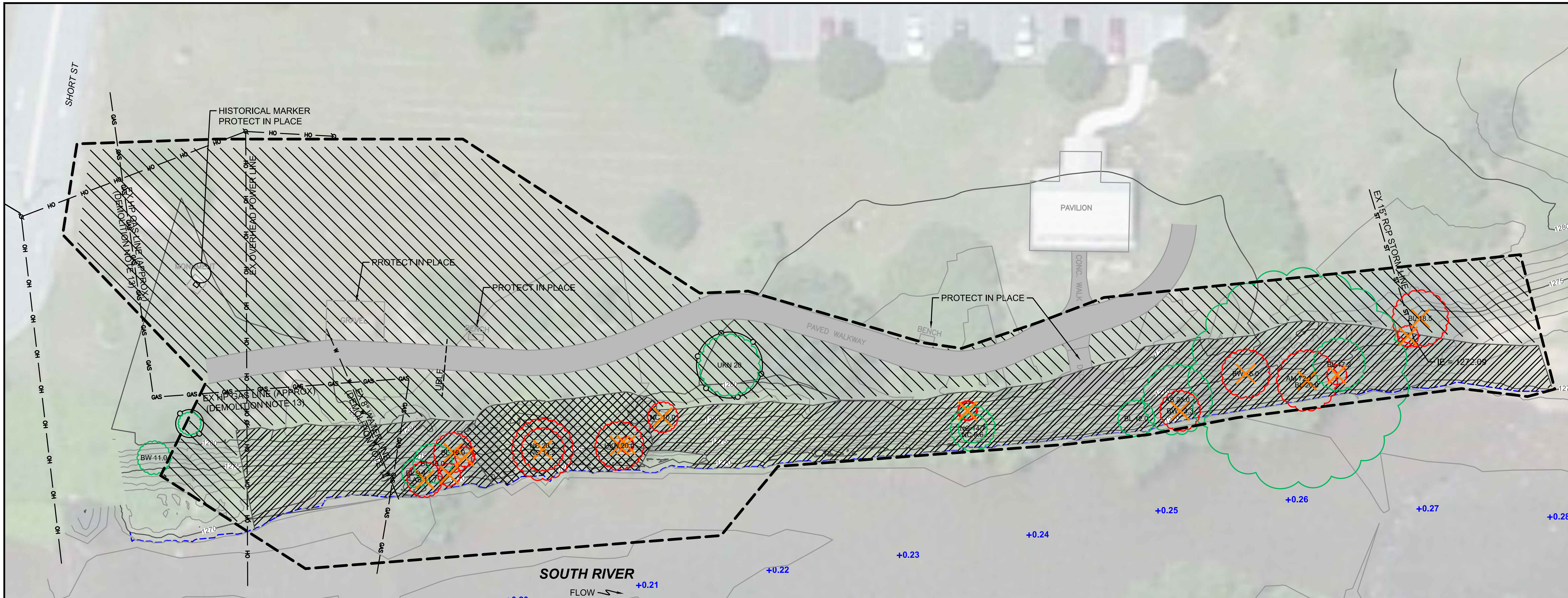
SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

TESC NOTES

ES-7

SHEET NO. 13 OF 42

Jul 25, 2017 1:38pm jason.jerrytone S:\Projects\Private-Sector\DuPont\South River VA\CAD\Details □ Notes.dwg Notes 2



CLEARING NOTES:

1. SEE DRAWING G-2 FOR SURVEY NOTES.
2. PRIOR TO ANY CLEARING, DEMOLITION, AND EARTHWORK ACTIVITIES, CONTRACTOR SHALL PROVIDE AND INSTALL TEMPORARY EROSION AND SEDIMENTATION MEASURES IN ACCORDANCE WITH DRAWINGS ES-1 TO ES-7, SPECIFICATIONS, AND PERMIT REQUIREMENTS.
3. THE CONTRACTOR SHALL NOT STOCKPILE EQUIPMENT OR MATERIALS ON TOP OF UTILITY LINES UNLESS PROTECTIVE MEASURES HAVE BEEN CONSTRUCTED TO THE SATISFACTION OF THE UTILITY OWNER AND THE DSR.
4. SHRUBS TO REMAIN ARE NOT SHOWN ON THE DRAWINGS. THE DSR WILL IDENTIFY SHRUBS TO REMAIN IN THE FIELD PRIOR TO THE START OF CONSTRUCTION. THE LOCATIONS OF TREES IN THE ACCESS CLEARING AREAS HAVE NOT BEEN SURVEYED. TREE LOCATIONS WITHIN THE ACCESS CLEARING AREAS SHALL BE SURVEYED DURING THE PRE-CONSTRUCTION SURVEY.
5. THE CONTRACTOR SHALL PROTECT IN PLACE ITEMS NOT DESIGNATED FOR DEMOLITION OR REMOVAL ON THESE DRAWINGS OR BY THE DSR IN THE FIELD. THE CONTRACTOR SHALL REPAIR OR REPLACE ITEMS TO REMAIN THAT ARE DAMAGED DURING DEMOLITION AND CONSTRUCTION AS REQUIRED BY THE DSR.
6. PRIOR TO DEMOLITION, THE CONTRACTOR SHALL MARK ITEMS TO BE PROTECTED WITH TAPE OR MARKING PAINT. ALL TESC MEASURES SHALL BE IN PLACE PRIOR TO ANY CLEARING AND GRADING (SEE DRAWINGS ES-1 TO ES-7). SITE DEMOLITION SHALL NOT PROCEED UNTIL MARKING IS REVIEWED BY THE DSR.
7. SALVAGE AND STOCKPILE REMOVED TREES FOR REUSE AS LWM, WHERE APPROVED BY THE DSR. REMOVED TREES NOT SUITABLE FOR USE AS LWM SHALL BE DISPOSED OF ACCORDING TO THE PROVISIONS DETAILED IN THE SPECIFICATIONS.
8. THE CONTRACTOR SHALL PREPARE AND SUBMIT FOR DSR APPROVAL A REFINED PLAN FOR ACCESS, STOCKPILING, AND STAGING THAT GENERALLY FOLLOWS THIS PLAN.
9. THE CONTRACTOR SHALL PROTECT THE PAVED WALKWAY. THE CONTRACTOR SHALL REPAIR AND REPLACE SECTIONS OF THE WALKWAY THAT ARE DAMAGED DURING DEMOLITION AND CONSTRUCTION TO THEIR ORIGINAL CONDITION FOLLOWING THE CITY OF WAYNESBORO STANDARDS AND SPECIFICATIONS FOR PAVEMENT.
10. AREA TO BE CLEARED AND GRUBBED OF ALL VEGETATION (SEE SPECIFICATION SECTION 31 11 00 FOR DETAILS).
11. CLEAR ALL GROUND COVER. PROTECT TREES AND SHRUBS TO REMAIN. ALL STUMPS LEFT IN PLACE SHALL BE CLOSE CUT PARALLEL TO THE GROUND (SEE SPECIFICATION SECTION 31 12 00 FOR DETAILS).
12. CLEAR AND GRUB TO THE MINIMUM EXTENT NECESSARY TO OBTAIN ACCESS. OBTAIN DSR APPROVAL BEFORE REMOVING ANY TREES. ALL TREES REMOVED IN THE ACCESS CLEARING AREAS SHALL BE REPLACED WITH 2 INCH CALIPER TREES AT A RATIO OF 2 TO 1.
13. HEAVY EQUIPMENT MAY DAMAGE HIGH PRESSURE GAS LINE. CONTACT COLUMBIA GAS FOR PIPELINE PROTECTION SPECIFICATIONS PRIOR TO BEGINNING WORK.
14. PRIOR TO COMMENCING DEMOLITION THE CONTRACTOR SHALL POTHOLE WATER MAIN WITH A REPRESENTATIVE FROM THE CITY OF WAYNESBORO PRESENT TO DETERMINE ELEVATION AND MATERIAL OF WATER MAIN.

LEGEND:

- 1250 — EXISTING CONTOURS (1 FT INTERVAL)
- BL12.0 — EXISTING TREE TO REMAIN (COMMON NAME, DBH)
- BL12.0 — EXISTING TREE TO BE REMOVED (COMMON NAME, DBH)
- UNKNOWN BURIED LINEAR FEATURE
- TEMPORARY TREE PROTECTION FENCING
- +0.20 — RELATIVE RIVER MILE
- EXISTING PAVED WALKWAY
- APPROXIMATE OHWM
- CLEARING AND GRUBBING AREA (CLEARING NOTE 10)
- SELECTIVE CLEARING AREA (CLEARING NOTE 11)
- ACCESS CLEARING AREA (CLEARING NOTE 12)
- PROJECT LIMITS

NORTH

0 20 40
SCALE IN FEET

NOTES:

1. AERIAL BY ESRI DATED 5/9/11.
2. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
3. VERTICAL DATUM: NAVD 88.
4. SEE DRAWING G-2 FOR ADDITIONAL SURVEY NOTES AND EXISTING UTILITY LEGEND.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1

DESIGNED BY: S. HAFFEY
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

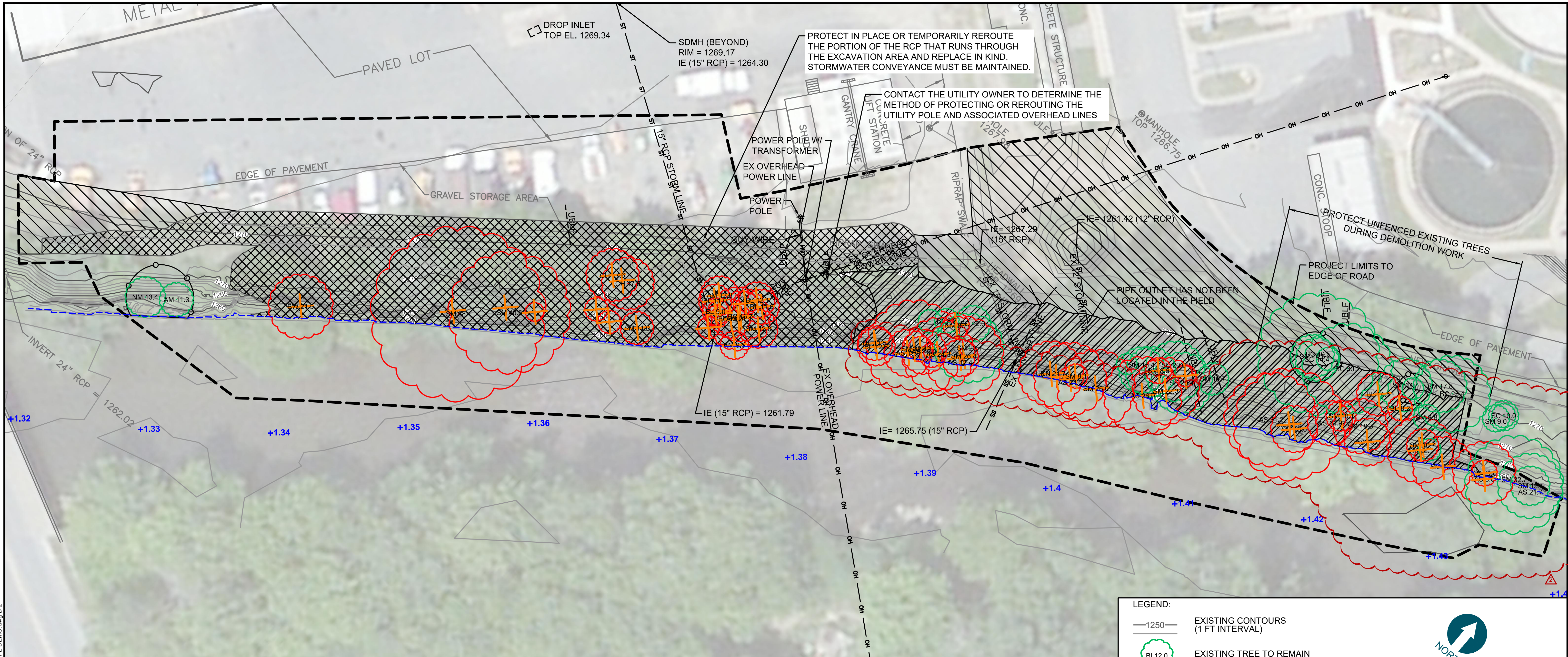
SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

CLEARING PLAN - CONSTITUTION PARK BMA

D-1

SHEET NO. 14 OF 42

Jul 25, 2017 9:54am tgriga K:\Projects\0952-DuPont\South River Phase 1 Interim Remedial Mea\Construction Plans\0952-PL-DEMO.dwg D-1



CLEARING NOTES:

1. SEE DRAWING G-2 FOR SURVEY NOTES.
2. PRIOR TO ANY CLEARING, DEMOLITION, AND EARTHWORK ACTIVITIES, CONTRACTOR SHALL PROVIDE AND INSTALL TEMPORARY EROSION AND SEDIMENTATION MEASURES IN ACCORDANCE WITH DRAWINGS ES-1 TO ES-7, SPECIFICATIONS, AND PERMIT REQUIREMENTS. REMOVE AND DISPOSE OF FENCE ALONG ROAD IN THIS AREA AS REQUIRED FOR ACCESS.
3. THE CONTRACTOR SHALL NOT STOCKPILE EQUIPMENT OR MATERIALS ON TOP OF UTILITY LINES UNLESS PROTECTIVE MEASURES HAVE BEEN CONSTRUCTED TO THE SATISFACTION OF THE UTILITY OWNER AND THE DSR.
4. SHRUBS TO REMAIN ARE NOT SHOWN ON THE DRAWINGS. THE DSR WILL IDENTIFY SHRUBS TO REMAIN IN THE FIELD PRIOR TO THE START OF CONSTRUCTION.
5. THE CONTRACTOR SHALL PROTECT IN PLACE ITEMS NOT DESIGNATED FOR DEMOLITION OR REMOVAL ON THESE DRAWINGS OR BY THE DSR IN THE FIELD. THE CONTRACTOR SHALL REPAIR OR REPLACE ITEMS TO REMAIN THAT ARE DAMAGED DURING DEMOLITION AND CONSTRUCTION AS REQUIRED BY THE DSR.
6. PRIOR TO DEMOLITION, THE CONTRACTOR SHALL MARK ITEMS TO BE PROTECTED WITH TAPE OR MARKING PAINT. ALL TESC MEASURES SHALL BE IN PLACE PRIOR TO ANY CLEARING AND GRADING (SEE DRAWINGS ES-1 TO ES-7). SITE DEMOLITION SHALL NOT PROCEED UNTIL MARKING IS REVIEWED BY THE DSR.
7. SALVAGE AND STOCKPILE REMOVED TREES FOR REUSE AS LWM, WHERE APPROVED BY THE DSR. REMOVED TREES NOT SUITABLE FOR USE AS LWM SHALL BE DISPOSED OF ACCORDING TO THE PROVISIONS DETAILED IN THE SPECIFICATIONS.
8. THE CONTRACTOR SHALL PREPARE AND SUBMIT FOR DSR APPROVAL A REFINED PLAN FOR ACCESS, STOCKPILING, AND STAGING THAT GENERALLY FOLLOWS THIS PLAN.
9. THE CONTRACTOR SHALL PROTECT ALL PAVED AREAS. THE CONTRACTOR SHALL REPAIR AND REPLACE SECTIONS OF THE PAVEMENT THAT ARE DAMAGED DURING DEMOLITION AND CONSTRUCTION TO THEIR ORIGINAL CONDITION IN ACCORDANCE WITH THE CITY OF WAYNESBORO STANDARDS AND SPECIFICATIONS FOR PAVEMENT.
10. AREA TO BE CLEARED AND GRUBBED OF ALL VEGETATION (SEE SPECIFICATION SECTION 31 11 00 FOR DETAILS).
11. CLEAR ALL GROUND COVER. PROTECT TREES AND SHRUBS TO REMAIN. ALL STUMPS LEFT IN PLACE SHALL BE CLOSE CUT PARALLEL TO THE GROUND (SEE SPECIFICATION SECTION 31 12 00 FOR DETAILS).
12. CLEAR AND GRUB TO THE MINIMUM EXTENT NECESSARY TO OBTAIN ACCESS. OBTAIN DSR APPROVAL BEFORE REMOVING ANY TREES. ALL TREES REMOVED IN THE ACCESS CLEARING AREAS SHALL BE REPLACED WITH 2 INCH CALIPER TREES AT A RATIO OF 2 TO 1.

LEGEND:

- 1250 — EXISTING CONTOURS (1 FT INTERVAL)
- BL12.0 — EXISTING TREE TO REMAIN (COMMON NAME, DBH)
- BL12.0 — EXISTING TREE TO BE REMOVED (COMMON NAME, DBH)
- UNKNOWN BURIED LINEAR FEATURE
- TEMPORARY TREE PROTECTION FENCING
- +0.20 — RELATIVE RIVER MILE
- APPROXIMATE OHWM
- CLEARING AND GRUBBING AREA (CLEARING NOTE 10)
- SELECTIVE CLEARING AREA (CLEARING NOTE 11)
- ACCESS CLEARING AREA (CLEARING NOTE 12)
- PROJECT LIMITS

NORTH

0 20 40
SCALE IN FEET

NOTES:

1. AERIAL BY ESRI DATED 5/9/11.
2. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
3. VERTICAL DATUM: NAVD 88.
4. SEE DRAWING G-2 FOR ADDITIONAL SURVEY NOTES AND EXISTING UTILITY LEGEND.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

K:\Projects\0952-DuPont\South River Phase 1 Interim Remedial Mea\Construction Plans\0952-PL-DEMO.dwg D-2
Oct 19, 2017 11:16am tgriga

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
10/19/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1
2	10/19/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #2

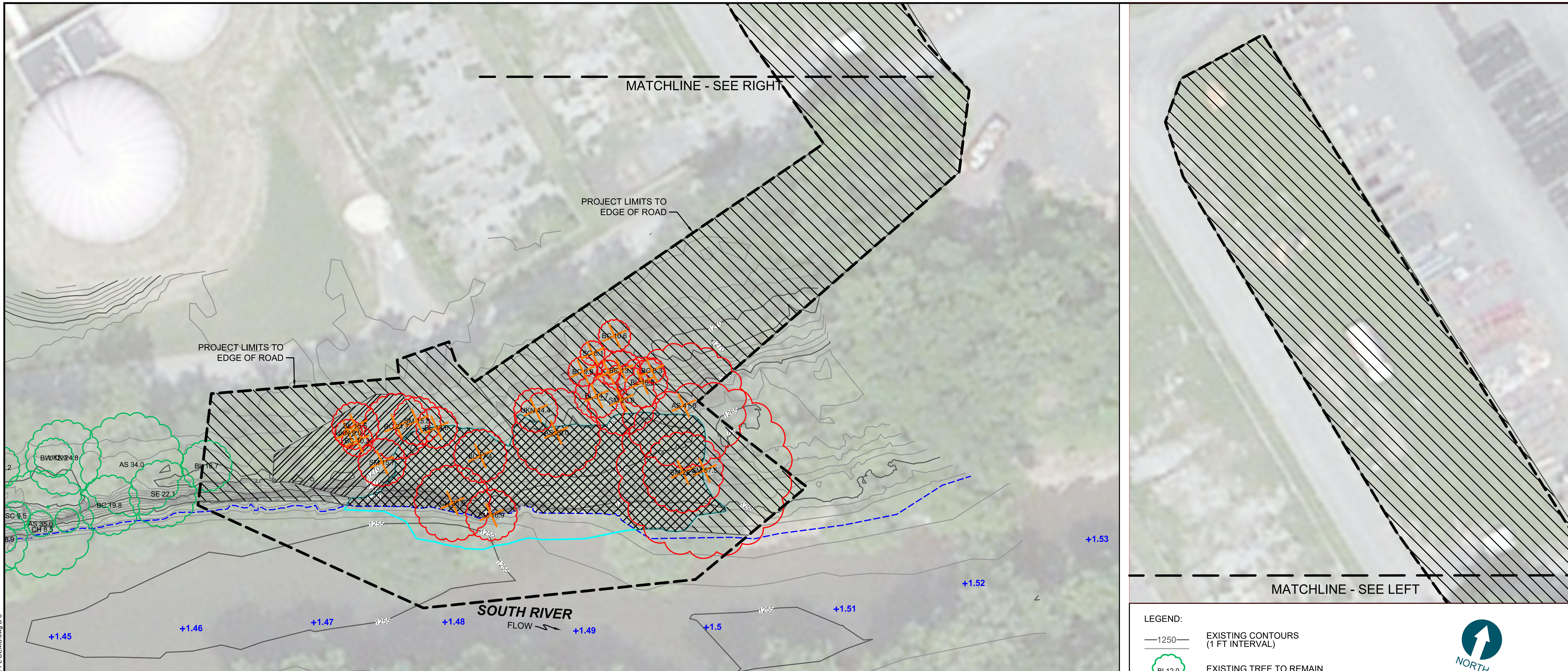
DESIGNED BY: S. HAFFEY
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

CLEARING PLAN - WWTP A BMA

D-2

SHEET NO. 15 OF 42



CLEARING NOTES:

1. SEE DRAWING G-2 FOR SURVEY NOTES.
2. PRIOR TO ANY CLEARING, DEMOLITION, AND EARTHWORK ACTIVITIES, CONTRACTOR SHALL PROVIDE AND INSTALL TEMPORARY EROSION AND SEDIMENTATION MEASURES IN ACCORDANCE WITH DRAWINGS ES-1 TO ES-7, SPECIFICATIONS, AND PERMIT REQUIREMENTS. REMOVE AND DISPOSE OF FENCE ALONG ROAD IN THIS AREA AS REQUIRED FOR ACCESS.
3. THE CONTRACTOR SHALL NOT STOCKPILE EQUIPMENT OR MATERIALS ON TOP OF UTILITY LINES UNLESS PROTECTIVE MEASURES HAVE BEEN CONSTRUCTED TO THE SATISFACTION OF THE UTILITY OWNER AND THE DSR.
4. SHRUBS TO REMAIN ARE NOT SHOWN ON THE DRAWINGS. THE DSR WILL IDENTIFY SHRUBS TO REMAIN IN THE FIELD PRIOR TO THE START OF CONSTRUCTION.
5. THE CONTRACTOR SHALL PROTECT IN PLACE ITEMS NOT DESIGNATED FOR DEMOLITION OR REMOVAL ON THESE DRAWINGS OR BY THE DSR IN THE FIELD. THE CONTRACTOR SHALL REPAIR OR REPLACE ITEMS TO REMAIN THAT ARE DAMAGED DURING DEMOLITION AND CONSTRUCTION AS REQUIRED BY THE DSR.
6. PRIOR TO DEMOLITION, THE CONTRACTOR SHALL MARK ITEMS TO BE PROTECTED WITH TAPE OR MARKING PAINT. ALL TESC MEASURES SHALL BE IN PLACE PRIOR TO ANY CLEARING AND GRADING (SEE DRAWINGS ES-1 TO ES-7). SITE DEMOLITION SHALL NOT PROCEED UNTIL MARKING IS REVIEWED BY THE DSR.
7. SALVAGE AND STOCKPILE REMOVED TREES FOR REUSE AS LWM, WHERE APPROVED BY THE DSR. REMOVED TREES NOT SUITABLE FOR USE AS LWM SHALL BE DISPOSED OF ACCORDING TO THE PROVISIONS DETAILED IN THE SPECIFICATIONS.
8. THE CONTRACTOR SHALL PREPARE AND SUBMIT FOR DSR APPROVAL A REFINED PLAN FOR ACCESS, STOCKPILING, AND STAGING THAT GENERALLY FOLLOWS THIS PLAN.
9. THE CONTRACTOR SHALL PROTECT ALL PAVED AREAS. THE CONTRACTOR SHALL REPAIR AND REPLACE SECTIONS OF THE PAVEMENT THAT ARE DAMAGED DURING DEMOLITION AND CONSTRUCTION TO THEIR ORIGINAL CONDITION IN ACCORDANCE WITH THE CITY OF WAYNESBORO STANDARDS AND SPECIFICATIONS FOR PAVEMENT.
10. AREA TO BE CLEARED AND GRUBBED OF ALL VEGETATION (SEE SPECIFICATION SECTION 31 12 00 FOR DETAILS).
11. CLEAR ALL GROUND COVER. PROTECT TREES AND SHRUBS TO REMAIN. ALL STUMPS LEFT IN PLACE SHALL BE CLOSE CUT PARALLEL TO THE GROUND (SEE SPECIFICATION SECTION 31 12 00 FOR DETAILS).
12. CLEAR AND GRUB TO THE MINIMUM EXTENT NECESSARY TO OBTAIN ACCESS. OBTAIN DSR APPROVAL BEFORE REMOVING ANY TREES. ALL TREES REMOVED IN THE ACCESS CLEARING AREAS SHALL BE REPLACED WITH 2 INCH CALIPER TREES AT A RATIO OF 2 TO 1.

LEGEND:

- 1250 — EXISTING CONTOURS (1 FT INTERVAL)
- BL12.0 — EXISTING TREE TO REMAIN (COMMON NAME, DBH)
- BL12.0 — EXISTING TREE TO BE REMOVED (COMMON NAME, DBH)
- UNKNOWN BURIED LINEAR FEATURE
- TEMPORARY TREE PROTECTION FENCING
- +0.20 — RELATIVE RIVER MILE
- APPROXIMATE OHWM
- CLEARING AND GRUBBING AREA (CLEARING NOTE 10)
- SELECTIVE CLEARING AREA (CLEARING NOTE 11)
- ACCESS CLEARING AREA (CLEARING NOTE 12)
- PROJECT LIMITS

NORTH

0 20 40
SCALE IN FEET

NOTES:

1. AERIAL BY ESRI DATED 5/9/11.
2. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
3. VERTICAL DATUM: NAVD 88.
4. SEE DRAWING G-2 FOR ADDITIONAL SURVEY NOTES AND EXISTING UTILITY LEGEND.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

K:\Projects\0952-DuPont\South River Phase 1 Interim Remedial Mea\Construction Plans\0952-PL-DEMO.dwg D-3
Jul 25, 2017 9:55am tgriga

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1

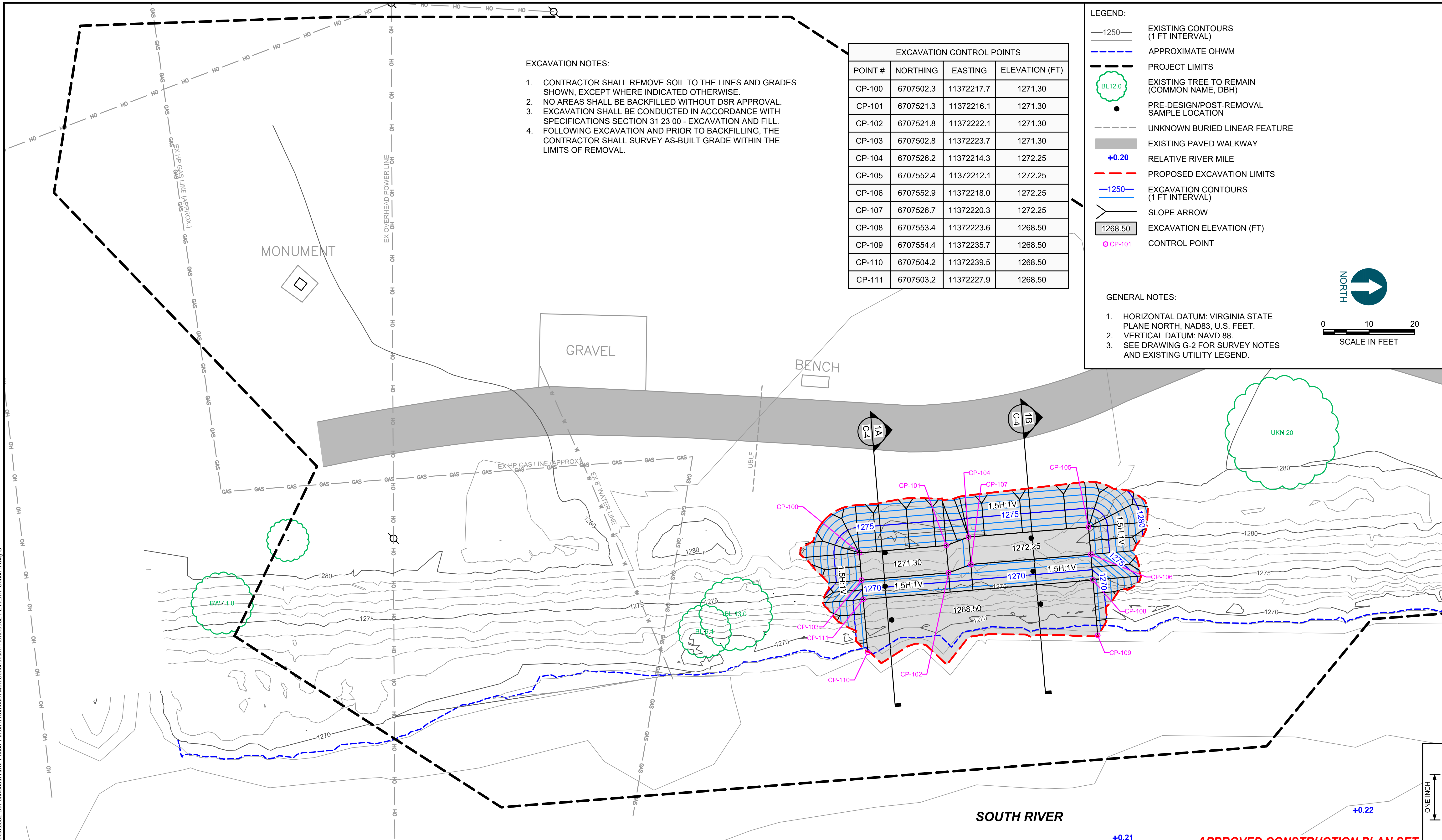
DESIGNED BY: S. HAFFEY
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

CLEARING PLAN - WWTP B BMA

D-3

SHEET NO. 16 OF 42



EXCAVATION NOTES:

1. CONTRACTOR SHALL REMOVE SOIL TO THE LINES AND GRADES SHOWN, EXCEPT WHERE INDICATED OTHERWISE.
2. NO AREAS SHALL BE BACKFILLED WITHOUT DSR APPROVAL.
3. EXCAVATION SHALL BE CONDUCTED IN ACCORDANCE WITH SPECIFICATIONS SECTION 31 23 00 - EXCAVATION AND FILL.
4. FOLLOWING EXCAVATION AND PRIOR TO BACKFILLING, THE CONTRACTOR SHALL SURVEY AS-BUILT GRADE WITHIN THE LIMITS OF REMOVAL.

EXCAVATION CONTROL POINTS

POINT #	NORTHING	EASTING	ELEVATION (FT)
CP-100	6707502.3	11372217.7	1271.30
CP-101	6707521.3	11372216.1	1271.30
CP-102	6707521.8	11372222.1	1271.30
CP-103	6707502.8	11372223.7	1271.30
CP-104	6707526.2	11372214.3	1272.25
CP-105	6707552.4	11372212.1	1272.25
CP-106	6707552.9	11372218.0	1272.25
CP-107	6707526.7	11372220.3	1272.25
CP-108	6707553.4	11372223.6	1268.50
CP-109	6707554.4	11372235.7	1268.50
CP-110	6707504.2	11372239.5	1268.50
CP-111	6707503.2	11372227.9	1268.50

LEGEND:

- 1250 — EXISTING CONTOURS (1 FT INTERVAL)
- APPROXIMATE OHWM
- PROJECT LIMITS
- BL12.0 — EXISTING TREE TO REMAIN (COMMON NAME, DBH)
- PRE-DESIGN/POST-REMOVAL SAMPLE LOCATION
- UNKNOWN BURIED LINEAR FEATURE
- EXISTING PAVED WALKWAY
- +0.20 — RELATIVE RIVER MILE
- PROPOSED EXCAVATION LIMITS
- 1250 — EXCAVATION CONTOURS (1 FT INTERVAL)
- SLOPE ARROW
- 1268.50 — EXCAVATION ELEVATION (FT)
- CP-101 — CONTROL POINT

GENERAL NOTES:

1. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
2. VERTICAL DATUM: NAVD 88.
3. SEE DRAWING G-2 FOR SURVEY NOTES AND EXISTING UTILITY LEGEND.

NORTH

0 10 20
SCALE IN FEET

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

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Jul 25, 2017 9:55am tgriga

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: S. HAFFEY
DRAWN BY: T. GRIGA
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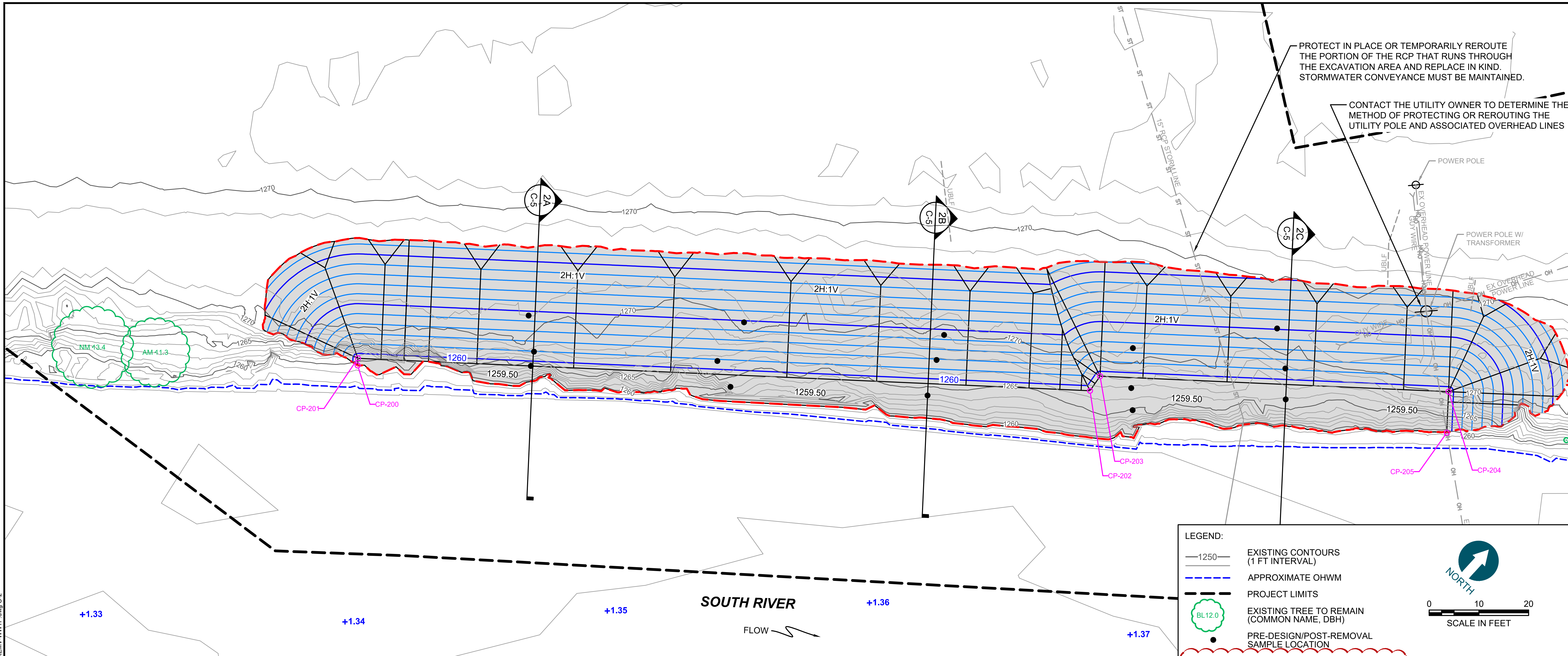
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

EXCAVATION PLAN - CONSTITUTION PARK BMA

C-1

SHEET NO. 17 OF 42



EXCAVATION NOTES:

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2. NO AREAS SHALL BE BACKFILLED WITHOUT DSR APPROVAL.
3. EXCAVATION SHALL BE CONDUCTED IN ACCORDANCE WITH SPECIFICATIONS SECTION 31 23 00 - EXCAVATION AND FILL.
4. FOLLOWING EXCAVATION AND PRIOR TO BACKFILLING, THE CONTRACTOR SHALL SURVEY AS-BUILT GRADE WITHIN THE LIMITS OF REMOVAL.

EXCAVATION CONTROL POINTS

POINT #	NORTHING	EASTING	ELEVATION (FT)
CP-200	6712080.8	11374779.2	1259.50
CP-201	6712081.9	11374778.4	1259.50
CP-202	6712171.5	11374895.3	1259.50
CP-203	6712175.1	11374895.0	1259.50
CP-204	6712217.8	11374950.7	1259.50
CP-205	6712211.2	11374955.7	1259.50

LEGEND:

1250	EXISTING CONTOURS (1 FT INTERVAL)
	APPROXIMATE OHWM
	PROJECT LIMITS
BL12.0	EXISTING TREE TO REMAIN (COMMON NAME, DBH)
	PRE-DESIGN/POST-REMOVAL SAMPLE LOCATION
	UNKNOWN BURIED LINEAR FEATURE
+0.20	RELATIVE RIVER MILE
	PROPOSED EXCAVATION LIMITS
1250	EXCAVATION CONTOURS (1 FT INTERVAL)
	SLOPE ARROW
1268.50	EXCAVATION ELEVATION (FT)
CP-101	CONTROL POINT

NORTH

0 10 20

SCALE IN FEET

GENERAL NOTES:

1. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
2. VERTICAL DATUM: NAVD 88
3. SEE DRAWING G-2 FOR SURVEY NOTES AND EXISTING UTILITIES LEGEND.

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

K:\Projects\0952-DuPont\South River Phase 1 Interim Remedial Mea\Construction Plans\0952-PL-REM-WWTP.dwg C-2

Jul 25, 2017 9:56am tgriga

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1

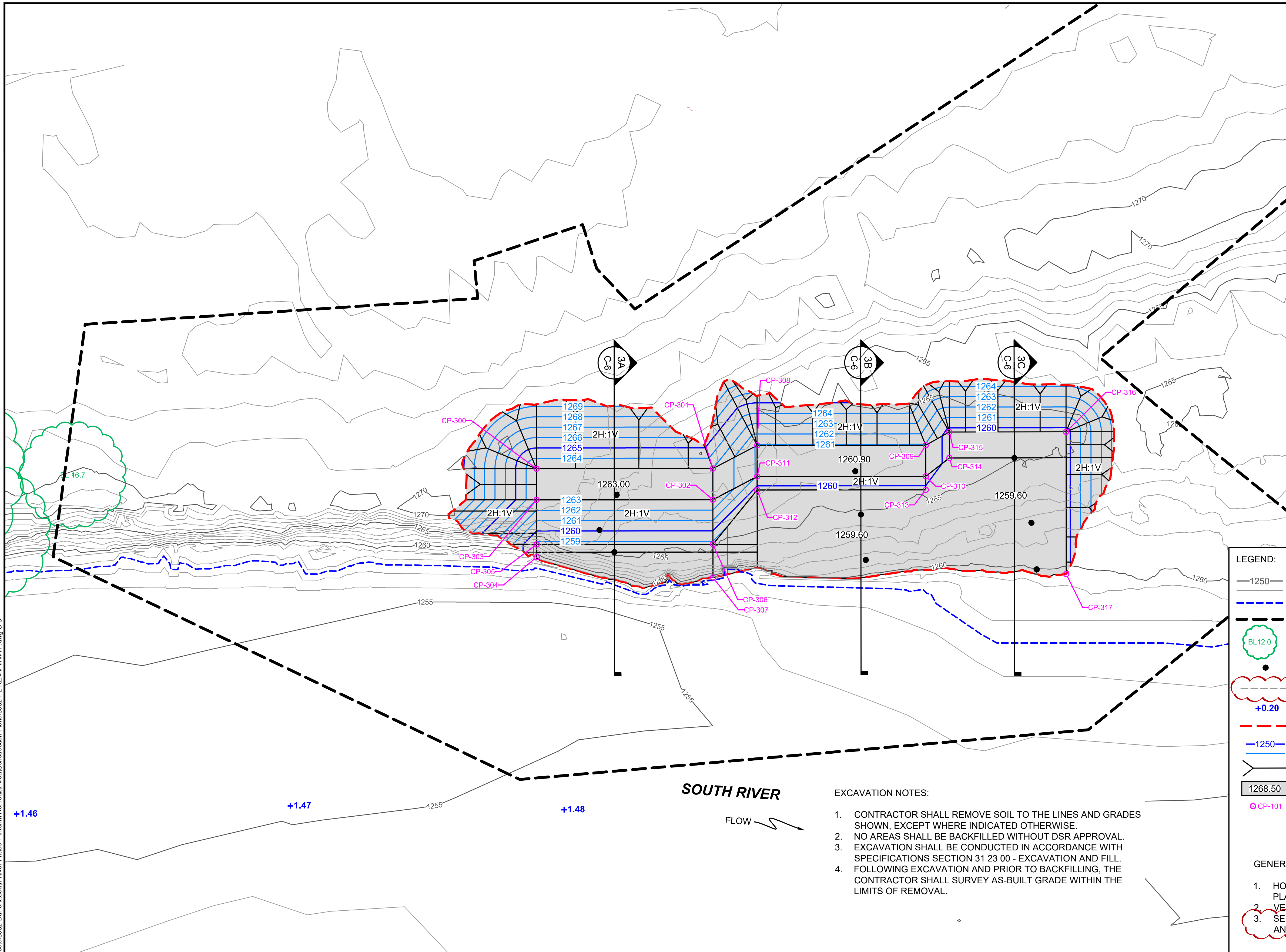
DESIGNED BY: S. HAFFEY
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

EXCAVATION PLAN - WWTP A BMA

C-2

SHEET NO. 18 OF 42



EXCAVATION CONTROL POINTS			
POINT #	NORTHING	EASTING	ELEVATION (FT)
CP-300	6712464.4	11375418.2	1263.00
CP-301	6712476.6	11375449.9	1263.00
CP-302	6712471.0	11375452.1	1263.00
CP-303	6712458.8	11375420.4	1263.00
CP-304	6712448.4	11375424.3	1258.70
CP-305	6712450.7	11375423.5	1258.70
CP-306	6712463.0	11375455.2	1258.70
CP-307	6712457.0	11375457.5	1258.70
CP-308	6712483.8	11375456.3	1260.90
CP-309	6712495.5	11375486.6	1260.90
CP-310	6712489.9	11375488.8	1260.90
CP-311	6712478.2	11375458.5	1260.90
CP-312	6712475.8	11375459.4	1259.60
CP-313	6712487.5	11375489.7	1259.60
CP-314	6712494.8	11375491.8	1259.60
CP-315	6712499.5	11375490.0	1259.60
CP-316	6712507.6	11375511.0	1259.60
CP-317	6712482.0	11375520.8	1259.60

LEGEND:

- 1250 — EXISTING CONTOURS (1 FT INTERVAL)
- APPROXIMATE OHWM
- PROJECT LIMITS
- BL12.0 — EXISTING TREE TO REMAIN (COMMON NAME, DBH)
- PRE-DESIGN/POST-REMOVAL SAMPLE LOCATION
- UNKNOWN BURIED LINEAR FEATURE
- +0.20 — RELATIVE RIVER MILE
- PROPOSED EXCAVATION LIMITS
- 1250 — EXCAVATION CONTOURS (1 FT INTERVAL)
- SLOPE ARROW
- 1268.50 — EXCAVATION ELEVATION (FT)
- CP-101 — CONTROL POINT

NORTH

0 10 20
SCALE IN FEET

EXCAVATION NOTES:

1. CONTRACTOR SHALL REMOVE SOIL TO THE LINES AND GRADES SHOWN, EXCEPT WHERE INDICATED OTHERWISE.
2. NO AREAS SHALL BE BACKFILLED WITHOUT DSR APPROVAL.
3. EXCAVATION SHALL BE CONDUCTED IN ACCORDANCE WITH SPECIFICATIONS SECTION 31 23 00 - EXCAVATION AND FILL.
4. FOLLOWING EXCAVATION AND PRIOR TO BACKFILLING, THE CONTRACTOR SHALL SURVEY AS-BUILT GRADE WITHIN THE LIMITS OF REMOVAL.

GENERAL NOTES:

1. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
2. VERTICAL DATUM: NAVD 88
3. SEE DRAWING G-2 FOR SURVEY NOTES AND EXISTING UTILITIES LEGEND.

ONE INCH — AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

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Jul 25, 2017 9:56am tgriga

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA — WALTER J. DINICOLA — Lic. No. 052817 — PROFESSIONAL ENGINEER — 7/14/17

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1

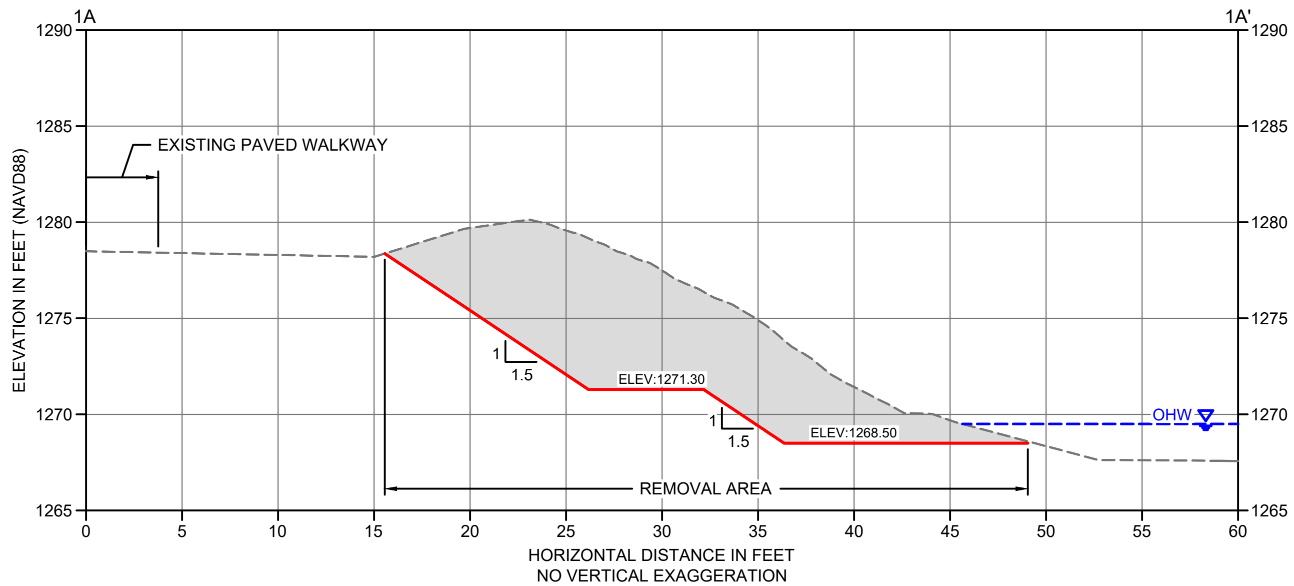
DESIGNED BY: S. HAFFEY
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

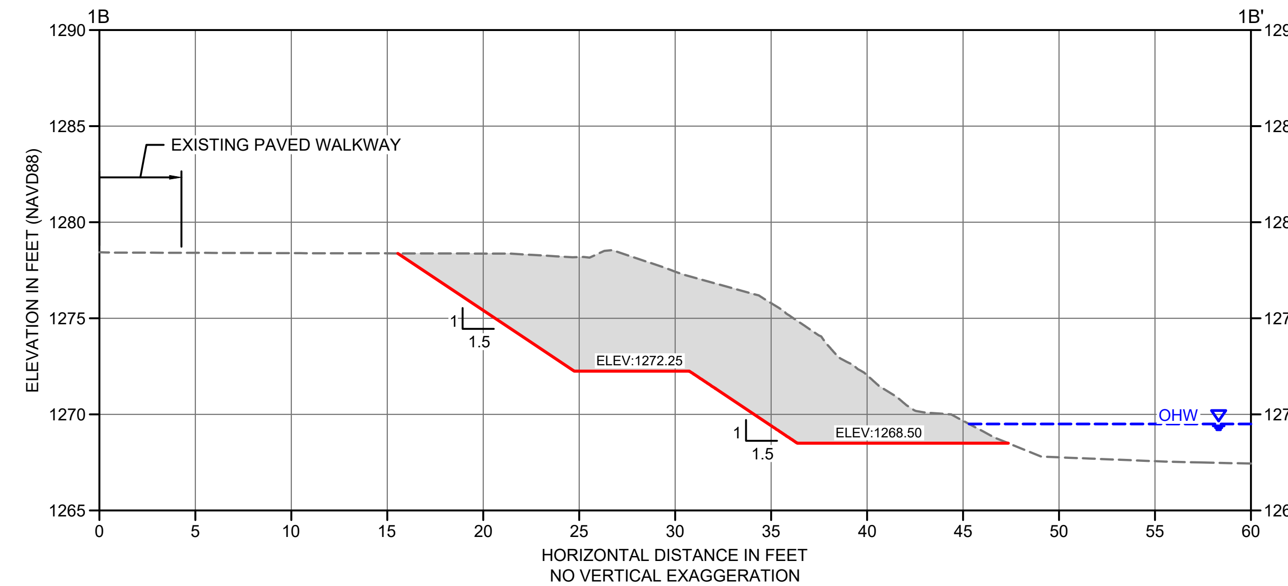
EXCAVATION PLAN - WWTP B BMA

C-3

SHEET NO. 19 OF 42



1A / C-1 EXCAVATION SECTION - CONSTITUTION PARK BMA
SCALE: 1" = 5'



1B / C-1 EXCAVATION SECTION - CONSTITUTION PARK BMA
SCALE: 1" = 5'

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

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Jul 25, 2017 9:57am tgriga

ANCHOR QEA

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COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
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PROFESSIONAL ENGINEER
7/14/17

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

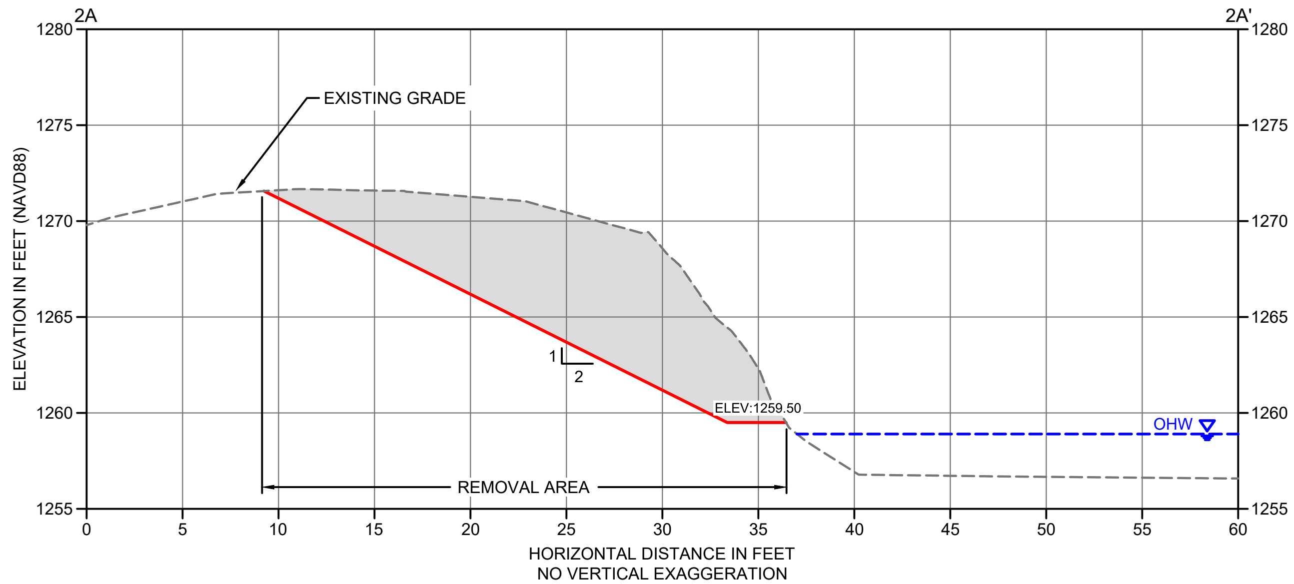
DESIGNED BY: S. HAFFEY
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

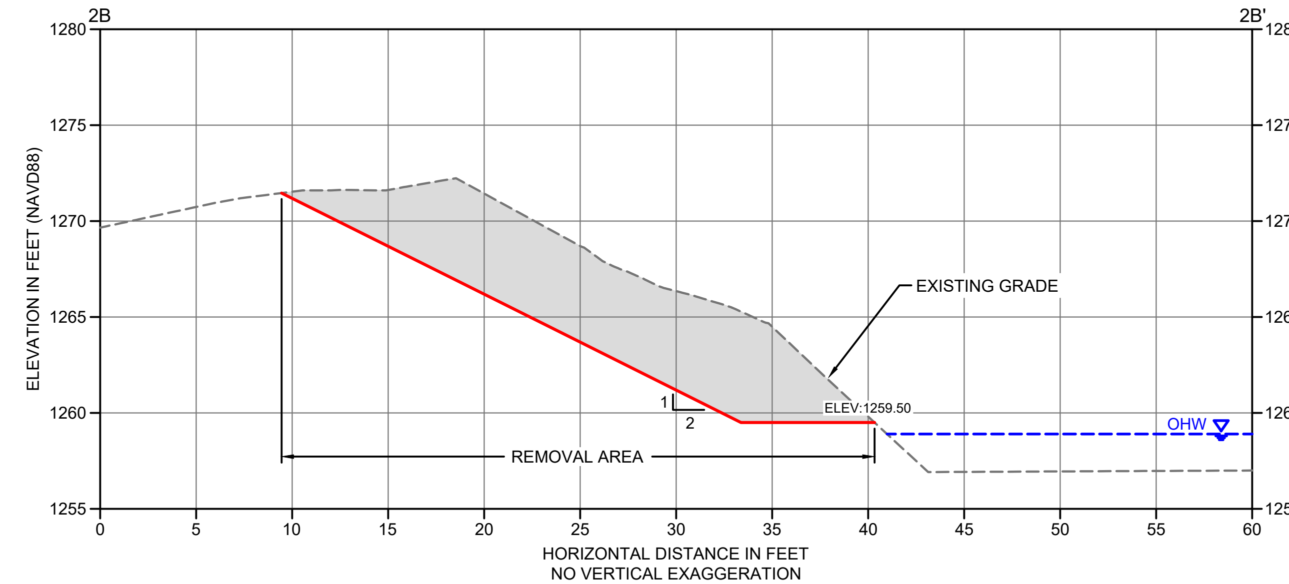
EXCAVATION CROSS SECTIONS - CONSTITUTION PARK BMA

C-4

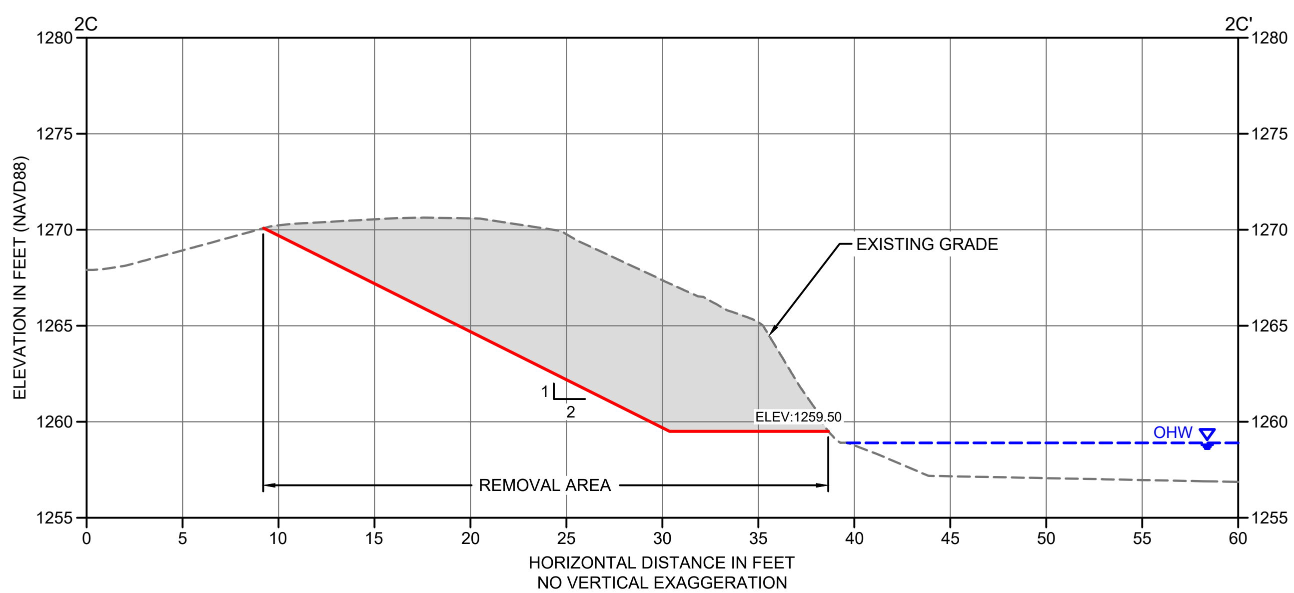
SHEET NO. 20 OF 42



2A / C-2 EXCAVATION SECTION - WWTP A BMA
SCALE: 1" = 5'



2B / C-2 EXCAVATION SECTION - WWTP A BMA
SCALE: 1" = 5'



2C / C-2 EXCAVATION SECTION - WWTP A BMA
SCALE: 1" = 5'

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

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Sep 11, 2017 1:36pm tgriga

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

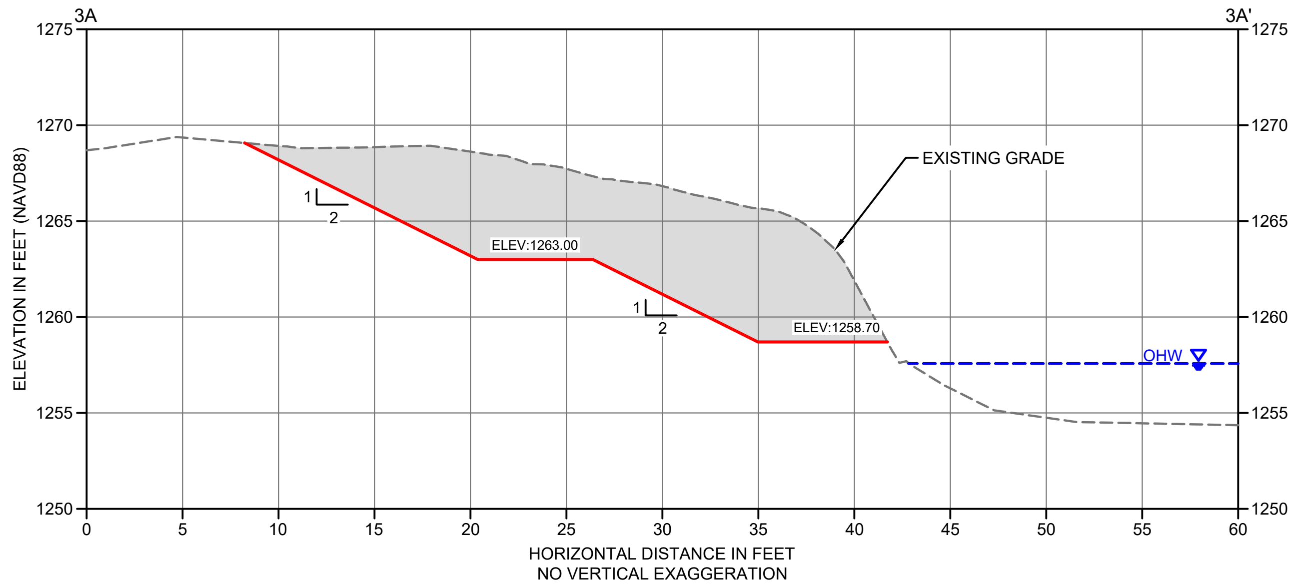
DESIGNED BY: S. HAFFEY
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

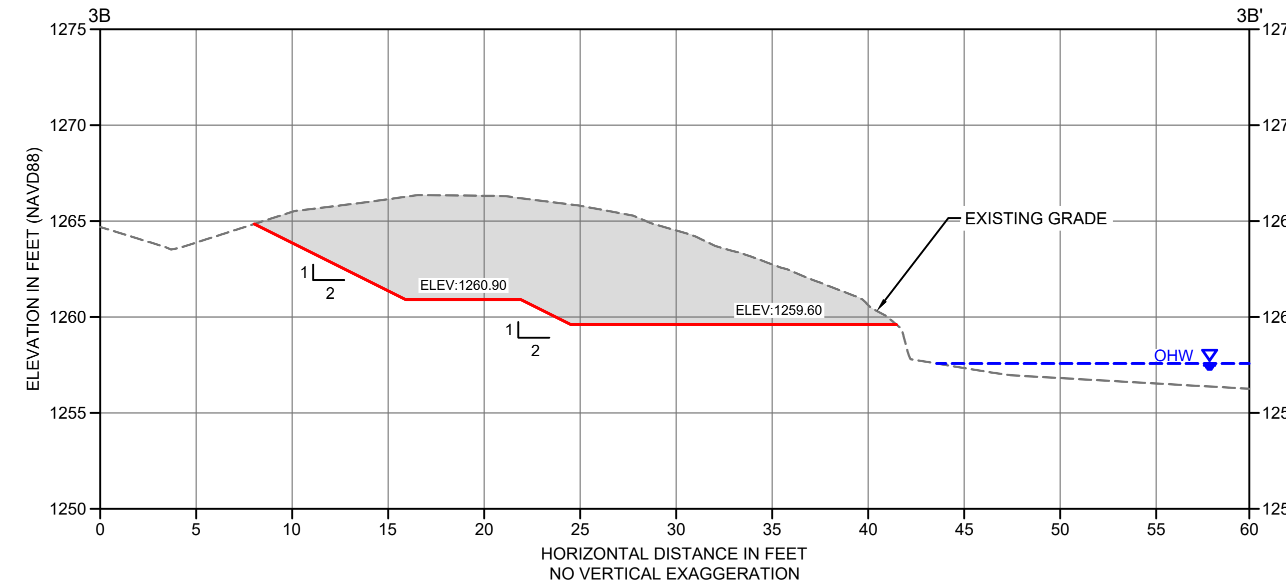
EXCAVATION CROSS SECTIONS - WWTP A BMA

C-5

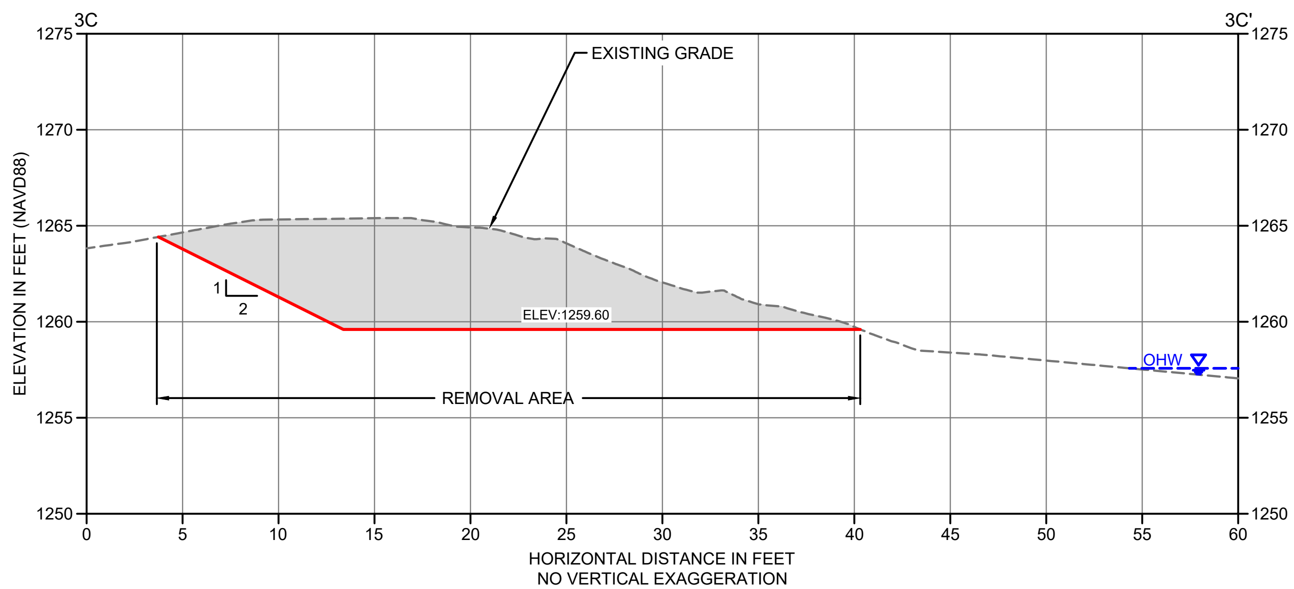
SHEET NO. 21 OF 42



3A / C-3 EXCAVATION SECTION - WWTP B BMA
SCALE: 1" = 5'



3B / C-3 EXCAVATION SECTION - WWTP B BMA
SCALE: 1" = 5'



3C / C-3 EXCAVATION SECTION - WWTP B BMA
SCALE: 1" = 5'

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

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COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
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PROFESSIONAL ENGINEER
7/14/17

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: S. HAFFEY
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

EXCAVATION CROSS SECTIONS - WWTP B BMA

C-6

SHEET NO. 22 OF 42

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Sep 11, 2017 1:36pm tgriga

CONSTRUCTION MATERIALS NOTES:

1. MAINTAIN TREE PROTECTION IN ACCORDANCE WITH THE SPECIFICATIONS THROUGHOUT APPLICATION OF BANK STABILIZATION MATERIALS AND BACKFILL.
2. PLANT TREES PRIOR TO INSTALLING THE GEOCELL AND WORK GEOCELL AROUND PLANTED TREES AND TREES TO REMAIN.
3. INSTALL GEOCELL ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.
4. CUT AND WORK COIR FABRIC AROUND TREES TO REMAIN. INSTALLATION OF COIR FABRIC SHALL BE IN ACCORDANCE WITH THE SPECIFICATION.
5. USE CONTROL POINTS FOR LIMITS OF STABILIZATION TO ESTABLISH UPSTREAM AND DOWNSTREAM EXTENTS OF THE BANK STABILIZATION MEASURES. STABILIZATION MEASURES SHALL EXTEND FROM THE CREST OF THE BANK TO THE TOE EXCEPT WHERE NOTED ON THE PLANS.

FINISHED GRADE CONTROL POINTS

POINT #	NORTHING	EASTING	ELEVATION (FT)
CP-400	6707502.2	11372215.9	1279.40
CP-401	6707552.4	11372211.7	1279.40

LIMITS OF STABILIZATION

POINT #	NORTHING	EASTING
CP-402	6707396.2	11372217.8
CP-403	6707920.2	11372183.6

LEGEND:

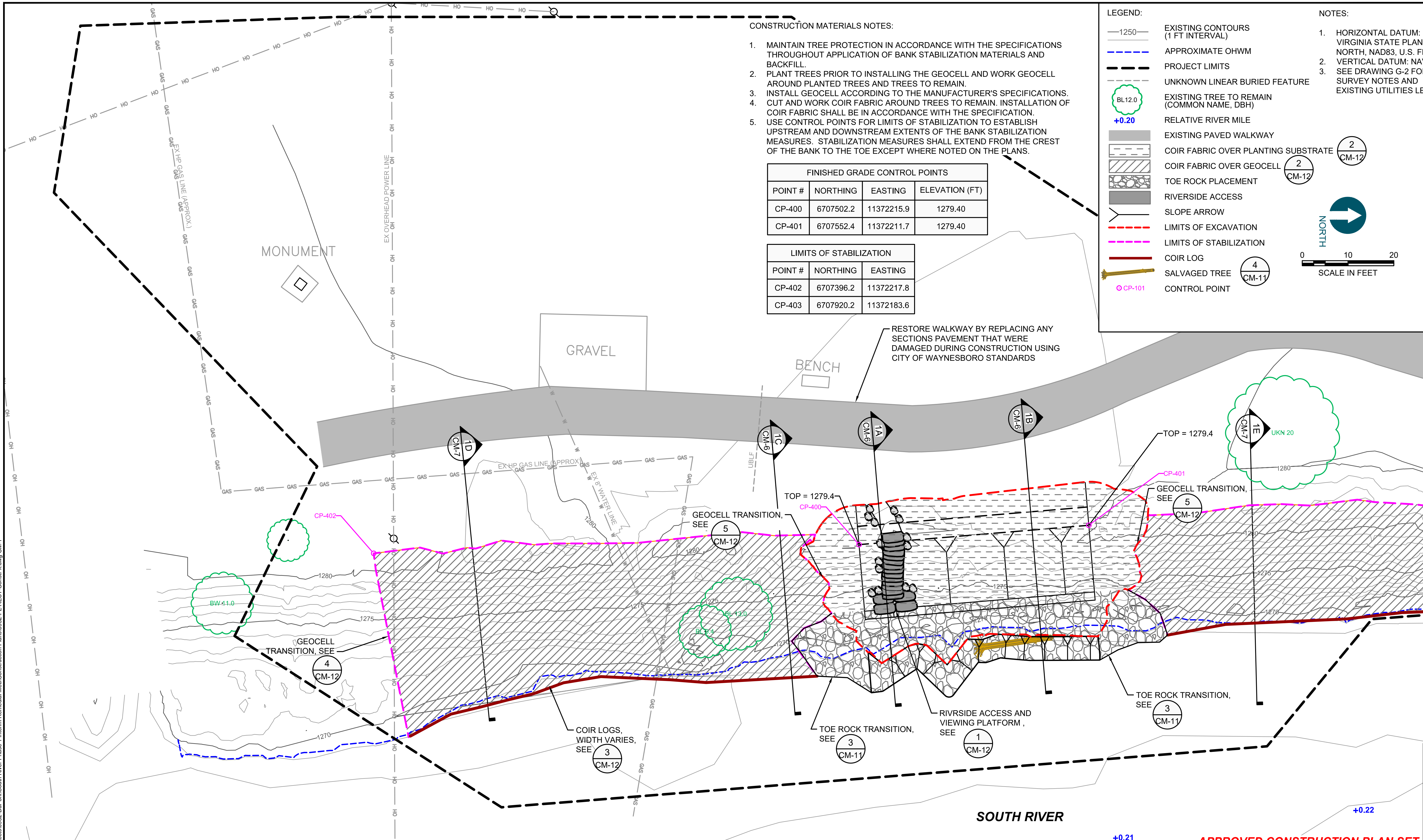
1250	EXISTING CONTOURS (1 FT INTERVAL)
	APPROXIMATE OHWM
	PROJECT LIMITS
	UNKNOWN LINEAR BURIED FEATURE
BL12.0	EXISTING TREE TO REMAIN (COMMON NAME, DBH)
+0.20	RELATIVE RIVER MILE
	EXISTING PAVED WALKWAY
	COIR FABRIC OVER PLANTING SUBSTRATE (2 / CM-12)
	COIR FABRIC OVER GEOCELL (2 / CM-12)
	TOE ROCK PLACEMENT
	RIVERSIDE ACCESS
	SLOPE ARROW
	LIMITS OF EXCAVATION
	LIMITS OF STABILIZATION
	COIR LOG
	SALVAGED TREE (4 / CM-11)
CP-101	CONTROL POINT

NOTES:

1. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
2. VERTICAL DATUM: NAVD 88.
3. SEE DRAWING G-2 FOR SURVEY NOTES AND EXISTING UTILITIES LEGEND.

NORTH

0 10 20
SCALE IN FEET



APPROVED CONSTRUCTION PLAN SET

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

K:\Projects\0952-DuPont\South River Phase 1 Interim Remedial Mea\Construction Plans\0952-PL-REST-ConstPk.dwg CM-1
Jul 25, 2017 9:58am tgriga

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

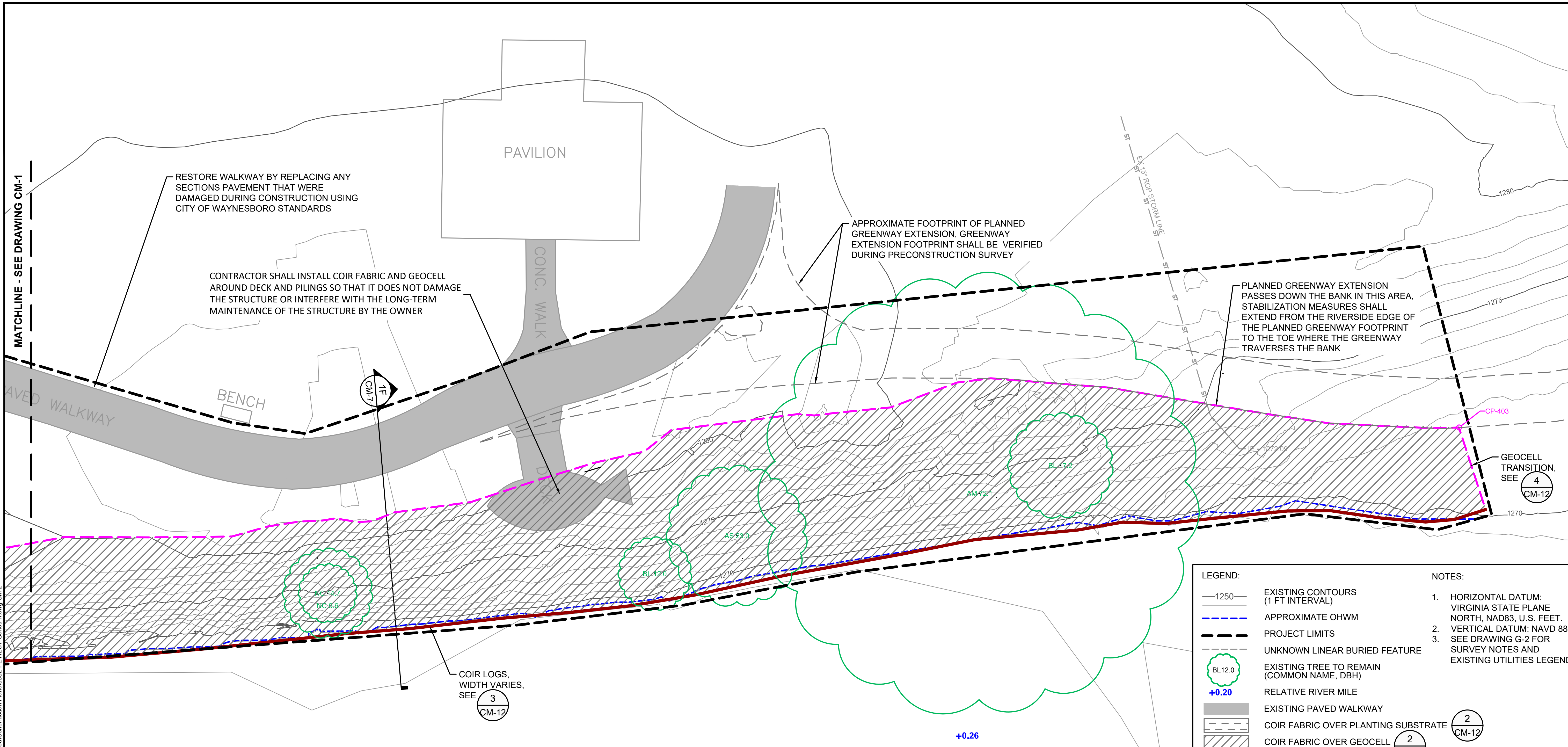
DESIGNED BY: M. DOO
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

CONSTRUCTION MATERIALS PLAN - CONSTITUTION PARK BMA - SHEET 1

CM-1

SHEET NO. 23 OF 42



CONSTRUCTION MATERIALS NOTES:

1. MAINTAIN TREE PROTECTION IN ACCORDANCE WITH THE SPECIFICATIONS THROUGHOUT APPLICATION OF BANK STABILIZATION MATERIALS AND BACKFILL.
2. PLANT TREES PRIOR TO INSTALLING THE GEOCELL AND WORK GEOCELL AROUND PLANTED TREES AND TREES TO REMAIN.
3. INSTALL GEOCELL ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.
4. CUT AND WORK COIR FABRIC AROUND TREES TO REMAIN. INSTALLATION OF COIR FABRIC SHALL BE IN ACCORDANCE WITH THE SPECIFICATION.
5. USE CONTROL POINTS FOR LIMITS OF STABILIZATION TO ESTABLISH UPSTREAM AND DOWNSTREAM EXTENTS OF THE BANK STABILIZATION MEASURES. STABILIZATION MEASURES SHALL EXTEND FROM THE CREST OF THE BANK TO THE TOE EXCEPT WHERE NOTED ON THE PLANS.

LEGEND:

1250	EXISTING CONTOURS (1 FT INTERVAL)
	APPROXIMATE OHWM
	PROJECT LIMITS
	UNKNOWN LINEAR BURIED FEATURE
BL12.0	EXISTING TREE TO REMAIN (COMMON NAME, DBH)
+0.20	RELATIVE RIVER MILE
	EXISTING PAVED WALKWAY
	COIR FABRIC OVER PLANTING SUBSTRATE 2 CM-12
	COIR FABRIC OVER GEOCELL 2 CM-12
	TOE ROCK PLACEMENT
	RIVERSIDE ACCESS
	SLOPE ARROW
	LIMITS OF EXCAVATION
	LIMITS OF STABILIZATION
	COIR LOG
	SALVAGED TREE 4 CM-11
CP-101	CONTROL POINT

NOTES:

1. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
2. VERTICAL DATUM: NAVD 88.
3. SEE DRAWING G-2 FOR SURVEY NOTES AND EXISTING UTILITIES LEGEND.

NORTH

0 10 20
SCALE IN FEET

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

K:\Projects\0952-DuPont\South River Phase 1 Interim Remedial Mea\Construction Plans\0952-PL-REST-ConstPk.dwg CM-2

Jul 25, 2017 9:58am tgriga

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COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

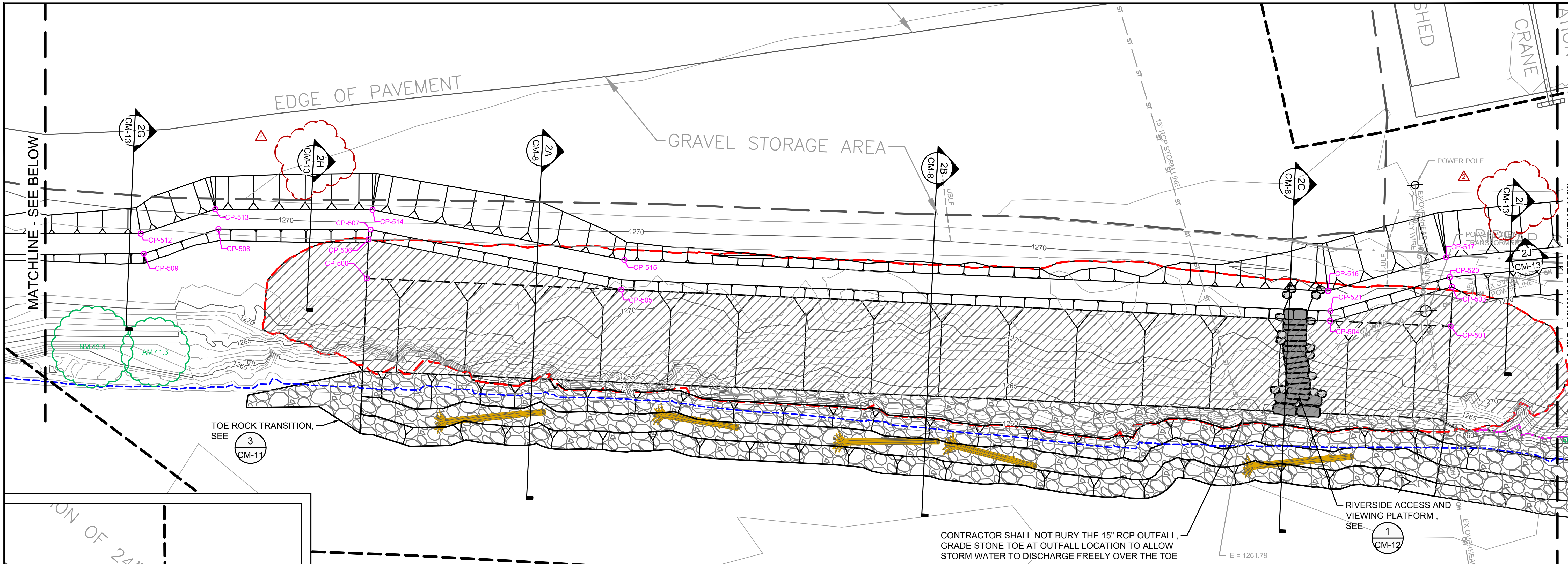
DESIGNED BY: M. DOO
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

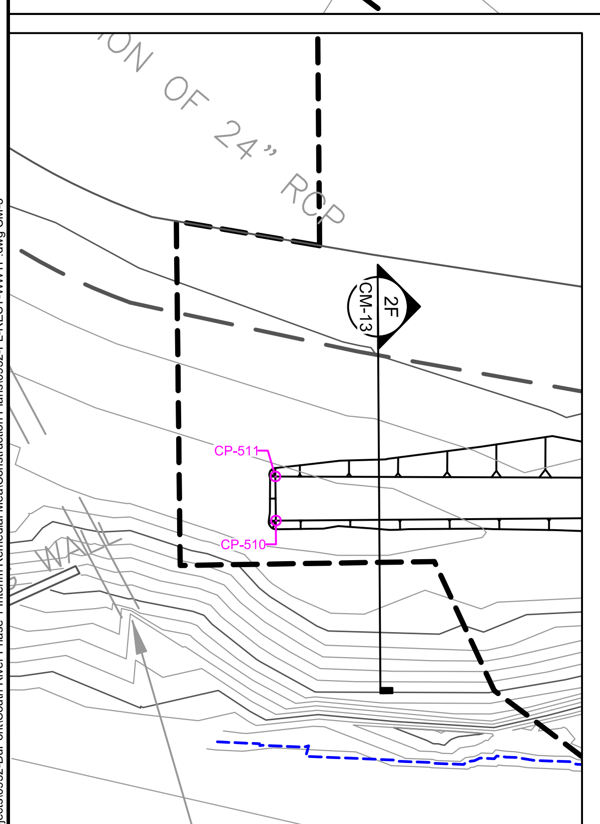
SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

CONSTRUCTION MATERIALS PLAN - CONSTITUTION PARK BMA - SHEET 2

CM-2

SHEET NO. 24 OF 42





CONTROL POINTS			
POINT #	NORTHING	EASTING	ELEVATION (FT)
CP-500	6712095.4	11374769.5	1271.50
CP-501	6712228.2	11374942.7	1271.50
CP-503	6712234.4	11374937.8	1271.50
CP-504	6712213.4	11374923.4	1271.50
CP-505	6712126.5	11374810.1	1271.50
CP-506	6712101.6	11374764.7	1271.50
CP-507	6712103.4	11374763.7	1272.50
CP-508	6712083.8	11374740.2	1272.50
CP-509	6712070.3	11374731.9	1272.50
CP-510	6712036.8	11374692.5	1272.50

CONTROL POINTS			
POINT #	NORTHING	EASTING	ELEVATION (FT)
CP-511	6712040.3	11374689.5	1272.50
CP-512	6712073.0	11374728.8	1272.50
CP-513	6712086.4	11374737.1	1272.50
CP-514	6712106.7	11374761.4	1272.50
CP-515	6712131.5	11374806.8	1272.50
CP-516	6712217.7	11374919.2	1272.50
CP-517	6712238.2	11374933.1	1272.50
CP-520	6712235.6	11374936.2	1272.50
CP-521	6712214.9	11374922.2	1272.50

CONSTRUCTION MATERIALS NOTES:

1. MAINTAIN TREE PROTECTION IN ACCORDANCE WITH THE SPECIFICATIONS THROUGHOUT APPLICATION OF BANK STABILIZATION MATERIALS AND BACKFILL.
2. PLANT TREES PRIOR TO INSTALLING THE GEOCELL AND WORK GEOCELL AROUND PLANTED TREES AND TREES TO REMAIN.
3. INSTALL GEOCELL ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.
4. CUT AND WORK COIR FABRIC AROUND TREES TO REMAIN. INSTALLATION OF COIR FABRIC SHALL BE IN ACCORDANCE WITH THE SPECIFICATION.

LEGEND:

- 1250 — EXISTING CONTOURS (1 FT INTERVAL)
- APPROXIMATE OHWM
- PROJECT LIMITS
- UNKNOWN BURIED LINEAR FEATURE
- BL12.0 — EXISTING TREE TO REMAIN (COMMON NAME, DBH)
- +0.20 — RELATIVE RIVER MILE
- COIR FABRIC OVER PLANTING SUBSTRATE (2 / CM-12)
- COIR FABRIC OVER GEOCELL (2 / CM-12)
- TOE ROCK PLACEMENT
- RIVERSIDE ACCESS
- SLOPE ARROW
- LIMITS OF EXCAVATION
- LIMITS OF STABILIZATION
- COIR LOG
- SALVAGED TREE (4 / CM-11)
- CP-101 — CONTROL POINT

NOTES:

1. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
2. VERTICAL DATUM: NAVD 88.
3. SEE DRAWING G-2 FOR SURVEY NOTES AND EXISTING UTILITIES LEGEND.

NORTH

0 10 20
SCALE IN FEET

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

K:\Projects\0952-DuPont\South River Phase 1 Interim Remedial Mea\Construction Plans\0952-PL-REST-WWTP.dwg CM-3
Jul 25, 2017 9:59am tgriga

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1
2	7/14/17	TPG	WJD	REVISION TO ADDRESS PERMIT COMMENTS

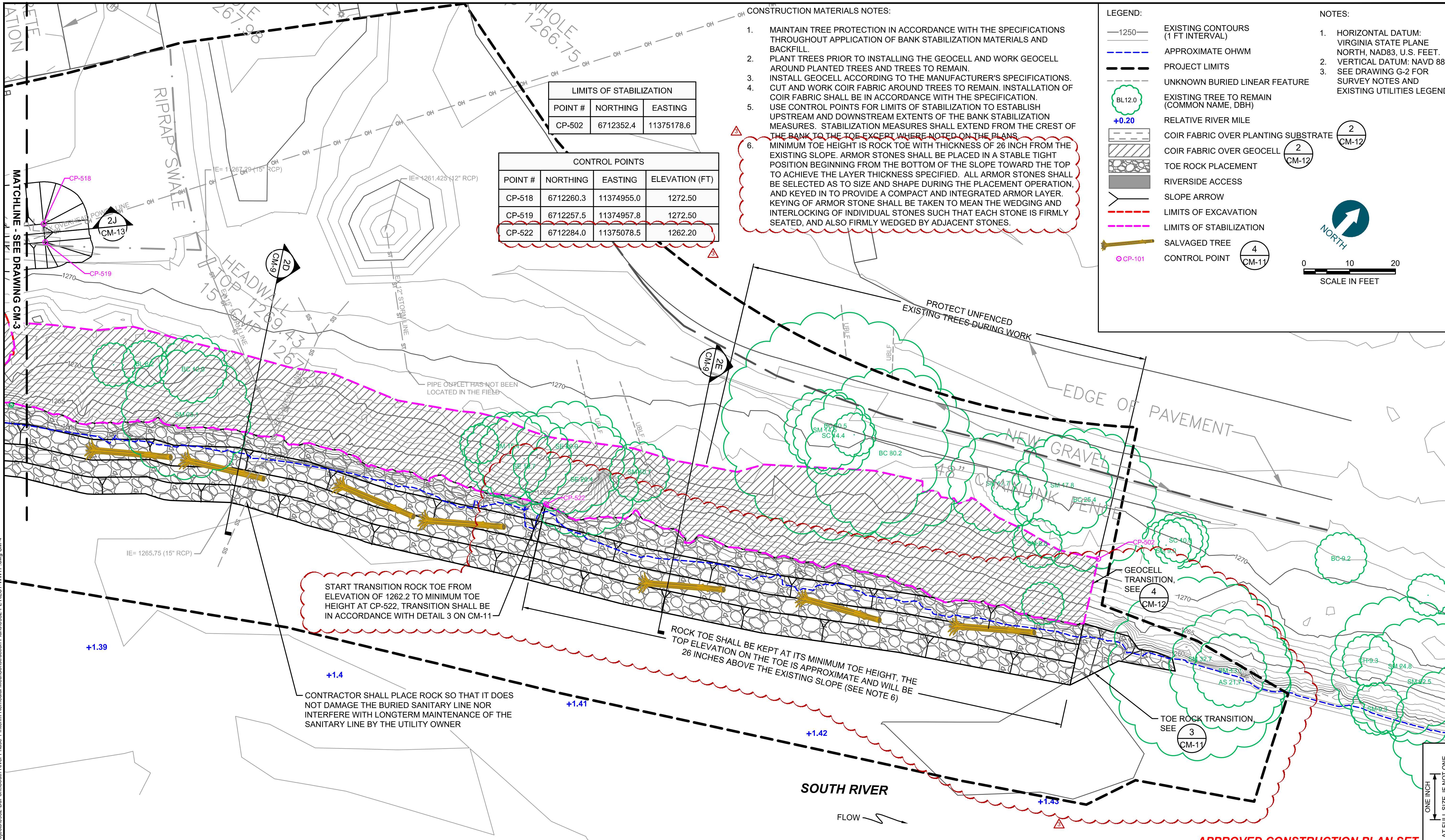
DESIGNED BY: M. DOO
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

CONSTRUCTION MATERIALS PLAN - WWTP A BMA - SHEET 1

CM-3

SHEET NO. 25 OF 42



LIMITS OF STABILIZATION		
POINT #	NORTHING	EASTING
CP-502	6712352.4	11375178.6

CONTROL POINTS			
POINT #	NORTHING	EASTING	ELEVATION (FT)
CP-518	6712260.3	11374955.0	1272.50
CP-519	6712257.5	11374957.8	1272.50
CP-522	6712284.0	11375078.5	1262.20

CONSTRUCTION MATERIALS NOTES:

1. MAINTAIN TREE PROTECTION IN ACCORDANCE WITH THE SPECIFICATIONS THROUGHOUT APPLICATION OF BANK STABILIZATION MATERIALS AND BACKFILL.
2. PLANT TREES PRIOR TO INSTALLING THE GEOCELL AND WORK GEOCELL AROUND PLANTED TREES AND TREES TO REMAIN.
3. INSTALL GEOCELL ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.
4. CUT AND WORK COIR FABRIC AROUND TREES TO REMAIN. INSTALLATION OF COIR FABRIC SHALL BE IN ACCORDANCE WITH THE SPECIFICATION.
5. USE CONTROL POINTS FOR LIMITS OF STABILIZATION TO ESTABLISH UPSTREAM AND DOWNSTREAM EXTENTS OF THE BANK STABILIZATION MEASURES. STABILIZATION MEASURES SHALL EXTEND FROM THE CREST OF THE BANK TO THE TOE EXCEPT WHERE NOTED ON THE PLANS.
6. MINIMUM TOE HEIGHT IS ROCK TOE WITH THICKNESS OF 26 INCH FROM THE EXISTING SLOPE. ARMOR STONES SHALL BE PLACED IN A STABLE TIGHT POSITION BEGINNING FROM THE BOTTOM OF THE SLOPE TOWARD THE TOP TO ACHIEVE THE LAYER THICKNESS SPECIFIED. ALL ARMOR STONES SHALL BE SELECTED AS TO SIZE AND SHAPE DURING THE PLACEMENT OPERATION, AND KEYED IN TO PROVIDE A COMPACT AND INTEGRATED ARMOR LAYER. KEYING OF ARMOR STONE SHALL BE TAKEN TO MEAN THE WEDGING AND INTERLOCKING OF INDIVIDUAL STONES SUCH THAT EACH STONE IS FIRMLY SEATED, AND ALSO FIRMLY WEDGED BY ADJACENT STONES.

LEGEND:

- 1250 — EXISTING CONTOURS (1 FT INTERVAL)
- APPROXIMATE OHWM
- PROJECT LIMITS
- UNKNOWN BURIED LINEAR FEATURE
- BL12.0 — EXISTING TREE TO REMAIN (COMMON NAME, DBH)
- +0.20 — RELATIVE RIVER MILE
- COIR FABRIC OVER PLANTING SUBSTRATE (2 / CM-12)
- COIR FABRIC OVER GEOCELL (2 / CM-12)
- TOE ROCK PLACEMENT
- RIVERSIDE ACCESS
- SLOPE ARROW
- LIMITS OF EXCAVATION
- LIMITS OF STABILIZATION
- SALVAGED TREE (4 / CM-11)
- CP-101 — CONTROL POINT

NOTES:

1. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
2. VERTICAL DATUM: NAVD 88.
3. SEE DRAWING G-2 FOR SURVEY NOTES AND EXISTING UTILITIES LEGEND.

APPROVED CONSTRUCTION PLAN SET

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
10/19/17

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1
2	7/14/17	TPG	WJD	REVISION TO ADDRESS PERMIT COMMENTS
3	10/19/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #2

DESIGNED BY: S. HAFFEY
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

CONSTRUCTION MATERIALS PLAN - WWTP A BMA - SHEET 2

CM-4

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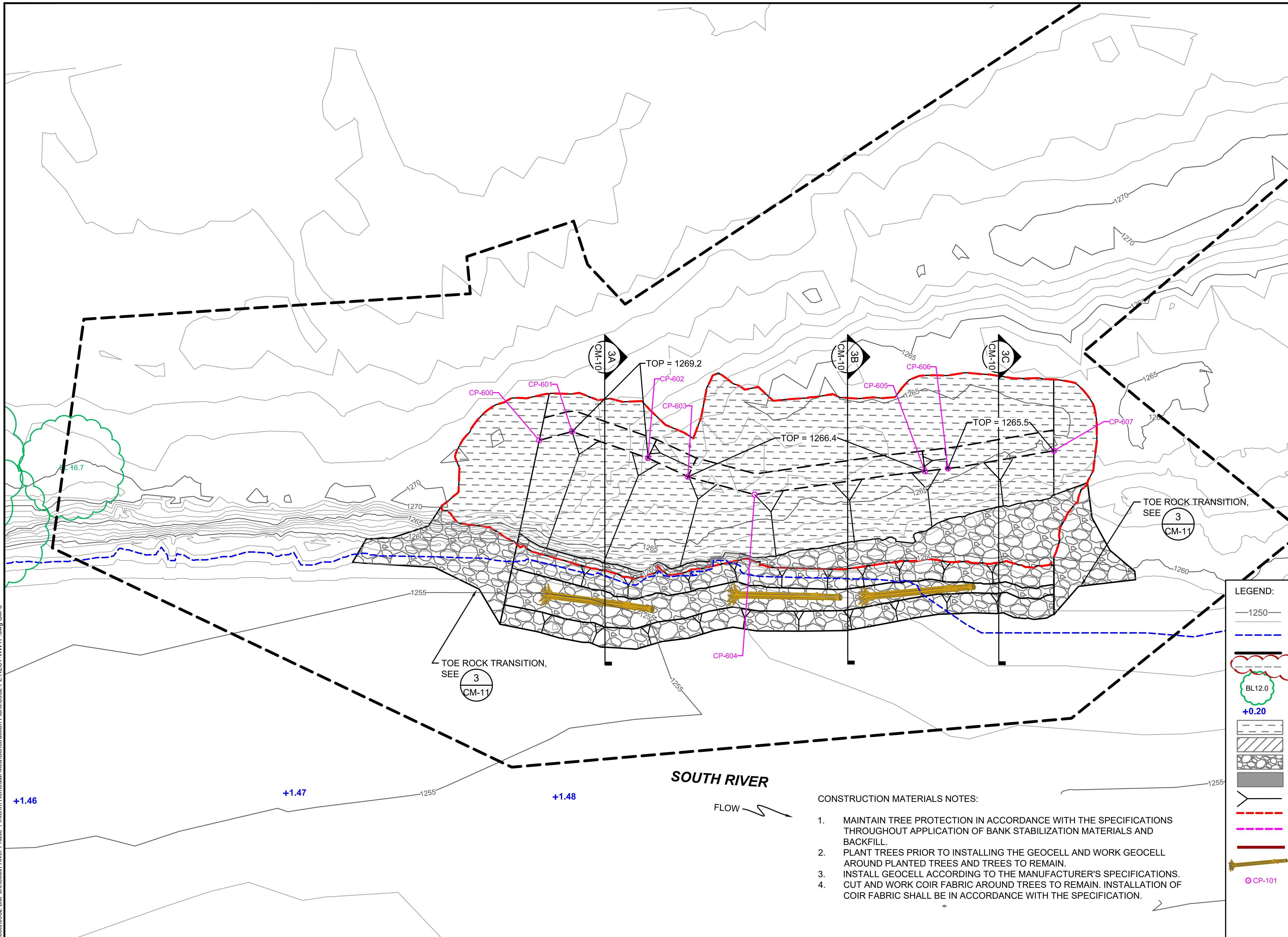
Oct 19, 2017 11:34am tgriga



CONTROL POINTS			
POINT #	NORTHING	EASTING	ELEVATION (FT)
CP-600	6712469.0	11375418.8	1269.20
CP-601	6712472.9	11375424.1	1269.20
CP-602	6712473.4	11375439.9	1269.20
CP-603	6712472.8	11375448.5	1266.40
CP-604	6712474.2	11375461.9	1266.40
CP-605	6712490.4	11375491.4	1266.40
CP-606	6712492.5	11375495.4	1265.50
CP-607	6712503.2	11375513.5	1265.50

CONSTRUCTION MATERIALS NOTES:

1. MAINTAIN TREE PROTECTION IN ACCORDANCE WITH THE SPECIFICATIONS THROUGHOUT APPLICATION OF BANK STABILIZATION MATERIALS AND BACKFILL.
2. PLANT TREES PRIOR TO INSTALLING THE GEOCELL AND WORK GEOCELL AROUND PLANTED TREES AND TREES TO REMAIN.
3. INSTALL GEOCELL ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.
4. CUT AND WORK COIR FABRIC AROUND TREES TO REMAIN. INSTALLATION OF COIR FABRIC SHALL BE IN ACCORDANCE WITH THE SPECIFICATION.

LEGEND:

- 1250 — EXISTING CONTOURS (1 FT INTERVAL)
- APPROXIMATE OHWM
- PROJECT LIMITS
- UNKNOWN BURIED LINEAR FEATURE
- BL12.0 — EXISTING TREE TO REMAIN (COMMON NAME, DBH)
- +0.20 — RELATIVE RIVER MILE
- COIR FABRIC OVER PLANTING SUBSTRATE (2 CM-12)
- COIR FABRIC OVER GEOCELL (2 CM-12)
- TOE ROCK PLACEMENT
- RIVERSIDE ACCESS
- SLOPE ARROW
- LIMITS OF EXCAVATION
- LIMITS OF STABILIZATION
- COIR LOG
- SALVAGED TREE (4 CM-11)
- CP-101 — CONTROL POINT

NOTES:

1. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
2. VERTICAL DATUM: NAVD 88.
3. SEE DRAWING G-2 FOR SURVEY NOTES AND EXISTING UTILITIES LEGEND.

NORTH

0 10 20
SCALE IN FEET

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

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Jul 25, 2017 9:59am tgriga

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E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
7/14/17

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1

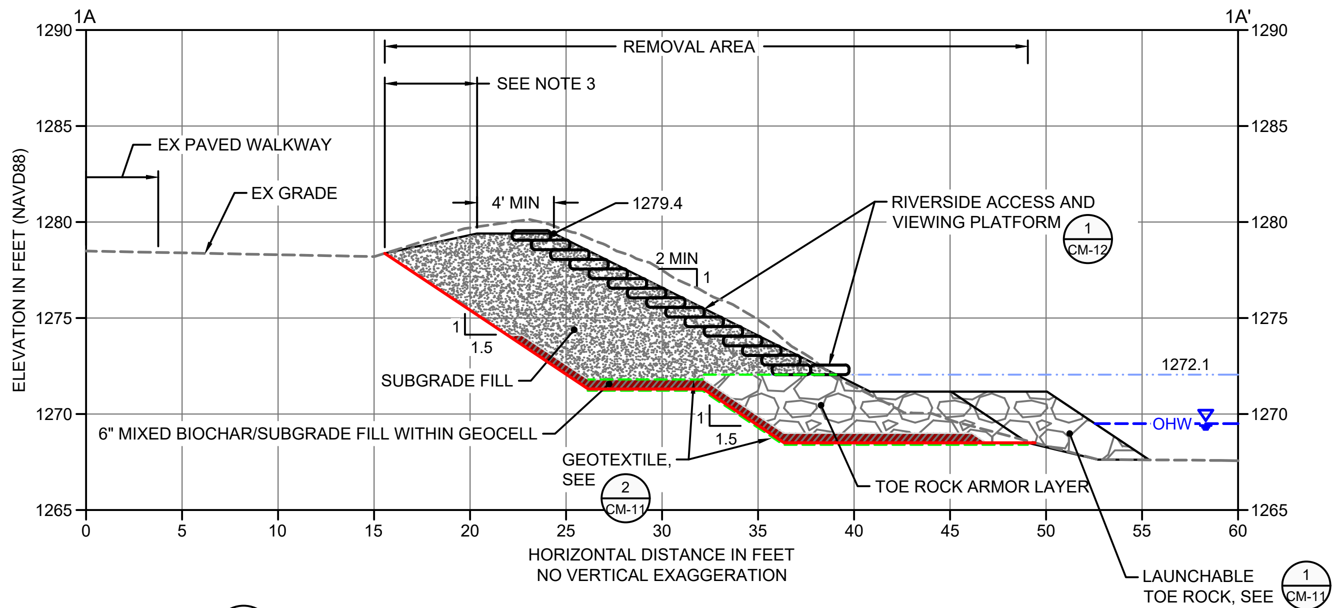
DESIGNED BY: M. DOO
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

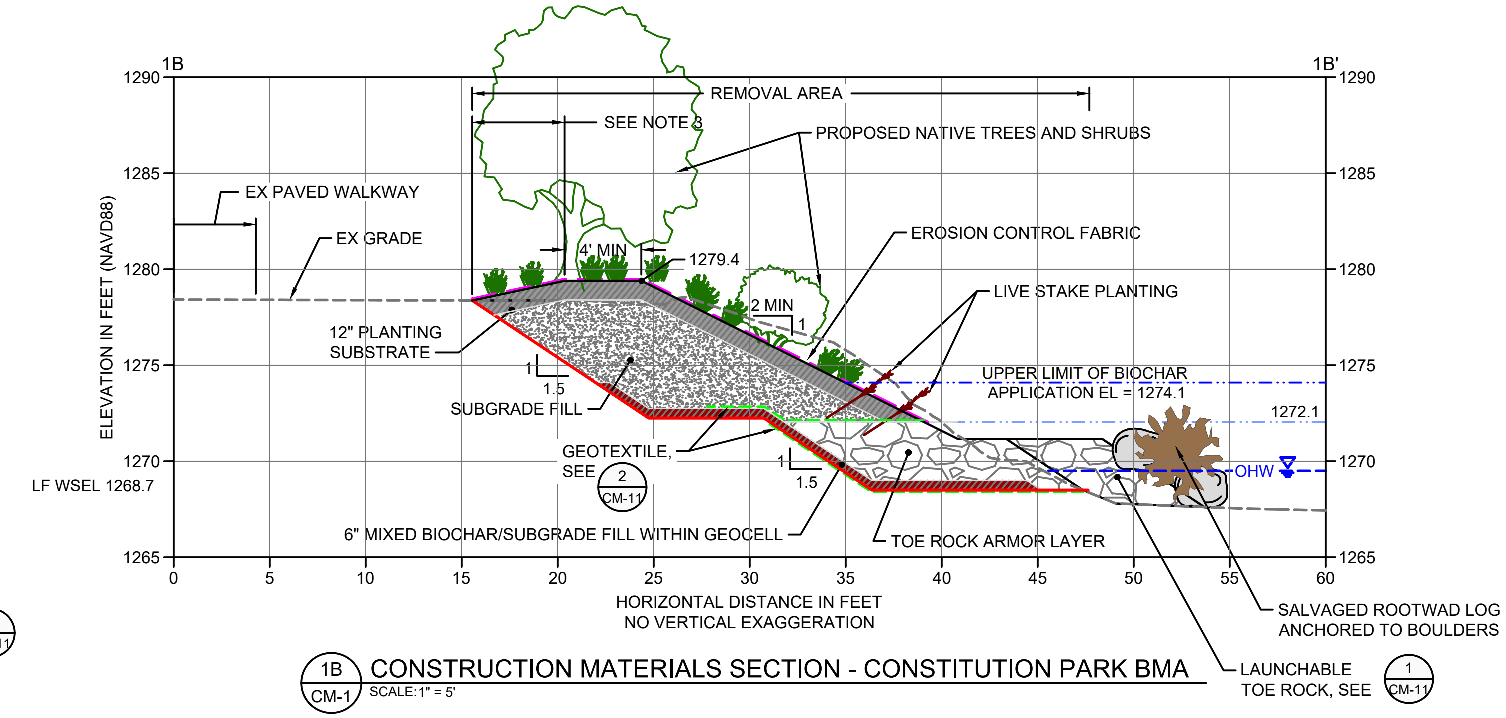
CONSTRUCTION MATERIALS PLAN - WWTP B BMA

CM-5

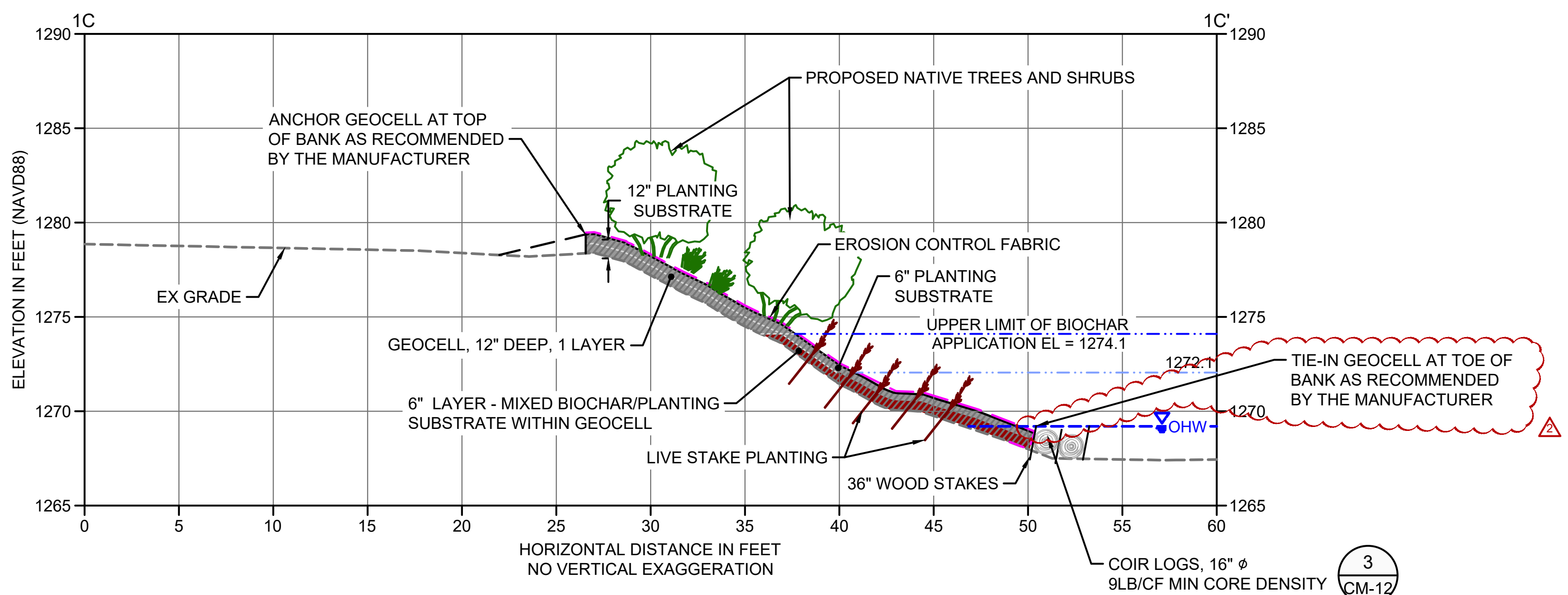
SHEET NO. 27 OF 42



1A
CM-1
CONSTRUCTION MATERIALS SECTION - CONSTITUTION PARK BMA
SCALE:1" = 5'



1B
CM-1
CONSTRUCTION MATERIALS SECTION - CONSTITUTION PARK BMA
SCALE:1" = 5'



1C
CM-1
CONSTRUCTION MATERIALS SECTION - CONSTITUTION PARK BMA
SCALE:1" = 5'

LEGEND:

- EXISTING GRADE
- POST REMOVAL SURFACE
- MINIMUM ELEVATION OF ROCK TOE UPPER LIMIT
- UPPER LIMIT OF BIOCHAR APPLICATION
- GEOTEXTILE

NOTES:

1. INSTALL COIR LOGS AT THE TOE OF THE SLOPE AS SHOWN, LOWER COIR LOGS SHALL BE COUNTERSUNK 1/2 TO 2/3 OF THE LOG DIAMETER. WHERE DENSE TREE ROOTS AT THE TOE MAKES STAKE INSTALLATION IMPRACTICAL, ABUT THE COIR LOG TO EITHER SIDE OF THE ROOTMASS AND STAKE THE ENDS.
2. WHERE THE TOE HAS VERTICAL EROSION TALLER THAN 1-FT OR THE SLOPE OF THE TOE IS GREATER THAN 2H:1V, INSTALL COIR LOGS IN BUNDLE OF 3 OR MORE TO MATCH THE SITE SPECIFIC CONDITION. THEN, SECURE THE BUNDLE WITH DUCKBILL ANCHORS DRIVEN MINIMUM 2-FT INTO THE GROUND.
3. 2H:1V MAXIMUM SLOPE. MINIMIZE FILL PLACEMENT TO THE LANDWARD SIDE OF THE EXCAVATION DAY LIGHT LINE.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

K:\Projects\0952-DuPont\South River Phase 1 Interim Remedial Mea\Construction Plans\0952-PL-REST-ConstPk.dwg CM-6
Jul 25, 2017 10:00am tgriga

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1
2	7/14/17	TPG	WJD	REVISION TO ADDRESS PERMIT COMMENTS

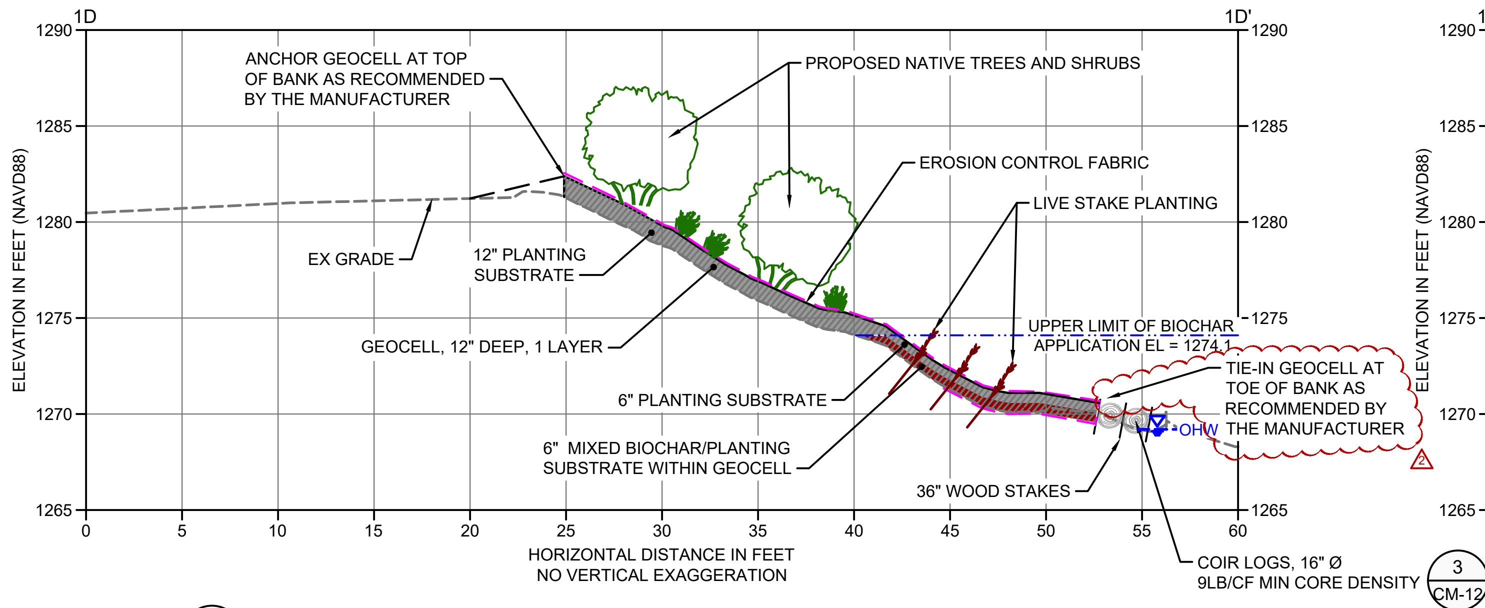
DESIGNED BY: M. DOO
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

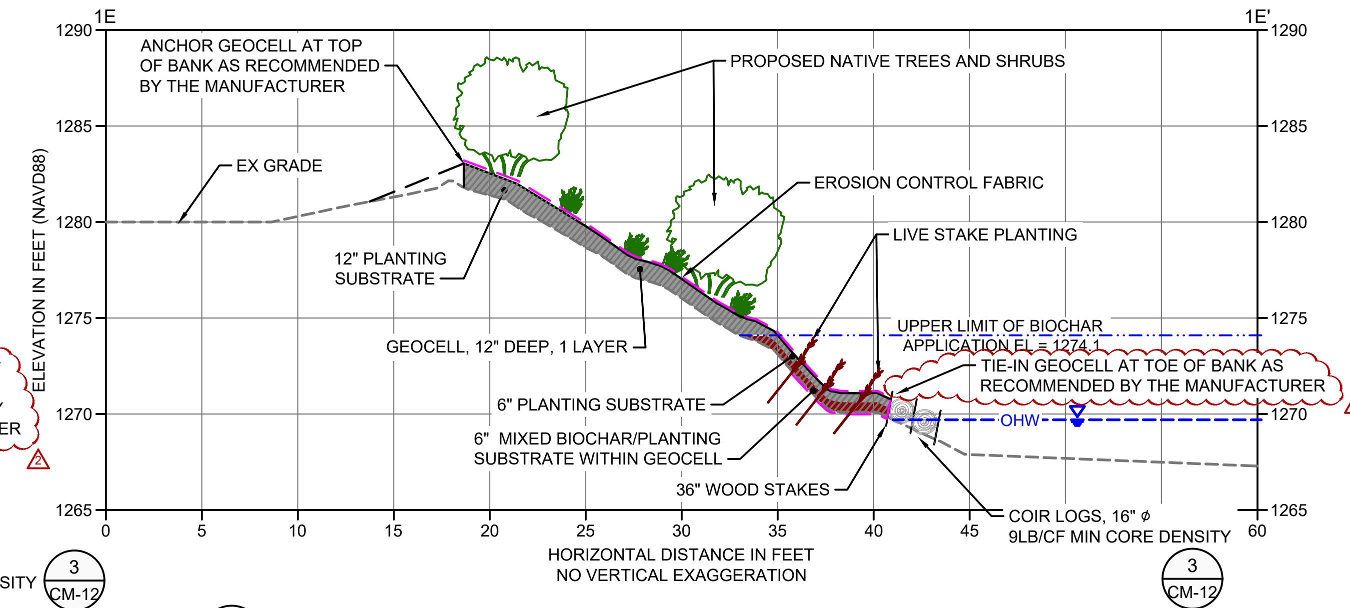
CONSTRUCTION MATERIALS CROSS SECTIONS, PRIMARY AREA, CONSTITUTION PARK BMA

CM-6

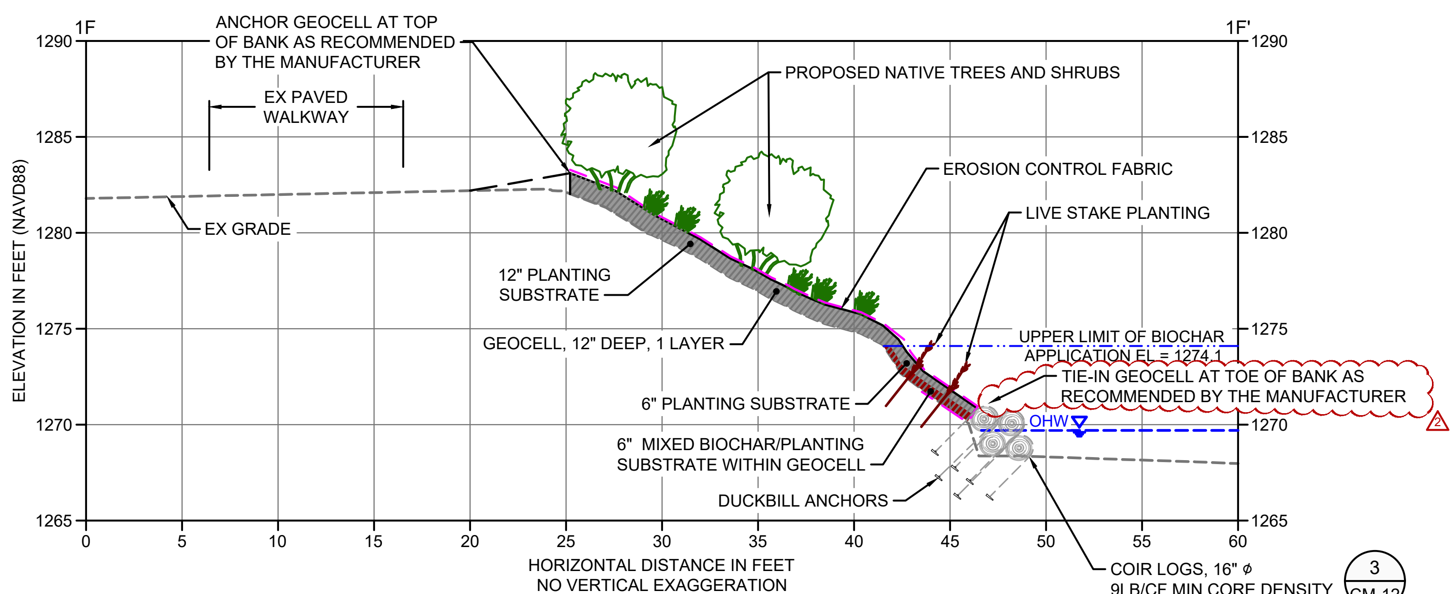
SHEET NO. 28 OF 42



1D / CM-1 CONSTRUCTION MATERIALS SECTION - CONSTITUTION PARK BMA
SCALE: 1" = 5'



1E / CM-1 CONSTRUCTION MATERIALS SECTION - CONSTITUTION PARK BMA
SCALE: 1" = 5'



1F / CM-2 CONSTRUCTION MATERIALS SECTION - CONSTITUTION PARK BMA
SCALE: 1" = 5'

LEGEND:

- EXISTING GRADE
- POST REMOVAL SURFACE
- MINIMUM ELEVATION OF ROCK TOE UPPER LIMIT
- UPPER LIMIT OF BIOCHAR APPLICATION
- GEOTEXTILE

NOTES:

1. INSTALL COIR LOGS AT THE TOE OF THE SLOPE AS SHOWN, LOWER COIR LOGS SHALL BE COUNTERSUNK 1/2 TO 2/3 OF THE LOG DIAMETER. WHERE DENSE TREE ROOTS AT THE TOE MAKES STAKE INSTALLATION IMPRACTICAL, ABUT THE COIR LOG TO EITHER SIDE OF THE ROOTMASS AND STAKE THE ENDS.
2. WHERE THE TOE HAS VERTICAL EROSION TALLER THAN 1-FT OR THE SLOPE OF THE TOE IS GREATER THAN 2H:1V, INSTALL COIR LOGS IN BUNDLE OF 3 OR MORE TO MATCH THE SITE SPECIFIC CONDITION. THEN, SECURE THE BUNDLE WITH DUCKBILL ANCHORS DRIVEN MINIMUM 2-FT INTO THE GROUND.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

K:\Projects\0952-DuPont\South River Phase 1 Interim Remedial Meas\Construction Plans\0952-PL-REST-ConstPk.dwg CM-7
Jul 25, 2017 10:00am tgriga

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
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PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1
2	7/14/17	TPG	WJD	REVISION TO ADDRESS PERMIT COMMENTS

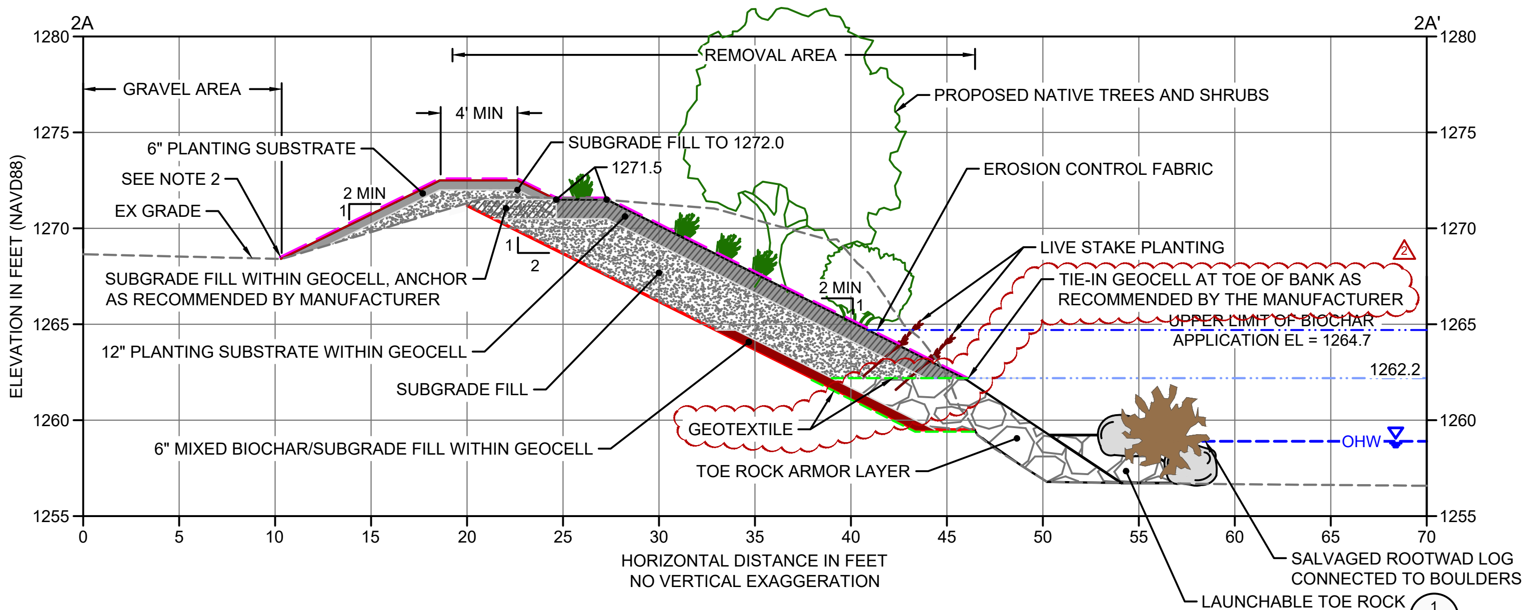
DESIGNED BY: M. DOO
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

CONSTRUCTION MATERIALS
CROSS SECTIONS, SECONDARY
AREA - CONSTITUTION PARK BMA

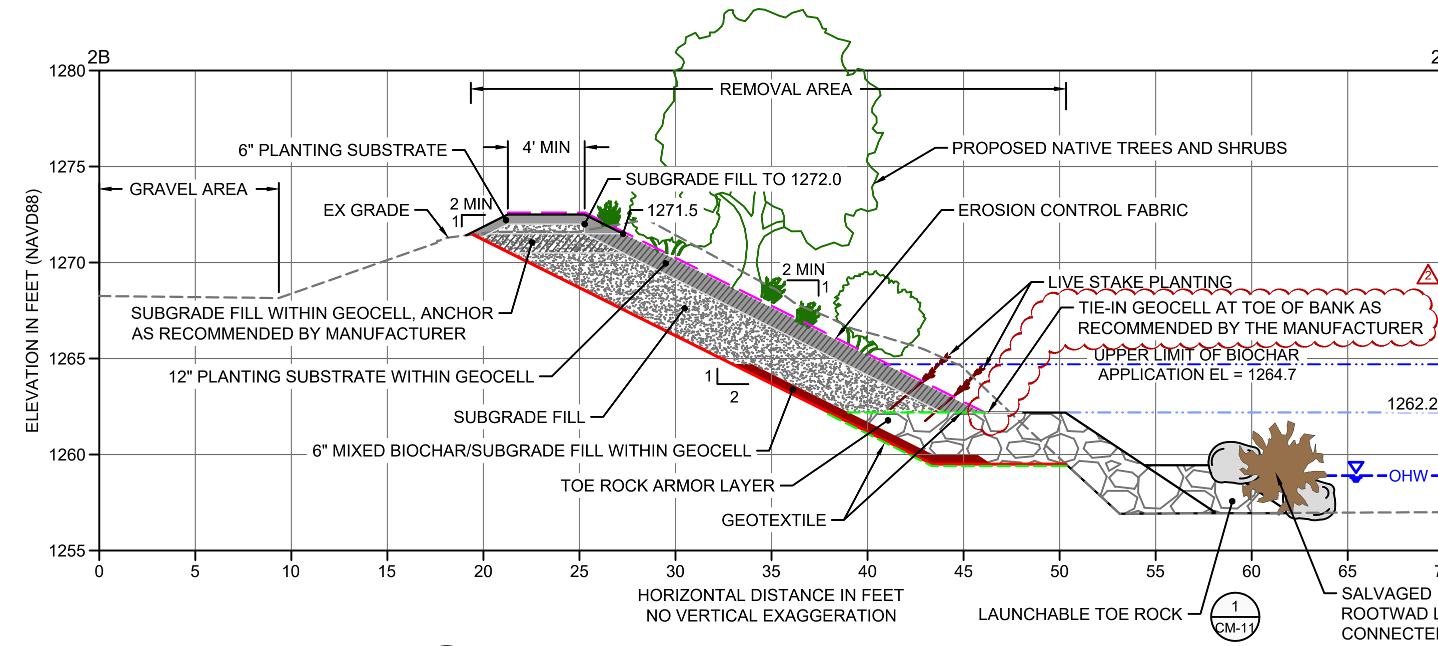
CM-7

SHEET NO. 29 OF 42



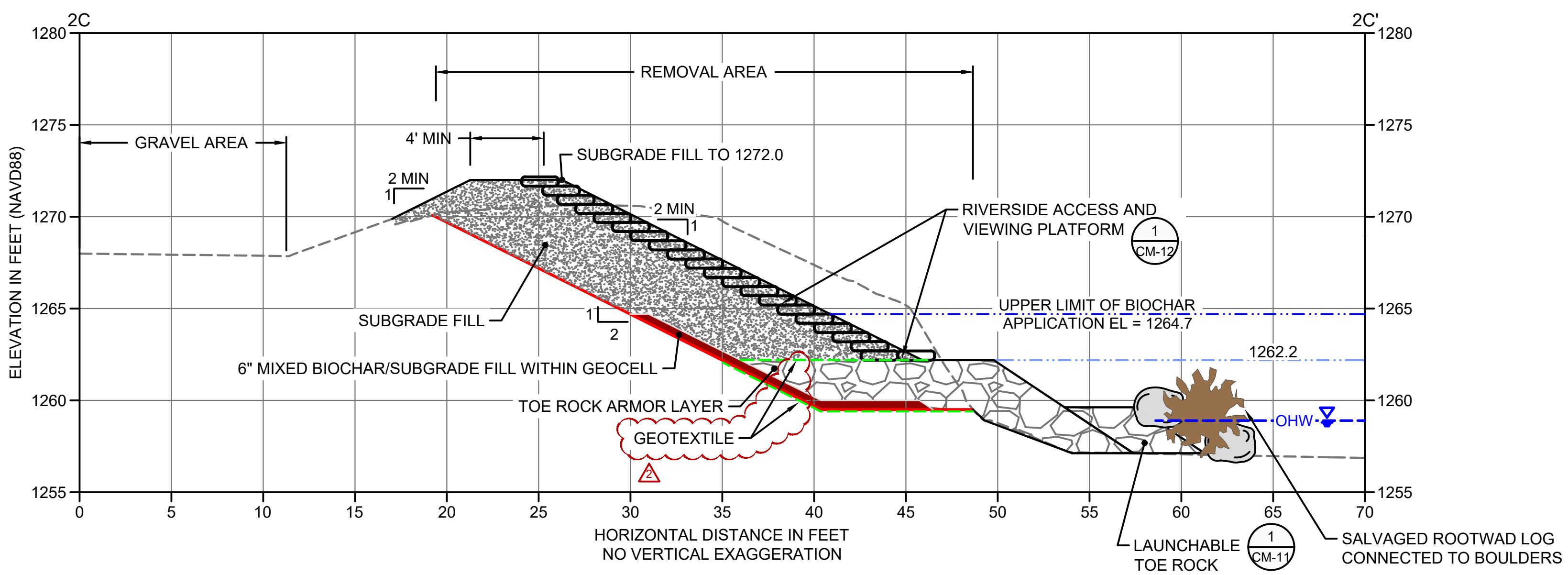
2A CM-3 CONSTRUCTION MATERIALS SECTION - WWTP A BMA

SCALE: 1" = 5'



2B CM-3 CONSTRUCTION MATERIALS SECTION - WWTP A BMA

SCALE: 1" = 5'



2C CM-3 CONSTRUCTION MATERIALS SECTION - WWTP A BMA

SCALE: 1" = 5'

LEGEND:

- EXISTING GRADE
- POST REMOVAL SURFACE
- MINIMUM ELEVATION OF ROCK TOE UPPER LIMIT
- UPPER LIMIT OF BIOCHAR APPLICATION
- GEOTEXTILE

NOTE:

1. 2H:1V MAXIMUM SLOPE. MINIMIZE FILL PLACEMENT OVER GRAVEL STORAGE AREA.
2. IN AREAS WHERE THE BERM IS ADJACENT TO OR ENCROACHES ON THE GRAVEL AREA, ARMOR TOE OF SLOPE WITH 3" STONE IN STRIP 1 FOOT WIDE.

ONE INCH — AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

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Jul 25, 2017 10:00am tgriga

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA — WALTER J. DINICOLA — Lic. No. 052817 — PROFESSIONAL ENGINEER — 7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1
2	7/14/17	TPG	WJD	REVISION TO ADDRESS PERMIT COMMENTS

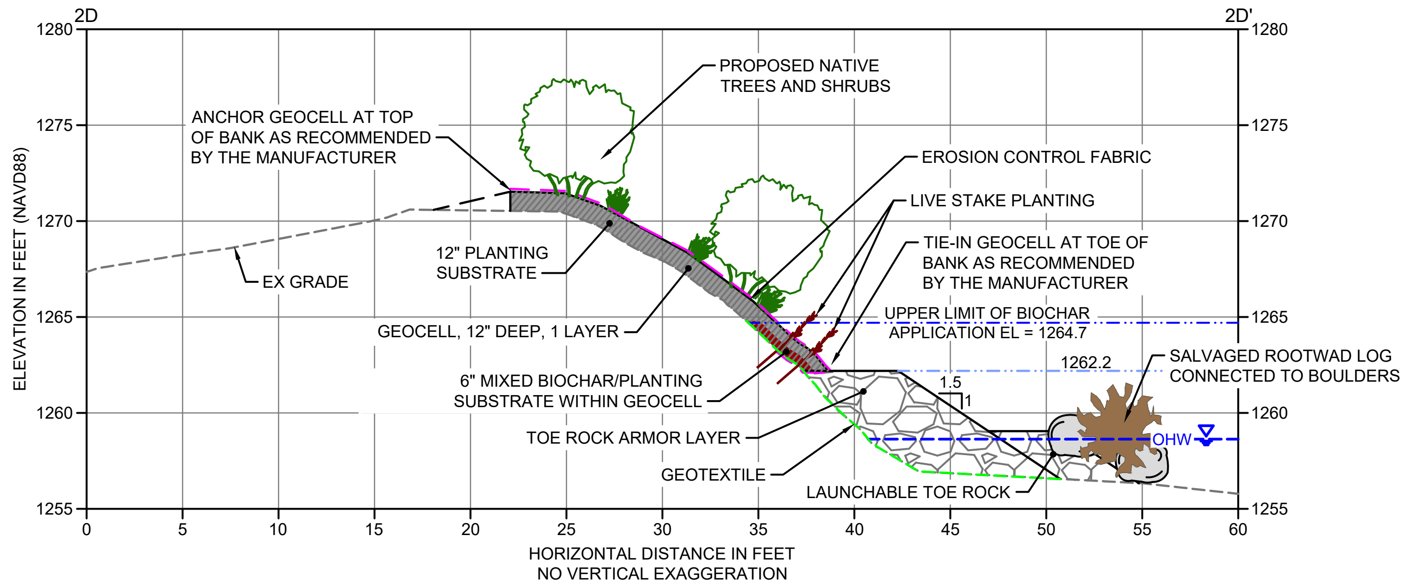
DESIGNED BY: M. DOO
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

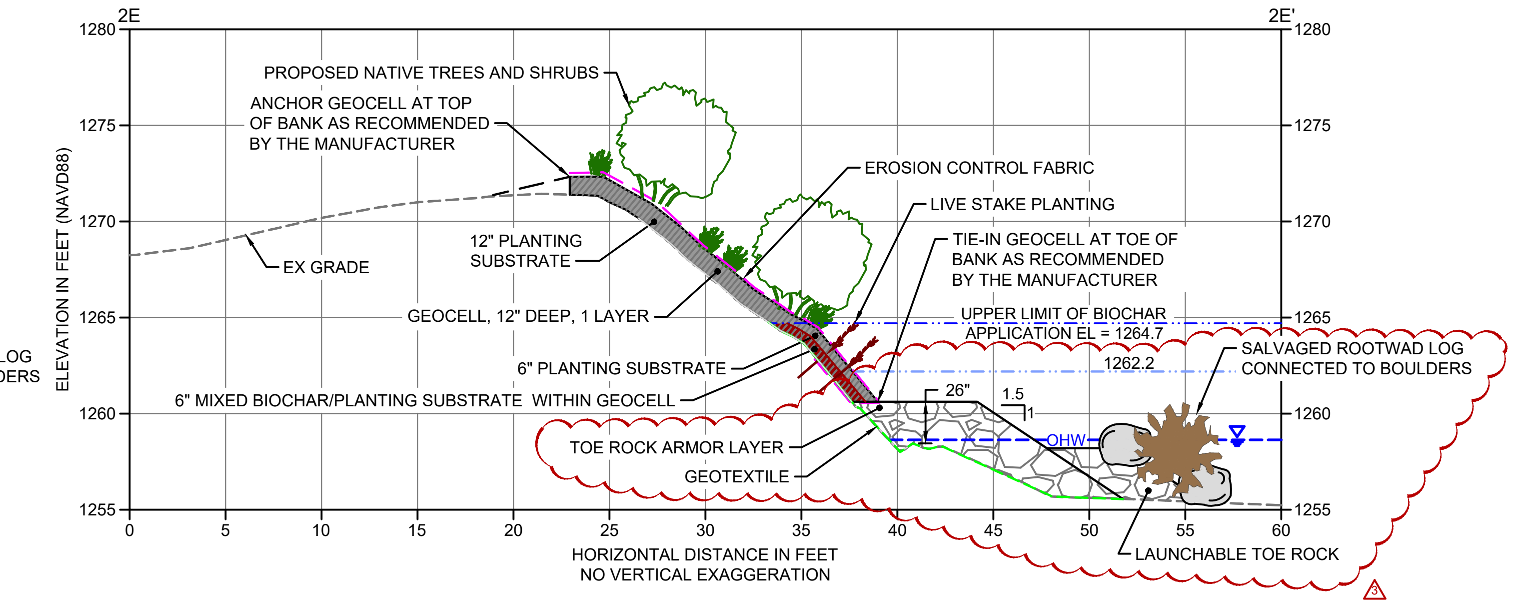
CONSTRUCTION MATERIALS CROSS SECTIONS, PRIMARY AREA - WWTP A BMA

CM-8

SHEET NO. 30 OF 42



2D CM-4 CONSTRUCTION MATERIALS SECTION - WWTP A BMA
SCALE: 1" = 5'



2E CM-4 CONSTRUCTION MATERIALS SECTION - WWTP A BMA
SCALE: 1" = 5'

LEGEND:

- EXISTING GRADE
- POST REMOVAL SURFACE
- MINIMUM ELEVATION OF ROCK TOE UPPER LIMIT
- GEOTEXTILE

NOTES:

1. INSTALL COIR LOGS AT THE TOE OF THE SLOPE AS SHOWN, LOWER COIR LOGS SHALL BE COUNTERSUNK 1/2 TO 2/3 OF THE LOG DIAMETER. WHERE DENSE TREE ROOTS AT THE TOE MAKES STAKE INSTALLATION IMPRACTICAL, ABUT THE COIR LOG TO EITHER SIDE OF THE ROOTMASS AND STAKE THE ENDS.
2. WHERE THE TOE HAS VERTICAL EROSION TALLER THAN 1-FT OR THE SLOPE OF THE TOE IS GREATER THAN 2H:1V, INSTALL COIR LOGS IN BUNDLE OF 3 OR MORE TO MATCH THE SITE SPECIFIC CONDITION. THEN, SECURE THE BUNDLE WITH DUCKBILL ANCHORS DRIVEN MINIMUM 2-FT INTO THE GROUND.
3. 2H:1V MAXIMUM SLOPE. MINIMIZE FILL PLACEMENT TO THE LANDWARD SIDE OF THE EXCAVATION DAY LIGHT LINE.

APPROVED CONSTRUCTION PLAN SET

ONE INCH — AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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Oct 19, 2017 11:17am tgriga

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA — WALTER J. DINICOLA Lic. No. 052817 — PROFESSIONAL ENGINEER — 10/19/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1
2	7/14/17	TPG	WJD	REVISION TO ADDRESS PERMIT COMMENTS
3	10/19/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #2

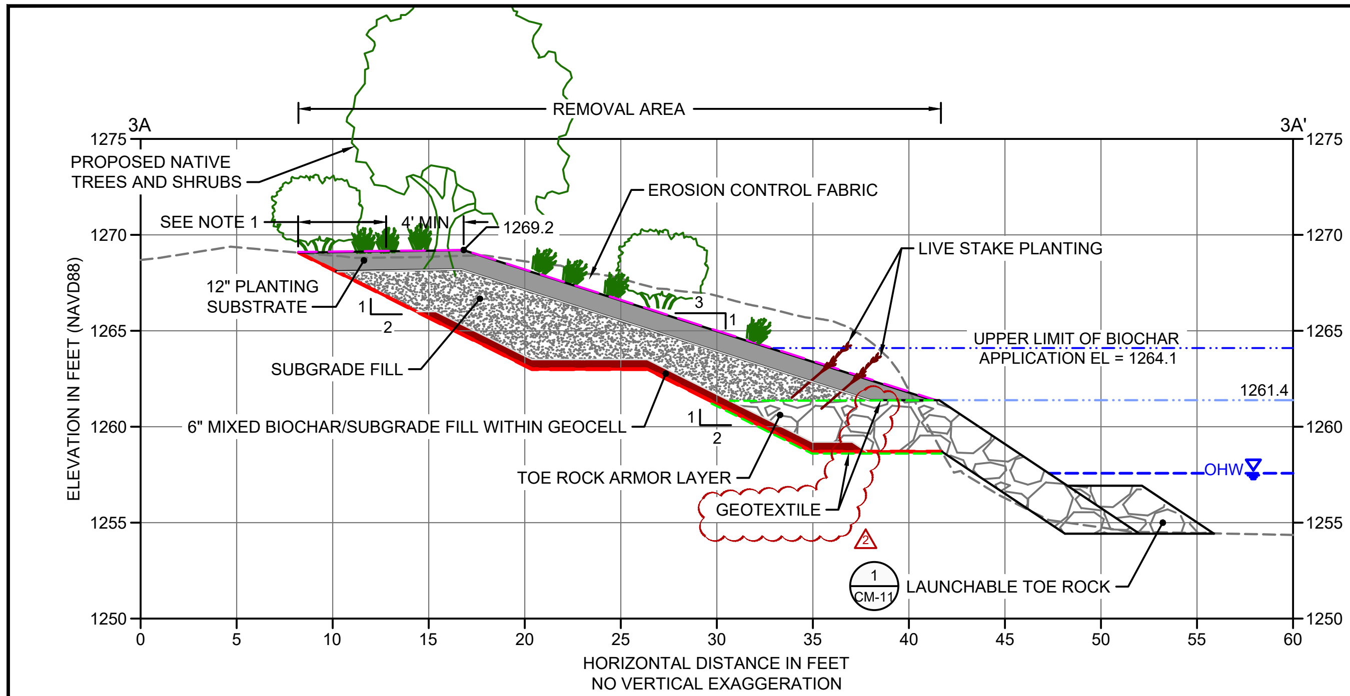
DESIGNED BY: M. DOO
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

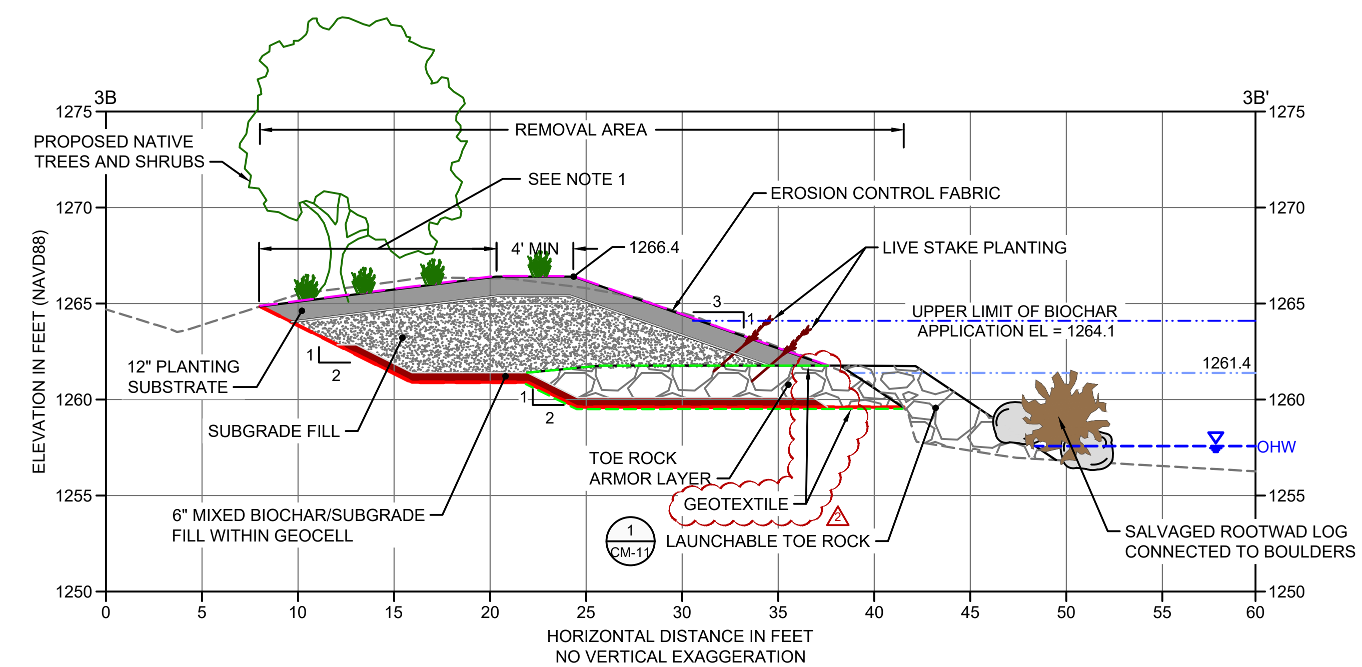
CONSTRUCTION MATERIALS CROSS SECTIONS, SECONDARY AREA - WWTP A BMA

CM-9

SHEET NO. 31 OF 42



3A CM-5 CONSTRUCTION MATERIALS SECTION - WWTP B BMA
SCALE: 1" = 5'



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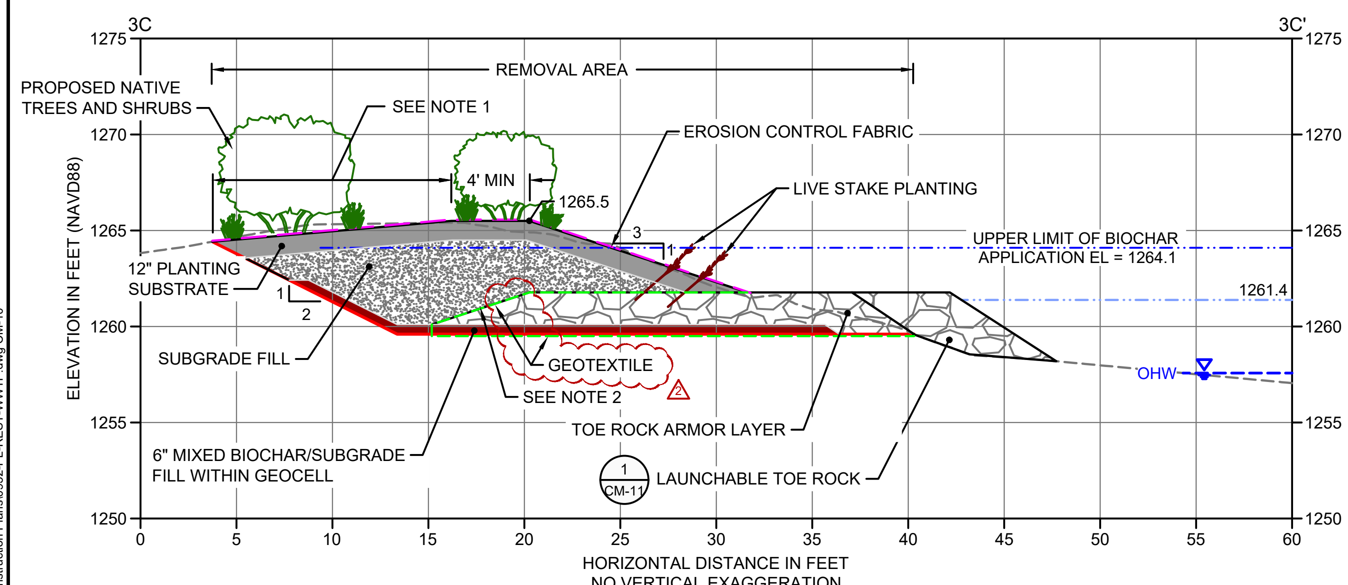

3C CM-5 CONSTRUCTION MATERIALS SECTION - WWTP B BMA
SCALE: 1" = 5'

LEGEND:

- EXISTING GRADE
- POST REMOVAL SURFACE
- MINIMUM ELEVATION OF ROCK TOE UPPER LIMIT
- UPPER LIMIT OF BIOCHAR APPLICATION
- GEOTEXTILE

NOTE:

1. 2H:1V MAXIMUM SLOPE. MINIMIZE FILL PLACEMENT TO THE LANDWARD SIDE OF THE EXCAVATION DAY LIGHT LINE.
2. MINIMIZE PLACEMENT OF TOE ROCK BENEATH EMBANKMENT FILL BY ENDING THE TOE ROCK LAYER DIRECTLY UNDERNEATH THE TOP OF THE RIVER FACING 3H:1V SLOPE AS SHOWN. TRANSITION TOE ROCK BACK TO THE BASE OF THE EXCAVATION ON THE LANDWARD SIDE AT A 3H:1V SLOPE AS NECESSARY.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

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Jul 25, 2017 10:01am tgriga

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
7/14/17

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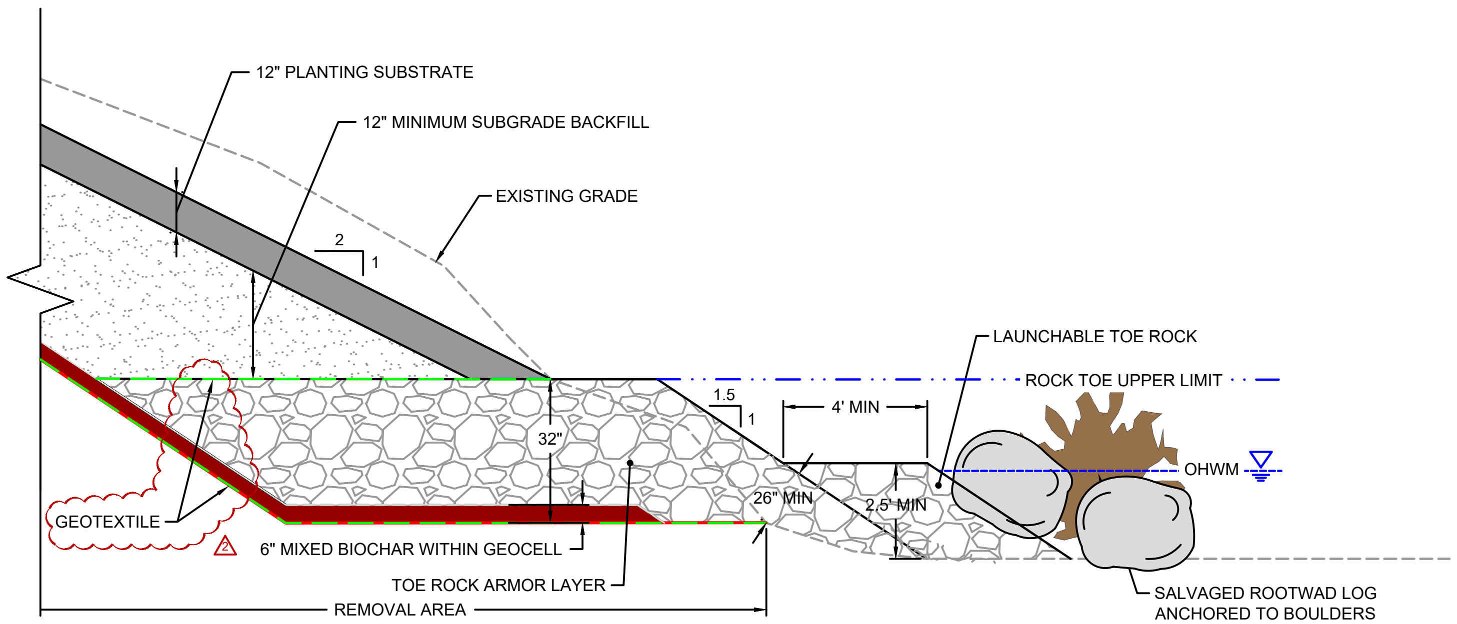
DESIGNED BY: M. DOO
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

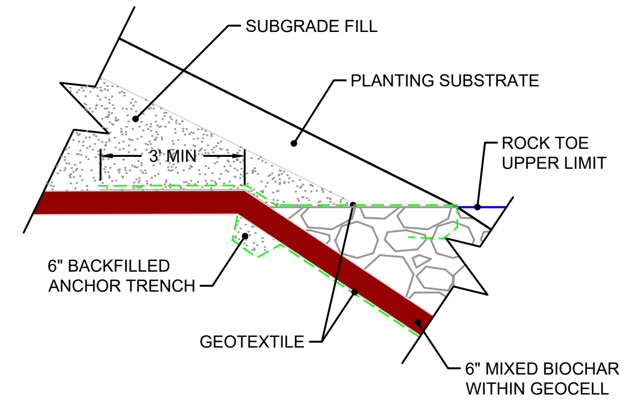
CONSTRUCTION MATERIALS CROSS SECTIONS, PRIMARY AREA - WWTP B BMA

CM-10

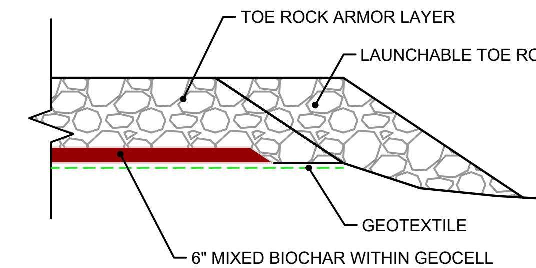
SHEET NO. 32 OF 42



1 SECTION: LAUNCHABLE TOE ROCK DETAIL
SCALE:NTS



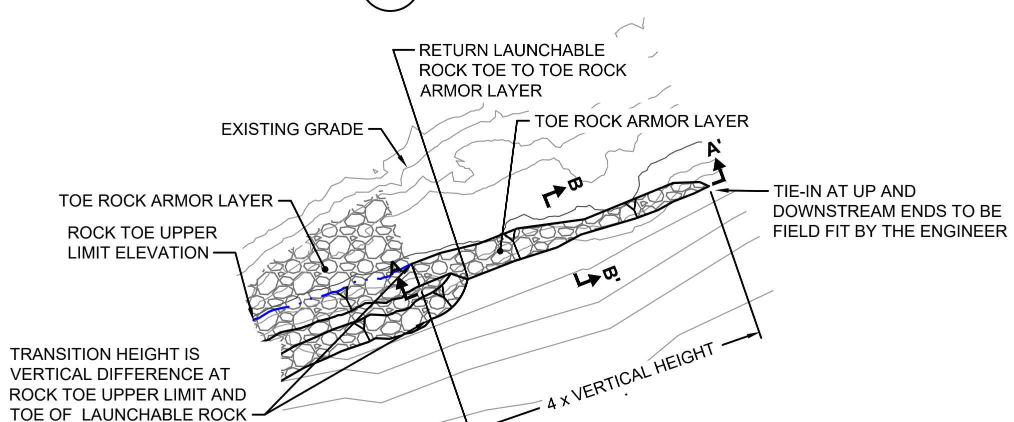
TOP OF SLOPE ANCHOR DETAIL



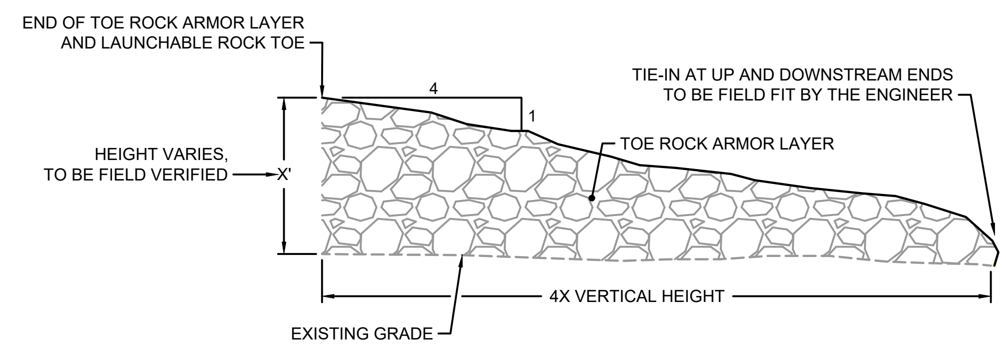
NOTES:

1. SLOPE SURFACE SHALL BE FREE OF ROCKS, CLODS, STICKS AND GRASS. GEOTEXTILE SHALL HAVE GOOD SOIL CONTACT.
2. GEOTEXTILE SHOULD BE INSTALLED VERTICALLY DOWNSLOPE.
3. GEOTEXTILE SHALL BE ROLLED IN A CONTROLLED FASHION. FABRIC SHALL NOT BE ALLOWED TO ROLL DOWN THE SLOPE ON ITS OWN.
4. ANCHOR GEOTEXTILE INSTALLATION ON TOP OF THE STONE TOE BY EXTENDING THE GEOTEXTILE LANDWARD SO THAT ATLEAST 3 FEET OF THE FABRIC EXTENDS PAST THE STONE TOE ON A FLAT SURFACE.

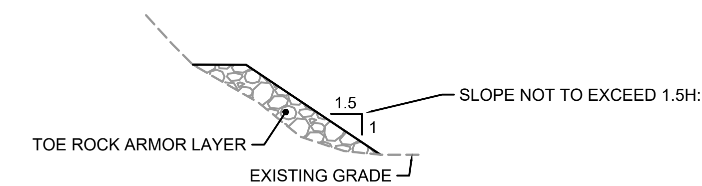
2 GEOTEXTILE INSTALLATION DETAILS
SCALE:NTS



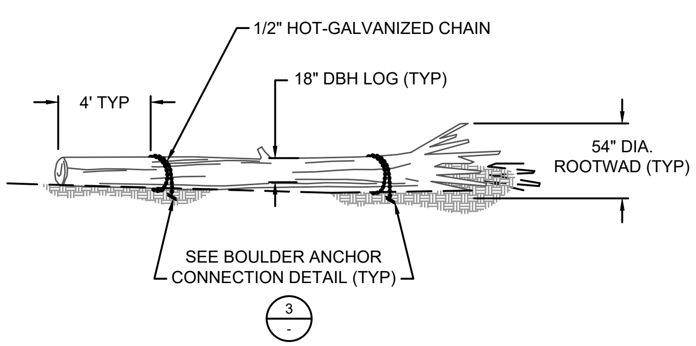
3 PLAN VIEW: TOE ROCK TRANSITION DETAIL
SCALE:NTS



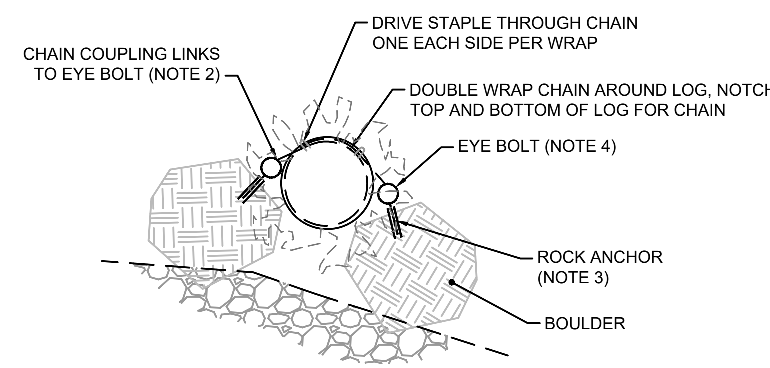
SECTION A-A': TOE ROCK TRANSITION DETAIL



SECTION B-B': TOE ROCK TRANSITION DETAIL



4 SALVAGED TREE PLACEMENT DETAIL
SCALE:NTS



5 BOULDER ANCHOR CONNECTION
SCALE:NTS

BOULDER ANCHOR CONNECTION NOTES

1. CHAIN SHALL BE 1/2-INCH TRADE SIZE, GRADE 40/43, HOT-GALVANIZED, WLL NO LESS THAN 9,200 LB.
2. CHAIN COUPLING LINKS SHALL BE FIGURE-EIGHT TYPE, FOR LIFTING, GRADE 80, WLL NO LESS THAN 12,000 LB.
3. ROCK ANCHORS SHALL BE EXPANSION ANCHORS, 4 WAY, 3/4 IN. - 10 INTERNALLY THREADED, ALTERNATIVELY ADHESIVE STYLE ANCHORS MAY BE USED AS APPROVED BY THE ENGINEER, SEE SPECIFICATIONS.
4. EYE BOLTS SHALL BE PLAIN OR BLACK OXIDE STEEL, FOR LIFTING, 3/4 IN. - 10 THREAD, SEE SPECIFICATIONS.
5. PRIOR TO FINISHING A CONNECTION REMOVE ALL SLACK FROM THE CONNECTION USING MECHANICAL ADVANTAGE.
6. SEE SPECIFICATIONS FOR FURTHER INFORMATION.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
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PROFESSIONAL ENGINEER
7/14/17

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SCALE: AS NOTED
DATE: AUGUST 2016

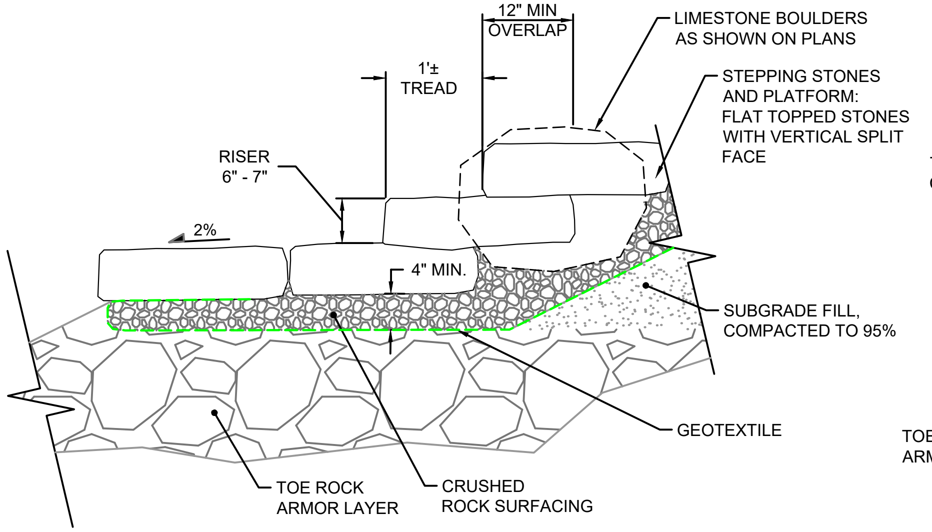
SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

CONSTRUCTION MATERIALS DETAILS

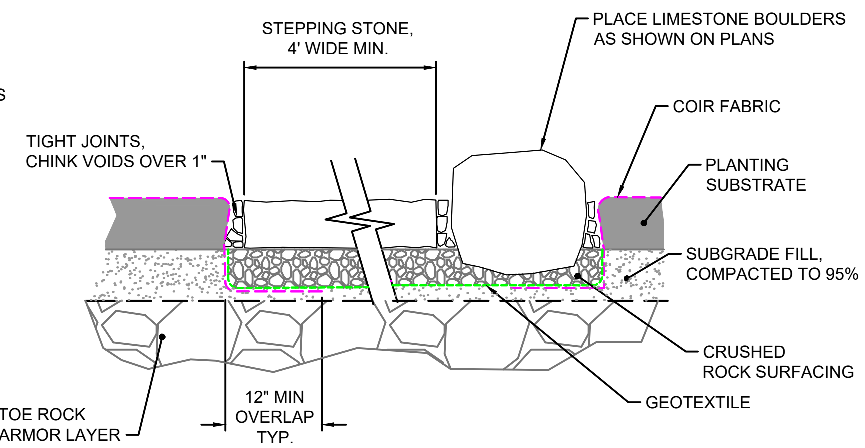
CM-11

SHEET NO. 33 OF 42

Jul 25, 2017 10:01am tgriga K:\Projects\0952-DuPont\South River Phase 1 Interim Remedial Mea\Construction Plans\0952-PL-Details.dwg CM-11

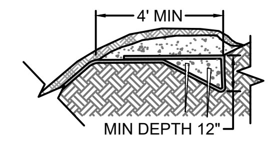


TYPICAL SECTION
DRAWN PERPENDICULAR TO THE SHORELINE

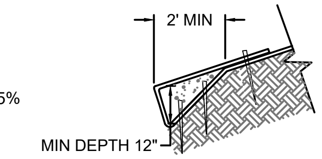


TYPICAL SECTION
DRAWN PARALLEL TO THE SHORELINE

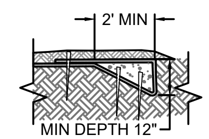
1 RIVERSIDE ACCESS AND VIEWING PLATFORM DETAILS
SCALE:1" = 1'



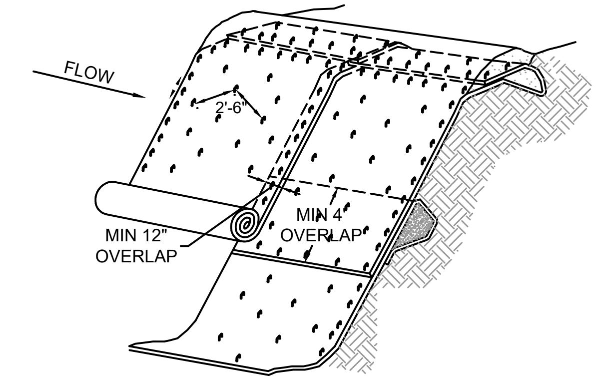
TOP OF SLOPE ANCHOR DETAIL



TOE OF SLOPE ANCHOR DETAIL



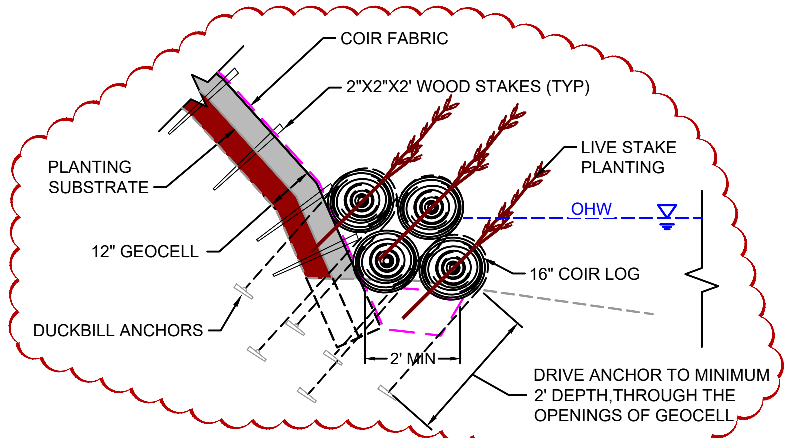
UPSTREAM END ANCHOR DETAIL



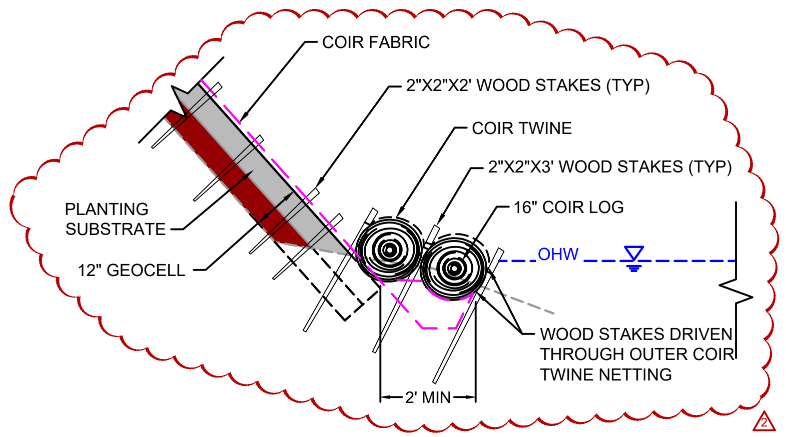
COIR FABRIC INSTALLATION, TOP OF SLOPE ISOMETRIC VIEW

NOTES:
1. SLOPE SURFACE SHALL BE FREE OF ROCKS, CLODS, STICKS AND GRASS. MATS/BLANKETS SHALL HAVE GOOD SOIL CONTACT.
2. LAY BLANKETS LOOSELY AND STAKE OR STAPLE TO MAINTAIN DIRECT CONTACT WITH THE SOIL. DO NOT STRETCH.
3. MATS/BLANKETS SHOULD BE INSTALLED VERTICALLY DOWNSLOPE.
4. INSTALL COIR FABRIC OVER ENTIRE PLANTING AREA. AVOID EXISTING TREES AND EXISTING STUMPS.
5. COIR FABRIC SHALL BE ROLLED IN A CONTROLLED FASHION. INSTALL WOOD STAKES AS MAT IS UNROLLED. FABRIC SHALL NOT BE ALLOWED TO ROLL DOWN THE SLOPE ON ITS OWN.
6. COIR FABRIC ALONG THE FIRST UPSTREAM EDGE SHALL BE BURIED AND ANCHORED AS SHOWN IN THE UPSTREAM END ANCHOR DETAIL.
7. COIR FABRIC SHALL BE ANHCORED AT TOE OF BANK AS SHOWN. DO NOT LEAVE FLAPS OF UNANCHORED COIR FABRIC AT TOE OF SLOPE.

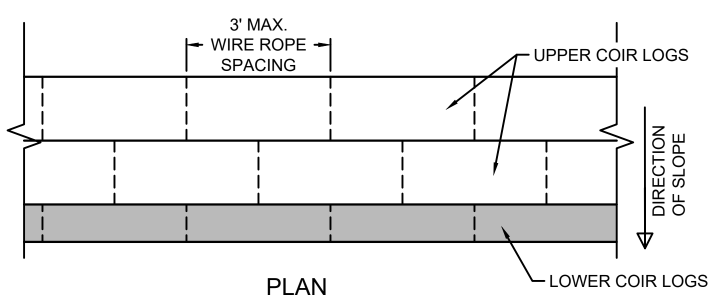
2 COIR FABRIC SLOPE PROTECTION
SCALE:NTS



SECTION

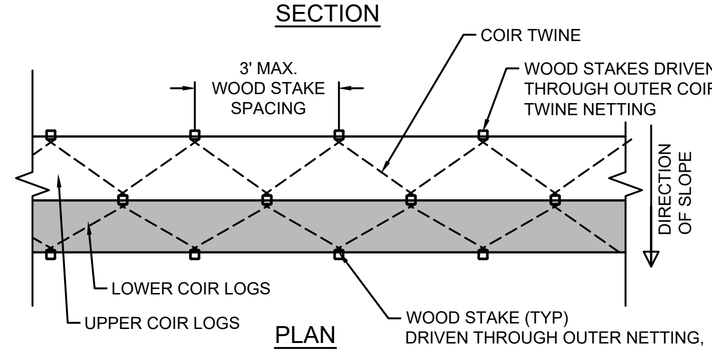


SECTION



PLAN

TYPICAL INSTALLATION ON STEEP/ERODED SLOPES

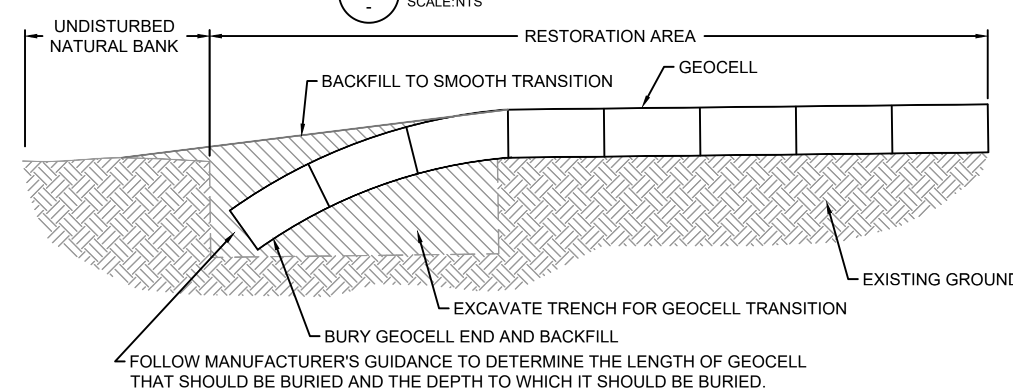


PLAN

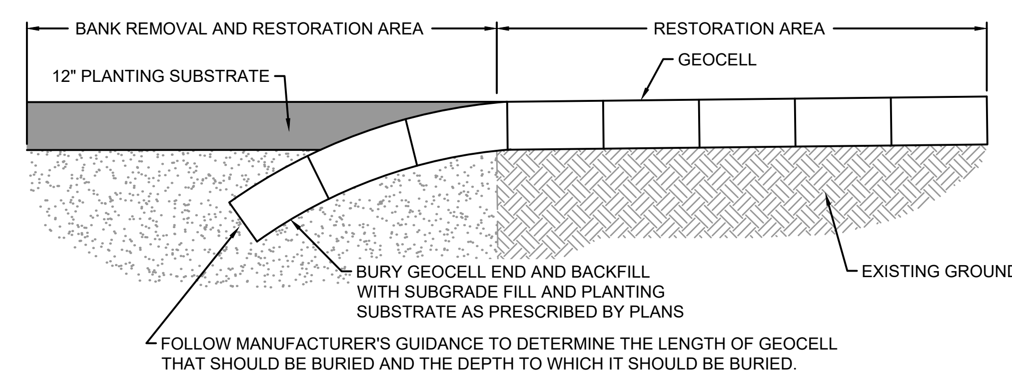
TYPICAL INSTALLATION ON ALL OTHER SLOPES

NOTES:
1. LOWER COIR LOGS SHALL BE COUNTERSUNK 1/2 TO 2/3 OF THE LOG DIAMETER
2. WHERE THE TOE HAS VERTICAL EROSION TALLER THAN 1 FOOT OR THE SLOPE OF THE TOE IS GREATER THAN 2H:1V, INSTALL COIR LOGS IN BUNDLE OF THREE OR MORE TO MATCH THE SITE-SPECIFIC CONDITION AS SHOWN BELOW FOR TYPICAL INSTALLATION ON STEEP/ERODED SLOPES. SECURE THE BUNDLE WITH DUCKBILL ANCHORS. FOR ALL OTHER LOCATIONS, INSTALL COIR LOGS IN BUNDLE OF TWO AND SECURE THE BUNDLE WITH STAKES AS SHOWN FOR TYPICAL INSTALLATION ON ALL OTHER SLOPES.

3 COIR LOG INSTALLATION DETAILS
SCALE:NTS



4 GEOCELL TRANSITION DETAIL: FROM RESTORATION AREA TO NATURAL BANK
SCALE:NTS



5 GEOCELL TRANSITION DETAIL: FROM RESTORATION AREA TO BANK REMOVAL AREA
SCALE:NTS

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

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ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
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7/14/17

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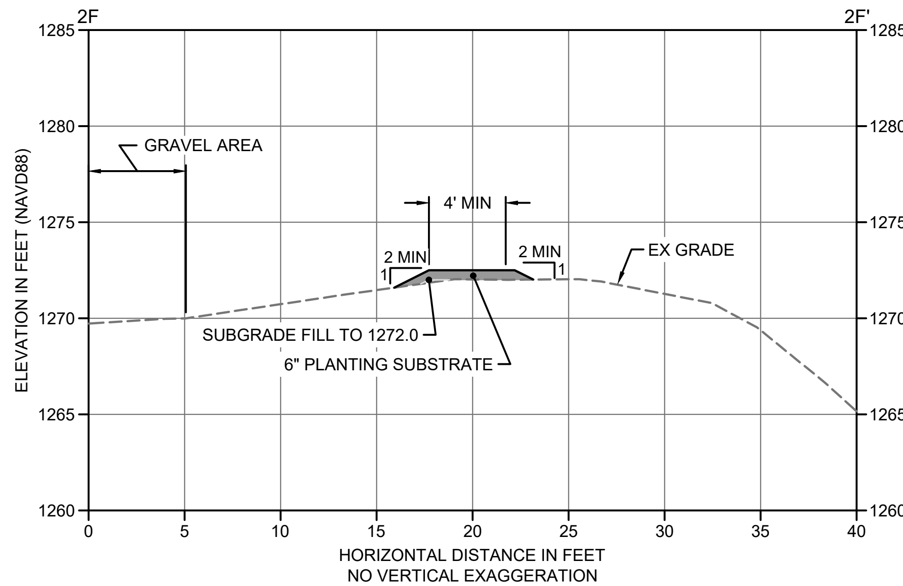
DESIGNED BY: M. DOO
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

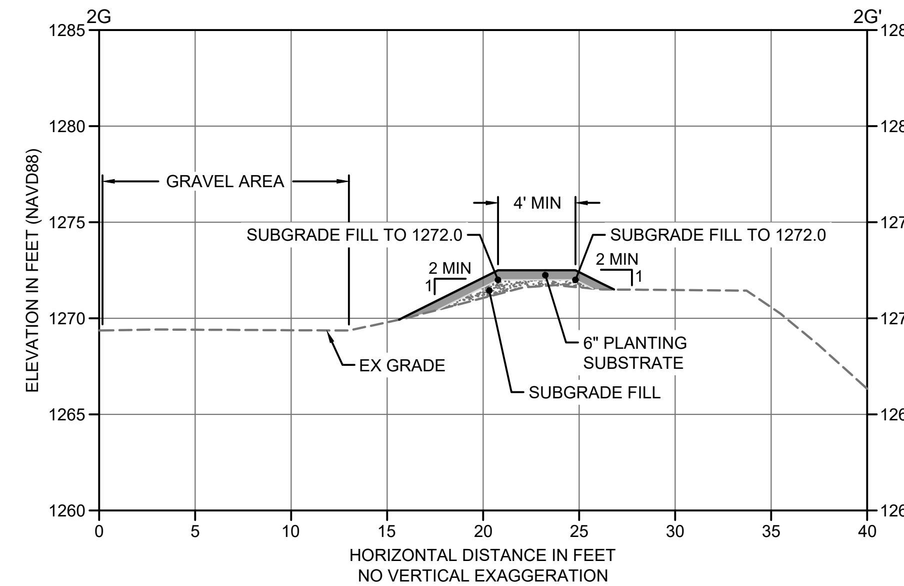
CONSTRUCTION MATERIALS DETAILS

CM-12

SHEET NO. 34 OF 42



2F / CM-3 CONSTRUCTION MATERIALS SECTION - WWTP A BMA
SCALE: 1" = 5'



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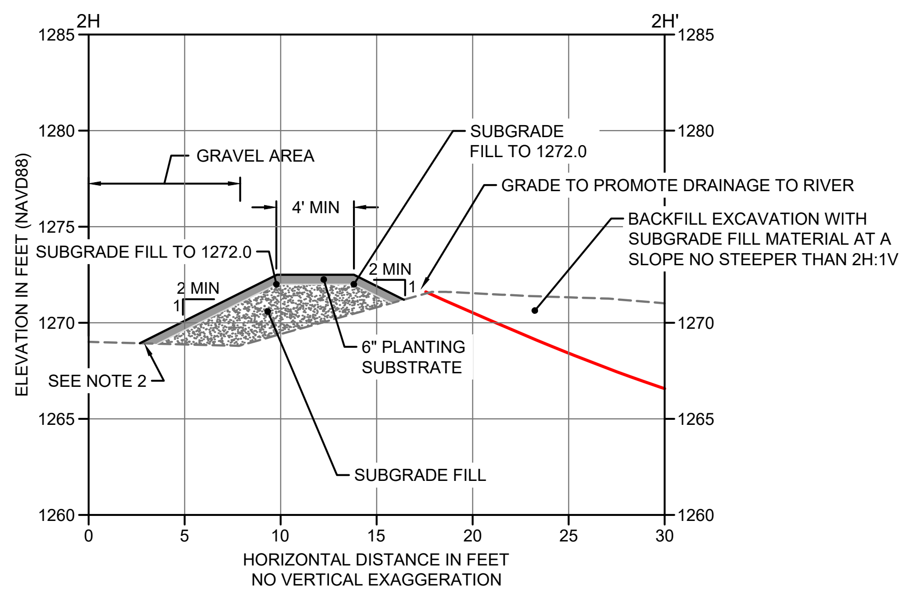

2H / CM-3 CONSTRUCTION MATERIALS SECTION - WWTP A BMA
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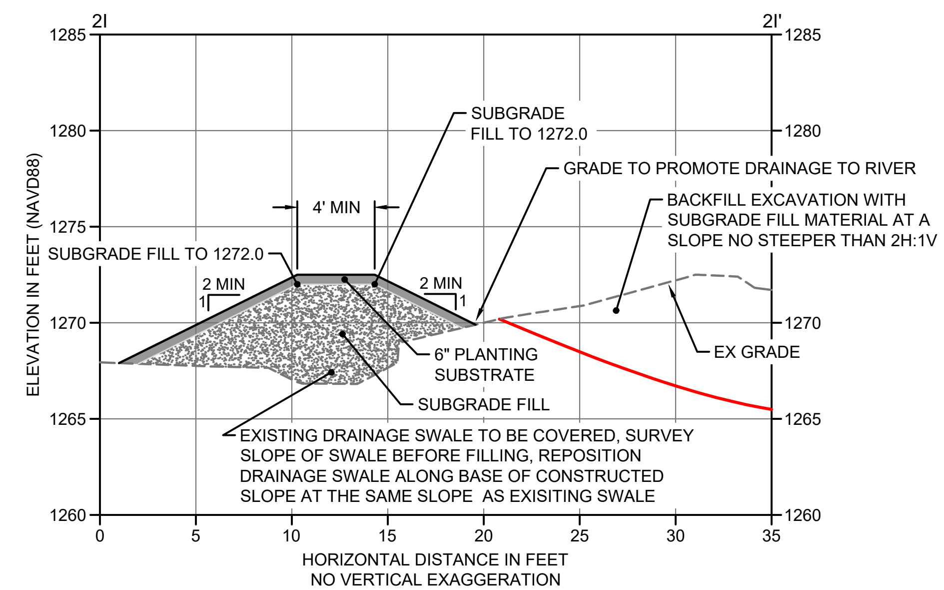

2I / CM-3 CONSTRUCTION MATERIALS SECTION - WWTP A BMA
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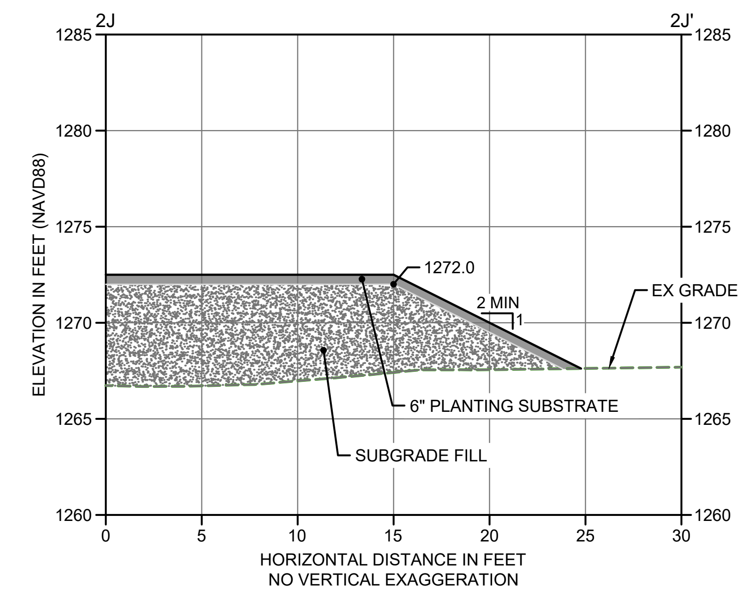

2J / CM-3/4 CONSTRUCTION MATERIALS SECTION - WWTP A BMA
SCALE: 1" = 5'

LEGEND:

- EXISTING GRADE
- PROPOSED EXCAVATION GRADE
- FINISHED GRADE

NOTE:

1. 2H:1V MAXIMUM SLOPE. MINIMIZE FILL PLACEMENT OVER GRAVEL STORAGE AREA.
2. IN AREAS WHERE THE BERM IS ADJACENT TO OR ENCROACHES ON THE GRAVEL AREA, ARMOR TOE OF SLOPE WITH 3" STONE IN STRIP 1 FOOT WIDE.

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

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E. I. DU PONT DE NEMOURS AND COMPANY

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7/14/17

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1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1

DESIGNED BY: S. HAFFEY
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

CONSTRUCTION MATERIALS CROSS SECTIONS, PRIMARY AREA - WWTP A BMA

CM-13

SHEET NO. 35 OF 42

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Jul 25, 2017 10:02am tgriga

PLANTING SCHEDULE

	SPECIES NAME	COMMON NAME	SIZE	SPACING	QUANTITY
	RIPARIAN LIVESTAKES				
1 / L-6	*Salix sericea*	Sillky Willow	Live Stake	2' O.C.	496
	Viburnum dentatum	Southern Arrow-wood	Live Stake	2' O.C.	496
2 / L-6	RIPARIAN SHRUBS				
	Cornus amomum	Silky Dogwood	1 Gal.	5' O.C.	32
	Viburnum lentago	Nannyberry	1 Gal.	5' O.C.	32
	Viburnum dentatum	Southern Arrow-wood	1 Gal.	5' O.C.	32
	Sambucus canadenis	Black Elderberry	1 Gal.	5' O.C.	32
	Staphylea trifolia	Bladdernut	1 Gal.	5' O.C.	32

NOTE: QUANTITY SHOWN IS THE TOTAL OF CONSTITUTION PARK PLANTING AREAS SHOWN ON L-1 AND L-2.

	SPECIES NAME	COMMON NAME	SIZE	SPACING	QUANTITY
	UPLAND TREES, SHRUBS, AND GRASSES				
1 / L-6	*Asimina triloba*	Pawpaw	5 Gal.	15' O.C.	4
	Acer rubrum	Red Maple	5 Gal.	15' O.C.	4
	Ostrya virginiana	Eastern Hornbeam	5 Gal.	15' O.C.	4
2 / L-6	*Platanus occidentalis*	American Sycamore	5 Gal.	15' O.C.	4
	Juniperus virginia	Eastern Red Cedar	5 Gal.	15' O.C.	4
	Aronia melanocarpa	Black Chokecherry	1 Gal.	5' O.C.	19
	Alnus serrulata	Hazel Alder	1 Gal.	5' O.C.	19
	Lindera benzoin	Spicebush	1 Gal.	5' O.C.	19
	Physocarpus opulifolius	Ninebark	1 Gal.	5' O.C.	19
	Hydrangea arborescens	Smooth Hydrangea	1 Gal.	5' O.C.	19
	Salix sericea	Silky Willow	1 Gal.	5' O.C.	19
	Rhus typhina	Staghorn sumac	1 Gal.	5' O.C.	19
	Crataegus crusgalli	Cockspur Hawthorn	1 Gal.	5' O.C.	19
	Cornus amomum	Silky dogwood	1 Gal.	5' O.C.	19
	Hamamelis virginiana	Witch hazel	1 Gal.	5' O.C.	19
		Native Seed Mix	Seed Mix	See Specs.	

LEGEND:

- 1250 — EXISTING CONTOURS (1 FT INTERVAL)
- PROJECT LIMITS
- APPROXIMATE OHWM
- BL12.0 — EXISTING TREE TO REMAIN (COMMON NAME, DBH)
- +0.20 — RELATIVE RIVER MILE
- EXISTING PAVED WALKWAY
- TOE ROCK PLACEMENT
- RIPARIAN LIVE STAKE AND SHRUBS
- UPLAND TREES AND SHRUBS
- RIVERSIDE ACCESS
- LIMITS OF EXCAVATION
- LIMITS OF STABILIZATION
- LIMIT OF RIPARIAN PLANTING
- COIR LOG
- SALVAGED TREE

NOTES:

1. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
2. VERTICAL DATUM: NAVD 88.
3. PLANT TREES PRIOR TO GEOCELL INSTALLATION. SEE SPECIFICATION 32 90 00.

NORTH

0 10 20
SCALE IN FEET

PLANTING NOTES

1. ALL DISTURBED AREAS BEYOND THE LIMITS OF PLANTING WILL BE RESTORED TO THE PRE-CONSTRUCTION CONDITION. APPLY SEED TO ALL AREAS OF GROUND DISTURBANCE. THE CONTRACTOR SHALL REFER TO SPECIFICATION FOR SEEDING MIXES.
2. PLANT TREES PRIOR TO INSTALLING THE GEOCELL IN BANK STABILIZATION AREA. 5-GALLON CONTAINERIZED TREES TO BE PLANTED PRIOR TO GEOCELL INSTALLATION. 1-GALLON CONTAINERIZED TREES TO BE PLANTED WITHIN GEOCELL AFTER GEOCELL INSTALLATION.
3. SET CROWN OF TREES AT OR ABOVE FINISHED GRADE AS SHOWN IN DETAILS. DO NOT PLACE PLANTING SUBSTRATE OVER THE DRIPLINE OF TREES PLANTED IN GEOCELL.
4. APPLY MULCH IMMEDIATELY AFTER PLANTING IN ACCORDANCE WITH THE SPECIFICATION.
5. ALL SEEDED AND PLANTED AREAS SHALL BE PROTECTED AND MAINTAINED THROUGHOUT THE CONSTRUCTION OF THE PROJECT AND UNTIL THE WORK IS ACCEPTED. NO CONSTRUCTION TRAFFIC WILL BE ALLOWED OVER A SEEDED OR PLANTED AREA ONCE THE SEED AND EROSION CONTROL MEASURES HAVE BEEN COMPLETED. FOOT TRAFFIC SHALL BE MINIMIZED AND WORKERS SHALL TRAVEL ALONG COMPLETED BANKS ONLY IN DESIGNATED AREAS.
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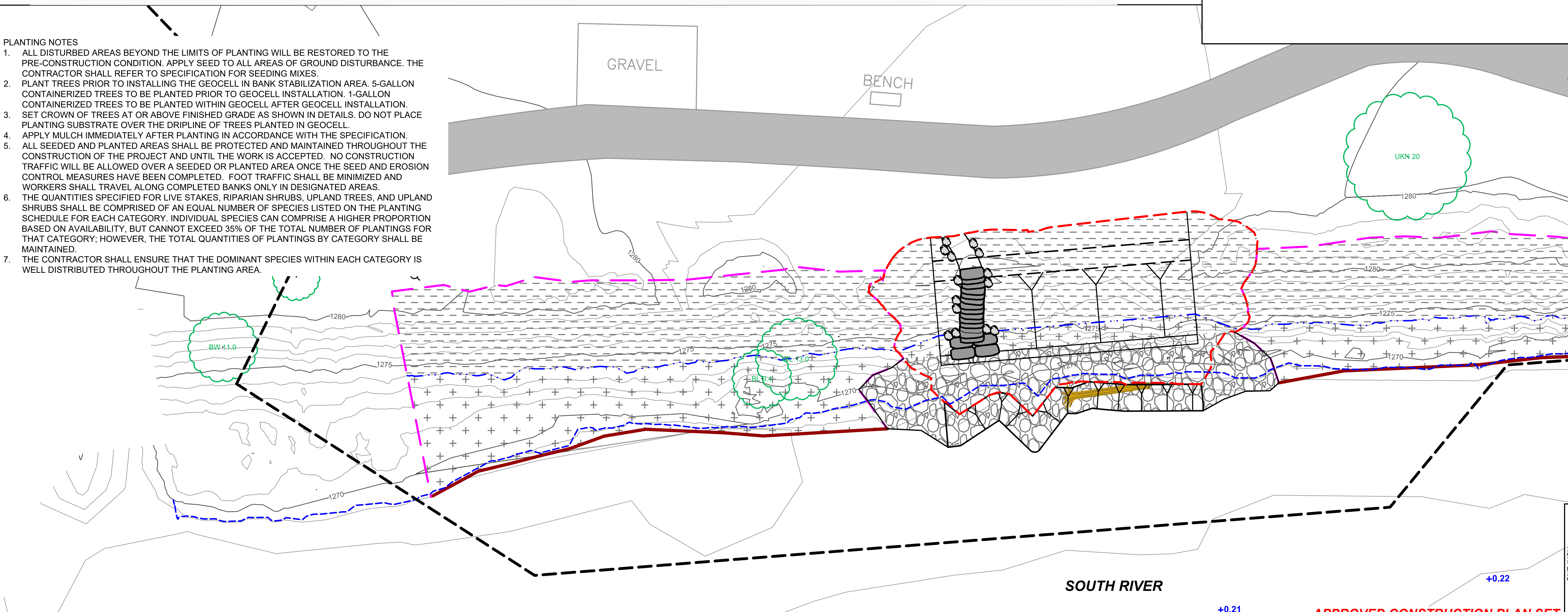
7. THE CONTRACTOR SHALL ENSURE THAT THE DOMINANT SPECIES WITHIN EACH CATEGORY IS WELL DISTRIBUTED THROUGHOUT THE PLANTING AREA.



APPROVED CONSTRUCTION PLAN SET

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

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Jul 25, 2017 10:02am lgriga

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

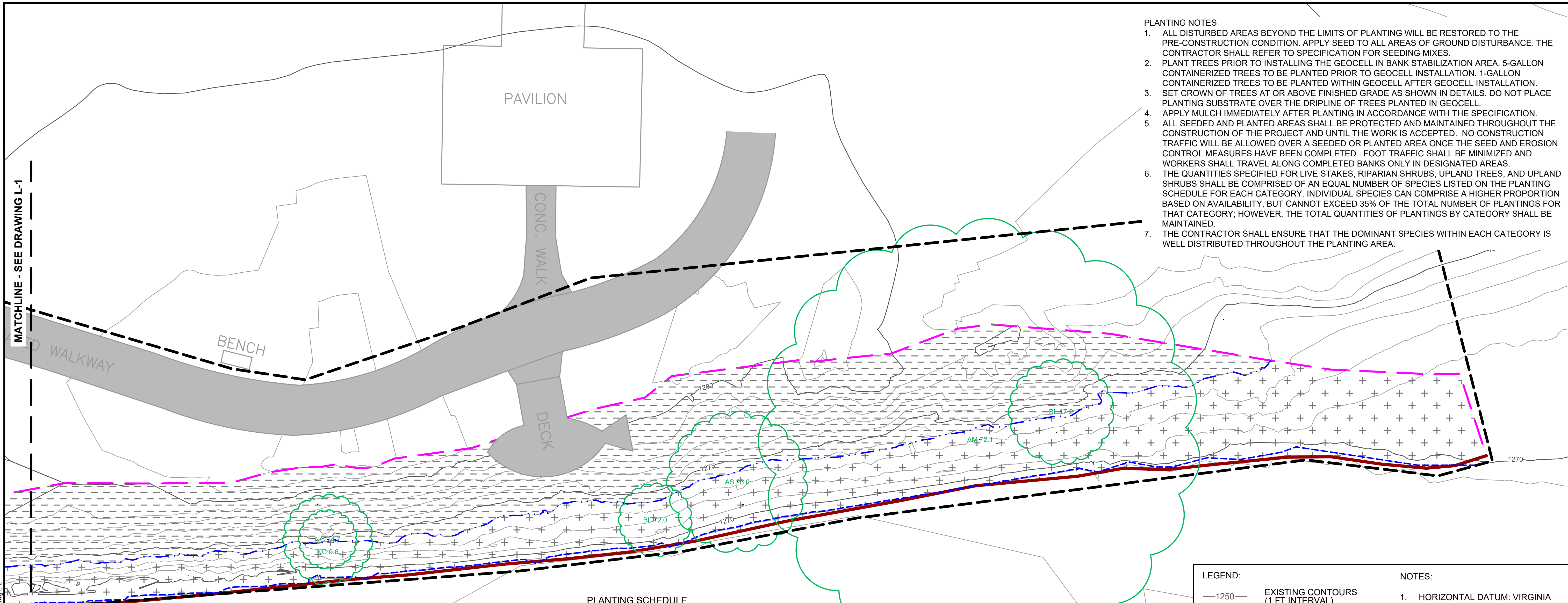
DESIGNED BY: M. DOO
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

PLANTING PLAN -
CONSTITUTION PARK BMA -
SHEET 1

L-1

SHEET NO. 36 OF 42



PLANTING NOTES

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3. SET CROWN OF TREES AT OR ABOVE FINISHED GRADE AS SHOWN IN DETAILS. DO NOT PLACE PLANTING SUBSTRATE OVER THE DRIPLINE OF TREES PLANTED IN GEOCELL.
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7. THE CONTRACTOR SHALL ENSURE THAT THE DOMINANT SPECIES WITHIN EACH CATEGORY IS WELL DISTRIBUTED THROUGHOUT THE PLANTING AREA.

PLANTING SCHEDULE

	SPECIES NAME	COMMON NAME	SIZE	SPACING	QUANTITY
	RIPARIAN LIVESTAKES				
1 / L-6	*Salix sericea*	Silky Willow	Live Stake	2' O.C.	496
	Viburnum dentatum	Southern Arrow-wood	Live Stake	2' O.C.	496
2 / L-6	**RIPARIAN SHRUBS**				
	Cornus amomum	Silky Dogwood	1 Gal.	5' O.C.	32
	Viburnum lentago	Nannyberry	1 Gal.	5' O.C.	32
	Viburnum dentatum	Southern Arrow-wood	1 Gal.	5' O.C.	32
	Sambucus canadenis	Black Elderberry	1 Gal.	5' O.C.	32
	Staphylea trifolia	Bladdernut	1 Gal.	5' O.C.	32

NOTE: QUANTITY SHOWN IS THE TOTAL OF CONSTITUTION PARK PLANTING AREAS SHOWN ON L-1 AND L-2.

	SPECIES NAME	COMMON NAME	SIZE	SPACING	QUANTITY
	UPLAND TREES, SHRUBS, AND GRASSES				
1 / L-6	*Asimina triloba*	Pawpaw	5 Gal.	15' O.C.	4
	Acer rubrum	Red Maple	5 Gal.	15' O.C.	4
2 / L-6	*Ostrya virginiana*	Eastern Hornbeam	5 Gal.	15' O.C.	4
	Platanus occidentalis	American Sycamore	5 Gal.	15' O.C.	4
	Juniperus virginia	Eastern Red Cedar	5 Gal.	15' O.C.	4
	Aronia melanocarpa	Black Chokecherry	1 Gal.	5' O.C.	19
	Alnus serrulata	Hazel Alder	1 Gal.	5' O.C.	19
	Lindera benzoin	Spicebush	1 Gal.	5' O.C.	19
	Physocarpus opulifolius	Ninebark	1 Gal.	5' O.C.	19
	Hydrangea arborescens	Smooth Hydrangea	1 Gal.	5' O.C.	19
	Salix sericea	Silky Willow	1 Gal.	5' O.C.	19
	Rhus typhina	Staghorn sumac	1 Gal.	5' O.C.	19
	Crataegus crusgalli	Cockspur Hawthorn	1 Gal.	5' O.C.	19
	Cornus amomum	Silky dogwood	1 Gal.	5' O.C.	19
	Hamamelis virginiana	Witch hazel	1 Gal.	5' O.C.	19
		Native Seed Mix	Seed Mix	See Specs.	

LEGEND:

- 1250 — EXISTING CONTOURS (1 FT INTERVAL)
- PROJECT LIMITS
- APPROXIMATE OHWM
- BL12.0 — EXISTING TREE TO REMAIN (COMMON NAME, DBH)
- +0.20 — RELATIVE RIVER MILE
- EXISTING PAVED WALKWAY
- TOE ROCK PLACEMENT
- RIPARIAN LIVE STAKE AND SHRUBS
- UPLAND TREES AND SHRUBS
- RIVERSIDE ACCESS
- LIMITS OF EXCAVATION
- LIMITS OF STABILIZATION
- LIMIT OF RIPARIAN PLANTING
- COIR LOG
- SALVAGED TREE

NOTES:

1. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
2. VERTICAL DATUM: NAVD 88.
3. PLANT TREES PRIOR TO GEOCELL INSTALLATION. SEE SPECIFICATION 32 90 00.

NORTH

0 10 20

SCALE IN FEET

ONE INCH

AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

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Jul 25, 2017 10:02am tgriga

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

DESIGNED BY: M. DOO
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

PLANTING PLAN -
CONSTITUTION PARK BMA -
SHEET 2

L-2

PLANTING NOTES
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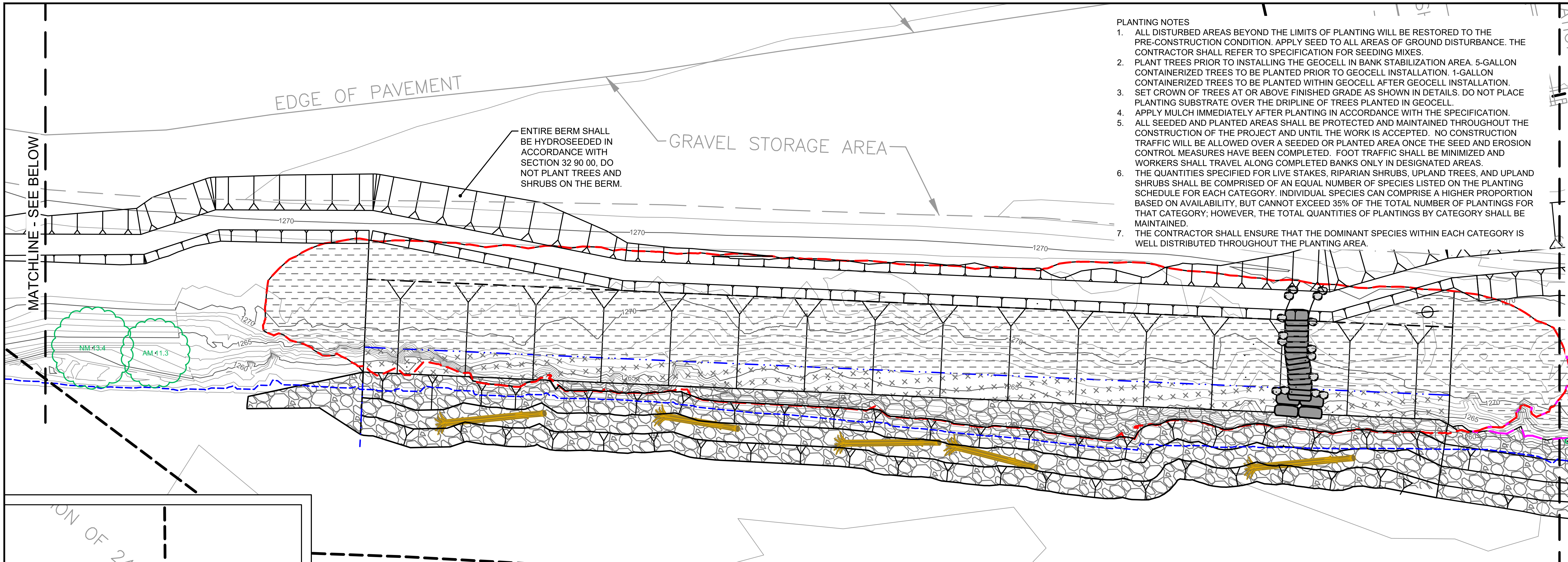

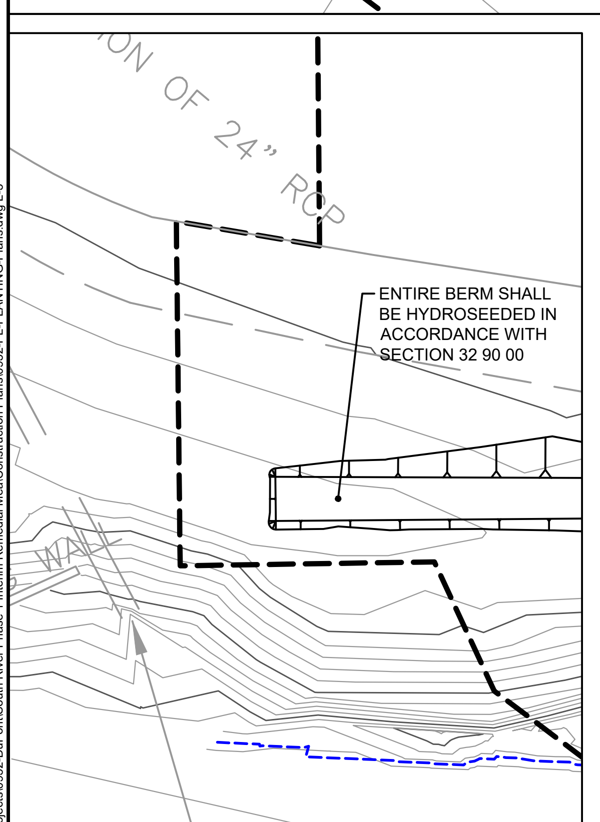

PLANTING SCHEDULE

SPECIES NAME	COMMON NAME	SIZE	SPACING	QUANTITY
RIPARIAN LIVESTAKES (2 / L-6)				
Salix sericea	Sillky Willow	Live Stake	2' O.C.	181
Viburnum dentatum	Southern Arrow-wood	Live Stake	2' O.C.	181
RIPARIAN SHRUBS (1 / L-6)				
Cornus amomum	Silky Dogwood	1 Gal.	5' O.C.	12
Viburnum lentago	Nannyberry	1 Gal.	5' O.C.	12
Viburnum dentatum	Southern Arrow-wood	1 Gal.	5' O.C.	12
Sambucus canadenis	Black Elderberry	1 Gal.	5' O.C.	12
Staphylea trifolia	Bladdernut	1 Gal.	5' O.C.	12

NOTE: QUANTITY SHOWN IS THE TOTAL OF WWTP A AREAS SHOWN ON L-3 AND L-4.

UPLAND TREES, SHRUBS, AND GRASSES

SPECIES NAME	COMMON NAME	SIZE	SPACING	QUANTITY
Asimina triloba	Pawpaw	5 Gal.	15' O.C.	5
Acer rubrum	Red Maple	5 Gal.	15' O.C.	5
Ostrya virginiana	Eastern Hornbeam	5 Gal.	15' O.C.	5
Platanus occidentalis	American Sycamore	5 Gal.	15' O.C.	5
Aronia melanocarpa	Black Chokecherry	1 Gal.	5' O.C.	22
Alnus serrulata	Hazel Alder	1 Gal.	5' O.C.	22
Lindera benzoin	Spicebush	1 Gal.	5' O.C.	22
Physocarpus opulifolius	Ninebark	1 Gal.	5' O.C.	22
Hydrangea arborescens	Smooth Hydrangea	1 Gal.	5' O.C.	22
Salix sericea	Silky Willow	1 Gal.	5' O.C.	22
Rhus typhina	Staghorn sumac	1 Gal.	5' O.C.	22
Crataegus crusgalli	Cockspur Hawthorn	1 Gal.	5' O.C.	22
Cornus amomum	Silky dogwood	1 Gal.	5' O.C.	22
Hamamelis virginiana	Witch hazel	1 Gal.	5' O.C.	22
	Native Seed Mix	Seed Mix	See Specs.	

1 / L-6 ; 1 / L-6

LEGEND:
- 1250 — EXISTING CONTOURS (1 FT INTERVAL)
- PROJECT LIMITS
- APPROXIMATE OHWM
- BL12.0 — EXISTING TREE TO REMAIN (COMMON NAME, DBH)
- +0.20 — RELATIVE RIVER MILE
- EXISTING PAVED WALKWAY
- TOE ROCK PLACEMENT
- RIPARIAN LIVE STAKE AND SHRUBS
- UPLAND TREES AND SHRUBS
- RIVERSIDE ACCESS
- LIMITS OF EXCAVATION
- LIMITS OF STABILIZATION
- LIMIT OF RIPARIAN PLANTING
- COIR LOG
- SALVAGED TREE

NOTES:
1. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
2. VERTICAL DATUM: NAVD 88.
3. PLANT TREES PRIOR TO GEOCELL INSTALLATION. SEE SPECIFICATION 32 90 00.

NORTH

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SCALE IN FEET

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

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Jul 25, 2017 10:02am tgriga

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1
2	7/14/17	TPG	WJD	REVISION TO ADDRESS PERMIT COMMENTS

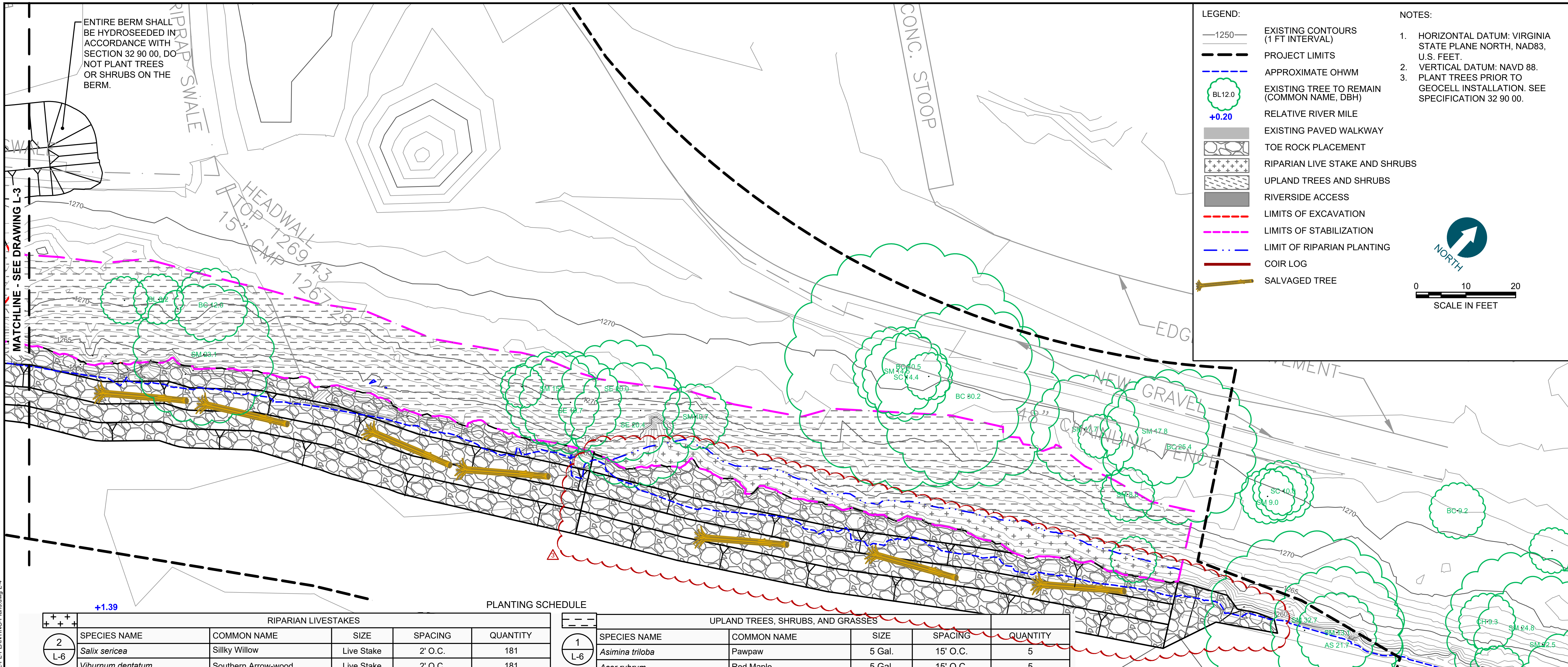
DESIGNED BY: M. DOO
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

PLANTING PLAN - WWTP A PARK BMA - SHEET 1

L-3

SHEET NO. 38 OF 42



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NORTH

0 10 20
SCALE IN FEET

PLANTING SCHEDULE

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	SPECIES NAME	COMMON NAME	SIZE	SPACING	QUANTITY
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		Native Seed Mix	Seed Mix	See Specs.	

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APPROVED CONSTRUCTION PLAN SET

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ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
10/19/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1
2	7/14/17	TPG	WJD	REVISION TO ADDRESS PERMIT COMMENTS
3	10/19/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #2

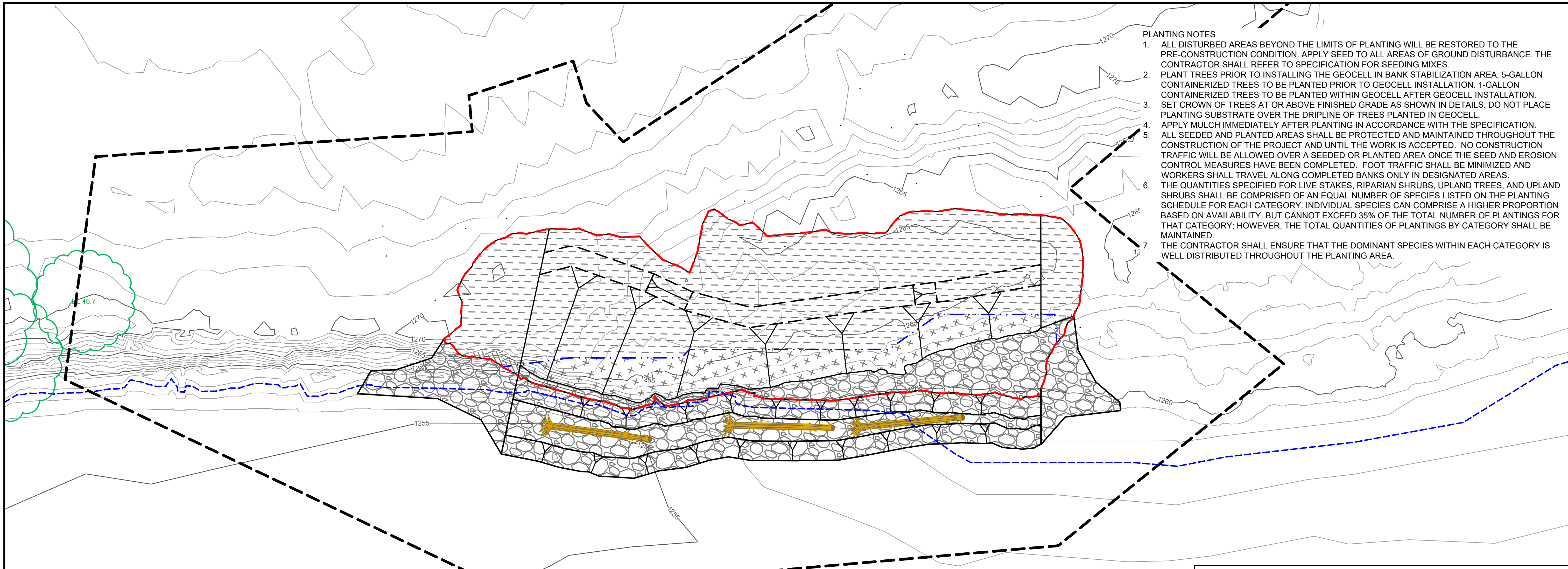
DESIGNED BY: M. DOO
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

PLANTING PLAN - WWTP A PARK BMA - SHEET 2

L-4

SHEET NO. 39 OF 42



PLANTING NOTES
1. ALL DISTURBED AREAS BEYOND THE LIMITS OF PLANTING WILL BE RESTORED TO THE PRE-CONSTRUCTION CONDITION. APPLY SEED TO ALL AREAS OF GROUND DISTURBANCE. THE CONTRACTOR SHALL REFER TO SPECIFICATION FOR SEEDING MIXES.
2. PLANT TREES PRIOR TO INSTALLING THE GEOCELL IN BANK STABILIZATION AREA. 5-GALLON CONTAINERIZED TREES TO BE PLANTED PRIOR TO GEOCELL INSTALLATION. 1-GALLON CONTAINERIZED TREES TO BE PLANTED WITHIN GEOCELL AFTER GEOCELL INSTALLATION.
3. SET CROWN OF TREES AT OR ABOVE FINISHED GRADE AS SHOWN IN DETAILS. DO NOT PLACE PLANTING SUBSTRATE OVER THE DRIPLINE OF TREES PLANTED IN GEOCELL.
4. APPLY MULCH IMMEDIATELY AFTER PLANTING IN ACCORDANCE WITH THE SPECIFICATION.
5. ALL SEEDED AND PLANTED AREAS SHALL BE PROTECTED AND MAINTAINED THROUGHOUT THE CONSTRUCTION OF THE PROJECT AND UNTIL THE WORK IS ACCEPTED. NO CONSTRUCTION TRAFFIC WILL BE ALLOWED OVER A SEEDED OR PLANTED AREA ONCE THE SEED AND EROSION CONTROL MEASURES HAVE BEEN COMPLETED. FOOT TRAFFIC SHALL BE MINIMIZED AND WORKERS SHALL TRAVEL ALONG COMPLETED BANKS ONLY IN DESIGNATED AREAS.
6. THE QUANTITIES SPECIFIED FOR LIVE STAKES, RIPARIAN SHRUBS, UPLAND TREES, AND UPLAND SHRUBS SHALL BE COMPRISED OF AN EQUAL NUMBER OF SPECIES LISTED ON THE PLANTING SCHEDULE FOR EACH CATEGORY. INDIVIDUAL SPECIES CAN COMPRISE A HIGHER PROPORTION BASED ON AVAILABILITY, BUT CANNOT EXCEED 35% OF THE TOTAL NUMBER OF PLANTINGS FOR THAT CATEGORY; HOWEVER, THE TOTAL QUANTITIES OF PLANTINGS BY CATEGORY SHALL BE MAINTAINED.
7. THE CONTRACTOR SHALL ENSURE THAT THE DOMINANT SPECIES WITHIN EACH CATEGORY IS WELL DISTRIBUTED THROUGHOUT THE PLANTING AREA.

+1.46

PLANTING SCHEDULE

RIPARIAN LIVESTAKES (2 / L-6)				
SPECIES NAME	COMMON NAME	SIZE	SPACING	QUANTITY
Salix sericea	Silky Willow	Live Stake	2' O.C.	56
Viburnum dentatum	Southern Arrow-wood	Live Stake	2' O.C.	56
RIPARIAN SHRUBS (1 / L-6)				
Cornus amomum	Silky Dogwood	1 Gal.	5' O.C.	4
Viburnum lentago	Nannyberry	1 Gal.	5' O.C.	4
Viburnum dentatum	Southern Arrow-wood	1 Gal.	5' O.C.	4
Sambucus canadenis	Black Elderberry	1 Gal.	5' O.C.	4
Staphylea trifolia	Bladdernut	1 Gal.	5' O.C.	4

NOTE: QUANTITY SHOWN IS THE TOTAL OF WWTP B PLANTING AREAS SHOWN ON L-5.

UPLAND TREES, SHRUBS, AND GRASSES (1 / L-6)				
SPECIES NAME	COMMON NAME	SIZE	SPACING	QUANTITY
Asimina triloba	Pawpaw	5 Gal.	15' O.C.	2
Acer rubrum	Red Maple	5 Gal.	15' O.C.	
Ostrya virginiana	Eastern Hornbeam	5 Gal.	15' O.C.	1
Platanus occidentalis	American Sycamore	5 Gal.	15' O.C.	1
Aronia melanocarpa	Black Chokecherry	1 Gal.	5' O.C.	8
Alnus serrulata	Hazel Alder	1 Gal.	5' O.C.	8
Lindera benzoin	Spicebush	1 Gal.	5' O.C.	8
Physocarpus opulifolius	Ninebark	1 Gal.	5' O.C.	8
Hydrangea arborescens	Smooth Hydrangea	1 Gal.	5' O.C.	8
Salix sericea	Silky Willow	1 Gal.	5' O.C.	8
Rhus typhina	Staghorn sumac	1 Gal.	5' O.C.	8
Crataegus crusgalli	Cockspur Hawthorn	1 Gal.	5' O.C.	8
Cornus amomum	Silky dogwood	1 Gal.	5' O.C.	8
Hamamelis virginiana	Witch hazel	1 Gal.	5' O.C.	8
	Native Seed Mix	Seed Mix	See Specs.	

LEGEND:
- 1250 — EXISTING CONTOURS (1 FT INTERVAL)
- PROJECT LIMITS
- APPROXIMATE OHWM
- BL12.0 — EXISTING TREE TO REMAIN (COMMON NAME, DBH)
- +0.20 — RELATIVE RIVER MILE
- EXISTING PAVED WALKWAY
- TOE ROCK PLACEMENT
- RIPARIAN LIVE STAKE AND SHRUBS
- UPLAND TREES AND SHRUBS
- RIVERSIDE ACCESS
- LIMITS OF EXCAVATION
- LIMITS OF STABILIZATION
- LIMIT OF RIPARIAN PLANTING
- COIR LOG
- SALVAGED TREE

NOTES:
1. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
2. VERTICAL DATUM: NAVD 88.
3. PLANT TREES PRIOR TO GEOCELL INSTALLATION. SEE SPECIFICATION 32 90 00.

NORTH

0 10 20
SCALE IN FEET

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1
2	7/14/17	TPG	WJD	REVISION TO ADDRESS PERMIT COMMENTS

DESIGNED BY: M. DOO
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

PLANTING PLAN - WWTP B PARK BMA

L-5

SHEET NO. 40 OF 42

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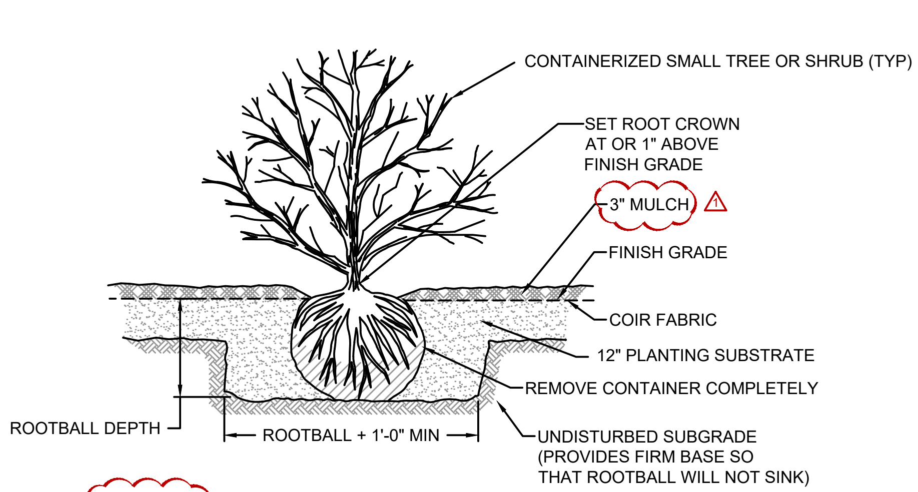
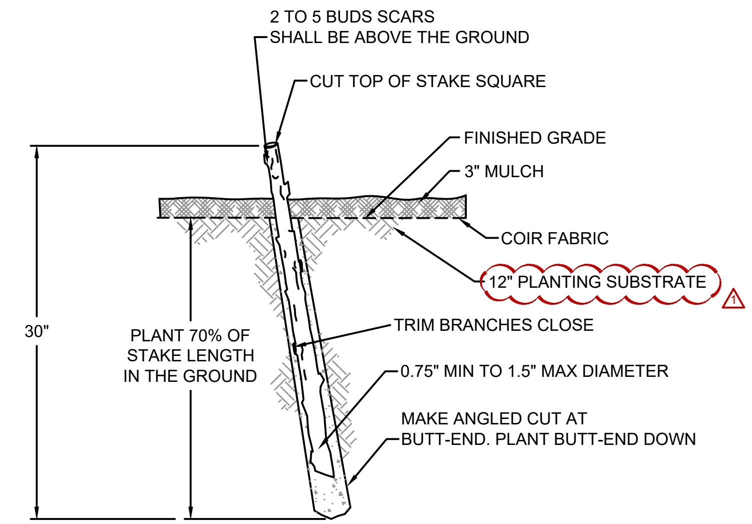
Jul 25, 2017 10:02am tgriga



NOTES:

1. APPLY MULCH ON TOP OF COIR FABRIC AS SHOWN AROUND PLANTED TREE OR SHRUB.
2. IN AREAS WHERE BANK FACE WILL BE COVERED BY THE GEOCELL, PLANT SHRUBS WITHIN THE OPENINGS OF THE GEOCELL.
3. IN AREAS WHERE THE BANK FACE IS TO BE COVERED BY GEOCELLS, PLANT TREES PRIOR TO INSTALLING THE GEOCELL. DO NOT COVER ROOT CROWN WITH PLANTING SUBSTRATE.

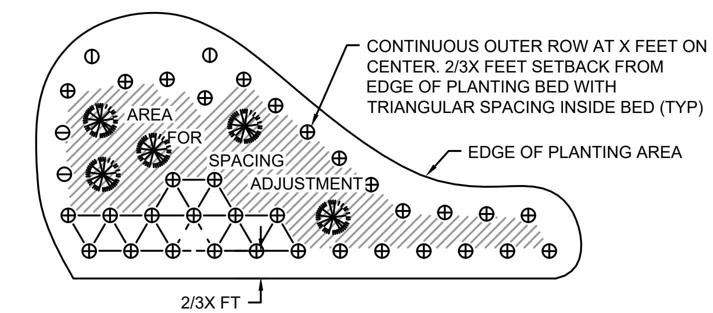
1 SMALL TREE AND SHRUB PLANTING
SCALE:NTS



NOTES:

1. HARVEST AND PLANT STAKES DURING THE DORMANT SEASON.
2. MAKE CLEAN CUTS AND DO NOT DAMAGE STAKES OR SPLIT ENDS DURING INSTALLATION, USE A PILOT BAR IN FIRM SOILS.
3. SOAK CUTTINGS CONTINUOUSLY PRIOR TO INSTALLATION.
4. TAMP THE SOIL AROUND THE STAKE.
5. USE EQUAL NUMBER AND EVEN DISTRIBUTION OF EACH WILLOW SPECIES.

2 LIVESTAKE PLANTING
SCALE:NTS



SEE PLANTING PLAN FOR RECOMMENDED SPACING

⊕ ACTUAL PLANT LOCATIONS TREE

3 TYPICAL WOODY SPECIES PLANTING PATTERN
SCALE:NTS

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

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Jul 25, 2017 10:03am tgriga

ANCHOR QEA

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	5/1/17	TPG	WJD	REVISED WWTP FINAL DESIGN SET #1

DESIGNED BY: M. DOO
DRAWN BY: T. GRIGA
CHECKED BY: R. DAVIS
APPROVED BY: W. DINICOLA
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

PLANTING DETAILS

L-6

SHEET NO. 41 OF 42

LEGEND:

- PROJECT LIMITS
- PROPOSED ACCESS
- LIMITED ACCESS; PRIOR CITY APPROVAL REQUIRED

NORTH

0 40 80
SCALE IN FEET

NOTES:

1. AERIAL BY VIRGINIA BASE MAPPING PROGRAM (VBMP) DATED 5/29/2017.
2. HORIZONTAL DATUM: VIRGINIA STATE PLANE NORTH, NAD83, U.S. FEET.
3. VERTICAL DATUM: NAVD 88.
4. SEE DRAWING G-2 FOR ADDITIONAL SURVEY NOTES AND EXISTING UTILITIES LEGEND.
5. SEE DRAWING ES-2 AND ES-3 FOR E&S MEASURES TO BE INSTALLED AT THE WWTP. THIS PLAN IS INTENDED TO SHOW THE PROPOSED ACCESS AREAS AND STORM DRAIN INLET PROTECTION WITHIN AND NEAR THOSE AREAS ONLY.
6. CROSS-HATCHED AREA IN TRANSPORTATION ROUTE CAN ONLY BE USED FOR DELIVERIES WHEN ACCESS THROUGH OTHER DESIGNATED PORTIONS OF THE SITE IS NOT POSSIBLE. THE CONTRACTOR SHALL COORDINATE WITH THE DSR BEFORE UTILIZING THIS SECTION OF THE TRANSPORTATION ROUTE. THE DSR WILL OBTAIN PERMISSION FROM THE CITY BEFORE ALLOWING THE CONTRACTOR TO USE THE CROSS-HATCHED AREA.

EROSION AND SEDIMENT CONTROL PRACTICES LEGEND (VIRGINIA UNIFORM CODING SYSTEM):

VESCH STD AND SPEC NO.	TITLE / DESCRIPTION	KEY	SYMBOL	DETAIL DRAWING REFERENCE
3.07	STORM DRAIN INLET PROTECTION	IP		5 / ES-4

ONE INCH
AT FULL SIZE, IF NOT ONE INCH SCALE ACCORDINGLY

APPROVED CONSTRUCTION PLAN SET

ANCHOR QEA
AECOM

E. I. DU PONT DE NEMOURS AND COMPANY

COMMONWEALTH OF VIRGINIA
DONALD FRANKLIN MAYER, III
No. 029879
PROFESSIONAL ENGINEER
7/14/17

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION
1	7/14/17	JRJ	DFM	REVISION TO ADDRESS PERMIT COMMENTS

DESIGNED BY: J. JERRYTONE
DRAWN BY: J. JERRYTONE
CHECKED BY: D. MAYER
APPROVED BY: D. MAYER
SCALE: AS NOTED
DATE: AUGUST 2016

SOUTH RIVER PHASE 1A BMAS
AREA OF CONCERN 4

WWTP TRANSPORTATION PLAN

T-1

SHEET NO. 42 OF 42

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Jul 25, 2017 1:38pm jason.jerrytone

APPENDIX L
TECHNICAL SPECIFICATIONS

PHASE 1A BANK MANAGEMENT AREAS (BMA)
SOUTH RIVER AREA OF CONCERN (AOC) 4

Project Specification and Contract Documents

Table of Contents

COMMONWEALTH OF VIRGINIA
WALTER J. DINICOLA
Lic. No. 052817
PROFESSIONAL ENGINEER
6/8/16

PHASE 1A BANK MANAGEMENT AREAS (BMA)
SOUTH RIVER AREA OF CONCERN (AOC) 4
Project Specification and Contract Documents
Table of Contents

END OF TABLE OF CONTENTS

DIVISION 00—PROCUREMENT AND CONTRACTING REQUIREMENTS

Section 00 31 32—Geotechnical Data

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Material Testing Information

a) Jones Hollow Property borrow material

2. Exploratory Excavation Information

a) Jones Hollow Property

1.02 RELATED WORK

A. Not used

1.03 DEFINITIONS

A. Acronym

1. DSR – DuPont Site Representative

1.04 REFERENCES

A. Not used

1.05 ADMINISTRATIVE REQUIREMENTS

A. Contractor may rely upon the accuracy of the “technical data” contained in the provided reports and Contract Drawings, but such reports and Contract Drawings are not Contract Documents.

B. Contractor may not rely upon or make any claim with respect to

1. The completeness of provided report and drawing for Contractor’s purposes, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs.

2. Other data, interpretations, opinions, and information contained in provided reports or shown or indicated in provided Contract Drawings.

3. Contractor interpretation of or conclusion drawn from any “technical data” or any such other data, interpretations, opinions, or information.

4. Utility locations

C. Promptly notify DSR in writing, before further disturbing the subsurface or physical conditions or performing any Work in connection therewith, about any subsurface or physical condition that is uncovered or revealed that Contractor believes

1. Is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely is materially inaccurate.

2. Is of such a nature as to require a change in the Contract Documents.

3. Differs materially from that shown or indicated in the Contract Documents.

4. Is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents.

D. Do not further disturb such condition or perform any work in connection therewith, except in an emergency, until receipt of written order to do so.

E. DSR's Review: After receipt of written notice, DSR will promptly review the pertinent condition, determine the necessity of DuPont's obtaining additional exploration or tests with respect thereto, and advise DuPont in writing (with a copy to Contractor) of DSR's findings and conclusions.

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

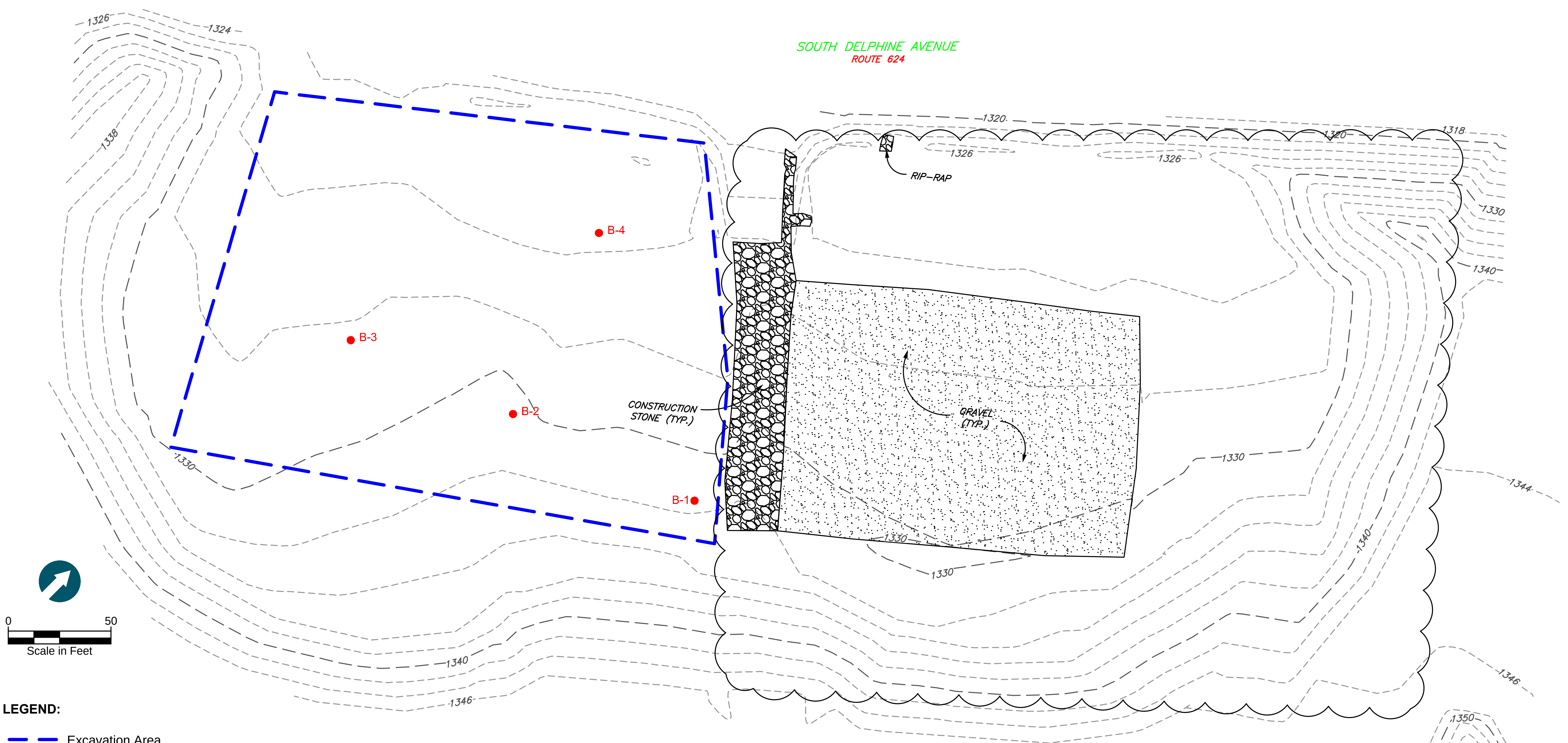
3.01 ATTACHMENTS

A. Jones Hollow Borrow Source Site Plan and Approximate Area of Potential Excavation Limits

B. Jones Hollow Geotechnical Test Data report completed April 2016

END OF SECTION

ATTACHMENT A
JONES HOLLOW BORROW SOURCE SITE PLAN AND APPROXIMATE AREA OF POTENTIAL EXCAVATION LIMITS



LEGEND:

Excavation Area

B-3 Soil Boring

Previously Restored Area (Approx.)

Existing Major Contour (5' Interval)

Existing Minor Contour (1' Interval)

SOURCE: As-built drawing provided by AECOM, February 25, 2016.
HORIZONTAL DATUM: VA State Plane North, NAD83, U.S. feet.
VERTICAL DATUM: North American Vertical Datum of 1988, U.S. feet.

NOTES:

1. Excavation shall only take place within the dashed area identified in this drawing. The contractor shall not excavate on the restored area to the east.
2. The contractor may propose to use the eastern area of the site for equipment and materials storage for the duration of the project if approved by the Owner and Engineer.

Apr 27, 2016 1:33pm epipkin K:\Projects\0952-DuPont\South River Phase 1 Interim Remedial Mea\0952-RP-020 Jones Hollow.dwg Figure X

ANCHOR QEA

Figure 1
Jones Hollow As-built
South River

ATTACHMENT B
JONES HOLLOW GEOTECHNICAL TEST DATA REPORT COMPLETED APRIL 2016

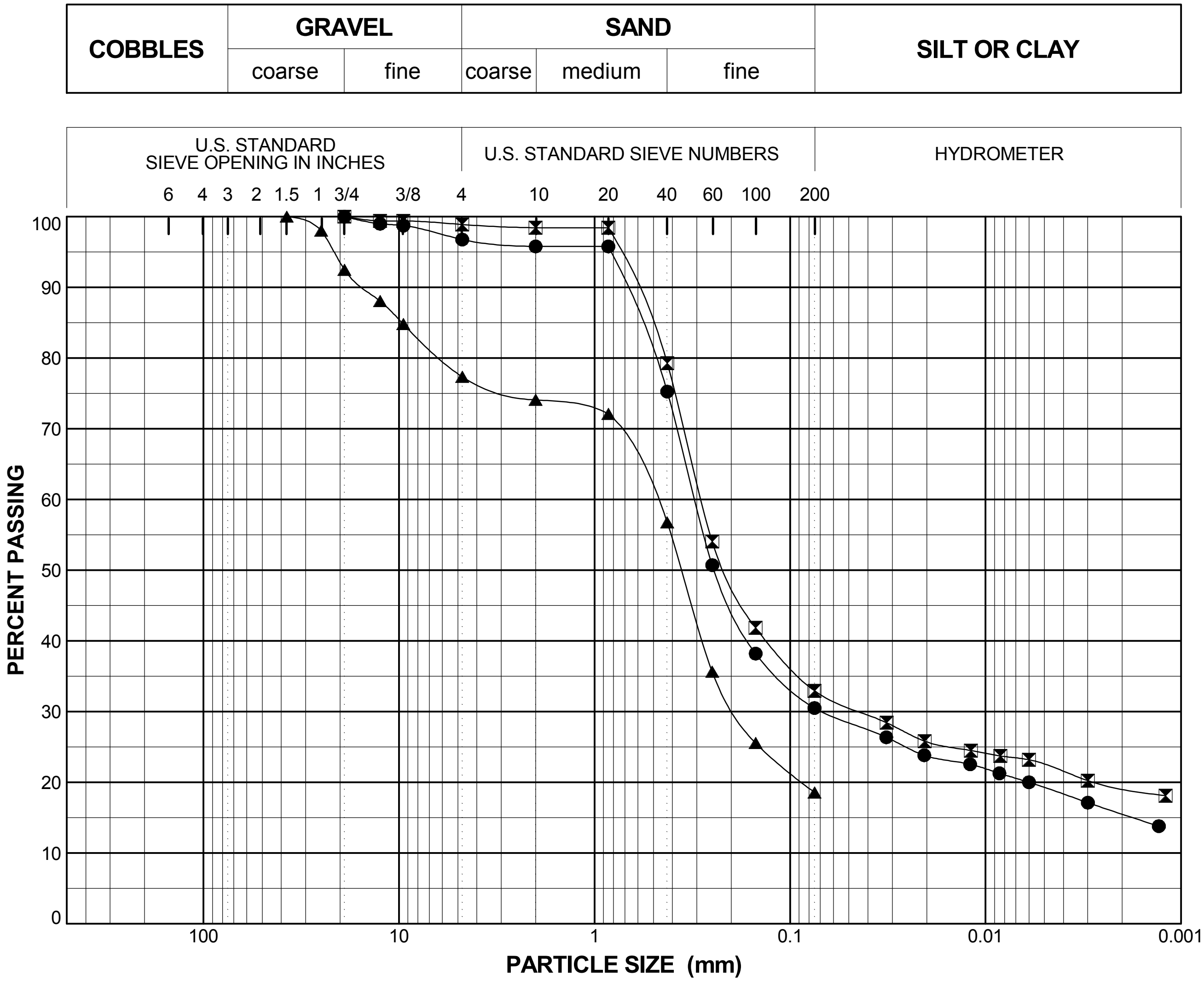
Project: South River: Jones Hollow
Project No.: 60390328

AECOM

SUMMARY OF LABORATORY TEST RESULTS

Boring and Sample Number	Depth (feet)	Classification	USCS Symbols	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits		Specific Gravity	Organic Content (%)	Grain Size		Compaction	Consolidation	Direct Shear	Analytical Results (ppm)			Unconfined Compression		Resistivity (Ohm-cm)	pH
						Liquid Limit	Plastic Limit			<#200 (%)	<2µ (%)				Chloride	Sulfate	Sulfide	Stress (psi)	Strain (%)		
B-1	0.0-12.0	Brown CLAYEY SAND	SC	15.4		27	18	2.69		31	16	*		*							6.2
B-2	0.0-12.0	Brown CLAYEY SAND	SC	18.1		29	17			33	19										
B-3	0.0-12.0	Brown SILTY SAND with GRAVEL	SM	12.9				2.68		19		*									
B-4	0.0-12.0	Brown SILTY SAND	SM	17.1						34											

* Refer to Laboratory Test Curves



SYMBOL	●	⧗	▲
Boring	B-1	B-2	B-3
Sample			
Spec			
Depth (in)	0.0-12.0	0.0-12.0	0.0-12.0
% +3"	0.0	0.0	0.0
% Gravel	3.2	1.1	22.7
% Sand	66.2	65.9	58.8
% Fines	30.5	32.9	18.6
% -2μ	15.5	19.3	
Cc			
Cu			
LL	27	29	
PL	18	17	
PI	9	12	
USCS	SC	SC	SM
w (%)	15.4	18.1	12.9

Particle Size (Sieve #)	PERCENT FINER ●	⧗	▲
2"			
1 1/2"			100.0
1"			98.0
3/4"	100.0	100.0	92.5
1/2"	99.0	99.4	88.1
3/8"	98.7	99.4	84.8
4	96.8	98.9	77.3
10	95.8	98.4	74.1
20	95.8	98.4	72.1
40	75.3	79.3	56.8
60	50.7	54.1	35.6
100	38.2	41.8	25.6
200	30.5	32.9	18.6

SYMBOL	DESCRIPTION AND REMARKS
●	Brown CLAYEY SAND (SC)
⧗	Brown CLAYEY SAND (SC)
▲	Brown SILTY SAND with GRAVEL (SM)

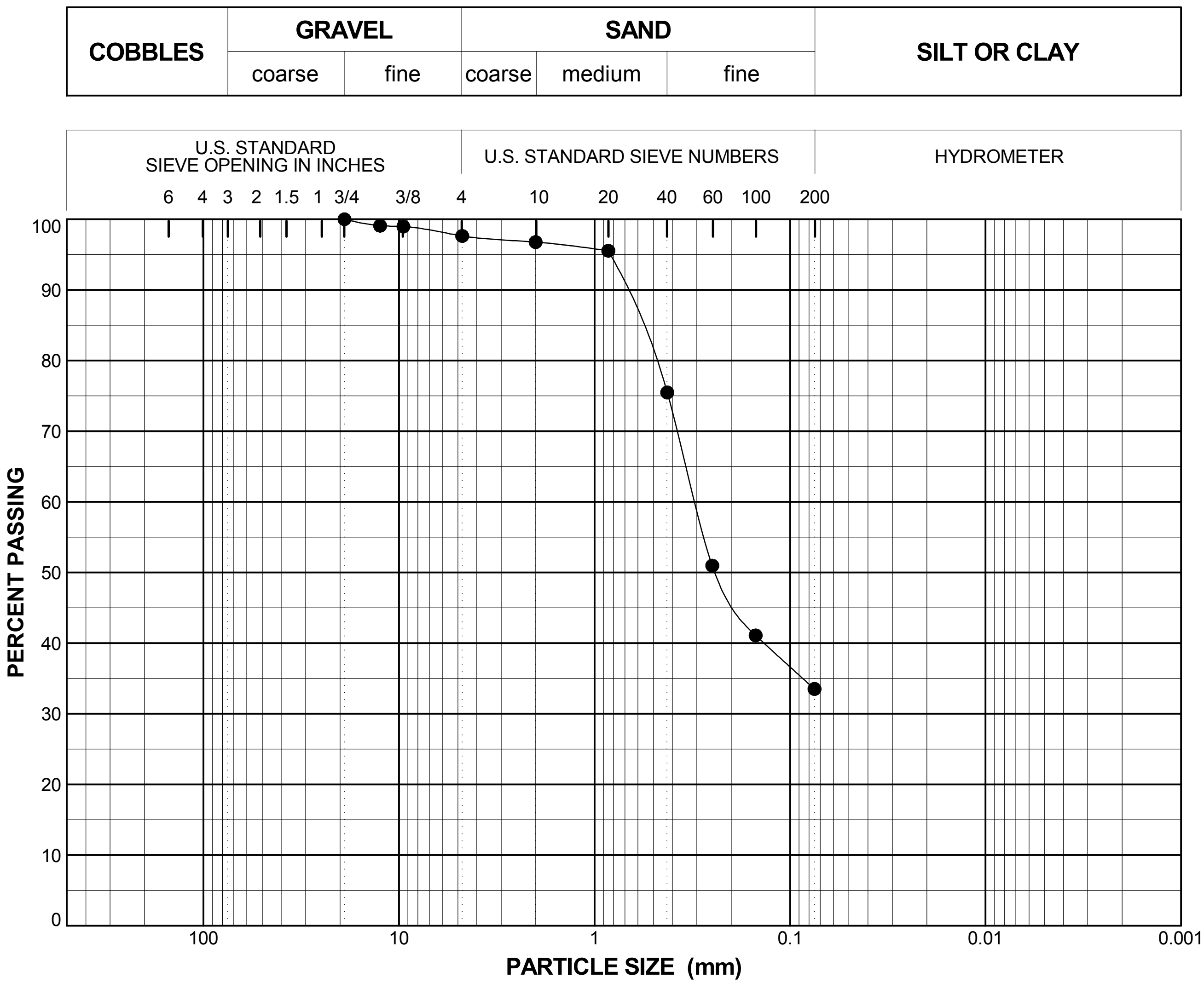
PARTICLE SIZE DISTRIBUTION

South River: Jones Hollow

Project Number 60390328	April 2016	Figure 1

AECOM

SIEVE_BLUEBELL_NEW 60390328_2016-03-11_SOUTH_RIVER_JONES_HOLLOW.GPJ URS_BLUE.GDT 4/18/16



SYMBOL	●		
Boring	B-4		
Sample			
Spec			
Depth (in)	0.0-12.0		
% +3"	0.0		
% Gravel	2.4		
% Sand	64.1		
% Fines	33.5		
% -2µ			
Cc			
Cu			
LL			
PL			
PI			
USCS	SM		
w (%)	17.1		

Particle Size (Sieve #)	PERCENT FINER		
	●		
2"			
1 1/2"			
1"			
3/4"	100.0		
1/2"	99.1		
3/8"	99.0		
4	97.6		
10	96.8		
20	95.5		
40	75.5		
60	51.0		
100	41.1		
200	33.5		

SYMBOL	DESCRIPTION AND REMARKS
●	Brown SILTY SAND (SM)

PARTICLE SIZE DISTRIBUTION

South River: Jones Hollow

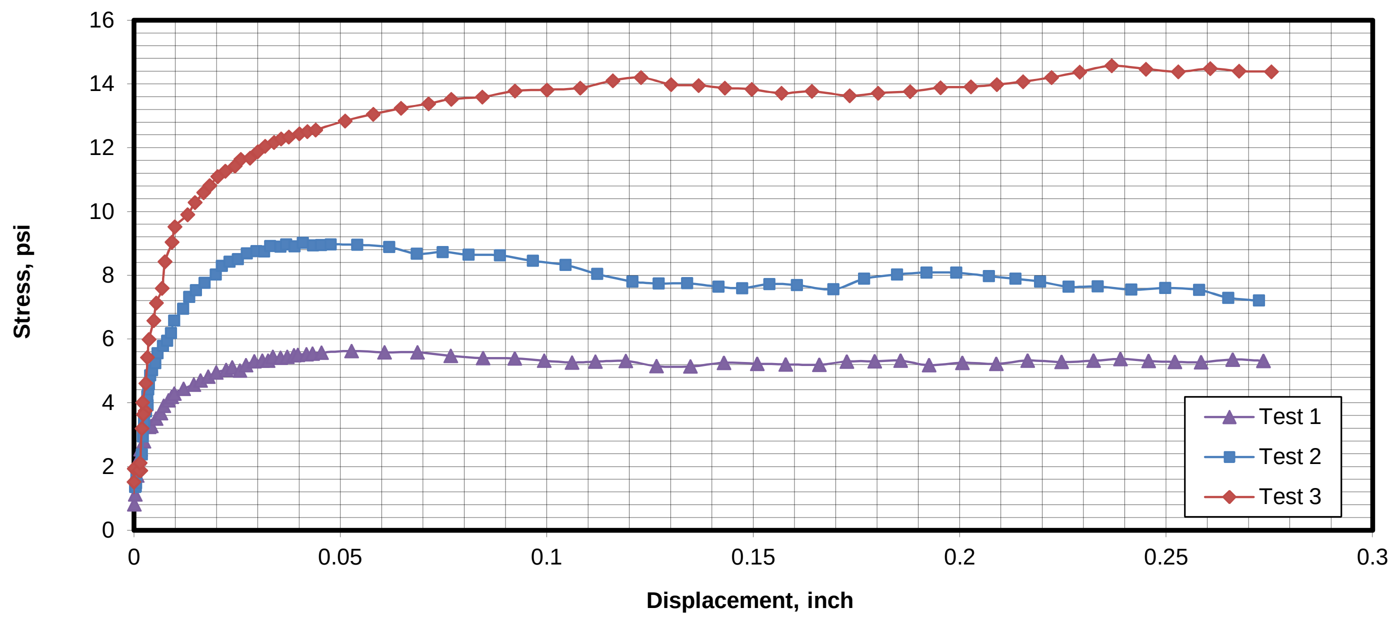
Project Number 60390328	April 2016	Figure 2

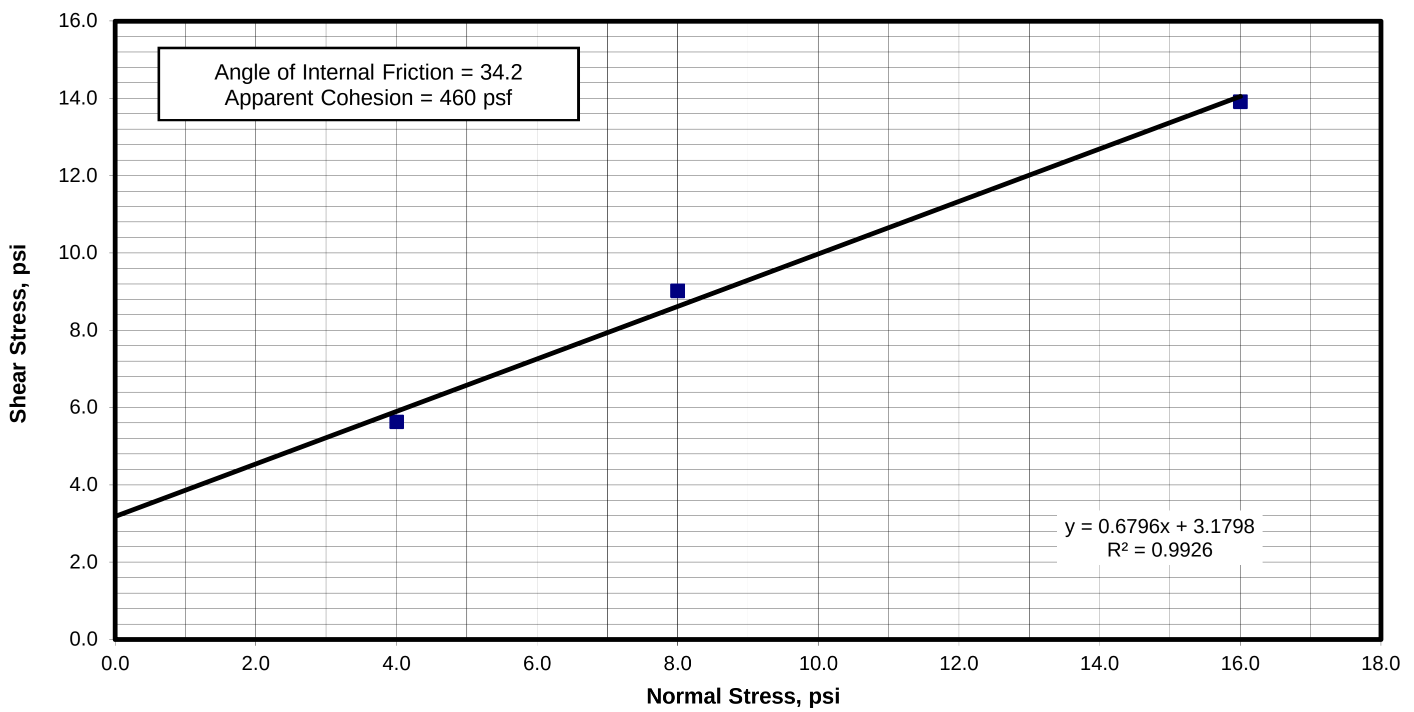
AECOM

SIEVE_BLUEBELL_NEW 60390328_2016-03-11_SOUTH_RIVER_JONES_HOLLOW.GPJ URS_BLUE.GDT 4/18/16

Direct Shear Test of Soils Under Consolidated Drained Condition (ASTM D 3080)

			Test No.	1	2	3	4
Project No.	60390328		Test No.	1	2	3	4
Project Name	South River: Jones Hollow		Initial Water Content, %	14.6	14.0	14.5	
Boring No.	B-1		Dry Density, pcf	111.4	111.5	111.5	
Sample No.	--		% Compaction	92.1	92.2	92.2	
Depth, ft.	0.0-12.0		Normal Stress, psi	4.0	8.0	16.0	
Liquid Limit	27		Initial Saturation, %	77.2	74.7	77.4	
Plastic Limit	18		Initial Void Ratio	0.507	0.506	0.506	
Plastic Index	9		Final Water Content, %	17.8	16.7	17.3	
Specific Gravity	2.69		Final Void Ratio	0.494	0.450	0.480	
Description	Brown CLAYEY SAND		Final Saturation, %	96.8	99.7	97.1	
Compaction Method (ASTM):		D1557	Maximum Peak Load, psi	5.63	9.02	13.92	
Maximum Dry Density g_d, pcf:		121.0	Displacement at Peak, inch	0.05	0.04	0.20	
Optimum Moisture Content, %:		11.1	Displacement rate, inch/min	0.0019	0.0019	0.0019	



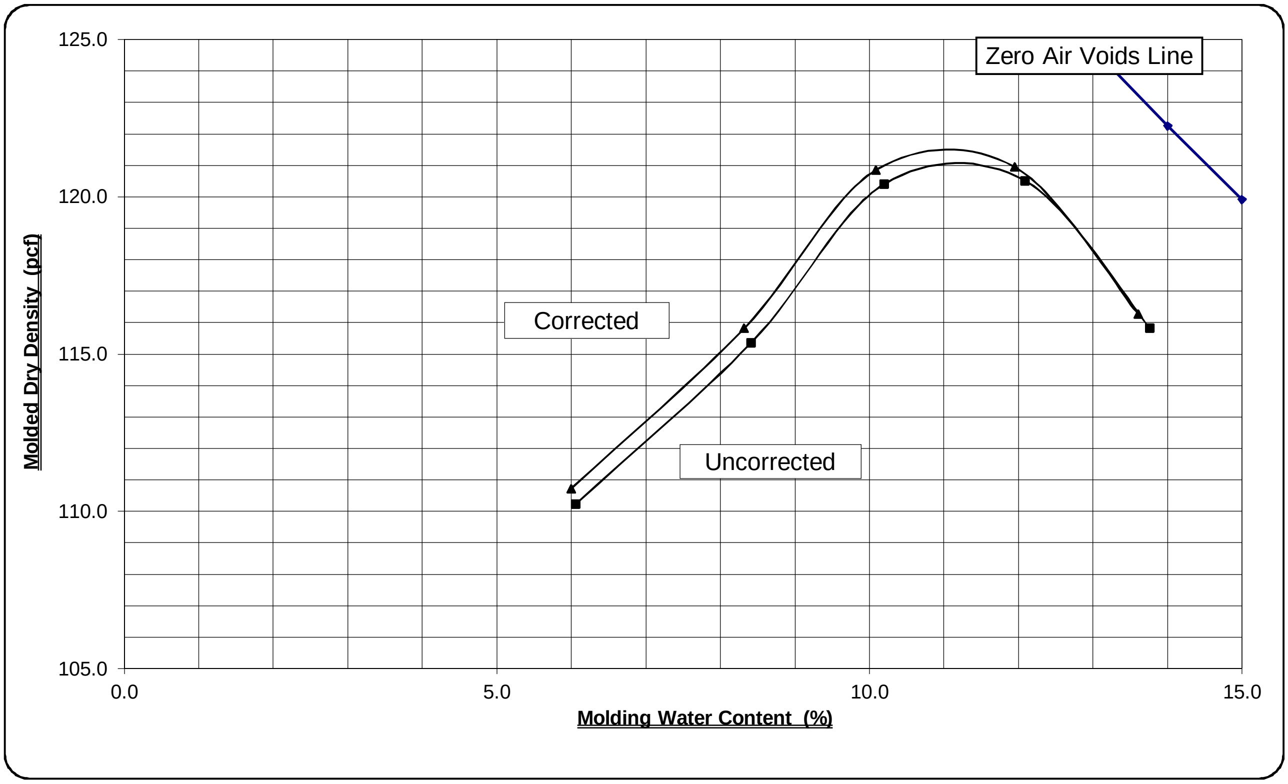


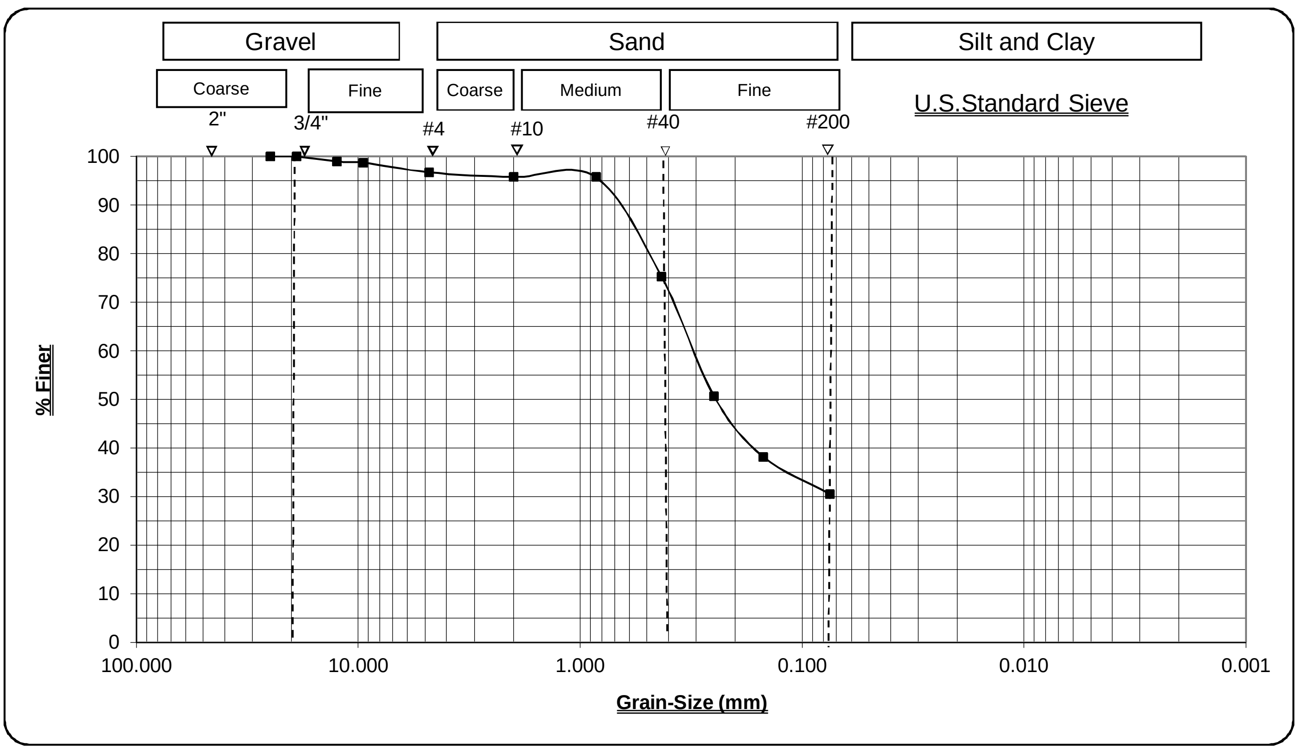
AECOM

Laboratory Compaction Characteristic of Soil Using Modified Effort (ASTM D 1557-07) Method B

Job No.	60390328	Date	18-Apr-16
File No.	2016-03-11	Assumed Specific Gravity (-10 Sieve Mat.)	2.70
Job Name:	South River: Jones Hollow	Assumed Specific Gravity (+#4 Sieve Mat.)	2.70
Sample	B-1 0.0-12.0'	Average Specific Gravity	2.70
Description	Brown CLAYEY SAND	Maximum Dry Density, pcf	121.0
Liquid Limit	27	Optimum Water Content, %	11.1
Plastic Limit	18	Corrected Max. Dry Density, pcf	121.4
Plastic Inde›	9	Corrected Optimum Water Content, %	11.0
As-Received Water Content,%	15.4		

\\URSFTWASHINGTON\FtWashington\Projects\Private-Sector\AGC\19994621\SoilsLab\3. Lab 2016_Projects\60390328_2016-03-11_South River Jones Hollow\Compaction\[compact_B-1_0-12.XLS]014C-1

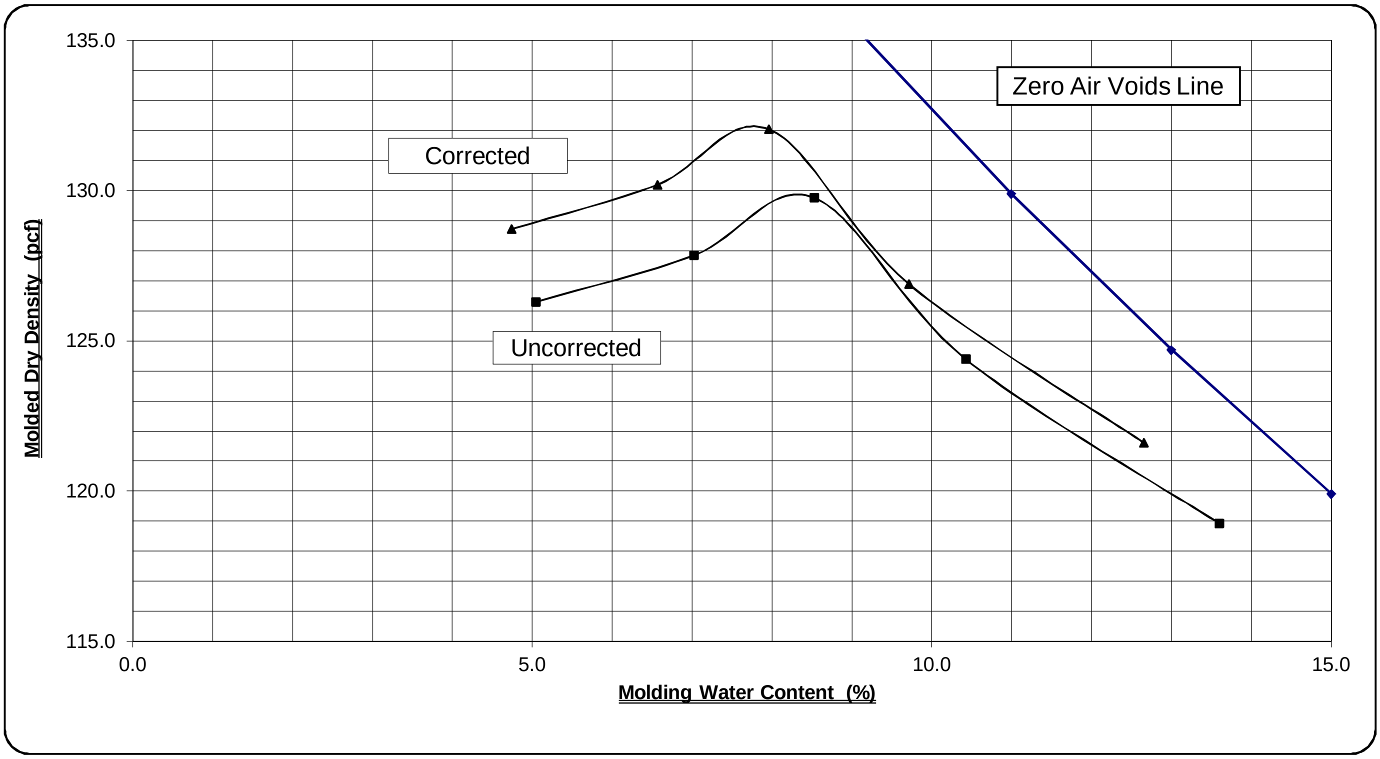


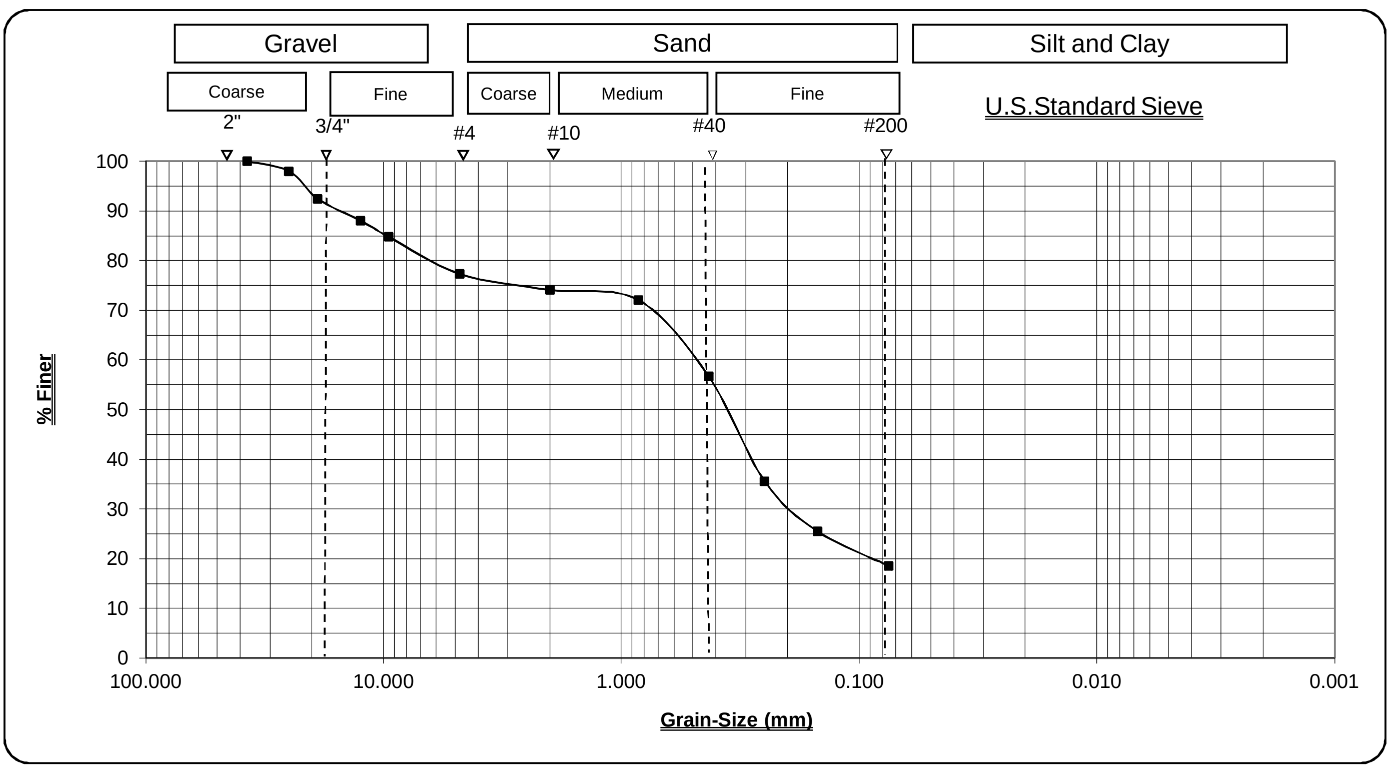


AECOM

Laboratory Compaction Characteristic of Soil Using Modified Effort (ASTM D 1557-07) Method C

Job No.	60390328	Date	18-Apr-16
File No.	2016-03-11	Assumed Specific Gravity (-10 Sieve Mat.)	2.70
Job Name:	South River: Jones Hollow	Assumed Specific Gravity (+#4 Sieve Mat.)	2.70
Boring No.:	B-3 0.0-12.0'	Average Specific Gravity	2.70
Description:	Brown SILTY SAND with GRAVEL	Maximum Dry Density, pcf	129.9
Liquid Limit:	NA	Optimum Water Content, %	8.3
Plastic Limit:	NA	Corrected Max. Dry Density, pcf	132.2
Plastic Index:	NA	Corrected Optimum Water Content, %	7.8
As-Received Water Content,%	12.9		
Ref. No.	\\URSFTWASHINGTON\FtWashington\Projects\Private-Sector\AGC\19994621\SoilsLab\3. Lab 2016_Projects\60390328_2016-03-11_South River Jones Hollow\Compaction\[compact_B-3_0-12.XLS]014C-1		





60390328.

2016-03-11

Laboratory Assignment Sheet

Assignment No.: 2016-03-11

Project Name: South River: Jones Hollow
Project Manager: Joshua Collins Reviewed By: MHD
Project Number: 60390328.18986308.01630

Date Received: 3/14/16
Date Completed By:

Boring No.	Sample No.	Depth ft.	Water Content, % ASTM D 2216	Atterberg Limits ASTM D 4318 Air Dried	Atterberg Limits ASTM D 4318 Oven Dried	Specific Gravity ASTM D 854	Specific Gravity ASTM D 127	Grain-Size ASTM D 422 Sieve	Grain-Size ASTM D 422 Hydro	Compaction Test ASTM D 698	Compaction Test ASTM D 1557	CBR Test ASTM D 1883	Permeability Test ASTM D 2434	Permeability Test ASTM D 5084	Consol. Test ASTM D 2435	CRS Test ASTM 4186	Triaxial Test Uc ASTM D 2216	Triaxial Test UU ASTM D 2850	Triaxial Test CIU ASTM D 4767	Direct Shear ASTM D 3080	pH	Organic Content, % ASTM D 2974	Other/ Remarks/ Confining Pressures
B-1		0-12'	/	/		/		/	/		/									/	/		@ 4,8,16 psi
B-2		0-12'	/	/				/	/														
B-3		0-12'	/			/		/			/												
B-4		0-12'	/					/															

Notes:

S:\Resources\Office_Dept Info\Soils_Lab\Lab Forms for Printing\Assignment\Assignment_Sheet

2016-03-11

DIVISION 01—GENERAL REQUIREMENTS

DIVISION 01—GENERAL REQUIREMENTS
Section 01 10 00—Summary of Work

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. A brief description of the major construction activities included under this Contract. Individual activities are more thoroughly described in subsequent sections of the Contract Specifications.

1.02 RELATED WORK

A. Section 02 01 00 – Maintenance of Existing Conditions

B. Section 02 51 00 – Equipment Decontamination and Screening

C. Section 02 60 00 – Contaminated Site Material Removal

D. Section 04 40 00 – Stone Assemblies for Public Access

E. Section 05 17 00 – Structure Connections

F. Section 06 13 43 – Large Woody Materials

G. Section 31 05 19 – Geosynthetics

H. Section 31 11 00 – Clearing and Grubbing

I. Section 31 12 00 – Selective Clearing

J. Section 31 23 00 – Earthwork and Fill

K. Section 31 25 00 – Erosion and Sedimentation Controls

L. Section 31 35 00 – Slope Protection

M. Section 31 37 00 – Stone Toe Protection

N. Section 31 52 00 – Temporary Cofferdams

O. Section 32 90 00 – Planting and Habitat Restoration

1.03 DEFINITIONS

A. Abbreviations and Acronyms

1. BMA – Bank Management Area

2. DSR – DuPont Site Representative

3. H:V – horizontal to vertical

4. SS – Supplemental Specifications

5. USACE – United States Army Corps of Engineers

6. VADEQ – Virginia Department of Environmental Quality

7. VDOT – Virginia Department of Transportation

8. VMRC – Virginia Marine Resources Commission

9. WWTP – Waste Water Treatment Plant

1.04 REFERENCES

A. VDOT Standard Specification Section 105.08.

B. VDOT 2007 Road and Bridge Supplemental Specifications (SS) Sections 105.14 and SS Section 512.03.

1.05 WORK COVERED BY CONTRACT DOCUMENTS

A. Location of Work

1. The work of this Contract is located on property owned by the City of Waynesboro and DuPont at the Constitution Park Bank Management Area (BMA) and on property owned by the City of Waynesboro at the Waste Water Treatment Plant (WWTP) BMAs. These sites are in Waynesboro, Virginia. A location map is provided on the cover of the Contract Drawings.

B. General Requirements

1. Provide equipment, labor, and materials to execute Work activities for final acceptance. Provide materials, equipment, and incidentals that are reasonably and properly inferable and necessary for the proper completion of the work, whether specifically indicated in the Contract documents or not.

2. Comply with federal, state, and local rules and regulations.

3. Notify proper federal, state, and local agencies of the nature and timing of Work on-site.

4. Obtain permits required to construct the work except for the following that will be obtained by DuPont.

    a) USACE Section 404 Permit – Nation Wide Permit <PERMIT NUMBER HAS NOT BEEN ASSIGNED BY USACE – WILL UPDATE WHEN AVAILABLE>

    b) USACE Section 401 Water Quality Permit

    c) VADEQ Virginia Water Protection Permit

    d) VMRC Permit for Sub-aqueous Encroachment

    e) City of Waynesboro Erosion and Sediment Control Plan/Permit

    f) City of Waynesboro Storm Water Discharge Permit

5. Obtain inspections required by jurisdictional officials.

6. Coordinate with jurisdictional transportation officials; coordinate traffic flow resulting from the work; and repair roads in compliance with the requirements of jurisdictional transportation officials. The Contractor shall submit a traffic control plan(s) showing a method of handling traffic including pedestrian and bicycle traffic. All construction signs, flaggers, spotters or other traffic control devices shall be shown on the traffic control plan(s) except for emergency situations. Traffic control plan(s) shall conform Virginia Department of Transportation (VDOT) Road and Bridge Specifications Section 105.14 and Section 512, and VDOT 2007 Road and Bridge Supplemental Specifications (SS) Sections 105.14 and SS Section 512.03.

7. Protect and maintain survey and grid stakes, existing monitoring wells, and Site structures against damage. Repair damage or replace in kind.

8. Protect utility lines and appurtenances that are to remain.

    a) Utility locations shown on the Contract Drawings are based on field geophysical survey and have not been field verified through potholing or using a vacuum truck.

    b) Locate and verify existing utilities through potholing or using a vacuum truck.

    c) Contact the national construction alert system for utilities at 811 prior to digging.

    d) Repair damage, except when utility is to be abandoned in place.

e) If utilities are temporarily modified by the Contractor, the Contractor is responsible for ensuring that the adjustment of utilities, consisting of the relocation, removal, replacement, rearrangement, reconstruction, improvement, disconnection, connection, shifting, or altering of an existing utility facility in any manner, shall be in accordance with VDOT Standard Specification Section 105.08.

9. Store and use materials and equipment in a safe manner and meet requirements of applicable codes.

10. Contract Drawings and Contract Specifications are intended to be used in conjunction with each other for instructing the Work to be performed by the Contractor. If the Contractor identifies a discrepancy between any of the Contract documents, they shall immediately notify the DuPont Site Representative (DSR). In general, the more stringent requirement shall take precedence.

C. Description of Work

1. Site Work

a) Construct and provide temporary erosion and sediment control structures prior to full-scale earth disturbance and earth-moving activities; maintain controls throughout construction; remove and dispose of controls at the specified time or at the end of the Contract Period, if a time is not specified; and establish vegetation throughout the disturbance area.

b) Construct, provide, operate, and maintain temporary stormwater-management structures, equipment, and materials during construction.

c) Clear and grub disturbance areas and perform selective clearing as noted on the Contract Drawings. Remove fence at the WWTP to accommodate construction as approved by the DSR. Stockpile trees identified for reuse as noted in Section 06 13 43 – Large Woody Materials and Section 32 90 00 – Planting and Habitat Restoration.

d) Excavate material from the designated “bank removal areas” indicated on the Contract Drawings. Consolidate and export the contaminated material to the identified disposal site(s) in accordance with Section 02 60 00 – Contaminated Site Material Removal.

e) Grade excavated areas to obtain slopes that are no steeper than indicated on the Contract Drawings.

f) Excavate, load, transport, and offload soil from the Jones Hollow Property. Manage borrow source operations and maintain slopes that are no steeper than 3H:1V.

g) Construct temporary surface access roads.

h) Construct stone toe as indicated on the Contract Drawings. Maintain the finished slope of stone toe no steeper than 1.5H:1V.

i) Construct the excavated bank with geotextile layer, geocell system for blended biochar stabilization, backfill material, and planting substrate material. Maintain finished slope no steeper than 2H:1V and the finished top of the bank reach the elevation indicated on Contract Drawings.

j) In bank stabilization areas, install geocell system on bank face for blended biochar and planting substrate stabilization. Place blended biochar material and planting substrate material into geocell system. Place erosion control fabric on top of the planting substrate. Install coir logs at the toe of the bank as shown on Contract Drawings.

k) Pant live stakes, trees, and shrubs as indicated on Contract Drawings.

2. Restoration and Landscaping

a) Restore vegetated areas disturbed by construction operations at the Waste Water Treatment Plant A, Waste Water Treatment Plant B, Constitution Park, and Jones Hollow Property sites.

b) Repair or replace damaged paved surfaces and structures.

c) Reinstall fences, posts, and poles.

D. Incidental Work

1. Temporary Site Facilities – Provide and maintain temporary Site facilities, including offices, staging areas, Contractor security and communication operations, personnel and equipment cleaning facilities, and project signs throughout Contract Period.

2. Temporary Site Utilities – Provide, operate, and maintain temporary Site utilities, including telephone, electricity, water, and sanitation to the temporary Site facilities throughout Contract Period.

3. Plan Submittal – Develop, implement, and revise required Contractor plans.

4. Quality Control – Implement the Contractor's quality control program.

5. Safety – Provide, operate, and maintain required personnel, Site safety officer, supplies, materials, and equipment to implement the project Health and Safety Plan.

6. Waste Management – Provide, operate, and maintain required personnel, supplies, materials, and equipment to manage Contractor generated waste and sediment filter bags during the Contract Period. Equipment decontamination shall be in accordance with Section 02 51 00 – Equipment Decontamination and Screening.

7. Project Documentation – Provide required documentation of the work, including construction activities, health and safety activities, quality control activities, field engineering activities, and preparation of record survey and documents.

8. Project Closeout – Clean and remove Contractor equipment, remove temporary construction facilities, disconnect temporary utilities, and transfer records, drawings, and other project-related material to the DSR.

1.06 WORK BY DUPONT

A. No work will be furnished or provided by DuPont.

1.07 PROJECT UTILITY SOURCES

A. Utilities are not available within the work area.

B. Obtain permission from the DSR and the local utility company, and provide utility connections for Contractor's use.

1.08 WORK RESTRICTIONS

A. Access to Site

1. Limit Site access to

a) Contractor employees directly involved with the work

b) Deliveries required to complete the work

c) DuPont and City of Waynesboro, personnel

d) DuPont Corporate Remediation Group or other DuPont personnel approved by the DSR

e) Regulatory Agencies

f) Visitors approved by the DSR

2. Personnel entering the Site must receive the appropriate level of orientation prior to entrance. Visitors must be escorted continuously.

3. Time Restrictions for Performing Work

a) Construction activity will be limited to 9.5 hours per day between 7:00 a.m. and 4:30 p.m. Do not conduct work overnight, unless otherwise approved by the DSR.

b) Do not conduct work on Saturdays, Sundays or Holidays unless written approval is provided by the DSR. Contractor may propose Saturday Work in their bid for consideration by the DSR.

c) Requests to perform Work outside of these hours must be provided with a minimum of 48 hours advanced written notice to the DSR.

B. Coordination with Occupants

1. Coordinate with property owner occupants at the Site.

2. Cooperate with DuPont to minimize conflict and to facilitate the property owner occupants. Coordinate activities with DuPont and their authorized representatives.

3. Secure the Site to protect the public from construction activities.

C. Use of Site

1. Contractor will not have complete and exclusive use of the Site for execution of the Work. Share the Site with DuPont property owner occupants, and their authorized representatives, including the DSR, and regulatory authorities who have received prior approval for Site entrance by DuPont.

2. Limit construction operations to the indicated Limit of Disturbance noted on the Contract Drawings.

3. Obtain DSR approval of temporary Site facility, staging and laydown area, and office facility locations prior to using the Site.

4. No construction activity will be allowed until the Contractor's submittals for that activity have been accepted by the DSR as required by the individual sections of these Contract Specifications.

5. Assume full responsibility for the protection and safekeeping of equipment and materials located on-site.

6. Assume full responsibility for the health and safety of on-site personnel under Contractor's control.

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

A. Not used

END OF SECTION

DIVISION 01—GENERAL REQUIREMENTS
Section 01 14 00—Work Restrictions

PART 1 – GENERAL

1.01 SUMMARY

A. Not used

1.02 RELATED WORK

A. The provisions and intent of the Contract, including the Procurement and Contracting Requirements, the Standard Provisions, and General Conditions, apply to this Work as if specified in this Section. Work related to this Section is described throughout the Contract Specifications.

B. Section 01 32 00 – Construction Progress Documentation

C. Section 01 41 26 – Permits

D. Section 01 40 00 – Quality Requirements

1.03 DEFINITIONS

A. Acronym

1. DSR – DuPont Site Representative

1.04 REFERENCES

A. Not used

1.05 USE OF PREMISES

A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of Site beyond areas in which the work is indicated. Disturbance outside the Project limits (as shown on the Contract Drawings) is only to designated access points and storage areas as shown on the Contract Drawings or specified herein.

1. Limits: Confine construction operations to limits as shown on the Contract Drawings. In those locations where existing vegetation is to remain, the Contractor must work around and protect the material from damage.

2. Public Access and Use: Public use of the Site shall be restricted.

3. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to the property Owner, the property owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

a) Schedule deliveries to minimize use of driveways and entrances.

b) Schedule deliveries to minimize space and time requirements or storage of materials and equipment on-site.

4. Move any stored products, under Contractor's control, that interfere with the operations of the property Owner or access to adjacent properties.

5. Stormwater outfalls, shoreline below ordinary high water, and other areas (as designated by the DSR) that release directly into the river shall be protected from impacts due to water runoff or soil migration (excavated material or import) resulting from construction activities.

B. Surround project site with highly visible fencing prior to the start of the work.

1.06 STAGING AREAS

A. Staging areas are limited to within the project limits shown on the Contract Drawings, and an additional area is located on eastern side of the Jones Hollow Property. Contractor's use of these areas shall be limited to purposes directly related to the construction of this Project. Prior to mobilization, Contractor shall submit a proposal at the Pre-Construction Meeting for review by the owner of these (and other) areas indicating specific use, access, restoration, and anticipated duration of use. No use of these areas is permitted until DuPont provides written approval of Contractor's proposal.

B. Contractor may provide legal staging and storage areas off-site for stockpiling and storing non-hazardous materials at Contractor’s discretion. Provide the DuPont Site Representative (DSR) with locations for approval. Protect downstream areas by covering or otherwise containing stockpiles of loose materials. Provide DuPont with a release from property owner that states the Site was returned in an acceptable condition and all obligations associated with its use have been met.

1.07 RESTORATION CLAUSE

A. Restore all areas disturbed by the construction process. All ingress or egress points that are disturbed shall be regraded, reseeded, replanted, or repaved to restore them to original or better conditions.

B. Unless otherwise designated, protect all existing Site features to remain from potential Contractor damage above and below grade. If unavoidable damage occurs, notify the DSR immediately and a decision will be rendered as to how the Contractor is to replace or repair the damage, at the Contractor's expense.

1.08 EQUIPMENT STANDARDS

A. All equipment furnished and/or installed under this Contract shall meet safety requirements of all applicable codes.

1.09 PARKING

A. Parking for personnel on the work will be limited to areas within the project limits shown on the Contract Documents, the Jones Hollow Property, or at other off-site locations arranged by the Contractor. The Contractor can obtain additional off-site parking, material stockpiling, and storage with the approval of DSR. The Contractor will be responsible for ensuring that no nuisance is created for the DSR or adjacent properties through use of the streets for parking or workers access.

1.10 TRUCK AND EQUIPMENT ACCESS

A. To avoid traffic conflict with local residents, and to avoid overloading of streets and driveways elsewhere on City of Waynesboro property, limit the access of trucks and equipment to the designated haul routes and access points as shown on the attached Truck Route Plan (Attachments 1 through 3) and the Contract Drawings.

B. Vehicular traffic is limited to area within the Project limits except areas designated for access.

1.11 WORK HOURS

A. Contractor shall submit a schedule of working hours to the DSR at the Pre-construction Meeting for acceptance prior to the start of any work on the Site. The schedule of working hours submitted by the Contractor shall comply with the maximum allowable working hours set by the City of Waynesboro. The Contractor shall not perform any activities outside of these hours without prior approval of the DSR. Said approval from the DSR shall be requested no later than 48 hours prior to the proposed work outside of these hours.

1.12 COORDINATION WITH OTHER CONTRACTORS

A. Work in the Constitution Park BMA may coincide with the City's Greenway expansion. Contractor shall coordinate with the City's Greenway contractor for work within Constitution Park to avoid conflicts that may be caused by working in the same area.

B. Work in the Constitution Park BMA may also coincide with ongoing construction by the Virginia Department of Transportation (VDOT) at the Main Street Bridge. Contractor shall coordinate work with VDOT to minimize interference.

1.13 PERMIT RESTRICTIONS AND REGULATORY REQUIREMENTS

Contractor shall comply with all conditions in approved permits found in Appendix B – Permits, and subsequently obtained by the DSR and Contractor. See Section 01 41 26 – Permits, and Section 01 40 00 – Quality Requirements.

1.14 JONES HOLLOW PROPERTY

A. The Jones Hollow Property shall be used as a staging and stockpiling area by the Contractor for construction of the Work. Stockpiling shall only be of non-contaminated materials imported for the Project or excavated within the limits of the Jones Hollow Property, and shall not consist of any materials removed from the Project sites prior to restoration.

1.15 SEQUENCING

A. The Contractor shall sequence the work so that exposed areas with loose uncovered soils are minimized.

B. See Section 01 32 00 – Construction Progress Documentation, for additional discussion of proposed construction sequencing.

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

A. Not used

END OF SECTION

ATTACHMENTS

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ANCHOR QEA

Attachment I
Truck Route Overview
Section 01 14 00 – Work Restrictions

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ANCHOR QEA

Attachment II
Truck Route at Constitution Park
Section 01 14 00 – Work Restrictions

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ANCHOR QEA

Attachment III
Truck Route at Waste Water Treatment Plant
Section 01 14 00 – Work Restrictions

DIVISION 01—GENERAL REQUIREMENTS
Section 01 25 00—Substitution Procedures

PART 1 – GENERAL

1.01 SUMMARY

A. This Section describes the procedures that must be followed for the Contractor to make any substitution to the materials, equipment or methods shown on the Contract Drawings or stated in the Contract Specifications

1.02 RELATED WORK

A. The provisions and intent of the Contract, including the Procurement and Contracting Requirements, the Standard Provisions, and General Conditions, apply to this Work as if specified in this Section. Work related to this Section is described throughout the Contract Specifications.

B. Section 01 33 00 – Submittal Procedures

1.03 DEFINITIONS

A. Acronym

1. DSR – DuPont Site Representative

1.04 REFERENCES

A. Not used

1.05 QUALITY ASSURANCE

A. Contract is based upon products and standards established in Contract Documents without consideration of proposed substitutions.

B. Products specified define standard of quality, type, function, dimension, appearance, and performance required.

C. The DSR will consider proposals for substitutions of materials, equipment, and methods only when such proposals are accompanied by full and complete technical data as required by the DSR to evaluate the proposed substitution.

D. Do not substitute materials, equipment, or methods unless such substitution has been specifically approved in writing for this Work by the DSR.

E. Do not substitute products unless substitution has been accepted and approved in writing by the DSR.

1.06 TIME OF SUBSTITUTION REQUESTS

A. Requests for substitutions must be made during the bidding period. Written requests by prime bidders for substitutions may be considered if received by the DSR at least 14 calendar days prior to the bid submittal deadline. The DSR may, in its sole discretion, defer the consideration of a proposed substitution until after Contract award. Use Substitution Request Form attached to this Section.

B. Each substitution request shall, in accordance with the applicable provisions of Section 01 33 00 – Submittal Procedures, describe the proposed substitution in its entirety including the name of the material or equipment, drawings, catalog cuts, performance or test data and all other information required for an evaluation. The submittal shall also include a statement noting all changes required in adjoining, dependent, or other interrelated Work necessitated by the incorporation of the proposed substitution. The bidder shall bear the burden of proof to show that the proposed substitution meets or exceeds the required function and is equal or superior to the Contract Specification.

C. The DSR may require that samples be submitted or demonstration made prior to approval. The DSR’s decision of approval or disapproval of a proposed substitution shall be final.

D. Approval of substitutions will be made by addenda. When, in the sole opinion of the DSR, the product is equivalent, in all respects to the product specified it will be approved subject to Contract requirements and the Contractor's assumption of all responsibility therefore.

E. After written approval, this submission shall become a part of the Contract, and may not be deviated from except upon written approval of the DSR.

F. Catalog data for equipment approved by the DSR does not in any case supersede the Contract Documents. The approval by the DSR shall not relieve the Contractor from responsibility for deviations from Contract Drawings or Contract Specifications, unless the Contractor has, in writing, called the DSR's attention to such deviations at the time of the submission, nor shall it relieve the Contractor from responsibility for errors of any sort in the items submitted. The Contractor shall check the Work described by the catalog data with the Contract Documents for deviations and errors.

G. It shall be the responsibility of the Contractor to insure that items to be furnished fit the space available. The Contractor shall make necessary field measurements to ascertain space requirements, including those for connections and shall order such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the Contract Drawings and Contract Specifications.

H. Where equipment requiring different arrangement of connections from those shown as approved is used, it shall be the responsibility of the Contractor to install the equipment to operate properly, and in harmony with the intent on the Contract Drawings and Contract Specifications, and to make all changes in the Work required by the different arrangement of connections together with any cost of redesign necessitated thereby, all at the Contractor's expense.

I. Where the phrase "or equal" or "or equal as approved by the DSR" occurs in the Contract Documents, do not assume that material, equipment, or methods will be approved as equal by the DSR unless the item has specifically been approved as a substitution for this work by the DSR.

J. The decision of the DSR shall be final.

1.07 SUBSTITUTION PROCEDURES

A. Limit each request to one proposed substitution.

B. Submit substitution requests on required form complete with attachments necessary to fully document proposed substitution. Submit in number of copies required for the Contractor's use and distribution, plus one copy to be retained by DSR, as applicable.

C. Document each request with supporting data substantiating compliance of proposed substitution with Contract Documents, including

1. Manufacturer's name and address, product, trade name, model, or catalog number, performance and test data, and reference standards.

2. Itemized point-by-point comparison of proposed substitution with specified product, listing variations in quality, performance and other pertinent characteristics.

3. Reference to article and paragraph numbers in Contract Specifications Section.

4. Cost data comparing proposed substitution with specified product and amount of net change to Contract Sum.

5. Changes required in other work.

6. Availability of maintenance service and source of replacement parts, as applicable.

7. Certified test data to show compliance with performance characteristics specified.

8. Samples, when applicable or requested.

9. Other information as necessary to assist the DSR's evaluations.

D. A request for substitution constitutes a representation that the Contractor

1. Has investigated proposed product and determined that it is equal or superior in all respects to specified product.

2. Will provide identical or better warranty as required for specified product.

3. Will coordinate installation and make changes to other work which may be required.

4. Waives claims for additional costs or time extension which may subsequently become apparent.

5. Certifies that proposed product will not affect or delay Construction Progress Schedule.

6. Will pay for changes to the engineering design, detailing, and construction costs caused by the requested substitution.

E. Substitutions will not be considered when

1. Indicated or implied on shop drawings or product data submittals without formal request submitted in accordance with this Section.

2. Submittal for substitution request has not been reviewed and approved by the DSR.

3. Acceptance will require substantial revision of Contract Documents or other items of the work.

4. Submittal for substitution request does not include point-by-point comparison of proposed substitution with specified product.

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

A. Not used

END OF SECTION

SUBSTITUTION REQUEST FORM

Contractor:______________________________________ Project: South River Phase 1A Bank Management Areas   Note: Limit this Request to One Proposed Substitution.

To: Engineer   Date: _________________   Request No.:_____________________________

From: ________ Contractor ________ Subcontractor ________ Supplier ________ Manufacturer

Specified Item: Section: ______________ Page:_____________ Paragraph:_______________

Proposed Substitution:

Manufacturer:___________________ Address:____________________ Phone No.:_______________

Trade Name:____ Model No.:_________________

Installer:_______________________ Address:____________________ Phone No.:_______________

History:____ New Product ____ 2 to 5 years old ____ 5 to 10 years old ____ More than 10 years old

Differences between proposed substitution and specified product:

____

Point-by-point comparison data attached - REQUIRED BY ENGINEER

Similar Installations:

Project:__________________________________ Engineer:__________________________

Address:_________________________________ Owner:_____________________________

_________________________________ Date Installed:______________________

Project:__________________________________ Engineer:__________________________

Address:_________________________________ Owner:_____________________________

_________________________________ Date Installed:_______________________

Proposed substitution affects other parts of work: _____ No _____ Yes; Explain

____

____

Proposed substitution changes Contract Time: _____ No _____ Yes; Add/Deduct _______ Days

Supporting Data Attached: __ Product Data __ Drawings __ Tests __ Reports __ Samples __ Other

Reason for Not Providing Specified Item, (N/A for substitutions during bidding)   ___ Unavailability ___ Unsuitability ___ Regulatory Changes ___ Owner Request

Savings to Owner for accepting substitution (N/A for substitutions during bidding): $_____________

Undersigned certifies:

1. Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
2. Same warranty will be furnished for proposed substitution as for specified product.

3. Same maintenance service and source of replacement parts, as applicable, is available.
4. Proposed substitution will not affect or delay Construction Progress Schedule.
5. Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
6. Proposed substitution does not affect dimensions and functional clearances.
7. Payment will be made for changes to building design, including engineering design, detailing, and construction costs caused by the requested substitution.
8. Coordination, installation, and changes in the work as necessary for accepted substitution will be complete in all respects.

(Note during bidding must be signed and submitted by Bidder)

Submitted By: ____

Signature: ____

Firm: ____

Address: ____

Telephone No: ____________________ Email Address: ___________________________________

Attachments:____

DESIGN ENGINEER'S REVIEW AND ACTION

____ Approve Substitution - Make submittals in accordance with Specification Section 01 33 00.

____ Approve Substitution as noted - Make submittals in accordance with Specification Section 01 33 00.

____ Reject Substitution - Use specified products. Engineer shall not have responsibility for performance of substitution approved by Owner and rejected by Engineer.

____ Substitution Request received too late - Use specified products.

Signed by:____

Comments:____

OWNER'S REVIEW AND ACTION (Approval of Substitution is not valid without Owner's signature)

____ Substitution approved - Make submittals in accordance with Specification Section 01 33 00.

____ Substitution approved as noted - Make submittals in accordance with Specification Section 01 33 00.

____ Substitution rejected - Use specified products.

Signed by: ____

Comments:____

DIVISION 01—GENERAL REQUIREMENTS
Section 01 29 00—Payment Procedures

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. The measurement and payment criteria applicable to portions of the work performed under a lump sum and unit price payment method.

2. Lump sum schedule payment items.

3. Unit price schedule payment items for changes in scope of work.

B. Include in the contract price on the Bid Form full compensation for the labor, materials, tools, equipment, and incidentals necessary to complete the work as shown on the Contract Drawings and specified in the Contract Documents.

C. Include in the contract price an amount adequate to cover the Contractor's indirect costs, including, but not limited to, applicable taxes, insurance fees, management and Site supervision, overhead and profit for each separately identified item.

D. Coordination

1. Contractor is authorized to take measurements and compute quantities.

2. Coordinate with the DuPont Site Representative (DSR) prior to performing work to verify measurements taken and quantities computed by the Contractor as basis for computing values for progress payments under a lump sum payment method.

3. The authority of the DSR to assess defects in the work is final. Replace the work and portions of the work not conforming to specified requirements.

1.02 RELATED WORK

A. Section 00 21 13 – Instruction to Bidders

B. Section 00 31 32 –Geotechnical Data (Jones Hollow) – Attachment 1

C. Section 01 10 00 – Summary of Work

D. Section 01 33 00 – Submittal Procedures

E. Section 05 17 00 – Structure Connections

F. Section 31 37 00 – Stone Toe Protection

G. Section 31 35 00 – Slope Protection

H. Section 32 90 00—Planting and Habitat Restoration

I. Section 31 23 00 – Earthwork and Fill

J. Related Documents

1. The provisions and intent of the Contract, including the Bid Proposal Form, General Conditions, Supplementary Conditions, and General Requirements, apply to this work as if specified in this Section.

1.03 DEFINITIONS

A. Acronyms

1. DSR – DuPont Site Representative

2. HASP – Health and Safety Plan

3. PSA – Personnel Support Activity

1.04 REFERENCES

A. Waste Management Plan – Appendix C

1.05 MEASUREMENT AND PAYMENT

A. Lump Sum Payment Items

1. Payment items for the work of this contract for which contract lump sum payments will be made are listed on the Bid Form and described below. Include costs for items of work that are not specifically mentioned to be included in a particular lump sum or unit price payment item in the listed lump sum item most closely associated with the work involved. The lump sum price and payment made for each item listed constitutes full compensation for furnishing plant, labor, materials, and equipment, and performing associated Contractor quality control, environmental protection, meeting safety requirements, tests and reports, and for performing work required for which separate payment is not otherwise provided.

2. Pay Item 1 – General Requirements

a) Work Included

1) Project Management and Coordination: Providing Project management and Site supervision, providing representation

at and coordinating Project meetings, and participating in safety audits.

2) Construction Progress Documentation: Providing Project schedules, submittal schedules, submittals, equipment delivery schedules, and construction progress reporting.

3) Health, Safety, and Emergency Response Procedures: Developing and executing the Health and Safety Plan (HASP) and Overhead and Underground Obstructions Plan, submitting safety data forms, executing and reporting health and safety activities, providing health and safety staff, personal protective equipment, traffic control and protection, and work zone control.

4) Environmental Protection Procedures: Developing the pre-construction condition survey and implementing environmental protection requirements, spill and discharge response procedures, and corrective action procedures.

5) Quality Requirements: Providing quality control staff and developing and implementing the Contractor’s Quality Control Plan.

6) Temporary Facilities and Controls: Providing temporary construction facilities and utilities, protocol for restricting public access to the Site and security for Contractor’s assets and construction materials.

7) Examination and Preparation: Mobilization, inspecting existing conditions, construction layout, field survey and engineering, and subsurface utility location and identification.

8) Site Maintenance and Final Cleaning: Routine and final cleaning of the Site and maintaining construction facilities.

9) Closeout Procedures: Completing punch-out inspection, pre-final inspection, final inspection, and demobilization.

10) Closeout Submittals: Preparing and submitting record documents and executing warranties.

b) Payment: Progress basis in accordance with the submitted Schedule of Values and acceptance by the DSR of the percentage of the work completed.

3. Pay Item 2 – Temporary Erosion, Stormwater, and Sediment Control Measures

   a) Work Included: Procurement (initial and replacement materials), placing, constructing, inspecting, maintaining through Final Acceptance of work, and removing and disposing of temporary sediment traps, silt fence, construction access and stabilized entrances, tire wash, inlet protection, temporary seeding, and other temporary stormwater, erosion and sediment control structures shown on the Contract Drawings.

   b) Payment: Based on the submitted Schedule of Values for completion ofthe installation and removal of the erosion and sediment control measures as determined by the DSR with 80 percent of the payment to follow completion and acceptance of the installation and 20 percent to follow the completion and acceptance of the removal.

4. Pay Item 3 – Planting and Habitat Restoration

   a) Work Included: Procure, prepare, place, and grade Planting Substrate and Biochar Blend in Bank Stabilization Areas, fertilize, mulch, and seed disturbed areas; procure and install foundation base layer, stepping stones and viewing platform, limestone boulders, coir logs and erosion control fabric, procure and plant trees and shrubs where indicated on the Contract Drawings and in accordance Section 31 35 00 – Slope Protection, Section 04 40 00 – Stone Assemblies for Public Access, 32 90 00 – Planting and Habitat Restoration, and any other related Contract Specifications.

   b) Payment: Progress basis in accordance with the submitted Schedule of Values and acceptance by the DSR of the percentage of the work completed.

B. Indirect Costs

Include contract requirements not directly associated with specific work items in the contract price.

1. Installation Indirect Costs

   a) Permits, plans, and associated work products

   b) Quantity Variations

      1) Waste, overlaps, damaged materials, repairs, or materials used for the convenience of the Contractor

2. Product Indirect Costs

   a) Air and weather monitoring equipment

   b) Dust control, odor control, vector control, and traffic control

   c) Collection and disposal of sanitary sewage and construction wastes

   d) Required trailers and supplies

   e) Utility bills

3. Time Allowances

   a) Implementation and updating of special procedures required by the Contractor to complete the work.

   b) PSA – Include an allowance of 2 hours per person for the Project Manager, Superintendent, and designated safety personnel for completion of the PSA. Include an additional allowance of one hour per employee working on the Site for review of the PSA upon the first day that the employee reports to the Site.

   c) Preparation and obtaining DuPont authorization of daily work permits, confined space entry permits, excavation permits, and other special work permits identified in the HASP as required by DuPont.

   d) Daily "tailgate meetings," Project meetings, and progress reporting.

   e) Construction scheduling and preparation and updating of schedules.

   f) Maintaining and preparing Project record documents and drawings.

C. Unit Prices

1. Unit Price Measurement

   a) Take measurements and calculate quantities and submit to the DSR to serve as the basis for computing values for payments under a unit price payment method or as requested by DuPont to verify completed items of the work.

   b) The method of measurement for the work of this contract on which the contract unit price payment will be made are described in the Schedule of Unit Prices.

2. Unit Price Payment

   a) Payment items for the work of this contract on which the contract unit price payments will be made are listed in the Bid Form and described in the Schedule of Unit Prices.

   b) The unit price and payment made for each item listed shall constitute full compensation for furnishing all plant, labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, tests and reports, and for performing all work required for each of the unit price items.

D. Schedule of Unit Prices

1. Pay Item 4 – Site Clearing

   a) Work Included: Installing tree protection measures to protect trees that need to be protected as indicated on the Contract Drawings, clearing the Site of vegetation and debris, removing and reinstalling fence in designated areas or as necessary to facilitate construction, processing and stockpiling cleared materials for beneficial reuse (i.e., salvaged trees) within approved on-site areas, disposing of remaining cleared material in accordance with the Waste Management Plan (Appendix C).

   b) Payment: Based on the submitted Schedule of Values following completion and acceptance by the DSR of the work.

2. Pay Item 5 – Earthwork and Drainage Structures

   a) Work Included: Earthwork, control of surface water, and other incidentals necessary to complete the following work.

      1) Earthwork and grading of bank soils to construct intermediate grades prior to restoration.

      2) Storage, loading, transporting, testing (if required), and disposal of bank soils.

      3) Earthwork and grading of subgrade fill (from Jones Hollow or other approved source) to construct restored embankment to final grades.

      4) Construction of permanent ditches and outlet structures.

5) Protecting and/or temporarily relocating utility lines (overhead and underground) and poles during construction.

b) Payment: Progress basis in accordance with the submitted Schedule of Values and acceptance by the DSR of the percentage of the work completed.

3. Pay Item 6 – Earthwork and Drainage Structures (Jones Hollow Property)

a) Work Included: Earthwork, control of surface water, and other incidentals necessary to complete the following work.

1) Excavating and grading of borrow material from within the boundaries as shown in Section 00 31 32 –Geotechnical Data (Jones Hollow) – Attachment 1 to obtain material for project. Final grade elevation shall be dependent on volume of material required, but shall not be deeper than twelve feet below existing grade as noted in Section 00 31 32 –Geotechnical Data (Jones Hollow) – Attachment 1.

2) Developing and managing the Jones Hollow Property borrow source.

3) Loading, transporting, and storage of subgrade backfill.

4) Protecting monitoring wells, overhead utility lines, and poles during construction.

b) Payment: Progress basis in accordance with the submitted Schedule of Values and acceptance by the DSR of the percentage of the work completed.

4. Pay Item 7 – Geotextile

a) Work Included: Testing, supplying, staging, installing, and certifying geotextile in accordance with Section 31 05 19 – Geosynthetics, Section 31 37 00 – Stone Toe Protection, any other related Contract Specifications and the Contract Drawings.

b) Payment: Progress basis in accordance with the submitted Schedule of Values and acceptance by the DSR of the percentage of the work completed.

5. Pay Item 8 – Geocell Systems for Bank Management Areas

a) Work Included: Testing, supplying, staging, installing, and certifying geocell system in accordance with Section 31 05 19 –

Geosynthetics, Section 31 35 00 – Slope Protection, Section 31 37 00 – Stone Toe Protection, Section 32 90 00 – Planting and Habitat Restoration, and any other related Contract Specifications and the Contract Drawings.

b) Payment: Progress basis in accordance with the submitted Schedule of Values and acceptance by the DSR of the percentage of the work completed.

6. Pay Item 9 – Biochar Blend for Application in Bank Removal and Restoration Areas

a) Work Included: Purchasing, conditioning, staging, preparing, and installing biochar blend in accordance with Section 31 23 00 – Earthwork and Fill, Section 31 37 00 - Stone Toe Protection, any other related Contract Specifications and the Contract Drawings.

b) Payment: Progress basis in accordance with the submitted Schedule of Values and acceptance by the DSR of the percentage of the work completed.

7. Pay Item 10 – Toe Rock

a) Work Included: Purchasing, staging and constructing stone toe protection in accordance with Section 31 3 700 – Stone Toe Protection, any other related Contract Specifications and the Contract Drawings.

b) Payment: Progress basis in accordance with the submitted Schedule of Values and acceptance by the DSR of the percentage of the work completed.

8. Pay Item 11 – Boulders for Stone Toe Protection

a) Work Included: Purchasing, staging, and installing boulders to anchor large woody material in accordance Section 31 37 00 – Stone Toe Protection, 05 17 00 – Structure Connections, any other related Contract Specifications and the Contract Drawings.

b) Payment: Progress basis in accordance with the submitted Schedule of Values and acceptance by the DSR of the percentage of the work completed.

9. Pay Item 12 – Large Woody Material

a) Work Included: Procurement and transport of large woody material, if an insufficient quantity of large woody materials exist in the bank removal and restoration area locations identified on the Contract Drawings, the Contractor must source additional large woody materials from off-Site; sources approved by the DSR to meet the large woody material requirements identified in Section 06 13 43—Large Woody Material.

b) Payment: Progress basis in accordance with the submitted Schedule of Values and acceptance by the DSR of the percentage of the work completed.

10. Pay Item 13: Dormant Seeding - Permanent Seed Mix

a) Work Included: Increase permanent seed mix application rate when soil temperature is below 55° Fahrenheit.

b) Measurement: Pounds of seed applied to soil surface, computed by multiplying the differential application rate by the measured area seed is applied to, excluding the seeding for ditches, sediment traps, and channels, when the material is acceptably utilized as specified. The measurement will not include the seed that is applied under Pay Item 13 Site Restoration and will not include the seed applied without authorization or the seed used for purposes other than directed.

c) Payment: Paid for at the contract unit price per pound for dormant seeding of permanent seed mix.

11. Pay Item 14: Borrow for Backfill

a) Work Included: Excavate, load, transport, and offload additional unclassified borrow material from the Jones Hollow Property to the South River Remediation Site for out of scope work.

b) Measurement: Cubic yard in place, computed by the average end area method from cross sections taken from the excavation or embankment location before and after the backfill operations, when the material is acceptably utilized as herein specified. The measurement will not include the volume of subgrade material or other material that is scarified or plowed and reused in-place, and will not include the volume excavated without authorization or the volume of material used for purposes other than directed. The measurement will not include the volume of excavation performed prior to the taking of elevations and measurements of the undisturbed grade.

c) Payment: Paid for at the contract unit price per cubic yard for unclassified borrow.

E. Options

1. Options are not specified for this Contract.

F. PAYMENT PROCEDURES

1. Schedule of Values

a) Data Required

1) Within 15 calendar days of the effective date of the Agreement, prepare and deliver to DuPont a schedule of values on 8½-inch by 11-inch or 11-inch by 17-inch white paper. DuPont will consider Contractor’s standard forms and automated printout for approval upon Contractor’s request.

2) Provide a detailed breakdown of the contract price, giving quantities for each of the various kinds of work, unit prices, and extended prices.

3) Include the following identification information on the Schedule of Values

3.1) Title of Project and location

3.2) Project Number

3.3) Name and Address of Contractor

3.4) Contract Designation

3.5) Date of Submission

b) Schedule Instructions

1) Payments will not be made until the Schedule of Values has been submitted to and accepted by DuPont.

2) List on the Schedule of Values the installed value of the component parts of the work in sufficient detail to serve as a basis for computing values of items whose quantity is determined using lump sum measurement for progress

payments during construction. At a minimum, use the line items listed on the Bid Form.

3) Identify each line item with the number and title of the respective major section of the Contract Specifications.

4) For each major line item, list sub-values of major products or operations under the item.

5) Ensure the sum of all values listed in the schedule equals the Total Contract Sum.

6) Use the accepted Schedule of Values as the basis for progress payments of items whose quantity is determined using lump sum measurement on the Contractor's Applications for Payment.

2. Progress Payment Procedures

a) No payment will be made for the following

1) Products wasted or disposed of in a manner that is not acceptable

2) Products determined as unacceptable before or after placement

3) Products not completely unloaded from the transporting vehicle

4) Products placed beyond the lines and levels of the required work

5) Products remaining on hand after completion of the work

6) Loading, hauling, and disposing of rejected Products

b) Final payment for work will be made upon the acceptance of the work by the DSR on the basis of the contract price and approved change orders. Final invoices not accompanied by Release of Liens and Claims will be considered incomplete and will be returned to the Contractor.

1.06 CHANGE ORDERS

A. A Change Order is a written order to the Contractor signed by the DSR, issued after execution of the Contract, authorizing a change in the Work or an adjustment in the Contract Sum. The Contract Sum may be changed only by Change Order. A Change Order signed by the Contractor indicates his/her agreement therewith, including the adjustment in the Contract Sum.

B. If the Contractor claims that any instructions by drawings or otherwise involve extra cost under the Contract, he/she shall give the DSR written notice thereof no longer than 10 working days after the receipt of such instructions, and in any event before proceeding to execute the work, except in emergency endangering life or property, and the procedure shall then be as provided for changes in the work. NO CLAIM SHALL BE VALID UNLESS SO MADE. Amount of cost claim shall be finalized with DSR within 15 working days of receipt of notice.

C. The Contractor shall provide the percent markup that will be charged on an increase in the total Contract Sum resulting from the Change Order during the bid process. The percent markup will be reviewed by the DSR and will be determined in a manner agreed upon by both the Contractor and the DSR.

D. In the case of an increase in the total Contract Sum resulting from the Change Order, the cost of such work shall be determined by the DSR on the basis of the reasonable expenditures and savings of those performing the work attributable to the change. The Contractor’s overhead and profit combined is limited to percent markup agreed upon by the Contractor and the DSR. If all or a portion of the work is performed by an approved subcontractor, subcontractor’s overhead and profit combined is limited to 10% of the cost of the work.

1.07 SUBMITTALS

DSR review is required for submittals designated as “Action Submittals.” Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to DSR for information only. Submit the following in accordance with Section 013300 – Submittal Procedures.

A. Action Submittals

1. Schedule of Values

B. Informational Submittals

1. Not used

C. Closeout Submittals

1. Not used

D. Maintenance Material Submittals

1. Not used

1.08 REFERENCES

A. Not used

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

A. Not used

END OF SECTION

Section 01 31 00—Project Management and Coordination

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. General administrative requirements.
2. Requirements for coordination between Project participants.
3. Project meetings and weekly field safety audit requirements.

1.02 RELATED WORK

A. Section 01 32 00 – Construction Progress Documentation.

B. Section 01 33 00 – Submittal Procedures

C. Section 01 78 00 – Closeout Submittals

1.03 DEFINITIONS

A. Acronyms

1. AASHTO –- American Association of State Highway and Transportation Officials
2. ANSI – American National Standards Institute
3. ASCE – American Society of Civil Engineers
4. CRG – DuPont Corporate Remediation Group
5. DuPont – E. I. DuPont de Nemours Company
6. DSR – DuPont Site Representative
7. EPA – Environmental Protection Agency
8. GRI – Geosynthetic Research Institute
9. GSI – Geosynthetic Institute
10. HASP – Health and Safety Plan
11. NARA – U.S. National Archives and Records Administration
12. NIOSH – National Institute for Occupational Safety and Health

13. OSHA – Occupational Safety and Health Administration
14. PSA – Project Safety Analysis
15. QC – Quality Control
16. SSHO –Contractor Site Safety and Health Officer
17. USDA – U.S. Department of Agriculture
18. VDCR – Virginia Department of Conservation and Recreation
19. VDOT – Virginia Department of Transportation
20. VOSH – Virginia State Occupational Safety and Health Program

B. Definitions

1. Contract Administrator – the designated representative of DuPont for contract administration and contract administration support.
2. Contractor – The general contractor or subcontractor at any tier. This section and the section in which it is used provide context for defining Contractor.
3. CRG – DuPont organization undertaking the Work through the Contractor and DSR.
4. DSR – The on-site representative of DuPont, or their designee, responsible for daily on-site construction monitoring, coordination with DuPont or other DuPont representatives, and quality assurance.
5. Furnish – Supply required items.
6. Provide – Furnish and install complete, in place and ready for operation and use.
7. PSA – A process to identify project safety and health hazards that may be known or anticipated and the associated control measures that will be implemented while planning for the implementation of the project.
8. Site – The area of the Work including the existing grounds, proposed additions to the grounds, staging areas, storage areas, and access roads.

1.04 REFERENCE STANDARD

A. Reference Standards

1. DuPont Corporate Remediation Group (CRG)

    a) CRG Standard Operating Procedure SHE-O-03 Field Audits

    b) CRG Standard Operating Procedure SHE-O-14 Work Permit & Safety Briefing Procedure

B. Reference Citations

1. Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, title, and date.

2. The document number used in the citation is the number assigned by the standards producing organization. When the standards producing organization has not assigned a number to a document, the reference is identified by the standards producing organization abbreviation and title.

3. When a publication date is not referenced, use the most recent edition of the publication.

C. Ordering Information

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Order documents listed in the specifications without numbers assigned by the standards producing organization from the source by title and publication date, if provided.

1. American Association of State
   Highway and Transportation
   Officials (AASHTO)
   444 North Capital Street, NW,
   Suite 249
   Washington, DC 20001
   Phone: 202-624-5800
   Fax: 202-624-5806
   E-Mail: info@aashto.org
   Internet: http://www.aashto.org

2. American National
   Standards Institute (ANSI)
   1819 L Street, NW,
   11th Floor
   Washington, DC 20036
   Ph: 202-293-8020

Fax: 202-293-9287
E-mail: info@ansi.org
Internet:
http://www.ansi.org/

3. American Society of Civil Engineers (ASCE)
1801 Alexander Bell
Drive Reston, VA 20191-4400
Ph: 703-295-6300 and 1-800-548-2723
Fax: 703-295-6333
E-mail: member@asce.org Internet:
http://www.asce.org

4. ASTM International (ASTM)
100 Barr Harbor Drive,
P.O. Box C700
West Conshohocken, PA 19428-2959
Ph: 610-832-9585
Fax: 610-832-9555
E-mail: service@astm.org Internet:
http://www.astm.org

5. Geosynthetic Institute (GSI)/Geosynthetic Research Institute (GRI)
475 Kedron Avenue
Folsom, PA 19033 1208
Ph: 610-522-8440
Fax: 610-522-8441
E-mail: mvashley@verizon.net
Internet: http://www.geosynthetic-institute.org

6. National Institute for Occupational Safety and Health (NIOSH)
Mail Stop C-34
4676 Columbia Parkway
Cincinnati, OH 45226
Ph: 513-533-8611
Fax: 513-533-8285
E-mail:
nioshdocket@cdc.gov
Internet:
http://www.cdc.gov/nchs/products.htm

7. State of Virginia Department of Transportation (VDOT)
   1401 E. Broad St.
   Richmond, VA 23219
   Ph: 800-367-7623
   Internet: http://www.virginiadot.org/

8. U.S. Department of Agriculture (USDA)
   Order AMS Publications from:
   Agricultural Marketing Service (AMS)
   Seed Regulatory and Testing Branch
   801 Summit Crossing Place, Suite C
   Gastonia, NC 28054-2193
   Ph: 704-810-8871
   Fax: 704-852-4189
   E-mail: seed.ams@usda.gov
   Internet:
   http://www.ams.usda.gov/lsg/seed.htm

   Order Other Publications from:
   U.S. Department of Agriculture,
   Rural Utilities Service
   14th and Independence Avenue, SW,
   Room 4028-S
   Washington, DC 20250
   Ph: 202-720-2791
   Fax: 202-720-2166
   Internet: http://www.usda.gov/rus

9. U.S. Environmental Protection Agency (EPA)
   Ariel Rios Building
   1200 Pennsylvania Avenue, N.W.
   Washington, DC 20004
   Ph: 202-272-0167
   for Fax and E-mail see below Internet:
   http://www.epa.gov

   --- Some EPA documents are available only from:
   National Technical Information Service (NTIS)
   5301 Shawnee Road

Alexandria, VA 22312
Ph: 703-605-6050 or
1-688-584-8332
Fax: 703-605-6900
E-mail: info@ntis.gov
Internet:
http://www.ntis.gov

10. U.S. National Archives and
Records Administration (NARA)
8601 Adelphi Road
College Park, MD 20740-6001
Ph: 866-272-6272
Fax: 301-837-0483
E-mail: contactcenter@gpo.gov
Internet: http://www.archives.gov

Order documents from:
Superintendent of Documents
U.S. Government Printing Office
(GPO)
732 North Capitol Street, NW
Washington, DC 20401
Ph: 202-512-1800
Fax: 202-512-2104
E-mail: contactcenter@gpo.gov
Internet:
http://www.gpoaccess.gov

11. Virginia Department of
Conservation and Recreation
(VDCR)
600 E. Main St., 24th Floor
Richmond, VA 23219
Ph: 804-786-6124
Email: pco@dcr.virginia.gov
Internet:
http://www.dcr.virginia.gov/

D. Reference Standards

The publications listed below form a part of this Contract Specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Contractor shall coordinate with the Contract Administrator and DSR to

a) Furnish documentation supporting pay quantities, applications for payment, and requests for change orders.

b) Furnish construction progress documentation in accordance with Section 01 32 00 – Construction Progress Documentation.

c) Furnish Contract closeout documents in accordance with Section 01 78 00 – Closeout Submittals.

2. Where there are changes to the approved plans, the DSR shall contact the City of Waynesboro to obtain approval when necessary before granting approval to the Contractor. A 2-day turnaround for response from the City of Waynesboro after DSR submitting the request for approval is recommended.

3. Contractor shall coordinate with the DSR to

a) Submit list of Contractor and Subcontractor emergency contact personnel, addresses, and telephone numbers. Update list and resubmit as changes occur.

b) Furnish documentation demonstrating adherence to the HASP.

c) Furnish documentation verifying that necessary approvals from regulatory agencies have been obtained.

d) Furnish documentation demonstrating compliance with Contract Documents, Contract Drawings, and Contract Specifications.

e) Furnish documentation demonstrating that the quality control program is in compliance with the Contract Specifications.

f) Furnish daily documentation of work completed under time and materials contract terms including labor hours, materials, and equipment used.

g) Assist with scheduling and attend Project meetings.

h) Furnish submittals for verification of compliance with the Contract Documents.

i) Submit proposed changes or substitutions in specified construction materials or procedures for review.

j) Submit proposed field design changes for review.

k) Respond to design change requests from the DSR.

1.06 SUBMITTALS

DSR review is required for submittals designated as “Action Submittals.” Submittals not designated as "Action Submittals" are for Contractor QC approval and are to be for information only.

Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

A. Action Submittals

1. Qualification Statements

a) Project Manager résumé

b) Project Superintendent résumé

B. Informational Submittals

1. Special Procedure Submittals

a) List of emergency contacts

C. Closeout Submittals

1. Not used

D. Maintenance Material Submittals

1. Not used

1.07 CONTRACTOR’S RESPONSIBILITIES

A. Perform work in accordance with the Contract Documents.

B. Coordinate the work and the work of subcontractors, delivery and staging of materials, and access to work locations. Coordinate with other contractors performing work on-site not related to the subject project.

C. Supervise and direct the work. Contractor is solely responsible for the means, methods, techniques, procedures, and sequences, except erosion and sediment control sequence of construction. Construct erosion and sediment control in accordance with the erosion and sediment control plan and details, and the Standards for Soil Erosion and Sediment Control in Virginia.

1.08 SUPERVISION

A. Furnish qualified individuals for Project Manager, and on-site Project Superintendent with minimum 10 years' experience in management of projects similar in size and complexity to this Project. These individuals shall be approved by DuPont before the Contractor assigns them to the Project.

B. Submit resumes for the proposed Project Manager and Project Superintendent describing their experience with references and qualifications.

C. DuPont reserves the right to interview the proposed Project Manager and Project Superintendent in order to verify the submitted qualifications.

D. Project Manager and Project Superintendent are subject to removal by DuPont for non-compliance with requirements specified in the contract and for failure to manage the Project to ensure timely completion.

1.09 PROJECT MEETINGS

A. Attend pre-construction meeting, Site mobilization meeting, periodic progress meetings, and specially called meetings.

B. Ensure representatives of Contractor, subcontractors, and suppliers attending meetings are qualified and authorized to act on behalf of the entity each represents.

C. Schedule and administer a QC coordination meeting to ascertain work is implemented consistent with the Contract Documents and construction schedules.

1.10 PRE-CONSTRUCTION CONFERENCE

A. Attend the pre-construction conference scheduled by the DSR. Do not commence work prior to the conference.

B. Attendees

1. DSR

2. Required Contractor Participants

a) Project Superintendent

b) SSHO

c) QC Supervisor

d) Major subcontractors

3. Optional Contractor Participants

a) Major suppliers

b) Utility representatives

C. Address project orientation, personnel contact, safety issues, permits, Project coordination issues, schedule, deficiencies, and the location of the Contractor's Site office.

D. Attend the "Plan of Action Discussion" and PSA to address specific safety hazards associated with selected construction means and methods and assist DSR in developing plans to mitigate these hazards.

1.11 SITE MOBILIZATION MEETING

A. Attend a Site mobilization meeting scheduled by the DSR prior to mobilization activities.

B. Attendees

1. DSR

2. Required Contractor Participants

a) Contractor's Superintendent

b) SSHO

c) QC Supervisor

d) Personnel that will be working on Site during each portion of the Project

3. Optional Contractor Participants

a) Others as appropriate

C. Address HASP orientation, PSA review, safety expectations, emergency procedures, and Site conditions.

1.12 PROGRESS MEETINGS

A. Attend weekly project meetings scheduled by the DSR. In addition to the regularly scheduled meetings, the DSR may schedule additional meetings at their discretion, at the request of government agency representatives, or at the request of the Contractor. The Contractor may initiate a meeting by addressing a request to the DSR.

B. Hold progress meetings at the Project Site.

C. Attendees

1. DSR

2. Required Contractor Participants

a) Contractor's Superintendent

b) SSHO

c) QC Supervisor

3. Optional Contractor Participants

a) Subcontractor representatives

b) Suppliers appropriate to the agenda

D. Address

1. Health and safety issues

2. Work progress since previous meeting

3. Projected progress during succeeding work period

4. Field observations, problems, and conflicts

5. Problems that impede construction schedule and proposed corrective actions

6. Revisions to construction schedule

7. Off-site delivery schedules

8. Submittal schedules

9. Quality Control

10. Proposed changes for effect on construction schedule and on completion date, and effect on other contracts of the Project

11. Other business as appropriate

1.13 DAILY SAFETY BRIEFING AND COORDINATION MEETINGS

A. Daily safety and coordination meetings are for the purposes of reviewing the planned work for the day, identifying and reviewing safety issues and procedures relevant to the work, and obtaining required daily or special work (e.g., hot work, excavation) permits.

B. Schedule and administer daily safety and coordination meetings at the Project Site throughout the progress of work. Schedule additional meetings to address changes in planned activities.

C. The DSR may conduct additional meetings at their discretion or at the request of the Contractor.

D. Attendees

1. DSR
2. Required Contractor Participants
    a) Contractor’s Superintendent
    b) SSHO
    c) QC Supervisor
    d) Personnel that will be working on site that day

E. Address

1. Health and safety issues
2. Work planned for the day
3. Review of scheduled deliveries and visitors
4. QC issues
5. Review and issuance of required work permits
6. Other business as appropriate

F. Record minutes and include them in the required progress reports in accordance with Section 01 32 00 – Construction Progress Documentation.

1.14 WEEKLY FIELD SAFETY AUDIT

A. DuPont will schedule and administer field safety audits on a weekly basis throughout the progress of work.

B. In addition to the regularly scheduled audits, the DSR may conduct additional audits at their discretion.

C. Ensure Project Superintendent, SSHO, or site personnel are available to participate in these audits.

D. The CRG safety audit team will record audit results and provide the results to the DSR for review with Contractor

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

A. Not used

END OF SECTION

Section 01 32 00—Construction Progress Documentation

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Construction progress schedule

2. Submittal schedule

3. Survey data

4. Construction progress reporting

1.02 RELATED WORK

A. Section 01 33 00 – Submittal Procedures

1.03 DEFINITIONS

A. Acronyms

1. DSR – DuPont Site Representative

2. DTM – Digital Terrain Models

3. NAD – North American Datum

4. NAVD – North American Vertical Datum

5. NOAA – National Oceanic and Atmospheric Administration

6. NTP – Notice to Proceed

1.04 REFERENCES

A. Horizontal: North American Datum of 1983 (NAD83); Virginia State Plane Coordinate System

B. Vertical: North American Vertical Datum (NAVD) of 1988

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Designate an authorized representative to be responsible for schedule preparation, required activity status updating, and report preparation.

2. Ensure authorized representative is experienced in scheduling projects similar in nature and complexity to this Project and is experienced in using scheduling software that meets the specified requirements.

1.06 SUBMITTALS

DuPont Site Representative (DSR) review is required for submittals designated as “Action Submittals.” Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to the DSR for information only. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

A. Action Submittals

1. Initial project schedule

2. Initial submittal schedule

B. Informational Submittals

1. Periodic schedule updates

2. Periodic submittal schedule updates

3. Equipment delivery schedule

C. Closeout Submittals

1. Record Documentation

a) Record schedule

b) Record submittal schedule

D. Maintenance Material Submittals

1. Not used

1.07 PROJECT SCHEDULE REQUIREMENTS

A. General Requirements

1. Develop and maintain an accurate Project Schedule using the Critical Path Method of network calculation. Ensure consensus with Contractor management personnel, subcontractors, and suppliers.

2. Show the sequence work will be performed in, and start and completion dates for each schedule activity.

3. Schedule the entire duration of the Project.

4. Use the Project Schedule to plan and monitor progress of the work.

B. Approved Project Schedule

1. The approved Project Schedule will be used to measure the progress of the work and to aid in evaluating time extensions.

2. The schedule in conjunction with the schedule of values will provide the basis for each progress payment.

3. Failure to submit schedules within the prescribed time will be basis for withholding approval of progress payments until the required schedule is submitted.

C. Schedule Corrective Action

1. Show necessary corrective action to improve progress, including increasing the number of shifts, overtime operations, days of work, and the quantity of construction resources to regain compliance with the approved Project Schedule.

2. Submit for approval supplementary schedule or schedules to demonstrate how the approved rate of progress will be regained.

D. Default Terms

1. Failure to take corrective action to maintain the approved Project Schedule will be grounds for determination that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the Contract.

2. Upon making this determination, the Contractor's right to proceed with the work and each separable part of it may be terminated in accordance with the default terms of the Contract.

E. Level of Detail Required

Develop the Project Schedule to the following level of detail.

1. Activity Duration

a) Duration that allows the progress of ongoing activities to be accurately determined between update periods.

b) Ensure less than 10 percent of non-procurement activities have original duration greater than 20 workdays or 30 calendar days.

2. Procurement Activities

a) Activities associated with the submittal, approval, procurement, fabrication, and delivery of long-lead materials, equipment, fabricated assemblies, and supplies.

b) Long-lead procurement activities are those with an anticipated procurement sequence of more than 90 calendar days.

c) Include submit, approve, procure, fabricate, and deliver activities in the procurement sequence.

3. Mandatory Tasks

a) Submission and approval of As-built Drawings

b) Performance verification testing

c) DSR's pre-final inspection

d) Correction of punch list from DSR's pre-final inspection

e) DuPont’s pre-final inspection

f) Correction of punch list from the DuPont’s pre-final inspection

g) Final inspection

4. DuPont’s Activities

a) Show DuPont’s and other agency activities that could impact progress. Examples: approvals, environmental permit approvals by State regulators, inspections, utility tie-in, DuPont-furnished equipment, and Notice to Proceed (NTP) for phasing requirements.

b) Label responsibility for DuPont activities to DuPont or the agency responsible for performing the activity.

5. Contract Changes

a) Show activity or sequence of activities added to the schedule as a result of a Contract Modification, at the time the modification is approved.

b) Add activities or sequence of activities resulting from alleged constructive changes made by DSR to the current schedule. Addition of these activities does not indicate DSR accepts responsibility or liability for such activities and associated impacts to the schedule, but rather DSR recognizes such activities are appropriately added to the schedule for the purpose of maintaining a realistic and meaningful schedule.

F. Scheduled Project Completion and Activity Calendars

1. Schedule Interval: From NTP date to the required Contract completion date.

2. Contract Completion Activity (End Project): Based on the required Contract duration in the accepted Contract proposal, adjusted for approved Contract time extensions.

3. First Scheduled work Period: The day after the Contractor acknowledges NTP.

4. Schedule activities on a calendar to which the activity logically belongs.

5. Activities may be assigned to a 7-day calendar when the Contract assigns calendar day duration for the activity such as a DSR acceptance activity.

6. Schedule physical work less than 7 days per week on a calendar with non-work periods identified, including weekends and holidays.

7. Anticipated Weather Delays

a) Use the National Oceanic and Atmospheric Administration's (NOAA) historical monthly averages for the NOAA location closest to the Project Site as the basis for establishing a "Weather Calendar" showing the number of anticipated non-workdays for each month due to adverse weather, Saturdays, Sundays, and Federal Holidays as non-work days.

b) Assign the Weather Calendar to any activity that could be impacted by adverse weather.

c) Evaluation of requests for time extension due to adverse weather delay will be based on the difference of days between the anticipated and actual adverse weather delay if the number of actual adverse weather delay days exceeds the number of days anticipated for the month in which the delay occurs, and the adverse weather delayed activities critical to Contract completion.

d) A lost workday due to weather conditions is defined as a day in which the Contractor cannot work at least 50 percent of the day on the impacted activity.

8. Work periods not identified as non-work periods indicate that the Contractor intends to perform work during those periods.

1.08 PROJECT SCHEDULE SUBMISSIONS

A. Initial Project Schedule Submission

1. Submit the Initial Project Schedule for approval within 14 calendar days after NTP.

2. Ensure the schedule demonstrates a reasonable and realistic sequence of activities that represents the work through the entire Contract performance period.

3. Ensure the Initial Schedule presents the level of detail specified in Paragraph Level of Detail Required.

B. Periodic Schedule Updates

1. Submit complete updates of the Project Schedule containing approved progress, revisions, and adjustments every 2 weeks.

2. Updated schedule will be subject to the approval of the DSR.

3. Address the following items on an activity by activity basis during each progress meeting.

a) Start and Finish Dates – Accurately show the status of the Actual Start and/or Actual Finish dates for each activity currently in-progress or completed since the last update. Only assign Actual Start dates when actual progress occurs on an activity.

b) Remaining Duration – Update the estimated Remaining Duration for incomplete activities independent of Percent Complete.

c) Percent Complete – Update the percent complete for each activity started based on the realistic assessment of earned value.

d) Logic Changes – Identify and discuss logic changes pertaining to NTP on change orders, change orders to be incorporated into the schedule, Contractor-proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, and other changes that have been made pursuant to Contract provisions. DSR will only approve logic revisions for the purpose of keeping the schedule valid in terms of its usefulness in calculating a realistic completion date, correcting erroneous logic ties, and accurately sequencing the work.

e) Other Changes – Other changes required due to delays in completion of an activity or group of activities include

1) Delays beyond the Contractor's control, such as strikes and unusual weather.

2) Delays encountered due to submittal reviews, DuPont activities, deliveries, or work stoppages that make re-planning the work necessary.

3) Changes correcting a schedule that does not represent the actual or planned prosecution and progress of the work.

4. Failure or refusal to furnish Project Schedule data necessary to verify the Contractor's progress will be deemed as the Contractor not providing an estimate upon which progress payment can be made.

C. Record Schedule

1. Submit the Record Project Schedule for approval within 14 calendar days after approval of As-built Drawings.

2. The Record Project Schedule will be subject to the approval of the DSR and must contain each approved revision and adjustment, Actual Start Dates, Actual Finish Dates, and indicate 100 Percent Complete for each activity.

1.09 REQUESTS FOR TIME EXTENSIONS

A. Furnish justification, Project Schedule data, and supporting evidence for events that the Contractor believes it is entitled to an extension of the Contract performance period, completion date, or any interim milestone date.

B. Submission of proof of excusable delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is a condition precedent to any approvals by the DSR.

C. Submit a schedule impact analysis demonstrating whether or not Engineering Change Requests issued by the DSR impact the critical path.

D. Justification of Delay

1. Clearly display that the Contractor has used, in full, the entire float time available for the work involved with the delay request.

2. The DSR's determination as to the number of allowable days of Contract extension will be based on the Project Schedule updates in effect for the time period in question and other factual information.

3. Actual delays that are found to be caused by the Contractor's own actions, which result in a calculated schedule delay, will not be a cause for an extension to the performance period, completion date, or any interim milestone date.

E. Submission Requirements

1. Submit justification for each request for a change in the Contract completion date of less than 2 weeks based on the most recent schedule update at the time of the NTP or constructive direction issued for the change.

2. Submit requests in accordance with the requirements of other appropriate Contract Clauses and include, as a minimum

a) A list of affected activities, with their associated Project Schedule activity number.

b) A brief explanation of the causes of the change.

c) An analysis of the overall impact of the changes proposed.

d) A sub-network of the affected area.

3. Identify activities impacted in each justification for change by a unique activity code contained in the required data file.

F. Additional Submission Requirements

1. Provide, within 4 days of the request, an interim update with revised activities for any requested time extension of more than 2 weeks.

G. No compensation will be considered for any weather related delays, time extension requests, or lost workdays due to weather events.

1.10 DIRECT CHANGES

A. Submit proposed schedule revisions for changes in which the NTP is issued prior to settlement of price and time within 2 weeks of the NTP being issued.

B. Submit proposed revisions to the schedule for approval prior to inclusion of those changes within the Project Schedule.

C. Failure to submit proposed revisions will be basis for the DSR, at their discretion, to furnish the Contractor with suggested revisions to the Project Schedule. Include DSR-suggested revisions in the Project Schedule until revisions are submitted and final changes and impacts have been negotiated.

D. Submit objections to the DSR-furnished revisions and proposed alternative within 2 weeks of receipt of the DSR revisions. Continue to update the schedule with the DSR revisions until a mutual agreement in the revisions is reached.

E. Failure to submit alternative revisions within 2 weeks of receipt of the DSR's proposed revisions will indicate that the Contractor concurs with the DSR's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

1.11 OWNERSHIP OF FLOAT

A. Float available in the schedule, at any time, will not be considered for the exclusive use of either the DSR or the Contractor.

1.12 SUBMITTAL SCHEDULE REQUIREMENTS

A. Submit a Project Submittal Schedule showing full coordination with the Project Schedule.

B. Indicate the proposed submittal number, referenced Contract Specification Section, submittal description, proposed date of submittal, and the due date of the review.

C. Prioritize and link to the progress schedule, products, and tests under each submittal number.

D. Periodic Submittal Schedule Updates

1. Submit a complete update of the Project Submittal Schedule indicating status of review and revisions biweekly.

2. Update information, including proposed submittal date, actual submittal dates, actual review completion dates, disposition of reviewed submittals, and status of items requiring revision and re-submittal. Clearly indicate submittals that are beyond the allotted review period.

E. Record Submittal Schedule

1. Submit the Record Project Submittal Schedule for approval within 14 calendar days after approval of As-built Drawings.

2. The Record Project Submittal Schedule will be subject to the approval of the DSR and shall contain actual submittal dates, actual review completion dates, and final disposition.

1.13 EQUIPMENT DELIVERY SCHEDULE

A. Submit a schedule showing procurement plans for materials and equipment within 14 calendar days after acceptance of the proposed construction schedule.

B. Submit the following information

1. Description

2. Date of the purchase order

3. Promised shipping date

4. Name of the manufacturer or supplier

5. Date delivery is expected

6. Date the material or equipment is required, according to the current construction schedule

C. When the expected delivery date exceeds the date required, submit a description of the effect that delayed delivery date will have on the Contract completion date and a summary of efforts made by the Contractor to expedite the delayed delivery date to bring it in line with the needed delivery date, including efforts made to place the order (or subcontract) with other suppliers.

D. Update the equipment delivery schedule at monthly intervals or when the schedule has been revised. Reflect any changes occurring since the last update.

E. Submit copies of the purchase orders and confirmation of the delivery dates as directed.

1.14 SURVEY DATA REQUIREMENTS

A. Maintain a complete and accurate log of control and survey work as it progresses.

B. On completion of major Site improvements, prepare a certified survey illustrating dimensions, locations, angles, and elevations of construction and Site work.

C. Provide Digital Terrain Models (DTM) at the same scale provided in the Contract Drawings with a 1-foot contour interval corresponding to the United States National Map Accuracy Standards.

D. Datum

1. Horizontal: North American Datum of 1983 (NAD83); Virginia State Plane Coordinate System.

2. Vertical: North American Vertical Datum (NAVD) of 1988

E. The DTM AutoCAD file must be compatible for use with the Autodesk Civil 3D 2015 software package. Provide elevation information at appropriate 3-D elevations. Place each entry on layers named adequately to describe the entity being mapped.

F. Provide topographic maps in electronic format and reproduction-quality paper prints.

1.15 CONSTRUCTION PROGRESS REPORTING REQUIREMENTS

A. Submit biweekly Progress Reports addressing potential factors of delay, deficiencies, material delivery schedules, submittals, and safety issues.

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

A. Not used

END OF SECTION

DIVISION 01—GENERAL REQUIREMENTS
Section 01 33 00—Submittal Procedures

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. General procedures regarding submittals called for in other sections of the Contract Specifications.

1.02 RELATED WORK

A. Not used

1.03 DEFINITIONS

A. Abbreviations and Acronyms

1. DSR – DuPont Site Representative

2. O&M – operations and maintenance

3. QC – quality control

4. SDS –Safety Data Sheet

B. Definitions

1. Certificates – Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system, or material attesting that product, system, or material meets Contract Specification requirements. Must be dated after award of Project Contract and clearly name the Project. Document required of Contractor, or of a manufacturer, supplier, installer, or subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures and acceptability of methods or personnel qualifications.

2. Closeout Submittals – Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism. Special requirements are necessary to properly close out a construction Contract. For example, Record Drawings, manufacturer's help, and product lines necessary to maintain and install equipment. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase Contract.

3. Design Data – Design calculations, mix designs, analyses, or other data pertaining to a part of work.

4. Manufacturer's Field Reports – Documentation of the testing and verification actions taken by manufacturer's representative at the job Site, in the vicinity of the job Site, or on a sample taken from the job Site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be signed by an authorized official of a testing laboratory or agency and must state the test results; and indicate whether the material, product, or system has passed or failed the test.

5. Manufacturer's Instructions – Preprinted material describing installation of a product, system, or material, including special notices and SDSs concerning impedances, hazards, and safety precautions.

6. Operation and Maintenance Data – Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel. These data are needed by operation and maintenance (O&M) personnel for the safe and efficient operation, maintenance, and repair of the item. These data are intended to be incorporated in an operations and maintenance manual or control system.

7. Originator – The designated person or organization responsible for producing a submittal and submitting it to the Quality Control (QC) Manager for review.

8. Preconstruction Submittals – Submittals that are required prior to a notice to proceed on a new Contract.

9. Product Data – Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions, and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work. Samples of warranty language when the Contract requires extended product warranties.

10. QC Manager – Designated person authorized to approve submittal.

11. Samples – Fabricated or unfabricated physical examples of materials, equipment, or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged. Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the Project. Field samples and mock-ups constructed on the Project Site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies that are to be incorporated into the Project and those which will be removed at conclusion of the work.

12. Shop Drawings – Drawings, diagrams, and schedules specifically prepared to illustrate some portion of the work. Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the Project. Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

13. Submittals – Data normally submitted for review to establish conformance with the design concept and Contract Documents.

14. Test Reports – Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product, or system to be provided has been tested in accord with specified requirements. (Testing must have been within 3 years of date of Contract award for the Project.) Report that includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the Project before shipment to job Site. Report that includes finding of a test made at the job Site, or on sample taken from the job Site, on portion of work during or after installation.

15. Work – As used in this Section, on- and off-site construction required by Contract Documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.04 REFERENCES

A. Not used

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Make submittals as required by the Contract Specifications.

2. Furnish submittals in addition to those specified to adequately describe the work covered in the respective sections.

3. Use the same units of weights and measures on submittals as those used in the Contract Drawings.

4. Ensure each submittal is complete and of sufficient detail to allow ready determination of compliance with Contract requirements.

5. Furnish submittals that have been checked, approved, stamped, signed, and dated by the Quality Control (QC) Manager, indicating action taken for each item.

6. Clearly identify proposed deviations from the Contract requirements.

7. Include applicable Contractor's, manufacturer's, or fabricator's drawings; descriptive literature in the form of catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals.

8. When the DuPont Site Representative's (DSR's) review is required, obtain DSR review prior to the acquisition of the material or equipment.

9. Pick up and dispose of samples remaining upon completion of the work in accordance with manufacturer's Safety Datasheet (SDS) and in compliance with existing laws and regulations.

B. Scheduling

1. Coordinate scheduling, sequencing, preparing, and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential requirements to resubmit.

2. Except as specified otherwise, allow review period that includes sufficient working days for QC Manager's approval and an additional 10 working days for submittals requiring DSR's review.

3. QC Manager review period begins when the QC Manager receives the submittal from the Originator. DSR review period begins when DSR receives the approved submittal from the QC Manager.

4. Period of review for each re-submittal is the same as for initial submittal.

5. No delay damages or time extensions will be allowed for time lost in late submittals.

1.06 SUBMITTALS

A. Not used

1.07 PROCEDURES FOR SUBMITTALS

A. Reviewing, Certifying, Approving Authority

1. Unless otherwise specified for a specific submittal, the QC Manager is responsible for reviewing and approving or certifying that submittals are in compliance with Contract requirements.

B. Constraints

1. Complete submittals for each definable feature of work. Submit components of definable features, interrelated as a system, at the same time.

2. Submittal will be returned without review when acceptability of the submittal is dependent on conditions, items, or materials included in separate subsequent submittals.

3. Approval of a separate material, product, or component does not imply approval of assembly in which item functions.

C. Variations

1. Variations from Contract requirements require DSR review and will be considered where advantageous to DuPont.

2. Discuss how functional and quality requirements are met with the DSR prior to submission to minimize rejections and re-submittals.

3. Proposing Variations

a) When proposing variation, deliver written request to the DSR with documentation of the nature and features of the variation and why the variation is desirable and beneficial to DuPont.

b) If lower cost is a benefit, also include an estimate of the cost savings.

c) In addition to documentation required for variation, include the submittals required for the item.

d) Clearly mark the proposed variation in each document.

4. Warranting that Variations are Compatible

a) When delivering a variation for consideration, Contractor warrants that this Contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

5. Review Schedule is Modified

a) In addition to normal submittal review period, allow an additional period of 10 working days for consideration by DuPont of submittals with variations.

D. Originator's Responsibilities

1. Determine and verify field measurements, materials, and field construction criteria; review each submittal; and check and coordinate each submittal with requirements of the work and Contract Documents.

2. Transmit submittals in accordance with schedule on approved Submittal Register, and to prevent delays in the work, delays to DuPont, or delays to separate Contractors.

3. Indicate variations as required by Paragraph VARIATIONS.

4. Correct and resubmit submittal as directed. When re-submittal is required, provide a copy of the original submittal, including reviewer comments. Direct specific attention in writing or on the submittal to revisions not requested by the reviewers on previous submissions.

5. Furnish additional copies of submittal when requested.

6. Complete work that must be accomplished as basis of a submittal in time to allow submittal to occur as scheduled.

7. Do not initiate work until submittals for that work have been returned as "Furnish As Submitted" or "Furnish As Corrected," except to the extent that a portion of work must be accomplished as basis of submittal.

E. QC Manager's Responsibilities

1. Note date submittal was received from Originator on each submittal.

2. Review each submittal and check and coordinate each submittal with requirements of Work and Contract Documents.

3. Review submittals for conformance with Project design concepts and compliance with Contract Documents.

4. Advise DSR of variation, as required by Paragraph VARIATIONS.

5. Act on submittals, determining appropriate action based on review of submittal.

   a) Take appropriate action on submittal from the possible actions defined in Paragraph Actions Possible.

   b) When DSR review is required or a variation has been proposed, forward submittal to the DSR with certifying statement or return submittal to the Originator marked "Not Reviewed" or "Revise and Resubmit," as appropriate. The QC Manager's review of submittal determines appropriate action.

6. Ensure written material is clearly legible.

7. Stamp each sheet of each submittal with QC-certifying statement or approving statement, except that data submitted in a bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only.

   a) Certify submittals forwarded to DSR with the following certifying statement

      "I hereby certify that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with Contract Number [__], is in compliance with the Contract Drawings and Contract Specification, can be installed in the allocated spaces, and is submitted for DSR review.

      Certified by QC Manager____________________, Date______" (Signature)

   b) QC Manager will use the following approval statement when returning submittals to Originator as "Approved" or "Approved as Noted."

      "I hereby certify that the (material) (equipment) (article) shown and marked in this submittal and proposed to be incorporated with Contract Number [__], is in compliance with the Contract Drawings and Contract Specification, can be installed in the allocated spaces, and is approved [as noted] for use.

      Approved by QC Manager_____________________, Date_____" (Signature)

8. Sign certifying statement or approval statement in original ink. Stamped signatures are not acceptable.

9. Update submittal register as submittal actions occur and maintain the submittal register at Project Site until final acceptance of work.

10. Retain a copy of approved submittals at Project Site, including copy of approved samples.

F. DSR's Responsibilities

1. Note date on which submittal was received from QC Manager on each submittal requiring DSR's review.

2. Review submittals within scheduling period specified and only for conformance with Project design concepts and compliance with Contract Documents.

3. Identify returned submittals with one of the actions defined in Paragraph Actions Possible and with markings appropriate for action indicated.

G. Actions Possible – Submittals will be returned with one of the following notations

1. Submittals marked "Not Reviewed" will indicate submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by the QC Manager, or is not complete. A submittal marked "Not Reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by the QC Manager or for being incomplete, with appropriate action, coordination, or change.

2. Submittals marked "Furnish as Submitted" authorize Contractor to proceed with work covered.

3. Submittals marked "Furnish as Corrected" authorize Contractor to proceed with work as noted provided Contractor takes no exception to the notations.

4. Submittals marked "Revise and Resubmit" indicate submittal is incomplete or does not comply with design concept or requirements of the Contract Documents and must be resubmitted with appropriate changes. Do not proceed with work for this item until re-submittal is reviewed and returned with an action of “Furnish as Submitted” or “Furnish as Corrected.”

5. Submittals marked "Rejected" indicate submittal does not comply with design concept or requirements of the Contract Documents. Do not proceed with work for this item until an entirely new submittal is made for review.

1.08 FORMAT OF SUBMITTALS

A. Transmittal Form

1. Transmit each submittal, except sample installations and sample panels, to the QC Manager.

2. Transmit submittals with transmittal form accepted by the DSR and standard for the Project.

3. On the transmittal form, identify the Originator, indicate date of submittal, and include information prescribed by the transmittal form and required in Paragraph Identifying Submittals.

4. Process transmittal forms to record actions regarding sample panels and sample installations.

B. Identifying Submittals

1. Identify submittals, except sample panel and sample installation, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form.

2. Mark each copy of each submittal identically, with the following

a) Project title and location.

b) Construction Contract number.

c) Section number of the Contract Specification Section by which submittal is required.

d) Submittal number of each component of submittal.

e) When a resubmission, add alphabetic suffix on submittal description, for example, 10A, to indicate resubmission.

f) Name, address, and telephone number of subcontractor, supplier, manufacturer, and any other second-tier Contractor associated with submittal.

g) Product identification and location in Project.

C. Format for Shop Drawings

1. Submit on not less than 8.5 by 11 inches, nor more than 30 by 42 inches.

2. Present 8.5 by 11 inches sized shop drawings as part of the bound volume for submittals required by Section.

3. Present larger drawings in sets.

4. Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in Paragraph Identifying Submittals.

5. Dimension drawings, except diagrams and schematic drawings. Prepare drawings demonstrating interface with other trades to scale. Use the same

unit of measure for shop drawing dimensions as indicated on the Contract Drawings. Identify materials and products for work shown.

6. Indicate nameplate data, size and capacity, applicable federal, military, industry, and technical society publication references.

D. Format of Product Data and Manufacturer's Instruction

1. Present product data submittals for each Section as a complete, bound volume. Include table of contents, listing page and catalog item numbers for product data.

2. Indicate, by prominent notation, each product that is being submitted. Indicate Contract Specification Section number and paragraph number to which it pertains.

3. Supplement product data with material prepared for Project to satisfy submittal requirements for which product data does not exist. Identify this material as developed specifically for Project, with information and format as required for submission of Certificates.

4. Provide product data in English unit dimensions. Where product data are included in preprinted catalogs with metric only, submit English unit dimensions on separate sheet.

5. Include the manufacturer's name, trade name, place of manufacture, catalog model or number, and applicable federal, military, industry and technical society publication references. Submit manufacturer's data requiring supplemental information for clarification as specified for Certificates.

6. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute, American Society for Testing and Materials International, National Electrical Manufacturer's Association, Underwriters Laboratories, and Association of Edison Illuminating Companies, submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and accepted by the DSR. State on the certificate that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

7. Submit manufacturer's instruction prior to installation.

E. Format of Samples

1. Furnish samples in sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately same size as specified

    a) Sample of Equipment or Device: Full size.

    b) Sample of Materials Less Than 2 by 3 inches: Built up to A4 (8.5 by 11 inches, 297 by 210 mm).

    c) Sample of Materials Exceeding 8.5 by 11 inches: Cut down to 8.5 by 11 inches and adequate to indicate color, texture, and material variations.

    d) Sample of Linear Devices or Materials: 10-inch (250 mm) length or length to be supplied, if less than 10 inches (250 mm). Examples of linear devices or materials are conduit and handrails.

    e) Sample of Non-solid Materials: Pint (750 ml). Examples of non-solid materials are sand and paint.

    f) Color Selection Samples: 2 by 4 inches (50 by 100 mm).

    g) Sample Panel: 4 by 4 feet (1200 by 1200 mm).

    h) Sample Installation: 100 square feet (10 square meters).

2. Samples Showing Range of Variation: Where variations are unavoidable due to nature of the materials, submit sets of samples of not less than three units showing extremes and middle of range.

3. Reusable Samples: Incorporate returned samples into work only if so specified or indicated. Incorporate samples in undamaged condition at time of use.

4. Recording of Sample Installation: Note and preserve the notations of area constituting sample installation but remove notation at final cleanup of Project.

5. When color, texture, or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

F. Format of Design Data and Certificates

1. Provide design data and certificates on 8.5 by 11 inches (297 by 210-mm) paper. Provide a bound volume for submittals containing numerous pages.

G. Format of Test Reports and Manufacturer's Field Reports

1. Provide reports on 8.5 by 11 inches (297 by 210-mm) paper in a complete, bound volume.

2. Indicate by prominent notation, each report in the submittal. Indicate Contract Specification number and paragraph number to which it pertains.

H. Format of O&M Data

1. Comply with the requirements specified in 01 70 00 – Closeout Procedures.

I. Format of Preconstruction Submittals and Closeout Submittals

1. When submittal includes a document that is to be used in the Project or become part of Project record, other than as a submittal, do not apply Contractor's approval stamp to the document, but to a separate sheet accompanying the document.

2. Provide dimensions in administrative submittals in English units. Where data are included in preprinted material with metric only, submit English unit dimensions on separate sheet.

1.09 QUANTITY OF SUBMITTALS

A. Number of Copies of Shop Drawings

1. In addition to the number of copies necessary for Contractor use, submit four copies of submittals of shop drawings requiring review and approval only by QC Manager and six copies of shop drawings requiring DSR review.

B. Number of Copies of Product Data and Manufacturer's Instructions

1. Submit in compliance with quantity requirements specified for shop drawings.

C. Number of Samples

1. Submit two samples, or two sets of samples showing range of variation, of each required item. The DSR will retain one approved sample or set of samples, and the QC Manager will retain one approved sample or set of samples.

2. Submit one sample panel. Include components listed in technical section or as directed.

3. Submit one sample installation, where directed.

4. Submit one sample of non-solid materials.

D. Number of Copies Design Data and Certificates

1. Submit in compliance with quantity requirements specified for shop drawings.

E. Number of Copies Test Reports and Manufacturer's Field Reports

1. Submit in compliance with quantity with quality requirements specified for shop drawings.

F. Number of Copies of O&M Data

1. Submit three copies of O&M Data for review.

G. Number of Copies of Preconstruction Submittals and Closeout Submittals

1. Unless otherwise specified, submit administrative submittals in compliance with quantity requirements specified for shop drawings.

1.10 SUBMITTAL CLASSIFICATION

A. Action Submittal

1. DSR review is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated in the Contract Specifications.

2. DSR review and DuPont approval is required for any deviations from the Solicitation or Accepted Proposal and other items as designated in the Contract Specifications.

B. Informational Submittal

1. Submittals not requiring DSR review will be for information only.

2. Submittals for information only will generally not be returned.

3. DuPont reserves the right to require the Contractor to resubmit any item found not to comply with the Contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and Contract Specifications; will not prevent DuPont from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish

samples for testing by the DuPont laboratory or for check testing by DuPont in those instances where the Contract Specifications so prescribe.

C. Closeout Submittals

1. DSR will review Closeout Submittals and O&M Data to verify the submittals comply with the Contract requirements. Submit data specified for a given item within 30 calendar days after the item is delivered to the Site.

2. In the event the Contractor fails to deliver Closeout Submittals and O&M Data within the time limits specified, the DSR may withhold from progress payments 50 percent of the price of the item with which such submittals are applicable.

1.11 ACCEPTED SUBMITTALS

A. Do not construe submittals accepted as “Furnish as Submitted” or “Furnish as Corrected” as a complete check, but indicate only that the general method of construction, materials, detailing, and other information are satisfactory design, general method of construction, materials, detailing, and other information appear to meet the Solicitation and Accepted Proposal.

B. Acceptance will not relieve the Contractor of the responsibility for any error which may exist, because the Contractor under the Contractor QC requirements of this Contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of the work.

C. After submittals have been accepted, no re-submittal for the purpose of substituting materials or equipment will be considered, unless accompanied by an explanation of why a substitution is necessary.

1.12 DISAPPROVED SUBMITTALS

A. Make corrections required by DSR and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal.

B. Re-submit "information only" submittals found to contain errors or unapproved deviations from the Solicitation or Accepted Proposal as one requiring "approval" action, requiring DuPont approval.

C. If the Contractor considers any correction indicated on the submittals to constitute a change to the Contract, give prompt notice in accordance with the Contract to the DSR.

1.13 WITHHOLDING OF PAYMENT

A. Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

B. No payment will be made for any materials incorporated into the work for any conformance review submittals or information only submittals found to contain errors or deviations from the Solicitation or Accepted Proposal.

1.14 REFERENCES

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

A. Not used

END OF SECTION

DIVISION 01—GENERAL REQUIREMENTS

Section 01 35 29—Health, Safety, and Emergency Response Procedures

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Health and safety requirements, including safety staff organization, qualifications, and responsibilities, Site safety hazard considerations, implementation of the Contractor's Site Safety Program, Site control requirements, and training and medical surveillance requirements.

1.02 RELATED WORK

A. Section 01 31 00 – Project Management and Coordination

B. Section 01 33 00 – Submittal Procedures

C. Section 01 40 00 – Quality Requirements

1.03 DEFINITIONS

A. Acronyms

1. ANSI – American National Standards Institute
2. CFR – Code of Federal Regulations
3. HASP – Health and Safety Plan
4. NARA – U.S. National Archives and Records Administration
5. HAZWOPER – Hazardous Waste Operations and Emergency Response
6. NIOSH – National Institute for Occupational Safety and Health
7. OSHA – Occupational Safety and Health Administration
8. PPE – personal protective equipment
9. SSHO – Site Safety and Health Officer

1.04 REFERENCES

A. Reference Standards

The publications listed below form a part of this Contract Specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. American National Standards Institute (ANSI)

    a) ANSI Z358.1 (2004) Standard for Emergency Eyewash and Shower Equipment

2. National Institute for Occupational Safety and Health (NIOSH)

    a) NIOSH 85-115 (1985) Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities

3. U.S. National Archives and Records Administration (NARA)

    a) 29 Code of Federal Regulations (CFR) 1904 Recording and Reporting Occupational Injuries and Illnesses

    b) 29 CFR 1910 Occupational Safety and Health Standards

    c) 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response

    d) 29 CFR 1926 Safety and Health Regulations for Construction

    e) 29 CFR 1926.65 Hazardous Waste Operations and Emergency Response

1.05 ADMINISTRATIVE REQUIREMENTS

A. Provide the required personnel and execute the Project in accordance with the Contractor's Site Safety Program and DuPont procedures.

B. Develop the Contractor's Site Safety Program in compliance with the requirements detailed in the Health and Safety Plan (HASP), including, but not limited to

1. Personnel requirements.

2. Required meetings prior to and during construction activities.

3. Personal protective equipment levels specific for each work activity.

4. Development of rigging, fall protection, excavation support, and other safe work practice plans, as necessary, based on the Contractor's proposed means and methods to complete the Work.

C. If discrepancies are found between the DuPont and Contractor programs and procedures, the DSR will work with appropriate representatives of DuPont and Contractor to determine the procedure to be used.

D. Overhead and Underground Obstructions Plans

1. Assist the DSR in developing Overhead and Underground Obstructions Plans prior to mobilization.

2. The Overhead and Underground Obstructions Plans typically include

a) List of obstructions (e.g., electrical wires and other overhead utilities, pipe racks and associated piping, low-clearance structures such as roof overhangs and bridges, buried utilities and pipelines, structural foundations, and vibration-sensitive structures and equipment) located in the immediate work area and each potential route of vehicular access to the Site.

b) Contractor-provided list of equipment with potential for contacting overhead or underground obstructions (e.g., dump trucks and other equipment with beds capable of being raised, drill rigs, cranes and other rigging equipment, excavators and other bucket type heavy equipment, and high clearance loads, including tanks, columns, storage silos, and treatment systems) in prioritized order by frequency of usage and potential hazard.

c) List of the proposed measures (e.g., utility removal or relocation, utility shut-off, locking out of pipelines, temporary shut-down of adjacent processes, and shoring/bracing of adjacent structures) for mitigating each identified hazard.

d) List of procedures (e.g., use of “soft dig” technologies, use of spotters and driver duties) to be followed.

e) List of the control systems to be used (e.g., isolation of hazards using curbing or barricades, marking traffic routes, use of stop signs, warning signs, warning sensors, electric eyes, warning chains or false work, and additional visual and audible alarms).

1.06 SUBMITTALS

DSR review is required for submittals designated as “Action Submittals.” Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to the DSR for information only.

Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

A. Action Submittals

1. Submit Subcontractor Safety Data Forms for each subcontractor to the DSR for approval a minimum of 10 working days prior to use of the subcontractor.

2. Submit, as part of the daily construction report, a summary of health and safety activities, including the topic discussed at the daily health and safety meeting.

B. Informational Submittals

1. Special Procedure Submittals

a) Contractor's Corporate Health and Safety Program or at a minimum, each Section that relates to this Project.

2. Qualification Statements

a) Health and Safety Professional

b) Site Safety and Health Officer (SSHO)

c) Documentation that all workers have completed the Occupational Safety and Health Act (OSHA) 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training and hold current certificates

d) For workers whose 40-hour HAZWOPER training was completed more than a year ago, provide documentation they have completed annual 8-hour HAZWOPER refresher training within the current calendar year.

C. Closeout Submittals

1. Not used

D. Maintenance Material Submittals

1. Not used

1.07 QUALIFICATIONS

A. Develop an organizational structure that sets forth lines of authority, responsibility, and communication. At a minimum, include the following individuals having the qualifications and responsibilities defined below.

B. Health and Safety Professional

1. Qualifications

a) Possesses a minimum of 5 years of experience in developing and implementing health and safety programs for construction.

b) Has demonstrable experience in supervising professional and technician level personnel.

c) Has working knowledge of applicable state and federal occupational safety and health regulations.

2. Responsibilities

a) Be responsible for the implementation, oversight, and enforcement of the requirements outlined in this document and the Contractor's Site Safety Program.

b) Conduct initial Site-specific training.

c) Visit the Site at least once per month for the duration of activities.

d) Be available for emergencies.

e) Provide on-site consultation as needed to ensure that the Contractor's Site Safety Program is fully implemented.

f) Coordinate any necessary modifications to the Contractor's Site Safety Program.

g) Serve as a member of the quality control staff as specified in Section 01 40 00 – Quality Requirements.

C. SSHO

1. Qualifications

a) Possesses a minimum of 3 years of experience in developing and implementing health and safety programs for construction.

b) Possesses demonstrable experience in construction safety techniques and procedures.

c) Has working knowledge of applicable state and federal occupational safety and health regulations.

d) Is certified in first aid and CPR by the Red Cross, or equivalent agency.

2. Responsibilities

a) Assist and represent the Health and Safety Professional in the on-Site implementation and enforcement of the Contractor's Site Safety Program, Site Conditions, and regulatory health and safety requirements.

b) Be assigned to the Site on a full-time basis for the entire duration of field activities. The SSHO may have duties other than those directly related to health and safety, provided that adequate time is made available to complete health and safety duties.

c) Ensure each aspect of the Contractor's Site Safety Program is enforced.

d) Participate in weekly field safety audits as specified in Section 01 31 00 – Project Management and Coordination.

e) Has authority to stop work if unacceptable health or safety conditions exist.

f) Consults with and coordinates necessary modifications to the Contractor's Site Safety Program with the Health and Safety Professional and the DSR.

1.08 FIELD CONDITIONS

A. Consider the following Site conditions in performing the work.

1. There are overhead obstructions along access roads leading to the Site and within the Site boundaries. Ensure heavy equipment remains a safe distance and no less than 20 feet from overhead power lines. The HASP contains requirements for working in proximity to overhead obstructions.

2. Consult and follow the procedures presented in the HASP whenever excavations of six inches or greater are required. The procedure does not apply for excavations that employees physically could not enter (i.e., well borehole).

3. Consult and follow the procedures presented in the HASP when working adjacent to and over water.

4. The Project Site is located near natural waterways and wildlife habitats; therefore, biological hazards might be encountered. The primary biological hazards are mosquitoes, and stinging insects, and poisonous plants (e.g., poison ivy). Although unlikely, snakes, fox, rodents, and other feral animals may migrate onto the Site from surrounding areas.

5. DuPont Corporate lifting guideline restricts lifting by personnel to a maximum 50-pound limit.

B. These conditions are given for the benefit of the Contractor and are not intended to be complete or to be the basis for the structuring of the Contractor's Health and Safety Program. Refer to the General Conditions, Supplementary Conditions, and the Site Conditions for additional Site and contract conditions.

1.09 HEALTH AND SAFETY PLAN

A. The HASP has been developed in accordance with the DuPont Corporate Remediation Group safety and health standard operating procedures and applicable OSHA and other federal and state regulations.

B. The DSR has responsibility for implementing and enforcing the HASP. In the event of conflict, the DSR will govern.

C. Each participant involved in the Project will be briefed on and afforded the opportunity to question the HASP.

D. Develop the Contractor’s Site Safety Program in accordance to the requirements in the HASP and other regulatory requirements set forth by the OSHA and other federal and state regulations.

1.10 PERSONAL PROTECTIVE EQUIPMENT

A. As part of the Project scope, levels of personal protective equipment (PPE) might vary depending on the specific work tasks and areas.

B. At a minimum, work will be performed in hardhat, safety glasses, shirt with sleeves extending over the shoulder, pants that fully cover the leg, and steel-toe footwear with disposal protective non-permeable boot covers that shall be disposed of daily or whenever workers leave a Site.

C. Clearing and grubbing activities where poisonous plants are present will require additional PPE (i.e., Tyvek suites).

D. Activities that produce excessive noise, dust, or debris may require additional PPE.

E. Task-specific protection requirements are detailed in the HASP.

F. Provide employees and subcontractors the required PPE for the task being performed. In addition, the SSHO, with the DSR or his designee, may make modifications to levels of PPE in the field.

1.11 SITE CONTROL

A. Inform on-site personnel and visitors of hazardous substances, health hazards, confined spaces, and other risks that they might be exposed to, prior to commencement of the work.

B. Escort visitors throughout the duration that they are on-site.

C. Limit equipment, operations, and on-site personnel and visitors in accordance with the following work areas.

1. Work zone: Only authorized personnel are allowed to enter the work zone. On-site personnel and visitors entering the work zone must wear the prescribed level of personal protective equipment.

2. Support Zone: The function of the Support Zone includes

a) Entry and exit area for on-site personnel, visitors, and equipment to and from the work zone of Site operations.

b) Storage areas for clean safety and work equipment.

c) Field offices, eating and sanitary facilities, and parking.

D. The work zone will be clearly delineated using tape, barriers, signs, or whatever means are appropriate for the site.

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

A. Not used

END OF SECTION

Section 01 35 43—Environmental Protection Procedures

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Environmental protection requirements, spill and discharge response procedures, and corrective action procedures.

1.02 RELATED WORK

A. Section 01 33 00 – Submittal Procedures

B. Section 01 35 29 – Health, Safety and Emergency Response Procedures

C. Section 01 78 00 – Closeout Submittals

D. Section 31 23 00 – Excavation and Fill

E. Section 32 90 00 – Planting and Habitat Restoration

1.03 DEFINITIONS

A. Acronyms

1. ANSI – American National Standards Institute

2. ASTM – ASTM International

3. DSR – DuPont Site Representative

4. NPDES – National Pollutant Discharge Elimination System

5. SDS – Safety Data Sheet

6. TESC – Temporary Erosion and Sediment Control

7. VOC – Volatile Organic Compounds

8. VDEQ – Virginia Department of Environmental Quality

9. VPDES – Virginia Pollutant Discharge Elimination System

B. Definitions

1. Biobased Content: The amount of biobased carbon in the material or product as a percentage of weight (mass) of the total organic carbon in the material or product.

2. Biobased Materials: As defined in the Farm Security and Rural Investment Act, for purposes of Federal procurement of biobased products, “biobased” means a, “commercial or industrial product (other than food or feed) that is composed, in whole or in significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials.” Biobased materials also include fuels, chemicals, building materials, or electric power or heat produced from biomass as defined by The Biomass Research and Development Act of 2000.

3. Biodiesel: A fuel comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats, designated B100, and meeting the requirements of ASTM D6751.

4. Biodiesel Blend: A blend of biodiesel fuel meeting ASTM D6751 with petroleum-based diesel fuel, designated BXX, where XX represents the volume percentage of biodiesel fuel in the blend.

5. Readily Biodegradable: More than 60 percent of the fluid must break down into innocuous products when exposed to the atmosphere during a 28-day period.

6. Virtually Non-toxic: More than half the rainbow trout fingerlings in a population must survive after four days in an aquatic solution with concentrations of the fluid greater than 1,000 parts per million.

1.04 REFERENCES

A. The publications listed below form a part of this Contract Specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. ANSI

a) ANSI Z400.1 (2004) Hazardous Industrial Chemicals – Material Safety Data Sheets – Preparation

2. ASTM

a) ASTM D975 Standard Specification for Diesel Fuel Oils

b) ASTM D6751 Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels

c) ASTM D7467 Standard Specification for Diesel Fuel Oil, Biodiesel Blend (B6 to B20)

3. U.S. Environmental Protection Agency (EPA)

    a) National Pollutant Discharge Elimination System (NPDES) (1972; R 2005)

4. U.S. National Archives and Records Administration (NARA)

    a) 40 Code of Federal Regulations (CFR) Protection of Environment

    b) 40 CFR 261 Identification and Listing of Hazardous Waste

5. Waste Management Plan – Appendix C

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Meet with the DSR to review and alter proposed means and methods, as needed, to comply with the environmental pollution control program.

2. Direct agents of the press and regulatory officials to the DSR. Communicate with regulatory officials and agents of the press only as approved by the DSR.

B. Bio-diesel Blend Survey

1. Submit cost differential to substitute diesel with the use of bio-diesel blends B5 and B20 and complete the "comfort survey" describing issues that are anticipated to be encountered when using bio-diesel.

2. Identify locations that will be used to purchase the bio-diesel, how bio-diesel will be delivered to the Site, and the total gallons of diesel and equipment used in estimating the cost differential.

1.06 SUBMITTALS

DSR review is required for submittals designated as "Action Submittals." Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to the DSR for information only.

Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

A. Action Submittals

1. Pre-construction Condition Survey

2. Product datasheets for environmentally safe hydraulic fluid

B. Informational Submittals

1. Safety Data Sheets (SDS)

2. Bio-diesel blend survey

C. Closeout Submittals

1. Not used

D. Maintenance Material Submittals

1. Not used

1.07 QUALITY ASSURANCE

A. Regulatory Requirements

1. Comply with federal, state, and local regulatory requirements pertaining to legal disposal of construction and demolition waste materials.

2. Maintain records of permits, licenses, certificates, and other environmental regulatory requirement correspondences.

B. Pre-construction Condition Survey

1. Conduct a joint Pre-construction Condition Survey with the DSR and representatives of City of Waynesboro, prior to starting on-site construction activities.

2. Prepare a report, immediately after completing the survey, with hand sketches, photographs, or video recordings that indicate the condition of trees and shrubs, grassed and wetland areas, and existing features immediately adjacent to the work site, adjacent to assigned storage areas, and contiguous to access routes.

3. Submit the Pre-construction Condition Survey report to the DSR for signature and approval within 5 working days of conducting the Pre-construction Condition Survey. The Contractor and DSR will sign this report upon mutual agreement as to its accuracy and completeness.

4. The DSR will submit the Pre-construction Condition Survey report to the City for approval prior to the commencement of construction.

1.08 DELIVERY, STORAGE, AND HANDLING

A. SDS

1. Submit an SDS that has been prepared within the previous five years for each product specified in other sections or required by the Occupational Safety and Health Act to have an SDS.

2. Include information for SDS Sections 1 through 16 in accordance with ANSI Z400.1 and as follows.

    a) Section 11: Include data used to determine the hazards cited in Section 3. Identify acute data, carcinogenicity, reproductive effects, and target organ effects.

    b) Section 12: Include data regarding environmental impacts during raw materials acquisition, manufacture, and use. Include data regarding environmental impacts in the event of an accidental release.

    c) Section 13: Include data regarding the proper disposal of the chemical. Include information regarding recycling and reuse. Indicate whether or not the product is considered to be "hazardous waste" according to 40 CFR 261.

    d) Section 14: Identify hazard class for shipping.

    e) Section 15: Identify federal, state, and local regulations applicable to the material.

    f) Section 16: Include additional information relative to recycled content, bio-based content, and other information regarding environmental and health impacts.

B. Packaging Waste Management

1. When possible, furnish products with minimal and easily recyclable packaging and use manufacturers with policies that take back product packaging.

1.09 PROTECTION OF NATURAL RESOURCES

A. Preserve the natural resources within the Project boundaries and outside the limits of permanent work in their existing condition or restore to an equivalent condition approved by the DSR.

B. Control noise, dust, vectors, and the disposal of materials and other pollutants.

C. General Disturbance

1. Confine demolition and construction activities to work Area limits indicated on the Contract Drawings.

2. Remove debris, rubbish, and other waste materials resulting from demolition and construction operations from Site in accordance with the Waste Management Plan (Appendix C).

3. Transport materials with appropriate vehicles and dispose of them off site to areas that are approved for disposal by governing authorities having jurisdiction.

4. Avoid spillage by covering and securing loads when hauling on or adjacent to public streets and highways.

5. Remove spillage and sweep, wash, or otherwise clean Project Site, streets, and highways.

6. Burning is prohibited.

D. Water Resources

1. Comply with requirements of the NPDES and the applicable Virginia Pollutant Discharge Elimination System (VPDES) programs.

2. Prevent oily or other hazardous substances from entering the ground, drainage areas, and local bodies of water. Use readily biodegradable and virtually non-toxic hydraulic fluid in equipment operating on the water or within 50 feet of the shoreline.

3. Store and service construction equipment at areas designated for temporary staging and laydown.

4. Prevent ponding of stagnant water conducive to mosquito breeding habitat.

5. Prevent run-off from Site during demolition and construction operations.

6. Equipment will not be permitted to ford live streams.

E. Land Resources

1. Prior to construction, identify land resources to be preserved within the work area.

2. Do not remove, cut, deface, injure, or destroy land resources, including trees, shrubs, vines, grasses, topsoil, and landforms without permission from the DSR.

3. Coordinate protection practices with work specified in other sections of the Contract Specifications.

4. Erodible Soils

   a) Plan and conduct earthwork to minimize the duration of exposure of unprotected soils, except where the constructed feature obscures borrow areas, quarries, and waste material areas.

   b) Clear areas in reasonably sized increments only as needed to use the areas developed.

   c) Form earthwork to final grade as shown.

   d) Immediately protect side slopes and back slopes upon completion of rough grading.

5. Erosion and Sedimentation Control Devices

   a) Construct or install temporary and permanent erosion and sedimentation control features as required.

6. Tree and Plant Protection

   a) Prior to start of construction, tag each tree and plant scheduled to remain.

   b) Protect trees and plants scheduled to remain from damage.

   c) In the event of damage to tree or plant, DuPont may deduct the indicated value of the damaged tree or plant from the contract sum.

F. Air Resources

1. Prevent creation of dust, air pollution, and odors.

2. Sequence construction to avoid unnecessary disturbance to Site.

3. Use mulch, water sprinkling, temporary enclosures, and other appropriate methods as needed to limit dust and dirt rising and scattering in air. Do not use water when it may create hazardous or other adverse conditions such as flooding and pollution.

4. Store volatile liquids, including fuels and solvents, in closed containers. Do not store with materials that have a high capacity to adsorb Volatile Organic Compounds (VOC) emissions or in occupied spaces.

5. Properly maintain equipment to reduce gaseous pollutant emissions.

G. Fish and Wildlife Resources

1. Manage and control construction activities to minimize interference with and damage to fish and wildlife.

2. Do not conduct activities that could introduce sediment into a stream or cause a stream to become turbid during the time period of May 1 through June 30 of each year unless working within a cofferdam and TESC measures have been installed.

3. Do not disturb fish and wildlife.

4. Do not alter water flows or otherwise significantly disturb the native habitat related to the Project and critical to the survival of fish and wildlife, except as indicated or specified.

1.10 NOISE AND VECTOR CONTROL

A. Control noise pollution at the Site, to avoid causing a hazard or nuisance, and comply with local regulations.

B. Provide methods, means, and facilities to prevent pests and insects from posing a safety hazard or damaging the work.

C. Provide methods, means, and facilities to prevent rodents from accessing and invading premises.

1.11 SPILL AND DISCHARGE RESPONSE

A. Develop, implement, maintain, supervise, and be responsible for Environmental Protection and Spill and Discharge Control Procedures.

B. Keep spill response materials on site, in sufficient quantity to control spills from Contractor equipment and storage containers, through the duration of construction.

C. Notify the DSR immediately of each spill or discharge.

D. Be solely responsible for each spill and discharge that occur as a result of, or are contributed to, the actions of employees and subcontractors.

E. Cleanup such spills and leaks to the satisfaction of the DSR and in a manner that complies with applicable federal, state, and local laws and regulations.

F. Provide equipment and personnel to perform emergency measures required to contain spills and to remove spilled materials and soils and liquids that become contaminated due to spill. Properly dispose of collected spill material.

G. Provide equipment and personnel to perform decontamination measures that might be required to remove spilled material from previously uncontaminated structures, equipment, and material.

1. Determine the acceptable level of decontamination in consultation with the DSR, and as necessary, the Virginia Department of Environmental Quality (VDEQ).

2. Remove contaminated soils to complete cleanup.

3. Decontamination personnel using showers and cleansing or disposing of clothing and equipment in accordance with the Health and Safety Plan, Section 01 35 29 – Health, Safety and Emergency Response Procedures, and the Waste Management Plan (Appendix C).

4. Properly containerize, label, and dispose of contaminated materials such as soil and wood that cannot be decontaminated in accordance with applicable laws and regulations.

5. Pay for decontamination procedures and disposal of residues.

H. Spill Incident Report

1. Report spill incidents in accordance with Section 01 35 29 – Health, Safety, and Emergency Response Procedures.

2. Comply with requirements specified in the Waste Management Plan (Appendix C) and participate in the incident investigation.

3. Document spills on the Project Record Drawings and submit to the DSR as specified in Section 01 78 00 – Closeout Submittals.

1.12 CORRECTIVE ACTION

A. Take immediate corrective action upon receipt of a notice in writing from the DSR of noncompliance with the foregoing provisions.

B. Failure or refusal to comply promptly will be basis for the DSR to issue an order stopping all or part of the work until satisfactory corrective action has been taken.

C. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs of damages by the Contractor unless it was later determined that the Contractor was in compliance.

1.13 POST-CONSTRUCTION CLEANUP

A. Remove signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work, unless otherwise instructed in writing by the DSR.

B. Grade and fill disturbed areas and seed the entire area in accordance with Section 31 23 00 – Excavation and Fill and Section 32 90 00 – Planting and Habitat Restoration.

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

A. Not used

END OF SECTION

Section 01 40 00—Quality Requirements

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Contractor quality control (QC) requirements, including QC organization, documentation requirements, enforcement procedure, and notification of noncompliance procedure.

1.02 RELATED WORK

1. Section 01 33 00 – Submittal Procedures
2. Section 01 78 00 – Closeout Submittals

1.03 DEFINITIONS

A. Abbreviations and Acronyms

1. A2LA – American Association for Laboratory Accreditation
2. AASHTO – American Association of State Highway and Transportation Officials
3. CQC – Contractor's Quality Control
4. DFOW – Definable feature of work
5. DSR – DuPont Site Representative
6. GAI – Geosynthetic Accreditation Institute
7. HASP - Health and Safety Plan
8. IAS – International Accreditation Services, Inc.
9. MTC – Materials Testing Center
10. NVLAP – National Voluntary Laboratory Accreditation Program
11. PSA – Project Safety Analysis
12. QC – quality control
13. SDS – Safety Datasheet

1.04 REFERENCES

1. National Voluntary Laboratory Accreditation Program (NVLAP) administered by the National Institute of Standards and Technology

2. American Association of State Highway and Transportation Officials (AASHTO)

3. International Accreditation Services, Inc. (IAS)

4. U. S. Army Corps of Engineers Materials Testing Center (MTC)

5. American Association for Laboratory Accreditation (A2LA)

6. Geosynthetic Accreditation Institute (GAI)

1.05 ADMINISTRATIVE REQUIREMENTS

A. Establish and maintain an effective QC Program consisting of a QC Manager, plans, procedures, and organization necessary to produce an end product that complies with the Contract requirements.

B. Cover within the QC Program, construction operations, both on-site and off-site, and coordinate with the proposed construction sequence.

C. Furnish qualified personnel, appropriate facilities, instruments, and testing devices necessary for the performance of the QC function.

D. No construction work or testing may be performed unless the QC Manager or designated QC Staff is on the work site.

E. The DuPont Site Representative (DSR) reserves the right to require changes in the QC Program and operations as necessary, including removal of personnel, to ensure the specified quality of Work. The DSR reserves the right to interview members of the QC organization throughout the Contract Time in order to verify the submitted qualifications.

F. Notify the DSR, in writing, of proposed changes in the QC organization personnel a minimum of 7 calendar days prior to a proposed change. Proposed changes are subject to the acceptance by the DSR.

G. Complete sufficient inspections and tests of items of Work, including that of subcontractors, to ensure conformance to applicable Contract Drawings and Contract Specifications.

1.06 SUBMITTALS

A. DSR review is required for submittals designated as "Action Submittals." Submittals not designated as "Action Submittals" are for Contractor QC approval and are to be submitted to DSR for information only. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

B. Action Submittals

1. Proposed changes to the QC Program

C. Informational Submittals

1. Certificates
   a) Testing laboratory Certificate of Accreditation and Scope of Accreditation

   b) QC Certifications: As required by Article QC CERTIFICATIONS.

2. Qualification Statements

   a) QC Manager

   b) QC Staff

D. Closeout Submittals

1. Record Documentation

   a) Certificate attesting to the accuracy of the As-built Drawings.

1.07 QUALITY ASSURANCE

A. Regulatory Requirements

1. Comply with applicable federal, state, and local laws, ordinances, rules and regulations, specifications and standards.

2. References to laws, ordinances, rules and regulations, specifications and standards in the Contract Documents imply the latest issue in effect, including amendments and errata at the time bids are taken, unless otherwise stated.

3. Give necessary notices, obtain permits (except as otherwise noted) and pay governmental taxes, fees, and other costs in connection with the work.

4. File necessary plans, prepare documents, and obtain necessary approvals of governmental departments having jurisdiction.

5. Obtain required Certificates of Inspection and Approval for the work and deliver the same to the DSR, except as otherwise noted herein.

B. Qualifications

1. QC Manager

a) Provide a QC Manager at the work site to implement and manage the QC Program. The QC Manager may perform the duties of Project Superintendent.

b) Submit documentation showing that the QC Manager is qualified to perform the inspection and testing required and has a minimum of 10 years combined experience as a superintendent, inspector, QC Manager, Project Manager, or Construction Manager on similar size and type construction contracts that included the major trades that are part of this Contract.

c) The QC Manager is required to conduct QC meetings, perform the three phases of control (see paragraph 1.08), perform submittal review and approval, ensure testing is performed, and provide QC certifications and documentation required in this Contract.

d) The QC Manager is responsible for managing and coordinating the three phases of control and documentation performed by others.

2. Alternate QC Manager

a) Designate an alternate for the QC Manager, meeting the QC Manager qualifications, to serve in the event of the designated QC Manager's absence.

b) The period of absence may not exceed 2 weeks at one time, and not more than 30 workdays during a calendar year.

3. QC Staff

a) Provide QC personnel to ensure coverage of each work phase, work shift, and work crew involved in the construction.

b) Perform QC activities under the direction of the QC Manager and have no other duties on site.

c) The actual strength of the QC staff may vary during any specific work period to cover the needs of the work period. Add additional staff when necessary for a proper QC organization.

d) Submit documentation showing that the QC staff is fully qualified by experience and technical training to perform their assigned QC responsibilities and allow sufficient time to carry out these responsibilities.

e) Clearly identify the duties and responsibilities of each staff member in the QC Program.

f) Provide QC staff at the site of work during construction activities and ensure they have the authority to take action necessary to ensure compliance with the Contract.

g) Fulfillment of the minimum QC staff in no way relieves the Contractor of meeting the basic requirements of quality construction in accordance with this Contract.

h) QC staff members are subject to acceptance by the DSR.

4. Testing Laboratory

a) Perform testing specified in individual specifications by an approved commercial testing laboratory.

b) Provide construction materials testing laboratories accredited by a laboratory accreditation authority and submit a copy of the Certificate of Accreditation and Scope of Accreditation.

c) Laboratory Accreditation Authorities include

1) National Voluntary Laboratory Accreditation Program (NVLAP) administered by the National Institute of Standards and Technology

2) American Association of State Highway and Transportation Officials (AASHTO)

3) ASTM International (ASTM)

4) International Accreditation Services, Inc. (IAS)

5) U. S. Army Corps of Engineers Materials Testing Center (MTC)

6) American Association for Laboratory Accreditation (A2LA)

7) Geosynthetic Accreditation Institute (GAI)

d) Include in the laboratory's scope of accreditation the appropriate materials and testing standards (e.g., ASTM D3666) listed in the technical sections of the Specifications.

e) Ensure laboratories engaged in Hazardous Materials Testing meet the requirements of OSHA and EPA.

f) The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."

g) Capability Check and Recheck

1) The DSR retains the right to check laboratory equipment in the proposed laboratory and the laboratory technician's testing procedures, techniques, and other items pertinent to testing, for compliance with the standards set forth in this Contract.

2) If the selected laboratory fails the capability check, the Contractor will be assessed the actual cost for the recheck to reimburse DuPont for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the Contract amount due the Contractor.

5. Organizational Changes

a) Obtain the DSR's approval before replacing any member of the QC staff. Include the names, qualifications, duties, and responsibilities of each proposed replacement in each request.

1.08 THREE PHASES OF CONTROL

A. Adequately cover both on-site and off-site work and include the following for each definable feature of work.

B. Preparatory Phase (Phase 1)

1. Conduct the preparatory phase with the superintendent and the foreman responsible for the Definable feature of work (DFOW).

2. Document the results of the preparatory phase actions in the daily report.

3. Perform the following prior to beginning work on each DFOW

a) Review each paragraph of the applicable specification sections.

b) Review the Contract Drawings.

c) Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required.

d) Review the testing requirements and ensure that provisions have been made to provide the required QC testing.

e) Examine the work area to ensure the required preliminary work has been completed.

f) Examine the required materials, equipment, and sample work to ensure they are on hand and conform to the approved shop drawings and submitted data.

g) Review the Health and Safety Plan (HASP) and the appropriate PSA to ensure applicable safety requirements are met, and that required Safety Data Sheet (SDS) are submitted.

h) Discuss construction methods and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each DFOW.

C. Initial Phase (Phase 2)

1. Conduct the Initial Phase with the foreman responsible for a DFOW when construction crews are ready to start work on that DFOW.

2. Observe the initial segment of the work to ensure it complies with Contract requirements.

3. Document the results of the Initial Phase in the daily report.

4. Perform the following for each DFOW

a) Establish the quality of workmanship required.

b) Resolve conflicts.

c) Ensure the approved laboratory performs testing.

d) Check work procedures for compliance with the HASP and the appropriate PSA to ensure applicable safety requirements are met.

D. Follow-up Phase (Phase 3)

1. Perform daily checks to ensure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work.

2. Record the checks in the Contractor's Quality Control (CQC) documentation.

3. Conduct final follow-up checks and correct deficiencies prior to the start of additional features of work that may be affected by the deficient work.

4. Do not build upon nor conceal non-conforming work.

E. Additional Preparatory and Initial Phases

1. Conduct additional preparatory and initial phases on the same definable features of work if

a) The quality of on-going work is unacceptable.

b) There are changes in the applicable CQC staff, onsite production supervision, or work crew.

c) Work on a definable feature is resumed after a substantial period of inactivity.

d) Other problems develop.

1.09 TESTING OF MATERIALS

A. Perform required sampling and testing. The DSR and Engineer retains the right to perform additional tests on materials and equipment.

B. Submit materials for testing, taking into consideration when the materials will be incorporated in the work and the capabilities and capacities of the testing laboratory.

C. Furnish to the DSR and Engineer duplicate certified copies of routine tests made by the mill, shop, or factory where material or equipment has been fabricated or manufactured for the Project.

D. Perform tests specified or required to verify that control measures are adequate to provide a product that conforms to the Contract Specifications. Testing includes operation and acceptance tests when specified.

E. Perform the following activities and record and provide the following data

1. Verify testing procedures comply with Contract requirements.

2. Verify facilities and testing equipment are available and comply with testing standards.

3. Check test instrument calibration data against certified standards.

4. Verify recording forms and test identification control number system, including test documentation requirements, have been prepared.

5. Record tests taken, both passing and failing, on the QC report for the date taken. Include Contract Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test. Actual test reports for tests performed off-site may be submitted later with a reference to the test number and date taken.

F. Test Results

1. Cite applicable Contract requirements, tests, or analytical procedures used.

2. Provide actual results and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, notify the DSR and Engineer immediately.

3. Conspicuously stamp the cover sheet for each report in large red letters "CONFORMS" or "DOES NOT CONFORM" to the Contract Specification requirements, whichever is applicable.

4. Ensure a testing laboratory representative authorized to sign certified test reports signs the test results.

5. Furnish the signed reports, certifications, and other documentation to the DSR and Engineer via the QC Manager.

6. Failure to submit timely test reports, as stated, may result in nonpayment for related work performed and disapproval of the test facility for this Contract.

1.10 QC CERTIFICATION

A. Contractor Quality Control Report Certification

1. Include the following statement on each daily report: "On behalf of the Contractor, I certify that this report is complete and correct and equipment and material used and work performed during this reporting period is in compliance with the Contract Drawings and Contract Specifications to the best of my knowledge except as noted in this report."

B. Invoice Certification

1. Furnish a certificate to the DSR with each payment request, signed by the QC Manager, attesting that As-built Drawings are current and attesting that the work for which payment is requested, including stored material, is in compliance with Contract requirements.

C. Completion Certification

1. Upon completion of work under this Contract, furnish a certificate from the QC Manager to the DSR and Engineer attesting that "the work has been completed, inspected, tested and is in compliance with the contract."

1.11 DOCUMENTATION

A. Records

1. Maintain current records of on-site and off-site QC operations, activities, and tests performed, including the work of subcontractors and suppliers.

2. Furnish records on an acceptable form and include factual evidence that required QC activities and/or tests have been performed.

3. Furnish records covering conforming and deficient features and include a statement that equipment and materials incorporated in the work and workmanship comply with the Contract.

4. Reports are required for each day work is performed. Account for each calendar day throughout the life of the Contract. Prepare and submit one report for every 7 days of no work and on the last day of a no work period. The first report following a day of no work will be for that day only.

5. Fill in every space on forms. Use "N/A" if nothing can be reported in one of the spaces.

6. Ensure the superintendent and the QC Manager prepares and signs the Contractor daily reports, respectively.

7. Use terminology consistent with the construction schedule for reporting of work.

8. Include pertinent information in the "remarks" section of reports, including directions received, problems encountered during construction, work progress and delays, conflicts or errors in the Contract Drawings or Contract Specifications, field changes, safety hazards encountered, instructions given and corrective actions taken, delays encountered and a record of visitors to the work site.

9. For each remark given, identify the Schedule Activity Number that is associated with the remark.

B. Quality Control Validation

1. Establish and maintain the following in a series of divided and tabbed three ring binders.

    a) Milestone inspections arranged by Activity/Event Number.

    b) A current up-to-date copy of the Testing Plan and Log with supporting field test reports, arranged by Contract Specification section.

    c) Copies of Contract modifications, arranged in numerical order. Include documentation that modified work was accomplished.

    d) A current up-to-date copy of the Rework Items List.

    e) Maintain up-to-date copies of punch lists issued by the QC Staff on the Contractor and Subcontractors and punch lists issued by the DSR and Engineer.

2. Ensure binders are readily available to the DSR and Engineer during business hours.

C. As-built Drawings

1. Review the As-built Drawings required by Section 01 78 00 – Closeout Submittals, keep As-built Drawings current on a daily basis and mark to show deviations that have been made from the Contract Drawings.

2. Ensure each deviation has been identified with the appropriate modifying documentation number.

3. Initial each deviation or revision.

4. Upon completion of work, submit a certificate attesting to the accuracy of the As-built Drawings prior to submission to the DSR.

1.12 NOTIFICATION OF NONCOMPLIANCE

A. The DSR will notify the Contractor of each detected noncompliance with the foregoing requirements.

B. Immediately take corrective action after receipt of such notice.

C. Such notice, when delivered to the Contractor at the site of the work, will be deemed sufficient for the purpose of notification.

D. Failure or refusal to comply promptly might be basis for the DSR to issue an order stopping all or part of the work until satisfactory corrective action has been taken.

E. Such stop orders may not be made the basis of a claim for extension of time or for excess costs or damages.

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

A. Not used

END OF SECTION

Section 01 41 26—Permits

PART 1 – GENERAL

1.01 SUMMARY

A. This Section describes the Contract-applicable permits.

1.02 RELATED WORK

A. The provisions and intent of the Contract, including the Procurement and Contracting Requirements, the Standard Provisions, and General Conditions, apply to this work as if specified in this Section. Work related to this Section is described throughout the specifications.

1.03 DEFINITIONS

A. Acronym

1. DSR – DuPont Site Representative

2. USACE – United States Army Corps of Engineers

3. VADEQ – Virginia Department of Environmental Quality

4. VMRC – Virginia Marine Resources Commission

1.04 REFERENCES

A. Not used

1.05 PERMITS

A. Keep fully informed of all local ordinances, as well as state and federal laws that in any manner affect the Work herein specified. At all times, comply with said ordinances, laws, and regulations, and protect and indemnify the DSR and its officers and agents against any claim or liability arising from or based on the violation of such laws, ordinances, or regulations. Secure and pay for all permits, licenses, and inspection fees necessary for prosecution and completion of the work unless otherwise specified.

B. The Contractor shall comply with all conditions attached to applicable city, county, federal, state, and local permits found in Appendix B – Permits. These permits include the following.

1. USACE Section 404 Permit – Nation Wide Permit <PERMIT NUMBER HAS NOT BEEN ASSIGNED BY USACE – WILL UPDATE WHEN AVAILABLE>

2. USACE Section 401 Water Quality Permit

3. VADEQ Virginia Water Protection Permit

4. VMRC Permit for Sub-aqueous Encroachment

5. City of Waynesboro Erosion and Sediment Control Plan/Permit

6. City of Waynesboro Storm Water Discharge Permit

1.06 PERMITS OBTAINED AFTER BID SUBMITTAL

A. If, after the bid submittal date, the DSR obtains any permits that require changes to the work hereunder, and thereby cause an increase or decrease in the cost of, or the time required for, the performance of the work, submit information sufficient for the DSR to determine the extent of the effects on the cost and/or schedule. If the DSR agrees the cost and/or schedule will be affected by such changes, such effects will be handled in accordance with the General Conditions. The DSR will provide Contractor with a copy of any such permits. The Contractor shall comply with all applicable terms and conditions contained in such permits.

1.07 POSTING PERMITS

A. Post permits at the site of the work and make available for review and inspection upon request by regulatory authorities.

1.08 INSPECTIONS

A. The Contractor shall call and make any arrangements for all inspections and testing required by the permits and conditions of the permits.

B. Post inspection reports at the work Site.

1.09 RESTORATION OF PROPERTY

A. Comply with all property-restoration requirements contained in permits and agreements to complete the work.

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

A. Not used

END OF SECTION

APPENDIX A

DIVISION 01—GENERAL REQUIREMENTS
Section 01 50 00—Temporary Facilities and Controls

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Temporary construction facilities, utilities, and controls, including, access roads during construction, parking requirements, and temporary buildings.

1.02 RELATED WORK

A. Section 02 51 00 – Equipment Decontamination and Screening

1.03 DEFINITIONS

A. Abbreviations and Acronyms

1. ANSI – American National Standards Institute
2. BMA – Bank Management Area
3. CFR – Code of Federal Regulations
4. DSR – DuPont Site Representative
5. NARA – U.S. National Archives and Records Administration
6. OSHA – Occupational Safety and Health Act
7. VDOT – Virginia Department of Transportation
8. WWTP – Waste water treatment plant

1.04 REFERENCES

A. Reference Standards: The publications listed below form a part of this Contract Specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. American National Standards Institute (ANSI)
   a) ANSI/ISEA Z308.1 Minimum Requirements for Workplace First Aid Kits and Supplies
2. U.S. National Archives and Records Administration (NARA)
   a) 29 CFR 1910.151b Medical Services and First Aid

b) 29 CFR 1926 Safety and Health Regulations for Construction

c) 29 CFR 1926.51 Sanitation

d) 29 CFR 1926.56 Illumination

1.05 ADMINISTRATIVE REQUIREMENTS

A. Not used

1.06 SUBMITTALS

Submit the following in accordance with Section 01 33 00 – Submittal Procedures

A. Action Submittals

1. Shop Drawings

a) Layout of temporary facilities to be installed at the Jones Hollow Property site including temporary fences, points of access, roads, parking areas, buildings, and staging and storage areas prior to mobilization.

b) Layout of temporary facilities to be installed at the BMA sites including temporary fences, points of access, roads, parking areas, and staging and storage areas prior to mobilization.

1.07 FIELD OFFICES AND SHEDS AT THE JONES HOLLOW PROPERTY

A. Provide portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations with steps and landings at entrance doors. Securely fix steps and landings to the structure prior to use.

B. Provide additional structures as required. Existing structures on the site may not be used by the Contractor without the written consent of the DuPont Site Representative (DSR).

C. Obtain written permission from the DSR prior to siting temporary structures on the site. Provide off site facilities for office and storage spaces to meet Contractor’s needs.

D. Fill and grade sites for temporary structures to provide drainage away from buildings.

E. Construction: Structurally sound, secure, weather-tight enclosures for office and storage spaces with lighting, electrical outlets, heating, cooling, and ventilating equipment as specified.

F. Size sheds to storage requirements for products of individual sections, allowing for access and orderly provision for maintenance and for inspection of products.

G. Interior Materials in Storage Sheds: As required to provide specified conditions for storage of products.

H. Locate offices and sheds a minimum distance of 30 feet from existing and new structures.

I. Fire Extinguishers: Provide appropriate type fire extinguisher at each office and each storage area. Minimum required: 10-pound capacity, rated A, B, C.

J. Heating, Cooling, and Ventilating for Offices: Provide automatic equipment to maintain comfort conditions in conformance with Article TEMPORARY HEATING, COOLING AND VENTILATION.

K. Heating, Cooling, and Ventilating for Storage Spaces: Provide heating and ventilation as needed to maintain products in accordance with Contract Documents; adequate lighting for maintenance and inspection of products in conformance with Article TEMPORARY HEATING, COOLING AND VENTILATION.

L. Install office spaces ready for occupancy prior to mobilization.

M. Employee Residential Occupancy: Not allowed.

N. Contractor Office and Facilities

1. Size: For Contractor's needs.

2. Telephone and Fax: For Contractor’s needs.

3. Other Furnishings: Contractor's option.

4. Equipment: Six adjustable band hard hats, six pairs of side-shield safety glasses with clear lenses, and six Virginia Department of Transportation (VDOT)-compliant, high-visibility safety vests for visitors.

O. Provide the following furnishings in an easily accessible area.

1. One industrial first aid kit conforming to Occupational Safety and Health Act (OSHA) requirements 29 CFR 1910.151b and 29 CFR 1926.50 and containing components in accordance with ANSI/ISEA Z308.1.

2. One outside thermometer (high/low recording type).

3. Potable water dispenser with dual temperature (warm/cool) spigots.

P. DSR Office Facilities

1. Provide one private office at site for the sole use of the DSR with separate entrance door with new lock and two keys.

2. Telephone

    a) Provide, maintain, and pay for telephone service to DSR's field office at time of project mobilization.

    b) Provide one dedicated direct-line instrument in the DSR's field office.

    c) Provide one pushbutton telephone with speakerphone and wireless handset. Speakerphone application must be clear, audible, and able to perform conference calls.

3. Furnishings

    a) One standard size desk, 3-feet by 5-feet with plastic laminate top and three drawers.

    b) One drafting table: 36-inches by 72-inches by 33-inches high with one equipment drawer.

    c) One metal, double-door storage cabinet to fit under table.

    d) Plan rack to hold working drawings, shop drawings, and record documents.

    e) One standard four-drawer, legal-size metal filling cabinet with locks and two keys per lock.

    f) One rolling, swivel desk chair with adjustable height, back, lumbar support, and armrests.

    g) Two straight chairs.

    h) Wastebasket

Q. Maintain temporary field offices and furnishings.

1.08 ACCESS ROADS FOR JONES HOLLOW PROPERTY AND BMA SITES

A. Construct temporary all-weather access roads from designated area to serve construction area, of a width and load bearing capacity to provide unimpeded traffic for construction purposes.

B. Extend and relocate as work progress requires. Provide detours necessary for unimpeded traffic flow.

C. Provide and maintain access to fire hydrants and control valves free of obstructions.

D. Provide means of removing mud from vehicle wheels before entering streets (e.g., stabilized construction entrance) from Jones Hollow Property and BMA sites.

E. Provide means of decontaminating vehicles and equipment before entering streets from project BMA sites. See Section 02 51 00 – Equipment Decontamination and Screening.

F. Designated existing on-site roads may be used for construction traffic.

G. Operating tracked vehicles on paved surfaces should be minimized. Use rubber tracks or rubber pads for steel tracks if operating tracked vehicles on paved surfaces. Obtain written permission from the DSR before operating any tracked vehicle on paved surfaces.

1.09 PARKING

A. Improve existing parking areas to accommodate construction personnel.

B. When site space is not adequate, provide additional off-site parking.

1.10 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

1. At the Constitution Park Bank Management Area (BMA), enclose the project site with a temporary 6-foot high security fence to protect the public from entering the project site.

2. At the Waste water treatment plant (WWTP) A and B BMAs, enclose the project site with highly visible snow fencing.

3. At all BMAs, use jersey barriers to block temporary construction entrances from vehicular traffic during non-work hours.

B. Provide protection for plants designated to remain. Replace damaged plants.

C. Protect vehicular traffic, stored materials, site, and structures from damage.

1.11 TEMPORARY ELECTRICITY AND LIGHTING FOR CONSTRUCTION

A. Comply with National Electric Code, federal, state, and local codes and regulations, and utility company requirements.

B. Complement existing power service capacity and characteristics as required. Determine actual power requirements associated with site work activities and arrange with the local utilities for installation and service of additional supply or provide portable electrical supply. Coordinate with the Power Company to ensure the system is sufficient and adequate for temporary power needs and that existing power lines and poles are relocated to accommodate excavation and other construction activities.

C. Installation by personnel familiar with code requirements and qualified for the work to be performed. Install circuit and branch wiring with area distribution boxes located so that power and lighting are available, if required, throughout the construction site by the use of construction-type power cords. Guard, bury, or isolate by elevation temporary wiring to prevent accidental contact by equipment.

D. Grounding System: Protect circuits with ground fault interrupters.

E. Lighting: Maintain lighting and provide routine repairs. Provide adequate artificial lighting for work areas when natural light is not adequate for work. Light work areas to not less than the minimum illumination intensities listed in OSHA Standard 29 CFR 1926.56.

1.12 TEMPORARY HEATING COOLING AND VENTILATION

A. Provide heating, cooling, and ventilation devices and heat, cool, and ventilate as needed to maintain specified conditions for construction operations.

B. Prior to operation of equipment for temporary heating, cooling, or ventilation purposes, verify installation is approved for operation, equipment is lubricated, and filters are in place. Provide for operation, maintenance, and regular replacement of filters and worn or consumed parts.

C. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

D. Utilize existing ventilation equipment. Extend and supplement equipment with temporary fan units as required to maintain clean air for construction operations.

1.13 TEMPORARY WATER SERVICE

A. Provide water for construction purposes. DuPont will not furnish water for Contractor use.

B. Provide installation, maintenance, usage, and removal of temporary water lines and equipment.

1.14 TEMPORARY SANITARY FACILITIES

A. Provide, at time of project mobilization, and maintain required facilities and enclosures.

B. Provide sanitary facilities of the chemical toilet type complying with OSHA Standard 29 CFR 1926.51 unless otherwise accepted by the DSR.

C. Collect and remove sanitary wastes from the site in an appropriate manner.

D. Remove sanitary facilities from the site after final acceptance unless otherwise directed by the DSR.

1.15 PROTECTION OF INSTALLED WORK

A. Protect installed work and provide special protection where specified in individual Contract Specification sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Prohibit traffic from landscaped areas.

1.16 SECURITY

A. Provide supplemental security and facilities to protect the work and Contractor's operations from unauthorized entry, vandalism, or theft.

B. Contact the local emergency response agencies to ascertain the type of response required to potential emergency situations associated with the work and to coordinate the responses of the various units.

C. Prepare a list of emergency points of contact, telephone numbers, radio frequencies, and call signs so that dependable responses can be executed.

D. Maintain program throughout construction period until DuPont acceptance precludes the need for Contractor security.

E. Restrict entrance of persons and vehicles into Project site. Allow entrance only to authorized persons with proper identification.

F. Maintain a list of accredited persons; submit copy to DSR on request.

G. Require personnel to sign in upon entering the site and to sign out when leaving.

H. Minimize personnel on-site. Ensure off-duty personnel leave the site as soon as possible.

I. Allow no visitors without the approval of the DSR except for properly identified regulatory personnel.

J. Do not permit visitors to enter active work areas without the expressed permission of the DSR.

K. Maintain log of visitors that includes name, affiliation, and purpose of visit. Make available to DuPont or the DSR on request.

L. Require signature of visitors on a form relieving DuPont and the DSR of the liability of any consequences related to potential hazards associated with the site.

1.17 REMOVAL OF FACILITIES, UTILITIES AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials prior to final inspection.

B. Remove underground temporary installations to a minimum depth of 2 feet below final grade. Grade site as indicated.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

E. DuPont-owned structures, office trailers, and other property that was utilized during the project will remain on site unless other arrangements are made between the Contractor and DuPont.

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

A. Not used

END OF SECTION

DIVISION 01—GENERAL REQUIREMENTS
Section 01 60 00—Product Requirements

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Product transportation, handling, storage, protection, and support requirements.

1.02 RELATED WORK

A. Section 01 33 00 – Submittal Procedures

1.03 DEFINITIONS

A. Acronym

1. DSR – DuPont Site Representative

B. Definition

1. Product – New material, machinery, components, equipment, fixtures, and systems forming the work, excluding machinery and equipment used for preparation, fabrication, conveying, and erection of the work. Products may also include existing materials or components required for reuse.

1.04 REFERENCES

A. Waste Management Plan – Appendix C

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Coordinate the delivery and installation of products with the work of other sections.

2. Electrical interface: Install or mount electrical components and apparatus as required for the equipment specified.

3. Startup and testing: Coordinate startup and testing with work of other sections and ensure required utilities and water supply are available.

1.06 SUBMITTALS

DuPont Site Representative (DSR) review is required for submittals designated as “Action Submittals.” Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to the DSR for information only. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

A. Action Submittals

1. Not used

B. Informational Submittals

1. Qualification Statements

a) Qualification of Manufacturer Representative

C. Closeout Submittals

1. Not used

D. Maintenance Material Submittals

1. Not used

1.07 QUALITY ASSURANCE

A. Qualifications

1. Manufacturer Representative

a) Endorsed by the product manufacturer to review installation, perform pre-start-up checks, startup, test, adjust, demonstrate, and provide instruction for the product.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements

1. Transport products in accordance with supplier and manufacturer written instructions.

2. Promptly inspect shipments to ensure products comply with requirements and quantities are correct.

3. Inspect products delivered to site for damage. Do not offload damaged products. Return damaged products to manufacturer.

4. Unload with minimum handling. Provide special lifting harness and apparatus required by manufacturer to unload products.

B. Storage and Handling Requirements

1. Handle, store, and protect products in accordance with the manufacturer's recommendations.

2. Ensure products are accessible for inspection.

3. Ensure packaging, seals, and labels remain intact and legible.

4. Protect from the weather, excessive humidity, excessive temperature variation, detrimental conditions, and dirt, dust, and other contaminants.

5. Do not store products directly on ground. Ensure water and other liquids do not impound under and around stored products.

6. Provide off-site storage and protection when on-site storage and protection are not available or allowed.

7. Deliver products to final location in sound, undamaged condition.

8. Prevent damage to interior and exterior surfaces. Repair damage.

9. Carry and do not drag products.

C. Packaging Waste Management

1. When possible, furnish products with minimal and easily recyclable packaging and use manufacturers with policies that take back product packaging.

2. Dispose of product packaging in accordance with the Waste Management Plan (Appendix C) and applicable laws and regulations.

1.09 PRODUCT OPTIONS

A. Products specified by reference standards or by description only: Any product meeting those standards or description.

B. Products specified by naming one or more manufacturer: Products of manufacturer(s) named and meeting specifications, no options or substitutions allowed.

C. Products specified by naming one or more manufacturers with a provision for substitutions: Submit a request for substitution for each manufacturer not named.

D. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

E. Provide interchangeable components of the same manufacturer for similar components.

1.10 SUBSTITUTIONS

A. The products specified establish a standard of required function, dimension, appearance and quality to be met by each proposed substitution to become an “or equal” item.

B. Submit written request for approval for each proposed substitution no less than 10 days prior to the date for receipt of Bids. Substitutions received by DSR after this time will not be considered.

C. Include the following in proposed substitution requests

1. Name of the product that substitution is requested for.

2. A complete description of the proposed substitute including Contract Drawings, cut sheets, performance and test data, and other information necessary for an evaluation.

3. A statement setting forth changes in other materials, equipment, and work that incorporation of the substitute would require.

D. The burden of proof of the merit of the proposed substitute is upon the Bidder. The DSR's decision of approval or disapproval of a proposed substitution is final. If the DSR approves proposed substitution, such approval will be set forth in an Addendum issued to each prospective Bidder. Do not rely upon approvals made in any other manner.

E. After bidding, substitutions might be considered when a product becomes unavailable through no fault of the Contractor by following the procedure described in the following paragraphs.

F. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.

G. A request constitutes a representation that the Bidder

1. Has investigated the proposed product and determined that it meets or exceeds the quality level of the specified product.

2. Will provide the same warranty for the Substitution as for the specified product.

3. Will coordinate installation and make changes to other work, which may be required for the work to be complete with no additional cost to DuPont.

4. Waives claims for additional costs or time extension, which may subsequently become apparent.

H. Substitutions will not be considered when they are indicated or implied on product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

I. Substitution Submittal Procedure

1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.

2. Submit supporting documentation demonstrating the proposed product equivalence.

3. The DSR will notify Bidder, in writing, of decision to accept or reject request prior to closing date for bids.

1.11 INSTALLATION REQUIREMENTS

A. Check each dimension indicated immediately after award of the Contract. Advise the DSR promptly of discrepancies or interference and obtain such measurements and information as may be required to satisfactorily install the work.

B. Verify that each measurement and elevation is correct before ordering material or doing work. Submit differences found between field measurements and elevations and those indicated promptly to the DSR for adjustment and approval before proceeding with the work.

C. Verify that site conditions are ready to receive the work.

D. Accurately lay out work and establish heights and grades in strict accordance with the Contract Drawings, buildings.

E. Verify that required utilities are available and of the correct characteristics.

F. Align, level, and adjust equipment for satisfactory operation. Install so that connection and disconnection of piping and accessories can be done readily, and so that parts are easily accessible for inspection, operation, and maintenance.

G. Install products in accordance with manufacturer’s written instructions and recommendations.

H. Furnish and apply initial grease or oil recommended by manufacturer before startup.

I. In the event that installation requirements need clarification as to Contract responsibility, the DSR will be final judge in delineation of responsibility. In no case will need for clarification result in extension of Contract Time or change in Contract Price.

1.12 MANUFACTURER'S REPRESENTATIVE

A. Provide a qualified Manufacturer Representative to review product installation, perform pre-startup checks, startup, test, adjust, and demonstrate the product and provide written certification that product and its installation meet manufacturer's recommendations and comply with the Specifications.

B. Provide services of Manufacturer Representative for the minimum period of time indicated in the Specification for each product. Times indicated do not include travel time. Extend time as necessary to correct deficiencies and retest. Provide time for instruction in addition to hours provided for startup, testing, correction of deficiencies, and demonstrations during non-instructive time. Time spent in these other activities will not be considered training hours.

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

A. Not used

END OF SECTION

DIVISION 01—GENERAL REQUIREMENTS
Section 01 71 00—Examination and Preparation

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Mobilization

2. Acceptance of conditions

3. Field engineering

1.02 RELATED WORK

A. Section 01 33 00 – Submittal Procedures

1.03 DEFINITIONS

A. Definitions

1. Demobilization – Disassembly and removal from the site of equipment, tools, materials, and supplies that are not incorporated in the work, restoration on of the work area, and services preparatory to closeout of the work.

2. Mobilization – Assembly and delivery to the site of equipment, tools, materials, and supplies necessary for the prosecution of work that are not intended to be incorporated in the Work, preparation of the work area, and services preparatory to commencement of the work.

B. Acronyms

1. ASCE – American Society of Civil Engineers (ASCE)

2. DSR – DuPont Site Representative

1.04 REFERENCES

The publications listed below form a part of this Contract Specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. American Society of Civil Engineers (ASCE)

a) CI/ASCE 38-02 (2003) Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Furnish information to local utility and the DuPont Site Representative (DSR) that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, and other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

2. Coordinate fabrication schedule with construction progress to avoid delaying the work.

1.06 SUBMITTALS

DSR review is required for submittals designated as "Action Submittals." Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to DSR for information only.

Submit the following in accordance with Section 01 33 00 – Submittal Procedures

A. Action Submittals

1. Shop Drawings

a) Layout of temporary fences, points of access, roads, parking areas, buildings, and staging and storage areas prior to mobilization.

b) Pre-construction Survey

c) Surveys for Measurement and Payment

1) Informational Submittals

2. Field Quality Control Submittals

a) Submit documentation to verify the accuracy of field engineering work upon the request of the DSR.

3. Special Procedure Submittals

a) Submit copies of original field notes, computations, and other survey records to the extent necessary to determine the proper amounts of progress and final payments to the DSR.

4. Qualification Statements

a) Submit name, address, and telephone number of Surveyor and Engineers before starting work.

B. Closeout Submittals

1. Record Documentation

a) Log of control and survey work.

b) Certified survey illustrating dimensions, locations, angles, and elevations of construction and site work.

c) Two copies of original surveyor notes, records, and calculations used and developed by the licensed surveyor. Submit data in a bound book organized chronologically and fully indexed.

d) Description and recovery sketches of permanent control survey monuments established during the Contract.

e) Subsurface utility engineering data and record drawings.

f) Record drawings to be used for determining work quantities and documenting construction.

C. Maintenance Material Submittals

1. Not used

1.07 QUALITY ASSURANCE

A. Qualifications

1. Licensed Professional

a) Land Surveyor registered in the State of Virginia and acceptable to the DSR.

b) Professional Engineer licensed in the State of Virginia.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements

1. Deliver construction tools, equipment, plant, temporary buildings, materials, and supplies to the site in conformance with local governing ordinances and regulations.

1.09 FIELD CONDITIONS

A. Existing Conditions

1. Investigate and verify the existence and location of mechanical and electrical systems, underground utilities, and other construction affecting the work.

2. Investigate and verify points of connection of utility services, including the invert elevation at points of connection for sanitary sewer, storm sewer, and water-service piping, and underground electrical services.

1.10 MOBILIZATION AND DEMOBILIZATION

A. Provide construction tools, equipment, materials, and supplies of the types and quantities necessary to facilitate the timely execution of the work.

B. Provide personnel, products, construction materials, equipment, tools, and supplies at the site at the time they are scheduled to be installed or utilized.

C. Locate plant or plants appropriately close to the portion of the work for which it/they will be used.

D. Remove construction tools, apparatus, equipment mobile units and buildings, unused materials and supplies, plant, and personnel from the site upon completion of the work.

E. Restore areas utilized for mobilization to their original, natural state, or as indicated in the Contract Documents.

1.11 ACCEPTANCE OF CONDITIONS

A. Examine subgrades, slope areas, foundation conditions of toe rock areas, and general affected areas, and conditions with Installer present for suitability, compatibility, and compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

B. Submit a written report listing conditions detrimental to performance of the work that includes the following

1. Description of the work.

2. List of detrimental conditions, including subgrades, slope areas, foundation conditions of toe rock areas, and general affected areas.

3. List of unacceptable installation tolerances.

4. Recommended corrections.

C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the work indicates acceptance of conditions.

1.12 PREPARATION

A. Take field measurements as required to fit the work properly. Recheck measurements before installing each product. Where portions of the work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication.

B. Verify space requirements and dimensions of items shown diagrammatically on Contract Drawings.

C. Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to the DSR. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

1.13 CONSTRUCTION LAYOUT

A. Before proceeding to lay out the work, verify layout information shown on the Contract Drawings in relation to existing benchmarks. Notify the DSR promptly if discrepancies are discovered.

B. Provide a qualified land surveyor to lay out the work using accepted surveying practices.

C. Establish benchmarks and control points to set lines and levels to locate each element of work.

D. Establish dimensions within tolerances indicated. Do not scale Contract Drawings to obtain required dimensions.

E. Inform installers of lines and levels to which they must comply.

F. Notify the DSR when deviations from required lines and levels exceed allowable tolerances.

G. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

H. Locate and lay out site improvements, including grading, fill and topsoil placement, utility slopes, and invert elevations.

I. Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name, and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by the DSR.

1.14 FIELD ENGINEERING

A. Existing benchmarks and control points are identified on the Contract Drawings.

B. Reference Points

1. Locate existing permanent benchmarks, control points, and similar reference points before beginning the work.

2. Preserve and protect permanent benchmarks and control points during construction operations.

3. Do not change or relocate existing benchmarks and control points without prior written approval of the DSR.

4. Report lost or destroyed permanent benchmarks and control points promptly.

5. Report the need to relocate permanent benchmarks and control points to the DSR before proceeding.

6. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks

1. Establish and maintain a minimum of two permanent benchmarks on site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

2. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

3. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the work.

4. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. On completion of major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and site work.

E. Provide qualified civil, structural, and other professional engineering services as specified or required to execute the Contractor's construction methods.

1.15 SUBSURFACE UTILITY ENGINEERING REQUIREMENTS

A. Provide qualified subsurface utility engineering services to

1. Advise the Contractor of the known or foreseeable risks and impacts that existing subsurface utilities may create on the Project.

2. Educate the Contractor regarding utility quality levels and reliability of data for each quality level, including a discussion of costs and benefits associated with obtaining quality levels.

3. Suggest mitigation measures for these impacts.

4. Recommend a scope for utility investigations, including a listing of types of utilities for detection and depiction and the desired utility data quality level.

5. Select appropriate suite of surface geophysical methods to search for utilities within the Project limits.

6. Apply appropriate surface geophysics within the Project limits.

7. Interpret the surface geophysics.

8. Mark the indications of utilities on the ground surface for subsequent survey of those markings.

B. Survey the markings of the indicated utilities and include the depictions on the Record Drawings.

C. Collect and depict information and required submittals in accordance with the applicable provisions of CI/ASCE 38-02.

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

A. Not used

END OF SECTION

Section 01 71 23—Field Engineering

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. This Section describes the general requirements for Site surveying and grade control including pre-construction and post-construction topographic and bathymetric surveys, utilities and record drawings, construction progress surveying, record keeping, and submittals. In addition, establish and maintain design lines and grades shown on the Contract Drawings.

1.02 RELATED WORK

A. Section 01 33 00 – Submittal Procedures

B. Section 01 70 00 –Closeout Procedures

1.03 DEFINITIONS

A. Acronyms

1. BMA – bank management area

2. DSR – DuPont Site Representative

1.04 REFERENCES

A. Not used

1.05 QUALITY ASSURANCE

A. It is the responsibility of the Contractor to schedule Contractor's survey and to verify it has met the Contract requirements prior to proceeding to the next sequence of work. The DuPont Site Representative (DSR) shall review and approve each survey or survey increment prior to the Contractor proceeding to the next phase of work in that area. The Contractor shall allow up to 3 working days for DSR review. Surveys of the Project shall be surveyed using the same vertical datum and horizontal coordinate system as the Contract Drawings. Surveys may need to be completed in small increments to document work progress and sequential excavation and backfill. Survey requirements include.

1. Pre-Construction Surveying for Bank Management Areas (BMAs): Following completion of clearing and grubbing, the Contractor shall conduct topographic and bathymetric surveys to establish pre-construction conditions.

a) The Contractor shall establish the ordinary high water elevation on the opposite side of the river of the BMAs.

b) The Contractor shall establish local horizontal and vertical control at each BMA project site. Local control shall be established using local survey markers. The Contractor shall ensure closure of all survey loops.

c) The survey shall be adequate resolution to allow subsequent accurate calculations of excavated volumes. The survey shall consist of a minimum of transects every 25-feet with a point every 2-feet or so and at breaks in grade; locate all tops and toes of slopes, and locate all grade breaks, with horizontal and vertical coordinates.

2. Post-Construction Surveying for BMAs and Jones Hollow Property: The Contractor shall perform a post-construction bathymetric and topographic survey of the entire Project Site. This survey shall be incorporated into the As-built Drawings.

B. All surveys for verification of pay quantities shall be performed and stamped by an independent, licensed Professional Land Surveyor acceptable to the DSR.

C. The surveyor shall have insurance that has limits that meet or exceed the requirements of the Contract Specifications.

D. The DSR reserves the right to retain an independent surveyor to periodically check the Contractor's survey. Surveying performed by the DSR will be at no cost to the Contractor.

E. EGS & Associates and Spicer Group are DuPont’s Surveyor of Record for the base information provided. EGS & Associates is eligible for Contractor surveying services during this project.

1.06 SUBMITTALS

A. General submittals required in accordance with this Section include the following.

1. Name, address, telephone number, and statement of qualifications of the Professional Land Surveyor before starting survey work. This surveyor shall be responsible for stamping and signing all work as noted below.

2. On request, field notes and documentation verifying accuracy of survey work.

3. Project survey data shall be stored as electronic files on a DVD, compact disc, flash drive, or other portable media, formatted as: a) DWG; b) TIF; c) PDF; d) XYZ text file and printed to a paper sheet. At a minimum, data for each survey point shall include a sequential reference number, the elevation, and appropriate northing and easting coordinates.

4. Field notes, drawings, quantity computations, and point data for each survey shall be submitted to the DSR.

5. Progress surveys shall be conducted to monitor the accuracy of the work being performed. Progress surveys shall be submitted prior to submittal of progress payment requests.

6. Closure calculation for horizontal and vertical control. Submit prior to commencing pre-construction survey work.

B. As-built Drawings

1. Upon completion of all activities, the Contractor shall prepare As-built Drawings for each survey described in this Section. The post-construction As-built Drawing shall locate all features as constructed and all real estate/property boundaries and public land survey section corners and lines. The As-built Drawings shall be produced full size (ANSI D) on bond paper and signed by the surveyor and Contractor. A paper copy of half-size As Builts shall also be created by the Contractor. Contractor to submit As-built Drawings in paper and electronic formats.

2. Contractor electronic files for the As-Builts shall be fully editable so as to allow future changes by DuPont. The Contractor shall submit the electronic version of the As-built Drawings with hard copies as specified.

1.07 SURVEY VERTICAL DATUM

A. The vertical datum used for this Project is North American Vertical Datum of 1988, based on the elevations from benchmarks included on the Contact Drawings.

1.08 SURVEY HORIZONTAL DATUM

A. The horizontal datum used for this Project is Virginia State Plane, North Zone, North American Datum 83, U.S. Feet based on the coordinates from survey benchmarks included on the Contract Drawings.

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

3.01 GENERAL

A. At the Pre-construction Meeting, the Surveyor shall meet with the DSR to discuss the survey proceedings, methods, and equipment to be employed for the Contractor's surveys and the survey submittal schedules.

3.02 SURVEY REFERENCE POINTS

A. Locate and establish survey control points and monuments for the layout for the Project as required. Control points and monuments shall be established for demolition and clearing limits, erosion and sedimentation control, grading, storm sewer utilities, sewer utilities, water utilities, gas lines, electrical facilities, sidewalks and promenades, and any other items shown on the Contract Drawings, as needed. Promptly notify the DSR in writing of any discrepancies discovered.

B. Provide a control traverse in the horizontal and vertical datum established for the Project.

C. Mark and protect survey control points prior to starting Site work. Make no change without prior written notice to the DSR.

D. Promptly report to the DSR the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

E. Obtain written permission from the City of Waynesboro Public Works to remove survey monuments anticipated to be disturbed or destroyed during construction. Monuments shall be restored in accordance with City of Waynesboro’s “Standard Details and Approved Products Manual,” Details R-1 and R-2 (current edition).

F. Replace or relocate dislocated survey control points, or establish new control points, based on original survey control at no added cost to DuPont.

3.03 PROCEDURES

A. Contractor survey procedures (positioning modes, equipment calibration, and data reduction, adjustment, processing, and plotting) shall conform to industry standards.

B. Failure to perform and process such surveys in accordance with recognized standards will result in a rejection and nonpayment for work performed.

3.04 UNDERGROUND UTILITIES

A. The Contractor shall be responsible for locating all underground utilities and notifying all underground utility companies prior to commencing work.

B. The Contractor shall be responsible for providing As-built Drawings showing accurate locations of utilities installed or relocated as part of the work.

C. Prior to placing utility backfill, the Contractor shall survey the utility to accurately record the installed depth, alignment, and location of bends, valves, manholes, and all other items or conditions to provide an accurate record of all below-grade utilities. Contractor shall provide 72 hour written notice to the DSR at least before any utility backfill and surveys. Provide survey data as described in Article 1.06.

3.05 NEW CONSTRUCTION

A. Contractor shall develop and make all detailed surveys necessary for construction of new work, including setting benchmarks for location of working points, verification of existing structures and critical topographic features, cut sheets, slope stakes, and other surveys as required to ensure the work is installed in accordance with the Contract Documents. Contractor is responsible for notifying the DSR of any discrepancies found as a result of the detailed survey.

3.06 EXCAVATION, BACKFILL AND RESTORATION

A. Contractor shall develop and make all detailed surveys necessary to ensure the excavation has been completed in accordance with the lines and grades shown on the Contract Drawings. The survey must be reviewed and approved by the DSR prior to the placement of subgrade fill materials and the installation of measures for restoration.

B. Contractor shall develop and make all detailed surveys necessary to ensure the placement of subgrade fill and other measures for restoration are all in accordance with the elevations, grades, and extents shown on the Contract Drawings.

3.07 SLOPE PROTECTION

A. Contractor shall develop and make all detailed surveys necessary for construction of toe rock placement and restoration, including pre- and post-placement surveys of the foundation and slope to verify that the slope protection materials have been placed in accordance with the lines and grades shown on the Contract Drawings.

B. Contractor shall develop and make all detailed surveys following the placement of toe rock to ensure the slope, elevation, and thickness of the toe rock has been constructed in accordance with the Contract Drawings and Contract Specifications.

C. The slope shall be surveyed prior to and following restoration to verify that the materials have been placed in accordance with the Contract Drawings. Contractor is responsible for maintaining the stability of the slope for the duration of the Project.

D. The final surveys for acceptance of the planting and habitat restoration, and restoration of Jones Hollow Property shall be completed by a Surveyor as described in Paragraph 1.03.B.

END OF SECTION

Section 01 74 00—Site Maintenance and Final Cleaning

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Progress cleaning
2. Site maintenance
3. Waste management
4. Final cleaning

1.02 RELATED WORK

A. Section 01 33 00 – Submittal Procedures

B. Section 01 35 29 – Health, Safety, and Emergency Response Procedures

C. Section 01 50 00 – Temporary Facilities and Controls

1.03 DEFINITIONS

A. Acronyms

1. CFR – Code of Federal Regulations
2. DSR – DuPont Site Representative
3. HASP – Health and Safety Plan
4. NARA – U.S. National Archives and Records Administration

1.04 REFERENCES

A. Reference Standards

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. U.S. National Archives and Records Administration (NARA)

   a) 29 Code of Federal Regulations (CFR) 1926 Safety and Health Regulations for Construction

B. Waste Management Plan – Appendix C

1.05 ADMINISTRATIVE REQUIREMENTS

1. Not used

1.06 SUBMITTALS

DSR review is required for submittals designated as "Action Submittals." Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to DSR for information only.

Submit the following in accordance with Section 01 33 00 – Submittal Procedures

A. Action Submittals

1. Cleaning procedures within 7 calendar days of mobilization

B. Informational Submittals

1. Not used

C. Closeout Submittals

1. Not used

D. Maintenance Material Submittals

1. Not used

1.07 PROGRESS CLEANING

A. General Cleaning

1. Provide, operate, and maintain the equipment and materials required to execute the cleaning procedures.

2. Provide weekly janitorial services for offices and periodic cleaning for office and storage areas. Sweep floor and dust furnishings daily.

3. Use a potable water supply for cleaning. Do not use on-site surface water for the purposes of cleaning.

4. Provide a reduced-pressure backflow preventer for the water supply line that satisfies the requirements of the water supplier and applicable local codes.

5. Provide scrub brushes and other equipment and supplies necessary to execute the approved cleaning procedures.

6. Dispose of expendable materials.

B. Personnel Cleaning

1. Comply with the requirements of 29 CFR 1926.51.

2. Communicate the procedures to on-site personnel.

3. Ensure procedures are implemented prior to commencing work in areas where potential for exposure to hazardous substances exists.

4. Complete in accordance with Section 01 35 29 – Health, Safety, and Emergency Response Procedures and the project HASP.

1.08 SITE MAINTENANCE

A. Provide periodic maintenance for office and storage areas.

B. Furnish, replace, and replenish light bulbs, fluorescent tubes, toilet paper, paper towels, soap, bottled water, and other products required to maintain field facilities in a clean condition.

C. Maintain approach walks, parking areas, and access roads free of mud, water, ice, and snow.

1.09 WASTE MANAGEMENT

A. Manage waste in accordance with the Site Conditions and the Waste Management Plan (Appendix C).

B. Remove waste material dumped in unauthorized areas and restore the area to the condition of the adjacent undisturbed areas.

C. Remove material for disposal from the site in accordance with the Waste Management Plan (Appendix C).

D. Do not remove material from the site without written permission from the DSR.

E. Do not burn material associated with the Project.

F. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.10 FINAL CLEANING

A. Execute final cleaning prior to final acceptance inspection.

B. Leave premises "broom clean."

C. Clean debris from drainage systems.

D. Disconnect and remove temporary utilities in accordance with Section 01 50 00 – Temporary Facilities and Controls.

E. Dismantle and properly dispose of temporary facilities in accordance with Section 01 50 00 – Temporary Facilities and Controls.

F. Inspect the perimeter and security fence and repair damaged portions of the fence or gates.

G. Sweep paved areas and rake clean landscaped areas.

H. Remove waste and surplus materials, rubbish, and construction materials from the site.

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

A. Not used

END OF SECTION

Section 01 77 00—Closeout Procedures

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Contract closeout procedures

1.02 RELATED WORK

A. Section 01 10 00 – Summary of Work

B. Section 01 29 00 – Payment Procedures

C. Section 01 33 00 – Submittal Procedures

D. Section 01 50 00 – Temporary Facilities and Controls

E. Section 01 78 00 – Closeout Submittals

1.03 DEFINITIONS

A. Acronym

1. DSR – DuPont Site Representative

1.04 REFERENCES

A. Not used

1.05 ADMINISTRATIVE REQUIREMENTS

A. Not used

1.06 SUBMITTALS

DuPont Site Representative (DSR) review is required for submittals designated as "Action Submittals." Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to DSR for information only.

Submit the following in accordance with Section 01 33 00 – Submittal Procedures

A. Action Submittals

1. Not used

B. Informational Submittals

1. Certificates

    a) Certification that Contract Documents are complete and ready for DSR's review.

2. Special Procedure Submittals

    a) Punch-out Inspection Punch List.

    b) Notice to schedule the Pre-final Inspection.

    c) Notice to schedule the Final Acceptance Inspection.

    d) Release of Liens and Claims.

C. Closeout Submittals

1. Not used

D. Maintenance Material Submittals

1. Not used

1.07 COMPLETION INSPECTIONS

A. Punch-out Inspection

1. Inspect the Work and develop a punch list of items that do not conform to the approved Contract Drawings and Contract Specifications. Schedule near the completion of Work or any increment thereof established by a completion time stated in the Contract or stated elsewhere in the Contract Specifications. Ensure Quality Control Manager has reviewed and signed the punch list.

2. Include in the punch list each remaining item requiring rework that was not corrected prior to the Punch-out Inspection.

3. Include the estimated date that the deficiencies will be corrected on the punch list.

4. Submit a copy of the punch list to the DSR.

5. Complete additional inspections to ascertain that each deficiency has been corrected. Once this is accomplished, notify the DSR that the facility is ready for the "Pre-Final Inspection."

B. Pre-Final Inspection

1. The DSR will perform this inspection to verify the work is complete and ready for final acceptance inspection.

2. The DSR may develop a pre-final punch list as a result of this inspection.

3. Ensure each item on this list is corrected prior to notifying the DSR that a "Final" inspection with DuPont can be scheduled.

4. Correct items noted on the "Pre-Final" inspection in a timely manner and prior to the Contract completion date for the Work or particular increments thereof if the project is divided into increments by separate completion dates.

C. Final Acceptance Inspection

1. Notify the DSR at least 14 days prior to the desired Final Acceptance Inspection date.

2. State in the notice that specific items previously identified to the Contractor as being unacceptable will be complete by the date scheduled for the final acceptance inspection.

3. The DSR will formally schedule the Final Acceptance Inspection based upon results of the "Pre-Final Inspection."

4. The Quality Control Manager, the superintendent, or other Contractor management personnel must attend the Final Acceptance Inspection. The DSR will attend this inspection. Additional DuPont personnel may attend at their discretion.

5. Failure to have Contract Work acceptably complete for this inspection will be cause for the DSR to bill the Contractor for additional inspection cost in accordance with the Contract.

1.08 CLOSEOUT PROCEDURES

A. Conduct completion inspections, including Pre-final and Final Acceptance Inspections.

B. Submit final periodic Application for Payment in accordance with Section 01 29 00 – Payment Procedures.

C. Submit draft project record documents to DSR for review in accordance with Section 01 78 00 – Closeout Submittals.

D. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for DSR's review.

E. Execute warranty documents in accordance with Section 01 78 00 – Closeout Submittals.

F. The DSR will return reviewed draft project record documents to Contractor for revisions as specified in Section 01 78 00 – Closeout Submittals.

G. Complete demobilization and remove temporary utilities, facilities, and controls as specified in Section 01 50 00 – Temporary Facilities and Controls.

H. Submit final project record documents and warranty information to the DSR in accordance with Section 01 78 00 – Closeout Submittals.

I. Submit Release of Liens and Claims from each Subcontractor and Supplier.

J. Submit final Application for Payment requesting release of retainage and identifying total adjusted Contract Sum, previous payments, and sum remaining due.

K. The DSR will conduct Final Application for Payment inspection to confirm demobilization is complete and acceptable.

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

A. Not used

END OF SECTION

Section 01 78 00—Closeout Submittals

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Record documents and document maintenance

2. Warranties

1.02 RELATED WORK

A. Section 01 33 00 – Submittal Procedures

1.03 DEFINITIONS

A. Acronym

1. DSR – DuPont Site Representative

1.04 REFERENCES

A. Not used

1.05 ADMINISTRATIVE REQUIREMENTS

A. Prepare, maintain, and submit Project record documents as required by the Contract Specifications.

B. Maintain two bound sets and four electronic sets of the following record documents

1. Drawings

a) Contract Drawings as issued for construction

b) As-built (red line) Drawings

2. Contract Specifications

3. Addenda

4. Change Orders and other modifications to the Contract

5. Reviewed Submittals and Record Submittal Schedule

6. Record schedule

7. Survey notes, records, and calculations
8. DuPont Site Representative (DSR) field orders and written instructions
9. Daily progress reports, including required attachments
10. Spill incident reports
11. Approved site-specific Health and Safety Plan and addenda
12. Approved Project-specific Waste Management Plan and addenda
13. Manufacturer's instruction for assembly, installation, and adjusting
14. Daily Quality Control reports
15. Daily Safety Logs
16. Lab analytical results
17. Daily Work Activity Summary Reports
18. Photographic documentation
19. Other items as required by the DSR

C. Record actual revisions to the work concurrent with construction progress.

D. Ensure entries are complete, legible, and accurate, enabling future reference.

E. Store a minimum of one set of documents and samples in the Contractor's field office apart from documents used for work.

F. File documents and samples to facilitate retrieval.

G. Maintain documents in a clean, dry, legible condition and in good order.

H. Do not use record documents for work purposes.

I. Make documents available continuously for inspection by the DSR. Bring one copy of the current As-built Drawings to every other weekly progress meeting for the DSR to review.

1.06 SUBMITTALS

DSR review is required for submittals designated as "Action Submittals." Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to DSR for information only.

Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

A. Action Submittals

1. Draft Submittal

a) Submit two draft copies of completed record documents, including As-built (red line) Drawings to the DSR following Substantial Completion of construction and at least 15 days prior to the Final Acceptance Inspection.

b) Ensure the draft record documents are neat, legible, and accurate.

c) If upon review, the draft record drawings are found to contain errors or omissions, they will be returned to the Contractor for corrections. Complete the corrections and return the draft record documents to the DSR within 10 calendar days.

d) One copy of the approved draft record documents with the DSR comments will be returned to the Contractor after the Final Acceptance Inspection for use in preparation of final record documents.

B. Informational Submittals

1. Not used

C. Closeout Submittals

1. Operation and Maintenance Data

a) Provide two bound and four electronic sets of copies of operation and maintenance instructions, arranged by system and subdivided by Contract Specification section.

b) For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers.

c) Identify the following

1) Significant design criteria.

2) List of equipment.

3) Parts list for each component.

4) Operating instructions.

5) Maintenance instructions for equipment and systems.

6) Maintenance instructions for finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

2. Warranty Documentation

a) Equipment/Product Warranty List.

b) Provide six sets of notarized copies of warranties required in individual Contract Specification sections.

3. Record Documentation

a) Submit final record documents to the DSR with final Application for Payment.

D. Maintenance Material Submittals

1. Label and deliver spare parts, maintenance items, and extra materials to the Site. Place in locations as directed.

a) Include “NOT FOR WARRANTY REPAIRS” on the labels.

b) Obtain receipt prior to final payment.

2. Do not use the spare parts and maintenance materials required by the Contract Documents to remedy defects during the warranty period, except when approved otherwise by the DSR. In such cases, replace items used.

3. Furnish the names, business addresses, and telephone numbers of fully equipped authorized service organizations.

4. Applications for final payment will not be approved until these items are delivered.

1.07 RECORD DOCUMENTS

A. Contract Specifications

1. Legibly mark and record at each product reference the description of actual Products installed, including the following

a) Manufacturer's name and product model and number.

b) Product substitutions or alternates utilized.

c) Changes made by Addenda and modifications. Include reference to approved Engineering Change Order or Contract Change Order.

2. Legibly mark and record changes to execution methods specified. Include reference to approved Engineering Change Order.

B. Contractor's Pre-construction Submittals

1. Legibly mark and record alternate vendors and subcontractors used.

2. Legibly mark and record changes to environmental protection, spill, and discharge control procedures.

3. Legibly mark and record changes to the Submittal Register, including

a) Date of submittal

b) Date submittal was approved

c) Additional submittals required

4. Legibly mark and record changes to the following

a) Contractor's Quality Control Plan

b) Overhead and Underground Obstructions Plan

c) Sample Forms

5. Approved site-specific Health and Safety Plan and addenda

6. Legibly mark and record approved changes to the Health and Safety Plan and addenda.

C. Manufacturer's instruction for assembly, installation, and adjusting

1. Legibly mark and record variances from Manufacturer's instructions, including the following

a) Description of variance

b) Reason for variance

c) Effect of variance on manufacturer's guarantee or warranty

d) Additional considerations or procedures required due to variance

2. Provide correspondence regarding Manufacturer's recommendations in support of or against the variance.

1.08 RECORD DOCUMENTS

A. Contract Specifications

1. Legibly mark and record at each product reference the description of actual Products installed, including the following

a) Manufacturer's name and product model and number.

b) Product substitutions or alternates utilized.

c) Changes made by Addenda and modifications. Include reference to approved Engineering Change Order or Contract Change Order.

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B. Contractor's Pre-construction Submittals

1. Legibly mark and record alternate vendors and subcontractors used.

2. Legibly mark and record changes to environmental protection, spill, and discharge control procedures.

3. Legibly mark and record changes to the Submittal Register including

a) Date of submittal

b) Date submittal was approved

c) Additional submittals required

4. Legibly mark and record changes to the following

a) Contractor's Quality Control Plan

b) Overhead and Underground Obstructions Plan

c) Sample Forms

C. Approved site-specific Health and Safety Plan and addenda

1. Legibly mark and record approved changes to the Health and Safety Plan and addenda.

D. Manufacturer's instruction for assembly, installation, and adjusting

1. Legibly mark and record variances from Manufacturer's instructions, including the following

a) Description of variance

b) Reason for variance

c) Effect of variance on manufacturer's guarantee or warranty

d) Additional considerations or procedures required due to variance

2. Provide correspondence regarding Manufacturer's recommendations in support of or against the variance.

1.09 RECORD DRAWINGS

A. Keep record drawings current and available on the job site at all times, two sets of marked drawings (paper prints) showing as-built conditions.

B. Accurately and neatly record changes from the Contract Drawings that are made in the work or additional information that might be uncovered in the course of construction as they occur by means of details and notes.

C. Legibly mark drawings to record actual construction, including

1. Field changes of dimension and detail including

a) Correct grade or alignment of pipelines or utilities if changes were made from Contract Drawings.

b) Correct elevations if changes were made in site grading.

c) Design and additional information obtained from working drawings specified to be prepared and furnished by the Contractor, including but not limited to, fabrication, installation plans and placing details, and pipe sizes.

2. Changes made by field order and by change order.

3. Details not on original Contract Drawings.

4. The location and description of utilities and appurtenances and other installations or description known to exist within the construction area. Include measured horizontal and vertical dimensions referenced to permanent surface features.

5. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.

6. The topography and grades of installed or affected work as a part of the Project construction.

7. Changes or modifications that result from the final inspection.

8. Show only the option selected for construction on the As-built Drawings where Contract Drawings or Contract Specifications allow options.

1.10 WARRANTY REQUIREMENTS

A. Equipment/Product Warranty List

1. Submit a bound and indexed notebook containing written warranties for equipment/products furnished and prepare a complete listing of such equipment/products.

2. State the description or name of the equipment/product, the Contract Specification section applicable to the equipment/product, serial number (where applicable), duration of the warranty, start date of the warranty, ending date of the warranty, maintenance procedures and schedule (where applicable), and the point of contact for fulfillment of the warranty.

   a) Ensure the guarantor's representative will honor the warranty during the warranty period, and will provide the services prescribed by the terms of the warranty.

3. Start the warranty period on the same date as Project acceptance and continue for the full product warranty period.

4. Execute the full list and submit prior to final acceptance of the Project.

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

A. Not used

END OF SECTION

DIVISION 02—EXISTING CONDITIONS

DIVISION 02—EXISTING CONDITIONS
Section 02 01 00—Maintenance of Existing Conditions

PART 1 – GENERAL

1.01 SUMMARY OF WORK

A. The work described in this Section includes removing and disposing of, or salvaging, structures, utilities, asphalt paving, concrete debris and rock riprap, and other materials identified in the Contract Documents, or as required to complete the work. The work also includes the backfilling of trenches and holes/pits that result from the removal of foundations, timber piles, and other structures below grade.

B. Items identified to be removed and reinstalled shall be removed in a manner to prevent damage, stored in a secure area, and reinstalled as indicated.

C. Demolition work shown on the Contract Drawings is schematic in nature, and is intended to identify general features of the structures, utilities, paving, materials, or other obstructions to be removed. Bidders shall visit the Site to verify the quantity and details of demolition work. Lack of complete details on the Contract Drawings will not be considered as grounds for additional compensation.

1.02 RELATED WORK

A. The provisions and intent of the Contract, including the Procurement and Contracting Requirements, the Standard Provisions, and General Conditions, apply to this work as if specified herein. Work related to this Section is described in.

1. Section 01 33 00 – Submittal Procedures
2. Section 01 35 29 – Health, Safety, and Emergency Response Procedures
3. Section 02 60 00 — Contaminated Site Material Removal
4. Section 31 11 00 – Clearing and Grubbing
5. Section 31 12 00 – Selective Clearing
6. Section 31 23 00 – Excavation and Fill
7. Section 31 25 00 – Erosion and Sedimentation Control
8. Section 31 37 00 – Stone Toe Protection
9. Section 32 90 00 – Planting and Habitat Restoration

1.03 DEFINITIONS

A. Not used

1.04 REFERENCES

A. Waste Management Plan – Appendix C

1.05 EXISTING SITE CONDITIONS

A. The Contract Drawings show existing Site features and facilities, but may not show all equipment and materials existing at the jobsite.

B. Existing Utilities

1. Existing utilities of record have been shown on the Contract Drawings insofar as it has been possible to do so. These, however, are shown for convenience only and DuPont assumes no responsibility for improper locations or failure to show utility locations on the Contract Drawings. The Contractor shall be responsible for determining existing utility locations.

2. The Contractor shall call Miss Utility of Virginia at 811 for field location of existing utilities before the scheduled date for commencement of work at the Site that may affect underground utility facilities, unless otherwise agreed upon by the parties involved. If Miss Utility cannot be contacted, notice shall be provided to the individual utility owners of the Contractor's intent to work at the Site.

3. The Contractor shall verify the location of buried conduit, pipe, cable, ground mat, and other buried items no more than 10 working days prior to mobilization. This includes the features marked as "UNKNOWN BURIED LINEAR FEATURE" (UBLF) on the plans. UBLFs were identified via geophysical survey but have not been claimed by a utility owner.

4. The Contractor shall pothole all buried utility to determine depth and material. The Contractor shall notify the utility owner and the City of Waynesboro at least five working days before uncovering the utility.

5. The Contractor shall pothole to a maximum depth of 5 feet all UBLFs in the work area to identify the feature and determine depth and material. If the UBLF is not discovered within the 5-foot deep hole, then the DSR will determine whether additional excavation is required. The Contractor shall notify the City of Waynesboro at least 5 working days before uncovering the UBLFs.

6. The Contractor shall note the location and extent of overhead utilities. Caution should be taken when working near overhead utilities. The Contractor shall be responsible for the safety of his/her employees and equipment when working near overhead utilities.

7. The Contractor shall be responsible for any breakage of utilities or services that are to remain resulting from its operations, and shall hold DuPont and its consultants and agents harmless from any claims resulting from disruption of or damages to same.

8. All existing utilities shall be maintained in continuous service during the Contractor's operations, unless the Contractor receives written approval from the utility owner for interruption of service. The Contractor shall pay all permit, inspection, and other fees levied by the utility owners.

9. The Contractor shall anticipate that the requirements of the owners of existing utility systems may hinder, delay, and complicate execution of the work. The Contractor shall not be entitled to any claim for damages because of hindrances, delays, and complications caused by or resulting from requirements imposed by the owners of the utility systems.

C. The Contract Drawings indicate the character and general location and coverage of existing structures and surface materials on the Site. The information provided is general in nature and may not be completely representative of all features present at the Site, at the time of construction. The Contractor shall therefore ascertain, to their own satisfaction, the condition of existing slope and ground coverage, including debris, rock riprap, timber pile stubs, and other materials that will need to be removed during the course of demolition.

1.06 SUBMITTALS

A. Contractor shall submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Health and Safety Plan (HASP)

a) The work area, conditions, and type of work create considerable potential for accidents. See Section 01 35 29 – Health, Safety, and Emergency Response Procedures for submittal requirements.

2. Submit a flood protection plan for protecting the City Shops area (i.e., paved area immediately landward of the WWTP A BMA) from floods up to the FEMA 100-year flood elevation of 1,272 feet while the berm at the top of the bank is temporarily breached to accommodate soil removal.

3. Submit documentation for each utility identified within the work areas prior to mobilization.

a) Indicate that each utility has been properly field located by a Virginia licensed surveyor, proper field markings have been made, and depth and material of utility have been ascertained.

b) Submit a relocation plan and emergency management plan for each utility required to be temporarily relocated.

c) Indicate how each utility will be relocated or protected in place.

d) Describe how each temporarily relocated utility will maintain functionality for the duration of construction.

e) Submit a plan for restitution of utilities in the event that damage occurs to any utilities.

4. Demolition and Disposal Plan (per 3.03) Waste Management Plan (per 3.04; Appendix C)

5. Disposal Records (per 3.08)

1.07 MEASUREMENT AND PAYMENT

A. Measurement

1. Unit of measure shall be “Lump Sum.”

B. Payment

1. Payment shall be considered incidental to completing the work.

2. Utilities damaged during relocation shall be replaced at the Contractor’s expense.

1.08 REFERENCES

A. Not used

PART 2 – PRODUCTS

A. Not used

PART 3 – EXECUTION

3.01 PREPARATION

A. The Contractor is responsible for field locating all existing utilities in the work areas prior to mobilization.

1. A 15-inch diameter reinforced concrete stormwater pipe at Waste Water Treatment Plant A has been identified on the Contract Drawings within the proposed excavation limits.

3.02 GENERAL

A. The Contractor shall remove and recycle, salvage, or dispose of designated structures, foundations, paving, utilities, rock and concrete rubble, and all other obstructions required to complete the work in accordance with the Waste Management Plan (see Article 3.03 and Appendix C) and all applicable regulations, codes and ordinances. Care shall be taken that demolition work is accomplished such that damage does not occur to adjacent structures, improvements, or private property. Any improvements not designated for removal that are damaged by the Contractor shall be repaired or replaced by the Contractor at the Contractor's expense.

B. Blasting or other special methods for the removal of an existing structure or obstruction will not be permitted.

3.03 DEMOLITION AND DISPOSAL PLAN

A. Prior to the start of this work, the Contractor shall submit to DuPont, a Demolition and Disposal Plan that, at a minimum, addresses the following.

1. Worker safety.

2. Protection of the public.

3. Work sequence and schedule.

4. Protection of the environment.

5. Material Identification: Indicating anticipated types and quantities (by weight) of materials to be salvaged, recycled, and disposed of. Indicate whether materials will be sorted on-site or co-mingled.

6. Waste management including, but not limited to, disposal sites, procedures, and required permits, as described in Article 3.03.

3.04 WASTE MANAGEMENT

A. Waste Management Plan

1. The Contractor shall submit a Waste Management Plan (Appendix C) as part of the Demolition and Disposal Plan (see Article 3.02) to DuPont within 15 calendar days following the Notice of Award. The plan shall address the procedures the Contractor will implement to handle, transport, and dispose of waste materials, and to recycle reusable materials generated during construction. At a minimum, the Waste Management Plan shall include the following sections.

a) Salvage, Reuse, Recycling, and Disposal Methods

1) The Waste Management Plan (Appendix C) shall identify methods for waste salvage, reuse, and recycling during demolition including, but not limited to, one of more of the following.

a. Contracting with a deconstruction specialist to salvage materials generated

b. Selective salvage as part of demolition Contractor's work

c. Reuse of materials on-site or off-site sale or donation to a third party

2) The Waste Management Plan (Appendix C) shall identify methods for salvage, reuse, recycling and disposal during construction including, but not limited to, one or more of the following.

a. Requiring subcontractors to take their waste to a recycling facility

b. Contracting with a recycling hauler to haul recyclable waste to an approved recycling or material recovery facility

c. Processing and reusing materials on-site

d. Self-hauling to a recycling or material recovery facility

3) The Contractor shall include methods that will be used for separating recyclable waste, including sizes of containers, container labeling, and designated location on Project Site where materials separation will be located.

b) Disposal Sites, Procedures, and Required Permits

1) Appropriate sites for disposal have been provided in Section 02 60 00 — Contaminated Site Material Removal. The Waste Management Plan (Appendix C) shall also indicate all required permits and documentation required for disposal at the sites.

2) All Contractor-provided disposal sites shall be subject to approval of DuPont. DuPont reserves the right to reject or discontinue the use of a proposed disposal or recycling facility at any time. In the event that DuPont rejects a facility, the Contractor shall propose an alternate facility for approval by DuPont, at no additional cost to the DuPont.

c) Transportation Routes

1) The Contractor shall identify the proposed transportation method(s) and route(s) to the disposal site. Haul routes shall be selected so that there is minimum disruption of local traffic.

3.05 TEMPORARY RELOCATION OF EXISTING DRAINAGE STRUCTURES

A. Existing stormwater outfalls shall not be removed unless required to complete the work.

B. The Contractor shall be responsible for diverting and bypassing stormwater runoff through the Site while existing outfalls, culverts, catch basins, inlets, and other drainage structures are being modified or removed.

C. The Contractor shall provide equipment needed to bypass stormwater runoff through the Site, as needed to accommodate the work and comply with the construction stormwater permit requirements for the Project. The Contractor shall be responsible for temporary diversion and control of the full range of flows that can be expected during construction. The Contractor should be aware of the sources of and estimated flow rate of runoff through the Site.

D. The Contractor shall be responsible for preventing discharge of sediment-laden runoff to South River or existing drainage facilities during the work, in accordance with Section 31 25 13 – Erosion and Sediment Control.

3.06 TEMPORARY RELOCATION OF EXISTING UTILITIES

A. Prior to the start of utility relocation, the Contractor shall notify each affected utility owner of the impending demolition and arrange with each utility for all work required by that utility to complete the work under this Contract. Special conditions required by the utility shall be the sole responsibility of the Contractor. Utilities should be contacted prior to submitting a bid to determine any bond or related cost requirements.

B. All utility piping facilities and equipment designated on the Contract Drawings or within these Specifications interfering with completion of the work shall be temporarily relocated, including piping that is under-ground, exposed, or fixed to existing structures.

C. All utility piping facilities and equipment designated on the Contract Drawings to remain shall be protected from damage or disruption. The Contractor shall repair, at their expense, existing utility installations designated on the Contract Drawings to remain that are damaged due to the Contractor's operations or the Contractor's failure to provide proper protection.

D. Relocation of City water lines, sewer lines, storm drains, outfall structures, and related facilities shall be as noted on the Contract Drawings.

3.07 DEMOLITION OF ROCK AND CONCRETE RUBBLE

A. Rock and concrete rubble shall be completely removed from the areas identified on the Contract Drawings. The Contractor shall remove rock and concrete rubble separately from the underlying soils and/or sediments, and shall minimize the amount of soil and/or sediment that is removed simultaneously with the rock and concrete rubble.

B. If additional rock or concrete rubble is encountered below the surface layer, then they shall be removed only to the limits of the required excavation. If rock or concrete rubble is encountered that apparently extends well beneath the required depths of excavation, then the Contractor shall alert DuPont, who will determine whether it is necessary to remove the material.

C. All rock materials shall be salvaged for re-use as basalt rock facing or basalt rock in stone walls.

3.08 RELOCATION

A. The Contractor is responsible for temporarily relocating all existing utilities that conflict with construction activities required to complete the work.

1. The relocation plan must be approved by the utility owner and the DuPont Site Representative prior to mobilization.

3.09 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

A. Refer to Section 02 60 00 – Contaminated Site Material Removal.

3.10 CLEANUP

A. After removal of obstructions designated for demolition, the Contractor shall clean the area. There shall be no debris, rubble, or litter left at the Site from any of the demolition operations.

3.11 RESTORATION AND CLOSEOUT

A. Restore all relocated utilities to their previous locations and continue construction activities necessary to complete the Work.

B. The Contractor shall maintain neat and orderly storage and work areas, as much as possible. The Contract will not be considered complete until all of the Contractor’s tools, equipment, and property have been removed from the Project Site, and the Contractor’s storage and work areas have been properly cleaned.

END OF SECTION

DIVISION 02—EXISTING CONDITIONS
Section 02 51 00—Equipment Decontamination and Screening

PART 1 – GENERAL

1.01 SUMMARY OF WORK

A. The Contractor shall conduct decontamination of equipment, personnel, and materials utilized during the work activities.

B. The Contractor shall conduct a mercury-vapor screening program to verify that items are appropriately decontaminated.

C. The Contractor shall containerize and dispose of used cleaning equipment, Personal Protective Equipment, and decontamination wastewater in accordance with the Waste Management Plan (Appendix C) and applicable rules and regulations.

D. The Contractor shall be solely responsible for their means, methods, and sequences with regard to the work.

E. Work area, conditions, and type of work required create considerable potential for accidents. Perform all work related to this specification in accordance with the approved project HASP. See Section 01 35 29 – Health, Safety, and Emergency Response Procedures for HASP submittal requirements.

1.02 RELATED WORK

A. Work related to this Section is described in

1. Section 01 35 29 – Health, Safety, and Emergency Response Procedures

1.03 DEFINITIONS

A. Acronyms

1. $\mu g/m^3$ – micrograms per cubic meter
2. DSR – DuPont Site Representative
3. HASP – Health and Safety Plan
4. MVA – mercury vapor analyzer
5. USDOT – United States Department of Transportation

1.04 REFERENCES

A. Waste Management Plan – Appendix C

PART 2 – MATERIALS

2.01 MATERIALS AND EQUIPMENT

A. To be specified and supplied by the Contractor.

2.02 CONTAINERS

A. The Contractor shall provide United States Department of Transportation (USDOT)-approved containers for storage of wastes generated by the construction activities prior to transportation for off-site disposition.

PART 3 – EXECUTION

3.01 EQUIPMENT DECONTAMINATION

A. Planned areas for equipment decontamination are shown on the Contract Drawings. These include stabilized construction entrances and tire wash areas. The Contractor shall conduct decontamination activities in these or other areas within the work area proposed by the Contractor and approved by the DSR. The decontamination areas shall be bermed and lined with 20-mil (minimum) reinforced polyethylene sheeting that slopes to a lined collection sump.

B. The Contractor shall be responsible for constructing and maintaining the decontamination area to accommodate all loads, equipment, and potential decontamination fluid migration scenarios.

C. Any equipment and materials to be taken off site by the Contractor will be subject to a final visual review by the DSR and cleaning by the Contractor (when necessary) at the decontamination area. The extent and method of cleaning shall be at the discretion of the Contractor. However, each piece of equipment/materials will be observed by the DSR for visible soils, dust, or other debris prior to the removal of equipment/materials from the Site. Any observed soils or other debris shall be promptly removed and containerized by the Contractor into USDOT-approved containers.

D. Prior to removal from the Site, each piece of the Contractor’s reusable equipment/materials will be screened by the Contractor for the potential presence of mercury using the Mercury Scanning Guidelines presented below. If the item sampled exceeds the action levels presented below, the Contractor shall decontaminate the item. If the item cannot be decontaminated to meet the Mercury Scanning Guidelines below, the Contractor shall place the item into appropriate USDOT-approved waste containers for characterization (by the Contractor) and off-site disposal. Any equipment/materials or other items owned, leased, and/or rented by the Contractor that cannot be decontaminated in accordance with the Mercury Scanning Guidelines (Section 3.02 below) shall be designated for off-site disposal at no additional cost to the DuPont.

E. Solid waste materials generated during decontamination activities shall be separated from washwaters, collected, and containerized into appropriate USDOT-approved waste containers prior to off-site transportation and disposal in accordance with Section 02 60 00 – Contaminated Site Material Removal. Washwater generated by the decontamination activities shall be collected and transported for off-site disposal in accordance with the Waste Management Plan (Appendix C).

F. Following completion of decontamination activities associated with the Work activities, the Contractor shall dismantle the decontamination area and dispose of all waste materials associated with the decontamination area in accordance with Section 02 60 00 – Contaminated Site Material Removal and the Waste Management Plan (Appendix C).

3.02 MERCURY SCREENING GUIDELINES

A. The below guidelines will be used to screen reusable equipment/materials as identified above. This guideline is not intended for the screening of waste materials (e.g., demolition debris, excavated soil, and subsurface structure debris) generated by the work activities.

B. The Contractor will use a MVA (Jerome Model 405 or equivalent) to screen a minimum of three locations (consisting of an average of three readings at each location). Because the resolution of the Jerome MVA is ± 3 micrograms per cubic meter ($\mu g/m^3$), averaged readings between 0 and 3 $\mu g/m^3$ will be recorded as 0 $\mu g/m^3$. The readings will be collected from immediately above the item's surface.

1. If the item sampled is below 10 $\mu g/m^3$, then it may be removed from the Site.

2. If the item sampled ranges from 10 $\mu g/m^3$ and 49.99 $\mu g/m^3$, then the item will be transferred to a designated area, covered with polyethylene, and sampled after a 15-minute holding time.

3. If the reading of the covered item is less than 49.99 $\mu g/m^3$, and decreases during follow-up sampling, then the item may be removed from the Site.

4. If the reading of the covered item is less than 49.99 $\mu g/m^{3,}$ and follow-up samples do not decrease, then the item will be decontaminated in accordance with the guidelines presented herein.

5. If the item sampled is greater than 50.00 $\mu g/m^3$, then the item will be decontaminated in accordance with the guidelines presented herein.

C. If the results for subsequent scanning activities continue to exceed the action levels for mercury, then the object will be evaluated with the DSR to determine appropriate off-site disposal in accordance with applicable regulations.

END OF SECTION

DIVISION 02—EXISTING CONDITIONS
Section 02 60 00—Contaminated Site Material Removal

PART 1 – GENERAL

1.01 SUMMARY

A. The Contractor shall collect and containerize all soil, debris, dust (e.g., including sawdust, wood chips, and concrete debris), and other waste materials generated by the work activities for off-site transportation and disposal in accordance with applicable regulations, this Contract Specification, and the Contractor's approved work plan.

B. Waste material handling, segregation, and containerization activities shall be conducted by the Contractor, as the waste materials are generated, throughout the implementation of the work.

C. The Contractor shall propose specific methods for handling, segregating, and containerizing (including proposed containers to be provided by the Contractor) for each anticipated waste stream generated during the work.

D. The Contractor shall be responsible for characterizing the waste in accordance with the Waste Management Plan (Appendix C) prior to transport to the ultimate disposal facility.

E. The Contractor shall complete air monitoring activities in accordance with applicable regulations and as detailed in the Air Monitoring Plan (Attachment 1).

F. The Contractor shall be solely responsible for their methods and sequences with regard to the work.

G. Work area, conditions, and type of work required create considerable potential for accidents. Perform all work related to this specification in accordance with the approved project HASP. See Section 01 35 29 – Health, Safety, and Emergency Response Procedures for HASP submittal requirements.

1.02 RELATED WORK

A. Work related to this Section is described in

1. Section 01 35 29 – Health, Safety, and Emergency Response Procedures

2. Section 31 11 00 – Clearing and Grubbing

1.03 DEFINITIONS

A. Acronyms

1. BMA – Bank Management Area

2. HASP – Health and Safety Plan

3. RCRA – Resource Conservation and Recovery Act

4. TCLP – toxicity characteristic leaching procedures

5. THg – total mercury

6. USDOT – U.S. Department of Transportation

1.04 REFERENCES

A. SW-846 Test Method 9095B

PART 2 – MATERIALS

2.01 MATERIALS AND EQUIPMENT

A. To be specified and supplied by the Contractor.

2.02 CONTAINERS

A. The Contractor shall provide U.S. Department of Transportation- (USDOT)-approved containers for storage of wastes generated by the removal activities prior to transportation for off-site disposition. Containers may be lined rolloff containers, Super Sacks, or other approved products.

PART 3 – EXECUTION

3.01 GENERAL

A. During the progress of the work, the Contractor shall keep the premises free from accumulations of waste materials, rubbish, and other debris resulting from the work. At the completion of the work, the Contractor shall remove all waste materials, rubbish, debris, and surplus materials from the premises. In particular, tripping hazards shall be consistently monitored, as identified by Site workers, and shall be addressed immediately.

B. Soil testing to determine levels of contamination shall be performed, at a minimum frequency of every 500 cubic yards of material as per the Waste Management Plan (Appendix C). This will determine the appropriate disposal facility at which the soils excavated from each Bank Management Area (BMA) shall be disposed.

C. The Contractor shall be responsible for transporting all waste (including excavated soils) to its final disposal facility.

1. The Contractor may elect to load excavated soils from the BMAs directly into trucks for direct transport to disposal facility.

2. The Contractor may also elect to load excavated soil into secure USDOT-approved waste containers for transport to appropriate disposal facility.

3. The Contractor may also elect to stockpile excavated material at the BMA site before loading to trucks for transport to the final disposal facility. Stockpiles shall be in temporary stockpile areas shown on the Contract Drawings. No excavated soils will be stockpiled at the Jones Hollow Property.

D. All trucks used to transport excavated soils shall be lined with durable plastic sheeting. The liners shall be durable enough to withstand physical (tearing) and chemical degradation during transport, and shall be inspected daily and replaced by the Contractor if damage is noted.

E. If moisture is observed in excavated material, the material must pass a paint filter test (i.e., SW-846 Test Method 9095B) before being loaded into trucks or containers. No free liquids shall be loaded into trucks that are not completely enclosed and watertight.

F. The Contractor shall not burn or bury any materials on site.

3.02 WASTE MATERIAL STAGING AREAS

A. Only like waste materials with similar waste characteristics and/or disposal requirements may be staged together (if staging is required). Area within the project limits shown on the Contract Drawings is available for temporary staging and laydown. If any of these locations are to be used for waste material staging areas, it shall be proposed by the Contractor and approved by the DSR.

B. Waste material staging area(s) shall be constructed within the project limits shown on the Contract Drawings with a 24-inch-high (minimum) berm along the perimeter, lined with two layers of 20-mil (minimum) reinforced polyethylene sheeting, and sloped to a polyethylene-lined sump to allow for collection of liquids (if any). The polyethylene sheeting shall be extended over the top and outside face of the berm, and shall be adequately secured to prevent disturbance due to wind forces and/or on-site operation. The polyethylene sheeting shall be overlain by a layer of sand (minimum depth of 4 inches) and a layer of gravel (minimum depth of 4 inches). In addition, the Contractor shall install erosion- and sediment-control measures surrounding all waste material staging areas located outside.

C. Waste material staging areas shall be covered with a low-permeability cover of 20-mil polyethylene sheeting whenever the waste material is not actively being placed into/removed from the staging areas, during overnight hours, during periods of precipitation, whenever dust or mercury vapor action levels are being exceeded, or whenever directed by the DSR. The low-permeability cover shall be adequately anchored to prevent disturbance due to wind or other forces. Soil, demolition debris, or other waste materials shall not be utilized to anchor the cover.

D. Liquids collected within the waste material staging area shall be collected and containerized for characterization (by the Contractor) prior to off-site disposition.

E. Release of waste materials outside designated staging areas or waste containers shall be immediately removed and the impacted area remediated to pre-release conditions, at no additional cost to DuPont.

F. Following completion of the off-site transportation and disposition activities, staging area materials shall be disposed in accordance with the waste material stored in the staging area.

3.03 WASTE MATERIAL CHARACTERIZATION

A. Bank soils targeted for excavation will be characterized according to the Waste Management Plan (Appendix C)

1. Soil testing to determine levels of contamination shall be performed per 500 cubic yards of material as per the Waste Management Plan (Appendix C). This will determine the appropriate disposal facility at which the soils excavated from each BMA shall be disposed.

a) The Contractor may elect to perform waste characterization of soils in situ. In this case, the Contractor shall advance test pits and collect samples from the test pits to characterize the waste profile of the bank soils targeted for removal immediately after clearing and grubbing (See Section 31 11 00 – Clearing and Grubbing) in the bank removal and restoration areas.

b) Alternatively, the Contractor may elect to perform waste characterization of soils post excavation. In this case, the Contractor shall collect waste characterization samples from soil stockpiles or containers prior to transport to the final disposal facility.

B. Waste materials generated during the work activities shall be handled and segregated into appropriate waste streams (based on waste characterization) to facilitate off-site transportation and disposition in accordance with applicable federal, state, and local regulations.

C. Waste materials that have not been characterized based on the results of previous Site investigation activities (including, but not limited to, unanticipated waste materials, materials inaccessible during the Site investigation activities, and waste materials to be generated during work implementation) will be characterized by the Contractor prior to off-site transportation and disposition.

3.04 WASTE MATERIAL PROCESSING

A. The Contractor shall be responsible for processing waste materials into manageable sizes, as necessary, to satisfy off-site transport and disposal requirements. All waste material processing activities shall be conducted at the point of generation (e.g., within the work area limits prior to removal), within on-site staging areas, and/or at the disposition facility.

B. The Contractor shall submit to the DSR proposed methods necessary for processing all waste materials, as well as maximum size requirements, to satisfy off-site transportation and disposition requirements. The Contractor's proposed methods shall include appropriate dust and mercury vapor control measures to be utilized during the processing activities. The Contractor shall present their proposed methods for material processing in their work plan for review by the DSR.

C. Like waste streams shall be consolidated to facilitate off-site transportation and disposal.

D. Failure by the Contactor to keep the waste streams segregated, resulting in a new waste stream(s) to be characterized and disposed, shall not result in additional costs to DuPont. If a previously nonhazardous waste stream is rendered a hazardous waste stream due to the Contractor's failure to maintain segregation of waste materials, the Contractor shall be responsible for all additional costs associated with the transportation and off-site disposition of the new hazardous waste stream.

3.05 CONTAINERIZATION REQUIREMENTS

A. The Contractor shall be responsible for containerizing all waste materials generated during the work activities. All wastes generated during the work activities shall be containerized by the Contractor into USDOT-approved waste containers prior to shipment.

B. All rolloff containers, dump trucks, and/or dump trailers used for the transport of waste materials generated during the work activities shall be lined with durable polyethylene sheeting (with a minimum thickness of 20 mil) and shall be covered with a tarp secured to minimize the potential for release of dust and/or mercury vapors during transportation. If the container/truck/trailer lining or cover materials are ripped, not secured, or otherwise unacceptable to the DSR, the container/truck/trailer shall not exit the Site until the deficiencies have been addressed (to the satisfaction of the DSR).

3.06 DISPOSITION REQUIREMENTS

A. The Contractor shall be responsible for establishing waste profiles for each waste stream, as required by the waste disposition facilities. The DSR may be consulted during the completion of waste profiles, as necessary. The Contractor shall submit the completed profiles to the DSR for review and signature.

B. All hazardous wastes transported from the Site shall be under manifests as required by their status as hazardous waste. Nonhazardous wastes shall be transported from the Site under nonhazardous waste manifests. Each waste manifest shall include a waste material description according to USDOT requirements (i.e., proper shipping name, hazard class, and ID number). All hazardous wastes shall be assigned the appropriate hazardous waste codes according to characterization information. Land Disposal Restriction (LDR) Notification Forms shall also be prepared by the Contractor for each hazardous waste stream subject to LDR regulations (40 CFR 268).

C. The Contractor shall be responsible for preparing all waste manifests (for hazardous and nonhazardous wastes) for each off-site shipment of waste material generated during the work activities. The prepared manifests will be subject to review by the DSR. The DSR will be responsible for signing waste manifests for each off-site shipment of waste materials.

D. Certificates of Destruction/Disposal from all disposition facilities shall be provided directly to the Contractor, who will forward copies to the DSR. Copies of manifests and Certificates of Destruction/Disposal will be maintained by the DSR at the Site. The Contractor shall be responsible for obtaining and providing to the DSR documentation of weights for each waste shipment from the disposition facilities for the Project information and invoice payment purposes. The documentation shall present the weights of materials disposed/recycled/reclaimed at the facility for each manifest identification number.

E. Only waste transporters licensed and permitted in accordance with USDOT, Virginia Department of Transportation, and other state agencies (as applicable) to handle the type of waste material transported shall be used. The waste transportation companies shall be subject to DSR review and approval.

F. Prior to off-site transportation, the Contractor shall screen all waste containers for mercury vapor. If the results of screening indicate that the waste should be re-characterized based on the final planned disposition method, the DSR shall be notified and the materials shall be re-characterized for appropriate off-site disposal as necessary.

G. The Contractor shall only utilize disposition facilities that have been reviewed by the DSR prior to off-site shipment of waste materials. Each disposition facility utilized shall be licensed, permitted, and compliant (as applicable) with all applicable federal, state, and local regulations.

1. The DSR has identified facilities in Table 1 for waste disposal dependent on final tested values for Resource Conservation and Recovery Act (RCRA) toxicity characteristic leaching procedures (TCLP) and total mercury (THg). The Contractor may propose alternative disposal facilities, but shall use these facilities unless written approval is given by the DSR.

Tested Values	RCRA Classification	Disposal Facility
TCLP Hg < 0.2 mg/L	RCRA Non-Hazardous	Waste Management Amelia Landfill (Jettersville, VA)
TCLP Hg ≥ 0.2 mg/L THg < 260 mg/kg	RCRA Hazardous	U.S. Ecology Subtitle-C Landfill in Belleville, MI
TCLP Hg ≥ 0.2 mg/L THg ≥ 260 mg/kg	RCRA Hazardous	Bethlehem Apparatus (Retorting Facility) in Bethlehem, PA

H. At a minimum, waste materials generated from the work activities (including materials with TCLP mercury less than values noted in the Table above) shall be sent to a non-hazardous RCRA Subtitle D landfill disposal facility. Based on characterization results and/or waste characteristics, other wastes may be disposed at a disposition and/or recycling facility with more stringent criteria and/or as required by local, state, and federal regulations.

END OF SECTION

ATTACHMENT 1
AIR MONITORING PLAN

SOUTH RIVER AIR MONITORING PLAN CONSTITUTION PARK, WWTB A AND B SITES

Prepared for

Virginia Department of Environmental Quality

City of Waynesboro

Prepared by

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10320 Little Patuxent Parkway, Suite 1140

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1 INTRODUCTION

1.1 General

This document presents an Air Monitoring Plan for soil removal activities at the South River Constitution Park, Wastewater Treatment Plant Site A (WWTP A) and WWTB Site B (WWTP B) Sites (site) located in Waynesboro, Virginia. This Air Monitoring Plan has been prepared by Anchor QEA, LLC, at the request of DuPont. This Air Monitoring Plan presents air monitoring activities to be performed at the site during the implementation of the soil removal activities, and identifies control measures to be implemented based on the results of air monitoring. Air monitoring to be conducted for on-site personnel is to be addressed in the Contractor's site-specific Health and Safety Plans (HASPs).

2 AIR MONITORING PLAN

2.1 General

This section presents a description of air monitoring to be implemented during soil removal activities (work activities) at the site. Air monitoring activities will be conducted prior to and during the work activities, and will include the collection of meteorological data and real-time monitoring data for particulate (dust) levels, and mercury vapor concentrations. The air monitoring activities are to be conducted by the Contractor, as described below. The main parameters of concern during implementation of the work activities are airborne particulates and mercury vapors. Additional parameters for personal and work-area air monitoring (including carbon monoxide and volatile organic compounds) will be presented in the site-specific HASPs to be prepared by the Contractor. These additional parameters will be identified based on the Contractor's proposed equipment and methods for implementation of the work activities.

The air monitoring program to be implemented during the work activities shall consist of the following monitoring tasks:

- Background Air Monitoring
- Meteorological Monitoring
- Work Area Air Monitoring
- Perimeter Air Monitoring

A description of the monitoring activities to be conducted is presented below.

2.2 Monitoring Equipment

The monitoring devices to be used, at a minimum, include those presented in Table 1.

Table 1
Monitoring Equipment

Parameter	Monitoring Equipment
Mercury Vapors	Jerome Mercury Vapor Analyzer direct read (i.e., real-time) or equivalent
Airborne Particulates	MIE DataRAM™ Portable Particulate Monitor (or equivalent)

Air monitoring equipment will be maintained and calibrated in accordance with the specific manufacturers' procedures. Preventive maintenance and repairs will be conducted in accordance with the respective manufacturers' procedures. Only manufacturer-trained and/or authorized personnel will be allowed to perform instrument repairs or preventive maintenance.

If an instrument is found to be inoperative or fails a calibration check, the instrument shall be immediately removed from service and repaired or replaced. If the instrument is essential for air monitoring during a specific work activity, that activity must cease until the instrument is repaired or an appropriate replacement unit is obtained.

Unless specified elsewhere in this plan, air monitoring will be conducted at the breathing zone, which will be assumed to be located 5 feet above ground.

2.3 Background Air Monitoring

Community and site background values for airborne particulates and mercury vapors will be compared to the air monitoring results obtained during the work activities to identify the control measures to be implemented. The Contractor will conduct the background air monitoring activities discussed in this subsection.

Mercury vapor readings will be collected using the Jerome Mercury Vapor Analyzer, and particulate levels will be measured using the MIE DataRAM particulate monitor. The air monitoring data will be recorded on an air monitoring log and maintained by the Contractor in an on-site project file.

2.3.1 Site Perimeter Pre-Work Background Readings

Prior to initiation of work activities, the Contractor will collect background air monitoring data for airborne particulates and mercury vapors for a minimum period of 2 days prior to initiation of work activities.

Background readings will be collected every 15 minutes for 1 hour, three times per day (morning, midday, and end of day). Background monitoring data is to be collected approximately every 50 feet along access paths, sidewalks, and parking areas located around the entire perimeter of the site.

2.4 Meteorological Monitoring

Throughout the work activities, meteorological monitoring will be conducted using a Met One meteorological system (or equivalent), provided by the Contractor, to measure wind speed, wind direction, and temperature. The meteorological sensors will be mounted on a tower, as appropriate, to provide for representative readings relative to the site. If required, the tower will include a grounding system and lightning-protection system that meets the manufacturer's recommendations. Meteorological readings will be recorded on a data logging device; readings will be evaluated at least three times per day (i.e., once in the early morning, once in the mid-afternoon, and once in the late afternoon) by the Contractor to determine the upwind and downwind boundaries of the site.

2.5 Air Monitoring Action Levels

Action levels have been selected for mercury vapor and airborne particulates to protect site personnel and the public during the implementation of the work activities. These action levels are assumed to be over background levels.

Work area action levels are to be determined by the Contractor and presented in their HASP.

Should the action levels for mercury vapors or airborne particulates be met or exceeded in the active work areas, the Contractor shall implement appropriate control measures (e.g., dust/vapor control measures and stop work) to reduce the airborne concentrations of constituent(s) of concern to below action levels. A discussion of control measures that may be implemented is presented in Section 3.

Table 2 presents the air monitoring action levels.

Table 2
Air Monitoring Action Levels

<table>
<tr><th>Parameter</th><th>Action Levels</th><th>Action</th></tr>
<tr><td colspan="3">Work Area (Monitor Every 15 Minutes)</td></tr>
<tr><td rowspan="3">Mercury Vapor</td><td>≤ 0.025 mg/m³</td><td>Normal operations; Level D</td></tr>
<tr><td>> 0.025 mg/m³ to ≤ 0.5 mg/m³</td><td>Upgrade to Level C</td></tr>
<tr><td>> 0.5 mg/m³</td><td>Stop work; Implement control measures</td></tr>
<tr><td rowspan="3">Airborne Particulates</td><td>0 mg/m³ to 0.1 mg/m³</td><td>Normal operations</td></tr>
<tr><td>≥ 0.1 mg/m³ to ≤ 1mg/m³</td><td>Upgrade to Level C</td></tr>
<tr><td>> 1 mg/m³</td><td>Stop work; Implement control measures</td></tr>
<tr><td colspan="3">Work Area Perimeter (Monitor Every 15 Minutes)</td></tr>
<tr><td rowspan="3">Mercury Vapor</td><td>≤ 0.025 mg/m³</td><td>Normal operation</td></tr>
<tr><td>> 0.025 mg/m³ to ≤ 0.05 mg/m³</td><td>Implement measures to control mercury vapors; Increase site perimeter monitoring to 15-minute intervals</td></tr>
<tr><td>≥ 0.05 mg/m³</td><td>Stop work; implement Response Plan</td></tr>
<tr><td rowspan="3">Total Airborne Particulates</td><td>< 0.1 mg/m³</td><td>Normal operation</td></tr>
<tr><td>≥ 0.1 mg/m³ to ≤ 0.5 mg/m³</td><td>Implement measures to control particulates; Initiate site perimeter monitoring</td></tr>
<tr><td>≥ 0.5 mg/m³</td><td>Stop work</td></tr>
</table>

Parameter	Action Levels	Action
Site Perimeter (Monitor Every Hour, Unless Perimeter Exceedance)		
Mercury Vapor	≤ 0.015 mg/m^3	Normal operation
	> 0.015 mg/m^3, ≤ 0.025 mg/m^3	Implement measures to control mercury vapors; increase site perimeter monitoring to 15-minute intervals
	> 0.025 mg/m^3	Stop work; implement Response Plan
Total Airborne Particulates	< 0.1 mg/m^3	Normal operation
	≥ 0.1 mg/m^3, ≤ 0.5 mg/m^3	Implement measures to control particulates; initiate site perimeter monitoring
	> 0.5 mg/m^3	Stop work

Notes:
1. Mercury vapor levels based on American Conference of Governmental Industrial Hygienists 8-hour Time Weighted Average (TWA) of 0.025 mg/m^3
2. Work area perimeter air monitoring will be conducted at three perimeter monitoring locations and will be located such that a triangle is formed around the work area. The monitoring points will be located at the work area perimeter boundaries closest to work areas that are most likely to produce fugitive dusts and/or mercury vapors. In the event that the work area perimeter coincides with any exterior building wall, then the work area perimeter monitoring readings will serve as the site perimeter monitoring readings.

mg/m^3 = milligram per cubic meter

Site perimeter air monitoring will be conducted at four perimeter monitoring locations, including two upwind locations and two downwind locations, such that a rectangle is formed around the work area. The meteorological system will be utilized to monitor wind direction. The site perimeter monitoring locations will be adjusted if the wind direction changes more than 45 degrees. Such an adjustment will be determined by the Contractor, and documented in the field notebook. The monitoring stations will be located at the site perimeter boundaries closest to work areas that are most likely to produce fugitive dusts and/or mercury vapors.

3 CONTROL MEASURES

Measures to be utilized to control mercury vapor and airborne particulate levels shall be proposed by the Contractor and reviewed by the DuPont Site Representative.

Measures for mercury vapor control may include, but are not limited to, the following items:

- Reduced rate of removal/remedial activities

Measures for airborne particulate control may include, but are not limited to, the following items:

- Use of water spray
- Reduced rate of removal/remedial activities

DIVISION 04—MASONRY

DIVISION 04—MASONRY
Section 04 40 00—Stone Assemblies for Riverside Access

PART 1 – GENERAL

1.01 SUMMARY

A. Work includes furnishing and installing limestone boulders, stepping stones, and viewing platform.

B. The work area, conditions, and type of work required create considerable potential for accidents. Perform all work related to this specification in accordance with the approved project Health and Safety Plan (HASP). See Section 01 35 29 – Health, Safety, and Emergency Response Procedures for HASP submittal requirements.

C. If the Contractor identifies a discrepancy between any of the Contract Documents, they shall immediately notify the DuPont Site Representative (DSR). In general, the more stringent requirement shall take precedence.

1.02 RELATED WORK

A. Work related to this Section is described in

1. Section 01 33 00 – Submittal Procedures
2. Section 01 35 29 – Health, Safety, and Emergency Response Procedures
3. Section 31 23 00 – Earthwork and Fill
4. Section 31 35 00 – Slope Protection
5. Section 32 90 00 – Planting and Habitat Restoration

1.03 DEFINITIONS

A. Acronym

1. DSR – DuPont Site Representative
2. HASP – Health and Safety Plan

1.04 REFERENCES

A. Not used

1.05 TOLERANCES

A. The finished surface elevations and gap sizes shall not deviate from the lines and grades shown on the Contract Drawings by more than the tolerances listed below. Tolerances are measured perpendicular to the indicated neatlines. Extreme limits of the tolerances given shall not be continuous in any direction for more than five times the nominal stone dimension for rock, backfill, and depth of foundation.

Neatline Tolerances		
Material	**Above Neatline feet (inches)**	**Below Neatline feet (inches)**
Foundation/Bedding Layer	0.10 (1.2)	0.10 (1.2)
Steps and Platform	0.10 (1.2)	0.10 (1.2)
Boulder (Surface Elevation)	1 (12)	0.0 (0.0)
All Other Materials	0.10 (1.2)	0.10 (1.2)

B. The intention is that the Work shall be built generally to the required elevations, slope, and grade, and the outer surfaces shall be even and present a neat appearance. Placed material not meeting these limits shall be removed or reworked as directed by the DSR.

1.06 SUBMITTALS

A. Contractor shall submit the following in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data

1. The Contractor shall provide the DSR with a copy of product datasheet for limestone boulders, stepping stones, and geotextile showing they meet the Specifications herein.

PART 2 – PRODUCTS

2.01 LIMESTONE BOULDERS

A. Limestone Boulders shall be provided by the Contractor. The Contractor shall obtain Boulders from approved off-site sources such as Frazier Quarry or other DSR-approved source.

1. Boulders shall consist of limestone or the Contractor may propose an alternative for DSR review and approval.

2. Color of boulders shall closely match surrounding rocks in the project area.

3. The diameter of the boulders shall be 2 to 3 feet.

2.02 STEPPING STONES AND VIEWING PLATFORM

A. Stepping stones shall be of a single stone with flat split faces at right angles for the riser and tread surfaces. Exposed faces of the stones shall be broken or otherwise roughened to provide traction and be generally flat with no irregularities that would result in a trip hazard. All riser faces shall have vertical edges and distinct corners when installed.

B. The color of Stepping Stones shall closely match surrounding rocks in the project area.

2.03 CRUSHED GRAVEL BASE FOR STEPPING STONES

A. Crushed Gravel Base for boulders shall be crushed rock per Section 31 23 00 – Earthwork and Fill.

PART 3 – EXECUTION

3.01 BASE PREPARATION

A. Areas on which Stepping Stones are to be placed shall be graded and/or dressed to conform to cross sections and details shown on the Contract Drawings within an allowable tolerance as stated in Article 1.03 of this Section. The prepared base shall be approved by the DSR. Immediately prior to placing the foundation/base layer, the prepared base will be inspected by the DSR, and no material shall be placed thereon until that area has been approved.

3.02 PLACEMENT OF FOUNDATION BASE LAYER FOR BOULDERS, STEPPING STONES AND VIEWING PLATFORM

A. General

1. Material shall be spread uniformly to the slope lines and grades as indicated in the Contract Drawings and in such manner as to avoid damage to the prepared base. Placing of materials by methods that tend to segregate the particle sizes within the bedding layer or cause mixing of the separate layers will not be permitted.

B. Foundation Base Layer

1. Placement shall begin at the bottom of the area to be covered in one lift. Foundation/base layer shall be compacted to 95 percent dry density prior to placement of any subsequent layers of rock material and approved by the DSR. Any damage to the surface of the prepared base during placing of the material shall be repaired before proceeding with the Work.

3.03 CONSTRUCTION OF STEPPING STONES AND VIEWING PLATFORM

A. Stepping Stones shall be placed on site as shown on the Contract Drawings and directed by the DSR. Locations shown in the Contract Drawings are approximate. Placement and orientation of each stone shall be approved by the DSR on site.

1. The Contractor shall excavate as needed to place stepping stones.

2. Install base layer per Article 3.02, foundation base layer, shall be compacted to a dense configuration.

3. Stepping stones and Viewing Platform shall be set as shown in the Contract Drawings. Each stepping stone shall have at least three contact surfaces and shall be set stable, with no rocking.

3.04 INSTALLING BOULDERS

A. All boulders shall be placed on site as shall be approved by the DSR. Locations shown on the Contract Drawings are approximate.

B. Boulders shall be partially embedded into the foundation at least half way from the bottom in compacted subgrade and placed on crushed rock base.

END OF SECTION

DIVISION 05—METALS

DIVISION 05—METALS
Section 05 17 00—Structure Connections

PART 1 – GENERAL

1.01 SUMMARY

A. The work described in this Section includes furnishing all labor, materials, tools, equipment, and incidentals required for making connections for large woody material (LWM) members for salvaged logs and salvaged trees shown on the Contract Drawings.

B. Note that much of the work will take place away from existing infrastructure and may require the use of self- or generator-powered equipment. All equipment operated in or near natural waterways may be subject to hydraulic permit conditions.

C. The work area, conditions, and type of work required create considerable potential for accidents. Perform all work related to this specification in accordance with the approved project HASP. See Section 01 35 29 – Health, Safety, and Emergency Response Procedures for HASP submittal requirements.

D. If the Contractor identifies a discrepancy between any of the Contract Documents, they shall immediately notify the DuPont Site Representative (DSR). In general, the more stringent requirement shall take precedence.

1.02 RELATED WORK

A. Work related to this Section is described in the following sections

1. Section 01 33 00 – Submittal Procedures
2. Section 01 35 29 – Health, Safety, and Emergency Response Procedures
3. Section 06 13 43 – Large Woody Materials
4. Section 31 37 00 – Stone Toe Protection

1.03 DEFINITIONS

A. Acronyms

1. ASTM – American Society of Testing and Materials
2. HASP – Health and Safety Plan
3. DSR – DuPont Site Representative
4. lb – pound
5. LWM – large woody material

6. UNC – Unified National Coarse

7. WLL – working load limit

1.04 REFERENCES

A. American Society of Testing and Materials (ASTM) F541

B. Unified National Coarse (UNC)

1.05 SUBMITTALS

A. Contractor shall submit the following in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data

1. Staples: Material cut sheet from manufacturer and/or supplier showing that product meets all requirements of these Contract Specifications.

2. Rock Anchors: Material cut sheet from manufacturer and/or supplier showing that the system meets all requirements of these Contract Specifications.

3. Eye Bolts: Material cut sheet from manufacturer and/or supplier showing that the product meets all requirements of these Contract Specifications.

4. Figure-Eight Chain Coupling Links: Material cut sheet from manufacturer and/or supplier showing that the product meets all requirements of these Contract Specifications.

5. Chain: Material cut sheet from manufacturer and/or supplier showing that system meets all requirements of these Contract Specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Inspection on delivery

1. Upon delivery to the Contractor’s work or storage area, the products shall be inspected in the presence of the DSR for condition and conformance with the Contract Specifications.

PART 2 – PRODUCTS

2.01 STAPLES

A. Staples shall be “U”-shaped, hot dip galvanized, with rolled diamond point.

B. Staple size, unless otherwise approved by the DSR.

1. 1/2-inch by 6-inch: 1-inch minimum opening, 6-inch length.

2.02 ROCK ANCHORS

A. Rock anchors shall be internally threaded four-way expansion anchors (also called vibration-resistant expansion anchors).

B. Rock anchors shall be zinc coated and have a Class 2B thread fit.

C. Rock anchor size, unless otherwise approved by the DSR, shall be

1. 3/4-inch diameter, 10 UNC screw size: 9,800-pound (lb) ultimate pull-out capacity

D. Rock anchors shall be installed per the manufacturer’s recommendations.

E. As approved by the DSR, an adhesive anchoring system may be used in place of the specified mechanical rock anchors, provided the following conditions are met

1. The adhesive anchor system shall have a minimum 9,800-lb ultimate pull-out capacity.

2. The adhesive anchor system shall be compatible with the specified galvanized steel eye bolt diameter, type, and strength.

3. Shop Drawings and anchor strength calculations shall be provided by the Contractor for approval by the DSR.

4. Installation of the adhesive anchoring system shall be in strict accordance with the manufacturer’s recommendations.

2.03 EYE BOLTS

A. Eye bolts shall be for lifting.

B. Eye bolts shall be plain or black oxide steel.

C. Eye bolt size, unless otherwise approved by the DSR, shall be

1. 3/4-inch diameter, 10 UNC threaded shaft: Minimum 6,000-lb working load limit.

2. No longer than required to fully set the mechanical rock anchor and protrude from the rock face no more than 1/2 an inch.

D. Eye bolts shall meet ASTM F541.

2.04 CHAIN

A. Grade: 40/43 (high-test); Finish: Hot-galvanized steel; Trade Size: 1/2-inch, working load limit (WLL) no less than 9,200-lb.

2.05 CHAIN COUPLING LINKS

A. Grade: 80; Style: Figure-eight, removable; finish: Plain finish, for chain trade size: 1/2-inch, WLL no less than 12,000-lb.

PART 3 – EXECUTION

3.01 STAPLES

A. Chain at a finished connection shall be fastened with staples to the LWM on both sides of the connection hardware as indicated on the Contract Drawings.

B. If a staple bends or is otherwise unsuccessfully installed, the Contractor shall install a second staple next to the failed staple. Failed staples shall be removed if they protrude from the surface of the LWM by more than 2 inches.

3.02 CHAIN CONNECTIONS

A. Contractor shall provide connections involving steel chain for LWM as indicated on the Contract Drawings and as described in the Contract Specifications, or as otherwise approved by the DSR.

B. Chain Connections shall be made after the LWM has been placed at its final location in the river as indicated on the Contract Drawings.

C. The DSR shall witness and inspect a mock-up of a connection, completed by the Contractor, proposed for use in construction. If modifications are necessary, the mock-up shall be re-worked under the review of the DSR.

D. In order to prevent the chain from slipping, connections shall involve notching logs, wrapping chain, stapling, and/or other effective methods approved by the DSR.

E. Connections shall always be finished with the appropriate connection hardware as indicated on the Contract Drawings and as described in the Contract Specifications, or as otherwise approved by the DSR.

F. If a finished connection is judged non-approved, the Contractor shall rework the connection at no additional cost.

3.03 ROCK CONNECTIONS

A. The Contractor shall provide connections that involve ballasting rock to LWM as indicated on the Contract Drawings and as described in the Contract Specifications, or as otherwise approved by the DSR.

B. Rock to chain connections shall be made after the rock and LWM have been placed at their final locations in the river as indicated on the Contract Drawings.

C. Connections shall involve drilling anchors, installing eye bolts, making chain connections, and/or other effective methods approved by the DSR.

D. Connections shall always be finished with the appropriate connection hardware as indicated on the Contract Drawings and as described in the Contract Specifications, or as otherwise approved by the DSR.

E. If a finished connection is judged non-approved, the Contractor shall rework the connection at no additional cost to the DSR.

3.04 ORDERLY WORK AREA/SITE CLEANUP

A. Connections shall not be backfilled or otherwise obstructed from review by the DSR without prior approval.

B. The Contractor shall collect and properly dispose of remaining materials, debris, and rubbish resulting from completion of connections.

C. The Contractor shall maintain neat and orderly storage and work areas as much as possible. The Contract will not be considered complete until all of the Contractor’s tools, equipment, and property have been removed from the Project Site, and the Contractor’s storage and work areas have been properly cleaned. All litter, packaging material, and unused hardware shall be removed from the Project Site and disposed of in a proper manner. Special care shall be taken to ensure no foreign materials fall into or contaminate Project waters.

END OF SECTION

DIVISION 06—WOOD, PLASTIC, AND COMPOSITES

DIVISION 06—WOOD, PLASTIC, AND COMPOSITES
Section 06 13 43—Large Woody Materials

PART 1 – GENERAL

1.01 SUMMARY

A. Furnish all materials, equipment, and labor necessary to remove, manage, and install the large woody material members included in the various locations as indicated for salvaged logs and salvaged trees on the Contract Drawings and as described in the Contract Specifications. Work includes:

1. The Contractor shall be responsible for the care and installation of the large woody materials, once the large woody materials are removed from the bank and in his/her possession. Possession of the large woody materials is assumed once the following are accomplished

a) The large woody material has been mechanically excavated from the existing Bank Management Areas (BMAs) with the rootwad intact.

b) The Contractor and DuPont Site Representative (DSR) has conducted an inspection and inventory of large woody materials excavated and stockpiled by the Contractor.

B. Large woody materials are required in multiple locations, as indicated on the Contract Drawings.

C. Large woody materials shall be salvaged logs, as described in Part 2 of this specification.

1. If an insufficient quantity of large woody materials exist at the BMA locations identified on the Contract Drawings, the Contractor must source additional large woody materials from off-site, from sources approved by the DSR to meet the salvage log requirements.

D. The work area, conditions, and type of work required create considerable potential for accidents. Perform all work related to this specification in accordance with the approved project HASP. See Section 01 35 29 – Health, Safety, and Emergency Response Procedures for HASP submittal requirements.

E. If the Contractor identifies a discrepancy between any of the contract documents, they shall immediately notify the DSR. In general, the more stringent requirement shall take precedence.

1.02 RELATED WORK

A. Work related to this Section is described in

1. Section 01 33 00 – Submittal Procedures

2. Section 01 35 29 – Health, Safety, and Emergency Response Procedures
3. Section 02 60 00 – Contaminated Site Material Removal
4. Section 02 51 00 – Equipment Decontamination and Screening
5. Section 05 17 00 – Structure Connections
6. Section 31 37 00 – Stone Toe Protection

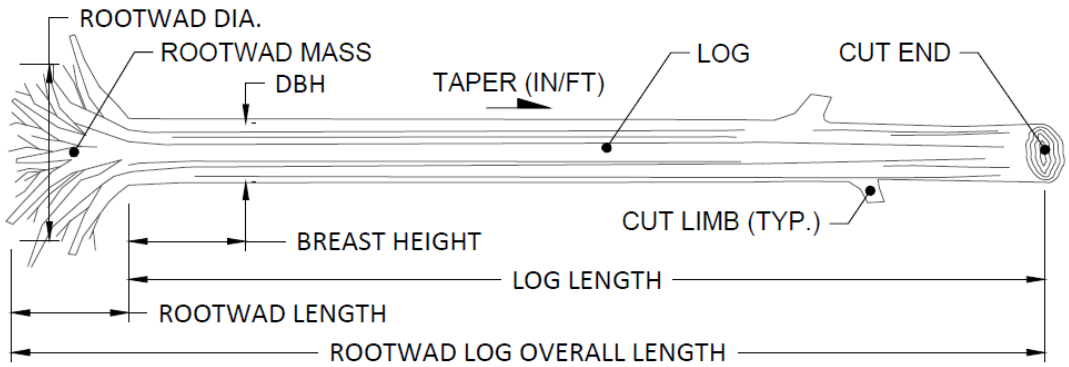
1.03 DEFINITIONS

A. Abbreviations and Acronyms

1. BMA – bank management area
2. DBH – diameter at breast height
3. dia. – diameter
4. DSR – DuPont Site Representative
5. HASP – Health and Safety Plan

B. Definitions

1. Large Woody Material: Natural logs meeting the dimensions and characteristics indicated on the Contract Drawings and described in the Contract Specifications.
2. Member: An individual piece of large woody material.
3. Bole: The trunk of a tree.
4. Rootwad Mass: The roots and the flared portion of the tree transitioning between the roots and the bole.
5. Rootwad Log: Large woody material that includes an intact rootwad mass connected to a portion of the bole of the tree. Rootwad logs are typically produced by removing an entire tree, including the rootwad mass, from the ground, cutting the limbs, and cutting the log to a specified length. The principal features and dimensions of a rootwad log are shown below.



1.04 REFERENCES

A. The publication listed below forms a part of this Contract Specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. United States Department of Agriculture (USDA)

USDA NRS-38	(2009) Specific Gravity and Other Properties of Wood and Bark for 156 Tree Species Found in North America

1.05 SUBMITTALS

A. Contractor shall submit the following in accordance with Section 01 33 00 – Submittal Procedures

1. The DSR shall provide a survey of the large woody materials existing in the bank removal and restoration areas on-site.

a) The survey shall include the height, DBH or diameter, species, and approximate location of the large woody materials on-site.

2. The Contractor shall provide the following documentation indicating that they have field located trees to be removed that are candidates for the large woody materials to be reused on-site. This documentation shall be provided no later than 21 calendar days prior to mobilization.

a) An inventory of members from the on-site locations showing that members meet the requirements for large woody materials, as described in the Contract Specifications (except for the requirements regarding the rootwad mass, which cannot be assessed in situ).

b) Flagging, paint, or another form of visual indication that a tree is marked as a candidate for salvage and use as large woody material for approval by the DSR.

1.06 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall remove any soil that adheres to large woody material salvaged from the BMAs by first sweeping off the soil. If here is still visible soil adhered to the large woody material that cannot be removed by sweeping, the contractor will power wash the large woody material to remove the remaining soil.

1. All soil removed from the large woody material shall be handled in accordance with Section 02 60 00 – Contaminated Site Material Removal.

2. Power washing shall occur on site in the decontamination areas on site approved by the DSR. Washwater generated during power washing will be handled in accordance with Section 02 51 00 – Equipment Decontamination and Screening, Part 3.01 E.

3. Power washing shall be performed so as to minimize damage to the large woody material.

B. The Contractor shall store large woody materials removed from the BMAs or sourced from off-site within designated staging and/or stockpile areas and as described in the Contract Specifications, or as approved by the DSR.

C. The Contractor shall protect the large woody materials from theft, damage from fire, breakage during handling, vandalism, and other means that result in the large woody materials not meeting the requirements indicated on the Contract Drawings and as described in the Contract Specifications.

D. The Contractor shall replace, at no additional cost to the DSR, members of large woody materials that are damaged during handling or placement that had met the requirements indicated on the Contract Drawings and as described in the Contract Specifications.

E. The Contractor shall handle the large woody material with equipment appropriate for the task. Handling shall not damage the large woody material.

F. The Contractor shall place large woody material into position using appropriate equipment and methods, and shall not drop large woody material into position.

G. Handling and moving large woody material shall not damage existing features or landscapes.

PART 2 – PRODUCTS

2.01 SALVAGED LOGS

A. Salvaged Logs

1. Are included in multiple locations shown on Contract Drawings.

2. Include an intact rootwad mass consisting of root fibers ranging in size down to a diameter of 1 inch or less.

3. Shall be sourced from hardwood species native to Virginia, or as approved by the DSR.

4. Logs exhibiting breakage, rot, splitting, holes, pest infestation, foreign objects/finishes, vandalism, burns, and other damages are not allowed and may be rejected by the DSR.

5. Log length shall be no more than 35 feet in length.

6. DBH requirements shall be determined by the DSR using the stockpile of salvaged rootwad logs made available during the project. The DSR may reject some of the salvaged materials based on these Contract Specifications.

   a) In general, the DBH shall not exceed 18 inches.

7. Limbs shall be trimmed within 1 foot of the face of the log, unless otherwise approved by the DSR. Limbs do not include the root mass.

8. Rootwad masses shall be no larger than 54 inches in diameter.

9. Rootwad masses shall be reasonably uniform and full; rootwad logs with asymmetrical rootwad masses may be rejected by the DSR.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Installation of large woody materials involves placing member(s) in accordance with the Contract Drawings and Contract Specifications.

B. Large woody materials shall be placed such that at least half of the log sits below the ordinary highwater line (OHW).

C. Excavation into the river bed for large woody material installation is not permitted. The Contractor may minimally trim the rootwad mass with DSR approval such that half of the log is below OHW.

3.02 ORDERLY WORK AREA AND SITE CLEANUP

A. The Contractor shall maintain neat and orderly storage and work areas, as much as possible. The Contract will not be considered complete until all of the Contractor's tools, equipment, and property have been removed from the Project site, and the Contractor's storage and work areas have been properly cleaned.

B. The Contractor shall collect and properly dispose of remaining materials, debris, and rubbish resulting from stockpiling of large woody materials. Woody debris may be chipped and placed on site with the approval of the DSR.

END OF SECTION

DIVISION 31—EARTHWORK

Section 31 05 19—Geosynthetics

PART 1 – GENERAL

1.01 SUMMARY

A. Work shall consist of furnishing and placing geosynthetic soil reinforcement for construction of embankments, 6-inch blended biochar placement, and 12-inch planting substrate placement.

B. The work area, conditions, and type of work required create considerable potential for accidents. Perform all work related to this specification in accordance with the approved project HASP. See Section 01 35 29 – Health, Safety, and Emergency Response Procedures for HASP submittal requirements.

C. If the Contractor identifies a discrepancy between any of the Contract Documents, they shall immediately notify the DuPont Site Representative (DSR). In general, the more stringent requirement shall take precedence.

1.02 RELATED WORK

A. Section 01 33 00 – Submittals

B. Section 01 35 29 – Health, Safety, and Emergency Response Procedures

C. Section 31 23 00 – Earthwork and Fill

D. Section 31 35 00 – Slope Protection

E. Section 31 37 00 – Stone Toe Protection

F. Section 32 90 00 – Planting and Habitat Restoration

1.03 DEFINITIONS

A. Acronyms

1. ASTM – American Society for Testing and Materials
2. DSR – DuPont Site Representative
3. HASP – Health and Safety Plan
4. VDOT – Virginia Department of Transportation

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM) D4873

B. Virginia Department of Transportation (VDOT) Road and Bridge Specifications (2007)

1.05 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals, for each geosynthetic product described in this section.

1. Geotextile:

a) Reinforcement material supplier

b) Reinforcement product information including manufacturer name, manufacturer product number, and test results that verify the product complies with required Contract Specifications

c) Geosynthetic manufacturer's certification that the geosynthetics supplied meet the respective index criteria provided in this section, measured in full accordance with all test methods and standards specified.

2. Geotextile and Geocell System: The Contractor shall submit manufacturer data showing that geotextile and geocell system meets or exceeds the requirements outlined herein for the DuPont Site Representative's (DSR's) review and approval prior to ordering materials.

PART 2 – PRODUCTS

2.01 GEOTEXTILE

A. Geotextile shall comply with VDOT Standard Specification Section 245.03 (b) except that it shall be nonwoven, and maximum apparent opening size (AOS) shall be 0.30 mm.

2.02 GEOCELL SYSTEM FOR BANK REMOVAL AND RESTORATION AREAS

A. The Contractor shall submit a geosynthetic 6-inch geocell system and appurtenances or equivalent for the DSR for review and approval. The 6-inch geocell system shall be placed on top of the geotextile in Section 2.01 and underneath the Section 31 37 00 – Stone Toe Protection and as noted in the Contract Drawings.

B. Backfill material shall be in accordance with Section 31 23 00 – Earthwork and Fill, Subsection 2.06.

2.03 GEOCELL SYSTEM FOR BANK STABILIZATION AREAS

A. The Contractor shall submit a geosynthetic 12-inch geocell system and appurtenances or equivalent for DSR for review and approval. The 12-inch geocell system shall be placed in accordance with Section 32 90 00 – Planting and Habitat Restoration and as noted in the Contract Drawings.

B. Backfill material shall be in accordance with Section 31 23 00 – Earthwork and Fill, Subsection 2.07.

PART 3 – EXECUTION

3.01 DELIVERY, STORAGE AND HANDLING

A. Check products upon delivery to ensure proper material has been received and material is dry and undamaged.

B. Protect materials from damage and exposure in accordance with ASTM D4873.

1. Protect geosynthetic from deleterious materials, chemicals, sparks and flames, excess temperature, and any other environmental conditions that may degrade physical properties.

2. If stored outdoors, rolls shall be elevated from the ground surface.

C. Label each roll with manufacturer's name, product identification, roll dimensions, lot number, and date manufactured.

D. Handle and unload rolls by hand or with load-carrying straps, fork lift with stinger bar, or axial bar assembly, or as recommended by the manufacturer.

E. Do not drag, lift by one end, lift by cables or chains, or drop roll to the ground.

3.02 SUBGRADE PREPARATION

A. Prepare subgrade to be level and free from deleterious materials, loose, or otherwise unsuitable soils.

B. Final DSR approval for the subgrade condition is required prior to placement of geosynthetics.

C. Prior to geosynthetics placement in bank removal and restoration areas, proof roll subgrade to identify soft areas. Proof rolling is not required in bank stabilization areas.

D. Soft subgrade areas shall be excavated and backfilled with suitable compacted soils.

E. Bench the back cut as necessary in a manner that results in stable slope conditions.

3.03 GEOSYNTHETIC PLACEMENT

A. Install geosynthetics in accordance with manufacturer's recommendations and this Contract Specification.

B. Where conflicts arise between the recommendations of the manufacturer and this Contract Specification, the stricter of the requirements, as determined by the DSR, shall govern the installation.

C. Place geosynthetic in continuous longitudinal strips in the direction of the main reinforcement.

D. Horizontal coverage of less than 100% is not allowed.

E. Place only that amount of geosynthetic reinforcement required for immediately pending work to prevent undue damage.

F. Geosynthetic reinforcement shall be placed to lie flat and pulled tight prior to backfilling.

3.04 GEOCELL SYSTEMS FOR BANK REMOVAL AND RESTORATION AREAS

A. The geocell system shall be installed in accordance with the manufacturer recommendations. The Contractor shall perform any Quality Control testing or verification as recommended by the manufacturer.

B. Where conflicts arise between the recommendations of the manufacturer and this Contract Specification, the stricter of the requirements, as determined by the DSR, shall govern the installation.

3.05 FILL PLACEMENT OVER GEOTEXTILE

A. Place, spread, and compact backfill in a manner to minimize the development of wrinkles and/or displacement of the geosynthetic.

B. Place fill in maximum 12-inch-thick lift thickness when heavy compaction equipment is used, and maximum 6-inch-thick lift thickness when hand-operated compaction equipment is used.

C. Grade backfill away from the slope crest, and roll backfill at the end of the work shift to prevent ponding of water on the reinforced backfill surface.

D. Do not operate tracked construction equipment directly on the geosynthetic surface. A minimum of 6 inches of backfill shall overlay the geosynthetic where tracked equipment is operating.

E. Compact backfill as noted in Section 31 23 00 – Earthwork and Fill for the appropriate backfill product.

F. Conduct one in situ density test for each 500 cubic yards of backfill placed to verify conformance with these Contract Specifications.

3.06 FILL PLACEMENT WITHIN GEOCELL SYSTEMS FOR BANK STABILIZATION AREAS

A. Place and spread backfill in a manner to minimize the development of wrinkles and/or displacement of the geocell systems.

B. Place fill in lift thicknesses as recommended by the manufacturer.

C. There is no required backfill compaction requirement, but hand tamping of the backfill shall be performed in order to reach a compacted state to the satisfaction of the DSR.

D. Hand-operated machinery may be used if recommended by the manufacturer. The Contractor shall take precautions not to damage the geocell systems. If damage occurs, the Contractor shall be responsible to perform repairs as recommended by the manufacturer, up to and including replacement.

END OF SECTION

DIVISION 31—EARTHWORK
Section 31 11 00—Clearing and Grubbing

PART 1 – GENERAL

1.01 SUMMARY

A. The Contractor shall determine the extent of clearing and grubbing necessary to complete the work. Clearing and grubbing is expected to be necessary for Site access and in the Bank Management Areas (BMAs) prior to bank excavation in the removal and restoration areas and placement of geocells in the bank stabilization areas. The work includes the requirements for clearing, grubbing, and cleanup of the areas identified by the Contractor in accordance with the Contract Drawings sheets D-1 through D-3 for areas identified as Clearing and Grubbing Areas. The work is to be accomplished by removing and stockpiling existing trees identified for salvage as well as disposing of all other trees, brush, down timber, stumps, roots, rubbish, and debris from the BMAs and as necessary to construct temporary construction access roads.

B. The work area, conditions, and type of work required create considerable potential for accidents. Perform all work related to this specification in accordance with the approved project HASP. See Section 01 35 29 – Health, Safety, and Emergency Response Procedures for HASP submittal requirements.

C. If the Contractor identifies a discrepancy between any of the Contract Documents, they shall immediately notify the DuPont Site Representative (DSR). In general, the more stringent requirement shall take precedence.

1.02 RELATED WORK

A. Work related to this Section is described in

1. Section 01 10 00 – Summary of Work
2. Section 01 33 00 – Submittal Procedures
3. Section 01 35 29 – Health, Safety, and Emergency Response Procedures
4. Section 01 35 43 – Environmental Protection Procedures
5. Section 02 60 00 – Contaminated Site Material Removal
6. Section 06 13 43 – Large Woody Material
7. Section 31 25 00 – Erosion and Sedimentation Control

1.03 DEFINITIONS

A. Acronym

1. BMA – bank management area

2. HASP – Health and Safety Plan

3. DSR – DuPont Site Representative

1.04 REFERENCES

1. Not used

PART 2 – PRODUCTS

A. Products that are required to accomplish, or to be incorporated into, the work of this Section shall be as selected by the Contractor, subject to the approval of the DuPont Site Representative.

PART 3 – EXECUTION

3.01 CLEARING

A. Within the limits determined by the Contractor in accordance with the Contract Drawings, all trees identified as salvaged logs, shall be removed with rootwad mass intact and temporarily stockpiled at a staging location identified by the Contractor.

B. Remove and dispose of all other trees, including roots, brush, logs, upturned stumps, roots of downed trees, rubbish, and debris from within the bank removal and restoration area and bank stabilization area limits as necessary to facilitate bank excavation and geocell placement.

C. Within the Access Clearing Area shown on the Contract Drawings, clear trees and vegetation to the minimum extent necessary to enable access. All trees removed from within the Access Clearing Areas shall be replaced with 2-inch caliper trees of the same species removed at a ratio of two trees per each tree removed.

D. If necessary for protection, trees and shrubs on the boundaries of the clearing limits shall be fenced during the Contractor's operations.

3.02 GRUBBING

A. Perform grubbing where necessary to accommodate the work. Remove from the ground all stumps, roots, buried logs, and other vegetation of a decomposable nature.

B. Grub all Primary BMAs where slopes will be excavated and re-graded in accordance with Section 02 60 00 – Contaminated Site Material Removal.

C. Within the limits of grubbing, grubbing shall be to the depth necessary to remove all stumps, large roots, buried logs, and other objectionable material.

D. Within the Access and Clearing Areas shown on the Contract Drawings, grub to the minimum extent necessary to enable access.

E. Dispose of the refuse resulting from the grubbing operations in accordance with Section 02 60 00 – Contaminated Site Material Removal.

3.03 ORDERLY WORK AREA AND SITE CLEANUP

A. The Contractor shall maintain neat and orderly staging, storage and work areas. The Contract will not be considered complete until all of the Contractor's tools, equipment, and property have been removed from the Project Site, and the Contractor's storage and work areas have been properly cleaned.

END OF SECTION

DIVISION 31—EARTHWORK
Section 31 12 00—Selective Clearing

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for the protection of trees not designated for removal and procedures for cutting trees designated for removal in the Selective Clearing Areas identified on the Contract Drawings (sheets D-1 through D-3) as Selective Clearing Areas.

B. The work area, conditions, and type of work required create considerable potential for accidents. Perform all work related to this specification in accordance with the approved project HASP. See Section 01 35 29 – Health, Safety, and Emergency Response Procedures for HASP submittal requirements.

C. If the Contractor identifies a discrepancy between any of the Contract Documents, they shall immediately notify the DuPont Site Representative (DSR). In general, the more stringent requirement shall take precedence.

1.02 RELATED WORK

A. Work related to this Section is described in

1. Section 01 33 00 – Submittal Procedures
2. Section 01 35 39 - Health, Safety, and Emergency Response Procedures
3. Section 31 11 00 – Clearing and Grubbing
4. Section 32 90 00 – Planting and Habitat Restoration

1.03 DEFINITIONS

A. Acronyms

1. DSR – DuPont Site Representative
2. HASP – Health and Safety Plan

1.04 REFERENCES

A. National Arborist Association tree-pruning standards

1.01 SUBMITTALS

The Contractor shall submit the following for the approval by the DSR, in accordance with Section 01 33 00 – Submittal Procedures, and as further specified in this Section.

A. Certificates: The Contractor shall provide DuPont with copies of the following documentation.

1. Professional tree service company(s): Prior to commencing of tree trimming activities, the Contractor shall submit for review the name, applicable State identification number, past performance record of tree service company. The Contractor shall also submit a letter of commitment from the tree service company which they are proposing to use for tree trimming services.

PART 2 – PRODUCTS

2.01 TEMPORARY TREE PROTECTION FENCING

A. Furnish and install temporary tree protection fencing as shown on the Contract Drawings where work is occurring near tree drip-line.

B. The temporary fence shall consist of woven wire mesh not less than six feet in height, complete with metal or wood posts and all required bracing, and with truck and pedestrian gates, required to accomplish the work.

C. Construction fencing and gates shall not block access to the park driveway and private residences who have an easement to use this driveway.

2.02 HERBICIDES

A. Provide an appropriate herbicide, such as Rodeo, to eliminate Japanese knotweed in bank stabilization areas where mass excavation is not taking place.

PART 3 – EXECUTION

3.01 PROTECTION WITHIN THE DRIP-LINE WITHIN THE AREA OF WORK

A. Where existing trees are to remain in the area of work, the Contractor shall employ all methods to minimize adverse impact to these existing trees, including limbs and roots, during installation of the geocell and other work. These methods may include but not be limited to

1. Temporary tie-up of low limbs.

2. Application of a 4- to 6-inch thick layer of mulch (or wood chips salvaged from clearing and grubbing operations) within the drip-line of trees.

3. Timber or steel planking for protection of surface roots from equipment.

4. Tree limb and/or root pruning or other tree limb and/or root treatment as directed by a Virginia-certified Arborist.

B. No storage of equipment or materials shall be allowed within the drip-line of trees not designated for removal. Steel planking, or timber planking made of 4-inch-thick material, each plank covering a minimum of 8 square feet, shall be used to support backhoe and other equipment stabilizers when set within the drip-line of a tree to remain.

C. The Contractor shall use lightweight machinery around the trees and shrubs to remain in place, or perform work by hand.

D. Any mulch or planking placed within the drip-line of trees to remain as root protection will be removed before installation of the geocell. Once root protection is removed, all work within the drip-line of the trees to remain will be performed by hand.

3.02 PROTECTION WITHIN THE DRIP-LINE OUTSIDE OF THE AREA OF WORK

A. Where existing trees outside the area of work have drip-lines extending into the area of work, the Contractor shall employ all methods to minimize adverse impact to these existing trees, including limbs and roots from equipment mobilization and other work. These methods may include but not be limited to

1. Temporary chain link construction fencing.

2. Temporary tie-up of low limbs.

3. Application of a 4- to 6-inch-thick layer of mulch (or wood chips salvaged from clearing and grubbing operations) within the drip-line of trees.

4. Timber or steel planking for protection of surface roots from equipment.

5. Tree limb and/or root pruning or other tree limb and/or root treatment as directed by a Virginia-certified Arborist.

B. No storage of equipment or materials shall be allowed within the drip-line of trees not designated for removal. Steel planking, or timber planking made of 4-inch-thick material, each plank covering a minimum of 8 square feet, shall be used to support backhoe and other equipment stabilizers when set within the drip-line of a tree to remain.

3.03 ABOVE-GRADE WORK

A. Tree removal or tree trimming within 10 feet of any overhead utility line requires the Contractor to notify the DuPont Site Representative (DSR) at least 5 working days in advance of commencing such operations.

B. Trees greater than 8 inches in diameter that will be removed are shown on the Contract Drawings. Trees smaller than 8 inches in diameter within the Selective

Clearing Areas, but not shown on the Contract Drawings, shall also be removed. The Contractor shall cut tree trunks flush with the soil surface as accepted by the DSR.

C. When the Contractor anticipates construction operations that will unavoidably affect tree limbs, the Contractor shall notify the DSR at least 5 working days in advance of commencing such operations.

1. Before trimming any trees, the Contractor shall notify DSR of the proposed method and the amount of trimming required.

D. Trimming shall be done by a professional tree service company whose past and current performance is in accordance with National Arborist Association tree-pruning standards.

E. Within the bank stabilization areas, treat the cut stems of Japanese knotweed with an appropriate herbicide to kill the rhizomes. Apply herbicide according to the manufacturer’s recommendation.

3.04 ORDERLY WORK AREA AND SITE CLEANUP

A. The Contractor shall maintain neat and orderly storage and work areas to the satisfaction of the DSR. The Contract will not be considered complete until all of the Contractor’s tools, equipment, and property have been removed from the Project site, and the Contractor’s storage and work areas have been properly cleaned.

END OF SECTION

DIVISION 31—EARTHWORK
Section 31 23 00—Earthwork and Fill

PART 1 – GENERAL

1.01 SUMMARY

A. Work Includes

1. Site excavation, grading, filling, and compaction as required to achieve the lines and grades shown on the Contract Drawings.

2. Dewatering of trenches and other excavations.

3. Other miscellaneous earthwork required to complete the Project.

B. The work area, conditions, and type of work required create considerable potential for accidents. Perform all work related to this specification in accordance with the approved project HASP. See Section 01 35 29 – Health, Safety, and Emergency Response Procedures for HASP submittal requirements.

C. If the Contractor identifies a discrepancy between any of the Contract Documents, they shall immediately notify the DuPont Site Representative (DSR). In general, the more stringent requirement shall take precedence.

1.02 RELATED WORK

A. Work related to this Section is described in

1. Section 00 31 32 – Geotechnical Data

2. Section 01 29 00 – Payment Procedures

3. Section 01 33 00 – Submittal Procedures

4. Section 01 35 29 – Health, Safety, and Emergency Response Procedures

5. Section 02 60 00 – Contaminated Site Material Removal

6. Section 04 40 00 – Stone Assemblies for Public Access

7. Section 31 05 19 – Geosynthetics

8. Section 31 11 00 –Clearing and Grubbing

9. Section 31 12 00 – Selective Clearing

10. Section 31 25 00 – Erosion and Sediment Controls

11. Section 31 35 00 – Slope Protection

12. Section 31 37 00 – Stone Toe Protection

13. Section 31 52 00 – Temporary Cofferdams

14. Section 32 90 00 – Planting and Habitat Restoration

B. Acronyms

1. ASTM – American Society for Testing and Materials

2. AASHTO – American Association of State Highway and Transportation Officials

3. BMA – Bank Management Area

4. DSR – DuPont Site Representative

5. HASP – Health and Safety Plan

6. mmhos/cm – millimhos per centimeter

7. TMECC – Test Methods for the Examination of Composting and Compost

8. VDOT – Virginia Department of Transportation

9. VADEQ – Virginia Department of Environmental Quality

1.03 REFERENCES

The references listed below shall be the current adopted version(s) at time of project award.

A. City of Waynesboro “Standard Details and Approved Products Manual,” Details R-12 and R-12A

B. American Association of State Highway and Transportation Officials (AASHTO) M57

C. Virginia Department of Transportation (VDOT) –Road and Bridge Specifications and Road and Bridge Standards, Volume I and II (current adopted edition)

D. VDOT Special Provision Copied Notes, Special Provision, and Supplemental Specifications (current edition)

E. American Society for Testing and Materials (ASTM) D422 – Standard Test Method for Particle-Size Analysis of Soils

F. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 pounds per square foot)

G. ASTM D2922 – Standard Test Methods for Density of Soil and Soil Aggregate in Place by Nuclear Methods

H. TMECC 04.10-A Electrical Conductivity.

I. All applicable sections of the Virginia Occupational Safety and Health and Occupational Safety and Health Act standards for Construction and General Industry unless superseded by

1. Virginia Unique Standards http://www.doli.virginia.gov/vosh_enforcement/vaunique_standards.html

1.04 QUALITY ASSURANCE

A. The Contractor is responsible for verifying the quality of the work and shall perform compaction and density tests on request of the DuPont Site Representative (DSR) to check compliance with these Contract Specifications. A copy of the test reports shall be furnished to the DSR.

B. Inspection of Materials at the Site: Truckloads of imported material shall be visually inspected by the Contractor upon delivery. Materials shall be inspected for the presence of foreign, recycled, or reprocessed material. The DSR may, at any and all times, perform an independent inspection.

a) The DSR may require that an independent testing laboratory test imported materials at any time.

b) If the material is found to be non-compliant with the Contract, the Contractor shall bear the cost of testing and removal of all non-compliant materials from the Project Site, and replacement of the materials with those meeting the requirements of the Contract.

C. It is the responsibility of the Contractor to verify the accuracy of all survey information provided by DuPont prior to commencing excavations or filling operations. Commencement of these operations constitutes acceptance of the survey information as appropriate to meet the intent of the Contract.

1.05 EXISTING CONDITIONS

A. Information on existing soil conditions of the Bank Management Areas (BMAs) is provided in the geotechnical report for the site, included in Appendix A – Geotechnical Investigation Report.

B. Excavated soils within the BMA sites shall not be reused on the Site and shall be removed from the site in accordance with Section 02 60 00 – Contaminated Site Material Removal.

C. Information on existing soil conditions of Jones Hollow Property is located in Section 00 31 32 – Geotechnical Data (Jones Hollow)

1.06 SUBMITTALS

The Contractor shall submit the following for the approval by the DSR, in accordance with Section 01 33 00 – Submittal Procedures, and as further specified in this Section.

A. Earthwork Plan: Prior to commencing earthwork activities on the Project, the Contractor shall prepare and submit an Earthwork Plan for approval by the DSR. The Earthwork Plan shall include, at a minimum, detailed descriptions of the following items.

1. Methods and equipment that will be used for excavation.

2. Methods and equipment that will be used for transport and hauling of excavated materials.

3. Sequence and estimated duration of excavation activity including anticipated cubic yards of excavated soils generated daily.

4. Means by which limits and cut depths will be checked and verified by the Contractor.

5. Plan for methods for proper moisture conditioning and compaction all fill materials.

6. Means for managing excavated materials and preparing them for transportation in accordance with Section 02 60 00 – Contaminated Site Material Removal.

7. Disposal locations for excavated materials, including haul routes and any locations where re-handling or offloading is required, and documentation of the disposal facility acceptance of the waste in accordance with Section 02 60 00 – Contaminated Site Material Removal.

8. Methods, equipment, and location(s) for isolating excavated materials from the environment and preventing unfiltered off-flow water from entering Site waters

9. Means of protecting excavated materials and exposed subgrade surfaces from erosion, wind, and spillage

10. Worker safety and protection of the public.

11. Methods and equipment for survey control.

12. Methods for shoring and securing trenches and temporary excavations in accordance with applicable Occupational Safety and Health Act and Virginia Occupational Safety and Health requirements (Standard 1926, Subpart P and all applicable standards referenced therein)

    a) Unless otherwise indicated, remove all sheeting, shoring, and bracing after placement and compaction of backfill.

13. Traffic control during construction duration.

14. Notification and procedures to be used to coordinate with and accommodate marine vessel traffic while dredging, when work is performed from the river side.

If the Earthwork Plan is judged unsatisfactory to the DSR, then it will be returned to the Contractor for amendment and resubmission. No physical work at the Site shall be started until the Earthwork Plan is accepted.

B. Certificates: The Contractor shall provide DuPont with copies of the following documentation.

1. Shipping and Disposal Documents: The Contractor shall submit copies of trip tickets and Certificates of Disposal signed by the receiving disposal facility for any waste transported from the site. The Contractor shall also submit all manifests and shipping documents.

2. Imported Materials: The Contractor shall submit a particle gradation analysis in graph and table form, based on the sieve sizes in these Contract Specifications, for each product specified in this Section, unless otherwise specified. By submitting the test reports, the Contractor certifies that the test results are representative of the material purchased and delivered for use in the project. Products specified in this Section shall be approved by the DSR prior to being imported to the site.

    a) The initial test reports shall be submitted to the DSR no less than 7 calendar days prior to delivery to the site.

    b) If the required volume of a product is more than 200 cubic yards then the Contractor shall submit additional test reports for every 20 percent of the total volume of each material delivered to the site.

3. Soil Analysis Reports: The Contractor shall submit test results for Planting Substrate as specified in Article 2.05 (A). Testing shall be performed by a lab approved by DSR.

PART 2 – PRODUCTS

2.01 GENERAL

A. Imported materials shall be from the Jones Hollow Property or from sources arranged for by the Contractor and approved by the DSR.

B. Materials shall be of the quality, size, shape, gradation, or equal to that of the manufacture as specified herein. During the course of importing materials, the Contractor shall be responsible for continually checking the materials to ensure they continue to meet the Contract Specifications.

C. Refer to Section 31 05 19 – Geosynthetics for geotextile, geocell system for the Bank Removal and Restoration Areas, and geocell system for the Bank Stabilization Areas.

D. Refer to Section 04 40 00 – Stone Assemblies for Public Access for stepping stones, viewing platform, and limestone boulders.

E. Refer to Section 31 37 00 – Stone Toe Protection for toe rock and imported boulders.

2.02 CONTAMINATED ON-SITE SOILS

A. A. All onsite soils to be disturbed and/or excavated at the sites of Constitution Park, Wastewater Treatment Plant A and Wastewater Treatment Plant B shall be considered contaminated and shall be handled in accordance with Section 02 60 00 – Contaminated Site Material Removal.

2.03 SUBGRADE FILL MATERIAL

A. The Contractor shall backfill excavations with imported subgrade fill material from the Jones Hollow Property or an approved source.

1. If material is imported from a source other than the Jones Hollow Property, the Contractor shall provide verification that the materials conform to the requirements listed in this Contract Specification.

a) Grain Size Analysis (American Society for Testing and Materials [ASTM] D422)

b) Moisture Content (ASTM D 2216)

c) Specific Gravity (ASTM D854)

d) Total organic carbon (Standard Methods [SM] method 5310B)

e) U.S. Environmental Protection Agency [USEPA] publication SW 846, Method 7471A

2. Jones Hollow Property materials do not require additional testing unless requested by the DSR.

B. Subgrade Fill Material shall be granular material and shall be imported or processed from suitable native material that is non-contaminated with mercury. Individual particles shall be free from all objectionable coating. The material shall contain no organic matter or soft friable particles in quantities considered objectionable by the DSR.

1. Concrete, slag, and glass shall not be used on the site.

2. Subgrade Fill material shall meet the requirements of VDOT Standard Specification Section 303.02(a) and American AASHTO M57, Section 4.2.1 except that material classified as A-4, A-5, A-6, and A-7 shall not be used without the DSR's approval.

2.04 CRUSHED GRAVEL

A. Crushed rock surfacing shall be used underneath the Riverside Access and Viewing Platform assembly and elsewhere as noted on the Contract Drawings. The material shall be clean, washed crushed stone or gravel meeting the requirements of VDOT Standard Specification Section 203.02.

1. Concrete, slag, and glass shall not be approved for use on the site.

2. Crushed rock surfacing material shall comprise equal parts of Virginia Size Nos. 5, 57, and 68, as noted in Table II-3 of the VDOT Standard Specifications (current edition) and all other requirements of VDOT Standard Specification Section 203.03.

a) The Contractor shall provide current gradation information to DSR.

b) The Contractor shall provide other verification information noted in Section 203.03 at the DSR's requests.

c) Any additional testing and delays to schedule in order to verify conformance with Section 203.03 shall be the Contractor's responsibility.

B. Chinking material shall be used to fill voids greater than 1 inch in the Riverside Access and Viewing Platform assembly as noted on the Contract Drawings. The material shall be clean, washed crushed stone or gravel meeting the requirements of VDOT Standard Specification Section 203.02.

1. Concrete, slag, and glass shall not be approved for use on the site.

2. Chinking material shall comprise equal parts of Virginia Size Nos. 3 and 57 as noted in Table II-3 of the VDOT Standard Specifications (current edition) and all other requirements of VDOT Standard Specification Section 203.03.

a) The Contractor shall provide current gradation information to DSR.

b) The Contractor shall provide other verification information noted in Section 203.03 at the DSR's requests.

c) Any additional testing and delays to schedule in order to verify conformance with Section 203.03 shall be the Contractor's responsibility.

2.05 PLANTING SUBSTRATE

A. Planting substrate mix shall consist of 50 percent Subgrade Fill and 50 percent compost by volume.

1. Mix shall contain 10 percent to 20 percent organic matter, by weight (loss on ignition).

2. The pH range shall be from 6.0 to 7.5.

3. Soluble salt contents shall be less than 3.0 mmhos/cm tested in accordance with TMECC 04.10-A "Electrical Conductivity."

Subgrade Fill shall conform to Article 2.03 of this Section and shall be free of phyto-toxic materials and viable seeds, rhizomes, or roots of State-listed noxious weeds

B. Compost

1. Compost shall be derived from plant material and meet the general criteria set forth by the U.S. Composting Seal of Testing Assurance (STA) program. See www.compostingcouncil.org for a list of local providers.

2. The compost shall be the result of the biological degradation and transformation of plant-derived materials under conditions that promote anaerobic decomposition. The material shall be well composted, free of

viable weed seeds, and stable with regard to oxygen consumption and carbon dioxide generation. The compost shall have a moisture content that has no visible free water or dust produced when handling the material. It shall meet the following criteria, as reported by the U.S. Composting Council STA Compost Technical Data Sheet provided by the vendor.

a) 100 percent of the material must pass through a 0.5-inch screen

b) The pH of the material shall be between 5.5 and 8.5.

c) Manufactured inert material (e.g., plastic, concrete, ceramics, and metal) shall be less than 1.0 percent by weight.

d) Minimum organic matter shall be 40 percent dry weight basis, as determined by TMECC 05.07A, LOI.

e) Soluble salt contents shall be less than 4.0 mmhos/cm, tested in accordance with TMECC 04.10-A “Electrical Conductivity.”

f) Must be mature and stable per the appropriate test(s) as specified by STA.

g) Carbon/nitrogen ratio shall be less than 25:1.

h) Must meet U.S. Environmental Protection Agency Part 503 levels for heavy metals.

i) The compost shall have an dry bulk density ranging from 30 to 45 pounds/cubic feet (ft^3).

3. Compost may be sourced from below supplier or other approved equal

a. Black Bear Composting, Crimora, Virginia

2.06 BIOCHAR BLEND FOR APPLICATION IN BANK REMOVAL AND RESTORATION AREAS

A. The biochar blend shall consist of 50-50 biochar and subgrade fill.

1. Subgrade fill shall be in accordance with 2.03 of this Section.

2. Biochar shall be an all-natural hardwood lump charcoal product with no added chemical or fillers. Cowboy Brand Premium Lump Charcoal or equivalent is an acceptable product.

B. The biochar blend shall meet the gradation noted in the table below.

1. If necessary, the Contractor shall grind or process the biochar prior to mixing with the subgrade fill, then perform particle size analysis (ASTM D422) on the blended material in order to meet the gradation requirements of the table below.

C. The biochar blend shall have a hydraulic conductivity of 10^-3 centimeter/second (50 feet/day) or greater (more permeable). The DSR may request that the Contractor provide test results on the blended materials to confirm conformance.

U.S. Sieve Size	Percent Passing
8-inch	100
4-inch	95-100
3 /4-inch	60-90
U.S. No. 10	25-65
U.S. No. 40	10-40
U.S. No. 200	0-4

2.07 BIOCHAR BLEND FOR APPLICATION IN BANK STABILIZATION AREAS

A. The biochar blend shall consist of 50-50 biochar and planting substrate.

1. Planting Substrate shall be in accordance with 2.05 of this Section.

2. Biochar shall be in accordance with 2.06 (A.2) of this Section.

a) If necessary, the Contractor shall grind or process the biochar prior to mixing in order to meet the gradation requirements of the table below prior to blending with the Planting Substrate.

U.S. Sieve Size	Percent Passing
3 /4-inch	Min. 100
U.S. No. 4	94-100
U.S. No. 50	Max. 25

2.08 UTILITY BACKFILL MATERIALS

A. The Contractor shall follow the material and design requirements of the City of Waynesboro Public Works for replacement in kind of utilities (reinforced concrete pipe (RCP) storm sewer).

1. The class of RCP shall be determined by the utility owner, but if not, then the Contractor shall not procure and install RCP below Class III.

2. The utility owner shall determine whether VDOT Road and Bridge Standard EW-1, EW-1PC, ES-1 shall be used for construction.

3. Materials shall be in accordance with VDOT Road and Bridge Standard PB-1 for “normal earth foundation”

4. Only natural earth materials shall be allowed for backfill.

2.09 PAVEMENT REPAIR

A. The Contractor shall conform with the requirements of the City of Waynesboro “Standard Details and Approved Products Manual,” Details R-12 and R-12A (current version).

2.10 STABILIZED CONSTRUCTION ENTRANCE

A. Materials shall conform with the requirements of VDOT Road and Bridge Standard EC-11 (current version).

PART 3 – EXECUTION

3.01 SITE EXCAVATION, GRADING AND BACKFILL

A. Earthwork – General

1. The Contractor shall excavate material encountered within the limits, lines, and grades specified on the Contract Plans. The Contractor shall maintain side slopes of excavations so that they remain stable and free of sloughing soil.

2. Excavation on slopes shall proceed downward, working from top of slope to toe of slope. As the work progresses, it is anticipated that some slope material will slough into the cut area. The Contractor shall remove this material and will make a final pass with the excavator bucket along the sections’ edges when the excavation is completed to help assure proper grades are achieved.

3. The Contractor shall not store any equipment within 5 horizontal feet of the upper edge of any excavation or farther as deemed necessary for safety reasons. Locate and retain soil materials away from edge of excavations and drip lines of trees to remain.

4. Work shall be performed in the dry, see Part 3.03 of this Section.

5. Do not excavate in frozen material without the written approval of the DSR.

6. In performing the excavation, the Contractor shall pay particular attention to the conditions of issued permits and authorizations requiring the minimization of turbidity and siltation and adherence to water quality requirements.

B. Over Excavation

1. Removal of materials beyond indicated sub-grade elevations or dimensions without specific direction of the DSR is not authorized. Unauthorized excavation, as well as corrective work directed by the DSR, shall be at the Contractor's expense.

a) Undercut Excavation and Backfill Procedures: Refer to VDOT Standard Specification Sections 303.04(c) and 303.04(f)

b) Backfilling Openings Made for Structures: Refer to VDOT Standard Specification Sections 303.04(g)

c) Removal of Unsuitable Materials: Refer to VDOT Standard Specification Section 303.04(e)

C. Tolerances:

1. Excavation shall, at a minimum, meet the elevation of cutlines shown on the Contract Drawings, unless bedrock is encountered above the cutline elevations. Over excavation below the cutline elevation shall not exceed 0.5 feet.

2. All backfill and grading earthwork shall, at a minimum, meet the elevations shown on the Contract Drawings. Over placement shall not exceed 0.5 feet.

D. Bedrock: Bedrock may be encountered before reaching the cutline elevations shown on the Contract Drawings. All bedrock shall remain in place. The Contractor shall not remove bedrock by blasting or hammering.

E. The Contractor shall contact the DSR for additional guidance on excavation adjustments once bedrock is encountered, and the Contractor shall not proceed with excavating until the adjusted excavation plan is approved by the DSR.

3.02 MANAGEMENT OF EXCAVATED SURFACES

A. The Contractor shall be aware of the potential for erosion, contamination, and generation of water sheen from newly excavated surfaces. The Contractor shall control the potential for erosion of materials and loss of soils from freshly exposed excavated surfaces by rolling or grading the surfaces to a smooth condition. If this procedure is judged to be insufficient for protection against erosion in the opinion of the DSR, then the Contractor shall institute additional procedures.

3.03 DEWATERING

A. All water management activities (i.e., diversion/dewatering, treatment, and discharge) shall conform to local, county, and state regulations, in particular the City of Waynesboro and the VADEQ.

B. Prevent surface and subsurface water from flowing into excavations and from flooding project site.

1. See Section 31 52 00 – Temporary Cofferdams for river diversion structures.

C. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or run-off areas. If required, line ditches and sumps with coarse-grained material that acts as a filter. Do not use trench excavations as temporary drainage ditches..

D. The Contractor shall be responsible for providing, maintaining, and operating necessary pumps and any other equipment for removal of any type of water that is found in the excavation.

E. If a generator is to be used to operate pumping equipment, generator shall be placed at the top of the bank or inland of the top of the bank within an approved spill protection area.

F. Provide dewatering facilities capable of operating in freezing temperatures if freezing weather conditions occur.

G. Monitor and control discharge in accordance with Section 31 25 00 – Erosion and Sediment Controls and the permits required under that section.

H. Excavations Below Groundwater Table

1. Where excavation and trenching extends below the groundwater level, dewater the portion below the groundwater level in advance of excavation.

2. Dewater to prevent loss of fines from the foundation, maintain the stability of the excavation, and allow for construction work to be performed in the dry.

I. Seepage Control

1. Before excavating to final grade for utilities and embankments, bring the water level to an elevation at least 1 foot below the required subgrade elevation.

2. Maintain this water level until utilities have been placed, embankments have been completed, and backfill has been placed.

3. After backfill has been placed, with approval of the DSR, allow groundwater to rise to natural levels. Control pumping and dewatering operations so that the groundwater level rises slowly and uniformly.

3.04 EXCAVATED SOILS

A. Handling, storage, transport, and disposal of soils shall be in accordance with Section 02 60 00 – Contaminated Site Material Removal.

B. It is the responsibility of the Contractor to properly store the stockpiled materials. The Contractor shall be responsible for the protection stockpiled reusable fill from erosion and the effects of inclement weather.

C. Depending on the facility utilized for disposal, the excavated material may be taken in trucks directly to the landfill. Appropriate controls shall be utilized to prevent material loss and spillage in accordance with Section 02 60 00 – Contaminated Site Material Removal.

3.05 EXCAVATED SOILS (JONES HOLLOW PROPERTY)

A. Reusable fill must be free of deleterious materials, including, soft friable particles, clay balls, wood debris, organics, large objects, and is subject to the DSR's approval.

B. Store the stockpiled materials in accordance with Paragraph 3.09 below.

C. It is the responsibility of the Contractor to maintain proper moisture conditions in stockpiled materials so that they may be used as subgrade fill.

3.06 EMBANKMENT PROCEDURES:

A. Refer to VDOT Standard Specification 303.04(h) with following exception:

a) Refer to Article 3.09 in this Section for Compaction

b) Surfaces where the geocell system will be installed should not be roughed. Follow the manufacturer's guidance on the treatment of the surface of the slope where the geocell system will be installed.

3.07 TRENCHING AND BACKFILLING FOR UTILITY INSTALLATION

A. Installation shall be in accordance with VDOT Road and Bridge Standard PB-1 for “normal earth foundation”

B. The utility owner shall determine whether VDOT Road and Bridge Standard EW-1, EW-1PC, ES-1 shall be used for construction of end section.

3.08 PAVEMENT REPAIR

A. The Contractor shall follow the design and construction requirements of the City of Waynesboro ”Standard Details and Approved Products Manual,” Details R-12 and R-12A

B. The Contractor shall be responsible for restoring all pavement to pre-construction conditions as documented by the Pre-construction Condition Survey.

3.09 COMPACTION

A. The Contractor shall compact backfill by means of an appropriately sized static, vibratory, or impact type compactor suited to the soil and physical restrictions of the area to be compacted. Although the Contractor is responsible for the selection of the method of compaction, selection of an inappropriate method shall not relieve the Contractor of the responsibility to achieve the specified result. Jetting, sluicing, or water settling will not be permitted.

B. Compaction testing performed by the DSR shall not relieve the Contractor of the obligation to place and compact backfill materials as required in accordance with these Contract Specifications.

C. Control soil compaction during construction so as to provide percentage of density specified for area classification. Do not overly compact planting substrate beyond specified percentage. Correct over-compaction as directed by the DSR, including ripping, regrading and re-compaction or over-excavation and in-kind replacement per plan.

D. Unless otherwise specified for a specific backfill or fill material, place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand operated tampers.

E. Follow the geocell system manufacturer’s recommendations for compacting fill material placed within a geocell system. Compaction of fill material within a geocell shall be performed in accordance with Section 31 05 19 – Geosynthetics.

F. In locations where fill will be placed over existing grade, the Contractor shall scarify the upper 8 inches after clearing and grubbing and smooth the subbase to show no pits, holes, pumping, or soft surface as verified by the DSR, prior to placing fill.

G. Do not place backfill on surfaces that are frozen, overly wet, or graded inconsistently.

H. Percentage of Maximum Density Requirements: Soil compaction rate shall conform to the following requirements based on the maximum dry density for soils determined in accordance with ASTM 1557 (Modified Proctor).

1. Backfill

a) Subgrade fill – The minimum compaction rate shall be 95 percent of the maximum dry density

b) Planting substrate and soil amendments (planted/seeded areas) – The compaction rate shall be between 75 and 85 percent of the maximum dry density

2. Subgrade under paved area

a) Subgrade soils in paving areas – The minimum compaction rate shall be 95 percent of the maximum dry density

b) Import aggregate base in paving areas – The minimum compaction rate shall be 95 percent of the maximum dry density

I. Moisture Control

1. Moisture content of compacted backfill, subgrades, and surface fills that require 90 percent relative density (or greater) shall have a moisture content tolerance of +/- two percent of optimum moisture content.

2. Where sub-grade or lift of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations.

3. Before compaction, moisten or aerate each layer as necessary to provide optimum content. Compact each layer to required percentages of maximum dry density or relative dry density for each area classification.

4. Do not perform compaction operations on excessively wetted soils.

3.10 TEMPORARY STOCKPILES (JONES HOLLOW PROPERTY)

A. The Contractor may elect to establish an area for temporary stockpiling of excavated soils from Jones Hollow Property in preparation for their use as subgrade fill. The location of this area shall avoid any interference with ongoing traffic and activities at and around the Site, and shall be subject to the written approved of the DSR.

B. Stockpiles shall not be placed within 5 horizontal feet of the upper edge of any excavation. Stockpiles and stockpile areas shall be maintained in good condition and constructed of materials that are compatible with the material being stored.

C. Stockpile areas shall be fenced and locked while work is not taking place on the site. The Contractor shall also post a sign at each entrance to the stockpile areas, bearing the legend “Unauthorized Persons Keep Out,” or an equivalent legend, legible from a distance of 25 feet or more.

D. The Contractor shall employ best management practices as necessary to prevent loss of stockpiled materials by such events as erosion, spillage, or wind. The Contractor shall also prevent loss of material during transfer of materials to and from the stockpile area from trucks, or other selected excavation, dredging, and hauling equipment.

E. Stockpile excavated native materials meeting the material requirements for products specified as backfill until processed or placed as pipe bedding or backfill material.

F. Place, grade, and shape all stockpiles for proper drainage. Protect from wind and moisture with plastic sheeting and secure sheeting with sand bags or other approved material.

G. Do not compact stockpiled material.

END OF SECTION

DIVISION 31—EARTHWORK
Section 31 25 00—Erosion and Sedimentation Control

PART 1 – GENERAL

1.01 SUMMARY

A. Work Includes

1. Requirements for soil erosion and sediment control measures used in complying with the Virginia Department of Environmental Quality Virginia Erosion and Sediment Control Handbook (Third Edition, 1992), the Virginia Department of Conservation and Recreation – Virginia Stormwater Management Handbook (First Edition, 1999), and the City of Waynesboro.

2. The soil erosion and sediment control measures presented on the Plan Drawings serve as the minimum for erosion control during construction. The Contractor is ultimately responsible for providing adequate erosion control and water quality throughout the duration of the project. Temporary erosion control measures shall be installed, relocated, and modified (as necessary) to accommodate site conditions and the Contractor's means and methods and as directed by the DuPont Site Representative (DSR), Engineer, and/or regulatory agencies.

A. The work area, conditions, and type of work required create considerable potential for accidents. Perform all work related to this specification in accordance with the approved project HASP. See Section 01 35 29 – Health, Safety, and Emergency Response Procedures for HASP submittal requirements.

B. If the Contractor identifies a discrepancy between any of the Contract Documents, they shall immediately notify the DuPont Site Representative (DSR). In general, the more stringent requirement shall take precedence.

1.02 RELATED WORK

A. Work related to this Section is described in

1. Section 01 11 00 – Summary of Work
2. Section 01 35 29 – Health, Safety, and Emergency Response Procedures
3. Section 31 11 00 – Clearing and Grubbing
4. Section 31 12 00 – Selective Clearing
5. Section 31 23 23 – Earthwork and Fill

1.03 DEFINITIONS

A. Acronyms

1. HASP – Health and Safety Plan

2. DSR – DuPont Site Representative

3. ASTM – American Society of Testing and Materials

4. NPDES – National Pollutant Discharge Elimination System

5. VDOT – Virginia Department of Transportation

B. Definitions

1. Erosion Control Blanket – A temporary, biodegradable rolled erosion control product made of natural fibers attached to synthetic netting and used to protect newly seeded areas from environmental forces such as wind, rain, and intense sunlight, and to enhance the growth of vegetation.

2. Filter Bag – A geosynthetic bag used to filter dewatered sediment-impacted areas prior to discharge.

3. Silt Fence – A temporary sediment barrier consisting of sediment trapping geotextile fence that reduces the off-site transport of sediment via ponding of runoff allowing sediment to filter out on the upstream side of the fence.

4. Stabilized Construction Entrance – A stabilized pad of aggregate placed over a geotextile fabric to reduce the amount of soil and mud tracked off site by construction-related traffic.

5. Diversion – A temporary ridge of compacted soil and/or an interceptor ditch/channel at the top or base of a sloping disturbed areas to divert overland flow away from exposed slopes (crest or toe) and discharge through a stabilized outlet.

1.04 REFERENCES

A. Reference Standards: The publications listed below form a part of this Contract Specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. American Society of Testing and Materials (ASTM)

a) ASTM C33/C33M-08 – Standard Specification for Concrete Aggregates

b) ASTM C136 – Sieve Analysis of Fine and Coarse Aggregate.

c) ASTM D123 – Terminology Relating to Textiles Materials.

d) ASTM D488 – Standard Classification for Sizes of Aggregate for Road and Bridge Construction

e) ASTM D3786 – Test Method for Hydraulic Bursting Strength of Knitted Goods and Non-woven Fabrics: Diaphragm Bursting Strength Tester Method

f) ASTM D4354 – Practice for Sampling of Geotextiles for Testing.

g) ASTM D4355 – Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).

h) ASTM D4491 – Test Method for Water Permeability of Geotextiles by Permittivity

i) ASTM D4632 – Test Method for Grab Breaking Load and Elongation of Geotextiles.

j) ASTM D4751 – Test Method for Determining the Apparent Opening Size of a Geotextile.

k) ASTM D4759 – Test Method for Determining the Specification Conformance of Geosynthetics

l) ASTM D6461e2 – Standard Specification for Silt Fence Materials

2. Virginia Department of Environmental Quality

a) Virginia Erosion and Sediment Control Handbook (Third Edition, 1992).

3. Virginia Department of Conservation and Recreation

a) Virginia Stormwater Management Handbook (First Edition, 1999).

1.05 ADMINISTRATIVE REQUIREMENTS

A. Sequencing

1. Prior to earth disturbance activities, the Contractor shall notify the regulatory agencies in accordance with the permit requirements.

2. Within 24 hours following soil disturbance or re-disturbance, complete permanent or temporary stabilization to the surface of each perimeter sediment control, topsoil stockpile, and other disturbed or graded areas on the Project Site. These requirements do not apply to those areas that are shown on the Plan Drawings and are currently being used for material storage, or for those areas on which actual earth moving activities are currently being performed.

   a) If adverse weather is expected within 24 hours following soil disturbance, then measures shall be installed immediately following these activities.

B. Scheduling

1. Submit a construction work sequence schedule, with the approved erosion control plan prior to start of construction.

2. Schedule the work to coordinate the timing of land disturbing activities with the provision of erosion control measures.

1.06 SUBMITTALS

DSR's review is required for submittals designated as "Action Submittals." Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to the DSR for information only. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

A. Action Submittals

1. Product Data

   a) Geotextile

   b) Erosion control blanket

   c) Silt fence

   d) Filter bag

   e) Aggregate

   f) Temporary construction fence

   g) Seed, fertilizer, and soil amendments/conditioners

B. Informational Submittals

1. Manufacturer Instructions
   a) Erosion control blanket installation instructions
2. Qualification Statements
   a) Installer qualification statement
3. Erosion and Sediment Control Inspection Logs
   a) Inspections required in accordance with regulatory standards, permit applications, approvals, and conditions, and as designated by the DSR, Engineer, and/or regulatory agencies

C. Closeout Submittals

1. Operation and Maintenance Data
   a) Maintenance record for erosion controls
2. Bonds
   a) City of Waynesboro erosion and sediment control
3. Warranty Documentation
4. Record Documentation
   a) As-built location of installed permanent erosion controls.

D. Maintenance Material Submittals

1. Not used

1.07 QUALITY ASSURANCE

A. Regulatory Requirements

1. Comply with the Virginia Erosion and Sediment Control Handbook and the Virginia Stormwater Management Handbook, Volumes I & II.
2. Comply with City of Waynesboro Code of Ordinances, Chapter 30, Article II, "Erosion and Sediment Control Ordinance of the City of Waynesboro, Virginia" and Chapter 30, Article III Stormwater Management.

B. Qualifications

1. Installer

    a) Certified by the manufacturer for training and experience installing the material.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements

1. Inspect products delivered to Site for damage. Do not offload damaged products. Return damaged products to manufacturer.

2. Unload with minimum handling.

3. Deliver and store geosynthetic binders and synthetic soil binders in the manufacturer's original sealed containers.

B. Storage and Handling Requirements

1. Store and protect products in accordance with the manufacturer’s recommendations.

2. Protect products from the weather, excessive humidity, excessive temperature variation, ultraviolet exposure, and dirt, dust, or other contaminants.

3. Do not store products directly on ground.

4. Deliver products to final location in sound, undamaged condition.

5. Prevent damage to interior and exterior surfaces. Repair damage.

6. Carry and do not drag products.

C. Packaging Waste Management

1. When possible, furnish products with minimal and easily recyclable packaging and use manufacturers with policies that take back product packaging.

2. Dispose of product packaging in accordance with the Waste Management Plan.

1.09 FIELD CONDITIONS

A. Ambient Conditions

1. Perform erosion control operations under favorable weather conditions. Stop work when excessive moisture, frozen ground, or other unsatisfactory conditions prevail.

2. When special conditions warrant a variance to earthwork operations, submit a revised construction schedule for approval.

3. Do not apply erosion control materials in adverse weather conditions that could affect their performance.

B. Existing Conditions

1. When obstructions below ground affect the work, submit shop drawings showing proposed adjustments to placement of erosion control material for approval.

1.10 WARRANTY AND BOND

A. Manufacturer Warranty

1. Provide erosion control material with a warranty for use and durable condition for Project-specific installations.

2. Provide a minimum 18-month warranty on temporary erosion control materials.

3. Provide a minimum 3-year warranty on permanent erosion control materials.

B. Bond

1. Furnish the bond required by the City of Waynesboro.

PART 2 – PRODUCTS

2.01 GENERAL

A. Products that are required to accomplish or be incorporated into the work of this Section shall be as shown on the Plan Drawings, or as selected by the Contractor, subject to approval by the DSR and the regulatory agencies, if required.

2.02 DUST CONTROL

A. Dust palliative for dust control shall be proposed by the Contractor and approved by the DSR.

2.03 MARKING CLEARING LIMITS

A. Clearing limits shall be marked with high-visibility plastic or metal fence, in accordance with City of Waynesboro Erosion and Sediment Control Standards.

PART 3 – EXECUTION

3.01 GENERAL

A. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply as determined by the DSR.

B. No discharge of water shall be allowed that exceeds the regulated pollutant levels in the National Pollutant Discharge Elimination System (NPDES) General Permit for Discharges Associated with Construction Activities.

C. The Contractor shall be solely responsible for any damages and fines incurred because of Contractor, subcontractor, or supplier actions in implementing the requirements of this section.

D. The Contractor shall be solely responsible for schedule impacts incurred because of Contractor, subcontractor, or supplier actions in implementing the requirements of this section.

3.02 PREPARATION

A. Protection of In-place Conditions

1. Verify and mark the location of underground utilities and facilities in the area of the work.

2. Repair damage to underground utilities and facilities at the Contractor's expense.

B. Surface Preparation

1. Prepare surfaces of ditches and slopes to conform to the lines, grades, and cross sections shown on the Plan Drawings.

2. Finish surfaces and slopes to a smooth and even condition with debris, roots, stones, and clods greater than 3 inches in diameter raked out or removed prior to the placement of erosion control measures.

3. Correct subgrade irregularities exceeding previously specified limit by removing or adding material as required, followed by rolling until compacted in accordance with Section 31 23 00 – Earthwork and Fill.

3.03 TEMPORARY EROSION AND SEDIMENT CONTROL DEVELOPMENT

A. Construction Access Routes

1. Wherever construction vehicles enter or leave a construction site, a stabilized construction entrance is required.

2. Temporary access roads, including public road surfaces (as necessary) shall be cleaned thoroughly at the end of each work day. Sediments removed from roadways shall be shoveled or swept and transported to a sediment controlled staging/disposal area. Any public roadway street cleaning shall be performed only after sediments have been removed.

3. Temporary access roads shall be maintained and additional geotextile fabric and aggregate stone shall be applied to maintain roadway thicknesses and prevent rutting or other unsafe and environmentally sensitive condition.

4. As required and at the discretion of the DSR, all construction vehicles shall be cleaned (i.e., decontaminated/washed) and inspected prior to leaving the Site.

B. Erosion and Sediment Control Measures

1. All temporary and permanent erosion and sediment control measures shall be maintained and repaired as necessary to ensure continued performance of their intended function. If the overall function and intent of erosion control is not being met, the DSR will require the Contractor to provide additional measures as required to obtain the desired results.

2. Erosion control measures installed by the Contractor shall be adequately maintained by the Contractor until the project is complete and accepted by the DSR and all regulatory agencies.

3. Properties adjacent to the Site shall be protected from sediment deposition. Sediment barriers (i.e., silt fence, straw bales, etc.) and diversions shall be installed in accordance with the Contract Drawings and permit approvals/conditions.

3.04 FIELD QUALITY CONTROL

A. Field Inspections

1. Maintain the integrity of the erosion control devices as long as they are necessary to contain sediment runoff associated with the work to be performed.

2. Inspect erosion controls once every 7 days and within 24 hours of a rainfall event of 0.25 inches or greater.

3.05 CLEANING

A. Properly dispose of excess material, debris, and waste materials.

B. Clear adjacent paved areas.

C. Immediately upon completion of the installation in an area, protect the area against traffic or other use by erecting barricades and providing signage as required or as directed.

3.06 MAINTENANCE

A. Remove sediment deposits, eradicate weeds; protect embankments and ditches from surface erosion; maintain the performance of the erosion control materials and mulch; and protect installed areas from traffic.

B. Furnish written instructions containing Plan Drawings and other necessary information, describing the care of the installed material, including when and where maintenance should occur, and the procedures for material replacement.

C. Unless otherwise directed, place, seam, or patch material as recommended by the manufacturer.

D. Remove material not meeting the required performance as a result of placement, seaming, or patching from the Site.

E. Replace the unacceptable material.

F. Furnish a record describing the maintenance work performed, record of measurements and findings for product failure, recommendations for repair, and products replaced.

3.07 DISPOSITION OF TEMPORARY MEASURES

A. All temporary erosion and sediment control measures shall be removed and disposed of within thirty (30) days after final Site stabilization is achieved or after the temporary measures are no longer needed as determined by the DSR.

B. Any trapped sediment and other disturbed soil areas resulting from disposition of temporary measures shall be permanently stabilized to prevent further erosion.

C. Any damages to the Site shall be repaired to the satisfaction of the DSR and at no additional expense.

END OF SECTION

DIVISION 31—EARTHWORK
Section 31 35 00—Slope Protection

PART 1 – GENERAL

1.01 SUMMARY

A. Work Includes

1. Furnishing and installing synthetic slope protection product, including geocell for slope stabilization.

2. Furnishing and installing biodegradable erosion control product, including coir fabric and coir logs.

B. The work area, conditions, and type of work required create considerable potential for accidents. Perform all work related to this specification in accordance with the approved project HASP. See Section 01 35 29 – Health, Safety, and Emergency Response Procedures for HASP submittal requirements.

C. If the Contractor identifies a discrepancy between any of the Contract Documents, they shall immediately notify the DuPont Site Representative (DSR). In general, the more stringent requirement shall take precedence.

1.02 RELATED WORK

A. Work related to this Section is described in:

1. Section 01 33 00 – Submittal Procedures

2. Section 01 35 29 – Health, Safety, and Emergency Response Procedures

3. Section 31 05 19 – Geosynthetics

4. Section 31 23 00 – Excavation and Fill

5. Section 31 37 00 – Stone Toe Protection

6. Section 32 90 00 – Planting and Habitat Restoration

1.03 DEFINITIONS

A. Acronyms

1. DSR – DuPont Site Representative

2. H:V – horizontal to vertical

3. HASP – Health and Safety Plan

1.04 REFERENCES

1. Not used

1.05 QUALITY ASSURANCE

1. All products supplied shall comply with applicable state and local codes.

1.06 SUBMITTALS

A. Submit the following material certification/datasheets

1. Geocell

2. Coir fabric and coir logs

PART 2 – PRODUCTS

2.01 GEOCELL FOR SLOPE STABILIZATION

A. Geocell for Slope Stabilization shall conform to Section 31 05 19 – Geosynthetics.

2.02 COIR FABRIC

A. Nedia KoirMat 700, or pre-bid approved equal, available from Nedia Enterprises, Inc. See http://www.nedia.com/.

2.03 COIR LOGS

A. Nedia KoirLog 16HD, or pre-bid approved equal, available from Nedia Enterprises, Inc. See http://www.nedia.com. Coir logs shall be manufactured from 100 percent new, un-dyed, coconut fiber (coir). Coir logs shall be rolls of netting with maximum 2-inch openings with knotted conjunctions. Coir logs shall be a minimum of 16 inches in diameter (+/-1 inch), 10 or 20 feet long (+/- 0.5 feet), and 9 pounds per square feet minimum density.

2.04 WOOD STAKES FOR COIR FABRIC

A. Stakes shall be 2-inch by 2-inch hardwood with one tapered end, 2 feet in length. No split or badly splintered stakes will be accepted.

2.05 WOOD STAKES FOR COIR LOG

A. Stakes shall be 2-inch by 2-inch hardwood with one tapered end, 3 feet in length. No split or badly splintered stakes will be accepted.

2.06 DUCKBILL ANCHORS FOR COIR LOG

A. Duckbill Earth Anchor Model 68, or pre-bid approved equal, available from Foresight Products. See http://www.earthanchor.com.

PART 3 – EXECUTION

3.01 GEOCELL FOR SLOPE STABILIZATION INSTALLATION

A. Geocell for slope stabilization shall be installed as shown on the Contract Drawings and according to manufacturer's instruction for the appropriate slope conditions.

3.02 COIR FABRIC INSTALLATION

A. Coir fabric shall be placed immediately after planting substrate is placed to final grade to prevent erosion. The Contractor shall install coir erosion control fabric to the limits shown on the Contract Drawings and per the manufacturer's instructions. Where more than one strip of coir fabric is required to cover the given area, coir fabric shall be installed from upstream to downstream, and it shall overlap the adjacent mat by a minimum of 12 inches. The upslope end of each coir mat shall be staked and buried in a 12-inch-deep trench with the soil firmly tamped against the mat.

B. Drive stakes below the finish ground line prior to backfilling of the trench according to manufacturer's instruction for the appropriate slope condition. The DuPont Site Representative may require that any other edge exposed to more than normal flow of water or strong prevailing winds be staked and buried in a similar manner.

C. Coir erosion control fabric shall be held in place by approved wooden stakes driven vertically into the soil. The fabric shall be anchored according to manufacturer's instruction for the appropriate slope conditions. The top of stakes shall be driven 4 inches above the finished grade.

D. If the staking pattern provided on the Contract Drawings differs from the manufacturer's guidance, the Contractor shall contact the DSR. The DSR shall determine which pattern shall be used for staking.

3.03 COIR LOG INSTALLATION

A. Install coir logs and secure with wood stakes on either side of the coir logs at 3 feet on center as shown on the Contract Drawings, secure logs down to stakes using 6-millimeter coir twine. Where the toe has vertical erosion taller than 1 foot or the slope of the toe is greater than 2H:1V, install coir logs in bundle of three or more to match the Site-specific condition. Secure the bundle with duckbill anchors as shown on the Contract Drawing at 3 feet on center. Duckbill anchors shall be installed according to manufacturer's instruction based on site-specific soil conditions.

3.04 ORDERLY WORK AREA AND SITE CLEANUP

A. The Contractor shall maintain neat and orderly storage and work areas. The Contract will not be considered complete until all of the Contractor's tools, equipment, and property have been removed from the Project Site, and the Contractor's storage and work areas have been properly cleaned.

END OF SECTION

DIVISION 31—EARTHWORK
Section 31 37 00—Stone Toe Protection

PART 1 – GENERAL

1.01 SUMMARY

A. The work described in this Section includes

1. Furnishing all labor, materials, tools, equipment, and incidentals required for importing, stockpiling, and placing imported bank protection and anchoring materials, for the purposes of achieving required grades, slopes, and elevations, as described on the Contract Drawings.

2. Section includes the following

   a) Boulders, imported

   b) Toe rock (riprap), imported

   c) Geotextile

3. Boulders and toe rock will be imported to the staging areas by the Contractor. The Contractor will be required to disperse to final placement locations on the construction site.

4. All imported rock shall be placed as described in these Contract Specifications and as shown on the Contract Drawings.

5. The Contractor shall be responsible for the care and proper installation of the geotextile under the toe rock.

B. The work area, conditions, and type of work required create considerable potential for accidents. Perform all work related to this specification in accordance with the approved project HASP. See Section 01 35 29 – Health, Safety, and Emergency Response Procedures for HASP submittal requirements.

C. If the Contractor identifies a discrepancy between any of the Contract Documents, they shall immediately notify the DuPont Site Representative (DSR). In general, the more stringent requirement shall take precedence.

1.02 RELATED WORK

A. Work related to this Section is described in

1. Section 01 33 00 – Submittal Procedures

2. Section 01 35 29 – Health, Safety, and Emergency Response Procedures

3. Section 05 17 00 – Structure Connections

4. Section 06 13 43 – Large Woody Material

5. Section 31 05 19 – Geosynthetics

1.03 DEFINITIONS

A. Acronyms

1. ASTM – American Society for Testing and Materials

2. DSR – DuPont Site Representative

3. HASP – Health and Safety Plan

4. VDOT –Virginia State Department of Transportation

1.04 REFERENCES

A. The publications listed below form a part of this Contract Specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. American Association of State Highway and Transportation Officials (AASHTO) –Standard Specifications for Transportation Materials and Methods of Sampling and Testing (2015)

2. Virginia State Department of Transportation (VDOT) – Road and Bridge Specifications (2007)

1.05 SUBMITTALS

A. Contractor shall submit the following in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data

1. The Contractor shall provide the DSR with a copy of the Earthwork Plan that includes product datasheet for imported boulders, toe rock, and geotextile showing they meet the Specifications herein.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Inspection on delivery

1. Upon delivery to the Contractor’s work or storage area, the products shall be inspected in the presence of the DSR for condition and conformance with the Specifications.

PART 2 – PRODUCTS

2.01 IMPORTED BOULDERS

A. Boulders shall be hard, dense, and durable.

1. Minimum specific gravity, American Society of Testing and Materials (ASTM) C 97: 2.6

2. Maximum absorption, ASTM C 97: 2 percent

3. Maximum loss, sulfate soundness, ASTM C 88: 10 percent

B. Either quarried rock or native boulders may be used.

C. Shape

1. Predominantly rounded and sub-angular

2. Predominantly equidimensional or cylindrical

D. Size and Weight

1. Each boulder shall have a minimum diameter of 2.95 feet along its intermediate axis.

2. Each boulder shall have a minimum dry weight of 2,000 pounds (lbs).

2.02 TOE ROCK

A. Toe Rock shall conform to VDOT Specification Section 204 and Section 414 for "Class II Dry Riprap."

B. Toe Rock shall be sound and durable, free of cracks, soft seams, and other structural defects. Toe rock shall consist of well-graded, crushed, angular stone free of fine-grained particles and organic material. Unless otherwise approved by DSR, the Toe Rock shall meet the following specifications.

1. The minimum stone diameter shall be 8 inches across the smallest dimension of the stone. The maximum stone diameter shall be 26 inches across the largest dimension of the stone.

2. Material shall be well graded between 8 to 26 inches.

3. Material shall also meet the following requirements.

Property	ASTM Method	Requirement
Minimum Specific Gravity	C-127	2.6

Maximum Absorption	C-127	2%

C. Shall be imported quarried rock in conformance with 2.01B.

2.03 GEOTEXTILE

A. Geotextile shall include required appurtenances and conform to Section 31 05 19 – Geosynthetic Soil Reinforcement, Article 2.01.

B. Geocell system shall conform to Section 31 05 19 – Geosynthetics, Article 2.02

PART 3 – EXECUTION

3.01 INSTALLATION OF GEOTEXTILE AND GEOCELL SYSTEM FOR BANK REMOVAL AND RESTORATION AREAS

A. Refer to Section 31 05 19 Geosynthetics, Articles 3.01 through 3.05 for geotextile and Geocell System for Bank Removal and Restoration Areas.

B. Refer to Section 31 23 00, Article 2.06 for biochar blend.

C. Place geotextile as shown on Contract Drawings or as directed by the DSR.

D. Place biochar blend within the geocell system. Hand compact biochar blend to a relatively dense state as approved by the DSR and Engineer. Biochar blend shall fill the entire geocell system so as not to damage the exposed edges of the geocells when subjected to construction foot traffic and toe rock placement.

1. The Contractor shall take care if using equipment over the geocell system. The Contractor shall be responsible for all repairs or replacement of the geocell system in accordance with the manufacturer's recommendations for any damage identified by the DSR.

2. The Contractor shall be responsible for any associated work or labor to remove and reconstruct areas that were disturbed by the Contractor to gain access to the geocell system for repair or replacement.

E. In underwater applications, the geotextile, geocell system, and overlying toe rock shall be placed the same day.

3.02 BOULDER PLACEMENT

A. Place boulders as shown on the Contract Drawings or as directed by the DSR.

B. Anchor large woody material with boulders at locations indicated on Contract Drawings.

3.03 TOE ROCK PLACEMENT

A. Toe rock shall be placed at the locations and to elevations shown on the Contract Drawings.

B. The toe rock placement shall begin at the toe and proceed up the slope. Placement shall take place so as to avoid stretching and subsequent tearing of the geotextile and geocell system.

C. Placement shall occur along the embankment as soon as practicable after geotextile bedding has been finished, but shall not exceed 10 calendar days.

D. Larger rocks shall be reasonably well distributed to produce a well graded rock mass minimizing voids.

1. Final placement shall be free from objectionable pockets of small rocks and clusters of large rocks.

2. Hand placing may be required to the extent necessary to secure the results specified and form uniform slopes.

E. Toe rock shall not be dropped onto the geotextile and geocell system from a height greater than 1 foot.

F. Construction access shall be maintained by the Contractor until the placement is approved by the DSR. Misplaced material shall be replaced to the locations and elevations shown on the Contract Drawings at the Contractor's expense.

3.04 ORDERLY WORK AREA AND SITE CLEANUP

A. The Contractor shall maintain neat and orderly storage and work areas. The Contract will not be considered complete until all of the Contractor's tools, equipment, and property have been removed from the Project Site, and the Contractor's storage and work areas have been properly cleaned.

END OF SECTION

DIVISION 31—EARTHWORK
Section 31 52 00—Temporary Cofferdams

PART 1 – GENERAL

1.01 SUMMARY

A. Work includes

1. Furnishing temporary cofferdam system

2. Installing temporary cofferdam system

3. Dewatering and maintaining dry the area isolated within the temporary cofferdam system

4. Removing the temporary cofferdam system

B. The work area, conditions, and type of work required create considerable potential for accidents. Perform all work related to this specification in accordance with the approved project HASP. See Section 01 35 29 – Health, Safety, and Emergency Response Procedures for HASP submittal requirements.

C. If the Contractor identifies a discrepancy between any of the Contract Documents, they shall immediately notify the DuPont Site Representative (DSR). In general, the more stringent requirement shall take precedence.

1.02 RELATED WORK

A. Work related to this section is described in

1. Section 01 33 00 – Submittal Procedures

2. Section 01 35 29 – Health, Safety, and Emergency Response Procedures

3. Section 31 23 00 – Earthwork and Fill

4. Section 31 37 00 – Stone Toe Protection

1.03 DEFINITIONS

A. Acronym

1. DSR – DuPont Site Representative

2. HASP – Health and Safety Plan

3. USGS – U.S. Geological Survey

1.04 REFERENCES

1. Not used

1.05 QUALITY ASSURANCE

1. Notify DuPont Site Representative (DSR) 48 hours in advance of installation of temporary cofferdam system.

2. Notify DSR 48 hours in advance of removal of temporary cofferdam system.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Inspection on Delivery

1. Upon delivery to the Contractor's work or storage area, the system shall be inspected in the presence of the DSR for conformance with the Contract Specifications and condition.

B. Storage

1. Store materials in accordance with manufacturer's instructions.

C. Handling

1. Protect materials during handling, installation, and removal to prevent damage.

1.07 SUBMITTALS

A. Water Control Plan

1. The Contractor shall submit a Water Control and Emergency Action Plan for approval by the DSR prior to mobilization that

a) Defines how Site water will be managed during construction at each site.

b) Discusses additional standby water control measures for adapting to changing water levels in the South River.

c) Describes emergency action procedures if flooding occurs on the South River during construction.

PART 2 – PRODUCTS

2.01 COFFERDAM SYSTEM

A. Temporary Cofferdam System that will accomplish the following.

1. Effectively isolate the work area from South River water for the duration of the work.

2. Minimize impacts to the existing river channel and the adjacent banks and upland areas and floodplains.

3. Adapt to fluctuations in water levels in the South River.

a) Water levels may change rapidly due to late summer thunderstorms or fall storm events. The following table presents % monthly exceedance flows for the South River as measured at USGS gages near Waynesboro, Virginia (USGS gage 01626000), and Dooms, Virginia (USGS gage 01626850), which upstream and downstream of the project area respectively.

STREAMFLOW STATISTICS – USGS GAGE 01626000 NEAR WAYNESBORO, VA							
MONTH	DISCHARGE CORRESPONDS TO THE GIVEN FLOW EXCEEDANCE PROBABILITY (CFS)						
	20%	10%	5%	1%	0.5%	0.25%	0%
JANUARY	224	328	452	1,051	1,756	2,279	6,390
FEBRUARY	230	341	515	1,347	1,755	2,031	3,930
MARCH	349	519	746	1,475	1,785	2,332	3,630
APRIL	300	449	612	1,405	1,899	2,324	4,400
MAY	205	302	431	861	1,258	1,577	4,430
JUNE	116	172	273	905	1,088	2,063	7,430
JULY	68	94	140	423	648	898	1,410
AUGUST	57	87	173	513	885	1,494	9,670
SEPTEMBER	68	130	294	1,002	1,651	2,425	8,110
OCTOBER	121	201	359	1,174	1,804	2,304	3,730
NOVEMBER	156	266	421	1,003	1,479	2,387	9,070
DECEMBER	202	294	415	864	954	1,313	1,710

STREAMFLOW STATISTICS - USGS GAGE 01626850 NEAR DOOMS, VA							
MONTH	DISCHARGE CORRESPONDS TO THE GIVEN FLOW EXCEEDANCE PROBABILITY (CFS)						
	20%	10%	5%	1%	0.5%	0.25%	0%
JANUARY	162	196	237	691	2,691	3,828	9,870
FEBRUARY	171	197	229	536	1,583	2,498	2,790
MARCH	243	287	347	1,035	2,762	3,082	5,310
APRIL	206	242	300	834	3,083	3,634	5,390
MAY	167	188	216	528	1,740	2,057	2,680
JUNE	102	115	130	346	1,451	2,278	4,230
JULY	79	85	95	192	1,019	1,360	1,630
AUGUST	67	70	79	210	675	951	1,740
SEPTEMBER	62	66	78	432	1,910	2,713	8,780
OCTOBER	70	78	101	481	1,616	2,440	3,720
NOVEMBER	92	120	164	565	3,136	4,455	12,000
DECEMBER	153	175	211	542	1,238	1,505	1,760

PART 3 – EXECUTION

3.01 EXAMINATION

A. The Contractor shall perform a Site examination of the area(s) to receive temporary cofferdam placement as noted on the Contract Drawings.

1. The Contractor shall notify DSR of conditions that would adversely affect installation or removal.

2. The Contractor shall not begin installation or removal until unacceptable conditions are corrected to the satisfaction of the DSR.

B. The Contractor shall evaluate foundation/subgrade conditions to verify consistencies relating to load bearing capacity or other conditions as recommended by the Manufacturer are satisfactory before installation if applicable. The highest anticipated water surface elevation for the construction timeframe should be considered in all calculations.

C. The DSR shall not be liable for costs or delays associated with the unsatisfactory or inadequate performance of the temporary cofferdam.

1. The Contractor shall responsible to inspect the cofferdams frequently throughout the Project duration to verify its performance and to correct any defects to the system.

3.02 INSTALLATION

A. Install temporary cofferdam system in a way that minimizes disturbance to the existing river bed, banks, and upland areas and in accordance with manufacturer's instructions if applicable.

B. Elements of the temporary cofferdam system shall not be placed outside the Project limits indicated on the Contract Drawings unless otherwise approved by the DSR.

C. Access for equipment used to install cofferdams shall be limited to bank removal and restoration areas, unless approved by the DSR and specifically agreed to by the City of Waynesboro.

3.03 REMOVAL

A. Allow for inspection and acceptance of the dry work by the DSR before re-watering enclosed area.

B. Remove temporary cofferdam system in a way that minimizes disturbance to the existing river bed, banks, and upland areas and in accordance with manufacturer's instructions if applicable.

C. Access for equipment used to remove cofferdams shall be limited to bank removal and restoration areas, unless approved by the DSR and specifically agreed to by the City of Waynesboro.

D. Re-water enclosed area after completion of all work and cleanup in the area protected by the cofferdam, only after approval by the DSR.

E. The Contractor shall collect and properly dispose of remaining materials, debris, and rubbish resulting from cofferdam system removal.

F. Maintain neat and orderly storage and work areas. The Contract will not be considered complete until all of the Contractor's tools, equipment, and property have been removed from the Project Site, and the Contractor's storage and work areas have been properly cleaned up. All litter, packaging material and unused hardware, shall be removed from the Project Site and disposed of in a proper manner. Special care shall be taken to ensure that no foreign materials fall into or contaminate Project waters.

END OF SECTION

DIVISION 32—EXTERIOR IMPROVEMENTS

Section 32 90 00—Planting and Habitat Restoration

PART 1 – GENERAL

1.01 SUMMARY

A. Work Includes

1. Furnishing and installing Planting Substrate, and amendments, for seeding and planting areas.

2. Provide and plant trees, shrubs, and live stakes as shown on the Contract Drawings and specified.

B. The work area, conditions, and type of work required create considerable potential for accidents. Perform all work related to this specification in accordance with the approved project HASP. See Section 01 35 29 – Health, Safety, and Emergency Response Procedures for HASP submittal requirements.

C. If the Contractor identifies a discrepancy between any of the Contract Documents, they shall immediately notify the DuPont Site Representative (DSR). In general, the more stringent requirement shall take precedence.

1.02 RELATED WORK

A. Work related to this Section is described in

1. Section 01 33 00 – Submittal Procedures

2. Section 01 35 29 – Health, Safety, and Emergency Response Procedures

3. Section 31 05 19 – Geosynthetics

4. Section 31 23 00 – Earthwork and Fill

5. Section 31 25 00 – Erosion and Sedimentation Controls

6. Section 31 35 00 – Slope Protection

1.03 DEFINITIONS

A. Acronyms

1. ASTM – American Society for Testing and Materials

2. BMA – Bank Management Area

3. cfu – colony forming unit

4. DSR – DuPont Site Representative

5. ft^3 – cubic feet

6. HASP – Health and Safety Plan

7. H:V – horizontal to vertical

8. lb – pound

9. LOI – Loss-on-Ignition Organic Matter Method

10. mmhos/cm – milliMhos/centimeter

11. STA – Seal of Testing Assurance

12. TMECC – Test Methods for the Examination of Composting and Compost

1.04 REFERENCES

A. Hortus Third compiled by the L. H. Bailey Arboretum, Cornell University, 1976

B. American Society for Testing and Materials (ASTM) C602

C. ASTM D5268

D. ASTM D4972

E. Virginia Erosion and Sediment Control Handbook

F. U.S. Environmental Protection Agency Part 503 levels for heavy metals

G. Test Methods for the Examination of Composting and Compost (TMECC) 05.07A, “Loss-on-Ignition Organic Matter Method (LOI)

H. TMECC 04.10-A Electrical Conductivity.

1.05 QUALITY ASSURANCE

A. All products supplied shall comply with applicable state and local codes.

B. Comply with sizing and grading standards of the latest edition of “American Standard for Nursery Stock.”

C. Nomenclature shall conform to Hortus Third compiled by the L. H. Bailey Arboretum, Cornell University, 1976.

D. All plants shall be nursery grown or collected materials that have been held in a nursery for at least 1 year. Nursery climatic conditions must be similar to those in the locality of the project. All plants shall be weed-free at the time of planting.

E. Stock furnished shall be at least the minimum size indicated. Larger stock is acceptable at no additional cost, and providing that the larger plants will not be cut back to size indicated. Provide plants indicated by two measurements so that only a maximum of 25 percent are of the minimum size indicated, and 75 percent are of the maximum size indicated.

1.06 SUBMITTALS

The Contractor shall submit the following in accordance with Section 01 33 00 – Submittal Procedures.

A. Plant nursery sources and photographs

1. Contractor shall submit a list of nurseries supplying all plant species shown on the Contract Drawings. Submit representative color, dated photographs of each plant species.

B. Submit the following material samples

1. Mulch submittal

a) Contractor shall notify the DuPont Site Representative (DSR) of the source of supply and provide a 1 gallon sample for approval before installation.

C. Submit the following material certification/data sheets

1. Planting fertilizer

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver fertilizer materials in original, unopened, and undamaged containers showing weight, analysis, and name of manufacturer. Store in such a manner as to prevent wetting and deterioration of the fertilizer.

B. Dig, pack, transport, and handle plants with care to ensure protection against injury. Inspection certificates required by law shall accompany each shipment invoice or order to stock. On arrival, the certificate shall be filed with the DSR. Protect all plants from desiccation. Wilt-proof or another anti-dessicant shall be applied only with approval of the DSR. If plants cannot be planted immediately upon delivery, properly protect them with soil, wet peat moss, or in a manner acceptable to the DSR. Water heeled-in plantings daily. No plant shall be bound with rope or wire in a manner that could damage or break the branches.

C. Cover plants transported on open vehicles with a protective covering to prevent wind-burn.

D. Provide dry, loose soils for planting. Frozen or muddy soil is not acceptable.

E. Stock shall be handled by root ball only, not the trunks, stems, or tops.

F. Inspect seed upon arrival at the job site for conformity to species and quality.

G. Reject seed that is wet, moldy, or bears a test date 5 months or older.

1.08 PROJECT CONDITIONS

A. Ambient Conditions

1. Do not plant when the ground is frozen, snow covered, muddy, or air temperatures exceeds 90 ˚F.

B. Time Limitations

1. Permanent seed in accordance with seeding schedule on Contract Drawings.

2. Complete permanent seeding within 7 days after final grading operations have been completed.

3. Apply seed within 24 hours after seed bed preparation.

4. When hydroseeding, do not hold seed in the slurry for more than 24 hours.

C. Seeding Conditions

1. Perform seeding operations only during periods when beneficial results can be obtained.

2. When drought, excessive moisture, or other unsatisfactory conditions prevail, stop the work when directed.

3. When special conditions warrant a variance to the seeding operations, submit proposed alternate times for approval.

4. If seeding will not be completed before October 1, a cover crop of annual rye and oats will be applied as overwinter cover, and the native seed mix will be applied the following spring. For areas that will be covered by coir fabric after seeding, use dormant seeding in accordance with Paragraph 3.08 Seeding and also seed with a cover crop of Grain Rye at 30 lbs per acre before covering with the coir fabric.

1.09 SEQUENCING AND SCHEDULING

A. Planting live stakes shall commence after November 1st or when live stakes become available from local suppliers, whichever is earlier. Tubelings may be substituted for live stakes if bank restoration work is finished prior to the dormant season. Contractor shall acquire written permission by the DSR prior to planting live stakes or tubelings.

B. Planting all other vegetation shall be performed during the construction window.

1.10 WARRANTY

A. Warrant plant material to remain alive and be in healthy, vigorous condition for a period of 1 year after the date of Physical Completion. Inspection of plants will be made by the DSR at the completion of planting.

B. Replace, in accordance with the Contract Drawings and Contract Specifications, all plants that are dead or, as determined by the DSR, are in an unhealthy or unsightly condition, and have lost their natural shape due to dead branches, or other causes due to the Contractor's negligence. The cost of such replacement(s) is at the Contractor's expense. Warrant all replacement plants for 1 year after Physical Completion or installation, whichever is longer.

C. Warranty shall not include damage or loss of trees, plants, or groundcovers caused by fires, floods, freezing rains, lightning storms, or winds more than 75 miles per hour, winter kill caused by extreme cold and severe winter conditions not typical of planting area, acts of vandalism, or negligence on the part of the DSR.

D. Remove and immediately replace all plants, as determined by the DSR, to be unsatisfactory during the initial planting installation.

PART 2 – PRODUCTS

2.01 PLANTING SUBSTRATE

A. Refer to Section 31 23 00 – Earthwork and Fill, Article 2.05

2.02 BIOCHAR BLEND

A. Refer to Section 31 23 00 – Earthwork and Fill, Article 2.07

2.03 GEOCELL SYSTEM FOR BANK STABILIZATION AREAS

A. Refer to Section 31 05 19 – Geosynthetics, Article 2.03

2.04 PLANT MATERIALS

A. Plants: Provide plants typical of their species or variety, with normal, densely developed branches and vigorous, fibrous root systems. Provide only sound, healthy, vigorous plants free from weeds, defects, disfiguring knots, sunscald injuries, abrasions of the bark, plant diseases, insect eggs, borers, and all forms of infestation. All plants shall have a fully developed form without voids, open spaces, broken branches, flush cuts, or stubs.

1. Container-grown stock (including plugs): Grown in a container for sufficient length of time for the root system to have developed to hold its soil together, firm, and whole.

    a) No plants shall be loose in the container.

    b) Container stock shall not be pot bound.

    c) No pruning wounds shall be present with a diameter of more than 1/2 inch, and such wounds must show vigorous callous on all edges. Trees shall not be pruned within 6 months prior to delivery.

    d) Deciduous trees that have solitary leaders shall have only the lateral branches thinned by pruning. All conifer trees shall have only one leader (growing apex) and one terminal bud and shall not be sheared or shaped. Trees having a damaged or missing leader, multiple leaders, or Y-crotches will be rejected.

2. Livestake cuttings are live plant material without a previously developed root system. Source plants for cuttings shall be dormant when cuttings are taken, and all cuts shall be made with a sharp instrument. Livestake cuttings shall have a straight top cut immediately above a bud. The lower, rooting end shall be cut at an approximately 45-degree angle. Livestakes are cut from 1- to 2-year-old wood. Livestake cuttings shall be cut and installed with the bark intact, with no branches or stems attached.

2.05 SEED

A. Seed Classification

1. Provide State-approved seed of the latest season's crop in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material.

2. Ensure labels are in conformance with Agricultural Marketing Service Seed Act and applicable state seed laws.

B. Permanent Seed Mix

1. Ernst Seeds, ERNMX-822, or pre-bid approved equal, available from Ernst Conservation Seeds, Inc. See http://www.ernstseeds.com/.

C. Temporary Seed Species Mix

1. Ernst Seeds, ERNMX-101, or pre-bid approved equal, available from Ernst Conservation Seeds, Inc. See http://www.ernstseeds.com/.

D. Quality

1. Comply with minimum standards in the Virginia Erosion and Sediment Control Handbook.

E. Seed Mixing

1. The mixing of seed may be done by the seed supplier prior to delivery or on site in the presence of the DSR.

F. Substitutions

1. Substitutions will not be allowed without written request and DSR approval.

2.06 SOIL AMENDMENTS

A. Provide soil amendments consisting of pH adjuster, organic material, soil conditioners, and fertilizer meeting the following requirements. Do not use vermiculite.

B. pH Adjuster

1. Agricultural liming material in accordance with ASTM C602.

2. Provide burnt lime, hydrated lime, ground limestone, sulfur, or shells.

3. Use the pH adjuster to create a favorable soil pH for the plant material specified.

4. Limestone

a) Minimum calcium carbonate equivalent of 80 percent

b) Gradation: A minimum 95 percent passing a No. 8 sieve and a minimum 55 percent passing a No. 60 sieve

c) Use ground limestone to raise soil pH

5. Hydrated Lime

    a) Minimum calcium carbonate equivalent of 110 percent

    b) Gradation: A minimum 100 percent passing a No. 8 sieve and a minimum 97 percent passing a No. 60 sieve

6. Burnt Lime

    a) Minimum calcium carbonate equivalent of 140 percent

    b) Gradation: A minimum 95 percent passing a No. 8 sieve and a minimum 35 percent passing a No. 60 sieve

2.07 FERTILIZERS

A. Hydroseeding Fertilizer

1. Controlled release fertilizer, to use with hydroseeding and composed of pills coated with plastic resin to provide a continuous release of nutrients for at least 6 months and based on soil tests or containing the following minimum percentages, by weight, of plant food nutrients.

2. 10 percent available nitrogen

3. 20 percent available phosphorus

4. 10 percent available potassium

B. Tree Fertilizer

1. Fertilizer for all tree plantings shall be “BioPaks-16-6-8 plus minors and biostimulants” available from Reforestation Technologies International (RTI), 1-800-784-4769.

2. BioPak®, or approved equivalent, shall consist of a 10-gram biodegradable planting packet containing a blend of 16.00 percent total nitrogen (N), 6.00 percent available phosphoric acid (P_2O_5), and 8.00 percent soluble potash (K_20). Also containing 6.92 percent combined sulfur (S), 0.52 percent zinc (Zn), 0.54 percent Iron (Fe), 0.54 percent Magnesium (Mg), 0.23 percent Copper (Cu), 0.05 percent Boron (B), and 0.56 percent Manganese (Mn). The N, phosphorous, and potassium sources shall be coated with a polyurethane coating to provide 15.69 percent coated slow release nitrogen, 5.09 percent coated slow release available phosphate, and 6.80 percent available soluble potash. Also contains: 5.0 percent humic acid derived from rutile sands, 0.25 percent Kelp extract, and 0.9 percent naphthalene acetic acid.

3. Soil conditioner shall consist of Mycor Tree Saver mycorrhizal fungal transplant inoculant for trees and shrubs or approved equal consisting of:

Ectomycorrhizal Fungi	95 million spores/lb
Vesicular Arbuscular Mycorrhizal (VAM) Fungi	5,300 spores/lb
Rhizosphere Bacillus	324 million cfu/lb
Potassium polyacrylamide	33%
Formononetin	0.007%
Microbial Nutrients	39.4%
Inert Ingredients	27.3%

2.08 MULCH

A. Free from weeds, mold, and other deleterious materials.

B. Native to the region.

C. Mulch particles shall not exceed 2 inches in the greatest dimension, and a minimum of 75 percent of the mulch shall pass through a 1-inch screen.

2.09 HYDROMULCH FOR HYDROSEEDING AREA

A. Hydromulch shall be wood cellulose fiber, containing no growth- or germination-inhibiting substances. A soil-binding agent (tackifier) is required. Mulch shall be dyed a suitable color to facilitate placement coverage observation.

PART 3 – EXECUTION

3.01 PREINSTALLATION TESTING

A. Soil Test

1. Test delivered and stockpiled Planting Substrate in accordance with ASTM D5268 and ASTM D4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, and soluble salts analysis.

2. Collect samples from stockpiled Planting Substrate at different levels in the stockpile.

3. Determine the quantities and type of soil amendments required to meet local growing conditions for the species specified.

B. Seeding Equipment Calibration

1. Immediately prior to the commencement of seeding operations, conduct calibration tests on the equipment to be used.

2. Confirm that the equipment is operating within the manufacturer's specifications and will meet the specified criteria.

3. Calibrate the equipment a minimum of once every day during the operation.

4. Provide calibration test results within 1 week of testing.

3.02 PLANTING AND SEEDING PREPARATION

A. Finish Grade and Planting Substrate

1. For all Areas to receive Planting Substrate except within Geocell and Jones Hollow Property

a) Verify that finished grades are as indicated on Contract Drawings, and that placing 12-inches of Planting Substrate, smooth grading, and compaction requirements have been completed in accordance with Section 31 23 00 – Earthwork and Fill prior to the commencement of the planting operation.

2. Planting Substrate and Biochar Blend Placement within Geocell System for Bank Stabilization Areas

a) Refer to Section 31 05 19 Geosynthetics, Article 3.01 and 3.06 for Bank Stabilization Areas.

b) Place Planting Substrate within the geocell system. Where indicated in the Contract Drawing, place a 6-inch layer of Biochar Blend (specified in 2.02 of this Section). Then, after evenly spreading the first 6-inches, place a second 6-inch layer consisting only of Planting Substrate in the same manner described in Article 2.05 of Section 31 23 00 Earthwork and Fill.

c) Hand compact all materials within the geocell system to a relatively dense state as approved by the DSR and Engineer. Entire geocell system shall be completely filled so as not to damage the exposed edges of the geocells when subjected to construction foot traffic.

1) The Contractor shall take care if using equipment over the geocell system. If damage is noted by the DSR and Engineer, then the Contractor shall be responsible for all

repairs or replacement of the geocell system in accordance with the manufacturer's recommendations

2) The Contractor shall be responsible for any associated work or labor to remove and reconstruct areas that were disturbed by the Contractor to gain access to the geocell system for repair or replacement.

d) Limit drop height to a maximum of 3 feet to prevent panel distortion.

e) Fill sections from the crest of the slope to toe or in accordance with DSR's direction.

f) Infill material shall be free-flowing and not frozen when placed into the sections.

g) Evenly spread infill and tamp into place.

3. Planting Substrate Placement within Jones Hollow Property

a) Verify that finished grades are as indicated on Contract Drawings, and that placing 4-inches of Planting Substrate, smooth grading, and compaction requirements have been completed in accordance with Section 31 23 00 – Earthwork and Fill prior to the commencement of the planting operation.

B. Application of Soil Amendments

1. Applying pH Adjuster

a) Apply as recommended by the soil test.

b) Incorporate the pH adjuster into the soil to a maximum 4-inch depth or as part of the tillage operation.

2. Applying Soil Conditioner

a) Apply as recommended by the soil test.

b) Spread soil conditioner uniformly over the soil a minimum 1-inch depth and thoroughly incorporate by tillage into the soil to a maximum 4-inch depth.

C. Tillage

1. No tillage is required on slopes with geocell.

2. On slopes that are 3-horizontal-to-1-vertical (3H:1V) or flatter: Till soil on slopes to a maximum 4 inch depth.

3. On slopes between 3H:1V and 1H:1V: till the soil to a maximum 2-inch depth by scarifying with heavy rakes, or other method.

4. Use rototillers where soil conditions and length of slope permit.

5. On slopes 1H:1V and steeper, no tillage is required.

6. Maintain drainage patterns as indicated on Contract Drawings.

7. Completely pulverize by tillage areas compacted by construction operations.

8. Use soil conforming to Planting Substrate requirements for repair of surface erosion or grade deficiencies.

9. The pH adjuster and soil conditioner may be applied during this procedure.

10. Tillage is not permitted within the drip-line of the trees to remain.

D. Prepared Surface

1. Preparation

a) Blend new surfaces to existing areas.

b) Complete the prepared surface with a light raking to remove debris.

2. Debris

a) Remove debris and stones more than 5/8 inches in any dimension from the surface.

3. Protection

a) Protect areas with the prepared surface from compaction or damage by vehicular or pedestrian traffic and surface erosion.

3.03 PLANT INSPECTION

A. The Contractor shall notify the DSR least 48 hours in advance of the time of inspection required for completion of soil preparation before the planting of trees, shrubs, and groundcover can occur.

B. Plant material shall be inspected and approved by the DSR at the nursery or site prior to installation. Remove unsatisfactory material from the site immediately.

3.04 PLANTING PREPARATION AND SEQUENCING

A. The Contractor shall locate plants by staking with stakes and flags as indicated on the Contract Drawings or as approved in the field. If obstructions are encountered that are not shown on the Contract Drawings, do not proceed until DSR has selected alternate plant locations.

1. Do not plant containerized trees and shrubs or live stakes within 2 feet of either side of buried utility lines.

B. In Slope Stabilization Areas, trees shall be installed before installing geocell.

C. In all other areas, plant materials shall be installed after log edging, planting substrate, and coir fabric have been installed and approved by the DSR.

3.05 CONTAINER PLANT INSTALLATION

A. Container plants brought to the planting site shall be in containers and sized as specified in the planting schedule in the Contract Drawings for the particular type of planting material. Plants shall not be planted during freezing weather or when the ground is frozen. Plants shall not be planted during excessively wet conditions. Plants shall not be placed on any day in which temperatures are forecast to exceed 80 degrees F unless the DSR approves otherwise. Plants shall not be placed in areas that are below finished grade.

B. Plants shall be removed from containers in a manner that prevents damage to the root system. Containers may require vertical cuts down the full depth of the container to accommodate removal. All circling roots shall be loosened to ensure natural directional growth after planting.

C. Plant installation shall be performed using the following steps.

1. Dig a hole 12 inches in diameter and 12 inches deep; minimize disturbance to the jute matting.

2. Install fertilizer packets around plant root balls based on plant size and manufacturer recommendations.

3. Set the container plant material in the planting pit to the proper grade and alignment. Set plants upright, plumb, and faced to give the best appearance or relationship to each other or adjacent structures. Set the crown of plant material at the finish grade. No filling will be permitted around trunks or stems or above grafts on grafted trees. Backfill the

planting pit with Planting Substrate. Form a ring of soil around the edge of each planting pit to retain water.

4. Space plants using triangular spacing in accordance with indicated dimensions. Adjust spacing as necessary to evenly fill planting area. Plant to within 12 inches of the edge of the planting area.

D. Mulching

1. Mulch tree and shrub planting pits and shrub beds with required mulching material immediately after planting. Thoroughly water mulched areas. After watering, rake mulch to provide a uniform finished surface.

E. Pruning

1. Prune all trees only to remove broken or damaged branches, or for aesthetic purposes as directed by the DSR. Branches will be pruned at the branch collar. Neither stubs nor flush cuts will be acceptable.

3.06 LIVESTAKE PLANT INSTALLATION

A. All livestake cuttings shall be continuously soaked in water immediately after cutting until delivery to the site. Cuttings shall be planted the same day that they are delivered to the site. Cuttings shall be kept continually soaked in water on site until immediately before planting.

B. Livestake and pole installation shall be performed using the following steps.

1. Cut an “X” in the coir fabric, with 2 inches maximum length for each cut.

2. Use an iron stake or bar of similar diameter to the livestakes and poles to create a pilot hole of sufficient depth through the jute matting.

3. Plant the stakes with an angled bottom end in the ground, with at least two to five emerging buds exposed at the top end.

4. Install the stakes with a rubber mallet, and protect the stakes from damage such as splitting, bark peeling, and bud breakage during installation.

5. Install each stake with 80 percent (4/5) buried and 20 percent (1/5) exposed.

6. Ensure good contact through soil tamping of backfilling.

7. Install stakes perpendicular to the slope as shown on the Contract Drawings.

3.07 PLANT MAINTENANCE

A. The contractor shall maintain planting for 12 months following completion of planting in a bank management area (BMA).

B. Maintain planting until acceptance by the DSR.

C. Replace any tree or shrub that does not survive first year.

D. Maintenance shall include cultivating, weeding, removal of invasive species, watering, pruning (only as directed), installation of herbivory controls if necessary, and application of appropriate insecticides and fungicides necessary to maintain plants free of insects and disease.

1. Reset settled plants to proper grade and position. Restore planting saucer and adjacent material and remove dead material.

2. Straighten, repair, and adjust guy wires and stakes as required.

3. Correct defective work as soon as possible after deficiencies become apparent and as weather and season permit.

4. Install herbivory controls as directed by the DSR if browsing damage is observed.

5. Water trees, shrubs, livestakes, and seeded areas within the first 24 hours of initial planting, and not less than twice per week (including rain) until Physical Completion.

3.08 SEEDING

A. If special conditions exist that may warrant a variance in the specified seeding dates or conditions, submit a written request stating the special conditions and proposed variance.

B. Sow seed by approved sowing equipment. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing.

C. Seed Application Method (Use one of the following seeding methods)

1. Broadcast and Drop Seeding in BMA

    a) Seed immediately after Planting Substrate is placed, and before Coir Fabric is installed.

    b) Uniformly broadcast permanent seed mix at the rates recommended by the manufacturer.

c) Use broadcast or drop seeders.

d) Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing.

e) Cover seed uniformly to a maximum depth of 1/4 inch in clay soils and 1/2 inch in sandy soils by means of spike-tooth harrow, cultipacker, raking, or other approved devices.

2. Hydroseeding in All Disturbed Areas including Jones Hollow.

a) First, mix water and hydromulch.

b) Add hydromulch at 1,000 lbs, dry weight, per acre.

c) Add supplier's recommended lbs of seed and mix temporary seed mix and fertilizer to produce a homogeneous slurry.

d) Add soil binding agent (tackifier) at the rate recommended by manufacturer.

e) When hydraulically sprayed on the ground, ensure material forms a blotter like cover impregnated uniformly with grass seed.

f) Spread with one application with no second application of mulch.

3. Dormant Seeding

a) Increase permanent seed mix application rate by 25 percent when soil temperature is below 55° Fahrenheit

3.09 ROLLING

A. Immediately after seeding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 lbs for each foot of roller width.

B. If seeding is performed with cultipacker-type seeder or by hydroseeding, rolling may be eliminated.

3.10 WATERING IN SEEDING AREA

A. Start watering immediately after completing the seeding of an area.

B. Apply water to supplement rainfall at a rate sufficient to ensure moist soil conditions to a minimum 1 inch depth.

C. Prevent run-off and puddling.

D. Prevent watering of other adjacent areas or plant material.

3.11 SURFACE EROSION CONTROL IN SEEDING AREA

A. Surface Erosion Control Material

1. Where indicated or as directed, install surface erosion control material in accordance with Section 31 25 00 – Erosion and Sedimentation Controls and manufacturer's instructions.

2. Place material without damage to installed material or without deviation to finished grade.

B. Temporary Seeding

1. When directed during contract delays affecting the seeding operation or when a quick cover is required to prevent surface erosion, seed the designated areas in accordance with temporary seed mix.

2. Immediately seed disturbed areas that will be left exposed more than thirty (30) days, and not subject to construction traffic using temporary seed. Immediately following rough grading, seed critical areas subject to erosion using temporary seed in combination with straw mulch.

3. Soil Amendments

a) When soil amendments have not been applied to the area, apply ½ of the required soil amendments and till the area in accordance with Paragraph SITE PREPARATION.

b) Water the area in accordance with Paragraph WATERING.

c) Apply remaining soil amendments in accordance with the Paragraph TILLAGE when the surface is prepared for installing seed.

3.12 RESTORATION

A. Restore existing turf areas, pavements, and facilities damaged from the seeding and planting operations to original condition.

3.13 FIELD QUALITY CONTROL

A. Quantity Check

1. For materials provided in bags, retain the empty bags for recording the amount used.

2. For materials provided in bulk, retain the weight certificates as a record of the amount used.

3. Compare the amount of material used with the total area covered to determine the rate of application used.

4. Adjust differences between the quantity applied and the quantity specified as directed.

3.14 SEED ESTABLISHMENT PERIOD

A. Commencement

1. The seed establishment period to obtain a healthy stand of grass plants will begin on the first day of seeding work and will end 12 months after the last day of the seeding operation.

2. Furnish written calendar time period for the seed establishment period.

3. When there is more than 1 seed establishment period, describe the boundaries of the seeded area covered for each period.

4. Modify the seed establishment period for inclement weather, shut down periods, and for separate completion dates of areas.

B. Satisfactory Stand of Grass Plants

1. Evaluate grass plants for species and health when the grass plants are a minimum 1 inch high.

2. The maximum allowable dimensions of bare spots is 6 inches square.

3. The maximum total number of bare spots is 30 percent of the total seeded area.

C. Maintenance during Establishment Period

1. Eradicate weeds, invasive plant species, insects and diseases; protect embankments and ditches from surface erosion; maintain erosion control materials and mulch; protect installed areas from traffic and water.

2. Repair or Reinstall

   a) Repair or reinstall unsatisfactory stand of grass plants and mulch, and repair eroded areas in accordance with Paragraph SITE PREPARATION.

3. Maintenance Record

a) Furnish a record of each site visit, describing the maintenance work performed; areas repaired or reinstalled; and diagnosis for unsatisfactory stand of grass plants.

3.15 PHYSICAL COMPLETION

A. Inspection to determine Physical Completion of planted areas will be made by the DSR 1 year after planting and seeding upon Contractor's request. Provide notification at least 10 working days before requested inspection date.

1. Planted areas will be accepted, provided all requirements, including the maintenance period, have been complied with and plant materials are alive and in a healthy, vigorous condition.

B. Upon Physical Completion, the DSR will assume plant maintenance.

3.16 ORDERLY WORK AREA AND SITE CLEANUP

A. The Contractor shall maintain neat and orderly storage and work areas. The Contract will not be considered complete until all of the Contractor’s tools, equipment, and property have been removed from the Project site, and the Contractor’s storage and work areas have been properly cleaned.

END OF SECTION

APPENDIX A
GEOTECHNICAL INVESTIGATION REPORT

APPENDIX A
GEOTECHNICAL INVESTIGATION REPORT

AREA OF CONCERN 4 GEOTECHNICAL DATA SUMMARY REPORT
SOUTH RIVER REMEDIATION
WAYNESBORO, VIRGINIA

Prepared for

E. I. du Pont de Nemours and Company

Prepared by

Anchor QEA, LLC

10400 Little Patuxent Parkway, Suite 220

Columbia, MD 21044

February 2015

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LIST OF ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
ASTM	ASTM International
bgs	below ground surface
BMA	Bank Management Area
DGPS	differential global positioning system
DuPont	E.I du Pont de Nemours and Company
site	South River site downstream of DuPont facility in Waynesboro, Virginia
SPT	standard penetration testing
USCS	Unified Soil Classification System

1 INTRODUCTION

This report summarizes and presents the findings of the geotechnical investigation performed in November 2014 as part of the Area of Concern (AOC) 4 Bank Management Area Phase 1A Interim Measures Design detailed in the AOC 4 Phase 1 Work Plan (Anchor QEA, URS, and DuPont 2014). The investigation was conducted in support of remediation design of mercury-contaminated riverbanks downstream of the former E.I du Pont de Nemours and Company (DuPont) facility in Waynesboro, Virginia (the site). The investigation focused on characterizing physical (geotechnical) properties of upland soil and riverbank sediment within AOC 4 (also referred to herein as the Bank Management Areas [BMAs]) shown in Figures 1 through 6. Characterization of the upland soil and sediments within the BMAs will inform design elements of remedial measures as well as disposal options. Details of the explorations as well as laboratory test results are tabulated at the end of the report. Boring logs and laboratory reports from the testing labs are included as Appendices A and B, respectively.

The 2.0-mile section of the South River investigated lies within the city limits of Waynesboro, Virginia, and work performed for Phase 1A was limited to BMAs within City of Waynesboro property. The explorations performed in the BMAs consisted of 10 hollow stem auger soil borings ranging from 6.2 to 23.5 feet below ground surface (bgs) with standard penetration testing (SPT; ASTM 1586) performed in 2.5-foot intervals. All borings were terminated at or in bedrock. A total of 46 soil samples were collected and submitted for laboratory testing.

2 FIELD SAMPLING SUMMARY

The field sampling performed at the site consisted of 10 upland boring performed along the riverbank of the South River between river miles 0.0 and 2.0. All explorations, in situ testing, and sampling were performed by Total Depth Drilling of Knoxville, Tennessee. Borehole logging, sample collection and labeling, and oversight of the investigation were performed by an Anchor QEA geotechnical engineer. Work was performed from November 6 to November 7, 2014, and samples were shipped to GeoTesting Express in Anton, Massachusetts for laboratory testing on November 8, 2014. Boring locations were first selected based on proximity to the mapped BMAs and were adjusted in the field as necessary due to access limitations and utilities. Location AQSR-05 was moved approximately 90 feet due to the presence of utilities. All other locations were moved fewer than 10 feet for access purposes.

Navigation and recording of exploration, sample, and testing locations were performed using a Trimble Geo6000XH differential global positioning system (DGPS). The horizontal datum used was Virginia State Plane North 1983. Coordinates of the locations are presented in U.S. Survey feet in Table 1. Figures 1 through 6 present the actual exploration, sampling, and testing locations performed during the Phase 1A geotechnical investigation.

2.1 Soil Borings

Hollow-stem augers were utilized for soil borings. SPT was performed through the hollow-stem augers, which allowed for collection of soil and sediment samples. The borings were performed to total depths of 6.2 and 23.5 feet bgs. Boring depth was limited by refusal from bedrock, which was encountered in all borings.

2.2 Soil and Sediment Sampling

Soil and sediment samples were obtained using both disturbed and undisturbed sampling methods. Disturbed sampling was performed using a split-spoon, standard penetration sampler (i.e., 18-inch length, 1.375-inch inside diameter, and 2.0-inch outside diameter). Sample recovery length was recorded and the soil units were classified and logged in accordance with the Unified Soil Classification System (USCS; ASTM D2487) and were logged at each location shown in Figures 1 through 6. Disturbed samples were labeled, stored, and sealed in water-tight plastic bags to minimize moisture loss. Samples were shipped to the testing laboratory in a sealed 5-gallon bucket and held in a moisture-controlled environment until testing was performed. A total of 47 disturbed samples were submitted to the testing laboratory, 28 for analysis and 19 for archiving. These samples were tested for index properties, including moisture content, organic matter, grain size distribution, specific gravity, and Atterberg limits. Testing results for disturbed samples are presented in Table 2.

Undisturbed sampling was performed by advancing a 3-inch outside diameter, thin-walled Shelby tube into cohesive soil units using constant hydraulic pressure (ASTM 1587). Only one undisturbed sample was successfully retrieved. Upon retrieval, the sample was characterized by visual observation of both the top and bottom of the Shelby tube, then moisture-sealed using wax. The ends were additionally sealed with plastic caps. The undisturbed sample was wrapped with bubble wrap and shipped in a Schedule 40 PVC tube with PVC end-caps to the testing laboratory. The sample was stored in a moisture-controlled room until tested. This sample was tested for compressibility and strength properties using one-dimensional consolidation and direct shear testing, respectively. Testing results for undisturbed samples are presented in Table 3.

2.3 Work Plan Deviations

The following deviations from the Work Plan occurred:

- Location AQSR-05 was moved 94 feet to the southeast and parallel to the river for purposes of avoiding underground utilities.
- Strength testing of the undisturbed sample utilized the direct shear test (ASTM D3080) rather than the tri-axial compression test (ASTM D2850). The direct shear test was chosen because it required less material per test and therefore enabled more tests results to be obtained.

3 INVESTIGATION RESULTS

A discussion of the findings and testing results performed for the geotechnical investigation is presented in this section. Soil boring logs are included in Appendix A.

3.1 Subsurface Conditions

Characterization of subsurface conditions was performed during soil borings through observations of samples obtained from regular intervals from the ground surface to the final boring depth (i.e., bedrock surface). Three principal soil units were identified during the investigation. All soil borings were terminated at bedrock surface. Soil units are described in order from the ground surface downward, as follows.

Topsoil/Silty SAND (SM)

The near-surface soils consisted primarily of top soil, fill, and/or recently deposited river sediments. This unit consisted of a loose to medium dense, dry to moist, dark brown to yellow-brown, fine silty sand with non- to slightly plastic fines, occasional gravel and rock fragments, and varying amounts of organic matter. This unit varied in thickness from 2.0 to 13.5 feet, with an average thickness of 6.9 feet. This unit was observed at all sampling locations.

Alluvium (SM/GM)

Underlying the near-surface soils was a predominately granular alluvium. This unit was loose to medium dense, damp to wet, brown/yellow-brown to olive-gray, fine to coarse silty sand and silty gravel with frequent large gravel and cobbles that are sub-rounded to sub-angular in shape. This unit was typically observed immediately beneath the topsoil/silty sand unit and ranged in thickness from 2.5 to 5.0 feet, with an average thickness of 3.8 feet. This unit was not observed in soil borings AQSR-04, AQSR-05, and AQSR-07.

SILT/CLAY (ML/MH/CL)

Cohesive soil units were observed at five of the ten soil boring locations: AQSR-01, AQSR-03, AQSR-04, AQSR-05, and AQSR-06. This unit was highly variable and ranged from a stiff, moist, brown to dark brown, non-plastic very fine sandy silt/clay to a very soft, moist/wet, orange-brown silt with medium to high plasticity. Moisture content of the cohesive units ranged from 11.9% to 99.1%. Thickness of this unit ranged from 2.0 to 9.5 feet, with an average thickness of 4.8 feet.

At AQSR-01 and AQSR-06, where cohesive units were observed to be very soft to soft, the units were immediately above bedrock and exhibited a blocky fracture when intact pieces were broken apart. The material appeared to be very highly weathered bedrock, such as limestone, that exhibits a clay-like behavior when disturbed and remolded. An undisturbed sample was successfully collected at AQSR-01, while all other sampling used disturbed methods. Four other undisturbed sampling attempts were performed unsuccessfully in the cohesive unit.

Bedrock

Bedrock outcrops were frequently observed at various locations of the site. Bedrock was encountered in all boring logs and was the contacted at the bottom of each boring. For boring logs AQSR-01 and AQSR-06, soil borings were terminated in weathered bedrock. The soil overburden thickness and zones of weathered bedrock are expected be variable throughout the site.

Groundwater

Groundwater was observed in all soil borings except AQSR-04, where shallow bedrock was encountered. Depth to groundwater ranged from 5.0 to 19.0 feet bgs, as shown in Table 1.

3.2 Geotechnical Laboratory Testing

Testing performed as part of the geotechnical investigation consisted of laboratory and in situ testing. Laboratory testing included the following tests:

- Moisture Content (ASTM D2216)
- Organic Content (ASTM D2974)
- Atterberg limits (ASTM D4318)
- Dry Density (ASTM D2937)
- Specific Gravity (ASTM D854)
- Grain Size (ASTM D422)
- One-Dimension Consolidation (ASTM D2435)

- Direct Shear (ASTM D3080)

All testing was performed by GeoTesting Express. Results of the laboratory testing for index testing and strength testing are presented in Tables 2 and 3, respectively. Results of consolidation testing are presented in Appendix B.

4 REFERENCES

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ASTM Standard D2435, 2011. *Standard Test Methods for One-Dimensional Consolidation Properties of Sediments Using Incremental Loading*. ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D2487, 2011. *Standard Practice for Classification of Sediments for Engineering Purposes (Unified Soil Classification System)*. ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D2850, 2007. *Standard Test Methods for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils*. ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D2937, 2010. *Standard Test Methods for Density of Soil in Place by the Drive-Cylinder Method*. ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D2974, 2014. *Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils*. West Conshohocken, PA, www.astm.org.

ASTM Standard D3080, 2011. *Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions*. ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D4318, 2010. *Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Sediments*. ASTM International, West Conshohocken, PA, www.astm.org.

TABLES

Table 1
Summary of Explorations

Exploration ID	Easting (x)[1]	Northing (y)[1]	Type of Exploration	Date of Exploration[2]	Depth to groundwater (feet)	Termination Depth[3] (feet)
AQSB-01	11372203.92	6707572.17	Soil Boring	11/6/2014	10.9	21.5
AQSB-02	11371910.44	6709143.97	Soil Boring	11/6/2014	5.0	6.6
AQSB-03	11372825.57	6710897.65	Soil Boring	11/7/2014	10.0	11.2
AQSB-04	11373219.19	6711330.99	Soil Boring	11/7/2014	---	9.7
AQSB-05	11374051.98	6711620.90	Soil Boring	11/7/2014	15.3	16.1
AQSB-06	11374380.48	6711781.40	Soil Boring	11/6/2014	19.0	24.1
AQSB-07	11374716.77	6711891.29	Soil Boring	11/7/2014	6.0	6.2
AQSB-08	11374869.93	6712194.14	Soil Boring	11/6/2014	13.3	14.3
AQSB-09	11375102.30	6712314.58	Soil Boring	11/6/2014	14.0	16.1
AQSB-10	11374916.48	6713802.35	Soil Boring	11/7/2014	9.4	11.0

Notes:

[1] Horizontal datum is North American Datum of 1983 Virginia State Plane North, U.S. Survey feet.

[2] Depth to groundwater refers to the groundwater depth below ground surface at the time of drilling.

[3] Termination depth is relative to the ground surface.

Table 2
Index Test Results

		In Situ Sample Depth (feet)[1]						Atterberg Limits			Particle Size Summary			
Boring ID	Sample ID[2]	Top	Bottom	Recovery (inches)	Moisture Content (%)	Organic Matter (%)	Specific Gravity	Liquid Limit	Plastic Limit	Plasticity Index	Gravel (%)	Sand (%)	Fines (%)	USCS Symbol
AQSB-01	SS02	3.5	5.0	12.0	12.1	3.0	2.63	---	---	---	10.4	58.1	31.5	SM
AQSB-01	SS04	8.5	10.0	8.0	6.4	---	2.71	---	---	---	42	50.2	7.8	SP-SM
AQSB-01	SS06	13.5	15.0	14.0	36.4	---	2.81	47	32	15	---	---	---	ML
AQSB-01	ST01	18.0	20.0	24.0	52.6	---	2.75	NP	NP	NP	28.2	28.6	43.2	SM
AQSB-02	SS01	1.0	2.5	12.0	18.5	2.5	2.66	---	---	---	6.0	48.0	46.0	SM
AQSB-03	SS01	1.0	2.5	12.0	9.4	1.0	2.68	---	---	---	4.8	63.1	32.1	SM
AQSB-03	SS03	6.0	7.5	18.0	19.4	---	2.61	29	17	12	---	---	---	CL
AQSB-03	SS04	9.5	11.0	12.0	15.3	---	---	---	---	---	40.5	46.2	13.3	SM
AQSB-04	SS01	1.0	2.5	6.0	9.4	1.6	2.72	---	---	---	19.7	56.2	25.1	SM
AQSB-04	SS02	3.5	5.0	11.0	15.7	---	---	---	---	---	3.7	27.6	68.7	ML
AQSB-05	SS02	3.5	5.0	16.0	7.0	---	2.63	---	---	---	5.8	66.1	28.1	SM
AQSB-05	SS03	6.0	7.5	18.0	11.9	---	---	---	---	---	0.0	45.8	54.2	ML
AQSB-06	SS04	8.5	10.0	4.0	11.2	---	---	---	---	---	10.8	56.1	33.1	SM
AQSB-06	SS05	11.0	12.5	12.0	16.0	---	2.68	---	---	---	0.0	51.2	48.8	SM
AQSB-06	SS06	13.5	15.0	18.0	43.5	---	2.60	38	22	16	---	---	---	CL
AQSB-06	SS08	18.5	20.0	18.0	20.9	---	---	---	---	---	31.1	36.4	32.5	SM
AQSB-06	SS09	21.0	22.5	18.0	99.1	---	2.74	89	43	46	---	---	---	MH
AQSB-07	SS01	1.0	2.5	18.0	9.8	2.2	2.64	---	---	---	19.1	43.8	37.1	SM
AQSB-08	SS01	1.0	2.5	11.0	8.8	0.8	2.72	---	---	---	43.4	29.3	27.3	GM
AQSB-08	SS03	6.0	7.5	13.0	6.6	---	---	---	---	---	2.1	66.3	31.6	SM
AQSB-08	SS04	8.5	10.0	12.0	6.7	---	2.72	---	---	---	38.5	47.0	14.5	SM
AQSB-08	SS05	11.0	12.5	10.0	6.4	---	---	---	---	---	47.8	44.2	8.0	GP-GM
AQSB-09	SS02	3.5	5.0	18.0	8.3	2.2	2.68	---	---	---	0.0	57.7	42.3	SM
AQSB-09	SS04	8.5	10.0	18.0	4.6	---	2.71	---	---	---	38.1	53.0	8.9	SP-SM
AQSB-09	SS06	13.5	15.0	11.0	13.1	---	2.82	---	---	---	45.2	42.2	12.6	GP-GM
AQSB-10	SS01	1.0	2.5	8.0	17.3	2.9	2.68	---	---	---	0.5	54.4	45.1	SM
AQSB-10	SS03	6.0	7.5	15.0	29.9	---	2.69	43	26	17	0.0	53.6	46.4	SC

Notes:

[1] In situ depth refers to the depth below the surface at the time of sampling.

[2] SS = Split-spoon; ST = Shelby tube

USCS = Unified Soil Classification System

Table 3
Direct Shear Test Results

Boring ID	Sample ID	Test ID	In Situ Depth[1] (feet) Top	In Situ Depth[1] (feet) Bottom	Initial Moisture Content (%)	Specific Gravity	Initial Void Ratio	Normal Shear Stess (psf)	Maximum Shear Stess (psf)	Apparent Cohesion (psf)	Friction Angle (degrees)	Description (USCS Symbol)
AQSB-01	ST01	DS-1	19.0	19.5	29.8	2.75	0.83	450	582	440	36.3	Silty SAND (SM) with gravel
AQSB-01	ST01	DS-2	19.5	20.0	23.7	2.75	0.78	900	1320			Silty SAND (SM) with gravel
AQSB-01	ST01	DS-3[2]	20.0	20.5	---	---	---	---	---			Silty SAND (SM) with gravel
AQSB-01	ST01	DS-4	20.5	21.0	63.6	2.75	1.81	3600	3050			Silty SAND (SM) with gravel

Notes:

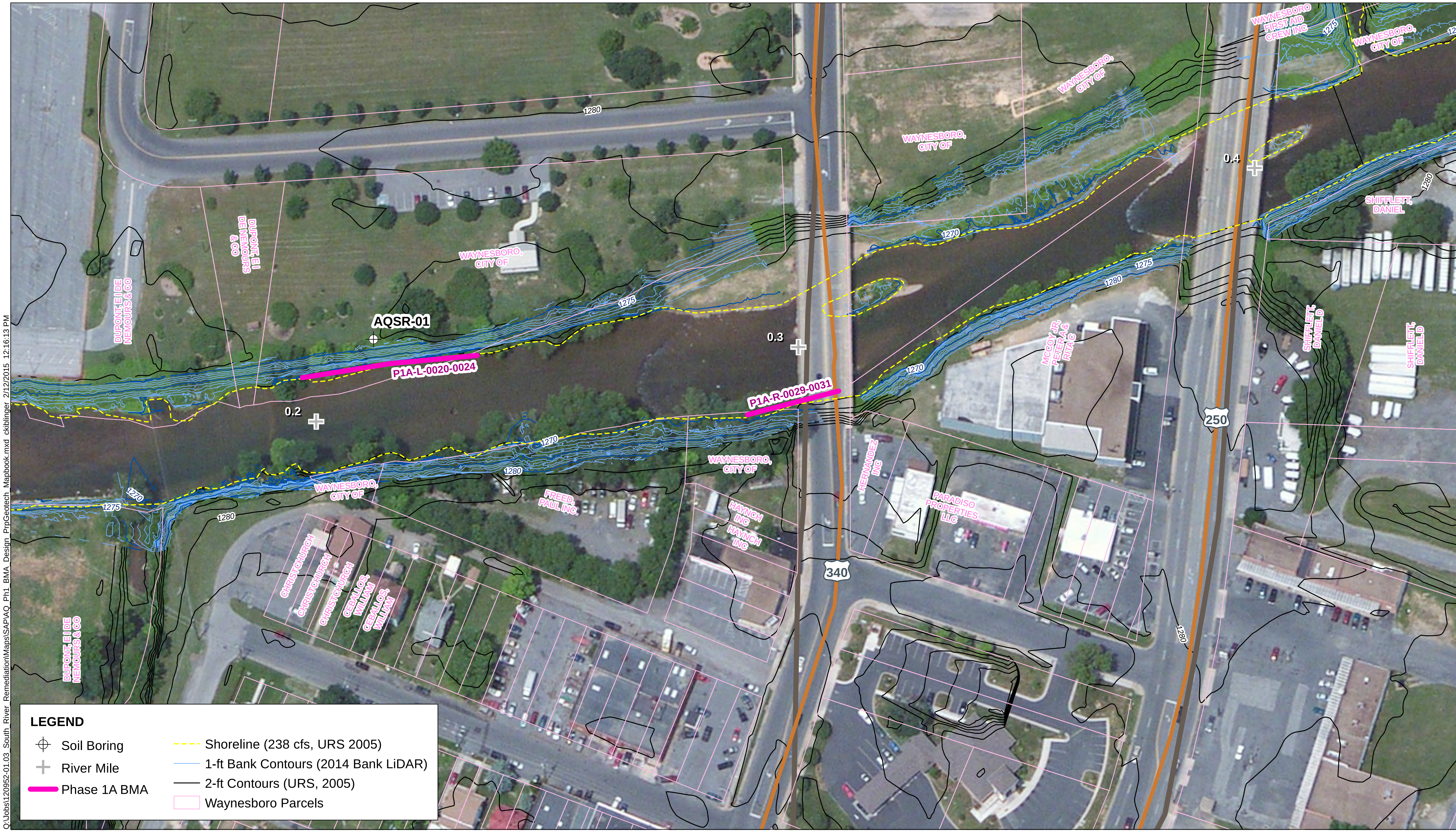
[1] In situ depth is referenced from ground surface for AQSB-01.

[2] Testing was not preformed due to high sample disturbance during sample preparation.

psf = pounds per square foot

USCS = Unified Soil Classification System

FIGURES



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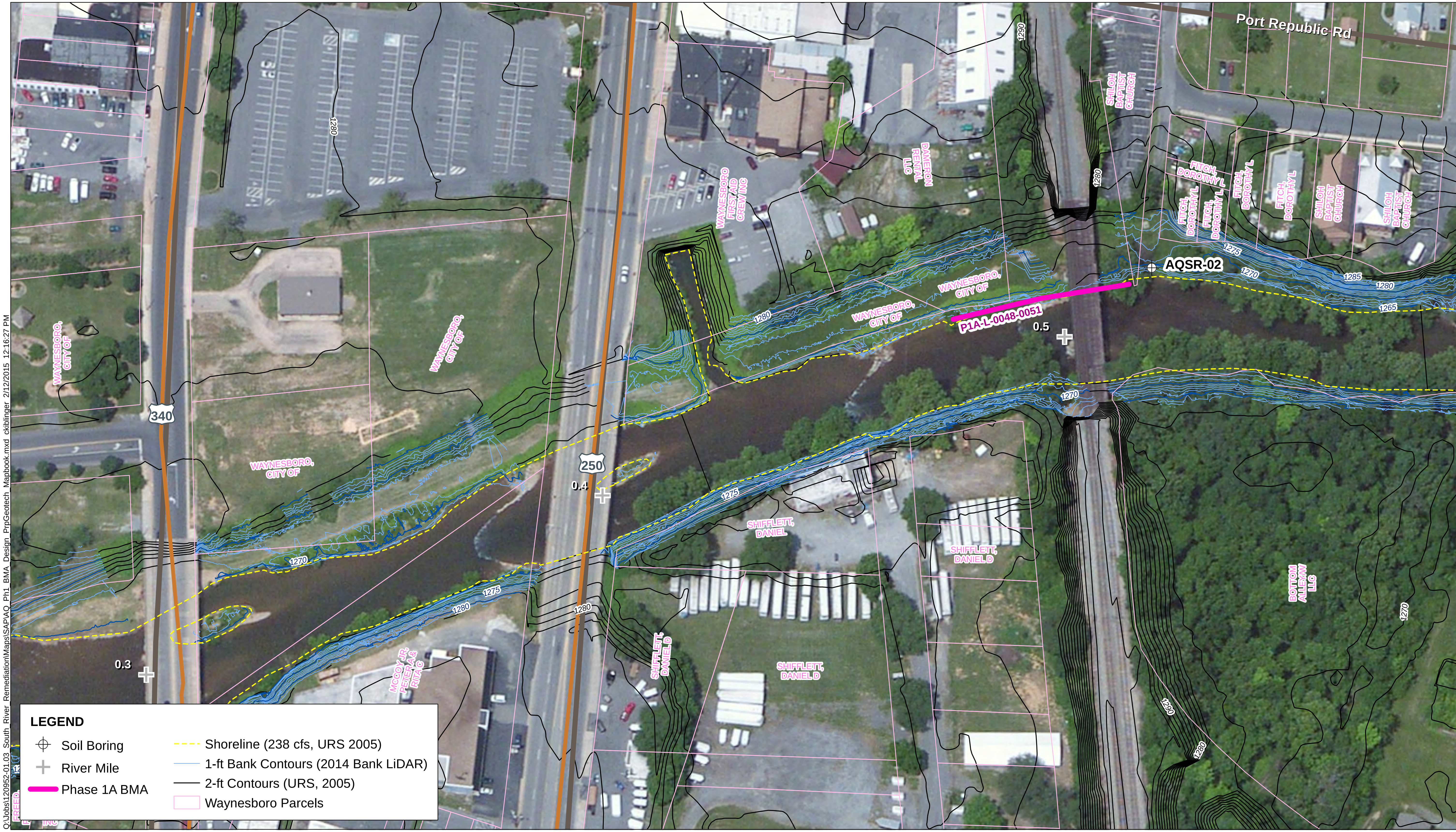
ANCHOR QEA

NOTE:
Aerial Imagery: ESRI (20110509).

Figure 1
Geotechnical Data Report
River Mile 0.1 - 0.4
AOC 4 Phase 1A - South River



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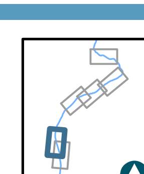

Feet
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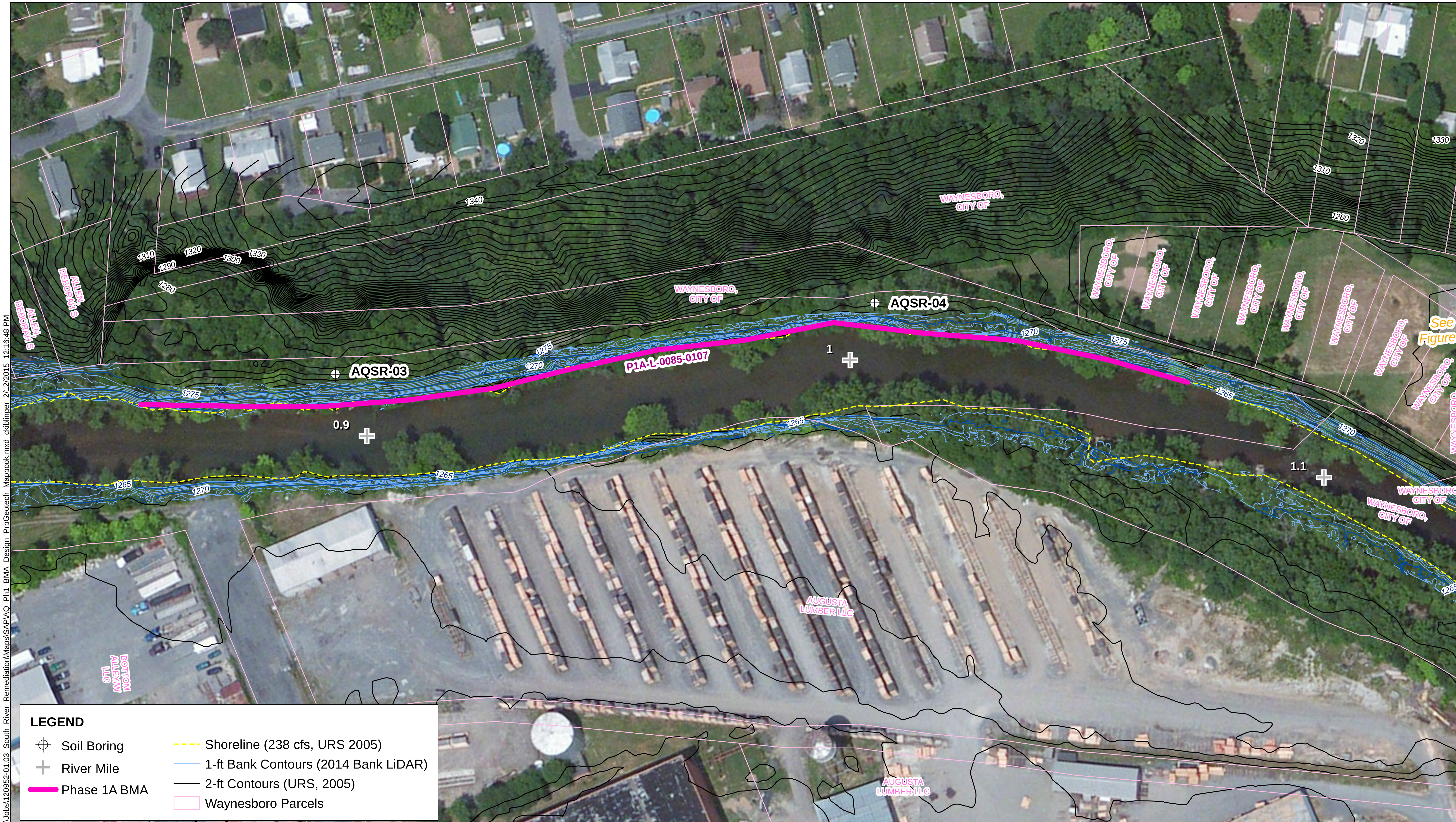
Figure 2
Geotechnical Data Report
River Mile 0.3 - 0.5
AOC 4 Phase 1A - South River



ANCHOR QEA

NOTE:
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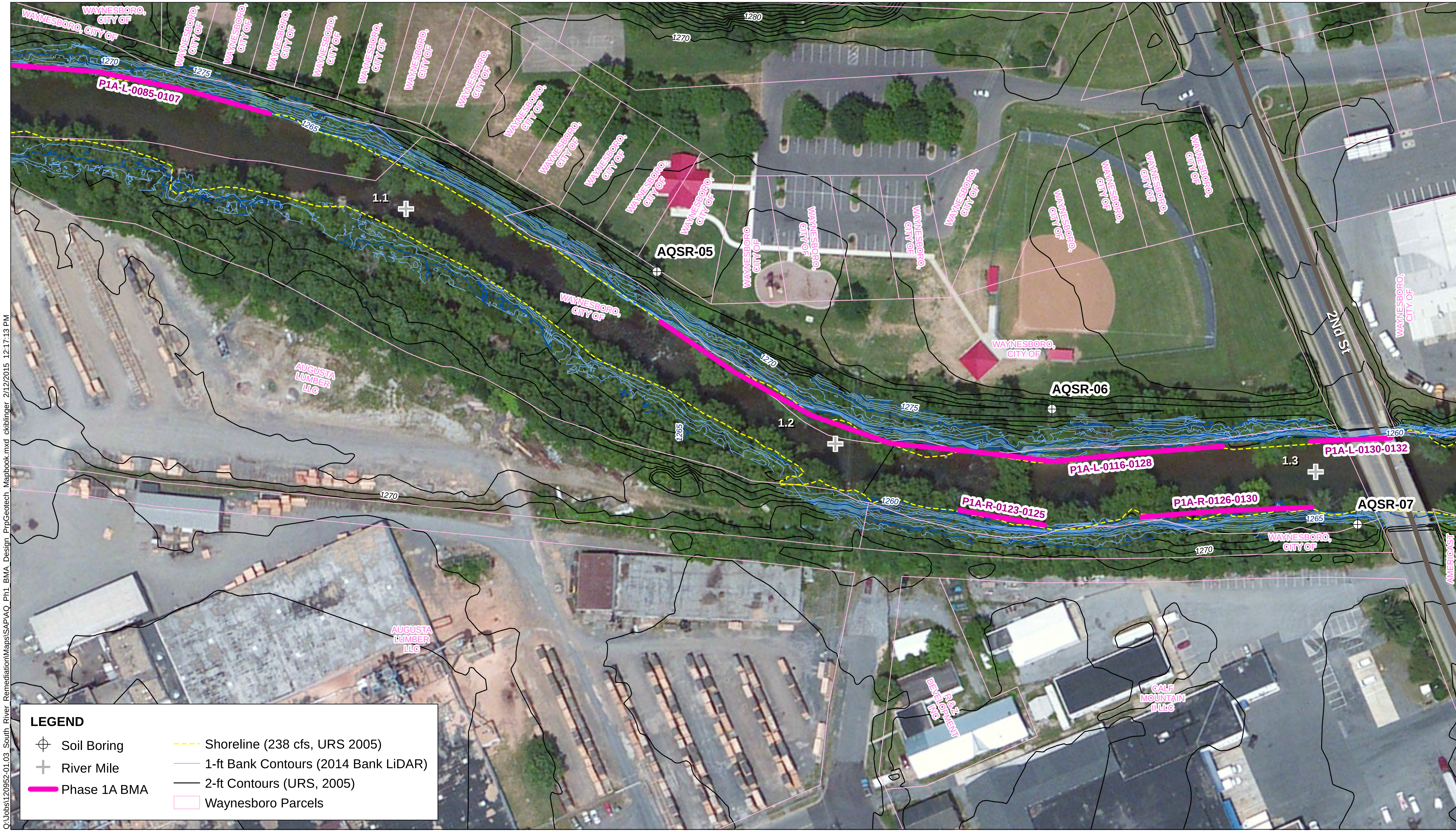
Figure 3
Geotechnical Data Report
River Mile 0.8 - 1.1
AOC 4 Phase 1A - South River



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ANCHOR QEA

NOTE:
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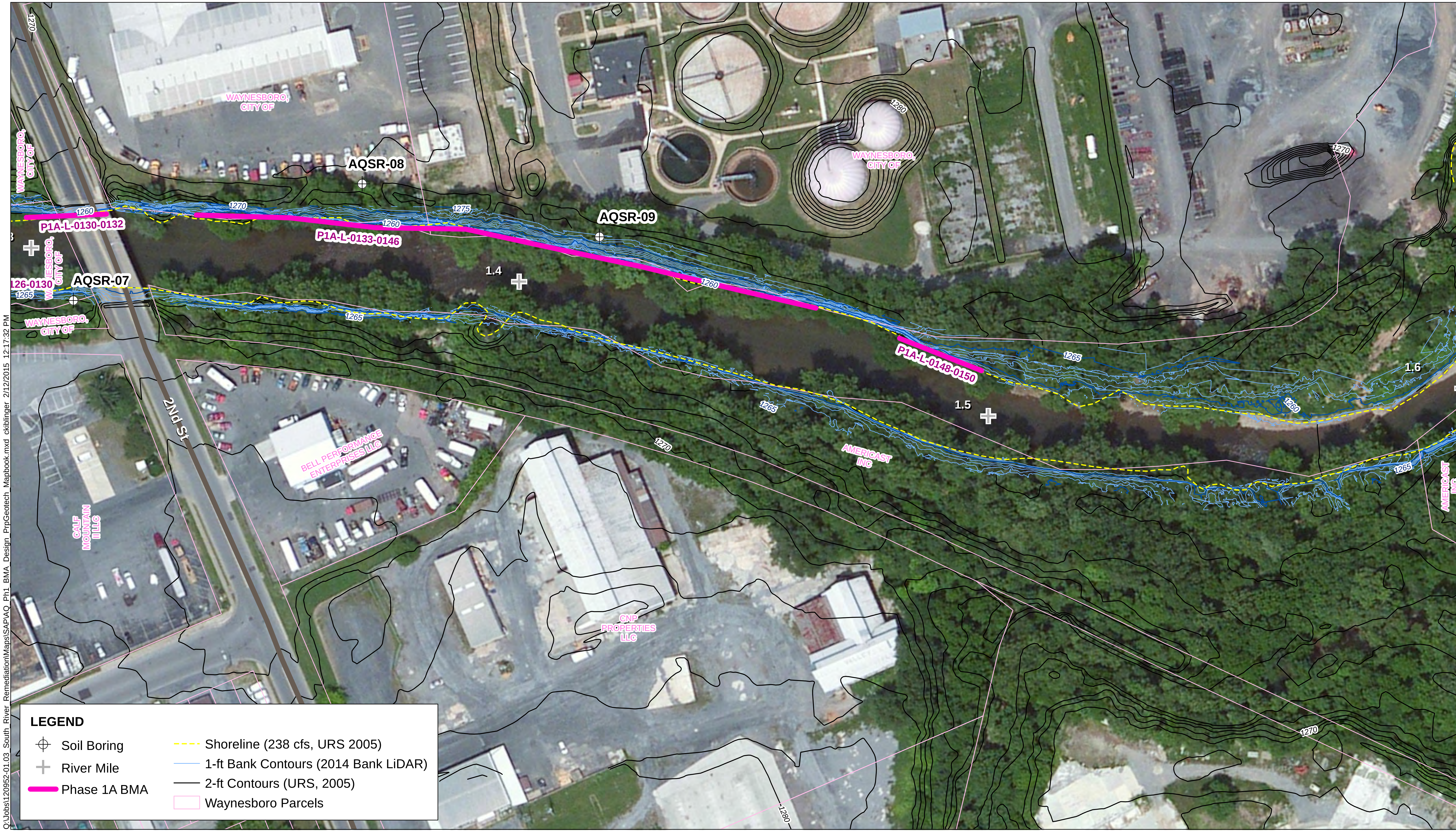
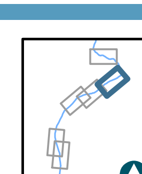
Figure 4
Geotechnical Data Report
River Mile 1.0 - 1.3
AOC 4 Phase 1A - South River





Feet
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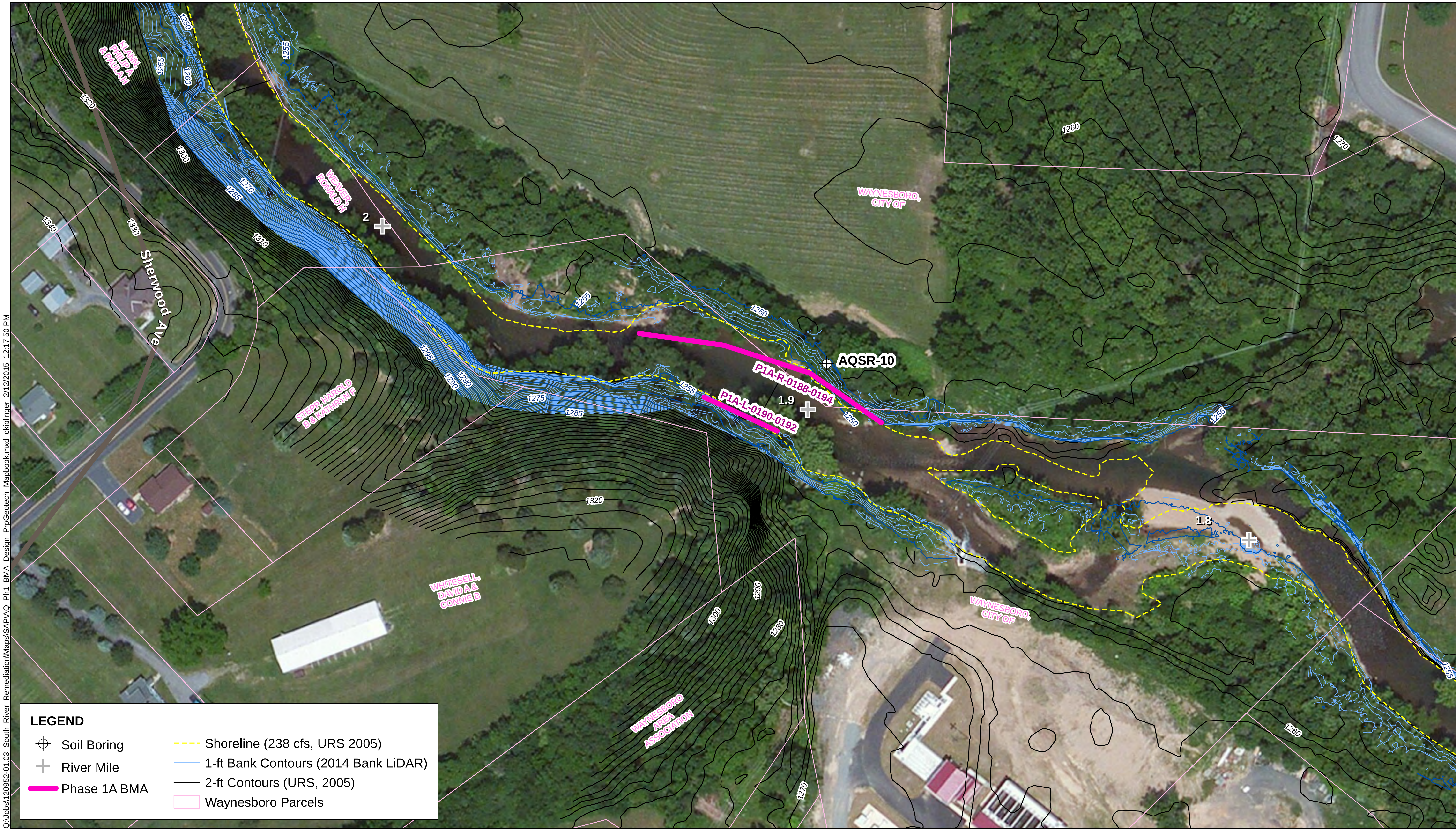
NOTE:
Aerial Imagery: ESRI (20110509).

Figure 5
Geotechnical Data Report
River Mile 1.3 - 1.5
AOC 4 Phase 1A - South River



ANCHOR QEA

NOTE:
Aerial Imagery: ESRI (20110509).

Feet
0 100 200

Figure 6
Geotechnical Data Report
River Mile 1.8 - 2.0
AOC 4 Phase 1A - South River

APPENDIX A
SOIL BORING LOGS

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits is estimated based on visual observation and is presented parenthetically on the test pit logs.

Density SAND or GRAVEL	Standard Penetration Resistance (N) in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance (N) in Blows/Foot	Approximate Shear Strength in TSF
Very loose	0 - 4	Very soft	0 - 2	<0.125
Loose	4 - 10	Soft	2 - 4	0.125 - 0.25
Medium dense	10 - 30	Medium stiff	4 - 8	0.25 - 0.5
Dense	30 - 50	Stiff	8 - 15	0.5 - 1.0
Very dense	>50	Very stiff	15 - 30	1.0 - 2.0
		Hard	>30	>2.0

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible moisture, probably above optimum

Minor Constituents

Minor Constituents	Estimated Percentage
Not identified in description	0 - 5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Legends

Sampling Test Symbols

BORING SAMPLES

- ⊠ Split Spoon
- ⧄ Shelby Tube
- ⧗ CAL-MOD Split-Spoon
- * CAL-MOD Adjusted SPT Resistance

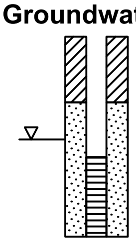
TEST PIT SAMPLES

- ⊠ Grab (Jar)
- ⧄ Bag

Test Symbols

AL	Atterberg Limits
Arc	Archive Sample
Consol	One-dimension consolidation
DD	Dry Density
DS	Direct Shear
GS	Grain Size
MC	Moisture Content
OC	Organic Content
SG	Specific Gravity
WOR	Weight of Rods

Groundwater Observations



Groundwater Level on Date (ATD) At Time of Drilling

Groundwater Seepage (Test Pits)

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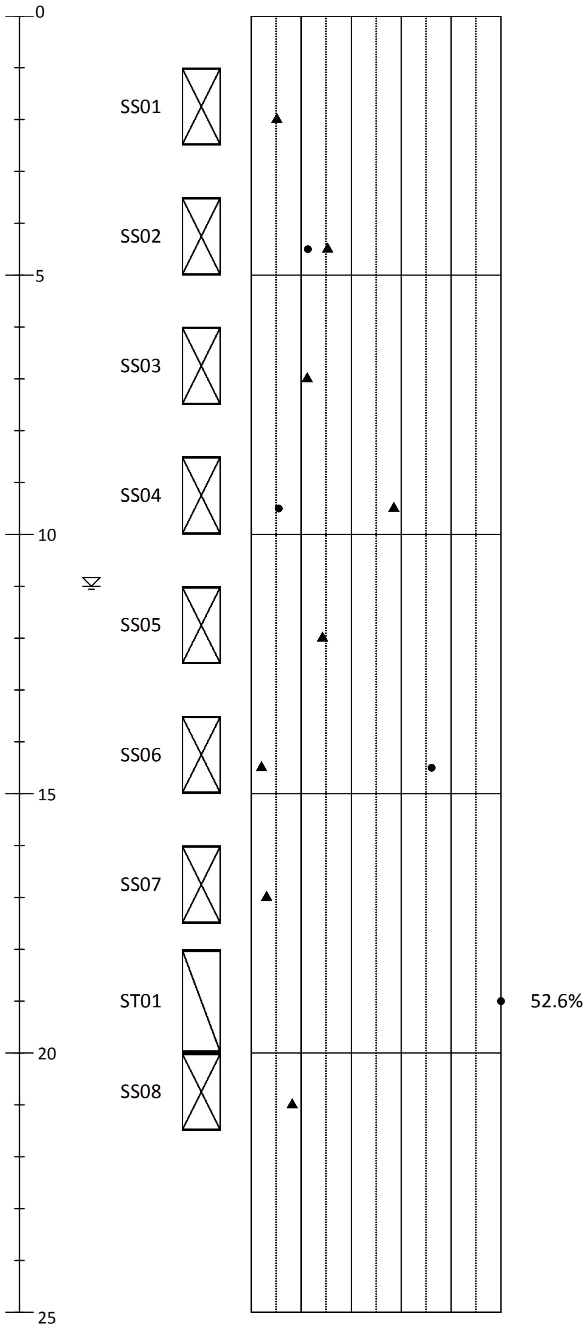
Soil Boring Log

AQSR-01

Project: **South River Phase 1 Interim Remedial Measure**	Location: **River Mile 0.0 to 2.0 of South River near Waynesboro, VA**	Method: **Hollow Stem Auger**
Project #: **120592-01.05**	N/LAT: **6707572.17** E/LONG: **11372203.92**	Total Depth (ft): **21.5**
Client: **DuPont**	Horiz. Datum: **Virginia State Plane North, NAD1983, US Feet**	Observed GW (bgs): **11.0**
Collection Date: **11/06/2014**	Vert. Datum: **NAVD88**	Mudline Elevation (ft):
Contractor: **Total Depth Drilling**	Sampler(s): **2in O.D./1.375in I.D. Split - Spoon** **3in O.D. Shelby Tube**	Hammer: **140 lbs w/ 30 inch drop**
Logged By: **Zac Koehn**		Hammer Efficiency: **84%**

Depth (ft)	Water Level	Samples	Uncorrected Standard Penetration Resistance (blows per foot) and Water Content (%) 0 10 20 30 40 50	Values Greater than 50	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test



Soil Description

Silty SAND (SM): Loose, damp, dark brown with orange mottling, fine to medium silty SAND (SM), occasional gravel and trace organics.

No recovery.

SAND with silt (SP-SM): Medium dense, moist, light orange-brown, fine to coarse SAND with silt (SP-SM) with trace silt and occasional gravel and rock fragments (alluvium).
Heavy drill chatter.

Rock at end of sampler of SS04.

Increasing gravel content.

SILT (ML): Soft, moist to wet, reddish orange with olive gray mottling, fine sandy SILT (ML) with low to medium plasticity.

Material feels stiffer than indicated by blow counts.

Bottom of boring @ 21.5 feet below ground surface. Completed on 11/06/2014.

Lab Test

Sample	Lab Test
SS01	Arc
SS02	MC, GS, SG, OC
SS04	MC, GS, SG
SS05	Arc
SS06	MC, AL. SG
SS07	Arc
ST01	MC, AL, SG, Consol, DS, DD

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▲ SPT N-Value
● Water Content (%)

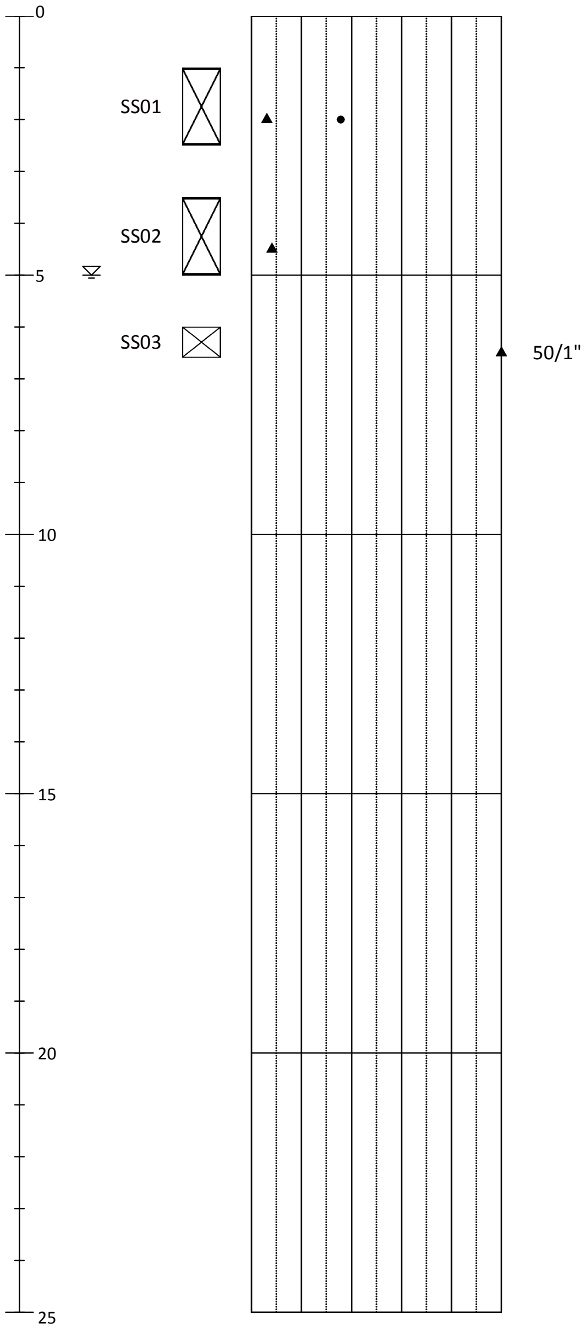
Notes:
1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

Soil Boring Log

AQSR-02

Project: South River Phase 1 Interim Remedial Measure	Location: River Mile 0.0 to 2.0 of South River near Waynesboro, VA	Method: Hollow Stem Auger
Project #: 120592-01.05	N/LAT: 6709143.973 E/LONG: 11371910.44	Total Depth (ft): 6.6
Client: DuPont	Horiz. Datum: Virginia State Plane North, NAD1983, US Feet	Observed GW (bgs): 5.0
Collection Date: 11/06/2014	Vert. Datum: NAVD88	Mudline Elevation (ft):
Contractor: Total Depth Drilling	Sampler(s): 2in O.D./1.375in I.D. Split - Spoon 3in O.D. Shelby Tube	Hammer: 140 lbs w/ 30 inch drop
Logged By: Zac Koehn		Hammer Efficiency: 84%

Depth (ft)	Water Level	Samples	Uncorrected Standard Penetration Resistance (blows per foot) and Water Content (%) 0 10 20 30 40 50	Values Greater than 50	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test



Soil Description	Lab Test
Silty SAND (SM): Loose, moist, dark brown to reddish brown, fine to medium silty SAND (SM), slighly plastic fines with trace gravel and occasional hair-like roots (sediment).	MC, GS, SG, OC
Silty SAND (SM): Loose, moist, brown to olive-gray, fine to coarse silty SAND (SM) with gravel-sized rock fragment (alluvium). Low recovery due to large rock fragment plugging the sampler for SS02. Thin silt seam (~2 inch thick) @ 4.5 feet.	Arc Arc
0.5 feet zone of weathered bedrock (white to gray rock fragment) over bedrock, refusal at 6.6 feet.	
Bottom of boring @ 6.6 feet below ground surface. Completed on 11/06/2014.	

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▲ SPT N-Value
● Water Content (%)

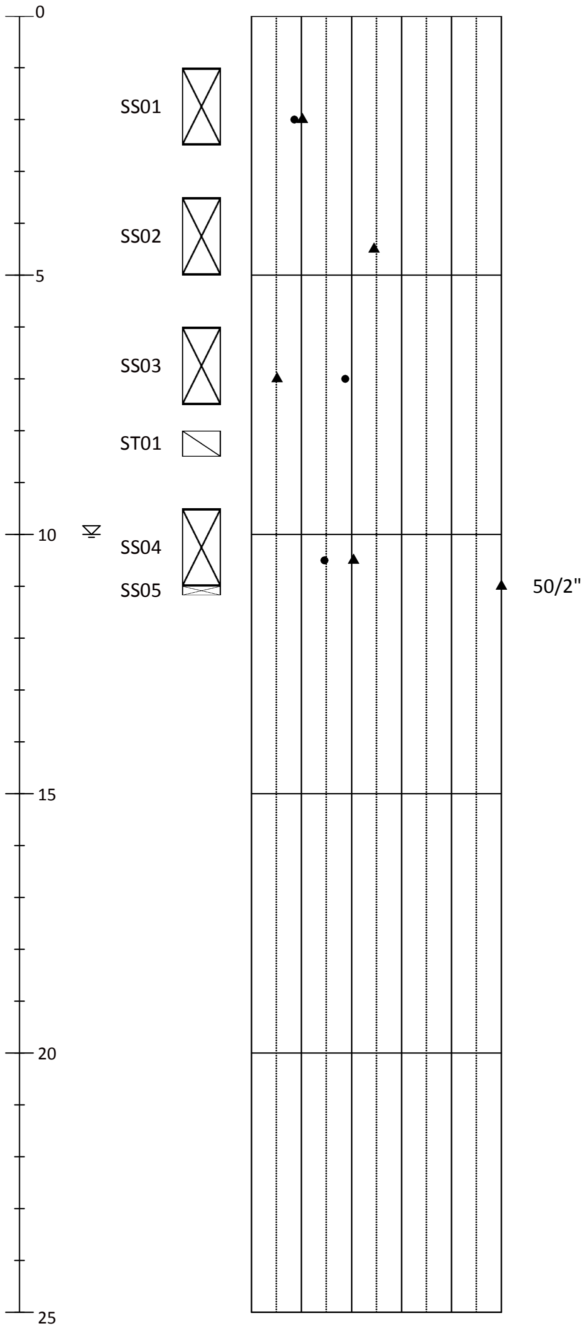
Notes:
1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

Soil Boring Log

AQSR-03

Project: **South River Phase 1 Interim Remedial Measure**	Location: **River Mile 0.0 to 2.0 of South River near Waynesboro, VA**	Method: **Hollow Stem Auger**
Project #: **120592-01.05**	N/LAT: **6710897.646** E/LONG: **11372825.57**	Total Depth (ft): **11.2**
Client: **DuPont**	Horiz. Datum: **Virginia State Plane North, NAD1983, US Feet**	Observed GW (bgs): **10.0**
Collection Date: **11/07/2014**	Vert. Datum: **NAVD88**	Mudline Elevation (ft):
Contractor: **Total Depth Drilling**	Sampler(s): **2in O.D./1.375in I.D. Split - Spoon** **3in O.D. Shelby Tube**	Hammer: **140 lbs w/ 30 inch drop**
Logged By: **Zac Koehn**		Hammer Efficiency: **84%**

Depth (ft)	Water Level	Samples	Uncorrected Standard Penetration Resistance (blows per foot) and Water Content (%) 0 10 20 30 40 50	Values Greater than 50	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test



Soil Description	Lab Test
Silty SAND (SM): Loose, damp, brown to dark brown, fine to medium silty SAND (SM) with organics (topsoil).	
Silty SAND (SM): Loose to medium dense, dry to damp, reddish brown, fine silty SAND (SM) with non-plastic fines and occasional gravel.	MC,GS, SG, OC
No recovery.	
CLAY (CL): Soft, damp to moist, orange-brown with dark gray-brown mottling, fine sandy silty CLAY (CL) with low to moderate plasticity. Transitions to silty SAND (SM). Refusal of shelby tube, sample not retained.	MC, AL, SG MC, GS
Silty SAND (SM): Loose to medium dense, moist, orange-brown to gray-brown, fine to medium silty SAND (SM) with non-plastic to low plastic fines (alluvium).	
Bedrock	
Bottom of boring @ 11.2 feet below ground surface. Completed on 11/07/2014.	

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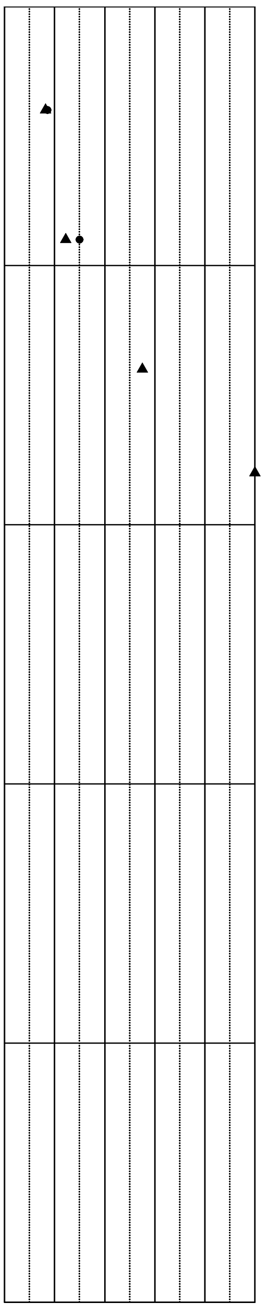
▲ SPT N-Value
● Water Content (%)

Notes:
1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

Soil Boring Log
AQSR-04

Project: South River Phase 1 Interim Remedial Measure	Location: River Mile 0.0 to 2.0 of South River near Waynesboro, VA	Method: Hollow Stem Auger
Project #: 120592-01.05	N/LAT: 6711330.986 E/LONG: 11373219.19	Total Depth (ft): 9.7
Client: DuPont	Horiz. Datum: Virginia State Plane North, NAD1983, US Feet	Observed GW (bgs): N/A
Collection Date: 11/07/2014	Vert. Datum: NAVD88	Mudline Elevation (ft):
Contractor: Total Depth Drilling	Sampler(s): 2in O.D./1.375in I.D. Split - Spoon 3in O.D. Shelby Tube	Hammer: 140 lbs w/ 30 inch drop
Logged By: Zac Koehn		Hammer Efficiency: 84%

Depth (ft)	Water Level	Samples	Uncorrected Standard Penetration Resistance (blows per foot) and Water Content (%) 0 10 20 30 40 50	Values Greater than 50	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
0		SS01			Silty SAND (SM): Loose, damp, dark brown, fine to medium silty SAND (SM) with abundant organics (topsoil). Low recovery due to large rock fragment plugging the sampler for SS01.	MC, GS, OC
		SS02			SILT (ML): Soft to medium stiff, dry to damp, dark reddish brown with white chalk-like particles, fine sandy SILT (ML), low to medium plastic fines and trace gravel.	MC,GS, SG
5		SS03			Weathered bedrock, appears to be limestone.	Arc
		SS04		50/2"	Bedrock	
10					Bottom of boring @ 9.7 feet below ground surface. Completed on 11/07/2014.	
15						
20						
25						



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▲ SPT N-Value
● Water Content (%)

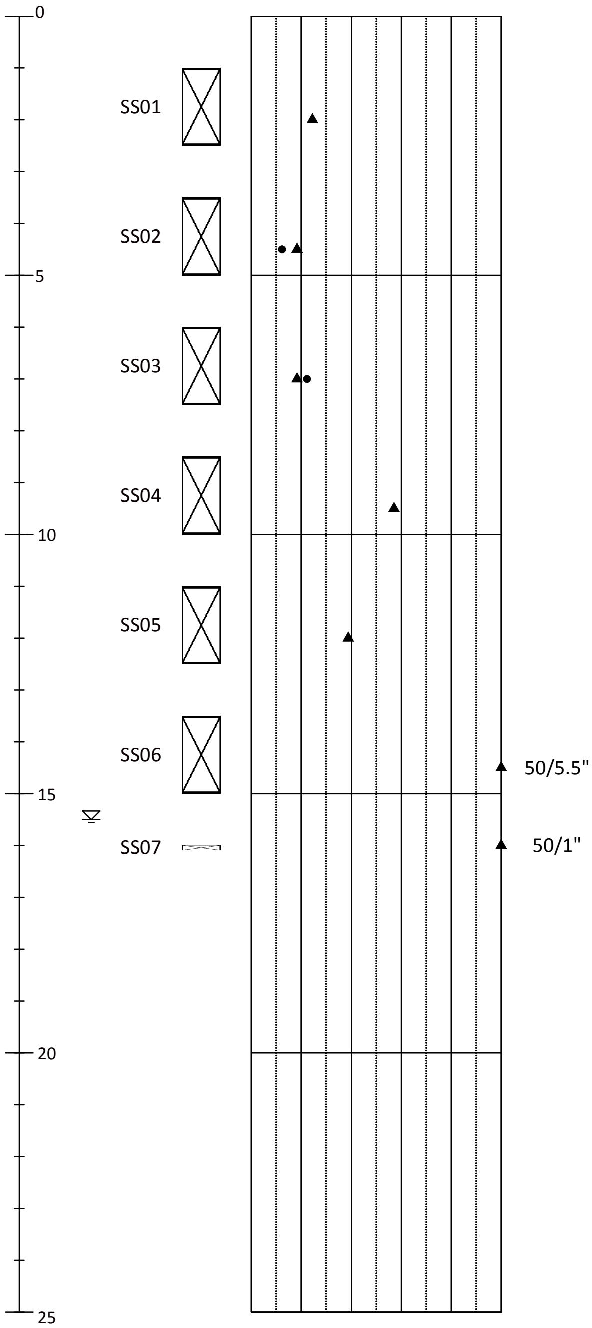
Notes:
1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

Soil Boring Log

AQSR-05

Project: South River Phase 1 Interim Remedial Measure	Location: River Mile 0.0 to 2.0 of South River near Waynesboro, VA	Method: Hollow Stem Auger
Project #: 120592-01.05	N/LAT: 6711620.898 E/LONG: 11374051.98	Total Depth (ft): 16.1
Client: DuPont	Horiz. Datum: Virginia State Plane North, NAD1983, US Feet	Observed GW (bgs): 15.5
Collection Date: 11/07/2014	Vert. Datum: NAVD88	Mudline Elevation (ft):
Contractor: Total Depth Drilling	Sampler(s): 2in O.D./1.375in I.D. Split - Spoon 3in O.D. Shelby Tube	Hammer: 140 lbs w/ 30 inch drop
Logged By: Zac Koehn		Hammer Efficiency: 84%

Depth (ft)	Water Level	Samples	Uncorrected Standard Penetration Resistance (blows per foot) and Water Content (%) 0 10 20 30 40 50	Values Greater than 50	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test



Soil Description	Lab Test
Silty SAND (SM): Loose, damp, dark brown, fine to medium silty SAND (SM) with abundant organics (topsoil).	
Silty SAND (SM): Loose to medium dense, dry to damp, dark reddish brown with white chalk-like particles, fine silty SAND (SM), low to medium plastic fines and trace gravel.	Arc (SS01); MC, GS, SG, OC (SS02)
Transitions to very fine sandy SILT (ML). Fades from reddish brown to brown.	MC, GS (SS03); Arc (SS04)
Transitions back to fine silty SAND (SM) and becomes medium dense with some limestone rock fragment. Low recovery due to large rock fragment plugging the sampler for SS05. Soft contact @ 12.3 feet.	
Weathered bedrock, appears to be limestone.	Arc (SS06)
Bedrock	
Bottom of boring @ 16.1 feet below ground surface. Completed on 11/07/2014.	

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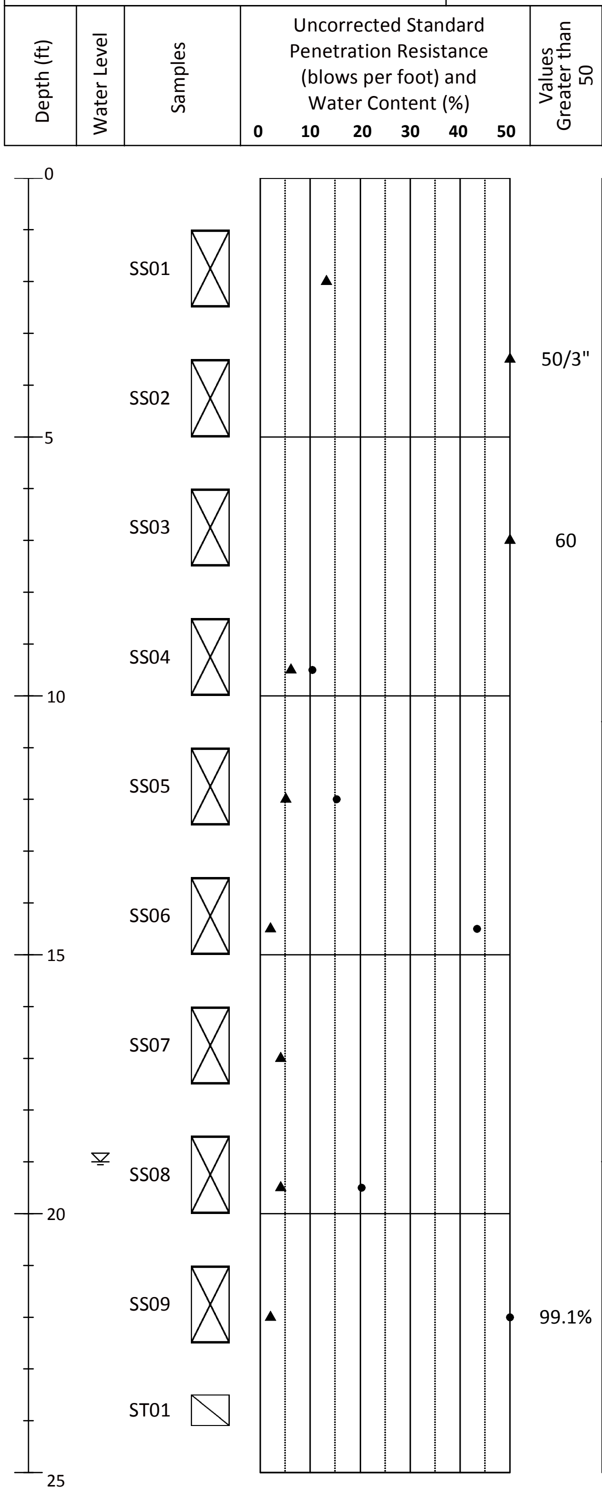
▲ SPT N-Value
● Water Content (%)

Notes:
1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

Soil Boring Log

AQSR-06

Project: South River Phase 1 Interim Remedial Measure	Location: River Mile 0.0 to 2.0 of South River near Waynesboro, VA	Method: Hollow Stem Auger
Project #: 120592-01.05	N/LAT: 6711781.398 E/LONG: 11374380.48	Total Depth (ft): 24.1
Client: DuPont	Horiz. Datum: Virginia State Plane North, NAD1983, US Feet	Observed GW (bgs): 19
Collection Date: 11/07/2014	Vert. Datum: NAVD88	Mudline Elevation (ft):
Contractor: Total Depth Drilling	Sampler(s): 2in O.D./1.375in I.D. Split - Spoon 3in O.D. Shelby Tube	Hammer: 140 lbs w/ 30 inch drop
Logged By: Zac Koehn		Hammer Efficiency: 84%



Soil Description (Samples and descriptions are in recovered depths. Classification scheme: USCS)	Lab Test
Silty SAND (SM): Loose to medium dense, brown with some pinkish rock fragment, fine to medium silty SAND (SM) with trace organics.	Arc
No recovery, refusal from obstruction. Hard drilling. No recovery.	
Low recovery due to large rock fragment plugging the sampler.	MC, GS
Silty SAND (SM): Loose, damp, dark brown, fine silty SAND (SM), non-plastic fines with uniform sand grain size.	MC, GS, SG
Increasing silt content. Soft, damp, dark gray-brown, fine sandy SILT (ML), low plastic fines. Wood debris @ 14.8 feet.	MC, AL, SG
Silty SAND (SM): Loose, wet, orange-brown, fine to coarse gravelly silty SAND (SM) with cream colored rock fragments (alluvium).	Arc
SILT (MH): Very soft, wet, orange-brown, SILT (MH) with medium plasticity.	MC, GS
	MC, AL, SG
Bottom of boring @ 23.5 feet below ground surface. Completed on 11/06/2014.	

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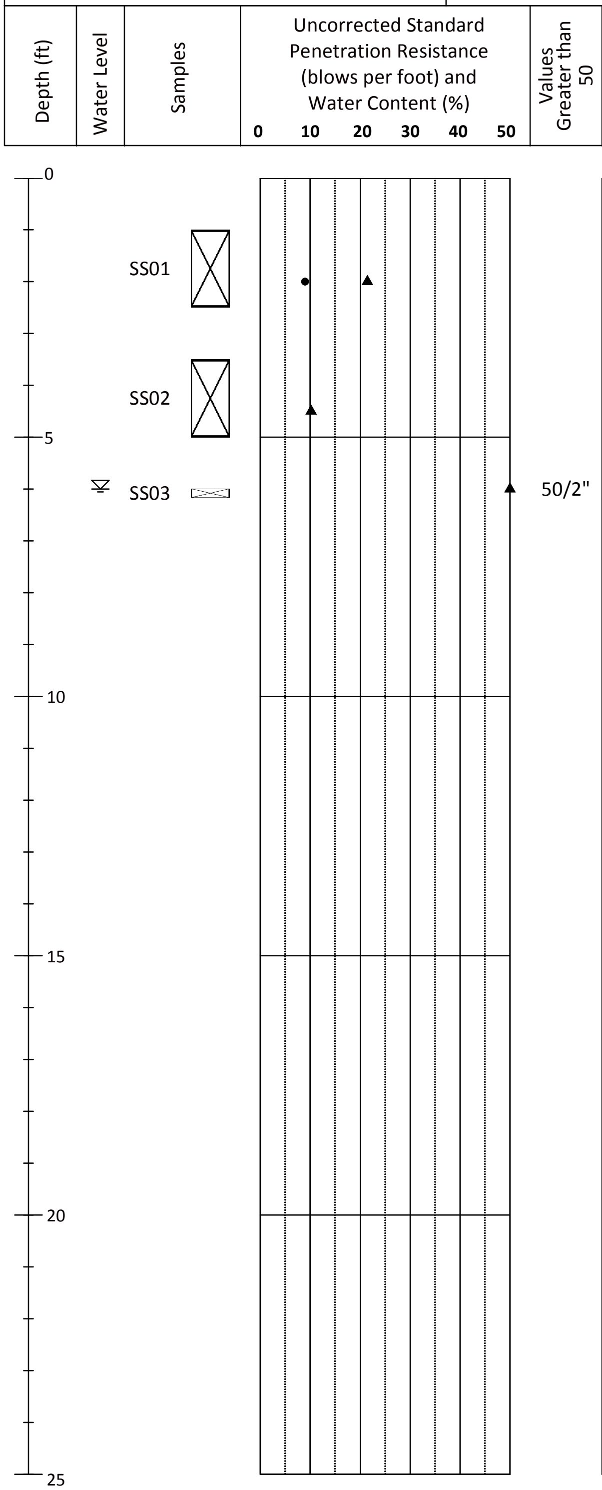
▲ SPT N-Value
● Water Content (%)

Notes:
1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

Soil Boring Log

AQSR-07

Project: South River Phase 1 Interim Remedial Measure	Location: River Mile 0.0 to 2.0 of South River near Waynesboro, VA	Method: Hollow Stem Auger
Project #: 120592-01.05	N/LAT: 6711891.292 E/LONG: 11374716.77	Total Depth (ft): 6.2
Client: DuPont	Horiz. Datum: Virginia State Plane North, NAD1983, US Feet	Observed GW (bgs): 6.0
Collection Date: 11/07/2014	Vert. Datum: NAVD88	Mudline Elevation (ft):
Contractor: Total Depth Drilling	Sampler(s): 2in O.D./1.375in I.D. Split - Spoon 3in O.D. Shelby Tube	Hammer: 140 lbs w/ 30 inch drop
Logged By: Zac Koehn		Hammer Efficiency: 84%



Soil Description

Samples and descriptions are in recovered depths.
Classification scheme: USCS

Silty SAND (SM): Loose, damp, dark brown, fine to medium silty SAND (SM) with abundant organics (topsoil).

Silty SAND (SM): Loose to medium dense, dry to damp, dark reddish brown with orange mottling, fine silty SAND (SM) with occasional gravel.

Refusal due to bedrock.

Bottom of boring @ 6.2 feet below ground surface.

Lab Test

MC, GS, SG, OC

Arc

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▲ SPT N-Value
● Water Content (%)

Notes:

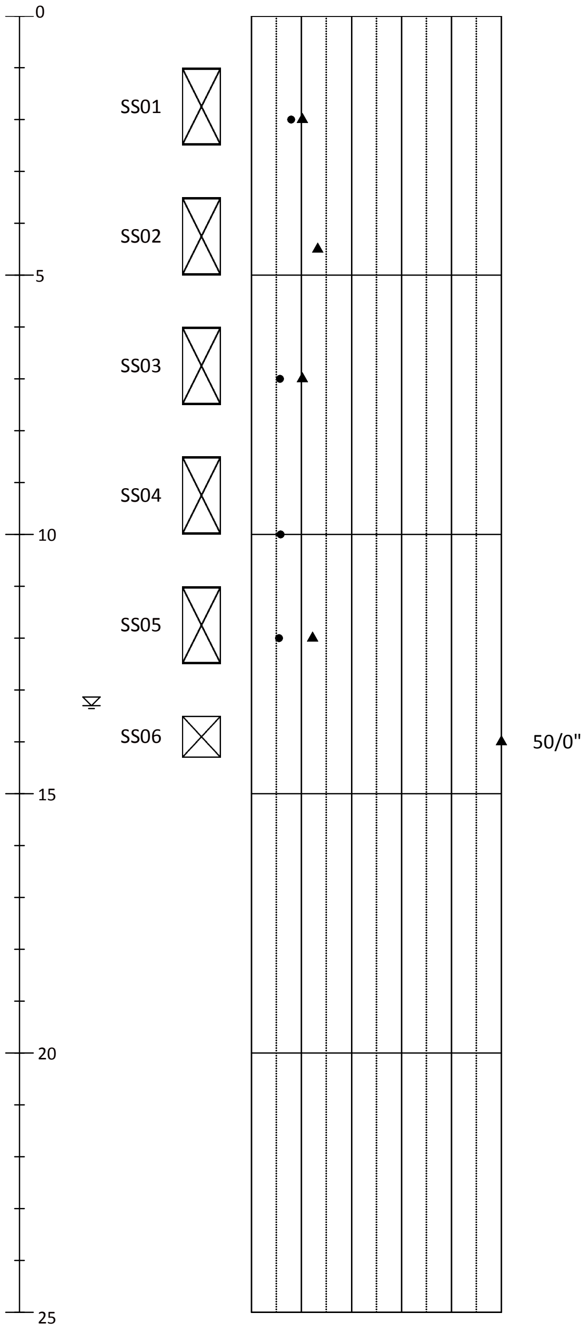
1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

Soil Boring Log

AQSR-08

Project: **South River Phase 1 Interim Remedial Measure**	Location: **River Mile 0.0 to 2.0 of South River near Waynesboro, VA**	Method: **Hollow Stem Auger**
Project #: **120592-01.05**	N/LAT: **6712194.137** E/LONG: **11374869.93**	Total Depth (ft): **14.3**
Client: **DuPont**	Horiz. Datum: **Virginia State Plane North, NAD1983, US Feet**	Observed GW (bgs): **13.3**
Collection Date: **11/07/2014**	Vert. Datum: **NAVD88**	Mudline Elevation (ft):
Contractor: **Total Depth Drilling**	Sampler(s): **2in O.D./1.375in I.D. Split - Spoon** **3in O.D. Shelby Tube**	Hammer: **140 lbs w/ 30 inch drop**
Logged By: **Zac Koehn**		Hammer Efficiency: **84%**

Depth (ft)	Water Level	Samples	Uncorrected Standard Penetration Resistance (blows per foot) and Water Content (%)	Values Greater than 50	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test



Soil Description	Lab Test
Silty GRAVEL (GM): Loose to medium dense, dry, reddish brown to yellow-brown, fine to medium silty sandy GRAVEL (GM) with non-plastic fines, occasional rock fragments.	MC, GS, SG, OC
	Arc
Low recovery due to large rock fragment plugging the sampler.	MC, GS
GRAVEL with silt (GP-GM): Medium dense, damp, reddish yellow-brown with brick and colored rock fragment, fine to coarse sandy GRAVEL with silt (GP-GM), non-plastic fines and frequent rock fragments.	MC, GS, SG
Large rock fragment at end of sampler of SS05.	MC, GS
Weathered Shale, 6 inch in 1 blow then weight of rods for 4 inches followed by refusal.	
Bottom of boring @ 14.3 feet below ground surface. Completed on 11/06/2014.	

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▲ SPT N-Value
● Water Content (%)

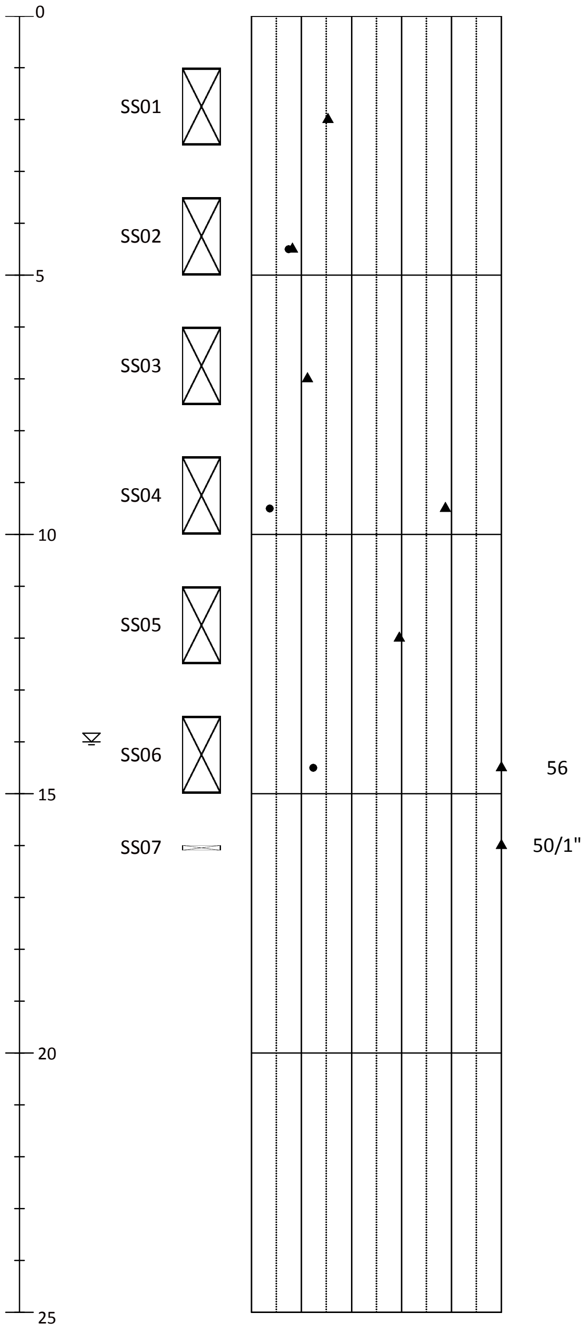
Notes:
1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

Soil Boring Log

AQSR-09

Project: **South River Phase 1 Interim Remedial Measure**	Location: **River Mile 0.0 to 2.0 of South River near Waynesboro, VA**	Method: **Hollow Stem Auger**
Project #: **120592-01.05**	N/LAT: **6712314.576** E/LONG: **11375102.3**	Total Depth (ft): **16.1**
Client: **DuPont**	Horiz. Datum: **Virginia State Plane North, NAD1983, US Feet**	Observed GW (bgs): **14.0**
Collection Date: **11/07/2014**	Vert. Datum: **NAVD88**	Mudline Elevation (ft):
Contractor: **Total Depth Drilling**	Sampler(s): **2in O.D./1.375in I.D. Split - Spoon** **3in O.D. Shelby Tube**	Hammer: **140 lbs w/ 30 inch drop**
Logged By: **Zac Koehn**		Hammer Efficiency: **84%**

Depth (ft)	Water Level	Samples	Uncorrected Standard Penetration Resistance (blows per foot) and Water Content (%) 0 10 20 30 40 50	Values Greater than 50	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test



Silty SAND (SM): Medium dense, dry to damp, reddish brown, fine to medium silty SAND (SM) with non-plastic fines and occasional gravel and wood debris.

@2 feet, transitions to yellow-brown.

Increasing density.

SAND with silt (SP-SM): Medium dense, dry to damp, reddish to yellow-brown with cream colored fragments, gravelly SAND with silt (SP-SM) with angular rock fragments (alluvium).
Hard drilling at 10 to 11 feet. Increasing gravel content, transitions to GRAVEL with silt (GP-GM).

Weathered bedrock, limestone.

Bottom of boring @ 16.1 feet below ground surface. Completed on 11/07/2014.

Sample	Lab Test
SS01	Arc
SS02	MC, GS, SG, OC
SS03	Arc
SS04	MC, GS, SG
SS05	Arc
SS06	MC, GS, SG

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▲ SPT N-Value
● Water Content (%)

Notes:
1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

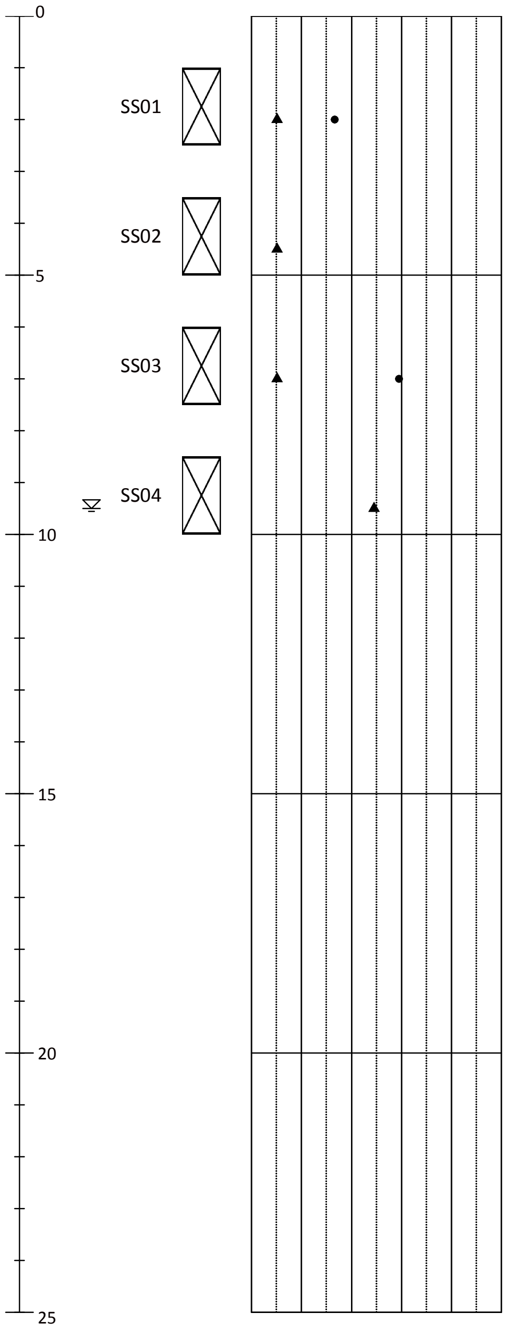
Soil Boring Log

Sheet 1 of 1

AQSR-10

Project: **South River Phase 1 Interim Remedial Measure**	Location: **River Mile 0.0 to 2.0 of South River near Waynesboro, VA**	Method: **Hollow Stem Auger**
Project #: **120592-01.05**	N/LAT: **6713802.346** E/LONG: **11374916.48**	Total Depth (ft): **11.0**
Client: **DuPont**	Horiz. Datum: **Virginia State Plane North, NAD1983, US Feet**	Observed GW (bgs): **9.5**
Collection Date: **11/07/2014**	Vert. Datum: **NAVD88**	Mudline Elevation (ft):
Contractor: **Total Depth Drilling**	Sampler(s): **2in O.D./1.375in I.D. Split - Spoon** **3in O.D. Shelby Tube**	Hammer: **140 lbs w/ 30 inch drop**
Logged By: **Zac Koehn**		Hammer Efficiency: **84%**

Depth (ft)	Water Level	Samples	Uncorrected Standard Penetration Resistance (blows per foot) and Water Content (%) 0 10 20 30 40 50	Values Greater than 50	**Soil Description** Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
0		SS01			Silty SAND (SM): Loose, dry to damp, reddish brown, fine silty SAND (SM) with non-plastic to low plastic fines, trace gravel and some hair-like roots.	MC, GS, SG, OC
		SS02				Arc
		SS03			Increasing fines content, dark brown-gray, fine silty clayey SAND (SC).	MC, AI, GS, SG
	▽	SS04			SAND with silt (SP-SM): Medium dense, wet, light yellow-brown, fine to coarse gravelly SAND with silt (SP-SM), subangular to angular particles (alluvium).	Arc
					Bottom of boring @ 11.0 feet below ground surface. Completed on 11/07/2014.	



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▲ SPT N-Value

● Water Content (%)

Notes:

1. Soil descriptions and stratum lines are interpretive and actual conditions may vary
2. Groundwater level was observed at the time and date specified.
3. GS = Grain Size Analysis; AL = Atterberg Limits; OC = Organic Content; SG = Specific Gravity; DS = Direct Shear; Consol = 1 Dimensional Consolidation ARC = Archive

APPENDIX B
GEOTECHNICAL LABORATORY REPORTS

GeoTesting EXPRESS

Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: ---	Sample Type: ---	Tested By:	jek
Sample ID: ---	Test Date: 12/03/14	Checked By:	jdt
Depth : ---	Test Id: 315483		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content, %
AQSB-01	SS02	---	Moist, dark brown silty sand	12.1
AQSB-01	SS04	---	Moist, yellowish brown sand with silt and gravel	6.4
AQSB-01	SS06	---	Moist, brownish yellow silt	36.4
AQSB-01	ST01	---	Moist, yellowish brown silty sand with gravel	52.6
AQSB-02	SS01	---	Moist, brown silty sand	18.5
AQSB-03	SS01	---	Moist, brown silty sand	9.4
AQSB-03	SS03	---	Moist, brown clay	19.4
AQSB-03	SS04	---	Wet, brownish yellow silty sand with gravel	15.3
AQSB-04	SS01	---	Moist, dark grayish brown silty sand with gravel	9.4
AQSB-04	SS02	---	Moist, brown sandy silt	15.7

Notes: Temperature of Drying : 110º Celsius

Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	---	Sample Type:	---	Tested By:	jek
Sample ID:	---	Test Date:	12/03/14	Checked By:	jdt
Depth :	---	Test Id:	315491		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content, %
AQSB-05	SS02	---	Moist, brown silty sand	7.0
AQSB-05	SS03	---	Moist, brown sandy silt	11.9
AQSB-06	SS04	---	Moist, brown silty sand	11.2
AQSB-06	SS05	---	Moist, brown silty sand	16.0
AQSB-06	SS06	---	Moist, dark grayish brown clay	43.5
AQSB-06	SS08	---	Moist, brownish yellow clayey sand with gravel	20.9
AQSB-06	SS09	---	Moist, brownish yellow silt	99.1
AQSB-07	SS01	---	Moist, brown silty sand with gravel	9.8

Notes: Temperature of Drying : 110° Celsius

Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	---	Sample Type:	---	Tested By:	jek
Sample ID:	---	Test Date:	12/03/14	Checked By:	jdt
Depth :	---	Test Id:	315500		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content, %
AQSB-08	SS01	---	Moist, light yellowish brown silty gravel with sand	8.8
AQSB-08	SS03	---	Moist, brown silty sand	6.6
AQSB-08	SS04	---	Moist, brown silty sand with gravel	6.7
AQSB-08	SS05	---	Moist, brown gravel with silt and sand	6.4
AQSB-09	SS02	---	Moist, brown silty sand	8.3
AQSB-09	SS04	---	Moist, brown sand with silt and gravel	4.6
AQSB-09	SS06	---	Wet, olive silty gravel with sand	13.1
AQSB-10	SS01	---	Moist, brown silty sand	17.3
AQSB-10	SS03	---	Moist, brown clayey sand	29.9

Notes: Temperature of Drying : 110º Celsius

Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	---	Sample Type:	---	Tested By:	jek
Sample ID:	---	Test Date:	12/03/14	Checked By:	jdt
Depth :	---	Test Id:	315538		

Moisture, Ash, and Organic Matter - ASTM D2974

Boring ID	Sample ID	Depth	Description	Moisture Content, %	Ash Content, %	Organic Matter, %
AQSB-01	SS02	---	Moist, dark brown silty sand	12	97.0	3.0
AQSB-02	SS01	---	Moist, brown silty sand	18	97.5	2.5
AQSB-03	SS01	---	Moist, brown silty sand	9	99.0	1.0
AQSB-04	SS01	---	Moist, dark grayish brown silty sand with gravel	9	98.4	1.6
AQSB-05	SS02	---	Moist, brown silty sand	7	97.9	2.1
AQSB-07	SS01	---	Moist, brown silty sand with gravel	10	97.8	2.2
AQSB-08	SS01	---	Moist, light yellowish brown silty gravel with sand	9	99.2	.8
AQSB-09	SS02	---	Moist, brown silty sand	8	97.8	2.2
AQSB-10	SS01	---	Moist, brown silty sand	17	97.1	2.9

Notes: Moisture content determined by Method A and reported as a percentage of oven-dried mass;
dried to a constant mass at temperature of 105º C
Ash content and organic matter determined by Method C; dried to constant mass at temperature 440º C

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Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	---	Sample Type:	---	Tested By:	jek
Sample ID:	---	Test Date:	12/01/14	Checked By:	jdt
Depth :	---	Test Id:	315547		

Specific Gravity of Soils by ASTM D854

Boring ID	Sample ID	Depth	Visual Description	Specific Gravity	Comment
AQSB-01	SS02	---	Moist, dark brown silty sand	2.63	
AQSB-01	SS04	---	Moist, yellowish brown sand with silt and gravel	2.71	
AQSB-01	SS06	---	Moist, brownish yellow silt	2.81	
AQSB-01	ST01	---	Moist, yellowish brown silty sand with gravel	2.75	
AQSB-02	SS01	---	Moist, brown silty sand	2.66	
AQSB-03	SS01	---	Moist, brown silty sand	2.68	
AQSB-03	SS03	---	Moist, brown clay	2.61	
AQSB-04	SS02	---	Moist, brown sandy silt	2.72	
AQSB-05	SS02	---	Moist, brown silty sand	2.63	

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

GeoTesting EXPRESS

Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID: ---	Sample Type: ---	Tested By:	jek
Sample ID: ---	Test Date: 12/02/14	Checked By:	jdt
Depth : ---	Test Id: 315556		

Specific Gravity of Soils by ASTM D854

Boring ID	Sample ID	Depth	Visual Description	Specific Gravity	Comment
AQSB-06	SS05	---	Moist, brown silty sand	2.68	
AQSB-06	SS06	---	Moist, dark grayish brown clay	2.60	
AQSB-06	SS09	---	Moist, brownish yellow silt	2.74	
AQSB-07	SS01	---	Moist, brown silty sand with gravel	2.64	
AQSB-08	SS01	---	Moist, light yellowish brown silty gravel with sand	2.72	
AQSB-08	SS04	---	Moist, brown silty sand with gravel	2.72	
AQSB-09	SS02	---	Moist, brown silty sand	2.68	
AQSB-09	SS04	---	Moist, brown sand with silt and gravel	2.71	
AQSB-09	SS06	---	Wet, olive silty gravel with sand	2.82	

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

Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: ---	Sample Type: ---	Tested By:	jek
Sample ID: ---	Test Date: 11/26/14	Checked By:	jdt
Depth : ---	Test Id: 315558		

Specific Gravity of Soils by ASTM D854

Boring ID	Sample ID	Depth	Visual Description	Specific Gravity	Comment
AQSB-10	SS01	---	Moist, brown silty sand	2.68	
AQSB-10	SS03	---	Moist, brown clayey sand	2.69	

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

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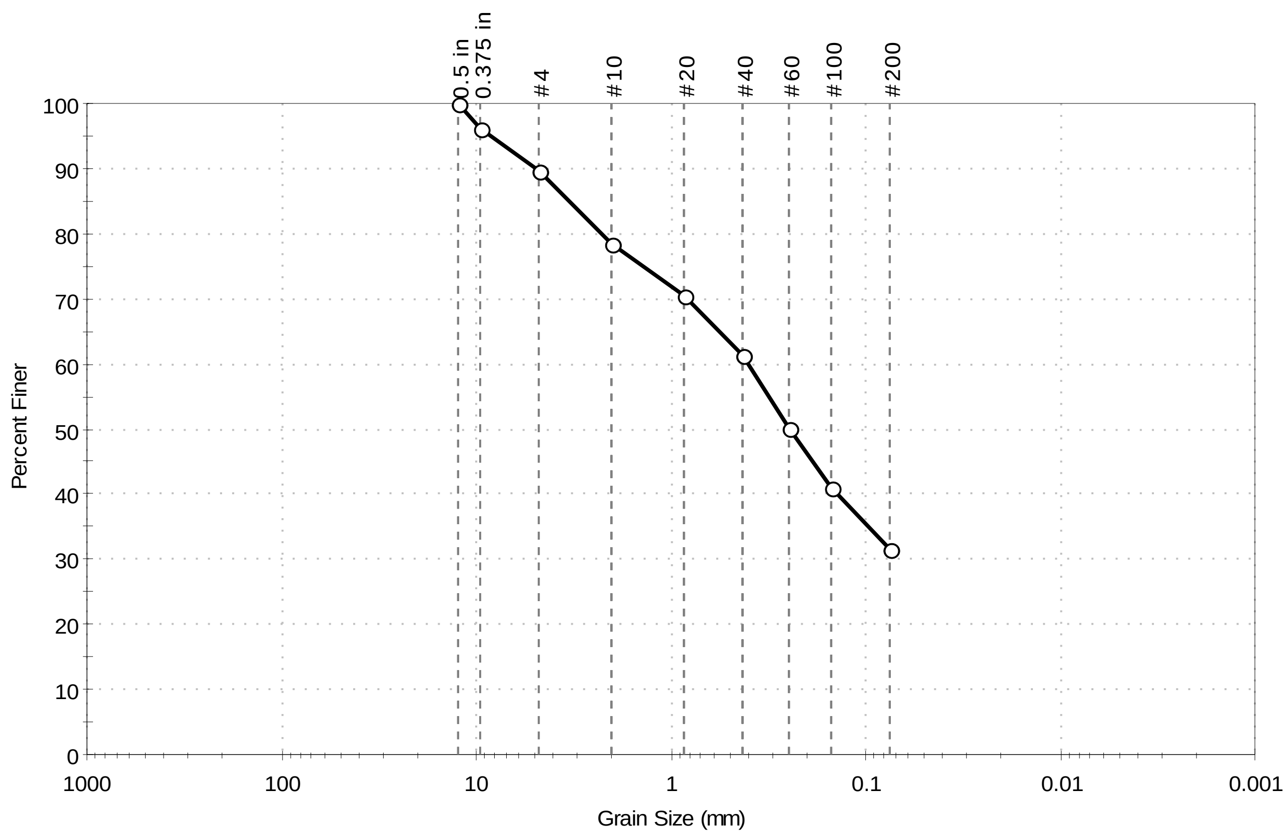
Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	AQSB-01	Sample Type:	bag	Tested By:	jbr
Sample ID:	SS02	Test Date:	12/01/14	Checked By:	jdt
Depth :	---	Test Id:	315501		
Test Comment:	---				
Sample Description:	Moist, dark brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	10.4	58.1	31.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	96		
#4	4.75	90		
#10	2.00	78		
#20	0.85	71		
#40	0.42	61		
#60	0.25	50		
#100	0.15	41		
#200	0.075	31		

Coefficients

D_{85} = 3.3366 mm　　D_{30} = N/A

D_{60} = 0.3984 mm　　D_{15} = N/A

D_{50} = 0.2459 mm　　D_{10} = N/A

C_u = N/A　　C_c = N/A

Classification

ASTM　N/A

AASHTO　Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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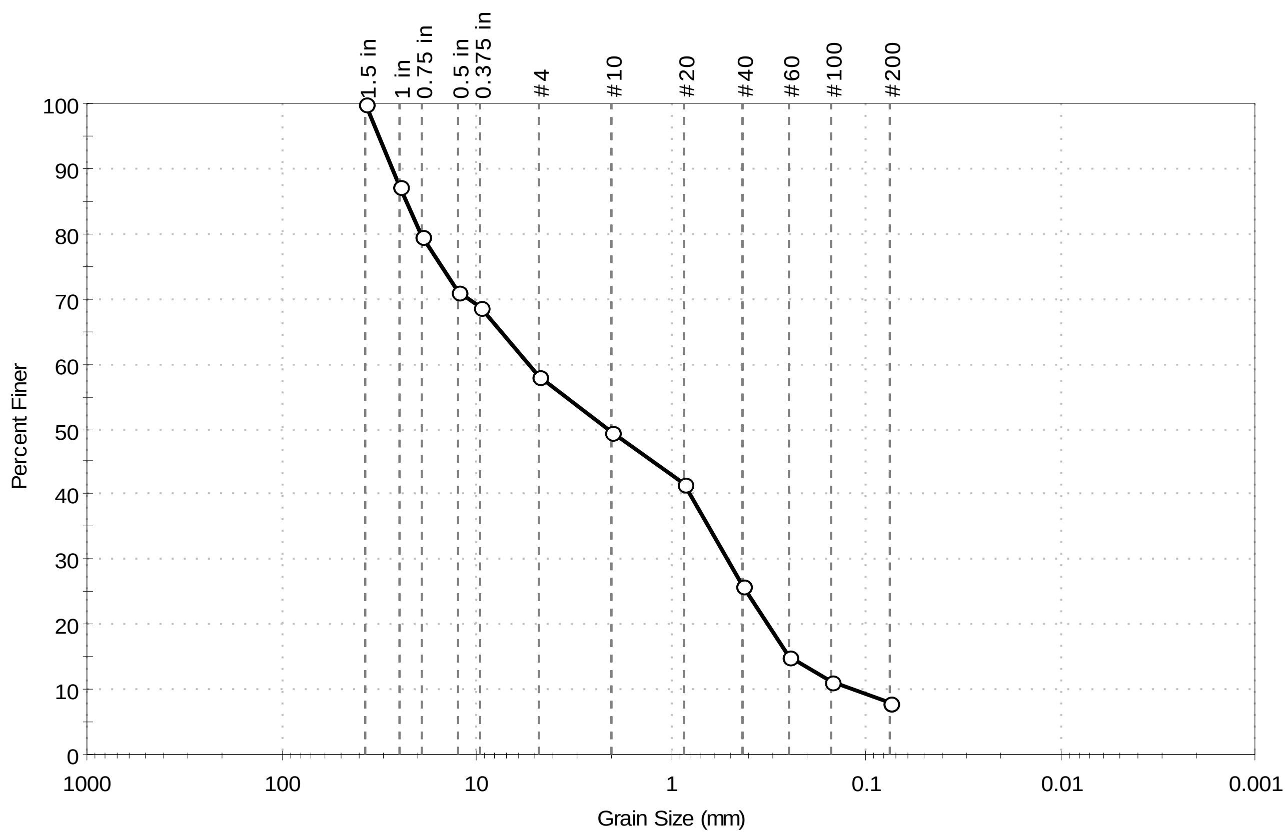
Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-01	Sample Type: bag	Tested By:	jbr
Sample ID: SS04	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315502		
Test Comment: ---			
Sample Description: Moist, yellowish brown sand with silt and gravel			
Sample Comment: ---			

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	42.0	50.2	7.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	87		
0.75 in	19.00	80		
0.5 in	12.50	71		
0.375 in	9.50	69		
#4	4.75	58		
#10	2.00	50		
#20	0.85	42		
#40	0.42	26		
#60	0.25	15		
#100	0.15	11		
#200	0.075	7.8		

Coefficients

D_{85} = 23.0722 mm D_{30} = 0.5107 mm
D_{60} = 5.3764 mm D_{15} = 0.2461 mm
D_{50} = 2.0733 mm D_{10} = 0.1192 mm
C_u = 45.104 C_c = 0.407

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-a (1))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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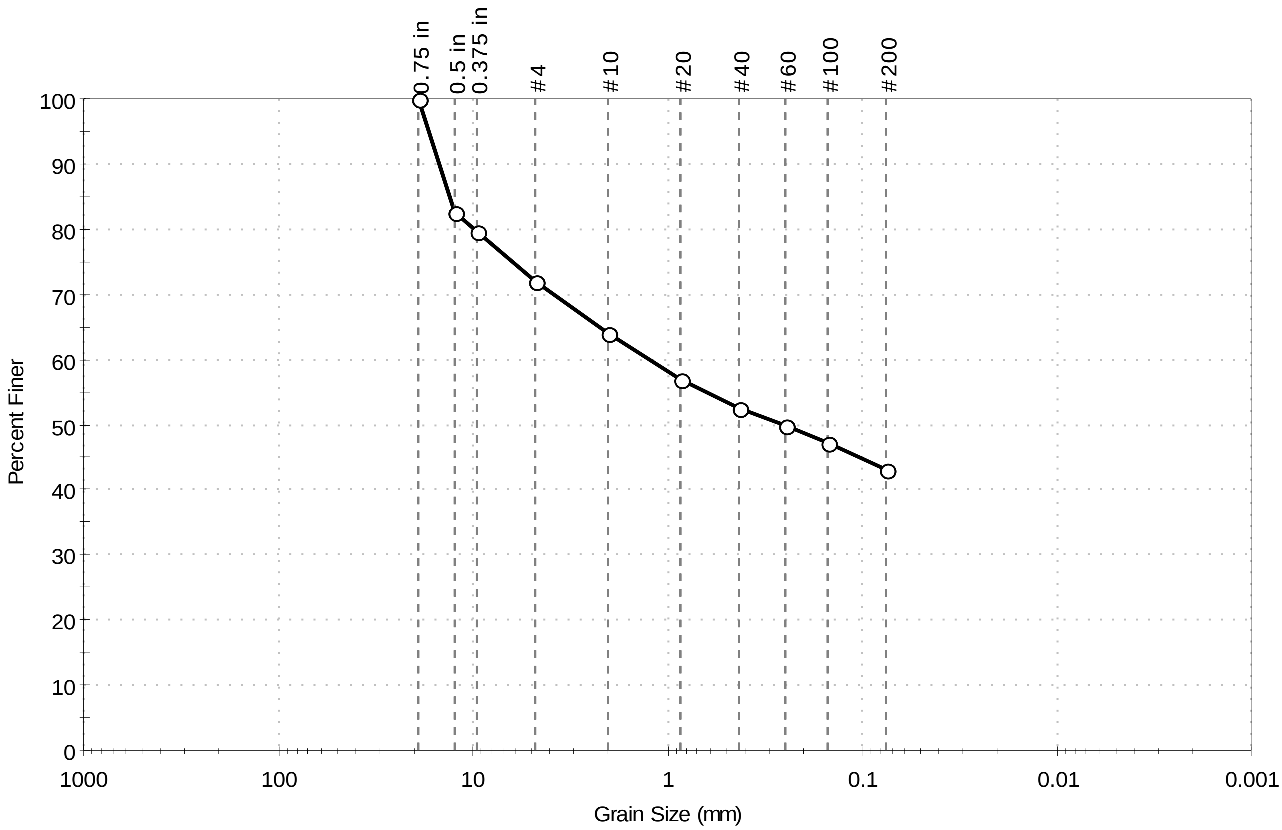
Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID: AQSB-01	Sample Type: tube	Tested By:	jbr
Sample ID: ST01	Test Date: 12/08/14	Checked By:	jdt
Depth : ---	Test Id: 315503		
Test Comment:	---		
Sample Description:	Moist, yellowish brown silty sand with gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	28.2	28.6	43.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	83		
0.375 in	9.50	80		
#4	4.75	72		
#10	2.00	64		
#20	0.85	57		
#40	0.42	53		
#60	0.25	50		
#100	0.15	47		
#200	0.075	43		

Coefficients

D_{85} = 13.2131 mm	D_{30} = N/A
D_{60} = 1.2340 mm	D_{15} = N/A
D_{50} = 0.2549 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM Silty sand with gravel (SM)

AASHTO Silty Soils (A-4 (0))

Sample / Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : SOFT

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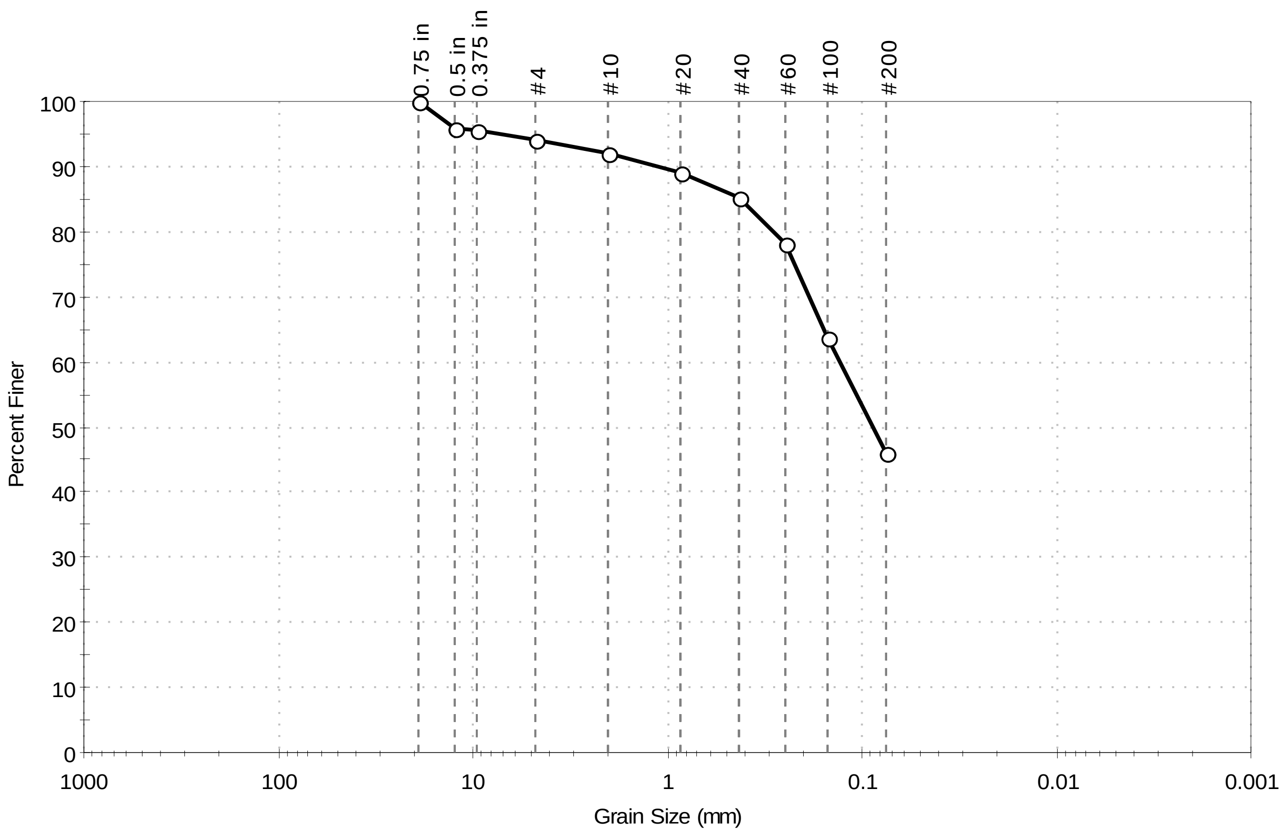
Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	AQSB-02	Sample Type:	bag	Tested By:	jbr
Sample ID:	SS01	Test Date:	12/01/14	Checked By:	jdt
Depth :	---	Test Id:	315504		

Test Comment: ---
Sample Description: Moist, brown silty sand
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	6.0	48.0	46.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	96		
0.375 in	9.50	95		
#4	4.75	94		
#10	2.00	92		
#20	0.85	89		
#40	0.42	85		
#60	0.25	78		
#100	0.15	64		
#200	0.075	46		

Coefficients

D_{85} = 0.4202 mm D_{30} = N/A
D_{60} = 0.1294 mm D_{15} = N/A
D_{50} = 0.0876 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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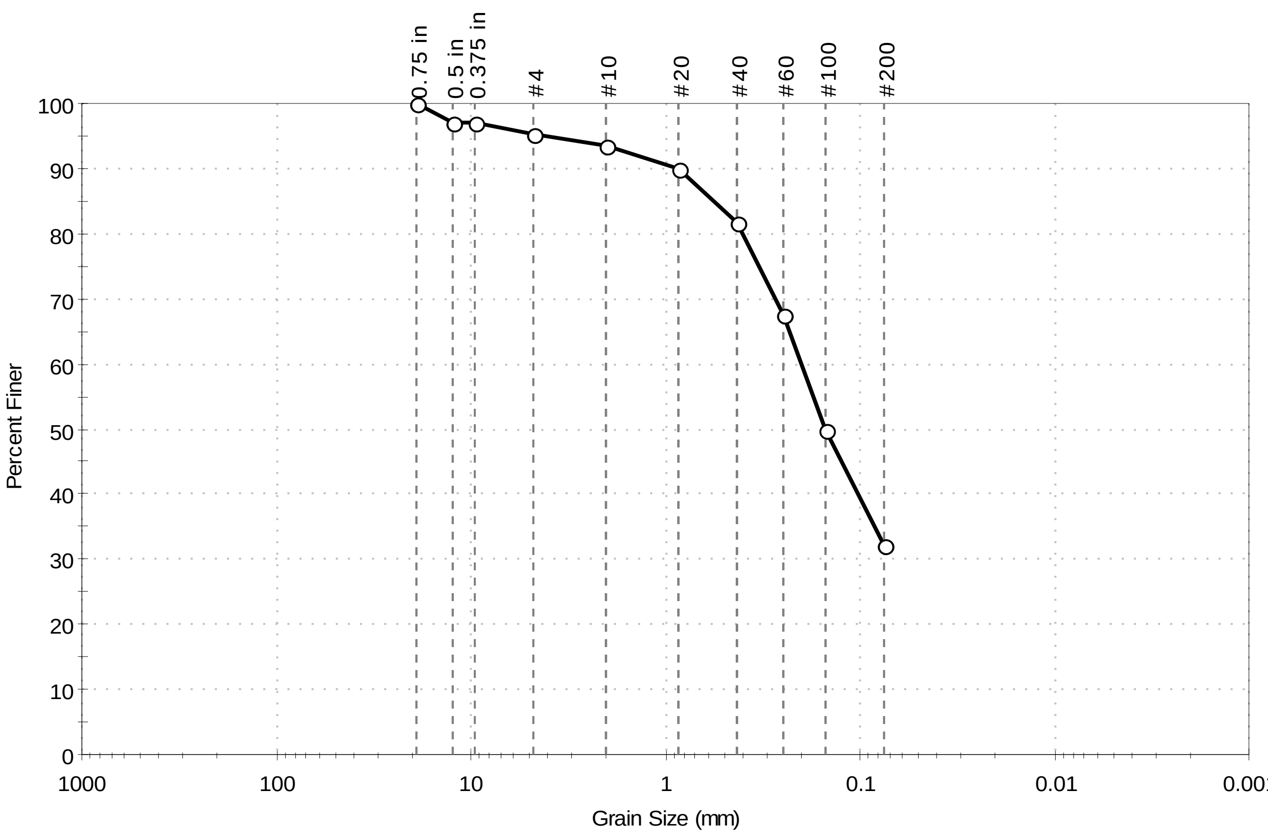
Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-03	Sample Type: bag	Tested By:	jbr
Sample ID: SS01	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315505		
Test Comment: ---			
Sample Description: Moist, brown silty sand			
Sample Comment: ---			

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	4.8	63.1	32.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	97		
0.375 in	9.50	97		
#4	4.75	95		
#10	2.00	93		
#20	0.85	90		
#40	0.42	82		
#60	0.25	68		
#100	0.15	50		
#200	0.075	32		

Coefficients

D_{85} = 0.5609 mm D_{30} = N/A

D_{60} = 0.2009 mm D_{15} = N/A

D_{50} = 0.1504 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

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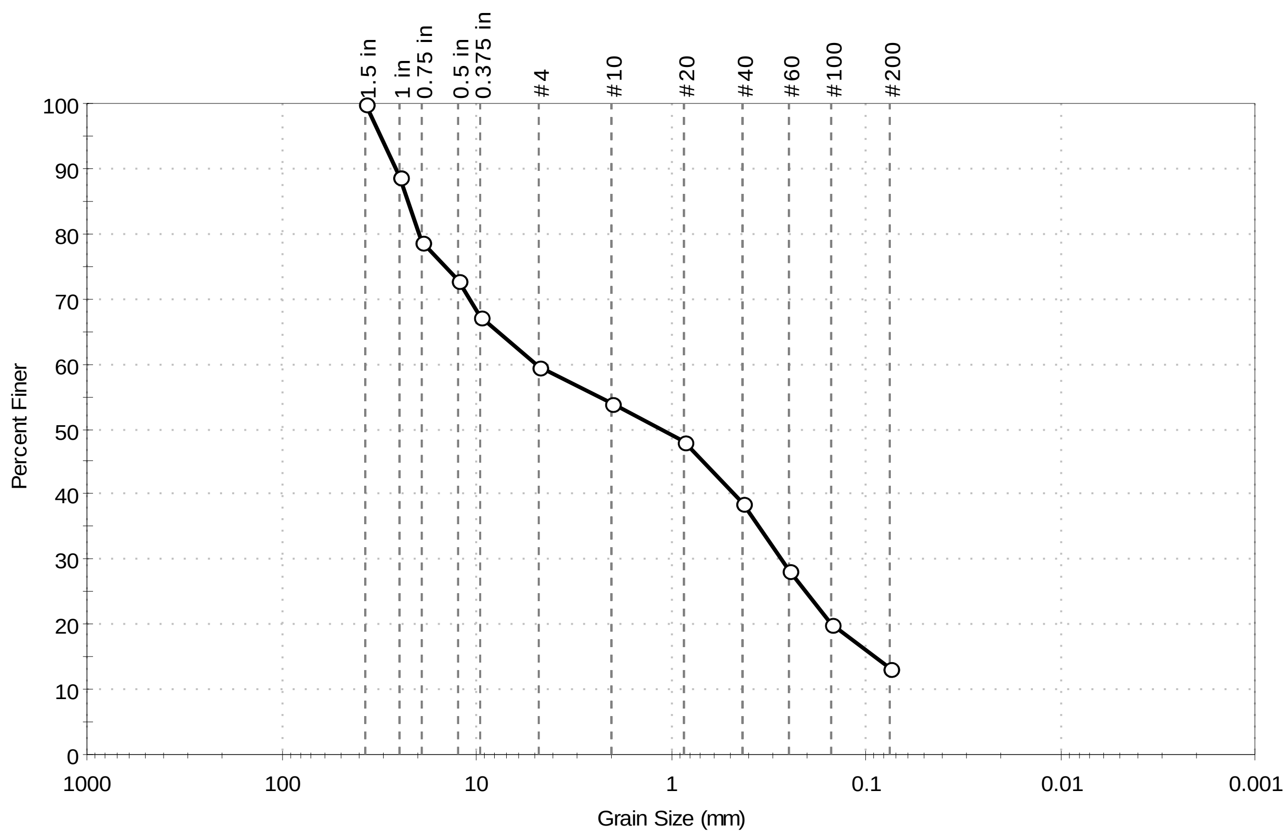
Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	AQSB-03	Sample Type:	bag	Tested By:	jbr
Sample ID:	SS04	Test Date:	12/02/14	Checked By:	jdt
Depth :	---	Test Id:	315506		
Test Comment:	---				
Sample Description:	Wet, brownish yellow silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	40.5	46.2	13.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	89		
0.75 in	19.00	79		
0.5 in	12.50	73		
0.375 in	9.50	67		
#4	4.75	60		
#10	2.00	54		
#20	0.85	48		
#40	0.42	39		
#60	0.25	28		
#100	0.15	20		
#200	0.075	13		

Coefficients

D_{85} = 22.6240 mm D_{30} = 0.2731 mm

D_{60} = 4.9556 mm D_{15} = 0.0891 mm

D_{50} = 1.1165 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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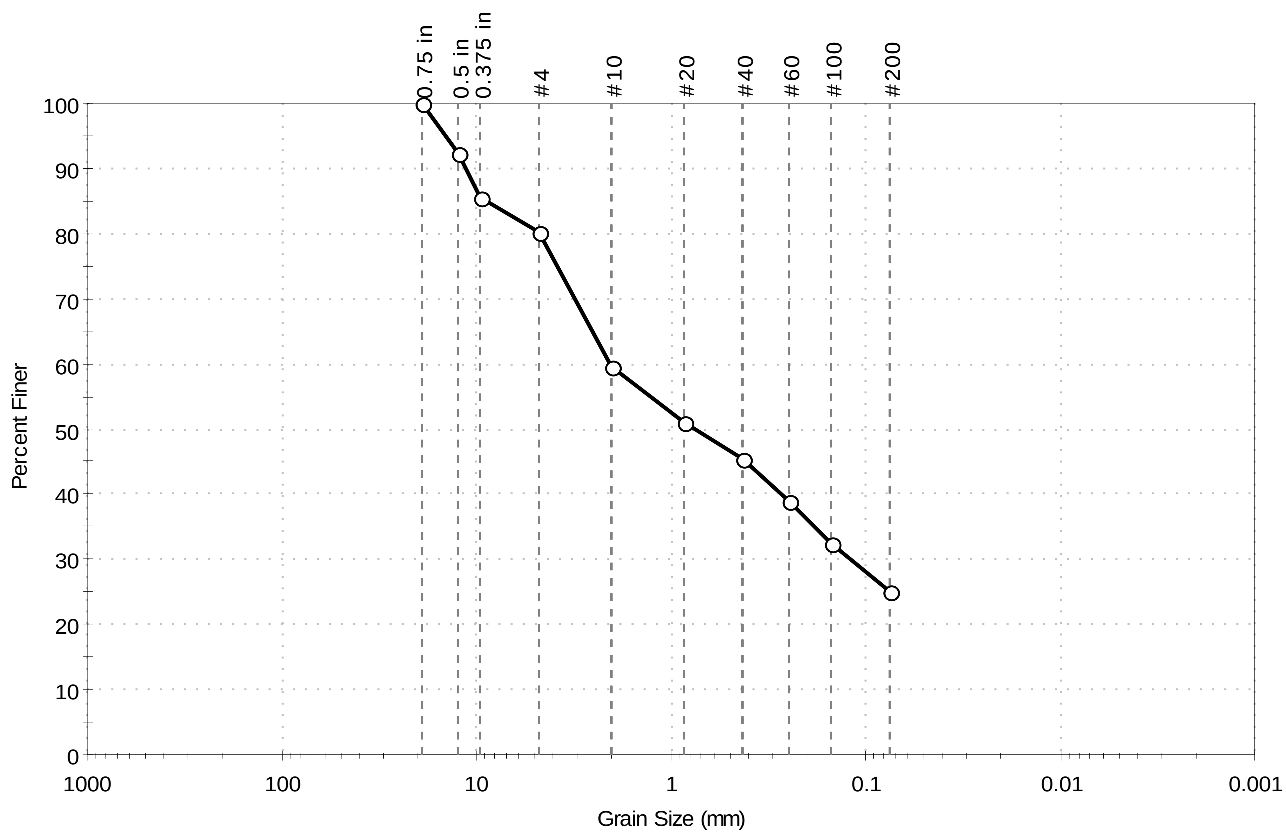
Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID: AQSB-04	Sample Type: bag	Tested By:	jbr
Sample ID: SS01	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315507		
Test Comment:	---		
Sample Description:	Moist, dark grayish brown silty sand with gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	19.7	55.2	25.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	92		
0.375 in	9.50	85		
#4	4.75	80		
#10	2.00	60		
#20	0.85	51		
#40	0.42	45		
#60	0.25	39		
#100	0.15	32		
#200	0.075	25		

Coefficients

D_{85} = 8.9966 mm
D_{30} = 0.1191 mm
D_{60} = 2.0246 mm
D_{15} = N/A
D_{50} = 0.7534 mm
D_{10} = N/A
C_u = N/A
C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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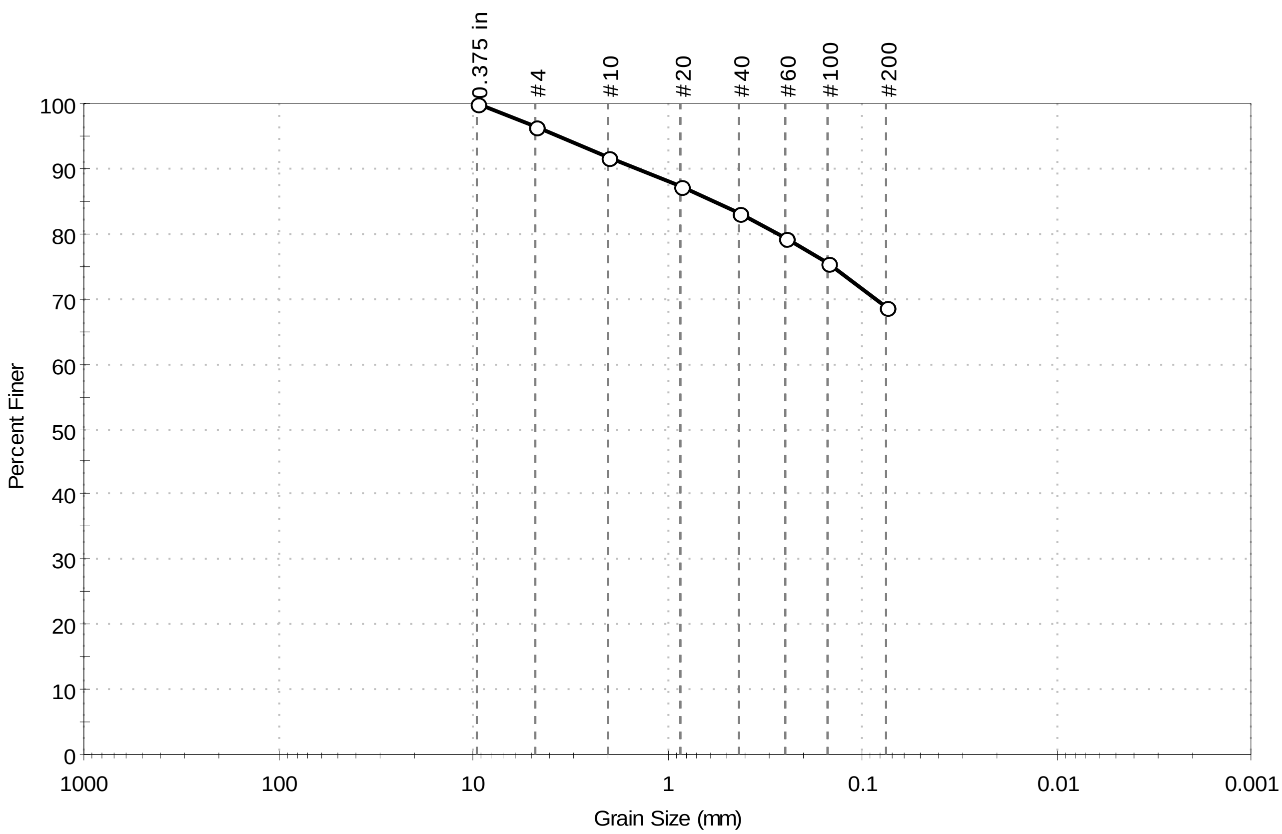
GeoTesting EXPRESS

Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-04	Sample Type: bag	Tested By:	jbr
Sample ID: SS02	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315508		
Test Comment: ---			
Sample Description: Moist, brown sandy silt			
Sample Comment: ---			

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	3.7	27.6	68.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	96		
#10	2.00	92		
#20	0.85	87		
#40	0.42	83		
#60	0.25	79		
#100	0.15	76		
#200	0.075	69		

Coefficients

D_{85} = 0.5842 mm D_{30} = N/A

D_{60} = N/A D_{15} = N/A

D_{50} = N/A D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample / Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

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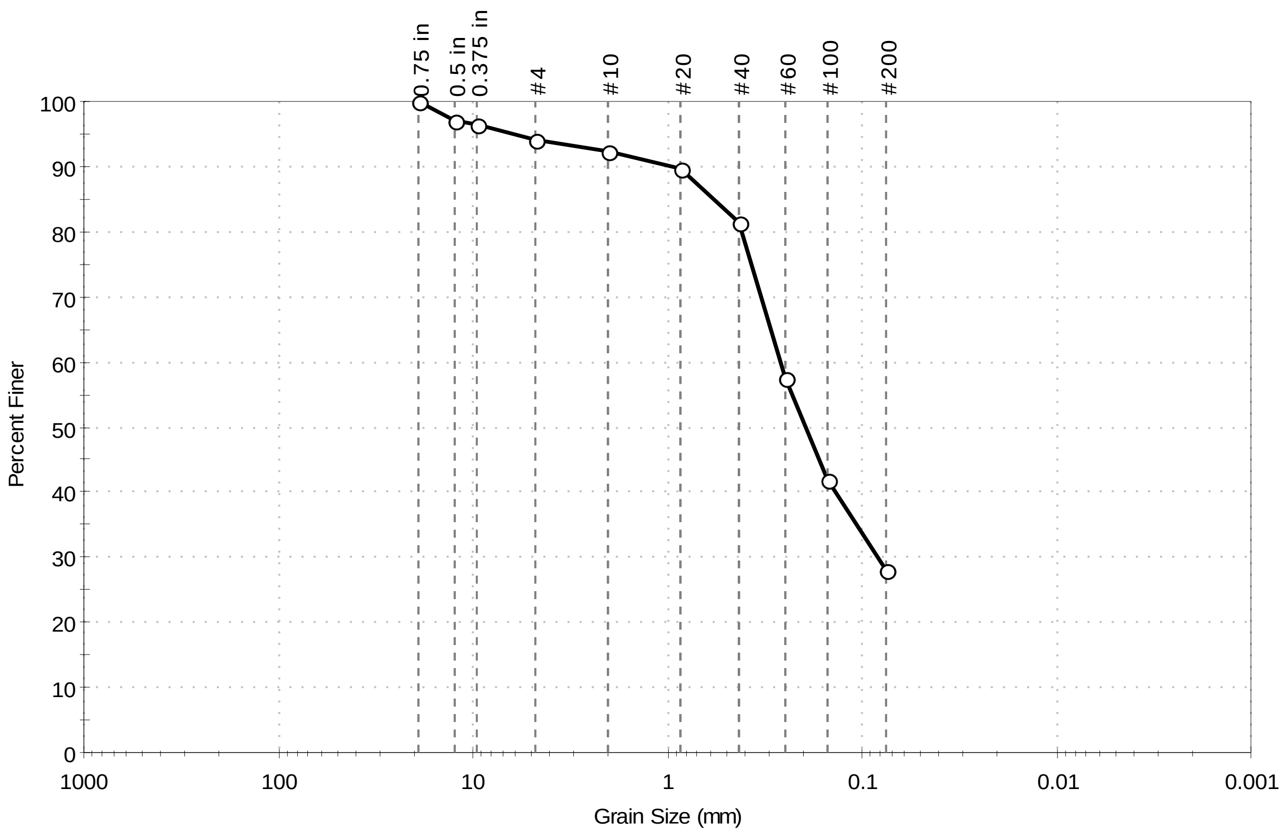
Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID: AQSB-05	Sample Type: bag	Tested By:	jbr
Sample ID: SS02	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315509		
Test Comment:	---		
Sample Description:	Moist, brown silty sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	5.8	66.1	28.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	97		
0.375 in	9.50	96		
#4	4.75	94		
#10	2.00	92		
#20	0.85	90		
#40	0.42	81		
#60	0.25	58		
#100	0.15	42		
#200	0.075	28		

Coefficients

D_{85} = 0.5756 mm D_{30} = 0.0827 mm

D_{60} = 0.2635 mm D_{15} = N/A

D_{50} = 0.1952 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM   N/A

AASHTO   Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

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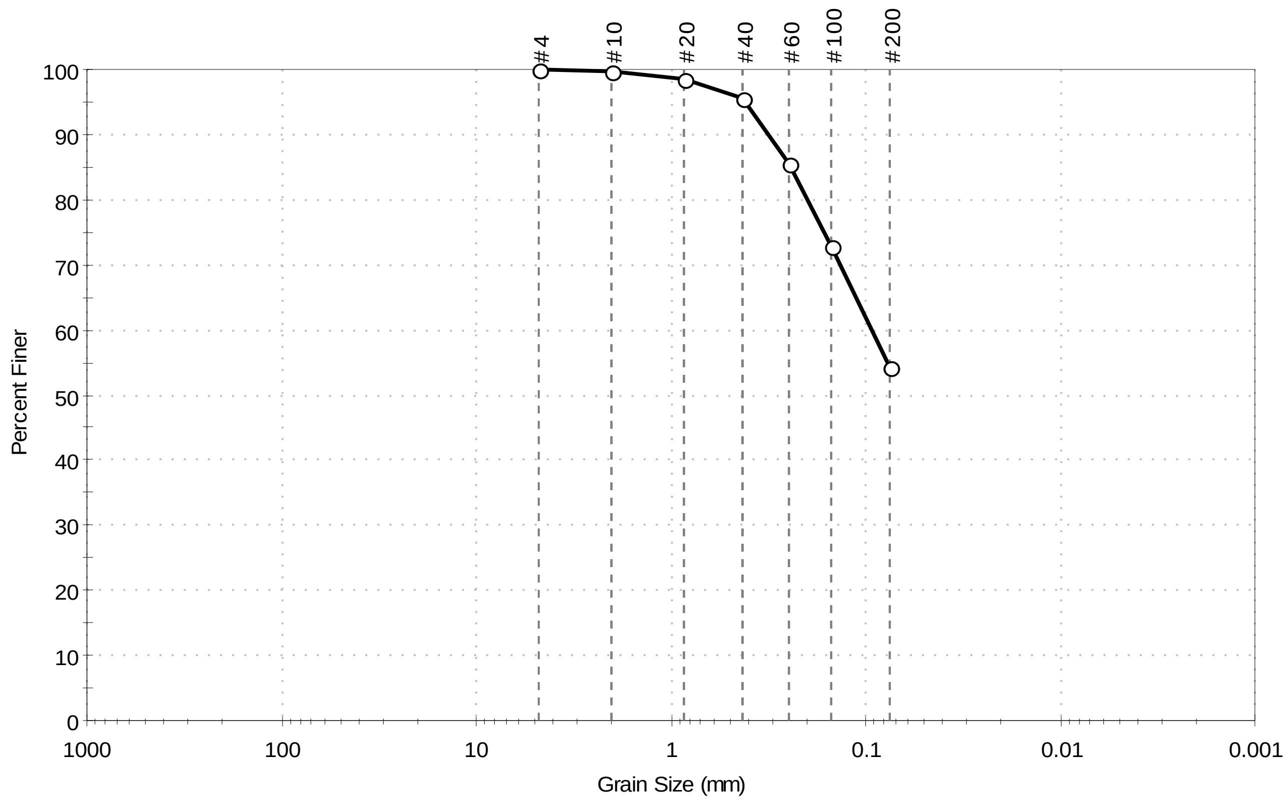
Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	AQSB-05	Sample Type:	bag	Tested By:	jbr
Sample ID:	SS03	Test Date:	12/01/14	Checked By:	jdt
Depth :	---	Test Id:	315510		

Test Comment: ---
Sample Description: Moist, brown sandy silt
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	45.8	54.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	98		
#40	0.42	96		
#60	0.25	86		
#100	0.15	73		
#200	0.075	54		

Coefficients

D_{85} = 0.2446 mm
D_{30} = N/A
D_{60} = 0.0931 mm
D_{15} = N/A
D_{50} = N/A
D_{10} = N/A
C_u = N/A
C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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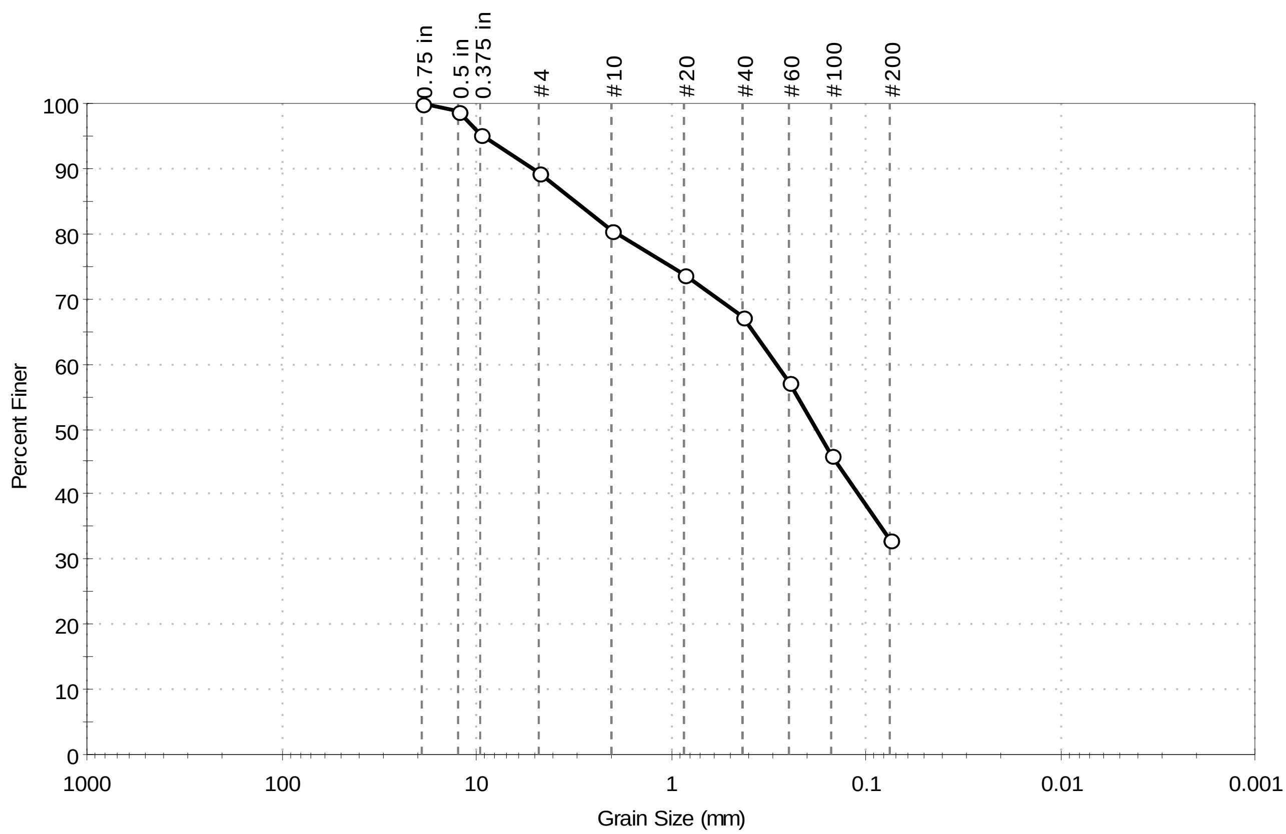
Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	AQSB-06	Sample Type:	bag	Tested By:	jbr
Sample ID:	SS04	Test Date:	12/02/14	Checked By:	jdt
Depth :	---	Test Id:	315511		

Test Comment: ---
Sample Description: Moist, brown silty sand
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	10.8	56.1	33.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	99		
0.375 in	9.50	95		
#4	4.75	89		
#10	2.00	80		
#20	0.85	74		
#40	0.42	67		
#60	0.25	57		
#100	0.15	46		
#200	0.075	33		

Coefficients

D_{85} = 3.1354 mm	D_{30} = N/A
D_{60} = 0.2883 mm	D_{15} = N/A
D_{50} = 0.1793 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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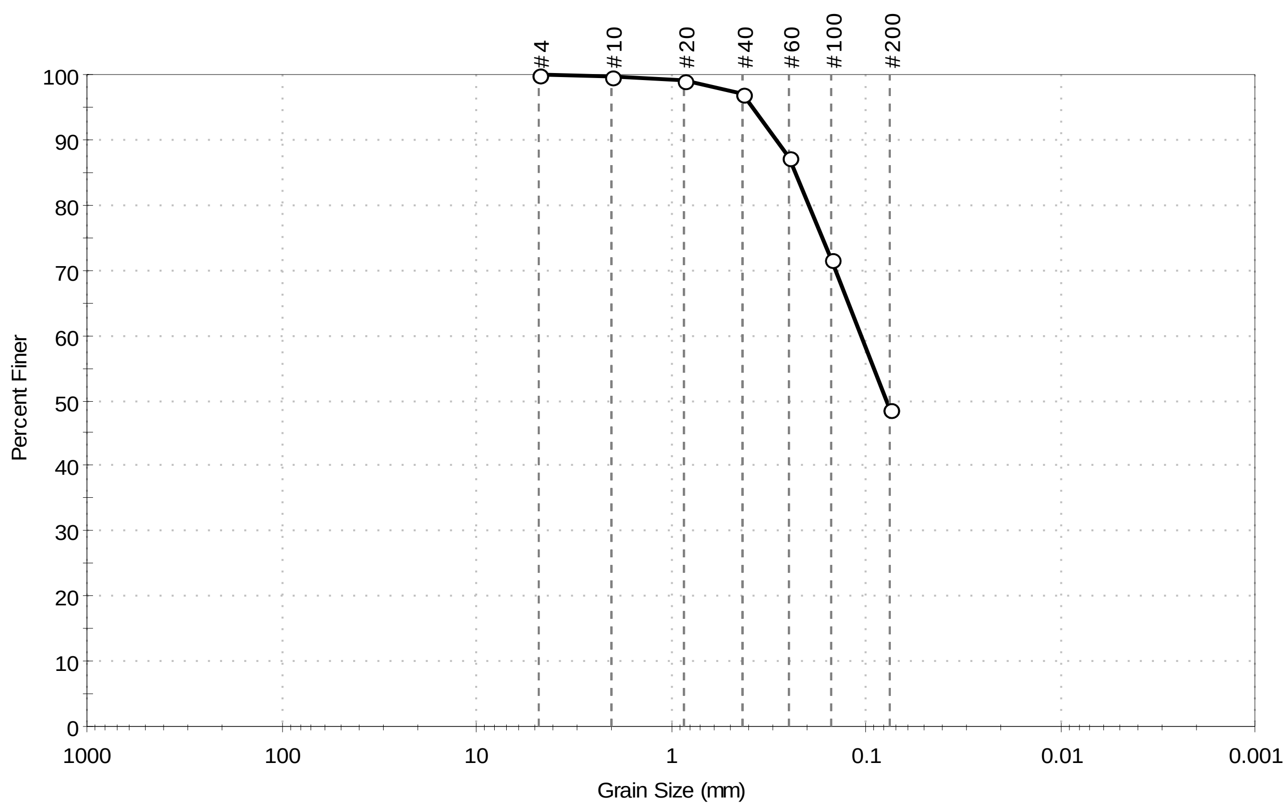
Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-06	Sample Type: bag	Tested By:	jbr
Sample ID: SS05	Test Date: 12/02/14	Checked By:	jdt
Depth : ---	Test Id: 315512		
Test Comment: ---			
Sample Description: Moist, brown silty sand			
Sample Comment: ---			

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	51.2	48.8

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	97		
#60	0.25	87		
#100	0.15	72		
#200	0.075	49		

Coefficients

D_{85} = 0.2323 mm D_{30} = N/A

D_{60} = 0.1052 mm D_{15} = N/A

D_{50} = 0.0778 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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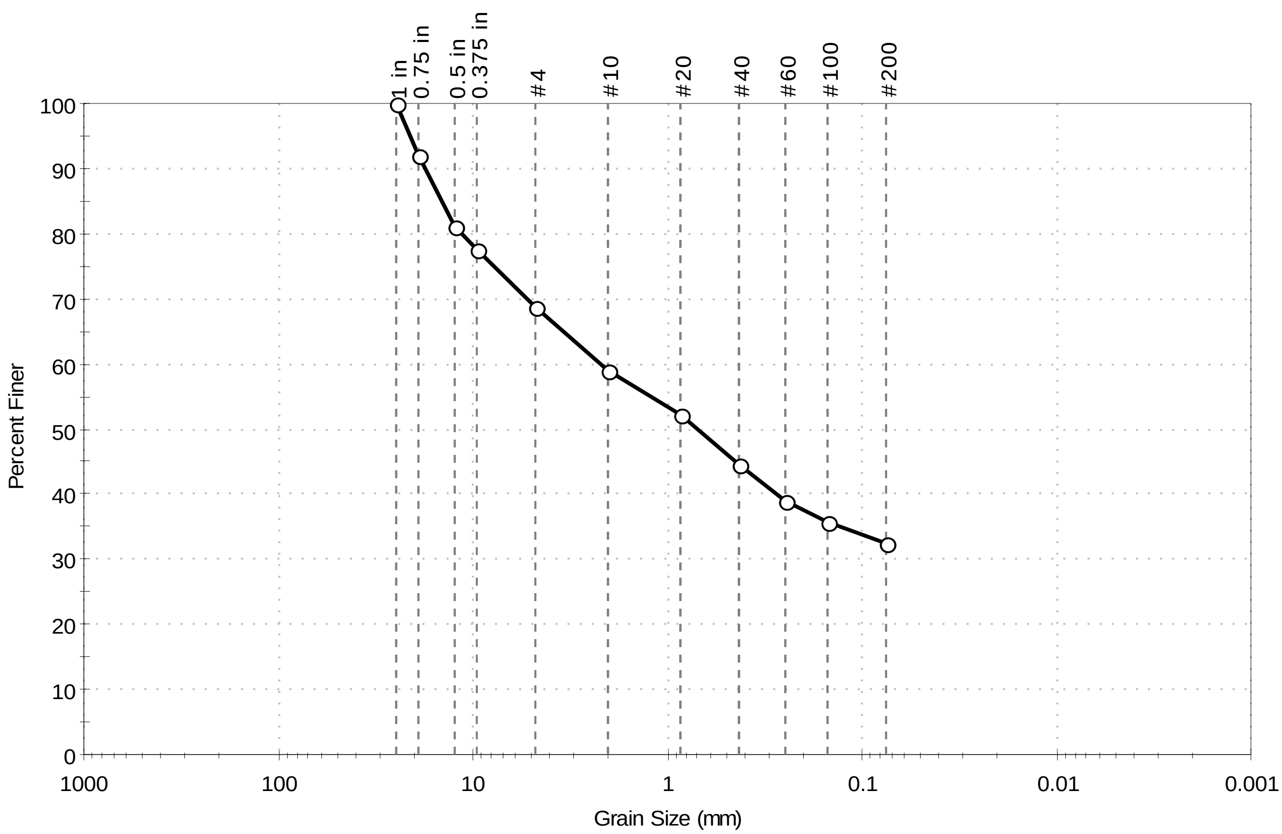
Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-06	Sample Type: bag	Tested By:	jbr
Sample ID: SS08	Test Date: 12/02/14	Checked By:	jdt
Depth : ---	Test Id: 315513		

Test Comment: ---
Sample Description: Moist, brownish yellow clayey sand with gravel
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	31.1	36.4	32.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	92		
0.5 in	12.50	81		
0.375 in	9.50	78		
#4	4.75	69		
#10	2.00	59		
#20	0.85	52		
#40	0.42	45		
#60	0.25	39		
#100	0.15	36		
#200	0.075	32		

Coefficients

D_{85} = 14.4499 mm	D_{30} = N/A
D_{60} = 2.1754 mm	D_{15} = N/A
D_{50} = 0.6982 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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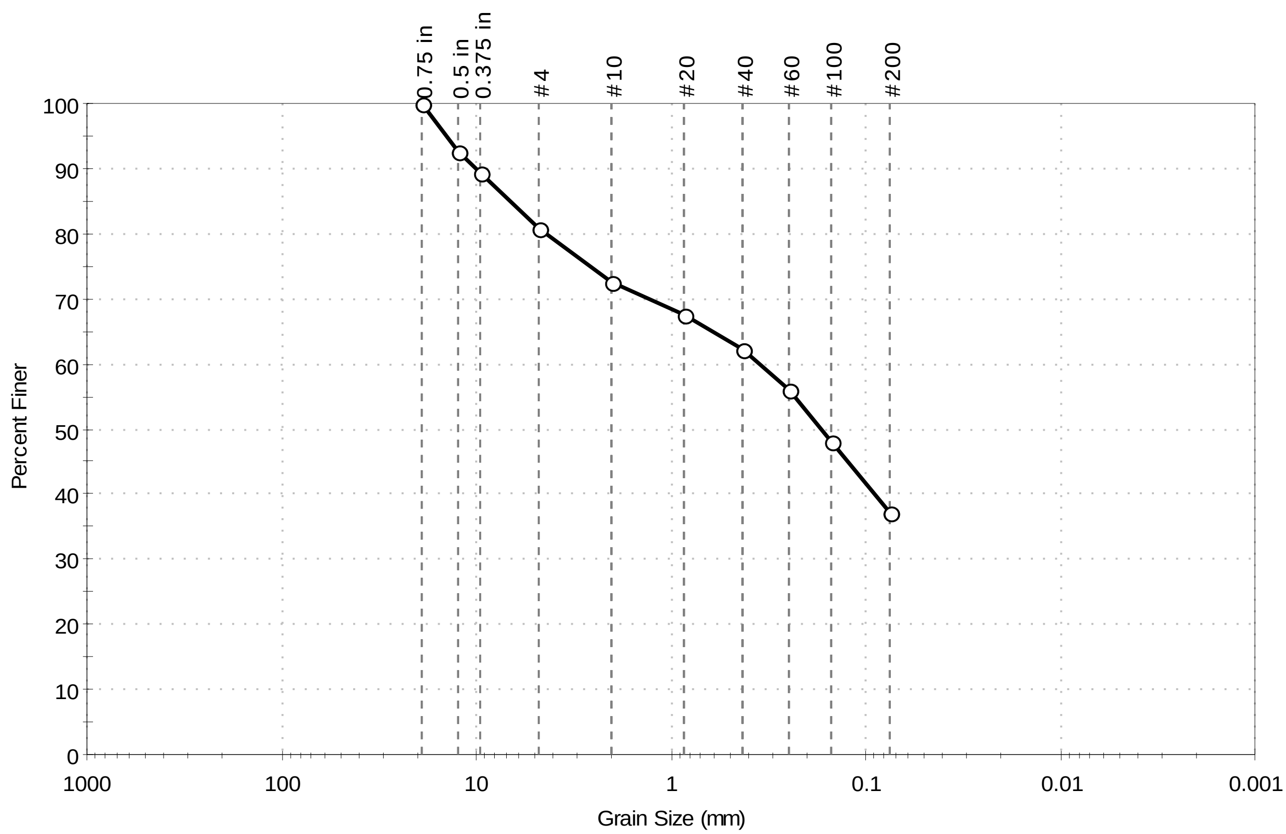
GeoTesting EXPRESS

Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-07	Sample Type: bag	Tested By:	jbr
Sample ID: SS01	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315514		
Test Comment: ---			
Sample Description: Moist, brown silty sand with gravel			
Sample Comment: ---			

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	19.1	43.8	37.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	92		
0.375 in	9.50	89		
#4	4.75	81		
#10	2.00	73		
#20	0.85	68		
#40	0.42	62		
#60	0.25	56		
#100	0.15	48		
#200	0.075	37		

Coefficients

D_{85} = 6.6544 mm D_{30} = N/A

D_{60} = 0.3506 mm D_{15} = N/A

D_{50} = 0.1688 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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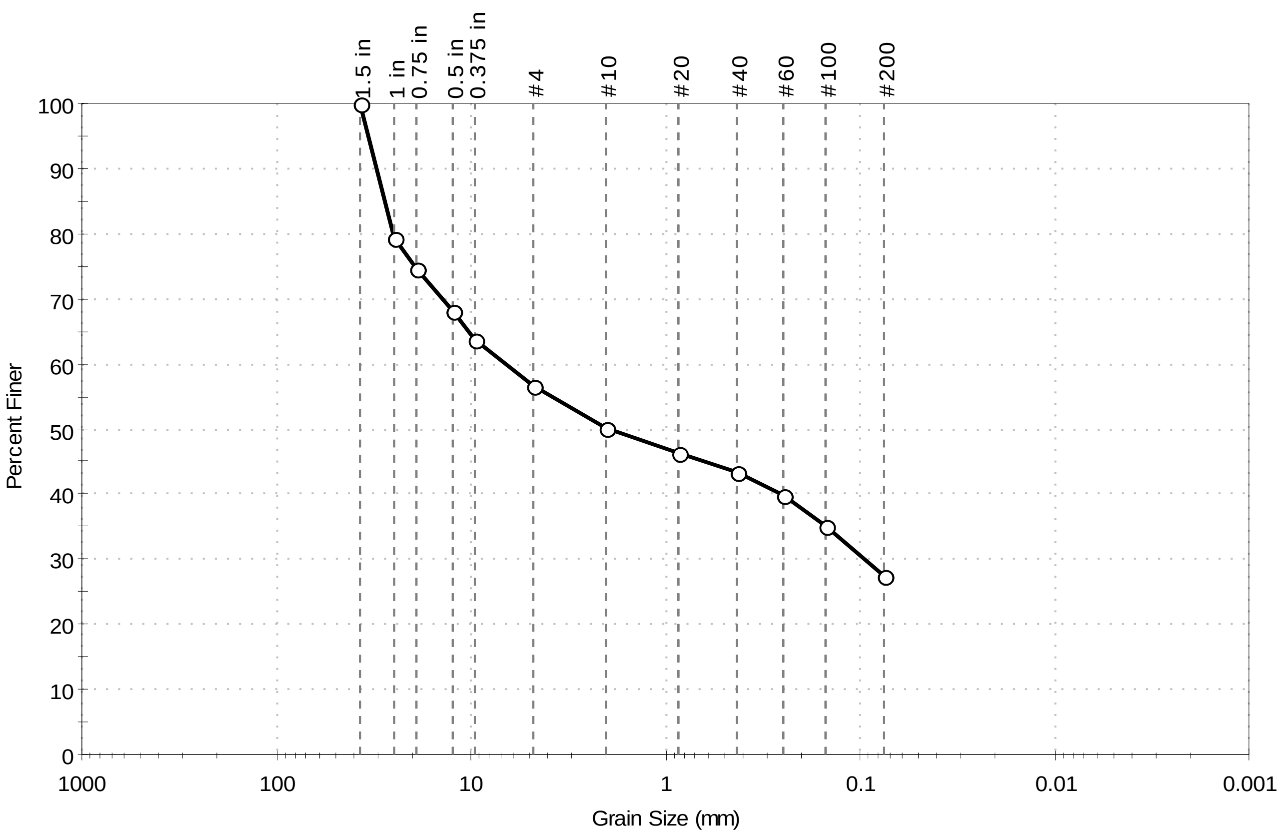
GeoTesting EXPRESS

Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-08	Sample Type: bag	Tested By:	jbr
Sample ID: SS01	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315515		

Test Comment: ---
Sample Description: Moist, light yellowish brown silty gravel with sand
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	43.4	29.3	27.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	79		
0.75 in	19.00	75		
0.5 in	12.50	68		
0.375 in	9.50	64		
#4	4.75	57		
#10	2.00	50		
#20	0.85	46		
#40	0.42	43		
#60	0.25	40		
#100	0.15	35		
#200	0.075	27		

Coefficients

D_{85} = 27.8977 mm | D_{30} = 0.0955 mm
D_{60} = 6.6315 mm | D_{15} = N/A
D_{50} = 1.9680 mm | D_{10} = N/A
C_u = N/A | C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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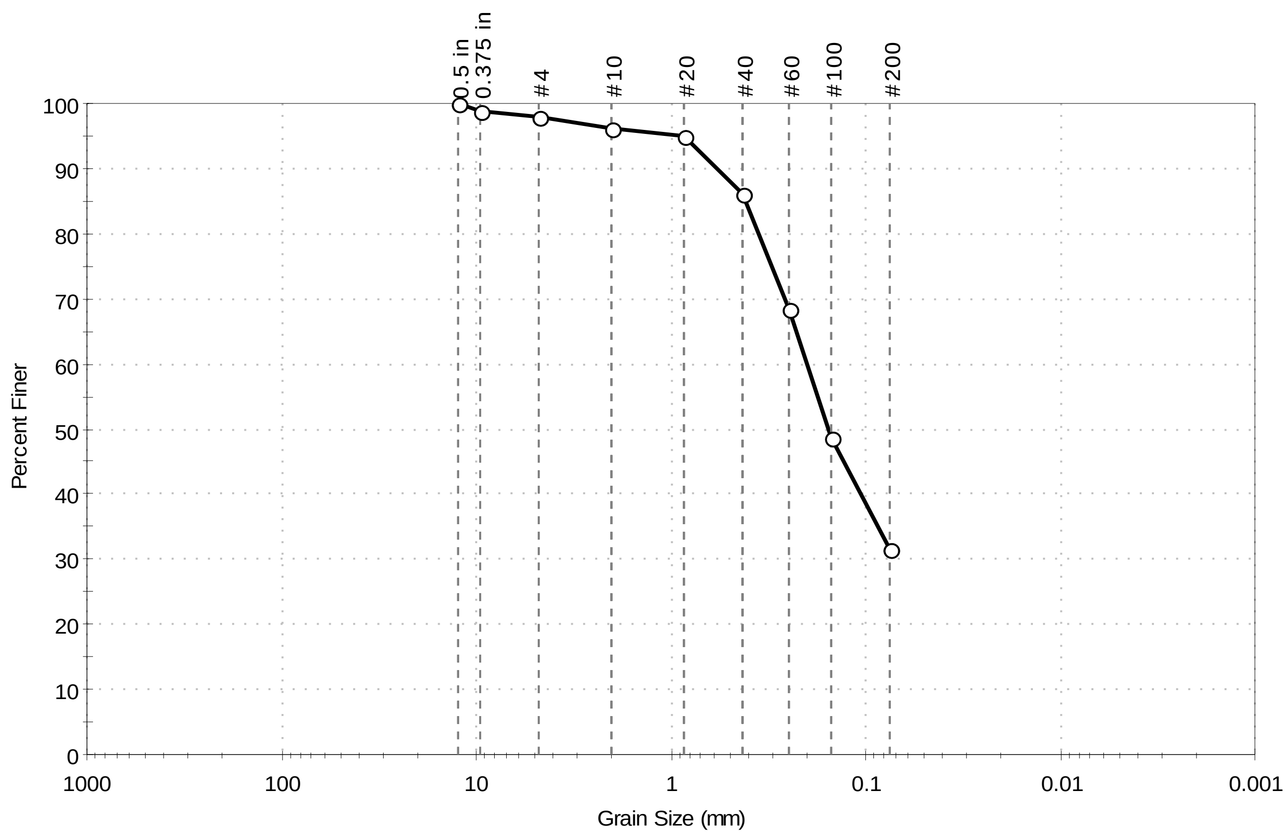
Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	AQSB-08	Sample Type:	bag	Tested By:	jbr
Sample ID:	SS03	Test Date:	12/01/14	Checked By:	jdt
Depth :	---	Test Id:	315516		

Test Comment: ---
Sample Description: Moist, brown silty sand
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	2.1	66.3	31.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	99		
#4	4.75	98		
#10	2.00	96		
#20	0.85	95		
#40	0.42	86		
#60	0.25	68		
#100	0.15	49		
#200	0.075	32		

Coefficients

D_{85} = 0.4111 mm D_{30} = N/A
D_{60} = 0.2012 mm D_{15} = N/A
D_{50} = 0.1549 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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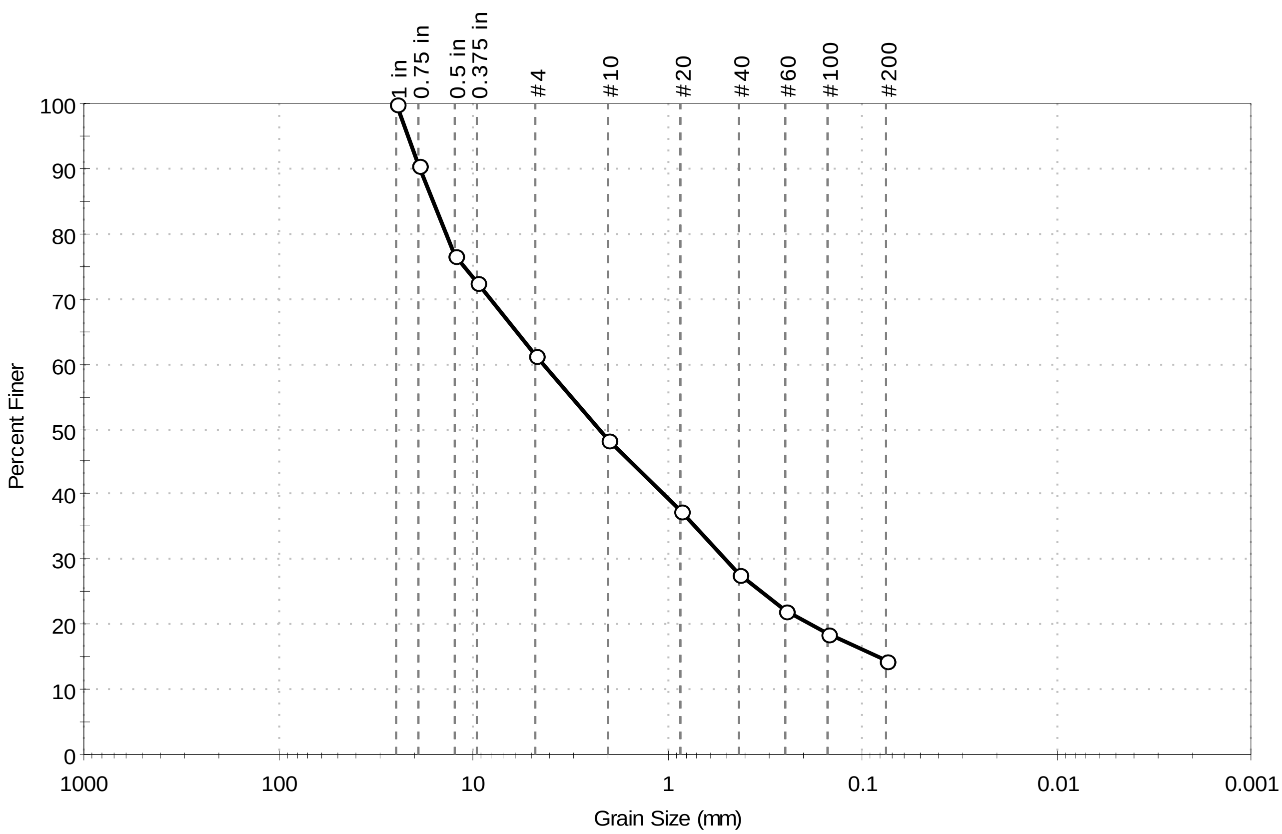
Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	AQSB-08	Sample Type:	bag	Tested By:	jbr
Sample ID:	SS04	Test Date:	12/02/14	Checked By:	jdt
Depth :	---	Test Id:	315517		

Test Comment: ---
Sample Description: Moist, brown silty sand with gravel
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	38.5	47.0	14.5

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	91		
0.5 in	12.50	77		
0.375 in	9.50	73		
#4	4.75	61		
#10	2.00	48		
#20	0.85	37		
#40	0.42	28		
#60	0.25	22		
#100	0.15	19		
#200	0.075	14		

Coefficients

D_{85} = 16.0455 mm
D_{30} = 0.4975 mm
D_{60} = 4.2995 mm
D_{15} = 0.0819 mm
D_{50} = 2.2122 mm
D_{10} = N/A
C_u = N/A
C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-a (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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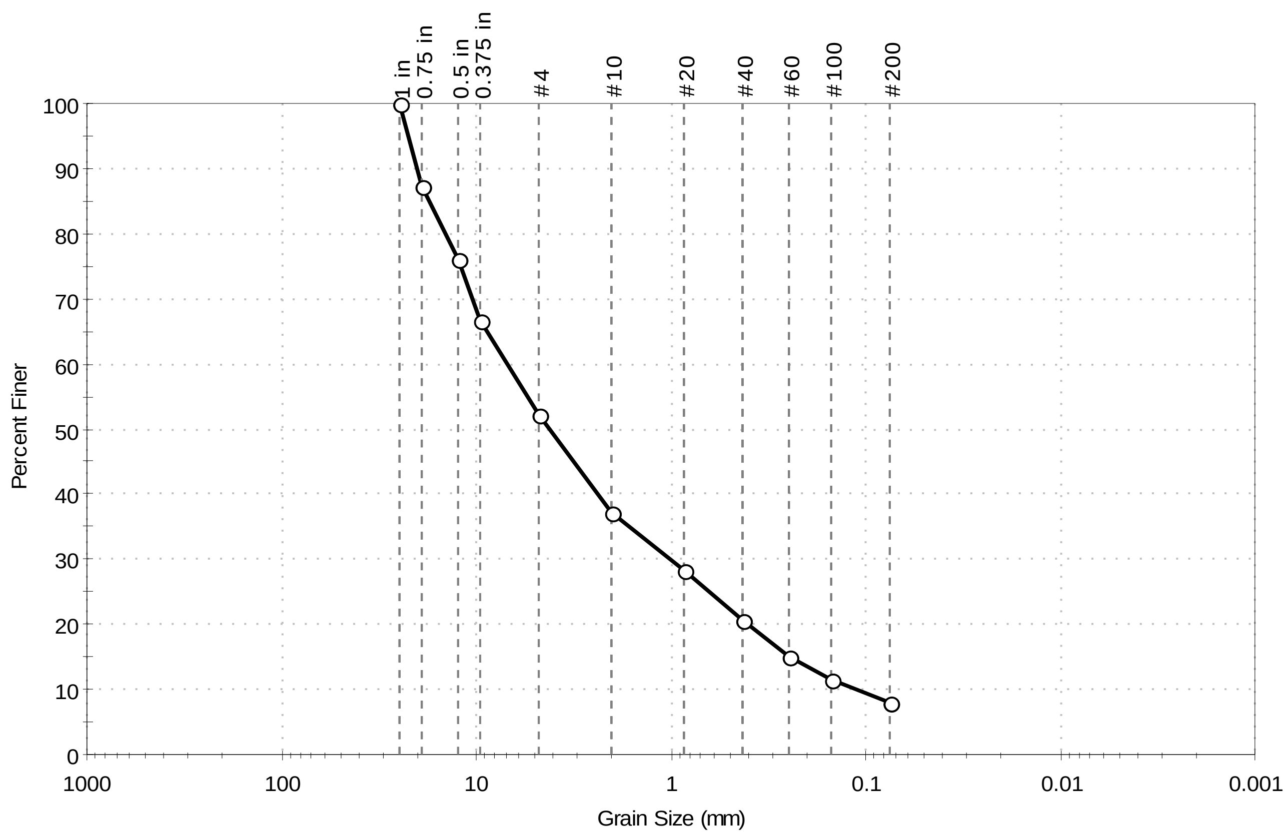
Client:	Anchor QEA, LLC			
Project:	South River			
Location:	---		Project No:	GTX-302574
Boring ID:	AQSB-08	Sample Type: bag	Tested By:	jbr
Sample ID:	SS05	Test Date: 12/02/14	Checked By:	jdt
Depth :	---	Test Id: 315518		

Test Comment: ---
Sample Description: Moist, brown gravel with silt and sand
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	47.8	44.2	8.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	87		
0.5 in	12.50	76		
0.375 in	9.50	67		
#4	4.75	52		
#10	2.00	37		
#20	0.85	28		
#40	0.42	21		
#60	0.25	15		
#100	0.15	11		
#200	0.075	8.0		

Coefficients

D_{85} = 17.3739 mm
D_{30} = 0.9957 mm
D_{60} = 6.8864 mm
D_{15} = 0.2452 mm
D_{50} = 4.1927 mm
D_{10} = 0.1130 mm
C_u = 60.942
C_c = 1.274

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-a (1))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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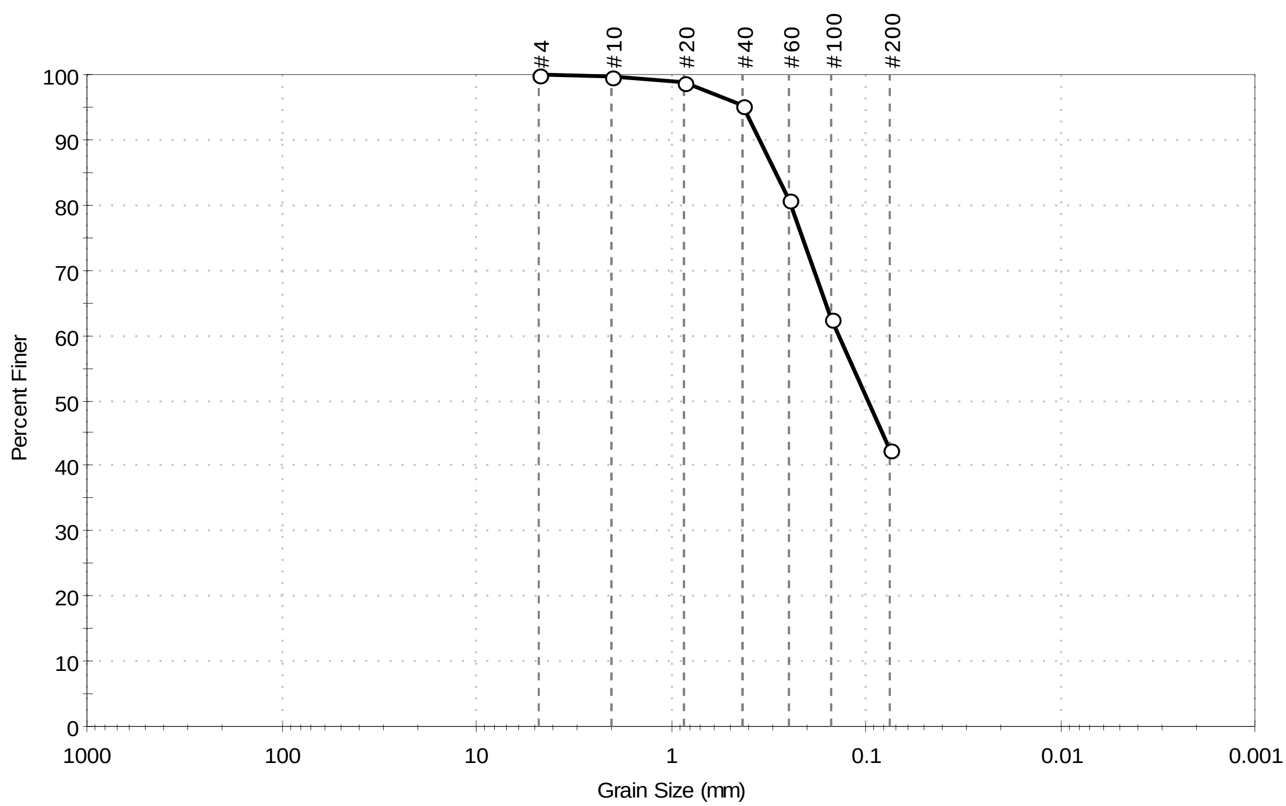
Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID: AQSB-09	Sample Type: bag	Tested By:	jbr
Sample ID: SS02	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315519		
Test Comment:	---		
Sample Description:	Moist, brown silty sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	57.7	42.3

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	95		
#60	0.25	81		
#100	0.15	62		
#200	0.075	42		

Coefficients

D_{85} = 0.2921 mm | D_{30} = N/A

D_{60} = 0.1380 mm | D_{15} = N/A

D_{50} = 0.0977 mm | D_{10} = N/A

C_u = N/A | C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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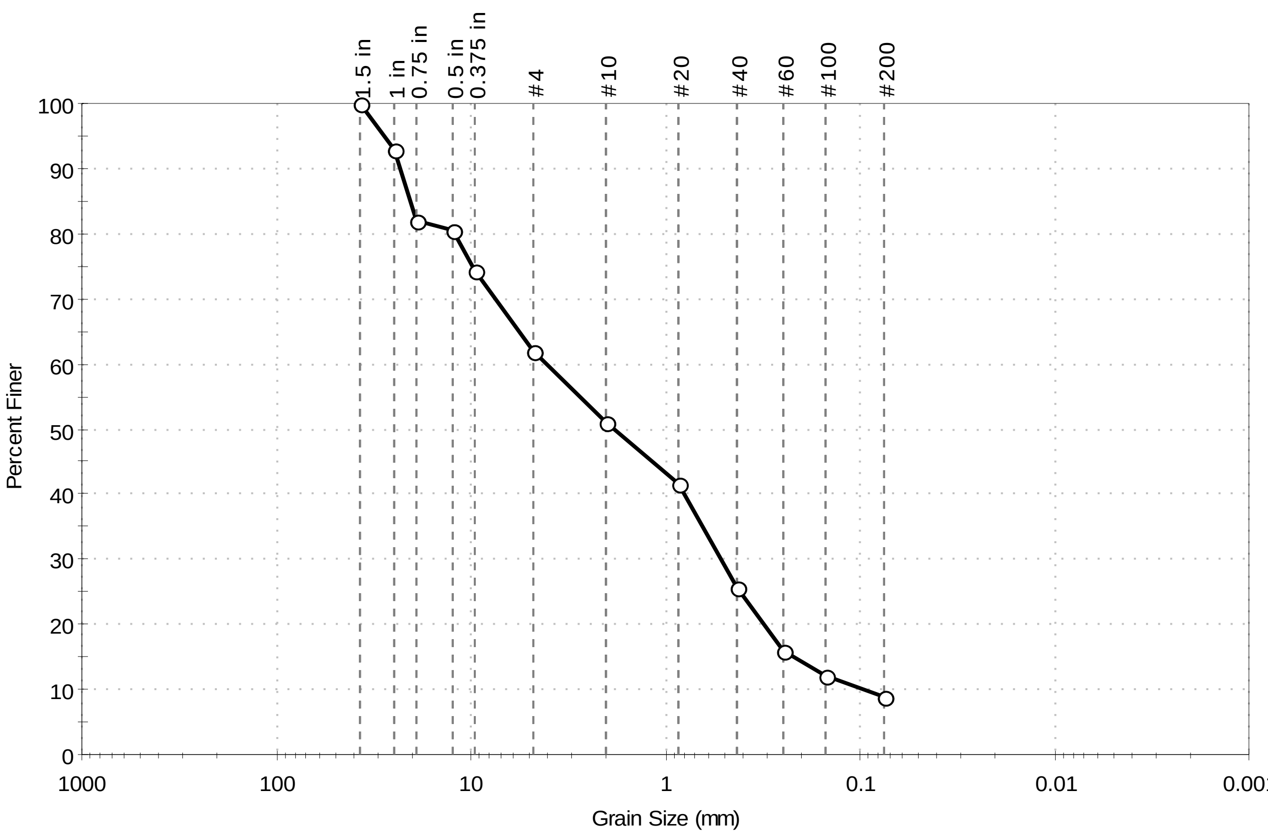
Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	AQSB-09	Sample Type:	bag	Tested By:	jbr
Sample ID:	SS04	Test Date:	12/02/14	Checked By:	jdt
Depth :	---	Test Id:	315520		

Test Comment: ---
Sample Description: Moist, brown sand with silt and gravel
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	38.1	53.0	8.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	93		
0.75 in	19.00	82		
0.5 in	12.50	81		
0.375 in	9.50	74		
#4	4.75	62		
#10	2.00	51		
#20	0.85	42		
#40	0.42	26		
#60	0.25	16		
#100	0.15	12		
#200	0.075	8.9		

Coefficients

D_{85} = 20.4706 mm　　D_{30} = 0.5138 mm
D_{60} = 4.0896 mm　　D_{15} = 0.2202 mm
D_{50} = 1.8063 mm　　D_{10} = 0.0966 mm
C_u = 42.335　　C_c = 0.668

Classification

ASTM　N/A

AASHTO　Stone Fragments, Gravel and Sand (A-1-b (1))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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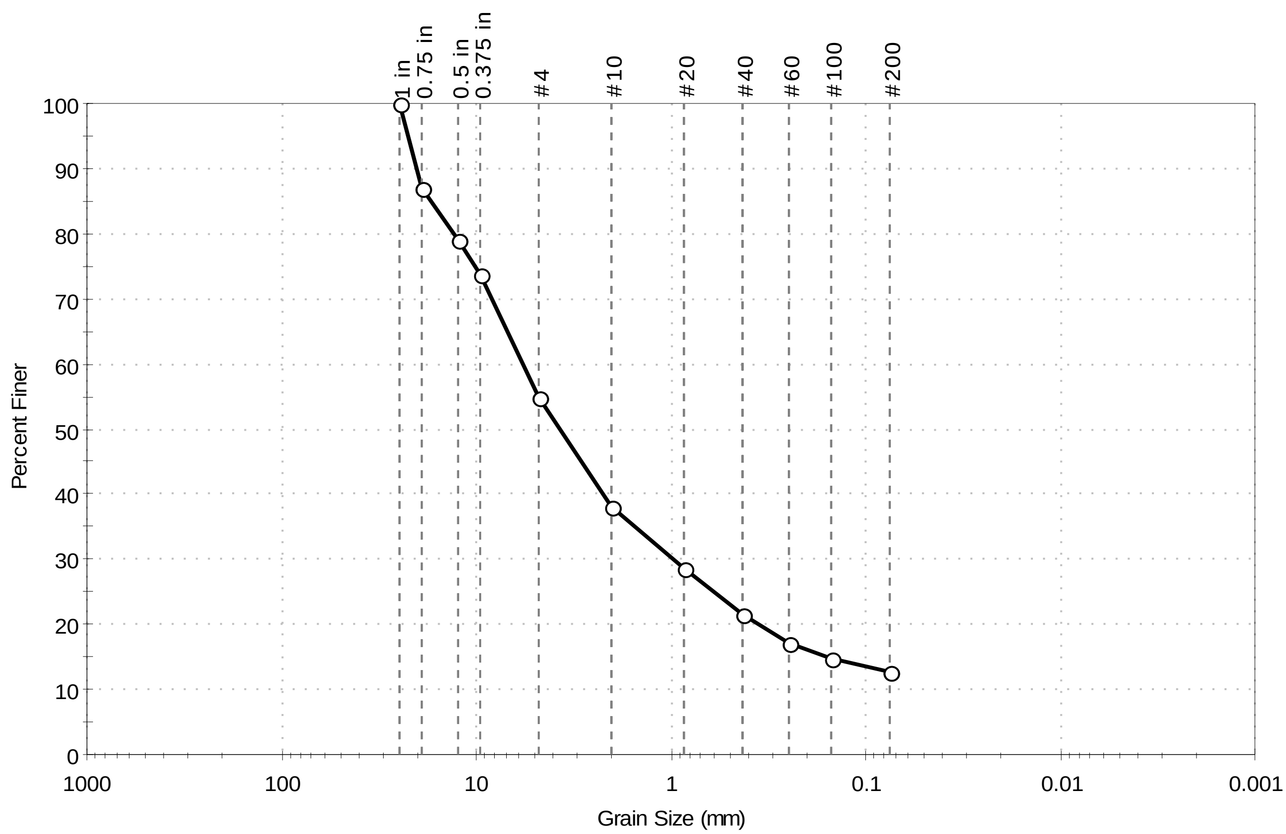
Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	AQSB-09	Sample Type:	bag	Tested By:	jbr
Sample ID:	SS06	Test Date:	12/02/14	Checked By:	jdt
Depth :	---	Test Id:	315521		

Test Comment: ---
Sample Description: Wet, olive silty gravel with sand
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	45.2	42.2	12.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	87		
0.5 in	12.50	79		
0.375 in	9.50	74		
#4	4.75	55		
#10	2.00	38		
#20	0.85	29		
#40	0.42	21		
#60	0.25	17		
#100	0.15	15		
#200	0.075	13		

Coefficients

D_{85} = 17.0003 mm　　D_{30} = 0.9697 mm
D_{60} = 5.7447 mm　　D_{15} = 0.1561 mm
D_{50} = 3.7186 mm　　D_{10} = N/A
C_u = N/A　　C_c = N/A

Classification

ASTM　N/A

AASHTO　Stone Fragments, Gravel and Sand (A-1-a (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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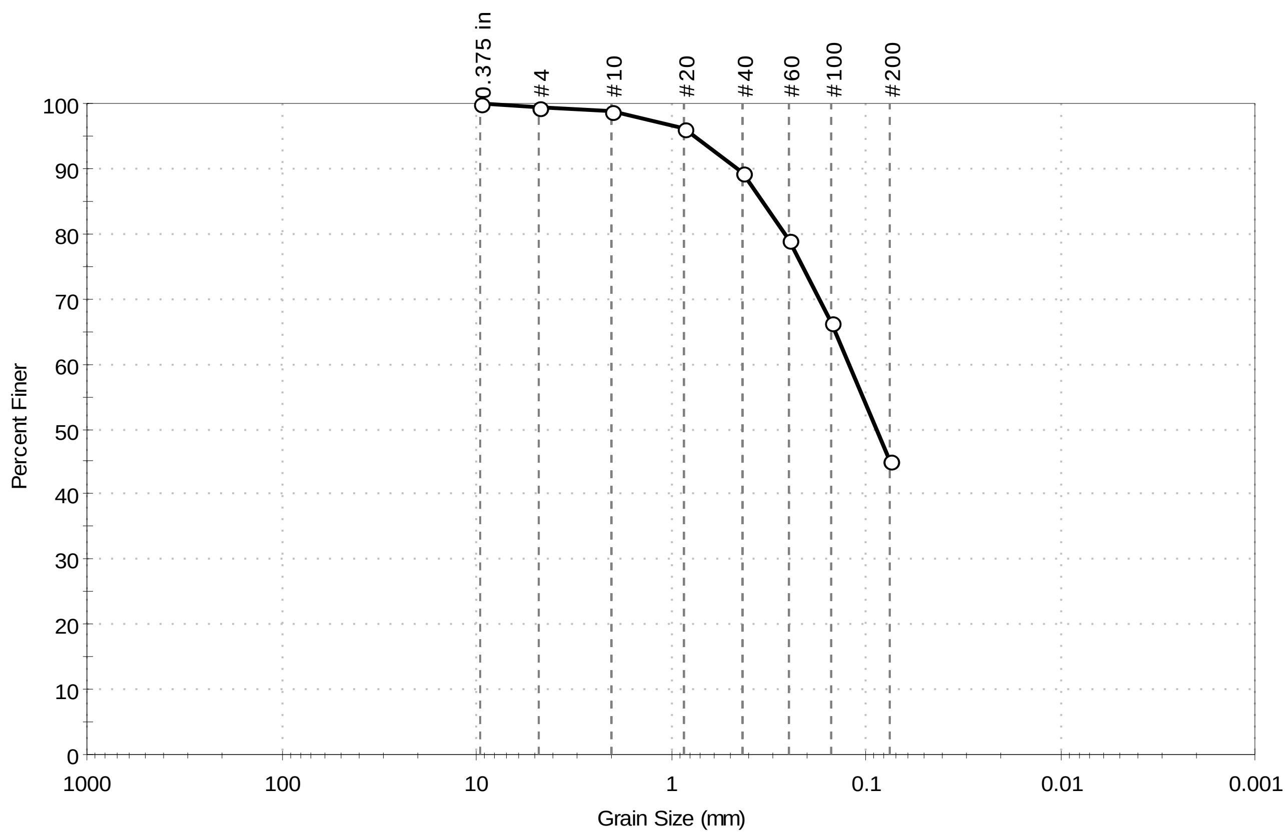
GeoTesting EXPRESS

Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-10	Sample Type: bag	Tested By:	jbr
Sample ID: SS01	Test Date: 12/01/14	Checked By:	jdt
Depth : ---	Test Id: 315522		
Test Comment: ---			
Sample Description: Moist, brown silty sand			
Sample Comment: ---			

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.5	54.4	45.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	99		
#20	0.85	96		
#40	0.42	89		
#60	0.25	79		
#100	0.15	66		
#200	0.075	45		

Coefficients

D_{85} = 0.3399 mm | D_{30} = N/A

D_{60} = 0.1219 mm | D_{15} = N/A

D_{50} = 0.0881 mm | D_{10} = N/A

C_u = N/A | C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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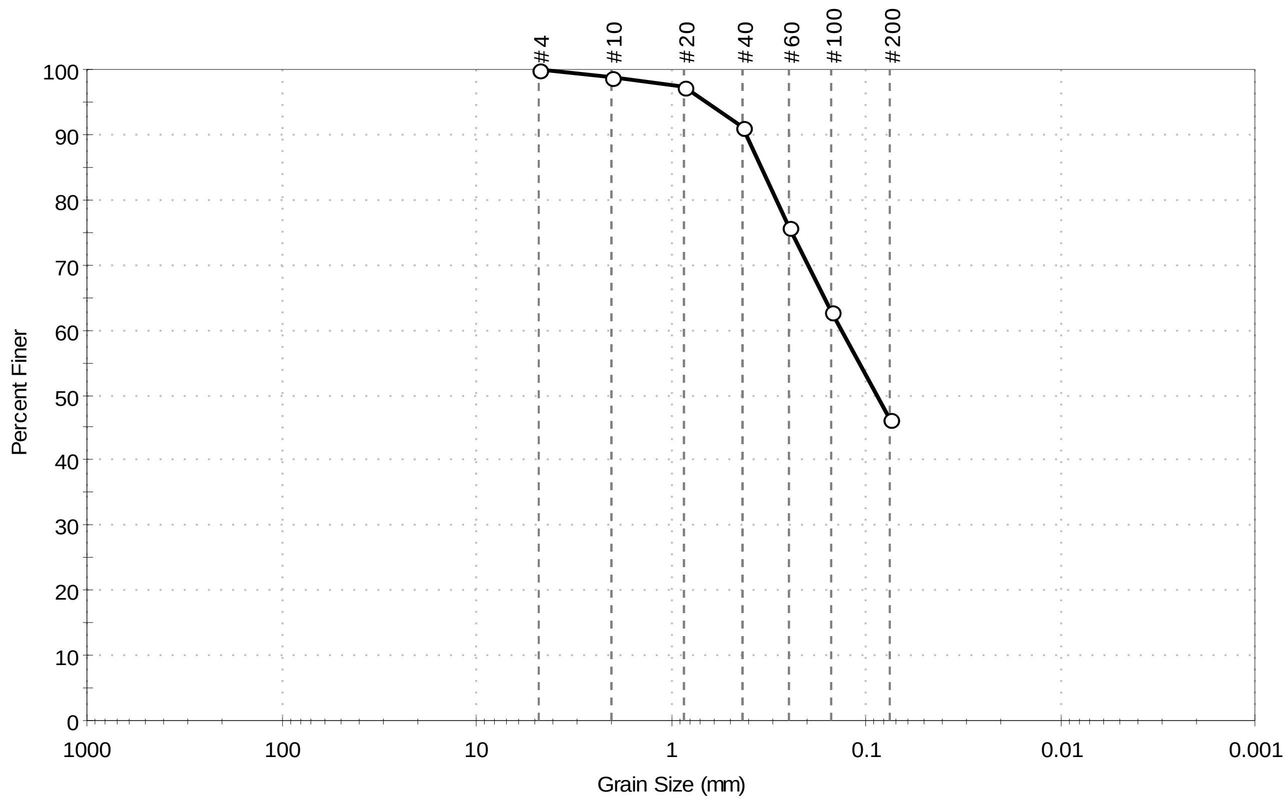
Client:	Anchor QEA, LLC			
Project:	South River			
Location:	---		Project No:	GTX-302574
Boring ID: AQSB-10		Sample Type: bag	Tested By:	jbr
Sample ID: SS03		Test Date: 12/01/14	Checked By:	jdt
Depth : ---		Test Id: 315523		
Test Comment:	---			
Sample Description:	Moist, brown clayey sand			
Sample Comment:	---			

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	53.6	46.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	99		
#20	0.85	97		
#40	0.42	91		
#60	0.25	76		
#100	0.15	63		
#200	0.075	46		

Coefficients

D_{85} = 0.3423 mm　　D_{30} = N/A

D_{60} = 0.1328 mm　　D_{15} = N/A

D_{50} = 0.0873 mm　　D_{10} = N/A

C_u = N/A　　C_c = N/A

Classification

ASTM　Clayey sand (SC)

AASHTO　Clayey Soils (A-7-6 (5))

Sample / Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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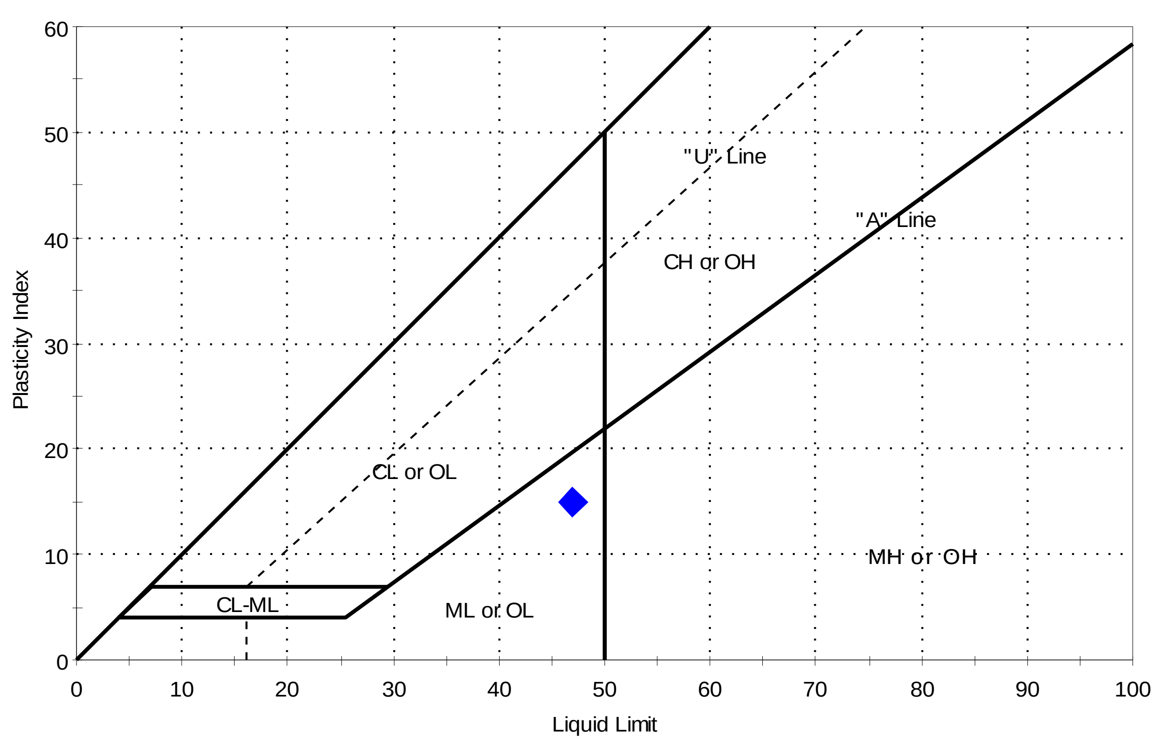
Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID: AQSB-01	Sample Type: bag	Tested By:	cam
Sample ID: SS06	Test Date: 12/05/14	Checked By:	jdt
Depth : ---	Test Id: 315524		
Test Comment:	---		
Sample Description:	Moist, brownish yellow silt		
Sample Comment:	---		

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS06	AQSB-01	---	36	47	32	15	0.3	

Sample Prepared using the WET method

Dry Strength: HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	AQSB-01	Sample Type:	tube	Tested By:	cam
Sample ID:	ST01	Test Date:	12/10/14	Checked By:	jdt
Depth :	---	Test Id:	315525		

Test Comment: ---
Sample Description: Moist, yellowish brown silty sand with gravel
Sample Comment: ---

Atterberg Limits - ASTM D4318

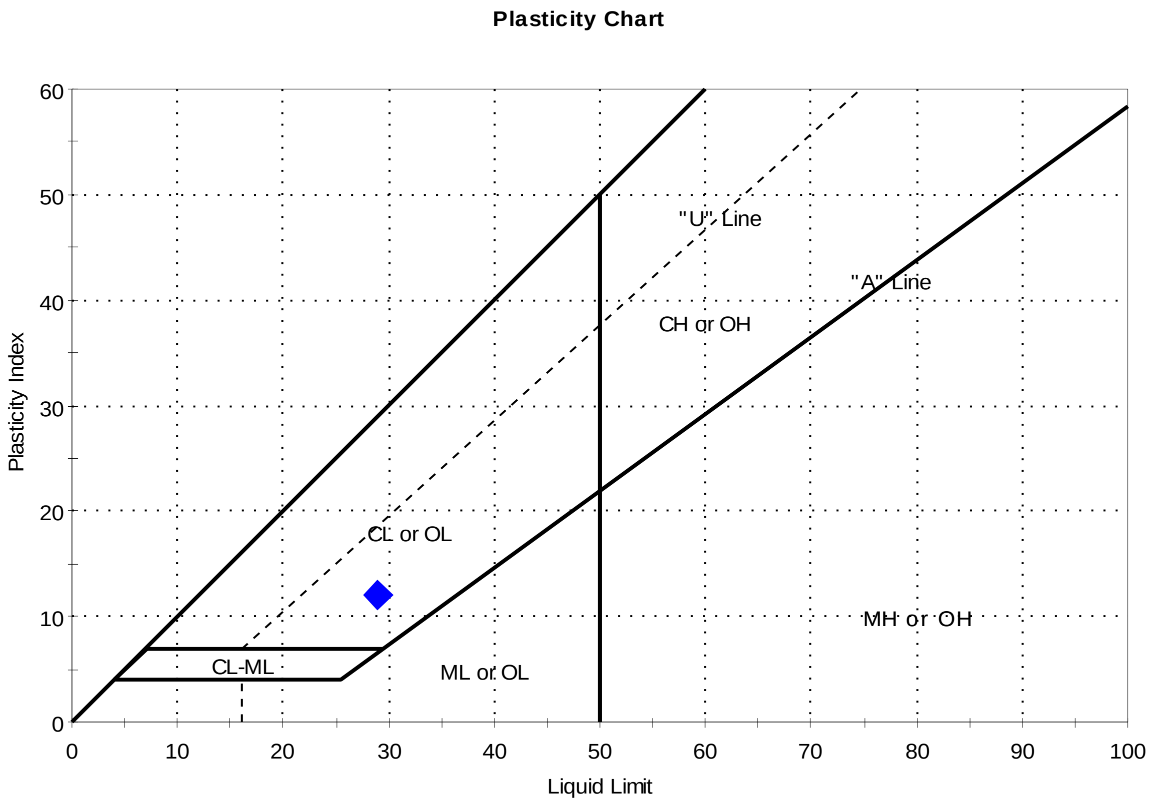
Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	ST01	AQSB-01	---	53	n/a	n/a	n/a	n/a	Silty sand with gravel (SM)

47% Retained on #40 Sieve
Dry Strength: LOW
Dilatancy: RAPID
Toughness: n/a
The sample was determined to be Non-Plastic

Client: Anchor QEA, LLC			
Project: South River			
Location: ---		Project No:	GTX-302574
Boring ID: AQSB-03	Sample Type: bag	Tested By:	cam
Sample ID: SS03	Test Date: 12/10/14	Checked By:	jdt
Depth : ---	Test Id: 315526		
Test Comment: ---			
Sample Description: Moist, brown clay			
Sample Comment: ---			

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS03	AQSB-03	---	19	29	17	12	0.2	

Sample Prepared using the WET method

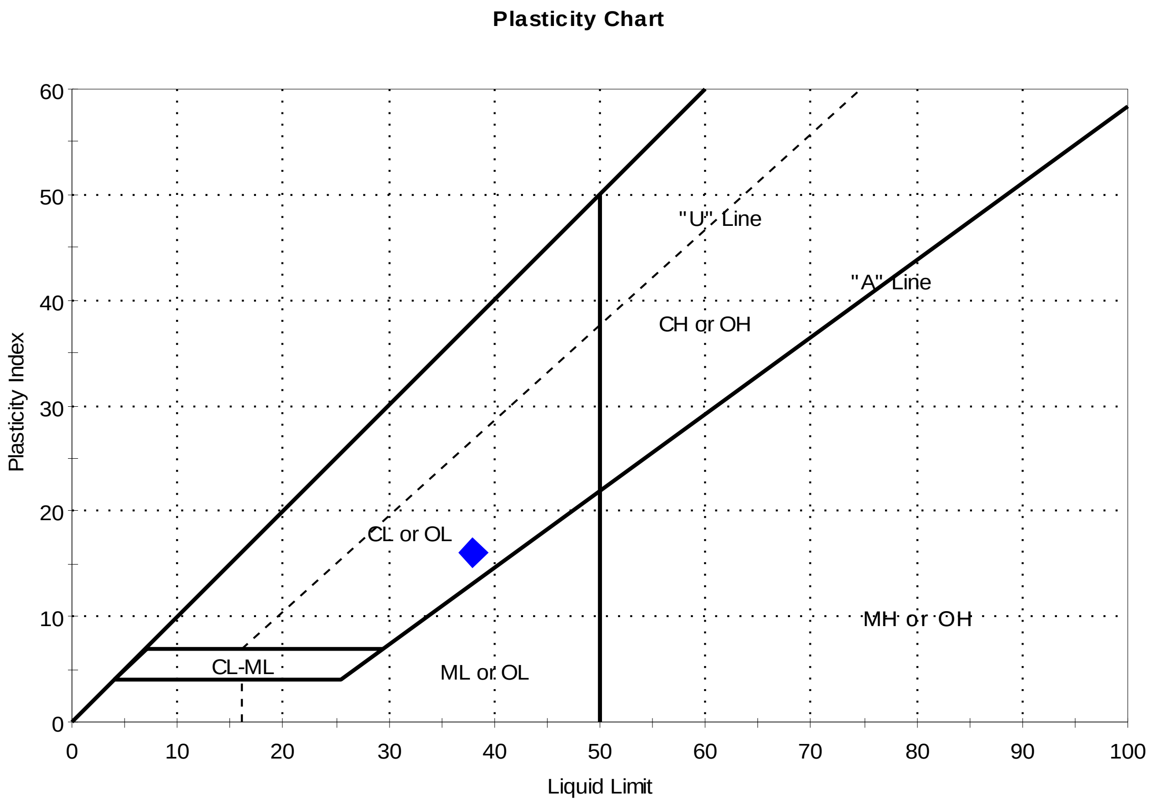
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Anchor QEA, LLC			
Project:	South River			
Location:	---		Project No:	GTX-302574
Boring ID: AQSB-06		Sample Type: bag	Tested By:	cam
Sample ID: SS06		Test Date: 12/09/14	Checked By:	jdt
Depth : ---		Test Id: 315527		
Test Comment:	---			
Sample Description:	Moist, dark grayish brown clay			
Sample Comment:	---			

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS06	AQSB-06	---	43	38	22	16	1.3	

Sample Prepared using the WET method

Dry Strength: HIGH

Dilatancy: SLOW

Toughness: LOW

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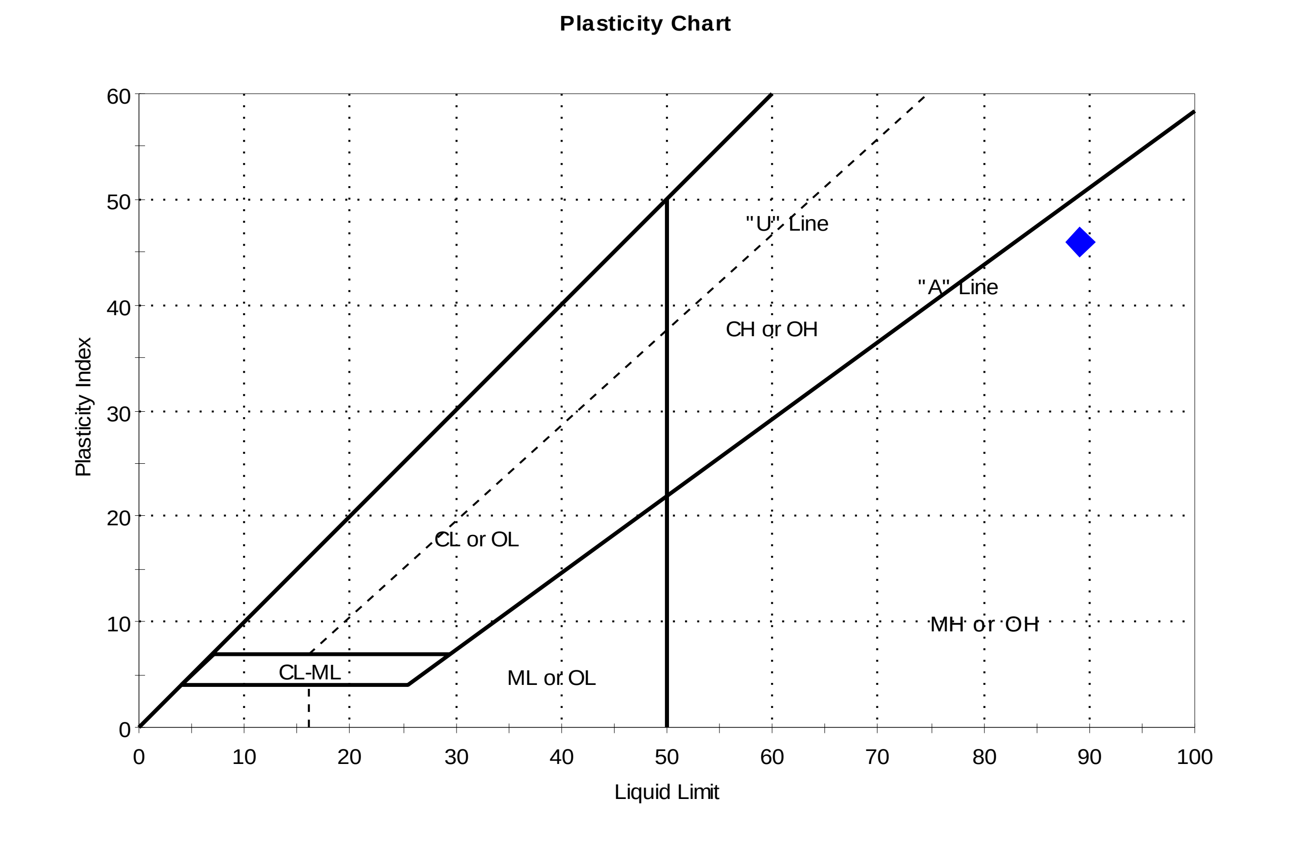
Client:	Anchor QEA, LLC		
Project:	South River		
Location:	---	Project No:	GTX-302574
Boring ID: AQSB-06	Sample Type: bag	Tested By:	cam
Sample ID: SS09	Test Date: 12/05/14	Checked By:	jdt
Depth : ---	Test Id: 315528		
Test Comment:	---		
Sample Description:	Moist, brownish yellow silt		
Sample Comment:	---		

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS09	AQSB-06	---	99	89	43	46	1.2	

Sample Prepared using the WET method

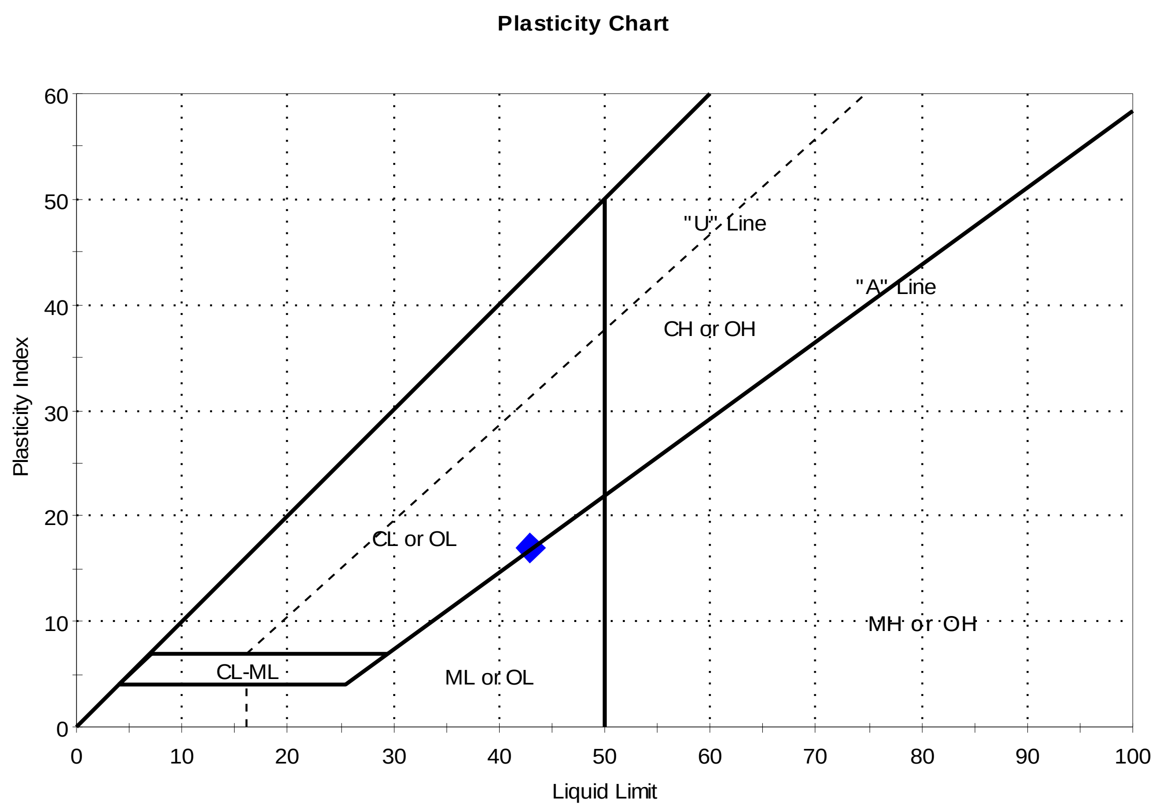
Dry Strength: MEDIUM

Dilatancy: SLOW

Toughness: LOW

Client:	Anchor QEA, LLC				
Project:	South River				
Location:	---			Project No:	GTX-302574
Boring ID:	AQSB-10	Sample Type:	bag	Tested By:	cam
Sample ID:	SS03	Test Date:	12/08/14	Checked By:	jdt
Depth :	---	Test Id:	315529		
Test Comment:	---				
Sample Description:	Moist, brown clayey sand				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	SS03	AQSB-10	---	30	43	26	17	0.2	Clayey sand (SC)

Sample Prepared using the WET method

9% Retained on #40 Sieve

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

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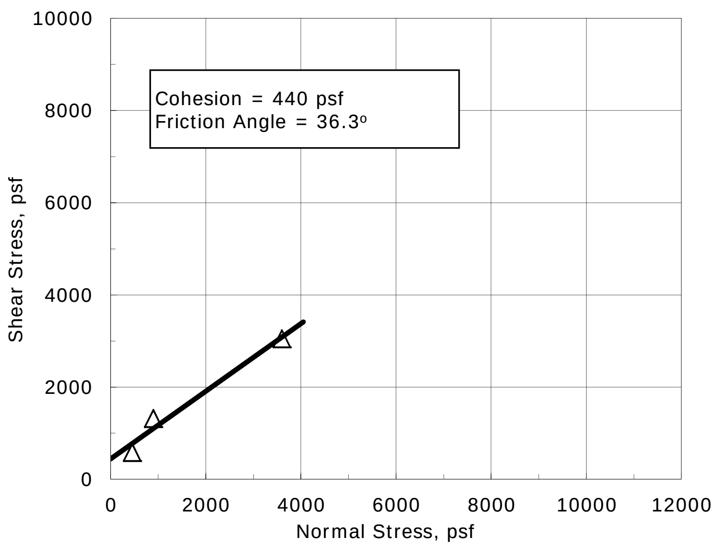
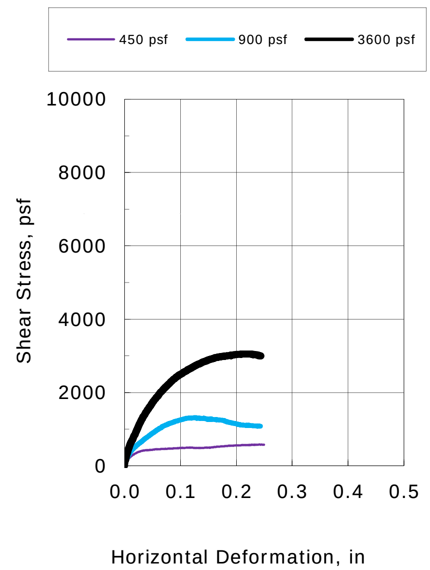
Client:	Anchor QEA, LLC
Project Name:	South River
Project Location:	---
GTX #:	302574
Test Date:	12/8/2014
Tested By:	md
Checked By:	jdt
Boring ID:	AQSB-01
Sample ID:	ST01
Depth, ft:	---
Visual Description:	Moist, yellowish brown silty sand with gravel

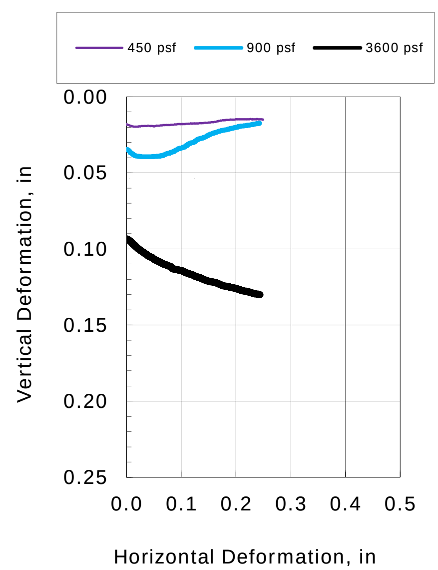
Direct Shear Test of Soils Under Consolidated Drained Conditions by ASTM D3080





Test No.:	DS-1	DS-2	DS-4	
Initial Diameter, in:	2.5	2.5	2.5	
Initial Height, in:	1.0	1.0	1.0	
Initial Mass, grams:	158.9	153.6	121.6	
Initial Dry Density, pcf:	93.8	96.4	61.1	
Initial Moisture Content, %:	29.8	23.7	63.6	
Initial Bulk Density, pcf:	122	119	100	
Initial Degree of Saturation:	98.7	83.4	96.7	
Initial Void Ratio:	0.83	0.78	1.81	
Final Dry Density, pcf:	95.2	98.1	70.2	
Final Moisture Content, %:	21.4	35.5	46.8	
Final Bulk Density, pcf:	116	133	103	
Normal Stress, psf:	450	900	3600	
Maximum Shear Stress, psf:	582	1320	3050	
Shear Rate, in/min:	0.0004	0.0004	0.0004	

Sample Type:	intact
Measured Specific Gravity:	2.75
Liquid Limit:	Non-Plastic
Plastic Limit:	Non-Plastic
Plasticity Index:	Non-Plastic
% Passing #200 sieve:	43.2
Soil Classification:	Silty Sand with Gravel
Group Symbol:	SM

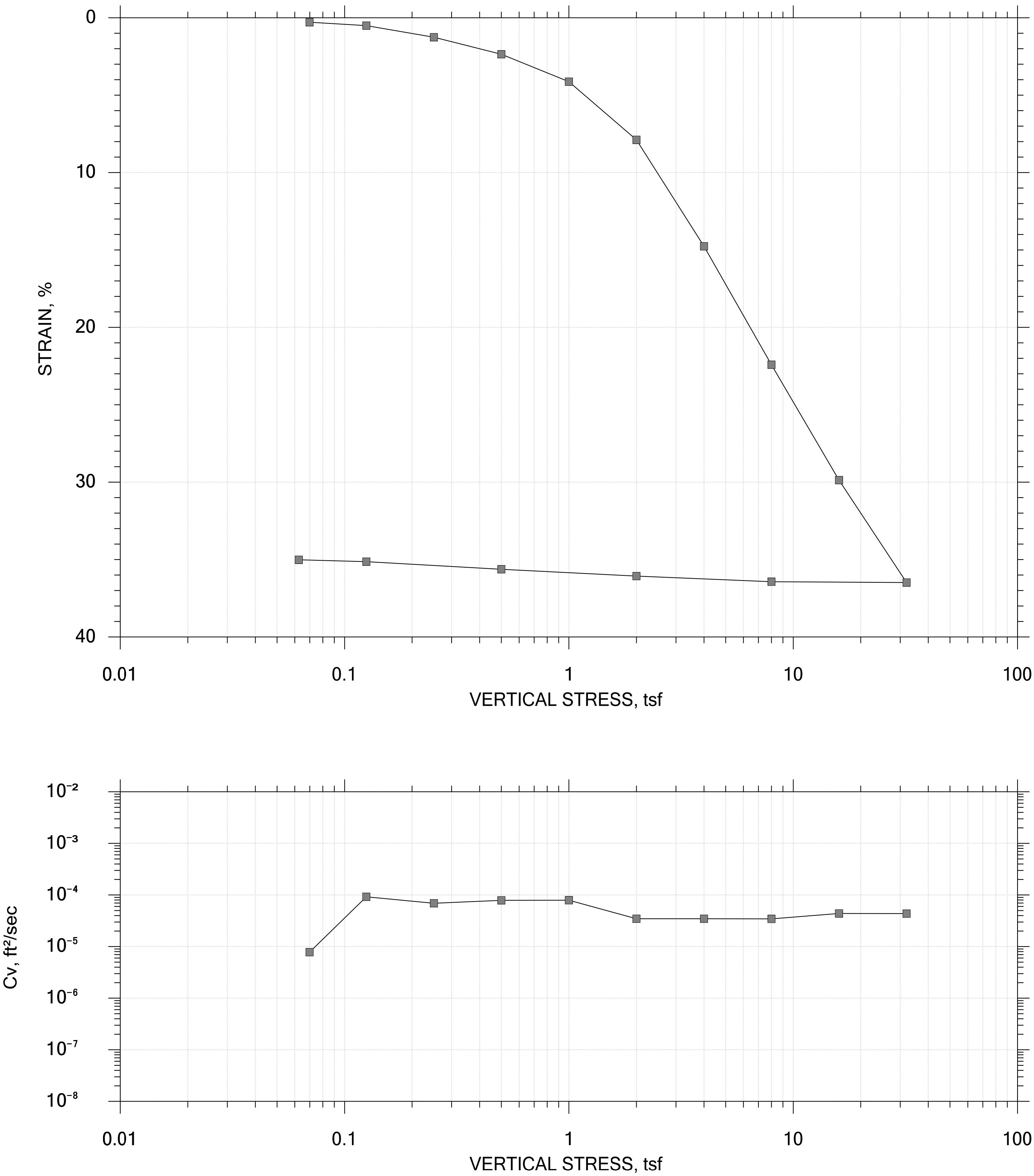


Notes: Moisture content obtained before shear from sample trimmings
Moisture Content determined by ASTM D2216
Specific Gravity determined by ASTM D854
Atterberg Limits determined by ASTM D4318
% Passing #200 Sieve determined by ASTM D422

Values for cohesion and friction angle determined from best-fit straight line to the data for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site-specific conditions.
"---" indicates testing required to determine these values was not requested.

One-Dimensional Consolidation by ASTM D2435 - Method B

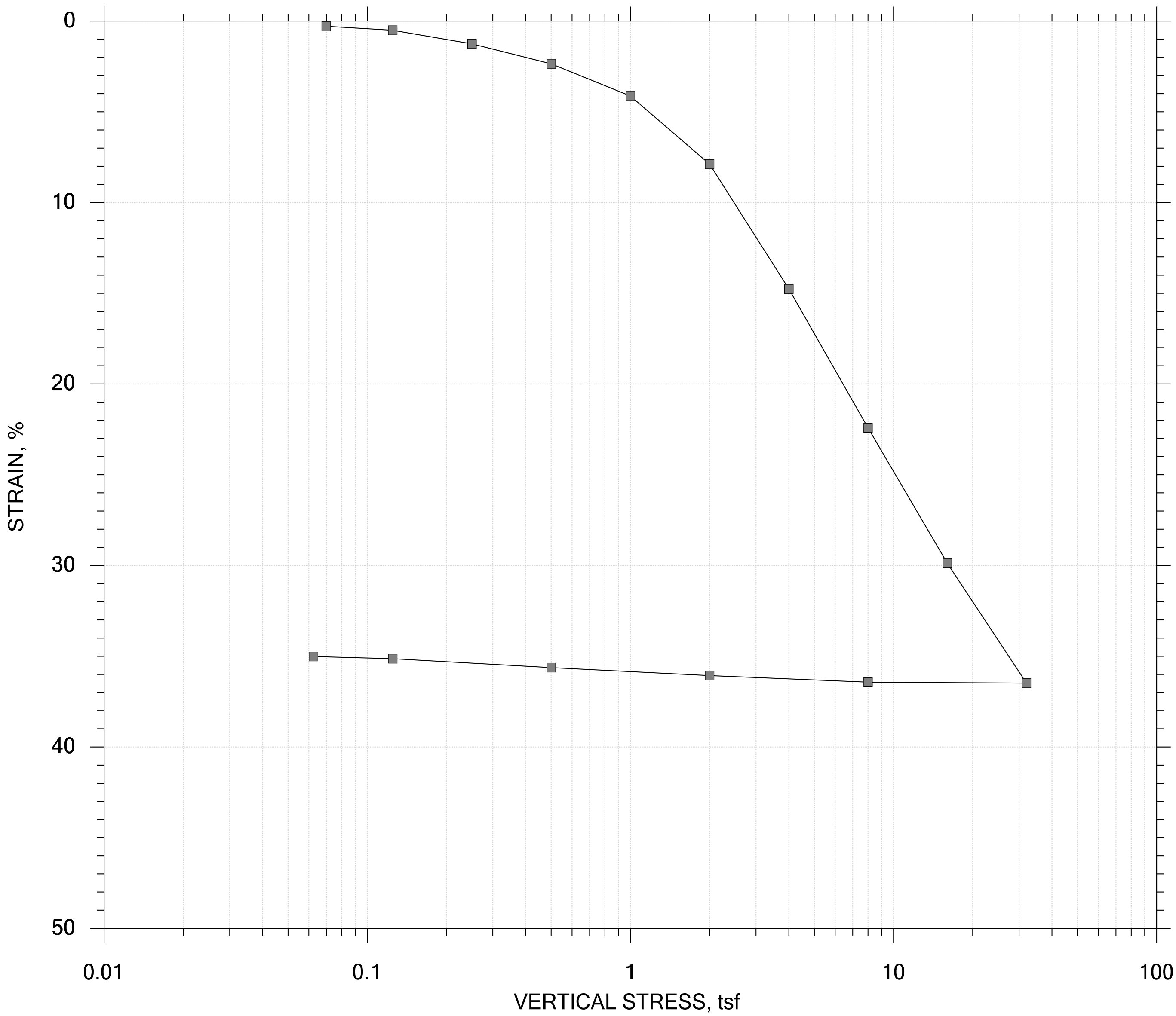
SUMMARY REPORT



GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT



					Before Test	After Test
Current Vertical Effective Stress: ---				Water Content, %	79.06	40.81
Preconsolidation Stress: ---				Dry Unit Weight, pcf	51.769	80.889
Compression Ratio: ---				Saturation, %	93.86	100.00
Diameter: 2.5 in		Height: 1 in		Void Ratio	2.32	1.12
LL: NP	PL: NP	PI: NP	GS: 2.75			

GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: South River	Location: ---	Project No.: GTX-302574
Boring No.: AQSB-01	Tested By: md	Checked By: jdt
Sample No.: ST01	Test Date: 12/01/14	Depth: ---
Test No.: IP-1	Sample Type: intact	Elevation: ---

Soil Description: Moist, yellowish brown silty sand with gravel
Remarks: System O, Swell Pressure = 0.0698 tsf

Measured Specific Gravity: 2.75	Liquid Limit: NP	Specimen Diameter: 2.50 in
Initial Void Ratio: 2.32	Plastic Limit: NP	Initial Height: 1.00 in
Final Void Ratio: 1.12	Plasticity Index: NP	Final Height: 0.64 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	14752	RING		15308
Wt. Container + Wet Soil, gm	55.800	228.27	202.76	103.85
Wt. Container + Dry Soil, gm	38.370	175.54	175.54	76.240
Wt. Container, gm	9.1000	108.83	108.83	8.5900
Wt. Dry Soil, gm	29.270	66.705	66.705	67.650
Water Content, %	59.55	79.06	40.81	40.81
Void Ratio	---	2.32	1.12	---
Degree of Saturation, %	---	93.86	100.00	---
Dry Unit Weight, pcf	---	51.769	80.889	---

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: South River
Boring No.: AQSB-01
Sample No.: ST01
Test No.: IP-1

Location: ---
Tested By: md
Test Date: 12/01/14
Sample Type: intact

Project No.: GTX-302574
Checked By: jdt
Depth: ---
Elevation: ---

Soil Description: Moist, yellowish brown silty sand with gravel
Remarks: System O, Swell Pressure = 0.0698 tsf

Displacement at End of Increment

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft²/sec	Mv 1/tsf	k ft/day
1	0.0698	0.002825	2.31	0.283	6.002	4.08e-006	4.05e-002	4.45e-004
2	0.125	0.005031	2.30	0.503	0.395	6.16e-005	4.00e-002	6.65e-003
3	0.250	0.01256	2.27	1.26	0.488	4.94e-005	6.03e-002	8.03e-003
4	0.500	0.02355	2.24	2.36	0.425	5.57e-005	4.40e-002	6.60e-003
5	1.00	0.04122	2.18	4.12	0.408	5.64e-005	3.53e-002	5.37e-003
6	2.00	0.07882	2.05	7.88	0.929	2.33e-005	3.76e-002	2.37e-003
7	4.00	0.1476	1.83	14.8	0.532	3.62e-005	3.44e-002	3.36e-003
8	8.00	0.2241	1.57	22.4	0.467	3.48e-005	1.91e-002	1.79e-003
9	16.0	0.2987	1.33	29.9	0.414	3.23e-005	9.32e-003	8.12e-004
10	32.0	0.3648	1.11	36.5	0.388	2.83e-005	4.13e-003	3.15e-004
11	8.00	0.3643	1.11	36.4	0.396	2.50e-005	2.19e-005	1.48e-006
12	2.00	0.3607	1.12	36.1	0.355	2.81e-005	6.02e-004	4.56e-005
13	0.500	0.3563	1.13	35.6	0.377	2.68e-005	2.93e-003	2.12e-004
14	0.125	0.3513	1.15	35.1	0.986	1.04e-005	1.32e-002	3.71e-004
15	0.0625	0.3501	1.16	35.0	22.429	4.61e-007	1.85e-002	2.30e-005

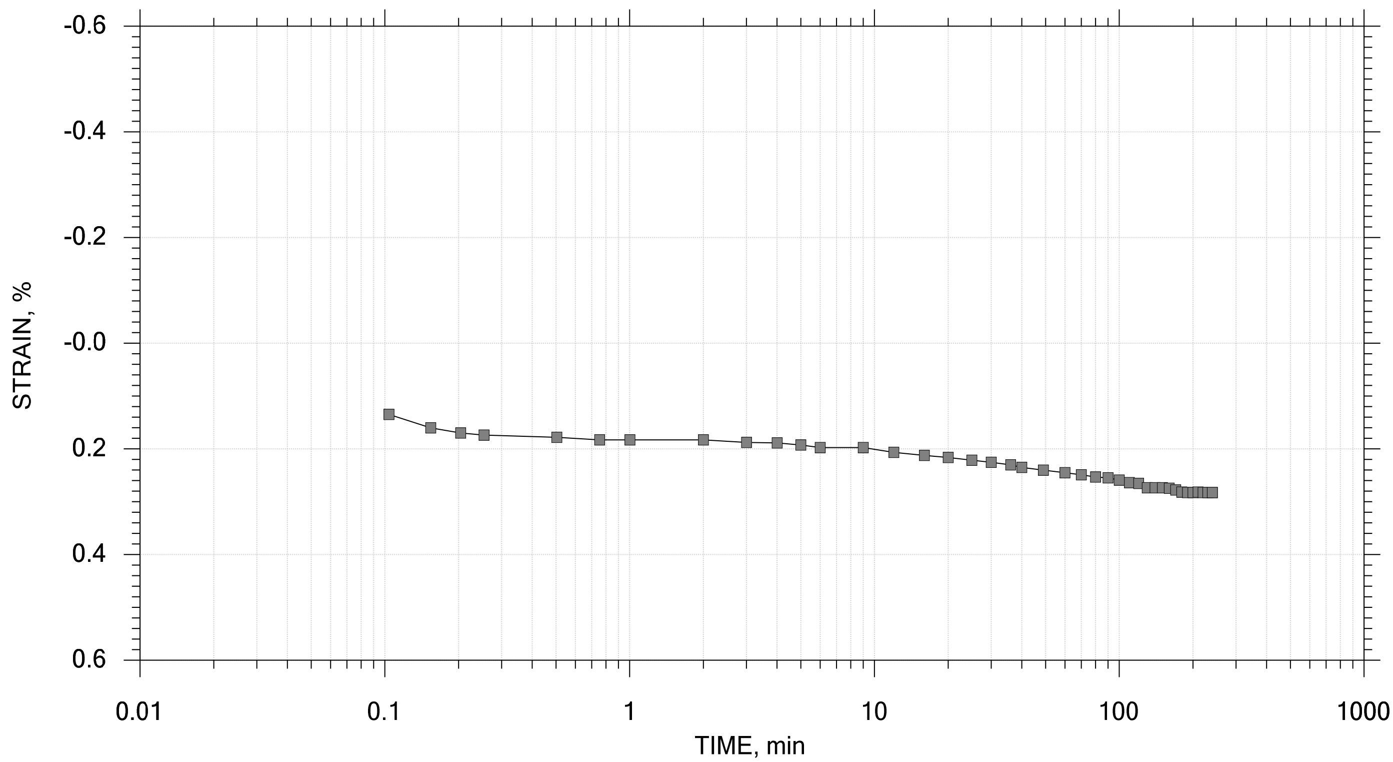
	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/sec	Mv 1/tsf	k ft/day	Ca %
1	0.0698	0.002825	2.31	0.283	0.000	0.00e+000	4.05e-002	0.00e+000	0.00e+000
2	0.125	0.005031	2.30	0.503	0.000	0.00e+000	4.00e-002	0.00e+000	0.00e+000
3	0.250	0.01256	2.27	1.26	0.000	0.00e+000	6.03e-002	0.00e+000	0.00e+000
4	0.500	0.02355	2.24	2.36	0.000	0.00e+000	4.40e-002	0.00e+000	0.00e+000
5	1.00	0.04122	2.18	4.12	0.000	0.00e+000	3.53e-002	0.00e+000	0.00e+000
6	2.00	0.07882	2.05	7.88	0.106	4.76e-005	3.76e-002	4.83e-003	0.00e+000
7	4.00	0.1476	1.83	14.8	0.135	3.32e-005	3.44e-002	3.08e-003	0.00e+000
8	8.00	0.2241	1.57	22.4	0.118	3.21e-005	1.91e-002	1.65e-003	0.00e+000
9	16.0	0.2987	1.33	29.9	0.000	0.00e+000	9.32e-003	0.00e+000	0.00e+000
10	32.0	0.3648	1.11	36.5	0.000	0.00e+000	4.13e-003	0.00e+000	0.00e+000
11	8.00	0.3643	1.11	36.4	0.000	0.00e+000	2.19e-005	0.00e+000	0.00e+000
12	2.00	0.3607	1.12	36.1	0.000	0.00e+000	6.02e-004	0.00e+000	0.00e+000
13	0.500	0.3563	1.13	35.6	0.000	0.00e+000	2.93e-003	0.00e+000	0.00e+000
14	0.125	0.3513	1.15	35.1	0.000	0.00e+000	1.32e-002	0.00e+000	0.00e+000
15	0.0625	0.3501	1.16	35.0	0.000	0.00e+000	1.85e-002	0.00e+000	0.00e+000

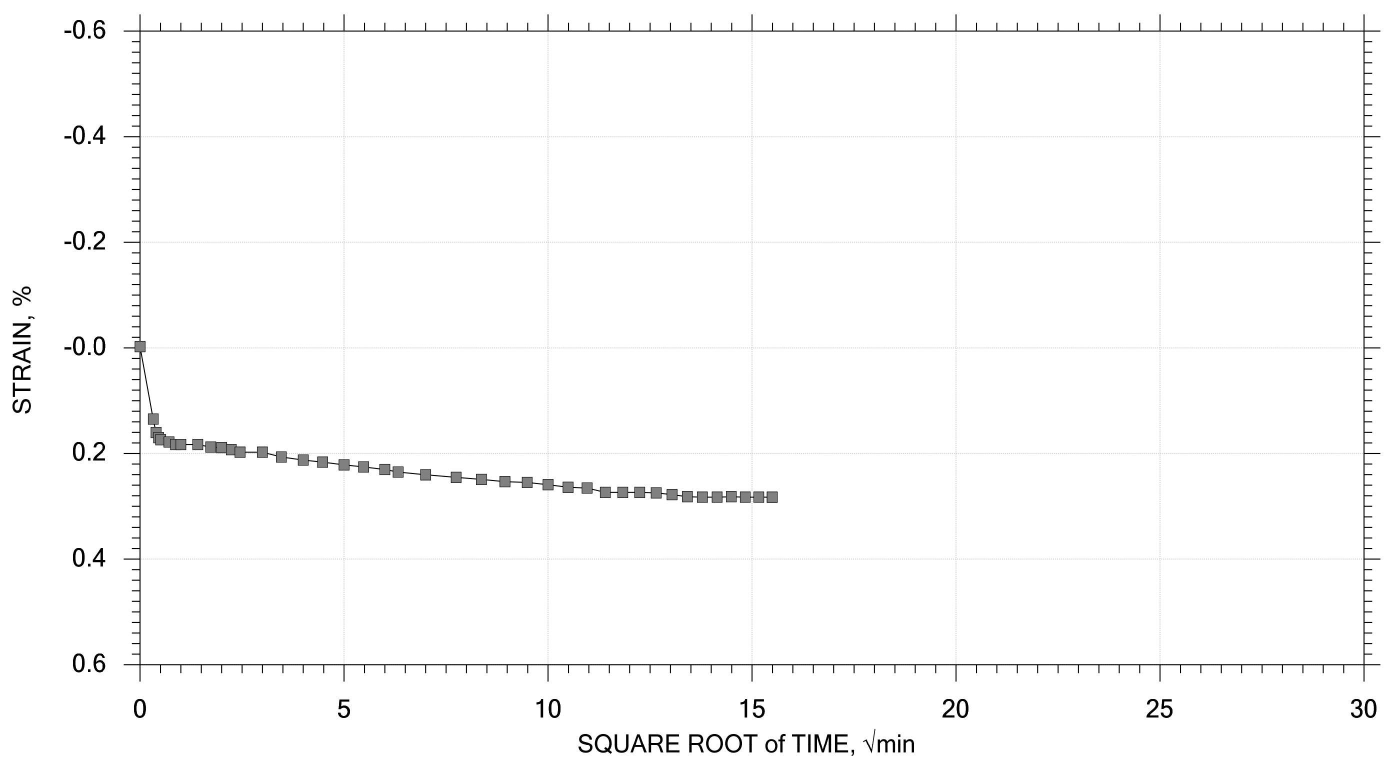
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Volume Step 1 of 15

Stress: 0.069818 tsf





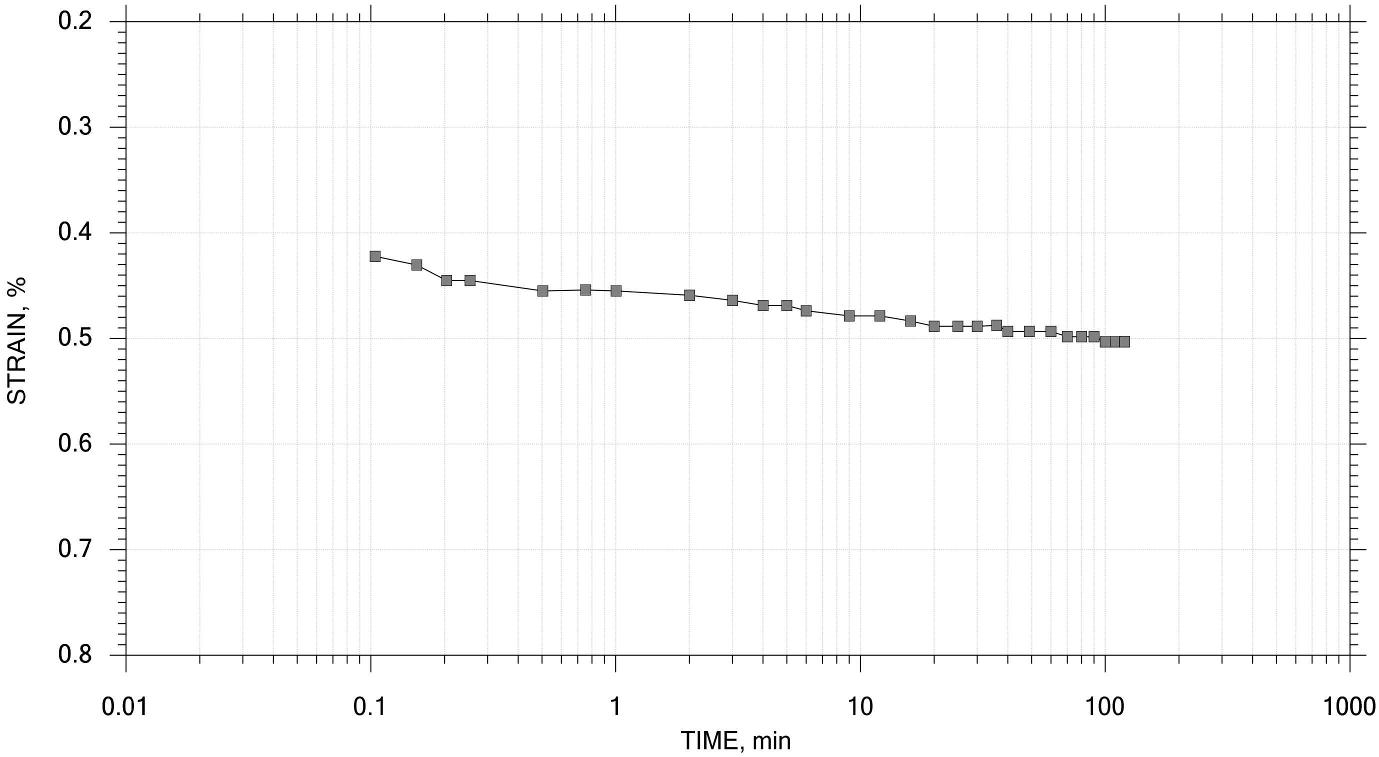
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

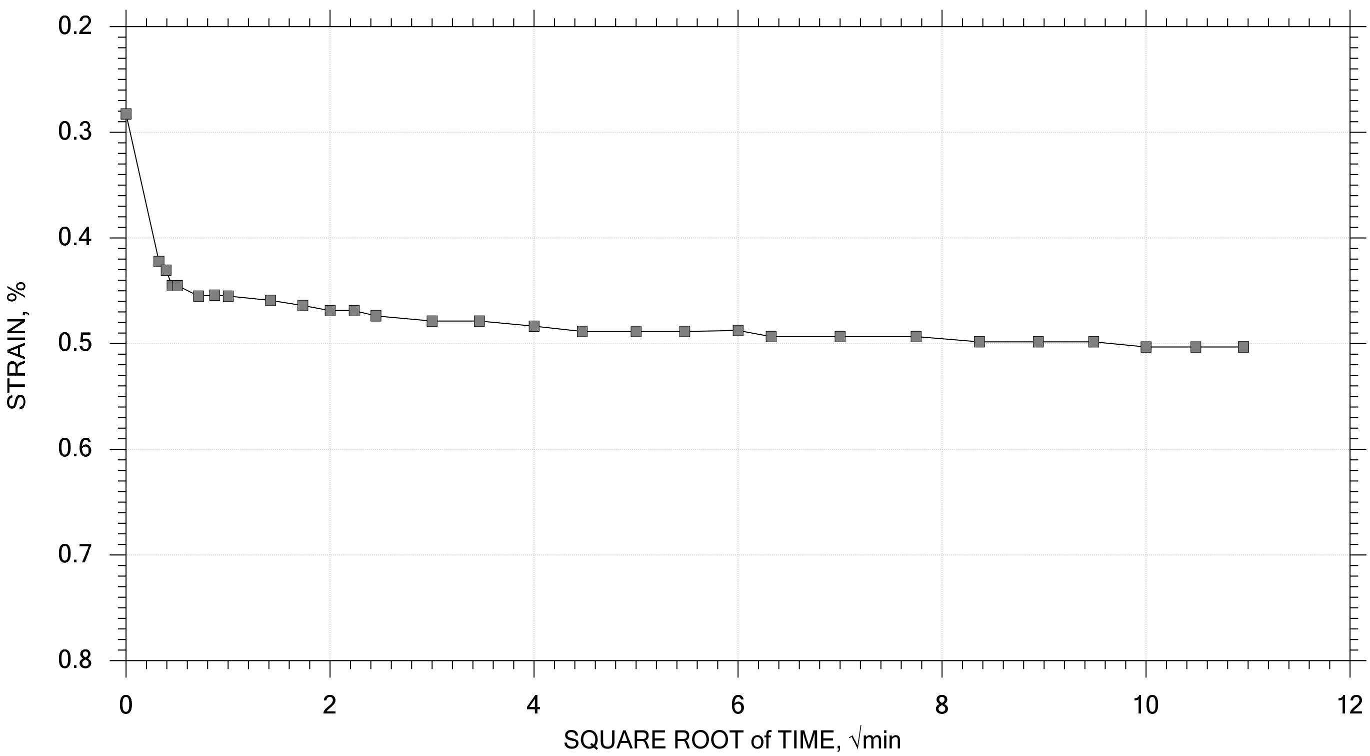
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 2 of 15

Stress: 0.125 tsf





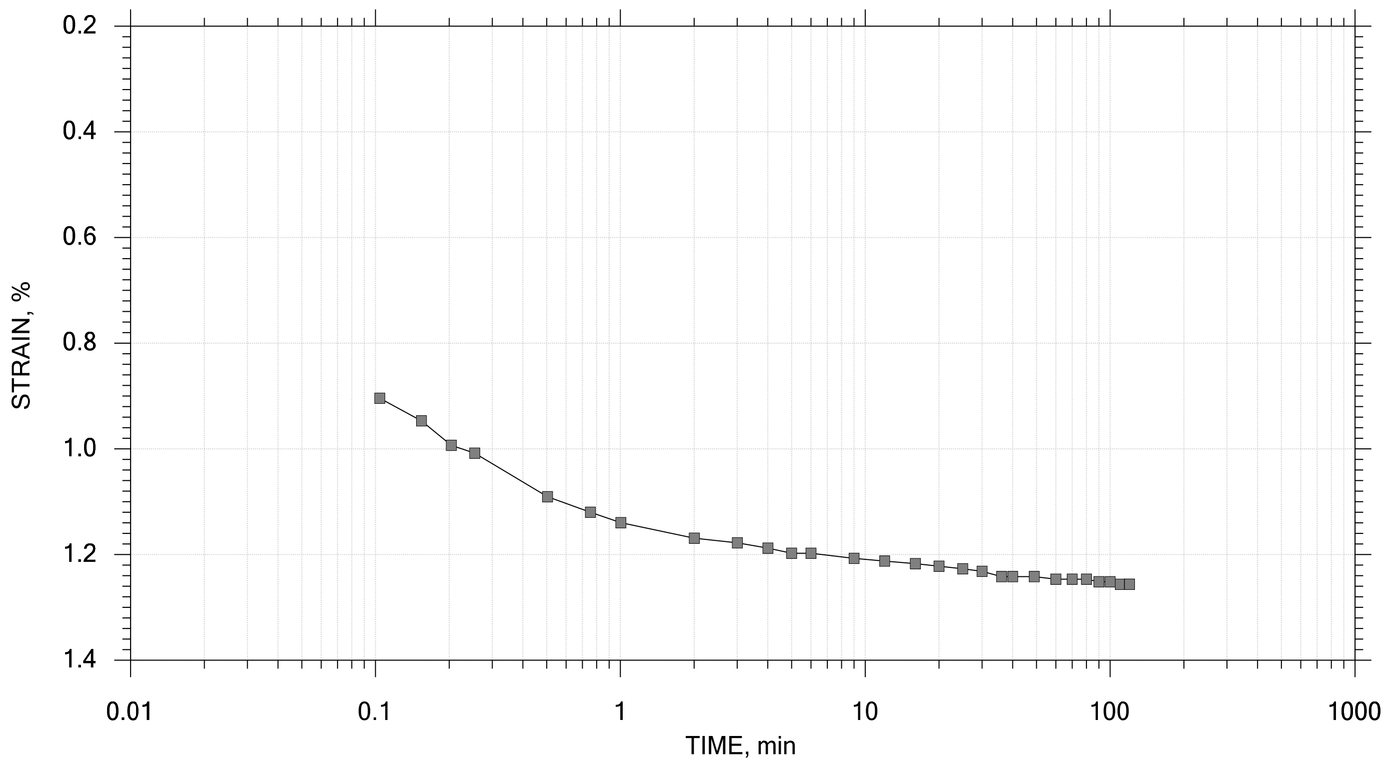
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

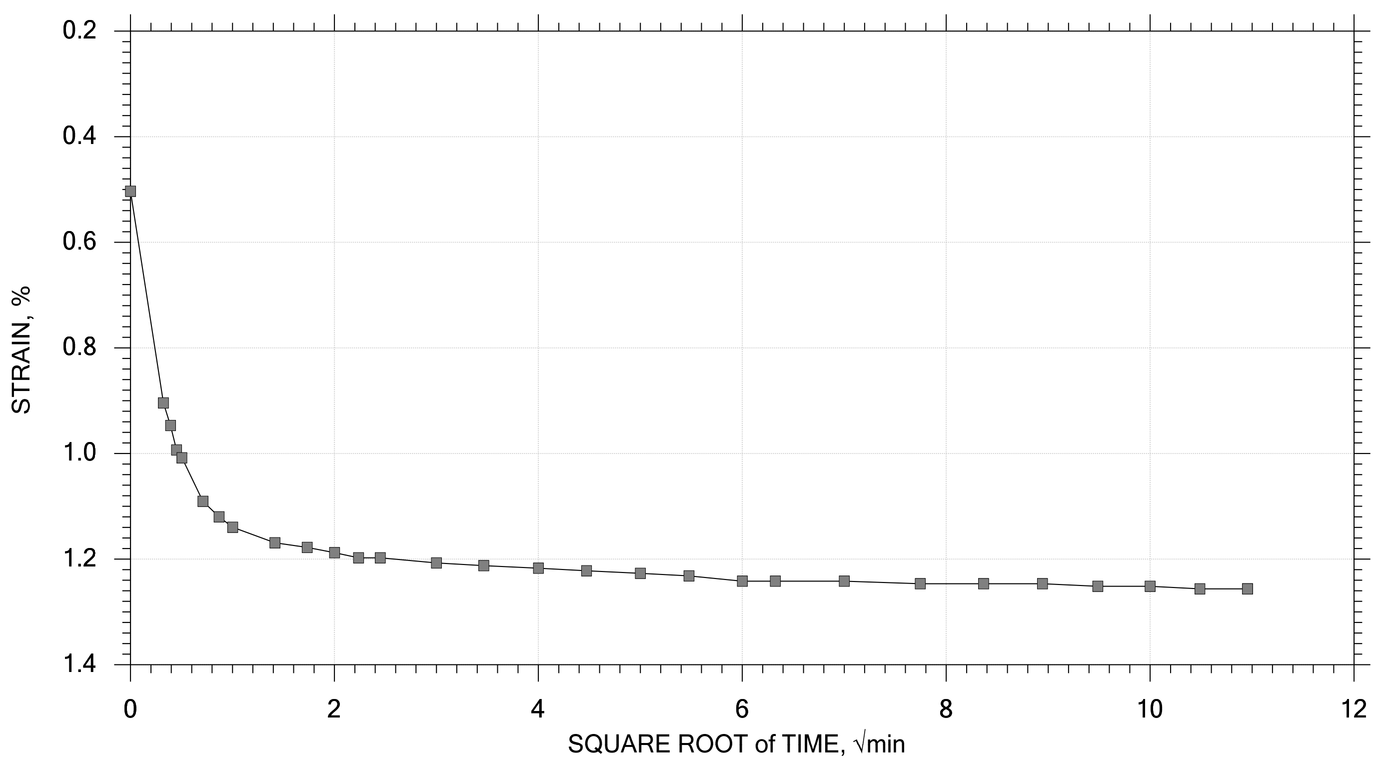
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 3 of 15

Stress: 0.25 tsf





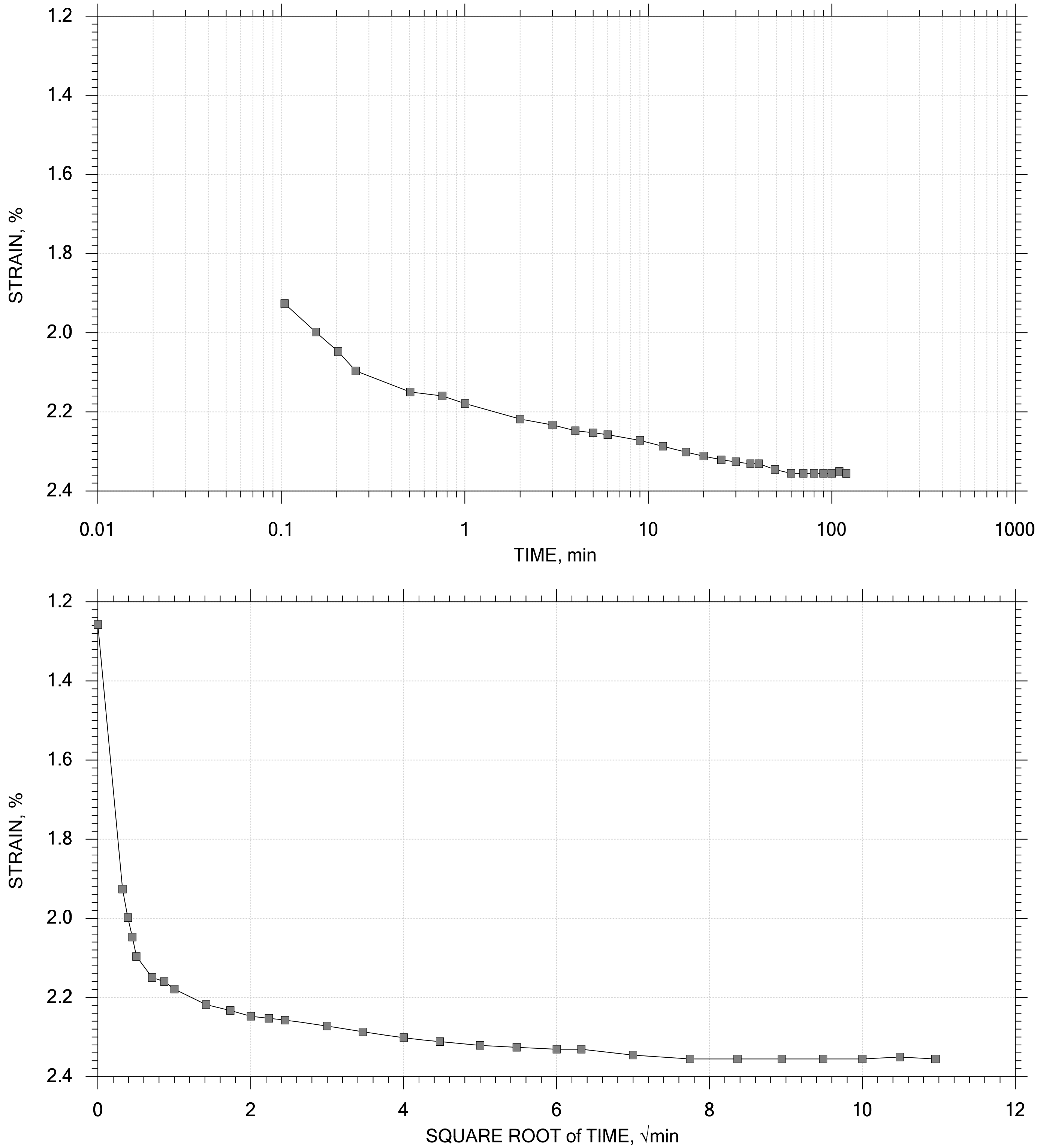
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 4 of 15

Stress: 0.5 tsf



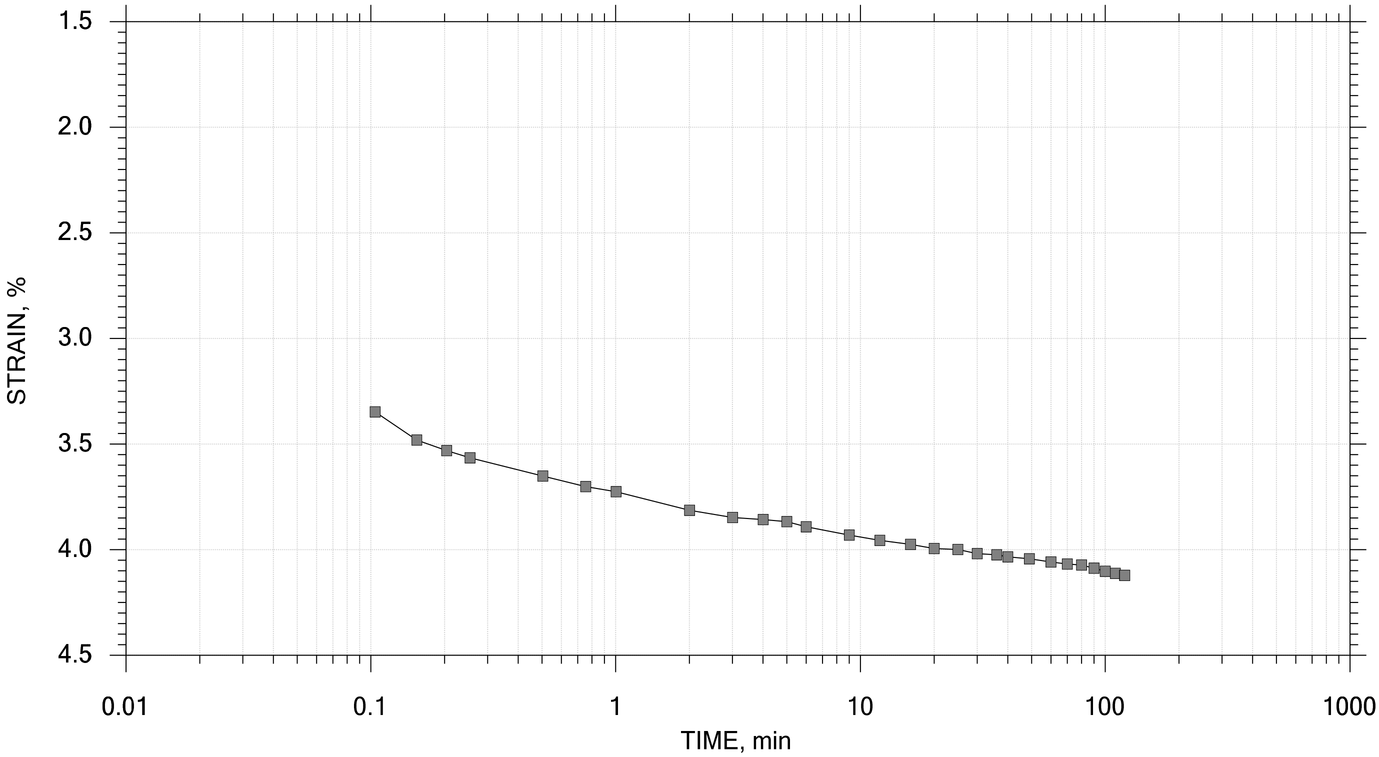
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

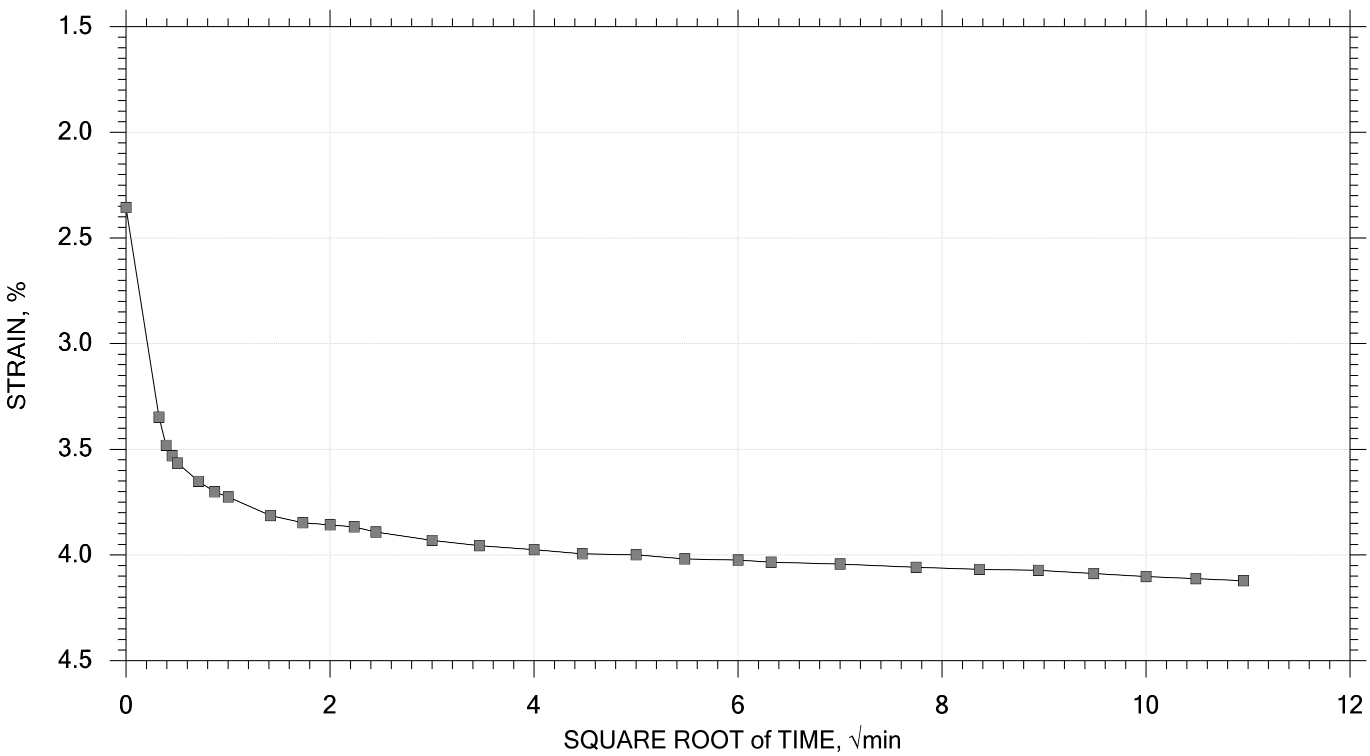
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 15

Stress: 1 tsf





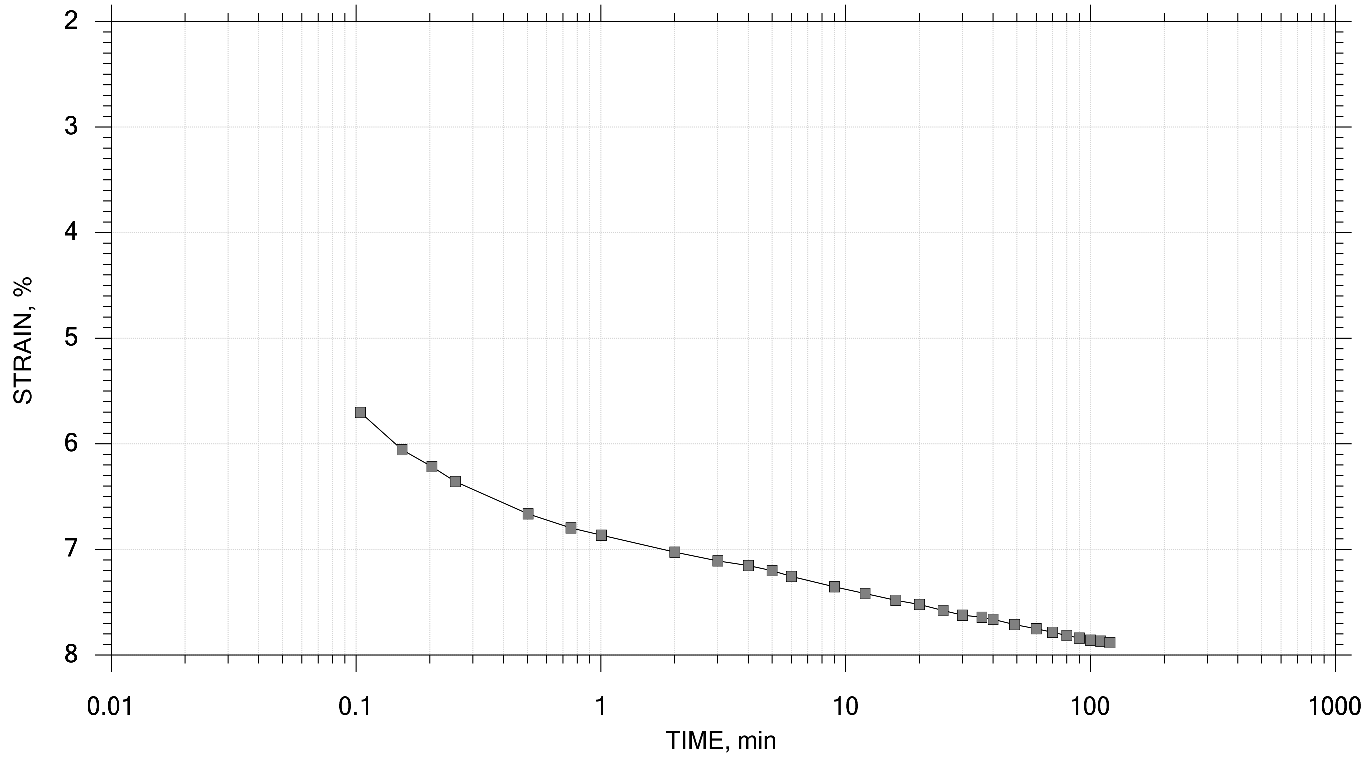
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

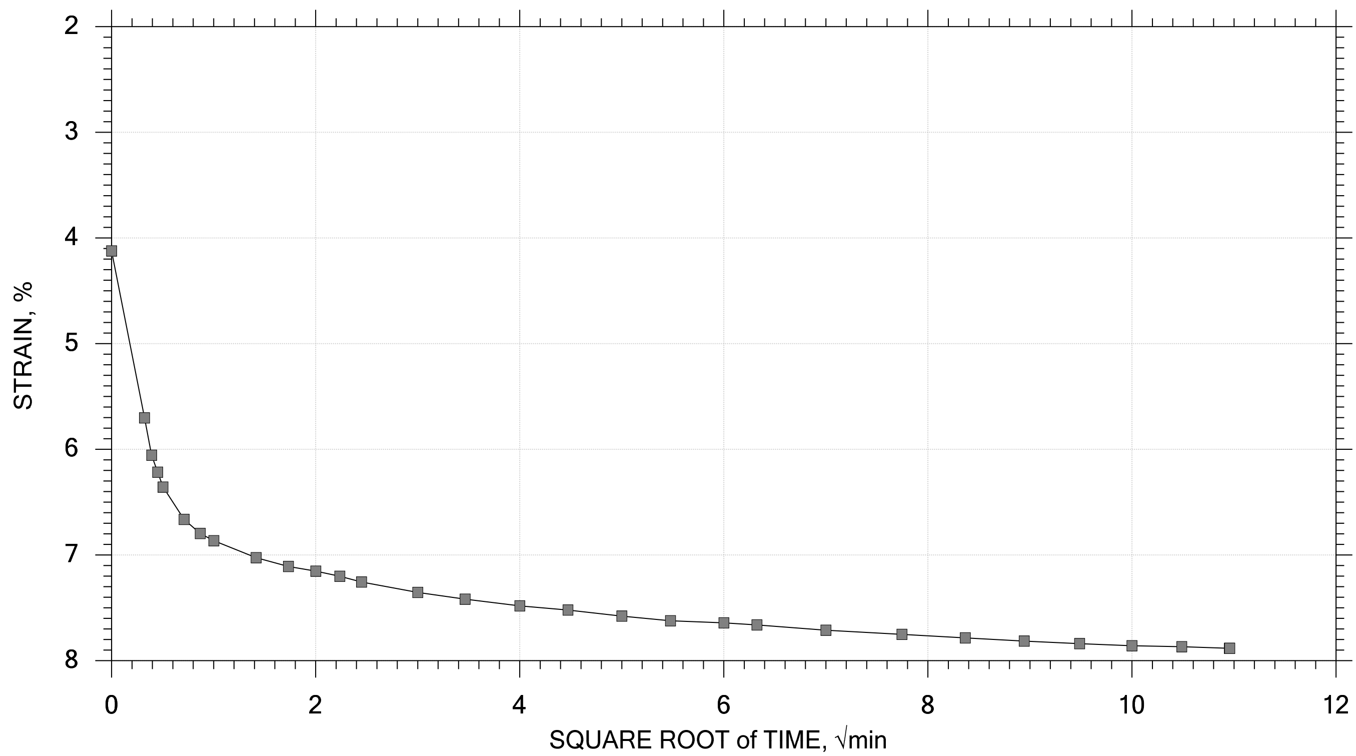
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 6 of 15

Stress: 2 tsf





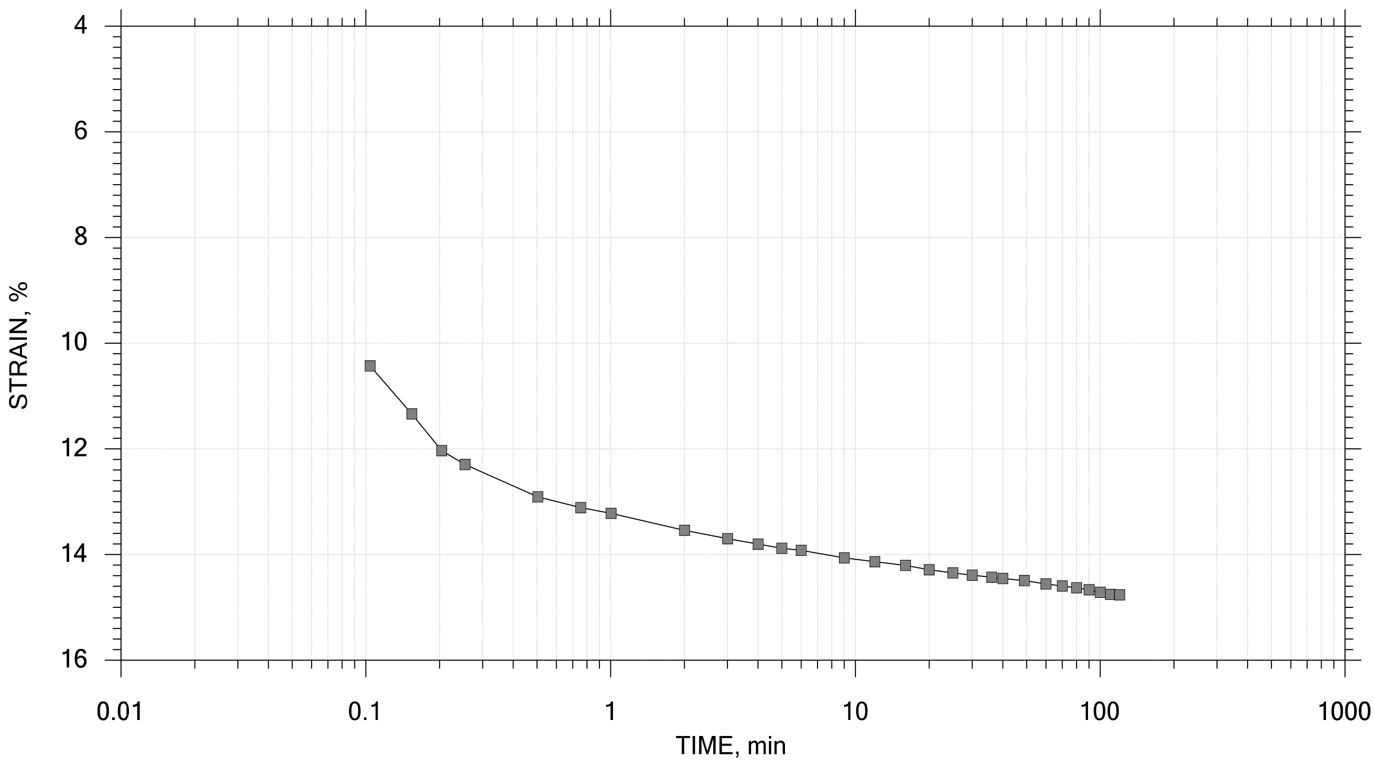
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

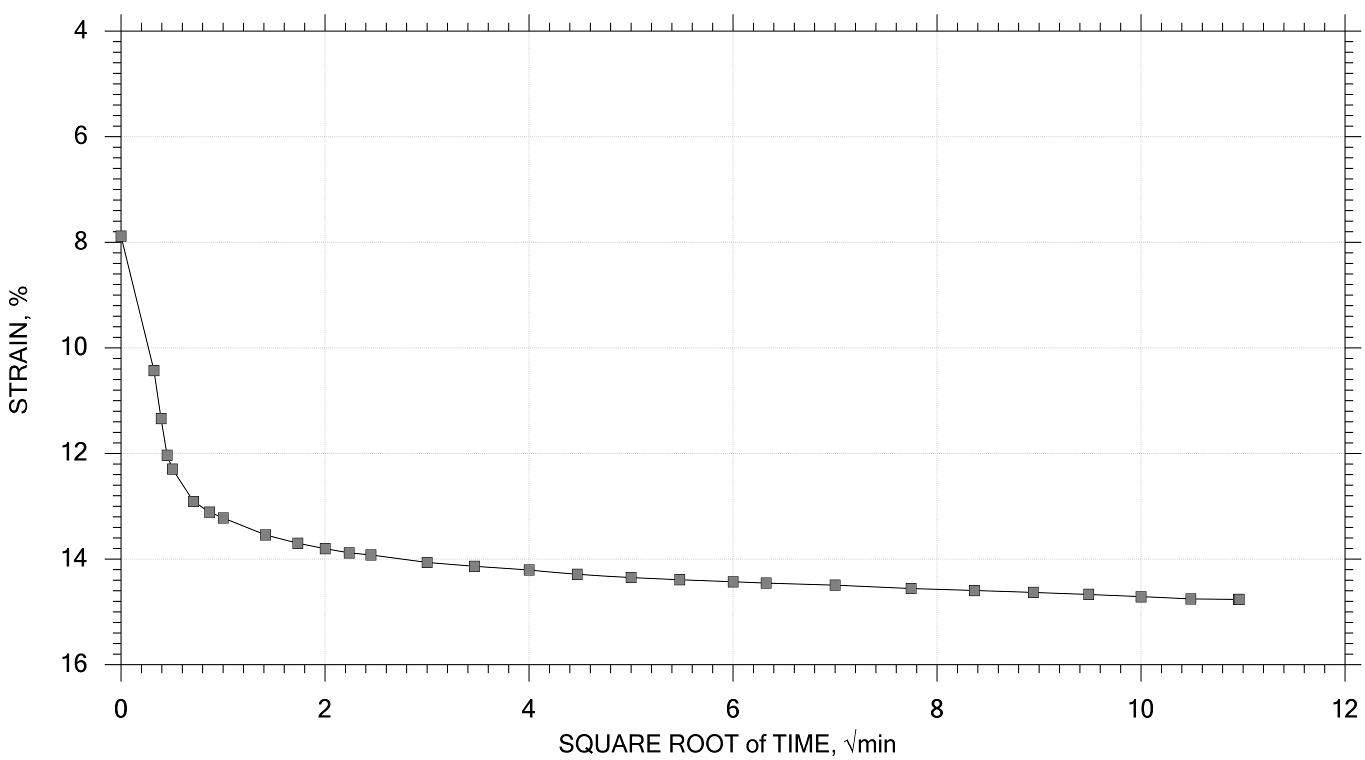
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 15

Stress: 4 tsf





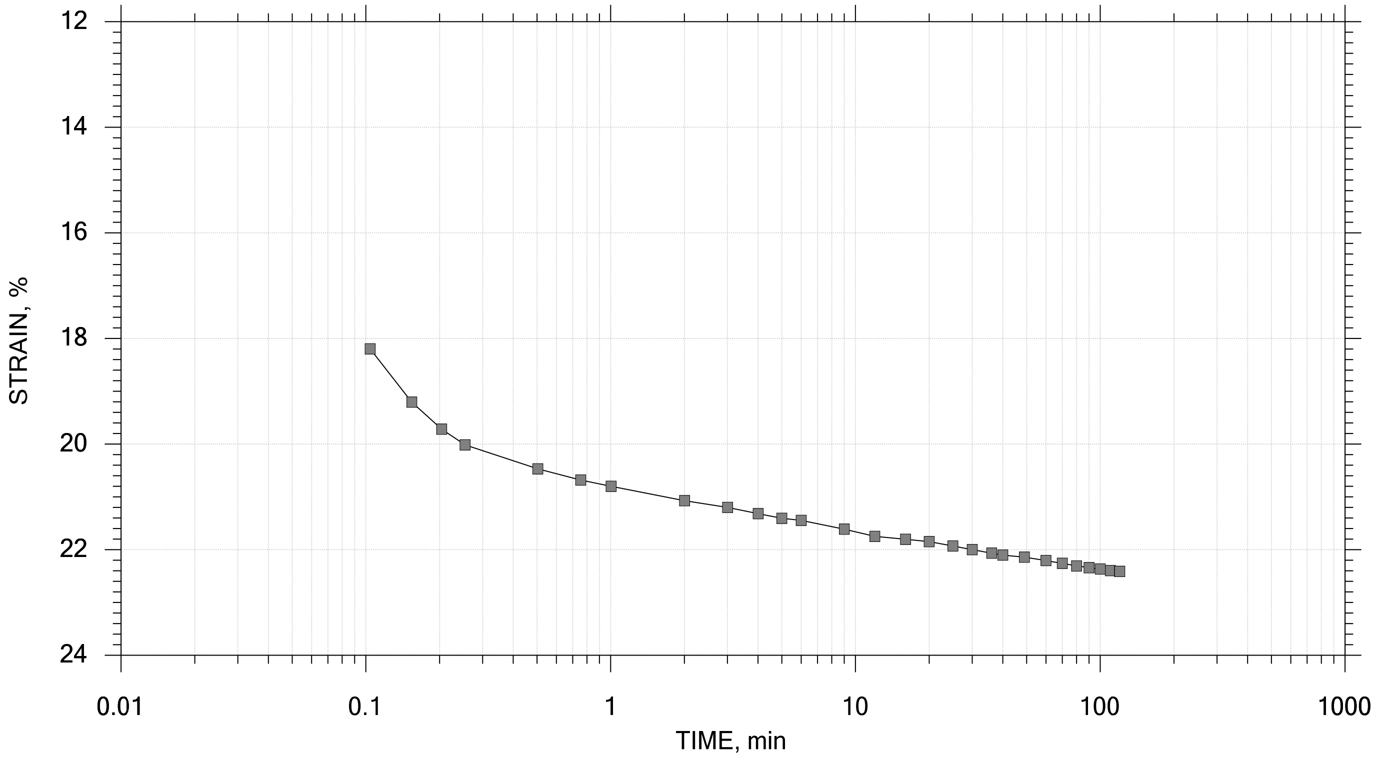
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

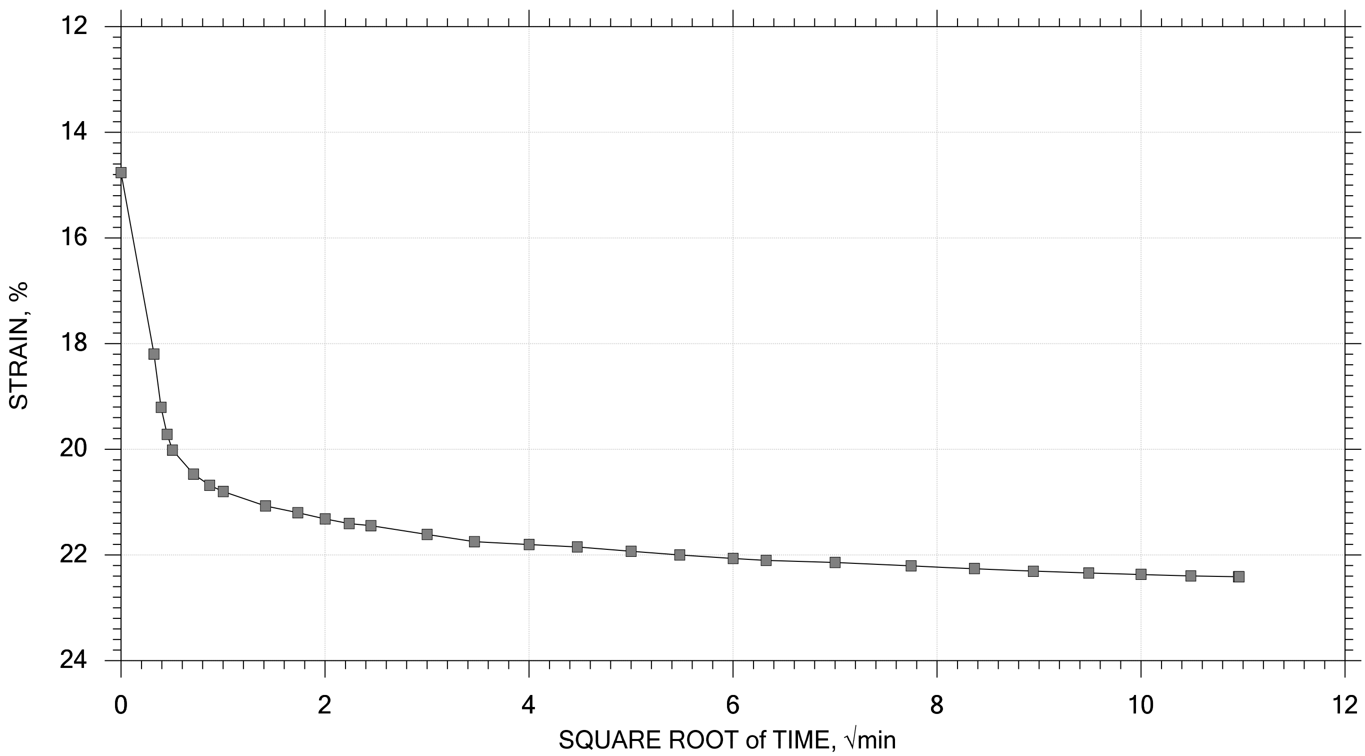
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 15

Stress: 8 tsf





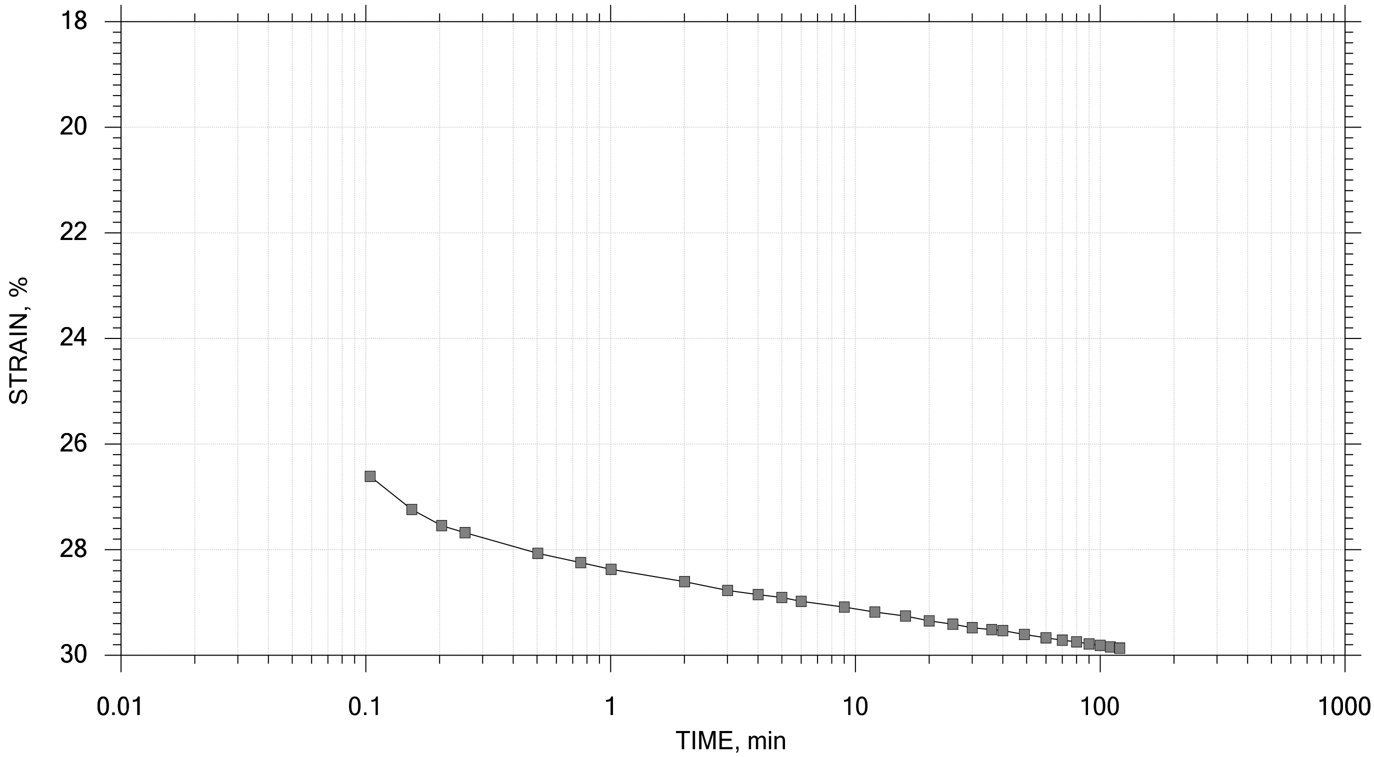
Project: South River	Location: ---	Project No.: GTX-302574
Boring No.: AQSB-01	Tested By: md	Checked By: jdt
Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
Depth: ---	Sample Type: intact	Elevation: ---
Description: Moist, yellowish brown silty sand with gravel		
Remarks: System O, Swell Pressure = 0.0698 tsf		

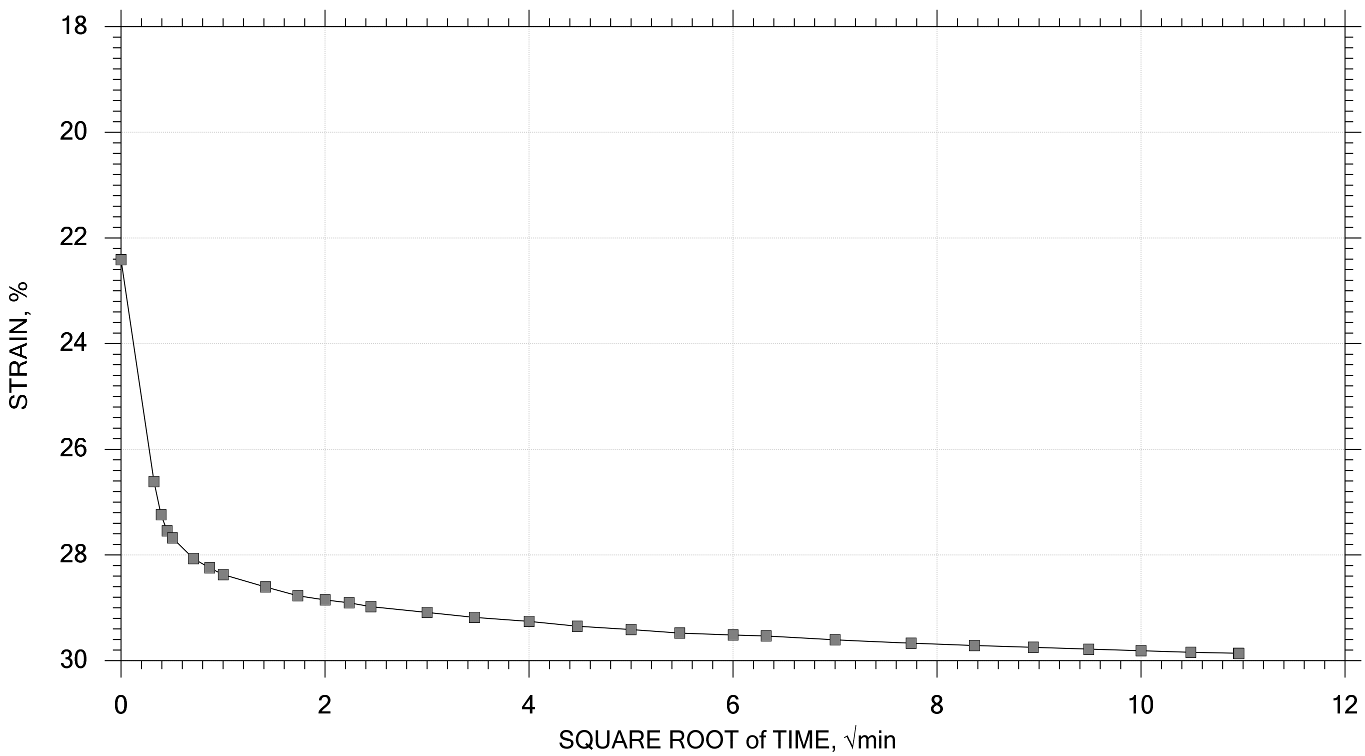
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 9 of 15

Stress: 16 tsf





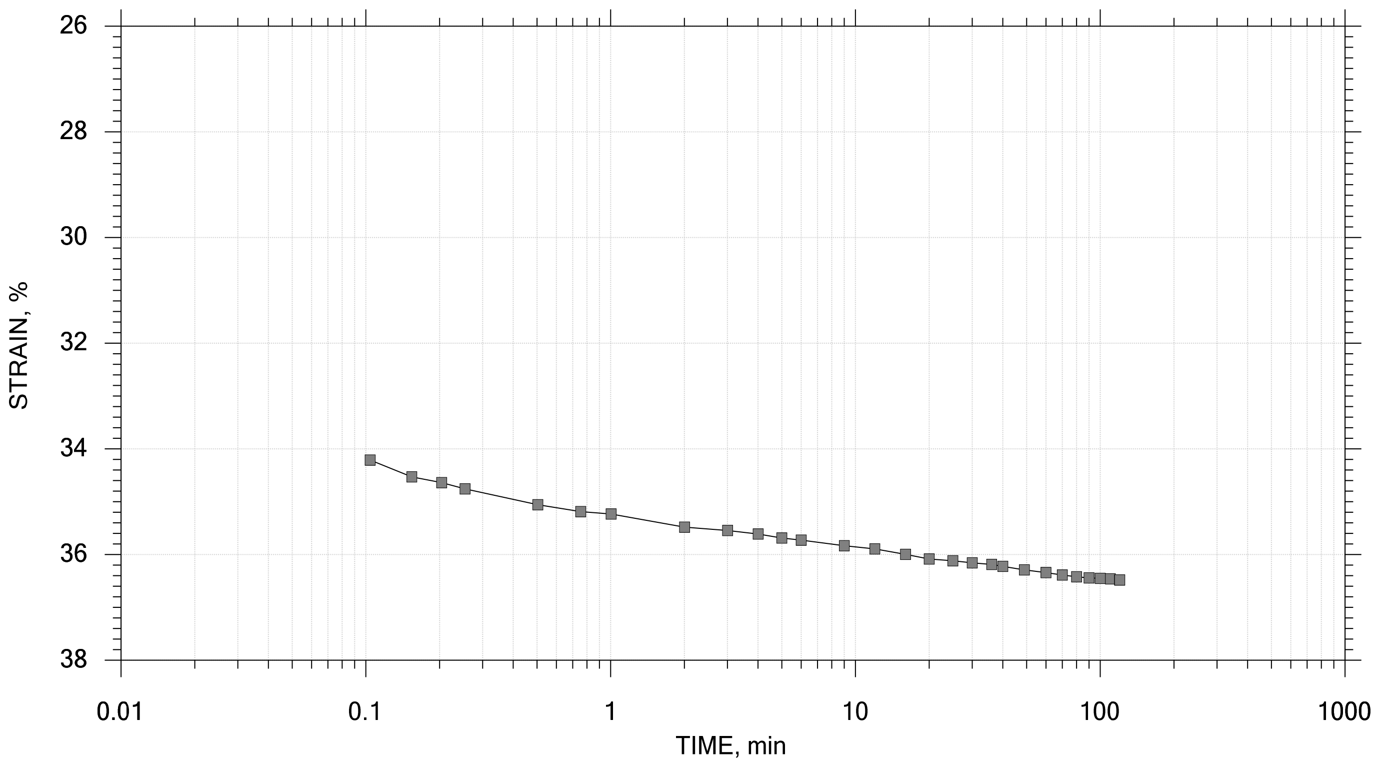
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

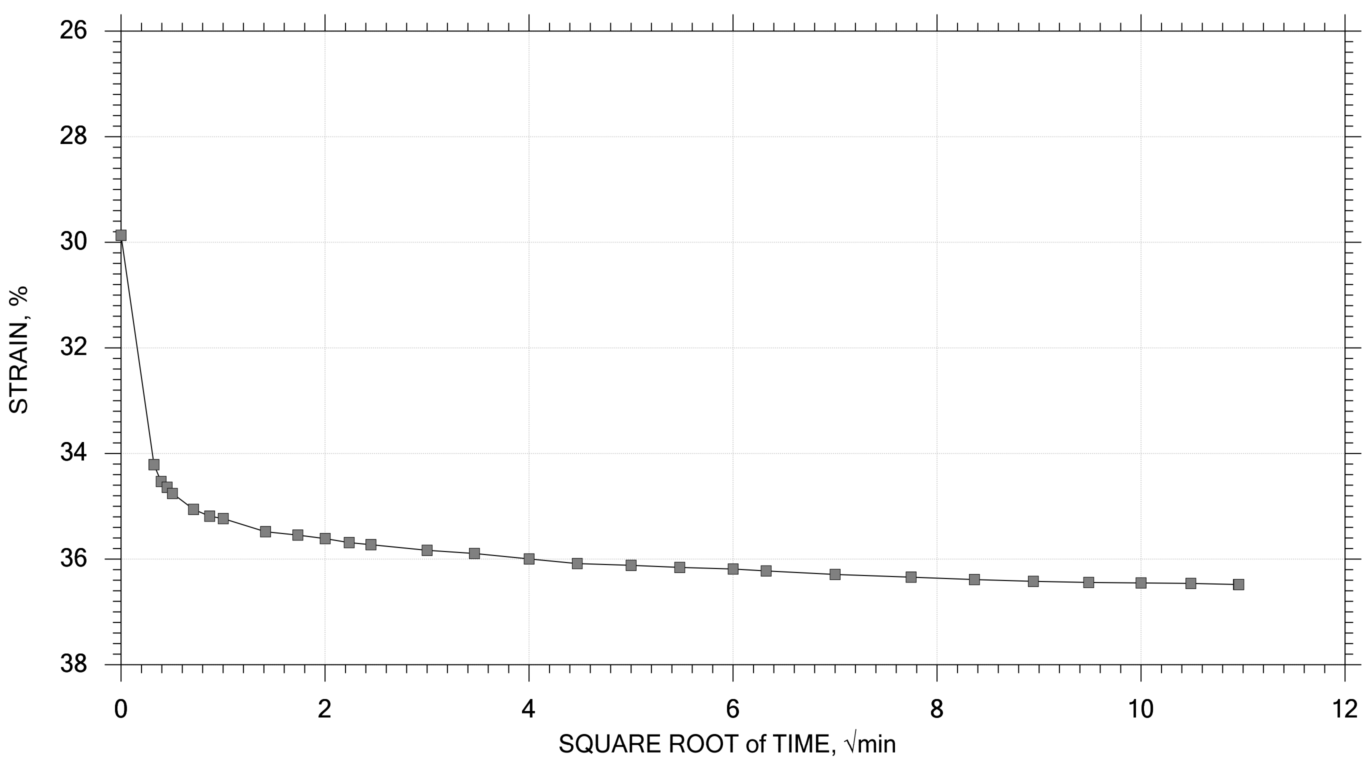
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 10 of 15

Stress: 32 tsf





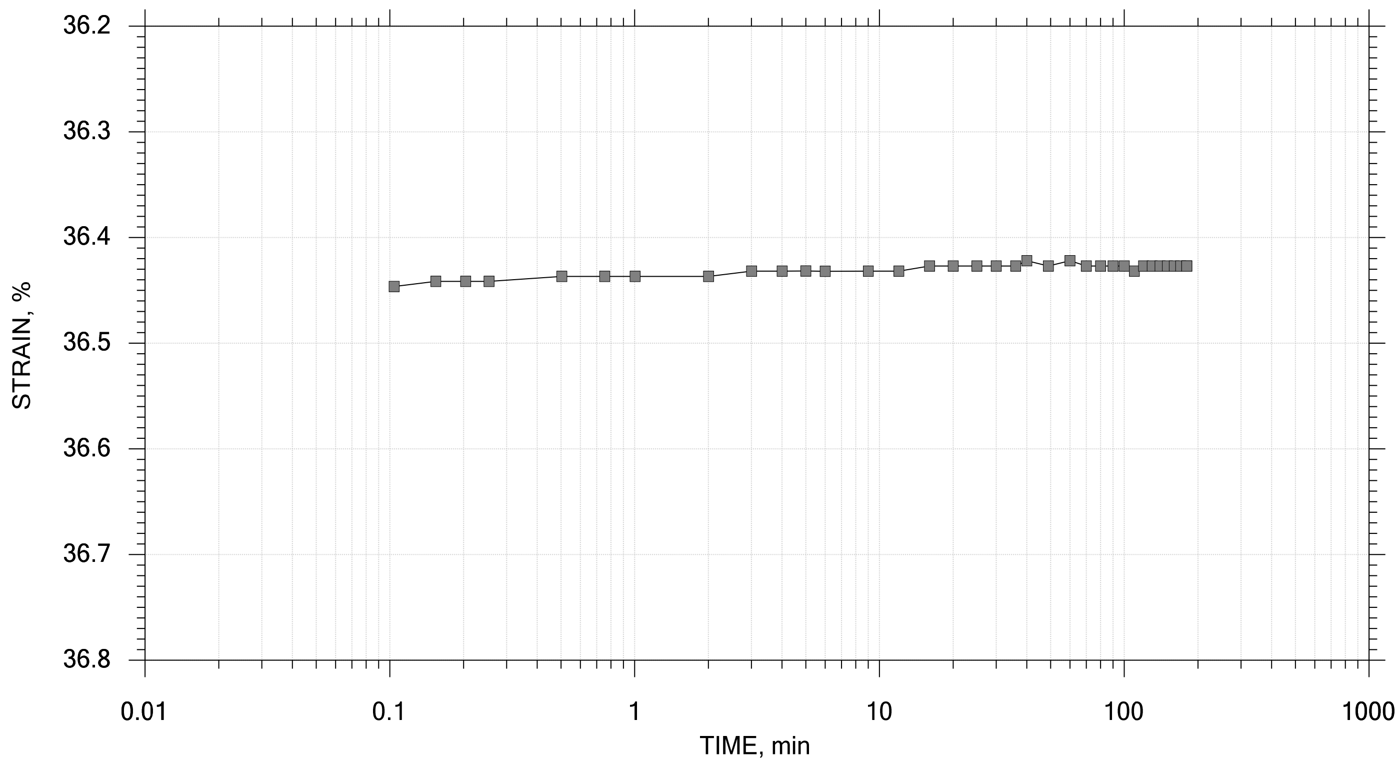
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

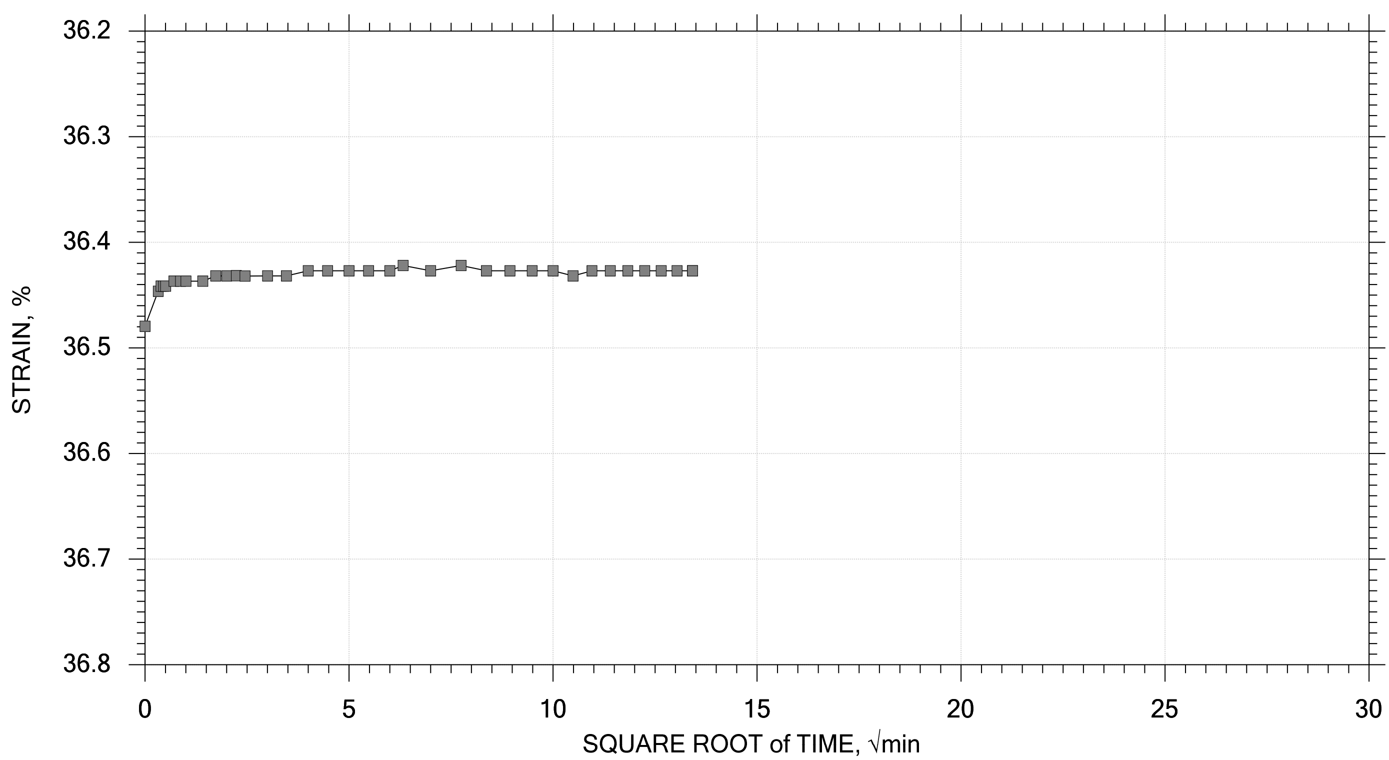
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 11 of 15

Stress: 8 tsf





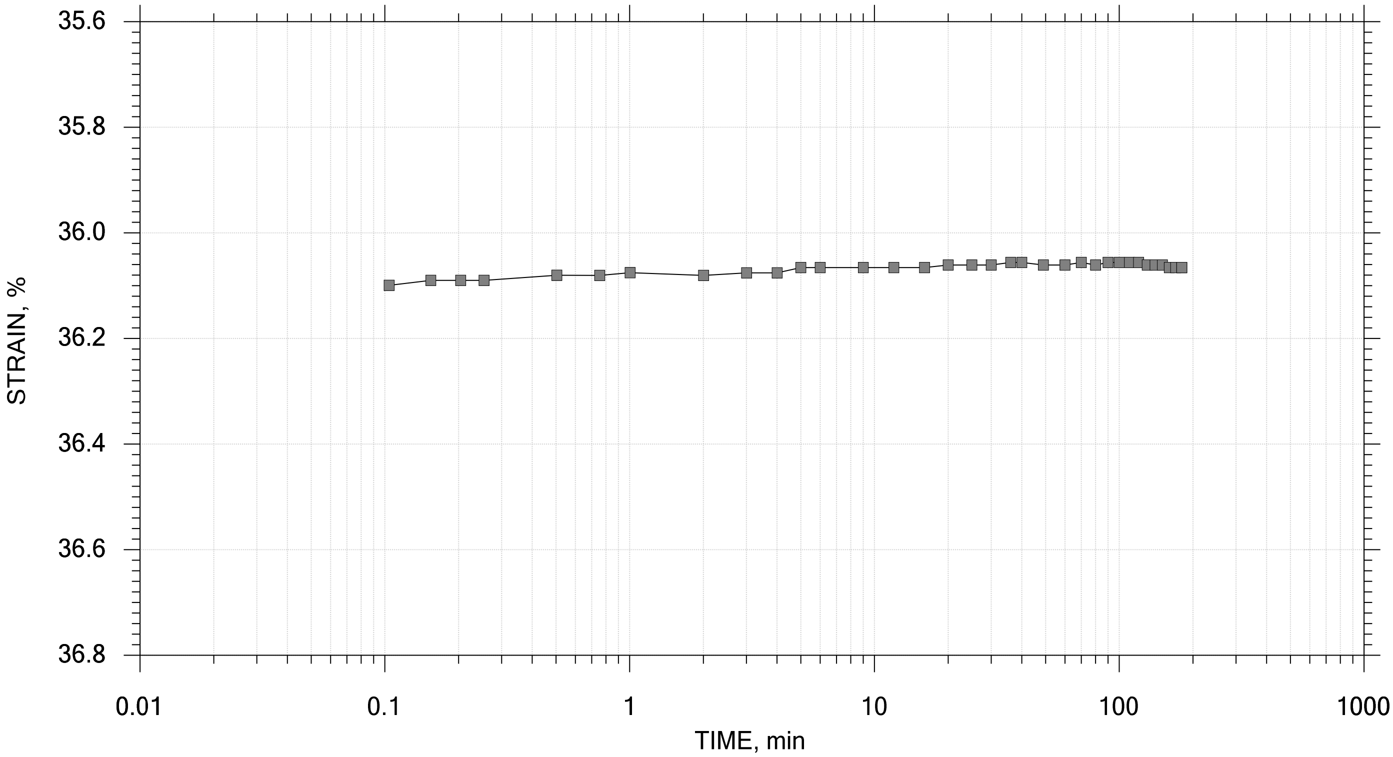
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

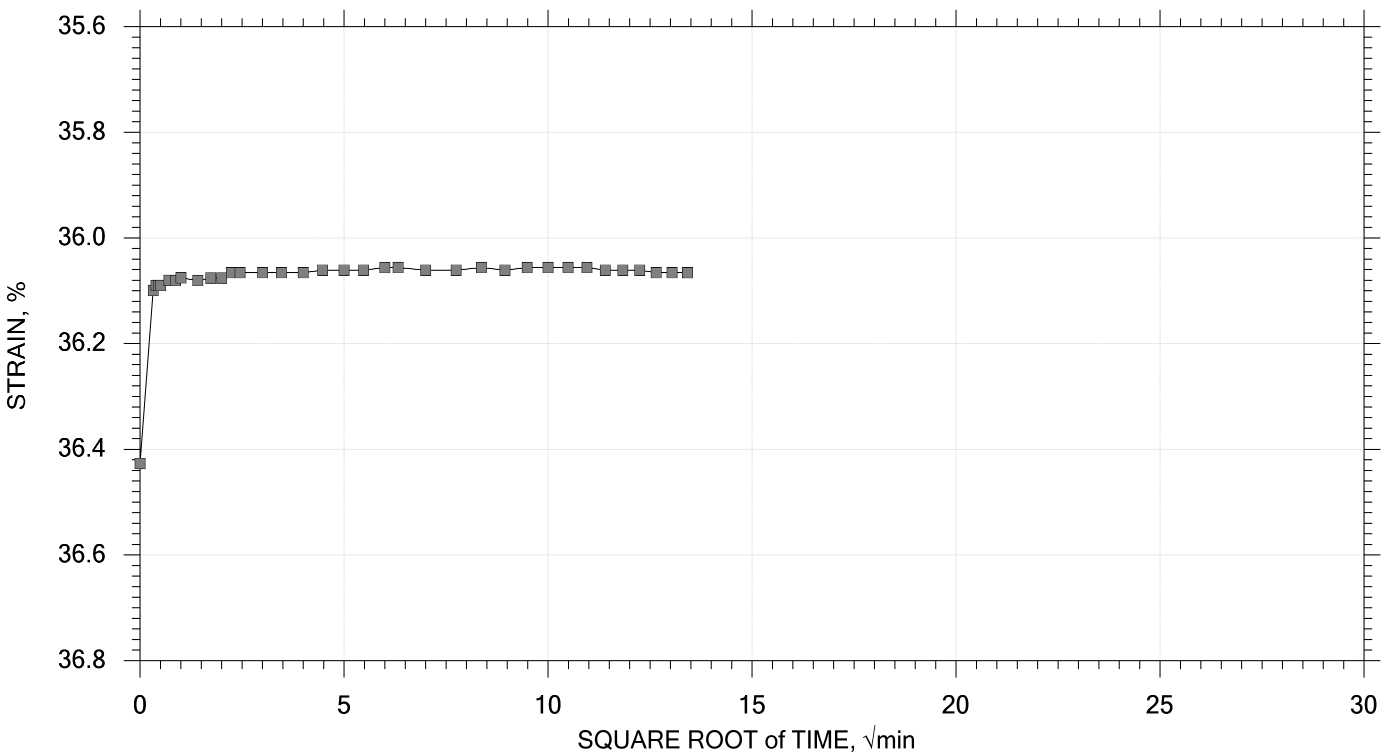
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 12 of 15

Stress: 2 tsf





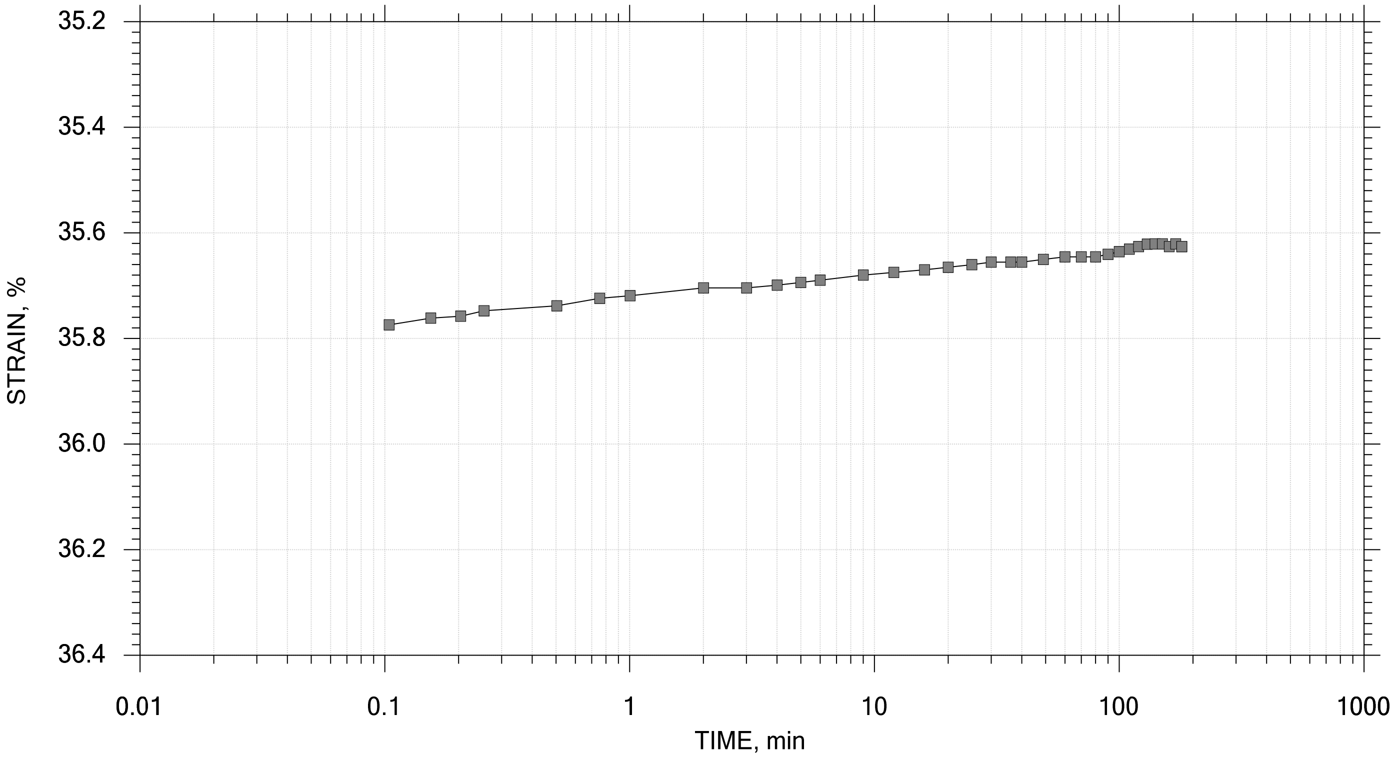
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

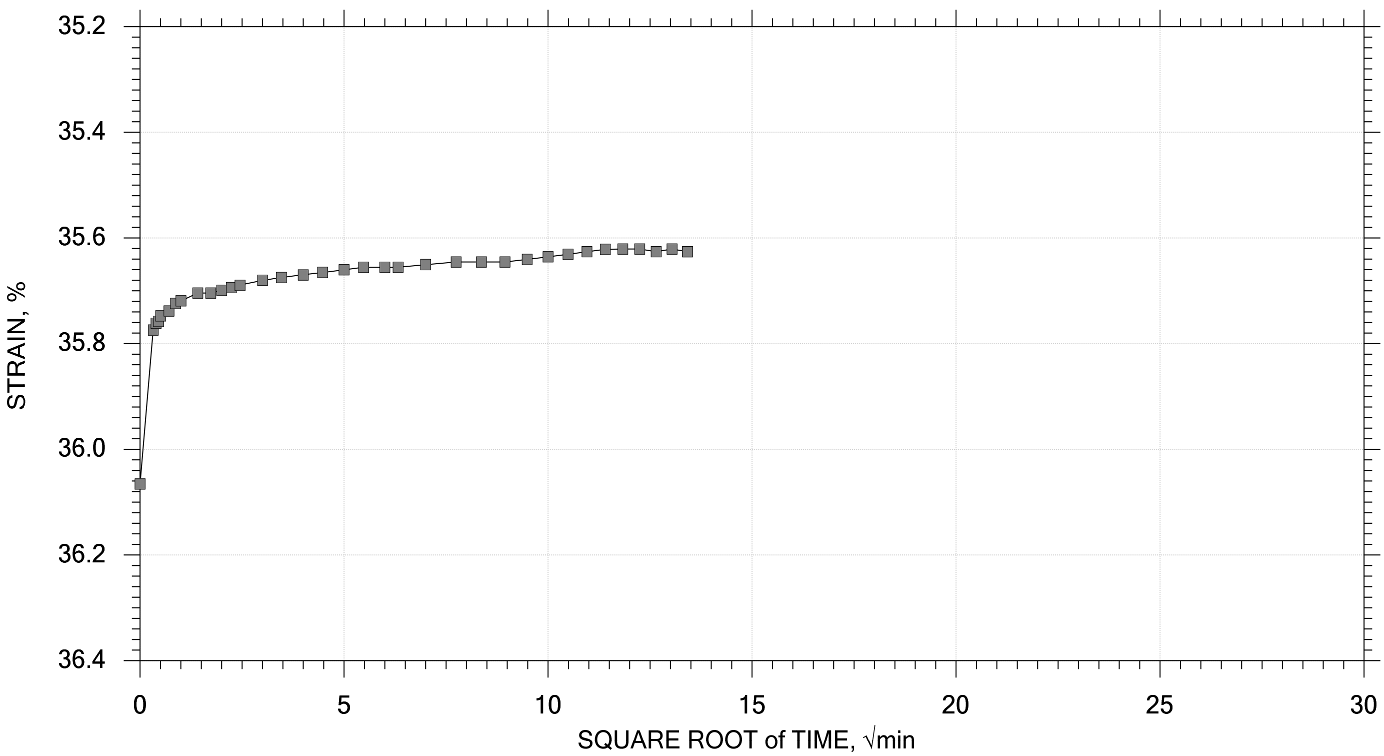
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 13 of 15

Stress: 0.5 tsf





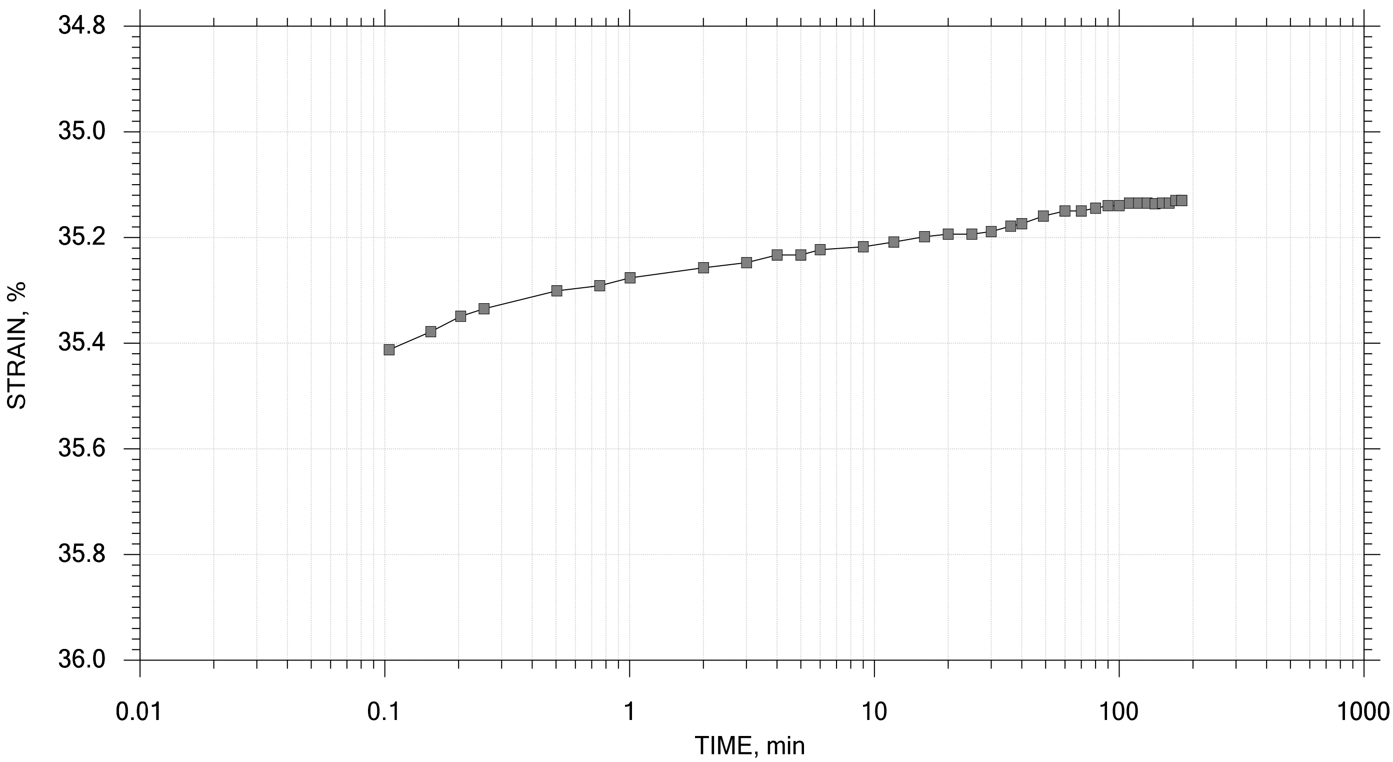
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

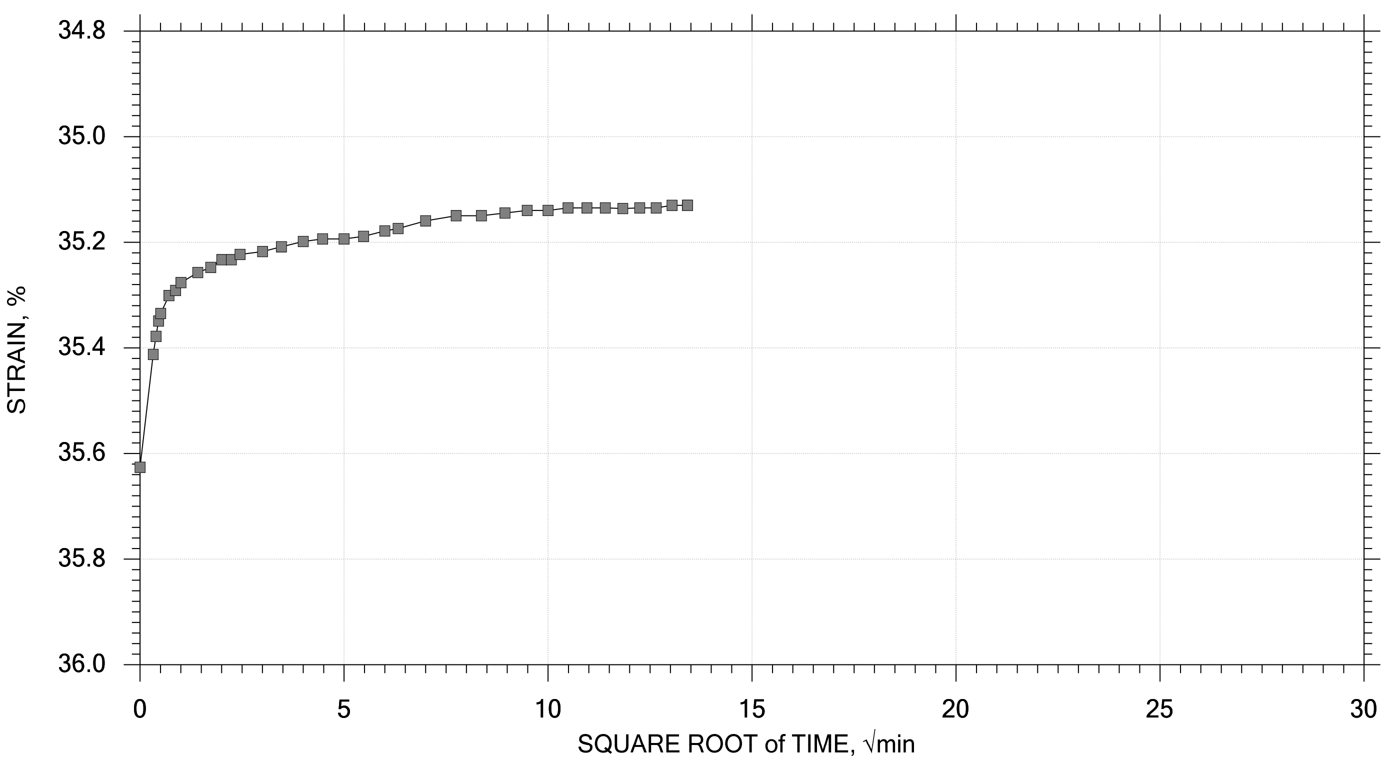
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 14 of 15

Stress: 0.125 tsf





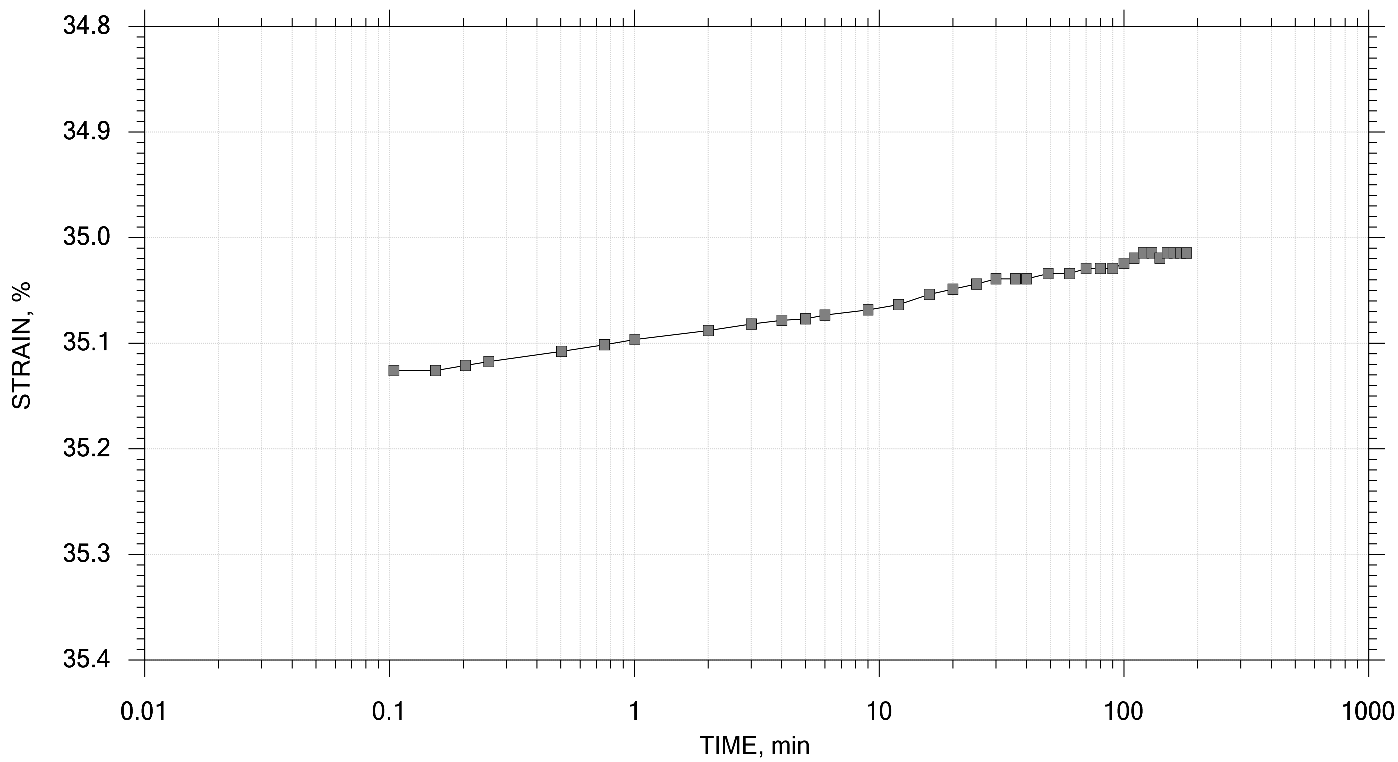
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

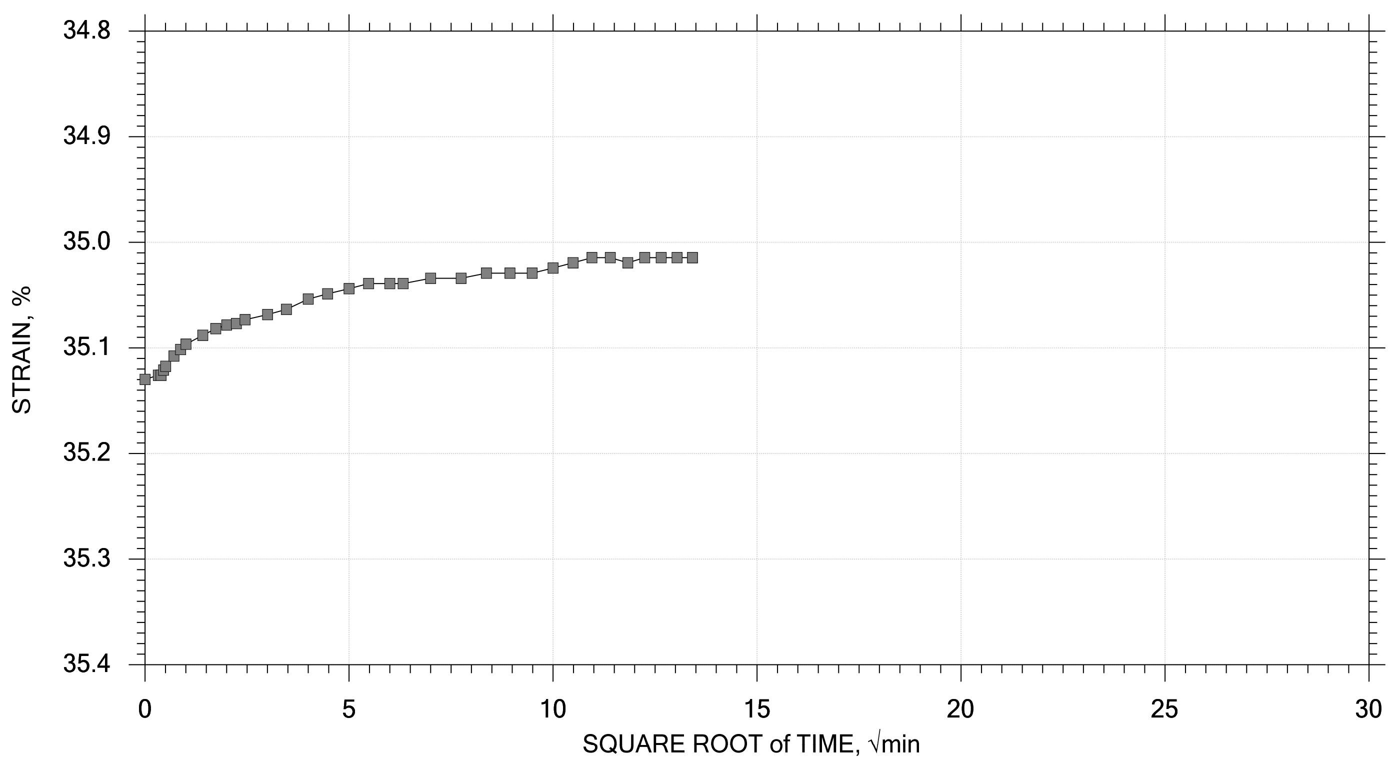
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 15 of 15

Stress: 0.0625 tsf

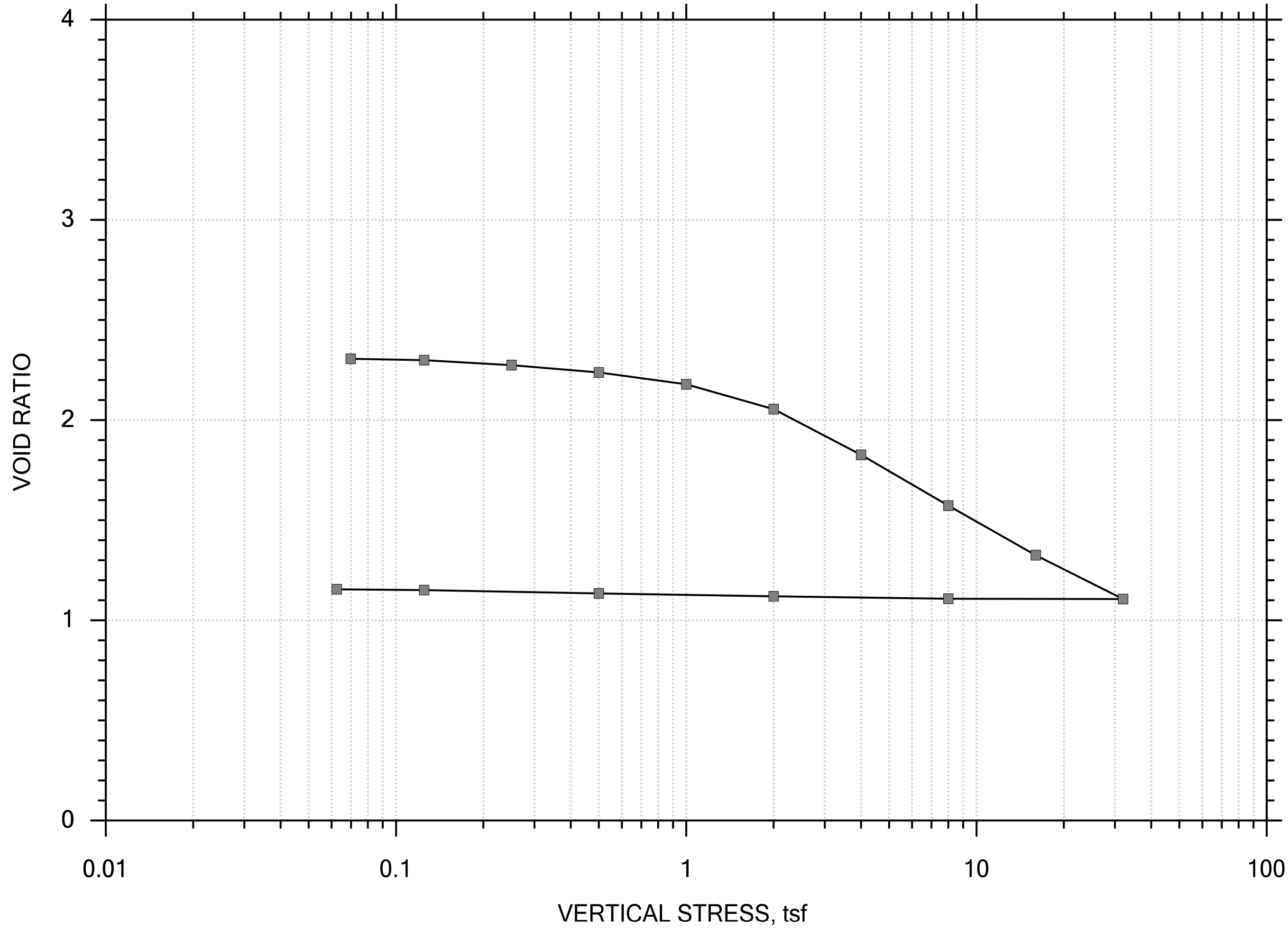


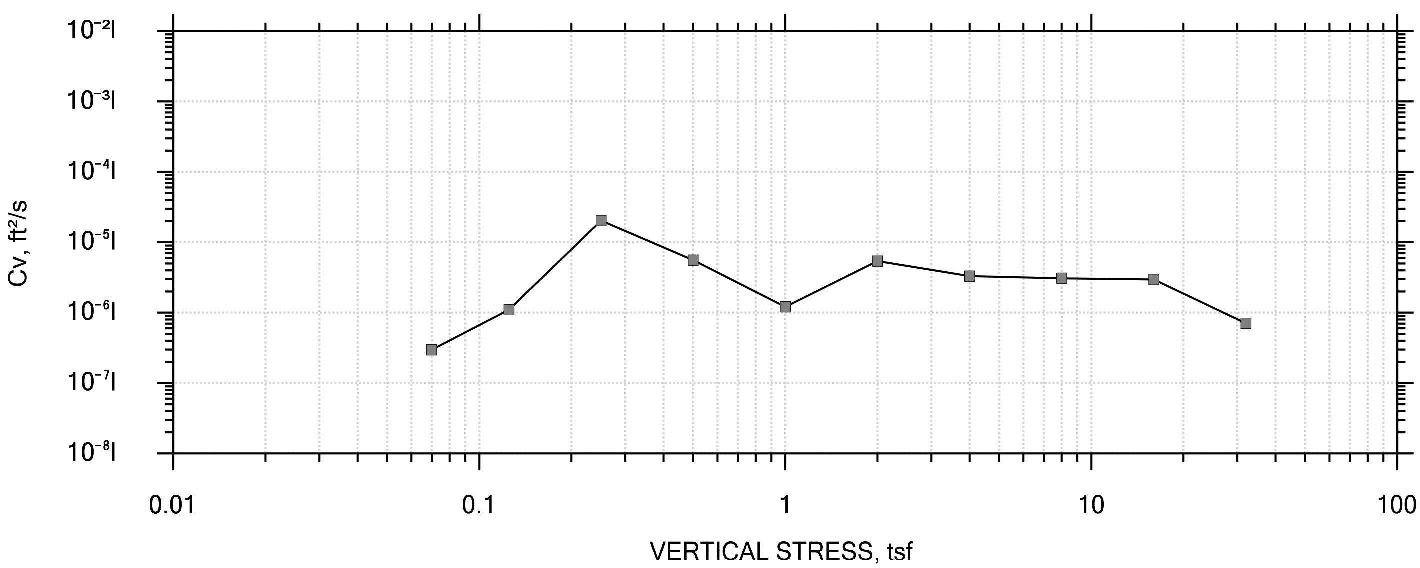


GeoTesting EXPRESS			
	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

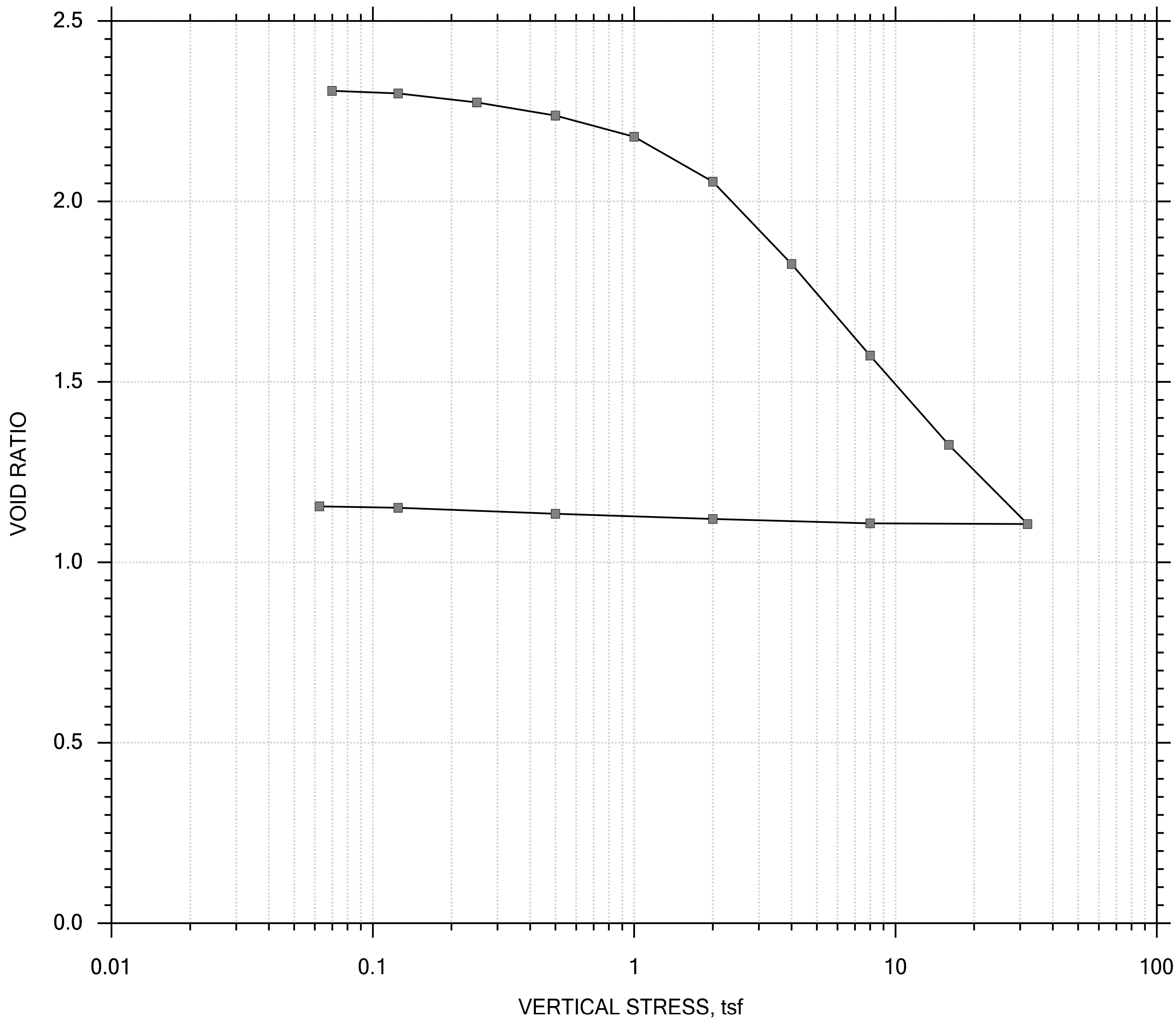




GeoTesting EXPRESS			
	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT



					Before Test	After Test
Current Vertical Effective Stress: ---				Water Content, %	79.06	40.81
Preconsolidation Stress: ---				Dry Unit Weight, pcf	51.769	80.889
Compression Ratio: ---				Saturation, %	93.86	100.00
Diameter: 2.5 in		Height: 1 in		Void Ratio	2.32	1.12
LL: NP	PL: NP	PI: NP	GS: 2.75			

GeoTesting EXPRESS			
	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: South River
Boring No.: AQSB-01
Sample No.: ST01
Test No.: IP-1

Location: ---
Tested By: md
Test Date: 12/01/14
Sample Type: intact

Project No.: GTX-302574
Checked By: jdt
Depth: ---
Elevation: ---

Soil Description: Moist, yellowish brown silty sand with gravel
Remarks: System O, Swell Pressure = 0.0698 tsf

Measured Specific Gravity: 2.75
Initial Void Ratio: 2.32
Final Void Ratio: 1.12

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

Specimen Diameter: 2.50 in
Initial Height: 1.00 in
Final Height: 0.64 in

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	14752	RING		15308
Wt. Container + Wet Soil, gm	55.800	228.27	202.76	103.85
Wt. Container + Dry Soil, gm	38.370	175.54	175.54	76.240
Wt. Container, gm	9.1000	108.83	108.83	8.5900
Wt. Dry Soil, gm	29.270	66.705	66.705	67.650
Water Content, %	59.55	79.06	40.81	40.81
Void Ratio	---	2.32	1.12	---
Degree of Saturation, %	---	93.86	100.00	---
Dry Unit Weight, pcf	---	51.769	80.889	---

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: South River
Boring No.: AQSB-01
Sample No.: ST01
Test No.: IP-1

Location: ---
Tested By: md
Test Date: 12/01/14
Sample Type: intact

Project No.: GTX-302574
Checked By: jdt
Depth: ---
Elevation: ---

Soil Description: Moist, yellowish brown silty sand with gravel
Remarks: System O, Swell Pressure = 0.0698 tsf

Displacement at End of Increment

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft²/s	Mv 1/tsf	k ft/day
1	0.0698	0.002842	2.31	0.284	79.906	3.06e-07	4.07e-02	3.36e-05
2	0.125	0.005047	2.30	0.505	19.886	1.22e-06	4.00e-02	1.32e-04
3	0.250	0.01259	2.27	1.26	1.194	2.02e-05	6.03e-02	3.28e-03
4	0.500	0.02358	2.24	2.36	4.588	5.16e-06	4.40e-02	6.11e-04
5	1.00	0.04124	2.18	4.12	18.502	1.24e-06	3.53e-02	1.18e-04
6	2.00	0.07885	2.05	7.88	5.171	4.19e-06	3.76e-02	4.25e-04
7	4.00	0.1477	1.83	14.8	6.016	3.21e-06	3.44e-02	2.98e-04
8	8.00	0.2241	1.57	22.4	5.611	2.90e-06	1.91e-02	1.49e-04
9	16.0	0.2987	1.33	29.9	4.816	2.78e-06	9.32e-03	6.99e-05
10	32.0	0.3648	1.11	36.5	15.318	7.15e-07	4.13e-03	7.97e-06
11	8.00	0.3643	1.11	36.4	35.909	2.76e-07	2.19e-05	1.63e-08
12	2.00	0.3607	1.12	36.1	4.910	2.03e-06	6.02e-04	3.30e-06
13	0.500	0.3563	1.13	35.6	17.233	5.86e-07	2.93e-03	4.63e-06
14	0.125	0.3513	1.15	35.1	17.485	5.86e-07	1.32e-02	2.09e-05
15	0.0625	0.3502	1.15	35.0	23.147	4.47e-07	1.85e-02	2.22e-05

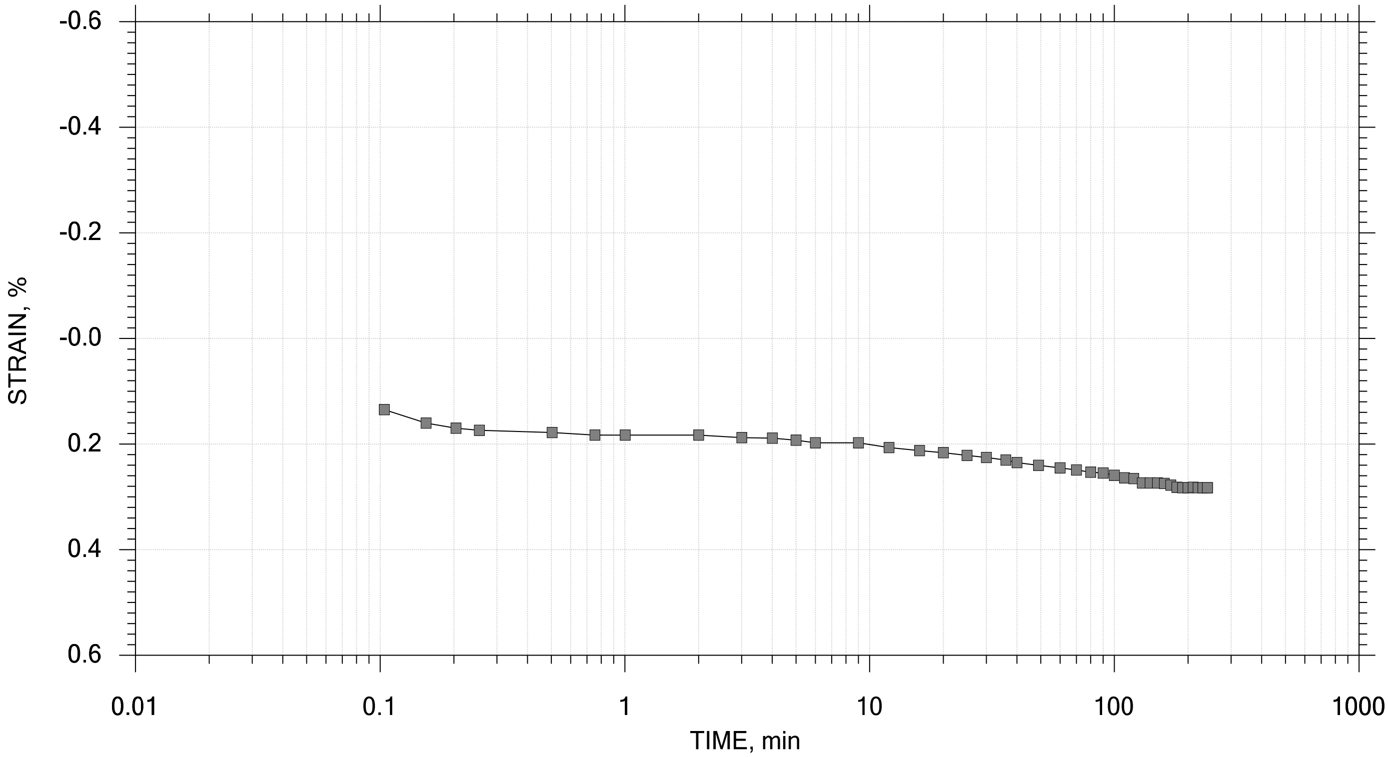
	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft²/s	Mv 1/tsf	k ft/day	Ca %
1	0.0698	0.002842	2.31	0.284	0.000	0.00e+00	4.07e-02	0.00e+00	0.00e+00
2	0.125	0.005047	2.30	0.505	0.000	0.00e+00	4.00e-02	0.00e+00	0.00e+00
3	0.250	0.01259	2.27	1.26	0.284	1.97e-05	6.03e-02	3.20e-03	0.00e+00
4	0.500	0.02358	2.24	2.36	0.000	0.00e+00	4.40e-02	0.00e+00	0.00e+00
5	1.00	0.04124	2.18	4.12	0.000	0.00e+00	3.53e-02	0.00e+00	0.00e+00
6	2.00	0.07885	2.05	7.88	0.715	7.04e-06	3.76e-02	7.14e-04	0.00e+00
7	4.00	0.1477	1.83	14.8	0.000	0.00e+00	3.44e-02	0.00e+00	0.00e+00
8	8.00	0.2241	1.57	22.4	0.000	0.00e+00	1.91e-02	0.00e+00	0.00e+00
9	16.0	0.2987	1.33	29.9	0.000	0.00e+00	9.32e-03	0.00e+00	0.00e+00
10	32.0	0.3648	1.11	36.5	0.000	0.00e+00	4.13e-03	0.00e+00	0.00e+00
11	8.00	0.3643	1.11	36.4	0.000	0.00e+00	2.19e-05	0.00e+00	0.00e+00
12	2.00	0.3607	1.12	36.1	0.000	0.00e+00	6.02e-04	0.00e+00	0.00e+00
13	0.500	0.3563	1.13	35.6	0.000	0.00e+00	2.93e-03	0.00e+00	0.00e+00
14	0.125	0.3513	1.15	35.1	0.000	0.00e+00	1.32e-02	0.00e+00	0.00e+00
15	0.0625	0.3502	1.15	35.0	0.000	0.00e+00	1.85e-02	0.00e+00	0.00e+00

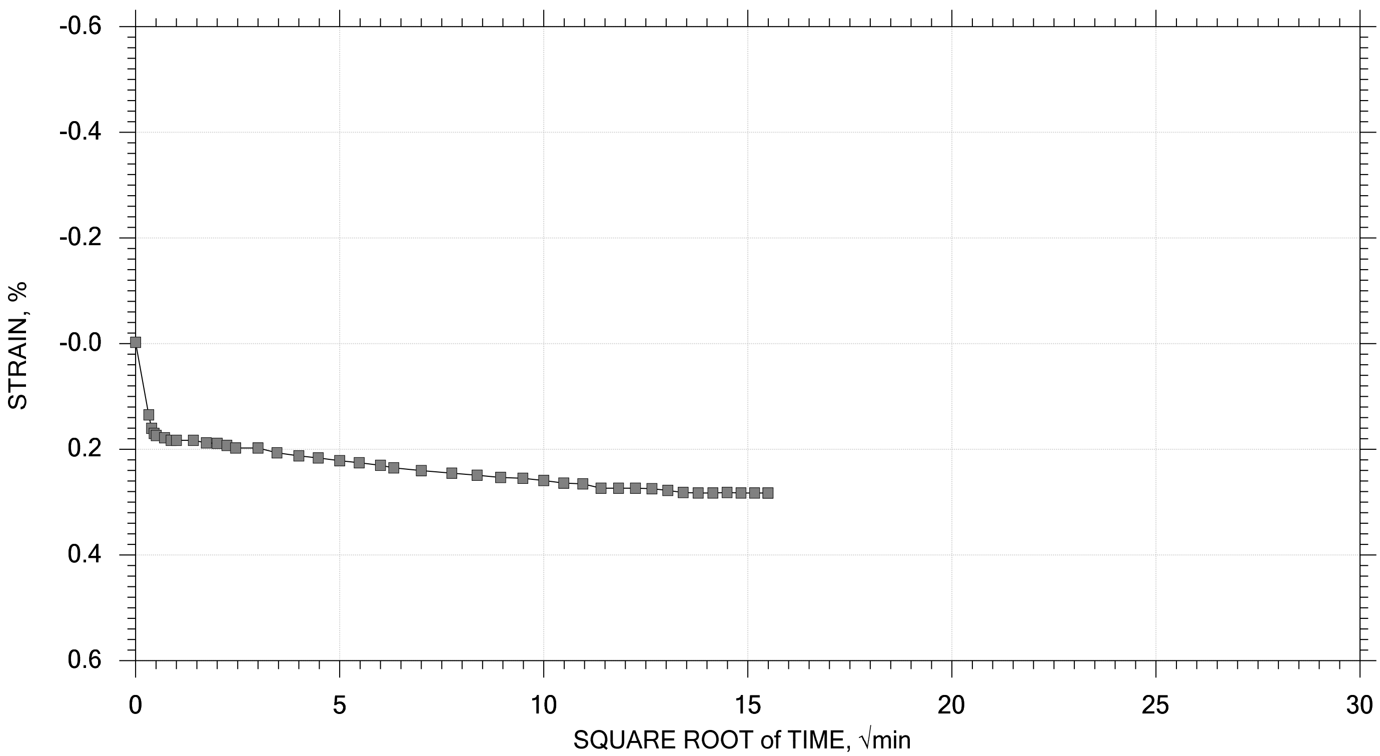
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Volume Step 1 of 15

Stress: 0.069818 tsf

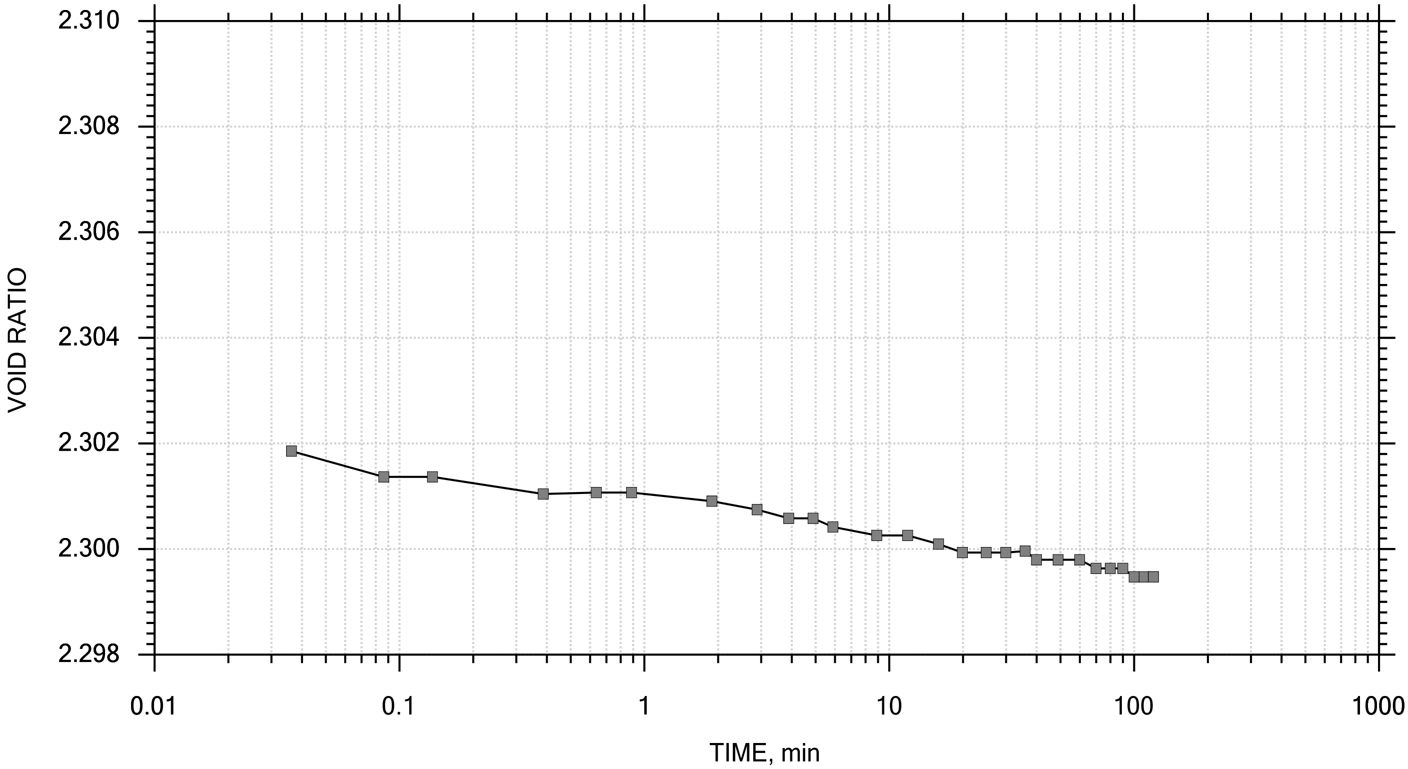


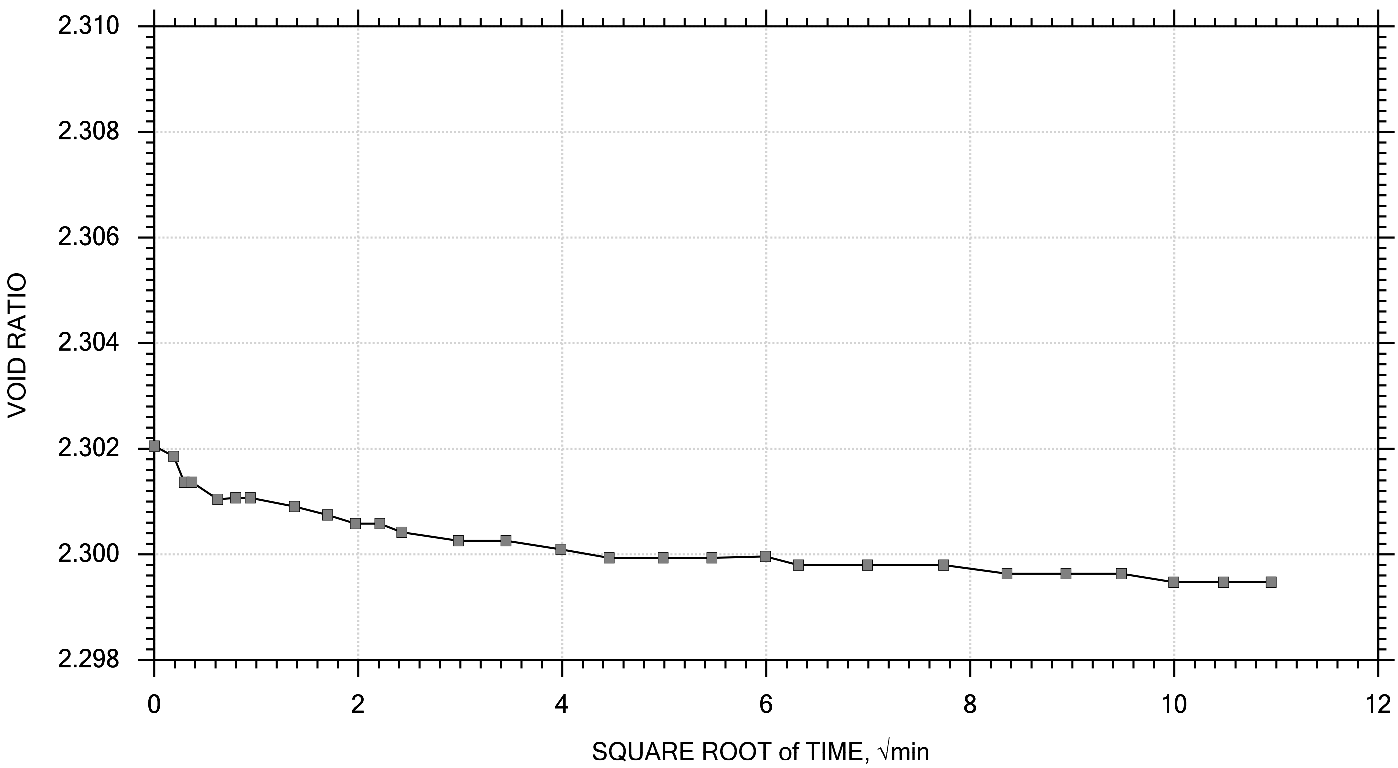


GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 2 of 15
Stress: 0.125 tsf

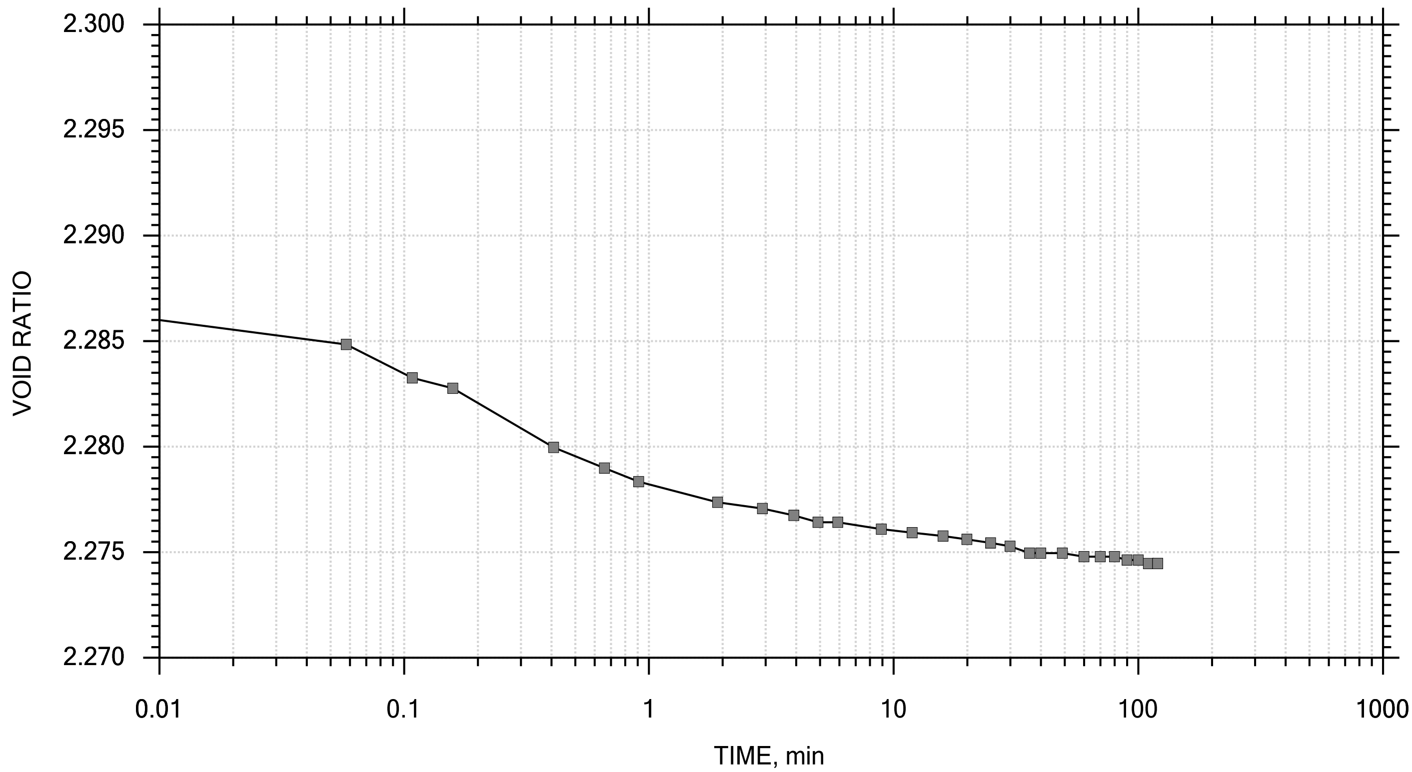


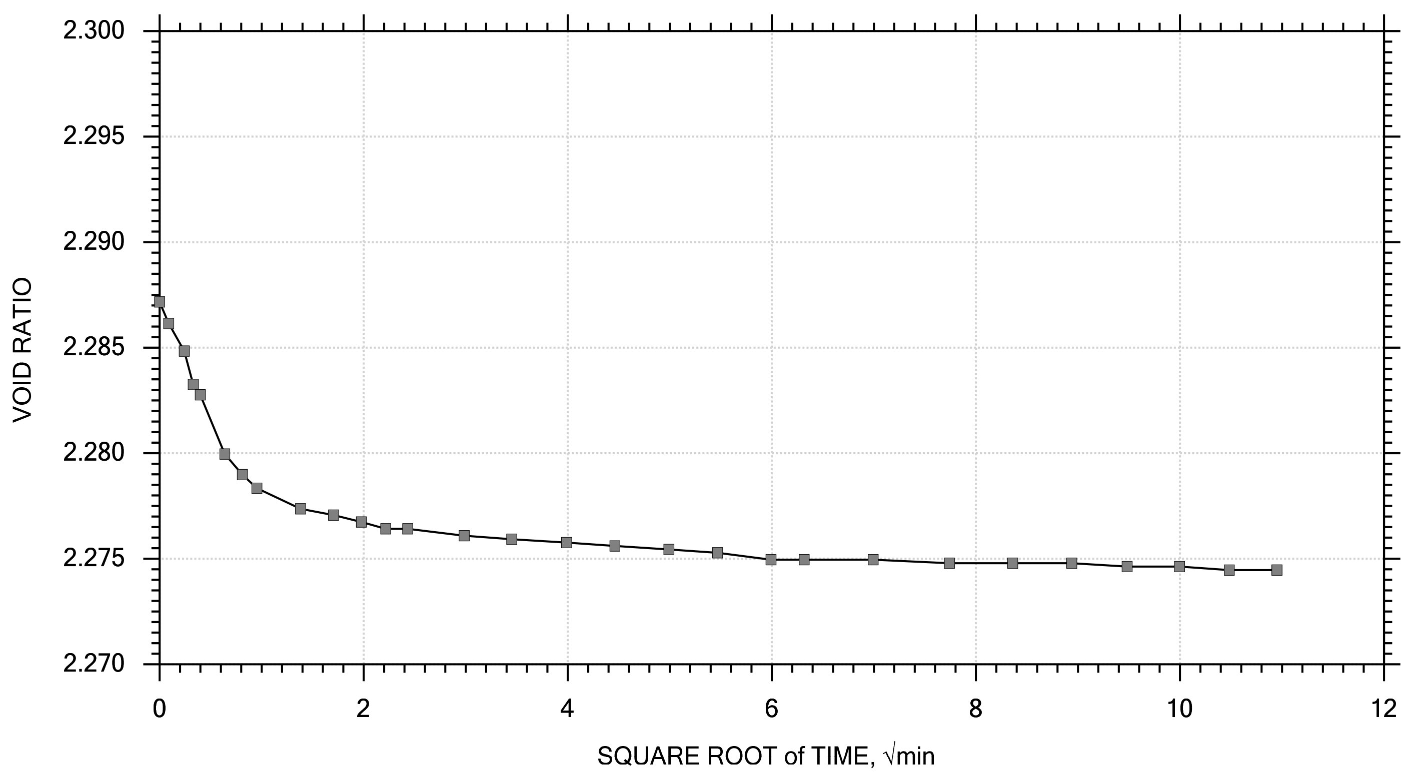


GeoTesting EXPRESS			
	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 3 of 15
Stress: 0.25 tsf

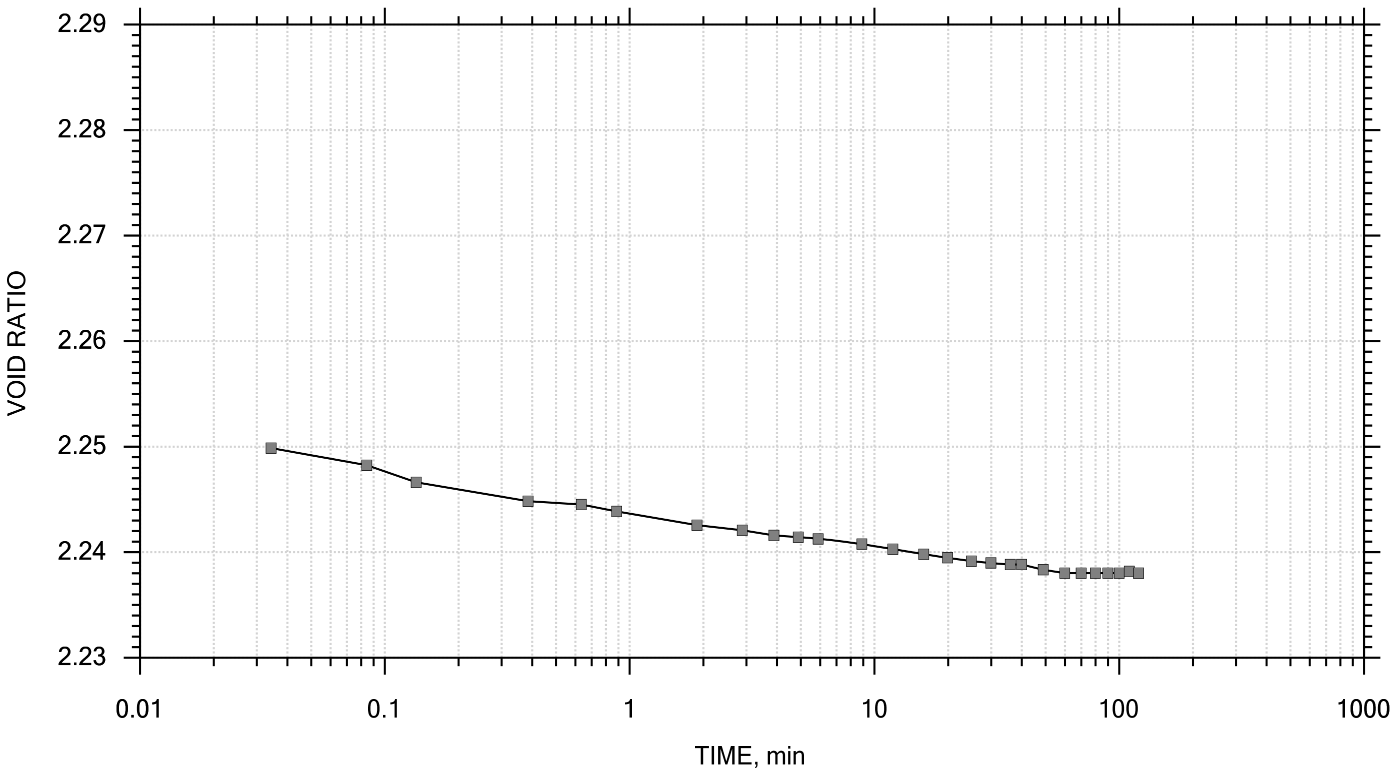


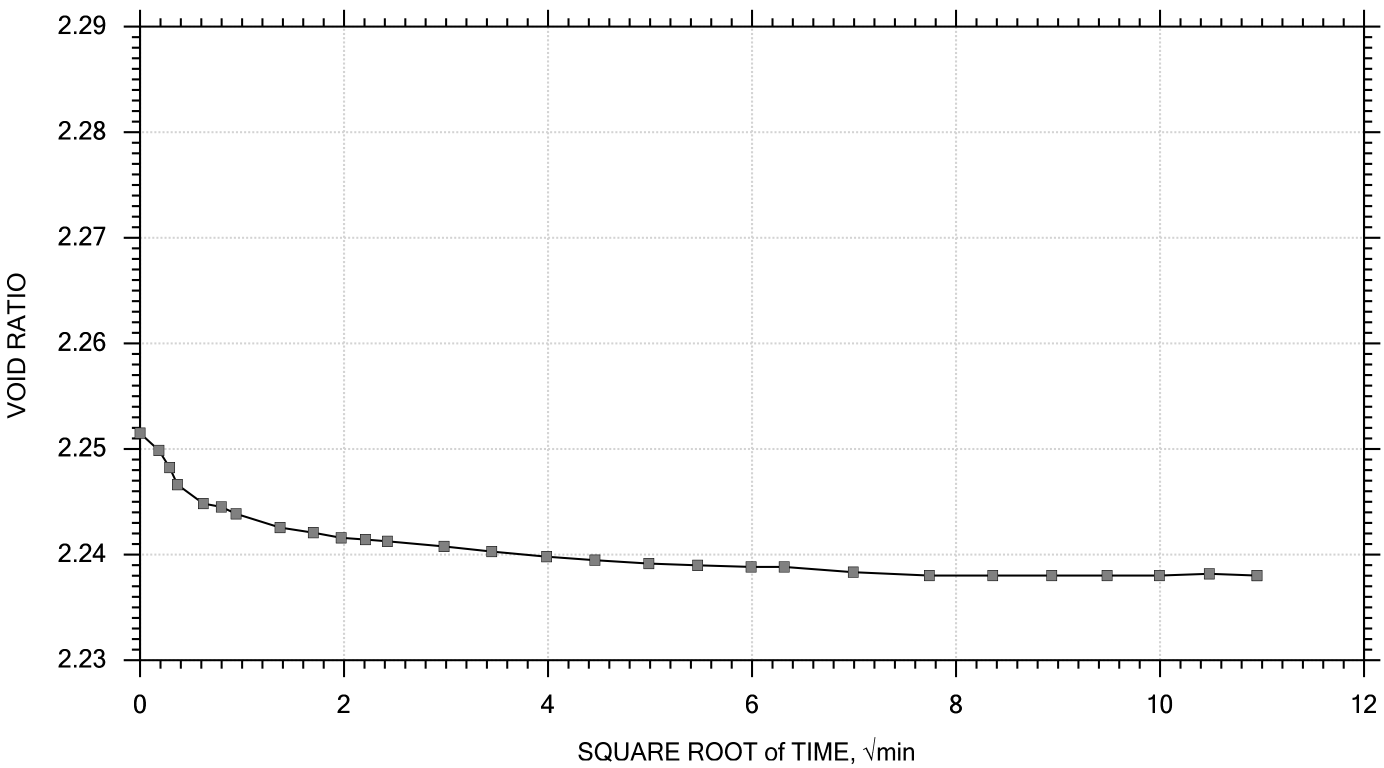


GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 4 of 15
Stress: 0.5 tsf





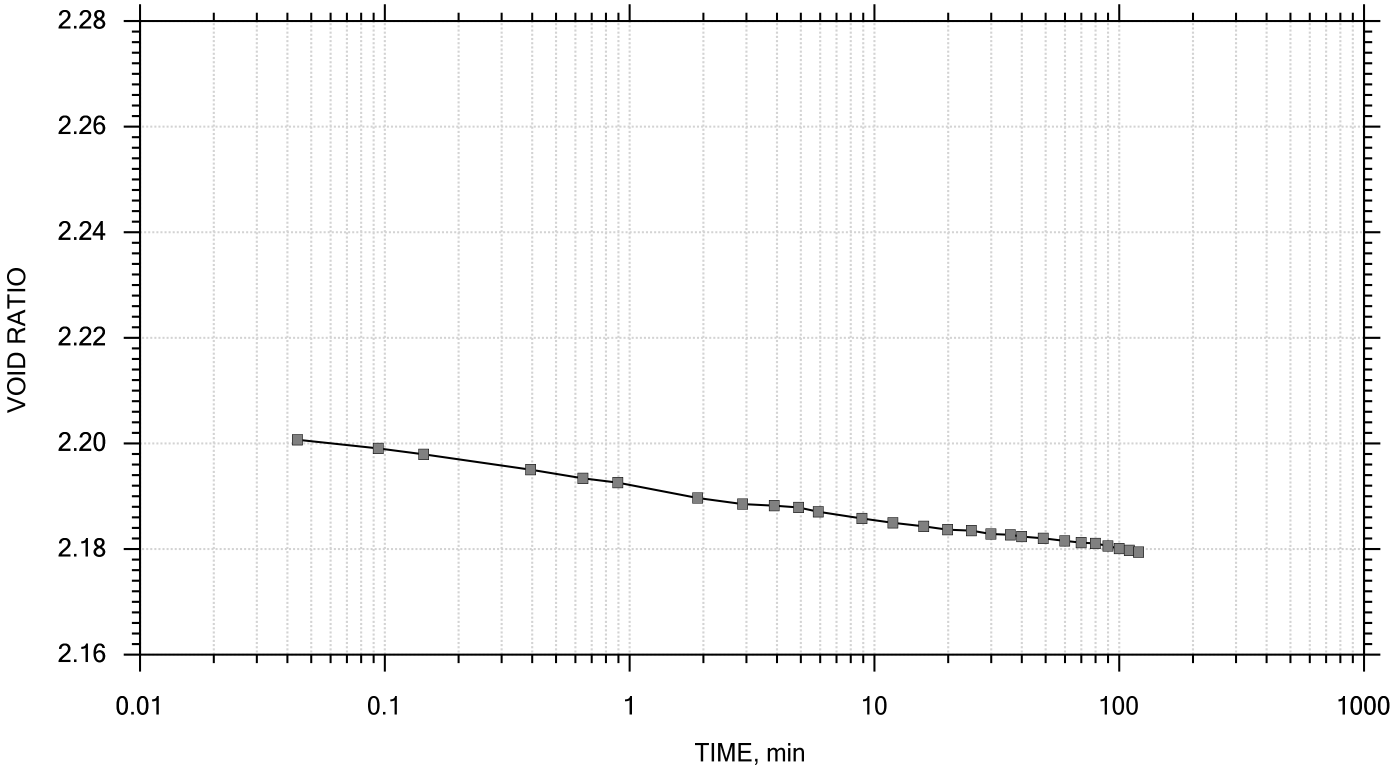
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

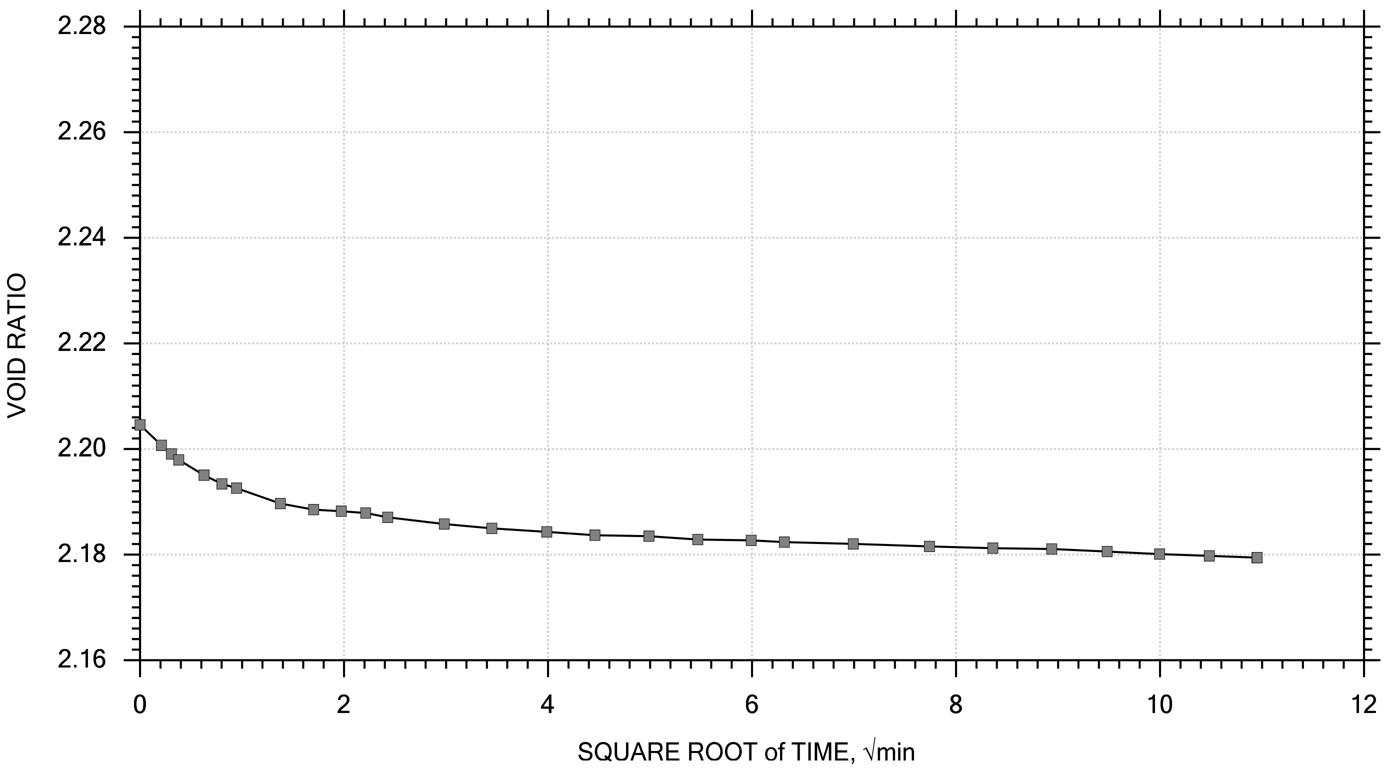
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 15

Stress: 1 tsf

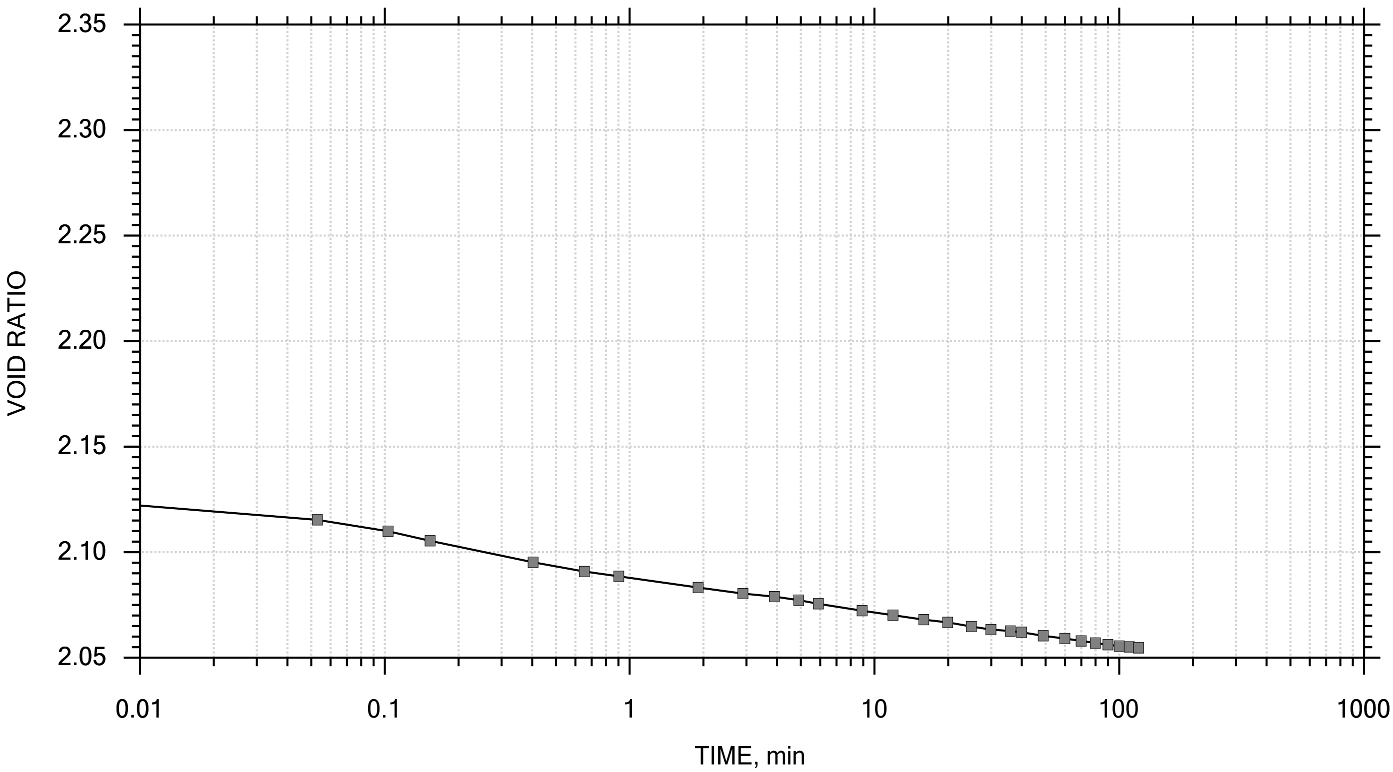


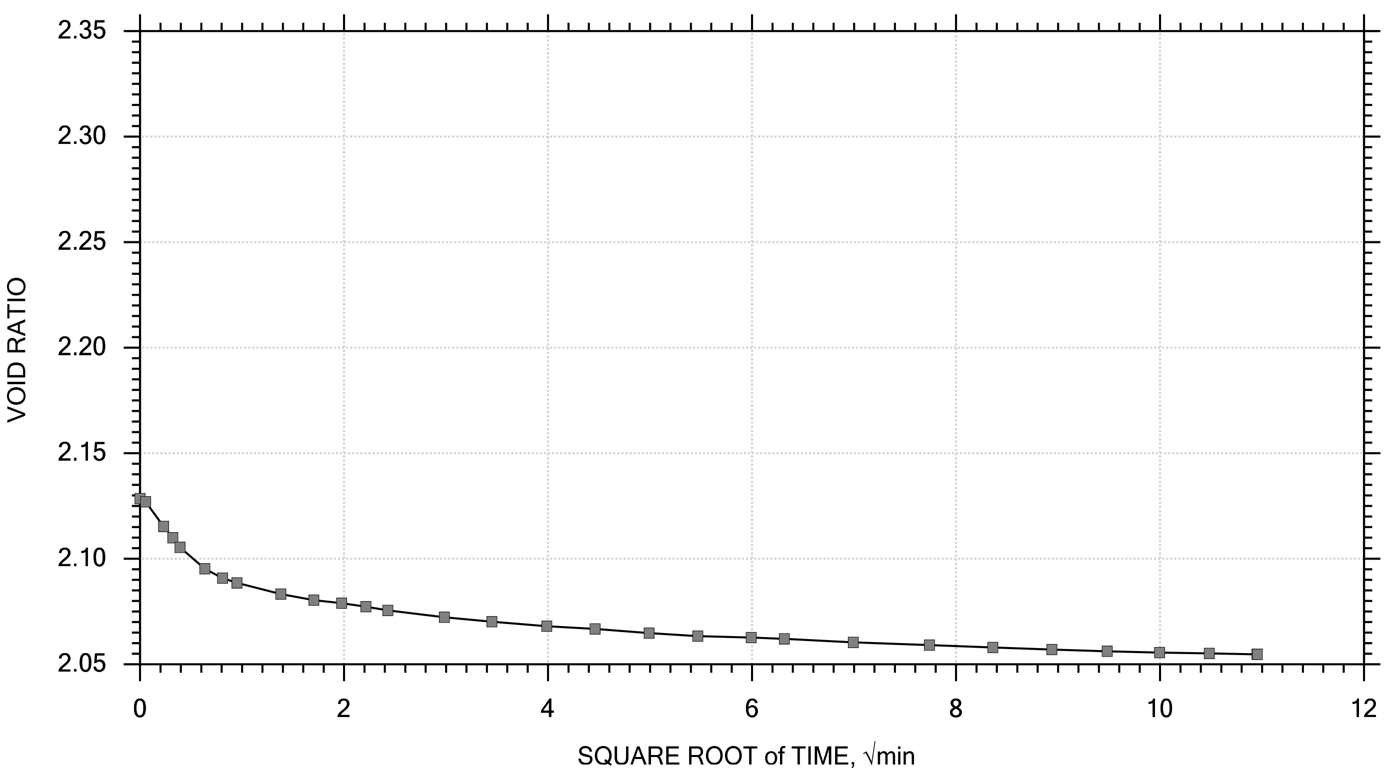


GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 6 of 15
Stress: 2 tsf





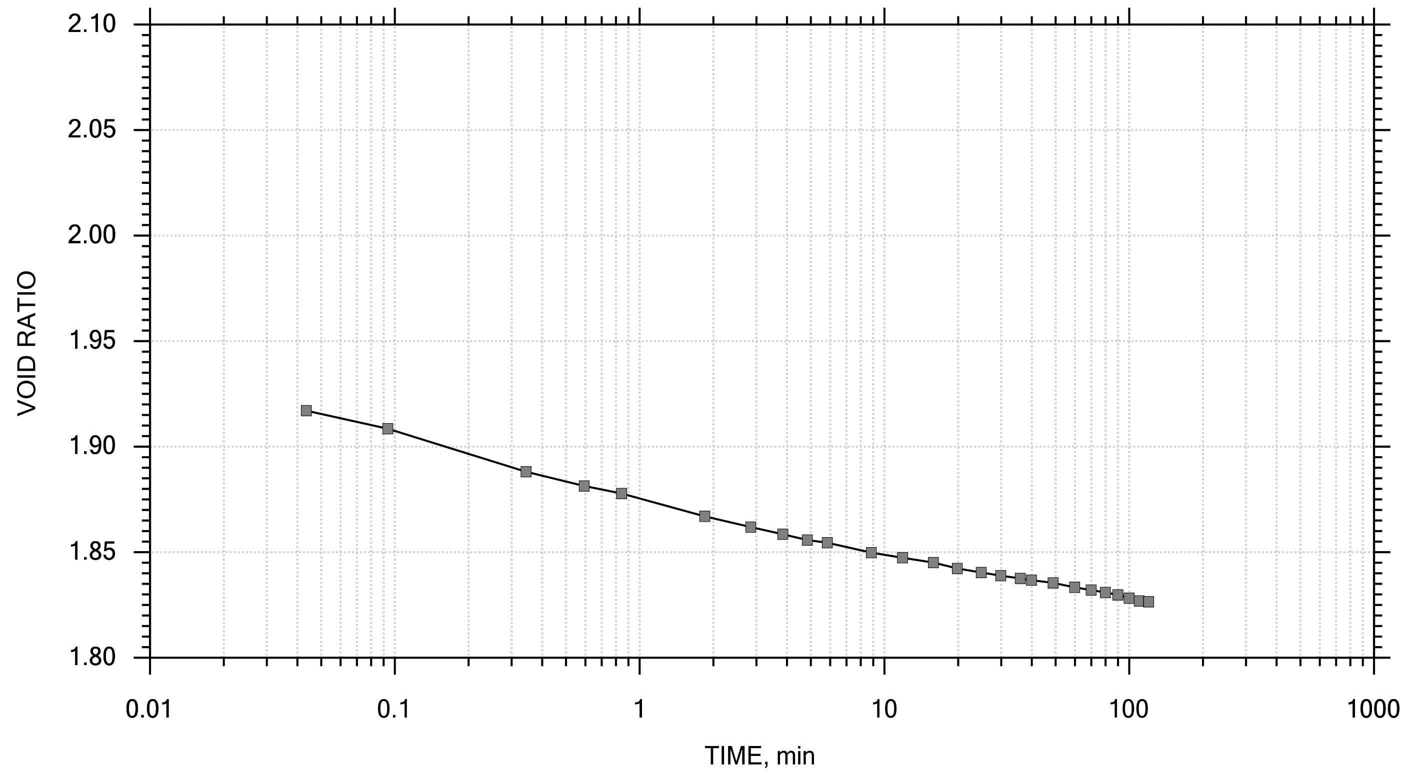
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

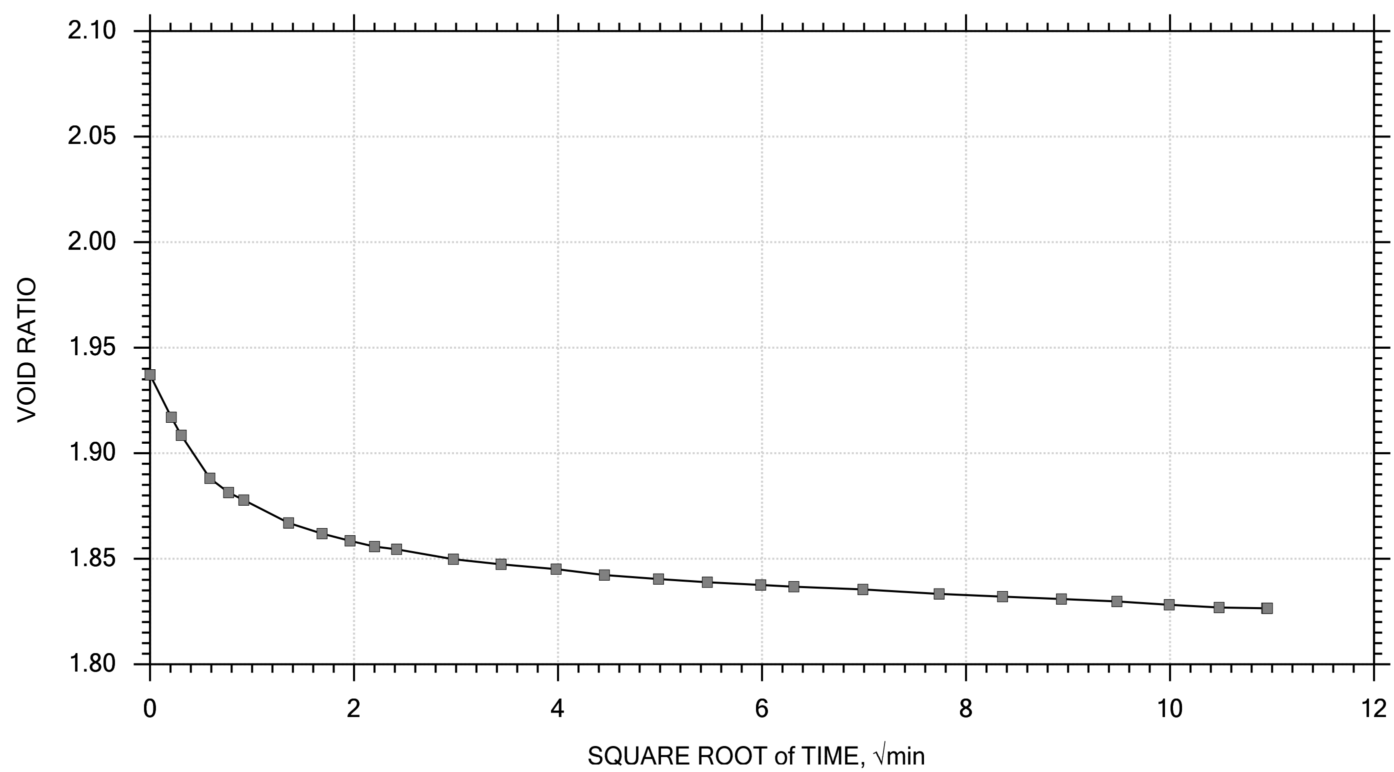
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 15

Stress: 4 tsf

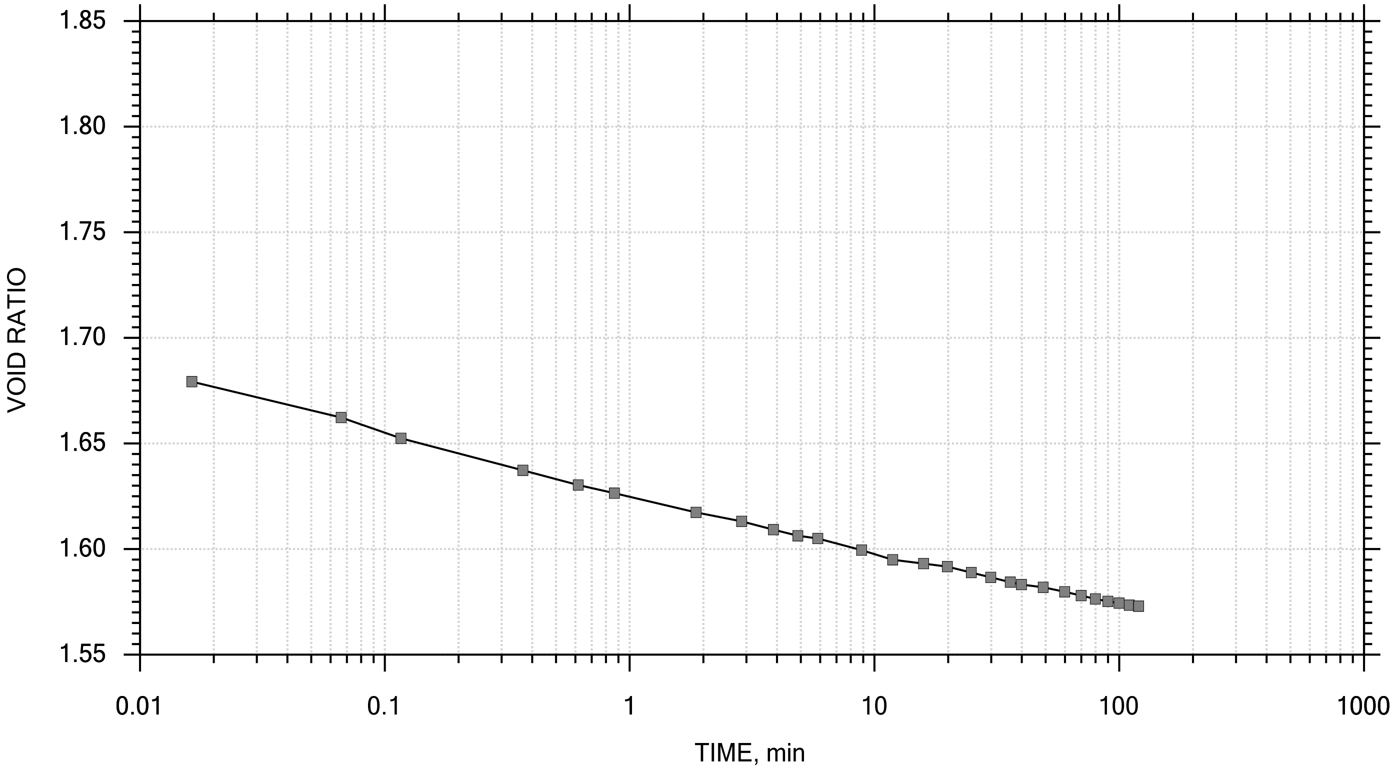


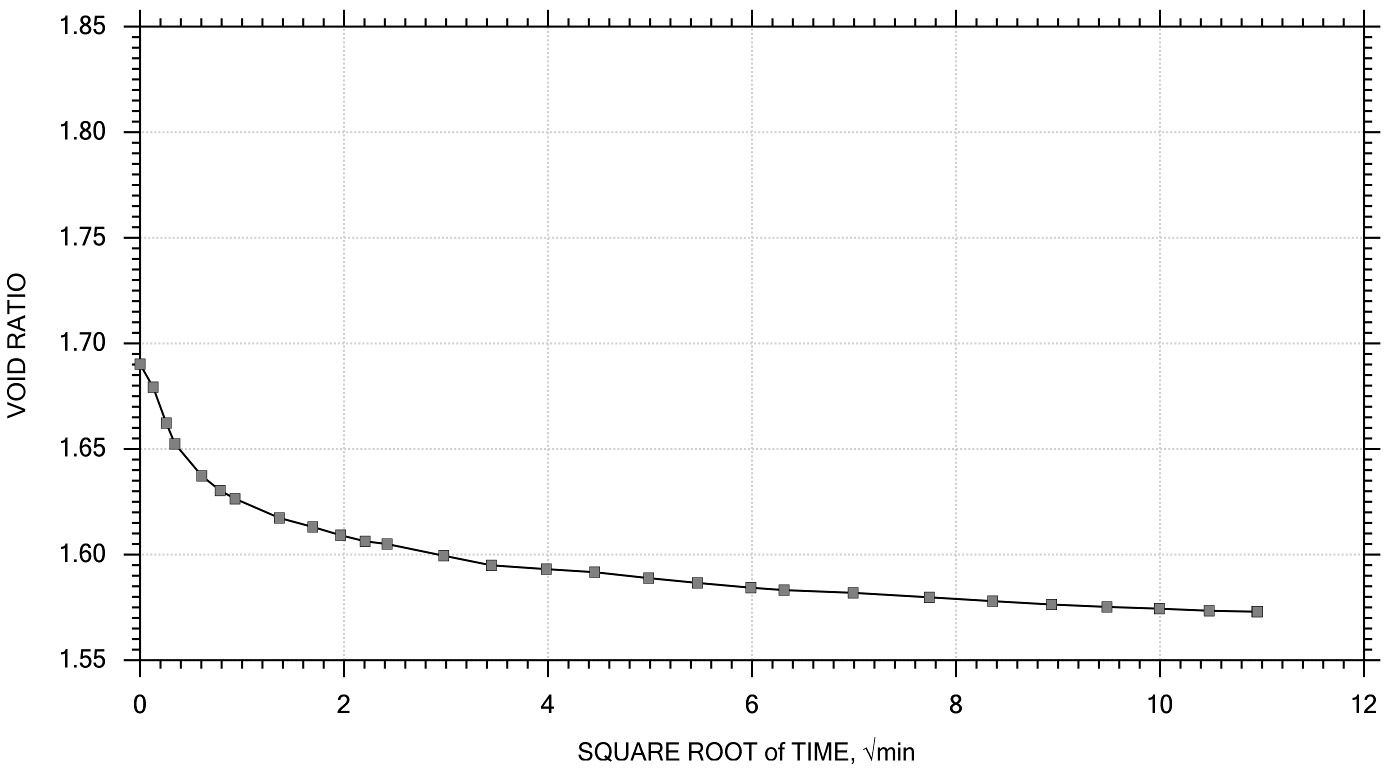


GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 8 of 15
Stress: 8 tsf





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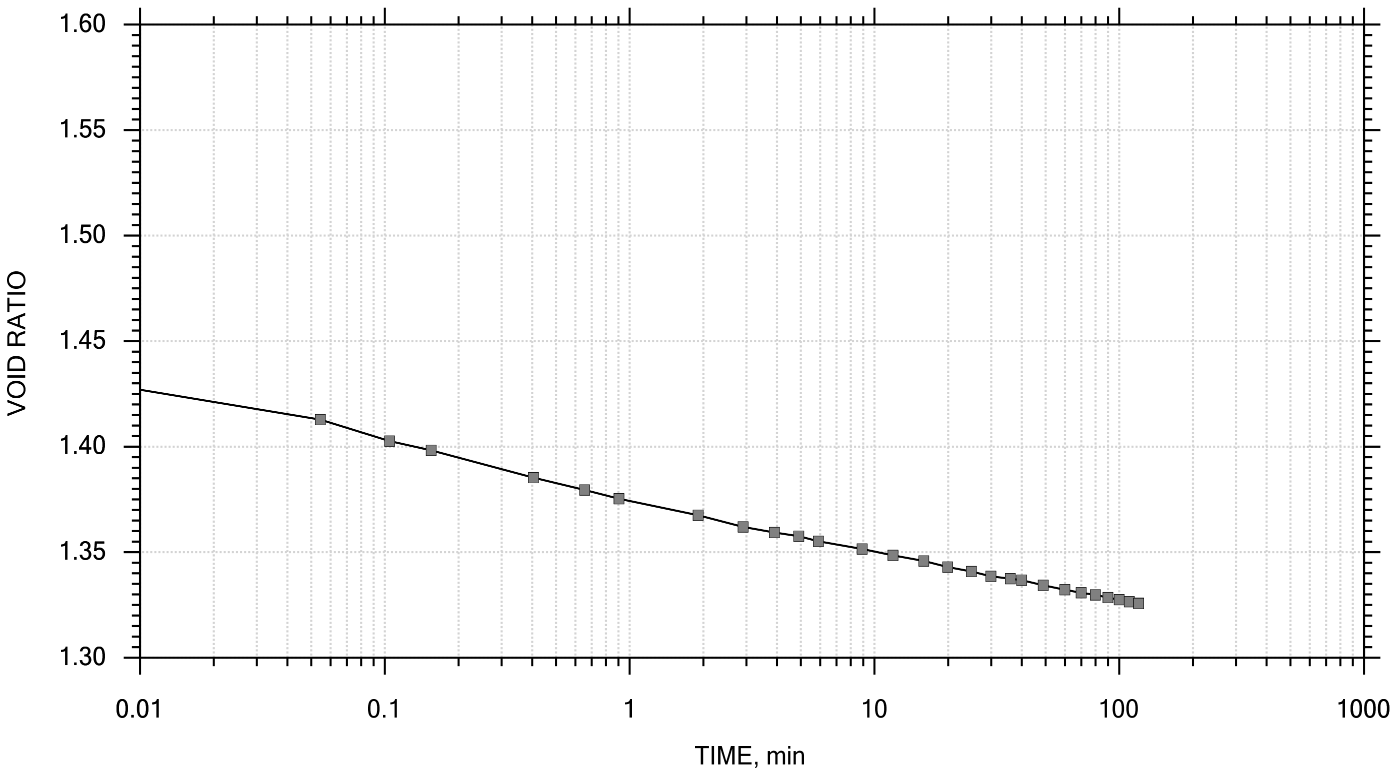
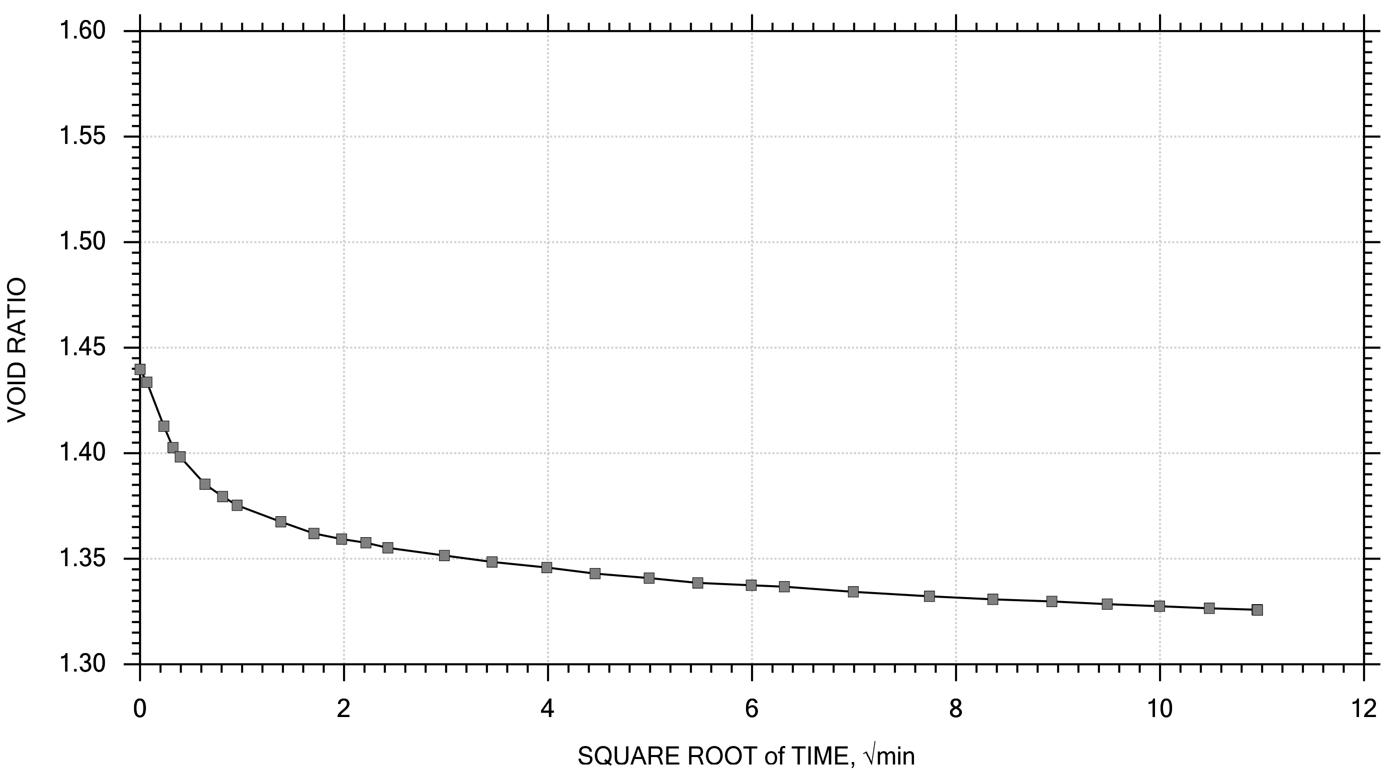
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 9 of 15
Stress: 16 tsf





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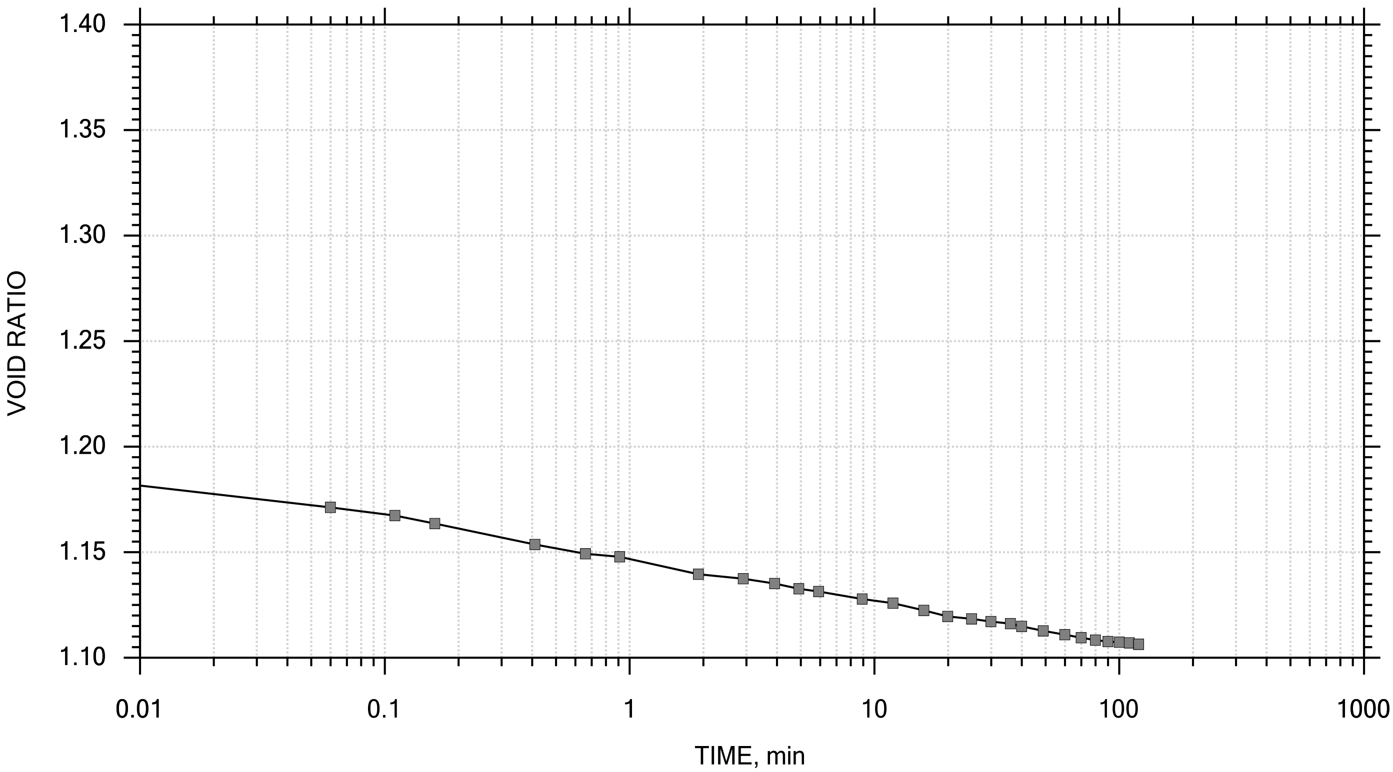
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

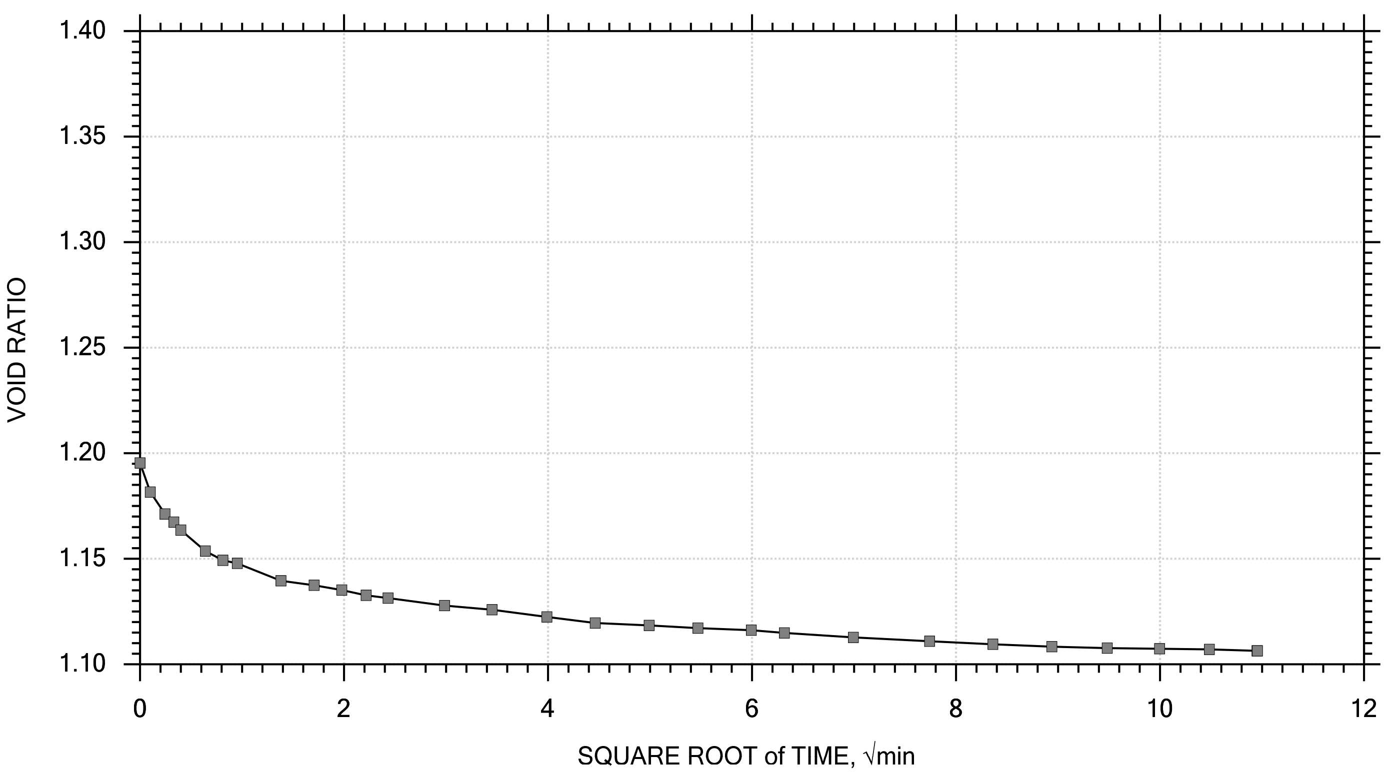
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 10 of 15

Stress: 32 tsf





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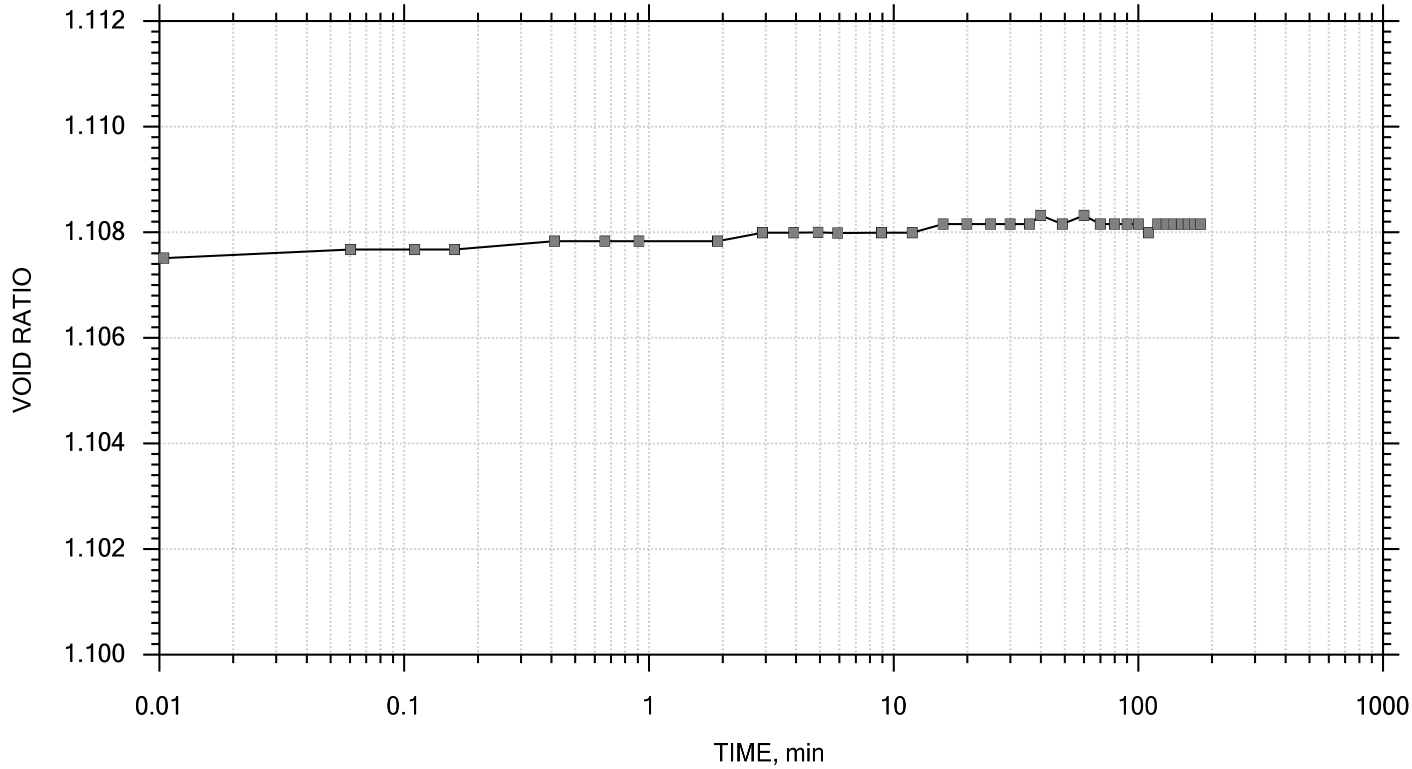
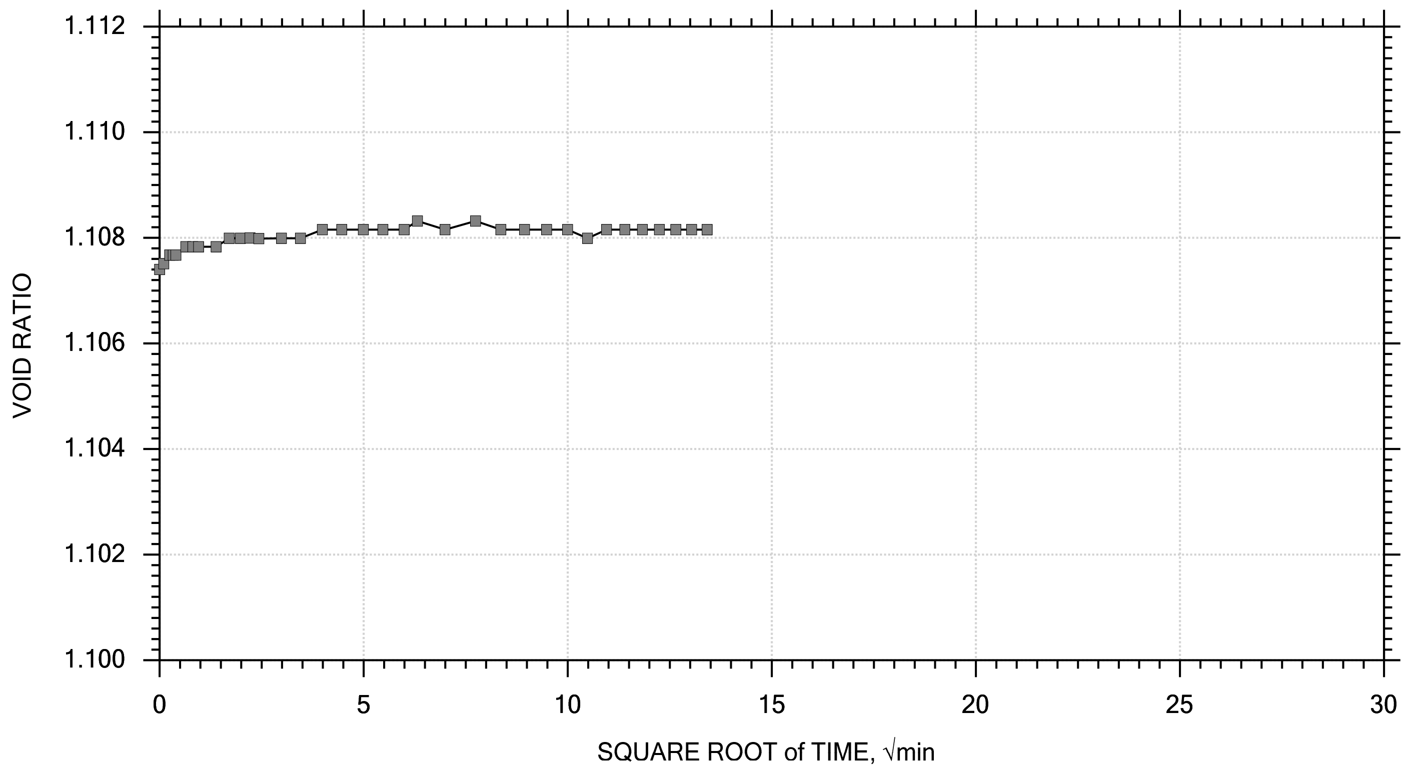
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 11 of 15
Stress: 8 tsf

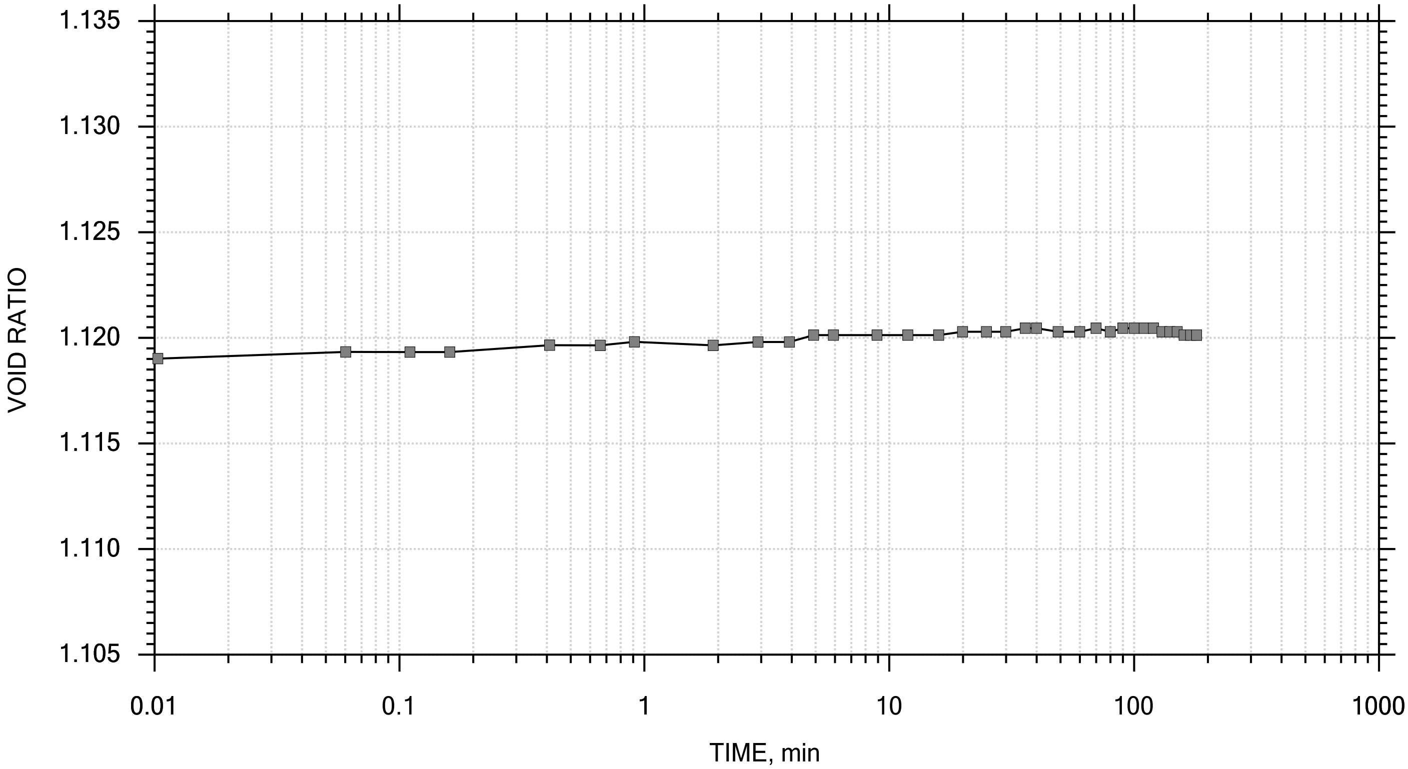


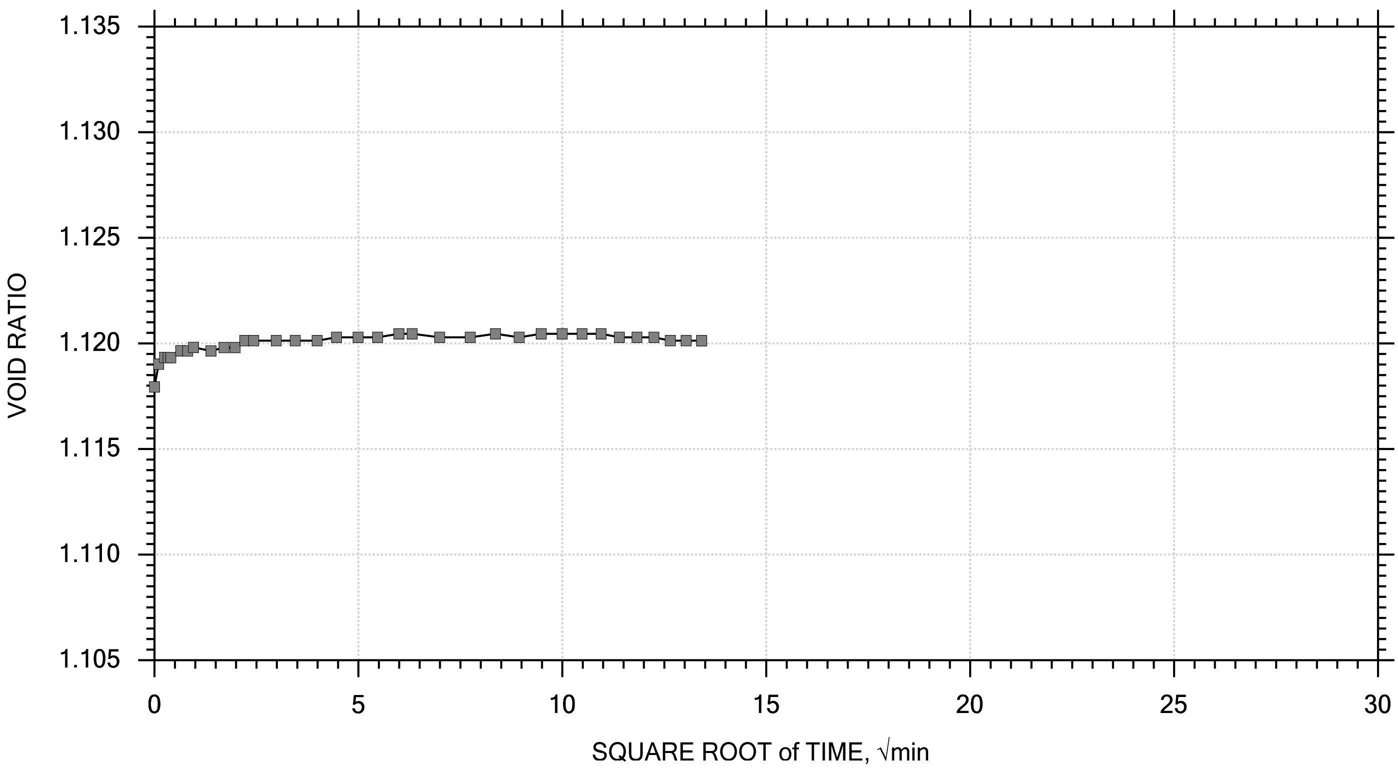


GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 12 of 15
Stress: 2 tsf





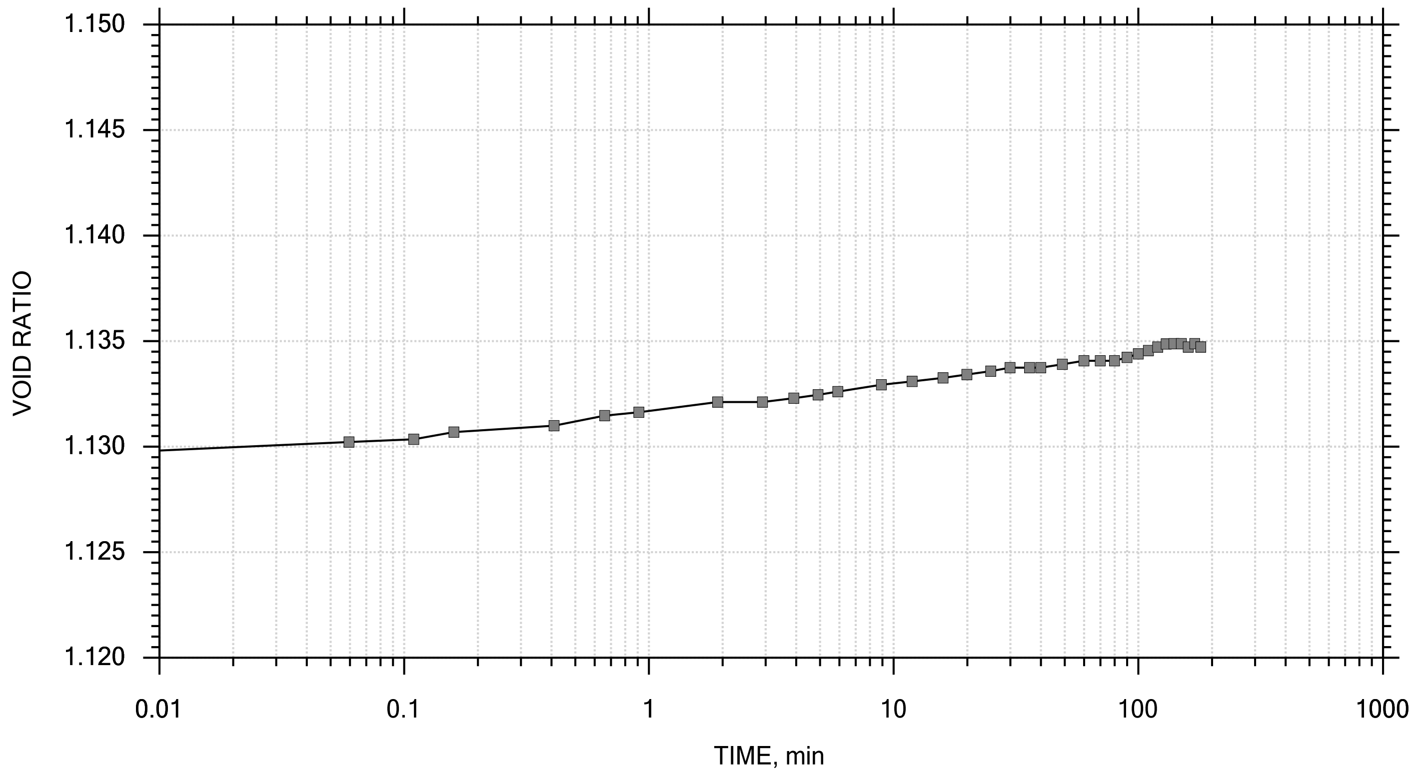
GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

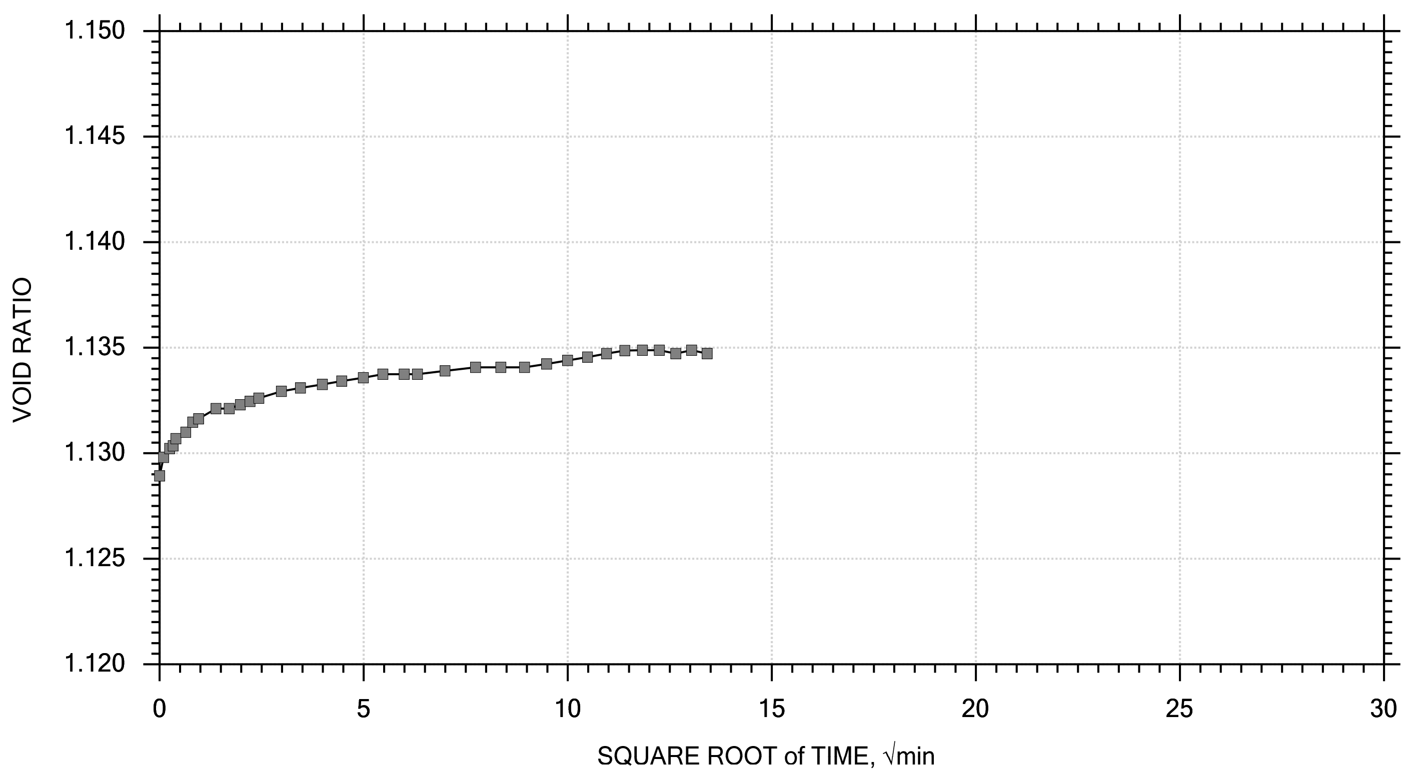
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 13 of 15

Stress: 0.5 tsf





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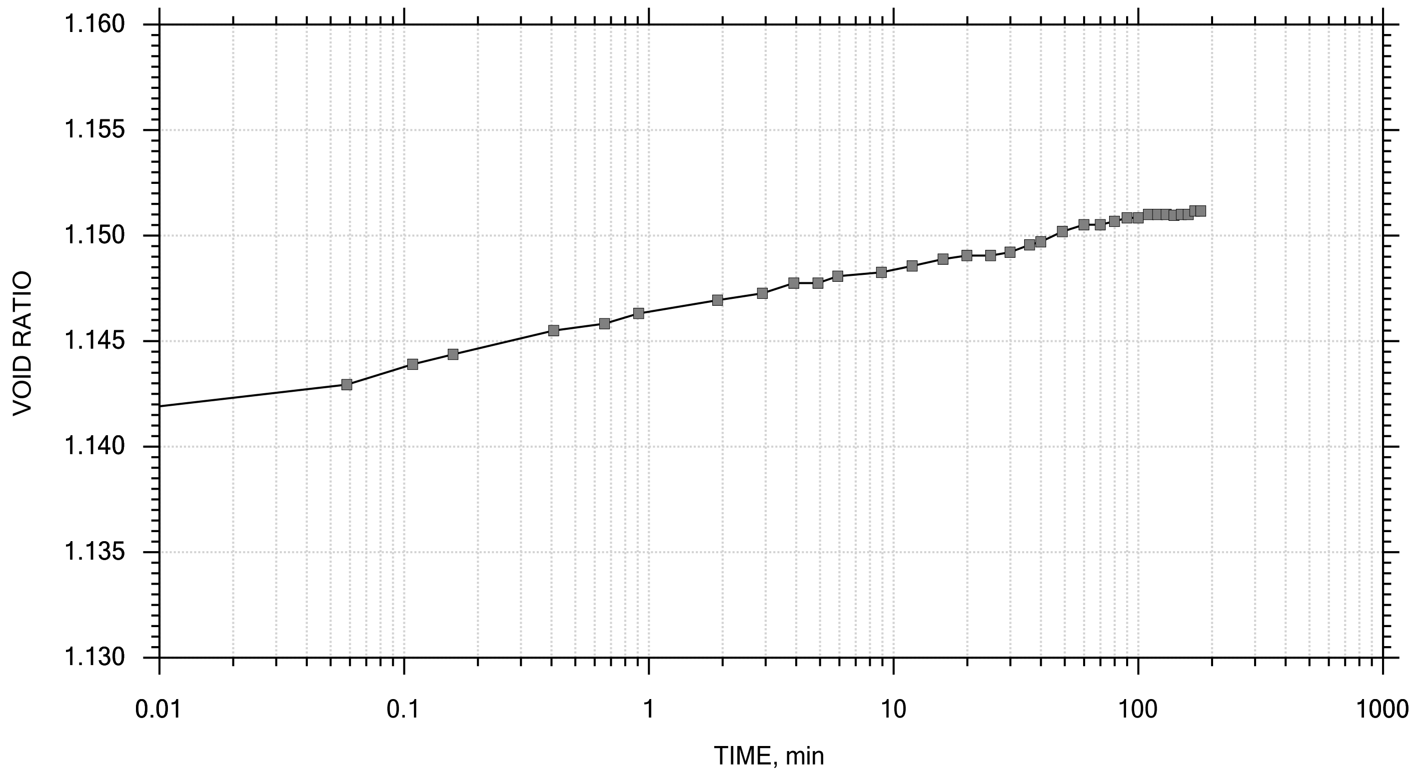
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

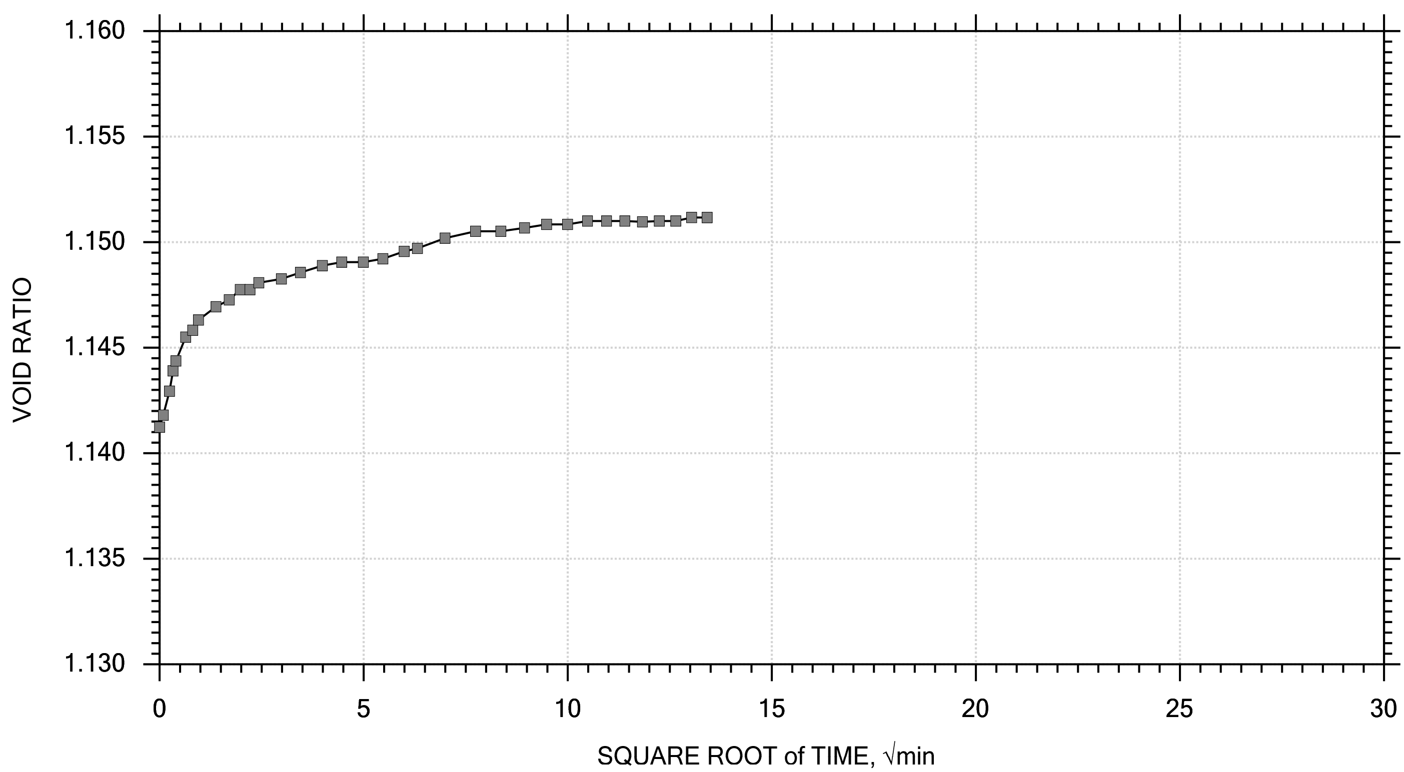
One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 14 of 15

Stress: 0.125 tsf

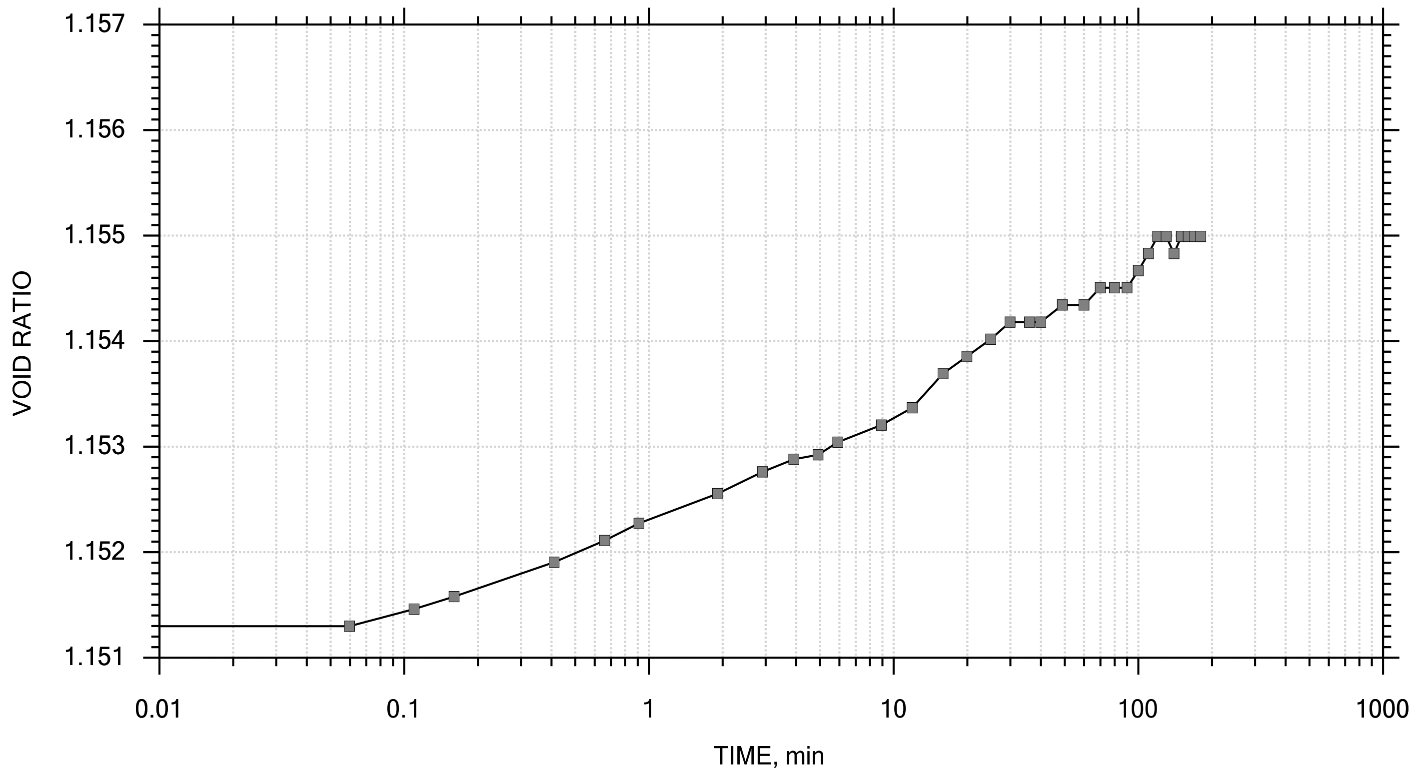


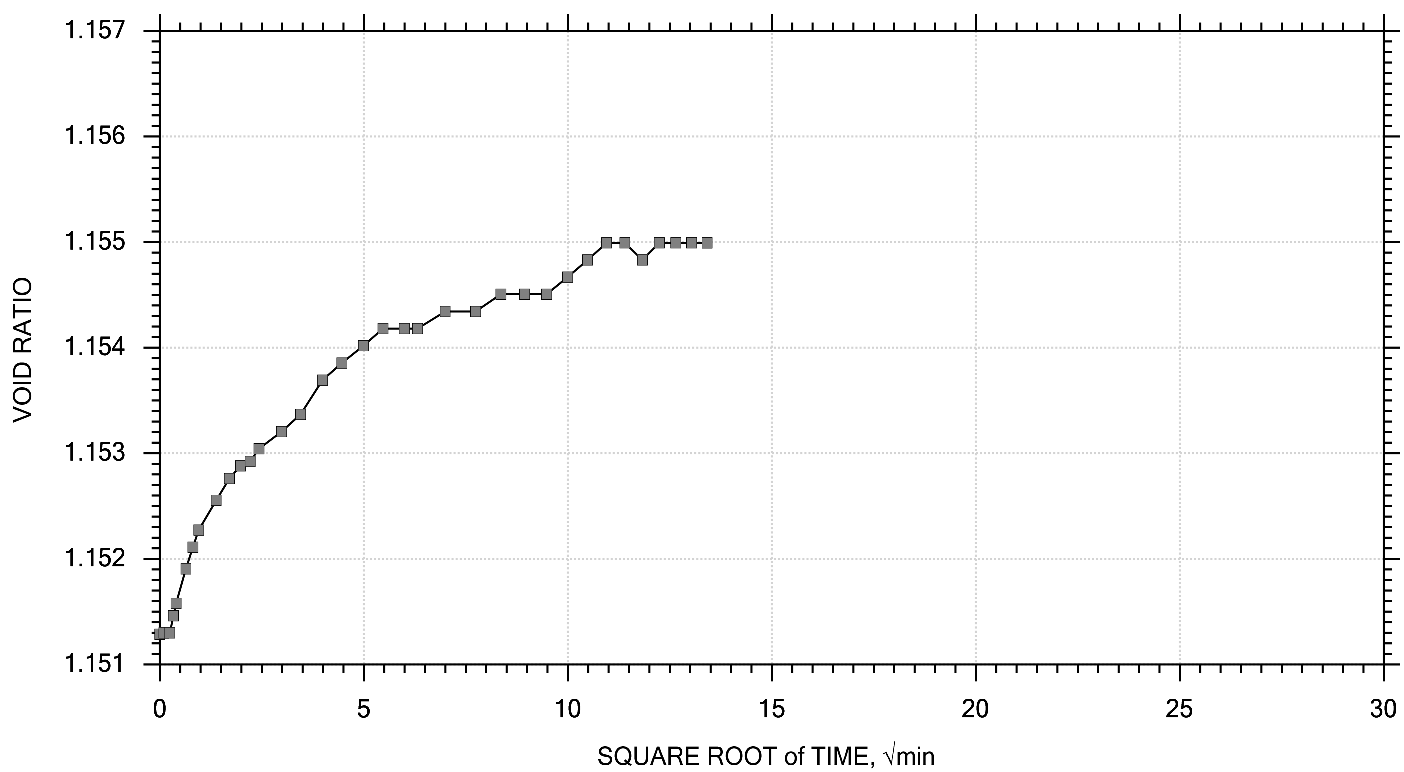


GeoTesting EXPRESS			
	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES
Constant Load Step 15 of 15
Stress: 0.0625 tsf





GeoTesting EXPRESS	Project: South River	Location: ---	Project No.: GTX-302574
	Boring No.: AQSB-01	Tested By: md	Checked By: jdt
	Sample No.: ST01	Test Date: 12/01/14	Test No.: IP-1
	Depth: ---	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown silty sand with gravel		
	Remarks: System O, Swell Pressure = 0.0698 tsf		

APPENDIX B
PERMITS (PLACEHOLDER)

APPENDIX M
MAINTENANCE PLAN

MAINTENANCE PLAN
PHASE 1A BANK MANAGEMENT AREAS
SOUTH RIVER AREA OF CONCERN 4

Prepared for

Virginia Department of Environmental Quality

City of Waynesboro

Prepared by

Anchor QEA, LLC

10320 Little Patuxent Parkway, Suite 1140

Columbia, Maryland 21044

September 2016

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ACRONYMS AND ABBREVIATIONS

BMA	bank management area
CCS	cellular containment system
STMP	Short-Term Monitoring Plan

1 INTRODUCTION

This Maintenance Plan supports Phase 1A Interim Measures to be constructed in the South River Area of Concern 4. Following completion of these Interim Measures, and in conjunction with the Short-Term Monitoring Plan (STMP; URS 2015a), Phase 1A Bank Management Areas (BMAs) will be periodically inspected to identify maintenance requirements. The monitoring and maintenance described in this Maintenance Plan is focused on ensuring vegetative development, stability of the Phase 1A BMAs, and the integrity of the design features. The STMP (as revised July 2015; AECOM 2015) and Long Term Monitoring Plan (URS 2015b) include additional monitoring elements related to bank stability (e.g., LiDAR surveys for the remediated banks) and for evaluating the effectiveness of the interim measures (e.g., biota and water sampling).

A key goal of the Phase 1A Interim Measures is to establish beneficial perennial ground cover (herbaceous) species to help stabilize the BMAs, as measured by plant cover, which in turn is determined by the amount of available light and canopy cover. Monitoring will also include evaluation of installed stability features (e.g., rock toe and erosion-control products) to evaluate whether the features are remaining in place and are not exposed (e.g., for the erosion-control products). Other metrics directly related to bank stability will also be monitored, including exposed roots, undercutting, presence of at-risk trees, and evidence of local scour (Section 2).

This Maintenance Plan will be updated after completion of Interim Measures construction, with additional details on how the data collected under this plan and the STMP will be used to evaluate bank stability and potential corrective measures.

2 MONITORING APPROACH

The following monitoring data will be collected along transects located every 50 feet within a BMA:

- Undercutting
- Exposed roots
- At-risk trees
- Stability features
- Local scour

Fixed reference locations will be established for periodic monitoring such as photography so that results can be compared over time. Collected data will be recorded in the field on a field data form (Attachment 1) for transfer to a Microsoft Excel spreadsheet for analysis and reporting.

2.1 Monitoring Metrics

Individual monitoring metrics are described below.

2.1.1 Undercutting

Undercutting at the toe can occur during low flows, whereas undercutting at the center of the bank can occur during higher flows. Field indicators of undercutting include the lack of vegetation and an upper portion of the bank that is more riverward than the lower portion of the bank. Additionally, because all of the reconstructed banks in the Primary BMAs will be near continuous grade, a significant deviation from continuous bank slope or break in grade in these areas will be used as an indicator of undercutting. Examples of low, moderate, and high levels of undercutting are provided in Figure 1.

2.1.2 Exposed Roots

Trees root into soil so the roots can transport water and nutrients to the tree. The presence of exposed tree roots is a field indicator that soil has eroded away from that location over time. The level of exposed roots (i.e., the extent to which roots are exposed) may provide a relative measure of the magnitude of the erosion. Although exposed roots on the face of the bank may deflect or absorb some energy, they do not bind up bank soil as would well-rooted vegetation. Exposed roots can also limit the establishment of ground cover in the area that is important to minimize surface soil erosion in the event that erosive forces do reoccur at that location. Examples of low, moderate, and high levels of exposed roots are provided in Figure 2.

2.1.3 At-Risk Trees

The presence of at-risk trees is indicated by the location of the tree on the bank face and typically includes exposed roots, as described above. Trees that lean toward the river, rather than standing vertical, have a greater potential to fall into the river over the short-term compared to vertical trees. At-risk trees that fail have the potential to dislodge the bank soil and erosion-control products immediately around and above the tree. Examples of at-risk trees are provided in Figure 3. Although monitoring for at-risk trees will be focused at the monitoring transects, all at risk trees that are observed during field visits will be noted.

2.1.4 Installed Stability Features

The stability features installed at each BMA will be monitored to ensure they are performing as designed. The Phase 1A BMAs include the following installed stability features (note: not all features are installed at each BMA):

- Toe and bench protection (i.e., stone, natural logs, and coir logs)
- A cellular containment system (CCS) soil-stabilizing material (i.e., a geocell product)
- Surface erosion protection (i.e., erosion control fabrics)

Monitoring will include visual evaluation of the installed stability features to ensure they remain appropriately anchored, where appropriate, and no exposed areas of erosion-control fabric or CCS material are visible. In addition, the area where stone is placed for toe or bench protection will be monitored to identify any areas where material has sloughed, or been eroded, or moved downstream significantly.

2.1.5 Local Scour

For the purposes of this Maintenance Plan, local scour is defined as small, localized areas, approximately 10 to 20 square feet in size, where noticeable soil/sediment loss is observed.

Local scour can be caused by changes in velocities and shear stresses related to obstructions such as downed trees or rocks. The presence of local scour areas will be qualitatively assessed at the toe and center of each transect and approximately 10 feet on either side of the transect. In addition, approximately 25 feet upstream and downstream of the ends of each BMA will be visually inspected for presence of local scour to monitor for potential future impacts on the BMA.

3 SCHEDULE AND REPORTING

Annual bank monitoring will begin in the year following construction of the Phase 1A BMAs and continue for a minimum of 3 years. After 3 years, the collected data will be evaluated to determine what, if any, changes to the monitoring frequency, metrics, or duration are needed.

Data will be collected during two separate monitoring events each year. One monitoring event will be conducted during leaf-off conditions after high-water conditions (typically March or April) so the banks are less obscured with vegetation. Data on undercutting and exposed roots will be collected during this monitoring event. The remaining data will be collected during the second monitoring event that will be conducted during leaf-on conditions (typically during the months of July and August) in order to better assess vegetative cover, as specified in the STMP.

The leaf-off monitoring event will also serve as an annual maintenance inspection designed to identify and correct issues that may need more immediate attention. Any geocell panels or erosion-control fabrics that have become unanchored will be addressed. The installed vegetation will also be actively managed. Areas where herbaceous vegetation is not fully established by the end of the first full growing season may need to be reseeded. Trees and/or shrubs will be replanted as needed to meet a 90% survival goal. For the large trees (5-gallon size), all individuals that do not survive the first year will be replaced. Trees and shrubs that do not survive the first year will be replaced with species performing well at the site. During the maintenance inspections, site conditions will also be evaluated to determine if additional measures, such as herbivory control, are warranted. Any replanting required will occur in the next appropriate planting window, which may occur in the same year as the observation.

During the first two growing seasons after construction, spot treatments with chemical herbicides (e.g., Rodeo) will be applied where invasive species are observed (i.e., 10% cover or greater), especially Japanese knotweed (*Fallopia japonica*). For the remaining year of the monitoring program, chemical herbicides will be applied to invasive species if percent cover of invasive species exceeds 10% or establishing patches are observed within the project boundaries during the field surveys. Alternative control measures will be recommended, if needed, based on the species identified in the field.

A BMA monitoring report will be submitted at the end of each monitoring year that describes the results of the monitoring and a description of the stability of each area. The BMA monitoring report will also contain a description of any maintenance activities planned for the subsequent year, if it is determined there has been a change in bank stability. In addition, the BMA monitoring report will describe any maintenance activities conducted in the prior year based on monitoring results.

4 REFERENCES

Aecom, 2015. *Short-Term Monitoring Plan – Revised Habitat Metrics Dupont Former Waynesboro Site, Area Of Concern 4 – Revised July 2015.* Memorandum prepared for DuPont. July 17, 2015.

URS, 2015a. *Final AOC 4 Short-term Monitoring Plan; Relative River Mile 0-2 of the South River, Virginia.* Former DuPont Waynesboro Site - Area of Concern 4, Waynesboro, Virginia. February 2015.

URS, 2015b. *Final AOC 4 Long-term Monitoring Plan; South River and a Segment of the South Fork of the Shenandoah River, Virginia.* Former DuPont Waynesboro Site - Area of Concern 4, Waynesboro, Virginia. February 2015.

FIGURES

ANCHOR QEA

Figure 1
Examples of Levels of Undercutting
Appendix M – Maintenance Plan
Basis of Design Report - Phase 1A Bank Management Areas
South River Area of Concern 4

Figure 2
Examples of Levels of Exposed Roots
Appendix M – Maintenance Plan
Basis of Design Report - Phase 1A Bank Management Areas
South River Area of Concern 4

ANCHOR QEA

ANCHOR QEA

Figure 3
Examples of At-risk Trees
Appendix M – Maintenance Plan
Basis of Design Report - Phase 1A Bank Management Areas
South River Area of Concern 4

ATTACHMENT 1
BMA MONITORING AND MAINTENANCE INSPECTION

BMA Monitoring and Maintenance Inspection
Phase 1A Interim Remedial Measures
DuPont South River AOC 4

BMA ID: ______________________
Field Team: ___________________________
Weather: _____________________________

Date : ________________________
Time: ________________________
River Discharge: _________________

Station (ft)	Undercutting			Exposed Roots		At Risk Trees		Installed Stabilization Features Intact				Local Scour	
	Approximate Bank Angle	Consistent Grade (Y/N)	Notes/Photo #	Exposed Roots (L / M / H)	Notes/Photo #	At Risk Trees Present (Y/N + #)	Notes/Photo #	Rock Toe/LWD (Y/N)	Geocell (Y/N)	Erosion Control Fabric (Y/N)	Notes/Photo #	Scour Present (Y/N)	Notes/Photo #
00 - 25													
00 + 00													
00 + 50													
00 + 100													
00 + 150													
00 + 200													
00 + 250													
00 + 300													
00 + 350													
00 + 400													
00 + 450													
00 + 500													
00 + 550													
00 + 600													
00 + 650													
00 + 700													
00 + 750													
00 + 800													

AECOM

BMA Monitoring and Maintenance Inspection
Phase 1A Interim Remedial Measures
DuPont South River AOC 4

BMA ID: ______________________ **Date :** ________________________
Field Team: ___________________________ **Time:** ________________________
Weather: _____________________________ **River Discharge:** __________________

Station (ft)	Undercutting			Exposed Roots		At Risk Trees		Installed Stabilization Features Intact				Local Scour	
	Approximate Bank Angle	Consistent Grade (Y/N)	Notes/Photo #	Exposed Roots (L / M / H)	Notes/Photo #	At Risk Trees Present (Y/N + #)	Notes/Photo #	Rock Toe/LWD (Y/N)	Geocell (Y/N)	Erosion Control Fabric (Y/N)	Notes/Photo #	Scour Present (Y/N)	Notes/Photo #
00 + 850													
00 + 900													
00 + 950													
01 + 00													
01 + 50													
01 + 100													
01 + 150													
01 + 200													
01 + 250													
01 + 300													
01 + 350													
01 + 400													
01 + 450													
01 + 500													

Notes:

APPENDIX N
PROJECT-SPECIFIC WASTE MANAGEMENT PLAN FOR INTERIM MEASURES DESIGN AND IMPLEMENTATION – AREA OF CONCERN (AOC) 4

Environment

Submitted on behalf of
DuPont

Submitted by
AECOM
Sabre Building
Suite 300
4051 Ogletown Road
Newark, DE 19713

Project-Specific Waste Management Plan for Interim Measures Design and Implementation – Area of Concern (AOC) 4

DuPont Former Waynesboro Facility
Waynesboro, Virginia
June 2016
AECOM Project Number: 60390328

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Figures

Appendices

1.0 Introduction

The United States Environmental Protection Agency (USEPA) issued a Hazardous Waste Permit for Corrective Action (Permit) for on-site areas of the former DuPont Waynesboro Facility (Site) under the Resource Conservation and Recovery Act (RCRA) in September 1998. A revised Permit (VAD003114832) was approved by The Virginia Department of Environmental Quality (VDEQ) - Office of Waste Permitting and Compliance (OWPC) on September 24, 2009 (VDEQ, 2009). VDEQ signed a modification to the existing on-site RCRA permit that now includes the off-site area, designated as Area of Concern (AOC) 4. AOC 4 includes the aquatic and terrestrial systems of parts of the South River downstream of the Site and parts of the South Fork Shenandoah (SFS) River, Virginia (see Figure 1-1). In February, 2015 an interim measures work plan (IMWP) was submitted to VDEQ describing the first phase of the AOC 4 interim remedial measures (Anchor QEA et al., 2015). The IMWP was approved in March, 2015.

1.1 Purpose and PSWMP Scope

The purpose of this project specific waste management plan (PSWMP) is to define elements of management of program-generated waste. The PSWMP outlines the following:

- Section 2.0: Hazardous Waste Generator Information and Classification
- Section 3.0: Waste Management Procedures and Handling
- Section 4.0: Spill Response

The Plan will be used by the project team to ensure that project-related wastes are managed consistently and appropriately.

Prior to and during construction, this Plan will be reviewed by the DuPont CRG and the remediation contractor to establish and maintain waste management practices at the project site, ensure continual compliance, and allow for plan updates as a result of operational, regulatory, and/or technical changes, as appropriate.

1.2 Project Scope of Work

The following work is anticipated to be performed by AECOM or its designated Subcontractor(s) for this project:

- Construction oversight and waste management;
- Collection of in-situ waste characterization samples;
- Post-excavation sampling (as required);
- Use and Decontamination of sampling equipment; and
- Management and either recycle on-site or remove and dispose of off-site sample media and excavated media (soils/rock).

The following work is anticipated to be performed by the Remediation Contractor for this project:

- Site Preparation
  - Install site access, including removal/on-site management of sod and placement of imported stone aggregate and geosynthetics;
  - Install erosion and sediment control measures and stormwater best management practices (BMPs), including imported stone aggregate, geosynthetics (i.e., silt fence, geotextile fabric, cofferdams, etc.), and organic, biodegradable materials (i.e., straw bales, mulch, erosion control matting, etc.);
  - Install laydown / staging areas for temporary facilities/utilities and waste management areas, including containment and decontamination/wash pads.
  - Demolish existing structures / abandoned utilities, as necessary, to facilitate the work;
  - Clear and grub, including on-site recycling of trees/shredded mulch or off-site recycling/disposal of vegetation; and
  - Collect in-situ waste characterization samples.
- Site Remediation
  - Site remediation, including excavation of contaminated soils/sediments and dewatering/discharge of surface and groundwater (as necessary);
  - Handling, staging, loading, and transportation of contaminated soils/sediments and liquid wastes for disposal off-site; and
  - Decontamination of equipment and personnel, including handling, staging, loading, and transportation off-site of personal protective equipment (PPE), decon/wash fluids, and miscellaneous equipment, materials, and debris.
- Site Restoration
  - Import and place imported backfill materials (i.e., biochar, backfill, topsoil, etc.);
  - Import and place slope stabilization materials (i.e., toe stone, stone aggregate, geosynthetics, etc.);
  - Import and place soil amendments, vegetation, and stabilization materials (i.e., seed, fertilizer, limestone, trees, shrubs, mulch, erosion control matting, etc.); and
  - Remove and recycle/dispose of off-site all excess, off-specification, and temporary facilities/utilities, backfill materials, slope stabilization materials, soil amendments, vegetation, and other stabilization/restoration materials.

Project Team Responsibilities

Task	Organization	Individual
Oversee waste management activities.	AECOM WM Network	Nadia Suhaka
Conduct waste coordinator duties. • Order containers • Schedule waste pick ups	AECOM	Joshua Collins or the DuPont Site Representative (DSR)
Label containers.	AECOM	DSR
Move waste into the waste accumulation area.	AECOM	DSR
Complete/submit Waste Management Field Documentation Form to the Waste Management Network.	AECOM	Field Team Lead
Coordinate sampling activities.	AECOM	Joshua Collins or the DSR
Provide characterization testing bottles and final analyses reports.	AECOM	Sharon Nordstrom
Collect waste characterization samples.	AECOM	Field Team Lead
Review analytical data to determine RCRA classification.	AECOM WM Network	Nadia Suhaka
Inspect RCRA Hazardous and HAZARDOUS WASTE - PENDING ANALYSIS wastes weekly.	DuPont/AECOM	N/A
Label waste containers for shipment.	AECOM	DSR
Prepare shipping papers (i.e., manifests and LDR forms).	AECOM WM Network / Waste Vendor	Nadia Suhaka
Sign manifest/LDRs/Bill of Ladings for Shipment	DuPont/ AECOM WM Network	Nadia Suhaka
Notify project team [Project Director (PD) and Project Manager (PM)] of waste disposal completion of activities.	AECOM WM Network	Nadia Suhaka
Prepare/submit related reporting.	AECOM WM Network	Nadia Suhaka
Archive and maintain all required documents.	DuPont	Mike Liberati

2.0 Hazardous Waste Generator Information and Classification

In this section the waste generator status, requirements and management procedures are provided.

2.1 Status

The DuPont Waynesboro site, including AOC 4, is considered a Small Quantity Generator (SQG) of RCRA hazardous waste. However, if more than 2,200 pounds (approximately three full drums of contaminated soil) of hazardous waste are generated in a month, the generator status will change to Large Quantity Generator (LQG). Therefore, given the potential for the generation of more than five drums of contaminated soil during the interim measures and sewer investigation activities, this plan includes the requirements of both classes of generators.

VDEQ signed a modification to the existing on-site RCRA permit that now includes the off-site area, designated as Area of Concern (AOC) 4. The generated in AOC 4 waste will be managed under DuPont Waynesboro site's U.S. Environmental Protection Agency (EPA) generator identification number: VAD003114832.

2.2 Requirements

2.2.1 Episodic Generation

Generators may periodically exceed their normal generation limits in any given calendar month. If the amount of waste generated in a given calendar month places the generator in a higher category, the generator is responsible for complying with all applicable requirements of that category for all waste generated during that calendar month. For example, if a generator produces 300 kg of hazardous waste in the calendar month of March, that waste must be managed in accordance with the SQG regulations; if the same generator produces 1,500 kg of hazardous waste the following month, in April, that waste must be managed in accordance with the LQG regulations (51 FR 10146, 10153; March 24, 1986).

As a general rule, DuPont will segregate any waste generated at a higher episodic generator status from the routine lower generator status. Therefore, DuPont will be responsible for managing only the episodic waste under the higher episodic generator status.

2.2.2 Large Quantity Generator (LQG)

As a LQG, the following general hazardous waste generator requirements are applicable for the DuPont Waynesboro site along with any applicable site procedures.

- EPA/State must be notified of any hazardous waste activity.
- Hazardous waste on-site is allowed to accumulate no longer than 90 days.
- There is no limit on the quantity of hazardous waste that can be accumulated on-site.
- Accumulation start date must appear on each waste container.
- As necessary, the words "Hazardous Waste" are required on each container.

- The container storage location must be at least 50 feet from property line.
- Hazardous waste treatment is allowed in accumulation units.
- A manifest must be used to ship hazardous waste off-site.
- Hazardous waste must be shipped using transporters and facilities that have EPA ID numbers.
- The site must prepare land disposal restriction (LDR) notifications/certifications.
- The site must conduct personnel training.
- The site must have a preparedness and prevention plan on file at the site.
- The site must have a contingency plan that outlines site emergency procedures on file with local emergency responders.
- The site must prepare and file on-site all hazardous waste records.

2.2.3 Small Quantity Generator (SQG)

As a SQG, the following general hazardous waste generator requirements are applicable for the DuPont Waynesboro site along with any applicable site procedures.

- EPA/State must be notified of any hazardous waste activity.
- Hazardous waste is allowed to accumulate on-site no longer than 180 days or no longer than 270 days if the waste will be shipped 200 miles or more.
- Less than 6,000 kg of hazardous waste can be accumulated on-site.
- Accumulation start date must appear on each waste container.
- As necessary, the words “Hazardous Waste” are required on each container.
- The container storage location must be at least 50 feet from property line.
- Hazardous waste treatment is allowed in accumulation units.
- A manifest must be used to ship hazardous waste off-site.
- Hazardous waste must be shipped using transporters and facilities that have EPA ID numbers.
- The site must prepare LDR notifications/certifications.
- The site must conduct personnel training.
- The site must have a preparedness and prevention plan on file at the site.
- The site must prepare and file on-site all hazardous waste records.

2.3 Waste Classification

2.3.1 Potential Federal and State Waste Codes

Listed RCRA Waste

Potential source areas for waste streams from this project have been reviewed to determine if they meet federal and/or state listed waste definitions. Based on currently identified waste streams, there no waste streams that meet the definition of a federal or state listed waste.

Characteristic RCRA Waste

Identified waste streams from this project have been reviewed or will be sampled to determine if they exhibit a RCRA defined characteristic. Based on currently identified waste streams, there are waste streams that need to be sampled to determine the applicability of a RCRA hazardous waste characteristic.

Waste Code	Characteristic	Waste Management Area
D009	Toxic (mercury)	AOC 4

3.0 Waste Management Procedures and Handling

3.1 Procedures

3.1.1 Project Waste

The following waste streams and corresponding storage, classification, and labeling requirements are identified below. As discussed in the Remediation Proposal (Anchor QEA et al. 2013) and the Interim Measures Work Plan (Anchor QEA et al. 2015), enhanced vegetative stabilization and structural stabilization achieve greater protectiveness with far less short-term impact on the environment during remedy implementation. However, additional evaluations will be performed to further assess which elements of the proposed technologies are most appropriately applied to a given area to be remediated based on landowner preferences, site characteristics, regulatory requirements, and other factors. As the detailed interim measures design proceeds, all promising technologies including focused bank soil removal will be considered, therefore a soil disposal option is included into this PSWMP.

Anticipated Waste Streams

Waste Stream	Proposed RCRA Classification	Anticipated Waste Characterization Testing	Container Requirements and Estimated Volume	Labeling Requirements	Anticipated Disposal Method
PPE and sampling materials after decontamination	RCRA non-hazardous based on historical groundwater analysis and existing data on proposed locations	None	Place into opaque trash bag	None	Place into on-site trash dumpster
Excess soil cuttings from soil sampling	TBD	None	Place back in the borehole	None	Place back in the borehole
Bank Soil (Free Hg)	Hazardous	Visual observation for free mercury Full RCRA TCLP for every 500 cy	Place into UN-rated 1-cubic yard boxes	Yellow Label “Hazardous Waste”	Bethlehem Apparatus retorting facility in Bethlehem, PA
Bank soil (no free Hg) ~3000 cu y	Non-Hazardous	Full RCRA TCLP, for every 500 cu y will be collected in-situ Visual observation for free mercury	Place into roll-off containers	Green Label “Non-Hazardous Waste”	To the DuPont approved landfill: Waste Management Amelia Landfill in Jettersville, VA

Anticipated Waste Streams

Waste Stream	Proposed RCRA Classification	Anticipated Waste Characterization Testing	Container Requirements and Estimated Volume	Labeling Requirements	Anticipated Disposal Method
Bank soil (no free Hg)	Hazardous D009	Full RCRA TCLP, for every 500 cu y will be collected in-situ Visual observation for free mercury	Place into roll-off containers	Yellow Label "Hazardous Waste"	To the DuPont approved landfill: THg < 260 mg/kg US Ecology Belleville Hazardous Landfill THg > 260 mg/kg Bethlehem Apparatus retorting facility in Bethlehem, PA
Rainwater in contact with impacted soils collected within bermed stockpile areas	Non-Hazardous	None; use contained in RCRA rule	Place into 55-gal drums, frac tank, etc. for liquid services	Green Label "Non-Hazardous Waste"	DuPont-approved disposal facility
Rainwater in contact with impacted soils collected within bermed stockpile areas	Hazardous	None; use contained in RCRA rule	Place into 55-gal drums, frac tank, etc. for liquid services	Yellow Label "Hazardous Waste"	DuPont-approved disposal facility
Decon Water from construction and sampling equipment (no free Hg)	Non-Hazardous	None; use contained-in RCRA rule	Place into 55-gal drums, frac tank, etc. for liquid services	Green Label "Non-Hazardous Waste"	DuPont-approved disposal facility
Decon Water from construction and sampling equipment (free Hg)	Hazardous	None; use contained-in RCRA rule	Place into 55-gal drums, 55-gal drums, frac tank, etc. for liquid services	Yellow Label "Hazardous Waste"	DuPont-approved disposal facility
Rags (Oily)	RCRA Non-Hazardous	None	Place into DOT approved drum/pail	Green Label "Non-Hazardous Waste"	DuPont-approved facility
Rags (with soil) No Free Hg	Non-Hazardous	None; use contained-n RCRA rule	Place into DOT approved drum/pail	Green Label "Non-Hazardous Waste"	DuPont-approved facility
Rags (with soil) Free Hg	Hazardous	None; use contained-in RCRA rule	Place into DOT approved drum/pail	Yellow Label "Hazardous Waste"	DuPont-approved facility

Anticipated Waste Streams

Waste Stream	Proposed RCRA Classification	Anticipated Waste Characterization Testing	Container Requirements and Estimated Volume	Labeling Requirements	Anticipated Disposal Method
Construction Debris	RCRA Non-Hazardous based on generator's knowledge	None	Place into the roll-off provided by subcontractor	None	Subcontractor is responsible for disposal
Vegetation debris from clear cut	RCRA Non-Hazardous based on generator's knowledge	None	Place into the roll-off provided by subcontractor	None	Subcontractor is responsible for disposal
Sanitary facility waste	RCRA Non-Hazardous	None	Managed by designated subcontractor	None	Managed by designated subcontractor
Vegetation root balls with soil residues	RCRA Non-Hazardous	None; use contained-n RCRA rule	Place into roll-off container with soil (any size as long as it fits into roll-off container)	Green Label "Non-Hazardous Waste"	To DuPont-approved facility Waste Management Amelia in Jettersville, VA
Empty Chemical Containers (fertilizers)	RCRA Non-Hazardous	None	None	None	Place into on-site trash dumpster

3.1.2 Empty Chemical Containers

In order to meet the RCRA requirements for an empty container, which for this project will apply to containers that held non-acute hazardous waste, the following conditions must be met:

- All wastes must have been removed that can be removed using "commonly employed practices" (e.g., pouring, pumping, and aspirating).
- No more than one inch of residue may remain in the bottom of the container.

The empty containers will be disposed in the on-site dumpsters.

The chemicals that will be used in the site restoration process that may result in empty containers will be determined by the designated subcontractors. Safety Data Sheets (SDS) for these chemicals will be provided by subcontractor and included in Appendix A.

3.2 Waste Handling

3.2.1 Waste Container Inventory Documentation

At the conclusion of the field event, the following documentation must be forwarded to the AECOM Waste Management Group (as necessary).

- Waste Management Field Documentation Form (see Appendix B).
- Waste Container and Equipment Log (see Appendix C)

3.2.2 Container Labeling Instructions

Example labels for the waste streams are included in Appendix F. Label information will be completed with a permanent marker.

During on site storage, drummed waste must have one label affixed to the top 1/3 of each drum and clearly visible.

When roll-offs are offered for shipment off-site, they must comply with DOT rules. Per DOT rules, roll-off boxes that contain hazardous waste require one label per side (four total) before offering the roll-off box for shipment. RCRA non-hazardous wastes need only one label indicating non-hazardous waste for shipment and hazard communication purposes.

3.2.3 Container Covering Requirements

All roll-off boxes will be equipped with tarps. Per RCRA subpart CC, tarps must be securely strapped down on all roll-off boxes except during placement and/or removal of waste from the box. The tarps are equipped with black rubber straps, which must be secured before leaving the Site or offering the roll-off box for over the road shipment.

Under the same requirements, drum lids must be securely closed after filling. Per DOT requirements, lids must fit tightly, and closure bolts must be securely tightened before offering the drum for shipment.

3.2.4 Container Storage Time Limits and Inspection Requirements

Waste Type	Generator Status	Storage Time Limit	Inspection Requirement
RCRA Non-Hazardous	Not Applicable	1 Year	Initial Inventory, and as added
RCRA Hazardous	Conditionally Exempt Small Quantity Generator	NA	Inventory weekly
RCRA Hazardous	Large Quantity Generator	90 days	Inventory and inspect weekly

The accumulation start date is the date waste was first placed in the storage container (e.g., drum roll-off box or tank) or container is moved from AOC.

Waste containers may be stored in a designated waste accumulation area until characterization is completed, and may remain in this area until shipment. See hazardous waste ispection form in Appendic G.

4.0 Spill Response and Reporting Requirements

Based on the identified scope compared to federal and state spill requirements, the following substances have been identified that may potentially require spill reporting. If any of the identified substances are released, the following contacts will be made to determine spill reporting requirements.

Chemical Substance	Reportable Quantity
Petroleum Products (Motor Oil, Hydraulic Oil)	• Cannot cause a sheen on the surface of the water • Cannot violate applicable water quality standards • Cannot cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shoreline

4.1 Project Contacts

Should a release occur for any of the substances identified above or any others, it should be appropriately reported to the project contacts (and/or site emergency coordinator) identified below. Based on media affected and/or amount of substance, agency reporting may be necessary.

Name	Location	Telephone
Scott Gregory (DuPont Site Representative)	Waynesboro, VA	**540-949-5361** **(cell) 727-542-9723**
Joshua Collins (AECOM Project Manager)	Conshohocken, PA	**610-832-3585**
Mike Liberati (DuPont CRG Project Director)	Wilmington, DE	**302-999-2891**

* **Mike Liberati** will make the appropriate reporting within the CRG organization.

4.2 Agency Spill Reporting Requirements and Contacts

If a release exceeds the quantity cited above, the release must be reported to the appropriate federal and/or state agency. **Mike Liberati** shall notify the following agencies as necessary.

Emergency Response and Agency Contacts for Spill Reporting

Name	Telephone
U.S. EPA National Response Center	800-424-8802
VA State 24-hour Notification Number	In-state: 800-468-8892 Out-of-state: 800-674-2400
Local Emergency Planning Commission (LEPC)	911
Augusta Joint LEPC	540-942-6698
Virginia Department of Environmental Quality—Valley Regional Office (contact during normal business hours)	540-574-7800

References

Anchor QEA (Anchor QEA, LLC), URS, and DuPont, 2013. *Remediation Proposal: South River and a Segment of the South Fork Shenandoah River, Virginia.* Prepared by Anchor QEA, LLC, URS Corporation, and E. I. du Pont de Nemours and Company. October 2013.

Anchor QEA, URS, and DuPont, 2015. *Interim Measures Design, Implementation, and Monitoring Work Plan, Phase 1 – South River Area of Concern 4.* Prepared by Anchor QEA, LLC, URS Corporation, and E. I. du Pont de Nemours and Company. August 2015.

Figures

Appendices

Waste Management Field Documentation Form

The DuPont Site Representative (DSR) is to submit this form to the AECOM Waste Management Network Consultant via electronic mail at the completion of the project. The designated Waste Management Consultant(s) for this project are:

WM Name: Nadia Suhaka Email: Nadia.suhaka@aecom.com Phone: 302-781-5962

General Information

Field Event Date(s): TBD

CRG Project No. 18986755.01520 Project Manager: Ceil Mancini

Site Name: DuPont Former Waynesboro Facility AOC 4 Project Name: Interim Measures Design and Implementation

Site Address: Waynesboro, VA

DSR: Scott Gregory Phone: ______

Site Environmental Coordinator/Contact: ______ Phone: ______

Waste Information

1. Does this project need help from your AECOM WM Consultant to dispose of waste from this project?

   x YES (Complete the attached waste inventory sheet)

   ______ NO (Answer questions 2 and 3 below)

2. Who will be responsible for disposal of the waste?

   ______

3. How was the waste disposed?

   ______

Waste Inventory Sheet

Container Number	Matrix (e.g., Soil, GW)	Container Type (e.g., roll-off, drum)	Percent Full	Label (e.g., Hazardous, Pending)	Accumulation Start Date	Waste Characterization Sample Name (If applicable)

Waste Container and Equipment Log Tracking Sheet

Equipment (Tanker Truck, Roll-Off, Dump Truck, Baker Tank®)	Vendor	Delivery Date	Pickup Date	Container Volume	Final Destination

NON-HAZARDOUS

Waste

OPTIONAL INFORMATION

SHIPPER DuPont – Former Waynesboro Facility

ADDRESS Waynesboro, VA

CITY, STATE, ZIP

CONTENTS PPE and sampling materials

NON-HAZARDOUS WASTE

HAZARDOUS WASTE

FEDERAL AND/OR STATE LAWS PROHIBIT IMPROPER DISPOSAL.

IF FOUND, CONTACT THE NEAREST POLICE OR PUBLIC SAFETY AUTHORITY, THE U.S. ENVIRONMENTAL PROTECTION AGENCY.

GENERATOR INFORMATION:

Name: Former DuPont Waynesboro AOC 4
Address: ______ **Phone:** 609-334-1460
City: Waynesboro **State:** VA **ZIP:** 22980

EPA ID NO./
MANIFEST DOCUMENT NO.: VAD003114832

ACCUMULATION START DATE: ______ **EPA WASTE NO.:** D009

NA3077 Hazardous Waste, solid, n.o.s. (mercury), 9, III

D.O.T PROPER SHIPPING NAME AND UN OR NA NO. WITH PREFIX

HANDLE WITH CARE!

Hazardous Waste

Pending Analysis

LOCATION: Former DuPont
Waynesboro AOC 4

ACCUM. DATE: ____________________

SAMPLE DATE: ____________________

MU-62395

90-Day - Accumulation Area Inspection Log
(Completed weekly when Hazardous Waste exists in 90-Day Storage Pad)

Date: ______________________ Time: ____________________________

Inspector Name: ____

Requirements	Meets Requirements (Yes or No)	Changes Needed	Date Corrected
Each container (as applicable) labeled with words “Hazardous Waste.”			
Each container (as applicable) has “Accumulation Start Date.”			
Each container has applicable waste code.			
Container labels legible.			
Containers tightly closed.			
No evidence of rust, dents, etc on drums.			
No containers leaking.			
Aisle space is open and free of obstructions.			
Storage is less than 180 days (SQG).			
Waste (hazardous and non-hazardous) is segregated properly.			
‘No Smoking Sign’ is clearly visible.			
Spill kit and materials are present and in good condition.			
No strange smells are noted.			
Communication or warning devices are present and working properly.			

Comments ____

APPENDIX O
MEMORANDUM – PHASE 1A BANK STABILIZATION, SLOPE STABILITY ANALYSIS OF BERM IMPROVEMENTS OUTSIDE OF BANK MANAGEMENT AREA

DRAFT

720 Olive Way, Suite 1900
Seattle, Washington 98101
206.287.9130

ANCHOR QEA

Memorandum

July 18, 2017

To: Project File

From: Casey Janisch, JoDee Taylor, and John Laplante

cc: Walt Dinicola and Sam Haffey, Anchor QEA, LLC

Re: South River Area of Concern 4 (AOC 4) Phase 1A Bank Stabilization, Slope Stability Analysis of Berm Improvements Outside of Bank Management Area (BMA)

This memorandum presents a summary of the slope stability analysis performed to evaluate stability of reconstructed berms located outside of the primary and secondary bank management areas (BMAs) of the Wastewater Treatment Plant (WWTP) A and WWTP B sites along the South River in Waynesboro, Virginia. At the request of the City of Waynesboro, E.I. DuPont de Nemours and Company plans to improve the existing berms outside of the BMA project limits by reconstructing them with consistent side slopes of 2H:1V, crown height at elevation 1272 feet NAVD88, and crown width of 4 feet. There is no plan to alter the existing slopes or vegetation outside of what is necessary for the construction. A stability evaluation was performed by Anchor QEA, LLC, to evaluate the potential effect of the berm reconstruction on global stability of the adjacent slopes along the South River.

Soil Conditions

The generalized soil conditions of the entire alignment (including areas not evaluated in this memorandum) are summarized in the Basis of Design Report. For brevity, the description is not included herein. The nearest exploration (AQSR-08) noted 8 feet of silty gravel over about 5.5 feet of gravel over weathered bedrock. The upper two soil layers were modeled as "sandy alluvium," consistent with the methodology used in the Basis of Design Report (Anchor et al. 2016). Groundwater in the AQSR-08 was observed about 13.3 feet below the existing ground surface.

Slope Stability Evaluation

Two cross-sections were developed to evaluate the slope stability of the berm outside of the BMA. These cross-sections, named A-A' and B-B', were selected at approximately the steepest bank slopes southwest of the BMA site WWTP A as displayed in Figures 1 and 2. Each cross-section was evaluated in the current condition and post-berm construction condition.

The sandy alluvium is estimated to exist above an elevation of 1,254 feet NAVD88, with the bedrock underlying the alluvium. The river elevation was evaluated at elevations of 1,258 feet NAVD88 (Ordinary High Water) and 1,267 feet NAVD88 (5-year flood). The soil parameters used for each analysis are provided in Table 1, and the bedrock underlying the site was modeled as "infinite strength." An apparent cohesion of 100 pounds per square foot (psf) was included in the soil strength parameters for the sandy alluvium. The apparent cohesion accounts for some reinforcement of the soil mass by the root system of the existing vegetation and is consistent with the methodology used in the Basis of Design Report (Anchor QEA et al. 2016).

Table 1
Slope Stability Soil Parameters

Soil Type	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)
Subgrade Backfill (Berm)	130	33	0
Sandy Alluvium	130	33	100

Note:
pcf = pounds per cubic foot

To calibrate the modeling assumptions, the existing condition was analyzed to verify the assumed soil parameters would result in a factor of safety (FOS) of at least 1.0, which is consistent with the observed current stable condition (i.e. Anchor QEA is not aware of reported movement or distress of the existing slopes). Following this calibration check, the short-term stability (construction condition) was evaluated, with the berm being constructed of subgrade backfill to the design profile.

Due to the granular nature of the underlying soils, the short-term stability (characterized by undrained soil behavior) is expected to be the same as the long-term stability (steady-state condition, characterized by drained soil behavior).

Results

The evaluation indicates stability is maintained with the proposed berm configuration based on a typical target FOS range of 1.25 to 1.3 for long-term stability criteria of non-critical embankments (Virginia Department of Transportation 2012). The results of the analysis are displayed in Table 2. Figures 3 and 4 (A-A′) and Figures 5 and 6 (B-B′) show all slip surfaces with a FOS less than 1.3 for the two river elevations evaluated.

Table 2
Slope Stability Results

Cross Section	Factor of Safety at Ordinary High Water	Factor of Safety at 5-Year Flood Elevation
Section A-A′	1.25	1.27
Section B-B′	1.34	1.50

References

Anchor QEA (Anchor QEA, LLC), AECOM, and E.I. DuPont de Nemours and Company, 2016. *Basis of Design Report, Phase 1A Bank Management Areas, South River Area of Concern 4*. September 2016.

Virginia Department of Transportation (Materials Division), 2012. Manual of Instructions, *Chapter III – Geotechnical Engineering*. May 2012.

Figures

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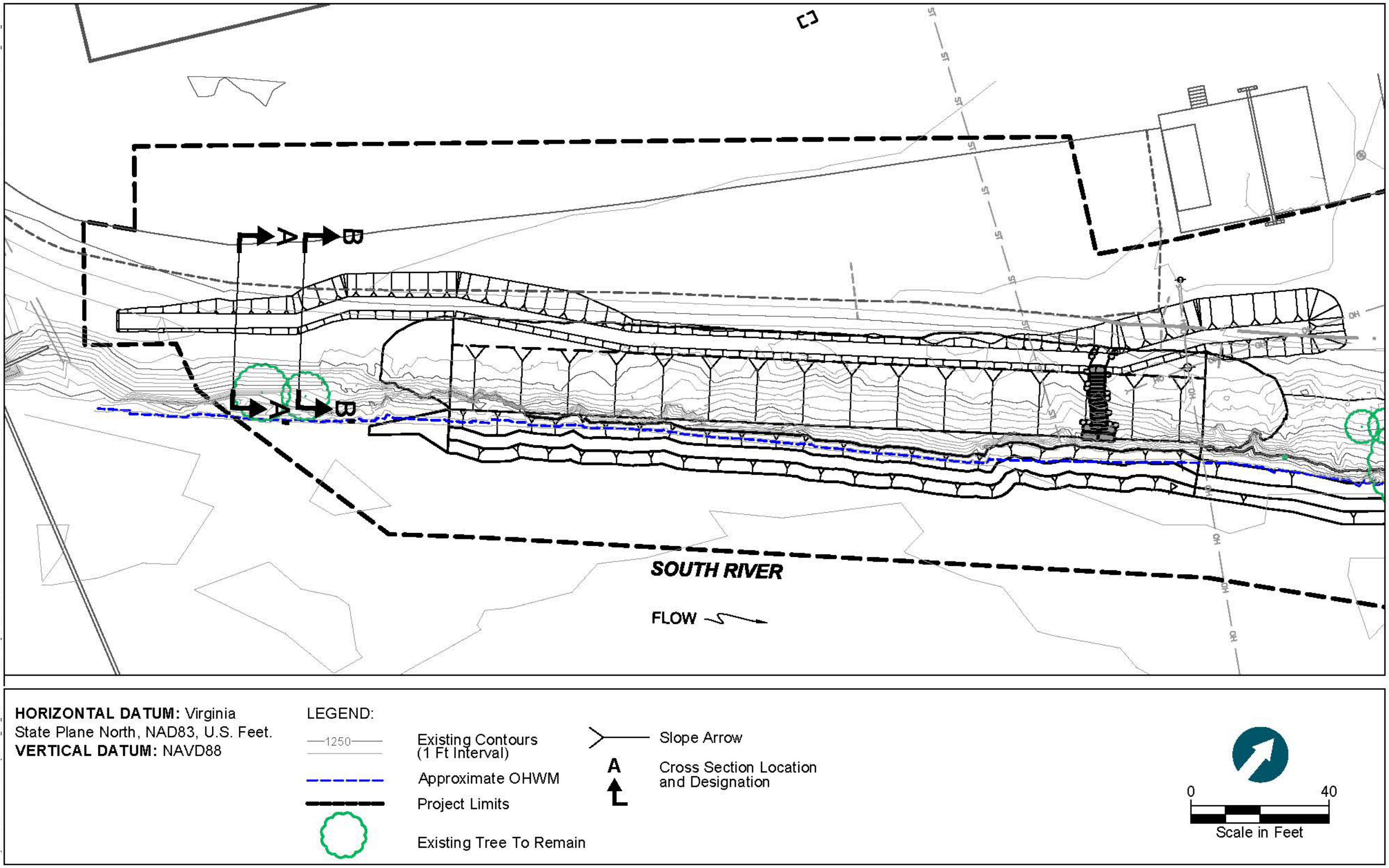

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ANCHOR QEA

Figure 1
Plan View

Slope Stability Analysis Memorandum
South River Area of Concern 4 ,Phase 1A Bank Stabilization

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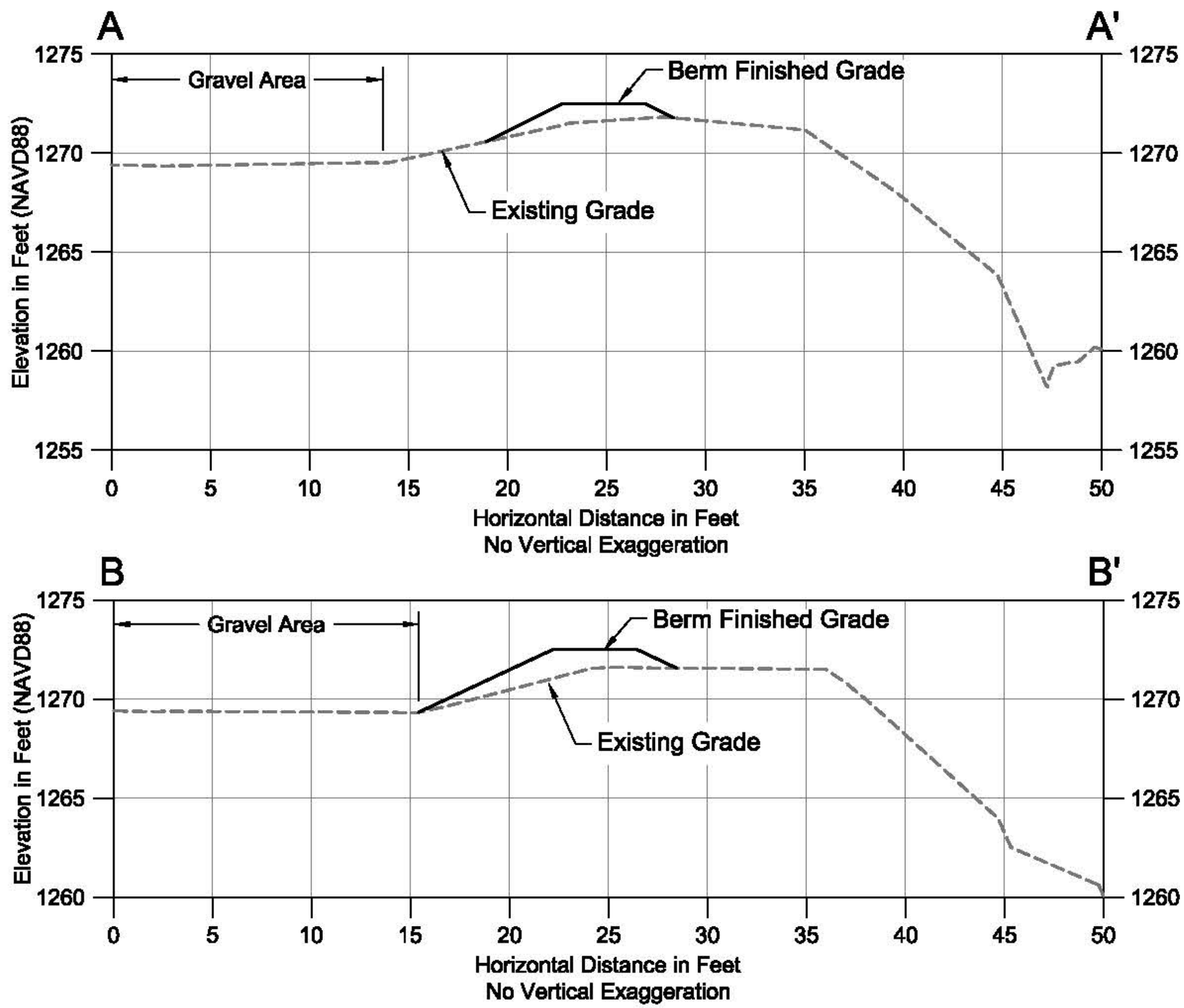

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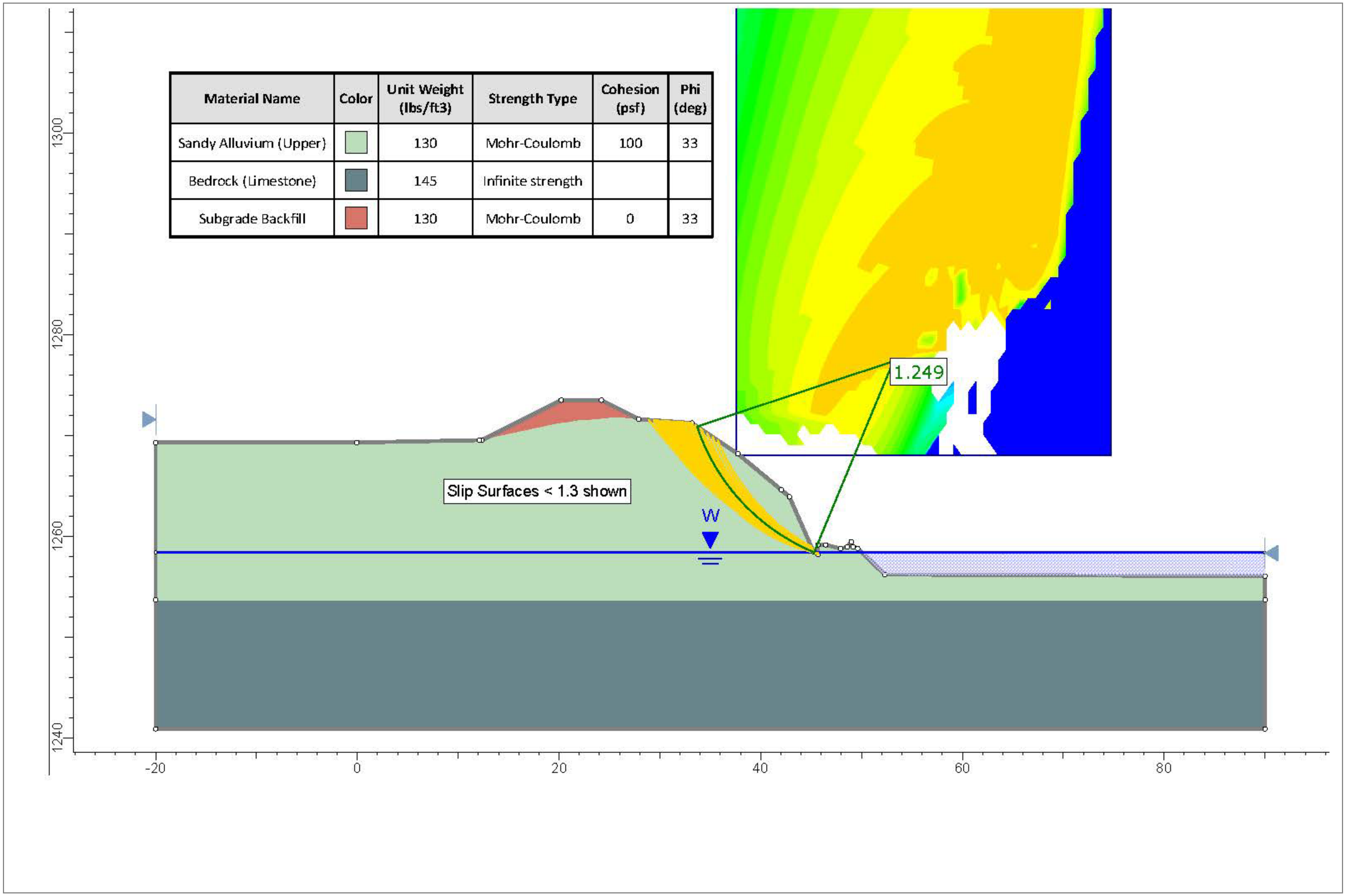
ANCHOR QEA

Figure 2
Cross Sections

Slope Stability Analysis Memorandum
South River Area of Concern 4 ,Phase 1A Bank Stabilization



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sandy Alluvium (Upper)		130	Mohr-Coulomb	100	33
Bedrock (Limestone)		145	Infinite strength		
Subgrade Backfill		130	Mohr-Coulomb	0	33

DRAFT

ANCHOR QEA

Figure 3

A-A': Steady-State Analysis with Ordinary High Water Elevation

Slope Stability Analysis Memorandum

South River Area of Concern 4 ,Phase 1A Bank Stabilization

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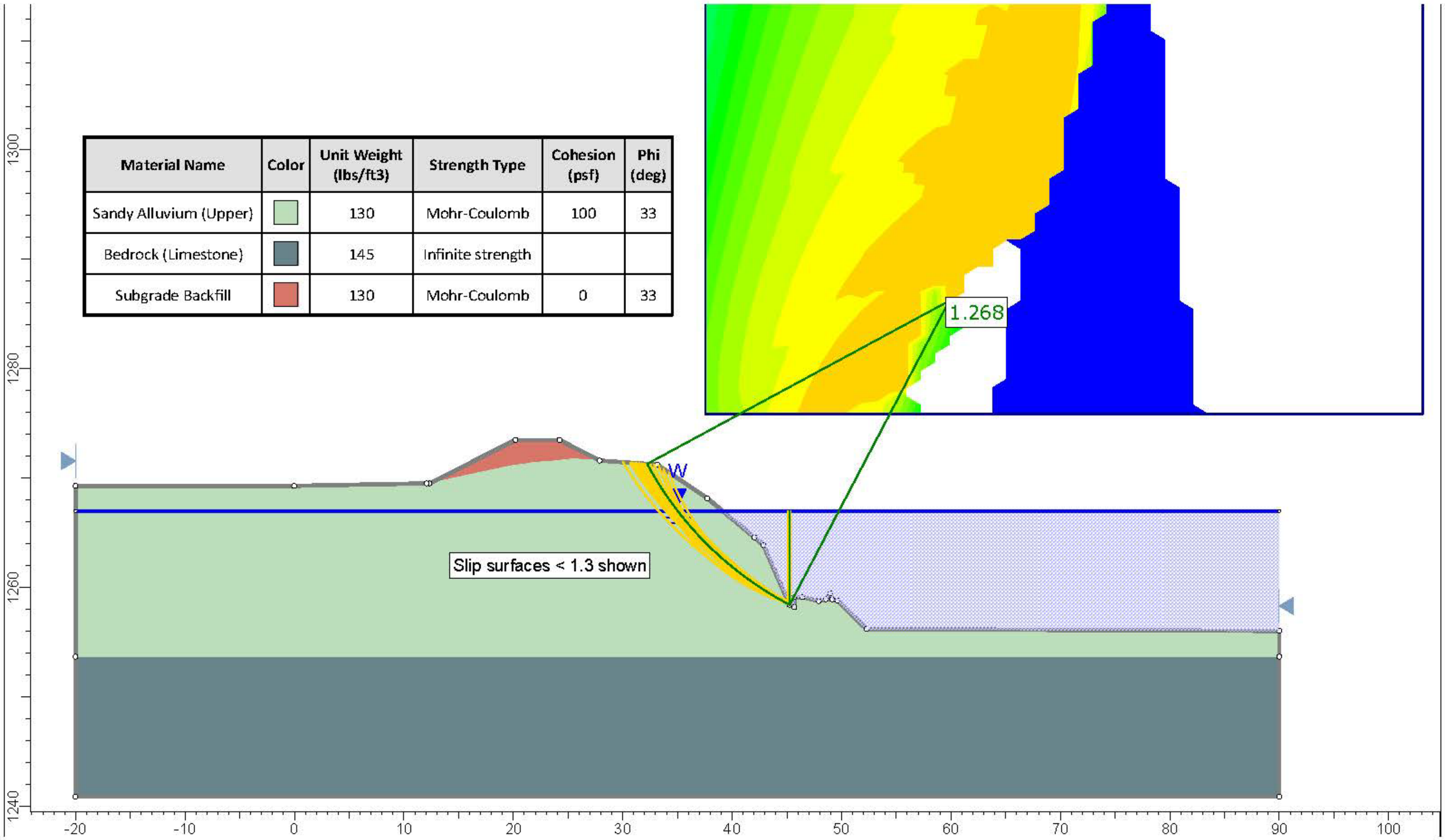
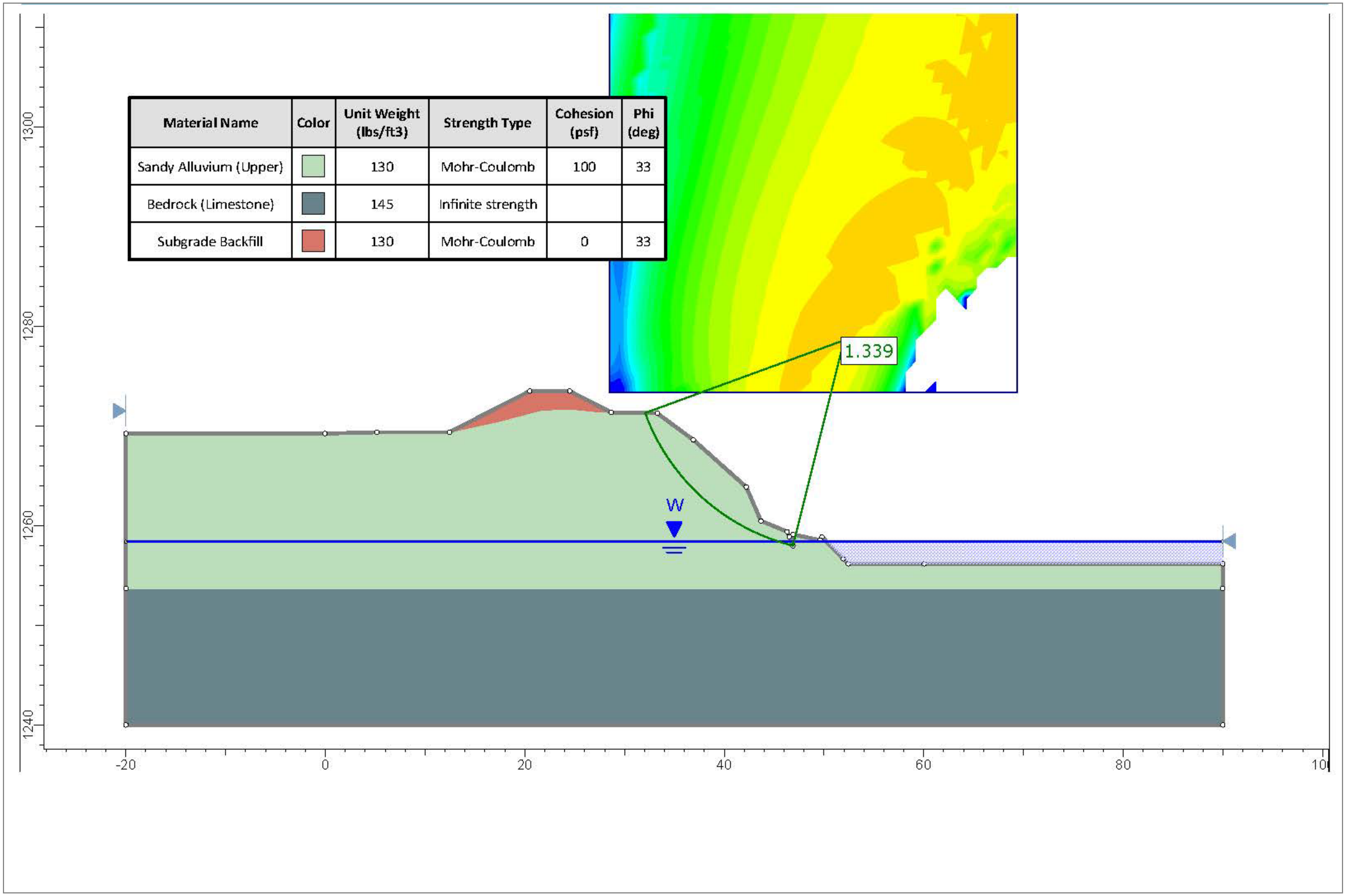


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sandy Alluvium (Upper)		130	Mohr-Coulomb	100	33
Bedrock (Limestone)		145	Infinite strength		
Subgrade Backfill		130	Mohr-Coulomb	0	33

Figure 4
A-A': Steady-State Analysis with 5-year Flood River Elevation
Slope Stability Analysis Memorandum
South River Area of Concern 4 ,Phase 1A Bank Stabilization



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sandy Alluvium (Upper)		130	Mohr-Coulomb	100	33
Bedrock (Limestone)		145	Infinite strength		
Subgrade Backfill		130	Mohr-Coulomb	0	33

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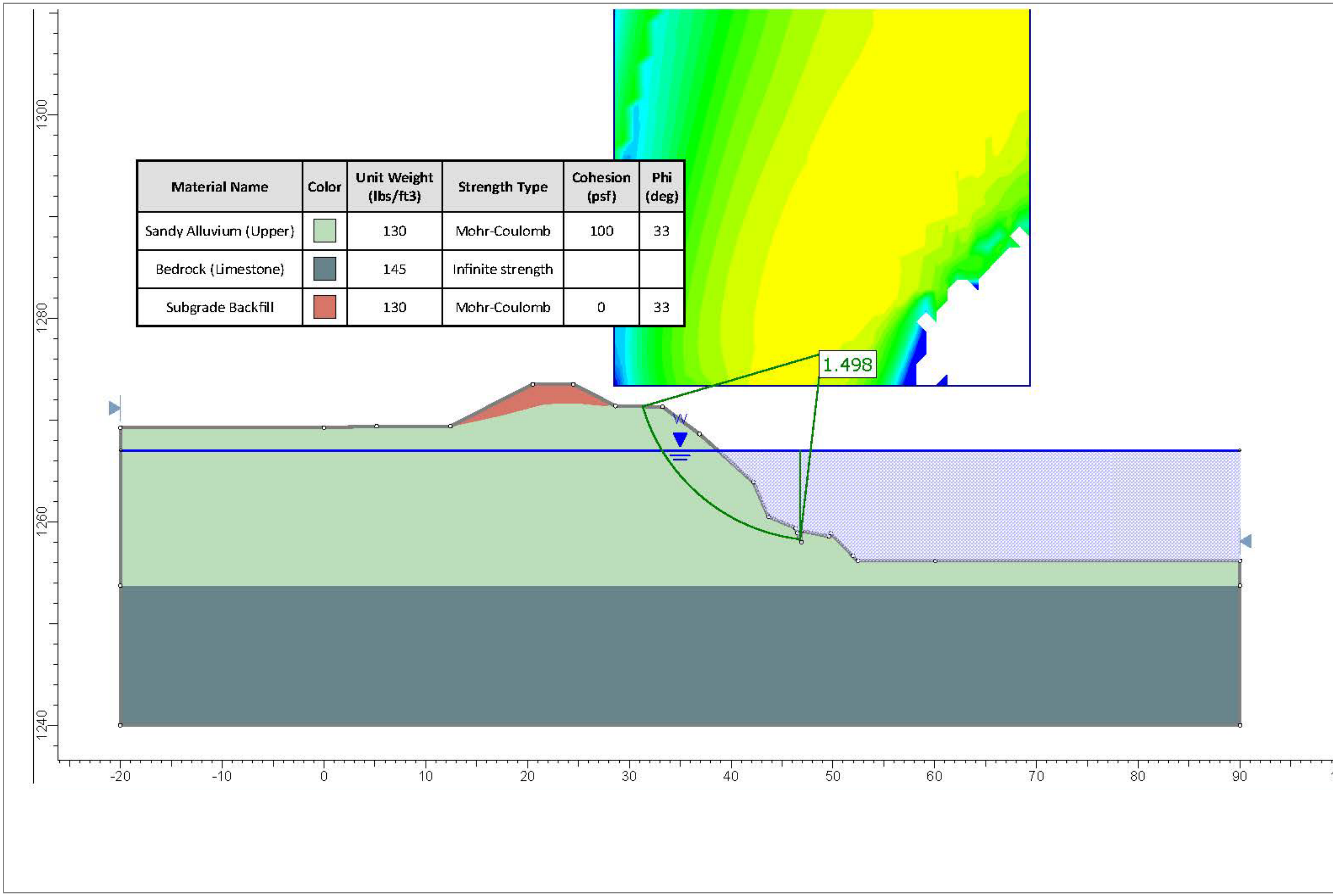
ANCHOR QEA

Figure 5

B-B': Steady-State Analysis with Ordinary High Water Elevation

Slope Stability Analysis Memorandum

South River Area of Concern 4 ,Phase 1A Bank Stabilization



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sandy Alluvium (Upper)		130	Mohr-Coulomb	100	33
Bedrock (Limestone)		145	Infinite strength		
Subgrade Backfill		130	Mohr-Coulomb	0	33

DRAFT

Figure 6
B-B': Steady-State Analysis with 5-year Flood River Elevation

Slope Stability Analysis Memorandum
South River Area of Concern 4 ,Phase 1A Bank Stabilization