Appendix F – Marine Site Characterization Survey Reports

Appendix F-1 – Marine Site Characterization Survey Report

MARINE SITE CHARACTERIZATION SURVEY REPORT

Virginia Offshore Wind Technology Advancement Project

(VOWTAP)

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EXECUTIVE SUMMARY

Tetra Tech, Inc. (Tetra Tech) performed marine geophysical and shallow geotechnical site characterization surveys supporting development of the Virginia Offshore Wind Technology Advancement Project (VOWTAP or Project) in June of 2013. Marine surveys covered five Outer Continental Shelf (OCS) sub-blocks, or aliquots, identified as the lease area, an area approximately 7.2 square kilometers (km^2) (1,779 acres) in size; as well as a corridor approximately 44 km long (27.3 miles) by 300 meter (m) wide (984 feet) (13.2 km^2; 3,261 acres) located between the lease area and the shoreline to accommodate the siting of an offshore electric transmission cable (survey corridor). Survey activities adhered to a written survey plan developed in accordance with Bureau of Ocean Energy Management (BOEM) *Guidelines for Providing Geological and Geophysical, Hazards, and Archaeological Information Pursuant to 30 CFR Part 585.* Survey protocols for the Geophysical and Shallow Geotechnical Surveys were submitted for agency review and comment prior to deployment.

Geophysical methods used to characterize the seabed and subsurface sediments included the acquisition and interpretation of bathymetry, sidescan sonar imagery, marine magnetic data, and shallow- and medium-penetration sub-bottom profiling; and a shallow geotechnical investigation that included the collection, processing, and laboratory testing of seabed grab and core samples. Results of the geophysical and shallow geotechnical surveys indicate that conditions in the survey corridor and lease area are favorable for the construction, operation, and maintenance of the proposed VOWTAP facilities.

Seabed bathymetry along the survey corridor has low relief and is generally smooth with minor undulations. Seabed within the lease area also shows low relief, with slightly more variable bathymetry noted within BOEM Lease Block 6111 Aliquot D. Shallow subsurface sediments along the survey corridor and in the lease area are comprised predominantly of sands and interbedded sands, silts and clay and are conducive to cable burial. Six well-defined acoustic reflectors (R1 through R6) considered to represent major boundaries between different geologic units, were interpreted in the medium-penetration sub-bottom profiler data collected in the lease area. These reflectors were continuous across the lease area and, with the exception of the shallowest reflector (R1), were nearly horizontal. These subsurface conditions are indicative of conditions suitable for installation of wind turbine generators (WTGs). However, in accordance with BOEM regulations (30 Code of Federal Regulations Part 585), additional geotechnical investigations will be required at each WTG foundation to support the final engineering design.

In addition to characterization of the surface and subsurface conditions, survey data were reviewed to identify the presence of natural and/or man-made hazards. Types of hazards identified within the Project Area include buried channels and bedforms, such as sand ridges and ripples. Isolated areas of water scour were also identified in the survey corridor. The corridor passes through the Dam Neck Ocean Disposal Site for approximately 1.6 miles (3-km). Scattered sonar contacts and magnetometer targets representing natural or man-made hazards were present in this area and throughout the survey corridor and lease area. It is likely that impacts associated with these objects can be avoided and/or mitigated.

Unexploded ordnance (UXO) presents a potential hazard where the survey corridor passes through to firing ranges (Danger Zone 334.380 and Danger Zone 334.390) east of the Dam Neck naval facility. Additional surveys specifically designed for UXO detection and evaluation are recommended.

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Attachment B – Equipment Specifications

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Attachment F – Sidescan Sonar Contacts

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ACRONYMS AND ABBREVIATIONS

Acronym	Definition
2D	two dimensional
3D	three dimensional
AIS	Automatic Identification System
AS	alignment sheet
BOEM	Bureau of Ocean Energy Management
CFR	Code of Federal Regulations
CHIRP	compressed high intensity radar pulse
cm	centimeter(s)
CTD	Conductivity, Temperature and Depth
DMME	Virginia Department of Mines, Minerals and Energy
DoD	Department of Defense
DOE	Department of Energy
Dominion	Virginia Electric and Power Company, a wholly-owned subsidiary of Dominion Resources Inc.
DPR	Daily Progress Report
G&G Survey Plan	Geophysical and Shallow Geotechnical Survey Plan
GAPS	Global Acoustic Positioning System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
Hz	hertz
IMU	inertial motioning unit
INS	Inertial Navigation System
KBR	Kellogg Brown & Root
kg	kilogram
km	kilometer(s)
km^2	square kilometer(s)
KP	kilometer post
kV	kilovolts
µmhos	micromhos
m	meter
mg/L	milligram per liter
MLLW	mean lower low water
MRU	motion reference unit
NAD83	North American Datum of 1983
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	NOAA National Marine Fisheries Service
nT	nanotesla
OCS	Outer Continental Shelf
PHINS	PHotonic Inertial Navigation System
Project	Virginia Offshore Wind Technology Advancement Project
RAP	Research Activities Plan
R/V	Research Vessel

Acronym	Definition
UCTD	Underway Conductivity, Temperature and Depth
USACE	U.S. Army Corps of Engineers
USBL	ultra-short baseline
USCG	U.S. Coast Guard
USDN	U.S. Department of the Navy
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UTC	Coordinated Universal Time
UTM	Universal Transverse Mercator
UXO	unexploded ordnance
VHF	Very High Frequency
VOWTAP	Virginia Offshore Wind Technology Advancement Project
WTG	wind turbine generator

1 INTRODUCTION

Tetra Tech, Inc. (Tetra Tech) conducted geophysical and shallow geotechnical marine surveys for Virginia Electric and Power Company, a wholly-owned subsidiary of Dominion Resources, Inc. (Dominion) for the Virginia Offshore Wind Technology Advancement Project (VOWTAP or Project) in June of 2013. VOWTAP is a proposed two-turbine, 12 megawatt, offshore wind technology demonstration project located approximately 24 nautical miles (27 statute miles, 43 kilometers [km]) offshore of Virginia Beach, Virginia (Figure 1). The primary objectives of this research project are to test technological and other innovations in the deployment of offshore wind projects with the goal of achieving the cost reductions necessary to support an economically viable commercial-scale offshore wind industry in the United States.

1.1 Survey Area Description

VOWTAP marine surveys were performed in U.S. federal waters within Outer Continental Shelf (OCS) Lease Blocks 6111 (aliquots D, H, L) and 6112 (aliquots E and I) as depicted in Table 1. Each offshore aliquot measures 1.44 square kilometers (km^2) resulting in a total of 7.2 km^2 (1,779 acres) of seabed surveyed in the Lease Area and an area 44 km long and 300 meters (m) wide (984 feet) (13.2 km^2; 3,261 acres) centered on the proposed submarine transmission cable (the Export Cable) covering the proposed survey corridor for a total marine survey area of 19.2 km^2 (4,733 acres). Bathymetry elevations (relative to the Project vertical datum of mean lower low water [MLLW]), ranged from -7 meters in the shallowest accessible extent of the survey corridor, to -28.3 m in the southeast portion of the lease area. Bathymetry in the survey area can be characterized as having relatively low relief with slopes not exceeding 6 percent.

Table 1. VOWTAP Marine Survey Area Federal Lease Blocks and Aliquots

Federal Lease Blocks	6011	6112
Marine Survey Area	Aliquots	
	D, H, L	E, I

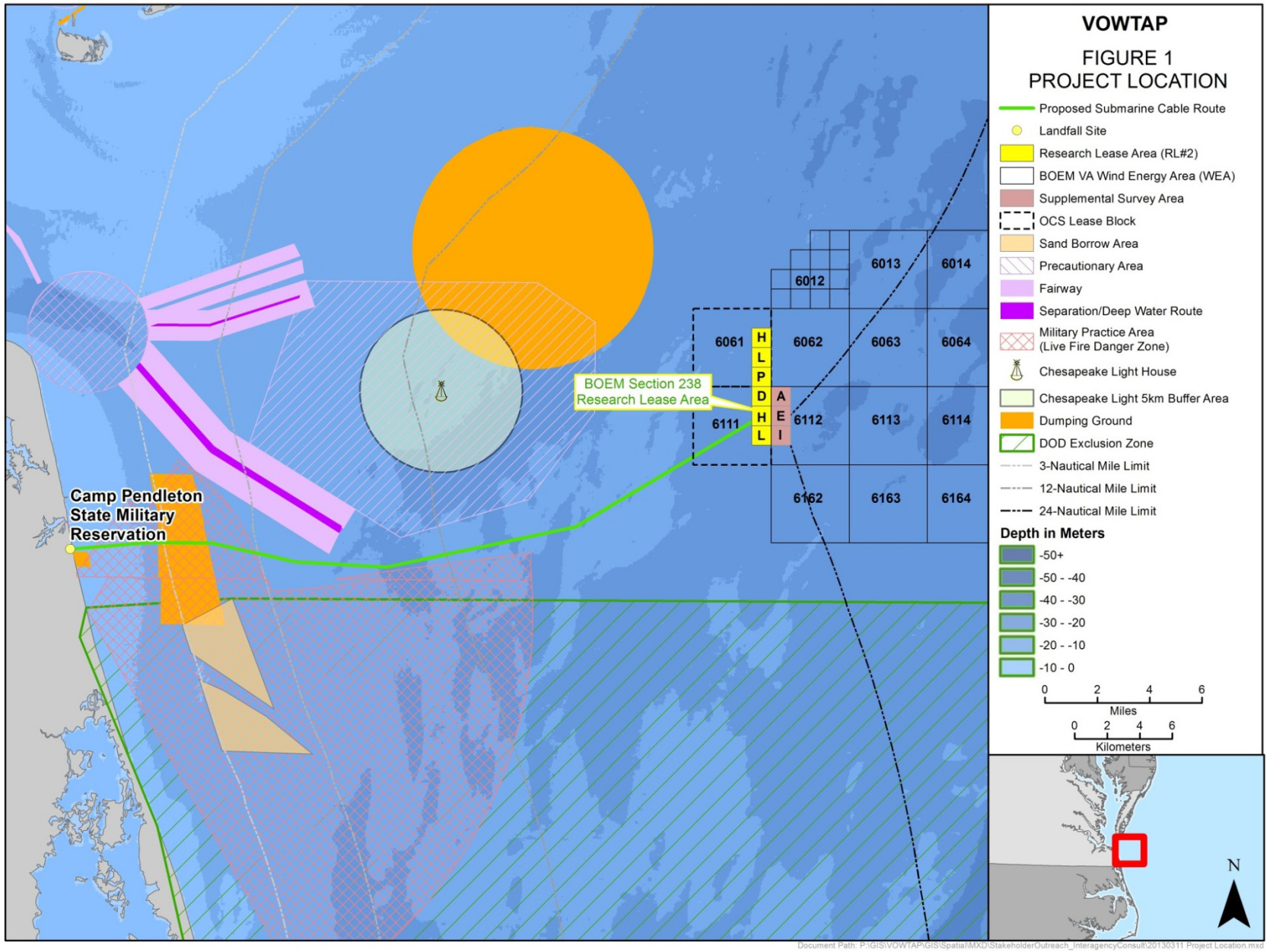


Figure 1. VOWTAP Marine Survey Location Map

1.2 Survey Planning and Regulatory Permitting

Marine geophysical and shallow geotechnical surveys were performed to support engineering designs of Project facilities, to comply with Bureau of Ocean Energy Management (BOEM) regulatory requirements, and to support BOEM's assessment of the environmental effects of the Project pursuant to the National Environmental Policy Act. BOEM requires applicants proposing to file a Research Activities Plan (RAP) for projects proposing installation of structures or cables on the OCS to perform marine site characterization surveys in accordance with 30 Code of Federal Regulations (CFR) Part 585.645(a) and associated guidelines (BOEM, 2012).

Tetra Tech prepared a VOWTAP Geophysical and Shallow Geotechnical Survey Plan (G&G Survey Plan) (Tetra Tech 2013) that was submitted to the following agencies for review and comment prior to deployment:

- BOEM
- U.S. Department of Energy
- U.S. Army Corps of Engineers
- U.S. Department of Navy
- U.S. Fish and Wildlife Service
- National Oceanic and Atmospheric Administration (NOAA) Fisheries Division (NOAA Fisheries)
- U.S. Coast Guard
- Virginia Department of Mines, Minerals, and Energy
- Virginia Department of Game and Inland Fisheries
- Virginia Department of Historic Resources
- Virginia Marine Resources Commission

Tetra Tech also hosted technical working sessions and conference calls with the above-referenced agencies to review the G&G Survey Plan on April 22 and 29, 2013. Several iterations of the Survey Plan were prepared to allow for all agency comments to be adequately addressed. Tetra Tech's final G&G Survey Plan was submitted to BOEM and other applicable agencies on May 15, 2013. BOEM pre-survey meetings suggested pursuant to BOEM's Guidelines (BOEM 2012) were held on May 16 and 22, 2013.

2 FIELD OPERATIONS SUMMARY

VOWTAP marine surveys were conducted from June 1 to June 28, 2013, and are summarized in Table 2. Surveys commenced with acquisition of geophysical data that informed selection of locations for benthic sampling and the shallow geotechnical investigation. Following completion of the first phase of geophysical data collection, the survey vessel was equipped for the second phase, which included acquisition of medium penetration sub-bottom profiling data, as well collection of sediment grab samples for the benthic investigation. Seabed coring and geotechnical testing were conducted during the final phase of the survey.

Survey activities were interrupted briefly by Tropical Storm Andrea, the first named storm of the 2013 hurricane season. The storm originated from an area of low pressure in the eastern Gulf of Mexico on June 5, 2013. Despite strong wind shear and an abundance of dry air, Andrea strengthened into a strong tropical

storm with winds peaking at 65 miles per hour (100 km/hour) on June 6, 2013. Later that day, the storm made landfall in the Florida Big Bend region at the same intensity. The storm weakened and began losing tropical characteristics while tracking across Florida, Georgia, and South Carolina, before transitioning into an extratropical cyclone over North Carolina on June 7, 2013. The Research Vessel (R/V) *Sea Lion V* transited to safe harbor in Portsmouth, VA, as the storm arrived at the survey area. Geophysical survey efforts resumed on June 8, 2013 after the storm passed and sea conditions allowed for safe operations offshore.

Table 2. Marine Survey Field Operations Summary

Start Date	End Date	Activity
01 June 2013	02 June 2013	Survey vessel departs port in Portsmouth, VA and performs system tests and calibrations.
03 June 2013	05 June 2013	Multibeam bathymetry, sidescan sonar, shallow-penetration sub-bottom profiling and magnetometer survey of lease area.
06 June 2013	07 June 2013	Vessel in port in Portsmouth, VA due to Tropical Storm Andrea
08 June 2013	11 June 2013	Multibeam bathymetry, sidescan sonar, shallow-penetration sub-bottom profiling and magnetometer survey of survey corridor.
11 June 2013	13 June 2013	Demobilize bathymetry, sidescan sonar, shallow-penetration sub-bottom profiling and magnetometer survey equipment and mobilize benthic sampling and medium-penetration sub-bottom profiler systems.
14 June 2013	15 June 2013	Setup and test benthic sampling and medium-penetration sub-bottom profiler systems. Depart for survey area.
16 June 2013	17 June 2013	Benthic sampling and medium-penetration sub-bottom survey.
17 June 2013	20 June 2013	Demobilize medium-penetration sub-bottom equipment, continue benthic sampling.
20 June 2013	21June 2013	Complete benthic sampling, package samples for shipment, mobilize piston and vibracore equipment.
22 June 2013	24 June 2013	Core sampling in lease area.
24 June 2013	27 June 2013	Core sampling along survey corridor.
28 June 2013	28 June 2013	Core sampling complete, transit back to port.

3 SURVEY PERSONNEL ROLES AND RESPONSIBILITIES

The personnel involved in the geophysical and shallow geotechnical surveys are listed in Table 3 along with their respective roles and responsibilities.

Table 3. Survey Personnel Roles and Responsibilities

Personnel	Title	Responsibilities
Jennifer Daniels	VOWTAP Project Manager	Project management, VOWTAP team coordination, health and safety plan oversight, support of technical leads, final PM review of technical documents and reports, regulatory permitting for marine surveys
Robert Feldpausch	Marine Survey Task Manager	Management and oversight of marine survey personnel, primary author of G&G Survey Plan and review with regulatory agencies, planning and execution of surveys, and final technical review of survey results documents and reports
Brent Johnston	Principal Investigator / Offshore Survey Manager	Management and direct oversight of personnel on the survey vessel, data acquisition and reporting to task manager and Project manager
Joanna Hobson	Senior Marine Geologist	Oversight of sub-bottom profiling/sidescan sonar data acquisition and interpretation; primary author of survey results documents and reports
Richard Funk	Senior Geophysicist	Oversight of magnetometer data acquisition, processing and reporting and offshore sediment coring collection and processing
Dick Sylwester	Senior Consulting Geophysicist	Oversight of Boomer and Bubble Pulser data acquisition, interpretation and reporting

Table 3. Survey Personnel Roles and Responsibilities (continued)

Personnel	Title	Responsibilities
Neil Parry	Principal Geophysicist	Oversight of Boomer and Bubble Pulser data acquisition and technical review of interpretation and reporting
Tom Ingra	Principal Engineer and Laboratory Director	Management of testing of sediment samples and cores and associated reporting
Jan Wildman	Laboratory Quality Control Manager	In laboratory logging of cores, processing of samples and testing of samples
Ronald Eckhardt	Owner and engineer's representative	Oversight of geophysical survey activities to ensure data acquisition is suitable to support required facilities design and engineering
David Chisnall	Owner and engineer's representative	Oversight of geotechnical survey activities to ensure data acquisition is suitable to support required facilities design and engineering

4 DAILY REPORTING

All phases of the survey were documented in Daily Progress Reports (DPRs) and daily survey operations logs, copies of which are provided in Attachment A. The DPRs documented personnel onboard and included a daily analysis of survey progress noted by time and distance milestones, unexpected findings, and safety issues. The DPRs were submitted by the Tetra Tech Offshore Survey Manager daily to the Project and Task Managers. The daily survey operations logs included date, survey line, start and end times, heading, and other relevant notes related to the survey.

5 SURVEY EQUIPMENT TECHNICAL SPECIFICATIONS

This section describes the setup procedures for the vessel and equipment mobilized by Tetra Tech to conduct the Project survey operations.

5.1 Vessel

The R/V *Sea Lion V* (Figure 2) is 30.5 m (110 feet) in length with a back deck adequate for the efficient and safe deployment, recovery and stowing of survey and sampling systems. Mounts and side poles were rigidly installed for mounting of the surface positioning and altitude sensor, multibeam echosounder, and ultra-short acoustic baseline (USBL) positioning system. The vessel was outfitted with an A-frame, winches, and crane for deployment of towed survey and sediment sampling equipment. During mobilization, two shipping containers were installed on the vessel for use as data acquisition and onboard data processing labs and equipment spares storage.

Figure 2. R/V *Sea Lion V* Mobilized to Conduct Surveys for the VOWTAP

5.2 Equipment

Equipment mobilized for the survey is listed in Table 4 and major components are described further in Section 7.

Table 4. Primary Geophysical Survey Systems

System Type/Sensor	Manufacturer
Survey Vessel	R/V *Sea Lion V*
Positioning Systems and Software	iXBlue PHINS 6000 (with DELPH INS Software), Trimble SPS651 with MarineStar, Trimble Ag132 DGPS
Subsea Positioning	iXBlue GAPS USBL
Heading, and Motion Reference System	iXBlue PHINS 6000
Sound Velocity Profilers	OceanScience UCTD
Multibeam Sonars	RESON SeaBat 7125 SV2
Magnetometer/ Gradiometer Overhauser	Marine Magnetics SeaQuest
SideScan Sonar	EdgeTech 2000-DSS Dual Frequency 110/540 kHz
Shallow-penetration Sub-bottom Profiler	EdgeTech 2000-DSS CHIRP 2-16 kHz
Medium-penetration Sub-bottom Profiler	HMS-620 Bubble Pulser 350-800 Hz
Medium-penetration Sub-bottom Profiler	AAE Boomer System 800 Hz-2 kHz
Multi-channel Medium-penetration Sub-bottom Profiler	Geometric Geode and MicroEel
Grab Sampler	Pneumatic Power Grab
Vibracore/Gravity/Piston System	220V 3-phase Vibracore and Piston corer
Digital Imagery	DeepSea Power and Light WideEye, GoPro Hero 3 cameras, scaling laser, and LED lights
Acquisition and Processing Software	
HYPACK/HYSWEEP 2012a, CARIS HIPS/SIPS v7.1.2, EdgeTech Discover, Chesapeake Sonar Wiz, DELPH INS 2.3 SP2, Fledermaus Pro, and Tetra Tech custom software	

6 POSITION DATA AND TIDES

6.1 Geodesy

Horizontal (X, Y) positioning data for the Project were collected in North American Datum 1983 (NAD83), Universal Transverse Mercator (UTM) Zone 18N, in meters. Vertical data were collected in mean lower low water (MLLW), in meters. Table 5 lists the geodetic settings used for the survey. Figure 3 shows the survey monument that was used to cross check the Global Navigation Satellite System (GNSS) used for the survey.

Table 5. Marine Survey Geodetic Projection

Projection Parameters	
Grid Projection	Universal Transverse Mercator
UTM Zone	18 N
Central Meridian	75° 00' 00" W
Latitude of Origin	00° 00' 00" North
False Easting	500 000 m
False Northing	0 m
Scale factor on Central Meridian	0.9996
Horizontal Datum	North American Datum 1983 (NAD83)
Vertical Datum	MLLW, Epoch 1987 - 2001
Distance Unit	Meter
Depth Unit	Meter
Geoid Model	g2012au0

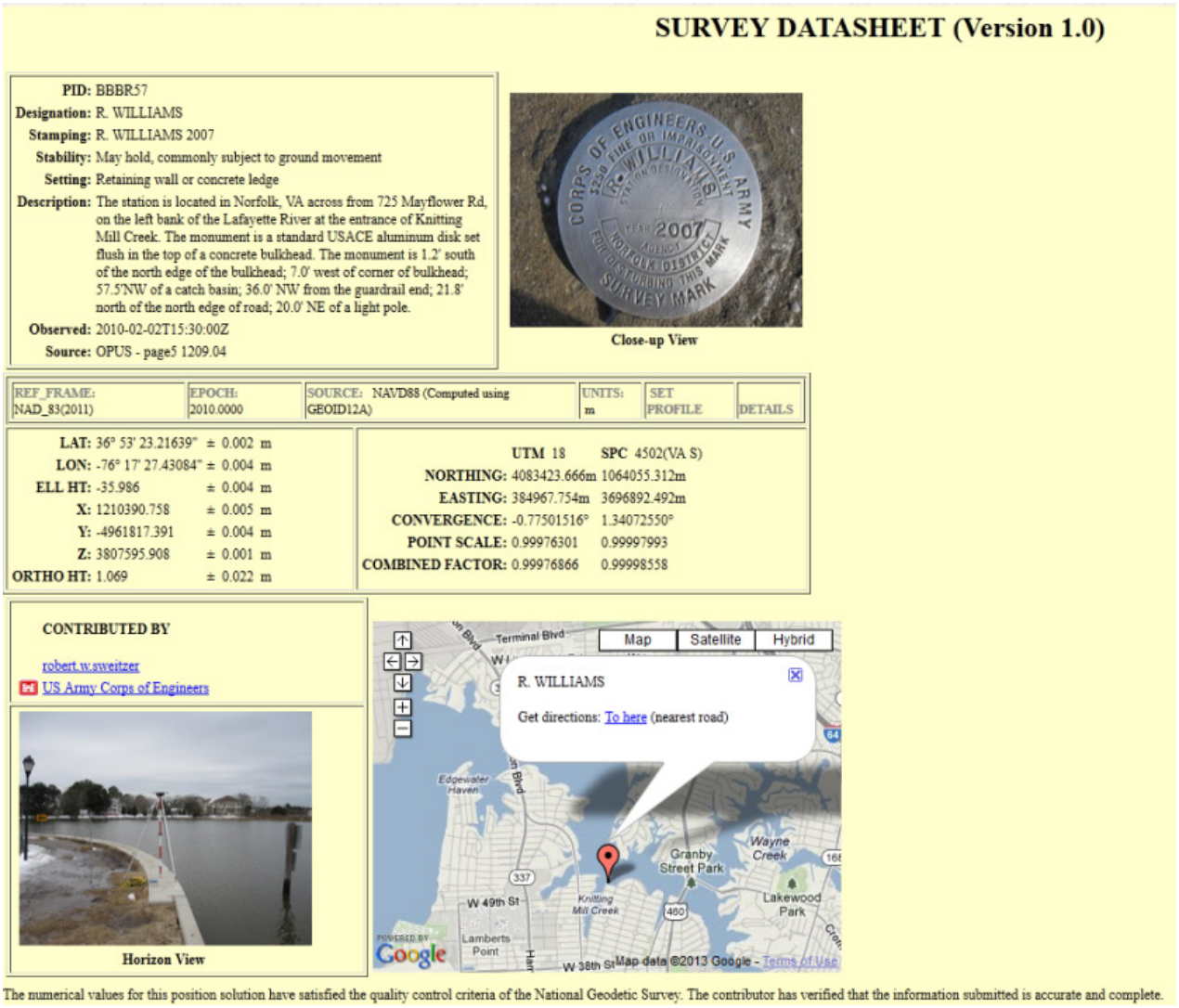


Figure 3. GPS Geodetic Survey Control Monument

6.2 Vessel Positioning and Tides

The position of the vessel was obtained with an iXBlue PHotonic Inertial Navigation System (PHINS) interfaced with a Trimble SPS651 with MarineStar corrections; this combination provided approximately two decimeter level horizontal positional accuracy and approximately three decimeter vertical positional accuracy. Position data were merged with multibeam bathymetry and other sensor data in the data collection software used for each data type. The shipboard receiver output differentially corrected latitude and longitude values > 5 times every second. The HYPACK/HYSWEEP data collection and navigation system was interfaced to the ship autopilot and also provided real time graphical displays of vessel position and bathymetry survey coverage. IXBlue DELPH Inertial Navigation System (INS) software was used to post-process the positioning data and merge supplemental Global Positioning System (GPS) data to develop a tide file and improve the quality of the horizontal and vertical positioning.

The INS derived position was updated every 15 seconds by an iXBlue Global Acoustic Positioning System (GAPS) USBL mounted to an over-the-side pole on the port side of the R/V *Sea Lion V*. Sea surface elevation data were generated from post-processed PHINS data that were filtered through a 10-minute box-car average to remove short-term variability.

To confirm that the GNSS system met BOEM's surface positioning accuracy requirement of ± 1m for the survey, the system was taken to a survey monument and the three dimensional (3D) position reported by the GNSS was compared to the published coordinates of the control point. The results of the comparison are shown in Table 6.

Table 6. Global Navigation Satellite System Datum Control Crosscheck Results

Parameter	Easting (m)	Northing (m)	Elevation (m)
Control Coordinates	384967.754	4083423.666	-35.986
Tetra Tech Observed	384968.046	4083423.653	-35.760
Accuracy Threshold	1.000	1.000	
1D Difference	0.292	0.013	0.226
RMS 2D Error		0.292	
RMS 3D Error			0.320

6.3 Positioning and Motion Sensors

Ancillary positioning and vessel attitude systems that were used to conduct the seabed mapping are presented in Table 7. Horizontal and vertical positional accuracy and target detection conformed to BOEM survey standards (BOEM 2012).

Table 7. Positioning and Motion Systems

System Type/Sensor	Manufacturer	Details
Positioning Systems and Software	iXBlue PHINS 6000 (with DELPH INS Software), Trimble SPS651 with MarineStar, Trimble Ag132 DGPS,	<1m horizontal accuracy
Subsea Positioning	iXBlue GAPS USBL	Accuracy 0. 2% of slant range
Heading, and Motion Reference System	iXBlue PHINS 6000 (or similar)	Pitch, roll and heading accuracy of <0.02°. Heave accuracy of 5 cm or 5% whichever is greater for period of 20 seconds or less.
Sound Velocity Profilers	OceanScience UCTD, YSI Castaway CTD, Seabird MicroCAT37	Conductivity, temperature, depth and sound velocity
Acquisition and Processing Software		
HYPACK/HYSWEEP, CARIS HIPS/SIPS, EdgeTech Discover, Chesapeake SonarWiz, DELPH INS, Fledermaus Pro, and Tetra Tech custom software		

6.3.1 Instrument Offsets for Ship-Mounted Systems

The multibeam sonar, PHINS, and GAPS USBL system were all mounted on or adjacent to a pole installed on the port side of the vessel. The antenna for the Trimble GPS used in conjunction with the INS was mounted on the container which housed the data collection systems and operators. The offsets are shown in Table 8.

Table 8. Instrument Vessel Offsets

Sensor	Across (Starboard Positive) meters	Along (Forward Positive) meters	Vertical (Down Positive) meters
iXBlue PHINS position, heading, motion	0	0	0
Trimble SPS 651	2.875	4.080	-4.275
SeaBat 7125	-0.740	0.120	4.734
iXBlue GAPS USBL	-0.740	-1.260	4.734

6.3.2 Instrument Offsets of Towed Geophysical Sensors

Positioning for the magnetometer, shallow-penetration, frequency-modulated compressed high-intensity radar pulse (CHIRP) sub-bottom profiler, sidescan sonar, and seabed coring operations was provided by a GAPS USBL. The GAPS has integrated USBL, an INS, and GNSS. Due to the integration of attitude (pitch and roll) and motion (heave), this positioning system requires no calibration. The accuracy of the GAPS is among the best commercially available at 0.2 percent of slant range. The GAPS is shown in Figure 4 mounted on the pole that has been retracted out of the water for vessel transit.

Figure 4. SeaBat 7125 Multibeam Sonar and GAPS USBL Systems on Retracted Pole

The offsets of the sidescan sonar, CHIRP sub-bottom profiler, and magnetometer were measured relative to the USBL responder transducer which was installed near the front and top of the towfish. The towfish is comprised of the hydrodynamic enclosure which houses the sidescan sonar and CHIRP sub-bottom profiler units. Positioning of the medium penetration sub-bottom systems, including two sources, two single-channel hydrophones, and a multi-channel hydrophone, were determined by measuring the offset left and right of the vessel centerline and the distance from the stern to the attachment point on the device being towed. The cables were then marked at their attachment point on the vessel once the accepted offsets had been determined.

The offsets are shown in Table 9.

Table 9. Towfish Vessel Offsets

Sensor	Across (Starboard Positive) meters	Along (Forward Positive) meters	Vertical (Down Positive) meters
EdgeTech 216 sub-bottom profiler	0.0	-0.4	0.2
EdgeTech sidescan sonar	0.0	-0.4	0.2
Marine Magnetics SeaQuest	0.0	-10	0.0
Multi-channel hydrophone	0	-35	0
Single-channel hydrophone 1	-10	-30	0
Single-channel hydrophone 2	10	-30	0
Boomer acoustic source	-5	-30	0
Bubble pulser acoustic source	5	-30	0

7 GEOPHYSICAL FIELD INVESTIGATION

Tetra Tech performed geophysical field investigations including the collection of bathymetry, sidescan sonar imagery, magnetometer, and shallow- and medium-penetration sub-bottom profiler data in accordance with BOEM Guidelines (BOEM 2012). Equipment specification sheets are provided for these systems in Attachment B.

Operational considerations include the following:

- The multibeam echosounder was operated to allow for 100 percent ensonification of the seafloor;
- The sidescan sonar survey line spacing and operational range were set to allow for at least 100 percent overlapping coverage of the primary lines and the system was towed at an altitude that was 10 to 20 percent of slant range. The magnetometer sensors were towed targeting an altitude of </= 6 meters above the seabed; data sampling interval was 2 hertz (Hz);
- Shallow-penetration sub-bottom and medium-penetration sub-bottom (single-channel and multi-channel) were acquired to characterize stratigraphic data from the seabed to a maximum depth of 100 meters; and
- Survey lines were oriented to align with the aliquots to minimize turns and maximize survey efficiency.

7.1 Sound Velocity Measurements

Sound velocity profiles were collected throughout the survey to maintain quality and accuracy of bathymetric data under changing oceanographic conditions. Three conductivity (salinity), temperature, and

depth (CTD) and/or velocimeter devices were mobilized to measure sound speed at the various bathymetric sonar arrays and through the water column.

To maximize survey production rates, an Oceanscience Underway CTD (UCTD) system was used on the survey vessel to profile the speed of sound in the water column while the vessel was underway (Figure 5). A modified (extended) outrigger was used on the R/V *Sea Lion V* to minimize the risk of entanglement of the probe with the towed sensors behind the vessel. Water conditions and multibeam data quality were closely monitored to determine the frequency of UCTD casts.

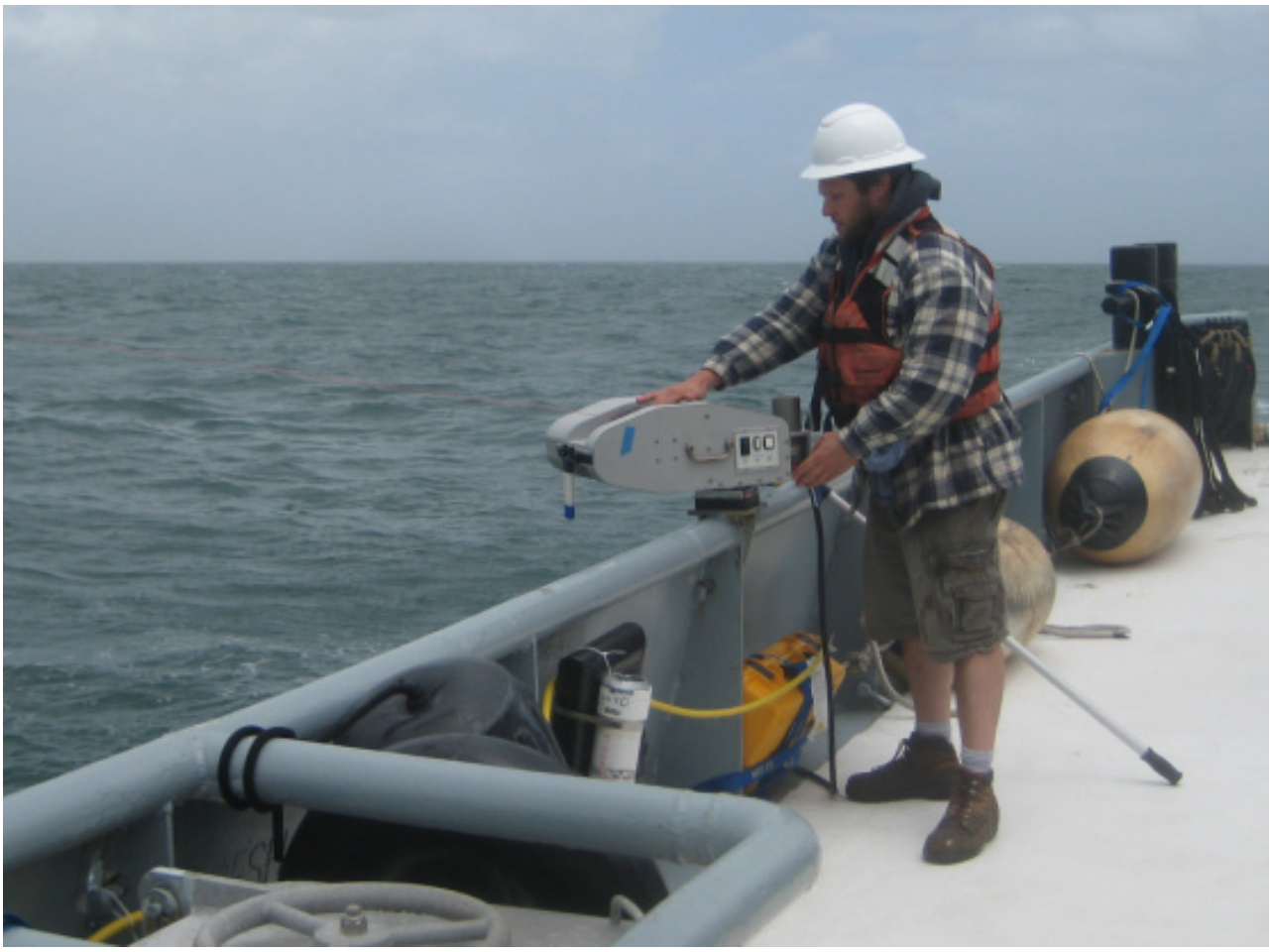


Figure 5. Deploying the Underway Conductivity, Temperature and Depth (UCTD) Sensor

7.2 Bathymetric, Sidescan, Magnetometer and Shallow Penetration Sub-bottom Profiler Systems

Bathymetric, sidescan, magnetometer, and shallow-penetration sub-bottom profiler data were acquired simultaneously and reviewed in real time to monitor data quality and coverage. The on-board acquisition station aboard the R/V *Sea Lion V* is shown in Figure 6. Bathymetric and high-frequency (540 kilohertz [kHz]) sidescan sonar data were collected to map surface elevations and features on the seabed. Multibeam backscatter data and low-frequency sidescan (110 kHz; acquired simultaneously with the high frequency data) were acquired and archived. Magnetometer data were acquired and processed to detect potential cultural deposits and high-resolution, shallow-penetration sub-bottom profiler data were acquired with the CHIRP sub-bottom profiler to investigate the shallow subsurface sediments. These systems are presented in

Table 10. The SeaBat sonar arrays and co-located SeaBird CTD for measuring sound speed at the arrays are shown in Figure 4 with the pole retracted out of the water. The layout of the systems is depicted in Figure 7.

Figure 6. Acquisition Lab Aboard the R/V *Sea Lion V*

Table 10. Bathymetry, Sidescan Sonar, and Magnetometer Systems

System Type/Sensor	Manufacturer	Details
Multibeam Echosounder	RESON SeaBat 7125SV2	400 kHz, 256 beams (0.5°x1°)
Sidescan Sonar	EdgeTech 2000-DSS	Dual-frequency 110/540 kHz
Shallow-penetration Sub-bottom Profiler	EdgeTech 2000-DSS	CHIRP 2-16 kHz
Magnetometer/Gradiometer Overhauser	Marine Magnetics SeaQuest	Absolute Accuracy 0.1 nT; 0.001 nT counter sensitivity Sensitivity 0.01 nT Sampling interval 1, 2 or 4 Hz (user-selectable)
Acquisition and Processing Software		
HYPACK/HYSWEEP, CARIS HIPS/SIPS, EdgeTech Discover, Chesapeake SonarWiz, DELPH INS, Fledermaus Pro, ESRI ArcGIS, AutoCAD, GeoSoft Oasis Montaj, and Tetra Tech custom software		

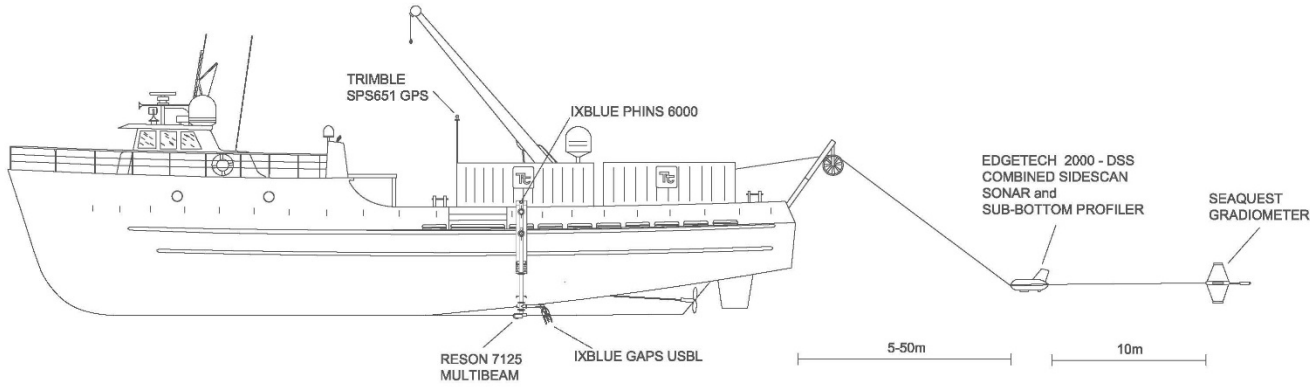


Figure 7. Systems Layout Diagram for Phase 1 of the Geophysical Survey

7.3 Medium-Penetration Sub-bottom Profiling

The subsurface investigation was conducted using the shallow-penetration CHIRP sub-bottom profiler described in Section 7.2 to provide high resolution shallow subsurface data and medium-penetration sub-bottom profiling systems to provide deeper subsurface reflection data to a depth of approximately 100 meters below the seabed. Two single-channel medium-penetration sub-bottom profiling systems, a Boomer and Bubble Pulser, were proposed initially to meet the penetration objectives for the Project. However, following discussions with BOEM, a multi-channel system was added to the survey suite in an effort to improve the sub-bottom records and potentially suppress multiples. Multiple reflections are inherent in seismic studies and multi-channel systems can improve the record by increasing the signal to noise ratio and by decreasing the number of multiples. While this is not always the case, particularly in shallow water, a multi-channel system was added to take advantage of these possible benefits following BOEM's recommendation. Selected systems included a multi-channel system consisting of 24 channels and two single-channel systems which were deployed for real-time monitoring purposes. The following is a brief discussion of these instruments.

The medium-penetration sub-bottom data were collected after the high-resolution shallow-penetration sub-bottom, multibeam, sidescan, and magnetometer field acquisition was complete. The multi-channel and single-channel monitoring data were acquired together over a 2-day period on transects spaced 150 m apart running north to south and along four crosslines spaced 900 meters apart running east to west across the lease area. The objective of multi-channel data acquisition was to identify potential geohazards (faults, shallow paleochannels, gas-charged sediment, zones of boulders) and to map the vertical extent of distinct sedimentary units.

The multi-channel data were acquired digitally using a Boomer acoustic source and a 24 channel hydrophone array. A single-channel hydrophone was also deployed to monitor the Boomer acoustic source and the general reflection characteristics of the seabed and subseabed stratigraphy. The single channel data were displayed in real-time on a thermal printer and also acquired digitally. A second single-channel dataset was acquired with the low-frequency Bubble Pulser source as an additional monitoring system.

The medium-penetration sub-bottom profiler systems are outlined in Table 11; the layout of the towed systems is shown in Figure 8.

Table 11. Medium-penetration Sub-bottom Profiler Systems

System	Model	Specifications	Comments
Acoustic Source	HMS-620 Bubble Pulser	300-900 Hz	Achieved 130- meters subsurface penetration at 1m vertical resolution; deployed 30 meters astern of vessel
Acoustic Source	AAE Model CSP 300 Boomer	800 Hz–2 kHz	Achieve 85-meter subsurface penetration at 0.5-meter vertical resolution; deployed 30 meters astern of vessel, Used as source for Multi-channel and Single Channel Boomer
Multi-channel Hydrophone	Geometrics MicroEel	24-channel, 3.25 m group spacing, 3 elements per group	First channel deployed 35 meters astern of vessel, Cable sensitivity -196 dB re 1 Volt per 1 µPa
Single-Channel Hydrophone	Benthos Model	8 element, 1-ft spacing	Towed 30 meters astern starboard side
Single-Channel Hydrophone	NWGS Model 15	15 element, 1-ft spacing	Towed 30 meters astern, port side
On-board processing Multi-channel	Geometric MGOS	Ethernet controller, SEG-D file, integrated with nav data	Real-time spectral analysis, QC monitor function, real-time single channel and shot gather display.
Processing Single Channel Monitoring	KH Model 1000 Amplified Filter	300 Hz-1 kHz, 30 dB fixed gain	Used with Bubble Pulser system
Processing Single Channel Monitoring	GeoAcoustic Amplifier Filter	500 Hz-2.5 kHz, 40 dB fixed gain	Used with Boomer system
Digital Acquisition Multi-channel	Geometrics Geode	24-channel, 24-bit, 144 dB dynamic range	Operated in continuous cycle, time based triggering, marine mode
Digital Acquisition (2 units) Single Channel Monitoring	Chesapeake SonarWiz 5	4-channel, 12-bit, SEG Y format	Used for single-channel monitoring system
Digital Acquisition Single Channel Monitoring	Sony Model 208 digital tape recorder.	16 ch; 80 db dynamic range, bandwidth dc-10kHz	Used for single-channel monitoring system
Graphic Display (2 units) Single Channel Monitoring	EPC Model 1086-500 thermal graphic recorder (2 each)	25 cm display, 203 dpi, 2048 pixel	140 ms full display for Boomer and 200 ms full display for Bubble Pulser

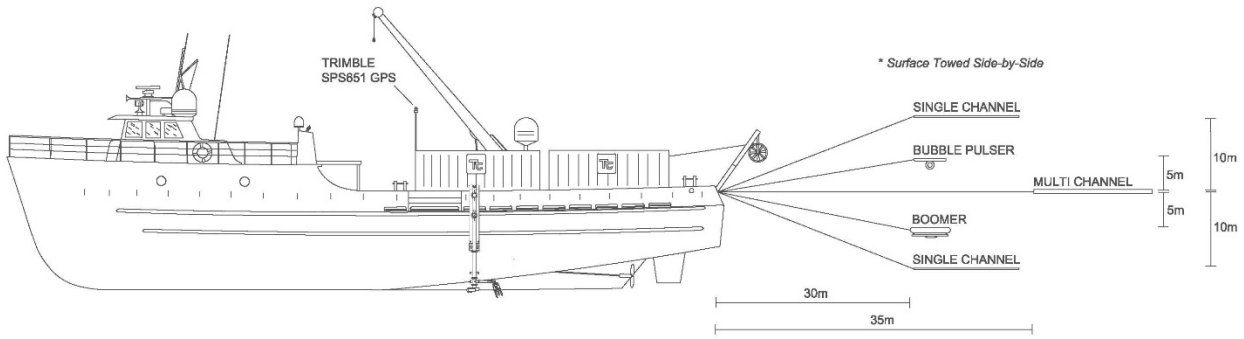


Figure 8. Layout Diagram for Towed Systems Used in Phase 2 of the Geophysical Survey

7.3.1 Multi-channel System

Multi-channel data were acquired using the Boomer source and a 24-channel neutrally buoyant marine streamer cable. The Boomer system was used as the acoustic source because it was judged to have sufficient power to provide subsurface penetration to the specified investigation depths of interest while at the same time providing good vertical resolution. The 24-channel marine streamer cable was designed with a 3.25 m group interval, with each group consisting of three hydrophone elements spaced 0.5 m apart. Data from all 24 channels were digitized at the Geode head using a 24-bit precision simultaneous sampling system with a sensitivity of 0.2 microvolts. Data were acquired using time-based triggering at a varied rate of approximately every 1–1.5 seconds depending on the speed of the survey vessel. The rate of acquisition was optimized based on the vessel ground speed to confirm that 12-fold stacking was possible and that at least 1 shot gather was collected for each group interval movement of the multi-channel hydrophone elements (3.25 m). Typically, at least 250 milliseconds of data were acquired using a digital sample interval of 125 microseconds. Positional data for the Boomer source were provided at a rate of 20 Hz to the multi-channel software acquisition system and recorded directly to the field file headers as each shot gather was acquired.

7.3.2 Single-Channel Systems

The single-channel seismic reflection data used for monitoring were acquired with two different acoustic sources and two different hydrophones. The single-channel reflection data are referred to as single-channel monitoring data since they were acquired at the same rate and at the same time as the multi-channel data. That is, the data were acquired at a discharge rate of 1–1.5 shots/second depending on the vessel speed. True single-channel reflection data are normally acquired at a rate of 4 shots/second, which provides an increase in signal to noise and increased coherency along the transect.

A short test was conducted offshore with the single-channel system firing at a faster rate to determine if there would be a significant improvement in the data quality to justify re-running the survey area with just single-channel systems. Following discussion between the on-board client representative and lead geophysicists it was agreed that no significant improvement was evident and therefore this option was not selected.

7.3.3 Data Acquisition

The multi-channel medium-penetration sub-bottom profiler data and single-channel monitoring data were acquired first with the Boomer source. Approximately 300 milliseconds later, the second single channel monitoring data were acquired with the Bubble Pulser source. Alternately firing the two sources prevented the Bubble Pulser data from overriding the Boomer multi-channel data and cross-talk interference between the two single-channel datasets and the multi-channel dataset. The information from both sources was received on the two single-channel hydrophones, and archived on the digital acquisition systems, the digital tape recorder and displayed in real time on two separate thermal graphic recorders. Position data from the GPS navigation system were also archived on all digital acquisition systems.

8 SHALLOW GEOTECHNICAL INVESTIGATION

The shallow geotechnical investigation included acquisition of sediment grab samples, underwater video/still images, and sediment cores (vibracores and piston cores). Sample locations were selected following review of the geophysical data and were submitted to and approved by BOEM and NOAA.

The sediment grab data were used to ground truth the geological interpretation that was based on multibeam, sidescan sonar, and shallow-penetration sub-bottom data. In addition, grain-size testing was used to help assess potential sediment mobility in the survey area and supported the benthic assessment.

The sediment cores are used primarily to evaluate the near surface conditions at the potential WTG locations and along the survey corridor. Sediment core samples can also be used to determine whether stratigraphy detected in the sub-surface geophysical investigation contains Pleistocene-Holocene components indicative of sensitive areas for archaeological sites. The location and number of sediment cores taken was based on a technical review of the geophysical data collected during the geophysical surveys. The geophysical and shallow geotechnical survey teams worked closely with BOEM and the Project Marine Archaeologist to obtain the information necessary to understand the stratigraphy, particularly in any areas thought to have potential archaeological significance.

Grab and core samples are presented on Plates 7 and 8 and the Alignment Sheets, included in Attachment C; and in Attachments D, E and H.

8.1 Equipment

The shallow geotechnical investigation was conducted following completion of the geophysical survey operations. Underwater video/still imagery was collected during sediment sampling operations to support the geological interpretation effort and the benthic resource investigation. Tools that were used to collect the sediment samples, video/still images, and sediment characteristics are presented in Table 12. Sediment sampling methods included:

- Sediment grab samples collected for grain size testing and benthic analyses, and
- Sediment cores to investigate the upper 3–5 meters of the subsurface (or refusal) for stratigraphic definition and to provide samples for geotechnical laboratory testing.

A power grab sampler, configured with positioning and camera systems was used to collect benthic samples. Two different types of coring systems, a vibracore and a piston core system, were deployed with the intent of collecting 3–5-m-long cores in the lease area and at specified intervals along the survey corridor.

Analog and digital video camera systems were mounted to the benthic grab sampler to document surface sediments and any marine life at the sample sites.

Table 12. Geotechnical Investigative Tools

System Type	Manufacturer and Specifications
Grab Sampler	Tetra Tech; pneumatic power grab
Vibracore / Piston Core System	Tetra Tech; 220V 3-phase 10 cm diameter, 3 vibracore and 7.5 cm diameter, 3-meter piston corer
Digital Imagery	DeepSea Power and Light WideEye, GoPro Hero 3 Cameras (color), scaling laser, and LED lights.

8.2 Sampling Plan

8.2.1 Benthic Grab Samples

In accordance with BOEM (2013) Guidelines, benthic power grab samples were collected within each of the survey area aliquots as well as along the proposed survey corridor. The grab sampler was also equipped with

a USBL transponder for accurate positioning of the sample and with cameras and lights to document information on the surface sediments and to support benthic habitat studies.

Figure 9 shows the grab sampler and supporting equipment being deployed. A total of 69 grab sample locations were selected following review of the geophysical data and were proposed to and approved by BOEM and NOAA for collection and laboratory analysis (refer to Attachment D). Sixty of these locations, designated GS-001 through GS-060, were located in the survey area; with 45 collected in the survey corridor and 15 in the lease area. The other nine grab samples (GS-REF-001 to GS-REF-009) were collected outside of the survey area as control samples for the benthic investigation. Please refer to Appendix J - Benthic Survey Report of the VOWTAP RAP for additional details on the control samples.

Figure 9. Benthic Power Grab Sampler Deployment

Figure 10 shows the camera and light systems installed on the grab sampler frame. These included video camera with imagery feedback to the surface, a high-definition video camera, high-power underwater lights with dimmer control, and a scaling laser system.

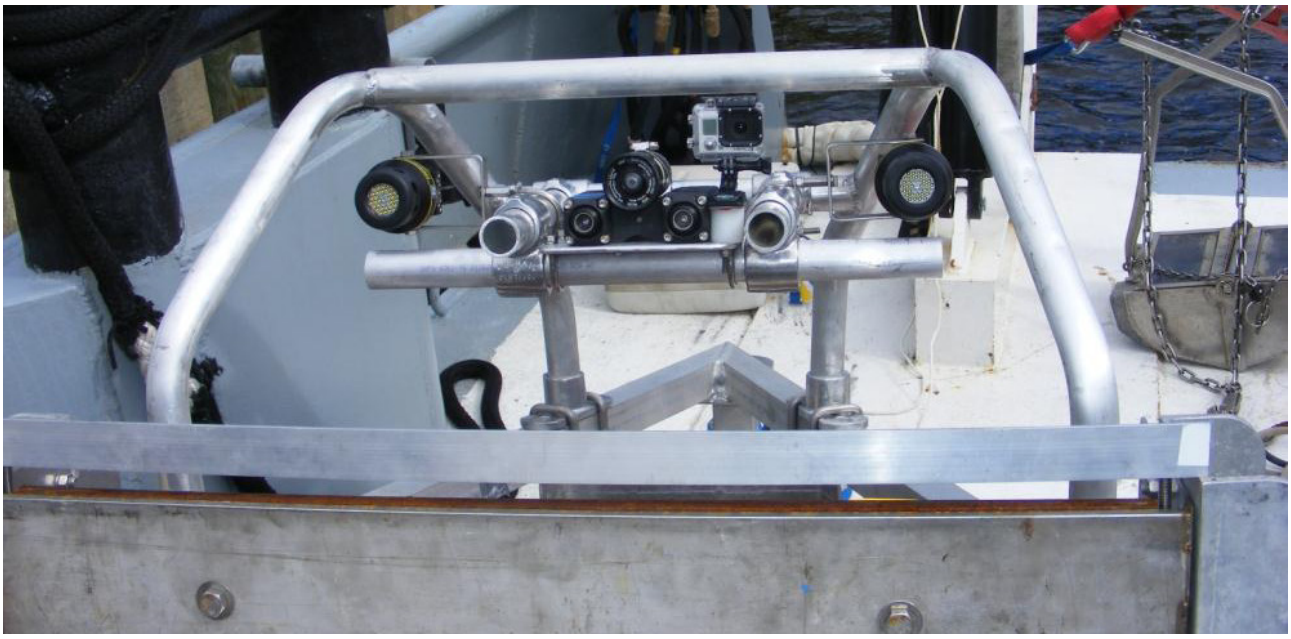


Figure 10. Grab Sampler Camera and Light Systems

Figure 11 shows an example image from the video collected during a grab sample.

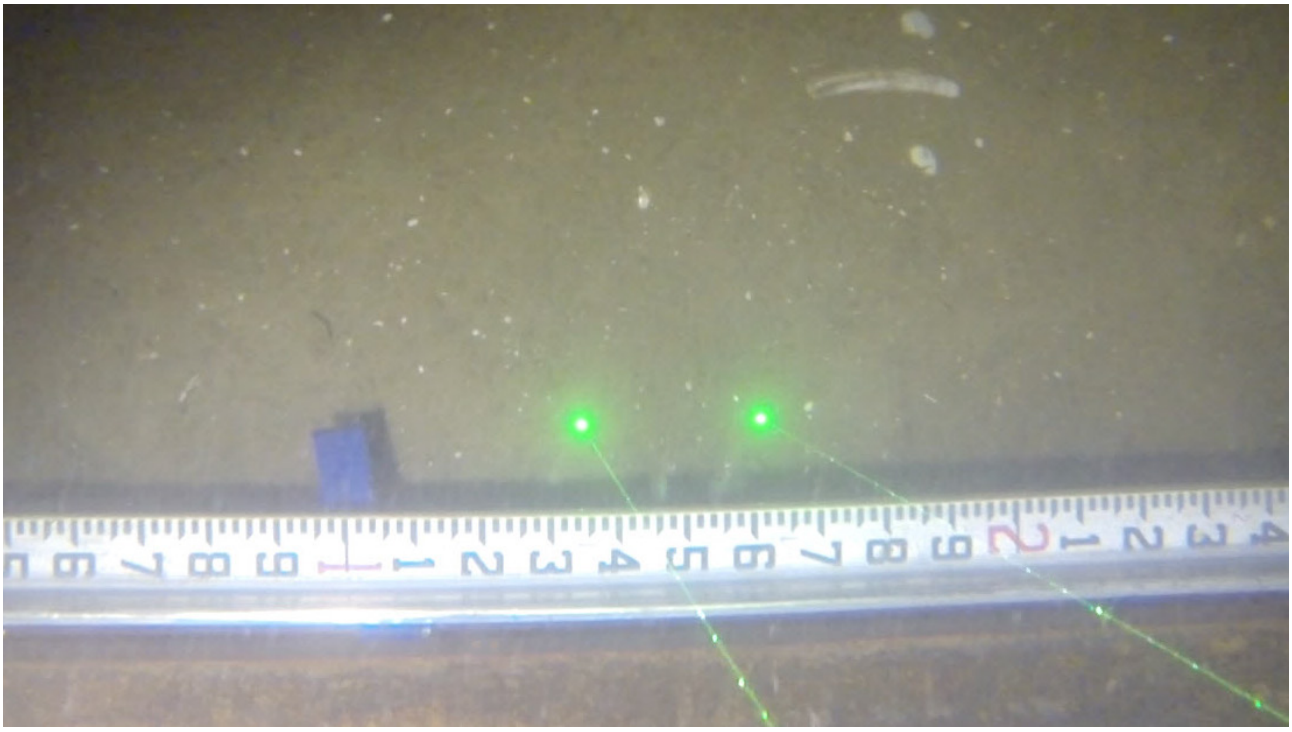


Figure 11. Still Frame Image from High-Definition Video

8.2.2 Sediment Cores

Sediment core samples were collected at the four potential WTG locations, T1A, T1B, T2A and T2B, and along the survey corridor (Figure 12; Plates 7 and 8 in Attachment C). Both piston core and vibracore

samples were collected at three of the WTG locations (T1B [1 piston core, 2 vibracores], T2A [2 piston cores, 2 vibracores], and T2B [1 piston core, 2 vibracores]); and two vibracores were collected at the fourth WTG location, T1A. The vibracore system provided much better sample collection and retention in comparison to the piston core system, and therefore, samples from all of the remaining stations were collected using the vibracore system only. Core samples were collected from four stations in the lease area (8 vibracores and 4 piston cores) and 17 stations (19 vibracores) along the survey corridor. Core logs that incorporate lab testing results are provided in Attachment E and are included on the charts in Attachment C.

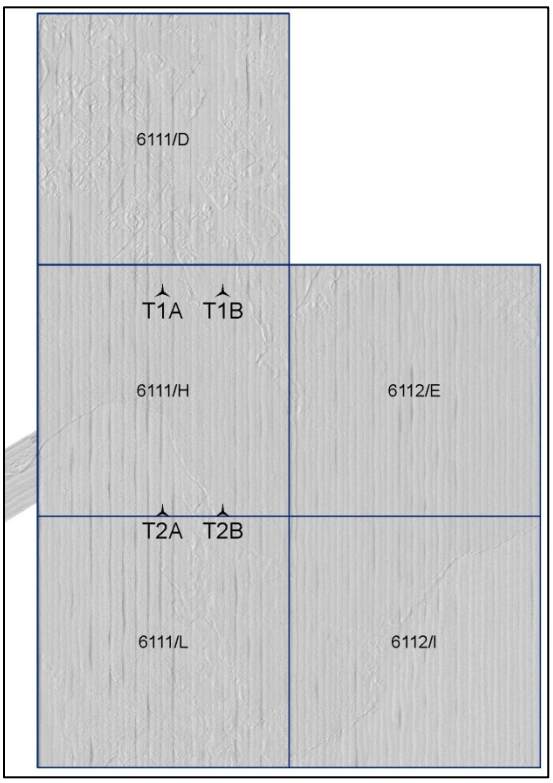


Figure 12. Proposed Turbine Locations in the Lease Area

8.2.2.1 Vibracoring

The primary core sample collection system used was the vibracore (Figure 13), which was lowered to the seafloor using a winch and driven into the seabed by force of gravity enhanced with vibration (Figure 14). The system drives an approximately 4-inch-diameter steel core barrel in 3-meter and 5-meter lengths into the sediment. The penetrating end of the core barrel was fitted with a core-catcher to retain the sample when the corer was retracted from the seabed and recovered to the ship.

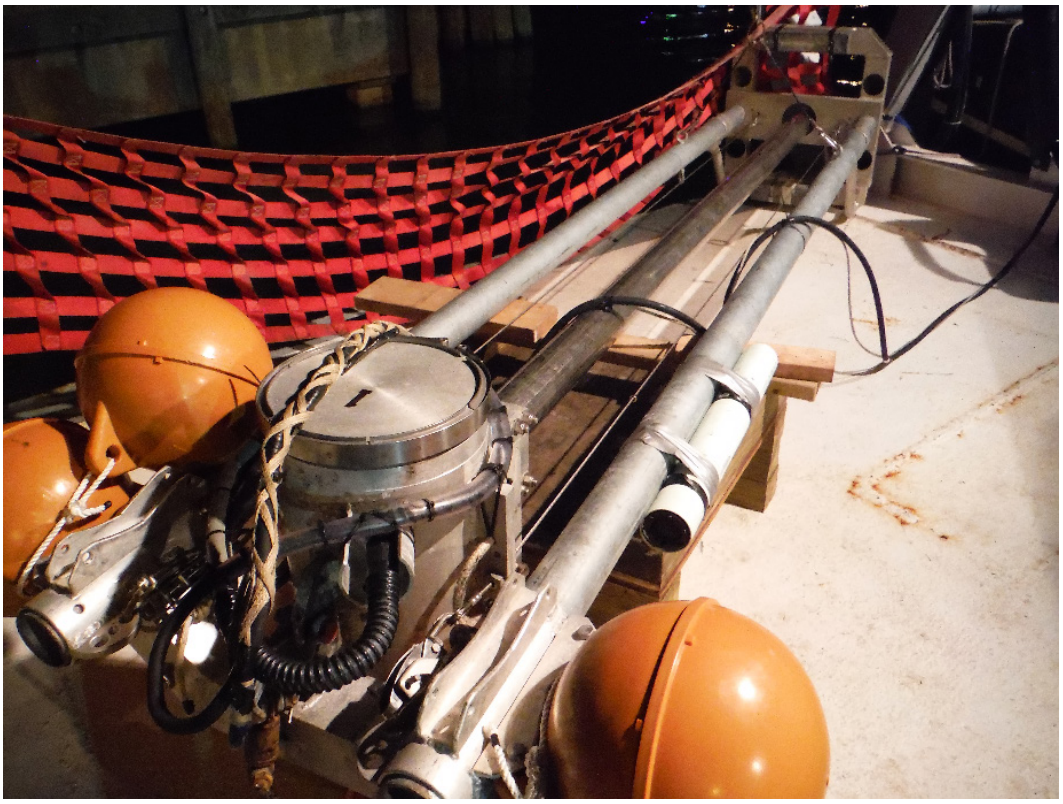


Figure 13. The Vibracore on the Aft Deck

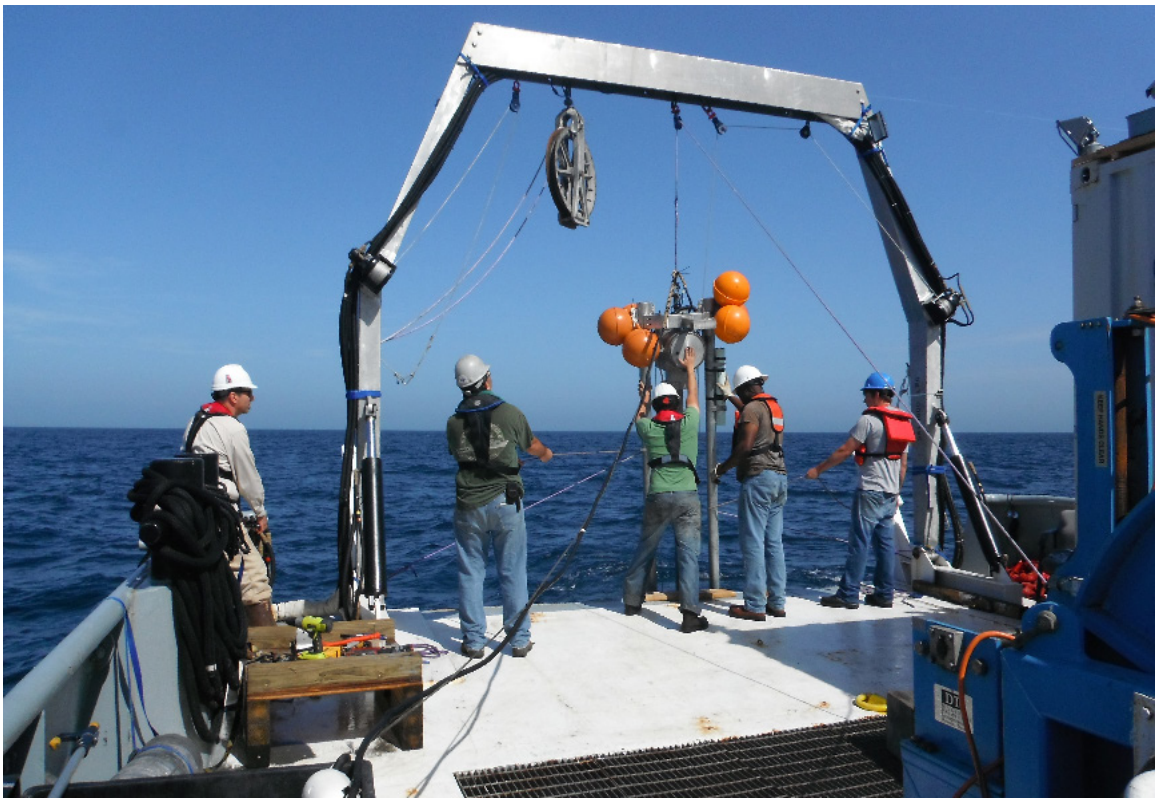


Figure 14. Deploying the Vibracore

8.2.2.2 Piston Core

Piston cores were collected as a secondary collection system at three of the proposed WTG locations. As noted in Section 8.2.2, piston core collection was abandoned following collection of four samples due to the superior performance of the vibracore system. The piston core system was operated from a winch with sufficient cable to deploy the corer to the seabed (Figure 15). Core barrels were 3 m in length and 7.62 cm (3 inches) in diameter. The penetrating end of the core barrel was fitted with a cutter and a concave spring-steel core-catcher to retain the sample when the corer was retracted from the seabed and recovered to the ship. Weights were attached at the top end of the core barrel and a deployment and recovery line was attached to the top of the corer (Figure 16). A release device, consisting of a free-fall loop with latch to retain the corer, a trigger arm attached to the lift line and from which was suspended a trigger weight that held the latch closed, allowed the corer to free fall to the seabed. The trigger weight line was approximately 5 meters long to allow free-fall. When the weight touched the seabed, tension was released from the trigger arm, the latch released, and the piston core fell to the seabed.

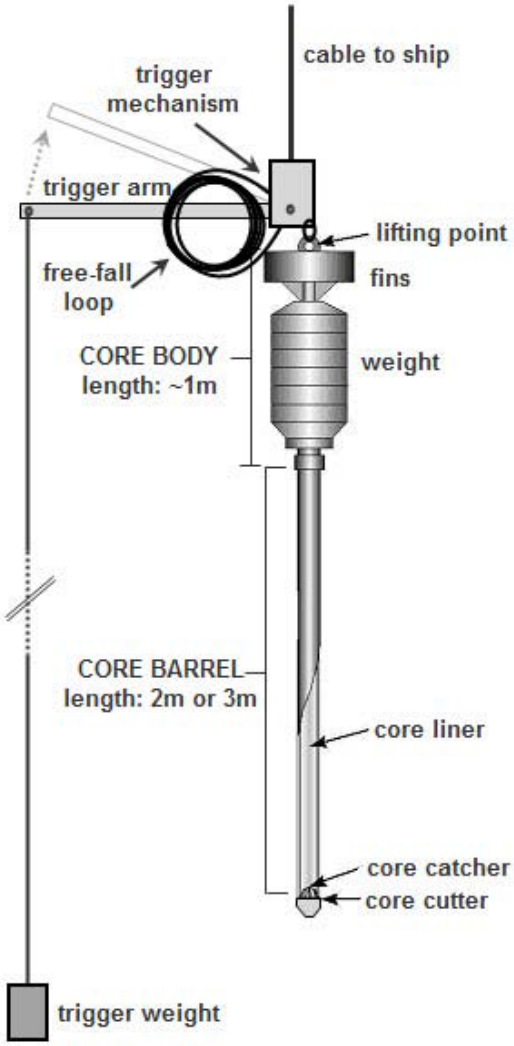


Figure 15. Piston Core Diagram

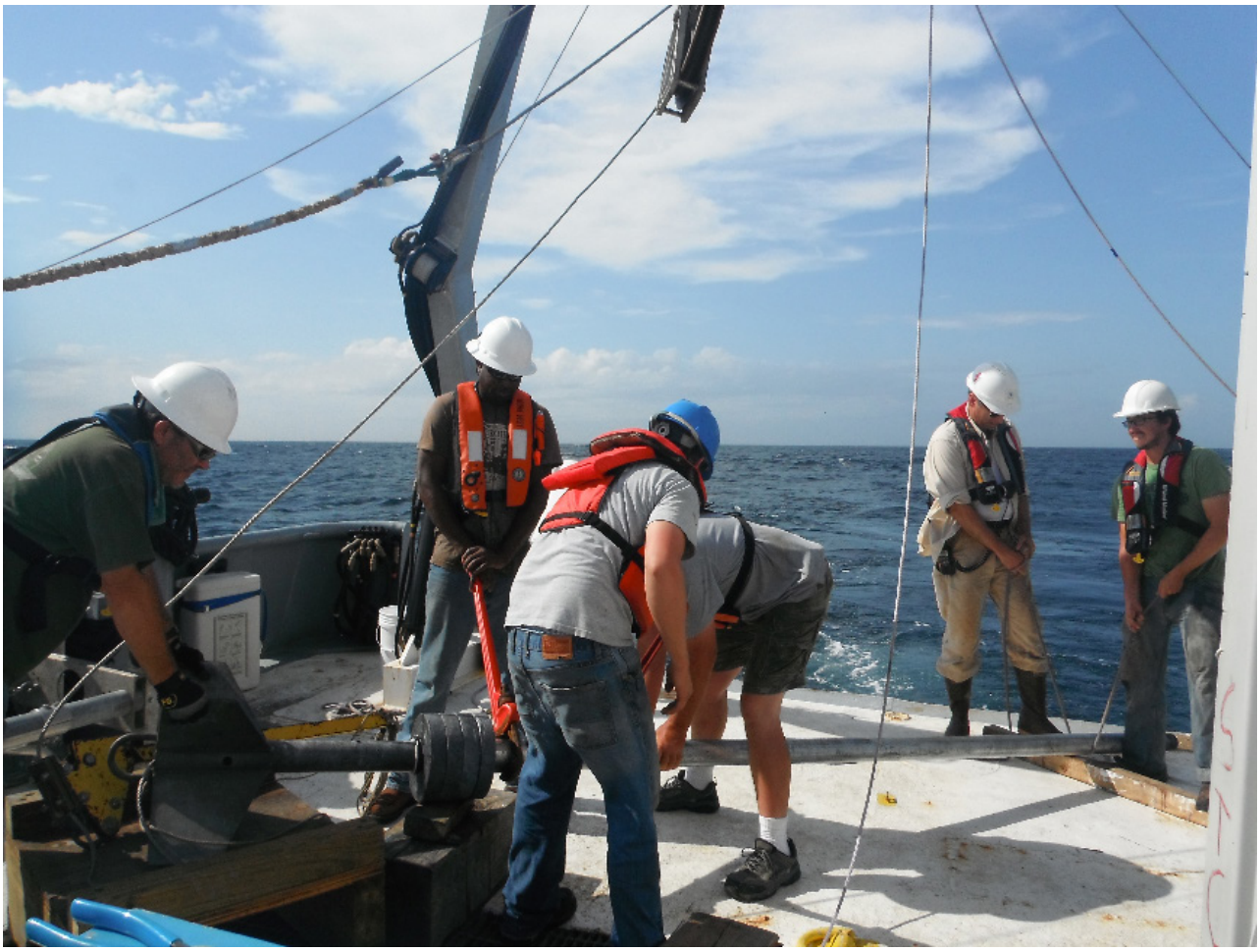


Figure 16. Recovering the Piston Core and Extracting the Core Sample from the Barrel

9 DATA PROCESSING AND ANALYSIS

9.1 Geophysical Data Processing and Analysis

Tetra Tech's survey crew performed data processing in parallel with data collection on the vessel (to the extent possible) so that preliminary data products could be used to check data quality, confirm survey coverage, and be reviewed for selection of sampling locations.

- Preliminary bottom charting data (bathymetry, sidescan sonar mosaic, magnetic anomalies) were made available to the on-board client representative throughout the survey.
- Datasets were transferred from the survey vessel to Tetra Tech's office(s) once data acquisition was completed.
- Final processed data were checked for accuracy and completeness, packaged and uploaded to the geological/geophysical and archaeological interpretation teams for identification of potential hazards and cultural deposits.

- Multi-channel Boomer data were processed onshore by Denver, Colorado–based Excel Geophysical Services, specialists in seismic data processing. Processed results were incorporated into the final charts and this report.

9.1.1 Navigation

Primary surface positioning of the R/V *Sea Lion V* was accomplished using a Trimble SPS651 GNSS augmented with the MarineStar satellite based correction system, as described in Section 6.2. The GNSS position was in turn supplied to a PHINS INS, where it was combined with inertial measurements to calculate the ship's position and attitude up to 200 times per second. Following survey acquisition, raw iXBlue navigation and attitude data were post-processed using iXBlue's Delph INS version 2.3 Service Pack 2 inertial navigation post-processing software.

Positioning for towed systems was provided by the GAPS USBL system. Trackline plots for the tandem-towed geophysical systems (sidescan, magnetometer and shallow-penetration sub-bottom profiler) and towed medium-penetration sub-bottom profiling systems (Boomer, Bubble Pulser) are provided in Attachment C on Plate 1 and on Plate 2, respectively.

9.1.2 Bathymetry

The RESON SeaBat 7125 multibeam sonar was selected for this Project to achieve maximum swath width and resolution given the Project parameters. The support sensors used to measure vessel attitude (roll, pitch, and heave), position, heading, and sound speed through the water column were selected to confirm that the associated accuracies were commensurate with the accuracy and resolution of the sonars.

Prior to field data collection, a standard patch test, also known as an installation calibration test, was carried out to calculate the angular offsets between the pole-mounted SeaBat 7125 and the vessel's motion reference unit (MRU). The installation calibration process is used to derive the roll, pitch, and yaw angular offsets between the multibeam sonar and the local reference frame defined by the MRU's inertial measurement unit. The installation calibration tests are also used to determine latency in the positioning equipment. The sonar, positioning system, and data collection computer are all time-synchronized to GPS Universal Coordinated Time (UTC), which should result in zero position latency. Results of the pole-mounted SeaBat 7125 patch test are displayed in Table 13.

Table 13. Multibeam Echosounder Patch Test Results

SeaBat 7125	Value
Roll	-1.86
Pitch	-0.75
Yaw	-0.28
Latency	0.00

Tetra Tech also performed a bar check to verify the depth reported by the sonar versus the depth of a target placed in the field of view of the sonar at a measured depth below the waterline. The HYPACK/HYSWEEP Bar Check Utility was used to collect and process the data from the sonar, correcting for system offsets and vessel attitude. The results are shown in Table 14.

Table 14. Multibeam Echosounder Bar Check Results

Parameter	Value
Bar Depth (m)	3.00
Sonar Measured Depth (m)	3.14
Difference (m)	0.14

The collected bathymetry data were processed using CARIS HIPS software to generate the XYZ soundings in the survey coordinate system and units. Data cleaning was also performed in CARIS HIPS two-dimensional (2D) and 3D editing software to eliminate outliers induced by noise in the sensor systems or the acoustic environment. A subsequent area-based cleaning, using the merged data from all the survey lines, was then conducted using the CARIS HIPS subset editing tool. Edited sounding data were used to create 1-m gridded uncertainty surfaces. Uncertainty surfaces are calculated by computing the uncertainty budgets for each sounding, based on beam geometry and the accuracies of the position system(s), motion sensor, sonar and sound speed measurement devices. Bathymetry accuracy and precision are a function of the positioning and attitude measurements errors, timing errors, water depth, and water sound speed profile. A statistical comparison of the bathymetry surfaces versus cross-line data showed the final bathymetric dataset is all within the maximum allowable mean bias per International Hydrographic Organization (IHO) Special Order standards. Refer to Table 15 for an average of the statistical analysis and IHO acceptance.

Table 15. Average Surface to Cross Line Comparison Statistical Analysis

Survey Area	Mean (m)	STD DEV (m)	Special Order Accepted
Lease Area	0.041	0.077	99.98%
Survey Corridor	-0.018	-0.053	99.99%

ASCII XYZ files of the gridded BASE surfaces at 1-m resolution were exported out of CARIS and are provided in the deliverable digital data (Attachment A) and are displayed on Plate 3 in Attachment C. Multibeam echosounder snippet (backscatter) data were collected and archived with the Project data at the request of BOEM. Additional types of imagery data were collected during the Project, including the sidescan and sub-bottom sonar imagery from the 2000-DSS and the magnetic anomaly imagery from the SeaQuest Gradiometer. These imagery data were processed using different techniques and software packages, as described in the sections below.

As an additional analysis tool to aid in the characterization of the seabed in the Project Area, the bathymetric data were assessed using the Benthic Terrain Modeler, a set of ESRI ArcGIS® tools developed by Oregon State University and NOAA to analyze seabed characteristics such as slope and rugosity captured in high-resolution bathymetric data. Slope, rugosity and benthic zone maps are included with the charts in Appendix C (Plates 4, 5 and 6, respectively).

9.1.3 Sidescan Sonar

Sidescan sonar imagery data collected using the 2000-DSS towfish were acquired in proprietary EdgeTech format (JSF) using EdgeTech's Discover acquisition software and then imported into Chesapeake SonarWiz 5 for post-processing. Towfish position from the GAPS USBL was written into the raw data file, thus geo-referencing all raw data. The SonarWiz processing package allowed the operator to remove erroneous

navigation points, bottom track the data to remove the water column, and apply gains and conduct other signal processing to prepare the sonar data for final export.

The imagery was then exported from SonarWiz as 1-m resolution geotiff mosaics which are provided with the electronic deliverables in Attachment A and displayed on the charts provided in Attachment C (Plate 7).

Targets identified in the sidescan sonar data, which included suspected anthropogenic objects or potential hazards detected in the sonar record, were digitized from the full resolution data in SonarWiz and exported to shapefile for presentation on the charts included in Attachment C. The naming convention for the sidescan sonar contacts was SC-LA/CR-### (e.g., SC-LA-001), with LA or CR referring to Lease Area or Cable Route (i.e., survey corridor), respectively. Sidescan sonar contacts are tabulated and presented in a report provided in Attachment F.

9.1.4 Magnetometer

Magnetometer data were collected using a Marine Magnetics SeaQuest system which includes four separate Overhauser sensors configured to provide real-time 3D gradient and analytic signal data in addition to time coincident total field data from each sensor.

The data were acquired in two software packages, HYPACK and Marine Magnetics BoB. HYPACK served as the primary with BoB being used for real-time data display, magnetometer interfacing, and as a redundant data collection. Towfish position from the GAPS USBL was recorded directly into the raw data files during acquisition. Data collected from the SeaQuest were processed through Tetra Tech–developed software and Oasis Montaj to generate surfaces showing the magnetic environment and to detect and locate significant magnetic anomalies within the survey area. Table 16 outlines the magnetometer data processing steps.

Table 16. Processing Sequence for Magnetometer Data

Sequence	Task
1	HyPack RAW files read into Tt MagProc software
2	MagProc Output of full raw magnetometer data with attitude, altitude, gradients and true 3-D analytic signal in Geosoft XYZ file format
3	Import Geosoft XYZ file into Oasis Montaj for processing
4	Filter navigation data for fliers
5	De-spike magnetometer readings
6	Diurnally correct/filter total field magnetic readings
7	Grid total field and analytic signal data at 2m grid cell size using minimum curvature algorithm, with interpolation between lines.
8	Generate analytic signal and total field contours at 10nT/gamma interval
9	Run automatic target picker to pick peaks along each magnetometer profile that were greater than 3nT
10	Manually review target picks for duplicates, and add targets as required
11	Export magnetometer target picks

The final data processing included identification, listing, and output of magnetometer anomalies. Total magnetic field data are measurements of the absolute value of the Earth's magnetic field. Total field readings are highly influenced by geologic features and diurnal variations in the earth's magnetic field. The effect of diurnal variations in the Earth's magnetic field can be reduced by diurnally correcting/filtering the total field data. Gradient and analytic signal data are not affected by diurnal variations in the Earth's magnetic field and suppress longer wavelength geologic anomalies; as a result, target detection and positional accuracy of detected anomalies are improved. Magnetic anomalies are presented on the charts that

accompany this report in Attachment C. Plate 9 of Attachment C provides total field data, and Plate 10 provides analytic signal data. The total field magnetometer data provided in Plate 9 were diurnally corrected/filtered and contoured at a 10 nanotesla (nT) interval. The analytic signal data provided in Plate 10 are contoured at a 5 nT interval. Tabulated magnetometer anomalies are presented in Attachment G. Targets were numbered and displayed on Plate 10 in Attachment C.

9.1.5 Shallow-penetration CHIRP Sub-bottom Profiler

Sub-bottom profiler data from the 2000-DSS were processed using SonarWiz software. As with the sidescan sonar files, towfish position from the GAPS USBL was recorded into the raw data files acquired in the EdgeTech Discover acquisition program. The files were recorded in proprietary EdgeTech JSF format and converted to SEG-Y format to meet the deliverable specifications.

Data were imported into a SonarWiz project as described for sidescan sonar data in Section 9.1.3. The sub-bottom profile data were bottom-tracked and time-varying gain and angle varying gain were then applied where appropriate. Because the GAPS USBL navigation was recorded into the JSF files, all of the raw data files were geo-referenced.

The CHIRP sub-bottom data were reviewed to provide a qualitative description of stratigraphy in the shallow subsurface and identify subsurface features that suggested the presence of potential geohazards or anomalous geologic conditions such as subcropping hard bottom or rock, extensive areas of gravel, buried channels, or other conditions that might affect cable installation. The seabed in the VOWTAP area is comprised primarily of sand, gravel, silt, and clay that have been deposited and re-worked during cycles of sea level fluctuation resulting in discontinuous layers that make reflectors difficult to follow.

9.1.6 Single-channel Monitoring Data

Preliminary processing and interpretation of the single-channel medium-penetration sub-bottom profiler data were undertaken on board the survey vessel at the end of each day. Final data processing, completed onshore, included the steps listed in Table 17.

Table 17. Processing Sequence for Selected Single-channel Monitoring Data

Sequence	Task
1	Review all field records (Boomer and Bubble Pulser) printed on separate thermal graphic recorders and select records that could potentially be enhanced with additional processing.
2	Reprocess selected data files from digital tape for potential enhancement through seismic amplifier and band-pass filter and printing results to thermal graphic recorder.
3	Reprocess selected files from digital archives thru Sonar WIZ and displaying on color monitor.

9.1.7 Multi-channel Medium-Penetration Sub-bottom Profiler Data

The multi-channel data were processed by Excel Geophysical Services. Six reflectors (R1 through R6; described in Section 10.2.5 and depicted on Plates 11 through 17 in Attachment C), representing the upper and lower boundaries of interpreted sedimentary units, were generally coherent on the data from each transect. These reflectors are discussed further in Section 10.5. Table 18 shows the processing sequence for the multi-channel data.

Table 18. Processing Sequence for Multi-channel Data

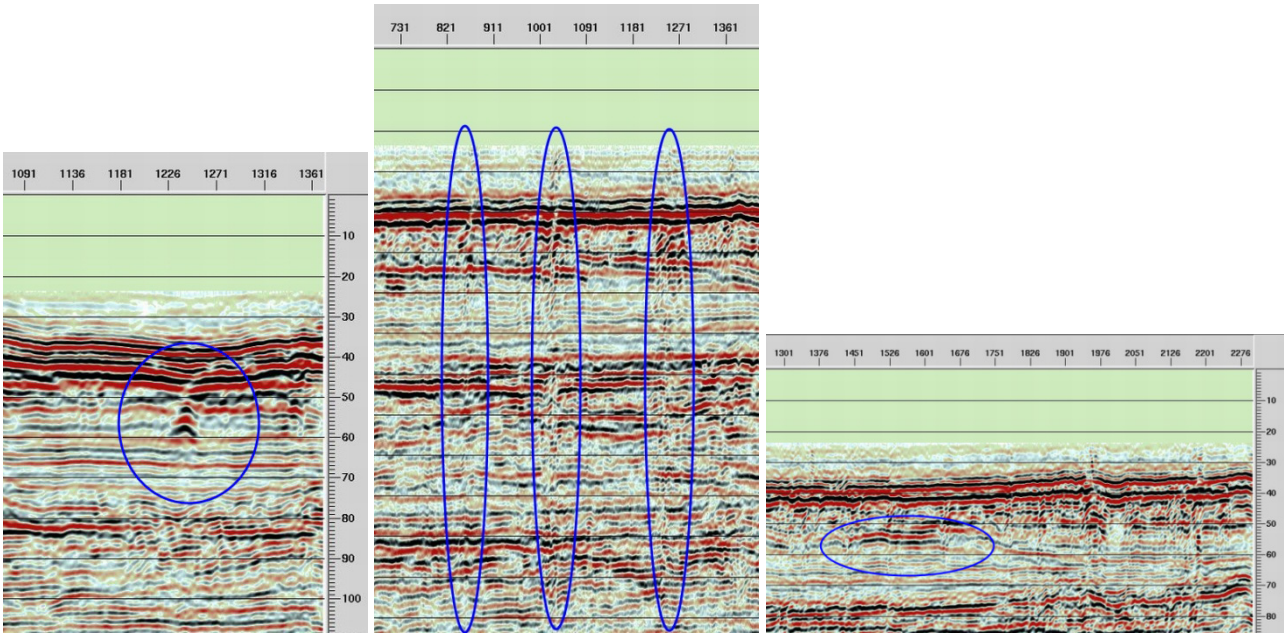
Sequence	Task
1	Format Conversion Source De-Signature Geometry Noise Edit of Trace Data Gain Recovery / Spherical Divergence Frequency & Amplitude Analysis Deconvolution Pre-Stack (Testing) CDP Sort Preliminary CDP Stack Multiple Analysis & Attenuation Interactive Velocity Analysis (as needed) Final Mute (Testing) Final CDP Stack Spectral Analysis Deconvolution Post Stack (Testing) Band pass Filter Noise Attenuation (if needed) Time Variant Scaling Migration (Testing) Final processed data output in SEG-Y format.
2	Produce processed sections for interpretation.
3	Correlate processed multi-channel data with interpreted single channel data.

The single-channel and multi-channel medium-penetration sub-bottom profiler data were analyzed to provide a qualitative classification of stratigraphy, based on seismic characteristics, and to determine the thickness of unconsolidated sediment and/or depth to an interpreted acoustically-hard material or coherent reflectors. In addition, an effort was made to identify subsurface features that suggested the presence of potential geohazards or anomalous geologic conditions such as buried channels, potential faults, and the presence of large boulders or other conditions that might affect construction of the wind towers.

The processed data were analyzed and interpreted by applying, where possible, the method of seismic facies analysis. A seismic facies unit is defined as a sedimentary unit that is different from adjacent units in its seismic characteristics. Parameters or seismic characteristics that were considered included reflection amplitude, dominant frequency, reflection continuity, abundance of reflections, geometry of the unit, reflection polarity, and interval velocity.

In addition to using this classification method to identify sedimentary units and the presence of distinct acoustic boundaries (R1, R2 etc.), reflectors were used to further constrain the upper and lower boundaries of interpreted sedimentary units. However, within each of the interpreted sedimentary units, an anomalous reflection having different acoustic properties than the overall unit may have occurred on occasion. These reflectors might represent the presence of:

- hyperbolic or arcuate reflector characteristic of a discrete object such as a boulder (Line 4P500, 1246, 50-60ms) (Figure 17a);
- water column noise or bubble wipe down at the hydrophone and starting at the top of the displayed trace (Line 9; 911, 1080, 1271) (Figure 17b); or
- coarse-grained material appearing as a discontinuous high amplitude reflector (Line 10, 1378-1601, 105ms) (Figure 17c).



a) b) c)

Figure 17. Examples of Acoustic Artifacts and Isolated Features in the Multi-Channel Reflection Data

However, there were no laterally continuous reflectors that were interpreted to be evidence of gas charged sediment, boulder deposits, or buried channels.

For confirmation of the interpretation of the multi-channel data, depths measured in two-way travel time from the seabed to the interpreted reflectors representing the boundaries between seismic units were compared between the single-channel and multi-channel data at selected points for each of the 21 transects. The comparison between the two-way travel time measurements at selected points ranged from 1 to 3 milliseconds or 0.8 to 2.4 meters at an assumed compressional velocity of 1,600 meters/second.

9.2 On-board Sample Processing

9.2.1 On-board Grab Sample Processing

Grab samples brought aboard the vessel were examined for sample acceptability, and then sub-samples were extracted and stored for laboratory testing of grain size, total organic carbon (TOC), and water content. Grab samples were named with the prefix "GS-" followed by the site number (e.g. GS-001 through GS-060). Refer to Table 19 for a list of all grab samples collected. The sediments remaining following subsampling were processed and preserved for benthic analyses as described in Appendix J - Benthic Survey Report of the VOWTAP RAP.

9.2.2 On-board Core Processing

Cores and core sections were named a prefix "VC-" for vibracores and "PC-" for piston cores, followed by the site number (e.g. VC-001). Multiple attempts were appended with an "A" or "B" as needed. At each turbine location, where two cores were collected rather than just one as for the other sites, the core names

were appended with "1" or "2" at the end of the name to specify the first and second core at that station. Refer to Table 20 for a list of core samples collected. Once recovered and cut into 1-m sections (as described below), each section was labeled from top to bottom as "1 of 5," "2 of 5," and so forth (Figure 18). Photographs of acquired core samples from the survey vessel are provided in Attachment A.

Figure 18. Top of Core Section 3 of 5 for the Second Vibracore Acquired at Station VC-T2B

Core sample details were recorded in a geotechnical log. Core samples were cut into nominally 1-m sections (Figure 19). In cases where the core was not full, a core section may have been cut to a smaller length. When the core catcher contained sediment, the sediment was collected, double-bagged in gallon size plastic bags, and labeled with the core name and with the description "Core Tip." Field descriptions for each section were determined following ASTM D-2487 Unified Soil Classification and a Munsell Color Chart; for fine-grained, cohesive sediment, consistency and compressive strength and undrained shear strength were estimated using a pocket penetrometer and hand-held Torvane device, respectively.

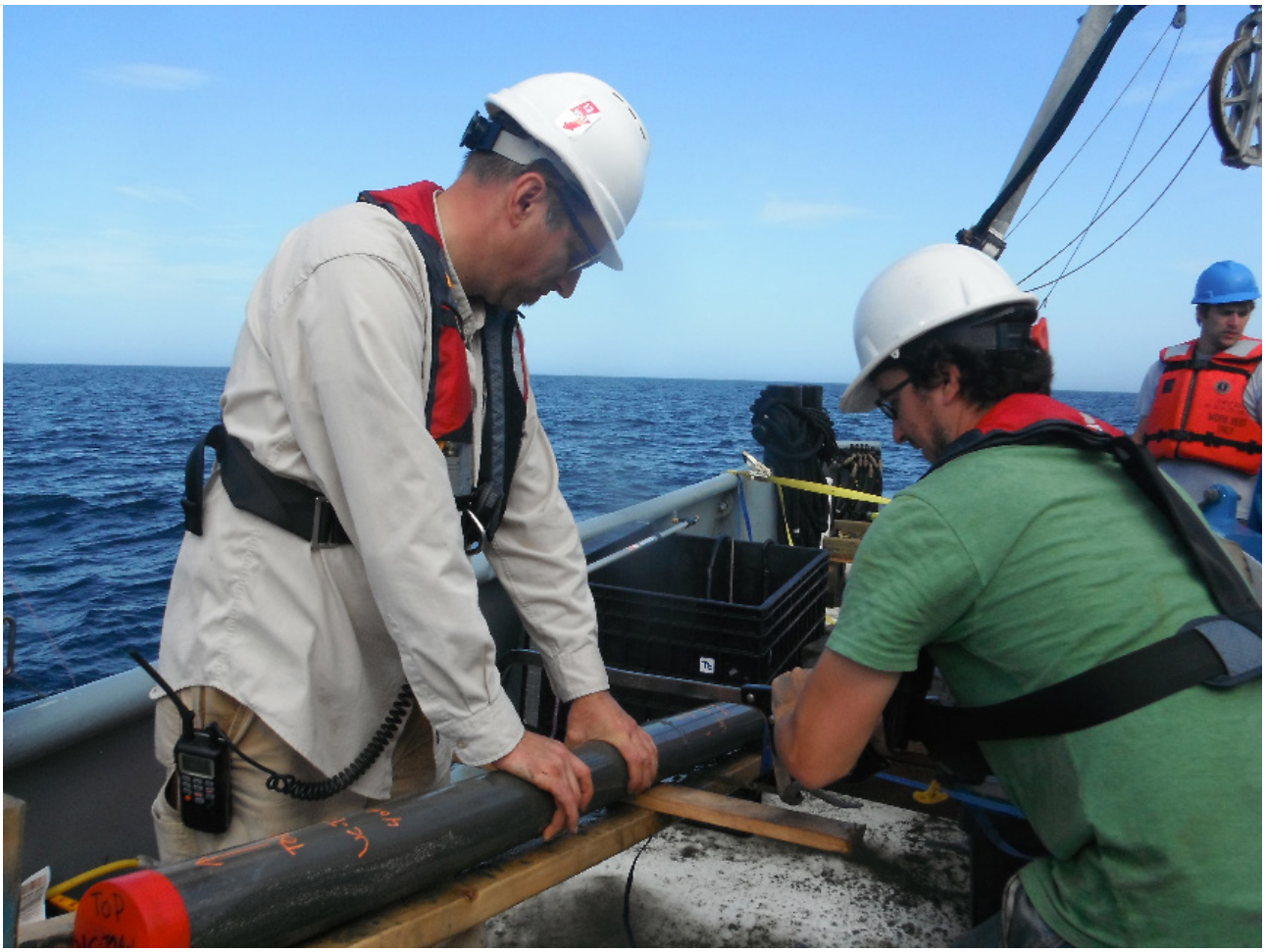


Figure 19. Cutting the Core into 1-m Sections

Core sections were capped, taped, sealed with wax, and stored vertically until they were transported to Tetra Tech's onshore laboratory where the following tests were performed, as described fully in Section 9.3:

- Sample extruding, classification, and photography;
- Water content measurement;
- Grain size analysis of representative samples;
- Atterberg limits (plasticity) of representative clay and silt samples;
- Organic content measurement;
- Carbonate content measurement;
- Specific gravity testing of representative clay and silt samples;
- Consolidation testing on representative clay samples;
- Strength testing on representative samples; and
- Resistivity, pH, conductivity, sulfate, and chloride measurements.

9.3 Shallow Geotechnical Laboratory Testing and Analysis

Tetra Tech's laboratory received 69 grab samples; 35 sections from eight vibracores and six sections from four piston cores collected at the proposed WTG sites; and 54 sections from 19 vibracores collected in the survey corridor. Additionally, the laboratory made four composite soil samples by combining soil samples from selected benthic grab samples or selected portions of vibracore samples. As discussed in Section 8.2.2, piston core recovery was consistently less than from the vibracore system and therefore collection of piston cores was abandoned following collection of six piston cores. Aside from a visual description and particle size analyses, the results from which are provided in Attachment H, no other laboratory testing was conducted on the piston cores samples.

9.3.1 Grab Samples

A summary of grab samples collected and delivered to the lab for testing is provided in Table 19; the visual description and Unified Soil Classification System (USCS) group provided in the table were determined from the laboratory tests. These descriptions were incorporated into the geological interpretation and are provided on the charts in Attachment C.

The 69 grab samples were received sealed in 1-gallon size plastic bags. Each bag was thoroughly mixed, and specimens were selected for water content, organic content, and particle-size distribution. Water contents were determined in accordance with ASTM Standard D2216, "Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass," using Method B and an oven temperature of 107°C. Organic contents were determined in accordance with ASTM Standard D2974, "Moisture, Ash and Organic Matter of Peat and Other Organic Soils," using Method C and a muffle furnace temperature of 440°C. The particle-size distribution was determined in accordance with either ASTM Standard D422, "Particle-Size Analysis of Soils," or ASTM Standard D6913, "Particle-Size Distribution (Gradation) of Soils using Sieve Analysis," with the D6913 test method used for 12 samples that required the composite sieving method because of the mass of gravel-size shell within the samples. Classification and Group Symbol designations for the samples are in accordance with ASTM Standard D2487, "Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)."

Water contents were calculated for the grab samples using both the measured oven-dried mass of each sample and a dry mass corrected for a pore water salt concentration of 34,800 milligrams per liter (mg/L). The conductivity and total dissolved solids concentration measured on a water sample obtained from the grab samples equaled 46,000 micromhos (µmhos)/centimeter (cm) and 34,800 mg/L. The difference in calculated water contents was not significant, ranging from 0.1 to 0.4 percent for sand samples with water contents of 20 to 35 percent to a maximum of 0.7 to 0.8 percent for silty sand and sandy lean clay samples with water contents of 45 to 50 percent. Considering that the differences in calculated water contents were relatively small, specimen dry masses uncorrected for pore water salt concentration were used for calculating test results.[1]

[1] Except for specific gravity and hydrometer test specimens where the dry mass corrected for pore water salt concentration was used.

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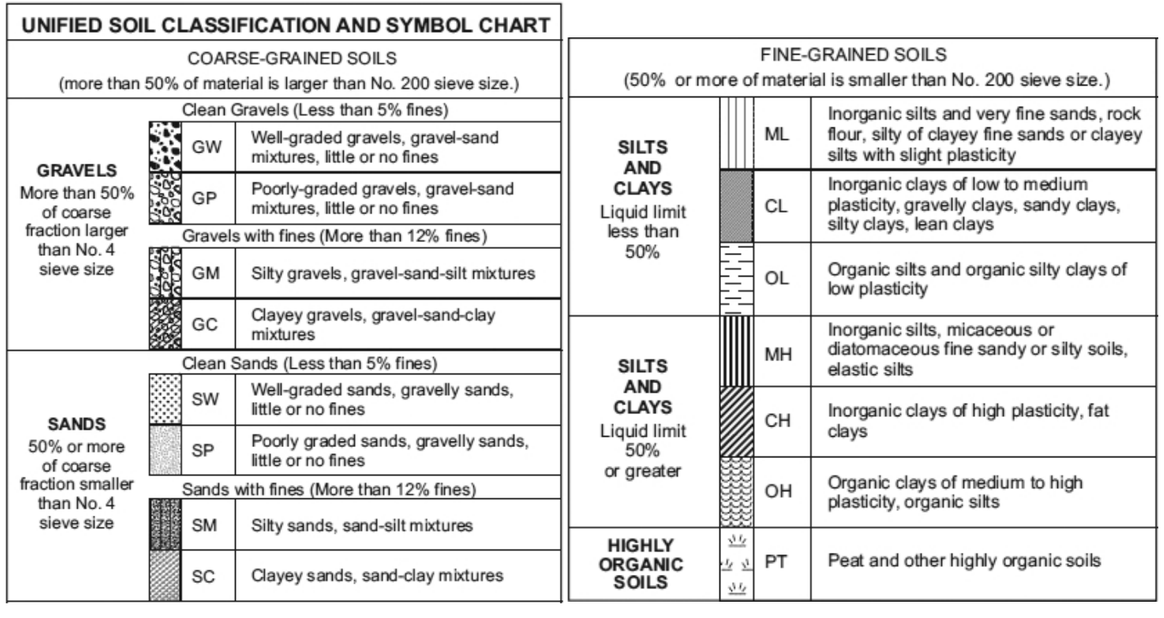
Table 19. Grab Samples Collected

Area	Grab ID	Collection Date	Collection Time (UTC)	Easting (m)	Northing (m)	Projection	Latitude (°N)	Longitude (°W)	Water Depth (m) (MLLW)	Description	USCS Group**
Lease Area	GS-001	6/16/2013	00:45	455996.45	4084517.81	UTM 18N-NAD83	-75.493943	36.905632	21.10	Grayish-brown medium SAND with shell	SP
Lease Area	GS-002	6/16/2013	02:42	456216.56	4083727.93	UTM 18N-NAD83	-75.491427	36.898522	23.78	Grayish-brown fine SAND with shell	SP
Lease Area	GS-003	6/16/2013	01:56	456226.15	4084324.54	UTM 18N-NAD83	-75.491354	36.903901	25.37	Grayish-brown medium SAND with shell	SP
Lease Area	GS-004	6/16/2013	03:25	455865.73	4083407.62	UTM 18N-NAD83	-75.495346	36.895618	24.70	Gray fine SAND with silt and shell	SP-SM
Lease Area	GS-005	6/16/2013	04:03	455796.71	4082871.61	UTM 18N-NAD83	-75.496089	36.890783	26.15	Brown medium SAND with shell	SP
Lease Area	GS-006	6/16/2013	04:45	455927.75	4082562.98	UTM 18N-NAD83	-75.494601	36.888007	24.15	Brown medium SAND with shell	SP
Lease Area	GS-007	6/16/2013	05:28	456561.17	4082004.12	UTM 18N-NAD83	-75.487460	36.882999	26.33	Gray fine SAND with silt and shell	SP-SM
Lease Area	GS-008	6/16/2013	05:50	455896.43	4082105.49	UTM 18N-NAD83	-75.494926	36.883882	24.59	Brown medium SAND with shell	SP
Lease Area	GS-009	6/16/2013	06:33	456106.9	4081500.48	UTM 18N-NAD83	-75.492529	36.878438	26.01	Brown fine SAND with shell	SP
Lease Area	GS-010	6/16/2013	23:58	457436.4	4083427.28	UTM 18N-NAD83	-75.477719	36.895868	24.97	Dark gray fine SAND with trace shell	SP
Lease Area	GS-011	6/16/2013	23:08	457013.14	4082884.67	UTM 18N-NAD83	-75.482439	36.890957	25.90	Dark gray fine SAND with silt and shell	SP-SM
Lease Area	GS-012	6/17/2013	00:51	456972.97	4083427.54	UTM 18N-NAD83	-75.482920	36.895849	24.33	Gray fine SAND with shell	SP
Lease Area	GS-013	6/16/2013	20:55	457270.77	4081371.07	UTM 18N-NAD83	-75.479462	36.877325	25.38	Brown medium SAND with shell	SP
Lease Area	GS-014	6/16/2013	21:25	457298.47	4081882.4	UTM 18N-NAD83	-75.479180	36.881936	28.11	Gray sandy CLAY with shell	CL
Lease Area	GS-015	6/16/2013	20:33	457667.65	4082304.91	UTM 18N-NAD83	-75.475061	36.885761	26.84	Gray fine SAND with silt and shell	SP-SM
Survey Corridor	GS-016	6/19/2013	18:48	414712.35	4074924.71	UTM 18N-NAD83	-75.956238	36.816336	7.85	Gray silty fine SAND with shell	SM
Survey Corridor	GS-017	6/19/2013	19:13	415747.4	4074995.16	UTM 18N-NAD83	-75.944643	36.817063	8.13	Gray silty fine SAND with shell	SM
Survey Corridor	GS-018	6/19/2013	20:15	416645.36	4075063.83	UTM 18N-NAD83	-75.934583	36.817762	8.41	Gray silty fine SAND with shell	SM
Survey Corridor	GS-019	6/19/2013	22:16	417719.71	4075154.5	UTM 18N-NAD83	-75.922549	36.818673	9.12	Gray silty fine SAND with shell	SM
Survey Corridor	GS-020	6/19/2013	22:37	419236.55	4075206.66	UTM 18N-NAD83	-75.905549	36.819274	11.27	Dark gray silty fine SAND with trace shell	SM
Survey Corridor	GS-021	6/19/2013	23:00	419670.05	4075222.85	UTM 18N-NAD83	-75.900691	36.819457	11.01	Light brown fine SAND with trace shell	SP
Survey Corridor	GS-022	6/19/2013	23:25	420492.71	4075221.86	UTM 18N-NAD83	-75.891468	36.819517	10.98	Brown medium SAND with shell	SP
Survey Corridor	GS-023	6/19/2013	23:50	421679.97	4075201.8	UTM 18N-NAD83	-75.878155	36.819436	14.01	Dark gray silty fine SAND with trace shell	SM
Survey Corridor	GS-024	6/20/2013	00:16	422597.92	4075150.98	UTM 18N-NAD83	-75.867859	36.819053	14.79	Brown fine SAND with trace shell	SP
Survey Corridor	GS-025	6/20/2013	00:47	423181.24	4075021.92	UTM 18N-NAD83	-75.861306	36.817937	15.77	Dark gray silty fine SAND with trace shell	SM
Survey Corridor	GS-026	6/20/2013	01:12	424334.87	4074734.38	UTM 18N-NAD83	-75.848344	36.815439	16.03	Brown fine SAND with trace shell	SP
Survey Corridor	GS-027	6/19/2013	17:05	425191.4	4074584.24	UTM 18N-NAD83	-75.838727	36.814153	15.65	Gray silty fine SAND with shell	SM
Survey Corridor	GS-028	6/19/2013	16:30	425738.57	4074443.67	UTM 18N-NAD83	-75.832579	36.812929	15.85	Gray silty fine SAND with shell	SM
Survey Corridor	GS-029	6/19/2013	16:08	426293.33	4074308.49	UTM 18N-NAD83	-75.826347	36.811754	16.17	Gray silty fine SAND with shell	SM
Survey Corridor	GS-030	6/19/2013	15:49	427532.39	4074028.43	UTM 18N-NAD83	-75.812430	36.809326	16.12	Gray silty fine SAND with shell	SM
Survey Corridor	GS-031	6/19/2013	15:25	428389.35	4073981.85	UTM 18N-NAD83	-75.802819	36.808971	16.60	Gray silty fine SAND with shell	SM
Survey Corridor	GS-032	6/19/2013	15:02	429097.58	4073914.54	UTM 18N-NAD83	-75.794874	36.808418	18.41	Dark gray medium SAND with silt and shell	SP-SM
Survey Corridor	GS-033	6/19/2013	14:12	430379.06	4073865.44	UTM 18N-NAD83	-75.780504	36.808070	19.32	Gray fine SAND with trace shell	SP
Survey Corridor	GS-034	6/19/2013	14:40	431348.83	4073818.12	UTM 18N-NAD83	-75.769629	36.807715	18.53	Gray fine SAND with shell	SP
Survey Corridor	GS-035	6/19/2013	12:55	432141.63	4073739.55	UTM 18N-NAD83	-75.760735	36.807063	18.89	Gray medium SAND with gravel and shell	SP
Survey Corridor	GS-036	6/19/2013	12:05	433006.71	4073728.86	UTM 18N-NAD83	-75.751036	36.807029	19.88	Gray fine SAND with silt and shell	SP-SM
Survey Corridor	GS-037	6/19/2013	11:28	433839.7	4073863.4	UTM 18N-NAD83	-75.741710	36.808300	21.03	Gray fine SAND with silt and shell	SP-SM
Survey Corridor	GS-038	6/18/2013	07:10	434609.32	4074026.55	UTM 18N-NAD83	-75.733097	36.809824	19.66	Light brown fine SAND with trace shell	SP
Survey Corridor	GS-039	6/18/2013	06:45	435375.32	4074176.44	UTM 18N-NAD83	-75.724523	36.811228	20.37	Brown fine SAND with trace shell	SP
Survey Corridor	GS-040	6/18/2013	05:48	436429.71	4074406.95	UTM 18N-NAD83	-75.712722	36.813377	18.1	Light brown fine SAND with shell	SP
Survey Corridor	GS-041	6/18/2013	05:16	437469.8	4074615.62	UTM 18N-NAD83	-75.701079	36.815327	17.18	Light brown medium SAND with shell	SP
Survey Corridor	GS-042	6/18/2013	04:50	438404.11	4074817.74	UTM 18N-NAD83	-75.690620	36.817211	17.82	Light brown fine SAND with shell	SP
Survey Corridor	GS-043	6/18/2013	04:21	439378.27	4075027.9	UTM 18N-NAD83	-75.679715	36.819168	20.03	Dark gray fine SAND with shell	SP
Survey Corridor	GS-044	6/18/2013	03:56	440425.07	4075238.68	UTM 18N-NAD83	-75.667996	36.821135	18.52	Brown fine SAND with shell	SP
Survey Corridor	GS-045	6/18/2013	03:28	441310.19	4075549.57	UTM 18N-NAD83	-75.658096	36.823992	19.17	Brown fine SAND with shell	SP
Survey Corridor	GS-046	6/18/2013	02:43	442325.74	4075645.7	UTM 18N-NAD83	-75.646716	36.824921	17.93	Brown fine SAND with shell	SP
Survey Corridor	GS-047	6/18/2013	02:07	443262.48	4075856.97	UTM 18N-NAD83	-75.636228	36.826882	23.68	Dark gray fine SAND with silt and trace shell	SP-SM
Survey Corridor	GS-048	6/18/2013	01:40	443999.13	4076011.53	UTM 18N-NAD83	-75.627980	36.828319	19.39	Dark gray and light brown fine SAND with trace shell	SP
Survey Corridor	GS-049	6/18/2013	00:43	445185.3	4076427.87	UTM 18N-NAD83	-75.614709	36.832142	19.9	Light brown fine SAND with shell	SP
Survey Corridor	GS-050	6/17/2013	23:52	446079.7	4076967.92	UTM 18N-NAD83	-75.604718	36.837061	18.03	Brown fine SAND with trace shell	SP
Survey Corridor	GS-051	6/17/2013	23:30	446952.89	4077480.21	UTM 18N-NAD83	-75.594961	36.841729	18.14	Brown fine SAND with trace shell	SP

Table 19. Grab Samples Collected (continued)

Area	Grab ID*	Collection Date	Collection Time (UTC)	Easting (m)	Northing (m)	Projection	Latitude (°N)	Longitude (°W)	Water Depth (m) (MLLW)	Description	USCS Group**
Survey Corridor	GS-052	6/17/2013	22:58	447804.34	4077980.21	UTM 18N-NAD83	-75.585447	36.846283	18.59	Brown fine SAND with shell	SP
Survey Corridor	GS-053	6/17/2013	22:28	448658.79	4078486.6	UTM 18N-NAD83	-75.575897	36.850895	19.55	Brown fine SAND with shell	SP
Survey Corridor	GS-054	6/17/2013	05:12	449526.51	4078980.26	UTM 18N-NAD83	-75.566197	36.855391	18.38	Light brown fine SAND with shell	SP
Survey Corridor	GS-055	6/17/2013	05:42	450387.41	4079494.53	UTM 18N-NAD83	-75.556574	36.860073	18.68	Brown fine SAND with trace shell	SP
Survey Corridor	GS-056	6/17/2013	21:30	451211.34	4080046.62	UTM 18N-NAD83	-75.547367	36.865092	22.36	Dark gray fine SAND with shell	SP
Survey Corridor	GS-057	6/17/2013	04:35	452112.17	4080539.75	UTM 18N-NAD83	-75.537292	36.869584	24.29	Gray fine SAND with trace shell	SP
Survey Corridor	GS-058	6/17/2013	06:11	453314.54	4081277.11	UTM 18N-NAD83	-75.523847	36.876291	23.54	Brown fine SAND with shell	SP
Survey Corridor	GS-059	6/17/2013	20:27	454649.17	4082060.28	UTM 18N-NAD83	-75.508919	36.883415	24.74	Dark gray fine SAND with silt and shell	SP-SM
Survey Corridor	GS-060	6/17/2013	03:48	455522.87	4082587	UTM 18N-NAD83	-75.499146	36.888205	24.59	Brown medium SAND with shell	SP
Reference	GS-REF-001	6/19/2013	19:40	415683.81	4075737.7	UTM 18N-NAD83	-75.945438	36.823751	7.41	Gray silty fine SAND with shell	SM
Reference	GS-REF-002	6/20/2013	01:42	422667.84	4074384.92	UTM 18N-NAD83	-75.866997	36.812154	13.82	Dark gray silty fine SAND with trace shell	SM
Reference	GS-REF-003	6/19/2013	13:28	430533.93	4074589.33	UTM 18N-NAD83	-75.778834	36.814607	18.39	Gray silty fine SAND with shell	SM
Reference	GS-REF-004	6/18/2013	06:20	436446.87	4073661.62	UTM 18N-NAD83	-75.712467	36.806660	14.12	Dark gray medium SAND with trace shell	SP
Reference	GS-REF-005	6/18/2013	01:10	444282.72	4076825.54	UTM 18N-NAD83	-75.624860	36.835674	17.17	Light brown fine SAND	SP
Reference	GS-REF-006	6/17/2013	21:55	451212.3	4079257.4	UTM 18N-NAD83	-75.547305	36.857978	17.17	Brown fine SAND with shell	SP
Reference	GS-REF-007	6/17/2013	01:25	457168.97	4084515.92	UTM 18N-NAD83	-75.480782	36.905669	20.52	Dark gray fine SAND with shell	SP
Reference	GS-REF-008	6/17/2013	02:00	455249.71	4083409.47	UTM 18N-NAD83	-75.502260	36.895606	19.61	Gray fine SAND with shell	SP
Reference	GS-REF-009	6/17/2013	02:40	458398.85	4081896.62	UTM 18N-NAD83	-75.466833	36.882113	23.57	Gray fine SAND with silt and shell	SP-SM

Notes:
* GS refers to Grab Sample
** Unified Soil Classification System (refer to table below)



The results of water content, organic content and particle-size distribution tests are presented on Table A-1, Summary of Geotechnical Test Results on Grab Samples in Attachment D, and Particle-Size Analysis Test Reports, in Attachment H, Section H-1.

- Group Symbol SP: Forty-three of the grab samples classified as Group Symbol SP, typically consisting of gray, grayish-brown or brown sand with shell.
- Group Symbol SP-SM: Ten samples classified as Group Symbol SP-SM, typically consisting of dark gray to gray sand with silt and shell.
- Group Symbol SM: Fifteen samples classified as Group Symbol SM, typically consisting of dark gray to gray silty sand with shell.
- Group Symbol CL: One sample classified as gray sandy lean clay with a liquid limit of 34, plasticity index of 17 and carbonate content of 8.1 percent.

A summary of test results on the grab samples by Group Symbol is presented in Table 20.

Table 20. Summary of Test Results on Grab Samples

Group Symbol	Number of Samples	Average Value							
		Organic Content, OC (%)	Water Content, w_c (%)	Size Fraction by Dry Mass (%)					Dry Density (lb/ft^3)
				Gravel	Coarse Sand	Medium Sand	Fine Sand	Silt and Clay	
SP	43	0.3	24.2	2.4	2.8	29.0	64.2	1.7	95.7
SP-SM	10	0.7	30.3	5.6	5.6	13.5	69.1	6.3	93.6
SM	15	0.7	36.4	0.1	0.2	0.5	83.7	15.5	85.9
CL	1	2.3	46.0	0.7	0.6	6.8	27.0	64.9	80.0

Samples were recovered in the field from each grab sample to determine total unit weight and dry density by pushing small aluminum containers (water content tares) into the soil mass within the sampler, and then inverting and extracting the soil-filled container. The containers were sealed with tight-fitting aluminum lids taped in-place. Three containers were obtained from 60 of the grab samples (GS-001 through GS-060). The lids were removed and the water content and dry mass within each soil-filled container was determined in accordance with ASTM Standard D2216, Method B and an oven temperature of 107°C. Eight tares were randomly selected from the 180 tares for determination of volume to calculate dry density, with the volume determined by measuring the mass of water required to fill each container and then calculating the corresponding volume using a temperature corrected specific gravity of water. The average container volume from the eight measurements equaled 137.67 cm^3 with a standard deviation of 0.28 cm^3.

The results of the water content and dry density determinations are presented on Table A-1 in Attachment H-1. The corresponding saturations of the specimens calculated using an assumed mineral specific gravity of 2.66 (quartz) are also shown in Table A-1 in Attachment H-1. Many of the calculated saturations are relatively low, indicating that the sampling method either entrained air and/or allowed drainage to occur during the container insertion and removal process. The average dry densities measured on the container samples are presented in Table 20.

9.3.2 Vibracore and Piston Core Samples

A total of 31 cores (4 piston cores and 27 vibracores) were collected, processed, and transferred to Tetra Tech's laboratory for testing. Table 21 provides details on the core samples, including the number of

sections (also referred to as tube samples) per core; USCS group classifications were added following lab testing. Core logs produced following laboratory testing for the vibracore samples are provided in Attachment E; these results were incorporated into the geological interpretation and are provided on the charts in Attachment C. Photographs of extruded vibracore samples taken in the lab are provided in Attachment H.

Five of the eight WTG core holes (VC-T1A-1A, VC-T1A-2A, VC-T2A-1, VC-T2B-1, and VC-T2B-2) contained some clay; of those, VC-T2B-1 was mostly clay. Seven of the eight cores contained mostly sandy soils. Four of the cores (VC-007, VC-013, VC-016 and VC-017) from the 19 survey corridor core holes contained some clay, one of which (VC-017) was mostly clay. Eighteen of the cores contained mostly sandy soils (i.e., all cores except VC-017).

9.3.2.1 Core Sample Extrusion

Eighty-nine 10.2-cm (4-inch) diameter, clear plastic vibracore tube samples (9.1-cm [3.6-inch] inside diameter) and five 7.6-cm (3-inch) diameter piston core samples (6.7-cm [2.6-inch] inside diameter) were received for testing. The field cut plastic tubes varied in length from 28 cm to 110 cm (11 to 43 inches). The ends of the tubes were sealed with plastic end caps and secured until they were extruded during July 1 through 3, 2013, with a representative from Kellogg Brown & Root (KBR) present to examine the samples and select portions for testing. The remaining four vibracore samples from core hole VC-T1B-2 and the survey corridor vibracore samples were sealed with tape and a coat of wax. Thirty-one vibracore samples from the WTG core holes were extruded between July 5 and 11, 2013 without a KBR representative present. The piston core samples from proposed turbine sites T1B, T2A and T2B (core holes T1B-1, T2A-1, T2A-2, and T2B-1), which were not initially scheduled for testing were opened between July 24 and August 20 without a KBR representative present; only particle size analyses were performed on the piston core samples, the results from which are provided in Attachment H.

The recovered length and total mass of soil within each tube were determined after removing the end caps. The tube samples were extruded horizontally, photographed, the soils visually classified, and the lengths of different soil types within the tube measured. Water content test specimens were trimmed from selected locations along the sample, specimens were selected for the requested tests, and the average total unit weight and dry density of the sample calculated from the measured total mass, soil volume and water contents. Undrained shear strengths were measured on clay portions of the samples using a hand-held Torvane device. Some samples contained voids in the soil along the tube wall that prevented determination of an accurate soil volume, and hence, calculation of the total unit weight and dry density of the recovered sample.

Descriptions and lengths of soils recovered within the tube samples are presented in the Extrusion Test Reports on Table B-1 through Table B-4 in Attachment H-2 for the T1 and T1A WTG site core holes, Table C-1 through Table C-4 in Attachment H-3 for the T2 and T2A WTG site core holes, and Table D-1 through D-19 in Attachment H-4 for the survey corridor core holes. Photographs of the extruded samples are also included with the Extrusion Test Reports.

Table 21. Core Samples Collected

Area	Core ID*	Collection Date	Collection Time (UTC)	Number of Attempts	Core Barrel Length (m)	Recovered Core Length (m)	Number of Core Sections	Easting (m)	Northing (m)	Projection	Latitude (°N)	Longitude (°W)	Water Depth (m) (MLLW)	Sample UCSC Group**									
														Section 1		Section 2		Section 3		Section 4		Section 5	
Survey Corridor	VC-001	6/27/2013	20:17	1	3	1.07	3	416226.99	4075017.62	UTM 18N-NAD83	36.817308	-75.939269	8.10	SM		SM							
Survey Corridor	VC-001A	6/27/2013	20:50	2	3	2.41	3	416218.98	4075014.26	UTM 18N-NAD83	36.817277	-75.939359	8.11	SM		SM		SM					
Survey Corridor	VC-002B	6/22/2013	16:47	3	3	1.7	2	420159.61	4075204.53	UTM 18N-NAD83	36.819333	-75.895201	9.67	SP	SP-SM	ML	SP						
Survey Corridor	VC-003	6/22/2013	17:52	1	3	2.13	2	421141.95	4075165.15	UTM 18N-NAD83	36.819060	-75.884184	12.62	SP	SP-SM	SM							
Survey Corridor	VC-004	6/27/2013	21:35	1	3	2.55	3	421866.56	4075182.98	UTM 18N-NAD83	36.819281	-75.876062	14.12	SP-SM		SM		SM					
Survey Corridor	VC-005	6/27/2013	17:21	1	3	2.61	3	422901.62	4075083.5	UTM 18N-NAD83	36.818469	-75.864447	15.12	SP		SM		SP	SW				
Survey Corridor	VC-006	6/27/2013	18:43	1	3	2.43	3	424022.07	4074823.55	UTM 18N-NAD83	36.816217	-75.851860	15.83	SM		SP-SM	SP	SP					
Survey Corridor	VC-007	6/27/2013	17:51	1	3	2.28	3	426992.85	4074142.23	UTM 18N-NAD83	36.810309	-75.818490	15.91	SP-SM		SM		SM	CL				
Survey Corridor	VC-008	6/27/2013	16:41	1	3	2.66	2	429943.63	4073888.01	UTM 18N-NAD83	36.808241	-75.785388	18.86	SM		SM	SP	SP					
Survey Corridor	VC-009	6/27/2013	15:36	1	3	1.86	2	433325.16	4073723.32	UTM 18N-NAD83	36.807001	-75.747467	19.62	SW-SM	SM	SM							
Survey Corridor	VC-010	6/27/2013	14:50	1	3	2.9	3	435900.88	4074284.45	UTM 18N-NAD83	36.812237	-75.718640	17.87	SP		SP		SP	SM				
Survey Corridor	VC-011	6/27/2013	11:57	1	3	2.83	3	438826.46	4074926.13	UTM 18N-NAD83	36.818215	-75.685894	19.34	SP		SP	SM	SP-SM	SP				
Survey Corridor	VC-012	6/27/2013	11:12	1	3	2.2	2	441860.01	4075570.48	UTM 18N-NAD83	36.824214	-75.651933	17.37	SP		SP							
Survey Corridor	VC-013	6/26/2013	23:29	1	3	2.45	3	444774.36	4076206.82	UTM 18N-NAD83	36.830125	-75.619302	17.80	SP	SM	CH	SP	SP					
Survey Corridor	VC-014	6/26/2013	22:12	1	3	2.64	3	447329.52	4077704.3	UTM 18N-NAD83	36.843769	-75.590753	18.31	SP		SP		SP					
Survey Corridor	VC-015	6/24/2013	12:13	1	5	1.64	2	449917.31	4079241.85	UTM 18N-NAD83	36.857770	-75.561831	17.92	SP		SP							
Survey Corridor	VC-015A	6/24/2013	13:01	2	5	1.64	2	449918.22	4079247.29	UTM 18N-NAD83	36.857819	-75.561822	17.95	SP		SP							
Survey Corridor	VC-016	6/24/2013	10:39	1	5	4.71	5	452537.26	4080795.79	UTM 18N-NAD83	36.871913	-75.532539	24.56	SC	SP	SC	SP	SP		CL		CL	
Survey Corridor	VC-017	6/24/2013	08:15	1	5	3.74	4	455040.84	4082296.8	UTM 18N-NAD83	36.885566	-75.504539	25.58	SP	CH	CH		CH	SC	SP	CL		
Lease Area	VC-T1A-1A	6/22/2013	22:41	2	3	2.27	3	456169.04	4083480.65	UTM 18N-NAD83	36.896290	-75.491947	24.50	SP		SP		SP	CH				
Lease Area	VC-T1A-2A	6/23/2013	02:51	2	5	4.69	5	456201.68	4083492.23	UTM 18N-NAD83	36.896396	-75.491581	24.35	SP		SP	CH	CH		CH	SC	SP	
Lease Area	VC-T1B-1	6/23/2013	05:11	1	5	4.81	5	456523.61	4083474.87	UTM 18N-NAD83	36.896255	-75.487967	23.99	SP-SM		SP		SP-SM		SP-SM		SP	
Lease Area	VC-T1B-2	6/23/2013	07:15	1	5	3.97	4	456487.09	4083498.41	UTM 18N-NAD83	36.896465	-75.488378	23.93	SP		SP		SP-SM		SP			
Lease Area	VC-T2A-1	6/23/2013	12:10	1	5	5.11	5	456192.92	4082423.94	UTM 18N-NAD83	36.886766	-75.491618	24.92	SP		SP-SM		SP-SM		SM	CL	CL-ML	
Lease Area	VC-T2A-2	6/23/2013	16:06	1	5	3.07	3	456196.99	4082430.29	UTM 18N-NAD83	36.886823	-75.491572	24.93	SP		SP		SP					

Table 21. Core Samples Collected (continued)

Area	Core ID*	Collection Date	Collection Time (UTC)	Number of Attempts	Core Barrel Length (m)	Recovered Core Length (m)	Number of Core Sections	Easting (m)	Northing (m)	Projection	Latitude (°N)	Longitude (°W)	Water Depth (m) (MLLW)	Sample UCSC Group**									
														Section 1		Section 2		Section 3		Section 4		Section 5	
Lease Area	VC-T2B-1	6/23/2013	09:21	1	5	4.75	5	456495.74	4082495.97	UTM 18N-NAD83	36.887429	-75.488223	25.89	SP-SM	GP	SP	CL	CL		CL		SM	
Lease Area	VC-T2B-2	6/23/2013	10:37	1	5	4.67	5	456496.73	4082498.11	UTM 18N-NAD83	36.887449	-75.488212	25.88	SP		SP-SM	GP	GC	CL	CL	SP	SP	CL
Lease Area	PC-T1B-1	6/24/2013	00:05	1	3	0.75	1	456494.12	4083482.65	UTM 18N-NAD83	36.896323	-75.488298	23.94	SP									
Lease Area	PC-T2A-1	6/23/2013	19:12	1	3	0.94	1	456209.71	4082431.64	UTM 18N-NAD83	36.886836	-75.491430	24.98	SP									
Lease Area	PC-T2A-2	6/23/2013	20:21	1	5	1.27	1	456188.31	4082427.98	UTM 18N-NAD83	36.886802	-75.491669	24.90	SP		SP							
Lease Area	PC-T2B-1	6/23/2013	21:41	1	3	0.94	1	456467.34	4082427.49	UTM 18N-NAD83	36.886811	-75.488538	25.98	SP									

Notes:
* VC refers to vibracore sample / PC refers to piston core sample
** Unified Soil Classification System (refer to table below)

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)			
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
		SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures

FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)			
SILTS AND CLAYS Liquid limit less than 50%		ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

9.3.2.2 *Index Tests*

Water content, organic content, and particle-size distribution tests were performed using the same methods as described for grab samples in Section 9.3.1. Specific gravity tests were performed on vibracore samples in accordance with ASTM Standard D854, "Specific Gravity of Soil Solids by Water Pycnometer," with the dry mass of soil and calculated volume of the pycnometer corrected for the pore water salt concentration. Atterberg limits were determined in accordance with ASTM Standard D4318, "Liquid Limit, Plastic Limit and Plasticity Index of Soils," using Method A (multi-point) and the wet preparation method. Carbonate content tests were performed in accordance with ASTM Standard D4373, "Rapid Determination of Carbonate Content of Soils." The soil fraction finer than the U.S. Standard No. 200 sieve was determined on consolidation and strength test specimens at the end of testing in accordance with ASTM Standard D1140, "Amount of Material in Soils Finer than No. 200 (75µm) Sieve." The test results are presented on Table B-1 through Table B-4, Table C-1 through Table C-4, and Table D-1 through Table D-19 in Attachments H-2, H-3, and H-4, respectively. Particle-size distributions are shown on the Particle-Size Analysis Test Reports in Attachments H-2, H-3, and H-4.

An inventory of index tests performed on the vibracore samples is presented in Table 22.

Table 22. Inventory of Index Tests Performed on Core Samples

Samples	Number of Tests						
	Atterberg Limits	Specific Gravity	Organic Content	Carbonate Content	Hydrometer Analysis	Sieve Analysis	Fines Content
WTG Site Cores	10	14	19	17	4	38	25
Survey Corridor Cores	8	20	28	21	4	58	0

9.3.2.3 *Consolidation Tests*

One-dimensional incremental loading consolidation tests were performed on five clay specimens selected by the KBR representative in accordance with ASTM Standard D2435, "One-Dimensional Consolidation Properties of Soils Using Incremental Loading," Method B with 24-hour increments. Each test was performed with an unload-reload cycle, with the unload-reload cycle started at a stress corresponding to about twice the apparent maximum past consolidation stress. Time-deformation behavior for each load and unload increment was interpreted using the log-time method when satisfactory log-time curves were obtained, with the square-root of time interpretation method used only when consistent, satisfactory log-time curves were not obtained. The selected samples, index properties, and initial consolidation test specimen conditions are shown in Table 23.

Table 23. Consolidation Test Specimens

Core Hole	Sample	Group Symbol	Index Properties					Initial Specimen Conditions		
			LL	PI	OC (%)	-75µm (%)	-2µm (%)	wc (%)	γd (lb/ft3)	e
VC-T1A-2A	3 / 5	CH	60	35	2.8	93.4	33.3	65.2	61.3	1.78
VC-T2B-1	4 / 5	CL	48	26	3.3	99.5	---	46.5	75.8	1.30
VC-T2B-1	2 / 5	CL	35	17	2.7	96.7	27.8	39.1	82.9	1.08
VC-T2B-2	3 / 5	CL	32	14	2.5	93.8	22.8	31.3	92.4	0.86
VC-T2A-1	4 / 5	CL	27	10	2.0	93.1	19.0	29.7	94.5	0.82

Where: LL= Liquid limit; PI= Plasticity index; OC= Organic content; -75µm= Soil fraction by dry mass finer than the U.S. Standard No. 200 sieve; -2µm= Soil fraction by dry mass finer than 2µm (clay-size fraction); w_c= Water content; γ_d= Dry density; and e= Void ratio. Group Symbols are per the Unified Soil Classification System.

The test results are included in Attachments H-2 and H-3 (of this report) in the One-Dimensional Incremental Loading Consolidation Test Reports. The test reports present plots of void ratio versus log effective vertical consolidation stress and coefficient of consolidation versus log of effective vertical consolidation stress, and tabulated values of void ratio, coefficient of consolidation, secondary compression index, and coefficient of permeability (hydraulic conductivity). The coefficient of permeability, k_v, was back-calculated from the coefficient of consolidation, c_v, and coefficient of volume change, m_v, for each load increment from the relationship $k_v=c_v(\gamma_w)(m_v)$ where γ_w is the density of water, $m_v=[\Delta\varepsilon_v/\Delta\sigma'_{vc}]$, $\Delta\varepsilon_v$ is the vertical strain over the load increment, and $\Delta\sigma'_{vc}$ is the change in effective vertical consolidation stress over the load increment.

A summary of the consolidation properties measured on the test specimens is presented in Table 24.

Table 24. Consolidation Properties

Core Hole	Sample	Depth (meters)	Group Symbol	LL	PI	e	Consolidation Properties						
							CR	RR	σ'_{vm} (tons/ft²)	σ'_{vo} (tons/ft²)	OCR	c_v (cm²/sec)	C_α (%)
VC-T1A-2A	3 / 5	2.2	CH	60	35	1.78	0.23	0.023	0.60	0.18	3.3	$4.3x10^{-4}$	1.0
VC-T2B-1	4 / 5	3.6	CL	48	26	1.30	0.19	0.023	0.90	0.36	2.5	$9.2x10^{-4}$	0.6
VC-T2B-1	2 / 5	1.2	CL	35	17	1.08	0.14	0.017	0.67	0.14	4.8	$1.3x10^{-3}$	0.5
VC-T2B-2	3 / 5	2.2	CL	32	14	0.86	0.11	0.013	0.80	0.24	3.3	$3.2x10^{-3}$	0.3
VC-T2A-1	4 / 5	4.1	CL	27	10	0.82	0.11	0.011	0.80	0.43	1.9	$7.0x10^{-3}$	0.3

Where: LL= Liquid limit; PI= Plasticity index; e= Void ratio; CR= Virgin compression ratio; RR= Recompression ratio; σ'_{vm}= Maximum past consolidation stress; σ'_{vc}= Estimated in-situ effective vertical consolidation stress; OCR= Over-consolidation ratio $[\sigma'_{vm}/\sigma'_{vc}]$; c_v= Coefficient of consolidation; and C_α=Coefficient of secondary compression. Group Symbols are per the Unified Soil Classification System.

The consolidation properties were selected using the following procedures: (i) the maximum past consolidation stress was estimated using the Schmertmann (1955) method; (ii) the recompression ratio was selected from the slope of the recompression curve during the reload cycle; (iii) the virgin compression ratio was selected from the reconstructed compression curve from the Schmertmann (1955) method; and (iv) the coefficient of consolidation and coefficient of secondary compression are shown for normally-consolidated conditions at a stress level, $\sigma'_{vc}/\sigma'_{vm}$, of 1 to 2. The coefficient of consolidation and coefficient of secondary compression vary with stress level, however, and specific values for design should be selected for the appropriate stress level using the data tabulated in the test reports.

As shown, the clays are slightly over-consolidated with estimated over-consolidation ratios of 1.9 to 3.3. Compression ratios vary from 0.23 for fat clay to 0.19 to 0.11 for lean and decrease with decreasing plasticity as expected. Recompression ratios are 10 to 12 percent of the virgin compression ratios.

9.3.2.4 Strength Testing

Triaxial compression tests were performed on five clay samples selected by the KBR representative. Consolidated undrained triaxial compression tests with pore pressure measurements (CIUC tests) were performed on 15 test specimens in accordance with ASTM Standard D4767, "Consolidated Undrained Triaxial Compression Test for Cohesive Soils," using a constant rate of vertical strain of about 1 percent per hour. Test specimens were trimmed from the 9.1-cm diameter core samples to a diameter of 3.55 cm and length of 7.10 cm to provide a length to diameter ratio of 2.0.

The selected samples, index properties, and initial and pre-shear test specimen conditions are shown in Table 25.

Table 25. Consolidated Undrained Triaxial Compression Test Specimen Index Properties and Initial and Pre-Shear Conditions

Core Hole	Sample	Group Symbol	Index Properties				Initial Conditions		σ'_c (kg/cm^2)	$\Delta V/V_o$ (%)	Pre-Shear Conditions	
			LL	PI	OC (%)	-75µm (%)	w_c (%)	γ_d (lb/ft^3)			w_c (%)	γ_d (lb/ft^3)
VC-T1A-2A	3 / 5	CH	60	35	2.8	97.7	70.8	58.1	0.24	-8.0	62.2	63.1
						95.1	60.0	63.1	0.49	-6.8	55.5	67.7
						98.6	72.8	56.9	0.98	-14.8	56.8	66.8
VC-T2B-1	2 / 5	CL	35	17	2.7	92.5	40.3	81.3	0.24	-1.8	39.2	82.8
						96.4	32.9	89.7	0.79	-7.3	28.2	96.8
						91.4	29.6	93.2	1.98	-11.3	23.2	105.0
						95.7	32.6	89.3	4.88 0.98*	-13.6	24.2	103.3
VC-T2B-2	3 / 5	CL	32	14	2.5	87.4	27.2	98.2	0.24	-3.6	25.1	101.8
						94.0	30.7	93.2	0.68	-6.9	26.1	100.1
						91.4	29.3	95.3	1.98	-8.4	23.8	104.0
						94.2	32.0	90.2	4.50 1.50**	-13.0	24.0	103.6
VC-T2B-1	3 / 5	CL	30	14	3.5	95.0	43.6	77.0	0.24	-6.9	39.1	82.7
						97.1	46.5	75.0	0.49	-8.3	39.9	81.8
						98.2	44.1	77.6	0.98	-9.4	36.5	85.7
VC-T2A-1	5 / 5	CL-ML	24	7	1.7	88.4	21.6	107.0	0.39	-4.4	19.0	111.8
						79.8	18.8	110.0	0.78	-5.3	16.9	116.2
						87.3	22.4	105.5	1.95	-3.8	20.1	109.7

Where: LL= Liquid limit; PI= Plasticity index; OC= Organic content; -75µm= Soil fraction by dry mass finer than the U.S. Standard No. 200 sieve; w_c= Water content; γ_d= Dry density; σ'_c= Isotropic effective consolidation stress; and $\Delta V/V_o$= Volume change during consolidation. Group Symbols are per the Unified Soil Classification System.

* Specimen unloaded to an over-consolidation ratio of 5

** Specimen unloaded to an over-consolidation ratio of 3

The test results are included in Attachments H-2 and H-3 on the Consolidated Undrained Triaxial Compression Test Reports. The test reports present plots of the effective stress paths (half-principal stress difference, q, versus average effective principal stress, p'), and the principal stress difference (2q), excess

pore pressure, and principal stress ratio (σ'1/σ'3) versus axial strain. Group plots of effective stress paths from triaxial compression tests performed on a given sample are also presented. Photographs of the triaxial compression test specimens at the end of testing are also included with the test reports.

Normalized undrained shear strength ratios and effective friction angles determined from the triaxial test specimens are summarized in Table 26. The Mohr-Coulomb failure envelopes for each series of tests are shown on the figures in Attachments H-2 and H-3 based on linear regression of measured shear strengths at maximum obliquity.

Table 26. Strength Properties

Core Hole	Sample	Group Symbol	LL	PI	Undrained Shear Strength Ratio			Drained Shear Strength	
					OCR	s_u/σ'_c	s_u/σ'_{vc}	c' (kg/cm²)	φ'
VC-T1A-2A	3 / 5	CH	60	35	---	---	---	0.078	33.2°
VC-T2B-1	2 / 5	CL	35	17	5.0	1.34	0.82	0.070	32.8°
VC-T2B-2	3 / 5	CL	32	14	3.0	1.00	0.67	0.080	32.5°
VC-T2B-1	3 / 5	CL	30	14	---	---	---	0.083	31.5°
VC-T2A-1	5 / 5	CL-ML	24	7	---	---	---	0.000	40.0°

The drained shear strength of the CL and CH clays determined from CIUC triaxial compression tests is characterized by an effective cohesion of 0.08 kg/cm2 and effective friction angle of 32 degrees. The clays are slightly over-consolidated, so a small effective cohesion is possible. The effective friction angles of 31.5 degrees to 32.8 degrees are reasonable for lean clays. The effective friction angle of 33.2 degrees displayed by the fat clay is higher than expected, with a value of no more than 28 degrees likely more appropriate for CH clay with a plasticity index of 35. The effective friction angle of 40.0 degrees displayed by the silty clay is also somewhat high, with a value of no more than 35 degrees likely more appropriate for silty clay with a plasticity index of 7.

The normalized undrained shear strength ratios were determined for two test specimen of lean clay with over-consolidation ratios of 3 and 5. The undrained shear strength normalized to the effective isotropic consolidation stress, su/σ'c, varies from 1.00 to 1.34 for over-consolidation ratios of 3 to 5. The undrained shear strength normalized to the effective vertical consolidation stress, su/σ'vc, back-figured assuming the clays exhibit basic strength principles in accordance with the simple clay model (Ladd, 1964) and assuming a coefficient of earth pressure at rest, Ko, of 0.5, varies from 0.67 to 0.82. Based upon these values, the normalized undrained shear strength ratio, su/σ'vc, for normally consolidated lean clay is expected to be about 0.30.

Unconsolidated-undrained triaxial compression tests (UU tests) were performed on six test specimens in accordance with ASTM Standard D2850, "Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soil," using a constant rate of vertical strain of 1 percent per minute hour. Test specimens were trimmed from the 9.1-cm diameter core samples to a diameter of 3.55 cm and length of 7.10 cm to provide a length to diameter ratio of 2.0.

The UU triaxial compression tests were performed on the six clay samples presented in Table 27.

Table 27. Unconsolidated-Undrained Triaxial Test Specimens

Core Hole	Sample	Group Symbol	Index Properties				w_c (%)	γ_d (lb/ft^3)	σ_c (kg/cm^2)	s_u[UU] (kg/cm^2)
			LL	PI	OC (%)	-75µm (%)				
VC-T1A-1A	3 / 3	CH	64	38	2.8	97.7	67.8	57.5	0.25	0.15
						96.8	66.6	59.4	0.50	0.16
						96.8	68.5	58.9	1.00	0.19
VC-T2B-2	5 / 5	CL	43	22	3.4	99.7	41.1	79.1	0.75	0.23
						100.0	42.8	77.4	1.50	0.18
VC-016	4 / 5	CL	43	21	---	96.6	37.1	85.1	0.75	0.24

Where: LL= Liquid limit; PI= Plasticity index; OC= Organic content; -75µm= Soil fraction by dry mass finer than the U.S. Standard No. 200 sieve; w_c= Water content; γ_d= Dry density; σ_c= Isotropic confining stress; and s_u[UU]= Undrained shear strength. Group Symbols are per the Unified Soil Classification System.

The test results are included in Attachments H-2, H-3, and H-4 (of this report) in the Unconsolidated Undrained Triaxial Compression Test Reports. Photographs of the UU triaxial compression test specimens at the end of testing are also included with the test reports.

Laboratory miniature shear tests were performed on seven test specimens in accordance with ASTM Standard D4648, "Laboratory Miniature Vane Shear Test for Saturated Fine-Grained Clayey Soil," using a vane rotation rate of 60 degrees per minute. The tests were performed on samples maintained at the as-received diameter with the vane inserted to a bottom depth of twice the height of the vane. The remolded undrained shear strength was measured after rotating the vane one complete revolution following measurement of the intact undrained shear strength. The test results are presented in Table 28.

Table 28. Miniature Vane Shear Test Results

Core Hole	Sample	Group Symbol	Index Properties				w_c (%)	Vane Size		s_u[LV] (kg/cm^2)	Remolded s_u[LV] (kg/cm^2)
			LL	PI	OC (%)	-75µm (%)		D (cm)	[L/D]		
VC-T1A-2A	3 / 5	CH	60	35	2.8	93.8	61.0	0.75	1.3	0.20	0.05
VC-T2A-1	5 / 5	CL-ML	24	7	1.7	84.6	25.9	0.50	2.0	0.16	0.04
VC-T2B-1	3 / 5	CL	30	14	3.5	---	35.7	0.75	1.3	0.11	0.02
	4 / 5				2.5	---	31.4	0.75	1.3	0.21	0.06
VC-007	3 /3	CL	46	23	2.9	99.2	34.4	0.75	1.3	0.19	0.06
VC-017	2 / 4	CH	61	35	2.7-	97.6	56.2	0.75	1.3	0.28	0.06
	3 / 4	CH	51	29	---	85.8	47.7	0.75	1.3	0.27	0.06

Where: LL= Liquid limit; PI= Plasticity index; OC= Organic content; -75µm= Soil fraction by dry mass finer than the U.S. Standard No. 200 sieve; w_c= Water content; D= Vane diameter; [L/D] = Vane length to diameter ratio; and s_u[LV]= Undrained shear strength. Group Symbols are per the Unified Soil Classification System.

The laboratory miniature vane shear test results are also listed on the Extrusion Test Reports in Attachments H-2, H-3, and H-4 of this report.

Undrained shear strengths were measured on clay portions of the samples during extrusion with a hand-held Torvane device with a capacity of 1.00 kilogram (kg)/cm2. The Torvane was inserted into a wire-saw trimmed smooth surface on the end of the core sample and rotated at a steady rate. A water content specimen was then trimmed from the test area. A total of 54 strength measurements were made with the

Torvane device. The undrained shear strengths, su[TV], and corresponding water contents are presented on the Extrusion Test Reports in Attachments H-2, H-3, and H-4 of this report.

Consolidated drained direct shear tests were performed on remolded test specimens from one sand sample selected by the KBR representative in accordance with ASTM Standard D3080 "Direct Shear Test of Soils under Consolidated Drained Conditions." The circular test specimens (diameter of 5.86 cm [2.30 inches] and height of 2.79 cm [1.10 inches]) were compacted to a target initial dry density of 98 lb/ft3. The target initial dry density was selected as an estimate of in-situ dry density from available core sample dry densities. Three specimens were prepared and tested at normal stresses of 0.25, 0.51, and 1.00 kg/cm2. The specimens were tested while submerged at a constant horizontal displacement rate of 0.22 cm/hour. The initial and pre-shear conditions of test specimens are presented in Table 29.

Table 29. Direct Shear Test Specimens

Core Hole	Sample	Group Symbol	Index Properties			Initial Conditions		σ'_n (kg/cm^2)	ε_v (%)	Pre-Shear Conditions	
			CaCO3 (%)	OC (%)	-75µm (%)	w_c (%)	γ_d (lb/ft^3)			w_c (%)	γ_d (lb/ft^3)
VC-T2A-1	2 / 5	SP-SM	3.6	0.7	9.9	16.2	97.6	0.25	-1.7	23.9	99.3
					10.6	16.5	97.4	0.51	-1.8	24.0	99.2
					10.5	23.2	97.3	1.00	-2.1	23.2	99.4

Where: $CaCO_3$= Carbonate content; OC= Organic content; -75µm= Soil fraction by dry mass finer than the U.S. Standard No. 200 sieve; w_c= Water content; γ_d= Dry density; σ'_n= Normal consolidation stress; and ε_v= Vertical strain during consolidation. Group Symbols are per the Unified Soil Classification System.

The test results are included in Attachment H-2 (of this report) on the Consolidated Drained Direct Shear Test Reports. The test reports present plots of normalized shear stress ratio ($\tau/\sigma'n$) and vertical displacement versus horizontal displacement. The Mohr-Coulomb failure envelopes from the three tests, determined by linear regression of measured shear strengths constrained for zero cohesion, are presented for peak shear strength and shear strength at the end of the test after 0.55–0.60 cm [0.21–0.24 inch] of horizontal displacement (corresponding to about 9 to 10 percent of the test specimen diameter). The effective friction angles equaled 35.9 degrees at peak shear strength and 35.1 degrees at the end of the test.

9.3.2.5 Corrosion Series Tests

Soil resistivity, pH, conductivity, sulfate, and chloride measurements were made on 18 sandy soil specimens from 17 of the 19 survey corridor core holes. Specimens for testing were typically selected from about a depth of about 2 meters as directed by the KBR representative.

The corrosion series tests were performed using Florida Department of Transportation standard test methods (FM) for soils. Resistivity tests were performed in accordance with FM-5-551, "Resistivity of Soil and Water," using a four-electrode soil box. The resistivity was determined at the as-received water content and then at progressively higher water contents until the minimum resistivity was determined. Soil pH was measured in accordance with FM-5-550, "pH of Soil and Water," on air-dried samples mixed with distilled water at a ratio of 1 part soil to 1 part distilled water by volume using a pH probe approximately 24 hours after preparing the suspension. Conductivity was measured on the same suspension with a conductivity probe. Soil sulfate and chloride contents were measured in accordance with FM-5-552, "Chloride in Soil and Water," and FM-5-553, "Sulfate in Soil and Water," respectively, on air-dried samples mixed with

distilled water at a ratio of 1 part soil to 3 parts distilled water by mass. The test results are presented in Table 30.

Table 30. Corrosion Series Test Results

Core Hole	Sample	Group Symbol	-75µm (%)	OC (%)	w_c (%)	pH	Conductivity (µS/cm)	Resistivity at w_c (ohm-cm)	Resistivity (ohm-cm)	Chloride Cl (mg/l)	Sulfate SO_4 (mg/l)
VC-001	2 / 2	SM	21.6	0.6	21.9	7.55	13,120	50	30	4,400	1,080
VC-001A	2 / 3	SM	13.7	0.5	23.0	7.19	14,970	104	100	5,400	1,180
VC-002B	2 / 2	SP	1.9	0.4	10.8	7.67	7,870	---*	---*	3,000	550
VC-003	2 / 2	SM	15.7	0.9	22.1	7.63	13,640	106	91	5,400	1,270
VC-004	2 / 2	SM	31.2	1.1	25.7	7.69	12,820	85	70	4,800	1,300
VC-005	3 / 3	SW	3.0	0.4	15.3	7.25	10,160	90	90	3,000	520
VC-006	2 / 2	SP	1.4	0.2	13.9	7.44	11,480	160	90	3,600	640
VC-007	2 / 3	SM	19.4	0.7	22.3	7.43	12,880	96	84	4,800	1,140
VC-008	2 / 3	SP	1.9	0.2	16.4	7.14	13,530	70	70	3,600	650
VC-010	2 / 3	SP	0.7	0.3	8.2	7.29	7,650	560	160	2,400	400
VC-011	2 / 3	SP	4.6	0.3	19.4	7.32	14,420	60	40	4,800	1,080
	3 / 3	SP-SM	8.4	0.6	19.8	7.64	13,350	50	50	4,800	950
VC-012	2 / 2	SP	1.2	0.4	13.8	7.54	11,320	150	100	3,600	750
VC-013	2 / 3	SP	1.9	0.3	12.5	7.54	11,160	210	100	3,000	710
VC-014	2 / 3	SP	1.7	0.3	11.9	7.81	9,790	260	90	3,000	730
VC-015	2 / 2	SP	1.4	0.3	19.8	7.62	15,070	50	15	4,800	970
VC-015A	2 / 2	SP	1.0	0.2	20.1	7.62	13,150	50	10	4,200	900
VC-016	2 / 5	SC	12.3	0.7	23.1	7.63	10,640	97	95	4,800	1,140

Where: -75µm= Soil fraction by dry mass finer than the U.S. Standard No. 200 sieve; OC=Organic content; and wc=Water content. Group Symbols are per the Unified Soil Classification System.

* Insufficient sample soil mass to perform resistivity test.

The corrosion series test results are also listed on the Extrusion Test Reports in Attachments H-2, H-3, and H-4 of this report.

9.3.3 Composite Test Samples

Four composite soil samples made in the laboratory by combining soil samples from selected grab samples or selected portions of vibracore samples. The composite samples were made as requested by KBR for direct shear testing on sandy soils and permeability testing on a gravel sample. The results of index tests performed on the composite samples are presented in Table 31.

Table 31. Composite Samples Index Test Results

Sample Description	Group Symbol	Soil Fraction by Dry Mass (%)					w_c (%)	Index Dry Density	
		Gravel	Coarse Sand	Medium Sand	Fine Sand	-75µm		γ_{dmin} (lb/ft³)	γ_{dmax} (lb/ft³)
1WG. Brownish-gray sand with silt & shell	SP-SM	11.1	15.6	40.0	27.1	6.2	20.9	122.0	95.7
2MS. Brown sand with shell	SP	1.1	4.2	48.6	45.0	1.1	24.4	113.6	94.7
3FS. Brownish-gray sand with shell	SP	0.1	0.1	5.5	92.2	2.1	30.6	109.1	84.8

Table 31. Composite Samples Index Test Results (continued)

Sample Description	Group Symbol	Soil Fraction by Dry Mass (%)					w_c (%)	Index Dry Density	
		Gravel	Coarse Sand	Medium Sand	Fine Sand	-75µm		γ_{dmin} (lb/ft^3)	γ_{dmax} (lb/ft^3)
4. Gray & brown gravel with sand & shell	GW	51.1	16.9	14.2	16.0	1.8	-	-	-

Where: -75µm= Soil fraction by dry mass finer than the U.S. Standard No. 200 sieve; w_c=Water content; γ_{dmin}= Minimum index dry density; and γ_{dmax}= Maximum index dry density. Group Symbols are per the Unified Soil Classification System.

The minimum and maximum density tests were performed in accordance with ASTM Standard D4253, "Maximum Index Density and Unit Weight of Soils Using a Vibratory Table," and ASTM Standard D4254, "Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density." The results of the minimum and maximum density and particle-size distribution tests on the composite samples are presented in Attachment H-5 of this report.

Consolidated drained direct shear tests were performed on remolded test specimens of the composite samples in accordance with ASTM Standard D3080 "Direct Shear Test of Soils Under Consolidated Drained Conditions." The circular test specimens (diameter of 5.86 cm [2.31 inches] and height of 2.79 cm [1.10 inches]) were compacted to the target initial dry densities listed in Table 31. The target initial dry densities were selected as estimates of *in-situ* dry densities from available core sample dry densities. Three specimens of each sample were prepared and tested at normal stresses of 0.25, 0.50 and 1.00 kg/cm^2. The specimens were tested while submerged and sheared at a constant horizontal displacement rate of 0.22 cm/hour. The initial and pre-shear conditions of test specimens are presented in Table 32.

Table 32. Composite Direct Shear Test Specimen Initial and Pre-Shear Conditions

Composite Sample	Group Symbol	Target Initial γ_d (lb/ft^3)	-75µm (%)	Initial Conditions		σ'_n (kg/cm^2)	ε_v (%)	Pre-Shear Conditions	
				w_c (%)	γ_d (lb/ft^3)			w_c (%)	γ_d (lb/ft^3)
3FS	SP	97	1.5	13.6	95.6	0.24	-0.4	23.3	96.0
			1.9	12.7	96.4	0.49	-0.4	21.6	96.7
			1.5	10.3	98.4	0.98	-0.6	24.0	99.1
2MS	SP	105	0.6	10.1	104.8	0.25	-0.2	19.7	105.0
			1.0	9.1	105.8	0.49	-0.3	18.8	106.1
			0.5	9.1	105.0	0.98	-0.7	20.5	105.7
1WG	SP-SM	112	6.2	8.1	111.3	0.25	-0.4	16.7	111.7
			6.6	7.3	112.1	0.52	-0.4	14.1	112.6
			5.3	8.8	110.8	1.00	-0.7	15.8	111.5
		117	6.0	7.6	116.8	0.52	-0.1	14.1	116.9
			–	7.6	116.8	1.07	-0.3	14.7	116.7

Where: -75µm= Soil fraction by dry mass finer than the U.S. Standard No. 200 sieve; w_c= Water content; γ_d= Dry density; σ'_n= Normal consolidation stress; and ε_v= Vertical strain during consolidation. Group Symbols are per the Unified Soil Classification System.

The test results are included in Attachment H-5 (of this report) on the Consolidated Drained Direct Shear Test Reports. The test reports present plots of normalized shear stress ratio (τ/σ'_n) and vertical displacement versus horizontal displacement. The Mohr-Coulomb failure envelopes for each sample, determined by linear regression of measured shear strengths constrained for zero cohesion, are presented for peak shear strength

and shear strength at the end of the test after 0.40–0.60 cm (0.16–0.24 inch) of horizontal displacement (corresponding to about 7 to 10 percent of the test specimen diameter).

The target initial dry densities of 3FS and 2MS composite samples correspond to about 55 to 60 percent relative density. The peak effective friction angles measured on the 3FS and 2MS composite samples equaled 34.5 degrees and 41.0 degrees, respectively. The peak effective friction angle measured on the 2MS composite sample is relatively high, characteristic of dense sand, which is consistent with the observed expansion (dilatancy) of the specimens during drained shear, but somewhat higher than expected for the initial relative density of 60 percent. The peak effective friction angle measured on the 3FS composite sample is characteristic of medium sand, consistent with the initial relative density of 57 percent.

The peak effective friction angle of 29.2 degrees measured on 1WG composite sample test specimens compacted at a target initial dry density of 112 lb/ft^3 is relatively low, characteristic of loose sand, which is consistent with the observed compression of the specimens during drained shear but lower than expected for the initial relative density of 70 percent (the lower than expected effective friction angle for the test specimen relative density may be due to scalping the plus U.S. Standard No 4 sieve size material from the direct shear test specimens). The peak effective friction angle measured on 1WG composite sample test specimens compacted at a higher target initial dry density of 117 lb/ft^3 equaled 40.7 degrees, characteristic of a dense sand, which is consistent with the observed expansion (dilatancy) of the specimens during drained shear and the initial relative density of 84 percent.

The initial dry densities for the direct shear test specimens were selected from limited and variable dry densities measured on vibracore samples. Therefore, the relatively high and low effective friction angles measured on the 2MS and 1WG composite samples may not be characteristic of *in-situ* behavior.

A permeability test was performed on a remolded test specimen of the gravel composite sample in accordance with ASTM Standard D2434 "Permeability of Granular Soils (Constant Head)." The test specimen (diameter of 11.40 cm [4.49 inches] and initial height of 12.74 cm [5.02 inches]) was compacted to a target initial dry density of 115 lb/ft^3. The test results are presented in Table 33.

Table 33. Permeability Test Results

Composite Sample	Group Symbol	Target Initial γd (lb/ft3)	-75µm (%)	Dry Density, γd (lb/ft3)	Hydraulic Conductivity, k (cm/sec)
4	GW	115	1.8	114.4	1.00
				117.8	0.18
Where: -75µm= Soil fraction by dry mass finer than the U.S. Standard No. 200 sieve. Group Symbols are per the Unified Soil Classification System.					

The test results are included in Attachment H-5 (of this report) in the Hydraulic Conductivity Test Report. The measured hydraulic conductivities are characteristic of permeable (high hydraulic conductivity) gravel.

9.4 Data Products

The final data products generated in support of the VOWTAP Marine Site Characterization Study are summarized in Table 34. An external hard drive accompanying this report contains other digital products as required under BOEM guidelines.

Table 34. Data Products

Product		Description	Format/Media		
Marine Site Characterization Survey Report		Survey summary results	1 digital copy (.pdf) 1 paper copy		
Charts North-up 1:5,000 (Lease Area) 1:10,000 (Survey Corridor)	Navigation Map	Survey tracklines (Sub-bottom, Sidescan, Mag) Survey tracklines (Multi-channel CDP gathers)	.pdf	Plate 1 Sheets 1 to 4 Plate 2 Sheet 1	Attachment C
	Bathymetry Map	Shaded Relief (1m) with Contours (0.5m)		Plate 3 Sheets 1 to 4	
	Slope Map	Bathymetric Slope (Benthic Terrain Modeler)		Plate 4 Sheets 1 to 4	
	Rugosity Map	Seabed Rugosity (Benthic Terrain Modeler)		Plate 5 Sheets 1 to 4	
	Benthic Zones Map	Benthic Zones (Benthic Terrain Modeler)		Plate 6 Sheets 1 to 4	
	Sidescan Sonar and Sediment Sampling Map	Sidescan Mosaic overlaid with Sonar Contacts and Sediment Sampling Locations (grabs and cores)		Plate 7 Sheets 1 to 4	
	Geologic Features Map	Sidescan Mosaic overlaid with Surface Sediment Types, Sonar Contacts and Sediment Sample Locations (grabs and cores)		Plate 8 Sheets 1 to 4	
	Total Field Map	Magnetic Total Field (nT) with 5 nT contours and Target Locations		Plate 9 Sheets 1 to 4	
	Analytic Signal Map	Magnetometer Analytic Signal (nT) with Target Locations		Plate 10 Sheets 1 to 4	
	Seismic Elevation Map	Reflector 1 Elevation		Plate 11 Sheet 1	
	Seismic Elevation Map	Reflector 2 Elevation		Plate 12 Sheet 1	
	Seismic Elevation Map	Reflector 3 Elevation		Plate 13 Sheet 1	
	Seismic Elevation Map	Reflector 4 Elevation		Plate 14 Sheet 1	
	Seismic Elevation Map	Reflector 5 Elevation		Plate 15 Sheet 1	
	Seismic Elevation Map	Reflector 6 Elevation		Plate 16 Sheet 1	
	Seismic Isopach Map	Isopach Map - Reflector 1		Plate 17 Sheet 1	
Alignment Sheets 1:10,000	Cable Corridor - Marine Geophysical Results	Panel 1 – Bathymetry Panel 2 – Geology Interpretation Panel 3 – Bathymetric profile/SBP Interpretation		Plate 18 Sheets 1 to 7	
Profile Charts	Seismic Profiles at Potential Turbine Locations	Bathymetric profile / Elevation Profiles (R1-R6)		Plate 19 Sheets 1 to 2	

Table 34. Data Products (continued)

Product		Description	Format/Media	
Digital Data	Daily Progress Reports (offshore)	Submitted daily to Tetra Tech and VOWTAP Project managers.	.pdf	Attachment A (on external hard drive)
	Tracklines and tielines	(w/ time ticks and line direction indicators)	Shapefile	
	Bathymetric Contours	Contours 0.5 m	Shapefile	
	Bathymetry	x,y,z	tab-delimited.txt or .xls	
	Bathymetry	x,y,z (requested by BOEM)	ArcASCII grid	
	Multibeam Backscatter	Acquired and archived	RESON 7k	
	Slope	Requested by BOEM	ArcGrid	
	Rugosity	Requested by BOEM	ArcGrid	
	Zones	Requested by BOEM	ArcGrid	
	Magnetic Contours	Contour interval 5 nT	Shapefile	
	Magnetic data	x,y,nT	tab-delimited.txt or .xls	
	Sidescan Sonar 110 kHz	Acquired and archived	.xtf	
	Sidescan Sonar 540 kHz	Requested by BOEM	.xtf	
	Sidescan Sonar Contacts	Unmarked and annotated images of sidescan sonar contacts	.jpg/.tif/.pdf	
	Sidescan Sonar Mosaic	Geo-referenced mosaics (0.5m)	.tif/.tfw	
	Sidescan Sonar Transects	Geo-referenced, high resolution (0..2 m)	.tif/.tfw	
	Shallow and Medium-penetration Sub-bottom Profiler Systems	SEG-Y byte positions for 2-D data and a list of 2D lines, including SP and CDP ranges for each line	SEG-Y	
		Navigation file formatted in standard SEG-P1, UKOOA P1-09 format.	Seg-P1	
		Processing sequences applied to the data	.pdf	
		Digital images plot of the survey	.jpg	
	Seabed Samples	Grab and core sample locations/data	Shapefile	
		Sample photos	.jpg	
Digital Logs	Bridge Log	Includes vessel speed, course changes, sea state and weather conditions	.pdf	
	Multibeam Sonar Acquisition Log	Date, survey line, start and end times, heading and other relevant notes.	.pdf	
	Sidescan Sonar/ Sub-bottom Profiler/ Magnetometer Acquisition Log	Date, survey line, start and end times, heading and other relevant notes.	.pdf	
	Medium-penetration Sub-bottom Profiler Acquisition Log	Date, survey line, start and end times, heading and other relevant notes.	.pdf	
	Sonar Contacts List	Table listing Anomaly ID, Survey Area, Line #, Date, Time, and Details for Sidescan Sonar Contacts	shapefile/.xls/.pdf	
	Magnetometer Contacts List	Table listing Anomaly ID, Survey Area, Line #, Date, Time, and Details for Magnetic Anomalies	shapefile/.xls/.pdf	
	Geotechnical Survey Log	Table listing Area, Sample ID, Date, Time, Position and Details for all Vibracore and Grab Samples.	.xls/.pdf	
	Metadata	Metadata for each spatial feature will be provided in accordance with the FGDC Content Standard for Digital Geospatial Metadata (CSDGM) or International Standardization Organization's (ISO) 19115 metadata format.	xml	

10 SUMMARY OF FINDINGS

10.1 Regional Geological Setting

The VOWTAP survey area lies on the shallow shelf of the Atlantic continental margin. The shelf represents the seaward portion of the coastal plain geological province of Virginia that is currently covered by the sea. Thick, gently seaward-dipping units of sediments have been deposited on the Atlantic Margin over the past 175 million years. Variations in global sea-level and localized subsidence and uplift of the Earth's crust have created a complex series of sea-level transgressions and regressions. These changes have caused the coastline of Virginia to migrate—varying from low stands where the shoreline was at the continental shelf break, approximately 120 km (75 miles) farther offshore than the modern coastline—to extreme highs where the coastline pushed inland and is believed to have covered nearly the entire state of Virginia (Oertel and Foyle 1995; Hobbs 2004).

The geological features observed in the VOWTAP survey data collected along the survey corridor and in the lease area can be directly attributed to either modern features created by the action of waves and currents or to relic features, deposited and/or eroded at the previous stages of sea-level over the last 500,000 years (Hobbs 2004). The seafloor in the survey area is composed of unconsolidated sediments, with crystalline bedrock deeply buried below. In areas where older geological units outcrop at or near the seafloor, these units may be stiffer clays or more indurated, harder sands and muds. Erosional channels and other incised features have mostly been filled in by more recent Holocene sediments and have little to no seafloor expression (Hobbs 2004). Localized bathymetric highs experience erosion and winnowing of sediments, leaving coarser sands and gravels on the shoals and allowing deposition of finer material in the lows (Snedden and Dalrymple 1999).

Historic data indicate that the survey corridor and lease area were subaerially exposed within the last 10,000 years (Fleming et al. 1998), which resulted in erosion and channeling of the seabed and older geological features. Nearshore and shoreline features previously deposited in what are now areas of deeper water have also been reworked by the landward transgression of the shoreline, or "drowned" and preserved as localized highs (Nordfjord 2009). Where erosional features such as channels have not been completely filled in and overlain by flat-lying sediments, they are observed in the VOWTAP survey data as localized basins, lows, and rugged areas of bathymetry. Sand ridges, the remnants of offshore bars (Snedden and Dalrymple 1999) or the roots of barrier islands, now represent the majority of the localized bathymetric highs observed in the survey data.

Subsidence of the land and eustatic sea level change account for the local sea level trends observed at tidal stations near the Project Area. Subsidence is the motion of the Earth's surface relative to a fixed datum. Eustatic sea level change is the change of sea level relative to a fixed point, such as the center of the Earth, due to a change in the volume of water in the ocean that results from the melting of ice caps and glaciers. Tidal stations have measured the changing water levels for decades near the project area and provide linear estimates of the relative rate of sea level rise. NOAA Stations in Kiptopeke, VA (8632200), Sewells Point, VA (8638610), and Duck, NC (8651370) indicate sea level rise of 3.56 mm/yr (1.17 ft/century), 4.57 mm/yr (1.5 ft/century), and 4.57 mm/yr (1.5 ft/century), respectively (NOAA 2014). Subtracting out the global eustatic rate of sea level rise of 1.7 to 1.8 mm/yr (0.56 to 0.59 ft/century) observed over the last 100 years yields a subsidence rate range of 1.81 to 2.82 mm/yr (0.60 to 0.93 ft/century) for the Project Area. Relative

sea level rise due to subsidence and eustatic sea level change is not anticipated to be a substantial hazard to the project over its planned operational lifetime.

Anthropogenic (man-made) features are also visible in the survey results on both a small scale, such as debris identified in the sidescan records and magnetic anomalies, and large scale, such as dredging operations to deepen and maintain critical navigational channels and the dumping of the same dredged materials in other areas. As recently as the spring of 2013, sands have been "borrowed" from offshore areas approximately 2.5 miles (4.0 km) south of the Project Area to replenish eroding beaches, modifying the offshore bathymetry (City of Virginia Beach 2013).

10.2 Summary by Data Type

10.2.1 Multibeam Bathymetry

The bathymetry survey–derived bottom elevations, relative to the Project vertical datum of MLLW, range from -7 m in the shallowest accessible extent of the survey corridor, to -28.3 m in the southeast of the lease area (Plate 3 in Attachment C). The seabed deepens gently to the east along the survey corridor; low-relief sand ridges, oriented primarily northwest to southeast, are the dominant features along the survey corridor and in the lease area. Bathymetry can be characterized throughout the survey areas as relatively low relief with slopes generally not exceeding four degrees, except on faces of the steeper sand ridges, particularly in northwest corner of the lease area (Block 6111 Aliquot D) where slopes are up to 10 degrees. Plate 4 in Attachment C displays the slopes as calculated by the Benthic Terrain Modeler.

10.2.2 Sidescan Sonar

The sidescan sonar data show similar bottom features to the multibeam data along with finer-scale features, such as ripples, superimposed on the larger features (Figure 20; Plate 7 in Attachment C). The majority of these features are a result of bottom sedimentation transport and deposition processes. In addition, a total of 79 sonar contacts were detected that are considered sufficiently anomalous from normal bottom features to be of note. These contacts are tabulated, and compiled in a Sonar Contacts Report which includes high resolution images, and is provided in Attachment F. The majority of the sonar contacts are present along the survey corridor (66) while 13 are located within the lease area. The sonar contacts are mostly small in size and not recognizable as specific objects. A total of 40 sonar contacts are associated with magnetic anomalies while 38 are not. Some magnetic anomalies are associated with several sonar contacts suggesting that the sonar contacts are possibly different aspects of the same debris area and are associated. Some examples of this are contacts SC-CR-0008 and SC-CR-0009 as well as SC-CR-0010, SC-CR-0011, SC-CR0012, and SC-CR0013 (refer to Sidescan Sonar Contacts Report in Attachment F).

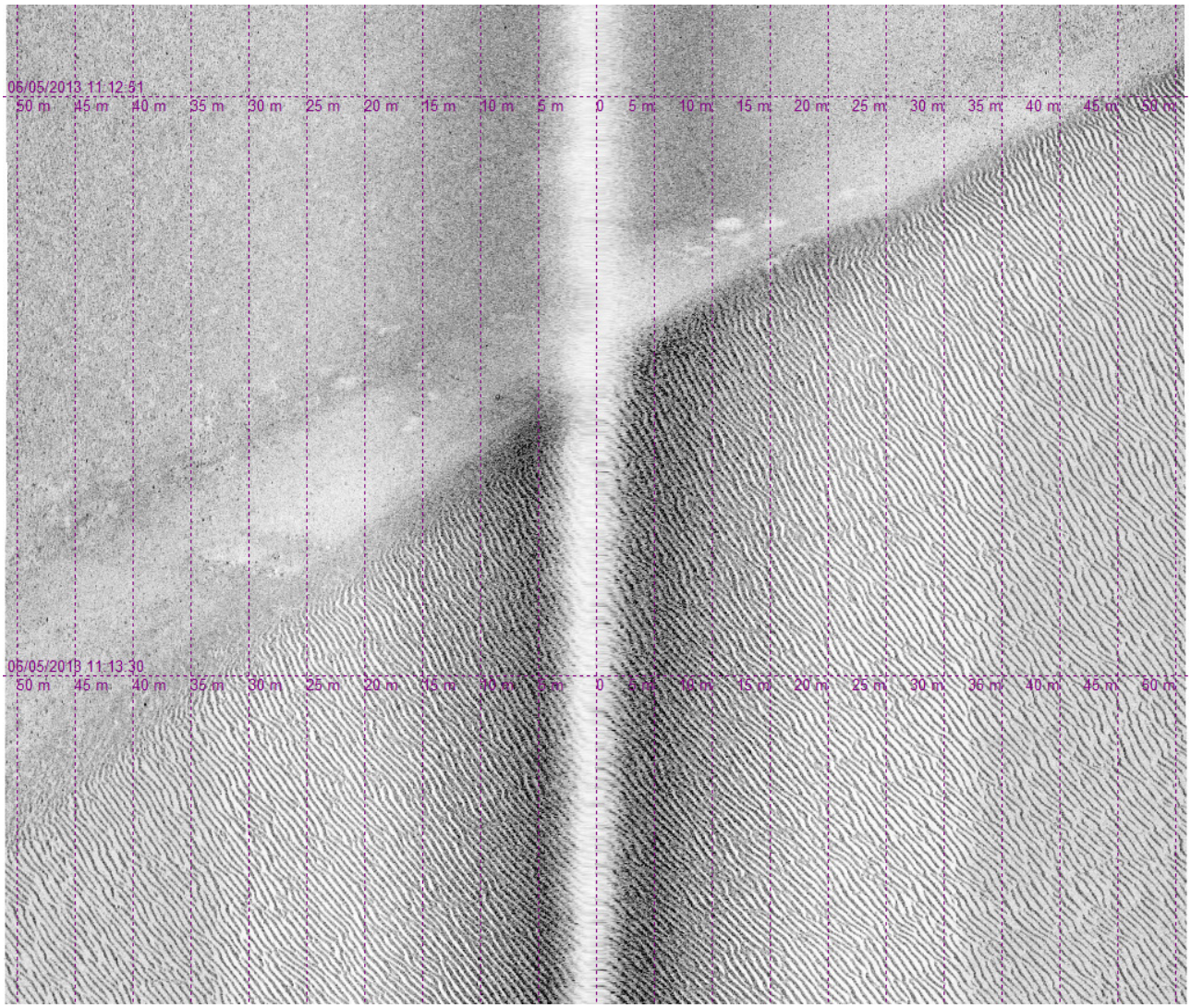


Figure 20. NW-SE Trending Sediment Ripples Superimposed on a NE-SW Trending Sand Ridge in Block 6112 Aliquot I

10.2.3 Magnetometer

A total of 624 individual magnetic target anomalies have been identified in the magnetic data collected. A full listing of the magnetic anomalies identified and their locations are listed in Attachment G. Of the 624 magnetic anomalies identified, only 65 separate magnetic anomalies are within 100 m of the identified sonar contacts, indicating that the majority are covered with sediment. Along the survey corridor within and in the vicinity of the firing ranges (Danger Zone 334.380 and Danger Zone 334.390) it should be noted that there is a possibility that some of the magnetic anomalies are munitions and explosives of concern (MEC).

10.2.4 Shallow-penetration Sub-bottom Profiler

The CHIRP sub-bottom profiler achieved five to 10 meters of penetration in the coarse-grained sandy sediments, with up to 15 meters in finer grained subsurface channel deposits where thinly-layered beds of 10

to 12 cm in thickness were resolved (Figure 21). Along the survey corridor, intermittent reflectors were digitized to characterize the sediment structure (refer to Alignment Sheets in Attachment C); however, these reflectors were not laterally coherent or continuous across the survey area. In localized areas, such as between KP 10 to KP 13 where subsurface channels were detected in the shallow-penetration sub-bottom record, a distinct reflector marks the base of recent sand deposits over these well-layered channel deposits (Figure 21 and Figure 26 in Section 10.3.4).

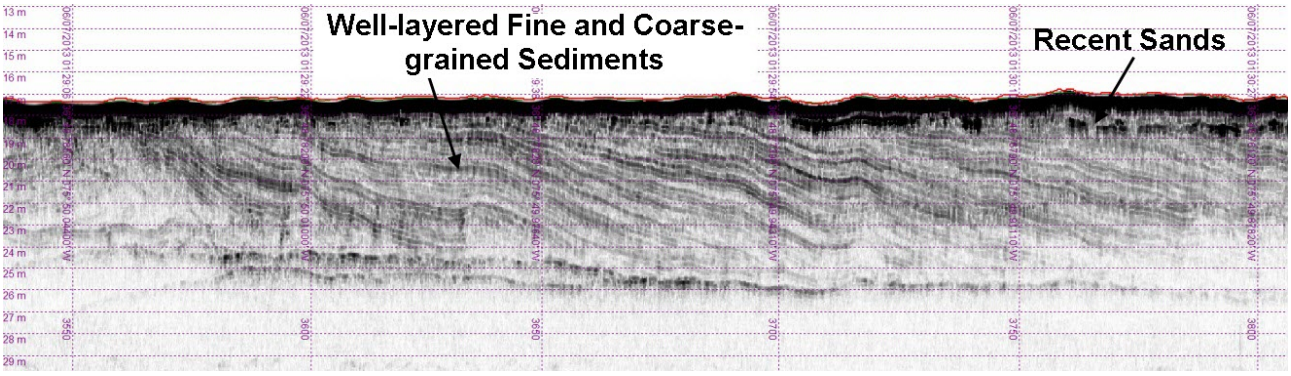


Figure 21. Thin (approximately 1 m) Layer of Recent Sands Over Well-layered Subsurface Channel Deposits

In the lease area, numerous, faint, discontinuous reflectors indicate the interbedded sands, silts and clays in the near-surface sediments (Figure 22).

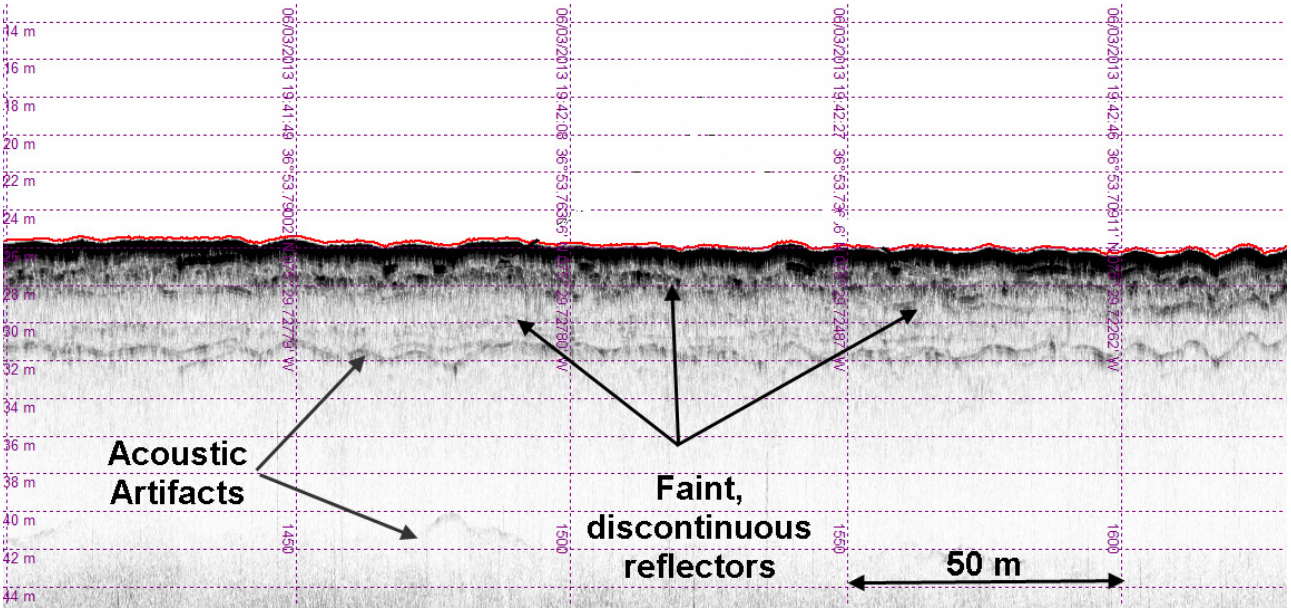


Figure 22. Discontinuous Reflectors in Lease Area (154-010-1932.000 at 19:42 UTC)

10.2.5 Medium-penetration Sub-bottom Profiler

The subsurface sediments in the lease area were investigated using the shallow-penetration sub-bottom profiler for the near-surface sediments and the single-channel and multi-channel medium-penetration sub-bottom profiler systems for deeper stratigraphy. Significant reflectors present in the medium-penetration sub-bottom dataset were digitized as described in Section 9.1. Both the single-channel monitoring and

multi-channel data were reviewed. A first pass at interpretation was done on the single-channel data while the multi-channel data were being processed. The single-channel data were not collected at full firing rate to minimize interference with multi-channel data acquisition and therefore the resolution of the data was not optimal. Once the multi-channel data were processed the preliminary interpretation was checked and adjusted where necessary. The multichannel data had a much improved signal/noise ratio compared to the single-channel data. This resulted in much greater confidence in interpretation of complex subsurface features. An example of multi-channel data with interpreted primary reflectors is provided in Figure 23.

Six well-defined acoustic reflectors (R1 through R6), considered to represent major boundaries between different geologic units, were interpreted in the medium-penetration sub-bottom profiler data and digitized in the sub-bottom records. These reflectors were continuous across the lease area and, with the exception of the shallowest reflector (R1), were nearly horizontal, as shown in Plates 11 through 17 and Plate 19 in Attachment C.

Table 35 summarizes the character of these reflectors and provides a brief description in terms of their acoustic characteristics. Geologic interpretation is based on information from two other studies including data from borings that were acquired for Chesapeake Bay Light Tower located approximately 12 to 15 nautical miles west of the lease area (McClelland Engineering, 1963), and the four piled structures at the U.S. Navy range located 15 to 32 nautical miles offshore of Kitty Hawk, North Carolina (Ling, 1978). In accordance with BOEM regulations (30 CFR Part 585), additional geotechnical investigations will be conducted in the direct vicinity of each WTG foundation to provide more descriptive geotechnical and geological characterization of the interpreted stratigraphy in support of final engineering and design.

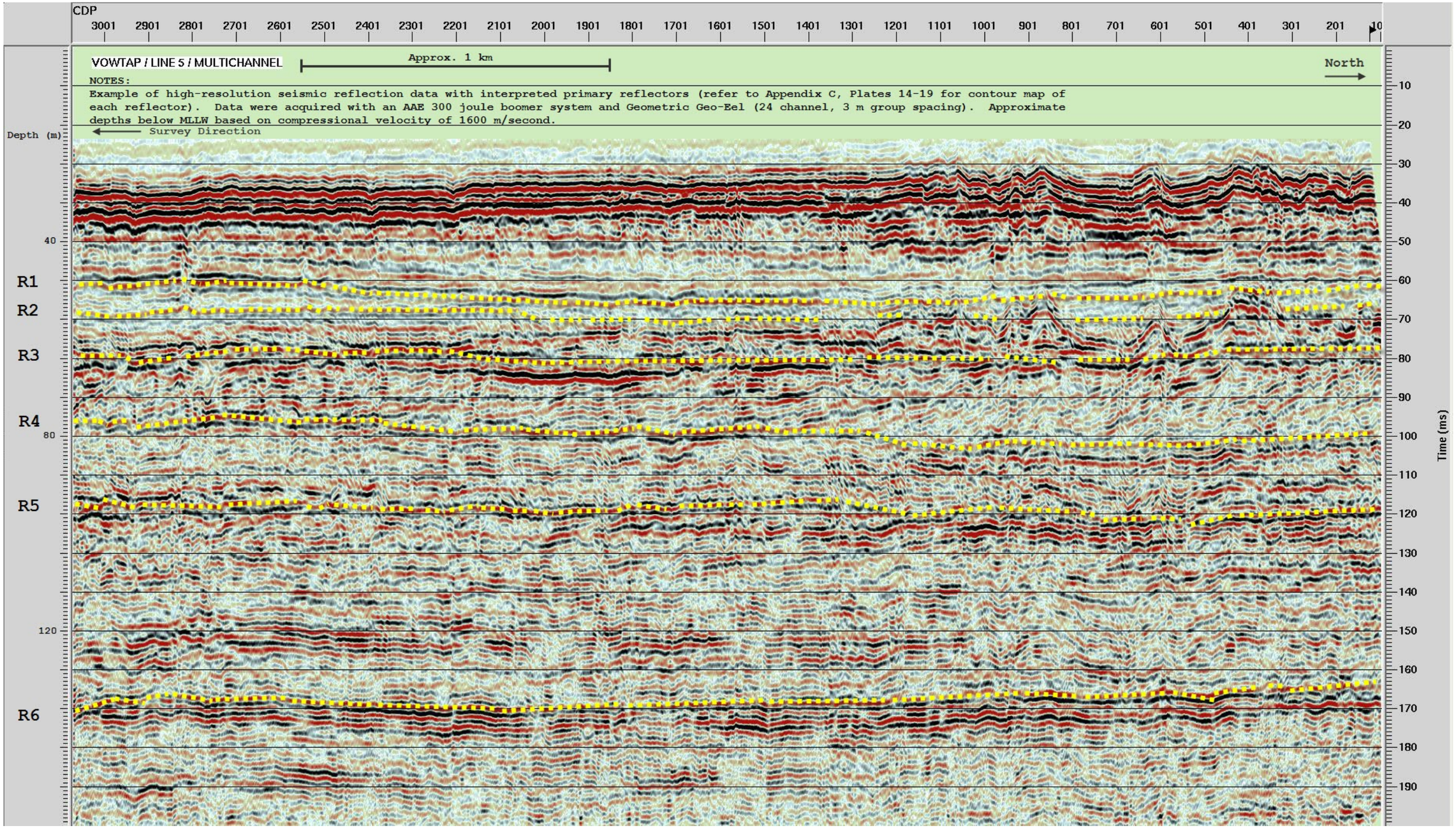


Figure 23. Example of Multi-channel Medium-penetration Sub-bottom Profiler Data with Interpreted Primary Reflectors

Table 35. Characteristics of Seismic Reflectors

Reflector	Unit	Depth (m) to top of reflector	Thickness of unit (m)	Description
	Seabed to R1			Surficial unconsolidated marine sediment (silt to fine sand)
R1		12-25	3-12	This reflector becomes shallower towards the south end of the survey area.
	R1-R2			Stiff clay unit?
R2		20-28	8-18	Nearly horizontal, continuous reflector, relatively high amplitude.
	R2-R3			Numerous, closely spaced reflectors that are possibly interbedded sands?
R3		32-34	19-37	Erosional angular unconformity that separates the Tertiary from overlying Quaternary sequences. This reflector is interpreted to be the top of the Yorktown Formation.
	R3-R4			Yorktown Formation – overconsolidated clay-sand unit; reflectors have a relative dip to the south of approximately 5 degrees (McClelland Engineering, 1963).
R4		50-64	8-14	Horizontal and continuous reflector that is the lower boundary of the angular unconformity
	R4-R5			Relatively low amplitude reflectors, possibly a stiff clay unit?
R5		63-74	34-41	Relatively high-amplitude, horizontal, continuous reflector
	R5-R6			Sequence of semicontinuous, high-amplitude reflectors; possibly sand and gravel sequence?
R6		104-112		High-amplitude continuous, horizontal acoustic reflector
	>R6-Bottom of record			Nearly reflection free, possibly semiconsolidated material resulting from depth of burial.

10.3 Survey Corridor Summary

The following sections describe the geologic conditions along the survey corridor, from the cable landfall location at Camp Pendleton to its intersection with BOEM Lease Block 6111 Aliquot H (6111H).

The survey corridor has been referenced to the nearest kilometer post (KP). The VOWTAP survey data collected aboard the survey vessel R/V *Sea Lion V* began at the safe operating water depth for the vessel (approximately 7 m) at a location approximately 800 m from the proposed submarine cable landfall site at a manhole to be located in the parking lot at the east end of Rifle Range Road, on Camp Pendleton. For the purpose of this report, the manhole location has been established as KP 0.0. Table 36 provides a summary of the features and hazards documented along the VOWTAP survey corridor and a more thorough discussion in provided in the following sections.

Table 36. Summary of Features and Potential Hazards in the Survey Corridor

Kilometer Point Range or Aliquot ID	Water Depth (m MLLW)	Predominant Seafloor Sediment Type	Seabed and Sub-bottom Features, Hazards, and Cautions
KP0.0-KP0.8	0 – 7.5	UNSURVEYED Presumed to be fine to medium sand	UNSURVEYED Hazards and Cautions: An identified unexploded ordnance (UXO) area is approximately 220 m south of the centerline of the corridor.
KP0.8-KP5.5	7.5 – 10.5	Fine sand	Seafloor Features: low relief fine sand Maximum Seabed Slope: 1.5° Sidescan Sonar Targets: 7 Mag Targets: Scattered: 83 Sub-bottom Features: minor stratified bedding with internal reflectors Hazards and Cautions: The survey corridor enters Danger Zone 334.380 (firing range) at approximately KP1.4 and Danger Area 334.390 (firing range) at KP 3.5. UXO may be encountered.
KP5.5-KP7.5	9-12.5	Fine to medium sand	Seafloor Features: small sand ridges 1.5-2.5 m relief Maximum Seabed Slope: 5° Sidescan Sonar: 6 Mag Targets: Scattered: 47 Sub-bottom Features: minor stratified bedding with internal reflectors; Hazards and Cautions: UXO risk; dumped dredge material and/or debris. The survey corridor enters the Dam Neck Disposal Site are at approximately KP5.5 and exits Danger Zone 334.380 at approximately KP5.7.
KP7.5-KP16.5	13 – 18	Fine to medium sand	Seafloor Features: linear bathymetric features 1-2 m high and spaced 400 m to 1.25 km with steeper shoreward face Maximum Seabed Slope: 4° Sidescan Sonar: 7 Mag Targets: Scattered: 87 Sub-bottom Features: infilled subsurface channels; minor stratified bedding with internal reflectors Hazards and Cautions: UXO risk--the survey corridor exits Danger Zone (334.390) at KP11.4. The survey corridor exits the Dam Neck Disposal Site area at approximately KP 8.5.
KP16.5-KP22.0	19.5 – 21.5	Fine to medium sand, some gravel	Seafloor Features: low relief with isolated small-scale features 0.15-0.5 m high and 15-30 m across Maximum Seabed Slope: 4° Sidescan Sonar: 13 Mag Targets: Scattered: 34 Sub-bottom Features: fairly consistent reflector, likely base of recent sand deposition, minor stratified bedding with internal reflectors Hazards and Cautions: None
KP22.0-KP29.5	17 – 21	Fine to medium sand	Seafloor Features: two broad highs with lengths 3 and 1.8 km. Maximum Seabed Slope: 5° Sidescan Sonar: 24 Mag Targets: Scattered: 69 Sub-bottom Features: areas of well-layered sediments, minor stratified bedding with internal reflectors Hazards and Cautions: None

Table 36. Summary of Features and Potential Hazards in the Survey Corridor (continued)

Kilometer Point Range or Aliquot ID	Water Depth (m MLLW)	Predominant Seafloor Sediment Type	Seabed and Sub-bottom Features, Hazards, and Cautions
KP29.5-KP31.0	19 – 24	Fine to medium sand	Seafloor Features: a broad 4-5m low approximately 775 m across, likely part of a larger partially buried channel Maximum Seabed Slope: 2° Sidescan Sonar: 2 Mag Targets: Scattered: 15 Sub-bottom Features: fewer reflectors, minor stratified bedding with internal reflectors Hazards and Cautions: None
KP31.0-KP39.0	17 – 20	Fine sand	Seafloor Features: small sand ridges, with steeper (2-2.5°) seaward-facing slopes Maximum Seabed Slope: 3° Sidescan Sonar: 6 Mag Targets: Scattered: 99 Sub-bottom Features: minor stratified bedding with internal reflectors Hazards and Cautions: None
KP39.0-KP44.1	19 – 26	Fine to medium sand	Seafloor Features: NW-SE trending slope to a localized low; several smaller ridges with moderate slopes; a SW-NE trending rise Maximum Seabed Slope: 4° Sidescan Sonar: 7 Mag Targets: Scattered: 45 Sub-bottom Features: minor stratified bedding with internal reflectors; well-layered sediments between KP 43 and 44, VC-017 contains over a meter of clay overlain by sand. Hazards and Cautions: None

Geophysical data collected along the survey corridor are presented in a series of alignment sheets presented in Attachment C. Reference to the appropriate chart is provided in the heading of the following sections. The alignment sheets display the bathymetric and interpreted geologic data in the survey corridor and provide subsurface information along the survey corridor centerline. The interpreted data are displayed in three data panels and a key plan and legend are shown on the right side of the sheet. The route runs from left to right across the sheets. Each panel shows a different data set with the same KP range; the route centerline and KPs are displayed on all panels. Information presented on each panel is described below:

- Panel 1 – Shaded-relief bathymetry with contour lines shown at 0.5-m intervals.
- Panel 2 – Geological interpretation along the survey corridor. The colors follow the legend on the right side of the sheet. Sonar contacts, magnetometer contacts, and core sample locations are plotted following the legend.
- Panel 3 – Bathymetric profile is plotted. Geological interpretation of the sub-bottom profiler data is shown under the bathymetric profile. Core and grab sample locations and descriptive panels are also plotted along the profile.

10.3.1 KP 0.0 – KP 0.8 (Plate 21 Sheet 1)

While the area between the possible beach manhole location (at KP 0.0) and KP 0.8 was not surveyed in 2013, trends observed in the VOWTAP survey data and historic data in the vicinity of the Project Area suggest that the seabed in this area and the shallow subsurface are likely comprised of sandy, unconsolidated sediments.

10.3.2 KP 0.8 – KP 5.5 (Plate 21 Sheet 1)

From KP 0.8 to approximately KP 5.5, the survey corridor traverses a region of low-relief seabed composed of silty fine sands. The water depth decreases in the offshore direction very gradually, from approximately 7 m MLLW to approximately 10.5 m. The survey corridor enters a firing range (Danger Zone 334.380) at approximately KP 1.4 and another firing range (Danger Zone 334.390) at KP 3.5 (Code of Federal Regulations: 33 CFR 334.380 Atlantic Ocean south of entrance to Chesapeake Bay off Dam Neck, Virginia; naval firing range and 33 CFR 334.390 Atlantic Ocean south of entrance to Chesapeake Bay; firing range). There are 7 sonar contacts categorized as debris and 83 magnetometer contacts in this region of the corridor. GS-016 to GS-020 were collected in this area and all were comprised of gray to dark gray silty fine sand with shell. Two vibracore samples collected in the area near KP 2.5 (VC-001 and VC-001A) contained just over 1 m and 2.4 m, respectively, of silty sand.

10.3.3 KP 5.5 – KP 7.5 (Plate 21 Sheet 1 and 2)

The corridor from KP 5.5 to approximately KP 7.5 traverses several small sand ridges with approximately 1.5 to 2.0 m of relief and wavelengths of approximately 300 m crest to crest. Grab sample GS-021, collected between two of these small ridges contained light brown fine sand with trace shell. Another grab sample, collected atop one of the ridges (GS-022) was comprised of brown medium sand with shell. Water depths along this portion of the survey corridor vary from 9 to 12.5 m. The survey corridor enters the Dam Neck Ocean Disposal Site area at approximately KP 5.5 and exits Danger Area 334.380 at approximately KP 5.7. Vibracore results from VC-002B indicate that the ridges consist of the same fine to medium gray to brown sands as sampled elsewhere within the corridor. The maximum slope along the flanks of the ridges is approximately 5 degrees. The area of the sand ridges also falls within the Dam Neck Ocean Disposal Site area and likely contains dredged materials reworked into the surficial sediment. Several of the sidescan sonar contacts and small patches of seafloor with notable texture differences, as observed in the sidescan sonar records, may also be attributed to dumped dredge spoils (Figure 24). A cluster of four small mounds (less than 1 m in height) detected in the multibeam bathymetry (Figure 25) and shown in the far right sidescan image in Figure 24, have been categorized as debris and may also be dumped material. There are a total of 6 sonar contacts categorized as debris in this region of the corridor and 47 magnetometer contacts.

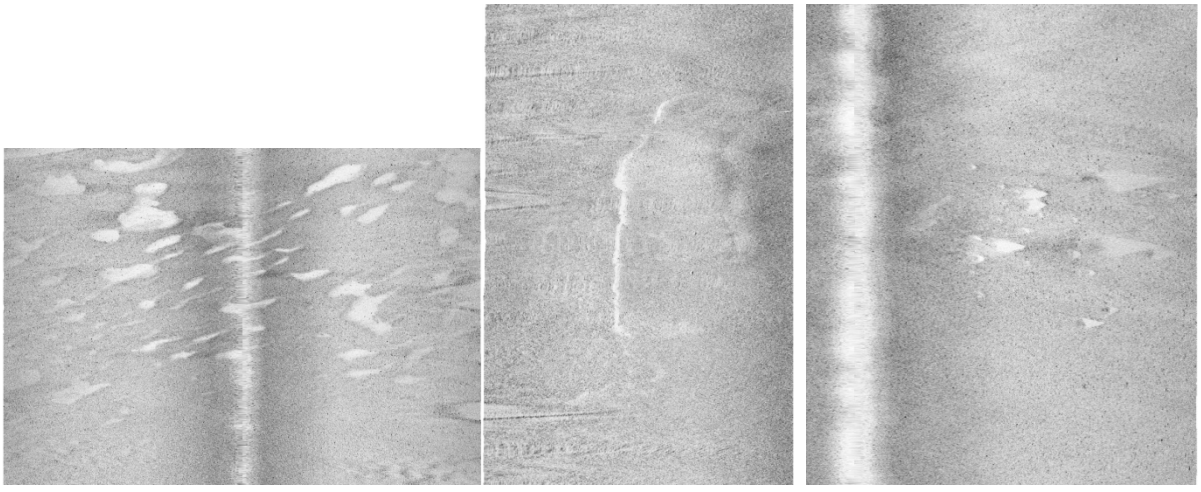


Figure 24. Possible Dumped Materials Observed in Sidescan Data at KP 5.5, 6.4 and 7.2 (left to right)

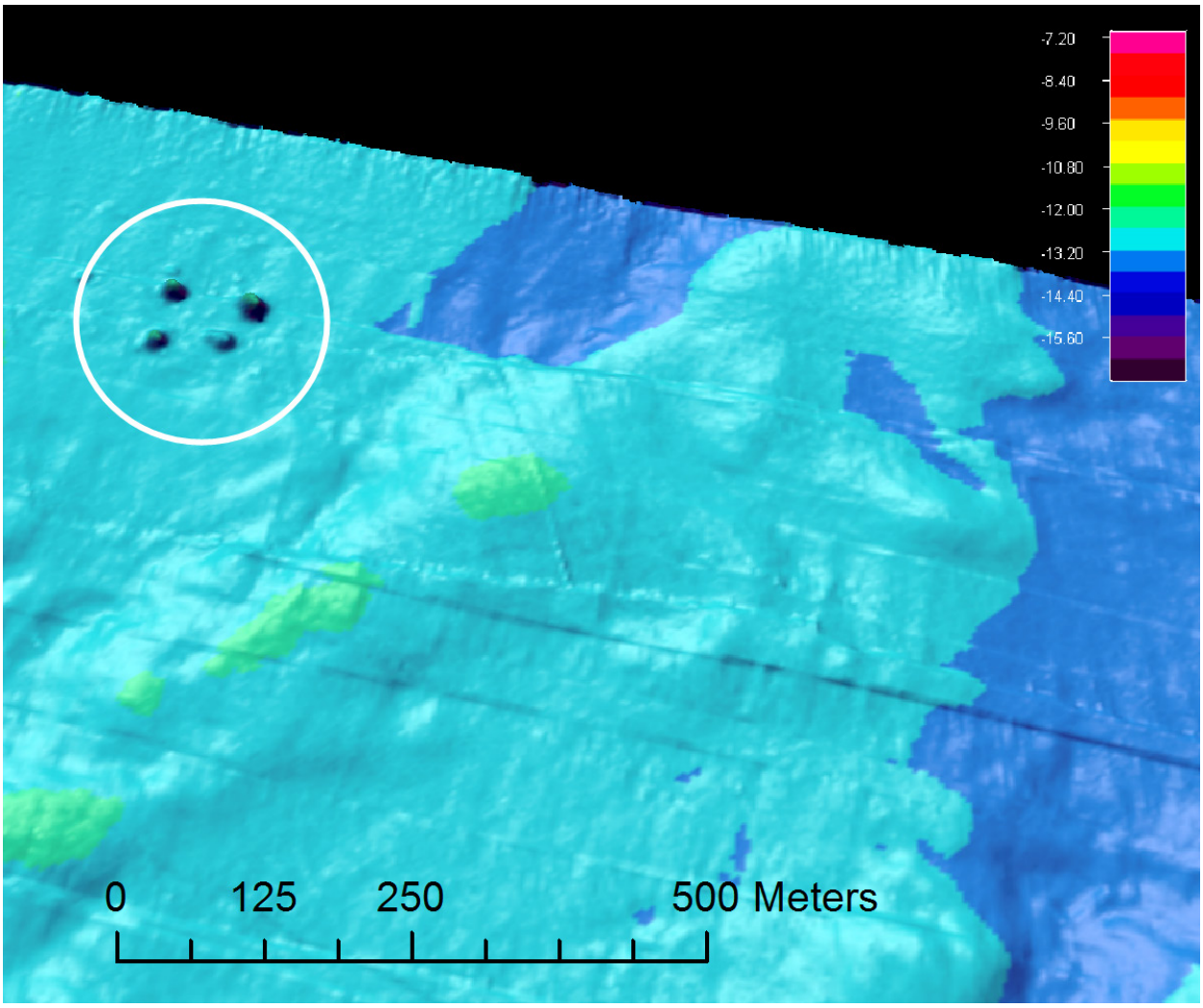


Figure 25. Four Mounds (Upper Left) Detected in the Bathymetry (As Well As Sidescan) Data in the Dam Neck Disposal Site

10.3.4 KP 7.5 – KP 16.5 (Plate 21 Sheet 2 and 3)

Following KP 7.5, the seafloor flattens and gently slopes offshore. Water depths range from 13 to 18 m. Grab samples (GS-023 and GS-025) collected on the smooth seabed near KP 8 and KP 9.5, respectively, contained dark gray silty fine sand with trace shell. Several linear bathymetric features, low sand ridges, cut across the corridor in a south-southwest/north-northeast orientation. These isolated highs are spaced from 400 to 1,200 m apart and are 1 to 2 m high with steeper slopes on the shore-facing side. Two grab samples (GS-024 and GS-026) collected adjacent to these ridges contained brown fine sand with trace shell. Several buried subsurface channels were also identified in this region (Figure 26). Grab samples (GS-027 to GS-031) collected on the smooth sand above these buried features were comprised of gray silty fine sand with shell. Figure 27 shows an example of a subsurface channel in the sub-bottom profile, the interpolated channel across the survey corridor (based on the sub-bottom profiles from all of the survey lines), and the presence of the corresponding anomaly detected in the magnetic total field. Also shown in the sub-bottom profiler record in Figure 27 and also in Figure 28 are small, isolated bright areas, indicating an increase in the seismic reflection amplitude. These features are relatively isolated and randomly distributed vertically

and horizontally in the unit. The absence of diffraction parabolas indicates that it is unlikely that these higher-amplitude areas are the result of isolated hard-targets, such as buried debris or boulders. We interpret these to be due to minor changes in grain size, porosity, and fine-scale sediment layer geometry. Where sediment layering is thin, relative to the wavelength of the acoustic source, constructive and destructive interference occurs, and can cause changes in the received reflection amplitude (Widess 1973). Beds on the scale of this tuning frequency will exaggerate the reflection characteristics of minor grain-size and porosity changes of the sediment. The tuning thickness of the chirp source is in the range of 3 to 15 cm, which is consistent with the scale of minor sediment bedding thickness in these units, as noted in cores VC-004 through VC-007. It is also possible that small areas of increased porosity and minor changes in overlying sediment allow an increase in the concentration of shallow, biogenic gas within the sediment pore space. With no appreciable blanking below these areas noted in the data, the concentration of gas would be quite low and only large enough to influence the reflection coefficient of the units, but should not represent any hazard to cable installation.

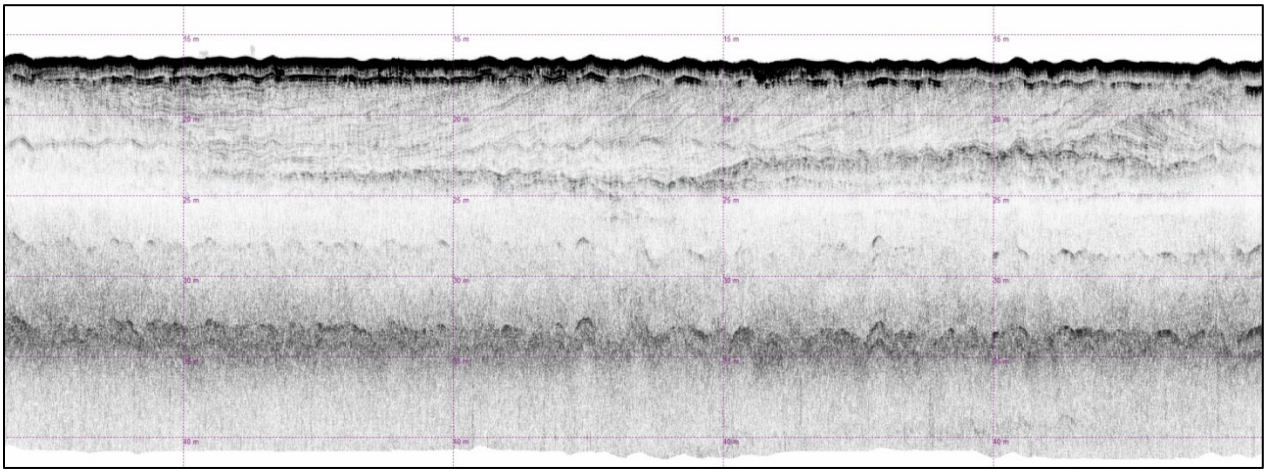


Figure 26. Sand Over Layered Sediments in Subsurface Channels

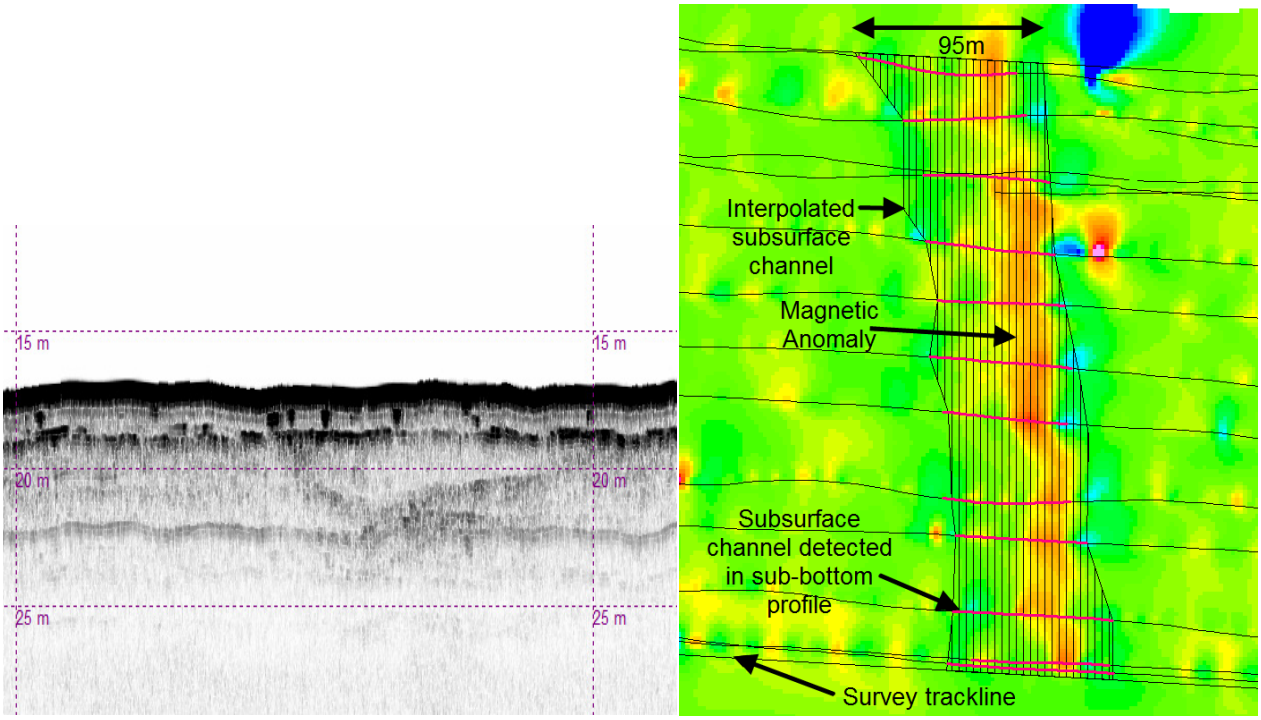


Figure 27. Subsurface Channel Detected in Sub-bottom Profile (Left) and Shown in Plan View Overlain on the Magnetometer Data (Right)

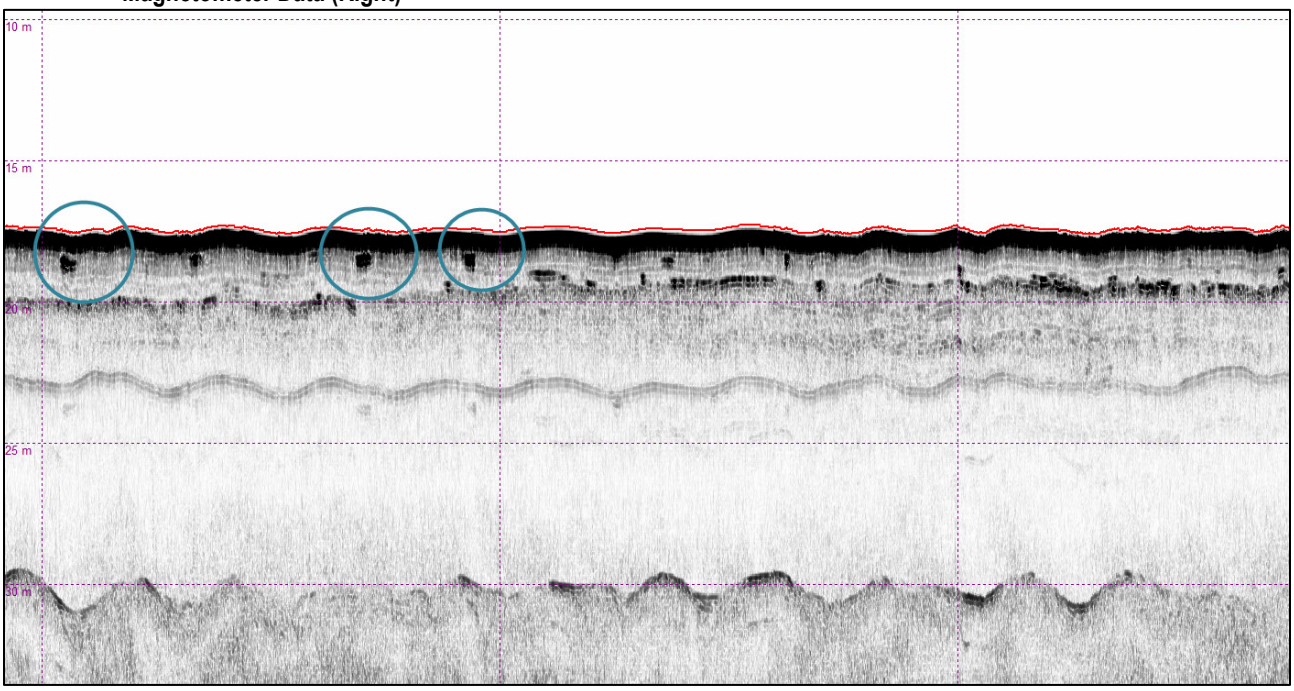


Figure 28. Isolated Bright Spots in the Sub-bottom Profile Between KP 8 and KP 14

At several locations, most notably near KP 15.5, a break in the very low-relief surficial sand cover is observed entering the southern edge of the corridor and extending to the middle of the corridor Figure 29. The underlying layer of sand is exposed at the seafloor, with the grab sample (GS-032) indicating slightly darker gray medium sand with silt and shells compared to the gray, silty fine sand with shells

blanketing the seabed to either side. The distinct boundaries observed in the sidescan imagery may be either erosional or depositional in origin; however, the composition and geotechnical properties are anticipated to be very similar on both sides of this boundary. The survey corridor exits the Dam Neck Disposal Site area at approximately KP 8.5 and exits Danger Zone 334.390 at approximately KP 11.4. There are 7 sonar contacts categorized as debris and 87 magnetometer contacts in this region of the corridor.

Four core samples (VC-004 through VC-007) were collected in this area that contained over 2 m of sediment comprising primarily sand and silty sand; VC-007 also contained thin lenses of clay. These silt, sand, and clay interbeds were observed as faint, discontinuous layers in the sub-bottom profile.

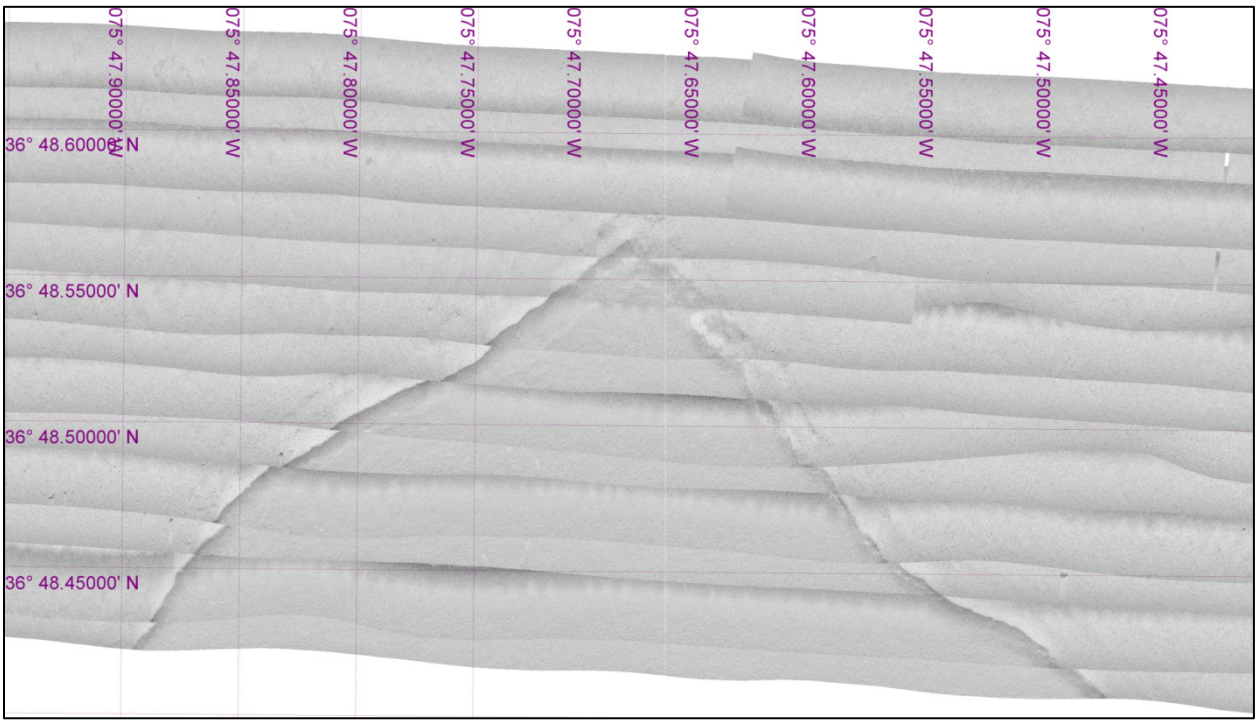


Figure 29. Area of Underlying Medium Sand Exposed on the Seabed

10.3.5 KP 16.5 – KP 22.0 (Plate 21 Sheet 3)

The seafloor character changes after approximately KP 16.5, exhibiting lower overall relief but containing more small-scale features in the bathymetry and sidescan sonar data. This area is one of the deeper points along the survey corridor, with water depths ranging from 19.5 to 21.5 m. The features that occur along this segment of the survey corridor have a bathymetric expression of 0.15 to 0.5 m and a variety of shapes, the most common being small ridges, sheet edges, and circular or oblong localized highs. The features are smaller, with average lateral extents of 15 to 30 m. The orientations of linear and elongated features are north-south or north-northeast/south-southwest. Seafloor composition here is consistently fine to medium sands. Grab samples (GS-033 to GS-37) contained gray fine sand with trace shell with increasing amounts of silt along the survey corridor, with the exception of GS-035 which contained gray medium sand with gravel and shell. The vibracore taken at VC-008, a shallower location within this segment of the corridor, contained units of clean, brown sands, which are generally better sorted and in the medium sand fraction which indicates that the underlying sand sheets and sand ridges likely control the bathymetric relief in this area. Grab samples GS-038 and GS-039 collected near these sand ridges contained light brown to brown

fine sand with shell. VC-009 was collected in a deeper location and contains mostly layers of silty, gray fine sand. Both of these cores contained some gravel. Localized seafloor slopes approach 4 degrees. There are 13 sonar contacts categorized as debris and 34 magnetometer targets in this region of the corridor.

10.3.6 KP 22.0 – KP 29.5 (Plate 21 Sheet 4)

The corridor from KP 22 to KP 29.5 becomes smoother, with features generally increasing in breadth. The depth varies from approximately 17 to 21 m with two broad highs, and with a length of approximately 3 km and 1.8 km representing the underlying sand ridges and sheets. The cores (VC-010, VC-011 and VC-012) and grab samples indicate that the seafloor sediment is primarily fine to medium sands with some gravel. Grab samples GS-040 to GS-042, collected on one of these broad highs contained light brown fine to medium sand with shell. This is consistent with the interpretation that the localized highs are underlain by sand ridges and sand sheets. The clean brown sands indicate a nearshore area of deposition during historic periods of lower sea level. The lack of finer sediment cover shows that currently the area is experiencing bypass or minor erosion and scouring, with minimal modern sediment being deposited. GS-043, collected in a deeper area, contained dark gray fine sand with shell, while GS-044 through GS-046, which were collected on bathymetric highs, contained brown fine sand with shell. Seafloor slopes are generally 1 to 2 degrees with a few isolated areas exhibiting up to 5 degree gradients. There are 24 sonar contacts categorized as debris and 69 magnetometer contacts in this region of the corridor.

10.3.7 KP 29.5 – KP 31.0 (Plate 21 Sheet 5)

The corridor crosses a broad low, which appears to be part of a larger north-south trending linear depression, likely part of an older channel complex or bathymetric low observed in the regional bathymetry. The width of the feature is approximately 775 m with a vertical relief of 4 to 5 m, dropping from approximately 19 m to approximately 24 m. The grab sample from the floor of the low (GS-047) contained dark gray fine sand with silt and trace shell, while GS-048, collected on a surrounding high contained dark gray and light brown fine sand with trace shell. Seafloor slopes are less than 2 degrees. There are 2 sonar contacts categorized as debris and 15 magnetometer contacts identified in this area of the corridor.

10.3.8 KP 31.0 – KP 39.0 (Plate 21 Sheet 5 and 6)

After the channel feature, the corridor shoals to 17 to 20 m water depth and exhibits smaller sand-ridge features with crests oriented either northwest/southeast or east-northeast/west-southwest. The seaward face of these features is steeper (2 to 2.5 degrees) than the more gradual (1 to 1.5 degrees) landward side, as is common with sand ridge features. The east-northeast/west-southwest trending features occur from KP 31.0 to KP 33.0 and KP 35.0 to KP 39.0, while the northwest/southeast orientated features occur from KP 33.0 to KP 35.0. Grab samples collected in this area (GS-49 to GS-055) were comprised of light brown to brown fine sand with shell. This zone of the corridor contains 6 sonar contacts categorized as debris and 99 magnetometer contacts. Core samples collected in this area (VC-013, VC-014, VC-015, and VC-015A) comprise primarily clean brown and gray sand.

10.3.9 KP 39.0 – KP 44.1 (Plate 21 Sheet 6)

Following KP 39 the corridor progresses into an area of deeper water taking it to the edge of Aliquot 6111H. The water depth in the corridor drops from approximately 19 m to below 26 m, a local depth maximum along the corridor. Grab samples collected as the seabed deepens (GS-056 and 057) were comprised of gray

to dark gray fine sand with shell. GS-058, collected where the seabed shoals, contained brown fine sand with shell; while GS-059, collected where the seabed deepens again contained dark gray fine sand with silt and shell. The slope at the initial drop is approximately 4 degrees and trends northwest/southeast across the survey data. Further along the corridor, several isolated areas of approximately 4 degree slopes are also encountered. In the deepest part of the survey corridor just before the boundary with Aliquot 6111H where the seabed shoals on a northeast-southwest trending sand ridge with an approximately 4 degrees maximum slope, the seabed is covered by fine and medium sand, as seen elsewhere, but the shallow subsurface here is composed of finer-grained sediments than observed in other areas of the corridor and is comprised of well-layered fine-grained and coarse-grained sediments. Core samples VC-016 and VC-017 each contain some clay, with VC-017 having over a meter of clay overlain and underlain by sand. A grab sample collected on the sand ridge, which dominates the survey corridor as it meets the lease area, contained brown medium sand with shell. There were 45 magnetometer contacts and 7 sonar contacts in this region of the corridor. Five of the sonar contacts were noted as debris, but two of the contacts have been noted as fish in the water column and are not of concern.

10.4 Lease Area Summary

The following sections describe the conditions within the five 1.2-km by 1.2-km BOEM aliquots (6111 D, H, L and 6112 E, I) that comprise the lease area. Four proposed WTG sites were selected by KBR following preliminary review of the geophysical survey data. These sites, all located within aliquot 6111 H, are presented in Table 37 and are displayed on the charts in Attachment C. Table 38 provides a summary of the features and hazards documented in the lease area, with a more thorough discussion provided in the following sections.

Table 37. Potential WTG Sites

Turbine Name	Easting (m)*	Northing (m)[1/]	Water Depth (m)[2/]
T1A	456196.93	4083479.99	24.3
T1B	456196.93	4082429.99	23.9
T2A	456485.93	4083479.99	24.9
T2B	456485.93	4082429.99	25.9
1/ Coordinates in North American Datum 1983 Universal Transverse Mercator Zone 18N 2/ Water depths are referenced to mean lower low water			

Table 38. Summary of Features and Potential Hazards in the Lease Area

Kilometer Point Range or Aliquot ID	Water Depth (m MLLW)	Predominant Seafloor Sediment Type	Seabed and Sub-bottom Features, Hazards, and Cautions
Aliquot 6111D	21 – 26	Fine to medium sands	Seafloor Features: NW-SE oriented ridges Maximum Seabed Slope: 7-10° Sidescan Sonar: 2 Mag Targets: Scattered: 24 Sub-bottom Features: minor stratified bedding with internal reflectors; reflectors disappear beneath sand ridges Hazards and Cautions: Locally steep slopes on the sand ridges.

Table 38. Summary of Features and Potential Hazards in the Lease Area (continued)

Kilometer Point Range or Aliquot ID	Water Depth (m MLLW)	Predominant Seafloor Sediment Type	Seabed and Sub-bottom Features, Hazards, and Cautions
Aliquot 6111H	24 – 26	Fine to medium sands	Seafloor Features: small shoal, likely sand ridge, in SW quadrant of the aliquot Maximum Seabed Slope: 3° Sidescan Sonar: 2 Mag Targets: Scattered: 62 Sub-bottom Features: Stratified bedding with internal reflectors, some gravel Hazards and Cautions: None
Aliquot 6111L	24 – 26	Fine to medium sands	Seafloor Features: gradual transition from the shoal in the NW corner of the block Maximum Seabed Slope: 3° Sidescan Sonar: 4 Mag Targets: Scattered: 31 Sub-bottom Features: minor stratified bedding with internal reflectors Hazards and Cautions: None
Aliquot 6112E	24 – 27	Fine to medium sands	Seafloor Features: approximately1-m deep linear depression running across the NW corner of the block; otherwise 6112E is the lowest relief of the aliquots surveyed Maximum Seabed Slope: 5° Sidescan Sonar: 2 Mag Targets: Scattered: 37 Sub-bottom Features: minor stratified bedding with internal reflectors Hazards and Cautions: None
Aliquot 6112I	25.5 – 27	Fine to medium sands with silts/clays	Seafloor Features: approximately 2-m high shoal in the SW half of 6112I Maximum Seabed Slope: 3° Sidescan Sonar: 3 Mag Targets: Scattered: 27 Sub-bottom Features: Stratified bedding with internal reflectors Hazards and Cautions: None

10.4.1 Aliquot 6111D

Aliquot 6111D contains the most rugged seafloor features of the surveyed aliquots. Water depths vary between approximately 21 and 26 m. The seabed consists of a series of sand ridges oriented northwest/southeast that appear split and offset in places by northeast/southwest trending channel-like lows, resulting in a hummocky, irregular seabed. These channels appear to possibly link up with deeper channel-like lows in the seaward direction observed in the regional bathymetric dataset. Seafloor gradients are approximately 5 degrees on the shoreward side of the features and up to approximately 10 degrees on the seaward sides.

Grab samples (GS-001 and GS-002) indicate that surficial sediments are fine to medium sands with some silt- to clay-sized materials. Faint, inconsistent reflectors are visible in the shallow-penetration sub-bottom profiler data in the lows between the sand ridges. Two sonar contacts categorized as debris and 24 magnetometer contacts are noted in the aliquot.

10.4.2 Aliquot 6111H

Aliquot 6111H is intersected by the survey corridor on the southwestern side. The more shallow area of the seabed noted at the end of the survey corridor, which appears to be a broad, northeast-trending sand ridge, is

the prominent feature in the block. The bathymetry varies from 24 to 26 m, with the steepest seabed slopes of about 3 degrees found at the transition to the local high in the southwest corner of the aliquot.

Two grab samples collected on the sand ridge (GS-005 and GS-006) comprised brown medium sand with shell. GS-004 collected north of the sand ridge on flat, slightly mottled seabed contained gray fine sand with silt and shell.

Core samples collected at the northwestern proposed turbine location, T1A, included two vibracores (VC-T1A-1A and VC-T1A-2A) that both contained over a meter of sand over clay. VC-T1A-2A contained an additional layer of sand below the clay. The northeastern proposed turbine location, T2A, was sampled with two vibracores and one piston core (VC-T1B-1, VC-T1B-2, and PC-T1B-1). All recovered samples contained sand, with the vibracore samples collecting over 4 m of sand. These results tie in well with the shallow subsurface interpretation based on the sub-bottom profile that the sediments are comprised of layers of fine and coarse-grained sediments, with varying thicknesses of sand at the seabed. The southwestern proposed turbine location, T2A, was sampled with two vibracore and two piston core samples (VC-T2A-1, VC-T2A-2, PC-T2A-1, and PC-T2A-2). Both piston core samples contained over a meter of sand, and both vibracore samples contained about 3 m of sand, with 1 m of clay at the base of core T2A-1. The southeastern proposed turbine location, T2B, was sampled with two vibracores and one piston core (VC-T2B-1, VC-T2B-2, and PC-T2B-1). Again, the piston core recovered about a meter of sand, and both vibracore samples contained about a meter of sand over clay and sand layers. Vibracore samples at three of the turbine locations (VC-T2A-1, VC-T2B-1, and VC-T2B-2 also contained a thin layer of gravel above the clay layer. Again, the vibracore results support the interpretation of shallow subsurface sediments composed of interbedded sands and clays, with an overlying layer of sand and sand ridges. Two sonar contacts have been identified in this aliquot and are categorized as debris. There are 62 magnetometer contacts in this aliquot.

10.4.3 Aliquot 6111L

Aliquot 6111L is crossed by the same localized bathymetric high, likely a sand ridge, observed in Aliquot 6111H. The depths in the block range between 24 and 26 m. The transition from the high in the northwest portion of the block is more gradual and less well defined than in the block to the north. Seabed slopes have a maximum of approximately 3 degrees. The seabed is composed of interbedded sands and clays. Grab sample GS-008, collected on the sand ridge, comprised brown medium sand with shell. GS-009, collected on the hummocky edge of the sand ridge was comprised of brown fine sand with shell; and GS-007, which was collected in the slightly deeper, more flat area of the aliquot where the seabed is fairly smooth and shallow-penetration sub-bottom profiles show sand over layered sediments, was comprised of gray fine sand with silt and shell. In some areas the seabed has a mottled appearance, likely due to the mixing of medium brown sand from the sand ridge mixing with the finer-grained sands and silts of the surrounding seabed. Shallow sub-bottom profiles show that the layer of fine and medium sand in these mottled areas is about a meter, over layered fine and coarse-grained sediments. Four sonar contacts were identified, with one being attributed to geology, and the rest were categorized as debris. There are 31 magnetometer contacts in this aliquot.

10.4.4 Aliquot 6112E

Aliquot 6112E has the lowest relief of the aliquots surveyed. A linear depression approximately 75 m wide and 1 m deep cuts across the northwest corner of the aliquot, trending NNE-SSW adjacent to a NE-SW trending sand ridge that has been cut and offset similar to the ridges in Aliquot 6111D. Additional lower relief hummocky seabed is present in the northeast corner of the aliquot. The rest of the area is relatively featureless, with a smooth seabed. Two grab samples (GS-010 and GS-011) collected on the smooth seabed contained dark gray fine sand with silt and shell. Localized slopes near the linear depression approach 5 degrees, but the remainder of the area is very flat. The shallow subsurface is composed of fine sands and silts expressed as faint continuous to discontinuous layers in the shallow-penetration sub-bottom profiles; the overlying sand layer is thickest (approximately 4 m) in the northern part of the aliquot and thins to the south. An third grab sample (GS-012) collected in the northwestern corner of the aliquot adjacent to the sand ridge contained gray fine sand with shell. Two sonar contacts (SC-LA-009 and SC-LA-012) are identified in the aliquot, with both being attributed to geology. There are 37 magnetometer contacts in this aliquot.

10.4.5 Aliquot 6112I

An approximately 2 m shoal in the southwest half of Aliquot 6112I is the predominant feature observed in the aliquot and appears to be another NE-SW trending sand ridge. Abundant, symmetrical, NW-SE ripples are superimposed on the feature. Grab sample GS-013 collected on the sand ridge was comprised of brown medium sand with shell. The seafloor is relatively flat and smooth both below and on top of this feature, with the maximum observed slopes reaching approximately 3 degrees. The depth ranges from approximately 25.5 to 27 m, making this the deepest aliquot surveyed. A grab sample collected in the deepest part of this aliquot (GS-014) consisted of sandy clay. A third grab sample (GS-015) collected on the smooth seabed to the north of the sand ridge contained gray fine sand with silt and shell. Three sonar contacts have been identified and categorized as debris. There are 27 magnetometer contacts in this aliquot.

10.5 Summary of Shallow Hazards

10.5.1 Natural Seafloor Hazards

The geophysical and geotechnical datasets were analyzed for shallow hazards, which could pose a potential risk to the installation, operation, and maintenance of the VOWTAP were selected to avoid known hazards, both natural and man-made. As such, few areas of concern were encountered during the survey of the Project Area. Table 39 summarizes major types of seafloor hazards and associated details observed during the survey, as necessary.

Table 39. Survey Corridor and Lease Area Seafloor Hazards

Hazard	Definition	Identification and description
Steep seabed slopes	Steep seafloor gradients, posing a risk of unstable seabed and complications during installation	Not present
Sediment failure / mass movement	Large-scale movement of the seabed due to gravity, such as slumps and slides	Not present
Hard grounds	Rock or lithified sediments	Not present
Diapiric structures	Structures caused by the movement and flow of ductile sediments due to pressure	Not present

Table 39. Survey Corridor and Lease Area Seafloor Hazards (continued)

Hazard	Definition	Identification and description
Bedforms and sand waves	Current controlled deposition of sediment, causing variable or wavy seabed. Large-scale sediment waves pose an issue for cable burial and subsea installations	Present throughout the surveyed area. A variety of bedforms are observed including sand ridges and sediment ripples. Movement/migration of sand ridges is anticipated to be minimal and does not pose a risk to the planned installations. Sediment ripples observed are sub-meter scale and do not pose a hazard to the subsea assets or cable burial
Faulting	A feature caused by relative movement of adjacent portions of seafloor, due to deeper movements of the Earth's crust or by shallower differential compaction of soft sediments	Not present
Fluid or gas expulsion	Movement of gas or fluid through the seabed and into the water column	Not present
Water scour	Erosion of seabed due to tidal, storm-induced, or other currents along the seabed	Present throughout the surveyed area. Areas of scour were observed near the base of sand ridges and other bathymetric features, where the current is concentrated in these areas. Scour appears to be minimal to moderate
Ice scour	Gouges in seabed caused by the movement of pack ice	Not present
Channels	Pathway taken by water and sediment flowing due to gravity	Present. Sub-surface channel-like features observed in the sub-surface sediments at approximately KP 10 to 15.5 are likely relic and no longer contain any substantial flow The origin of channel-like lows mapped between offset sand ridges in Aliquot D are unknown but are not expected to contain substantial current or sediment flow.

10.5.2 Natural Sub-seafloor Hazards

The shallow and medium-penetration sub-bottom profiler data were analyzed to identify possible hazards below the seabed. The penetration of the profiler systems is variable and dependent on geology, and typically ranged from 5 to 10 m (16 to 33 ft) and up to 15 m (49 ft) in the corridor using the CHIRP. Refer to Section 10.2.4 for additional details. Table 40 lists common subsurface hazards and identifies those found during the survey. The sub-bottom profiles were generally unremarkable, as evidenced by the imaged stratigraphy (Attachment A – Digital Deliverables). Infilled channels were observed in the subsurface from approximately KP10 to KP15.5.

Table 40. Survey Corridor and Lease Area Shallow Sub-bottom Hazards

Hazard	Definition	Identification and description
Shallow faults	A feature caused by relative movement of adjacent portions of seafloor, due to deeper movements of the Earth's crust or by shallower differential compaction of soft sediments	Not evident
Sediment failure / mass movement	Large-scale movement of the seabed due to gravity, such as slumps and slides	Not evident
Shallow gas	Buildup of gas due to biological or chemical processes and trapped by less permeable layers in the seabed	Not evident

Table 40. Survey Corridor and Lease Area Shallow Sub-bottom Hazards (continued)

Hazard	Definition	Identification and description
Shallow rock or hard ground	Rock or lithified sediments subcropping the seafloor	Not evident
Diapiric structures	Structures caused by the movement and flow of ductile sediments due to pressure	Not evident
Fluid or gas expulsion	Movement of gas or fluid through the seabed and into the water column	Not evident
Degradation of permafrost	Instability and subsidence due to melting of permafrost layers in the subsurface	Not evident
Channels	Former pathways of the transport of water and sediment due to gravity, partially or fully filled in by sedimentation	Present from KP10-KP15.5. Channel-like features observed in the sub-bottom profile and range in size from 10s to 100s of meters wide. Most are below the likely depth of cable burial

10.5.3 Man-made Hazards

Anthropogenic hazards can be present on the seafloor or in the shallow subsurface. Table 41 lists potential man-made hazards and identifies those found during the survey.

Table 41. Corridor and Aliquot Man-made Hazards

Hazard	Definition	Identification and description
Shipwrecks	Wreckage and debris from lost vessels	None identified, to be confirm by archeological review
Debris	Discarded or lost objects on or below the seafloor	Present throughout the survey corridor and lease area. Low concentration of sonar targets should be able to be avoided during engineering of the survey corridor
Cables	Power or telecommunications cables, typically buried in the seabed in shallow water depths.	Not present
Pipelines	Linear conduit for transporting liquid or gas	Not present
Ordnance	Detonated or undetonated ammunitions	Possible between KP0 to KP11.4. The survey corridor is adjacent to an identified UXO area near the landing and passes through two firing ranges (Danger Zone 334.380 and 334.390) before exiting at KP 11.4. Some risk of UXO out to KP 29, as the survey corridor runs parallel and within 1.3 km of Danger Zone 334.390. Some sidescan and magnetometer targets could potentially be UXO. Further UXO survey and investigation should be considered.
Cultural resources	Historically significant objects or sites	None identified, to be confirmed by archeological review

The gradiometer survey conducted over the survey corridor and lease area screens for ferrous objects on the seafloor and in the shallow subsurface. A significant number of magnetic anomalies were detected in the Project Area (refer to the Magnetometer Contacts Report in Attachment G). Since the first 11.4 km of the survey corridor are within an active firing range (Danger Zone 334.380 and 334.390), there is a possibility that UXO could be encountered within this region. It is recommended that surveys specifically designed for UXO detection and evaluation be conducted as necessary within the firing ranges prior to cable installation. Coordination with the military regarding their exercises and the timing of clearance and cable installation operations will be critical.

11 CONCLUSIONS AND RECOMMENDATIONS

Tetra Tech's VOWTAP marine survey efforts successfully surveyed and delineated surface and subsurface conditions of the seafloor in the vicinity of proposed offshore Project facilities. Seafloor and subsurface characterization of the Project Area was completed through analysis and interpretation of survey information including water depths and bottom topography, sidescan sonar imagery, marine magnetic data, shallow and medium-penetration sub-bottom profiling, and a geotechnical investigation that included the collection processing, and laboratory testing of sediment grabs and core samples.

The result of the geophysical and shallow geotechnical surveys indicate that both the survey corridor and lease area have conditions that are favorable for the construction, operation, and maintenance of the proposed VOWTAP facilities. The survey corridor is dominated by low-relief sandy seabed, exhibiting minor undulations, with broad lows and highs related to underlying sand ridges and sand sheets. The seafloor itself is either smooth or contains small ripples. Generally, seabed slopes range from 2 to 4 degrees, with slightly greater slopes being highly isolated. The shallow subsurface does not contain geological features that will prevent the installation of the proposed cable to a target burial depth of 2–3 meters. The composition of seabed in the survey corridor is generally interbedded sands and silty sands with some clay. There are numerous sidescan and magnetometer contacts throughout the route; however, none of these identified contacts will have significant impact on the construction and/or operation of the proposed cable. Objects identified within the survey corridor and/or lease area can be avoided and/or mitigated. A potential risk to the construction and operation of the cable is associated with the approximately 6.5 mile (10.4 km) survey corridor crossing of two firing areas (334.380 and 334.390) located east of the Dam Neck naval facility (KP 1.40 to KP 11.8) where there is the potential for UXO. Additional surveys specifically designed for UXO detection and evaluation should be conducted as necessary in and in the vicinity of the firing areas prior to cable installation. These surveys will need to be performed in close coordination with applicable military stakeholders to ensure the safe installation of the submarine cable in this area.

The lease area is dominated by smooth, sandy seabed, with more relief noted in Aliquot 6111D than in the remainder of the aliquots. Broad highs that appear to be sand ridges are observed across Aliquots 6111H and 6111L and the southeastern corner of 6112I. Excluding at the transitions to these localized shoals, the lease area exhibits very flat topography with slopes of less than 2 degrees. Shallow subsurface conditions in the lease area are comprised of interbedded sands, silts, and clays and are indicative of conditions suitable for installation of WTGs. However, in accordance with BOEM regulations (30 CFR Part 585), additional geotechnical investigations will be required in the direct vicinity of each WTG foundation to support the final engineering design.

12 REFERENCES

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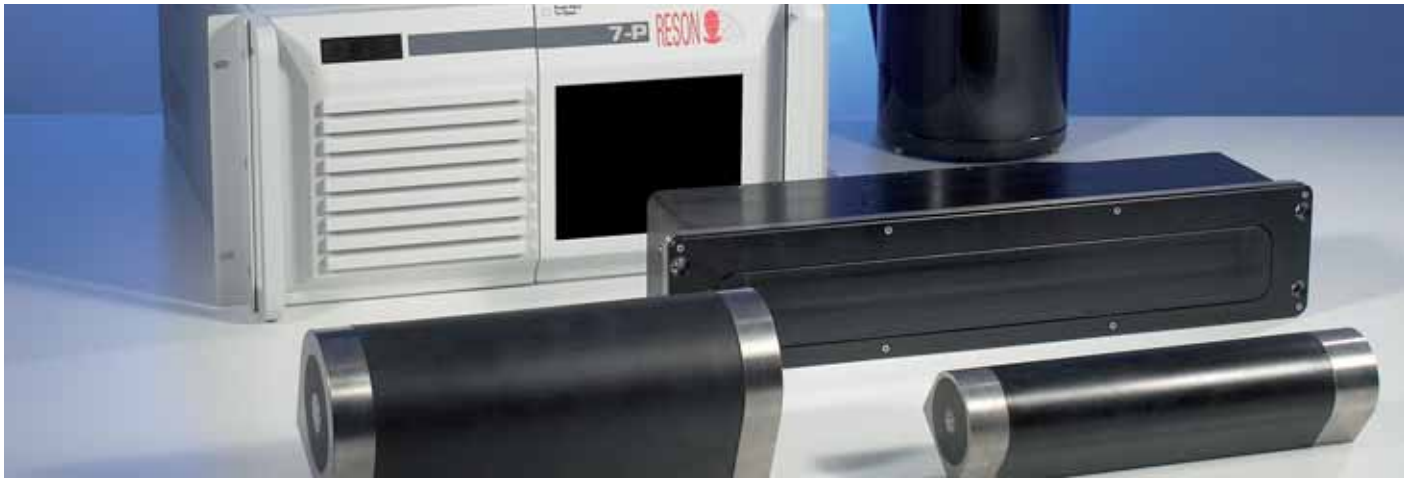
Attachment A – Digital Deliverables

[Delivered on Hard Drive]

Attachment B – Equipment Specifications

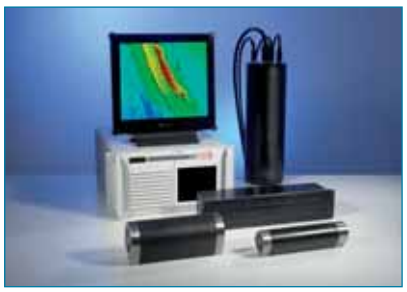
SeaBat 7125

High-Resolution Multibeam Echosounder System



SeaBat 7125

- **Unparalleled Resolution and Installation Flexibility**
- **Single or Dual-Frequency Operation (200 and/or 400kHz)**
- **256 or 512 Focused 0.5° Beams at 400kHz (1° at 200kHz)**
- **128° Swath Coverage (4x Water Depth)**
- **400 meter Depth Rated (6000 meter option)**
- **Built-in test environment (BITE)**



The new generation SeaBat 7125 represents yet another technological breakthrough in high quality performance. With unparalleled resolution and installation flexibility, the SeaBat 7125 is ideal for a great variety of hydrographic, offshore, military, sidescan & snippets applications from a surface vessel, ROV or AUV to 6000 meter depth.

The SeaBat 7125 is a single and / or dual frequency (200/400kHz) multibeam echosounder system. In the 200kHz configuration, the receiver forms 256 equi-angle or equi-distant dynamically focused 1° receive beams to cover a 128° swath, with a maximum range of 500 meters. In the 400kHz configuration, the receiver forms 256 equi-angle focused 0.5° receive beams or 512 in equi-distant mode, to cover a 128° swath, with ultra high resolution and a typical range of 200 meters.

The SeaBat 7125 is controlled by the 7-P, a high performance Sonar Processor that manages data flow and signal processing using a state-of-the-art FPGA architechture. The 7-P provides a Windows®-based GUI user interface, allowing system configuration, control, data output, storage and built-in test environment (BITE) displays to assist the operator.

Equi-distant or equi-angular beam spacing across the entire swath is selectable by the operator to provide uniform sounding density and maximize usable outer swath. Data logging of beamformed water column data or pre-beamformed stave data to a RAID disk system is also optionally provided.

The SeaBat 7125 receiver sonar head design provides increased bandwidth, improved dynamic range and noise immunity over earlier models and makes full use of Commercial-off-the-Shelf (COTS) hardware and software to increase cost effectiveness with a well defined path for future upgrades and expansion.

SeaBat 7125

High-Resolution Multibeam Echosounder System

SYSTEM PERFORMANCE

Frequency:	200kHz	400kHz
Max Range:	500 m	200 m
Swath Coverage:	128°	128°
Beamwidth:	1° x 2°	0.5° x 1°
Number of Beams:	256 Equi-angle or Equi-distant	256 / 512 Equi-angle or 512 Equi-distant
Max Update Rate:	50 Hz	50 Hz
Waveform:	Gated CW	Gated CW
Depth Resolution:	5 mm	5 mm
Pulse Length:	20 to 300 µseconds	10 to 300 µseconds
Depth Rating:	400 m (standard) 6000 m (option)	400 m (standard) 6000 m (option)

INTERFACE

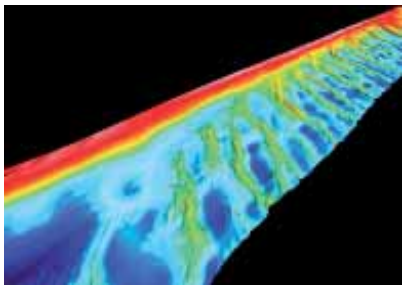
System Control:	7-P Processor Unit
Power Requirements:	48V DC 58W (Provided by sonar processor) 110/220 VAC 50/60Hz, 300W
Data Transfer:	Ethernet,1Gbit

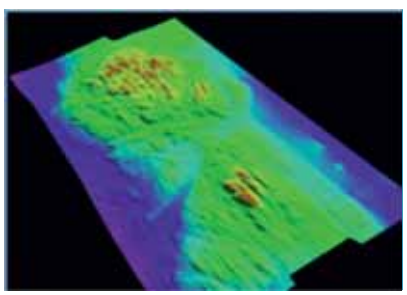
MECHANICAL

Weight:	200kHz	400kHz
Receive Array:	9.6 kg (dry), 4.6 kg (wet)	9.6 kg (dry), 4.6 kg (wet)
Transmit Array:	7.5 kg (dry), 6.4kg (wet)	2.75 kg (dry), 1.75 kg (wet)
7-L LCU:	15.7 kg (dry), 5.2 kg (wet) 7-P	15.7 kg (dry), 5.2 kg (wet) 7-P
Processor:	30 kg	30 kg
Dimensions:		
Receive Array:	102 x 496 x 131 mm	102 x 496 x 131 mm
Transmit Array:	100 x 259 x 117 mm	62 x 285 mm
Link Control Unit:	530.9 x 174 mm	530.9 x 174 mm
7-P Processor:	431 x 146 mm	431 x 146 mm
Temperature:	Operating: 0° to +40° C	Operating: 0° to +40° C
	Storage: -30° to +55° C	Storage: -30° to +55° C

OPTIONS

AUV Configuration	SVP-70 Sound Velocity Probe
Dual Frequency	Extended Warranty / Support & Maintenance Contracts
Mounting Bracket with Fairing	Beam Data Recording & High Speed Export (includes 1TB external RAID array)
10m Array to LCU Cable Set	Fiber-Optic Conversion for ROV Installations





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Version: B066 070724 / US

2000-DSS

INTEGRATED Sub-Bottom & Side Scan Sonar

Advanced System for Survey Professionals

Model 2000-DSS Towfish

EdgeTech, the market leader in deep water sonar systems since 1965, now offers the ***2000-DSS***, an integrated combined system that gathers side scan and sub-bottom data utilizing EdgeTech's proprietary Full Spectrum CHIRP technology in water depths up to 2000 meters.

The 2000-DSS System is available with either 100/400 kHz or 300/600 kHz dual simultaneous CHIRP side scan sonar frequencies in addition to a wideband 2-16 kHz sub-bottom profiler.

A standard 2000-DSS System comes complete with a combined towfish, digital telemetry that runs over a single coaxial cable up to 6000 meters long and a 19 inch rack mount topside processor running EdgeTech's DISCOVER acquisition software. Additionally, the 2000-DSS System can be integrated with a number of auxiliary sensors such as magnetometer, depth, altitude and USBL responder.

The 2000-DSS System is priced competitively and has an exceptional price performance value.

Features:

- Dual simultaneous CHIRP side scan sonar frequencies (either 100/400 kHz or 300/600 kHz)
- CHIRP 2-16 kHz sub-bottom profiler
- 2000 meter depth rating
- Turn key system; easy to operate
- Superior resolution, range & penetration
- Digital telemetry over single coaxial cable
- Improved SNR from Full-Spectrum CHIRP signal processing
- Built-in motion, heading & temperature sensors
- Modular design allows easy sensor removal and integration in AUV/UUV/ROV/ROTV
- EdgeTech quality & reliability you can depend on backed by 24/7 support

Options:

- Integrated magnetometer
- Integrated pressure/depth sensor
- Integrated tracking system
- Interface to 3rd party topside

Applications:

- Geological & geophysical surveys
- Archeological surveys
- Sediment classification
- Buried pipeline and cable location
- Dredging studies
- Coastal studies
- Scour/erosion investigation
- Marine construction surveys

2000-DSS SUB-BOTTOM & SIDE-SCAN SONAR SYSTEM

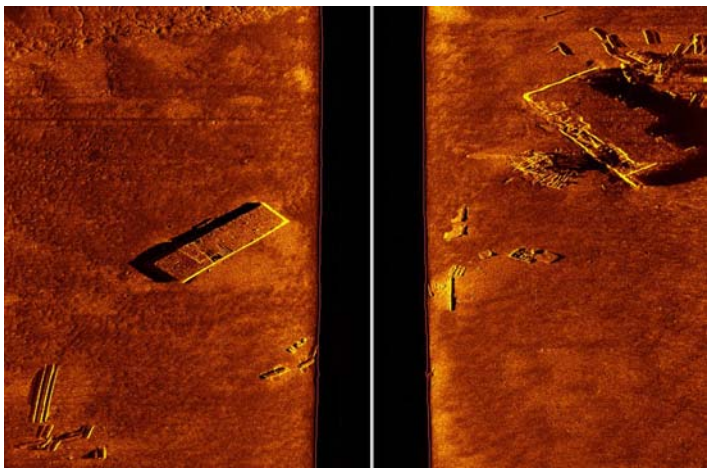
Key Specifications

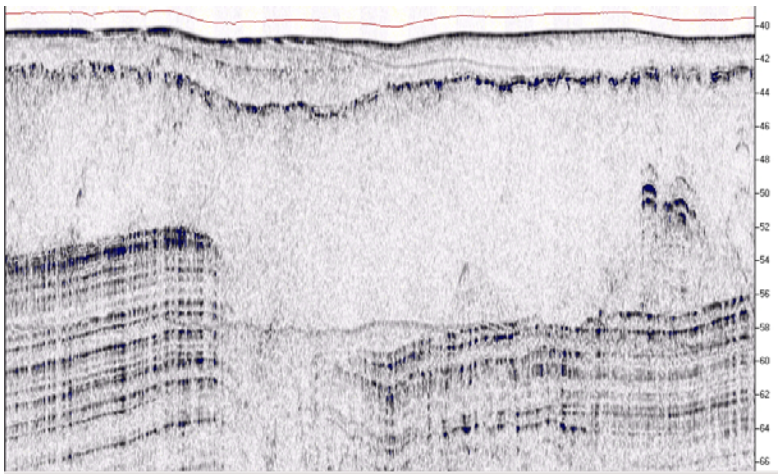
Side Scan Sonar Specifications		
Frequency (nom.)	100/400 kHz	300/600 kHz
Operating Range	100 kHz: 500 meters/side 400 kHz: 150 meters/side	300 kHz: 230 meters/side 600 kHz: 120 meters/side
Beam Width (2-way) & Along Track Resolution	100 kHz: 1.08 deg or 1.90 m @ 100 m 400 kHz: 0.56 deg or 0.96 m @100 m	300 kHz: 0.6 deg or 1.0 m @ 100 m 600 kHz: 0.26 deg 0.45 m @ 100 m
Across Track Resolution	100 kHz: 6.3 cm 400 kHz: 1.8 cm	300 kHz: 2.8 cm 600 kHz: 1.4 cm

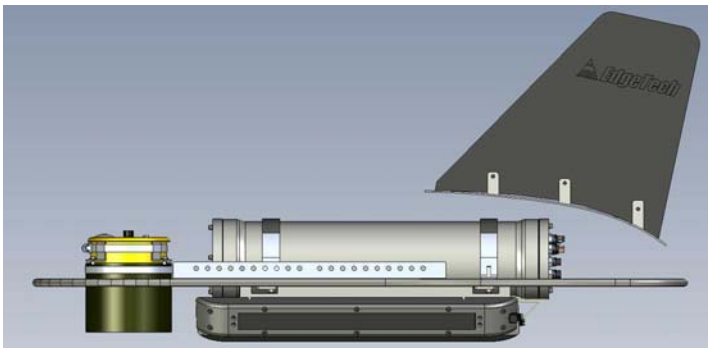
Sub-bottom Profiler Specifications	
Frequency Band	2 - 16 kHz
Resolution	6 - 10 cm
Penetration (typical in soft material)	60 - 80 m

Towfish Specifications	
Length	145 cm (57”)
Width	74 cm (29”)
Height	84 cm (33”)
Weight (air/water)	145 kg (320 lbs) / 78 kg (172 lbs)
Maximum Water Depth	2000 meters

Specifications subject to change without notice.







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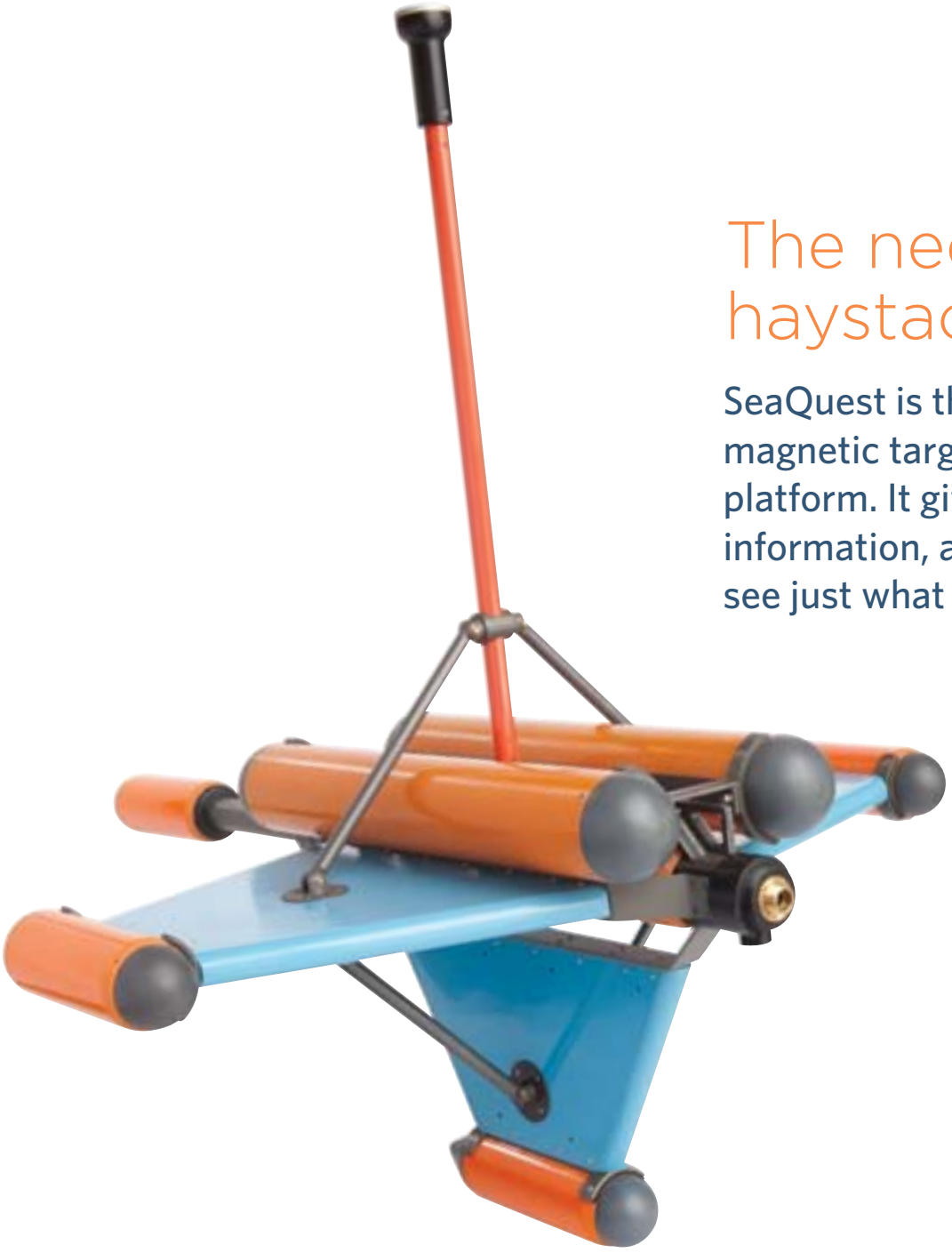
SeaQuest

3-Axis Gradiometer



The needle in a haystack finder

SeaQuest is the ultimate magnetic target detection platform. It gives you more information, and helps you see just what you want to see.

Marine Magnetics

Features

The Overhauser Effect

Marine Magnetics' SeaQuest gradiometer measures the ambient magnetic field using a specialized branch of nuclear Magnetic Resonance technology, applied specifically to hydrogen nuclei.

Highest Absolute Accuracy

SeaQuest has the best absolute accuracy of any marine gradiometer: 0.1nT.

High Sensitivity

SeaQuest sensors deliver high-resolution output with a noise level of 0.01nT; counter sensitivity is 0.001nT.

Worldwide Operation With No Restrictions

SeaQuest is entirely omnidirectional, meaning you never have to orient your sensor because it is already optimized to work around the world. As a result, regardless of where you are in the world and no matter what the magnetic field strength is, your SeaQuest sensors will continue to provide a strong signal and accurate data.

Maintenance-Free Sensors, No Realignment and No Consumable Parts

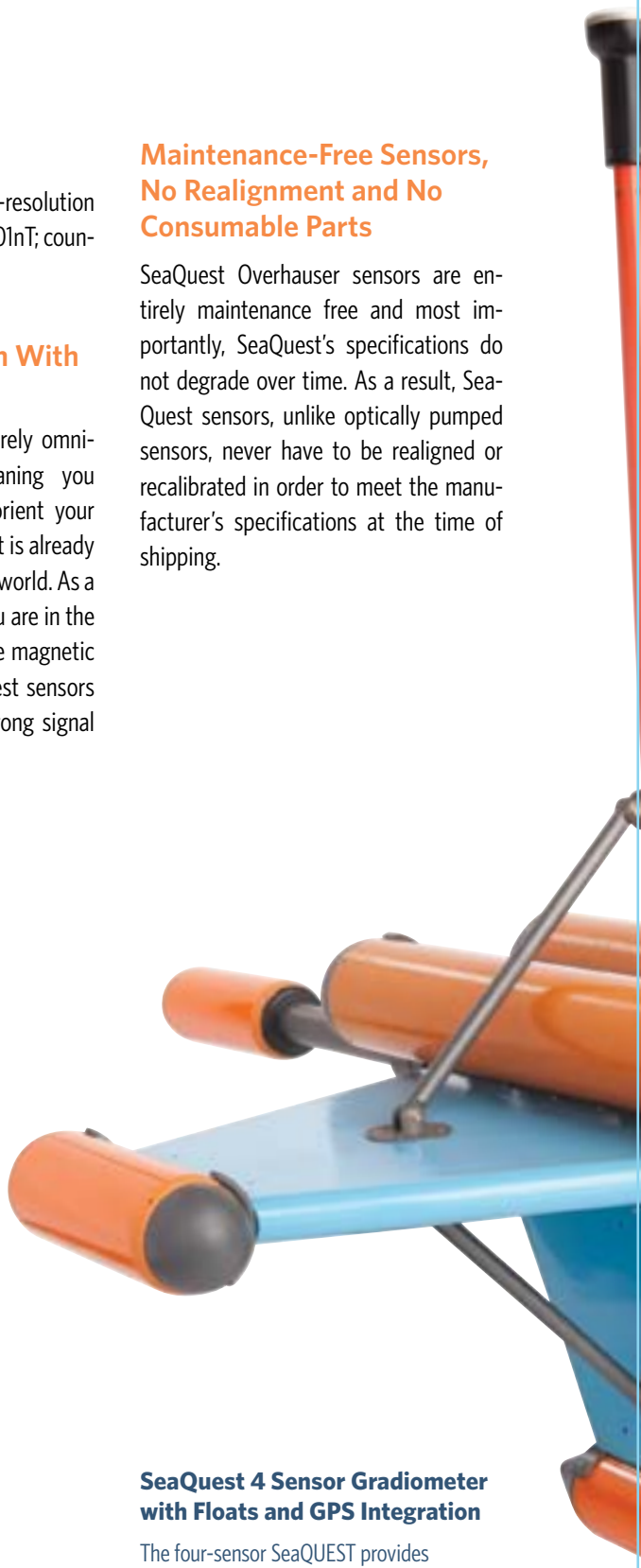
SeaQuest Overhauser sensors are entirely maintenance free and most importantly, SeaQuest's specifications do not degrade over time. As a result, SeaQuest sensors, unlike optically pumped sensors, never have to be realigned or recalibrated in order to meet the manufacturer's specifications at the time of shipping.

Stability and Durability

Accidents happen. SeaQuest's hard-anodized aluminum frame is ready for them, providing strength and rigidity while keeping weight down. Most of the frame is covered with an ultra-tough and flexible composite that forms the surface area of the wings protects the frame from impact.

All cables are contained within the pressurized sub-housings, or within the hollow free-flooded wings. This, coupled with its sleek, swept design minimizes the ability to snag foreign objects and debris. The entire structure is designed to deflect impact rather than absorb it.

The bottom-wing ballast weight keeps SeaQuest's center of gravity lower than the towing axis, keeping pitching and rolling motion to a minimum. The large surface area of the wings ensures that the platform will tow straight and smooth, even in high sea states. All this comes together to produce the highest quality data possible in a towed marine gradiometer.



SeaQuest 4 Sensor Gradiometer with Floats and GPS Integration

The four-sensor SeaQUEST provides horizontal, vertical, and longitudinal gradient measurements. A floatation sub-assembly keeps the gradiometer within metres of the water surface. An on-board GPS receiver enables the system to append a position to each measurement.

On-Board Sensors

In addition to our Overhauser sensors, accuracy is further improved by the integrated tilt sensor. The sensor continuously monitors the tiniest platform movements caused by rough seas, telling the operator exactly how 'horizontal' and 'vertical' the gradient measurements are. The echosounder/altimeter measures bathymetry with 0.1m precision, which provides a precise reference for the vertical gradient measurement, and allows continuous compensation for magnetic variation caused by igneous bedrock.

Floats

This makes deployment and retrieval very easy, as the vessel can be stopped and the tow body can be brought in by hand, with very little resistance.

The floats can be adjusted to sit more forward or aft on SeaQuest, presetting its natural pitch in the water. When the floats are forward, SeaQuest will remain at the surface at any speed. In aft positions, the SeaQuest wings act as a depressor, causing it to descend to a fixed depth at a fixed speed.

The floats are air-filled, and equipped with pressure relief valves. If the floats are damaged and leak under pressure, the valves will allow any internal pressure to dissipate slowly as SeaQuest is brought to the surface

On-Board GPS

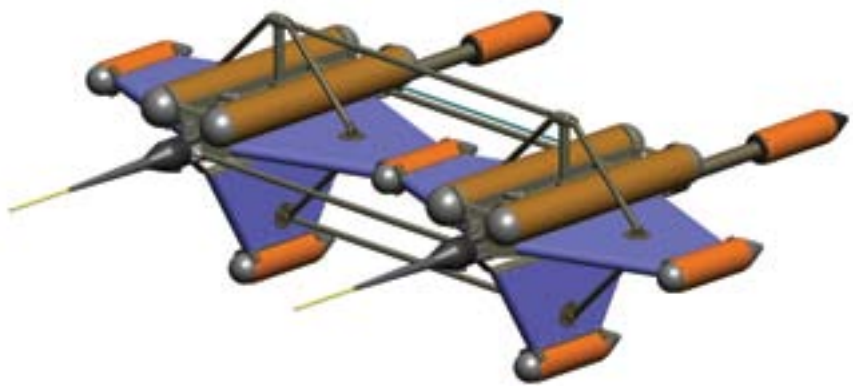
SeaQuest's floatation assembly can be equipped with a GPS mast. With the system configured to tow up to 1.5m below the surface, SeaQuest will position its gradiometer data with the onboard GPS, providing unmatched positioning accuracy. The GPS antenna is engineered for marine use, and is fully waterproof and submersible.

SeaQuest is Ideal For

- UXO and mine detection
- Cable and pipeline tracking
- Environmental survey
- Archaeology

I have been using a complete 2-unit SeaQuest array and have found the magnetic data delivered to be excellent, with less than one nano-tesla of variability in the total gradient (analytic signal).

Richard Funk, Geophysicist



SeaQuest 7 Sensor Array with Floats

The SeaQuest Array combines seven sensors to provide two sets of horizontal, vertical and longitudinal gradients.

Case Study

Mapping Marine Ferrous Targets Using the SeaQuest Gradiometer System

The figures on the right show the results of a target survey conducted by the United States Naval Undersea Warfare Center (NUWC) – Keyport, WA. The images show the striking contrast between conventional magnetometer (total field) data and the high resolution gradient data obtainable with SeaQuest.

Figure 1 shows the total magnetic field data collected by the top sensor of the SeaQuest platform. This image represents data that would be obtainable by a conventional total field survey and is presented for comparison purposes. The total field image is dominated by north-south trending curvilinear anomalies, which are likely related to magnetic susceptibility variations in the bedrock. This strong background magnetic response makes it difficult to quickly identify anomalies associated with ferrous objects. Presenting the total field grid with a 'stretched' colour-scale allows identification of at least four potential ferrous targets in the western half of the survey site.

In contrast, the total gradient map (Figure 2) allows easy identification of at least 12 (high-confidence) ferro-magnetic objects within the survey block. The wavelengths associated with the geological magnetic effects are effectively suppressed in this image in comparison to the total field image. Targets are defined by simple 'bulls-eye type' positive anomalies, which are centered over the target position. In the western part of the survey block, a low amplitude NNW-trending linear anomaly is present. This anomaly corresponds to a known pipeline marked on the marine charts of the area. It is worth noting that the amplitude of the pipeline anomaly is less than 0.5nT/m, and yet it is clearly visible in the total gradient map.

Also of interest is the large anomaly east of the center of the map. Despite its size, the anomaly is obscured by geology in the total field data, yet it shows up prominently in the total gradient data.

It is easy to see that the total gradient (Analytic Signal) directly measured by SeaQuest provides the clearest results, effectively creating an intuituve magnetic 'image' of the sea bottom. While the singleaxis gradient results enhance only certain types of anomalies based on their geographic direction, the total gradient is effectively a direction-independent result, enhancing all near-surface anomaliesequally, and suppressing deep geology evenly.

Magnetic gradient is commonly used to enhance the signals from small, relatively close sources typical of iron manmade objects, and to suppress the signals from large distant sources associated with geological variation. The total gradient technique goes even further by eliminating the directional dependence of conventional gradiometer methods. This produces an easily interpreted magnetic 'image' of the sea floor, with target positions unambiguously marked by 'bulls-eye' type anomalies. Also, the total gradient anomalies are expressed with a higher signal-to-background-noise ratio than with conventional techniques, enabling the identification of tiny targets that would otherwise be invisible.

The SeaQuest gradiometer platform enables the acquisiton of high-quality total gradient data because of its hydrodynamic stability and the high absolute accuracy of its sensors, producing clean results free from heading errors and offsets. Despite high currents and demanding conditions, SeaQuest provided consistent results that did not require the filtering or level-shifting that are necessary steps, yet large sources of calculation error, for other gradiometer instruments.

For a more comprehensive discussion on the threory of total-field gradiometry see the detailed case study available for download from our website at www.marinemagnetics.com

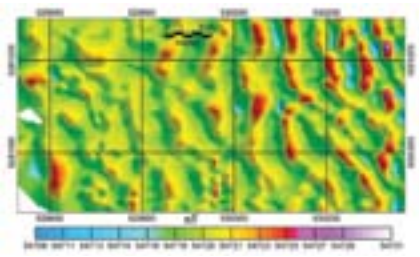


Figure 1: Total magnetic field map of the NUWC survey site. The image is dominated by North-South trending curvilinear anomalies related to buried geology. Only a few ferro-magnetic targets are identifiable. The Eastern part of the survey block is dominated by geological noise.

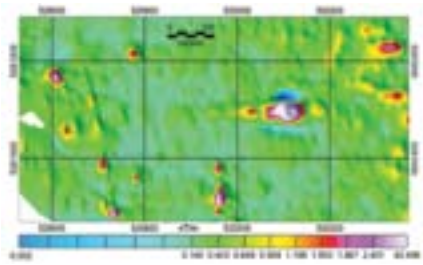


Figure 2: Total Magnetic Gradient (analytic signal) map of the NUWC survey site. The deep geological signal is eliminated, and extremely small targets can be easily resolved, including a faint linear feature in the west that was invisible in the total field data. The linear feature corresponds to a known pipeline.

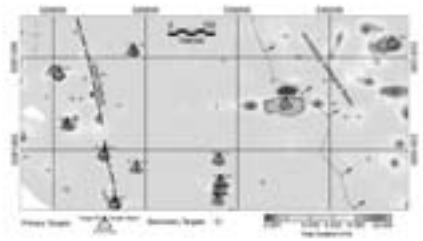
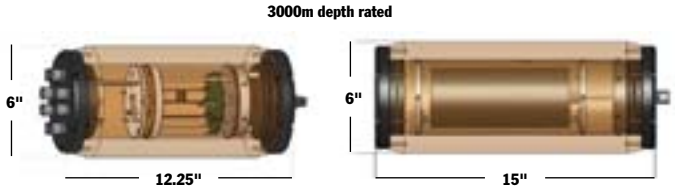


Figure 3: Interpretation of data products overlaid on grayscale total gradient map. Primary target depth estimates (see triangle symbols) obtained from Euler Deconvolution of the measured gradients. Total gradient grid values of the target position provide an estimate of the relative target.

A Gradiometer Solution for AUV & ROV Installations



SeaQuest 6 sensor gradiometer with 2 electronics modules

Electronics module

In Pressurized Housing

RATING	LENGTH	DIAMETER
300m	12.7"	0.5
1000m	12.75"	0.5
3000m	12.25"	0.6
6000m	12.25"	0.65

Sensor

In Pressurized Housing

RATING	LENGTH	DIAMETER
300m	15.5"	0.5
1000m	15.5"	0.5
3000m	15.0"	0.6
6000m	15.0"	0.65

It's expandable

Each SeaQuest is comprised of a single electronics module that can drive up to 4 sensors. Add as many SeaQuests as you need.

Auto synchronization – it just works

Multiple SeaQuests are always synchronized to each other via a sync line hardwired to each additional electronics module. Synchronization of SeaQuests is entirely seamless. You can even synchronize by sending communications from the host directly to the gradiometer.

The only gradiometer that delivers an expandable sensor array without compromise

- Worldwide operation, no dead zones
- No heading error
- Best absolute accuracy on the market 0.1nT
- 0.01nT sensitivity; 0.001nT counter sensitivity
- Ultra low power requirement
- Sensors do not degrade with time and never need calibration to meet our specs at time of shipping

Features

- Isolated inputs/outputs/RS232 no ground loops
- Auxiliary sensors include: 3D compass, tilt sensor, leak detector in E/M, pressure sensor, altimeter
- Sensor distance from another sensor: no restrictions, ie sensors can even touch
- Sensor distance from electronics module: 0.25m (10 inches) to 30m (98 feet)
- Entirely non magnetic construction. All aluminum and fiberglass
- Depth ratings available 300m, 1000m, 3000m, 6000m

Why SeaQuest?

You get more information

SeaQuest measures the gradient in all three axes simultaneously, so no matter how your heading changes no information is lost. Horizontal gradiometers, on the other hand, are limited by the fact that they can only measure the gradient in one axis (direction) at a time. When surveying with a one axis gradiometer and your heading changes by even a few degrees you are no longer measuring the same gradient.

See what you want to see

SeaQuest suppresses geology and enhances small nearby targets, enabling you to see more of what you want to see, while suppressing what you don't want to see. Single-axis gradiometers and arrays enhance targets and geological features within the direction of their axis. Since SeaQuest measures the complete 3-dimensional gradient, it enhances signals from small targets uniformly, regardless of their geometry or position in space.

Features at Glance

- Auxiliary sensors include: 3D compass, tilt sensor, leak detector in E/M, pressure sensor, altimeter
- Sensor distance from another sensor: no restrictions, ie sensors can even touch
- Sensor distance from electronics module: 0.25m (10") to 30m (98')
- Entirely non magnetic construction. All aluminum and fiberglass
- Depth ratings available 300m, 1000m

Specifications

Worldwide operation	No restrictions or dead zones
Highest absolute accuracy	0.1nT
High sensitivity	0.01nT
Resolution	0.001nT
Power consumption	2W standby, +1W persensor,+2W per altimeter
Maintenance free sensors	No realignment and no consumable parts
No heading error	Eliminates the need to level your data
No drift	A complete lack of1/fnoise providing a totally flat noise spectrum
No temperature dependence	Data accuracy does not change through a temperature range of-40C to +60C
Altimeter	0-100m range,0.1m step
Heading	3-axis magnetoresistive compass,0.1 degree step
Tilt sensor	Two-axis,0.1 degree step
Pressure sensor	300m range,0.1m step (others optional)

Marine Magnetics

info@marinemagnetics.com

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PHINS

HIGH-PERFORMANCE INERTIAL NAVIGATION SYSTEM

PHINS, Photonic Inertial Navigation System outputs position, heading, attitude, depth, speed, and heave. Its high accuracy inertial measurement unit is based on **iXBlue**'s FOG technology coupled with an embedded digital signal processor that runs an advanced Kalman filter.

FEATURES

- All-in-one high-accuracy 3D positioning with heading, roll and pitch
- Fiber Optic Gyroscope (FOG), unique strap-down technology
- Multiple interfaces (DVL, EM log, GPS and depth sensor)
- Compact, lean and reliable
- Ethernet, Web-based Man-Machine Interface (MMI)

BENEFITS

- Complete navigation unit
- No spinning element hence maintenance free
- Versatile
- Appropriate for all underwater vehicles

APPLICATIONS

- Surface navigation for frigates, MCMV and fast patrol boats
- AUV • ROV • HOV • SDV

Courtesy of Boskalis

Courtesy of Subsea 7

Courtesy of Net Marine

iXBLUE
DEEP INSIGHT. SHARPER SENSES.

PHINS

TECHNICAL SPECIFICATIONS

Ethernet

IMO Certified
N° 19110/A1 EC
N° 19183/A1 EC

PERFORMANCE

Position accuracy [1]	
With GPS	Three times better than GPS accuracy
With USBL/LBL (Subsea Applications)	Three times better than USBL/LBL accuracy
With DVL	0.1% of travelled distance
No aiding for 2 minutes	3 m
No aiding for 5 minutes	20 m
Pure inertial mode	0.6 Nm/hr
Heading accuracy [2] [3]	
With GPS	0.01 deg secant latitude
With USBL/LBL/ DVL (Subsea Applications)	0.02 deg secant latitude
Roll and Pitch dynamic accuracy [2]	0.01 deg
Heave accuracy	5 cm or 5% (whichever is greater)

OPERATING RANGE / ENVIRONMENT

Operating / Storage Temperature	-20 to 55 °C / -40 to 80 °C
Rotation rate dynamic range	Up to 750 deg/s
Acceleration dynamic range	± 15 g
Heading / Roll / Pitch	0 to +360 deg / ±180 deg / ±90 deg
MTBF (computed/observed)	40,000 hours / 80,000 hours
No warm-up effects	
Shock and Vibration proof	

PHYSICAL CHARACTERISTICS

Dimensions (L x W x H)	180 x 180 x 162 mm
Weight in air	4.5 kg
Water proof	IP66
Material	Aluminium

INTERFACES

Serial RS232/RS422 port	5 inputs / 5 outputs / 1 configuration port
Ethernet port [4]	UDP / TCP Client / TCP server
Pulse port [5]	4 inputs and 2 outputs
Sensors supported	GPS, USBL, RAMSES, LBL, DVL, DEPTH, CTD/SVP
Intput/Output formats	Industry standards: NMEA0183, ASCII, BINARY
Baud rates	600 bauds to 115.2 kbaud
Data output rate	0.1 Hz to 200 Hz
Power supply	24 VDC
Power consumption	< 20 W

(1) CEP: 50 % circular Error Probability. DVL aiding position accuracy is dependent on DVL performances.
(2) RMS values
(3) Secant latitude = 1 / cosine latitude
(4) All input /output serial ports are available and can be duplicated on Ethernet ports
(5) Use GPS PPS pulse for accurate time synchronization of PHINS

Specifications subject to change without notice

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IXBLUE
DEEP INSIGHT. SHARPER SENSES.

2012-02-PS-PHI

GAPS

PORTABLE, CALIBRATION FREE USBL

The calibration free Global Acoustic Positioning System (GAPS) combines USBL, INS and GPS technologies. The most accurate USBL in its category, it works in deep or extremely shallow water and difficult environments where other systems have failed.

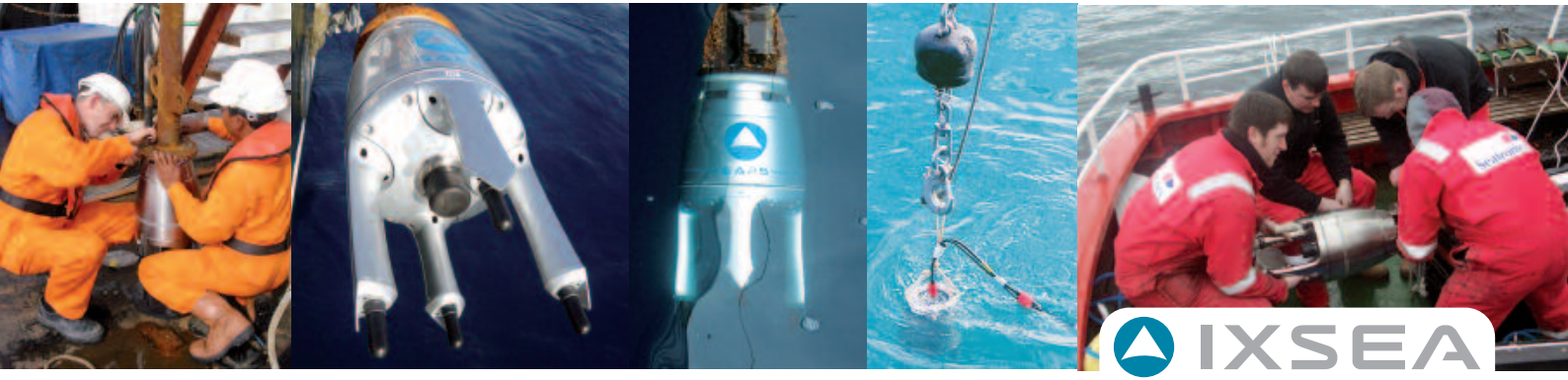
FEATURES

- Calibration-free
- 4,000 m range, accuracy 0.2% of the slant range*, 200 deg coverage
- All-in-one system, simple to use
- Provides absolute position as well as surface GPS-robust position

BENEFITS

- No mobilization/demobilization: fully operational in less than 1 hour
- Adapted to all applications: shallow and deep water, and noisy environments
- Easily transferrable from one vessel to another
- Robust to acoustic and GPS hazards

*Performance depends on environment/noise conditions



APPLICATIONS

• Towfish tracking • AUV, ROV and any subsea vehicle • Diver tracking

GAPS
TECHNICAL SPECIFICATIONS

PERFORMANCE

Subsea positioning(1)	
Positioning accuracy	0.2% of slant range
Operating range	4,000 m
Coverage	200 deg below acoustic array
Operating frequency	20 to 30 kHz MFSK CHIRP modulation technique
Surface positioning and attitude	
Heading / Roll / Pitch	0.01 deg(2)
Position	2 to 5 cm (external RTK receiver) 0.5 to 3 m (supplied DGPS or accurate GPS receiver)
Position drift (GPS drop-out)	2 m / 2 minutes

OPERATING / ENVIRONMENT

Power supply / consumption	28 VDC / 50 W
Operating temperature	-5 °C to 35 °C
Storage temperature	-20 °C to + 70 °C

PHYSICAL CHARACTERISTICS

Housing material	Carbon composite
Weight in air / water	15 kg / -7 kg (positive buoyancy)
Housing dimensions (Ø x H)	295 mm x 638 mm
Array depth-rating	50 m

INTERFACES

Protocols	Industry standards (Native compatibility with IXSEA sensors PHINS, RAMSES, ...)
Fully compatible	Any external GPS, DGPS and RTK receivers

Automatic sound velocity corrections (ray bending & velocity error)
10 Hz output rate for subsea positioning data (irrespective of depth)
100 Hz output rate for surface positioning data

(1) Performance depends on environment / noise conditions
(2) Heading, Roll, Pitch figures are RMS values

Specifications subject to change without notice

IXSEA: • EMEA : +33 (0)1 30 08 98 88 • USA : +1 (781) 937 8800 • ASIA : +65 6747 4912 • www.ixsea.com

2008-01-PS-GAP

APPLIED ACOUSTICS
Underwater Technology

: Technical Specification

AA201 and AA301 Seismic Sound Source, Boomer Plates

The two boomer plates, the AA201 and AA301, produce a sharp, repeatable "industry standard" single pulse. Both models are field proven and differ in detail specification.

The Model AA201 is the 'small format' transducer which can be towed on either the CAT100 or CAT200 surface tow vehicles. It is ideal for inshore surveys for high resolution sediment analysis with the CSP-L energy source or as a higher penetration device with the CSP-P and CSP-D models.

The Model AA301 is designed for higher power applications and has the extra advantage of use as a variable frequency boomer when used with the CSP-D range of energy sources. This allows wide ranging pulse widths not formerly available. The lengthening of the pulse width ensures even greater penetration whilst maintaining a high quality single pulse.

AA201

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Great Yarmouth NR31 0NB
United Kingdom

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F +44(0)1493 440720
E general@appliedacoustics.com
W www.appliedacoustics.com

MODEL TYPES - PHYSICAL SPECIFICATION

	Size	Weight air/water	Fixing Centres
Model AA201	38cm x 38cm	18kg/10kg	31.5cm^2
Model AA301	62cm x 52cm	25kg/14kg	48.5cm x 44.0cm

ELECTRICAL INPUT

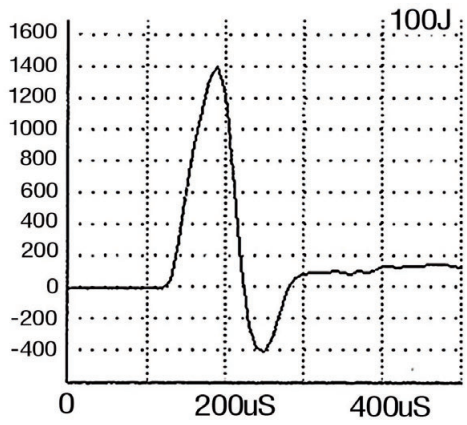
Recommended Power	AA201, 50 – 200J/shot AA301, 100 – 300J/shot
Maximum Energy Input	AA201, 300J/shot AA301, 350J/shot
Maximum Power Input	AA201, 600J/second AA301, 1000J/second

SOUND OUTPUT

Source level	AA201, Typically 212 dB re 1 µPa at 1 metre with 200J AA301, Typically 215 dB re 1 µPa at 1 metre with 300J
Pulse Length	AA201, 120/150/180 µS at 50/100/200J AA301, 150 – 400 µS depending on energy setting of CSP-D
Reverberation	AA201, <1/10 x initial pulse AA301, < 1/10 x initial pulse
Connector type	RMK

COMPATIBILITY*

Energy Source	AA201: CSP-L, CSP-P, CSP-D AA301: CSP-P, CSP-D, CSP-S
Catamaran	AA201: CAT100, CAT200 AA301: CAT200



AA201 PULSE SHAPE

* Also compatible with older model CSP units.

Registration No. U6447
BS: EN: ISO9001

APPLIED ACOUSTICS
Underwater Technology

Due to continual product improvement, specification information may be subject to change without notice.

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HMS-620 Bubble Pulser

Portable Low-Frequency Acoustic Seismic System

The HMS-620 Bubble Pulser uses low-frequency acoustic signals to provide superior signal penetration vertically through coarse sand, gravel tills, and other difficult-to-penetrate sediments.
Small system component size and portability make this a valuable tool for any survey platform.

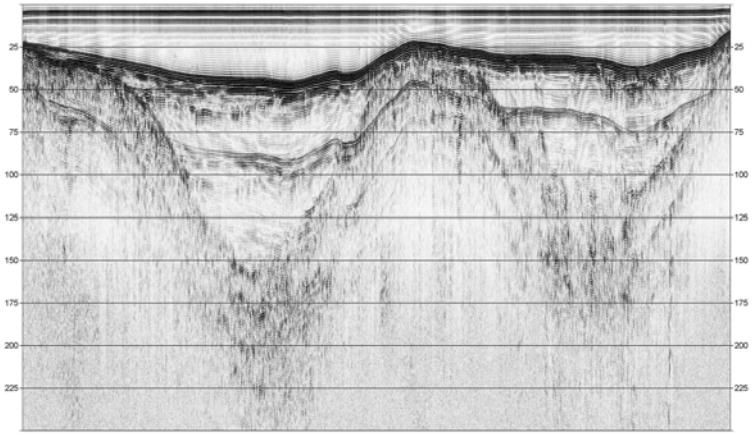
The HMS-620 Bubble Pulser System's size makes it ideal for small survey vessels.

APPLICATIONS

- Offshore Wind Turbine and Dam Site Surveys
- Cross River Surveys for Bridge Construction
- Bedrock Investigation
- Pipeline Construction Surveys
- Geotechnical Site Investigation
- Coastal Engineering

FEATURES/BENEFITS

- Narrow-band 400 Hz acoustic pulse provides bottom penetration through many sediment types
- Rugged, lightweight transducer platform provides stable operation in adverse sea-state conditions
- Flexible portable transceiver unit optimizes system for a wide range of sediments
    - User-selectable trigger or external trigger
    - Low-noise pre-amp with high/low pass filters and gain control
- **Portable power supply operates from a 110 or 220 VAC source of less than 1 KWatt**
- Oil-filled hydrophone streamer cable incorporates a 7-meter multi-element active section
- 35-meter deactivation switches on each hydrophone element enable exportation outside of USA



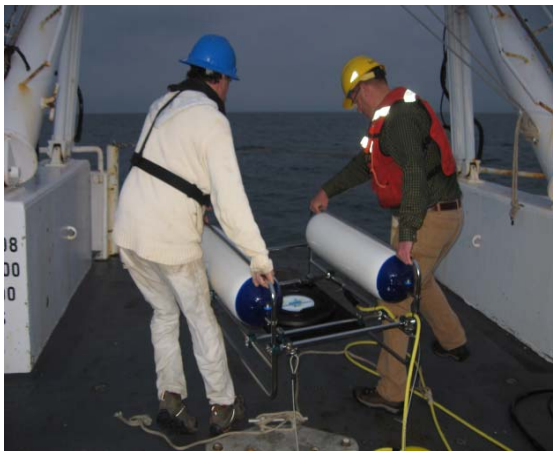
HMS-620 provided over 125 meters of penetration in this survey in Narragansett Bay, Rhode Island (scale in msec)

Courtesy of University of Rhode Island Graduate School of Oceanography

SPECIFICATIONS

HMS-620 System Components

Source Vehicle and Electromechanical Tow Cable



Source Type:	Electromagnetic
Frequency:	Narrow band, 400 Hz pulse
Acoustic Source Level:	Approximately +200 dB ref 1µPa at 1 meter with 15 cubic inch volume
Tow Vehicle:	Stainless steel frame, buoyant surface-towed vehicle
Tow Cable:	50-meter abrasion resistant
Dimensions:	109.22cm x 93.97cm x 48.26cm (43 in x 37 in x 26 in)
Weight in Air:	Vehicle/Source 43.5 kg (96 lbs) Tow Cable 12.25 kg (27 lbs)

Seismic Transceiver

Signal Input:	Designed to operate with HMS-620 System Hydrophone Streamer Cable. 7-pin amphenol connector
Gain:	Adjustable in 3 dB steps 0 to 45 dB
Filters:	Adjustable high- and low-pass active
Analog Interface:	± 10 V Output

Power Supply

Trigger Input:	External key or manual time-based selection
Repetition Rate:	1/8 second maximum
Transducer Connector:	4-pin amphenol to mate with HMS-620 Source Vehicle Towing cable
Packaging:	Portable splash-resistant case
Dimensions:	55.88 cm x 53.34 cm x 25.4 cm 22 in x 21 in x 10 in
Weight:	17.24 kg (38 lbs)

Hydrophone Streamer Cable

Length:	Active section - 7 meters; Single- channel, 24 elements; Leader – 50 meters
Preamplifier:	Integral preamp - 20 dB gain; **D**esigned to operate with HMS-620 Transceiver
Power Input:	Supplied by transceiver
Weight in Air:	13.6 kg (30 lbs)

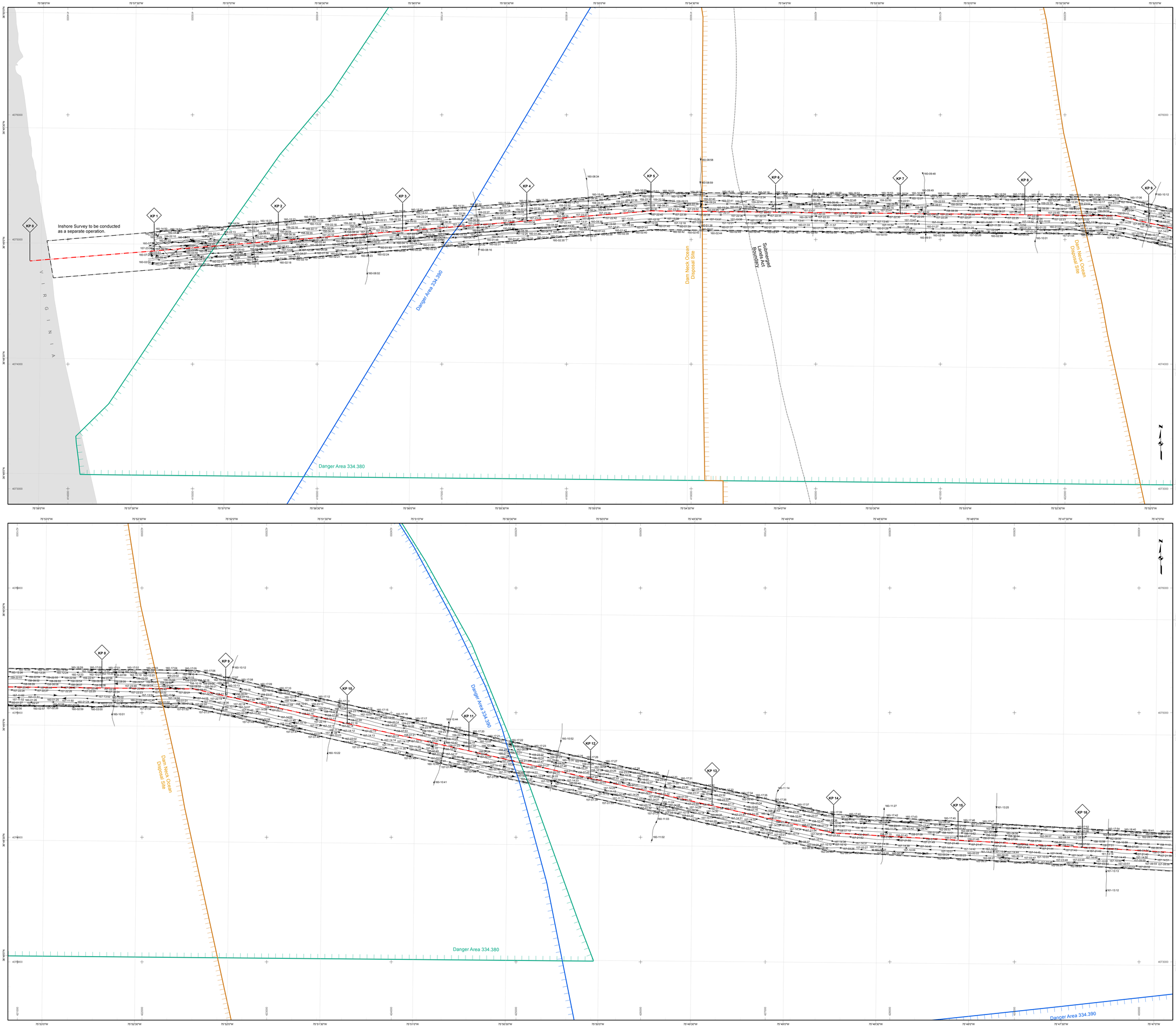
Falmouth Scientific, Inc.
1400 Route 28A, PO Box 315, Cataumet, MA 02534-0315
Email: fsi@falmouth.com • Tel: 508-564-7640 • Fax: 508-564-7643 • **www.falmouth.com**

Attachment C – Survey Charts

LIST OF CHARTS

Plate 1, Sheets 1-4, North-Up – Towed System Tracklines
Plate 2, North-Up – Seismic Tracklines with CDP Gather Points
Plate 3, Sheets 1-4, North-Up – Bathymetry
Plate 4, Sheets 1-4, North-Up – Slope
Plate 5, Sheets 1-4, North-Up – Rugosity
Plate 6, Sheets 1-4, North-Up – Benthic Zones
Plate 7, Sheets 1-4, North-Up – Sidescan Sonar
Plate 8, Sheets 1-4, North-Up – Geologic Features
Plate 9, Sheets 1-4, North-Up – Total Field
Plate 10, Sheets 1-4, North-Up – Analytic Signal
Plate 11, North-Up – Reflector 1 Elevation
Plate 12, North-Up – Reflector 2 Elevation
Plate 13, North-Up – Reflector 3 Elevation
Plate 14, North-Up – Reflector 4 Elevation
Plate 15, North-Up – Reflector 5 Elevation
Plate 16, North-Up – Reflector 6 Elevation
Plate 17, North-Up – Isopach Map of Near Surface Sediments (Seabed to top of Reflector 1)
Plate 18, Sheets 1-6, Alignment Sheets
Plate 19, Sheets 1- 2, Seismic Profiles at Potential Turbine Locations

Attachment C – Survey Charts



L E G E N D

- 5 minute interval
- 1 minute interval
- Trackline
- Survey Centerline
- Dam Neck Ocean Disposal Site
- Danger Area 334.380*
- Danger Area 334.390**
- Maritime Boundaries
- Survey Corridor
- Research Lease Area

*33 CFR 334.380 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY OFF DAM NECK, VIRGINIA; NAVAL FIRING RANGE.

**33 CFR 334.390 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY; FIRING RANGE.

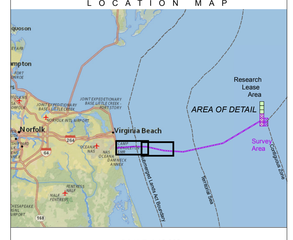
SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS851 with MarineStar
Subsurface Positioning	IXBlue GAPS
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
Sidescan Sonar Sensor	EdgeTech 2000-DSS 110 kHz/540 kHz
Sub-bottom Profiler	EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



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Feet: 0, 400, 800, 1,600, 2,400, 3,200

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Towed System Tracklines

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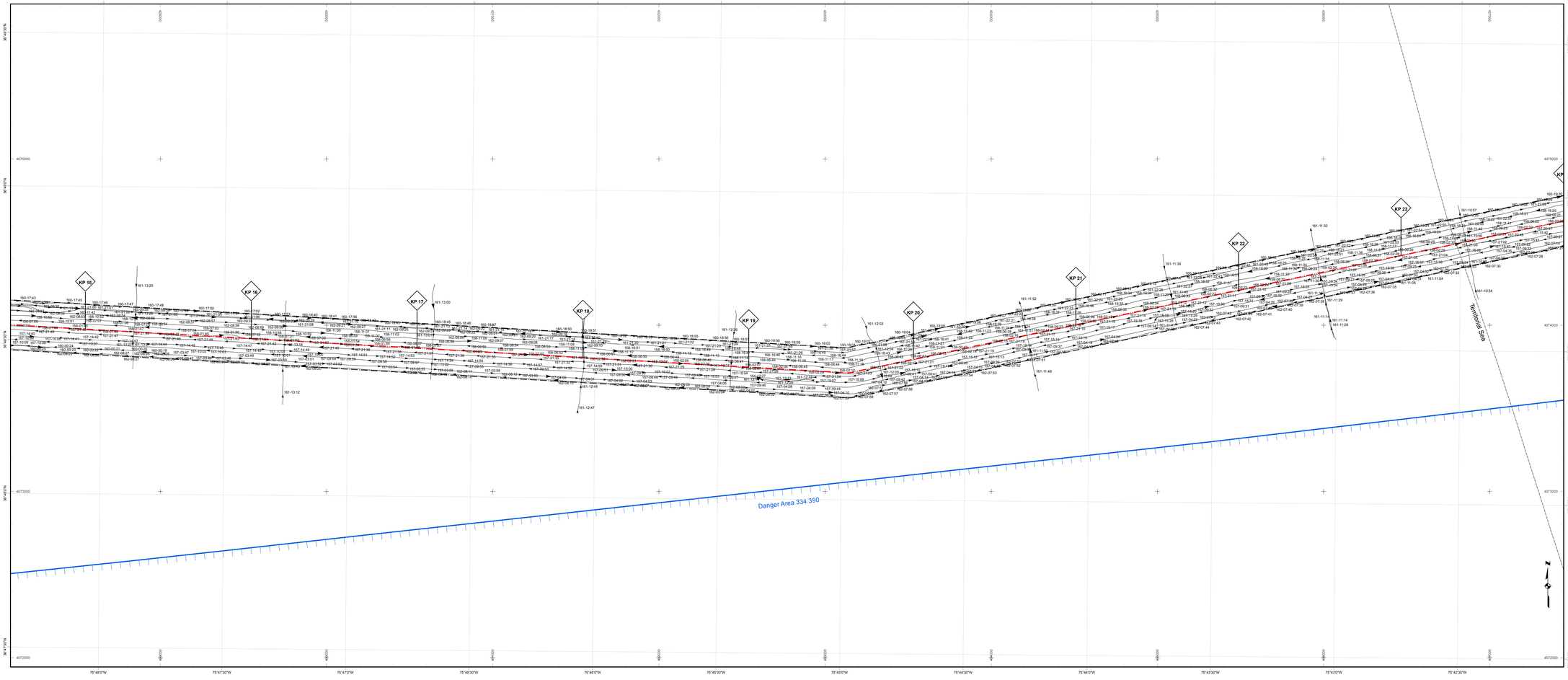

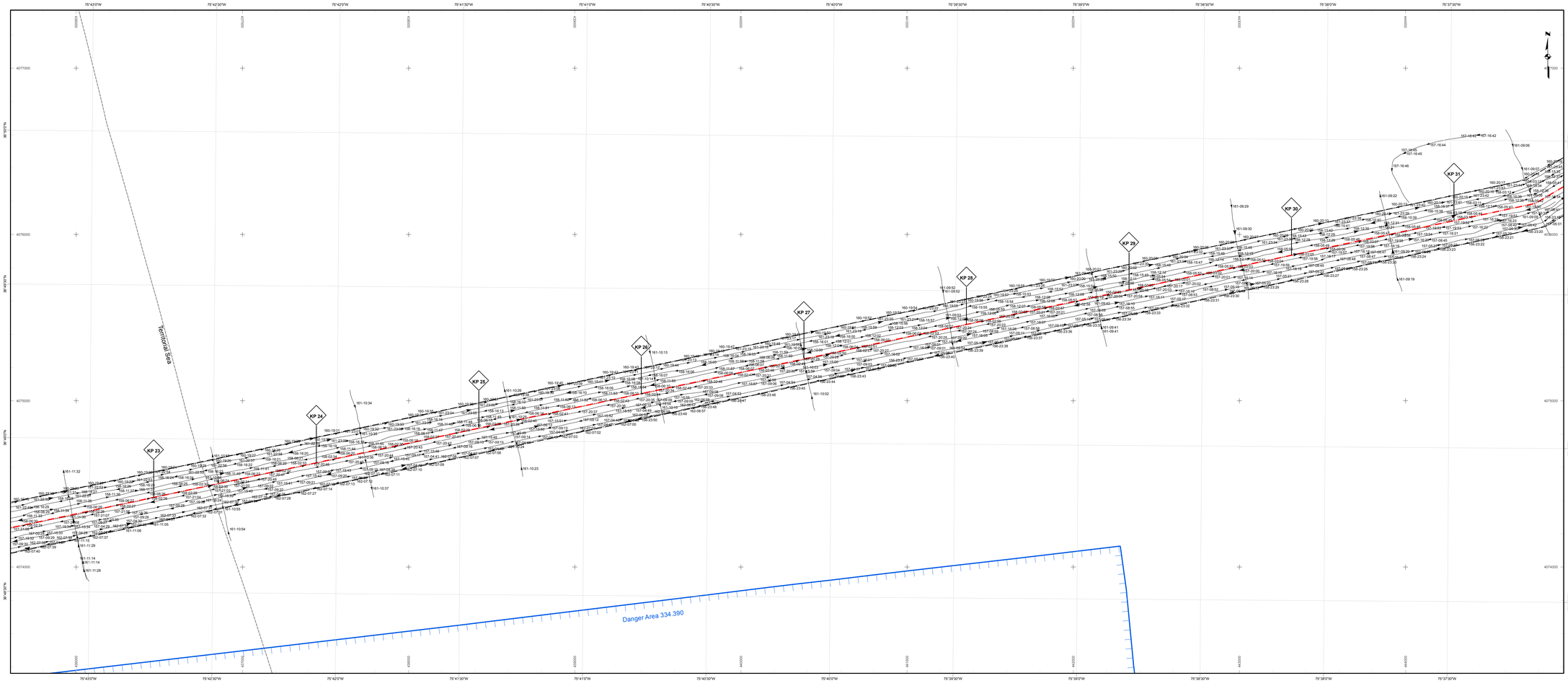

L E G E N D

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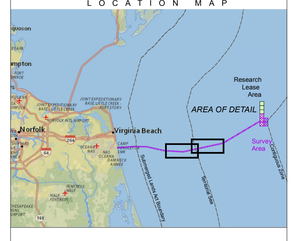
SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS851 with MarineStar
Subsurface Positioning	IXBlue GAPS
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
Sidescan Sonar Sensor	EdgeTech 2000-DSS 110 kHz/540 kHz
Sub-bottom Profiler	EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



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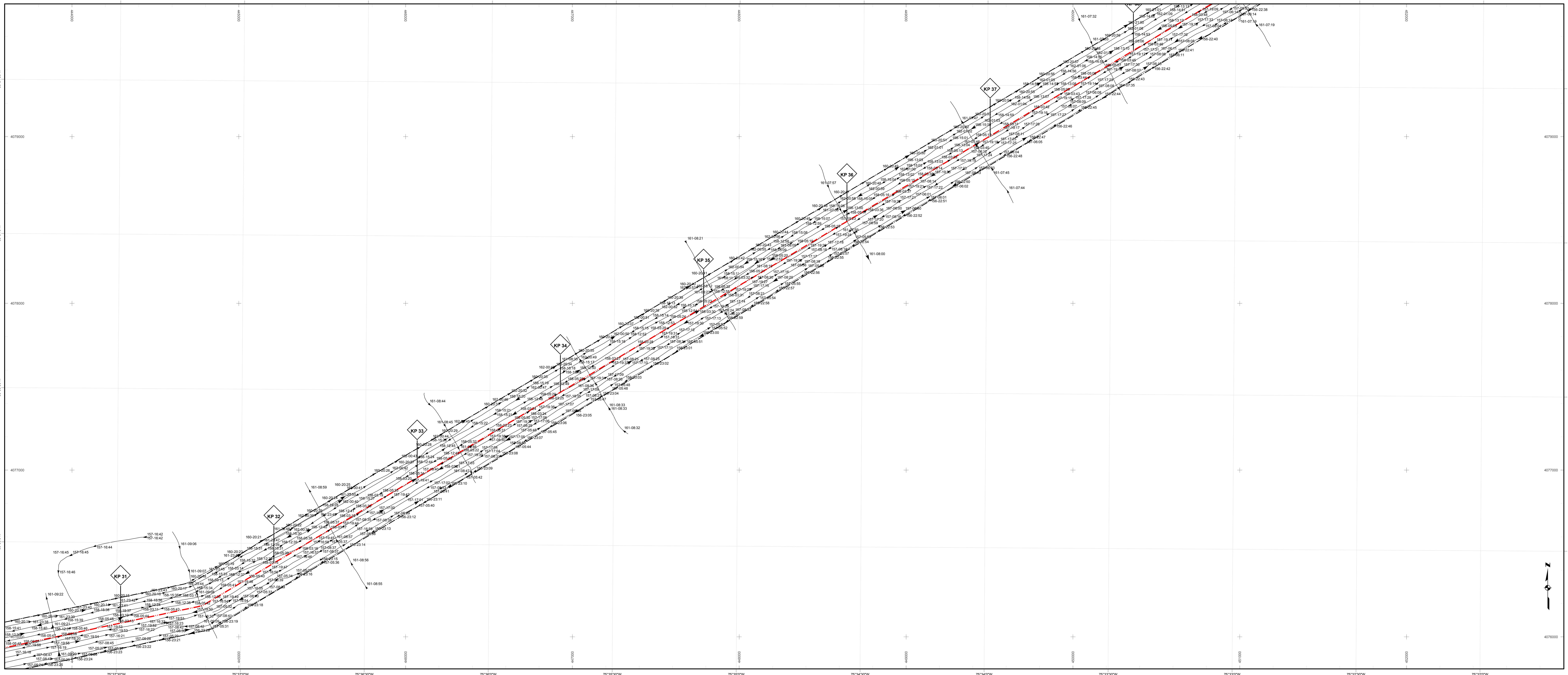

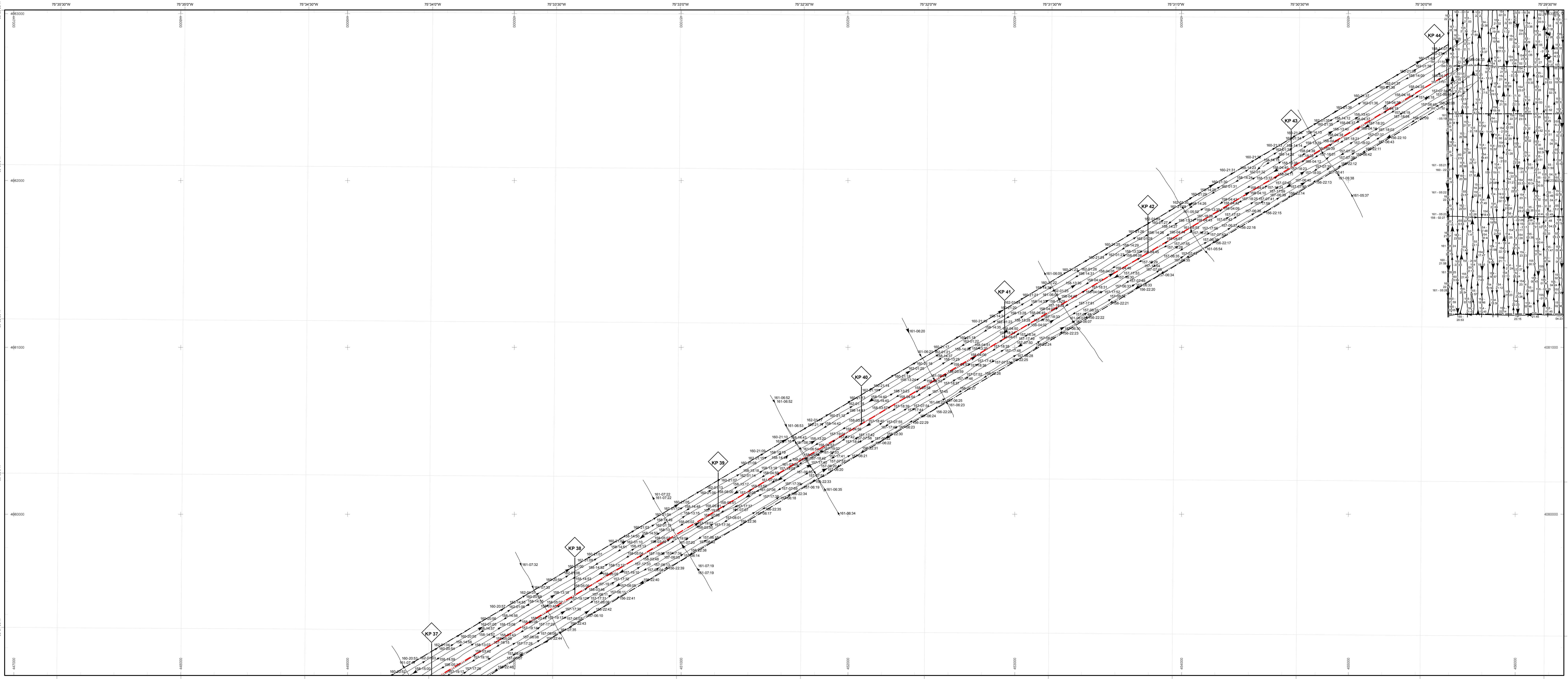

LEGEND

- 5 minute interval
- 1 minute interval
- Trackline
- Survey Centerline
- Dam Neck Ocean Disposal Site
- Danger Area 334.380*
- Danger Area 334.390**
- Maritime Boundaries
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- Research Lease Area

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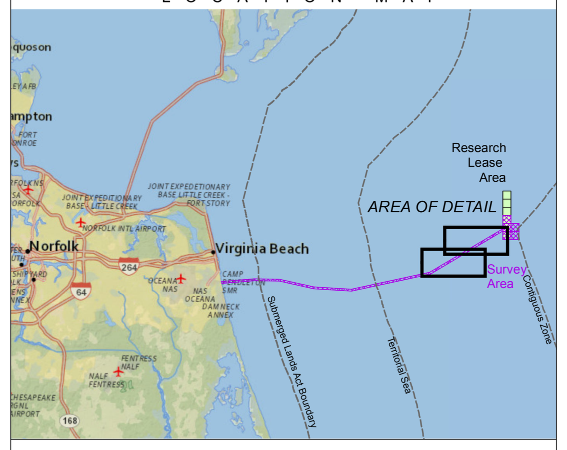
SURVEY NOTES

Survey dates.............................. June 1 - June 28, 2013
Survey Vessel.............................. R/V Sea Lion V
Surface Positioning...................... Trimble SPS651 with MarineStar
Subsurface Positioning.................. IXBlue GAPS
Heading/Motion Sensor................ IXBlue PHINS 6000
Bathymetry Sensor....................... RESON SeaBat 7125 SV2
Sidescan Sonar Sensor................. EdgeTech 2000-DSS 110 kHz/540 kHz
Sub-bottom Profiler...................... EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor.................. Marine Magnetics SeaQuest
Sound Speed Profilers.................. Oceanscience UCTD
Seismic System 1.........................AAE 300 Boomer
Seismic System 2.........................Datasonic Bubble Pulser
RPL Issue.................................... CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum .... NAD 83
Projection ....UTM Zone 18 North
Horizontal Units ....Meters
Vertical Units...............................Meters
Vertical Datum ....MLLW EPOCH 1987-2001
GPS L1/L2 Corrections ....Marine Star

LOCATION MAP



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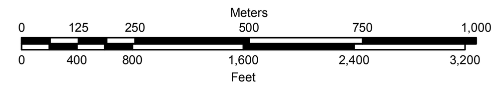

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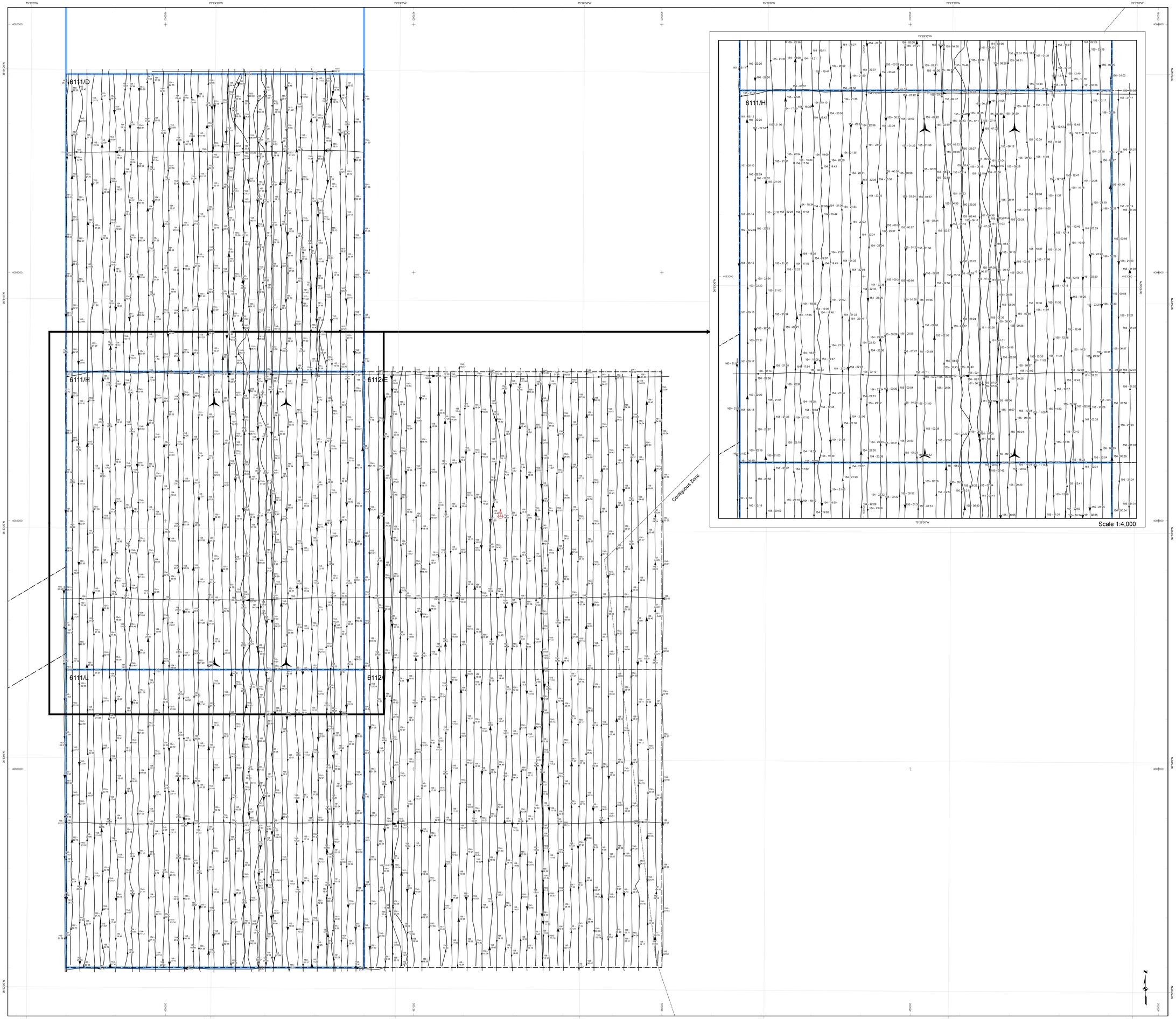

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L E G E N D

- Preliminary Turbine Sites
- Buoy Avoided 06/05/13 per Survey Log
- 5 minute interval
- 1 minute interval
- Trackline
- Maritime Boundaries
- Survey Corridor
- Research Lease Area

SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS851 with MarineStar
Subsurface Positioning	IXBlue GAPS
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
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Seismic System 1	AAE 300 Boomer
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RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

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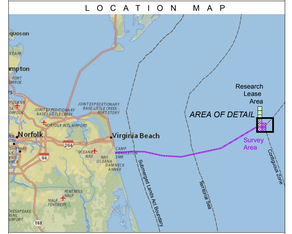
L O C A T I O N M A P



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North-Up – Towed System Tracklines

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00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

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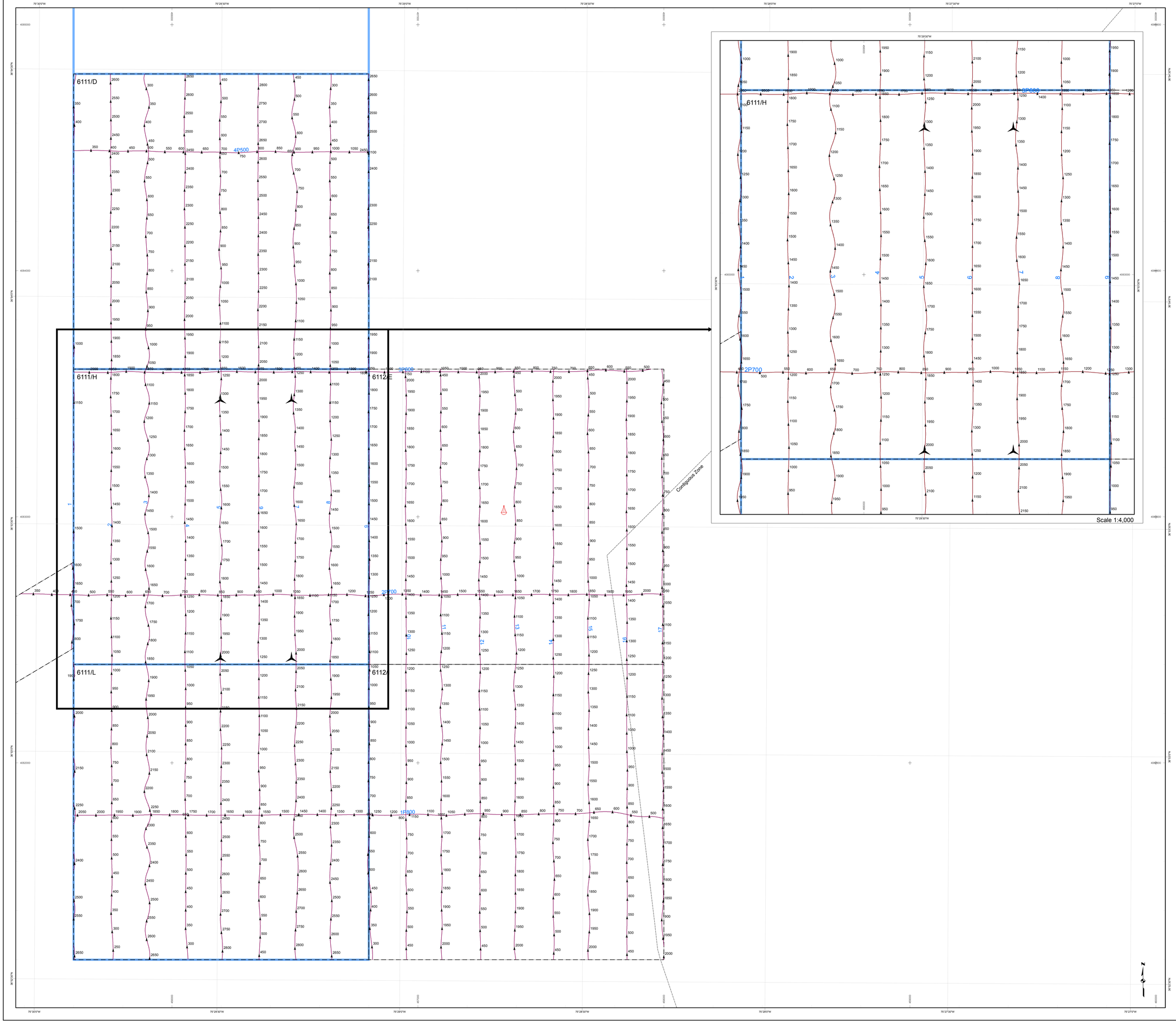

L E G E N D

- Preliminary Turbine Sites
- Buoy Avoided 06/05/13 per Survey Log
- CDP Gather
- Trackline
- Maritime Boundaries
- Survey Corridor
- Research Lease Area

SURVEY NOTES

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GEODETIC PARAMETERS

Horizontal Datum	NAD 83
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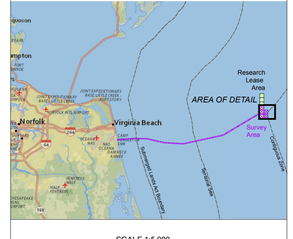
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



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Meters: 0 62.5 125 250 375 500

Feet: 0 187.5 375 750 1,125 1,500

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Seismic Tracklines with CDP Gather Points

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00	10/17/13	Draft	MJW	JH	RJF
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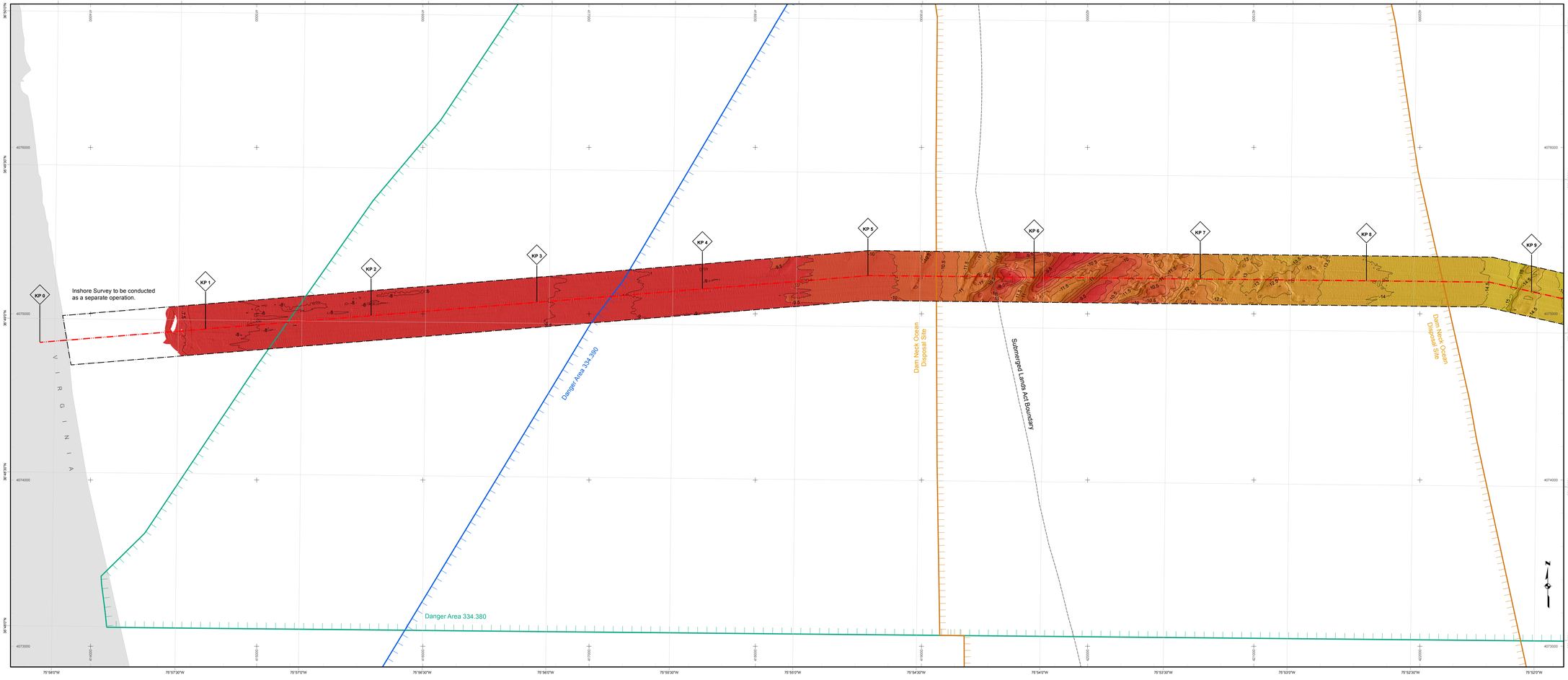

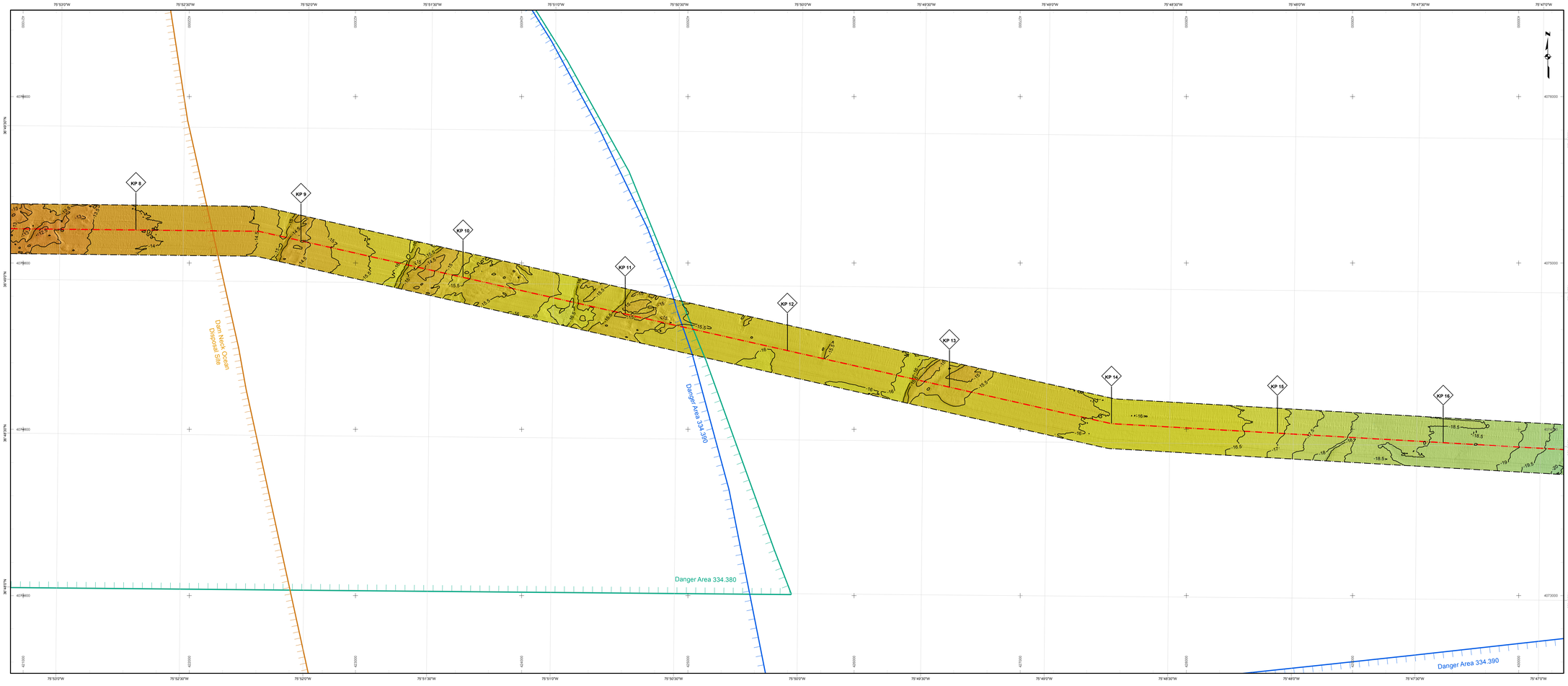

L E G E N D

- 0.5m Contour
- Survey Centerline
- Maritime Boundaries
- Dam Neck Ocean Disposal Site
- Danger Area 334.380*
- Danger Area 334.390**
- Survey Corridor
- Research Lease Area

Elevation (m)

- -9.4 - -9
- -9.9 - -9.5
- -10.4 - -10
- -10.9 - -10.5
- -11.4 - -11
- -11.9 - -11.5
- -12.4 - -12
- -12.9 - -12.5
- -13.4 - -13
- -13.9 - -13.5
- -14.4 - -14
- -14.9 - -14.5
- -15.4 - -15
- -15.9 - -15.5
- -16.4 - -16
- -16.9 - -16.5
- -17.4 - -17
- -17.9 - -17.5
- -18.4 - -18
- -18.9 - -18.5
- -19.4 - -19
- -19.9 - -19.5
- -20.4 - -20
- -20.9 - -20.5
- -21.4 - -21
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- -28.9 - -28.5
- -29.4 - -29
- -29.9 - -29.5
- -30.4 - -30
- -30.7 - -30.5

*33 CFR 334.380 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY OFF DAM NECK, VIRGINIA; NAVAL FIRING RANGE.

**33 CFR 334.390 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY; FIRING RANGE.

SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS851 with MarineStar
Subsurface Positioning	IXBlue GAPS
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
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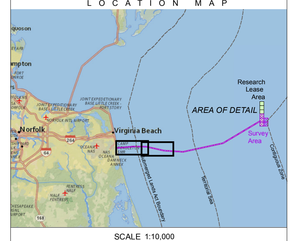
Sub-bottom Profiler	EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



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Meters: 0 125 250 500 750 1,000

Feet: 0 400 800 1,600 2,400 3,200

Dominion Resources, Inc.
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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Bathymetry

Revision No.	Date	Description	Prepared by	Checked by	Approved by
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

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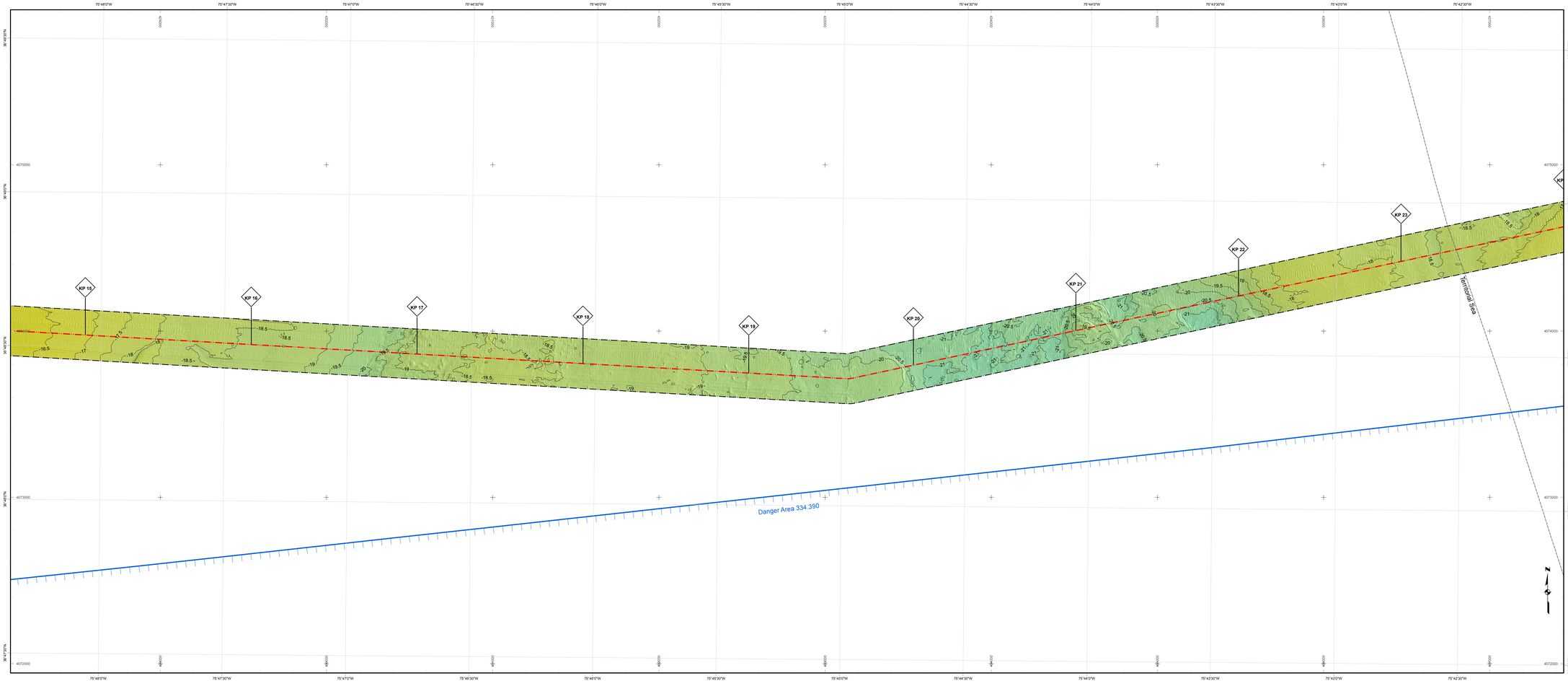

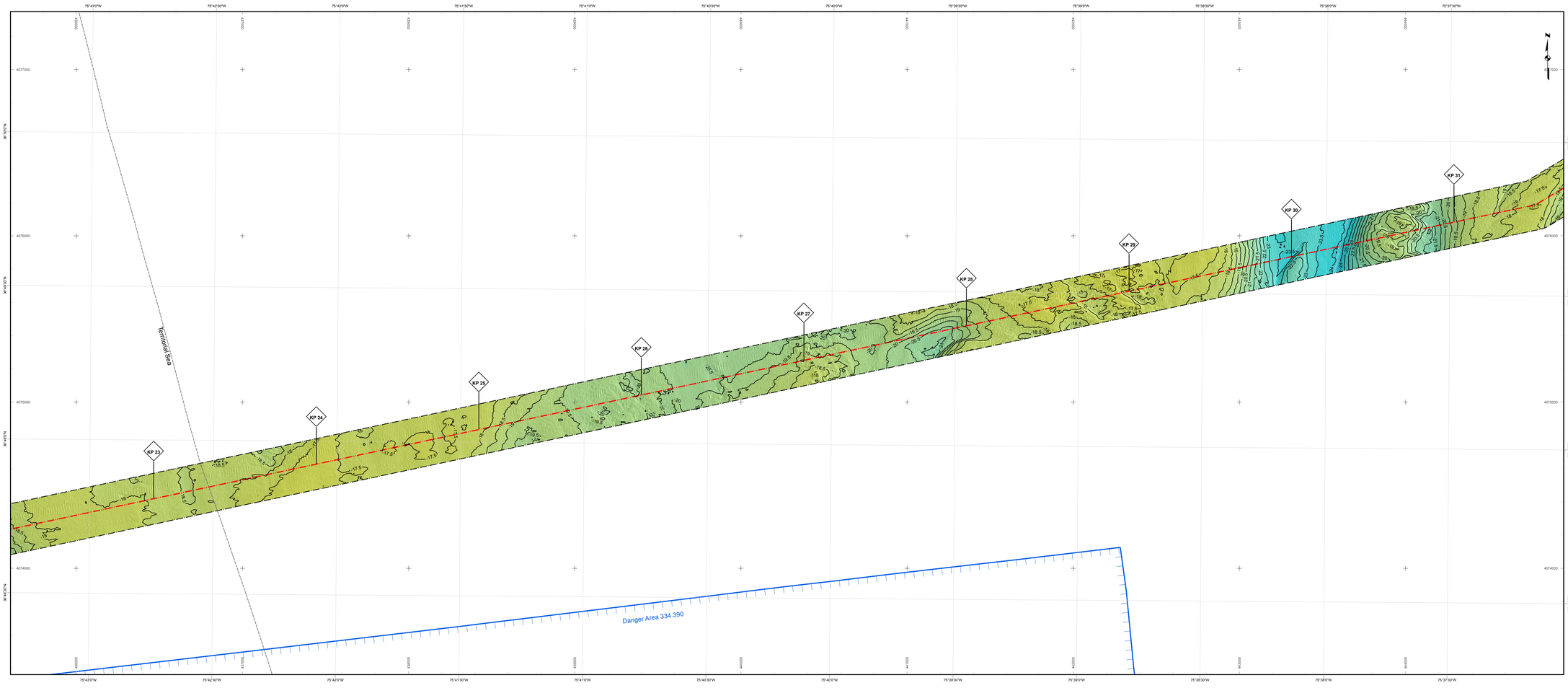

L E G E N D

- 0.5m Contour
- Survey Centerline
- Maritime Boundaries
- Dam Neck Ocean Disposal Site
- Danger Area 334.380*
- Danger Area 334.390**
- Survey Corridor
- Research Lease Area

Elevation (m)

- -9.4 - -9
- -9.9 - -9.5
- -10.4 - -10
- -10.9 - -10.5
- -11.4 - -11
- -11.9 - -11.5
- -12.4 - -12
- -12.9 - -12.5
- -13.4 - -13
- -13.9 - -13.5
- -14.4 - -14
- -14.9 - -14.5
- -15.4 - -15
- -15.9 - -15.5
- -16.4 - -16
- -16.9 - -16.5
- -17.4 - -17
- -17.9 - -17.5
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- -19.9 - -19.5
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- -30.4 - -30
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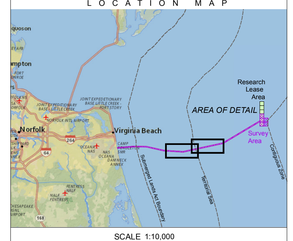
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



SCALE 1:10,000

Meters: 0 125 250 500 750 1,000

Feet: 0 400 800 1,600 2,400 3,200

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Bathymetry

Revision No.	Date	Description	Prepared by:	Checked by	Approved by
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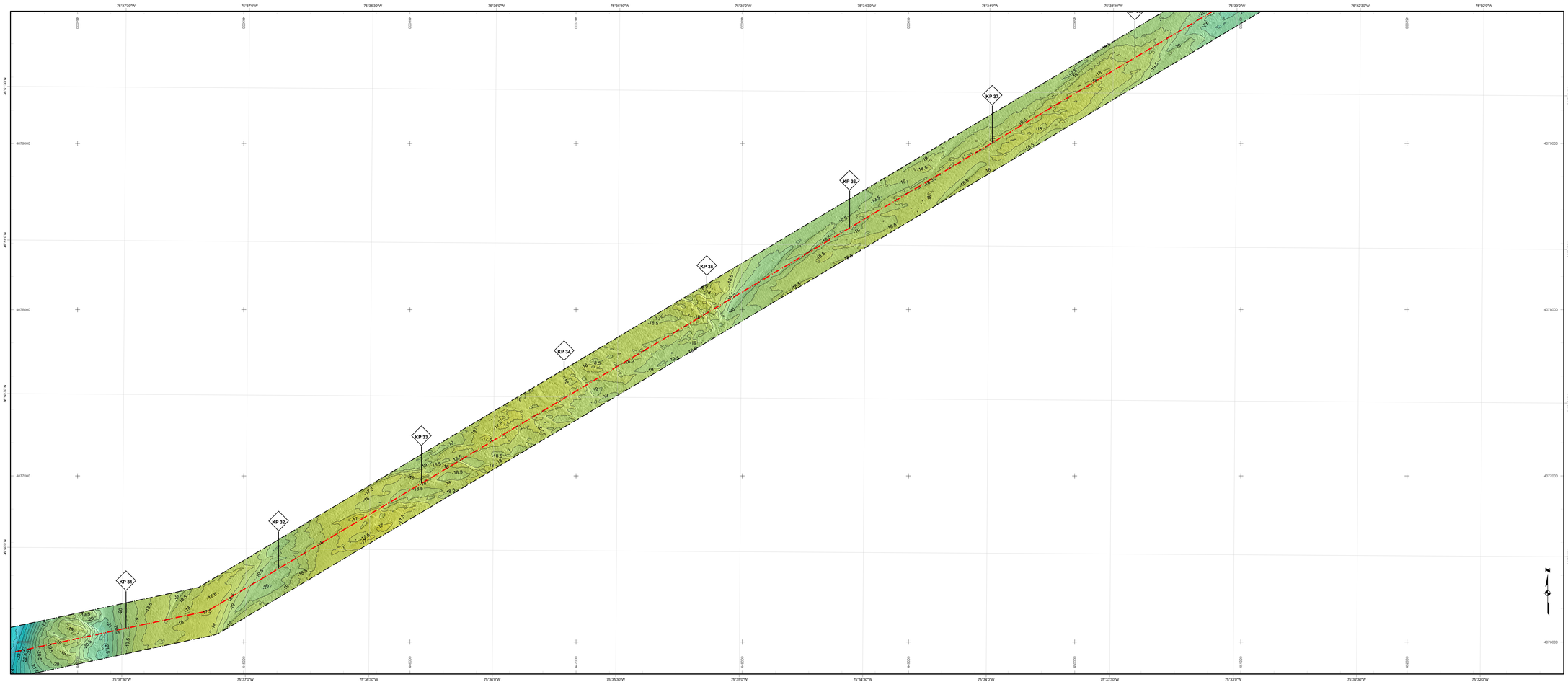

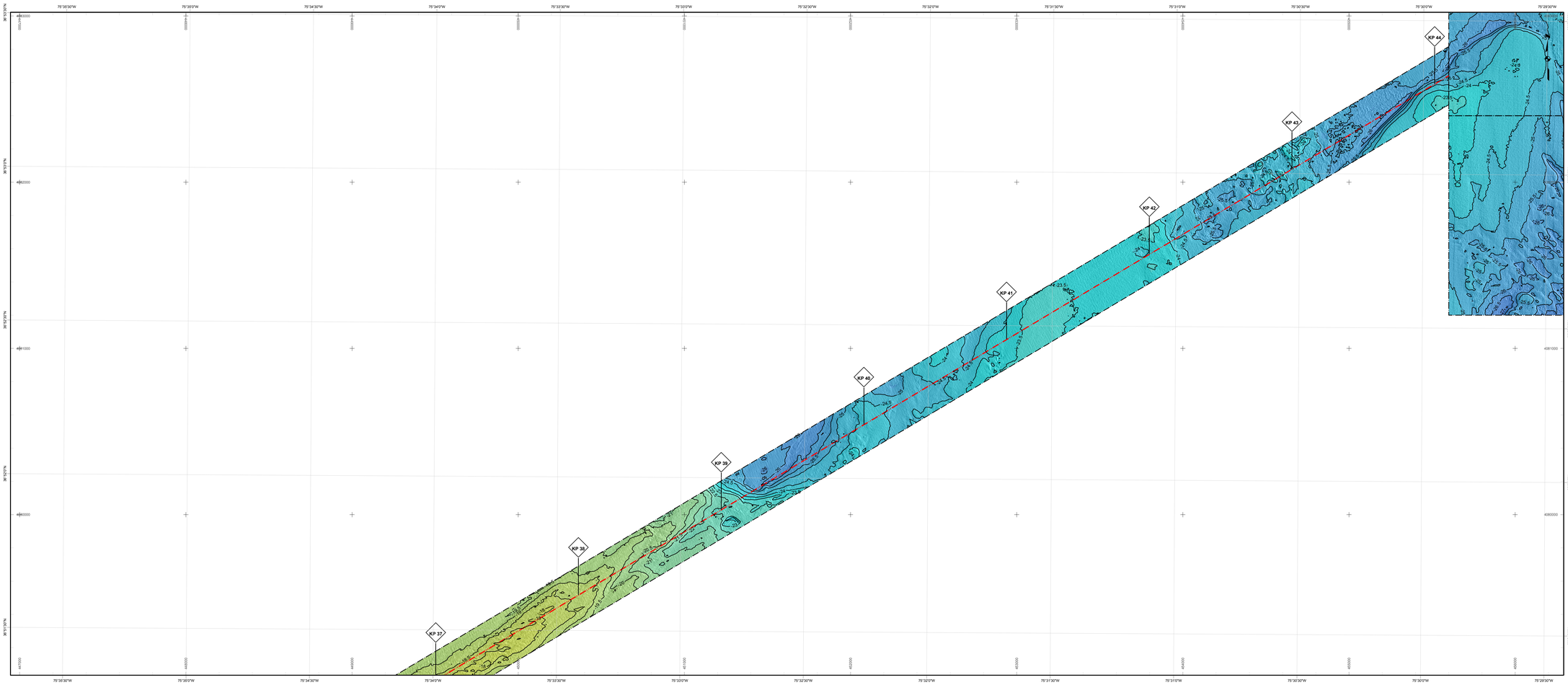

L E G E N D

- 0.5m Contour
- Survey Centerline
- Maritime Boundaries
- Dam Neck Ocean Disposal Site
- Danger Area 334.380*
- Danger Area 334.390**
- Survey Corridor
- Research Lease Area

Elevation (m)

- -9.4 - -9
- -9.9 - -9.5
- -10.4 - -10
- -10.9 - -10.5
- -11.4 - -11
- -11.9 - -11.5
- -12.4 - -12
- -12.9 - -12.5
- -13.4 - -13
- -13.9 - -13.5
- -14.4 - -14
- -14.9 - -14.5
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- -28.9 - -28.5
- -29.4 - -29
- -29.9 - -29.5
- -30.4 - -30
- -30.7 - -30.5

*33 CFR 334.380 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY OFF DAM NECK, VIRGINIA; NAVAL FIRING RANGE.

**33 CFR 334.390 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY; FIRING RANGE.

SURVEY NOTES

Survey dates	June 1 - June 28, 2013
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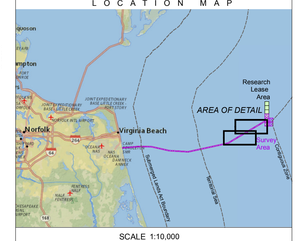
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



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Feet: 0 400 800 1,600 2,400 3,200

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Bathymetry

Revision No.	Date	Description	Prepared by:	Checked by	Approved by
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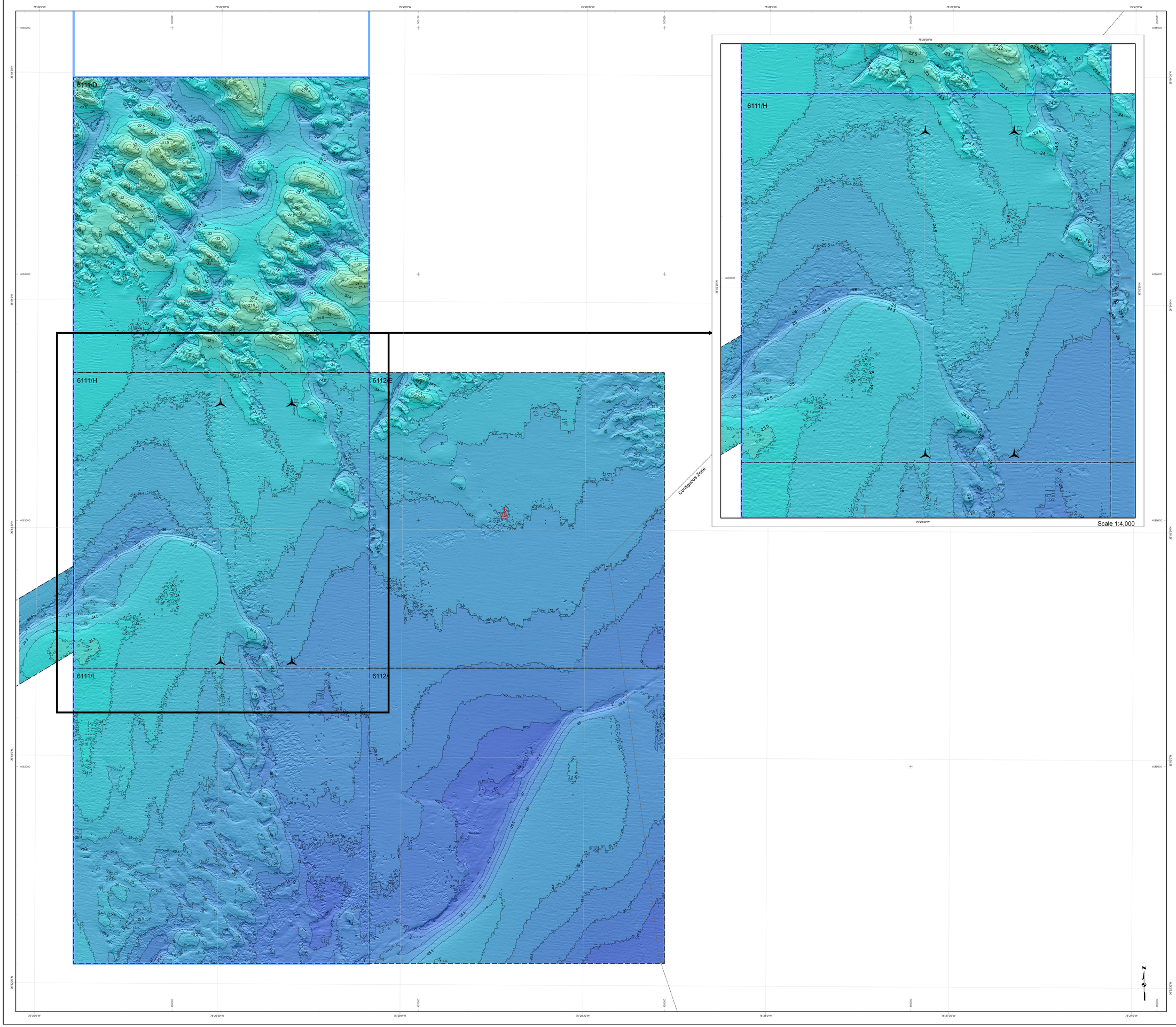

L E G E N D

- Preliminary Turbine Sites
- Buoy Avoided 06/05/13 per Survey Log
- 0.5m Contour
- Maritime Boundaries
- Survey Corridor
- Research Lease Area

Elevation (m)

- -9.49 - -9
- -9.99 - -9.5
- -10.49 - -10
- -10.99 - -10.5
- -11.49 - -11
- -11.99 - -11.5
- -12.49 - -12
- -12.99 - -12.5
- -13.49 - -13
- -13.99 - -13.5
- -14.49 - -14
- -14.99 - -14.5
- -15.49 - -15
- -15.99 - -15.5
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- -25.99 - -25.5
- -26.49 - -26
- -26.99 - -26.5
- -27.49 - -27
- -27.99 - -27.5
- -28.49 - -28
- -28.99 - -28.5
- -29.49 - -29
- -29.99 - -29.5
- -30.49 - -30
- -30.66 - -30.5

SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS851 with MarineStar
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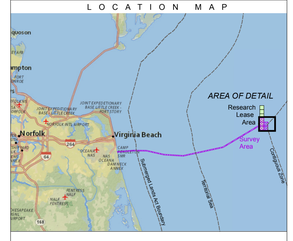
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



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Feet: 0, 187.5, 375, 750, 1,125, 1,500

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Bathymetry

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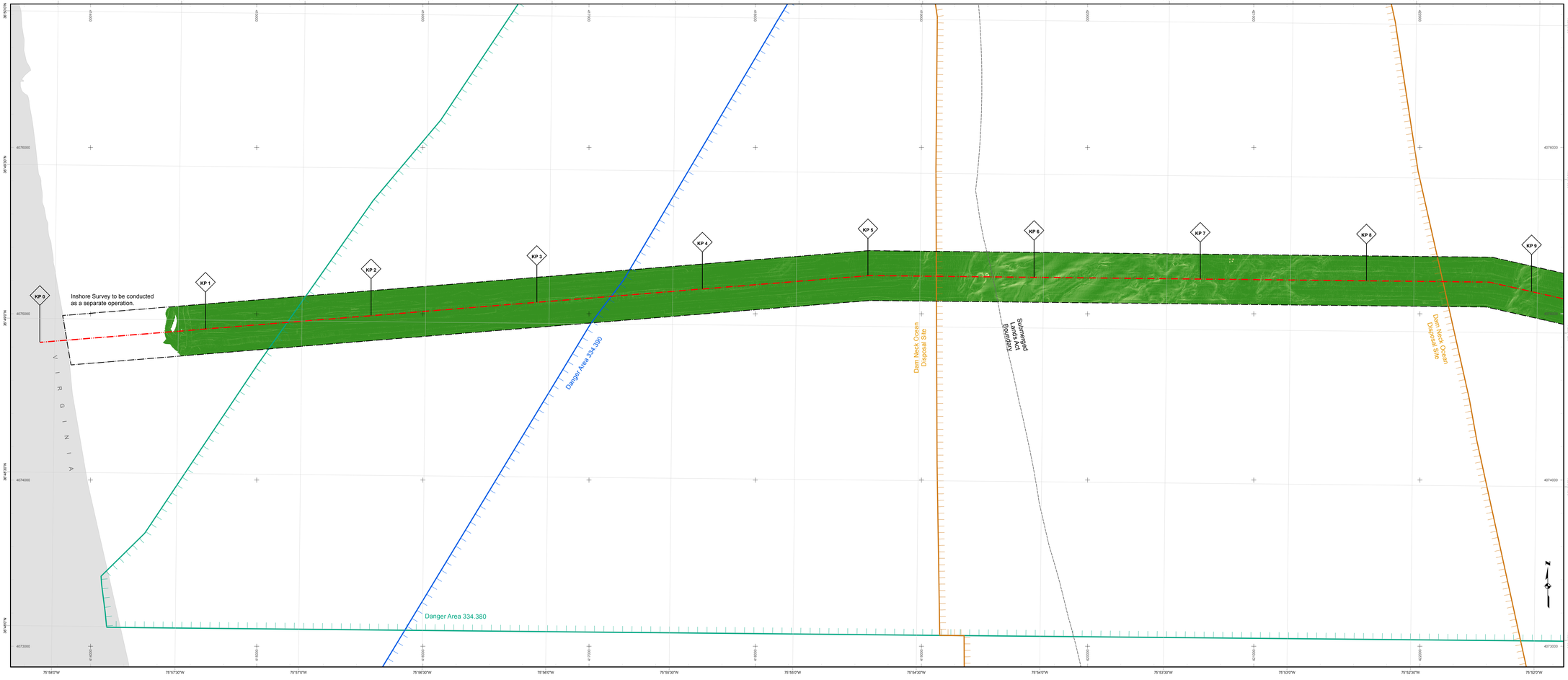

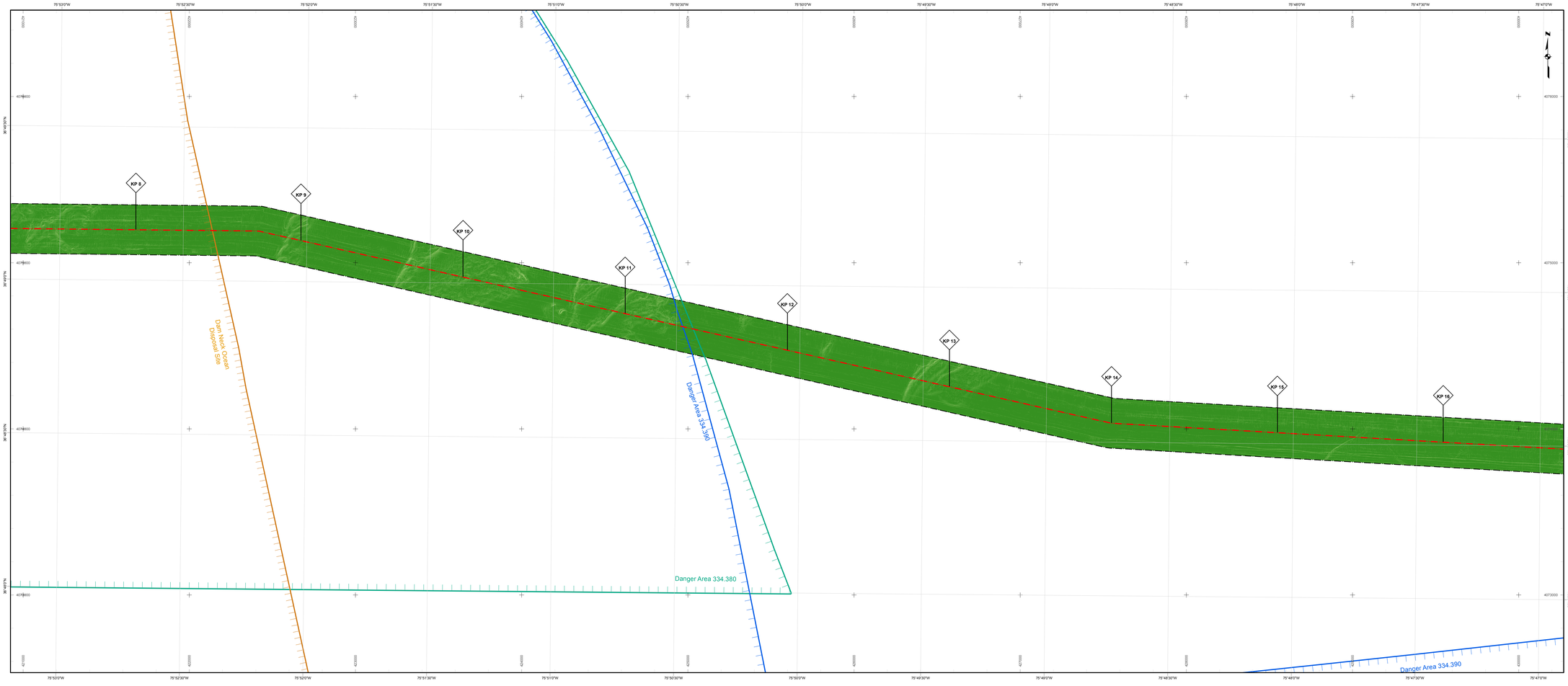

L E G E N D

- Survey Centerline
- Maritime Boundaries
- Dam Neck Ocean Disposal Site
- Danger Area 334.380*
- Danger Area 334.390**
- Survey Corridor
- Research Lease Area

Degree Slope

- 0 - 0.5
- 0.6 - 1
- 1.1 - 1.5
- 1.6 - 2
- 2.1 - 2.5
- 2.6 - 3
- 3.1 - 3.5
- 3.6 - 4
- 4.1 - 4.5
- 4.6 - 5
- 5.1 - 5.5
- 5.6 - 6
- 6.1 - 6.5
- 6.6 - 7
- 7.1 - 7.5
- 7.6 - 8
- 8.1 - 8.5
- 8.6 - 9
- 9.1 - 9.5
- 9.6 - 10
- 10.1 - 10.5
- 10.6 - 11
- 11.1 - 11.5
- 11.6 - 12
- 12.1 - 12.5
- 12.6 - 13
- 13.1 - 13.5
- 13.6 - 14
- 14.1 - 14.5
- 14.6 - 15
- 15.1 - 15.5

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Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
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L O C A T I O N M A P

SCALE 1:10,000

Meters: 0 125 250 500 750 1,000

Feet: 0 400 800 1,600 2,400 3,200

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Slope

Revision No.	Date	Description	Prepared by:	Checked by	Approved by
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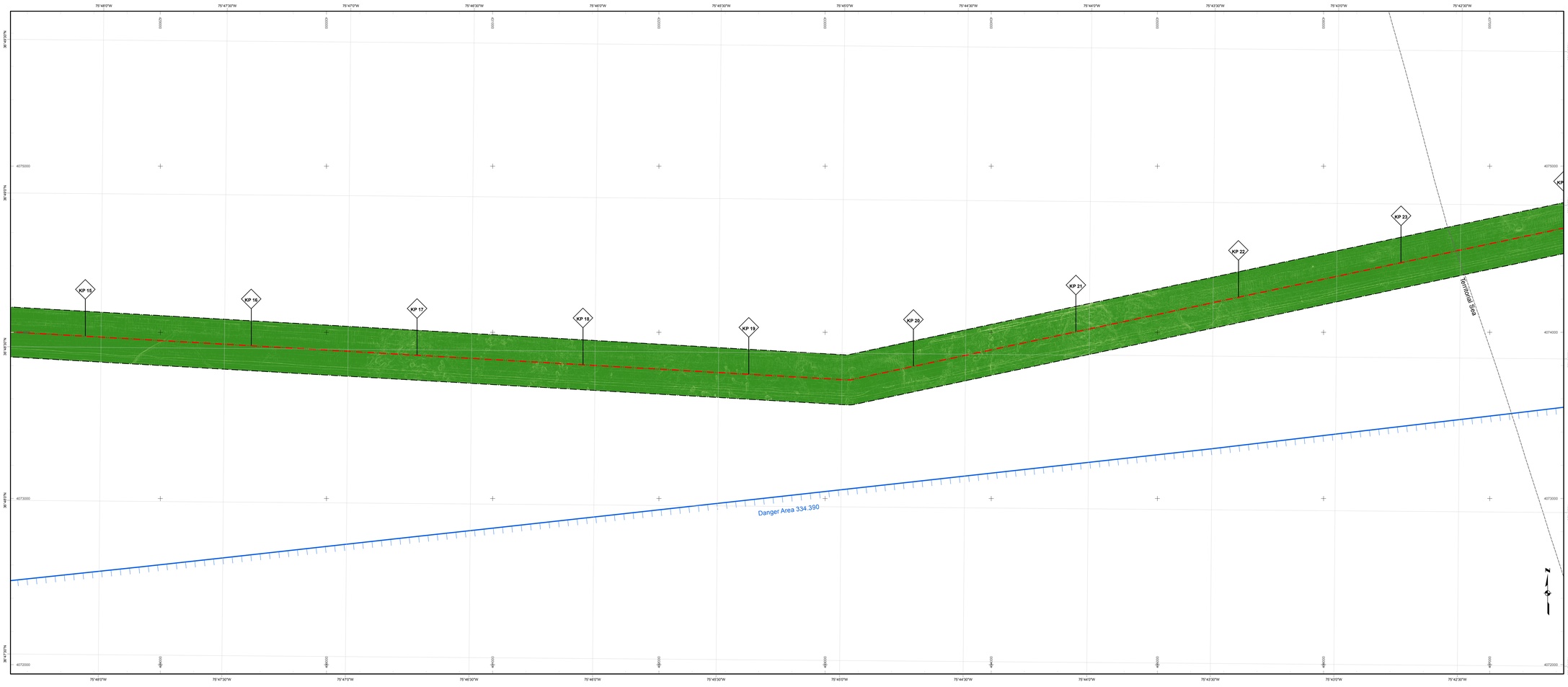

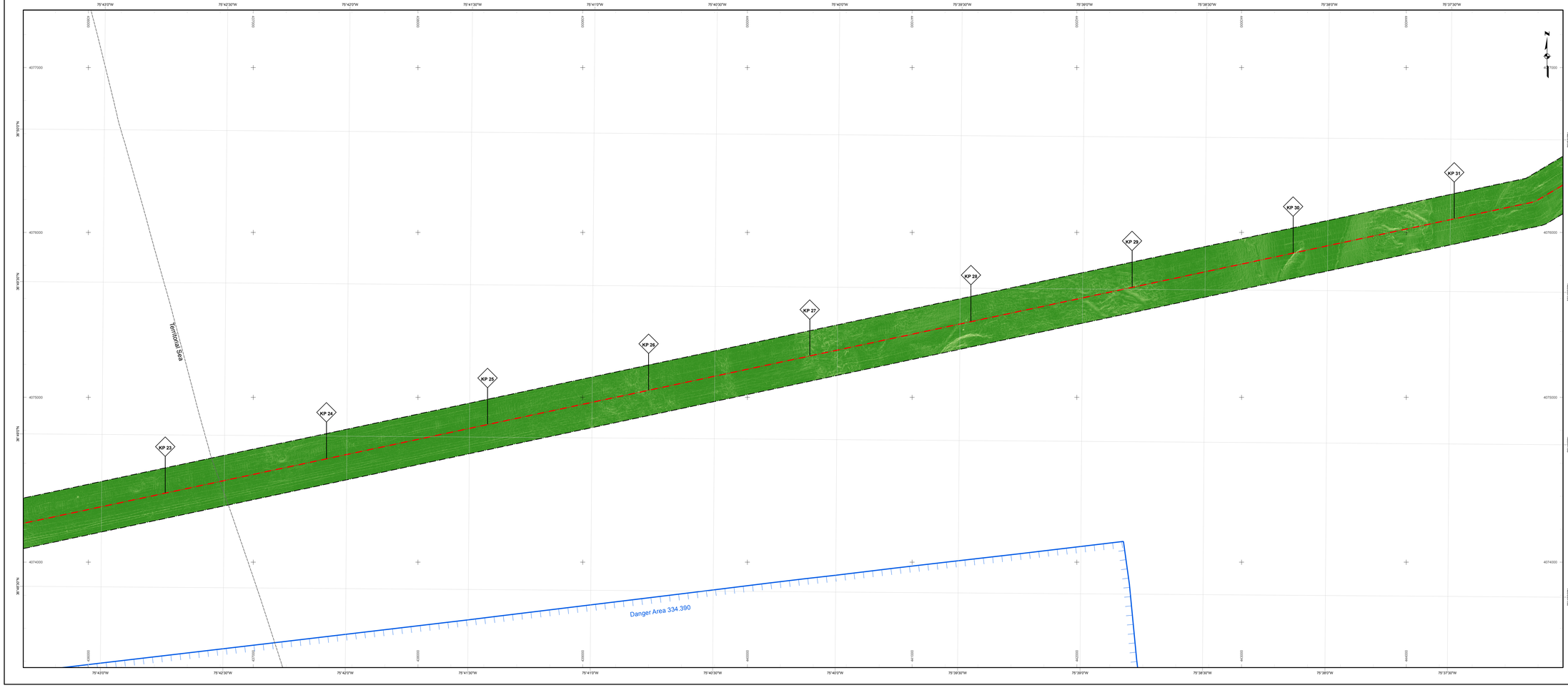

L E G E N D

- Survey Centerline
- Maritime Boundaries
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- Danger Area 334.380*
- Danger Area 334.390**
- Survey Corridor
- Research Lease Area

Degree Slope

- 0 - 0.5
- 0.6 - 1
- 1.1 - 1.5
- 1.6 - 2
- 2.1 - 2.5
- 2.6 - 3
- 3.1 - 3.5
- 3.6 - 4
- 4.1 - 4.5
- 4.6 - 5
- 5.1 - 5.5
- 5.6 - 6
- 6.1 - 6.5
- 6.6 - 7
- 7.1 - 7.5
- 7.6 - 8
- 8.1 - 8.5
- 8.6 - 9
- 9.1 - 9.5
- 9.6 - 10
- 10.1 - 10.5
- 10.6 - 11
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- 12.1 - 12.5
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- 14.1 - 14.5
- 14.6 - 15
- 15.1 - 15.5

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L O C A T I O N M A P

SCALE 1:10,000

Meters: 0 125 250 500 750 1,000

Feet: 0 400 800 1,600 2,400 3,200

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North-Up – Slope

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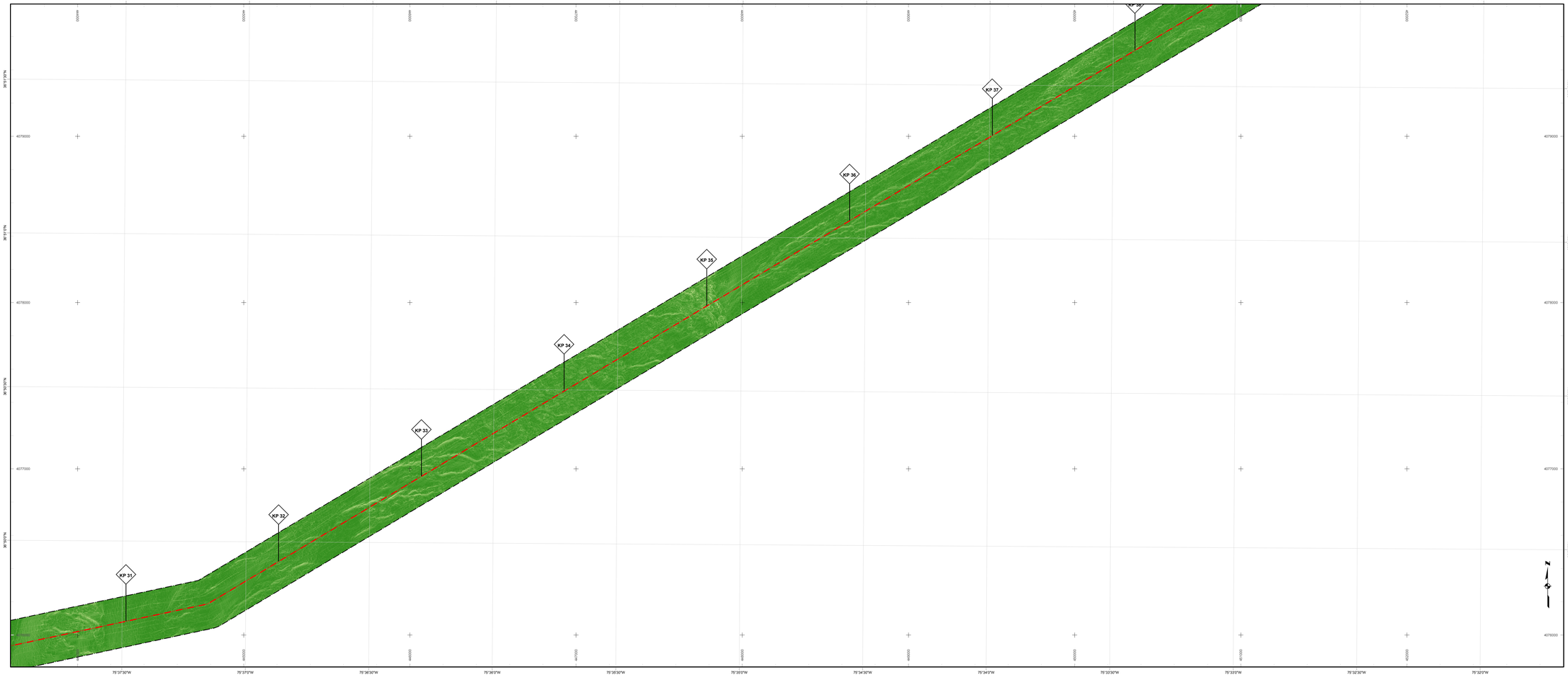
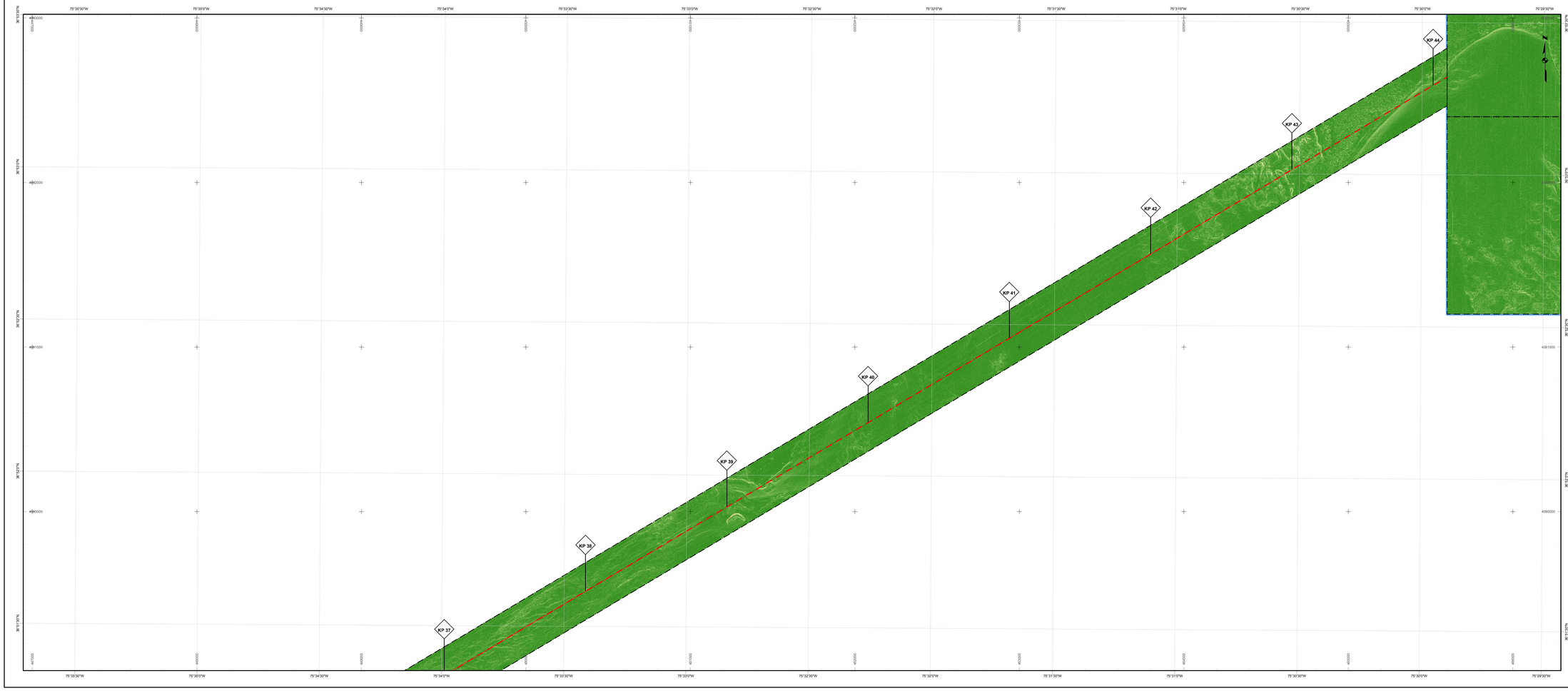
01	06/11/14	Final	MJW	JH	RJF

MXD File Name: POA_Slope_CableRoute.mxd	Scale: 1:10000	Size: ANSI E	Plate: 4	Sheet Number: 2 of 4





L E G E N D

- Survey Centerline
- Maritime Boundaries
- Dam Neck Ocean Disposal Site
- Danger Area 334.380*
- Danger Area 334.390**
- Survey Corridor
- Research Lease Area

Degree Slope

- 0 - 0.5
- 0.6 - 1
- 1.1 - 1.5
- 1.6 - 2
- 2.1 - 2.5
- 2.6 - 3
- 3.1 - 3.5
- 3.6 - 4
- 4.1 - 4.5
- 4.6 - 5
- 5.1 - 5.5
- 5.6 - 6
- 6.1 - 6.5
- 6.6 - 7
- 7.1 - 7.5
- 7.6 - 8
- 8.1 - 8.5
- 8.6 - 9
- 9.1 - 9.5
- 9.6 - 10
- 10.1 - 10.5
- 10.6 - 11
- 11.1 - 11.5
- 11.6 - 12
- 12.1 - 12.5
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- 13.1 - 13.5
- 13.6 - 14
- 14.1 - 14.5
- 14.6 - 15
- 15.1 - 15.5

*33 CFR 334.380 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY OFF DAM NECK, VIRGINIA; NAVAL FIRING RANGE.

**33 CFR 334.390 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY; FIRING RANGE.

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Survey dates	June 1 - June 28, 2013
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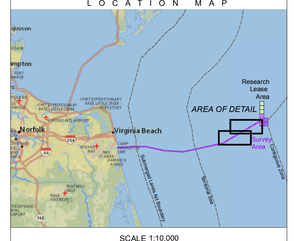
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



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Feet: 0 400 800 1,600 2,400 3,200

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Slope

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01	06/11/14	Final	MJW	JH	RJF

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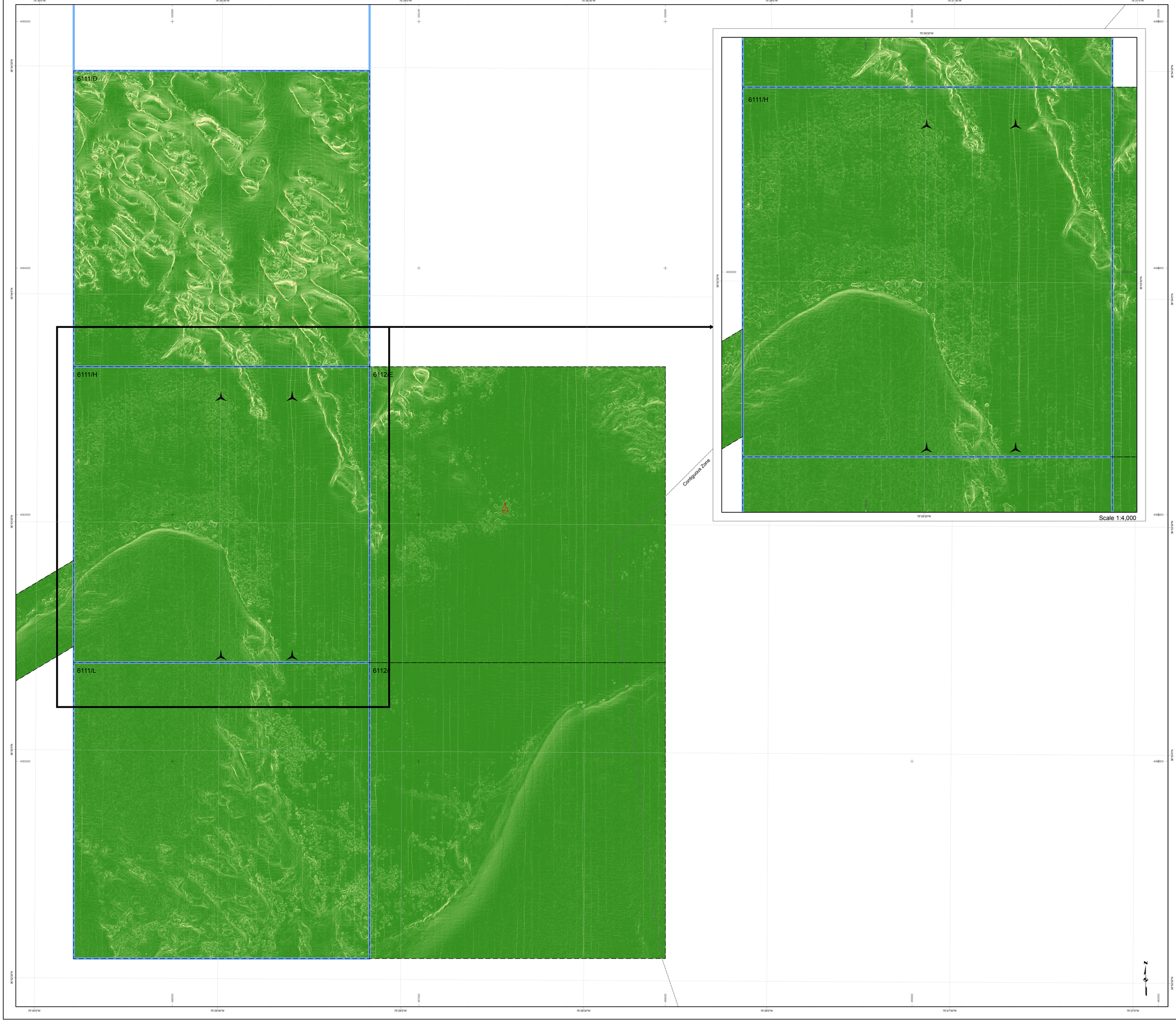

L E G E N D

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- Buoy Avoided 06/05/13 per Survey Log
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Degree Slope

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- 0.6 - 1
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- 2.1 - 2.5
- 2.6 - 3
- 3.1 - 3.5
- 3.6 - 4
- 4.1 - 4.5
- 4.6 - 5
- 5.1 - 5.5
- 5.6 - 6
- 6.1 - 6.5
- 6.6 - 7
- 7.1 - 7.5
- 7.6 - 8
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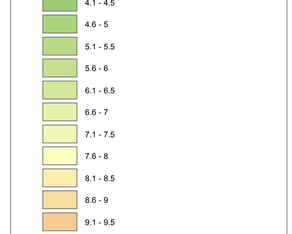
L O C A T I O N M A P



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Feet: 0, 187.5, 375, 750, 1,125, 1,500

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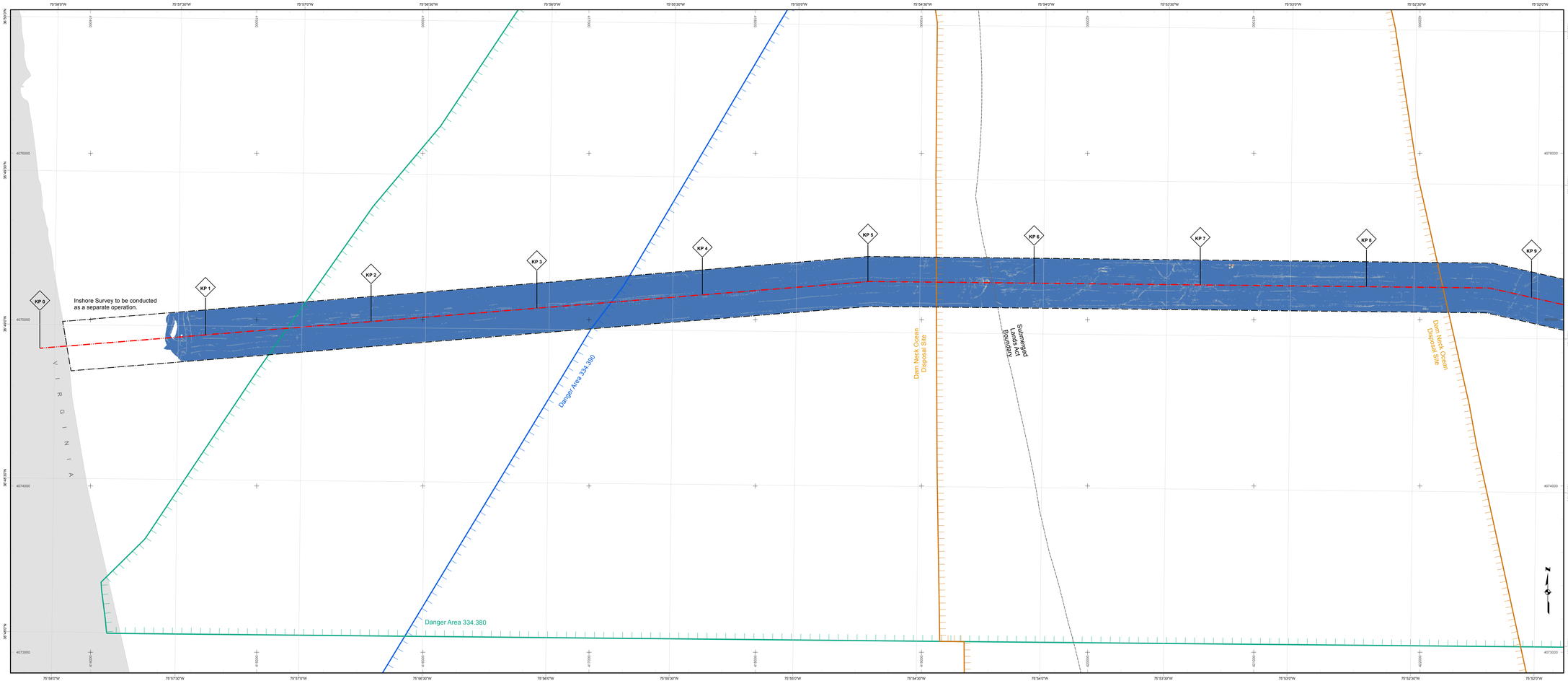

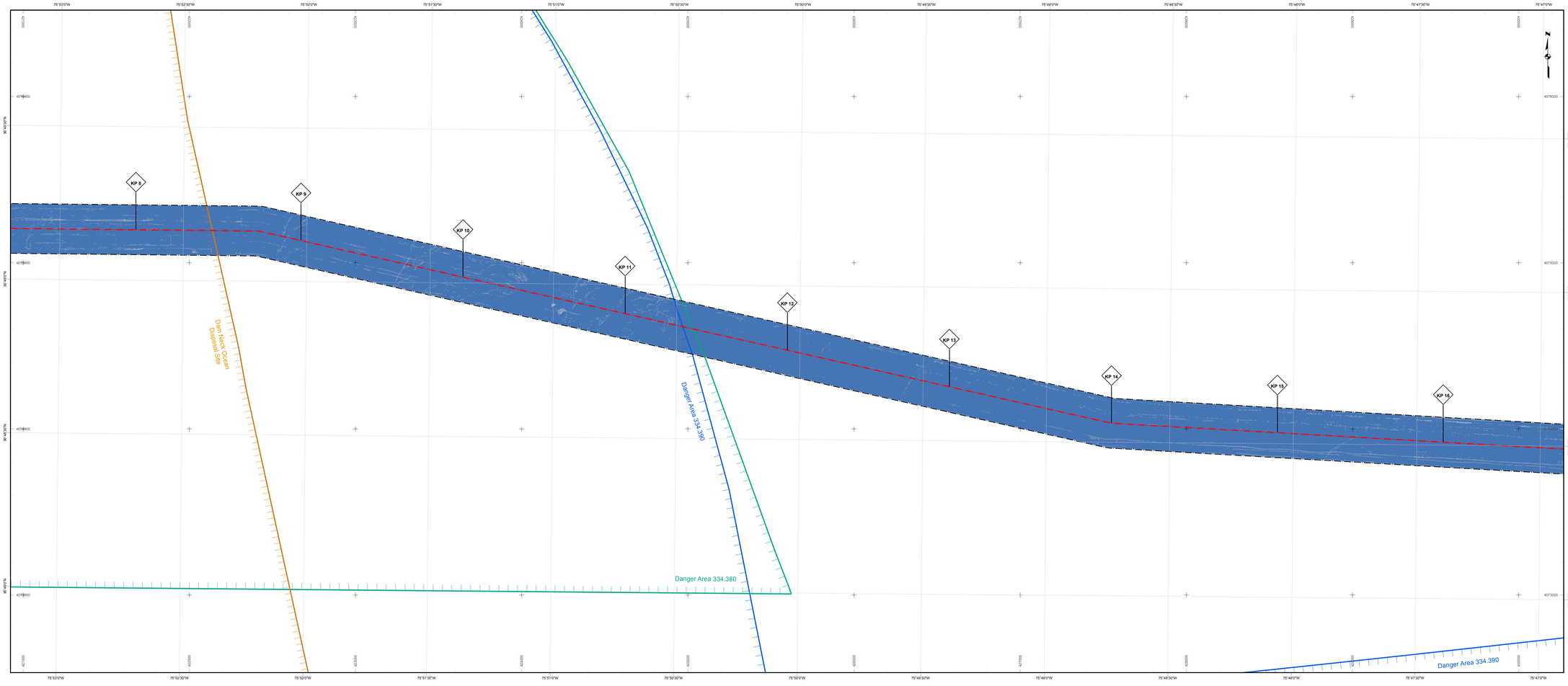

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Rugosity - Ratio of Surface Area to Planar Area

- 0 - 0.0001
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- 0.0012 - 0.0017
- 0.0018 - 0.0023
- 0.0024 - 0.0031
- 0.0032 - 0.0046
- 0.0047 - 0.0093
- 0.0094 - 0.0195

Note:
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L O C A T I O N M A P

SCALE 1:10,000

Meters: 0 125 250 500 750 1,000

Feet: 0 400 800 1,600 2,400 3,200

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North-Up – Rugosity

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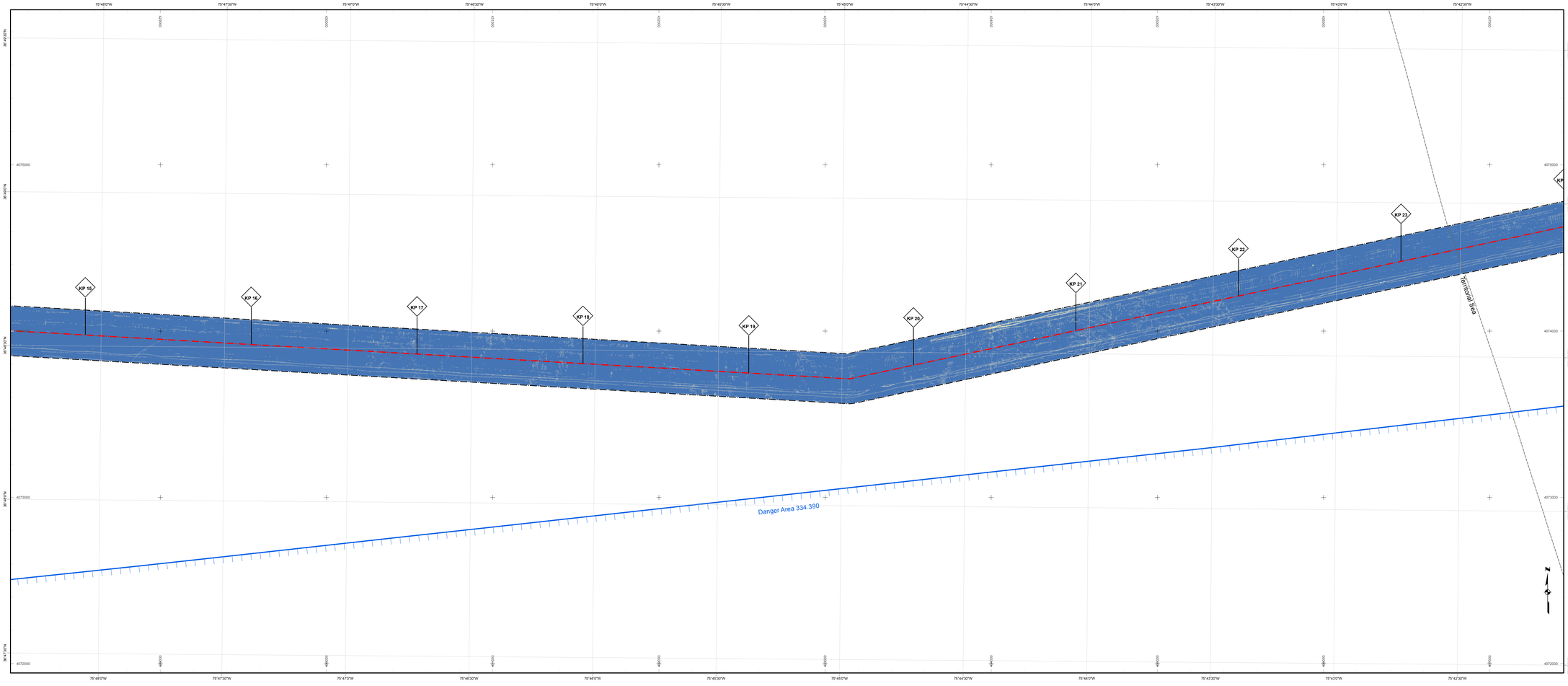

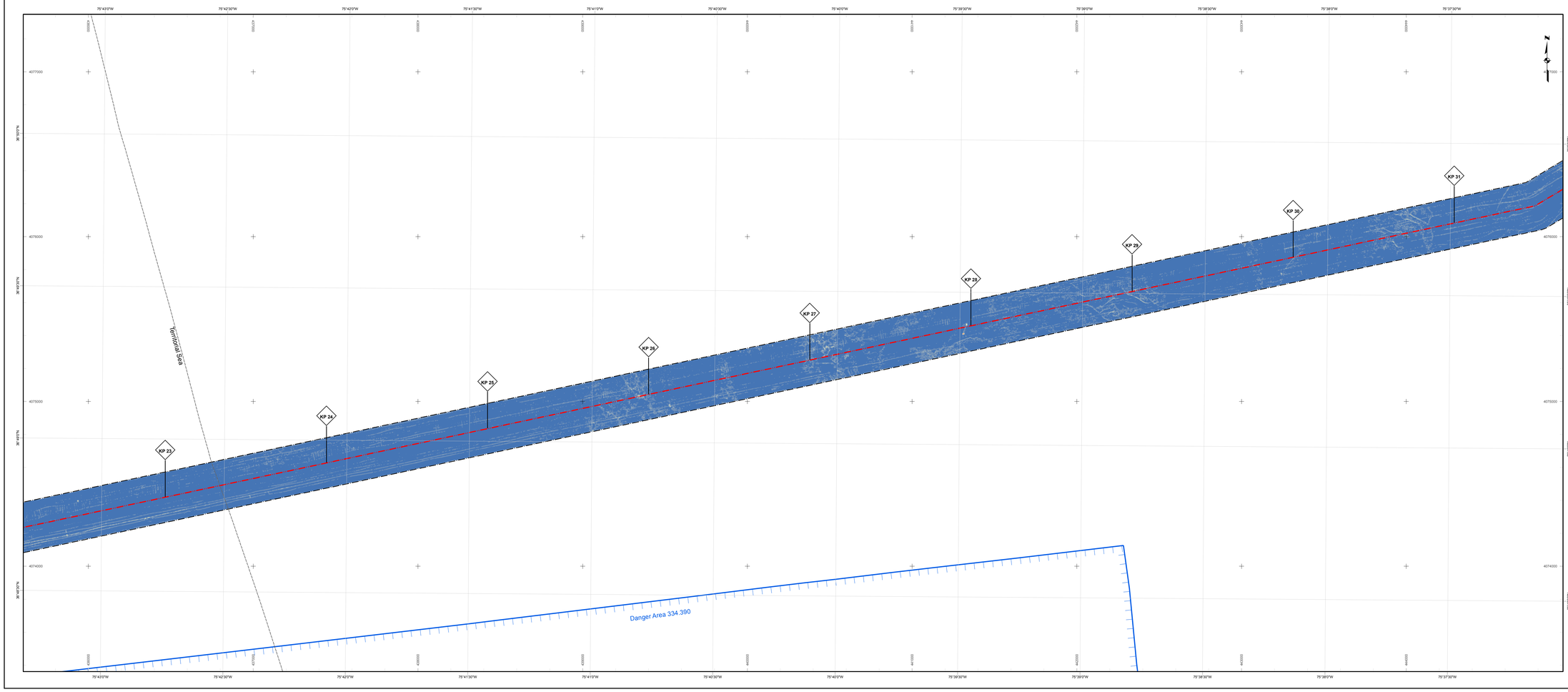

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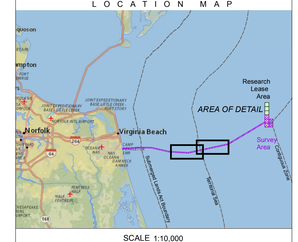
L O C A T I O N M A P



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North-Up – Rugosity

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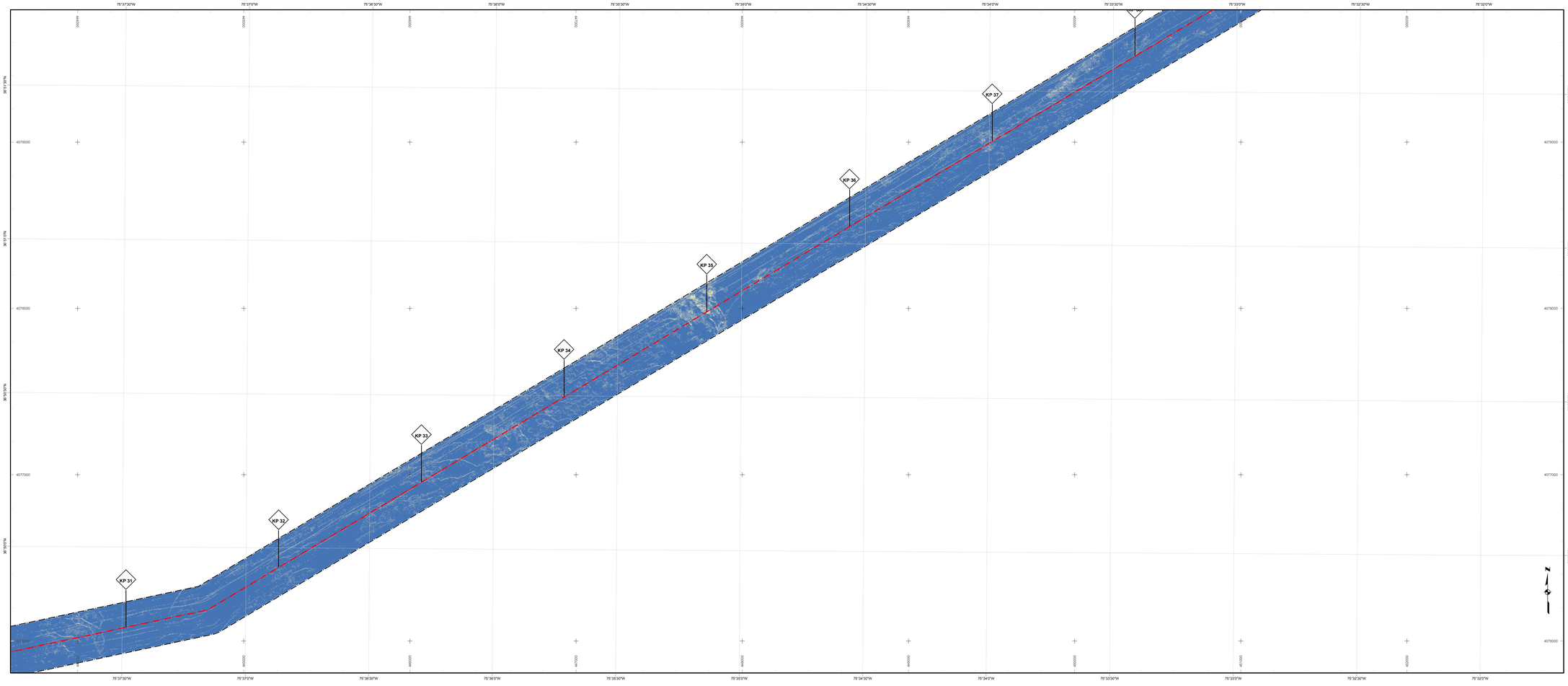

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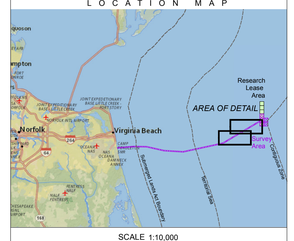
L O C A T I O N M A P



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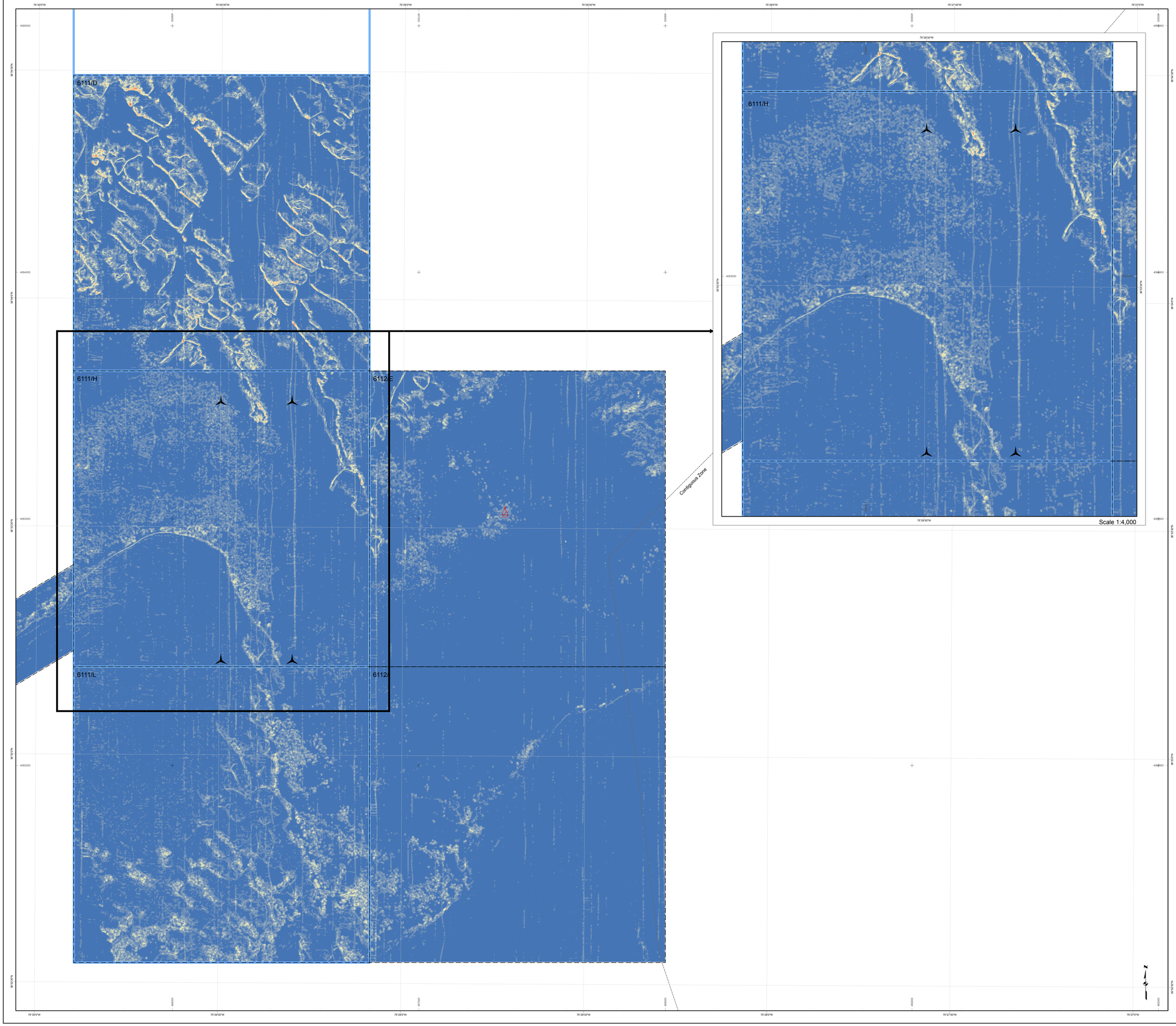
MXD File Name: P08_Rugosity_CableRoute.mxd	Scale: 1:10000	Size: ANSI E	Plate: 5	Sheet Number: 3 of 4



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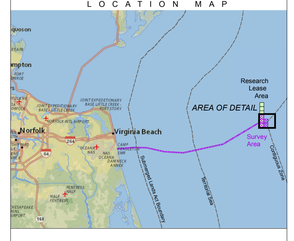

SCALE 1:5,000

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Feet: 0 187.5 375 750 1,125 1,500

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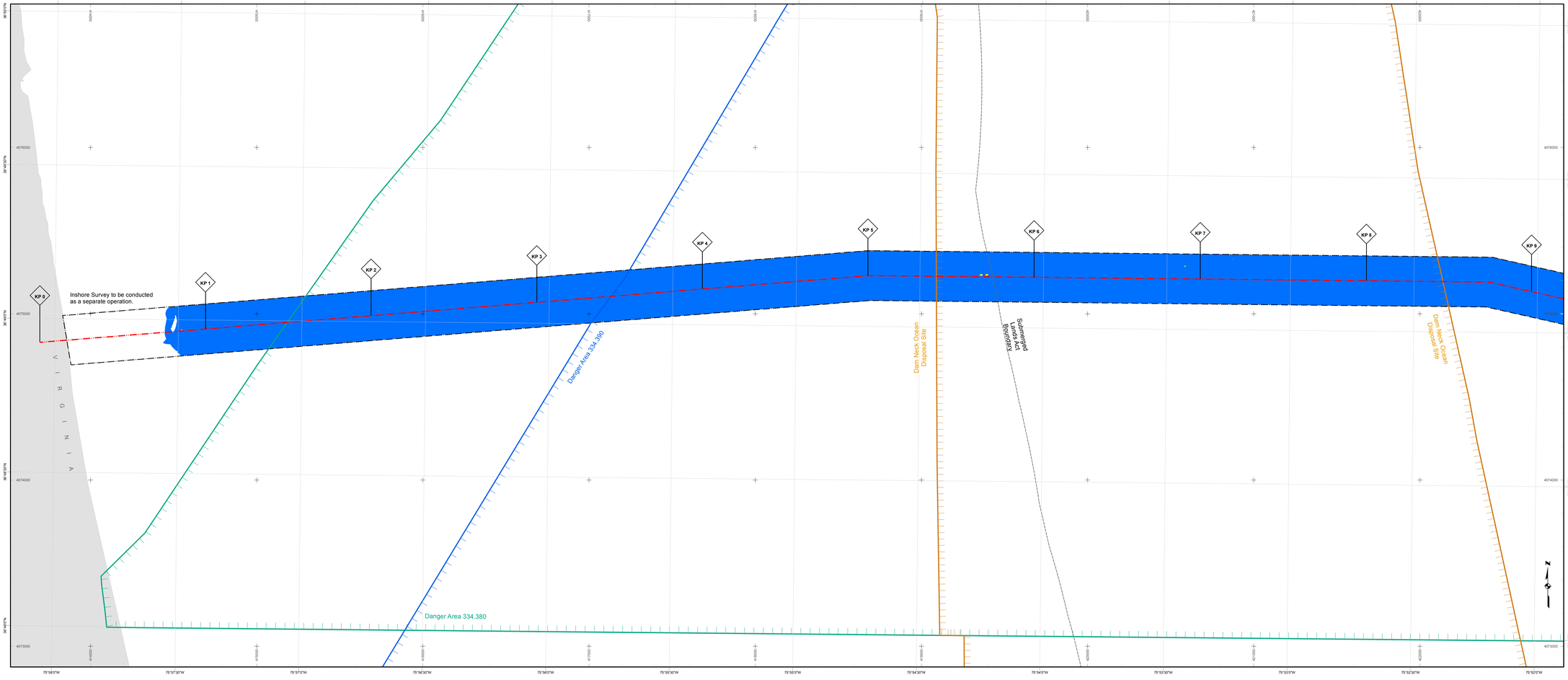

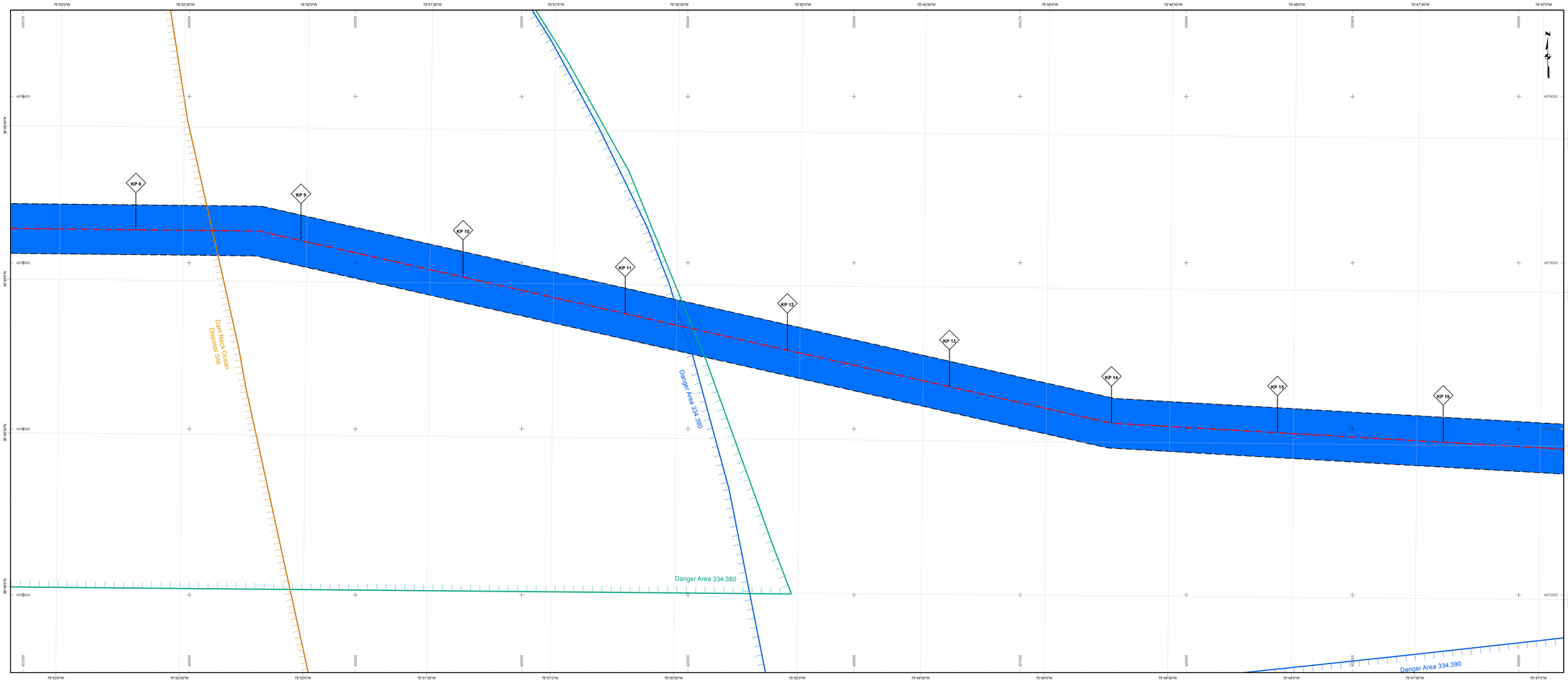

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Benthic Zones

- Crests
- Flats

Benthic Zone Classification Descriptions:
1. Crests - High points in the terrain where there are positive bathymetric position index values greater than one standard deviation from the mean in the positive direction
2. Depressions - Low points in the terrain where there are negative bathymetric position index values greater than one standard deviation from the mean in the negative direction
3. Flats - Flat points in the terrain where there are near zero bathymetric position index values that are within one standard deviation of the mean. Flats have aslope that is <= 5°.
4. Slopes - Sloping points in the terrain where there are near zero bathymetric position index values that are within one standard deviation of the mean. Slopes have a slope that is > 5°. Slopes are otherwise called escarpments in the NOAA/NOS classification scheme.

Derived using the Benthic Terrain Modeler (BTM), version 1.0, released April 2005. Wright, D. J., E. R. Lundblad, E. M. Larkin, R. W. Rinehart, J. Murphy, L. Cary-Kothera, and K. Draganov. 2005. ArcGIS Benthic Terrain Modeler, Corvallis, Oregon, Oregon State University, Davey Jones Locker Seafloor Mapping/Marine GIS Laboratory and NOAA Coastal Services Center.
Accessible online at: http://www.csc.noaa.gov/products/btm/

BTM functions as an interactive toolbar within ArcMap, and relies on a methodology developed by former graduate students Emily Lundblad, Emily Larkin, and Ron Rinehart under the direction of Dr. Dawn Wright, to analyze benthic terrain from input multibeam bathymetry in ESRI's GRID (raster) format. The BTM toolbar contains a set of tools that allow users to create grids of slope, bathymetric position index (BPI, similar to the TPI developed by Andrew Weiss), and rugosity (based on Jeff Jenness' 3.x extension) from an input data set.Benthic terrain classification is highly dependent on grid size, as a result classification may vary for the same region when analyzed at different grid resolutions.

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RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P

SCALE 1:10,000

Meters: 0 125 250 500 750 1,000

Feet: 0 400 800 1,600 2,400 3,200

Dominion Resources, Inc.
5000 Dominion Boulevard
Glen Allen, VA 23060

Tetra Tech, Inc.
4101 Cox Road, Suite 120
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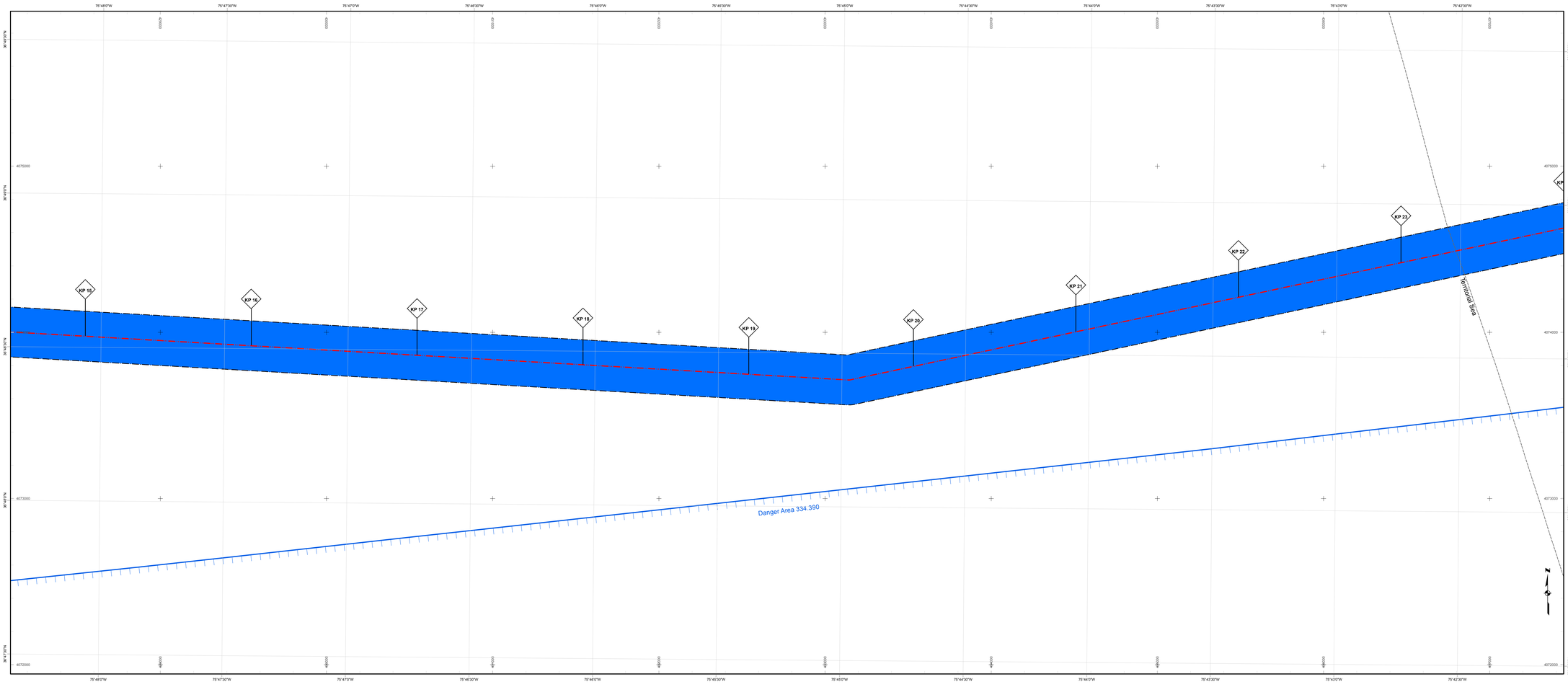
www.tetratech.com

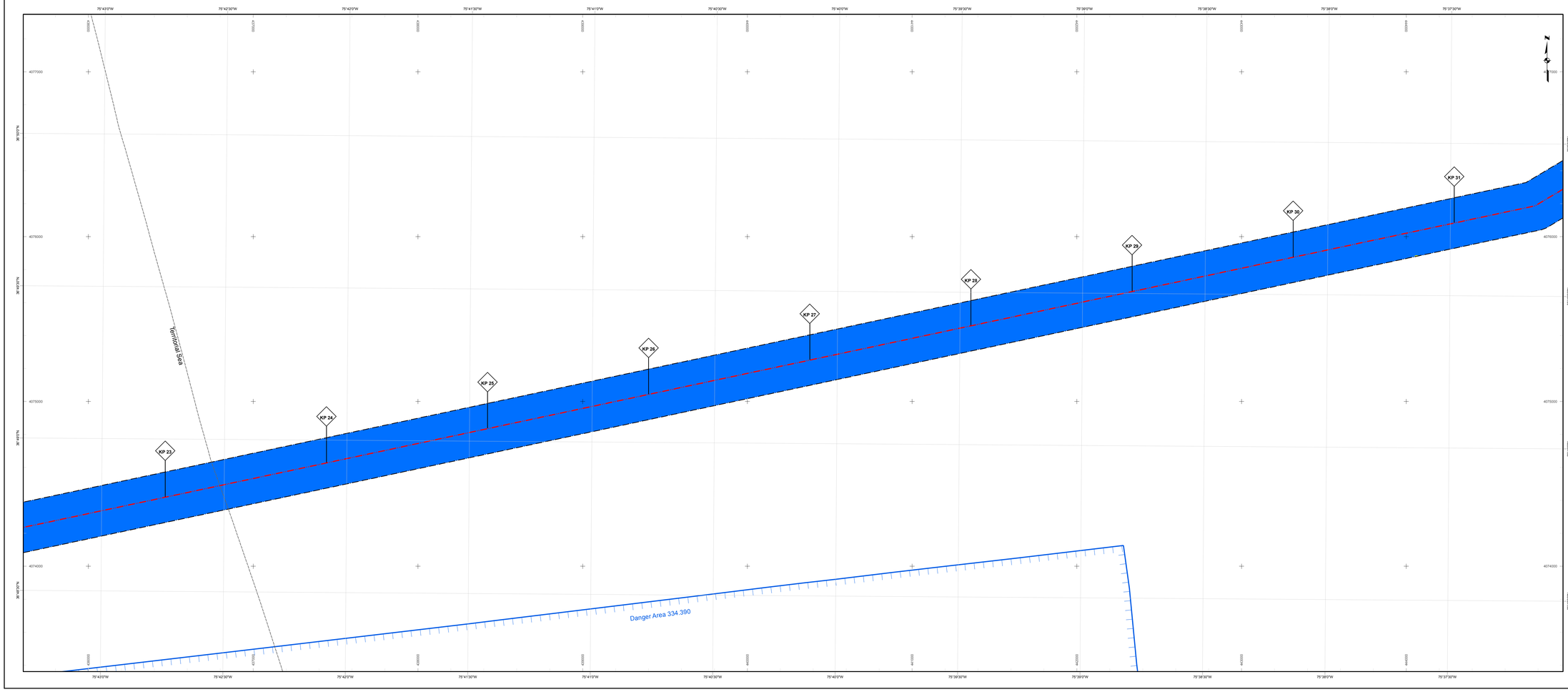
Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Benthic Zones

Revision No.	Date	Description	Prepared by	Checked by	Approved by
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

MXD File Name: P08_B7_Zones_CableRoute.mxd	Scale: 1:10000	Size: ANSI E	Plate: 6	Sheet Number: 1 of 4





L E G E N D

- Survey Centerline
- Maritime Boundaries
- Dam Neck Ocean Disposal Site
- Danger Area 334.380*
- Danger Area 334.390**
- Survey Corridor
- Research Lease Area

Benthic Zones

- Crests
- Flats

Benthic Zone Classification Descriptions:
1. Crests - High points in the terrain where there are positive bathymetric position index values greater than one standard deviation from the mean in the positive direction
2. Depressions - Low points in the terrain where there are negative bathymetric position index values greater than one standard deviation from the mean in the negative direction
3. Flats - Flat points in the terrain where there are near zero bathymetric position index values that are within one standard deviation of the mean. Flats have aslope that is <= 5°.
4. Slopes - Sloping points in the terrain where there are near zero bathymetric position index values that are within one standard deviation of the mean. Slopes have a slope that is > 5°. Slopes are otherwise called escarpments in the NOAA/NOS classification scheme.

Derived using the Benthic Terrain Modeler (BTM), version 1.0, released April 2005. Wright, D. J., E. R. Lundblad, E. M. Larkin, R. W. Rinehart, J. Murphy, L. Cary-Kothera, and K. Draganov. 2005. ArcGIS Benthic Terrain Modeler, Corvallis, Oregon, Oregon State University, Davey Jones Locker Seafloor Mapping/Marine GIS Laboratory and NOAA Coastal Services Center.
Accessible online at: http://www.csc.noaa.gov/products/btm/

BTM functions as an interactive toolbar within ArcMap, and relies on a methodology developed by former graduate students Emily Lundblad, Emily Larkin, and Ron Rinehart under the direction of Dr. Dawn Wright, to analyze benthic terrain from input multibeam bathymetry in ESRI's GRID (raster) format. The BTM toolbar contains a set of tools that allow users to create grids of slope, bathymetric position index (BPI, similar to the TPI developed by Andrew Weiss), and rugosity (based on Jeff Jenness' 3.x extension) from an input data set.Benthic terrain classification is highly dependent on grid size, as a result classification may vary for the same region when analyzed at different grid resolutions.

*33 CFR 334.380 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY OFF DAM NECK, VIRGINIA; NAVAL FIRING RANGE.

**33 CFR 334.390 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY; FIRING RANGE.

SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS851 with MarineStar
Subsurface Positioning	IXBlue GAPS
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
Sidescan Sonar Sensor	EdgeTech 2000-DSS 110 kHz/540 kHz
Sub-bottom Profiler	EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

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Horizontal Units	Meters
Vertical Units	Meters
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SCALE 1:10,000

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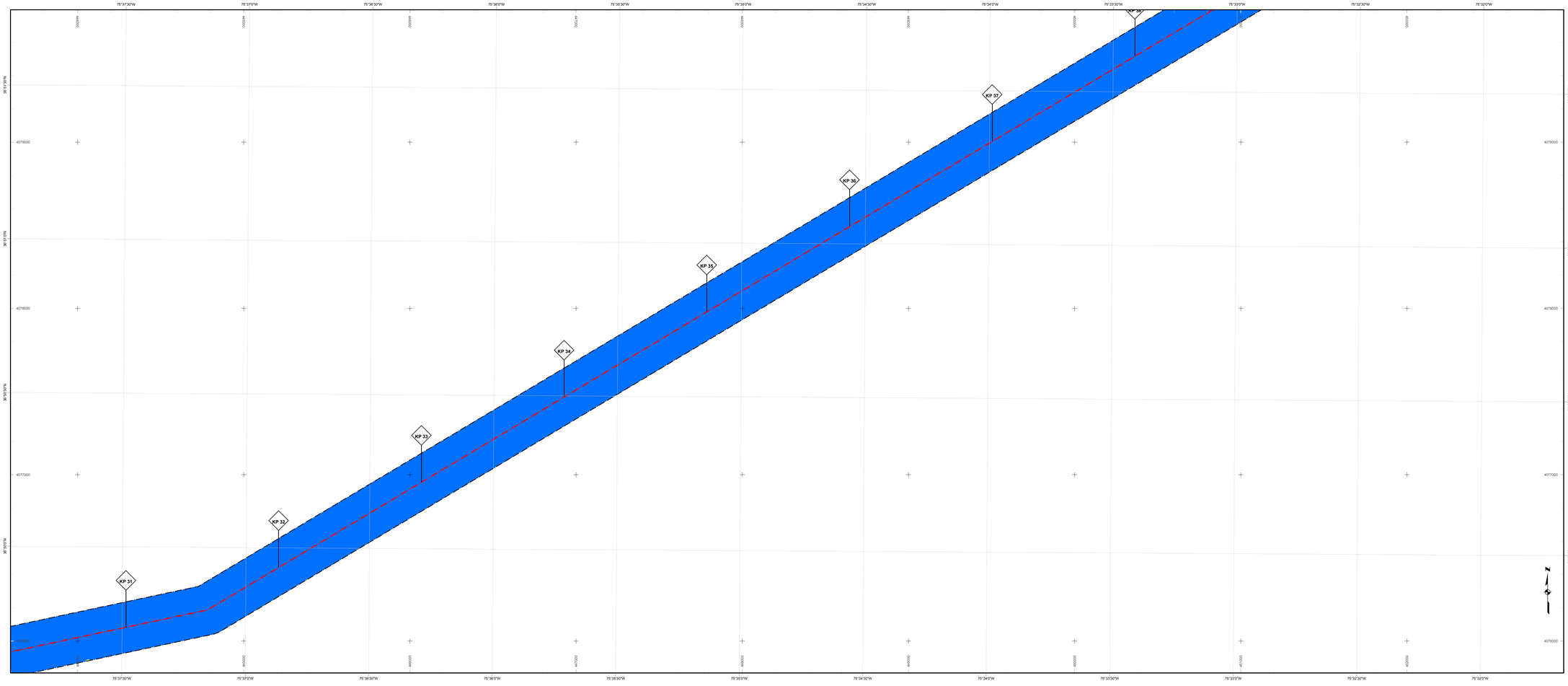
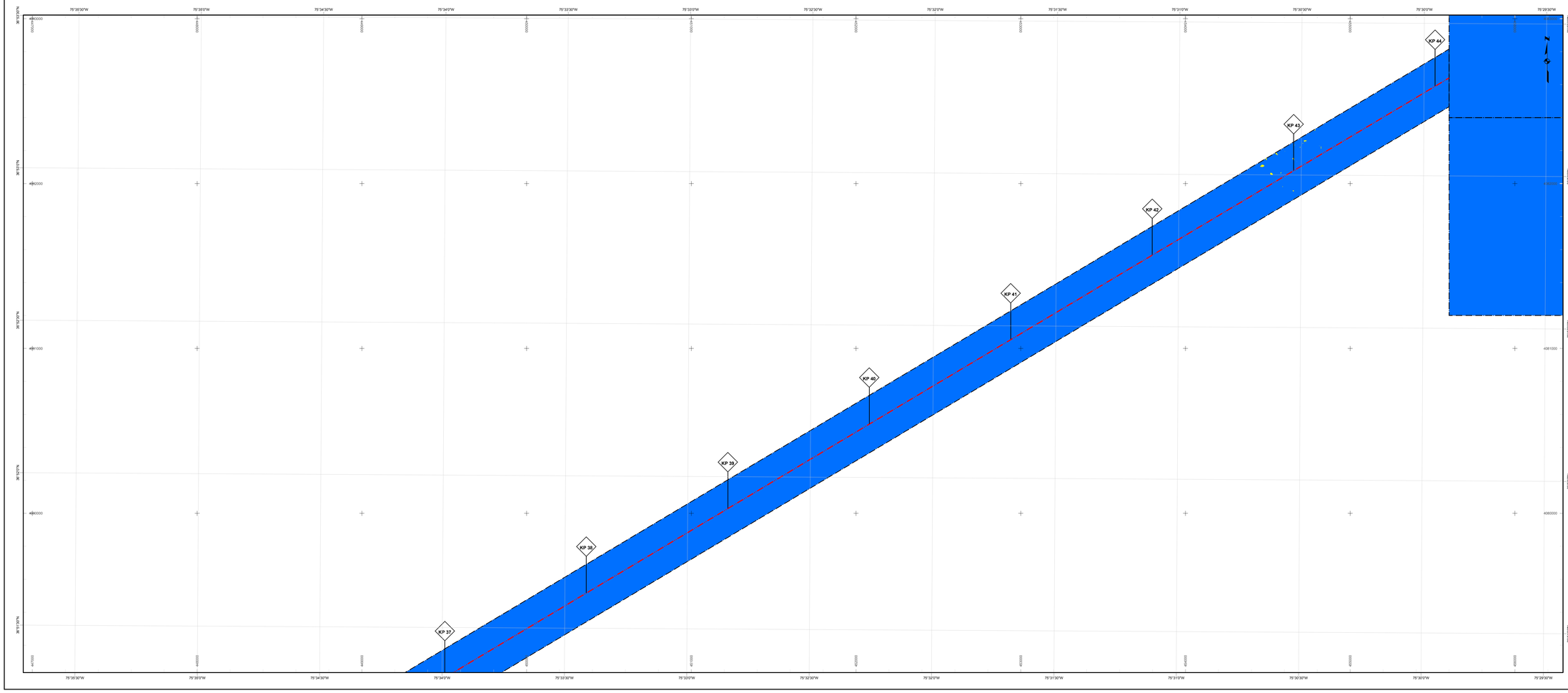
Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Benthic Zones

Revision No.	Date	Description	Prepared by	Checked by	Approved by
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

MXD File Name: P06_07_Zones_CableRoute.mxd	Scale: 1:10000	Size: ANSI E	Plate: 6	Sheet Number: 2 of 4





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RPL Issue	CableRoute_04222013 (DRAFT)

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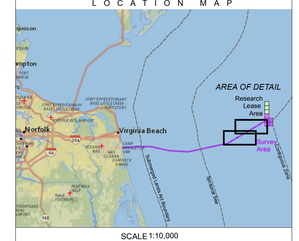

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Meters: 0 125 250 500 750 1,000

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Benthic Zones

Revision No.	Date	Description	Prepared by	Checked by	Approved by
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

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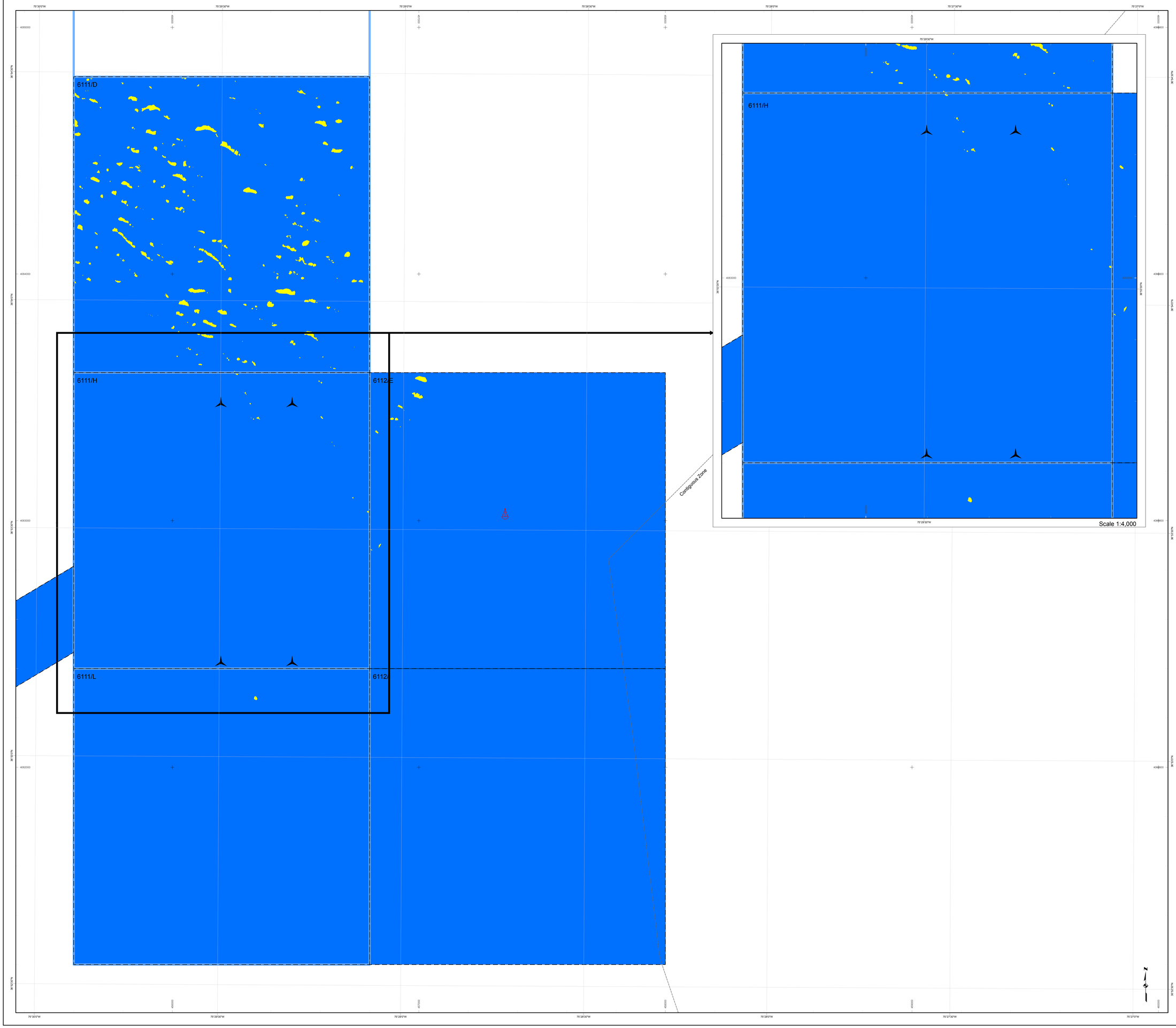
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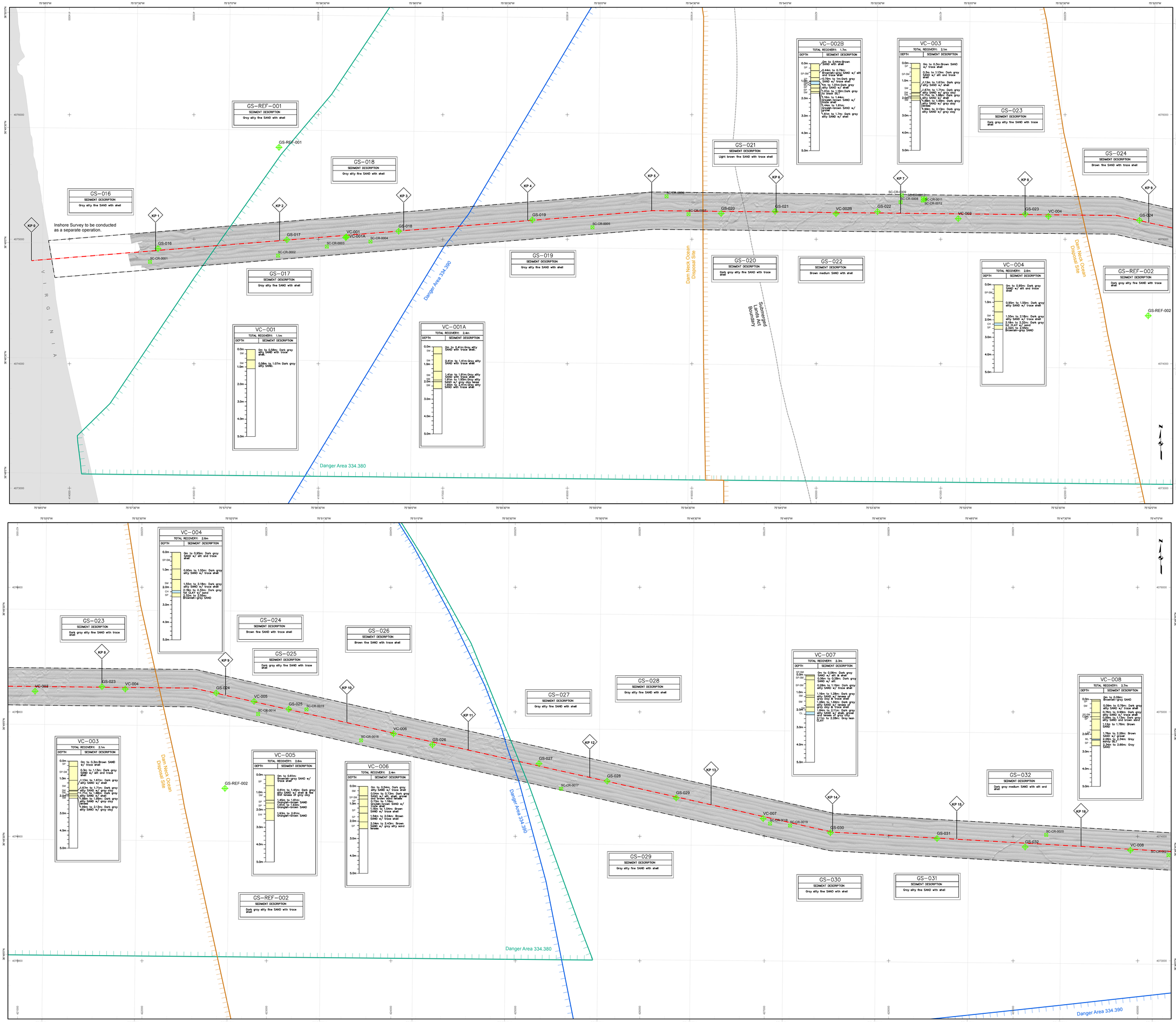

L E G E N D

- Seabed Sample Location with reference number
  - GS (Grab Sample)
  - VC (Vibra Core)
  - PC (Piston Core)
- Sonar Contacts
- Fine-grained sediment (SILT/CLAY)
- Coarse-grained sediment (SAND)
- Very coarse-grained sediment (GRAVEL)
- Reflectivity
  - Low
  - High
- Survey Centerline
- Maritime Boundaries
- Dam Neck Ocean Disposal Site
- Danger Area 334.380*
- Danger Area 334.390**
- Survey Corridor
- Research Lease Area

*33 CFR 334.380 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY OFF DAM NECK, VIRGINIA; NAVAL FIRING RANGE.

**33 CFR 334.390 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY; FIRING RANGE.

SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS851 with MarineStar
Subsurface Positioning	IXBlue GAPS
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
Sidescan Sonar Sensor	EdgeTech 2000-DSS 110 kHz/540 kHz
Sub-bottom Profiler	EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Dalasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P

SCALE 1:10,000

Meters: 0 125 250 500 750 1,000

Feet: 0 400 800 1,600 2,400 3,200

Dominion Resources, Inc.
5000 Dominion Boulevard
Glen Allen, VA 23060

Tetra Tech, Inc.
4101 Cox Road, Suite 120
Glen Allen, VA 23060
www.tetratech.com

Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Sidescan Sonar

Revision No.	Date	Description	Prepared by	Checked by	Approved by
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

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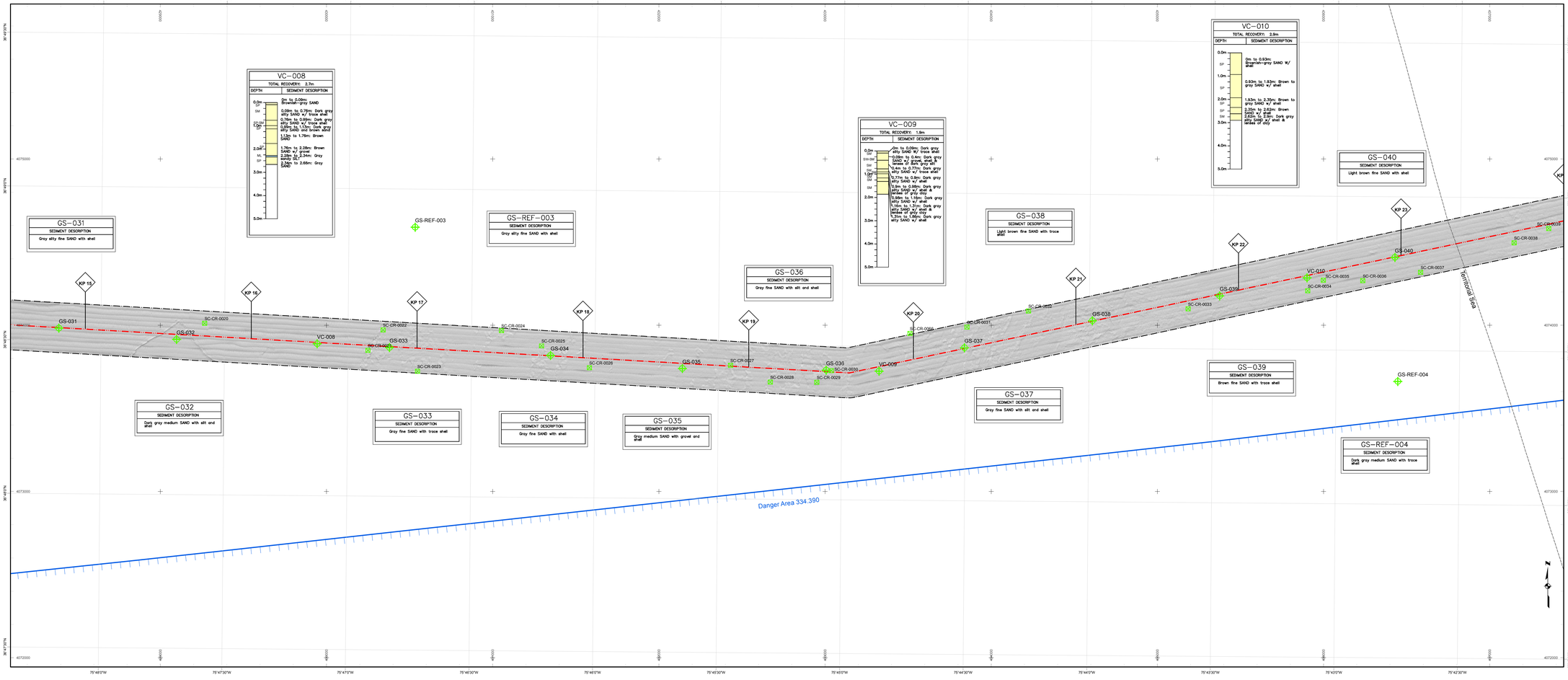

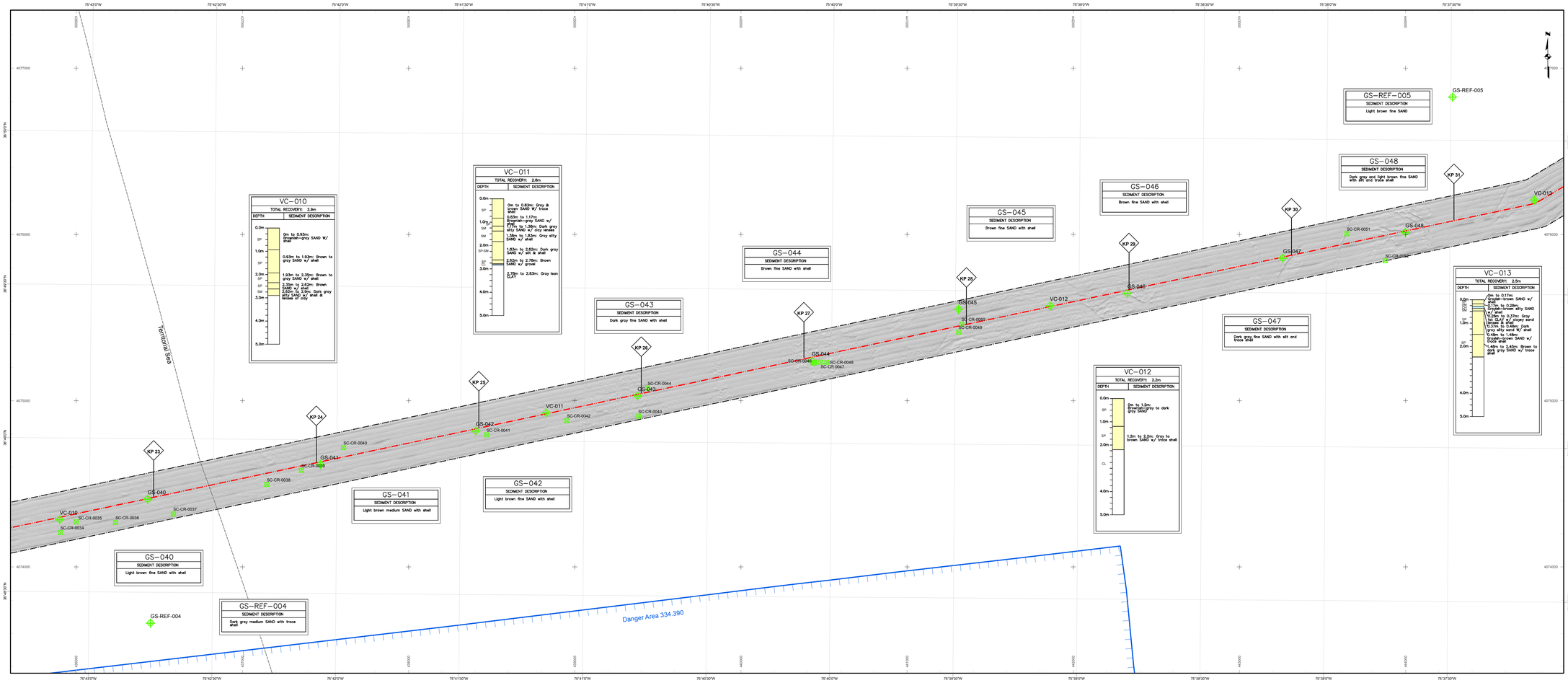

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- Danger Area 334.390**
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*33 CFR 334.380 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY OFF DAM NECK, VIRGINIA; NAVAL FIRING RANGE.

**33 CFR 334.390 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY; FIRING RANGE.

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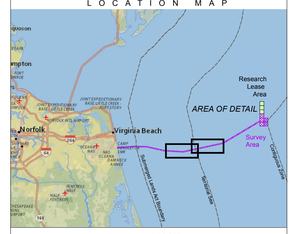
L O C A T I O N M A P



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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Sidescan Sonar

Revision No.	Date	Description	Prepared by	Checked by	Approved by
00	10/17/13	Draft	MJW	JH	RJF
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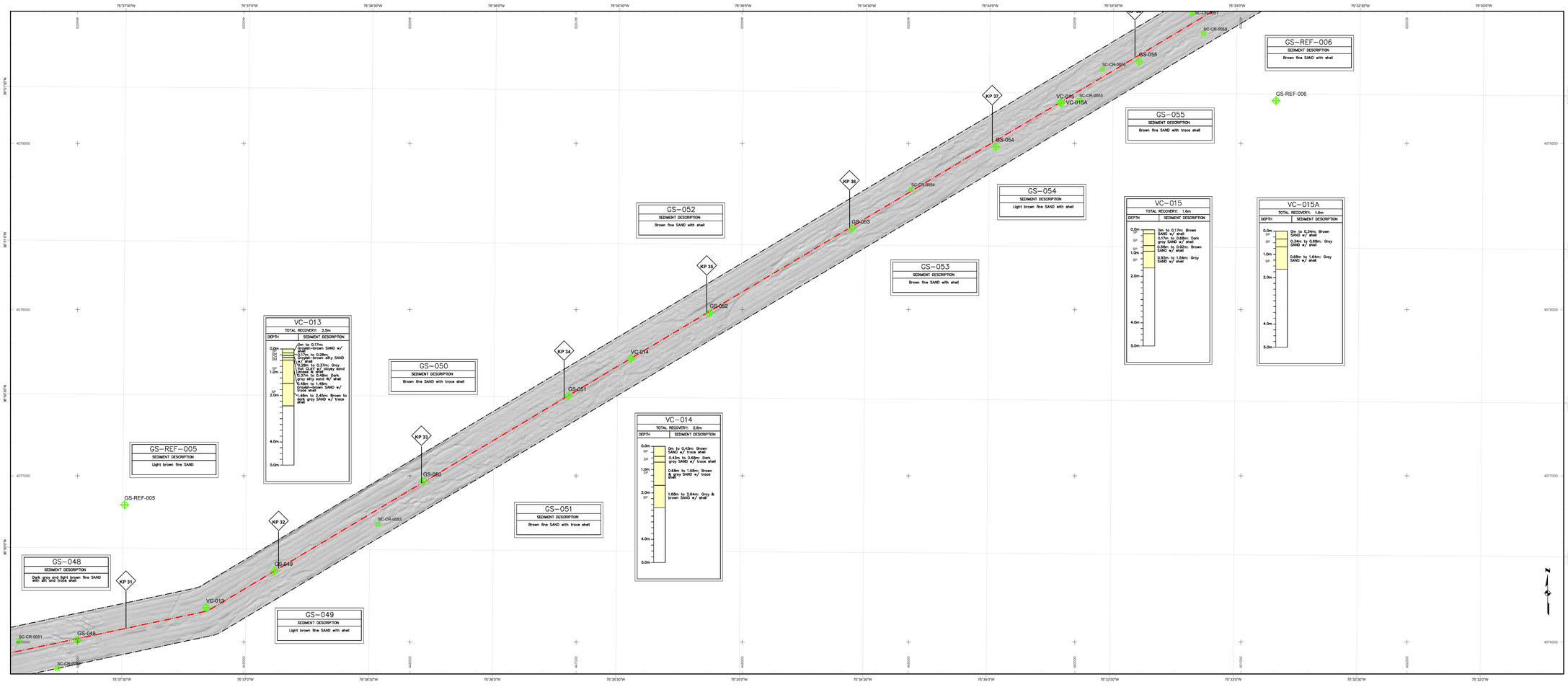

L E G E N D

- Seabed Sample Location with reference number
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- Sonar Contacts
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- Low
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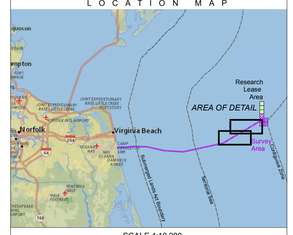

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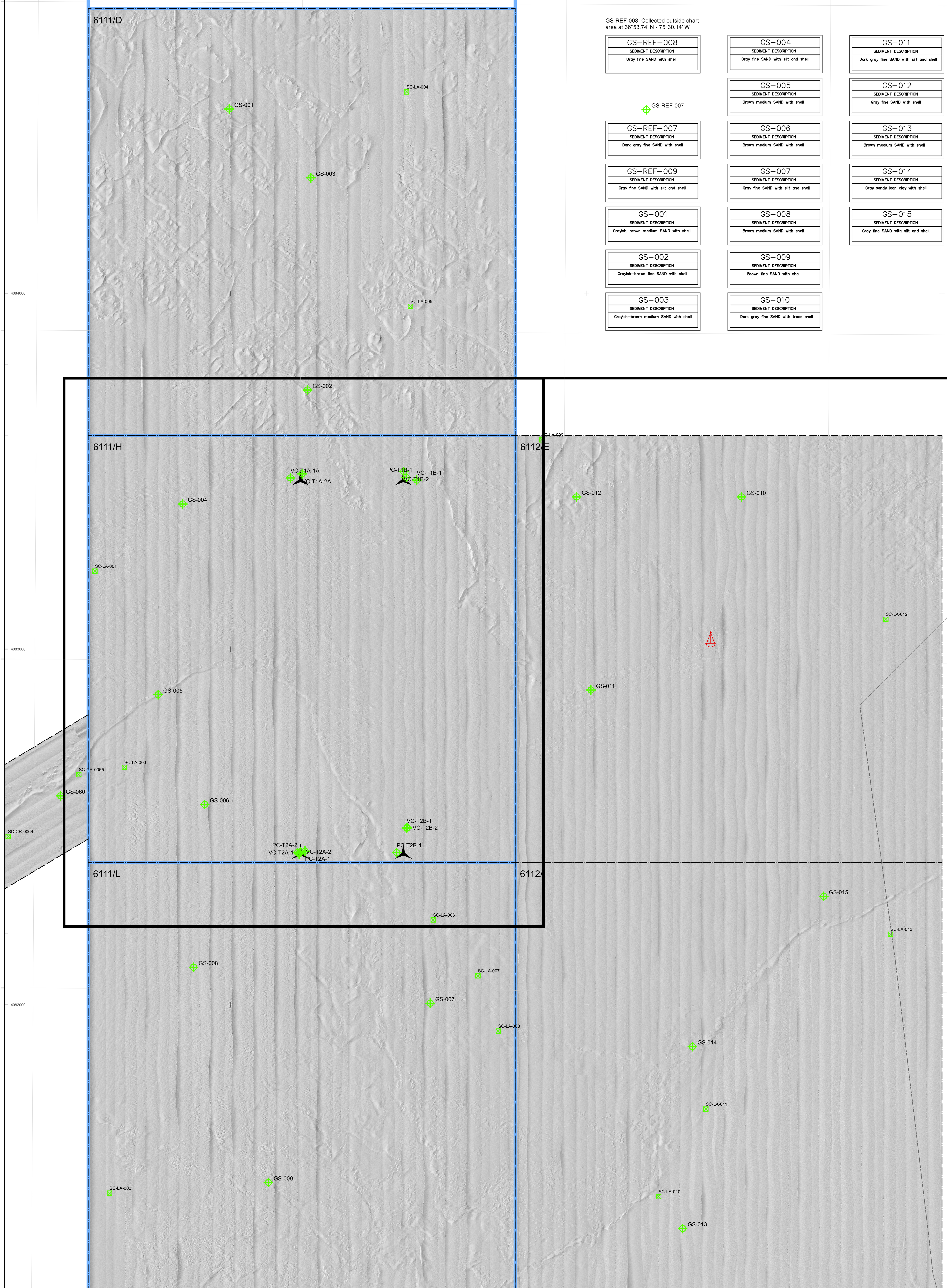


GS-REF-008: Collected outside chart area at 36°53.74' N - 75°30.14' W

GS–REF–008
SEDIMENT DESCRIPTION
Gray fine SAND with shell

GS-REF-007

GS–REF–007
SEDIMENT DESCRIPTION
Dark gray fine SAND with shell

GS–REF–009
SEDIMENT DESCRIPTION
Gray fine SAND with silt and shell

GS–001
SEDIMENT DESCRIPTION
Grayish–brown medium SAND with shell

GS–002
SEDIMENT DESCRIPTION
Grayish–brown fine SAND with shell

GS–003
SEDIMENT DESCRIPTION
Grayish–brown medium SAND with shell

GS–004
SEDIMENT DESCRIPTION
Gray fine SAND with silt and shell

GS–005
SEDIMENT DESCRIPTION
Brown medium SAND with shell

GS–006
SEDIMENT DESCRIPTION
Brown medium SAND with shell

GS–007
SEDIMENT DESCRIPTION
Gray fine SAND with silt and shell

GS–008
SEDIMENT DESCRIPTION
Brown medium SAND with shell

GS–009
SEDIMENT DESCRIPTION
Brown fine SAND with shell

GS–010
SEDIMENT DESCRIPTION
Dark gray fine SAND with trace shell

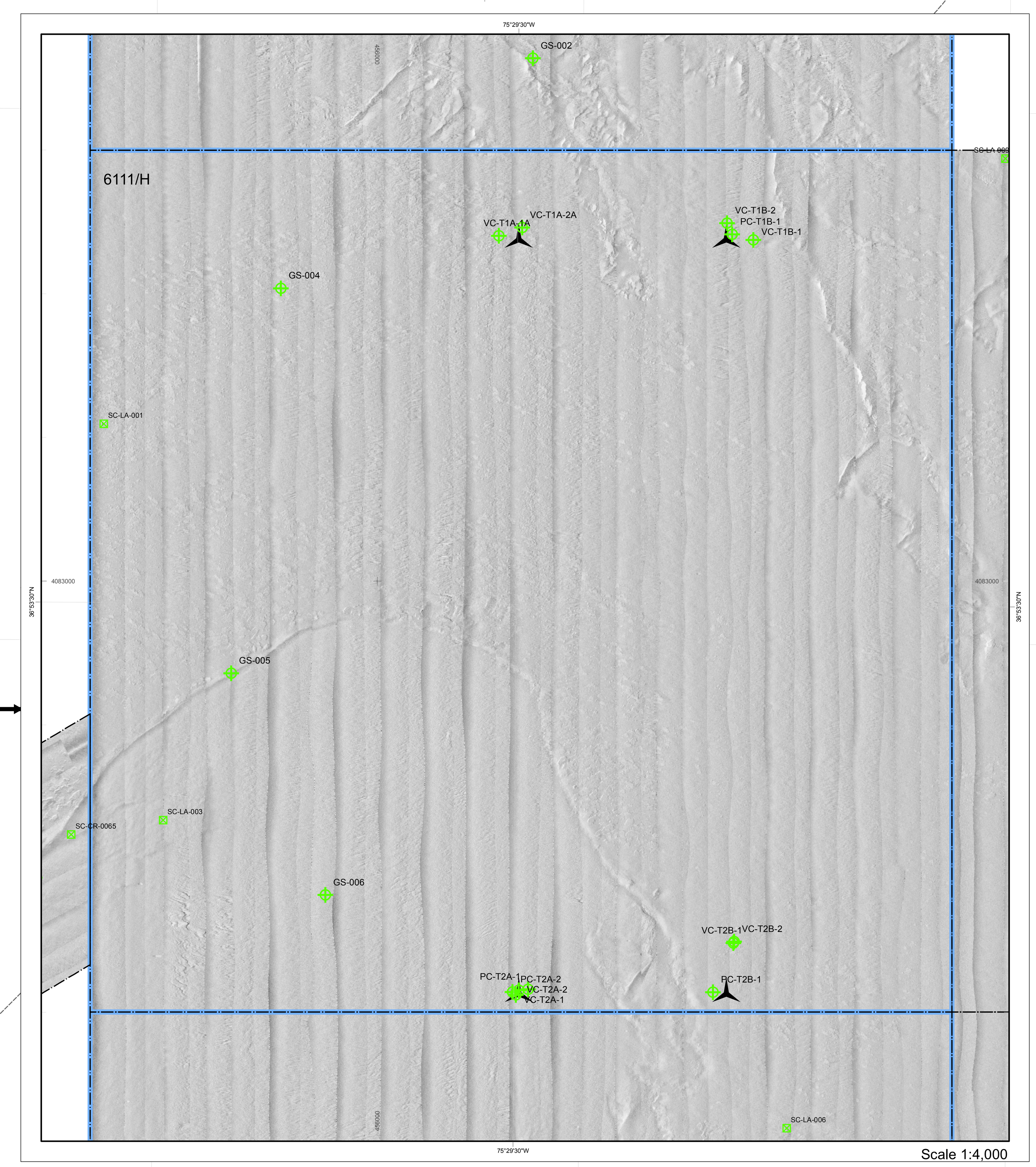
GS–011
SEDIMENT DESCRIPTION
Dark gray fine SAND with silt and shell

GS–012
SEDIMENT DESCRIPTION
Gray fine SAND with shell

GS–013
SEDIMENT DESCRIPTION
Brown medium SAND with shell

GS–014
SEDIMENT DESCRIPTION
Gray sandy lean clay with shell

GS–015
SEDIMENT DESCRIPTION
Gray fine SAND with silt and shell



VC–T1A–1A
TOTAL RECOVERY: 2.3m

DEPTH	SEDIMENT DESCRIPTION
SP	0m to 0.12m: Gray SAND w/ trace shell
SP	0.12m to 0.27m: Brown SAND w/ shell
SP	0.27m to 0.69m: Brownish–gray SAND w/ trace shell
SP	0.69m to 1.27m: Gray SAND w/ shell
SP	1.27m to 1.68m: Gray SAND w/ shell
CH	1.27m to 1.68m: Dark gray fat CLAY w/ trace shell

VC–T1A–2A
TOTAL RECOVERY: 4.7m

DEPTH	SEDIMENT DESCRIPTION
SP	0m to 0.56m: Brownish–gray SAND w/ shell
SP	0.56m to 0.87m: Gray SAND w/ trace shell
SP	0.87m to 1.06m: Brown SAND
SP	1.06m to 1.15m: Brown SAND w/ shell
SP	1.15m to 1.34m: Gray SAND
CH	1.34m to 1.72m: Gray fat CLAY
CH	1.72m to 2.69m: Gray fat CLAY w/ trace shell
CH	2.69m to 2.89m: Gray fat CLAY w/ trace shell
SC	2.89m to 3.55m: Gray clayey SAND
SP	3.55m to 3.69m: Gray SAND
SC	2.89m to 3.75m: Gray clayey SAND
SP	3.75m to 4.64m: Brownish–gray SAND w/ lenses of gray flat clay
SP	4.64m to 4.69m: Gray SAND

VC–T1B–1
TOTAL RECOVERY: 4.8m

DEPTH	SEDIMENT DESCRIPTION
SP-SM	0m to 0.81m: Dark gray SAND w/ silt & trace shell
SP	0.81m to 1.66m: Dark gray SAND w/ trace shell
SP	1.66m to 1.81m: Dark gray SAND
SP-SM	1.81m to 2.81m: Gray SAND w/ silt & trace shell
SP-SM	2.81m to 3.81m: Dark gray SAND w/ silt & trace shell
SP	3.81m to 4.12m: Gray SAND w/ shell
SP	4.12m to 4.4m: Brownish–gray SAND w/ shell
SP	4.4m to 4.81m: Gray SAND w/ shell

PC–T1B–1
TOTAL RECOVERY: 0.75 m

DEPTH	SEDIMENT DESCRIPTION
SP	0m to 0.75m: Dark gray SAND with trace shell

VC–T1B–2
TOTAL RECOVERY: 4.0m

DEPTH	SEDIMENT DESCRIPTION
SP	0m to 0.84m: Gray SAND w/ shell
SP	0.84m to 1.84m: Gray to dark gray SAND w/ trace shell
SP-SM	1.84m to 2.84m: Dark gray SAND w/ silt & shell
SP	2.84m to 3.36m: Gray SAND w/ shell
SP-SM	3.36m to 3.97m: Dark gray & brown SAND w/ silt & shell

VC–T2A–1
TOTAL RECOVERY: 5.1m

DEPTH	SEDIMENT DESCRIPTION
SP	0m to 0.26m: Brown SAND w/ shell
SP	0.26m to 0.4m: Dark gray SAND w/ shell & lenses of gray sandy clay
SP	0.4m to 0.46m: Brown SAND w/ shell
SP	0.46m to 1.16m: Dark gray SAND w/ shell
SP-SM	1.16m to 1.33m: Brownish–gray SAND w/ shell & silt
SP-SM	1.33m to 2.16m: Dark gray SAND w/ silt, shell & lenses of clayey sand
SP-SM	2.16m to 3.16m: Brownish–gray SAND w/ silt & trace shell
SM	3.16m to 3.47m: Gray silty SAND
GP	3.47m to 3.6m: Brown sandy GRAVEL
SM	3.6m to 3.73m: Gray silty SAND
GP	3.73m to 3.77m: Brown sandy GRAVEL
SM	3.77m to 3.82m: Gray silty SAND w/ lenses of gray lean clay
CL	3.82m to 4.16m: Dark gray lean CLAY w/ trace shell
CL-ML	4.16m to 5.11m: Dark gray silty CLAY w/ sand & trace shell

PC–T2A–1
TOTAL RECOVERY: 0.94 m

DEPTH	SEDIMENT DESCRIPTION
SP	0m to 0.94m: Brown sand with shell

GS-REF-009

VC–T2A–2
TOTAL RECOVERY: 3.1m

DEPTH	SEDIMENT DESCRIPTION
SP	0m to 0.27m: Brown SAND w/ shell
SP	0.27m to 1.07m: Dark gray SAND w/ shell & gray sandy clay lenses
SP	1.07m to 1.23m: Brown SAND w/ shell
SP	1.23m to 1.56m: Dark gray SAND w/ shell
SP	1.56m to 1.59m: Dark gray SAND w/ shell
SP	1.59m to 2.07m: Dark gray SAND w/ trace shell
SP	2.07m to 3.04m: Gray to dark gray SAND w/ shell
GP	3.04m to 3.07m: Gray GRAVEL w/ sand

VC–T2B–1
TOTAL RECOVERY: 4.8m

DEPTH	SEDIMENT DESCRIPTION
SP-SM	0m to 0.3m: Dark gray SAND w/ silt & shell
GP	0.3m to 0.56m: Brown GRAVEL w/ sand
SP	0.56m to 0.79m: Gray SAND w/ gravel
SP	0.79m to 0.97m: Gray SAND w/ gravel
CL	0.97m to 1.79m: Dark gray lean CLAY w/ lenses of gray silt
CL	1.79m to 2.67m: Dark gray lean CLAY w/ lenses of gray silt & clayey sand
SC	2.67m to 2.72m: Dark gray clayey SAND
CL	2.72m to 2.79m: Dark gray lean CLAY w/ lenses of gray silt & clayey sand
CL	2.79m to 3.32m: Dark gray CLAY w/ lenses of silt & clayey sand
SP-SM	3.32m to 3.55m: Gray SAND w/ silt and trace shell
CL	3.55m to 3.79m: Dark gray lean CLAY w/ silt and lenses of sand & trace shell
SP-SM	3.79m to 4.11m: Dark gray SAND w/ silt and lenses of brown clay
SM	4.11m to 4.75m: Gray silty SAND w/ shell

VC–T2B–2
TOTAL RECOVERY: 4.7m

DEPTH	SEDIMENT DESCRIPTION
SP	0m to 0.74m: Gray SAND w/ trace shell
SP	0.74m to 0.8m: Gray SAND w/ trace shell (coarser than above)
SP-SM	0.8m to 1.44m: Brownish–gray SAND w/ silt & shell
GP	1.44m to 1.73m: Gray to white GRAVEL w/ sand, shell & lenses of gray sandy clay
GC	1.73m to 1.84m: Gray clayey GRAVEL w/ sand
CL	1.84m to 1.95m: Gray lean CLAY
CL	1.95m to 2.67m: Gray lean CLAY w/ trace organics
CL	2.67m to 2.98m: Gray lean CLAY w/ lenses of sandy clay
SP	2.98m to 3.35m: Gray SAND w/ shell
CL	3.35m to 3.67m: Dark gray lean CLAY
CL	3.67m to 3.73m: Dark gray lean CLAY
SP	3.73m to 4.06m: Gray SAND w/ shell
CL	4.06m to 4.11m: Dark gray lean CLAY w/ organics
CL	4.11m to 4.44m: Dark gray lean CLAY
SM	4.44m to 4.67m: Dark gray silty SAND w/ lenses of gray lean clay

PC–T2A–2
TOTAL RECOVERY: 1.27 m

DEPTH	SEDIMENT DESCRIPTION
SP	0m to 0.06m: Dark gray SAND with trace shell
SP	0.06m to 0.46m: Brownish–gray SAND with trace shell
SP	0.46m to 0.94m: Brownish–gray SAND with shell
SP	0.94m to 1.27m: Brown SAND with shell

PC–T2B–1
TOTAL RECOVERY: 0.94 m

DEPTH	SEDIMENT DESCRIPTION
SP-SM	0m to 0.32m: Dark gray SAND with silt and shell
SP	0.32m to 0.75m: Gray SAND with shell
SP-SM	0.75m to 0.94m: Dark gray SAND with silt and shell

L E G E N D

- Preliminary Turbine Sites
- Buoy Avoided 06/05/13 per Survey Log
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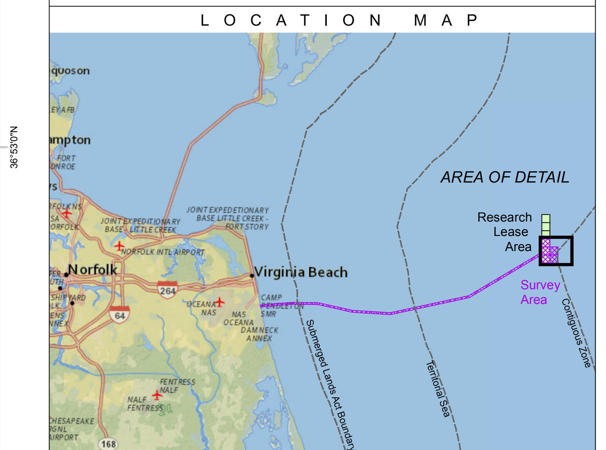

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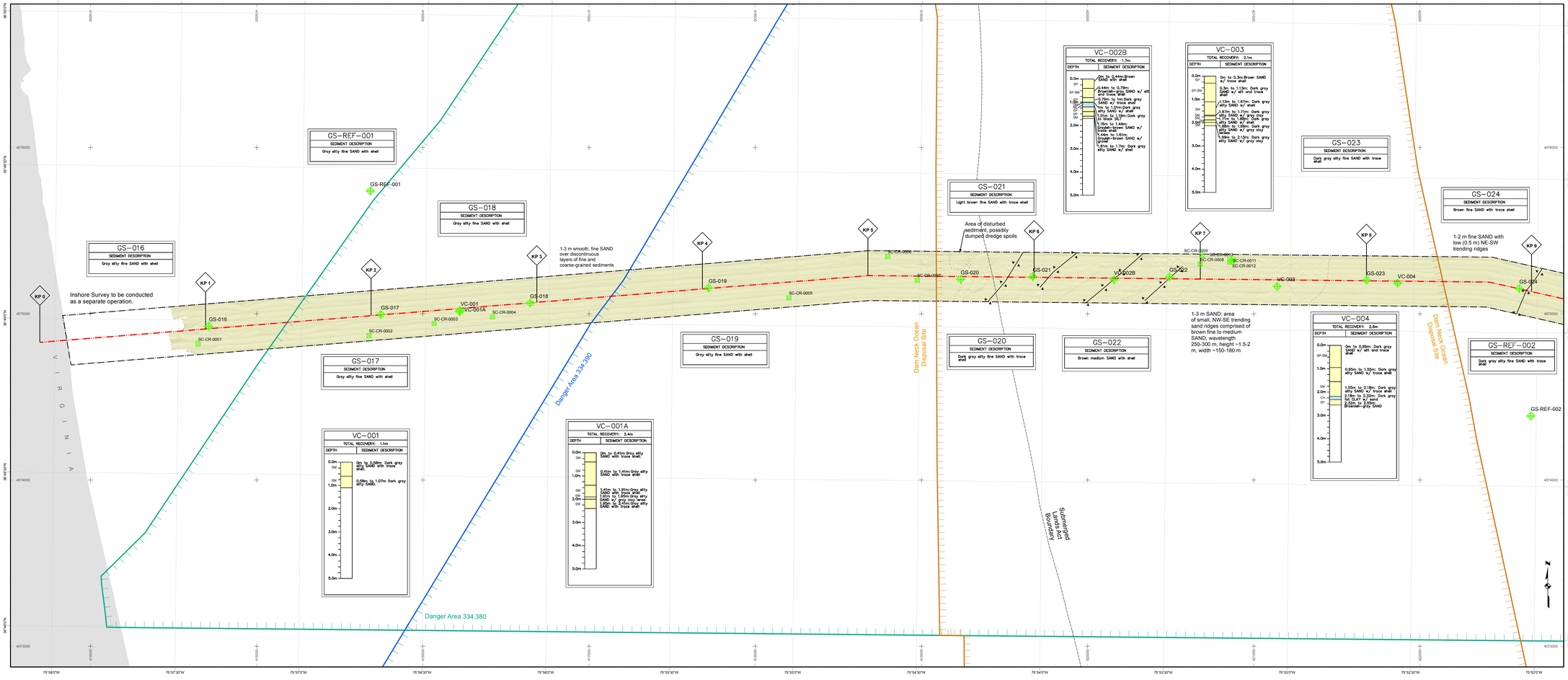

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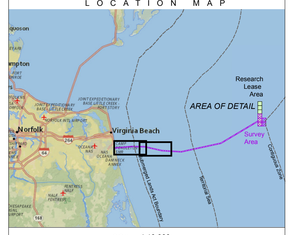

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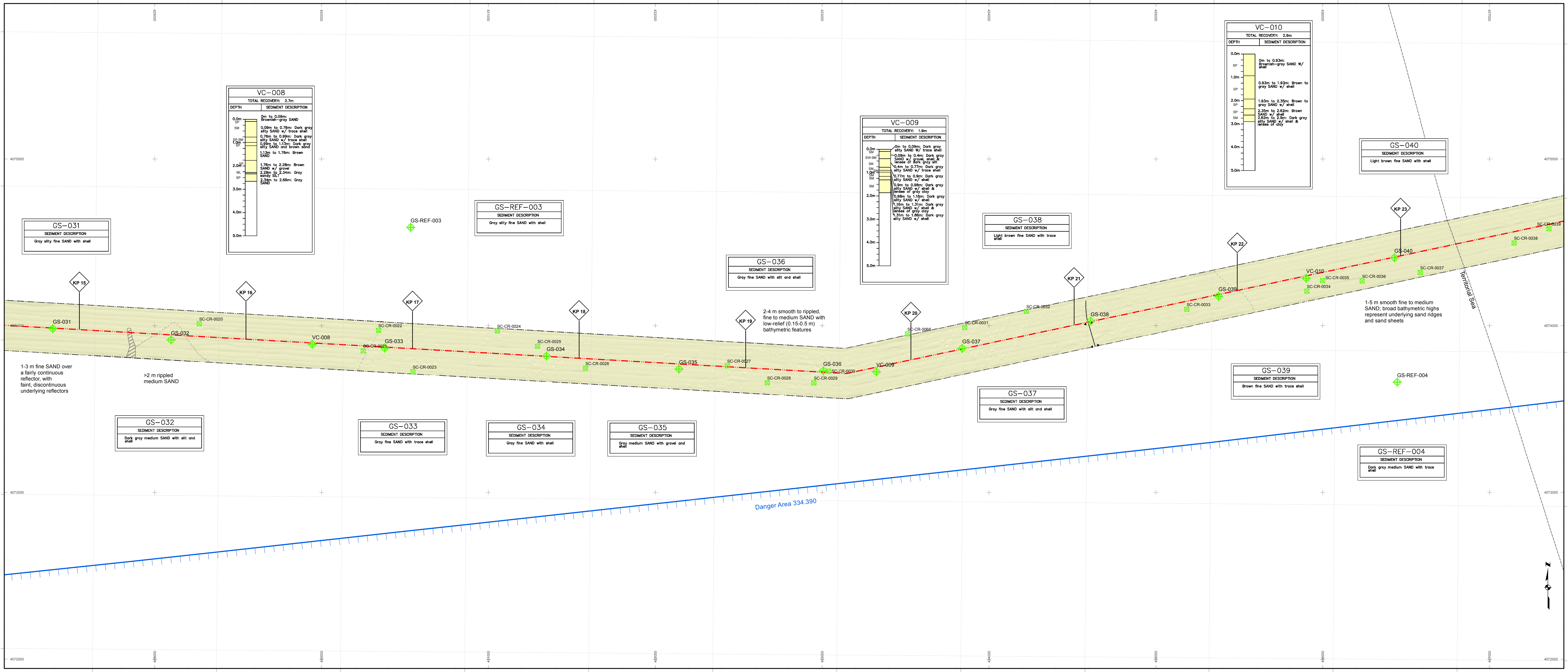

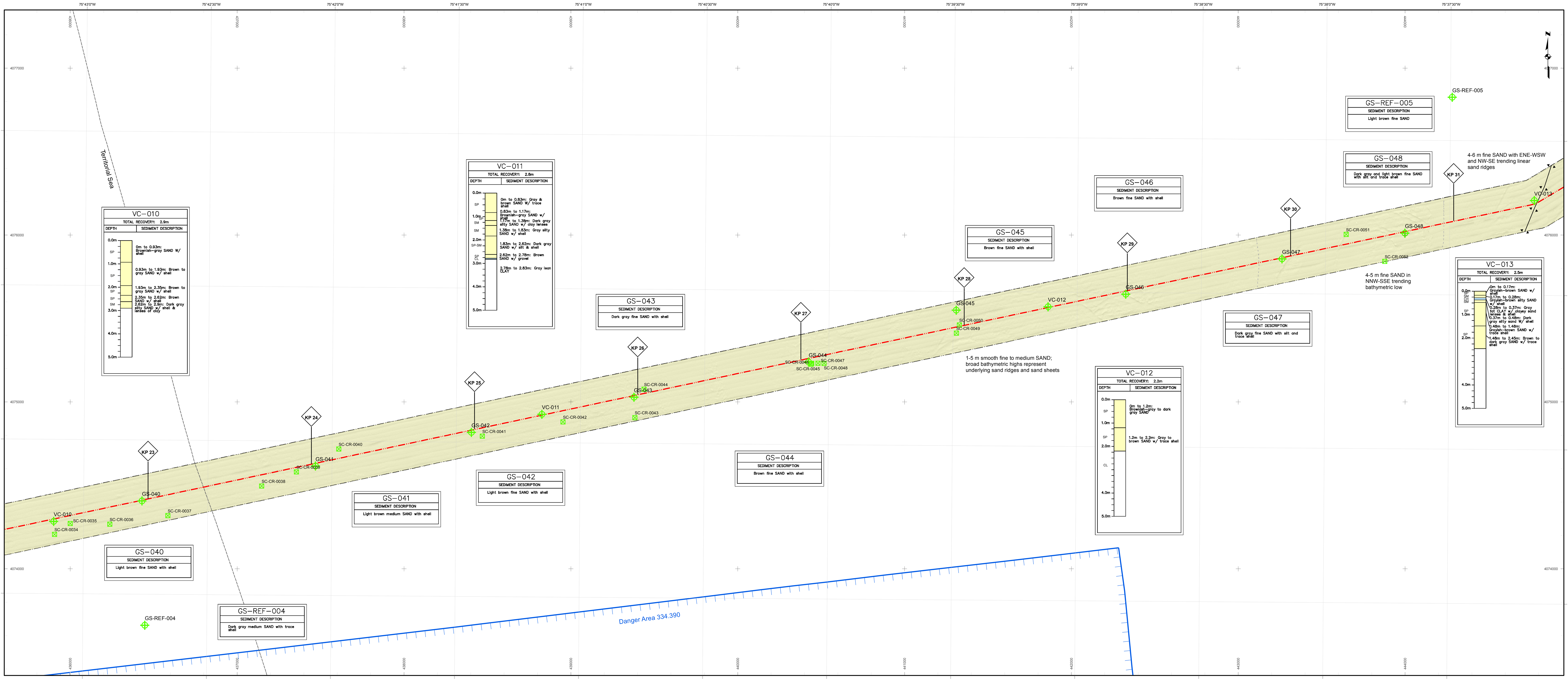

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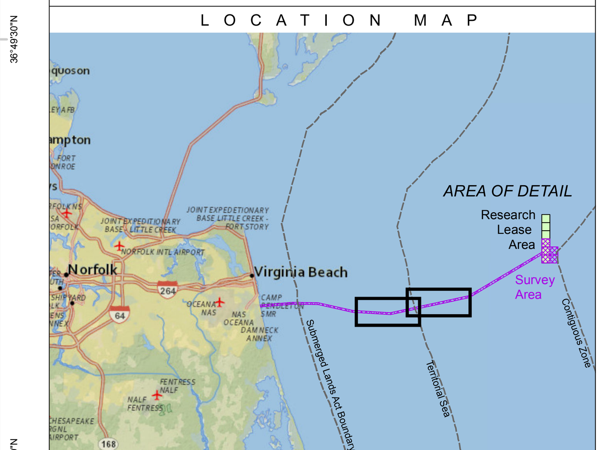

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MXD File Name:	Scale:	Size:	Plate:	Sheet Number:
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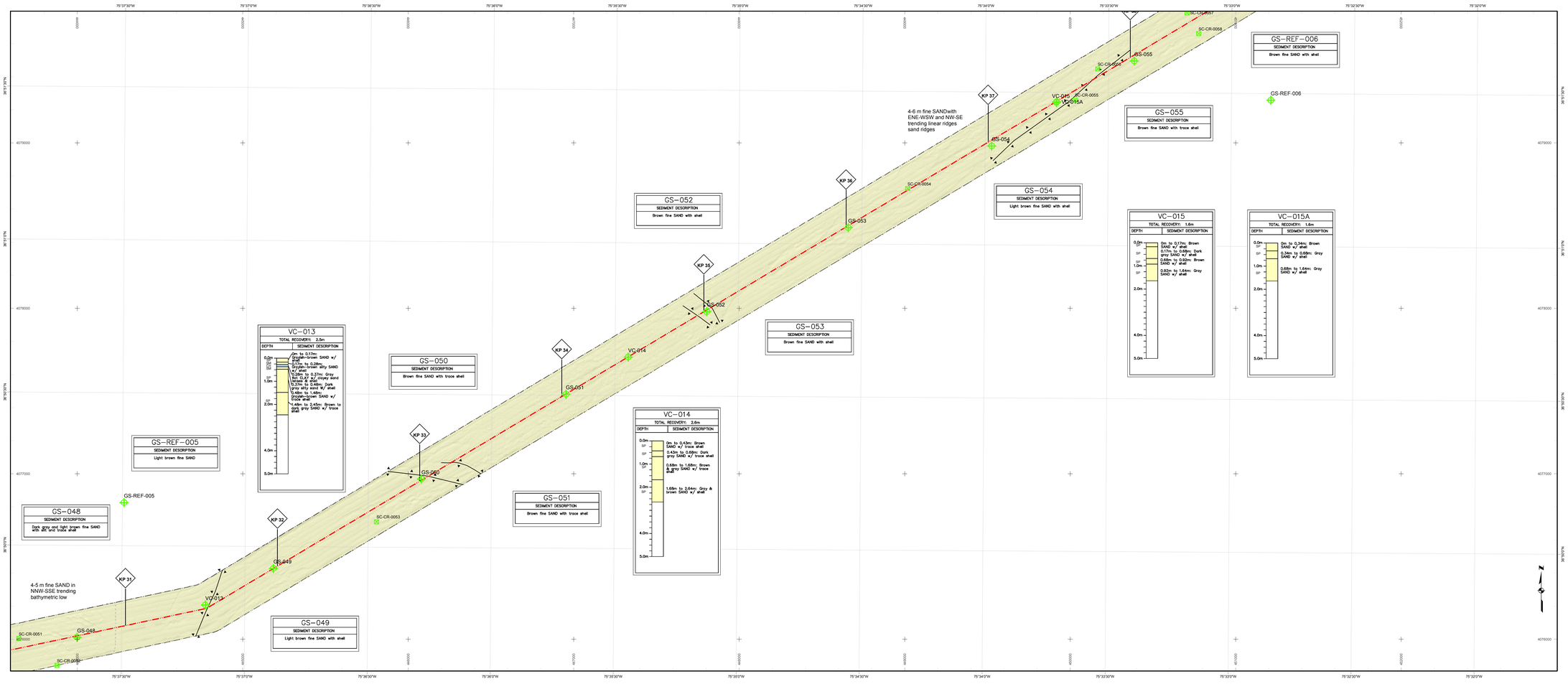


L E G E N D

- Seabed Sample Location with reference number
  - GS (Grab Sample)
  - VC (Vibra Core)
  - PC (Piston Core)
- Sonar Contacts
- Fine-grained sediment (SILT/CLAY)
- Coarse-grained sediment (SAND)
- Very coarse-grained sediment (GRAVEL)
- Subsurface Channels

Reflectivity
- Low
- High

Sidescan sonar imagery semi-transparent below interpreted surface sediments

- Feature or Sediment Boundary
- Sand Ridge
- Channel
- Survey Centerline
- Maritime Boundaries
- Dam Neck Ocean Disposal Site
- Danger Area 334.380*
- Danger Area 334.390**
- Survey Corridor
- Research Lease Area

*33 CFR 334.380 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY OFF DAM NECK, VIRGINIA; NAVAL FIRING RANGE.

**33 CFR 334.390 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY; FIRING RANGE.

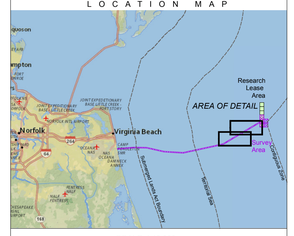
SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS851 with MarineStar
Subsurface Positioning	IXBlue GAPS
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
Sidescan Sonar Sensor	EdgeTech 2000-DSS 110 kHz/540 kHz
Sub-bottom Profiler	EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



SCALE 1:10,000

Meters: 0 125 250 500 750 1,000

Feet: 0 400 800 1,600 2,400 3,200

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Geologic Features

Revision No.	Date	Description	Prepared by	Checked by	Approved by
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

MXD File Name: P08_GeoFeat_CableRoute_EAST.mxd	Scale: 1:10000	Size: ANSI E	Plate: 8	Sheet Number: 3 of 4

75°30'0"W 75°29'30"W 75°29'0"W 75°28'30"W 75°28'0"W 75°27'30"W 75°27'0"W

36°54'30"N 36°54'0"N 36°53'30"N 36°53'0"N 36°52'30"N

4085000 4084000 4083000 4082000 4081000 4080000

6111/D

1-2 m smooth, fine SAND over somewhat continuous to discontinuous layers of fine and coarse-grained sediments

1-2 m smooth, fine SAND over somewhat continuous to discontinuous layers of fine and coarse-grained sediments

1-3 m smooth, fine SAND over somewhat continuous to discontinuous layers of fine and coarse-grained sediments

2-4 m rippled fine to medium SAND, ripples primarily in NW-SE orientation, wavelength 0.5-1 m, height < 0.5 m

1-3 m smooth, fine SAND over somewhat continuous to discontinuous layers of fine and coarse-grained sediments

GS-001 GS-002 GS-003 SC-LA-004 SC-LA-005

GS-REF-008: Collected outside chart area at 36°53.74' N - 75°30.14' W

GS-REF-008	GS-004	GS-011
SEDIMENT DESCRIPTION: Gray fine SAND with shell	SEDIMENT DESCRIPTION: Gray fine SAND with silt and shell	SEDIMENT DESCRIPTION: Dark gray fine SAND with silt and shell
	GS-005	GS-012
	SEDIMENT DESCRIPTION: Brown medium SAND with shell	SEDIMENT DESCRIPTION: Gray fine SAND with shell
GS-REF-007		
GS-REF-007	GS-006	GS-013
SEDIMENT DESCRIPTION: Dark gray fine SAND with shell	SEDIMENT DESCRIPTION: Brown medium SAND with shell	SEDIMENT DESCRIPTION: Brown medium SAND with shell
GS-REF-009	GS-007	GS-014
SEDIMENT DESCRIPTION: Gray fine SAND with silt and shell	SEDIMENT DESCRIPTION: Gray fine SAND with silt and shell	SEDIMENT DESCRIPTION: Gray sandy lean clay with shell
GS-001	GS-008	GS-015
SEDIMENT DESCRIPTION: Grayish-brown medium SAND with shell	SEDIMENT DESCRIPTION: Brown medium SAND with shell	SEDIMENT DESCRIPTION: Gray fine SAND with silt and shell
GS-002	GS-009	
SEDIMENT DESCRIPTION: Grayish-brown fine SAND with shell	SEDIMENT DESCRIPTION: Brown fine SAND with shell	
GS-003	GS-010	
SEDIMENT DESCRIPTION: Grayish-brown medium SAND with shell	SEDIMENT DESCRIPTION: Dark gray fine SAND with trace shell	

6111/H

VC-T1A-1A VC-T1A-2A PC-T1B-1 VC-T1B-1 VC-T1B-2

GS-004

SC-LA-001

<1-2 m mottled fine to medium SAND over layered fine and coarse-grained sediments

GS-005

SC-CR-0065 SC-LA-003

GS-060 GS-006

SC-CR-0064

VC-T2B-1 VC-T2B-2 PC-T2A-2 VC-T2A-1 VC-T2A-2 PC-T2B-1

6111/L

6112/E

3-5 m rippled SAND with intermittent, discontinuous reflectors

1-3 m mottled fine to medium SAND over somewhat continuous to discontinuous layers of fine and coarse-grained sediments

GS-012 GS-010

3-5 m hummocky rippled SAND with intermittent, discontinuous reflectors

SC-LA-009

1-3 m smooth, fine SAND over somewhat continuous to discontinuous layers of fine and coarse-grained sediments

GS-011

SC-LA-012

Contiguous Zone

<1-2 m smooth fine SAND over somewhat continuous to discontinuous layers of fine and coarse-grained sediments

GS-015

SC-LA-013

SC-LA-006

GS-008 GS-007

SC-LA-007 SC-LA-008

1-3 m rippled SAND with intermittent, discontinuous layers of fine and coarse-grained sediments

GS-014

<1 m sandy CLAY over fine and coarse sediment layers

SC-LA-011

~1 m mottled, fine to medium SAND over somewhat continuous to discontinuous layers of fine and coarse-grained sediments

1-3 m rippled medium SAND over discontinuous layers of fine and coarse-grained sediments

GS-009 SC-LA-002 SC-LA-010

GS-013

1-2 m rippled medium SAND with intermittent, discontinuous reflectors

6111/H

GS-002

2-4 m rippled fine to medium SAND, ripples primarily in NW-SE orientation, wavelength 0.5-1 m, height < 0.5 m

1-3 m smooth, fine SAND over somewhat continuous to discontinuous layers of fine and coarse-grained sediments

VC-T1A-1A VC-T1A-2A VC-T1B-2 PC-T1B-1 VC-T1B-1

GS-004

3-5 m rippled SAND with intermittent, discontinuous reflectors

SC-LA-001

<1-2 m mottled fine to medium SAND over layered fine and coarse-grained sediments

GS-005

1-3 m smooth, fine SAND over somewhat continuous to discontinuous layers of fine and coarse-grained sediments

SC-CR-0065 SC-LA-003

GS-006

<1-2 m smooth fine SAND over somewhat continuous to discontinuous layers of fine and coarse-grained sediments

VC-T2B-1 VC-T2B-2

1-3 m rippled SAND with intermittent, discontinuous layers of fine and coarse-grained sediments

PC-T2A-1 PC-T2A-2 VC-T2A-2 VC-T2A-1 PC-T2B-1

~1 m mottled, fine to medium SAND over somewhat continuous to discontinuous layers of fine and coarse-grained sediments

SC-LA-006

Scale 1:4,000

GS-REF-009

VC-T1A-1A	VC-T1A-2A	VC-T1B-1	VC-T1B-2	VC-T2A-1
TOTAL RECOVERY: 2.3m	TOTAL RECOVERY: 4.7m	TOTAL RECOVERY: 4.8m	TOTAL RECOVERY: 4.0m	TOTAL RECOVERY: 5.1m
DEPTH / SEDIMENT DESCRIPTION	DEPTH / SEDIMENT DESCRIPTION	DEPTH / SEDIMENT DESCRIPTION	DEPTH / SEDIMENT DESCRIPTION	DEPTH / SEDIMENT DESCRIPTION
0m to 0.12m: Gray SAND w/ trace shell 0.12m to 0.27m: Brown SAND w/ shell 0.27m to 0.88m: Grayish-brown silty SAND w/ trace shell 0.88m to 1.27m: Gray SAND w/ shell 1.27m to 1.68m: Gray SAND w/ shell 1.27m to 1.68m: Dark gray fat CLAY w/ trace shell	0m to 0.56m: Brownish-gray SAND w/ shell 0.56m to 0.87m: Gray clayey SAND 0.87m to 1.06m: Brown SAND 1.06m to 1.15m: Brown clayey SAND w/ shell 1.15m to 1.34m: Gray SAND 1.34m to 1.72m: Gray fat CLAY 1.72m to 2.69m: Gray fat CLAY w/ trace shell 2.69m to 2.89m: Gray fat CLAY w/ trace shell 2.89m to 3.55m: Gray clayey SAND 3.55m to 3.69m: Gray SAND w/ trace shell 3.69m to 3.79m: Gray clayey SAND 3.79m to 4.64m: Brownish-gray SAND w/ lenses of gray fat clay 4.64m to 4.69m: Gray SAND	0m to 0.81m: Dark gray SAND w/ silt & trace shell 0.81m to 1.08m: Dark gray SAND w/ trace shell 1.08m to 1.81m: Dark gray SAND 1.81m to 2.81m: Dark gray SAND w/ silt & trace shell 2.81m to 3.81m: Dark gray SAND w/ silt & trace shell 3.81m to 4.12m: Gray SAND w/ shell 4.12m to 4.4m: Brownish-gray SAND w/ trace shell 4.4m to 4.81m: Gray SAND w/ shell	0m to 0.84m: Gray SAND w/ shell 0.84m to 1.84m: Gray to dark gray SAND w/ trace shell 1.84m to 2.84m: Dark gray SAND w/ silt & shell 2.84m to 3.36m: Gray SAND w/ shell 3.36m to 3.97m: Dark gray & brown SAND w/ silt & shell	0m to 0.26m: Brown SAND 0.26m to 0.4m: Dark gray SAND w/ shell & lenses of gray silty clay 0.4m to 0.86m: Brown SAND w/ shell 0.86m to 1.16m: Gray SAND w/ shell 1.16m to 1.36m: Brown SAND w/ lenses of clayey sand 1.36m to 3.16m: Dark gray SAND w/ silt, shell & lenses of clayey sand 3.16m to 3.36m: Brownish-gray SAND w/ silt & trace shell 3.36m to 3.47m: Gray silty SAND 3.47m to 3.97m: Brown clayey SAND 3.97m to 4.19m: Gray silty SAND w/ lenses of silty clay 4.19m to 4.59m: Dark gray lean CLAY w/ trace shell 4.59m to 4.77m: Dark gray silty SAND w/ sand & trace shell
PC-T1B-1				PC-T2A-1
TOTAL RECOVERY: 0.75 m				TOTAL RECOVERY: 0.94 m
DEPTH / SEDIMENT DESCRIPTION				DEPTH / SEDIMENT DESCRIPTION
0m to 0.75m: Dark gray SAND with trace shell				0m to 0.94m: Brown sand with shell
VC-T2A-2		VC-T2B-1	VC-T2B-2	
TOTAL RECOVERY: 3.1m		TOTAL RECOVERY: 4.8m	TOTAL RECOVERY: 4.7m	
DEPTH / SEDIMENT DESCRIPTION		DEPTH / SEDIMENT DESCRIPTION	DEPTH / SEDIMENT DESCRIPTION	
0m to 0.27m: Brown SAND 0.27m to 1.07m: Dark gray SAND w/ shell & gray sandy clay lenses 1.07m to 1.23m: Brown SAND w/ shell 1.23m to 1.56m: Dark gray SAND w/ shell 1.56m to 1.79m: Dark gray SAND w/ shell 1.79m to 2.07m: Dark gray SAND w/ trace shell 2.07m to 3.04m: Gray to dark gray SAND w/ shell 3.04m to 3.07m: Gray GRAVEL w/ sand		0m to 0.3m: Dark gray SAND w/ silt & shell 0.3m to 0.58m: Brown GRAVEL w/ sand 0.58m to 0.79m: Gray SAND w/ shell 0.79m to 0.97m: Gray SAND w/ gravel 0.97m to 1.79m: Dark gray SAND w/ lenses of silt & clay 1.79m to 2.67m: Dark gray lean CLAY w/ lenses of gray silt & clayey sand 2.67m to 2.72m: Dark gray SAND w/ shell 2.72m to 2.79m: Dark gray lean CLAY w/ lenses of sand 2.79m to 3.55m: Dark gray CLAY w/ lenses of silt & sand 3.55m to 3.79m: Dark gray SAND w/ silt and trace lenses of soft to stiff clay 3.79m to 4.11m: Dark gray lean CLAY w/ silt and lenses of sand 4.11m to 4.75m: Gray silty SAND w/ shell	0m to 0.74m: Gray SAND w/ trace shell 0.74m to 0.8m: Gray SAND w/ trace shell Coarser 0.8m to 1.44m: Brownish-gray SAND w/ silt 1.44m to 1.73m: Gray to white GRAVEL w/ sand 1.73m to 1.84m: Gray SAND w/ shell 1.84m to 1.95m: Gray lean CLAY 1.95m to 2.67m: Gray lean CLAY w/ trace organics 2.67m to 3.33m: Gray lean CLAY w/ lenses of silty clay 3.33m to 3.35m: Gray SAND w/ shell 3.35m to 3.87m: Dark gray lean CLAY w/ shell 3.87m to 4.17m: Gray SAND w/ shell 4.17m to 4.44m: Dark gray lean CLAY w/ lenses of silty SAND w/ lenses of gray lean clay	
PC-T2A-2		PC-T2B-1		
TOTAL RECOVERY: 1.27 m		TOTAL RECOVERY: 0.94 m		
DEPTH / SEDIMENT DESCRIPTION		DEPTH / SEDIMENT DESCRIPTION		
0m to 0.06m: Dark gray SAND with trace shell 0.06m to 0.46m: Brown clayey SAND with trace shell 0.46m to 0.64m: Brownish-gray SAND with shell 0.64m to 1.27m: Brown SAND with shell		0m to 0.33m: Dark gray SAND with silt and shell 0.33m to 0.75m: Gray SAND with shell 0.75m to 0.94m: Dark gray SAND with silt and shell		

L E G E N D

- Preliminary Turbine Sites
- Buoy Avoided 06/05/13 per Survey Log
- Seabed Sample Location with reference number
  - GS (Grab Sample)
  - VC (Vibra Core)
  - PC (Piston Core)
- Sonar Contacts
- Fine-grained sediment (SILT/CLAY)
- Coarse-grained sediment (SAND)
- Very coarse-grained sediment (GRAVEL)
- Subsurface Channels
- Reflectivity
  - Low
  - High
- Sidescan sonar imagery semi-transparent below interpreted surface sediments
- Feature or Sediment Boundary
- Sand Ridge
- Channel
- Maritime Boundaries
- Survey Corridor
- Research Lease Area

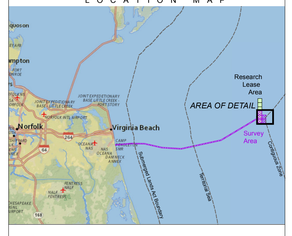
SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS651 with MarineStar
Subsurface Positioning	IXBlue GAPS
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
Sidescan Sonar Sensor	EdgeTech 2000-DSS 110 kHz/540 kHz
Sub-bottom Profiler	EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



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Feet: 0 187.5 375 750 1,125 1,500

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Geologic Features

Revision No.	Date	Description	Prepared by	Checked by	Approved by
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

MXD File Name:	Scale:	Size:	Plate:	Sheet Number:
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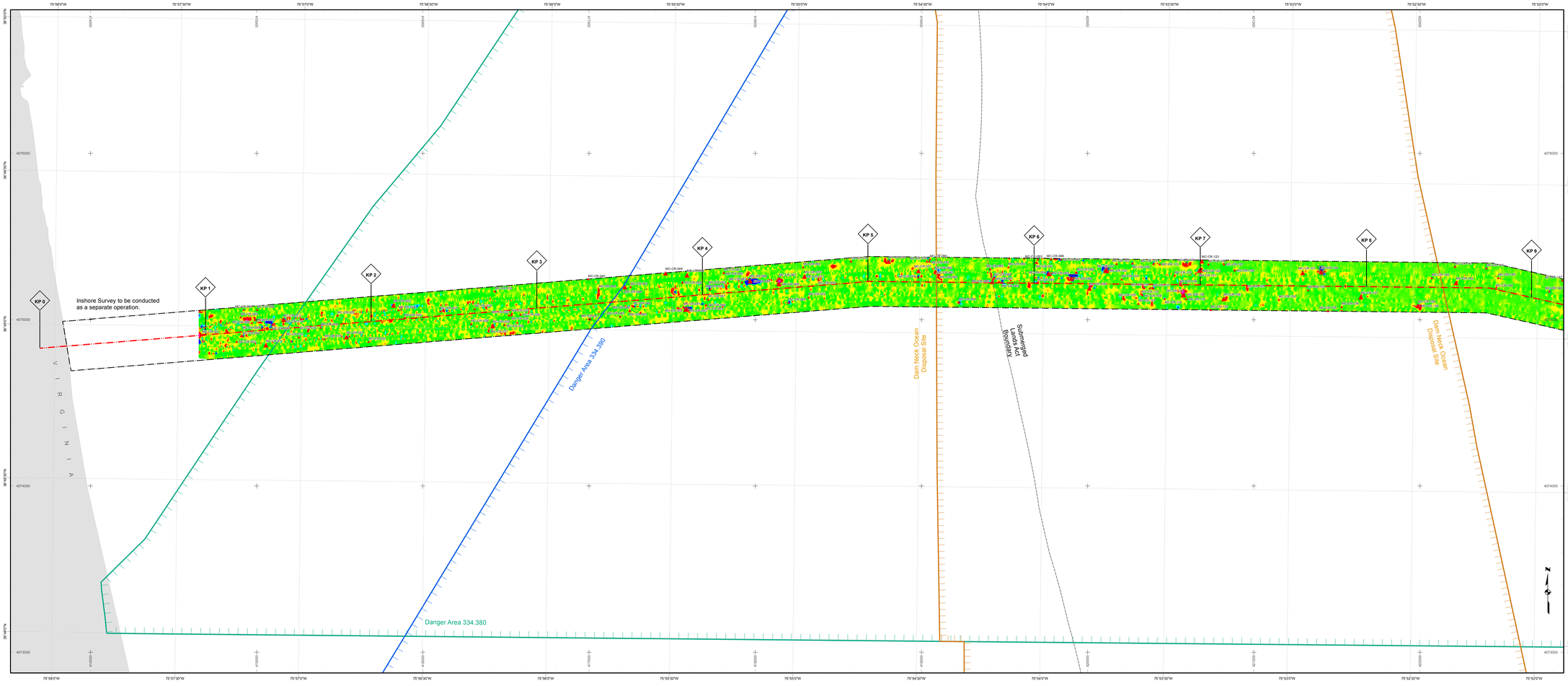

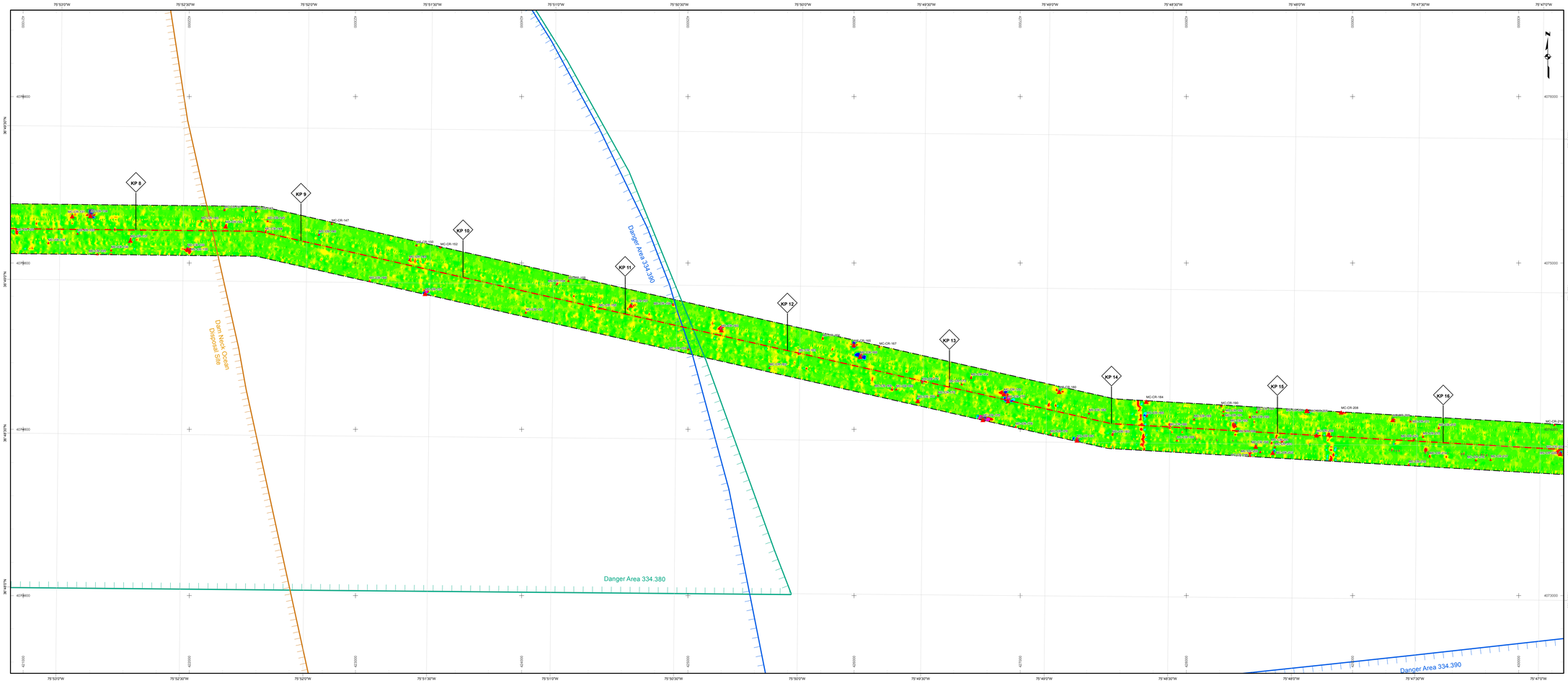

L E G E N D

- Mag Target (<10nT)
- Mag Target (>10nT)
- Contours 5nT*
- Survey Centerline
- Maritime Boundaries
- Dam Neck Ocean Disposal Site
- Danger Area 334.380*
- Danger Area 334.390**
- Survey Corridor
- Research Lease Area

14.4 13.7 13.1 12.4 11.8 11.2 10.5 9.9 9.2 8.6 7.9 7.3 6.7 6.0 5.4 4.7 4.1 3.5 2.8 2.2 1.5 0.9 0.3 -0.4 -1.0 -1.7 -2.3 -2.9 -3.6 -4.2 -4.9 -5.5 -6.2 -6.8 -7.4 -8.1 -8.7 -9.4

Total Field - n-Tesla (gamma)
nT (diurnally corrected/median filtered)

*33 CFR 334.380 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY OFF DAM NECK, VIRGINIA; NAVAL FIRING RANGE.

**33 CFR 334.390 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY; FIRING RANGE.

SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS851 with MarineStar
Subsurface Positioning	IXBlue GAPS
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
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GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P

SCALE 1:10,000
Meters
0 125 250 500 750 1,000
Feet
0 400 800 1,600 2,400 3,200

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Total Field

Revision No.	Date	Description	Prepared by	Checked by	Approved by
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

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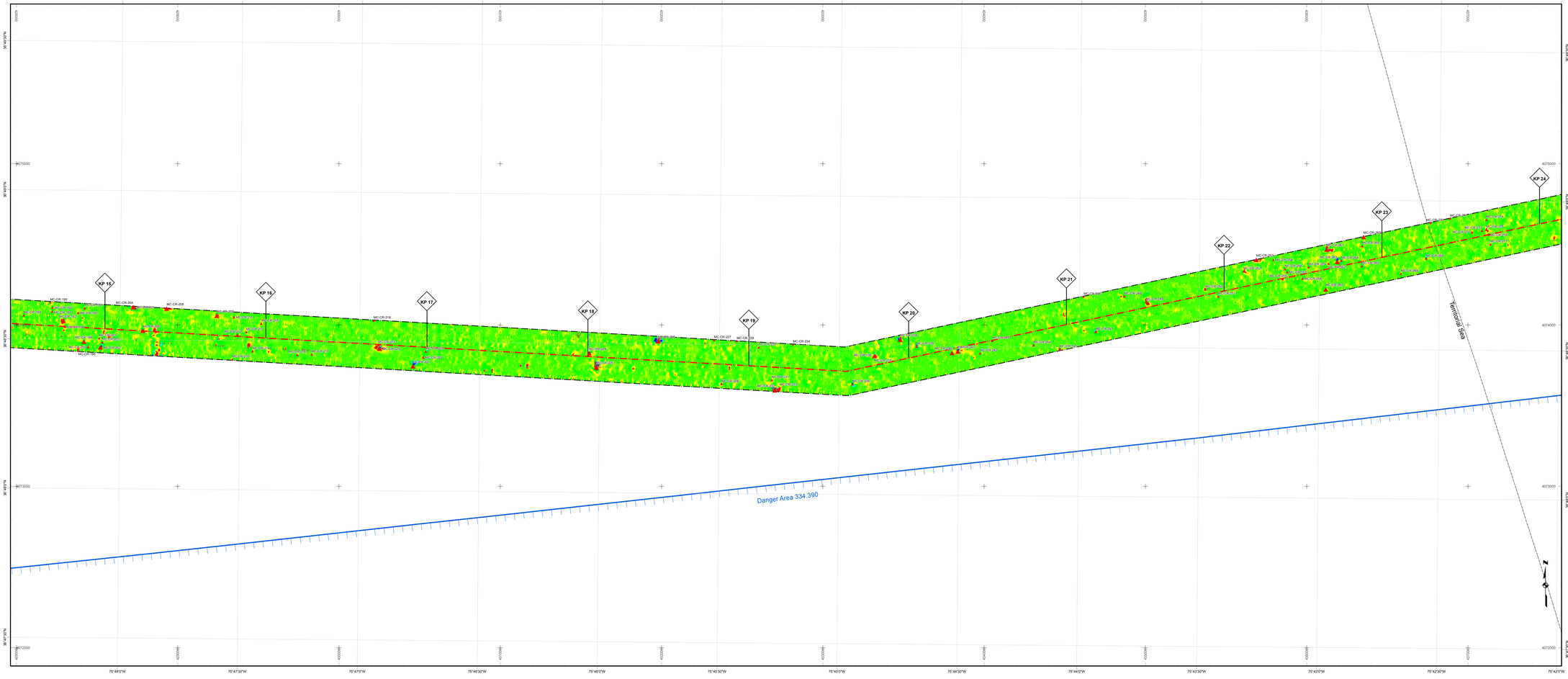

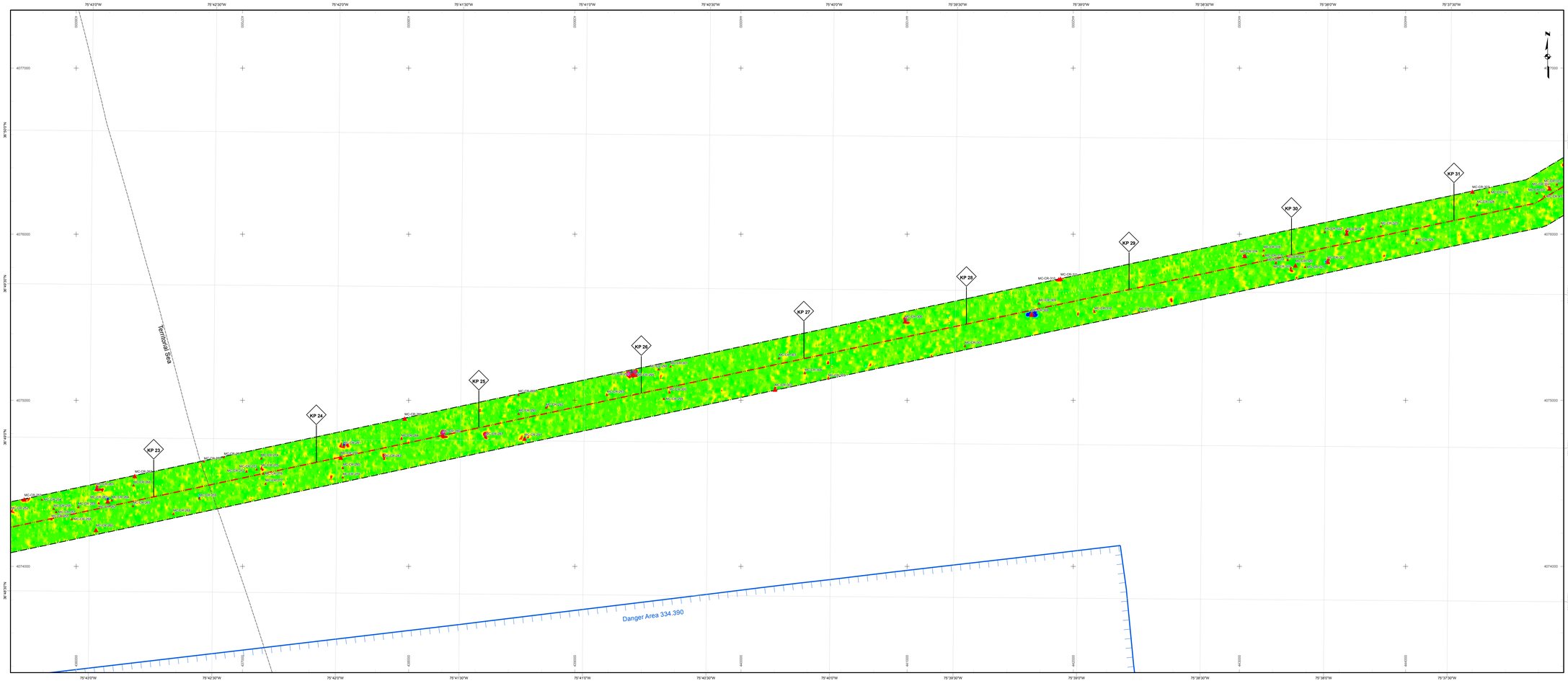

L E G E N D

- Mag Target (<10nT)
- Mag Target (>10nT)
- Contours 5nT*
- Survey Centerline
- Maritime Boundaries
- Dam Neck Ocean Disposal Site
- Danger Area 334.380*
- Danger Area 334.390**
- Survey Corridor
- Research Lease Area

14.4
13.7
13.1
12.4
11.8
11.2
10.5
9.9
9.2
8.6
7.9
7.3
6.7
6.0
5.4
4.7
4.1
3.5
2.8
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1.5
0.9
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-5.5
-6.2
-6.8
-7.4
-8.1
-8.7
-9.4

Total Field - n-Tesla (gamma)
nT (diurnally corrected/median filtered)

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Vertical Units	Meters
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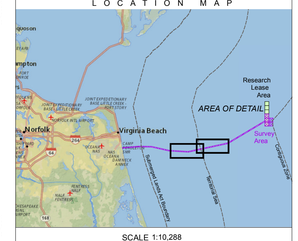
L O C A T I O N M A P



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Feet: 0 412.5 825 1,650 2,475 3,300

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Total Field

Revision No.	Date	Description	Prepared by	Checked by	Approved by
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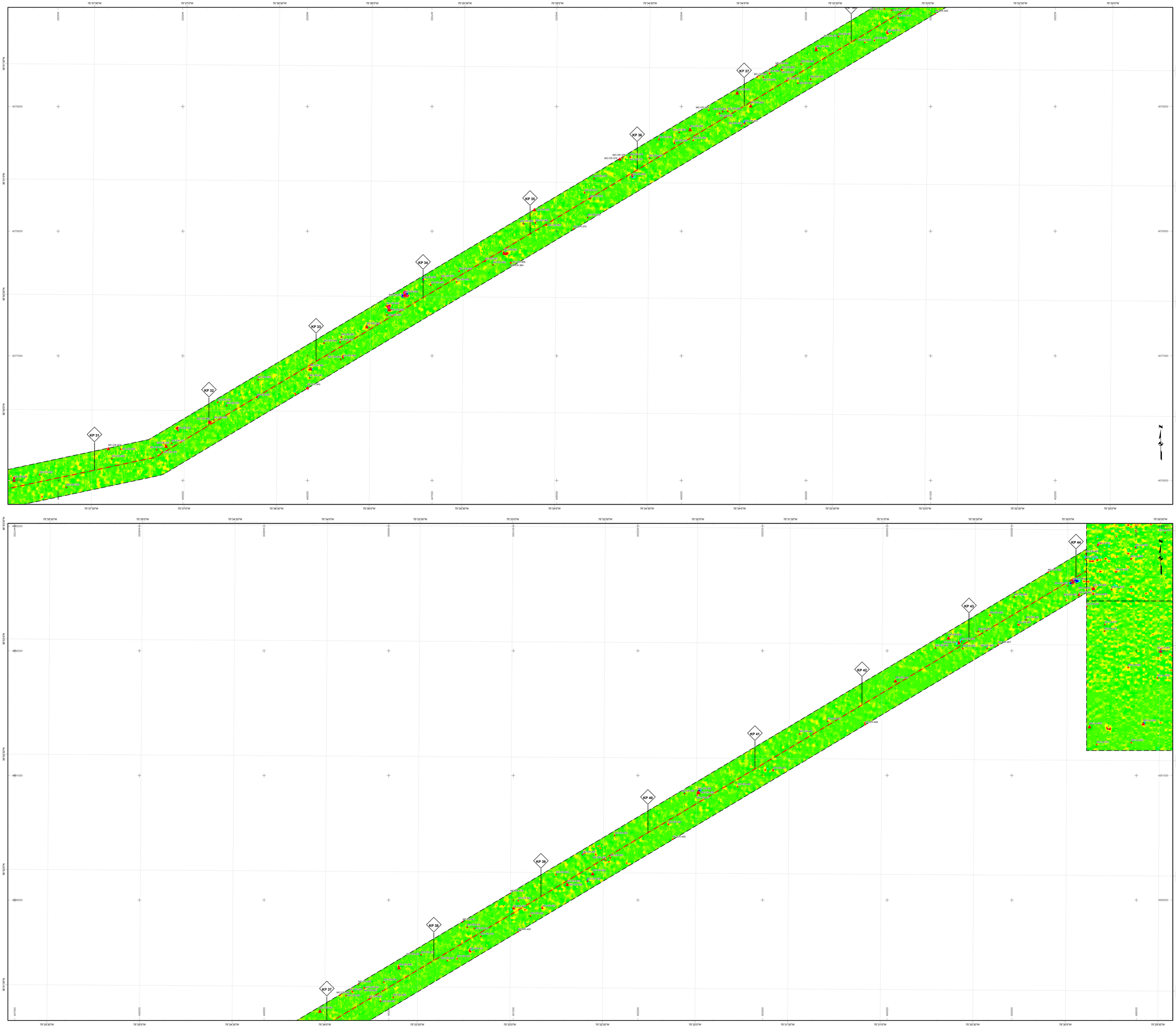

L E G E N D

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- Survey Corridor
- Research Lease Area

14.4
13.7
13.1
12.4
11.8
11.2
10.5
9.9
9.2
8.6
7.9
7.3
6.7
6.0
5.4
4.7
4.1
3.5
2.8
2.2
1.5
0.9
0.3
-0.4
-1.0
-1.7
-2.3
-2.9
-3.6
-4.2
-4.9
-5.5
-6.2
-6.8
-7.4
-8.1
-8.7
-9.4

Total Field - n-Tesla (gamma)
nT (diurnally corrected/median filtered)

*33 CFR 334.380 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY OFF DAM NECK, VIRGINIA; NAVAL FIRING RANGE.

**33 CFR 334.390 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY; FIRING RANGE.

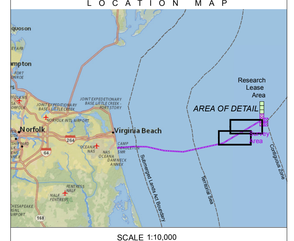
SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS851 with MarineStar
Subsurface Positioning	IXBlue GAPS
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
Sidescan Sonar Sensor	EdgeTech 2000-DSS 110 kHz/540 kHz
Sub-bottom Profiler	EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



SCALE 1:10,000
Meters
0 125 250 500 750 1,000
Feet
0 400 800 1,600 2,400 3,200

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Total Field

Revision No.	Date	Description	Prepared by	Checked by	Approved by
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

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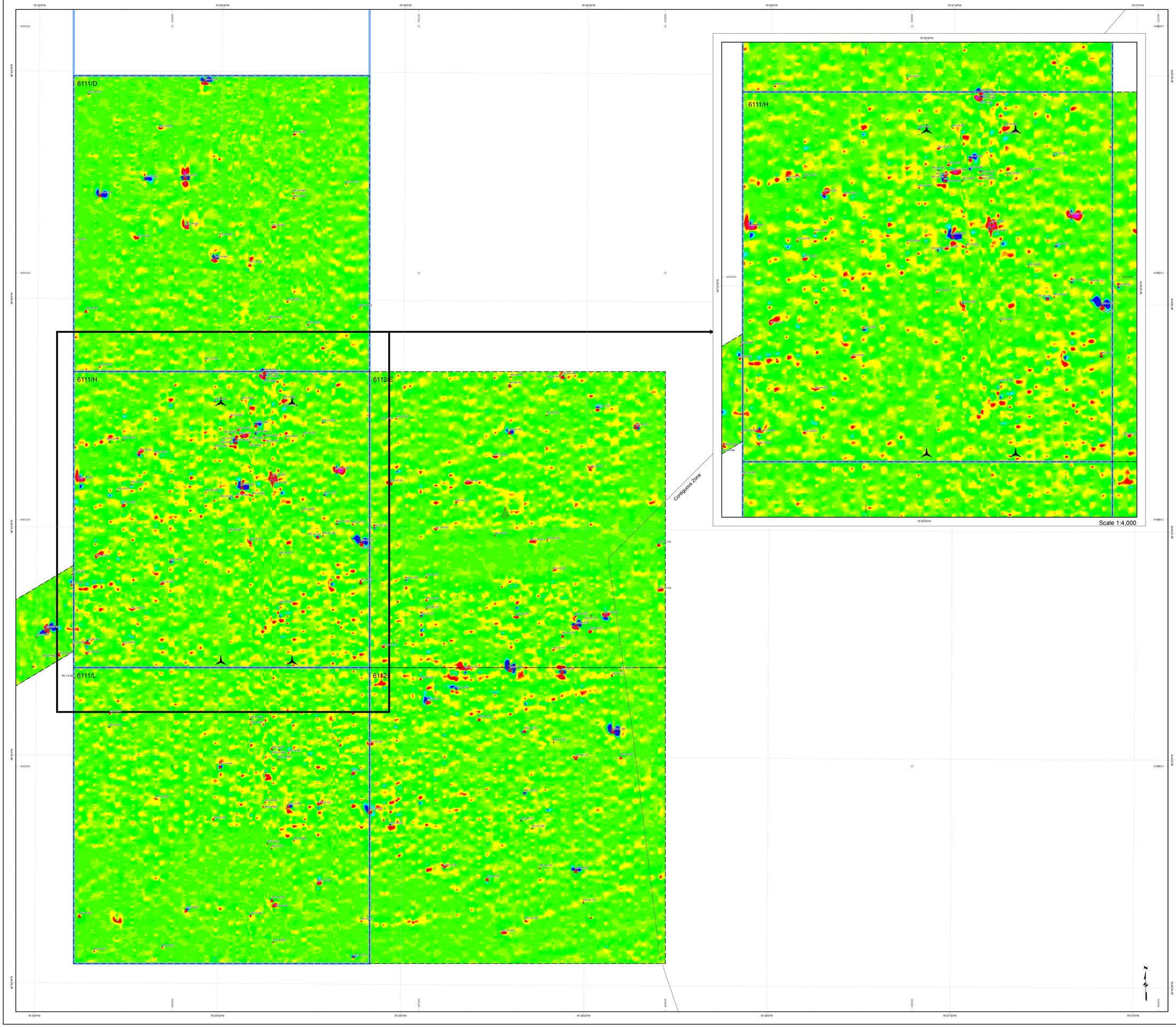

L E G E N D

- Preliminary Turbine Sites
- Buoy Avoided 06/05/13 per Survey Log
- Mag Target (<10nT)
- Mag Target (>10nT)
- Contours 5nT*
- Maritime Boundaries
- Survey Corridor
- Research Lease Area

* Contours not shown at 0nT, contours at 3nT added

14.4
13.7
13.1
12.4
11.8
11.2
10.5
9.9
9.2
8.6
7.9
7.3
6.7
6.0
5.4
4.7
4.1
3.5
2.8
2.2
1.5
0.9
0.3
-0.4
-1.0
-1.7
-2.3
-2.9
-3.6
-4.2
-4.9
-5.5
-6.2
-6.8
-7.4
-8.1
-8.7
-9.4

Total Field - n-Tesla (gamma)
nT (diurnally corrected/median filtered)

SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS851 with MarineStar
Subsurface Positioning	IXBlue GAPS
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
Sidescan Sonar Sensor	EdgeTech 2000-DSS 110 kHz/540 kHz
Sub-bottom Profiler	EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P

SCALE 1:5,000

Meters: 0 62.5 125 250 375 500
Feet: 0 187.5 375 750 1,125 1,500

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Total Field

Revision No.	Date	Description	Prepared by	Checked by	Approved by
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

MXD File Name:	Scale:	Size:	Plate:	Sheet Number:
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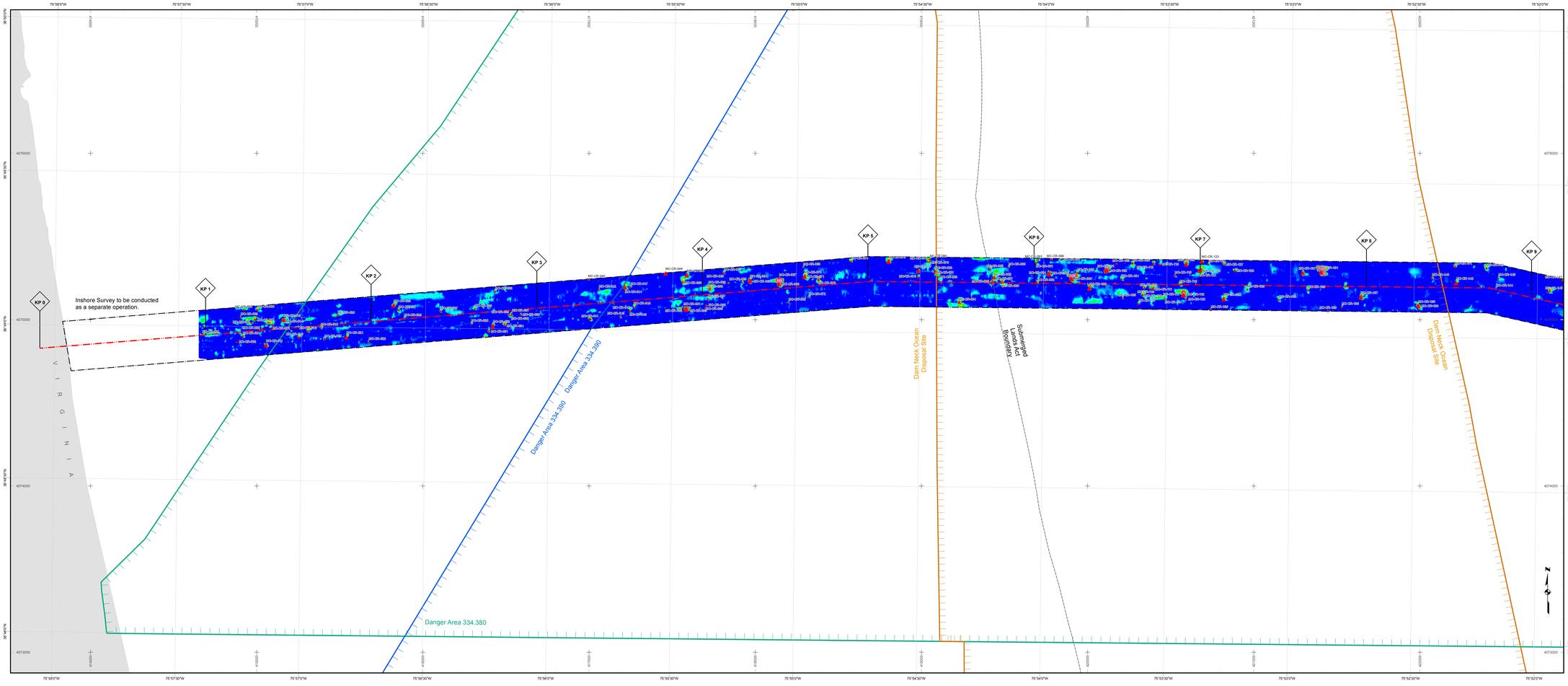

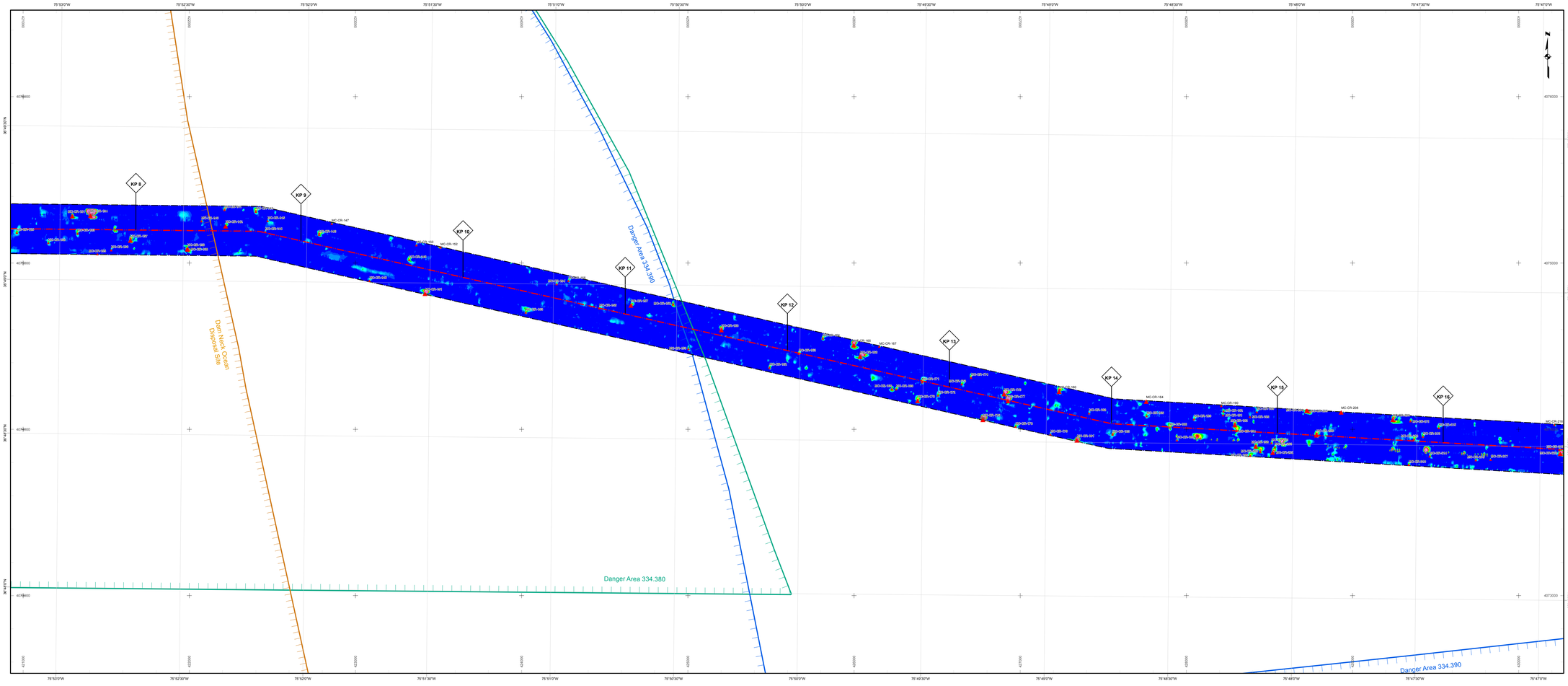

L E G E N D

- Mag Target (<10nT)
- Mag Target (>10nT)
- Contours 5nT*
- Survey Centerline
- Maritime Boundaries
- Dam Neck Ocean Disposal Site
- Danger Area 334.380*
- Danger Area 334.390**
- Survey Corridor
- Research Lease Area

Analytic Signal - n-Tesla (gamma)
nT (diurnally corrected/median filtered)

*33 CFR 334.380 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY OFF DAM NECK, VIRGINIA; NAVAL FIRING RANGE.

**33 CFR 334.390 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY; FIRING RANGE.

SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS851 with MarineStar
Subsurface Positioning	IXBlue GAPS
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
Sidescan Sonar Sensor	EdgeTech 2000-DSS 110 kHz/540 kHz
Sub-bottom Profiler	EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P

SCALE 1:10,000

Meters: 0 125 250 500 750 1,000

Feet: 0 400 800 1,600 2,400 3,200

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Analytic Signal

Revision No.	Date	Description	Prepared by:	Checked by	Approved by
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

MXD File Name:	Scale:	Size:	Plate:	Sheet Number:
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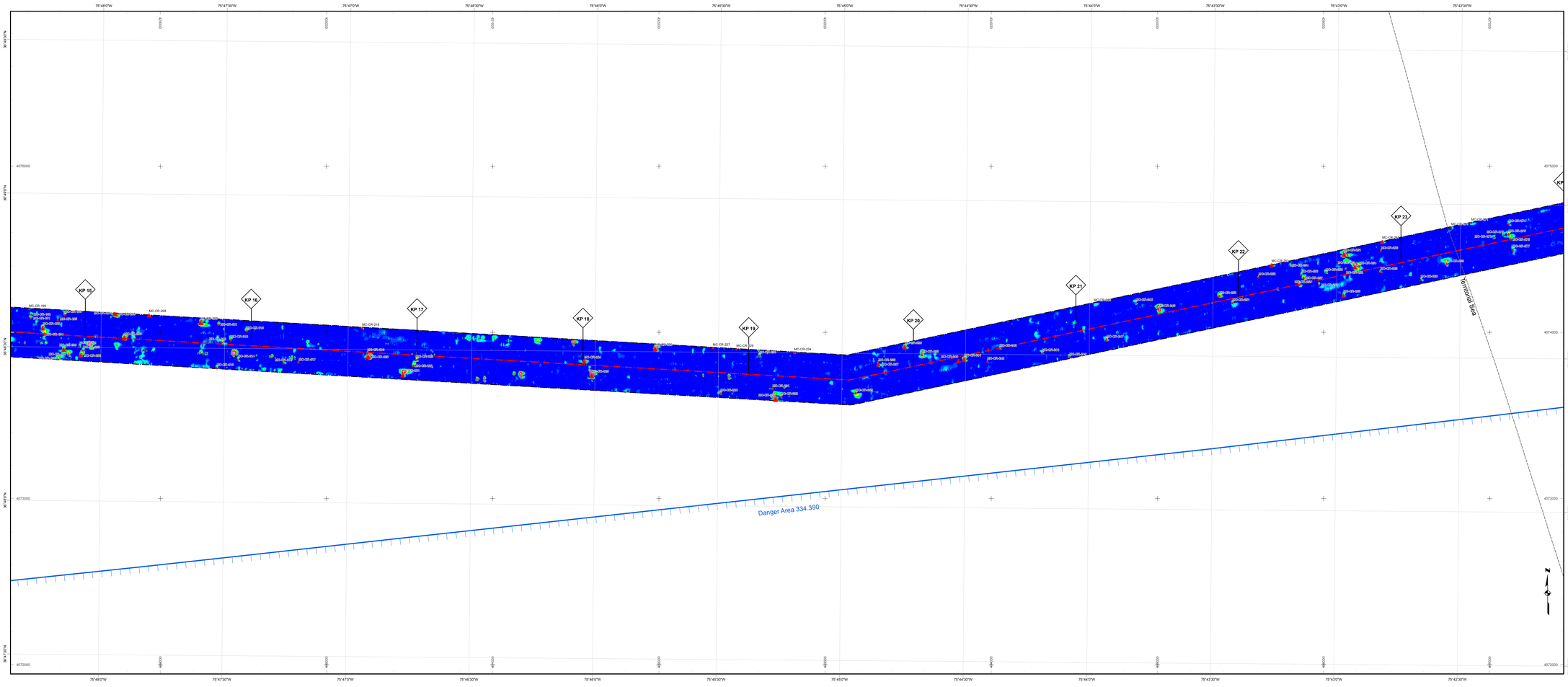

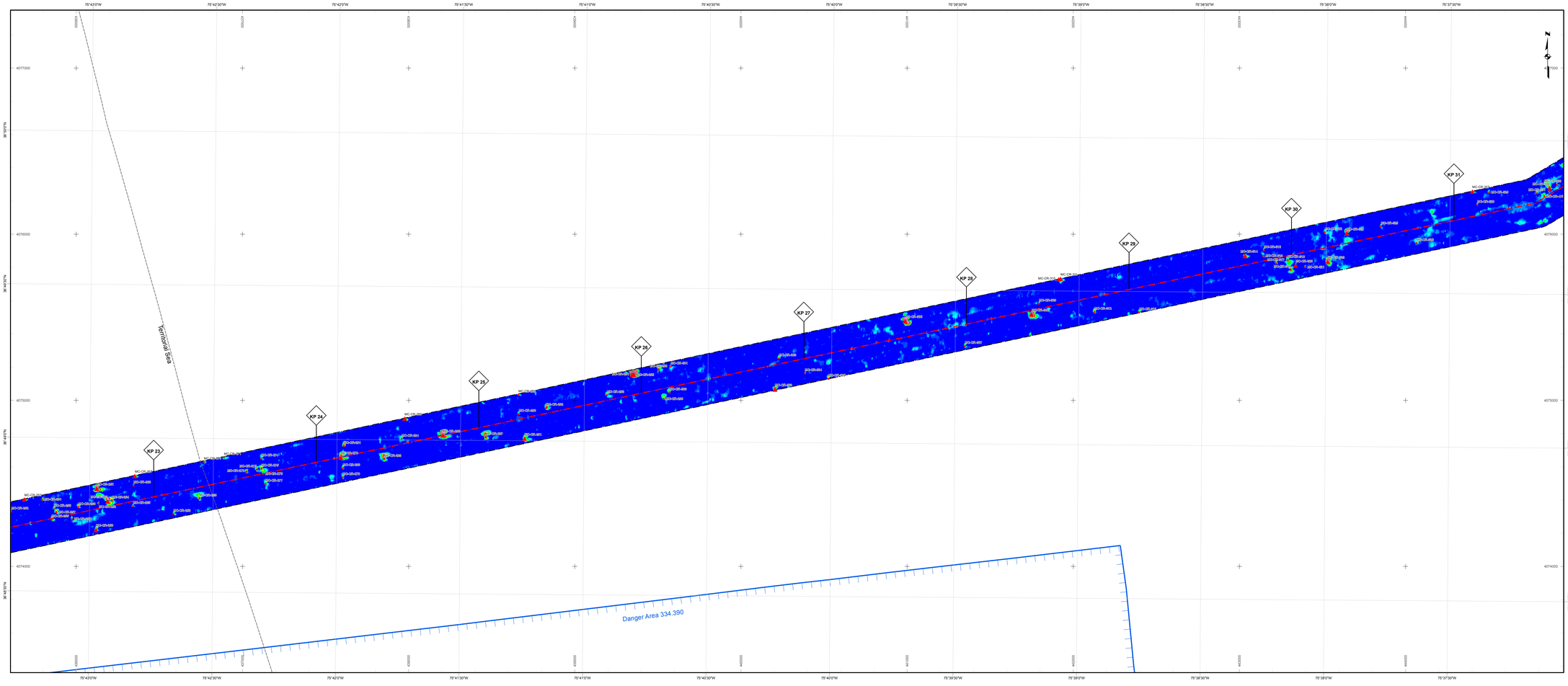

L E G E N D

- Mag Target (<10nT)
- Mag Target (>10nT)
- Contours 5nT*
- Survey Centerline
- Maritime Boundaries
- Dam Neck Ocean Disposal Site
- Danger Area 334.380*
- Danger Area 334.390**
- Survey Corridor
- Research Lease Area

4.9 4.7 4.6 4.5 4.4 4.2 4.1 4.0 3.8 3.7 3.6 3.5 3.3 3.2 3.1 2.9 2.8 2.7 2.6 2.4 2.3 2.2 2.1 1.9 1.8 1.7 1.5 1.4 1.3 1.2 1.0 0.9 0.8 0.6 0.5 0.4 0.3 0.1

Analytic Signal - n-Tesla (gamma)
nT (diurnally corrected/median filtered)

*33 CFR 334.380 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY OFF DAM NECK, VIRGINIA; NAVAL FIRING RANGE.

**33 CFR 334.390 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY; FIRING RANGE.

SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS851 with MarineStar
Subsurface Positioning	IXBlue GAPS
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
Sidescan Sonar Sensor	EdgeTech 2000-DSS 110 kHz/540 kHz
Sub-bottom Profiler	EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P

SCALE 1:10,000

Meters: 0 125 250 500 750 1,000

Feet: 0 400 800 1,600 2,400 3,200

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Analytic Signal

Revision No.	Date	Description	Prepared by	Checked by	Approved by
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

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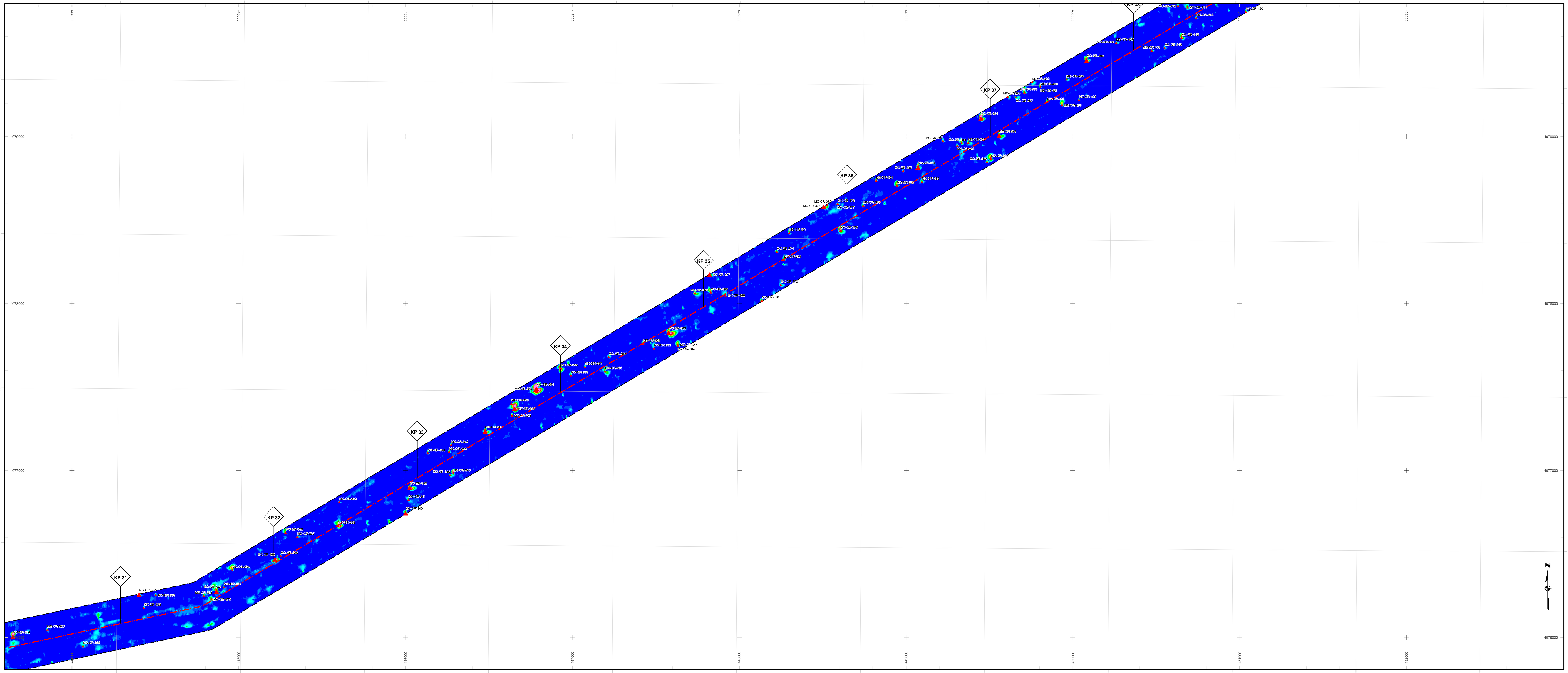
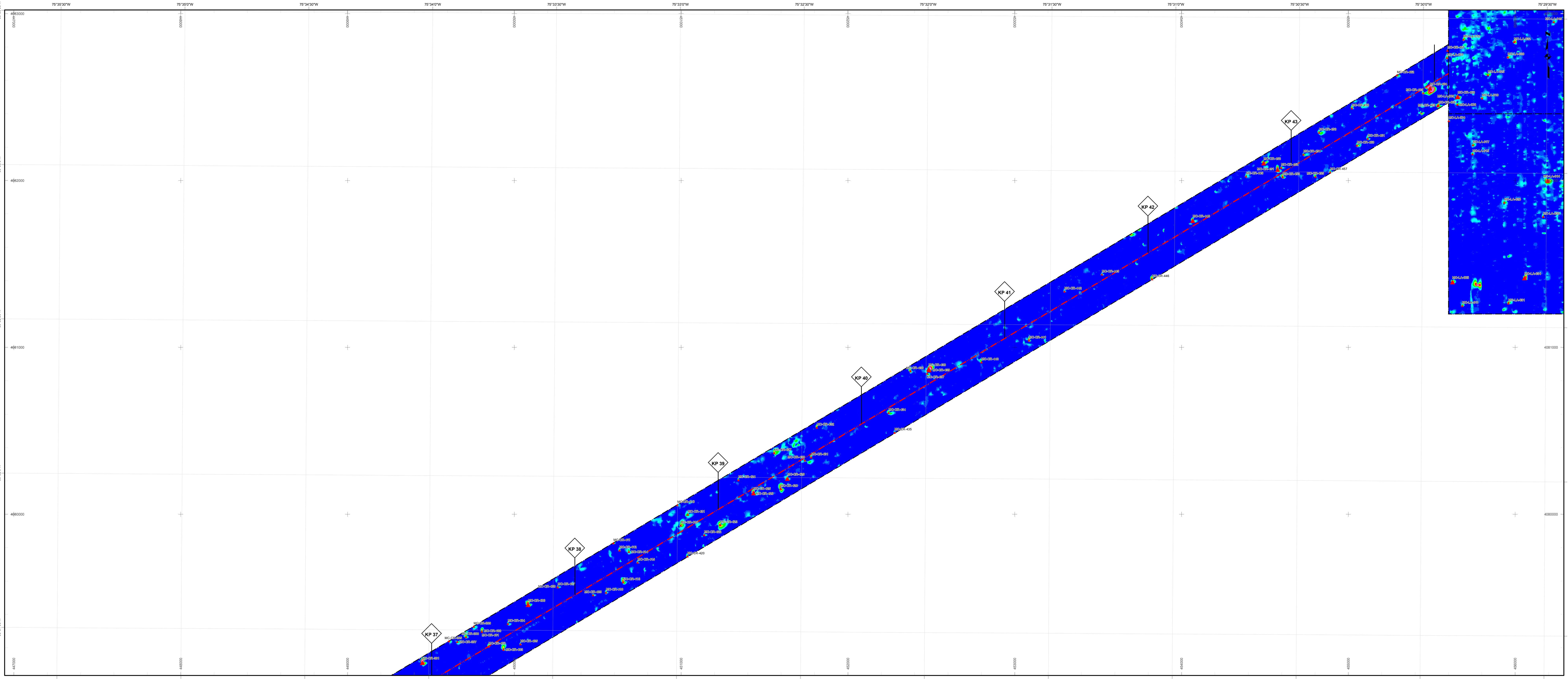
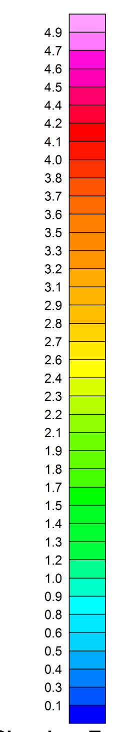




L E G E N D

- Mag Target (<10nT)
- Mag Target (>10nT)
- Contours 5nT*
- Survey Centerline
- Maritime Boundaries
- Dam Neck Ocean Disposal Site
- Danger Area 334.380*
- Danger Area 334.390**
- Survey Corridor
- Research Lease Area



*33 CFR 334.380 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY OFF DAM NECK, VIRGINIA; NAVAL FIRING RANGE.

**33 CFR 334.390 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY; FIRING RANGE.

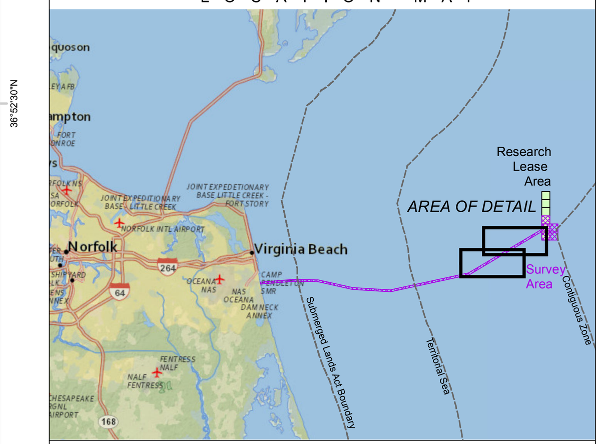
SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS651 with MarineStar
Subsurface Positioning	IXBlue GAPS
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
Sidescan Sonar Sensor	EdgeTech 2000-DSS 110 kHz/540 kHz
Sub-bottom Profiler	EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N   M A P



SCALE 1:10,000

Meters: 0, 125, 250, 500, 750, 1,000
Feet: 0, 400, 800, 1,600, 2,400, 3,200

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Analytic Signal

Revision No.	Date	Description	Prepared by:	Checked by:	Approved by:
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

MXD File Name:	Scale:	Size:	Plate:	Sheet Number:
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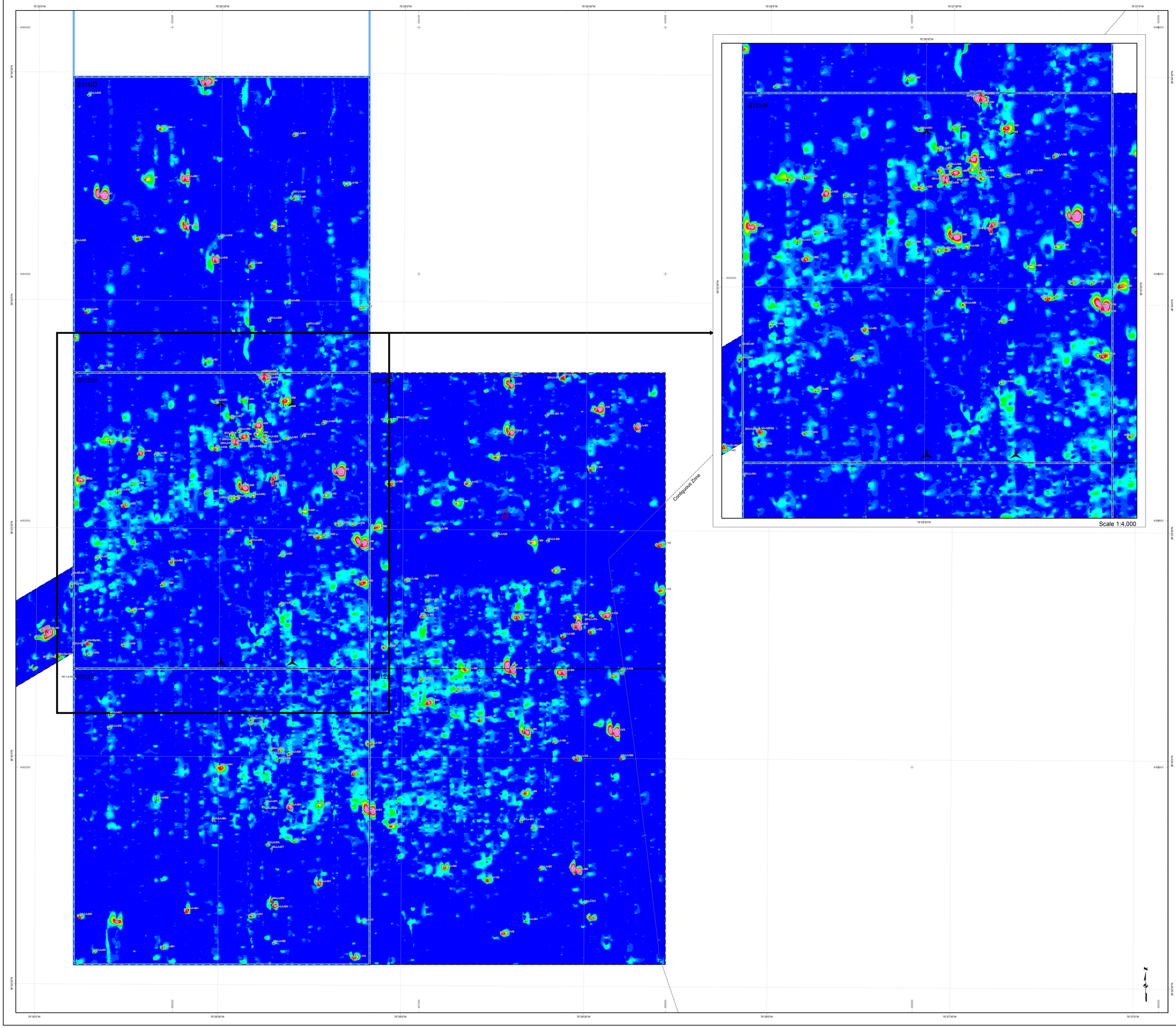


L E G E N D

- Preliminary Turbine Sites
- Buoy Avoided 06/05/13 per Survey Log
- Mag Target (<10nT)
- Mag Target (>10nT)
- Contours 5nT*
- Maritime Boundaries
- Survey Corridor
- Research Lease Area

* Contours not shown at 0nT, contours at 3nT added

Analytic Signal - n-Tesla (gamma)
nT (diurnally corrected/median filtered)

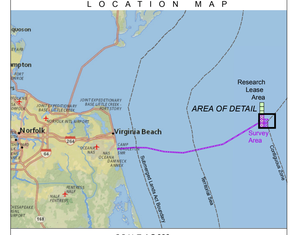
SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS851 with MarineStar
Subsurface Positioning	IXBlue GAPS
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
Sidescan Sonar Sensor	EdgeTech 2000-DSS 110 kHz/540 kHz
Sub-bottom Profiler	EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



SCALE 1:5,000

Meters: 0, 62.5, 125, 250, 375, 500
Feet: 0, 187.5, 375, 750, 1,125, 1,500

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Analytic Signal

Revision No.	Date	Description	Prepared by:	Checked by	Approved by:
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

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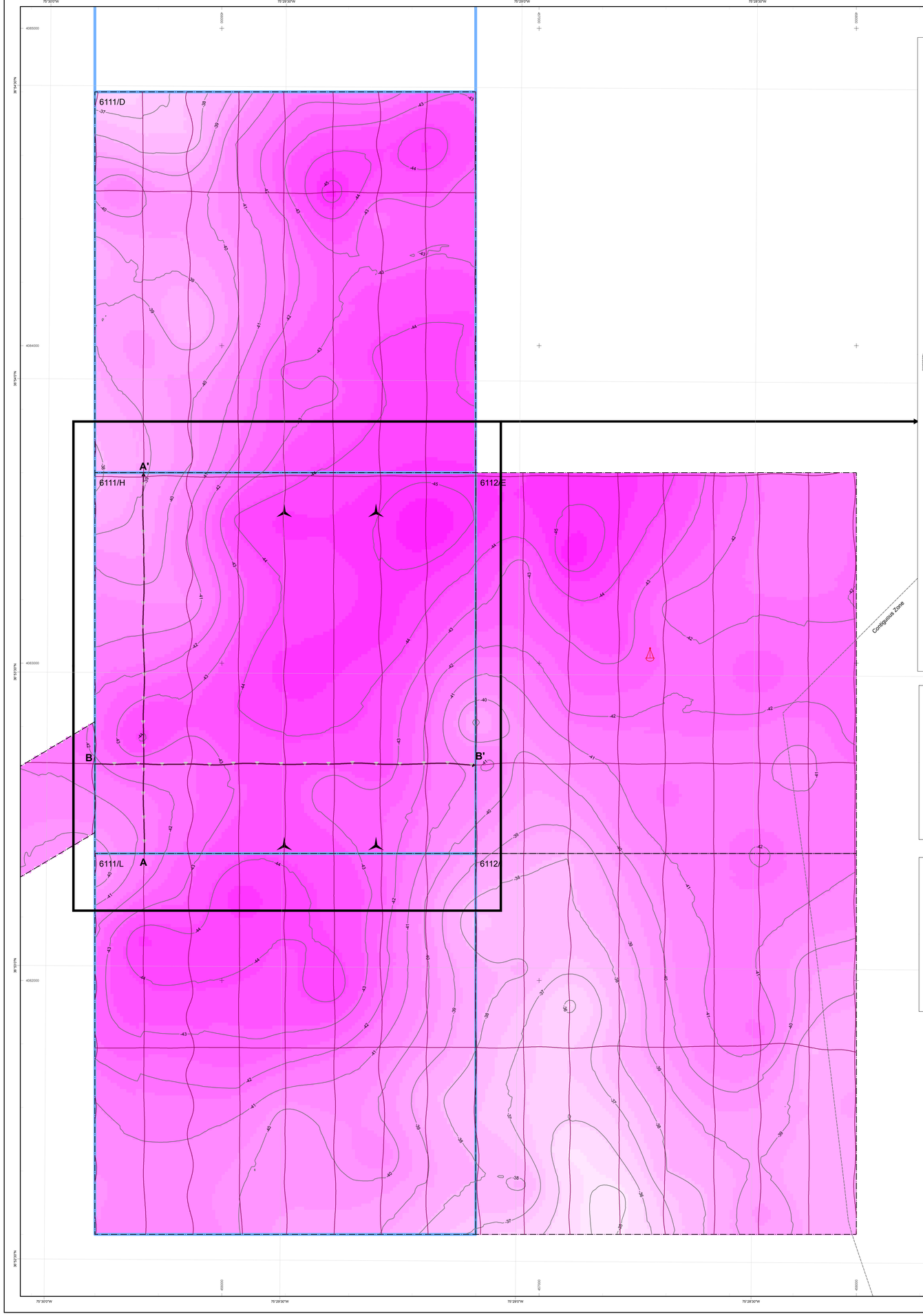
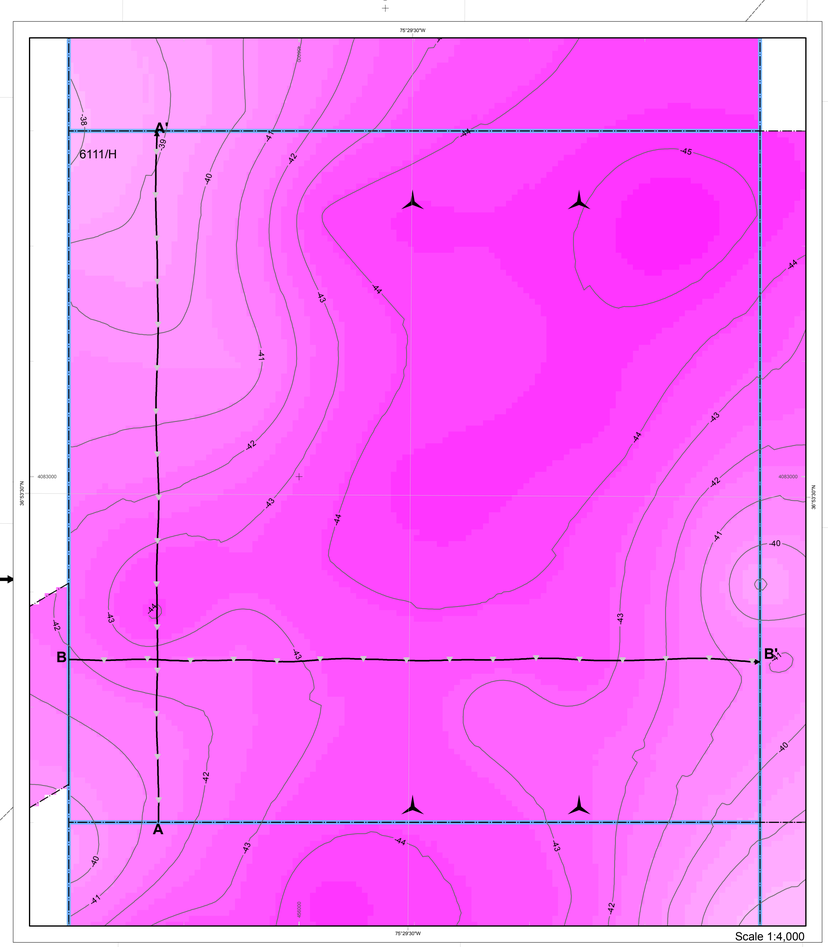
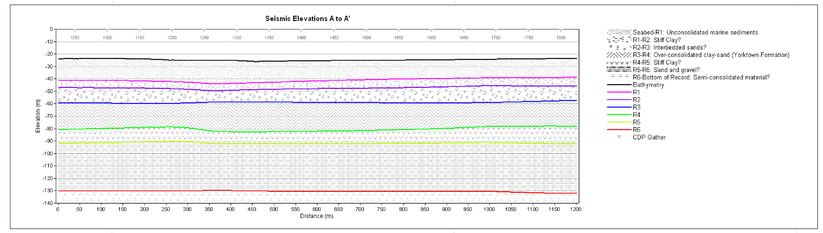
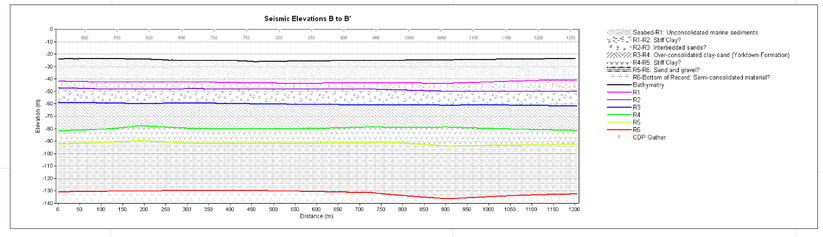








L E G E N D

- Preliminary Turbine Sites
- Buoy Avoided 06/05/13 per Survey Log
- CDP Gather
- 1m Contour
- Profile Alignment
- Trackline
- Maritime Boundaries
- Survey Corridor
- Research Lease Area

Reflector 1 Elevation (m)

- -35.1 - -34.5
- -35.8 - -35.2
- -36.5 - -35.9
- -37.3 - -36.6
- -38 - -37.4
- -38.7 - -38.1
- -39.4 - -38.8
- -40.2 - -39.5
- -40.9 - -40.3
- -41.6 - -41
- -42.3 - -41.7
- -43.1 - -42.4
- -43.8 - -43.2
- -44.5 - -43.9
- -45.2 - -44.6
- -46 - -45.3

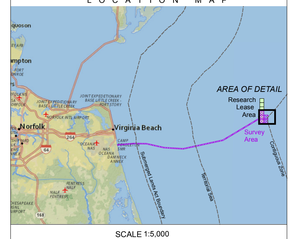
SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	RV Sea Lion V
Surface Positioning	Trimble SPS851 with MarineStar
Subsurface Positioning	IXBlue GAPS
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
Sidescan Sonar Sensor	EdgeTech 2000-DSS 110 kHz/540 kHz
Sub-bottom Profiler	EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



SCALE 1:5,000

Meters: 0, 62.5, 125, 250, 375, 500
Feet: 0, 187.5, 375, 750, 1,125, 1,500

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Reflector 1 Elevation

Revision No.	Date	Description	Prepared by:	Checked by	Approved by:
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

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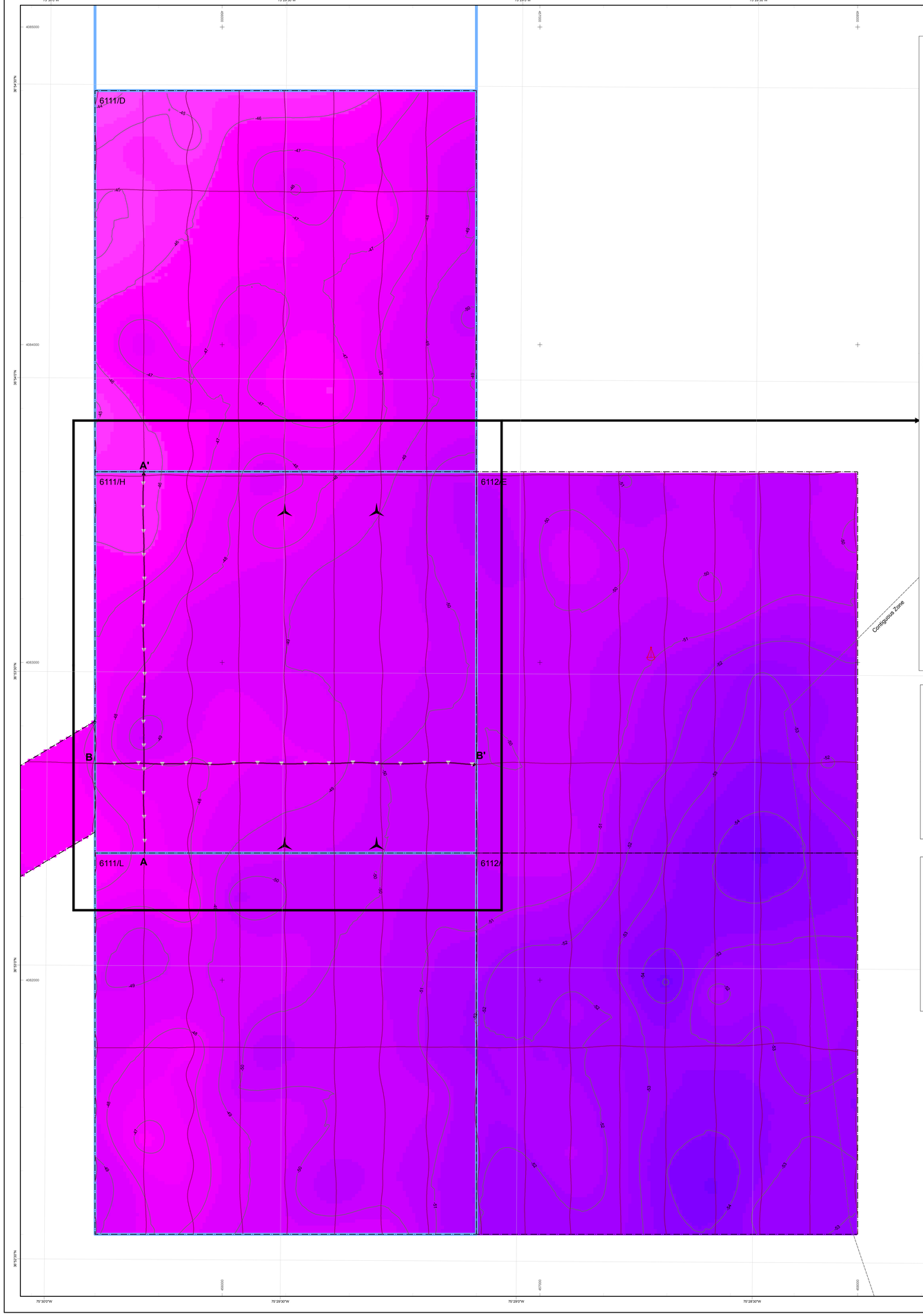
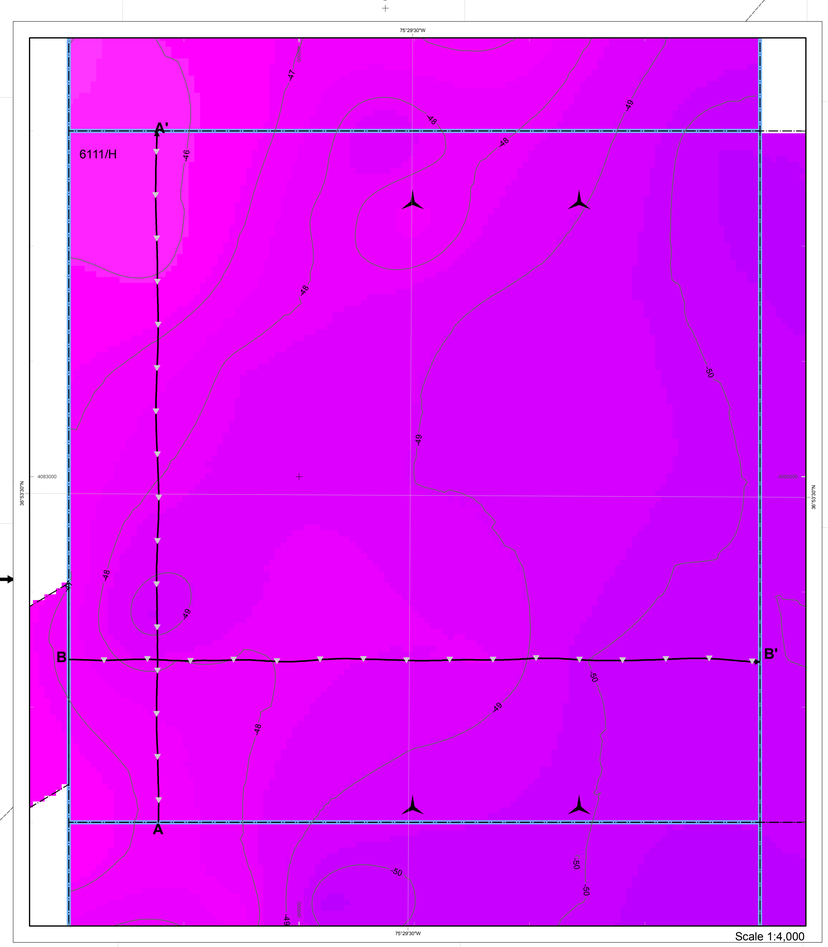
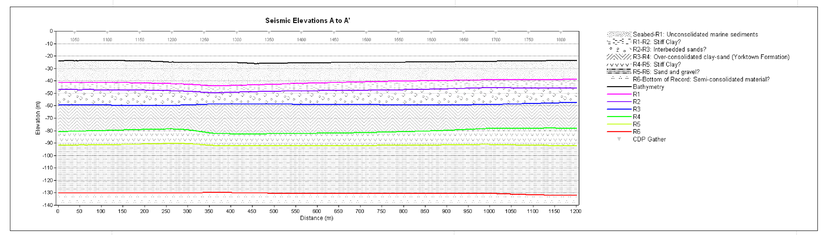
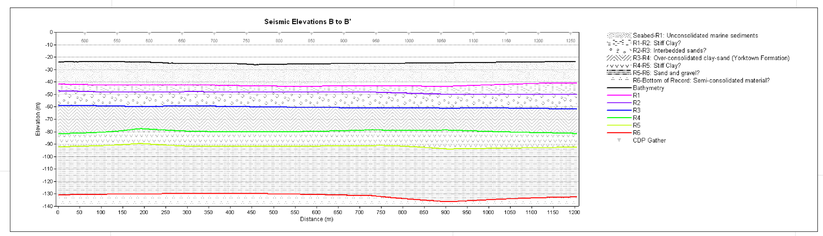








L E G E N D

- Preliminary Turbine Sites
- Buoy Avoided 06/05/13 per Survey Log
- CDP Gather
- Profile Alignment
- Trackline
- 1m Contour
- Maritime Boundaries
- Survey Corridor
- Research Lease Area

Reflector 2 Elevation (m)

- -43.8 - -43.2
- -44.5 - -43.9
- -45.2 - -44.6
- -46 - -45.3
- -46.7 - -46.1
- -47.4 - -46.8
- -48.1 - -47.5
- -48.9 - -48.2
- -49.6 - -49
- -50.3 - -49.7
- -51.1 - -50.4
- -51.8 - -51.2
- -52.5 - -51.9
- -53.2 - -52.6
- -54 - -53.3
- -54.7 - -54.1
- -55.4 - -54.8

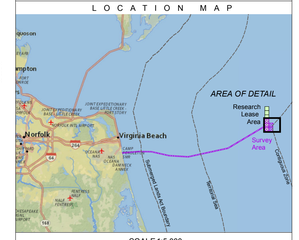
SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS851 with MarineStar
Subsurface Positioning	IXBlue GAPS
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
Sidescan Sonar Sensor	EdgeTech 2000-DSS 110 kHz/540 kHz
Sub-bottom Profiler	EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



SCALE 1:5,000

Meters: 0, 62.5, 125, 250, 375, 500
Feet: 0, 187.5, 375, 750, 1,125, 1,500

Dominion Resources, Inc.
5000 Dominion Boulevard
Glen Allen, VA 23060

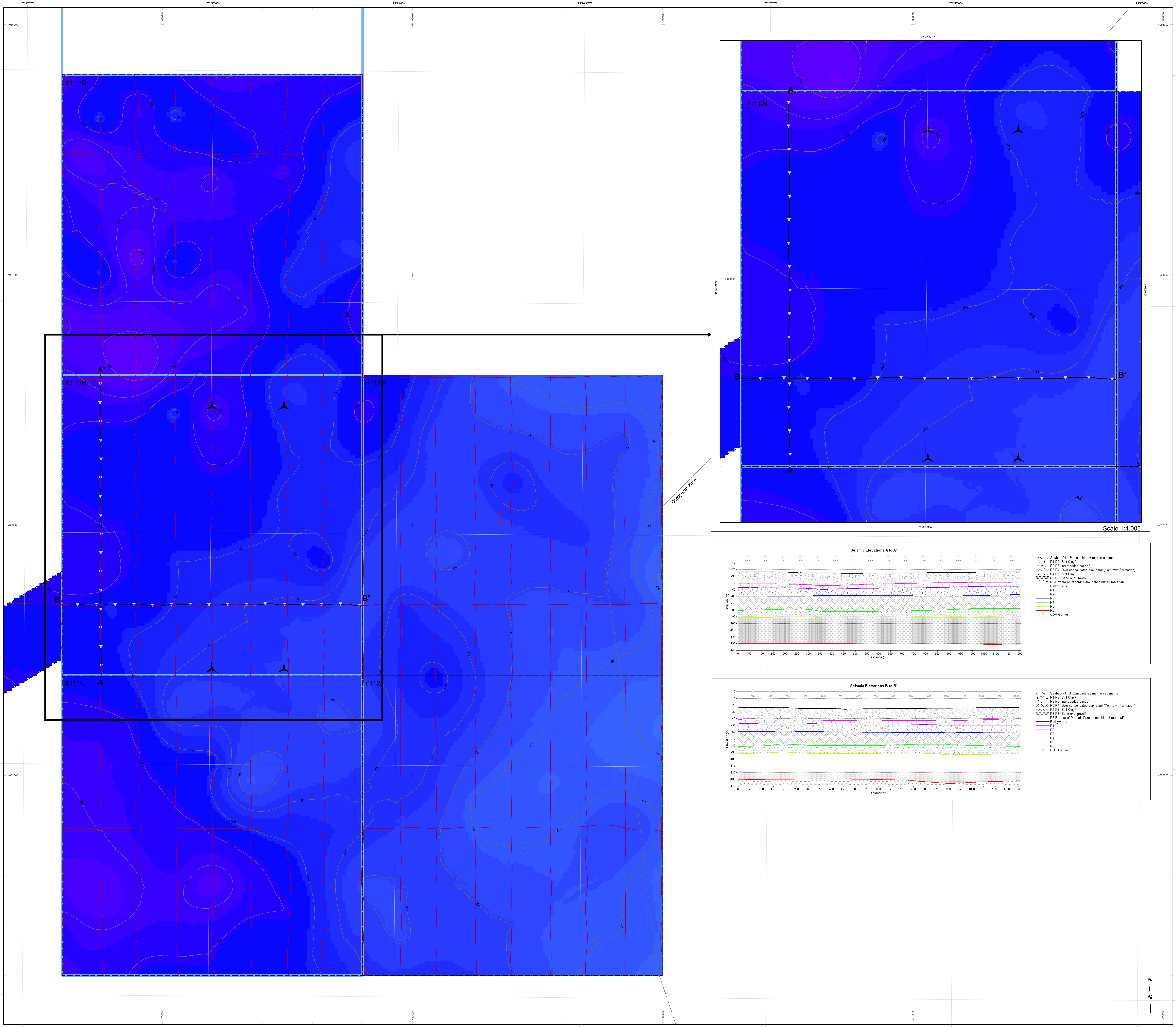
Tetra Tech, Inc.
4101 Cox Road, Suite 120
Glen Allen, VA 23060
www.tetratech.com

Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Reflector 1 Elevation

Revision No.	Date	Description	Prepared by:	Checked by	Approved by
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

MXD File Name: P12_R2_SeismicElevation_LeaseArea.mxd	Scale: 1:5000	Size: ANSI E	Plate: 12	Sheet Number: 1 of 1



L E G E N D

- Preliminary Turbine Sites
- Buoy Avoided 06/05/13 per Survey Log
- CDP Gather
- Profile Alignment
- Trackline
- 1m Contour
- Maritime Boundaries
- Survey Corridor
- Research Lease Area

Reflector 3 Elevation (m)

- -56.1 - -55.5
- -56.9 - -56.2
- -57.6 - -57
- -58.3 - -57.7
- -59 - -58.4
- -59.8 - -59.1
- -60.5 - -59.9
- -61.2 - -60.6
- -61.9 - -61.3
- -62.7 - -62
- -63.4 - -62.8
- -64.1 - -63.5
- -64.8 - -64.2

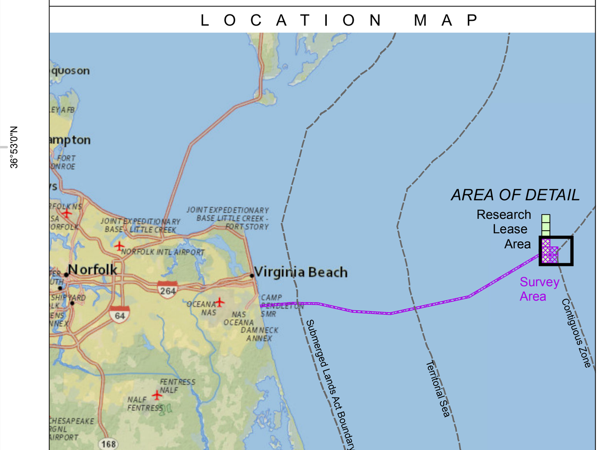
SURVEY NOTES

Survey dates.............................. June 1 - June 28, 2013
Survey Vessel.............................. R/V Sea Lion V
Surface Positioning...................... Trimble SPS651 with MarineStar
Subsurface Positioning.................. IXBlue GAPS
Heading/Motion Sensor................ IXBlue PHINS 6000
Bathymetry Sensor...................... RESON SeaBat 7125 SV2
Sidescan Sonar Sensor................ EdgeTech 2000-DSS 110 kHz/540 kHz
Sub-bottom Profiler...................... EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor.................. Marine Magnetics SeaQuest
Sound Speed Profilers.................. Oceanscience UCTD
Seismic System 1.......................... AAE 300 Boomer
Seismic System 2.......................... Datasonic Bubble Pulser
RPL Issue...................................... CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum .... NAD 83
Projection .... UTM Zone 18 North
Horizontal Units .... Meters
Vertical Units.................................. Meters
Vertical Datum .... MLLW EPOCH 1987-2001
GPS L1/L2 Corrections .... Marine Star

L O C A T I O N   M A P



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Meters: 0, 62.5, 125, 250, 375, 500
Feet: 0, 187.5, 375, 750, 1,125, 1,500

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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Reflector 3 Elevation

Revision No.	Date	Description	Prepared by:	Checked by:	Approved by:
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

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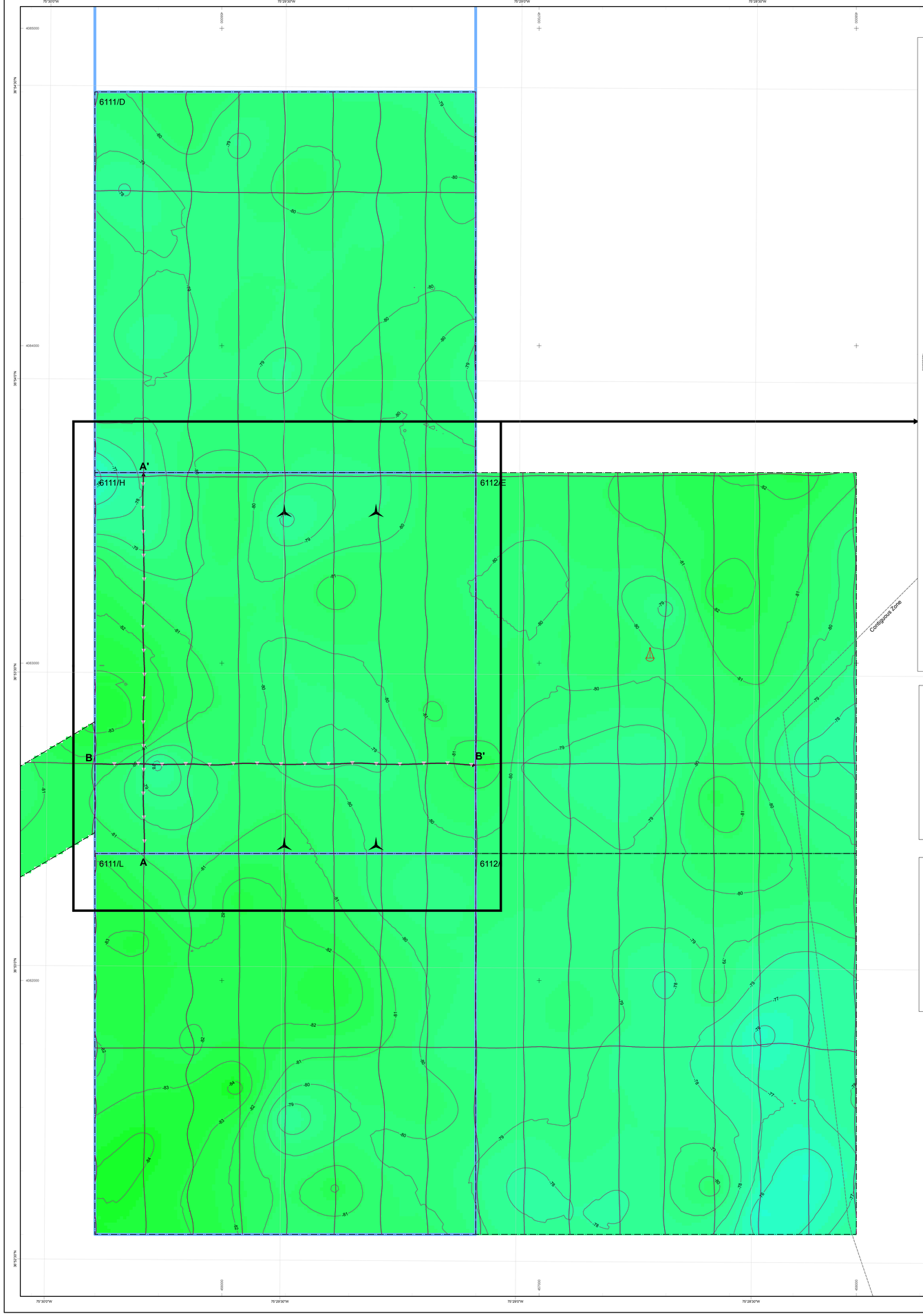
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6112/E
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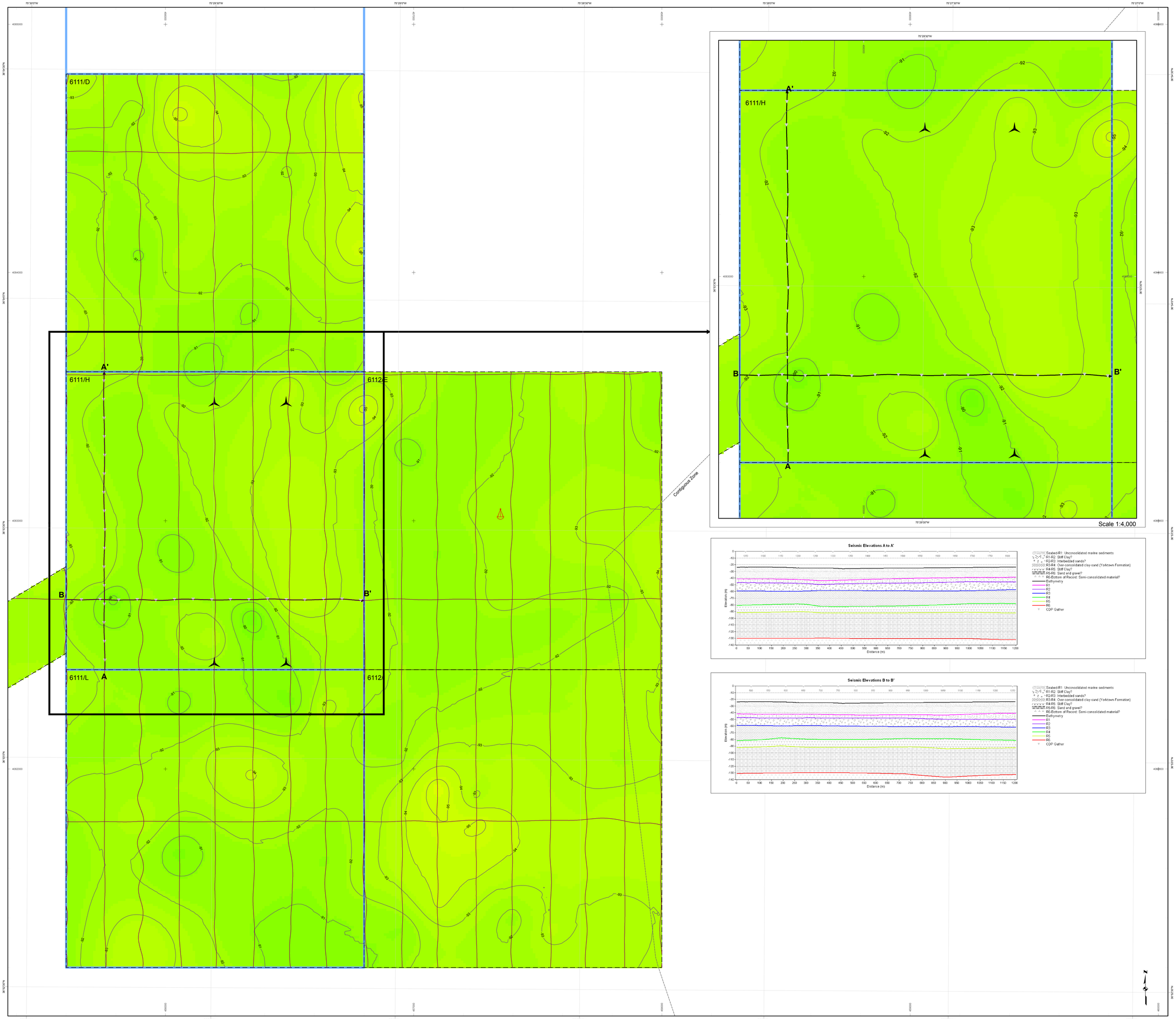

L E G E N D

- Preliminary Turbine Sites
- Buoy Avoided 06/05/13 per Survey Log
- CDP Gather
- Profile Alignment
- Trackline
- 1m Contour
- Maritime Boundaries
- Survey Corridor
- Research Lease Area

Reflector 5 Elevation (m)

- -89.5 - -88.9
- -90.2 - -89.6
- -91 - -90.3
- -91.7 - -91.1
- -92.4 - -91.8
- -93.2 - -92.5
- -93.9 - -93.3
- -94.6 - -94
- -95.3 - -94.7
- -96.1 - -95.4

SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS851 with MarineStar
Subsurface Positioning	IXBlue GAPS
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
Sidescan Sonar Sensor	EdgeTech 2000-DSS 110 kHz/540 kHz
Sub-bottom Profiler	EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P

SCALE 1:5,000

Meters: 0 62.5 125 250 375 500
Feet: 0 187.5 375 750 1,125 1,500

Dominion Resources, Inc.
5000 Dominion Boulevard
Glen Allen, VA 23060

Tetra Tech, Inc.
4101 Cox Road, Suite 120
Glen Allen, VA 23060
www.tetratech.com

Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Reflector 5 Elevation

Revision No.	Date	Description	Prepared by	Checked by	Approved by
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

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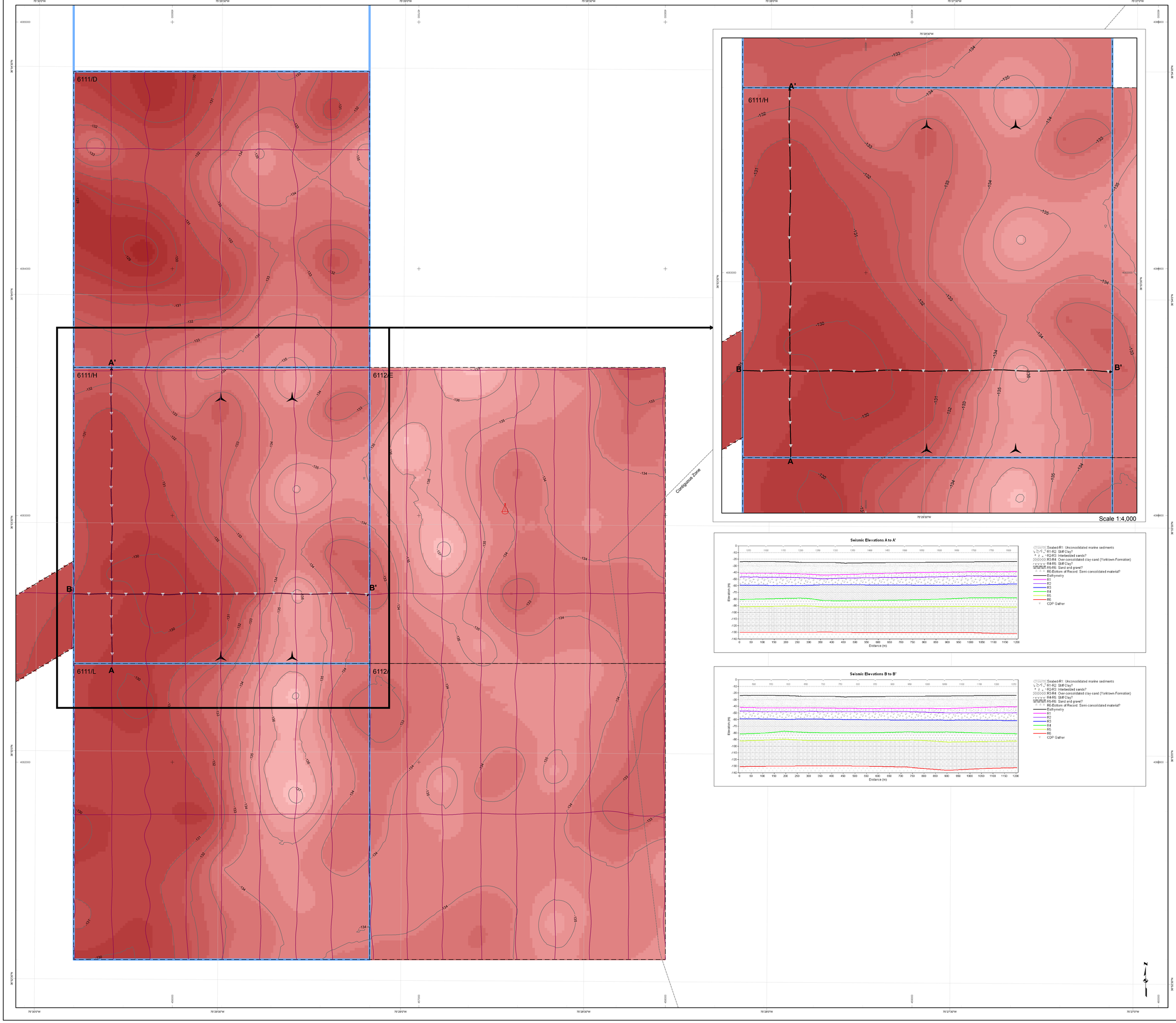
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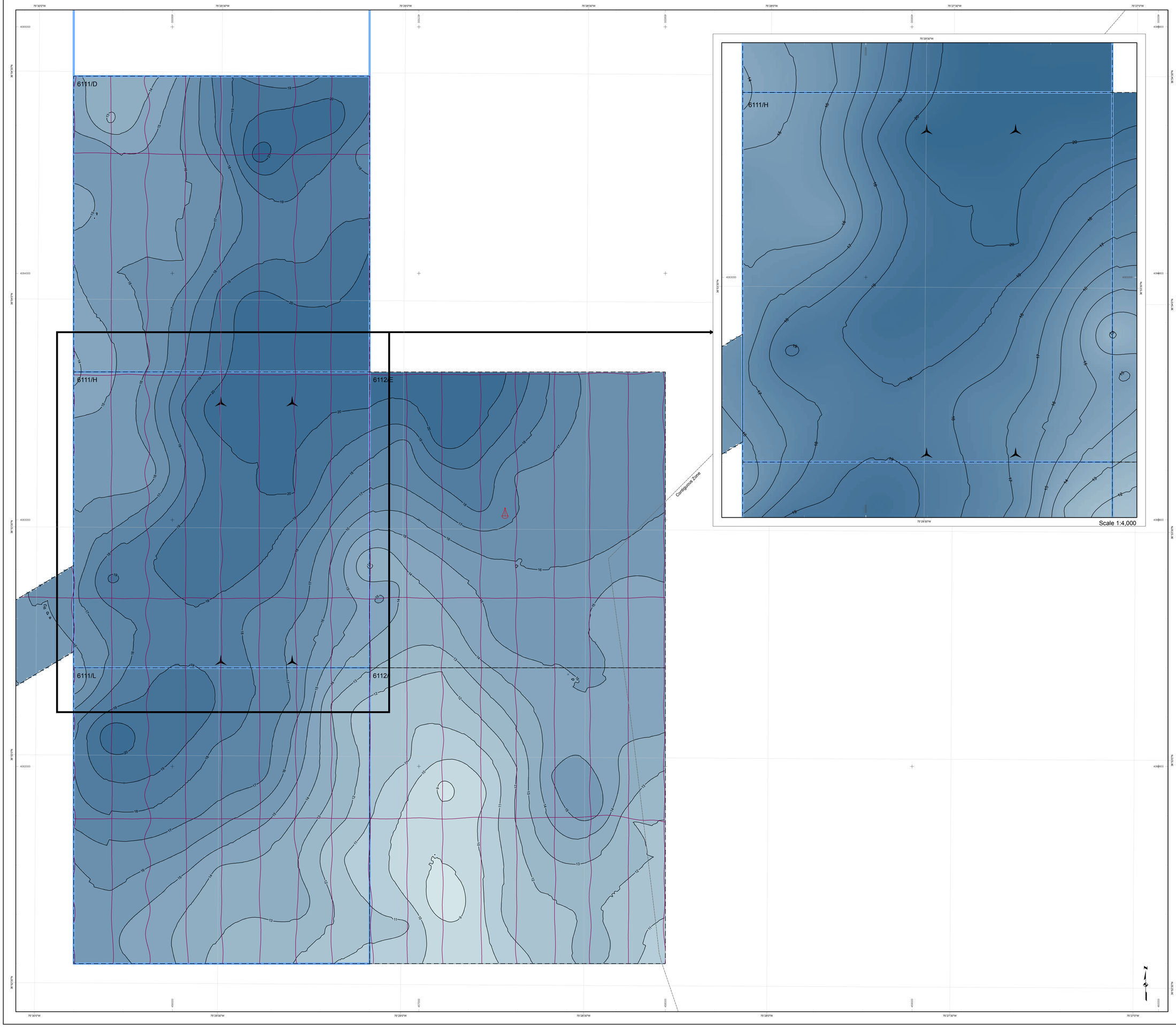

L E G E N D

- Preliminary Turbine Sites
- Buoy Avoided 06/05/13 per Survey Log
- Trackline
- Isopach Contour
- Maritime Boundaries
- Survey Corridor
- Research Lease Area

Thickness of Sediment Over Reflector 1

- 8.1 - 9
- 9.1 - 10
- 10.1 - 11
- 11.1 - 12
- 12.1 - 13
- 13.1 - 14
- 14.1 - 15
- 15.1 - 16
- 16.1 - 17
- 17.1 - 18
- 18.1 - 19
- 19.1 - 20
- 20.1 - 21
- 21.1 - 22

SURVEY NOTES

Survey dates	June 1 - June 28, 2013
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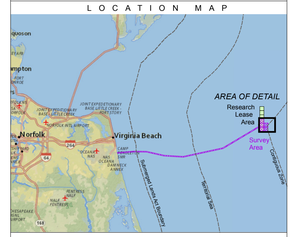
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



SCALE 1:5,000

Meters: 0, 62.5, 125, 250, 375, 500
Feet: 0, 187.5, 375, 750, 1,125, 1,500

Dominion Resources, Inc.
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Virginia Offshore Wind Technology Advancement Project (VOWTAP)

North-Up – Isopach Map of Near Surface Sediments
(Seabed to top of Reflector 1)

Revision No.	Date	Description	Prepared by:	Checked by:	Approved by:
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

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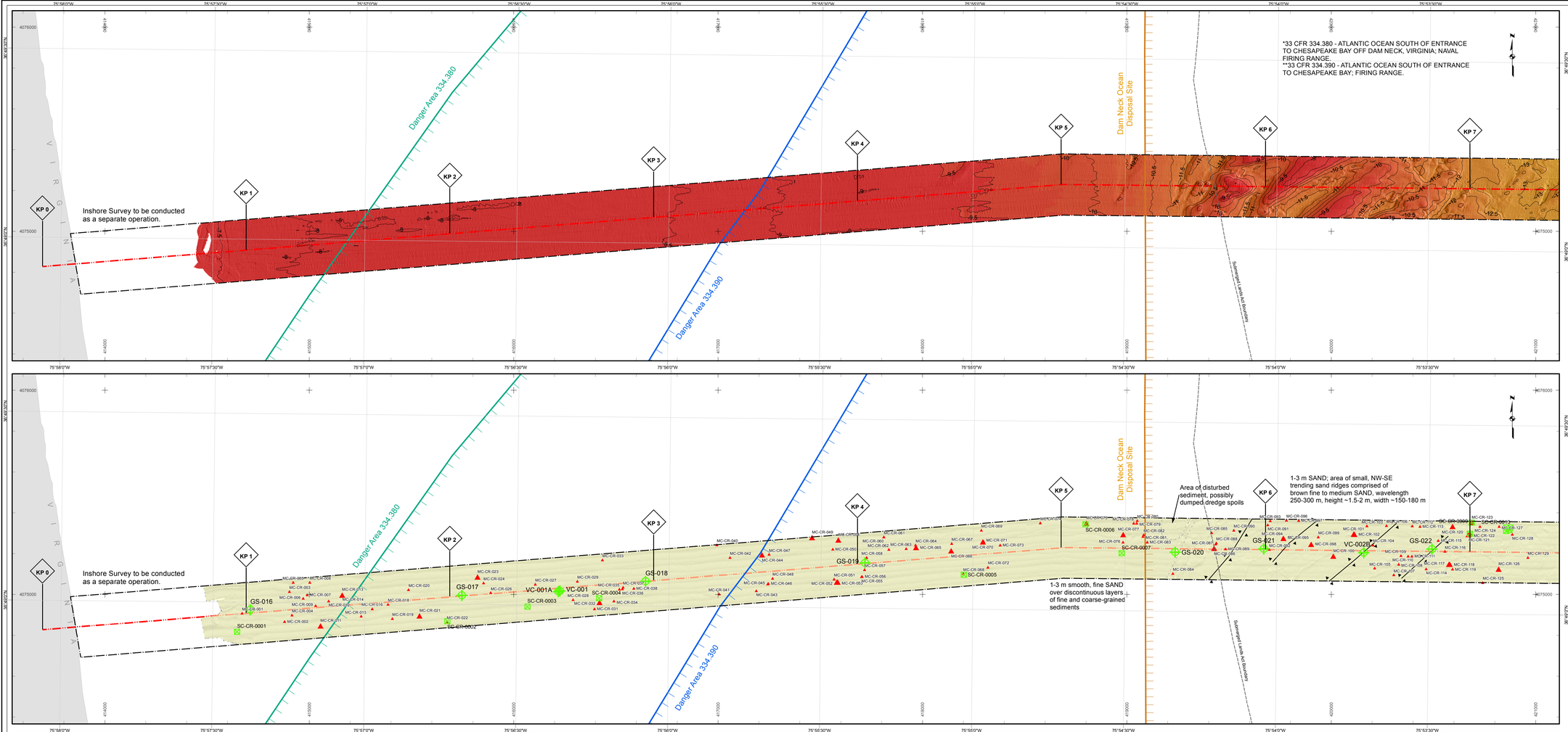

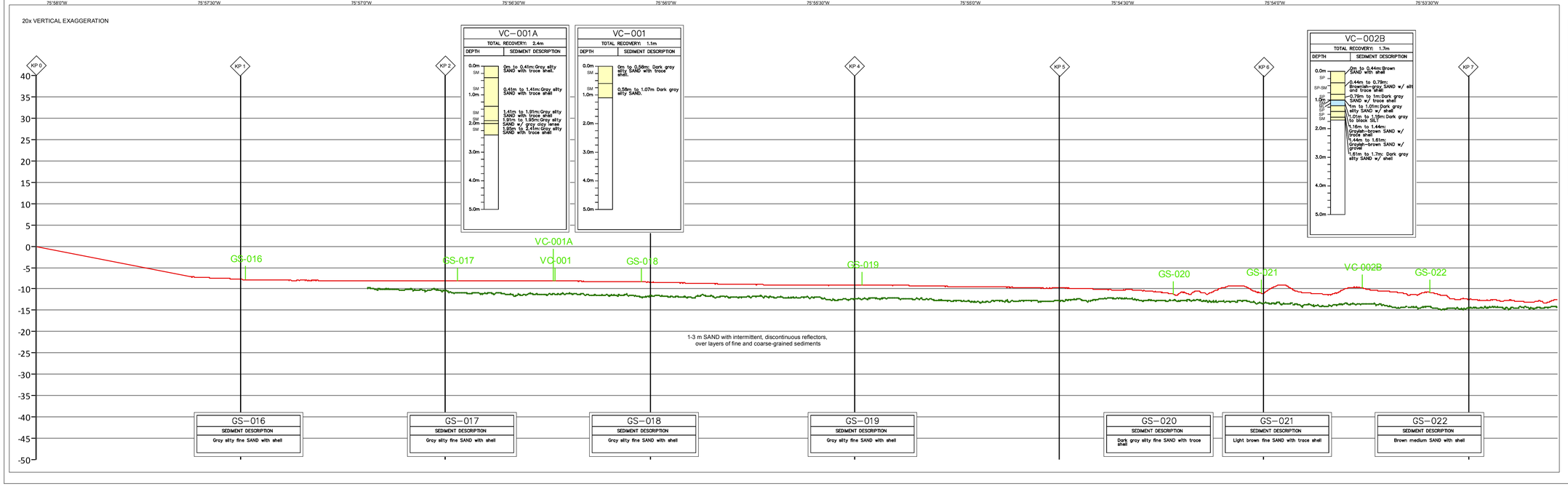

L E G E N D

- 0.5m Contour
- Seabed Sample Location with reference number
  - GS (Grab Sample)
  - VC (Vibra Core)
  - PC (Piston Core)
- Sonar Contacts
- Mag Target (<10nT)
- Mag Target (>10nT)
- Fine-grained sediment (SILT/CLAY)
- Coarse-grained sediment (SAND)
- Very coarse-grained sediment (GRAVEL)
- Subsurface Channels

Reflectivity

- Low
- High

Sidescan sonar imagery semi-transparent below interpreted surface sediments

- Feature or Sediment Boundary
- Sand Ridge
- Channel
- Survey Centerline
- Dam Neck Ocean Disposal Site
- Danger Area 334.380*
- Danger Area 334.390**
- Maritime Boundaries
- Survey Corridor

Profile Features

- Seabed
- Subsurface reflectors

Elevation (m)

-7.4 - -7
-7.9 - -7.5
-8.4 - -8
-8.9 - -8.5
-9.4 - -9
-9.9 - -9.5
-10.4 - -10
-10.9 - -10.5
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-26.4 - -26
-26.9 - -26.5
-27.4 - -27
-27.9 - -27.5
-28.3 - -28

SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
Surface Positioning	Trimble SPS651 with MarineStar
Subsurface Positioning	IXBlue GAPS
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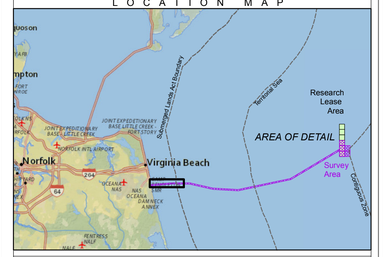
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



SCALE 1:10,000

Meters: 0 125 250 500 750 1,000
Feet: 0 400 800 1,600 2,400 3,200

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Virginia Offshore Wind Technology Advancement Project

Alignment Sheet

Revision No.	Date	Description	Prepared by:	Checked by:	Approved by:
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

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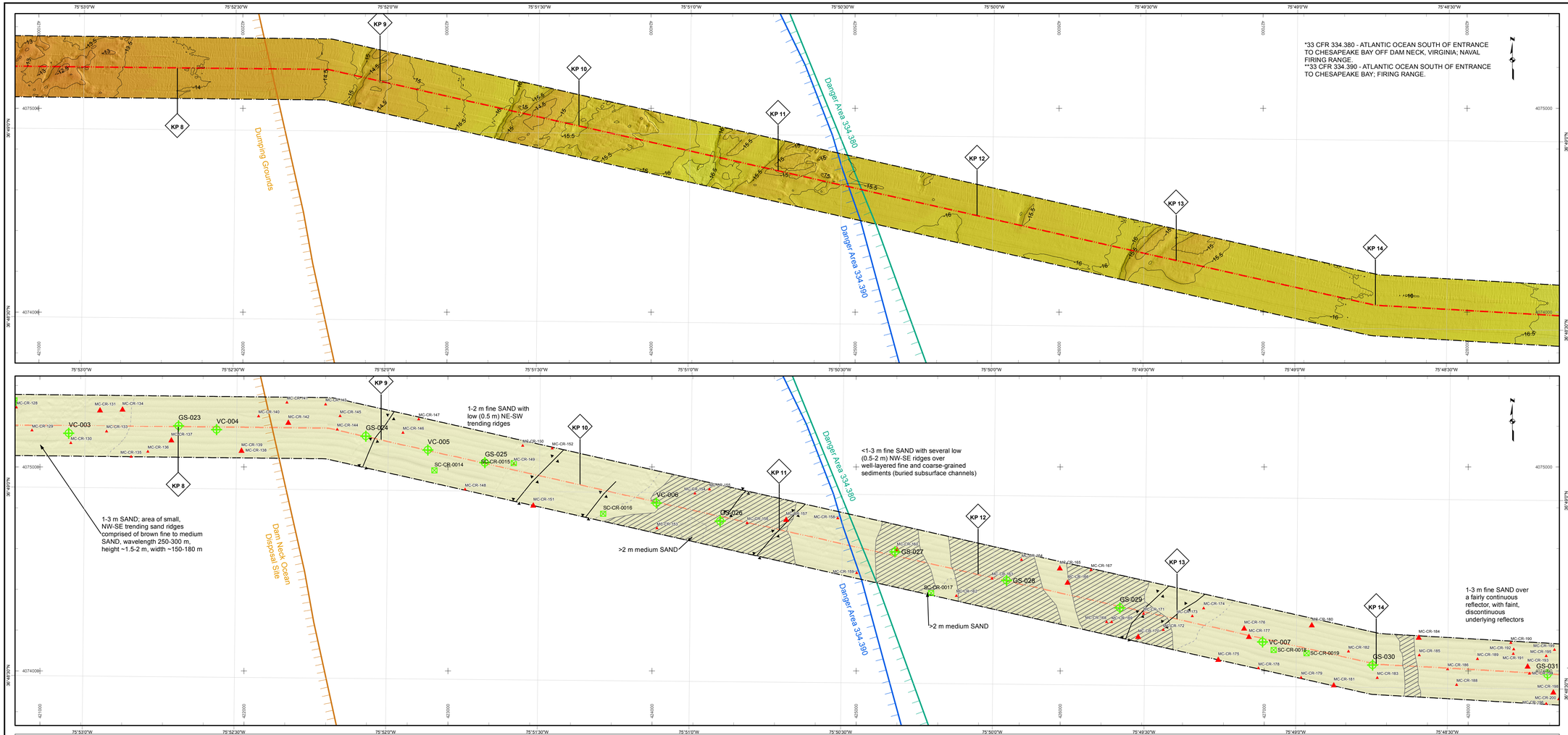

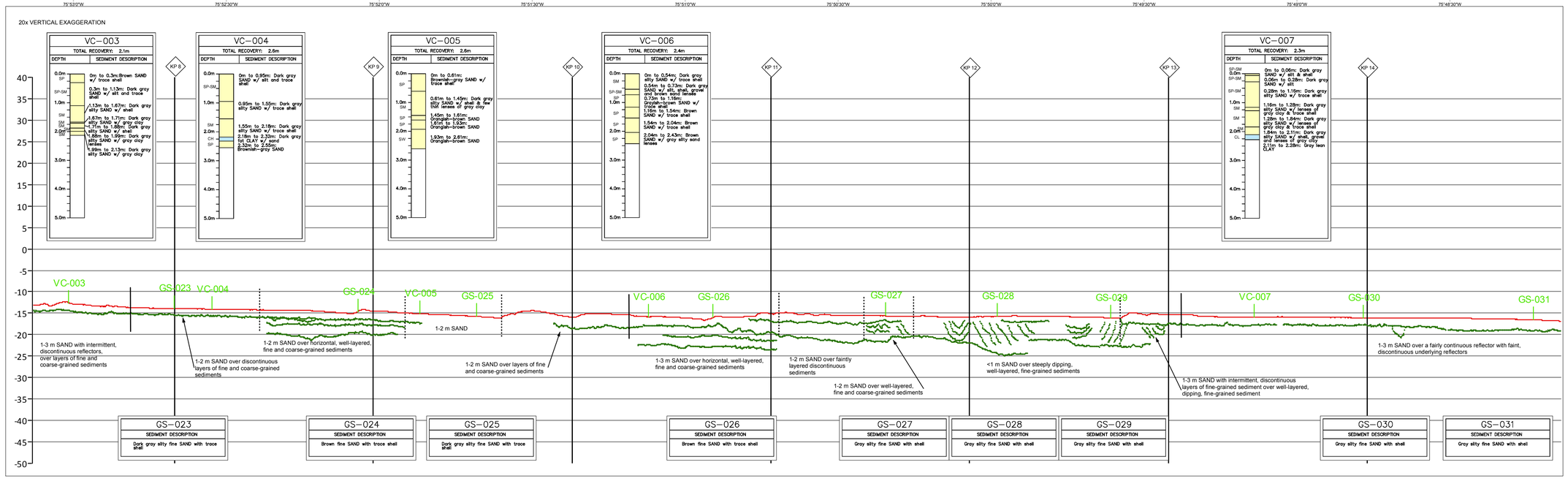

L E G E N D

- 0.5m Contour
- Seabed Sample Location with reference number
  - GS (Grab Sample)
  - VC (Vibra Core)
  - PC (Piston Core)
- Sonar Contacts
- Mag Target (<10nT)
- Mag Target (>10nT)
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- Very coarse-grained sediment (GRAVEL)
- Subsurface Channels

Reflectivity

- Low
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Sidescan sonar imagery semi-transparent below interpreted surface sediments

- Feature or Sediment Boundary
- Sand Ridge
- Channel
- Survey Centerline
- Maritime Boundaries
- Dam Neck Ocean Disposal Site
- Danger Area 334.380*
- Danger Area 334.390**
- Survey Corridor

Profile Features

- Seabed
- Subsurface reflectors

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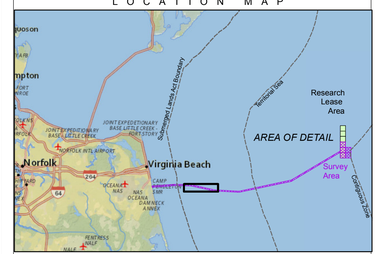
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



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Virginia Offshore Wind Technology Advancement Project

Alignment Sheet

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00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

MXD File Name:	Scale:	Size:	Plate:	Sheet Number:
Cable_Route_AS_2.mxd	1:10000	ARCH D	18	2 of 6

*33 CFR 334.380 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY OFF DAM NECK, VIRGINIA; NAVAL FIRING RANGE.
**33 CFR 334.390 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY; FIRING RANGE.

1-3 m fine SAND over a fairly continuous reflector, with faint, discontinuous underlying reflectors

2-4 m smooth to rippled, fine to medium SAND with low-relief (0.15-0.5 m) bathymetric features

>2 m rippled medium SAND

1-5 m smooth fine to medium SAND; broad bathymetric highs represent underlying sand ridges and sand sheets

20x VERTICAL EXAGGERATION

1-3 m SAND over a fairly continuous reflector with faint, discontinuous underlying reflectors

Uniform SAND, no visible reflectors

2-4 m SAND over fairly distinct reflector, possible erosional unconformity

4 m uniform SAND

1-3 m SAND over well-layered fine and coarse-grained sediments

VC–008	
TOTAL RECOVERY:	2.7m
DEPTH	SEDIMENT DESCRIPTION
0.0m	0m to 0.09m: Brownish-gray SAND
SP	
SM	0.09m to 0.79m: Dark gray silty SAND w/ trace shell
SP-SM	0.79m to 0.99m: Dark gray silty SAND w/ trace shell & lenses of dark gray silt
1.0m SP	0.99m to 1.12m: Dark gray silty SAND and brown shell
	1.12m to 1.76m: Brown SAND
SP	
2.0m ML	1.76m to 2.28m: Brown silty SAND w/ gravel
SP	2.28m to 2.34m: Gray peaty SILT
	2.34m to 2.66m: Gray SAND
3.0m	
4.0m	
5.0m	

VC–009	
TOTAL RECOVERY:	1.9m
DEPTH	SEDIMENT DESCRIPTION
0.0m SP	0m to 0.09m: Dark gray silty SAND w/ trace shell
SW-SM	0.09m to 0.4m: Dark grey SAND w/ gravel, shell & lenses of dark gray silt
SM	0.4m to 0.77m: Dark gray silty SAND w/ trace shell
1.0m SM	0.77m to 0.9m: Dark gray silty SAND w/ shell
SM	0.9m to 0.98m: Dark gray silty SAND w/ shell & lenses of gray clay
2.0m	0.98m to 1.16m: Dark gray silty SAND w/ shell
	1.16m to 1.31m: Dark gray silty SAND w/ shell & lenses of gray clay
3.0m	1.31m to 1.85m: Dark gray silty SAND w/ shell
4.0m	
5.0m	

GS–032	
SEDIMENT DESCRIPTION	
Dark gray medium SAND with silt and shell	

GS–033	
SEDIMENT DESCRIPTION	
Gray fine SAND with trace shell	

GS–034	
SEDIMENT DESCRIPTION	
Gray fine SAND with shell	

GS–035	
SEDIMENT DESCRIPTION	
Gray medium SAND with gravel and shell	

GS–036	
SEDIMENT DESCRIPTION	
Gray fine SAND with silt and shell	

GS–037	
SEDIMENT DESCRIPTION	
Gray fine SAND with silt and shell	

GS–038	
SEDIMENT DESCRIPTION	
Light brown fine SAND with trace	

GS–039	
SEDIMENT DESCRIPTION	
Brown fine SAND with trace shell	

L E G E N D

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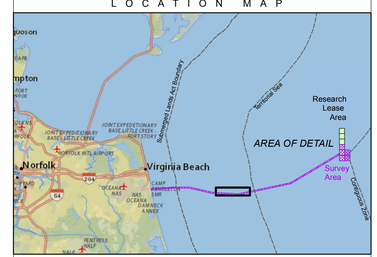
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



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Feet: 0 400 800 1,600 2,400 3,200

Dominion Resources, Inc.
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Glen Allen, VA 23060

Tetra Tech, Inc.
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Virginia Offshore Wind Technology Advancement Project

Alignment Sheet

Revision No.	Date	Description	Prepared by:	Checked by:	Approved by
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

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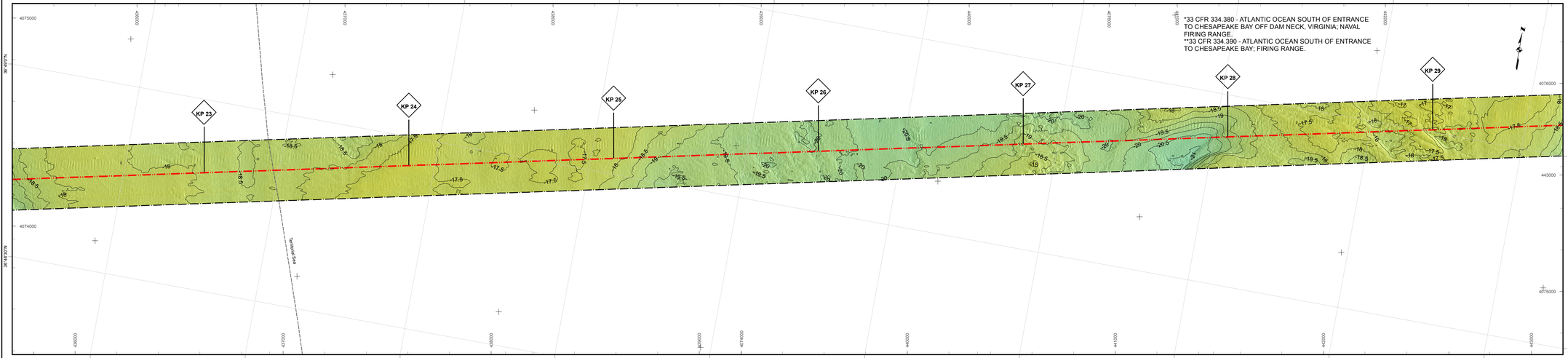
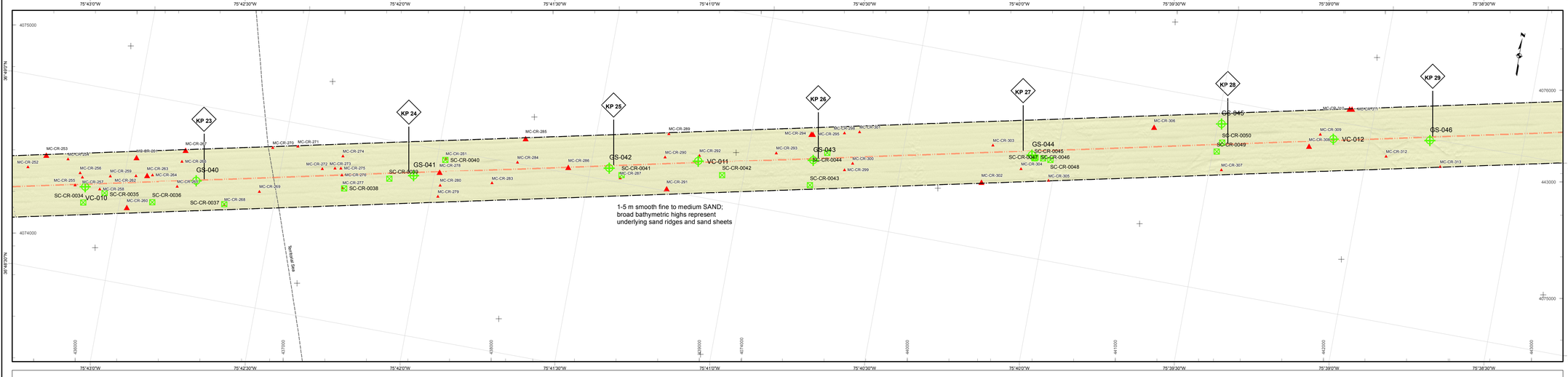
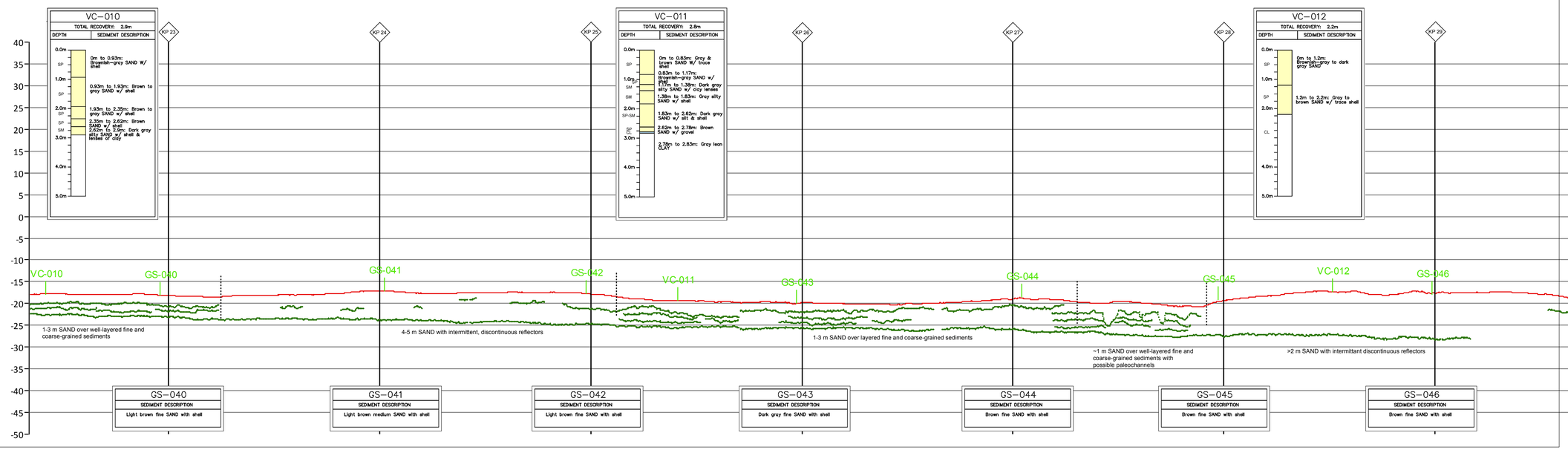




20x VERTICAL EXAGGERATION



L E G E N D

- 0.5m Contour
- Seabed Sample Location with reference number
  - GS (Grab Sample)
  - VC (Vibra Core)
  - PC (Piston Core)
- Sonar Contacts
- Mag Target (<10nT)
- Mag Target (>10nT)
- Fine-grained sediment (SILT/CLAY)
- Coarse-grained sediment (SAND)
- Very coarse-grained sediment (GRAVEL)
- Subsurface Channels

Reflectivity

- Low
- High

Sidescan sonar imagery semi-transparent below interpreted surface sediments

- Feature or Sediment Boundary
- Sand Ridge
- Channel
- Survey Centerline
- Maritime Boundaries
- Dam Neck Ocean Disposal Site
- Danger Area 334.380*
- Danger Area 334.390**
- Survey Corridor

Profile Features

- Seabed
- Subsurface reflectors

Elevation (m)

-7.4 - -7
-7.9 - -7.5
-8.4 - -8
-8.9 - -8.5
-9.4 - -9
-9.9 - -9.5
-10.4 - -10
-10.9 - -10.5
-11.4 - -11
-11.9 - -11.5
-12.4 - -12
-12.9 - -12.5
-13.4 - -13
-13.9 - -13.5
-14.4 - -14
-14.9 - -14.5
-15.4 - -15
-15.9 - -15.5
-16.4 - -16
-16.9 - -16.5
-17.4 - -17
-17.9 - -17.5
-18.4 - -18
-18.9 - -18.5
-19.4 - -19
-19.9 - -19.5
-20.4 - -20
-20.9 - -20.5
-21.4 - -21
-21.9 - -21.5
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-22.9 - -22.5
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-23.9 - -23.5
-24.4 - -24
-24.9 - -24.5
-25.4 - -25
-25.9 - -25.5
-26.4 - -26
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SURVEY NOTES

Survey dates	June 1 - June 28, 2013
Survey Vessel	R/V Sea Lion V
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Subsurface Positioning	IXBlue GAPS
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Bathymetry Sensor	RESON SeaBat 7125 SV2
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Magnetometer Sensor	Marine Magnetics SeaQuest
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Seismic System 1	AAE 300 Boomer
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Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
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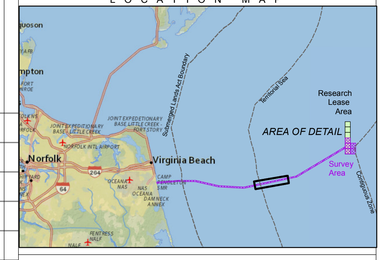
L O C A T I O N M A P



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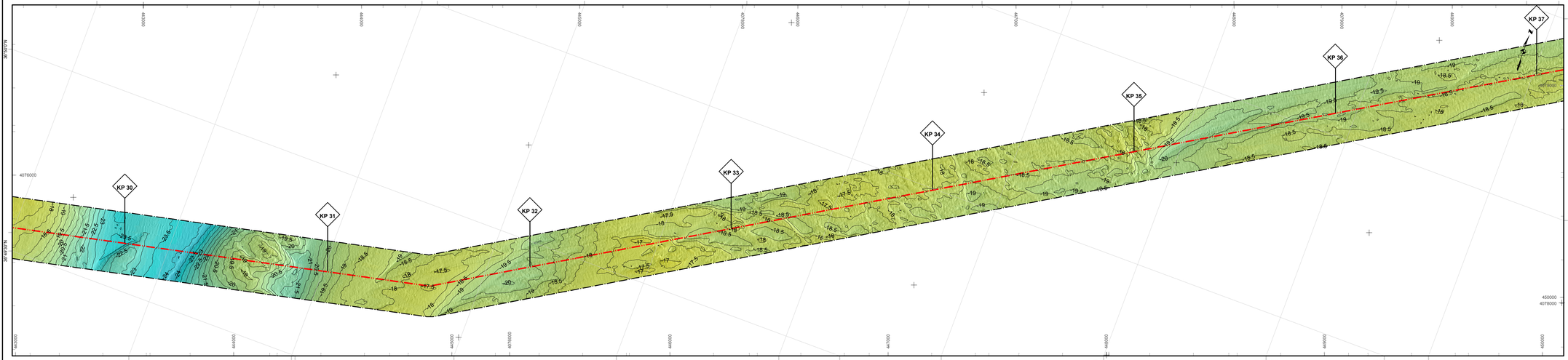
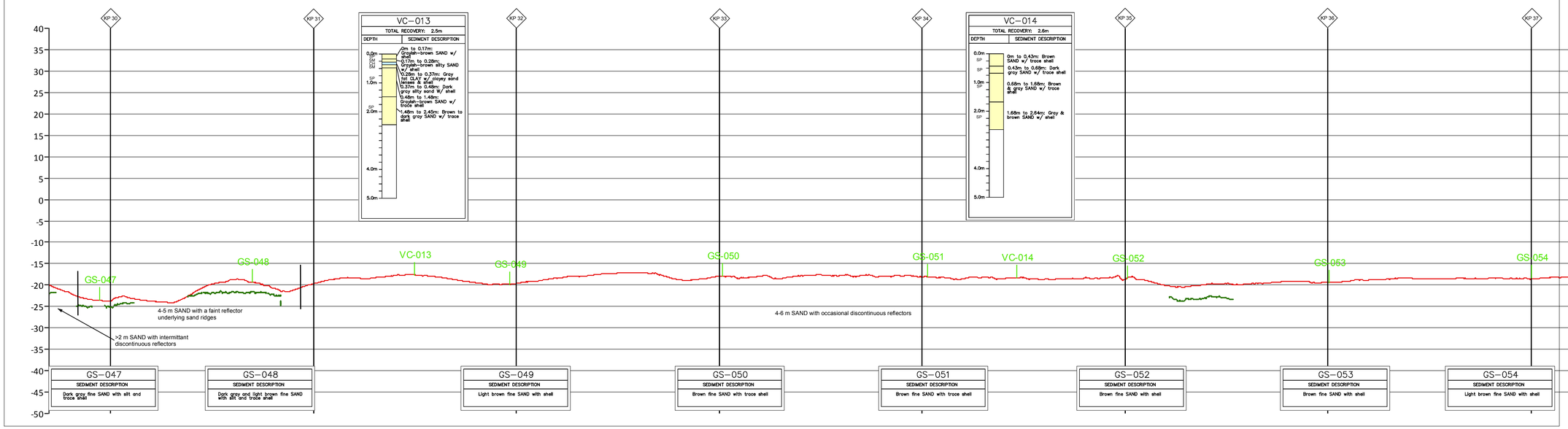


*33 CFR 334.380 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY OFF DAM NECK, VIRGINIA; NAVAL FIRING RANGE.
**33 CFR 334.390 - ATLANTIC OCEAN SOUTH OF ENTRANCE TO CHESAPEAKE BAY; FIRING RANGE.

20x VERTICAL EXAGGERATION



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-14.4 - -14
-14.9 - -14.5
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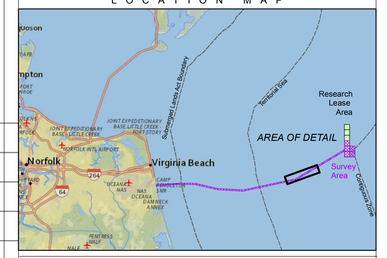

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MXD File Name: Cable_Route_AS_5.mxd	Scale: 1:10000	Size: ARCH D	Plate: 18	Sheet Number: 5 of 6

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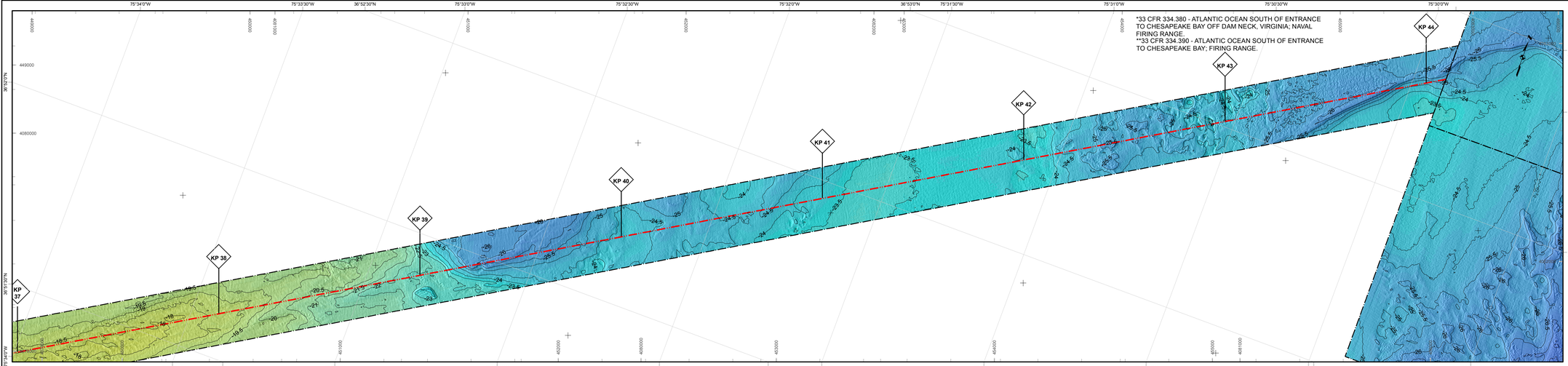

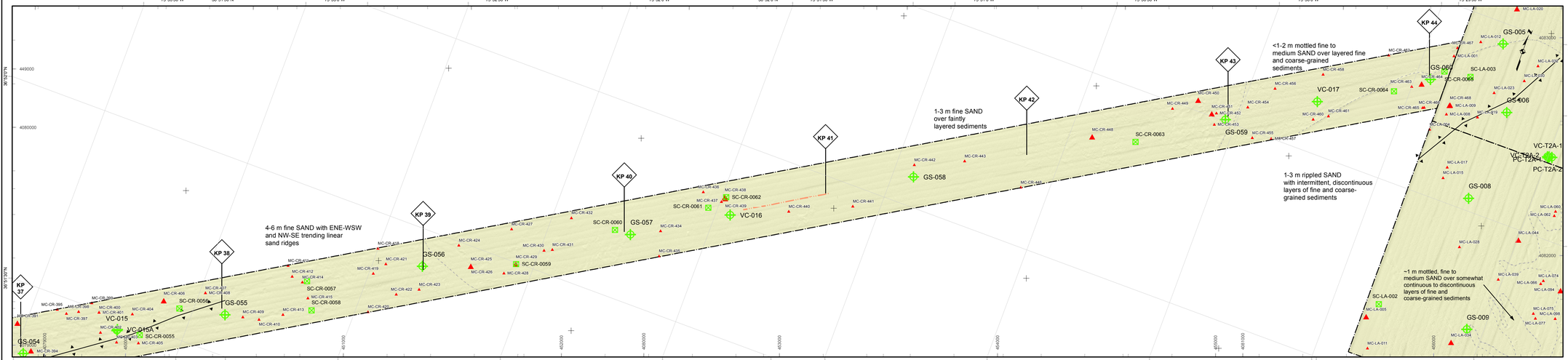

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L O C A T I O N M A P

SCALE 1:10,000

Meters: 0 125 250 500 750 1,000
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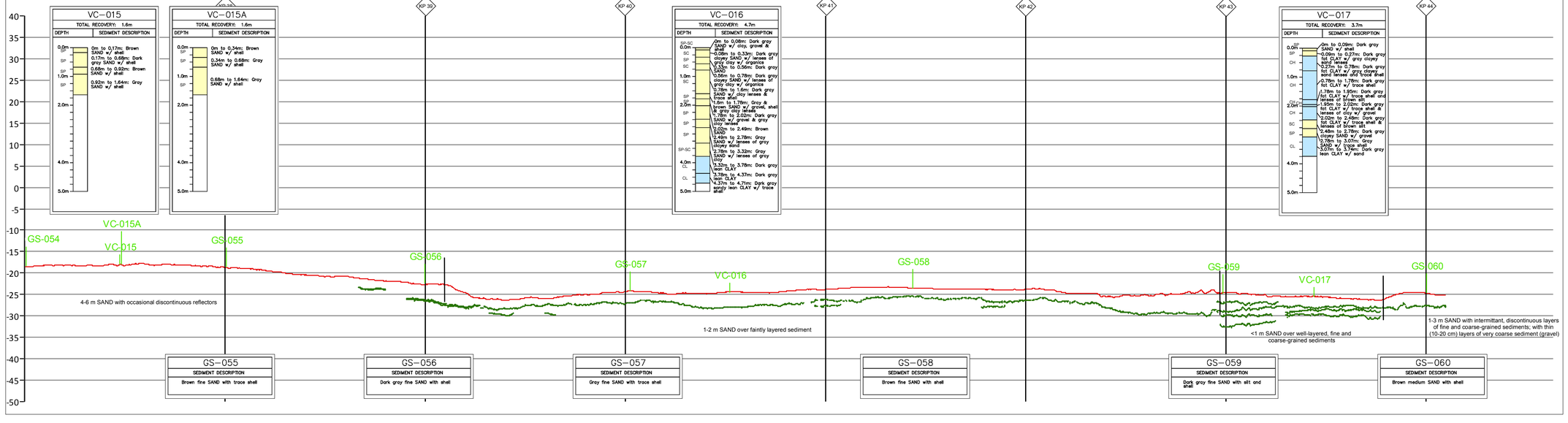

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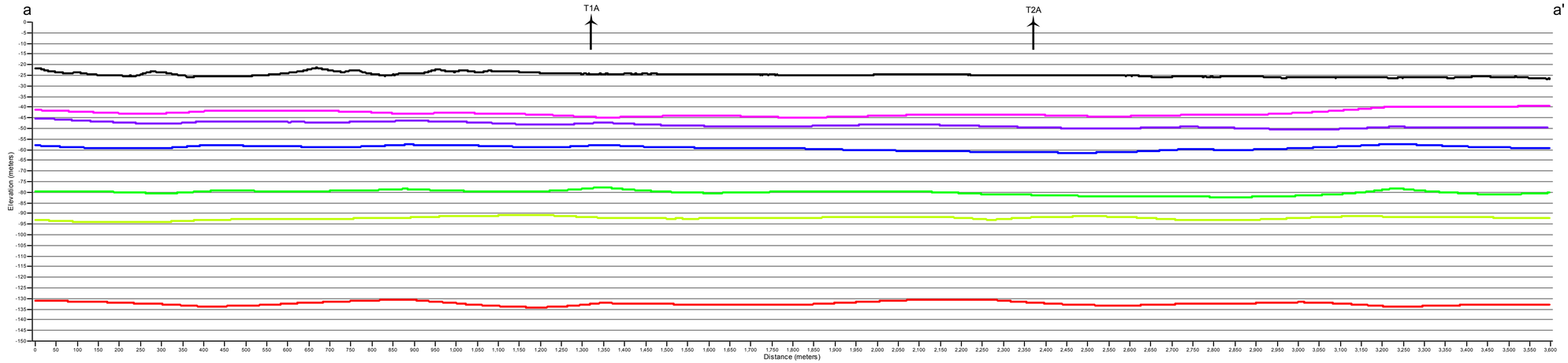
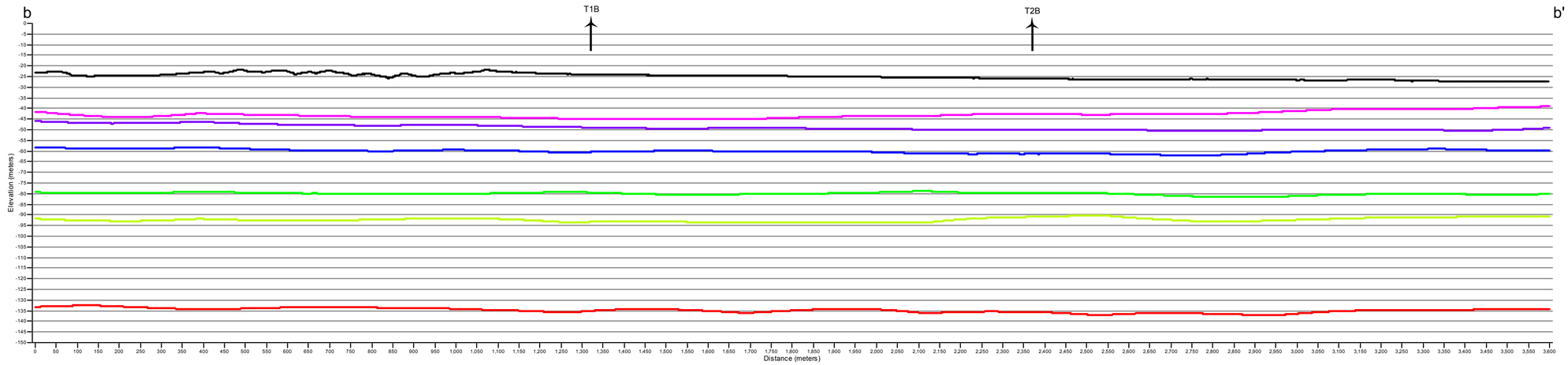
Cable_Route_AS_6.mxd	1:10000	ARCH D	18	6 of 6



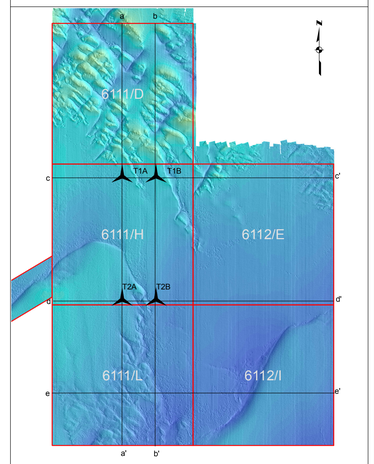


L E G E N D

Profile Features

- Seabed
- R1
- R2
- R3
- R4
- R5
- R6

Preliminary Turbine Site



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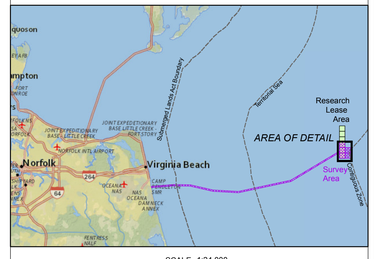

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Feet 0 750 1,500 3,000 4,500 6,000

Reflector	Unit	Depth (m) to top of reflector	Thickness of unit (m)	Description
	Seabed to R1			Surficial unconsolidated marine sediment (silt to fine sand)
R1		12-25	3-12	This reflector becomes shallower towards the south end of the survey area.
	R1-R2			Stiff clay unit?
R2		20-28	8-18	Nearly horizontal, continuous reflector, relatively high amplitude.
	R2-R3			Numerous, closely spaced reflectors that are possibly interbedded sands?
R3		32-34	19-37	Erosional angular unconformity that separates the Tertiary from overlying Quaternary sequences. This reflector is interpreted to be the top of the Yorktown Formation.
	R3-R4			Yorktown Formation – overconsolidated clay-sand unit; reflectors have a relative dip to the south of approximately 5 degrees (McClelland Engineering, 1963).
R4		50-64	8-14	Horizontal and continuous reflector that is the lower boundary of the angular unconformity
	R4-R5			Relatively low amplitude reflectors, possibly a stiff clay unit?
R5		63-74	34-41	Relatively high-amplitude, horizontal, continuous reflector
	R5-R6			Sequence of semicontinuous, high-amplitude reflectors; possibly sand and gravel sequence?
R6		104-112		High-amplitude continuous, horizontal acoustic reflector
	>R6-Bottom of record			Nearly reflection free, possibly semiconsolidated material resulting from depth of burial.

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SEISMIC PROFILES

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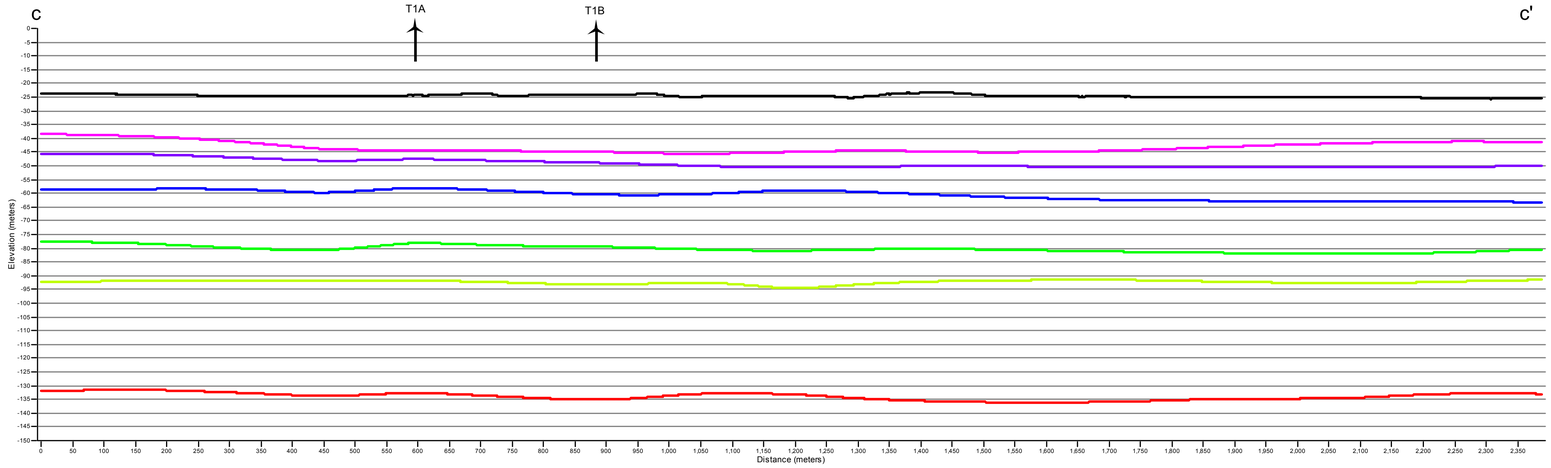

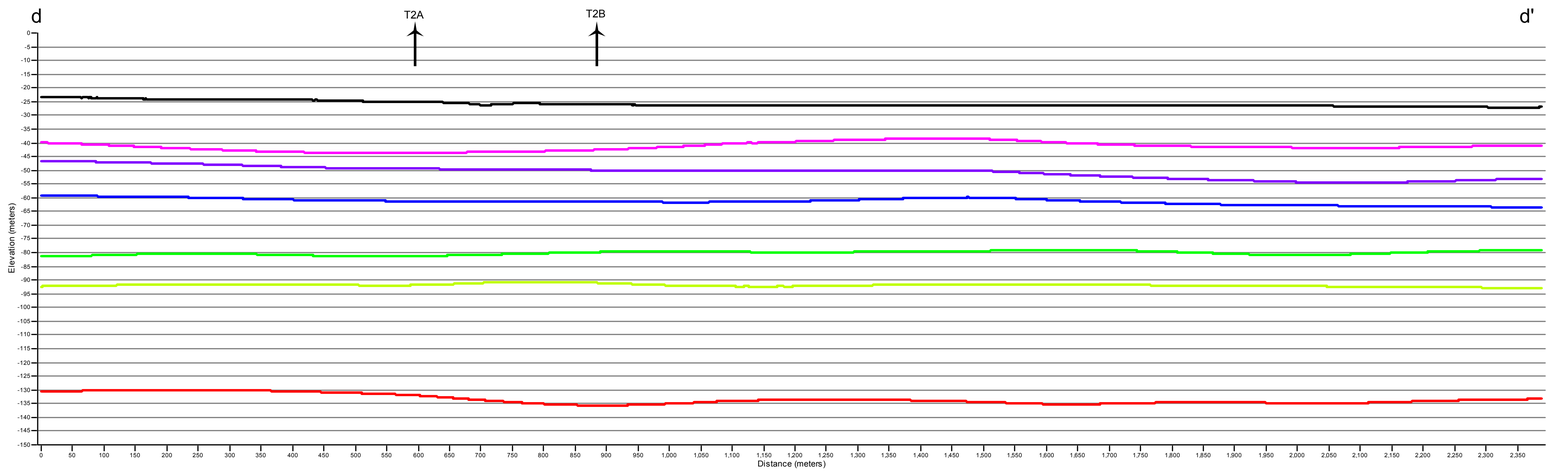

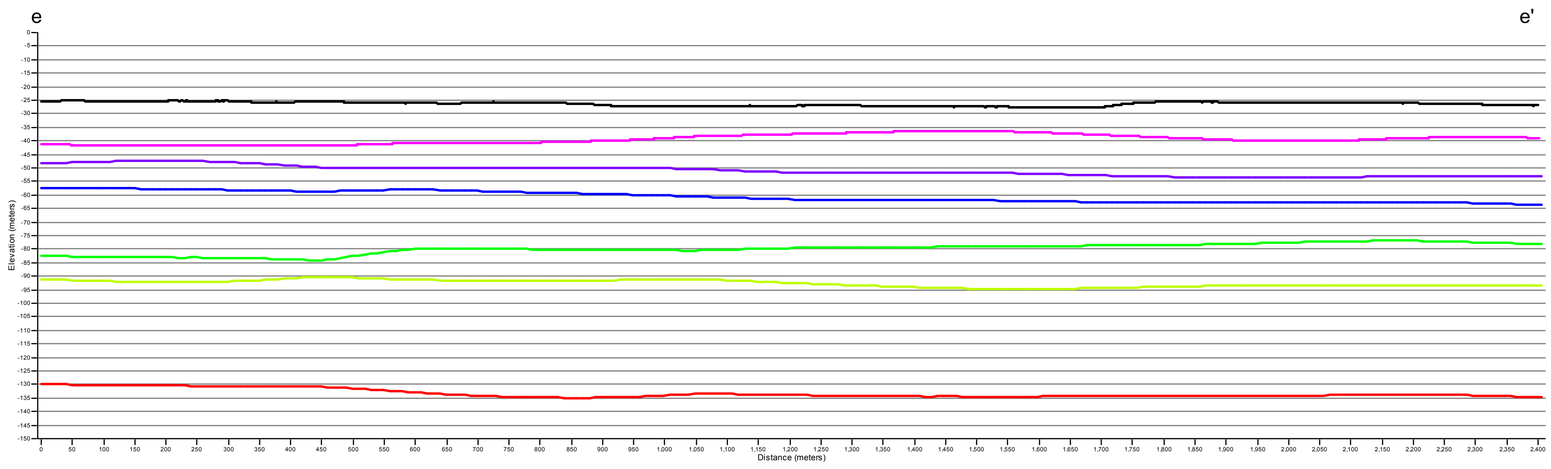

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	R5-R6			Sequence of semicontinuous, high-amplitude reflectors; possibly sand and gravel sequence?
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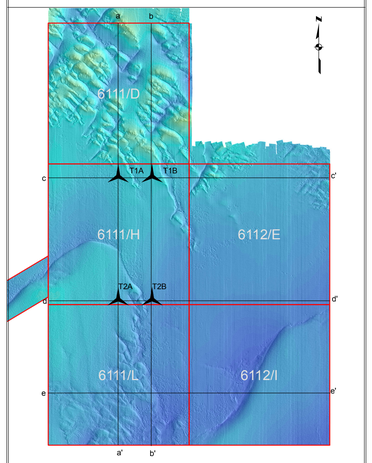

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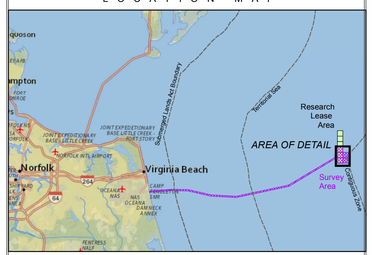
Heading/Motion Sensor	IXBlue PHINS 6000
Bathymetry Sensor	RESON SeaBat 7125 SV2
Sidescan Sonar Sensor	EdgeTech 2000-DSS 110 kHz/540 kHz
Sub-bottom Profiler	EdgeTech 2000-DSS 2-16 kHz
Magnetometer Sensor	Marine Magnetics SeaQuest
Sound Speed Profilers	Oceanscience UCTD
Seismic System 1	AAE 300 Boomer
Seismic System 2	Datasonic Bubble Pulser
RPL Issue	CableRoute_04222013 (DRAFT)

GEODETIC PARAMETERS

Horizontal Datum	NAD 83
Projection	UTM Zone 18 North
Horizontal Units	Meters
Vertical Units	Meters
Vertical Datum	MLLW EPOCH 1987-2001
GPS L1/L2 Corrections	Marine Star

L O C A T I O N M A P



SCALE 1:24,000

Meters 0 250 500 1,000 1,500 2,000

Feet 0 750 1,500 3,000 4,500 6,000

Dominion Resources, Inc.
5000 Dominion Boulevard
Glen Allen, VA 23060

Tetra Tech, Inc.
4101 Cox Road, Suite 120
Glen Allen, VA 23060
www.tetratech.com

Virginia Offshore Wind Technology Advancement Project

SEISMIC PROFILES

Revision No.	Date	Description	Prepared by:	Checked by:	Approved by:
00	10/17/13	Draft	MJW	JH	RJF
01	06/11/14	Final	MJW	JH	RJF

MXD File Name:	Vertical Exaggeration:	Size:	Plate:	Sheet Number:
Seismic_profiles_2.mxd	5x	ARCH D	19	2 of 2

Attachment D – Grab Sample Log

VOWTAP
File No.: 13-13-0084
Revision: 0 (ISSUED FOR USE)

TABLE A-1 SUMMARY OF GEOTECHNICAL TEST RESULTS ON GRAB SAMPLES

Grab Sample	Visual Description	Group Symbol	Organic Content (%)	Particle-Size Distribution (dry mass basis)							Water Content, w_c (%)								Total Unit Weight, γ_t (lb/ft^3)				Dry Density, γ_d (lb/ft^3)				Saturation, S (%); G_s= 2.66			Comments
				Speciman Mass (grams)	Maximum Particle Size (inch)	Gravel-Size (%)	Sand-Size (%)			Silt- & Clay-Size (%)	Bag Sample				0.14 liter Containers				0.14 liter Containers				0.14 liter Containers				0.14 liter Containers			
							Coarse	Medium	Fine		SA Specimen	OC Specimen	SA and OC Average	Average Corrected for NaCl	Top	Middle	Bottom	Average	Top	Middle	Bottom	Average	Top	Middle	Bottom	Average	Top	Middle	Bottom	
GS-001	Grayish-brown sand with shell	SP	0.3	399.04	< 3/4	0.9	0.8	56.9	40.2	1.2	22.1	22.3	22.2	22.4	18.2	17.9	18.4	18.2	104.2	125.7	122.6	117.5	88.1	106.7	103.6	99.5	55	86	81	
GS-002	Grayish-brown sand with shell	SP	0.4	125.26	< 3/16	0.0	0.1	4.5	93.0	2.4	31.0	30.6	30.8	31.1	23.4	22.8	25.9	24.0	114.5	106.1	113.6	111.4	92.8	86.4	90.2	89.8	79	66	82	
GS-003	Grayish-brown sand with shell	SP	0.4	661.46	< 3/4	2.1	1.6	83.2	12.1	1.0	19.3	19.0	19.2	19.3	19.3	18.1	17.5	18.3	128.3	125.0	117.2	123.5	107.5	105.8	99.7	104.3	94	85	70	
GS-004	Gray sand with silt and shell	SP-SM	0.6	156.84	< 3/16	0.0	0.1	1.2	93.3	5.4	35.6	35.5	35.6	36.0	29.2	27.6	29.3	28.7	110.9	112.4	114.8	112.7	85.8	88.1	88.8	87.6	83	83	90	
GS-005	Brown sand with shell	SP	0.3	880.54	< 3/4	1.1	1.3	67.5	29.0	1.1	21.5	20.8	21.2	21.3	19.7	18.5	18.2	18.8	114.5	108.6	116.1	113.1	95.7	91.7	98.2	95.2	71	61	70	
GS-006	Brown sand with shell	SP	0.4	834.20	< 3/4	2.8	6.8	53.9	35.5	1.0	18.8	18.6	18.7	18.8	19.0	18.2	17.7	18.3	120.0	113.5	116.1	116.5	100.8	96.1	98.7	98.5	78	66	69	
GS-007	Gray sand with silt and shell	SP-SM	0.7	248.66	< 3/8	0.2	0.1	2.6	91.2	5.9	34.1	35.5	34.8	35.2	28.2	26.0	28.6	27.6	116.4	108.4	119.4	114.7	90.8	86.1	92.8	89.9	90	74	96	
GS-008	Brown sand with shell	SP	0.3	512.63	< 3/4	1.2	5.1	58.7	34.0	1.0	20.1	20.1	20.1	20.2	18.3	17.6	17.5	17.8	121.6	108.0	113.9	114.5	102.8	91.8	96.9	97.2	79	58	65	
GS-009	Brown sand with shell	SP	0.3	235.86	< 3/16	0.0	0.5	42.8	55.3	1.4	20.6	21.7	21.2	21.3	19.6	19.2	20.5	19.8	115.7	120.1	116.1	117.3	96.7	100.7	96.4	97.9	73	79	75	
GS-010	Dark gray sand with trace shell	SP	0.5	215.73	< 3/4	0.1	0.2	1.2	94.7	3.8	29.8	29.4	29.6	29.9	24.6	26.3	26.6	25.8	119.8	113.6	109.8	114.4	96.1	90.0	86.7	90.9	90	83	77	
GS-011	Dark gray sand with silt and shell	SP-SM	0.6	248.00	< 3/8	0.1	0.1	0.9	93.3	5.6	32.8	33.3	33.1	33.4	32.7	31.9	29.3	31.3	105.2	116.9	108.0	110.0	79.3	88.7	83.5	83.8	79	97	79	[1]
GS-012	Gray sand with shell	SP	0.5	308.10	< 3/8	0.0	0.1	3.6	93.8	2.5	23.8	23.7	23.8	23.9	26.5	29.7	25.4	27.2	111.0	104.4	117.6	111.0	87.8	80.5	93.8	87.4	79	74	88	[1]
GS-013	Brown sand with shell	SP	0.3	665.38	< 3/4	13.2	13.5	57.3	14.9	1.1	16.0	13.6	14.8	14.9	16.1	14.9	15.5	15.5	123.8	126.3	127.8	126.0	106.6	110.0	110.6	109.1	77	78	82	
GS-014	Gray sandy lean clay with shell	CL	2.3	209.50	< 3/8	0.7	0.6	6.8	27.0	64.9	44.1	46.4	45.3	46.0	37.7	42.5	38.9	39.7	110.2	114.1	111.1	111.8	80.0	80.0	80.0	80.0	93	105	96	[4]
GS-015	Gray sand with silt and shell	SP-SM	0.6	215.80	< 3/8	0.1	0.1	0.6	92.5	6.7	35.3	34.5	34.9	35.3	31.2	30.1	31.2	30.8	116.8	114.9	109.5	113.7	89.0	88.3	83.4	86.9	96	91	84	
GS-016	Gray silty sand with shell	SM	0.7	138.09	< 3/8	0.4	0.1	0.6	78.8	20.1	36.0	35.3	35.7	36.1	28.0	30.2	32.3	30.2	116.8	108.7	113.8	113.1	91.2	83.5	86.0	86.9	91	81	92	
GS-017	Gray silty sand with shell	SM	0.6	141.90	< 3/16	0.0	0.1	0.4	87.3	12.2	37.0	34.6	35.8	36.3	28.8	28.2	29.9	29.0	114.7	112.7	116.2	114.5	89.1	87.9	89.5	88.8	89	84	93	
GS-018	Gray silty sand with shell	SM	0.6	145.87	< 3/16	0.0	0.1	0.5	86.8	12.6	32.9	34.1	33.5	33.9	26.2	29.5	32.2	29.3	110.9	115.1	117.0	114.3	87.9	88.9	88.5	88.4	78	90	98	
GS-019	Gray silty sand with shell	SM	0.5	148.02	< 3/16	0.0	0.2	0.3	86.9	12.6	32.6	30.6	31.6	32.0	32.2	31.6	31.6	31.8	114.9	118.3	118.0	117.1	86.9	89.9	89.7	88.8	94	99	99	
GS-020	Dark gray silty sand with trace shell	SM	0.7	182.74	< 3/16	0.0	0.1	1.9	84.1	13.9	32.7	32.9	32.8	33.2	27.7	32.2	32.3	30.7	110.7	112.0	112.5	111.7	86.7	84.7	85.0	85.5	80	89	90	
GS-021	Light brown sand with trace shell	SP	0.2	158.94	< 3/8	0.3	0.4	3.1	94.9	1.3	25.8	26.1	26.0	26.2	24.9	25.2	24.4	24.8	112.1	118.5	117.1	115.9	89.7	94.6	94.1	92.8	78	89	85	[1]
GS-022	Brown sand with shell	SP	0.3	547.22	< 1½	4.6	8.0	50.2	36.1	1.1	19.6	20.3	20.0	20.1	15.0	18.9	20.8	18.2	108.4	117.6	122.1	116.0	94.2	98.9	101.1	98.1	52	74	86	
GS-023	Dark gray silty sand with trace shell	SM	1.4	147.00	< 3/16	0.0	0.1	0.5	72.7	26.7	49.0	48.9	49.0	49.8	43.0	38.7	35.1	38.9	109.4	113.1	92.3	104.9	76.5	81.6	68.3	75.5	98	99	65	
GS-024	Brown sand with trace shell	SP	0.4	505.65	< 3/8	0.2	0.2	29.5	67.8	2.3	24.2	24.6	24.4	24.6	22.4	22.7	21.4	22.2	118.9	108.9	112.0	113.3	97.2	88.7	92.3	92.7	84	69	71	
GS-025	Dark gray silty sand with trace shell	SM	0.7	204.90	< 3/16	0.0	0.0	0.2	82.6	17.2	33.7	33.5	33.6	34.0	29.7	31.4	33.8	31.6	117.2	104.2	116.4	112.6	90.4	79.2	86.9	85.5	94	76	99	
GS-026	Brown sand with trace shell	SP	0.5	598.66	< 3/8	0.1	0.2	17.5	77.5	4.7	27.4	26.3	26.9	27.1	20.9	23.8	25.9	23.5	111.4	109.1	113.3	111.3	92.1	88.1	90.0	90.1	69	72	82	
GS-027	Gray silty sand with shell	SM	0.8	139.88	< 3/16	0.0	0.8	0.4	83.7	15.1	34.6	34.5	34.6	35.0	28.9	29.5	29.1	29.2	113.5	116.3	114.8	114.9	88.1	89.8	88.9	88.9	87	92	89	
GS-028	Gray silty sand with shell	SM	0.6	145.19	< 3/8	0.1	0.1	0.2	84.5	15.1	34.4	34.3	34.4	34.8	29.8	27.4	30.7	29.3	117.9	115.3	108.7	114.0	90.9	90.5	83.2	88.2	96	87	82	
GS-029	Gray silty sand with shell	SM	0.8	394.34	< 3/8	0.1	0.1	1.0	85.6	13.2	34.8	34.8	34.8	35.2	27.9	27.6	29.7	28.4	106.7	109.8	103.7	106.7	83.4	86.1	79.9	83.1	75	79	73	
GS-030	Gray silty sand with shell	SM	0.8	293.28	< 3/16	0.0	0.1	0.2	84.5	15.2	35.4	35.0	35.2	35.6	26.2	31.6	24.9	27.6	115.2	109.8	109.8	111.6	91.3	83.4	87.9	87.5	85	85	74	
GS-031	Gray silty sand with shell	SM	0.6	238.23	< 3/8	0.1	0.1	0.2	84.1	15.5	37.8	39.1	38.5	39.0	30.6	32.9	33.2	32.2	113.7	105.4	113.8	111.0	87.1	79.3	85.4	83.9	90	80	93	
GS-032	Dark gray sand with silt and shell	SP-SM	1.2	612.84	< 3/4	12.3	25.5	44.9	9.2	8.1	21.4	24.7	23.1	23.2	15.9	15.6	16.3	15.9	127.7	126.2	121.3	125.1	110.2	109.1	104.4	107.9	83	79	73	
GS-033	Gray sand with trace shell	SP	0.2	631.35	< 1½	14.3	3.4	34.2	46.0	2.1	20.4	22.2	21.3	21.5	19.6	17.6	17.9	18.4	120.7	101.0	119.8	113.8	100.9	85.8	101.6	96.1	81	50	75	
GS-034	Gray sand with shell	SP	0.4	249.18	< 3/8	0.0	0.3	18.8	78.7	2.2	25.5	26.5	26.0	26.2	24.4	22.9	21.8	23.0	124.0	109.8	114.0	115.9	99.7	89.4	93.6	94.2	98	71	75	
GS-035	Gray sand with gravel and shell	SP	0.3	819.47	<1	20.7	24.3	32.8	17.3	4.9	12.7	13.2	13.0	13.0	14.1	12.0	11.6	12.6	122.7	122.2	123.4	122.8	107.5	109.0	110.5	109.0	69	61	61	
GS-036	Gray sand with silt and shell	SP-SM	0.5	683.73	<1	22.3	12.5	28.9	30.2	6.1	17.2	18.7	18.0	18.1	20.1	18.6	14.2	17.6	123.7	134.5	137.2	131.8	103.0	113.4	120.2	112.2	87	107	99	
GS-037	Gray sand with silt and shell	SP-SM	0.8	502.12	< 3/4	13.0	10.0	31.9	39.1	6.0	22.6	23.2	22.9	23.1	21.7	23.3	18.3	21.1	115.9	119.3	131.4	122.2	95.3	96.8	111.1	101.1	78	87	98	
GS-038	Light brown sand with trace shell	SP	0.4	185.56	< 3/8	0.2	0.2	31.8	66.6	1.2	23.1	23.0	23.1	23.2	23.6	22.5	24.1	23.4	116.2	109.7	112.0	112.6	94.1	89.6	90.3	91.3	82	70	76	
GS-039	Brown sand with trace shell	SP	0.4	177.06	< 3/16	0.0	0.1	17.3	81.1	1.5	26.4	26.6	26.5	26.7	23.2	25.2	25.1	24.5	118.4	108.6	115.4	114.1	96.1	86.7	92.3	91.7	85	73	84	
GS-040	Light brown sand with shell	SP	0.3	496.23	< 3/8	2.4	8.6	38.2	49.9	0.9	20.2	20.2	20.2	20.3	16.5	17.3	17.5	17.1	128.1	115.7	125.8	123.2	110.0	98.6	107.1	105.2	86	67	85	[1]
GS-041	Light brown sand with shell	SP	0.3	593.42	< 1	6.5	9.5	43.7	39.5	0.8	18.3	17.3	17.8	17.9	15.7	16.4	15.3	15.8	108.6	131.4	131.6	123.9	93.8	112.8	114.1	106.9	54	92	89	
GS-042	Light brown sand with shell	SP	0.3	574.73	< 1½	4.0	4.6	45.2	45.3	0.9	21.9	22.2	22.1	22.2	18.9	21.0	18.3	19.4	120.5	120.1	123.6	121.4	101.3	99.2	104.5	101.7	79	83	83	[1]
GS-043	Dark gray sand with shell	SP	0.4	620.86	< 1½	3.3	4.0	21.0	71.5	0.2	24.8	23.8	24.3	24.5	20.8	21.4	19.0	20.4	116.5	122.8	117.1	118.8	96.4	101.2	98.4	98.7	77	89	73	[1]
GS-044	Brown sand with shell	SP	0.3	214.43	< 3/4	0.7	0.5	26.5	71.2	1.1	24.1	25.1	24.6	24.8	23.1	24.0	21.8	23.0	123.1	123.8	116.3	121.1	100.0	99.9	95.9	98.6	93	96	79	[1]
GS-045	Brown sand with shell	SP	0.4	237.31	< 3/16	0.0	0.0	3.0	96.0	1.0	28.0	27.7	27.9	28.1	23.3	22.7	24.2	23.4	112.7	117.8	103.6	111.4	91.4	96.0	83.4	90.3	76	83	65	
GS-046	Brown sand with shell	SP	0.4	276.57	< 3/8	0.1	0.1	9.5	89.2	1.1	28.2	28.7	28.5	28.7	22.1	26.1	20.3	22.8	121.6	122.1	125.4	123.0	99.6	96.8	104.3	100.2	88	97	91	
GS-047	Dark gray sand with silt and trace shell	SP-SM	0.8	208.11	< 3/8	0.1	0.4	4.0	88.3	7.2	31.9	31.9	31.9	32.3	41.1	29.9	27.9	33.0	110.2	113.6	107.4	110.4	78.1	87.4	84.0	83.2	97	88	76	
GS-048	Dark gray and light brown sand with trace shell	SP	0.4	272.98	< 3/8	0.1	1.1	32.1	64.5	2.2	25.6	25.6	25.6	25.8	20.1	23.1	37.8	27.0	124.7	113.9	109.2	115.9	103.8	92.5	79.3	91.9	89	77	92	[1]
GS-049	Light brown sand with shell	SP	0.4	627.06	< 1½	2.7	0.8	17.2	79.2	0.1	24.4	24.6	24.5	24.7	28.6	21.8	21.4	23.9	113.8	112.4	119.4	115.2	88.5	92.3	98.4	93.1	87	73	83	
GS-050	Brown sand with trace shell	SP	0.2	210.75	< 3/8	0.0	0.2	14.1	84.6	1.1	26.0	25.6	25.8	26.0	24.7	23.0	20.4	22.7	122.7	118.1	118.0	119.6	98.4	96.0	98.0	97.5	96	84	78	
GS-051	Brown sand with trace shell	SP	0.2	318.04	< 3/8	0.5	1.9	26.1	70.4	1.1	24.5	24.1	24.3	24.5	20.9	24.1	20.0	21.7	115.6	107.6	121.0	114.7	95.6	86.6	100.9	94.4	75	70	82	
GS-052	Brown sand with shell	SP	0.5	319.36	< 3/16	0.0	0.1	6.1	91.0	2.8	32.9	33.3	33.1	33.5	32.0	23.6	24.4	26.7	102.2	115.0	117.9	111.7	77.4	93.0	94.8	88.4	74	80	86	[1]
GS-053	Brown sand with shell	SP	0.2	352.12	< 3/4	0.5	0.4	7.6	90.2	1.3	28.0	28.8	28.4	28.7	22.5	22.9	22.5	22.6	116.2	111.6	122.6	116.8	94.8	90.8	100.1	95.2	80	73	91	
GS-054	Light brown sand with shell	SP	0.2	613.80	< 1½	12.2	4.7	27.2	55.1	0.8	19.6	20.2	19.9	20.0	24.0	22.0	20.5	22.2	116.5	113.1	120.9	116.8	93.9	92.7	100.4	95.7	83	74	83	[2]
GS-055	Brow sand with trace shell	SP	0.3	308.54	< 3/8	0.1	0.2	6.4	92.2	1.1	25.5	25.0	25.3	25.5	21.3	23.4	23.5	22.7	114.5	112.1	114.3	113.6	94.4	90.8	92.5	92.6	75	75	79	[1]
GS-056	Dark gray sand with shell	SP	0.6	510.39	< 3/8	0.3	1.5	26.2	68.8	3.2	28.6	28.6	28.6	28.9	38.0	23.1	25.5	28.9	92.8	112.1	116.4	107.1	67.3	91.1	92.8	83.7	69	75	86	
GS-057	Gray sand with trace shell	SP	0.3	227.76	< 3/8	0.3	0.6	39.7	58.2	1.2	24.1	23.8	24.0	24.2	21.2	19.4	20.7	20.4	119.1	116.4	114.4	116.6	98.2	97.5	94.7	96.8	82	73	73	
GS-058	Brown sand with shell	SP	0.3	466.70	< 3/8	0.2	1.1	39.4	58.2	1.1	24.2	24.2	24.2	24.4	22.4	19.7	19.7	20.6	116.0	108.2	105.6	109.9	94.8	90.4	88.2	91.1	79	63	59	
GS-059	Dark gray sand with silt and shell	SP-SM	0.6	319.49	< 3/4	1.9	1.5	6.4	84.5	5.7	36.3	35.2	35.8	36.2	34.2	26.6	21.6	27.5	109.7	115.3	118.6	114.5	81.7	91.1	97.5	90.1	88	86	82	
GS-060	Brown sand with shell	SP	0.3	565.47	< 1½	3.6	6.1	52.2	37.2	0.9	18.6	19.3	19.0	19.1	19.5	17.8	17.5	18.3	106.2	102.0	102.2	103.5	88.8	86.6	87.0	87.5	60	52	51	
GS-REF-001	Gray silty sand with shell	SM	0.6	156.98	< 3/16	0.0	0.2	0.3	86.8	12.7	37.2	36.3	36.8	37.2																
GS-REF-002	Dark gray silty sand with trace shell	SM	0.6	495.89	< 3/8	0.1	0.1	0.3	87.2	12.3	37.3	37.3	37.3	37.8																
GS-REF-003	Gray silty sand with shell	SM	0.8	256.53	< 3/8	0.8	0.2	1.2	79.8	18.0	34.6	35.9	35.3	35.7																[1]
GS-REF-004	Dark gray sand with trace shell	SP	0.3	331.62	< 3/8	0.4	2.9	67.8	28.0	0.9	18.6	17.4	18.0	18.1																[3]
GS-REF-005	Light brown sand	SP	0.4	253.63	< 3/8	0.1	0.1	2.4	95.3	2.1	31.4	31.2	31.3	31.6																
GS-REF-006	Brown sand with shell	SP	0.2	442.74	< 3/4	1.8	2.1	26.9	68.1	1.1	22.7	25.3	24.0	24.2																
GS-REF-007	Dark gray sand with shell	SP	0.5	236.30	< 3/8	0.1	0.3	2.5	93.1	4.0	33.4	34.3	33.9	34.3																
GS-REF-008	Gray sand with shell	SP	0.5	235.12	< 3/16	0.0	0.0	0.5	95.2	4.3	29.2	29.9	29.6	29.9																
GS-REF-009	Gray sand with silt and shell	SP-SM	0.8	266.22	< 3/4	0.6	0.1	0.4	92.6	6.3	37.1	36.6	36.9	37.3																

Notes: 1. Group symbol in accordance with ASTM Standard D2487 "Classification of Soils for Engineering Purposes (Unified Soil Classification System)".
2. Organic content in accordance with ASTM Standard D2974 "Moisture, Ash and Organic Matter of Peat and Other Organic Soils" , Method C (loss on ignition at 440°C).
3. Water content in accordance with ASTM Standard D2216 "Laboratory Determination of water (Moisture) Content of Soil and Rock by Mass" , Method B (107°C).
4. Particle-size distribution in accordance with ASTM Standard D422 "Particle-Size Analysis of Soils" using sieve analysis or ASTM Standard D6913 "Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis".
Gravel-size: retained on No. 4 sieve (0.185"); Coarse sand-size: passing No. 4 sieve and retained on No. 10 sieve (0.078"); Medium sand-size: passing No. 10 sieve and retained on No. 40 sieve (0.0164"); Fine sand-size: passing No. 40 sieve and retained on No. 200 sieve (0.0029"); Silt- and clay-size: passing No. 200 sieve.
5. Total unit weight and dry density determined on 140 cc aluminum tare samples by weighing as-received samples and drying entire sample in 107°C oven. Fixed volume of tare for calculations equalled 137.67 cc based on average measured volume with water on eight randomly selected tares (standard deviation = 0.28 cc).
6. Water content corrected for salt water concentration of 34,800 mg/l.
7. Saturation back-calculated from measured water contents and dry densities using assumed mineral specific gravity of 2.66.

Comments: [1] Plastic bag with bulk sample displayed evidence of minor leakage. Measured water contents on sieve analysis (SA) and organic content (OC) test specimens may be slightly lower than water content when sampled.
[2] Excluding one 4" x 6" shell (58.9 grams)
[3] Excluding one 2" x 3-3/4" shell (65.4 grams)
[4] Atterberg limits (ASTM Standard D4318, Method A): LL= 34; PL= 17; PI= 17. Carbonate content (ASTM Standard D4373):$CaCO_3$=8.1%.

Attachment E – Core Logs

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)			
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)		
		GW	Well-graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)		
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)		
		SW	Well-graded sands, gravelly sands, little or no fines
		SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)		
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)			
SILTS AND CLAYS Liquid limit less than 50%		ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

2. HOLE NUMBER: VC-T1A-1A
LOCATION COORDINATES: N 4,083,480.7 E 456,169.0

3. DRILLING AGENCY: TETRA TECH, INC.

4. NAME OF DRILLER: -------

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED
DEG FROM VERTICAL: -----
BEARING: -----

6. THICKNESS OF OVERBURDEN (m): -----

7. DEPTH DRILLED INTO ROCK (m): -----

8. TOTAL DEPTH OF BORING (m): 2.3

9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:

10. SIZE AND TYPE OF BIT: VIBRACORE

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

12. TOTAL SAMPLES: 3
DISTURBED:
UNDISTURBED:

13. TOTAL NUMBER CORE BOXES: 0

14. DEPTH GROUND WATER: -----

15. DATE BORING: STARTED 6/22/2013 COMPLETED 6/22/2013

16. ELEVATION TOP OF BORING:

17. TOTAL CORE RECOVERY FOR BORING (m): 2.16

18. SIGNATURE AND TITLE OF INSPECTOR:

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class
	0.1		**0m to 0.12m:** Gray sand with trace shell	1A	21.2						SP
	0.3		**0.12m to 0.27m:** Brown sand with shell	1B	4.8						SP
	0.7		**0.27m to 0.69m:** Brownish-gray sand with trace shell	2A	14.3	2.7		1.8			SP
	1.3		**0.69m to 1.27m:** Gray sand with shell	2B	11.6						SP
	1.7		**1.27m to 1.68m:** Gray sand with shell	3A	20.4						SP
	2.3		**1.68m to 2.27m:** Dark gray fat clay with trace shell	3B	66.2	97.1	2.8		64	38	CH

REMARKS

Mudline Elevation=24.5 m (MLLW)

Legend patterns correspond to ASTM Group Symbol Classification.
WC(%) = water content
-200(%) = percent fines
OC (%) = organic content
CC (%) = carbonate content
LL = liquid limit
PI = plasticity index

ACE 1836-A DRILLING LOG - LVC TURBINE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

9. COORDINATE SYSTEM | HORIZONTAL | VERTICAL

10. SIZE AND TYPE OF BIT: VIBRACORE

2. HOLE NUMBER: VC-T1A-2A | LOCATION COORDINATES: N 4,083,492.2 E 456,201.7

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

3. DRILLING AGENCY: TETRA TECH, INC.

12. TOTAL SAMPLES: 5 | DISTURBED | UNDISTURBED

4. NAME OF DRILLER: -------

13. TOTAL NUMBER CORE BOXES: 0

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED | DEG FROM VERTICAL: ----- | BEARING: -----

14. DEPTH GROUND WATER: -----

15. DATE BORING | STARTED: 6/23/2013 | COMPLETED: 6/23/2013

6. THICKNESS OF OVERBURDEN (m): -----

16. ELEVATION TOP OF BORING

7. DEPTH DRILLED INTO ROCK (m): -----

17. TOTAL CORE RECOVERY FOR BORING (m): 4.58

8. TOTAL DEPTH OF BORING (m): 4.7

18. SIGNATURE AND TITLE OF INSPECTOR

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory: WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
			0m to 0.56m: Brownish-gray sand with shell	1A	10.0						SP	Mudline Elevation=24.4 m (MLLW)
	0.6											
			0.56m to 0.87m: Gray sand with trace shell	1B	22.8	4.9					SP	
	0.9											
			0.87m to 1.06m: Brown sand	2A	12.0						SP	
	1.1											
	1.2		**1.06m to 1.15m:** Brown sand with shell	2B							SP	
			1.15m to 1.34m: Gray sand	2C	22.9						SP	
	1.3											
			1.34m to 1.72m: Gray fat clay	2D	63.2		3.2		59	35	CH	
	1.7											
			1.72m to 2.69m: Gray fat clay with trace shell	3	65.1	96.7	2.8	1.4	60	35	CH	
	2.7											
			2.69m to 2.89m: Gray fat clay with trace shell	4A	59.8						CH	
	2.9											
			2.89m to 3.55m: Gray clayey sand	4B	29.2						SC	
	3.6											
	3.7		**3.55m to 3.69m:** Gray sand	4C	17.0						SP	
	3.8		**3.69m to 3.75m:** Gray clayey sand	5A							SC	
			3.75m to 4.64m: Brownish-gray sand with lenses of gray fat clay	5B	14.7	13.5	0.8				SP	
	4.6											
	4.7		**4.64m to 4.69m:** Gray sand	5C	15.3						SP	

ACE 1836-A (DRILLING LOG) - LVC TURBINE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

2. HOLE NUMBER: VC-T1B-1

LOCATION COORDINATES: N 4,083,474.9 E 456,523.6

3. DRILLING AGENCY: TETRA TECH, INC.

4. NAME OF DRILLER: -------

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: -----; BEARING: -----

6. THICKNESS OF OVERBURDEN (m): -----

7. DEPTH DRILLED INTO ROCK (m): -----

8. TOTAL DEPTH OF BORING (m): 4.8

9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:

10. SIZE AND TYPE OF BIT: VIBRACORE

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

12. TOTAL SAMPLES: 5; DISTURBED: ; UNDISTURBED:

13. TOTAL NUMBER CORE BOXES: 0

14. DEPTH GROUND WATER: -----

15. DATE BORING: STARTED 6/23/2013; COMPLETED 6/23/2013

16. ELEVATION TOP OF BORING:

17. TOTAL CORE RECOVERY FOR BORING (m): 4.30

18. SIGNATURE AND TITLE OF INSPECTOR:

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.8		**0m to 0.81m:** Dark gray sand with silt and trace shell	1	22.8	9.4		4.3			SP-SM	Mudline Elevation=24.0 m (MLLW)
	1.7		**0.81m to 1.66m:** Dark gray sand with trace shell	2A	18.1	2.6		1.7			SP	
	1.8		**1.66m to 1.81m:** Dark gray sand	2B	25.6						SP	
	2.8		**1.81m to 2.81m:** Gray sand with silt and trace shell	3	21.6	5.2		2.3			SP-SM	
	3.8		**2.81m to 3.81m:** Dark gray sand with silt and trace shell	4	22.9	5.0	0.5				SP-SM	
	4.1		**3.81m to 4.12m:** Gray sand with shell	5A	24.1						SP	
	4.4		**4.12m to 4.4m:** Brownish-gray sand with shell	5B	11.4	1.3		5.1			SP	
	4.8		**4.4m to 4.81m:** Gray sand with shell	5C	20.3						SP	

ACE 1836-A (DRILLING LOG) - LVC_TURBINE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

9. COORDINATE SYSTEM | HORIZONTAL | VERTICAL

10. SIZE AND TYPE OF BIT: VIBRACORE

2. HOLE NUMBER: VC-T1B-2 | LOCATION COORDINATES: N 4,083,498.4 E 456,487.1

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

3. DRILLING AGENCY: TETRA TECH, INC.

12. TOTAL SAMPLES: 4 | DISTURBED | UNDISTURBED

4. NAME OF DRILLER: -------

13. TOTAL NUMBER CORE BOXES: 0

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED | DEG FROM VERTICAL: ----- | BEARING: -----

14. DEPTH GROUND WATER: -----

15. DATE BORING | STARTED: 6/23/2013 | COMPLETED: 6/23/2013

6. THICKNESS OF OVERBURDEN (m): -----

16. ELEVATION TOP OF BORING

7. DEPTH DRILLED INTO ROCK (m): -----

17. TOTAL CORE RECOVERY FOR BORING (m): 3.40

8. TOTAL DEPTH OF BORING (m): 4.0

18. SIGNATURE AND TITLE OF INSPECTOR

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory: WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.8		**0m to 0.84m:** Gray sand with shell	1	21.3	3.5					SP	Mudline Elevation=23.9 m (MLLW)
	1.8		**0.84m to 1.84m:** Gray to dark gray sand with trace shell	2	22.1	4.3	0.5	1.7			SP	
	2.8		**1.84m to 2.84m:** Dark gray sand with silt and shell	3	24.5	5.6					SP-SM	
	3.4		**2.84m to 3.36m:** Gray sand with shell	4A	24.4						SP	
	4.0		**3.36m to 3.97m:** Dark gray and brown sand with silt and shell	4B	20.4	5.4	0.6	6.3			SP-SM	

ACE 1836-A (DRILLING LOG) - LVC TURBINE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

9. COORDINATE SYSTEM | HORIZONTAL | VERTICAL

10. SIZE AND TYPE OF BIT: VIBRACORE

2. HOLE NUMBER: VC-T2A-1 | LOCATION COORDINATES: N 4,082,423.9 E 456,192.9

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

3. DRILLING AGENCY: TETRA TECH, INC.

12. TOTAL SAMPLES: 5 | DISTURBED | UNDISTURBED

4. NAME OF DRILLER: -------

13. TOTAL NUMBER CORE BOXES: 0

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED | DEG FROM VERTICAL: ----- | BEARING: -----

14. DEPTH GROUND WATER: -----

15. DATE BORING | STARTED: 6/23/2013 | COMPLETED: 6/23/2013

6. THICKNESS OF OVERBURDEN (m): -----

16. ELEVATION TOP OF BORING

7. DEPTH DRILLED INTO ROCK (m): -----

17. TOTAL CORE RECOVERY FOR BORING (m): 4.46

8. TOTAL DEPTH OF BORING (m): 5.1

18. SIGNATURE AND TITLE OF INSPECTOR

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory: WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.3		**0m to 0.26m:** Brown sand with shell	1A	11.3	0.9					SP	Mudline Elevation=24.9 m (MLLW)
	0.4		**0.26m to 0.4m:** Dark gray sand with shell and lenses of gray sandy clay	1B	22.1		0.6				SP	
	0.5			1C							SP	
			0.4m to 0.46m: Brown sand with shell	1D	20.9	3.1					SP	
	1.2		**0.46m to 1.16m:** Dark gray sand with shell									
	1.3		**1.16m to 1.33m:** Brownish-gray sand with shell and silt lenses	2A	10.2						SP-SM	
	2.2		**1.33m to 2.16m:** Dark gray sand with silt, shell and lenses of clayey sand	2B	21.5	11.1	0.7	3.6			SP-SM	
	3.2		**2.16m to 3.16m:** Brownish-gray sand with silt and trace shell	3	21.7	5.4		1.5			SP-SM	
	3.5		**3.16m to 3.47m:** Gray silty sand	4A	23.9						SM	
	3.6		**3.47m to 3.6m:** Brown sandy gravel	4B	14.7						GP	
	3.7		**3.6m to 3.73m:** Gray silty sand	4C							SM	
	3.8		**3.73m to 3.77m:** Brown sandy gravel	4D							GP	
	3.8		**3.77m to 3.82m:** Gray silty sand with lenses of gray lean clay	4E	26.5						SM	
				4F	26.8	92.9	2.0	6.0	27	10	CL	
	4.2		**3.82m to 4.16m:** Dark gray lean clay with trace shell									
	5.1		**4.16m to 5.11m:** Dark gray silty clay with sand and trace shell	5	23.7	85.0	1.7	6.6	24	7	CL-ML	

ACE 1836-A (DRILLING LOG) - LVC TURBINE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:

10. SIZE AND TYPE OF BIT: VIBRACORE

2. HOLE NUMBER: VC-T2A-2 | LOCATION COORDINATES: N 4,082,430.3 E 456,197.0

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

3. DRILLING AGENCY: TETRA TECH, INC.

12. TOTAL SAMPLES: 3 | DISTURBED: | UNDISTURBED:

4. NAME OF DRILLER: -------

13. TOTAL NUMBER CORE BOXES: 0

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED | DEG FROM VERTICAL: ----- | BEARING: -----

14. DEPTH GROUND WATER: -----

15. DATE BORING | STARTED: 6/23/2013 | COMPLETED: 6/23/2013

6. THICKNESS OF OVERBURDEN (m): -----

16. ELEVATION TOP OF BORING:

7. DEPTH DRILLED INTO ROCK (m): -----

17. TOTAL CORE RECOVERY FOR BORING (m): 2.86

8. TOTAL DEPTH OF BORING (m): 3.1

18. SIGNATURE AND TITLE OF INSPECTOR:

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory: WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.3		**0m to 0.27m:** Brown sand with shell	1A	3.3						SP	Mudline Elevation=24.93 m (MLLW)
	1.1		**0.27m to 1.07m:** Dark gray sand with trace shell and gray sandy clay lenses	1B	19.6	3.8					SP	
	1.2		**1.07m to 1.23m:** Brown sand with shell	2A	5.2						SP	
	1.6		**1.23m to 1.56m:** Dark gray sand with trace shell	2B	14.3						SP	
	1.6		**1.56m to 1.59m:** Dark gray sand with shell	2C	22.9	3.6	0.5	2.2			SP	
	2.1		**1.59m to 2.07m:** Dark gray sand with trace shell	2D	22.3						SP	
	3.0		**2.07m to 3.04m:** Gray to dark gray sand with shell	3A	22.7	4.0					SP	
	3.1		**3.04m to 3.07m:** Gray gravel with sand	3B							GP	

ACE 1836-A (DRILLING LOG) - LVC TURBINE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

2. HOLE NUMBER: VC-T2B-1

LOCATION COORDINATES: N 4,082,496.0 E 456,495.7

3. DRILLING AGENCY: TETRA TECH, INC.

4. NAME OF DRILLER: -------

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED | DEG FROM VERTICAL: ----- | BEARING: -----

6. THICKNESS OF OVERBURDEN (m): -----

7. DEPTH DRILLED INTO ROCK (m): -----

8. TOTAL DEPTH OF BORING (m): 4.8

9. COORDINATE SYSTEM | HORIZONTAL | VERTICAL

10. SIZE AND TYPE OF BIT: VIBRACORE

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

12. TOTAL SAMPLES: 5 | DISTURBED | UNDISTURBED

13. TOTAL NUMBER CORE BOXES: 0

14. DEPTH GROUND WATER: -----

15. DATE BORING: STARTED 6/23/2013 | COMPLETED 6/23/2013

16. ELEVATION TOP OF BORING

17. TOTAL CORE RECOVERY FOR BORING (m): 3.70

18. SIGNATURE AND TITLE OF INSPECTOR

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory: WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.3		**0m to 0.3m:** Dark gray sand with silt and shell	1A	24.3						SP-SM	Mudline Elevation=25.9 m (MLLW)
	0.6		**0.3m to 0.56m:** Brown gravel with sand	1B	4.7	0.7					GP	
	0.8		**0.56m to 0.79m:** Gray sand with gravel	1C	17.1						SP	
	1.0		**0.79m to 0.97m:** Gray sand with gravel	2A	7.7						SP	
	1.8		**0.97m to 1.79m:** Dark gray lean clay with lenses of gray silt	2B	31.0	94.3	2.4	3.7	35	17	CL	
	2.7		**1.79m to 2.67m:** Dark gray lean clay with lenses of silt and clayey sand	3A	35.3	95.2	3.5		30	14	CL	
	2.7		**2.67m to 2.72m:** Dark gray clayey sand	3B							SC	
	2.8		**2.72m to 2.79m:** Dark gray lean clay with lenses of gray silt and clayey sand	3C	32.4						CL	
	3.3		**2.79m to 3.32m:** Dark gray clay with lenses of silt and clayey sand	4A	36.4		2.5				CL	
	3.6		**3.32m to 3.55m:** Gray sand with silt and trace shell	4B	16.6	8.1					SP-SM	
	3.8		**3.55m to 3.79m:** Dark gray lean clay with lenses of sand and trace shell	4C	43.4	99.5		3.2	48	26	CL	
	4.1		**3.79m to 4.11m:** Dark gray sand with silt and lenses of brown clay	5A	28.3						SP-SM	
	4.8		**4.11m to 4.75m:** Gray silty sand with shell	5B	17.9	14.0					SM	

ACE 1836-A (DRILLING LOG) - LVC TURBINE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

Boring Designation VC-T2B-2

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT VOWTAP		9. COORDINATE SYSTEM	HORIZONTAL / VERTICAL
		10. SIZE AND TYPE OF BIT	VIBRACORE
2. HOLE NUMBER VC-T2B-2	LOCATION COORDINATES N 4,082,498.1 E 456,496.7	11. MANUFACTURER'S DESIGNATION OF DRILL	-----
3. DRILLING AGENCY TETRA TECH, INC.		12. TOTAL SAMPLES 5	DISTURBED / UNDISTURBED
4. NAME OF DRILLER -------		13. TOTAL NUMBER CORE BOXES	0
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL ----- / BEARING -----	14. DEPTH GROUND WATER	-----
		15. DATE BORING	STARTED 6/23/2013 / COMPLETED 6/23/2013
6. THICKNESS OF OVERBURDEN (m) -----		16. ELEVATION TOP OF BORING	
7. DEPTH DRILLED INTO ROCK (m) -----		17. TOTAL CORE RECOVERY FOR BORING (m)	4.67
8. TOTAL DEPTH OF BORING (m) 4.7		18. SIGNATURE AND TITLE OF INSPECTOR	

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.7		**0m to 0.74m:** Gray sand with trace shell	1A	18.7						SP	Mudline Elevation=25.9 m (MLLW)
	0.8		**0.74m to 0.8m:** Gray sand with trace shell (coarser than above)	1B	11.2	3.2		1.7			SP	
	1.4		**0.8m to 1.44m:** Brownish-gray sand with silt and shell	2A	23.3	6.1					SP-SM	
	1.7		**1.44m to 1.73m:** Gray to white gravel with sand and shell and lenses of gray sandy clay	2B	7.0	3.5					GP	
	1.8		**1.73m to 1.84m:** Gray clayey gravel with sand	3A							GC	
	2.0		**1.84m to 1.95m:** Gray lean clay	3B	29.6						CL	
	2.7		**1.95m to 2.67m:** Gray lean clay with trace organics	3C	28.8	92.4	2.5	5.6	32	14	CL	
	3.0		**2.67m to 2.98m:** Gray lean clay with lenses of sandy clay (with evidence of disturbance)	4A	26.9						CL	
	3.4		**2.98m to 3.35m:** Gray sand with shell	4B	18.7	2.5					SP	
	3.7		**3.35m to 3.67m:** Dark gray lean clay	4C	27.8						CL	
	3.7		**3.67m to 3.73m:** Dark gray lean clay	5A							CL	
	4.1		**3.73m to 4.06m:** Gray sand with shell	5B	17.8	2.9					SP	
	4.1		**4.06m to 4.11m:** Dark gray lean clay with organics	5C	44.9		3.4				CL	
	4.4		**4.11m to 4.44m:** Dark gray lean clay	5D	41.6	99.9			43	22	CL	
	4.7		**4.44m to 4.67m:** Dark gray silty sand with lenses of gray lean clay	5E	20.5						SM	

ACE 1836-A (DRILLING LOG) - LVC TURBINE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

9. COORDINATE SYSTEM | HORIZONTAL | VERTICAL

10. SIZE AND TYPE OF BIT: VIBRACORE

2. HOLE NUMBER: VC-001 | LOCATION COORDINATES: N 4,075,017.6 E 416,227.0

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

3. DRILLING AGENCY: TETRA TECH, INC.

12. TOTAL SAMPLES: 2 | DISTURBED: 2 | UNDISTURBED: 0

4. NAME OF DRILLER: -------

13. TOTAL NUMBER CORE BOXES: 0

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED | DEG FROM VERTICAL: ----- | BEARING: -----

14. DEPTH GROUND WATER: -----

15. DATE BORING | STARTED: 6/27/2013 | COMPLETED: 6/27/2013

6. THICKNESS OF OVERBURDEN (m): -----

16. ELEVATION TOP OF BORING

7. DEPTH DRILLED INTO ROCK (m): -----

17. TOTAL CORE RECOVERY FOR BORING (m): 0.94

8. TOTAL DEPTH OF BORING (m): 1.1

18. SIGNATURE AND TITLE OF INSPECTOR

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory: WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class
	0.6		**0m to 0.58m:** Dark gray silty sand with trace shell	1	22.5	15.1					SM
	1.1		**0.58m to 1.07m:** Dark gray silty sand	2	22.4	21.6		2.1			SM

REMARKS

Mudline Elevation=8.1 m (MLLW)

Legend patterns correspond to ASTM Group Symbol Classification.
WC(%) = water content
-200(%) = percent fines
OC (%) = organic content
CC (%) = carbonate content
LL = liquid limit
PI = plasticity index

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

2. HOLE NUMBER: VC-001A

LOCATION COORDINATES: N 4,075,014.3 E 416,219.0

3. DRILLING AGENCY: TETRA TECH, INC.

4. NAME OF DRILLER: -------

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: -----; BEARING: -----

6. THICKNESS OF OVERBURDEN (m): -----

7. DEPTH DRILLED INTO ROCK (m): -----

8. TOTAL DEPTH OF BORING (m): 2.4

9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:

10. SIZE AND TYPE OF BIT: VIBRACORE

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

12. TOTAL SAMPLES: 3; DISTURBED: 3; UNDISTURBED: 0

13. TOTAL NUMBER CORE BOXES: 0

14. DEPTH GROUND WATER: -----

15. DATE BORING: STARTED 6/27/2013; COMPLETED 6/27/2013

16. ELEVATION TOP OF BORING:

17. TOTAL CORE RECOVERY FOR BORING (m): 2.20

18. SIGNATURE AND TITLE OF INSPECTOR:

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory: IWC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.4		**0m to 0.41m:** Gray silty sand with trace shell	1	24.3	14.3	0.6				SM	Mudline Elevation=8.1 m (MLLW)
	1.4		**0.41m to 1.41m:** Gray silty sand with trace shell	2	23.0	13.7		1.6			SM	
	1.9		**1.41m to 1.91m:** Gray silty sand with trace shell	3A	25.3						SM	
	2.0		**1.91m to 1.95m:** Gray silty sand with gray clay lense	3B	63.4						SM	
	2.4		**1.95m to 2.41m:** Gray silty sand with trace shell	3C	23.2	14.3					SM	

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:

10. SIZE AND TYPE OF BIT: VIBRACORE

2. HOLE NUMBER: VC-002B

LOCATION COORDINATES: N 4,075,204.5 E 420,159.6

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

3. DRILLING AGENCY: TETRA TECH, INC.

12. TOTAL SAMPLES: 2 DISTURBED: 2 UNDISTURBED: 0

4. NAME OF DRILLER: -------

13. TOTAL NUMBER CORE BOXES: 0

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED

DEG FROM VERTICAL: ----- BEARING: -----

14. DEPTH GROUND WATER: -----

15. DATE BORING: STARTED 6/22/2013 COMPLETED 6/22/2013

6. THICKNESS OF OVERBURDEN (m): -----

16. ELEVATION TOP OF BORING:

7. DEPTH DRILLED INTO ROCK (m): -----

17. TOTAL CORE RECOVERY FOR BORING (m): 1.60

8. TOTAL DEPTH OF BORING (m): 1.7

18. SIGNATURE AND TITLE OF INSPECTOR:

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory: WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.4		**0m to 0.44m:** Brown sand with shell	1A	2.7	0.4					SP	Mudline Elevation=9.7 m (MLLW)
	0.8		**0.44m to 0.79m:** Brownish-gray sand with silt and trace shell	1B	18.1						SP-SM	
	1.0		**0.79m to 1m:** Dark gray sand with trace shell	1C	15.2						SP	
	1.0		**1m to 1.01m:** Dark gray silty sand with shell	2A	30.2						SM	
	1.2		**1.01m to 1.16m:** Dark gray to black silt	2B							ML	
	1.4		**1.16m to 1.44m:** Grayish-brown sand with trace shell	2C	21.7						SP	
	1.6		**1.44m to 1.61m:** Grayish-brown sand with gravel	2D	10.2	1.9		2.6			SP	
	1.7		**1.61m to 1.7m:** Dark gray silty sand with shell	2E	17.5						SM	

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

9. COORDINATE SYSTEM | HORIZONTAL | VERTICAL

10. SIZE AND TYPE OF BIT: VIBRACORE

2. HOLE NUMBER: VC-003 | LOCATION COORDINATES: N 4,075,165.2 E 421,142.0

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

3. DRILLING AGENCY: TETRA TECH, INC.

12. TOTAL SAMPLES: 2 | DISTURBED: 2 | UNDISTURBED: 0

4. NAME OF DRILLER: -------

13. TOTAL NUMBER CORE BOXES: 0

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED | DEG FROM VERTICAL: ----- | BEARING: -----

14. DEPTH GROUND WATER: -----

15. DATE BORING | STARTED: 6/22/2013 | COMPLETED: 6/22/2013

6. THICKNESS OF OVERBURDEN (m): -----

16. ELEVATION TOP OF BORING

7. DEPTH DRILLED INTO ROCK (m): -----

17. TOTAL CORE RECOVERY FOR BORING (m): 1.70

8. TOTAL DEPTH OF BORING (m): 2.1

18. SIGNATURE AND TITLE OF INSPECTOR

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory: WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
			0m to 0.3m: Brown sand with trace shell	1A	18.3						SP	Mudline Elevation=12.6 m (MLLW)
	0.3		**0.3m to 1.13m:** Dark gray sand with silt and trace shell	1B	20.9	8.9					SP-SM	
	1.1		**1.13m to 1.67m:** Dark gray silty sand with shell	2A	21.5	15.7	0.9	2.1			SM	
	1.7		**1.67m to 1.71m:** Dark gray silty sand with gray clay lenses	2B	21.8						SM	
	1.7			2C	21.7						SM	
	1.9		**1.71m to 1.88m:** Dark gray silty sand with shell	2D	25.3						SM	
	2.0		**1.88m to 1.99m:** Dark gray silty sand with gray clay lenses	2E	16.7						SM	
	2.1		**1.99m to 2.13m:** Dark gray silty sand with shell									

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT VOWTAP		9. COORDINATE SYSTEM	HORIZONTAL / VERTICAL
		10. SIZE AND TYPE OF BIT VIBRACORE	
2. HOLE NUMBER VC-004	LOCATION COORDINATES N 4,075,183.0 E 421,866.6	11. MANUFACTURER'S DESIGNATION OF DRILL -----	
3. DRILLING AGENCY TETRA TECH, INC.		12. TOTAL SAMPLES 3	DISTURBED 3 / UNDISTURBED 0
4. NAME OF DRILLER -------		13. TOTAL NUMBER CORE BOXES 0	
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL ----- / BEARING -----	14. DEPTH GROUND WATER -----	
		15. DATE BORING	STARTED 6/27/2013 / COMPLETED 6/27/2013
6. THICKNESS OF OVERBURDEN (m) -----		16. ELEVATION TOP OF BORING	
7. DEPTH DRILLED INTO ROCK (m) -----		17. TOTAL CORE RECOVERY FOR BORING (m) 1.87	
8. TOTAL DEPTH OF BORING (m) 2.6		18. SIGNATURE AND TITLE OF INSPECTOR	

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
			0m to 0.95m: Dark gray sand with silt and trace shell	1	23.8	10.8					SP-SM	Mudline Elevation=14.1 m (MLLW)
	1.0											
			0.95m to 1.55m: Dark gray silty sand with trace shell	2	26.0	31.2	1.1	2.1			SM	
	1.6											
			1.55m to 2.18m: Dark gray silty sand with trace shell	3A	23.1	19.4					SM	
	2.2											
	2.3		**2.18m to 2.32m:** Dark gray fat clay with sand	3B	49.9						CH	
			2.32m to 2.55m: Brownish-gray sand	3C	16.1						SP	
	2.6											

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

2. HOLE NUMBER: VC-005

LOCATION COORDINATES: N 4,075,083.5 E 422,901.6

3. DRILLING AGENCY: TETRA TECH, INC.

4. NAME OF DRILLER: -------

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: -----; BEARING: -----

6. THICKNESS OF OVERBURDEN (m): -----

7. DEPTH DRILLED INTO ROCK (m): -----

8. TOTAL DEPTH OF BORING (m): 2.6

9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:

10. SIZE AND TYPE OF BIT: VIBRACORE

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

12. TOTAL SAMPLES: 3; DISTURBED: 3; UNDISTURBED: 0

13. TOTAL NUMBER CORE BOXES: 0

14. DEPTH GROUND WATER: -----

15. DATE BORING: STARTED 6/27/2013; COMPLETED 6/27/2013

16. ELEVATION TOP OF BORING:

17. TOTAL CORE RECOVERY FOR BORING (m): 2.43

18. SIGNATURE AND TITLE OF INSPECTOR:

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.6		**0m to 0.61m:** Brownish-gray sand with trace shell	1	22.3	4.9	0.6				SP	Mudline Elevation=15.1 m (MLLW)
	1.5		**0.61m to 1.45m:** Dark gray silty sand with shell and few thin lenses of gray clay	2A	27.0	19.3					SM	
	1.6		**1.45m to 1.61m:** Orangish-brown sand	2B	15.3	1.3					SP	
	1.9		**1.61m to 1.93m:** Orangish-brown sand	3A	4.8						SP	
	2.6		**1.93m to 2.61m:** Orangish-brown sand	3B	11.7	3.0	0.4	0.2			SW	

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE_MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

2. HOLE NUMBER: VC-006

LOCATION COORDINATES: N 4,074,823.6 E 424,022.1

3. DRILLING AGENCY: TETRA TECH, INC.

4. NAME OF DRILLER: -------

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: -----; BEARING: -----

6. THICKNESS OF OVERBURDEN (m): -----

7. DEPTH DRILLED INTO ROCK (m): -----

8. TOTAL DEPTH OF BORING (m): 2.4

9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:

10. SIZE AND TYPE OF BIT: VIBRACORE

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

12. TOTAL SAMPLES: 3; DISTURBED: 3; UNDISTURBED: 0

13. TOTAL NUMBER CORE BOXES: 0

14. DEPTH GROUND WATER: -----

15. DATE BORING: STARTED 6/27/2013; COMPLETED 6/27/2013

16. ELEVATION TOP OF BORING:

17. TOTAL CORE RECOVERY FOR BORING (m): 2.43

18. SIGNATURE AND TITLE OF INSPECTOR:

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory: WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.5		**0m to 0.54m:** Dark gray silty sand with trace shell	1	23.4	14.2					SM	Mudline Elevation=15.8 m (MLLW)
	0.7		**0.54m to 0.73m:** Dark gray sand with silt, shell and gravel and brown sand lenses	2A	19.8	10.6	1.8				SP-SM	
	1.2		**0.73m to 1.16m:** Grayish-brown sand with trace shell	2B	10.8	1.4	0.2	0.2			SP	
	1.5		**1.16m to 1.54m:** Brown sand with trace shell	2C	20.2						SP	
	2.0		**1.54m to 2.04m:** Brown sand with trace shell	3A	13.4						SP	
	2.4		**2.04m to 2.43m:** Brown sand with gray silty sand lenses	3B	19.5	2.5					SP	

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

2. HOLE NUMBER: VC-007

LOCATION COORDINATES: N 4,074,142.2 E 426,992.9

3. DRILLING AGENCY: TETRA TECH, INC.

4. NAME OF DRILLER: -------

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: -----; BEARING: -----

6. THICKNESS OF OVERBURDEN (m): -----

7. DEPTH DRILLED INTO ROCK (m): -----

8. TOTAL DEPTH OF BORING (m): 2.3

9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:

10. SIZE AND TYPE OF BIT: VIBRACORE

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

12. TOTAL SAMPLES: 3; DISTURBED: 3; UNDISTURBED: 0

13. TOTAL NUMBER CORE BOXES: 0

14. DEPTH GROUND WATER: -----

15. DATE BORING: STARTED 6/27/2013; COMPLETED 6/27/2013

16. ELEVATION TOP OF BORING:

17. TOTAL CORE RECOVERY FOR BORING (m): 2.11

18. SIGNATURE AND TITLE OF INSPECTOR:

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.1		**0m to 0.06m:** Dark gray sand with silt and shell	1A	24.7						SP-SM	Mudline Elevation=15.9 m (MLLW)
	0.3		**0.06m to 0.28m:** Dark gray sand with silt	1B	23.1	10.2					SP-SM	
	1.2		**0.28m to 1.16m:** Dark gray silty sand with trace shell	2A	23.4	19.4	0.7	2.8			SM	
	1.3		**1.16m to 1.28m:** Dark gray silty sand with lenses of gray clay and trace shell	2B	42.3						SM	
	1.8		**1.28m to 1.84m:** Dark gray silty sand with lenses of gray clay and trace shell	3A	33.0						SM	
	2.1		**1.84m to 2.11m:** Dark gray silty sand with shell, gravel and lenses of gray clay	3B	32.6						SM	
	2.3		**2.11m to 2.28m:** Gray lean clay	3C	34.2	99.2	2.9				CL	

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

9. COORDINATE SYSTEM | HORIZONTAL | VERTICAL

10. SIZE AND TYPE OF BIT: VIBRACORE

2. HOLE NUMBER: VC-008 | LOCATION COORDINATES: N 4,073,888.0 E 429,943.6

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

3. DRILLING AGENCY: TETRA TECH, INC.

12. TOTAL SAMPLES: 3 | DISTURBED: 3 | UNDISTURBED: 0

4. NAME OF DRILLER: -------

13. TOTAL NUMBER CORE BOXES: 0

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED | DEG FROM VERTICAL: ----- | BEARING: -----

14. DEPTH GROUND WATER: -----

15. DATE BORING | STARTED: 6/27/2013 | COMPLETED: 6/27/2013

6. THICKNESS OF OVERBURDEN (m): -----

16. ELEVATION TOP OF BORING

7. DEPTH DRILLED INTO ROCK (m): -----

17. TOTAL CORE RECOVERY FOR BORING (m): 2.59

8. TOTAL DEPTH OF BORING (m): 2.7

18. SIGNATURE AND TITLE OF INSPECTOR

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.1		**0m to 0.09m:** Brownish-gray sand	1A	13.2	-					SP	Mudline Elevation=18.9 m (MLLW)
	0.8		**0.09m to 0.76m:** Dark gray silty sand with trace shell	1B	24.1	15.4	0.7				SM	
	1.0		**0.76m to 0.99m:** Dark gray silty sand with trace shell	2A	26.0						SM	
	1.1		**0.99m to 1.13m:** Dark gray silty sand and brown sand	2B	17.4						SP-SM	
	1.8		**1.13m to 1.76m:** Brown sand	2C	13.6	1.9	0.2	0.7			SP	
	2.3		**1.76m to 2.28m:** Brown sand with gravel	3A	8.7						SP	
	2.3		**2.28m to 2.34m:** Gray sandy silt	3B	20.1						ML	
	2.7		**2.34m to 2.66m:** Gray sand	3C	14.8	1.6					SP	

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP		9. COORDINATE SYSTEM	HORIZONTAL	VERTICAL
		10. SIZE AND TYPE OF BIT: VIBRACORE	
2. HOLE NUMBER: VC-009	LOCATION COORDINATES: N 4,073,723.3 E 433,325.2	11. MANUFACTURER'S DESIGNATION OF DRILL: -----	
3. DRILLING AGENCY: TETRA TECH, INC.		12. TOTAL SAMPLES: 2	DISTURBED: 2	UNDISTURBED: 0
4. NAME OF DRILLER: -------		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: -----	BEARING: -----	14. DEPTH GROUND WATER: -----	
		15. DATE BORING	STARTED: 6/27/2013	COMPLETED: 6/27/2013
6. THICKNESS OF OVERBURDEN (m): -----		16. ELEVATION TOP OF BORING	
7. DEPTH DRILLED INTO ROCK (m): -----		17. TOTAL CORE RECOVERY FOR BORING (m): 1.64	
8. TOTAL DEPTH OF BORING (m): 1.9		18. SIGNATURE AND TITLE OF INSPECTOR	

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory: WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.1		**0m to 0.09m:** Dark gray silty sand with trace shell	1A	20.3						SM	Mudline Elevation=19.6 m (MLLW)
	0.4		**0.09m to 0.4m:** Dark gray sand with gravel and shell and lenses of dark gray silt	1B	13.1	7.5					SW-SM	
	0.8		**0.4m to 0.77m:** Dark gray silty sand with trace shell	1C	17.2						SM	
	0.9		**0.77m to 0.9m:** Dark gray silty sand with shell	1D	17.5						SM	
	1.0		**0.9m to 0.98m:** Dark gray silty sand with shell and lenses of gray clay	2A	20.6						SM	
	1.2		**0.98m to 1.16m:** Dark gray silty sand with shell	2B	20.3						SM	
	1.3		**1.16m to 1.31m:** Dark gray silty sand with shell and lenses of gray clay	2C	23.6	26.1	1.0				SM	
	1.9		**1.31m to 1.86m:** Dark gray silty sand with shell	2D	17.0	42.0					SM	

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT VOWTAP		9. COORDINATE SYSTEM	HORIZONTAL / VERTICAL
		10. SIZE AND TYPE OF BIT	VIBRACORE
2. HOLE NUMBER VC-010	LOCATION COORDINATES N 4,074,284.5 E 435,900.9	11. MANUFACTURER'S DESIGNATION OF DRILL	-----
3. DRILLING AGENCY TETRA TECH, INC.		12. TOTAL SAMPLES 3	DISTURBED 3 / UNDISTURBED 0
4. NAME OF DRILLER -------		13. TOTAL NUMBER CORE BOXES	0
5. DIRECTION OF BORING ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL ----- / BEARING -----	14. DEPTH GROUND WATER	-----
		15. DATE BORING	STARTED 6/27/2013 / COMPLETED 6/27/2013
6. THICKNESS OF OVERBURDEN (m) -----		16. ELEVATION TOP OF BORING	
7. DEPTH DRILLED INTO ROCK (m) -----		17. TOTAL CORE RECOVERY FOR BORING (m)	2.21
8. TOTAL DEPTH OF BORING (m) 2.9		18. SIGNATURE AND TITLE OF INSPECTOR	

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.9		**0m to 0.93m:** Brownish-gray sand with shell	1	17.4						SP	Mudline Elevation=17.9 m (MLLW)
	1.9		**0.93m to 1.93m:** Brown to gray sand with shell	2	7.6	0.7	0.3	1.1			SP	
	2.4		**1.93m to 2.35m:** Brown to gray sand with shell	3A	14.6						SP	
	2.6		**2.35m to 2.62m:** Brown sand with shell	3B	9.7	1.6					SP	
	2.9		**2.62m to 2.9m:** Dark gray silty sand with shell and lenses of clay	3C	24.4	16.2					SM	

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

9. COORDINATE SYSTEM | HORIZONTAL | VERTICAL

10. SIZE AND TYPE OF BIT: VIBRACORE

2. HOLE NUMBER: VC-011 | LOCATION COORDINATES: N 4,074,926.1 E 438,826.5

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

3. DRILLING AGENCY: TETRA TECH, INC.

12. TOTAL SAMPLES: 3 | DISTURBED: 3 | UNDISTURBED: 0

4. NAME OF DRILLER: -------

13. TOTAL NUMBER CORE BOXES: 0

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED | DEG FROM VERTICAL: ----- | BEARING: -----

14. DEPTH GROUND WATER: -----

15. DATE BORING | STARTED: 6/27/2013 | COMPLETED: 6/27/2013

6. THICKNESS OF OVERBURDEN (m): -----

16. ELEVATION TOP OF BORING

7. DEPTH DRILLED INTO ROCK (m): -----

17. TOTAL CORE RECOVERY FOR BORING (m): 2.71

8. TOTAL DEPTH OF BORING (m): 2.8

18. SIGNATURE AND TITLE OF INSPECTOR

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory: WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.8		**0m to 0.83m:** Gray and brown sand with trace shell	1	18.7	3.7					SP	Mudline Elevation=19.3 m (MLLW)
	1.2		**0.83m to 1.17m:** Brownish-gray sand with shell	2A	20.4	4.6	0.5	1.7			SP	
	1.4		**1.17m to 1.38m:** Dark gray silty sand with clay lenses and shell	2B	26.1						SM	
	1.8		**1.38m to 1.83m:** Gray silty sand with shell	2C	22.0						SM	
	2.6		**1.83m to 2.62m:** Dark gray sand with silt and shell	3A	19.2	8.4	0.6	1.5			SP-SM	
	2.8		**2.62m to 2.78m:** Brown sand with gravel	3B							SP	
	2.8		**2.78m to 2.83m:** Gray lean clay	3C	20.3						CL	

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP	9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL
	10. SIZE AND TYPE OF BIT: VIBRACORE
2. HOLE NUMBER: VC-012 — LOCATION COORDINATES: N 4,075,570.5 E 441,860.0	11. MANUFACTURER'S DESIGNATION OF DRILL: -----
3. DRILLING AGENCY: TETRA TECH, INC.	12. TOTAL SAMPLES: 2 — DISTURBED: 2 — UNDISTURBED: 0
4. NAME OF DRILLER: -------	13. TOTAL NUMBER CORE BOXES: 0
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED — DEG FROM VERTICAL: ----- — BEARING: -----	14. DEPTH GROUND WATER: -----
	15. DATE BORING — STARTED: 6/27/2013 — COMPLETED: 6/27/2013
6. THICKNESS OF OVERBURDEN (m): -----	16. ELEVATION TOP OF BORING
7. DEPTH DRILLED INTO ROCK (m): -----	17. TOTAL CORE RECOVERY FOR BORING (m): 1.88
8. TOTAL DEPTH OF BORING (m): 2.2	18. SIGNATURE AND TITLE OF INSPECTOR

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory: WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	1.2		**0m to 1.2m:** Brownish-gray to dark gray sand	1	14.7	1.9					SP	Mudline Elevation=17.4 m (MLLW)
	2.2		**1.2m to 2.2m:** Gray to brown sand with trace shell	2	14.9	1.2	0.4	1.0			SP	

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:

10. SIZE AND TYPE OF BIT: VIBRACORE

2. HOLE NUMBER: VC-013

LOCATION COORDINATES: N 4,076,206.8 E 444,774.4

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

3. DRILLING AGENCY: TETRA TECH, INC.

12. TOTAL SAMPLES: 3 DISTURBED: 3 UNDISTURBED: 0

4. NAME OF DRILLER: -------

13. TOTAL NUMBER CORE BOXES: 0

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: ----- BEARING: -----

14. DEPTH GROUND WATER: -----

15. DATE BORING: STARTED 6/26/2013 COMPLETED 6/26/2013

6. THICKNESS OF OVERBURDEN (m): -----

16. ELEVATION TOP OF BORING:

7. DEPTH DRILLED INTO ROCK (m): -----

17. TOTAL CORE RECOVERY FOR BORING (m): 2.36

8. TOTAL DEPTH OF BORING (m): 2.5

18. SIGNATURE AND TITLE OF INSPECTOR:

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.2		**0m to 0.17m:** Grayish-brown sand with shell	1A	15.0	1.2					SP	Mudline Elevation=17.8 m (MLLW)
	0.3		**0.17m to 0.28m:** Grayish-brown silty sand with shell	1B	18.6						SM	
	0.4		**0.28m to 0.37m:** Gray fat clay with clayey sand lenses and shell	1C	70.5						CH	
	0.5			1D	21.7						SM	
	1.5		**0.37m to 0.48m:** Dark gray silty sand with shell **0.48m to 1.48m:** Grayish-brown sand with trace shell	2	13.1	1.9	0.3	0.9			SP	
	2.5		**1.48m to 2.45m:** Brown to dark gray sand with trace shell	3	14.2	1.9					SP	

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP	9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL
	10. SIZE AND TYPE OF BIT: VIBRACORE
2. HOLE NUMBER: VC-014 — LOCATION COORDINATES: N 4,077,704.3 E 447,329.5	11. MANUFACTURER'S DESIGNATION OF DRILL: -----
3. DRILLING AGENCY: TETRA TECH, INC.	12. TOTAL SAMPLES: 3 — DISTURBED: 3 — UNDISTURBED: 0
4. NAME OF DRILLER: -------	13. TOTAL NUMBER CORE BOXES: 0
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED — DEG FROM VERTICAL: ----- — BEARING: -----	14. DEPTH GROUND WATER: -----
	15. DATE BORING — STARTED: 6/26/2013 — COMPLETED: 6/26/2013
6. THICKNESS OF OVERBURDEN (m): -----	16. ELEVATION TOP OF BORING
7. DEPTH DRILLED INTO ROCK (m): -----	17. TOTAL CORE RECOVERY FOR BORING (m): 2.59
8. TOTAL DEPTH OF BORING (m): 2.6	18. SIGNATURE AND TITLE OF INSPECTOR

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory: WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.4		**0m to 0.43m:** Brown sand with trace shell	1A	10.1	0.7					SP	Mudline Elevation=18.3 m (MLLW)
	0.7		**0.43m to 0.68m:** Dark gray sand with trace shell	1B	21.7						SP	
	1.7		**0.68m to 1.68m:** Brown and gray sand with shell	2	11.7	1.7		4.6			SP	
	2.6		**1.68m to 2.64m:** Gray and brown sand with shell	3	17.6	1.4					SP	

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

9. COORDINATE SYSTEM: HORIZONTAL | VERTICAL

10. SIZE AND TYPE OF BIT: VIBRACORE

2. HOLE NUMBER: VC-015 | LOCATION COORDINATES: N 4,079,241.9 E 449,917.3

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

3. DRILLING AGENCY: TETRA TECH, INC.

12. TOTAL SAMPLES: 2 | DISTURBED: 2 | UNDISTURBED: 0

4. NAME OF DRILLER: -------

13. TOTAL NUMBER CORE BOXES: 0

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED | DEG FROM VERTICAL: ----- | BEARING: -----

14. DEPTH GROUND WATER: -----

15. DATE BORING | STARTED: 6/24/2013 | COMPLETED: 6/24/2013

6. THICKNESS OF OVERBURDEN (m): -----

16. ELEVATION TOP OF BORING

7. DEPTH DRILLED INTO ROCK (m): -----

17. TOTAL CORE RECOVERY FOR BORING (m): 1.43

8. TOTAL DEPTH OF BORING (m): 1.6

18. SIGNATURE AND TITLE OF INSPECTOR

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory: WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.2		**0m to 0.17m:** Brown sand with shell	1A	5.2						SP	Mudline Elevation=17.9 m (MLLW)
	0.7		**0.17m to 0.68m:** Gray sand with shell	1B	18.5	0.8					SP	
	0.9		**0.68m to 0.92m:** Brown sand with shell	2A	6.6						SP	
	1.6		**0.92m to 1.64m:** Gray sand with shell	2B	19.6	1.4	0.3	2.4			SP	

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP		9. COORDINATE SYSTEM	HORIZONTAL	VERTICAL
		10. SIZE AND TYPE OF BIT: VIBRACORE	
2. HOLE NUMBER: VC-015A	LOCATION COORDINATES: N 4,079,247.3 E 449,918.2	11. MANUFACTURER'S DESIGNATION OF DRILL: -----	
3. DRILLING AGENCY: TETRA TECH, INC.		12. TOTAL SAMPLES: 2	DISTURBED: 2	UNDISTURBED: 0
4. NAME OF DRILLER: -------		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: -----	BEARING: -----	14. DEPTH GROUND WATER: -----	
			15. DATE BORING	STARTED: 6/24/2013	COMPLETED: 6/24/2013
6. THICKNESS OF OVERBURDEN (m): -----		16. ELEVATION TOP OF BORING	
7. DEPTH DRILLED INTO ROCK (m): -----		17. TOTAL CORE RECOVERY FOR BORING (m): 1.53	
8. TOTAL DEPTH OF BORING (m): 1.6		18. SIGNATURE AND TITLE OF INSPECTOR	

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.3		**0m to 0.34m:** Brown sand with shell	1A	7.2	0.5					SP	Mudline Elevation=17.9 m (MLLW)
	0.7		**0.34m to 0.68m:** Gray sand with shell	1B	21.9						SP	
	1.6		**0.68m to 1.64m:** Brown and gray sand with shell	2	19.3	1.0	0.2	1.6			SP	

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG

DIVISION

INSTALLATION

SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP

2. HOLE NUMBER: VC-016

LOCATION COORDINATES: N 4,080,795.8 E 452,537.3

3. DRILLING AGENCY: TETRA TECH, INC.

4. NAME OF DRILLER: --------

5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED; DEG FROM VERTICAL: -----; BEARING: -----

6. THICKNESS OF OVERBURDEN (m): -----

7. DEPTH DRILLED INTO ROCK (m): -----

8. TOTAL DEPTH OF BORING (m): 4.7

9. COORDINATE SYSTEM: HORIZONTAL: VERTICAL:

10. SIZE AND TYPE OF BIT: VIBRACORE

11. MANUFACTURER'S DESIGNATION OF DRILL: -----

12. TOTAL SAMPLES: 5; DISTURBED: 5; UNDISTURBED: 0

13. TOTAL NUMBER CORE BOXES: 0

14. DEPTH GROUND WATER: -----

15. DATE BORING: STARTED 6/24/2013; COMPLETED 6/24/2013

16. ELEVATION TOP OF BORING:

17. TOTAL CORE RECOVERY FOR BORING (m): 4.58

18. SIGNATURE AND TITLE OF INSPECTOR:

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.1		**0m to 0.08m:** Dark gray sand with clay, gravel and shell	1A	14.1						SP-SC	Mudline Elevation=24.6 m (MLLW)
	0.3		**0.08m to 0.33m:** Dark gray clayey sand with lenses of gray clay with organics	1B	26.1						SC	
	0.6		**0.33m to 0.56m:** Dark gray sand	1C	23.9						SP	
	0.8		**0.56m to 0.78m:** Dark gray clayey sand with lenses of gray clay with organics	1D	26.1	28.3	1.0				SC	
	1.6		**0.78m to 1.6m:** Dark gray sand with clay lenses and trace shell	2A	22.5	12.3	0.7	0.5			SC	
	1.8		**1.6m to 1.78m:** Gray and brown sand with gravel and shell and gray clay lenses	2B	10.4	3.5					SP	
	2.0		**1.78m to 2.02m:** Dark gray sand with gravel and gray clay lenses	3A	8.1						SP	
	2.5		**2.02m to 2.49m:** Brown sand	3B	6.0	2.3					SP	
	2.8		**2.49m to 2.78m:** Gray sand with lenses of gray clayey sand	3C	16.7						SP	
	3.3		**2.78m to 3.32m:** Gray sand with lenses of gray clay	4A	16.8	6.2		0.5			SP-SC	
	3.8		**3.32m to 3.78m:** Dark gray lean clay	4B	36.4	96.6		2.9			CL	
	4.4		**3.78m to 4.37m:** Dark gray lean clay	5A	33.3	85.9	2.2				CL	
	4.7		**4.37m to 4.71m:** Dark gray sandy lean clay with trace shell	5B	20.7						CL	

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT: VOWTAP		9. COORDINATE SYSTEM	HORIZONTAL	VERTICAL
		10. SIZE AND TYPE OF BIT: VIBRACORE	
2. HOLE NUMBER: VC-017	LOCATION COORDINATES: N 4,082,296.8 E 455,040.8	11. MANUFACTURER'S DESIGNATION OF DRILL: -----	
3. DRILLING AGENCY: TETRA TECH, INC.		12. TOTAL SAMPLES: 4	DISTURBED: 4	UNDISTURBED: 0
4. NAME OF DRILLER: -------		13. TOTAL NUMBER CORE BOXES: 0	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG FROM VERTICAL: -----	BEARING: -----	14. DEPTH GROUND WATER: -----	
		15. DATE BORING	STARTED: 6/24/2013	COMPLETED: 6/24/2013
6. THICKNESS OF OVERBURDEN (m): -----		16. ELEVATION TOP OF BORING	
7. DEPTH DRILLED INTO ROCK (m): -----		17. TOTAL CORE RECOVERY FOR BORING (m): 3.59	
8. TOTAL DEPTH OF BORING (m): 3.7		18. SIGNATURE AND TITLE OF INSPECTOR	

ELEV (m)	DEPTH (m)	LEGEND	SOIL CLASSIFICATION (Description)	Samp No.	Laboratory WC (%)	-200 (%)	OC (%)	CC (%)	LL	PI	ASTM Class	REMARKS
	0.1		**0m to 0.09m:** Dark gray sand with shell	1A	21.8		0.5				SP	Mudline Elevation=25.6 m (MLLW)
	0.3		**0.09m to 0.27m:** Dark gray sand with gravel and gray clay lenses	1B	9.6						SP	
	0.8		**0.27m to 0.78m:** Dark gray fat clay with gray clayey sand lenses and trace shell	1C	55.7	87.9					CH	
	1.8		**0.78m to 1.78m:** Dark gray fat clay with trace shell	2	54.6	97.6	1.1				CH	
	2.0		**1.78m to 1.95m:** Dark gray fat clay with trace shell and lenses of brown silt	3A	43.7						CH	
	2.0			3B	39.0						CH	
	2.5		**1.95m to 2.02m:** Dark gray fat clay with trace shell and lenses of clay with gravel **2.02m to 2.48m:** Dark gray fat clay with trace shell and lenses of brown silt	3C	42.6	85.8					CH	
	2.8		**2.48m to 2.78m:** Dark gray clayey sand with gravel	3D	17.7	17.8					SC	
	3.1		**2.78m to 3.07m:** Gray sand with trace shell	4A	16.5						SP	
	3.7		**3.07m to 3.74m:** Dark gray lean clay with sand	4B	23.8	83.7	1.9	7.2			CL	

ACE 1836-A (DRILLING LOG) - LVC CABLE ROUTE CORE SAMPLES LOGS.GPJ ACE MVD WITH RAPID CPT 06-09-08.GDT 8/27/13

Attachment F – Sidescan Sonar Contacts

Contact	Area	Date	Time (UTC)	Line #	Latitude	Longitude	X	Y	Projection	Class	Height (m)	Length (m)	Shadow (m)	Width (m)	SBP Filename
SC-LA-001	Lease Area	6/10/2013	5:13	1	36.893907	-75.498102	455619.21	4083219.10	UTM83-18	debris	0.7	6.5	3.2	2.3	161_001_0502.001
SC-LA-002	Lease Area	6/9/2013	22:13	2	36.878151	-75.497542	455659.96	4081470.89	UTM83-18	debris	0	11.8	0	4.1	160_SSS_SBP_MAG_002
SC-LA-003	Lease Area	6/4/2013	21:01	4	36.888938	-75.497141	455701.90	4082667.34	UTM83-18	debris	0.2	4.1	1	1.5	155_004_2051.001
SC-LA-004	Lease Area	6/4/2013	9:36	30	36.906091	-75.488351	456494.93	4084566.17	UTM83-18	debris	0.1	5.3	0.4	0.6	155_030_0914.002
SC-LA-005	Lease Area	6/4/2013	11:00	33	36.900657	-75.488191	456506.06	4083963.33	UTM83-18	debris	0	1.6	0	3.4	155_033_1053
SC-LA-006	Lease Area	6/4/2013	11:30	34	36.885114	-75.487377	456569.77	4082238.67	UTM83-18	geology	0	4.2	0	2.2	155_034_1123
SC-LA-007	Lease Area	6/4/2013	12:39	36	36.883705	-75.485959	456695.36	4082081.70	UTM83-18	debris	0.2	5.5	1.5	2.7	155_036_1232
SC-LA-008	Lease Area	6/10/2013	2:36	38	36.882306	-75.485306	456752.74	4081926.24	UTM83-18	debris	0.3	3.7	2.3	3.6	161_SS_SB_MAG_DRV_038A.002
SC-LA-009	Lease Area	6/5/2013	20:25	45	36.897294	-75.484033	456874.62	4083588.36	UTM83-18	geology	0.3	8.5	2.2	7.5	156_045_2011.001
SC-LA-010	Lease Area	6/5/2013	16:25	55	36.878131	-75.480221	457203.56	4081460.87	UTM83-18	debris	0.4	2.2	0.8	2.1	156_055_1611.001
SC-LA-011	Lease Area	6/5/2013	14:19	60	36.880357	-75.478749	457336.03	4081707.09	UTM83-18	debris	0.3	2.9	2.3	1.2	156_060_1415
SC-LA-012	Lease Area	6/5/2013	5:30	75	36.892791	-75.473150	457841.83	4083083.88	UTM83-18	geology	0.3	4.1	1.4	2.5	156_075_0518.001
SC-LA-013	Lease Area	6/5/2013	4:30	77	36.884811	-75.472950	457855.25	4082198.57	UTM83-18	debris	0.1	8	0.5	4.6	156_077_0424
SC-CR-0001	Cable Route	6/9/2013	5:46	60	36.815368	-75.956950	414647.79	4074818.05	UTM83-18	debris	0.1	1.9	0.7	1.4	160_SSS_MAG_60C.001
SC-CR-0002	Cable Route	6/9/2013	2:17	150	36.815924	-75.945429	415675.98	4074869.44	UTM83-18	debris	0	2.7	0	1.4	160_ALL_150
SC-CR-0003	Cable Route	6/9/2013	5:38	60	36.816603	-75.941041	416068.10	4074940.88	UTM83-18	debris	0.3	1.3	1.2	0.8	160_SSS_MAG_60C
SC-CR-0004	Cable Route	6/9/2013	5:36	60	36.817000	-75.937115	416418.71	4074981.54	UTM83-18	debris	0.4	0.9	0.7	0.5	160_SSS_MAG_60C
SC-CR-0005	Cable Route	6/9/2013	1:42	120	36.818199	-75.917125	418202.96	4075097.28	UTM83-18	debris	0	2.1	0	1.6	160_ALL_120.004
SC-CR-0006	Cable Route	6/8/2013	22:37	-90	36.820485	-75.910477	418798.32	4075345.13	UTM83-18	debris	0	6.4	0	0.9	159_SPB_MAG_-90.003
SC-CR-0007	Cable Route	6/6/2013	23:31	0	36.819214	-75.908479	418975.19	4075202.49	UTM83-18	debris	0.6	3	3.1	1.2	157_000.2307.002
SC-CR-0008	Cable Route	6/9/2013	12:27	-120	36.820223	-75.889392	420678.60	4075298.40	UTM83-18	debris	0.2	2.8	1.5	2.1	160_M120_B_1144.004
SC-CR-0009	Cable Route	6/9/2013	12:27	-120	36.820715	-75.889299	420687.37	4075352.90	UTM83-18	debris	0	3.1	0	1.9	160_M120_B_1144.004
SC-CR-0010	Cable Route	6/9/2013	16:55	-150	36.820511	-75.887407	420855.90	4075328.66	UTM83-18	debris	0.5	6.8	2.7	7.4	160_M150G.001
SC-CR-0011	Cable Route	6/9/2013	16:55	-150	36.820354	-75.887401	420856.26	4075311.32	UTM83-18	debris	0	6.6	0	5.5	160_M150G.001
SC-CR-0012	Cable Route	6/9/2013	16:55	-150	36.820396	-75.887233	420871.34	4075315.81	UTM83-18	debris	0.4	7.3	3.3	6.2	160_M150G.001
SC-CR-0013	Cable Route	6/9/2013	16:55	-150	36.820507	-75.887180	420876.14	4075328.03	UTM83-18	debris	0.8	8	4.5	7.5	160_M150G.001
SC-CR-0014	Cable Route	6/6/2013	14:08	60	36.817575	-75.864072	422934.18	4074983.93	UTM83-18	debris	0.9	2.6	4.1	1	157_60_1401
SC-CR-0015	Cable Route	6/7/2013	10:21	-60	36.817933	-75.859717	423322.99	4075020.15	UTM83-18	debris	0.3	1.6	1.2	0.9	158_-060_1014
SC-CR-0016	Cable Route	6/6/2013	11:36	90	36.815733	-75.854774	423761.62	4074772.16	UTM83-18	debris	0.5	1.4	2.4	0.8	157_90_1130
SC-CR-0017	Cable Route	6/6/2013	3:12	120	36.812347	-75.836723	425368.41	4074382.32	UTM83-18	debris	0.3	0.9	0.9	0.3	157_120_0253.002
SC-CR-0018	Cable Route	6/7/2013	1:37	0	36.809961	-75.817875	427047.25	4074103.01	UTM83-18	debris	0.1	2.3	0.5	1	158_000_0108.003
SC-CR-0019	Cable Route	6/7/2013	1:38	0	36.809838	-75.816063	427208.78	4074088.04	UTM83-18	debris	0.1	2	0.7	1.1	158_000_0108.003
SC-CR-0020	Cable Route	6/10/2013	21:04	-120	36.809310	-75.792988	429266.61	4074012.19	UTM83-18	debris or rock	0.1	2.1	1.1	1.2	161_M120D

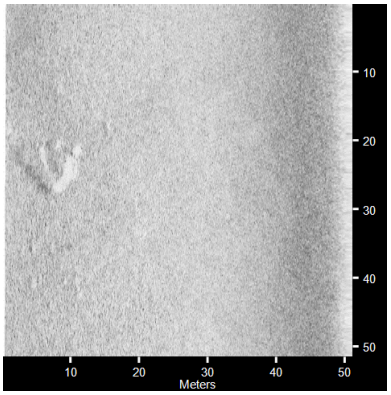
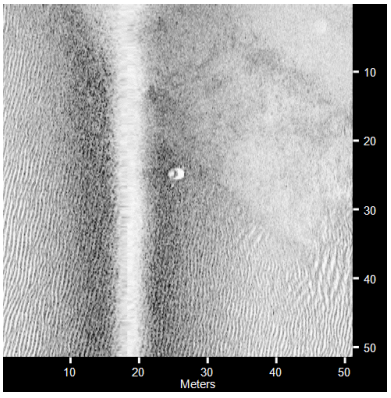
Contact	Area	Date	Time (UTC)	Line #	Latitude	Longitude	X	Y	Projection	Class	Height (m)	Length (m)	Shadow (m)	Width (m)	SBP Filename
SC-CR-0021	Cable Route	6/6/2013	14:51	60	36.807918	-75.781955	430249.51	4073849.63	UTM83-18	debris	0.5	0.9	2.7	1.3	157_60_1401.006
SC-CR-0022	Cable Route	6/10/2013	21:11	-120	36.809032	-75.780945	430340.63	4073972.51	UTM83-18	debris	0.1	6.5	0.3	1	161_M120D.001
SC-CR-0023	Cable Route	6/6/2013	3:55	120	36.806806	-75.778606	430547.20	4073723.84	UTM83-18	debris	0.2	5.6	0.7	3.7	157_120_0340.001
SC-CR-0024	Cable Route	6/10/2013	21:15	-120	36.809051	-75.772964	431052.54	4073968.80	UTM83-18	debris	0.3	1.3	1	0.5	161_M120D.002
SC-CR-0025	Cable Route	6/7/2013	6:52	-30	36.808240	-75.770246	431294.19	4073876.88	UTM83-18	debris or	0.2	1.1	1.1	0.7	158_-030_0432.017
SC-CR-0026	Cable Route	6/6/2013	21:31	30	36.807075	-75.767009	431581.96	4073745.30	UTM83-18	debris	0.1	33.5	0.4	0.2	157_30_2100.003
SC-CR-0027	Cable Route	6/6/2013	21:26	30	36.807264	-75.757490	432431.20	4073759.55	UTM83-18	debris	0.1	0.8	0.5	0.5	157_30_2100.002
SC-CR-0028	Cable Route	6/6/2013	9:45	90	36.806373	-75.754797	432670.65	4073658.75	UTM83-18	debris	0.4	0.9	0.7	0.9	157_90_0732.016
SC-CR-0029	Cable Route	6/6/2013	21:24	30	36.806384	-75.751658	432950.72	4073657.79	UTM83-18	debris	0.1	1.3	0.9	1.2	157_30_2100.002
SC-CR-0030	Cable Route	6/7/2013	6:43	-30	36.807020	-75.750683	433038.21	4073727.69	UTM83-18	debris	0.2	1.1	0.6	0.6	158_-030_0432.015
SC-CR-0031	Cable Route	6/9/2013	19:06	-150	36.809442	-75.741551	433854.92	4073989.94	UTM83-18	debris or	0.4	1.2	1.5	0.9	160_M150H.003
SC-CR-0032	Cable Route	6/7/2013	16:37	-90	36.810335	-75.737416	434224.48	4074086.13	UTM83-18	debris or	0.2	1.9	2.2	1	158_-090_1420.016
SC-CR-0033	Cable Route	6/6/2013	21:12	30	36.810519	-75.726646	435185.31	4074099.23	UTM83-18	debris	0.2	0.7	0.7	1.1	157_30_2100.001
SC-CR-0034	Cable Route	6/6/2013	4:27	120	36.811543	-75.718585	435905.21	4074207.35	UTM83-18	debris	0.1	1.7	1.2	0.1	157_120_0340.005
SC-CR-0035	Cable Route	6/6/2013	21:07	30	36.812131	-75.717535	435999.35	4074271.86	UTM83-18	debris	0.2	3.3	0.6	0.5	157_30_2100
SC-CR-0036	Cable Route	6/6/2013	4:29	120	36.812113	-75.714876	436236.49	4074268.10	UTM83-18	debris	0.1	5.8	0.3	0.2	157_120_0340.005
SC-CR-0037	Cable Route	6/6/2013	0:33	150	36.812599	-75.710981	436584.34	4074319.47	UTM83-18	debris	0.1	2.7	0.6	0.9	157_150_0015.002
SC-CR-0038	Cable Route	6/6/2013	21:01	30	36.814233	-75.704689	437146.93	4074496.54	UTM83-18	debris	0	0.9	0	0.9	157_30_2100
SC-CR-0039	Cable Route	6/7/2013	2:32	0	36.815011	-75.702360	437355.30	4074581.39	UTM83-18	debris	0.1	9	0.3	0.8	158_000_0108.010
SC-CR-0040	Cable Route	6/7/2013	16:18	-90	36.816262	-75.699526	437609.00	4074718.31	UTM83-18	debris	0.5	2.4	4	1.4	158_-090_1420.014
SC-CR-0041	Cable Route	6/6/2013	20:40	30	36.817013	-75.689886	438469.47	4074795.29	UTM83-18	debris	0	1.4	0	0.8	157_30_2016.002
SC-CR-0042	Cable Route	6/6/2013	20:37	30	36.817814	-75.684471	438953.07	4074880.78	UTM83-18	debris	0.1	4.2	0.7	1	157_30_2016.002
SC-CR-0043	Cable Route	6/5/2013	23:49	150	36.818076	-75.679649	439383.36	4074906.69	UTM83-18	debris	0.2	0.9	0.7	0.7	156_150_2206.012
SC-CR-0044	Cable Route	6/7/2013	2:44	0	36.819611	-75.679038	439439.06	4075076.65	UTM83-18	debris	0.7	2.5	4.4	1.3	158_000_0108.011
SC-CR-0045	Cable Route	6/7/2013	2:49	0	36.821028	-75.667831	440439.66	4075226.76	UTM83-18	debris	0.1	4.9	0.5	1.1	158_000_0108.012
SC-CR-0046	Cable Route	6/6/2013	15:59	60	36.821074	-75.667784	440443.91	4075231.85	UTM83-18	debris	0	28.5	0.2	0.6	157_60_1527.003
SC-CR-0047	Cable Route	6/6/2013	15:59	60	36.821083	-75.667369	440480.89	4075232.54	UTM83-18	debris	0.1	52.1	0.3	0.4	157_60_1527.003
SC-CR-0048	Cable Route	6/6/2013	16:00	60	36.821078	-75.666963	440517.13	4075231.77	UTM83-18	debris	0.2	28	0.4	0.8	157_60_1527.003
SC-CR-0049	Cable Route	6/6/2013	16:04	60	36.822754	-75.658082	441310.48	4075412.23	UTM83-18	debris	0.3	6.1	1.5	4.5	157_60_1527.004
SC-CR-0050	Cable Route	6/7/2013	12:05	-60	36.823199	-75.657887	441328.19	4075461.47	UTM83-18	debris	0	0	0	0	158_-060_1014.013
SC-CR-0051	Cable Route	6/7/2013	5:47	-30	36.828236	-75.631934	443646.49	4076004.62	UTM83-18	debris	0	1.4	0	1.1	158_-030_0432.009
SC-CR-0052	Cable Route	6/6/2013	5:24	120	36.826788	-75.629326	443877.94	4075842.41	UTM83-18	debris	0.3	1.1	2.2	1.1	157_120_0504.002
SC-CR-0053	Cable Route	6/6/2013	16:59	60	36.834730	-75.607739	445808.69	4076711.01	UTM83-18	debris	0.1	13.7	0.2	1.3	157_60_1652
SC-CR-0054	Cable Route	6/7/2013	5:14	-30	36.853062	-75.571885	449017.91	4078724.85	UTM83-18	debris	0	2.6	0.2	0.9	158_-030_0432.005

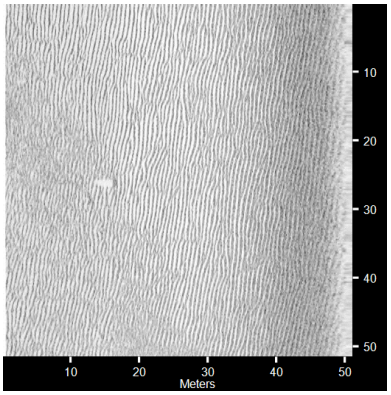
Contact	Area	Date	Time (UTC)	Line #	Latitude	Longitude	X	Y	Projection	Class	Height (m)	Length (m)	Shadow (m)	Width (m)	SBP Filename
SC-CR-0055	Cable Route	6/6/2013	8:08	90	36.857943	-75.560579	450029.03	4079260.32	UTM83-18	debris	0.2	1	1.9	0.7	157_90_0732.004
SC-CR-0056	Cable Route	6/7/2013	3:44	0	36.859642	-75.559046	450166.76	4079448.06	UTM83-18	debris or rock	0.1	1.2	1	0.4	158_000_0108.018
SC-CR-0057	Cable Route	6/7/2013	14:50	-90	36.862726	-75.553012	450706.62	4079786.96	UTM83-18	debris	0.1	12.9	0.4	0.5	158_-090_1420.003
SC-CR-0058	Cable Route	6/6/2013	17:33	50	36.861590	-75.552221	450776.43	4079660.56	UTM83-18	debris	0.2	1.6	1.2	1.2	157_60_1652.004
SC-CR-0059	Cable Route	6/6/2013	7:58	90	36.866622	-75.542601	451637.10	4080213.87	UTM83-18	debris	0.2	2.1	1.2	0.8	157_90_0732.003
SC-CR-0060	Cable Route	6/7/2013	4:55	-30	36.869541	-75.538177	452033.26	4080535.51	UTM83-18	debris or rock	0.3	1.6	0.8	1.5	158_-030_0432.002
SC-CR-0061	Cable Route	6/7/2013	13:23	-60	36.871890	-75.533809	452423.97	4080793.84	UTM83-18	debris	0.8	1.7	2.9	1.3	158_-060_1225.007
SC-CR-0062	Cable Route	6/7/2013	14:37	-90	36.872594	-75.533086	452488.88	4080871.55	UTM83-18	debris	0.3	0.6	1.4	0.3	158_-090_1420.002
SC-CR-0063	Cable Route	6/6/2013	18:25	30	36.881130	-75.513112	454274.20	4081808.76	UTM83-18	artifact	0	0	0	0	157_30_1815.001
SC-CR-0064	Cable Route	6/6/2013	18:18	30	36.887173	-75.500799	455375.00	4082473.33	UTM83-18	artifact	0	0	0	0	157_30_1815
SC-CR-0065	Cable Route	6/6/2013	18:16	30	36.888751	-75.498579	455573.73	4082647.30	UTM83-18	debris	0.1	2.6	0.5	0.6	157_30_1815
SC-CR-0066	Cable Route	6/10/2013	21:59	-150	36.809064	-75.745398	433511.40	4073950.66	UTM83-18	debris	0.7	8.9	5.6	4.6	161_M120E

Sonar Contacts, Lease Area East

Report SonarContacts_LA_East

Generated on 7/16/2013 10:08:06 AM

Target Image	Target Info	User Entered Info
	SC-LA-009 • Sonar Time at Target: 6/5/2013 8:25:16 PM • Click Position 36.8972943407 -75.4840332774 (WGS84) (X) 456874.62 (Y) 4083588.36 (Projected Coordinates) • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060513_LA_SSM\SSS\156_045_2011.001.jsf • Ping Number: 486209 • Range to target: 41.70 Meters • Fish Height: 5.52 Meters • Line Name: 156_045_2011.001 • Water Depth: 21.24 Meters	Dimensions and attributes • Target Width: 7.5 Meters • Target Height: 0.3 Meters • Target Length: 8.5 Meters • Target Shadow: 2.2 Meters • Mag Anomaly: N • Classification1: geology • Description: depression
	SC-LA-010 • Sonar Time at Target: 6/5/2013 4:25:03 PM • Click Position 36.8781314610 -75.4802213251 (WGS84) (X) 457203.56 (Y) 4081460.87 (Projected Coordinates) • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060513_LA_SSM\SSS\156_055_1611.001.jsf • Ping Number: 307471 • Range to target: 7.37 Meters • Fish Height: 4.58 Meters • Line Name: 156_055_1611.001 • Water Depth: 23.44 Meters	Dimensions and attributes • Target Width: 2.1 Meters • Target Height: 0.4 Meters • Target Length: 2.2 Meters • Target Shadow: 0.8 Meters • Mag Anomaly: N • Classification1: debris • Description: hard target w/ shadow

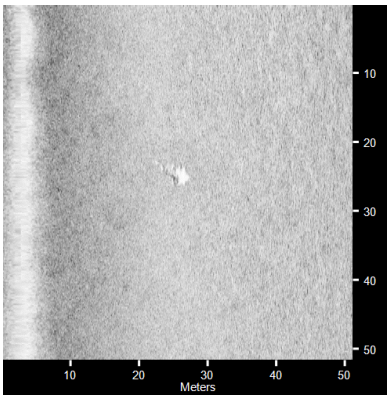


SC-LA-011

- Sonar Time at Target: 6/5/2013 2:19:31 PM
- Click Position
  36.8803569580 -75.4787487906 (WGS84)
  (X) 457336.03 (Y) 4081707.09 (Projected Coordinates)
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060513_LA_SSM\SSS\156_060_1415.jsf
- Ping Number: 208874
- Range to target: 36.33 Meters
- Fish Height: 5.82 Meters
- Line Name: 156_060_1415
- Water Depth: 21.93 Meters

Dimensions and attributes

- Target Width: 1.2 Meters
- Target Height: 0.3 Meters
- Target Length: 2.9 Meters
- Target Shadow: 2.3 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: hard target w/ shadow

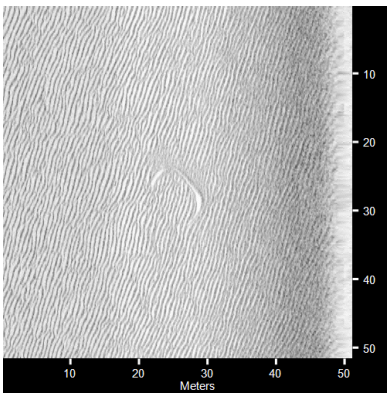


SC-LA-012

- Sonar Time at Target: 6/5/2013 5:30:06 AM
- Click Position
  36.8927905027 -75.4731497680 (WGS84)
  (X) 457841.83 (Y) 4083083.88 (Projected Coordinates)
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060513_LA_SSM\SSS\156_075_0518.001.jsf
- Ping Number: 367946
- Range to target: 22.89 Meters
- Fish Height: 4.78 Meters
- Line Name: 156_075_0518.001
- Water Depth: 22.40 Meters

Dimensions and attributes

- Target Width: 2.5 Meters
- Target Height: 0.3 Meters
- Target Length: 4.1 Meters
- Target Shadow: 1.4 Meters
- Mag Anomaly: N
- Classification1: geology
- Description: hard target w/ shadow



SC-LA-013

- Sonar Time at Target: 6/5/2013 4:30:58 AM
- Click Position
  36.8848106710 -75.4729499485 (WGS84)
  (X) 457855.24 (Y) 4082198.57 (Projected Coordinates)
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060513_LA_SSM\SSS\156_077_0424.jsf
- Ping Number: 327601
- Range to target: 24.29 Meters
- Fish Height: 5.62 Meters
- Line Name: 156_077_0424
- Water Depth: 21.91 Meters

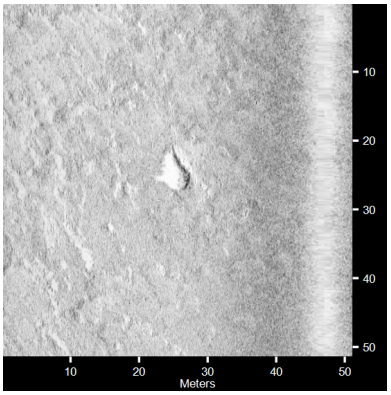
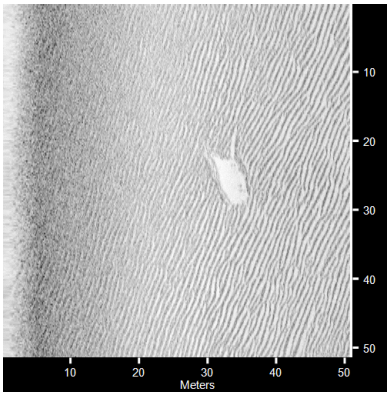
Dimensions and attributes

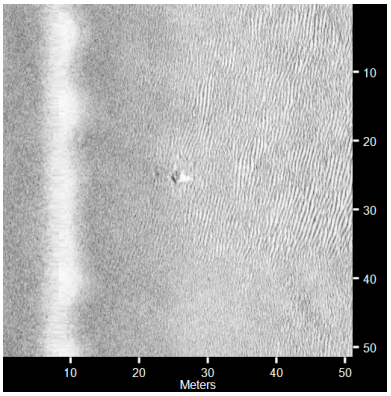
- Target Width: 4.6 Meters
- Target Height: 0.1 Meters
- Target Length: 8.0 Meters
- Target Shadow: 0.5 Meters
- Mag Anomaly: No
- Classification1: debris
- Description: Crescent shape in sandwaves

Sonar Contacts, Lease Area West

Report SonarContacts_LA_West

Generated on 7/16/2013 11:03:06 AM

Target Image	Target Info	User Entered Info
	SC-LA-001 • Sonar Time at Target: 6/10/2013 5:13:47 AM • Click Position 36.8939074899 -75.4981017917 (WGS84) (X) 455619.21 (Y) 4083219.10 (Projected Coordinates) • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_061013_SSM\SSS\161_001_0502.001.jsf • Ping Number: 1451339 • Range to target: 21.40 Meters • Fish Height: 5.52 Meters • Line Name: 161_001_0502.001 • Water Depth: 20.76 Meters	Dimensions and attributes • Target Width: 2.3 Meters • Target Height: 0.7 Meters • Target Length: 6.5 Meters • Target Shadow: 3.2 Meters • Mag Anomaly: No • Classification1: debris • Description: hard target
	SC-LA-002 • Sonar Time at Target: 6/9/2013 10:13:36 PM • Click Position 36.8781505104 -75.4975421240 (WGS84) (X) 455659.96 (Y) 4081470.88 (Projected Coordinates) • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060913_SSM\SSS\160_SSS_SBP_MAG_002.jsf • Ping Number: 1133599 • Range to target: 33.64 Meters • Fish Height: 5.92 Meters • Line Name: 160_SSS_SBP_MAG_002 • Water Depth: 21.34 Meters	Dimensions and attributes • Target Width: 4.1 Meters • Target Height: 0.0 Meters • Target Length: 11.8 Meters • Target Shadow: 0.0 Meters • Mag Anomaly: No • Classification1: debris • Description: linear target w/ shadow

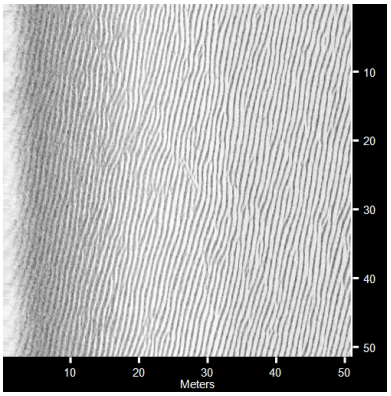


SC-LA-003

- Sonar Time at Target: 6/4/2013 9:01:22 PM
- Click Position
  36.8889376708 -75.4971414943 (WGS84)
  (X) 455701.90 (Y) 4082667.34 (Projected Coordinates)
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060413_LA_SSM\SSS\155_004_2051.001.jsf
- Ping Number: 10618
- Range to target: 17.32 Meters
- Fish Height: 4.78 Meters
- Line Name: 155_004_2051.001
- Water Depth: 22.48 Meters

Dimensions and attributes

- Target Width: 1.5 Meters
- Target Height: 0.2 Meters
- Target Length: 4.1 Meters
- Target Shadow: 1.0 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: hard target w/ shadow

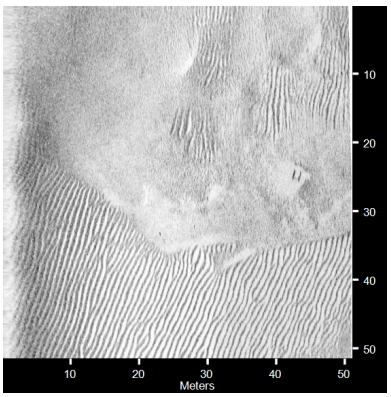


SC-LA-004

- Sonar Time at Target: 6/4/2013 9:36:03 AM
- Click Position
  36.9060910595 -75.4883508939 (WGS84)
  (X) 456494.93 (Y) 4084566.17 (Projected Coordinates)
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060413_LA_SSM\SSS\155_030_0914.002.jsf
- Ping Number: 564884
- Range to target: 27.57 Meters
- Fish Height: 4.88 Meters
- Line Name: 155_030_0914.002
- Water Depth: 21.64 Meters

Dimensions and attributes

- Target Width: 0.6 Meters
- Target Height: 0.1 Meters
- Target Length: 5.3 Meters
- Target Shadow: 0.4 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: Elongated hard target w/ mag anomaly

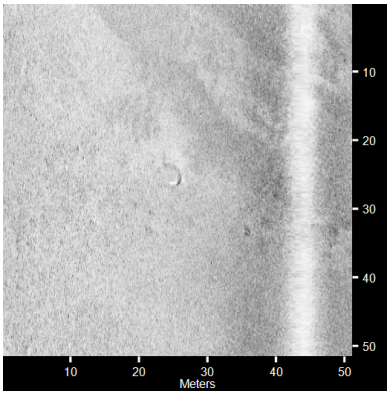


SC-LA-005

- Sonar Time at Target: 6/4/2013 11:00:20 AM
- Click Position
  36.9006574548 -75.4881913092 (WGS84)
  (X) 456506.06 (Y) 4083963.33 (Projected Coordinates)
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060413_LA_SSM\SSS\155_033_1053.jsf
- Ping Number: 631041
- Range to target: 42.80 Meters
- Fish Height: 3.53 Meters
- Line Name: 155_033_1053
- Water Depth: 23.39 Meters

Dimensions and attributes

- Target Width: 3.4 Meters
- Target Height: 0.0 Meters
- Target Length: 1.6 Meters
- Target Shadow: 0.0 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: hard target

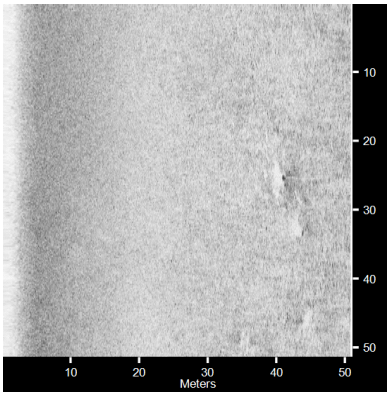


SC-LA-006

- Sonar Time at Target: 6/4/2013 11:30:55 AM
- Click Position
  36.8851138568 -75.4873773796 (WGS84)
  (X) 456569.77 (Y) 4082238.67 (Projected Coordinates)
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060413_LA_SSM\SSS\155_034_1123.jsf
- Ping Number: 655048
- Range to target: 18.01 Meters
- Fish Height: 4.58 Meters
- Line Name: 155_034_1123
- Water Depth: 23.45 Meters

Dimensions and attributes

- Target Width: 2.2 Meters
- Target Height: 0.0 Meters
- Target Length: 4.2 Meters
- Target Shadow: 0.0 Meters
- Mag Anomaly: N
- Classification1: geology
- Description: bump

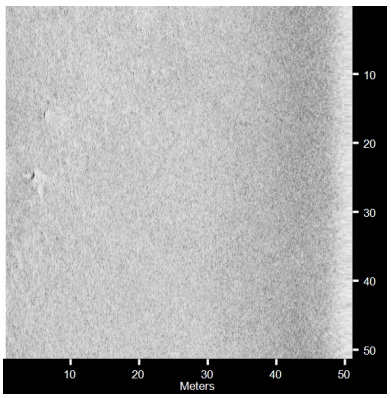


SC-LA-007

- Sonar Time at Target: 6/4/2013 12:39:22 PM
- Click Position
  36.8837046398 -75.4859591758 (WGS84)
  (X) 456695.36 (Y) 4082081.70 (Projected Coordinates)
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060413_LA_SSM\SSS\155_036_1232.jsf
- Ping Number: 708767
- Range to target: 40.61 Meters
- Fish Height: 4.83 Meters
- Line Name: 155_036_1232
- Water Depth: 22.44 Meters

Dimensions and attributes

- Target Width: 2.7 Meters
- Target Height: 0.2 Meters
- Target Length: 5.5 Meters
- Target Shadow: 1.5 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: hard target w/ mag anomaly



SC-LA-008

- Sonar Time at Target: 6/10/2013 2:36:54 AM
- Click Position
  36.8823059355 -75.4853064102 (WGS84)
  (X) 456752.74 (Y) 4081926.24 (Projected Coordinates)
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_061013_SSM\SSS\161_SS_SB_MAG_DRV_038A.002.jsf
- Ping Number: 1328183
- Range to target: 46.18 Meters
- Fish Height: 6.07 Meters
- Line Name: 161_SS_SB_MAG_DRV_038A.002
- Water Depth: 22.43 Meters

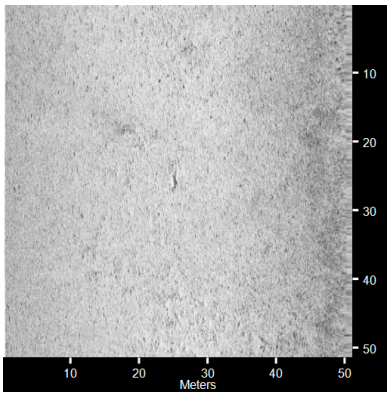
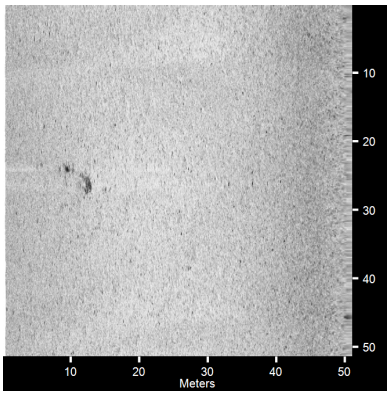
Dimensions and attributes

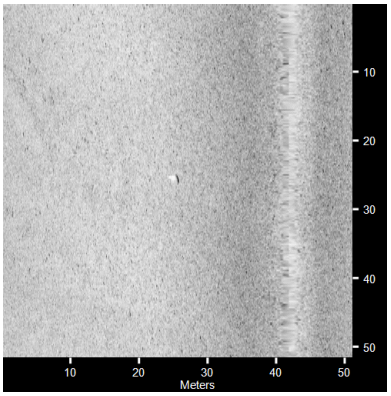
- Target Width: 3.6 Meters
- Target Height: 0.3 Meters
- Target Length: 3.7 Meters
- Target Shadow: 2.3 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: small hard target

Sonar Contacts, Survey Corridor

Report SonarContacts_CableRoute

Generated on 5/20/2014 8:15:21 AM

Target Image	Target Info	User Entered Info
	SC-CR-0001 • Sonar Time at Target: 6/9/2013 5:46:53 AM • Click Position 36.8153684130 -75.9569500022 (WGS84) (X) 414647.79 (Y) 4074818.05 (Projected Coordinates) • Map Projection: UTM84-18N • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060913_SSM\SSS\160_SSS_MAG_60C.001.jsf • Ping Number: 393013 • Range to target: 26.38 Meters • Fish Height: 5.18 Meters • Line Name: 160_SSS_MAG_60C.001	Dimensions and attributes • Target Width: 1.4 Meters • Target Height: 0.1 Meters • Target Length: 1.9 Meters • Target Shadow: 0.7 Meters • Mag Anomaly: unknown • Classification1: debris • Description: rectangular-shaped contact
	SC-CR-0002 • Sonar Time at Target: 6/9/2013 2:17:54 AM • Click Position 36.8159238093 -75.9454293208 (WGS84) (X) 415675.98 (Y) 4074869.44 (Projected Coordinates) • Map Projection: UTM84-18N • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060913_SSM\SSS\160_ALL_150.jsf • Ping Number: 231300 • Range to target: 38.82 Meters • Fish Height: 5.58 Meters • Line Name: 160_ALL_150	Dimensions and attributes • Target Width: 1.4 Meters • Target Height: 0.0 Meters • Target Length: 2.7 Meters • Target Shadow: 0.0 Meters • Mag Anomaly: Y • Classification1: debris • Description: hard target

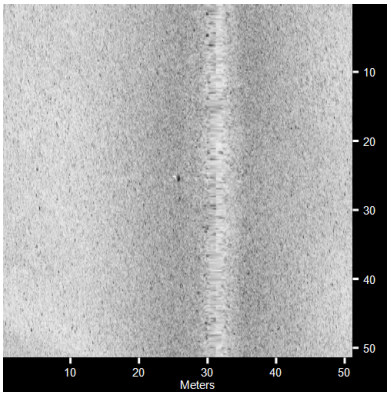


SC-CR-0003

- Sonar Time at Target: 6/9/2013 5:38:52 AM
- Click Position
  36.8166026126 -75.9410413277 (WGS84)
  (X) 416068.10 (Y) 4074940.88 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060913_SSM\SSS\160_SSS_MAG_60C.jsf
- Ping Number: 386721
- Range to target: 16.22 Meters
- Fish Height: 4.88 Meters
- Line Name: 160_SSS_MAG_60C

Dimensions and attributes

- Target Width: 0.8 Meters
- Target Height: 0.3 Meters
- Target Length: 1.3 Meters
- Target Shadow: 1.2 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: hard target w/ shadow

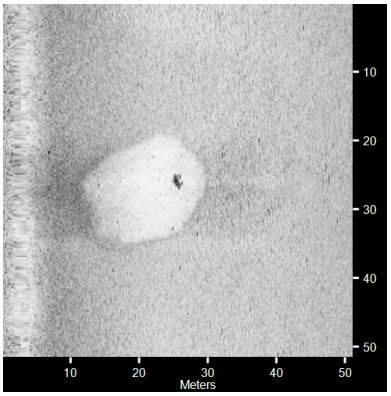


SC-CR-0004

- Sonar Time at Target: 6/9/2013 5:36:51 AM
- Click Position
  36.8170000836 -75.9371152740 (WGS84)
  (X) 416418.71 (Y) 4074981.53 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060913_SSM\SSS\160_SSS_MAG_60C.jsf
- Ping Number: 385145
- Range to target: 5.57 Meters
- Fish Height: 4.98 Meters
- Line Name: 160_SSS_MAG_60C

Dimensions and attributes

- Target Width: 0.5 Meters
- Target Height: 0.4 Meters
- Target Length: 0.9 Meters
- Target Shadow: 0.7 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: Small hard target w/ shadow and Mag Anomaly

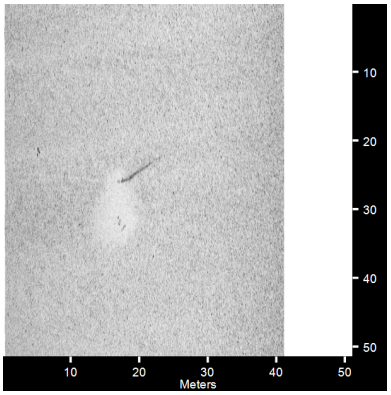


SC-CR-0005

- Sonar Time at Target: 6/9/2013 1:42:57 AM
- Click Position
  36.8181993417 -75.9171250132 (WGS84)
  (X) 418202.96 (Y) 4075097.28 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060913_SSM\SSS\160_ALL_120.004.jsf
- Ping Number: 205887
- Range to target: 22.89 Meters
- Fish Height: 5.03 Meters
- Line Name: 160_ALL_120.004

Dimensions and attributes

- Target Width: 1.6 Meters
- Target Height: 0.0 Meters
- Target Length: 2.1 Meters
- Target Shadow: 0.0 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: hard target in shallow depression

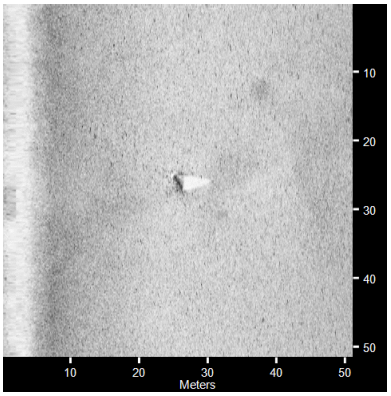


SC-CR-0006

- Sonar Time at Target: 6/8/2013 10:37:55 PM
- Click Position
  36.8204846397 -75.9104770209 (WGS84)
  (X) 418798.32 (Y) 4075345.13 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060813_SSM\SSS\159_SPB_MAG_-90.003.jsf
- Ping Number: 84389
- Range to target: 33.74 Meters
- Fish Height: 5.23 Meters
- Line Name: 159_SPB_MAG_-90.003

Dimensions and attributes

- Target Width: 0.9 Meters
- Target Height: 0.0 Meters
- Target Length: 6.4 Meters
- Target Shadow: 0.0 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: hard targets, one linear, w/ mag anomaly

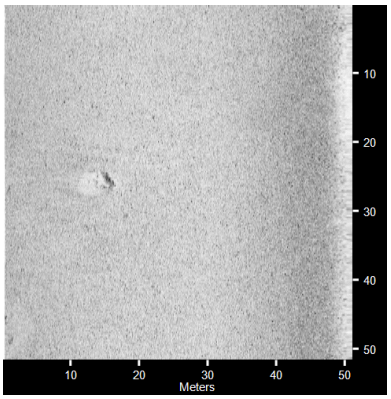


SC-CR-0007

- Sonar Time at Target: 6/6/2013 11:31:56 PM
- Click Position
  36.8192140901 -75.9084788589 (WGS84)
  (X) 418975.19 (Y) 4075202.49 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_000.2307.002.jsf
- Ping Number: 913355
- Range to target: 23.59 Meters
- Fish Height: 5.52 Meters
- Line Name: 157_000.2307.002

Dimensions and attributes

- Target Width: 1.2 Meters
- Target Height: 0.6 Meters
- Target Length: 3.0 Meters
- Target Shadow: 3.1 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: hard target w/ shadow

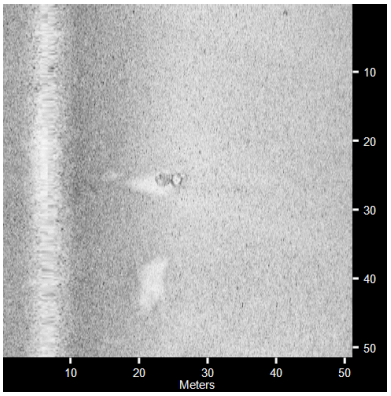
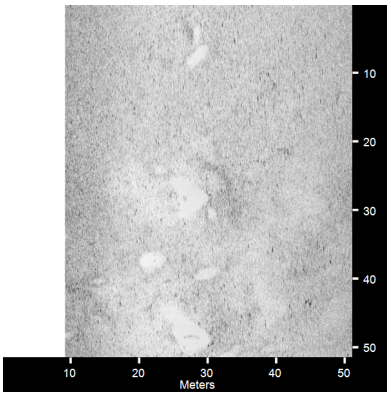
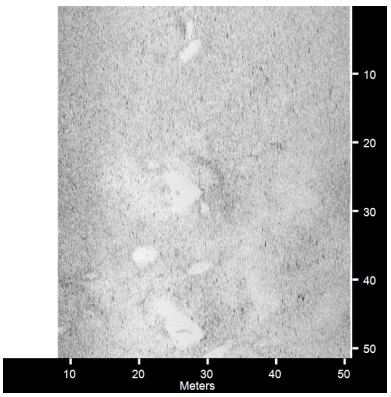


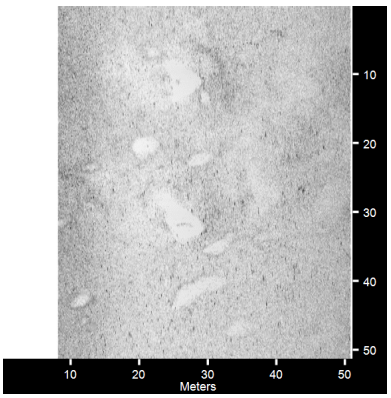
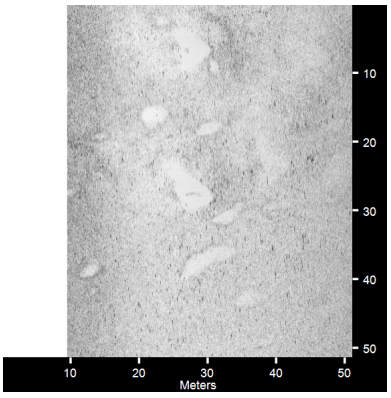
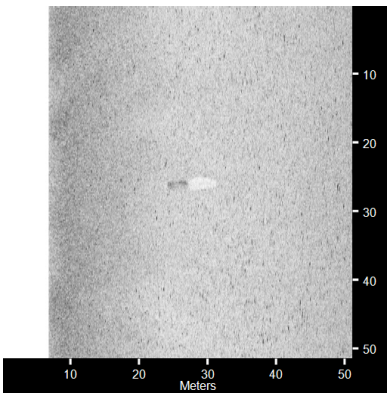
SC-CR-0008

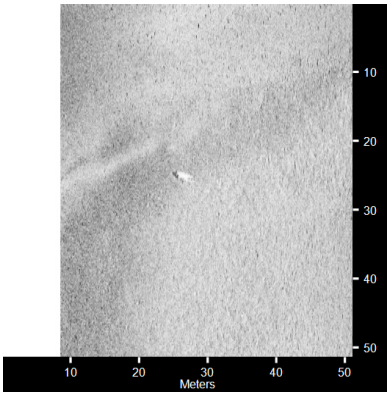
- Sonar Time at Target: 6/9/2013 12:27:23 PM
- Click Position
  36.8202229234 -75.8893917258 (WGS84)
  (X) 420678.60 (Y) 4075298.39 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060913_SSM\SSS\160_M120_B_1144.004.jsf
- Ping Number: 711105
- Range to target: 35.48 Meters
- Fish Height: 5.32 Meters
- Line Name: 160_M120_B_1144.004

Dimensions and attributes

- Target Width: 2.1 Meters
- Target Height: 0.2 Meters
- Target Length: 2.8 Meters
- Target Shadow: 1.5 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: hard target w/ anomaly

	SC-CR-0009 • Sonar Time at Target: 6/9/2013 12:27:20 PM • Click Position 36.8207149290 -75.8892991415 (WGS84) (X) 420687.37 (Y) 4075352.90 (Projected Coordinates) • Map Projection: UTM84-18N • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060913_SSM\SSS\160_M120_B_1144.004.jsf • Ping Number: 711066 • Range to target: 18.96 Meters • Fish Height: 4.68 Meters • Line Name: 160_M120_B_1144.004	Dimensions and attributes • Target Width: 1.9 Meters • Target Height: 0.0 Meters • Target Length: 3.1 Meters • Target Shadow: 0.0 Meters • Mag Anomaly: Y • Classification1: debris • Description: hard target w/ anomaly
	SC-CR-0010 • Sonar Time at Target: 6/9/2013 4:55:01 PM • Click Position 36.8205105632 -75.8874071473 (WGS84) (X) 420855.90 (Y) 4075328.66 (Projected Coordinates) • Map Projection: UTM83-18 • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060913_SSM\SSS\160_M150G.001.jsf • Ping Number: 921201 • Range to target: 24.38 Meters • Fish Height: 4.83 Meters • Line Name: 160_M150G.001	Dimensions and attributes • Target Width: 7.4 Meters • Target Height: 0.5 Meters • Target Length: 6.8 Meters • Target Shadow: 2.7 Meters • Mag Anomaly: Nearby • Classification1: debris • Description: Mound
	SC-CR-0011 • Sonar Time at Target: 6/9/2013 4:55:01 PM • Click Position 36.8203543156 -75.8874012231 (WGS84) (X) 420856.26 (Y) 4075311.32 (Projected Coordinates) • Map Projection: UTM83-18 • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060913_SSM\SSS\160_M150G.001.jsf • Ping Number: 921206 • Range to target: 41.70 Meters • Fish Height: 4.83 Meters • Line Name: 160_M150G.001	Dimensions and attributes • Target Width: 5.5 Meters • Target Height: 0.0 Meters • Target Length: 6.6 Meters • Target Shadow: 0.0 Meters • Mag Anomaly: Nearby • Classification1: debris • Description: Mound, 0.4m height on bathy

	SC-CR-0012 • Sonar Time at Target: 6/9/2013 4:55:07 PM • Click Position 36.8203960466 -75.8872327074 (WGS84) (X) 420871.34 (Y) 4075315.81 (Projected Coordinates) • Map Projection: UTM83-18 • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060913_SSM\SSS\160_M150G.001.jsf • Ping Number: 921285 • Range to target: 36.53 Meters • Fish Height: 4.93 Meters • Line Name: 160_M150G.001	Dimensions and attributes • Target Width: 6.2 Meters • Target Height: 0.4 Meters • Target Length: 7.3 Meters • Target Shadow: 3.3 Meters • Mag Anomaly: Nearby • Classification1: debris • Description: Mound
	SC-CR-0013 • Sonar Time at Target: 6/9/2013 4:55:09 PM • Click Position 36.8205065560 -75.8871800923 (WGS84) (X) 420876.14 (Y) 4075328.03 (Projected Coordinates) • Map Projection: UTM83-18 • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060913_SSM\SSS\160_M150G.001.jsf • Ping Number: 921306 • Range to target: 24.09 Meters • Fish Height: 5.08 Meters • Line Name: 160_M150G.001	Dimensions and attributes • Target Width: 7.5 Meters • Target Height: 0.8 Meters • Target Length: 8.0 Meters • Target Shadow: 4.5 Meters • Mag Anomaly: Nearby • Classification1: debris • Description: Mound
	SC-CR-0014 • Sonar Time at Target: 6/6/2013 2:08:01 PM • Click Position 36.8175748703 -75.8640717612 (WGS84) (X) 422934.18 (Y) 4074983.93 (Projected Coordinates) • Map Projection: UTM84-18N • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_60_1401.jsf • Ping Number: 501119 • Range to target: 22.79 Meters • Fish Height: 6.12 Meters • Line Name: 157_60_1401	Dimensions and attributes • Target Width: 1.0 Meters • Target Height: 0.9 Meters • Target Length: 2.6 Meters • Target Shadow: 4.1 Meters • Mag Anomaly: N • Classification1: debris • Description: reflective target w/ shadow

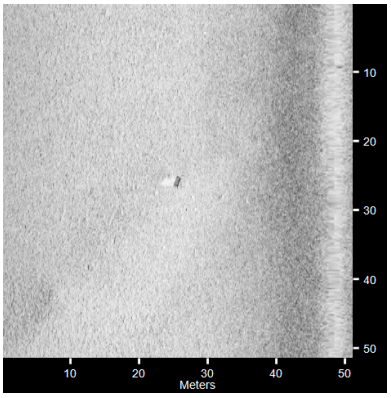


SC-CR-0015

- Sonar Time at Target: 6/7/2013 10:21:14 AM
- Click Position
  36.8179329908 -75.8597165387 (WGS84)
  (X) 423322.99 (Y) 4075020.15 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060713_SSM\SSS\158_-060_1014.jsf
- Ping Number: 1357990
- Range to target: 22.10 Meters
- Fish Height: 5.62 Meters
- Line Name: 158_-060_1014

Dimensions and attributes

- Target Width: 0.9 Meters
- Target Height: 0.3 Meters
- Target Length: 1.6 Meters
- Target Shadow: 1.2 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: hard target w/ shadow and mag anomaly

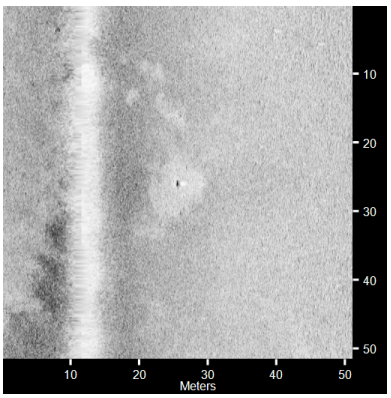


SC-CR-0016

- Sonar Time at Target: 6/6/2013 11:36:55 AM
- Click Position
  36.8157330897 -75.8547741138 (WGS84)
  (X) 423761.62 (Y) 4074772.16 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_90_1130.jsf
- Ping Number: 378924
- Range to target: 22.79 Meters
- Fish Height: 4.88 Meters
- Line Name: 157_90_1130

Dimensions and attributes

- Target Width: 0.8 Meters
- Target Height: 0.5 Meters
- Target Length: 1.4 Meters
- Target Shadow: 2.4 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: hard, rectangular target w/ shadow

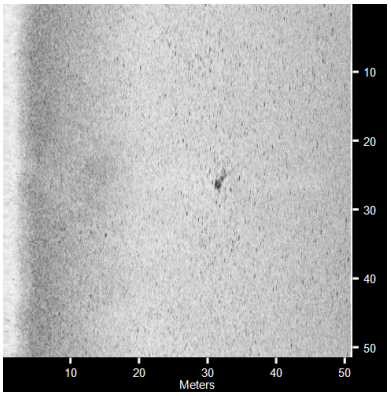


SC-CR-0017

- Sonar Time at Target: 6/6/2013 3:12:18 AM
- Click Position
  36.8123473344 -75.8367225939 (WGS84)
  (X) 425368.41 (Y) 4074382.32 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_120_0253.002.jsf
- Ping Number: 769195
- Range to target: 14.03 Meters
- Fish Height: 5.37 Meters
- Line Name: 157_120_0253.002

Dimensions and attributes

- Target Width: 0.3 Meters
- Target Height: 0.3 Meters
- Target Length: 0.9 Meters
- Target Shadow: 0.9 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: hard target w/ shadow

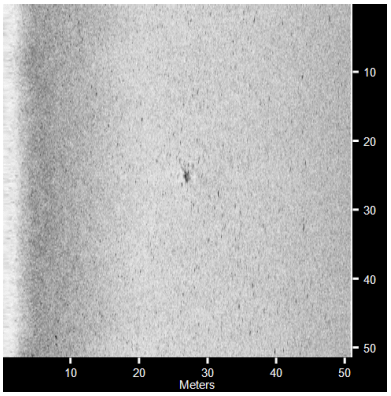


SC-CR-0018

- Sonar Time at Target: 6/7/2013 1:37:11 AM
- Click Position
  36.8099605874 -75.8178754818 (WGS84)
  (X) 427047.25 (Y) 4074103.01 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060713_SSM\SSS\158_000_0108.003.jsf
- Ping Number: 955278
- Range to target: 31.55 Meters
- Fish Height: 4.28 Meters
- Line Name: 158_000_0108.003

Dimensions and attributes

- Target Width: 1.0 Meters
- Target Height: 0.1 Meters
- Target Length: 2.3 Meters
- Target Shadow: 0.5 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: hard target w/ shadow

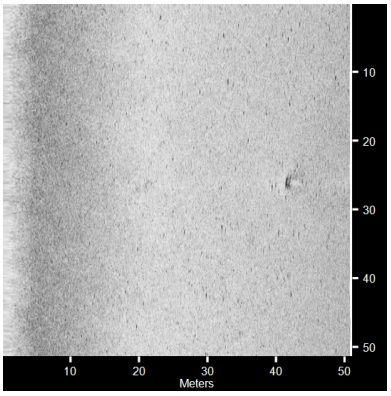


SC-CR-0019

- Sonar Time at Target: 6/7/2013 1:38:02 AM
- Click Position
  36.8098381304 -75.8160632582 (WGS84)
  (X) 427208.78 (Y) 4074088.04 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060713_SSM\SSS\158_000_0108.003.jsf
- Ping Number: 955949
- Range to target: 26.28 Meters
- Fish Height: 4.43 Meters
- Line Name: 158_000_0108.003

Dimensions and attributes

- Target Width: 1.1 Meters
- Target Height: 0.1 Meters
- Target Length: 2.0 Meters
- Target Shadow: 0.7 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: hard target

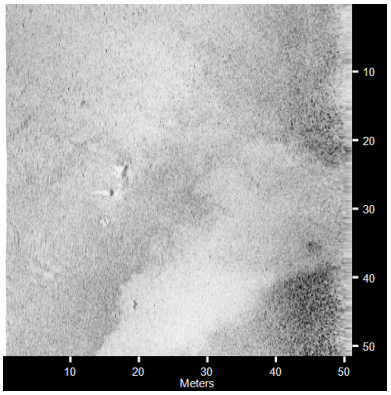


SC-CR-0020

- Sonar Time at Target: 6/10/2013 9:04:38 PM
- Click Position
  36.8093104592 -75.7929878366 (WGS84)
  (X) 429266.61 (Y) 4074012.19 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_061013_SSM\SSS\161_M120D.jsf
- Ping Number: 54260
- Range to target: 41.30 Meters
- Fish Height: 5.52 Meters
- Line Name: 161_M120D

Dimensions and attributes

- Target Width: 1.2 Meters
- Target Height: 0.1 Meters
- Target Length: 2.1 Meters
- Target Shadow: 1.1 Meters
- Mag Anomaly: N
- Classification1: debris or rock
- Description: hard target w/ shadow

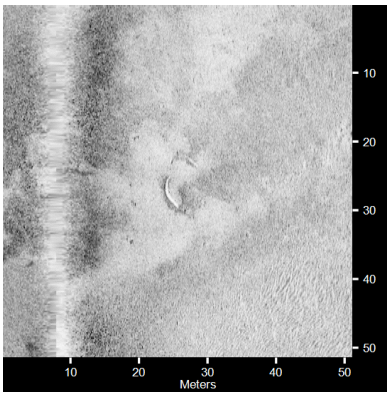


SC-CR-0021

- Sonar Time at Target: 6/6/2013 2:51:37 PM
- Click Position
  36.8079181484 -75.7819546638 (WGS84)
  (X) 430249.51 (Y) 4073849.63 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_60_1401.006.jsf
- Ping Number: 535348
- Range to target: 34.04 Meters
- Fish Height: 7.02 Meters
- Line Name: 157_60_1401.006

Dimensions and attributes

- Target Width: 1.3 Meters
- Target Height: 0.5 Meters
- Target Length: 0.9 Meters
- Target Shadow: 2.7 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: cluster of small (1m) hard targets w/ shadows and mag anomaly

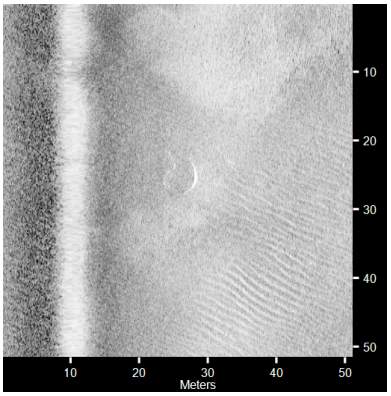


SC-CR-0022

- Sonar Time at Target: 6/10/2013 9:11:10 PM
- Click Position
  36.8090324944 -75.7809445415 (WGS84)
  (X) 430340.63 (Y) 4073972.51 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_061013_SSM\SSS\161_M120D.001.jsf
- Ping Number: 59383
- Range to target: 17.72 Meters
- Fish Height: 5.57 Meters
- Line Name: 161_M120D.001

Dimensions and attributes

- Target Width: 1.0 Meters
- Target Height: 0.1 Meters
- Target Length: 6.5 Meters
- Target Shadow: 0.3 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: cluster of elongated targets

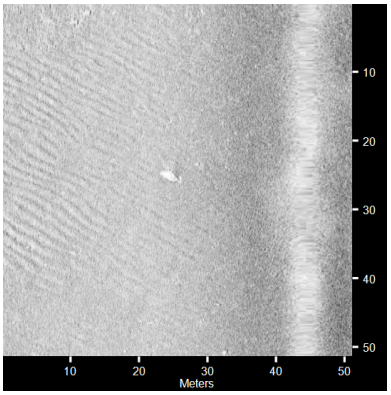


SC-CR-0023

- Sonar Time at Target: 6/6/2013 3:55:20 AM
- Click Position
  36.8068061481 -75.7786061727 (WGS84)
  (X) 430547.20 (Y) 4073723.84 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_120_0340.001.jsf
- Ping Number: 15703
- Range to target: 15.43 Meters
- Fish Height: 4.53 Meters
- Line Name: 157_120_0340.001

Dimensions and attributes

- Target Width: 3.7 Meters
- Target Height: 0.2 Meters
- Target Length: 5.6 Meters
- Target Shadow: 0.7 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: u-shaped linear target

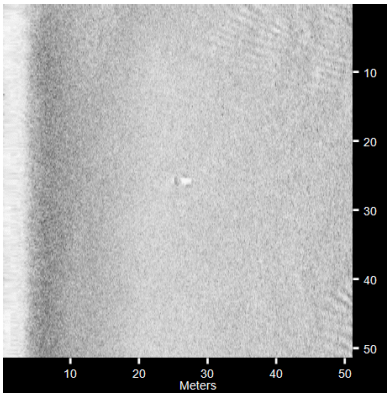


SC-CR-0024

- Sonar Time at Target: 6/10/2013 9:15:30 PM
- Click Position
  36.8090512055 -75.7729637249 (WGS84)
  (X) 431052.54 (Y) 4073968.80 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_061013_SSM\SSS\161_M120D.002.jsf
- Ping Number: 62784
- Range to target: 18.81 Meters
- Fish Height: 6.17 Meters
- Line Name: 161_M120D.002

Dimensions and attributes

- Target Width: 0.5 Meters
- Target Height: 0.3 Meters
- Target Length: 1.3 Meters
- Target Shadow: 1.0 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: elongated target w/ shadow

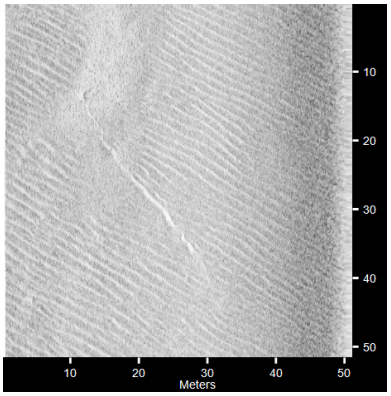


SC-CR-0025

- Sonar Time at Target: 6/7/2013 6:52:41 AM
- Click Position
  36.8082402097 -75.7702464835 (WGS84)
  (X) 431294.19 (Y) 4073876.88 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060713_SSM\SSS\158_-030_0432.017.jsf
- Ping Number: 1202765
- Range to target: 24.38 Meters
- Fish Height: 5.32 Meters
- Line Name: 158_-030_0432.017

Dimensions and attributes

- Target Width: 0.7 Meters
- Target Height: 0.2 Meters
- Target Length: 1.1 Meters
- Target Shadow: 1.1 Meters
- Mag Anomaly: N
- Classification1: debris or rock
- Description: hard target w/ shadow

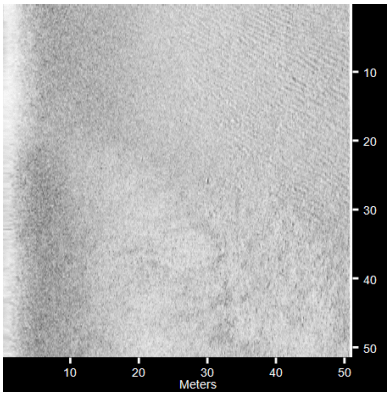


SC-CR-0026

- Sonar Time at Target: 6/6/2013 9:31:24 PM
- Click Position
  36.8070749756 -75.7670087529 (WGS84)
  (X) 431581.96 (Y) 4073745.30 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_30_2100.003.jsf
- Ping Number: 822277
- Range to target: 31.75 Meters
- Fish Height: 5.47 Meters
- Line Name: 157_30_2100.003

Dimensions and attributes

- Target Width: 0.2 Meters
- Target Height: 0.1 Meters
- Target Length: 33.5 Meters
- Target Shadow: 0.4 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: linear target w/ mag anomaly

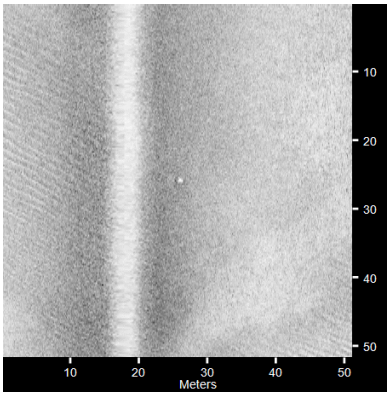


SC-CR-0027

- Sonar Time at Target: 6/6/2013 9:26:56 PM
- Click Position
  36.8072644636 -75.7574902564 (WGS84)
  (X) 432431.20 (Y) 4073759.55 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_30_2100.002.jsf
- Ping Number: 818766
- Range to target: 29.71 Meters
- Fish Height: 5.87 Meters
- Line Name: 157_30_2100.002

Dimensions and attributes

- Target Width: 0.5 Meters
- Target Height: 0.1 Meters
- Target Length: 0.8 Meters
- Target Shadow: 0.5 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: Small hard target

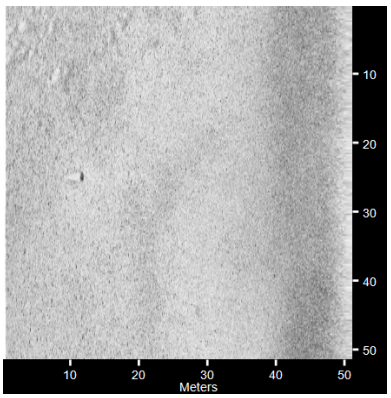


SC-CR-0028

- Sonar Time at Target: 6/6/2013 9:45:33 AM
- Click Position
  36.8063729412 -75.7547971498 (WGS84)
  (X) 432670.65 (Y) 4073658.75 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_90_0732.016.jsf
- Ping Number: 290449
- Range to target: 7.76 Meters
- Fish Height: 4.93 Meters
- Line Name: 157_90_0732.016

Dimensions and attributes

- Target Width: 0.9 Meters
- Target Height: 0.4 Meters
- Target Length: 0.9 Meters
- Target Shadow: 0.7 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: hard target

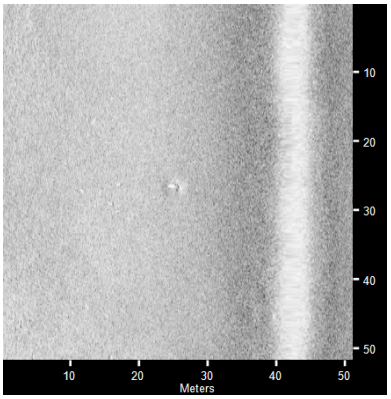


SC-CR-0029

- Sonar Time at Target: 6/6/2013 9:24:09 PM
- Click Position
  36.8063841487 -75.7516576434 (WGS84)
  (X) 432950.72 (Y) 4073657.79 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_30_2100.002.jsf
- Ping Number: 816588
- Range to target: 39.41 Meters
- Fish Height: 6.12 Meters
- Line Name: 157_30_2100.002

Dimensions and attributes

- Target Width: 1.2 Meters
- Target Height: 0.1 Meters
- Target Length: 1.3 Meters
- Target Shadow: 0.9 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: small hard target

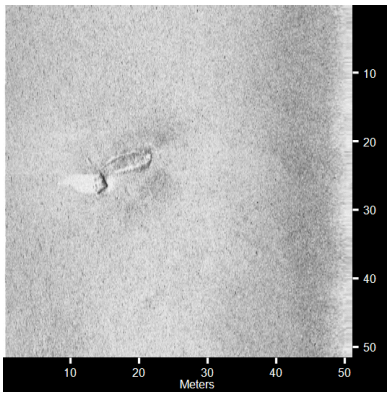


SC-CR-0030

- Sonar Time at Target: 6/7/2013 6:43:40 AM
- Click Position
  36.8070204012 -75.7506830585 (WGS84)
  (X) 433038.21 (Y) 4073727.69 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060713_SSM\SSS\158_-030_0432.015.jsf
- Ping Number: 1195679
- Range to target: 16.62 Meters
- Fish Height: 5.62 Meters
- Line Name: 158_-030_0432.015

Dimensions and attributes

- Target Width: 0.6 Meters
- Target Height: 0.2 Meters
- Target Length: 1.1 Meters
- Target Shadow: 0.6 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: small hard target w/ shadow

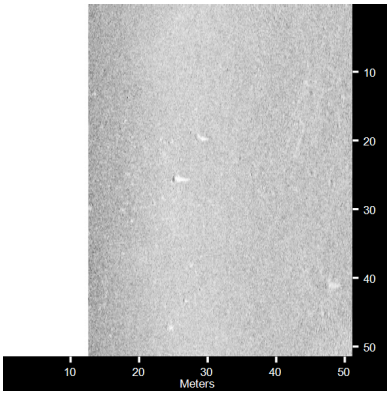


SC-CR-0066

- Sonar Time at Target: 6/10/2013 9:59:30 PM
- Click Position
  36.8090636544 -75.7453982391 (WGS84)
  (X) 433511.40 (Y) 4073950.66 (Projected Coordinates)
- Map Projection: UTM83-18
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_061013_SSM\SSS\161_M120E.jsf
- Ping Number: 97325
- Range to target: 35.43 Meters
- Fish Height: 5.47 Meters
- Line Name: 161_M120E

Dimensions and attributes

- Target Width: 4.6 Meters
- Target Height: 0.7 Meters
- Target Length: 8.9 Meters
- Target Shadow: 5.6 Meters
- Mag Anomaly:
- Classification1: debris
- Description: Hard target with shadow and surrounding debris

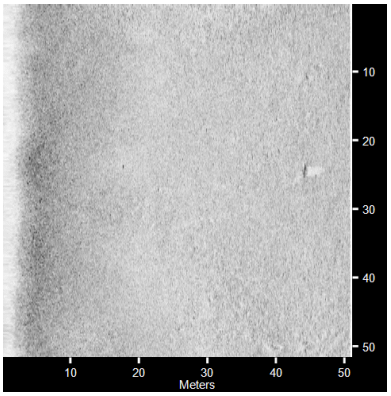


SC-CR-0031

- Sonar Time at Target: 6/9/2013 7:06:06 PM
- Click Position
  36.8094418001 -75.7415507218 (WGS84)
  (X) 433854.92 (Y) 4073989.94 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060913_SSM\SSS\160_M150H.003.jsf
- Ping Number: 997422
- Range to target: 22.99 Meters
- Fish Height: 6.52 Meters
- Line Name: 160_M150H.003

Dimensions and attributes

- Target Width: 0.9 Meters
- Target Height: 0.4 Meters
- Target Length: 1.2 Meters
- Target Shadow: 1.5 Meters
- Mag Anomaly: N
- Classification1: debris or rock
- Description: hard target w/ shadow

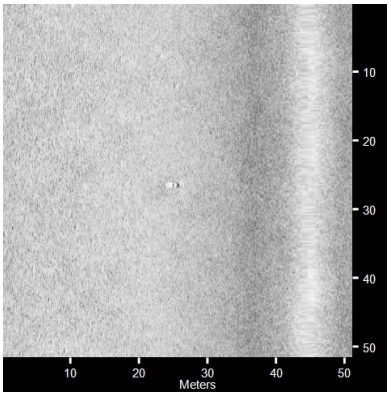


SC-CR-0032

- Sonar Time at Target: 6/7/2013 4:37:32 PM
- Click Position
  36.8103345837 -75.7374161710 (WGS84)
  (X) 434224.48 (Y) 4074086.13 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060713_SSM\SSS\158_-090_1420.016.jsf
- Ping Number: 1653680
- Range to target: 43.89 Meters
- Fish Height: 4.83 Meters
- Line Name: 158_-090_1420.016

Dimensions and attributes

- Target Width: 1.0 Meters
- Target Height: 0.2 Meters
- Target Length: 1.9 Meters
- Target Shadow: 2.2 Meters
- Mag Anomaly: N
- Classification1: debris or rock
- Description: hard target w/ shadow

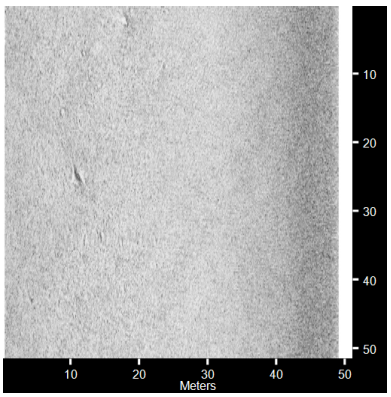


SC-CR-0033

- Sonar Time at Target: 6/6/2013 9:12:00 PM
- Click Position
  36.8105190194 -75.7266462135 (WGS84)
  (X) 435185.31 (Y) 4074099.23 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_30_2100.001.jsf
- Ping Number: 807051
- Range to target: 19.06 Meters
- Fish Height: 5.72 Meters
- Line Name: 157_30_2100.001

Dimensions and attributes

- Target Width: 1.1 Meters
- Target Height: 0.2 Meters
- Target Length: 0.7 Meters
- Target Shadow: 0.7 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: small hard target

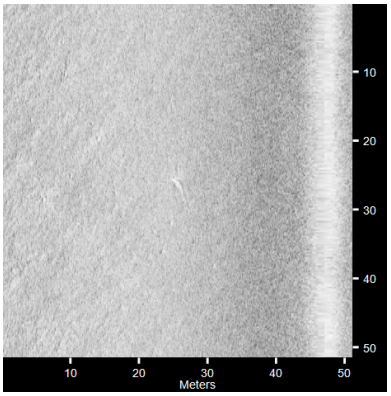


SC-CR-0034

- Sonar Time at Target: 6/6/2013 4:27:29 AM
- Click Position
  36.8115426285 -75.7185849827 (WGS84)
  (X) 435905.21 (Y) 4074207.35 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_120_0340.005.jsf
- Ping Number: 40946
- Range to target: 40.31 Meters
- Fish Height: 4.93 Meters
- Line Name: 157_120_0340.005

Dimensions and attributes

- Target Width: 0.1 Meters
- Target Height: 0.1 Meters
- Target Length: 1.7 Meters
- Target Shadow: 1.2 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: hard target

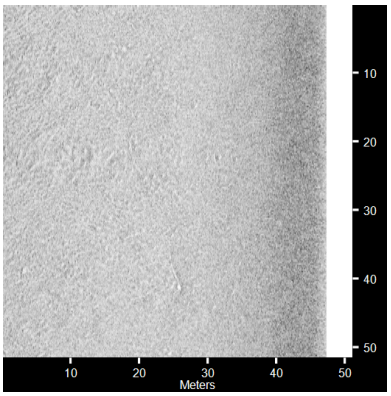


SC-CR-0035

- Sonar Time at Target: 6/6/2013 9:07:31 PM
- Click Position
  36.8121305013 -75.7175350474 (WGS84)
  (X) 435999.35 (Y) 4074271.86 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_30_2100.jsf
- Ping Number: 803530
- Range to target: 21.40 Meters
- Fish Height: 5.87 Meters
- Line Name: 157_30_2100

Dimensions and attributes

- Target Width: 0.5 Meters
- Target Height: 0.2 Meters
- Target Length: 3.3 Meters
- Target Shadow: 0.6 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: small target

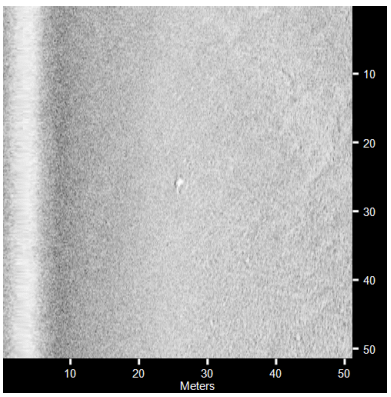


SC-CR-0036

- Sonar Time at Target: 6/6/2013 4:29:31 AM
- Click Position
  36.8121126179 -75.7148762506 (WGS84)
  (X) 436236.49 (Y) 4074268.10 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_120_0340.005.jsf
- Ping Number: 42537
- Range to target: 23.69 Meters
- Fish Height: 5.52 Meters
- Line Name: 157_120_0340.005

Dimensions and attributes

- Target Width: 0.2 Meters
- Target Height: 0.1 Meters
- Target Length: 5.8 Meters
- Target Shadow: 0.3 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: linear target w/ shadow

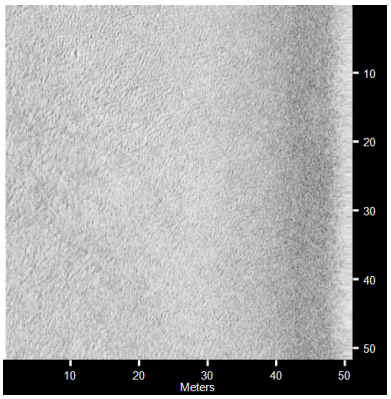
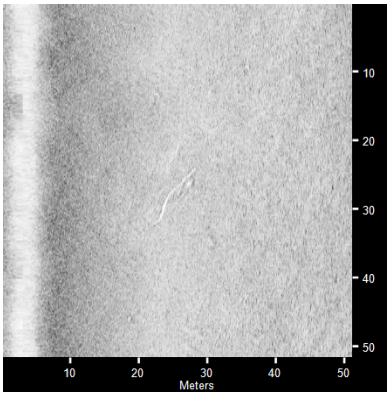
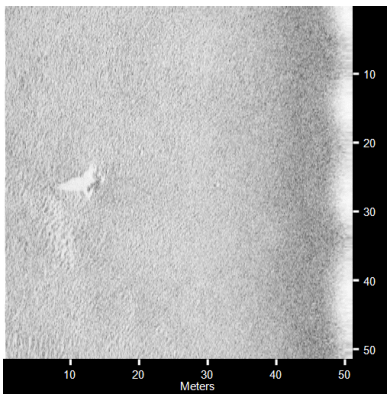


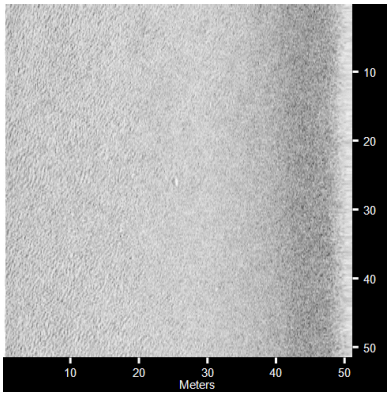
SC-CR-0037

- Sonar Time at Target: 6/6/2013 12:33:27 AM
- Click Position
  36.8125989916 -75.7109808688 (WGS84)
  (X) 436584.34 (Y) 4074319.46 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_150_0015.002.jsf
- Ping Number: 644569
- Range to target: 22.59 Meters
- Fish Height: 5.32 Meters
- Line Name: 157_150_0015.002

Dimensions and attributes

- Target Width: 0.9 Meters
- Target Height: 0.1 Meters
- Target Length: 2.7 Meters
- Target Shadow: 0.6 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: hard target

	SC-CR-0038 • Sonar Time at Target: 6/6/2013 9:01:12 PM • Click Position 36.8142327278 -75.7046885715 (WGS84) (X) 437146.93 (Y) 4074496.54 (Projected Coordinates) • Map Projection: UTM84-18N • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_30_2100.jsf • Ping Number: 798571 • Range to target: 40.41 Meters • Fish Height: 5.82 Meters • Line Name: 157_30_2100	Dimensions and attributes • Target Width: 0.9 Meters • Target Height: 0.0 Meters • Target Length: 0.9 Meters • Target Shadow: 0.0 Meters • Mag Anomaly: Y • Classification1: debris • Description: small hard target
	SC-CR-0039 • Sonar Time at Target: 6/7/2013 2:32:52 AM • Click Position 36.8150113851 -75.7023595032 (WGS84) (X) 437355.30 (Y) 4074581.39 (Projected Coordinates) • Map Projection: UTM84-18N • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060713_SSM\SSS\158_000_0108.010.jsf • Ping Number: 998975 • Range to target: 22.59 Meters • Fish Height: 4.93 Meters • Line Name: 158_000_0108.010	Dimensions and attributes • Target Width: 0.8 Meters • Target Height: 0.1 Meters • Target Length: 9.0 Meters • Target Shadow: 0.3 Meters • Mag Anomaly: N • Classification1: debris • Description: linear target
	SC-CR-0040 • Sonar Time at Target: 6/7/2013 4:18:06 PM • Click Position 36.8162622759 -75.6995264845 (WGS84) (X) 437609.00 (Y) 4074718.30 (Projected Coordinates) • Map Projection: UTM84-18N • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060713_SSM\SSS\158_-090_1420.014.jsf • Ping Number: 1638420 • Range to target: 37.62 Meters • Fish Height: 5.42 Meters • Line Name: 158_-090_1420.014	Dimensions and attributes • Target Width: 1.4 Meters • Target Height: 0.5 Meters • Target Length: 2.4 Meters • Target Shadow: 4.0 Meters • Mag Anomaly: Y • Classification1: debris • Description: hard target w/ shadow and mag anomaly

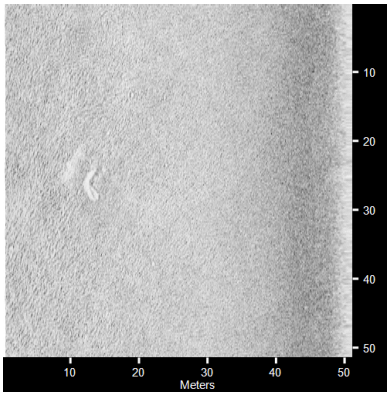


SC-CR-0041

- Sonar Time at Target: 6/6/2013 8:40:11 PM
- Click Position
  36.8170125637 -75.6898857841 (WGS84)
  (X) 438469.47 (Y) 4074795.29 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_30_2016.002.jsf
- Ping Number: 785664
- Range to target: 25.93 Meters
- Fish Height: 5.62 Meters
- Line Name: 157_30_2016.002

Dimensions and attributes

- Target Width: 0.8 Meters
- Target Height: 0.0 Meters
- Target Length: 1.4 Meters
- Target Shadow: 0.0 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: small hard target

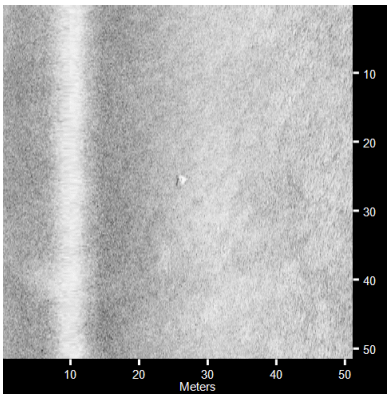


SC-CR-0042

- Sonar Time at Target: 6/6/2013 8:37:26 PM
- Click Position
  36.8178144933 -75.6844708870 (WGS84)
  (X) 438953.07 (Y) 4074880.78 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_30_2016.002.jsf
- Ping Number: 783502
- Range to target: 38.17 Meters
- Fish Height: 5.42 Meters
- Line Name: 157_30_2016.002

Dimensions and attributes

- Target Width: 1.0 Meters
- Target Height: 0.1 Meters
- Target Length: 4.2 Meters
- Target Shadow: 0.7 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: arcuate depression

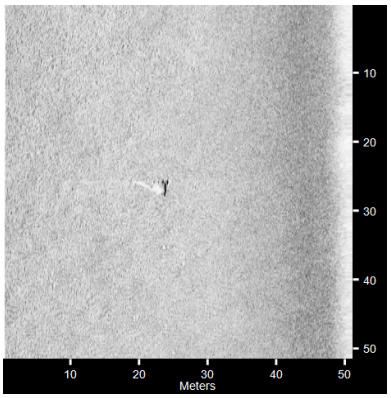


SC-CR-0043

- Sonar Time at Target: 6/5/2013 11:49:59 PM
- Click Position
  36.8180757331 -75.6796487001 (WGS84)
  (X) 439383.36 (Y) 4074906.69 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060513_LA_SSM\SSS\156_150_2206.012.jsf
- Ping Number: 624394
- Range to target: 15.78 Meters
- Fish Height: 5.18 Meters
- Line Name: 156_150_2206.012

Dimensions and attributes

- Target Width: 0.7 Meters
- Target Height: 0.2 Meters
- Target Length: 0.9 Meters
- Target Shadow: 0.7 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: hard target w/ shadow

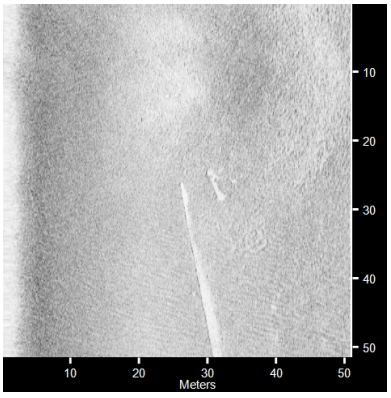


SC-CR-0044

- Sonar Time at Target: 6/7/2013 2:44:09 AM
- Click Position
  36.8196113843 -75.6790378290 (WGS84)
  (X) 439439.06 (Y) 4075076.65 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060713_SSM\SSS\158_000_0108.011.jsf
- Ping Number: 1007826
- Range to target: 27.47 Meters
- Fish Height: 5.28 Meters
- Line Name: 158_000_0108.011

Dimensions and attributes

- Target Width: 1.3 Meters
- Target Height: 0.7 Meters
- Target Length: 2.5 Meters
- Target Shadow: 4.4 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: hard target w/ shadow

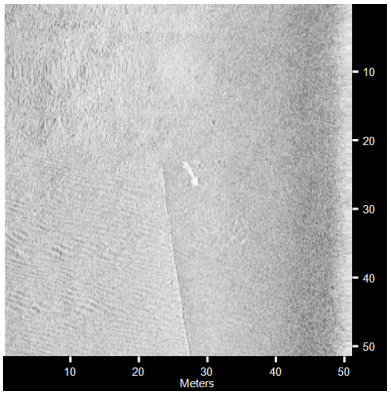


SC-CR-0045

- Sonar Time at Target: 6/7/2013 2:49:28 AM
- Click Position
  36.8210279433 -75.6678310486 (WGS84)
  (X) 440439.66 (Y) 4075226.75 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060713_SSM\SSS\158_000_0108.012.jsf
- Ping Number: 1012006
- Range to target: 30.36 Meters
- Fish Height: 4.78 Meters
- Line Name: 158_000_0108.012

Dimensions and attributes

- Target Width: 1.1 Meters
- Target Height: 0.1 Meters
- Target Length: 4.9 Meters
- Target Shadow: 0.5 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: linear target next to larger linear target

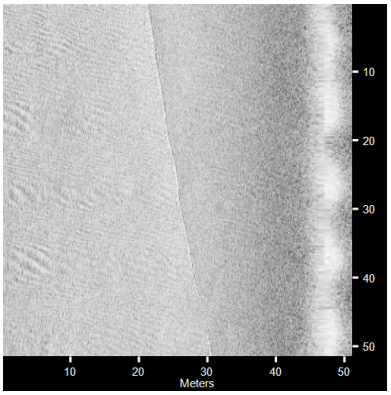


SC-CR-0046

- Sonar Time at Target: 6/6/2013 3:59:37 PM
- Click Position
  36.8210741629 -75.6677837621 (WGS84)
  (X) 440443.91 (Y) 4075231.85 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_60_1527.003.jsf
- Ping Number: 588720
- Range to target: 27.57 Meters
- Fish Height: 5.13 Meters
- Line Name: 157_60_1527.003

Dimensions and attributes

- Target Width: 0.6 Meters
- Target Height: 0.0 Meters
- Target Length: 28.5 Meters
- Target Shadow: 0.2 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: long, linear target, image shows half

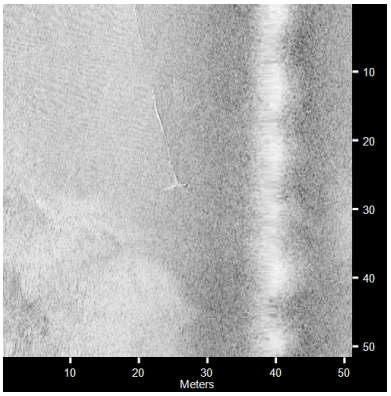


SC-CR-0047

- Sonar Time at Target: 6/6/2013 3:59:50 PM
- Click Position
  36.8210826864 -75.6673692302 (WGS84)
  (X) 440480.89 (Y) 4075232.54 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_60_1527.003.jsf
- Ping Number: 588890
- Range to target: 21.50 Meters
- Fish Height: 5.57 Meters
- Line Name: 157_60_1527.003

Dimensions and attributes

- Target Width: 0.4 Meters
- Target Height: 0.1 Meters
- Target Length: 52.1 Meters
- Target Shadow: 0.3 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: Linear Target, anchor chain?

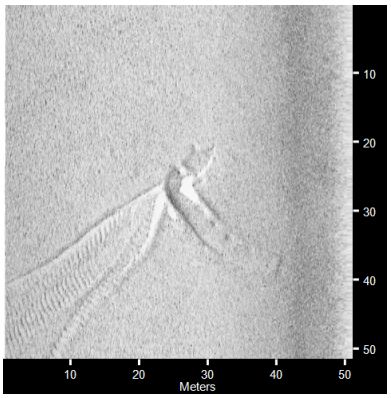


SC-CR-0048

- Sonar Time at Target: 6/6/2013 4:00:02 PM
- Click Position
  36.8210779874 -75.6669628667 (WGS84)
  (X) 440517.13 (Y) 4075231.77 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_60_1527.003.jsf
- Ping Number: 589054
- Range to target: 13.44 Meters
- Fish Height: 5.67 Meters
- Line Name: 157_60_1527.003

Dimensions and attributes

- Target Width: 0.8 Meters
- Target Height: 0.2 Meters
- Target Length: 28.0 Meters
- Target Shadow: 0.4 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: Long linear target, images shows half

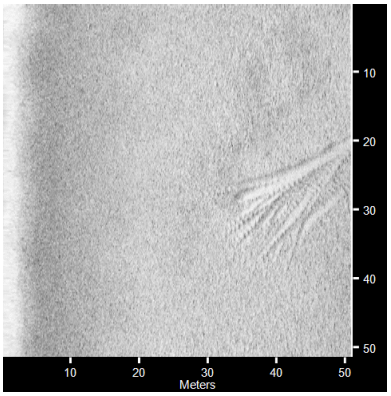


SC-CR-0049

- Sonar Time at Target: 6/6/2013 4:04:38 PM
- Click Position
  36.8227542697 -75.6580817413 (WGS84)
  (X) 441310.48 (Y) 4075412.23 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_60_1527.004.jsf
- Ping Number: 592668
- Range to target: 25.78 Meters
- Fish Height: 5.47 Meters
- Line Name: 157_60_1527.004

Dimensions and attributes

- Target Width: 4.5 Meters
- Target Height: 0.3 Meters
- Target Length: 6.1 Meters
- Target Shadow: 1.5 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: debris creating sediment ripples

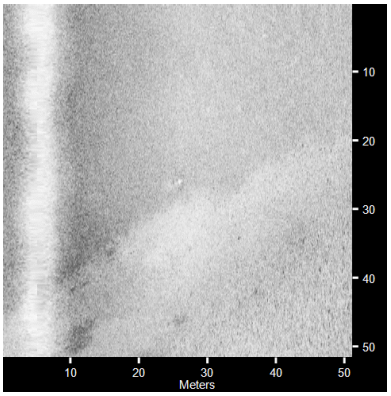


SC-CR-0050

- Sonar Time at Target: 6/7/2013 12:05:22 PM
- Click Position
  36.8231991880 -75.6578869841 (WGS84)
  (X) 441328.19 (Y) 4075461.47 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060713_SSM\SSS\158_-060_1014.013.jsf
- Ping Number: 1439650
- Range to target: 45.09 Meters
- Fish Height: 5.18 Meters
- Line Name: 158_-060_1014.013

Dimensions and attributes

- Target Width: 0.0 Meters
- Target Height: 0.0 Meters
- Target Length: 0.0 Meters
- Target Shadow: 0.0 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: rippled feature on seabed

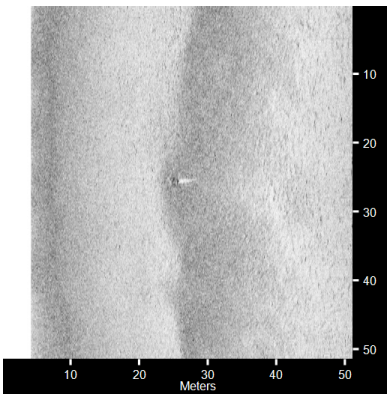


SC-CR-0051

- Sonar Time at Target: 6/7/2013 5:47:47 AM
- Click Position
  36.8282361915 -75.6319335618 (WGS84)
  (X) 443646.49 (Y) 4076004.61 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060713_SSM\SSS\158_-030_0432.009.jsf
- Ping Number: 1151813
- Range to target: 20.50 Meters
- Fish Height: 5.72 Meters
- Line Name: 158_-030_0432.009

Dimensions and attributes

- Target Width: 1.1 Meters
- Target Height: 0.0 Meters
- Target Length: 1.4 Meters
- Target Shadow: 0.0 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: hard target

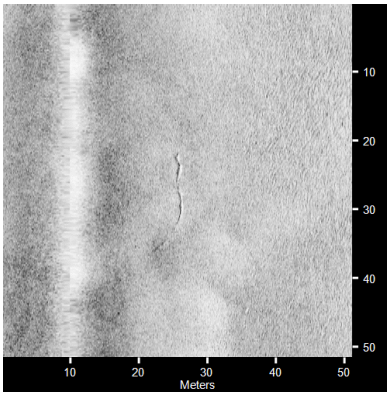
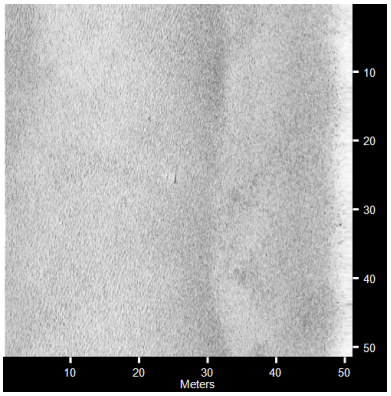
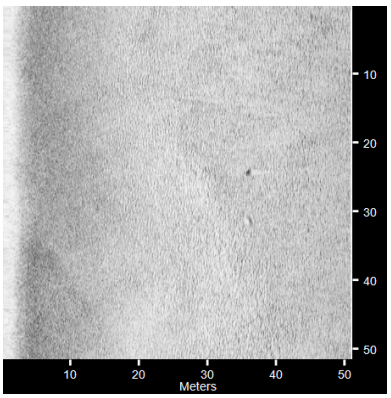


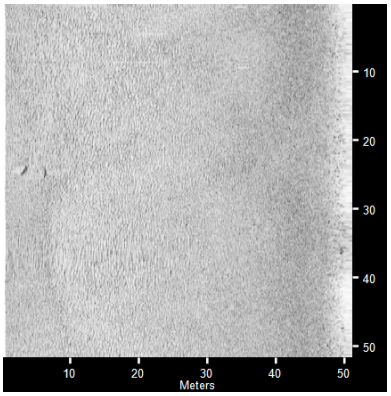
SC-CR-0052

- Sonar Time at Target: 6/6/2013 5:24:55 AM
- Click Position
  36.8267877715 -75.6293262657 (WGS84)
  (X) 443877.94 (Y) 4075842.40 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_120_0504.002.jsf
- Ping Number: 86030
- Range to target: 24.38 Meters
- Fish Height: 3.78 Meters
- Line Name: 157_120_0504.002

Dimensions and attributes

- Target Width: 1.1 Meters
- Target Height: 0.3 Meters
- Target Length: 1.1 Meters
- Target Shadow: 2.2 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: hard target w/ shadow

	SC-CR-0053 • Sonar Time at Target: 6/6/2013 4:59:36 PM • Click Position 36.8347301590 -75.6077388841 (WGS84) (X) 445808.69 (Y) 4076711.01 (Projected Coordinates) • Map Projection: UTM84-18N • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_60_1652.jsf • Ping Number: 619969 • Range to target: 15.73 Meters • Fish Height: 5.42 Meters • Line Name: 157_60_1652	Dimensions and attributes • Target Width: 1.3 Meters • Target Height: 0.1 Meters • Target Length: 13.7 Meters • Target Shadow: 0.2 Meters • Mag Anomaly: N • Classification1: debris • Description: linear target w/ shadow
	SC-CR-0054 • Sonar Time at Target: 6/7/2013 5:14:39 AM • Click Position 36.8530618571 -75.5718852637 (WGS84) (X) 449017.91 (Y) 4078724.85 (Projected Coordinates) • Map Projection: UTM84-18N • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060713_SSM\SSS\158_-030_0432.005.jsf • Ping Number: 1125859 • Range to target: 25.98 Meters • Fish Height: 5.23 Meters • Line Name: 158_-030_0432.005	Dimensions and attributes • Target Width: 0.9 Meters • Target Height: 0.0 Meters • Target Length: 2.6 Meters • Target Shadow: 0.2 Meters • Mag Anomaly: N • Classification1: debris • Description: elongated target
	SC-CR-0055 • Sonar Time at Target: 6/6/2013 8:08:33 AM • Click Position 36.8579427168 -75.5605789741 (WGS84) (X) 450029.03 (Y) 4079260.32 (Projected Coordinates) • Map Projection: UTM84-18N • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_90_0732.004.jsf • Ping Number: 214380 • Range to target: 36.03 Meters • Fish Height: 4.48 Meters • Line Name: 157_90_0732.004	Dimensions and attributes • Target Width: 0.7 Meters • Target Height: 0.2 Meters • Target Length: 1.0 Meters • Target Shadow: 1.9 Meters • Mag Anomaly: N • Classification1: debris • Description: hard target w/ shadow

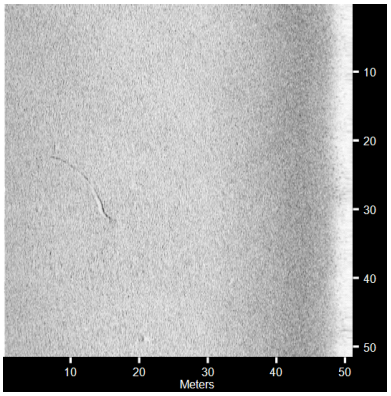


SC-CR-0056

- Sonar Time at Target: 6/7/2013 3:44:28 AM
- Click Position
  36.8596423055 -75.5590462603 (WGS84)
  (X) 450166.76 (Y) 4079448.06 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060713_SSM\SSS\158_000_0108.018.jsf
- Ping Number: 1055200
- Range to target: 47.67 Meters
- Fish Height: 5.62 Meters
- Line Name: 158_000_0108.018

Dimensions and attributes

- Target Width: 0.4 Meters
- Target Height: 0.1 Meters
- Target Length: 1.2 Meters
- Target Shadow: 1.0 Meters
- Mag Anomaly: N
- Classification1: debris or rock
- Description: hard target w/ shadow

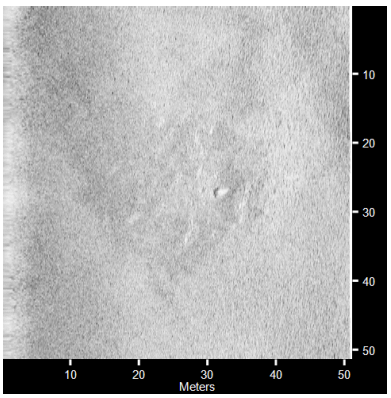


SC-CR-0057

- Sonar Time at Target: 6/7/2013 2:50:31 PM
- Click Position
  36.8627255883 -75.5530122151 (WGS84)
  (X) 450706.62 (Y) 4079786.96 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060713_SSM\SSS\158_-090_1420.003.jsf
- Ping Number: 1569714
- Range to target: 37.72 Meters
- Fish Height: 5.03 Meters
- Line Name: 158_-090_1420.003

Dimensions and attributes

- Target Width: 0.5 Meters
- Target Height: 0.1 Meters
- Target Length: 12.9 Meters
- Target Shadow: 0.4 Meters
- Mag Anomaly: N
- Classification1: debris
- Description: linear target

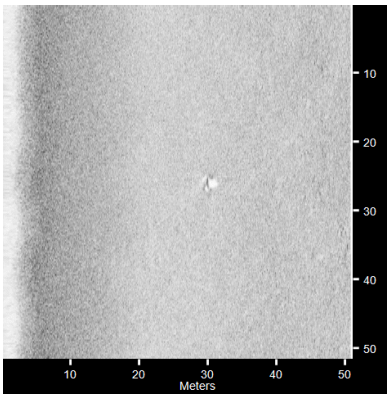
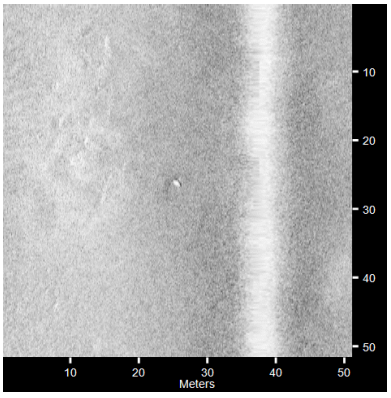
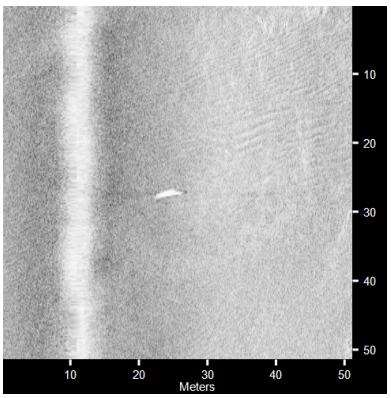


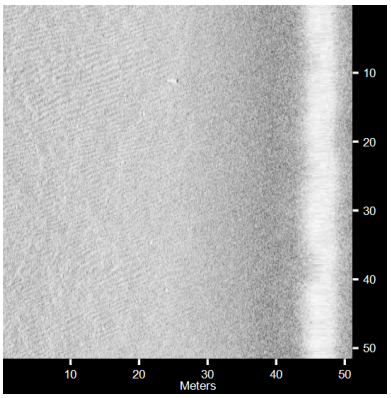
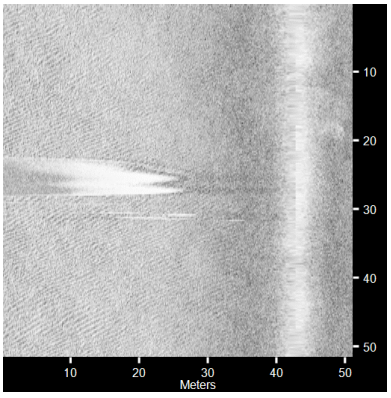
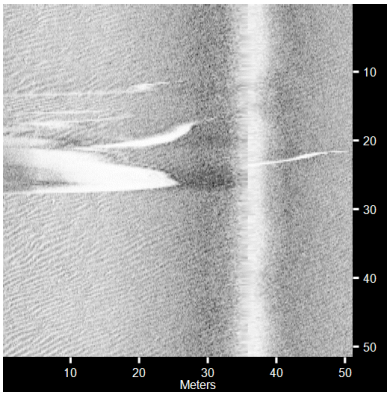
SC-CR-0058

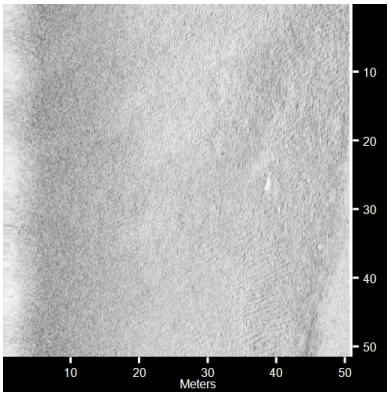
- Sonar Time at Target: 6/6/2013 5:33:04 PM
- Click Position
  36.8615898393 -75.5522208877 (WGS84)
  (X) 450776.43 (Y) 4079660.56 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_60_1652.004.jsf
- Ping Number: 646243
- Range to target: 31.35 Meters
- Fish Height: 5.62 Meters
- Line Name: 157_60_1652.004

Dimensions and attributes

- Target Width: 1.2 Meters
- Target Height: 0.2 Meters
- Target Length: 1.6 Meters
- Target Shadow: 1.2 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: hard target

	SC-CR-0059 • Sonar Time at Target: 6/6/2013 7:58:32 AM • Click Position 36.8666219603 -75.5426010038 (WGS84) (X) 451637.10 (Y) 4080213.87 (Projected Coordinates) • Map Projection: UTM84-18N • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_90_0732.003.jsf • Ping Number: 206586 • Range to target: 30.06 Meters • Fish Height: 5.32 Meters • Line Name: 157_90_0732.003	Dimensions and attributes • Target Width: 0.8 Meters • Target Height: 0.2 Meters • Target Length: 2.1 Meters • Target Shadow: 1.2 Meters • Mag Anomaly: Y • Classification1: debris • Description: small hard target
	SC-CR-0060 • Sonar Time at Target: 6/7/2013 4:55:38 AM • Click Position 36.8695414534 -75.5381768193 (WGS84) (X) 452033.26 (Y) 4080535.51 (Projected Coordinates) • Map Projection: UTM84-18N • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060713_SSM\SSS\158_-030_0432.002.jsf • Ping Number: 1110930 • Range to target: 11.94 Meters • Fish Height: 5.82 Meters • Line Name: 158_-030_0432.002	Dimensions and attributes • Target Width: 1.5 Meters • Target Height: 0.3 Meters • Target Length: 1.6 Meters • Target Shadow: 0.8 Meters • Mag Anomaly: N • Classification1: debris or rock • Description: hard target
	SC-CR-0061 • Sonar Time at Target: 6/7/2013 1:23:56 PM • Click Position 36.8718899156 -75.5338094712 (WGS84) (X) 452423.97 (Y) 4080793.84 (Projected Coordinates) • Map Projection: UTM84-18N • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060713_SSM\SSS\158_-060_1225.007.jsf • Ping Number: 1501317 • Range to target: 14.73 Meters • Fish Height: 4.88 Meters • Line Name: 158_-060_1225.007	Dimensions and attributes • Target Width: 1.3 Meters • Target Height: 0.8 Meters • Target Length: 1.7 Meters • Target Shadow: 2.9 Meters • Mag Anomaly: N • Classification1: debris • Description: target w/ shadow

	SC-CR-0062 • Sonar Time at Target: 6/7/2013 2:37:28 PM • Click Position 36.8725936534 -75.5330860806 (WGS84) (X) 452488.88 (Y) 4080871.55 (Projected Coordinates) • Map Projection: UTM84-18N • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060713_SSM\SSS\158_-090_1420.002.jsf • Ping Number: 1559469 • Range to target: 20.80 Meters • Fish Height: 5.42 Meters • Line Name: 158_-090_1420.002	Dimensions and attributes • Target Width: 0.3 Meters • Target Height: 0.3 Meters • Target Length: 0.6 Meters • Target Shadow: 1.4 Meters • Mag Anomaly: Y • Classification1: debris • Description: hard target w/ shadow and mag anomaly
	SC-CR-0063 • Sonar Time at Target: 6/6/2013 6:25:32 PM • Click Position 36.8811301210 -75.5131116063 (WGS84) (X) 454274.20 (Y) 4081808.76 (Projected Coordinates) • Map Projection: UTM84-18N • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_30_1815.001.jsf • Ping Number: 684270 • Range to target: 17.17 Meters • Fish Height: 5.52 Meters • Line Name: 157_30_1815.001	Dimensions and attributes • Target Width: 0.0 Meters • Target Height: 0.0 Meters • Target Length: 0.0 Meters • Target Shadow: 0.0 Meters • Mag Anomaly: • Classification1: artifact • Description: Fish in water column
	SC-CR-0064 • Sonar Time at Target: 6/6/2013 6:18:14 PM • Click Position 36.8871734241 -75.5007985866 (WGS84) (X) 455375.00 (Y) 4082473.33 (Projected Coordinates) • Map Projection: UTM84-18N • Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_30_1815.jsf • Ping Number: 678533 • Range to target: 10.20 Meters • Fish Height: 5.23 Meters • Line Name: 157_30_1815	Dimensions and attributes • Target Width: 0.0 Meters • Target Height: 0.0 Meters • Target Length: 0.0 Meters • Target Shadow: 0.0 Meters • Mag Anomaly: • Classification1: artifact • Description: Fish in water column



SC-CR-0065

- Sonar Time at Target: 6/6/2013 6:16:43 PM
- Click Position
  36.8887509918 -75.4985786723 (WGS84)
  (X) 455573.73 (Y) 4082647.30 (Projected Coordinates)
- Map Projection: UTM84-18N
- Acoustic Source File: Z:\VOWTAP\2000-DSS\Acquisition\VA_060613_SSM\SSS\157_30_1815.jsf
- Ping Number: 677354
- Range to target: 38.27 Meters
- Fish Height: 6.57 Meters
- Line Name: 157_30_1815

Dimensions and attributes

- Target Width: 0.6 Meters
- Target Height: 0.1 Meters
- Target Length: 2.6 Meters
- Target Shadow: 0.5 Meters
- Mag Anomaly: Y
- Classification1: debris
- Description: hard linear target

Sonar Contacts, Lease Area West

Sonar Contacts, Lease Area East

Sonar Contacts, Survey Corridor

Attachment G – Magnetometer Anomalies

			Shotpoint				Intensity (gammas)		Duration (meters)		NAD83 Coordinates (m)			
Anomaly ID	Area	Line	Date	Time	Tow Height	Signature	AS	T_filt	AS_Width	AS_HAWid	Easting	Northing	Latitude	Longitude
MC-CR-001	Cable Route	P160_MAG_M60AD	6/9/2013	7:20:25	-0.21	dipolar	3.22	4.61	4.36	1.67	414671.906	4074908.54	-75.95668986	36.81618618
MC-CR-002	Cable Route	P157_060_1246	6/6/2013	13:01:01	0.15	dipolar	2.57	-13.37	7.04	3.39	414879.876	4074867.89	-75.95435387	36.81583852
MC-CR-003	Cable Route	P159_SBP_MAG_M90	6/8/2013	22:10:46	4.01	dipolar	2.69	-1.71	9.46	4.13	414903.287	4075014.38	-75.95410781	36.81716101
MC-CR-004	Cable Route	P160_MAG_30	6/9/2013	3:50:10	3.9	dipolar	7.68	-25.74	21.02	6.65	414916.146	4074899.66	-75.95395082	36.81612814
MC-CR-005	Cable Route	P160_M150B	6/9/2013	15:17:34	3.61	complex	2.79	-4.25	9.08	1.03	414921.567	4075059.38	-75.95390791	36.81756826
MC-CR-006	Cable Route	P160_MAG_M60AA	6/9/2013	6:09:51	5.32	dipolar	2.43	4.75	8.22	2.88	414971.087	4074981.2	-75.95334402	36.81686803
MC-CR-007	Cable Route	P160_MAG_M60A	6/9/2013	5:53:04	5.27	dipolar	5.40	10.73	11.33	2.52	414990.307	4074998.98	-75.95313054	36.81703002
MC-CR-008	Cable Route	P160_M120A	6/9/2013	13:27:22	3.77	dipolar	3.84	-4.31	12.20	3.00	415003.027	4075059.45	-75.95299469	36.81757621
MC-CR-009	Cable Route	P157_000_2307	6/6/2013	23:10:29	4.82	single-pole	2.64	-30.84	9.07	2.74	415031.666	4074946.54	-75.95266101	36.81656107
MC-CR-011	Cable Route	P160_MAG_SSS_SBP	6/9/2013	4:02:25	3.68	single-pole	14.95	18.58	19.36	2.47	415055.646	4074846.04	-75.95238097	36.81565737
MC-CR-012	Cable Route	P160_MAG_M60AC	6/9/2013	6:27:56	0.31	dipolar	4.95	-0.55	7.84	3.07	415095.437	4074968.27	-75.95194854	36.81676266
MC-CR-013	Cable Route	P158_-060_0843	6/7/2013	8:50:57	3.77	single-pole	12.97	-25.17	20.33	6.12	415161.187	4074997.74	-75.95121473	36.81703418
MC-CR-014	Cable Route	P160_MAG_M30A	6/9/2013	5:54:15	3.64	complex	6.83	-48.43	5.01	2.05	415163.047	4074995.66	-75.95119365	36.8170156
MC-CR-015	Cable Route	P160_SSS_MAG_60C	6/9/2013	5:43:32	3.96	dipolar	6.39	6.94	22.58	4.81	415254.346	4074893.88	-75.95015878	36.81610639
MC-CR-016	Cable Route	P160_MAG_30	6/9/2013	3:47:53	4	complex	4.58	16.67	15.49	5.95	415308.596	4074930.45	-75.94955468	36.81644087
MC-CR-018	Cable Route	P159_SBP_MAG_M90	6/8/2013	22:03:09	3.27	dipolar	5.04	-6.42	27.13	5.07	415386.087	4074952.78	-75.94868846	36.81664907
MC-CR-019	Cable Route	P157_090_1217	6/6/2013	12:38:11	3.68	dipolar	2.55	10.74	2.84	1.25	415407.346	4074882.61	-75.94844232	36.8160185
MC-CR-020	Cable Route	P158_-060_0843	6/7/2013	8:52:53	3.51	dipolar	2.49	-2.06	11.92	2.45	415486.197	4075024.13	-75.94757409	36.81730113
MC-CR-021	Cable Route	P157_090_1217	6/6/2013	12:37:04	3.5	dipolar	10.19	11.91	21.59	NM	415540.106	4074895.11	-75.94695541	36.81614302
MC-CR-022	Cable Route	P160_MBES_SSS_SB	6/9/2013	1:57:54	3.74	dipolar	2.60	-0.60	11.67	4.75	415673.656	4074866.72	-75.9454551	36.81589904
MC-CR-023	Cable Route	P159_SBP_MAG_M90	6/8/2013	22:16:36	3.94	dipolar	13.63	30.48	17.41	5.11	415823.838	4075086.14	-75.94379577	36.81789015
MC-CR-024	Cable Route	P158_-060_0843	6/7/2013	8:55:01	3.82	dipolar	4.94	2.00	28.79	NM	415853.368	4075057.15	-75.94346152	36.81763148
MC-CR-026	Cable Route	P157_000_2307	6/6/2013	23:15:17	3.77	dipolar	2.71	-9.10	8.19	2.13	415888.397	4075008.91	-75.94306347	36.81719978
MC-CR-027	Cable Route	P158_-030_0741	6/7/2013	8:34:40	4.27	dipolar	5.96	-14.45	17.62	5.39	416106.058	4075050.23	-75.94062791	36.81759163
MC-CR-028	Cable Route	P160_SSS_MAG_60C	6/9/2013	5:37:42	2.97	dipolar	2.87	6.73	16.75	4.62	416290.587	4074974.64	-75.93855088	36.81692664
MC-CR-029	Cable Route	P158_-030_0741	6/7/2013	8:33:36	4.5	dipolar	2.84	2.87	16.32	5.62	416312.178	4075064.34	-75.9383187	36.81773707
MC-CR-031	Cable Route	P160_MBES_SSS_SB	6/9/2013	1:53:37	3.1	single-pole	10.00	19.13	14.71	2.75	416396.067	4074929.59	-75.93736343	36.81652991
MC-CR-032	Cable Route	P157_090_1217	6/6/2013	12:31:52	4.86	dipolar	14.84	11.90	16.27	2.33	416420.417	4074961.52	-75.93709396	36.81681986
MC-CR-033	Cable Route	P160_M120A	6/9/2013	13:19:05	3.29	dipolar	6.02	-12.18	19.58	1.86	416434.779	4075169.41	-75.9369558	36.81869495
MC-CR-034	Cable Route	P157_090_1217	6/6/2013	12:31:28	4.74	dipolar	9.45	-1.47	24.91	2.45	416491.087	4074967.82	-75.93630239	36.81688289
MC-CR-035	Cable Route	P160_MAG_30	6/9/2013	3:40:47	3.18	complex	3.55	0.72	17.57	5.18	416518.088	4075026.5	-75.93600614	36.81741418
MC-CR-036	Cable Route	P160_MAG_30	6/9/2013	3:40:42	3.43	complex	3.31	-7.34	12.50	3.36	416532.608	4075027.41	-75.93584346	36.81742367
MC-CR-037	Cable Route	P157_030_2100	6/6/2013	22:51:40	3.09	dipolar	3.54	13.82	11.16	4.07	416535.608	4075036.02	-75.93581077	36.81750154
MC-CR-038	Cable Route	P160_MAG_30	6/9/2013	3:40:23	3.56	dipolar	2.77	4.29	13.18	1.17	416588.248	4075031.12	-75.9352201	36.81746201
MC-CR-040	Cable Route	P160_M150B	6/9/2013	15:30:23	4.35	dipolar	4.91	10.19	8.24	1.16	416994.389	4075243.25	-75.9306901	36.81940977
MC-CR-041	Cable Route	P160_MAG_SSS_SBP	6/9/2013	4:14:23	4.36	dipolar	8.83	-7.60	23.08	9.00	417005.358	4075002.98	-75.93054092	36.81724505
MC-CR-042	Cable Route	P159_SBP_MAG_M90	6/8/2013	22:25:14	3.72	dipolar	3.82	3.80	10.03	3.56	417059.039	4075181.23	-75.92995855	36.81885642

			Shotpoint				Intensity (gammas)		Duration (meters)		NAD83 Coordinates (m)			
Anomaly ID	Area	Line	Date	Time	Tow Height	Signature	AS	T_filt	AS_Width	AS_HAWid	Easting	Northing	Latitude	Longitude
MC-CR-043	Cable Route	P160_MAG_SSS_SBP	6/9/2013	4:15:29	4.13	dipolar	4.19	-3.11	12.45	4.72	417187.588	4075018.91	-75.92849972	36.8174046
MC-CR-044	Cable Route	P159_SBP_MAG_M90	6/8/2013	22:26:24	3.89	dipolar	10.86	-18.39	15.90	3.19	417215.719	4075195.07	-75.92820352	36.81899489
MC-CR-045	Cable Route	P160_SSS_MAG_60A	6/9/2013	4:51:54	4.14	dipolar	2.81	5.23	6.69	1.09	417243.338	4075051.95	-75.92787831	36.81770729
MC-CR-046	Cable Route	P157_060_1323	6/6/2013	13:25:52	3.2	dipolar	5.21	9.67	9.58	5.91	417246.298	4075054.05	-75.92784536	36.81772647
MC-CR-047	Cable Route	P159_SBP_MAG_M90	6/8/2013	22:26:39	3.89	dipolar	2.55	7.44	11.83	2.52	417250.029	4075196.92	-75.92781907	36.81901457
MC-CR-048	Cable Route	P160_MAG_30	6/9/2013	3:36:23	3.99	dipolar	3.70	5.67	11.51	2.87	417267.429	4075078.75	-75.92761116	36.81795096
MC-CR-049	Cable Route	P160_M150B	6/9/2013	15:33:10	4.14	dipolar	14.96	23.65	14.42	2.19	417460.29	4075279.18	-75.92547077	36.81977439
MC-CR-050	Cable Route	P159_SBP_MAG_M90	6/8/2013	22:28:56	3.85	dipolar	8.78	19.39	14.48	4.51	417561.62	4075222.29	-75.92432859	36.81927044
MC-CR-051	Cable Route	P160_SSS_MAG_60	6/9/2013	4:33:49	1.19	dipolar	3.73	2.35	8.84	2.52	417567.419	4075075.9	-75.92424771	36.81795145
MC-CR-052	Cable Route	P157_090_1217	6/6/2013	12:25:14	3.85	complex	100.81	-179.61	20.58	2.69	417581.429	4075060.1	-75.92408893	36.81781026
MC-CR-053	Cable Route	P157_090_1217	6/6/2013	12:25:13	3.83	complex	102.28	171.51	23.93	2.49	417585.759	4075060.41	-75.92404042	36.81781343
MC-CR-054	Cable Route	P160_M120A	6/9/2013	13:12:21	3.77	dipolar	18.41	19.47	18.69	2.99	417589.3	4075267.11	-75.92402312	36.81967684
MC-CR-055	Cable Route	P160_SSS_MAG_60A	6/9/2013	4:49:16	4.03	dipolar	3.45	7.35	10.26	3.88	417702.579	4075086.55	-75.9227336	36.81805921
MC-CR-056	Cable Route	P157_060_1323	6/6/2013	13:28:35	3.78	dipolar	3.10	8.93	9.89	3.67	417705.089	4075088.44	-75.92270567	36.81807646
MC-CR-057	Cable Route	P157_030_2100	6/6/2013	22:45:12	3.78	dipolar	2.59	-5.97	12.41	1.14	417716.799	4075122	-75.92257801	36.81837998
MC-CR-058	Cable Route	P158_-030_0741	6/7/2013	8:26:19	3.48	dipolar	6.24	-10.98	80.44	NM	417727.94	4075181.33	-75.92245954	36.81891572
MC-CR-060	Cable Route	P160_M120	6/9/2013	12:56:31	3.19	complex	5.52	0.92	18.26	5.74	417810.77	4075281.77	-75.92154178	36.81982824
MC-CR-061	Cable Route	P160_M120A	6/9/2013	13:11:04	3.33	dipolar	3.63	0.70	14.56	2.97	417811.74	4075282.33	-75.92153097	36.81983337
MC-CR-062	Cable Route	P158_-060_0843	6/7/2013	9:06:31	3.78	dipolar	2.68	3.65	14.50	3.72	417835.85	4075220.12	-75.92125395	36.81927473
MC-CR-063	Cable Route	P158_-060_0843	6/7/2013	9:07:00	4.09	single-pole	6.85	15.15	16.85	4.74	417921.14	4075224.54	-75.92029823	36.81932198
MC-CR-064	Cable Route	P160_MAG_M60E	6/9/2013	13:02:40	3.87	dipolar	5.54	-14.00	31.88	14.94	417966.91	4075242.7	-75.91978706	36.81948963
MC-CR-065	Cable Route	P158_-060_0843	6/7/2013	9:07:17	4.15	dipolar	151.41	330.39	23.20	4.74	417969.01	4075230.59	-75.91976221	36.81938066
MC-CR-066	Cable Route	P158_-030_0741	6/7/2013	8:24:10	3.75	dipolar	20.57	27.11	11.68	3.23	418140.85	4075214.41	-75.91783396	36.8192497
MC-CR-067	Cable Route	P160_MAG_M60E	6/9/2013	13:03:48	3.86	dipolar	5.07	9.76	15.41	4.48	418143.34	4075250.2	-75.9178099	36.81957251
MC-CR-068	Cable Route	P157_090_1217	6/6/2013	12:21:45	3.6	dipolar	2.57	-12.01	13.25	7.97	418200.159	4075102.41	-75.917157	36.81824531
MC-CR-069	Cable Route	P160_M120	6/9/2013	12:53:48	3.26	dipolar	5.26	8.01	11.11	2.96	418288.501	4075315.46	-75.9161895	36.82017329
MC-CR-070	Cable Route	P160_SBP_M60	6/9/2013	3:30:05	3.78	dipolar	18.16	34.56	31.13	3.67	418296.02	4075258.83	-75.91609911	36.8196635
MC-CR-071	Cable Route	P158_-060_0916	6/7/2013	9:19:09	4.56	dipolar	3.31	19.32	8.66	2.15	418299.52	4075260.13	-75.91606001	36.81967552
MC-CR-072	Cable Route	P157_060_1323	6/6/2013	13:32:14	4.06	dipolar	3.34	5.62	11.12	3.92	418320.86	4075134.5	-75.91580728	36.81854498
MC-CR-073	Cable Route	P158_-030_0741	6/7/2013	8:22:56	4.35	single-pole	8.83	10.95	17.06	4.38	418380.48	4075241.81	-75.91515039	36.81951738
MC-CR-074	Cable Route	P160_M120	6/9/2013	12:52:09	3.63	complex	6.73	10.01	15.41	3.25	418576.781	4075350.44	-75.91296128	36.82051343
MC-CR-075	Cable Route	P160_M120	6/9/2013	12:50:52	3.57	complex	15.18	-37.06	32.48	7.01	418802.401	4075349.09	-75.91043165	36.82052066
MC-CR-076	Cable Route	P158_-030_0741	6/7/2013	8:19:49	3.89	dipolar	3.89	-17.52	14.71	5.34	418981.511	4075255.71	-75.90841365	36.81969432
MC-CR-077	Cable Route	P159_SBP_MAG_M90	6/8/2013	22:39:17	3.27	dipolar	11.99	21.77	6.64	2.36	418982.551	4075293.54	-75.90840602	36.82003539
MC-CR-078	Cable Route	P160_M120	6/9/2013	12:49:34	3.21	complex	3.46	7.87	11.24	4.07	419034.241	4075349.59	-75.90783248	36.82054503
MC-CR-079	Cable Route	P160_M120	6/9/2013	12:49:29	2.63	complex	3.73	4.48	10.53	1.57	419048.771	4075349.28	-75.90766955	36.82054348
MC-CR-080	Cable Route	P160_M150E	6/9/2013	16:14:32	3.76	complex	2.41	3.55	12.33	3.29	419051.122	4075362.62	-75.90764462	36.82066392

			Shotpoint				Intensity (gammas)		Duration (meters)		NAD83 Coordinates (m)			
Anomaly ID	Area	Line	Date	Time	Tow Height	Signature	AS	T_filt	AS_Width	AS_HAWid	Easting	Northing	Latitude	Longitude
MC-CR-081	Cable Route	P158_-060_0916	6/7/2013	9:23:48	3.86	dipolar	2.86	16.35	13.21	5.36	419079.231	4075284.26	-75.90732114	36.81996002
MC-CR-082	Cable Route	P160_5P400A	6/9/2013	8:59:58	3.11	complex	3.06	-2.13	16.50	7.00	419082.071	4075292.35	-75.90729016	36.82003318
MC-CR-083	Cable Route	P158_-030_0741	6/7/2013	8:19:13	3.08	single-pole	2.49	13.37	16.37	7.57	419100.291	4075256.86	-75.90708212	36.81971485
MC-CR-084	Cable Route	P160_MBES_SSS_SB	6/9/2013	1:37:06	4.6	dipolar	6.92	8.01	12.29	2.11	419225.31	4075103.3	-75.9056642	36.8183414
MC-CR-085	Cable Route	P159_SBP_MAG_M90	6/8/2013	22:42:26	3.75	single-pole	7.55	10.63	15.62	3.02	419415.491	4075303.31	-75.90355327	36.82016043
MC-CR-086	Cable Route	P157_000_2307	6/6/2013	23:34:28	4.15	dipolar	11.36	28.83	25.69	4.93	419427.121	4075226.85	-75.90341479	36.81947224
MC-CR-087	Cable Route	P160_MAG_M30BA	6/9/2013	3:22:46	3.93	dipolar	6.58	-6.59	13.04	4.88	419434.631	4075247.36	-75.90333277	36.81965775
MC-CR-088	Cable Route	P158_-030_0741	6/7/2013	8:17:28	4.95	single-pole	5.51	-13.58	31.50	6.92	419437.721	4075252.79	-75.9032987	36.81970696
MC-CR-089	Cable Route	P157_000_2307	6/6/2013	23:34:46	3.62	dipolar	7.20	-17.99	15.92	5.25	419483.261	4075223.5	-75.90278504	36.81944682
MC-CR-090	Cable Route	P159_SBP_MAG_M90	6/8/2013	22:43:12	3.32	single-pole	3.68	6.74	13.09	3.85	419523.232	4075315.28	-75.90234664	36.82027749
MC-CR-091	Cable Route	P160_M120_B	6/9/2013	12:32:56	3.98	dipolar	4.24	8.83	11.09	5.77	419689.532	4075341.82	-75.90048501	36.82053085
MC-CR-092	Cable Route	P157_000_2307	6/6/2013	23:35:58	5.03	dipolar	8.95	26.12	14.44	3.52	419697.301	4075220.21	-75.90038507	36.81943536
MC-CR-093	Cable Route	P160_M150E	6/9/2013	16:19:05	4.43	dipolar	2.68	-7.61	10.62	2.67	419701.542	4075361.25	-75.90035241	36.820707
MC-CR-094	Cable Route	P160_MAG_M60B	6/9/2013	3:20:18	4.89	dipolar	3.68	-45.36	3.65	1.04	419763.301	4075277.84	-75.89965121	36.81996041
MC-CR-095	Cable Route	P158_-060_0916	6/7/2013	9:27:51	3.83	dipolar	52.32	97.99	25.28	4.55	419766.931	4075275.07	-75.89961022	36.81993575
MC-CR-096	Cable Route	P160_M150E	6/9/2013	16:19:39	3.56	dipolar	8.37	11.38	11.43	2.21	419780.602	4075363.63	-75.8994663	36.82073516
MC-CR-097	Cable Route	P160_M150E	6/9/2013	16:20:04	5.85	dipolar	2.83	-17.85	31.76	5.02	419841.042	4075362.01	-75.89878851	36.82072568
MC-CR-098	Cable Route	P158_-030_0741	6/7/2013	8:15:01	3.77	dipolar	26.88	-47.38	16.79	4.36	419902.231	4075246.95	-75.89809038	36.81969375
MC-CR-099	Cable Route	P158_-060_0943	6/7/2013	9:45:15	4.22	dipolar	3.90	-1.76	17.52	5.95	419936.552	4075282.48	-75.89770935	36.82001691
MC-CR-100	Cable Route	P157_030_2100	6/6/2013	22:33:00	4.77	dipolar	13.98	29.74	13.89	2.79	420010.581	4075187.82	-75.89686943	36.81916994
MC-CR-101	Cable Route	P159_SBP_MAG_M90	6/8/2013	22:47:19	4.49	complex	79.36	176.62	13.21	1.91	420109.922	4075295.5	-75.89576703	36.82014893
MC-CR-102	Cable Route	P159_SBP_MAG_M90	6/8/2013	22:47:20	4.32	complex	90.51	-128.78	13.93	3.24	420114.092	4075295.15	-75.89572024	36.82014612
MC-CR-103	Cable Route	P160_M120_B	6/9/2013	12:30:15	3.16	dipolar	4.86	-6.77	12.03	1.86	420174.672	4075335.51	-75.89504529	36.82051503
MC-CR-104	Cable Route	P158_-030_0741	6/7/2013	8:13:25	3.3	single-pole	2.88	1.67	15.97	6.07	420204.951	4075242.87	-75.8946961	36.81968265
MC-CR-105	Cable Route	P157_090_1130	6/6/2013	11:56:23	3.24	dipolar	3.08	15.78	10.84	5.38	420213.001	4075129.05	-75.89459392	36.81865739
MC-CR-106	Cable Route	P160_M120_B	6/9/2013	12:29:43	3	dipolar	9.75	-18.51	12.94	3.42	420270.502	4075337.24	-75.89397109	36.8205387
MC-CR-107	Cable Route	P160_MBES_SSS_SB	6/9/2013	1:30:44	4.71	single-pole	2.80	3.61	16.43	6.42	420305.931	4075095.73	-75.89354859	36.81836489
MC-CR-108	Cable Route	P157_060_1323	6/6/2013	13:44:11	4.24	dipolar	7.09	-12.85	16.28	5.26	420330.321	4075148.75	-75.8932807	36.81884485
MC-CR-109	Cable Route	P157_030_2100	6/6/2013	22:31:16	4.03	dipolar	8.21	-18.82	11.26	5.37	420341.091	4075190.37	-75.89316431	36.8192209
MC-CR-110	Cable Route	P157_030_2100	6/6/2013	22:31:05	3.99	complex	4.44	-4.42	20.33	6.01	420376.131	4075188.46	-75.89277128	36.81920664
MC-CR-111	Cable Route	P157_030_2100	6/6/2013	22:30:59	3.99	complex	5.43	-10.57	14.78	4.62	420395.171	4075187.5	-75.89255772	36.81919959
MC-CR-112	Cable Route	P160_M120_B	6/9/2013	12:29:02	3.07	dipolar	6.02	-9.44	9.47	1.49	420396.702	4075335.63	-75.89255606	36.8205349
MC-CR-113	Cable Route	P160_M120_B	6/9/2013	12:28:50	2.78	dipolar	2.69	-10.81	18.41	6.43	420434.432	4075333.28	-75.89213281	36.8205169
MC-CR-114	Cable Route	P157_090_1130	6/6/2013	11:55:00	3.18	complex	2.73	-4.01	25.78	7.02	420464.511	4075125.67	-75.89177387	36.8186481
MC-CR-115	Cable Route	P158_-060_0943	6/7/2013	9:48:42	3.35	dipolar	3.70	13.44	9.68	4.07	420523.902	4075264.55	-75.89112255	36.81990491
MC-CR-116	Cable Route	P157_000_2307	6/6/2013	23:40:40	4.09	complex	4.97	20.67	16.51	5.43	420556.171	4075210.92	-75.89075517	36.81942422
MC-CR-117	Cable Route	P157_060_1323	6/6/2013	13:45:37	5.12	complex	21.62	44.28	16.53	2.14	420575.871	4075147.45	-75.89052768	36.81885377

			Shotpoint				Intensity (gammas)		Duration (meters)		NAD83 Coordinates (m)			
Anomaly ID	Area	Line	Date	Time	Tow Height	Signature	AS	T_filt	AS_Width	AS_HAWid	Easting	Northing	Latitude	Longitude
MC-CR-118	Cable Route	P157_060_1323	6/6/2013	13:45:38	5.11	complex	18.61	-40.43	18.39	1.25	420580.581	4075147.31	-75.89047487	36.81885291
MC-CR-119	Cable Route	P157_090_1130	6/6/2013	11:54:19	3.5	dipolar	3.64	7.88	10.30	1.45	420593.471	4075123.63	-75.89032788	36.81864055
MC-CR-120	Cable Route	P160_M120_B	6/9/2013	12:27:57	2.15	dipolar	26.84	-55.68	26.94	3.17	420594.032	4075332.71	-75.89034342	36.82052517
MC-CR-121	Cable Route	P159_SBP_MAG_M90	6/8/2013	22:51:14	4.43	complex	10.25	21.12	15.01	3.80	420672.012	4075294.07	-75.88946513	36.82018342
MC-CR-122	Cable Route	P159_SBP_MAG_M90	6/8/2013	22:51:19	4.76	complex	6.36	17.28	13.64	5.84	420684.152	4075293.87	-75.88932901	36.82018264
MC-CR-123	Cable Route	P160_M150G	6/9/2013	16:54:00	4.26	dipolar	14.77	30.46	24.04	4.13	420687.882	4075351.81	-75.88929323	36.8207052
MC-CR-124	Cable Route	P160_M120_B	6/9/2013	12:27:13	2.68	dipolar	6.61	5.14	12.24	3.34	420727.612	4075333.29	-75.88884587	36.8205416
MC-CR-125	Cable Route	P157_150_0223	6/6/2013	2:29:07	2.9	complex	5.40	8.80	11.63	3.38	420741.461	4075059.09	-75.88866204	36.81807121
MC-CR-126	Cable Route	P157_090_1130	6/6/2013	11:53:05	3.81	dipolar	13.48	-28.92	29.47	5.00	420818.921	4075124.28	-75.88780042	36.8186653
MC-CR-127	Cable Route	P160_M120_B	6/9/2013	12:26:42	3.3	dipolar	5.67	-8.88	10.82	1.76	420821.132	4075332.71	-75.88779733	36.8205442
MC-CR-128	Cable Route	P160_7P200	6/9/2013	9:49:31	4.02	dipolar	8.27	-6.25	22.53	6.71	420885.522	4075295.25	-75.88707154	36.82021193
MC-CR-129	Cable Route	P157_030_2100	6/6/2013	22:28:00	4.16	dipolar	3.74	14.71	23.00	8.52	420961.682	4075181.7	-75.88620589	36.8191948
MC-CR-130	Cable Route	P157_090_1130	6/6/2013	11:51:17	3.06	single-pole	5.24	10.46	18.82	3.05	421151.621	4075119.67	-75.88407002	36.81865153
MC-CR-131	Cable Route	P159_SBP_MAG_M90	6/8/2013	22:55:35	4.02	single-pole	14.15	-24.55	18.84	5.37	421295.072	4075281.73	-75.88247855	36.82012423
MC-CR-133	Cable Route	P157_030_2100	6/6/2013	22:26:05	3.46	dipolar	3.43	-8.68	16.34	4.72	421327.142	4075177.67	-75.88210824	36.81918893
MC-CR-134	Cable Route	P159_SBP_MAG_M90	6/8/2013	22:56:20	4.11	single-pole	52.34	-31.91	33.16	6.51	421404.952	4075284.85	-75.88124697	36.82016148
MC-CR-135	Cable Route	P157_150_0223	6/6/2013	2:24:28	2.67	dipolar	3.26	-22.75	19.19	10.24	421447.201	4075052.48	-75.88074931	36.81807048
MC-CR-136	Cable Route	P160_MBES_SSS_SB	6/9/2013	1:23:43	4.08	dipolar	2.62	7.58	9.97	1.04	421529.541	4075077.07	-75.87982873	36.81829896
MC-CR-137	Cable Route	P157_060_1323	6/6/2013	13:52:04	4.13	dipolar	11.31	17.12	12.06	4.00	421644.692	4075134.41	-75.87854369	36.81882535
MC-CR-138	Cable Route	P160_MBES_SSS_SB	6/9/2013	1:21:10	5.08	dipolar	41.08	-64.14	42.75	4.86	421988.242	4075082.72	-75.87468681	36.81838782
MC-CR-139	Cable Route	P160_MBES_SSS_SB	6/9/2013	1:02:51	4.85	dipolar	6.32	-11.36	19.35	6.51	421988.642	4075089.17	-75.87468298	36.81844599
MC-CR-140	Cable Route	P158_-060_0943	6/7/2013	9:57:59	4.11	dipolar	2.60	-10.75	5.29	1.90	422072.333	4075250.66	-75.87376126	36.81990851
MC-CR-141	Cable Route	P160_M120_B	6/9/2013	12:19:01	3.35	dipolar	9.84	-15.72	16.33	1.89	422211.263	4075318.27	-75.87221059	36.82052936
MC-CR-142	Cable Route	P158_-030_0741	6/7/2013	8:02:49	4.23	dipolar	10.80	21.56	14.32	3.26	422218.033	4075220.53	-75.8721247	36.81964891
MC-CR-143	Cable Route	P160_M120_B	6/9/2013	12:17:58	3.68	dipolar	5.48	-10.06	33.96	6.21	422400.643	4075308.98	-75.87008643	36.82046117
MC-CR-144	Cable Route	P158_000_0108	6/7/2013	1:11:19	4.16	dipolar	2.64	11.06	10.64	2.08	422457.092	4075186.45	-75.86944106	36.81936135
MC-CR-145	Cable Route	P158_-060_1014	6/7/2013	10:15:54	4.3	dipolar	2.65	8.60	11.56	1.14	422471.623	4075251.53	-75.86928479	36.81994915
MC-CR-146	Cable Route	P158_-060_1014	6/7/2013	10:17:58	3.52	dipolar	7.84	-13.87	16.17	3.61	422780.123	4075170.15	-75.86581784	36.81924084
MC-CR-147	Cable Route	P160_M150G	6/9/2013	17:08:21	3.45	dipolar	2.68	-5.51	10.45	5.20	422857.063	4075236.47	-75.86496198	36.81984491
MC-CR-148	Cable Route	P157_150_0015	6/6/2013	1:48:04	4.03	single-pole	2.60	3.82	9.36	3.56	423084.151	4074891.82	-75.86238117	36.81675682
MC-CR-149	Cable Route	P158_-030_0741	6/7/2013	7:56:52	5.03	dipolar	3.40	8.92	12.62	2.34	423323.342	4075018.31	-75.85971238	36.81791638
MC-CR-150	Cable Route	P160_M120_B	6/9/2013	12:12:21	4.14	dipolar	2.68	-6.51	13.19	3.88	423366.483	4075107.24	-75.85923769	36.81872146
MC-CR-151	Cable Route	P157_150_0015	6/6/2013	1:46:10	3.44	dipolar	34.10	74.73	21.71	3.99	423418.741	4074815.2	-75.85862242	36.81609342
MC-CR-152	Cable Route	P160_M150G	6/9/2013	17:12:35	3.01	complex	8.87	15.34	8.57	2.80	423511.573	4075093.46	-75.85760968	36.81860899
MC-CR-153	Cable Route	P157_120_0253	6/6/2013	3:04:26	4.52	complex	5.55	9.01	17.65	3.52	424024.79	4074701.5	-75.85181677	36.8151174
MC-CR-154	Cable Route	P159_SBP_MAG_M90	6/8/2013	23:15:49	3.85	dipolar	3.59	7.32	15.13	5.13	424210.601	4074872.61	-75.84975075	36.81667465
MC-CR-155	Cable Route	P160_M120_B	6/9/2013	12:06:53	4.46	single-pole	3.95	-5.52	15.54	2.72	424281.942	4074892.26	-75.84895292	36.81685748

			Shotpoint				Intensity (gammas)		Duration (meters)		NAD83 Coordinates (m)			
Anomaly ID	Area	Line	Date	Time	Tow Height	Signature	AS	T_filt	AS_Width	AS_HAWid	Easting	Northing	Latitude	Longitude
MC-CR-156	Cable Route	P158_000_0108	6/7/2013	1:22:50	3.55	dipolar	2.90	-7.61	18.60	4.69	424466.911	4074726.76	-75.84686282	36.81538048
MC-CR-157	Cable Route	P158_-060_1014	6/7/2013	10:29:22	3.71	single-pole	11.75	-21.43	17.80	3.87	424657.781	4074744.57	-75.84472479	36.81555623
MC-CR-158	Cable Route	P160_M120_B	6/9/2013	12:03:08	3.53	single-pole	9.10	15.75	25.87	3.89	424910.631	4074751.83	-75.84189087	36.81564177
MC-CR-159	Cable Route	P157_120_0253	6/6/2013	3:10:11	3.95	dipolar	2.54	-1.35	18.83	6.02	425003.759	4074482.01	-75.84082023	36.81321706
MC-CR-160	Cable Route	P158_-030_0741	6/7/2013	7:46:36	4.17	dipolar	28.60	-54.81	15.08	6.40	425201.56	4074596.19	-75.83861403	36.81426191
MC-CR-162	Cable Route	P157_120_0253	6/6/2013	3:13:06	4.16	dipolar	5.15	-5.36	19.36	3.41	425491.779	4074370.79	-75.83533844	36.81225309
MC-CR-163	Cable Route	P158_000_0108	6/7/2013	1:29:30	4.57	dipolar	4.93	-11.46	18.59	3.71	425667.16	4074455.56	-75.83338065	36.81303098
MC-CR-164	Cable Route	P160_M120_B	6/9/2013	11:57:42	3.35	dipolar	6.07	14.06	15.49	3.15	425811.46	4074546.72	-75.83177187	36.813864
MC-CR-165	Cable Route	P160_M120_B	6/9/2013	11:56:35	3.44	complex	16.51	-36.88	28.72	5.54	425998.6	4074506.16	-75.82966999	36.81351305
MC-CR-166	Cable Route	P158_-060_1014	6/7/2013	10:37:18	4.74	single-pole	94.26	149.99	26.82	5.19	426037.03	4074436.06	-75.82923236	36.81288419
MC-CR-167	Cable Route	P160_M150G	6/9/2013	17:29:48	3.85	dipolar	4.15	-10.90	12.66	5.41	426152.19	4074496.71	-75.82794726	36.81343987
MC-CR-168	Cable Route	P160_SBP_90	6/9/2013	0:37:14	4.22	dipolar	8.68	17.80	29.72	8.26	426228.048	4074241.23	-75.82707208	36.81114303
MC-CR-169	Cable Route	P157_090_1044	6/6/2013	10:44:56	3.56	complex	3.19	-4.17	10.05	1.86	426253.308	4074240.65	-75.82678885	36.81113977
MC-CR-170	Cable Route	P157_120_0253	6/6/2013	3:18:32	3.56	complex	12.83	-21.88	21.78	3.39	426383.188	4074169.87	-75.82532603	36.81051188
MC-CR-171	Cable Route	P158_000_0108	6/7/2013	1:33:38	4.11	dipolar	5.56	-15.97	16.95	4.86	426409.659	4074282.76	-75.82504021	36.81153151
MC-CR-172	Cable Route	P157_060_1401	6/6/2013	14:29:49	4.12	dipolar	2.81	-5.85	20.56	8.75	426506.098	4074202.92	-75.8239514	36.81081934
MC-CR-173	Cable Route	P158_-030_0432	6/7/2013	7:17:02	3.76	dipolar	3.18	2.23	16.85	5.16	426648.759	4074270.33	-75.82235865	36.81143803
MC-CR-174	Cable Route	P159_SBP_MAG_M90	6/8/2013	23:32:57	3.71	dipolar	6.72	17.97	10.27	3.74	426704.489	4074309.88	-75.82173772	36.81179884
MC-CR-175	Cable Route	P157_150_0015	6/6/2013	1:27:45	3.66	dipolar	193.38	-405.82	42.84	3.54	426775.497	4074057.42	-75.8209174	36.8095287
MC-CR-176	Cable Route	P158_-030_0432	6/7/2013	7:15:42	4.53	dipolar	25.62	-70.47	22.06	4.99	426902.789	4074211.2	-75.81950525	36.81092469
MC-CR-177	Cable Route	P158_000_0108	6/7/2013	1:36:32	3.52	single-pole	45.11	92.02	24.81	3.44	426926.368	4074170.49	-75.81923701	36.81055956
MC-CR-178	Cable Route	P162_Mag_150A	6/11/2013	8:38:52	3.86	dipolar	3.76	8.02	22.33	3.31	426972.417	4074014.91	-75.81870586	36.80916074
MC-CR-179	Cable Route	P162_Mag_150A	6/11/2013	8:37:29	3.86	dipolar	3.74	-6.06	9.80	3.71	427182.217	4073969.16	-75.81634965	36.80876452
MC-CR-180	Cable Route	P160_M120_B	6/9/2013	11:49:19	4.19	complex	10.41	-26.54	27.66	7.17	427234.729	4074226.98	-75.81578566	36.81109251
MC-CR-181	Cable Route	P162_Mag_150A	6/11/2013	8:36:26	3.73	dipolar	61.38	93.75	17.98	1.34	427341.747	4073932.75	-75.81455787	36.80844858
MC-CR-182	Cable Route	P158_-030_0432	6/7/2013	7:12:58	4.11	single-pole	2.58	-5.00	11.49	1.65	427414.068	4074096.6	-75.8137628	36.80993105
MC-CR-183	Cable Route	P157_060_1401	6/6/2013	14:36:08	4.64	dipolar	8.96	16.95	26.92	5.20	427555.257	4073967.72	-75.8121678	36.80878016
MC-CR-184	Cable Route	P160_M150G	6/9/2013	17:40:31	3.28	dipolar	23.00	-24.25	16.96	3.45	427758.439	4074166.85	-75.80990907	36.81059062
MC-CR-185	Cable Route	P158_-060_1014	6/7/2013	10:47:21	3.96	dipolar	6.59	26.98	17.50	4.40	427761.178	4074079.33	-75.80987005	36.80980194
MC-CR-186	Cable Route	P158_000_0108	6/7/2013	1:41:58	3.74	single-pole	4.44	11.16	17.15	1.91	427899.768	4074010.59	-75.80830995	36.80919289
MC-CR-188	Cable Route	P160_14P400	6/9/2013	11:25:12	3.52	dipolar	4.90	9.02	13.98	3.37	427943.617	4073933.57	-75.80781111	36.80850198
MC-CR-189	Cable Route	P158_-060_1014	6/7/2013	10:48:57	3.6	dipolar	4.76	-9.52	18.51	3.15	428046.198	4074060.32	-75.80667318	36.80965229
MC-CR-190	Cable Route	P160_M150G	6/9/2013	17:43:29	3.62	dipolar	8.60	-10.14	15.65	4.35	428209.939	4074139.33	-75.80484511	36.81037691
MC-CR-191	Cable Route	P162_Mag_M90F	6/11/2013	8:51:31	3.74	dipolar	2.62	-4.01	13.79	3.14	428221.428	4074084.77	-75.80471116	36.80988599
MC-CR-192	Cable Route	P161_M120	6/10/2013	13:46:29	4.03	dipolar	5.90	-8.73	16.81	3.38	428223.729	4074108.37	-75.8046876	36.81009889
MC-CR-193	Cable Route	P158_-030_0432	6/7/2013	7:08:21	3.31	dipolar	11.53	-26.78	15.38	3.70	428291.838	4074025.3	-75.80391626	36.80935527
MC-CR-194	Cable Route	P158_000_0108	6/7/2013	1:44:11	3.8	dipolar	4.76	-7.83	15.74	4.77	428301.338	4073988.48	-75.8038063	36.8090241

			Shotpoint				Intensity (gammas)		Duration (meters)		NAD83 Coordinates (m)			
Anomaly ID	Area	Line	Date	Time	Tow Height	Signature	AS	T_filt	AS_Width	AS_HAWid	Easting	Northing	Latitude	Longitude
MC-CR-195	Cable Route	P161_M120	6/10/2013	13:47:35	3.72	dipolar	3.21	4.76	14.19	1.60	428382.868	4074075.19	-75.80290051	36.80981186
MC-CR-196	Cable Route	P162_Mag_150A	6/11/2013	8:29:44	3.57	dipolar	4.06	10.13	9.95	3.44	428383.617	4073840.38	-75.80287002	36.80769537
MC-CR-198	Cable Route	P157_090_0732	6/6/2013	10:07:34	3.35	single-pole	12.52	-24.32	15.65	3.00	428417.777	4073896.78	-75.8024924	36.80820633
MC-CR-199	Cable Route	P161_M120D	6/10/2013	20:59:35	4.4	dipolar	2.93	5.29	13.49	3.17	428424.049	4074104.61	-75.80244165	36.81008016
MC-CR-200	Cable Route	P160_MAG_120	6/9/2013	0:23:32	3.73	dipolar	4.98	-5.55	9.69	2.39	428444.567	4073863.65	-75.80218898	36.80790973
MC-CR-201	Cable Route	P157_060_1401	6/6/2013	14:41:39	4.47	dipolar	3.58	9.88	17.45	4.37	428512.497	4073916.99	-75.80143251	36.80839566
MC-CR-202	Cable Route	P160_MAG_120	6/9/2013	0:22:58	3.19	dipolar	19.32	29.37	13.43	1.79	428519.957	4073860.31	-75.80134356	36.80788532
MC-CR-203	Cable Route	P157_090_0732	6/6/2013	10:06:59	3.59	complex	4.67	-1.88	20.94	6.76	428532.867	4073891.79	-75.8012018	36.80817005
MC-CR-204	Cable Route	P160_M150G	6/9/2013	17:46:49	3.66	complex	73.07	128.03	27.60	2.42	428723.639	4074110.67	-75.79908379	36.8101574
MC-CR-205	Cable Route	P160_M150G	6/9/2013	17:46:50	3.6	complex	88.02	-144.32	25.51	2.07	428727.349	4074110.57	-75.79904219	36.81015677
MC-CR-206	Cable Route	P158_000_0108	6/7/2013	1:46:50	3.68	single-pole	12.91	-18.37	22.68	5.20	428783.348	4073963.97	-75.79840072	36.80883955
MC-CR-208	Cable Route	P160_M150G	6/9/2013	17:48:11	3.99	complex	54.10	-81.88	27.98	4.06	428931.799	4074102.42	-75.79674953	36.81009868
MC-CR-209	Cable Route	P161_M120D	6/10/2013	21:04:33	3.52	dipolar	10.81	-22.08	20.32	6.52	429241.819	4074057.37	-75.79327	36.80971583
MC-CR-210	Cable Route	P162_Mag_150A	6/11/2013	8:23:29	4	dipolar	4.89	7.14	12.20	2.75	429338.527	4073786.36	-75.79216073	36.80728029
MC-CR-211	Cable Route	P161_M120D	6/10/2013	21:05:12	3.66	single-pole	5.37	-10.80	16.40	3.47	429348.499	4074047.66	-75.79207321	36.80963628
MC-CR-212	Cable Route	P158_000_0108	6/7/2013	1:50:03	3.95	dipolar	3.12	-5.91	17.87	5.80	429369.868	4073940.37	-75.7918237	36.80867086
MC-CR-213	Cable Route	P158_-030_0432	6/7/2013	7:02:26	3.56	dipolar	2.89	-3.72	11.30	1.85	429424.508	4073955.54	-75.7912126	36.80881168
MC-CR-214	Cable Route	P157_090_0732	6/6/2013	10:02:08	3.49	complex	2.98	12.39	6.67	1.18	429464.997	4073836.97	-75.79074773	36.80774591
MC-CR-215	Cable Route	P162_Mag_M90F	6/11/2013	8:58:44	4.32	dipolar	3.53	6.60	17.40	3.64	429519.329	4074007.99	-75.79015453	36.80929152
MC-CR-216	Cable Route	P161_16P200	6/10/2013	13:13:37	3.7	dipolar	6.79	11.10	13.60	2.19	429742.187	4073814.34	-75.78763841	36.80756254
MC-CR-217	Cable Route	P157_090_0732	6/6/2013	10:00:15	3.52	dipolar	2.94	-5.24	11.83	1.64	429831.848	4073817.92	-75.78663367	36.80760146
MC-CR-218	Cable Route	P160_M150H	6/9/2013	18:42:14	3.67	dipolar	3.18	9.46	22.28	8.17	430214.649	4074027.36	-75.78236177	36.80951764
MC-CR-219	Cable Route	P158_000_0108	6/7/2013	1:54:53	4.74	dipolar	2.75	-6.60	16.36	4.93	430244.738	4073875.97	-75.7820106	36.80815524
MC-CR-220	Cable Route	P157_030_2100	6/6/2013	21:38:33	4.57	single-pole	22.67	-27.67	35.52	6.81	430250.478	4073852.73	-75.78194412	36.80794618
MC-CR-221	Cable Route	P157_120_0340	6/6/2013	3:54:52	3.51	complex	14.22	-23.52	6.99	1.34	430457.597	4073743.81	-75.7796124	36.80697962
MC-CR-222	Cable Route	P157_060_1401	6/6/2013	14:53:17	3.39	dipolar	6.33	-7.49	23.30	3.86	430522.478	4073798.71	-75.77889013	36.80747925
MC-CR-223	Cable Route	P157_030_2100	6/6/2013	21:37:02	4.18	dipolar	4.26	-6.08	9.64	5.55	430538.838	4073835.56	-75.7787101	36.80781261
MC-CR-224	Cable Route	P161_18P000	6/10/2013	12:49:20	3.36	dipolar	28.49	-38.95	19.23	1.87	431551.049	4073823.78	-75.76736235	36.80778016
MC-CR-225	Cable Route	P157_060_1401	6/6/2013	14:59:17	4.04	dipolar	101.89	-112.72	17.89	2.89	431595.038	4073738.23	-75.76686155	36.80701219
MC-CR-226	Cable Route	P161_M120D	6/10/2013	21:21:18	3.45	dipolar	84.92	133.63	24.04	4.18	431977.659	4073899.21	-75.76258686	36.80849083
MC-CR-227	Cable Route	P160_M150H	6/9/2013	18:56:09	3.53	dipolar	5.36	7.87	12.37	3.64	432325.53	4073906.87	-75.75868794	36.80858481
MC-CR-228	Cable Route	P157_120_0340	6/6/2013	4:06:07	3.93	dipolar	3.30	7.09	16.95	5.82	432371.428	4073633.13	-75.7581491	36.8061207
MC-CR-229	Cable Route	P160_M150H	6/9/2013	18:57:03	4.12	dipolar	5.02	3.15	6.69	1.34	432466.41	4073899.9	-75.75710806	36.80853205
MC-CR-230	Cable Route	P161_M120D	6/10/2013	21:25:06	3.54	dipolar	3.75	7.06	12.15	2.83	432602.309	4073861.47	-75.75558123	36.80819542
MC-CR-231	Cable Route	P161_MAG_60	6/10/2013	12:13:38	3.05	dipolar	4.45	6.04	14.92	2.23	432683.468	4073658.34	-75.75465348	36.80637018
MC-CR-232	Cable Route	P162_Mag_150A	6/11/2013	8:01:18	3.54	dipolar	73.28	-135.75	32.45	6.32	432702.188	4073595.57	-75.75443809	36.8058057
MC-CR-233	Cable Route	P157_120_0340	6/6/2013	4:08:16	3.97	dipolar	3.23	3.46	11.07	2.99	432733.478	4073611.9	-75.75408879	36.80595512

			Shotpoint				Intensity (gammas)		Duration (meters)		NAD83 Coordinates (m)			
Anomaly ID	Area	Line	Date	Time	Tow Height	Signature	AS	T_filt	AS_Width	AS_HAWid	Easting	Northing	Latitude	Longitude
MC-CR-234	Cable Route	P160_M150H	6/9/2013	18:59:20	3.64	single-pole	8.09	10.06	16.26	1.31	432814.83	4073878.84	-75.75320043	36.8083671
MC-CR-235	Cable Route	P157_090_0732	6/6/2013	9:43:02	3.87	single-pole	7.30	-19.77	16.81	5.12	433184.348	4073632.85	-75.74903655	36.8061759
MC-CR-236	Cable Route	P161_19P800	6/10/2013	12:04:23	3.4	complex	10.83	14.95	42.99	NM	433320.579	4073808.2	-75.74752482	36.80776611
MC-CR-237	Cable Route	P161_19P800	6/10/2013	12:04:23	3.4	complex	10.83	14.95	44.02	NM	433320.579	4073808.2	-75.74752482	36.80776611
MC-CR-238	Cable Route	P161_M120E	6/10/2013	21:59:21	4.12	dipolar	19.86	40.59	26.18	4.82	433479.04	4073909.82	-75.74575738	36.80869326
MC-CR-239	Cable Route	P158_-060_1014	6/7/2013	11:20:51	4.8	single-pole	7.23	-12.17	17.51	3.34	433581.499	4073866.35	-75.74460501	36.80830862
MC-CR-240	Cable Route	P157_030_2100	6/6/2013	21:19:39	3.89	dipolar	20.32	27.34	9.89	NM	433801.699	4073827.96	-75.74213325	36.807978
MC-CR-241	Cable Route	P157_030_2100	6/6/2013	21:19:27	3.89	dipolar	14.64	-31.44	22.49	3.95	433837.099	4073835.7	-75.74173709	36.80805024
MC-CR-242	Cable Route	P157_060_1401	6/6/2013	15:13:05	3.51	single-pole	4.11	-6.06	10.54	1.82	433975.679	4073824.38	-75.74018264	36.80795788
MC-CR-243	Cable Route	P158_000_0108	6/7/2013	2:15:21	3.53	dipolar	2.57	-3.95	14.51	2.41	434050.389	4073901.61	-75.73935183	36.80865925
MC-CR-244	Cable Route	P157_090_0732	6/6/2013	9:37:07	3.79	single-pole	3.28	-4.92	15.20	2.53	434306.909	4073874.41	-75.73647389	36.8084319
MC-CR-245	Cable Route	P162_Mag_150A	6/11/2013	7:49:21	3.77	dipolar	9.44	-18.26	7.66	2.35	434470.209	4073849.52	-75.73464116	36.80821886
MC-CR-246	Cable Route	P160_M150H	6/9/2013	19:11:15	3.49	single-pole	3.82	7.16	16.54	3.44	434617.011	4074174.96	-75.73302348	36.81116255
MC-CR-247	Cable Route	P157_090_0732	6/6/2013	9:35:03	3.53	dipolar	9.61	25.01	30.09	2.47	434693.65	4073956.44	-75.73214558	36.80919809
MC-CR-248	Cable Route	P158_-090_1420	6/7/2013	16:34:00	3.74	single-pole	4.15	-5.23	15.39	3.59	434869.301	4074177.93	-75.73019547	36.81120671
MC-CR-249	Cable Route	P158_-030_0432	6/7/2013	6:33:30	4.01	single-pole	9.77	15.09	25.24	4.68	435004.711	4074141.42	-75.72867435	36.81088692
MC-CR-250	Cable Route	P158_-030_0432	6/7/2013	6:31:35	4.19	dipolar	4.70	10.92	18.33	5.79	435371.521	4074219.16	-75.72456887	36.81161279
MC-CR-251	Cable Route	P157_030_2100	6/6/2013	21:10:35	4.9	dipolar	3.19	-6.63	12.72	4.34	435452.291	4074176.84	-75.72365981	36.81123683
MC-CR-252	Cable Route	P158_-090_1420	6/7/2013	16:29:46	4.09	dipolar	7.60	-11.95	9.97	1.92	435608.852	4074332.23	-75.72191785	36.81264819
MC-CR-253	Cable Route	P160_M150H	6/9/2013	19:18:23	3.47	dipolar	77.36	-96.23	28.20	3.61	435687.592	4074403.86	-75.72104118	36.81329922
MC-CR-254	Cable Route	P161_M120G	6/10/2013	22:49:43	3.78	dipolar	4.33	9.21	17.81	5.03	435794.272	4074404.1	-75.71984524	36.81330863
MC-CR-255	Cable Route	P158_000_0108	6/7/2013	2:24:55	4.11	dipolar	4.53	-0.86	14.49	2.59	435851.221	4074284.92	-75.71919674	36.8122382
MC-CR-256	Cable Route	P158_-060_1014	6/7/2013	11:34:08	4.5	dipolar	2.86	-7.56	18.69	6.42	435864.562	4074347.46	-75.71905246	36.81280284
MC-CR-257	Cable Route	P158_-030_0432	6/7/2013	6:28:55	4.17	single-pole	4.65	-5.10	28.26	8.64	435879.711	4074328.26	-75.718881	36.8126308
MC-CR-258	Cable Route	P157_030_2100	6/6/2013	21:07:43	4.33	dipolar	4.28	-4.15	10.95	2.91	435972.951	4074286.6	-75.71783222	36.81226159
MC-CR-259	Cable Route	P158_-030_0432	6/7/2013	6:28:14	4.37	dipolar	4.47	-4.99	15.61	4.52	436012.432	4074358.07	-75.71739563	36.81290849
MC-CR-260	Cable Route	P157_120_0340	6/6/2013	4:28:50	3.32	dipolar	12.60	16.03	21.21	3.21	436118.661	4074220.46	-75.71619318	36.81167524
MC-CR-261	Cable Route	P161_M120G	6/10/2013	22:51:43	4.02	dipolar	24.37	36.83	23.68	2.17	436123.012	4074468.48	-75.71616522	36.8139112
MC-CR-262	Cable Route	P158_-030_0432	6/7/2013	6:27:36	4.34	dipolar	2.49	8.73	15.12	3.82	436135.612	4074380.31	-75.71601657	36.81311729
MC-CR-263	Cable Route	P158_-030_0432	6/7/2013	6:27:20	4.42	dipolar	10.81	-15.14	20.00	2.99	436189.192	4074391.88	-75.71541687	36.81322519
MC-CR-264	Cable Route	P158_-030_0432	6/7/2013	6:27:12	4.15	single-pole	4.79	-7.75	24.81	5.94	436214.672	4074398.02	-75.71513173	36.81328226
MC-CR-265	Cable Route	P157_030_2100	6/6/2013	21:05:42	4.24	dipolar	3.11	-7.51	16.05	5.27	436341.961	4074365	-75.71370195	36.81299318
MC-CR-266	Cable Route	P158_-090_1420	6/7/2013	16:25:32	3.77	dipolar	2.98	-5.89	7.94	3.03	436344.922	4074489	-75.71367914	36.81411113
MC-CR-267	Cable Route	P160_M150H	6/9/2013	19:22:51	4.29	dipolar	14.19	19.16	16.74	4.37	436352.973	4074545.08	-75.71359358	36.81461718
MC-CR-268	Cable Route	P157_120_0340	6/6/2013	4:31:40	4.39	dipolar	3.43	10.06	13.58	5.38	436584.431	4074317.88	-75.71097977	36.81258472
MC-CR-269	Cable Route	P157_060_1527	6/6/2013	15:38:29	4.21	dipolar	5.26	-14.00	26.35	7.70	436741.442	4074410.37	-75.70922727	36.81342894
MC-CR-270	Cable Route	P160_M150H	6/9/2013	19:25:40	4.23	dipolar	4.09	8.99	21.02	6.66	436768.753	4074632.2	-75.70893953	36.81543036

			Shotpoint				Intensity (gammas)		Duration (meters)		NAD83 Coordinates (m)			
Anomaly ID	Area	Line	Date	Time	Tow Height	Signature	AS	T_filt	AS_Width	AS_HAWid	Easting	Northing	Latitude	Longitude
MC-CR-271	Cable Route	P160_M150H	6/9/2013	19:26:29	4.19	dipolar	5.00	6.19	21.96	3.50	436888.913	4074659.5	-75.70759467	36.81568447
MC-CR-272	Cable Route	P158_-030_0432	6/7/2013	6:22:55	4.27	single-pole	6.67	13.89	20.70	5.52	437025.243	4074572.08	-75.70605902	36.81490554
MC-CR-273	Cable Route	P158_-030_0432	6/7/2013	6:22:36	4.24	dipolar	3.24	-6.44	10.67	1.90	437085.943	4074584.8	-75.70537957	36.81502424
MC-CR-274	Cable Route	P158_-090_1420	6/7/2013	16:21:07	3.99	single-pole	3.75	-6.97	14.53	2.25	437114.033	4074651.59	-75.70507017	36.81562815
MC-CR-275	Cable Route	P158_-030_0432	6/7/2013	6:22:27	4.27	single-pole	6.92	11.93	20.15	2.72	437114.353	4074590.54	-75.70506154	36.81507786
MC-CR-276	Cable Route	P158_000_0108	6/7/2013	2:31:45	3.74	dipolar	2.78	-4.81	19.59	2.45	437125.302	4074559.05	-75.70493618	36.81479474
MC-CR-277	Cable Route	P157_060_1527	6/6/2013	15:40:45	3.93	complex	2.76	1.05	24.07	11.66	437138.842	4074499.15	-75.70477943	36.81425569
MC-CR-278	Cable Route	P158_000_0108	6/7/2013	2:34:16	3.91	dipolar	31.67	-34.55	23.81	2.94	437591.943	4074655.55	-75.69971259	36.81569549
MC-CR-279	Cable Route	P157_120_0340	6/6/2013	4:37:49	4.13	single-pole	2.97	5.29	14.19	2.38	437604.202	4074537.59	-75.69956547	36.814633
MC-CR-280	Cable Route	P157_060_1527	6/6/2013	15:43:24	4.03	dipolar	2.99	-3.39	15.05	NM	437605.122	4074593.78	-75.69955976	36.81513956
MC-CR-281	Cable Route	P158_-060_1014	6/7/2013	11:44:16	4.29	dipolar	5.69	-24.06	20.41	7.87	437610.263	4074726.13	-75.69951298	36.81633291
MC-CR-283	Cable Route	P157_060_1527	6/6/2013	15:44:48	3.88	dipolar	7.52	11.65	22.29	4.30	437852.673	4074647.97	-75.69678889	36.81564432
MC-CR-284	Cable Route	P158_-030_0432	6/7/2013	6:18:01	3.77	dipolar	3.79	13.64	25.78	5.50	437957.963	4074768.66	-75.6956183	36.81673915
MC-CR-285	Cable Route	P160_M150H	6/9/2013	19:33:49	3.44	dipolar	18.37	35.16	21.16	3.82	437976.864	4074890.46	-75.69541633	36.8178383
MC-CR-286	Cable Route	P158_000_0108	6/7/2013	2:37:35	3.92	dipolar	34.89	48.93	24.13	4.94	438206.503	4074788.22	-75.69283344	36.81693173
MC-CR-287	Cable Route	P157_060_1527	6/6/2013	15:48:17	4.23	dipolar	8.26	-17.04	12.44	2.64	438464.773	4074780.11	-75.68993723	36.81687545
MC-CR-289	Cable Route	P160_M150H	6/9/2013	19:38:22	3.53	dipolar	4.17	11.11	26.29	6.60	438661.655	4075035.28	-75.6877505	36.81918837
MC-CR-290	Cable Route	P158_-030_0432	6/7/2013	6:14:17	2.95	dipolar	3.67	4.92	7.83	1.71	438663.354	4074919.43	-75.68772211	36.81814419
MC-CR-291	Cable Route	P157_120_0340	6/6/2013	4:44:29	3.81	single-pole	11.99	-29.83	32.52	5.91	438697.603	4074767.94	-75.68732592	36.81678087
MC-CR-292	Cable Route	P158_-030_0432	6/7/2013	6:13:25	3.61	dipolar	6.00	-11.84	15.94	2.62	438827.194	4074955.87	-75.68588814	36.81848328
MC-CR-293	Cable Route	P158_-030_0432	6/7/2013	6:11:29	4.06	dipolar	6.16	14.01	21.05	2.42	439193.874	4075033.42	-75.68178328	36.81920596
MC-CR-294	Cable Route	P161_M120G	6/10/2013	23:10:57	4.76	complex	83.85	-186.23	20.99	5.64	439346.835	4075153.65	-75.68007792	36.82029955
MC-CR-295	Cable Route	P161_M120G	6/10/2013	23:11:00	3.32	complex	56.46	152.30	19.97	3.54	439354.255	4075154.97	-75.67999483	36.82031192
MC-CR-298	Cable Route	P161_M120G	6/10/2013	23:11:55	4.04	dipolar	6.00	-10.35	16.92	6.19	439505.185	4075187.14	-75.67830518	36.82061157
MC-CR-299	Cable Route	P157_060_1527	6/6/2013	15:54:25	4.61	dipolar	6.34	-10.00	24.80	2.90	439535.764	4075009.42	-75.67794821	36.81901153
MC-CR-300	Cable Route	P157_030_2016	6/6/2013	20:33:57	3.7	single-pole	7.81	12.46	17.21	4.16	439569.734	4075048.06	-75.67757041	36.81936201
MC-CR-301	Cable Route	P161_M120G	6/10/2013	23:12:22	4.18	dipolar	2.97	5.22	14.27	4.31	439576.635	4075204.82	-75.6775055	36.8207755
MC-CR-302	Cable Route	P156_150_2206	6/5/2013	23:45:29	4.9	dipolar	11.35	17.90	22.15	4.95	440205.264	4075065.88	-75.67044642	36.81956302
MC-CR-303	Cable Route	P158_-030_0432	6/7/2013	6:06:00	4.66	dipolar	4.08	-6.97	19.10	5.31	440229.235	4075254.22	-75.67019247	36.82126226
MC-CR-304	Cable Route	P157_090_0732	6/6/2013	9:04:55	3.66	dipolar	3.63	14.39	12.67	NM	440384.365	4075164.49	-75.66844612	36.82046321
MC-CR-305	Cable Route	P156_150_2206	6/5/2013	23:43:42	3.89	single-pole	5.58	9.62	11.76	3.91	440525.774	4075131.36	-75.66685806	36.82017347
MC-CR-306	Cable Route	P158_-090_1420	6/7/2013	15:57:30	3.39	dipolar	31.51	46.59	21.63	4.93	440988.306	4075476.77	-75.66169901	36.82331601
MC-CR-307	Cable Route	P157_120_0504	6/6/2013	5:09:18	3.15	dipolar	3.10	-4.65	10.20	2.55	441347.775	4075328.89	-75.65765712	36.82200535
MC-CR-308	Cable Route	P157_030_2016	6/6/2013	20:21:35	4.05	dipolar	62.54	136.83	48.35	3.53	441748.866	4075516.39	-75.65317438	36.82372029
MC-CR-309	Cable Route	P158_-030_0432	6/7/2013	5:57:42	3.82	complex	2.67	-5.07	17.42	3.35	441793.337	4075583.5	-75.6526809	36.82432797
MC-CR-310	Cable Route	P160_M150H	6/9/2013	19:59:42	3.71	complex	11.41	-15.58	17.32	3.50	441912.588	4075729.03	-75.65135492	36.82564713
MC-CR-311	Cable Route	P160_M150H	6/9/2013	19:59:47	3.77	complex	25.24	-32.37	16.24	4.22	441924.078	4075731.56	-75.65122628	36.82567065

			Shotpoint				Intensity (gammas)		Duration (meters)		NAD83 Coordinates (m)			
Anomaly ID	Area	Line	Date	Time	Tow Height	Signature	AS	T_filt	AS_Width	AS_HAWid	Easting	Northing	Latitude	Longitude
MC-CR-312	Cable Route	P157_090_0732	6/6/2013	8:55:45	4.68	dipolar	4.20	9.40	20.76	5.03	442127.626	4075534.11	-75.64892892	36.82390327
MC-CR-313	Cable Route	P156_150_2206	6/5/2013	23:33:11	3.46	dipolar	2.81	-5.97	17.20	6.60	442396.576	4075530.54	-75.64591306	36.82388751
MC-CR-314	Cable Route	P158_-060_1014	6/7/2013	12:15:12	5.2	dipolar	10.49	-24.13	15.06	3.92	443032.478	4075870.21	-75.63880848	36.82698787
MC-CR-315	Cable Route	P158_-030_0432	6/7/2013	5:50:35	3.71	single-pole	3.08	6.01	12.58	1.91	443144.548	4075872	-75.63755199	36.82701075
MC-CR-316	Cable Route	P158_-060_1225	6/7/2013	12:26:54	3.83	single-pole	3.65	7.48	9.57	4.24	443146.208	4075904.34	-75.63753579	36.82730236
MC-CR-317	Cable Route	P157_030_1900	6/6/2013	19:58:55	3.7	single-pole	8.33	19.56	14.29	4.01	443219.088	4075827.13	-75.63671283	36.82661076
MC-CR-318	Cable Route	P157_030_1900	6/6/2013	19:58:30	4.36	single-pole	5.13	-6.14	20.16	5.15	443290.068	4075845.04	-75.63591827	36.82677646
MC-CR-319	Cable Route	P157_090_0732	6/6/2013	8:49:31	3.93	dipolar	8.22	17.06	18.49	3.26	443309.987	4075786.84	-75.63569058	36.82625303
MC-CR-320	Cable Route	P157_060_1527	6/6/2013	16:16:06	3.08	dipolar	16.67	23.58	11.14	2.96	443337.157	4075812.01	-75.6353878	36.82648154
MC-CR-321	Cable Route	P157_090_0732	6/6/2013	8:49:04	3.67	dipolar	5.34	-8.75	11.20	4.72	443395.577	4075803.51	-75.63473211	36.82640842
MC-CR-322	Cable Route	P158_-090_1420	6/7/2013	15:41:53	4.05	dipolar	2.82	-4.01	12.29	4.45	443514.119	4076013.92	-75.63341856	36.82831218
MC-CR-323	Cable Route	P157_090_0732	6/6/2013	8:48:22	3.64	dipolar	18.39	45.12	30.84	7.48	443529.857	4075833.31	-75.63322866	36.82668507
MC-CR-324	Cable Route	P158_-060_1225	6/7/2013	12:29:43	3.5	dipolar	13.56	21.89	13.48	2.41	443646.168	4076004.05	-75.63193713	36.82823109
MC-CR-325	Cable Route	P158_-060_1225	6/7/2013	12:30:52	2.18	dipolar	2.95	4.48	12.94	2.74	443851.799	4076047.33	-75.62963458	36.82863346
MC-CR-326	Cable Route	P157_090_0732	6/6/2013	8:45:29	3.72	dipolar	3.14	-4.61	15.62	4.71	444065.698	4075947.33	-75.62722873	36.82774471
MC-CR-327	Cable Route	P160_M150H	6/9/2013	20:15:54	3.18	dipolar	10.44	-17.19	15.22	1.53	444401.91	4076257.87	-75.62348147	36.8305638
MC-CR-328	Cable Route	P158_-060_1225	6/7/2013	12:34:04	3.59	dipolar	3.34	-5.70	10.14	2.07	444430.769	4076177.26	-75.62315197	36.82983887
MC-CR-329	Cable Route	P161_M120G	6/10/2013	23:42:44	4.51	dipolar	2.76	3.34	22.44	NM	444502.4	4076253.75	-75.62235433	36.83053257
MC-CR-331	Cable Route	P158_-060_1225	6/7/2013	12:36:05	4.44	dipolar	4.86	4.32	21.56	3.84	444790.129	4076248.32	-75.61912749	36.83050046
MC-CR-332	Cable Route	P158_-030_0432	6/7/2013	5:41:12	3.4	dipolar	10.04	11.43	12.08	1.09	444866.83	4076275.85	-75.61826941	36.8307531
MC-CR-333	Cable Route	P158_-030_0432	6/7/2013	5:40:55	3.55	single-pole	3.19	2.92	8.74	3.30	444911.18	4076300.47	-75.61777387	36.83097761
MC-CR-334	Cable Route	P158_-090_1420	6/7/2013	15:32:30	3.16	dipolar	6.16	17.00	13.70	1.78	444961.67	4076403.03	-75.61721512	36.83190505
MC-CR-335	Cable Route	P158_000_0108	6/7/2013	3:15:23	3.88	dipolar	5.06	-9.22	13.56	3.49	445251.161	4076487.3	-75.61397493	36.83268148
MC-CR-336	Cable Route	P161_M120G	6/10/2013	23:47:47	4.36	dipolar	2.96	-3.55	16.32	6.43	445281.212	4076628.91	-75.61364814	36.83395973
MC-CR-337	Cable Route	P158_-060_1225	6/7/2013	12:39:37	4.11	dipolar	5.31	7.33	14.73	2.22	445351.341	4076602.11	-75.61285978	36.8337222
MC-CR-338	Cable Route	P158_000_0108	6/7/2013	3:17:21	3.38	dipolar	7.85	-7.91	12.28	3.54	445593.942	4076668.79	-75.61014404	36.83433726
MC-CR-339	Cable Route	P162_M120	6/11/2013	0:40:00	3.77	dipolar	3.26	-2.25	8.79	4.58	445602.433	4076810.3	-75.61005896	36.83561335
MC-CR-340	Cable Route	P156_150_2206	6/5/2013	23:11:47	4.12	dipolar	11.15	-15.21	15.76	3.48	445999.472	4076744.89	-75.60560181	36.83504649
MC-CR-341	Cable Route	P157_090_0732	6/6/2013	8:33:46	3.52	dipolar	3.55	-6.28	12.55	4.29	446017.382	4076825.02	-75.60540665	36.83576982
MC-CR-342	Cable Route	P157_030_1900	6/6/2013	19:41:20	4.71	single-pole	13.39	-31.06	20.39	4.45	446024.633	4076896.6	-75.60533043	36.83641547
MC-CR-344	Cable Route	P158_-090_1420	6/7/2013	15:24:00	4.04	dipolar	9.39	-14.73	13.90	1.95	446133.614	4077103.15	-75.60412291	36.83828357
MC-CR-345	Cable Route	P158_-030_0432	6/7/2013	5:32:29	4.11	single-pole	8.18	13.37	15.60	5.04	446261.934	4077111.13	-75.60268441	36.83836281
MC-CR-346	Cable Route	P157_090_0732	6/6/2013	8:32:14	3.69	dipolar	3.07	-3.71	11.64	3.17	446266.593	4076972.85	-75.60262239	36.83711659
MC-CR-347	Cable Route	P158_-060_1225	6/7/2013	12:45:20	2.9	single-pole	6.34	-6.88	10.98	2.32	446273.004	4077152.44	-75.60256319	36.83873582
MC-CR-348	Cable Route	P157_090_0732	6/6/2013	8:32:07	4.02	dipolar	8.70	14.05	21.64	3.57	446285.613	4076983.11	-75.60240981	36.83721015
MC-CR-349	Cable Route	P158_-030_0432	6/7/2013	5:31:09	3.68	single-pole	17.14	-30.05	22.43	4.96	446476.275	4077233.81	-75.6002893	36.83948083
MC-CR-350	Cable Route	P158_-090_1420	6/7/2013	15:20:20	4.25	dipolar	2.61	-5.44	6.97	2.72	446634.126	4077401.88	-75.59853083	36.84100469

			Shotpoint				Intensity (gammas)		Duration (meters)		NAD83 Coordinates (m)			
Anomaly ID	Area	Line	Date	Time	Tow Height	Signature	AS	T_filt	AS_Width	AS_HAWid	Easting	Northing	Latitude	Longitude
MC-CR-351	Cable Route	P158_-030_0432	6/7/2013	5:30:08	3.41	single-pole	7.00	8.38	11.30	2.27	446637.685	4077328.76	-75.59848578	36.84034586
MC-CR-352	Cable Route	P158_-060_1225	6/7/2013	12:47:39	3.88	dipolar	12.98	34.69	35.62	5.86	446653.296	4077370.88	-75.59831367	36.84072633
MC-CR-353	Cable Route	P158_-090_1420	6/7/2013	15:19:18	3.87	complex	19.46	57.20	20.52	6.35	446778.436	4077484.75	-75.59691819	36.84175983
MC-CR-354	Cable Route	P158_-090_1420	6/7/2013	15:19:15	3.81	complex	23.95	58.39	16.09	4.76	446785.106	4077488.11	-75.59684362	36.8417905
MC-CR-355	Cable Route	P162_M120	6/11/2013	0:48:11	3.62	dipolar	8.51	19.14	13.41	2.23	446929.627	4077611.97	-75.59523145	36.84291513
MC-CR-356	Cable Route	P158_-060_1225	6/7/2013	12:49:47	4.17	single-pole	2.43	6.71	12.50	5.62	446990.767	4077569.9	-75.59454281	36.84253933
MC-CR-357	Cable Route	P161_34P200	6/10/2013	8:34:46	2.51	dipolar	3.52	-4.89	20.23	5.06	447074.717	4077621.03	-75.59360484	36.84300493
MC-CR-358	Cable Route	P157_030_1900	6/6/2013	19:33:21	4.01	dipolar	3.05	3.86	15.54	4.13	447196.347	4077594.59	-75.59223889	36.84277339
MC-CR-359	Cable Route	P158_-030_0432	6/7/2013	5:26:25	4.84	dipolar	3.26	6.68	15.56	6.26	447217.067	4077679.94	-75.59201243	36.84354392
MC-CR-361	Cable Route	P158_000_0108	6/7/2013	3:28:09	3.65	single-pole	2.69	-3.83	14.29	4.55	447424.348	4077760.32	-75.58969325	36.84428003
MC-CR-362	Cable Route	P157_060_1652	6/6/2013	17:11:01	3.77	dipolar	2.81	-4.53	9.61	3.24	447488.568	4077731.74	-75.58897102	36.84402597
MC-CR-363	Cable Route	P157_030_1900	6/6/2013	19:30:45	4.22	dipolar	11.81	25.16	24.85	4.94	447576.698	4077825.28	-75.58798904	36.84487406
MC-CR-364	Cable Route	P157_120_0504	6/6/2013	5:50:47	3.21	complex	5.12	16.43	7.18	1.53	447630.248	4077747.22	-75.58738307	36.84417338
MC-CR-365	Cable Route	P157_120_0504	6/6/2013	5:50:48	3.16	complex	7.47	-10.66	11.56	1.22	447632.718	4077748.64	-75.58735546	36.84418631
MC-CR-366	Cable Route	P158_-090_1420	6/7/2013	15:12:18	3.42	single-pole	7.79	-12.58	23.86	7.58	447734.24	4078061.9	-75.5862384	36.84701573
MC-CR-367	Cable Route	P160_M150H	6/9/2013	20:41:02	3.67	dipolar	11.00	-13.61	26.01	3.02	447821.34	4078173.8	-75.58526917	36.84802924
MC-CR-368	Cable Route	P158_-060_1225	6/7/2013	12:55:01	4.37	single-pole	8.25	17.17	21.19	6.32	447828.56	4078068.04	-75.58518093	36.84707629
MC-CR-369	Cable Route	P158_000_0108	6/7/2013	3:31:03	4.17	dipolar	2.90	-6.47	9.29	1.29	447917.799	4078049.15	-75.58417872	36.84691093
MC-CR-370	Cable Route	P156_150_2206	6/5/2013	22:57:40	4.27	single-pole	8.08	13.09	21.49	3.43	448135.429	4078018.56	-75.58173571	36.84664716
MC-CR-371	Cable Route	P158_-060_1225	6/7/2013	12:57:30	3.75	dipolar	5.75	14.40	16.49	4.29	448224.641	4078309.48	-75.58075495	36.84927447
MC-CR-372	Cable Route	P157_120_0504	6/6/2013	5:54:59	3.72	single-pole	2.47	-5.44	12.85	2.88	448248.56	4078112.11	-75.58047322	36.84749664
MC-CR-373	Cable Route	P158_000_0108	6/7/2013	3:33:09	4.04	single-pole	2.50	-7.20	19.40	5.01	448268.34	4078262.27	-75.58026159	36.8488513
MC-CR-374	Cable Route	P162_M120	6/11/2013	0:56:17	3.31	dipolar	3.32	-3.50	10.29	2.07	448299.962	4078424.15	-75.57991794	36.85031226
MC-CR-375	Cable Route	P160_M150H	6/9/2013	20:46:15	3.53	complex	17.40	23.79	24.67	2.48	448506.822	4078580.65	-75.57760831	36.85173428
MC-CR-376	Cable Route	P160_M150H	6/9/2013	20:46:24	3.47	complex	5.50	-11.91	22.35	7.42	448526.652	4078592.16	-75.57738666	36.85183912
MC-CR-377	Cable Route	P161_36P000	6/10/2013	7:57:48	3.84	dipolar	3.92	-5.04	7.33	2.32	448588.832	4078596.56	-75.57668951	36.85188216
MC-CR-378	Cable Route	P162_M120	6/11/2013	0:57:58	3.88	dipolar	2.49	0.25	18.51	4.05	448589.462	4078597.71	-75.57668252	36.85189256
MC-CR-379	Cable Route	P157_030_1900	6/6/2013	19:23:47	4.19	dipolar	9.87	26.71	15.34	3.32	448607.281	4078437.99	-75.57647184	36.85045378
MC-CR-380	Cable Route	P158_-030_0432	6/7/2013	5:16:28	4.09	dipolar	2.72	-7.82	7.34	1.76	448744.012	4078587.08	-75.57494826	36.85180514
MC-CR-381	Cable Route	P162_M120	6/11/2013	0:59:18	3.37	dipolar	6.25	13.86	18.29	5.85	448820.623	4078736.74	-75.57409903	36.85315836
MC-CR-382	Cable Route	P158_-030_0432	6/7/2013	5:15:09	4.11	single-pole	6.66	14.68	16.27	5.23	448945.403	4078707.5	-75.57269743	36.85290154
MC-CR-383	Cable Route	P158_-090_1420	6/7/2013	15:03:12	4.18	dipolar	3.37	-6.32	13.71	2.82	448983.723	4078794.74	-75.57227345	36.85369001
MC-CR-384	Cable Route	P158_-060_1225	6/7/2013	13:02:47	3.09	single-pole	19.89	19.83	19.14	4.31	449071.044	4078816.44	-75.57129544	36.85389033
MC-CR-385	Cable Route	P157_030_1900	6/6/2013	19:20:30	4.19	single-pole	3.50	6.27	18.68	2.60	449095.553	4078729.75	-75.57101471	36.8531102
MC-CR-387	Cable Route	P162_M120	6/11/2013	1:01:38	3.64	dipolar	4.18	6.40	14.94	4.23	449220.165	4078973.47	-75.56963326	36.85531384
MC-CR-388	Cable Route	P158_-060_1225	6/7/2013	13:04:14	3.69	dipolar	2.54	-7.35	17.13	5.22	449306.784	4078947.66	-75.5686599	36.85508586
MC-CR-389	Cable Route	P158_-060_1225	6/7/2013	13:04:24	3.43	dipolar	5.17	-8.74	13.52	4.64	449332.584	4078962.02	-75.56837146	36.85521668

			Shotpoint				Intensity (gammas)		Duration (meters)		NAD83 Coordinates (m)			
Anomaly ID	Area	Line	Date	Time	Tow Height	Signature	AS	T_filt	AS_Width	AS_HAWid	Easting	Northing	Latitude	Longitude
MC-CR-390	Cable Route	P158_-030_0432	6/7/2013	5:12:20	3.83	dipolar	5.76	9.58	12.21	4.26	449373.124	4078964.35	-75.56791687	36.85523986
MC-CR-391	Cable Route	P162_M120	6/11/2013	1:02:59	3.84	dipolar	25.98	-2.45	25.21	4.98	449448.465	4079110.52	-75.56708149	36.85656151
MC-CR-392	Cable Route	P161_36P900	6/10/2013	7:45:22	2.93	dipolar	7.12	8.44	21.04	3.02	449484.413	4078847.78	-75.56666076	36.85419502
MC-CR-393	Cable Route	P157_120_0504	6/6/2013	6:03:40	4.45	complex	6.64	-10.88	17.10	4.75	449509.424	4078866.27	-75.56638145	36.85436303
MC-CR-394	Cable Route	P157_030_1900	6/6/2013	19:17:23	4.4	dipolar	12.76	-21.47	18.85	3.01	449557.144	4079005.58	-75.56585542	36.85562136
MC-CR-395	Cable Route	P160_M150H	6/9/2013	20:54:38	3.31	dipolar	8.51	-9.73	17.11	3.75	449608.646	4079239.89	-75.56529327	36.85773624
MC-CR-397	Cable Route	P162_M120	6/11/2013	1:04:13	3.61	dipolar	5.61	-7.11	13.81	1.64	449657.606	4079235.96	-75.56474379	36.85770342
MC-CR-398	Cable Route	P162_M120	6/11/2013	1:04:31	3.46	dipolar	3.33	9.19	21.99	8.35	449709.806	4079265.31	-75.56416018	36.85797077
MC-CR-399	Cable Route	P160_M150H	6/9/2013	20:55:45	3.1	single-pole	3.30	-1.88	19.18	3.72	449756.216	4079327.52	-75.56364369	36.85853402
MC-CR-400	Cable Route	P158_-090_1420	6/7/2013	14:57:04	3.85	dipolar	5.76	6.91	13.79	NM	449805.416	4079296.28	-75.56308971	36.85825503
MC-CR-401	Cable Route	P158_-090_1420	6/7/2013	14:57:04	3.85	dipolar	5.76	6.91	33.30	NM	449805.416	4079296.28	-75.56308971	36.85825503
MC-CR-402	Cable Route	P158_000_0108	6/7/2013	3:42:32	3.68	single-pole	4.08	-8.03	16.60	3.76	449844.906	4079207.45	-75.56264086	36.85745639
MC-CR-403	Cable Route	P157_060_1652	6/6/2013	17:27:38	4.06	single-pole	6.34	6.18	22.33	4.38	449935.285	4079189.02	-75.56162581	36.85729505
MC-CR-404	Cable Route	P158_-060_1225	6/7/2013	13:08:21	3.71	dipolar	2.65	4.13	7.56	1.99	449960.886	4079343.64	-75.56134882	36.85869019
MC-CR-405	Cable Route	P157_090_0732	6/6/2013	8:08:43	3.01	dipolar	3.38	-5.55	11.11	2.82	450036.886	4079220.92	-75.56048821	36.85758798
MC-CR-406	Cable Route	P158_-090_1420	6/7/2013	14:55:02	3.81	dipolar	19.75	36.49	13.42	2.75	450082.287	4079457.18	-75.55999445	36.85972009
MC-CR-407	Cable Route	P158_-090_1420	6/7/2013	14:53:45	2.99	dipolar	9.48	17.56	27.96	NM	450260.238	4079563.43	-75.55800519	36.86068724
MC-CR-408	Cable Route	P158_-090_1420	6/7/2013	14:53:45	2.99	dipolar	9.48	17.56	29.75	NM	450260.238	4079563.43	-75.55800519	36.86068724
MC-CR-409	Cable Route	P157_060_1652	6/6/2013	17:31:14	4.52	single-pole	3.12	5.99	13.51	2.37	450472.017	4079515.87	-75.55562634	36.86026965
MC-CR-410	Cable Route	P157_090_0732	6/6/2013	8:05:29	2.91	dipolar	5.28	8.53	13.43	2.17	450549.957	4079531.37	-75.55475302	36.86041345
MC-CR-411	Cable Route	P160_M150H	6/9/2013	21:02:09	3.87	dipolar	6.75	-5.21	20.26	5.32	450594.099	4079827.16	-75.5542771	36.86308209
MC-CR-412	Cable Route	P158_-090_1420	6/7/2013	14:51:03	3.38	single-pole	4.08	-6.14	17.27	2.29	450630.419	4079783.7	-75.55386682	36.86269223
MC-CR-413	Cable Route	P157_090_0732	6/6/2013	8:04:51	3.1	dipolar	6.37	18.00	18.69	5.80	450651.828	4079592.87	-75.55361424	36.86097316
MC-CR-414	Cable Route	P158_-060_1225	6/7/2013	13:12:53	5.38	single-pole	3.65	1.42	20.34	6.13	450686.779	4079774.85	-75.55323399	36.8626154
MC-CR-415	Cable Route	P157_030_1900	6/6/2013	19:09:26	3.75	dipolar	3.76	4.17	10.48	3.89	450739.078	4079710.59	-75.5526431	36.86203887
MC-CR-418	Cable Route	P160_M150H	6/9/2013	21:05:05	3.28	dipolar	4.22	-11.90	28.57	4.54	450977.11	4080055.6	-75.54999509	36.86516127
MC-CR-419	Cable Route	P158_-030_0432	6/7/2013	5:02:05	2.91	complex	6.99	19.33	18.33	3.65	450997.859	4079932.88	-75.54975439	36.86405611
MC-CR-420	Cable Route	P156_150_2206	6/5/2013	22:38:12	3.31	single-pole	4.33	-8.38	16.24	6.18	451037.578	4079747.91	-75.54929687	36.8623908
MC-CR-421	Cable Route	P158_-060_1225	6/7/2013	13:15:12	4.77	dipolar	3.51	9.99	18.78	5.67	451039.57	4079997.56	-75.54929064	36.86464132
MC-CR-422	Cable Route	P157_090_0732	6/6/2013	8:01:52	2.22	dipolar	6.84	12.71	26.04	NM	451137.849	4079875.55	-75.54818022	36.86354658
MC-CR-423	Cable Route	P157_090_0732	6/6/2013	8:01:16	3.88	complex	7.37	15.48	8.29	2.84	451234.739	4079935.77	-75.54709713	36.86409442
MC-CR-424	Cable Route	P158_-090_1420	6/7/2013	14:45:52	3.27	dipolar	3.26	5.02	8.12	4.56	451343.251	4080205.54	-75.54589709	36.8665318
MC-CR-425	Cable Route	P157_030_1900	6/6/2013	19:04:50	3.66	dipolar	27.08	32.10	13.50	2.85	451433.55	4080127.48	-75.54487904	36.86583279
MC-CR-426	Cable Route	P161_SBP_30B	6/10/2013	7:06:13	2.74	dipolar	5.30	8.29	19.65	5.84	451436.89	4080124.66	-75.54484139	36.86580754
MC-CR-427	Cable Route	P162_M120	6/11/2013	1:15:20	3.72	dipolar	6.52	-15.21	20.31	2.81	451557.672	4080367.38	-75.54350186	36.86800169
MC-CR-428	Cable Route	P157_090_0732	6/6/2013	7:59:00	3.55	single-pole	6.48	-13.12	18.20	3.95	451595.98	4080152.51	-75.54305837	36.86606676
MC-CR-429	Cable Route	P157_060_1652	6/6/2013	17:39:09	3.71	dipolar	11.66	22.25	20.00	3.43	451636.541	4080213.29	-75.5426072	36.86661672

			Shotpoint				Intensity (gammas)		Duration (meters)		NAD83 Coordinates (m)			
Anomaly ID	Area	Line	Date	Time	Tow Height	Signature	AS	T_filt	AS_Width	AS_HAWid	Easting	Northing	Latitude	Longitude
MC-CR-430	Cable Route	P161_SBP_30B	6/10/2013	7:03:50	2.76	dipolar	2.86	7.36	15.41	2.12	451741.991	4080323.5	-75.54143117	36.86761558
MC-CR-431	Cable Route	P161_SBP_30B	6/10/2013	7:03:32	4.05	single-pole	7.55	14.27	17.77	4.71	451779.472	4080341.32	-75.54101181	36.86777813
MC-CR-432	Cable Route	P162_M120	6/11/2013	1:16:50	4.09	dipolar	7.10	13.98	12.55	2.97	451813.653	4080519.62	-75.54063965	36.86938703
MC-CR-434	Cable Route	P157_030_1815	6/6/2013	18:39:15	4.56	single-pole	4.34	8.96	17.58	2.90	452243.983	4080608.11	-75.53581721	36.87020665
MC-CR-435	Cable Route	P156_150_2206	6/5/2013	22:29:44	4.27	dipolar	3.92	6.98	12.02	3.83	452279.142	4080489.88	-75.53541531	36.86914267
MC-CR-436	Cable Route	P162_M120	6/11/2013	1:20:07	3.46	dipolar	4.74	-8.57	15.34	5.13	452375.254	4080857.77	-75.53436009	36.8724637
MC-CR-437	Cable Route	P158_-060_1225	6/7/2013	13:24:24	3.1	dipolar	3.93	6.34	11.15	2.29	452474.444	4080843.4	-75.53324631	36.87233916
MC-CR-438	Cable Route	P161_40P500	6/10/2013	6:21:38	3.17	complex	14.27	-30.56	19.69	3.72	452483.604	4080869.51	-75.53314517	36.87257498
MC-CR-439	Cable Route	P161_40P500	6/10/2013	6:21:40	3.19	complex	15.54	17.14	19.38	3.22	452486.884	4080864.5	-75.53310805	36.87252999
MC-CR-440	Cable Route	P157_060_1652	6/6/2013	17:47:13	3.56	dipolar	4.29	3.51	14.14	4.58	452799.754	4080911.11	-75.52960062	36.87296583
MC-CR-441	Cable Route	P157_090_0732	6/6/2013	7:49:43	3.19	dipolar	7.28	17.05	12.78	1.13	453085.115	4081041.51	-75.52640698	36.87415551
MC-CR-442	Cable Route	P158_-060_1225	6/7/2013	13:29:42	3.23	dipolar	3.62	-6.49	18.15	3.83	453297.987	4081335.2	-75.52403663	36.87681347
MC-CR-443	Cable Route	P158_-030_0432	6/7/2013	4:46:29	3.49	dipolar	2.99	-2.21	21.42	6.22	453522.227	4081436.72	-75.52152678	36.87773967
MC-CR-446	Cable Route	P156_150_2206	6/5/2013	22:19:28	3.82	single-pole	5.38	16.98	22.26	7.42	453822.737	4081409.27	-75.51815322	36.87750697
MC-CR-448	Cable Route	P158_-030_0432	6/7/2013	4:43:07	3.74	dipolar	10.20	18.06	14.68	4.66	454066.529	4081759.75	-75.51543897	36.88067819
MC-CR-449	Cable Route	P158_-090_1420	6/7/2013	14:23:39	3.66	dipolar	2.54	-3.46	15.43	3.83	454387.08	4082024.8	-75.511858	36.88308298
MC-CR-450	Cable Route	P158_-090_1420	6/7/2013	14:22:46	3.51	dipolar	17.90	25.20	10.22	2.48	454491.501	4082104.54	-75.51069105	36.88380682
MC-CR-451	Cable Route	P158_-030_0432	6/7/2013	4:39:58	3.98	complex	15.85	34.20	19.25	4.44	454576.03	4082064.83	-75.50974012	36.88345293
MC-CR-452	Cable Route	P158_-030_0432	6/7/2013	4:39:51	4.76	complex	7.07	14.72	15.37	4.80	454596.54	4082076.53	-75.50951067	36.88355938
MC-CR-453	Cable Route	P157_030_1815	6/6/2013	18:23:23	3.95	complex	6.03	-4.01	18.97	6.73	454605.97	4082020.58	-75.50940151	36.88305549
MC-CR-454	Cable Route	P158_-030_0432	6/7/2013	4:39:03	3	dipolar	6.43	9.04	9.33	2.66	454730.501	4082156.22	-75.5080122	36.88428417
MC-CR-455	Cable Route	P157_120_0504	6/6/2013	6:40:32	4.31	dipolar	3.49	-8.63	14.78	5.02	454802.38	4082023.2	-75.50719767	36.88308853
MC-CR-456	Cable Route	P158_-090_1406	6/7/2013	14:12:50	3.47	dipolar	7.19	6.54	16.59	2.52	454824.432	4082287.34	-75.50696597	36.88547062
MC-CR-457	Cable Route	P156_150_2206	6/5/2013	22:12:25	4.12	dipolar	4.03	7.52	18.77	1.87	454890.81	4082050.77	-75.50620701	36.88334128
MC-CR-458	Cable Route	P162_M120	6/11/2013	1:35:45	3.95	dipolar	4.16	-6.93	16.76	5.99	455020.612	4082432.68	-75.5047731	36.88679013
MC-CR-460	Cable Route	P157_090_0732	6/6/2013	7:37:29	3.94	dipolar	6.77	17.04	12.65	1.13	455051.001	4082209.64	-75.50441886	36.88478103
MC-CR-461	Cable Route	P157_090_0732	6/6/2013	7:37:04	4.35	dipolar	3.57	-6.91	15.34	5.23	455115.471	4082250.26	-75.5036978	36.88515026
MC-CR-462	Cable Route	P160_M150H	6/9/2013	21:39:00	3.61	single-pole	7.59	13.58	23.26	5.71	455290.623	4082630.64	-75.50175474	36.88858743
MC-CR-463	Cable Route	P157_030_1815	6/6/2013	18:17:48	4.39	complex	4.80	-7.35	17.22	5.19	455448.573	4082524.01	-75.49997593	36.8876337
MC-CR-464	Cable Route	P157_030_1815	6/6/2013	18:17:31	4.14	complex	67.20	108.58	32.22	8.64	455489.433	4082551.87	-75.49951903	36.88788677
MC-CR-465	Cable Route	P156_150_2206	6/5/2013	22:08:03	3.76	complex	5.45	-10.91	17.20	1.16	455533.772	4082446.02	-75.49901524	36.8869347
MC-CR-466	Cable Route	P156_150_2206	6/5/2013	22:08:00	3.81	complex	6.62	14.13	16.09	3.41	455539.942	4082449.35	-75.4989462	36.886965
MC-LA-001	Lease Area	P160_SSS_SBP_MAG	6/9/2013	21:49:54	4.49	dipolar	6.33	11.96	21.54	5.67	455590.934	4082734.99	-75.49839071	36.88954225
MC-CR-467	Cable Route	P158_-090_1406	6/7/2013	14:07:11	3.46	dipolar	3.05	4.65	8.04	1.23	455593.534	4082778.79	-75.49836409	36.8899372
MC-LA-003	Lease Area	P161_001_0502	6/10/2013	5:08:08	2.52	dipolar	5.10	-6.42	20.78	4.06	455600.123	4084127.91	-75.49836922	36.90209879
MC-LA-004	Lease Area	P161_001_0502	6/10/2013	5:19:19	3.91	single-pole	3.18	-3.35	18.14	5.11	455601.622	4082357.71	-75.49824867	36.88614184
MC-LA-005	Lease Area	P160_SSS_SBP_MAG	6/9/2013	22:13:15	3.82	single-pole	20.27	23.15	26.60	3.34	455623.655	4081391.57	-75.49794485	36.87743387

			Shotpoint				Intensity (gammas)		Duration (meters)		NAD83 Coordinates (m)			
Anomaly ID	Area	Line	Date	Time	Tow Height	Signature	AS	T_filt	AS_Width	AS_HAWid	Easting	Northing	Latitude	Longitude
MC-LA-006	Lease Area	P160_SSS_SBP_MAG	6/9/2013	22:23:09	3.45	dipolar	9.94	26.76	40.54	10.44	455626.147	4083161.1	-75.49802049	36.89338499
MC-LA-007	Lease Area	P160_SSS_SBP_MAG	6/9/2013	22:48:47	3.22	dipolar	11.94	20.26	16.59	3.09	455649.991	4083844.7	-75.49779291	36.8995482
MC-LA-008	Lease Area	P160_SSS_SBP_MAG	6/9/2013	22:57:20	3.69	dipolar	6.12	10.12	18.93	5.04	455653.292	4082455.06	-75.49767452	36.88702181
MC-LA-009	Lease Area	P160_SSS_SBP_MAG	6/9/2013	22:57:03	3.76	dipolar	21.63	32.14	25.39	3.95	455653.302	4082500.55	-75.49767707	36.88743187
MC-CR-468	Cable Route	P156_150_2206	6/5/2013	22:07:17	3.74	dipolar	26.48	-43.49	17.72	4.74	455655.092	4082501.89	-75.49765706	36.88744403
MC-LA-010	Lease Area	P160_SSS_SBP_MAG	6/9/2013	22:43:18	3.46	dipolar	4.06	-5.61	15.84	4.63	455660.417	4084725.24	-75.49772745	36.90748613
MC-LA-011	Lease Area	P155_004_2051	6/4/2013	20:53:20	4.81	dipolar	4.29	6.17	26.93	NM	455682.234	4081249.47	-75.49727926	36.87615569
MC-LA-012	Lease Area	P155_004_2051	6/4/2013	21:02:29	3.19	single-pole	3.15	10.85	24.28	10.93	455690.245	4082845.08	-75.49728265	36.89053931
MC-LA-013	Lease Area	P155_005_2120	6/4/2013	21:29:30	3.8	dipolar	4.29	6.01	17.04	1.98	455705.51	4083619.48	-75.49715661	36.89752061
MC-LA-014	Lease Area	P155_005_2120	6/4/2013	21:25:17	4.2	dipolar	20.69	-26.11	27.43	4.31	455706.634	4084313.75	-75.49718459	36.90377901
MC-LA-015	Lease Area	P155_006_2210	6/4/2013	22:17:27	4.1	dipolar	4.76	-9.08	12.71	3.79	455744.45	4082158.41	-75.49663423	36.88435199
MC-LA-016	Lease Area	P155_006_2210	6/4/2013	22:23:41	3.7	dipolar	5.98	-13.26	21.56	5.47	455746.208	4083317.49	-75.49668219	36.89480038
MC-LA-017	Lease Area	P155_006_2210	6/4/2013	22:17:44	4	dipolar	9.04	14.73	25.19	3.64	455746.291	4082212.57	-75.49661674	36.88484029
MC-LA-018	Lease Area	P154_007_1743	6/3/2013	17:56:33	4.13	dipolar	5.58	8.97	20.10	3.13	455778.246	4083116.68	-75.4963109	36.89299172
MC-LA-019	Lease Area	P154_008_1822	6/3/2013	18:38:39	4.31	dipolar	5.40	9.29	15.99	3.40	455800.852	4082492.66	-75.4960208	36.88736767
MC-LA-020	Lease Area	P154_008_1822	6/3/2013	18:35:06	3.87	dipolar	16.47	28.90	17.78	2.43	455800.856	4083057.52	-75.4960537	36.89245949
MC-LA-021	Lease Area	P154_008_1822	6/3/2013	18:33:26	3.88	dipolar	4.20	-7.53	15.17	5.22	455800.958	4083323.24	-75.49606806	36.89485478
MC-LA-022	Lease Area	P154_009_1854	6/3/2013	19:07:37	3.37	dipolar	3.68	7.00	15.83	3.81	455834.556	4083143.13	-75.49568048	36.89323279
MC-LA-023	Lease Area	P154_009_1854	6/3/2013	19:04:30	3.68	dipolar	3.71	8.98	13.43	2.86	455836.503	4082632.92	-75.4956289	36.88863369
MC-LA-024	Lease Area	P154_010_1932	6/3/2013	19:37:59	4.84	single-pole	8.32	18.36	18.56	6.73	455859.353	4084140.85	-75.49546033	36.9022276
MC-LA-025	Lease Area	P154_010_1932	6/3/2013	19:43:33	4.36	dipolar	15.39	30.82	23.65	6.55	455865.057	4083270.11	-75.49534557	36.89437885
MC-LA-026	Lease Area	P154_011_2047	6/3/2013	20:52:22	5.25	dipolar	4.83	-18.87	19.55	7.32	455890.084	4084382.29	-75.49512945	36.90440545
MC-LA-027	Lease Area	P154_012_2121	6/3/2013	21:34:19	3.84	dipolar	3.18	9.38	22.34	6.46	455930.537	4083265	-75.49461039	36.89433585
MC-LA-028	Lease Area	P154_012_2121	6/3/2013	21:26:18	3.51	dipolar	4.29	5.84	19.20	3.28	455934.658	4081867.68	-75.49448289	36.88174016
MC-LA-029	Lease Area	P154_013_2150	6/3/2013	21:53:09	3.89	dipolar	5.33	9.20	14.17	4.19	455950.466	4084586.44	-75.49446358	36.90624854
MC-LA-030	Lease Area	P154_013_2150	6/3/2013	22:04:49	3.82	dipolar	6.22	14.33	29.16	7.49	455955.084	4082738.71	-75.49430431	36.88959285
MC-LA-031	Lease Area	P154_013_2150	6/3/2013	22:13:54	3.5	dipolar	6.51	10.46	16.92	2.13	455959.365	4081263.97	-75.4941706	36.87629936
MC-LA-032	Lease Area	P154_014_2221	6/3/2013	22:32:20	4.89	dipolar	8.04	-9.70	26.19	6.06	455993.094	4082829.74	-75.49388303	36.8904152
MC-LA-033	Lease Area	P154_016_2323	6/3/2013	23:44:16	4.54	complex	28.02	-76.94	46.06	8.41	456051.534	4084383.83	-75.49331735	36.90442687
MC-LA-034	Lease Area	P154_016_2323	6/3/2013	23:26:46	3.94	dipolar	10.64	-18.75	28.26	5.43	456055.845	4081415.51	-75.49309682	36.87766989
MC-LA-035	Lease Area	P154_016_2323	6/3/2013	23:43:09	4.04	dipolar	16.78	26.46	28.02	4.12	456056.343	4084186.4	-75.49325191	36.9026474
MC-LA-036	Lease Area	P155_019C0112	6/4/2013	1:14:38	3.46	dipolar	30.28	37.81	19.27	1.87	456133.287	4084772.02	-75.4924222	36.90792993
MC-LA-037	Lease Area	P155_019C0112	6/4/2013	1:21:38	4.17	dipolar	4.00	4.72	12.19	4.87	456135.05	4083643.1	-75.49233703	36.8977536
MC-LA-038	Lease Area	P155_019C0112	6/4/2013	1:24:54	3.64	dipolar	3.15	2.52	15.17	6.10	456135.216	4083110.16	-75.4923043	36.89294961
MC-LA-039	Lease Area	P156_1P800	6/5/2013	2:30:29	3.62	single-pole	6.18	13.03	23.95	3.50	456167.898	4081782.89	-75.49186076	36.88098669
MC-LA-040	Lease Area	P155_020_0143	6/4/2013	1:57:18	3.72	single-pole	5.54	5.50	16.77	4.23	456172.847	4083289.2	-75.49189233	36.89456528
MC-LA-041	Lease Area	P155_020_0143	6/4/2013	1:58:26	4.56	single-pole	3.24	-8.81	19.84	6.05	456173.669	4083480.12	-75.49189416	36.89628633

			Shotpoint				Intensity (gammas)		Duration (meters)		NAD83 Coordinates (m)			
Anomaly ID	Area	Line	Date	Time	Tow Height	Signature	AS	T_filt	AS_Width	AS_HAWid	Easting	Northing	Latitude	Longitude
MC-LA-042	Lease Area	P155_020_0143	6/4/2013	2:01:50	4.51	dipolar	24.16	28.09	39.30	8.83	456174.002	4084053.15	-75.49192357	36.90145172
MC-LA-043	Lease Area	P155_021_0212	6/4/2013	2:18:10	3.84	single-pole	3.19	6.64	13.92	2.82	456193.453	4084147.95	-75.49171073	36.90230718
MC-LA-044	Lease Area	P155_021_0212	6/4/2013	2:31:02	3.89	complex	14.14	-29.58	24.95	4.33	456194.029	4081998.28	-75.49157999	36.8829295
MC-LA-045	Lease Area	P155_022_0243	6/4/2013	2:55:56	3.96	dipolar	4.91	6.32	18.27	2.76	456231.015	4082949.96	-75.49121991	36.89150997
MC-LA-046	Lease Area	P155_022_0243	6/4/2013	2:56:44	3.75	dipolar	6.45	-15.19	21.17	4.45	456234.096	4083085.63	-75.49119317	36.89273308
MC-LA-047	Lease Area	P155_022_0243	6/4/2013	2:58:40	3.54	dipolar	5.70	12.13	22.66	3.95	456235.108	4083414.74	-75.49120082	36.89569983
MC-LA-048	Lease Area	P155_022_0243	6/4/2013	2:58:16	3.68	dipolar	5.73	-9.46	15.67	3.61	456235.378	4083346.46	-75.49119385	36.89508434
MC-LA-049	Lease Area	P155_023_0421	6/4/2013	4:35:34	4.58	complex	21.51	-34.64	22.50	3.75	456256.747	4083312.16	-75.49095204	36.89477614
MC-LA-050	Lease Area	P155_023_0421	6/4/2013	4:35:38	4.55	complex	9.75	-16.20	8.66	1.74	456258.167	4083323.3	-75.49093674	36.89487663
MC-LA-051	Lease Area	P155_023_0421	6/4/2013	4:35:39	4.58	complex	9.59	17.40	13.97	2.20	456258.598	4083327.5	-75.49093216	36.89491451
MC-LA-052	Lease Area	P155_023_0421	6/4/2013	4:34:14	4.54	single-pole	6.40	11.97	24.12	4.06	456260.366	4083091.19	-75.49089867	36.89278442
MC-LA-053	Lease Area	P155_023_0312	6/4/2013	3:22:25	3.43	single-pole	5.64	11.10	17.65	1.99	456267.378	4083362.49	-75.49083564	36.89523033
MC-LA-054	Lease Area	P155_024_0502	6/4/2013	5:13:07	3.87	dipolar	3.37	2.14	12.53	2.31	456281.949	4083483.62	-75.4906791	36.8963229
MC-LA-055	Lease Area	P155_024_0502	6/4/2013	5:15:14	4.06	complex	12.30	-26.62	31.19	5.10	456282.476	4083130.8	-75.49065281	36.8931425
MC-LA-056	Lease Area	P155_024_0502	6/4/2013	5:14:00	3.95	dipolar	10.14	24.10	21.12	5.60	456284.488	4083337.78	-75.49064218	36.89500838
MC-LA-057	Lease Area	P155_025_0532	6/4/2013	5:46:49	4.08	complex	3.10	-5.62	21.46	5.61	456313.607	4083312.15	-75.49031389	36.89477869
MC-LA-058	Lease Area	P160_SBP_SSS_MAG	6/9/2013	23:30:28	4.17	dipolar	18.96	-25.24	25.83	3.77	456314.972	4084032.55	-75.49034012	36.90127256
MC-LA-059	Lease Area	P160_SBP_SSS_MAG	6/9/2013	23:24:21	3.46	dipolar	6.07	-11.53	25.91	6.05	456315.655	4082912.36	-75.49026786	36.89117495
MC-LA-060	Lease Area	P160_SBP_SSS_MAG	6/9/2013	23:20:27	3.88	single-pole	6.48	-13.85	20.24	5.13	456316.77	4082190.36	-75.49021373	36.88466666
MC-LA-061	Lease Area	P160_SBP_SSS_MAG	6/9/2013	23:16:09	3.15	dipolar	7.85	-12.89	9.48	1.92	456317.125	4081395.43	-75.49016394	36.87750101
MC-LA-062	Lease Area	P155_025_0532	6/4/2013	5:39:32	4.15	dipolar	6.68	-12.23	19.45	4.61	456317.97	4082169.62	-75.49019907	36.88447976
MC-LA-063	Lease Area	P155_025_0532	6/4/2013	5:45:31	3.87	dipolar	4.04	5.47	22.48	6.99	456325.406	4083097.92	-75.49016912	36.8928481
MC-LA-064	Lease Area	P155_026_0605	6/4/2013	6:16:03	4.13	complex	5.49	-12.75	20.35	5.23	456338.368	4083348.41	-75.49003809	36.89510669
MC-LA-065	Lease Area	P155_026_0605	6/4/2013	6:15:51	4.1	complex	12.42	17.97	17.37	2.98	456339.138	4083381.6	-75.49003136	36.89540591
MC-LA-066	Lease Area	P155_027_0655	6/4/2013	7:00:58	3.48	single-pole	4.91	9.23	14.84	3.93	456369.408	4081835.28	-75.48960261	36.88146829
MC-LA-067	Lease Area	P155_027_0655	6/4/2013	7:11:33	3.46	complex	47.84	75.30	17.37	2.58	456372.079	4083577.46	-75.48967293	36.89717289
MC-LA-068	Lease Area	P155_027_0655	6/4/2013	7:11:34	3.54	complex	48.15	-90.62	19.45	2.45	456372.299	4083581.58	-75.4896707	36.89721004
MC-LA-069	Lease Area	P161_ALL_DVR_027	6/10/2013	0:33:48	3.97	dipolar	25.96	45.04	21.54	3.89	456373.259	4083595.23	-75.48966071	36.89733313
MC-LA-070	Lease Area	P161_ALL_DVR_027	6/10/2013	0:35:13	3.62	complex	7.19	-14.06	10.83	2.83	456373.608	4083341.88	-75.48964221	36.89504946
MC-LA-071	Lease Area	P161_ALL_DVR_027	6/10/2013	0:35:19	3.64	complex	6.07	10.48	21.21	6.14	456373.747	4083322.1	-75.4896395	36.89487116
MC-LA-072	Lease Area	P156_3P600	6/5/2013	1:40:44	3.82	dipolar	4.24	12.11	27.91	7.76	456374.649	4083591.18	-75.48964488	36.89729668
MC-LA-073	Lease Area	P155_027_0655	6/4/2013	7:10:02	4.19	dipolar	4.40	7.48	12.14	2.77	456374.877	4083319.97	-75.4896267	36.89485201
MC-LA-074	Lease Area	P161_ALL_DVR_027	6/10/2013	0:43:29	3.56	dipolar	3.43	8.17	17.67	3.56	456376.528	4081852.84	-75.48952373	36.88162691
MC-LA-075	Lease Area	P155_027_0655	6/4/2013	7:00:04	2.26	dipolar	4.25	-4.27	17.90	2.32	456385.127	4081685.56	-75.48941761	36.88011948
MC-LA-076	Lease Area	P155_028_0724	6/4/2013	7:32:57	2.85	dipolar	4.35	-5.60	21.05	4.98	456393.781	4083813.07	-75.48944293	36.89929775
MC-LA-077	Lease Area	P155_028_0724	6/4/2013	7:46:22	3.44	dipolar	3.29	6.58	18.21	2.87	456402.777	4081667.27	-75.48921851	36.87995543
MC-LA-078	Lease Area	P155_028_0724	6/4/2013	7:47:39	4.55	dipolar	10.48	-17.57	24.26	5.16	456404.286	4081456.25	-75.48918945	36.87805329

			Shotpoint				Intensity (gammas)		Duration (meters)		NAD83 Coordinates (m)			
Anomaly ID	Area	Line	Date	Time	Tow Height	Signature	AS	T_filt	AS_Width	AS_HAWid	Easting	Northing	Latitude	Longitude
MC-LA-079	Lease Area	P155_028_0724	6/4/2013	7:43:55	4.8	dipolar	3.96	9.96	21.42	6.23	456405.18	4082067.55	-75.48921457	36.8835637
MC-LA-080	Lease Area	P161_MAG_DRV_28	6/10/2013	1:08:18	3.59	complex	4.76	9.93	19.13	4.98	456406.033	4084184.77	-75.48932681	36.90264893
MC-LA-081	Lease Area	P161_MAG_DRV_28	6/10/2013	1:02:56	3.27	dipolar	55.45	-107.27	28.70	2.51	456406.856	4083151.6	-75.48925811	36.89333575
MC-LA-082	Lease Area	P155_028_0724	6/4/2013	7:37:08	5.12	dipolar	27.58	-42.87	33.83	4.83	456408.216	4083169.66	-75.48924388	36.89349861
MC-LA-083	Lease Area	P161_MAG_DRV_28	6/10/2013	0:53:55	3.29	dipolar	5.99	-7.56	27.96	NM	456409.475	4081285.63	-75.48912142	36.8765155
MC-LA-084	Lease Area	P161_MAG_DRV_28	6/10/2013	0:54:36	3.75	single-pole	10.09	19.36	29.38	3.51	456409.616	4081435.55	-75.48912846	36.87786694
MC-LA-085	Lease Area	P155_029_0757	6/4/2013	8:03:53	3.68	dipolar	3.22	-7.78	16.18	4.21	456430.629	4082027.92	-75.48892671	36.88320764
MC-LA-086	Lease Area	P155_029_0856	6/4/2013	9:03:08	4.39	single-pole	5.66	-8.65	21.54	5.05	456434.46	4082066.48	-75.48888594	36.88355541
MC-LA-087	Lease Area	P155_029_0757	6/4/2013	8:08:47	3.34	dipolar	4.65	1.81	20.03	3.68	456436.965	4082856.51	-75.48890324	36.89067711
MC-LA-088	Lease Area	P155_029_0757	6/4/2013	8:07:37	3.41	dipolar	4.73	-9.71	11.18	1.09	456437.833	4082657.82	-75.48888207	36.88888609
MC-LA-089	Lease Area	P155_030_0914	6/4/2013	9:29:52	3.04	complex	14.84	14.49	16.87	2.62	456450.788	4083484.94	-75.48878422	36.89634261
MC-LA-090	Lease Area	P155_030_0914	6/4/2013	9:29:48	3.15	complex	5.46	10.09	12.66	4.06	456450.898	4083474.92	-75.48878241	36.89625229
MC-LA-091	Lease Area	P155_030_0914	6/4/2013	9:28:57	3.42	dipolar	4.55	5.37	9.94	1.85	456460.497	4083328.82	-75.48866628	36.89493575
MC-LA-092	Lease Area	P155_030_0914	6/4/2013	9:32:14	3.46	dipolar	4.11	8.01	20.95	3.46	456467.301	4083883.86	-75.48862182	36.89993927
MC-LA-093	Lease Area	P155_030_0914	6/4/2013	9:21:30	3.69	dipolar	8.27	7.67	14.56	4.24	456471.809	4082053.73	-75.48846609	36.8834422
MC-LA-094	Lease Area	P155_030_0914	6/4/2013	9:20:14	3.49	dipolar	21.24	-33.61	23.63	4.14	456471.898	4081835.6	-75.48845257	36.88147591
MC-LA-095	Lease Area	P155_031_0943	6/4/2013	9:47:29	1.91	dipolar	3.13	2.43	14.09	2.95	456490.274	4084324.83	-75.48838931	36.90391537
MC-LA-096	Lease Area	P161_MAG_31	6/10/2013	1:22:33	3.89	dipolar	6.06	11.10	17.61	1.33	456492.545	4084561.96	-75.48837744	36.90605303
MC-LA-097	Lease Area	P161_MAG_31	6/10/2013	1:24:07	2.74	dipolar	6.78	10.80	16.48	1.96	456492.644	4084303.24	-75.48836147	36.90372086
MC-LA-098	Lease Area	P155_031_0943	6/4/2013	10:03:02	3.79	dipolar	3.39	3.47	22.74	6.02	456493.587	4081698	-75.4882013	36.88023663
MC-LA-099	Lease Area	P155_032_1024	6/4/2013	10:36:47	3.32	dipolar	3.75	3.61	7.24	1.38	456528.526	4083033.61	-75.48788586	36.89227777
MC-LA-100	Lease Area	P155_032_1024	6/4/2013	10:38:32	3.67	dipolar	5.77	4.81	22.04	3.02	456531.228	4083342.05	-75.48787323	36.89505827
MC-LA-101	Lease Area	P155_033_1054	6/4/2013	11:01:35	2.15	dipolar	5.93	5.33	14.17	2.63	456551.06	4083790.32	-75.48767635	36.89909994
MC-LA-102	Lease Area	P155_034_1123	6/4/2013	11:35:10	3.13	dipolar	11.25	-20.17	18.80	1.43	456589.555	4082928.45	-75.48719491	36.89133263
MC-LA-103	Lease Area	P155_034_1123	6/4/2013	11:28:49	2.87	dipolar	3.35	11.58	18.26	6.38	456592.628	4081844.36	-75.48709834	36.88156043
MC-LA-104	Lease Area	P155_034_1123	6/4/2013	11:26:56	3.56	single-pole	12.86	33.88	39.91	6.23	456592.906	4081524.58	-75.48707691	36.87867793
MC-LA-105	Lease Area	P155_035_1208	6/4/2013	12:12:32	3.65	dipolar	6.47	-8.94	15.67	5.33	456610.288	4083393.26	-75.48698885	36.89552353
MC-LA-106	Lease Area	P155_035_1208	6/4/2013	12:15:13	4.89	dipolar	3.85	5.71	18.96	6.26	456611.185	4082935.7	-75.48695258	36.89139898
MC-LA-107	Lease Area	P155_035_1208	6/4/2013	12:14:15	4.45	dipolar	5.03	-9.94	23.31	5.53	456616.826	4083100.22	-75.4868987	36.89288228
MC-LA-108	Lease Area	P155_037_1608	6/4/2013	16:18:32	4.6	single-pole	26.27	47.62	30.04	5.97	456667.027	4083195.8	-75.48634077	36.89374617
MC-LA-109	Lease Area	P155_037_1608	6/4/2013	16:19:44	4.29	dipolar	7.38	-14.40	19.45	5.30	456668.275	4082983.1	-75.48631459	36.89182888
MC-LA-110	Lease Area	P161_SSS_SBP_MAG	6/10/2013	2:21:16	3.53	dipolar	3.76	1.91	15.84	1.36	456704.974	4084360.73	-75.48598147	36.90424886
MC-LA-111	Lease Area	P155_039_2308	6/4/2013	23:26:47	4.01	dipolar	11.64	26.78	25.79	4.10	456731.009	4081971.06	-75.48555277	36.8827089
MC-LA-112	Lease Area	P155_039_2308	6/4/2013	23:20:34	4.64	dipolar	3.96	7.03	14.76	4.38	456732.245	4082981.01	-75.48559656	36.89181298
MC-LA-114	Lease Area	P155_039_2308	6/4/2013	23:31:25	4.03	dipolar	7.99	-14.58	12.37	1.27	456735.764	4081225.67	-75.48545688	36.87599001
MC-LA-115	Lease Area	P156_040_0016	6/5/2013	0:23:51	4.43	dipolar	4.86	7.24	21.05	5.11	456761.961	4083859.95	-75.48531323	36.89973729
MC-LA-116	Lease Area	P156_040_0016	6/5/2013	0:31:05	3.6	dipolar	13.32	-16.54	21.87	3.76	456764.904	4082743.83	-75.48521651	36.88967646

			Shotpoint				Intensity (gammas)		Duration (meters)		NAD83 Coordinates (m)			
Anomaly ID	Area	Line	Date	Time	Tow Height	Signature	AS	T_filt	AS_Width	AS_HAWid	Easting	Northing	Latitude	Longitude
MC-LA-117	Lease Area	P156_040_0016	6/5/2013	0:39:57	3.17	dipolar	3.18	6.37	14.01	4.62	456767.125	4081372.07	-75.48511335	36.87731115
MC-LA-118	Lease Area	P156_040_0016	6/5/2013	0:30:05	3.92	complex	45.80	57.05	20.66	3.11	456767.925	4082899.6	-75.48519149	36.89108076
MC-LA-119	Lease Area	P156_040_0016	6/5/2013	0:30:04	3.91	complex	41.68	-82.57	18.11	1.41	456768.025	4082903.5	-75.48519059	36.89111592
MC-LA-120	Lease Area	P156_041_0046	6/5/2013	0:53:13	4.14	dipolar	9.78	15.59	23.69	4.02	456800.38	4082089.96	-75.48478112	36.88378389
MC-LA-121	Lease Area	P156_041_0046	6/5/2013	0:51:39	2.9	dipolar	66.02	43.44	33.60	3.67	456800.978	4081814.57	-75.48475871	36.88130146
MC-LA-122	Lease Area	P156_042_2115	6/5/2013	21:20:29	4.89	dipolar	5.84	-8.22	20.54	4.44	456821.155	4082967.52	-75.48459798	36.89169545
MC-LA-123	Lease Area	P156_043_2054	6/5/2013	21:02:14	3.62	dipolar	5.34	19.01	23.66	9.04	456856.322	4082483.8	-75.48417577	36.88733665
MC-LA-124	Lease Area	P156_044_2032	6/5/2013	20:35:36	2.99	dipolar	5.10	5.64	20.14	4.22	456884.118	4083401.86	-75.48391608	36.89561361
MC-LA-125	Lease Area	P156_044_2032	6/5/2013	20:45:00	4.01	dipolar	6.30	-14.78	27.39	9.51	456884.177	4081760.72	-75.48382205	36.88081993
MC-LA-126	Lease Area	P156_044_2032	6/5/2013	20:37:09	4.27	dipolar	10.75	20.48	28.16	4.51	456884.526	4083145.51	-75.48389691	36.89330281
MC-LA-127	Lease Area	P156_045_1943	6/5/2013	19:46:07	1.89	dipolar	3.15	4.99	18.84	3.16	456909.648	4083409.32	-75.48362998	36.89568202
MC-LA-128	Lease Area	P156_046_1920	6/5/2013	19:30:15	3.9	dipolar	5.77	-9.97	23.41	5.22	456947.574	4082755.2	-75.48316716	36.8897873
MC-LA-129	Lease Area	P156_048_1831	6/5/2013	18:39:34	3.57	dipolar	3.29	11.89	20.01	4.48	457007.381	4082351.06	-75.48247305	36.88614698
MC-LA-130	Lease Area	P156_048_1831	6/5/2013	18:40:55	3.7	dipolar	9.66	-15.14	17.15	4.24	457009.773	4082609.5	-75.48246087	36.88847675
MC-LA-131	Lease Area	P156_049_1813	6/5/2013	18:19:12	3.43	dipolar	4.93	7.63	17.22	2.87	457031.004	4082767.79	-75.48223159	36.8899046
MC-LA-132	Lease Area	P156_049_1813	6/5/2013	18:19:45	3.89	dipolar	3.63	10.67	19.08	7.32	457031.173	4082671.5	-75.48222423	36.88903662
MC-LA-133	Lease Area	P156_049_1813	6/5/2013	18:19:57	3.87	dipolar	3.74	-4.68	18.76	3.96	457031.203	4082636.87	-75.48222193	36.88872445
MC-LA-134	Lease Area	P156_049_1813	6/5/2013	18:22:06	4.08	dipolar	16.00	33.88	32.58	6.48	457033.701	4082259.26	-75.4821725	36.88532066
MC-LA-135	Lease Area	P156_050_1750	6/5/2013	18:01:46	4.03	dipolar	3.67	10.81	26.96	4.35	457068.215	4082958.57	-75.4818248	36.89162604
MC-LA-136	Lease Area	P161_MAG_51	6/10/2013	3:30:21	3.83	dipolar	8.37	17.44	34.54	5.17	457102.976	4081589.95	-75.48135723	36.87929052
MC-LA-137	Lease Area	P156_053_1651	6/5/2013	16:55:55	3.86	dipolar	4.57	10.99	14.47	2.71	457151.056	4083068.83	-75.48090134	36.89262373
MC-LA-138	Lease Area	P156_053_1651	6/5/2013	17:00:15	3.22	dipolar	3.55	-11.50	17.78	6.33	457153.171	4082310.23	-75.48083471	36.88578556
MC-LA-139	Lease Area	P156_054_1632	6/5/2013	16:40:28	3.99	dipolar	5.56	19.07	28.48	7.27	457188.261	4082392.46	-75.48044558	36.8865284
MC-LA-140	Lease Area	P156_054_1632	6/5/2013	16:44:33	3.65	dipolar	8.53	17.54	25.03	2.15	457191.206	4083148.51	-75.48045524	36.89334381
MC-LA-141	Lease Area	P156_056_1550	6/5/2013	15:57:04	3.16	dipolar	11.22	19.62	19.37	3.74	457244.19	4082189.6	-75.47980651	36.88470228
MC-LA-142	Lease Area	P156_057_1519	6/5/2013	15:32:30	2.96	dipolar	14.23	28.56	22.98	3.22	457277.086	4081540.84	-75.4794008	36.87885572
MC-LA-143	Lease Area	P156_058_1458	6/5/2013	15:09:21	3.52	dipolar	3.94	-5.47	19.38	4.46	457308.185	4082935.89	-75.47913042	36.89143249
MC-LA-144	Lease Area	P161_SBP_058	6/10/2013	3:48:24	4.43	dipolar	6.84	14.87	30.75	7.74	457309.287	4083255.16	-75.47913604	36.89431054
MC-LA-145	Lease Area	P156_059_1437	6/5/2013	14:51:57	3.48	dipolar	8.66	17.75	20.46	6.22	457336.885	4081324.63	-75.47871765	36.87690943
MC-LA-146	Lease Area	P156_060_1415	6/5/2013	14:29:05	3.1	dipolar	13.06	-23.24	21.67	6.12	457367.887	4083352.58	-75.47848384	36.89519137
MC-LA-147	Lease Area	P156_060_1415	6/5/2013	14:30:11	3.95	dipolar	19.62	-26.72	27.06	3.80	457368.959	4083542.07	-75.47848248	36.89689954
MC-LA-148	Lease Area	P156_060_1415	6/5/2013	14:23:31	3.46	dipolar	61.26	86.69	28.95	6.60	457370.561	4082389.53	-75.47839965	36.88651024
MC-LA-149	Lease Area	P156_060_1415	6/5/2013	14:30:23	3.92	dipolar	3.83	-4.08	7.46	NM	457371.999	4083577.6	-75.47845036	36.89721996
MC-LA-150	Lease Area	P156_061A1353	6/5/2013	14:00:21	3.92	dipolar	26.14	37.64	35.27	3.23	457396.483	4082605.39	-75.4781209	36.88845724
MC-LA-151	Lease Area	P156_1P800	6/5/2013	2:38:01	3.94	dipolar	6.55	-11.54	22.69	3.49	457416.097	4081779.63	-75.47785439	36.88101454
MC-LA-152	Lease Area	P156_062_1330	6/5/2013	13:37:56	3.52	dipolar	14.00	20.88	18.95	6.28	457428.93	4082142.04	-75.47773075	36.88428191
MC-LA-153	Lease Area	P156_062_1330	6/5/2013	13:36:27	4.48	dipolar	5.67	-10.23	26.98	9.56	457429.338	4081893.06	-75.47771218	36.88203754

			Shotpoint				Intensity (gammas)		Duration (meters)		NAD83 Coordinates (m)			
Anomaly ID	Area	Line	Date	Time	Tow Height	Signature	AS	T_filt	AS_Width	AS_HAWid	Easting	Northing	Latitude	Longitude
MC-LA-154	Lease Area	P156_062_1330	6/5/2013	13:33:26	3.92	dipolar	4.36	-4.91	10.23	1.65	457432.345	4081374.97	-75.47764936	36.87736752
MC-LA-155	Lease Area	P156_063_1301	6/5/2013	13:06:34	4.03	dipolar	7.84	16.20	24.21	4.38	457454.315	4082909.87	-75.47748899	36.89120454
MC-LA-156	Lease Area	P156_063_1301	6/5/2013	13:13:16	3	dipolar	9.25	-9.73	20.41	2.07	457458.867	4081748.44	-75.47737271	36.88073531
MC-LA-157	Lease Area	P156_064_1238	6/5/2013	12:41:38	2.63	dipolar	9.21	11.12	13.84	1.97	457490.406	4081587.78	-75.47700981	36.87928848
MC-LA-158	Lease Area	P156_065_1216	6/5/2013	12:18:24	4.23	dipolar	3.37	5.75	11.02	1.69	457518.338	4083424.24	-75.47679932	36.89584412
MC-LA-159	Lease Area	P156_065_1152	6/5/2013	12:04:07	3.02	single-pole	5.78	10.64	18.50	2.65	457521.435	4082916.12	-75.47673608	36.8912639
MC-LA-160	Lease Area	P156_066_1103	6/5/2013	11:09:26	3.96	dipolar	4.58	7.26	12.86	1.89	457545.784	4082793.57	-75.47645595	36.89016029
MC-LA-161	Lease Area	P156_066_1103	6/5/2013	11:11:19	4.06	single-pole	3.85	8.41	17.37	4.45	457545.822	4082470.59	-75.47643743	36.88724884
MC-LA-162	Lease Area	P156_066_1103	6/5/2013	11:13:31	3.49	dipolar	5.54	6.19	14.20	3.89	457546.839	4082098.74	-75.47640519	36.8838969
MC-LA-163	Lease Area	P156_067_1037	6/5/2013	10:54:34	3.91	single-pole	11.62	-23.91	21.51	4.59	457580.459	4083578.04	-75.47611073	36.89723332
MC-LA-164	Lease Area	P156_067_1037	6/5/2013	10:46:47	3.15	dipolar	33.42	-79.15	26.83	6.68	457580.751	4082380.97	-75.47604044	36.88644255
MC-LA-165	Lease Area	P156_067_1037	6/5/2013	10:47:45	3.27	dipolar	10.61	-19.25	19.62	2.68	457582.902	4082528.29	-75.47602455	36.88777064
MC-LA-166	Lease Area	P156_3P600	6/5/2013	1:48:03	4.02	complex	11.59	-27.81	18.36	8.84	457586.149	4083579.39	-75.47604695	36.89724574
MC-LA-167	Lease Area	P156_069_0728	6/5/2013	7:38:31	3.5	dipolar	4.08	-4.86	13.65	2.66	457636.533	4082609.2	-75.47542722	36.88850239
MC-LA-168	Lease Area	P156_069_0728	6/5/2013	7:32:26	2.47	dipolar	53.72	59.02	29.38	4.75	457636.666	4081574.42	-75.47536789	36.87917463
MC-LA-169	Lease Area	P156_069_0728	6/5/2013	7:38:17	3.57	dipolar	49.86	-78.49	54.20	NM	457637.002	4082568.63	-75.47541968	36.8881367
MC-LA-170	Lease Area	P156_069_0728	6/5/2013	7:35:08	4.21	dipolar	15.58	23.81	16.15	1.41	457637.029	4082032.74	-75.47538943	36.88330601
MC-LA-171	Lease Area	P156_070_0706	6/5/2013	7:21:30	3.81	dipolar	3.90	-2.87	9.70	3.18	457667.675	4081447.63	-75.47501287	36.87803309
MC-LA-172	Lease Area	P156_071_0645	6/5/2013	6:54:54	3.14	single-pole	10.46	23.40	29.48	4.55	457694.522	4082545.98	-75.47477292	36.88793511
MC-LA-173	Lease Area	P156_071_0645	6/5/2013	6:58:46	3.23	dipolar	14.94	-20.27	22.65	5.98	457696.086	4083203.82	-75.47479209	36.89386517
MC-LA-174	Lease Area	P156_071_0645	6/5/2013	6:55:17	3.35	single-pole	5.19	-7.79	18.45	2.34	457697.843	4082610.84	-75.47473928	36.88851993
MC-LA-175	Lease Area	P156_072_0622	6/5/2013	6:25:17	4.92	dipolar	21.60	28.33	41.84	3.98	457724.678	4083447.21	-75.47448479	36.89606045
MC-LA-176	Lease Area	P156_073_0602	6/5/2013	6:11:35	3.92	dipolar	14.60	40.77	36.07	7.49	457757.243	4082611.43	-75.47407271	36.88852791
MC-LA-177	Lease Area	P156_074_0538	6/5/2013	5:47:35	4.12	dipolar	6.16	10.40	17.54	3.53	457784.571	4082366.74	-75.47375239	36.88632341
MC-LA-178	Lease Area	P156_074_0538	6/5/2013	5:48:59	2.5	dipolar	27.54	-38.64	19.21	1.76	457786.82	4082139.04	-75.47371448	36.88427095
MC-LA-179	Lease Area	P156_075_0518	6/5/2013	5:26:10	3.84	dipolar	3.67	6.32	10.35	3.24	457818.951	4082390.24	-75.47336789	36.88653679
MC-LA-180	Lease Area	P156_075_0518	6/5/2013	5:24:07	3.58	dipolar	11.67	-13.87	23.15	1.99	457819.169	4082035.09	-75.47334568	36.88333535
MC-LA-181	Lease Area	P156_077_0424	6/5/2013	4:37:48	3.58	dipolar	43.95	-62.91	32.72	5.61	457880.707	4083373.05	-75.47272949	36.89539893
MC-LA-182	Lease Area	P161_080A	6/10/2013	4:23:24	3.36	dipolar	17.00	18.50	30.01	3.61	457973.364	4082897.04	-75.47166318	36.89111214
MC-LA-183	Lease Area	P161_080A	6/10/2013	4:22:27	3.44	single-pole	4.63	9.43	23.30	9.86	457974.173	4082713.76	-75.47164394	36.88946003
MC-CR-469	Cable Route	P162_003_0022	6/11/2013	0:23:03	4.92	dipolar	23.60	-33.11	34	NM	445216.95	4076468.87	-75.61435724	36.83251336
MC-CR-470	Cable Route	P162_003_0022	6/11/2013	0:25:59	4.73	single-pole	8.56	13.93	12	NM	444835.64	4076228.11	-75.61861569	36.83032094

Table Key	
Anomaly ID	Unique identifier MC=magnetic contact CR/LA=area
Area	Contact location
Line	Unique data collection line name

			Shotpoint				Intensity (gammas)		Duration (meters)		NAD83 Coordinates (m)			
Anomaly ID	Area	Line	Date	Time	Tow Height	Signature	AS	T_filt	AS_Width	AS_HAWid	Easting	Northing	Latitude	Longitude

Data	Data of data collection (UTC)
Time	Time magnetometer reading was taken (UTC)
Tow Height	Altitude of magnetic sensor from the seabed
Signature	dipolar, complex or single-pole*
AS	3-D measured Analytic Signal
T_filt	Total Field diurnally corrected/Filtered
AS_Width	Width or duration of the target based on the analytic signal
AS_HAWid	Oasis Montaj calculated anomaly half width value that
	relates to the target peakedness. Based on the analytic signal.
NM	Not Measured (in the case of manually choosen targets)
Easting	Virginia HGPN (NADCON), UTM zone 18N, Meters
Northing	Virginia HGPN (NADCON), UTM zone 18N, Meters
Lattitude	in decimal degrees
Longitude	in decimal degrees
*single-pole	*Since full coverage data was not collected the determinaion*
	of monopolar is not possible. The single-pole of a dipolar
	anomaly could be misinterpreted as a monopolar signature.
	Therefore, single-pole is being used in place of monopolar

Attachment H – Laboratory Geotechnical Testing Results

Attachment H-1

Appendix 1

GEOTECHNICAL TEST RESULTS

PARTICLE SIZE ANALYSIS REPORTS

GRAB SAMPLES

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-001**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Grayish-brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

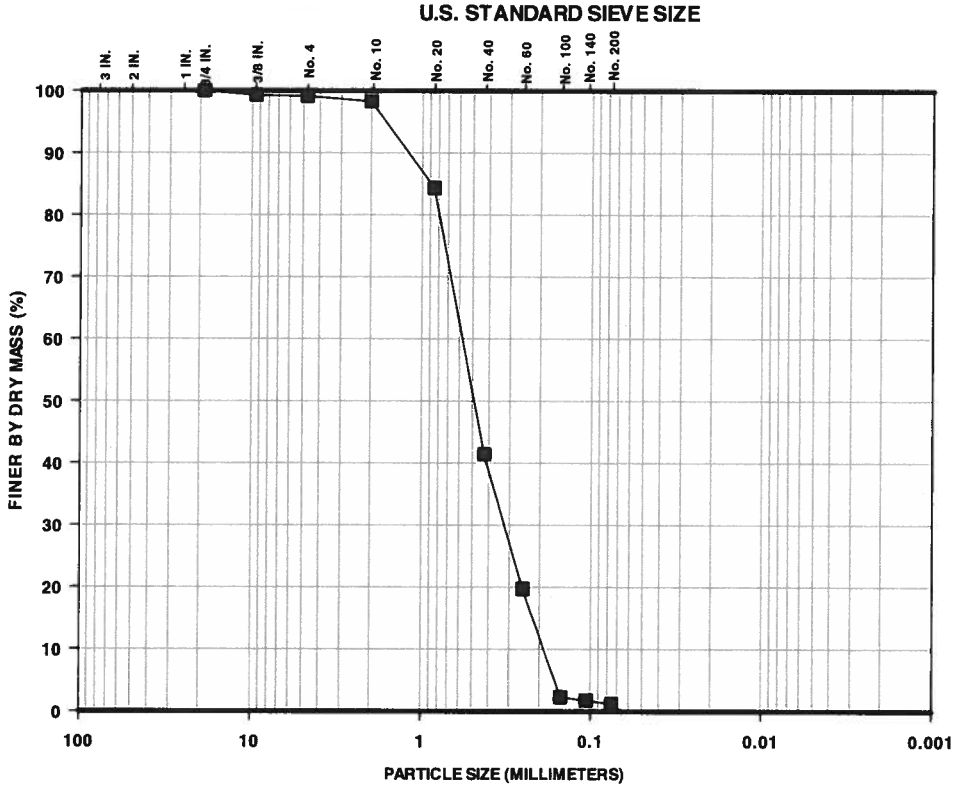
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 22.1
Mass Dry Solids (grams): 399.04

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	99.3	99.1	98.3	84.3	41.4	19.7	2.3	1.8	1.2	-	-	-

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-002**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Grayish-brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

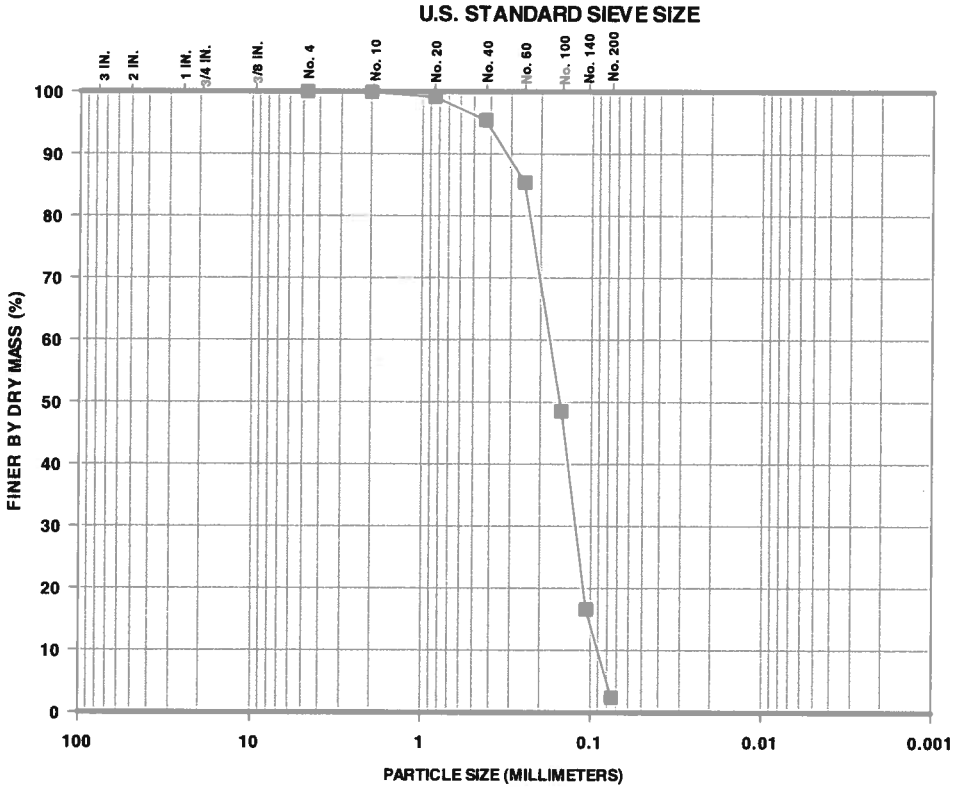
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 31.0
Mass Dry Solids (grams): 125.26

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.4
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	99.1	95.4	85.4	48.5	16.6	2.4	-	-	-

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-003**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Grayish-brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

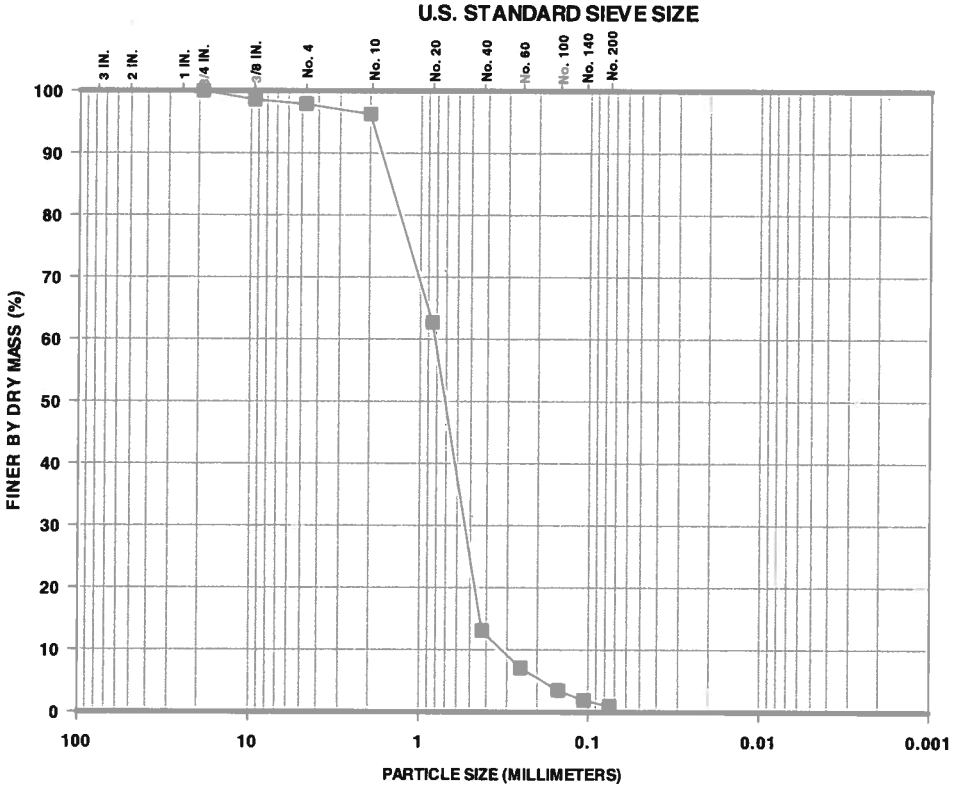
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 19.3
Mass Dry Solids (grams): 661.46

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.4
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	98.6	97.9	96.3	62.7	13.1	7.1	3.5	1.9	1.0	-	-	-

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: JM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-004**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray sand with silt and shell (SP-SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

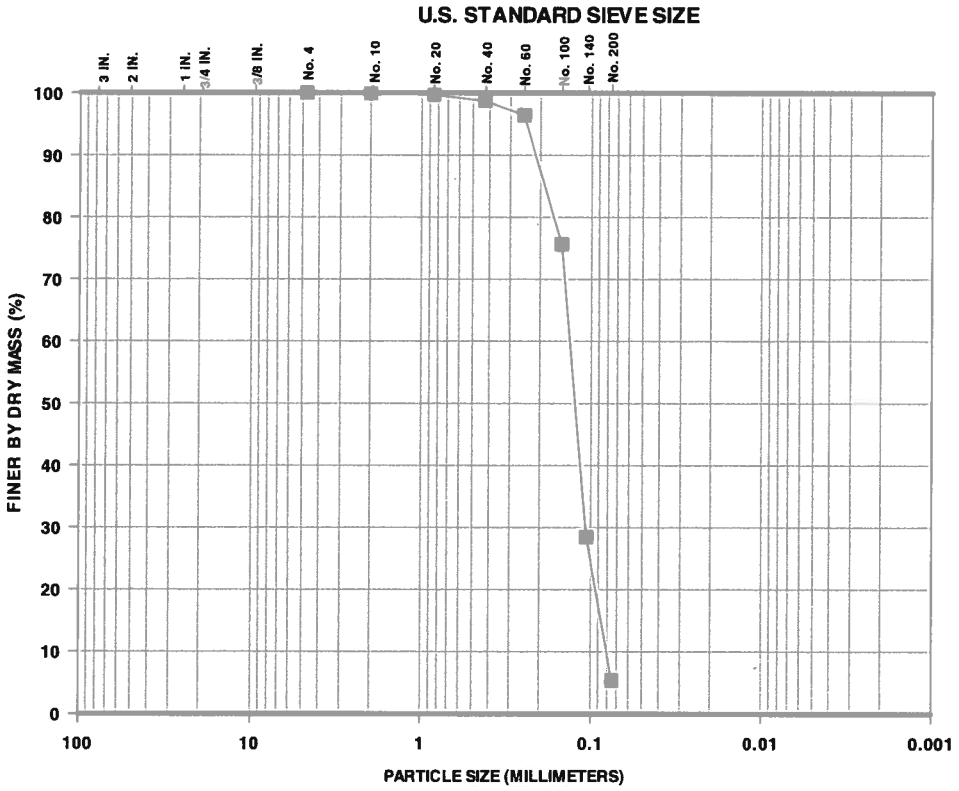
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 35.6
Mass Dry Solids (grams): 156.84

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.6
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	99.7	98.7	96.4	75.6	28.5	5.4	-	-	-

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/24/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-005**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

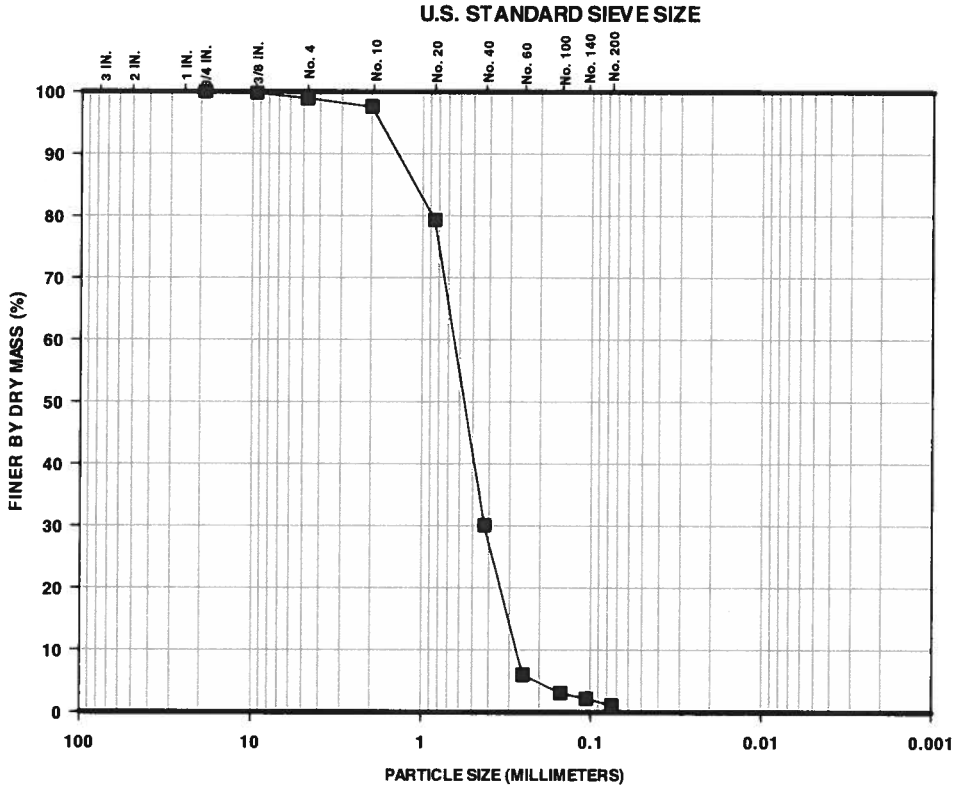
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 21.5
Mass Dry Solids (grams): 880.54

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	99.8	98.9	97.6	79.3	30.1	6.0	3.1	2.2	1.1	-	-	-

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-006**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

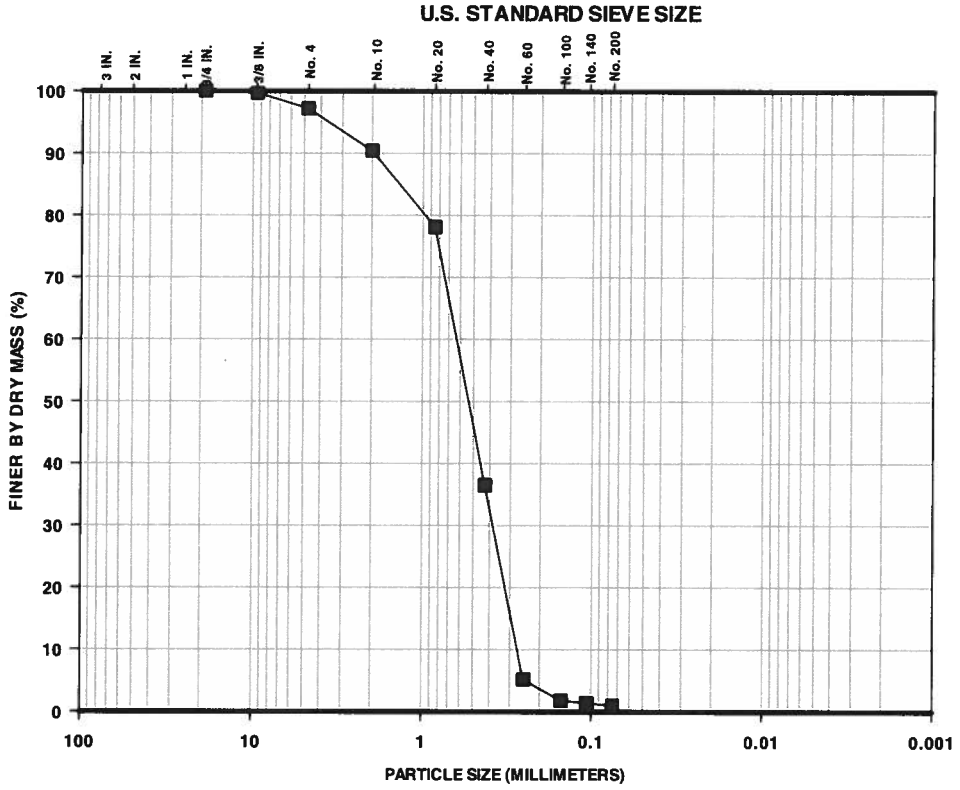
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 18.8
Mass Dry Solids (grams): 834.20

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.4
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	99.7	97.2	90.4	78.1	36.5	5.2	1.8	1.4	1.0	-	-	-

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-007**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray sand with silt and shell (SP-SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

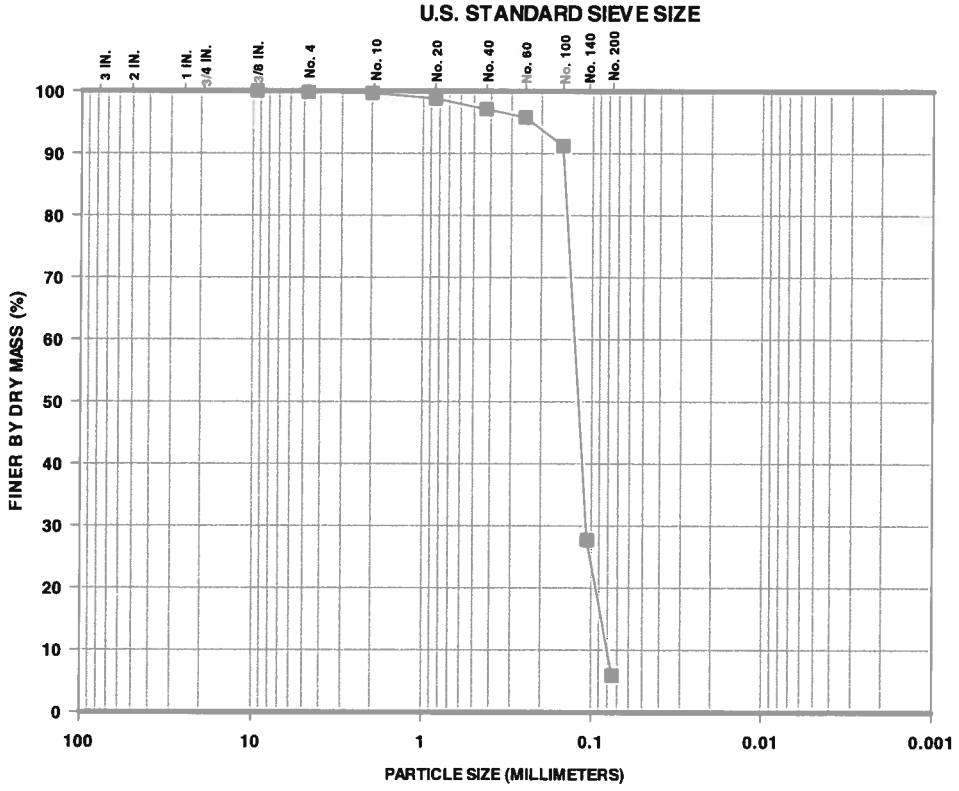
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 34.1
Mass Dry Solids (grams): 248.66

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.7
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.8	99.7	98.8	97.1	95.8	91.2	27.7	5.9	-	-	-

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: M Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-008**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

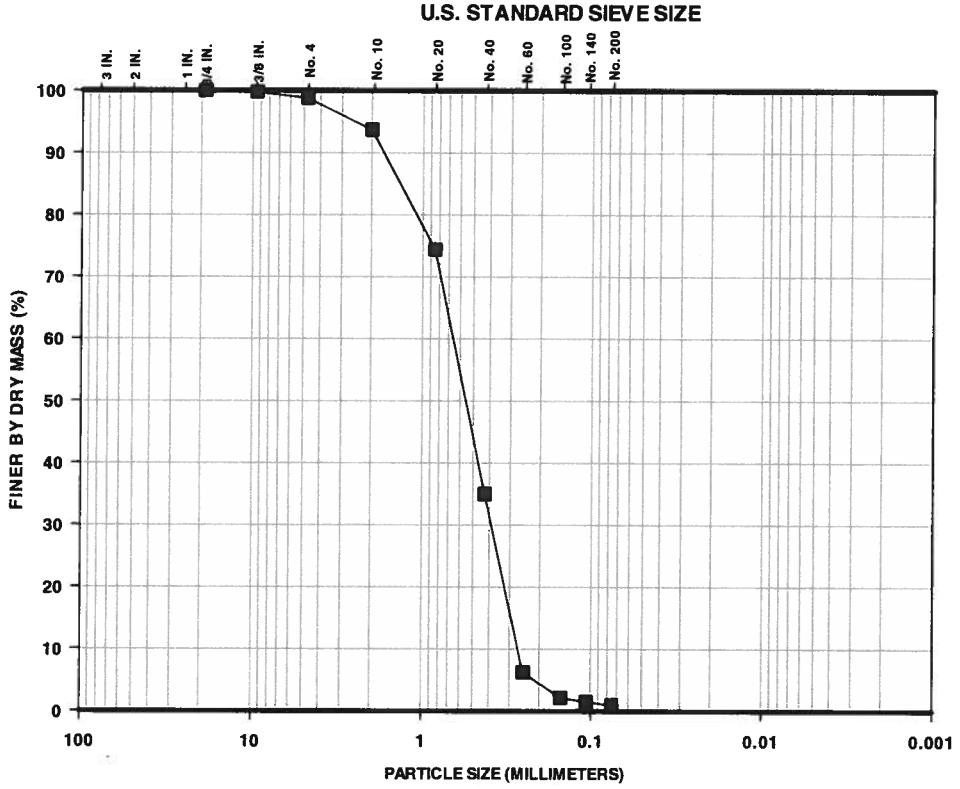
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 20.1
Mass Dry Solids (grams): 512.63

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	99.8	98.8	93.7	74.4	35.0	6.3	2.2	1.5	1.0	-	-	-

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: JM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-009**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

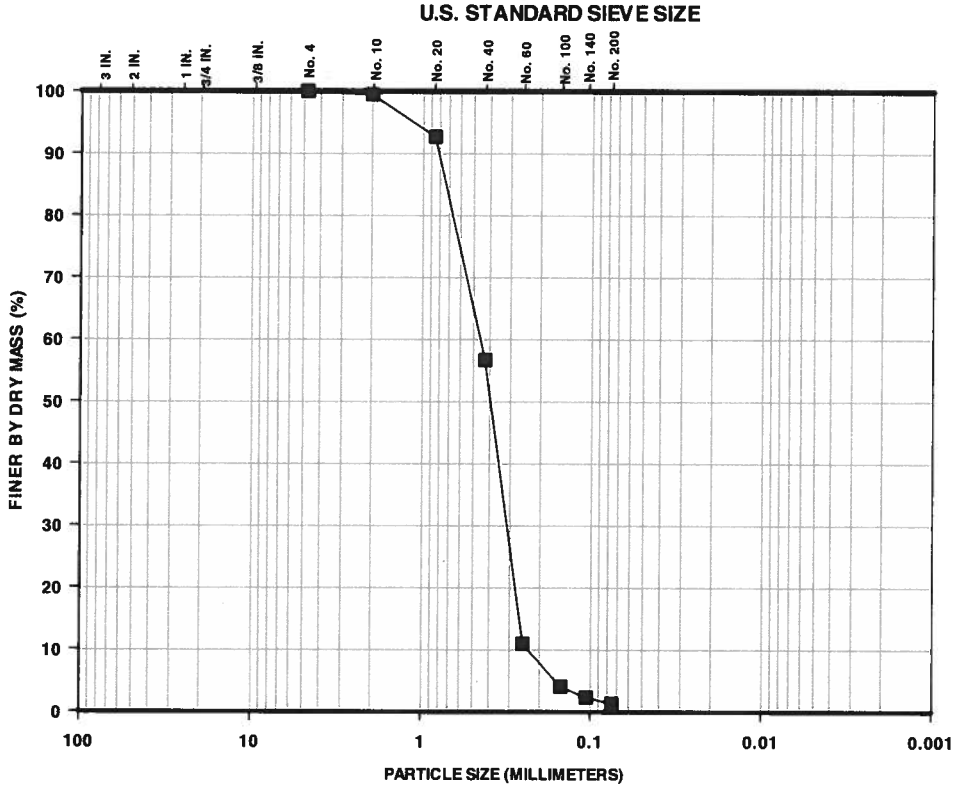
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 20.6
Mass Dry Solids (grams): 235.86

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.5	92.7	56.7	11.0	4.1	2.4	1.4	-	-	-

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-010**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Dark gray sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

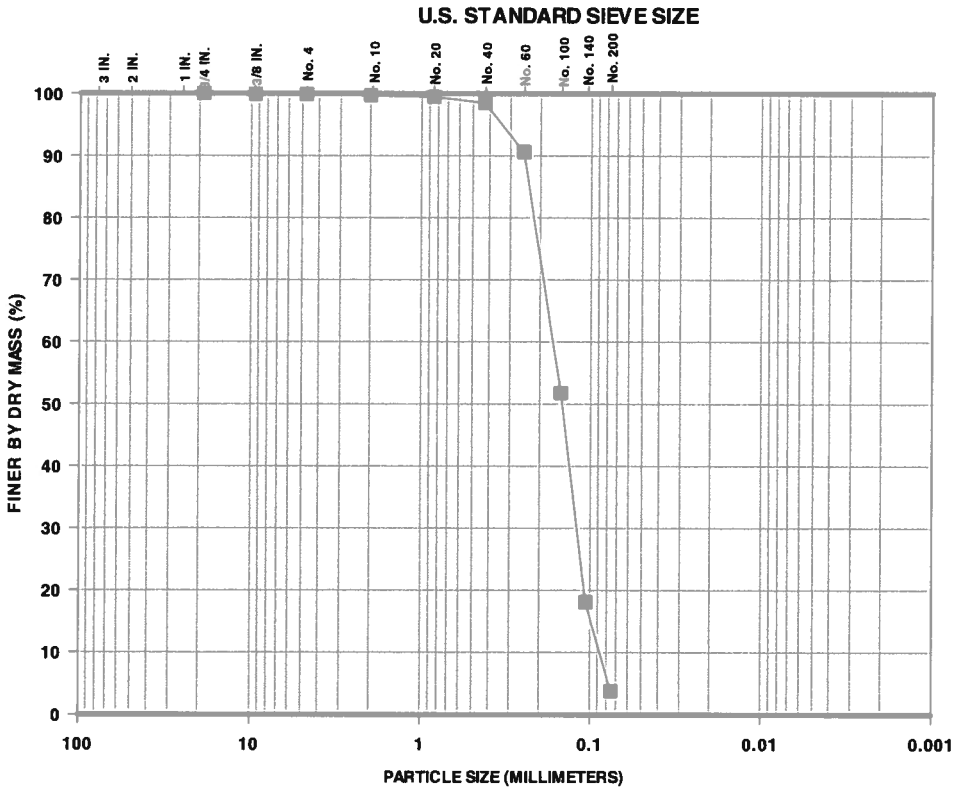
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 29.8
Mass Dry Solids (grams): 215.73

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.5
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	99.9	99.9	99.7	99.5	98.5	90.6	51.8	18.1	3.8	-	-	-

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Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-011**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Dark gray sand with silt and shell (SP-SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

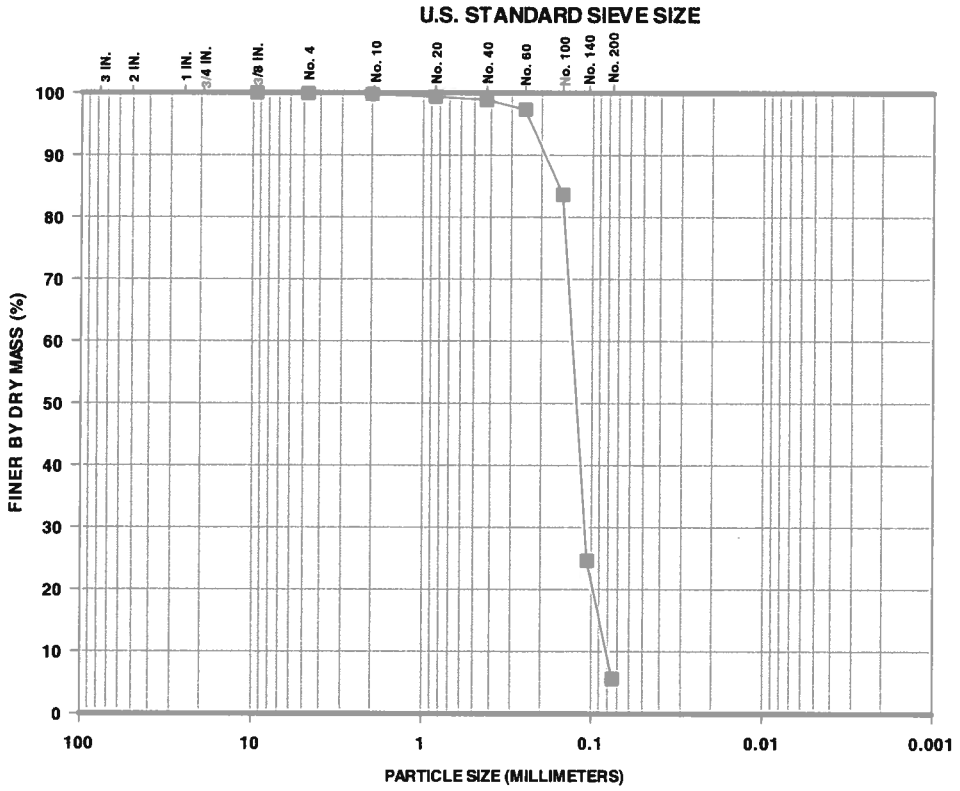
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 32.8
Mass Dry Solids (grams): 248.00

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.6
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.9	99.8	99.4	98.9	97.3	83.6	24.6	5.6	-	-	-

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Checked By: JM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/2513
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-012**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

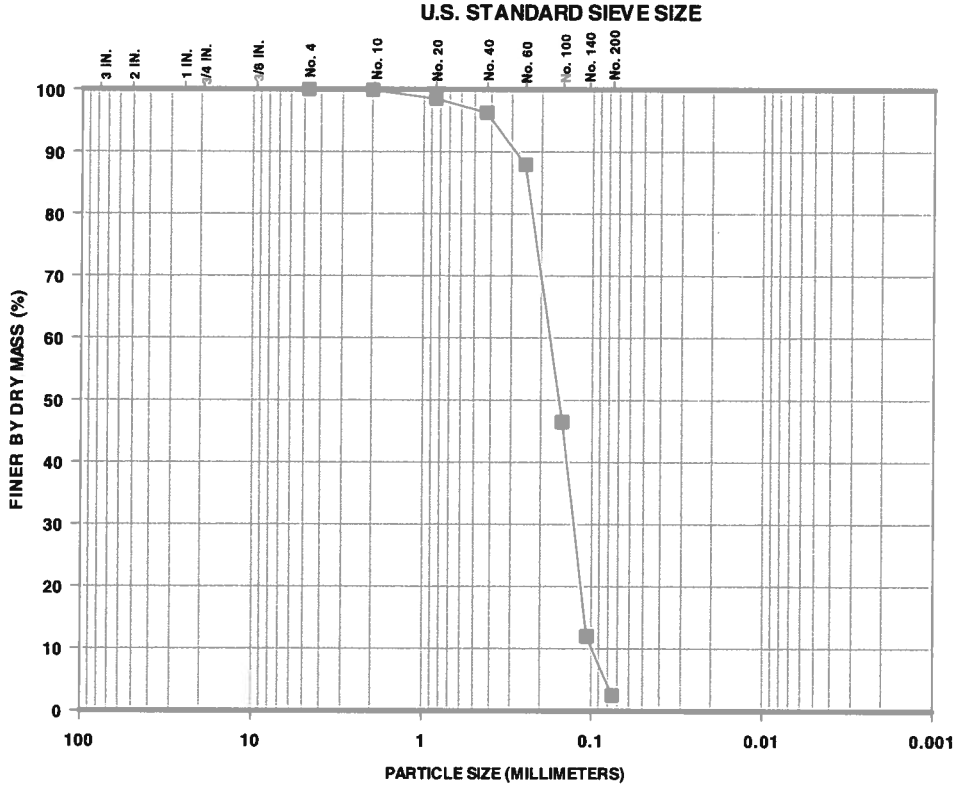
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 23.8
Mass Dry Solids (grams): 308.10

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.5
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	98.5	96.3	87.9	46.5	12.0	2.5	-	-	-

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Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-013**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☐ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☒ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

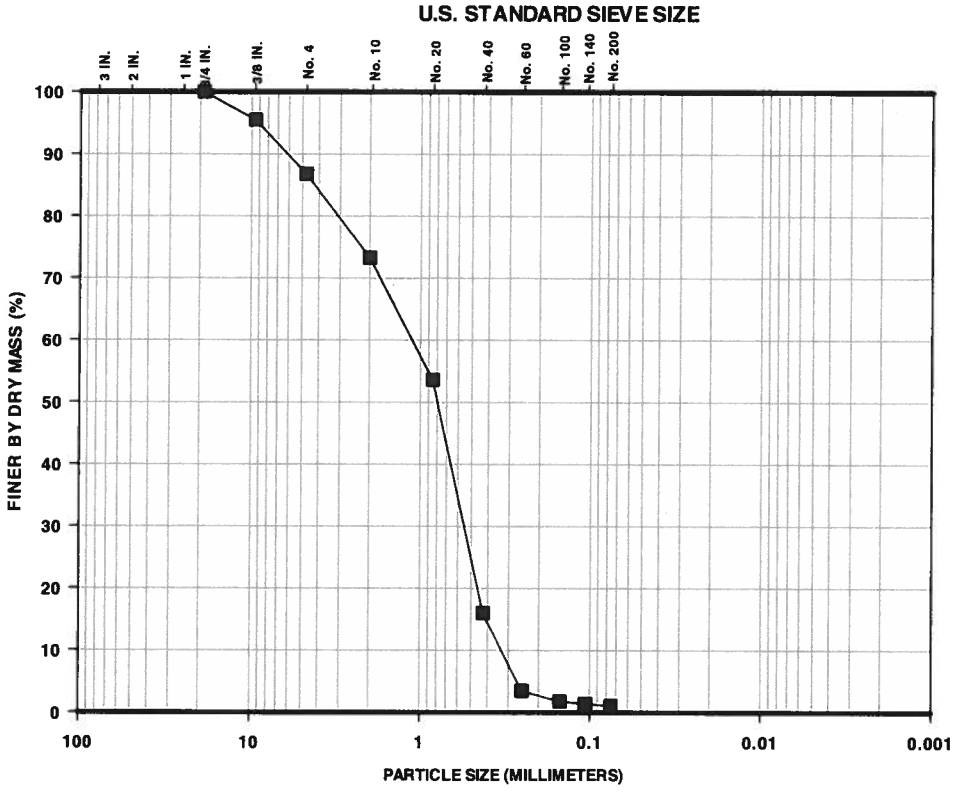
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 16.0
Mass Dry Solids (grams): 665.38

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	95.5	86.8	73.3	53.6	16.0	3.5	1.8	1.4	1.1	-	-	-

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Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13; REV. 07/23/13

INCOMING SAMPLE NO.: **GS-014**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray sandy lean clay with shell (CL);
ASTM Standard D4373: $CaCO_3$=8.1%
ASTM Standard D4318 (Method A): LL=34; PI=17

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

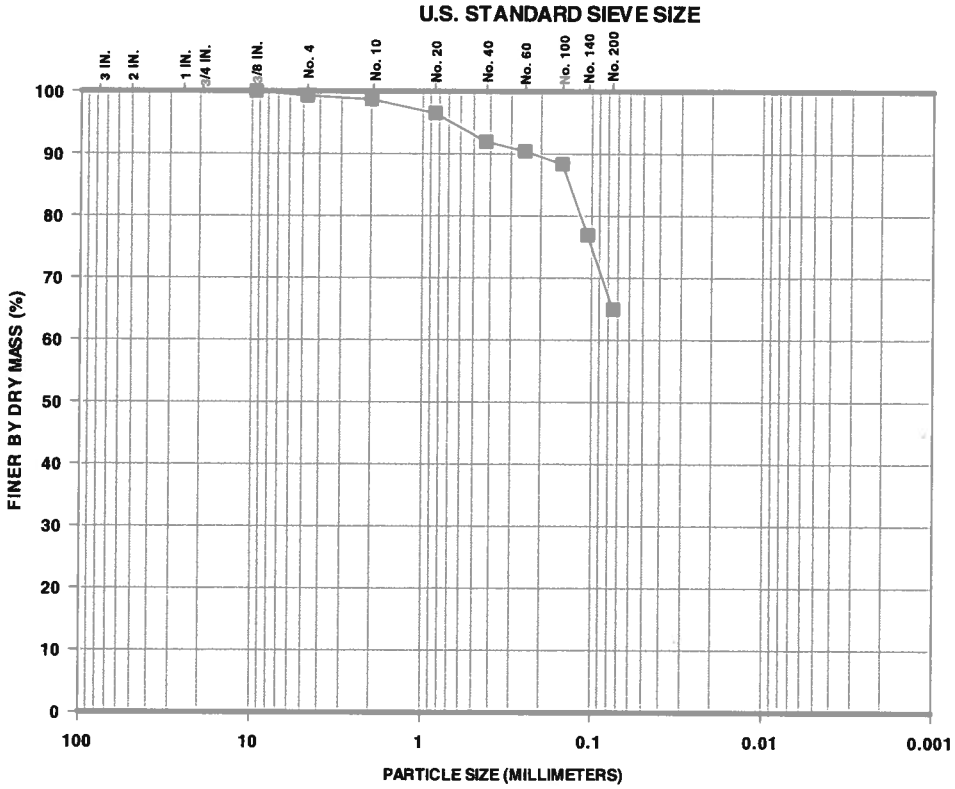
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 44.1
Mass Dry Solids (grams): 209.50

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 2.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.3	98.7	96.5	91.9	90.4	88.3	76.9	64.9	-	-	-

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Checked By: _____ Date: 07/23/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 07/01/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-015**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray sand with silt and shell (SP-SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

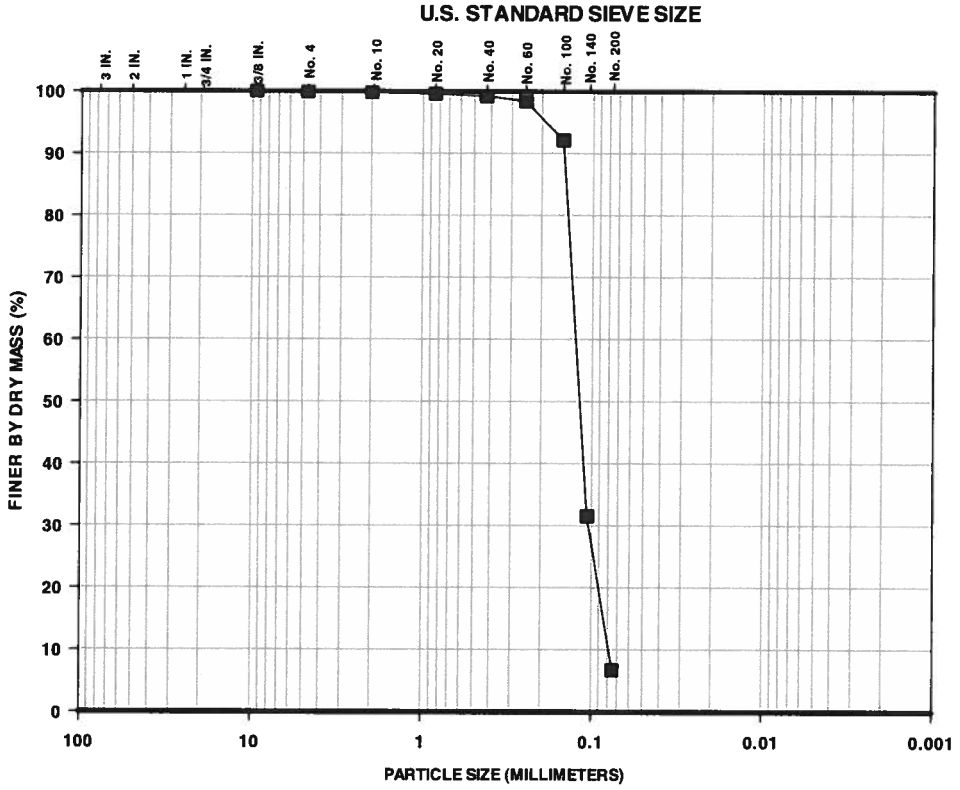
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 35.3
Mass Dry Solids (grams): 215.80

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.6
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.9	99.8	99.6	99.2	98.4	92.1	31.5	6.7	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-016**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray silty sand with shell (SM)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

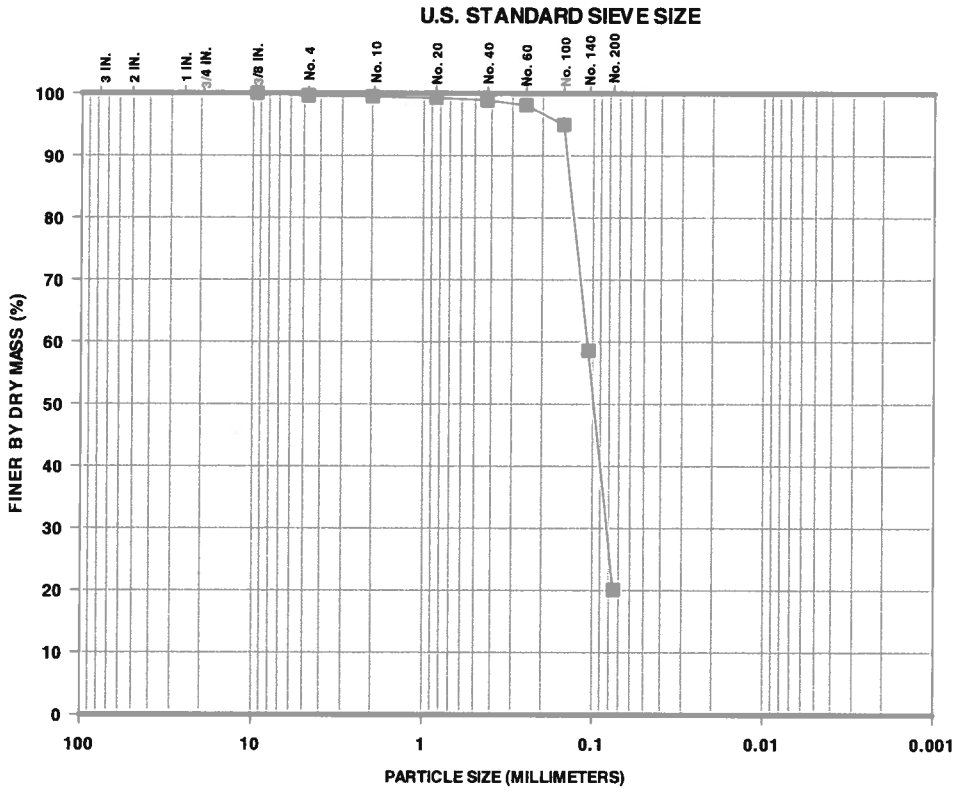
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 36.0
Mass Dry Solids (grams): 138.09

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.7
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.6	99.5	99.3	98.9	98.1	95.0	58.6	20.1	-	-	-

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Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-017**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray silty sand with shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

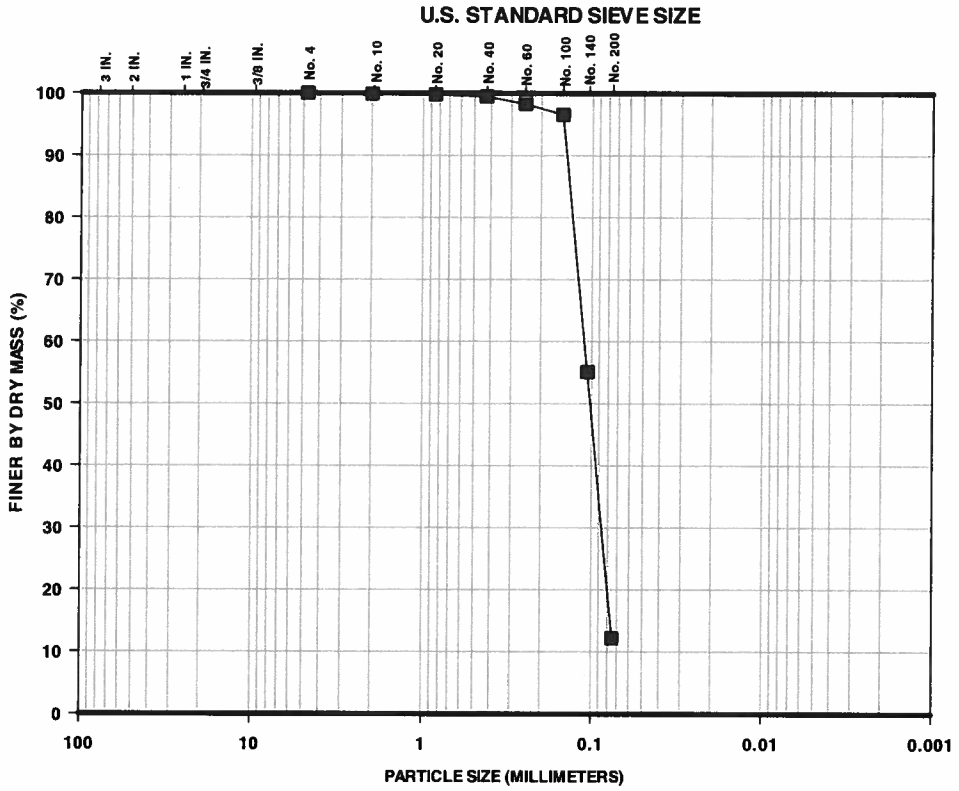
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 37.0
Mass Dry Solids (grams): 141.90

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.6
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	99.8	99.5	98.3	96.6	55.1	12.2	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-018**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray silty sand with shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

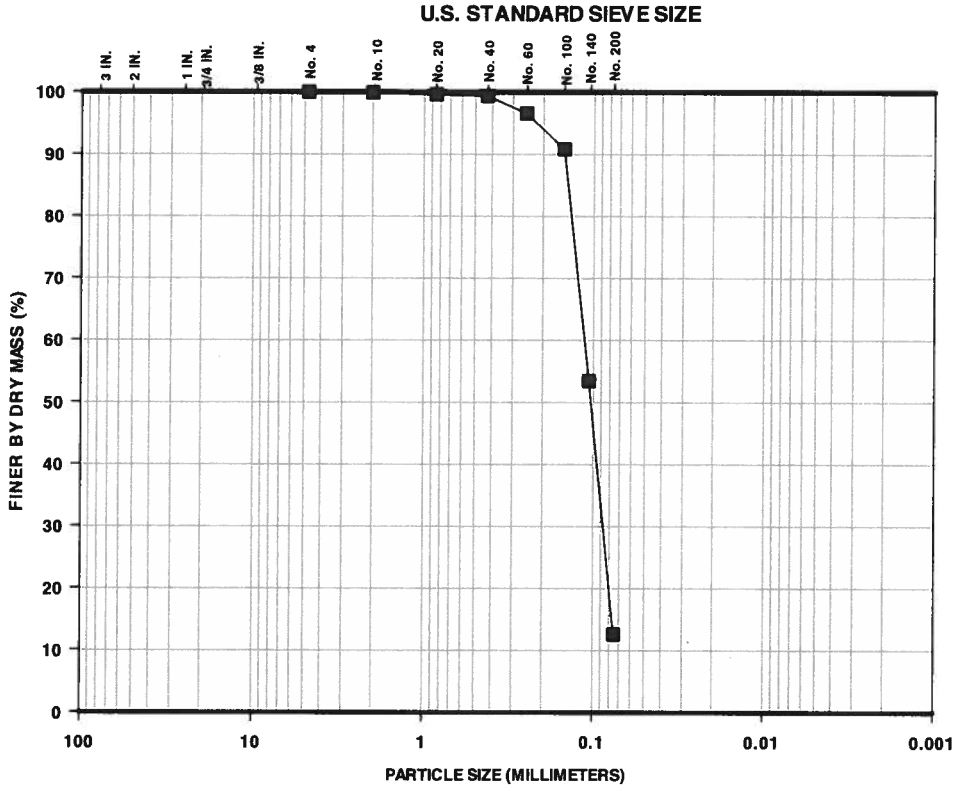
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 32.9
Mass Dry Solids (grams): 145.87

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.6
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	99.6	99.4	96.6	90.8	53.4	12.6	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-019**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray silty sand with shell (SM)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

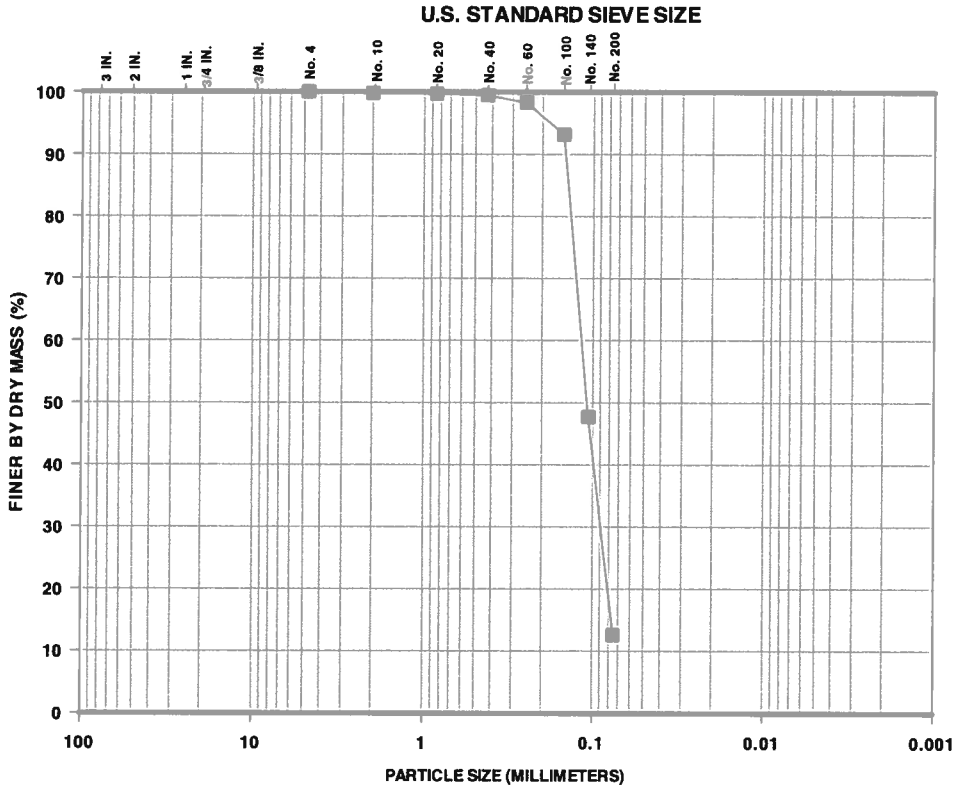
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 32.6
Mass Dry Solids (grams): 148.02

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.5
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.8	99.7	99.5	98.3	93.2	47.7	12.6	-	-	-

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Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-020**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Dark gray silty sand with trace shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

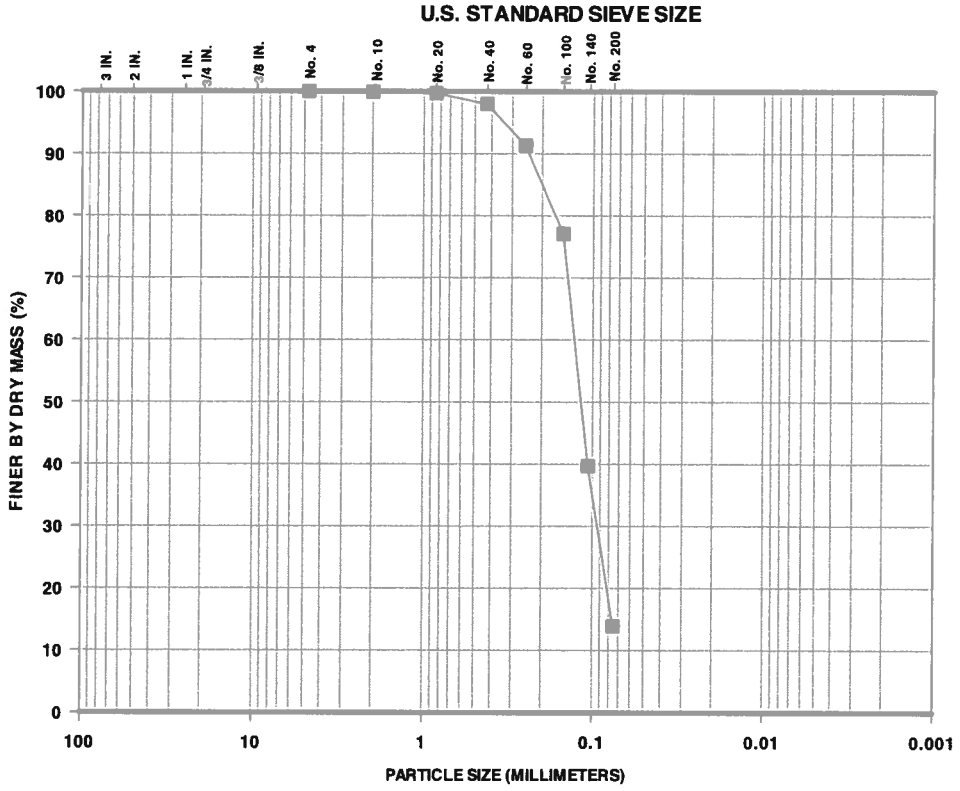
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 32.7
Mass Dry Solids (grams): 182.74

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.7
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	99.7	98.0	91.3	77.1	39.7	13.9	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-021**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Light brown sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

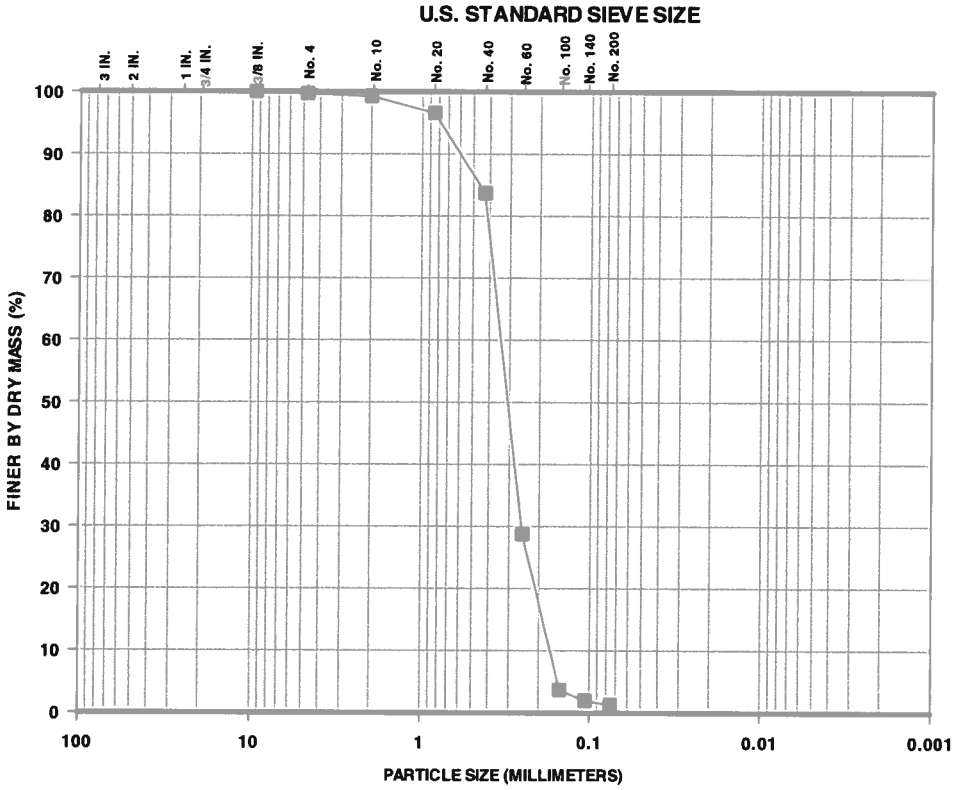
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 25.8
Mass Dry Solids (grams): 158.94

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.2
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.7	99.3	96.6	83.7	28.8	3.7	2.0	1.3	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-022**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☐ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☒ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

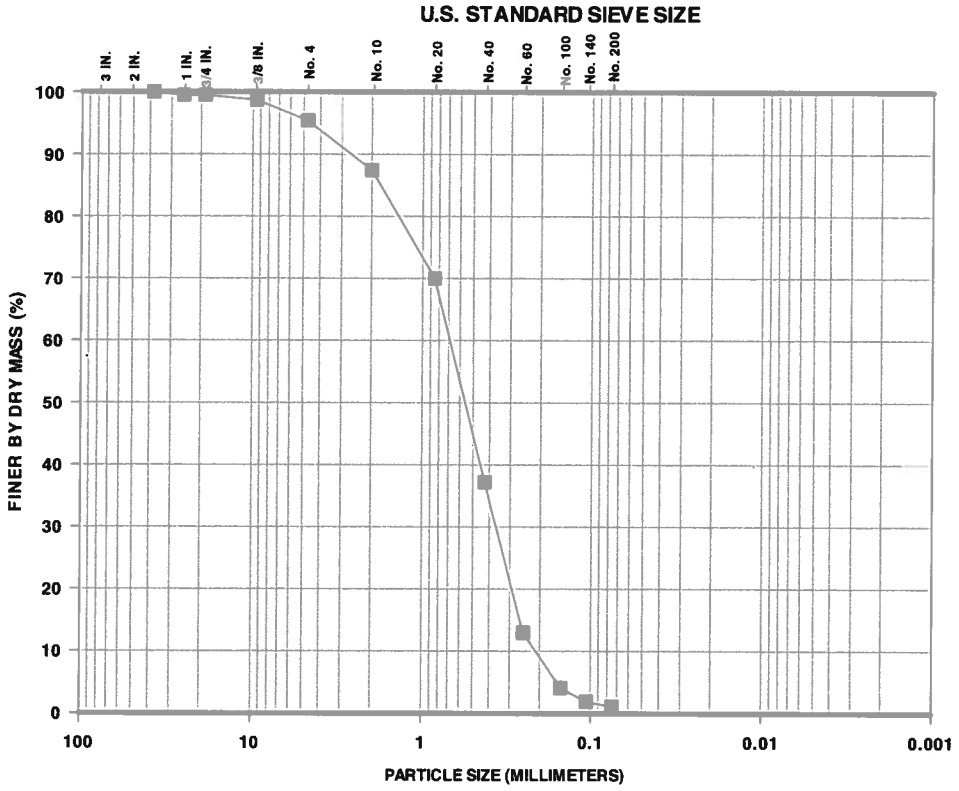
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 19.6
Mass Dry Solids (grams): 547.22

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	99.5	99.5	98.7	95.4	87.4	70.0	37.2	13.0	4.1	1.9	1.1	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-023**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Dark gray silty sand with trace shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

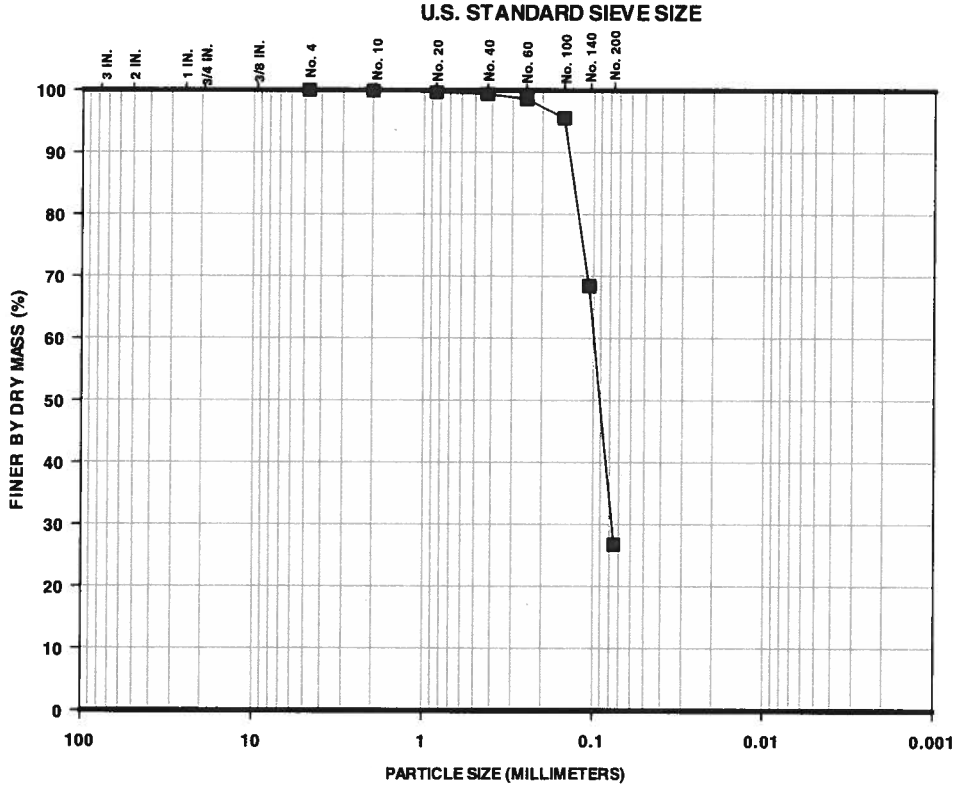
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 49.0
Mass Dry Solids (grams): 147.00

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 1.4
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	99.7	99.4	98.6	95.5	68.4	26.7	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-024**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

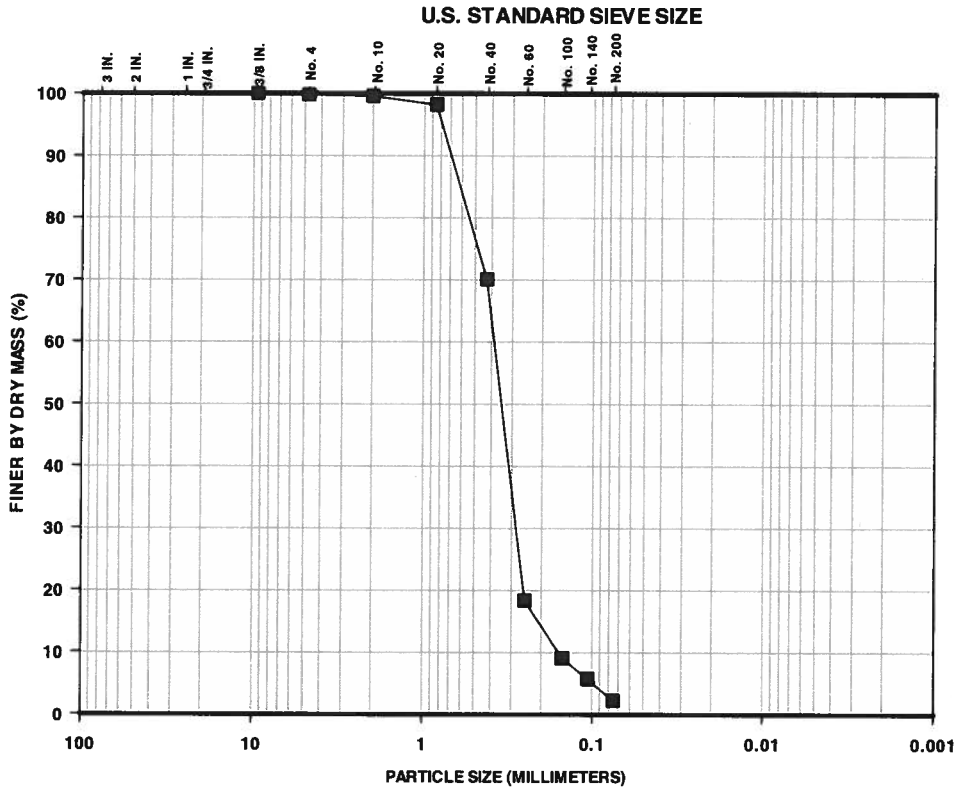
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 24.2
Mass Dry Solids (grams): 505.65

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.4
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.8	99.6	98.2	70.1	18.4	9.1	5.8	2.3	-	-	-

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Checked By: [signature] Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-025**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Dark gray silty sand with trace shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

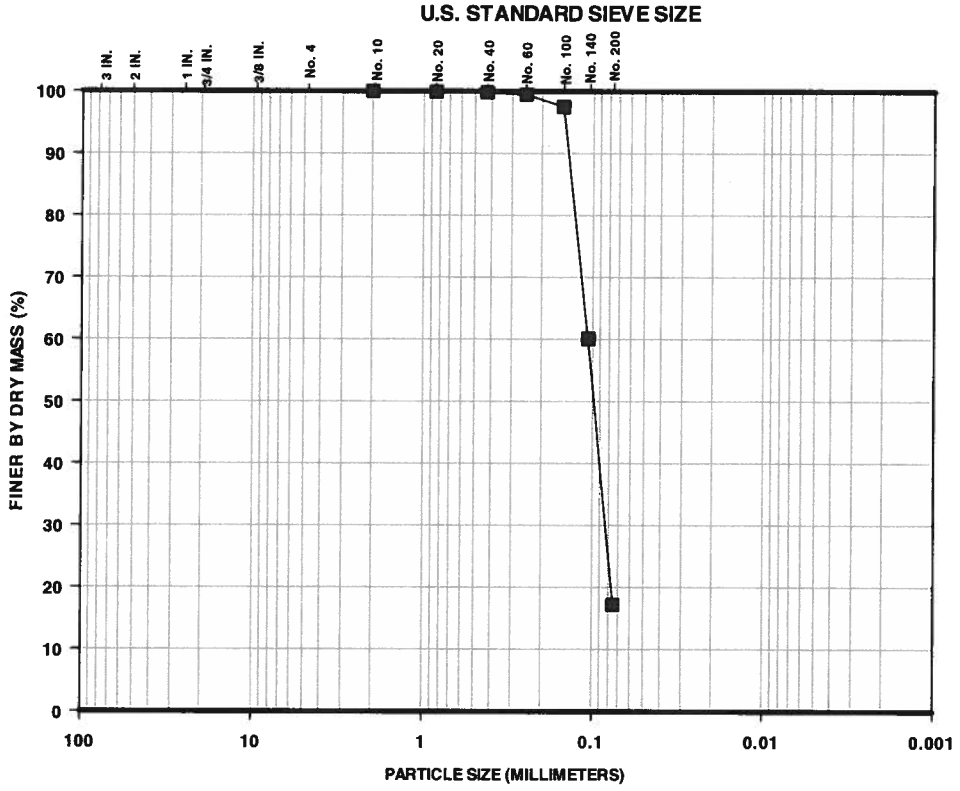
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 33.7
Mass Dry Solids (grams): 204.90

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.7
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	100	99.9	99.8	99.5	97.5	60.1	17.2	-	-	-

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Checked By: JM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-026**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

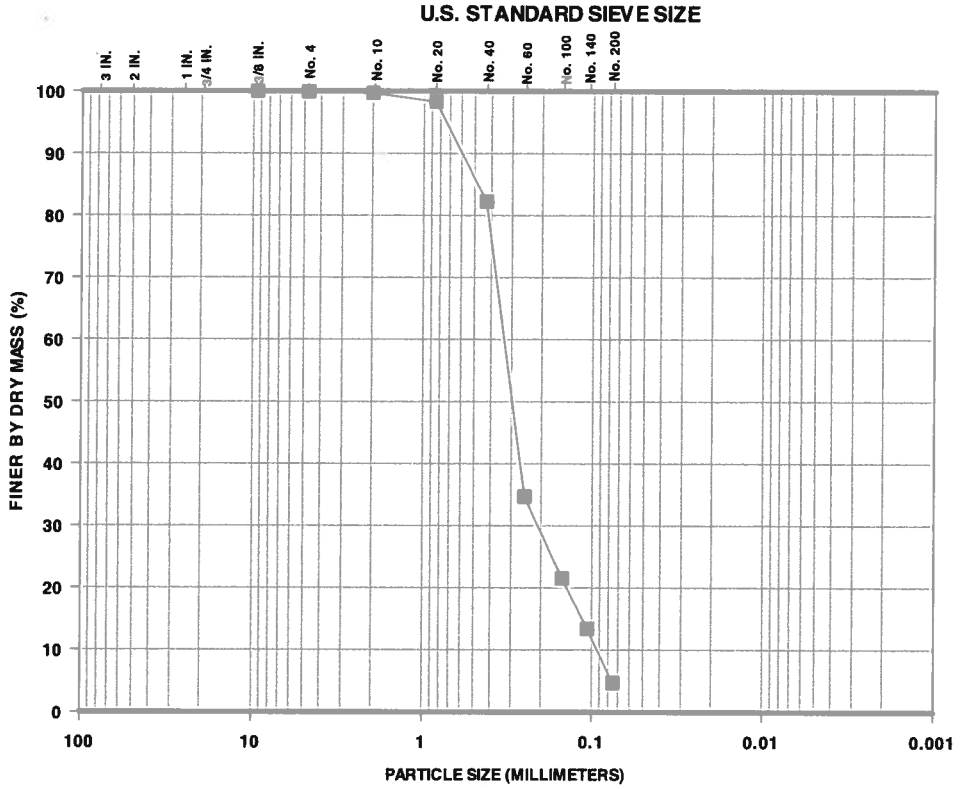
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 27.4
Mass Dry Solids (grams): 598.66

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.5
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.9	99.7	98.3	82.2	34.7	21.5	13.4	4.7	-	-	-

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Checked By: JM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-027**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray silty sand with shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

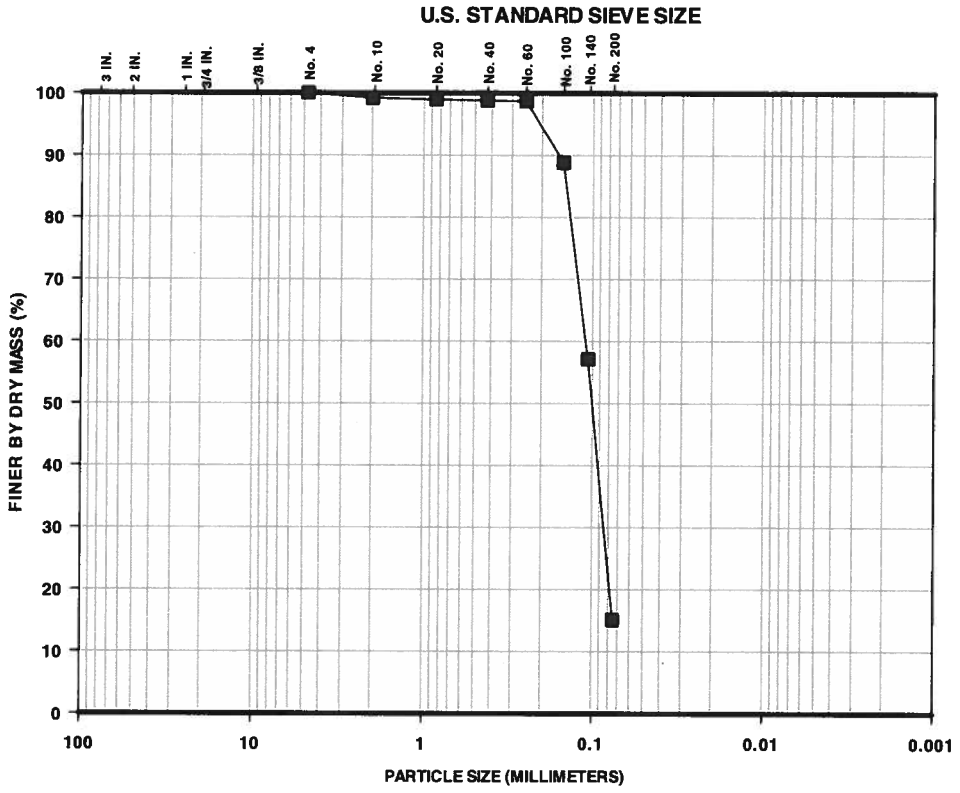
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 34.6
Mass Dry Solids (grams): 139.88

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.8
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.2	99.0	98.8	98.7	88.8	57.1	15.1	-	-	-

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Checked By: JM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-028**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray silty sand with shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

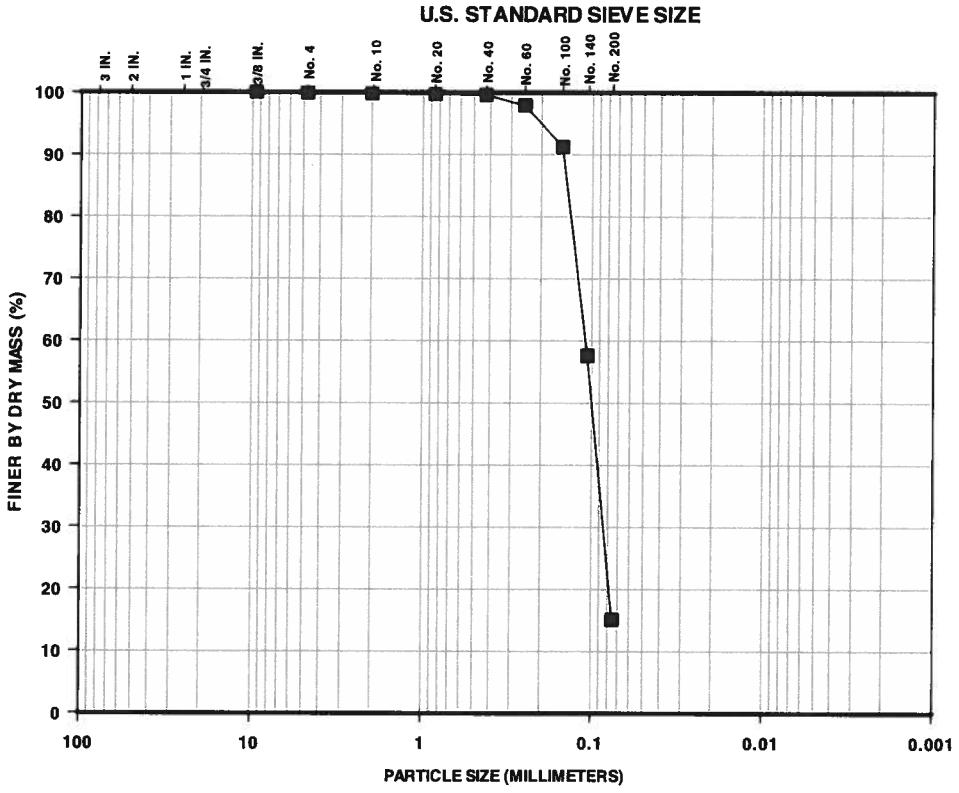
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 34.4
Mass Dry Solids (grams): 145.19

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.6
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.9	99.8	99.7	99.6	97.9	91.2	57.6	15.1	-	-	-

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Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-029**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray silty sand with shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

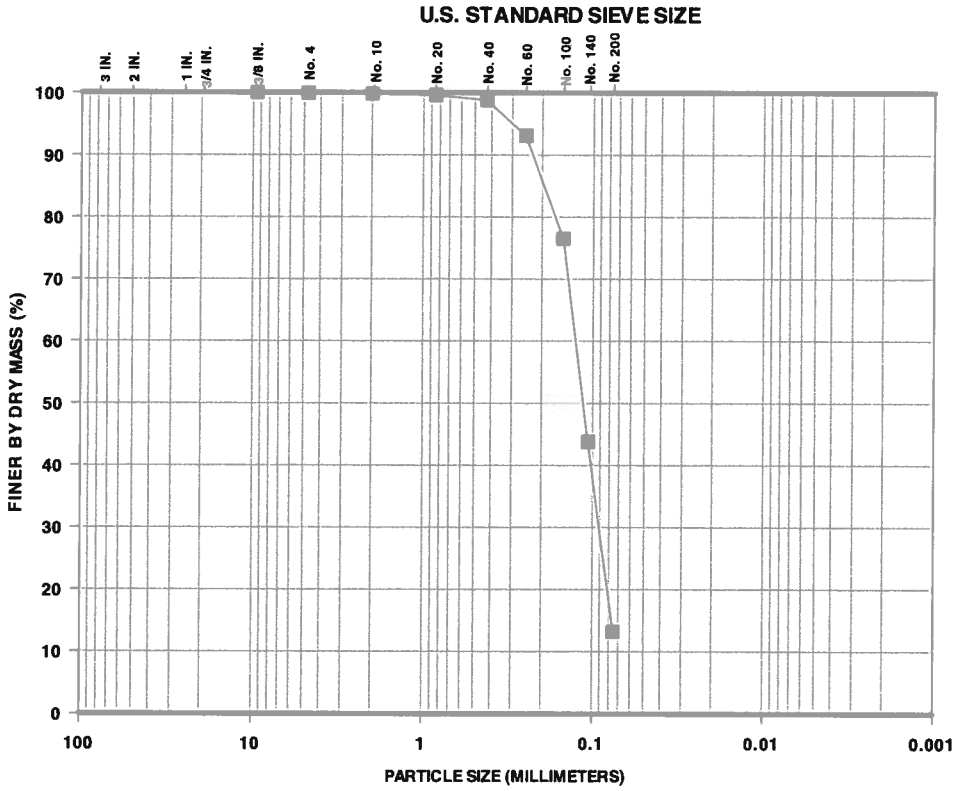
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 34.8
Mass Dry Solids (grams): 394.34

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.8
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.9	99.8	99.6	98.8	93.1	76.5	43.8	13.2	-	-	-

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Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-030**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray silty sand with shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

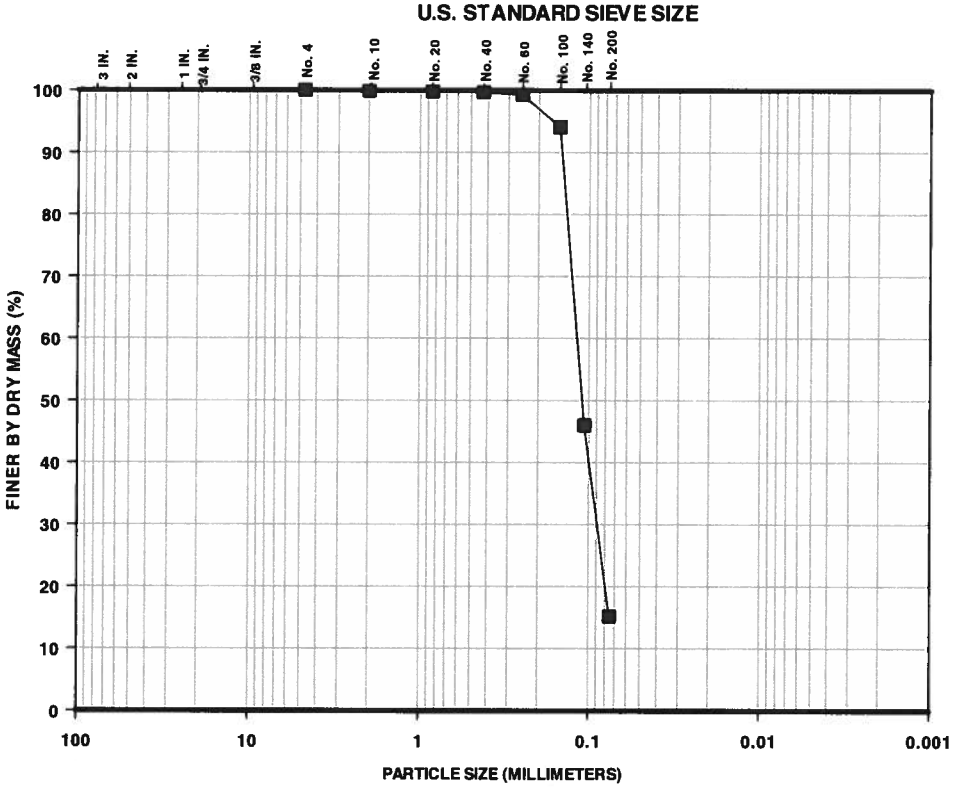
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 35.4
Mass Dry Solids (grams): 293.28

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.8
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	99.8	99.7	99.3	94.1	46.0	15.2	-	-	-

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Checked By: M Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-031**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray silty sand with shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

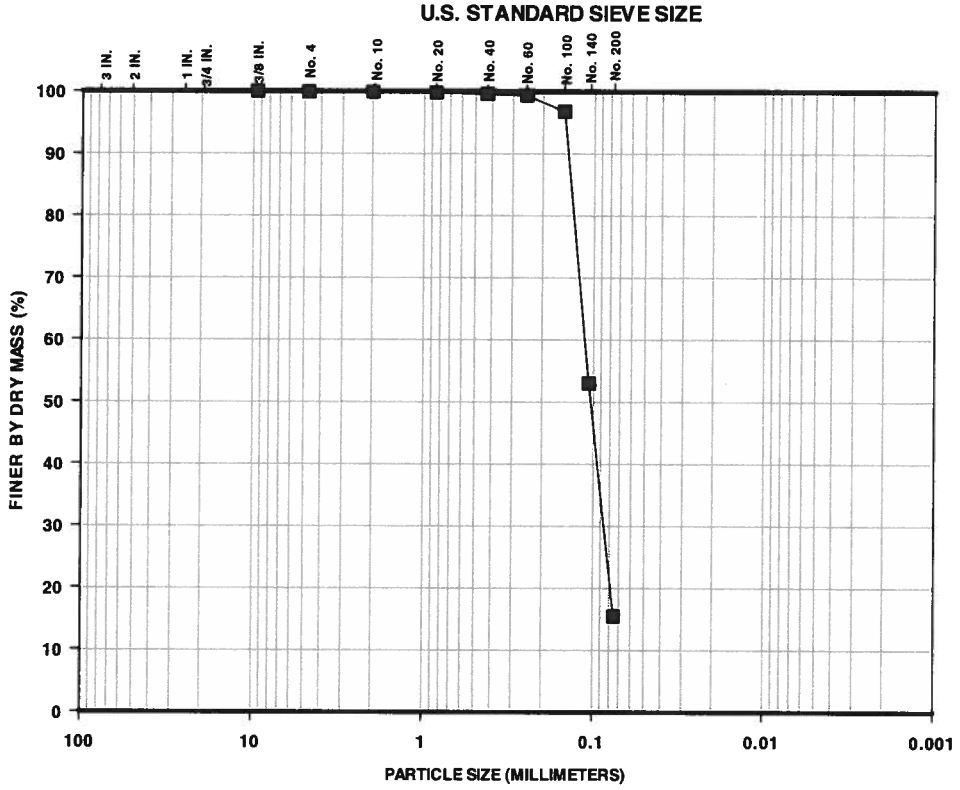
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 37.8
Mass Dry Solids (grams): 238.23

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.6
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.9	99.9	99.8	99.6	99.4	96.8	53.0	15.5	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-032**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Dark gray sand with silt and shell (SW-SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

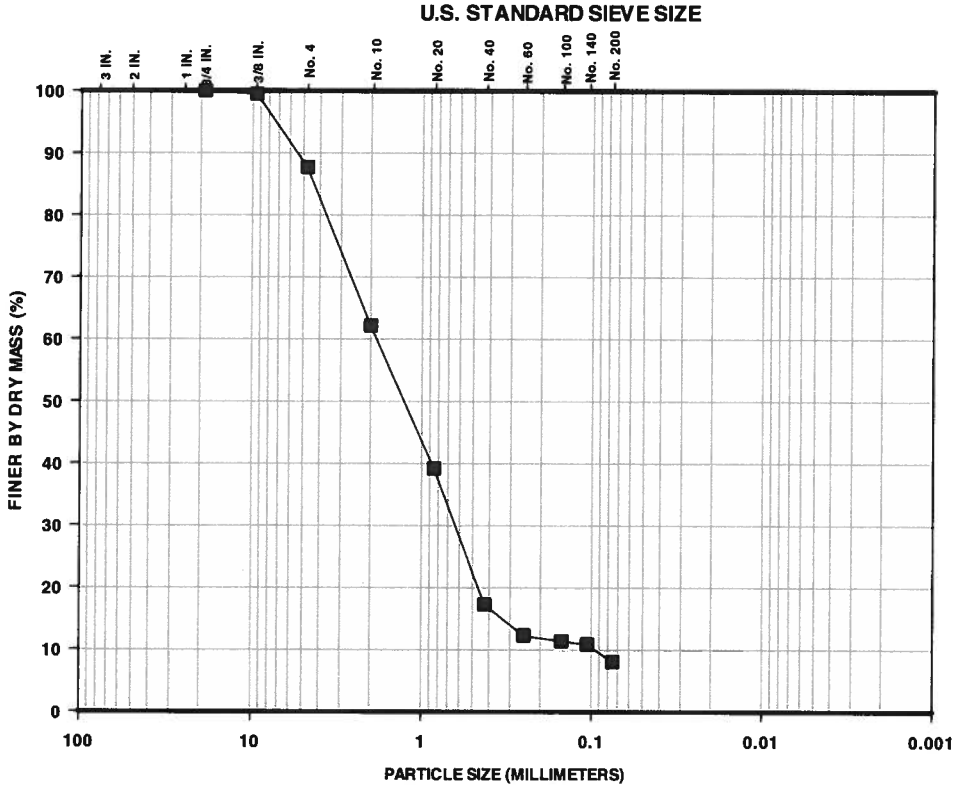
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 21.4
Mass Dry Solids (grams): 612.84

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 1.2
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	99.5	87.7	62.2	39.2	17.3	12.3	11.4	10.9	8.1	-	-	-

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Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/27/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-033**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☐ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☒ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

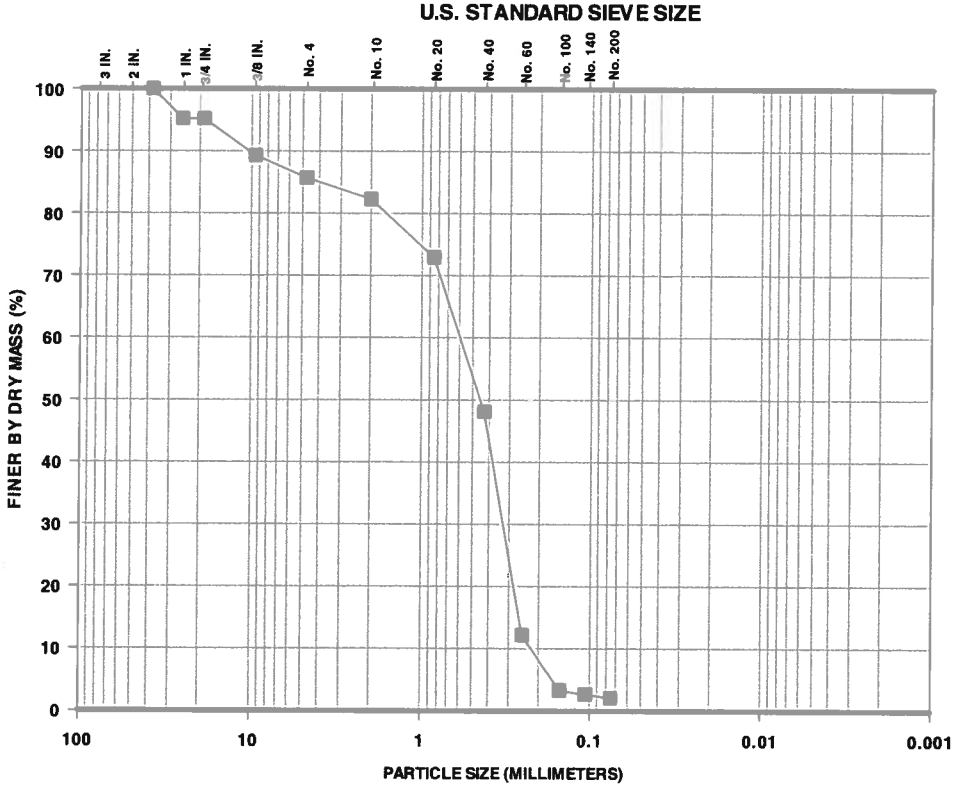
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 20.4
Mass Dry Solids (grams): 631.35

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.2
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	95.2	95.2	89.3	85.7	82.3	72.9	48.1	12.2	3.3	2.7	2.1	-	-	-

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Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-034**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

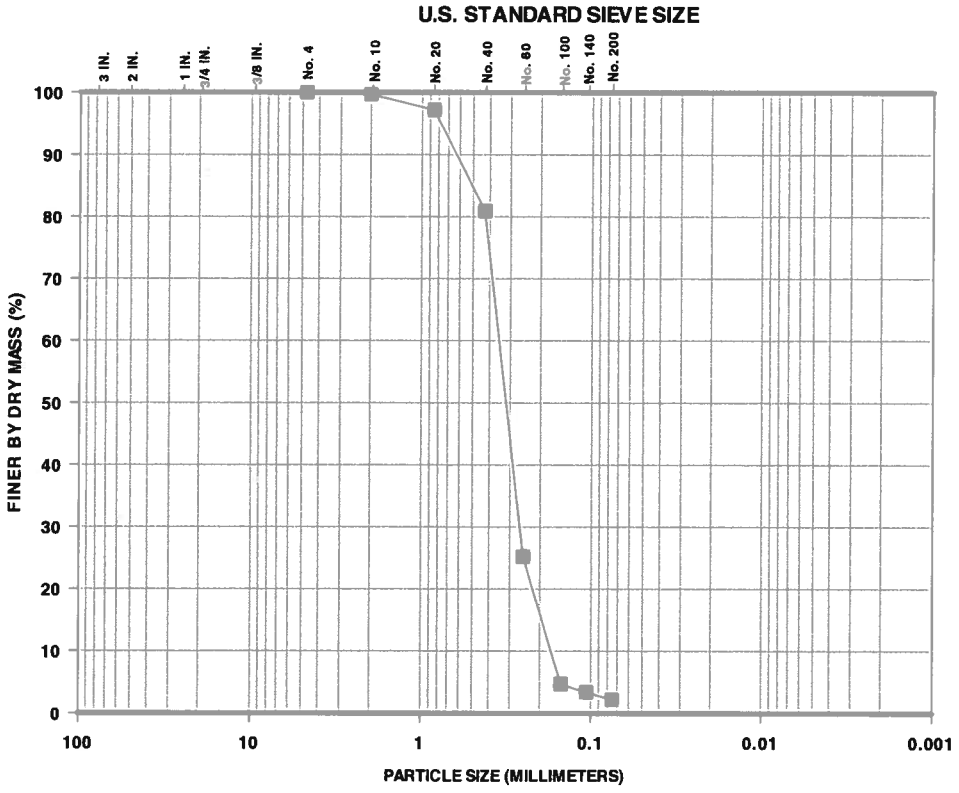
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 25.5
Mass Dry Solids (grams): 249.18

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.4
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.7	97.2	80.9	25.2	4.7	3.4	2.2	-	-	-

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Checked By: TW Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/27/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-035**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray sand with gravel and shell (SW)

TEST PROCEDURES

ASTM Standard D422:
- ☐ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☒ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

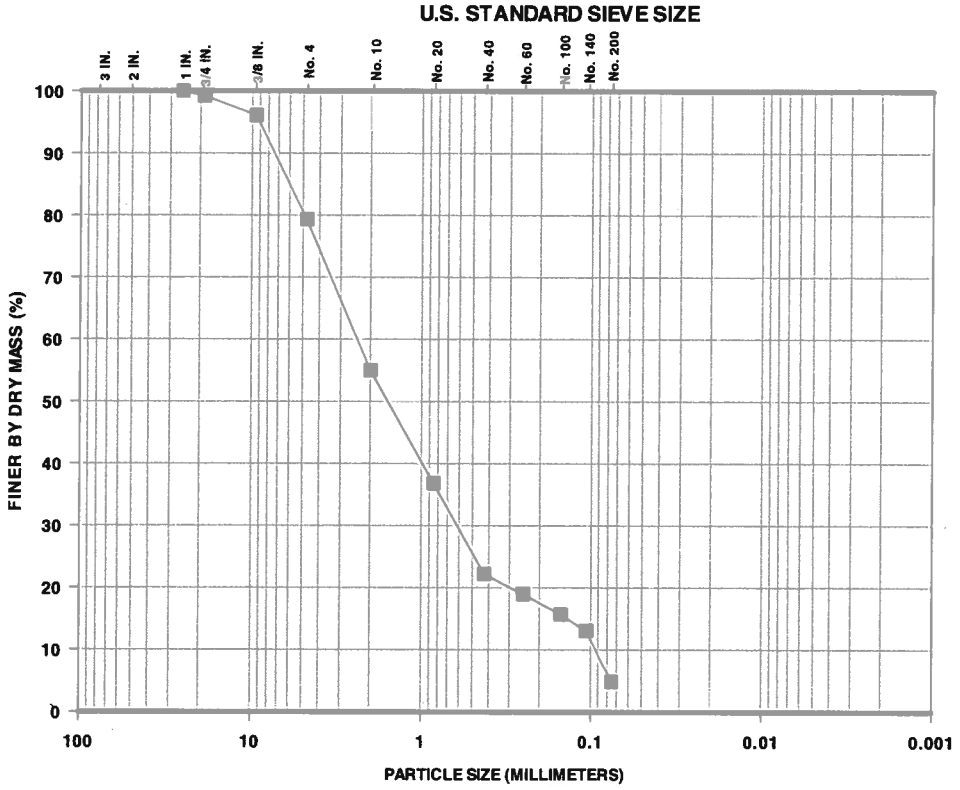
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 12.7
Mass Dry Solids (grams): 819.47

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	99.2	96.1	79.3	55.0	36.8	22.2	19.0	15.7	13.1	4.9	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/27/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-036**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray sand with silt and shell (SP-SM)

TEST PROCEDURES

ASTM Standard D422:
- ☐ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☒ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

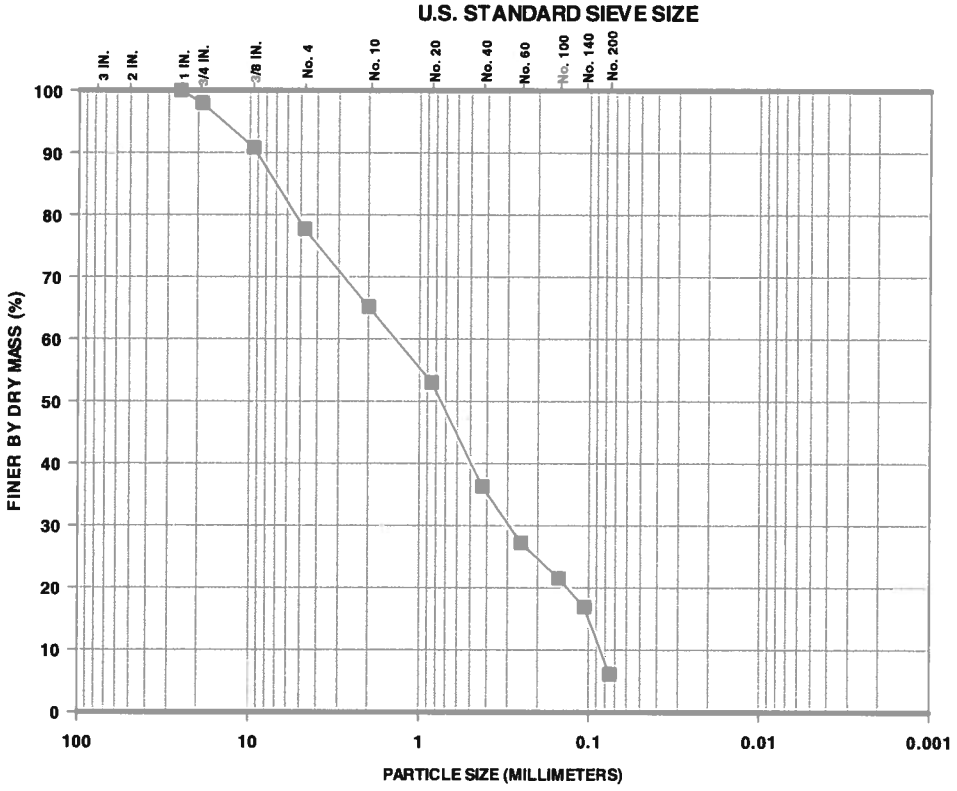
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 17.2
Mass Dry Solids (grams): 683.73

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.5
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	98.0	90.8	77.7	65.2	53.0	36.3	27.2	21.5	16.9	6.1	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-037**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray sand with silt and shell (SP-SM)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

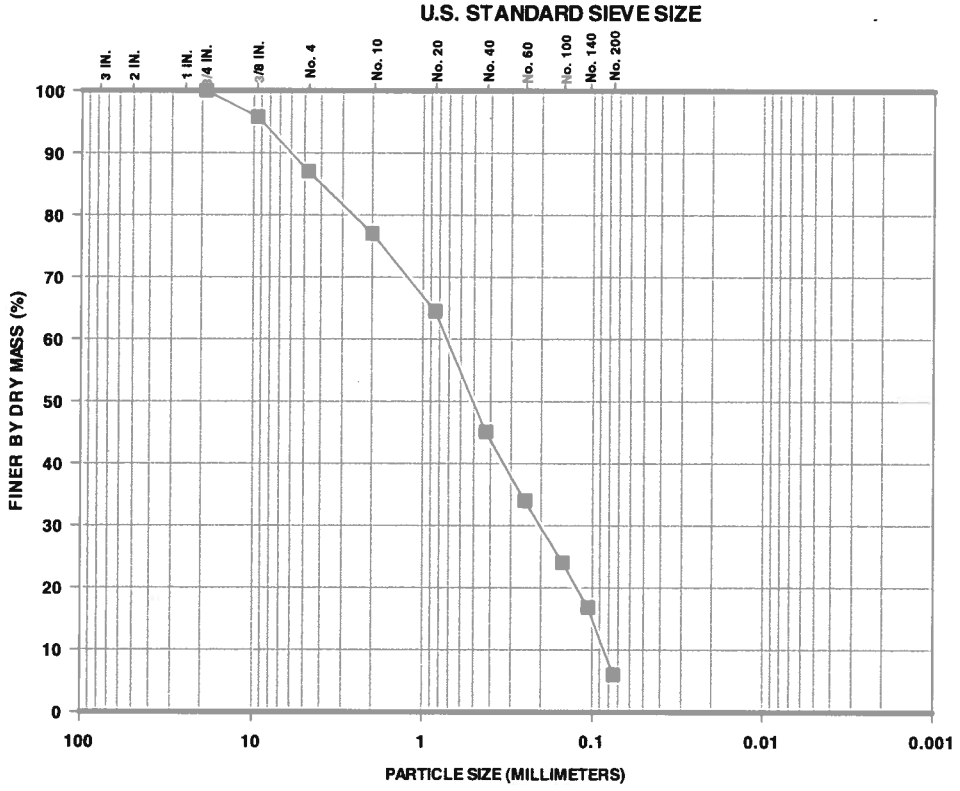
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 22.6
Mass Dry Solids (grams): 502.12

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.8
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	95.8	87.0	77.0	64.5	45.1	34.0	24.0	16.8	6.0	-	-	-

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Checked By: JM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-038**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Light brown sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

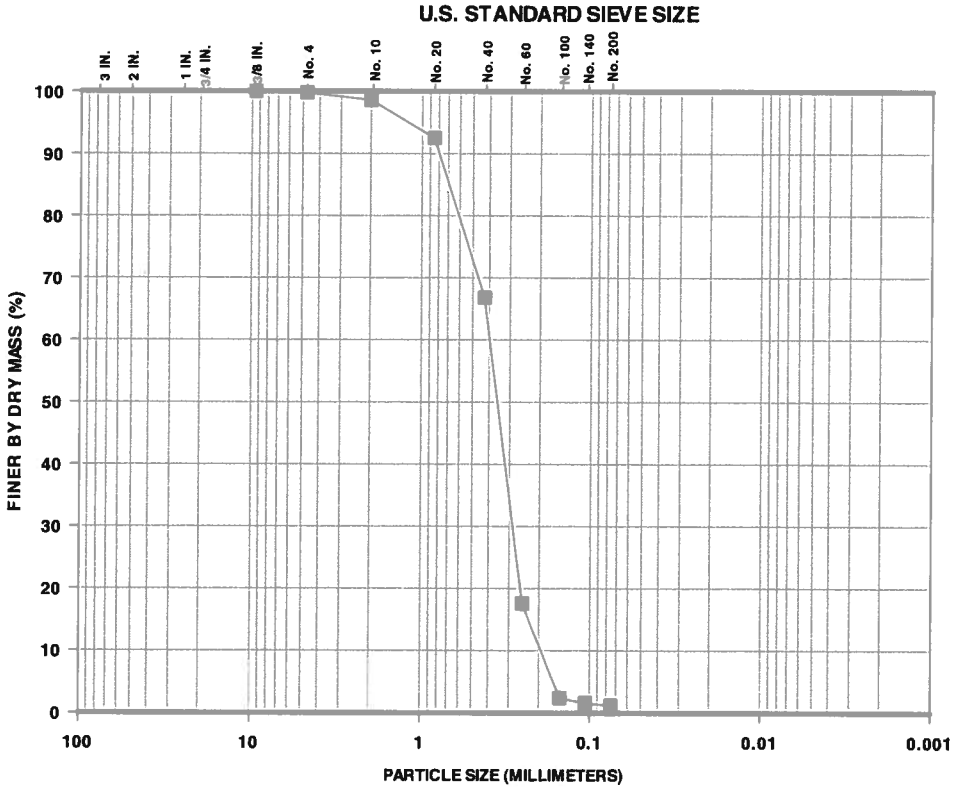
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 23.1
Mass Dry Solids (grams): 185.56

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.4
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.8	98.6	92.5	66.8	17.6	2.4	1.6	1.2	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-039**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other:

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other

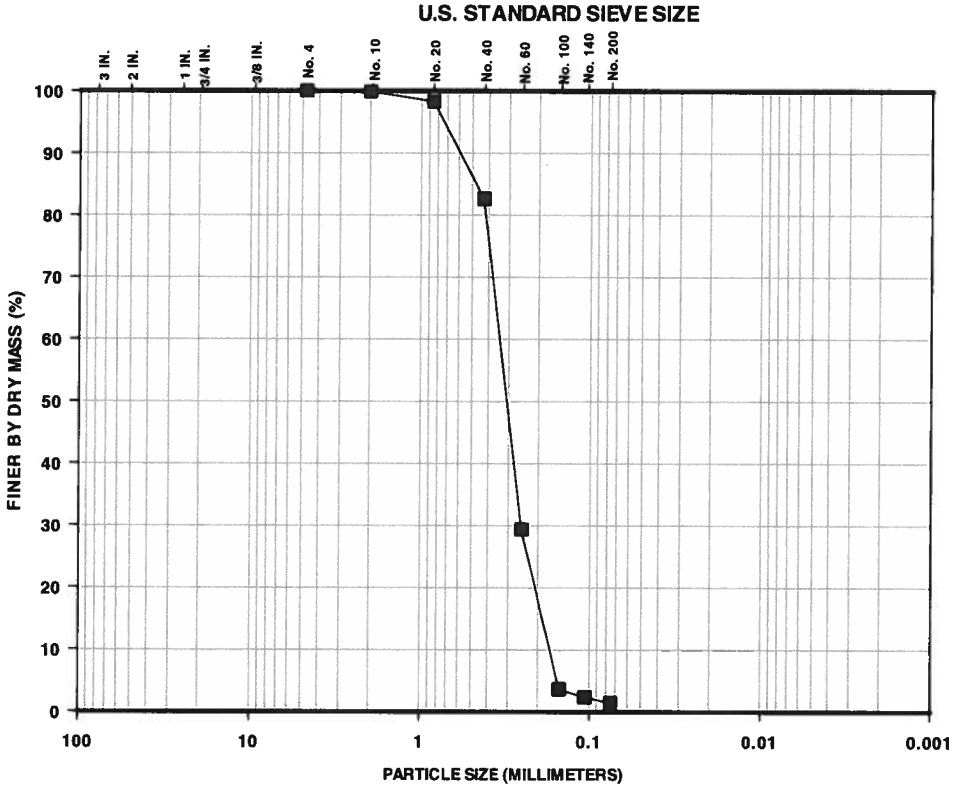
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours):

Water Content (%): 26.4
Mass Dry Solids (grams): 177.06

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.4
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	98.3	82.6	29.4	3.7	2.4	1.5	-	-	-

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Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-040**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Light brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

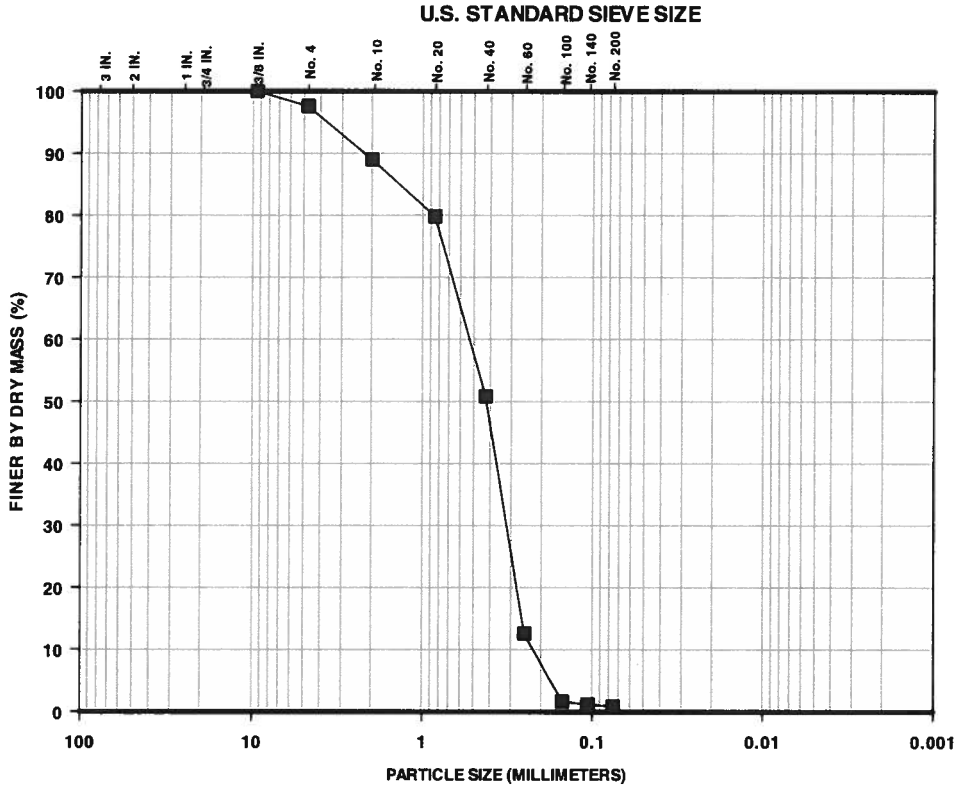
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 20.2
Mass Dry Solids (grams): 496.23

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	97.6	89.0	79.8	50.8	12.6	1.7	1.2	0.9	-	-	-

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Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-041**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Light brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☐ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☒ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

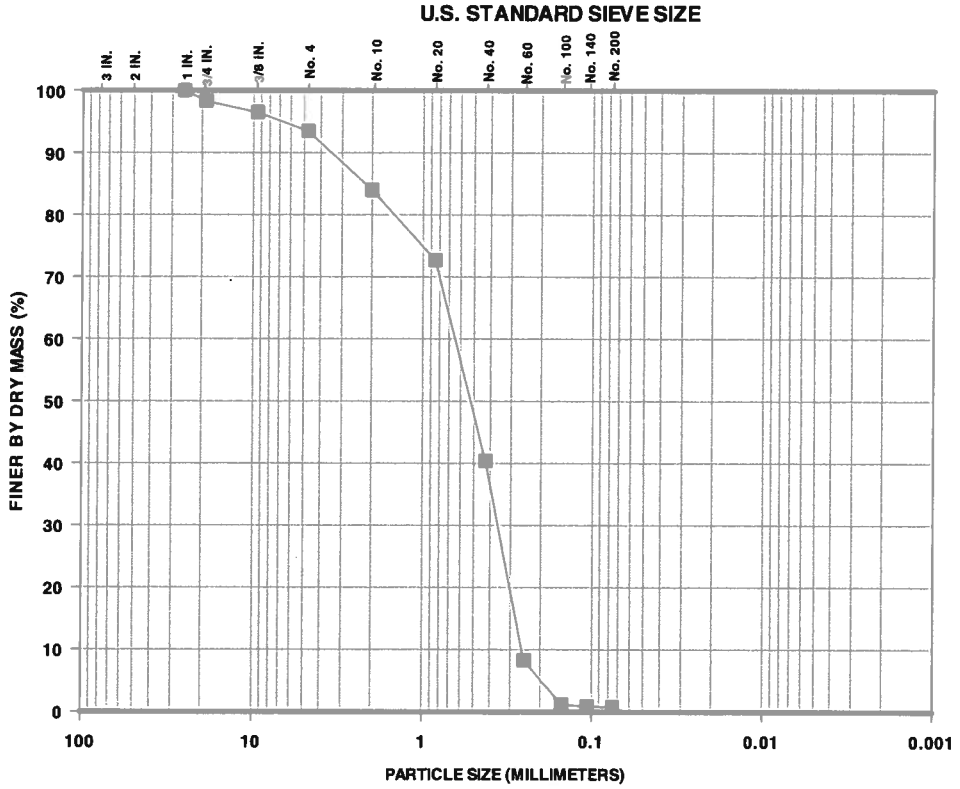
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 18.3
Mass Dry Solids (grams): 593.42

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	98.3	96.5	93.5	84.0	72.7	40.4	8.3	1.2	0.9	0.8	-	-	-

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Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-042**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Light brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☐ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☒ ASTM Standard D6913 Sieve Analysis
☐ Other:

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other

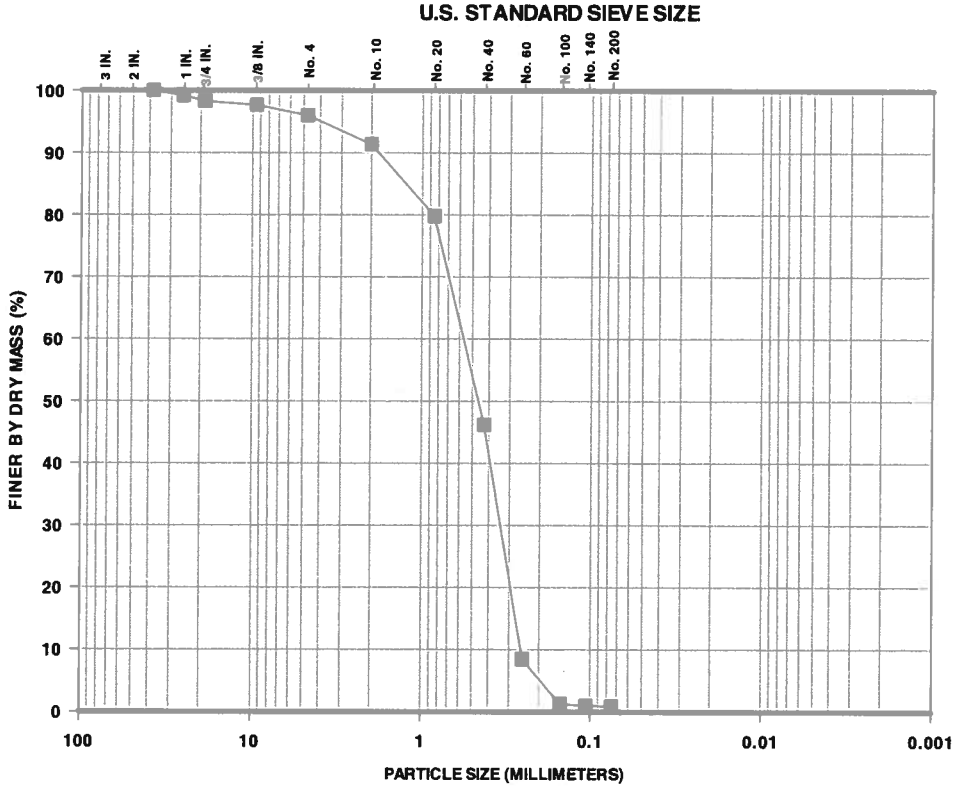
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours):

Water Content (%): 21.9
Mass Dry Solids (grams): 574.73

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	99.2	98.3	97.7	96.0	91.4	79.8	46.2	8.5	1.3	1.0	0.9	-	-	-

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Checked By: Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-043**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Dark gray sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☐ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☒ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

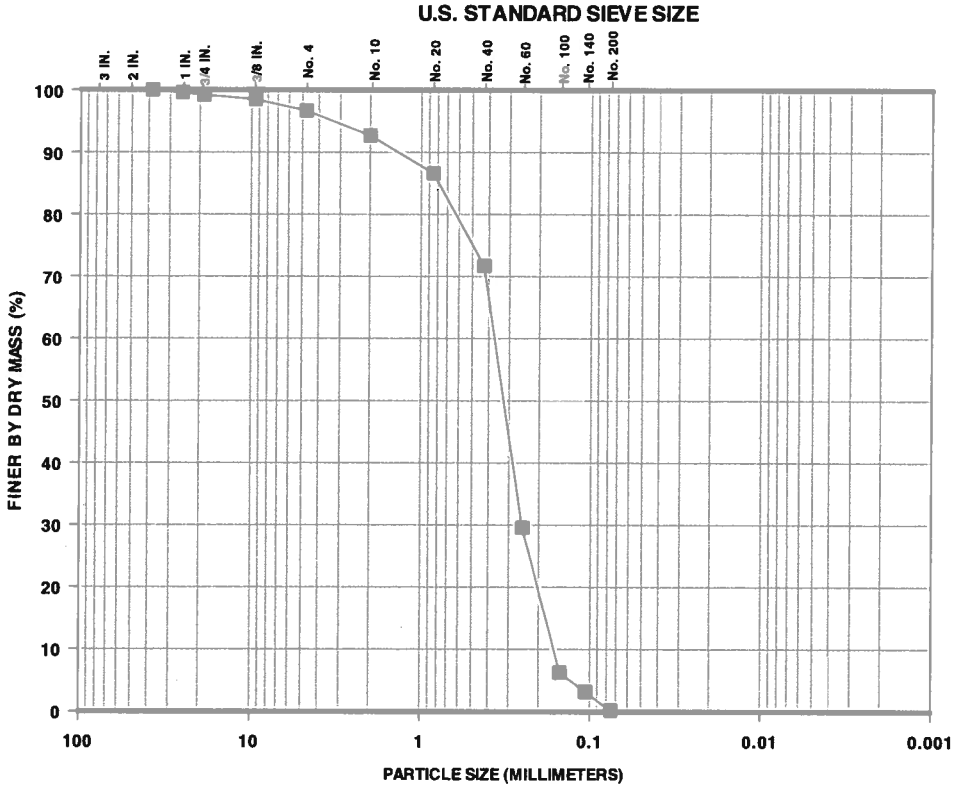
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 24.8
Mass Dry Solids (grams): 620.86

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.4
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	99.6	99.2	98.5	96.7	92.7	86.6	71.7	29.6	6.3	3.2	0.2	-	-	-

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Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 07/01/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-044**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

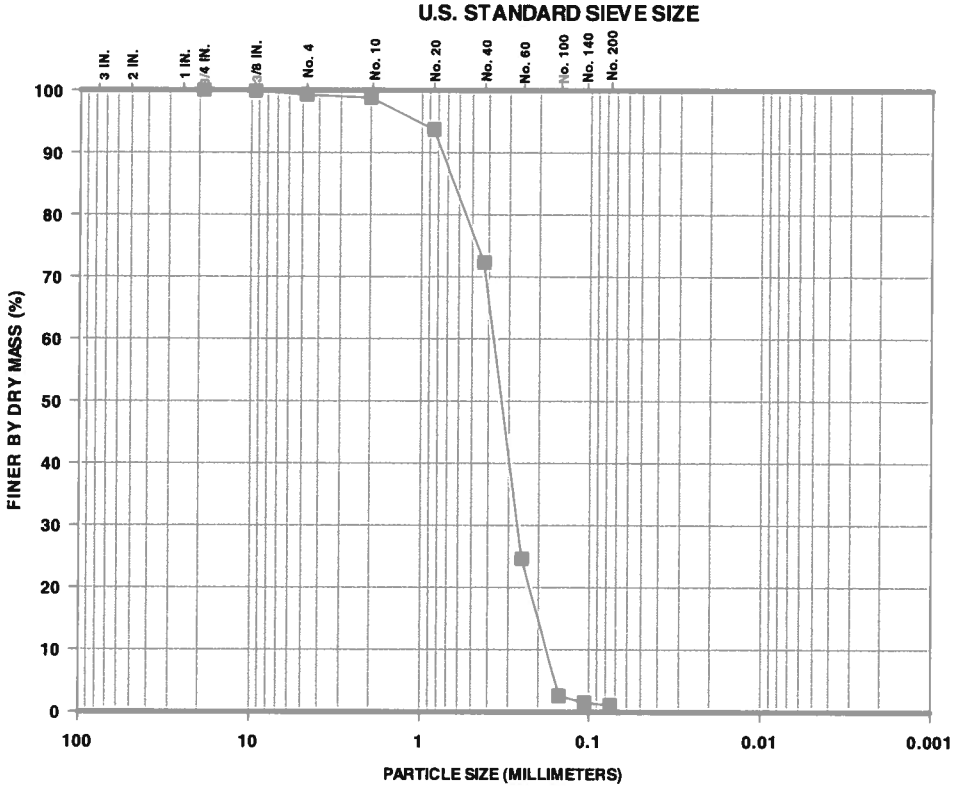
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 24.1
Mass Dry Solids (grams): 214.43

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	99.9	99.3	98.8	93.7	72.3	24.6	2.6	1.5	1.1	-	-	-

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Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 07/01/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-045**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with shell (SP)

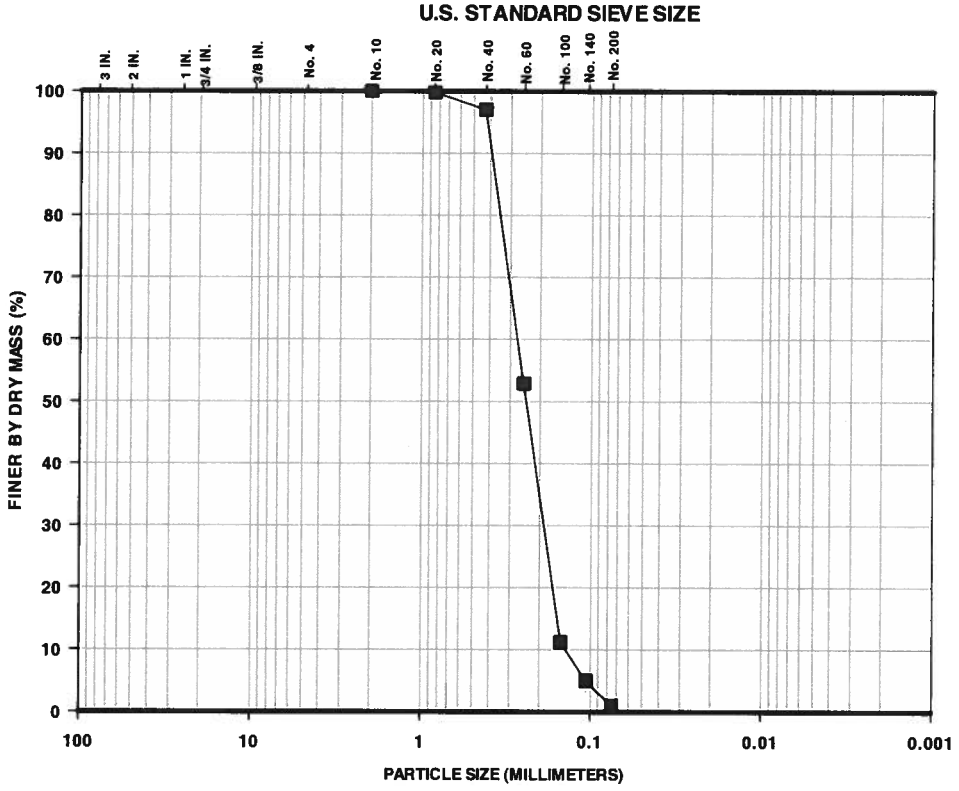
TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____
Dispersion Device: ☐ Apparatus A ☐ Apparatus B
Dispersion Period (hours): _____

Water Content (%): 28.0
Mass Dry Solids (grams): 237.31
G_s: - ☐ Assumed ☐ Measured
Organic Content (%): 0.4
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	100	99.8	97.0	52.9	11.2	5.0	1.0	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 07/01/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-046**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

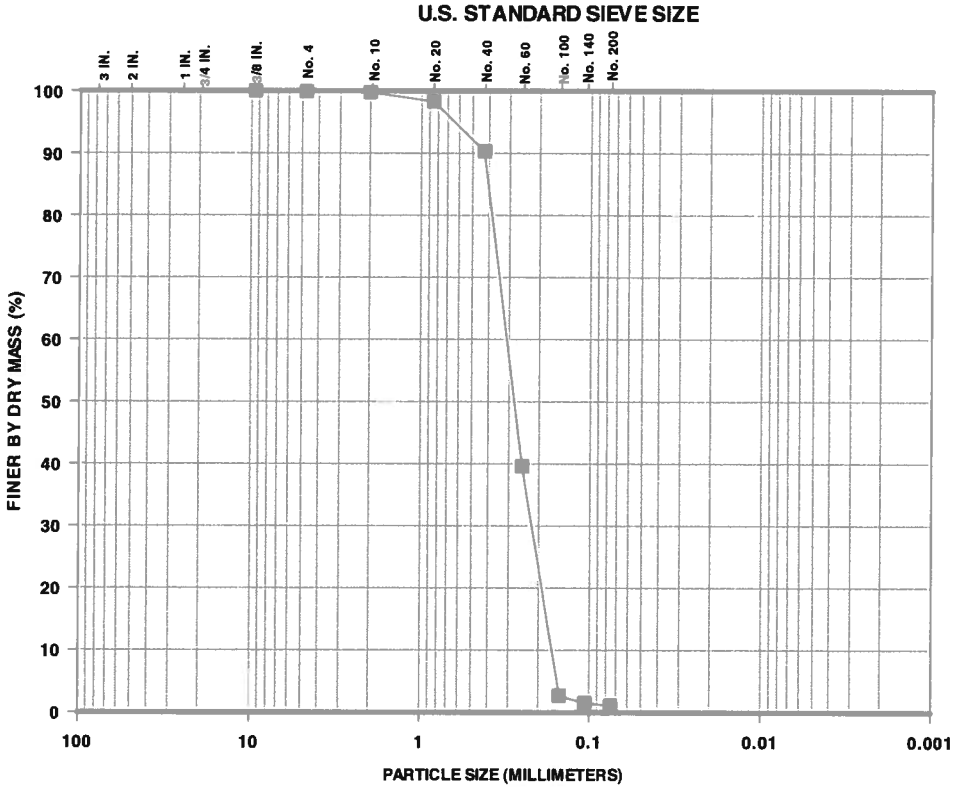
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 28.2
Mass Dry Solids (grams): 276.57

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.4
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.9	99.8	98.3	90.3	39.6	2.7	1.5	1.1	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-047**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Dark gray sand with silt and trace shell (SP-SM)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other:

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other

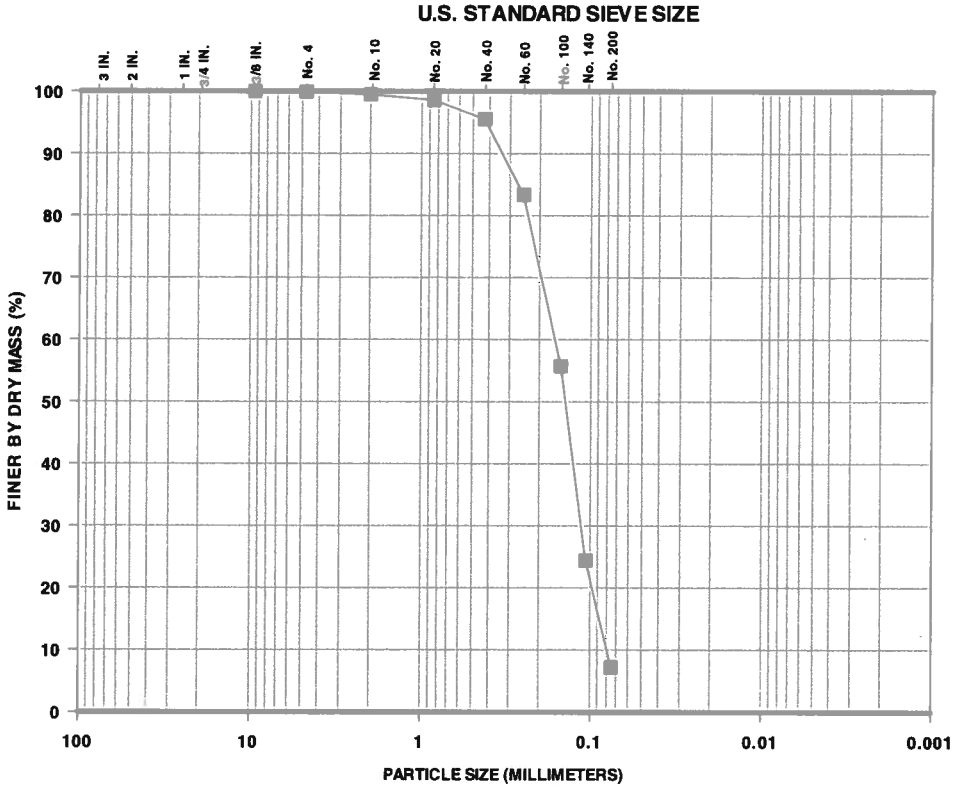
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours):

Water Content (%): 31.9
Mass Dry Solids (grams): 208.11

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.8
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.9	99.5	98.6	95.5	83.3	55.7	24.4	7.2	-	-	-

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Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-048**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Dark gray and light brown sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

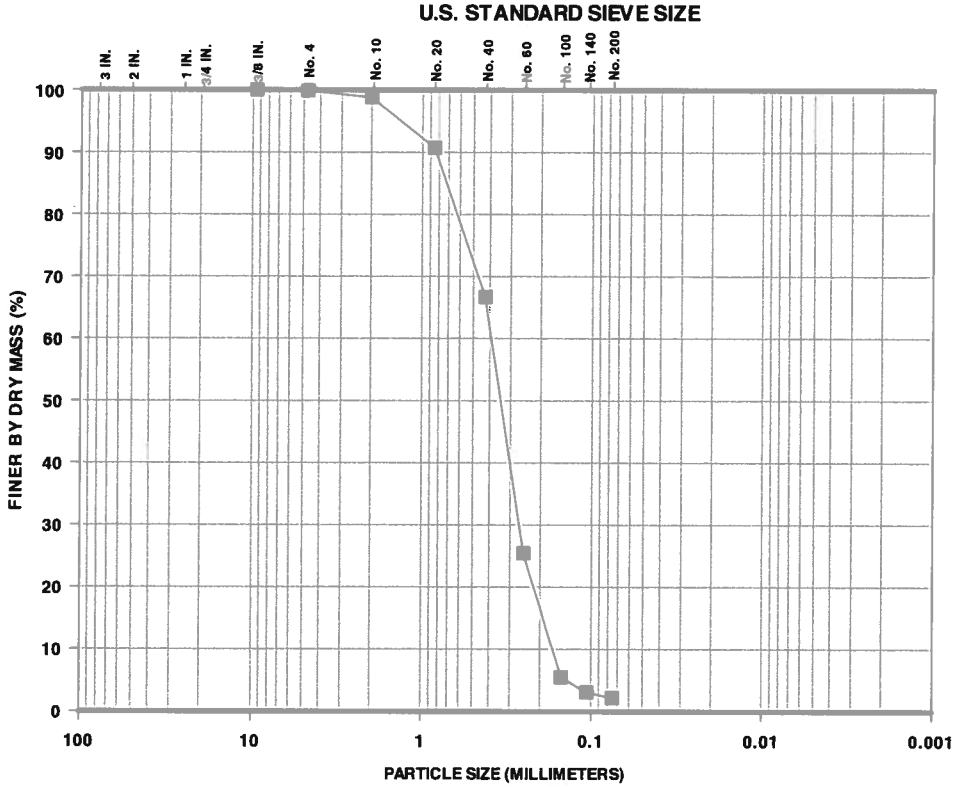
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 25.6
Mass Dry Solids (grams): 272.98

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.4
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.9	98.8	90.7	66.7	25.4	5.5	3.1	2.2	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-049**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Light brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☐ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☒ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

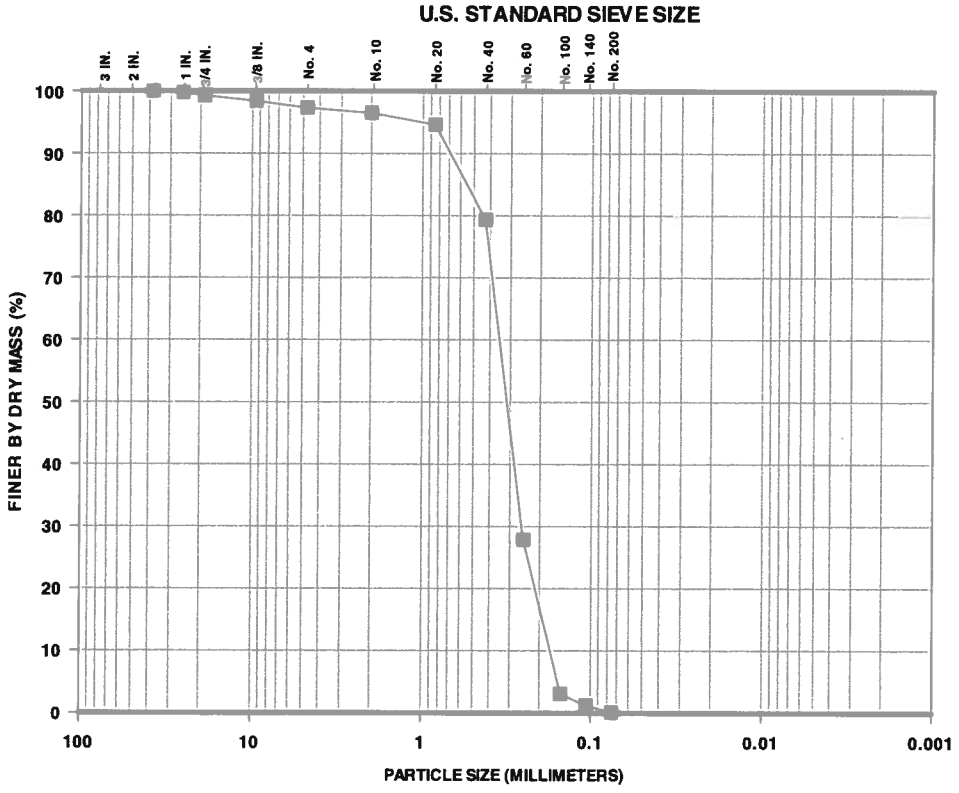
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 24.4
Mass Dry Solids (grams): 627.06

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.4
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	99.8	99.3	98.4	97.3	96.5	94.6	79.3	27.9	3.1	1.2	0.1	-	-	-

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Checked By: JM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-050**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

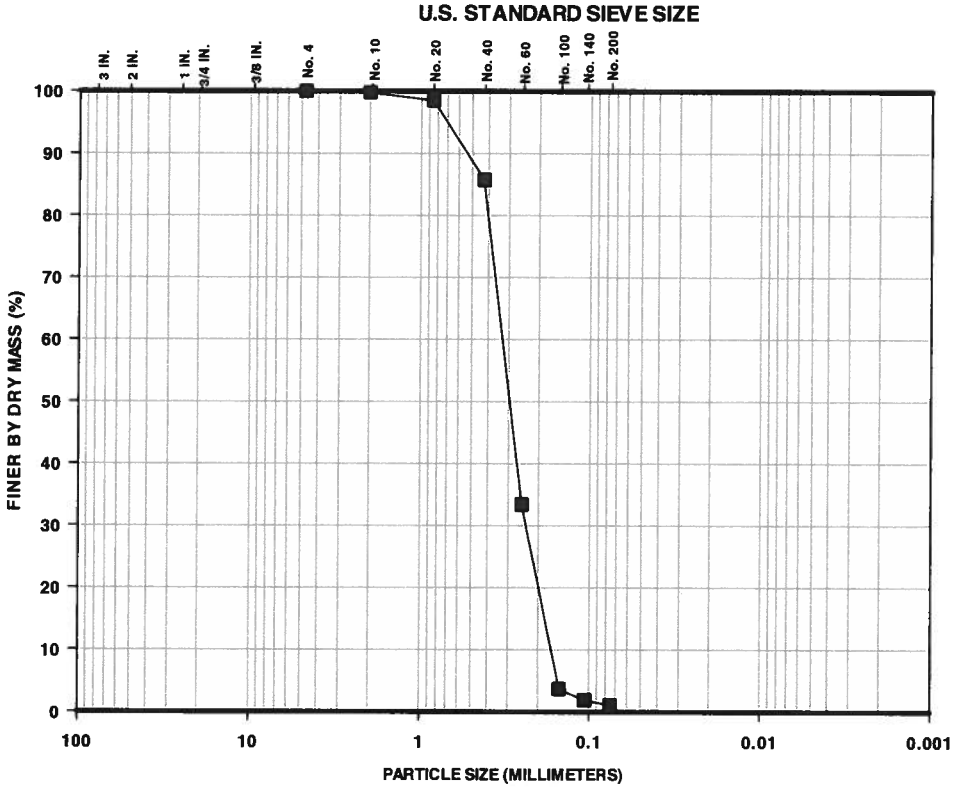
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 26.0
Mass Dry Solids (grams): 210.75

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.2
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.8	98.5	85.7	33.4	3.7	1.9	1.1	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-051**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

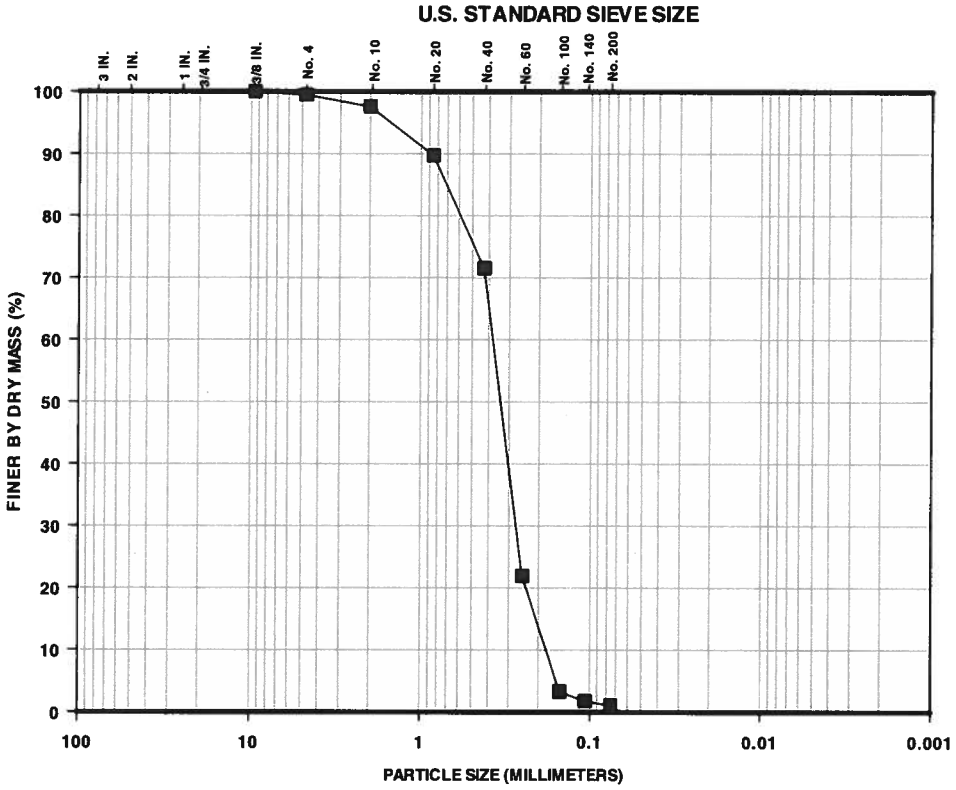
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 24.5
Mass Dry Solids (grams): 318.04

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.2
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.5	97.6	89.7	71.5	21.9	3.3	1.8	1.1	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-052**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

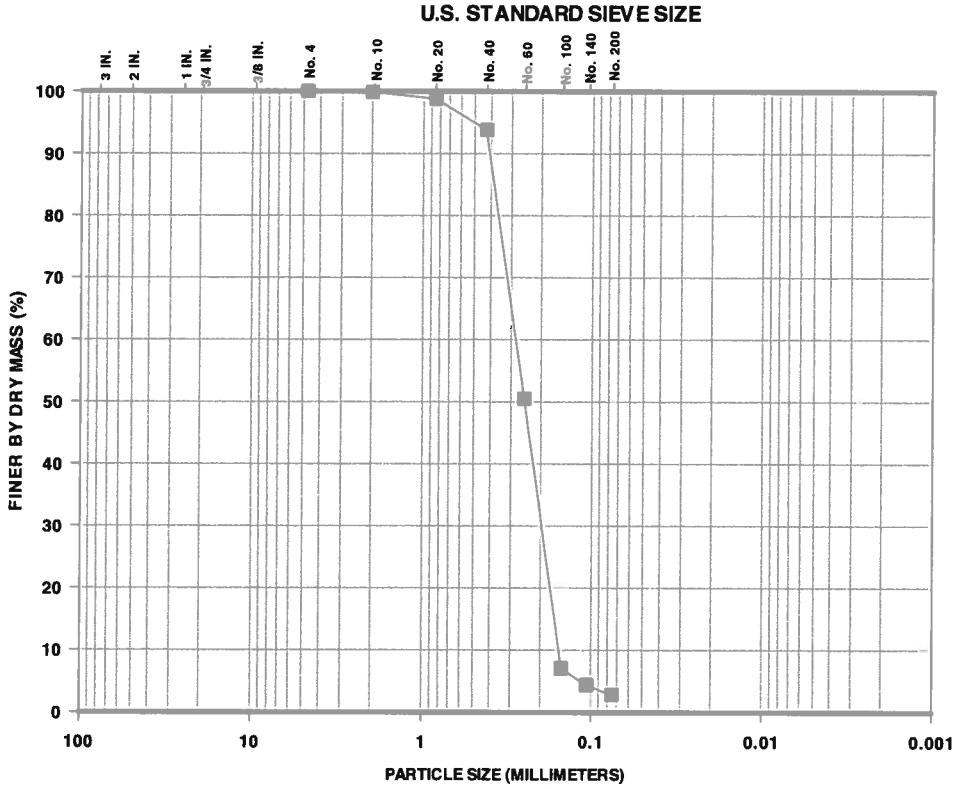
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 32.9
Mass Dry Solids (grams): 319.36

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.5
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	98.8	93.8	50.5	7.1	4.4	2.8	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-053**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

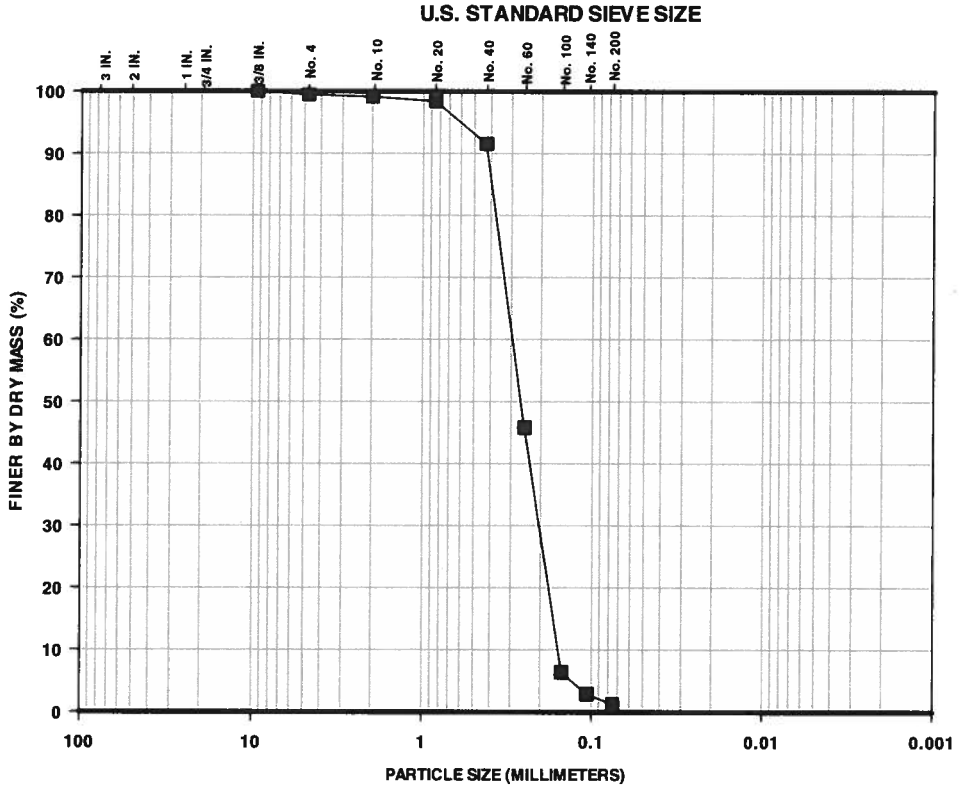
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 28.0
Mass Dry Solids (grams): 352.12

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.2
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.5	99.1	98.4	91.5	45.8	6.4	2.9	1.3	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-054**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Light brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☐ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☒ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

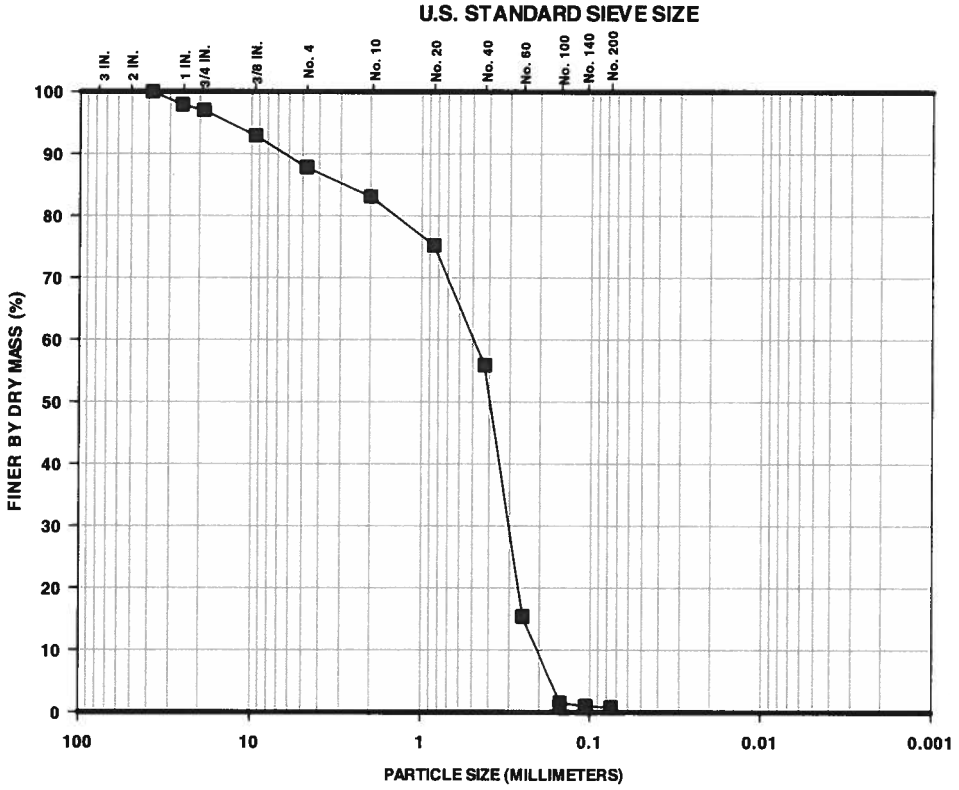
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 19.6
Mass Dry Solids (grams): 613.80

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.2
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	97.9	97.0	92.9	87.8	83.1	75.2	55.9	15.4	1.5	1.0	0.8	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-055**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

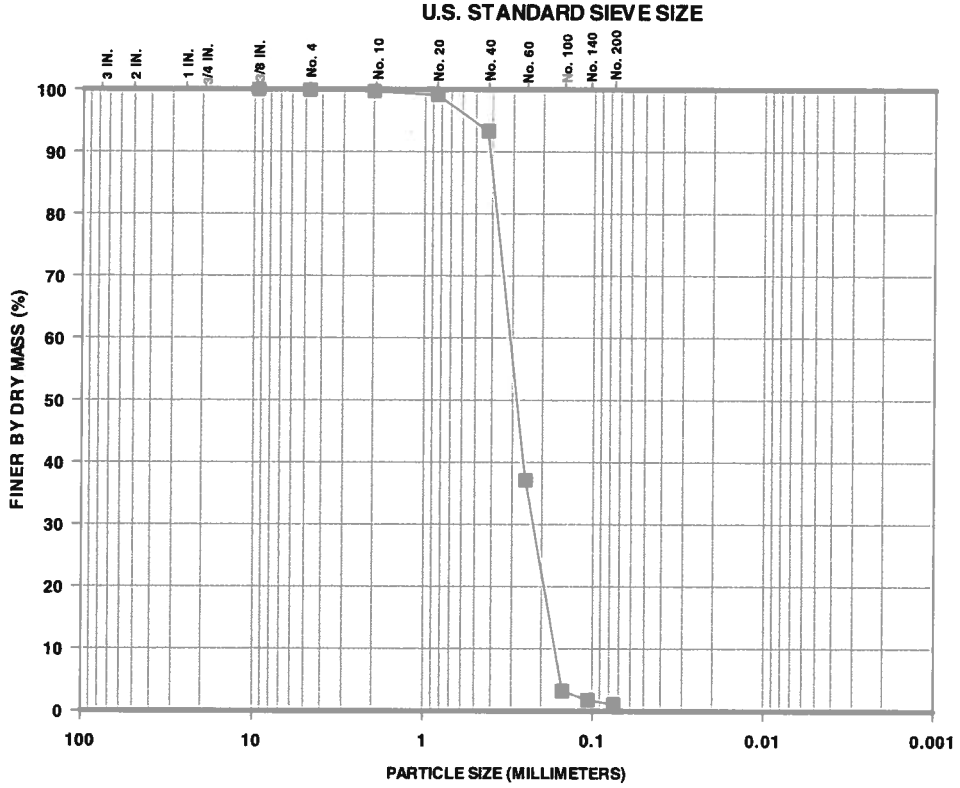
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 25.5
Mass Dry Solids (grams): 308.54

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.9	99.7	99.1	93.3	37.1	3.2	1.8	1.1	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-056**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Dark gray sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

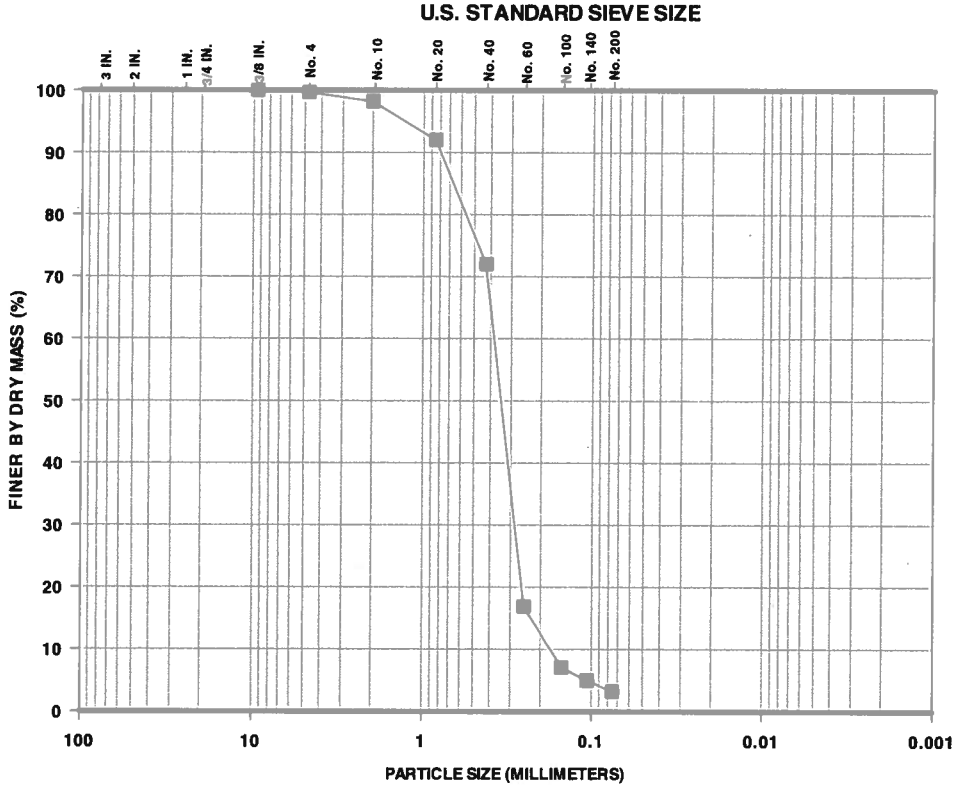
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 28.6
Mass Dry Solids (grams): 510.39

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.6
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.7	98.2	92.0	72.0	16.9	7.1	5.0	3.2	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-057**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

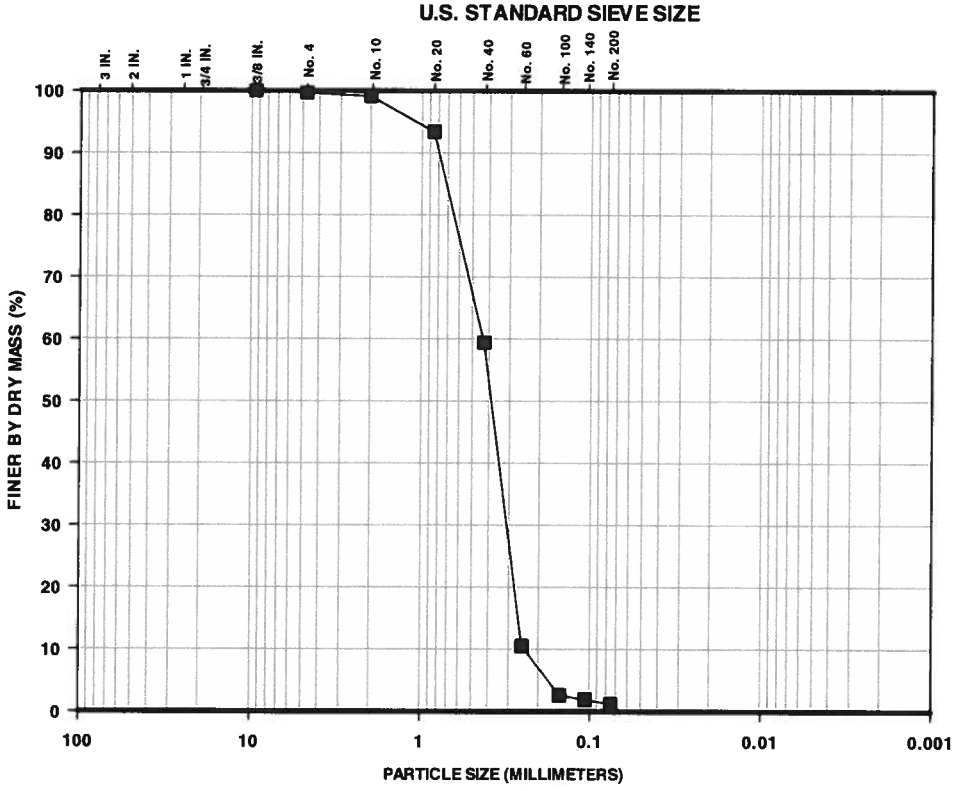
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 24.1
Mass Dry Solids (grams): 227.76

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.7	99.1	93.4	59.4	10.5	2.6	1.9	1.2	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-058**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

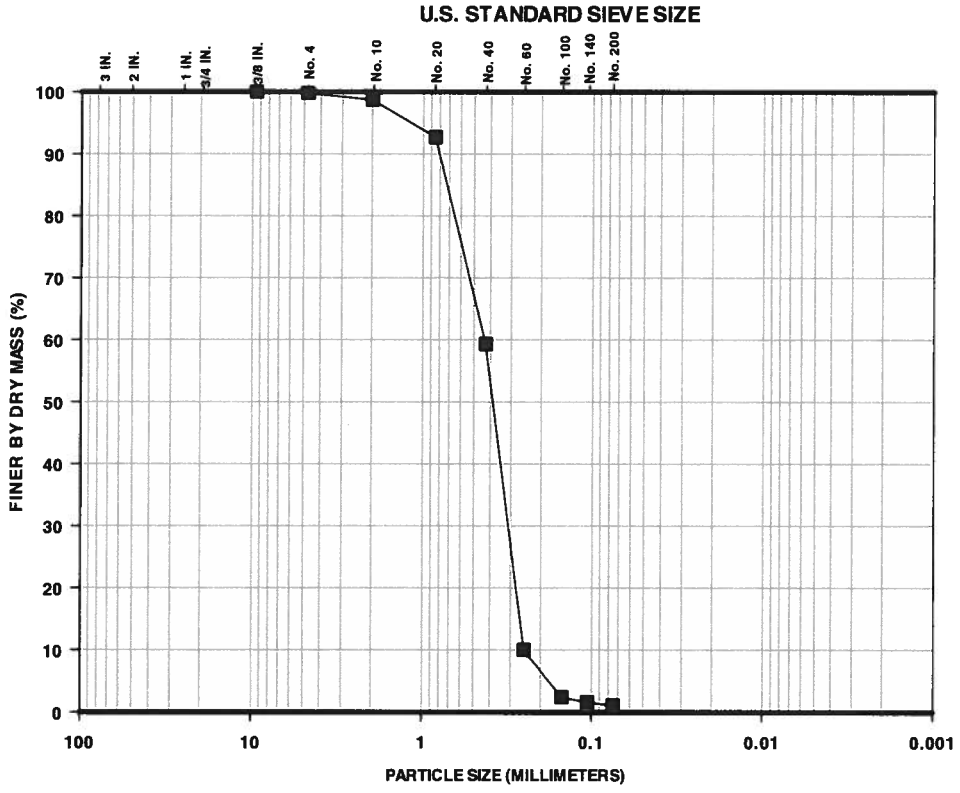
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 24.2
Mass Dry Solids (grams): 466.70

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.8	98.7	92.7	59.3	10.0	2.4	1.6	1.1	-	-	-

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Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-059**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Dark gray sand with silt and shell (SP-SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

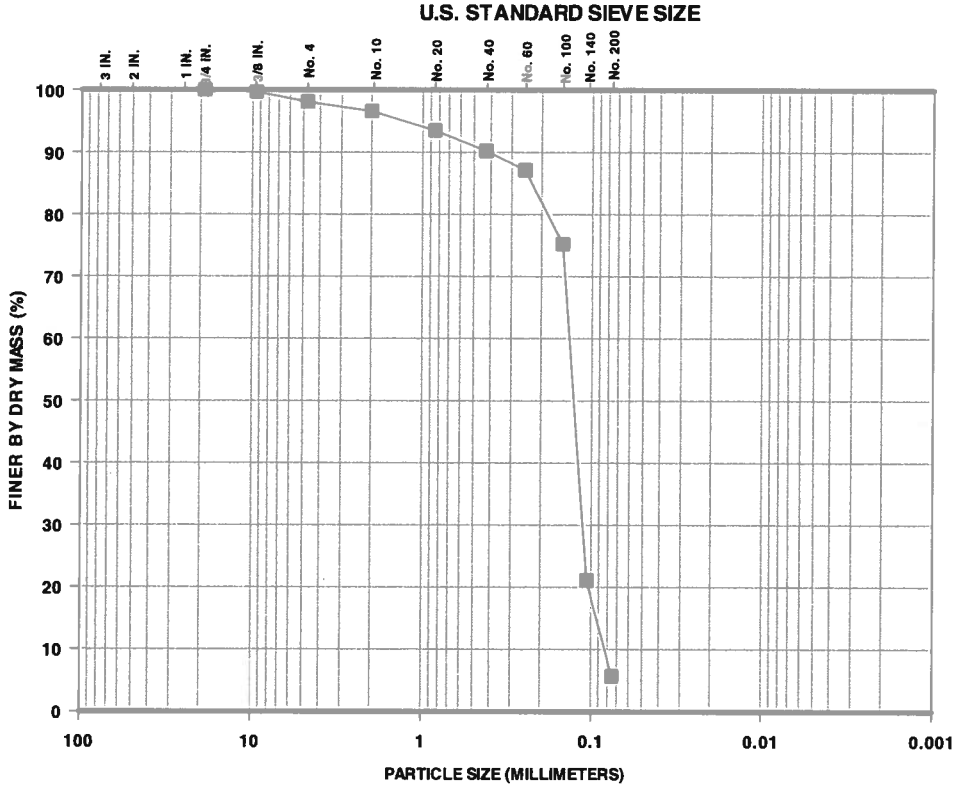
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 36.3
Mass Dry Solids (grams): 319.49

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.6
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	99.7	98.1	96.6	93.5	90.2	87.1	75.2	21.1	5.7	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-060**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☐ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☒ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

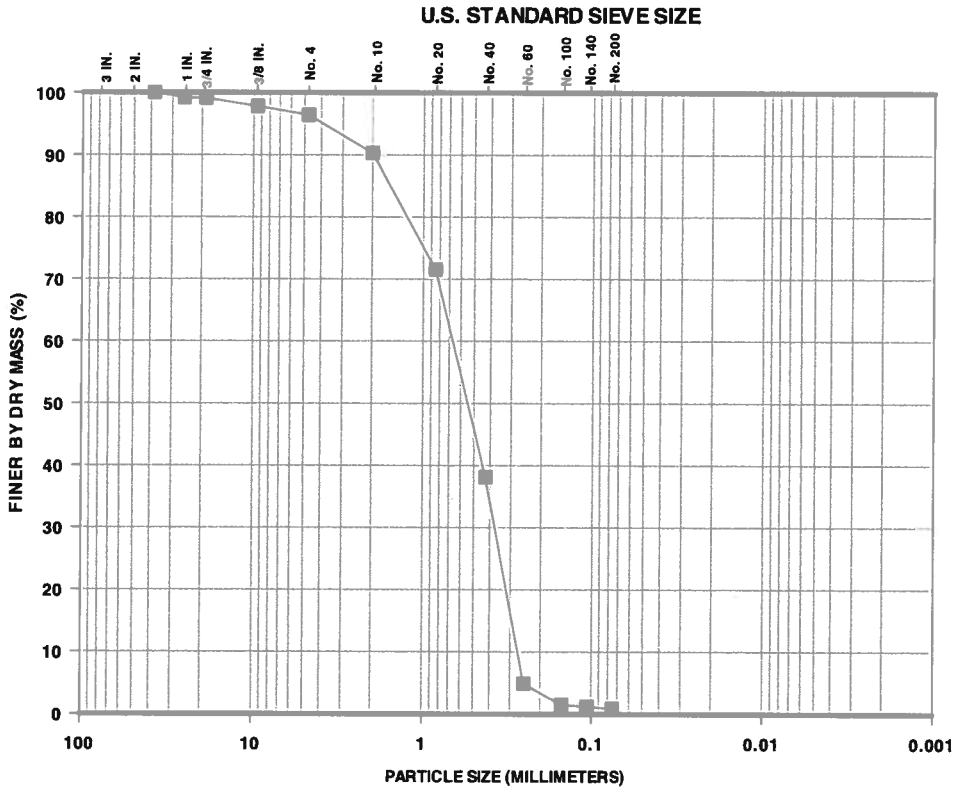
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 18.6
Mass Dry Solids (grams): 565.47

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	99.2	99.1	97.8	96.4	90.3	71.5	38.1	4.9	1.5	1.2	0.9	-	-	-

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: TH Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-REF-001**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray silty sand with shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

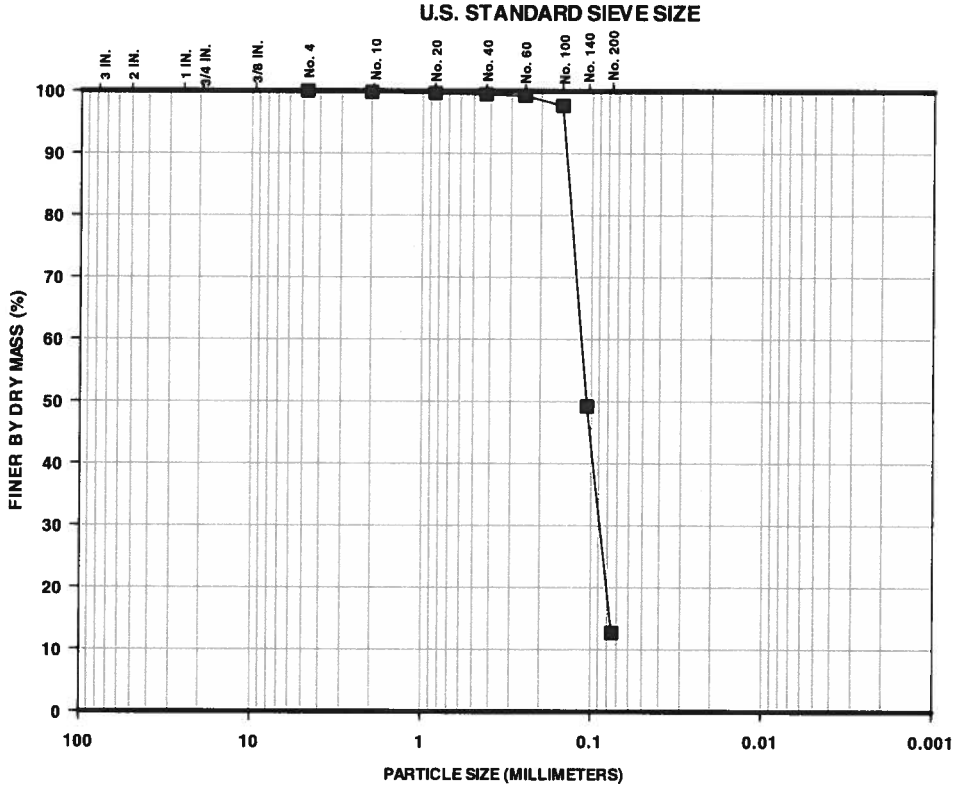
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 37.2
Mass Dry Solids (grams): 156.98

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.6
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.8	99.7	99.5	99.3	97.7	49.2	12.7	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-REF-002**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Dark gray silty sand with trace shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

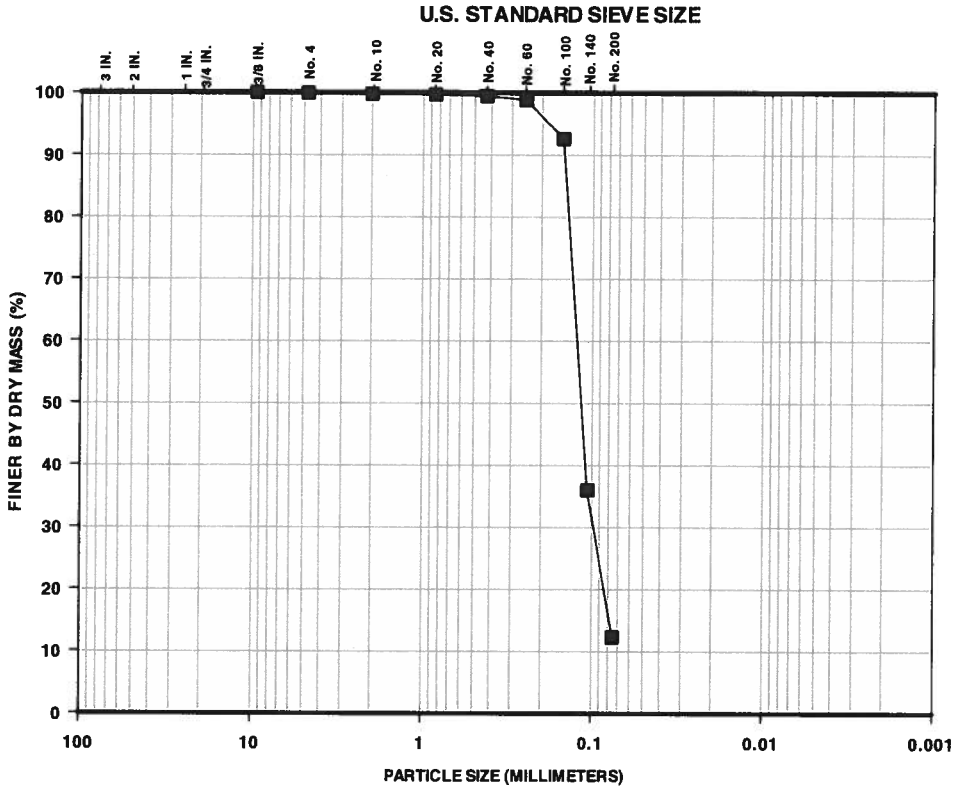
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 37.3
Mass Dry Solids (grams): 495.89

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.6
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.9	99.8	99.7	99.5	98.9	92.6	36.0	12.3	-	-	-

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Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-REF-003**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray silty sand with shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

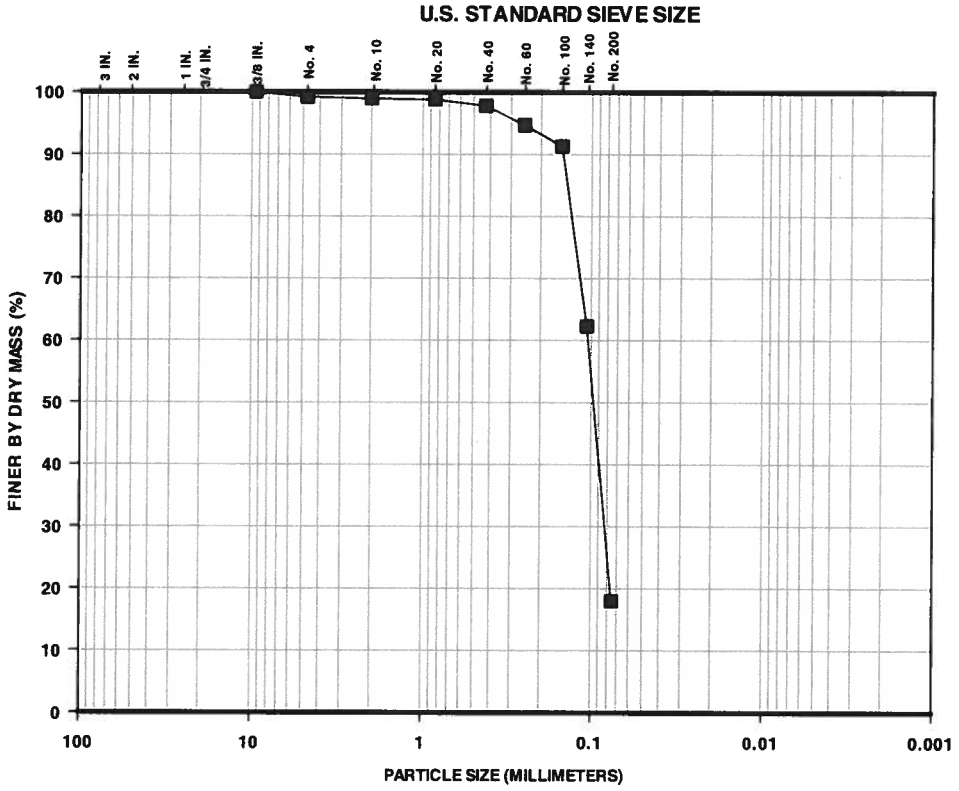
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 34.6
Mass Dry Solids (grams): 256.53

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.8
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.2	99.0	98.8	97.8	94.7	91.3	62.3	18.0	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/26/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-REF-004**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Dark gray sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

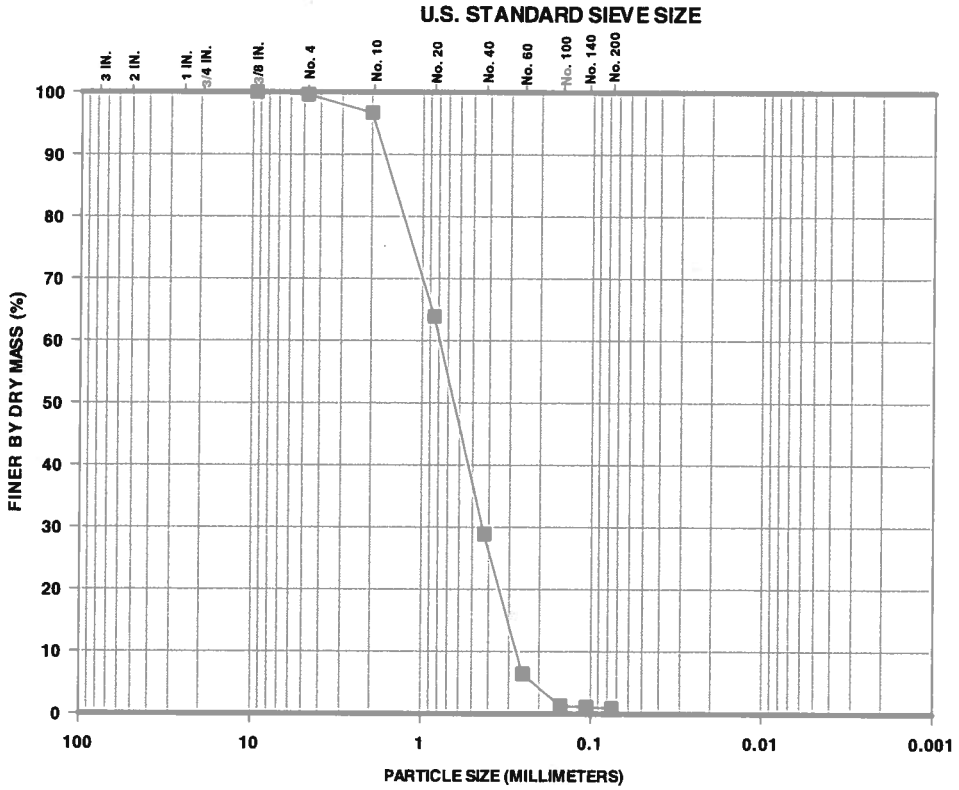
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 18.6
Mass Dry Solids (grams): 331.62

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.6	96.7	63.9	28.9	6.4	1.3	1.1	0.9	-	-	-

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-REF-005**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Light brown sand (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

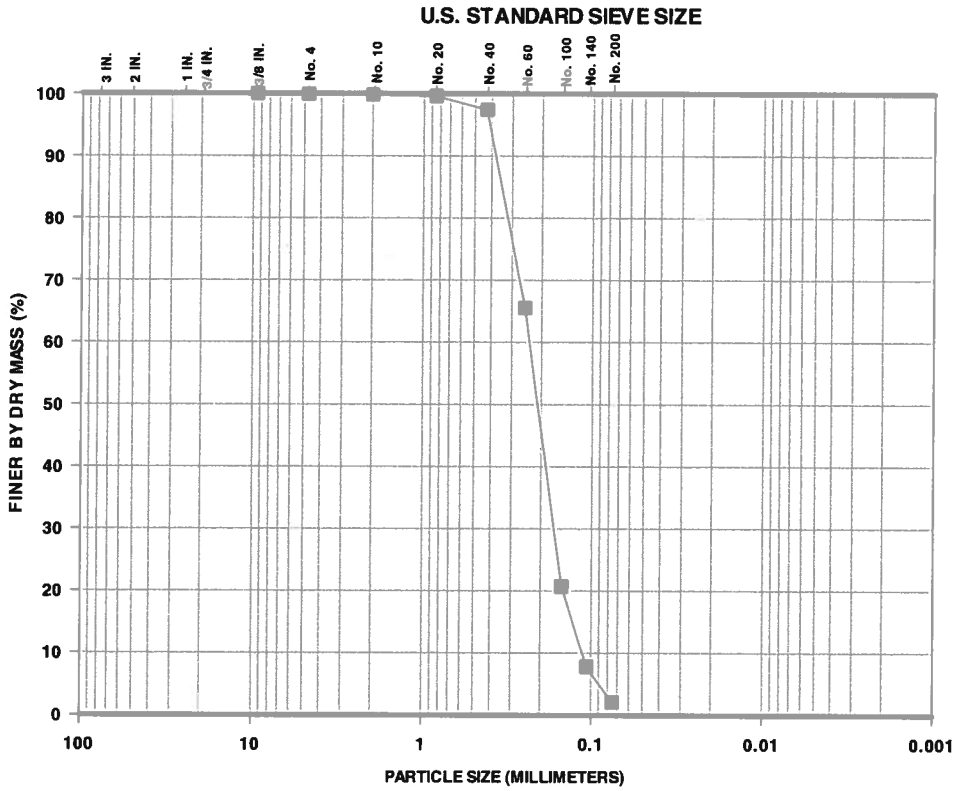
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 31.4
Mass Dry Solids (grams): 253.63

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.4
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.9	99.8	99.6	97.4	65.5	20.7	7.8	2.1	-	-	-

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Checked By: TM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/27/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-REF-006**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☐ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☒ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

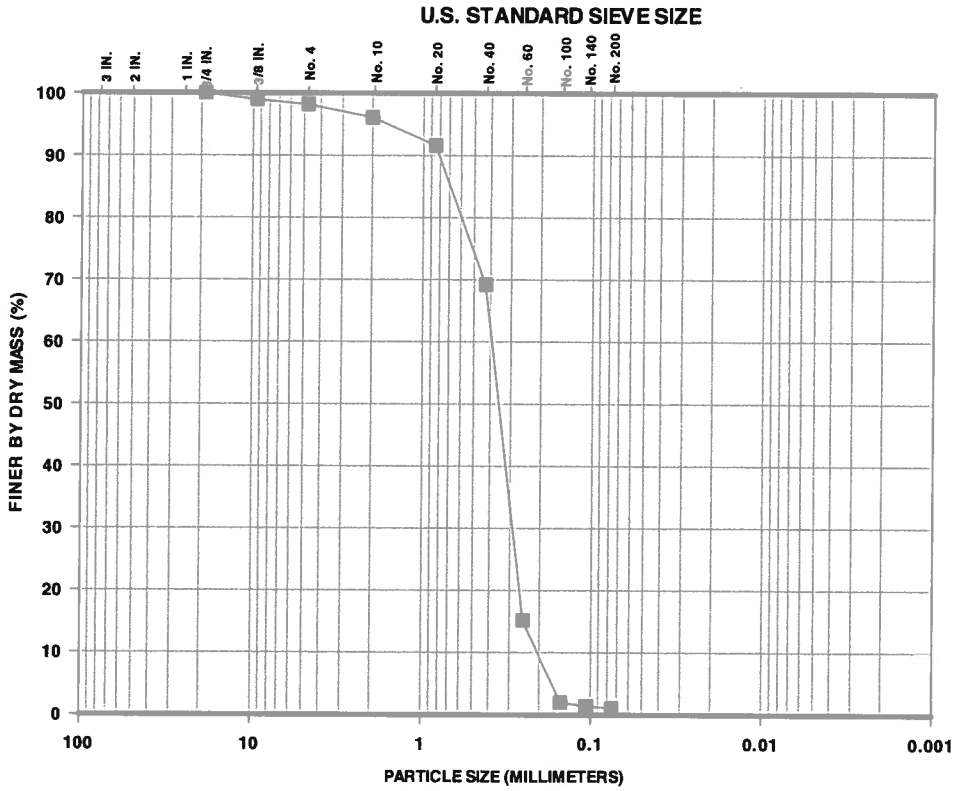
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 22.7
Mass Dry Solids (grams): 442.74

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.2
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	99.0	98.2	96.1	91.6	69.2	15.2	2.0	1.4	1.1	-	-	-

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Checked By: _____ Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-REF-007**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Dark gray sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

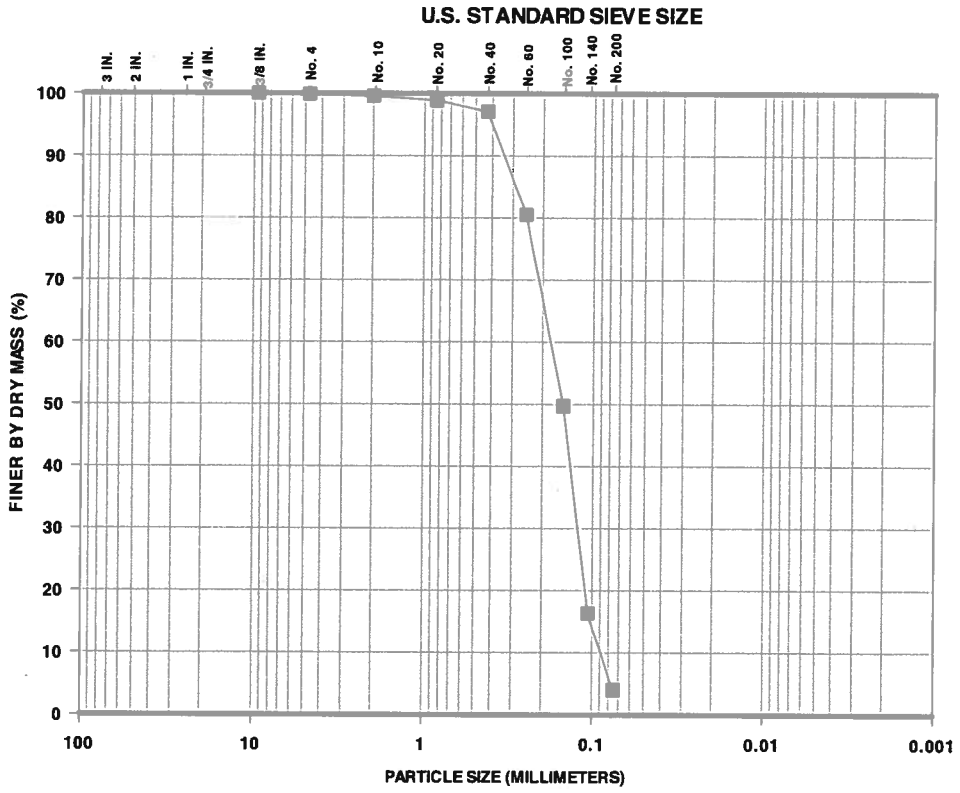
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 33.4
Mass Dry Solids (grams): 236.30

G_s: - ☐ Assumed ☐ Measured

Organic Content (%): 0.5
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.9	99.6	98.9	97.1	80.5	49.7	16.3	4.0	-	-	-

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: TW Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-REF-008**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray sand with shell (SP)

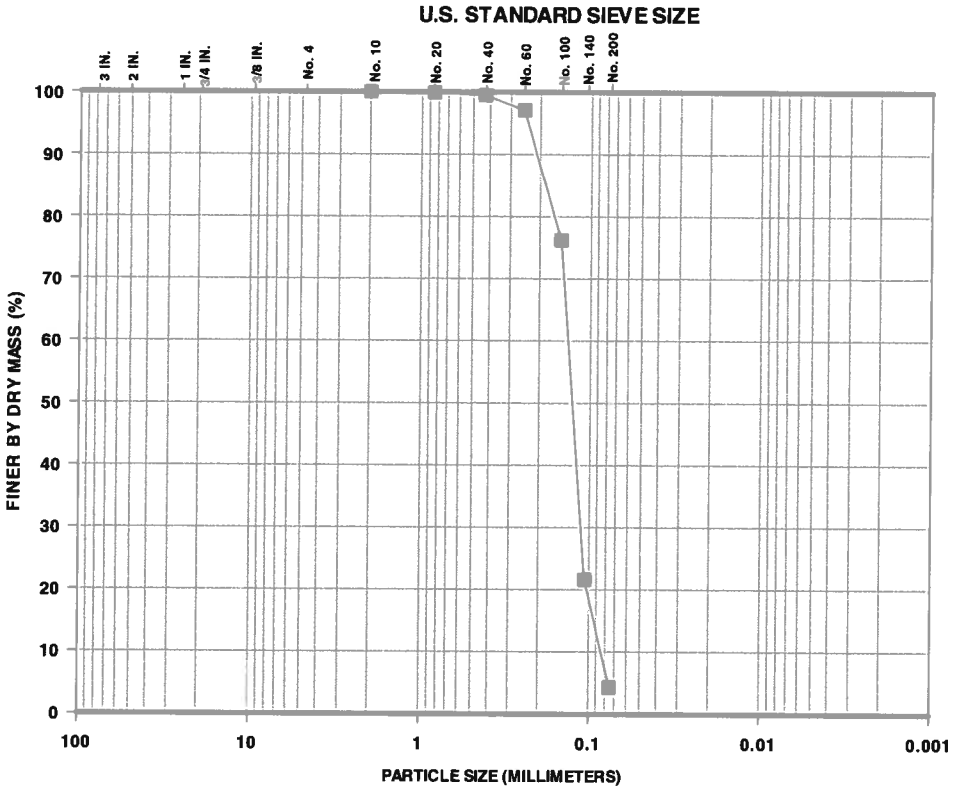
TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____
Dispersion Device: ☐ Apparatus A ☐ Apparatus B
Dispersion Period (hours): _____

Water Content (%): 29.2
Mass Dry Solids (grams): 235.12
G_s: - ☐ Assumed ☐ Measured
Organic Content (%): 0.5
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	100	99.9	99.5	97.1	76.2	21.6	4.3	-	-	-

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: JM Date: 07/11/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 06/25/13
DATE REPORTED: 07/11/13

INCOMING SAMPLE NO.: **GS-REF-009**
BORING: - SAMPLE: -
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/GS001
SAMPLE DESCRIPTION: Gray sand with silt and shell (SP-SM)

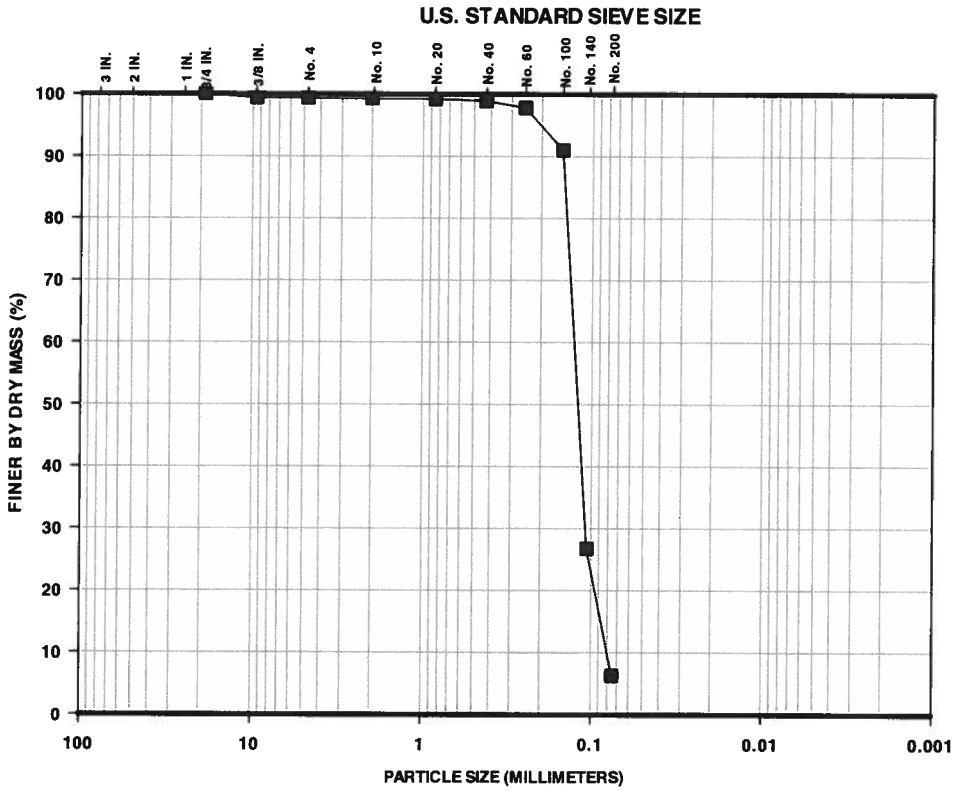
TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____
Dispersion Device: ☐ Apparatus A ☐ Apparatus B
Dispersion Period (hours): _____

Water Content (%): 37.1
Mass Dry Solids (grams): 266.22
G_s: - ☐ Assumed ☐ Measured
Organic Content (%): 0.8
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	99.4	99.4	99.3	99.2	98.9	97.8	91.0	26.7	6.3	-	-	-

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 07/11/13

Attachment H-2

Appendix 2

GEOTECHNICAL TEST RESULTS

TURBINE STATION T1A AND T1B CORE HOLES

VOWTAP
File No.: 13-13-0084
August 20, 2013
Revision: 0 (ISSUED FOR USE)

TABLE B-1 EXTRUSION TEST REPORT FOR CORE VC-T1A-1A

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Test Specimen Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity G_s	Atterberg Limits		
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation G_s=2.69 (%)					Liquid Limit, LL	Plastic Limit, PL	Plasticity Index, PI
T1A	VC-T1A-1A	1 / 3	0.0 - 0.27	27	Sample received in two sections. Lower section not intact within tube.	15.5	9.138	3.0	0.0	12.5	79	13.5	1,784.4	13.5	Gray sand with trace shell	SP	21.8 20.6	21.2	21.2	136.0	112.2	116 [Gs=2.68]										
						13.0	9.141	4.2	0.0	8.8		8.8	834.9	8.8	Brown sand with shell	SP	5.2 4.4	4.8	4.8	90.3	86.2	14 [Gs=2.68]										
		2 / 3	0.27 - 1.27	100	Slight void in soil along tube wall in upper 57.5 cm.	101.3	9.121	1.5	0.0	99.8	100	101.5	12,666	42.0	Brownish-gray sand with trace shell	SP	6.1 15.8 20.9	14.3	13.2	121.3	107.2	63 [Gs=2.68]	---	---	---	2.7	---	1.8				
														59.5	Gray sand with shell	SP	5.7 17.5	11.6														
		3 / 3	1.27 - 2.27	100	None	98.7	9.145	3.5	0.0	95.2	95	95.5	11,446	41.5	Gray sand with shell	SP	19.0 21.7	20.4	46.3	114.0	77.9	107 [Gs=2.71]								64	26	38
														54.0	Dark gray fat clay with trace shell s_u[UU]= 0.15; 0.16; and 0.19 kg/cm²	CH	64.9 65.7 66.6 66.0 65.1 67.9 67.8 68.1 68.2 68.5 59.7	66.2					99.0 --- 96.5 99.2	59.4 --- 57.5 58.9	98 --- 95 99	96.8 --- 97.7 96.8	2.8	---	---			

13-13-0084
VC-T1A-1
1/3
TOP

13-13-0084
VC-T1A-1A
1/3
TOP
SWANSON®
AE141

13-13-0084

C-T1A-1A

2/3

→

TOP

13-13-0084
VC-T1A-1A
2/3
→
TOP
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA

13-13-0084

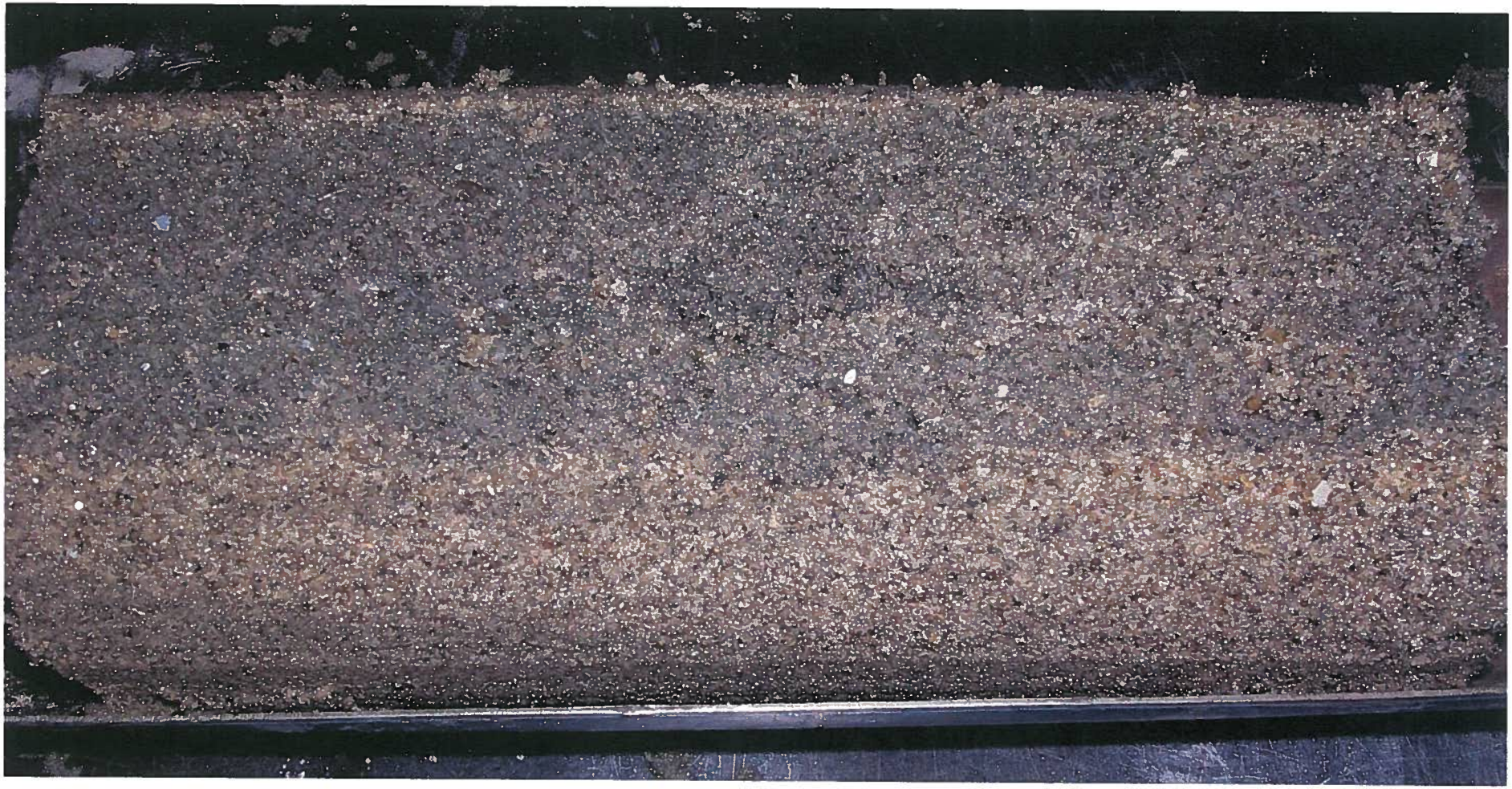
VC-T1A-1A

2/3

13-13-0084
VC-T1A-1A
2/3
→
TOP

13-13-0084
VC-T1A-1A
3/3
→
TOP
SWANSON
AE141

13-13-0084
VC-T1A-1A
3/3
→
SWANSON
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
MADE IN CHINA



13-13-0084

VC-T1A-1A

3/3

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/03/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1A-1A** SAMPLE: **2/3** [Block 1]
DEPTH: 0.27 – 1.27 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T1A1A-2/3
SAMPLE DESCRIPTION: Brownish-gray sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

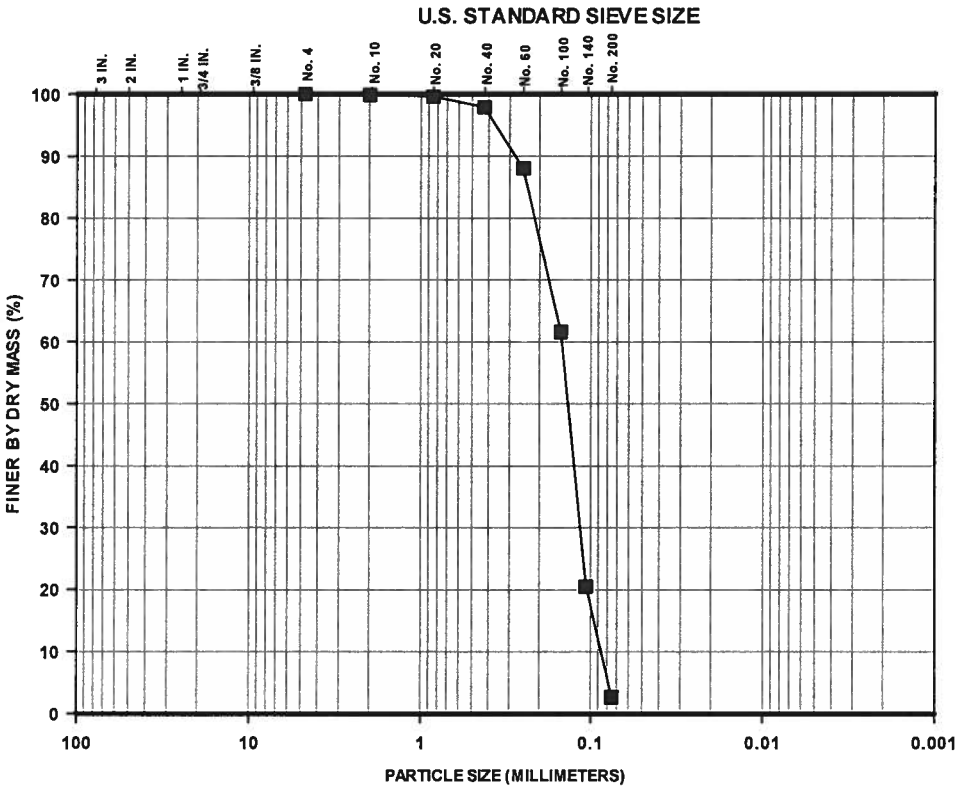
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 15.8
Mass Dry Solids (grams): 138.14

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	99.6	97.9	88.0	61.6	20.5	2.7	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 07/30/13

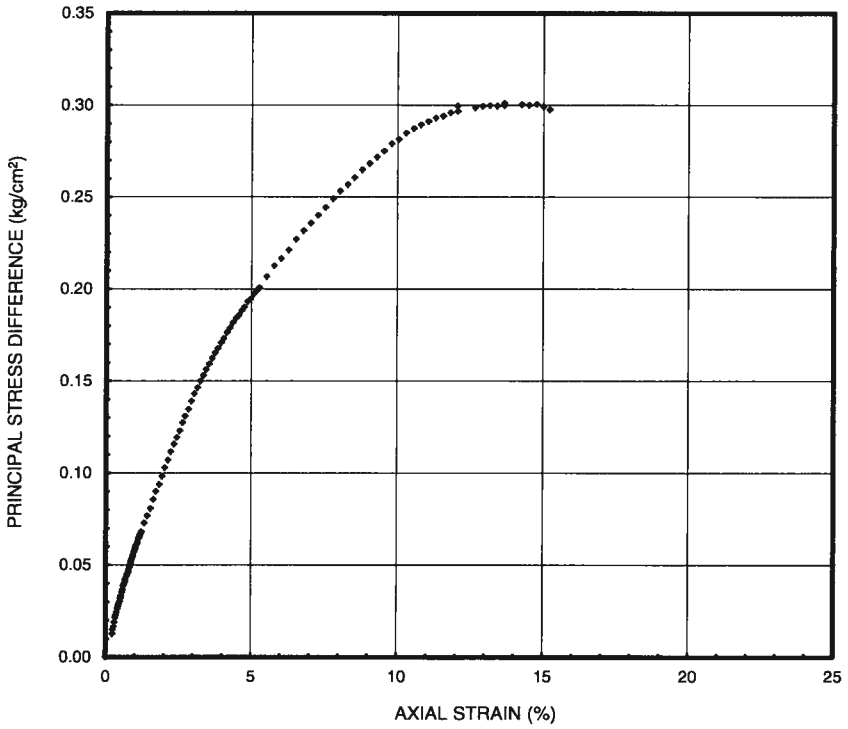
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/25/13
DATE REPORTED: 08/09/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1A-1A** SAMPLE: **3 / 3** [Block 3]
DEPTH: 1.27 - 2.27 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T1A1A
SAMPLE DESCRIPTION: Dark gray fat clay (CH)

Specimen Dimensions			Initial Conditions			Test Conditions			at $(\sigma_1-\sigma_3)_{max}$			
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	σ_c (kg/cm^2)	$\dot{\varepsilon}$ (cm/minute)	$\dot{\varepsilon}$ (%/minute)	ε_a (%)	Compressive Strength (kg/cm^2)	σ_1 (kg/cm^2)	σ_3 (kg/cm^2)
7.49	3.64	2.1	67.8	57.5	95	0.25	0.074	1.0	13.7	0.30	0.55	0.25
									Membrane Correction Made: ☐ Yes ☒ No			



SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Rock Core	
☐ Compacted	

☐ Tamped Uniform Lifts
No. of Lifts:

☐ Kneading
No. of Lifts:
Spring:
Blows per Lift:

G_s: 2.71 ☒ Assumed ☐ Measured

FAILURE SKETCH

☒ Diagonal Plane
☐ Bulging
☐ Combination
☐ Other

Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☒ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	71.29	Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	97.7

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c = Isotropic confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_a = Axial strain; σ_1 = Major principal stress; σ_3 = Minor principal stress; and G_s = Specific gravity.

Checked By: JM Date: 08/09/13

BORING: VCTIA IA SAMPLE: 3/3 DEPTH: ? ☐ ft; ☐ m BLOCK: B3

TYPE SAMPLE: ☑ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TYPE TEST: ☐ CIUC; ☑ UU; ☐ UU; ☐ CD ☐ OTHER

SAMPLE DESCRIPTION: Gray clay

MEASU | rage | L/D
Diamete | 635 | 2.060
Length | 488
120.12
Pa
Tare N
WWS | umed ☐ Measured
WDS
WW (| ☑ 1 Condoms
Wt. T | rane ☐ ____ Thin Mem ane
WDS | 2.25 3.47psi
MC (| u_o (kg/cm²)
FINA | ings: ☐ Entire Specimen

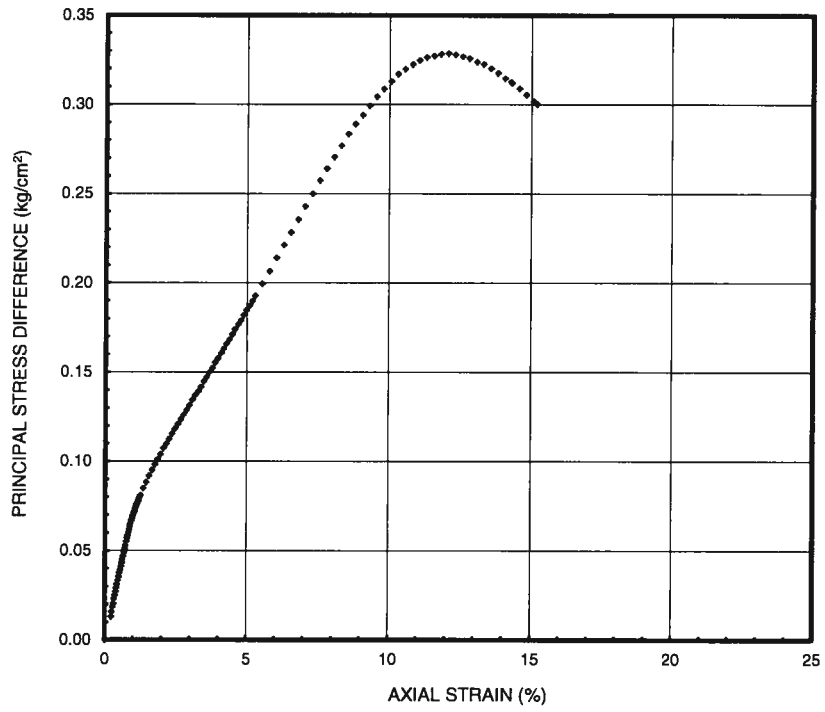
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/25/13
DATE REPORTED: 08/09/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1A-1A** SAMPLE: **3 / 3** [Block 2]
DEPTH: 1.27 - 2.27 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T1A1A
SAMPLE DESCRIPTION: Dark gray fat clay (CH)

Specimen Dimensions			Initial Conditions			Test Conditions			at $(\sigma_1-\sigma_3)_{max}$			
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	σ_c (kg/cm^2)	$\dot{\varepsilon}$ (cm/minute)	$\dot{\varepsilon}$ (%/minute)	ε_a (%)	Compressive Strength (kg/cm^2)	σ_1 (kg/cm^2)	σ_3 (kg/cm^2)
7.08	3.62	2.0	66.6	59.4	98	0.50	0.066	1.0	12.1	0.33	0.83	0.50
									Membrane Correction Made: ☐ Yes ☒ No			



SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Rock Core	
☐ Compacted	

☐ Tamped Uniform Lifts
No. of Lifts: ____

☐ Kneading
No. of Lifts: ____
Spring: ____
Blows per Lift: ____

G_s: 2.71 ☒ Assumed ☐ Measured

FAILURE SKETCH

☒ Diagonal Plane
☐ Bulging
☐ Combination
☐ Other ____

Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☒ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	69.35	Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	96.8

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c = Isotropic confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_a = Axial strain; σ_1 = Major principal stress; σ_3 = Minor principal stress; and G_s = Specific gravity.

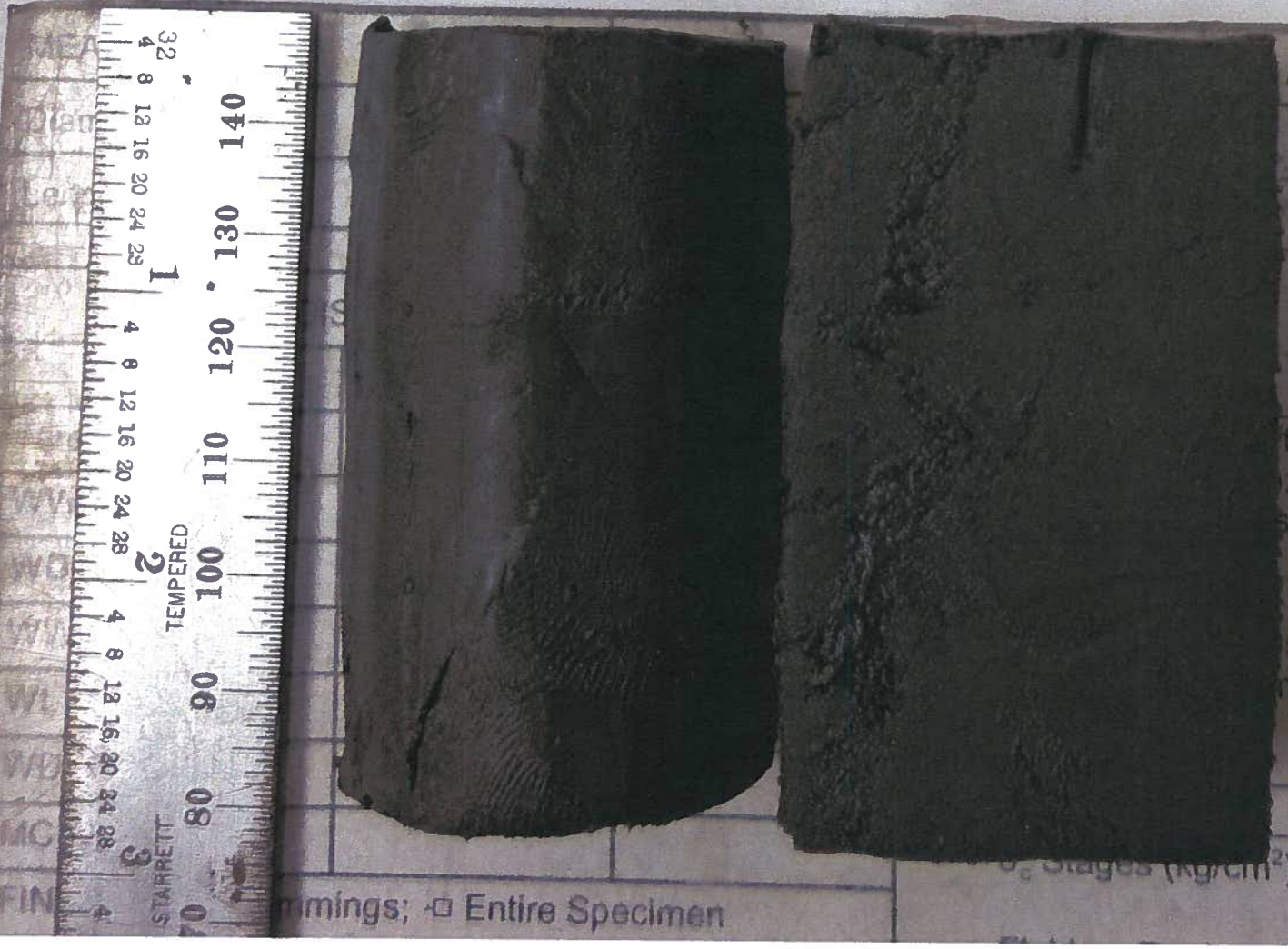
Checked By: TM Date: 08/09/13

BORING: VCTIA1A SAMPLE: 3/3 DEPTH: ? ☐ ft; ☐ m BLOCK: 2

TYPE SAMPLE: ☐ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TYPE TEST: ☐ CIUC; ☑ UU; ☐ UU; ☐ CD ☐ OTHER

SAMPLE DESCRIPTION: Gray clay



Average | L/D

.619 | 1.956

.080

115.50

ssumed ☐ Measure

☐ ____ Co doms

mbrane ☐ ____ Th Membrane

0.5 6.8 7.0

u_b (kg/cm²)

σ_c Stages (kg/cm²):

mmings; ☐ Entire Specimen

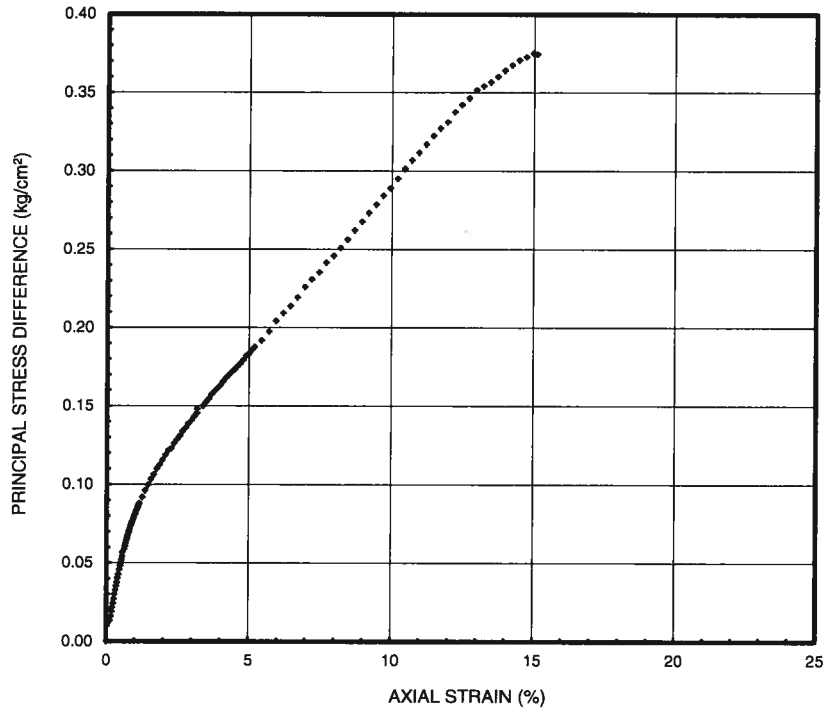
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/25/13
DATE REPORTED: 08/09/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1A-1A** SAMPLE: **3 / 3** [Block 4]
DEPTH: 1.27 - 2.27 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T1A1A
SAMPLE DESCRIPTION: Dark gray fat clay (CH)

Specimen Dimensions			Initial Conditions			Test Conditions			at $(\sigma_1-\sigma_3)_{max}$			
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	σ_c (kg/cm^2)	$\dot{\varepsilon}$ (cm/minute)	$\dot{\varepsilon}$ (%/minute)	ε_a (%)	Compressive Strength (kg/cm^2)	σ_1 (kg/cm^2)	σ_3 (kg/cm^2)
7.34	3.59	2.0	68.5	58.9	99	1.00	0.074	1.0	15.0	0.38	1.38	1.00
									Membrane Correction Made: ☐ Yes ☒ No			



SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Rock Core	
☐ Compacted	

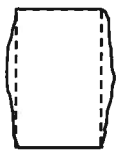
☐ Tamped Uniform Lifts
No. of Lifts:

☐ Kneading
No. of Lifts:
Spring:
Blows per Lift:

G_s: 2.71 ☒ Assumed ☐ Measured

FAILURE SKETCH

☐ Diagonal Plane
☒ Bulging
☐ Combination
☐ Other



Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☒ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	69.65	Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	96.8

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c = Isotropic confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_a = Axial strain; σ_1 = Major principal stress; σ_3 = Minor principal stress; and G_s = Specific gravity.

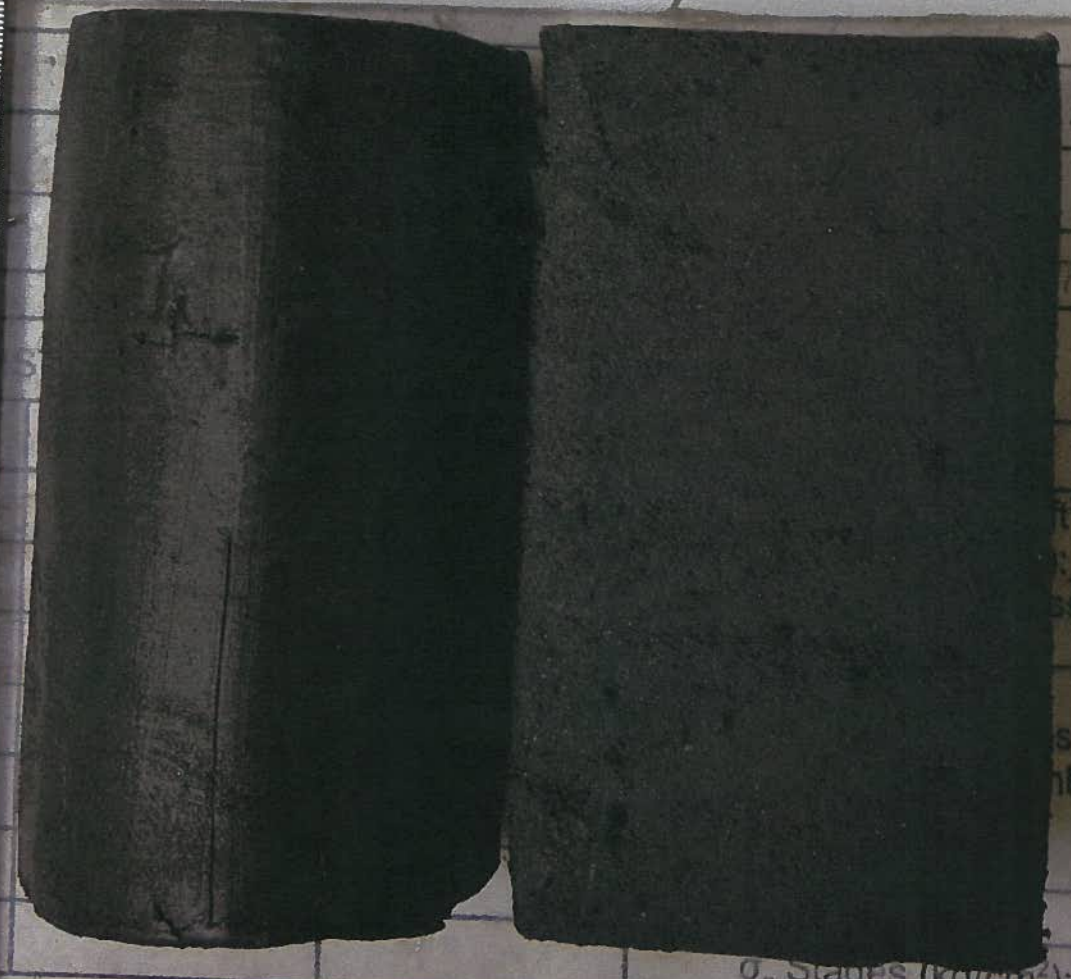
Checked By: TM Date: 08/09/13

BORING: VCTIA 1A SAMPLE: 3/3 DEPTH: ? ☐ ft; ☐ m BLOCK: 4

TYPE SAMPLE: ☒ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TYPE TEST: ☐ $\overline{CIUC}$; ☑ UU; ☐ $\overline{UU}$; ☐ CD ☐ OTHER

SAMPLE DESCRIPTION: Gray clay



Average	L/D
.585	2.048
7.342	

17.69

ssumed ☐ Measured

ndoms

in Membrane

1.0 tsf 13 9 psi

u_b (kg/cm²)

σ_c Stages (kg/cm²):

mings; ☐ Entire Specimen

10°C ☐ 40°C ☐

Fluid: ☐ Deaired Tap Water
☐ Other

VOWTAP
File No.: 13-13-0084
September 23, 2013
Revision: 0 (ISSUED FOR USE) 08/20/13
Revision: 1 (Add data to 3/5)

TABLE B-2 EXTRUSION TEST REPORT FOR CORE VC-T1A-2A

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Test Specimen Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity G_s	Atterberg Limits			Strength Index Tests	
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)					Liquid Limit, LL	Plastic Limit, PL	Plasticity Index, PI	s_u [TV] (kg/cm²)	s_u [LV] (kg/cm²)
T1A	VC-T1A-2A	1 / 5	0.0 - 0.69	69	Recovered length longer than sampling interval labeled on tube.	100.3	9.127	13.5	0.0	86.8	126	86.8	10,922	56.5	Brownish-gray sand with shell [shells up to 7 cm x 4 cm]	SP	6.4 13.5	10.0	16.4	120.1	103.2	71 [Gs=2.68]												
														30.3	Gray sand with trace shell	SP	23.7 21.9	22.8				---	---	---	4.9								
		2 / 5	0.69 - 1.69	100	None	100.3	9.145	15.0	0.0	85.3	85	85.3	10,427	19.0	Brown sand	SP	12.0	17.5	32.3	116.2	87.9	95 [Gs=2.71]												
														9.0	Brown sand with shell [shells up to 6.5 cm x 4 cm]		---																
														19.0	Gray sand		22.9																
														38.3	Gray fat clay	CH	62.0 63.9 63.7	63.2					---	---	---	---	3.2	---	---	59	24	35	0.20	---
		3 / 5	1.69 - 2.69	100	None	99.4	9.128	2.6	0.0	96.8	97	97.1	10,268	97.1	Gray fat clay with trace shell	CH	68.3 63.1 70.8 60.7 60.0 72.8 57.4 68.8 70.7 67.8 68.8 73.4 62.1 65.2 60.9 58.4 60.3 64.1 62.5 61.0 65.3	64.9	64.9	101.2	61.4	100 [Gs=2.73]	99.2 98.3 101.0 99.0 98.7 101.3 --- --- --- --- ---	58.1 56.9 63.1 58.0 56.9 61.3 --- --- --- --- ---	100 100 96 100 100 100 --- --- --- --- ---	97.7 98.6 95.1 98.5 98.0 93.4 --- --- --- 93.8 ---	2.8	1.4	2.73	60	25	35	0.20	0.20 ---
		4 / 5	2.69 - 3.69	100	None	100.3	9.116	5.4	0.0	94.9	95	94.6	11,943	19.8	Gray fat clay with trace shell	CH	59.8	59.8	34.4	120.4	89.6	105 [Gs=2.70]												
														65.8	Gray clayey sand	SC	44.2 24.0 21.7 26.8	29.2																
														9.0	Gray sand	SP	17.0	17.0																
		5 / 5	3.69 - 4.69	100	None	96.5	9.164	2.5	0.0	94.0	94	92.0	12,463	5.5	Gray clayey sand	SC	---	---	14.8	125.6	109.4	75 [Gs=2.68]												
														82.0	Brownish-gray sand with lenses of gray fat clay	SP with CH lenses	17.6 14.3 14.8 13.8 14.5 13.4	14.7					---	---	---	13.5	0.8	---	2.68					
														4.5	Gray sand	SP	15.3	15.3																

13-13-0084
VC-T1A-2A
1/5
TOP
SWANSON
AE141

13-13-0084

VC-T1A-2A

1/5

13-13-084
VC-T1A-2A
2/5
→
TOP
SWANSON
AE141

13-13-0084
VC-T1A-2A
2/5
→
TOP
AE141

13-13-0084
VC-T1A-2A
3/5
→
TOP

13-13-0084
VC-T1A-2A
3/5
→
TOP
SWANSON

13-13-0084
VC-T1A-2A
3/5
TOP
SWANSON®
AE141

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AE141

13-13-0084
VC-T1A-2A
4/5
→
TOP
SWANSON
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4/5

TOP

SWANSON®

AE141

13-13-0084
VC-T1A-2A
5/5
→
TOP

13-13-0084
VC-T1A-2A
5/5
→
TOP

13-13-0084
VC-T1A-2A
5/5
→
TOP
AE141

13-13-0084
VC-T1A-2A
5/5
→
TOP

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/02/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1A-2A** SAMPLE: **1/5** [Block 1]
DEPTH: 0.00 – 0.69 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T1A2-1/5
SAMPLE DESCRIPTION: Gray sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

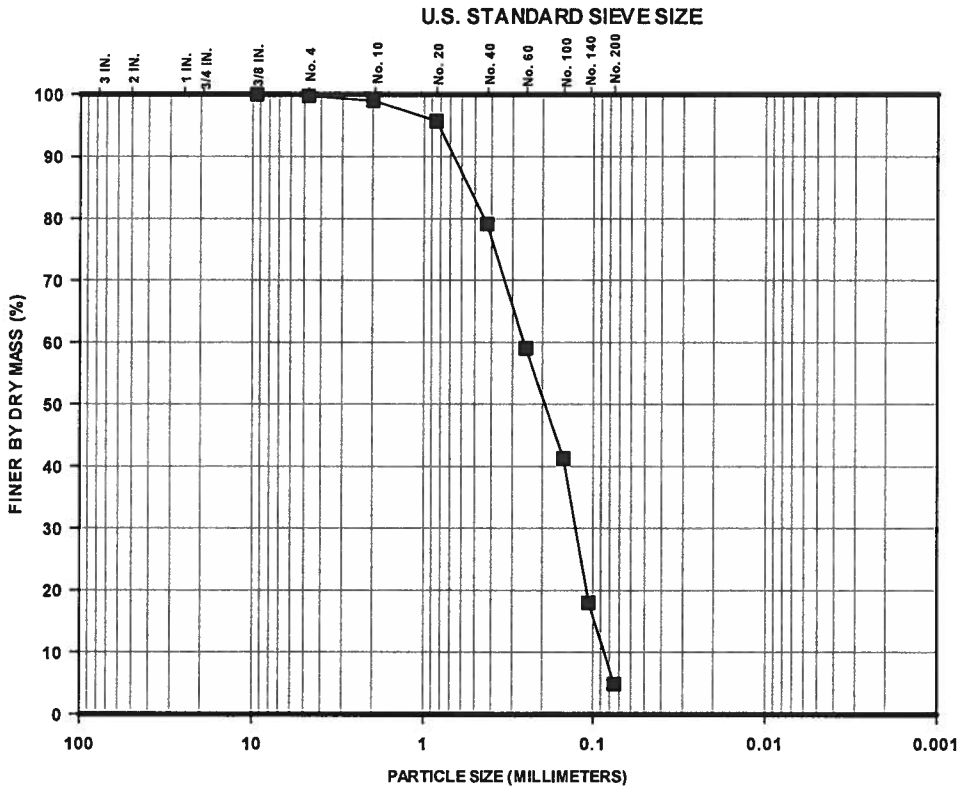
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 21.9
Mass Dry Solids (grams): 218.41

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.7	99.0	95.7	79.1	59.0	41.3	18.0	4.9	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
ONE-DIMENSIONAL INCREMENTAL LOADING CONSOLIDATION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

INCOMING SAMPLE NO.: ---------
BORING: **VC-T1A-2A** SAMPLE: **3 / 5**
DEPTH: 1.69 - 2.69 ☐ ft; ☑ m
LAB IDENTIFICATION NO.: 130084/T1A2A35
SAMPLE DESCRIPTION.: Gray fat clay with trace shell , CH

DATE SAMPLE RECEIVED: 06/27/13
DATE SAMPLE SET-UP: 07/02/13
DATE REPORTED: 08/12/13 REVISED: 10/18/13

Effective Vertical Stress σ'_{vc} (tons/ft^2)	Void Ratio		Vertical Strain (%)		Coefficient of Consolidation (cm^2/sec) c_v [Log Time] ☑ c_v [Sq. Root Time] ☐	Coefficient of Permeability (cm/sec)	Secondary Compression Index, $C_{\alpha e}$
	End of Primary Consolidation	End of Increment	End of Primary Consolidation	End of Increment			
0.0	--	1.781	--	0.00	--	--	-----
0.05	--	1.770	--	0.37	--	--	-----
0.10	1.755	1.753	0.93	1.00	4.3E-04	5.6E-08	0.002
0.20	1.728	1.718	1.89	2.25	5.6E-04	7.1E-08	0.008
0.40	1.661	1.648	4.31	4.76	3.5E-04	4.6E-08	0.012
0.80	1.564	1.537	7.79	8.75	4.8E-04	4.9E-08	0.019
1.60	1.423	1.378	12.85	14.49	5.4E-04	3.9E-08	0.028
0.40	1.403	1.408	13.58	13.42	2.2E-03	--	-----
0.20	--	1.425	--	12.79	--	--	-----
0.40	1.420	1.418	12.99	13.05	3.8E-03	5.2E-08	0.001
0.80	1.404	1.399	13.54	13.71	2.8E-03	4.8E-08	0.002
1.60	1.377	1.355	14.52	15.33	2.8E-03	5.8E-08	0.011
3.20	1.216	1.185	20.31	21.43	3.4E-04	1.3E-08	0.025
6.30	1.042	1.006	26.55	27.87	5.1E-04	1.1E-08	0.023
12.60	0.884	0.840	32.26	33.83	6.7E-04	6.5E-09	0.024
3.20	0.863	0.866	33.01	32.88	1.7E-03	--	-----
0.80	0.907	0.916	31.41	31.08	3.9E-04	--	-----
0.20	0.960	0.973	29.50	29.05	7.8E-05	--	-----

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Checked By: JCW Date: 10/18/2013

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/03/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1A-2A** SAMPLE: **5/5** [Block 1]
DEPTH: 3.69 – 4.69 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T1A2A-5/5
SAMPLE DESCRIPTION: Gray clayey sand (SC)
(Brownish-gray sand with lenses of gray fat clay)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

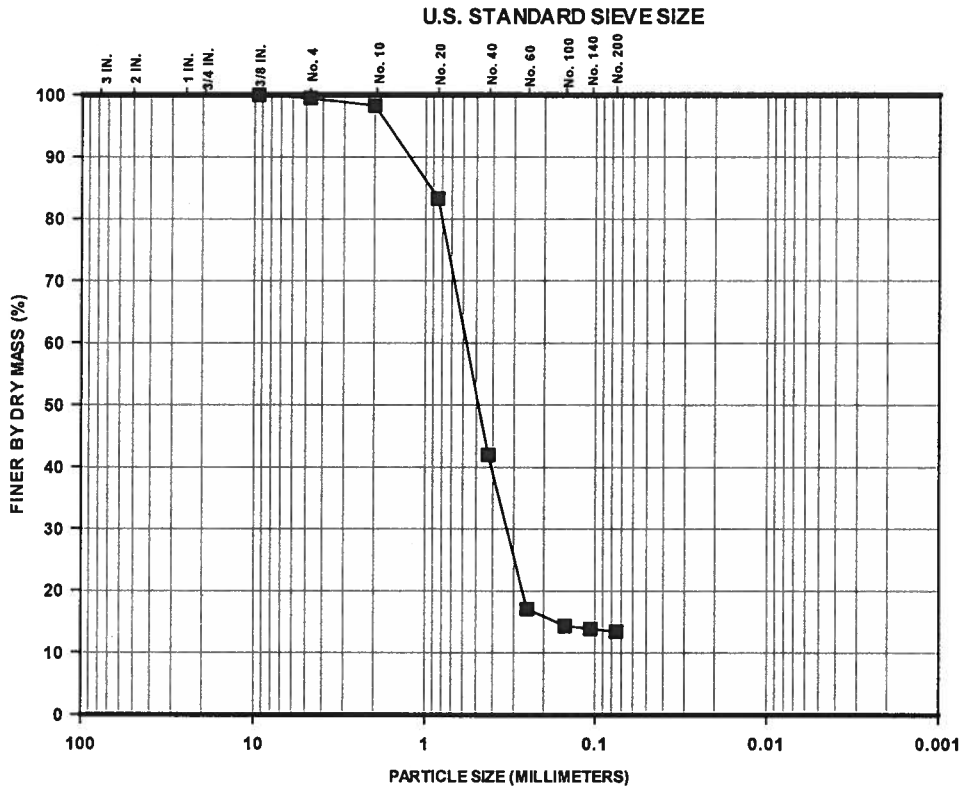
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 14.3
Mass Dry Solids (grams): 211.22

G_s: 2.68 ☐ Assumed ☒ Measured

Organic Content (%): 0.8
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.5	98.3	83.3	42.0	17.1	14.4	13.9	13.5	---	---	---

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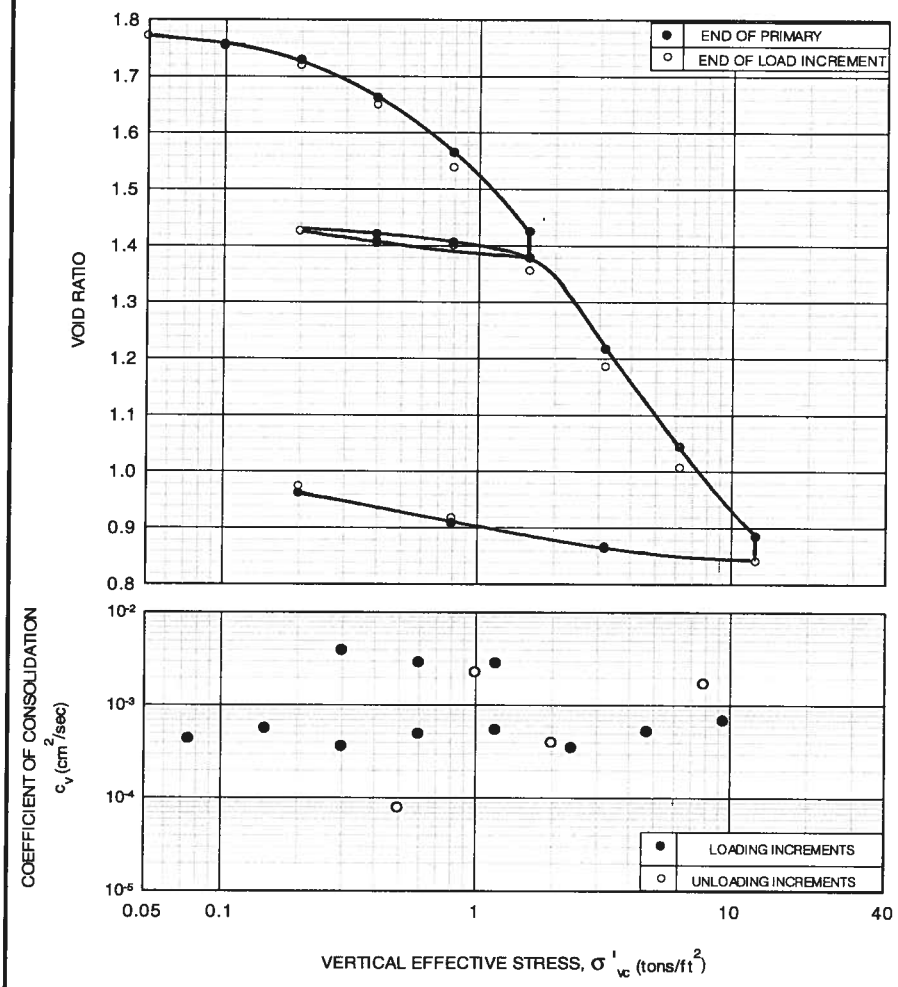
Checked By: _____ Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
ONE-DIMENSIONAL INCREMENTAL LOADING CONSOLIDATION TEST REPORT

CLIENT: Dominion
PROJECT: VOWTAP
FILE NO.: 13-13-0084

INCOMING SAMPLE NO.: ---------
BORING: VC-T1A-2A SAMPLE: 3 / 5
DEPTH: 1.69 - 2.69 ☐ ft; ☑ m
LAB IDENTIFICATION NO.: 130084/T1A2A35
SAMPLE DESCRIPTION.: Gray fat clay with trace shell , CH

DATE SAMPLE RECEIVED: 06/27/13
DATE SAMPLE SET-UP: 07/02/13
DATE REPORTED: 08/12/13



Test Methods & Procedures

ASTM Standard D2435
- ☐ Method A
- ☑ Method B

c_v Interpretation Method
- ☑ c_v [Log Time]
- ☐ c_v [Sq. Root Time]

Trimming Method
- ☑ cutting shoe
- ☐ other_____

Initial Sample Diameter 9.13 (cm)

Test Conditions

- ☐ Tested at Natural Moisture Content
- ☑ Specimen Tested Inundated
  Inundated at σ'_{vc} 0.05 (tsf)
  Inundation Fluid:
  - ☑ tap water
  - ☐ other _____

Specimen Conditions

Parameter	Initial	Final
D (cm)	5.000	5.000
H (cm)	1.922	1.372
w_c (%)	65.2	36.1
γ_d (pcf)	61.3	85.8
e	1.781	0.986
S (%)	100	100

G_s: 2.73 ☐ Assumed ☑ Measured

Index Properties

LL	60
PL	25
PI	35

Particle-Size Analysis
☐ ASTM D422
☑ ASTM D1140-Method

Dry Mass(g): 37.04

U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Soil Passing (%, dry mass basis)	-----	-----	-----	-----	-----	-----	-----	-----	-----	93.4

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Where: H=Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; e = Void ratio; S = Saturation; G_s= Specific gravity; c_v = Coefficient of consolidation; and $C_{\alpha e}$ = Secondary compression index.

Checked By: TM Date: 8/12/2013

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
ONE-DIMENSIONAL INCREMENTAL LOADING CONSOLIDATION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

INCOMING SAMPLE NO.: ---------
BORING: **VC-T1A-2A** SAMPLE: **3 / 5**
DEPTH: 1.69 - 2.69 ☐ ft; ☑ m
LAB IDENTIFICATION NO.: 130084/T1A2A35
SAMPLE DESCRIPTION.: Gray fat clay with trace shell , CH

DATE SAMPLE RECEIVED: 06/27/13
DATE SAMPLE SET-UP: 07/02/13
DATE REPORTED: 08/12/13

Effective Vertical Stress σ'_{vc} (tons/ft^2)	Void Ratio		Vertical Strain (%)		Coefficient of Consolidation (cm^2/sec) ☑ c_v [Log Time] ☐ c_v [Sq. Root Time]	Secondary Compression Index, $C_{\alpha\varepsilon}$
	End of Primary Consolidation	End of Increment	End of Primary Consolidation	End of Increment		
0.0	--	1.781	--	0.00	--	-----
0.05	--	1.770	--	0.37	--	-----
0.10	1.755	1.753	0.93	1.00	4.3E-04	0.002
0.20	1.728	1.718	1.89	2.25	5.6E-04	0.008
0.40	1.661	1.648	4.31	4.76	3.5E-04	0.012
0.80	1.564	1.537	7.79	8.75	4.8E-04	0.019
1.60	1.423	1.378	12.85	14.49	5.4E-04	0.028
0.40	1.403	1.408	13.58	13.42	2.2E-03	-----
0.20	--	1.425	--	12.79	--	-----
0.40	1.420	1.418	12.99	13.05	3.8E-03	0.001
0.80	1.404	1.399	13.54	13.71	2.8E-03	0.002
1.60	1.377	1.355	14.52	15.33	2.8E-03	0.011
3.20	1.216	1.185	20.31	21.43	3.4E-04	0.025
6.30	1.042	1.006	26.55	27.87	5.1E-04	0.023
12.60	0.884	0.840	32.26	33.83	6.7E-04	0.024
3.20	0.863	0.866	33.01	32.88	1.7E-03	-----
0.80	0.907	0.916	31.41	31.08	3.9E-04	-----
0.20	0.960	0.973	29.50	29.05	7.8E-05	-----

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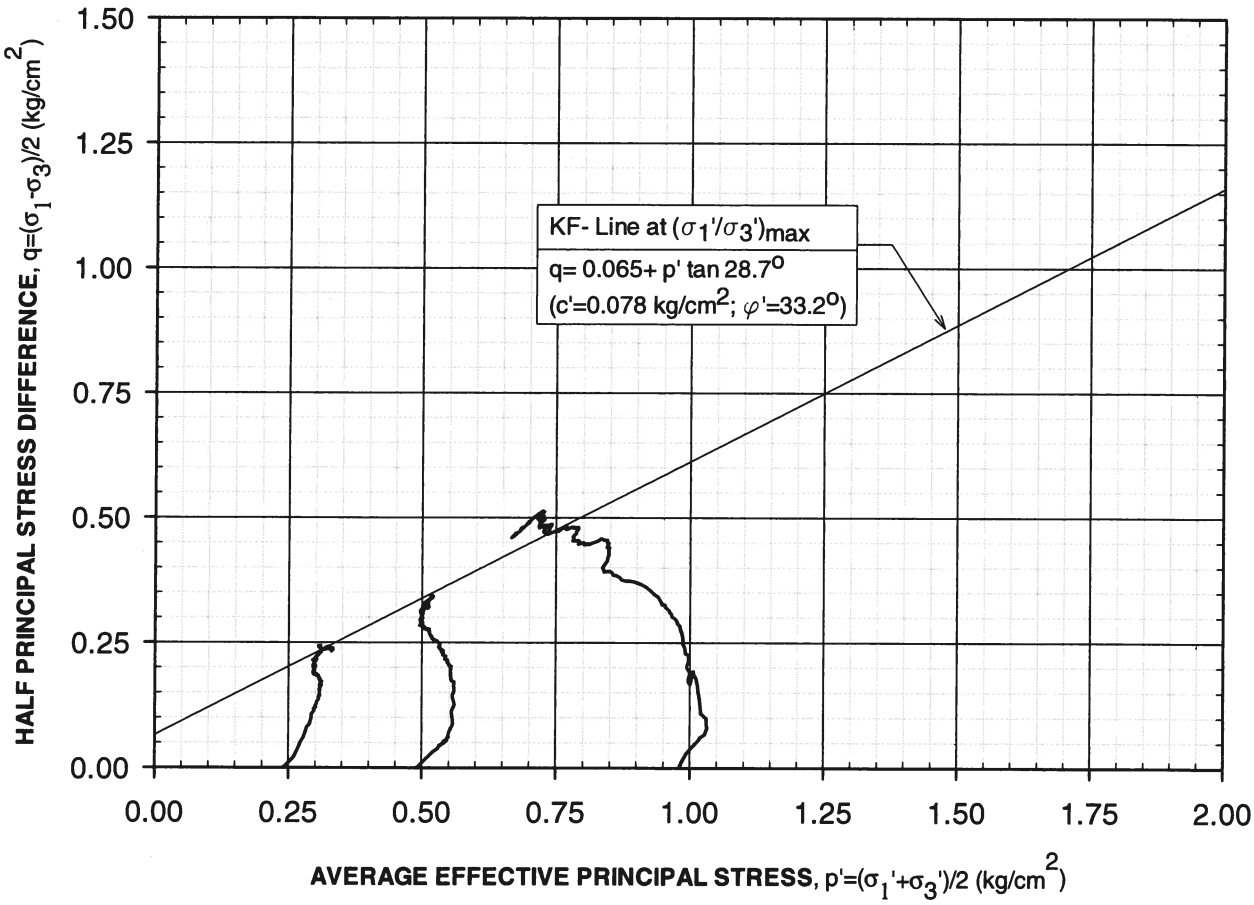
Checked By: _____ Date: 8/12/2013

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
EFFECTIVE STRESS PATHS

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/13/13-8/16/13
DATE REPORTED: 08/13/13 REVISED: 10/18/13

INCOMING SAMPLE NO.: -
BORING: **VC-T1A-2A** SAMPLE: **3/5**
DEPTH: 1.69 - 2.69 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/T2A15/5
SAMPLE DESCRIPTION: Gray fat clay (CH)



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Checked By: JAW Date: 10/18/13

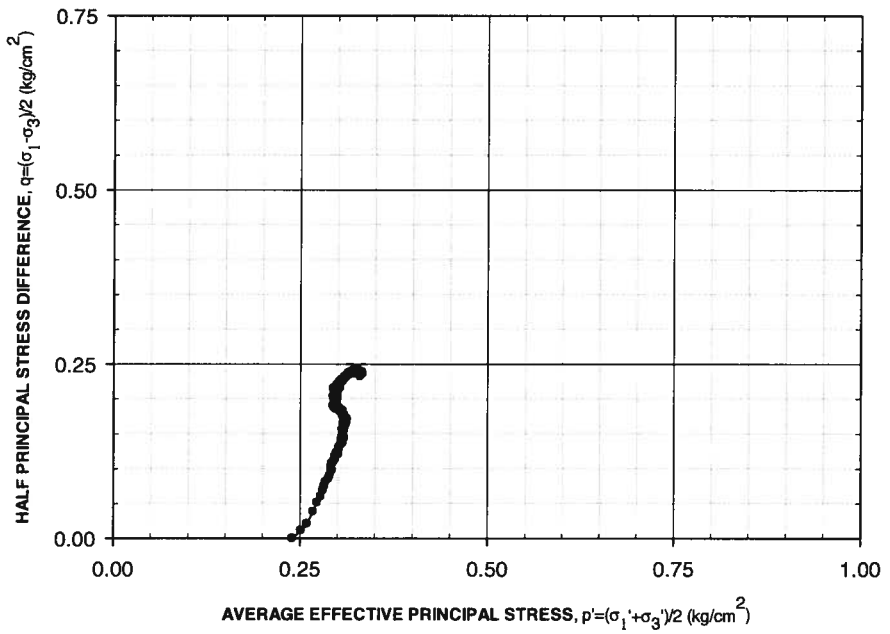
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/13/13
DATE REPORTED: 08/13/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1A-2A** SAMPLE: **3/5**
DEPTH: 1.69 – 2.69 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/1A2A3/5
SAMPLE DESCRIPTION: Gray fat clay (CH)

Specimen Dimensions			Initial Conditions			Test Conditions				Pre-shear Conditions					
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	u_b (kg/cm^2)	σ_c' (kg/cm^2)	$\dot{\varepsilon}$ (%/hour)	B-Factor (%)	ε_{vol} (%)	H_c (cm)	A_c (cm^2)	w_c (%)	γ_d (lb/ft^3)	S (%)
7.02	3.60	2.0	70.8	58.1	100	12.00	0.24	1.0	100	-8.0	6.97	9.45	62.2	63.1	100



TEST PROCEDURE: ASTM D4767

Specimen Mounting Method : ☐ Dry Method ☒ Wet Method

Filter Strip Correction Made : ☐ Yes ☒ No
Membrane Correction Made : ☐ Yes ☒ No

A_c Method: ☐ Method A ☒ Method B

w_c determined from: ☒ Entire Specimen ☐ Trimmings

SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Compacted	

☐ Tamped Uniform Lifts: No. of Lifts: _____

☐ Kneading: Blows per Lift: _____
No. of Lifts_____ Spring:_____lb

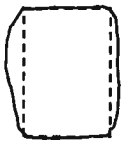
G_s: 2.73 ☐ Assumed ☒ Measured

Stresses and Strains at Failure

Failure Criteria	ε_a (%)	Δu (kg/cm^2)	σ_1' (kg/cm^2)	σ_3' (kg/cm^2)	p' (kg/cm^2)	q (kg/cm^2)
$[\sigma_1 - \sigma_3]_{max}$	9.5	0.16	0.57	0.08	0.33	0.24
$[\sigma_1' / \sigma_3']_{max}$	6.7	0.16	0.55	0.08	0.31	0.24

FAILURE SKETCH

☐ Diagonal Plane
☒ Bulging
☐ Combination
☐ Other _____



Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☒ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	66.62	Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	97.7

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c' = Isotropic effective confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_{vol} = Volume change(- denotes consolidation, + denotes swelling); H_c = Consolidated height; A_c = Consolidated area; ε_a = Axial strain; Δu = Excess pore pressure; σ_1' = Major effective principal stress; σ_3'= Minor effective principal stress; p' = Average effective principal stress; q = Half principal stress difference; and G_s = Specific gravity.

Checked By: TM Date: 08/13/13

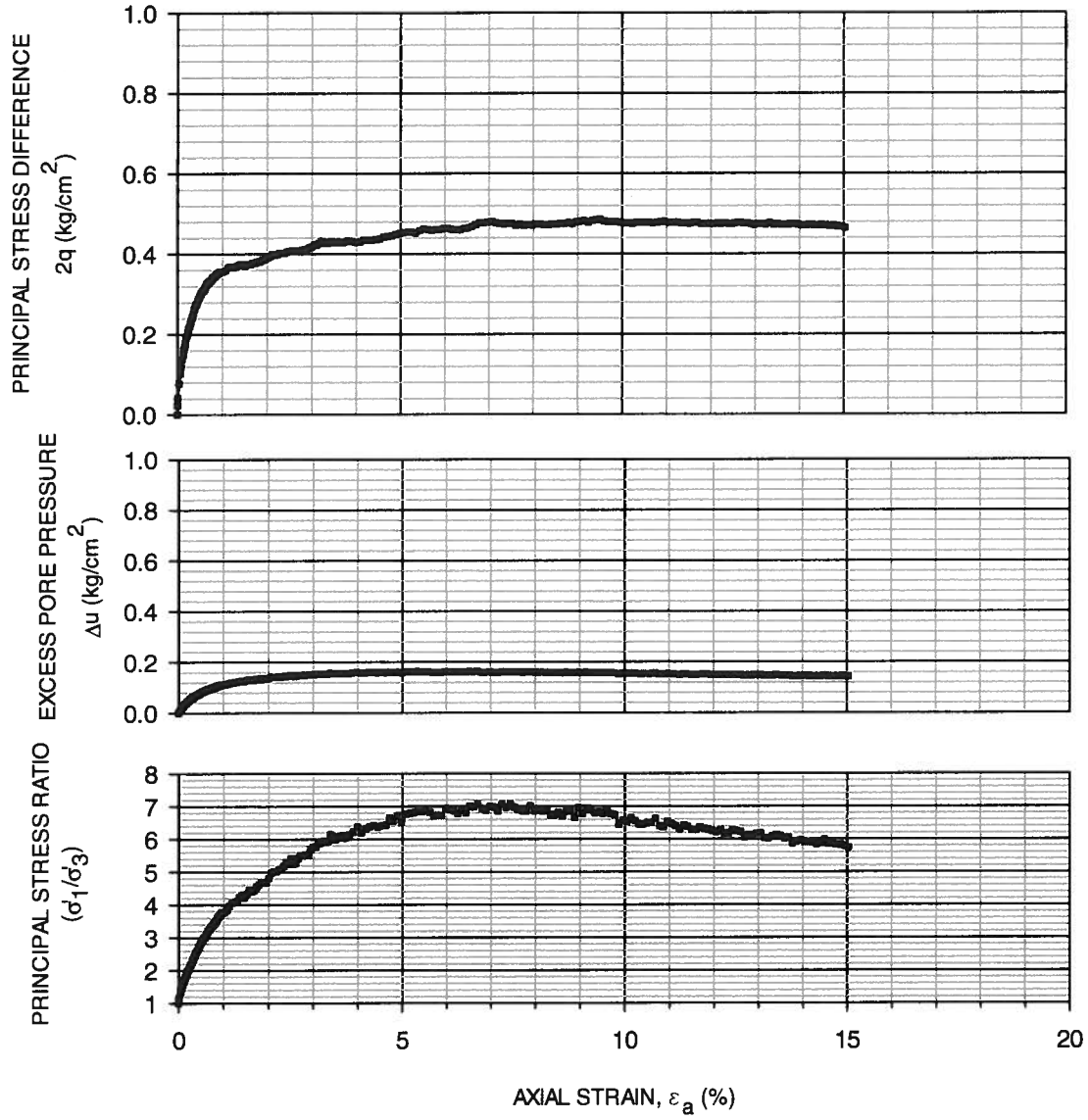
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS - STRAIN CURVES

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/13/13
DATE REPORTED: 08/13/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1A-2A** SAMPLE: **3/5**
DEPTH: 1.69 – 2.69 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/1A2A3/5
SAMPLE DESCRIPTION: Gray fat clay (CH)

Consolidation Stress = 0.24 kg/cm^2



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Where: Δu = Excess pore pressure; σ_1' = Major effective principal stress; and σ_3'= Minor effective principal stress.

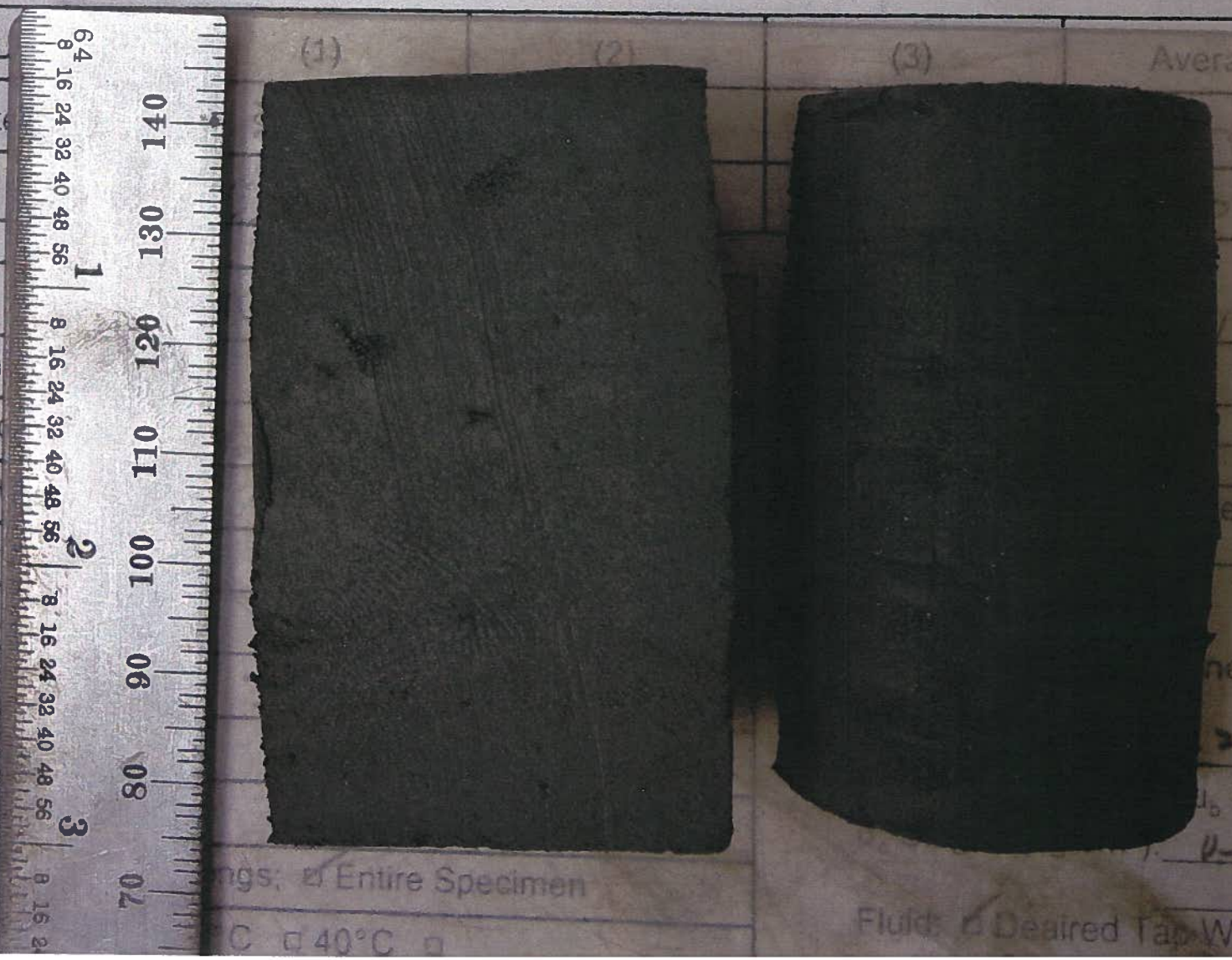
Checked By: TM Date: 08/13/13

BORING: VC SAMPLE: T1A DEPTH: 2A 3/5 ☐ ft; ☐ m BLOCK:

TYPE SAMPLE: ☒ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TYPE TEST: ☒ CIUC; ☐ UU; ☐ $\overline{UU}$; ☐ CD ☐ OTHER

SAMPLE DESCRIPTION: Gray clay



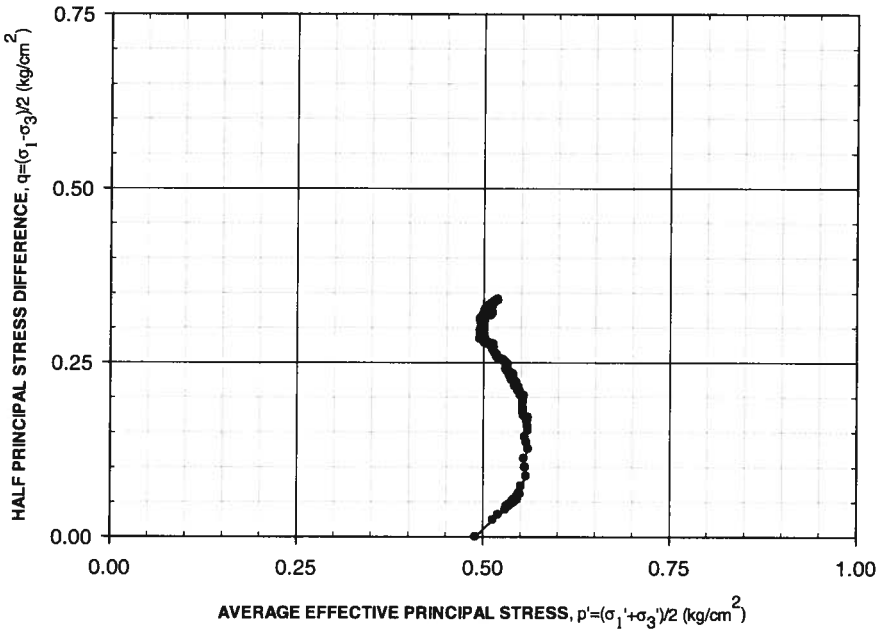
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 08/16/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1A-2A** SAMPLE: **3/5**
DEPTH: 1.69 – 2.69 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/1A2A3/5
SAMPLE DESCRIPTION: Gray fat clay (CH)

Specimen Dimensions			Initial Conditions			Test Conditions				Pre-shear Conditions					
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	u_b (kg/cm^2)	σ_c' (kg/cm^2)	$\dot{\varepsilon}$ (%/hour)	B-Factor (%)	ε_{vol} (%)	H_c (cm)	A_c (cm^2)	w_c (%)	γ_d (lb/ft^3)	S (%)
7.07	3.52	2.0	60.0	63.1	96	12.00	0.49	1.1	99	-6.8	6.91	9.26	55.5	67.7	100



TEST PROCEDURE: ASTM D4767

Specimen Mounting Method : ☐ Dry Method ☒ Wet Method

Filter Strip Correction Made : ☐ Yes ☒ No
Membrane Correction Made : ☐ Yes ☒ No

A_c Method: ☐ Method A ☒ Method B

w_c determined from: ☒ Entire Specimen ☐ Trimmings

SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Compacted	

☐ Tamped Uniform Lifts: No. of Lifts: _____

☐ Kneading: Blows per Lift: _____
No. of Lifts_____Spring:____lb

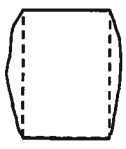
G_s: 2.73 ☐ Assumed ☒ Measured

Stresses and Strains at Failure

Failure Criteria	ε_a (%)	Δu (kg/cm^2)	σ_1' (kg/cm^2)	σ_3' (kg/cm^2)	p' (kg/cm^2)	q (kg/cm^2)
$[\sigma_1 - \sigma_3]_{max}$	7.9	0.31	0.86	0.18	0.52	0.34
$[\sigma_1' / \sigma_3']_{max}$	7.9	0.31	0.86	0.18	0.52	0.34

FAILURE SKETCH

☐ Diagonal Plane
☒ Bulging
☐ Combination
☐ Other _____



Particle-Size Analysis
☐ ASTM D422
☒ ASTM D1140-Method B

Dry Mass (g): 69.44

U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	95.1

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c' = Isotropic effective confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_{vol} = Volume change(- denotes consolidation, + denotes swelling); H_c = Consolidated height; A_c = Consolidated area; ε_a = Axial strain; Δu = Excess pore pressure; σ_1' = Major effective principal stress; σ_3'= Minor effective principal stress; p' = Average effective principal stress; q = Half principal stress difference; and G_s = Specific gravity.

Checked By: _____ Date: 09/23/13

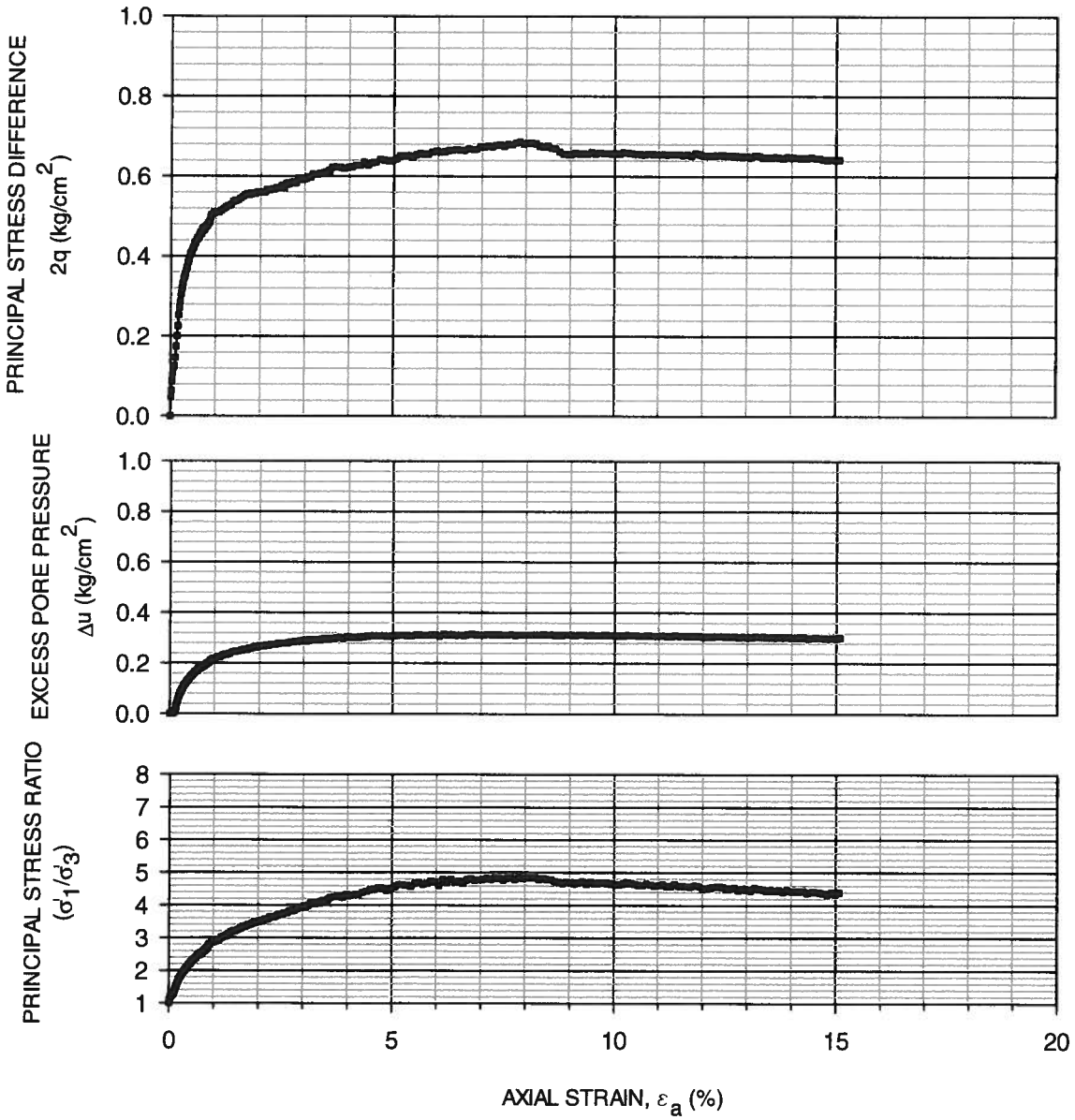
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS - STRAIN CURVES

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 08/16/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1A-2A** SAMPLE: **3/5**
DEPTH: 1.69 – 2.69 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/1A2A3/5
SAMPLE DESCRIPTION: Gray fat clay (CH)

Consolidation Stress = 0.49 kg/cm^2



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Where: Δu = Excess pore pressure; σ_1' = Major effective principal stress; and σ_3'= Minor effective principal stress.

Checked By: TM Date: 09/23/13

BORING: VCT1A2A SAMPLE: 3/5 DEPTH: pellet ☐ ft; ☐ m BLOCK: 5

TYPE SAMPLE: ☐ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TYPE TEST: ☒ CIUC; ☐ UU; ☐ $\overline{UU}$; ☐ CD ☐ OTHER

SAMPLE DESCRIPTION: grey clay

ME | (1) | (2) | (3) | Average | L/D

Dia

Len

117.41

Ta

W

W

W

W

W

M

Fl

lb/ft³):

ft³):

☐ Assumed ☐ Measured

trips 1 Condoms

Membrane Thin Membrane

n²): 0.40

0.49 u_b (kPa/cm²) 12.5

g/cm²): 0.40 ;

mmings; ☐ Entire Specimen

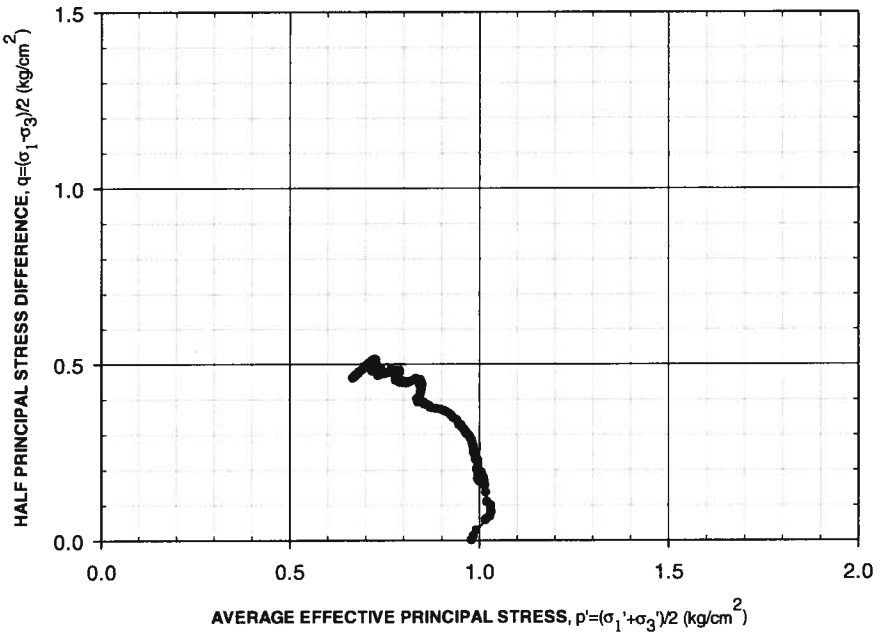
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/22/13
DATE REPORTED: 08/13/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1A-2A** SAMPLE: **3/5**
DEPTH: 1.69 – 2.69 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/1A2A3/5
SAMPLE DESCRIPTION: Gray fat clay (CH)

Specimen Dimensions			Initial Conditions			Test Conditions				Pre-shear Conditions					
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	u_b (kg/cm^2)	σ_c' (kg/cm^2)	$\dot{\varepsilon}$ (%/hour)	B-Factor (%)	ε_{vol} (%)	H_c (cm)	A_c (cm^2)	w_c (%)	γ_d (lb/ft^3)	S (%)
7.31	3.58	2.0	72.8	56.9	100	12.00	0.98	1.0	100	-14.8	7.13	8.80	56.8	66.8	100



TEST PROCEDURE: ASTM D4767

Specimen Mounting Method : ☐ Dry Method ☒ Wet Method

Filter Strip Correction Made : ☐ Yes ☒ No
Membrane Correction Made : ☐ Yes ☒ No

A_c Method: ☐ Method A ☒ Method B

w_c determined from: ☒ Entire Specimen ☐ Trimmings

SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Compacted	

☐ Tamped Uniform Lifts: No. of Lifts: _____

☐ Kneading: Blows per Lift: _____
No. of Lifts_____ Spring:_____lb

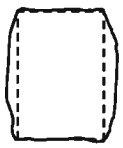
G_s: 2.73 ☐ Assumed ☒ Measured

Stresses and Strains at Failure

Failure Criteria	ε_a (%)	Δu (kg/cm^2)	σ_1' (kg/cm^2)	σ_3' (kg/cm^2)	p' (kg/cm^2)	q (kg/cm^2)
$[\sigma_1 - \sigma_3]_{max}$	11.1	0.77	1.24	0.21	0.73	0.51
$[\sigma_1' / \sigma_3']_{max}$	11.7	0.77	1.23	0.21	0.72	0.51

FAILURE SKETCH

☐ Diagonal Plane
☒ Bulging
☐ Combination
☐ Other _____



Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☒ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	67.14	Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	98.6

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c' = Isotropic effective confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_{vol} = Volume change(- denotes consolidation, + denotes swelling); H_c = Consolidated height; A_c = Consolidated area; ε_a = Axial strain; Δu = Excess pore pressure; σ_1' = Major effective principal stress; σ_3'= Minor effective principal stress; p' = Average effective principal stress; q = Half principal stress difference; and G_s = Specific gravity.

Checked By: JM Date: 08/13/13

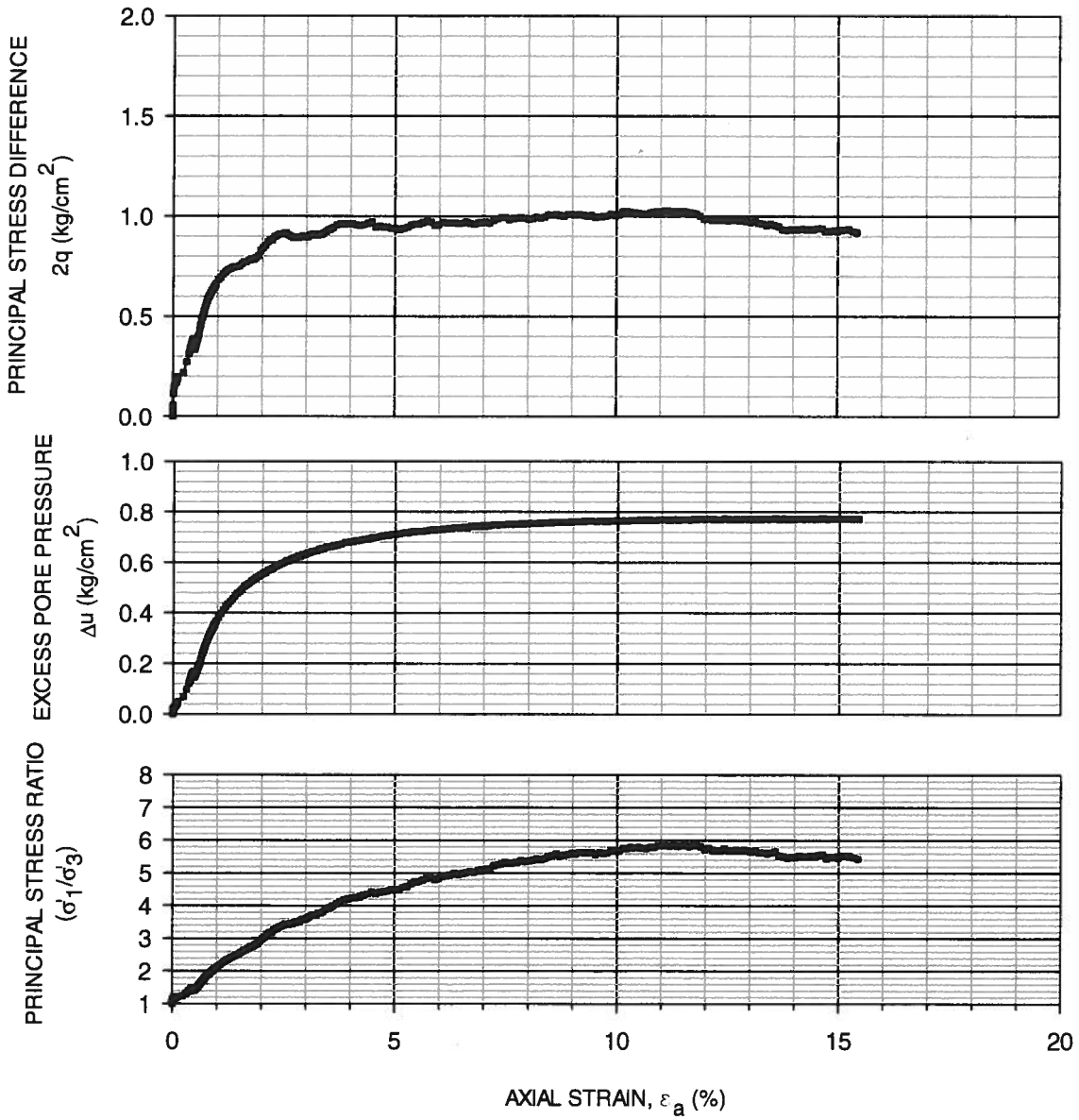
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS - STRAIN CURVES

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/22/13
DATE REPORTED: 08/13/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1A-2A** SAMPLE: **3/5**
DEPTH: 1.69 – 2.69 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/1A2A3/5
SAMPLE DESCRIPTION: Gray fat clay (CH)

Consolidation Stress = 0.98 kg/cm^2



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Where: Δu = Excess pore pressure; σ_1' = Major effective principal stress; and σ_3'= Minor effective principal stress.

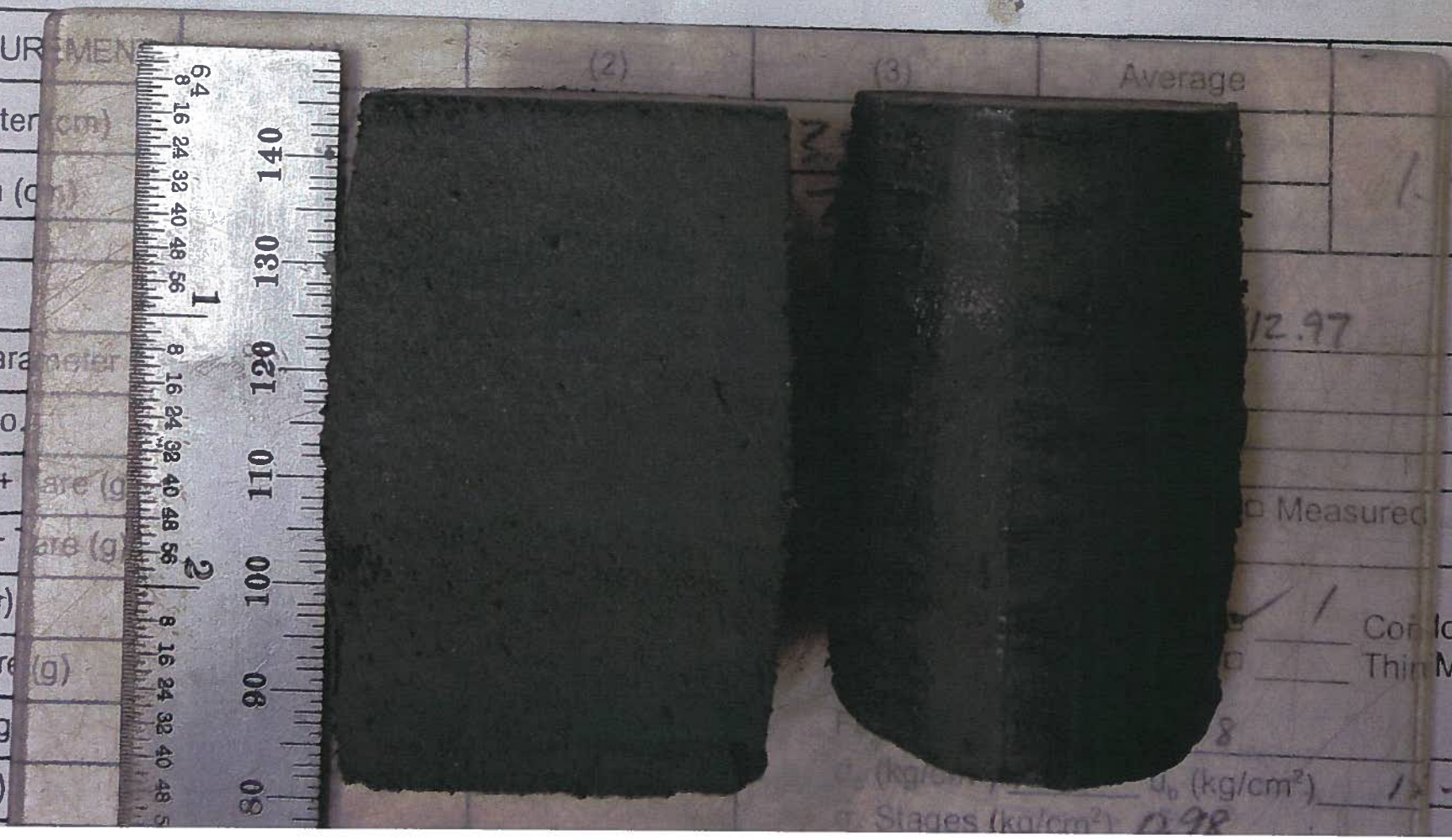
Checked By: _____ Date: 08/13/13

BORING: VC SAMPLE: T1A DEPTH: 2A 3/5 ☐ ft; ☐ m BLOCK: B3

TYPE SAMPLE: ☐ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TYPE TEST: ☐ CIUC; ☐ UU; ☐ $\overline{UU}$; ☐ CD ☐ OTHER

SAMPLE DESCRIPTION: Gray Clay



MEASUREMENT | (2) | (3) | Average | /D

Diameter (cm) | 1.66

Length (cm) | 12.97

Parameter

Tare No.

WWS + Tare (g)

WDS + Tare (g)

WW (g)

Wt. Tare (g)

WDS (g)

MC (%)

Measured

Coloms

Thin Membrane

σ_0 (kg/cm²)

Stages (kg/cm²) 0.98

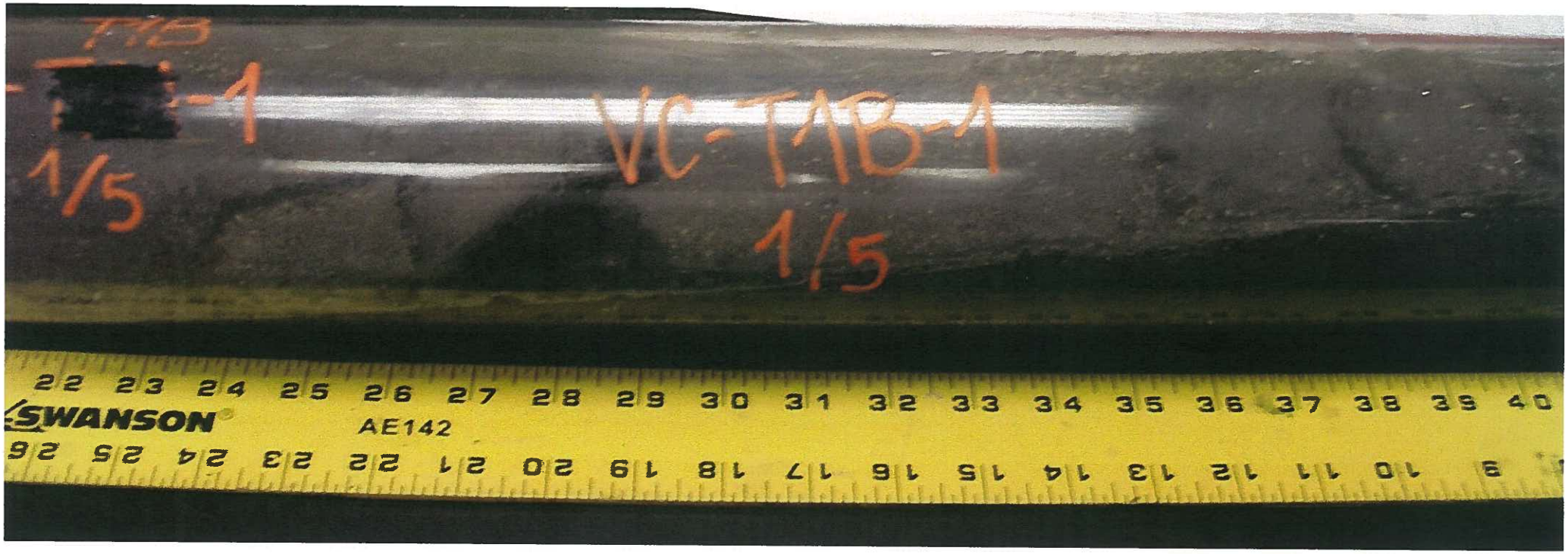
VOWTAP
File No.: 13-13-0084
September 23, 2013
Revision: 0 (ISSUED FOR USE) 08/20/13
Revision: 1 (Add PC-T1B-1)

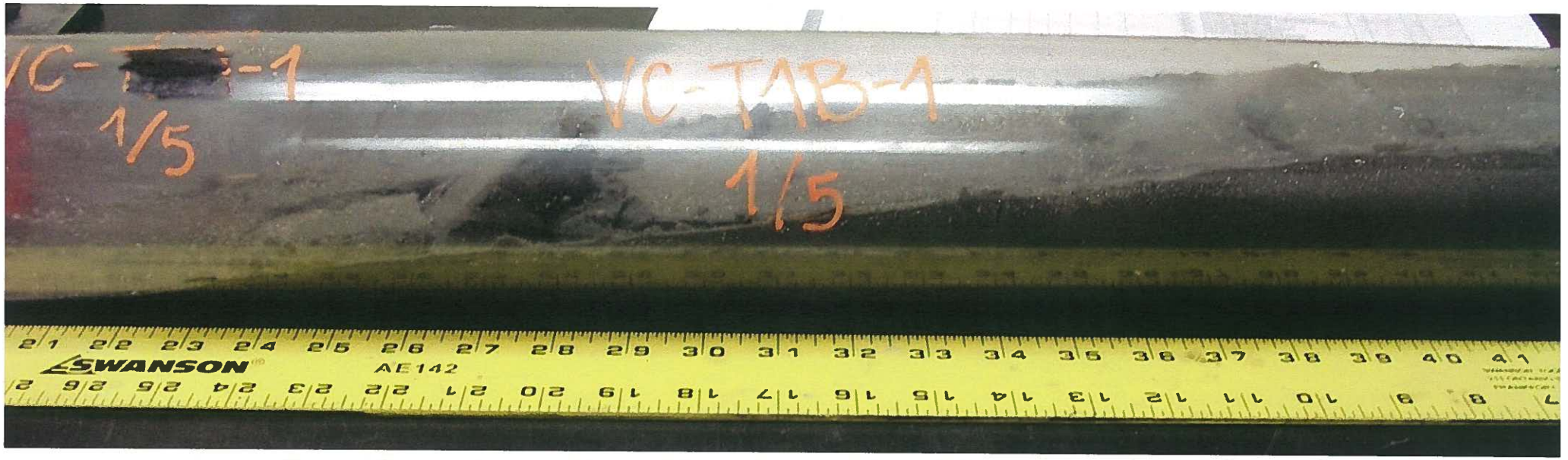
TABLE B-3 EXTRUSION TEST REPORT FOR CORE VC-T1B-1

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Test Specimen Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)				
T1B	VC-T1B-1	1 / 5	0.0 - 0.81	81	Large void in soil along tube wall except lower 7 cm. Sample not sufficiently intact for determining tube density.	72.3	9.105	3.0	0.0	69.3	86	48.0	5,192	48.0	Dark gray sand with silt and trace shell [one clay lense 7.5 cm x 5 cm x 4.5 cm at depth of 50 cm in sample]	SP-SM	20.8 26.7 23.2 24.4 18.7	22.8	22.8	Not Applicable. Voids within tube.			---	---	---	9.4	---	4.3	2.71
		2 / 5	0.81 - 1.81	100	Void in soil along tube wall except lower 15 cm. Sample not sufficiently intact for determining density.	100.0	9.182	0.0	0.0	100.0	100	97.4	11,103	82.1	Dark gray sand with trace shell	SP	11.2 15.2 22.4 23.6	19.6	19.6	Not Applicable. Voids within tube. Test specimen density and saturation for lower 11.0 cm section of core [w_c = 25.6%].			---	---	---	2.6	---	1.7	
														2.6	Void	Void												
														15.3	Dark gray sand	SP	25.6						124.4	99.0	99				
		3 / 5	1.81 - 2.81	100	Void in soil along tube wall except lower 26 cm. Sample not sufficiently intact for determining tube density.	99.7	9.121	7.8	0.5	91.4	91	91.4	9,324	91.4	Gray sand with silt and trace shell	SP-SM	14.9 18.3 23.6 22.8 24.4 25.4	21.6	21.6	Not Applicable. Voids within tube. Test specimen density and saturation for lower 18.0 cm section of core [w_c = 25.4%].			---	---	---	122.5	97.7	94	5.2	---	2.3	2.71
		4 / 5	2.81 - 3.81	100	Void in soil along tube wall except lower 18 cm. Sample not sufficiently intact for determining tube density.	98.7	9.157	2.5	0.0	96.2	96	90.0	10,741	90.0	Dark gray sand with silt and trace shell	SP-SM	14.9 23.6 24.6 24.5 24.2 25.7	22.9	22.9	Not Applicable. Voids within tube. Test specimen density and saturation for lower 15.5 cm section of core [w_c = 25.7%].			---	---	---	---	---	---	---	---	---	---
																							123.9	98.6	97	5.0	0.5		
		5 / 5	3.81 - 4.81	100	Void in soil along tube wall except lower 26 cm. Sample not sufficiently intact for determining tube density.	96.5	9.128	23.0	0.0	73.5	74	74.0	8,469	31.0	Gray sand with shell	SP	24.1	24.1	18.6	Not Applicable. Voids within tube. Test specimen density and saturation for lower 10.5 cm section of core [w_c = 20.3%].											
														27.5	Brownish-gray sand with shell	SP	12.5 11.6 10.1	11.4					---	---	---	---	---	---	---	---	---
																							---	---	---	1.3 ---	---	5.1	2.69
														15.5	Gray sand with shell	SP	20.3	20.3					125.3	104.2	89				

EXTRUSION TEST REPORT FOR CORE PC-T1B-1 [PISTON CORE SAMPLE]

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Test Specimen Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)				
T1B	PC-T1B-1	1 / 1	0.00-0.75	75	None	72.5	6.662	0.5	0.0	72.0	96	73.0	5,106	73.0	Dark gray sand with trace shell	SP	23.9 23.6 20.9 21.4 22.0 20.4 21.3	21.9	21.9	126.9	104.1	97 [Gs=2.68]				3.6			


VC-TAB-1
1/5
SWANSON
AE142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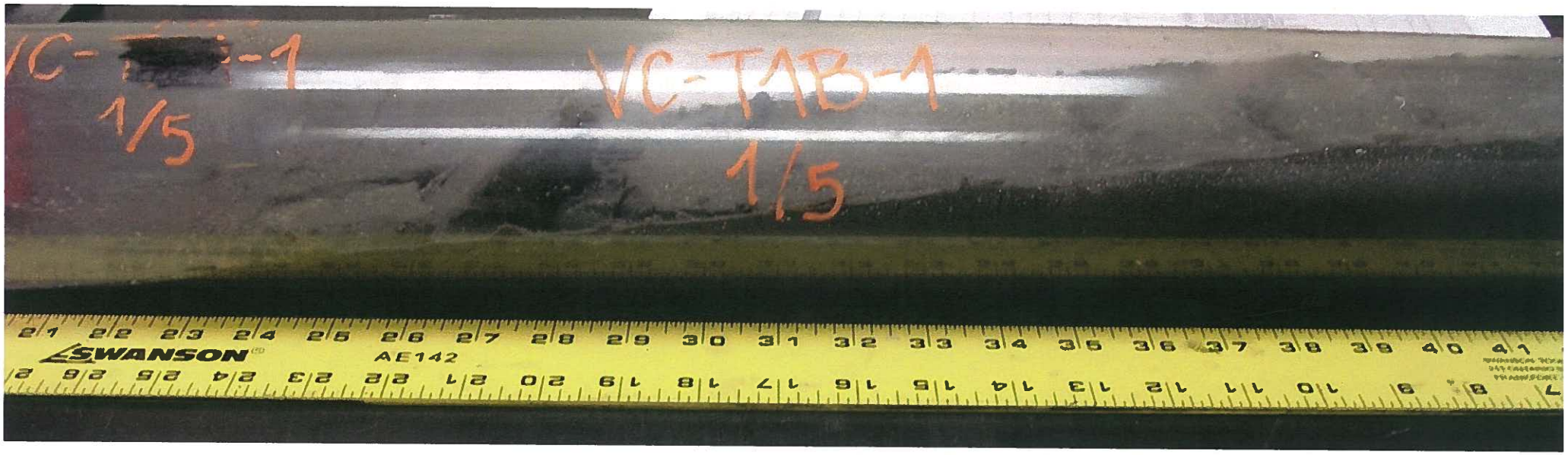
1/5
VC-TAB-1
1/5
SWANSON
AE142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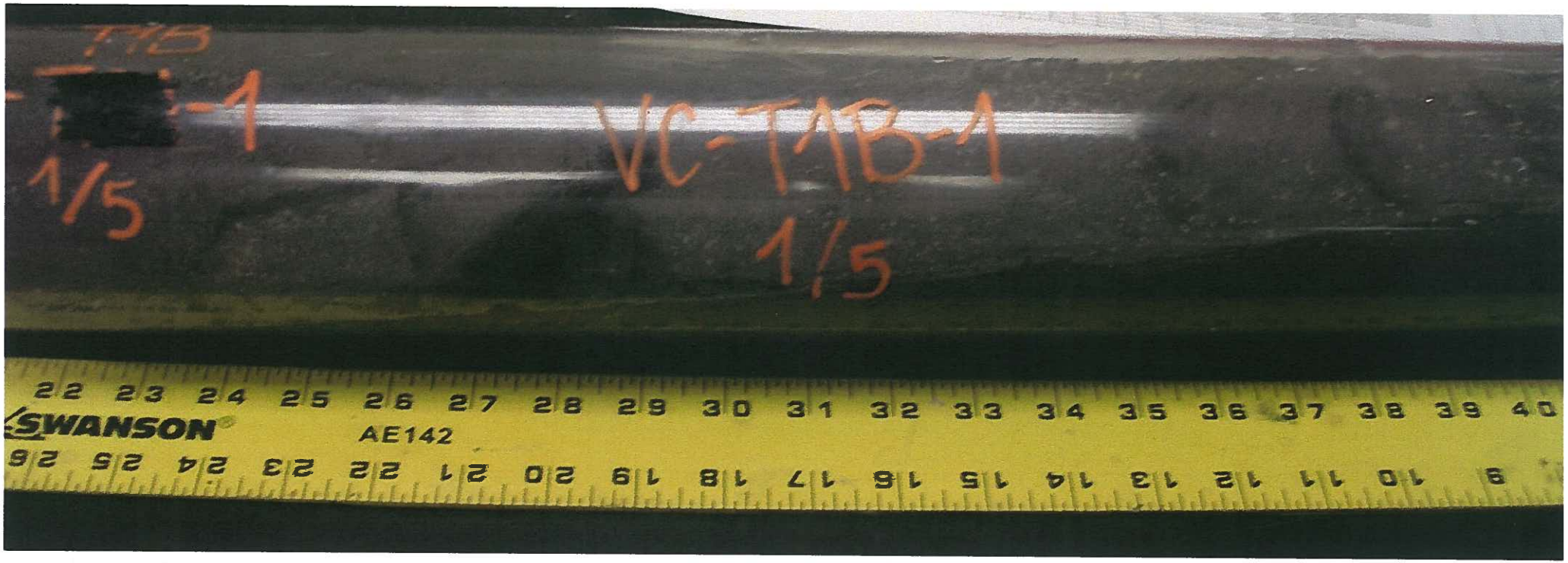
1/5
VC-TAB-1
1/5
SWANSON
AE142


TAB
-1
1/5
VC-TAB-1
1/5
SWANSON
AE142

SWANSON
13-13-0084
VC-T-1B-1
1/5
→
TOP

13-13-0084
VC-T-1B-1
1/5
TOP

13-13-0084

VC-T1B-1

2/5

SWANSON
13-13-0084
VC-T-1B-1
2/5
→
TOP

13-13-0084
VC-T-1B-1
2/5
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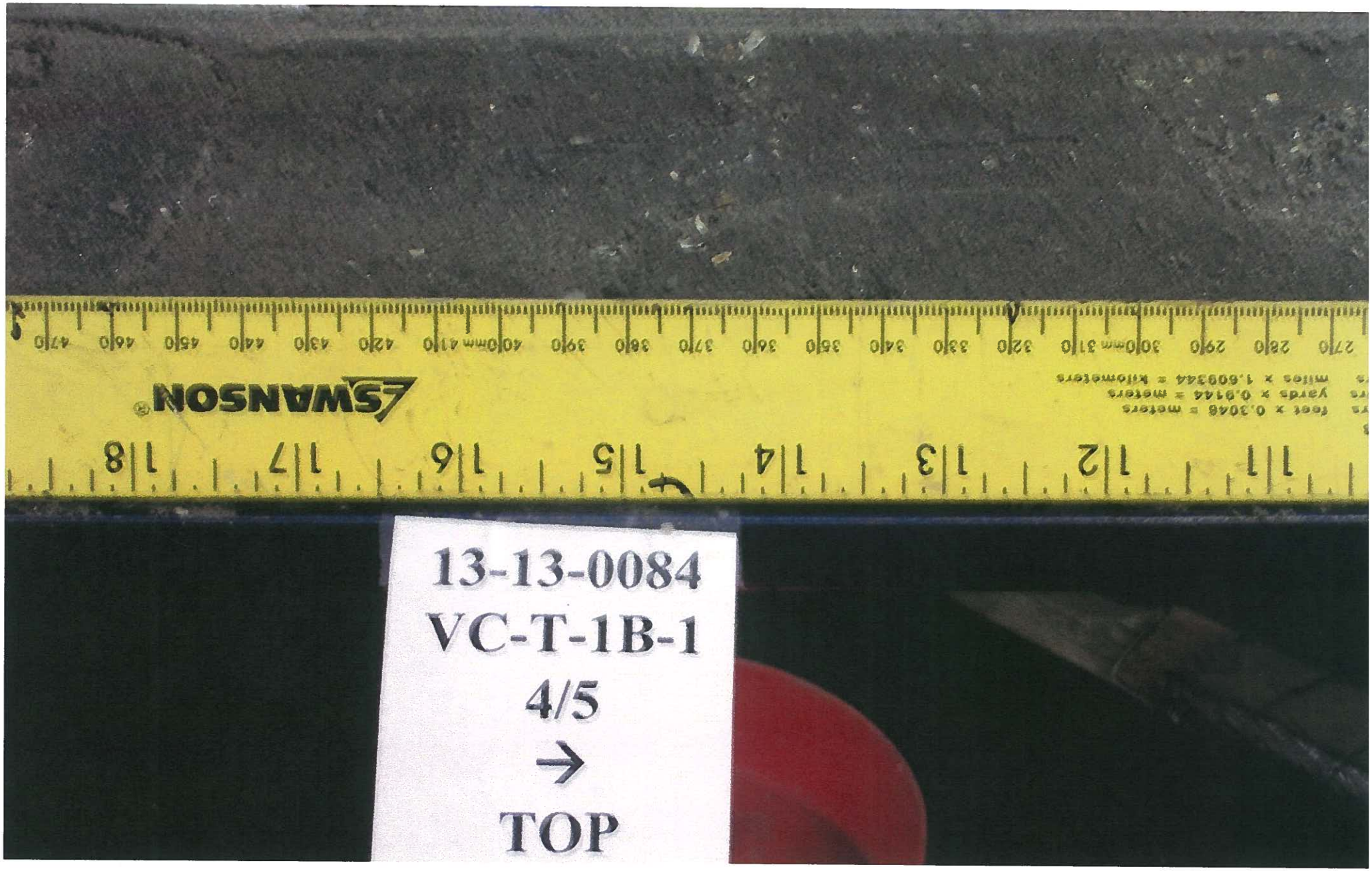
TOP

13-13-0084
VC-T-1B-1
3/5
→
TOP
SWANSON
AE141

13-13-0084
VC-T-1B-1
3/5
→
TOP
To read length in centimeters, omit the final zero after the index line. To read length in millimeters, include the final zero.
LINEAR METRIC UNITS AND SYMBOLS
1000 millimeters (mm) = 1 meter(m)
100 centimeters (cm) = 1 meter
1000 meters (m) = 1 kilometer


SWANSON
13-13-0084
VC-T-1B-1
4/5
→
TOP

13-13-0084
VC-T-1B-1
4/5
→
TOP
SWANSON
AE141

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/05/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1B-1** SAMPLE: **1/5** [Block 1]
DEPTH: 0.0 - 0.81 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T1B1-1/5
SAMPLE DESCRIPTION: Dark gray sand with silt and trace shell (SP-SM)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

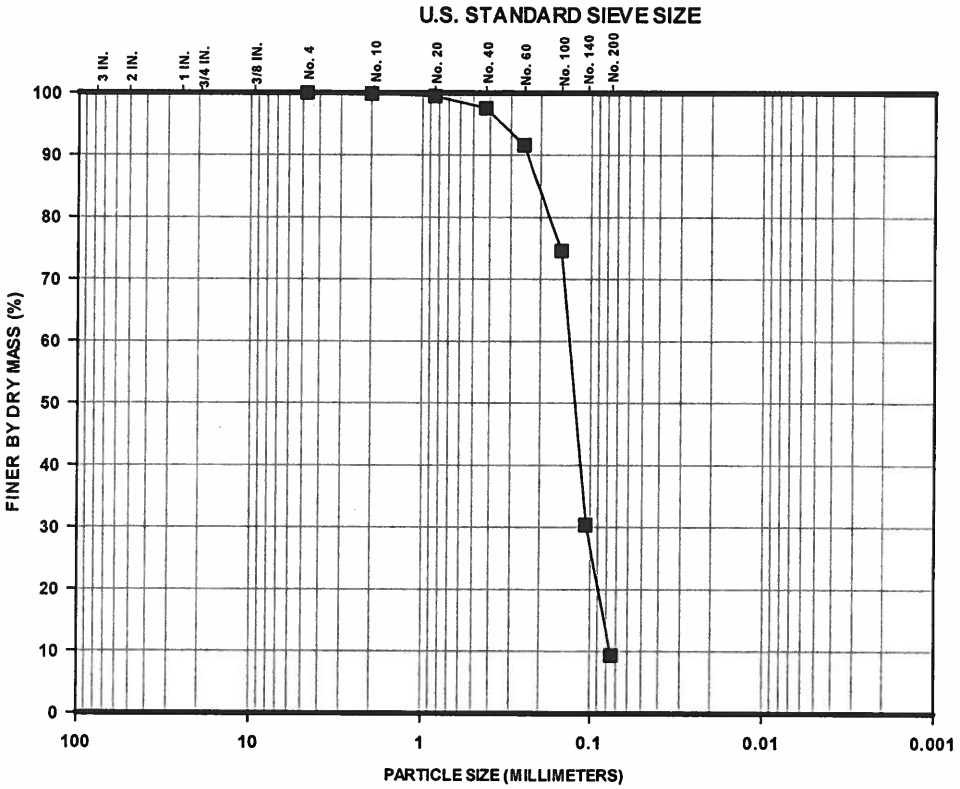
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 24.4
Mass Dry Solids (grams): 172.72

G_s: 2.71 ☐ Assumed ☒ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	99.5	97.6	91.6	74.6	30.4	9.4	---	---	---

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Checked By: TM Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/02/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1B-1** SAMPLE: **2/5** [Block 1]
DEPTH: 0.81 – 1.81 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T1B1-2/5
SAMPLE DESCRIPTION: Dark gray sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

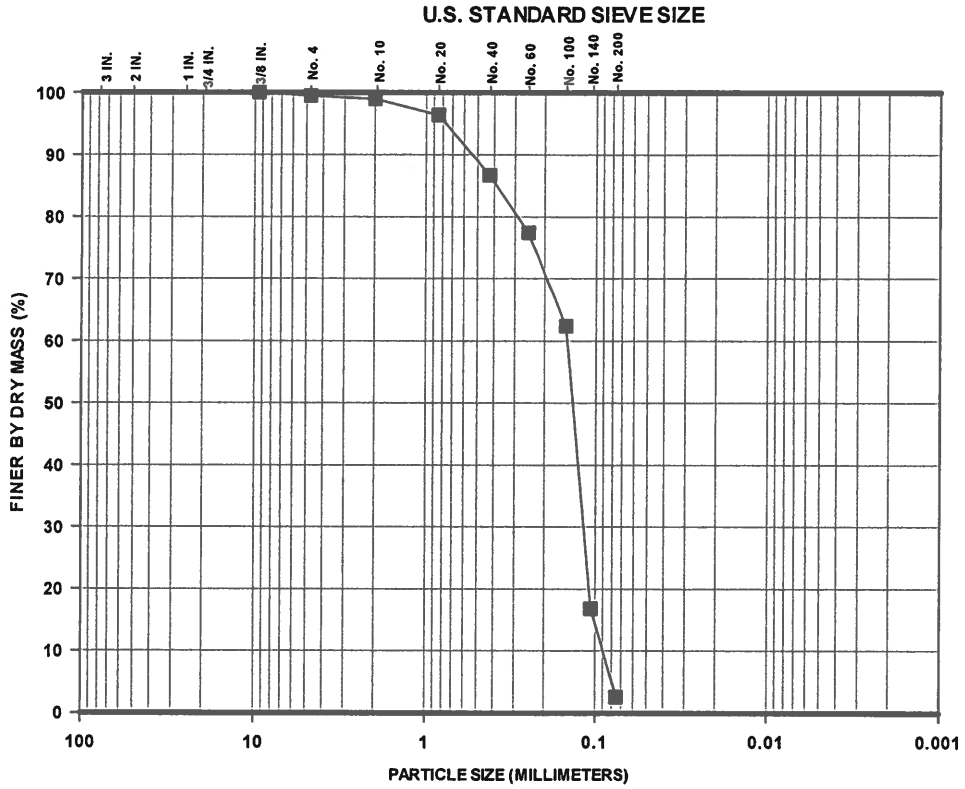
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 15.2
Mass Dry Solids (grams): 218.21

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.5	99.0	96.4	86.7	77.4	62.4	16.8	2.6	---	---	---

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Checked By: TM Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/02/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1B-1** SAMPLE: **3/5** [Block 1]
DEPTH: 1.69 – 2.69 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T1B1-3/5
SAMPLE DESCRIPTION: Gray sand with silt and trace shell (SP-SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

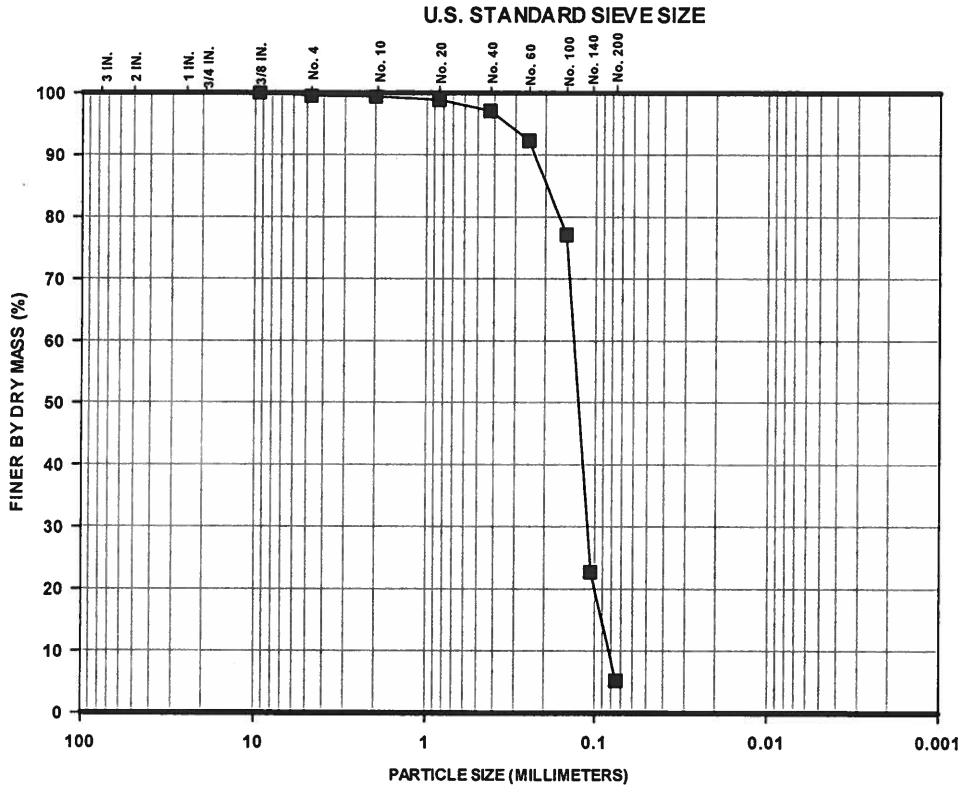
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 23.6
Mass Dry Solids (grams): 198.60

G_s: 2.71 ☐ Assumed ☒ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.5	99.4	98.9	97.1	92.3	77.1	22.7	5.2	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/02/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1B-1** SAMPLE: **4/5** [Block 1]
DEPTH: 2.69 – 3.69 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T1B1-4/5
SAMPLE DESCRIPTION: Dark gray sand with silt and trace shell (SP-SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

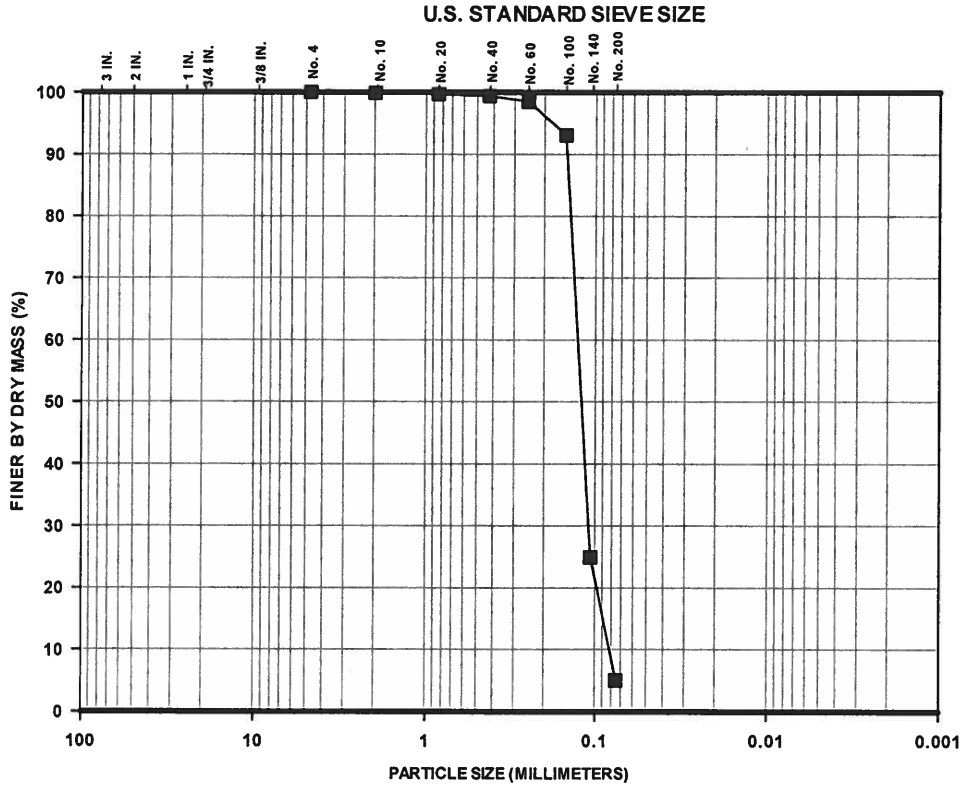
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 24.5
Mass Dry Solids (grams): 212.70

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): 0.5
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	99.7	99.4	98.5	93.1	24.9	5.0	---	---	---

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Checked By: _____ Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/02/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1B-1** SAMPLE: **5/5** [Block 1]
DEPTH: 3.69 – 4.69 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T1B1-5/5
SAMPLE DESCRIPTION: Brownish-gray sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

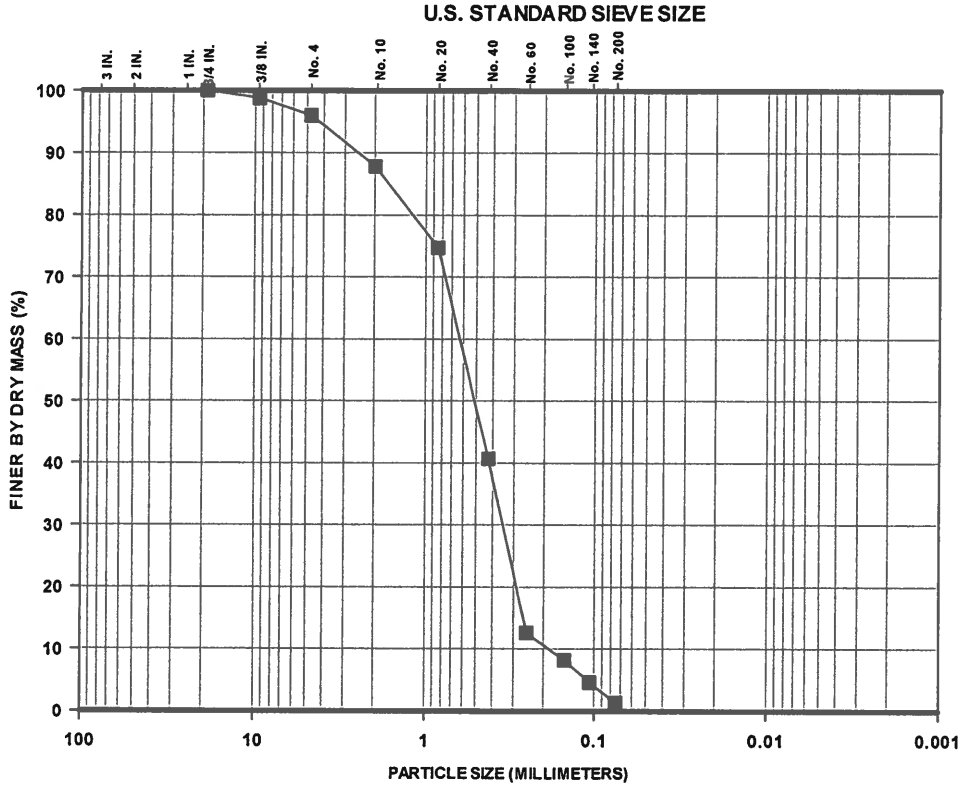
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 12.5
Mass Dry Solids (grams): 329.87

G_s: 2.69 ☐ Assumed ☒ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	98.8	96.0	87.8	74.7	40.7	12.6	8.2	4.6	1.3	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 08/21/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: ---
BORING: **PC-T1B-1** SAMPLE: 1/1 [Block 3]
DEPTH: 0.0– 0.75 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/PCT1B1
SAMPLE DESCRIPTION: Dark gray sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

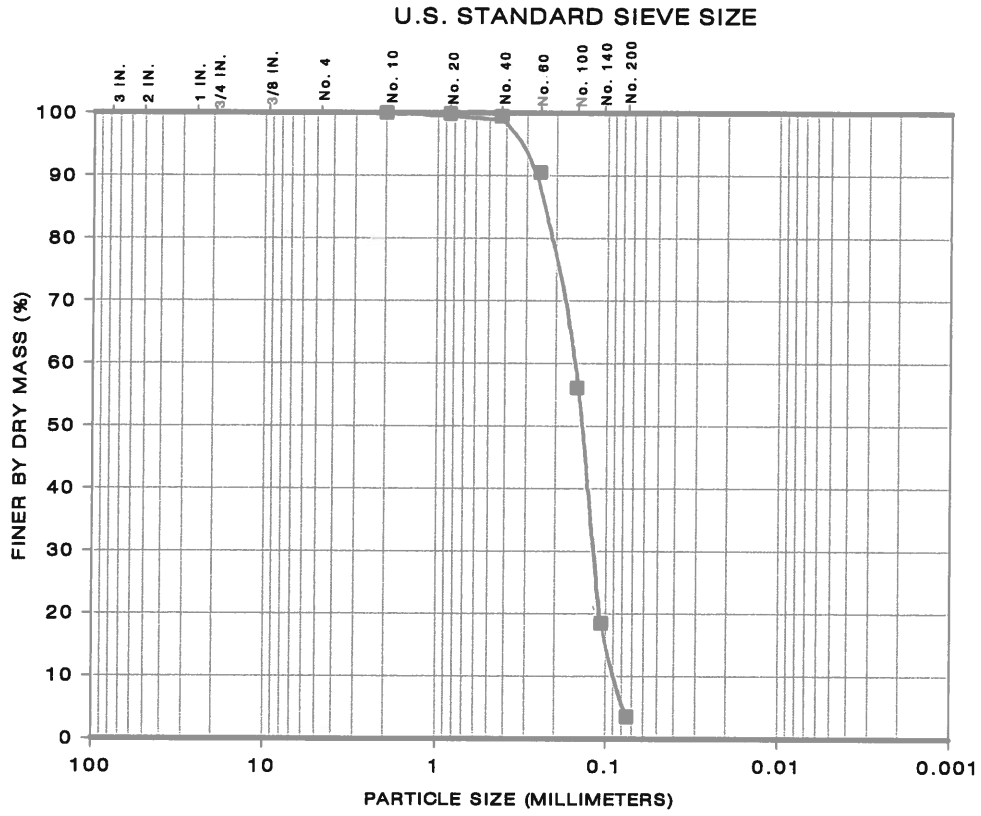
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 21.4
Mass Dry Solids (grams): 136.90

G_s: _____ ☐ Assumed ☐ Measured

Organic Content (%): _____
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	100	99.9	99.5	90.5	56.1	18.5	3.6	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: TM Date: 09/23/13

VOWTAP
File No.: 13-13-0084
August 20, 2013
Revision: 0 (ISSUED FOR USE)

TABLE B-4 EXTRUSION TEST REPORT FOR CORE VC-T1B-2

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Test Specimen Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)				
T1B	VC-T1B-2	1 / 4	0.0 - 0.84	84	Large void in soil along tube wall except lower 8.5 cm. Sample not sufficiently intact for determining tube density.	99.7	9.178	20.0	0.0	79.7	95	56.0	6,216	56.0	Gray sand with shell	SP	24.1 23.3 21.3 16.6	21.3	21.3	Not Applicable. Voids within tube. Test specimen density and saturation for lower 8.5 cm section of core [w_c = 21.3%].			--- 127.0	--- 104.7	--- 94	3.5			
		2 / 4	0.84 - 1.84	100	Large void in soil along tube wall except lower 13.2 cm. Sample not sufficiently intact for determining tube density.	90.3	9.178	3.0	0.0	87.3	87	87.3	11,363	87.3	Gray to dark gray sand with trace shell	SP	10.7 22.5 23.9 23.6 23.0 23.6 23.9 25.2	22.1	22.1	Not Applicable. Voids within tube. Test specimen density and saturation for lower 13.2 cm section of core [wc = 25.2%].			--- 122.7	--- 98.0	--- 94	4.3	0.5	1.7	2.70
		3 / 4	1.84 - 2.84	100	Large void in soil along tube wall except lower 19.3cm. Sample not sufficiently intact for determining tube density.	99.7	9.142	1.0	0.0	98.7	99	98.0	11,793	98.0	Dark gray sand with silt and shell	SP-SM	21.2 25.6 25.5 24.5 25.0 25.0	24.5	24.5	Not Applicable. Voids within tube. Test specimen density and saturation for lower 19.3 cm section of core [w_c = 25.0%].			--- 123.0	--- 98.4	--- 96	5.6			
		4 / 4	2.84 - 3.97	113	Large void in soil along tube wall and 20.3 cm length completely void. Sample not sufficiently intact for determining tube density.	95.9	9.082	1.0	0.0	94.9	84	74.6	8,580	52.5	Gray sand with shell	SP	25.6 23.2	24.4	23.2	Not Applicable. Voids within tube. Intact block not available for measurement of specimen density.									
														11.5	Dark gray and brown sand with silt and shell	SP-SM	20.4 ---												
														20.3	Void	Void												
														10.6	Dark gray and brown sand with silt and shell	SP-SM	20.2 18.2 21.3 21.8	20.4					--- ---	--- ---	--- ---	--- 5.4	0.6	6.3	2.68

13-13-0084
VC-T1-B2
1/4
TOP
SWANSON
AE141

TOP
13-13-0084
VC-T1-B2
1/4
SWANSON
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA

13-13-0084
VC-T1-B2
2/4
→
TOP
SWANSON
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
MADE IN CHINA

13-13-0084
VC-T1-B2
2/4
→
TOP
SWANSON

13-13-0084

VC-T1B-2

2/4

13-13-0084
VC-T1-B2
3/4
→
TOP
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA

13-13-0084
VC-T1-B2
3/4
→
TOP

13-13-0084

VC-T1B-2

3/4

13-13-0084
VC-T1-B2
4/4
→
TOP
SWANSON
AE141

13-13-008
VC-T1-B2
4/4
TOP
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
MADE IN CHINA

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/07/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1B-2** SAMPLE: **1/4** [Block 1]
DEPTH: 0.0 - 0.84 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T1B2-1/2
SAMPLE DESCRIPTION: Gray sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

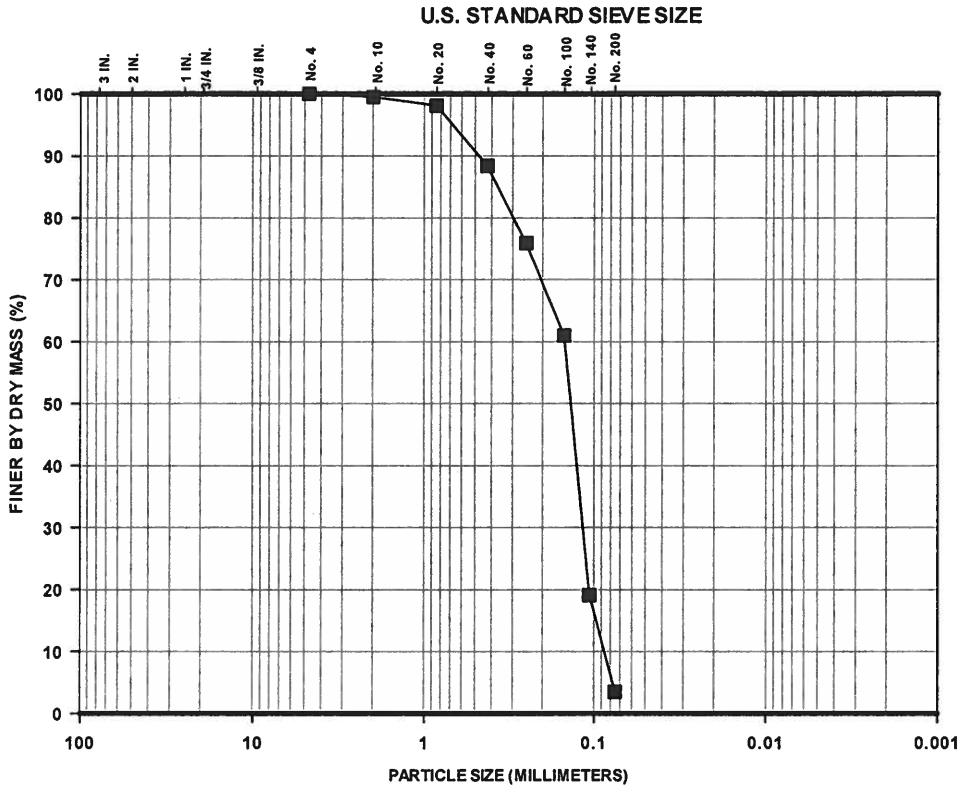
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 21.3
Mass Dry Solids (grams): 211.11

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.5	98.1	88.4	75.9	61.0	19.1	3.5	---	---	---

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Checked By: _____ Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/08/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1B-2** SAMPLE: **2/4** [Block 1]
DEPTH: 0.84 - 1.84 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T1B2-2/4
SAMPLE DESCRIPTION: Gray to dark gray sand with trace shell (SP)

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

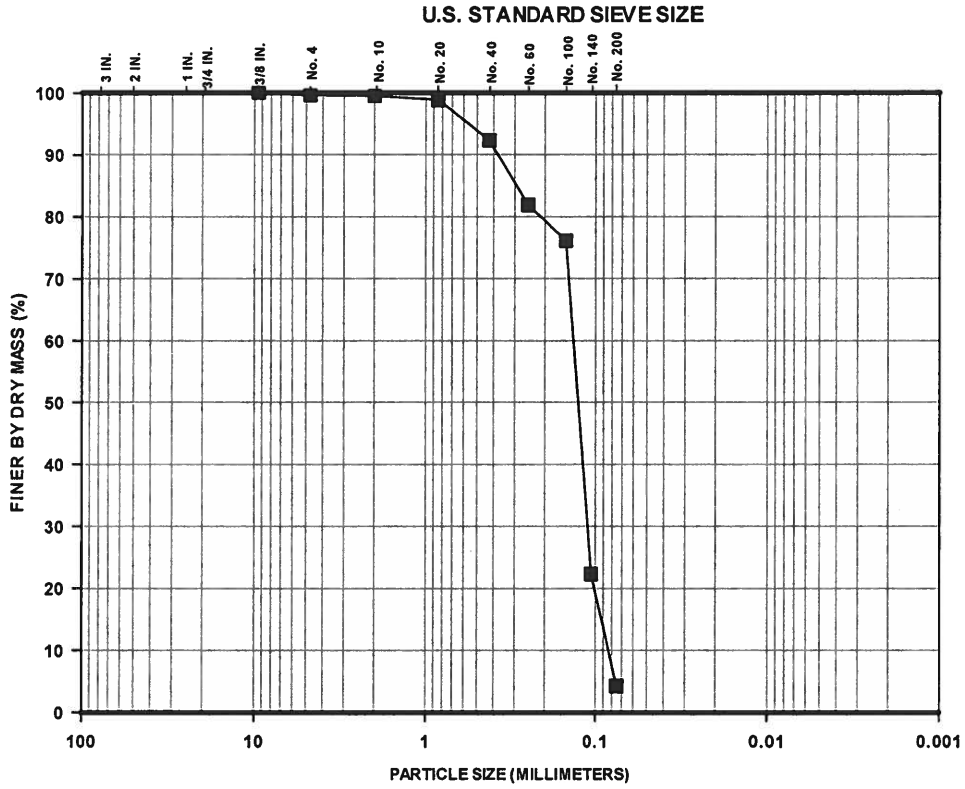
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 23.6
Mass Dry Solids (grams): 171.91

G_s: 2.70 ☐ Assumed ☒ Measured

Organic Content (%): 0.5
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.6	99.5	98.8	92.3	81.9	76.1	22.3	4.3	---	---	---

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Checked By: TM Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/07/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1B-2** SAMPLE: **3/4** [Block 1]
DEPTH: 1.84 – 2.84 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T1B2-3/4
SAMPLE DESCRIPTION: Dark gray sand with silt and shell (SP-SM)

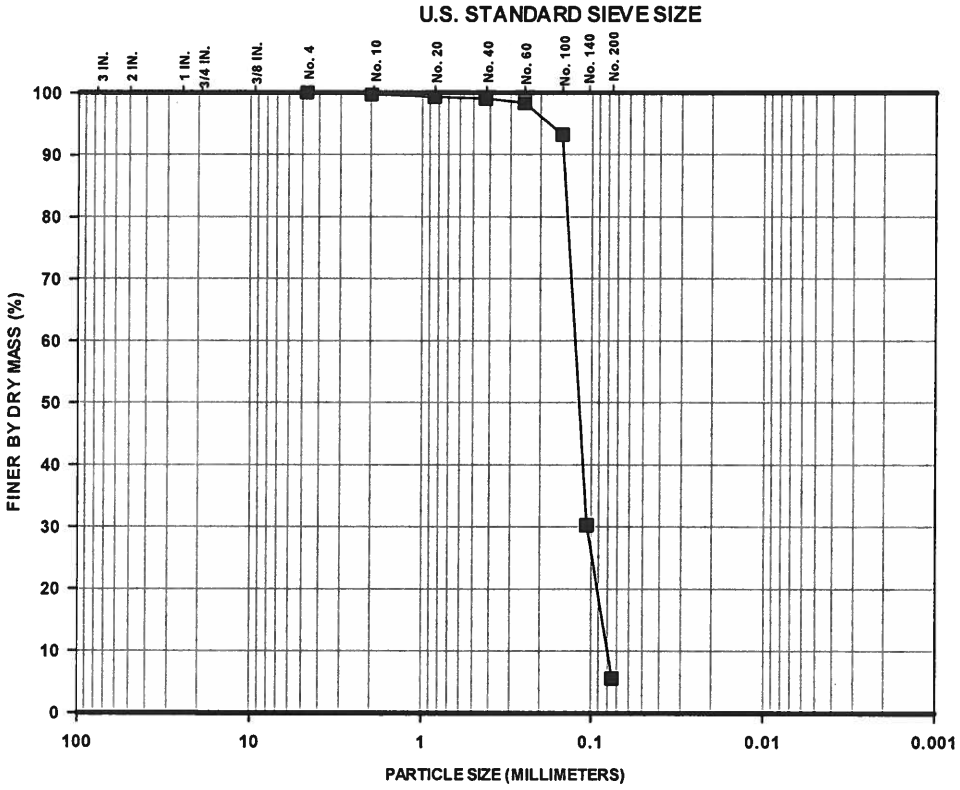
TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____
Dispersion Device: ☐ Apparatus A ☐ Apparatus B
Dispersion Period (hours): _____

Water Content (%): 24.5
Mass Dry Solids (grams): 159.95
G_s: --- ☐ Assumed ☐ Measured
Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.7	99.3	99.0	98.3	93.2	30.3	5.6	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: TW Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/08/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T1B-2** SAMPLE: **4/4** [Block 1]
DEPTH: 2.84 - 3.97 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T1B2-4/4
SAMPLE DESCRIPTION: Dark gray and brown sand with silt and shell (SP-SM)

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

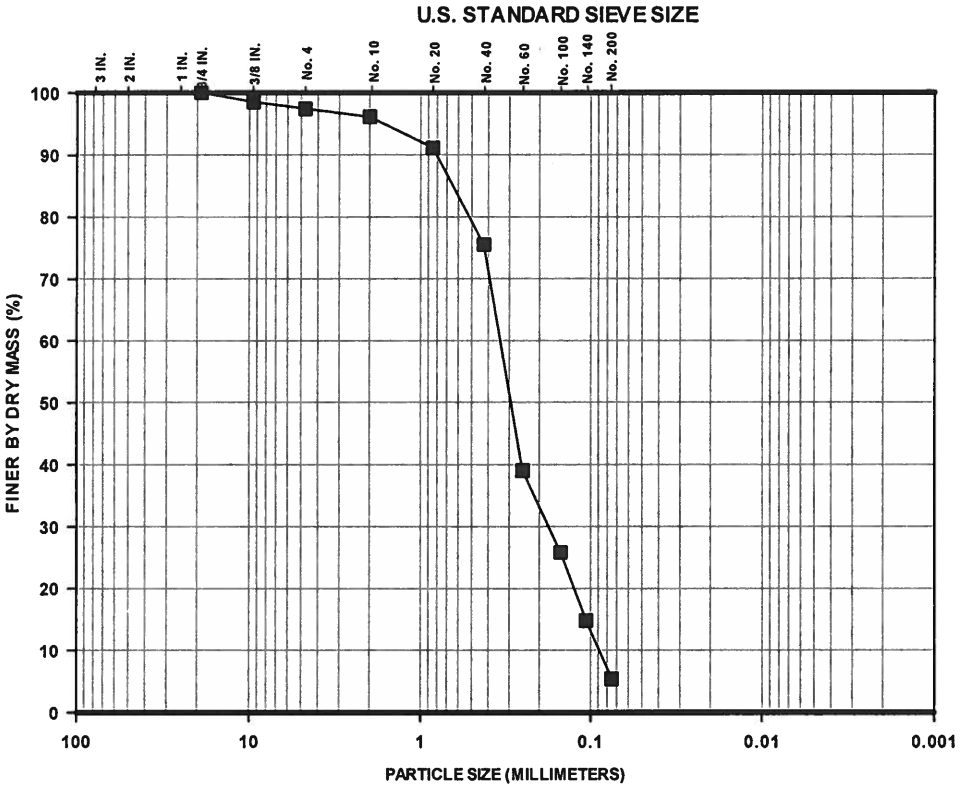
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 21.3
Mass Dry Solids (grams): 168.77

G_s: 2.68 ☐ Assumed ☒ Measured

Organic Content (%): 0.6
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	98.5	97.4	96.1	91.1	75.5	39.0	25.8	14.8	5.4	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: TW Date: 07/30/13

Attachment H-3

Appendix 3

GEOTECHNICAL TEST RESULTS

TURBINE STATION T2A AND T2B CORE HOLES

VOWTAP
File No.: 13-13-0084
September 23, 2013
Revision: 0 (ISSUED FOR USE) 08/20/13
Revision:1 (Add PC-T2A-1 & data to 2/5)

TABLE C-1 EXTRUSION TEST REPORT FOR CORE VC-T2A-1

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Test Specimen Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Atterberg Limits			Strength Index Tests	
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)					Liquid Limit, LL	Plastic Limit, PL	Plasticity Index, PI	s_u [TV] (kg/cm²)	s_u [LV] (kg/cm²)
T2A	VC-T2A-1	1 / 5	0.0 - 1.16	116	Multiple small voids throughout sample. Small amount of water drained from sample during removal of end cap.	100.3	9.170	25.5	0.0	74.8	64	75.1	9,463	16.5	Brown sand with shell	SP	10.6 11.9	11.3	18.4	119.6	101.0	75 [Gs=2.68]	--- ---	--- ---	--- ---	0.9								
														9.0	Dark gray sand with shell and lense of gray sandy clay		22.1	22.1					--- ---	--- ---	--- ---	--- ---	0.6							
														4.0	Brown sand with shell		---	---																	
														45.6	Dark gray sand with shell		17.8 21.6 21.8 22.5	20.9					--- ---	--- ---	--- ---	3.1							
		2 / 5	1.16 - 2.16	100	Void in soil along tube wall from 20 cm to 41 cm from top of sample. Sample not sufficiently intact for determining tube density.	100.3	9.129	20.0	0.0	100.3	100	79.5	9,402	17.0	Brownish-gray sand with shell and silt lenses		10.2	10.2																	
														62.5	Dark gray sand with silt, shell and lenses of clayey sand	SP-SM	15.1 24.9 24.0 24.5 19.1 21.1	21.5	19.0	Not Applicable. Voids within tube.			--- --- --- --- --- ---	--- --- --- --- --- ---	--- --- --- --- --- ---	10.3 11.1	0.7	3.6	2.69						
		3 / 5	2.16 - 3.16	100	Void in soil along tube wall from top of sample to 71 cm. Sample not sufficiently intact for determining tube density.	99.7	9.127	5.1	0.0	94.6	95	91.0	10,428	91.0	Brownish-gray sand with silt and trace shell	SP-SM	13.8 23.7 24.1 24.3 24.2 20.2	21.7	21.7	Not Applicable. Voids within tube. Test specimen density and saturation for lower 20.4 cm section of core [w_c = 22.9%].			--- --- --- 127.9	--- --- --- 104.1	--- --- --- 100	5.4 ---	--- ---	1.5	2.70						
		4 / 5	3.16 - 4.16	100	530 grams of free water drained from top of sample.	99.7	9.144	15.3	0.0	84.4	84	84.0	11,461	25.7	Gray silty sand	SM	23.9	23.9	23.4	129.2	104.6	100 [Gs=2.75]													
														11.0	Brown sandy gravel	GP	14.7	14.7																	
														11.0	Gray silty sand	SM	---	---																	
														3.5	Brown sandy gravel	GP	---	---																	
														4.5	Gray silty sand with lenses of gray lean clay	SM	26.5	26.5																	
														28.3	Dark gray lean clay with trace shell	CL	27.6 26.5 26.9 26.4 26.8 29.7 24.0	26.8					--- --- --- --- --- 122.6 ---	--- --- --- --- --- 94.5 ---	--- --- --- --- --- 100 ---	--- --- --- 92.6 --- 93.1 ---	--- 2.0 --- --- --- --- ---	--- 6.0 --- --- --- --- ---	--- 2.75 --- --- --- --- ---	--- 27 --- --- --- --- ---	--- 17 --- --- --- --- ---	--- 10 --- --- --- --- ---	0.30 --- 0.15	--- --- ---
		5 / 5	4.16 - 5.11	95	Soil appeared partially disturbed from 16 cm to 27 cm from top of sample	94.6	9.155	3.0	0.0	91.6	96	91.0	12,098	91.0	Dark gray silty clay with sand and trace shell	CL - ML	25.9 19.6 19.8 27.2 21.6 21.3 18.8 18.6 22.4 41.9	23.7	23.7	125.3	101.3	95 [Gs=2.72]	--- --- --- 130.1 130.7 129.1	--- --- --- 107.0 110.0 105.5	--- --- --- 100 94 100	--- 84.6 --- 88.4 79.8 87.3	--- 1.7	--- 6.6	--- ---	--- 24	--- 17	--- 7	--- ---	0.16

EXTRUSION TEST REPORT FOR CORE PC-T2A-1 [PISTON CORE SAMPLE]

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Test Specimen Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Atterberg Limits			Strength Index Tests	
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)					Liquid Limit, LL	Plastic Limit, PL	Plasticity Index, PI	s_u [TV] (kg/cm²)	s_u [LV] (kg/cm²)
T2A	PC-T2A-1	1 / 1	0.0-0.94	94	Voids in soil along tube wall between 74 and 80 cm from top of sample. Low water contents throughout sample.	84.8	6.664	1.0	0.0	83.8	89	84.0	5,426	84.0	Brown sand with shell	SP	10.4 2.5 2.3 2.8 5.8 13.3 18.5 13.9	8.7	8.7	115.8	106.5	41 [Gs=2.68]				0.3								

TOP
↓
5/11
VC-T2-A1
13-13-0084
SWANSON
AE141

13-13-008
VC-T2-A
1/5
TOP
AE141

13-13-0084
VC-T2-A1
2/5
TOP
SWANSON
AE141

TOP
↓
2/5
VC-T2-A1
13-13-0084
AE141

TOP
→
3/5
VC-T2-A1
13-13-0084
CONVERSIONS
inches x 25.4 = millimeters
inches x 2.54 = centimeters
feet x 30.48 = centimeters
feet x 0.3048 = meters
yards x 0.9144 = meters
miles x 1.609344 = kilometers
SWANSON

13-13-0084
VC-T2-A1
3/5
→
TOP
SWANSON®
AE141

TOP
↓
4/5
VC-T2-A1
13-13-0084
CONVERSIONS
inches x 25.4 = millimeters
inches x 2.54 = centimeters
feet x 30.48 = centimeters
feet x 0.3048 = meters
yards x 0.9144 = meters
miles x 1.609344 = kilometers
SWANSON

TOP
↓
4/5
VC-T2-A1
13-13-0084
SWANSON®
AE141

13-13-0084

VC-T2A-1

TOP
13-13-0084
VC-T2-A1
5/5
CONVERSIONS
inches x 25.4 = millimeters
inches x 2.54 = centimeters
feet x 30.48 = centimeters
feet x 0.3048 = meters
yards x 0.9144 = meters
miles x 1.609344 = kilometers

TOP
13-13-0084
VC-T2-A1
5/5
SWANSON
AE141

13-13-0084

VC-T2A-1

5/5

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/02/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2A-1** SAMPLE: **1/5** [Block 1]
DEPTH: 0.0 – 1.16 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2A1-1/5
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

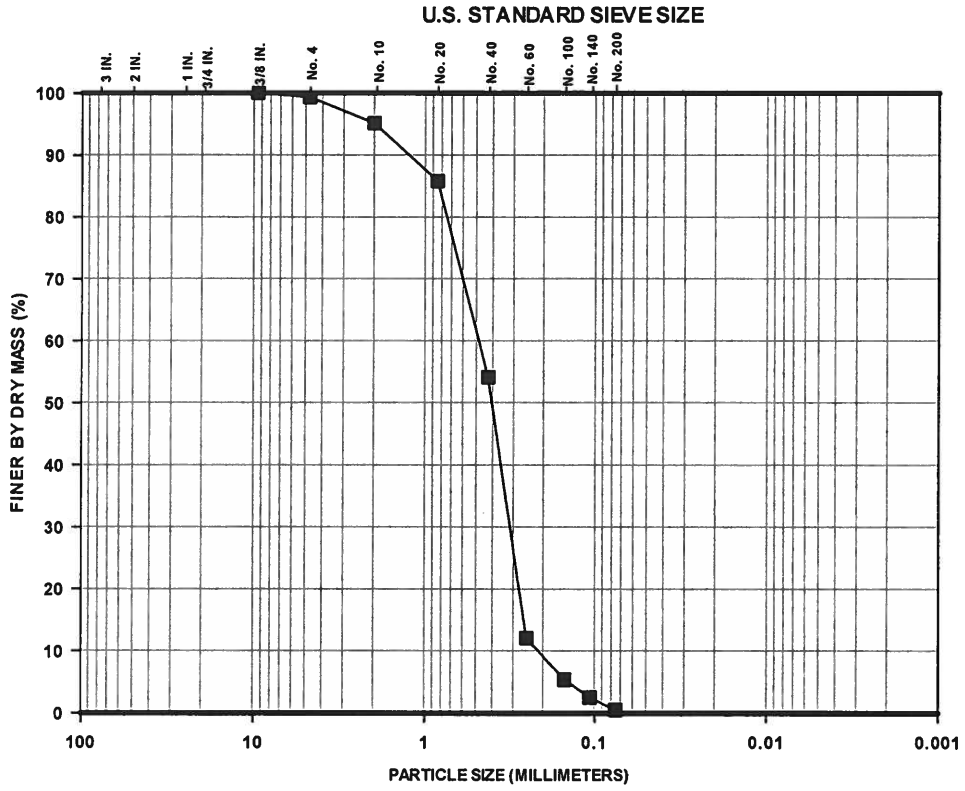
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 11.9
Mass Dry Solids (grams): 270.17

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.3	95.1	85.8	54.1	12.1	5.4	2.5	0.9	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/02/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2A-1** SAMPLE: **1/5** [Block 3]
DEPTH: 0.0 – 1.16 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2A1-1/5
SAMPLE DESCRIPTION: Dark gray sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

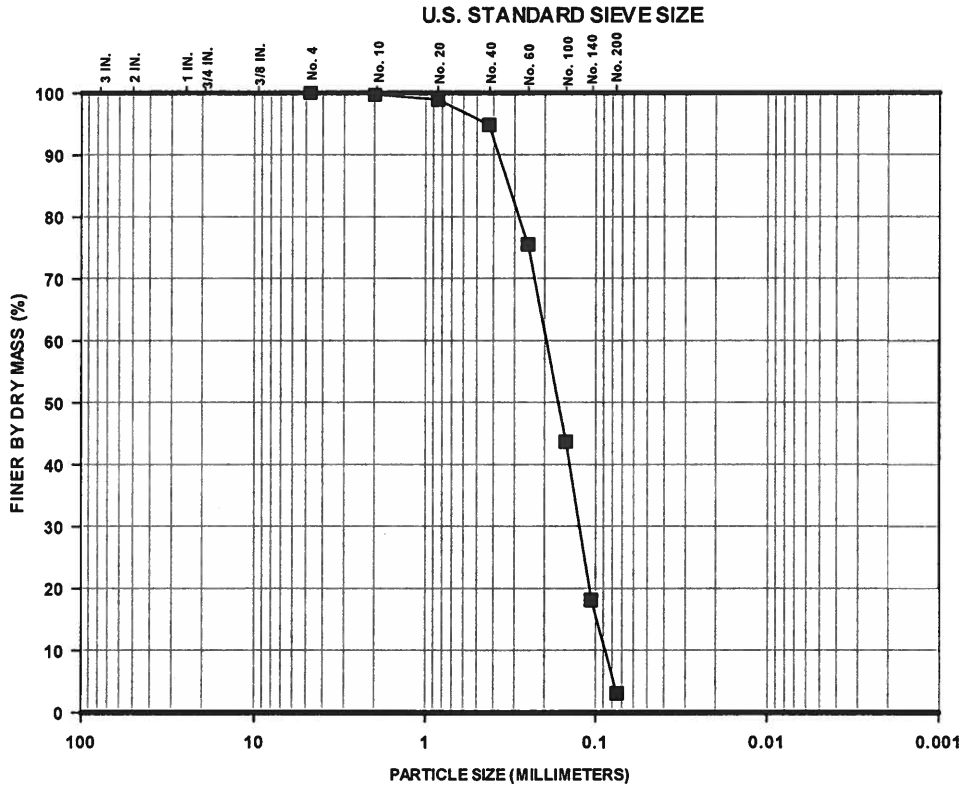
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 21.8
Mass Dry Solids (grams): 187.90

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.7	98.9	94.8	75.5	43.7	18.1	3.1	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: TW Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/15/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2A-1** SAMPLE: **2/5** [Block 1]
DEPTH: 1.16 – 2.16 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2A1-2/5
SAMPLE DESCRIPTION: Dark gray sand with silt and shell (SP-SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

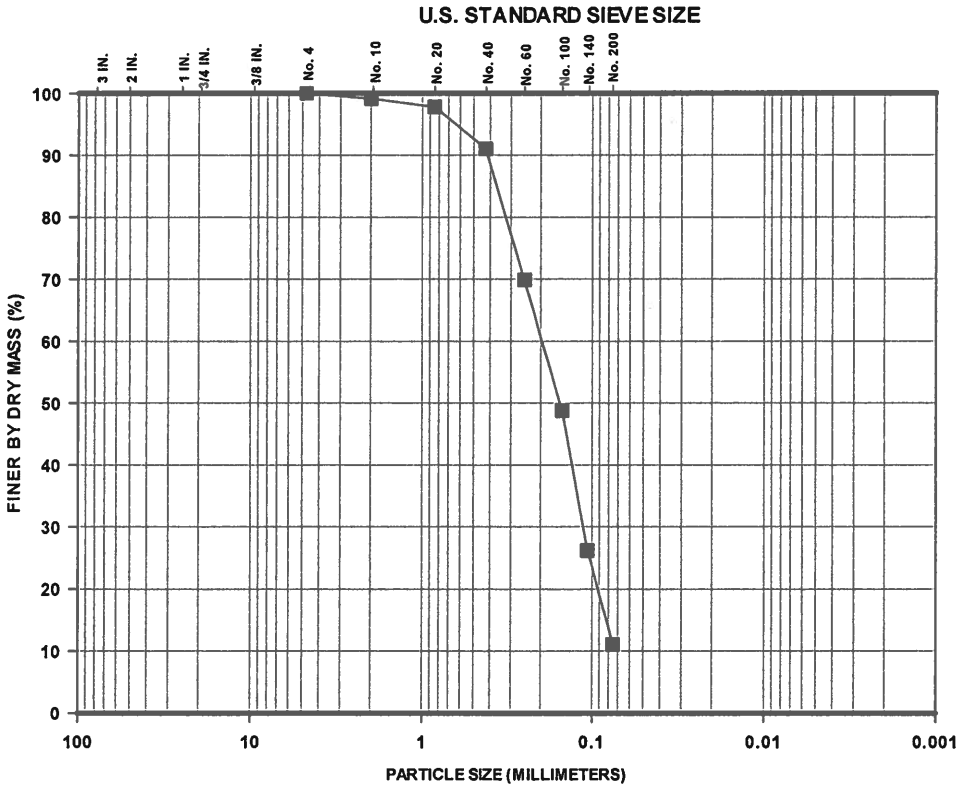
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 24.5
Mass Dry Solids (grams): 145.39

G_s: 2.69 ☐ Assumed ☒ Measured

Organic Content (%): 0.7
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.1	97.8	91.0	69.9	48.8	26.2	11.1	---	---	---

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Checked By: _____ Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/03/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2A-1** SAMPLE: **3/5** [Block 1]
DEPTH: 2.16 – 3.16 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2A1-3/5
SAMPLE DESCRIPTION: Brownish-gray sand with silt and trace shell (SP-SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

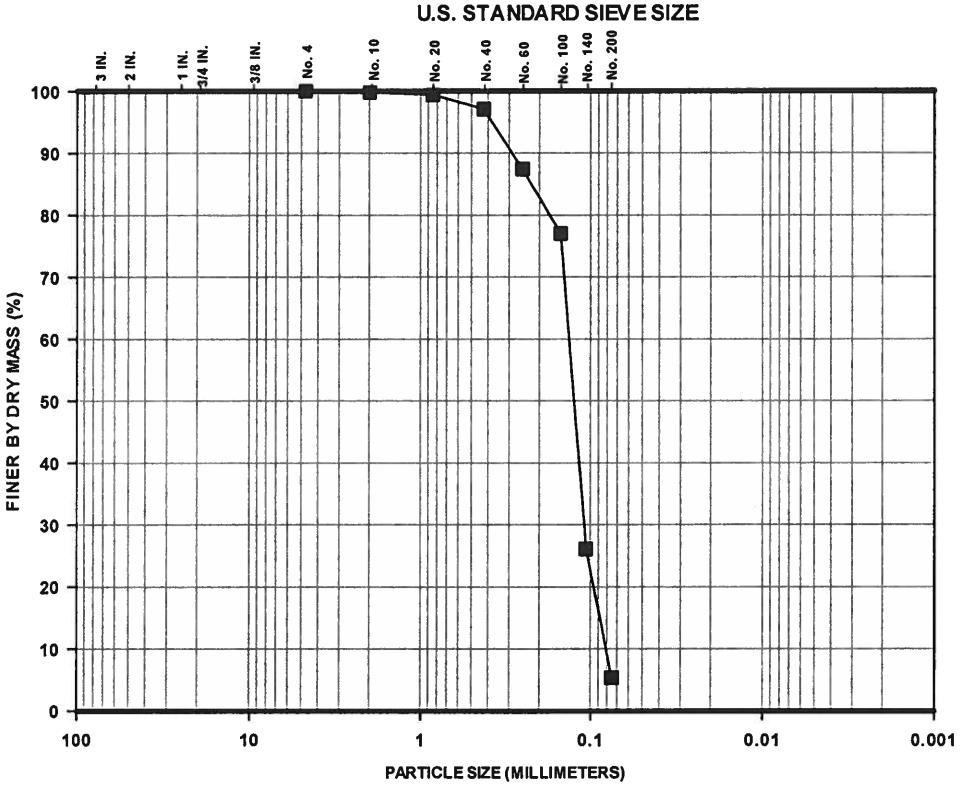
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 24.3
Mass Dry Solids (grams): 198.14

G_s: 2.70 ☐ Assumed ☒ Measured

Organic Content (%): _____
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.8	99.4	97.1	87.4	77.0	26.1	5.4	---	---	---

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Checked By: TM Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/09/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2-A1** SAMPLE: **4/5**
DEPTH: 3.16 – 4.16 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2A14/5
SAMPLE DESCRIPTION: Dark gray lean clay with trace shell (CL)

TEST PROCEDURES

ASTM Standard D422:
☐ Sieve Analysis
☐ Hydrometer Analysis
☒ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☒ Sodium Hexametaphosphate ☐ Other _____

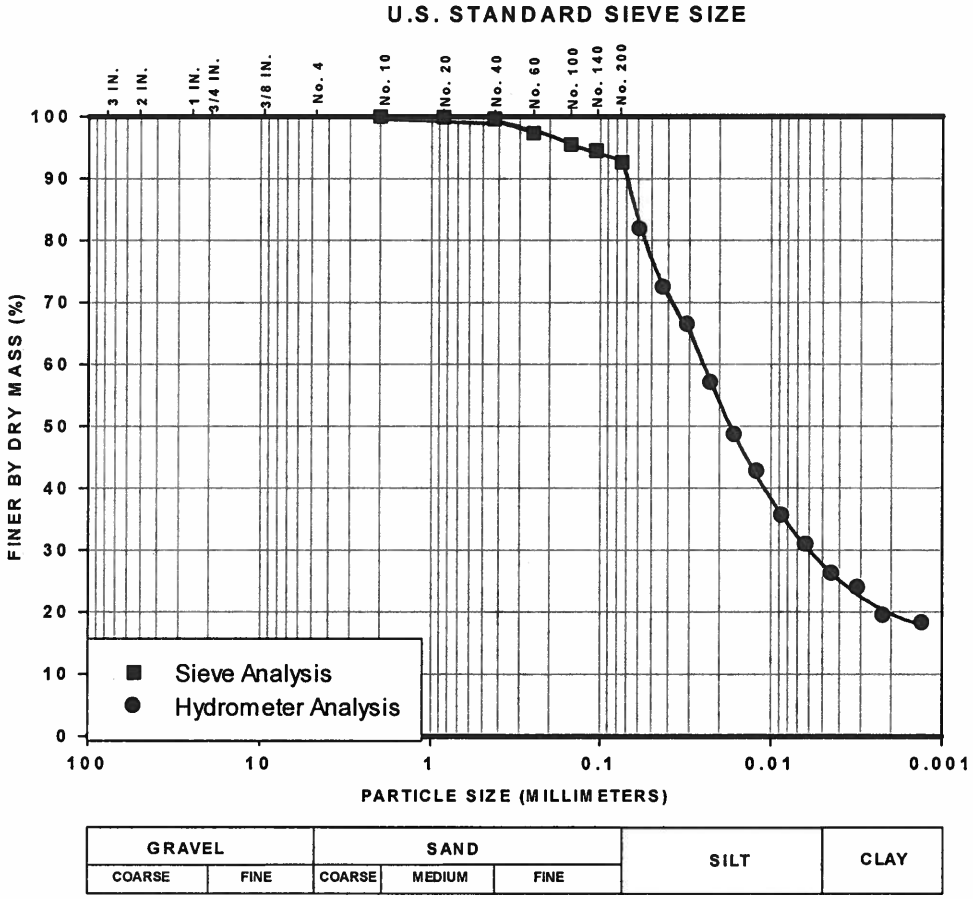
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): >24

Water Content (%): 26.4
Mass Dry Solids (grams): 41.95

G_s: 2.75 ☐ Assumed ☒ Measured

Organic Content (%): 2.0
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	100	99.9	99.6	97.3	95.5	94.5	92.6	27.7	19.0	17.7

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: TM Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2A-1** SAMPLE: **5/5** [Block 1]
DEPTH: 4.16 – 5.11 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2A1-5/5
SAMPLE DESCRIPTION: Dark gray silty clay with sand (CL-ML)
ASTM D4318-Method A: LL=24; PI=7

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

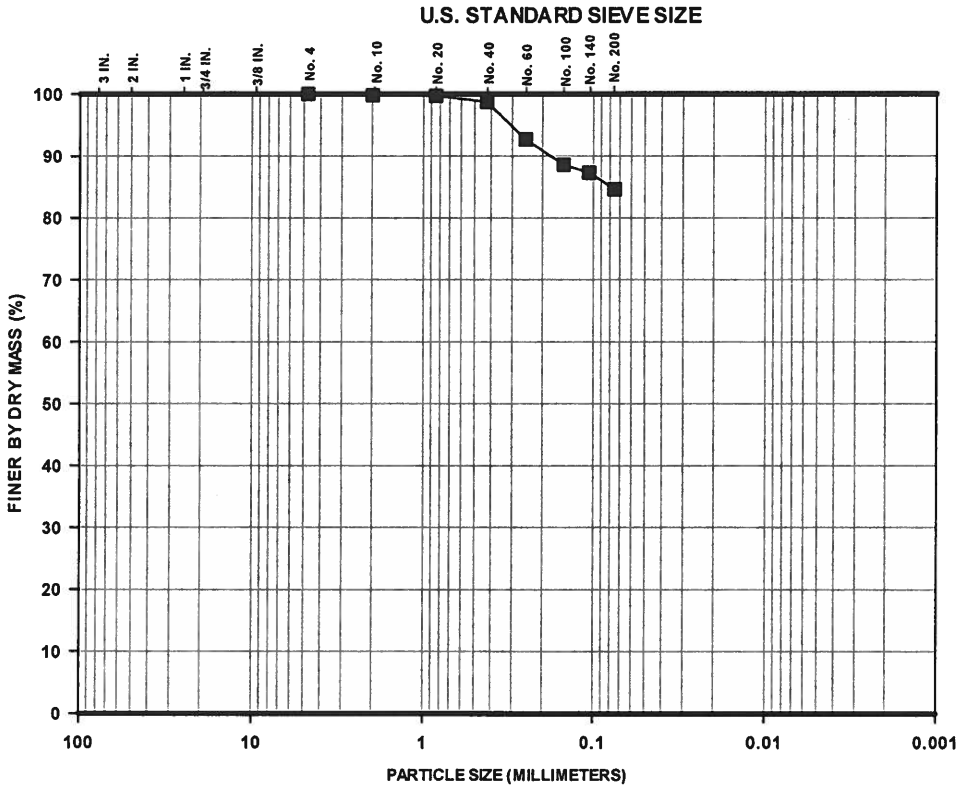
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 19.6
Mass Dry Solids (grams): 131.03

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): 1.7
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.8	99.7	98.7	92.7	88.6	87.3	84.6	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: TM Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 08/21/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: ---
BORING: **PC-T2A-1** SAMPLE: 1/1 [Block 3]
DEPTH: 0.0– 0.34 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/PCT2A1
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

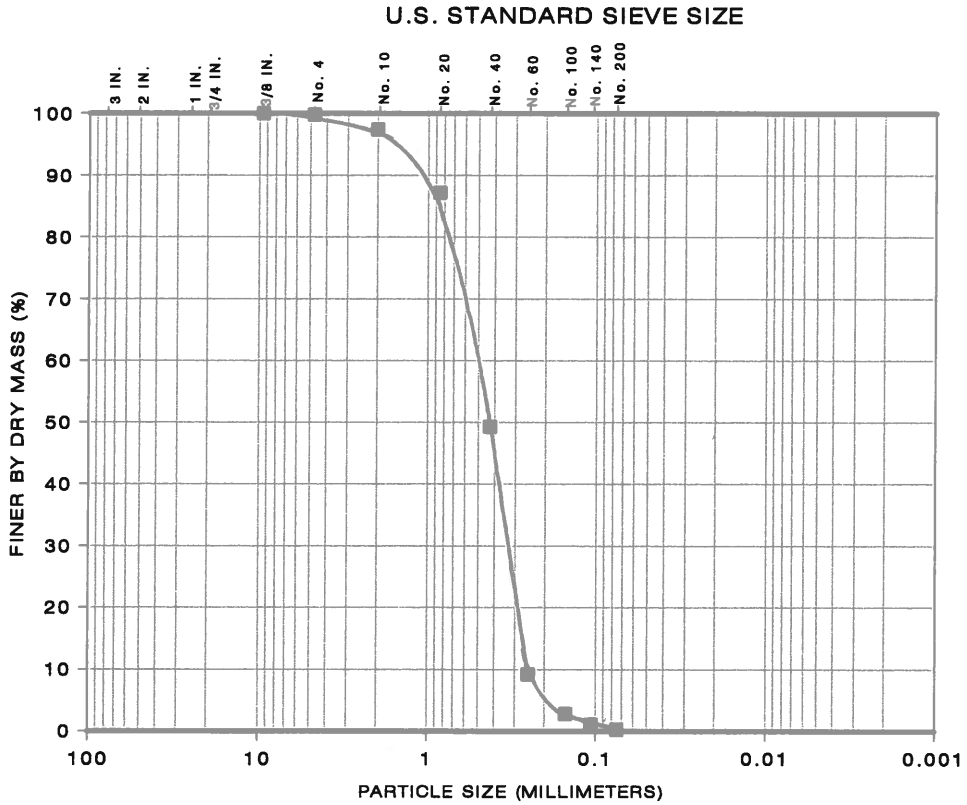
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 2.8
Mass Dry Solids (grams): 151.23

G_s: _____ ☐ Assumed ☐ Measured

Organic Content (%): _____
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.8	97.4	87.2	49.3	9.2	2.8	1.1	0.3	---	---	---

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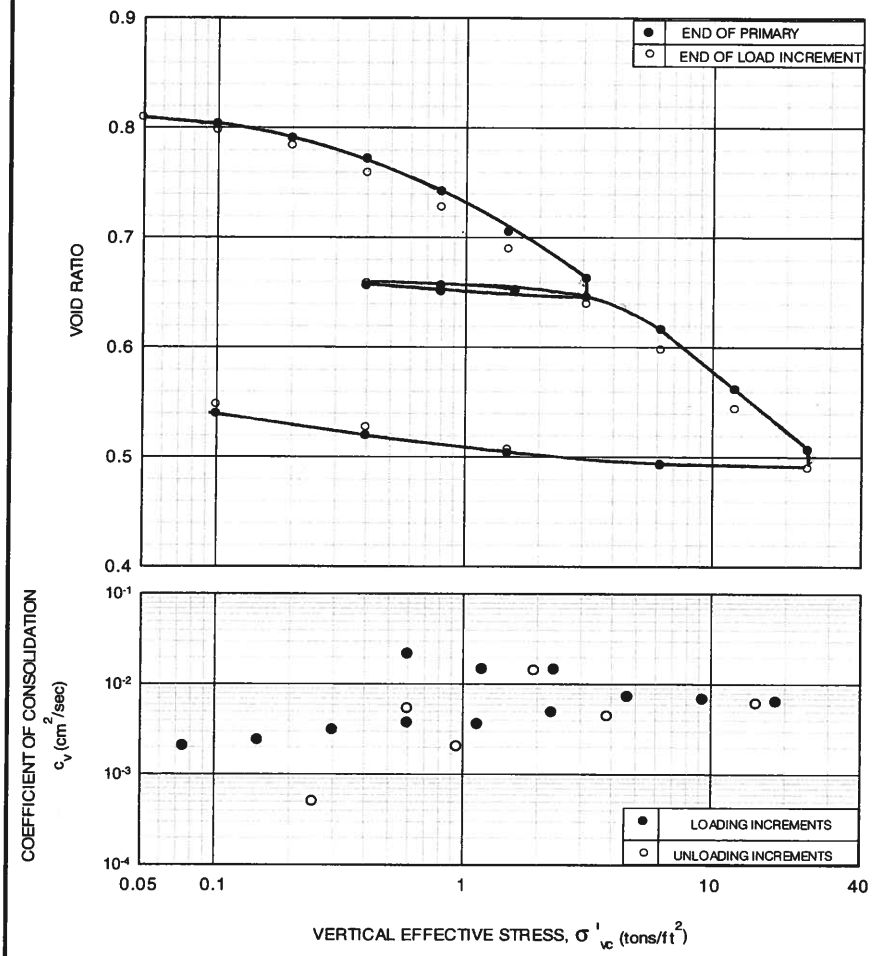
Checked By: _____ Date: 09/23/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
ONE-DIMENSIONAL INCREMENTAL LOADING CONSOLIDATION TEST REPORT

CLIENT: Dominion
PROJECT: VOWTAP
FILE NO.: 13-13-0084

INCOMING SAMPLE NO.: ---------
BORING: VC-T2A-1 SAMPLE: 4 / 5
DEPTH: 3.16 - 4.16 ☐ ft; ☑ m
LAB IDENTIFICATION NO.: 130084/T2A145
SAMPLE DESCRIPTION.: Dark gray lean clay with trace shell, CL

DATE SAMPLE RECEIVED: 06/27/13
DATE SAMPLE SET-UP: 07/02/13
DATE REPORTED: 08/12/13



Test Methods & Procedures

ASTM Standard D2435
- ☐ Method A
- ☑ Method B

c_v Interpretation Method
- ☐ c_v [Log Time]
- ☑ c_v [Sq. Root Time]

Trimming Method
- ☑ cutting shoe
- ☐ other_____

Initial Sample Diameter 9.14 (cm)

Test Conditions

- ☐ Tested at Natural Moisture Content
- ☑ Specimen Tested Inundated
  Inundated at σ'_{vc} 0.05 (tsf)
  Inundation Fluid:
  - ☑ tap water
  - ☐ other _____

Specimen Conditions

Parameter	Initial	Final
D (cm)	5.000	5.000
H (cm)	1.909	1.630
w_c (%)	29.7	20.0
γ_d (pcf)	94.5	110.7
e	0.816	0.551
S (%)	100	100

G_s: 2.75 ☐ Assumed ☑ Measured

Index Properties

LL	27
PL	17
PI	10

Particle-Size Analysis
☐ ASTM D422
☑ ASTM D1140-Method

Dry Mass(g): 56.75

U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Soil Passing (%, dry mass basis)	-----	-----	-----	-----	-----	-----	-----	-----	-----	93.1

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Where: H=Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; e = Void ratio; S = Saturation; G_s= Specific gravity; c_v = Coefficient of consolidation; and $C_{\alpha e}$ = Secondary compression index.

Checked By: TM Date: 08/12/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
ONE-DIMENSIONAL INCREMENTAL LOADING CONSOLIDATION TEST REPORT

CLIENT: Dominion
PROJECT: VOWTAP
FILE NO.: 13-13-0084

INCOMING SAMPLE NO.: ---------
BORING: VC-T2A-1 SAMPLE: 4 / 5
DEPTH: 3.16 - 4.16 ☐ ft; ☑ m
LAB IDENTIFICATION NO.: 130084/T2A145
SAMPLE DESCRIPTION.: Dark gray lean clay with trace shell, CL

DATE SAMPLE RECEIVED: 06/27/13
DATE SAMPLE SET-UP: 07/02/13
DATE REPORTED: 08/12/13 REVISED: 10/18/13

Effective Vertical Stress σ'_{vc} (tons/ft^2)	Void Ratio		Vertical Strain (%)		Coefficient of Consolidation (cm^2/sec) c_v [Log Time] ☐ c_v [Sq. Root Time] ☑	Coefficient of Permeability (cm/sec)	Secondary Compression Index, $C_{\alpha\varepsilon}$
	End of Primary Consolidation	End of Increment	End of Primary Consolidation	End of Increment			
0.0	--	0.816	--	0.00	--	--	-----
0.05	--	0.809	--	0.37	--	--	-----
0.10	0.803	0.797	0.72	1.02	2.0E-03	2.7E-07	0.001
0.20	0.790	0.783	1.42	1.80	2.4E-03 [cv(log t) =1.0E-3]	1.9E-07	0.002
0.40	0.771	0.759	2.46	3.15	3.1E-03 [cv(log t) =9.5E-4]	2.1E-07	0.004
0.80	0.742	0.727	4.09	4.88	3.7E-03 [cv(log t) =2.8E-3]	1.6E-07	0.005
1.50	0.705	0.689	6.12	6.97	3.6E-03 [cv(log t) =3.0E-3]	1.1E-07	0.005
3.10	0.662	0.645	8.45	9.40	4.9E-03	7.6E-08	0.006
0.80	0.650	0.652	9.12	9.01	1.4E-02	--	-----
0.40	0.656	0.658	8.82	8.70	5.3E-03	--	-----
0.80	0.656	0.655	8.81	8.84	2.1E-02	7.3E-08	-----
1.50	0.652	0.650	9.03	9.12	1.5E-02	6.1E-08	0.001
3.10	0.645	0.639	9.40	9.74	1.4E-02	5.7E-08	0.002
6.20	0.616	0.597	11.01	12.04	7.2E-03	5.5E-08	0.006
12.40	0.561	0.543	14.03	15.01	6.8E-03	3.3E-08	0.006
24.50	0.506	0.490	17.05	17.97	6.3E-03	1.6E-08	0.006
6.20	0.492	0.493	17.83	17.76	6.1E-03	--	-----
1.50	0.503	0.506	17.23	17.04	4.4E-03	--	-----
0.40	0.519	0.527	16.35	15.92	2.0E-03	--	-----
0.10	0.539	0.548	15.24	14.78	5.0E-04	--	-----

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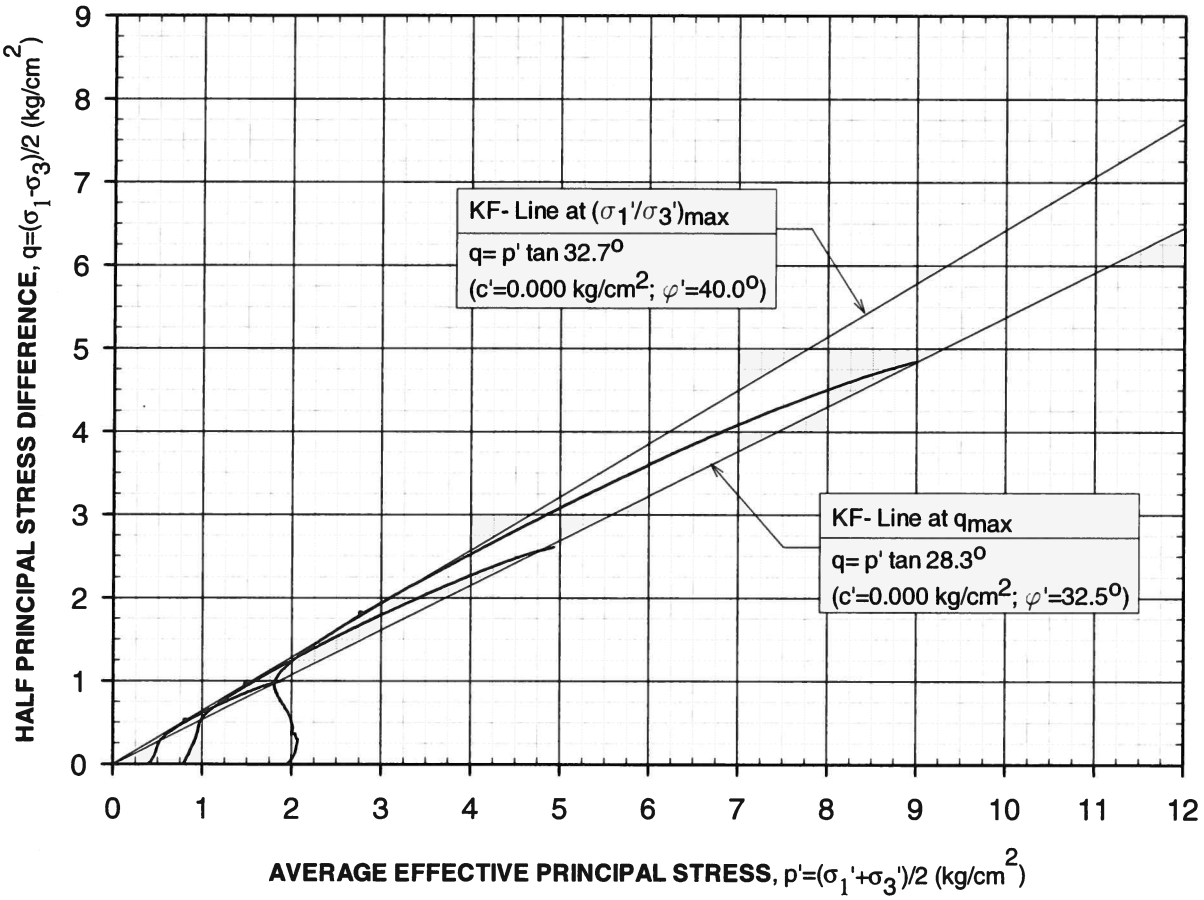
Checked By: JCW Date: 10/18/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
EFFECTIVE STRESS PATHS

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/24/13
DATE TEST SET-UP: 07/22/13
DATE REPORTED: 08/01/13 REVISED: 10/18/13

INCOMING SAMPLE NO.: -
BORING: **VC-T2A-1** SAMPLE: **5/5**
DEPTH: 4.16 – 5.11 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/T2A15/5
SAMPLE DESCRIPTION: Gray silty clay to gray silty clay with sand and trace shell (CL-ML)



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Checked By: JAW Date: 10/18/13

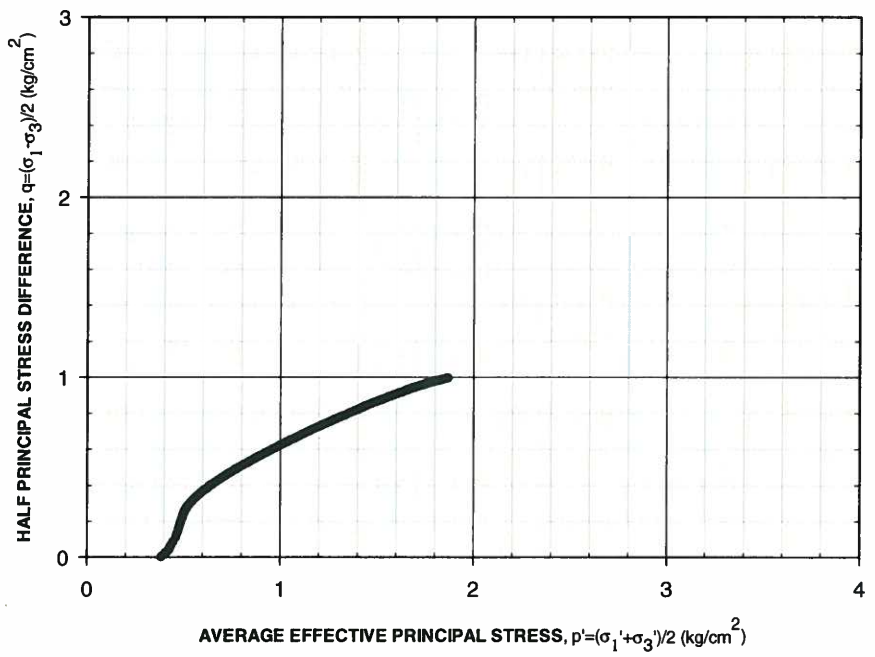
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/22/13
DATE REPORTED: 08/01/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2A-1** SAMPLE: **5/5**
DEPTH: 4.16 - 5.11 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/T2A15/5
SAMPLE DESCRIPTION: Gray silty clay with trace shell (CL-ML)

Specimen Dimensions			Initial Conditions			Test Conditions				Pre-shear Conditions					
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	u_b (kg/cm^2)	σ_c' (kg/cm^2)	$\dot{\varepsilon}$ (%/hour)	B-Factor (%)	ε_{vol} (%)	H_c (cm)	A_c (cm^2)	w_c (%)	γ_d (lb/ft^3)	S (%)
7.07	3.61	2.0	21.6	107.0	100	12.00	0.39	1.1	99	-4.3	7.02	9.86	19.0	111.8	100



TEST PROCEDURE: ASTM D4767

Specimen Mounting Method : ☐ Dry Method ☒ Wet Method

Filter Strip Correction Made : ☐ Yes ☒ No
Membrane Correction Made : ☐ Yes ☒ No

A_c Method: ☐ Method A ☒ Method B

w_c determined from: ☒ Entire Specimen ☐ Trimmings

SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Compacted	

☐ Tamped Uniform Lifts: No. of Lifts: ____

☐ Kneading: Blows per Lift: ____
No. of Lifts____ Spring:____lb

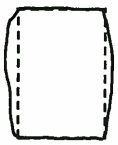
G_s: 2.72 ☒ Assumed ☐ Measured

Stresses and Strains at Failure

Failure Criteria	ε_a (%)	Δu (kg/cm^2)	σ_1' (kg/cm^2)	σ_3' (kg/cm^2)	p' (kg/cm^2)	q (kg/cm^2)
$[\sigma_1 - \sigma_3]_{max}$	14.6	-0.48	2.86	0.87	1.86	0.99
$[\sigma_1' / \sigma_3']_{max}$	2.8	0.09	1.33	0.30	0.82	0.51

FAILURE SKETCH

☐ Diagonal Plane
☒ Bulging
☐ Combination
☐ Other ____



Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☒ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	124.06	Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	88.4

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c' = Isotropic effective confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_{vol} = Volume change(- denotes consolidation, + denotes swelling); H_c = Consolidated height; A_c = Consolidated area; ε_a = Axial strain; Δu = Excess pore pressure; σ_1' = Major effective principal stress; σ_3'= Minor effective principal stress; p' = Average effective principal stress; q = Half principal stress difference; and G_s = Specific gravity.

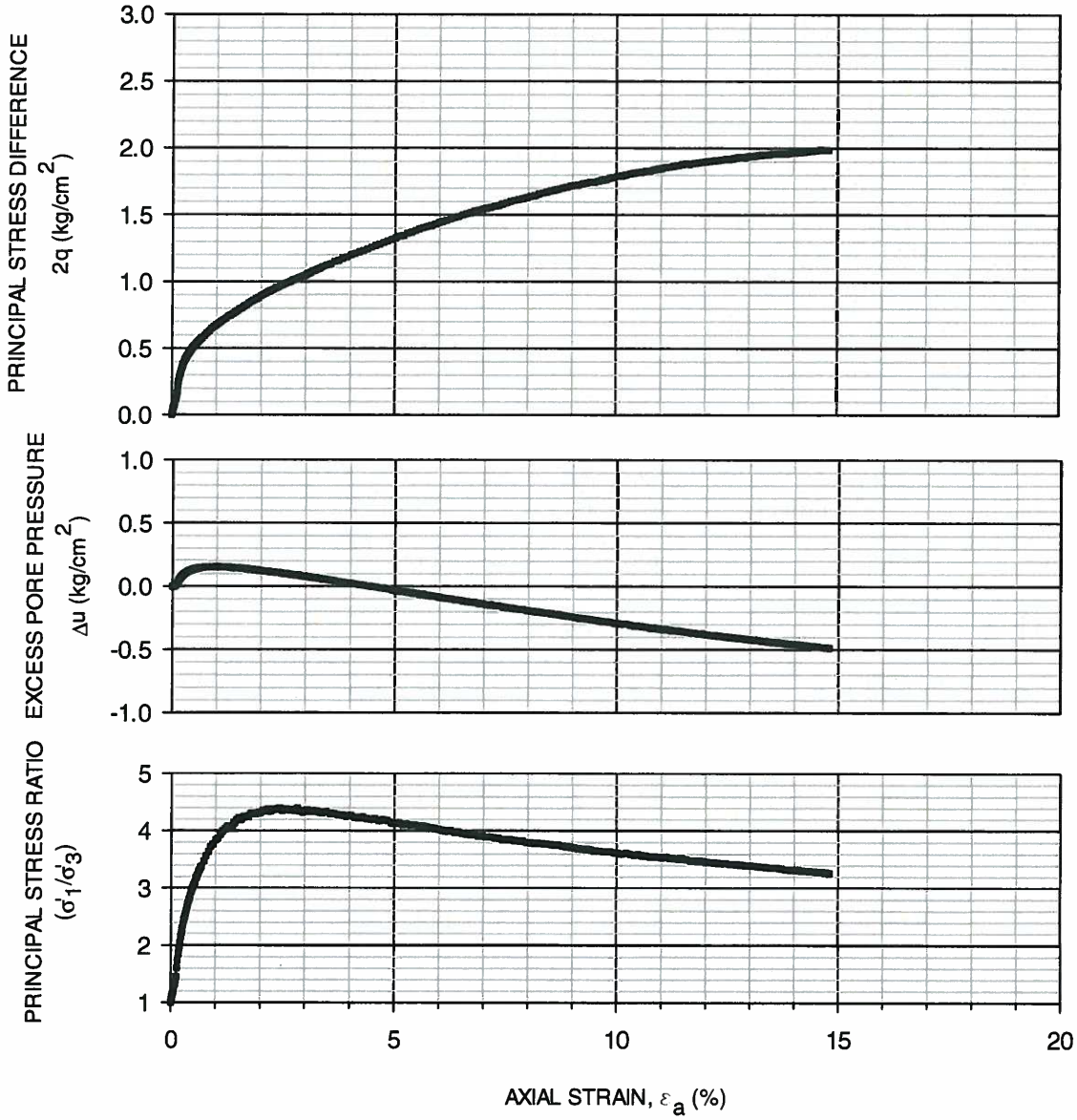
Checked By: TM Date: 08/01/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS - STRAIN CURVES

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/22/13
DATE REPORTED: 08/01/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2A-1** SAMPLE: **5/5**
DEPTH: 4.16 - 5.11 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T2A15/5
SAMPLE DESCRIPTION: Gray silty clay with trace shell (CL-ML)
Consolidation Stress = 0.39 kg/cm^2



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Where: Δu = Excess pore pressure; σ_1' = Major effective principal stress; and σ_3'= Minor effective principal stress.

Checked By: TM Date: 08/01/13

BORING: VC T2 A1 SAMPLE: 5/5 DEPTH: _____ ☐ ft; ☐ m BLOCK: 3

TYPE SAMPLE: ☐ UNDISTURBED; ☐ COMPACTED; ☐ OTHER _____

TYPE TEST: ☒ CIUC; ☐ UU; ☐ $\overline{UU}$; ☐ CD ☐ OTHER _____

SAMPLE DESCRIPTION: gry clayey Silt

ge

L/D

1.757

0.84

☐ Measure

☒ 1 Co doms

☐ ____ Thi Membra

0.4

σ_c (kg/cm^2): 12.39 u_b (kg/cm^2) 12.0

$\bar{\sigma}_c$ Stages (kg/cm^2): 0.39 ; ____

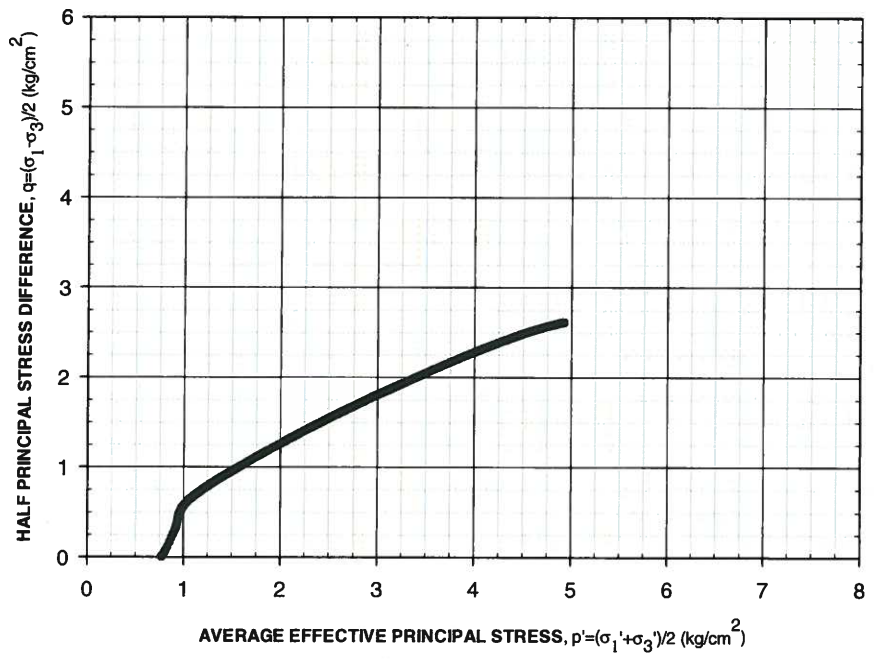
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/22/13
DATE REPORTED: 08/01/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2A-1** SAMPLE: **5/5**
DEPTH: 4.16 – 5.11 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/T2A15/5
SAMPLE DESCRIPTION: Gray silty clay with sand and trace shell (CL-ML)

Specimen Dimensions			Initial Conditions			Test Conditions				Pre-shear Conditions					
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	u_b (kg/cm^2)	σ_c' (kg/cm^2)	$\dot{\varepsilon}$ (%/hour)	B-Factor (%)	ε_{vol} (%)	H_c (cm)	A_c (cm^2)	w_c (%)	γ_d (lb/ft^3)	S (%)
6.95	3.68	1.9	18.8	110.0	94	12.00	0.78	1 .1	99	-5.3	6.90	10.14	16.9	116.2	100



TEST PROCEDURE: ASTM D4767

Specimen Mounting Method : ☐ Dry Method ☒ Wet Method

Filter Strip Correction Made : ☐ Yes ☒ No
Membrane Correction Made : ☐ Yes ☒ No

A_c Method: ☐ Method A ☒ Method B

w_c determined from: ☒ Entire Specimen ☐ Trimmings

SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Compacted	

☐ Tamped Uniform Lifts: No. of Lifts: _____

☐ Kneading: Blows per Lift: _____
No. of Lifts_____Spring:_____lb

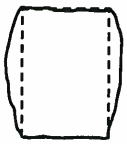
G_s: 2.72 ☒ Assumed ☐ Measured

Stresses and Strains at Failure

Failure Criteria	ε_a (%)	Δu (kg/cm^2)	σ_1' (kg/cm^2)	σ_3' (kg/cm^2)	p' (kg/cm^2)	q (kg/cm^2)
$[\sigma_1 - \sigma_3]_{max}$	14.9	-1.54	7.54	2.32	4.93	2.61
$[\sigma_1' / \sigma_3']_{max}$	2.4	0.23	2.45	0.55	1.50	0.95

FAILURE SKETCH

☐ Diagonal Plane
☒ Bulging
☐ Combination
☐ Other _____



Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☒ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	130.36	Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	79.8

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c' = Isotropic effective confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_{vol} = Volume change(- denotes consolidation, + denotes swelling); H_c = Consolidated height; A_c = Consolidated area; ε_a = Axial strain; Δu = Excess pore pressure; σ_1' = Major effective principal stress; σ_3'= Minor effective principal stress; p' = Average effective principal stress; q = Half principal stress difference; and G_s = Specific gravity.

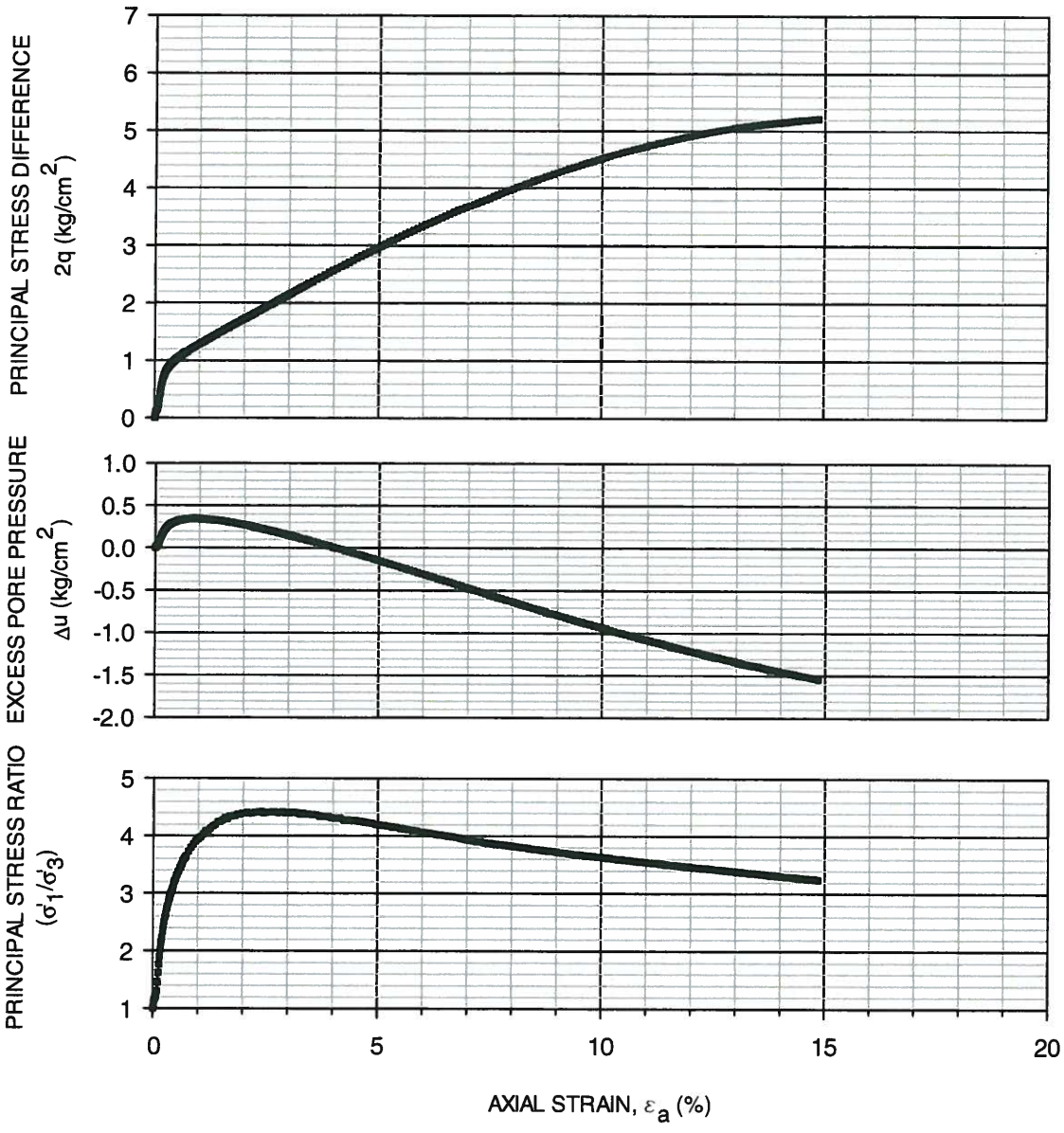
Checked By: TM Date: 08/01/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS - STRAIN CURVES

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/22/13
DATE REPORTED: 08/01/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2A-1** SAMPLE: **5/5**
DEPTH: 4.16 - 5.11 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T2A15/5
SAMPLE DESCRIPTION: Gray silty clay with sand and trace shell (CL-ML)
Consolidation Stress = 0.78 kg/cm^2



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Where: Δu = Excess pore pressure; σ_1' = Major effective principal stress; and σ_3'= Minor effective principal stress.

Checked By: TM Date: 08/01/13

BORING: VC SAMPLE: T2 DEPTH: A1 5/5 ☐ ft; ☐ m BLOCK: 4

TYPE SAMPLE: ☒ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TYPE TEST: ☒ CIUC; ☐ UU; ☐ UU; ☐ CD ☐ OTHER

SAMPLE DESCRIPTION: Gray Br Silt w sand TR clay

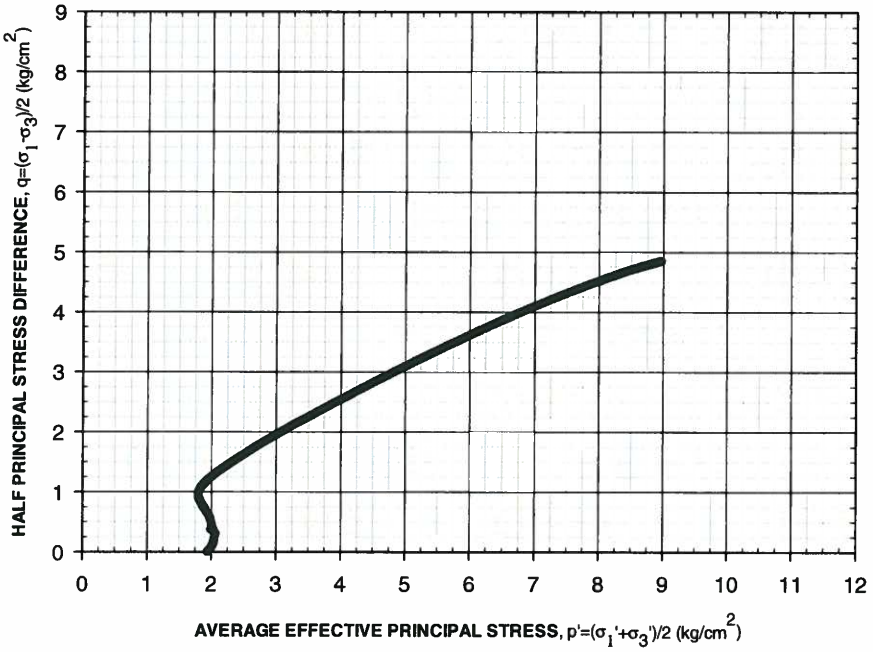
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/22/13
DATE REPORTED: 08/01/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2A-1** SAMPLE: **5/5**
DEPTH: 4.16 - 5.11 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/T2A15/5
SAMPLE DESCRIPTION: Gray silty clay with trace shell (CL-ML)

Specimen Dimensions			Initial Conditions			Test Conditions				Pre-shear Conditions					
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	u_b (kg/cm^2)	σ_c' (kg/cm^2)	$\dot{\varepsilon}$ (%/hour)	B-Factor (%)	ε_{vol} (%)	H_c (cm)	A_c (cm^2)	w_c (%)	γ_d (lb/ft^3)	S (%)
7.04	3.61	2.0	22.4	105.5	100	11.00	1.95	1.0	99	-3.8	6.98	9.90	20.1	109.7	100



TEST PROCEDURE: ASTM D4767

Specimen Mounting Method : ☐ Dry Method ☒ Wet Method

Filter Strip Correction Made : ☐ Yes ☒ No
Membrane Correction Made : ☐ Yes ☒ No

A_c Method: ☐ Method A ☒ Method B

w_c determined from: ☒ Entire Specimen ☐ Trimmings

SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Compacted	

☐ Tamped Uniform Lifts: No. of Lifts: _____

☐ Kneading: Blows per Lift: _____
No. of Lifts_____Spring:_____lb

G_s: 2.72 ☒ Assumed ☐ Measured

Stresses and Strains at Failure

Failure Criteria	ε_a (%)	Δu (kg/cm^2)	σ_1' (kg/cm^2)	σ_3' (kg/cm^2)	p' (kg/cm^2)	q (kg/cm^2)
$[\sigma_1 - \sigma_3]_{max}$	15.1	-2.19	13.8	4.14	8.98	4.84
$[\sigma_1' / \sigma_3']_{max}$	3.8	0.97	4.57	0.98	2.78	1.80

FAILURE SKETCH

☐ Diagonal Plane
☐ Bulging
☒ Combination
☐ Other _____

Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☒ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	121.53	Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	87.3

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c' = Isotropic effective confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_{vol} = Volume change(- denotes consolidation, + denotes swelling); H_c = Consolidated height; A_c = Consolidated area; ε_a = Axial strain; Δu = Excess pore pressure; σ_1' = Major effective principal stress; σ_3'= Minor effective principal stress; p' = Average effective principal stress; q = Half principal stress difference; and G_s = Specific gravity.

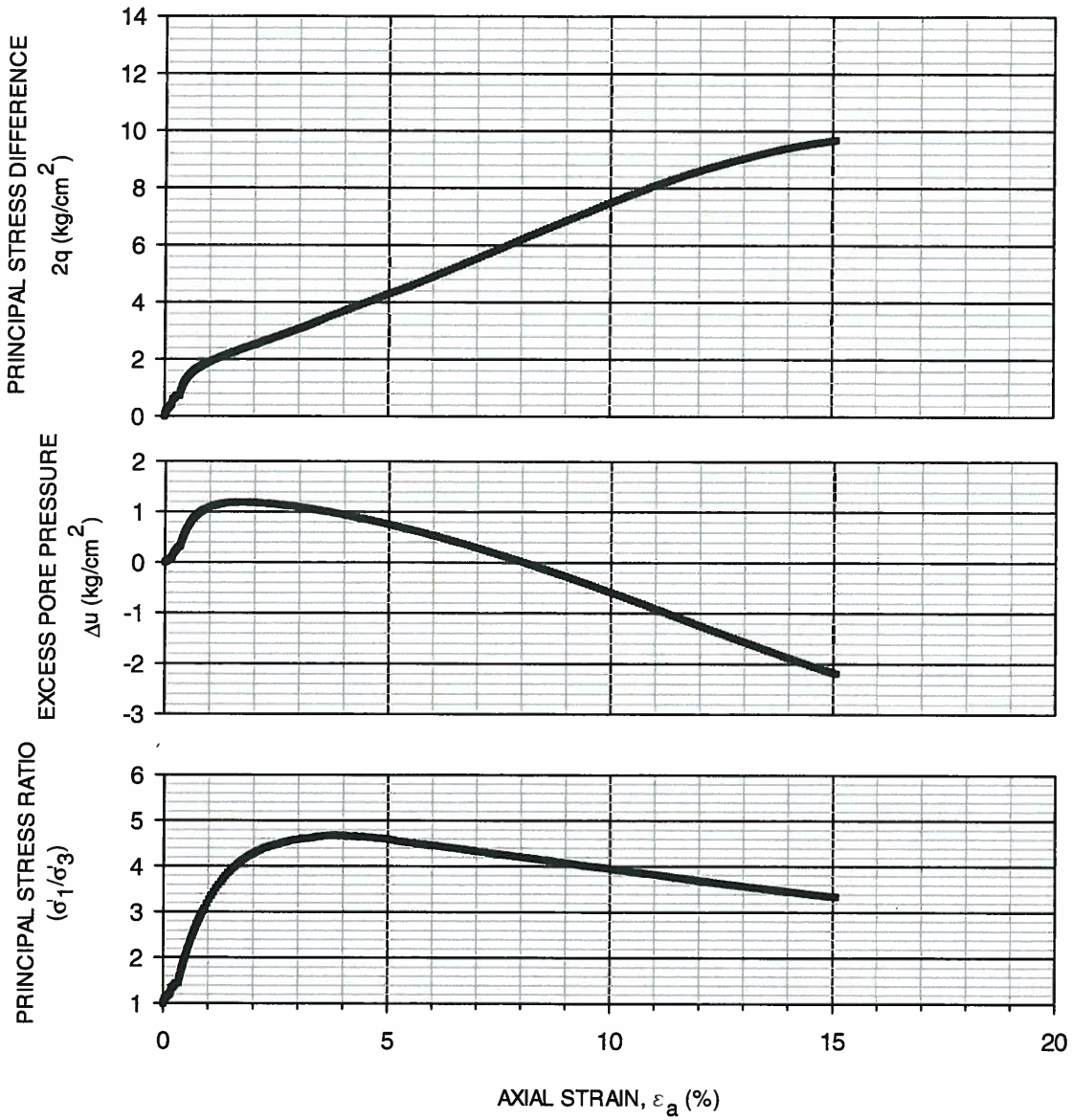
Checked By: TM Date: 08/01/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS - STRAIN CURVES

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/22/13
DATE REPORTED: 08/01/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2A-1** SAMPLE: **5/5**
DEPTH: 4.16 - 5.11 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T2A15/5
SAMPLE DESCRIPTION: Gray silty clay with trace shell (CL-ML)
Consolidation Stress = 1.95 kg/cm^2



The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Where: Δu = Excess pore pressure; σ_1' = Major effective principal stress; and σ_3'= Minor effective principal stress.

Checked By: TM Date: 08/01/13

BORING: VC SAMPLE: T2 DEPTH: A1 5/5 ☐ ft; ☐ m BLOCK: 5

TYPE SAMPLE: ☒ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TYPE TEST: ☒ $\overline{CIUC}$; ☐ UU; ☐ $\overline{UU}$; ☐ CD ☐ OTHER

SAMPLE DESCRIPTION: Grey Br clay w silt Sample 1

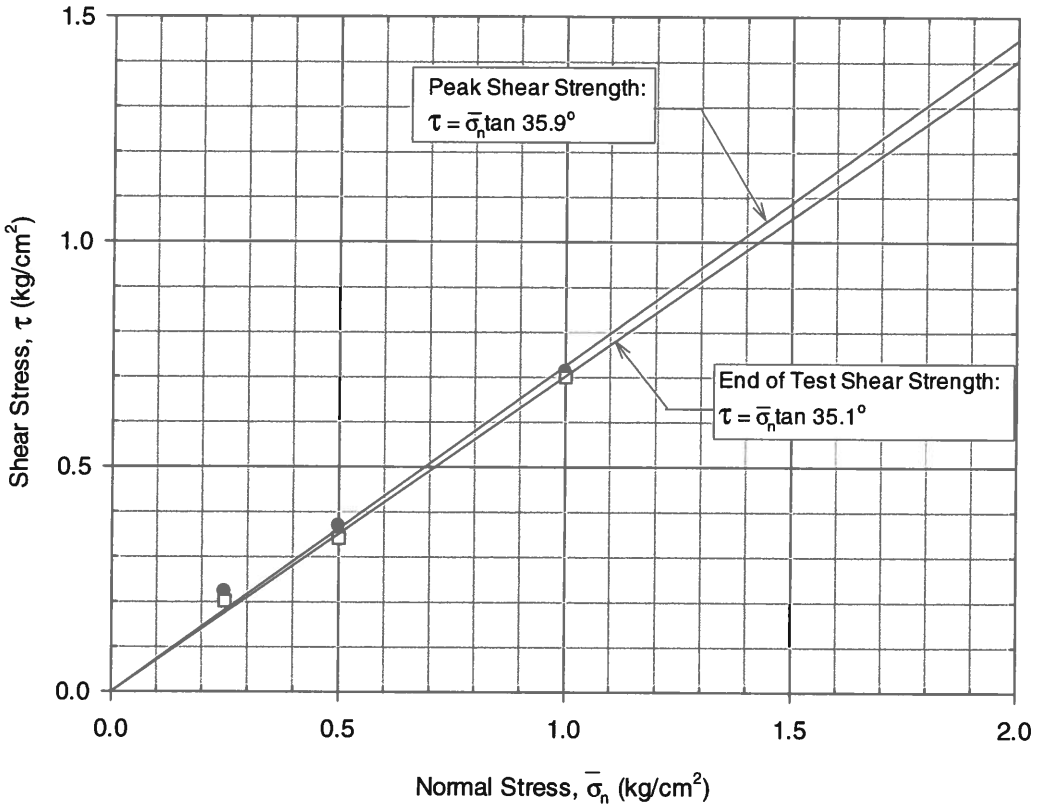
ME SUR
Dia eter
Le th (c
Para
Ta No.
W S + T
W S + T
W (g)
W Tare
W S (g)
M (%)
L/D
1.95
148.78
71.389
130.108
☐ Measured
☑ 1 Condor s
☐ ____ Thin Me nbrane
(kg/cm²) 4.0
σ₃ Stages (kg/cm²): 0.5 : 4.0

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST
MOHR-COULOMB FAILURE ENVELOPE

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 08/30/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2A-1** SAMPLE: 2/5
DEPTH: 1.16-2.16 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/t2a12/5
SAMPLE DESCRIPTION: Dark gray sand with silt and shell (SP-SM).
Pre-shear average γ_d = 99.3 lb/ft^3.



Sample	Normal Stress $\bar{\sigma}_n$ (kg/cm^2)	Peak Shear Strength τ (kg/cm^2)	End of Test Strength τ (kg/cm^2)
VC-T2A-1	0.25	0.22	0.20
	0.50	0.37	0.34
	1.00	0.71	0.70

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 09/23/13

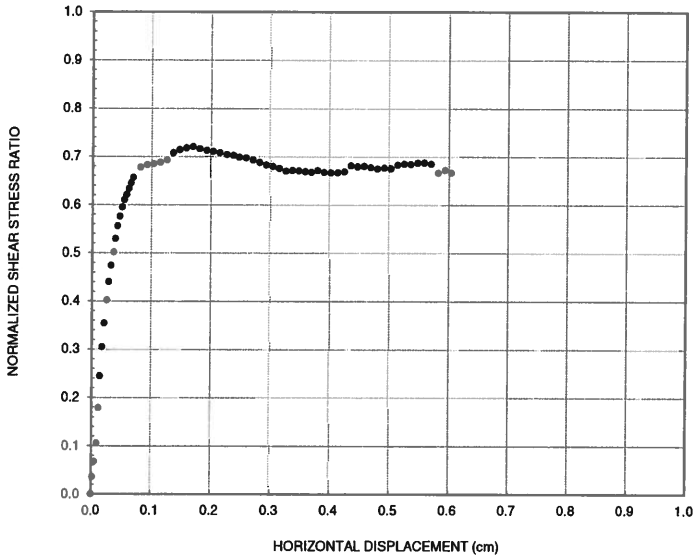
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT

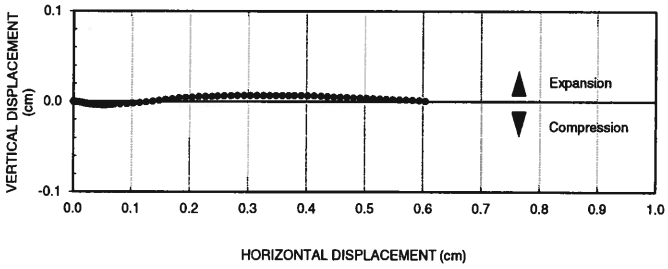
CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 08/30/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2A-1** SAMPLE: **2/5**
DEPTH: 1.16-2.16 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/t2a12/5
SAMPLE DESCRIPTION: Dark gray sand with silt and shell (SP-SM).
Target initial dry density equaled 98 lb/ft^3.

Initial Specimen Conditions						Normal Stress, $\bar{\sigma}_n$ (kg/cm^2)	Pre-Shear Conditions			Final Specimen Conditions			
WDS (g)	H (cm)	D (cm)	w_c (%)	γ_d (lb/ft^3)	S (%)		γ_d (lb/ft^3)	ε_{vc} (%)	t_c (hours)	w_c (%)	γ_d (lb/ft^3)	S (%)	ε_{vs} (%)
117.35	2.79	5.86	16.5	97.4	61	0.51	99.2	-1.8	1.2	24.0	99.2	94	0.0





Test Methods & Procedures

☒ ASTM Standard D3080
☐ Other:

Specimen Type: ☒ Circular ☐ Square
Sample Type: ☐ Undisturbed ☒ Compacted

Test Conditions

Normal Stress Loading Sequence:
0.16 kg/cm^2
0.51 kg/cm^2
kg/cm^2
kg/cm^2
Inundated at 0.16 kg/cm^2
Displacement Rate: 0.22 cm/hr

Peak Shear Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.17	0.72	35.8

End of Test Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.60	0.67	33.7

G_s: 2.68 ☒ Assumed ☐ Measured

Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☒ ASTM D422 ☐ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	117.35	Soil Passing (%, dry wt. basis)	100	100	100	99.4	97.8	90.4	70.0	46.8	26.3	10.6

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Where: WDS = Specimen dry mass; H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; G_s = Specific gravity; $\bar{\sigma}_n$ = Normal effective stress; ε_{vc} = Vertical strain during consolidation; ε_{vs} = Vertical strain during shear; t_c = Duration of final normal stress application prior to shear; γ_h = Horizontal displacement; τ = Shear stress; and $\bar{\varphi}_{ds}$ = Effective friction angle assuming zero cohesion.

Checked By: _____ Date: 09/23/13

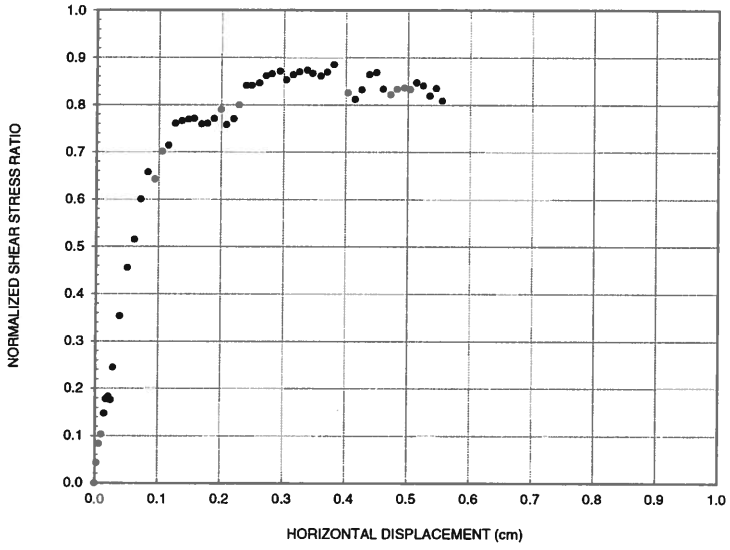
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 08/30/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2A-1** SAMPLE: **2/5**
DEPTH: 1.16-2.16 ☐ ft; ☐m
LABORATORY IDENTIFICATION NO.: 130084/t2a12/5
SAMPLE DESCRIPTION: Dark gray sand with silt and shell, (SP-SM).
Target initial dry density equaled 98 lb/ft^3.

Initial Specimen Conditions						Normal Stress, $\bar{\sigma}_n$ (kg/cm^2)	Pre-Shear Conditions			Final Specimen Conditions			
WDS (g)	H (cm)	D (cm)	w_c (%)	γ_d (lb/ft^3)	S (%)		γ_d (lb/ft^3)	ε_{vc} (%)	t_c (hours)	w_c (%)	γ_d (lb/ft^3)	S (%)	ε_{vs} (%)
116.63	2.78	5.85	16.3	97.5	61	0.25	99.2	-1.7	0.9	23.9	99.0	93	+0.2



Test Methods & Procedures

☒ ASTM Standard D3080
☐ Other: _____

Specimen Type: ☒ Circular ☐ Square
Sample Type: ☐ Undisturbed ☒ Compacted

Test Conditions

Normal Stress Loading Sequence:
0.25 kg/cm^2
_____ kg/cm^2
_____ kg/cm^2
_____ kg/cm^2
Inundated at 0.25 kg/cm^2
Displacement Rate: 0.22 cm/hr

Peak Shear Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.38	0.89	41.5

End of Test Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.56	0.81	39.0

G_s: 2.68 ☒ Assumed ☐ Measured

Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☒ ASTM D422 ☐ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	116.63	Soil Passing (%, dry wt. basis)	100	100	100	99.5	97.9	90.2	68.8	46.7	24.5	9.9

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Where: WDS = Specimen dry mass; H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; G_s = Specific gravity; $\bar{\sigma}_n$ = Normal effective stress; ε_{vc} = Vertical strain during consolidation; ε_{vs} = Vertical strain during shear; t_c = Duration of final normal stress application prior to shear; γ_h = Horizontal displacement; τ = Shear stress; and $\bar{\varphi}_{ds}$ = Effective friction angle assuming zero cohesion.

Checked By: _____ Date: 09/23/13

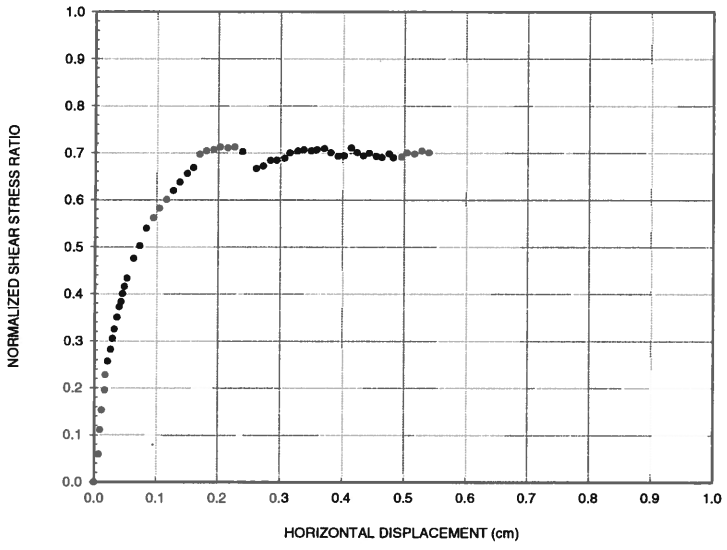
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 09/05/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2A-1** SAMPLE: **2/5**
DEPTH: 1.16-2.16 ☐ ft; ☐m
LABORATORY IDENTIFICATION NO.: 130084/t2a12/5
SAMPLE DESCRIPTION: Dark gray sand with silt and shell (SP-SM).
Target initial dry density equaled 98 lb/ft^3.

Initial Specimen Conditions						Normal Stress, $\bar{\sigma}_n$ (kg/cm^2)	Pre-Shear Conditions			Final Specimen Conditions			
WDS (g)	H (cm)	D (cm)	w_c (%)	γ_d (lb/ft^3)	S (%)		γ_d (lb/ft^3)	ε_{vc} (%)	t_c (hours)	w_c (%)	γ_d (lb/ft^3)	S (%)	ε_{vs} (%)
116.39	2.78	5.85	16.5	97.3	62	1.00	99.4	-2.1	4.0	23.2	99.9	92	-0.5



Test Methods & Procedures

☒ ASTM Standard D3080
☐ Other:

Specimen Type: ☒ Circular ☐ Square
Sample Type: ☐ Undisturbed ☒ Compacted

Test Conditions

Normal Stress Loading Sequence:
0.25 kg/cm^2
0.50 kg/cm^2
1.00 kg/cm^2
kg/cm^2
Inundated at 0.25 kg/cm^2
Displacement Rate: 0.22 cm/hr

Peak Shear Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.20	0.71	35.5

End of Test Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.54	0.70	35.0

G_s : 2.68 ☒ Assumed ☐ Measured

Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☒ ASTM D422 ☐ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	116.39	Soil Passing (%, dry wt. basis)	100	100	100	99.5	98.0	90.2	69.3	47.1	25.7	10.5

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Where: WDS = Specimen dry mass; H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; G_s = Specific gravity; $\bar{\sigma}_n$ = Normal effective stress; ε_{vc} = Vertical strain during consolidation; ε_{vs} = Vertical strain during shear; t_c = Duration of final normal stress application prior to shear; γ_h = Horizontal displacement; τ = Shear stress; and $\bar{\varphi}_{ds}$ = Effective friction angle assuming zero cohesion.

Checked By: TM Date: 09/23/13

VOWTAP
File No.: 13-13-0084
September 23, 2013
Revision: 0 (ISSUED FOR USE) 08/20/13
Revision: 1 (Add PC-T2A-2)

TABLE C-2 EXTRUSION TEST REPORT FOR CORE VC-T2A-2

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Test Specimen Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)				
T2A	VC-T2A-2	1 / 3	0.0 - 1.07	107	Void in soil along tube wall from 72.5 cm to 86.5 cm from top of sample.	100.6	9.146	1.5	0.0	99.1	93	95.0	12,311	27.0	Brown sand with shell	SP	2.8 3.8	3.3	15.0	123.2	107.1	71 [Gs=2.69]							
														68.0	Dark gray sand with trace shell and gray sandy clay lenses	SP	20.5 20.6 20.5 16.9	19.6					---	---	---	3.8			
		2 / 3	1.07 - 2.07	100	Void in soil along tube wall from top of sample to 52.0 cm from top of sample.	99.7	9.150	4.5	0.0	95.2	95	97.0	11,466	15.5	Brown sand with shell	SP	5.2	5.2	17.0	Not Applicable. Voids within tube. Test specimen density and saturation for lower 29.0 cm section of core [wc = 24.1%].										
														31.0	Dark gray sand with trace shell	SP	14.3	14.3											
														3.0	Dark gray sand with shell	SP	22.9	22.9											
														47.5	Dark gray sand with trace shell	SP	23.3 22.7 23.2 27.2	22.3					--- --- 124.4	--- --- 100.2	--- --- 96	3.6 --- ---	0.5	2.2	2.69
		3 / 3	2.07 - 3.07	100	Void in soil along tube wall from top of sample to 43.8 cm from top of sample.	95.3	9.150	3.3	0.0	92.0	92	95.0	11,678	92.0	Gray to dark gray sand with shell	SP	24.4 25.0 25.0 22.1 25.9 14.0	22.7	22.7	Not Applicable. Voids within tube. Test specimen density and saturation for lower 30.1 cm section of core [wc = 20.7%].				--- 128.8	--- 106.7	--- 97	4.0			
														3.0	Gray gravel with sand	GP	---	---											

EXTRUSION TEST REPORT FOR CORE PC-T2A-2 [PISTON CORE SAMPLE]

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Test Specimen Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)				
T2A	PC-T2A-2	1 / 1	0.0-1.27	127	Received in two sections of 93.7 cm and 23.4cm. Total tube length about 10 cm less than sampling interval.	93.7	6.654	0.0	0.0	93.7	91	94.2	6,782	6.0	Dark gray sand with trace shell	SP	20.5	20.5	17.1	129.9	111.0	90 [Gs=2.69]							
														40.2	Brownish-gray sand with trace shell	SP	16.1 18.7	17.4											
														48.0	Brownish-gray sand with shell	SP	17.0 18.6 17.0 15.1 14.5	16.4								0.8			
						23.4	6.633	1.0	0.0	22.4		22.5	1,612	22.5	Brown sand with shell	SP	13.3 14.9 15.6 14.8 17.4	15.2	15.2	130.0	112.8	84 [Gs=2.69]				0.8			

13-13-0084
VC-T2-A2
1/3
→
TOP
SWANSON
AE141

13-13-0084
VC-T2-A2
1/3
→
TOP
SWANSON
AE141

13-13-0084

VC-T2A-2

1/3

SWANSON
13-13-0084
VC-T2-A2
2/3
→
TOP

13-13-0084
VC-T2-A2
2/3
→
TOP
SWANSON
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT IL 60423 USA

13-13-0084

VC-T2A-2

2/3

13-13-0084
VC-T2-A2
3/3
→
TOP
SWANSON
CONVERSIONS
inches x 25.4 = millimeters
inches x 2.54 = centimeters
feet x 30.48 = centimeters
feet x 0.3048 = meters
yards x 0.9144 = meters
miles x 1.60934 = kilometers

13-13-0084
VC-T2-A2
3/3
→
TOP
WANSON®
AE141

13-13-0084

VC-T2A-2

3/3

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/03/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2A-2** SAMPLE: **1/3** [Block 1]
DEPTH: 0.0 – 1.07 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2A2-1/3
SAMPLE DESCRIPTION: Dark gray sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

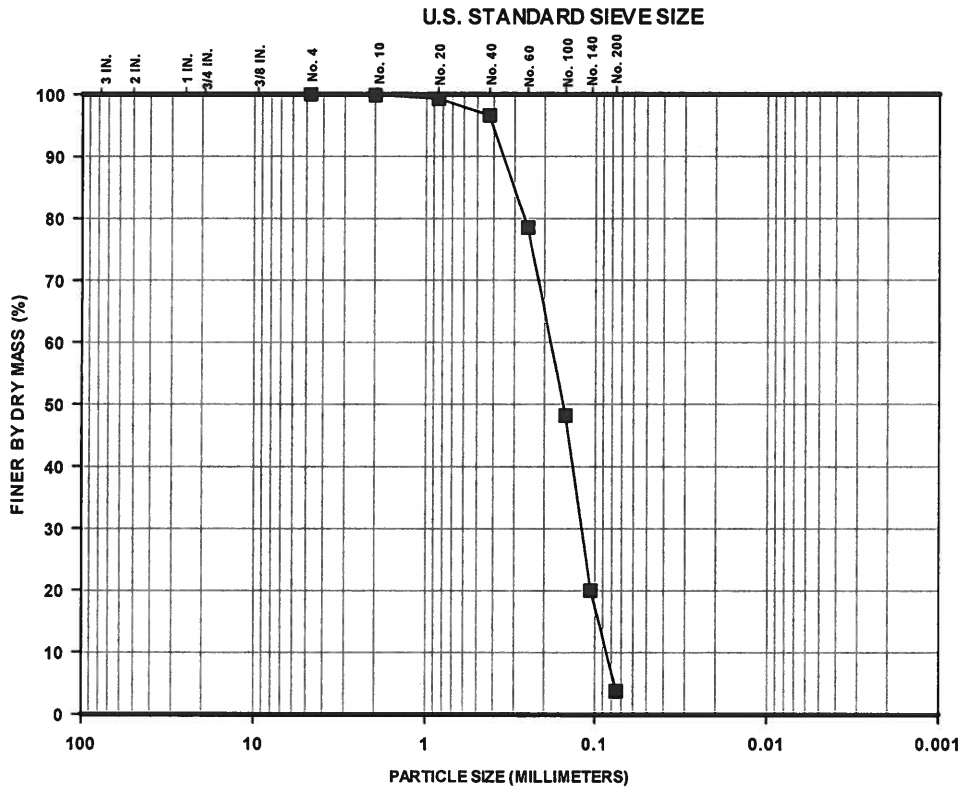
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 20.6
Mass Dry Solids (grams): 159.40

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	99.3	96.6	78.5	48.2	20.0	3.8	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/03/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2A-2** SAMPLE: **2/3** [Block 1]
DEPTH: 1.07 - 2.07 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2A2-2/3
SAMPLE DESCRIPTION: Dark gray sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

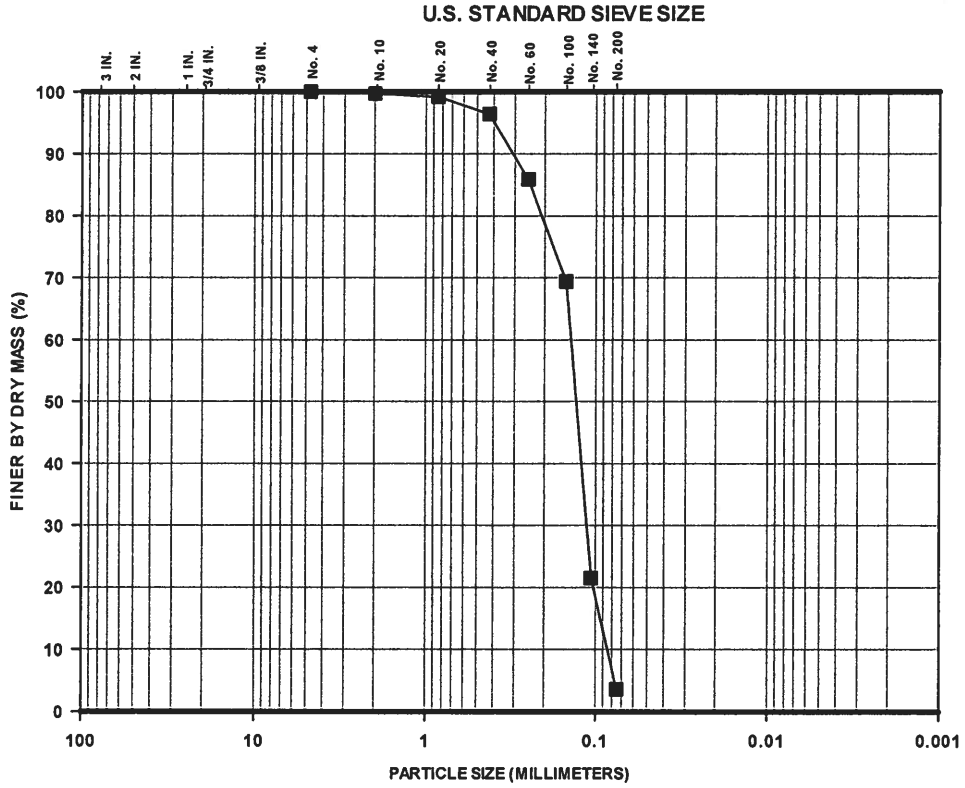
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 23.3
Mass Dry Solids (grams): 166.46

G_s: 2.69 ☐ Assumed ☒ Measured

Organic Content (%): 0.5
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.7	99.2	96.4	85.9	69.4	21.5	3.6	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/03/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2A-2** SAMPLE: **3/3** [Block 1]
DEPTH: 2.07 – 3.07 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2A2-3/3
SAMPLE DESCRIPTION: Gray to dark gray sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

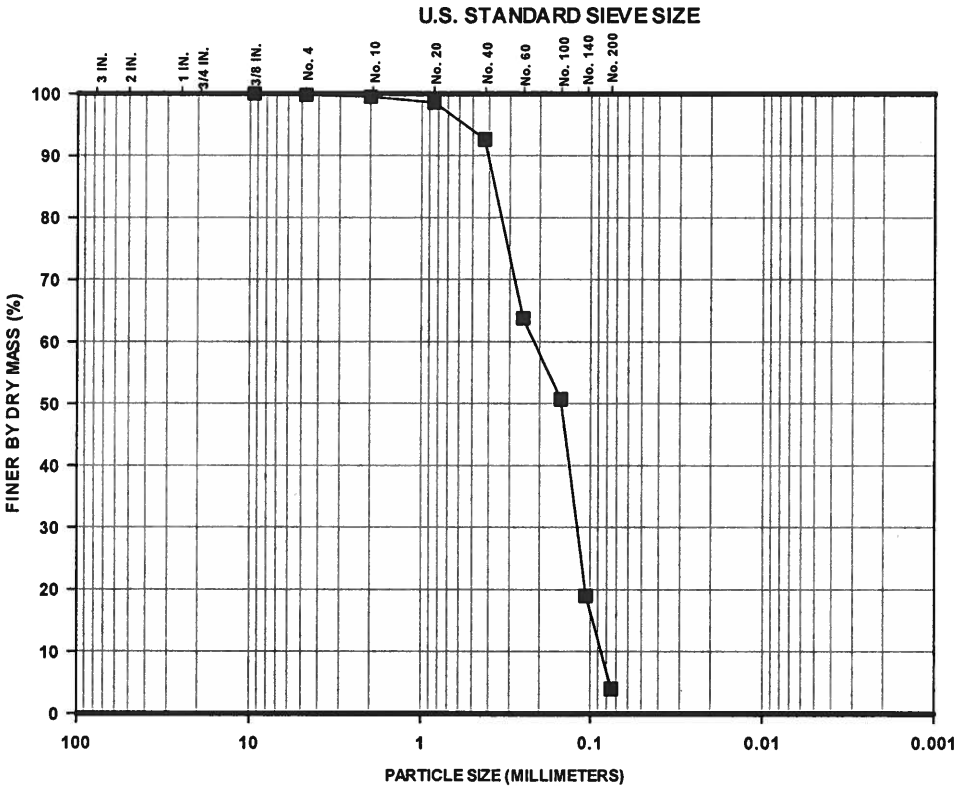
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 22.1
Mass Dry Solids (grams): 194.60

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.8	99.5	98.6	92.6	63.8	50.7	19.0	4.0	---	---	---

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Checked By: TM Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 08/21/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: ---
BORING: **PC-T2A-2** SAMPLE: 1/1 [Block 6]
DEPTH: 0.0– 1.27 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/PCT2A2
SAMPLE DESCRIPTION: Brownish-gray sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

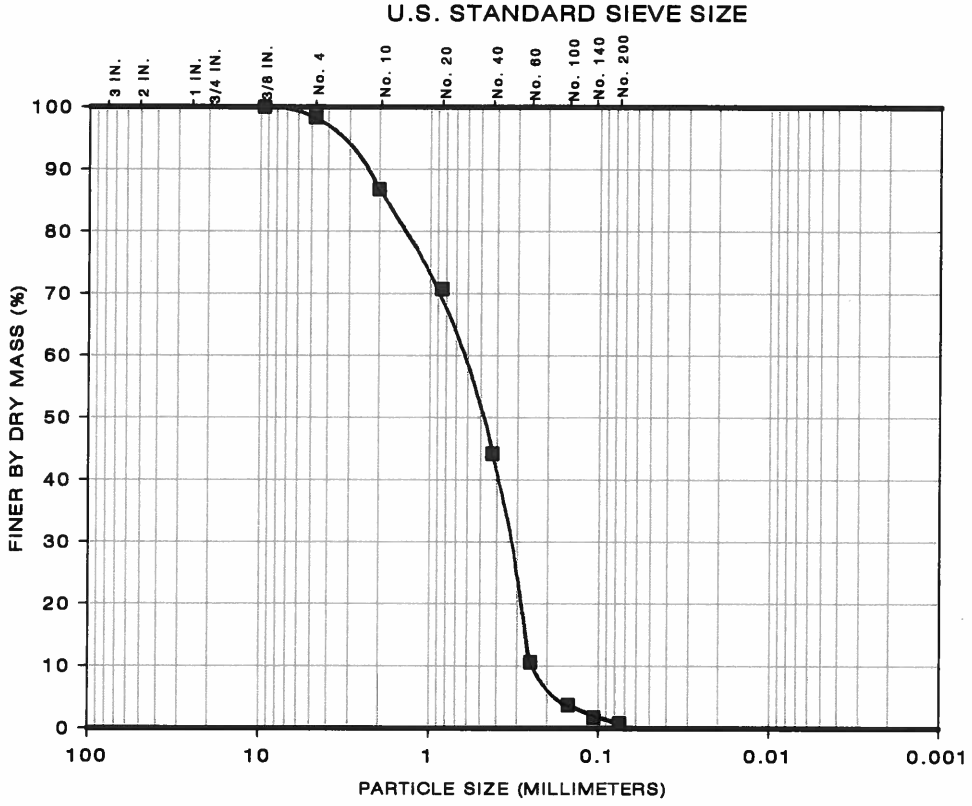
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 15.1
Mass Dry Solids (grams): 197.25

G_s: _____ ☐ Assumed ☐ Measured

Organic Content (%): _____
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	98.4	86.8	70.7	44.2	10.6	3.7	1.7	0.8	---	---	---

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Checked By: _____ Date: 09/23/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 08/21/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: ---
BORING: **PC-T2A-2** SAMPLE: 1/1 [Block 8]
DEPTH: 0.0– 1.27 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/PCT2A2
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

Dispersion Device: ☐ Apparatus A ☐ Apparatus B

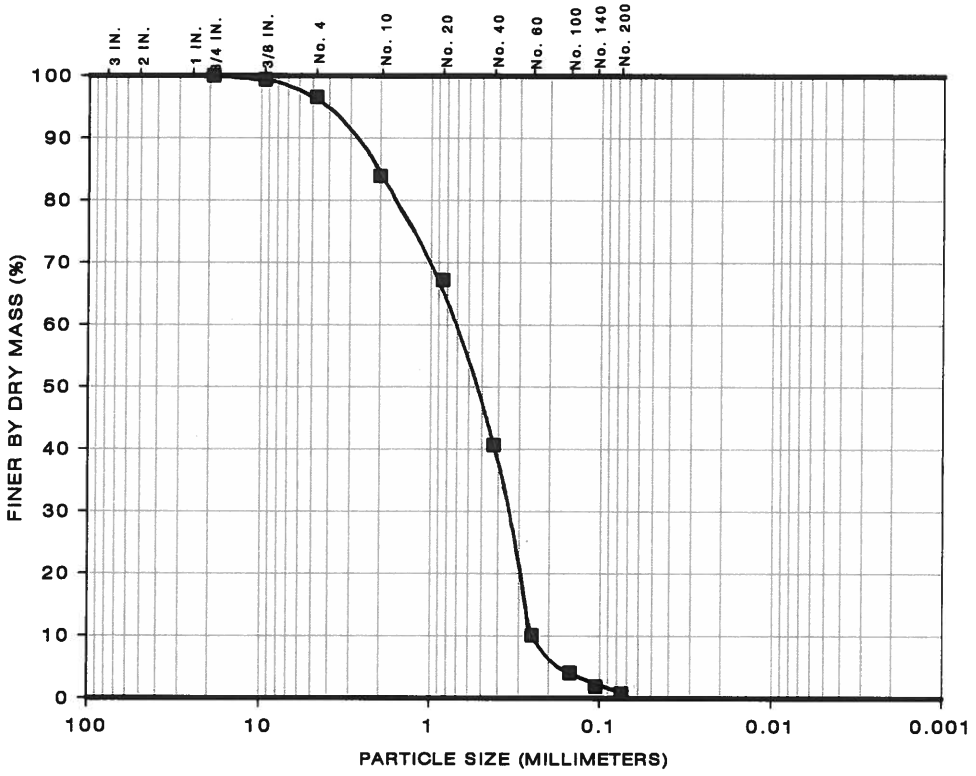
Dispersion Period (hours): _____

Water Content (%): 15.6
Mass Dry Solids (grams): 126.63

G_s: _____ ☐ Assumed ☐ Measured

Organic Content (%): _____
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]

U.S. STANDARD SIEVE SIZE



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	99.4	96.6	83.9	67.2	40.7	10.1	4.1	1.9	0.8	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 09/23/13

VOWTAP
File No.: 13-13-0084
September 23, 2013
Revision: 0 (ISSUED FOR USE) 08/20/13
Revision: 1 (Add data to 3/5 and 4/5)

TABLE C-3 EXTRUSION TEST REPORT FOR CORE VC-T2B-1

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Test Specimen Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Atterberg Limits			Strength Index Tests	
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)					Liquid Limit, LL	Plastic Limit, PL	Plasticity Index, PI	s_u [TV] (kg/cm²)	s_u [LV] (kg/cm²)
T2B	VC-T2B-1	1 / 5	0.0 - 0.79	79	Gravel layer did not remain intact during extrusion.	99.7	9.122	20.0	0.0	79.7	101	Not Applicable	10,881	29.5	Dark gray sand with silt and shell	SP-SM	23.7 24.8	24.3	15.6	130.5	112.9	86 [Gs=2.69]				0.7							
														26.5	Brown gravel with sand	GP	5.9 3.4	4.7					---	---	---									
														23.7	Gray sand with gravel	SP	17.1	17.1															
														17.0	Gray sand with gravel	SP	7.7	7.7															
		2 / 5	0.79 - 1.79	100	None	100.0	9.121	5.0	0.0	95.0	95	94.2	12,474	77.2	Dark gray lean clay with lenses of gray silt	CL	28.1 31.3 31.2 30.9 33.0 39.1 35.7 30.5 32.6 33.1 32.9 30.5 28.6 29.6 25.0 27.9 30.4 28.0	31.0	26.8	125.5	99.0	100 [Gs=2.75]	--- --- --- 115.3 --- 118.4 119.4 --- 120.7 --- 121.7 ---	--- --- --- 82.9 --- 89.3 89.8 --- 93.2 --- 93.3 ---	--- --- --- 100 --- 97 99 --- 96 --- 99 ---	--- --- 95.1 96.7 --- 95.7 96.4 --- 91.4 --- 90.6 ---	--- 2.7 --- --- --- --- --- --- --- --- --- 2.1	--- 3.7 --- --- --- --- --- --- --- --- --- ---	--- 2.76 --- --- --- --- --- --- --- --- --- ---	--- 35 --- --- --- --- --- --- --- --- --- ---	--- 18 --- --- --- --- --- --- --- --- --- ---	--- 17 --- --- --- --- --- --- --- --- --- ---	0.35 --- 0.30 --- 0.28 --- 0.40 --- 0.35	--- --- --- --- --- --- --- --- --- ---
		3 / 5	1.79 - 2.79	100	None	99.7	9.159	3.0	0.0	96.7	97	96.3	11,978	85.5	Dark gray lean clay with lenses of silt and clayey sand	CL	27.3 43.6 46.5 44.1 40.3 27.9 30.6 35.9 38.3 29.4 31.0 35.7 32.8	35.6	35.6	117.9	86.9	100 [Gs=2.76]	110.6 109.9 111.8 114.1 --- --- --- --- --- --- --- ---	77.0 75.0 77.6 81.3 --- --- --- --- --- --- --- ---	97 99 100 99 --- --- --- --- --- --- --- ---	95.0 97.1 98.2 92.5 --- --- --- 90.3 --- --- --- ---	--- --- --- --- --- --- --- --- 3.5 --- --- ---	--- --- --- --- --- --- --- --- --- --- --- ---	--- --- --- --- --- --- --- --- --- --- --- ---	--- --- --- --- --- --- --- --- 30 --- --- ---	--- --- --- --- --- --- --- --- 16 --- --- ---	--- --- --- --- --- --- --- --- 14 --- --- ---	0.20 0.15 --- 0.10 0.10 --- 0.42	--- --- --- --- --- 0.11 ---
														5.0	Dark gray clayey sand	SC	---	---															
														5.8	Dark gray lean clay with lenses of gray silt and clayey sand	CL	32.4	32.4															
		4 / 5	2.79 - 3.79	100	None	99.7	9.138	6.0	0.0	93.7	94	94.3	11,959	49.5	Dark gray clay with lenses of gray silt and clayey sand	CL	38.7 36.5 37.7 31.7 31.4 42.3	36.4	33.7	120.8	90.4	102 [Gs=2.77]	--- --- --- --- ---	--- --- --- --- ---	--- --- --- --- ---	--- --- --- --- ---	2.5 --- --- --- ---	--- --- --- --- ---	--- --- --- --- ---	--- --- --- --- ---	--- --- --- --- ---	--- --- --- --- ---	0.22 0.30 --- 0.30	--- --- 0.21
														21.5	Gray sand with silt and trace shell	SP-SM	17.2 15.9 16.6	16.6					---	---	---	8.1							
														23.3	Dark gray lean clay with lenses of sand and trace shell	CL	51.4 45.8 49.0 43.6 46.5 47.3 22.3	43.7					--- --- 111.0	--- --- 75.8	--- --- 100	--- --- 99.5	--- 3.3	--- 3.2	--- 2.79	--- 48	--- 22	--- 26	0.28 0.25	--- ---
		5 / 5	3.79 - 4.75	96	None	96.2	9.128	7.5	4.5	84.2	88	85.5	11,496	28.5	Dark gray sand with silt and lenses of brown clay	SP-SM	30.1 26.5	28.3	21.3	128.3	105.8	98 [Gs=2.69]											
														57.0	Gray silty sand with shell	SM	19.4 17.6 17.0 17.4	17.9					---	---	---	14.0							

EXTRUSION TEST REPORT FOR CORE PC-T2B-1 [PISTON CORE SAMPLE]

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Test Specimen Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Atterberg Limits			Strength Index Tests	
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)					Liquid Limit, LL	Plastic Limit, PL	Plasticity Index, PI	s_u [TV] (kg/cm²)	s_u [LV] (kg/cm²)
T2B	PC-T2B-1	1 / 1	0.0 - 0.94	94	Tube length less than reported sampling interval.	77.5	6.717	0.0	0.0	77.5	82	77.7	5,326	32.0	Dark gray sand with silt and shell	SP-SM	29.1 28.3 26.9	28.1	26.7	121.1	95.6	95 [Gs=2.69]											
														43.2	Gray sand with shell	SP	25.7 26.3	26.0															
														2.5	Dark gray sand with silt and shell	SP-SM	21.4	21.4															

13-13-0084
VC-T2-B1
1/5
→
TOP

13-13-0084
VC-T2-B1
1/5
→
TOP

SWANSON
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA

13-13-0084

VC-T2B-1

1/5

13-13-0084
VC-T2-B1
2/5
→
TOP

13-13-0084

VC-T2B-1

2/5

13-13-0084
VC-T2-B1
2/5
TOP
SWANSON
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA

13-13-0084
VC-T2-B1
2/5
→
TOP
SWANSON
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
MADE IN CHINA

13-13-0084
VC-T2-B1
3/5
→
TOP

13-13-0084
VC-T2-B1
3/5
→
TOP
SWANSON
AE141

13-13-0084
VC-T2-B1
4/5
→
TOP

13-13-0084
VC-T2-B1
4/5
→
TOP
SWANSON
AE141

13-13-0084
VC-T2B-1
4/5

13-13-0084
VC-T2-B1
5/5
→
TOP

13-13-0084
VC-T2-B1
5/5
→
TOP
SWANSON
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT IL 60423 USA

13-13-0084

VC-T2B-1

5/5

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/03/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **1/5** [Block 1]
DEPTH: 0.0 – 0.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2B1-1/5
SAMPLE DESCRIPTION: Brown gravel with sand (GP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

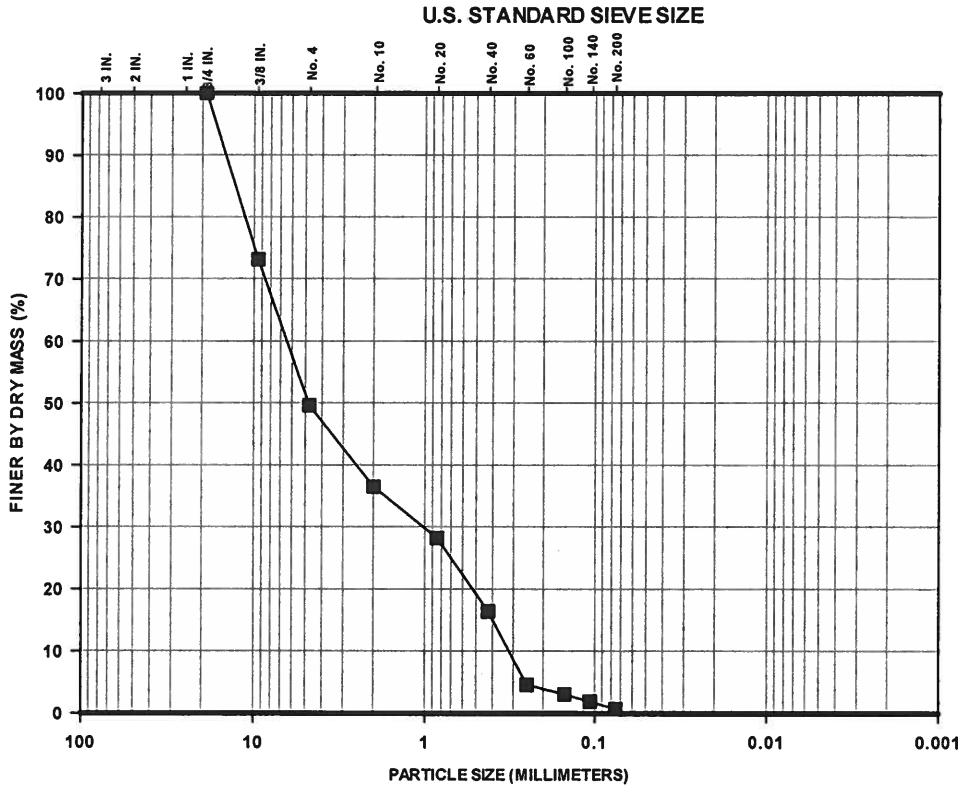
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 3.4
Mass Dry Solids (grams): 671.81

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	73.1	49.6	36.5	28.2	16.4	4.6	3.1	1.9	0.7	---	---	---

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Checked By: M Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/09/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **2/5**
DEPTH: 0.79-1.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2B12/5
SAMPLE DESCRIPTION: Gray lean clay (CL)

TEST PROCEDURES

ASTM Standard D422:
☐ Sieve Analysis
☐ Hydrometer Analysis
☒ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☒ Sodium Hexametaphosphate ☐ Other_____

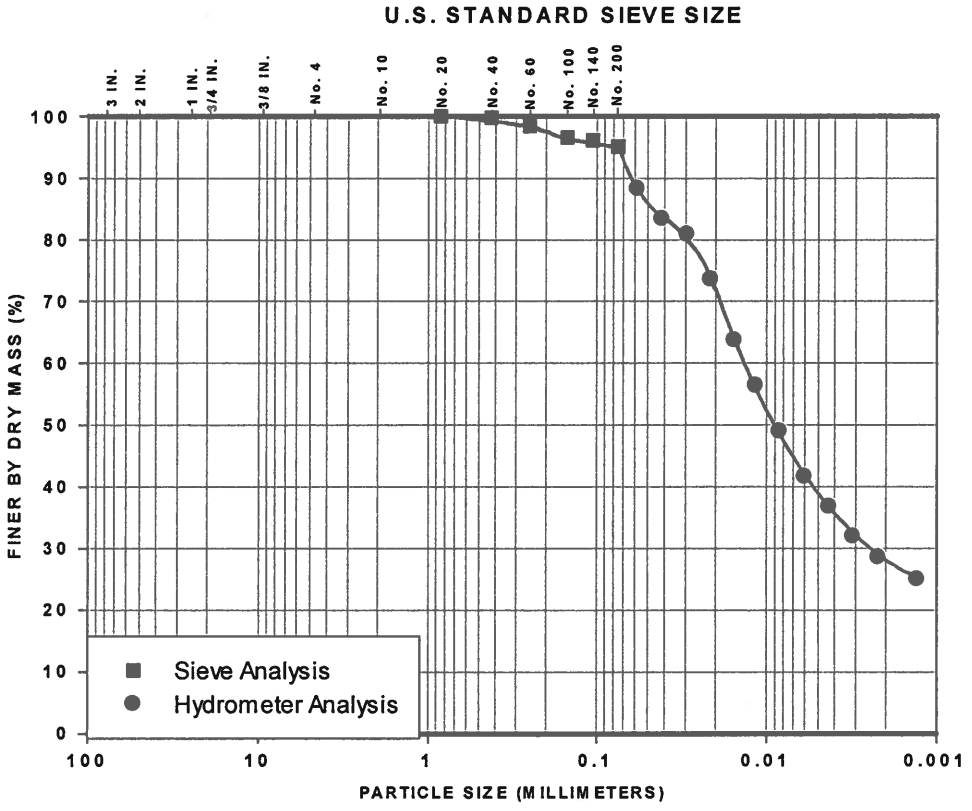
Dispersion Device: ☒ Apparatus A ☐ Apparatus B

Dispersion Period (hours): >24

Water Content (%): 30.9
Mass Dry Solids (grams): 39.87

G_s: 2.76 ☐ Assumed ☒ Measured

Organic Content (%): 2.7
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	100	100	99.8	98.4	96.6	96.1	95.1	38.7	27.8	23.8

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/03/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **3/5** [Block 3]
DEPTH: 1.79 – 2.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2B2-5/5
SAMPLE DESCRIPTION: Dark gray lean clay (CL)

ASTM D4318-Method A: LL=30; PI=14

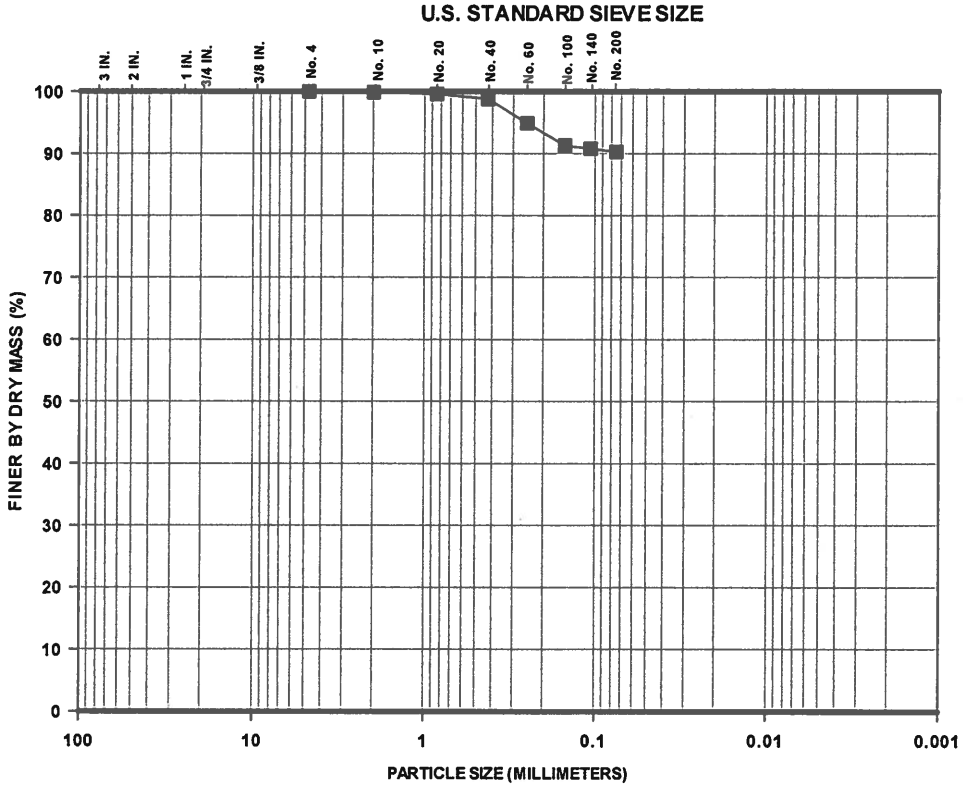
TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____
Dispersion Device: ☐ Apparatus A ☐ Apparatus B
Dispersion Period (hours): _____

Water Content (%): 35.9
Mass Dry Solids (grams): 119.17
G_s: --- ☐ Assumed ☐ Measured
Organic Content (%): 3.5
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	99.6	98.8	94.9	91.3	90.8	90.3	---	---	---

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Checked By: _____ Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/03/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **4/5** [Block 4]
DEPTH: 2.79 – 3.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2B1-4/5
SAMPLE DESCRIPTION: Gray sand with silt and trace shell (SP-SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

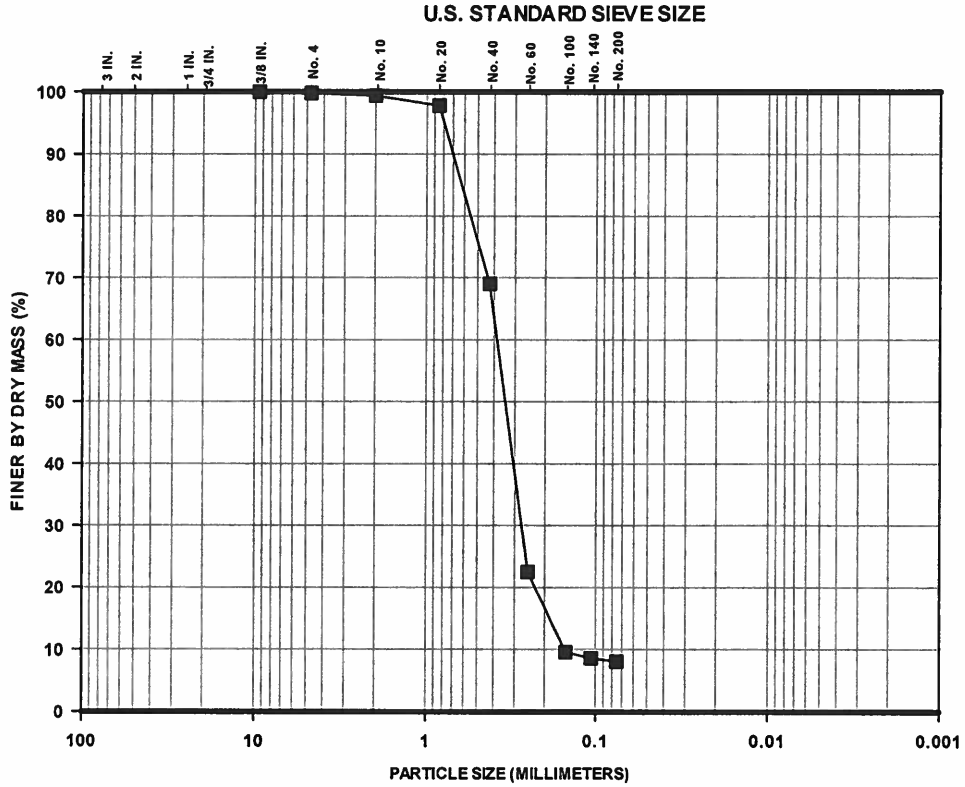
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 15.9
Mass Dry Solids (grams): 280.46

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.8	99.4	97.8	69.0	22.5	9.6	8.6	8.1	---	---	---

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Checked By: _____ Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/03/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **5/5** [Block 4]
DEPTH: 3.79 – 4.75 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2B1-5/5
SAMPLE DESCRIPTION: Gray silty sand with shell (SM)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

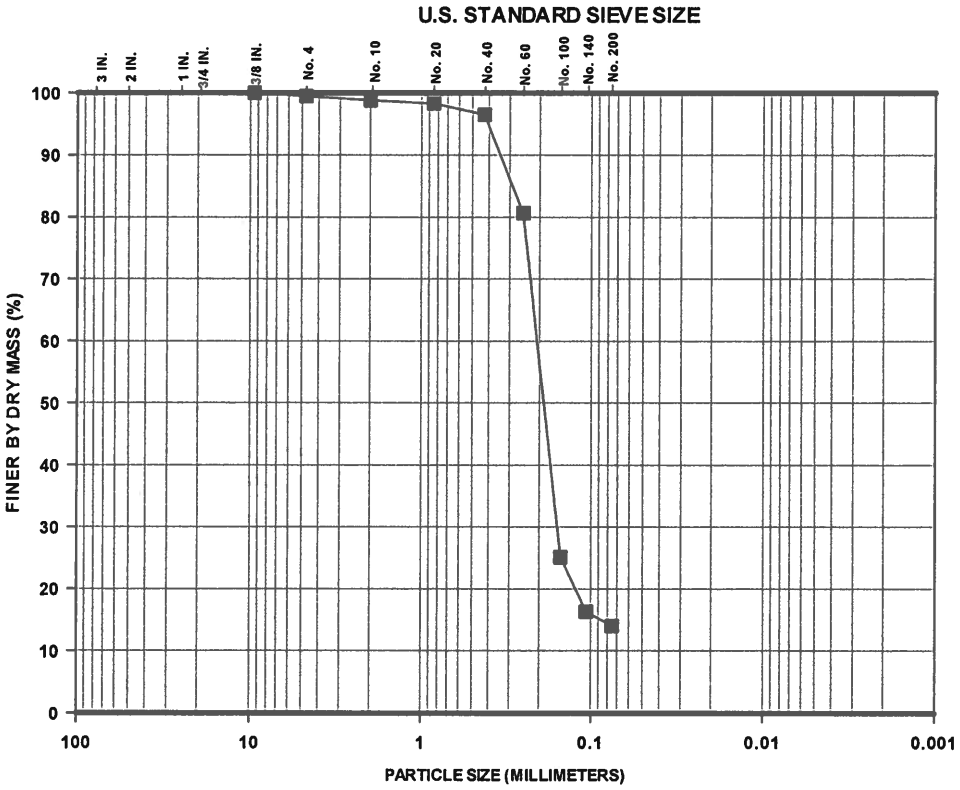
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 17.0
Mass Dry Solids (grams): 187.62

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.5	98.8	98.3	96.5	80.6	25.1	16.3	14.0	---	---	---

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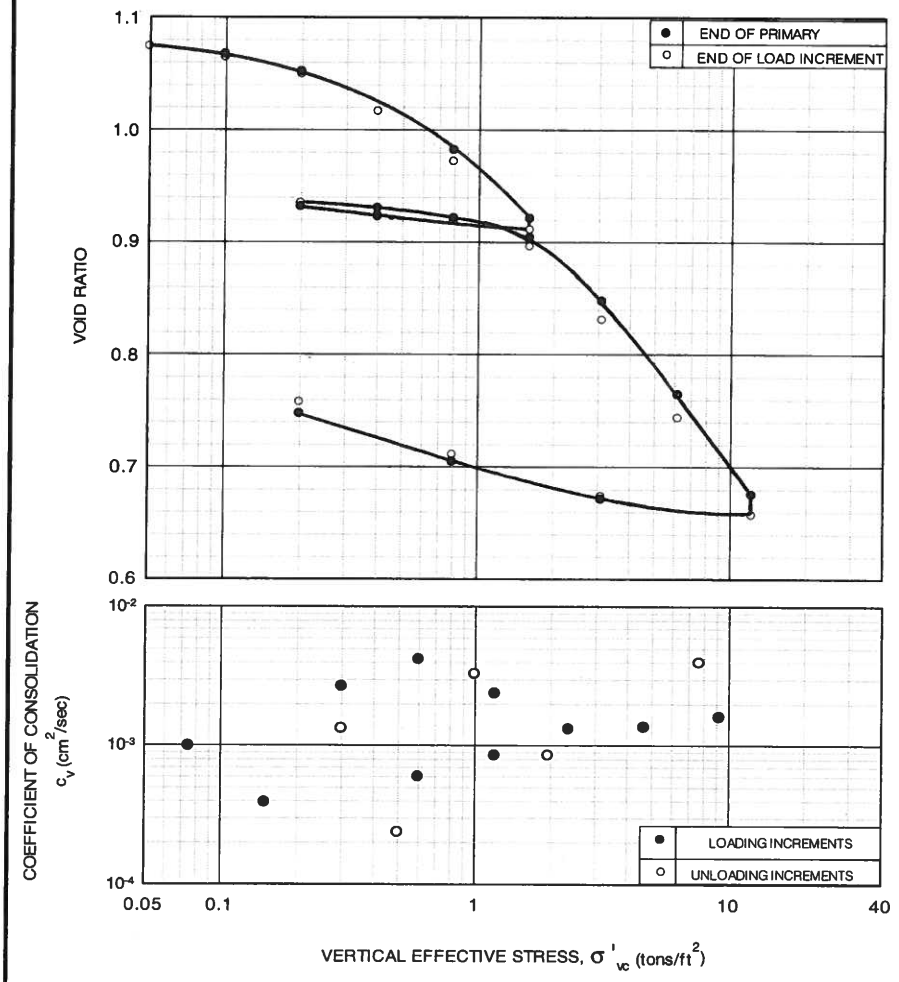
Checked By: _____ Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
ONE-DIMENSIONAL INCREMENTAL LOADING CONSOLIDATION TEST REPORT

CLIENT: Dominion
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE SAMPLE SET-UP: 07/03/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---------
BORING: VC-T2B-1 SAMPLE: 2 / 5
DEPTH: 0.79 - 1.79 ☐ ft; ☑ m
LAB IDENTIFICATION NO.: 130084/T2B125
SAMPLE DESCRIPTION.: Gray lean clay, CL



Test Methods & Procedures

ASTM Standard D2435
- ☐ Method A
- ☑ Method B

c_v Interpretation Method
- ☑ c_v [Log Time]
- ☐ c_v [Sq. Root Time]

Trimming Method
- ☑ cutting shoe
- ☐ other _____

Initial Sample Diameter 9.12 (cm)

Test Conditions

- ☐ Tested at Natural Moisture Content
- ☑ Specimen Tested Inundated
  Inundated at σ'_{vc} 0.05 (tsf)
  Inundation Fluid:
  - ☑ tap water
  - ☐ other _____

Specimen Conditions

Parameter	Initial	Final
D (cm)	5.000	5.000
H (cm)	1.932	1.632
w_c (%)	39.1	27.4
γ_d (pcf)	82.9	98.1
e	1.080	0.757
S (%)	100	100

G_s: 2.76 ☐ Assumed ☑ Measured

Index Properties

LL	35
PL	18
PI	17

Particle-Size Analysis	U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☑ ASTM D1140-Method		3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass(g): 50.34	Soil Passing (%, dry mass basis)	-----	-----	-----	-----	-----	-----	-----	-----	-----	96.7

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Where: H=Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; e = Void ratio; S = Saturation; G_s= Specific gravity; c_v = Coefficient of consolidation; and $C_{\alpha e}$ = Secondary compression index.

Checked By: TM Date: 08/12/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
ONE-DIMENSIONAL INCREMENTAL LOADING CONSOLIDATION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

INCOMING SAMPLE NO.: ---------
BORING: **VC-T2B-1** SAMPLE: **2 / 5**
DEPTH: 0.79 - 1.79 ☐ ft; ☑ m
LAB IDENTIFICATION NO.: 130084/T2B125
SAMPLE DESCRIPTION.: Gray lean clay, CL

DATE SAMPLE RECEIVED: 06/27/13
DATE SAMPLE SET-UP: 07/03/13
DATE REPORTED: 08/12/13 REVISED: 10/18/13

Effective Vertical Stress σ'_{vc} (tons/ft^2)	Void Ratio		Vertical Strain (%)		Coefficient of Consolidation (cm^2/sec) c_v [Log Time] ☑ c_v [Sq. Root Time] ☐	Coefficient of Permeability (cm/sec)	Secondary Compression Index, $C_{\alpha e}$
	End of Primary Consolidation	End of Increment	End of Primary Consolidation	End of Increment			
0.0	--	1.079	--	0.00	--	--	-----
0.05	--	1.074	--	0.28	--	--	-----
0.10	1.067	1.064	0.60	0.75	9.8E-04	9.5E-08	0.002
0.20	1.051	1.049	1.35	1.46	3.8E-04	2.8E-08	0.002
0.40	1.017	1.017	3.02	3.02	--	--	0.005
0.80	0.982	0.972	4.71	5.17	5.9E-04	3.2E-08	0.007
1.60	0.921	0.911	7.63	8.11	8.4E-04	3.2E-08	0.006
0.40	0.922	0.924	7.56	7.47	3.3E-03	--	-----
0.20	0.931	0.934	7.14	6.98	1.3E-03	--	-----
0.40	0.930	0.929	7.19	7.23	2.6E-03	3.4E-08	0.001
0.80	0.921	0.918	7.62	7.76	4.1E-03	5.6E-08	0.001
1.60	0.904	0.896	8.45	8.84	2.4E-03	3.2E-08	0.004
3.10	0.847	0.830	11.18	11.98	1.3E-03	2.8E-08	0.009
6.20	0.764	0.743	15.17	16.17	1.3E-03	1.9E-08	0.010
12.20	0.675	0.657	19.46	20.33	1.6E-03	1.1E-08	0.009
3.10	0.671	0.673	19.66	19.53	3.9E-03	--	-----
0.80	0.704	0.711	18.05	17.74	8.4E-04	--	-----
0.20	0.747	0.757	15.99	15.50	2.4E-04	--	-----

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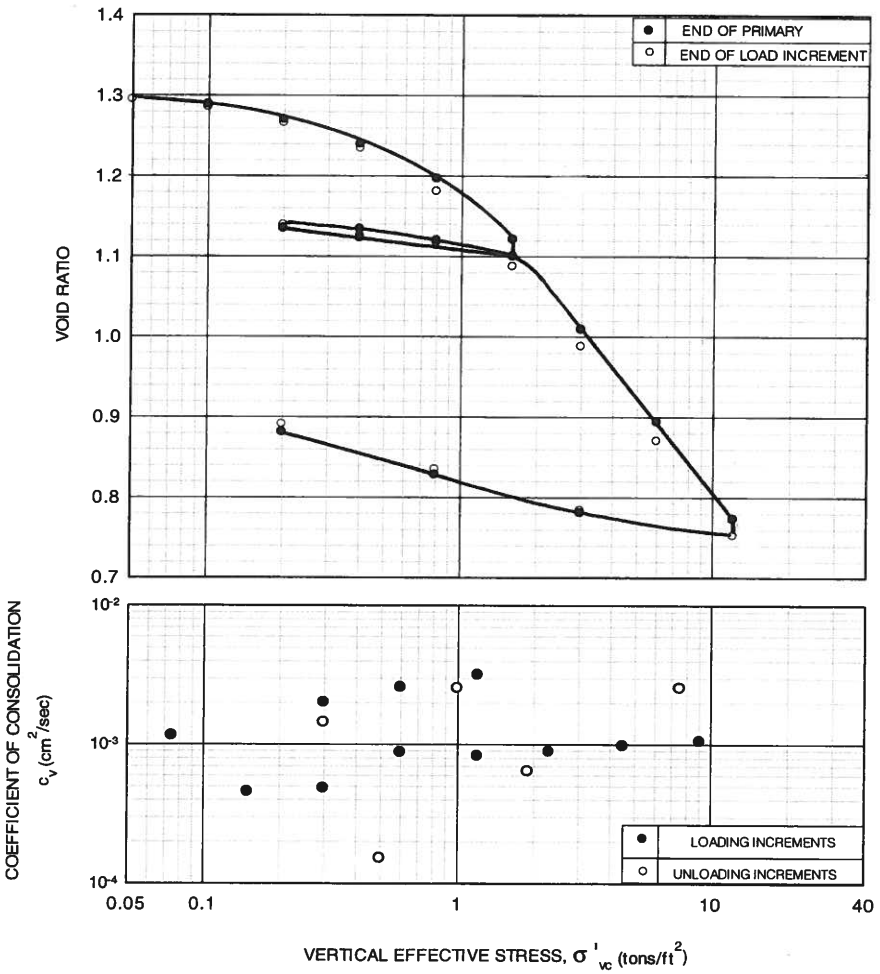
Checked By: JCW Date: 10/18/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
ONE-DIMENSIONAL INCREMENTAL LOADING CONSOLIDATION TEST REPORT

CLIENT: Dominion
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE SAMPLE SET-UP: 07/03/13
DATE REPORTED: 08/13/13

INCOMING SAMPLE NO.: ---------
BORING: VC-T2B-1 SAMPLE: 4 / 5
DEPTH: 2.79 - 3.79 ☐ ft; ☑ m
LAB IDENTIFICATION NO.: 130084/T2B145
SAMPLE DESCRIPTION.: Dark gray lean clay (CL)



Test Methods & Procedures

ASTM Standard D2435
☐ Method A
☑ Method B
c_v Interpretation Method
☑ c_v [Log Time]
☐ c_v [Sq. Root Time]
Trimming Method
☑ cutting shoe
☐ other_____
Initial Sample Diameter 9.14 (cm)

Test Conditions

☐ Tested at Natural Moisture Content
☑ Specimen Tested Inundated
Inundated at σ'_{vc} 0.05 (tsf)
Inundation Fluid:
☑ tap water
☐ other _____

Specimen Conditions

Parameter	Initial	Final
D (cm)	5.000	5.000
H (cm)	1.913	1.578
w_c (%)	46.5	32.1
γ_d (pcf)	75.8	91.9
e	1.298	0.896
S (%)	100	100

G_s: 2.79 ☐ Assumed ☑ Measured

Index Properties

LL	48
PL	22
PI	26

Particle-Size Analysis	U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☑ ASTM D1140-Method		3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass(g): 45.60	Soil Passing (%, dry mass basis)	-----	-----	-----	-----	-----	-----	-----	-----	-----	99.5

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Where: H=Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; e = Void ratio; S = Saturation; G_s= Specific gravity; c_v = Coefficient of consolidation; and $C_{\alpha e}$ = Secondary compression index.

Checked By: JM Date: 08/13/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
ONE-DIMENSIONAL INCREMENTAL LOADING CONSOLIDATION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

INCOMING SAMPLE NO.: ---------
BORING: **VC-T2B-1** SAMPLE: **4 / 5**
DEPTH: 2.79 - 3.79 ☐ ft; ☑ m
LAB IDENTIFICATION NO.: 130084/T2B145
SAMPLE DESCRIPTION.: Dark gray lean clay (CL)

DATE SAMPLE RECEIVED: 06/27/13
DATE SAMPLE SET-UP: 07/03/13
DATE REPORTED: 08/13/13 REVISED: 10/18/13

Effective Vertical Stress σ'_{vc} (tons/ft^2)	Void Ratio		Vertical Strain (%)		Coefficient of Consolidation (cm^2/sec) c_v [Log Time] ☑ c_v [Sq. Root Time] ☐	Coefficient of Permeability (cm/sec)	Secondary Compression Index, $C_{\alpha e}$
	End of Primary Consolidation	End of Increment	End of Primary Consolidation	End of Increment			
0.0	--	1.298	--	0.00	--	--	-----
0.05	--	1.295	--	0.13	--	--	-----
0.10	1.289	1.285	0.39	0.56	1.1E-03	1.0E-07	0.002
0.20	1.270	1.265	1.21	1.41	4.5E-04	3.9E-08	0.004
0.40	1.239	1.234	2.54	2.78	4.8E-04	3.4E-08	0.005
0.80	1.196	1.180	4.41	5.11	8.7E-04	5.2E-08	0.010
1.60	1.121	1.101	7.70	8.58	8.2E-04	3.6E-08	0.012
0.40	1.123	1.126	7.61	7.49	2.5E-03	--	-----
0.20	1.134	1.139	7.10	6.91	1.4E-03	--	-----
0.40	1.134	1.133	7.13	7.18	2.2E-03	3.2E-08	0.001
0.80	1.120	1.117	7.76	7.86	2.6E-03	4.5E-08	0.001
1.60	1.100	1.087	8.62	9.18	3.2E-03	5.3E-08	0.006
3.00	1.009	0.988	12.58	13.49	8.8E-04	2.8E-08	0.013
6.00	0.894	0.870	17.58	18.62	9.7E-04	1.7E-08	0.013
12.10	0.773	0.752	22.84	23.75	1.0E-03	9.0E-09	0.010
3.00	0.781	0.784	22.51	22.38	2.5E-03	--	-----
0.80	0.828	0.835	20.45	20.15	6.4E-04	--	-----
0.20	0.881	0.891	18.14	17.72	1.5E-04	--	-----

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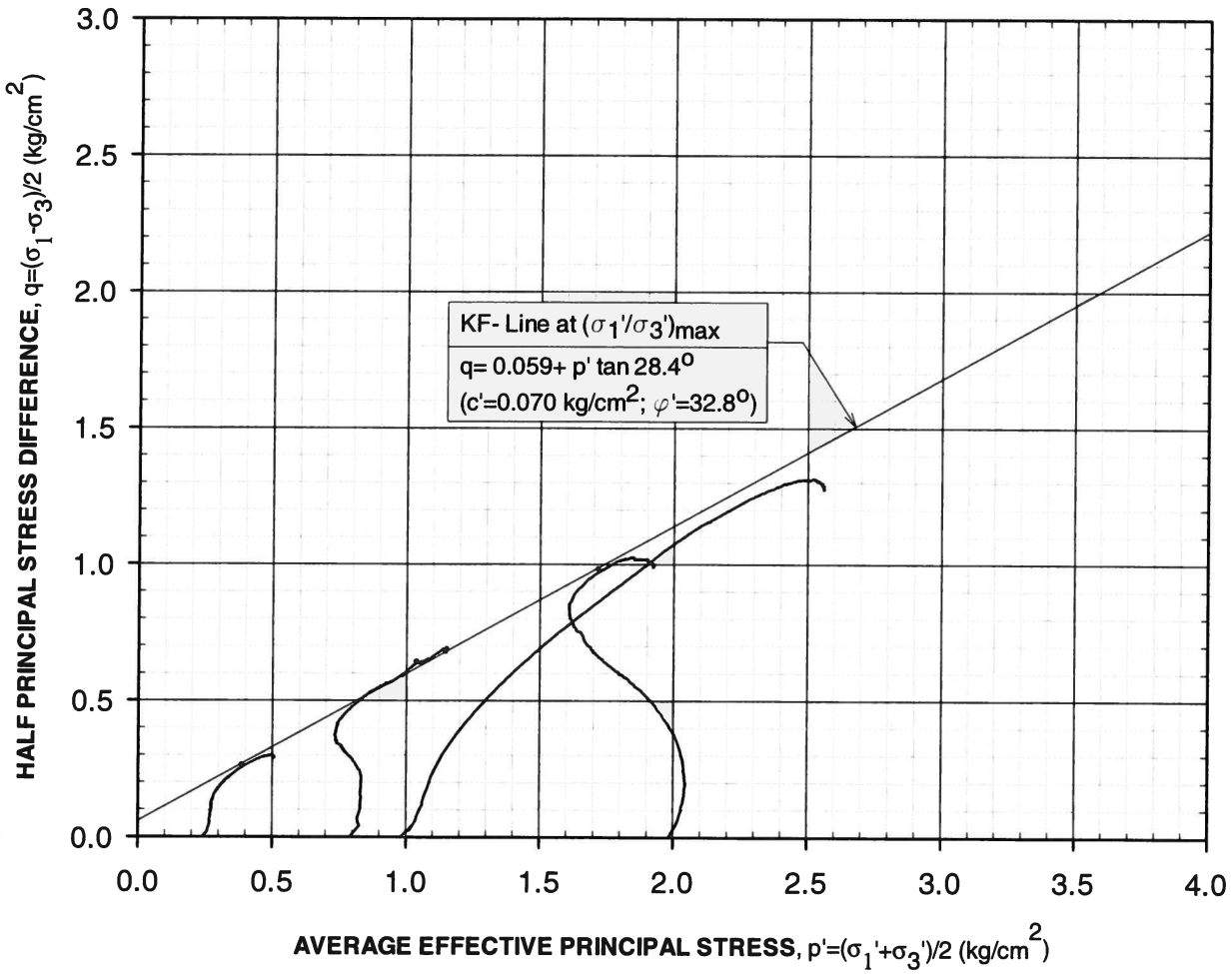
Checked By: JCW Date: 10/18/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
EFFECTIVE STRESS PATHS

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/30/13
DATE REPORTED: 08/16/13 REVISED: 10/18/13

INCOMING SAMPLE NO.: -
BORING: **VC-T2B-1** SAMPLE: **2 / 5**
DEPTH: 0.79 - 1.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/T2B12/5
SAMPLE DESCRIPTION: Dark gray lean clay (CL)



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Checked By: JCW Date: 10/18/13

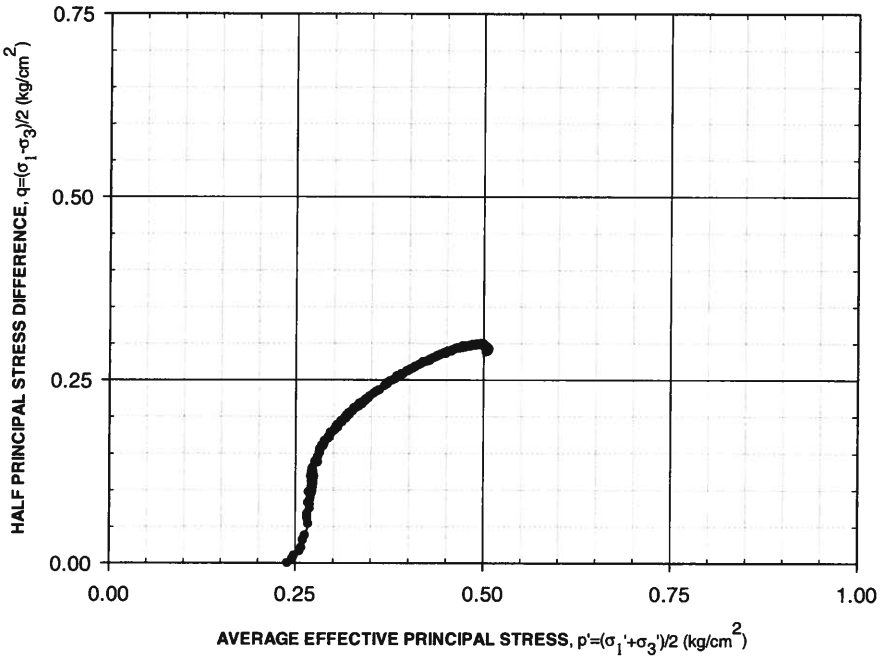
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 08/16/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **2 / 5**
DEPTH: 0.79 - 1.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/2B12/5
SAMPLE DESCRIPTION: Dark gray lean clay (CL)
test specimen from similar clay from VC-T2B-1, 3/5
used as replacement specimen for VC-T2B-1, 2/5.

Specimen Dimensions			Initial Conditions			Test Conditions				Pre-shear Conditions					
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	u_b (kg/cm^2)	σ_c' (kg/cm^2)	$\dot{\varepsilon}$ (%/hour)	B-Factor (%)	ε_{vol} (%)	H_c (cm)	A_c (cm^2)	w_c (%)	γ_d (lb/ft^3)	S (%)
7.06	3.51	2.0	40.3	81.3	99	12.00	0.24	0.9	100	-1.8	7.02	9.56	39.2	82.8	100



TEST PROCEDURE: ASTM D4767

Specimen Mounting Method : ☐ Dry Method ☒ Wet Method

Filter Strip Correction Made : ☐ Yes ☒ No
Membrane Correction Made : ☐ Yes ☒ No

A_c Method: ☐ Method A ☒ Method B

w_c determined from: ☒ Entire Specimen ☐ Trimmings

SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Compacted	

☐ Tamped Uniform Lifts: No. of Lifts: _____

☐ Kneading: Blows per Lift: _____
No. of Lifts_____ Spring:_____lb

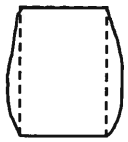
G_s: 2.76 ☐ Assumed ☒ Measured

Stresses and Strains at Failure

Failure Criteria	ε_a (%)	Δu (kg/cm^2)	σ_1' (kg/cm^2)	σ_3' (kg/cm^2)	p' (kg/cm^2)	q (kg/cm^2)
$[\sigma_1 - \sigma_3]_{max}$	10.7	0.04	0.80	0.20	0.50	0.30
$[\sigma_1' / \sigma_3']_{max}$	4.2	0.11	0.64	0.13	0.39	0.26

FAILURE SKETCH

☐ Diagonal Plane
☒ Bulging
☐ Combination
☐ Other _____



Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☒ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	89.07	Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	92.5

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c' = Isotropic effective confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_{vol} = Volume change(- denotes consolidation, + denotes swelling); H_c = Consolidated height; A_c = Consolidated area; ε_a = Axial strain; Δu = Excess pore pressure; σ_1' = Major effective principal stress; σ_3'= Minor effective principal stress; p' = Average effective principal stress; q = Half principal stress difference; and G_s = Specific gravity.

Checked By: _____ Date: 09/23/13

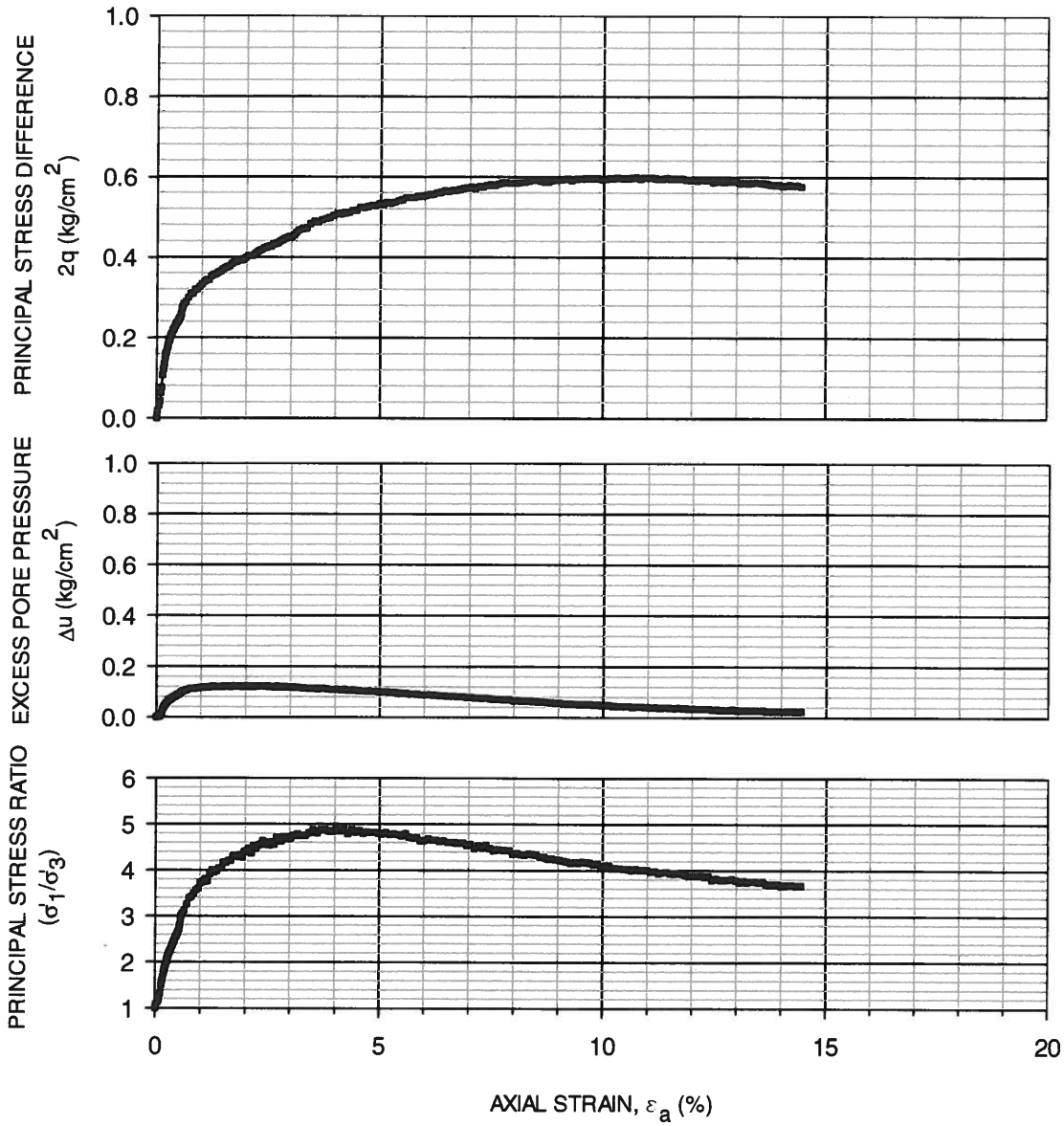
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS - STRAIN CURVES

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 08/16/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **2 / 5**
DEPTH: 0.79 – 1.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T2B12/5
SAMPLE DESCRIPTION: Dark gray lean clay (CL)

Consolidation Stress = 0.24kg/cm^2



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Where: Δu = Excess pore pressure; σ_1' = Major effective principal stress; and σ_3'= Minor effective principal stress.

Checked By: TM Date: 09/23/13

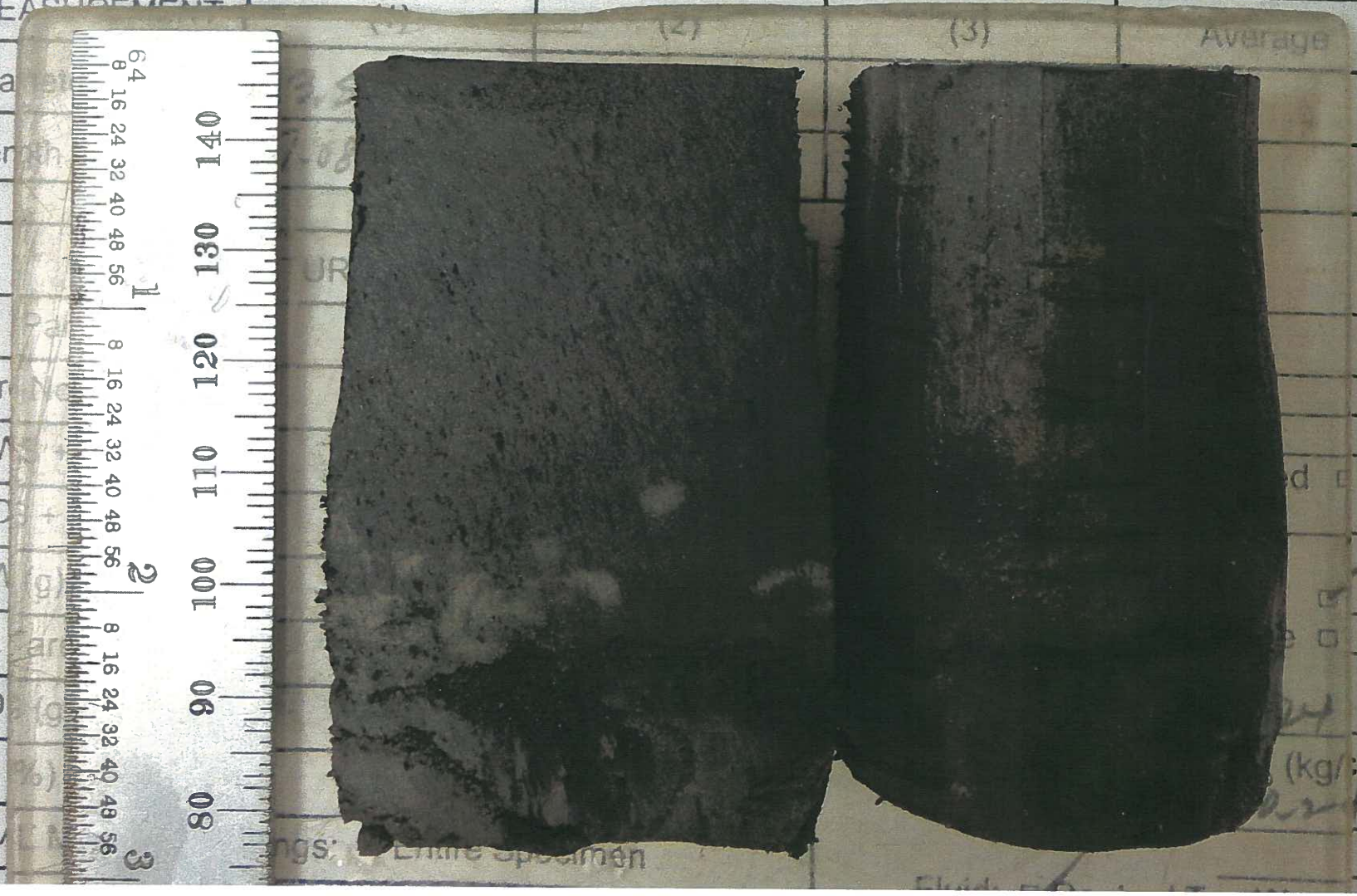
BORING: VCT2B1 SAMPLE: retest DEPTH: 3/5 ☐ ft; ☐ m BLOCK: 2

TYPE SAMPLE: ☐ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TYPE TEST: ☒ CIUC; ☐ UU; ☐ $\overline{UU}$; ☐ CD ☐ OTHER

SAMPLE DESCRIPTION: gry clay w/ pocket of fsnd at bottom

MEASUREMENT	(1)	(2)	(3)	Average	L/D
Dia					
Length					



Tare
WW
WD
WW (g)
Wt. Tare
WD (g)
MC (%)
FINAL

☐ Measured

___ Condoms
___ Thin Membr

0.25 tsf

(kg/cm²) 12.0

Comments: Entire Specimen

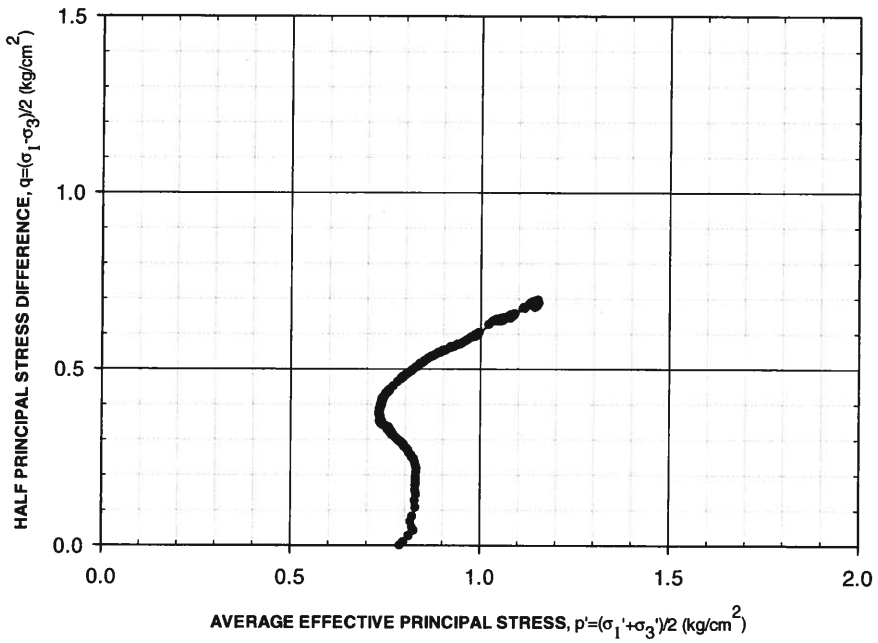
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/30/13
DATE REPORTED: 08/16/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **2 / 5**
DEPTH: 0.79 - 1.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/2B22/5
SAMPLE DESCRIPTION: Dark gray lean clay (CL)

Specimen Dimensions			Initial Conditions			Test Conditions				Pre-shear Conditions					
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	u_b (kg/cm^2)	σ_c' (kg/cm^2)	$\dot{\varepsilon}$ (%/hour)	B-Factor (%)	ε_{vol} (%)	H_c (cm)	A_c (cm^2)	w_c (%)	γ_d (lb/ft^3)	S (%)
7.29	3.58	2.0	32.9	89.7	99	12.00	0.79	1.0	99	-7.3	7.29	9.36	28.2	96.8	100



TEST PROCEDURE: ASTM D4767

Specimen Mounting Method : ☐ Dry Method ☒ Wet Method

Filter Strip Correction Made : ☐ Yes ☒ No
Membrane Correction Made : ☐ Yes ☒ No

A_c Method: ☐ Method A ☒ Method B

w_c determined from: ☒ Entire Specimen ☐ Trimmings

SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Compacted	

☐ Tamped Uniform Lifts: No. of Lifts: ____

☐ Kneading: Blows per Lift: ____
No. of Lifts____ Spring:____lb

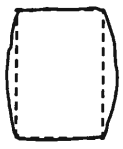
G_s: 2.76 ☐ Assumed ☒ Measured

Stresses and Strains at Failure

Failure Criteria	ε_a (%)	Δu (kg/cm^2)	σ_1' (kg/cm^2)	σ_3' (kg/cm^2)	p' (kg/cm^2)	q (kg/cm^2)
$[\sigma_1 - \sigma_3]_{max}$	13.6	0.33	1.85	0.46	1.15	0.70
$[\sigma_1' / \sigma_3']_{max}$	9.5	0.39	1.68	0.40	1.04	0.64

FAILURE SKETCH

☐ Diagonal Plane
☒ Bulging
☐ Combination
☐ Other ____



Particle-Size Analysis
☐ ASTM D422
☒ ASTM D1140-Method B

Dry Mass (g): 105.79

U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	96.4

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c' = Isotropic effective confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_{vol} = Volume change(- denotes consolidation, + denotes swelling); H_c = Consolidated height; A_c = Consolidated area; ε_a = Axial strain; Δu = Excess pore pressure; σ_1' = Major effective principal stress; σ_3'= Minor effective principal stress; p' = Average effective principal stress; q = Half principal stress difference; and G_s = Specific gravity.

Checked By: _____ Date: 08/16/13

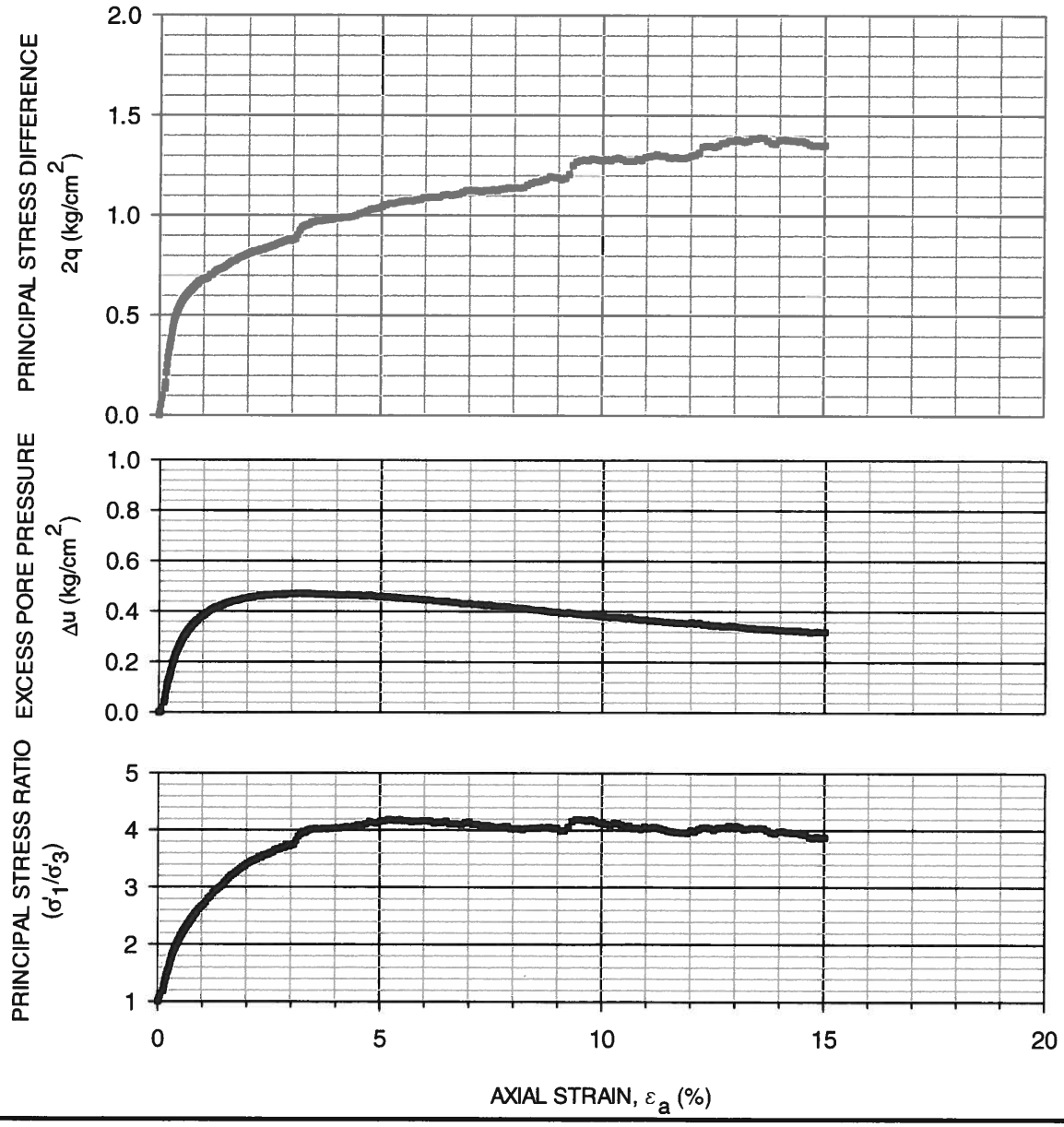
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS - STRAIN CURVES

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/30/13
DATE REPORTED: 08/16/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **2 / 5**
DEPTH: 0.79 – 1.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T2B12/5
SAMPLE DESCRIPTION: Dark gray lean clay (CL)

Consolidation Stress = 0.79 kg/cm^2



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Where: Δu = Excess pore pressure; σ_1' = Major effective principal stress; and σ_3'= Minor effective principal stress.

Checked By: JM Date: 08/16/13

BORING: VC72 B1 SAMPLE: 20.5 DEPTH: ? ☒ ft; ☐ m BLOCK: 2

TYPE SAMPLE: ☐ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TYPE TEST: ☒ CIUC; ☐ UU; ☐ UU; ☐ CD ☐ OTHER

SAMPLE DESCRIPTION:

	Average	L/D
M		
Di		
Le		

140.63

(lb/ft³):

/ft³):

☐ Assumed ☐ Measured

):

Strips ☐ 1 Condoms

Membrane ☐ Thin Membrane

Final $\bar{\sigma}_c$ (kg/cm²): 0.79 0.8+56

σ_c (kg/cm²): 12-79 u_b (kg/cm²) 12-0

$\bar{\sigma}_c$ Stages (kg/cm²): 0-9 ;

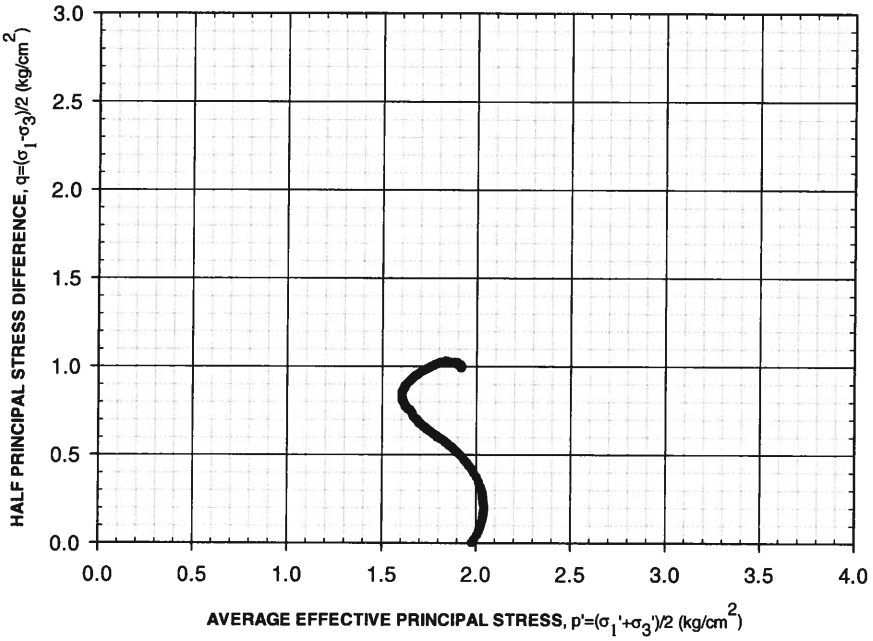
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/30/13
DATE REPORTED: 08/16/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **2 / 5**
DEPTH: 0.79 - 1.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/2B22/5
SAMPLE DESCRIPTION: Dark gray lean clay (CL)

Specimen Dimensions			Initial Conditions			Test Conditions				Pre-shear Conditions					
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	u_b (kg/cm^2)	σ_c' (kg/cm^2)	$\dot{\varepsilon}$ (%/hour)	B-Factor (%)	ε_{vol} (%)	H_c (cm)	A_c (cm^2)	w_c (%)	γ_d (lb/ft^3)	S (%)
7.24	3.56	2.0	29.6	93.2	96	11.00	1.98	1.1	98	-11.3	7.10	8.99	23.2	105.0	100



TEST PROCEDURE: ASTM D4767

Specimen Mounting Method : ☐ Dry Method ☒ Wet Method

Filter Strip Correction Made : ☐ Yes ☒ No
Membrane Correction Made : ☐ Yes ☒ No

A_c Method: ☐ Method A ☒ Method B

w_c determined from: ☒ Entire Specimen ☐ Trimmings

SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Compacted	

☐ Tamped Uniform Lifts: No. of Lifts: ____

☐ Kneading: Blows per Lift: ____
No. of Lifts____ Spring:____lb

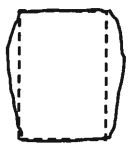
G_s: 2.76 ☐ Assumed ☒ Measured

Stresses and Strains at Failure

Failure Criteria	ε_a (%)	Δu (kg/cm^2)	σ_1' (kg/cm^2)	σ_3' (kg/cm^2)	p' (kg/cm^2)	q (kg/cm^2)
$[\sigma_1 - \sigma_3]_{max}$	8.6	1.17	2.87	0.81	1.84	1.03
$[\sigma_1' / \sigma_3']_{max}$	5.6	1.23	2.70	0.75	1.72	0.98

FAILURE SKETCH

☐ Diagonal Plane
☒ Bulging
☐ Combination
☐ Other _____



Particle-Size Analysis
☐ ASTM D422
☒ ASTM D1140-Method B

Dry Mass (g): 107.35

U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	91.4

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c' = Isotropic effective confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_{vol} = Volume change(- denotes consolidation, + denotes swelling); H_c = Consolidated height; A_c = Consolidated area; ε_a = Axial strain; Δu = Excess pore pressure; σ_1' = Major effective principal stress; σ_3'= Minor effective principal stress; p' = Average effective principal stress; q = Half principal stress difference; and G_s = Specific gravity.

Checked By: _____ Date: 08/16/13

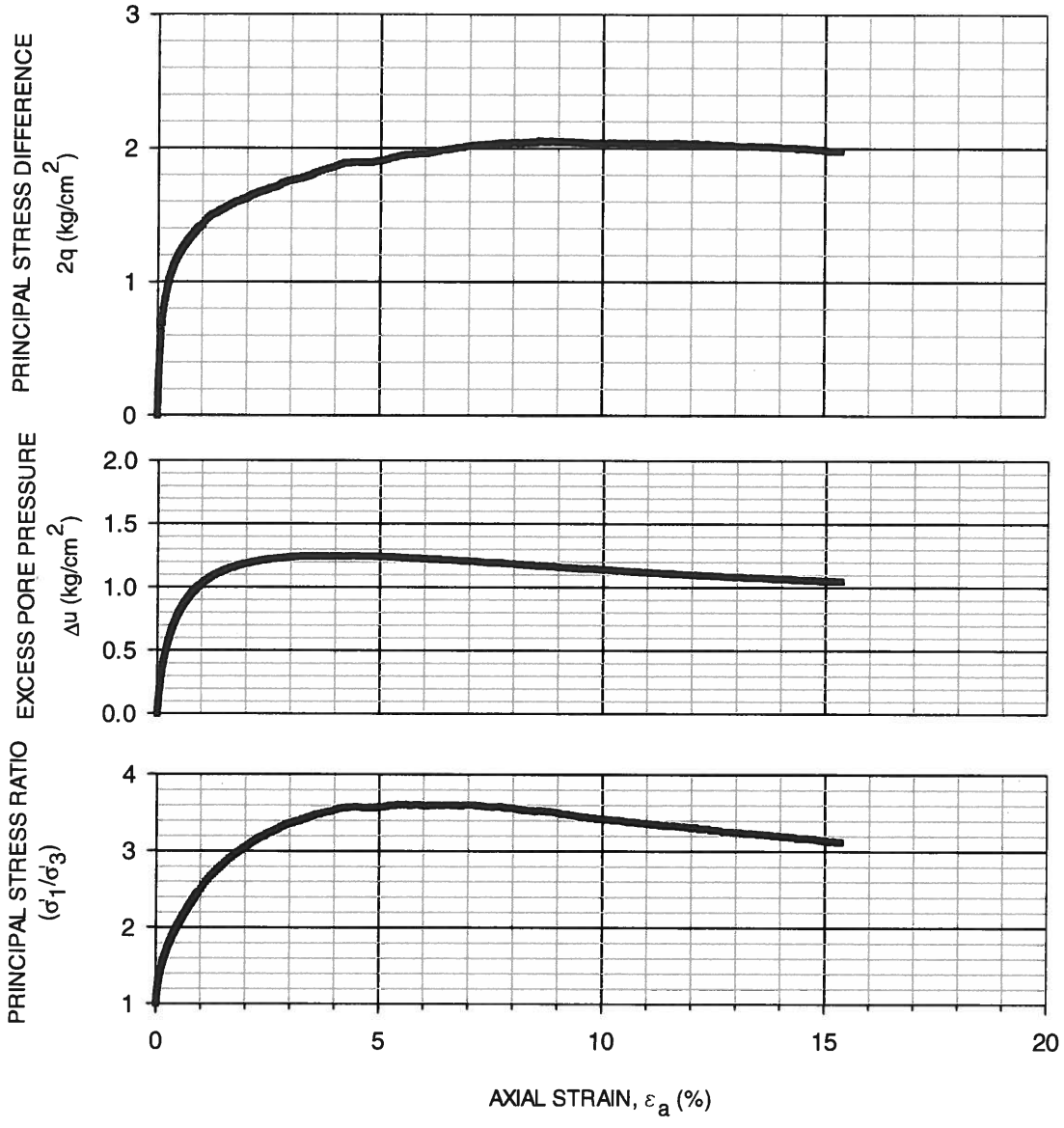
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS - STRAIN CURVES

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/30/13
DATE REPORTED: 08/16/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **2 / 5**
DEPTH: 0.79 – 1.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T2B12/5
SAMPLE DESCRIPTION: Dark gray lean clay (CL)

Consolidation Stress = 1.98 kg/cm^2



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Where: Δu = Excess pore pressure; σ_1' = Major effective principal stress; and σ_3'= Minor effective principal stress.

Checked By: _____ Date: 08/16/13

BORING: UC T2 SAMPLE: B1 2/5 DEPTH: ? ☐ ft; ☐ m BLOCK: 3

TYPE SAMPLE: ☐ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TYPE TEST: ☑ CIUC; ☐ UU; ☐ UU; ☐ CD ☐ OTHER

SAMPLE DESCRIPTION: Lean Gray clay w/ sand & silt

MEAS | Average | L/D

Diame | 2.034

Lengt

139.10

Tare M

WWS | ☐ Measured

WDS

WW | ☐ Condoms

Wt. T | ☐ Thin Membran

WDS | 2.0+g

MC (| 11.0

$\bar{\sigma}_c$ Stages (kg/cm²): 0.5 | 1.98

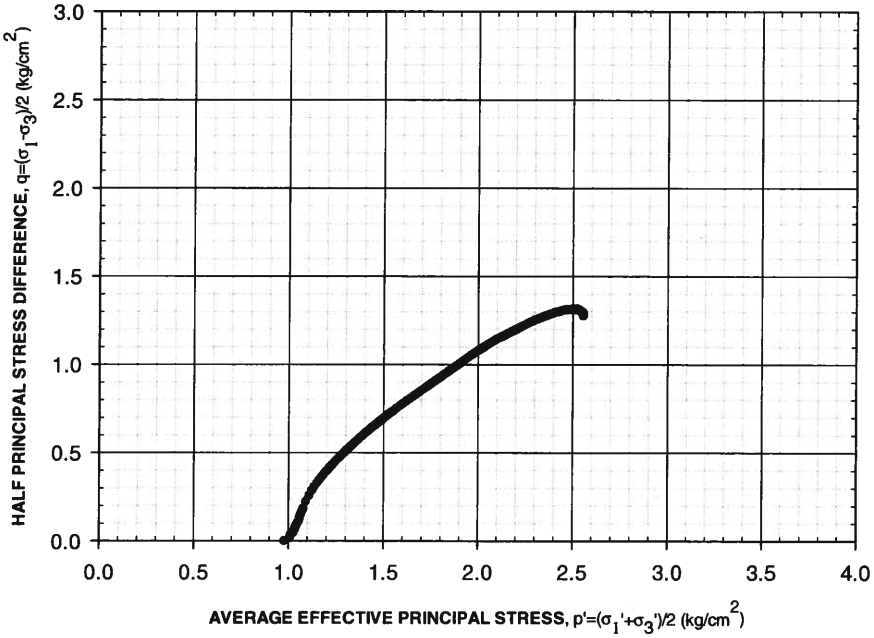
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/30/13
DATE REPORTED: 08/16/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **2 / 5**
DEPTH: 0.79 - 1.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/2B22/5
SAMPLE DESCRIPTION: Dark gray lean clay (CL)
Sample consolidated to 4.88 kg/cm^2 then rebounded to 0.98 kg/cm^2. OCR=5.0

Specimen Dimensions			Initial Conditions			Test Conditions				Pre-shear Conditions					
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	u_b (kg/cm^2)	σ_c' (kg/cm^2)	$\dot{\varepsilon}$ (%/hour)	B-Factor (%)	ε_{vol} (%)	H_c (cm)	A_c (cm^2)	w_c (%)	γ_d (lb/ft^3)	S (%)
7.27	3.60	2.0	32.6	89.3	97	8.00	0.98	1.0	99	-13.6	7.03	9.08	24.2	103.3	100



TEST PROCEDURE: ASTM D4767

Specimen Mounting Method : ☐ Dry Method ☒ Wet Method

Filter Strip Correction Made : ☐ Yes ☒ No
Membrane Correction Made : ☐ Yes ☒ No

A_c Method: ☐ Method A ☒ Method B

w_c determined from: ☒ Entire Specimen ☐ Trimmings

SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Compacted	

☐ Tamped Uniform Lifts: No. of Lifts: _____

☐ Kneading: Blows per Lift: _____
No. of Lifts_____Spring:_____lb

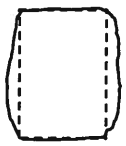
G_s: 2.76 ☐ Assumed ☒ Measured

Stresses and Strains at Failure

Failure Criteria	ε_a (%)	Δu (kg/cm^2)	σ_1' (kg/cm^2)	σ_3' (kg/cm^2)	p' (kg/cm^2)	q (kg/cm^2)
$[\sigma_1 - \sigma_3]_{max}$	12.2	-0.23	3.84	1.22	2.53	1.31
$[\sigma_1' / \sigma_3']_{max}$	6.4	-0.06	3.52	1.04	2.28	1.24

FAILURE SKETCH

☐ Diagonal Plane
☒ Bulging
☐ Combination
☐ Other _____



Particle-Size Analysis
☐ ASTM D422
☒ ASTM D1140-Method B

Dry Mass (g): 105.66

U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	95.7

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c' = Isotropic effective confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_{vol} = Volume change(- denotes consolidation, + denotes swelling); H_c = Consolidated height; A_c = Consolidated area; ε_a = Axial strain; Δu = Excess pore pressure; σ_1' = Major effective principal stress; σ_3'= Minor effective principal stress; p' = Average effective principal stress; q = Half principal stress difference; and G_s = Specific gravity.

Checked By: _____ Date: 08/16/13

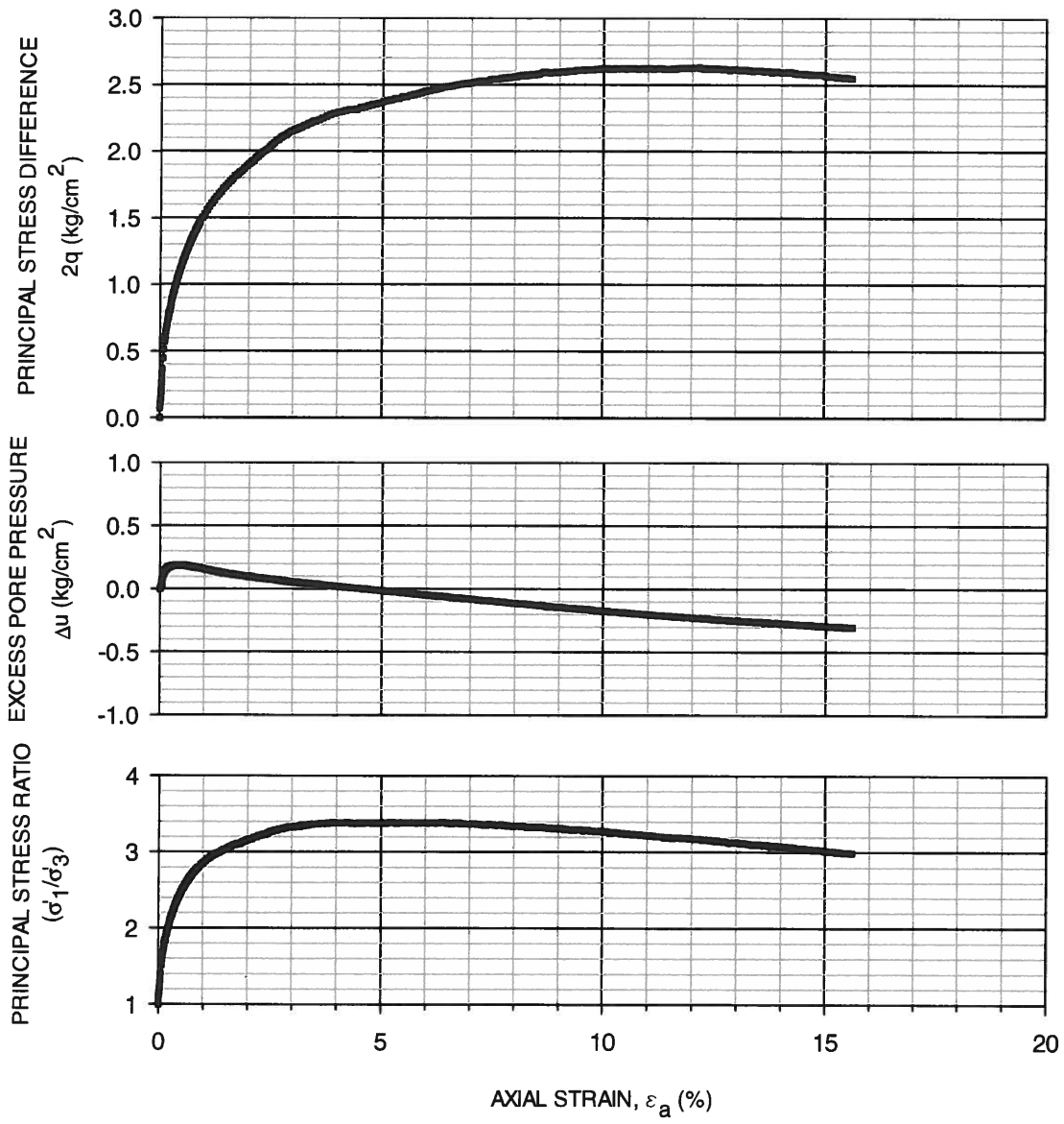
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS - STRAIN CURVES

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/30/13
DATE REPORTED: 08/16/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **2 / 5**
DEPTH: 0.79 – 1.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T2B12/5
SAMPLE DESCRIPTION: Dark gray lean clay (CL)

Consolidation Stress = 4.88 kg/cm^2 then rebounded to 0.98 kg/cm^2. OCR=5.0



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Where: Δu = Excess pore pressure; σ_1' = Major effective principal stress; and σ_3'= Minor effective principal stress.

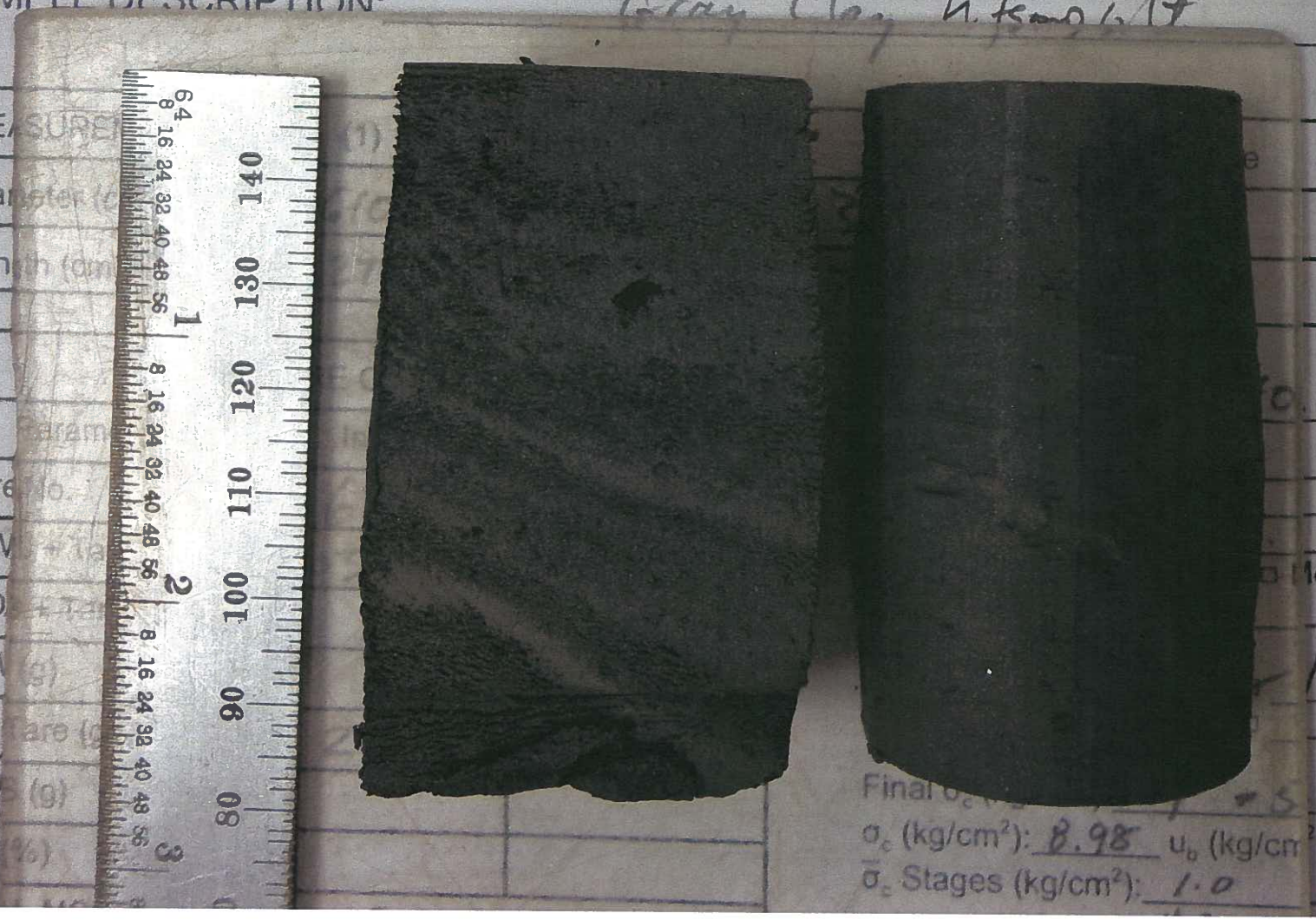
Checked By: TM Date: 08/16/13

BORING: VCT2 B1 SAMPLE: 3/5 DEPTH: ____ ☐ ft; ☐ m BLOCK: 2

TYPE SAMPLE: ☒ UNDISTURBED; ☐ COMPACTED; ☐ OTHER ____

TYPE TEST: ☒ CIUC; ☐ UU; ☐ $\overline{UU}$; ☐ CD ☐ OTHER ____

SAMPLE DESCRIPTION: Gray Clay, trace fine sand, lt



L/D
2.023

Measured

Condoms
Thin Membrane

σ_c (kg/cm²): 8.98 u_b (kg/cm²) 8.0

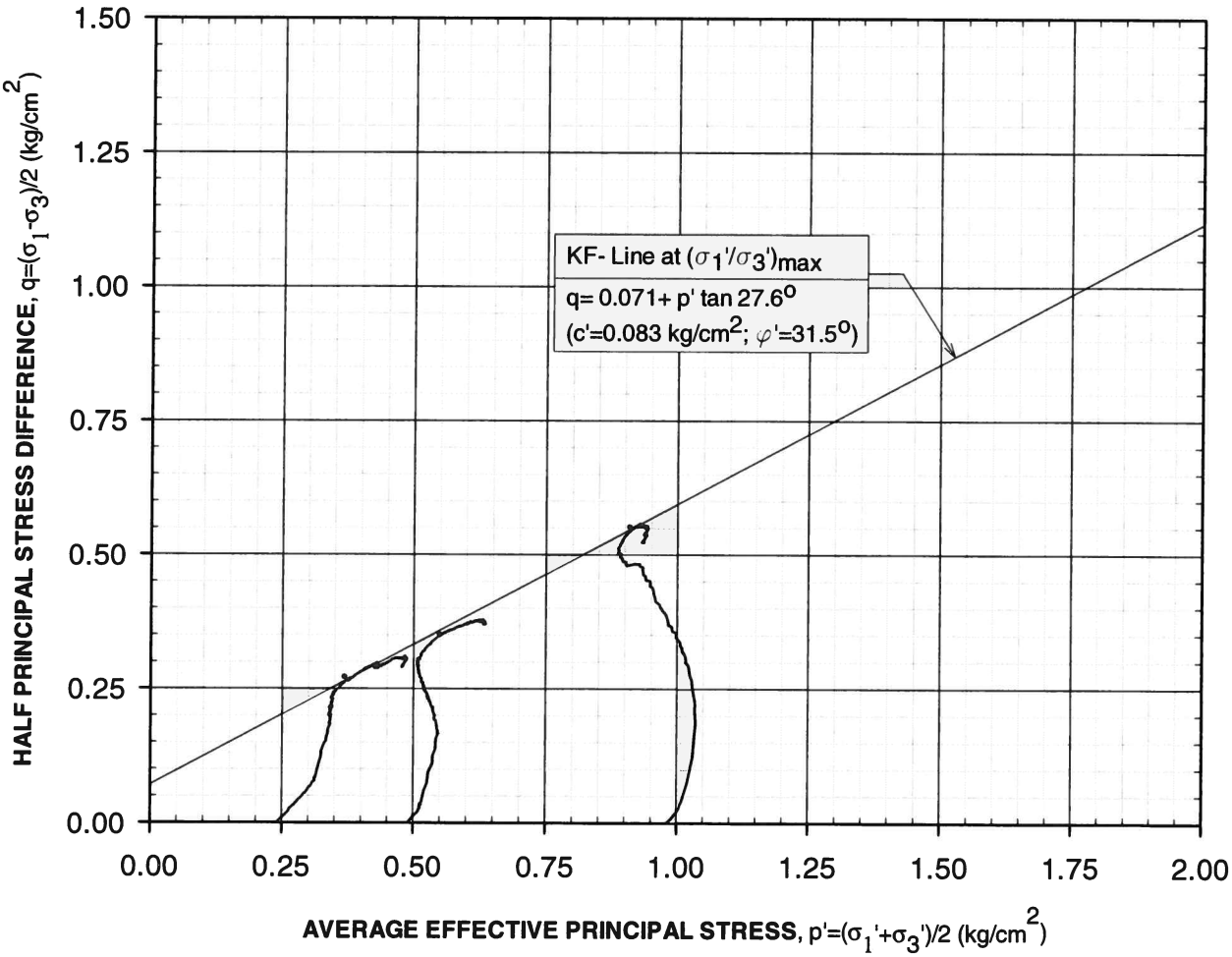
$\bar{\sigma}_c$ Stages (kg/cm²): 1.0 ; 2.0

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
EFFECTIVE STRESS PATHS

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/13-15/13
DATE REPORTED: 08/13/13 REVISED: 10/18/13

INCOMING SAMPLE NO.: -
BORING: **VC-T2B-1** SAMPLE: **3/5**
DEPTH: 1.79 - 2.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/T2B13/5
SAMPLE DESCRIPTION: Dark gray lean clay (CL)



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Checked By: JAW Date: 10/18/13 S:\Projects\2013\13-13-0084\triaxial strength tests\Form SR-7B Rev. 0-VC-T2B-1.docx

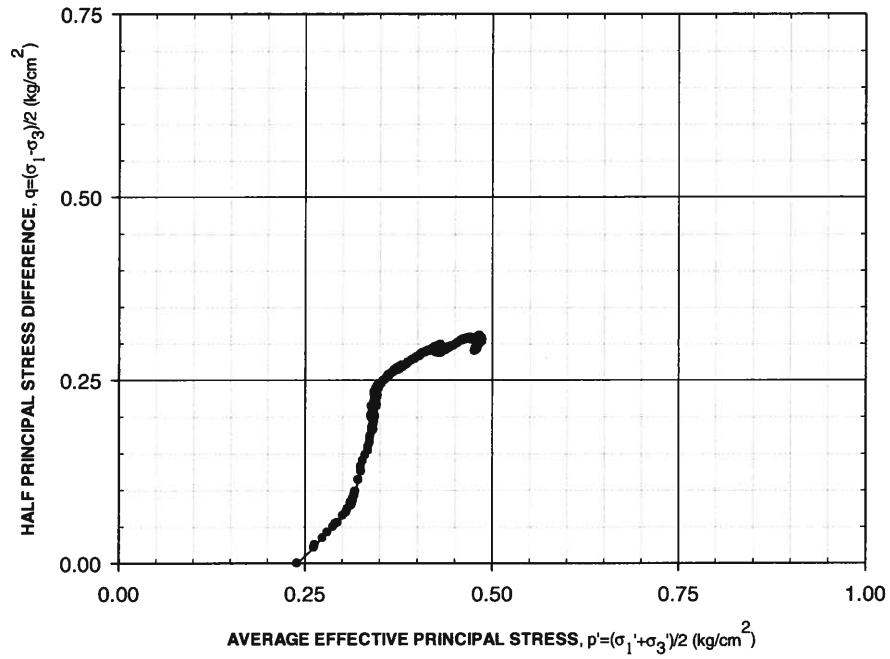
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/13/13
DATE REPORTED: 08/13/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **3/5**
DEPTH: 1.79 – 2.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/T2B13/5
SAMPLE DESCRIPTION: Dark gray lean clay (CL)

Specimen Dimensions			Initial Conditions			Test Conditions				Pre-shear Conditions					
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	u_b (kg/cm^2)	σ_c' (kg/cm^2)	$\dot{\varepsilon}$ (%/hour)	B-Factor (%)	ε_{vol} (%)	H_c (cm)	A_c (cm^2)	w_c (%)	γ_d (lb/ft^3)	S (%)
7.06	3.57	2.0	43.6	77.0	98	12.00	0.24	1.0	100	-6.9	7.02	9.38	39.1	82.7	100



TEST PROCEDURE: ASTM D4767

Specimen Mounting Method : ☐ Dry Method ☒ Wet Method

Filter Strip Correction Made : ☐ Yes ☒ No
Membrane Correction Made : ☐ Yes ☒ No

A_c Method: ☐ Method A ☒ Method B

w_c determined from: ☒ Entire Specimen ☐ Trimmings

SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Compacted	

☐ Tamped Uniform Lifts: No. of Lifts: _____

☐ Kneading: Blows per Lift: _____ No. of Lifts_____ Spring:_____lb

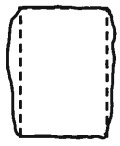
G_s: 2.75 ☒ Assumed ☐ Measured

Stresses and Strains at Failure

Failure Criteria	ε_a (%)	Δu (kg/cm^2)	σ_1' (kg/cm^2)	σ_3' (kg/cm^2)	p' (kg/cm^2)	q (kg/cm^2)
$[\sigma_1 - \sigma_3]_{max}$	12.3	0.07	0.79	0.17	0.48	0.31
$[\sigma_1' / \sigma_3']_{max}$	3.6	0.13	0.64	0.11	0.37	0.27

FAILURE SKETCH

☐ Diagonal Plane
☒ Bulging
☐ Combination
☐ Other _____



Particle-Size Analysis
☐ ASTM D422
☒ ASTM D1140-Method B

Dry Mass (g): 87.21

U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	95.0

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c' = Isotropic effective confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_{vol} = Volume change(- denotes consolidation, + denotes swelling); H_c = Consolidated height; A_c = Consolidated area; ε_a = Axial strain; Δu = Excess pore pressure; σ_1' = Major effective principal stress; σ_3'= Minor effective principal stress; p' = Average effective principal stress; q = Half principal stress difference; and G_s = Specific gravity.

Checked By: _____ Date: 08/13/13

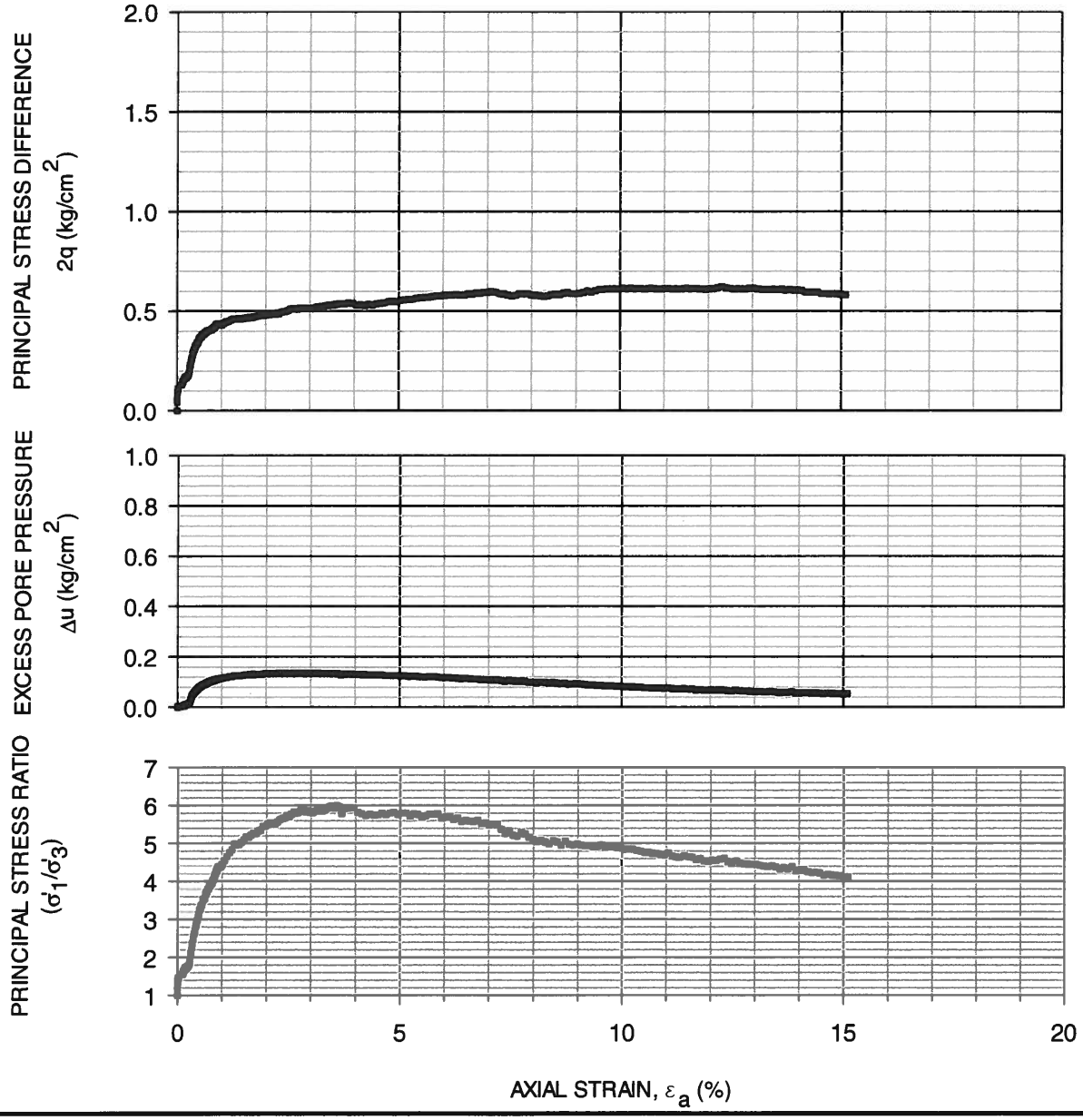
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS - STRAIN CURVES

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/13/13
DATE REPORTED: 08/13/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **3/5**
DEPTH: 1.79 – 2.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T2B13/5
SAMPLE DESCRIPTION: Dark gray lean clay (CL)

Consolidation Stress = 0.24 kg/cm^2



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Where: Δu = Excess pore pressure; σ_1' = Major effective principal stress; and σ_3'= Minor effective principal stress.

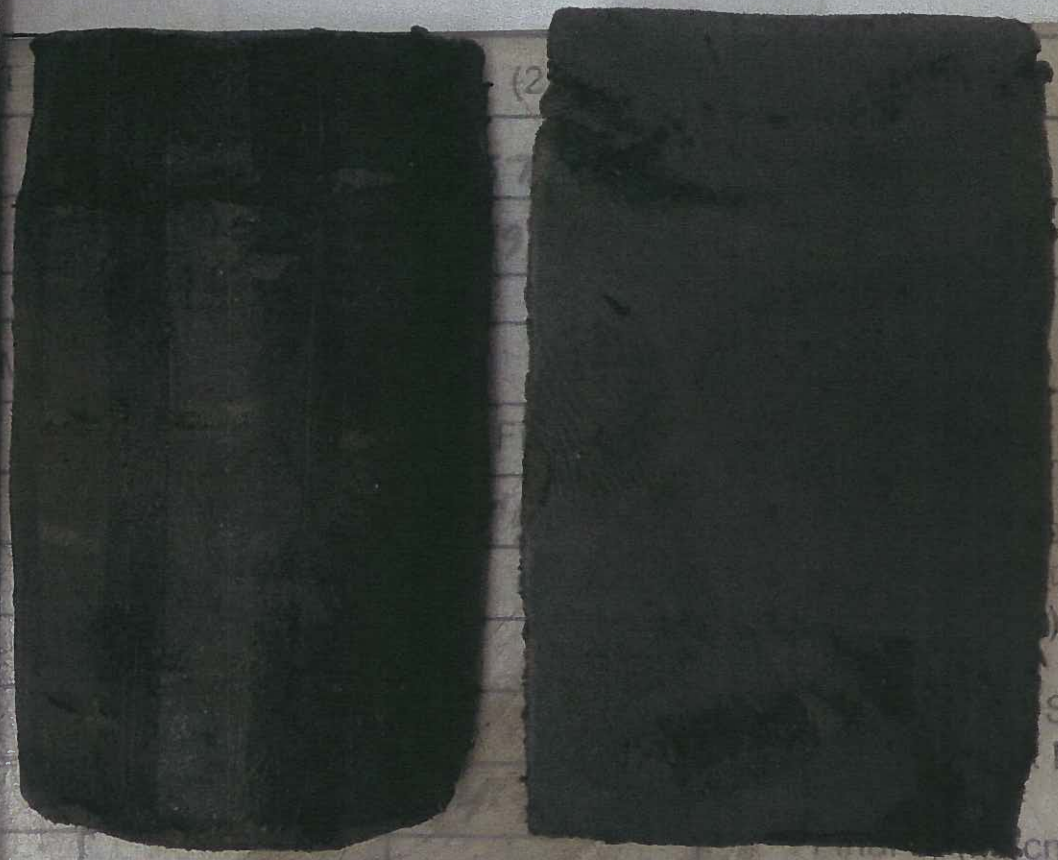
Checked By: _____ Date: 08/13/13

BORING: VC T2B1 SAMPLE: 3/5 DEPTH: ☐ ft; ☐ m BLOCK: 1

TYPE SAMPLE: ☑ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TY ☑ CIUC; ☐ UU; ☐ $\overline{UU}$; ☐ CD ☐ OTHER

SA CRIPTION: grey clay w/ sand



M
Di
Le
Ta
W
W
W
W
W
M
F

Average L/D

125-25

(lb/ft³):
/ft³):
☐ Assumed ☐ Measured
):

Strips ☑ 1 Condoms
Membrane ☐ Thin Membra

cm²): 0.24 kg/c 0.25 kg
σ_c (kg/cm²): 12.24 u_b (kg/cm²) 12 0
$\bar{\sigma}_c$ Stages (kg/cm²): 0.24

Specimen

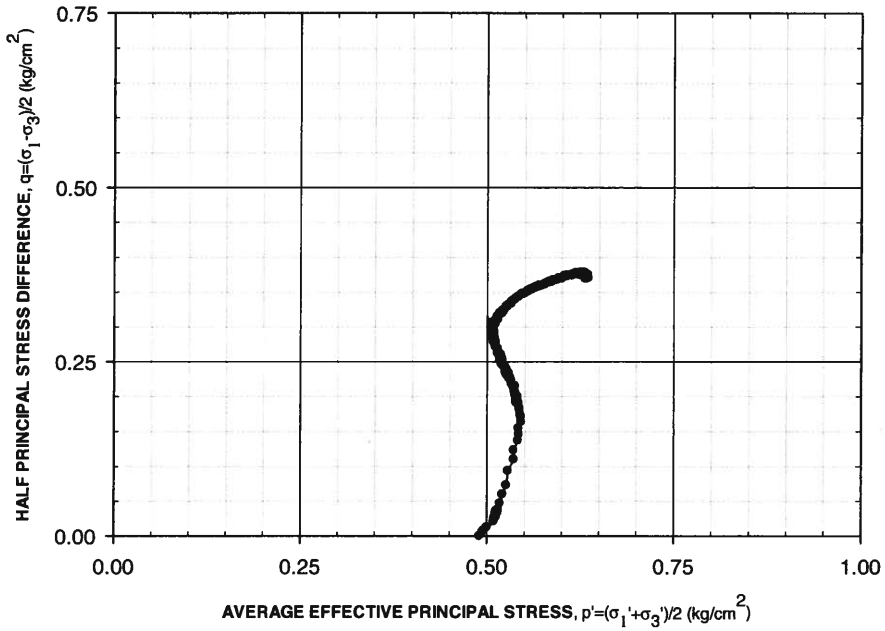
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/13/13
DATE REPORTED: 08/13/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **3/5**
DEPTH: 1.79 – 2.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/T2B13/5
SAMPLE DESCRIPTION: Dark gray lean clay (CL)

Specimen Dimensions			Initial Conditions			Test Conditions				Pre-shear Conditions					
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	u_b (kg/cm^2)	σ_c' (kg/cm^2)	$\dot{\varepsilon}$ (%/hour)	B-Factor (%)	ε_{vol} (%)	H_c (cm)	A_c (cm^2)	w_c (%)	γ_d (lb/ft^3)	S (%)
7.06	3.55	2.0	46.5	75.0	99	12.00	0.49	1.0	99	-8.3	6.95	9.23	39.9	81.8	100



TEST PROCEDURE: ASTM D4767

Specimen Mounting Method : ☐ Dry Method ☒ Wet Method

Filter Strip Correction Made : ☐ Yes ☒ No
Membrane Correction Made : ☐ Yes ☒ No

A_c Method: ☐ Method A ☒ Method B

w_c determined from: ☒ Entire Specimen ☐ Trimmings

SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Compacted	

☐ Tamped Uniform Lifts: No. of Lifts: _____

☐ Kneading: Blows per Lift: _____
No. of Lifts_____Spring:_____lb

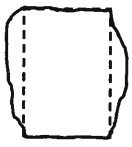
G_s: 2.75 ☒ Assumed ☐ Measured

Stresses and Strains at Failure

Failure Criteria	ε_a (%)	Δu (kg/cm^2)	σ_1' (kg/cm^2)	σ_3' (kg/cm^2)	p' (kg/cm^2)	q (kg/cm^2)
$[\sigma_1 - \sigma_3]_{max}$	11.5	0.24	1.00	0.25	0.63	0.38
$[\sigma_1' / \sigma_3']_{max}$	5.6	0.29	0.90	0.20	0.55	0.35

FAILURE SKETCH

☐ Diagonal Plane
☒ Bulging
☐ Combination
☐ Other _____



Particle-Size Analysis
☐ ASTM D422
☒ ASTM D1140-Method B

U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g) 84.07										
Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	97.1

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c' = Isotropic effective confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_{vol} = Volume change(- denotes consolidation, + denotes swelling); H_c = Consolidated height; A_c = Consolidated area; ε_a = Axial strain; Δu = Excess pore pressure; σ_1' = Major effective principal stress; σ_3'= Minor effective principal stress; p' = Average effective principal stress; q = Half principal stress difference; and G_s = Specific gravity.

Checked By: _____ Date: 08/13/13

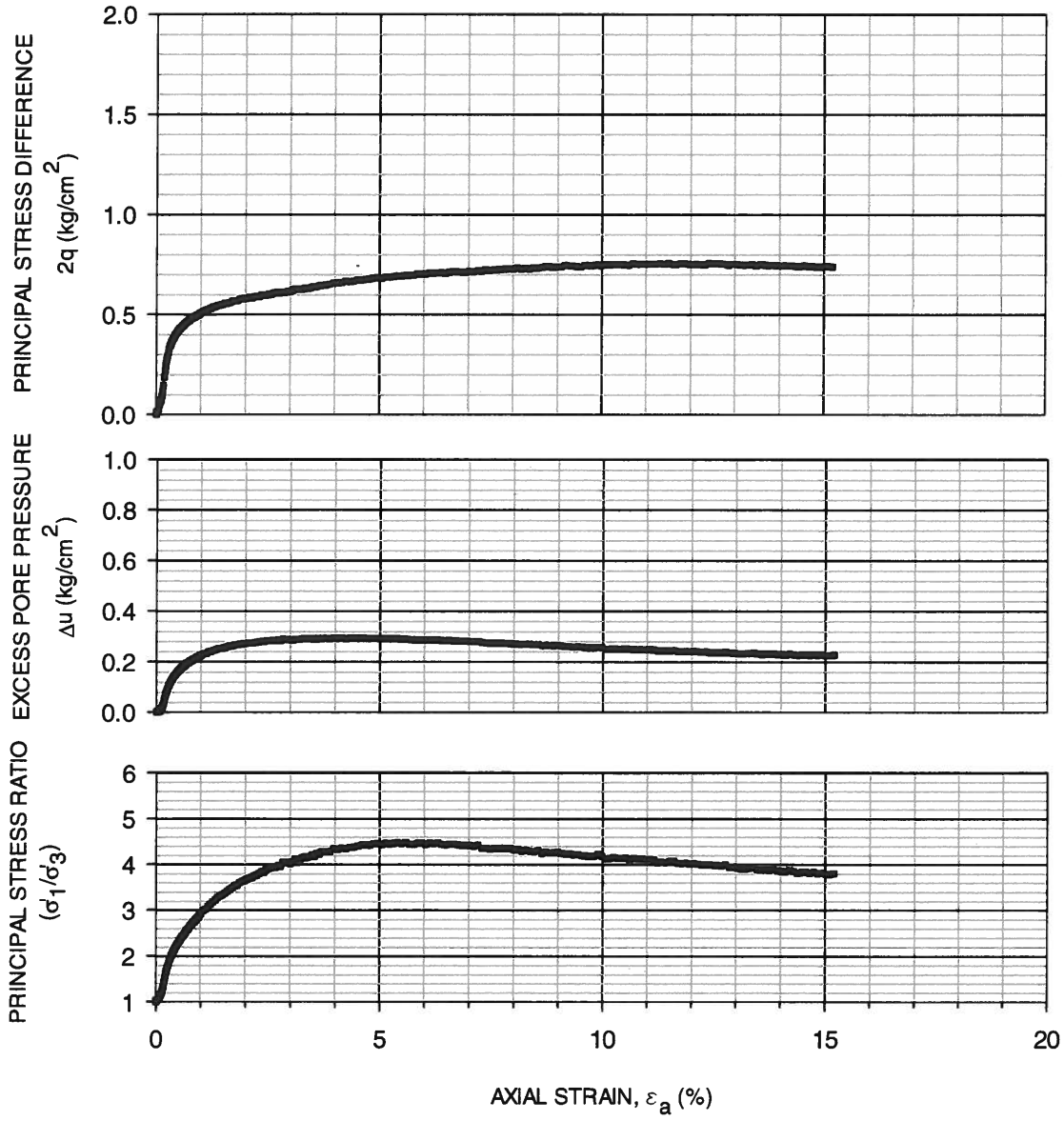
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS - STRAIN CURVES

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/13/13
DATE REPORTED: 08/13/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **3/5**
DEPTH: 1.79 – 2.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T2B13/5
SAMPLE DESCRIPTION: Dark gray lean clay (CL)

Consolidation Stress = 0.49 kg/cm^2



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Where: Δu = Excess pore pressure; σ_1' = Major effective principal stress; and σ_3'= Minor effective principal stress.

Checked By: _____ Date: 08/13/13

BORING: VCT2 B1 SAMPLE: 3/5 DEPTH: ☐ ft; ☐ m BLOCK: 1

TYPE SAMPLE: ☐ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TYPE TEST: ☐ CIUC; ☐ UU; ☐ $\overline{UU}$; ☐ CD ☐ OTHER

SAMPLE DESCRIPTION: Gray clay

Average | L/D

123.20

sumed ☐ Meas red

Condoms

Membrane ☒ 1 | Thin Memb

Final $\bar{\sigma}_c$ (kg/cm²): 0.49 kg/cm² | 0.56

$\bar{\sigma}_c$ (kg/cm²): 12.49 u_b (kg/cm²)

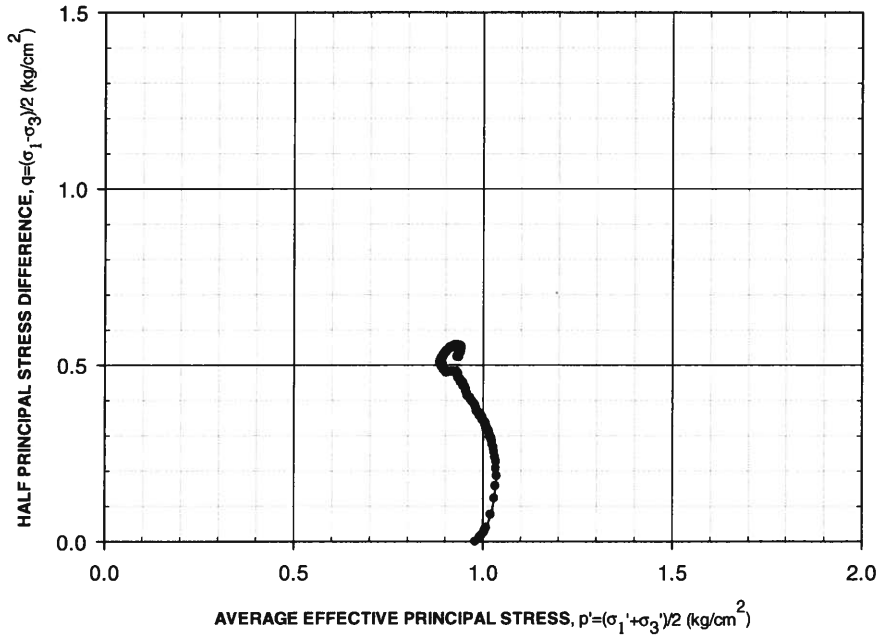
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/15/13
DATE REPORTED: 08/13/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **3/5**
DEPTH: 1.79 – 2.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/T2B13/5
SAMPLE DESCRIPTION: Dark gray lean clay (CL)

Specimen Dimensions			Initial Conditions			Test Conditions				Pre-shear Conditions					
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	u_b (kg/cm^2)	σ_c' (kg/cm^2)	$\dot{\varepsilon}$ (%/hour)	B-Factor (%)	ε_{vol} (%)	H_c (cm)	A_c (cm^2)	w_c (%)	γ_d (lb/ft^3)	S (%)
7.05	3.55	2.0	44.1	77.6	100	12.00	0.98	1.0	100	-9.4	6.90	9.15	36.5	85.7	100



TEST PROCEDURE: ASTM D4767

Specimen Mounting Method : ☐ Dry Method ☒ Wet Method

Filter Strip Correction Made : ☐ Yes ☒ No
Membrane Correction Made : ☐ Yes ☒ No

A_c Method: ☐ Method A ☒ Method B

w_c determined from: ☒ Entire Specimen ☐ Trimmings

SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Compacted	

☐ Tamped Uniform Lifts: No. of Lifts: ____

☐ Kneading: Blows per Lift: ____
No. of Lifts____ Spring:____lb

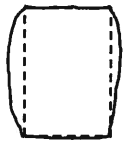
G_s: 2.75 ☒ Assumed ☐ Measured

Stresses and Strains at Failure

Failure Criteria	ε_a (%)	Δu (kg/cm^2)	σ_1' (kg/cm^2)	σ_3' (kg/cm^2)	p' (kg/cm^2)	q (kg/cm^2)
$[\sigma_1 - \sigma_3]_{max}$	7.9	0.61	1.49	0.37	0.93	0.56
$[\sigma_1' / \sigma_3']_{max}$	6.4	0.62	1.46	0.36	0.91	0.55

FAILURE SKETCH

☐ Diagonal Plane
☒ Bulging
☐ Combination
☐ Other _____



Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☒ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	86.68	Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	98.2

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c' = Isotropic effective confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_{vol} = Volume change(- denotes consolidation, + denotes swelling); H_c = Consolidated height; A_c = Consolidated area; ε_a = Axial strain; Δu = Excess pore pressure; σ_1' = Major effective principal stress; σ_3'= Minor effective principal stress; p' = Average effective principal stress; q = Half principal stress difference; and G_s = Specific gravity.

Checked By: TM Date: 08/13/13

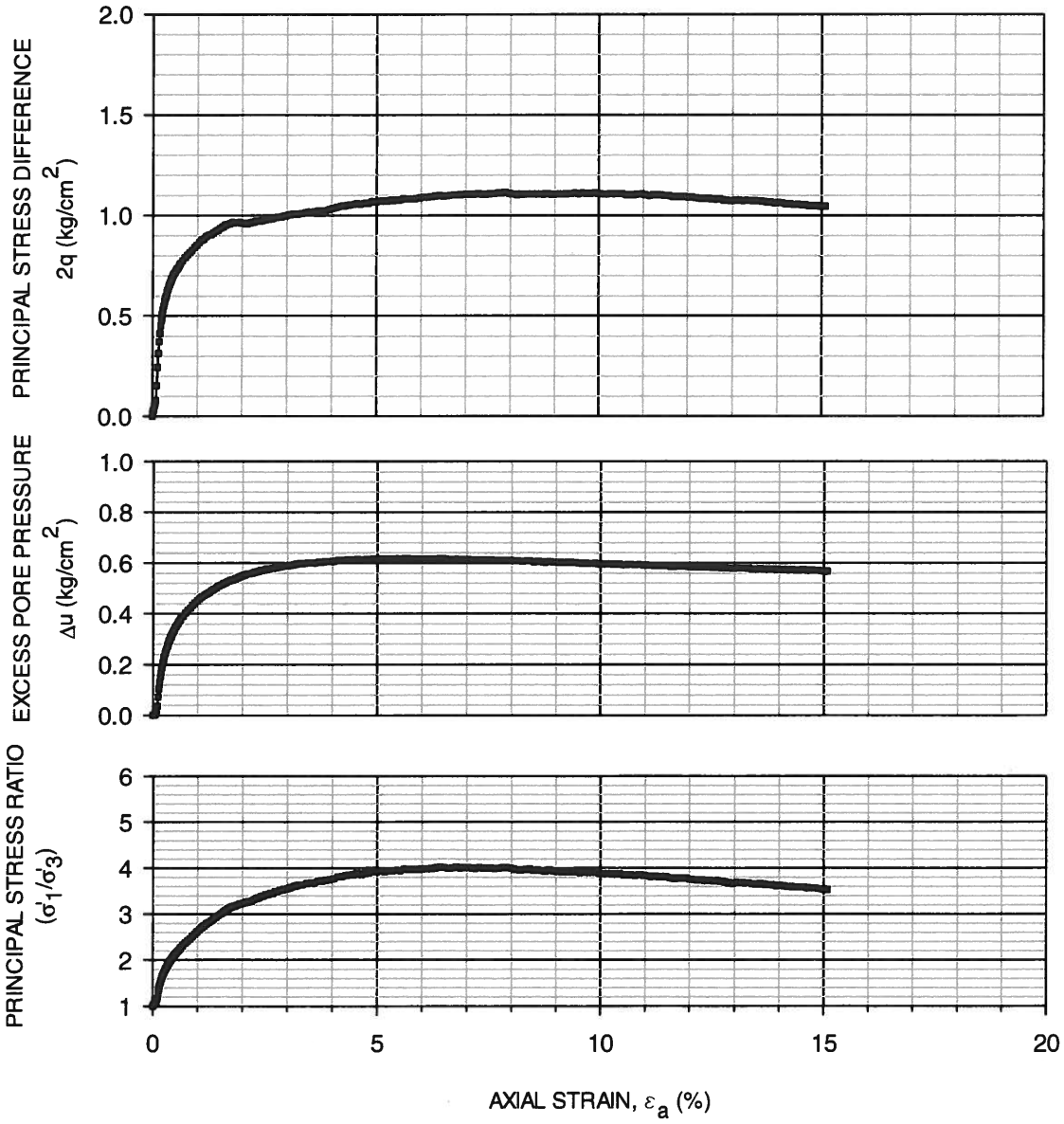
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS - STRAIN CURVES

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/15/13
DATE REPORTED: 08/13/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-1** SAMPLE: **3/5**
DEPTH: 1.79 – 2.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T2B13/5
SAMPLE DESCRIPTION: Dark gray lean clay (CL)

Consolidation Stress = 0.98 kg/cm^2



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Where: Δu = Excess pore pressure; σ_1' = Major effective principal stress; and σ_3'= Minor effective principal stress.

Checked By: _____ Date: 08/13/13

TECHNICIAN: _____ DATE TESTED: _____

BORING: VCT2 B1 SAMPLE: 3/5 DEPTH: _____ ☐ ft; ☐ m BLOCK: 1

TYPE SAMPLE: ☑ UNDISTURBED; ☐ COMPACTED; ☐ OTHER _____

TYPE TEST: ☐ CIUC; ☐ UU; ☐ $\overline{UU}$; ☐ CD ☐ OTHER _____

SAMPLE DESCRIPTION: grey clay

MEAS | Average | L/D

Diame

Length

P

Tare N

WWS

WDS

WW (

Wt. Ta

WDS

MC (%

Assumed ☐ Measured

Caps ☑ 1 Condom

Membrane ☐ _____ Thin Me

0.98 kg = 1.0 tf

σ_c (kg/cm²): 12.98 u_b (kg/cm²) 12.0

$\bar{\sigma}_c$ Stages (kg/cm²): 0.5 0.98

VOWTAP
File No.: 13-13-0084
August 20, 2013
Revision: 0 (ISSUED FOR USE)

TABLE C-4 EXTRUSION TEST REPORT FOR CORE VC-T2B-2

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Test Specimen Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Atterberg Limits			Strength Index Tests	
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)					Liquid Limit, LL	Plastic Limit, PL	Plasticity Index, PI	s_u [TV] (kg/cm²)	s_u [LV] (kg/cm²)
T2B	VC-T2B-2	1 / 5	0.0 - 0.67	67	Void in soil along tube wall except lower 22.7 cm. Sample not sufficiently intact for determining tube density. Recovered length longer than sampling interval labeled on tube.	99.7	9.124	0.0	0.0	99.7	149	79.5	9,058	73.8	Gray sand with trace shell	SP	8.4 21.6 21.4 23.2	18.7	18.1	Not Applicable. Voids within tube. Test specimen density and saturation for lower 19.5 cm section of core [wc = 16.5%].													
														5.7	Gray sand with trace shell (coarser than above)	SP	11.2	11.2				138.3	118.7	107	3.2	---	1.7						
		2 / 5	0.67 - 1.67	100	Void in soil along tube wall except lower 17.2 cm. Sample not sufficiently intact for determining tube density.	99.7	9.193	6.4	0.0	93.3	93	93.3	11,611	64.6	Brownish-gray sand with silt and shell	SP-SM	22.6 23.1 23.2 24.1	23.3	18.3	Not Applicable. Voids within tube.						---	---	---	6.1								
														28.7	Gray to white gravel with sand and shell and lenses of gray sandy clay	GP	6.9 7.1	7.0				---	---	---	3.5								
														11.5	Gray clayey gravel with sand	GC	---	---																
														10.5	Gray lean clay	CL	29.6	29.6																
		3 / 5	1.67 - 2.67	100	One cobble (9 cm x 8 cm x 5 cm) and gravel (5 cm x 1.7 cm x 1 cm) at top of tube.	99.7	9.142	5.5	0.0	94.2	94	94.0	12,332	72.0	Gray lean clay with trace organics	CL	27.9 30.7 30.3 28.7 28.6 29.7 28.9 31.3 28.8 27.3 26.0 27.2 28.1 26.8 32.0 28.7 29.3 27.4	28.8	27.5	124.6	97.7	99 [Gs=2.76]	121.8 --- --- --- --- 121.3 --- --- 124.9 --- 119.0 123.3 ---	93.2 --- --- --- --- 92.4 --- --- 98.2 --- 90.2 95.3 ---	100 --- --- --- --- 100 --- --- 99 --- 97 100 ---	94.0 --- --- --- 93.7 93.8 --- --- 87.4 --- 94.2 91.4 ---	--- --- 2.5 --- --- --- --- --- --- --- --- --- ---	--- --- 5.6 --- --- --- --- --- --- --- --- --- ---	--- --- 2.76 --- --- --- --- --- --- --- --- --- ---	--- 32 --- --- --- --- --- --- --- --- --- --- ---	--- 18 --- --- --- --- --- --- --- --- --- --- ---	--- 14 --- --- --- --- --- --- --- --- --- --- ---	0.25 --- 0.28 0.35 --- 0.25 --- 0.40	--- --- --- --- --- --- --- ---
		4 / 5	2.67 - 3.67	100	60 cc of free water (about 1 cm deep) on top end of sample.	99.7	9.184	4.2	0.0	95.5	96	95.5	12,394	29.8	Gray lean clay with lenses of sandy clay (with evidence of disturbance)	CL	31.3 22.4	26.9	24.1	122.4	98.6	91 [Gs=2.72]												
														35.5	Gray sand with shell	SP	19.3 18.0	18.7				---	---	---	2.5								
														30.2	Dark gray lean clay	CL	25.9 29.7	27.8																
		5 / 5	3.67 - 4.67	100	Small void in soil along tube wall in upper 3.0 cm of sample. 20 cc of free water on top end of sample.	84.0	9.137	0.0	0.0	84.0	84	84.0	10,814	5.0	Dark gray lean clay	CL	---	---	29.1	122.6	95.0	99 [Gs=2.76]												
														28.0	Gray sand with shell	SP	18.6 17.5 17.3	17.8				---	---	---	2.9								
														4.0	Dark gray lean clay with organics	CL	44.9	44.9				---	---	---	---	3.4							
														28.0	Dark gray lean clay s_u[UU]= 0.23 and 0.19 kg/cm²	CL	48.1 41.1 42.8 42.9 38.8 41.1 36.5	41.6				110.5 --- 111.6	77.4 --- 79.1	96 --- 96	100.0 --- 99.7	--- --- ---	--- --- ---	--- --- ---	43 --- ---	21 --- ---	22 --- ---	0.30 0.30 0.30	--- --- ---
														19.0	Dark gray silty sand with lenses of gray lean clay	SM	20.5	20.5																

13-13-0084
VC-2B-2
1/5
→
TOP
SWANSON

13-13-00
VC-2B-2
1/5
→
TOP

SWANSON®
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA

13-13-0084
VC-2B-2
2/5
→
TOP

13-13-0084
VC-2B-2
2/5
→
TOP
VANSON
AE141

13-13-0084

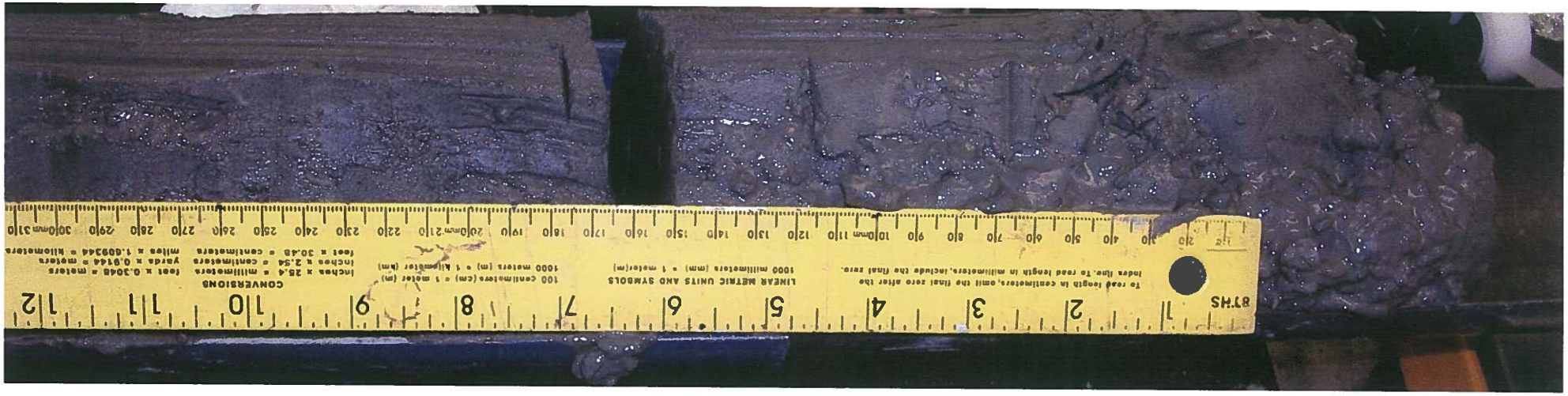
VC-T2B-2

2/5

13-13-0084

VC-T2B-2

2/5



13-13-0084

VC-T2B-2

3/5

13-13-0084
VC-2B-2
3/5
→
TOP
SWANSON
AE141

13-13-0084
VC-2B-2
3/5
→
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SWANSON TOOL CO., INC.
211 ONTARIO STREET
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VC-T2B-2

4/5

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VC-2B-2
4/5
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SWANSON®
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13-13-0084
VC-2B-2
4/5
→
TOP

13-13-0084

VC-T2B-2

4/5

13-13-0084
VC-28-2
5/5
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13-13-0084
VC-2B-2
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13-13-0084
VC-2B-2
5/5
→
TOP
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AE141

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/05/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-2** SAMPLE: **1/5** [Block 5]
DEPTH: 0.0 - 0.67 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2B2-1/5
SAMPLE DESCRIPTION: Gray sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

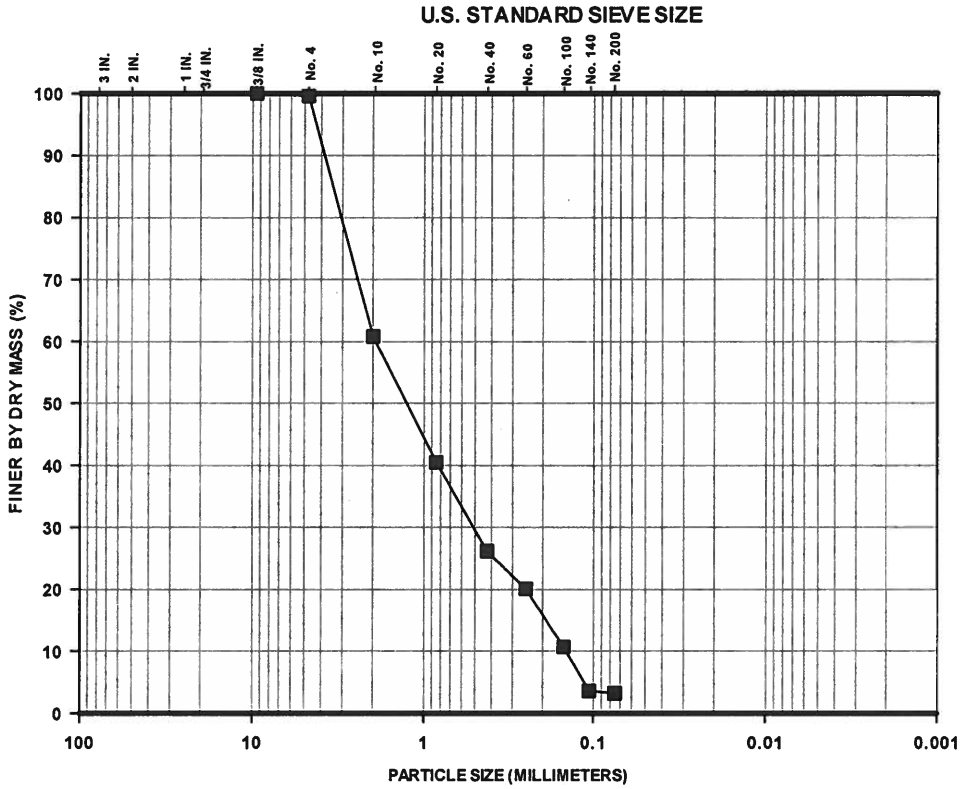
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 11.2
Mass Dry Solids (grams): 235.32

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.6	60.8	40.5	26.2	20.1	10.7	3.6	3.2	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/03/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-2** SAMPLE: **2/5** [Block 1]
DEPTH: 0.67 – 1.67 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2B2-2/5
SAMPLE DESCRIPTION: Brownish-gray sand with silt and trace shell (SP-SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

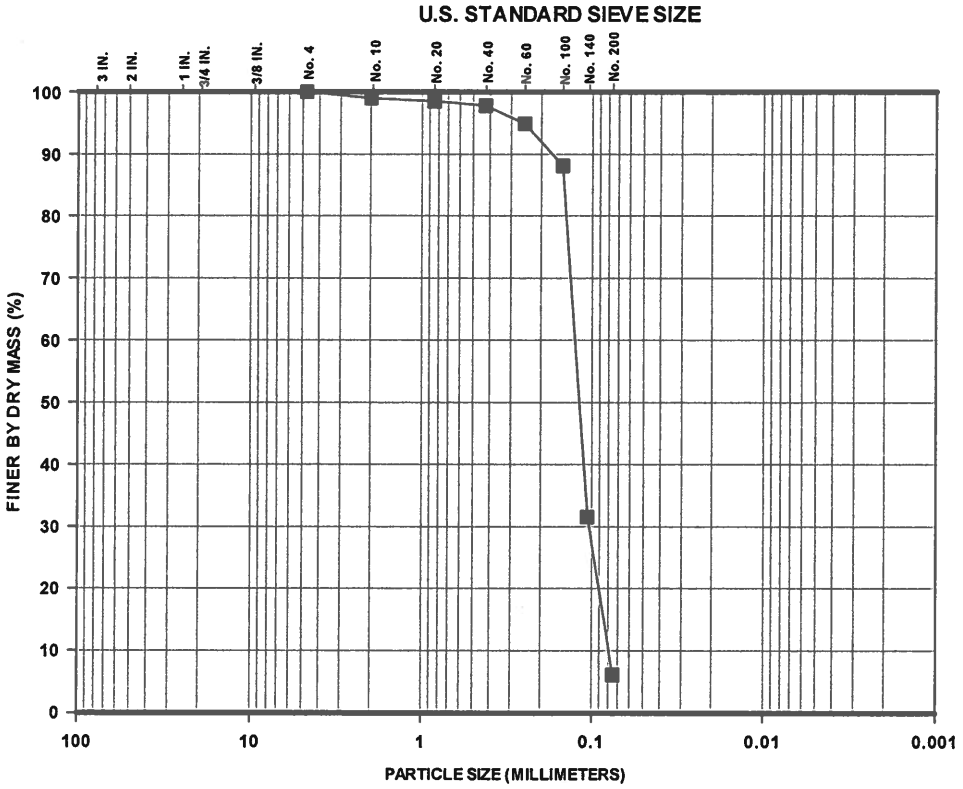
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 23.2
Mass Dry Solids (grams): 158.09

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.0	98.5	97.8	94.9	88.1	31.6	6.1	---	---	---

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Checked By: JM Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/03/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-2** SAMPLE: **2/5** [Block 2]
DEPTH: 0.67 – 1.67 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2B2-5/5
SAMPLE DESCRIPTION: Gray to white gravel with sand and shell (GP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

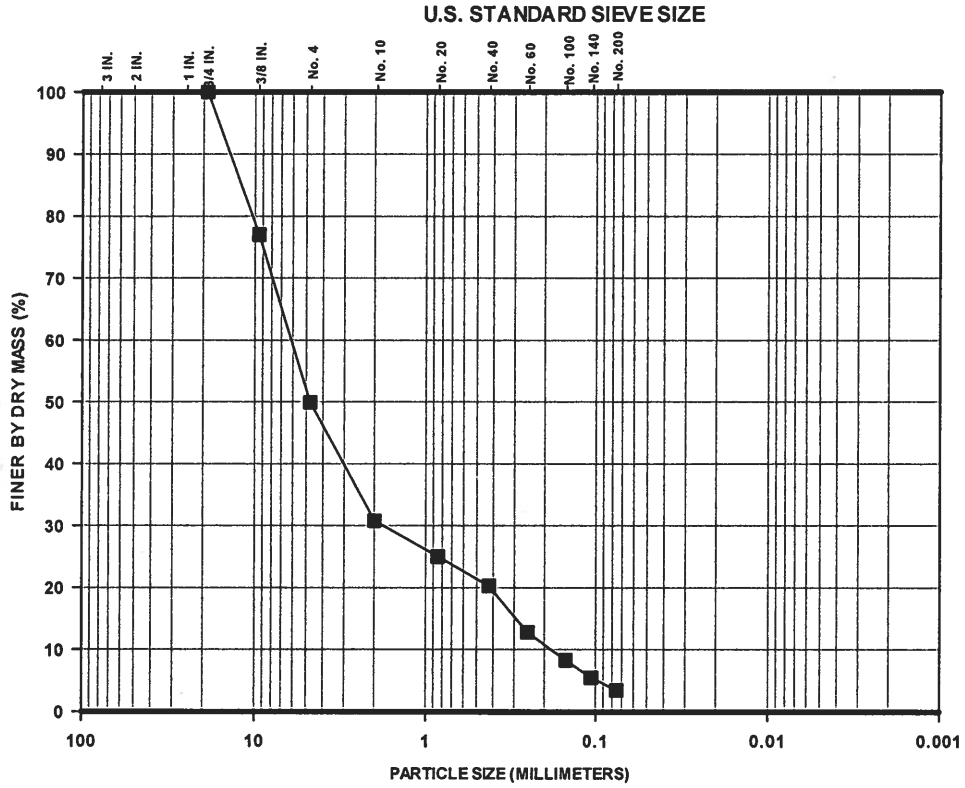
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 7.1
Mass Dry Solids (grams): 812.79

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	77.0	49.9	30.8	25.0	20.3	12.8	8.3	5.5	3.5	---	---	---

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Checked By: _____ Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/09/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-2** SAMPLE: **3/5**
DEPTH: 1.67 – 2.67 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/2B23/5
SAMPLE DESCRIPTION: Gray lean clay with trace organics (CL)

TEST PROCEDURES

ASTM Standard D422:
☐ Sieve Analysis
☐ Hydrometer Analysis
☒ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☒ Sodium Hexametaphosphate ☐ Other _____

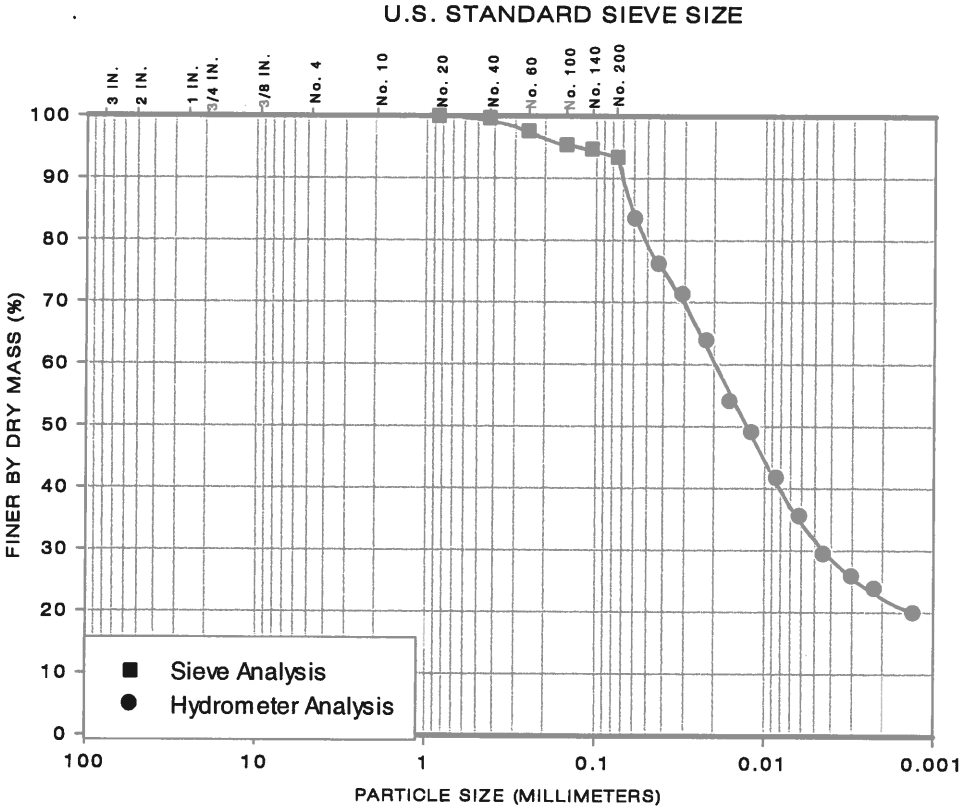
Dispersion Device: ☒ Apparatus A ☐ Apparatus B

Dispersion Period (hours): >24

Water Content (%): 29.7
Mass Dry Solids (grams): 39.84

G_s: 2.76 ☐ Assumed ☒ Measured

Organic Content (%): 2.5
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	100	100	99.7	97.6	85.4	94.7	93.7	31.5	22.8	18.6

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Checked By: TM Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/03/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-2** SAMPLE: **4/5** [Block 2]
DEPTH: 2.67 – 3.67 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2B2-4/5
SAMPLE DESCRIPTION: Gray sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

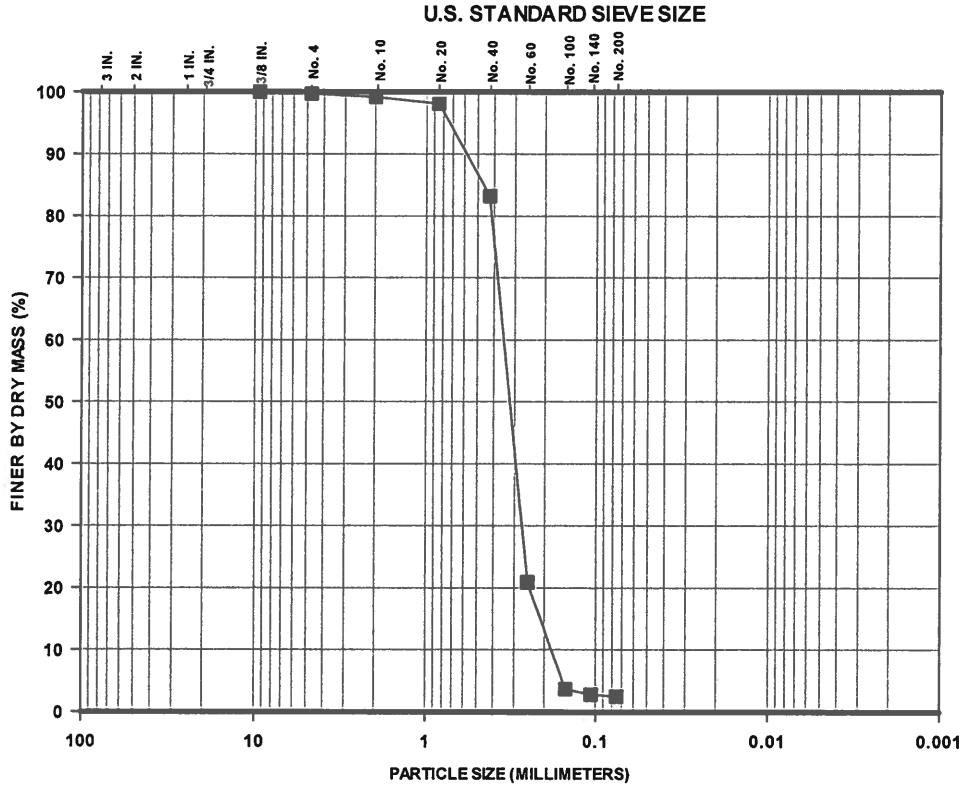
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 19.3
Mass Dry Solids (grams): 226.76

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.7	99.2	98.1	83.2	20.9	3.7	2.8	2.5	---	---	---

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Checked By: TM Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/03/13
DATE REPORTED: 07/30/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-2** SAMPLE: **5/5** [Block 1]
DEPTH: 3.67 – 4.67 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/T2B2-5/5
SAMPLE DESCRIPTION: Gray sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

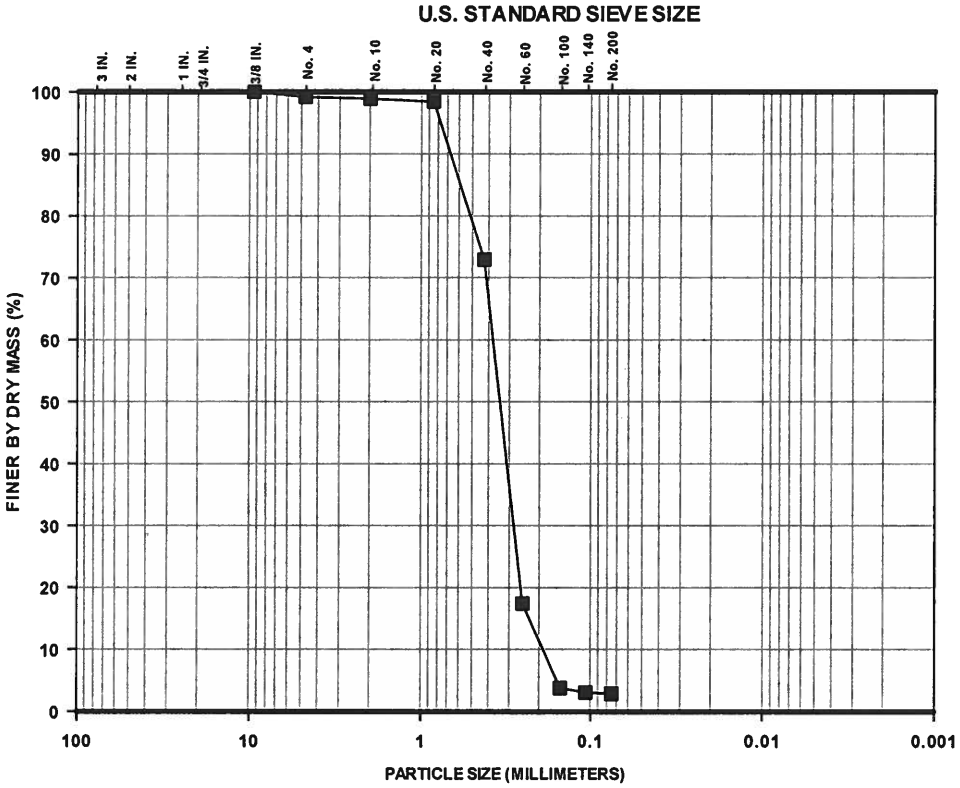
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 17.5
Mass Dry Solids (grams): 243.71

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.2	98.9	98.4	72.9	17.4	3.8	3.1	2.9	---	---	---

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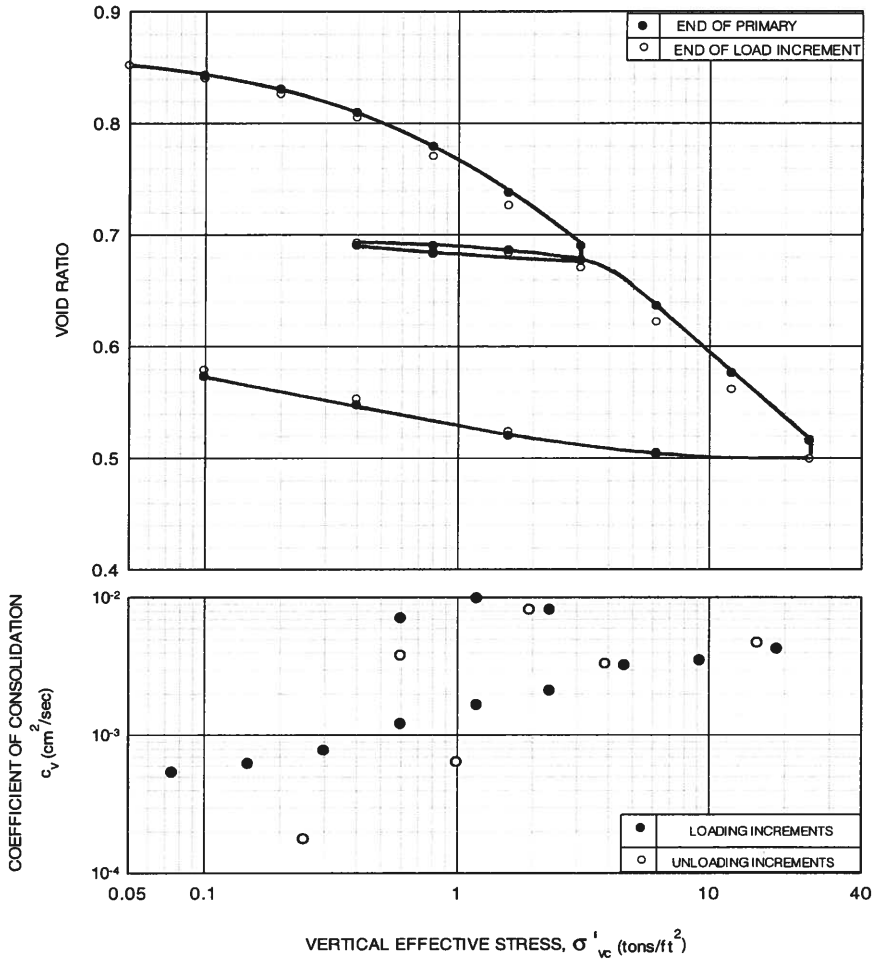
Checked By: [signature] Date: 07/30/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
ONE-DIMENSIONAL INCREMENTAL LOADING CONSOLIDATION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

INCOMING SAMPLE NO.: ---------
BORING: **VC-T2B-2** SAMPLE: **3 / 5**
DEPTH: 1.67 - 2.67 ☐ ft; ☑ m
LAB IDENTIFICATION NO.: 130084/T2B235
SAMPLE DESCRIPTION.: Gray lean clay, CL

DATE SAMPLE RECEIVED: 06/27/13
DATE SAMPLE SET-UP: 07/03/13
DATE REPORTED: 08/13/13



Test Methods & Procedures

ASTM Standard D2435
☐ Method A
☑ Method B
c_v Interpretation Method
☑ c_v [Log Time]
☐ c_v [Sq. Root Time]
Trimming Method
☑ cutting shoe
☐ other_____
Initial Sample Diameter 9.14 (cm)

Test Conditions

☐ Tested at Natural Moisture Content
☑ Specimen Tested Inundated
Inundated at σ'_{vc} 0.05 (tsf)
Inundation Fluid:
☑ tap water
☐ other _____

Specimen Conditions

Parameter	Initial	Final
D (cm)	5.000	5.000
H (cm)	1.905	1.612
w_c (%)	31.3	20.9
γ_d (pcf)	92.4	109.
e	0.865	0.578
S (%)	100	100

G_s: 2.76 ☐ Assumed ☑ Measured

Index Properties

LL	32
PL	18
PI	14

Particle-Size Analysis ☐ ASTM D422 ☑ ASTM D1140-Method	U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
		3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass(g): 55.36	Soil Passing (%, dry mass basis)	-----	-----	-----	-----	-----	-----	-----	-----	-----	93.8

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Where: H=Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; e = Void ratio; S = Saturation; G_s= Specific gravity; c_v = Coefficient of consolidation; and $C_{\alpha e}$ = Secondary compression index.

Checked By: TM Date: 08/13/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
ONE-DIMENSIONAL INCREMENTAL LOADING CONSOLIDATION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

INCOMING SAMPLE NO.: ---------
BORING: **VC-T2B-2** SAMPLE: **3 / 5**
DEPTH: 1.67 - 2.67 ☐ ft; ☑ m
LAB IDENTIFICATION NO.: 130084/T2B235
SAMPLE DESCRIPTION.: Gray lean clay, CL

DATE SAMPLE RECEIVED: 06/27/13
DATE SAMPLE SET-UP: 07/03/13
DATE REPORTED: 08/13/13 REVISED: 10/18/13

Effective Vertical Stress σ'_{vc} (tons/ft^2)	Void Ratio		Vertical Strain (%)		Coefficient of Consolidation (cm^2/sec) c_v [Log Time] ☑ c_v [Sq. Root Time] ☐	Coefficient of Permeability (cm/sec)	Secondary Compression Index, $C_{\alpha\varepsilon}$
	End of Primary Consolidation	End of Increment	End of Primary Consolidation	End of Increment			
0.0	--	0.865	--	0.00	--	--	-----
0.05	--	0.851	--	0.72	--	--	-----
0.10	0.842	0.840	1.21	1.35	5.3E-04	6.8E-08	0.002
0.20	0.830	0.826	1.88	2.11	6.1E-04	4.8E-08	0.003
0.40	0.809	0.804	3.00	3.25	7.6E-04	4.5E-08	0.004
0.80	0.779	0.770	4.63	5.09	1.2E-03	5.6E-08	0.005
1.60	0.737	0.726	6.85	7.45	1.6E-03	5.0E-08	0.006
3.10	0.690	0.676	9.40	10.12	2.1E-03	3.8E-08	0.006
0.80	0.683	0.685	9.77	9.67	8.1E-03	--	-----
0.40	0.690	0.692	9.39	9.27	3.8E-03	--	-----
0.80	0.690	0.689	9.39	9.43	7.0E-03	2.9E-08	-----
1.60	0.686	0.683	9.61	9.75	9.8E-03	4.0E-08	0.001
3.10	0.677	0.670	10.09	10.45	8.1E-03	3.9E-08	0.002
6.20	0.636	0.621	12.28	13.05	3.2E-03	2.7E-08	0.006
12.30	0.575	0.561	15.52	16.31	3.5E-03	1.9E-08	0.006
25.00	0.515	0.499	18.76	19.63	4.2E-03	1.1E-08	0.006
6.20	0.503	0.505	19.41	19.32	4.6E-03	--	-----
1.60	0.519	0.523	18.52	18.32	3.3E-03	--	-----
0.40	0.547	0.553	17.05	16.75	6.3E-04	--	-----
0.10	0.572	0.578	15.68	15.36	1.7E-04	--	-----

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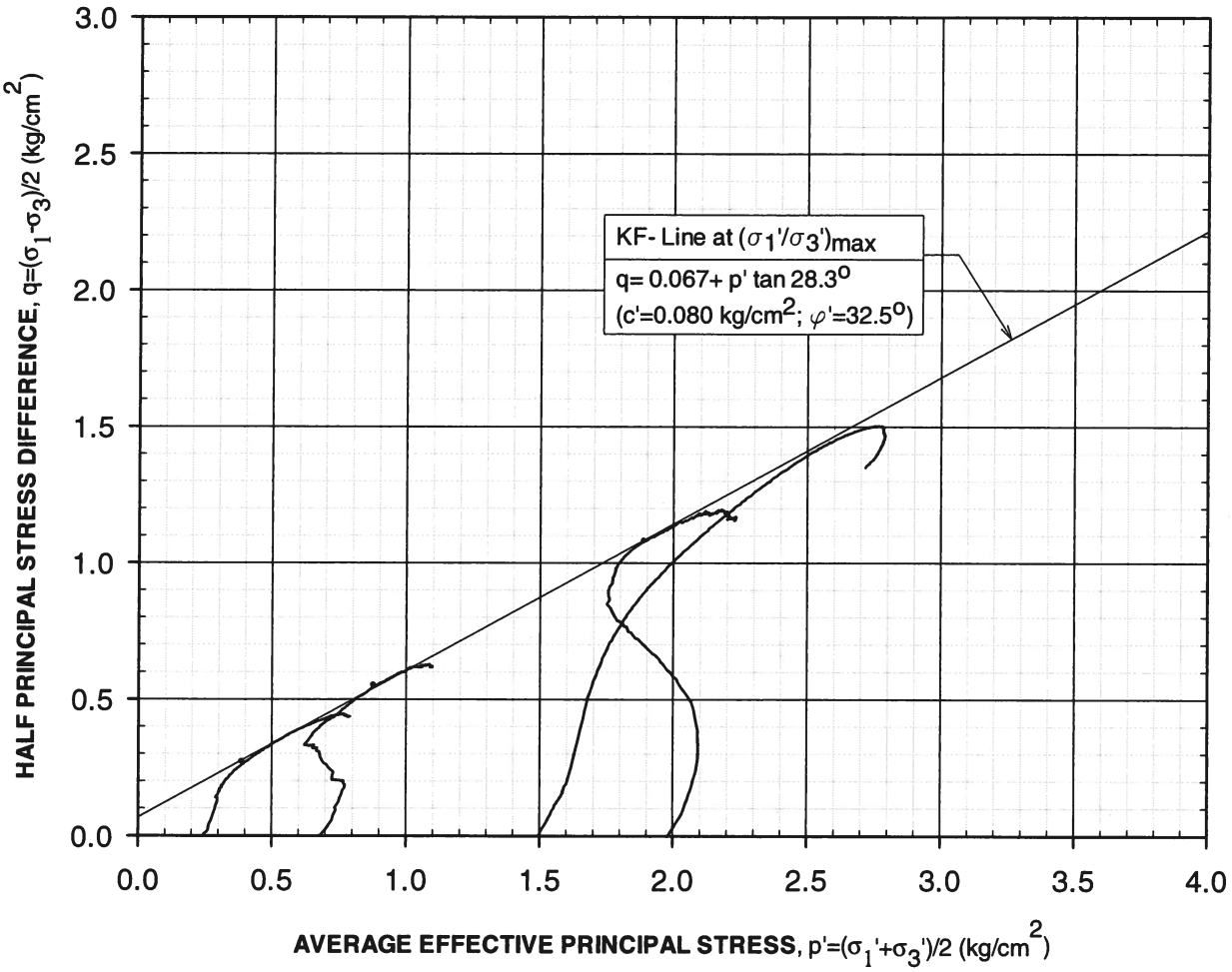
Checked By: JAW Date: 10/18/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
EFFECTIVE STRESS PATHS

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/30/13-08/06/13
DATE REPORTED: 08/16/13 REVISED: 10/18/13

INCOMING SAMPLE NO.: -
BORING: **VC-T2B-2** SAMPLE: **3 / 5**
DEPTH: 1.67 - 2.67 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/T2B23/5
SAMPLE DESCRIPTION: Gray lean clay (CL)



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Checked By: JCW Date: 10/18/13

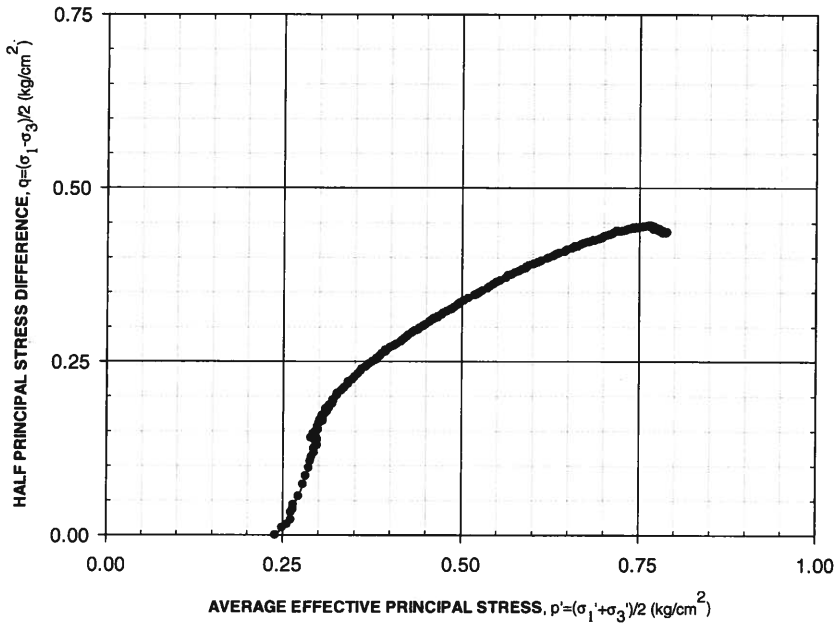
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/30/13
DATE REPORTED: 08/16/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-2** SAMPLE: **3 / 5**
DEPTH: 1.67 – 2.67 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/2B23/5
SAMPLE DESCRIPTION: Gray lean clay (CL)

Specimen Dimensions			Initial Conditions			Test Conditions				Pre-shear Conditions					
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	u_b (kg/cm^2)	σ_c' (kg/cm^2)	$\dot{\varepsilon}$ (%/hour)	B-Factor (%)	ε_{vol} (%)	H_c (cm)	A_c (cm^2)	w_c (%)	γ_d (lb/ft^3)	S (%)
7.05	3.59	2.0	27.2	98.2	99	12.00	0.24	1.1	99	-3.6	7.04	9.79	25.1	101.8	100



TEST PROCEDURE: ASTM D4767

Specimen Mounting Method : ☐ Dry Method ☒ Wet Method

Filter Strip Correction Made : ☐ Yes ☒ No
Membrane Correction Made : ☐ Yes ☒ No

A_c Method: ☐ Method A ☒ Method B

w_c determined from: ☒ Entire Specimen ☐ Trimmings

SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Compacted	

☐ Tamped Uniform Lifts: No. of Lifts: _____

☐ Kneading: Blows per Lift: _____
No. of Lifts_____ Spring:____lb

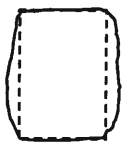
G_s: 2.76 ☐ Assumed ☒ Measured

Stresses and Strains at Failure

Failure Criteria	ε_a (%)	Δu (kg/cm^2)	σ_1' (kg/cm^2)	σ_3' (kg/cm^2)	p' (kg/cm^2)	q (kg/cm^2)
$[\sigma_1 - \sigma_3]_{max}$	10.7	-0.08	1.21	0.32	0.77	0.45
$[\sigma_1' / \sigma_3']_{max}$	1.8	0.11	0.66	0.13	0.39	0.27

FAILURE SKETCH

☐ Diagonal Plane
☒ Bulging
☐ Combination
☐ Other _____



Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☒ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	112.38	Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	87.4

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c' = Isotropic effective confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_{vol} = Volume change(- denotes consolidation, + denotes swelling); H_c = Consolidated height; A_c = Consolidated area; ε_a = Axial strain; Δu = Excess pore pressure; σ_1' = Major effective principal stress; σ_3'= Minor effective principal stress; p' = Average effective principal stress; q = Half principal stress difference; and G_s = Specific gravity.

Checked By: _____ Date: 08/16/13

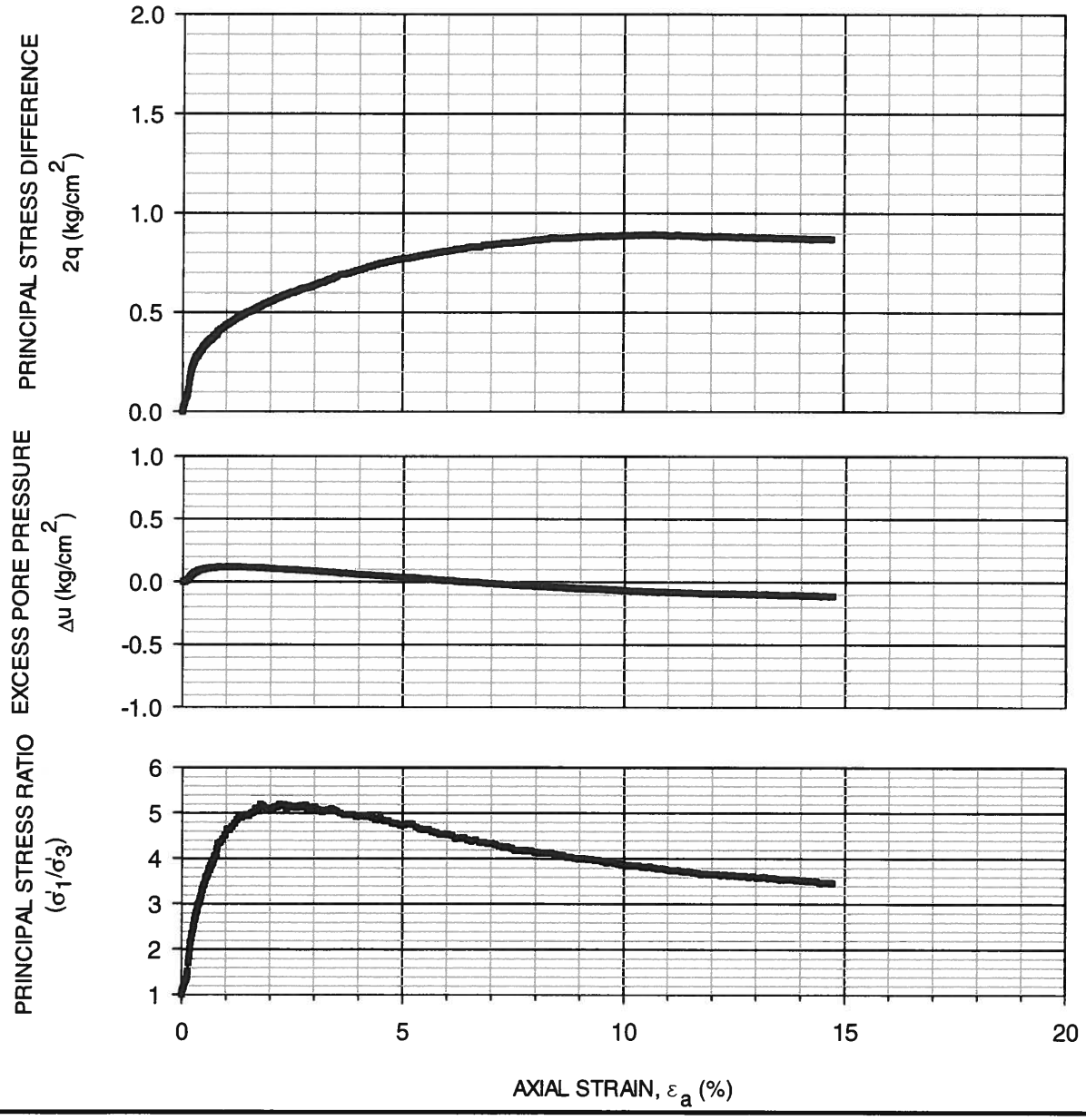
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS - STRAIN CURVES

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/30/13
DATE REPORTED: 08/16/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-2** SAMPLE: **3 / 5**
DEPTH: 1.79 – 2.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T2B23/5
SAMPLE DESCRIPTION: Gray lean clay (CL)

Consolidation Stress = 0.24 kg/cm^2



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Where: Δu = Excess pore pressure; σ_1' = Major effective principal stress; and σ_3'= Minor effective principal stress.

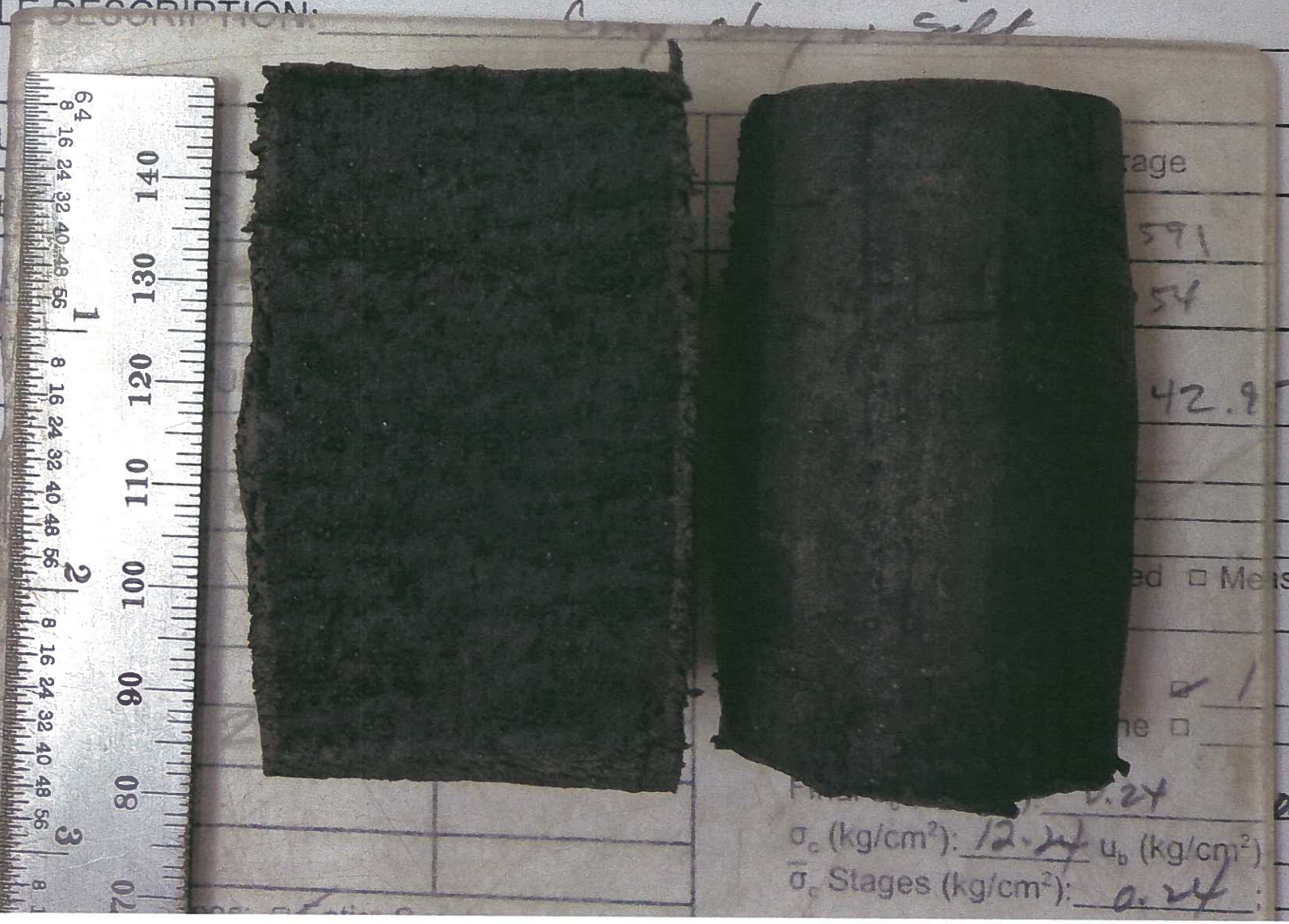
Checked By: JM Date: 08/16/13

BORING: VC T2 SAMPLE: B2 3/5 DEPTH: 1.67-2.67 ☐ ft; ☐ m BLOCK: 4

TYPE SAMPLE: ☒ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TYPE TEST: ☒ CIUC; ☐ UU; ☐ UU; ☐ CD ☐ OTHER

SAMPLE DESCRIPTION: Clay, silt



MEASU | Diamet | Length | Pa | Tare N | WWS | WDS | WW (g | Wt. Ta | WDS | MC (% | FINAL

age | 591 | 54 | 42.9 | ed ☐ Measured | ☒ 1 | ne ☐ | 0.24 | σ_c (kg/cm²): 12.24 u_b (kg/cm²) | $\bar{\sigma}_c$ Stages (kg/cm²): 0.24

L/D | 1.964 | _ Condoms | _ Thin Membran | 0.25+C | 12-0

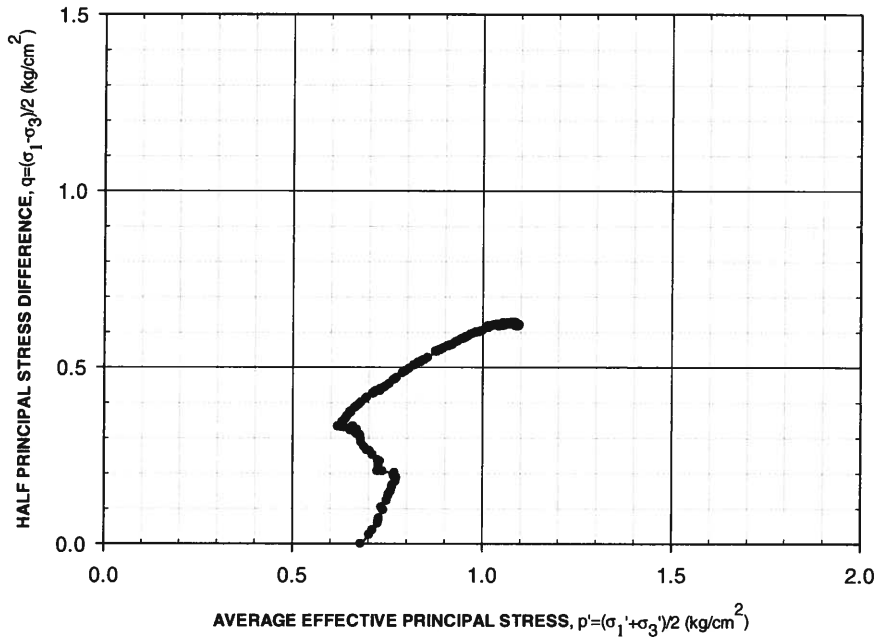
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/30/13
DATE REPORTED: 08/16/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-2** SAMPLE: **3 / 5**
DEPTH: 1.67 – 2.67 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/2B23/5
SAMPLE DESCRIPTION: Gray lean clay (CL)

Specimen Dimensions			Initial Conditions			Test Conditions				Pre-shear Conditions					
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	u_b (kg/cm^2)	σ_c' (kg/cm^2)	$\dot{\varepsilon}$ (%/hour)	B-Factor (%)	ε_{vol} (%)	H_c (cm)	A_c (cm^2)	w_c (%)	γ_d (lb/ft^3)	S (%)
7.14	3.66	2.0	30.7	93.2	100	12.00	0.68	1.1	99	-6.9	7.07	9.88	26.1	100.1	100



TEST PROCEDURE: ASTM D4767

Specimen Mounting Method : ☐ Dry Method ☒ Wet Method

Filter Strip Correction Made : ☐ Yes ☒ No
Membrane Correction Made : ☐ Yes ☒ No

A_c Method: ☐ Method A ☒ Method B

w_c determined from: ☒ Entire Specimen ☐ Trimmings

SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Compacted	

☐ Tamped Uniform Lifts: No. of Lifts: _____

☐ Kneading: Blows per Lift: _____
No. of Lifts_____ Spring:_____lb

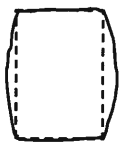
G_s: 2.76 ☐ Assumed ☒ Measured

Stresses and Strains at Failure

Failure Criteria	ε_a (%)	Δu (kg/cm^2)	σ_1' (kg/cm^2)	σ_3' (kg/cm^2)	p' (kg/cm^2)	q (kg/cm^2)
$[\sigma_1 - \sigma_3]_{max}$	13.4	0.22	1.71	0.46	1.08	0.63
$[\sigma_1' / \sigma_3']_{max}$	6.4	0.35	1.42	0.33	0.88	0.55

FAILURE SKETCH

☐ Diagonal Plane
☒ Bulging
☐ Combination
☐ Other _____



Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☒ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	111.99	Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	94.0

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c' = Isotropic effective confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_{vol} = Volume change(- denotes consolidation, + denotes swelling); H_c = Consolidated height; A_c = Consolidated area; ε_a = Axial strain; Δu = Excess pore pressure; σ_1' = Major effective principal stress; σ_3'= Minor effective principal stress; p' = Average effective principal stress; q = Half principal stress difference; and G_s = Specific gravity.

Checked By: _____ Date: 08/16/13

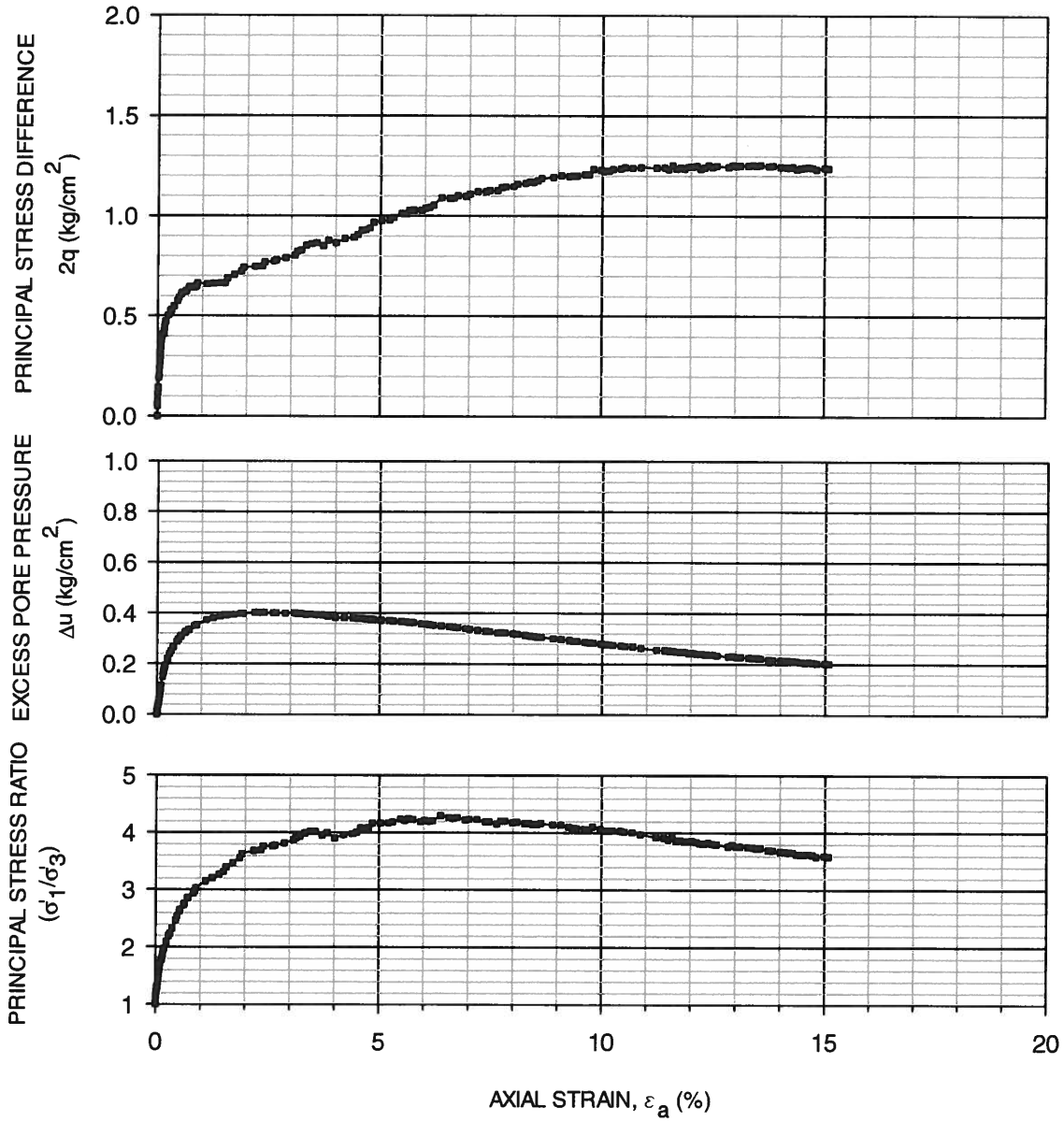
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS - STRAIN CURVES

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/30/13
DATE REPORTED: 08/16/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-2** SAMPLE: **3 / 5**
DEPTH: 1.79 – 2.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T2B23/5
SAMPLE DESCRIPTION: Gray lean clay (CL)

Consolidation Stress = 0.68 kg/cm^2



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Where: Δu = Excess pore pressure; σ_1' = Major effective principal stress; and σ_3'= Minor effective principal stress.

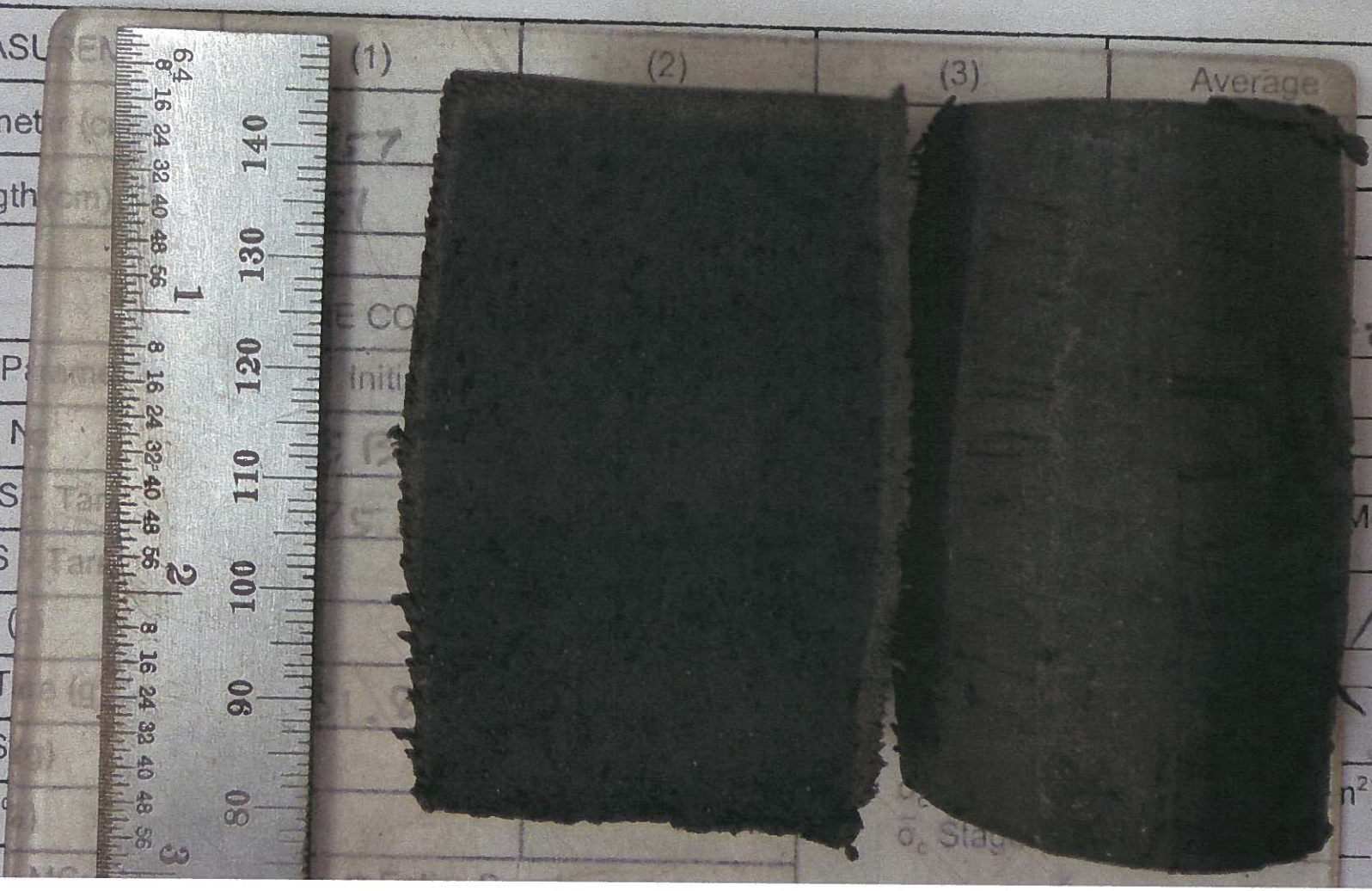
Checked By: JM Date: 08/16/13

BORING: VC T2 SAMPLE: B2 3/5 DEPTH: 1.67-2.67 ☐ ft; ☐ m BLOCK: 1

TYPE SAMPLE: ☒ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TYPE TEST: ☑ CIUC; ☐ UU; ☐ $\overline{UU}$; ☐ CD ☐ OTHER

SAMPLE DESCRIPTION: gray clay w silt



MEASU	(1)	(2)	(3)	Average	L/D
Diamet					
Length					1.954
Tare N					
WWS					
WDS					
WW					
Wt. T					
WDS					
MC (%					

Measured

Condoms
Thin Membrane

0.7 kg/cm²

n²) 12.0

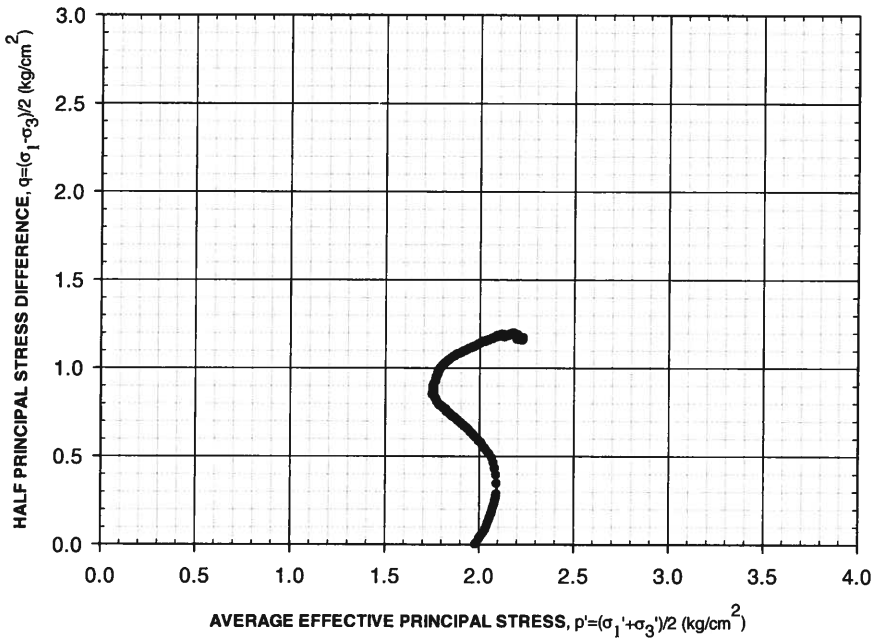
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 08/06/13
DATE REPORTED: 08/16/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-2** SAMPLE: **3 / 5**
DEPTH: 1.67 – 2.67 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/2B23/5
SAMPLE DESCRIPTION: Gray lean clay (CL)

Specimen Dimensions			Initial Conditions			Test Conditions				Pre-shear Conditions					
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	u_b (kg/cm^2)	σ_c' (kg/cm^2)	$\dot{\varepsilon}$ (%/hour)	B-Factor (%)	ε_{vol} (%)	H_c (cm)	A_c (cm^2)	w_c (%)	γ_d (lb/ft^3)	S (%)
7.02	3.62	1.9	29.3	95.3	100	11.00	1.98	1.1	98	-8.4	6.91	9.58	23.8	104.0	100



TEST PROCEDURE: ASTM D4767

Specimen Mounting Method : ☐ Dry Method ☒ Wet Method

Filter Strip Correction Made : ☐ Yes ☒ No
Membrane Correction Made : ☐ Yes ☒ No

A_c Method: ☐ Method A ☒ Method B

w_c determined from: ☒ Entire Specimen ☐ Trimmings

SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Compacted	

☐ Tamped Uniform Lifts: No. of Lifts: ____

☐ Kneading: Blows per Lift: ____ No. of Lifts____ Spring:____lb

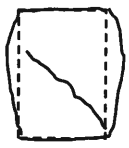
G_s: 2.76 ☐ Assumed ☒ Measured

Stresses and Strains at Failure

Failure Criteria	ε_a (%)	Δu (kg/cm^2)	σ_1' (kg/cm^2)	σ_3' (kg/cm^2)	p' (kg/cm^2)	q (kg/cm^2)
$[\sigma_1 - \sigma_3]_{max}$	10.9	1.00	3.38	0.99	2.18	1.20
$[\sigma_1' / \sigma_3']_{max}$	4.6	1.17	2.97	0.81	1.89	1.08

FAILURE SKETCH

☐ Diagonal Plane
☐ Bulging
☒ Combination
☐ Other _____



Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☒ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	110.35	Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	91.4

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c' = Isotropic effective confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_{vol} = Volume change(- denotes consolidation, + denotes swelling); H_c = Consolidated height; A_c = Consolidated area; ε_a = Axial strain; Δu = Excess pore pressure; σ_1' = Major effective principal stress; σ_3'= Minor effective principal stress; p' = Average effective principal stress; q = Half principal stress difference; and G_s = Specific gravity.

Checked By: _____ Date: 08/16/13

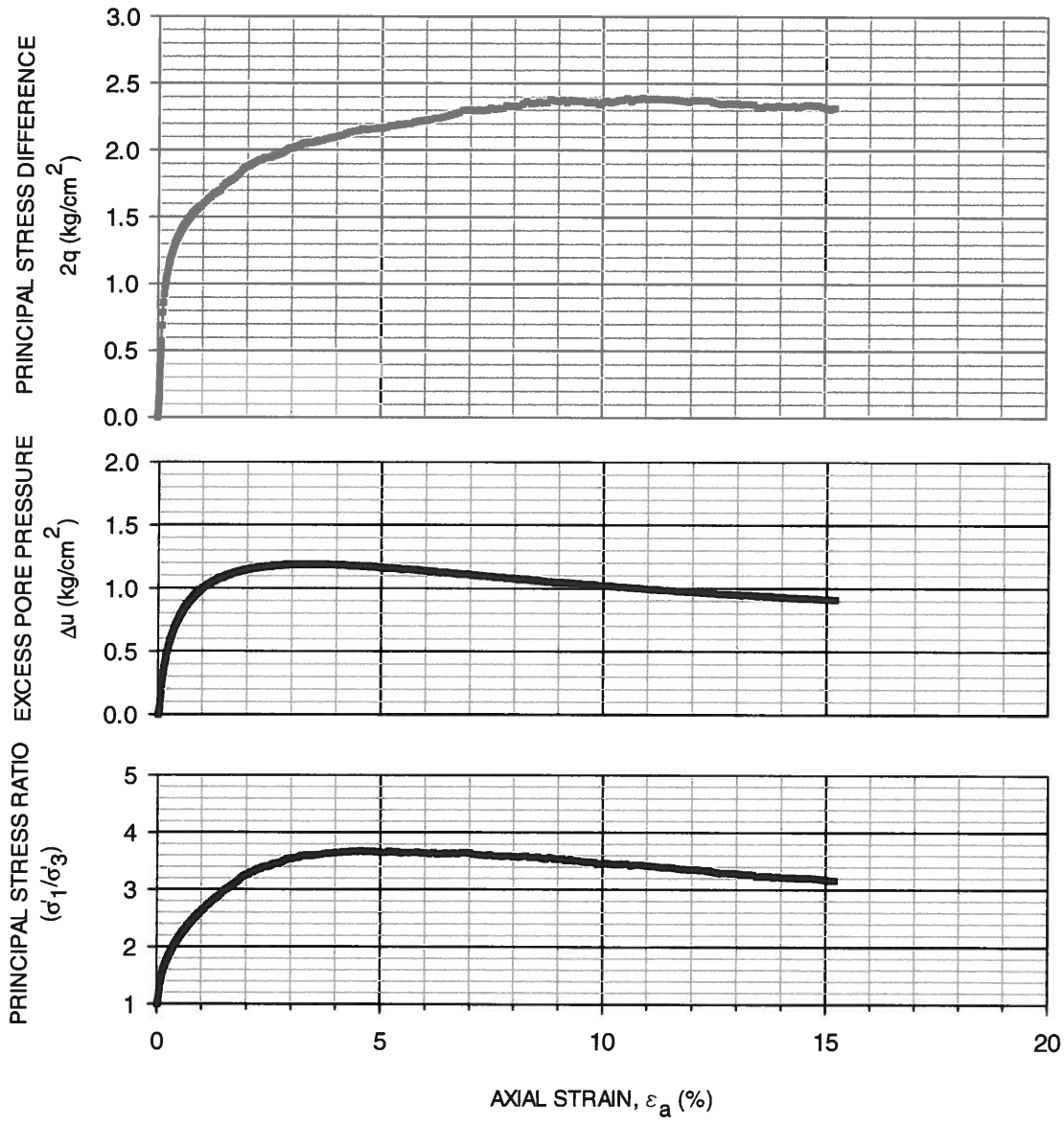
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS - STRAIN CURVES

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 08/06/13
DATE REPORTED: 08/16/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-2** SAMPLE: **3 / 5**
DEPTH: 1.79 – 2.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T2B23/5
SAMPLE DESCRIPTION: Gray lean clay (CL)

Consolidation Stress = 1.98 kg/cm^2



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Where: Δu = Excess pore pressure; σ_1' = Major effective principal stress; and σ_3'= Minor effective principal stress.

Checked By: _____ Date: 08/16/13

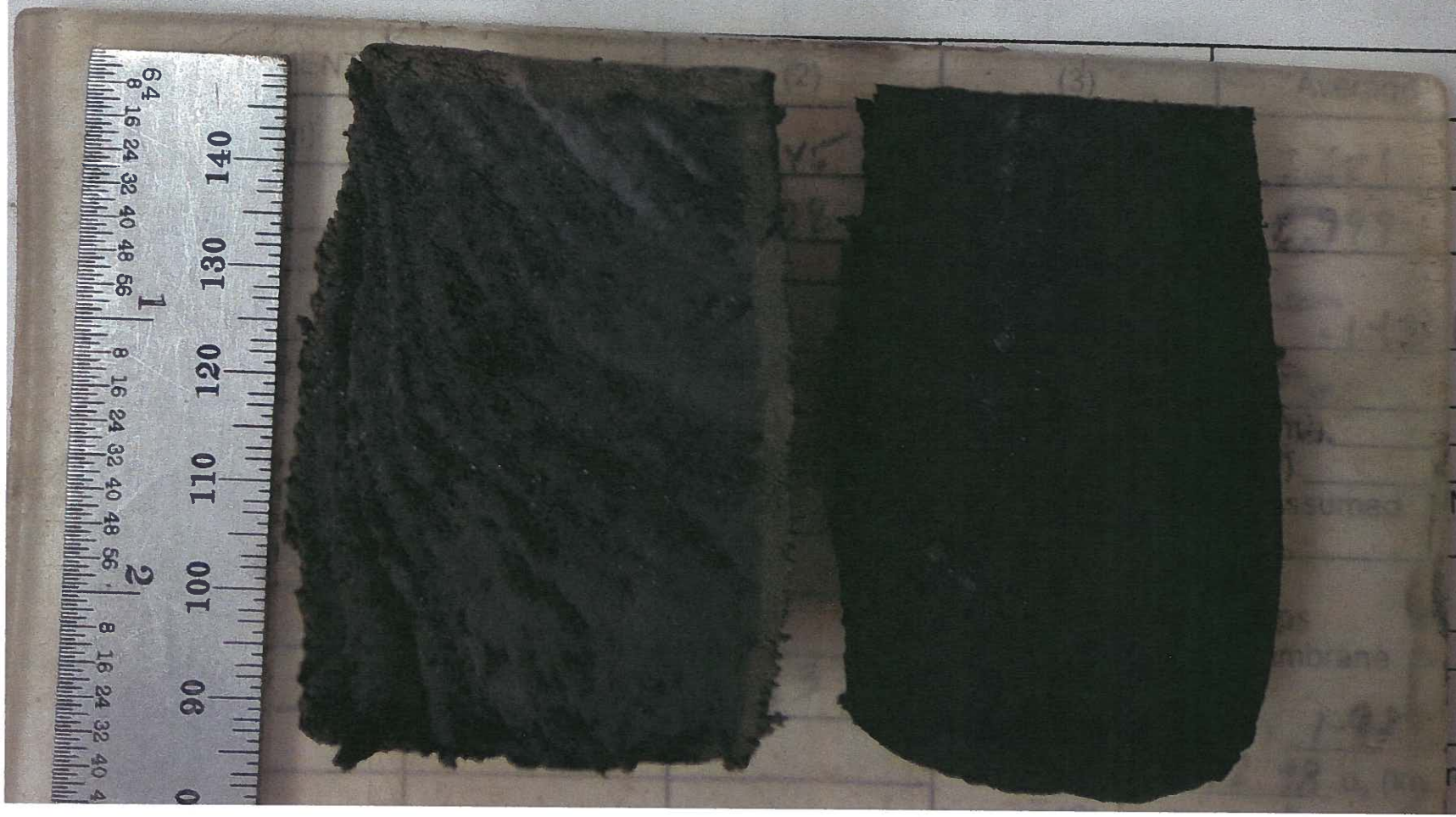
BORING: VC T2 SAMPLE: B2 3/5 DEPTH: 1.67-2.67 ☐ ft; ☑ m BLOCK: 5

TYPE SAMPLE: ☐ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TYPE TEST: ☑ CIUC; ☐ UU; ☐ UU; ☐ CD ☐ OTHER

SAMPLE DESCRIPTION: Gray clay w silt

A



- L/D

1.933

46

Measured

1 Condoms

Thin Membran

2.0+sf

m^2) 11.6

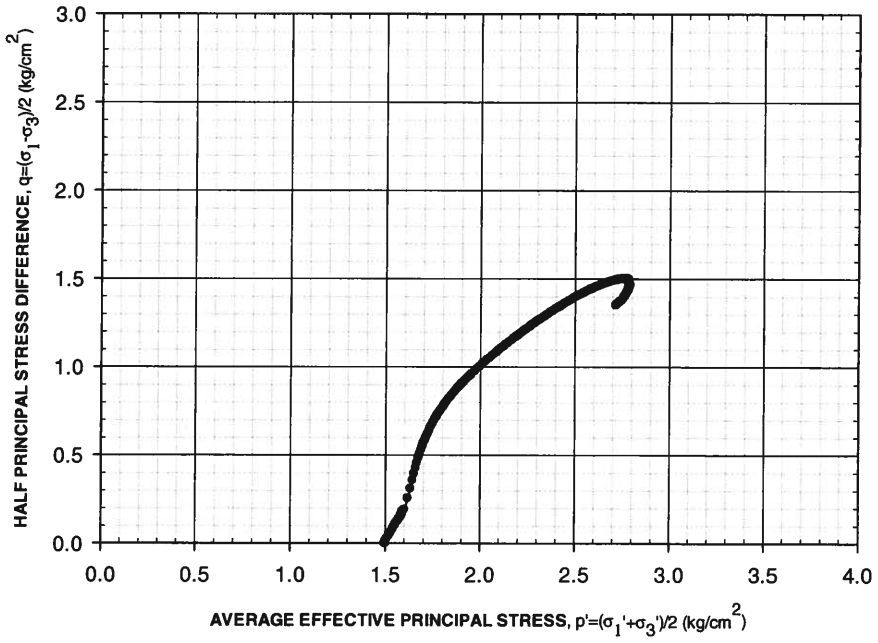
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 08/06/13
DATE REPORTED: 08/16/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-2** SAMPLE: **3 / 5**
DEPTH: 1.67 – 2.67 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 0084/2B23/5
SAMPLE DESCRIPTION: Gray lean clay (CL)
Sample consolidated to 4.5 kg/cm^2 then rebounded to 1.5 kg/cm^2. OCR=3.0

Specimen Dimensions			Initial Conditions			Test Conditions				Pre-shear Conditions					
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	u_b (kg/cm^2)	σ_c' (kg/cm^2)	$\dot{\varepsilon}$ (%/hour)	B-Factor (%)	ε_{vol} (%)	H_c (cm)	A_c (cm^2)	w_c (%)	γ_d (lb/ft^3)	S (%)
7.28	3.58	2.0	32.0	90.2	97	8.00	1.5	1.1	98	-13.0	7.07	9.03	24.0	103.6	100



TEST PROCEDURE: ASTM D4767

Specimen Mounting Method : ☐ Dry Method ☒ Wet Method

Filter Strip Correction Made : ☐ Yes ☒ No
Membrane Correction Made : ☐ Yes ☒ No

A_c Method: ☐ Method A ☒ Method B

w_c determined from: ☒ Entire Specimen ☐ Trimmings

SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Compacted	

☐ Tamped Uniform Lifts: No. of Lifts: ____

☐ Kneading: Blows per Lift: ____
No. of Lifts____ Spring:____lb

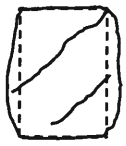
G_s: 2.76 ☐ Assumed ☒ Measured

Stresses and Strains at Failure

Failure Criteria	ε_a (%)	Δu (kg/cm^2)	σ_1' (kg/cm^2)	σ_3' (kg/cm^2)	p' (kg/cm^2)	q (kg/cm^2)
$[\sigma_1 - \sigma_3]_{max}$	9.2	0.23	4.28	1.27	2.78	1.50
$[\sigma_1' / \sigma_3']_{max}$	5.3	0.36	4.02	1.14	2.58	1.44

FAILURE SKETCH

☐ Diagonal Plane
☐ Bulging
☒ Combination
☐ Other _____



Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☒ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	105.84	Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	94.2

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c' = Isotropic effective confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_{vol} = Volume change(- denotes consolidation, + denotes swelling); H_c = Consolidated height; A_c = Consolidated area; ε_a = Axial strain; Δu = Excess pore pressure; σ_1' = Major effective principal stress; σ_3'= Minor effective principal stress; p' = Average effective principal stress; q = Half principal stress difference; and G_s = Specific gravity.

Checked By: _____ Date: 08/16/13

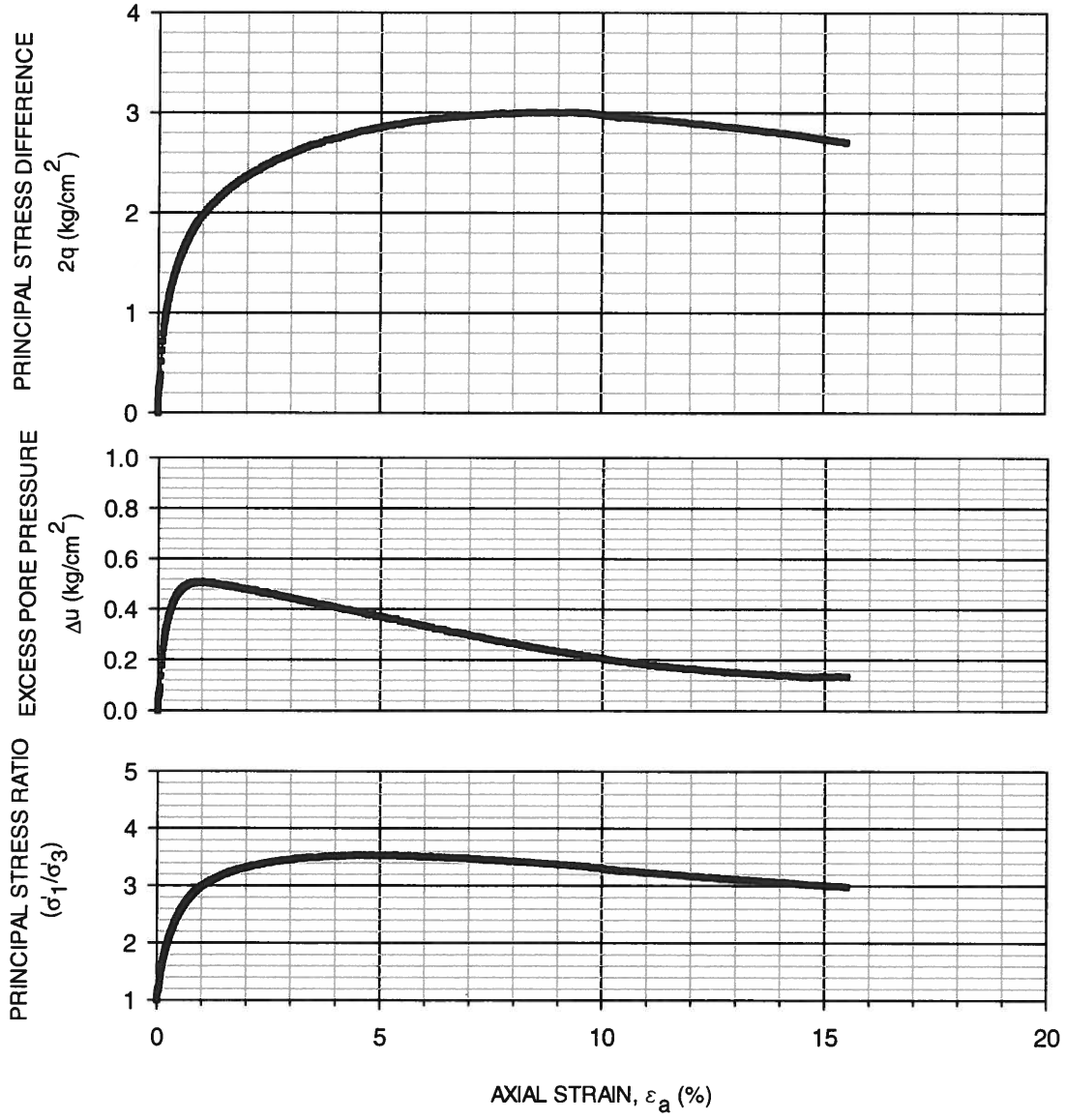
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS - STRAIN CURVES

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 08/06/13
DATE REPORTED: 08/16/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-2** SAMPLE: **3 / 5**
DEPTH: 1.79 – 2.79 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T2B23/5
SAMPLE DESCRIPTION: Gray lean clay (CL)

Consolidation Stress = 4.50 kg/cm^2 then rebounded to 1.5 kg/cm^2. OCR=3.0



The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Where: Δu = Excess pore pressure; σ_1' = Major effective principal stress; and σ_3'= Minor effective principal stress.

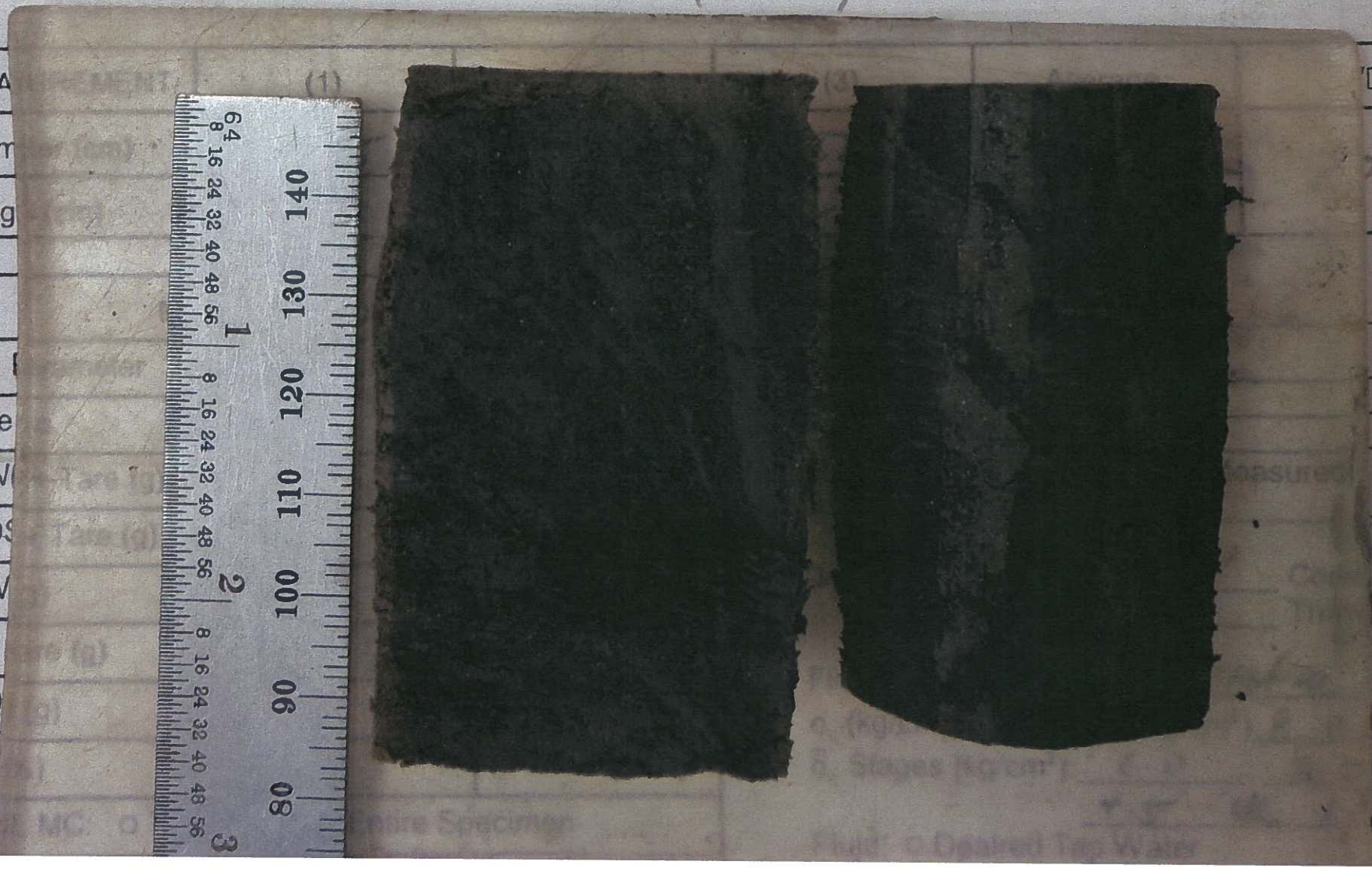
Checked By: TM Date: 08/16/13

BORING: VCT2 B2 SAMPLE: 3/5 DEPTH: ? ☐ ft; ☐ m BLOCK: 5

TYPE SAMPLE: ☒ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TYPE TEST: ☒ CIUC; ☐ UU; ☐ $\overline{UU}$; ☐ CD ☐ OTHER

SAMPLE DESCRIPTION: Gray clay



MEA | D

Diam | 531

Leng

Tare

WW

WDS

WW

Wt.

WD

MC

FIN

ms

lembrane

1.5 OCR 3

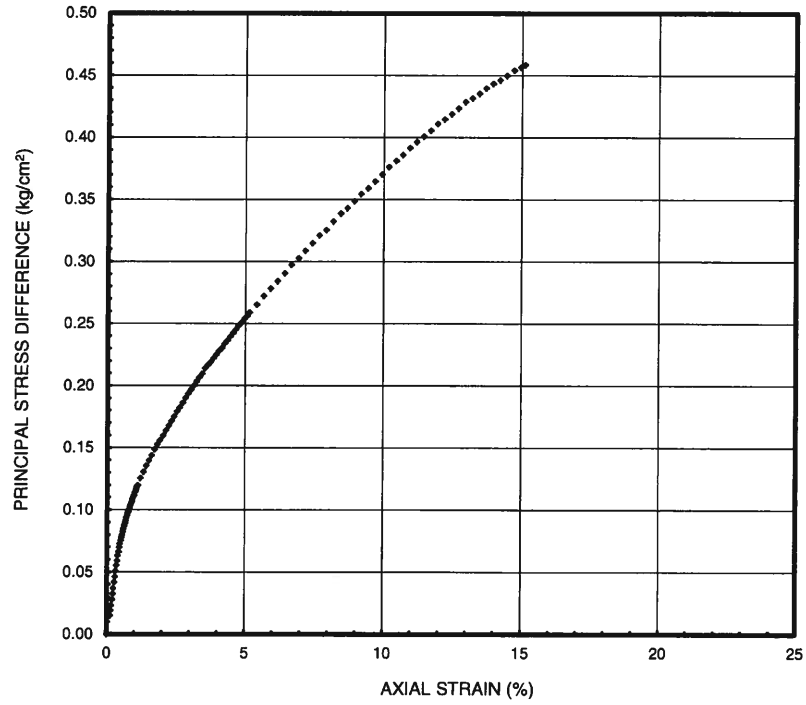
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/25/13
DATE REPORTED: 08/09/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-2** SAMPLE: **5 / 5 [Block 4]**
DEPTH: 3.67 - 4.67 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T2B2
SAMPLE DESCRIPTION: Dark gray lean clay (CL)

Specimen Dimensions			Initial Conditions			Test Conditions			at $(\sigma_1-\sigma_3)_{max}$			
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	σ_c (kg/cm^2)	$\dot{\varepsilon}$ (cm/minute)	$\dot{\varepsilon}$ (%/minute)	ε_a (%)	Compressive Strength (kg/cm^2)	σ_1 (kg/cm^2)	σ_3 (kg/cm^2)
7.24	3.60	2.0	41.1	79.1	96	0.75	0.073	1.0	15.0	0.46	1.21	0.75
									Membrane Correction Made: ☐ Yes ☒ No			



SAMPLE TYPE	
Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Rock Core	
☐ Compacted	

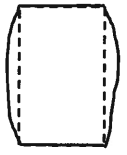
☐ Tamped Uniform Lifts
No. of Lifts: _____

☐ Kneading
No. of Lifts: _____
Spring: _____
Blows per Lift: _____

G_s: 2.76 ☒ Assumed ☐ Measured

FAILURE SKETCH

☐ Diagonal Plane
☒ Bulging
☐ Combination
☐ Other _____



Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☒ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	93.28	Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	99.7

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c = Isotropic confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_a = Axial strain; σ_1 = Major principal stress; σ_3 = Minor principal stress; and G_s = Specific gravity.

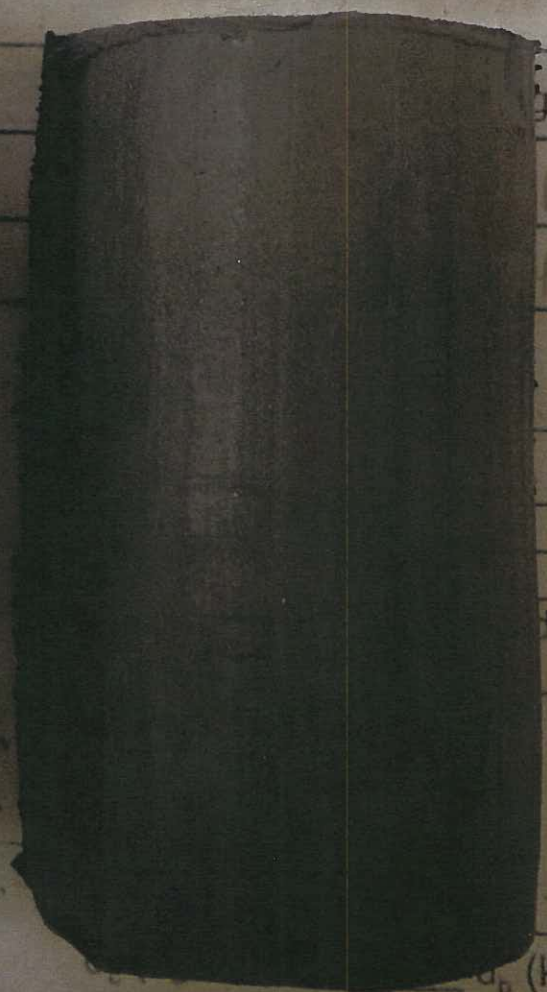
Checked By: JM Date: 08/09/13

BORING: VCT2B2 SAMPLE: S/S DEPTH: 3.67-4.67 ☐ ft; ☐ m BLOCK: 4

TYPE SAMPLE: ☐ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TYPE TEST: ☐ CIUC; ☒ UU; ☐ UU; ☐ CD ☐ OTHER

SAMPLE DESCRIPTION: S Gray Clay



MEAS REMB

Diame

Lengt

Tare

WWS Tare

WDS Tare

WW

Wt. T (g)

WDS

MC (

FINA MC:

☐ Entire Specimen

ge

L/D

2.012

85

.793

☐ Measured

☐ _____ Condoms

☐ _____ Thin Memb a

75

12.42

σ_b (kg/cm²)

$\bar{\sigma}_c$ Stages (kg/cm²): _____ ; _____

_____ ; _____

Fluid: ☐ Deaired Tap Water

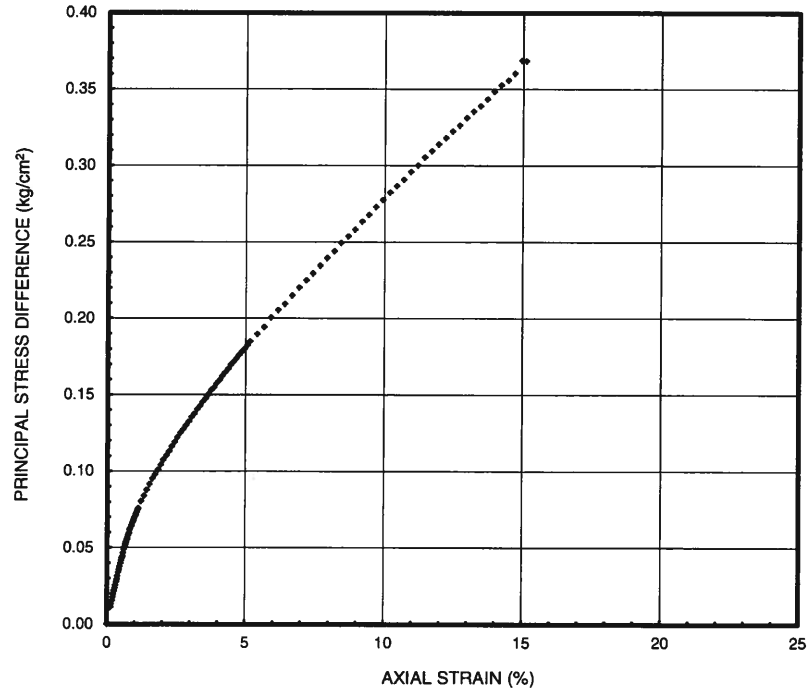
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/25/13
DATE REPORTED: 08/09/13

INCOMING SAMPLE NO.: ---
BORING: **VC-T2B-2** SAMPLE: **5 / 5 [Block 3]**
DEPTH: 3.67 - 4.67 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/T2B2
SAMPLE DESCRIPTION: Dark gray lean clay (CL)

Specimen Dimensions			Initial Conditions			Test Conditions			at $(\sigma_1-\sigma_3)_{max}$			
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	σ_c (kg/cm^2)	$\dot{\varepsilon}$ (cm/minute)	$\dot{\varepsilon}$ (%/minute)	ε_a (%)	Compressive Strength (kg/cm^2)	σ_1 (kg/cm^2)	σ_3 (kg/cm^2)
7.24	3.62	2.0	42.8	77.4	96	1.50	0.072	1.0	14.9	0.37	1.87	1.50
									Membrane Correction Made: ☐ Yes ☒ No			



SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Rock Core	
☐ Compacted	

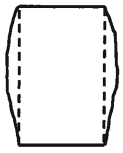
☐ Tamped Uniform Lifts
No. of Lifts: _____

☐ Kneading
No. of Lifts: _____
Spring: _____
Blows per Lift: _____

G_s: 2.76 ☒ Assumed ☐ Measured

FAILURE SKETCH

☐ Diagonal Plane
☒ Bulging
☐ Combination
☐ Other _____



Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☒ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	92.26	Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	100.0

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c = Isotropic confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_a = Axial strain; σ_1 = Major principal stress; σ_3 = Minor principal stress; and G_s = Specific gravity.

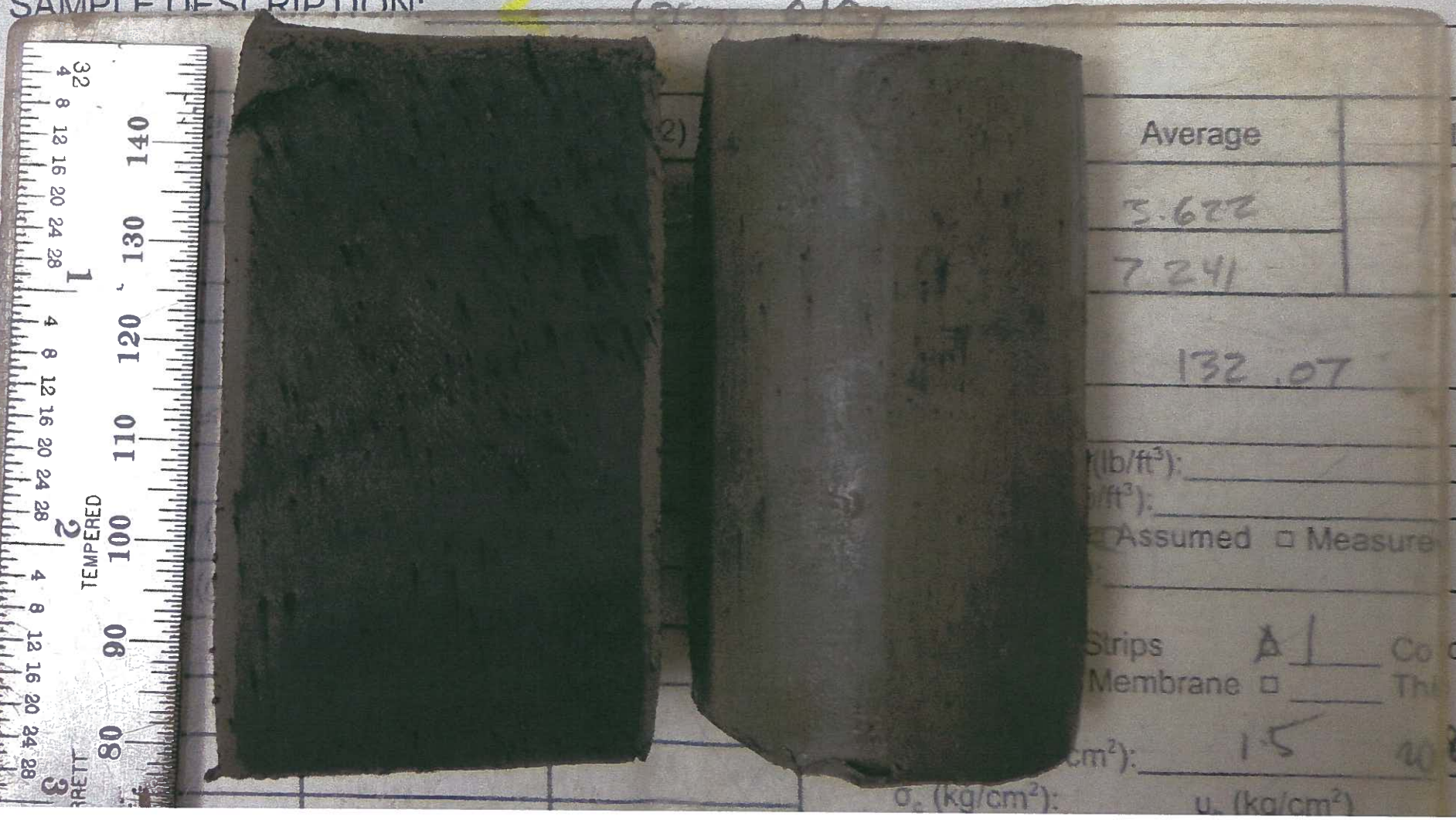
Checked By: [signature] Date: 08/09/13

BORING: VC T2 B2 SAMPLE: 5/5 DEPTH: 3.67-4.67 ☐ ft; ☐ m BLOCK: 3

TYPE SAMPLE: ☐ UNDISTURBED; ☐ COMPACTED; ☐ OTHER _____

TYPE TEST: ☐ $\overline{CIUC}$; ☒ UU; ☐ $\overline{UU}$; ☐ CD ☐ OTHER _____

SAMPLE DESCRIPTION: Core clay



Average

3.622

7.241

132.07

L/D

(lb/ft³): _____

/ft³): _____

Assumed ☐ Measure

Strips A 1 Co doms

Membrane ☐ _____ Thi Memb

cm²): 1.5

σc (kg/cm²): u (kg/cm²)

Attachment H-4

Appendix 4

GEOTECHNICAL TEST RESULTS

CABLE ROUTE CORE HOLES

VOWTAP
File No.: 13-13-0084
September 23, 2013
Revision: 0 (ISSUED FOR USE) 08/20/13
Revision: 1 (Add data to 2/2)

TABLE D-1 EXTRUSION TEST REPORT FOR CORE VC-001

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Soil Corrosion Test Series					
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)					Resistivity (ohm-cm)	Resistivity at w_c (ohm-cm)	pH	Conductivity (µS/cm)	Cl (mg/l)	SO_4 (mg/l)
VC-001	VC-001	1 / 2	0.00 - 0.58	58	Tube length less than reported sampling interval.	50.0	9.146	3.3	0.0	46.7	81	46.8	6,298	46.8	Dark gray silty sand with trace shell	SM	23.5 21.7 23.1 21.8	22.5	22.5	128.2	104.6	99 [Gs=2.70]	15.1									
		2 / 2	0.58 - 1.07	49	None	48.8	9.131	1.7	0.0	47.1	96	47.1	6,259	47.1	Dark gray silty sand	SM	21.9 22.5 21.1 20.8 21.9 22.4 24.9	22.2	22.2	126.8	103.7	96 [Gs=2.70]	21.6 --- ---	0.6 ---	2.1 ---	2.70 ---	30	50	7.55	13,120	4,800	1,080

13-13-0084
VC-001
1/2
TOP→
SWANSON

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/09/13
DATE REPORTED: 08/07/13

INCOMING SAMPLE NO.: ---
BORING: **VC-001** SAMPLE: **1/2** [Block 1]
DEPTH: 0.0 – 0.58 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/001-1/2
SAMPLE DESCRIPTION: Dark gray silty sand with trace shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

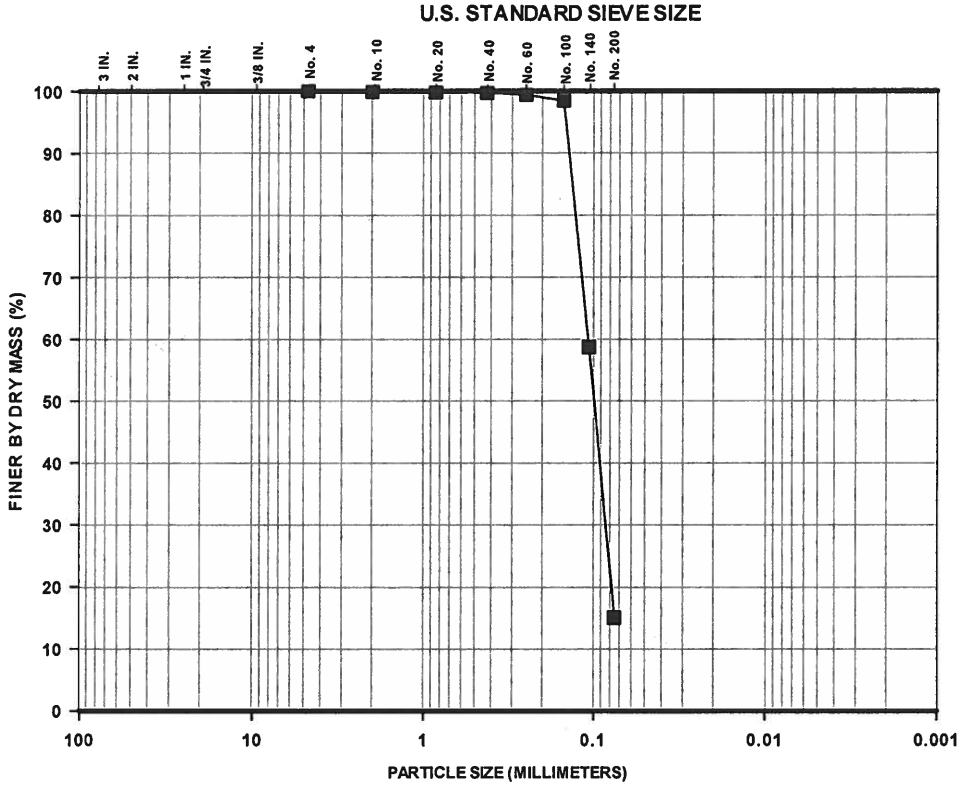
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 21.7
Mass Dry Solids (grams): 111.12

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	99.8	99.7	99.4	98.4	58.7	15.1	---	---	---

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Checked By: JCW Date: 08/07/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/07/13

INCOMING SAMPLE NO.: ---
BORING: **VC-001** SAMPLE: **2/2** [Block 1]
DEPTH: 0.58– 1.07 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/001-2/2
SAMPLE DESCRIPTION: Dark gray silty sand (SM)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

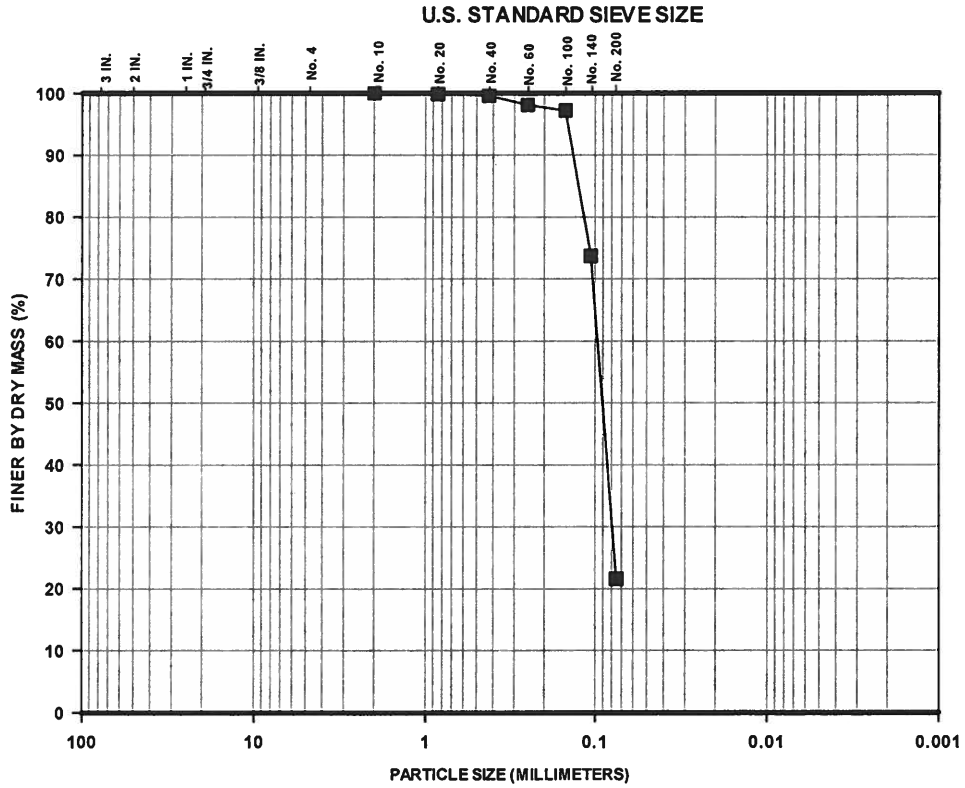
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 22.5
Mass Dry Solids (grams): 112.98

G_s: 2.70 ☐ Assumed ☒ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	100	99.9	99.6	98.1	97.2	73.7	21.6	---	---	---

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Checked By: JCW Date: 08/07/13

VOWTAP
File No.: 13-13-0084
September 23, 2013
Revision: 0 (ISSUED FOR USE) 08/20/13
Revision: 1 (Add data to 2/3)

TABLE D-2 EXTRUSION TEST REPORT FOR CORE VC-001A

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Soil Corrosion Test Series					
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)					Resistivity (ohm-cm)	Resistivity at w_c (ohm-cm)	pH	Conductivity (µS/cm)	Cl (mg/l)	SO_4 (mg/l)
VC-001	VC-001A	1 / 3	0.00 - 0.41	41	H_2S odor. Tube length less than reported sampling interval.	27.5	9.140	0.0	0.0	27.5	67	28.0	3,594	28.0	Gray silty sand with trace shell	SM	25.6 23.9 24.0 24.6 23.2	24.3	24.3	124.4	100.1	96 [Gs=2.70]	14.3 ---	0.6								
		2 / 3	0.41 - 1.41	100	None	100.1	9.152	6.2	0.0	93.9	94	95.3	12,412	95.3	Gray silty sand with trace shell	SM	24.0 21.4 23.0 22.9 21.8 23.2 24.2 23.1	23.0	23.0	125.5	102.1	95 [Gs=2.70]	13.7 --- ---	--- 0.5	--- 1.6	--- 2.70	100	104	7.19	14,970	5,400	1,180
		3 / 3	1.41 - 2.41	100	None	99.2	9.144	1.0	0.0	98.2	98	92.4	11,933	49.2	Gray silty sand with trace shell	SM	23.6 26.9	25.3	26.0	122.8	97.5	96 [Gs=2.70]										
														4.0	Gray silty sand with gray clay lens	SM	63.4	63.4														
														39.2	Gray silty sand with trace shell	SM	24.8 21.6	23.2				14.3									

13-13-0084
VC-001A
1/3
TOP→

13-13-0084
VC-001A
2/3
TOP→
SWANSON
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
MADE IN CHINA

13-13-0084
VC-001A
3/3
TOP→
SWANSON
AE141

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/10/13
DATE REPORTED: 08/07/13

INCOMING SAMPLE NO.: ---
BORING: **VC-001A** SAMPLE: **1/3** [Block 1 & 2]
DEPTH: 0.0 – 0.41 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/001A-1/3
SAMPLE DESCRIPTION: Gray silty sand with trace shell (SM)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

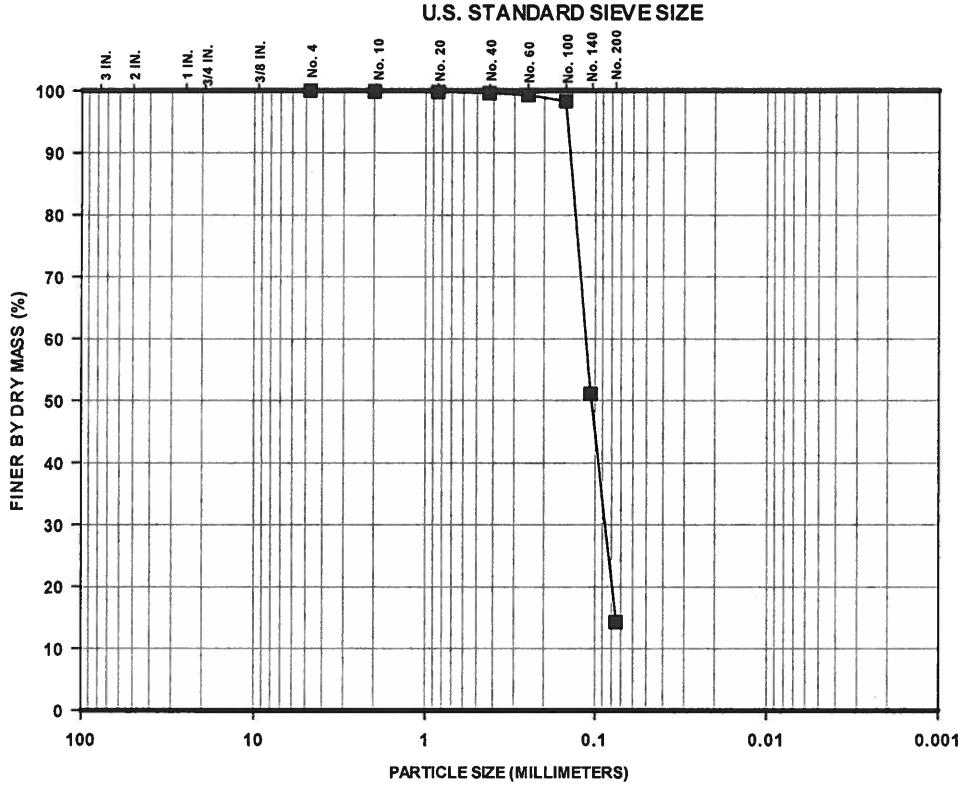
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 23.9
Mass Dry Solids (grams): 165.01

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): 0.6
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	99.8	99.6	99.3	98.3	51.1	14.3	---	---	---

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Checked By: JCW Date: 08/07/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/07/13

INCOMING SAMPLE NO.: ---
BORING: **VC-001A** SAMPLE: **2/3** [Block 1]
DEPTH: 0.41– 1.41 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/001A-2/3
SAMPLE DESCRIPTION: Gray silty sand with trace shell (SM)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

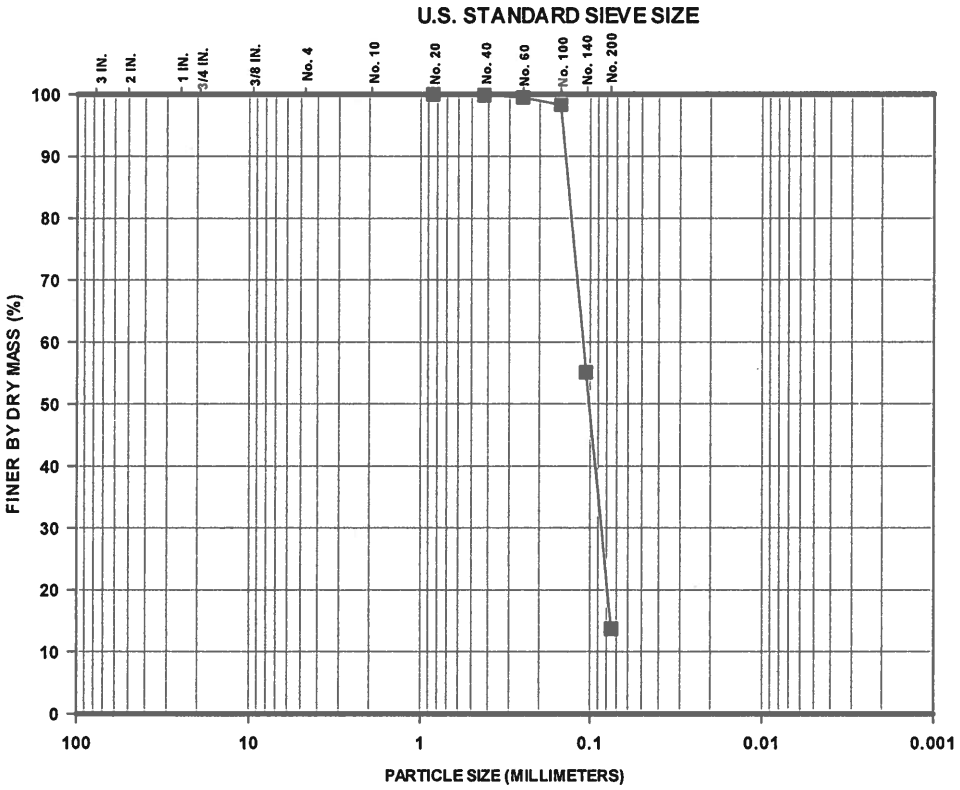
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 21.4
Mass Dry Solids (grams): 98.17

G_s: 2.70 ☐ Assumed ☒ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	100	100	99.9	99.5	98.3	55.1	13.7	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 08/07/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/10/13
DATE REPORTED: 08/07/13

INCOMING SAMPLE NO.: ---
BORING: **VC-001A** SAMPLE: **3/3** [Block 1]
DEPTH: 1.41 – 2.41 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/001A-3/3
SAMPLE DESCRIPTION: Gray silty sand with trace shell (SM)

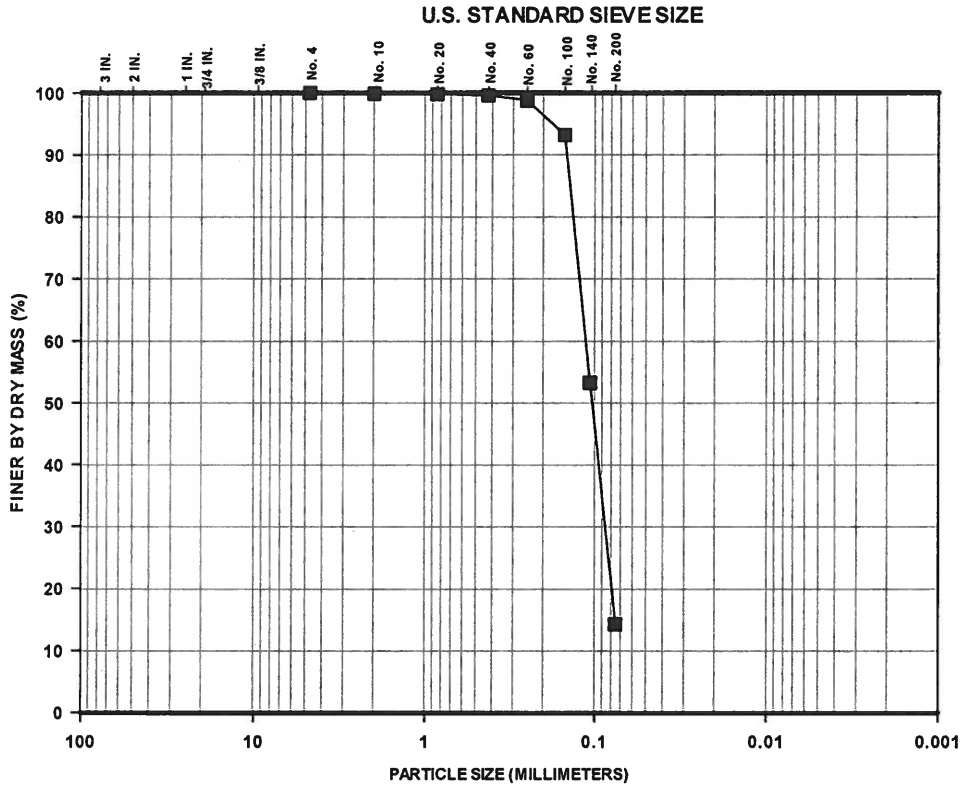
TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____
Dispersion Device: ☐ Apparatus A ☐ Apparatus B
Dispersion Period (hours): _____

Water Content (%): 24.8
Mass Dry Solids (grams): 166.59
G_s: --- ☐ Assumed ☐ Measured
Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	99.8	99.6	98.8	93.2	53.3	14.3	---	---	---

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Checked By: JCW Date: 08/07/13

VOWTAP
File No.: 13-13-0084
September 23, 2013
Revision: 0 (ISSUED FOR USE) 08/20/13
Revision: 1 (Add data to 2/2)

TABLE D-3 EXTRUSION TEST REPORT FOR CORE VC-002B

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Soil Corrosion Test Series						
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)					Resistivity (ohm-cm)	Resistivity at w_c (ohm-cm)	pH	Conductivity (µS/cm)	Cl (mg/l)	SO_4 (mg/l)
VC-002	VC-002B	1 / 2	0.00 - 1.00	100	None. Upper portion of sample had low water contents.	100.0	9.146	6.5	0.0	93.5	94	92.7	12,037	41.5	Brown sand with shell	SP	2.2 3.3 2.5	2.7	10.6	122.4	110.7	56 [Gs=2.68]	0.4									
														33.0	Brownish-gray sand with silt and trace shell	SP-SM	16.0 20.1	18.1														
														18.2	Dark gray sand with trace shell	SP	15.2	15.2														
		2 / 2	1.00 - 1.70	70	None	70.5	9.142	4.0	0.0	66.5	95	65.4	8,882	1.0	Dark gray silty sand with shell	SM	---	---	20.1	127.1	105.8	93 [Gs=2.68]	---	0.4	2.6	2.68						
														14.0	Dark gray to black silt	ML	24.5 35.9	30.2														
														27.0	Grayish-brown sand with trace shell	SP	21.7	21.7														
														16.0	Grayish-brown sand with gravel	SP	11.8 9.2 8.9 9.7 10.8	10.1					1.9 ---	---	---	---	Insufficient Sample		7.67	7,870	3,000	550
														7.4	Dark gray silty sand with shell	SM	17.5	17.5														

13-13-0084
VC-002B
1/2
→
TOP

13-13-0084
VC-002B
2/2
→
TOP

13-13-0084
VC-002B
2/2
→
TOP

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/07/13
DATE REPORTED: 08/07/13

INCOMING SAMPLE NO.: ---
BORING: **VC-002B** SAMPLE: **1/2** [Block 1]
DEPTH: 0.0 – 1.00 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/002B-1/2
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

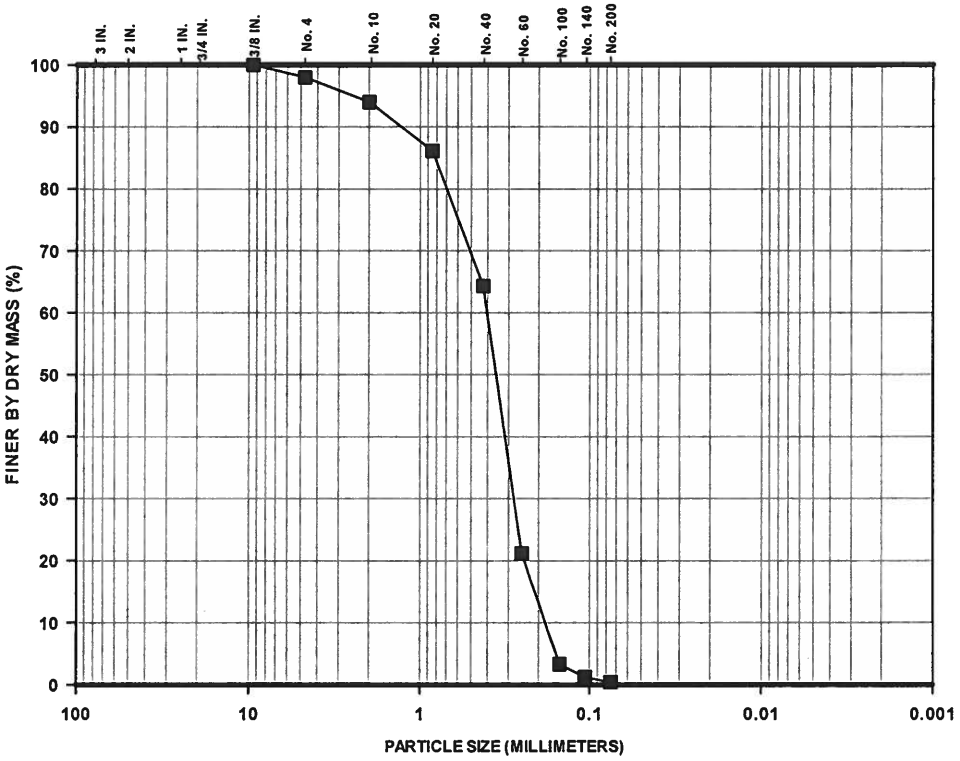
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 3.3
Mass Dry Solids (grams): 182.09

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	98.0	94.0	86.1	64.3	21.2	3.3	1.2	0.4	---	---	---

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Checked By: JCW Date: 08/07/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/07/13
DATE REPORTED: 08/07/13

INCOMING SAMPLE NO.: ---
BORING: **VC-002B** SAMPLE: **2/2** [Block 2]
DEPTH: 1.00 – 1.70 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/003-2/2
SAMPLE DESCRIPTION: Grayish-brown sand with gravel (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

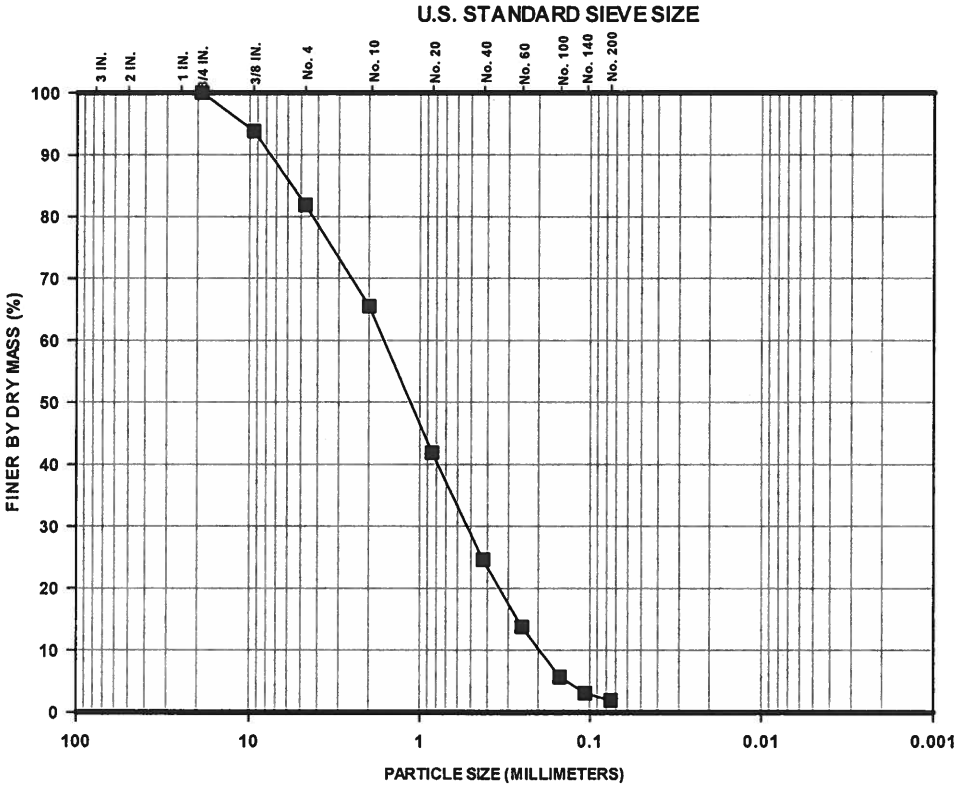
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 9.7
Mass Dry Solids (grams): 440.75

G_s: 2.68 ☐ Assumed ☒ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	93.8	81.9	65.5	41.9	24.6	13.8	5.7	3.1	1.9	---	---	---

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Checked By: JAW Date: 08/07/13

VOWTAP
File No.: 13-13-0084
August 20, 2013
Revision: 0 (ISSUED FOR USE)

TABLE D-4 EXTRUSION TEST REPORT FOR CORE VC-003

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Soil Corrosion Test Series					
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)					Resistivity (ohm-cm)	Resistivity at w_c (ohm-cm)	pH	Conductivity (µS/cm)	Cl (mg/l)	SO_4 (mg/l)
VC-003	VC-003	1 / 2	0.13 - 1.13	100	None	100.3	9.158	27.5	0.0	72.8	73	76.0	9,765	22.0	Brown sand with trace shell	SP	17.1 19.5	18.3	20.2	127.2	105.8	92 [Gs=2.70]										
														54.0	Dark gray sand with silt and trace shell	SP-SM	22.0 20.5 20.9 20.3	20.9					8.9									
		2 / 2	1.13 - 2.13	100	Bottom 6.7 cm of tube was shattered with pieces of the tube punched into the soil. Bottom 6.7 cm of sample cut and removed, and not included within extruded length and mass.	99.7	9.164	2.5	0.0	97.2	97	92.0	12,059	49.5	Dark gray silty sand with shell	SM	21.7 21.0 22.1 22.6 22.1 22.2	21.5	21.3	117.5	96.8	92 [Gs=2.70]	--- 15.7 --- ---	0.9 --- --- ---	2.1 --- --- ---	--- 2.72	91	106	7.63	13,840	5,400	1,270
														3.5	Dark gray silty sand with gray clay lenses	SM	21.8	21.8															
														16.5	Dark gray silty sand with shell	SM	21.7	21.7															
														10.0	Dark gray silty sand with gray clay lenses	SM	25.3	25.3															
														12.5	Dark gray silty sand with shell	SM	16.7	16.7															

13-13-0084
VC-003
1/2
→
TOP
SWANSON
AE141

-13-0084
/C-003
2/2
→
TOP

13-13-008
VC-003
2/2
→
TOP

AE141

SWANSON TOOL CO., INC.
251 ONTARIO STREET
FRANKFORT, IL 60423 USA

13-13-0084

VC-003

2/2

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/07/13
DATE REPORTED: 08/07/13

INCOMING SAMPLE NO.: ---
BORING: **VC-003** SAMPLE: **1/2** [Block 1]
DEPTH: 0.13 - 1.13 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/003-1/2
SAMPLE DESCRIPTION: Dark gray sand with silt and trace shell (SP-SM)

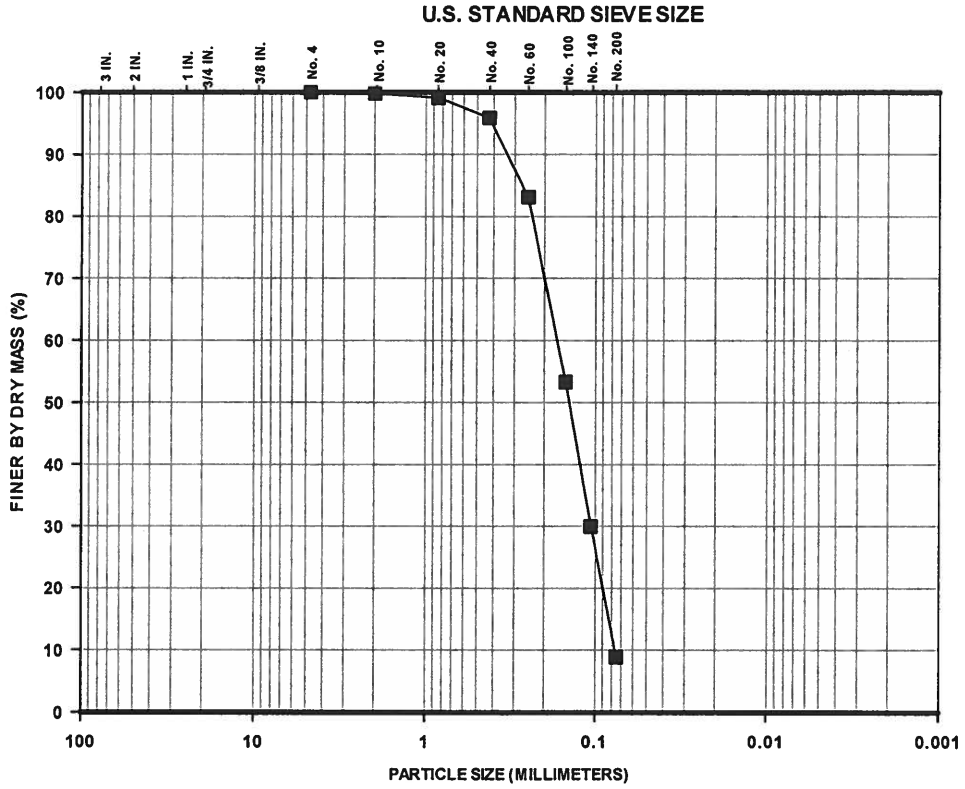
TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____
Dispersion Device: ☐ Apparatus A ☐ Apparatus B
Dispersion Period (hours): _____

Water Content (%): 20.5
Mass Dry Solids (grams): 200.56
G_s: --- ☐ Assumed ☐ Measured
Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.8	99.1	95.9	83.1	53.3	30.0	8.9	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: JCW Date: 08/07/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/07/13
DATE REPORTED: 08/07/13

INCOMING SAMPLE NO.: ---
BORING: **VC-003** SAMPLE: **2/2** [Block 1]
DEPTH: 1.13 - 2.13 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/003-2/2
SAMPLE DESCRIPTION: Dark gray silty sand with shell (SM)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

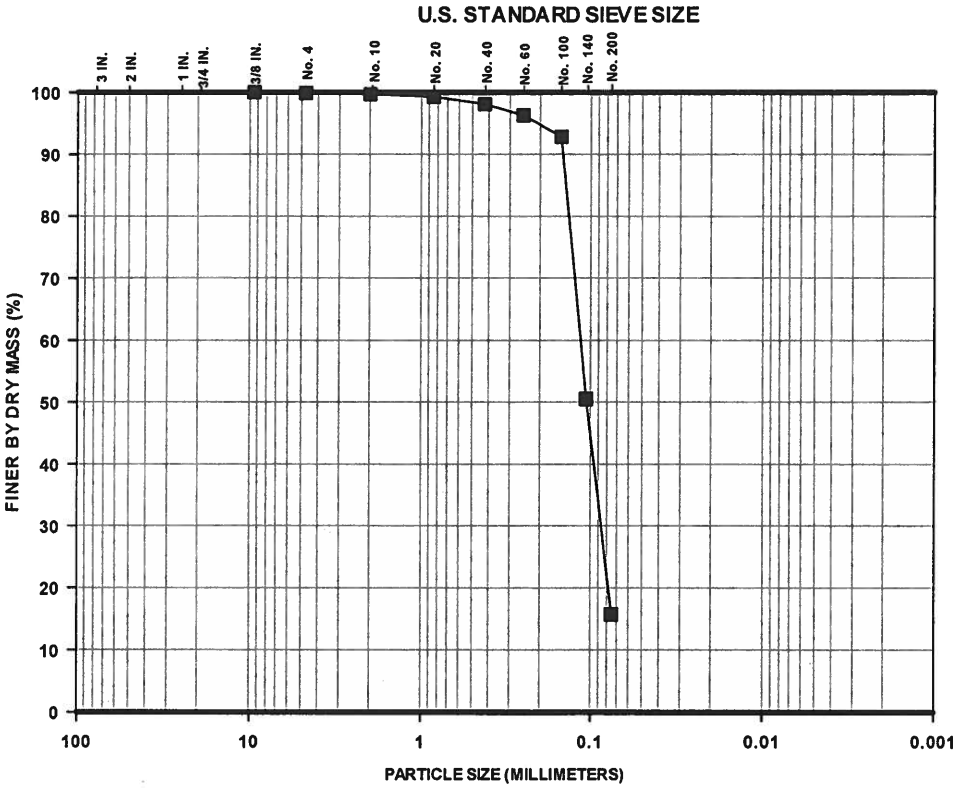
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 22.6
Mass Dry Solids (grams): 105.41

G_s: 2.72 ☐ Assumed ☒ Measured

Organic Content (%): 0.9
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.9	99.7	99.3	98.1	96.3	92.8	50.5	15.7	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: JAS Date: 08/07/13

VOWTAP
File No.: 13-13-0084
August 20, 2013
Revision: 0 (ISSUED FOR USE)

TABLE D-5 EXTRUSION TEST REPORT FOR CORE VC-004

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Soil Corrosion Test Series					
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)					Resistivity (ohm-cm)	Resistivity at w_c (ohm-cm)	pH	Conductivity (µS/cm)	Cl (mg/l)	SO_4 (mg/l)
VC-004	VC-004	1 / 3	0.00 - 0.95	95	Tube length less than reported sampling interval.	89.2	9.143	2.3	0.0	86.9	91	86.7	11,368	86.7	Dark gray sand with silt and trace shell [with gray clay lenses between 53 and 57 cm]	SP-SM	25.0 23.5 23.3 25.6 21.7	23.8	23.8	124.5	100.5	95 [Gs=2.70]	10.8									
		2 / 3	0.95 - 1.55	60	Tube length less than reported sampling interval.	54.1	9.149	3.0	0.0	51.1	85	51.0	6,732	51.0	Dark gray silty sand with trace shell	SM	25.6 28.1 25.4 25.7 26.2 26.1 24.8	26.0	26.0	125.2	99.4	100 [Gs=2.71]	31.2 --- --- ---	--- --- 1.1	2.1 ---	2.71 ---	70	85	7.69	12,820	4,800	1,300
		3 / 3	1.55 - 2.55	100	Tube length less than reported sampling interval.	49.8	9.156	1.0	0.0	48.8	49	49.2	6,444	31.0	Dark gray silty sand with trace shell	SM	24.7 23.0 21.7	23.1	25.3	125.3	99.9	98 [Gs=2.72]	19.4									
														7.0	Dark gray fat clay with sand	CH	49.9	49.9												
														11.2	Brownish-gray sand	SP	16.1	16.1												

13-13-0084
VC-004
1/3
TOP→
8THS
To read length in centimeters, omit the final zero after the index line. To read length in millimeters, include the final zero.
LINEAR METRIC UNITS AND SYMBOLS
1000 millimeters (mm) = 1 meter(m)

13-13-0084
VC-004
2/3
TOP

13-13-0084
VC-004
3/3
TOP→
SWANSON
AE141

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/10/13
DATE REPORTED: 08/07/13

INCOMING SAMPLE NO.: ---
BORING: **VC-004** SAMPLE: **1/3** [Block 1]
DEPTH: 0.0 – 0.95 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/004-1/3
SAMPLE DESCRIPTION: Dark gray sand with silt and trace shell (SP-SM)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

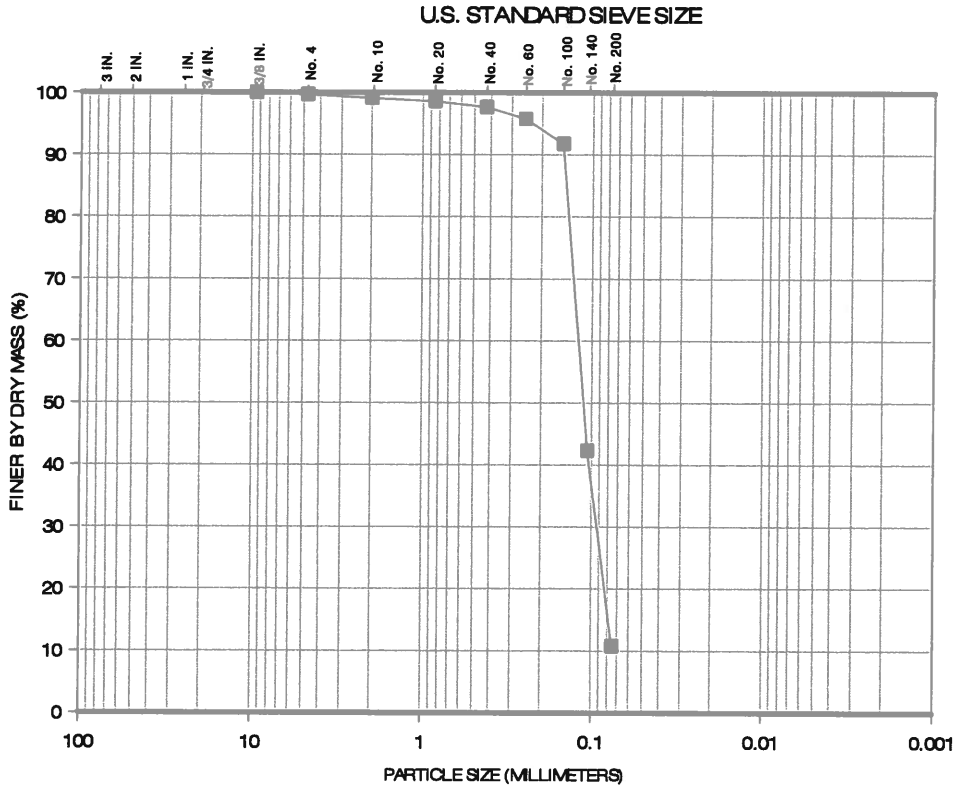
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 23.3
Mass Dry Solids (grams): 209.41

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.7	99.1	98.6	97.7	95.8	91.8	42.3	10.8	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: JAW Date: 08/07/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/07/13

INCOMING SAMPLE NO.: ---
BORING: **VC-004** SAMPLE: **2/3** [Block 1]
DEPTH: 0.95– 1.55 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/004-2/3
SAMPLE DESCRIPTION: Dark gray silty sand with trace shell (SM)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

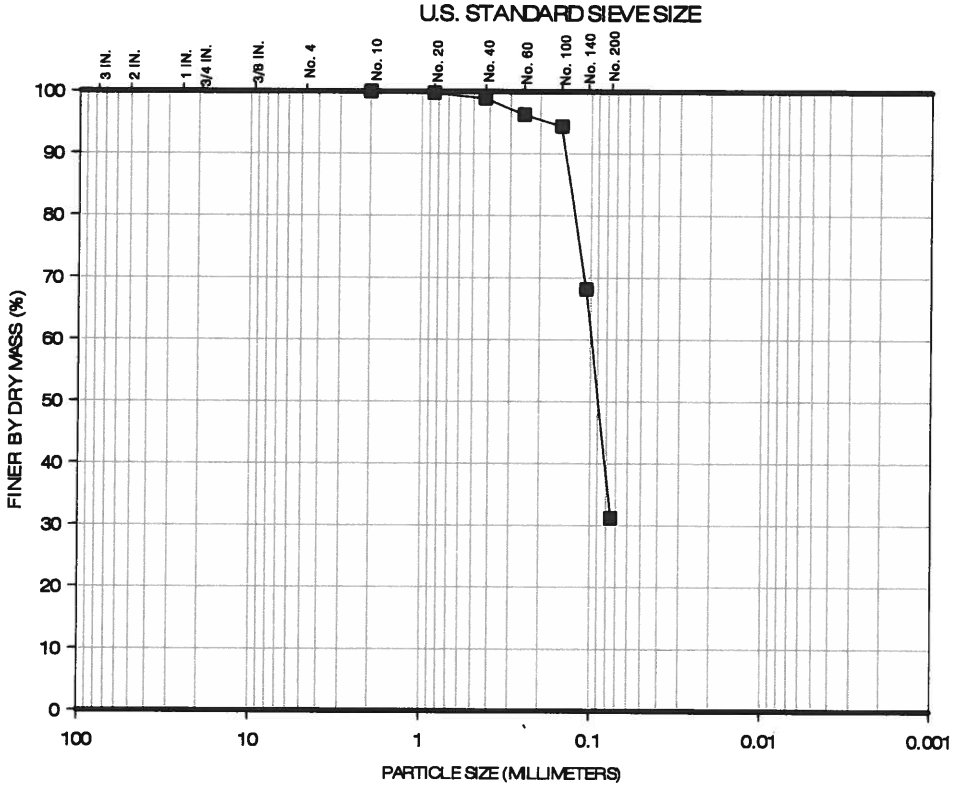
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 28.1
Mass Dry Solids (grams): 110.54

G_s: 2.71 ☐ Assumed ☒ Measured

Organic Content (%): 1.1
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	100	99.8	98.9	96.3	94.4	68.1	31.2	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: JW Date: 08/07/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/10/13
DATE REPORTED: 08/07/13

INCOMING SAMPLE NO.: ---
BORING: **VC-004** SAMPLE: **3/3** [Block 1]
DEPTH: 1.55 – 2.55 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/004-3/3
SAMPLE DESCRIPTION: Dark gray silty sand with trace shell (SM)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

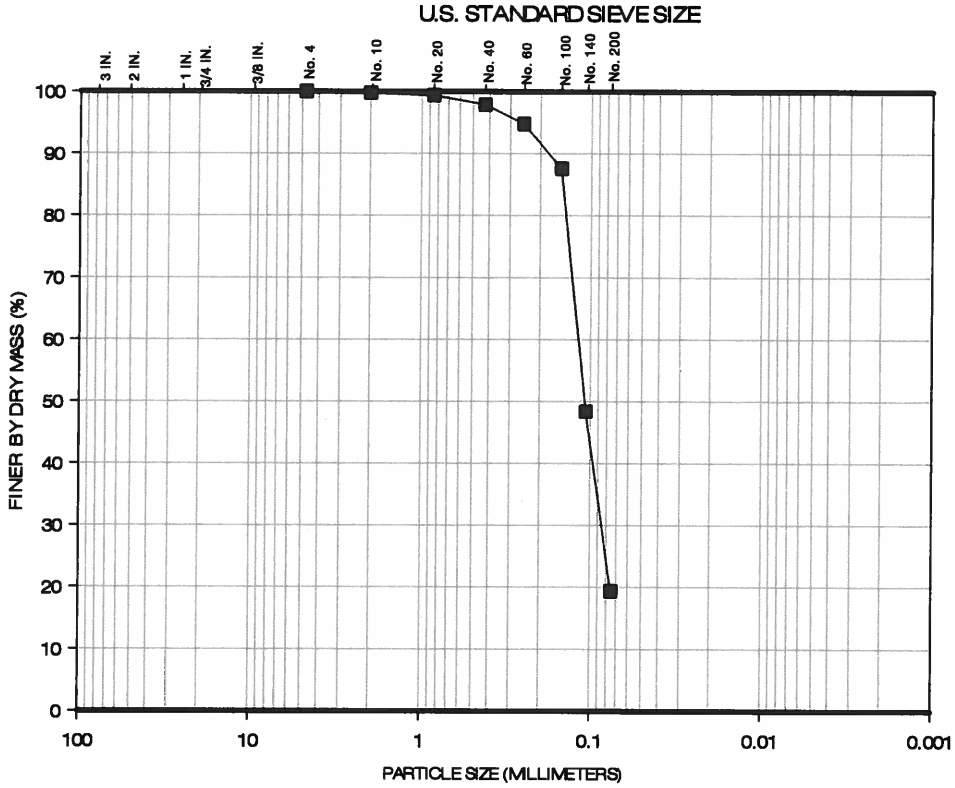
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 21.7
Mass Dry Solids (grams): 222.00

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.8	99.4	97.9	94.8	87.6	48.4	19.4	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: JW Date: 08/07/13

VOWTAP
File No.: 13-13-0084
August 20, 2013
Revision: 0 (ISSUED FOR USE)

TABLE D-6 EXTRUSION TEST REPORT FOR CORE VC-005

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Soil Corrosion Test Series					
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)					Resistivity (ohm-cm)	Resistivity at w_c (ohm-cm)	pH	Conductivity (µS/cm)	Cl (mg/l)	SO_4 (mg/l)
VC-005	VC-005	1 / 3	0.00 - 0.61	61	H_2S odor. Tube length less than reported sampling interval.	53.5	9.135	0.0	0.0	53.5	88	53.2	7,172	53.2	Brownish-gray sand with trace shell	SP	24.0 23.7 23.1 18.6 22.1	22.3	22.3	127.8	104.5	99 [Gs=2.68]	4.9 ---	0.6								
		2 / 3	0.61 - 1.61	100	Tube length less than reported sampling interval.	97.5	9.143	1.0	0.0	96.5	97	95.4	12,612	80.0	Dark gray silty sand with shell and few thin lenses of gray clay	SM	21.9 41.8 23.8 24.1 23.3	27.0	25.1	124.3	99.4	97 [Gs=2.70]	19.3								
														15.4	Orangish-brown sand	SP	11.8 18.7	15.3					1.3								
		3 / 3	1.61 - 2.61	100	Tube length less than reported sampling interval. Upper portion of tube had low water contents.	95.3	9.149	2.5	0.0	92.8	93	94.5	12,812	30.5	Orangish-brown sand	SP	5.5 4.1	4.8	9.5	131.2	119.8	65 [Gs=2.70]									
														64.0	Orangish-brown sand	SW	6.3 13.7 12.0 10.7 12.3 15.3	11.7					--- 3.0 ---	0.4 --- ---	0.2 --- ---	2.66 --- ---	90	90	7.25	10,160	3,000	520

13-13-0084
VC-005
1/3
TOP→
SWANSON
AE141

SWANSON
AE141
13-13-0084
VC-005
3/3
TOP→

13-13-0084
VC-005
3/3
TOP→
SWANSON
AE141
SWANSON TOOL CO. INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
MADE IN CHINA

13-13-0084
VC-005
3/3
TOP→
SWANSON
AE141

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/10/13
DATE REPORTED: 08/07/13

INCOMING SAMPLE NO.: ---
BORING: **VC-005** SAMPLE: **1/3** [Block 1]
DEPTH: 0.0 – 0.61 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/005-1/3
SAMPLE DESCRIPTION: Brownish-gray sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

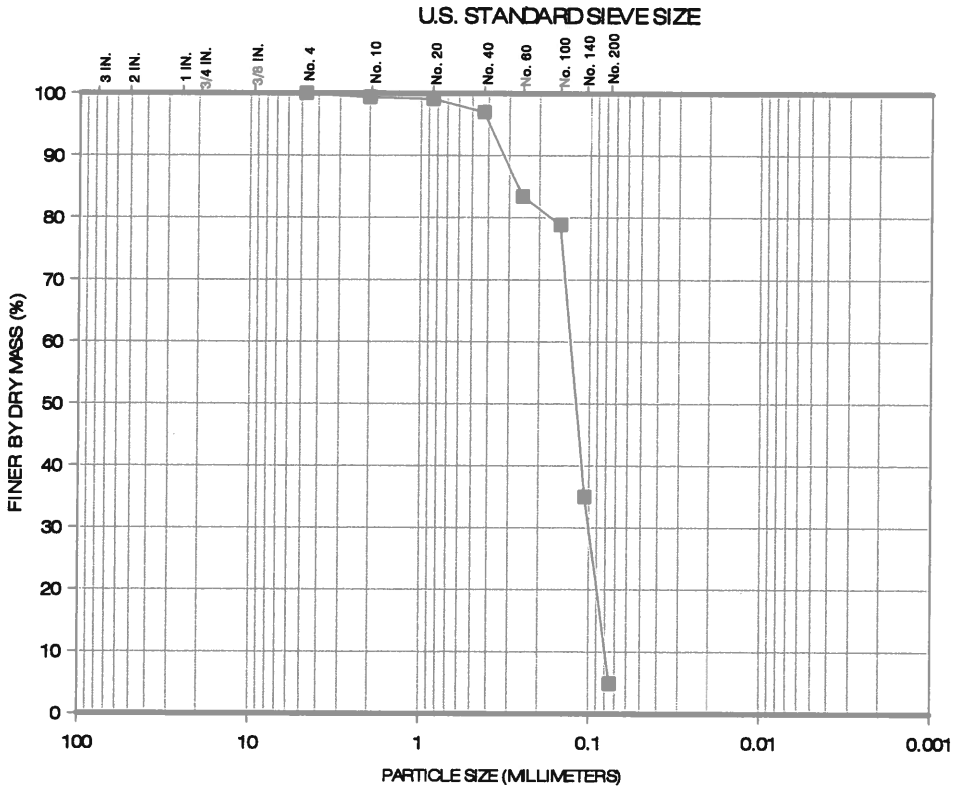
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 23.7
Mass Dry Solids (grams): 204.00

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): 0.6
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.4	99.1	97.0	83.4	78.8	35.0	4.9	---	---	---

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Checked By: JCW Date: 08/07/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/10/13
DATE REPORTED: 08/07/13

INCOMING SAMPLE NO.: ---
BORING: **VC-005** SAMPLE: **2/3** [Block 1]
DEPTH: 0.61 – 1.61 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/005-2/3b1
SAMPLE DESCRIPTION: Dark gray silty sand with trace shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

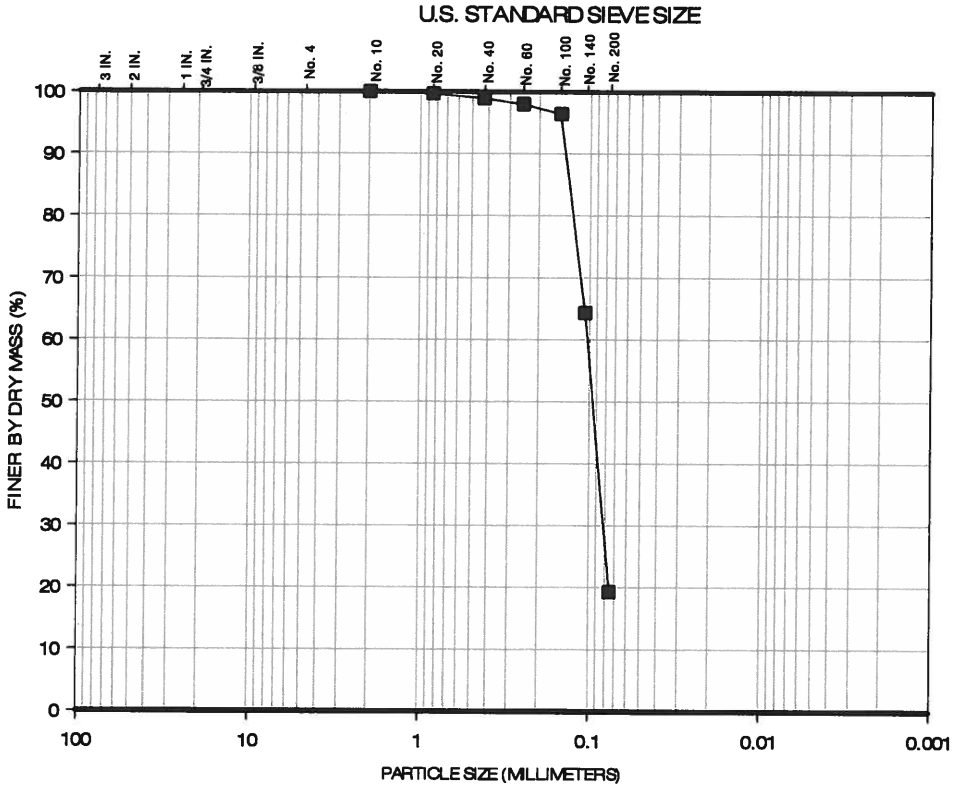
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 23.8
Mass Dry Solids (grams): 168.01

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): --
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	100	99.7	98.9	98.0	96.4	64.3	19.3	---	---	---

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Checked By: JCW Date: 08/07/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/10/13
DATE REPORTED: 08/07/13

INCOMING SAMPLE NO.: ---
BORING: **VC-005** SAMPLE: **2/3** [Block 2]
DEPTH: 0.61 – 1.61 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/005-2/3b2
SAMPLE DESCRIPTION: Orangish-brown sand (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

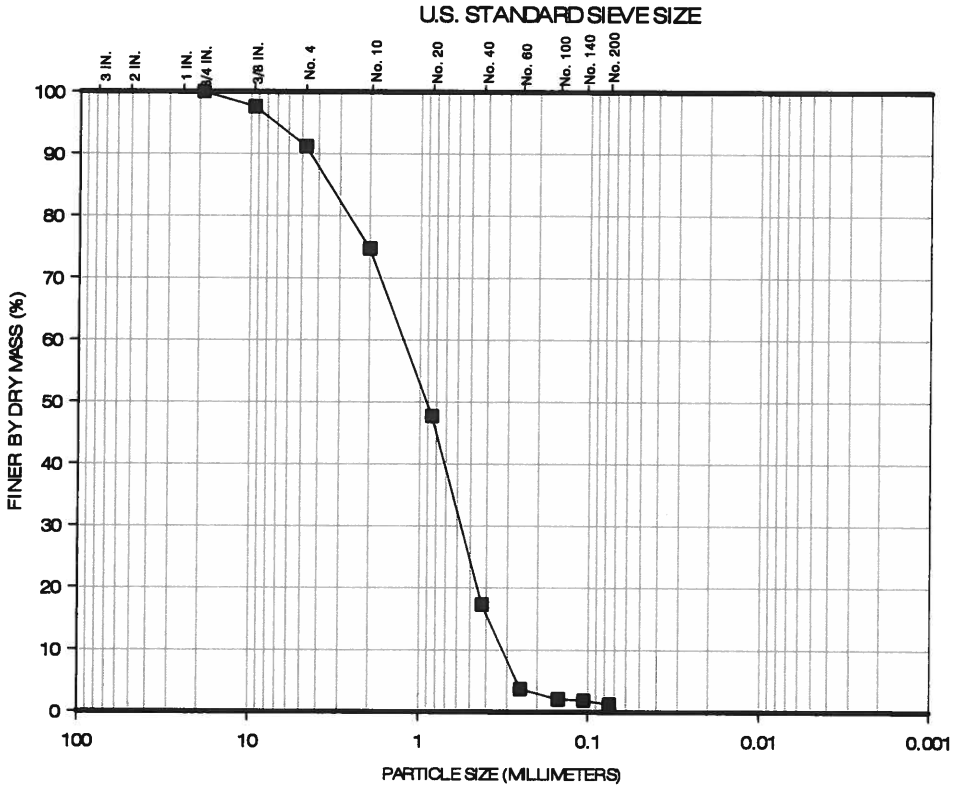
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 11.8
Mass Dry Solids (grams): 315.68

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	97.6	91.2	74.7	47.7	17.3	3.7	2.1	1.9	1.3	---	---	---

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Checked By: JAW Date: 08/07/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/07/13

INCOMING SAMPLE NO.: ---
BORING: **VC-005** SAMPLE: **3/3** [Block 3]
DEPTH: 1.61 – 2.61 ☐ ft; ☒
LABORATORY IDENTIFICATION: 130084/005-3/3
SAMPLE DESCRIPTION: Orangish-brown sand (SW)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

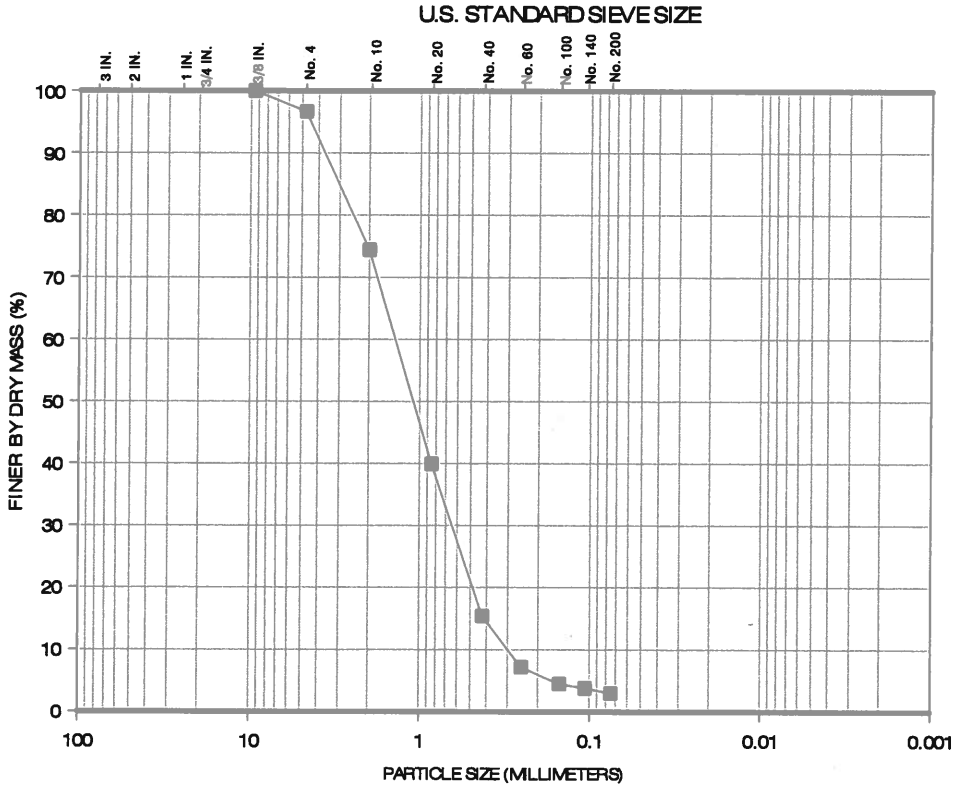
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 12.3
Mass Dry Solids (grams): 347.40

G_s: 2.66 ☐ Assumed ☒ Measured

Organic Content (%): 0.4
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	96.7	74.4	39.9	15.4	7.2	4.5	3.8	3.0	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: JCW Date: 08/07/13

VOWTAP
File No.: 13-13-0084
August 20, 2013
Revision: 0 (ISSUED FOR USE)

TABLE D-7 EXTRUSION TEST REPORT FOR CORE VC-006

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Soil Corrosion Test Series					
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)					Resistivity (ohm-cm)	Resistivity at w_c (ohm-cm)	pH	Conductivity (µS/cm)	Cl (mg/l)	SO_4 (mg/l)
VC-006	VC-006	1 / 3	0.00 - 0.43	43	Tube length greater than reported sampling interval. Top of sample liquified with minor vibration.	55.2	9.135	0.0	0.0	55.2	128	54.0	7,408	54.0	Dark gray silty sand with trace shell [with brown sand vertical lens along wall of tube between 13 and 29 cm]	SM	24.5 19.8 23.6 23.6 25.4	23.4	23.4	127.9	103.7	100 [Gs=2.72]	14.2									
		2 / 3	0.43 - 1.43	100	Sample had low water contents between 19 and 45 cm. Low water content soil crumbled during handling.	100.3	9.144	0.0	0.0	100.3	100	100.0	12,675	19.0	Dark gray sand with silt, shell and gravel and brown sand lens	SP-SM	24.5 18.3 15.1	19.8	16.1	120.2	103.5	69 [Gs=2.67]	--- 10.6	1.8	0.2	2.67						
														43.0	Grayish-brown sand with trace shell	SP	2.7 3.9 9.4 11.9 12.2 13.9 21.9	10.8					--- --- 1.4 ---	--- 0.2 --- ---			90	160	7.44	11,480	3,600	640
														38.0	Brown sand with trace shell	SP	21.0 19.4	20.2														
		3 / 3	1.43 - 2.43	100	Sample had low water contents between 0 and 27 cm. Top surface of sample loose. Voids in soil along tube wall between 6 and 11 cm, 27 and 48 cm, and 76 and 80 cm.	98.7	9.147	10.0	0.0	88.7	89	89.5	10,984	50.0	Brown sand with trace shell	SP	9.8 16.9	13.4														
														39.5	Brown sand with gray silty sand lenses	SP	21.3 19.4 19.1 18.2	19.5	16.1	117.7	101.4	67 [Gs=2.67]	2.5									

SWANSON
AE141
SWANSON TOOL CO. INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
13-13-0084
VC-006
1/3
TOP→

13-13-0084
VC-006
2/3
TOP

SWANSON
AE141
13-13-0084
VC-006
2/3
TOP

13-13-0084
VC-006
2/3
TOP

TOP→
3/3
VC-006
13-13-0084
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT IL 60423 USA

TOP→
3/3
VC-006
13-13-0084
AE141
SWANSON TOOL CO., INC
211 ONTARIO STREET
FRANKFORT, IL 60423 USA

13-13-0084
VC-006
3/3
TOP→

CONVERSIONS
inches x 25.4 = millimeters
inches x 2.54 = centimeters
feet x 30.48 = centimeters
feet x 0.3048 = meters
yards x 0.9144 = meters
miles x 1.609344 = kilometers
13-13-0084
VC-006
3/3
TOP→

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-006** SAMPLE: **1/3** [Block 1]
DEPTH: 0.0 – 0.43 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/006-1/3
SAMPLE DESCRIPTION: Dark gray silty sand with trace shell (SM)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

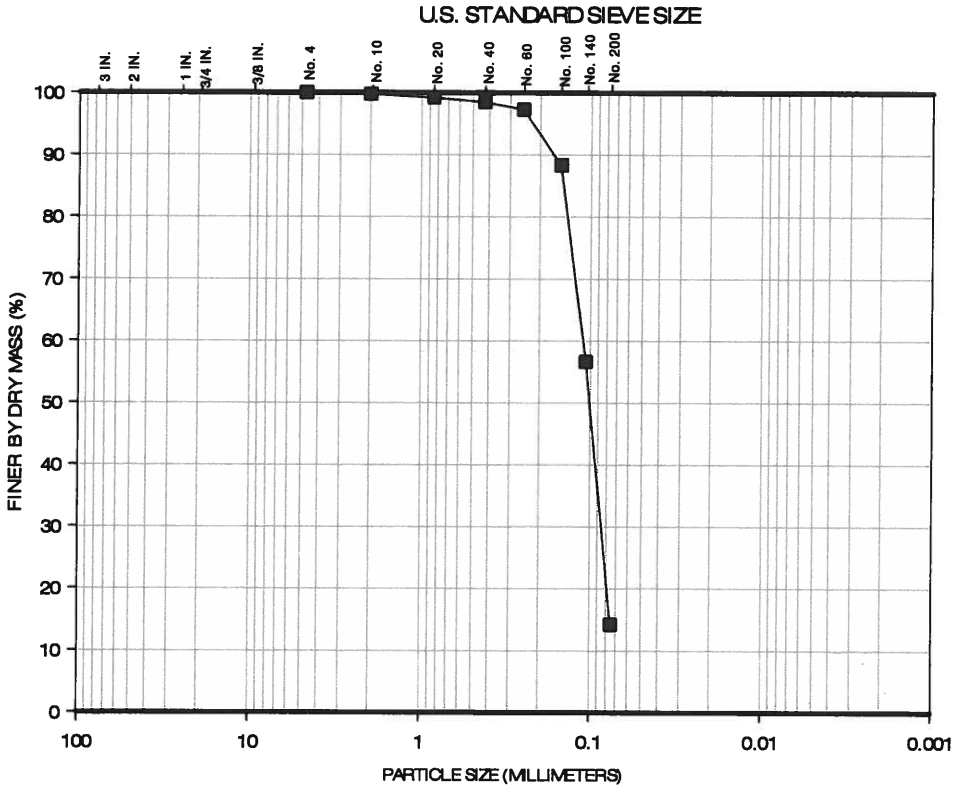
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 23.6
Mass Dry Solids (grams): 135.73

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): --
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.8	99.2	98.5	97.3	88.3	56.6	14.2	---	---	---

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Checked By: _____ Date: 08/08/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-006** SAMPLE: **2/3** [Block 1]
DEPTH: 0.43– 1.43 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/006-2/3b1
SAMPLE DESCRIPTION: Dark gray sand with silt, shell and gravel (SP-SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

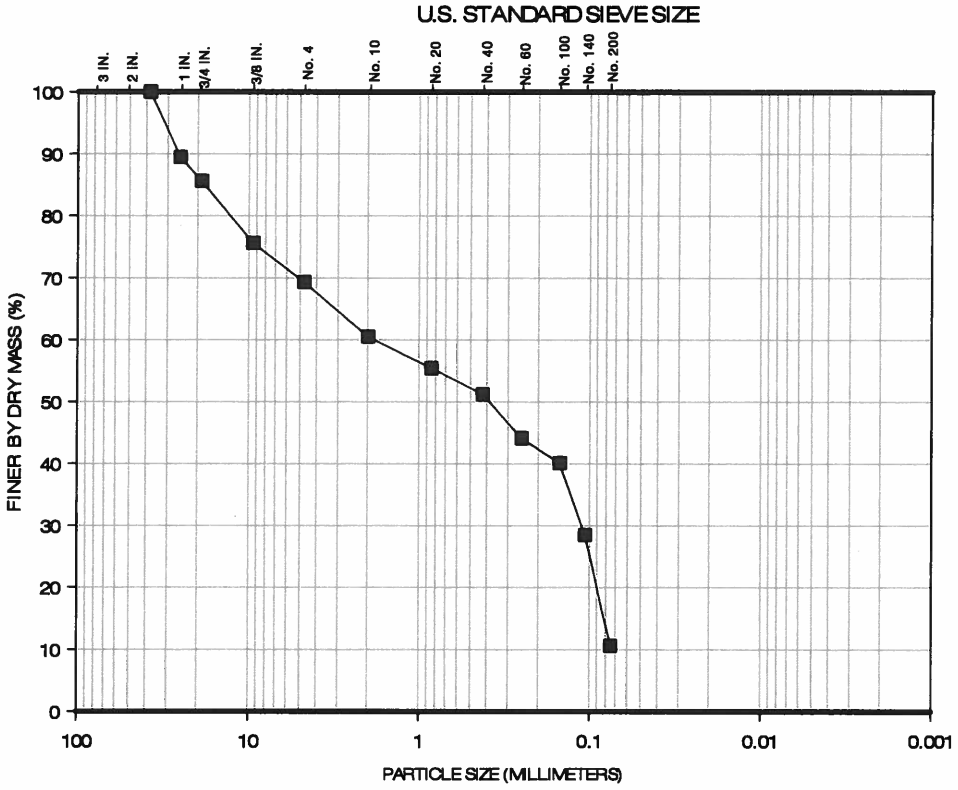
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 15.1
Mass Dry Solids (grams): 623.80

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): 1.8
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	89.5	85.6	75.6	69.3	60.5	55.4	51.2	44.1	40.1	28.5	10.6	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 08/08/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-006** SAMPLE: **2/3** [Block 2]
DEPTH: 0.43– 1.43 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/006-2/3b2
SAMPLE DESCRIPTION: Grayish-brown sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

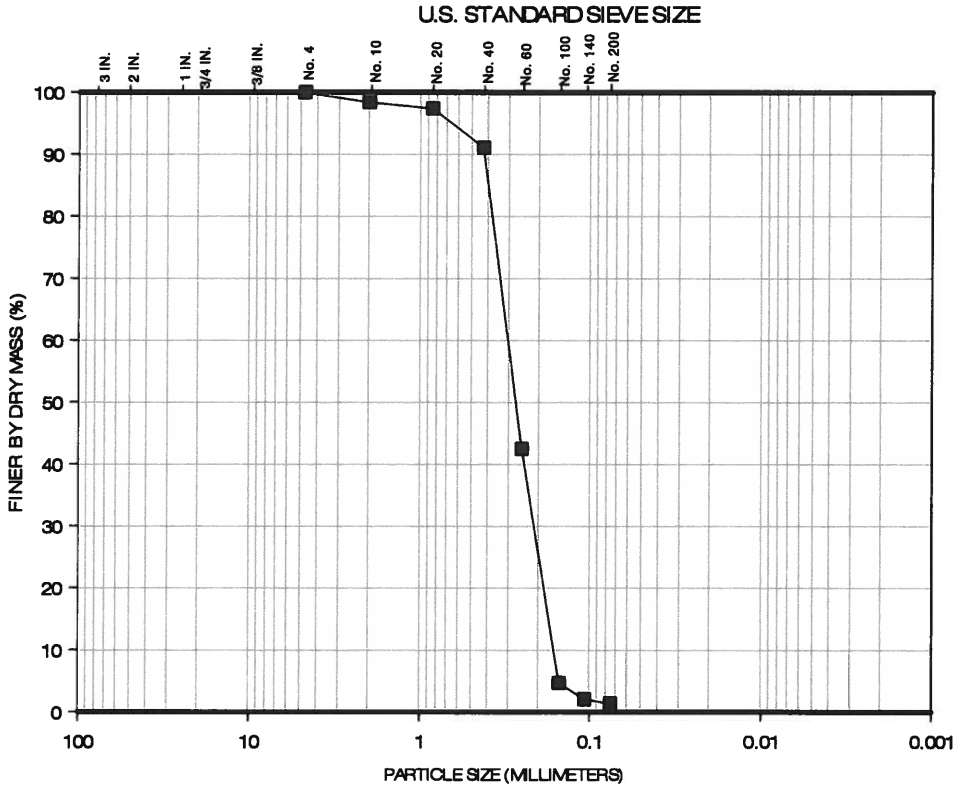
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 12.2
Mass Dry Solids (grams): 141.38

G_s: 2.67 ☐ Assumed ☒ Measured

Organic Content (%): 0.2
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	98.4	97.4	91.1	42.5	4.7	2.1	1.4	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 08/08/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/10/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-006** SAMPLE: **3/3** [Block 1]
DEPTH: 1.43 – 2.43 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/006-3/3
SAMPLE DESCRIPTION: Grayish-brown sand (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

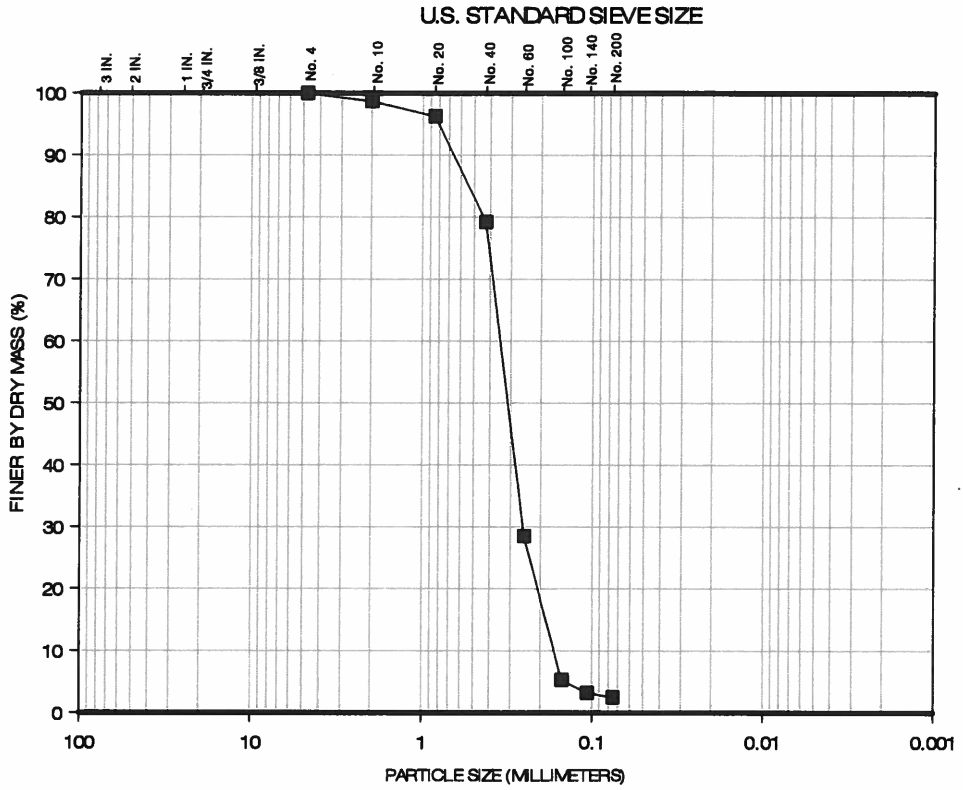
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 19.4
Mass Dry Solids (grams): 175.06

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	98.7	96.3	79.2	28.5	5.3	3.2	2.5	---	---	---

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Checked By: _____ Date: 08/08/13

VOWTAP
File No.: 13-13-
0044
August 20, 2013
Revision: 0 (ISSUED FOR USE)

TABLE D-8 EXTRUSION TEST REPORT FOR CORE VC-007

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Soil Corrosion Test Series						Atterberg Limits			Strength Index Tests	
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)					Resistivity (ohm-cm)	Resistivity at w_c (ohm-cm)	pH	Conductivity (µS/cm)	Cl (mg/l)	SO_4 (mg/l)	Liquid Limit, LL	Plastic Limit, PL	Plasticity Index, PI	s_u [TV] (kg/cm²)	s_u [LV] (kg/cm²)
VC-007	VC-007	1 / 3	0.0 - 0.28	28	Tube cut even with top of sample.	21.5	9.147	0.0	0.0	21.5	77	22.8	2,889	4.5	Dark gray sand with silt and shell	SP-SM	24.7	24.7	23.4	127.7	103.5	100 [Gs=2.69]														
														18.3	Dark gray sand with silt	SP-SM	23.3 22.8	23.1					10.2												
		2 / 3	0.28 - 1.28	100	None	96.5	9.142	1.5	0.0	95.0	95	95.5	12,524	84.0	Dark gray silty sand with trace shell	SM	23.8 23.4 23.5 23.5 23.9 23.7 22.3	23.4	25.7	124.8	99.3	100 [Gs=2.69]	19.4 --- ---	0.7 ---	2.8 ---	2.69 ---	84	96	7.43	12,880	4,800	1,140					
														11.5	Dark gray silty sand with lenses of gray clay and trace shell	SM	42.3	42.3																	
		3 / 3	1.28 - 2.28	100	Sample appears disturbed between 51.5 and 76.5 cm.	95.6	9.147	1.5	0.0	94.1	94	92.5	11,456	51.5	Dark gray silty sand with lenses of gray clay and trace shell	SM	28.4 30.1 67.9	33.0	33.1	115.6	86.9	95 [Gs=2.70]														
														25.0	Dark gray silty sand with shell, gravel and lenses of gray clay	SM	32.6	32.6																	
														16.0	Gray lean clay	CL	35.6 33.5 34.7 34.4 32.7	34.2					--- 99.2	2.9	---	---	---	---	---	---	---	46	23	23	1.00 --- 0.75	--- 0.20 ---

13-13-0084
VC-007
1/3
TOP→
SWANSON®
AE141

13-13-0
VC-00
2/3
TOP
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
AE141

SWANSON
AE141
13-13-0084
VC-007
2/3
TOP

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/10/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-007** SAMPLE: **1/3** [Block 1]
DEPTH: 0.0 – 0.28 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/007-1/3
SAMPLE DESCRIPTION: Dark gray sand with silt (SP-SM)

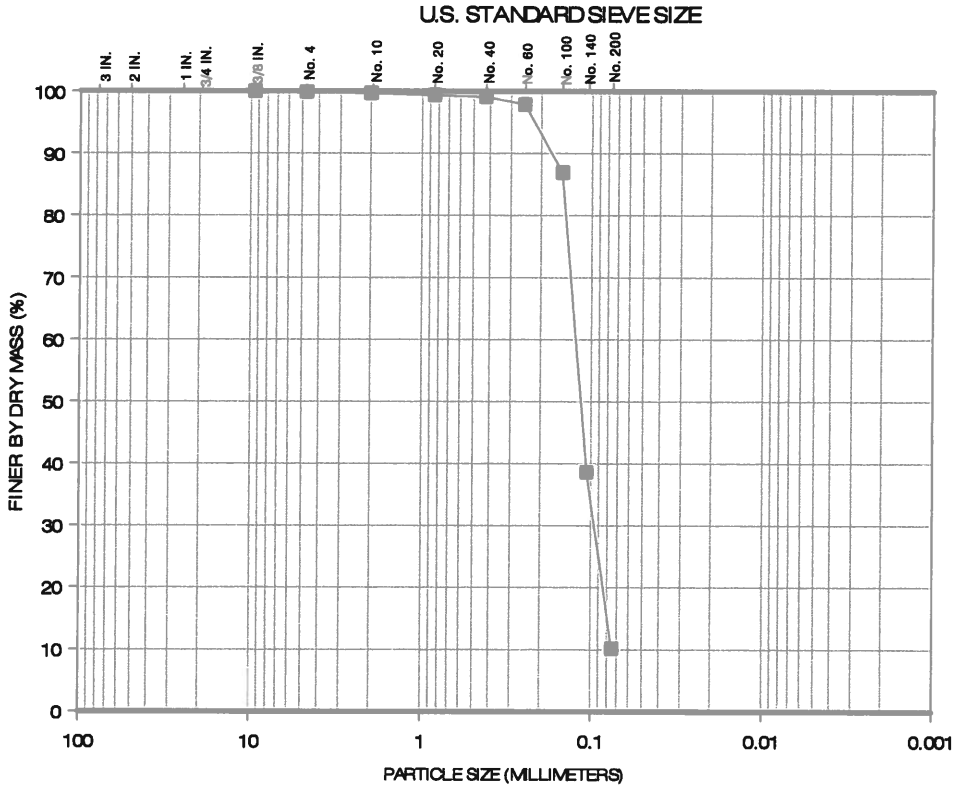
TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____
Dispersion Device: ☐ Apparatus A ☐ Apparatus B
Dispersion Period (hours): _____

Water Content (%): 23.3
Mass Dry Solids (grams): 201.61
G_s: --- ☐ Assumed ☐ Measured
Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.9	99.7	99.4	99.1	97.9	86.9	38.6	10.2	---	---	---

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Checked By: _____ Date: 08/08/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-007** SAMPLE: **2/3** [Block 1]
DEPTH: 0.28 – 1.28 ☐ ft; ☒
LABORATORY IDENTIFICATION: 130084/007-2/3
SAMPLE DESCRIPTION: Dark gray silty sand with trace shell (SM)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

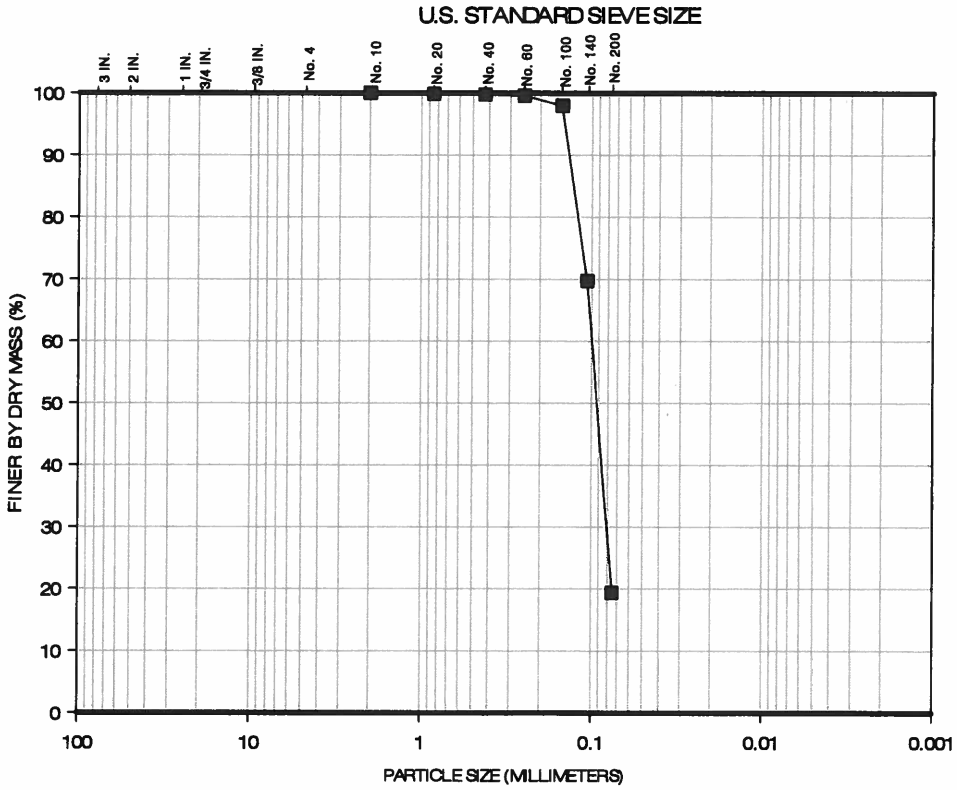
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 23.5
Mass Dry Solids (grams): 121.24

G_s: 2.69 ☐ Assumed ☒ Measured

Organic Content (%): 0.7
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	100	99.9	99.8	99.6	98.0	69.7	19.4	---	---	---

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Checked By: _____ Date: 08/08/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/18/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-007** SAMPLE: **3/3**
DEPTH: 1.28 – 2.28 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/0073/3
SAMPLE DESCRIPTION: Gray lean clay (CL)

TEST PROCEDURES

ASTM Standard D422:
☐ Sieve Analysis
☐ Hydrometer Analysis
☒ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☒ Sodium Hexametaphosphate ☐ Other_____

Dispersion Device: ☐ Apparatus A ☐ Apparatus B

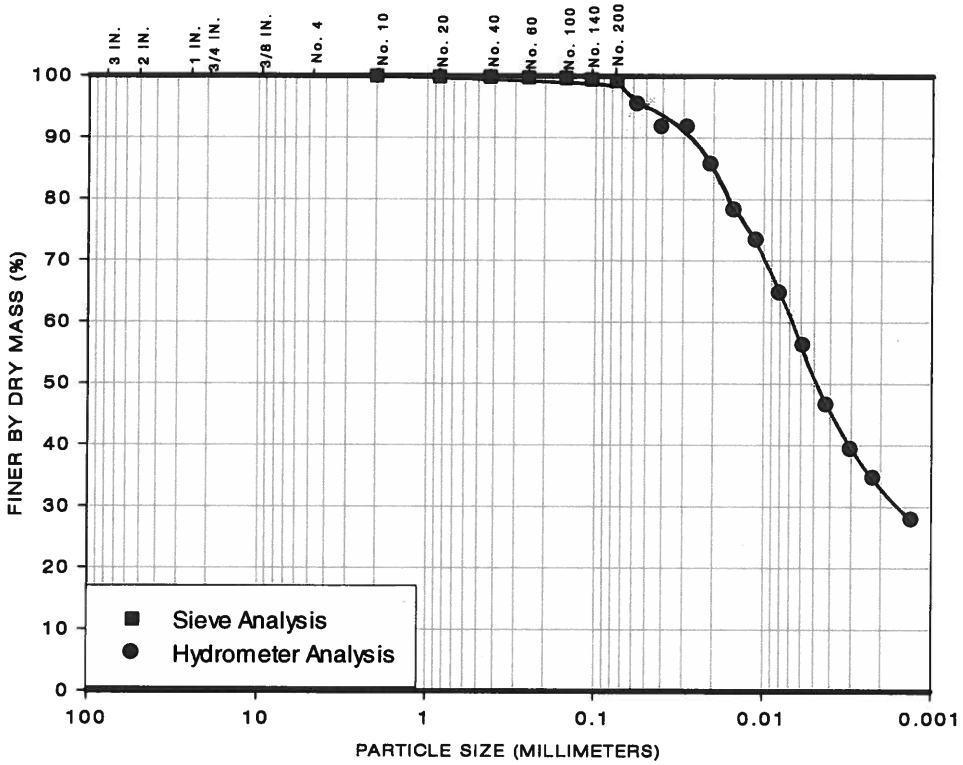
Dispersion Period (hours): >24

Water Content (%): 34.7
Mass Dry Solids (grams): 39.42

G_s: 2.75 ☒ Assumed ☐ Measured

Organic Content (%): 2.9
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]

U.S. STANDARD SIEVE SIZE



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	100	99.9	99.9	99.8	99.6	99.5	99.2	52.2	33.9	26.3

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Checked By: JM Date: 08/08/13

VOWTAP
File No.: 13-13-0084
August 20, 2013
Revision: 0 (ISSUED FOR USE)

TABLE D-9 EXTRUSION TEST REPORT FOR CORE VC-008

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Soil Corrosion Test Series					
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)					Resistivity (ohm-cm)	Resistivity at w_c (ohm-cm)	pH	Conductivity (µS/cm)	Cl (mg/l)	SO_4 (mg/l)
VC-008	VC-008	1 / 3	0.00 - 0.76	76	Tube length longer than reported sampling interval. H_2S odor between 8.5 and 26.5 cm.	100.2	9.145	27.5	0.0	72.7	96	73.5	9,460	8.5	Brownish-gray sand	SP	13.2	13.2														
														65.0	Dark gray silty sand with trace shell	SM	23.9 24.0 24.9 24.8 23.1	24.1	22.9	123.7	100.7	92 [Gs=2.70]	--- 15.4	0.7								
		2 / 3	0.76 - 1.76	100	None.	100.1	9.140	1.1	0.0	99.0	99	101.9	13,445	23.9	Dark gray silty sand with trace shell	SM	26.0	26.0														
														14.0	Dark gray silty sand and brown sand [transition zone between overlying and underlying soils]	SP-SM	17.4	17.4														
														64.0	Brown sand	SP	13.8 11.0 11.5 12.9 16.4 16.9 12.7	13.6	17.0	129.3	110.5	90 [Gs=2.66]	1.9 --- ---	0.2 ---	0.7 ---	2.66 ---	70	70	7.14	13,530	3,600	650
		3 / 3	1.76 - 2.66	90	Upper portion of tube had low water contents.	90.5	9.141	3.0	0.0	87.5	97	89.7	11,330	52.0	Brown sand with gravel [several large particles up to 4 cm]	SP	3.2 3.0 19.9	8.7	11.6	123.2	110.4	62 [Gs=2.66]										
														6.0	Gray sandy silt	ML	20.1	20.1														
														31.7	Gray sand	SP	13.9 15.6	14.8					1.6									

13-13-0084
VC-008
1/3
TOP→

TOP
13-13-0084
VC-008
SWANSON
AE141

13-13-0084
VC-008
2/3
TOP

TOP
2/3
C-008
3-0084
LINEAR METRIC UNITS AND SYMBOLS
1000 millimeters (mm) = 1 meter(m)
100 centimeters (cm) = 1 meter (m)
1000 meters (m) = 1 kilometer (km)
CONVERSIONS
inches x 25.4 = millimeters
inches x 2.54 = centimeters
feet x 30.48 = centimeters
feet x 0.3048 = meters
yards x 0.9144 = meters
miles x 1.609344 = kilometers
SWANS

13-13-0084
VC-008
2/3
TOP
SWANSON
AE141

13-13-0084
VC-0-008
2/3

SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
MADE IN CHINA

13-13-0084
VC-008
3/3
TOP→

TOP→

3/3

VC-008

13-13-0084

13-13-0084
VC-008
3/3
TOP→
SWANSON®
AE141

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-008** SAMPLE: **1/3** [Block 1]
DEPTH: 0.0 – 0.76 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/008-1/3
SAMPLE DESCRIPTION: Dark gray silty sand with trace shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

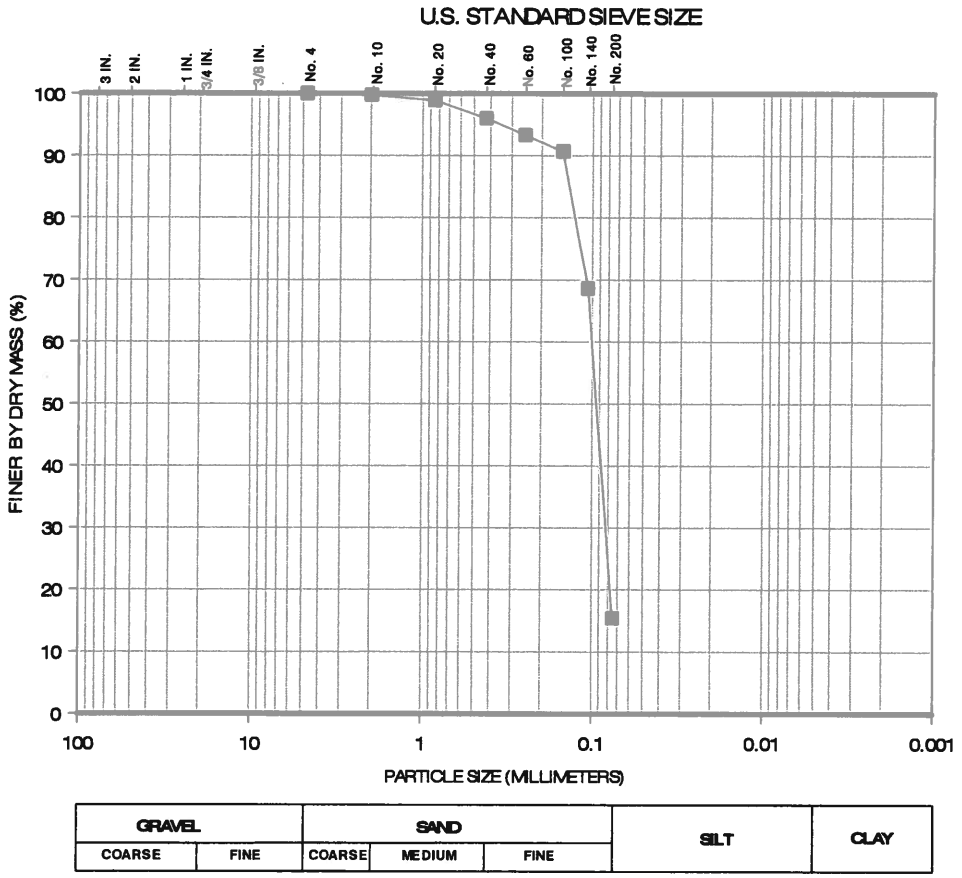
☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____
Dispersion Device: ☐ Apparatus A ☐ Apparatus B
Dispersion Period (hours): _____

Water Content (%): 24.0
Mass Dry Solids (grams): 132.85

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): 0.7
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.8	98.9	96.0	93.3	90.7	68.6	15.4	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 08/08/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-008** SAMPLE: **2/3** [Block 2]
DEPTH: 0.76– 1.76 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/008-2/3
SAMPLE DESCRIPTION: Brown sand (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

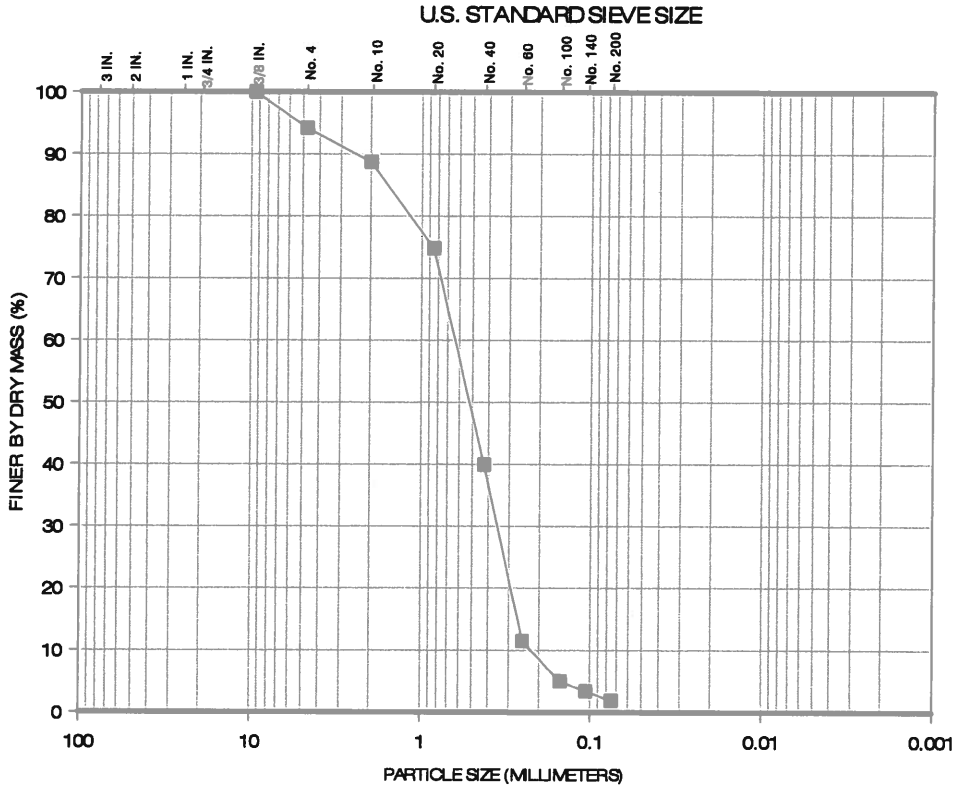
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 11.0
Mass Dry Solids (grams): 189.36

G_s: 2.66 ☐ Assumed ☒ Measured

Organic Content (%): 0.2
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	94.2	88.7	74.8	39.9	11.5	5.0	3.4	1.9	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 08/08/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-008** SAMPLE: **3/3** [Block 1]
DEPTH: 1.76– 2.66 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/008-3/3
SAMPLE DESCRIPTION: Gray sand (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

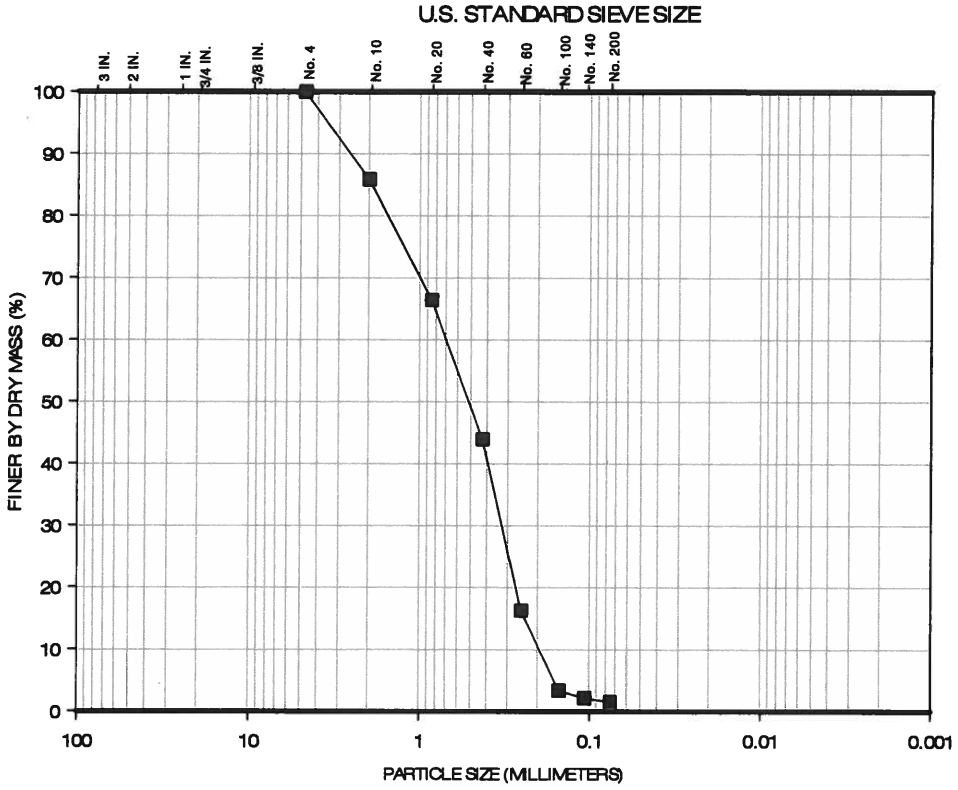
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 13.9
Mass Dry Solids (grams): 237.67

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	85.9	66.4	43.9	16.3	3.4	2.2	1.6	---	---	---

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Checked By: _____ Date: 08/08/13

VOWTAP
File No.: 13-13-0084
August 20, 2013
Revision: 0 (ISSUED FOR USE)

TABLE D-10 EXTRUSION TEST REPORT FOR CORE VC-009

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Soil Corrosion Test Series					
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)					Resistivity (ohm-cm)	Resistivity at w_c (ohm-cm)	pH	Conductivity (µS/cm)	Cl (mg/l)	SO_4 (mg/l)
VC-009	VC-009	1 / 2	0.00 -0.90	90	Tube length less than reported sampling interval. Approximately 3.3 cm of standing water (216 grams) on top of sample. H_2S odor.	76.1	9.150	0.0	0.0	76.1	85	75.0	10,836	7.5	Dark gray silty sand with trace shell	SM	20.3	20.3															
														25.5	Dark gray sand with gravel and shell and lenses of dark gray silt [sample contained one 7.6 cm shell and one 8.5 cm x 5 cm x 4 cm gravel (248 gram) particle]	SW-SM	14.0 12.2	13.1	16.1	135.3	116.5	97 [Gs=2.70]	7.5								
														31.0	Dark gray silty sand with trace shell	SM	14.9 19.4	17.2															
														11.0	Dark gray silty sand with shell	SM	17.5	17.5															
		2 / 2	0.90 - 1.86	96	Tube length less than reported sampling interval. Approximately 0.7 cm of standing water (46 grams) on top of sample. H_2S odor.	88.0	9.154	0.0	0.0	88.0	92	87.5	12,117	7.0	Dark gray silty sand with shell and lenses of gray clay	SM	20.6	20.6	19.0	130.7	109.9	96 [Gs=2.70]									
														16.0	Dark gray silty sand with shell	SM	20.3	20.3															
														14.0	Dark gray silty sand with shell and lenses of gray clay	SM	21.0 21.7 28.2	23.6					26.1 ---	1.0							
														50.5	Dark gray silty sand with shell	SM	21.2 18.4 15.5 12.9	17.0					42.0								

13-13-0084
VC-009
1/2
TOP→

13-13-0084
VC-0-600
1/2
TOP→
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
MADE IN CHINA

13-0084
C-009
2/2

13-13-008
VC-009
2/2
TOP

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-009** SAMPLE: **1/2** [Block 1]
DEPTH: 0.0 – 0.90 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/009-1/2
SAMPLE DESCRIPTION: Gray sand with gravel, shell and silt (SW-SM). One 3" shell excluded from sieve analysis.

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

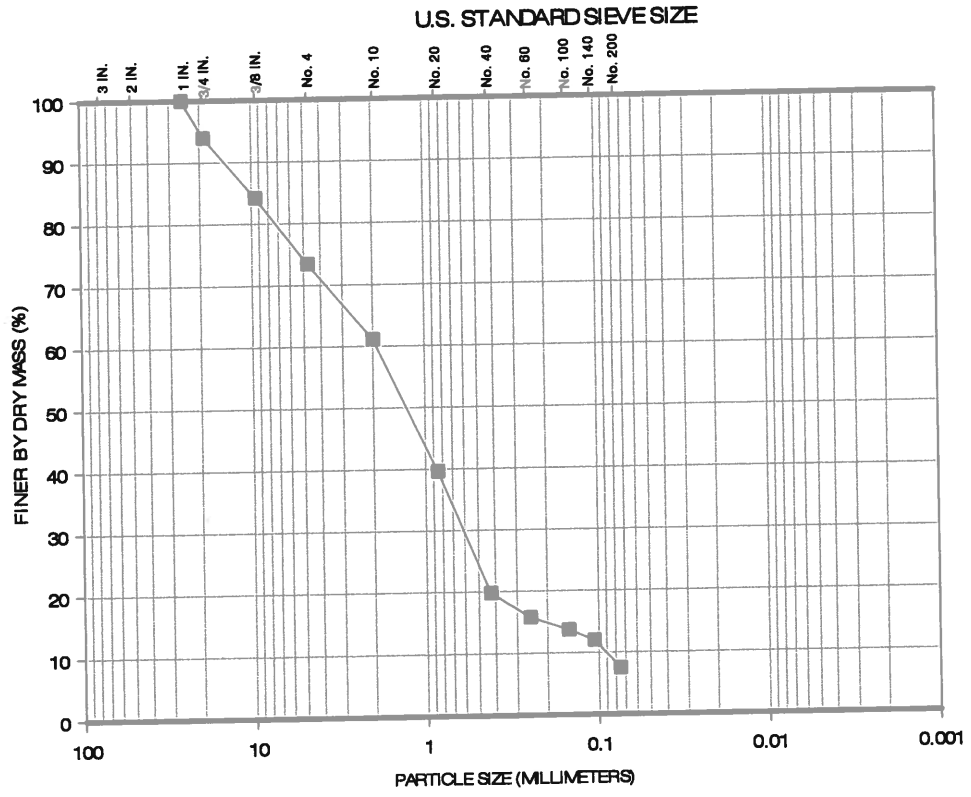
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 12.2
Mass Dry Solids (grams): 437.31

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	94.0	84.2	73.4	61.1	39.6	19.8	15.8	13.7	12.0	7.5	---	---	---

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Checked By: _____ Date: 08/08/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-009** SAMPLE: **2/2** [Block 1]
DEPTH: 0.90 – 1.86 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/009-2/2b1
SAMPLE DESCRIPTION: Dark gray silty sand with shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

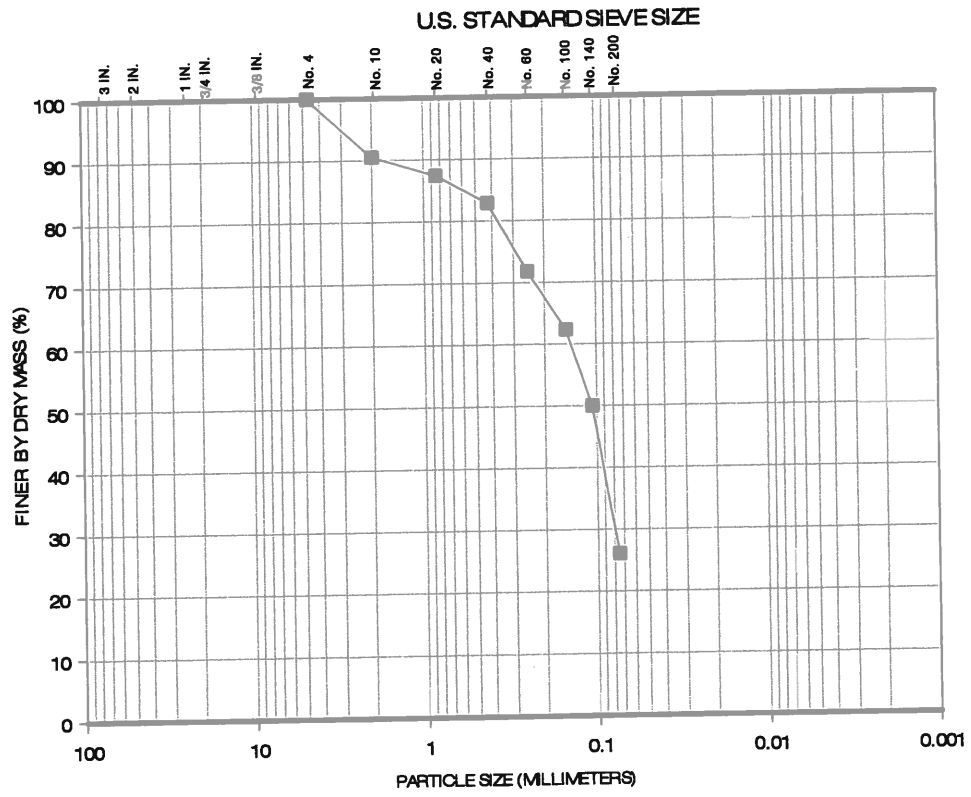
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 21.0
Mass Dry Solids (grams): 189.20

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): 1.0
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	90.5	87.4	82.9	71.8	62.3	50.0	26.1	---	---	---

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Checked By: _____ Date: 08/08/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-009** SAMPLE: **2/2** [Block 2]
DEPTH: 0.90 – 1.86 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/009-2/2b2
SAMPLE DESCRIPTION: Gray silty sand with shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

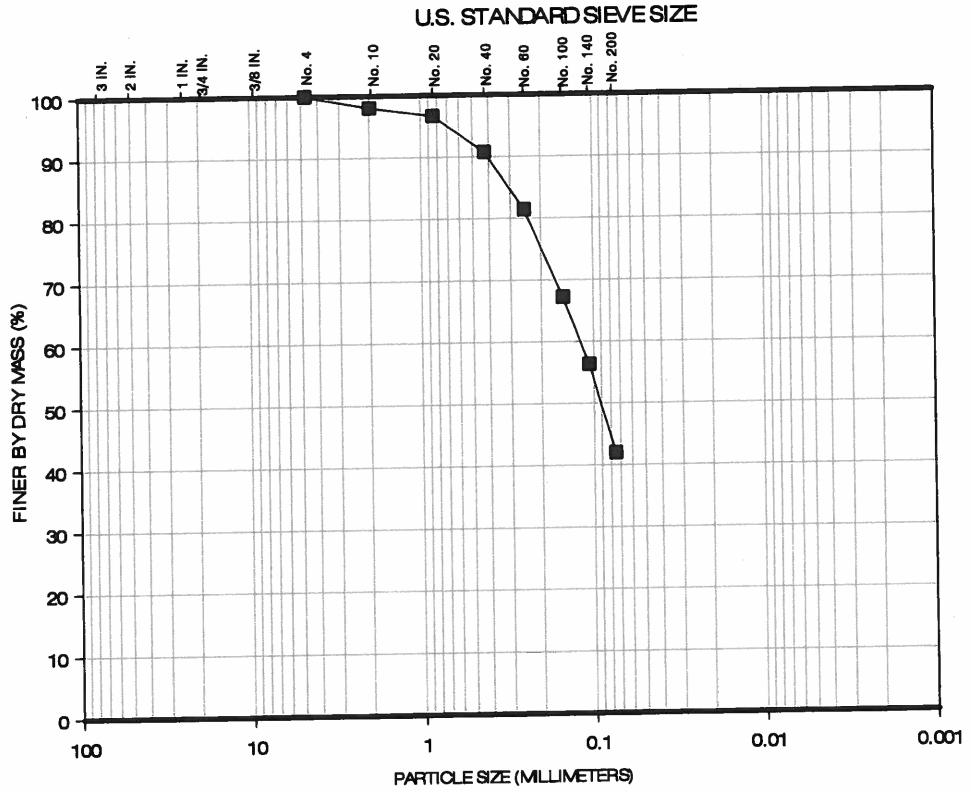
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 15.5
Mass Dry Solids (grams): 175.22

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	98.1	96.7	90.8	81.4	67.2	56.3	42.0	---	---	---

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Checked By: _____ Date: 08/08/13

VOWTAP
File No.: 13-13-0084
August 20, 2013
Revision: 0 (ISSUED FOR USE)

TABLE D-11 EXTRUSION TEST REPORT FOR CORE VC-010

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Soil Corrosion Test Series					
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)					Resistivity (ohm-cm)	Resistivity at w_c (ohm-cm)	pH	Conductivity (µS/cm)	Cl (mg/l)	SO_4 (mg/l)
VC-010	VC-010	1 / 3	0.00 -0.93	93	Tube length less than reported sampling interval.	32.0	9.169	8.5	0.0	23.5	25	24.3	3,061	24.3	Brownish-gray sand with shell	SP	16.6 18.2	17.4	17.4	123.2	105.0	79 [Gs=2.67]										
		2 / 3	0.93 - 1.93	100	Low water contents in upper 85 cm of sample. Sample crumbly where water content low.	100.0	9.146	4.7	0.0	95.3	95	99.9	11,615	99.9	Brown to gray sand with shell	SP	2.9 2.7 9.3 8.8 5.1 8.2 6.1 17.9	7.6	7.6	115.9	107.7	37 [Gs=2.67]	0.7 --- --- ---	0.3 ---	1.1 ---	2.67 ---	160	560	7.29	7,650	2,400	400
		3A / 3	1.93 - 2.35	42	Tube length greater than reported sampling interval. Low water content in upper 15 cm of sample.	53.5	9.154	0.0	0.0	53.5	127	53.8	6,781	53.8	Brown to gray sand with shell	SP	7.0 20.5 16.3	14.6	14.6	120.3	105.0	66 [Gs=2.67]										
		3B/3	2.35 - 2.90	55	Low water content in upper 15 cm of sample. Sample crumbly in upper 15 cm.	55.2	9.147	7.0	0.0	48.2	88	46.8	5,784	22.6	Brown sand with shell	SP	4.2 11.5 13.5	9.7	17.3	114.1	97.2	65 [Gs=2.67]	1.6									
														24.2	Dark gray silty sand with shell and lenses of clay	SM	31.5 21.4 20.2	24.4					16.2									

13-13-0084
VC-010
1/3
TOP→
AE141

13-13-0084
VC-010
3A/3
SWANSON
AE141

13-13-0084
VC-010
3B/3
TOP→
AE141

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-010** SAMPLE: **2/3** [Block 1]
DEPTH: 0.93– 1.93 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/010-2/3
SAMPLE DESCRIPTION: Brown sand with shell (SP)

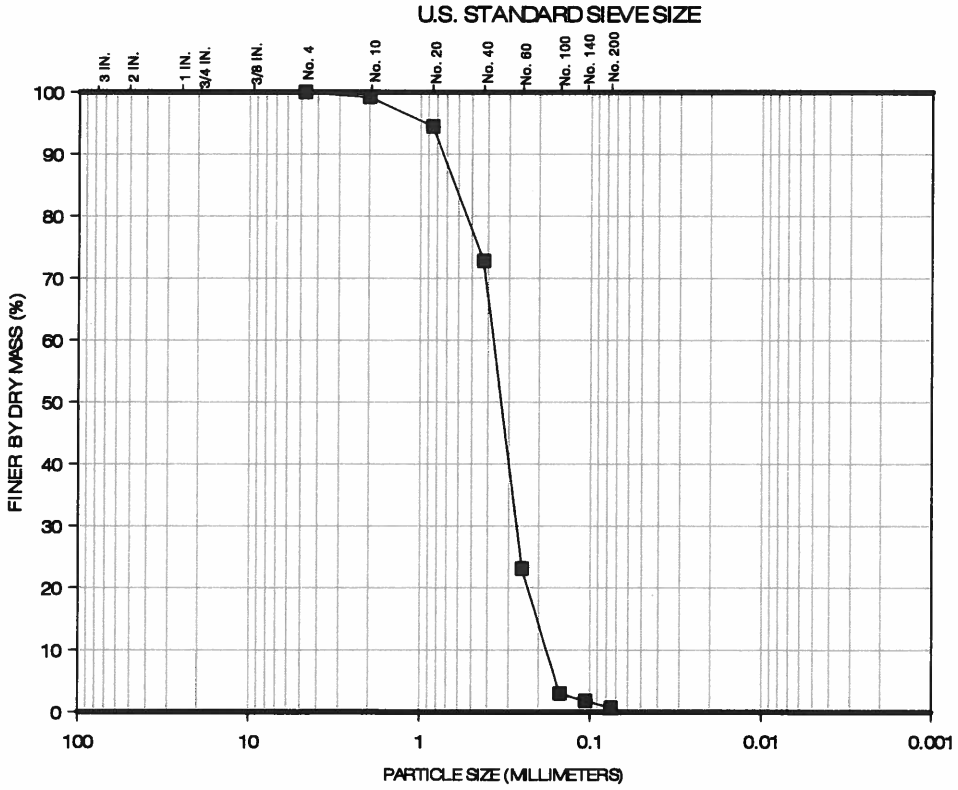
TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____
Dispersion Device: ☐ Apparatus A ☐ Apparatus B
Dispersion Period (hours): _____

Water Content (%): 9.3
Mass Dry Solids (grams): 138.59
G_s: 2.67 ☐ Assumed ☒ Measured
Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.2	94.5	72.8	23.1	3.0	1.8	0.7	---	---	---

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Checked By: _____ Date: 08/08/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-010** SAMPLE: **3B/3** [Block 1]
DEPTH: 0.93– 1.93 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/010-3B/3b1
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

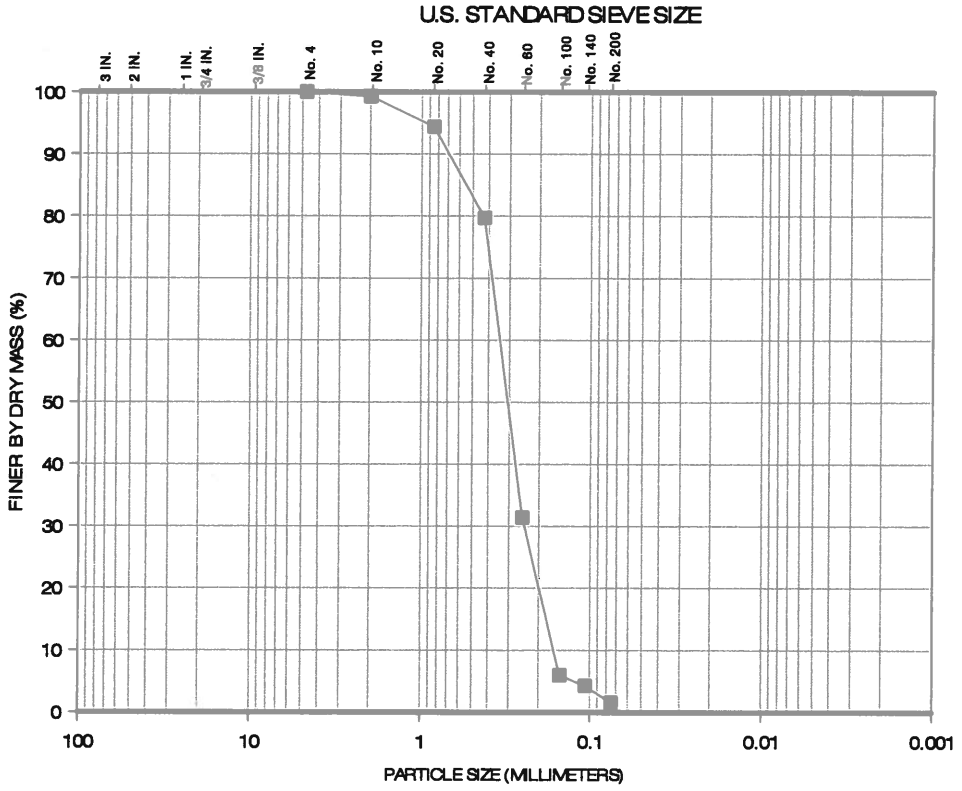
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 11.5
Mass Dry Solids (grams): 123.69

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.3	94.4	79.7	31.4	6.0	4.3	1.6	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 08/08/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-010** SAMPLE: **3B/3** [Block 2]
DEPTH: 0.93– 1.93 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/010-3B/3b2
SAMPLE DESCRIPTION: Dark gray silty sand with shell (SM)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

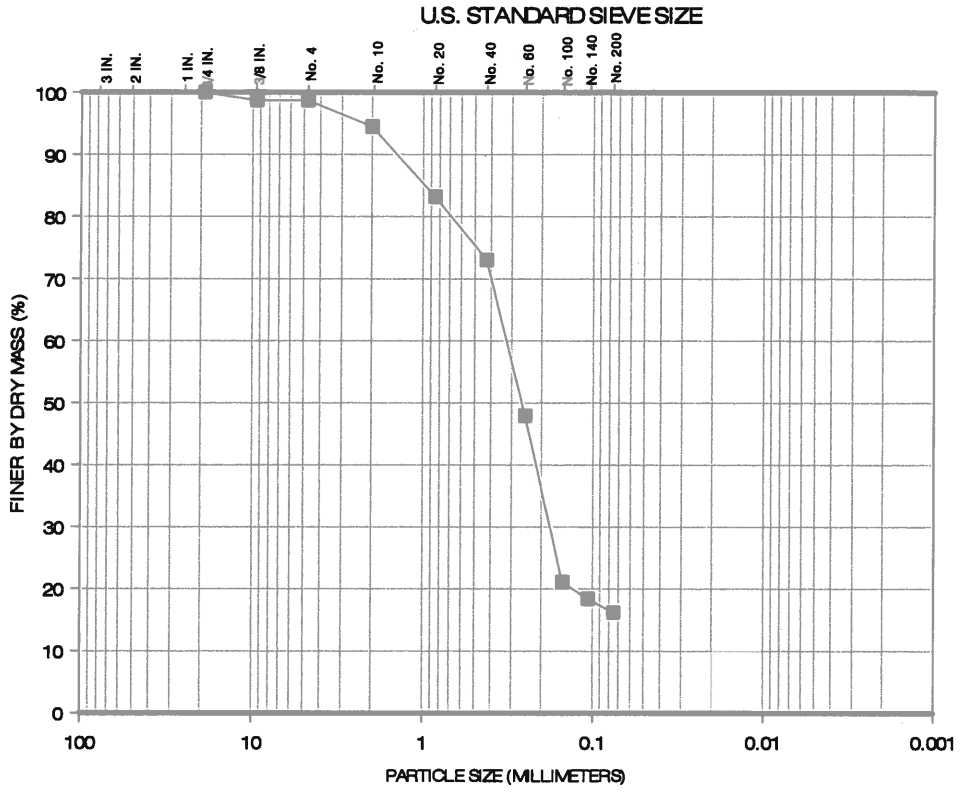
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 21.4
Mass Dry Solids (grams): 158.69

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	98.7	98.7	94.5	83.2	73.0	47.9	21.1	18.4	16.2	---	---	---

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Checked By: _____ Date: 08/08/13

VOWTAP
File No.: 13-13-0084
August 20, 2013
Revision: 0 (ISSUED FOR USE)

TABLE D-12 EXTRUSION TEST REPORT FOR CORE VC-011

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Soil Corrosion Test Series					
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)					Resistivity (ohm-cm)	Resistivity at w_c (ohm-cm)	pH	Conductivity (µS/cm)	Cl (mg/l)	SO_4 (mg/l)
VC-011	VC-011	1 / 3	0.0 - 0.83	83	Tube length greater than reported sampling interval. Water content low in upper portion of sample. Void in soil along tube wall from 0 cm to 41.8 cm from top of sample. Voids throughout exterior of lower portion of sample. Sample not sufficiently intact for determining tube density.	100.1	9.160	14.0	0.0	86.1	104	88.0	10,370	88.0	Gray and brown sand with trace shell [lens of gray clay between 73 cm and 77 cm]	SP	4.7 20.5 22.9 22.7 22.5	18.7	18.7	Not Applicable. Voids within tube.			3.7									
		2 / 3	0.83 - 1.83	100	Void in soil along tube wall from 0 cm to 44.5 cm from top of sample. Voids throughout exterior of lower portion of sample. Sample not sufficiently intact for determining tube density. Approximately 25 cc of free water drained from bottom of tube.	99.8	9.149	7.5	0.0	92.3	92	90.0	10,362	30.2	Brownish-gray sand with shell	SP	19.3 21.1 20.3 19.7 19.4 22.7	20.4	22.3	Not Applicable. Voids within tube.			4.6 --- ---	0.5 --- ---	1.7 --- ---	2.69 --- ---	40	60	7.32	14,420	4,800	1,080
														19.0	Dark gray silty sand with clay lenses and shell	SM	26.1	26.1													
														40.8	Gray silty sand with shell	SM	21.7 22.3	22.0													
		3 /3	1.83 - 2.83	100	Approximately 2.0 cm of free water (130 grams) on top of sample. Top cap on sample labeled 9 cm removed.	96.4	9.145	4.0	0.0	92.4	92	93.9	12,808	74.5	Dark gray sand with silt and shell	SP-SM	20.0 17.9 18.0 17.3 19.8 21.4 20.2	19.2	19.3	131.8	110.5	99 [Gs=2.70]	8.4 --- ---	0.6 --- ---	1.5 --- ---	2.70 --- ---	50	50	7.64	13,350	4,800	950
														15.0	Brown sand with gravel	SP	---	---													
														4.4	Gray lean clay	CL	20.3	20.3													

13-13-0084
VC-0011
1/3
TOP→
SWANSON
AE141

13-13-0084
VC-0011
1/3
TOP→
SWANSON®
AE141

CONVERSIONS
inches x 25.4 = millimeters
inches x 2.54 = centimeters
feet x 30.48 = centimeters
feet x 0.3048 = meters
yards x 0.9144 = meters
miles x 1.609344 = kilometers
SWANSON
13-13-0084
VC-0011
2/3

13-13-0084
VC-0011
3/3
TOP→
CONVERSIONS
inches x 25.4 = millimeters
inches x 2.54 = centimeters
feet x 30.48 = centimeters
feet x 0.3048 = meters
yards x 0.9144 = meters
miles x 1.609344 = kilometers
SWANSON

13-13-0084
VC-0011
3/3
TOP→

13-13-008
VC-0011
3/3
TOP→

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-011** SAMPLE: **1/3** [Block 1]
DEPTH: 0.0 – 0.83 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/011-1/3
SAMPLE DESCRIPTION: Gray sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

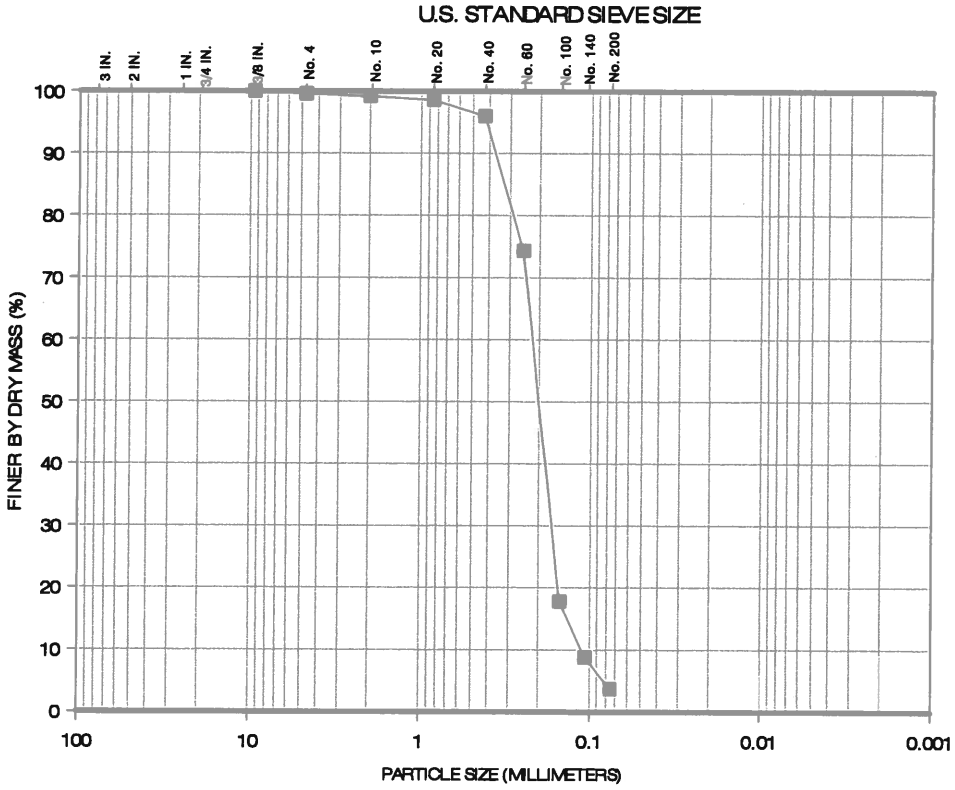
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 22.9
Mass Dry Solids (grams): 130.55

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.6	99.2	98.6	96.0	74.3	17.8	8.8	3.7	---	---	---

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Checked By: _____ Date: 08/08/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-011** SAMPLE: **2/3** [Block 1]
DEPTH: 0.83 – 1.83 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/011-2/3
SAMPLE DESCRIPTION: Brownish-gray sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

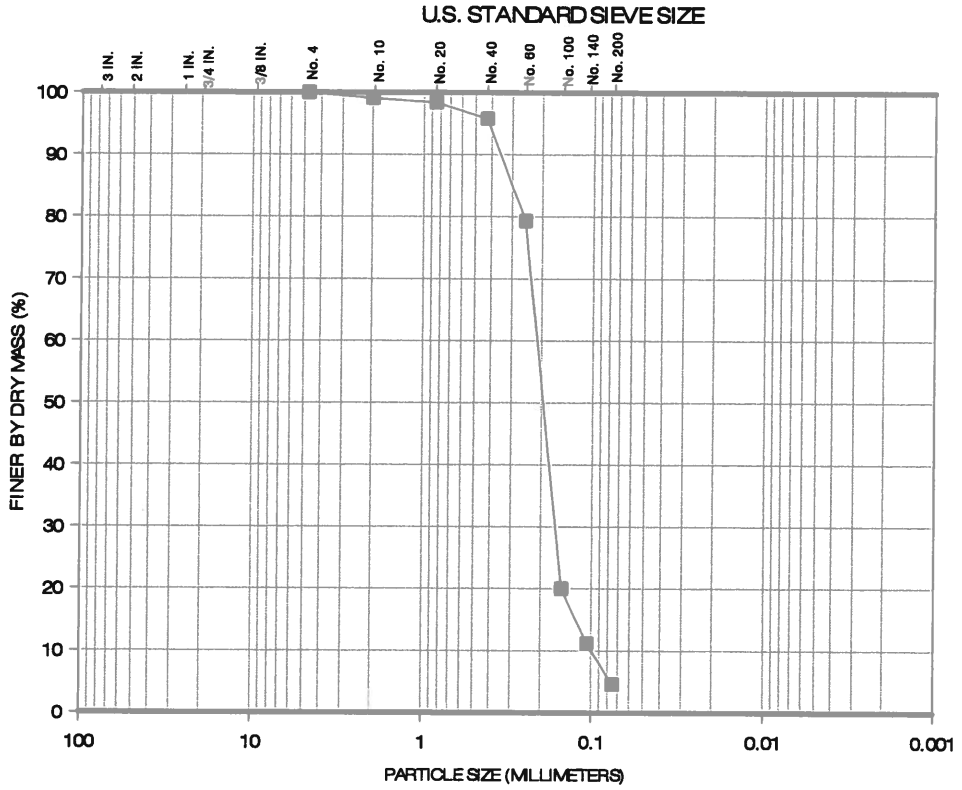
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 21.1
Mass Dry Solids (grams): 222.57

G_s: 2.69 ☐ Assumed ☒ Measured

Organic Content (%): 0.5
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.1	98.4	95.8	79.3	20.0	11.2	4.6	---	---	---

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Checked By: _____ Date: 08/08/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/08/13

INCOMING SAMPLE NO.: ---
BORING: **VC-011** SAMPLE: **3/3** [Block 1]
DEPTH: 1.83 – 2.83 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/011-3/3
SAMPLE DESCRIPTION: Dark gray sand with silt and shell (SP-SM)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

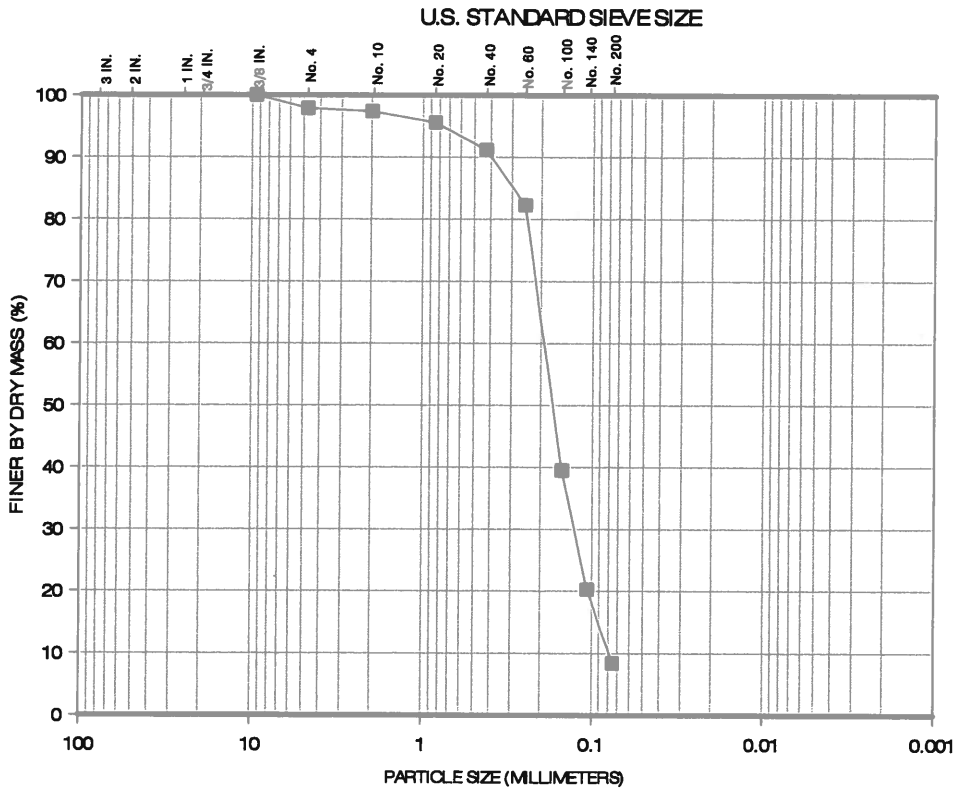
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 17.9
Mass Dry Solids (grams): 112.64

G_s: 2.70 ☐ Assumed ☒ Measured

Organic Content (%): 0.6
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	97.9	97.4	95.6	91.2	82.3	39.5	20.3	8.4	---	---	---

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Checked By: _____ Date: 08/08/13

VOWTAP
File No.: 13-13-0084
August 20, 2013
Revision: 0 (ISSUED FOR USE)

TABLE D-13 EXTRUSION TEST REPORT FOR CORE VC-012

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Soil Corrosion Test Series					
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)					Resistivity (ohm-cm)	Resistivity at w_c (ohm-cm)	pH	Conductivity (µS/cm)	Cl (mg/l)	SO_4 (mg/l)
VC-012	VC-012	1 / 2	0.00 - 1.20	120	Tube length less than reported sampling interval. Water content low in upper portion of sample. Void in soil along tube wall from 0 cm to 66.8 cm from top of sample. Voids throughout exterior of lower portion of sample. Sample not sufficiently intact for determining tube density.	95.8	9.142	2.2	0.0	93.6	78	96.0	11,143	96.0	Brownish-gray to dark gray sand	SP	3.8 10.7 20.1 19.8 19.2	14.7	14.7	Not Applicable. Voids within tube.			1.9										
		2 / 2	1.20 - 2.20	100	Small voids throughout sample. Water content low in upper portion of sample.	99.0	9.145	5.0	0.0	94.0	94	96.5	11,803	96.5	Gray to brown sand with trace shell	SP	4.2 15.0 12.7 13.8 10.4 15.4 19.7 21.0 21.6	14.9	14.9	119.4	104.0	65 [Gs=2.69]	1.2 -- ---	0.4 --- ---	1.0 --- ---	2.69 --- ---	100	150	7.54	11,320	3,600	750

13-13-0084
VC-012
1/2
TOP↔
NITS AND SYMBOLS
mm) = 1 meter(m)
100 centimeters (cm) = 1 meter (m)
1000 meters (m) = 1 Kilometer (km)
CONVERSIONS
inches x 25.4 = millimeters
inches x 2.54 = centimeters
feet x 30.48 = centimeters
feet x 0.3048 = meters
yards x 0.9144 = meters
miles x 1.609344 = kilometers

13-13-0084
VC-012
1/2
SWANSON
AE141
CONVERSIONS
inches x 25.4 = millimeters
inches x 2.54 = centimeters
feet x 30.48 = centimeters
feet x 0.3048 = meters
yards x 0.9144 = meters
miles x 1.609344 = kilometers

13-13-0084
VC-012
1/2
TOP→
SWANSON®
AE141

13-13-0084
VC-012
1/2
TOP→
SWANSON
AE141
SWANSON TOOL CO. INC
211 ONTARIO STREET
FRANKFORT IL 60423 USA

13-13-0084

VC-012

2/2

TOP

13-13-0084
VC-012
2/2

13-13-0084
VC-012
2/2

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-012** SAMPLE: **1/2** [Block 1]
DEPTH: 0.0 – 1.20 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/012-1/2
SAMPLE DESCRIPTION: Dark gray sand (SP)

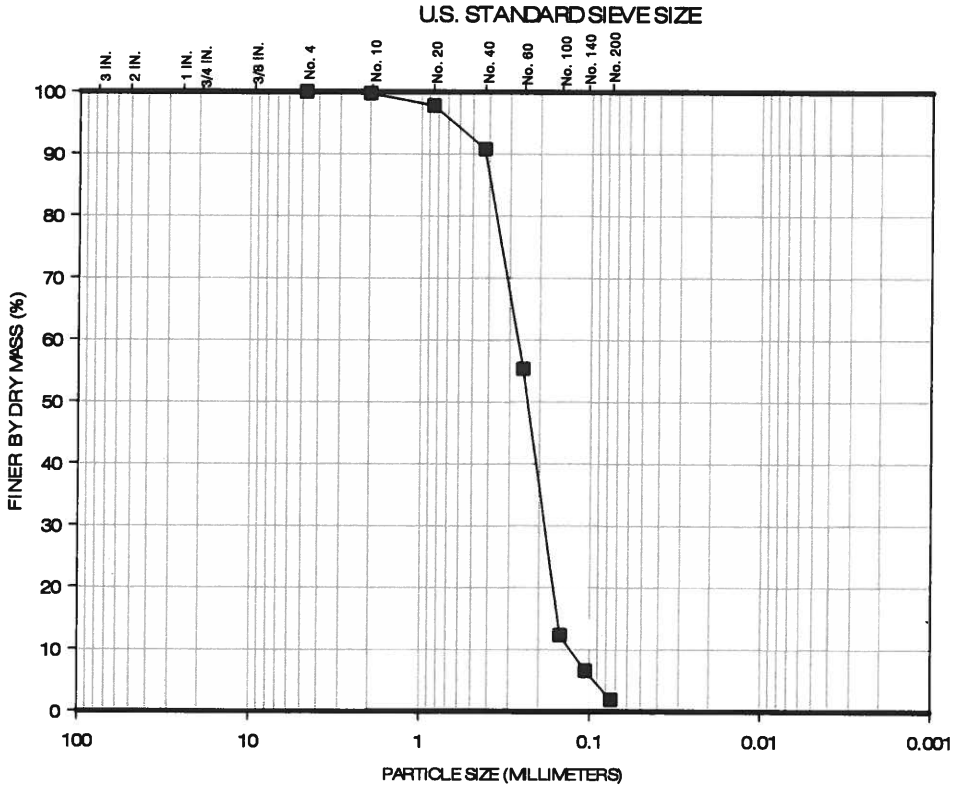
TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____
Dispersion Device: ☐ Apparatus A ☐ Apparatus B
Dispersion Period (hours): _____

Water Content (%): 19.8
Mass Dry Solids (grams): 173.07
G_s: --- ☐ Assumed ☐ Measured
Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.8	97.8	90.8	55.3	12.3	6.6	1.9	---	---	---

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Checked By: _____ Date: 08/12/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-012** SAMPLE: **2/2** [Block 1]
DEPTH: 1.20 – 2.20 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/012-2/2
SAMPLE DESCRIPTION: Gray sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

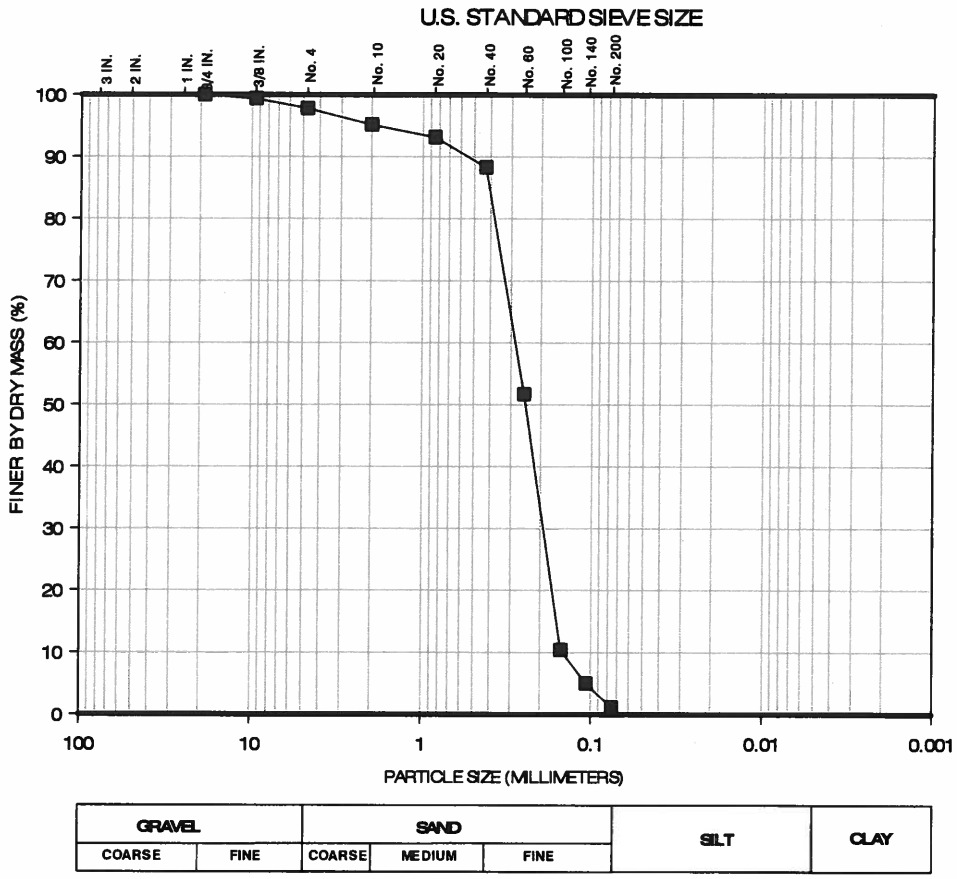
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 15.0
Mass Dry Solids (grams): 224.98

G_s: 2.69 ☐ Assumed ☒ Measured

Organic Content (%): 0.4
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	99.4	97.8	95.2	93.2	88.3	51.7	10.4	5.0	1.2	---	---	---

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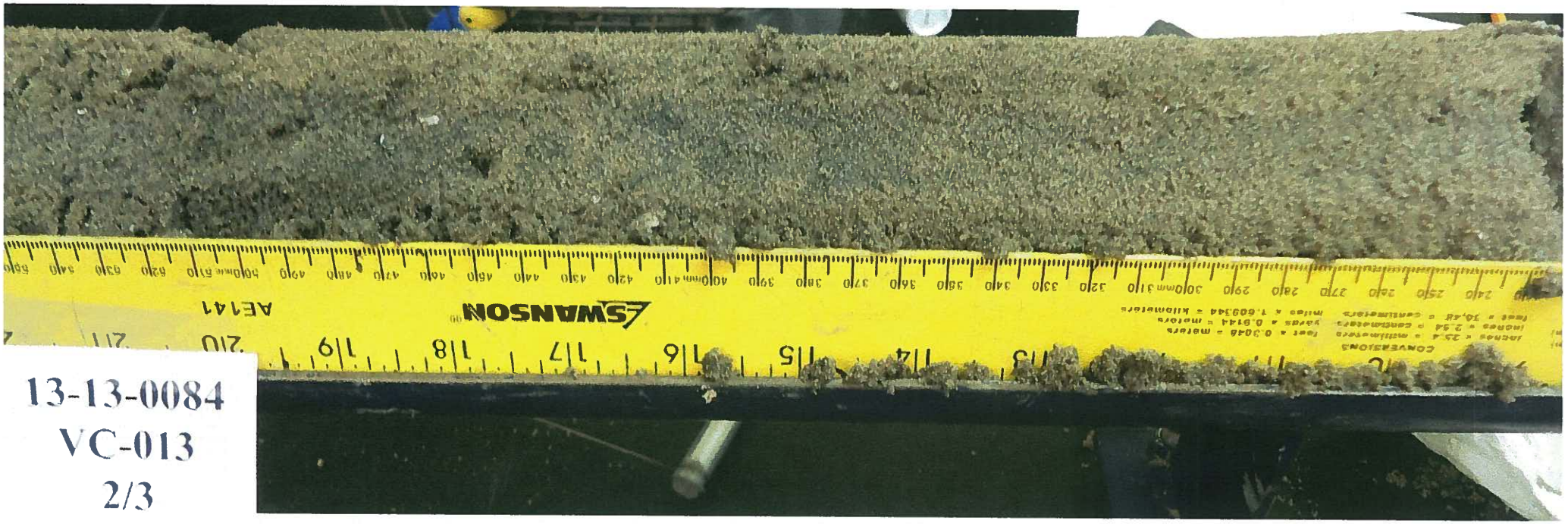
Checked By: _____ Date: 08/12/13

VOWTAP
File No.: 13-13-0084
August 20, 2013
Revision: 0 (ISSUED FOR USE)

TABLE D-14 EXTRUSION TEST REPORT FOR CORE VC-013

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Soil Corrosion Test Series					
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)					Resistivity (ohm-cm)	Resistivity at w_c (ohm-cm)	pH	Conductivity (µS/cm)	Cl (mg/l)	SO_4 (mg/l)
VC-013	VC-013	1 / 3	0.00 - 0.48	48	Water content low in upper portion of sample. Void in soil along tube wall from 17.0 cm to 27.0 cm from top of sample.	48.0	9.136	1.5	0.0	46.5	97	47.0	5,597	16.0	Grayish-brown sand with shell	SP	11.0 18.9	15.0	28.0	114.7	89.6	86 [Gs=2.70]	1.2									
														11.0	Grayish-brown silty sand with shell	SM	18.6	18.6														
														9.0	Gray fat clay with clayey sand lenses and shell	CH	70.5	70.5														
														11.0	Dark gray silty sand with shell	SM	21.7	21.7														
		2 / 3	0.48 - 1.48	100	Water content low in upper portion of sample. Void in soil along tube wall from 0 cm to 77.5 cm from top of sample. Sample not sufficiently intact for determining tube density.	100	9.147	1.5	0.0	98.5	99	99.6	11,780	99.6	Grayish-brown sand with trace shell	SP	6.0 4.7 11.0 9.9 12.5 14.1 15.7 21.1 22.8	13.1	13.1	Not Applicable. Voids within tube.				--- --- 1.9	0.3 ---	0.9 ---	2.67 ---	100	210	7.54	11,160	3,000	710
		3 / 3	1.48 - 2.45	97	Water content low in upper portion of sample. Soil crumbly where water content low. Void in soil along tube wall from 70.5 cm to 82.5 cm from top of sample. Voids throughout upper portion of sample. Sample not sufficiently intact for determining tube density.	96.0	9.151	5.5	0.0	90.5	93	93.7	10,769	93.7	Brown to dark gray sand with trace shell	SP	3.3 6.4 18.5 20.1 22.9	14.2	14.2	Not Applicable. Voids within tube.				1.9									

13-13-0084
VC-013
1/3
TOP→
SWANSON
AE141



13-13-0084
VC-013
2/3

13-13-0084
VC-013
2/3
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
MADE IN CHINA

SWANSON
AE141
13-13-0084
VC-013
2/3

13-13-0084
VC-013
3/3
TOP→

13-13-00
VC-013
3/3
TOP→
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA

SWANSON
AE141
13-13-0084
VC-013
3/3

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-013** SAMPLE: **1/3** [Block 1]
DEPTH: 0.0 – 0.48 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/013-1/3
SAMPLE DESCRIPTION: Grayish-brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

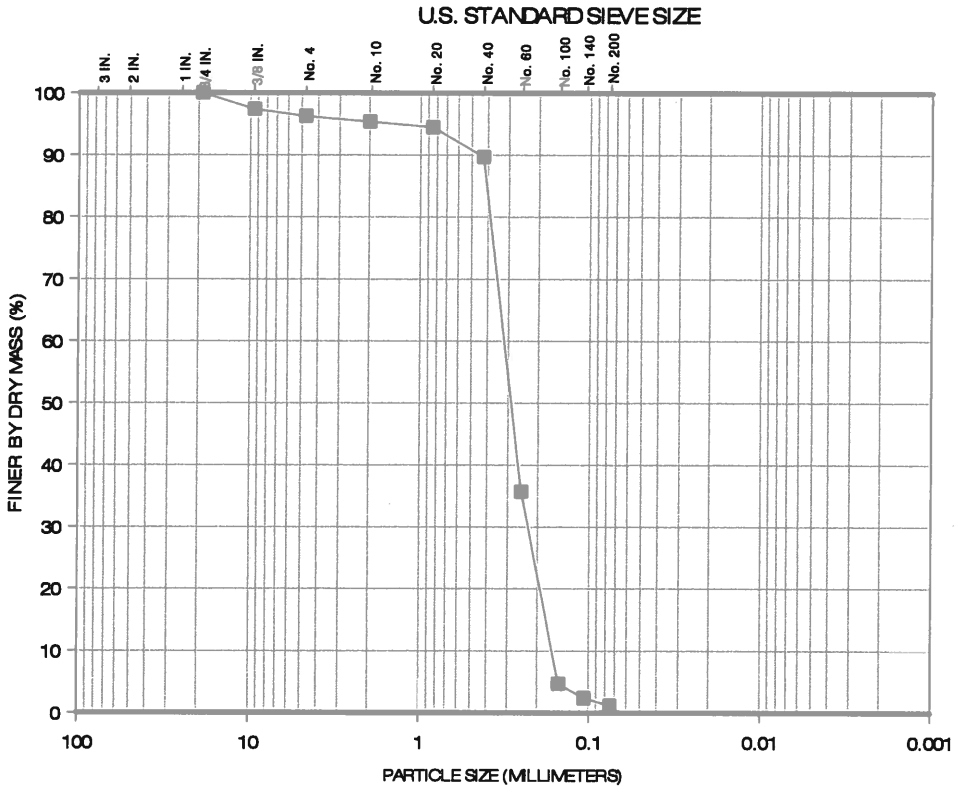
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 18.9
Mass Dry Solids (grams): 307.48

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	97.4	96.3	95.4	94.5	89.7	35.7	4.7	2.4	1.2	---	---	---

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Checked By: _____ Date: 08/12/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/15/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-013** SAMPLE: **2/3** [Block 1]
DEPTH: 0.48 – 1.48 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/013-2/3
SAMPLE DESCRIPTION: Grayish-brown sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

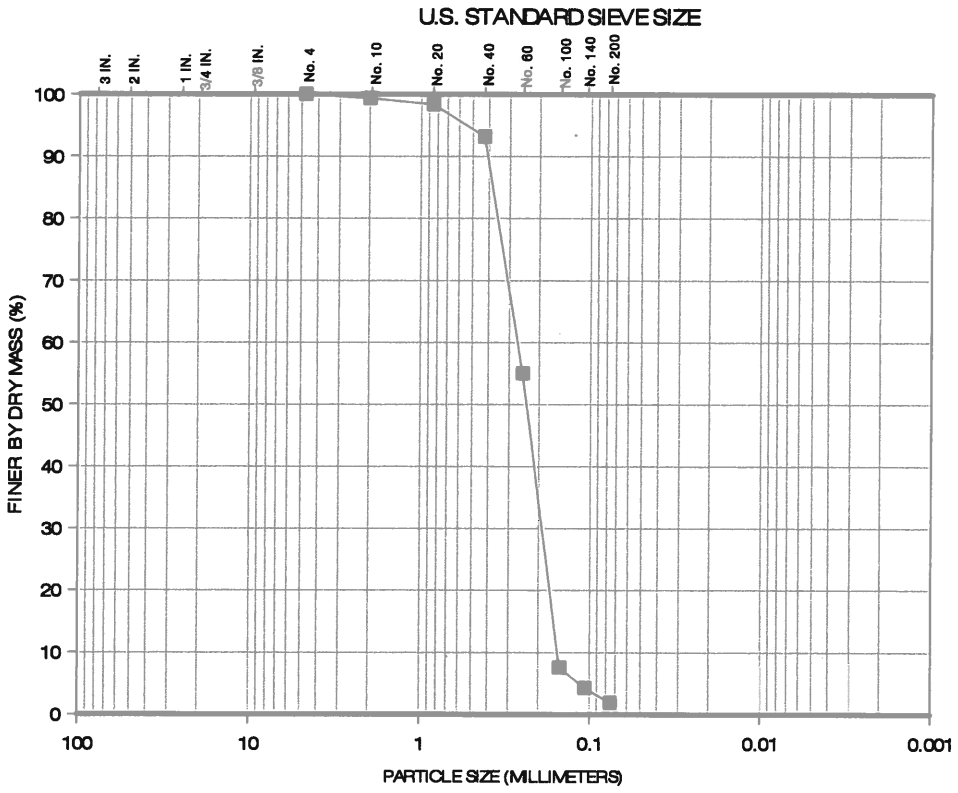
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 14.1
Mass Dry Solids (grams): 152.41

G_s: 2.67 ☐ Assumed ☒ Measured

Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.4	98.4	93.2	55.0	7.6	4.3	1.9	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 08/12/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-013** SAMPLE: **3/3** [Block 1]
DEPTH: 1.48 – 2.45 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/013-3/3
SAMPLE DESCRIPTION: Gray sand with trace shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

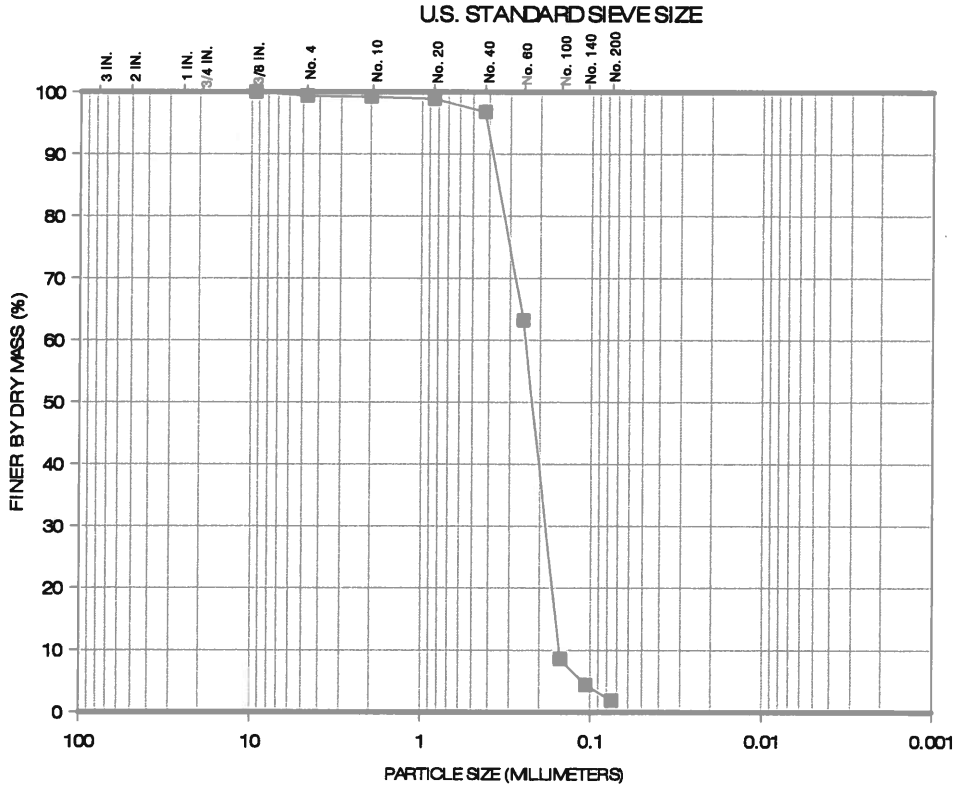
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 18.5
Mass Dry Solids (grams): 206.44

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.4	99.2	98.9	96.8	63.2	8.6	4.4	1.9	---	---	---

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Checked By: _____ Date: 08/12/13

VOWTAP
File No.: 13-13-0084
September 23, 2013
Revision: 0 (ISSUED FOR USE) 08/20/13
Revision: 1 (Add data to 2/3)

TABLE D-15 EXTRUSION TEST REPORT FOR CORE VC-014

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Soil Corrosion Test Series					
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)					Resistivity (ohm-cm)	Resistivity at w_c (ohm-cm)	pH	Conductivity (µS/cm)	Cl (mg/l)	SO_4 (mg/l)
VC-014	VC-014	1 / 3	0.00 - 0.68	68	Tube length greater than reported sampling interval. Water content low in upper portion of sample. Soil crumbly where water content low. Voids throughout exterior of sample. Sample not sufficiently intact for determining tube density.	100.2	9.156	25.2	0.0	75.0	110	76.2	9,151	48.3	Brown sand with trace shell	SP	4.9 6.3 10.9 18.3	10.1	14.3	Not Applicable. Voids within tube.			0.7									
														27.9	Dark gray sand with trace shell	SP	21.7	21.7														
		2 / 3	0.68 - 1.68	100	Small voids throughout exterior of sample	98.0	9.138	0.0	0.0	98.0	98	101.1	10,999	101.1	Brown and gray sand with shell	SP	6.8 5.5 9.6 11.0 10.6 11.9 15.9 21.3	11.6	11.6	106.9	95.8	42 [Gs=2.67]	1.7 --- ---	0.3 --- ---	4.6 --- ---	2.67 --- ---	90	260	7.81	9,790	3,000	730
		3 / 3	1.68 - 2.64	96	Water content low in upper portion of sample. Void in soil along tube wall from 0 cm to 30.2 cm from top of sample. Voids throughout exterior of lower portion of sample. Sample not sufficiently intact for determining tube density.	96.0	9.149	9.8	0.0	86.2	90	85.0	10,164	85.0	Gray and brown sand with shell	SP	9.9 14.9 19.6 20.0 23.7	17.6	17.6	Not Applicable. Voids within tube.			1.4									

13-13-0084
VC-014
1/3
TOP→
SWANSON

13-13-0084
VC-014
1/3
TOP→
SWANSON®
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA

SWANSON
AE141
13-13-0084
VC-014
2/3

13-13-0084
VC-014
2/3

13-13-0084
VC-014
2/3
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA

13-13-0084
VC-014
3/3
TOP→
SWANSON
AE141

13-13-0084
VC-014
3/3
TOP→
SWANSON

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-014** SAMPLE: **1/3** [Block 1]
DEPTH: 0.0 – 0.68 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/014-1/3
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

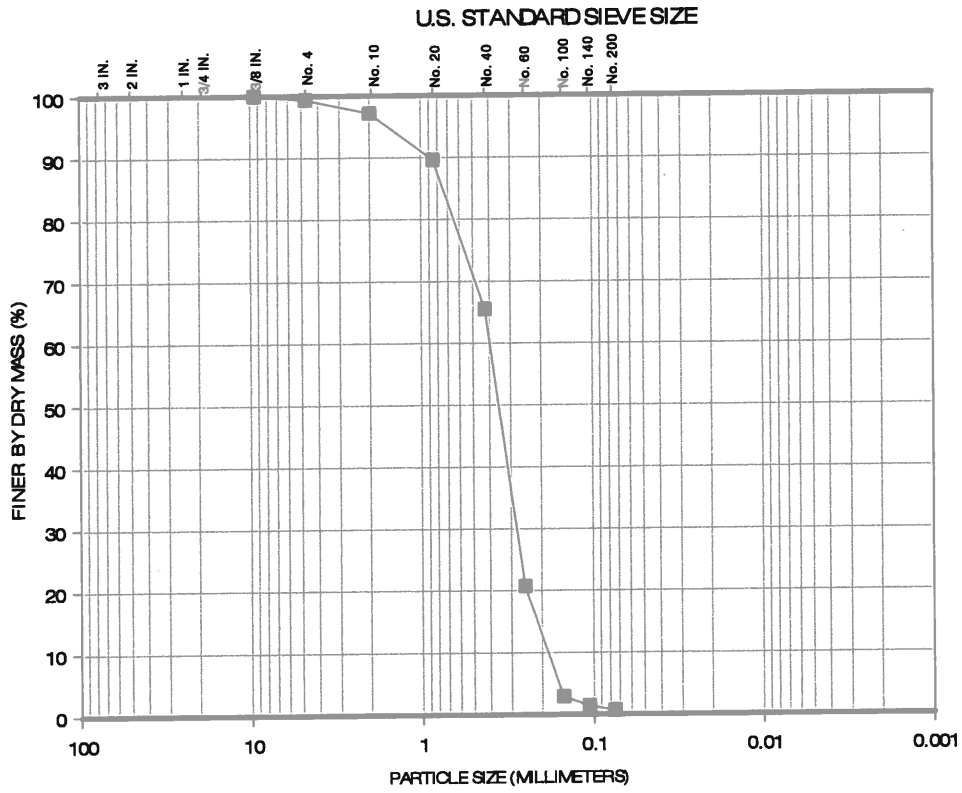
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 10.9
Mass Dry Solids (grams): 292.34

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.4	97.2	89.6	65.5	20.7	2.9	1.4	0.7	---	---	---

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Checked By: _____ Date: 08/12/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-014** SAMPLE: **2/3** [Block 1]
DEPTH: 0.68 – 1.68 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/014-1/3
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

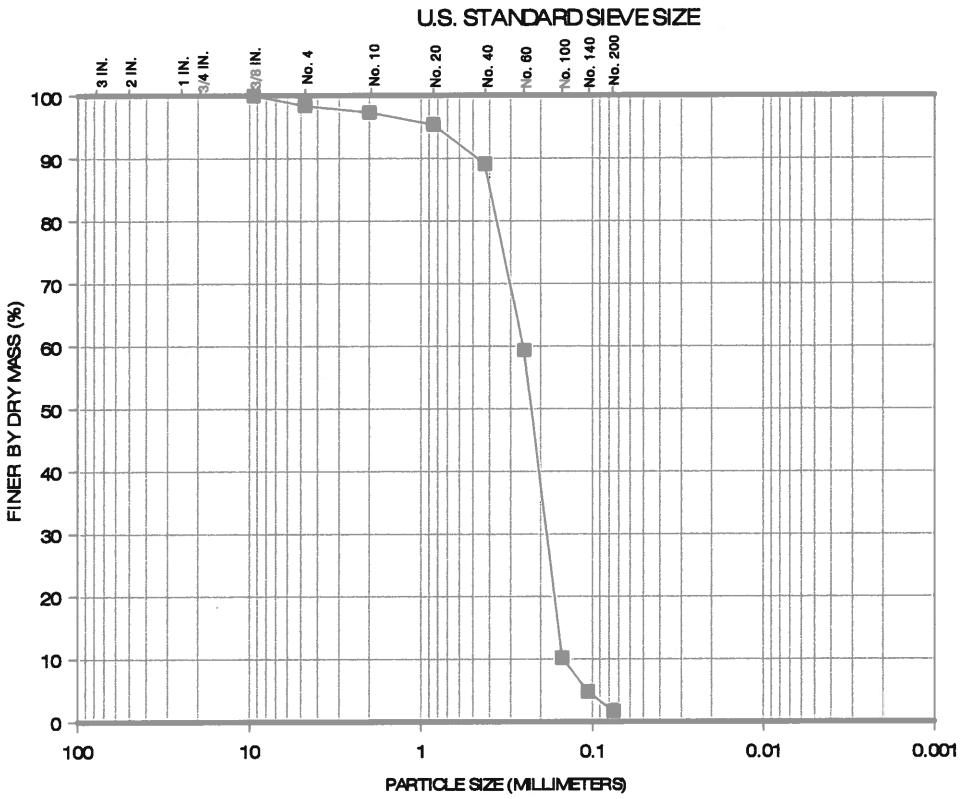
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 9.6
Mass Dry Solids (grams): 152.33

G_s: 2.67 ☐ Assumed ☒ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	98.4	97.3	95.4	89.1	59.3	10.2	4.8	1.7	---	---	---

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Checked By: _____ Date: 08/12/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/30/13
DATE TEST SET-UP: 07/11/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-014** SAMPLE: **3/3** [Block 1]
DEPTH: 1.68 – 2.64 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/014-3/3
SAMPLE DESCRIPTION: Gray sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

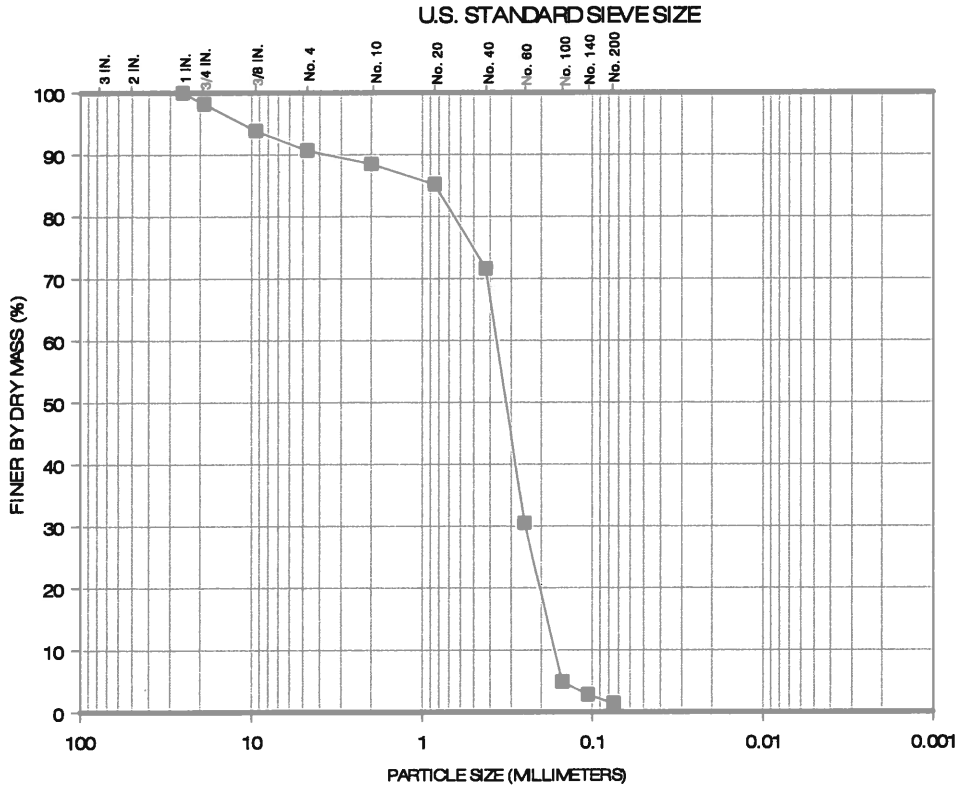
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 20.0
Mass Dry Solids (grams): 545.76

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	98.2	93.9	90.7	88.5	85.2	71.6	30.5	4.9	2.8	1.4	---	---	---

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Checked By: TW Date: 08/12/13

VOWTAP
File No.: 13-13-0084
August 20, 2013
Revision: 0 (ISSUED FOR USE)

TABLE D-16 EXTRUSION TEST REPORT FOR CORE VC-015

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Soil Corrosion Test Series					
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)					Resistivity (ohm-cm)	Resistivity at w_c (ohm-cm)	pH	Conductivity (µS/cm)	Cl (mg/l)	SO_4 (mg/l)
VC-015	VC-015	1 / 2	0.00 - 0.68	68	Tube length less than reported sampling interval. Water content low in upper portion of sample.	57.3	9.145	2.5	0.0	54.8	81	56.7	7,071	14.5	Brown sand with shell	SP	5.2	5.2	15.1	122.7	106.6	72 [Gs=2.67]	0.8									
														42.2	Gray sand with shell	SP	14.6 18.1 20.5 20.9	18.5													
		2 / 2	0.68 - 1.64	96	Water content low in upper portion of sample. One small void between 74 and 76 cm from top of sample.	93.7	9.148	6.0	0.0	87.7	91	88.0	11,326	22.0	Brown sand with shell	SP	6.6	6.6	16.4	122.7	105.5	75 [Gs=2.67]	1.4 --- ---	0.3 ---	2.4 ---	2.67 ---	15	50	7.62	15,070	4,800	970
														66.0	Gray sand with shell	SP	15.7 19.6 21.0 19.8 20.6 20.6 20.2	19.6													

13-13-0084
VC-015
1/2
→
TOP
SWANSON
AE141

TOP

→

1/2

VC-015

13-13-008

13-13-0084
VC-015
2/2
→
TOP
SWANSON®
AE141

13-13-0084
VC-015
2/2
→
TOP

13-13-0084

VC-015

2/2

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/07/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-015** SAMPLE: **1/2** [Block 1]
DEPTH: 0.0 - 0.68 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/015-1/2
SAMPLE DESCRIPTION: Gray sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

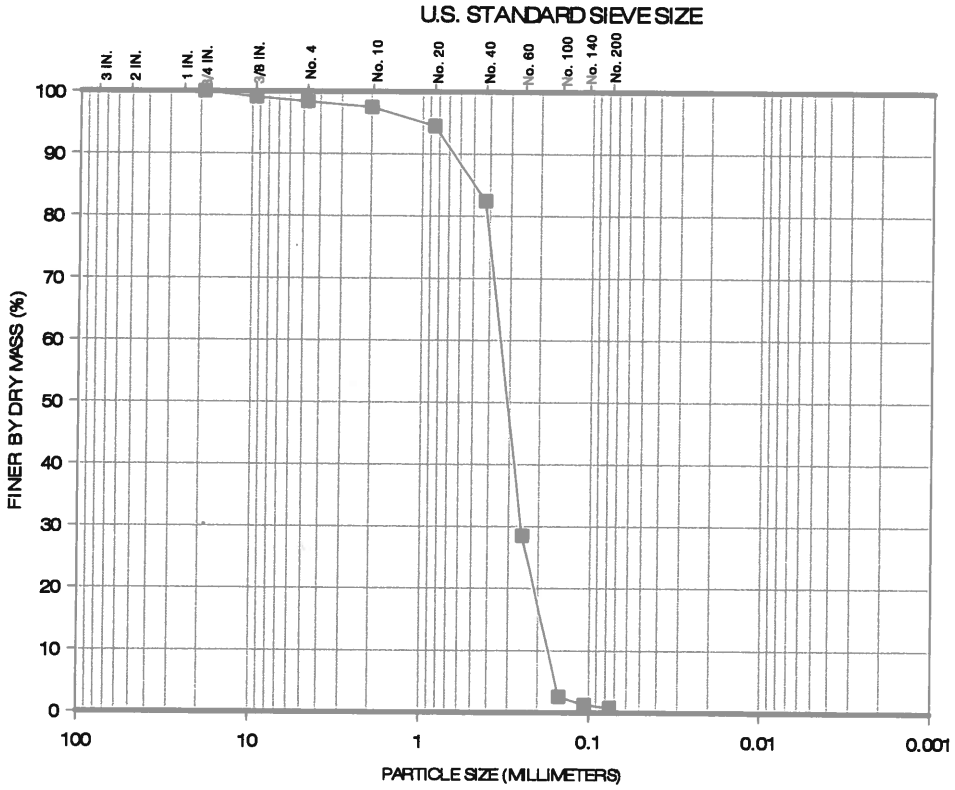
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 18.1
Mass Dry Solids (grams): 435.11

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	99.1	98.4	97.5	94.5	82.4	28.5	2.6	1.3	0.8	---	---	---

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Checked By: _____ Date: 08/12/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/07/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-015** SAMPLE: **2/2** [Block 1]
DEPTH: 0.68 - 1.64 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/015A-2/2
SAMPLE DESCRIPTION: Gray sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

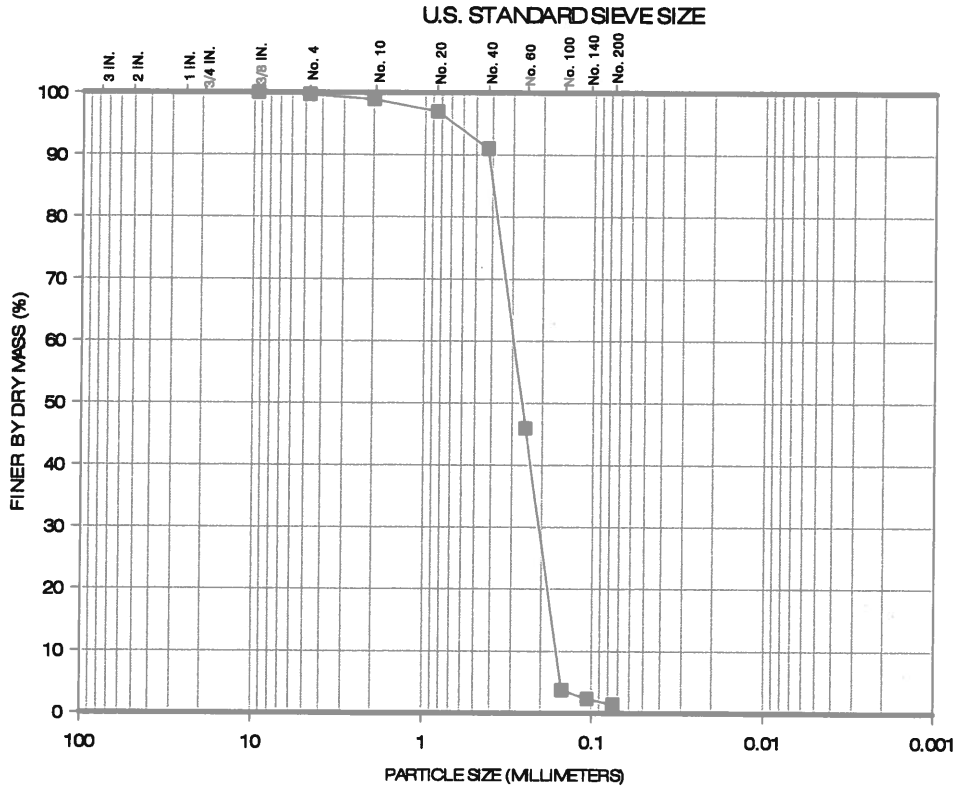
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 19.6
Mass Dry Solids (grams): 150.03

G_s: 2.67 ☐ Assumed ☒ Measured

Organic Content (%): 0.3
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.7	98.9	97.0	91.0	45.9	3.7	2.3	1.4	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 08/12/13

VOWTAP
File No.: 13-13-0084
August 20, 2013
Revision: 0 (ISSUED FOR USE)

TABLE D-17 EXTRUSION TEST REPORT FOR CORE VC-015A

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Soil Corrosion Test Series					
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)					Resistivity (ohm-cm)	Resistivity at w_c (ohm-cm)	pH	Conductivity (µS/cm)	Cl (mg/l)	SO_4 (mg/l)
VC-015	VC-015A	1 / 2	0.00 - 0.68	68	Water content low in upper portion of sample.	65.5	9.151	2.5	0.0	63.0	93	64.3	7,722	32.5	Brown sand with shell	SP	2.9 6.8 11.8	7.2	14.4	116.4	101.7	61 [Gs=2.66]	0.5									
														31.8	Gray sand with shell	SP	21.7 22.0	21.9														
		2 / 2	0.68 - 1.64	96	Water content low in upper portion of sample.	95.9	9.145	5.5	0.0	90.4	94	92.0	11,798	92.0	Brown and gray sand with shell	SP	13.4 18.9 19.5 20.0 21.5 20.1 20.3 20.8	19.3	19.3	124.1	104.0	86 [Gs=2.66]	1.0 --- --- ---	0.2 ---	1.6 ---	2.66 ---	10	50	7.62	13,150	4,200	900

13-13-0084
VC-015A
1/2
→
TOP
SWANSON
AE141
CONVERSIONS

TOP
←
1/2
VC-015A
13-13-0084
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
MADE IN CHINA
AE141

13-13-0084
VC-015A
2/2
→
TOP

13-13-008
VC-015A
2/2
→
TOP
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
MADE IN CHINA

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/07/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-015A** SAMPLE: **1/2** [Block 1]
DEPTH: 0.0 - 0.68 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/002B-1/2
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

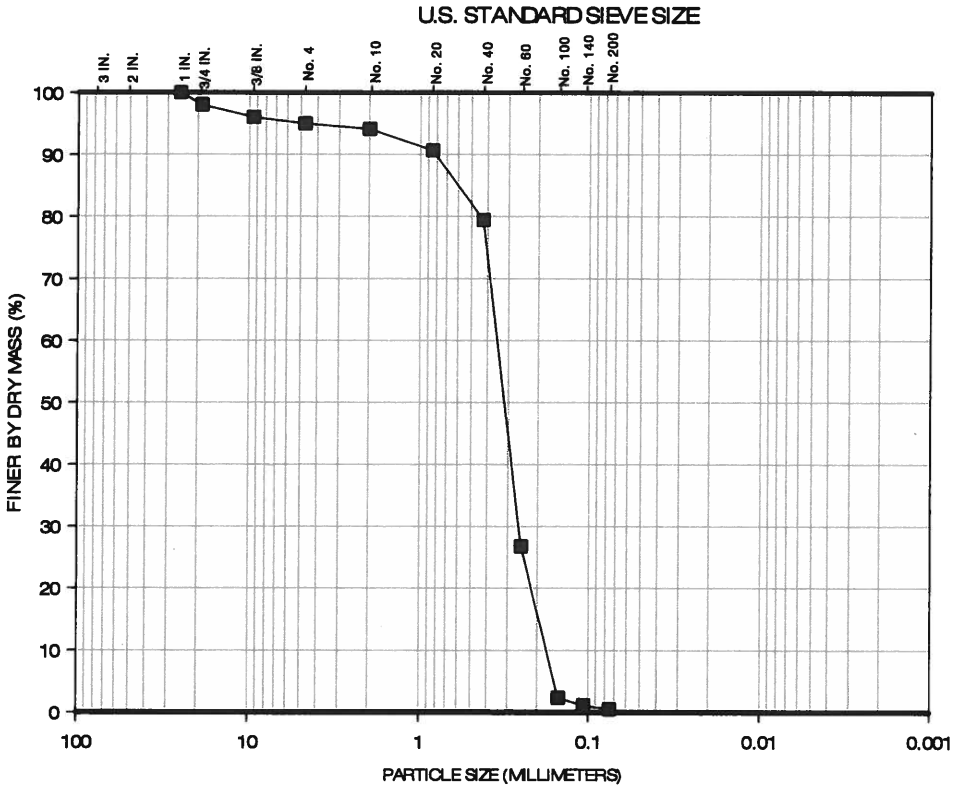
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 6.8
Mass Dry Solids (grams): 513.52

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	98.0	96.0	95.0	94.1	90.6	79.4	26.7	2.3	1.1	0.5	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: TM Date: 08/12/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/07/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-015A** SAMPLE: **2/2** [Block 1]
DEPTH: 0.68 - 1.64 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/015A-2/2
SAMPLE DESCRIPTION: Brown sand with shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

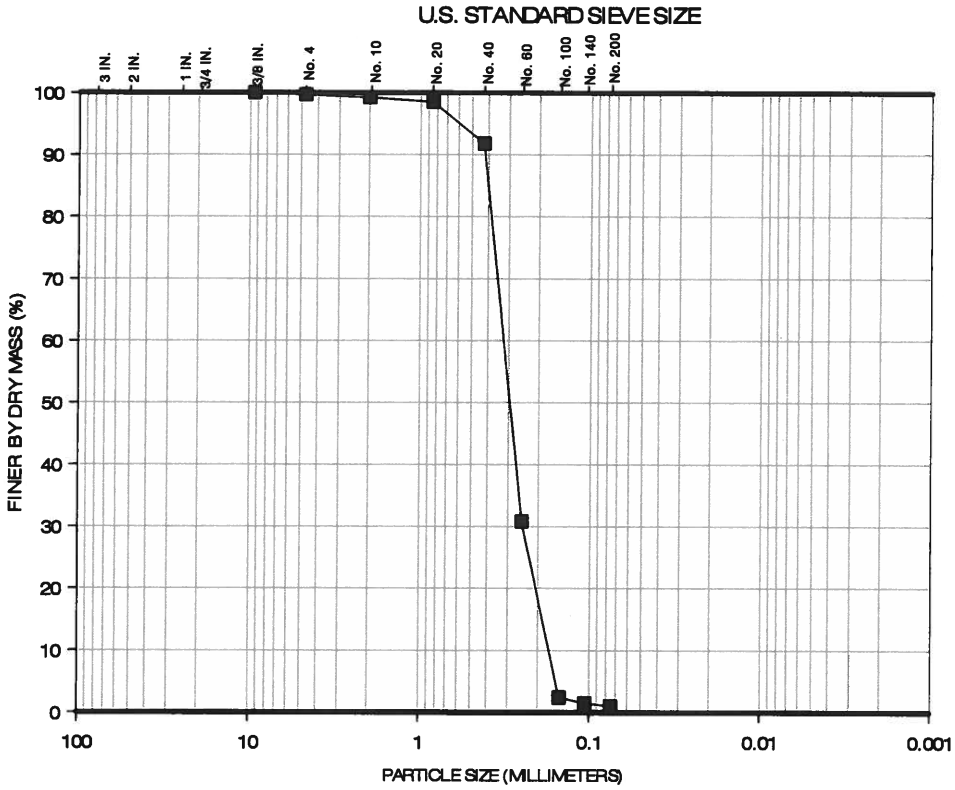
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 19.5
Mass Dry Solids (grams): 258.35

G_s: 2.66 ☐ Assumed ☒ Measured

Organic Content (%): 0.2
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.7	99.2	98.5	91.8	30.8	2.4	1.5	1.0	---	---	---

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Checked By: _____ Date: 08/12/13

VOWTAP
File No.: 13-13-0084
September 23, 2013
Revision: 0 (ISSUED FOR USE) 08/20/13
Revision: 1 (Add data to 4/5)

TABLE D-18 EXTRUSION TEST REPORT FOR CORE VC-016

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Soil Corrosion Test Series						Atterberg Limits			Strength Index Tests	
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft³)	Dry Density (lb/ft³)	Saturation (%)					Resistivity (ohm-cm)	Resistivity at w_c (ohm-cm)	pH	Conductivity (µS/cm)	Cl (mg/l)	SO4 (mg/l)	Liquid Limit, LL	Plastic Limit, PL	Plasticity Index, PI	s_u[TV] (kg/cm²)	s_u[LV] (kg/cm²)
VC-016	VC-016	1 / 5	0.00 - 0.78	78	Tube length greater than reported sampling interval. Approximately 3.6 cm of standing water (240 grams) on top of sample. H_2S odor.	99.7	9.142	29.3	0.0	70.4	90	71.7	9,248	7.7	Dark gray sand with clay, gravel and shell	SP-SC	14.1	14.1	24.2	125.0	100.7	97 [Gs=2.70]														
														24.0	Dark gray clayey sand with lenses of gray clay with organics	SC	26.1	26.1																		
														21.0	Dark gray sand	SP	23.9	23.9																		
														19.0	Dark gray clayey sand with lenses of gray clay with organics	SC	21.8 27.2 27.0 28.2	26.1					28.3 ---	1.0	---	---	---	---	---	---	---	25	12	13		
		2 / 5	0.78 - 1.78	100	None	100.3	9.138	2.5	0.0	97.8	98	100.5	13,226	82.5	Dark gray sand with clay lenses and trace shell	SC	25.7 21.1 21.4 20.8 23.1 21.3 23.8	22.5	20.3	128.8	107.1	97 [Gs=2.70]	12.3 --- ---	0.7 ---	0.5 ---	---	95	97	7.63	10,640	4,800	1,140					
														18.0	Gray and brown sand with gravel and shell and gray clay lenses	SP	11.5 9.2	10.4					3.5													
		3 / 5	1.78 - 2.78	100	Water content low in upper portion of sample.	100.3	9.136	1.0	0.0	99.3	99	99.0	13,473	24.0	Dark gray sand with gravel and gray clay lenses	SP	8.1	8.1	9.7	129.3	117.9	63 [Gs=2.66]														
														46.0	Brown sand	SP	6.4 4.7 7.0	6.0					2.3													
														29.0	Gray sand with lenses of gray clayey sand	SP	18.3 15.1	16.7																		
		4 / 5	2.78 - 3.78	100	None	99.7	9.132	2.5	0.0	97.2	97	98.0	12,902	53.3	Gray sand with lenses of gray clay	SP-SC	15.8 17.0 16.4 16.6 17.8	16.7	25.7	125.6	99.9	100 [Gs=2.71]	6.2 ---	0.3	0.5	2.66											
														44.7	Dark gray lean clay s_u[UU]= 0.24 kg/cm²	CL	38.9 33.1 35.5 36.3 37.6 37.1 36.4	36.4					--- --- --- --- 96.6 ---	--- --- --- --- --- ---	--- --- 2.9 --- --- ---	--- --- --- --- --- ---	--- --- --- --- --- ---	--- --- --- --- --- ---	--- --- --- --- --- ---	--- --- --- --- --- ---	--- --- --- --- --- ---	--- --- --- --- --- ---	--- --- --- 43 --- ---	--- --- --- 22 --- ---	--- --- --- 21 --- ---	0.25 0.45 --- --- --- 0.30	--- --- --- --- --- ---
		5 / 5	3.78 - 4.71	93	None	92.8	9.141	0.0	0.0	92.8	100	92.5	11,841	58.5	Dark gray lean clay	CL	34.2 34.6 33.0 31.9 33.4 32.7	33.3	28.7	121.8	94.7	97 [Gs=2.76]	--- --- --- 85.9	--- --- 2.2	--- --- --- ---	--- --- 2.76 ---	--- --- --- ---	--- --- --- ---	--- --- --- ---	--- --- --- ---	--- --- --- ---	--- --- --- ---	--- --- --- ---	--- --- --- 35	--- --- --- 17	--- --- --- 19	0.30 0.25 --- ---	--- --- --- ---
														34.0	Dark gray sandy lean clay with trace shell	CL	22.5 18.9	20.7																		

SWANSON
AE141
13-13-0084
VC-016
1/5
→
TOP

TOP
13-13-0084
VC-016
1/5
SWANSON TOOL CO. INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
AE141

13-13-0084
VC-016
2/5
→
TOP

TOP
2/5
VC-016
13-13-0084
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
MADE IN CHINA

TOP
S/S
VC-016
13-13-0084
AE141
SWANSON TOOL CO. INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
MADE IN CHINA

METRIC UNITS AND SYMBOLS
millimeters (mm) = 1 meter(m)
100 centimeters (cm) = 1 meter (m)
1000 meters (m) = 1 kilometer (km)
CONVERSIONS
inches x 25.4 = millimeters
inches x 2.54 = centimeters
feet x 30.48 = centimeters
feet x 0.3048 = meters
yards x 0.9144 = meters
miles x 1.609344 = kilometers
SWANSON
13-13-0084
VC-016
4/5
→
TOP

13-13-0084
VC-016
4/5

SWANSON®
AE141

TOP
←
4/5
VC-016
13-13-00
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
MADE IN CHINA

13-13-0084
VC-016
5/5
→
TOP
SWANSON
AE141

13-13-0084
VC-016
5/5
→
TOP
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/18/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-016** SAMPLE: **1/5** [Block 2]
DEPTH: 0.0 - 0.78 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/016-1/5
SAMPLE DESCRIPTION: Dark gray clayey sand (SC)

TEST PROCEDURES

ASTM Standard D422:
☐ Sieve Analysis
☐ Hydrometer Analysis
☒ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☒ Sodium Hexametaphosphate ☐ Other_____

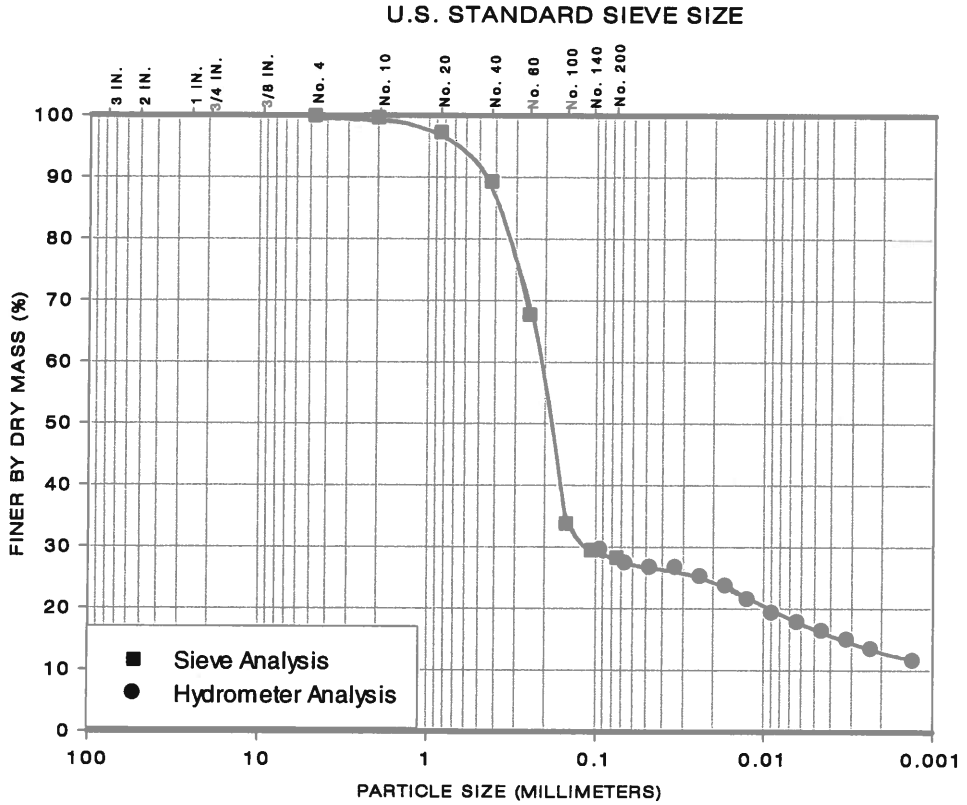
Dispersion Device: ☒ Apparatus A ☐ Apparatus B

Dispersion Period (hours): >24

Water Content (%): 27.2
Mass Dry Solids (grams): 67.04

G_s: 2.70 ☒ Assumed ☐ Measured

Organic Content (%): 1.0
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.7	97.3	89.3	67.7	33.8	29.5	28.3	16.7	12.9	10.9

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Checked By: _____ Date: 08/12/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/07/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-016** SAMPLE: **2/5** [Block 1]
DEPTH: 0.78 - 1.78 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/016-2/5
SAMPLE DESCRIPTION: Dark gray clayey sand with trace shell (SC)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

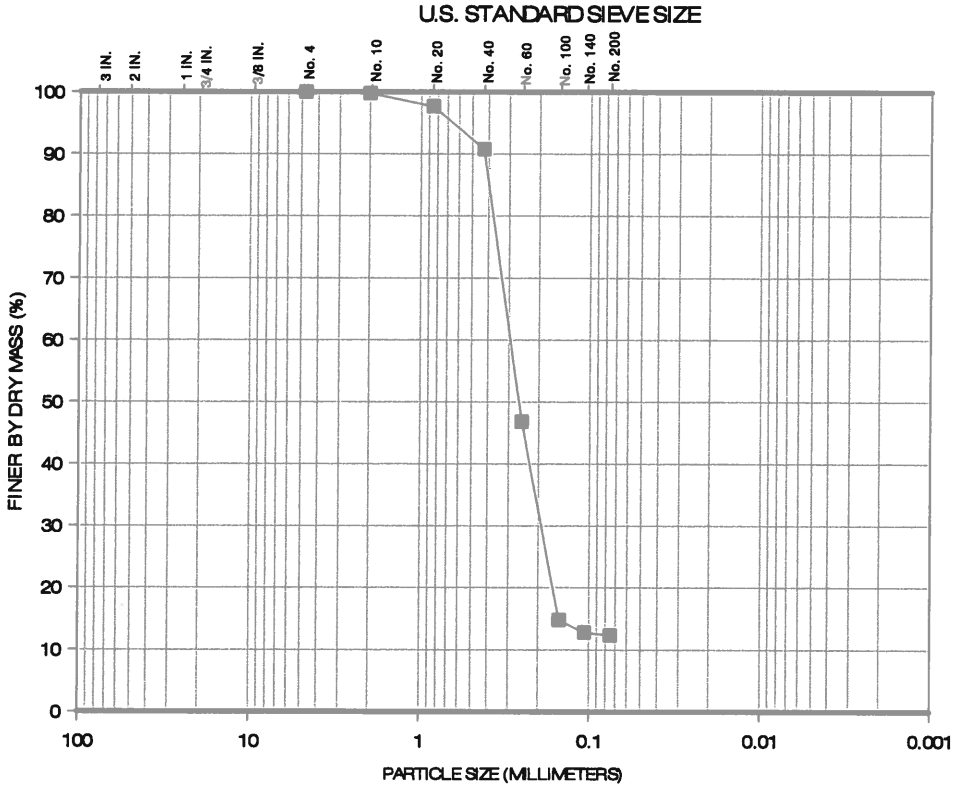
☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____
Dispersion Device: ☐ Apparatus A ☐ Apparatus B
Dispersion Period (hours): _____

Water Content (%): 21.4
Mass Dry Solids (grams): 156.36

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): 0.7
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.8	97.7	90.8	46.8	14.8	12.8	12.3	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 08/12/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/07/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-016** SAMPLE: **2/5** [Block 2]
DEPTH: 0.78 - 1.78 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/016-2/5
SAMPLE DESCRIPTION: Gray sand with gravel and shell (SP)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

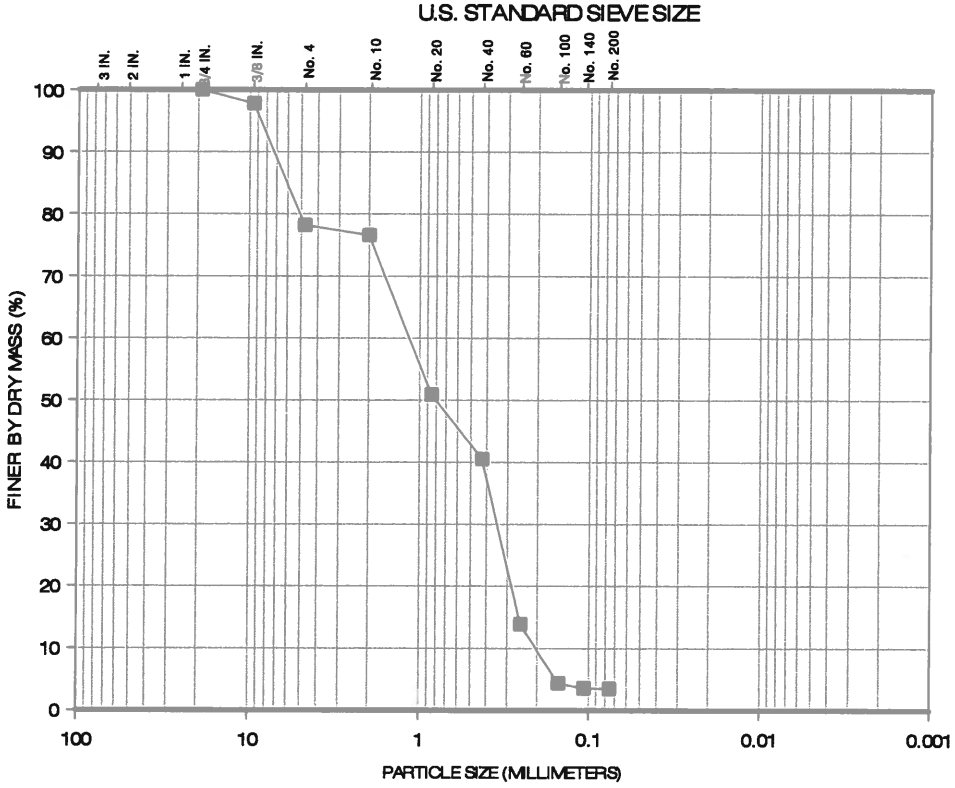
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 11.5
Mass Dry Solids (grams): 825.34

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	97.8	78.2	76.6	50.9	40.5	13.9	4.4	3.6	3.5	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 08/12/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/07/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-016** SAMPLE: **3/5** [Block 1]
DEPTH: 1.78 - 2.78 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/016-3/5
SAMPLE DESCRIPTION: Brown sand (SP)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

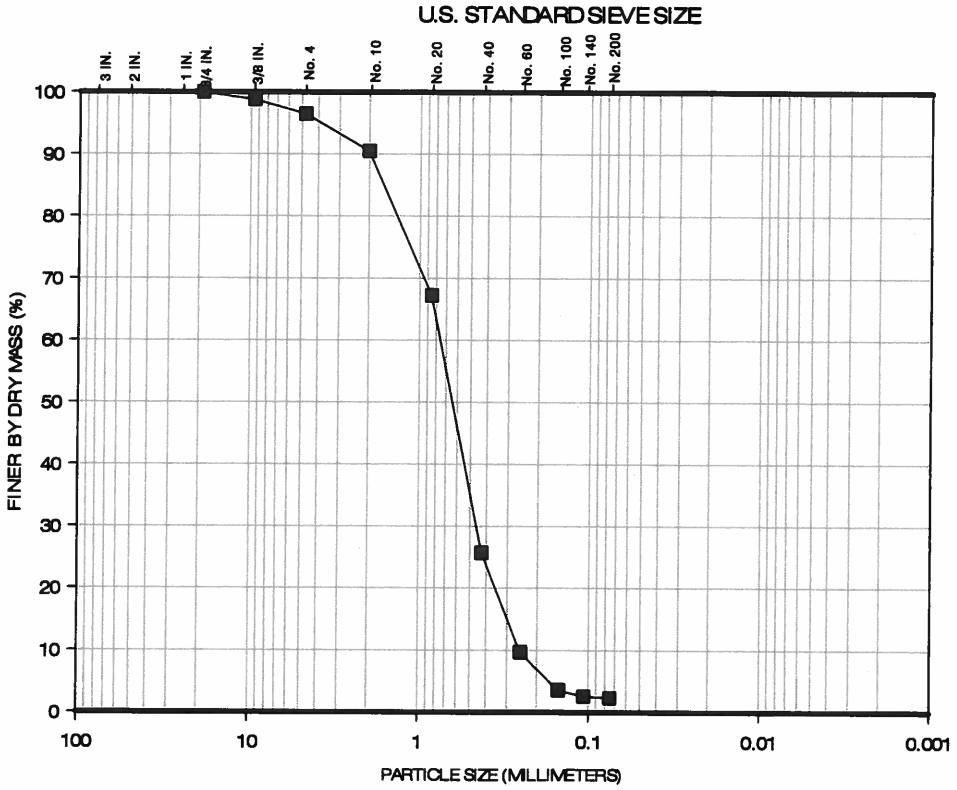
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 7.0
Mass Dry Solids (grams): 253.00

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	98.8	96.5	90.5	67.2	25.7	9.7	3.6	2.6	2.3	---	---	---

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Checked By: _____ Date: 08/12/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/07/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-016** SAMPLE: **4/5** [Block 1]
DEPTH: 2.78 - 3.78 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/016-4/5
SAMPLE DESCRIPTION: Gray sand with clay (SP-SC)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

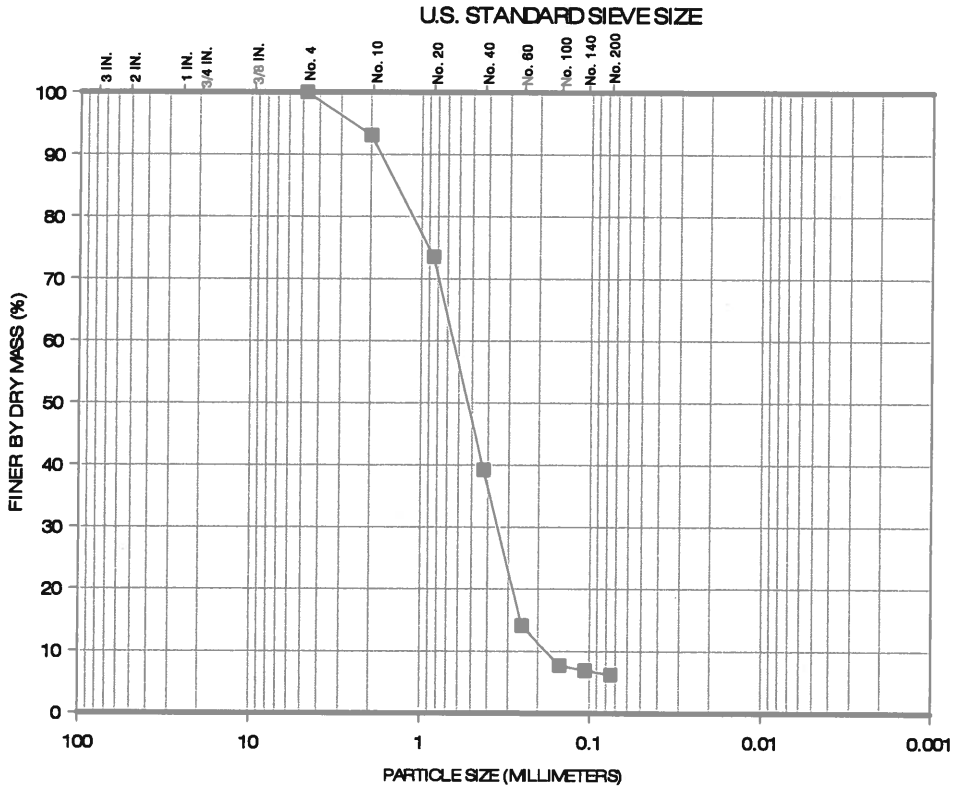
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 17.0
Mass Dry Solids (grams): 231.00

G_s: 2.67 ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	93.1	73.5	39.2	14.1	7.7	6.9	6.2	---	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: _____ Date: 08/12/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/18/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-016** SAMPLE: **5/5** [Block 2]
DEPTH: 3.78 - 4.71 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/016-5/5
SAMPLE DESCRIPTION: Dark gray lean clay (CL)

TEST PROCEDURES

ASTM Standard D422:
☐ Sieve Analysis
☐ Hydrometer Analysis
☒ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☒ Sodium Hexametaphosphate ☐ Other_____

Dispersion Device: ☒ Apparatus A ☐ Apparatus B

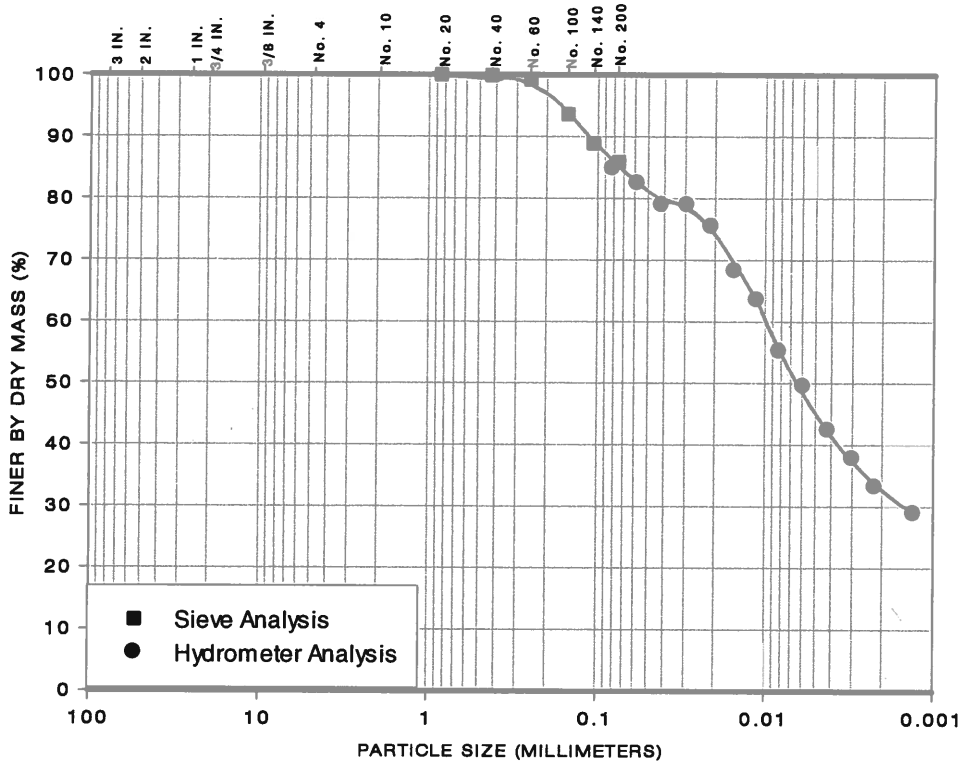
Dispersion Period (hours): >24

Water Content (%): 33.4
Mass Dry Solids (grams): 41.45

G_s: 2.76 ☐ Assumed ☒ Measured

Organic Content (%): 2.2
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]

U.S. STANDARD SIEVE SIZE



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	100	100	99.9	99.2	93.6	88.9	85.9	45.8	32.5	27.7

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Checked By: _____ Date: 08/12/13

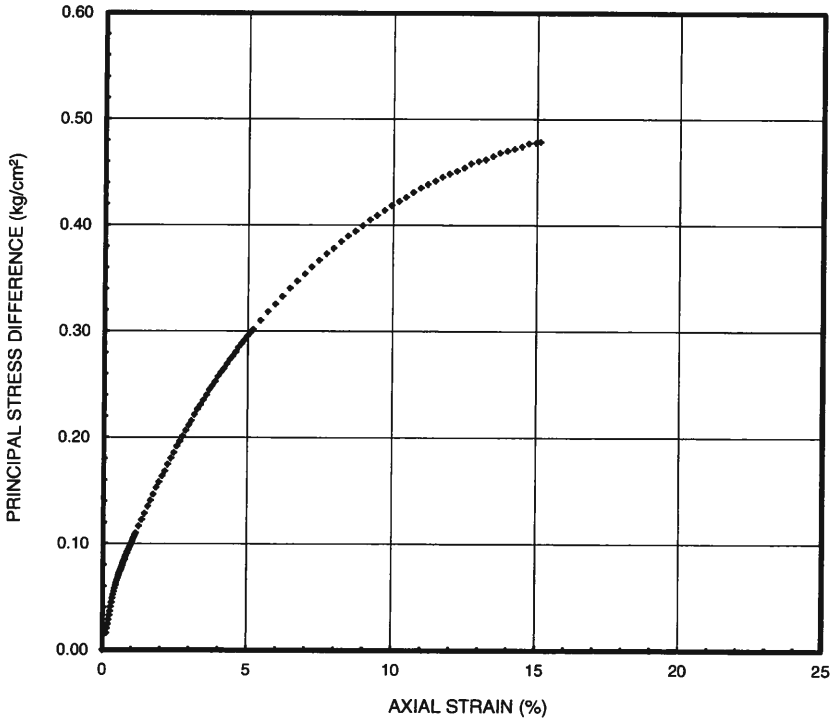
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/25/13
DATE REPORTED: 08/09/13

INCOMING SAMPLE NO.: ---
BORING: **VC-016** SAMPLE: **4 / 5** [Block 3]
DEPTH: 2.78 - 3.78 ☐ ft; ☒ m
LABORATORY IDENTIFICATION NO.: 130084/VC016
SAMPLE DESCRIPTION: Dark gray lean clay (CL)

Specimen Dimensions			Initial Conditions			Test Conditions			at $(\sigma_1-\sigma_3)_{max}$			
H (cm)	D (cm)	H/D	w_c (%)	γ_d (lb/ft^3)	S (%)	σ_c (kg/cm^2)	$\dot{\varepsilon}$ (cm/minute)	$\dot{\varepsilon}$ (%/minute)	ε_a (%)	Compressive Strength (kg/cm^2)	σ_1 (kg/cm^2)	σ_3 (kg/cm^2)
7.25	3.57	2.0	37.1	85.1	100	0.75	0.073	1.0	15.0	0.48	1.23	0.75
									Membrane Correction Made: ☐ Yes ☒ No			



SAMPLE TYPE

Type	Diameter (inch)
☒ Undisturbed	3.6
☐ Rock Core	
☐ Compacted	

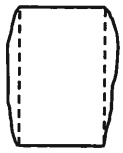
☐ Tamped Uniform Lifts
No. of Lifts:

☐ Kneading
No. of Lifts:
Spring:
Blows per Lift:

G_s: 2.76 ☐ Assumed ☒ Measured

FAILURE SKETCH

☐ Diagonal Plane
☒ Bulging
☐ Combination
☐ Other



Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☒ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	98.95	Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	96.6

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Where: H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; σ_c = Isotropic confining stress; $\dot{\varepsilon}$ = Vertical displacement rate; ε_a = Axial strain; σ_1 = Major principal stress; σ_3 = Minor principal stress; and G_s = Specific gravity.

Checked By: Date: 08/09/13

BORING: VC 016 SAMPLE: 4/5 DEPTH: B3 ☐ ft; ☐ m BLOCK: B3

TYPE SAMPLE: ☑ UNDISTURBED; ☐ COMPACTED; ☐ OTHER

TYPE TEST: ☐ CIUC; ☑ UU; ☐ UU; ☐ CD ☐ OTHER

	Average	L/D
	3.573	
	7.254	2.030

135.94

m³): 72.72

Wt. (lb/ft³):

ty (lb/ft³):

☑ Assumed ☐ Measured

(%):

ilter Strips ☐ ____ ondoms

hick Membrane ☐ ____ hin Membrane

inal σ_c (kg/cm²): 0.75 tsf 10.4 psi

σ_3 (kg/cm²):

VOWTAP
File No.: 13-13-0084
September 23, 2013
Revision: 0 (ISSUED FOR USE) 08/20/13
Revision: 1 (Add data to 2/4 and 3/4)

TABLE D-19 EXTRUSION TEST REPORT FOR CORE VC-017

Station	Core	Sample	Depth (meters)	Sampling Interval (cm)	Comments	Tube Dimensions (cm)				Sample Dimensions and Mass				Extruded Interval (cm)	Description	Group Symbol	Water Content w_c (%)			Core Average Density and Saturation			Fines Content (%)	Organic Content (%)	Carbonate Content $CaCO_3$ (%)	Specific Gravity	Atterberg Limits			Strength Index Tests	
						Length	Diameter	Top Void	Bottom Void	Recovered Length (cm)	Recovery (%)	Extruded Length (cm)	Wet Mass (grams)				Individual Specimens	Interval Average	Tube Average	Total Unit Weight (lb/ft^3)	Dry Density (lb/ft^3)	Saturation (%)					Liquid Limit, LL	Plastic Limit, PL	Plasticity Index, PI	s_u[TV] (kg/cm^2)	s_u[LV] (kg/cm^2)
VC-017	VC-017	1 / 4	0.00 - 0.78	78	Tube length greater than reported sampling interval. Gravel particles visible in photographs were on exterior surface of sample only.	98.7	9.132	22.5	0.0	76.2	98	75.5	9,186	9.0	Dark gray sand with shell	SP	23.2 20.3	21.8	41.3	115.0	81.4	102 [Gs=2.75]	---	0.5							
														17.0	Dark gray sand with gravel and gray clay lenses	SP	9.6	9.6													
														49.5	Dark gray fat clay with gray clayey sand lenses and trace shell	CH	53.1 55.0 52.3 58.9 59.3	55.7					87.9	---	---	---	56	23	33	0.25 0.45 0.30 0.35	--- --- --- ---
		2 / 4	0.78 - 1.78	100	Tube length less than reported sampling interval.	97.0	9.130	0.0	0.0	97.0	97	97.4	10,767	97.4	Dark gray fat clay with trace shell	CH	54.7 54.7 56.2 55.1 54.0 56.1 58.2 51.6 50.2	54.5	54.5	105.9	68.5	100 [Gs=2.73]	--- --- --- 97.6	--- --- --- 2.7	--- --- --- 1.1	--- --- --- ---	--- --- --- 61	--- --- --- 26	--- --- --- 35	0.28 0.40 --- 0.40 0.40 0.45	--- --- 0.28
		3 / 4	1.78 - 2.78	100	Tube length less than reported sampling interval.	96.8	9.138	0.0	0.0	96.8	97	96.5	11,857	16.0	Dark gray fat clay with trace shell and lenses of brown silt	CH	43.7	43.7	34.8	116.7	86.6	98 [Gs=2.73]	---	---	---	---	---	---	---	0.32	---
														7.0	Dark gray fat clay with trace shell and lens of clay with gravel	CH	39.0	39.0					---	---	---	---	---	---	---	0.30	---
														44.0	Dark gray fat clay with trace shell and lenses of brown silt	CH	47.8 46.5 38.2 47.7 33.0	42.6					--- 85.8 --- --- ---	--- --- --- --- ---	--- --- --- --- ---	--- --- --- --- ---	--- 51 --- --- ---	--- 22 --- --- ---	--- 29 --- --- ---	0.25 0.40 --- 0.42	--- --- 0.27 ---
														29.5	Dark gray clayey sand with gravel	SC	22.2 15.6 16.6 14.2	17.2					17.8	0.7							
		4 / 4	2.78 - 3.74	96	Tube length less than reported sampling interval.	92.2	9.129	2.8	0.0	89.4	93	91.0	12,017	27.8	Gray sand with trace shell	SP	16.5	16.5	21.6	128.3	105.5	98 [Gs=2.70]									
														63.2	Dark gray lean clay with sand	CL	23.8 22.3 22.2 22.9 21.8 23.0 24.3 29.9	23.8					--- --- --- 83.7 --- --- ---	--- --- 1.9 --- --- ---	--- --- 7.2 --- --- ---	--- --- 2.72 --- --- ---	--- --- 27 --- --- ---	--- --- 17 --- --- ---	--- --- 10 --- --- ---	0.40 0.38 0.45 0.30 0.42	--- --- --- --- ---

LINEAR METRIC UNITS AND SYMBOLS
1000 millimeters (mm) = 1 meter (m)
100 centimeters (cm) = 1 meter (m)
1000 meters (m) = 1 kilometer (km)
CONVERSIONS
inches x 25.4 = millimeters
inches x 2.54 = centimeters
feet x 30.48 = centimeters
feet x 0.3048 = meters
yards x 0.9144 = meters
miles x 1.609344 = kilometers
SWANSON
13-13-0084
VC-017
1/4
→
TOP

TOP
←
1/4
VC-017
13-13-0084
AE141

13-13-0084
VC-017
2/4
→
TOP
SWANSON

13-13-0084
VC-017
2/4
→
TOP
SWANSON
AE141
SWANSON TOOL CO. INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA

13-13-008
VC-017
3/4
→
TOP
SWANSON
AE141
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423

13-13-008
VC-017
3/4
→
TOP
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
MADE IN CHINA

LINEAR METRIC UNITS AND SYMBOLS
1000 millimeters (mm) = 1 meter (m)
100 centimeters (cm) = 1 meter (m)
1000 meters (m) = 1 kilometer (km)
CONVERSIONS
inches x 25.4 = millimeters
inches x 2.54 = centimeters
feet x 30.48 = centimeters
feet x 0.3048 = meters
yards x 0.0144 = meters
miles x 1.609344 = kilometers
13-13-0084
VC-017
4/4
TOP

TOP
4/4
VC-017
13-13-0084
SWANSON®
AE141

13-13-0084
VC-017
4/4
TOP
SWANSON TOOL CO., INC.
211 ONTARIO STREET
FRANKFORT, IL 60423 USA
MADE IN CHINA

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/10/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-017** SAMPLE: **1/4** [Block 2]
DEPTH: 0.0 – 0.78 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/017-1/4
SAMPLE DESCRIPTION: Dark gray fat clay with trace shell (CH)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

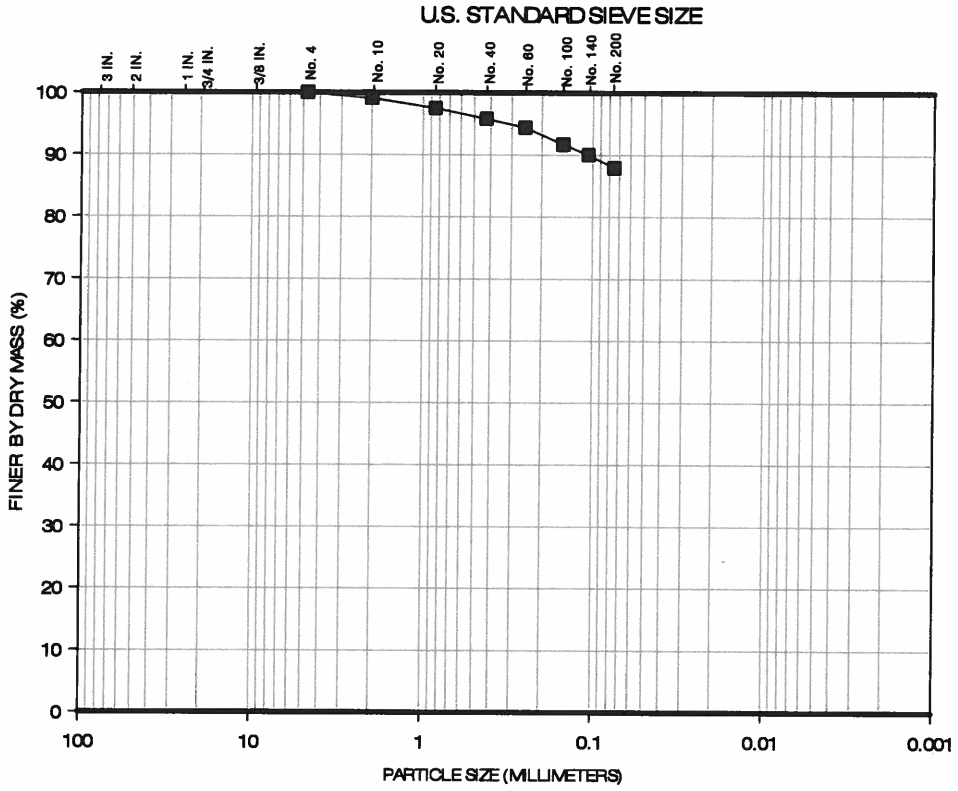
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 55.0
Mass Dry Solids (grams): 144.63

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.1	97.5	95.8	94.4	91.7	90.0	87.9	---	---	---

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Checked By: _____ Date: 08/12/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/18/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-017** SAMPLE: **2/4** [Block 3]
DEPTH: 0.0 - 0.78 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/017-2/4
SAMPLE DESCRIPTION: Dark gray fat clay with trace shell (CH)

TEST PROCEDURES

ASTM Standard D422:
☐ Sieve Analysis
☐ Hydrometer Analysis
☒ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☒ Sodium Hexametaphosphate ☐ Other _____

Dispersion Device: ☒ Apparatus A ☐ Apparatus B

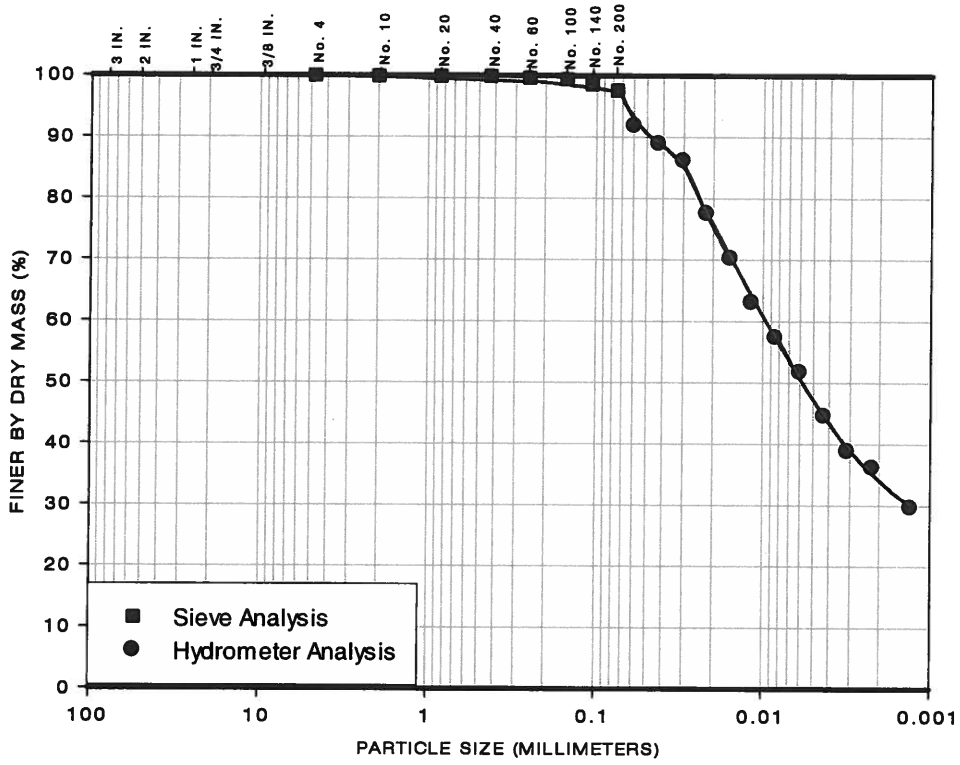
Dispersion Period (hours): >24

Water Content (%): 56.1
Mass Dry Solids (grams): 34.10

G_s: 2.75 ☒ Assumed ☐ Measured

Organic Content (%): -
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]

U.S. STANDARD SIEVE SIZE



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.9	99.9	99.9	99.6	99.4	98.6	97.6	47.4	34.8	27.6

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Checked By: TM Date: 08/12/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/09/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-017** SAMPLE: **3/4** [Block 3]
DEPTH: 1.78 – 2.78 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/017-3/4b3
SAMPLE DESCRIPTION: Dark gray fat clay with trace shell (CH)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

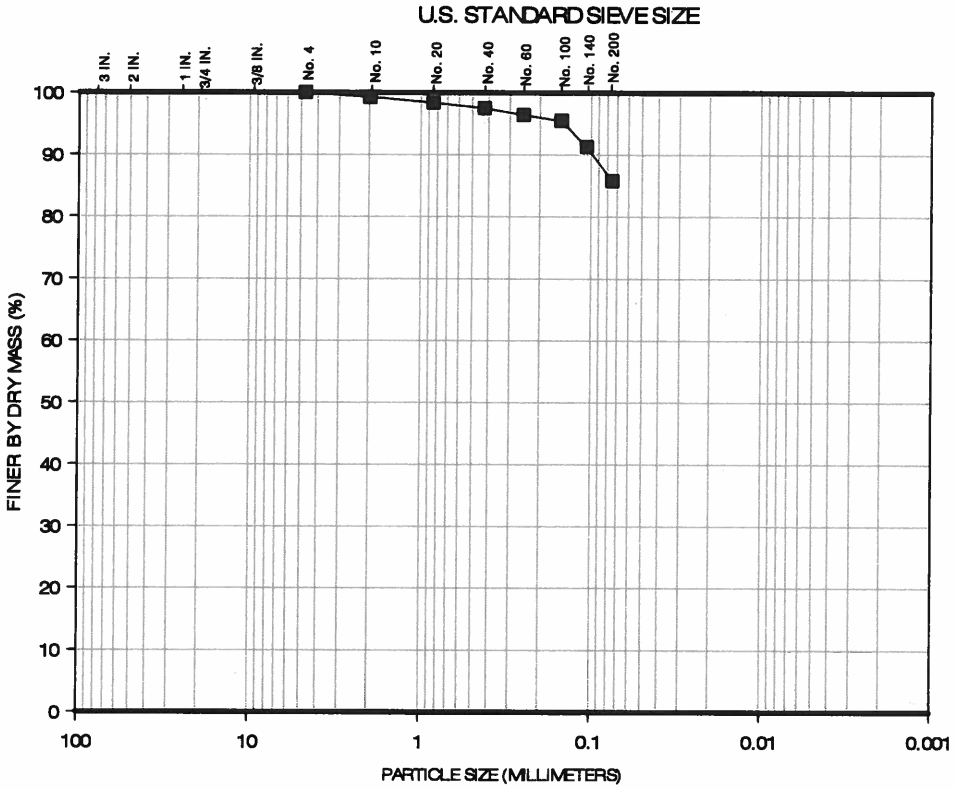
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 46.5
Mass Dry Solids (grams): 130.26

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.3	98.4	97.5	96.4	95.5	91.3	85.8	---	---	---

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Checked By: _____ Date: 08/12/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/09/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-017** SAMPLE: **3/4** [Block 5]
DEPTH: 1.78 – 2.78 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/017-3/4b5
SAMPLE DESCRIPTION: Dark gray clayey sand with gravel (SC)

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

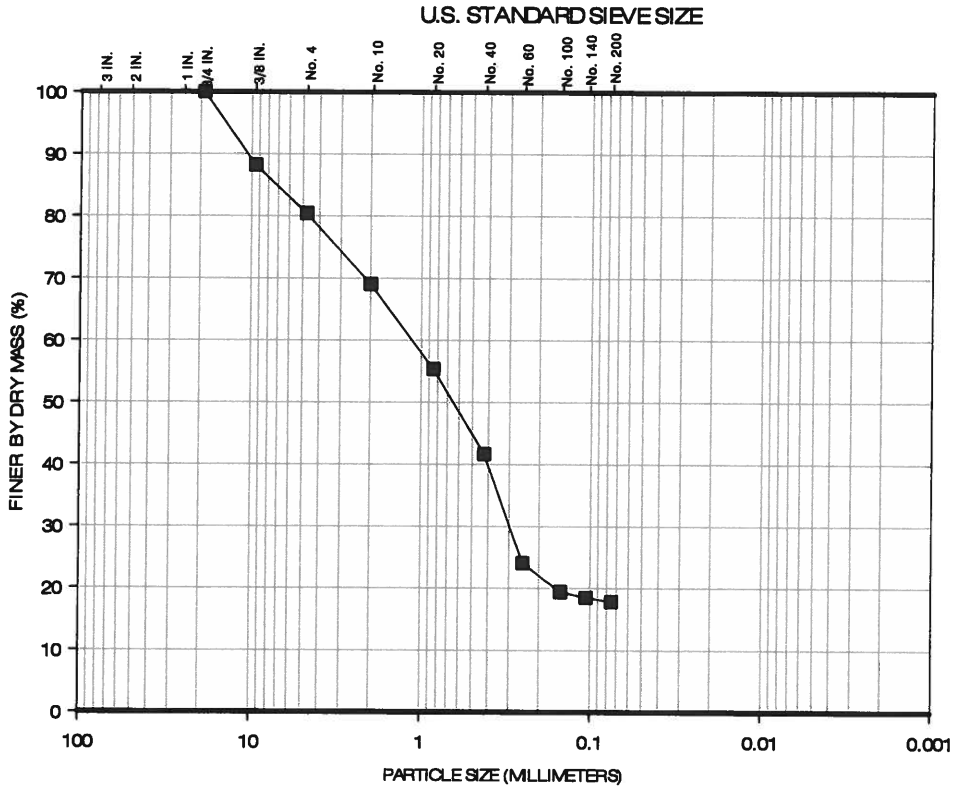
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 16.6
Mass Dry Solids (grams): 348.56

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	88.2	80.4	69.0	55.3	41.6	24.0	19.4	18.5	17.8	---	---	---

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Checked By: _____ Date: 08/12/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/10/13
DATE REPORTED: 08/12/13

INCOMING SAMPLE NO.: ---
BORING: **VC-017** SAMPLE: **4/4** [Block 2 & 3]
DEPTH: 2.78 – 3.74 ☐ ft; ☒ m
LABORATORY IDENTIFICATION: 130084/017-4/4
SAMPLE DESCRIPTION: Dark gray lean clay with sand (CL)

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

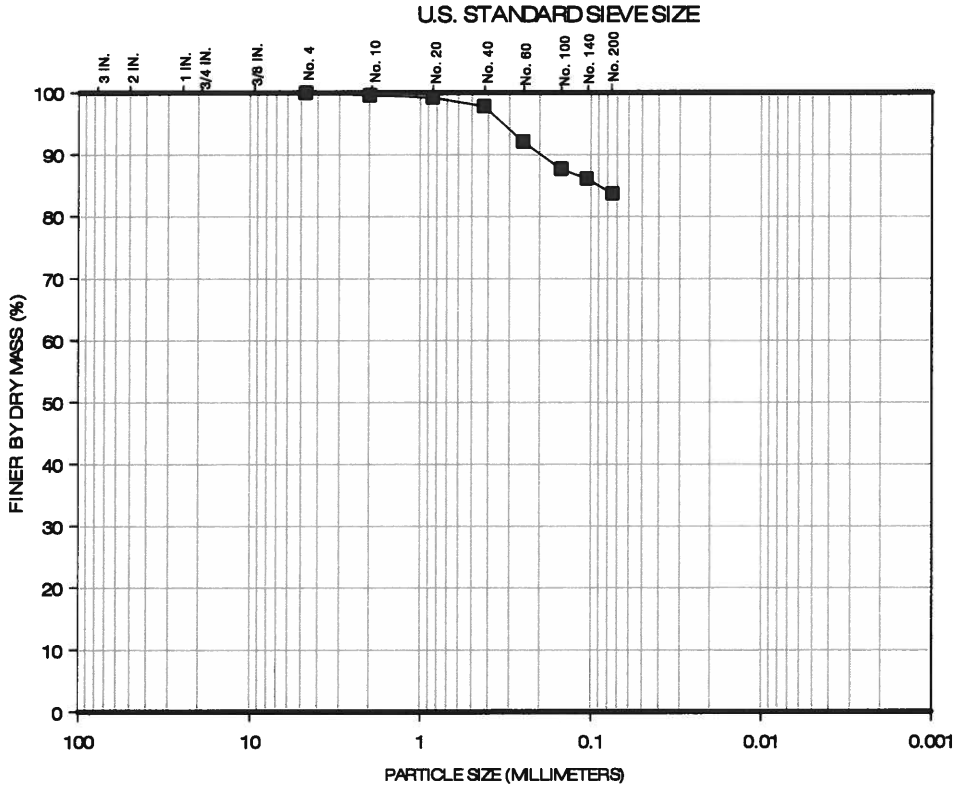
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 22.9
Mass Dry Solids (grams): 123.41

G_s: 2.72 ☐ Assumed ☒ Measured

Organic Content (%): 1.9
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]



Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	100	99.6	99.2	97.8	92.1	87.7	86.1	83.7	---	---	---

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Checked By: _____ Date: 08/12/13

Attachment H-5

Appendix 5

GEOTECHNICAL TEST RESULTS

COMPOSITE SAMPLES

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 07/22/13
DATE REPORTED: 08/13/13

INCOMING SAMPLE NO.: ---
SAMPLE: **Grab Sample Composite 1WG**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/1WG
SAMPLE DESCRIPTION: Brownish-gray sand with silt and shell (SP-SM)
[γ_{dmin}= 96 lb/ft^3; γ_{dmax}= 122 lb/ft^3]

TEST PROCEDURES

ASTM Standard D422:
☐ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☒ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other _____

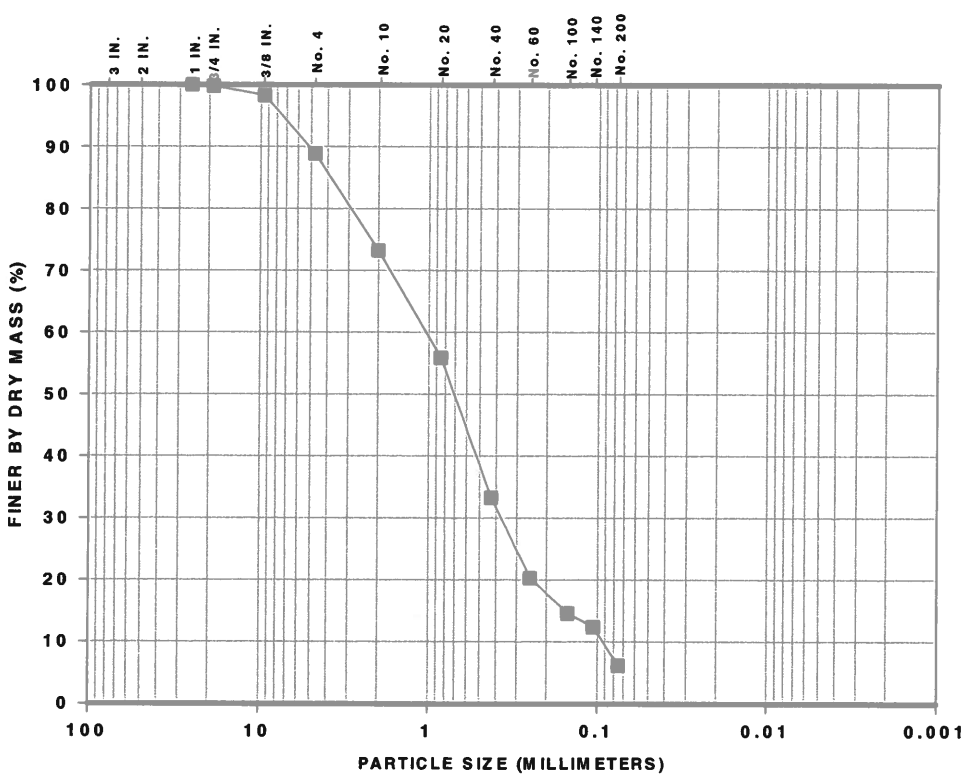
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 20.9
Mass Dry Solids (grams): +3/8"=123.72; -3/8"=507.76

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974, Method C



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	99.8	98.3	88.9	73.3	55.9	33.3	20.3	14.6	12.4	6.2	---	---	---

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Checked By: _____ Date: 08/13/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 07/22/13
DATE REPORTED: 08/13/13

INCOMING SAMPLE NO.: ---
SAMPLE: **Grab Sample Composite 2MS**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/2MS
SAMPLE DESCRIPTION: Brown sand with shell (SP)
[γ_{dmin}= 95 lb/ft^3; γ_{dmax}= 114 lb/ft^3]

TEST PROCEDURES

ASTM Standard D422:
☐ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☒ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

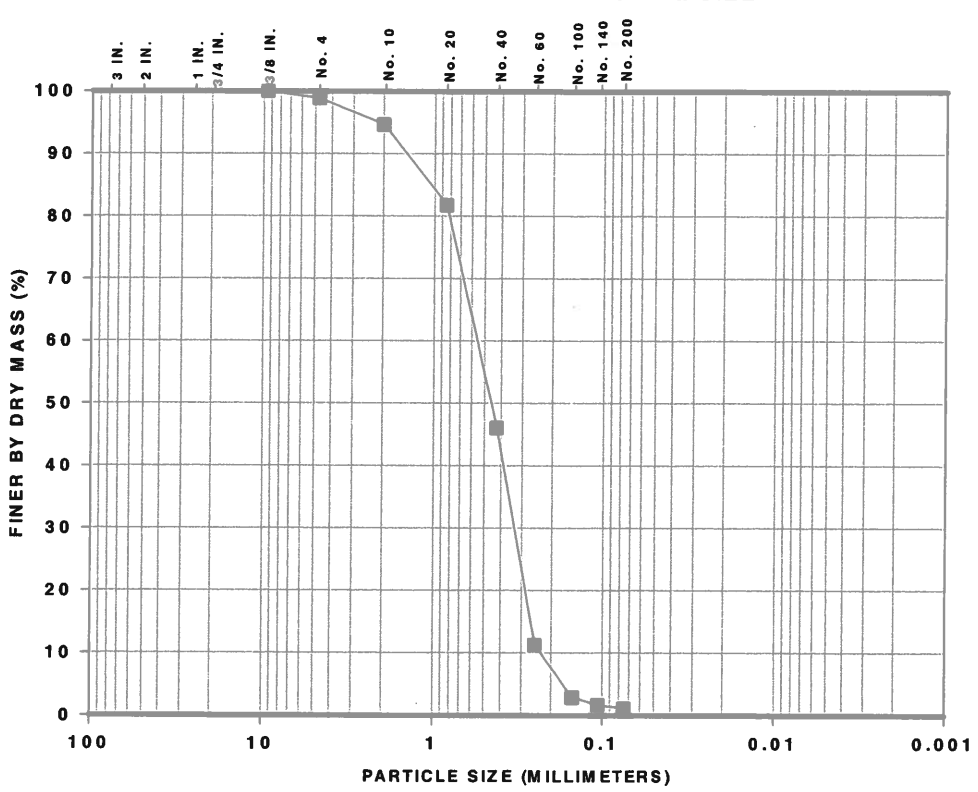
Dispersion Device: ☐ Apparatus A ☐ Apparatus B

Dispersion Period (hours): _____

Water Content (%): 24.4
Mass Dry Solids (grams): +3/8"=6.04; -3/8"=526.11

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974, Method C



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	98.9	94.7	81.8	46.1	11.3	2.9	1.7	1.1	---	---	---

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Checked By: _____ Date: 08/13/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 07/22/13
DATE REPORTED: 08/13/13

INCOMING SAMPLE NO.: ---
SAMPLE: **Grab Sample Composite 3FS**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/3FS
SAMPLE DESCRIPTION: Brownish-gray sand with shell (SP)
[γ_{dmin}= 85 lb/ft^3; γ_{dmax}= 109 lb/ft^3]

TEST PROCEDURES

ASTM Standard D422:
- ☒ Sieve Analysis
- ☐ Hydrometer Analysis
- ☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other: _____

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other_____

Dispersion Device: ☐ Apparatus A ☐ Apparatus B

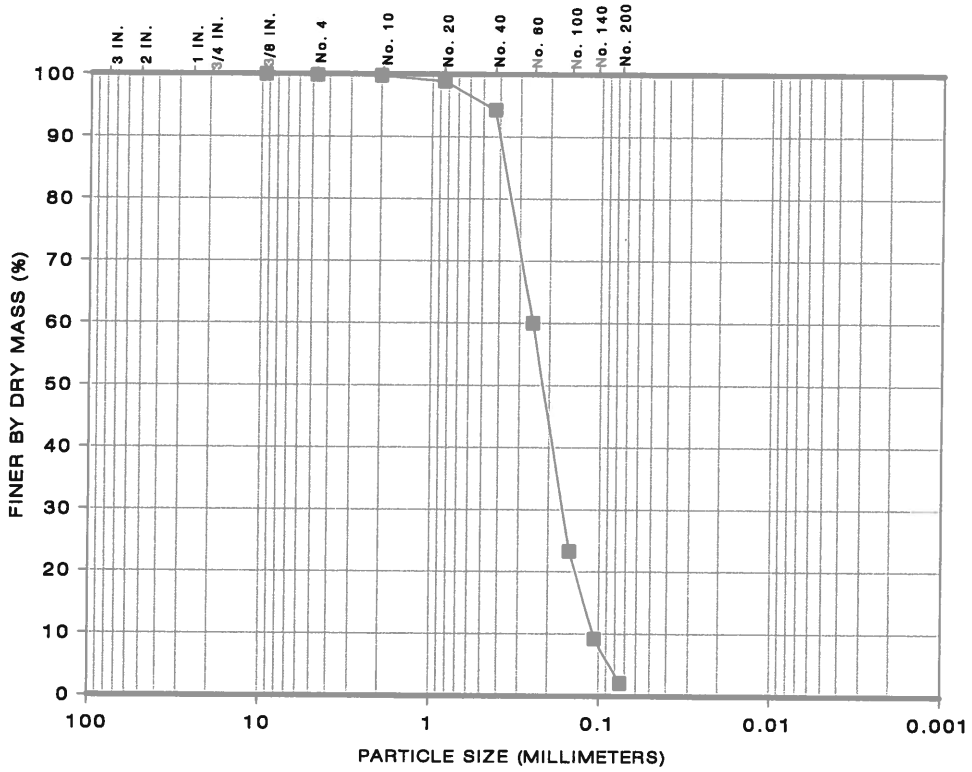
Dispersion Period (hours): _____

Water Content (%): 30.6
Mass Dry Solids (grams): 392.67

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): _____
ASTM Standard D2974
Method C [Loss on Ignition at 440°C]

U.S. STANDARD SIEVE SIZE



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	100	99.9	99.8	98.9	94.3	60.0	23.3	9.2	2.1	---	---	---

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Checked By: _____ Date: 08/13/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
PARTICLE-SIZE ANALYSIS TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 08/16/13
DATE REPORTED: 08/20/13

INCOMING SAMPLE NO.: ---
SAMPLE: **Turbine Core Composite Sample 4**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION: 130084/4
SAMPLE DESCRIPTION: Gray and brown gravel with sand and shell (GW)
C_u = 22, C_c = 1.7

TEST PROCEDURES

ASTM Standard D422:
☒ Sieve Analysis
☐ Hydrometer Analysis
☐ Sieve and Hydrometer Analysis

☐ ASTM Standard D6913 Sieve Analysis
☐ Other:

Dispersant Type: ☐ Sodium Hexametaphosphate ☐ Other

Dispersion Device: ☐ Apparatus A ☐ Apparatus B

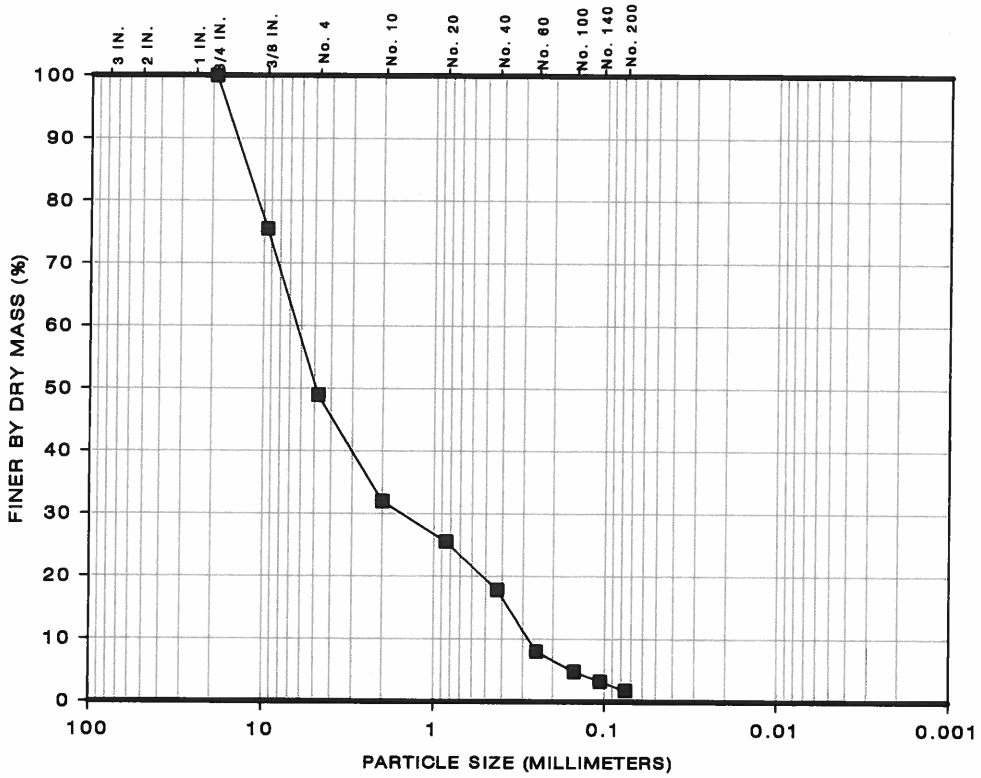
Dispersion Period (hours):

Water Content (%): -
Mass Dry Solids (grams): 1212.93

G_s: --- ☐ Assumed ☐ Measured

Organic Content (%): ---
ASTM Standard D2974, Method C

U.S. STANDARD SIEVE SIZE



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

Percent Finer (dry mass basis)

Sieve Analysis												Hydrometer Analysis		
Gravel-Size					Sand-Size							Silt-Size	Clay-Size	
					Coarse	Medium		Fine						
1½"	1"	3/4"	3/8"	No.4	No.10	No.20	No.40	No.60	No.100	No.140	No. 200	0.005 mm	0.002 mm	0.001 mm
100	100	100	75.5	48.9	32.0	25.5	17.8	8.0	4.8	3.2	1.8	---	---	---

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Checked By: _____ Date: 08/20/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
MINIMUM AND MAXIMUM INDEX DRY UNIT WEIGHT TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/22/13
DATE REPORTED: 08/20/13

INCOMING SAMPLE NO.: -
SAMPLE: **Grab Composite Sample 1WG**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION NO.: 130084/CS1
SAMPLE DESCRIPTION: Brownish-gray sand with silt and shell, SP-SM

SPECIMEN PREPARATION	TEST RESULTS
As-Received Water Content (ASTM D2216): 20.9 %	
Percentage of Soil Retained on U.S. Standard 3/4" Sieve: 0.2 ☐ Estimated ☒ Measured Plus 3/4" Sieve Material Removed: ☒ Yes; ☐ No Removed by: ☐ Hand ☒ Sieve ☐ Other _____	**MINIMUM INDEX DRY UNIT WEIGHT:** 122.0 **MAXIMUM INDEX DRY UNIT WEIGHT:** 95.7

Minimum Index Dry Unit Weight Test Method	Maximum Index Dry Unit Weight Test Method
ASTM D4254 Test Method: ☒ Method A: Pouring Device ☐ Method B: Thin-Walled Tube ☐ Method C: Graduate Cylinder Mold Size: ☒ 0.100 ft^3 [6" diameter] ☐ 0.500 ft^3 [11" diameter]	ASTM D4253 Test Method: ☒ Method 1: Electromagnetic, Vertically Vibrating Table ☒ 1A: Oven-dried Soil ☐ 1B: Wet Soil Mold Size: ☒ 0.100 ft^3 [6" diameter] ☐ 0.500 ft^3 [11" diameter]

Particle-Size Analysis

Test Method:
☒ ASTM D6913
☐ ASTM D1140-Method B

	Soil Passing U.S. Standard Sieve (%, dry mass basis)										
	Gravel				Coarse Sand	Medium Sand		Fine Sand			
	1"	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g): +3/8"=123.72 -3/8"=507.76	100	99.8	98.3	88.9	73.3	55.9	33.3	20.3	14.6	12.4	6.2

Comments: _____

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Checked By: MM Date: 08/20/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
MINIMUM AND MAXIMUM INDEX DRY UNIT WEIGHT TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/22/13
DATE REPORTED: 08/20/13

INCOMING SAMPLE NO.: -
SAMPLE: **Grab Composite Sample 2MS**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION NO.: 130084/CS2
SAMPLE DESCRIPTION: Brown sand with shell, SP

SPECIMEN PREPARATION	TEST RESULTS
As-Received Water Content (ASTM D2216): 24.4 %	
Percentage of Soil Retained on U.S. Standard 3/4" Sieve: 0.0 ☐ Estimated ☒ Measured Plus 3/4" Sieve Material Removed: ☐ Yes; ☐ No Removed by: ☐ Hand ☐ Sieve ☐ Other	**MINIMUM INDEX DRY UNIT WEIGHT:** 113.6 **MAXIMUM INDEX DRY UNIT WEIGHT:** 94.7

Minimum Index Dry Unit Weight Test Method	Maximum Index Dry Unit Weight Test Method
ASTM D4254 Test Method: ☒ Method A: Pouring Device ☐ Method B: Thin-Walled Tube ☐ Method C: Graduate Cylinder Mold Size: ☒ 0.100 ft^3 [6" diameter] ☐ 0.500 ft^3 [11" diameter]	ASTM D4253 Test Method: ☒ Method 1: Electromagnetic, Vertically Vibrating Table ☒ 1A: Oven-dried Soil ☐ 1B: Wet Soil Mold Size: ☒ 0.100 ft^3 [6" diameter] ☐ 0.500 ft^3 [11" diameter]

Particle-Size Analysis

Test Method:
☒ ASTM D6913
☐ ASTM D1140-Method B

Soil Passing U.S. Standard Sieve (%, dry mass basis)										
Gravel			Coarse Sand	Medium Sand		Fine Sand				
3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g): +3/8"=6.04 -3/8"=526.11	100	100	98.9	94.7	81.8	46.1	11.3	2.9	1.7	1.1

Comments: -

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Checked By: JM Date: 08/20/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
MINIMUM AND MAXIMUM INDEX DRY UNIT WEIGHT TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13
DATE TEST SET-UP: 07/22/13
DATE REPORTED: 08/20/13

INCOMING SAMPLE NO.: -
SAMPLE: **Grab Composite Sample 3FS**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION NO.: 130084/CS3
SAMPLE DESCRIPTION: Brownish-gray sand with shell, SP

SPECIMEN PREPARATION	TEST RESULTS
As-Received Water Content (ASTM D2216): 30.6 %	
Percentage of Soil Retained on U.S. Standard 3/4" Sieve: 0.0 ☐ Estimated ☒ Measured Plus 3/4" Sieve Material Removed: ☐ Yes; ☐ No Removed by: ☐ Hand ☐ Sieve ☐ Other	**MINIMUM INDEX DRY UNIT WEIGHT:** 109.1 **MAXIMUM INDEX DRY UNIT WEIGHT:** 84.8

Minimum Index Dry Unit Weight Test Method	Maximum Index Dry Unit Weight Test Method
ASTM D4254 Test Method: ☒ Method A: Pouring Device ☐ Method B: Thin-Walled Tube ☐ Method C: Graduate Cylinder Mold Size: ☒ 0.100 ft^3 [6" diameter] ☐ 0.500 ft^3 [11" diameter]	ASTM D4253 Test Method: ☒ Method 1: Electromagnetic, Vertically Vibrating Table ☒ 1A: Oven-dried Soil ☐ 1B: Wet Soil Mold Size: ☒ 0.100 ft^3 [6" diameter] ☐ 0.500 ft^3 [11" diameter]

Particle-Size Analysis

Test Method:
☒ ASTM D422
☐ ASTM D1140-Method B

Soil Passing U.S. Standard Sieve (%, dry mass basis)

	Gravel			Coarse Sand	Medium Sand		Fine Sand			
	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g): 392.67	100	100	99.9	99.8	98.9	94.3	60.0	23.3	9.2	2.1

Comments:

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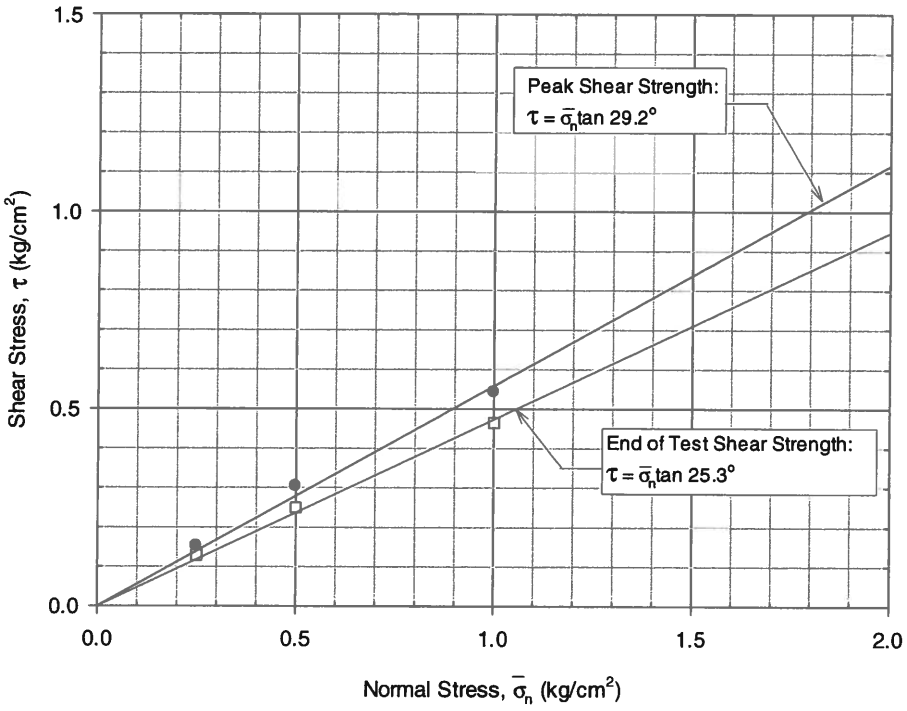
Checked By: TM Date: 08/20/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST
MOHR-COULOMB FAILURE ENVELOPE

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 08/23/13-08/29/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: -
SAMPLE: **Grab Sample Composite 1WG**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION NO.: 130084/1WG
SAMPLE DESCRIPTION: Brownish-gray sand with silt and shell (SP-SM). Pre-shear average γ_d = 111.9 lb/ft^3. +No. 4 sieve-size gravel removed.



Sample	Normal Stress $\bar{\sigma}_n$ (kg/cm^2)	Peak Shear Strength τ (kg/cm^2)	End of Test Strength τ (kg/cm^2)
1WG	0.25	0.15	0.13
	0.52	0.31	0.25
	1.00	0.54	0.46

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Checked By: TM Date: 09/23/13

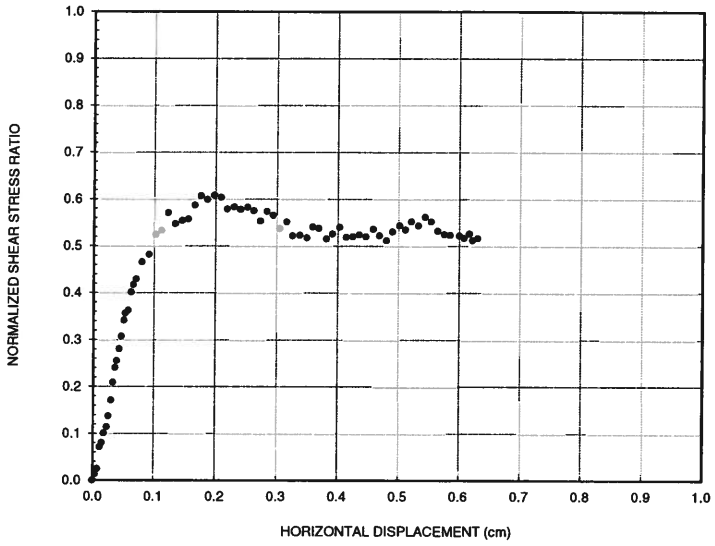
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 08/23/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: -
SAMPLE: **Grab Sample Composite 1WG**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION NO.: 130084/1WG
SAMPLE DESCRIPTION: Brownish-gray sand with silt and shell (SP-SM). Target initial dry density equaled 112 lb/ft^3. +No. 4 sieve-size gravel removed.

Initial Specimen Conditions						Normal Stress, $\bar{\sigma}_n$ (kg/cm^2)	Pre-Shear Conditions			Final Specimen Conditions			
WDS (g)	H (cm)	D (cm)	w_c (%)	γ_d (lb/ft^3)	S (%)		γ_d (lb/ft^3)	ε_{vc} (%)	t_c (hours)	w_c (%)	γ_d (lb/ft^3)	S (%)	ε_{vs} (%)
133.14	2.78	5.85	8.1	111.3	44	0.25	111.7	-0.4	19.4	16.7	114.6	100	-2.5



Test Methods & Procedures

☒ ASTM Standard D3080
☐ Other:

Specimen Type: ☒ Circular ☐ Square
Sample Type: ☐ Undisturbed ☒ Compacted

Test Conditions

Normal Stress Loading Sequence:
0.25 kg/cm^2
kg/cm^2
kg/cm^2
kg/cm^2
Inundated at 0.25 kg/cm^2
Displacement Rate: 0.22 cm/hour

Peak Shear Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.20	0.609	31.3

End of Test Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.63	0.517	27.3

G_s : 2.65 ☒ Assumed ☐ Measured

Particle-Size Analysis
☒ ASTM D422
☐ ASTM D1140-Method B

U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g) 133.14										
Soil Passing (%, dry mass basis)	100	100	100	78.2	56.0	32.0	19.3	14.0	11.8	6.2

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Where: WDS = Specimen dry mass; H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; G_s = Specific gravity; $\bar{\sigma}_n$ = Normal effective stress; ε_{vc} = Vertical strain during consolidation; ε_{vs} = Vertical strain during shear; t_c = Duration of final normal stress application prior to shear; γ_h = Horizontal displacement; τ = Shear stress; and $\bar{\varphi}_{ds}$ = Effective friction angle assuming zero cohesion.

Checked By: TM Date: 09/23/13

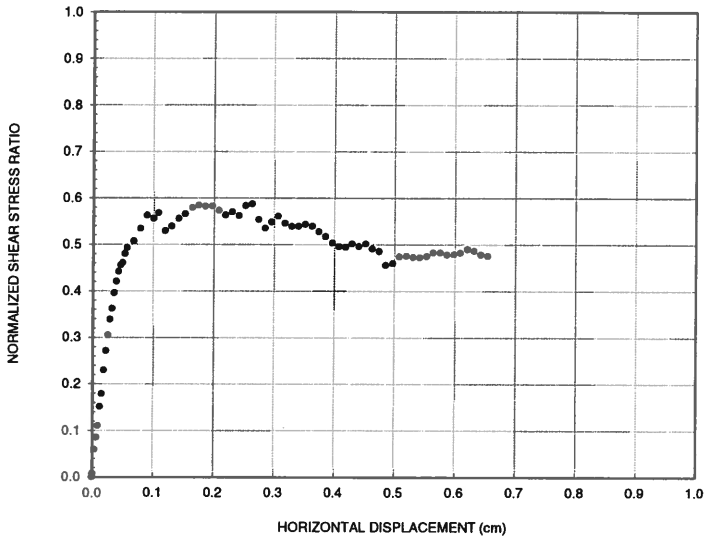
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 08/28/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: -
SAMPLE: **Grab Sample Composite 1WG**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION NO.: 130084/1WG
SAMPLE DESCRIPTION: Brownish-gray sand with silt and shell (SP-SM). Target initial dry density equaled 112 lb/ft^3. +No. 4 sieve-size gravel removed.

Initial Specimen Conditions						Normal Stress, $\bar{\sigma}_n$ (kg/cm^2)	Pre-Shear Conditions			Final Specimen Conditions			
WDS (g)	H (cm)	D (cm)	w_c (%)	γ_d (lb/ft^3)	S (%)		γ_d (lb/ft^3)	ε_{vc} (%)	t_c (hours)	w_c (%)	γ_d (lb/ft^3)	S (%)	ε_{vs} (%)
135.11	2.79	5.86	7.3	112.1	41	0.52	112.6	-0.4	1.8	14.1	117.2	91	-3.9



Test Methods & Procedures

☒ ASTM Standard D3080
☐ Other: _____

Specimen Type: ☒ Circular ☐ Square
Sample Type: ☐ Undisturbed ☒ Compacted

Test Conditions

Normal Stress Loading Sequence:
0.16 kg/cm^2
0.52 kg/cm^2
_____ kg/cm^2
_____ kg/cm^2
Inundated at 0.16 kg/cm^2
Displacement Rate: 0.22 cm/hour

Peak Shear Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.26	0.588	30.4

End of Test Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.65	0.476	25.5

G_s : 2.65 ☒ Assumed ☐ Measured

Particle-Size Analysis
☒ ASTM D422
☐ ASTM D1140-Method B

U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g) 135.11										
Soil Passing (%, dry mass basis)	100	100	99.7	77.0	55.6	31.8	19.4	14.3	12.2	6.6

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Where: WDS = Specimen dry mass; H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; G_s = Specific gravity; $\bar{\sigma}_n$ = Normal effective stress; ε_{vc} = Vertical strain during consolidation; ε_{vs} = Vertical strain during shear; t_c = Duration of final normal stress application prior to shear; γ_h = Horizontal displacement; τ = Shear stress; and $\bar{\varphi}_{ds}$ = Effective friction angle assuming zero cohesion.

Checked By: _____ Date: 09/23/13

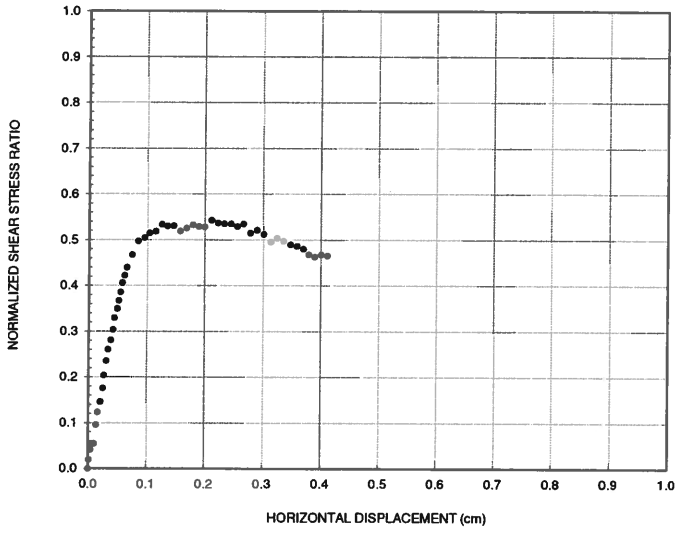
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 08/29/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: -
SAMPLE: **Grab Sample Composite 1WG**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION NO.: 130084/1WG
SAMPLE DESCRIPTION: Brownish-gray sand with silt and shell (SP-SM). Target initial dry density equaled 112 lb/ft^3. +No. 4 sieve-size gravel removed.

Initial Specimen Conditions						Normal Stress, $\bar{\sigma}_n$ (kg/cm^2)	Pre-Shear Conditions			Final Specimen Conditions			
WDS (g)	H (cm)	D (cm)	w_c (%)	γ_d (lb/ft^3)	S (%)		γ_d (lb/ft^3)	ε_{vc} (%)	t_c (hours)	w_c (%)	γ_d (lb/ft^3)	S (%)	ε_{vs} (%)
132.24	2.78	5.85	8.8	110.8	47	1.00	111.5	-0.7	17.1	15.8	114.6	94	-2.7



Test Methods & Procedures

☒ ASTM Standard D3080
☐ Other:

Specimen Type: ☒ Circular ☐ Square
Sample Type: ☐ Undisturbed ☒ Compacted

Test Conditions

Normal Stress Loading Sequence:
0.25 kg/cm^2
0.50 kg/cm^2
1.00 kg/cm^2
kg/cm^2
Inundated at 0.25 kg/cm^2
Displacement Rate: 0.21 cm/hour

Peak Shear Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.21	0.543	28.5

End of Test Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.41	0.465	24.9

G_s : 2.65 ☒ Assumed ☐ Measured

Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☒ ASTM D422 ☐ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	132.24	Soil Passing (%, dry mass basis)	100	100	100	76.0	54.2	30.6	18.2	13.1	10.9	5.3

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Where: WDS = Specimen dry mass; H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; G_s = Specific gravity; $\bar{\sigma}_n$ = Normal effective stress; ε_{vc} = Vertical strain during consolidation; ε_{vs} = Vertical strain during shear; t_c = Duration of final normal stress application prior to shear; γ_h = Horizontal displacement; τ = Shear stress; and $\bar{\varphi}_{ds}$ = Effective friction angle assuming zero cohesion.

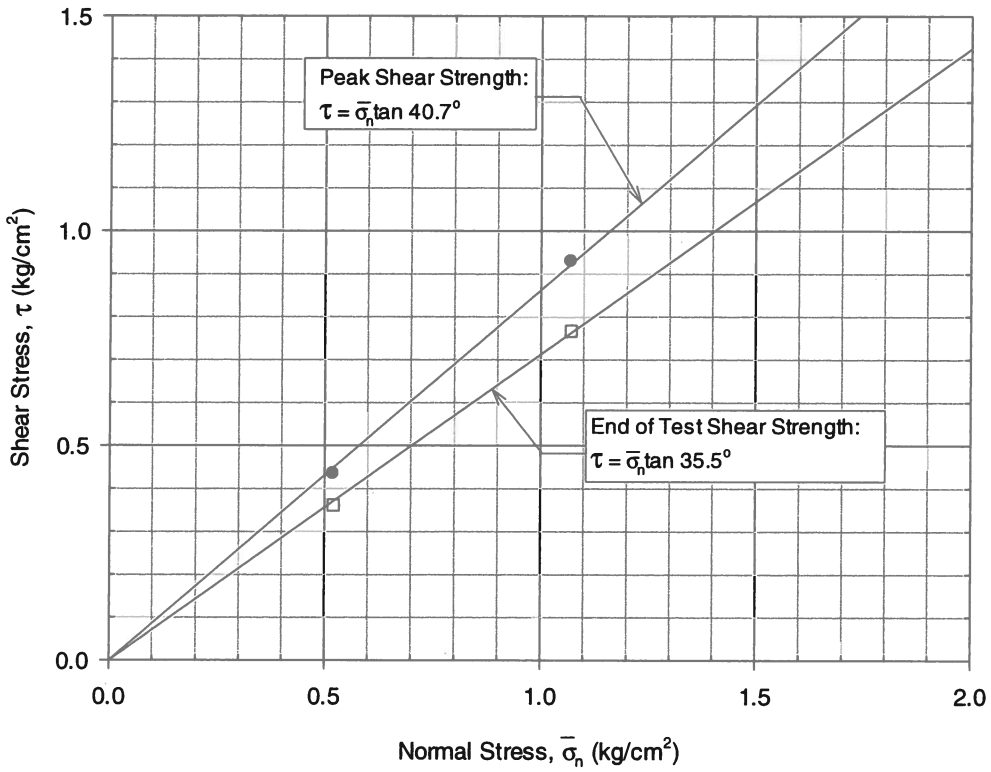
Checked By: TM Date: 09/23/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST
MOHR-COULOMB FAILURE ENVELOPE

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 09/10/13-09/23/13
DATE REPORTED: 10/18/13

INCOMING SAMPLE NO.: -
SAMPLE: **Grab Sample Composite 1WG**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION NO.: 130084/1WG
SAMPLE DESCRIPTION: Brownish-gray sand with silt and shell (SP-SM). Pre-shear average γ_d = 116.8 lb/ft^3. +No. 4 sieve-size gravel removed.



Sample	Normal Stress $\bar{\sigma}_n$ (kg/cm^2)	Peak Shear Strength τ (kg/cm^2)	End of Test Strength τ (kg/cm^2)
1WG	0.52	0.43	0.36
	1.07	0.93	0.77

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: JAW Date: 10/18/13

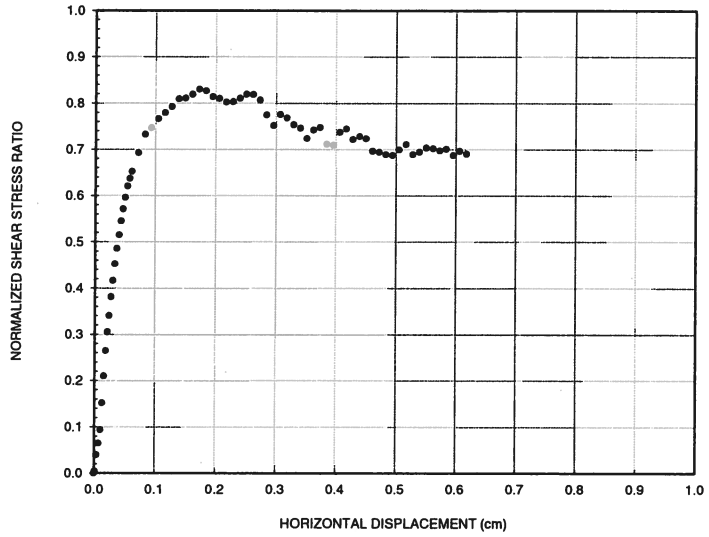
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT

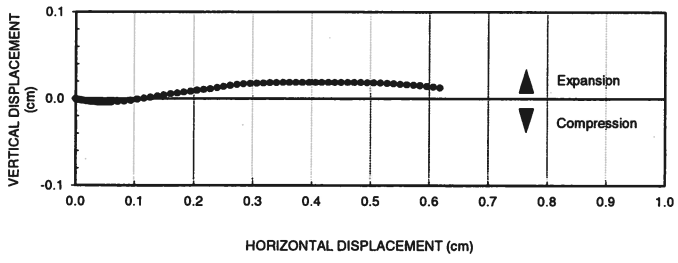
CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 09/10/13
DATE REPORTED: 10/18/13

INCOMING SAMPLE NO.: -
SAMPLE: **Grab Sample Composite 1WG**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION NO.: 130084/1WG
SAMPLE DESCRIPTION: Brownish-gray sand with silt and shell (SP-SM). Target initial dry density equaled 117 lb/ft^3. Estimated 11.1% + No. 4 sieve-size gravel removed.

Initial Specimen Conditions						Normal Stress, $\bar{\sigma}_n$ (kg/cm^2)	Pre-Shear Conditions			Final Specimen Conditions			
WDS (g)	H (cm)	D (cm)	w_c (%)	γ_d (lb/ft^3)	S (%)		γ_d (lb/ft^3)	ε_{vc} (%)	t_c (hours)	w_c (%)	γ_d (lb/ft^3)	S (%)	ε_{vs} (%)
140.73	2.79	5.86	7.6	116.8	49	0.52	116.9	-0.1	3.9	14.1	116.4	88	+0.5





Test Methods & Procedures

☒ ASTM Standard D3080
☐ Other:

Specimen Type: ☒ Circular ☐ Square
Sample Type: ☐ Undisturbed ☒ Compacted

Test Conditions

Normal Stress Loading Sequence:
0.16 kg/cm^2
0.52 kg/cm^2
kg/cm^2
kg/cm^2
Inundated at 0.16 kg/cm^2
Displacement Rate: 0.22 cm/hour

Peak Shear Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.17	0.830	39.7

End of Test Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.62	0.690	34.6

G_s: 2.65 ☒ Assumed ☐ Measured

Particle-Size Analysis
☐ ASTM D422
☒ ASTM D1140-Method B

U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g) 140.73										
Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	6.0

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Where: WDS = Specimen dry mass; H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; G_s = Specific gravity; $\bar{\sigma}_n$ = Normal effective stress; ε_{vc} = Vertical strain during consolidation; ε_{vs} = Vertical strain during shear; t_c = Duration of final normal stress application prior to shear; γ_h = Horizontal displacement; τ = Shear stress; and $\bar{\varphi}_{ds}$ = Effective friction angle assuming zero cohesion.

Checked By: JCW Date: 10/18/13

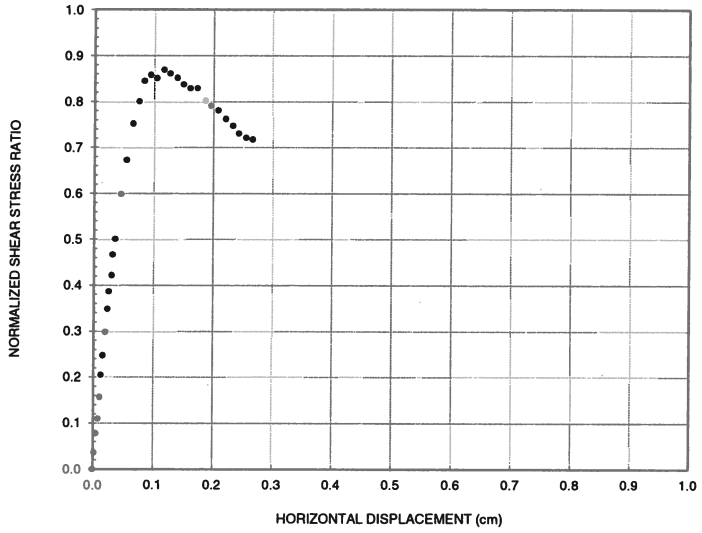
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 09/23/13
DATE REPORTED: 10/18/13

INCOMING SAMPLE NO.: -
SAMPLE: **Grab Sample Composite 1WG**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION NO.: 130084/1WG
SAMPLE DESCRIPTION: Brownish-gray sand with silt and shell (SP-SM). Target initial dry density equaled 117 lb/ft^3. Estimated 11.1% + No. 4 sieve-size gravel removed.

Initial Specimen Conditions						Normal Stress, $\bar{\sigma}_n$ (kg/cm^2)	Pre-Shear Conditions			Final Specimen Conditions			
WDS (g)	H (cm)	D (cm)	w_c (%)	γ_d (lb/ft^3)	S (%)		γ_d (lb/ft^3)	ε_{vc} (%)	t_c (hours)	w_c (%)	γ_d (lb/ft^3)	S (%)	ε_{vs} (%)
139.19	2.78	5.85	8.0	116.4	50	1.07	116.7	-0.3	17.6	14.7	115.9	91	+0.7



Test Methods & Procedures

☒ ASTM Standard D3080
☐ Other:

Specimen Type: ☒ Circular ☐ Square
Sample Type: ☐ Undisturbed ☒ Compacted

Test Conditions

Normal Stress Loading Sequence:
0.25 kg/cm^2
0.50 kg/cm^2
1.07 kg/cm^2
kg/cm^2
Inundated at 0.25 kg/cm^2
Displacement Rate: 0.22 cm/hour

Peak Shear Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.12	0.870	41.0

End of Test Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.27	0.719	35.7

G_s : 2.65 ☒ Assumed ☐ Measured

Particle-Size Analysis
☐ ASTM D422
☐ ASTM D1140-Method B

U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g) -										
Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	-

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Where: WDS = Specimen dry mass; H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; G_s = Specific gravity; $\bar{\sigma}_n$ = Normal effective stress; ε_{vc} = Vertical strain during consolidation; ε_{vs} = Vertical strain during shear; t_c = Duration of final normal stress application prior to shear; γ_h = Horizontal displacement; τ = Shear stress; and $\bar{\varphi}_{ds}$ = Effective friction angle assuming zero cohesion.

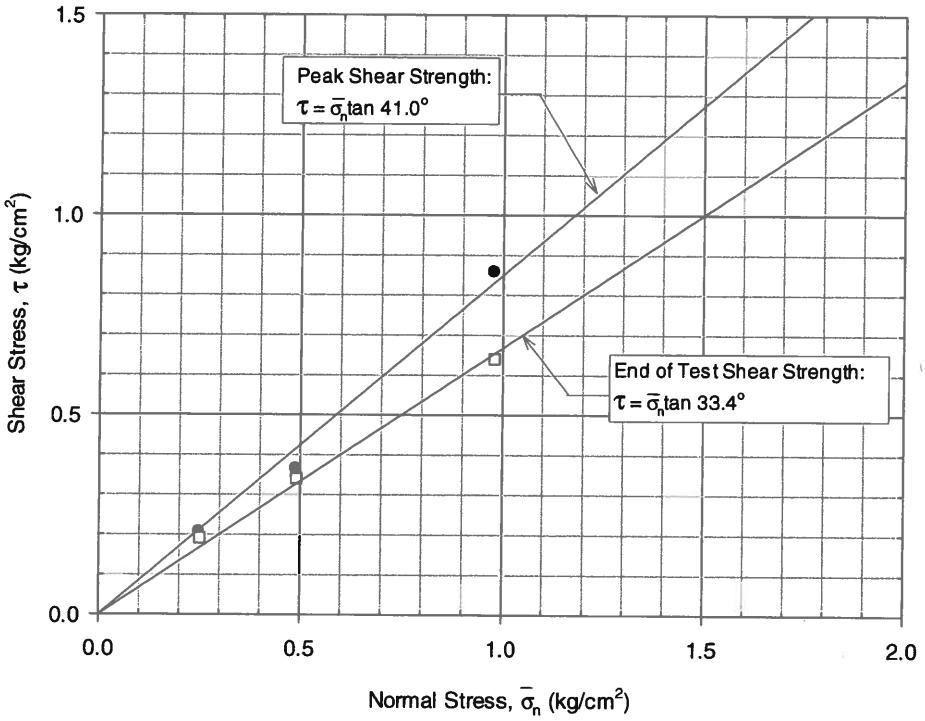
Checked By: JCW Date: 10/18/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST
MOHR-COULOMB FAILURE ENVELOPE

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 08/16/13-08/20/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: -
SAMPLE: **Grab Sample Composite 2MS**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION NO.: 130084/2MS
SAMPLE DESCRIPTION: Brown sand with shell (SP).
Pre-shear average γ_d = 105.6 lb/ft^3.



Sample	Normal Stress $\bar{\sigma}_n$ (kg/cm^2)	Peak Shear Strength τ (kg/cm^2)	End of Test Strength τ (kg/cm^2)
2MS	0.25	0.21	0.19
	0.49	0.37	0.34
	0.98	0.86	0.64

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Checked By: JM Date: 09/23/13

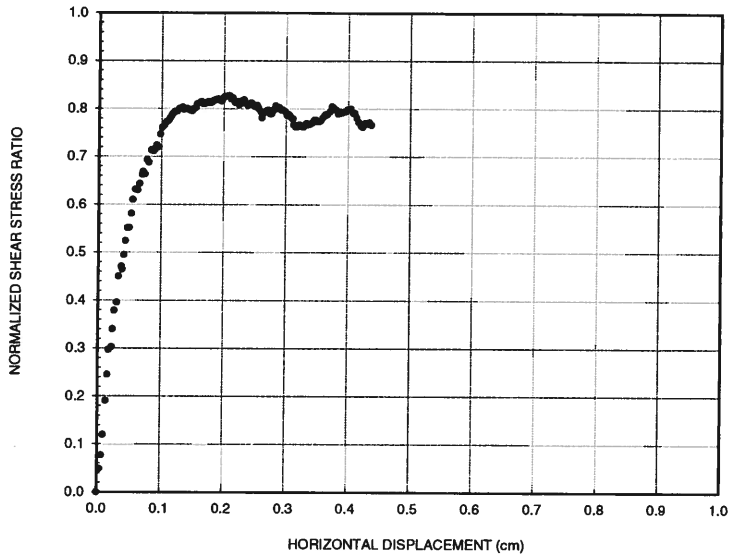
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 08/16/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: -
SAMPLE: **Grab Sample Composite 2MS**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION NO.: 130084/2MS
SAMPLE DESCRIPTION: Brown sand with shell (SP). Target initial dry density equaled 105 lb/ft^3.

Initial Specimen Conditions						Normal Stress, $\bar{\sigma}_n$ (kg/cm^2)	Pre-Shear Conditions			Final Specimen Conditions			
WDS (g)	H (cm)	D (cm)	w_c (%)	γ_d (lb/ft^3)	S (%)		γ_d (lb/ft^3)	ε_{vc} (%)	t_c (hours)	w_c (%)	γ_d (lb/ft^3)	S (%)	ε_{vs} (%)
125.00	2.79	5.83	10.1	104.8	46	0.25	105.0	-0.2	0.4	19.7	103.9	88	+1.0



Test Methods & Procedures

☒ ASTM Standard D3080
☐ Other:

Specimen Type: ☒ Circular ☐ Square
Sample Type: ☐ Undisturbed ☒ Compacted

Test Conditions

Normal Stress Loading Sequence:
0.25 kg/cm^2
kg/cm^2
kg/cm^2
kg/cm^2
Inundated at 0.25 kg/cm^2
Displacement Rate: 0.36 cm/hour

Peak Shear Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.21	0.827	39.6

End of Test Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.44	0.767	37.5

G_s : 2.65 ☒ Assumed ☐ Measured

Particle-Size Analysis
☐ ASTM D422
☒ ASTM D1140-Method B

U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g) 125.00										
Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	0.6

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Where: WDS = Specimen dry mass; H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; G_s = Specific gravity; $\bar{\sigma}_n$ = Normal effective stress; ε_{vc} = Vertical strain during consolidation; ε_{vs} = Vertical strain during shear; t_c = Duration of final normal stress application prior to shear; γ_h = Horizontal displacement; τ = Shear stress; and $\bar{\varphi}_{ds}$ = Effective friction angle assuming zero cohesion.

Checked By: M Date: 09/23/13

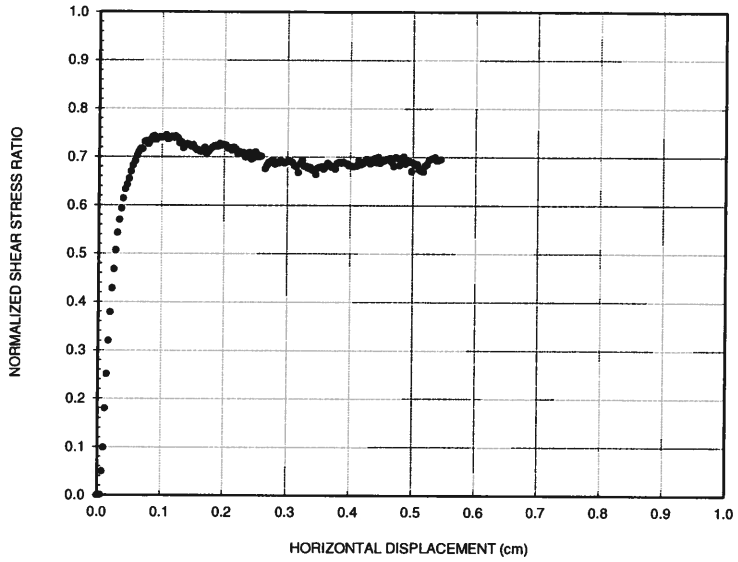
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT

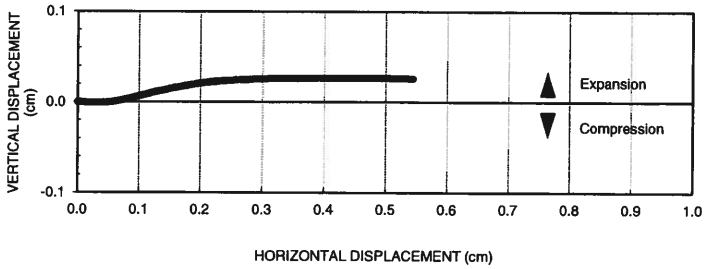
CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 08/16/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: -
SAMPLE: **Grab Sample Composite 2MS**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION NO.: 130084/2MS
SAMPLE DESCRIPTION: Brown sand with shell (SP).
Target initial dry density equaled 105 lb/ft^3.

Initial Specimen Conditions						Normal Stress, $\bar{\sigma}_n$ (kg/cm^2)	Pre-Shear Conditions			Final Specimen Conditions			
WDS (g)	H (cm)	D (cm)	w_c (%)	γ_d (lb/ft^3)	S (%)		γ_d (lb/ft^3)	ε_{vc} (%)	t_c (hours)	w_c (%)	γ_d (lb/ft^3)	S (%)	ε_{vs} (%)
126.16	2.79	5.83	9.1	105.8	43	0.49	106.1	-0.3	1.5	18.8	105.1	87	+0.9





Test Methods & Procedures

☒ ASTM Standard D3080
☐ Other: _____

Specimen Type: ☒ Circular ☐ Square
Sample Type: ☐ Undisturbed ☒ Compacted

Test Conditions

Normal Stress Loading Sequence:
0.16 kg/cm^2
0.49 kg/cm^2
_____ kg/cm^2
_____ kg/cm^2
Inundated at 0.16 kg/cm^2
Displacement Rate: 0.37 cm/hour

Peak Shear Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.11	0.745	36.7

End of Test Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.55	0.695	34.8

G_s : 2.65 ☒ Assumed ☐ Measured

Particle-Size Analysis
☐ ASTM D422
☒ ASTM D1140-Method B

U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g) 126.16 / Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	1.0

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Where: WDS = Specimen dry mass; H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; G_s = Specific gravity; $\bar{\sigma}_n$ = Normal effective stress; ε_{vc} = Vertical strain during consolidation; ε_{vs} = Vertical strain during shear; t_c = Duration of final normal stress application prior to shear; γ_h = Horizontal displacement; τ = Shear stress; and $\bar{\varphi}_{ds}$ = Effective friction angle assuming zero cohesion.

Checked By: _____ Date: 09/23/13

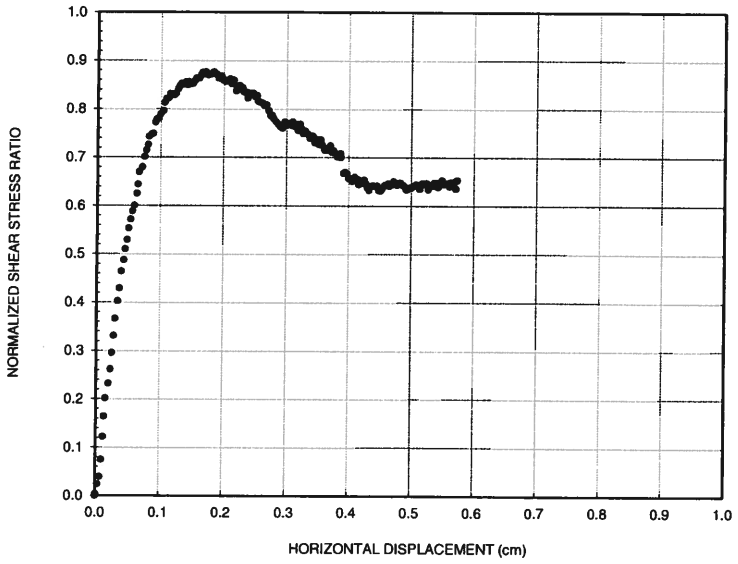
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 08/20/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: -
SAMPLE: **Grab Sample Composite 2MS**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION NO.: 130084/2MS
SAMPLE DESCRIPTION: Brown sand with shell (SP).
Target initial dry density equaled 105 lb/ft^3.

Initial Specimen Conditions						Normal Stress, $\bar{\sigma}_n$ (kg/cm^2)	Pre-Shear Conditions			Final Specimen Conditions			
WDS (g)	H (cm)	D (cm)	w_c (%)	γ_d (lb/ft^3)	S (%)		γ_d (lb/ft^3)	ε_{vc} (%)	t_c (hours)	w_c (%)	γ_d (lb/ft^3)	S (%)	ε_{vs} (%)
125.23	2.79	5.83	9.1	105.0	42	0.98	105.7	-0.7	1.6	20.5	104.9	94	+0.8



Test Methods & Procedures

☒ ASTM Standard D3080
☐ Other:

Specimen Type: ☒ Circular ☐ Square
Sample Type: ☐ Undisturbed ☒ Compacted

Test Conditions

Normal Stress Loading Sequence:
0.25 kg/cm^2
0.50 kg/cm^2
0.98 kg/cm^2
kg/cm^2
Inundated at 0.25 kg/cm^2
Displacement Rate: 0.36 cm/hour

Peak Shear Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.17	0.876	41.2

End of Test Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.57	0.653	33.2

G_s : 2.65 ☒ Assumed ☐ Measured

Particle-Size Analysis
☒ ASTM D422
☐ ASTM D1140-Method B

U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g) 125.23 / Soil Passing (%, dry mass basis)	100	100	98.4	94.2	80.3	45.0	9.9	1.8	0.9	0.5

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Where: WDS = Specimen dry mass; H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; G_s = Specific gravity; $\bar{\sigma}_n$ = Normal effective stress; ε_{vc} = Vertical strain during consolidation; ε_{vs} = Vertical strain during shear; t_c = Duration of final normal stress application prior to shear; γ_h = Horizontal displacement; τ = Shear stress; and $\bar{\varphi}_{ds}$ = Effective friction angle assuming zero cohesion.

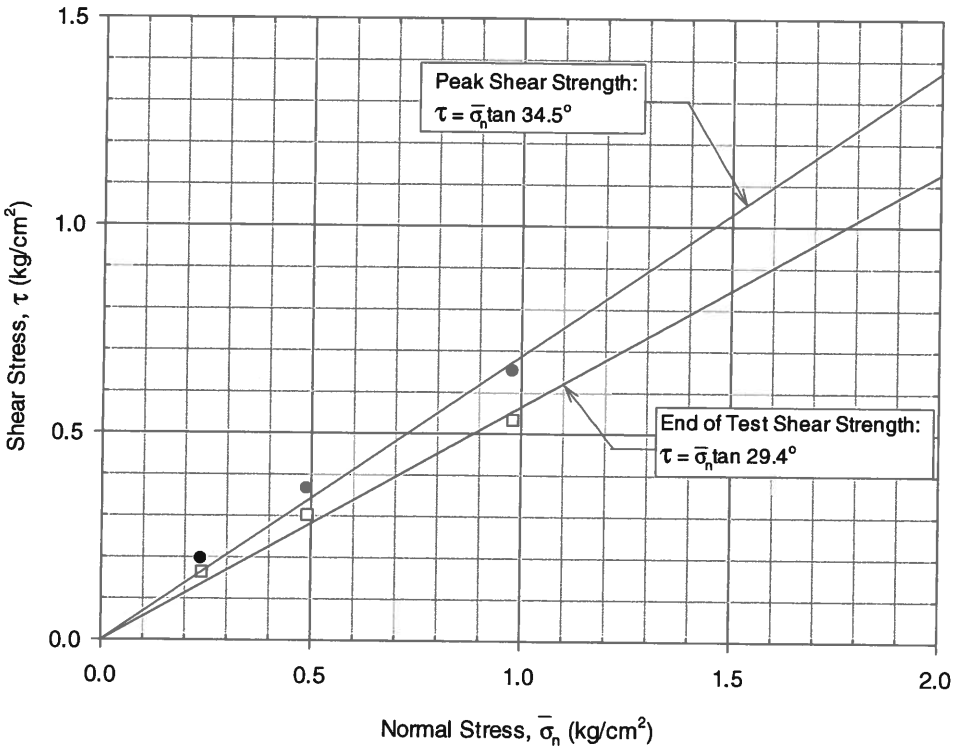
Checked By: _____ Date: 09/23/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST
MOHR-COULOMB FAILURE ENVELOPE

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 08/14/13-08/19/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: -
SAMPLE: **Grab Sample Composite 3FS**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION NO.: 130084/3FS
SAMPLE DESCRIPTION: Brownish-gray sand with shell (SP). Pre-shear average γ_d =97.3 lb/ft^3.



Sample	Normal Stress $\bar{\sigma}_n$ (kg/cm^2)	Peak Shear Strength τ (kg/cm^2)	End of Test Strength τ (kg/cm^2)
3FS	0.24	0.20	0.16
	0.49	0.36	0.29
	0.98	0.65	0.53

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Checked By: _____ Date: 09/23/13

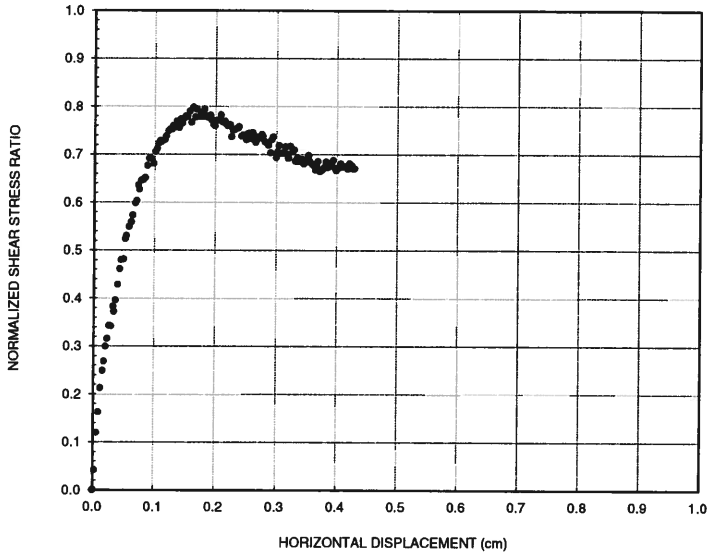
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT

CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 08/14/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: -
SAMPLE: **Grab Sample Composite 3FS**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION NO.: 130084/3FS
SAMPLE DESCRIPTION: Brownish-gray sand with shell (SP). Target initial dry density equaled 98 lb/ft^3.

Initial Specimen Conditions						Normal Stress, $\bar{\sigma}_n$ (kg/cm^2)	Pre-Shear Conditions			Final Specimen Conditions			
WDS (g)	H (cm)	D (cm)	w_c (%)	γ_d (lb/ft^3)	S (%)		γ_d (lb/ft^3)	ε_{vc} (%)	t_c (hours)	w_c (%)	γ_d (lb/ft^3)	S (%)	ε_{vs} (%)
114.05	2.79	5.83	13.6	95.6	49	0.24	96.0	-0.4	4.6	23.3	96.2	86	-0.1



Test Methods & Procedures

☒ ASTM Standard D3080
☐ Other:

Specimen Type: ☒ Circular ☐ Square
Sample Type: ☐ Undisturbed ☒ Compacted

Test Conditions

Normal Stress Loading Sequence:
0.24 kg/cm^2
kg/cm^2
kg/cm^2
kg/cm^2
Inundated at 0.24 kg/cm^2
Displacement Rate: 0.36 cm/hour

Peak Shear Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.16	0.798	38.6

End of Test Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.43	0.671	33.9

G_s : 2.65 ☒ Assumed ☐ Measured

Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☐ ASTM D422 ☒ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	114.05	Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	1.5

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Where: WDS = Specimen dry mass; H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; G_s = Specific gravity; $\bar{\sigma}_n$ = Normal effective stress; ε_{vc} = Vertical strain during consolidation; ε_{vs} = Vertical strain during shear; t_c = Duration of final normal stress application prior to shear; γ_h = Horizontal displacement; τ = Shear stress; and $\bar{\varphi}_{ds}$ = Effective friction angle assuming zero cohesion.

Checked By: _____ Date: 09/23/13

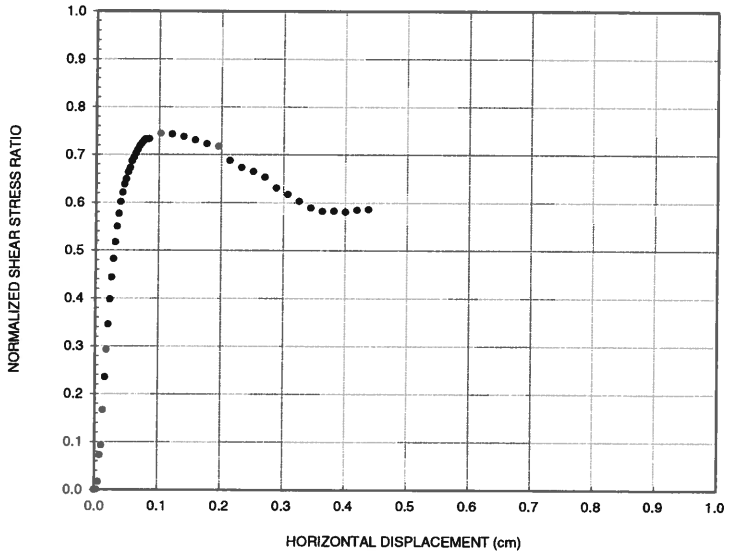
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT

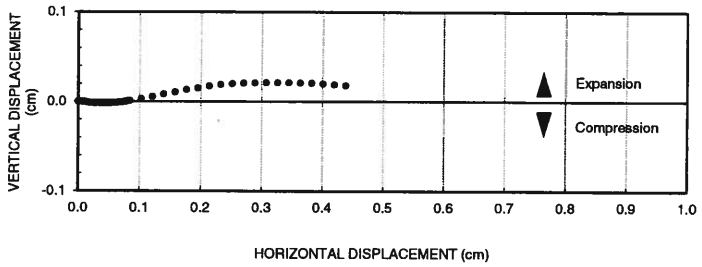
CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 08/14/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: -
SAMPLE: **Grab Sample Composite 3FS**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION NO.: 130084/3FS
SAMPLE DESCRIPTION: Brownish-gray sand with shell (SP). Target initial dry density equaled 98 lb/ft^3.

Initial Specimen Conditions						Normal Stress, $\bar{\sigma}_n$ (kg/cm^2)	Pre-Shear Conditions			Final Specimen Conditions			
WDS (g)	H (cm)	D (cm)	w_c (%)	γ_d (lb/ft^3)	S (%)		γ_d (lb/ft^3)	ε_{vc} (%)	t_c (hours)	w_c (%)	γ_d (lb/ft^3)	S (%)	ε_{vs} (%)
114.96	2.79	5.83	12.7	96.4	47	0.49	96.7	-0.4	3.1	21.6	96.2	80	+0.5





Test Methods & Procedures

☒ ASTM Standard D3080
☐ Other: _____

Specimen Type: ☒ Circular ☐ Square
Sample Type: ☐ Undisturbed ☒ Compacted

Test Conditions

Normal Stress Loading Sequence:
0.16 kg/cm^2
0.49 kg/cm^2
_____ kg/cm^2
_____ kg/cm^2
Inundated at 0.16 kg/cm^2
Displacement Rate: 0.37 cm/hour

Peak Shear Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.10	0.745	36.7

End of Test Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.44	0.586	30.4

G_s : 2.65 ☒ Assumed ☐ Measured

Particle-Size Analysis
☐ ASTM D422
☒ ASTM D1140-Method B

U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g) 114.96 / Soil Passing (%, dry mass basis)	-	-	-	-	-	-	-	-	-	1.9

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Where: WDS = Specimen dry mass; H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; G_s = Specific gravity; $\bar{\sigma}_n$ = Normal effective stress; ε_{vc} = Vertical strain during consolidation; ε_{vs} = Vertical strain during shear; t_c = Duration of final normal stress application prior to shear; γ_h = Horizontal displacement; τ = Shear stress; and $\bar{\varphi}_{ds}$ = Effective friction angle assuming zero cohesion.

Checked By: _____ Date: 09/23/13

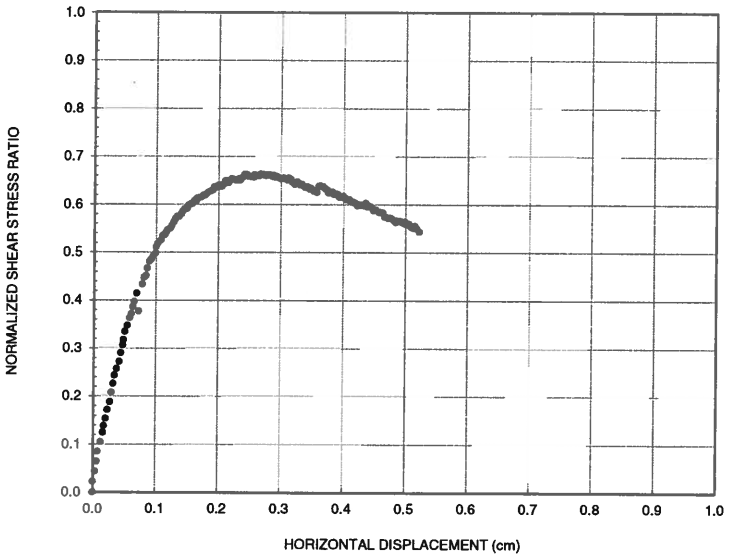
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
CONSOLIDATED DRAINED DIRECT SHEAR TEST REPORT

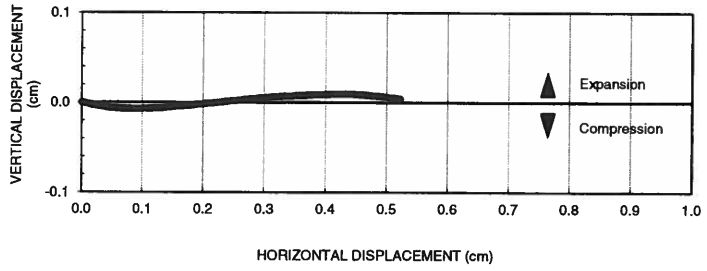
CLIENT: **Dominion**
PROJECT: VOWTAP
FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/23/13
DATE TEST SET-UP: 08/19/13
DATE REPORTED: 09/23/13

INCOMING SAMPLE NO.: -
SAMPLE: **Grab Sample Composite 3FS**
DEPTH: - ☐ ft; ☐ m
LABORATORY IDENTIFICATION NO.: 130084/3FS
SAMPLE DESCRIPTION: Brownish-gray sand with shell (SP) . Target initial dry density equaled 98 lb/ft^3.

Initial Specimen Conditions						Normal Stress, $\bar{\sigma}_n$ (kg/cm^2)	Pre-Shear Conditions			Final Specimen Conditions			
WDS (g)	H (cm)	D (cm)	w_c (%)	γ_d (lb/ft^3)	S (%)		γ_d (lb/ft^3)	ε_{vc} (%)	t_c (hours)	w_c (%)	γ_d (lb/ft^3)	S (%)	ε_{vs} (%)
117.45	2.79	5.83	10.3	98.4	40	0.98	99.1	-0.6	1.0	24.0	98.9	95	+0.1





Test Methods & Procedures

☒ ASTM Standard D3080
☐ Other:

Specimen Type: ☒ Circular ☐ Square
Sample Type: ☐ Undisturbed ☒ Compacted

Test Conditions

Normal Stress Loading Sequence:
0.25 kg/cm^2
0.50 kg/cm^2
0.98 kg/cm^2
kg/cm^2
Inundated at 0.25 kg/cm^2
Displacement Rate: 0.36 cm/hour

Peak Shear Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.27	0.664	33.6

End of Test Strength

γ_h (cm)	$\tau/\bar{\sigma}_n$	$\bar{\varphi}_{ds}$ (deg)
0.52	0.544	28.5

G_s : 2.65 ☒ Assumed ☐ Measured

Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☒ ASTM D422 ☐ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	117.45	Soil Passing (%, dry mass basis)	100	100	100	99.7	98.7	93.4	56.0	20.1	7.9	1.5

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Where: WDS = Specimen dry mass; H = Specimen height; D = Specimen diameter; w_c = Water content (ASTM D2216); γ_d = Dry density; S = Saturation; G_s = Specific gravity; $\bar{\sigma}_n$ = Normal effective stress; ε_{vc} = Vertical strain during consolidation; ε_{vs} = Vertical strain during shear; t_c = Duration of final normal stress application prior to shear; γ_h = Horizontal displacement; τ = Shear stress; and $\bar{\varphi}_{ds}$ = Effective friction angle assuming zero cohesion.

Checked By: TM Date: 09/23/13

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
HYDRAULIC CONDUCTIVITY TEST REPORT

CLIENT: **Dominion**

PROJECT: VOWTAP

FILE NO.: 13-13-0084

DATE SAMPLE RECEIVED: 06/27/13 SET UP: 08/16/13

DATE REPORTED: 09/23/13

ASTM D2434 TEST METHOD (Constant Head)

PERMEANT: ☒ Deaired Tap Water ☐ Other _____

G_s: 2.65 ☒ Assumed ☐ Measured

LABORATORY SAMPLE NO.: **Turbine Core Composite Gravel Sample**

LABORATORY IDENTIFICATION NO.: 130084/4

SAMPLE DESCRIPTION: Gray and brown gravel with sand and shell (GW)

SPECIMEN PREPARATION		
☒ Compacted	☒ Layers	No. of Layers 1
	☐ Kneading:	No. of Lifts _____ Spring _____ lb. Blows per Lift _____
☐ Other		

Specimen Conditions								Test Conditions		Hydraulic Conductivity
H (cm)	D (cm)	V (cm^3)	WDS (g)	w_c (%)	γ_d (pcf)	e	D_r (%)	i_{avg}	Q (cm^3)	k_{20} (cm/sec)
12.74	11.40	1,300.4	2,383.1	16.8	114.4	0.446	---	0.04	514	1.0
12.38		1,263.4		15.3	117.8	0.405	---	0.18	231	0.18

COMMENTS: Specimen vibrated within the permeameter after the end of the initial test to produce a denser specimen. Permeability test was then repeated at the higher dry density.

Particle-Size Analysis		U.S. Standard Sieve Size	Gravel			Coarse Sand	Medium Sand		Fine Sand			
☒ ASTM D422 ☐ ASTM D1140-Method B			3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Dry Mass (g)	1,212.93	Soil Passing (%, dry mass basis)	100	75.5	48.9	32.0	25.5	17.8	8.0	4.8	3.2	1.8

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records of each project are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Where: H = Specimen height; D = Specimen diameter; V = Volume; WDS = Dry mass; w_c = Water content (ASTM D2216); γ_d = Dry density;e = Void ratio; D_r = Relative density; i_{avg} = Average hydraulic gradient; Q = Flow volume; k_{20} = Saturated hydraulic conductivity at 20°C; and G_s = Specific gravity.

Checked By: _____ Date: 09/23/13

Form SR-2D: Rev. 0

Attachment H-1

Attachment H-2

Attachment H-3

Attachment H-4

Attachment H-5