FEASIBILITY REPORT
AND
ENVIRONMENTAL ASSESSMENT

WILMINGTON HARBOR NAVIGATION IMPROVEMENTS
Appendix C - Geotechnical Engineering

June 2014

**US Army Corps
of Engineers**

Wilmington District

Appendix C

Geotechnical Engineering

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1.0 Introduction

The alternatives that are being evaluated in this study are the widening and/or relocation of the Turning Basin, Battery Island Turn, and the Entrance Channel near Bald Head Island (Figure 1). The alternatives are evaluated using a variety of methods, which include historical data compilation, subsurface investigations, laboratory testing, and seepage and stability analyses using GeoStudio software. The viability of widening the Turning Basin is evaluated based on determining the potential impacts to the Southern Wood Piedmont and North Carolina State Ports Authority properties, which contain groundwater and soil contaminants on the east side of the river, and slope stability of Eagle Island dikes on the west side of the river. Dredged material disposal options for all three alternatives were evaluated using subsurface investigations, top of rock elevation determinations, and grain size analyses of unconsolidated material.

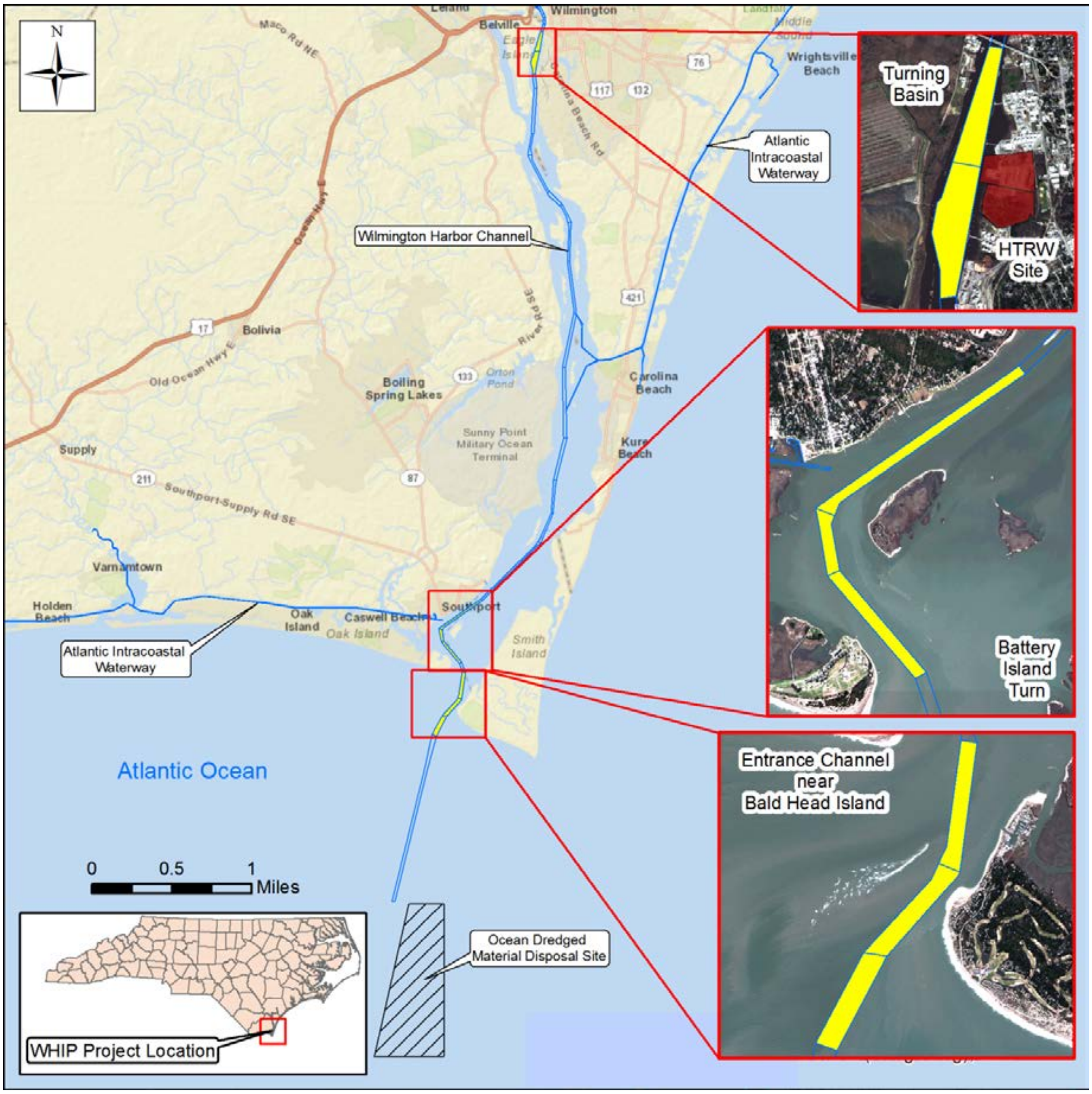

Figure 1. Wilmington Harbor Project vicinity map showing Turning Basin, Battery Island Turn, and Entrance Channel near Bald Head Island.

1.1 Description of Proposed Project and Alternatives

1.1.1 Turning Basin

The current size of container vessels that call on the port of Wilmington are up to 965 feet long and 107 feet wide (beam). These ships are referred to as Panamax size ships and are 100 feet longer than the design vessel accommodated in the 1996 project modifications. The existing Turning Basin provides a width of 1200 feet, which is inadequate for the larger post-Panamax container vessels. *Post-Panamax* or *over-Panamax* denotes vessels larger than Panamax vessels that do not fit in the Panama Canal, therefore are unable to call on the port. The Project Delivery Team (PDT) considered two options to increase the size of the turning basin. The first option involves creating a new 1450 feet wide turning basin, approximately 2 miles south of the existing one, at the confluence of the Brunswick and Cape Fear Rivers. This option has been excluded because of buried utility lines that would have to be relocated and vessels docked north of the turning basin would have to transit backwards 2 miles downstream before being able to turn. The second option consisted of widening the existing Turning Basin to 1450 feet, and the length would remain 1000 feet. In addition, the depth of the Turning Basin would remain as authorized at 42 feet plus the 1 foot required depth[1], plus 2 feet of allowable overdepth below mean low water[2].

1.1.2 Battery Island Turn

Battery Island Channel is adjoined by the Lower Swash Channel to the northwest and by the Southport Channel to the southeast. The Battery Island Turn is problematic for the larger container vessels currently calling on the Port of Wilmington. Transiting vessels often are delayed, as there are draft restrictions under certain conditions for wind and tide. Realigning or widening the Battery Island Turn has the potential to improve navigation safety and efficiency and reduce vessel delays.

1.1.3 Entrance Channel near Bald Head Island

The current Bald Head Shoal Channel alignment, located west of Bald Head Island and adjoining the Smith Island Channel, has proven susceptible to rapid and persistent shoaling. Increasing the distance between the Baldhead Shoal Channel area and Bald Head Island may reduce future maintenance costs, improve overall reliability, and increase full channel availability.

2.0 Regional and Site Geology

The Wilmington Harbor Project is located in the Atlantic Coastal Plain Physiographic Province (Figure 2). The project area is part of the Outer Coastal Plain of the Carolinas and has elevations less than 100 feet above Mean Sea Level (MSL). The low relief of the region tends to preserve the depositional pattern produced by eustatic sea-level fluctuation and shoreline migration. Erosional scarps and ancient marine terraces, which formed between depositional cycles, are distinct and the units they contain may only be mapped locally on the basis of elevation. The marine transgressive deposits are relatively thin and discontinuous, while regressive sequences predominate the area. Steadily migrating to the southwest over time, the Cape Fear River has

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[1] The 1 foot required overdepth is due to the presence of rock for safety clearance purposes.

[2] After the initial construction, future maintenance dredging of the Turning Basin will be to 42 feet plus 2 feet of allowable overdepth.

deposited considerable fluvial sediments as it drains the Piedmont and erodes the Coastal Plain marine terraces. River terrace deposits generally consist of fine, poorly-graded sands capping a fining-upward sequence of sandy fluvial sediments, which in turn overlie Cretaceous marine and deltaic silty sands, clays, and limestone (Soller, 1988).

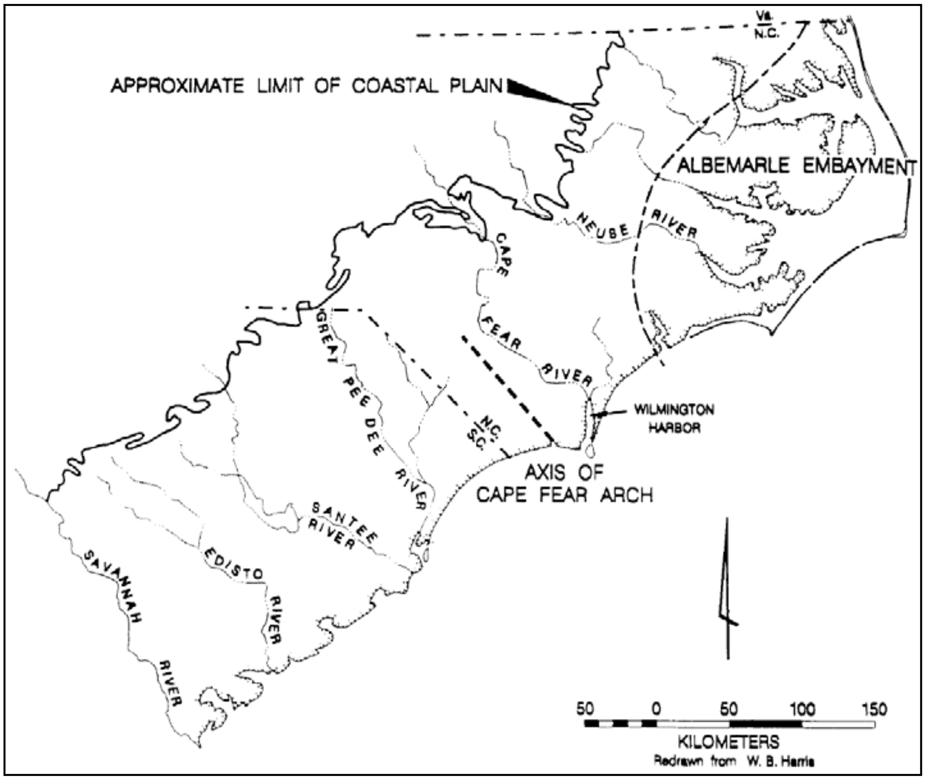

Figure 2. Project site location as it relates to the geological setting of the coastal plain, NC-SC.

The pattern of marine and fluvial terrace deposits results in a relatively flat or gently seaward sloping topography. Although the upland areas surrounding the project site are generally between 30 and 40 feet above MSL, the maximum relief is 80 feet, represented by high dune deposits in Wilmington, NC. There are some areas of localized karst terrain, where dissolution of the underlying limestone bedrock has resulted in sinkhole development.

The lithologic units that underlie Wilmington Harbor have largely been identified and described through previous rock coring operations. These units were originally described in the Final Feasibility Report and Environmental Impact Statement for the Cape Fear-Northeast Cape Fear Rivers Comprehensive Study conducted in 1996. The units include, from oldest to youngest, the Cretaceous Peedee Formation, the Upper Cretaceous Rocky Point Member of the Peedee Formation, a Lower Paleocene unit that was informally designated “olive sand”, a Paleocene or Lower Eocene unit that was informally designated “turritellid limestone”, the Eocene Castle Hayne Formation, the Oligocene Trent Formation, and the Pleistocene Waccamaw Formation. The Peedee Formation comprises the bedrock underlying Wilmington Harbor from the northern Federal Project limit to the southern end of Lower Brunswick Channel. Rock cores taken from the Turning Basin indicate that the Rocky Point Member is present in areas that are not heavily eroded.

The only bedrock unit underlying the Lower Swash and Battery Island channels is the Castle Hayne Formation. Little is known of the bedrock underlying Battery Island, Southport, Baldhead-Caswell, and Smith Island channels. Baldhead Shoals channel is underlain by the turritellid limestone unit to Sta. (station) 220+00, and by the Castle Hayne Formation southward to the mouth of the entrance channel. Detailed description of all units within Wilmington Harbor, their stratigraphic relationships, textural features and lithology can be found in Zullo et al. 1992 & 1993. The bedrock formations that were encountered during previous subsurface investigations indicate that the Turning Basin is underlain by bedrock belonging to the Peedee Formation and its uppermost stratum, the Rocky Point Member.

The Peedee Formation is described as consisting of interbedded silty sand (SM) or clayey sand (SC), and sandy limestone. The thickness of the limestone varies from a few inches thick to several feet thick. Cementation and hardness, as determined from unconfined compressive strength, varies from a few hundred pound-force per square inch (psi) to several thousand psi. The Peedee Formation is a moderately hard to hard, light gray to gray, fine to medium grained, sandy, fossiliferous limestone that is porous and vuggy. The rock cores recovered during drilling operations display variable degrees of fracturing; fractures may be clean or in-filled with sand or clay. The Peedee Formation is conformably overlain by the slightly younger Rocky Point Member, that were preserved and not removed by erosion.

The Rocky Point Member forms the uppermost unit of the Peedee Formation, and was initially recognized in core borings taken in 1994. These borings were drilled within Lower Brunswick, Upper Big Island, and Snows Marsh channel. Later drilling operations conducted in 1998 revealed that the Rocky Point Member was also present within the Turning Basin, but was not recognized by the earlier work. The Rocky Point Member is a moderately hard to hard, gray, fine to coarse grained, sandy, moldic limestone. The rock contains zones of closely spaced fractures which are either open and filled with sand or cemented with calcite.

The depth of the top of the rock (TOR) varies depending upon the location. Inside the authorized U.S. Army Corps of Engineers (USACE) navigation Turning Basin range, the approximate top of rock (TOR) elevation ranges between -44.0 to -55.8 ft MLLW (ft). The assumed TOR values outside of the authorized USACE navigation channel (between the east side of Eagle Island and the west side of the Turning Basin range, ranges from elevations -16.1 to -50.9 ft MLLW (ft).

3.0 Investigations

3.1 Turning Basin

3.1.1 Remedial Investigation Results for the North Carolina State Ports Authority Southern Wood Piedmont Site

Widening of the Turning Basin required an initial evaluation of an adjacent area referred to as the North Carolina State Ports Authority Southern Wood Piedmont Site (Figure 3). After evaluation, the North Carolina State Ports Authority Southern Wood Piedmont Site was eliminated from further consideration for Turning Basin Widening. It was found that the sediment along the waterfront of the Southern Wood Piedmont facility is contaminated primarily with arsenic and polycyclic aromatic hydrocarbons (PAHs) (byproducts of petroleum processing or combustion). Most of the site has contamination that is slightly above the U.S. Environmental Protection Agency (USEPA) regional preliminary remediation goals (PRGs), but there are some isolated areas that are contaminated well above the PRGs for arsenic and PAHs. Several of the areas that are well above the PRGs are within 50 feet of the waterfront. Generally, the contaminated soil between 50 and 150 feet of the waterfront is slightly above the PRGs. In addition, the contaminated areas well above the PRG for dioxins and furans have been detected in the soil within 200 feet of the waterfront. Since these contaminants are within the area to be excavated, hazardous waste management may be required prior to any site modification. For a complete description of the investigations and results, see the reports, "Supplemental Remedial Investigation Report, Southern Wood Piedmont and North Carolina State Ports Authority Site, Wilmington, New Hanover County, North Carolina, NCD 058 517 467" dated October 30, 2001 and "Additional DNAPL and Groundwater Delineation Supplemental Remedial Investigation Report Southern Wood Piedmont and North Carolina State Ports Authority Site, Wilmington, New Hanover County, North Carolina, NCD 058 517 467" dated July 31, 2003.

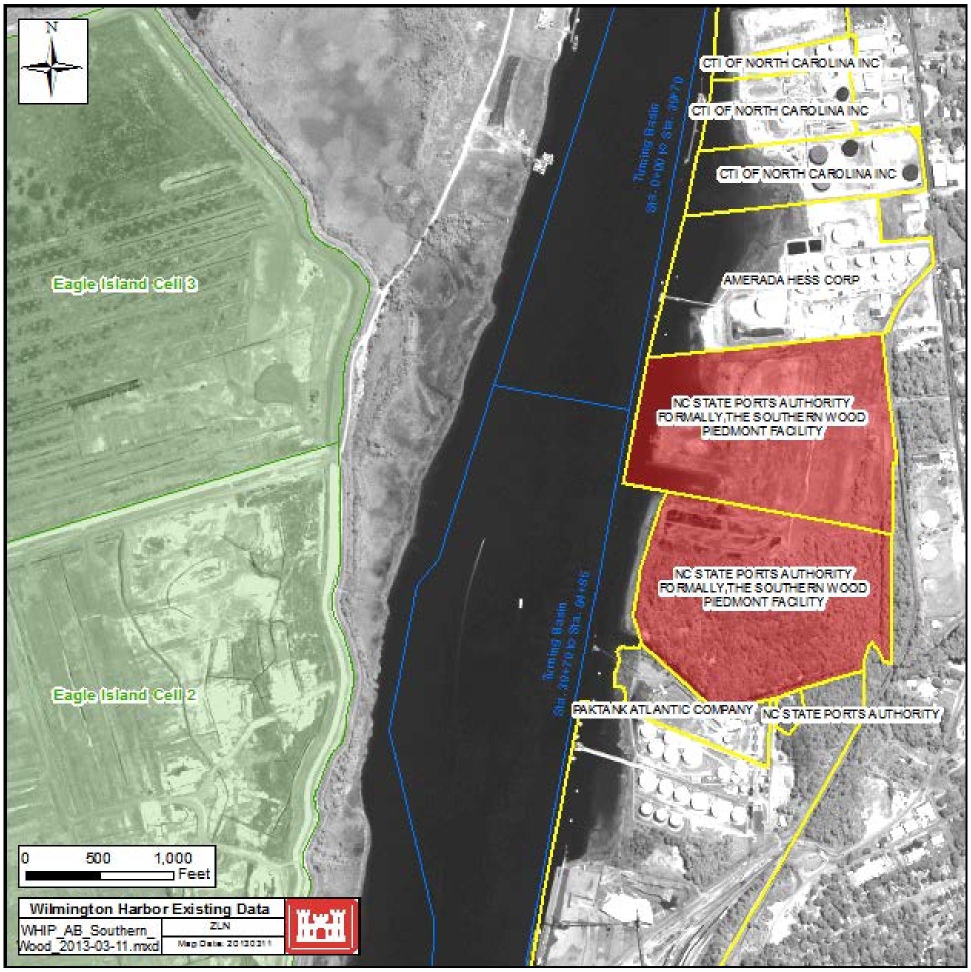

Figure 3. HTW Site Location.

3.1.2 Subsurface Data

A total of 51 borings have been collected within the Turning Basin between Sta. 0+00 and Sta. 39+70 since 1993 (Figure 4). Of the 51 borings, 34 were washprobes. Washprobes are used in determining the elevation of the refusal surface. The elevation of the top of bedrock may be inferred from the washprobe refusal; however, refusal can also result from encountering resistant cemented-compacted soils or buried objects. The results from a washprobe survey should always be compared to borings, where sampling has been conducted. The remaining borings include 15 rock cores and two Standard Penetration Test (SPT) borings. Between Sta. 39+70 and Sta. 84+85, 115 borings have been collected since 1993 (Figure 5). Most of the borings collected were washprobes. From previous dredging within the Turning Basin navigation channel, the top of bedrock ranges from elevations -44.0 to -55.8 feet MLLW (ft) and sediment generally consist of silts and organic material (MH-OH), well-graded sand (SW) and silty gravel (GM).

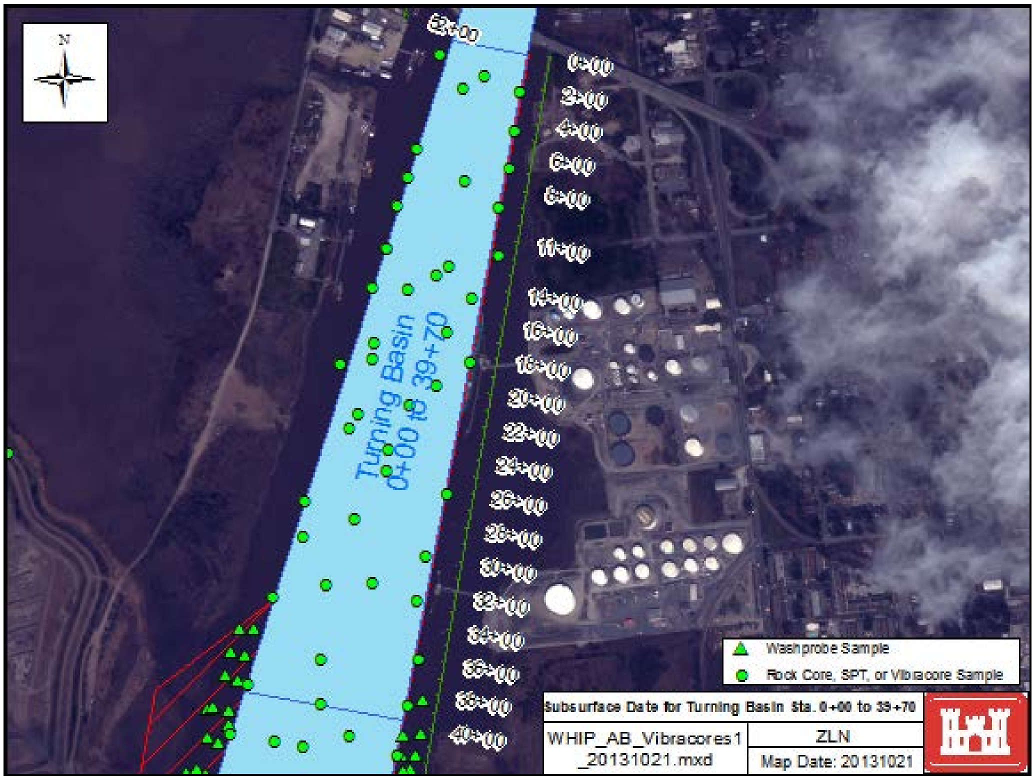

Figure 4. Subsurface Data for Turning Basin Sta. 0+00 to Sta. 39+70.

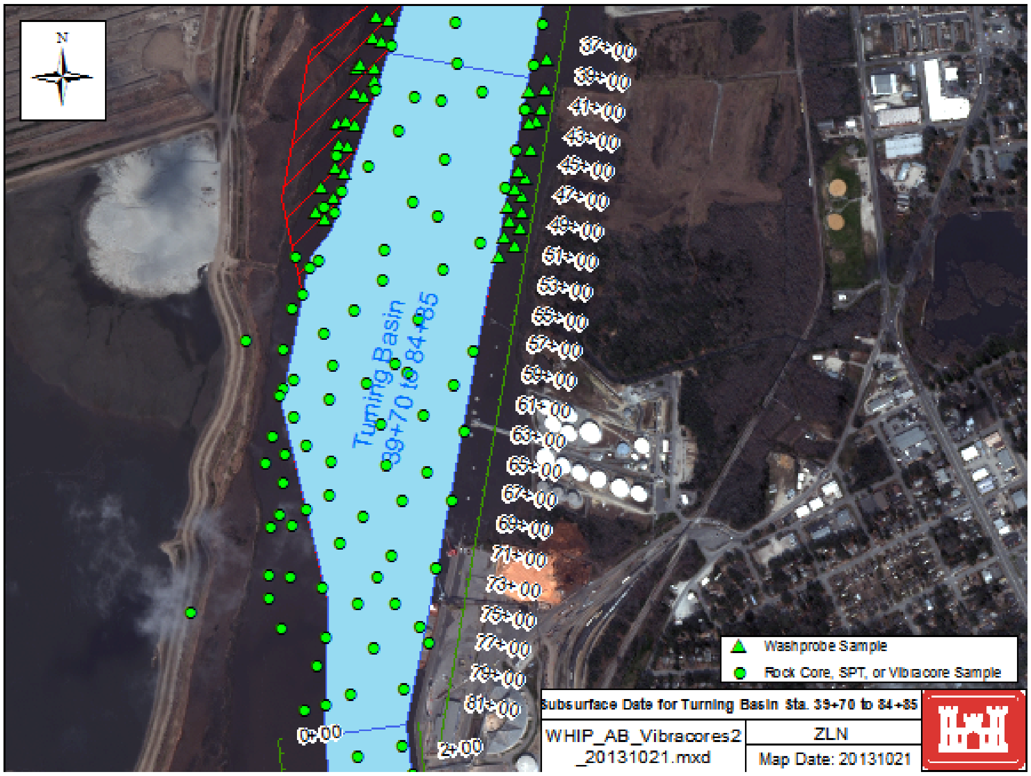

Figure 5. Subsurface Data for Turning Basin Sta. 39+70 to Sta. 84+85.55.

The assumed top of rock values outside of the Turning Basin navigation channel were derived by calculating the Mean Lower Low Water (MLLW) elevation minus the refusal depth encountered by washprobe penetration. The survey-grade HYPACK navigation system on the USACE Vessel *SNELL* was used to determine washprobe coordinates. Table 1 shows the river bottom elevation and the assumed top of rock obtained from the washprobes performed on 10 July 2012 within the proposed Turning Basin widening. Because the washprobes were collected outside of the authorized channel, recent deepening in 2013 did not affect top-of-rock elevations.

Table 1. Washprobe data collected outside of the authorized Turning Basin navigation channel and within proposed Turning Basin project.

Hole Number	MLLW (feet)		NC State Plane Feet Coordinates	
	River Bottom	Assumed Top of Rock	Northing (N)	Easting (E)
WH12-P-1	-15.22	-36.5	2314985	170424
WH12-P-2	-34.32	-50	2315317	171330
WH12-P-3	-23.58	-36.9	2315463	171892
WH12-P-4	-22.22	-34	2315412	171731
WH12-P-5	-25.77	-40.5	2315251	171226
WH12-P-6	-21.47	-34.7	2315313	171414
WH12-P-7	-22.96	-35.3	2315366	171593
WH12-P-8	-19.54	-36.5	2315185	171038
WH12-P-9	-21.2	-36.6	2315141	170901
WH12-P-10	-27.23	-49	2315117	170731
WH12-P-11	-27.89	-37.4	2315047	170565
WH12-P-12	-3.64	-50.5	2315375	171890
WH12-P-13	-4.94	-44.2	2315332	171755
WH12-P-14	-5.21	-34.8	2315301	171618
WH12-P-15	-3.5	-22.2	2315228	171437
WH12-P-16	-4.17	-26.2	2315188	171257
WH12-P-17	-5.82	-35.8	2315130	171072
WH12-P-18	-6.03	-30.6	2315080	170909
WH12-P-19	-8.47	-38	2315056	170764
WH12-P-20	-6.68	-50.9	2314935	170463
WH12-P-22	-2.5	-44.4	2315194	171418
WH12-P-23	-2.81	-35.6	2315065	171050
WH12-P-48	-5.12	-16.1	2314963	170627

Spatial analysis using ArcMap was used to interpolate between the washprobes locations and to contour the refusal elevations. Figure 6 shows the presence of material that may potentially require rock dredging outside of the existing authorized Wilmington Harbor navigation channel.

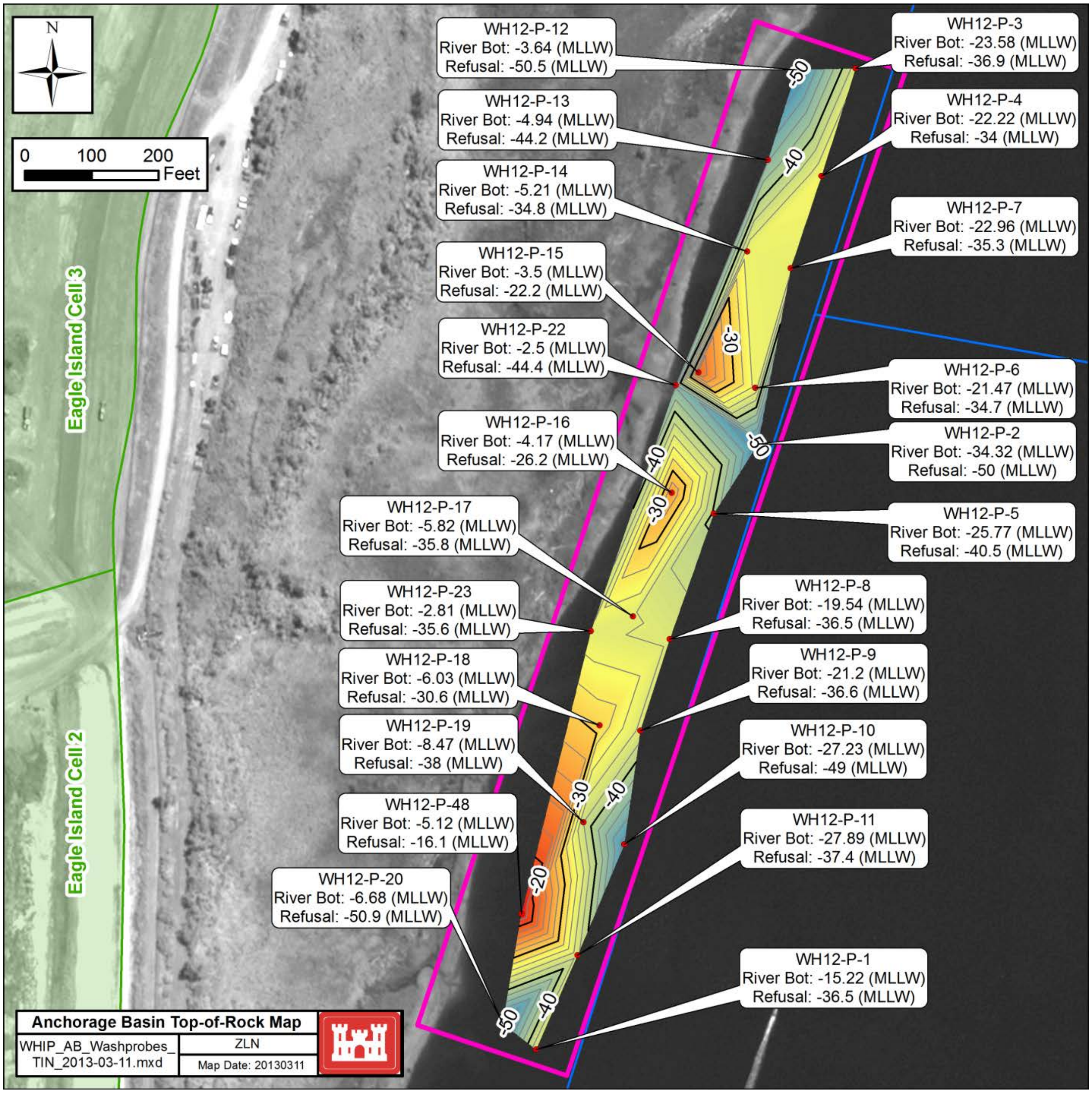

Figure 6. Proposed turning basin widening top-of-rock elevations.

3.1.3 Eagle Island

Eagle Island has been used as a dredge disposal area since the late 1970's and is the primary disposal site for dredged material from the upper portion of Wilmington Harbor. The USACE owns the 740-acre dredge disposal area. Currently, dredged material is disposed of in Cells 1, 2, and 3, which are approximately 220, 260 and 260 acres, respectively. The dikes at Eagle Island were constructed on a marsh foundation with an original elevation of approximately 7 feet NAVD88. The marsh foundation consists of soft deposits extending down to approximately

-38 feet NAVD88. Soil boring data indicate that the dredged material confined in cells 2 and 3 is over 20 feet thick in some areas and consists primarily of fine-grained, organic rich material, though there are some lenses of sand located along the eastern side of the disposal area.

Numerous subsurface investigations have been performed at Eagle Island since the 1970's. The most recent historical investigations include Cone Penetration Test (CPT) soundings acquired in 1999, SPT borings performed in 2004, and additional SPT borings performed in the vicinity of the failed area on the north side of Cell 3 in 2006. A typical borehole has 20 to 30 feet of soft silt or clay, a layer of sand ranging in thickness from 0.5 to 30 feet (average of 7.2 feet), and limestone bedrock. The strength of the foundation silt and clay is very low and ranges from approximately 150 psf to 1000 psf. There is a sand layer beneath cell 3 which starts at the approximate elevation of -30 feet NAVD88. The typical liquid limit values of the foundation soils range from 70 to 200 and natural moisture content ranges from 90 to 177 percent. It should be noted that soils with high liquid limits and high moisture contents contain a considerable amount of organics, which cause the soil to be light, compressible, drain very slow, and have low permeability.

From September through November 2011, a comprehensive subsurface investigation was performed by Terracon at Eagle Island. The data from this investigation were used to model stability of Eagle Island shown in Attachment 1. The investigation consisted of CPT, SPT, auger boring and bulk sampling, undisturbed sampling, piezometer installation, and in-place vane shear testing. Lab testing was also performed and included soil classification, sieve analysis, Atterberg limits, standard proctor tests, triaxial tests, and one-dimensional consolidation tests.

3.1.3.1 Field and Laboratory Test Results

Based on the CPT soundings and SPT borings, the correlation of soil behavior between the CPT sounding logs and the SPT borings are generally in agreement. The predominant soil types encountered within the embankment and the foundation are fine grained soils consisting of silts or clays, with varying organic content. The undrained shear strength of the fine grained materials calculated from the CPT soundings indicates that the materials are generally very soft to medium stiff in consistency. For a complete description of the investigations and the results, see the report, Geotechnical Report, Eagle Island Dredge Disposal Area, Contract W91236-09-D-0029 by Terracon.

The geometry for the seepage and slope stability cross-sections were analyzed in GeoStudio based on the topographic and planimetric survey conducted by Joyner Keeny, PLLC on 15 March 2012 titled: *Report of Survey on Topographic LiDAR Survey of the EAGLE ISLAND DISPOSAL AREA CELLS 1, 2, 3, and 4 Brunswick County, North Carolina* under Contract No. W912HN-10-D-0011, Task #14 and from the USACE Wilmington District, Turning Basin Condition Survey dated 15 November 2012.

Cross-section 1 is located on the southeast side of Cell 3 at Eagle Island Sta. 144+96 (Cape Fear River Turning Basin Sta. 42+50). The corresponding CPT locations used for the analysis were: CPT-14A, CPT-14B, CPT-14C, CPT-14D, and CPT-14E. Cross-section 2 is located approximately 813 feet south of cross-section 1 at Eagle Island Sta. 153+09 (Cape Fear River Turning Basin Sta. 50+00) on the northeast side of Cell 2. Because cross-section 2 is located approximately 300 feet south of CPT transect 4 and 690 feet north of CPT transect 5, the data for the corresponding hole (i.e. CPT soundings A, B, C, D, and E as shown in Figure 7) was combined and the lesser value of cohesion (C) at an elevation was input in the spatial function of SLOPE/W. The corresponding CPT locations used for the analysis at cross-section 2 were: CPT-4A & CPT-5A, CPT-4B & CPT-5B, CPT-4C & CPT-5C, CPT-4D & CPT-5D, and CPT-4E & CPT-5E. The complete result of CPT soundings at transects 4, 5, and 14 are located in the report, Geotechnical Report, Eagle Island Dredge Disposal Area, Contract W91236-09-D-0029 by Terracon.

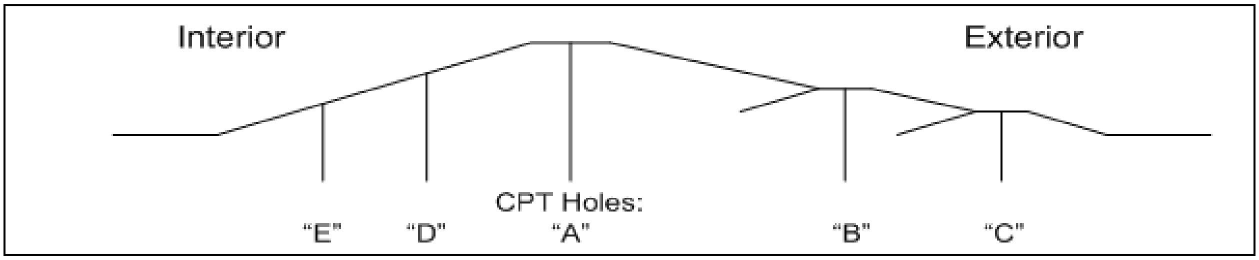

Figure 7. Typical CPT transects for cross-sections 1 and 2.

Cross-sections 1 and 2 were determined to be the most critical to analyze for the widening of the Turning Basin into Eagle Island due to proximity of the toe of the existing dikes to the proposed widening area. See Figure 8 for locations of the cross-sections analyzed in the seepage and stability analyses.

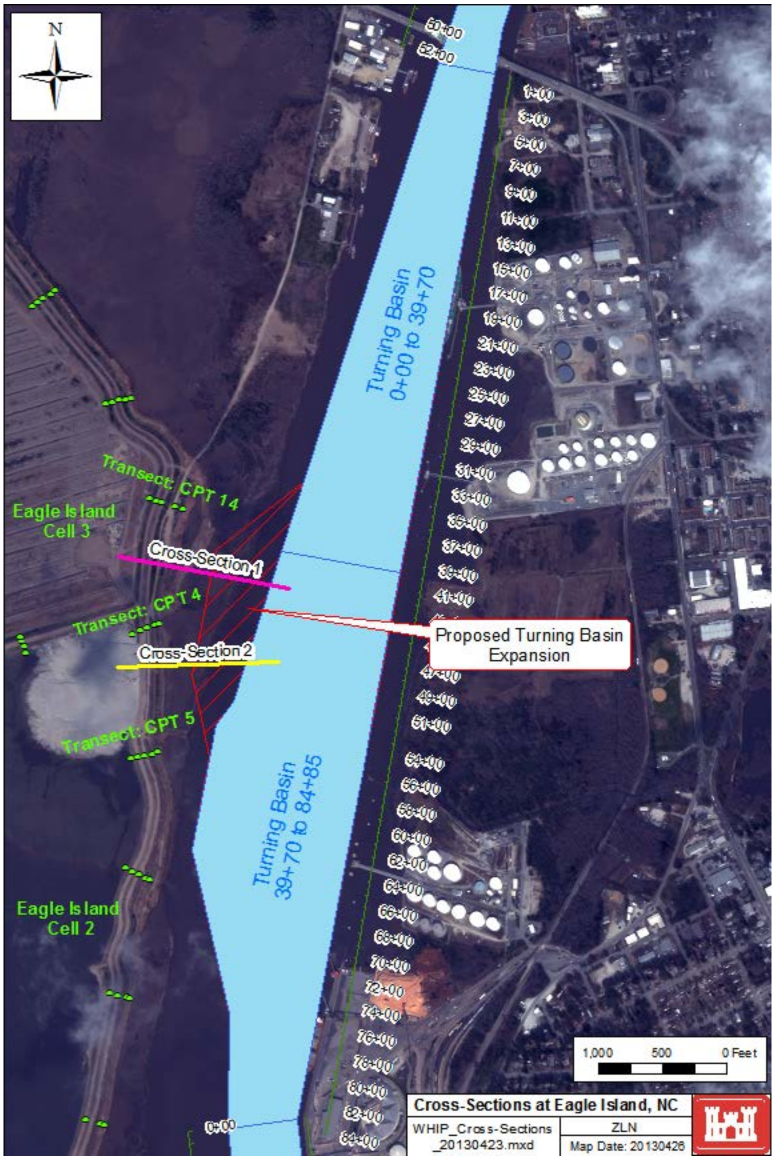

Figure 8. Locations of Cross-Sections Analyzed at Eagle Island, NC.

Grain size analysis, Atterberg limits testing, and visual engineering soil classification were performed on the SPT samples EI-2011-SPT-4 and EI-2011-SPT-14.

The U.S. sieve sizes were used for the grain size analyses were: 3 in., 1-1/2 in., 3/4 in., 3/8 in., No. 4, No. 8, No. 16, No. 30, No. 50, No. 100, and No. 200. The results of the sieve analyses are found in Attachment B, Figure 47 thru Figure 50.

The Atterberg limits tests are a series of tests that define the relationship between moisture content and soil consistency. This series include three separate tests: the liquid limit test, the plastic limit test, and the shrinkage limit test. The test results are expressed in terms of moisture content, with the percentage sign dropped: the liquid limit (LL) and plastic limit (PL). The results are then plotted against the plasticity index. The plasticity index (PI) is a measure of the range of moisture contents that encompass the plastic state. Soils with a large clay content retain this plasticity state over a wide range of moisture contents, and thus have a high plasticity index.

Clean sands and gravels are considered to be nonplastic (NP). The results of the Atterberg limits test for these samples can be found in Attachment B. Below, Tables 3 and 4 include summaries of the laboratory results for SPT borings EI-2011-SPT-4 and EI-2011-SPT-14.

Table 2. Summary of laboratory results for boring EI-2011-SPT-4.

Borehole	Elevation	Depth	Classification	Liquid Limit	Plastic Limit	Plasticity Index	% Sand	% Fines	Water Content (%)	Dry Density (pcf)	Organic Content (%)
EI-2011-SPT-4	30.0	3.0	SP-SM	NP	NP	NP	65	12	12		
EI-2011-SPT-4	23.0	10.0	MH	57	31	26		56	40		
EI-2011-SPT-4	16.5	16.5	MH	90	55	35		94	88		
EI-2011-SPT-4	7.5	25.5	CH	83	36	47		74	79		
EI-2011-SPT-4	1.0	32.0							66	60.4	
EI-2011-SPT-4	-4.0	37.0	MH	65	35	30	36	63	86	48.7	
EI-2011-SPT-4	-15.0	48.0	GW	NP	NP	NP	46	2	285		
EI-2011-SPT-4	-16.5	49.5							346		
EI-2011-SPT-4	-24.0	57.0	SP	NP	NP	NP	97	3	24		

Table 3. Summary of laboratory results for boring EI-2011-SPT-14.

Borehole	Elevation	Depth	Classification	Liquid Limit	Plastic Limit	Plasticity Index	% Sand	% Fines	Water Content (%)	Dry Density (pcf)	Organic Content (%)
EI-2011-SPT-14	28.5	4.5	SP-SM	NP	NP	NP	80	7	4		
EI-2011-SPT-14	21.0	12.0	SP-SM	NP	NP	NP	87	7	16		
EI-2011-SPT-14	3.0	30.0	SP	NP	NP	NP	96	4	27		
EI-2011-SPT-14	-4.0	37.0	MH	66	38	28	31	68	91	46.3	
EI-2011-SPT-14	-10.0	43.0	MH	76	38	38	10	90			
EI-2011-SPT-14	-16.5	49.5							415		38.3
EI-2011-SPT-14	-19.5	52.5	SM	75	45	30	53	38	100		
EI-2011-SPT-14	-24.0	57.0	SP	NP	NP	NP	97	3	24		
EI-2011-SPT-14	-30.0	63.0	SP-SM	NP	NP	NP	90	10	25		

Undisturbed sampling using a Shelby Tube, recovers soil completely intact and its in-place structure and stresses are assumed not modified in any way, making recovered samples desirable for laboratory test that depend on the structure of the soil. Such samples are ideal in consolidation tests and shear strength tests. Figure 9 is a photograph of an undisturbed soil sample labeled UD-14. This sample represents the corresponding boring hole, EI-2011-SPT-14, at transect 14. The elevation of the sample is from -4 feet to -6 feet MSL. Figure 10 shows all sample locations used in this analysis.

Figure 9. Photo of undisturbed sample UD-14.

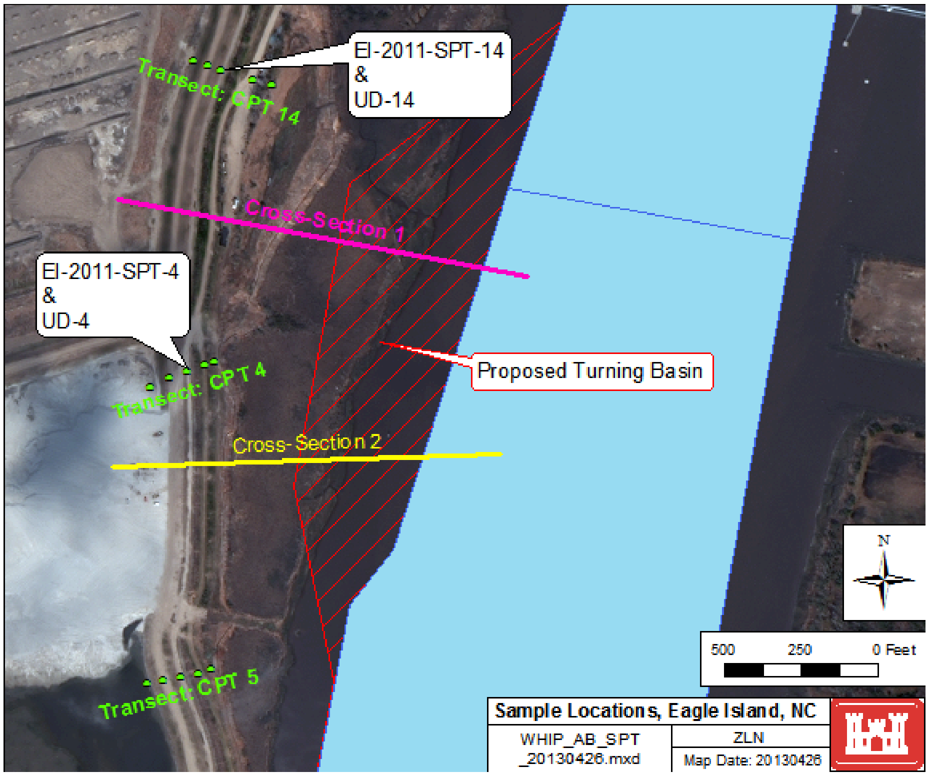

Figure 10. All sample locations used in the stability analysis.

The consolidated undrained (CU) triaxial shear (R) tests, with pore-pressure measured, were performed using material from the undisturbed sample UD-4. Each CU test consolidated the sample to a predetermined confining pressure. After reaching the predetermined confining pressure water is not allowed to drain from the sample and the axial load is increased on the sample. As the axial load increases the sample will eventual start to shear and will fail. During each test, the pore pressures were measured. The CU testing of UD-4 measured the total and effective strength parameters for three confining pressures. See the results in Attachment B, Figure 53 and Figure 54.

An unconsolidated undrained (UU) triaxial shear (Q) test was performed using material from sample UD-14. This test was performed to determine the undrained strength and the stress-strain material relationships. The UU test is performed similarly as the CU test except the test specimens are not allowed to drain during any part of the test. During the UU test, the specimen is sheared in compression at a constant rate of axial deformation as shown in Attachment B, Figure 55 and Figure 56.

One-Dimensional (1-D) Consolidation (S) testing was performed on material from cross-section 2, undisturbed sample UD-4 at elevation -4 feet to -6 feet NAVD88 and two undisturbed samples labeled UD-14 at cross-section 1, elevations -4 feet to -6 feet and -10 feet to -12 feet NAVD88. This consolidation test is used to determine the magnitude and time rate of consolidation of a laterally restrained soil sample. The results of the 1-D consolidation testing for UD-4 and UD-14 are shown in Attachment B, Figure 57, Figure 58, and Figure 59.

3.1.3.2 Design Shear Strengths

The design shear strength of the soils used in this analysis is presented in Table 4. The strength data for these soils are from laboratory test performed by Terracon. The tests corresponding to the drainage conditions are: unconsolidated-undrained (Q) tests, in which the water content is kept constant during the test; consolidated-undrained (R) tests, in which consolidation or swelling is allowed under initial stress conditions, but the water content is kept constant during application of shearing stresses; and consolidated-drained (S) tests in which full consolidation or swelling is permitted under the initial stress conditions and also for each increment of loading during shear.

Table 4. Design shear strengths for UD-4 and UD-14.

Borehole	Sample	Depth (ft)	Specimen	Water Content (%)		Saturation (%)		C (psf)		ϕ (degrees)	
				Initial	At Test	Initial	At Test	Total	Effective	Total	Effective
UD-4	1	37' - 39'	1	83.9	76.5	96.1	100	240	70.8	14.2	31.41[3]
UD-4	1	37' - 39'	2	81.5	72.4	99.5	100				
UD-4	1	37' - 39'	3	84.6	72	99.1	100				
UD-14	1	37' - 39'	1	81.5	81.5	100.8	100.8	848.9		0[4]	

3.1.3.3 Material Properties

The material properties for each material layer modeled using GeoStudio are listed in Table 5. For existing conditions, an example of the model geometry at cross-section 1 is shown in Figure 11, while an example of the cohesion spatial function is shown in Figure 13. The characteristics

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[3] Results obtained from (R) test with pore-pressure.

[4] Results obtained from (Q) test.

that distinguish the material properties for each soil layer (region) are the soil's unit weight, moisture content, and strength values, such as phi angle (angle of internal friction) and cohesive strength. In order to simplify the geometry, the foundation layers were combined into one layer and strength parameters were input using the cohesion spatial function option in SLOPE/W. The cohesion spatial function draws the contours based on points of known shear strength (s_u), derived from the CPT soundings collected in 2011. The unit weights of soil values (ɣ) used for the analyses are included in Table 6. Detailed cohesion spatial function shear strength points, related to depth, used in SLOPE/W for cross-sections 1 and 2 are represented in Attachment 1, Table 11 thru Table 24. Conservative minimum values were assumed in areas where data was not available. The shear strengths for both cross-sections were taken from SPT and CPT soundings. As a result, the model used to evaluate Eagle Island used 12 material layers.

Table 5. Material properties for soils used in analysis.

No.	**Material**	**Unit Weight ɣ (pcf)**	**Phi Angle ϕ (deg)**	**Cohesion C (psf)**
1	Sandy Clayey Silt	100	28	
2	Dredge Fill	80	150	
3	Silt Clay	Table 6		Function of the CPT Data
4	Foundation 1	110	28	
5	Foundation 2	125	32	
6	Marsh	85		150
7	River Muck	85		80
8	Dredge Fill Foundation	90		300
9	Silty Sand	95	28	
10	Elastic Silt	90		200
11	Poorly Graded Sand	115	30	
12	Foundation 3	120	35	

Table 6. Unit weight (ɣ) of soils values used in this analysis.

C (psi)	**ϕ (deg)**	**ɣ (pcf)**
0	28	100
0	32	125
100	0	75
150	0	80
200	0	86
250	0	86
280	0	88
300	0	90
350	0	90
400	0	95
500	0	100
550	0	100
600	0	105
700	0	110
800	0	110
1000	0	110

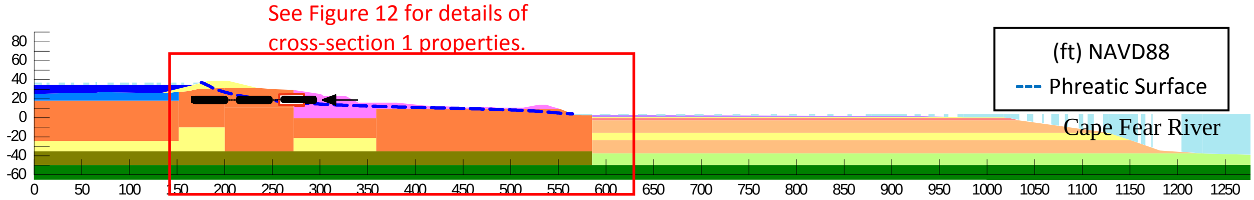
See Figure 12 for details of cross-section 1 properties.

Figure 11. Geometry of soil layers for cross-section 1, existing condition.

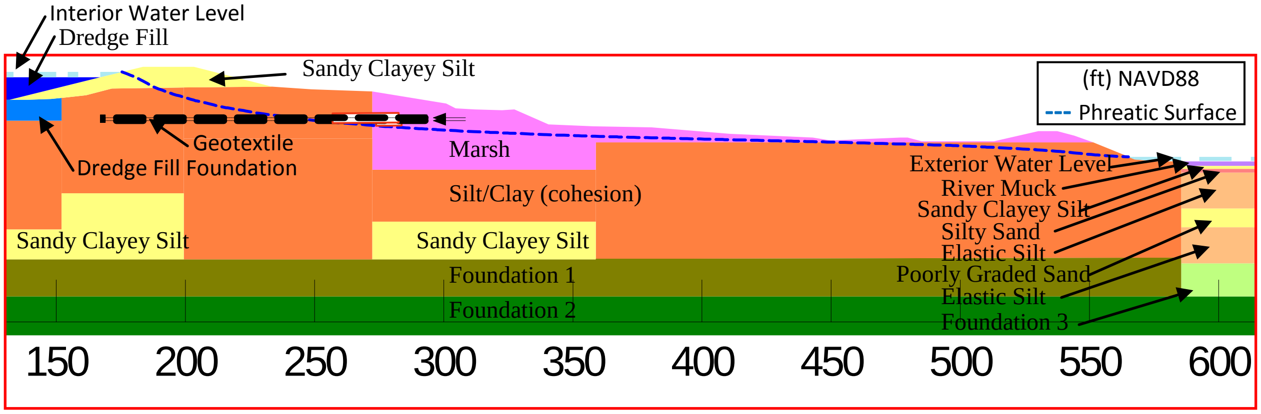

Figure 12. Closer view of the geometry of soil layers for cross-section 1.

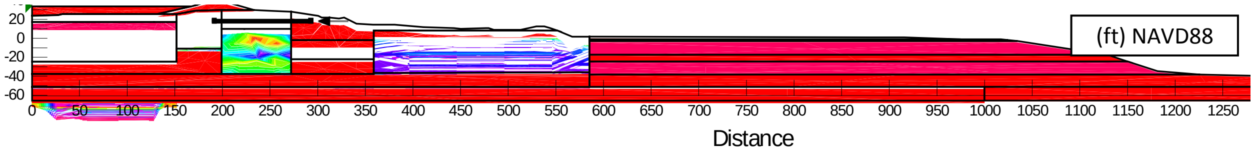

Figure 13. The cohesion spatial function for the Silt/Clay (cohesion) layer in the generalized model for cross-section 1, existing condition, using known points of strength.

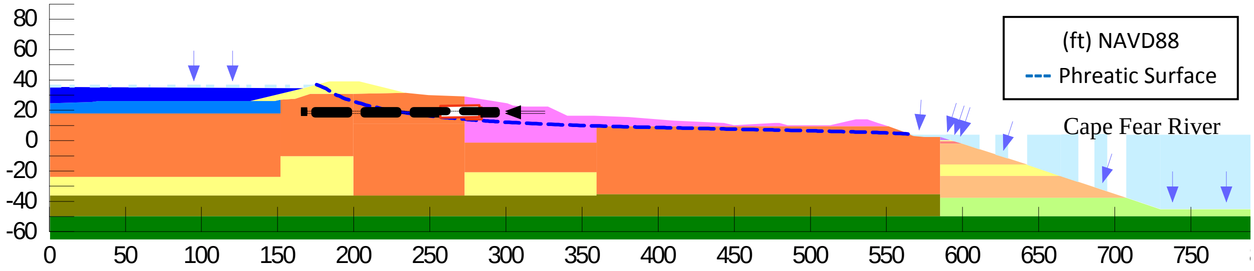

Figure 14. Geometry of soil layers for cross-section 1, future with project condition.

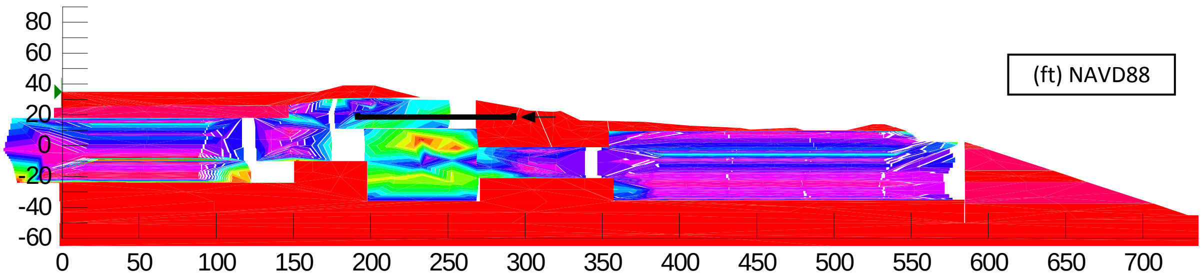

Figure 15. The cohesion spatial function for the Silt/Clay (cohesion) layer in the generalized model for cross-section 1, future with project condition, using known points of strength.

Model geometry for cross-section 2 is shown in Figure 16, while the cohesion spatial function is shown in Figure 18.

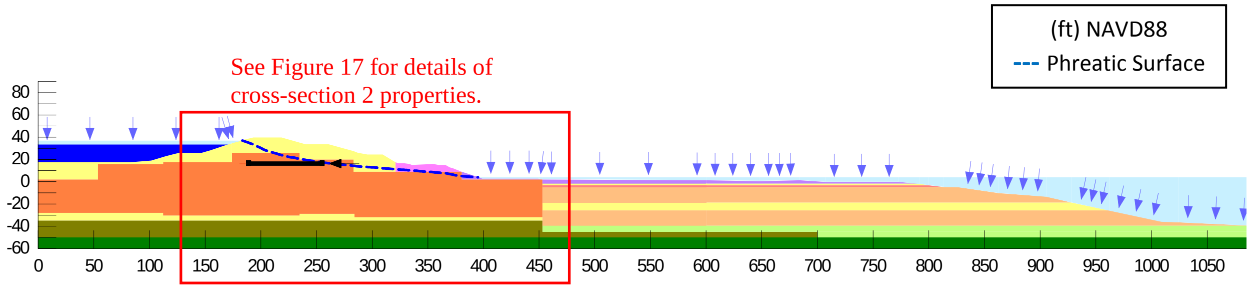
See Figure 17 for details of cross-section 2 properties.

Figure 16. Geometry of soil layers for cross-section 2, existing condition.

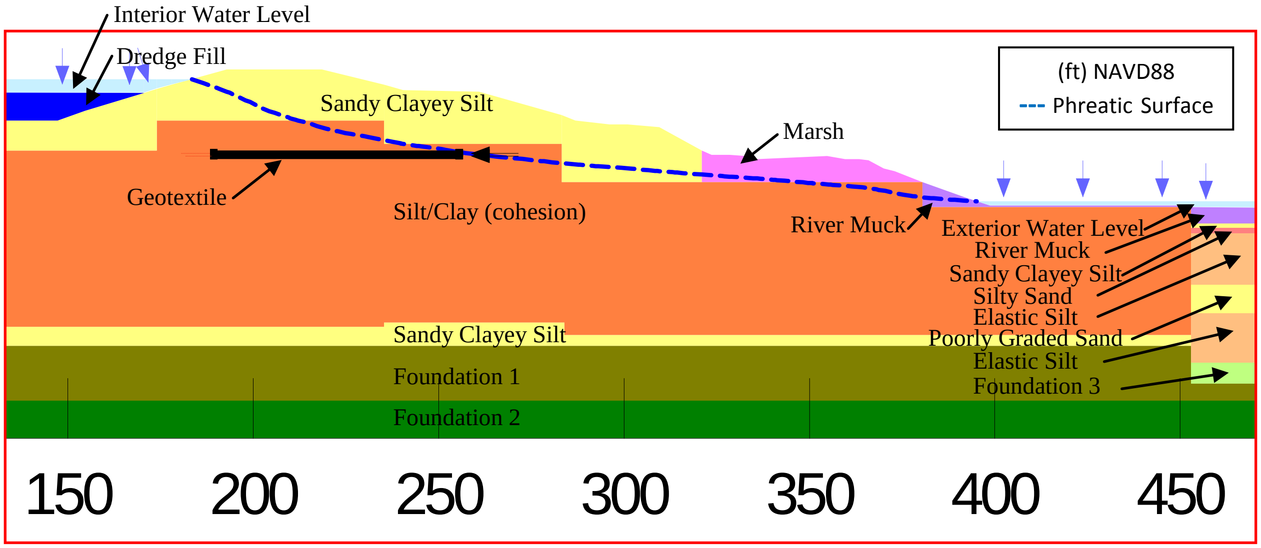

Figure 17. Geometry of soil layers for cross-section 2, existing condition.

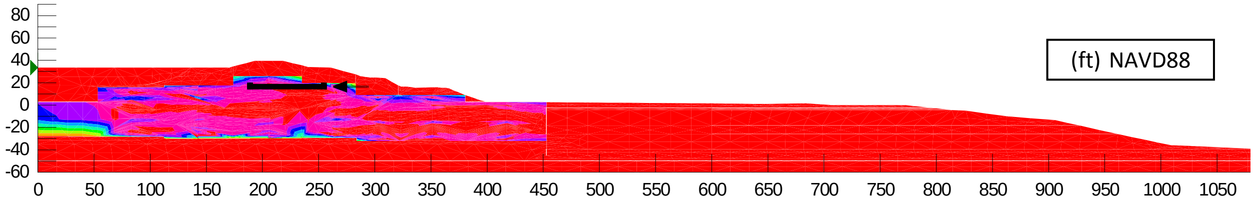

Figure 18. The cohesion spatial function for the Silt/Clay (cohesion) layer in the generalized model for cross-section 2, existing condition, using known points of strength.

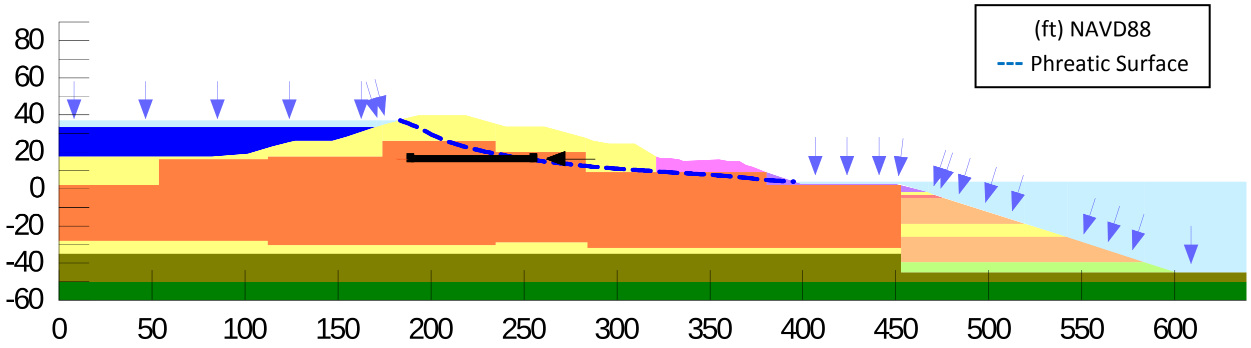

Figure 19. Geometry of soil layers for cross-section 2, future with project condition.

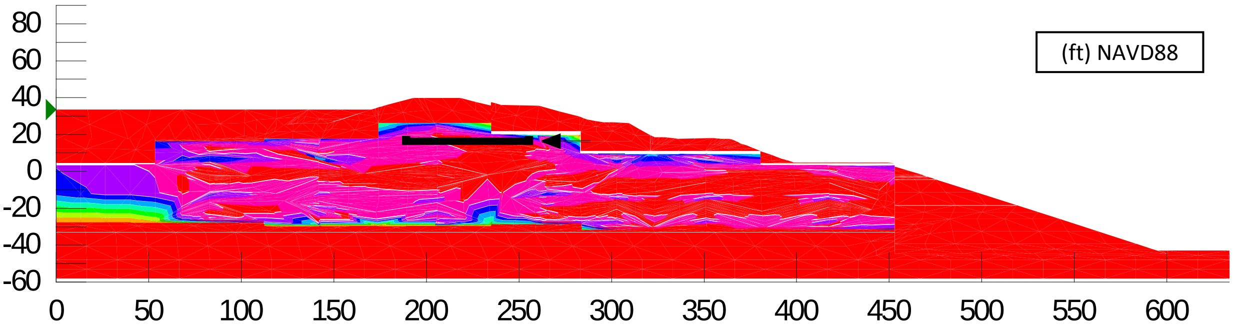

Figure 20. The cohesion spatial function for the Silt/Clay (cohesion) layer in the generalized model for cross-section 2, future with project condition, using known points of strength.

3.1.3.4 Seepage Analysis Results

The seepage analyses, performed using SEEP/W (Version 8.0.2.5675), were used to determine the piezometric surfaces within the soils of the dikes when the water level is increased within Cells 2 and 3 at Eagle Island. The SEEP/W analyses evaluated irregular saturated/unsaturated conditions as well as the embankment stability as the pore water pressure conditions change. SEEP/W is a part of the GeoStudio 2012 package and is a 2-dimensional finite element program. The seepage analyses included in this report are steady state analyses and the sections analyzed are located perpendicular to the dike alignment.

The pore water pressure (PWP) and piezometric lines used in the stability analyses are at 37 feet NAVD88 for the interior water surface level and 4 feet NAVD88 for the river water surface level. The resulting pore water pressures at cross-section 1 and 2 are shown in Figure 21 and Figure 23, respectively.

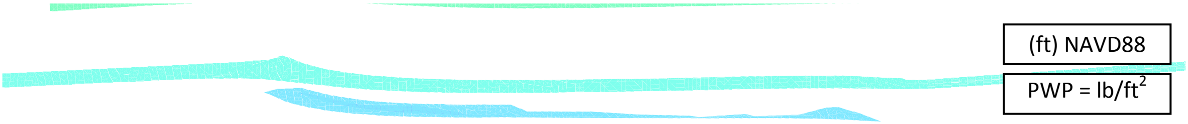

Figure 21. Pore-water-pressure at cross-section 1 from SEEP/W for existing condition.

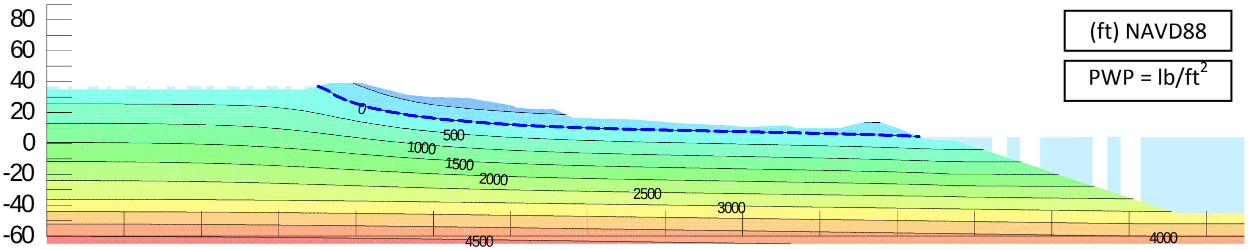

Figure 22. Pore-water-pressure at cross-section 1 from SEEP/W with project condition.

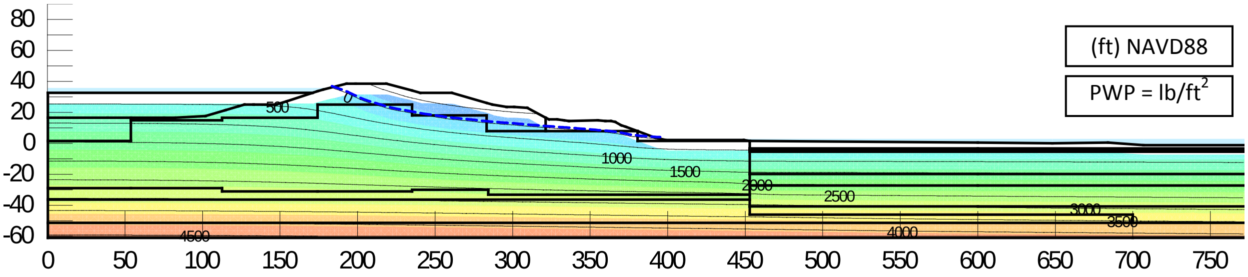

Figure 23. Pore-water-pressure at cross-section 2 from SEEP/W for existing condition.

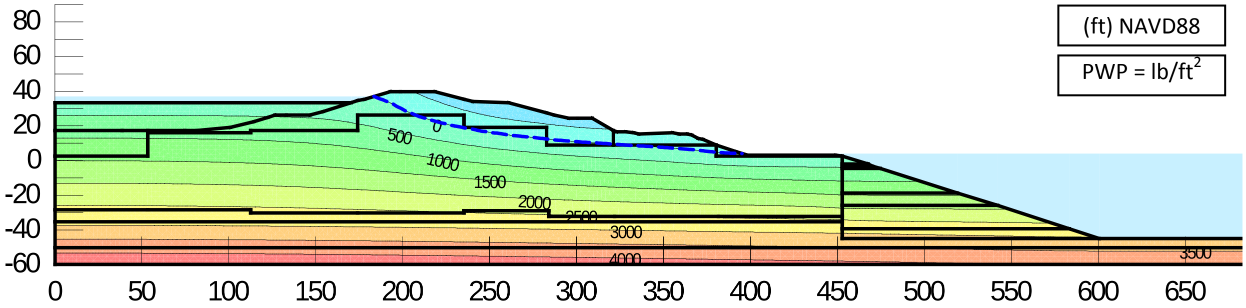

Figure 24. Pore-water-pressure at cross-section 2 from SEEP/W with project condition.

3.1.3.5 Stability Analysis Results

The slope stability analysis of Eagle Island was performed to ensure that the integrity of the dike is not affected by Turning Basin widening. The analyses outlined in this report were analyzed using SLOPE/W from the GeoStudio 2012 package. SLOPE/W is a software program that computes factors of safety through limit equilibrium computations. SLOPE/W offers several methods to compute factors of safety.

The assumptions used for the analyses are as follows:

- The existing dikes for Cell 2 and Cell 3 were designed in 2002 to elevation 39 (NAVD88) using CPT data collected in 1999. This analysis was performed using the UTEXAS series computer programs by a Wilmington District geotechnical engineer.
- The data collected in 2011 was used for the stability analysis used in this Study for cross-section 1 and cross-section 2. The results for the stability analysis included in this Study differ from the results of the stability analysis performed in 2002 because two different subsurface data sets were used and was completed using the GeoSlope computer program.
- Engineered geotextile is present in cross-section 1 at elevation 19 feet NAVD88 with a bond skin friction (F/Area) of 1400 psf and fabric capacity of 9300 lbs.
- Engineered geotextile is present in cross-section 2 at elevation 16 feet NAVD88 with a bond skin friction (F/Area) of 1400 psf and fabric capacity of 9300 lbs.
- Cross-section geometry was developed using topographic and planimetric survey collected in November 2012.
- Exterior (Cape Fear River side) slope of 4:1
- Interior (dredge fill retention side) slope of 3:1.
- Existing condition for cross-section 1 and cross-section 2 were modeled.
- Future with project condition was modeled for cross-section 1 and cross-section 2.
    - Cross-section 1: 451 linear feet of material was removed from the existing toe to depict Turning Basin widening.
    - Cross-section 2: 408 linear feet of material was removed from the existing toe to depict Turning Basin widening.
- The CPT soundings and SPT borings collected by Terracon (2011) were used to develop the cross-section soil layers and strength properties for subsurface stability analyses.
- The shear strength values input into the spatial function option in SLOPE/W for the exterior toe of the dike, to the intersection of the river at each cross-section, were assumed values obtained by the CPT soundings at hole C of the corresponding transect.
- The dredge fill has an undrained shear strength (cohesion) of 150 psf and a unit weight of 80 pcf.
- Conservative values for the river mud flats (River Muck layer) were used, Cohesion of 80 psf and a unit weight of 85 pcf.
- Piezometric surfaces for analyses were generated using SEEP/W.

The stability analyses were performed in accordance with the requirements of EM 1110-2-1902, Slope Stability and EM 1110-2-5027, Confined Disposal of Dredged Material. As required in the Engineer Manuals, the safety factors against global stability of the dike sections were computed using Spencer's method. The stability of the dike sections or 'slip surfaces', were input into SLOPE/W using the "Entry and Exit" and "Fully Specified" functions to find the lowest factor of safety.

The entry and exit function allows the user to specify a range of points where the slip surface might start and another range of points where the slip surface might exit (see the red lines on the slope surface of Figure 25. During the slip surface analysis, each entry point is connected with each exit point. For each set of entry and exit points, multiple slip surfaces are drawn according to different radius points, which are generated in SLOPE/W. The results are then reviewed and analyses may be re-run according to whether the critical slip surface is within the limits of the entry and exit points. The position of the critical slip surface is affected by the soil strength properties as discussed in *3.1.3.1 Field and Laboratory Test Results*. The following cross-sections each show the lowest computed factor of safety with an addition ten slip surfaces (gray lines) modeled in SLOPE/W.

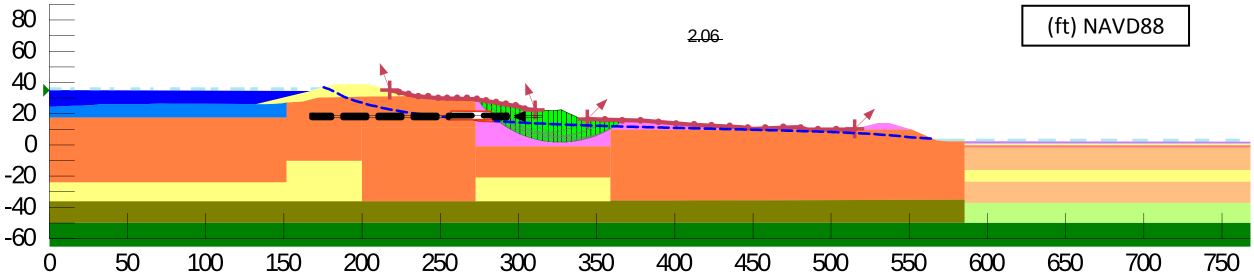

Figure 25. Entry and Exit method showing the factor of safety for a left to right circular slip surface during 'existing' conditions at cross-section 1.

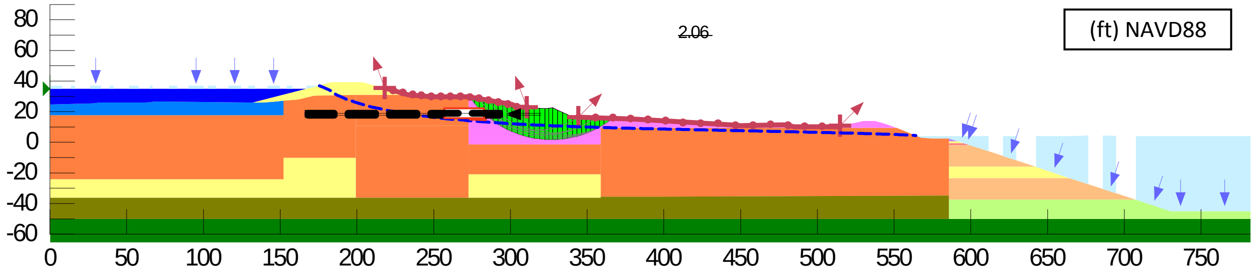

Figure 26. Entry/Exit method showing the factor of safety for a left to right circular slip surface during 'with project' conditions at cross-section 1.

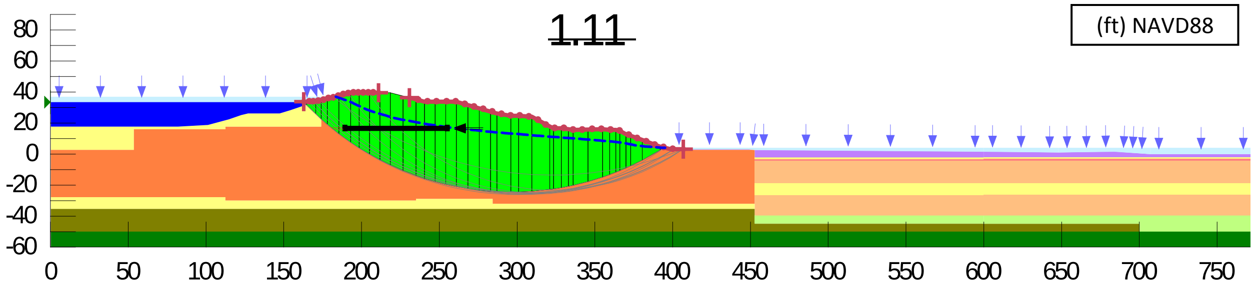

Figure 27. Entry/Exit method showing the factor of safety for a left to right circular slip surface during ‘existing conditions’ at cross-section 2.

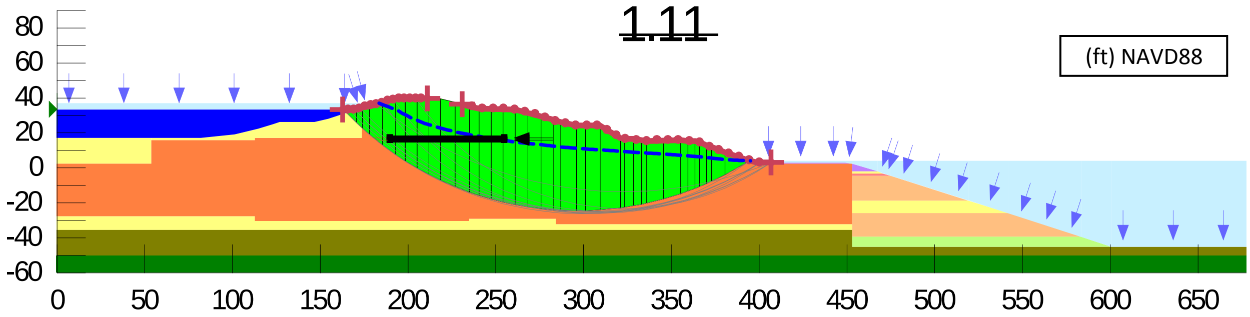

Figure 28. Entry/Exit method showing the factor of safety for a left to right circular slip surface during ‘with project’ conditions at cross-section 2.

The “Fully Specified” slip surfaces are slip surfaces made up of a series of line segments. Each slip surface must be specified individually by defining the points that make up the slip surface line or by drawing them on the screen with the “Draw Slip Surface: Fully Specified” command. The fully specified slip surfaces for both cross-sections were drawn based on low cohesion values in the embankment and foundation layers. The following cross-sections each show the lowest computed factor of safety with additional slip surfaces (gray lines) modeled in SLOPE/W.

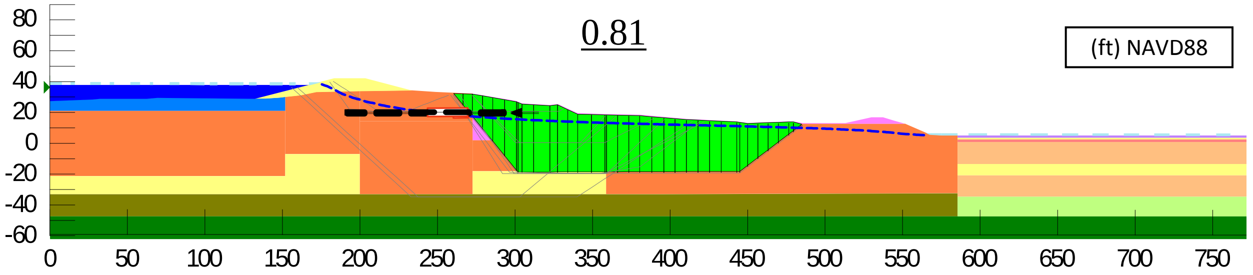

Figure 29. Fully Specified method showing the factor of safety for a left to right slip surface during ‘existing’ conditions at cross-section 1.

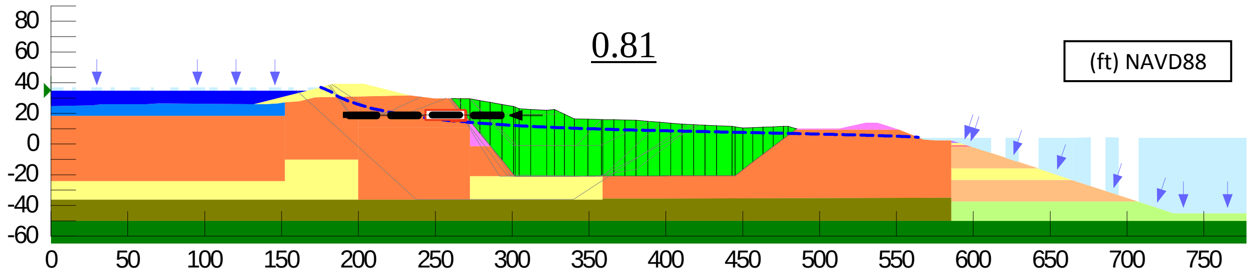

Figure 30. Fully Specified method showing the factor of safety for a left to right slip surface during 'with project' conditions at cross-section 1.

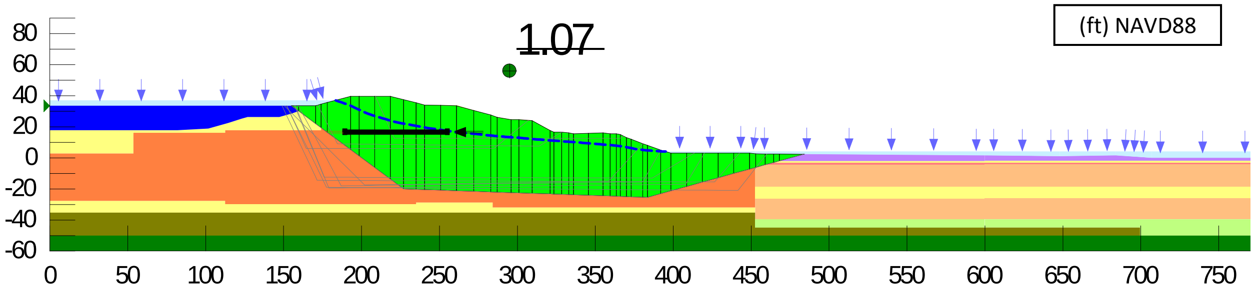

Figure 31. Fully Specified method showing the factor of safety for a left to right slip surface during 'existing' conditions at cross-section 2.

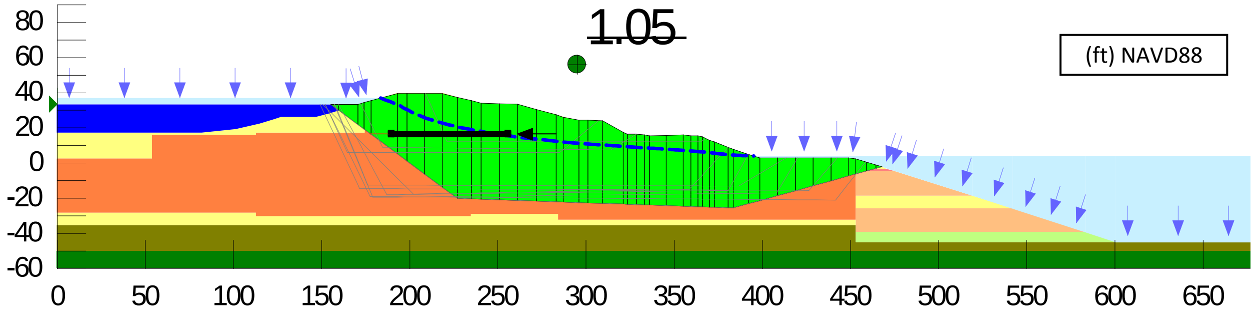

Figure 32. Fully Specified method showing the factor of safety for a left to right slip surface during 'with project' conditions at cross-section 2.

The Spencer's method factor of safety is determined at the point where the two curves cross in the Factor of Safety vs Lambda (λ) plot. At this point, the factor of safety satisfies both moment and force equilibrium. In this case, the moment equilibrium is completely independent of the interslice shear forces, as indicated by the horizontal moment equilibrium curve. The force equilibrium, however, is dependent on the interslice shear forces. The Factor of Safety vs Lambda (λ) plot for the lowest factors of safety using the "Entry and Exit" and "Fully Specified" methods for cross-sections 1 and 2, existing condition and with project condition, can be seen in Figure 33 thru Figure 40

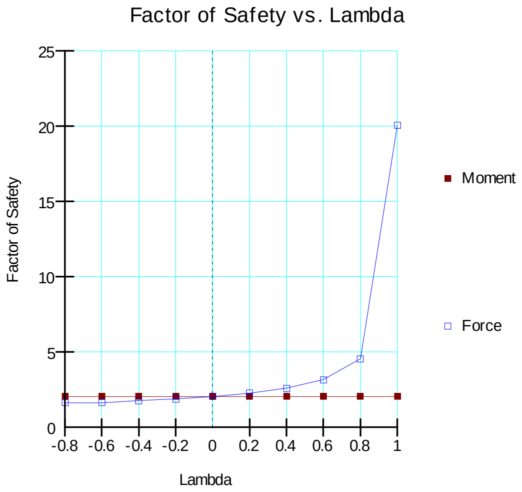

Figure 33. Factor of Safety vs Lambda (λ) plot for ‘existing’ condition at cross-section 1 using the Entry and Exit Method.

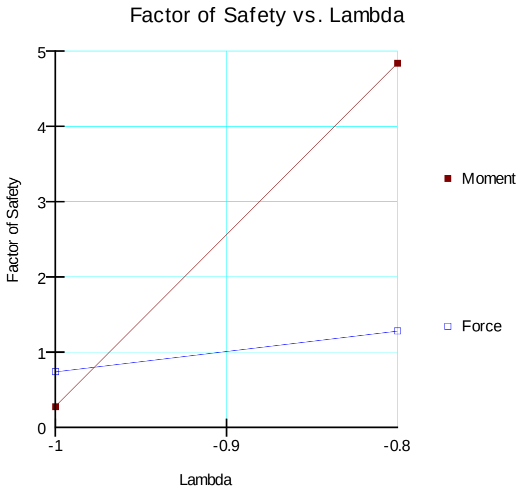

Figure 34. Factor of Safety vs Lambda (λ) plot for ‘existing’ condition at cross-section 1 using the Fully Specified Method.

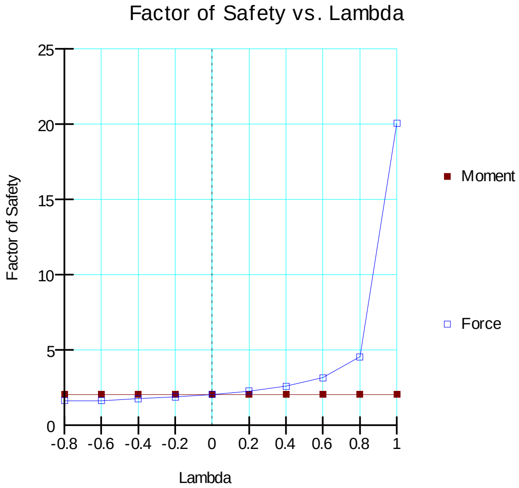

Figure 35. Factor of Safety vs Lambda (λ) plot for ‘with project’ condition at cross-section 1 using the Entry and Exit Method.

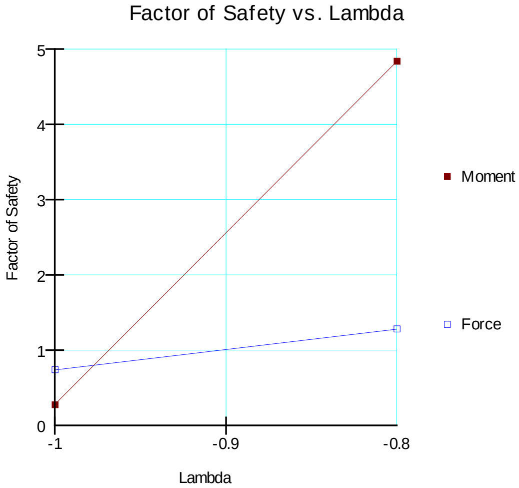

Figure 36. Factor of Safety vs Lambda (λ) plot for ‘with project’ condition at cross-section 1 using the Fully Specified Method.

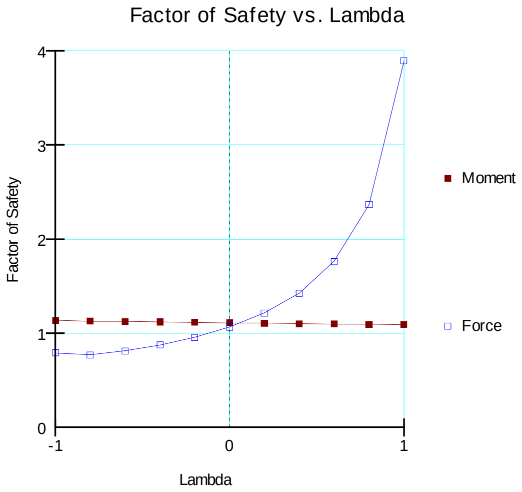

Figure 37. Factor of Safety vs Lambda (λ) plot for with 'existing' condition at cross-section 2 using the Entry and Exit Method.

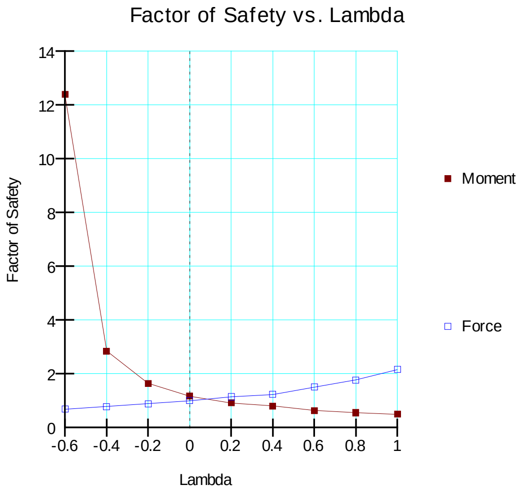

Figure 38. Factor of Safety vs Lambda (λ) plot for 'existing' condition at cross-section 2 using the Fully Specified Method.

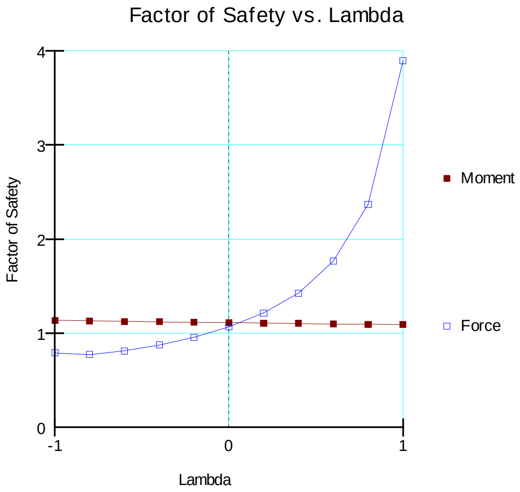

Figure 39. Factor of Safety vs Lambda (λ) plot for ‘with project’ condition at cross-section 2 using the Entry and Exit Method.

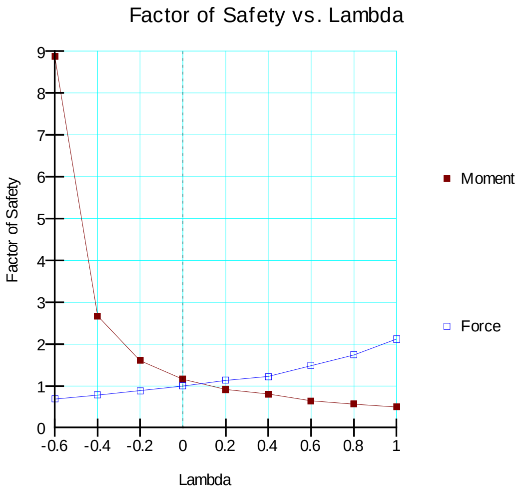

Figure 40. Factor of Safety vs Lambda (λ) plot for ‘with project’ condition at cross-section 2 using the Fully Specified Method.

Table 7 shows the summary of the factors of safety for the analyses performed at cross-sections 1 and 2 using the Spencer's method using SLOPE/W.

Table 7. Slope Stability results showing computed factors of safety for cross-sections 1 and 2.

Cross-Section	Condition	Factor of Safety	Slip Surface Method
1	Existing	2.06	Entry and Exit
1	Existing	0.81	Fully Specified
1	Future with Project	2.06	Entry and Exit
1	Future with Project	0.81	Fully Specified
2	Existing	1.11	Entry and Exit
2	Existing	1.07	Fully Specified
2	Future with Project	1.11	Entry and Exit
2	Future with Project	1.05	Fully Specified

The slope stability analysis of Eagle Island was performed to determine the stability of the east side dikes of Cell 2 and Cell 3 if materials from near the toe of the original dikes were removed, due to the widening of the Turning Basin. Previously, the dike was designed to elevation 39 (NAVD88) with a factor of safety of 1.2. The result of the stability analysis for this Study shows that a factor of safety is less than the desired 1.2. The analysis in this Study has a lower factor of safety because of updated subsurface information from the 1999 investigation. Although the dike was shown to be stable in previous analyses, it is believed that the low factor of safety computed using GeoStudio shows that a modification to the area around the dike would have a greater chance of affecting the stability of the dike structure. The dike is believed to be safe as it is presently, but because the factor of safety is less than 1.2, the conservative nature built into the factor of safety is not within the desired "good engineering judgment". The slope stability analysis confirmed that the turning basin cannot be lengthened into Eagle Island and the area cut into the dikes will not maintain a factor of safety greater than 1.2, which is considered acceptable based on the slope stability criteria in EM 1110-2-5027 for dike stability to elevation 48 NAVD88.

Subsurface investigations will be performed to collect additional data not obtained in the previous investigations. This investigations and updated stability analysis will be done in 2014 to verify the results of the previous analyses. Additionally, the dikes should be raised no more than 3 to 5 feet during each stage of construction.

3.1.3.6 Dredge Disposal Options for the Turning Basin Widening

The material dredged from the Turning Basin will more than likely be a slurry of mud, sand, gravel, rock, wood and organic material. In 2010, the estimated total dredging quantity of material in the Turning Basin was 1,530,000 cubic yards with approximately 154,000 cubic yards of that material being rock. Because of the heterogeneous-nature of the material, no known economic use is available; therefore it is assumed that disposal operations will be based upon closest proximity to dredging operations. Eagle Island is the most likely disposal site based upon the logistics of haul distance. If Eagle Island were not available, the next most likely course of action would be to barge disposal material downriver to the Ocean Dredged Material Disposal Site (ODMDS) located near the entrance of the harbor channel. The disposal material is considered to be unsuitable for use in fish estuaries or for use as fill for the erosional scour at the Cape Fear River Lock and Dam #2 because of the amount of fines and other undesirable material present in the slurry.

3.2 Battery Island Turn

3.2.1 Data Acquisition

On 11 and 12 July 2012 and 18 February 2013, subsurface investigations surrounding the Battery Island turn were performed using the USACE vessel *SNELL* and an Alpine model 270 Vibracore. The vibracore machine is a self-contained pneumatic powered vibratory corer that has a 20 ft metal barrel into which a clear Lexan 3 7/8 in. diameter liner (vibracore tube) is inserted for collecting sediment. The liner is held in place by a metal shoe that is screwed onto both the liner and metal barrel. A cutting edge is included in the metal shoe. The vibracore machine uses a pneumatic powered vibrator mounted at the uppermost end of the vibracore barrel. The machine is mounted in a stand that is lowered to the river floor by a crane. When the vibracore is activated the vibracore barrel vibrates into the unconsolidated sediment and a disturbed sediment sample is retained inside the liner. In general, vibratory drilling collects up to 20 ft of sediment unless refusal is encountered. Refusal occurs when the penetration rate of the vibracore is less than 0.01 ft/s. The survey-grade HYPACK navigation system on the USACE Vessel *SNELL* is used to determine the boring locations. The sea floor bottom elevation is determined by measuring water depth from the water line to the subsurface, with water line datum as 0.0 ft. The recorded water depth is then corrected to MLLW using NOAA-verified tidal data for the date and time for which the vibracore was drilled.

Once the vibracore sampling was complete, the tubes were taken to the Wilmington District, Snow’s Cut field facility, where they were cut open, logged, and field visually classified in accordance with the Unified Soils Classification System (USCS). Samples were collected from each tube at approximately 2 foot intervals or at each visible change of material. The retained samples were stored in jars and sent to a USACE validated soils laboratory for particle-size analysis. A particle-size analysis was conducted on each sample in accordance with ASTM Standard D 422, “Standard Test Method for Particle-Size Analysis of Soils” using the following U.S. Standard sieve sizes: No. 4, No. 18, No. 35, No. 60, No. 80, No. 120, No. 200, and No. 230 sieve. Since the vibracore samples are disturbed samples, strength properties cannot be determined from the samples and are therefore were not performed. In addition to the particle-size analysis, all the samples were classified using visual engineering soil classification in accordance with ASTM Standard D 2487, as required in Engineering Manual 1110-1-1804 and a visual estimation of the percent shell content was performed.

3.2.1.1 Location of Samples and Cross-Sections.

Five subsurface vibracore soil samples were collected during the July 2012 mission, east of the Wilmington Harbor channel at the Battery Island and Lower Swash range intersection. These samples are numbered: WH12-V-16, WH12-V-17, WH12-V-18, WH12-V-19, and WH12-V-20.

Six supplementary vibracore samples were required, due to the decision to evaluate additional alternative widening measures discussed by the PDT. These samples were collected on the west side of the Wilmington Harbor channel at the Battery Island and Lower Swash range, for a distance of 0.8 miles (4250 feet) with spacing more than 700 feet. The vibracores collected on 18 February 2013, are numbered WH13-V-01, WH13-V-02, WH13-V-03, WH13-V-04, WH13-V-05, and WH13-V-06. Figure 41 shows the locations of each vibracore.

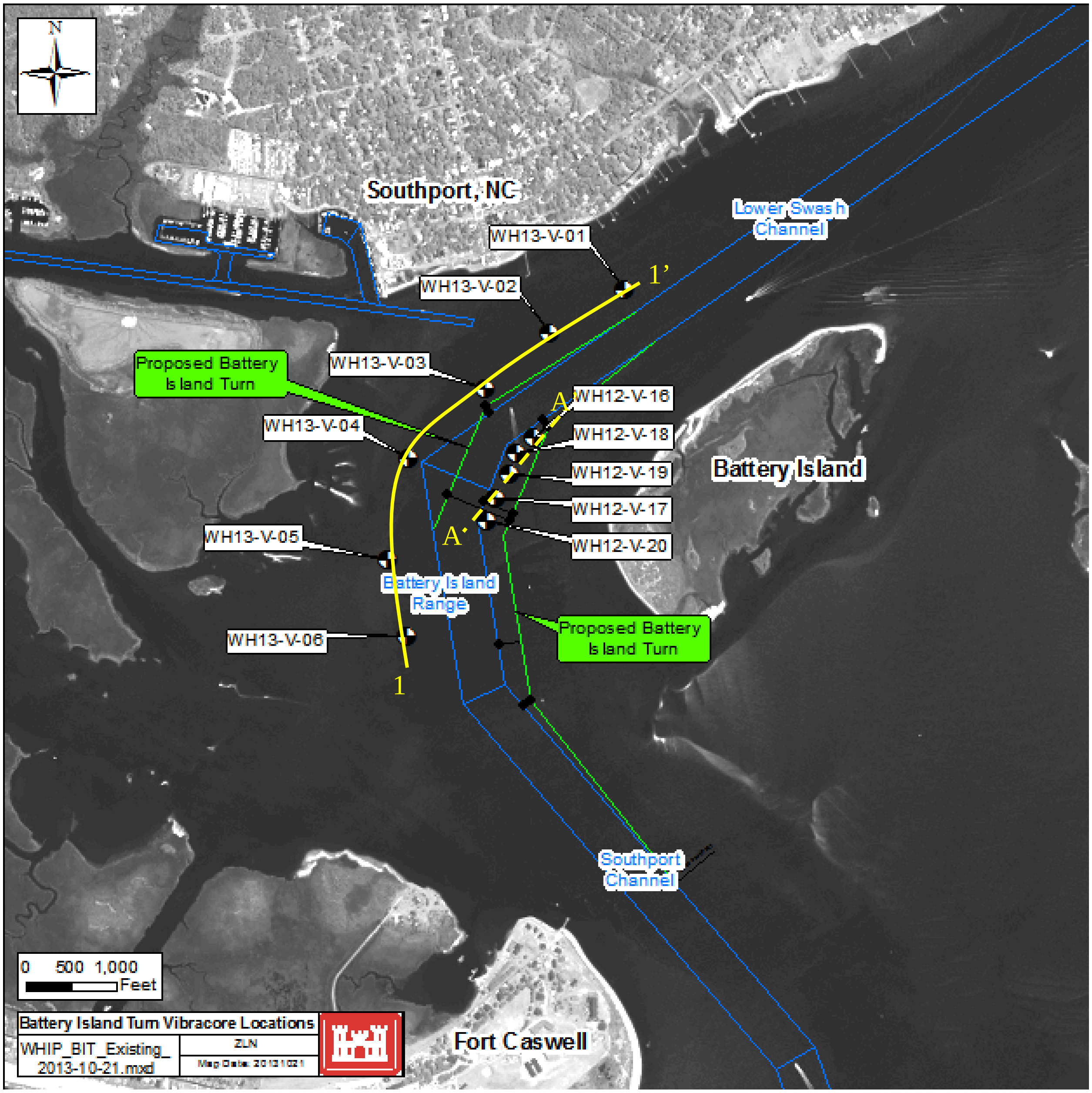

Figure 41. Vibracore locations performed in 2012 at the Battery Island turn.

A graphical representation of the geologic profiles for the samples collected at the Battery Island turn is show in Figure 42 and Figure 43. The intent of each profile was to verify the thickness of potentially useful strata utilizing the soils data. Each profile conveys the following information; river bottom, bottom of boring, graphical representation of the visually classified soils, and the laboratory soil classification in parenthesis. Interpretative weight should be given to laboratory classification over field visual classification, however, the laboratory data does not take into consideration discrete stratigraphic variations such as silt-filled lenses that raise the silt content of composited sandy soils. Therefore, these models are best approximations of the *in-situ* soil conditions.

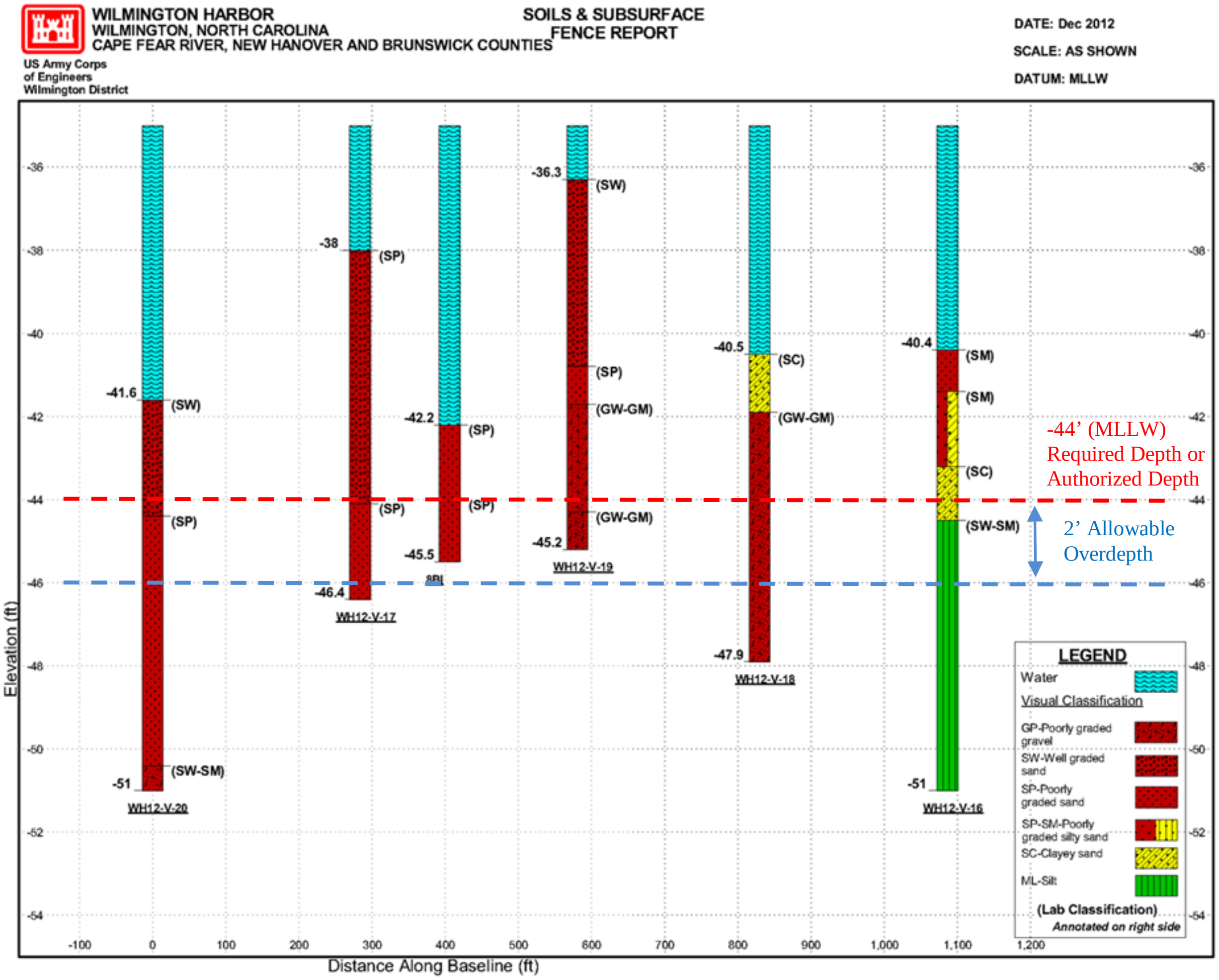

Figure 42. Geologic cross-section A-A´,Battery Island Turn.

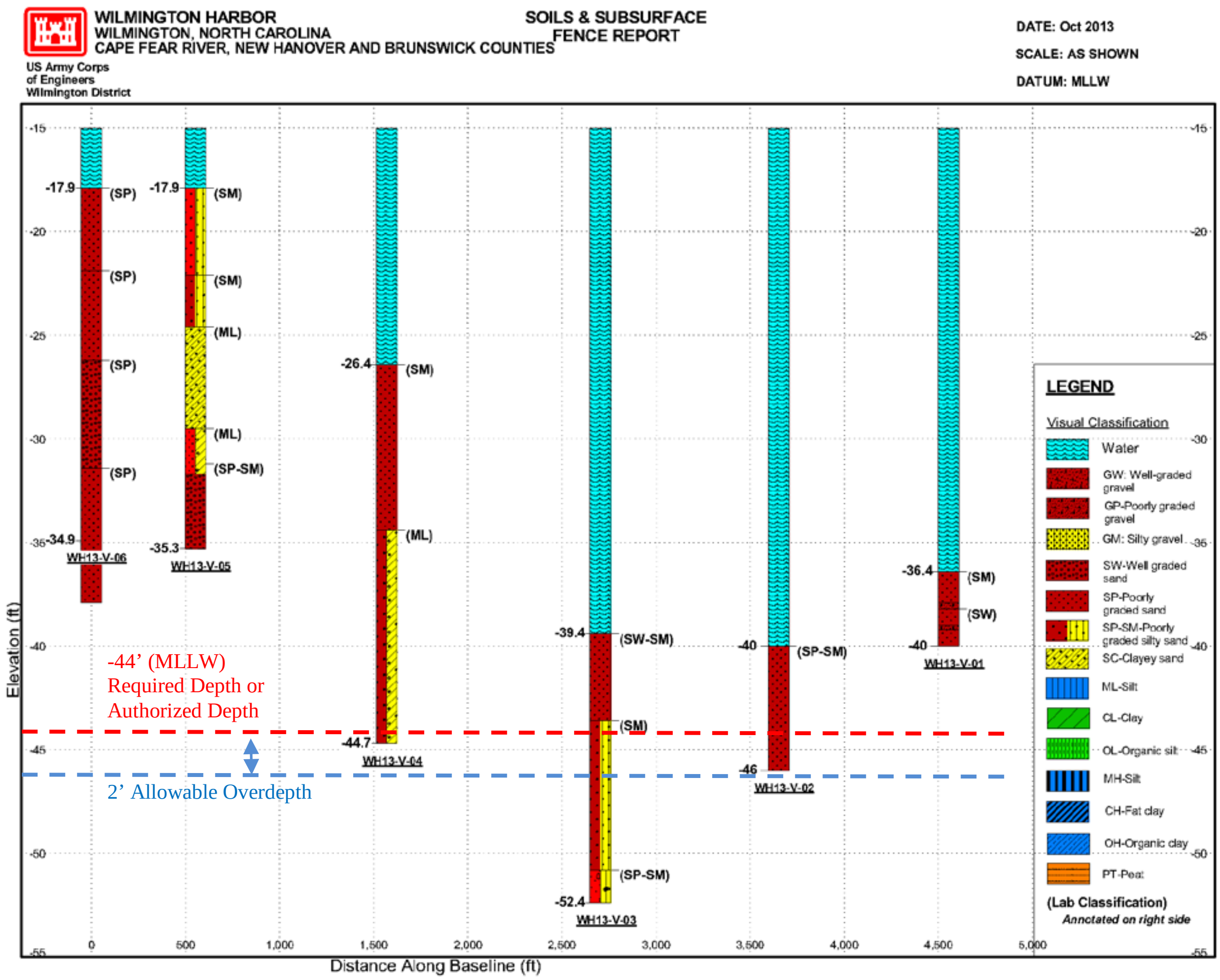

Figure 43. 2-D Geologic cross-section in Battery Island Turn for line 1-1'.

3.2.1.2 Material Properties

A particle grain size analysis was performed for each sample documented on the geologic cross-section logs. The particle grain size characteristics of the samples were used to develop a weighted composite grain size distribution that is representative of the material in each area. To determine the composite characteristics for the Battery Island turn excavation area, each core was weighted based upon the sampled strata thickness of material in the core and then the sum weighted characteristics from the cores are divided by the total strata thickness above the excavation or dredge elevation. Included in the analysis was an estimate of the amount of fine-grained sediments in each core that is finer than the #200 sieve (0.074 mm). The Wilmington District policy with regard to the percentage of fine-grained sediments is that in excavation areas where more than 10% pass the #200 sieve, materials are generally considered to be incompatible for beneficial placement on the beach due to potential problems with increased water turbidity and siltation during placement.

Between the Wilmington Harbor channel at the Battery Island and Lower Swash ranges intersection, and Battery Island, samples WH12-V-16, WH12-V-17, WH12-V-18, WH12-V-19, and WH12-V-20 were acquired for potential disposal options should the realignment of the Battery Island Turn be constructed eastward of the existing channel. These samples averaged a recovery length of 8.94 feet before hitting refusal between elevations -45.2’ to -51.0’ (MLLW). The location of refusal is the assumed ‘top-of-rock elevation’. This ‘top-of-rock elevation’ is below the authorized depth for the channel (-44’ MLLW) and the 2 feet required allowable overdepth. If material was to be removed from this location, the presence of rock is possible but not expected. A grain size compatibility analysis was run for this area from laboratory results for the “Typical Dredging Section” elevation, -46’ MLLW. The weighted percent fines passing the #200 sieve (0.075mm) is 7.44%, additionally, the weighted percent passing the #4 sieve (4.75mm) is 86.01%. Percent fines passing the #200 sieve for the each hole sampled ranged from 1.32% to 20.01%. The higher silt content samples were mainly found in the samples collected 400 feet north and east of the Lower Swash Range and Battery Island Range intersection.

Table 8. Results from the 2012 USACE vibracore borings for the Battery Island turn.

Hole	Thickness (ft)	% Passing #4	% Passing #200	Wtd % Passing #4	Wtd % Passing #200
WH12-V-16	5.6	91.27	20.01	15.77	3.46
WH12-V-17	8	88.54	1.32	21.86	0.33
WH12-V-18	5.5	96.43	12.20	16.37	2.07
WH12-V-19	8.9	78.15	4.34	21.47	1.19
WH12-V-20	4.4	77.63	2.9	10.54	0.39
Total =	32.4		Total	86.01	7.44

Field classification of vibracore WH12-V-16 indicated poorly graded silty sand (SP) between -40.4’ and -41.4’ (MLLW), poorly graded silty sand with clay and trace shells (SP-SC) between -41.4’ and -43.2’ (MLLW), clayey sand with shells (SC) between -43.2’ and -44.5’ (MLLW), and course grained silty sand with some gravels (ML) to refusal depth at -51.0’ (MLLW). Four samples were lab classified and analyzed for the same elevation ranges. The lab classification results from jar samples are: SM, SM, SC, and SW-SM.

Field classification of vibracore WH12-V-17 indicated well graded sand with some shells (SW) between -38.0’ and -44.1’ (MLLW), and poorly graded silty sand (SP) to refusal depth at -46.4’ (MLLW). Two samples were lab classified and analyzed for the same elevation ranges. The lab classification results from jar samples are: SP and SP.

Field classification of vibracore WH12-V-18 indicated clayey sand with gravel (SC) between -40.5’ and -41.9’ (MLLW), and well graded sandy gravel to refusal depth at -47.9’ (MLLW). Two samples were lab classified and analyzed for the same elevation ranges. The lab classification results from jar samples are: SC and GW-GM.

Field classification of vibracore WH12-V-19 indicated well graded sand with little shell (SW) between -36.3’ and -40.8’ (MLLW), poorly graded sand (SP) between elevations -40.8’ and -41.7’ (MLLW), well graded gravel (GW) between elevations -41.7’ and -44.3’ (MLLW), and poorly graded gravel (GP) to refusal depth at -45.2’ (MLLW). Four samples were lab classified and analyzed for the same elevation ranges. The lab classification results from jar samples are: SW, SP, GW-GM, and GW-GM.

Field classification of vibracore WH12-V-20 indicated well graded sand with little shell (SW) between -41.6’ and -44.4’ (MLLW), poorly graded sand (SP) between elevations -44.4’ and -50.4’ (MLLW), and well graded gravel (GP) to refusal depth at -51.0’ (MLLW). Three samples were lab classified and analyzed for the same elevation ranges. The lab classification results from jar samples are: SW, SP, and SW-SM.

The area east of the USACE DA 277 and between the Wilmington Harbor channel at the Battery Island Range and Lower Swash Range intersection and south of the town of Southport, NC, vibracore samples WH13-V-01, WH13-V-02, WH13-V-03, WH13-V-04, WH13-V-05, and WH13-V-06 were acquired for sediment analysis for potential disposal options should the realignment of the Battery Island Turn be constructed westward of the existing channel. These samples averaged a recovery length of 12.55 feet before hitting refusal between elevations -35.3’ to -52.4’ (MLLW). The location of refusal is the assumed ‘top-of-rock elevation’. This ‘top-of-rock elevation’ is found above and below the authorized depth for the channel. If material was to be removed from this location, the presence of rock is possible. A compatibility analysis was run for this area from laboratory results for the authorized depth of -44’ MLLW, and the 2 feet of required allowable overdepth. Where vibracore did not penetrate to at least -46’ MLLW, the compatibility analysis was only ran using material collected. The weighted percent fines passing the #200 sieve (0.075mm) is 23.04%, additionally, the weighted percent passing the #4 sieve (4.75mm) is 97.81%. Percent fines passing the #200 sieve for the each hole sampled ranged from 1.45% to 40.45%. The higher silt content samples were mainly found in the vibracores collected to the west of the Lower Swash Range and Battery Island Range intersection.

Table 9. Results from the 2013 USACE vibracore borings for the Battery Island turn.

Hole	Thickness (ft)	% Passing #4	% Passing #200	Wtd % Passing #4	Wtd % Passing #200
WH13-V-01	3.6	94.68	8.81	4.70	0.44
WH13-V-02	6.0	92.80	10.20	7.86	0.84
WH13-V-03	6.6	96.05	11.27	8.74	1.03
WH13-V-04	18.3	99.94	40.45	25.23	10.21
WH13-V-05	21.0	99.36	35.17	28.78	10.19
WH13-V-06	17.0	96.71	1.45	22.68	0.34
Total	72.5		Total	97.81	23.04

Field classification of vibracore WH13-V-01 indicated poorly graded silty sand (SP) between -36.4’ and -37.9’ (MLLW), gravel with rock fragments (GP) between elevations -37.9’ and -38.2’ (MLLW), course sand (SP) between elevations -37.9’ and -38.2’ (MLLW), gravel with rock fragments (GP) between elevations -39.0’ and -39.2’ (MLLW), and course sand (SP) to refusal depth at -40.0’ MLLW). Two samples were lab classified and analyzed for elevation ranges -36.4’ to -37.9’ (MLLW) and -38.2’ to -40.0’ (MLLW). The lab classification results from jar samples are: SM and SW, respectively.

Field classification of vibracore WH13-V-02 indicated poorly graded silty sand (SP) for the whole vibracore sample. The ocean bottom was at elevation 40.0’ (MLLW) and refusal depth was -46.0’ (MLLW). One sample was lab classified and analyzed. The lab classification results from the jar sample indicated an SM-SM soil.

Field classification of vibracore WH13-V-03 indicated poorly graded sand with some shell (SP) between elevations -39.4’ and -43.6’ (MLLW), poorly graded sand with silt (SP-SM) between elevations -43.6’ and -50.8’ (MLLW), and well graded gravel with silt (GW-GM) to refusal elevation -52.4’ (MLLW). Three samples were lab classified and analyzed for the same elevation ranges. The lab classification results from jar samples are: SW-SM, SM, and SP-SM.

Field classification of vibracore WH13-V-04 indicated poorly graded sand with some shell (SP) between elevations -26.4’ and -34.4’ (MLLW), and poorly graded fine sand with clay (SP-SC) to refusal at elevation -44.7’ (MLLW). Two samples were lab classified and analyzed for the same elevation ranges. The lab classification results from jar samples indicated the soils to be SM and ML.

Field classification of vibracore WH13-V-05 indicated well graded sand with silt and trace of shell (SW-SM) between elevations -17.9’ and -22.1’ (MLLW), poorly graded sand with silt (SP-SM) between elevations -22.1’ and -24.6’ (MLLW), clayey sand (SC) between elevations -24.6’ and ’29.5’ (MLLW), well graded sand with clay, little shell (SW-SC) between elevations -29.5’ and -31.7’ (MLLW), and well graded sand with few shells to refusal at elevation –35.3’ (MLLW). Five samples were lab classified and analyzed for the same elevation ranges. The lab classification results from jar samples indicated the soils to be SM, SM, ML, ML, and SP-SM, respectively.

Field classification of vibracore WH13-V-06 indicated fine, poorly graded sand with shell (SP) between elevations -17.9’ and -26.2’ (MLLW), fine to medium, well graded sand with few shell (SW) between elevations -26.2’ and -31.4’ (MLLW), and poorly graded sand (SP) to refusal at elevation 37.9’ (MLLW). Four samples were lab classified and analyzed for the same elevation ranges. The lab classification results from jar samples indicated the soils all to be SP.

3.2.1.3 Additional Geotechnical Investigation Data

Additional vibracores and washprobes are required to the east of Battery Island Range and Southport Channel. No more than 1 day of additional fieldwork is required. Approximately 10 vibracores and 20 washprobes are recommended for this area.

3.2.1.4 Dredge Disposal Options for the Battery Island Turn

The area immediately surrounding the sampled vibracore hole locations within the proposed channel realignment is not beach compatible or the vibracore refusal depth was above the authorized depth of the channel. This is because the required 10% passing the #200 sieve is not met. Therefore, disposal of material in the proposed channel alignment should go to the Wilmington District’s Offshore Dredged Material Disposal Site (ODMDS).

3.3 Entrance Channel near Bald Head Island

3.3.1 Data Acquisition

The same methods used to collect subsurface soil data and analyze materials at the Battery Island turn, were used for the vibracore samples collected at the Entrance Channel near Bald Head Island.

3.3.1.1 Location of Samples and Cross-Sections.

Fifteen subsurface vibracore soil samples were collected during the July 2012 mission. These samples are WH12-V-1 through WH12-V-15. Figure 44 shows the locations of each vibracore. Only vibracores WH12-V-1, WH12-V-2, WH12-V-3, WH12-V-5, WH12-V-9, WH12-V-10, and WH12-V-14 are within the proposed channel, and adjacent to the existing navigation channel.

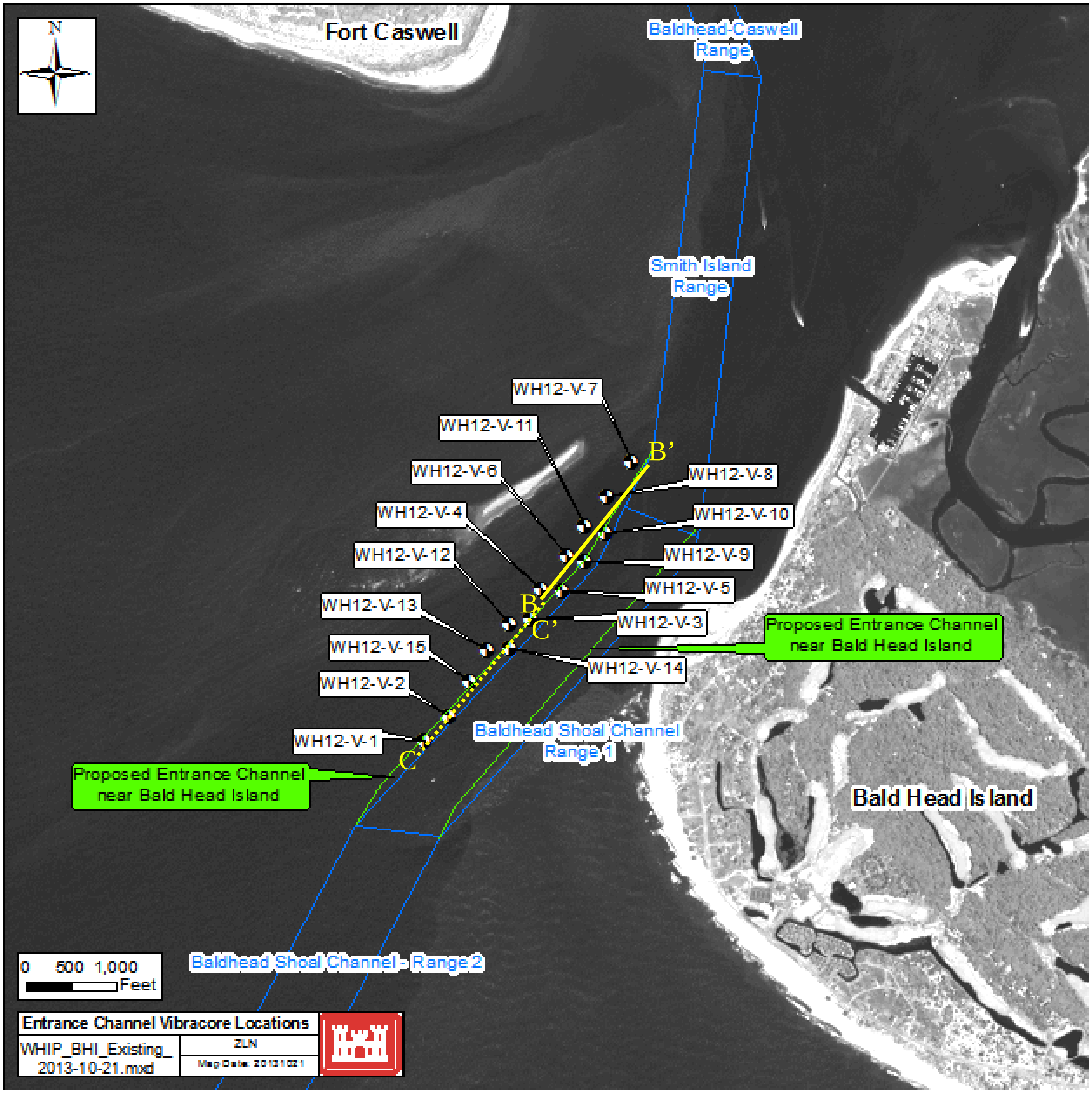

Figure 44. Vibracore locations performed in 2012 at the Entrance Channel near Bald Head Island.

A graphical representation of the Geologic profiles for these samples collected at the Entrance Channel near Bald Head Island is shown in Figure 45 and Figure 46. The intent of each profile was to verify the thickness of potentially useful strata utilizing the soils data. Each profile conveys the following information; river bottom, bottom of boring, graphical representation of the visually classified soils, and the laboratory soil classification in parenthesis. Interpretative weight should be given to laboratory classification over field visual classification, however, the laboratory data does not take into consideration discrete stratigraphic variations such as silt-filled lenses that raise the silt content of composited sandy soils. Therefore, these models are best approximations of the *in-situ* soil conditions.

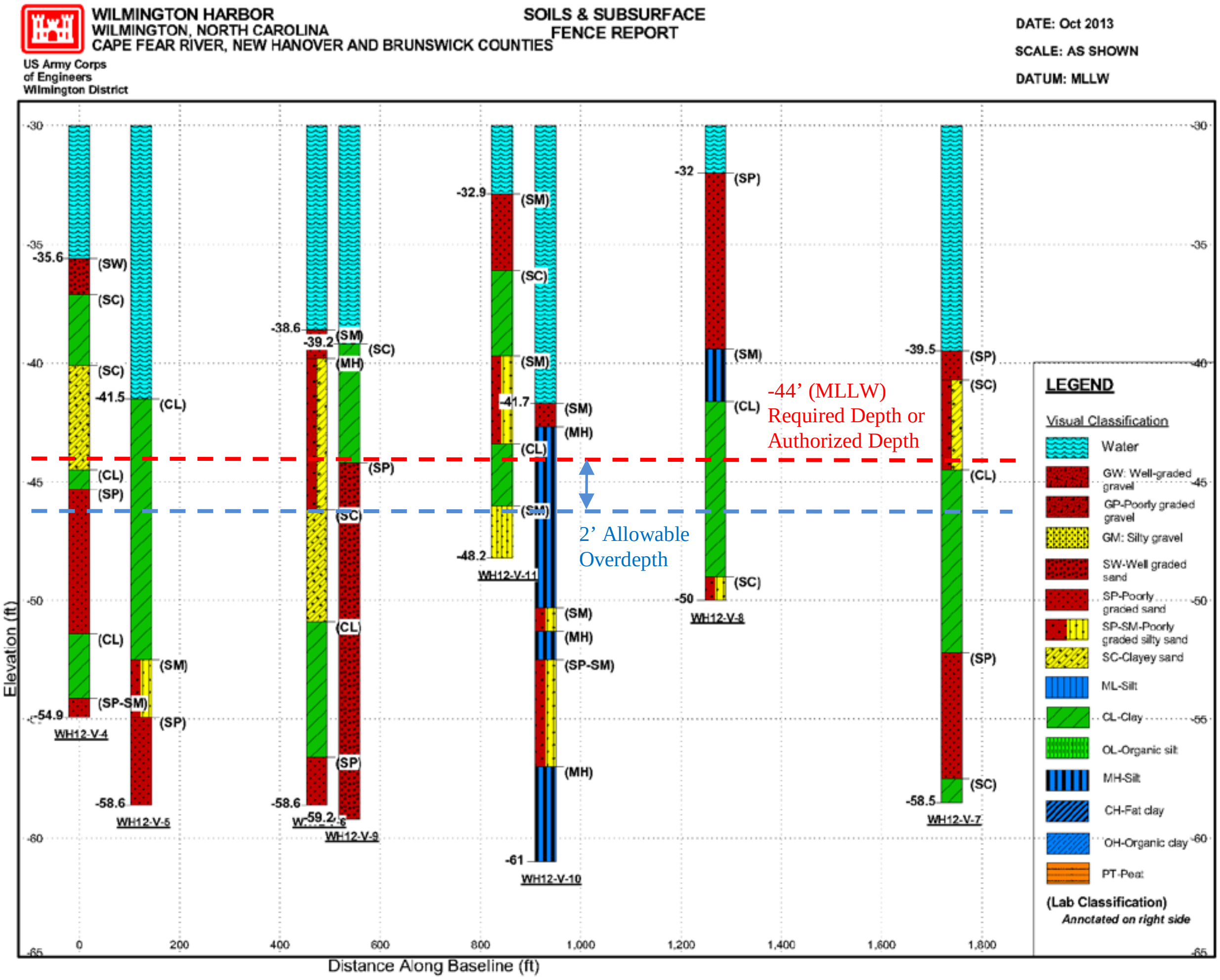

Figure 45. 2-D Geologic cross-section in Entrance Channel near Bald Head Island for line B-B'.

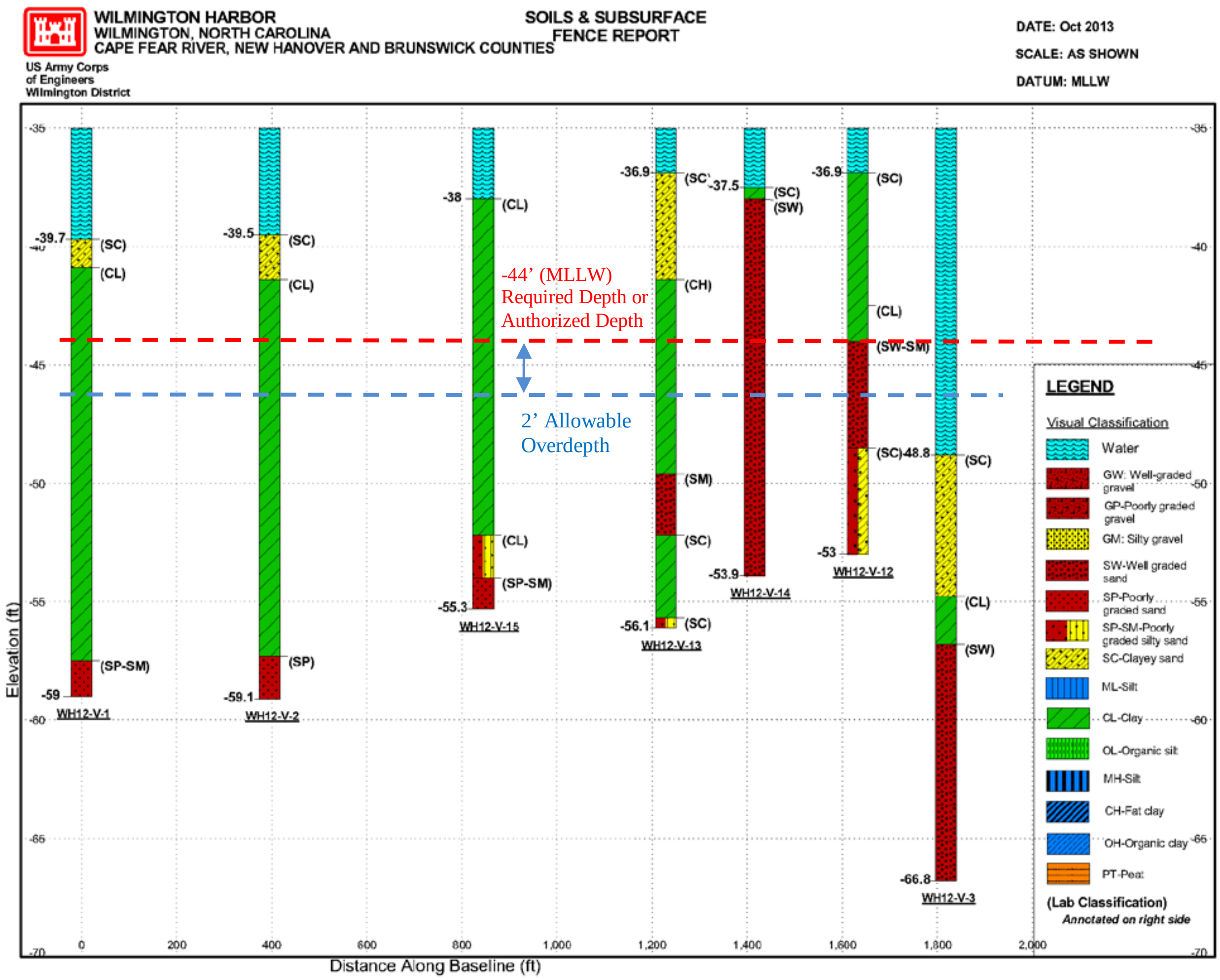

Figure 46. 2-D Geologic cross-section in Entrance Channel near Bald Head Island for line C-C'.

3.3.1.2 Material Properties

A particle size analysis was performed for each vibracore documented within the proposed channel for the authorized depth of -44' (MLLW), plus 2 feet of required allowable overdepth. Where vibracore did not penetrate to at least -46' (MLLW), the compatibility analysis was only ran using material collected. The particle/grain size characteristics of the vibracore samples were used to develop a weighted composite grain size distribution that is representative of the material in each area. To determine the composite characteristics for the proposed Entrance Channel excavation area, each core was weighted based upon the sampled strata thickness of material in the core and then the sum weighted characteristics from the cores are divided by the total strata thickness in the excavation or channel prism bottom. Included in the analysis is an estimate of the amount of fine-grained sediments in each core that is finer than the #200 sieve (0.074 mm). The Wilmington District policy with regard to the percentage of fine-grained sediments is that in excavated areas where more than 10% passes the #200 sieve, these materials are generally considered to be incompatible for beneficial placement on the beach due to potential problems with increased turbidity and siltation during placement.

A total of fifteen vibracores were collected adjacent to the existing Entrance Channel near Bald Head Island resulting in sixty sediment samples in July 2012. One sample (2%) contained well-graded sand with silt (SW-SM) between elevations -44 feet and -48.5 feet MLLW, one sample (2%) contained fat clay (CH) between elevations -41.4 feet and -49.6 feet MLLW, three samples (5%) contained well-graded sand (SW) between elevations -35.6 feet and -66.8 feet MLLW, four samples (7%) contained elastic silt (MH) between elevations -39.8 feet and -61 feet MLLW, four samples (7%) contained poorly graded sand with silt (SP-SM) between elevations -54 feet and -59 feet MLLW, eight samples (13%) contained poorly graded sand (SP) between elevations -32 feet and -59.2 feet MLLW, nine samples (15%) contained silty sand (SM) between elevations -32.9 feet and -54.9 feet MLLW, thirteen samples (21%) contained lean clay between elevations -38 feet and -57.5 feet MLLW, and seventeen samples (28%) contained clayey sand (SC) between elevations -36.1 feet and -59.5 feet MLLW.

Shell content (CaCO3) ranged from 0.0 to 49.2 percent, and averaged 7.26 percent for all samples. Composite shell content ranged from 0.11 to 21.45 percent, and averaged 6.40 percent for all samples. Shell content varied from fine shell hash (sand-sized shell fragments) to very coarse, large shells (e.g., oyster, scallop, etc). See Table 10 for the results from the 2012 USACE vibracore borings at Entrance Channel near Bald Head Island.

From the fifteen vibracores collected in 2012, six are within the proposed channel. Using the laboratory data from the six vibracores (11 total samples), the compatibility analysis indicated weighted percent fines passing the #200 sieve is 45.6%, additionally, the weighted percent passing the #4 sieve is 99.04%. Percent fines passing the #200 sieve for the holes sampled, within the proposed channel, ranged from 2.48% to 72.23%. See Table 10 for a summary of the samples analyzed.

Table 10. Results from the 2012 USACE vibracore borings for the Entrance Channel near Bald Head Island.

Hole	Thickness (ft)	% Passing #4	% Passing #200	Wtd % Passing #4	Wtd % Passing #200
WH12-V-1	6.3	99.11	65.95	16.92	11.26
WH12-V-2	6.5	97.98	64.86	17.26	11.43
WH12-V-5	4.5	99.69	62.28	12.16	7.59
WH12-V-9	6.8	99.43	34.37	18.32	6.33
WH12-V-10	4.3	98.91	72.23	11.53	8.42
WH12-V-14	8.5	99.2	2.48	22.85	0.57
Total	36.9		Total	99.04	45.6

3.3.1.3 Additional Geotechnical Investigation Data

No additional vibracore data is required at the Entrance Channel near Bald Head Island.

3.3.1.4 Dredge Disposal Options for the Entrance Channel near Bald Head Island

Historically, material that has accumulated in the existing Entrance Channel – Range 1 has been beach compatible and it is assumed to be so in the future. This material can be placed on the beach during future dredge cycles as long as there is less than 10% fines passing the #200 (0.075 mm) sieve. The material sampled within the proposed Entrance Channel near Bald Head Island is considered “virgin” material, and should not be considered for beach disposal, but rather the designated ODMDS. The weighted percent fines of the virgin material was calculated to be 45.60%% (much greater than 10% passing the #200 sieve) and the visual percent shell is approximately 6.5%. Therefore, when the virgin material is dredged , it is recommened the material disposal shall be the ODMDS.

4.0 Conclusions and Recommendations

In conclusion, the slope stability analysis confirmed that the proposed Turning Basin should not be lengthened into Eagle Island because the area to be excavated into the dikes will not maintain a factor of safety greater than 1.2. Due to such an inadequate factor of safety, it is recommended that the plan to widen the Turning Basin be abandoned at this time.

For the Battery Island Turn, the area immediately surrounding the sampled vibracore hole locations are not beach compatible or the vibracore refusal depth was above the authorized depth of the channel. This is because the required 10% passing the #200 sieve is not met. Therefore, material disposal should be the ODMDS for the realignment of Battery Island turn.

The virgin material sampled outside the Entrance Channel near Bald Head Island should not be considered for beach disposal. The weighted percent fines of 45.60% is much greater than 10% passing the #200 sieve and the visual percent shell is approximately 6.5%. Material disposal for the proposed channel alignment should to the ODMDS.

The following items are recommended for future activities:

Turning Basin Realignment:

- Continue to perform analysis of the dikes and evaluate the change in foundation conditions.
- Construct any dike raises over 5 feet by staged construction.
- Inspect dikes in Cell 2 and Cell 3 for cracking, settlement, and possible seepage and wet areas during construction activates.
- Check critical Eagle Island stability sections with UTEXAS4.

Battery Island Turn:

- Additional vibracores and washprobes are required to the east of Battery Island Range and Southport Channel. Approximately 10 vibracores and 20 washprobes are recommended.

Entrance Channel near Bald Head:

- None.

5.0 References

Soller, D.R., 1988, Geology and Tectonic History of the Lower Cape Fear River Valley, Southeastern North Carolina, USGS Professional Paper 1466A, Denver, CO.

Reconnaissance Study 905(b) Analysis, Wilmington Harbor Navigation Improvements (April 2011)

Geotechnical Report Eagle Island Dredge Disposal Area Brunswick County, North Carolina (May 2012)

Tolen, P.G., Gilbert, P.E., Zapata Engineering, P.A., 1999, Final Report – River Segment Geotechnical Engineering Analysis for Wilmington Harbor Deeping Project, Brunswick and New Hanover Counties, North Carolina, Vol. I, pages 25 and 60.

Harris, P.G., 2000, Evaluation, Analyses and Delineation of the Geology, Wilmington Harbor, Brunswick and New Hanover Counties, North Carolina, pages 7, 27-29, 34, 35,38, and 39.

US Army Corps of Engineers, Wilmington District, 1996, Final Feasibility Report and Environmental Impact Statement on Improvement of Navigation, Cape Fear – Northeast Cape Fear Rivers Comprehensive Study, Wilmington, North Carolina, Volume II, pages G-9, G-11, and G-13.

Limber, P. and Warren, J, North Carolina Division of Coastal Management, Raleigh, NC, Information Document CRC 06-01, Development of Sediment Criteria Regulations for Beach Fill Projects along North Carolina’s Atlantic Coast

EM 1110-2-1902 Slope Stability (Oct. 2003)

EM 1110-1-1804 Engineering and Design - Geotechnical Investigations, Chapter 7 (January 2001)

ASTM D1140 – Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75-µm) Sieve

ASTM D422 – Standard Test Method for Particle-Size Analysis of Soils

ASTM D4318 – 10 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D2216 – 10 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

ASTM D2974 – 07a Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

ASTM D4767 – 11 Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils

ASTM D2850 – 03a(2007) Standard Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D2435 / D2435M – 11 Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading

ASTM D2487 - 11 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

Attachment A: SPT & CPT Boring Logs for Eagle Island

Boring Designation EI-2011-SPT-4

DRILLING LOG

DIVISION: South Atlantic
INSTALLATION: Wilmington District
SHEET 1 OF 2 SHEETS

1. PROJECT: Eagle Island Dredge Disposal Area
2. HOLE NUMBER: EI-2011-SPT-4
LOCATION COORDINATES: N 170934.1 E 2314360
3. DRILLING AGENCY: Terracon Consultants, Inc
4. NAME OF DRILLER: W. Duggins
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED
DEG FROM VERTICAL: ---
BEARING:
6. THICKNESS OF OVERBURDEN:
7. DEPTH DRILLED INTO ROCK:
8. TOTAL DEPTH OF BORING: 68'
9. COORDINATE SYSTEM: State Plane - North Carolina
HORIZONTAL: NAD 83
VERTICAL: NAVD88
10. SIZE AND TYPE OF BIT: 2-15/16 Drag Bit
11. MANUFACTURER'S DESIGNATION OF DRILL: Diedrich D-50T
12. TOTAL SAMPLES: DISTURBED 45 UNDISTURBED 2
13. TOTAL NUMBER CORE BOXES: 0
14. ELEVATION GROUND WATER: See Remarks
15. DATE BORING: STARTED 10/10/11 COMPLETED 10/10/11
16. ELEVATION TOP OF BORING: 33'
17. TOTAL CORE RECOVERY FOR BORING: N/A
18. SIGNATURE AND TITLE OF INSPECTOR: B. Folsom, Staff Professional

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	UD*	REMARKS	Blows/ 0.5 ft	N-Value	
			POORLY GRADED SAND (SP), tan to brown, with gravel, with silt.	100	SS-1			3 12 5	17	0
				100	SS-2			6 6 6	12	
				100	SS-3		Gravel = 16; Sand = 65; Fines = 12; LL = NP; PI = NP; MC = 12; SP-SM	21 29 13	42	
27.0	6.0			100	SS-4			11 13 7	20	5
			ELASTIC SILT (MH), dark black to brown.	100	SS-5			3 3 5	8	
				100	SS-6			3 3 3	6	
				100	SS-7			0 2 3	5	10
				100	SS-8		Fines = 56; LL = 57; PI = 26; MC = 40; MH	3 5 6	11	
				100	SS-9			2 5 6	11	
			Nonwoven fabric and geogrid at 13.5 feet	100	SS-10			1 0 0	0	15
				100	SS-11			0 0 0	0	
				100	SS-12		Fines = 94; LL = 90; PI = 35; MC = 88; MH	0 0 0	0	
14.0	19.0			100	SS-13			0 2 10	12	
			SILTY SAND (SM), tan to brown.	100	SS-14			6 11 7	18	20
				100	SS-15			2 11 32	43	
				100	SS-16			14 11 8	19	
8.0	25.0			100	SS-17			4 2 1	3	25
			CLAY (CH), dark black to brown, high plasticity.	100	SS-18		Fines = 74; LL = 83; PI = 47; MC = 79; CH	0 0 3	3	
5.0	28.0			100	SS-19			0 1 3	4	
3.0	30.0		SILTY SAND (SM), fine to medium; black to tan.	100	SS-20			1 0 0	0	30
			SILT (MH), black to brown, high plasticity.	100	SS-21			0 0 0	0	
				100	SS-22	ST	Dry Density = 60.4 pcf MC = 66	0 0 0	0	
				100	SS-23			0 0 0	0	
								0		35

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FEB 08

Boring Designation EI-2011-SPT-4 SHEET 1 of 2

Boring Designation EI-2011-SPT-4

DRILLING LOG (Cont Sheet)	INSTALLATION Wilmington District			SHEET 2 OF 2 SHEETS
PROJECT Eagle Island Dredge Disposal Area	COORDINATE SYSTEM State Plane	HORIZONTAL NAD 83	VERTICAL NAVD88	
LOCATION COORDINATES N 170934.1 E 2314360	ELEVATION TOP OF BORING 33'			

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	UD*	REMARKS	Blows/ 0.5 ft	N-Value
			SILT (MH), black to brown, high plasticity. *(continued)*	100	SS-24		Vane Shear Test @ 35' peak = 3275 psf ; residual = 1025 psf	0 0	0
				100	SS-25			0 0 0	0
						ST	Dry Density=48.7 pcf Gravel = 1; Sand = 36; Fines = 63; LL = 65; PI = 30; MC = 86; MH CU, Consolidation		
				100	SS-26		Vane Shear Test @ 40' peak = 1845 psf ; residual = 615 psf	0 0 0	0
-9.0	42.0			100	SS-27			0 6 6	12
-10.0	43.0		SILTY SAND (SM), fine to medium; brown to tan.	100	SS-28			2 5 4	9
			PEAT (Pt), dark black to brown.	100	SS-29			2 1 1	2
				100	SS-30			2 2 3	5
				100	SS-31			0 0 1	1
			wood encountered in SS-32	100	SS-32		Gravel = 46; Sand = 46; Fines = 2; LL = NP; PI = NP; MC = 285; GW	5 4 3	7
				100	SS-33		MC = 346; Organic Content = 56% (Sample Consisted of mostly organic material)	0 0 0	0
-19.0	52.0			100	SS-34			3 5 9	14
			POORLY GRADED SAND (SP), brown to tan, with silt.	100	SS-35			6 9 9	18
				100	SS-36			5 6 8	14
				100	SS-37			4 6 6	12
				100	SS-38		Sand = 97; Fines = 3; LL = NP; PI = NP; MC = 24; SP	4 8 11	19
-26.5	59.5			100	SS-39			1 1 0	1
-29.0	62.0		SILT (MH), dark brown.	100	SS-40			0 0 0	0
			POORLY GRADED SAND (SP), fine to medium; dark brown to tan, with silt.	100	SS-41			9 15 22	37
				100	SS-42			12 13 13	26
				100	SS-43			7 10 12	22
-34.0	67.0			70	SS-44			34 100	100
-35.0	68.0		POORLY GRADED SAND (SP), pale gray, moderate cementation.	100	SS-45			100	100

BOTTOM OF BOREHOLE AT 68.0 ft

Water Level Data

Reading	**Depth**	**Notes**
After drilling		Not Recorded; Wash Drilling
24 hours	19.5	Cave in at 26 ft

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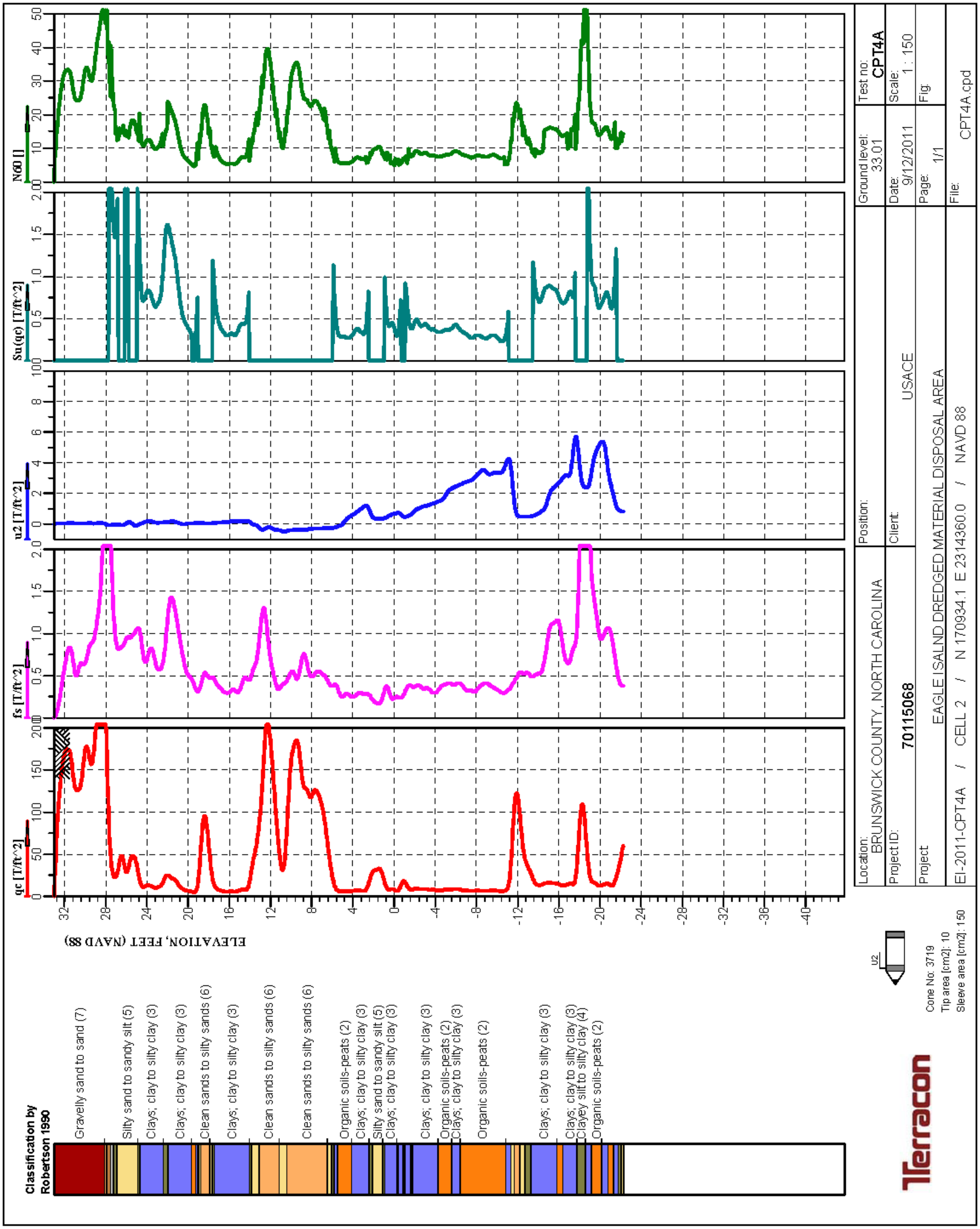
FEB 08

Boring Designation EI-2011-SPT-4 SHEET 2 of 2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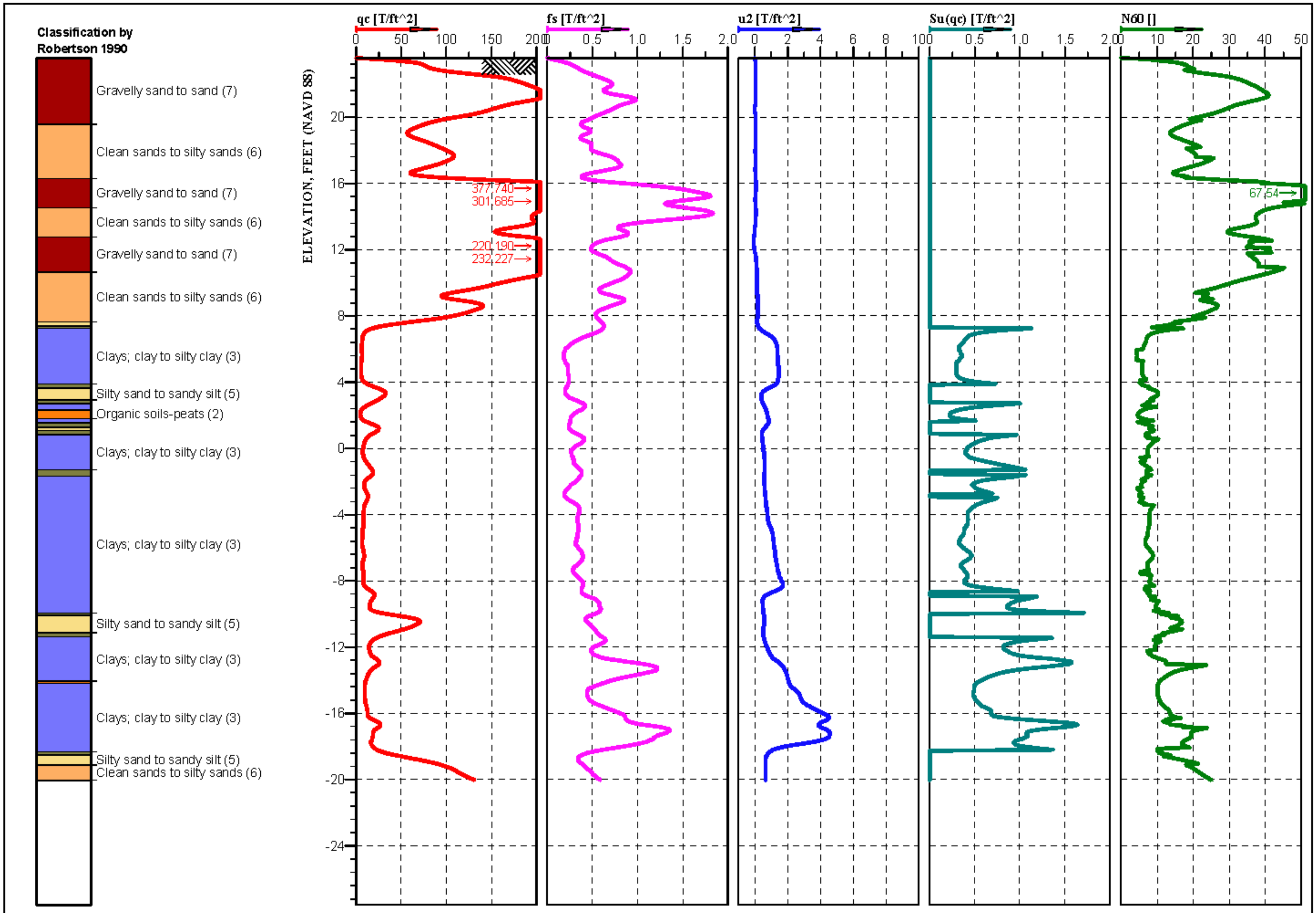
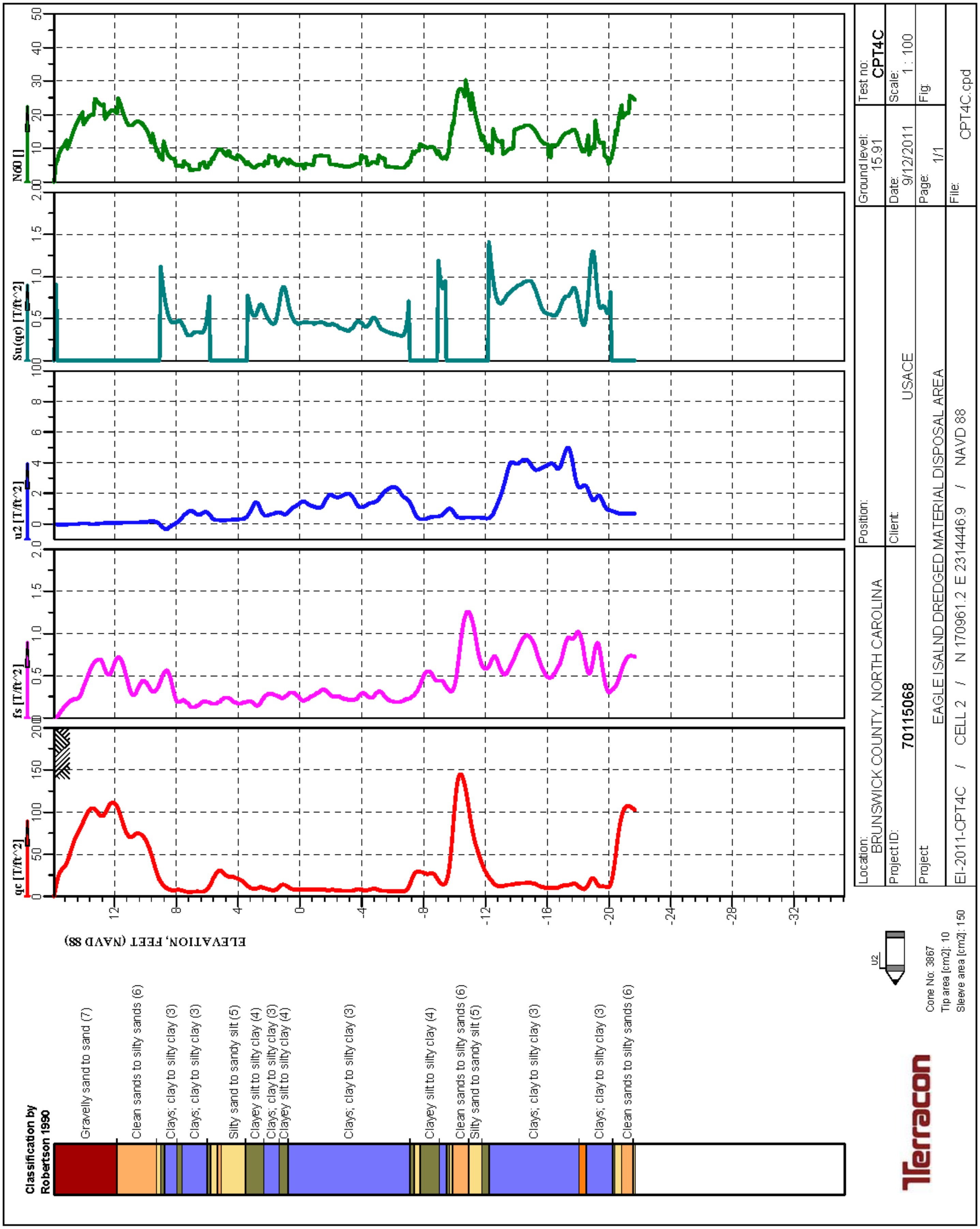
0
50
100
150
200
fs [T/ft^2]
0.5
1.0
1.5
2.0
u2 [T/ft^2]
0
2
4
6
8
10
Su(qc) [T/ft^2]
0.0
0.5
1.0
1.5
2.0
N60 []
10
20
30
40
50
ELEVATION, FEET (NAVD 88)
32
28
24
20
16
12
8
4
0
-4
-8
-12
-16
-20
-24
-28
-32
-36
-40
Classification by Robertson 1990
Gravelly sand to sand (7)
Silty sand to sandy silt (5)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Clean sands to silty sands (6)
Clays; clay to silty clay (3)
Clean sands to silty sands (6)
Clean sands to silty sands (6)
Organic soils-peats (2)
Clays; clay to silty clay (3)
Silty sand to sandy silt (5)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Organic soils-peats (2)
Clays; clay to silty clay (3)
Organic soils-peats (2)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Clayey silt to silty clay (4)
Organic soils-peats (2)
u2
Cone No: 3719
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Terracon
Location:
BRUNSWICK COUNTY, NORTH CAROLINA
Position:
Ground level:
33.01
Test no:
CPT4A
Project ID:
70115068
Client:
USACE
Date:
9/12/2011
Scale:
1 : 150
Project:
EAGLE ISALND DREDGED MATERIAL DISPOSAL AREA
Page:
1/1
Fig:
EI-2011-CPT4A / CELL 2 / N 170934.1 E 2314360.0 / NAVD 88
File:
CPT4A.cpd



Location: BRUNSWICK COUNTY, NORTH CAROLINA	Position:	Ground level: 23.59	Test no: **CPT4B**
Project ID: **70115068**	Client: USACE	Date: 9/12/2011	Scale: 1 : 100
Project: EAGLE ISALND DREDGED MATERIAL DISPOSAL AREA		Page: 1/1	Fig:
EI-2011-CPT4B / CELL 2 / N 170951.6 E 2314413.2 / NAVD 88		File: CPT4B.cpd	

u2

Cone No: 3719
Tip area [cm2]: 10
Sleeve area [cm2]: 150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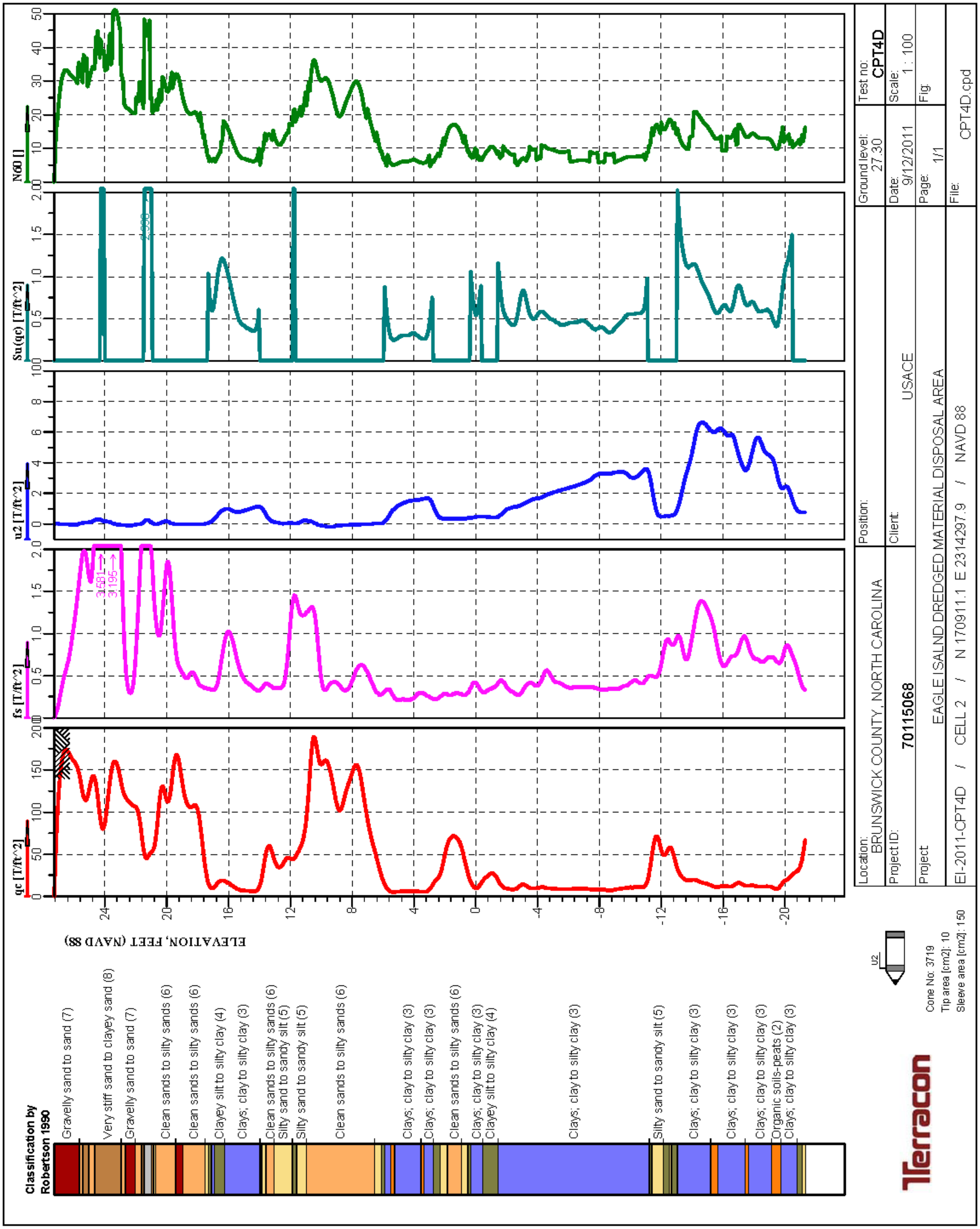
fs [T/ft^2]
u2 [T/ft^2]
Su(qc) [T/ft^2]
N60 []
ELEVATION, FEET (NAVD 88)
12
8
4
0
-4
-8
-12
-16
-20
-24
-28
-32
0
50
100
150
200
0.5
1.0
1.5
2.0
2
4
6
8
10
20
30
40
50
Classification by Robertson 1990
Gravelly sand to sand (7)
Clean sands to silty sands (6)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Silty sand to sandy silt (5)
Clayey silt to silty clay (4)
Clays; clay to silty clay (3)
Clayey silt to silty clay (4)
Clays; clay to silty clay (3)
Clayey silt to silty clay (4)
Clean sands to silty sands (6)
Silty sand to sandy silt (5)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Clean sands to silty sands (6)
Terracon
u2
Cone No: 3867
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Location:
BRUNSWICK COUNTY, NORTH CAROLINA
Position:
Ground level:
15.91
Test no:
CPT4C
Project ID:
70115068
Client:
USACE
Date:
9/12/2011
Scale:
1 : 100
Project:
EAGLE ISALND DREDGED MATERIAL DISPOSAL AREA
Page:
1/1
Fig:
EI-2011-CPT4C / CELL 2 / N 170961.2 E 2314446.9 / NAVD 88
File:
CPT4C.cpd


Classification by Robertson 1990
Gravelly sand to sand (7)
Very stiff sand to clayey sand (8)
Gravelly sand to sand (7)
Clean sands to silty sands (6)
Clean sands to silty sands (6)
Clayey silt to silty clay (4)
Clays; clay to silty clay (3)
Clean sands to silty sands (6)
Silty sand to sandy silt (5)
Silty sand to sandy silt (5)
Clean sands to silty sands (6)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Clean sands to silty sands (6)
Clays; clay to silty clay (3)
Clayey silt to silty clay (4)
Clays; clay to silty clay (3)
Silty sand to sandy silt (5)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Organic soils-peats (2)
Clays; clay to silty clay (3)
ELEVATION, FEET (NAVD 88)
24
20
16
12
8
4
0
-4
-8
-12
-16
-20
qc [T/ft^2]
0
50
100
150
200
fs [T/ft^2]
0.5
1.0
1.5
2.0
3.681→
3.195→
u2 [T/ft^2]
0
2
4
6
8
10
Su(qc) [T/ft^2]
0.5
1.0
1.5
2.0
2.503
N60 []
10
20
30
40
50
u2
Cone No: 3719
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Terracon
Location:
BRUNSWICK COUNTY, NORTH CAROLINA
Position:
Ground level:
27.30
Test no:
CPT4D
Project ID:
70115068
Client:
USACE
Date:
9/12/2011
Scale:
1 : 100
Project:
EAGLE ISALND DREDGED MATERIAL DISPOSAL AREA
Page:
1/1
Fig:
EI-2011-CPT4D / CELL 2 / N 170911.1 E 2314297.9 / NAVD 88
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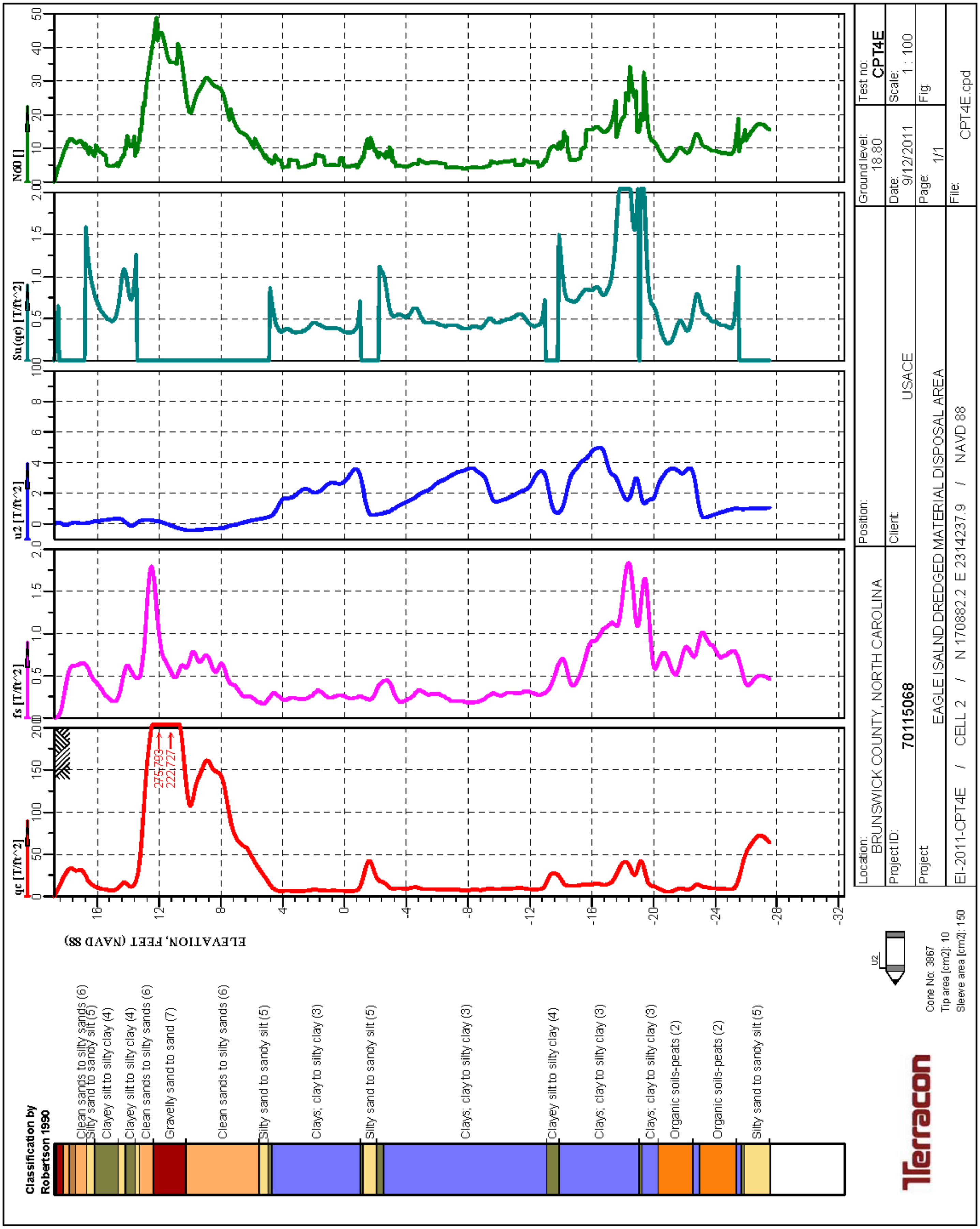
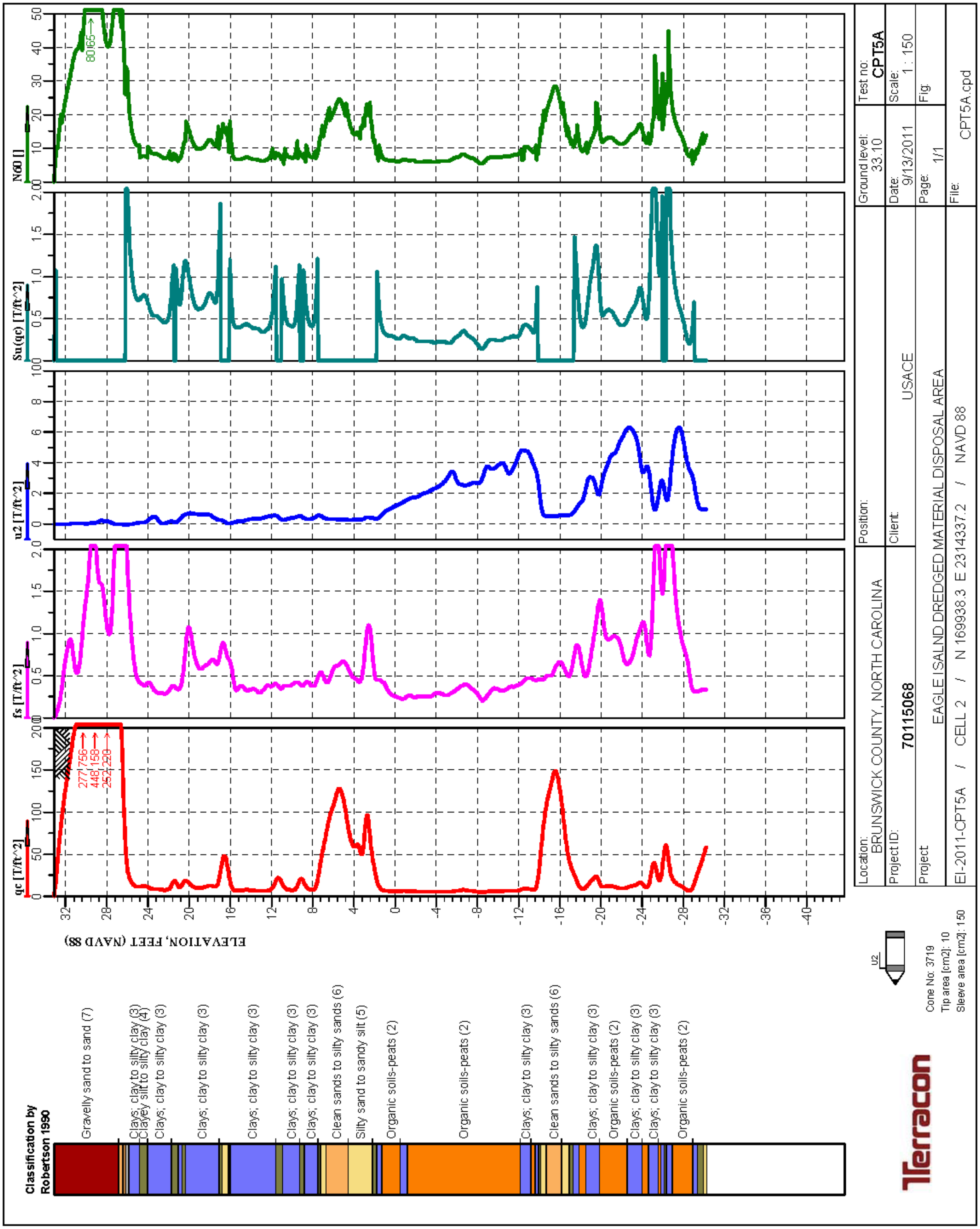

qc [T/ft^2]
0
50
100
150
200
275.793
222.727
fs [T/ft^2]
0.0
0.5
1.0
1.5
2.0
u2 [T/ft^2]
-2.0
0
2
4
6
8
10.0
Su(qc) [T/ft^2]
0.00
0.5
1.0
1.5
2.00
N60 []
0
10
20
30
40
50
16
12
8
4
0
-4
-8
-12
-16
-20
-24
-28
-32
ELEVATION, FEET (NAVD 88)
Classification by Robertson 1990
Clean sands to silty sands (6)
Silty sand to sandy silt (5)
Clayey silt to silty clay (4)
Clayey silt to silty clay (4)
Clean sands to silty sands (6)
Gravelly sand to sand (7)
Clean sands to silty sands (6)
Silty sand to sandy silt (5)
Clays; clay to silty clay (3)
Silty sand to sandy silt (5)
Clays; clay to silty clay (3)
Clayey silt to silty clay (4)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Organic soils-peats (2)
Organic soils-peats (2)
Silty sand to sandy silt (5)
u2
Cone No: 3867
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Terracon
Location:
BRUNSWICK COUNTY, NORTH CAROLINA
Position:
Ground level:
18.80
Test no:
CPT4E
Project ID:
70115068
Client:
USACE
Date:
9/12/2011
Scale:
1 : 100
Project:
EAGLE ISALND DREDGED MATERIAL DISPOSAL AREA
Page:
1/1
Fig:
EI-2011-CPT4E / CELL 2 / N 170882.2 E 2314237.9 / NAVD 88
File:
CPT4E.cpd



Cone No: 3719
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: BRUNSWICK COUNTY, NORTH CAROLINA
Position:
Ground level: 33.10
Test no: **CPT5A**
Project ID: **70115068**
Client: USACE
Date: 9/13/2011
Scale: 1 : 150
Project: EAGLE ISALND DREDGED MATERIAL DISPOSAL AREA
Page: 1/1
Fig:
EI-2011-CPT5A / CELL 2 / N 169938.3 E 2314337.2 / NAVD 88
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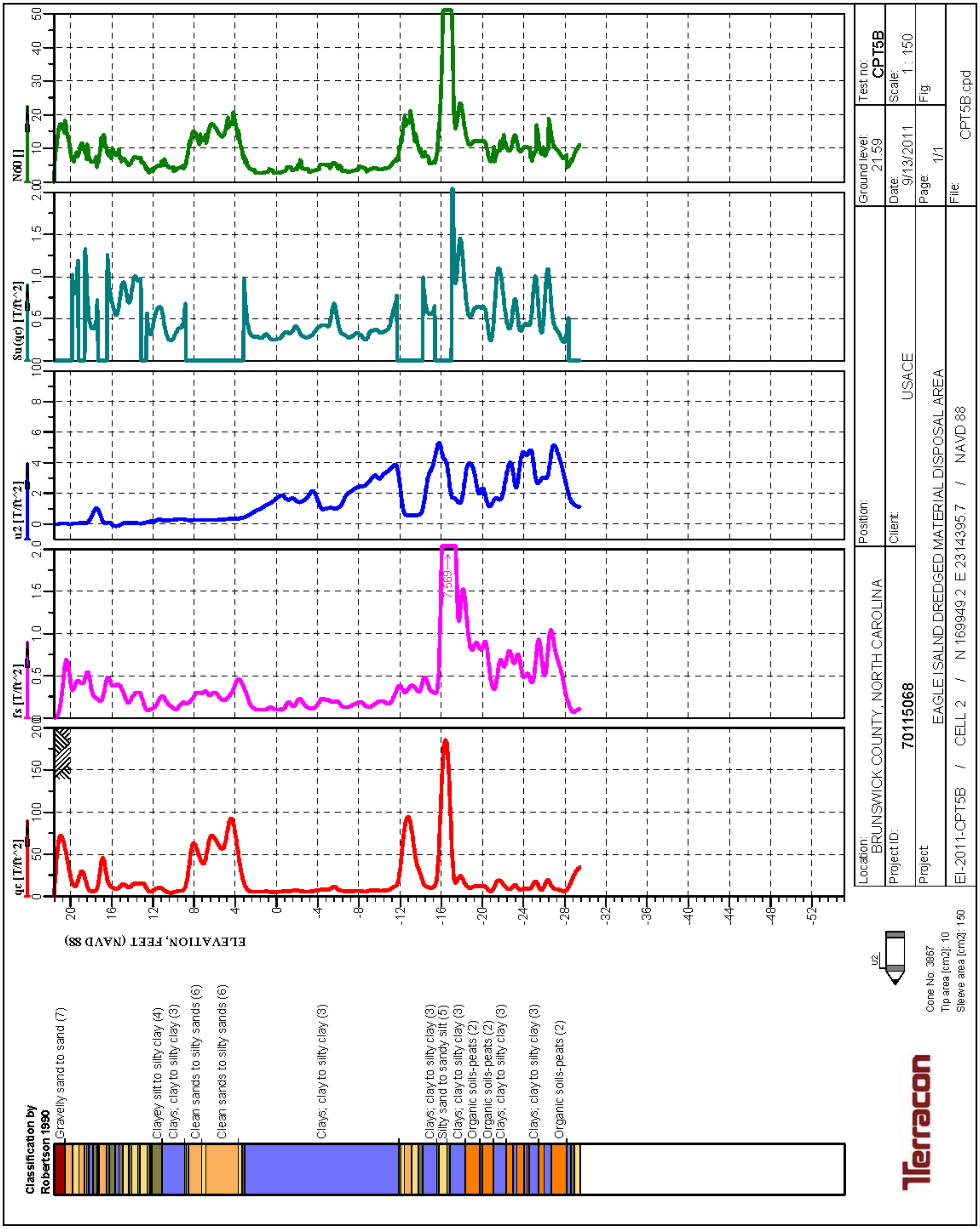
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fs [T/ft^2]
u2 [T/ft^2]
Su(qc) [T/ft^2]
N60 []
ELEVATION, FEET (NAVD 88)
20
16
12
8
4
0
-4
-8
-12
-16
-20
-24
-28
-32
-36
-40
-44
-48
-52
0
50
100
150
200
0.5
1.0
1.5
2.0
2
4
6
8
10.0
10
20
30
40
50
7569→
Classification by Robertson 1990
Gravelly sand to sand (7)
Clayey silt to silty clay (4)
Clays; clay to silty clay (3)
Clean sands to silty sands (6)
Clean sands to silty sands (6)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Silty sand to sandy silt (5)
Clays; clay to silty clay (3)
Organic soils-peats (2)
Organic soils-peats (2)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Organic soils-peats (2)
u2
Cone No: 3867
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Terracon
Location:
BRUNSWICK COUNTY, NORTH CAROLINA
Position:
Ground level:
21.59
Test no:
CPT5B
Project ID:
70115068
Client:
USACE
Date:
9/13/2011
Scale:
1 : 150
Project:
EAGLE ISALND DREDGED MATERIAL DISPOSAL AREA
Page:
1/1
Fig:
EI-2011-CPT5B / CELL 2 / N 169949.2 E 2314395.7 / NAVD 88
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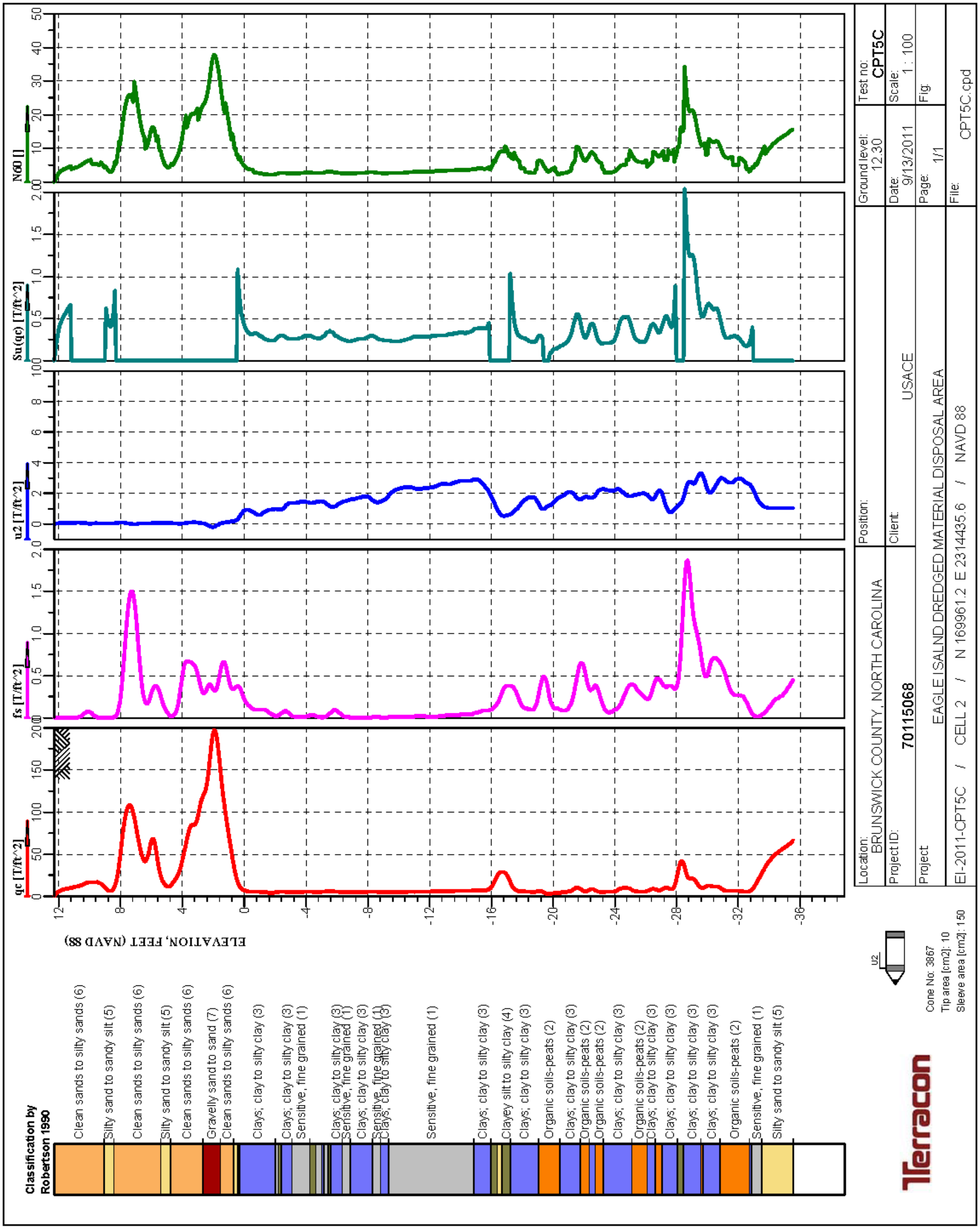
Classification by Robertson 1990
Clean sands to silty sands (6)
Silty sand to sandy silt (5)
Clean sands to silty sands (6)
Silty sand to sandy silt (5)
Clean sands to silty sands (6)
Gravelly sand to sand (7)
Clean sands to silty sands (6)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Sensitive, fine grained (1)
Clays; clay to silty clay (3)
Sensitive, fine grained (1)
Clays; clay to silty clay (3)
Sensitive, fine grained (1)
Clays; clay to silty clay (3)
Sensitive, fine grained (1)
Clays; clay to silty clay (3)
Clayey silt to silty clay (4)
Clays; clay to silty clay (3)
Organic soils-peats (2)
Clays; clay to silty clay (3)
Organic soils-peats (2)
Organic soils-peats (2)
Clays; clay to silty clay (3)
Organic soils-peats (2)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Organic soils-peats (2)
Sensitive, fine grained (1)
Silty sand to sandy silt (5)
ELEVATION, FEET (NAVD 88)
12
8
4
0
-4
-8
-12
-16
-20
-24
-28
-32
-36
qc [T/ft^2]
0
50
100
150
200
fs [T/ft^2]
0.0
0.5
1.0
1.5
2.0
u2 [T/ft^2]
0
2
4
6
8
10
Su(qc) [T/ft^2]
0.0
0.5
1.0
1.5
2.0
N60 []
0
10
20
30
40
50
u2
Cone No: 3867
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Terracon
Location:
BRUNSWICK COUNTY, NORTH CAROLINA
Position:
Ground level:
12.30
Test no:
CPT5C
Project ID:
70115068
Client:
USACE
Date:
9/13/2011
Scale:
1 : 100
Project:
EAGLE ISALND DREDGED MATERIAL DISPOSAL AREA
Page:
1/1
Fig:
EI-2011-CPT5C / CELL 2 / N 169961.2 E 2314435.6 / NAVD 88
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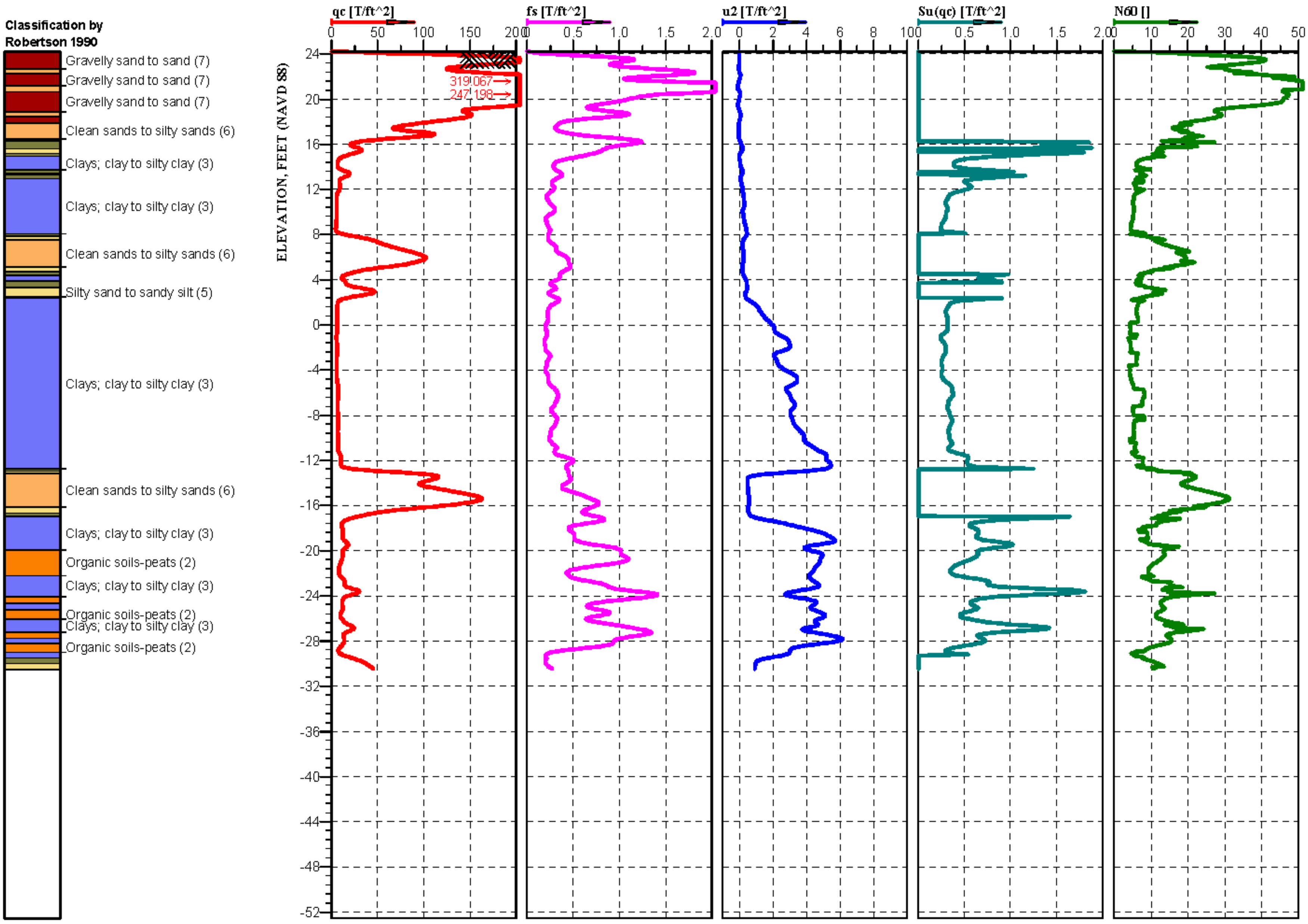
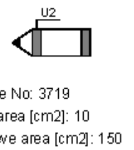
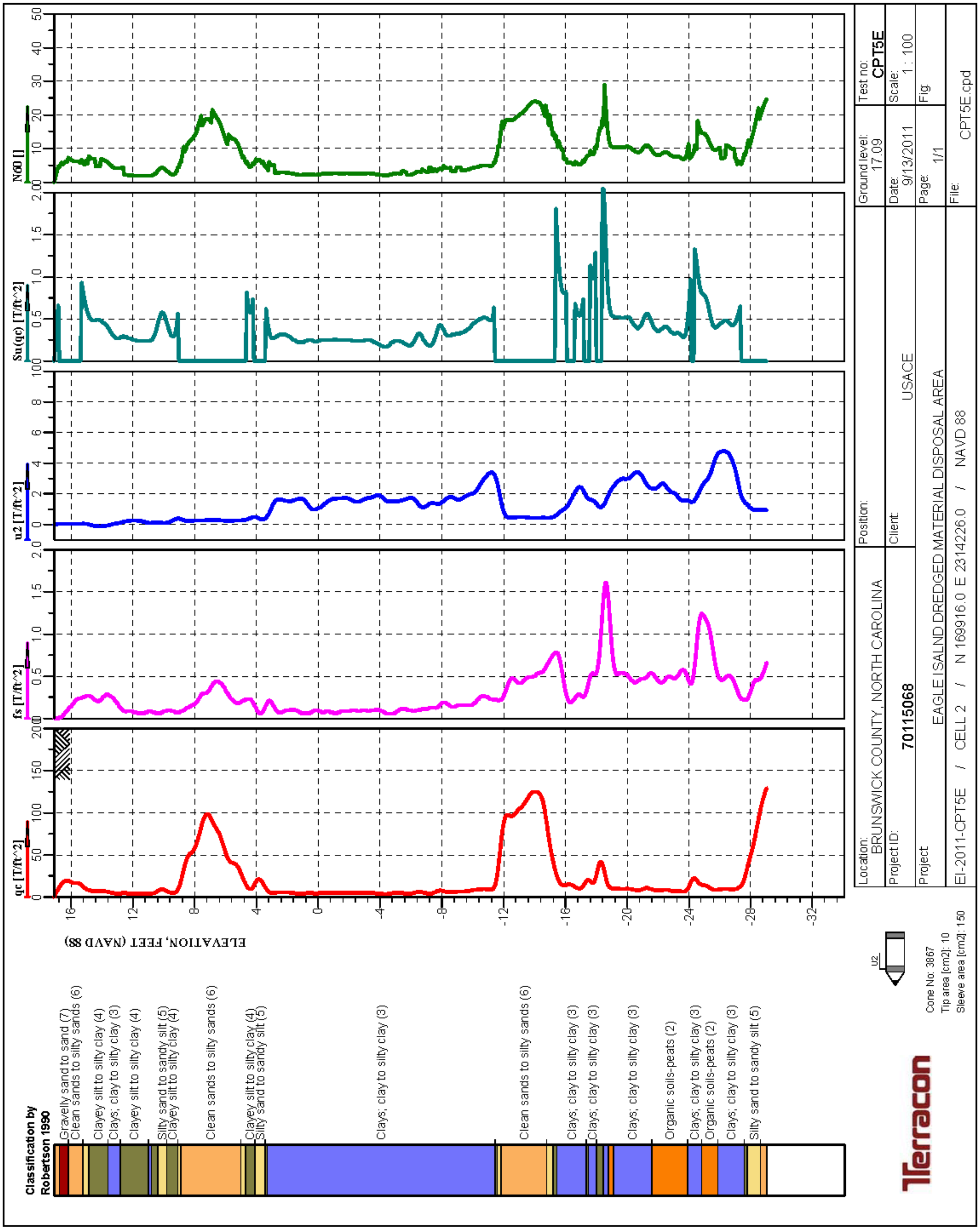




Terracon

Location: BRUNSWICK COUNTY, NORTH CAROLINA	Position:	Ground level: 24.21	Test no: **CPT5D**
Project ID: **70115068**	Client: USACE	Date: 9/13/2011	Scale: 1 : 150
Project EAGLE ISALND DREDGED MATERIAL DISPOSAL AREA		Page: 1/1	Fig:
EI-2011-CPT5D / CELL 2 / N 169926.9 E 2314278.4 / NAVD 88		File: CPT5D.cpd	


qc [T/ft^2]
fs [T/ft^2]
u2 [T/ft^2]
Su(qc) [T/ft^2]
N60 []
ELEVATION, FEET (NAVD 88)
16
12
8
4
0
-4
-8
-12
-16
-20
-24
-28
-32
Classification by Robertson 1990
Gravelly sand to sand (7)
Clean sands to silty sands (6)
Clayey silt to silty clay (4)
Clays; clay to silty clay (3)
Clayey silt to silty clay (4)
Silty sand to sandy silt (5)
Clayey silt to silty clay (4)
Clean sands to silty sands (6)
Clayey silt to silty clay (4)
Silty sand to sandy silt (5)
Clays; clay to silty clay (3)
Clean sands to silty sands (6)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Organic soils-peats (2)
Clays; clay to silty clay (3)
Organic soils-peats (2)
Clays; clay to silty clay (3)
Silty sand to sandy silt (5)
u2
Cone No: 3867
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Terracon
Location:
BRUNSWICK COUNTY, NORTH CAROLINA
Project ID:
70115068
Project:
EAGLE ISALND DREDGED MATERIAL DISPOSAL AREA
EI-2011-CPT5E / CELL 2 / N 169916.0 E 2314226.0 / NAVD 88
Position:
Client:
USACE
Ground level:
17.09
Test no:
CPT5E
Date:
9/13/2011
Scale:
1 : 100
Page:
1/1
Fig:
File:
CPT5E.cpd

Boring Designation EI-2011-SPT-14

DRILLING LOG

DIVISION: South Atlantic

INSTALLATION: Wilmington District

SHEET 1 OF 2 SHEETS

1. PROJECT: Eagle Island Dredge Disposal Area
2. HOLE NUMBER: EI-2011-SPT-14 LOCATION COORDINATES: N 171913.7 E 2314468.4
3. DRILLING AGENCY: Terracon Consultants, Inc
4. NAME OF DRILLER: W. Duggins
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED DEG FROM VERTICAL: --- BEARING:
6. THICKNESS OF OVERBURDEN:
7. DEPTH DRILLED INTO ROCK:
8. TOTAL DEPTH OF BORING: 69'
9. COORDINATE SYSTEM: State Plane - North Carolina HORIZONTAL: NAD 83 VERTICAL: NAVD88
10. SIZE AND TYPE OF BIT: 2-15/16 Drag Bit
11. MANUFACTURER'S DESIGNATION OF DRILL: Diedrich D-50T
12. TOTAL SAMPLES: DISTURBED: 46 UNDISTURBED: 2
13. TOTAL NUMBER CORE BOXES: 0
14. ELEVATION GROUND WATER: See Remarks
15. DATE BORING: STARTED: 10/14/11 COMPLETED: 10/17/11
16. ELEVATION TOP OF BORING: 33'
17. TOTAL CORE RECOVERY FOR BORING: N/A
18. SIGNATURE AND TITLE OF INSPECTOR: B. Folsom, Staff Professional

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	UD*	REMARKS	Blows/ 0.5 ft	N-Value
32.0	1.0		SILTY SAND (SM), fine to medium; brown to tan. SILT (MH), dark gray to black, high plasticity.		SS-1			1 1 1	2
29.5	3.5				SS-2			0 0 0	0
			POORLY GRADED SAND (SP), fine to medium; dark tan, with silt, with gravel.		SS-3			5 24 25	49
					SS-4		Gravel = 4; Sand = 80; Fines = 7; LL = NP; PI = NP; MC = 4; SP-SM	11 20 22	42
					SS-5			12 19 17	36
					SS-6			7 19 23	42
					SS-7			5 18 18	36
					SS-8			8 14 14	28
					SS-9		Gravel = 0; Sand = 87; Fines = 7; LL = NP; PI = NP; MC = 16; SP-SM	10 10 11	21
					SS-10			5 7 9	16
17.0	16.0		SILT (MH), dark gray to black, high plasticity.		SS-11			0 1 4	5
					SS-12			5 8 10	18
					SS-13			1 3 4	7
					SS-14			3 1 1	2
11.0	22.0		POORLY GRADED SAND (SP), dark tan, with silt.		SS-15			0 0 0	0
					SS-16			6 9 8	17
					SS-17			4 6 5	11
					SS-18			3 3 3	6
					SS-19			0 0 0	0
					SS-20			2 2 3	5
					SS-21		Gravel = 0; Sand = 96; Fines = 4; LL = NP; PI = NP; MC = 27; SP	2 3 4	7
					SS-22			1 2 3	5
					SS-23			1 3 7	10
								7	

Boring Designation EI-2011-SPT-14

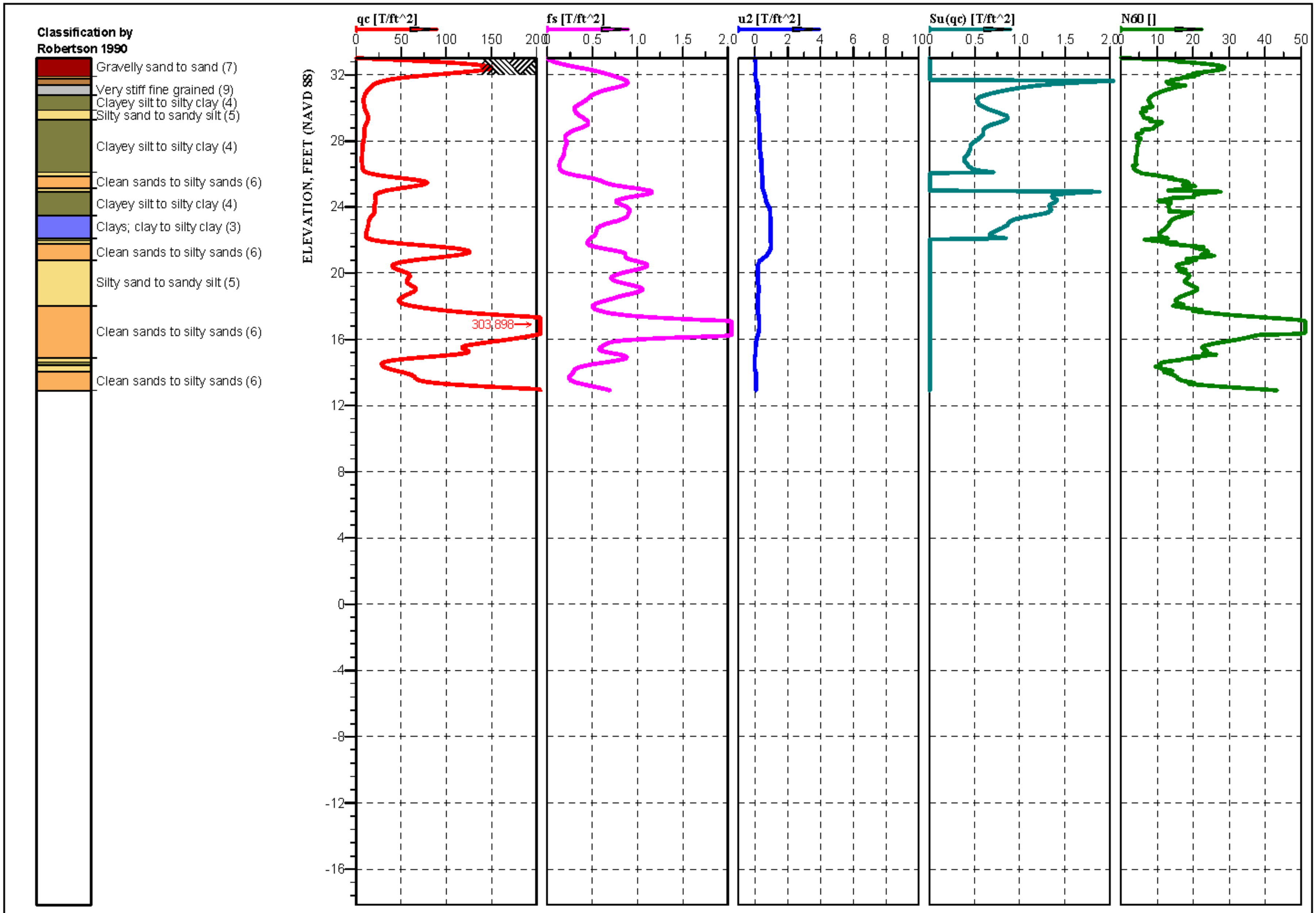
DRILLING LOG (Cont Sheet)	INSTALLATION Wilmington District		SHEET 2 OF 2 SHEETS
PROJECT Eagle Island Dredge Disposal Area	COORDINATE SYSTEM State Plane	HORIZONTAL NAD 83	VERTICAL NAVD88
LOCATION COORDINATES N 171913.7 E 2314468.4	ELEVATION TOP OF BORING 33'		

ELEV	DEPTH	LEGEND	FIELD CLASSIFICATION OF MATERIALS (Description)	% REC	Samp No.	UD*	REMARKS	Blows/ 0.5 ft	N-Value
			POORLY GRADED SAND (SP), dark tan, with silt. *(continued)*		SS-24			8 9	17
					SS-25			2 2 3	5
-5.5	38.5		SILT (MH), dark gray to black, high plasticity.		SS-26	ST	Dry Density = 46.3 pcf Gravel = 1; Sand = 31; Fines = 68; LL = 66; PI = 28; MC = 91; MH UU, Consolidation	0 0 0	0
					SS-27			0 0 0	0
					SS-28		Vane Shear @ 40' peak = 2610 psf ; remolded = 1085 psf	2 1 4	5
-9.0	42.0				SS-29			2 2 2	4
-11.0	44.0		SILT (MH), dark gray to black, high plasticity.		SS-30	ST	Gravel = 0; Sand = 10; Fines = 90; LL = 76; PI = 38; MH Consolidation	0 0 0	0
-13.0	46.0		SILTY PEAT (Pt), black to brown.		SS-31		Vane Shear @ 46' peak = 2610 psf ; remolded = 1190 psf	0 1 5	6
					SS-32			2 4 5	9
					SS-33			1 2 1	3
					SS-34		MC = 415; Organic Content = 38%	0 0 0	0
-19.0	52.0		SILTY SAND (SM), fine to medium; dark tan to brown.		SS-35			3 7 7	14
					SS-36		SS-36 Gravel = 7; Sand = 53; Fines = 38; LL = 75; PI = 30; MC = 100; SM	0 1 4	5
					SS-37			3 4 8	12
					SS-38			5 5 8	13
					SS-39		Sample contains wood on Sieve Size #8	4 8 9	17
-25.5	58.5		POORLY GRADED SAND (SP), brown to tan, with silt.		SS-40		Gravel = 0; Sand = 97; Fines = 3; LL = NP; PI = NP; MC = 24; SP	5 9 12	21
					SS-41			7 7 6	13
			with organics from 61.5 to 63 feet		SS-42			0 0 3	3
					SS-43		Gravel = 0; Sand = 90; Fines = 10; LL = NP; PI = NP; MC = 25; SP-SM	14 16 17	33
					SS-44			3 5 18	23
					SS-45			31 29 50	79
-36.0	69.0				SS-46			16 12 26	38

BOTTOM OF BOREHOLE AT 69.0 ft

Water Level Data

Reading	**Depth**	**Notes**
After drilling		Not Recorded; Wash Drilling
24 hours		Not Recorded; Cave in at 13 ft

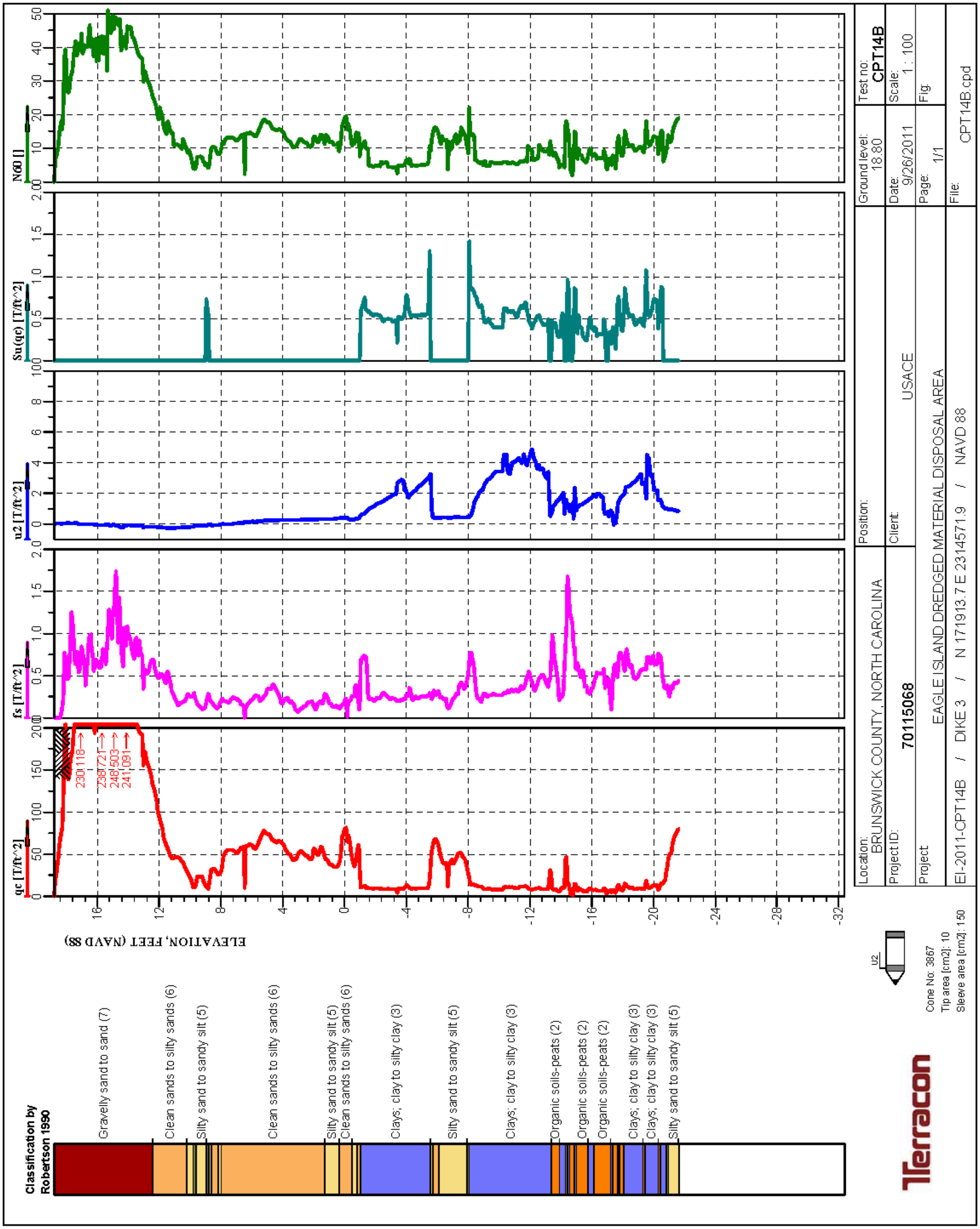


Terracon

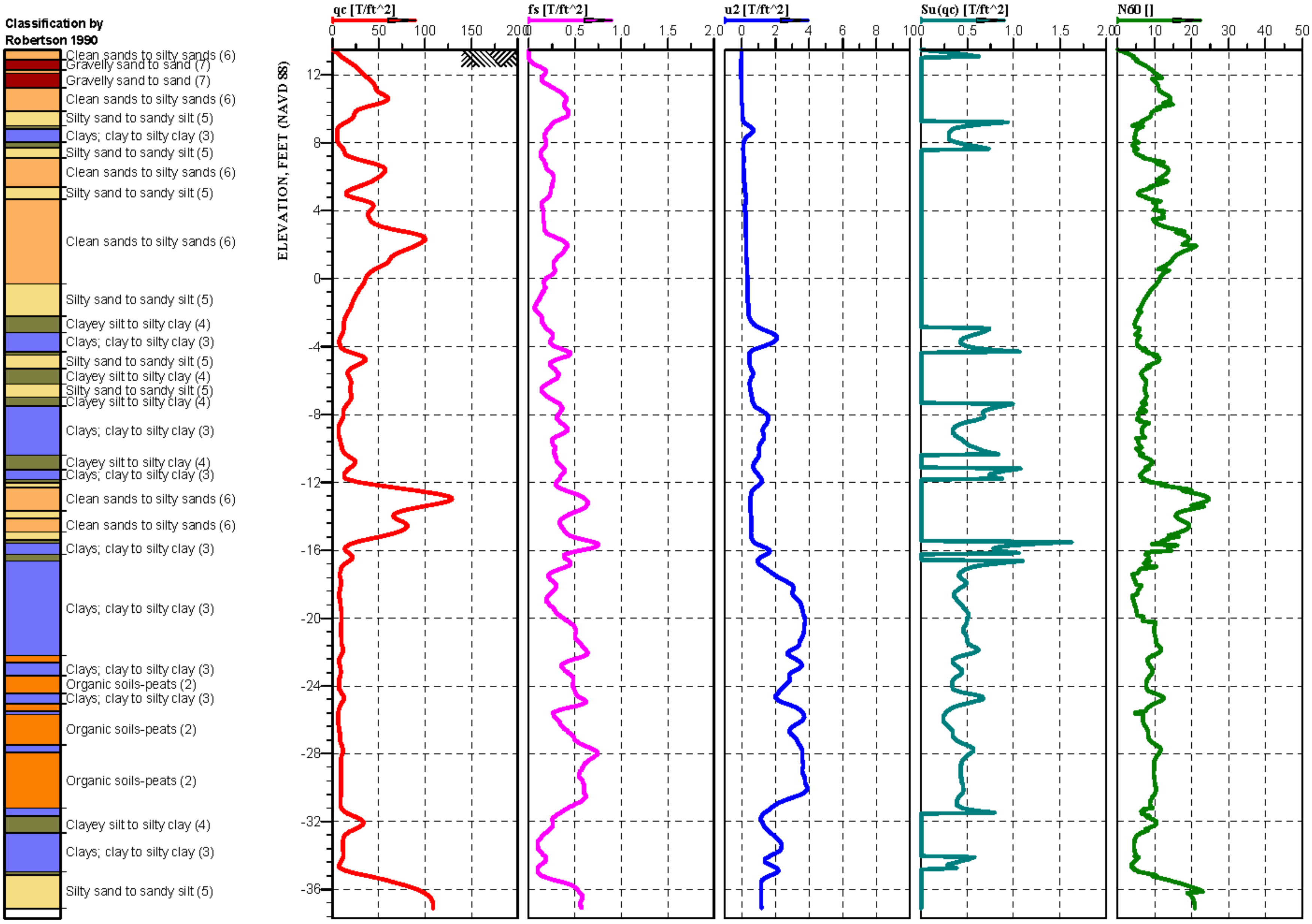
u2

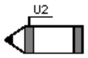
Cone No: 3867
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: BRUNSWICK COUNTY, NORTH CAROLINA	Position:	Ground level: 33.01	Test no: CPT14A
Project ID: 70115068	Client: USACE	Date: 9/20/2011	Scale: 1 : 100
Project EAGLE ISLAND DREDGED MATERIAL DISPOSAL AREA		Page: 1/1	Fig:
EI-2011-CPT14A / CELL 3 / N 171913.7 E 2314468.4 / NAVD 88		File: CPT14A.cpd	



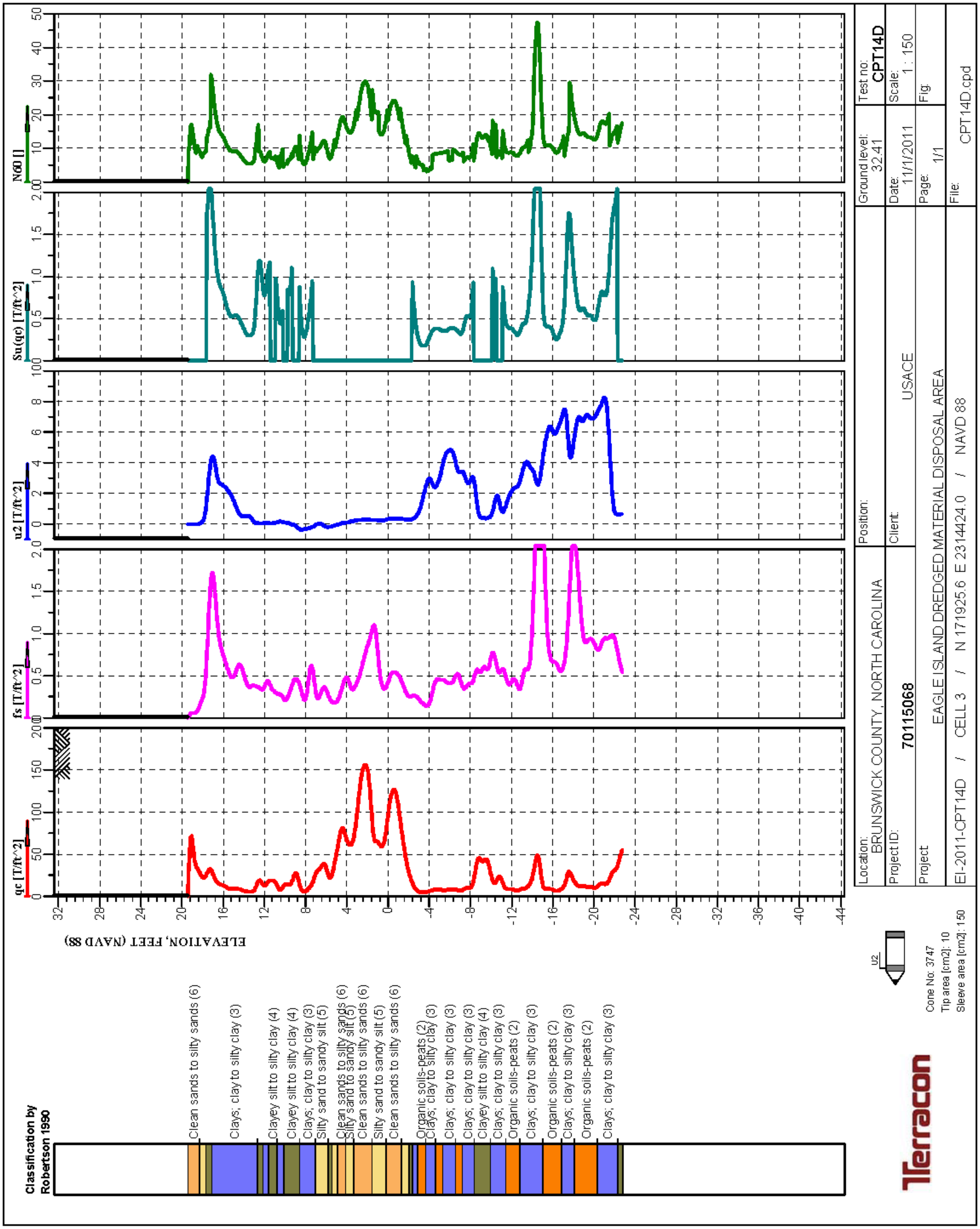
Location: BRUNSWICK COUNTY, NORTH CAROLINA
Position:
Ground level: 18.80
Test no: **CPT14B**
Project ID: **70115068**
Client: USACE
Date: 9/26/2011
Scale: 1 : 100
Project: EAGLE ISLAND DREDGED MATERIAL DISPOSAL AREA
Page: 1/1
Fig:
EI-2011-CPT14B / DIKE 3 / N 171913.7 E 2314571.9 / NAVD 88
File: CPT14B.cpd

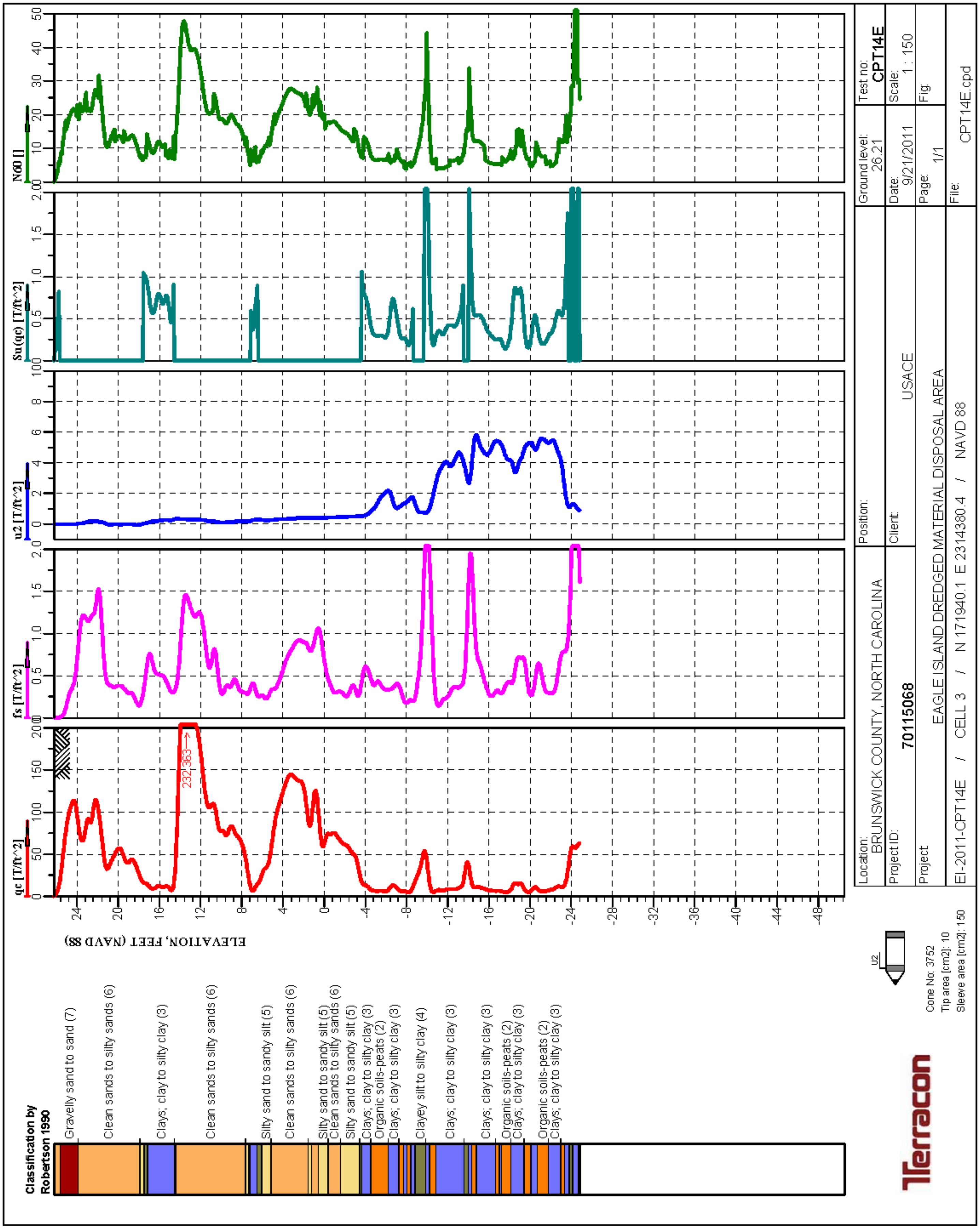




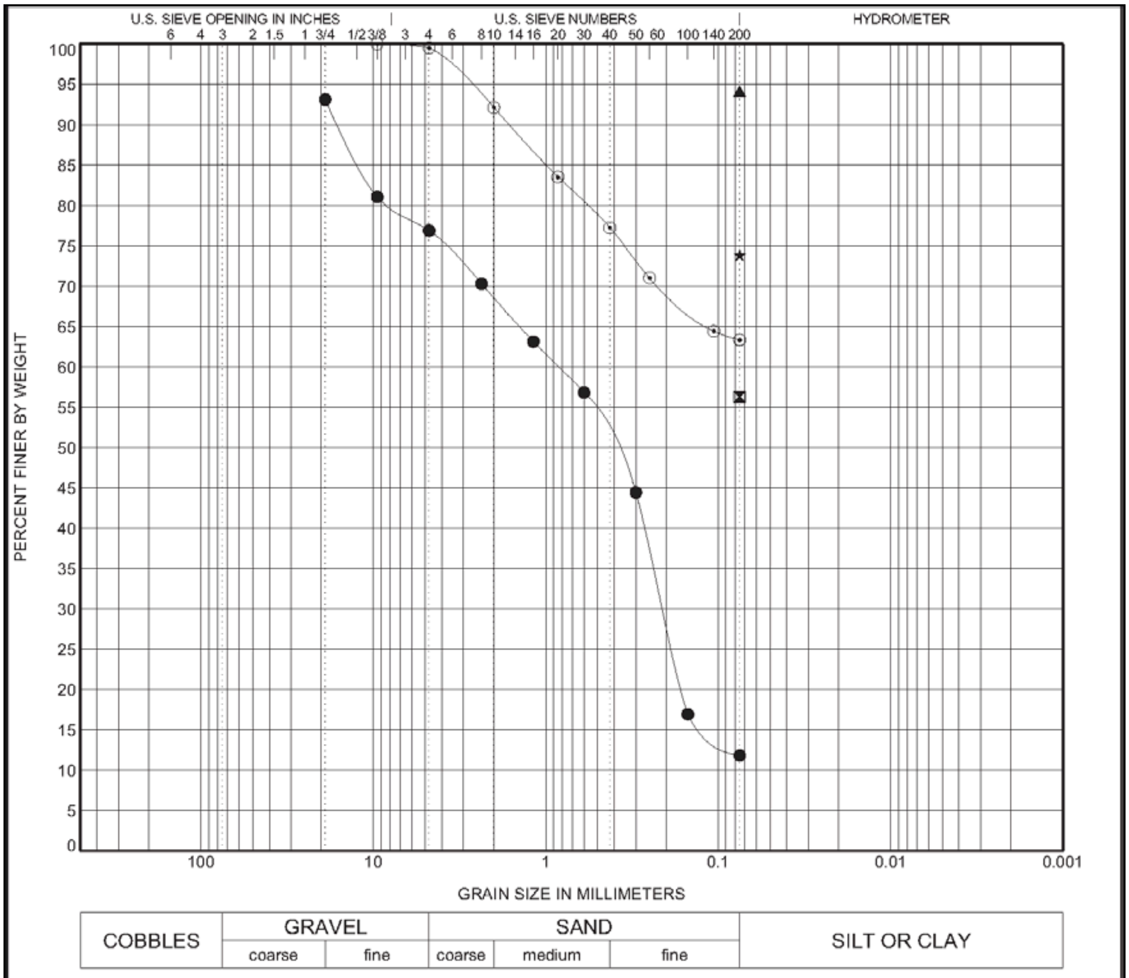
Cone No: 3752
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: BRUNSWICK COUNTY, NORTH CAROLINA
Position:
Ground level: 13.48
Test no: CPT14C
Project ID: 70115068
Client: USACE
Date: 9/21/2011
Scale: 1 : 100
Project: EAGLE ISLAND DREDGED MATERIAL DISPOSAL AREA
Page: 1/1
Fig:
EI-2011-CPT14C / CELL 3 / N 171864.8 E 2314632.2 / NAVD 88
File: CPT14C.cpd


qc [T/ft^2]
fs [T/ft^2]
u2 [T/ft^2]
Su(qc) [T/ft^2]
N60 []
ELEVATION, FEET (NAVD 88)
32
28
24
20
16
12
8
4
0
-4
-8
-12
-16
-20
-24
-28
-32
-36
-40
-44
0
50
100
150
200
0.5
1.0
1.5
2.0
2
4
6
8
10
10
20
30
40
50
Classification by Robertson 1990
Clean sands to silty sands (6)
Clays; clay to silty clay (3)
Clayey silt to silty clay (4)
Clayey silt to silty clay (4)
Clays; clay to silty clay (3)
Silty sand to sandy silt (5)
Clean sands to silty sands (6)
Silty sand to sandy silt (5)
Clean sands to silty sands (6)
Silty sand to sandy silt (5)
Clean sands to silty sands (6)
Organic soils-peats (2)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Clayey silt to silty clay (4)
Clays; clay to silty clay (3)
Organic soils-peats (2)
Clays; clay to silty clay (3)
Organic soils-peats (2)
Clays; clay to silty clay (3)
Organic soils-peats (2)
Clays; clay to silty clay (3)
u2
Cone No: 3747
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Terracon
Location:
BRUNSWICK COUNTY, NORTH CAROLINA
Position:
Ground level:
32.41
Test no:
CPT14D
Project ID:
70115068
Client:
USACE
Date:
11/1/2011
Scale:
1 : 150
Project:
EAGLE ISLAND DREDGED MATERIAL DISPOSAL AREA
Page:
1/1
Fig:
EI-2011-CPT14D / CELL 3 / N 171925.6 E 2314424.0 / NAVD 88
File:
CPT14D.cpd


Classification by Robertson 1990
Gravelly sand to sand (7)
Clean sands to silty sands (6)
Clays; clay to silty clay (3)
Clean sands to silty sands (6)
Silty sand to sandy silt (5)
Clean sands to silty sands (6)
Silty sand to sandy silt (5)
Clean sands to silty sands (6)
Silty sand to sandy silt (5)
Clays; clay to silty clay (3)
Organic soils-peats (2)
Clays; clay to silty clay (3)
Clayey silt to silty clay (4)
Clays; clay to silty clay (3)
Clays; clay to silty clay (3)
Organic soils-peats (2)
Clays; clay to silty clay (3)
Organic soils-peats (2)
Clays; clay to silty clay (3)
ELEVATION, FEET (NAVD 88)
24
20
16
12
8
4
0
-4
-8
-12
-16
-20
-24
-28
-32
-36
-40
-44
-48
qc [T/ft^2]
0
50
100
150
200
232.363-->
fs [T/ft^2]
0
0.5
1.0
1.5
2.0
u2 [T/ft^2]
0
2
4
6
8
10.0
Su(qc) [T/ft^2]
0.0
0.5
1.0
1.5
2.0
N60 []
0
10
20
30
40
50
u2
Cone No: 3752
Tip area [cm2]: 10
Sleeve area [cm2]: 150
Terracon
Location:
BRUNSWICK COUNTY, NORTH CAROLINA
Position:
Ground level:
26.21
Test no:
CPT14E
Project ID:
70115068
Client:
USACE
Date:
9/21/2011
Scale:
1 : 150
Project:
EAGLE ISLAND DREDGED MATERIAL DISPOSAL AREA
Page:
1/1
Fig:
EI-2011-CPT14E / CELL 3 / N 171940.1 E 2314380.4 / NAVD 88
File:
CPT14E.cpd

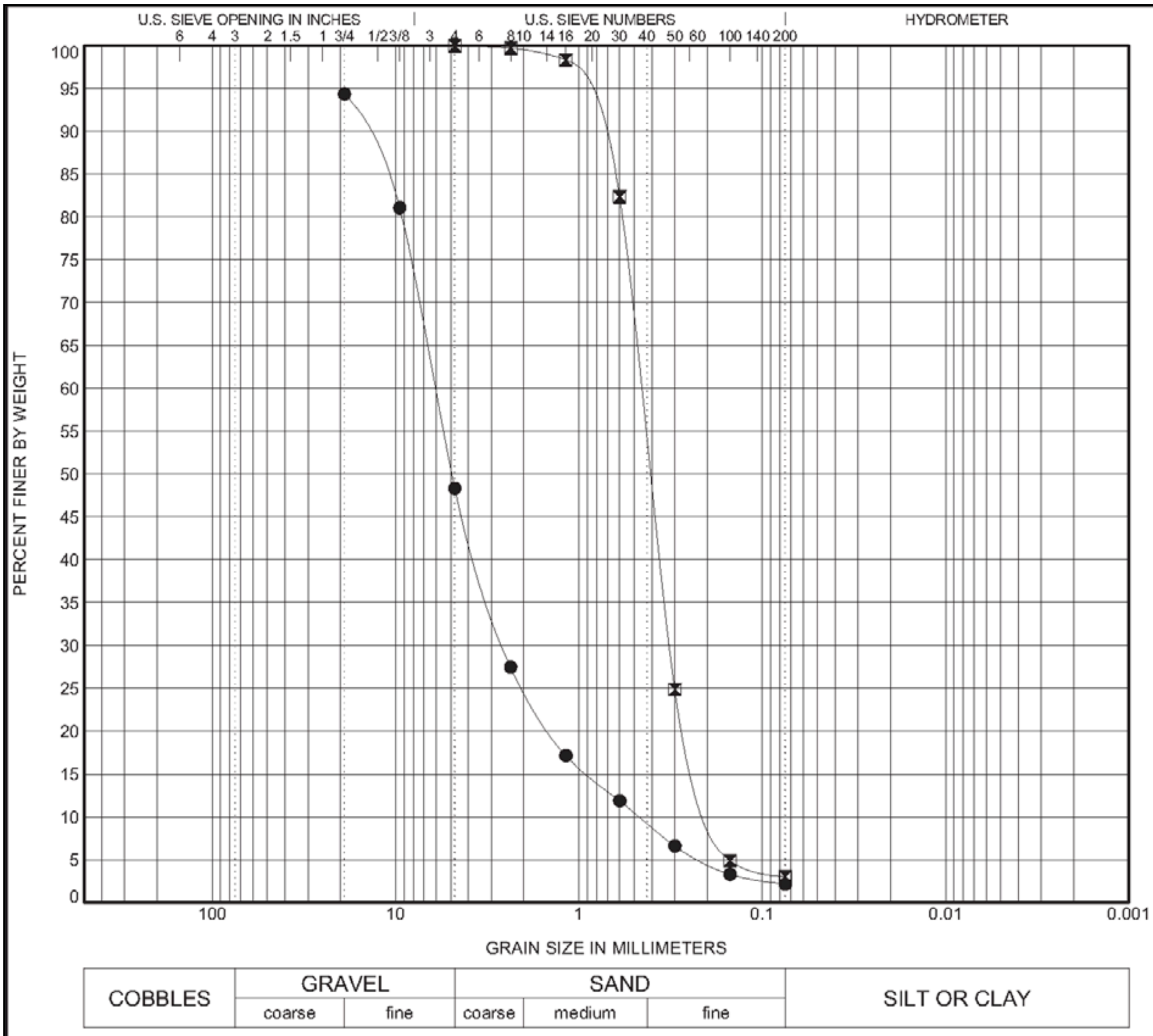
Attachment B: Data Used in Stability and Seepage Analysis



Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● EI-2011-SPT-4 3.0	POORLY GRADED SAND with SILT and GRAVEL(SP-SM)	NP	NP	NP	0.88	14.40
⧗ EI-2011-SPT-4 10.0	SANDY ELASTIC SILT(MH)	57	31	26		
▲ EI-2011-SPT-4 16.5	ELASTIC SILT(MH)	90	55	35		
★ EI-2011-SPT-4 25.5	FAT CLAY with SAND(CH)	83	36	47		
⊙ EI-2011-SPT-4 37.0	SANDY ELASTIC SILT(MH)	65	35	30		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● EI-2011-SPT-4 3.0	19	0.845	0.209		16.2	65.0	11.8	
⧗ EI-2011-SPT-4 10.0	0.075						56.3	
▲ EI-2011-SPT-4 16.5	0.075						94.1	
★ EI-2011-SPT-4 25.5	0.075						73.8	
⊙ EI-2011-SPT-4 37.0	9.5				0.5	36.2	63.3	

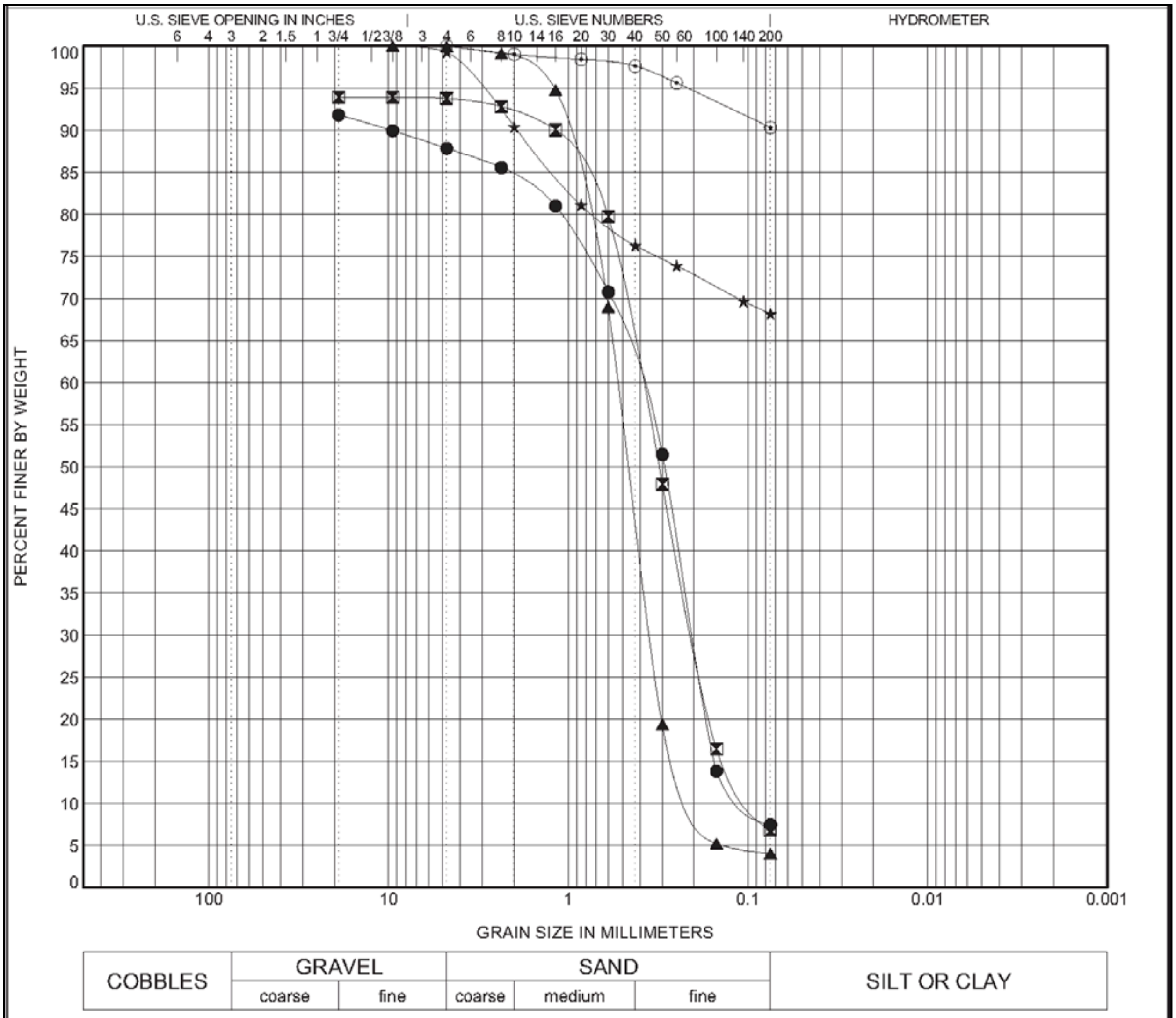
Figure 47. Grain size distribution results for EI-2011-SPT-4.



Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**EI-2011-SPT-4 48.0**	**WELL-GRADED GRAVEL with SAND(GW)**	**NP**	**NP**	**NP**	**2.32**	**13.00**
⧗	**EI-2011-SPT-4 57.0**	**POORLY GRADED SAND(SP)**	**NP**	**NP**	**NP**	**1.24**	**2.56**

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**EI-2011-SPT-4 48.0**	**19**	**6.079**	**2.568**	**0.468**	**46.0**	**46.2**	**2.1**	
⧗	**EI-2011-SPT-4 57.0**	**4.75**	**0.458**	**0.319**	**0.179**		**96.9**	**3.0**	

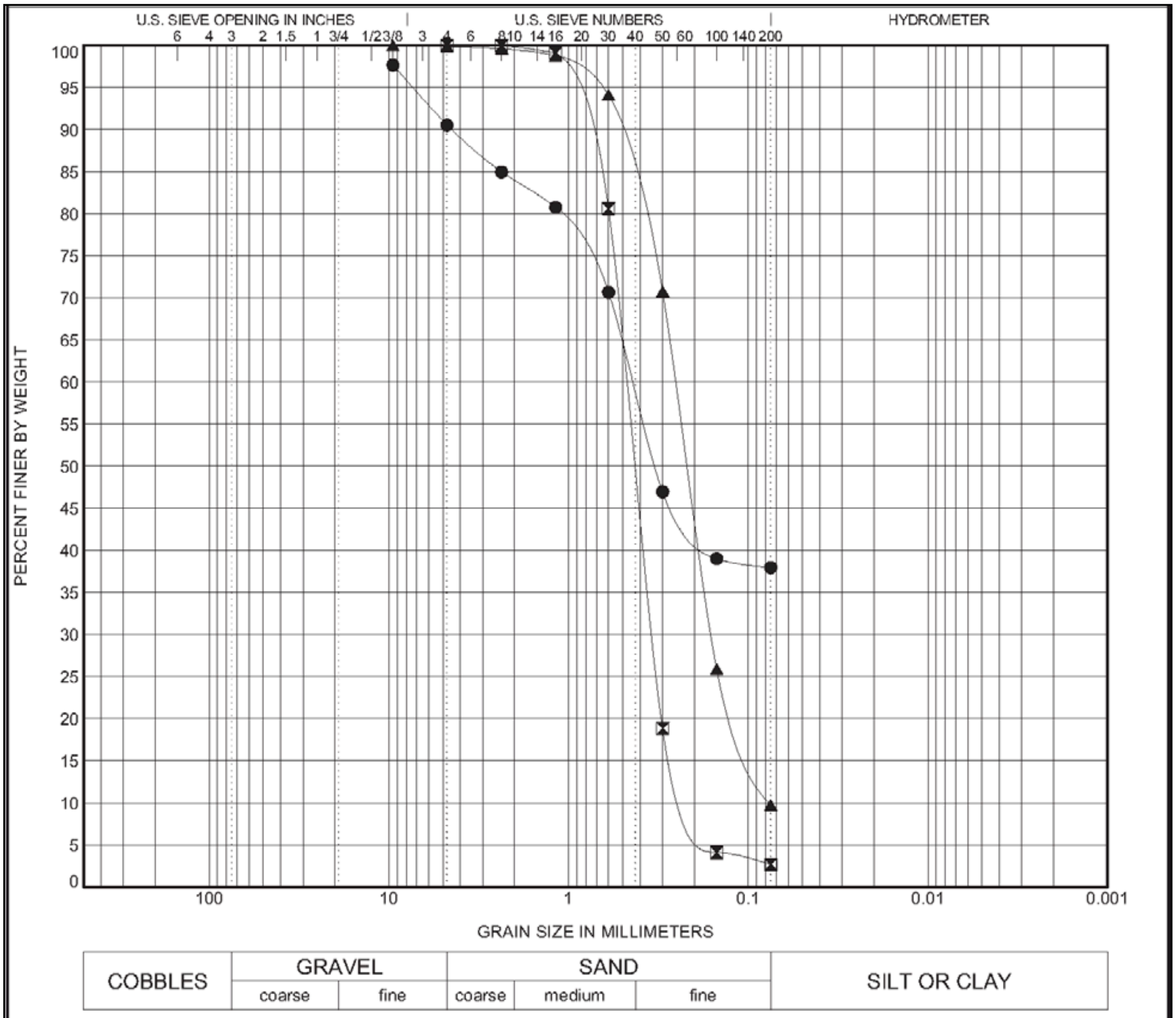
Figure 48. Grain size distribution results for EI-2011-SPT-4 (cont).



Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● **EI-2011-SPT-14 4.5**	**POORLY GRADED SAND with SILT(SP-SM)**	**NP**	**NP**	**NP**	**1.01**	**4.12**
⧗ **EI-2011-SPT-14 12.0**	**POORLY GRADED SAND with SILT(SP-SM)**	**NP**	**NP**	**NP**	**1.11**	**4.14**
▲ **EI-2011-SPT-14 30.0**	**POORLY GRADED SAND(SP)**	**NP**	**NP**	**NP**	**1.21**	**2.79**
★ **EI-2011-SPT-14 37.0**	**SANDY ELASTIC SILT(MH)**	**66**	**38**	**28**		
⊙ **EI-2011-SPT-14 43.0**	**ELASTIC SILT(MH)**	**76**	**38**	**38**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **EI-2011-SPT-14 4.5**	**19**	**0.407**	**0.202**	**0.099**	**4.0**	**80.4**	**7.5**	
⧗ **EI-2011-SPT-14 12.0**	**19**	**0.39**	**0.202**	**0.094**	**0.2**	**86.9**	**6.8**	
▲ **EI-2011-SPT-14 30.0**	**9.5**	**0.529**	**0.348**	**0.19**	**0.1**	**95.9**	**4.0**	
★ **EI-2011-SPT-14 37.0**	**9.5**				**0.7**	**31.1**	**68.2**	
⊙ **EI-2011-SPT-14 43.0**	**4.75**				**0.0**	**9.7**	**90.3**	

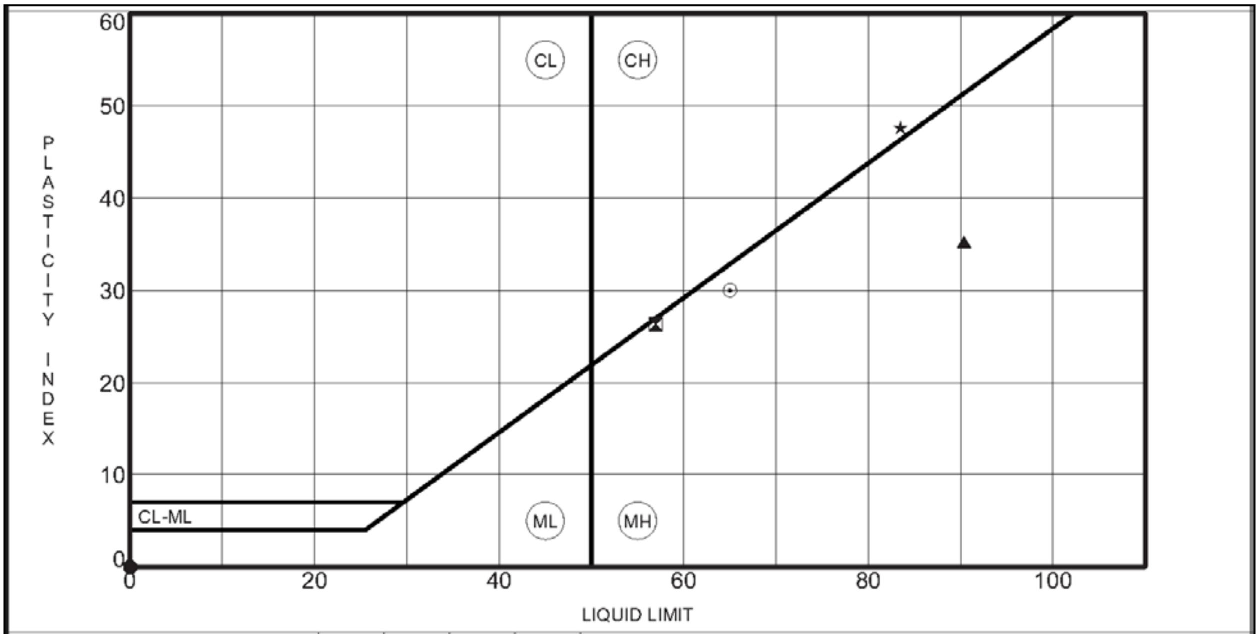
Figure 49. Grain size distribution results for EI-2011-SPT-14.



Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**EI-2011-SPT-14 52.5**	**SILTY SAND(SM)**	**75**	**45**	**30**		
⧗	**EI-2011-SPT-14 57.0**	**POORLY GRADED SAND(SP)**	**NP**	**NP**	**NP**	**1.23**	**2.41**
▲	**EI-2011-SPT-14 63.0**	**POORLY GRADED SAND with SILT(SP-SM)**	**NP**	**NP**	**NP**	**1.33**	**3.35**

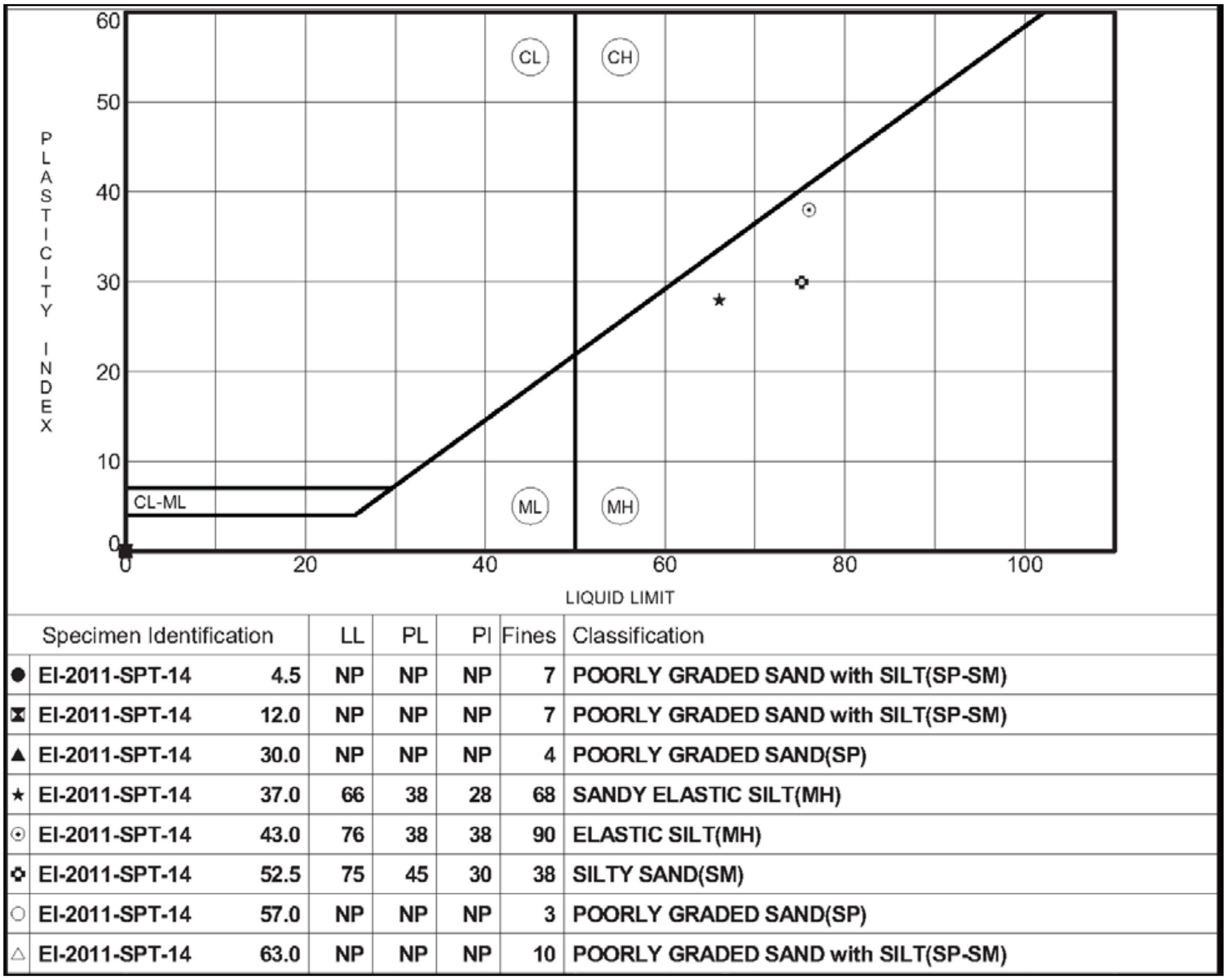
Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**EI-2011-SPT-14 52.5**	**9.5**	**0.439**			**7.1**	**52.6**	**38.0**	
⧗	**EI-2011-SPT-14 57.0**	**4.75**	**0.476**	**0.34**	**0.198**	**0.0**	**97.3**	**2.7**	
▲	**EI-2011-SPT-14 63.0**	**9.5**	**0.254**	**0.16**	**0.076**	**0.1**	**90.1**	**9.8**	

Figure 50. Grain size distribution results for EI-2011-SPT-14 (cont).



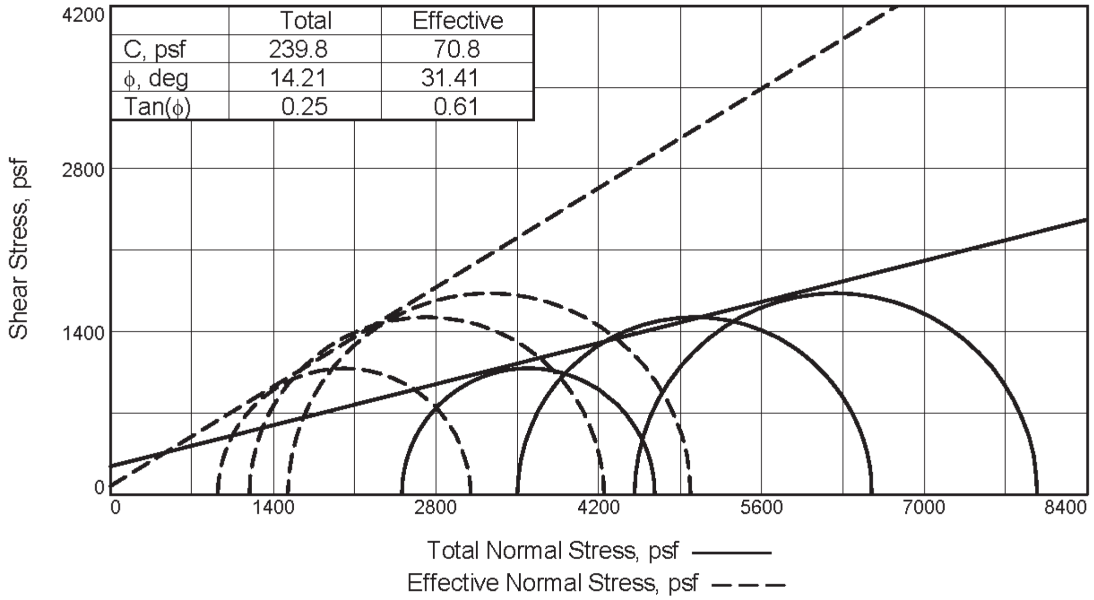
	Specimen Identification		LL	PL	PI	Fines	Classification
●	**EI-2011-SPT-4**	**3.0**	**NP**	**NP**	**NP**	**12**	**POORLY GRADED SAND with SILT and GRAVEL(SP-SM)**
⧗	**EI-2011-SPT-4**	**10.0**	**57**	**31**	**26**	**56**	**SANDY ELASTIC SILT(MH)**
▲	**EI-2011-SPT-4**	**16.5**	**90**	**55**	**35**	**94**	**ELASTIC SILT(MH)**
★	**EI-2011-SPT-4**	**25.5**	**83**	**36**	**47**	**74**	**FAT CLAY with SAND(CH)**
⊙	**EI-2011-SPT-4**	**37.0**	**65**	**35**	**30**	**63**	**SANDY ELASTIC SILT(MH)**
✿	**EI-2011-SPT-4**	**48.0**	**NP**	**NP**	**NP**	**2**	**WELL-GRADED GRAVEL with SAND(GW)**
○	**EI-2011-SPT-4**	**57.0**	**NP**	**NP**	**NP**	**3**	**POORLY GRADED SAND(SP)**

Figure 51. Atterberg Limit testing results for EI-2011-SPT-4.

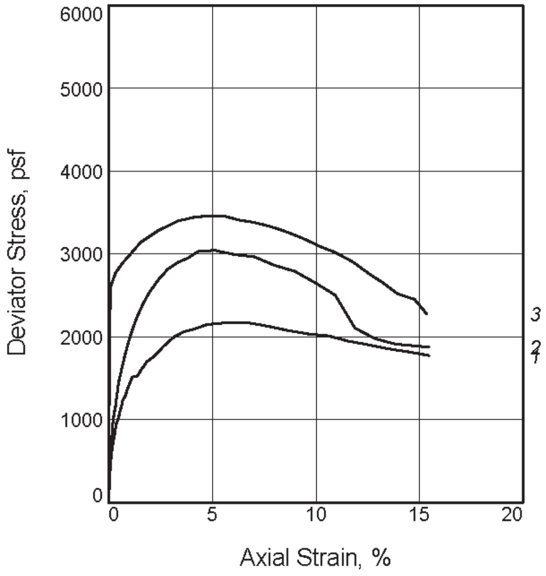


	Specimen Identification		LL	PL	PI	Fines	Classification
●	**EI-2011-SPT-14**	**4.5**	**NP**	**NP**	**NP**	**7**	**POORLY GRADED SAND with SILT(SP-SM)**
⧗	**EI-2011-SPT-14**	**12.0**	**NP**	**NP**	**NP**	**7**	**POORLY GRADED SAND with SILT(SP-SM)**
▲	**EI-2011-SPT-14**	**30.0**	**NP**	**NP**	**NP**	**4**	**POORLY GRADED SAND(SP)**
★	**EI-2011-SPT-14**	**37.0**	**66**	**38**	**28**	**68**	**SANDY ELASTIC SILT(MH)**
⊙	**EI-2011-SPT-14**	**43.0**	**76**	**38**	**38**	**90**	**ELASTIC SILT(MH)**
✿	**EI-2011-SPT-14**	**52.5**	**75**	**45**	**30**	**38**	**SILTY SAND(SM)**
○	**EI-2011-SPT-14**	**57.0**	**NP**	**NP**	**NP**	**3**	**POORLY GRADED SAND(SP)**
△	**EI-2011-SPT-14**	**63.0**	**NP**	**NP**	**NP**	**10**	**POORLY GRADED SAND with SILT(SP-SM)**

Figure 52. Atterberg Limit testing results for EI-2011-SPT-14.



	Total	Effective
C, psf	239.8	70.8
ϕ, deg	14.21	31.41
Tan(ϕ)	0.25	0.61



	Sample No.	1	2	3
Initial	Water Content, %	83.9	81.5	84.6
	Dry Density, pcf	49.0	51.2	49.8
	Saturation, %	96.1	99.5	99.1
	Void Ratio	2.1820	2.0476	2.1348
	Diameter, in.	2.828	2.852	2.845
	Height, in.	5.747	5.737	5.748
At Test	Water Content, %	76.5	72.4	72.0
	Dry Density, pcf	53.6	55.5	55.7
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.9132	1.8097	1.8012
	Diameter, in.	2.746	2.775	2.740
	Height, in.	5.582	5.585	5.539
	Strain rate, in./min.	0.000	0.000	0.000
	Back Pressure, psf	5760.0	5760.0	5760.0
	Cell Pressure, psf	8265.6	9259.2	10267.2
	Fail. Stress, psf	2173.9	3048.8	3463.1
	Total Pore Pr., psf	7344.0	8064.0	8740.8
	Ult. Stress, psf			
	Total Pore Pr., psf			
	$\bar{\sigma}_1$ Failure, psf	3095.5	4244.0	4989.5
	$\bar{\sigma}_3$ Failure, psf	921.6	1195.2	1526.4

Type of Test:
CU with Pore Pressures

Sample Type: ST

Description: DARK GRAY SILT

LL= 65 **PL=** 35 **PI=** 30

Assumed Specific Gravity= 2.5

Remarks: Lab No. 8623

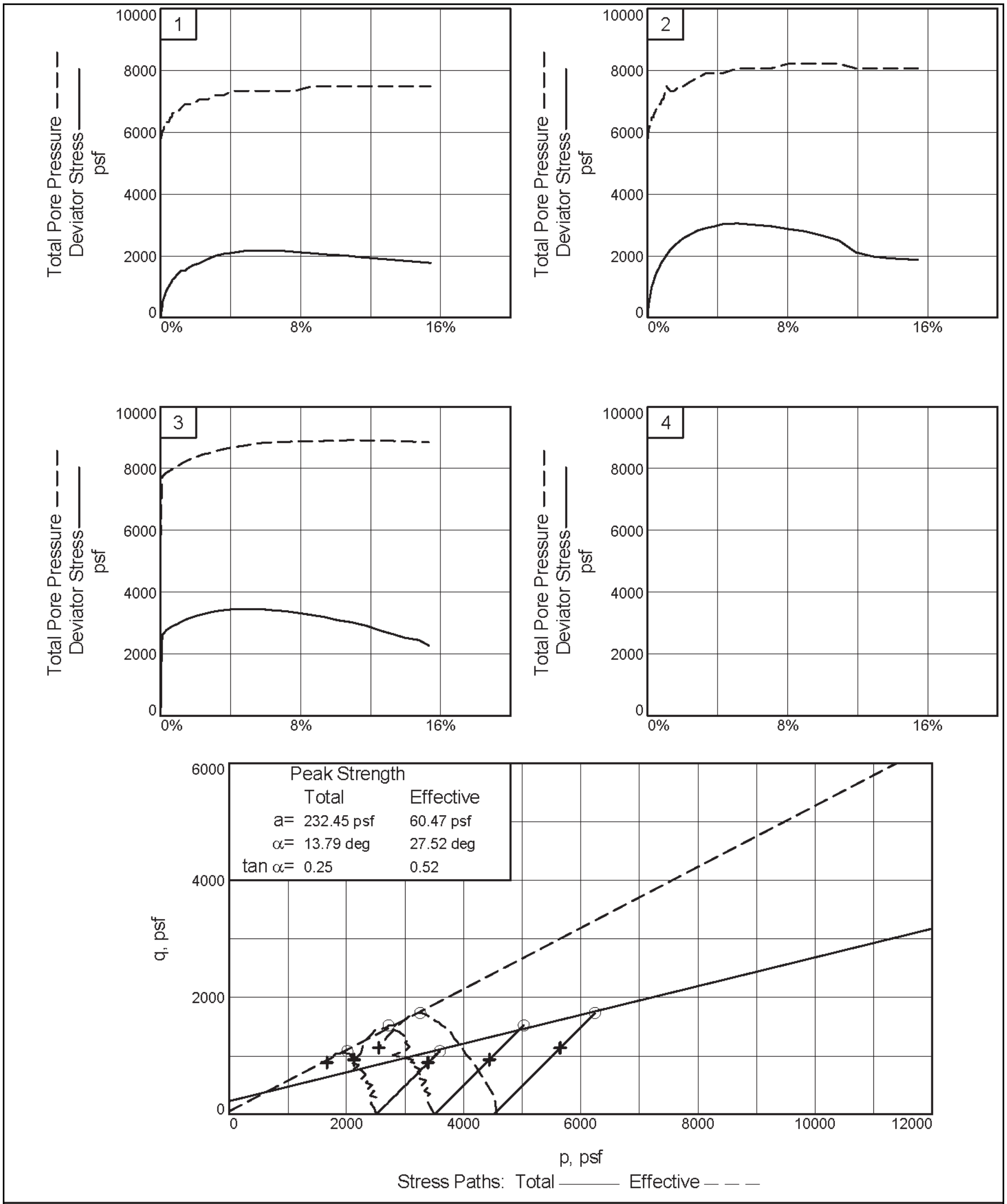
Client: UNITED STATES ARMY CORPS OF ENGINEERS

Project: EAGLE ISLAND DREDGE DISPOSAL AREA

Source of Sample: UD-4 **Depth:** 37-39'

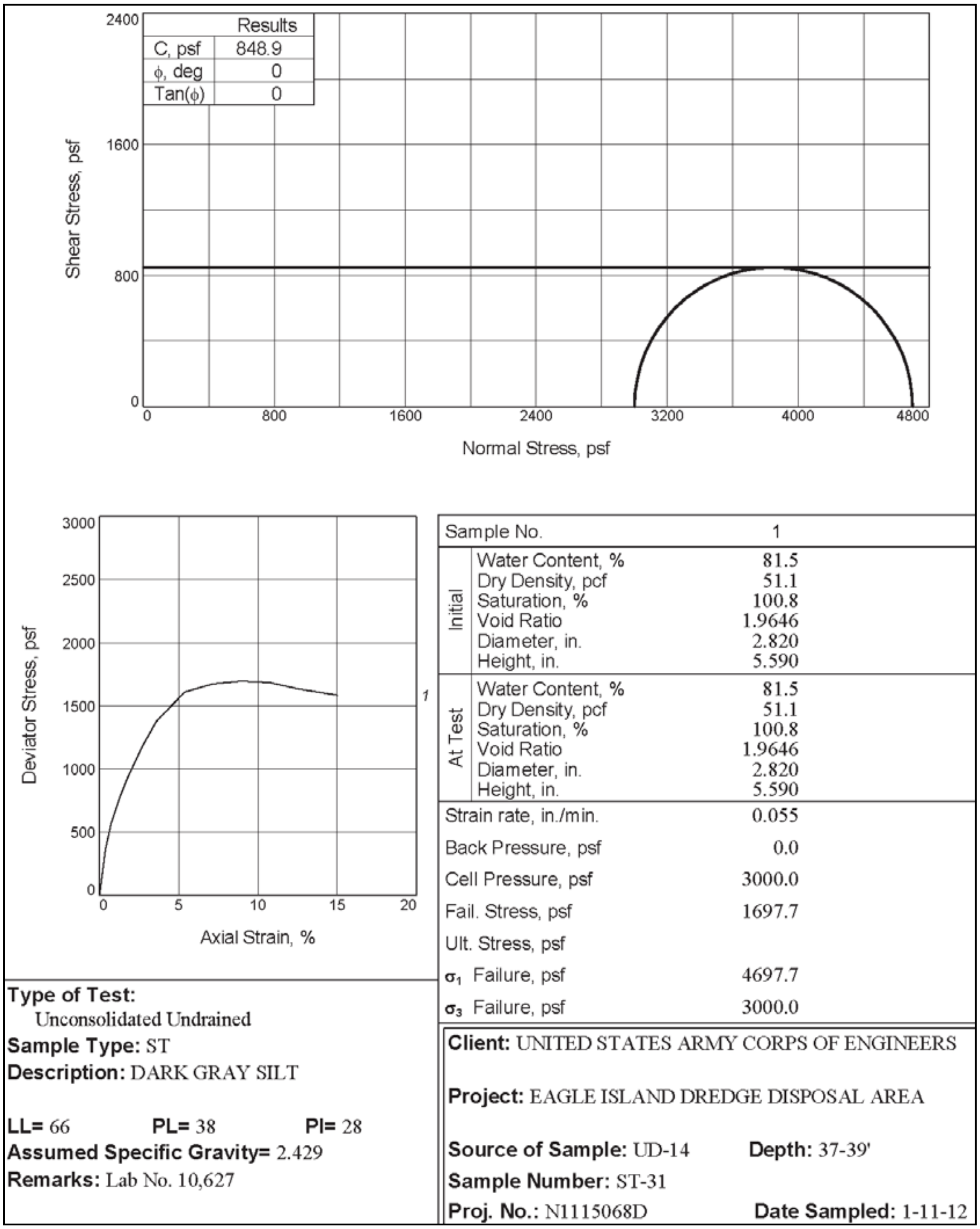
Sample Number: ST-16

Figure 53. CU test results for UD-4.



Client: UNITED STATES ARMY CORPS OF ENGINEERS
Project: EAGLE ISLAND DREDGE DISPOSAL AREA
Source of Sample: UD-4 **Depth:** 37-39' **Sample Number:** ST-16
Project No.: N1115068D **Figure** _______ Terracon, Inc.

Figure 54. CU results for UD-4 (cont).



Results	
C, psf	848.9
φ, deg	0
Tan(φ)	0

	Sample No.	1
Initial	Water Content, %	81.5
	Dry Density, pcf	51.1
	Saturation, %	100.8
	Void Ratio	1.9646
	Diameter, in.	2.820
	Height, in.	5.590
At Test	Water Content, %	81.5
	Dry Density, pcf	51.1
	Saturation, %	100.8
	Void Ratio	1.9646
	Diameter, in.	2.820
	Height, in.	5.590
	Strain rate, in./min.	0.055
	Back Pressure, psf	0.0
	Cell Pressure, psf	3000.0
	Fail. Stress, psf	1697.7
	Ult. Stress, psf	
	σ_1 Failure, psf	4697.7
	σ_3 Failure, psf	3000.0

Type of Test:
Unconsolidated Undrained
Sample Type: ST
Description: DARK GRAY SILT

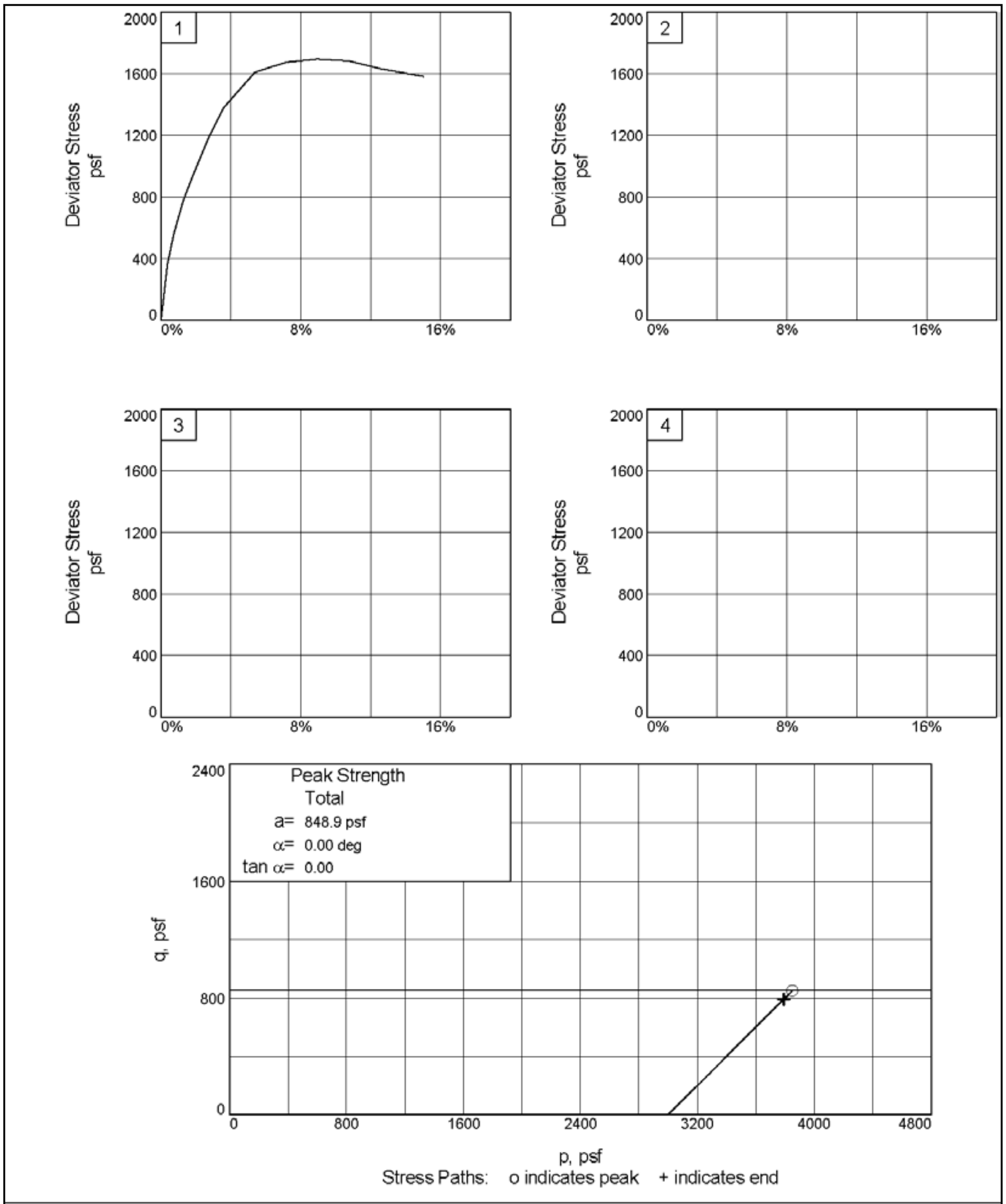
LL= 66 **PL=** 38 **PI=** 28
Assumed Specific Gravity= 2.429
Remarks: Lab No. 10,627

Client: UNITED STATES ARMY CORPS OF ENGINEERS

Project: EAGLE ISLAND DREDGE DISPOSAL AREA

Source of Sample: UD-14 **Depth:** 37-39'
Sample Number: ST-31
Proj. No.: N1115068D **Date Sampled:** 1-11-12

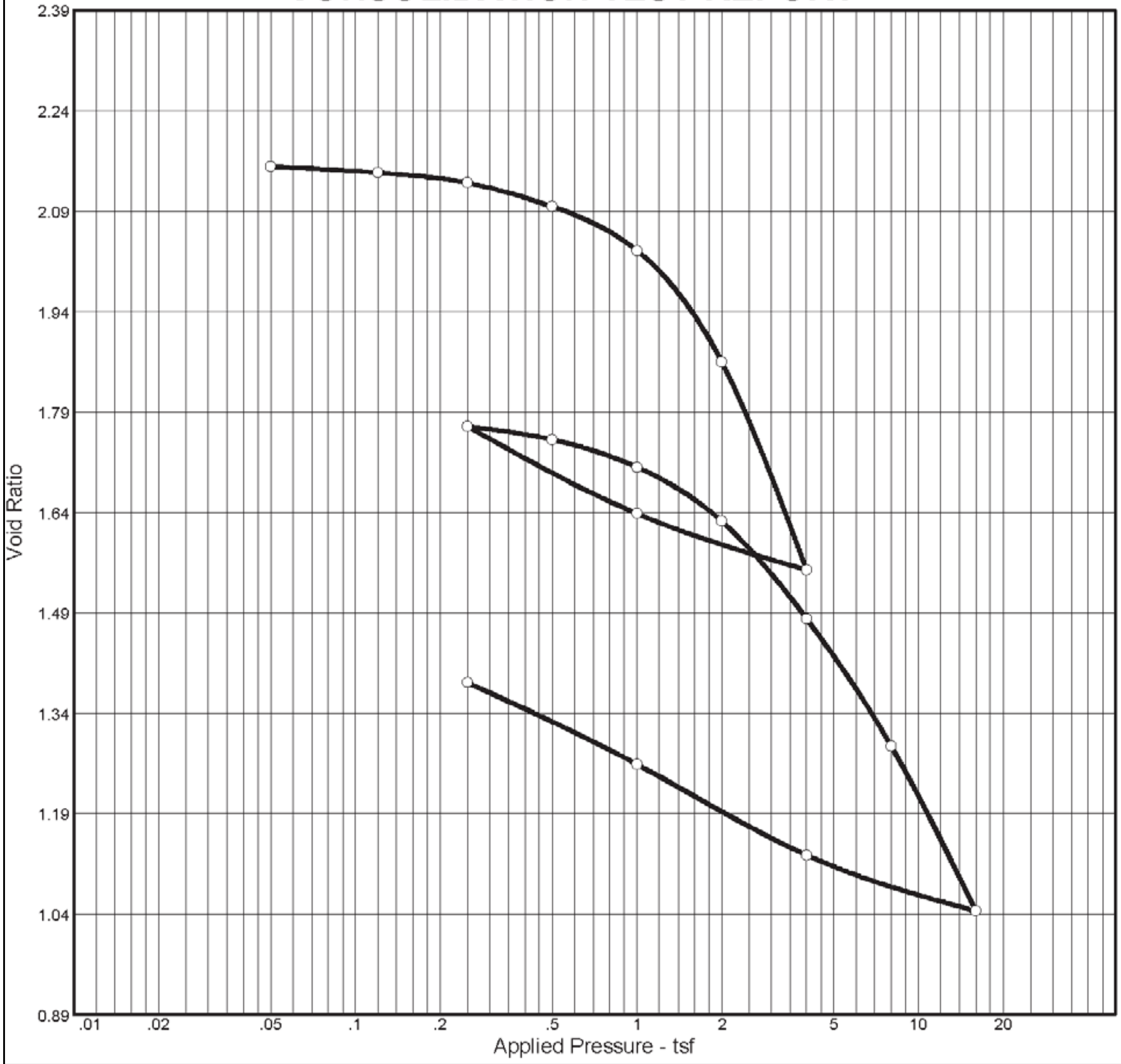
Figure 55. UU test results for UD-14.



Client: UNITED STATES ARMY CORPS OF ENGINEERS
Project: EAGLE ISLAND DREDGE DISPOSAL AREA
Source of Sample: UD-14 **Depth:** 37-39' **Sample Number:** ST-31

Figure 56. UU test results for UD-14 (cont).

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Swell Press. (tsf)	Swell %	e_o
Sat.	Moist.											
97.3 %	85.5 %	48.7	65	30	2.476		1.24	0.83	0.21			2.174

MATERIAL DESCRIPTION	USCS	AASHTO
DARK GRAY SILT	MH	A-7-5(19)

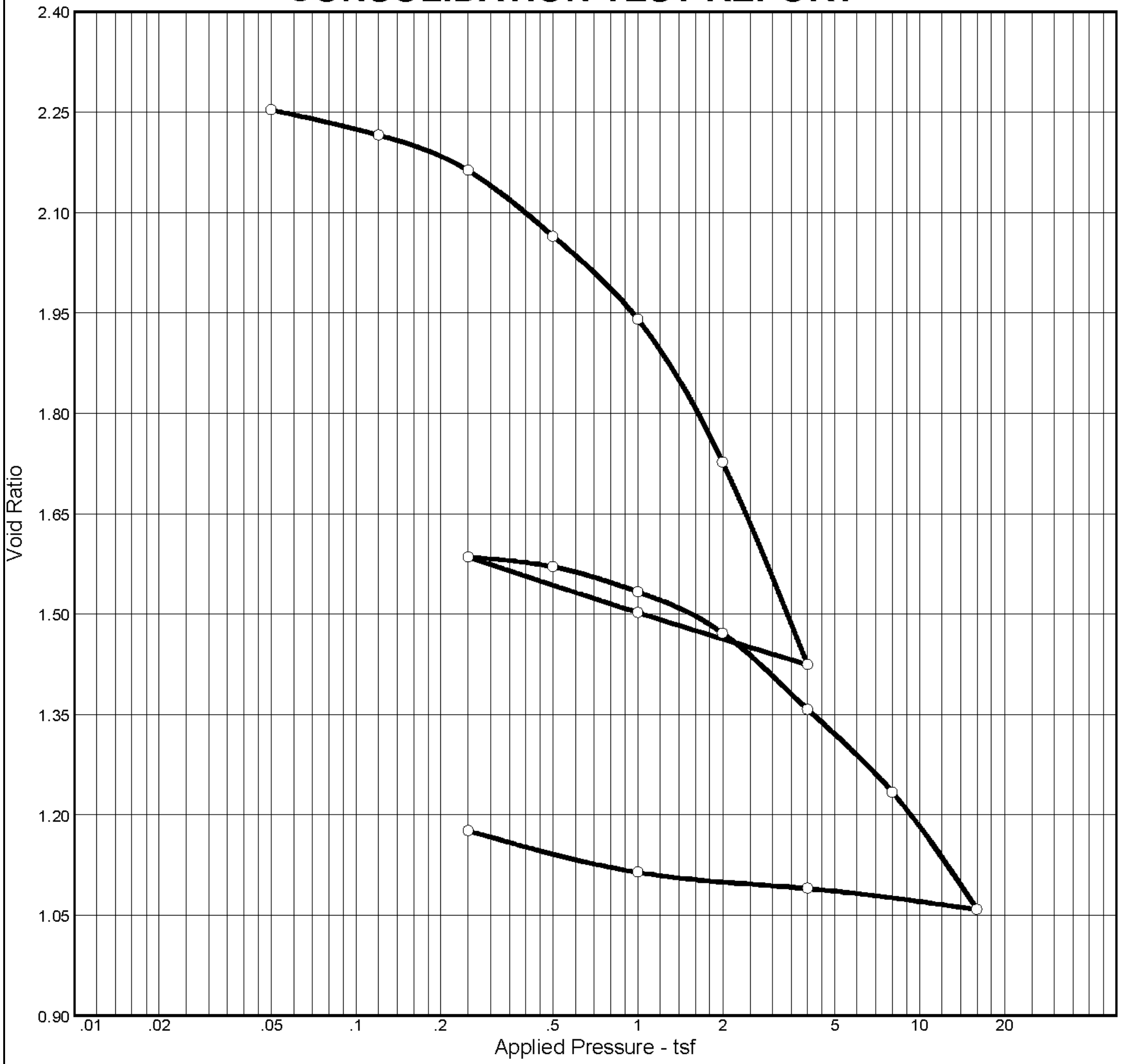
Project No. N1115068D **Client:** UNITED STATES ARMY CORPS OF ENGINEERS
Project: EAGLE ISLAND DREDGE DISPOSAL AREA

Source: UD-4 **Sample No.:** ST-16 **Elev./Depth:** 37-39'

Remarks:
Lab No. 8623

Figure 57. 1-D Consolidation test results for UD-4.

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Swell Press. (tsf)	Swell %	e_o
Sat.	Moist.											
96.9 %	90.8 %	46.3	66	28	2.429		3.72	0.59	0.14			2.278

MATERIAL DESCRIPTION	USCS	AASHTO
DARK GRAY BROWN SILT	MH	A-7-5(20)

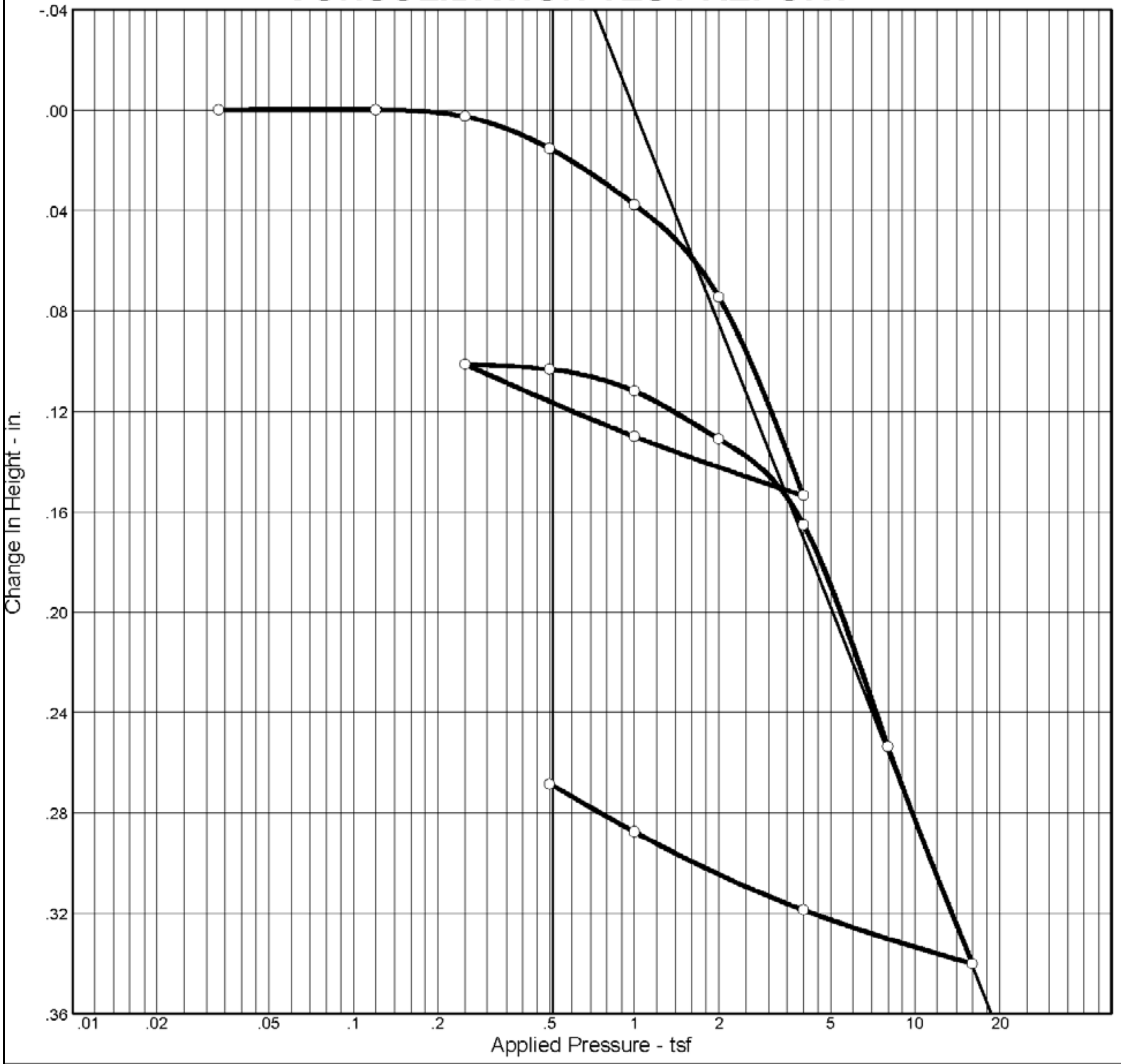
Project No. N1115068D **Client:** UNITED STATES ARMY CORPS OF ENGINEERS
Project: EAGLE ISLAND DREDGE DISPOSAL AREA

Source: UD-14 **Sample No.:** ST-31 **Elev./Depth:** 37-39'

Remarks:
Note: Stone may be rubbing the inside of the ring

Figure 58. 1-D Consolidation test results for UD-14 (Cross-Section 1 Undisturbed Sample 1).

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	Initial Void Ratio
Saturation	Moisture							
88.3 %	70.0 %	53.7	76	38	2.7		1.26	2.142

MATERIAL DESCRIPTION	USCS	AASHTO
Dark Gray MH	MH	

Project No. N1115068D **Client:** Army Corps of Engineers

Project: Eagle Island Dredge Disposal

Source: UD-14 **Sample No.:** UD-14 ST32 **Elev./Depth:** 43.0-45.0 ft

Remarks:

UD-14

Figure 59. 1-D Consolidation test results for UD-14 (Cross-Section 1 Undisturbed Sample 2).

Table 11. Cohesion spatial function values used for cross-section 1 at Sta. 223+00.

Sta (ft)	Elev (NAVD88)	Su (T/ft^2)	ɣ (pcf)
223+00	31	1680	110
223+00	30.5	1000	110
223+00	27	700	110
223+00	26	900	110
223+00	24.7	2140	110
223+00	24.1	1480	110
223+00	22.3	1140	110
223+00	14.4	2200	110

Table 12. Cohesion spatial function values used for cross-section 1 at Sta. 322+00.

Sta (ft)	Elev (NAVD88)	Su (T/ft^2)	ɣ (pcf)
322+00	-1.1	1180	110
322+00	-2.5	940	110
322+00	-3.4	420	95
322+00	-5.4	1120	110
322+00	-9.7	800	110
322+00	-12.2	780	110
322+00	-13	560	100
322+00	-15.1	480	95
322+00	-16.6	620	105
322+00	-17.9	860	110
322+00	-19.8	1040	110
322+00	-20.4	760	110
322+00	-20.8	2340	110

Table 13. Cohesion spatial function values used for cross-section 1 at Sta. 396+00.

Sta (ft)	Elev (NAVD88)	Su (T/ft^2)	ɣ (pcf)
396+00	9.1	880	110
396+00	8.7	480	95
396+00	4.9	800	110
396+00	-2.6	1320	110
396+00	-3.6	780	110
396+00	-4.3	860	110
396+00	-5.5	1760	110
396+00	-7.8	1000	110
396+00	-8.9	600	105
396+00	-10.3	900	110
396+00	-11.8	1020	110
396+00	-16	980	110
396+00	-16.9	840	110
396+00	-17.5	720	110
396+00	-18.5	660	105
396+00	-20.9	780	110
396+00	-22.3	580	100
396+00	-23.7	540	100
396+00	-25.7	420	95
396+00	-26.8	640	105
396+00	-28.5	800	110
396+00	-29.2	740	110
396+00	-30.9	640	105
396+00	-33.4	880	110
396+00	-34.6	220	90
396+00	-35	1100	110

Table 14. Cohesion spatial function values used for cross-section 1 at Sta. 176+00.

Sta (ft)	Elev (NAVD88)	Su (T/ft^2)	ɣ (pcf)
176+00	30.7	2620	110
176+00	28.1	960	110
176+00	26.7	560	100
176+00	24.9	860	110
176+00	23.3	340	90
176+00	22.5	1220	110
176+00	21.2	480	95
176+00	20.6	1360	110
176+00	19.8	900	110
176+00	18.5	2060	110
176+00	10.1	380	90
176+00	9.6	300	90
176+00	6	540	100
176+00	2.4	980	110
176+00	0.4	540	100
176+00	-0.5	880	110
176+00	-2.6	720	110
176+00	-3.6	540	100
176+00	-5.7	960	110
176+00	-7.2	840	110
176+00	-9.3	3060	110

Table 15. Cohesion spatial function values used for cross-section 1 at Sta. 128+00.

Sta (ft)	Elev (NAVD88)	Su (T/ft^2)	ɣ (pcf)
128+00	17.6	1540	110
128+00	16.9	1100	110
128+00	16.4	880	110
128+00	16.5	840	110
128+00	14.8	520	100
128+00	14.4	1700	110
128+00	7.2	900	110
128+00	6.8	460	95
128+00	6.3	1360	110
128+00	-4.6	620	105
128+00	-6	480	95
128+00	-7.6	260	90
128+00	-9.2	3380	110
128+00	-10.6	140	90
128+00	-11.6	480	95
128+00	-12.9	740	110
128+00	-15.9	620	105
128+00	-16.9	400	95
128+00	-18.2	340	90
128+00	-19.7	200	90
128+00	-21.2	320	90
128+00	-22.9	1560	110
128+00	-23.7	3140	110

Table 16. Cohesion spatial function values used for cross-section 2 at Sta. 206+00.

Sta (ft)	Elev (NAVD88)	Su (T/ft^2)	γ (pcf)
206+00	27.5	3280	110
206+00	25.1	1630	110
206+00	24.5	1160	110
206+00	23.6	1000	110
206+00	22.5	880	110
206+00	20.8	860	110
206+00	19.4	460	95
206+00	16.3	520	100
206+00	12.8	620	105
206+00	9.6	740	110
206+00	4.7	500	100
206+00	2.8	520	100
206+00	-0.2	380	90
206+00	-2.1	460	95
206+00	-2.4	440	95
206+00	-3.6	400	95
206+00	-8.2	280	90
206+00	-10.5	340	90
206+00	-11.7	520	100
206+00	-13.6	520	100
206+00	-16.7	1220	110
206+00	-18.1	700	110
206+00	-21.1	1000	110
206+00	-22.1	800	110
206+00	-22.3	1180	110
206+00	-24.3	820	110
206+00	-27.7	1060	110
206+00	-28.6	280	90
206+00	-29	460	95
206+00	-29.7	4520	110

Table 17. Cohesion spatial function values used for cross-section 2 at Sta. 265+00.

Sta (ft)	Elev (NAVD88)	Su (T/ft^2)	γ (pcf)
265+00	18.7	1840	110
265+00	18.5	760	110
265+00	18	680	105
265+00	17.5	760	110
265+00	15.8	940	110
265+00	14.5	1040	110
265+00	12.5	480	95
265+00	10.4	420	95
265+00	9.3	740	110
265+00	6	600	105
265+00	5.3	540	100
265+00	4.6	460	95
265+00	2.2	400	95
265+00	0.8	460	95
265+00	-2.7	520	100
265+00	-5.7	420	95
265+00	-6.7	480	95
265+00	-8.6	380	90
265+00	-10	540	100
265+00	-10.7	680	105
265+00	-11.7	1240	110
265+00	-12.4	1920	110
265+00	-14.2	940	110
265+00	-15	780	110
265+00	-18.6	900	110
265+00	-19.4	1100	110
265+00	-20.9	300	90
265+00	-22.6	520	100
265+00	-22.8	1020	110
265+00	-23.4	420	95
265+00	-24.4	660	105
265+00	-25.6	340	90
265+00	-27.6	320	90
265+00	-28.4	1740	110

Table 18. Cohesion spatial function values used for cross-section 2 at Sta. 303+00.

Sta (ft)	Elev (NAVD88)	Su (T/ft^2)	ɣ (pcf)
303+00	8.9	2080	110
303+00	8.2	840	110
303+00	7.4	520	100
303+00	6.2	560	100
303+00	5.4	2000	110
303+00	2.9	680	105
303+00	1.5	760	110
303+00	0.8	560	100
303+00	-0.4	440	95
303+00	-1.3	560	100
303+00	-2.6	540	100
303+00	-5.3	480	95
303+00	-7.8	460	95
303+00	-14.5	640	105
303+00	-15	1600	110
303+00	-16.2	520	100
303+00	-17.5	380	90
303+00	-18.5	140	90
303+00	-19.5	240	90
303+00	-20.8	160	90
303+00	-22.3	260	90
303+00	-24.4	320	90
303+00	-26.4	440	95
303+00	-27.5	1420	110
303+00	-29.4	760	110
303+00	-29.7	400	95
303+00	-31.1	240	90
303+00	-31.6	980	110

Table 19. Cohesion spatial function values used for cross-section 2 at Sta. 142+00.

Sta (ft)	Elev (NAVD88)	Su (T/ft^2)	ɣ (pcf)
142+00	17.4	1900	110
142+00	17	800	110
142+00	15.5	900	110
142+00	14.4	660	105
142+00	13.6	1760	110
142+00	12.8	840	110
142+00	11.7	640	105
142+00	10.9	540	100
142+00	8.8	460	95
142+00	8.3	340	90
142+00	7.9	920	110
142+00	6	2220	110
142+00	5.5	360	90
142+00	3.6	500	100
142+00	1.2	540	100
142+00	-1.1	460	95
142+00	-3.2	480	95
142+00	-4.7	500	100
142+00	-7.6	520	100
142+00	-8.5	600	105
142+00	-11.2	560	100
142+00	-12.9	1140	110
142+00	-15.5	660	105
142+00	-16.4	920	110
142+00	-17.4	560	100
142+00	-19.3	740	110
142+00	-20	1300	110
142+00	-21.4	680	105
142+00	-21.9	640	105
142+00	-22.9	1240	110
142+00	-24.6	1040	110
142+00	-25.6	800	110
142+00	-29	460	95
142+00	-29.5	2960	110

Table 20. Cohesion spatial function values used for cross-section 2 at Sta. 83+00.

Sta (ft)	Elev (NAVD88)	Su (T/ft^2)	γ (pcf)
83+00	16.7	2160	110
83+00	15.1	1220	110
83+00	13	480	95
83+00	10.9	420	95
83+00	9.5	500	100
83+00	4.9	1820	110
83+00	4.3	380	90
83+00	3.4	660	105
83+00	3.2	400	95
83+00	2.1	680	105
83+00	1.2	380	90
83+00	0.2	420	95
83+00	-3.4	460	95
83+00	-4.3	260	90
83+00	-6	320	90
83+00	-6.7	360	90
83+00	-9.9	740	110
83+00	-11.6	800	110
83+00	-12.2	780	110
83+00	-13.2	1640	110
83+00	-14.2	1160	110
83+00	-17.1	880	110
83+00	-17.9	560	100
83+00	-18.8	860	110
83+00	-20.7	680	105
83+00	-21.4	580	100
83+00	-22	440	95
83+00	-23.9	300	90
83+00	-25.3	640	105
83+00	-26.8	600	105
83+00	-27.5	1980	110

Table 21. Cohesion spatial function values used for cross-section 2 at Sta. 351+00.

Sta (ft)	Elev (NAVD88)	Su (T/ft^2)	γ (pcf)
351+00	8.9	2080	110
351+00	8.2	840	110
351+00	7.4	520	100
351+00	6.2	560	100
351+00	5.4	2000	110
351+00	2.9	680	105
351+00	1.5	760	110
351+00	0.8	560	100
351+00	-0.4	440	95
351+00	-1.3	560	100
351+00	-2.6	540	100
351+00	-5.3	480	95
351+00	-7.8	460	95
351+00	-14.5	640	105
351+00	-15	1600	110
351+00	-16.2	520	100
351+00	-17.5	380	90
351+00	-18.5	140	90
351+00	-19.5	240	90
351+00	-20.8	160	90
351+00	-22.3	260	90
351+00	-24.4	320	90
351+00	-26.4	440	95
351+00	-27.5	1420	110
351+00	-29.4	760	110
351+00	-29.7	400	95

Table 22. Cohesion spatial function values used for cross-section 2 at Sta. 417+50.

Sta (ft)	Elev (NAVD88)	Su (T/ft^2)	ɣ (pcf)
417+50	1.5	760	110
417+50	0.8	560	100
417+50	-0.4	440	95
417+50	-1.3	560	100
417+50	-2.6	540	100
417+50	-5.3	480	95
417+50	-7.8	460	95
417+50	-14.5	640	105
417+50	-15	1600	110
417+50	-16.2	520	100
417+50	-17.5	380	90
417+50	-18.5	140	90
417+50	-19.5	240	90
417+50	-20.8	160	90
417+50	-22.3	260	90
417+50	-24.4	320	90
417+50	-26.4	440	95
417+50	-27.5	1420	110
417+50	-29.4	760	110
417+50	-29.7	400	95
417+50	-31.1	240	90
417+50	-31.6	980	110

Table 23. Cohesion spatial function values used for cross-section 2 at Sta. 507+50.

Sta (ft)	Elev (NAVD88)	Su (T/ft^2)	ɣ (pcf)
507+50	-16.2	520	100
507+50	-17.5	380	90
507+50	-18.5	140	90
507+50	-19.5	240	90
507+50	-20.8	160	90
507+50	-22.3	260	90
507+50	-24.4	320	90
507+50	-26.4	440	95
507+50	-27.5	1420	110
507+50	-29.4	760	110
507+50	-29.7	400	95
507+50	-31.1	240	90
507+50	-31.6	980	110

Table 24. Cohesion spatial function values used for cross-section 2 at Sta. 53+00.

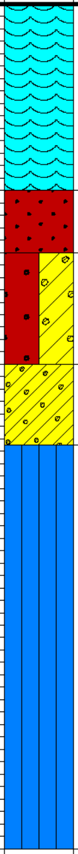
Sta (ft)	Elev (NAVD88)	Su (T/ft^2)	ɣ (pcf)
53	17.6	1540	110
53	16.9	1100	110
53	16.4	880	110
53	16.5	840	110
53	14.8	520	100
53	14.4	1700	110
53	7.2	900	110
53	6.8	460	95
53	6.3	1360	110
53	-4.6	620	105
53	-6	480	95
53	-7.6	260	90
53	-9.2	3380	110
53	-10.6	140	90
53	-11.6	480	95
53	-12.9	740	110
53	-15.9	620	105
53	-16.9	400	95
53	-18.2	340	90
53	-19.7	200	90
53	-21.2	320	90
53	-22.9	1560	110
53	-23.7	3140	110

Attachment C: Boring Logs for Battery Island Turn

Hole No.: **WH12-V-16**

Vibratory Drilling Log
DIVISION SAD
INSTALLATION WILMINGTON DISTRICT
SHEET 1 OF 1 SHEETS

1. PROJECT **WILMINGTON HARBOR**
2. LOCATION N 60,202.0 E 2,298,174.0
3. DRILLING AGENCY WILMINGTON DISTRICT
4. HOLE NO.(As shown on drawing title and file number) WH12-V-16
5. NAME OF DRILLER Talon Smith
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL
7. THICKNESS OF WATER COLUMN 40.4'
8. DEPTH DRILLED INTO ROCK 0.0'
9. TOTAL DEPTH OF HOLE 51.0'
10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN : DISTURBED 4 : UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER N/A
16. DATE HOLE : STARTED 7/12/12 COMPLETED 7/12/12
17. ELEVATION TOP OF HOLE 0.0
18. TOTAL CORE RECOVERY FOR BORING N/A
19. SIGNATURE OF INSPECTOR



ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f
-40.4	38.0 40.0		0.0' TO 40.4' WATER OCEAN BOTTOM @40.4'		40.4
-41.4			**SP**, Light gray, poorly graded silty sand.		1 41.4
-43.2	42.0		**SP-SC**, Gray, poorly graded silty sand, with clay, trace shells.		2 43.2
-44.5	44.0		**SC**, Gray, clayey sand, with, shells.		3 44.5
-51.0	46.0 48.0 50.0		**ML**, Light gray, silty sand, with, with some gravel.		4 51
	52.0 54.0 56.0		BOTTOM OF HOLE AT 51' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM		

REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g

Time begin vibracoring: 0000 hrs.

Soils Field Classified by Zachry Nichols, Civil Engineer

NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.

VIBRACORE BORING
From 0.0' to 15.10'
Ran 20' Rec: 20'

Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.

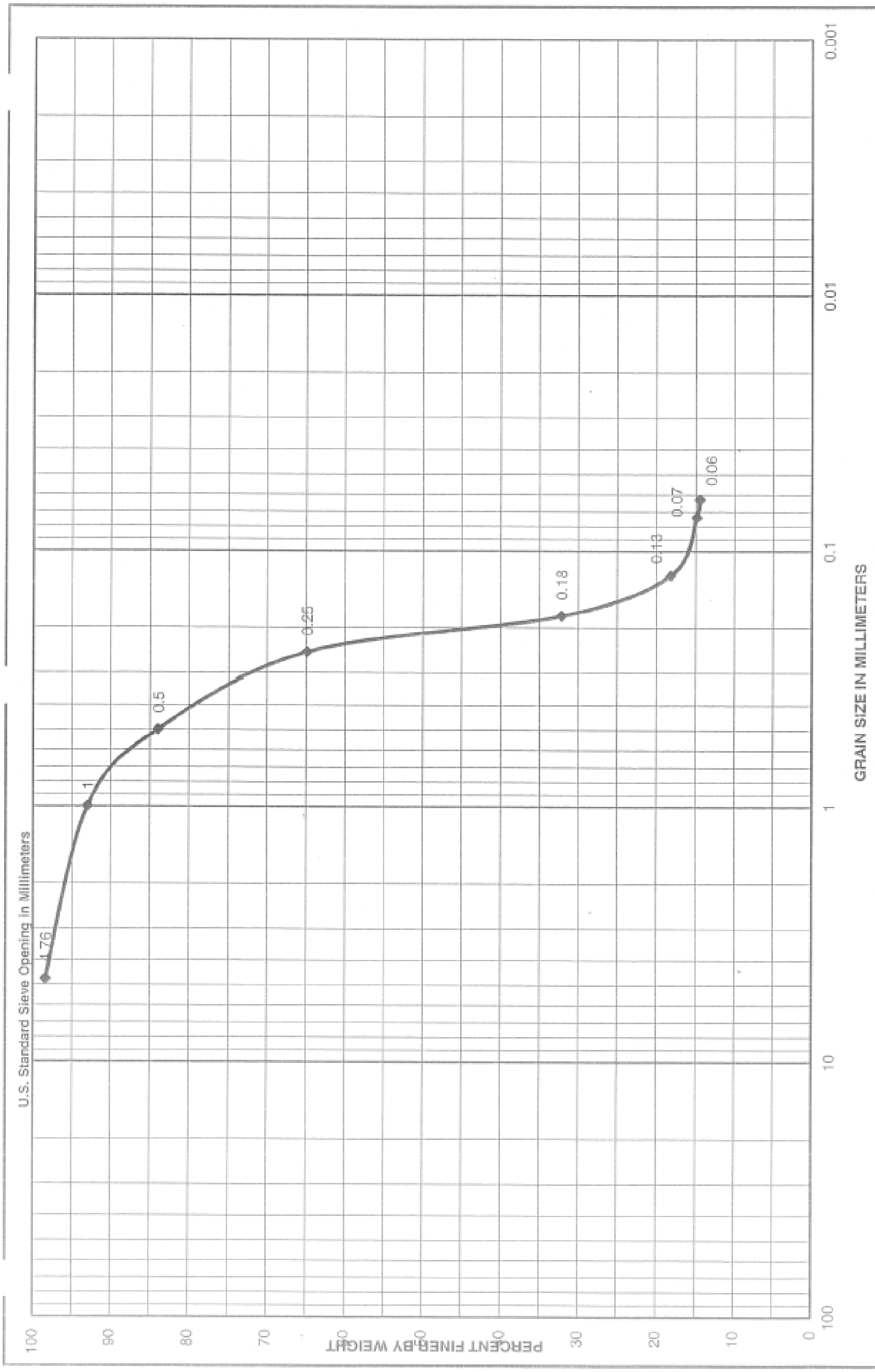
LAB CLASSIFICATION

Jar Number	Classification
1	SM
2	SM
3	SC
4	SW-SM

Soils are Lab Classified in Accordance with ASTM-D2487

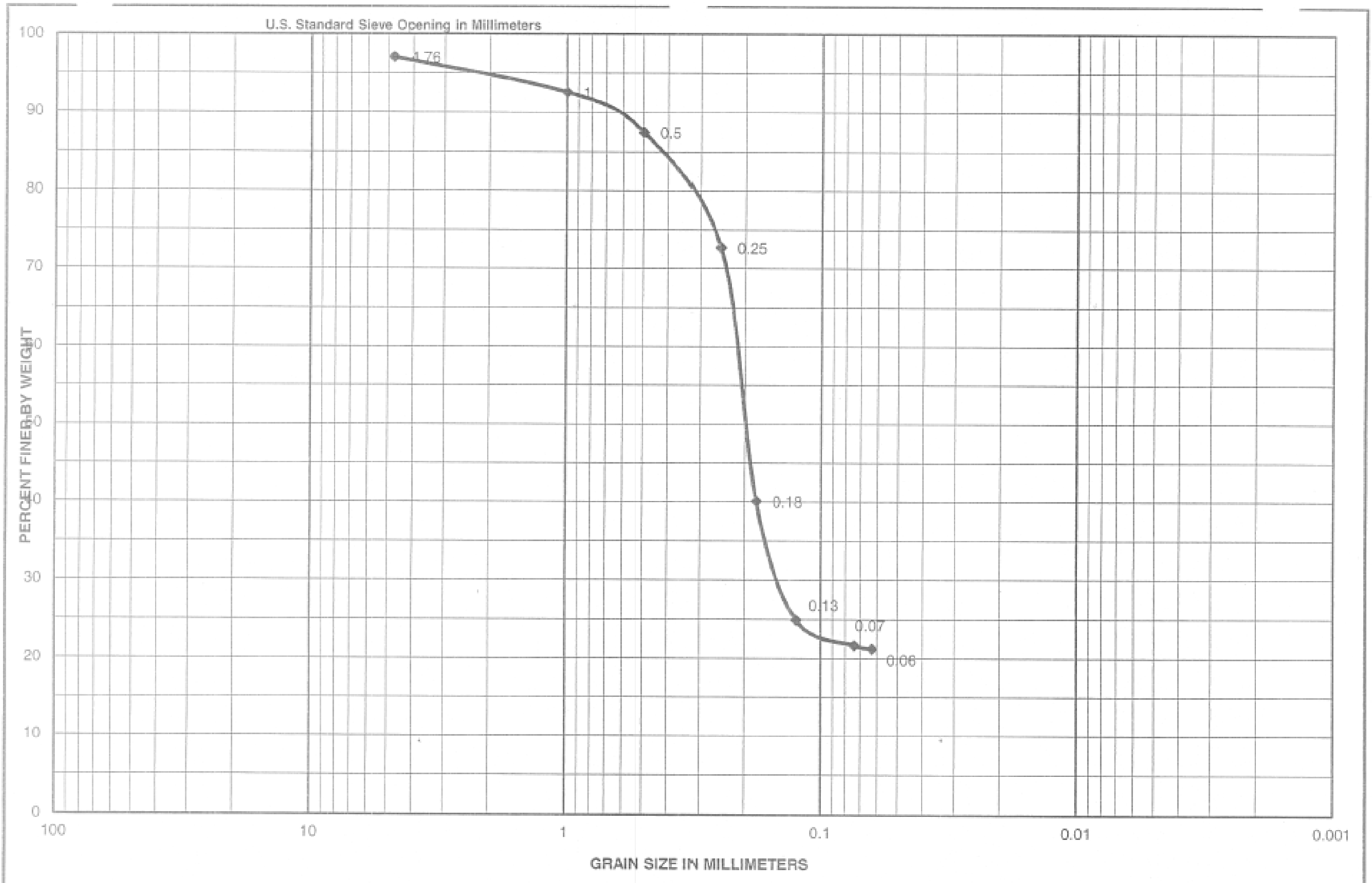
COMPLETION NOTE: Terminated hole at refusal or predetermined depth at 10.6' below ocean bottom

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-16

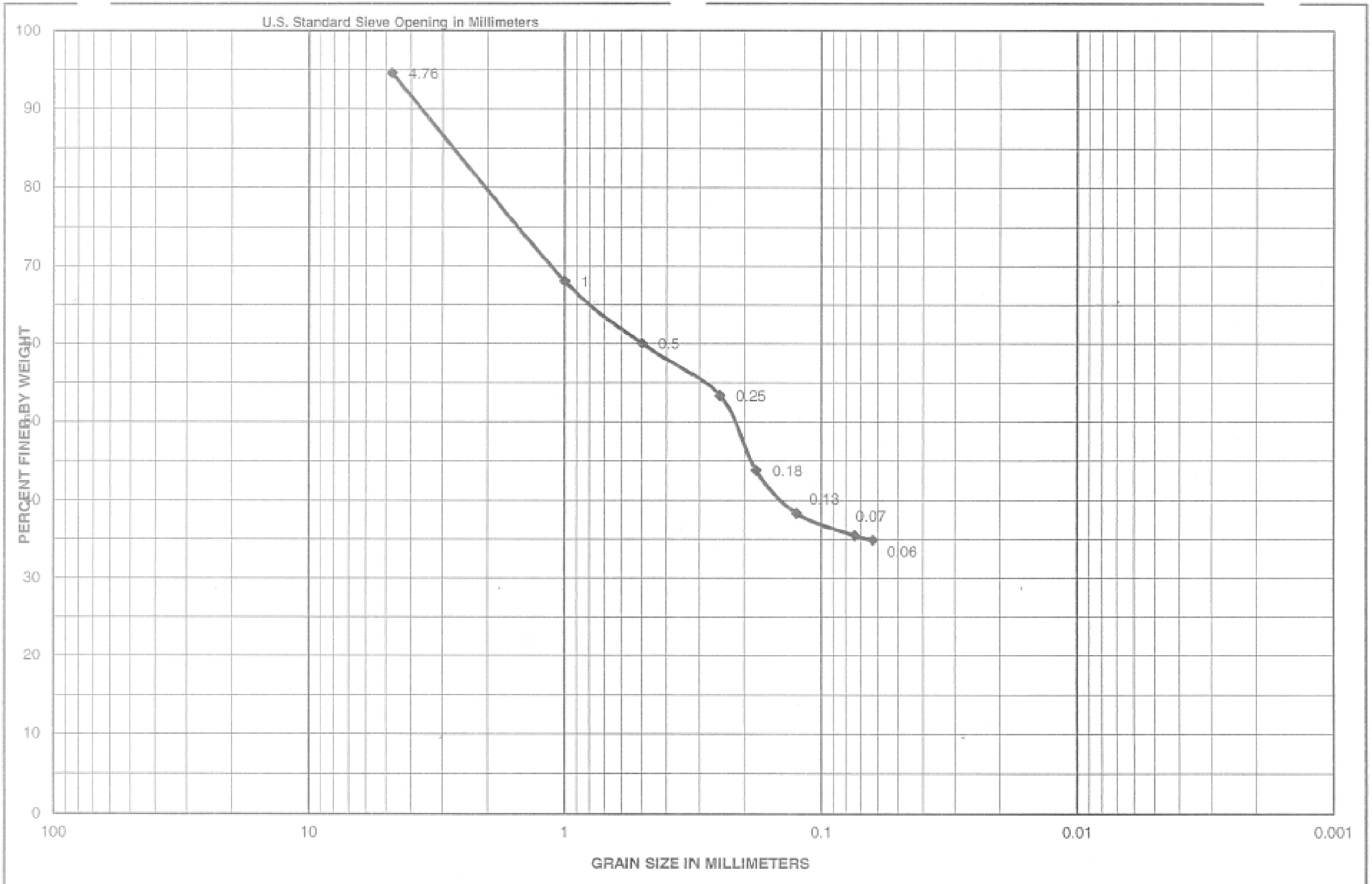


Sample No.	Elevation	Classification
1	40.4 to 41.4	Olive gray silty sand with few shells, SM
		7.0% Shells

Area	Wilmington Harbor
CATLIN Geotechnical Laboratory	
Boring No.	WH12-V-16
Date	10/15/12

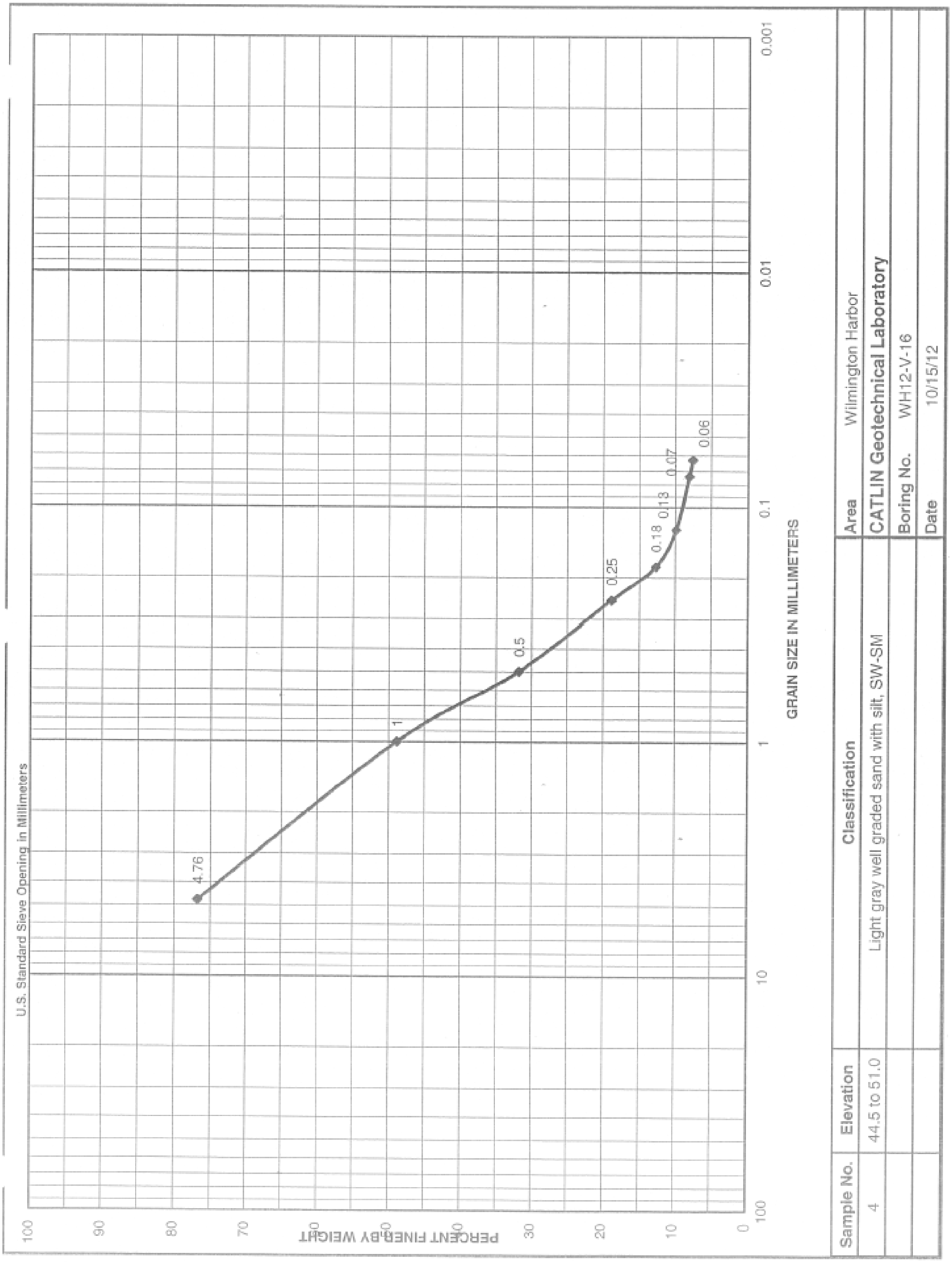


Sample No.	Elevation	Classification	Area	Wilmington Harbor
2	41.4 to 43.2	Olive gray silty sand with few shells, SM	**CATLIN Geotechnical Laboratory**	
		7.5% Shells	Boring No.	WH12-V-16
			Date	10/12/12



Sample No.	Elevation	Classification
3	43.2 to 44.5	Olive gray clayey sand with some shells, SC
		31.9% Shells

Area	Wilmington Harbor
CATLIN Geotechnical Laboratory	
Boring No.	WH12-V-16
Date	10/15/12



Sample No.	Elevation	Classification
4	44.5 to 51.0	Light gray well graded sand with silt, SW-SM

Area	Wilmington Harbor
CATLIN Geotechnical Laboratory	
Boring No.	WH12-V-16
Date	10/15/12

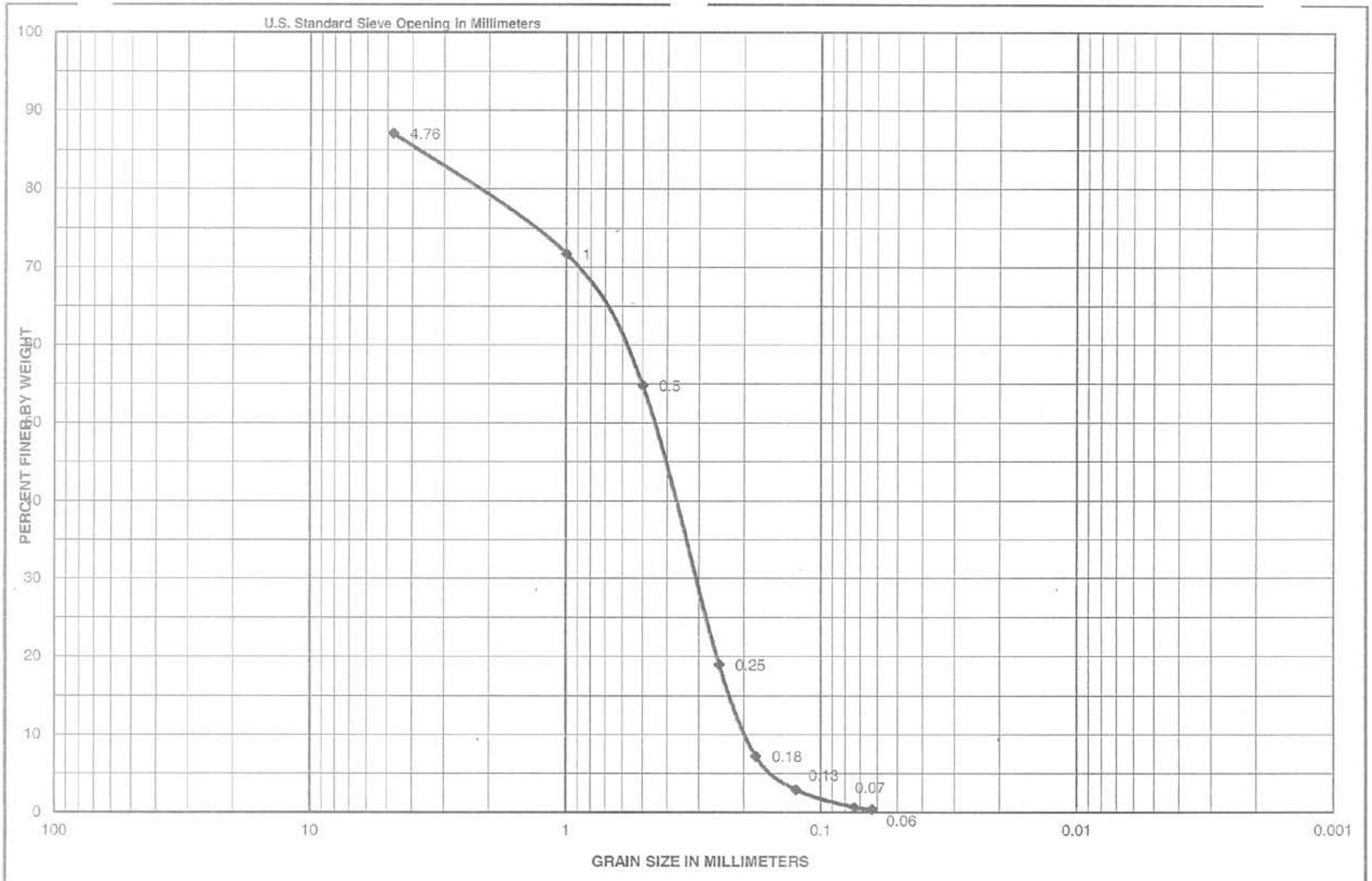
Hole No.: **WH12-V-17**

Vibratory Drilling Log
DIVISION SAD
INSTALLATION WILMINGTON DISTRICT
SHEET 1 OF 1 SHEETS

1. PROJECT **WILMINGTON HARBOR**
2. LOCATION N 59,520.0 E 2,297,750.0
3. DRILLING AGENCY WILMINGTON DISTRICT
4. HOLE NO. (As shown on drawing title and file number) WH12-V-17
5. NAME OF DRILLER Talon Smith
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL
7. THICKNESS OF WATER COLUMN 38.0'
8. DEPTH DRILLED INTO ROCK 0.0'
9. TOTAL DEPTH OF HOLE 46.4'
10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 2 UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER N/A
16. DATE HOLE STARTED 7/12/12 COMPLETED 7/12/12
17. ELEVATION TOP OF HOLE 0.0
18. TOTAL CORE RECOVERY FOR BORING N/A
19. SIGNATURE OF INSPECTOR ,

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	36.0	🟦	0.0' TO 38' WATER OCEAN BOTTOM @38'			Time begin vibracoring: 0000 hrs. Soils Field Classified by Zachry Nichols, Civil Engineer NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.
-38.0	38.0				38	
	40.0 42.0	🟥	**SW**, Gray, well graded sand, with, some shells.		1	
-44.1	44.0				44.1	<u>VIBRACORE BORING</u> From 0.0' to 12.00' Ran 20' Rec: 20' Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.
	46.0	🟥	**SP**, Light gray, poorly graded silty sand.		2	
-46.4			BOTTOM OF HOLE AT 46.4' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM		46.4	LAB CLASSIFICATION Jar <u>Number</u> <u>Classification</u> 1 SP 2 SP Soils are Lab Classified in Accordance with ASTM-D2487 COMPLETION NOTE: Terminated hole at refusal or predetermined depth at 8.4' below ocean bottom
	48.0 50.0 52.0 54.0					

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-17



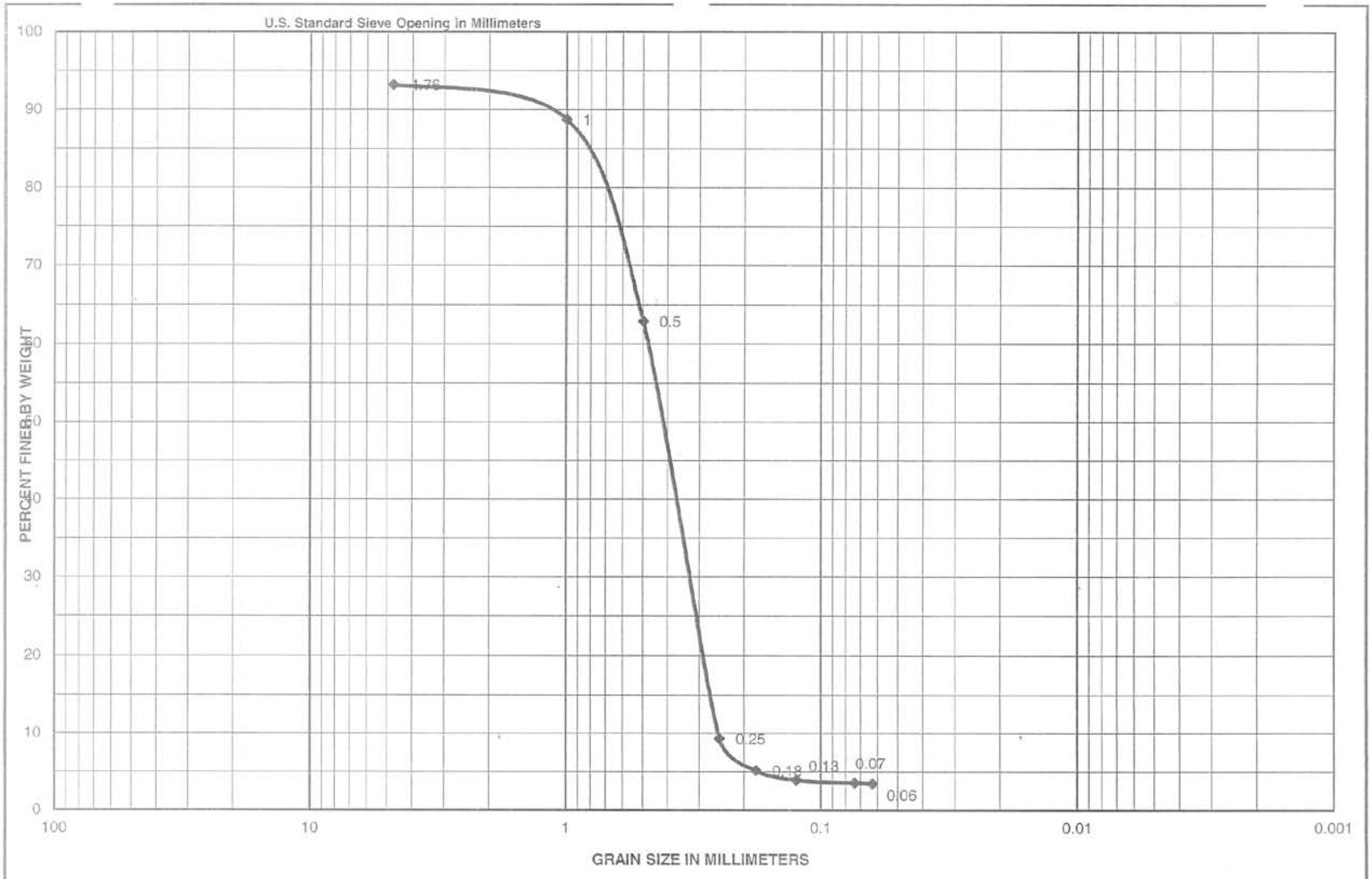
Sample No.	Elevation	Classification
1	38 to 44.1	Olive gray poorly graded sand with some shells, SP
		45.2% Shells

Area Wilmington Harbor

CATLIN Geotechnical Laboratory

Boring No. WH12-V-17

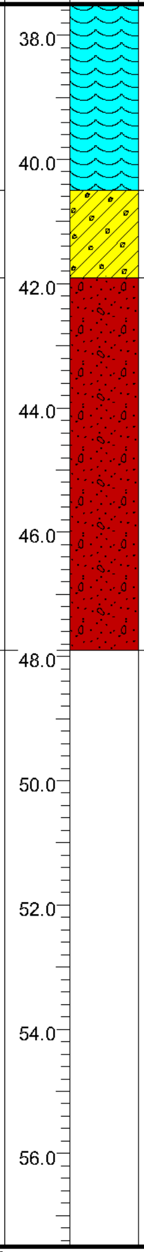
Date 10/8/2012



Sample No.	Elevation	Classification	Area	Wilmington Harbor
2	44.1 to 46.4	Light gray poorly graded sand, SP	**CATLIN Geotechnical Laboratory**	
			Boring No.	WH12-V-17
			Date	10/9/2012

Hole No.: **WH12-V-18**

Vibratory Drilling Log	DIVISION SAD	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT **WILMINGTON HARBOR**		10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE	
2. LOCATION N 60,021.0 E 2,297,978.0		11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell	
4. HOLE NO. (As shown on drawing title and file number) WH12-V-18		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 UNDISTURBED 0
5. NAME OF DRILLER Talon Smith		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF WATER COLUMN 40.5'		16. DATE HOLE	STARTED 7/12/12 COMPLETED 7/12/12
8. DEPTH DRILLED INTO ROCK 0.0'		17. ELEVATION TOP OF HOLE 0.0	
9. TOTAL DEPTH OF HOLE 47.9'		18. TOTAL CORE RECOVERY FOR BORING N/A	
		19. SIGNATURE OF INSPECTOR	



ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-40.5			0.0' TO 40.5' WATER OCEAN BOTTOM @40.5'		40.5	Time begin vibracoring: 0000 hrs. Soils Field Classified by Zachry Nichols, Civil Engineer NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.
-41.9			**SC**, Dark gray, clayey sand, with gravel.		1 41.9	
-47.9			**GW**, Dark to light gray, well graded sandy gravel.		2 47.9	
			BOTTOM OF HOLE AT 47.9' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			

VIBRACORE BORING
From 0.0' to 11.60'
Ran 20' Rec: 20'

Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.

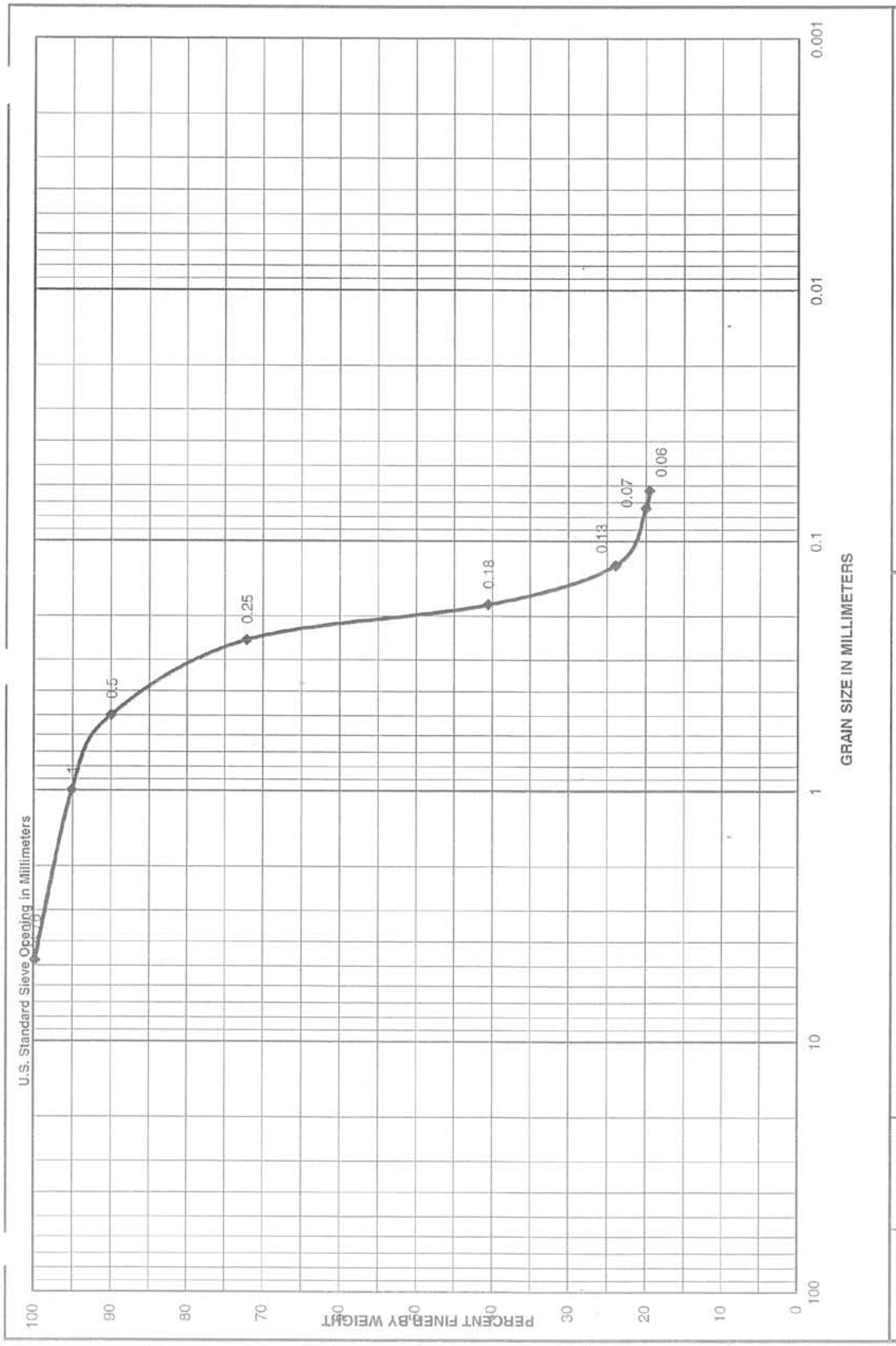
LAB CLASSIFICATION

Jar Number	Classification
1	SC
2	GW-GM

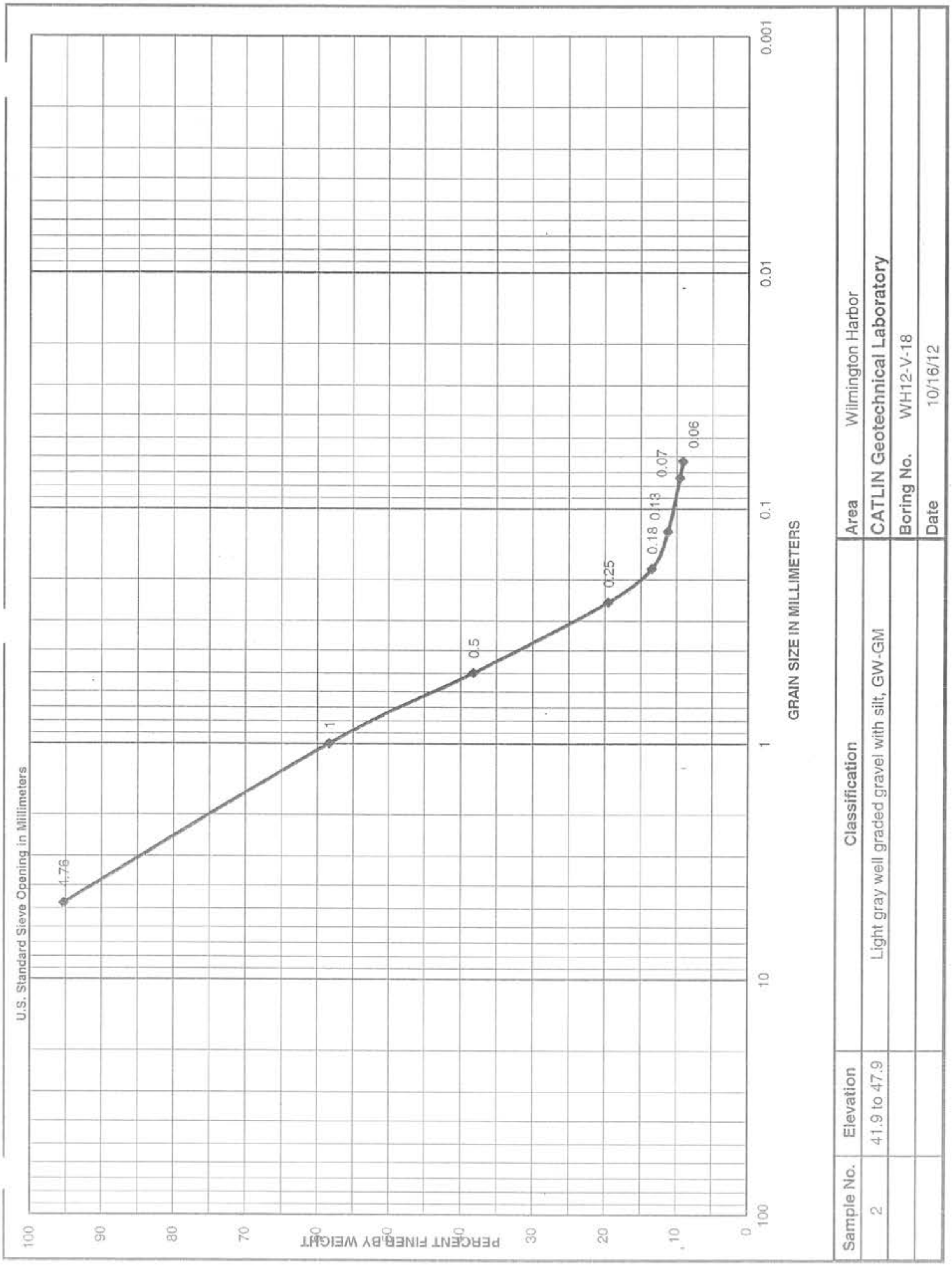
Soils are Lab Classified in Accordance with ASTM-D2487

COMPLETION NOTE: Terminated hole at refusal or predetermined depth at 7.4' below ocean bottom

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-18



Sample No.	Elevation	Classification	Area	Wilmington Harbor
1	40.5 to 41.9	Olive gray clayey sand with few shells, SC	CATLIN Geotechnical Laboratory	
		10.0% Shells	Boring No.	WH12-V-18
			Date	10/15/12



Sample No.	Elevation	Classification
2	41.9 to 47.9	Light gray well graded gravel with silt, GW-GM

Area Wilmington Harbor

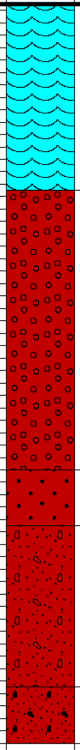
CATLIN Geotechnical Laboratory

Boring No. WH12-V-18

Date 10/16/12

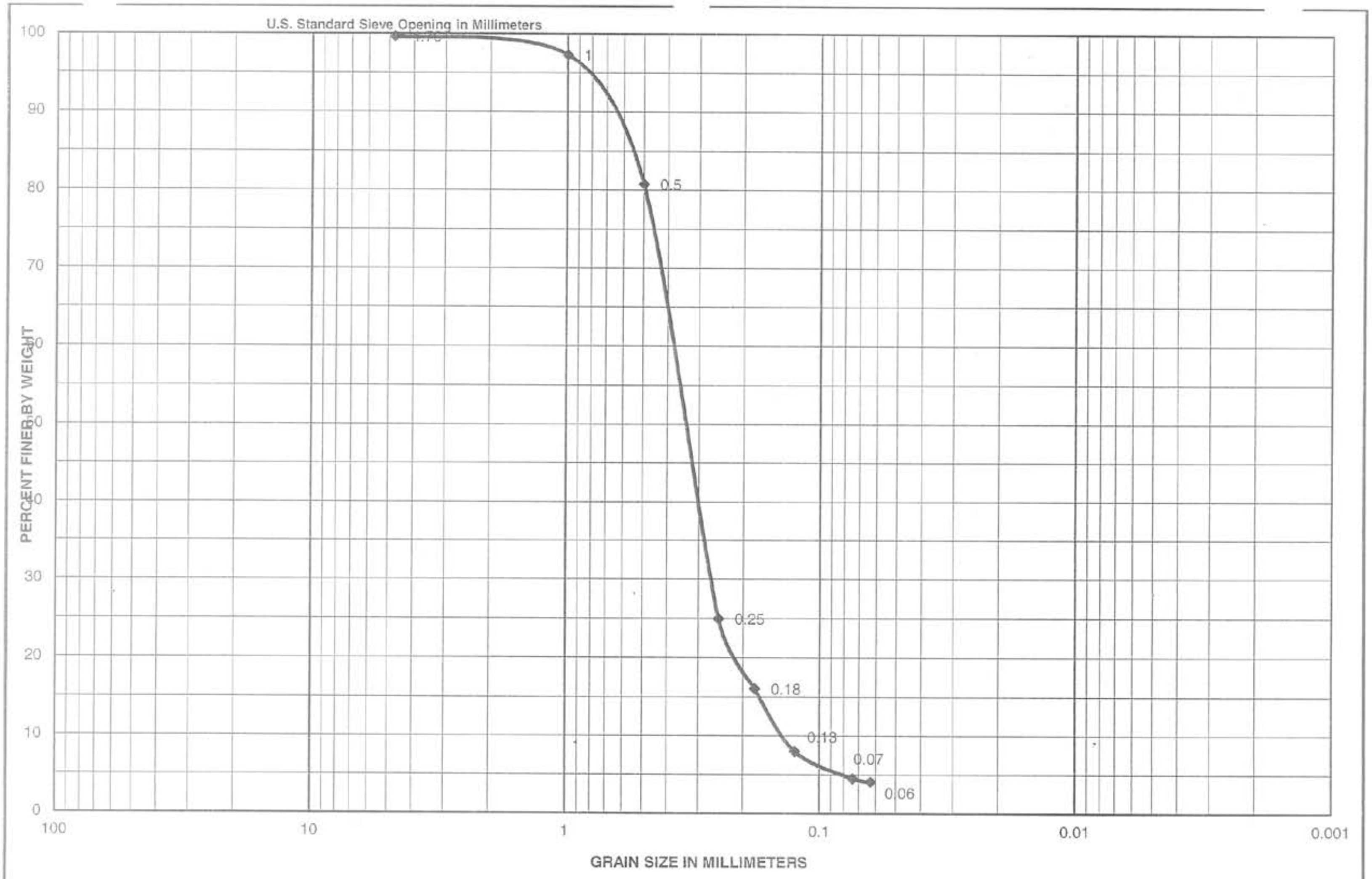
Hole No.: **WH12-V-19**

Vibratory Drilling Log	DIVISION SAD	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT **WILMINGTON HARBOR**		10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE	
2. LOCATION N 59,778.0 E 2,297,898.0		11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell	
4. HOLE NO.(As shown on drawing title and file number) WH12-V-19		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 4 UNDISTURBED 0
5. NAME OF DRILLER Talon Smith		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF WATER COLUMN 36.3'		16. DATE HOLE	STARTED 7/12/12 COMPLETED 7/12/12
8. DEPTH DRILLED INTO ROCK 0.0'		17. ELEVATION TOP OF HOLE 0.0	
9. TOTAL DEPTH OF HOLE 45.2'		18. TOTAL CORE RECOVERY FOR BORING N/A	
		19. SIGNATURE OF INSPECTOR ,	



ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-36.3	34.0 36.0		0.0' TO 36.3' WATER OCEAN BOTTOM @36.3'		36.3	Time begin vibracoring: 0000 hrs. Soils Field Classified by Zachry Nichols, Civil Engineer NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.
-40.8	38.0 40.0		**SW**, Gray, well graded sand, little shells.		1 40.8	
-41.7			**SP**, Light gray, poorly graded sand.		2 41.7	VIBRACORE BORING From 0.0' to 12.70' Ran 20' Rec: 20' Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.
-44.3	42.0 44.0		**GW**, Light gray, well graded gravel.		3 44.3	
-45.2			**GP**, Light gray, poorly graded gravel.		4 45.2	
	46.0 48.0 50.0 52.0		BOTTOM OF HOLE AT 45.2' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			LAB CLASSIFICATION Jar Number Classification 1 SW 2 SP 3 GW-GM 4 GW-GM Soils are Lab Classified in Accordance with ASTM-D2487 COMPLETION NOTE: Terminated hole at refusal or predetermined depth at 8.90000000000001' below ocean bottom

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-19



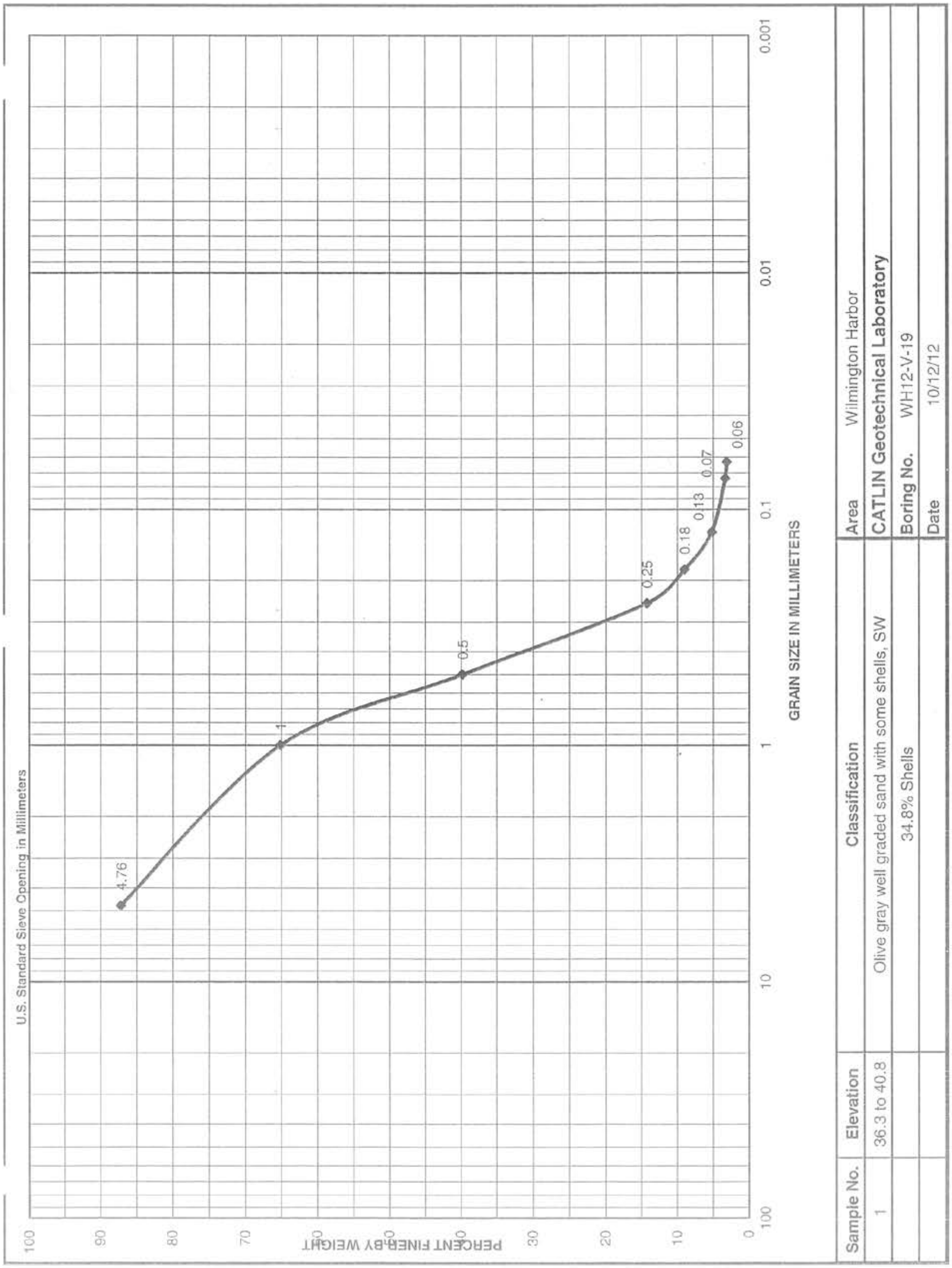
Sample No.	Elevation	Classification
2	40.8 to 41.7	Light gray poorly graded sand with trace shells, SP
		2.7% Shells

Area Wilmington Harbor

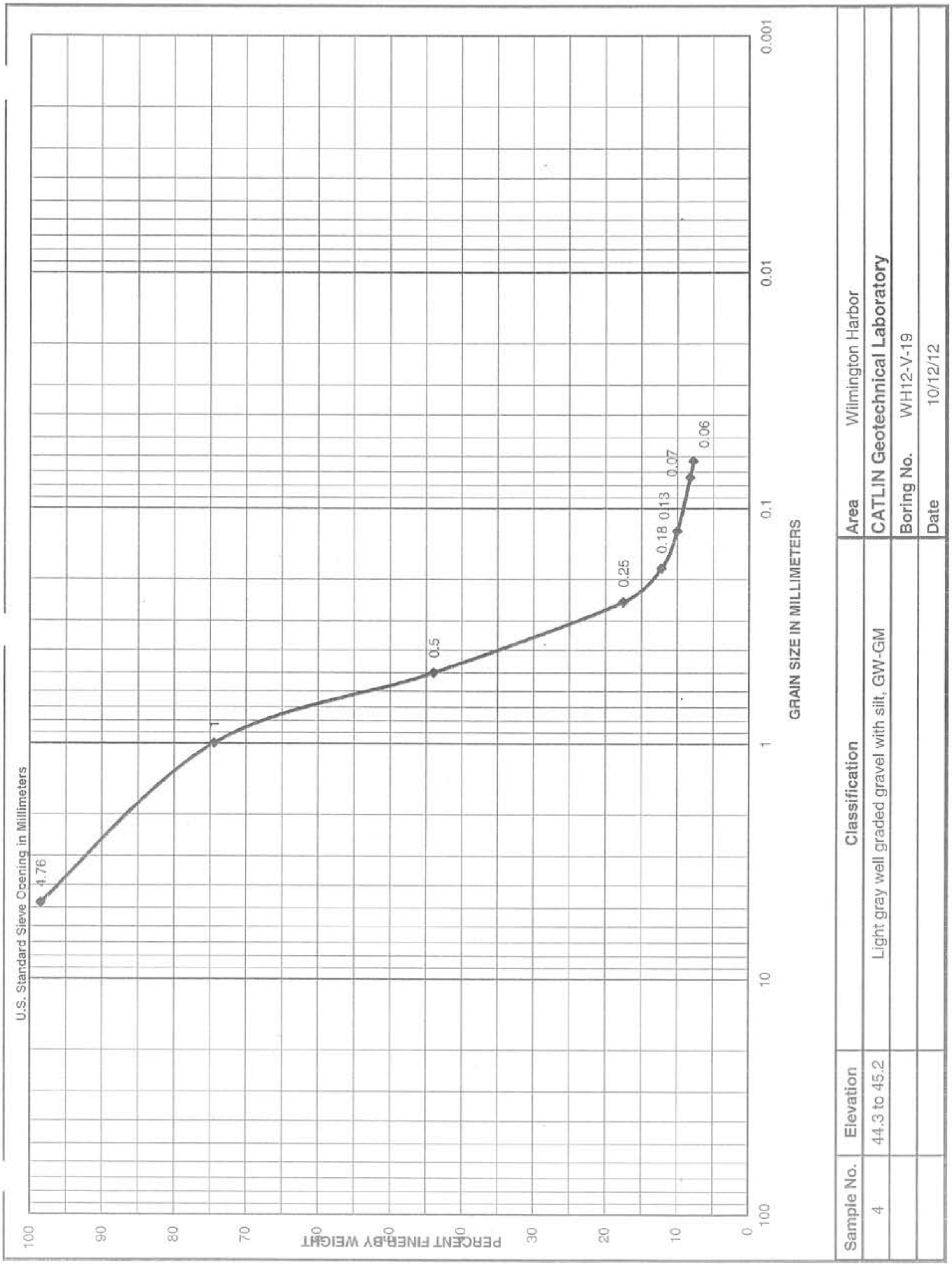
CATLIN Geotechnical Laboratory

Boring No. WH12-V-19

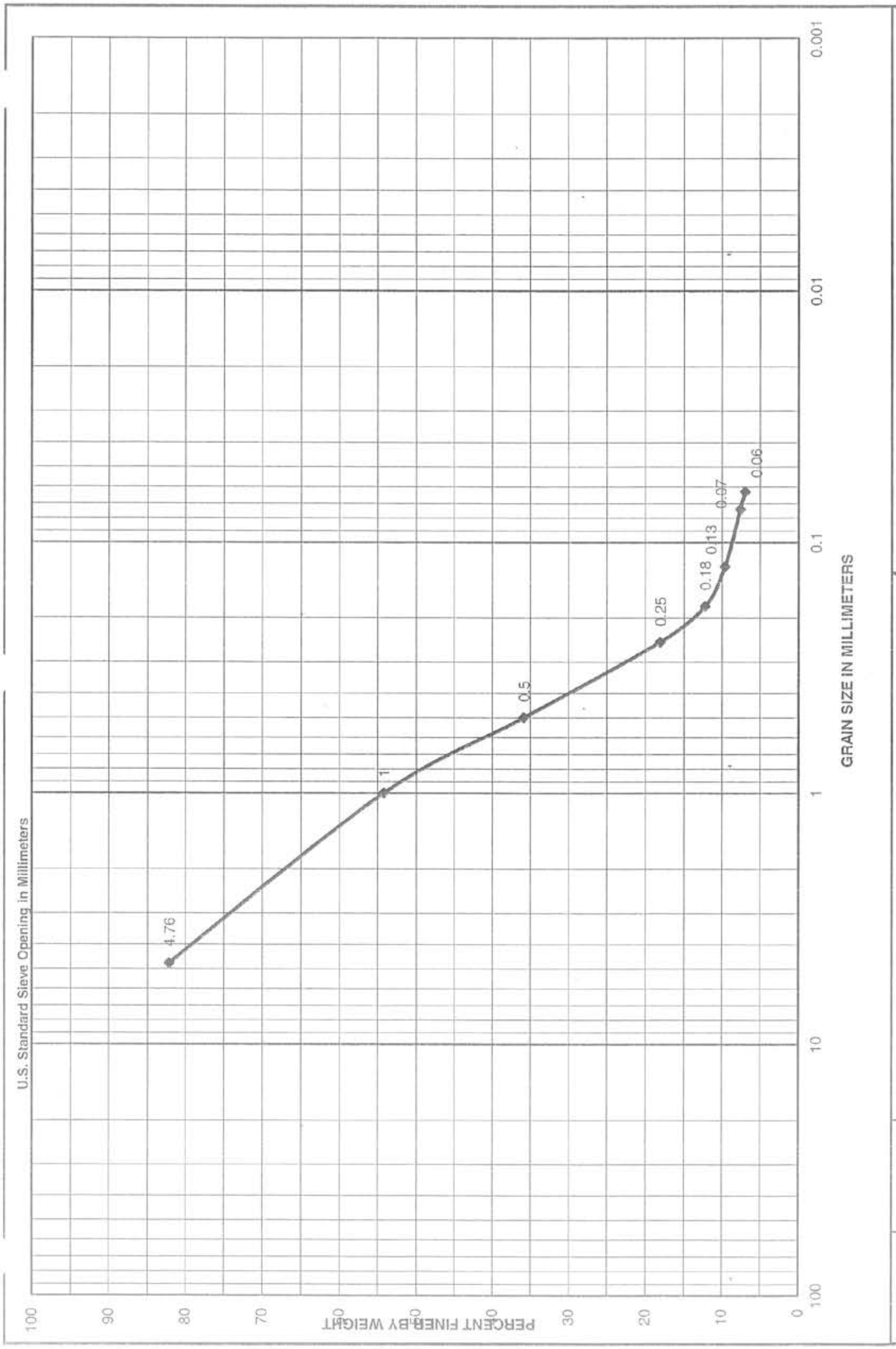
Date 10/12/12



Sample No.	Elevation	Classification	Area	Wilmington Harbor
1	36.3 to 40.8	Olive gray well graded sand with some shells, SW	**CATLIN Geotechnical Laboratory**	
		34.8% Shells	**Boring No.**	WH12-V-19
			Date	10/12/12



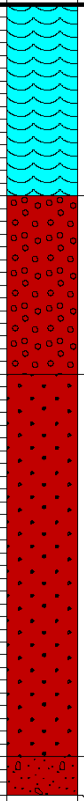
Sample No.	Elevation	Classification	Area	Wilmington Harbor
4	44.3 to 45.2	Light gray well graded gravel with silt, GW-GM	CATLIN Geotechnical Laboratory	
			Boring No.	WH12-V-19
			Date	10/12/12



Sample No.	Elevation	Classification	Area	Wilmington Harbor
3	41.7 to 44.3	Olive gray well graded gravel with silt, GW-GM	**CATLIN Geotechnical Laboratory**	
			Boring No.	WH12-V-19
			Date	10/15/12

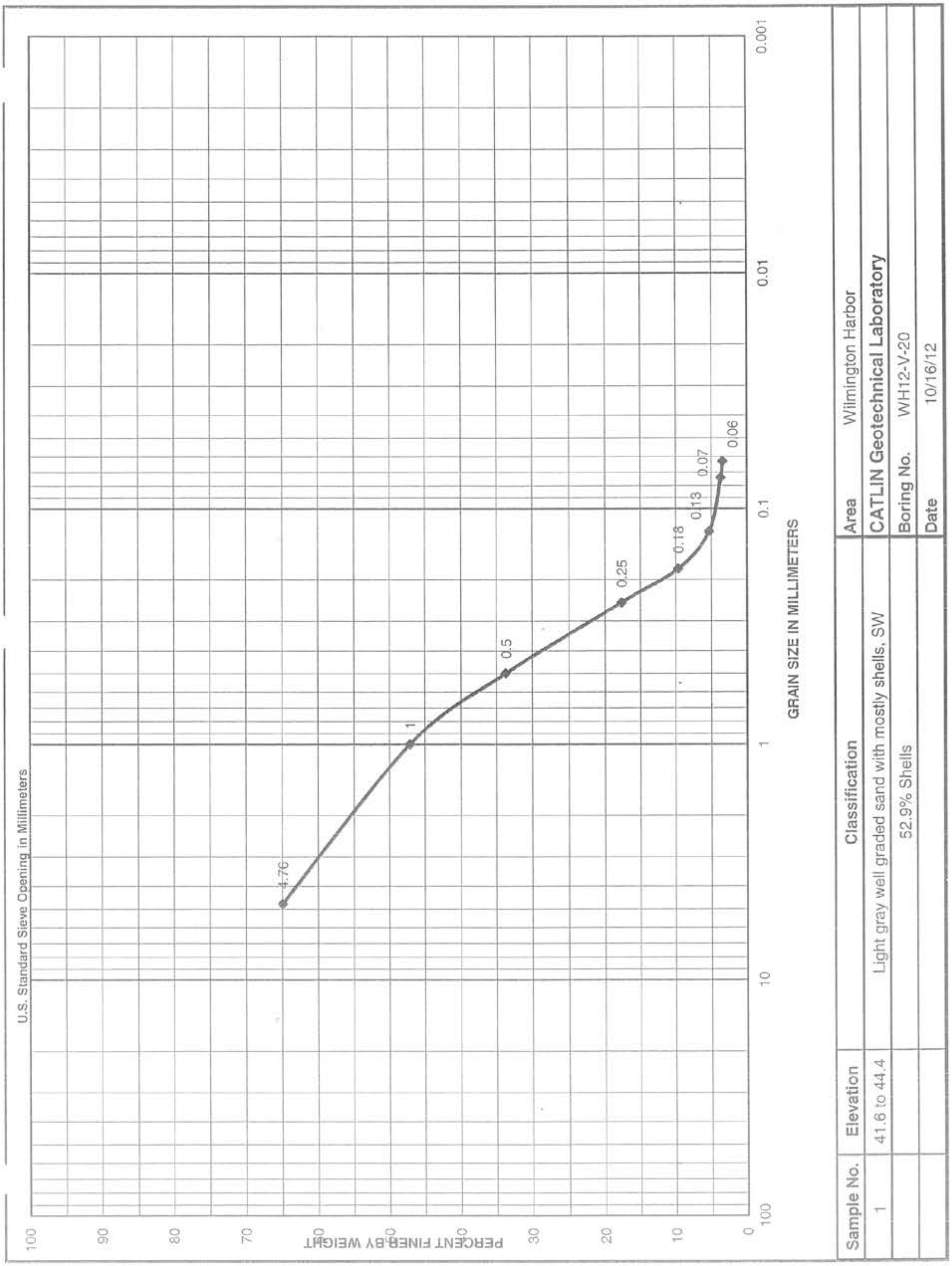
Hole No.: **WH12-V-20**

Vibratory Drilling Log	DIVISION SAD
INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT **WILMINGTON HARBOR**	10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
2. LOCATION N 59,252.0 E 2,297,643.0	11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW
3. DRILLING AGENCY WILMINGTON DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
4. HOLE NO.(As shown on drawing title and file number) WH12-V-20	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3; UNDISTURBED 0
5. NAME OF DRILLER Talon Smith	14. TOTAL NUMBER CORE BOXES 0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL	15. ELEVATION GROUND WATER N/A
7. THICKNESS OF WATER COLUMN 41.6'	16. DATE HOLE STARTED 7/12/12 COMPLETED 7/12/12
8. DEPTH DRILLED INTO ROCK 0.0'	17. ELEVATION TOP OF HOLE 0.0
9. TOTAL DEPTH OF HOLE 51.0'	18. TOTAL CORE RECOVERY FOR BORING N/A
	19. SIGNATURE OF INSPECTOR



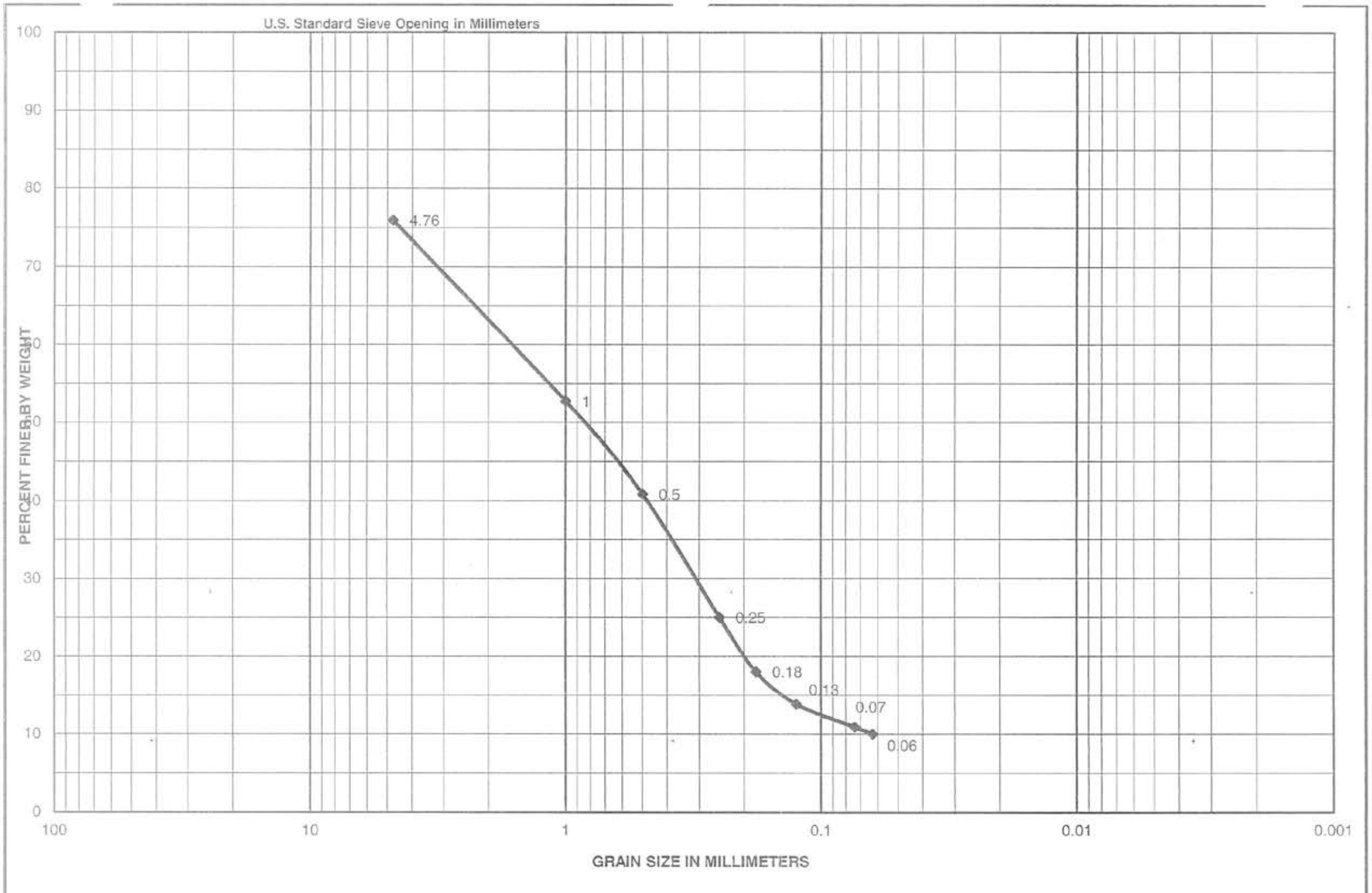
ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	40.0		0.0' TO 41.6' WATER OCEAN BOTTOM @41.6'			Time begin vibracoring: 0000 hrs. Soils Field Classified by Zachry Nichols, Civil Engineer NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.
-41.6	42.0		**SW**, Light gray, well graded sand.		41.6 1	
-44.4	44.0 46.0 48.0		**SP**, Tannish gray, poorly graded sand.		44.4 2	VIBRACORE BORING From 0.0' to 12.80' Ran 20' Rec: 20' Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.
-50.4	50.0		**GW**, Tan to gray, well graded gravel.		50.4 3	
-51.0	52.0 54.0 56.0 58.0		BOTTOM OF HOLE AT 51' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM		51	LAB CLASSIFICATION Jar Number / Classification 1 SW 2 SP 3 SW-SM Soils are Lab Classified in Accordance with ASTM-D2487 COMPLETION NOTE: Terminated hole at refusal or predetermined depth at 9.4' below ocean bottom

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-20



Sample No.	Elevation	Classification
1	41.6 to 44.4	Light gray well graded sand with mostly shells, SW
		52.9% Shells

Area	Wilmington Harbor
CATLIN Geotechnical Laboratory	
Boring No.	WH12-V-20
Date	10/16/12



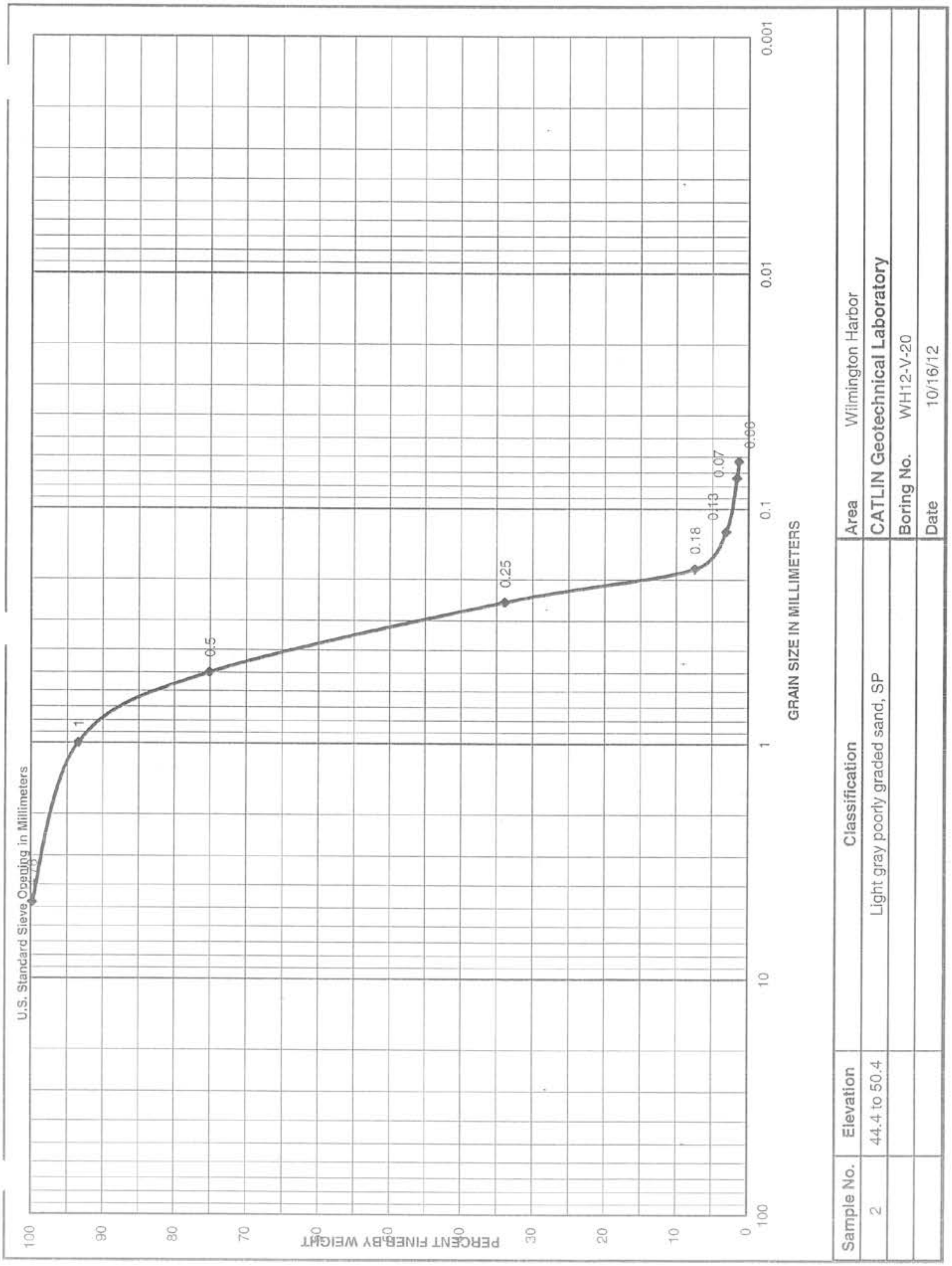
Sample No.	Elevation	Classification
3	50.4 to 51.0	Light gray well graded sand with silt, SW-SM

Area Wilmington Harbor

CATLIN Geotechnical Laboratory

Boring No. WH12-V-20

Date 10/16/12



Sample No.	Elevation	Classification
2	44.4 to 50.4	Light gray poorly graded sand, SP

Area Wilmington Harbor

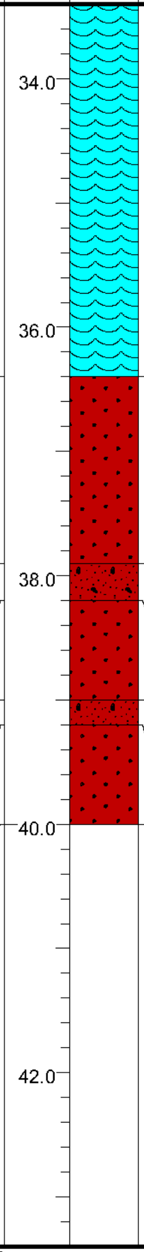
CATLIN Geotechnical Laboratory

Boring No. WH12-V-20

Date 10/16/12

Hole No.: **WH13-V-01**

Vibratory Drilling Log	DIVISION SAD
INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT **WILMINGTON HARBOR**	10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
2. LOCATION N 61,845.1 E 2,299,196.1	11. DATUM FOR ELEVATION SHOWN *BM or MSL* MLLW
3. DRILLING AGENCY WILMINGTON DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
4. HOLE NO. (As shown on drawing title and file number) WH13-V-01	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 2; UNDISTURBED 0
5. NAME OF DRILLER Lester Gavghf	14. TOTAL NUMBER CORE BOXES 0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL	15. ELEVATION GROUND WATER N/A
	16. DATE HOLE: STARTED 2/18/13; COMPLETED 2/18/13
7. THICKNESS OF WATER COLUMN 36.4'	17. ELEVATION TOP OF HOLE 0.0
8. DEPTH DRILLED INTO ROCK 0.0'	18. TOTAL CORE RECOVERY FOR BORING N/A
9. TOTAL DEPTH OF HOLE 40.0'	19. SIGNATURE OF INSPECTOR ,



ELEVATION (MLLW) a	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f
	0.0' TO 36.4' WATER OCEAN BOTTOM @36.4'		
-36.4	**SP**, Tannish brown, poorly graded sand, with gravel.		36.4 1
-37.9	**GP**, Light gray gravel with rock fragments, rock @ -37.9' to -38.2'.		37.9
-38.2	**SP**, Grayish brown, coarse, sand.		38.2 2
-39.0	**GP**, Light gray gravel with rock fragments, rock @ -39.0' to -39.2'.		
-39.2	**SP**, Grayish brown, coarse, sand.		
-40.0	BOTTOM OF HOLE AT 40' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM		40

REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g

Time begin vibracoring: 0000 hrs.

Soils Field Classified by Zachry Nichols, Civil Engineer

NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.

VIBRACORE BORING
From 0.0' to '
Ran ' Rec: '

Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.

LAB CLASSIFICATION

Jar Number	Classification
1	SM
2	SW

Soils are Lab Classified in Accordance with ASTM-D2487

Terminated hole upon refusal depth of 40' below ocean bottom

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH13-V-01

Hole No.: **WH13-V-02**

Vibratory Drilling Log
DIVISION SAD
INSTALLATION WILMINGTON DISTRICT
SHEET 1 OF 1 SHEETS

1. PROJECT **WILMINGTON HARBOR**
2. LOCATION N 61,362.0 E 2,298,355.0
3. DRILLING AGENCY WILMINGTON DISTRICT
4. HOLE NO. (As shown on drawing title and file number) WH13-V-02
5. NAME OF DRILLER Lester Gavghf
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL
7. THICKNESS OF WATER COLUMN 40.0'
8. DEPTH DRILLED INTO ROCK 0.0'
9. TOTAL DEPTH OF HOLE 46.0'
10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 1 UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER N/A
16. DATE HOLE STARTED 2/18/13 COMPLETED 2/18/13
17. ELEVATION TOP OF HOLE 0.0
18. TOTAL CORE RECOVERY FOR BORING N/A
19. SIGNATURE OF INSPECTOR ,

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		🟦				Time begin vibracoring: 0000 hrs. Soils Field Classified by Zachry Nichols, Civil Engineer NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.
	38.0	🟦	0.0' TO 40' WATER OCEAN BOTTOM @40'			
-40.0	40.0	🟥	**SP**, Gray, sand, with gravel, trace shell fragments.		40	
	42.0	🟥			1	
	44.0	🟥				VIBRACORE BORING From 0.0' to ' Ran ' Rec: ' Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.
-46.0	46.0		BOTTOM OF HOLE AT 46' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM		46	
	48.0					LAB CLASSIFICATION Jar Number Classification 1 SP-SM
	50.0					Soils are Lab Classified in Accordance with ASTM-D2487
	52.0					
	54.0					Terminated hole upon refusal depth of 46' below ocean bottom
	56.0					

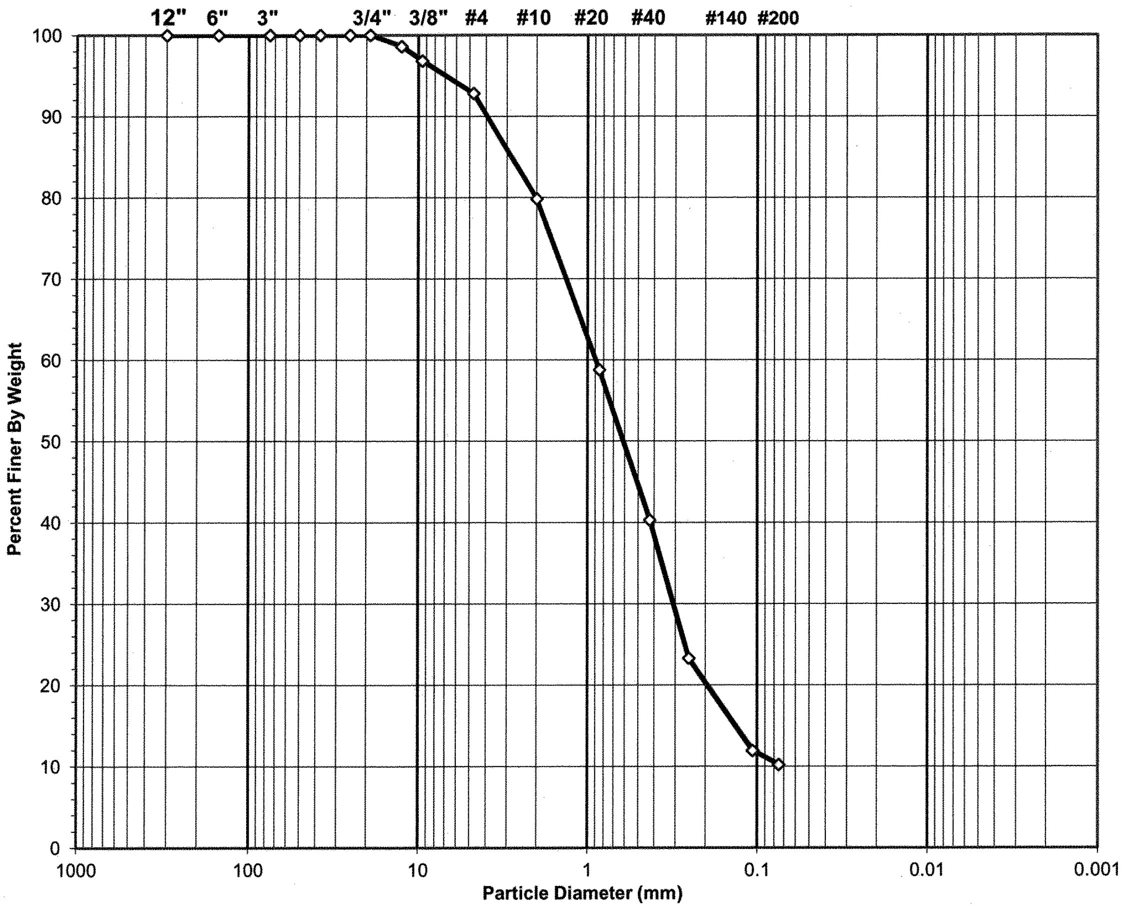
ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH13-V-02

SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-2
Client Reference	WHIP	Depth (ft)	40.0-46.0
Project No.	2013-677-01	Sample No.	1
Lab ID	2013-677-01-03	Soil Color	**GRAY**

USCS	*SIEVE ANALYSIS*		*HYDROMETER*
	gravel	sand	silt and clay



USCS Symbol ***sp-sm, ASSUMED***

USCS Classification POORLY GRADED SAND WITH SILT

Tested By AG Date 6/17/13 Checked By GEm Date 6-18-13

geotechnics
INTEGRITY IN TESTING

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-2
Client Reference	WHIP	Depth (ft)	40.0-46.0
Project No.	2013-677-01	Sample No.	1
Lab ID	2013-677-01-03	Soil Color	**GRAY**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	156	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	656.32	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	558.49	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	238.79	Weight of Tare (gm)	NA
Weight of Water (gm)	97.83	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	319.70	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**30.6**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	319.70
Dry Weight - 3/4" Sample (gm)	287.0	Weight of minus #200 material (gm)	32.67
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	287.03
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

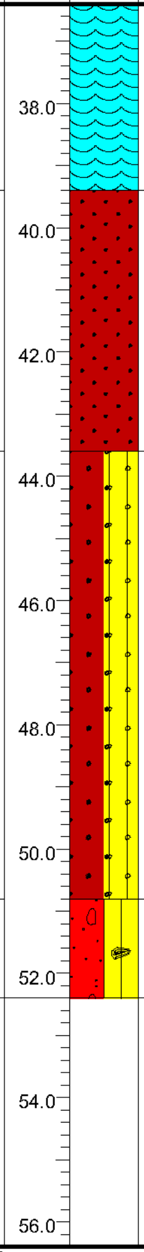
Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	4.41	1.4	1.4	98.6	**98.6**
3/8"	9.50	5.69	1.8	3.2	96.8	**96.8**
#4	4.75	12.83	4.0	7.2	92.8	**92.8**
#10	2.00	41.48	13.0	20.1	79.9	**79.9**
#20	0.850	67.28	21.0	41.2	58.8	**58.8**
#40	0.425	59.16	18.5	59.7	40.3	**40.3**
#60	0.250	54.36	17.0	76.7	23.3	**23.3**
#140	0.106	36.27	11.3	88.0	12.0	**12.0**
#200	0.075	5.55	1.7	89.8	10.2	**10.2**
Pan	-	32.67	10.2	100.0	-	-

Tested By AG Date 6/17/13 Checked By Gem Date 6-18-13

Hole No.: **WH13-V-03**

Vibratory Drilling Log	DIVISION SAD	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 1 SHEETS

1. PROJECT **WILMINGTON HARBOR**
2. LOCATION N 60,737.0 E 2,297,624.0
3. DRILLING AGENCY WILMINGTON DISTRICT
4. HOLE NO.(As shown on drawing title and file number) WH13-V-03
5. NAME OF DRILLER Lester Gavghf
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL
7. THICKNESS OF WATER COLUMN 39.4'
8. DEPTH DRILLED INTO ROCK 0.0'
9. TOTAL DEPTH OF HOLE 52.4'
10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN : DISTURBED 3 : UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER N/A
16. DATE HOLE : STARTED 2/18/13 COMPLETED 2/18/13
17. ELEVATION TOP OF HOLE 0.0
18. TOTAL CORE RECOVERY FOR BORING N/A
19. SIGNATURE OF INSPECTOR ,



ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-39.4			0.0' TO 39.4' WATER OCEAN BOTTOM @39.4'		39.4	Time begin vibracoring: 0000 hrs. Soils Field Classified by Zachry Nichols, Civil Engineer NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.
-43.6			**SP**, Gray, poorly graded sand, some shell fragments.		1 43.6	
-50.8			**SP-SM**, poorly graded sand, with silt.		2 50.8	
-52.4			**GW-GM**, well graded gravel, with silt.		3 52.4	
			BOTTOM OF HOLE AT 52.4' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			

VIBRACORE BORING
From 0.0' to '
Ran ' Rec: '

Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.

LAB CLASSIFICATION

Jar Number	Classification
1	SW-SM
2	SM
3	SP-SM

Soils are Lab Classified in Accordance with ASTM-D2487

Terminated hole upon refusal depth of 52.4' below ocean bottom

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH13-V-03

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-3
Client Reference	WHIP	Depth (ft)	39.4-43.6
Project No.	2013-677-01	Sample No.	1
Lab ID	2013-677-01-04	Soil Color	**GRAY**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	158	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	710.22	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	581.23	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	238.43	Weight of Tare (gm)	NA
Weight of Water (gm)	128.99	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	342.80	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**37.6**	**Moisture Content (%)**	**NA**

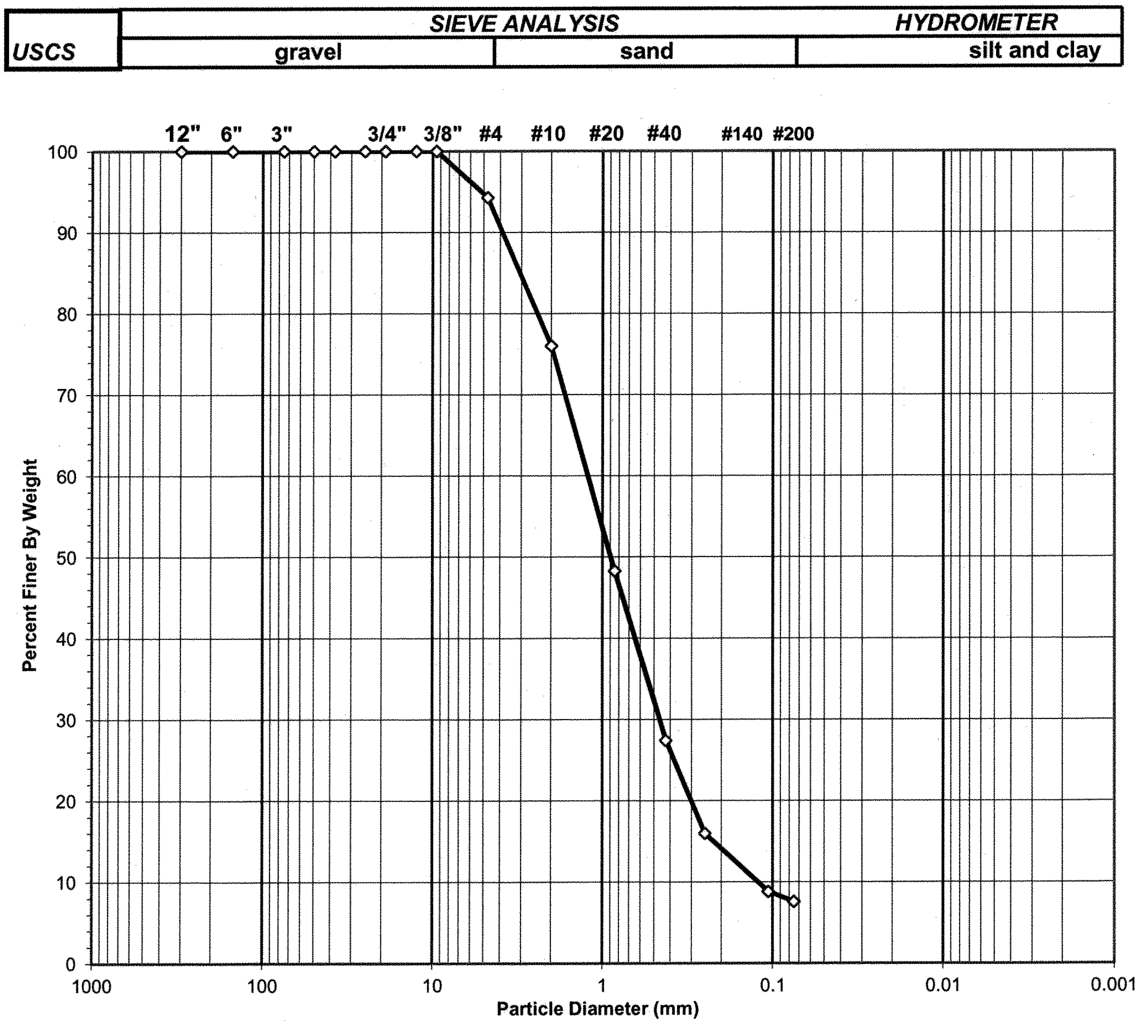
Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	342.80
Dry Weight - 3/4" Sample (gm)	316.8	Weight of minus #200 material (gm)	26.03
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	316.77
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	19.51	5.7	5.7	94.3	**94.3**
#10	2.00	62.61	18.3	24.0	76.0	**76.0**
#20	0.850	95.13	27.8	51.7	48.3	**48.3**
#40	0.425	71.50	20.9	72.6	27.4	**27.4**
#60	0.250	39.22	11.4	84.0	16.0	**16.0**
#140	0.106	24.57	7.2	91.2	8.8	**8.8**
#200	0.075	4.23	1.2	92.4	7.6	**7.6**
Pan	-	26.03	7.6	100.0	-	-

Tested By AG Date 6/18/13 Checked By GEM Date 6-18-13

SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-3
Client Reference	WHIP	Depth (ft)	39.4-43.6
Project No.	2013-677-01	Sample No.	1
Lab ID	2013-677-01-04	Soil Color	**GRAY**



USCS Symbol	***sw-sm, ASSUMED***	**D60 =**	**1.2**	**CC =**	**1.4**
USCS Classification	***WELL-GRADED SAND WITH SILT***	**D30 =**	**0.5**	**CU =**	**10.0**
		D10 =	**0.1**		

Tested By AG Date 6/18/13 Checked By GEm Date 6-18-13

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INTEGRITY IN TESTING

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-3
Client Reference	WHIP	Depth (ft)	50.8-52.4
Project No.	2013-677-01	Sample No.	3
Lab ID	2013-677-01-06	Soil Color	**GRAY**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	161	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	715.08	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	641.83	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	237.92	Weight of Tare (gm)	NA
Weight of Water (gm)	73.25	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	403.91	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**18.1**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	403.91
Dry Weight - 3/4" Sample (gm)	359.8	Weight of minus #200 material (gm)	44.12
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	359.79
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	5.48	1.4	1.4	98.6	**98.6**
3/8"	9.50	12.39	3.1	4.4	95.6	**95.6**
#4	4.75	73.85	18.3	22.7	77.3	**77.3**
#10	2.00	111.84	27.7	50.4	49.6	**49.6**
#20	0.850	51.82	12.8	63.2	36.8	**36.8**
#40	0.425	35.46	8.8	72.0	28.0	**28.0**
#60	0.250	31.30	7.7	79.8	20.2	**20.2**
#140	0.106	31.29	7.7	87.5	12.5	**12.5**
#200	0.075	6.36	1.6	89.1	10.9	**10.9**
Pan	-	44.12	10.9	100.0	-	-

Tested By AG Date 6/18/13 Checked By GBm Date 6-18-13

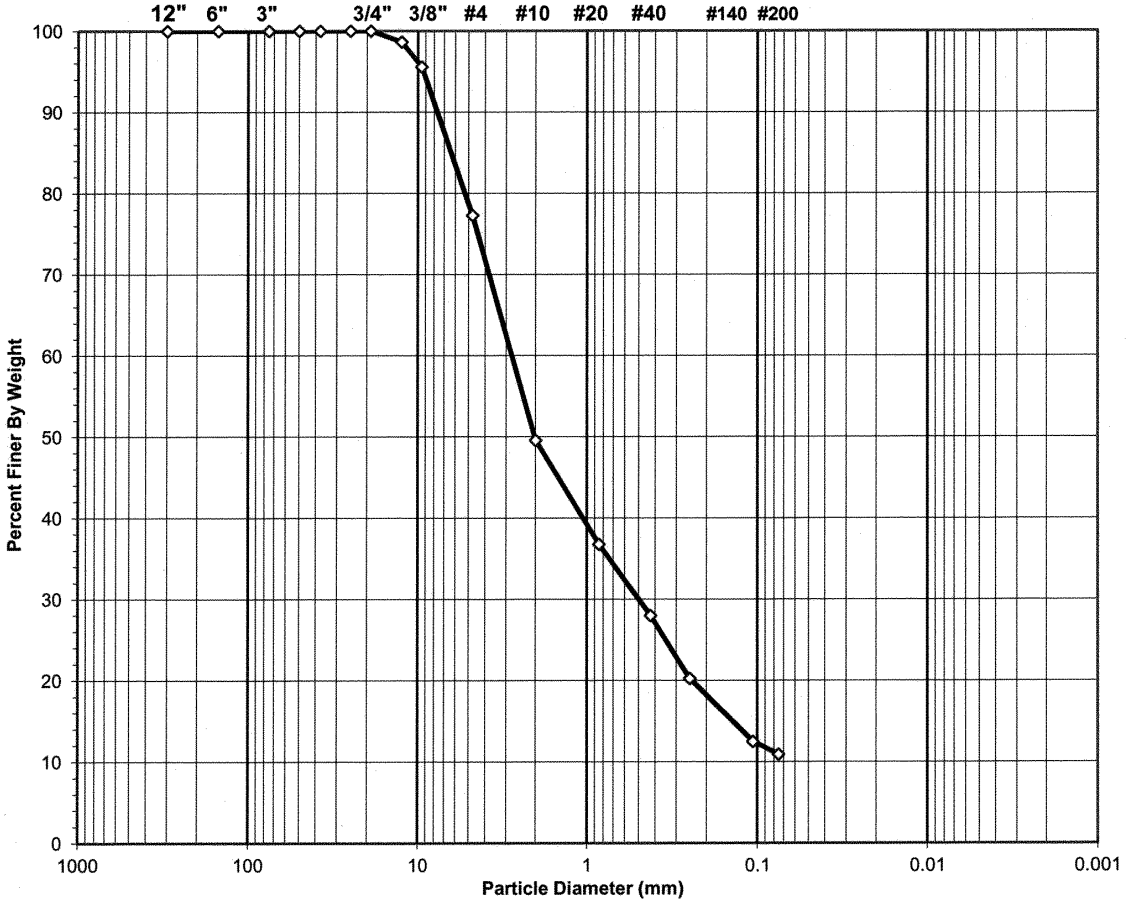
geotechnics
INTEGRITY IN TESTING

SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-3
Client Reference	WHIP	Depth (ft)	50.8-52.4
Project No.	2013-677-01	Sample No.	3
Lab ID	2013-677-01-06	Soil Color	**GRAY**

	SIEVE ANALYSIS		*HYDROMETER*
USCS	gravel	sand	silt and clay



USCS Symbol ***sp-sm, ASSUMED***

USCS Classification POORLY GRADED SAND WITH SILT AND GRAVEL

Tested By AG Date 6/18/13 Checked By GBM Date 6-18-13

page 1 of 2 **DCN: CT-S3C DATE 6-25-98 REVISION: 2** *Z:\2013 PROJECTS\2013-677 USACE whip\[2013-677-01-06 SIEVON REV 4 wHeader.xls]Sheet1*

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INTEGRITY IN TESTING

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-3
Client Reference	WHIP	Depth (ft)	43.6-50.8
Project No.	2013-677-01	Sample No.	2
Lab ID	2013-677-01-05	Soil Color	**GRAY**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	154	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	737.65	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	642.73	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	237.52	Weight of Tare (gm)	NA
Weight of Water (gm)	94.92	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	405.21	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**23.4**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	405.21
Dry Weight - 3/4" Sample (gm)	333.5	Weight of minus #200 material (gm)	71.76
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	333.45
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	3.54	0.9	0.9	99.1	**99.1**
#10	2.00	25.37	6.3	7.1	92.9	**92.9**
#20	0.850	76.89	19.0	26.1	73.9	**73.9**
#40	0.425	80.15	19.8	45.9	54.1	**54.1**
#60	0.250	72.59	17.9	63.8	36.2	**36.2**
#140	0.106	64.61	15.9	79.7	20.3	**20.3**
#200	0.075	10.30	2.5	82.3	17.7	**17.7**
Pan	-	71.76	17.7	100.0	-	**-**

Tested By AG Date 6/18/13 Checked By Gem Date 6-18-13

geotechnics
INTEGRITY IN TESTING

SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-3
Client Reference	WHIP	Depth (ft)	43.6-50.8
Project No.	2013-677-01	Sample No.	2
Lab ID	2013-677-01-05	Soil Color	**GRAY**

USCS Symbol ***sm, ASSUMED***

USCS Classification SILTY SAND

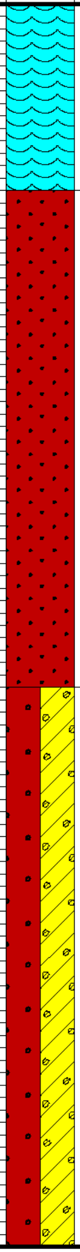
Tested By AG Date 6/18/13 Checked By GEM Date 6-18-13

page 1 of 2 **DCN: CT-S3C DATE 6-25-98 REVISION: 2** *Z:\2013 PROJECTS\2013-677 USACE whip\[2013-677-01-05 SIEVON REV 4 wHeader.xls]Sheet1*

Hole No.: **WH13-V-04**

Vibratory Drilling Log
DIVISION SAD
INSTALLATION WILMINGTON DISTRICT
SHEET 1 OF 2 SHEETS

1. PROJECT **WILMINGTON HARBOR**
2. LOCATION N 59,964.0 E 2,296,771.0
3. DRILLING AGENCY WILMINGTON DISTRICT
4. HOLE NO. (As shown on drawing title and file number) WH13-V-04
5. NAME OF DRILLER Lester Gavghf
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL
7. THICKNESS OF WATER COLUMN 26.4'
8. DEPTH DRILLED INTO ROCK 0.0'
9. TOTAL DEPTH OF HOLE 44.7'
10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 2 UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER N/A
16. DATE HOLE STARTED 2/18/13 COMPLETED 2/18/13
17. ELEVATION TOP OF HOLE 0.0
18. TOTAL CORE RECOVERY FOR BORING N/A
19. SIGNATURE OF INSPECTOR ,

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	24.0 26.0		0.0' TO 26.4' WATER OCEAN BOTTOM @26.4'			Time begin vibracoring: 0000 hrs. Soils Field Classified by Zachry Nichols, Civil Engineer NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.
-26.4	28.0 30.0 32.0 34.0		**SP**, Grayish tan poorly graded fine sand.		-26.4 1	VIBRACORE BORING From 0.0' to ' Ran ' Rec: ' Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.
-34.4	36.0 38.0 40.0 42.0		**SP-SC**, poorly graded fine sand, with clay.		-34.4 2	LAB CLASSIFICATION Jar Number / Classification 1 SM 2 ML Soils are Lab Classified in Accordance with ASTM-D2487 Terminated hole upon refusal depth of 44.7' below ocean bottom

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH13-V-04

Drilling Log (Cont Sheet)	ELEVATION TOP OF HOLE 0.0 MLLW	Hole No.: **WH13-V-04**
PROJECT **WILMINGTON HARBOR**	INSTALLATION WILMINGTON DISTRICT	SHEET 2 OF 2 SHEETS

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-44.7	44.0	🟥▨	**SP-SC**, poorly graded fine sand, with clay. *(continued from previous page)*		2 44.7	
	46.0 48.0 50.0 52.0 54.0 56.0 58.0 60.0 62.0 64.0 66.0		BOTTOM OF HOLE AT 44.7' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE MAR 71	PROJECT WILMINGTON HARBOR	HOLE NO. WH13-V-04

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-4
Client Reference	WHIP	Depth (ft)	34.4-44.7
Project No.	2013-677-01	Sample No.	2
Lab ID	2013-677-01-08	Soil Color	**GRAY**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	842	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	695.91	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	549.80	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	255.81	Weight of Tare (gm)	NA
Weight of Water (gm)	146.11	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	293.99	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**49.7**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	293.99
Dry Weight - 3/4" Sample (gm)	119.8	Weight of minus #200 material (gm)	174.16
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	119.83
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.30	0.1	0.1	99.9	**99.9**
#10	2.00	5.20	1.8	1.9	98.1	**98.1**
#20	0.850	10.55	3.6	5.5	94.5	**94.5**
#40	0.425	11.07	3.8	9.2	90.8	**90.8**
#60	0.250	16.21	5.5	14.7	85.3	**85.3**
#140	0.106	48.30	16.4	31.2	68.8	**68.8**
#200	0.075	28.20	9.6	40.8	59.2	**59.2**
Pan	-	174.16	59.2	100.0	-	-

Tested By AG Date 6/17/13 Checked By GEM Date 6-18-13

SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-4
Client Reference	WHIP	Depth (ft)	34.4-44.7
Project No.	2013-677-01	Sample No.	2
Lab ID	2013-677-01-08	Soil Color	**GRAY**

	SIEVE ANALYSIS		*HYDROMETER*
USCS	gravel	sand	silt and clay

USCS Symbol ***ml, ASSUMED***

USCS Classification SANDY SILT

Tested By AG Date 6/17/13 Checked By GBM Date 6-18-13

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-4
Client Reference	WHIP	Depth (ft)	26.4-34.4
Project No.	2013-677-01	Sample No.	1
Lab ID	2013-677-01-07	Soil Color	**GRAY**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	153	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	646.55	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	546.43	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	240.46	Weight of Tare (gm)	NA
Weight of Water (gm)	100.12	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	305.97	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**32.7**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	305.97
Dry Weight - 3/4" Sample (gm)	256.0	Weight of minus #200 material (gm)	50.01
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	255.96
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.00	0.0	0.0	100.0	**100.0**
#10	2.00	1.11	0.4	0.4	99.6	**99.6**
#20	0.850	4.73	1.5	1.9	98.1	**98.1**
#40	0.425	10.99	3.6	5.5	94.5	**94.5**
#60	0.250	19.46	6.4	11.9	88.1	**88.1**
#140	0.106	188.33	61.6	73.4	26.6	**26.6**
#200	0.075	31.34	10.2	83.7	16.3	**16.3**
Pan	-	50.01	16.3	100.0	-	-

Tested By AG Date 6/17/13 Checked By GEM Date 6-18-13

geotechnics
INTEGRITY IN TESTING

SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-4
Client Reference	WHIP	Depth (ft)	26.4-34.4
Project No.	2013-677-01	Sample No.	1
Lab ID	2013-677-01-07	Soil Color	**GRAY**

USCS Symbol ***sm, ASSUMED***

USCS Classification SILTY SAND

Tested By AG Date 6/17/13 Checked By Date 6-18-13

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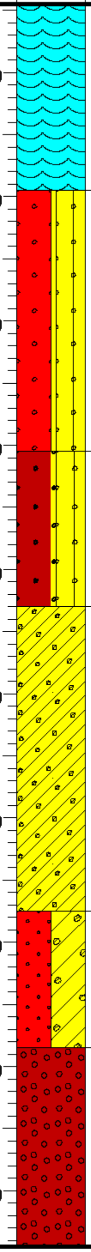
Hole No.: **WH13-V-05**

Vibratory Drilling Log	DIVISION SAD	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT **WILMINGTON HARBOR**		10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE	
2. LOCATION N 58,838.0 E 2,296,549.0		11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW	
3. DRILLING AGENCY WILMINGTON DISTRICT		12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell	
4. HOLE NO. (As shown on drawing title and file number) WH13-V-05		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 5 / UNDISTURBED 0
5. NAME OF DRILLER Lester Gavghf		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL		15. ELEVATION GROUND WATER N/A	
7. THICKNESS OF WATER COLUMN 17.9'		16. DATE HOLE	STARTED 2/18/13 / COMPLETED 2/18/13
8. DEPTH DRILLED INTO ROCK 0.0'		17. ELEVATION TOP OF HOLE 0.0	
9. TOTAL DEPTH OF HOLE 35.3'		18. TOTAL CORE RECOVERY FOR BORING N/A	
		19. SIGNATURE OF INSPECTOR	



ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	16.0		0.0' TO 17.9' WATER OCEAN BOTTOM @17.9'			Time begin vibracoring: 0000 hrs. Soils Field Classified by Zachry Nichols, Civil Engineer NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.
-17.9	18.0 20.0		**SW-SM**, Dark gray, well graded sand, with silt, trace shell fragments.		17.9 1	
-22.1	22.0 24.0		**SP-SM**, Light tan, poorly graded sand, with silt.		22.1 2	VIBRACORE BORING From 0.0' to ' Ran ' Rec: ' Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.
-24.6	26.0 28.0		**SC**, Dark gray, clayey sand.		24.6 3	LAB CLASSIFICATION Jar Number / Classification 1 SM 2 SM 3 ML 4 ML 5 SP-SM
-29.5	30.0		**SW-SC**, well graded sand, with clay, little shell fragments.		29.5 4 31.2	Soils are Lab Classified in Accordance with ASTM-D2487
-31.7	32.0 34.0		**SW**, well graded sand, few shell fragments.		5	Terminated hole upon refusal depth of 35.3' below ocean bottom

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH13-V-05

Drilling Log (Cont Sheet)	ELEVATION TOP OF HOLE 0.0 MLLW			Hole No.: **WH13-V-05**
PROJECT **WILMINGTON HARBOR**		INSTALLATION WILMINGTON DISTRICT		SHEET 2 OF 2 SHEETS

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		▨			5 35.3	
-35.3	36.0 38.0 40.0 42.0 44.0 46.0 48.0 50.0 52.0 54.0 56.0 58.0		BOTTOM OF HOLE AT 35.3' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71

PROJECT
WILMINGTON HARBOR

HOLE NO.
WH13-V-05

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INTEGRITY IN TESTING

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-5
Client Reference	WHIP	Depth (ft)	22.1-24.6
Project No.	2013-677-01	Sample No.	2
Lab ID	2013-677-01-10	Soil Color	**GRAY**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	830	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	737.49	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	626.42	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	258.32	Weight of Tare (gm)	NA
Weight of Water (gm)	111.07	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	368.10	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**30.2**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	368.10
Dry Weight - 3/4" Sample (gm)	301.8	Weight of minus #200 material (gm)	66.28
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	301.82
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.00	0.0	0.0	100.0	**100.0**
#10	2.00	0.87	0.2	0.2	99.8	**99.8**
#20	0.850	2.21	0.6	0.8	99.2	**99.2**
#40	0.425	2.75	0.7	1.6	98.4	**98.4**
#60	0.250	53.77	14.6	16.2	83.8	**83.8**
#140	0.106	193.82	52.7	68.8	31.2	**31.2**
#200	0.075	48.40	13.1	82.0	18.0	**18.0**
Pan	-	66.28	18.0	100.0	-	-

Tested By AG Date 6/17/13 Checked By GBM Date 6-18-13

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INTEGRITY IN TESTING

SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-5
Client Reference	WHIP	Depth (ft)	22.1-24.6
Project No.	2013-677-01	Sample No.	2
Lab ID	2013-677-01-10	Soil Color	**GRAY**

USCS Symbol ***sm, ASSUMED***

USCS Classification SILTY SAND

Tested By AG Date 6/17/13 Checked By GEM Date 6-18-13

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INTEGRITY IN TESTING

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-5
Client Reference	WHIP	Depth (ft)	17.9-22.1
Project No.	2013-677-01	Sample No.	1
Lab ID	2013-677-01-09	Soil Color	**GRAY**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	832	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	761.96	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	578.39	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	258.98	Weight of Tare (gm)	NA
Weight of Water (gm)	183.57	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	319.41	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**57.5**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	319.41
Dry Weight - 3/4" Sample (gm)	265.4	Weight of minus #200 material (gm)	53.98
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	265.43
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	2.29	0.7	0.7	99.3	**99.3**
#4	4.75	1.65	0.5	1.2	98.8	**98.8**
#10	2.00	9.12	2.9	4.1	95.9	**95.9**
#20	0.850	13.28	4.2	8.2	91.8	**91.8**
#40	0.425	30.64	9.6	17.8	82.2	**82.2**
#60	0.250	84.29	26.4	44.2	55.8	**55.8**
#140	0.106	115.33	36.1	80.3	19.7	**19.7**
#200	0.075	8.83	2.8	83.1	16.9	**16.9**
Pan	-	53.98	16.9	100.0	-	-

Tested By AG Date 6/17/13 Checked By GBM Date 6-18-13

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INTEGRITY IN TESTING

SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-5
Client Reference	WHIP	Depth (ft)	17.9-22.1
Project No.	2013-677-01	Sample No.	1
Lab ID	2013-677-01-09	Soil Color	**GRAY**

USCS Symbol ***sm, ASSUMED***

USCS Classification SILTY SAND

Tested By AG Date 6/17/13 Checked By GAM Date 6-18-13

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INTEGRITY IN TESTING

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-5
Client Reference	WHIP	Depth (ft)	31.2-35.3
Project No.	2013-677-01	Sample No.	5
Lab ID	2013-677-01-13	Soil Color	**LIGHT GRAY**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	839	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	749.55	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	620.15	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	257.76	Weight of Tare (gm)	NA
Weight of Water (gm)	129.40	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	362.39	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**35.7**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	362.39
Dry Weight - 3/4" Sample (gm)	337.0	Weight of minus #200 material (gm)	25.37
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	337.02
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	5.22	1.4	1.4	98.6	**98.6**
#10	2.00	20.44	5.6	7.1	92.9	**92.9**
#20	0.850	55.55	15.3	22.4	77.6	**77.6**
#40	0.425	80.98	22.3	44.8	55.2	**55.2**
#60	0.250	91.25	25.2	69.9	30.1	**30.1**
#140	0.106	77.61	21.4	91.4	8.6	**8.6**
#200	0.075	5.97	1.6	93.0	7.0	**7.0**
Pan	-	25.37	7.0	100.0	-	**-**

Tested By AG Date 6/17/13 Checked By Gem Date 6-18-13

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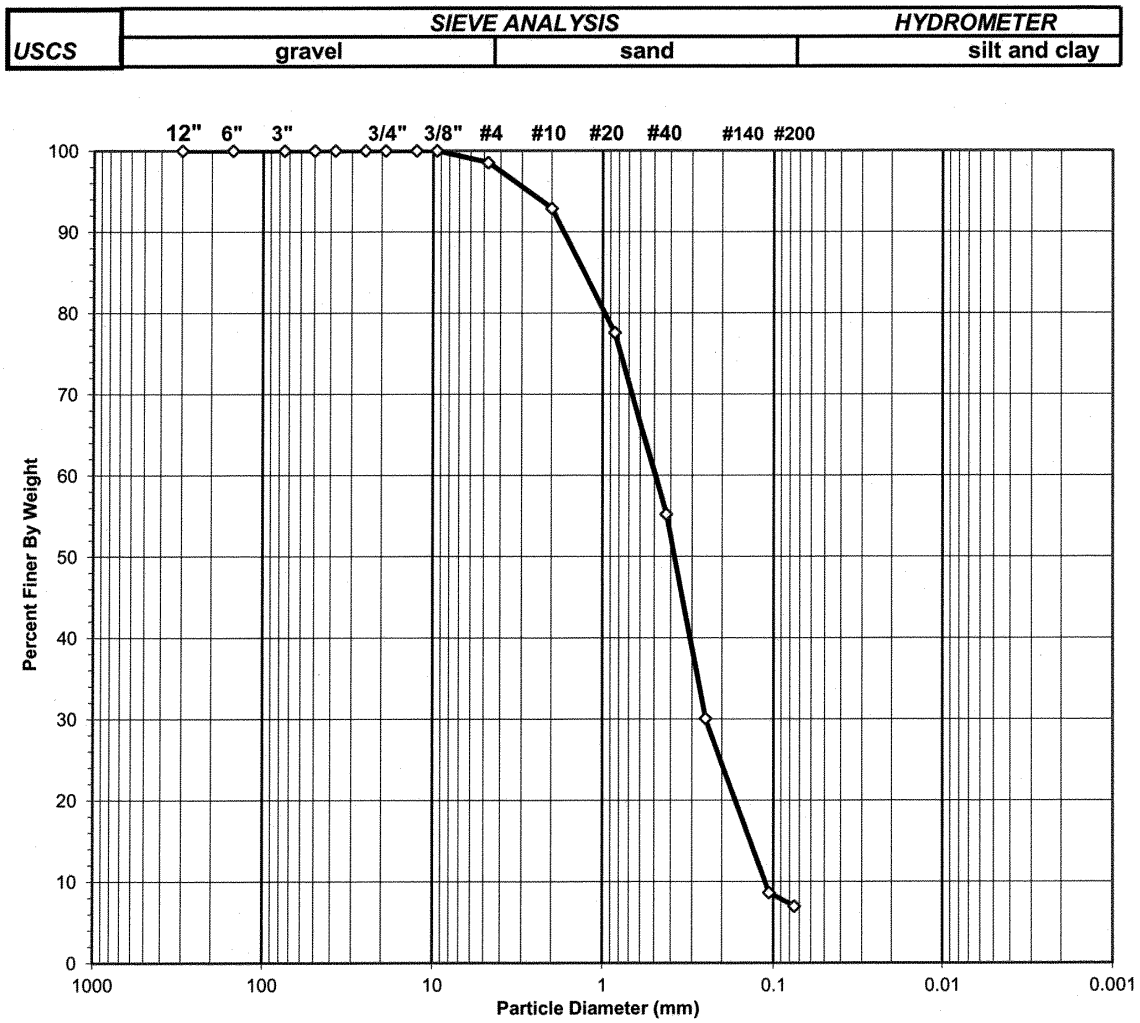
INTEGRITY IN TESTING

SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-5
Client Reference	WHIP	Depth (ft)	31.2-35.3
Project No.	2013-677-01	Sample No.	5
Lab ID	2013-677-01-13	Soil Color	**LIGHT GRAY**



USCS Symbol ***sp-sm, ASSUMED*** **D60 = 0.5** **CC = 1.1**

USCS Classification POORLY GRADED SAND WITH SILT **D30 = 0.2** **CU = 4.4**

D10 = 0.1

Tested By AG Date 6/17/13 Checked By GEm Date 6-18-13

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INTEGRITY IN TESTING

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-5
Client Reference	WHIP	Depth (ft)	29.5-31.2
Project No.	2013-677-01	Sample No.	4
Lab ID	2013-677-01-12	Soil Color	**GRAY**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	833	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	796.71	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	606.76	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	259.30	Weight of Tare (gm)	NA
Weight of Water (gm)	189.95	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	347.46	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**54.7**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	347.46
Dry Weight - 3/4" Sample (gm)	169.3	Weight of minus #200 material (gm)	178.14
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	169.32
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	1.55	0.4	0.4	99.6	**99.6**
#10	2.00	16.22	4.7	5.1	94.9	**94.9**
#20	0.850	40.54	11.7	16.8	83.2	**83.2**
#40	0.425	41.48	11.9	28.7	71.3	**71.3**
#60	0.250	35.76	10.3	39.0	61.0	**61.0**
#140	0.106	28.15	8.1	47.1	52.9	**52.9**
#200	0.075	5.62	1.6	48.7	51.3	**51.3**
Pan	-	178.14	51.3	100.0	-	-

Tested By AG Date 6/17/13 Checked By GEM Date 6-18-13

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INTEGRITY IN TESTING

SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-5
Client Reference	WHIP	Depth (ft)	29.5-31.2
Project No.	2013-677-01	Sample No.	4
Lab ID	2013-677-01-12	Soil Color	**GRAY**

USCS Symbol ***ml, ASSUMED***

USCS Classification SANDY SILT

Tested By AG Date 6/17/13 Checked By GEM Date 6-18-13

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INTEGRITY IN TESTING

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-5
Client Reference	WHIP	Depth (ft)	24.6-29.5
Project No.	2013-677-01	Sample No.	3
Lab ID	2013-677-01-11	Soil Color	**GRAY**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	831	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	703.32	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	558.73	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	262.41	Weight of Tare (gm)	NA
Weight of Water (gm)	144.59	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	296.32	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**48.8**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	296.32
Dry Weight - 3/4" Sample (gm)	101.7	Weight of minus #200 material (gm)	194.64
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	101.68
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.17	0.1	0.1	99.9	**99.9**
#10	2.00	5.60	1.9	1.9	98.1	**98.1**
#20	0.850	8.63	2.9	4.9	95.1	**95.1**
#40	0.425	7.37	2.5	7.3	92.7	**92.7**
#60	0.250	12.06	4.1	11.4	88.6	**88.6**
#140	0.106	42.82	14.5	25.9	74.1	**74.1**
#200	0.075	25.03	8.4	34.3	65.7	**65.7**
Pan	-	194.64	65.7	100.0	-	**-**

Tested By AG Date 6/17/13 Checked By GEM Date 6-18-13

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INTEGRITY IN TESTING

SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-5
Client Reference	WHIP	Depth (ft)	24.6-29.5
Project No.	2013-677-01	Sample No.	3
Lab ID	2013-677-01-11	Soil Color	**GRAY**

USCS Symbol ***ml, ASSUMED***

USCS Classification SANDY SILT

Tested By AG Date 6/17/13 Checked By Date 6-18-13

page 1 of 2 **DCN: CT-S3C DATE 6-25-98 REVISION: 2** *Z:\2013 PROJECTS\2013-677 USACE whip\[2013-677-01-11 SIEVON REV 4 wHeader.xls]Sheet1*

Hole No.: **WH13-V-06**

Vibratory Drilling Log
DIVISION SAD
INSTALLATION WILMINGTON DISTRICT
SHEET 1 OF 2 SHEETS

1. PROJECT **WILMINGTON HARBOR**
2. LOCATION N 57,968.0 E 2,296,750.0
3. DRILLING AGENCY WILMINGTON DISTRICT
4. HOLE NO.(As shown on drawing title and file number) WH13-V-06
5. NAME OF DRILLER Lester Gavghf
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL
7. THICKNESS OF WATER COLUMN 17.9'
8. DEPTH DRILLED INTO ROCK 0.0'
9. TOTAL DEPTH OF HOLE 34.9'
10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 4 UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER N/A
16. DATE HOLE STARTED 2/18/13 COMPLETED 2/18/13
17. ELEVATION TOP OF HOLE 0.0
18. TOTAL CORE RECOVERY FOR BORING N/A
19. SIGNATURE OF INSPECTOR ,

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	16.0		0.0' TO 17.9' WATER OCEAN BOTTOM @17.9'			Time begin vibracoring: 0000 hrs. Soils Field Classified by Zachry Nichols, Civil Engineer NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.
-17.9	18.0 20.0		**SP**, Tannish gray, fine, poorly graded sand, with, little shell fragments.		17.9 1	
-21.9	22.0 24.0		Trace shell fragments.		21.9 2	VIBRACORE BORING From 0.0' to ' Ran ' Rec: ' Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.
-26.2	26.0 28.0 30.0		**SW**, fine to medium, well graded sand, with, few shell fragments.		26.2 3	LAB CLASSIFICATION Jar Number / Classification 1 SP 2 SP 3 SP 4 SP Soils are Lab Classified in Accordance with ASTM-D2487
-31.4	32.0 34.0		**SP**, Gray, fine, poorly graded sand.		31.4 4	Terminated hole upon refusal depth of 34.9' below ocean bottom

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH13-V-06

Drilling Log (Cont Sheet)
ELEVATION TOP OF HOLE 0.0 MLLW
Hole No.: **WH13-V-06**
PROJECT **WILMINGTON HARBOR**
INSTALLATION WILMINGTON DISTRICT
SHEET 2 OF 2 SHEETS

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	36.0	🟥	**SP**, Gray, fine, poorly graded sand. *(continued from previous page)*		34.9	
-37.9	38.0		BOTTOM OF HOLE AT 34.9' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			
	40.0					
	42.0					
	44.0					
	46.0					
	48.0					
	50.0					
	52.0					
	54.0					
	56.0					
	58.0					

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH13-V-06

geotechnics
INTEGRITY IN TESTING

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-6
Client Reference	WHIP	Depth (ft)	17.9-21.9
Project No.	2013-677-01	Sample No.	1
Lab ID	2013-677-01-14	Soil Color	**DARK TAN**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	837	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	728.45	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	661.37	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	261.02	Weight of Tare (gm)	NA
Weight of Water (gm)	67.08	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	400.35	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**16.8**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	400.35
Dry Weight - 3/4" Sample (gm)	396.5	Weight of minus #200 material (gm)	3.90
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	396.45
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	1.07	0.3	0.3	99.7	**99.7**
3/8"	9.50	6.65	1.7	1.9	98.1	**98.1**
#4	4.75	11.02	2.8	4.7	95.3	**95.3**
#10	2.00	13.39	3.3	8.0	92.0	**92.0**
#20	0.850	28.19	7.0	15.1	84.9	**84.9**
#40	0.425	155.25	38.8	53.8	46.2	**46.2**
#60	0.250	80.12	20.0	73.9	26.1	**26.1**
#140	0.106	98.25	24.5	98.4	1.6	**1.6**
#200	0.075	2.51	0.6	99.0	1.0	**1.0**
Pan	-	3.90	1.0	100.0	-	**-**

Tested By AG Date 6/17/13 Checked By GEM Date 6-18-13

geotechnics
INTEGRITY IN TESTING

SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-6
Client Reference	WHIP	Depth (ft)	17.9-21.9
Project No.	2013-677-01	Sample No.	1
Lab ID	2013-677-01-14	Soil Color	**DARK TAN**

USCS Symbol	***sp, ASSUMED***	**D60 =**	**0.5**	**CC =**	**1.0**
USCS Classification	***POORLY GRADED SAND***	**D30 =**	**0.3**	**CU =**	**3.8**
		D10 =	**0.1**		

Tested By AG Date 6/17/13 Checked By Date 6-18-13

geotechnics
INTEGRITY IN TESTING

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-6
Client Reference	WHIP	Depth (ft)	26.2-31.4
Project No.	2013-677-01	Sample No.	3
Lab ID	2013-677-01-16	Soil Color	**GRAY**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	838	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	776.15	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	709.95	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	261.76	Weight of Tare (gm)	NA
Weight of Water (gm)	66.20	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	448.19	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**14.8**	**Moisture Content (%)**	**NA**

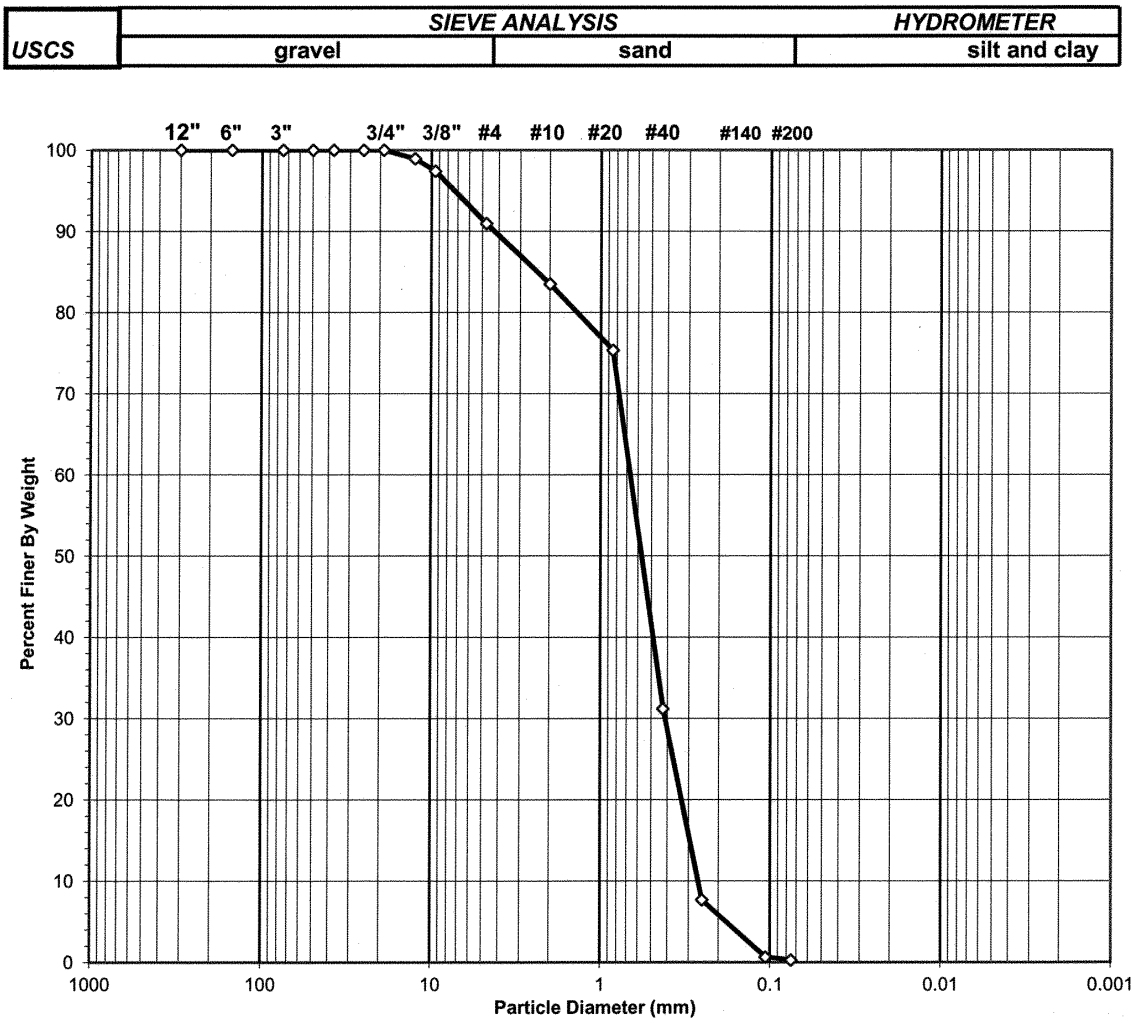
Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	448.19
Dry Weight - 3/4" Sample (gm)	446.8	Weight of minus #200 material (gm)	1.35
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	446.84
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	4.70	1.0	1.0	99.0	**99.0**
3/8"	9.50	6.86	1.5	2.6	97.4	**97.4**
#4	4.75	28.95	6.5	9.0	91.0	**91.0**
#10	2.00	33.29	7.4	16.5	83.5	**83.5**
#20	0.850	36.60	8.2	24.6	75.4	**75.4**
#40	0.425	198.00	44.2	68.8	31.2	**31.2**
#60	0.250	105.35	23.5	92.3	7.7	**7.7**
#140	0.106	31.46	7.0	99.3	0.7	**0.7**
#200	0.075	1.63	0.4	99.7	0.3	**0.3**
Pan	-	1.35	0.3	100.0	-	-

Tested By AG Date 6/17/13 Checked By Date 6-18-13

SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-6
Client Reference	WHIP	Depth (ft)	26.2-31.4
Project No.	2013-677-01	Sample No.	3
Lab ID	2013-677-01-16	Soil Color	**GRAY**



USCS Symbol	***sp, ASSUMED***	**D60 =**	**0.7**	**CC =**	**1.0**
USCS Classification	***POORLY GRADED SAND***	**D30 =**	**0.4**	**CU =**	**2.5**
		D10 =	**0.3**		

Tested By AG Date 6/17/13 Checked By GBM Date 6-18-13

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-6
Client Reference	WHIP	Depth (ft)	31.4-34.9
Project No.	2013-677-01	Sample No.	4
Lab ID	2013-677-01-17	Soil Color	**GRAY**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	208	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	704.80	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	630.40	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	169.54	Weight of Tare (gm)	NA
Weight of Water (gm)	74.40	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	460.86	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**16.1**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	460.86
Dry Weight - 3/4" Sample (gm)	451.2	Weight of minus #200 material (gm)	9.63
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	451.23
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.60	0.1	0.1	99.9	**99.9**
#4	4.75	0.99	0.2	0.3	99.7	**99.7**
#10	2.00	8.28	1.8	2.1	97.9	**97.9**
#20	0.850	42.60	9.2	11.4	88.6	**88.6**
#40	0.425	166.59	36.1	47.5	52.5	**52.5**
#60	0.250	188.64	40.9	88.5	11.5	**11.5**
#140	0.106	42.07	9.1	97.6	2.4	**2.4**
#200	0.075	1.46	0.3	97.9	2.1	**2.1**
Pan	-	9.63	2.1	100.0	-	-

Tested By AG Date 6/17/13 Checked By GEM Date 6-18-13

geotechnics
INTEGRITY IN TESTING

SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-6
Client Reference	WHIP	Depth (ft)	31.4-34.9
Project No.	2013-677-01	Sample No.	4
Lab ID	2013-677-01-17	Soil Color	**GRAY**

USCS Symbol	***sp, ASSUMED***	**D60 =**	**0.6**	**CC =**	**0.8**
USCS Classification	***POORLY GRADED SAND***	**D30 =**	**0.3**	**CU =**	**2.1**
		D10 =	**0.3**		

Tested By AG Date 6/17/13 Checked By Date 6-18-13

geotechnics
INTEGRITY IN TESTING

WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-6
Client Reference	WHIP	Depth (ft)	21.9-26.2
Project No.	2013-677-01	Sample No.	2
Lab ID	2013-677-01-15	Soil Color	**DARK TAN**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	834	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	772.15	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	686.59	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	259.30	Weight of Tare (gm)	NA
Weight of Water (gm)	85.56	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	427.29	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**20.0**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	427.29
Dry Weight - 3/4" Sample (gm)	418.8	Weight of minus #200 material (gm)	8.53
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	418.76
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	1.62	0.4	0.4	99.6	**99.6**
#4	4.75	2.40	0.6	0.9	99.1	**99.1**
#10	2.00	3.68	0.9	1.8	98.2	**98.2**
#20	0.850	7.70	1.8	3.6	96.4	**96.4**
#40	0.425	57.46	13.4	17.1	82.9	**82.9**
#60	0.250	133.33	31.2	48.3	51.7	**51.7**
#140	0.106	210.92	49.4	97.6	2.4	**2.4**
#200	0.075	1.65	0.4	98.0	2.0	**2.0**
Pan	-	8.53	2.0	100.0	-	-

Tested By AG Date 6/17/13 Checked By Gem Date 6-18-13

geotechnics
INTEGRITY IN TESTING

SIEVE ANALYSIS
ASTM D 422-63 (2007)

Client	USACE	Boring No.	WH-13-V-6
Client Reference	WHIP	Depth (ft)	21.9-26.2
Project No.	2013-677-01	Sample No.	2
Lab ID	2013-677-01-15	Soil Color	**DARK TAN**

	SIEVE ANALYSIS		*HYDROMETER*
USCS	gravel	sand	silt and clay

USCS Symbol	*sp, ASSUMED*	D60 =	0.3	CC =	0.8
USCS Classification	*POORLY GRADED SAND*	D30 =	0.2	CU =	2.4
		D10 =	0.1		

Tested By AG Date 6/17/13 Checked By Gem Date 6-18-13

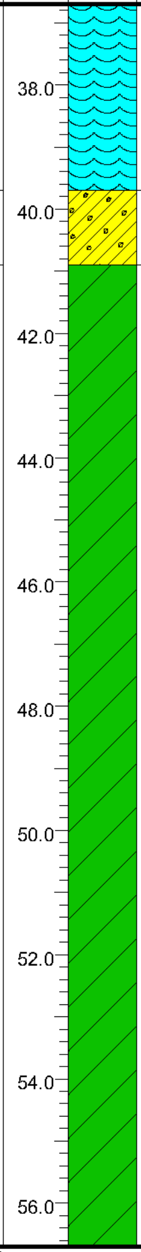
page 1 of 2 DCN: CT-S3C DATE 6-25-98 REVISION: 2 *Z:\2013 PROJECTS\2013-677 USACE whip\[2013-677-01-15 SIEVON REV 4 wHeader.xls]Sheet1*

Attachment D: Boring Logs for Entrance Channel near Bald Head Island

Hole No.: **WH12-V-1**

Vibratory Drilling Log
DIVISION SAD
INSTALLATION WILMINGTON DISTRICT
SHEET 1 OF 2 SHEETS

1. PROJECT **WILMINGTON HARBOR**
2. LOCATION N 43,958.0 E 2,298,254.0
3. DRILLING AGENCY WILMINGTON DISTRICT
4. HOLE NO.(As shown on drawing title and file number) WH12-V-1
5. NAME OF DRILLER Talon Smith
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL
7. THICKNESS OF WATER COLUMN 39.7'
8. DEPTH DRILLED INTO ROCK 0.0'
9. TOTAL DEPTH OF HOLE 59.0'
10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
11. DATUM FOR ELEVATION SHOWN *BM or MSL* MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3 : UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER N/A
16. DATE HOLE: STARTED 7/12/12 COMPLETED 7/12/12
17. ELEVATION TOP OF HOLE 0.0
18. TOTAL CORE RECOVERY FOR BORING N/A
19. SIGNATURE OF INSPECTOR ,



ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f
	0.0–39.7	🟦	0.0' TO 39.7' WATER OCEAN BOTTOM @39.7'		
-39.7	39.7–40.9	🟨	**SC**, Dark gray, clayey sand.		39.7 1 40.9
-40.9	40.9–	🟩	**CL**, Dark gray lean clay, with, trace wood, and organics.		2

REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g

Time begin vibracoring: 0000 hrs.

Soils Field Classified by Zachry Nichols, Civil Engineer

NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.

VIBRACORE BORING
From 0.0' to 19.30'
Ran 20' Rec: 20'

Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.

LAB CLASSIFICATION

Jar Number	Classification
1	SC
2	CL
3	SP-SM

Soils are Lab Classified in Accordance with ASTM-D2487

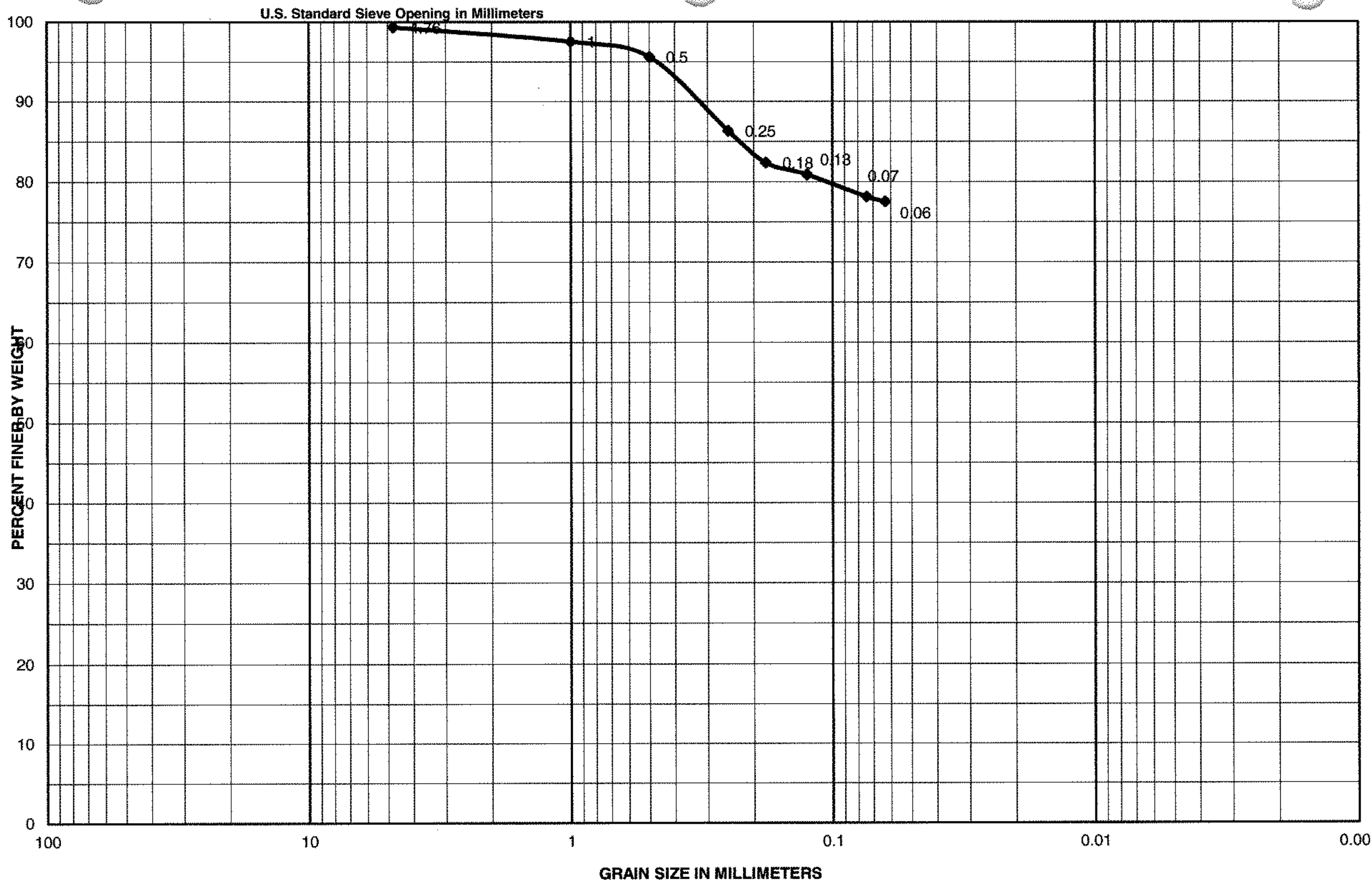
COMPLETION NOTE:
Terminated hole at refusal or predetermined depth at 19.3' below ocean bottom

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-1

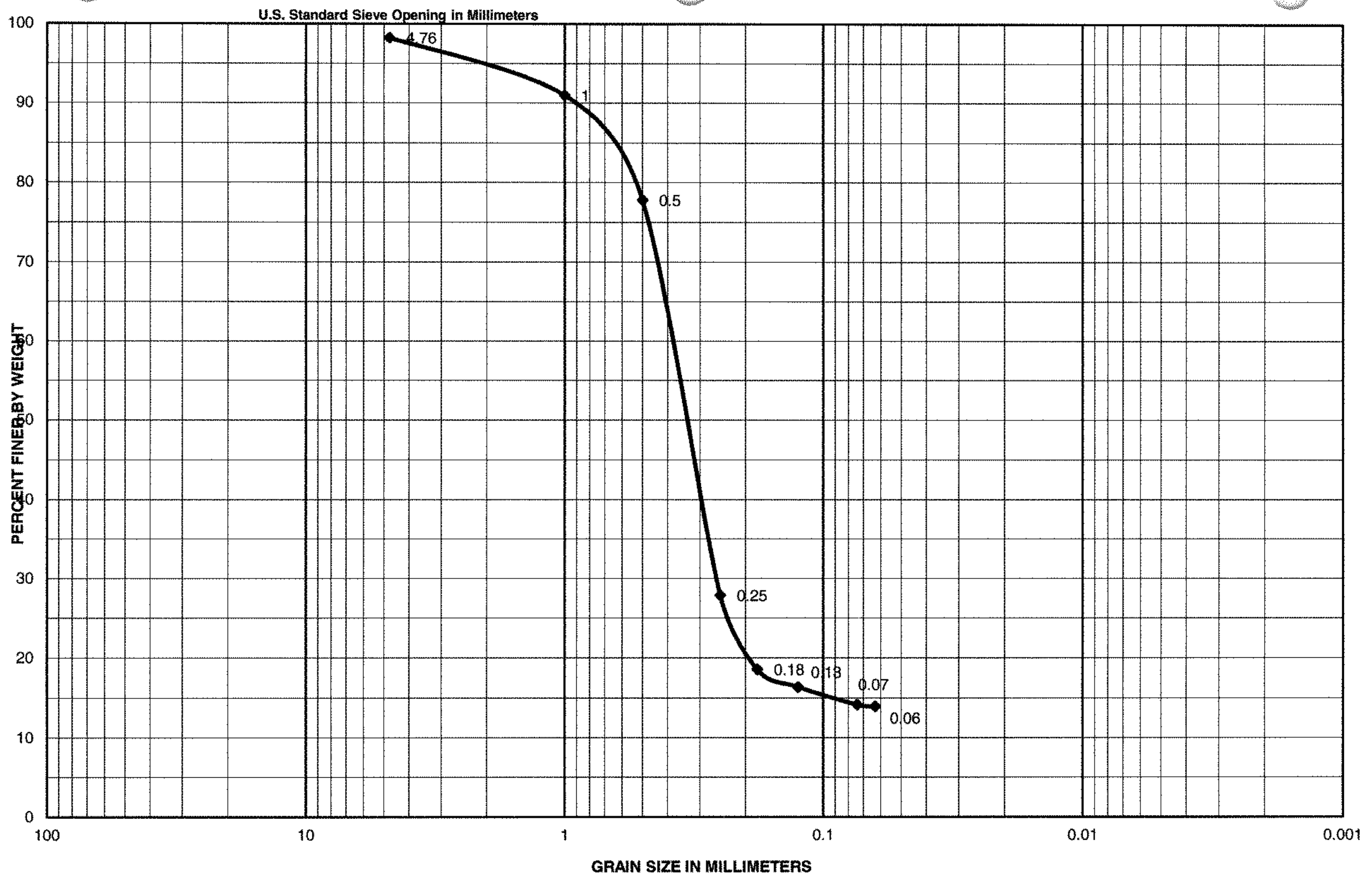
Drilling Log (Cont Sheet)
ELEVATION TOP OF HOLE 0.0 MLLW
Hole No.: **WH12-V-1**
PROJECT **WILMINGTON HARBOR**
INSTALLATION WILMINGTON DISTRICT
SHEET 2 OF 2 SHEETS

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		▨			2	
-57.5					57.5	
	58.0	🟥	**SP**, Tan to grayish brown, poorly graded sand.		3	
-59.0					59	
			BOTTOM OF HOLE AT 59' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			
	60.0					
	62.0					
	64.0					
	66.0					
	68.0					
	70.0					
	72.0					
	74.0					
	76.0					
	78.0					
	80.0					

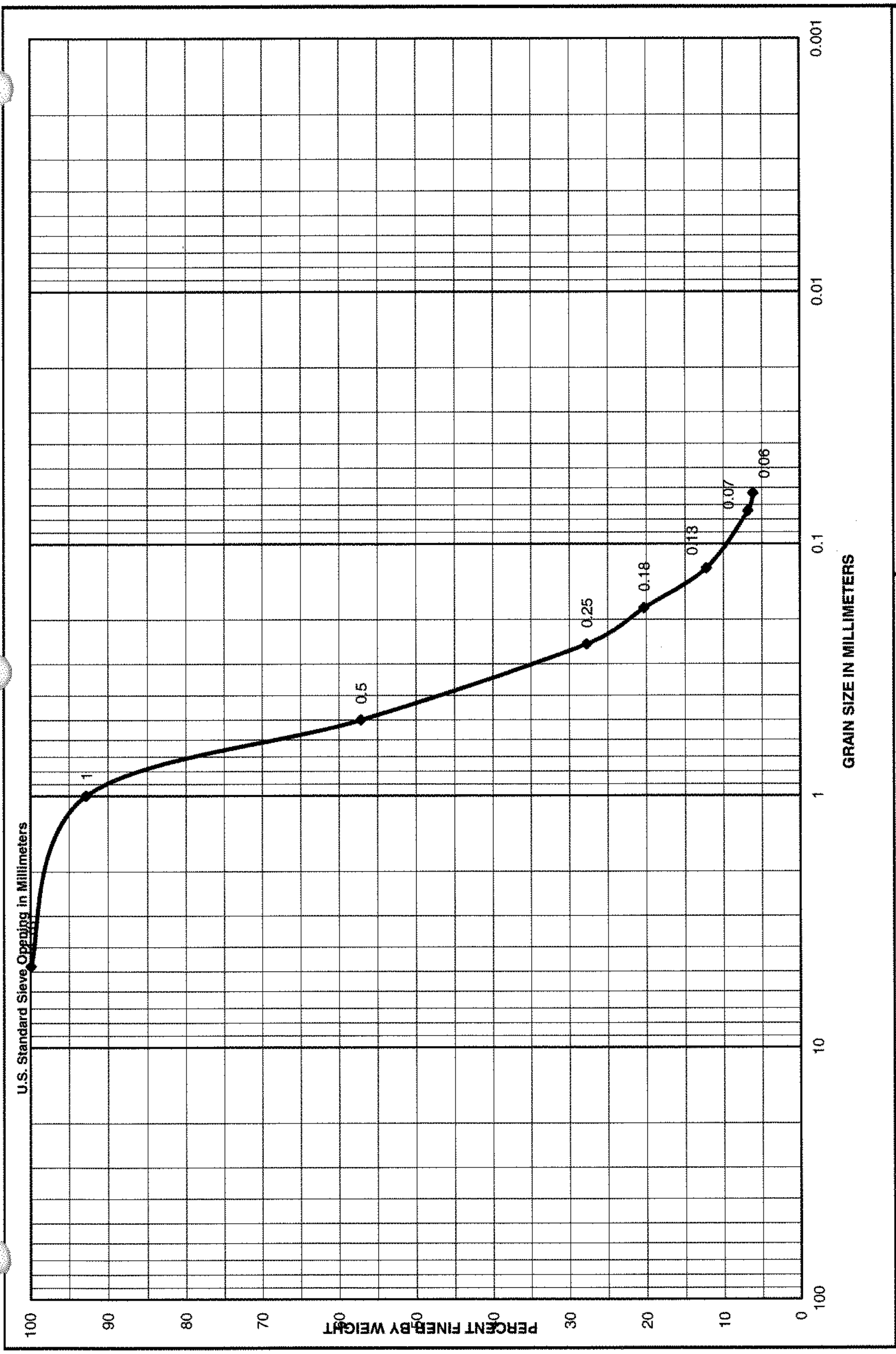
ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-1



Sample No.	Elevation	Classification	**Area**	Wilmington Harbor
2	40.9 to 57.5	Olive/dark lean clay with sand and trace shells/organics, CL	**CATLIN Geotechnical Laboratory**	
		3.5% Shells and Organics	**Boring No.**	WH12-V-1
			Date	10/8/2012



Sample No.	Elevation	Classification	Area	Wilmington Harbor
1	39.7 to 40.9	Dark gray clayey sand with little shells, SC	**CATLIN Geotechnical Laboratory**	
		18.9% Shells	**Boring No.**	WH12-V-1
			Date	10/8/2012

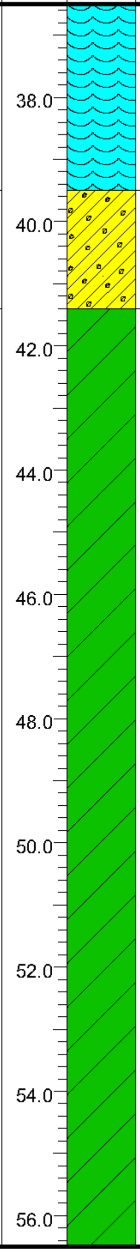


Sample No.	Elevation	Classification	Area	Wilmington Harbor
3	57.5 to 59.0	Light gray poorly graded sand with silt, SP-SM	**CATLIN Geotechnical Laboratory**	
			Boring No.	WH12-V-1
			Date	10/9/2012

Hole No.: **WH12-V-2**

Vibratory Drilling Log	DIVISION SAD
INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT **WILMINGTON HARBOR**	10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
2. LOCATION N 44,248.0 E 2,298,525.0	11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW
3. DRILLING AGENCY WILMINGTON DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
4. HOLE NO. (As shown on drawing title and file number) WH12-V-2	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3; UNDISTURBED 0
5. NAME OF DRILLER Talon Smith	14. TOTAL NUMBER CORE BOXES 0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL	15. ELEVATION GROUND WATER N/A
7. THICKNESS OF WATER COLUMN 39.5'	16. DATE HOLE STARTED 7/12/12 COMPLETED 7/12/12
8. DEPTH DRILLED INTO ROCK 0.0'	17. ELEVATION TOP OF HOLE 0.0
9. TOTAL DEPTH OF HOLE 59.1'	18. TOTAL CORE RECOVERY FOR BORING N/A
	19. SIGNATURE OF INSPECTOR

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			0.0' TO 39.5' WATER OCEAN BOTTOM @39.5'			Time begin vibracoring: 0000 hrs. Soils Field Classified by Zachry Nichols, Civil Engineer NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.
-39.5			**SC**, Dark gray, clayey sand, with, trace shell fragments.		39.5 1	
-41.4			**CL**, Dark gray lean clay, with, trace wood.		41.4 2	



VIBRACORE BORING
From 0.0' to 25.50'
Ran 17.2' Rec: 19.6'

Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.

LAB CLASSIFICATION

Jar Number	Classification
1	SC
2	CL
3	SP

Soils are Lab Classified in Accordance with ASTM-D2487

COMPLETION NOTE: Terminated hole at refusal or predetermined depth at 19.6' below ocean bottom

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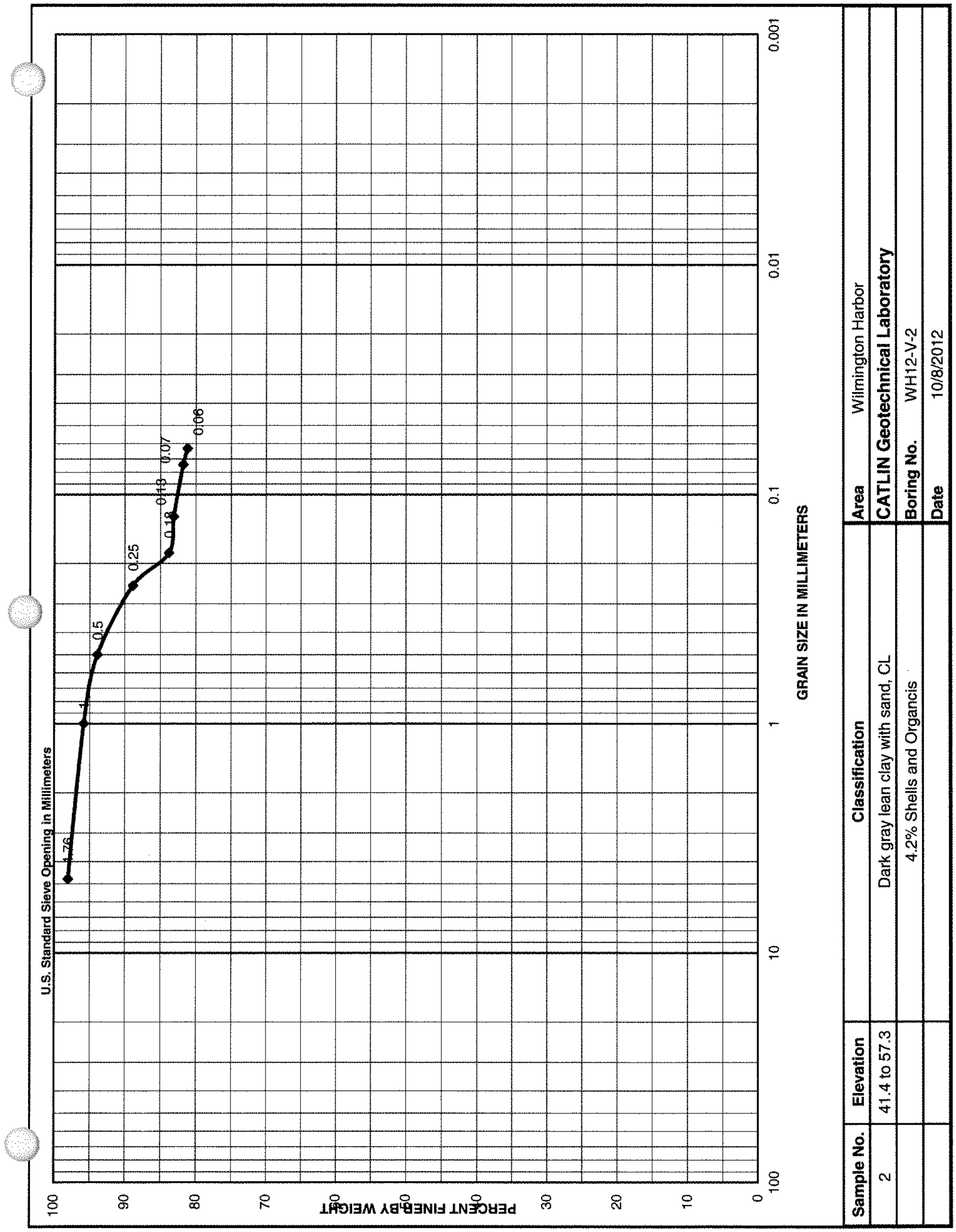
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-2

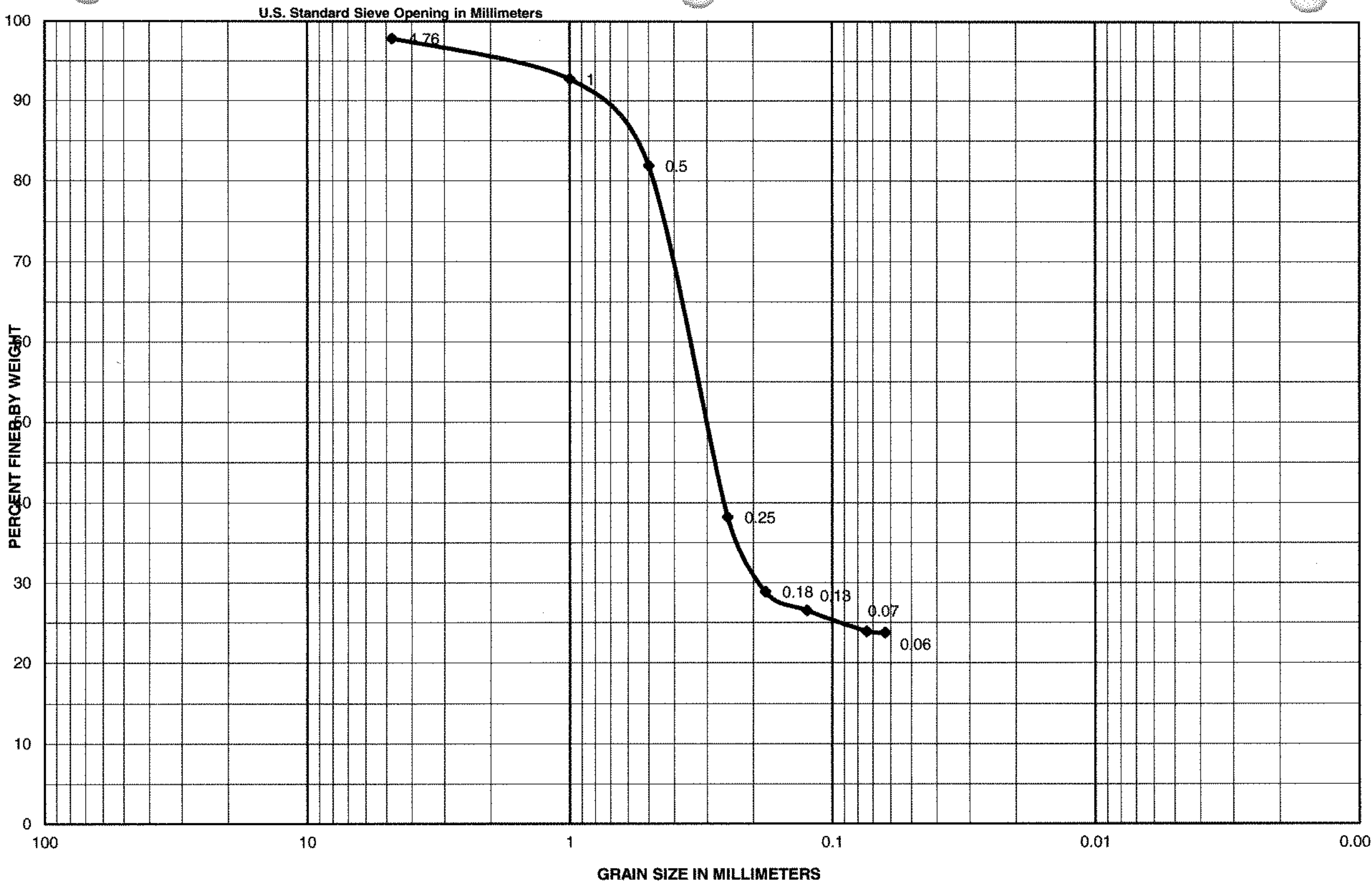
Drilling Log (Cont Sheet)
ELEVATION TOP OF HOLE 0.0 MLLW
Hole No.: **WH12-V-2**
PROJECT **WILMINGTON HARBOR**
INSTALLATION WILMINGTON DISTRICT
SHEET 2 OF 2 SHEETS

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		🟩			2	
-57.3					57.3	
	58.0	🟥	**SP**, Tan to light gray, poorly graded sand.		3	
-59.1					59.1	
	60.0 62.0 64.0 66.0 68.0 70.0 72.0 74.0 76.0 78.0 80.0		BOTTOM OF HOLE AT 59.1' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-2



Sample No.	Elevation	Classification	Area	Wilmington Harbor
2	41.4 to 57.3	Dark gray lean clay with sand, CL	CATLIN Geotechnical Laboratory	
		4.2% Shells and Organcis	Boring No.	WH12-V-2
			Date	10/8/2012



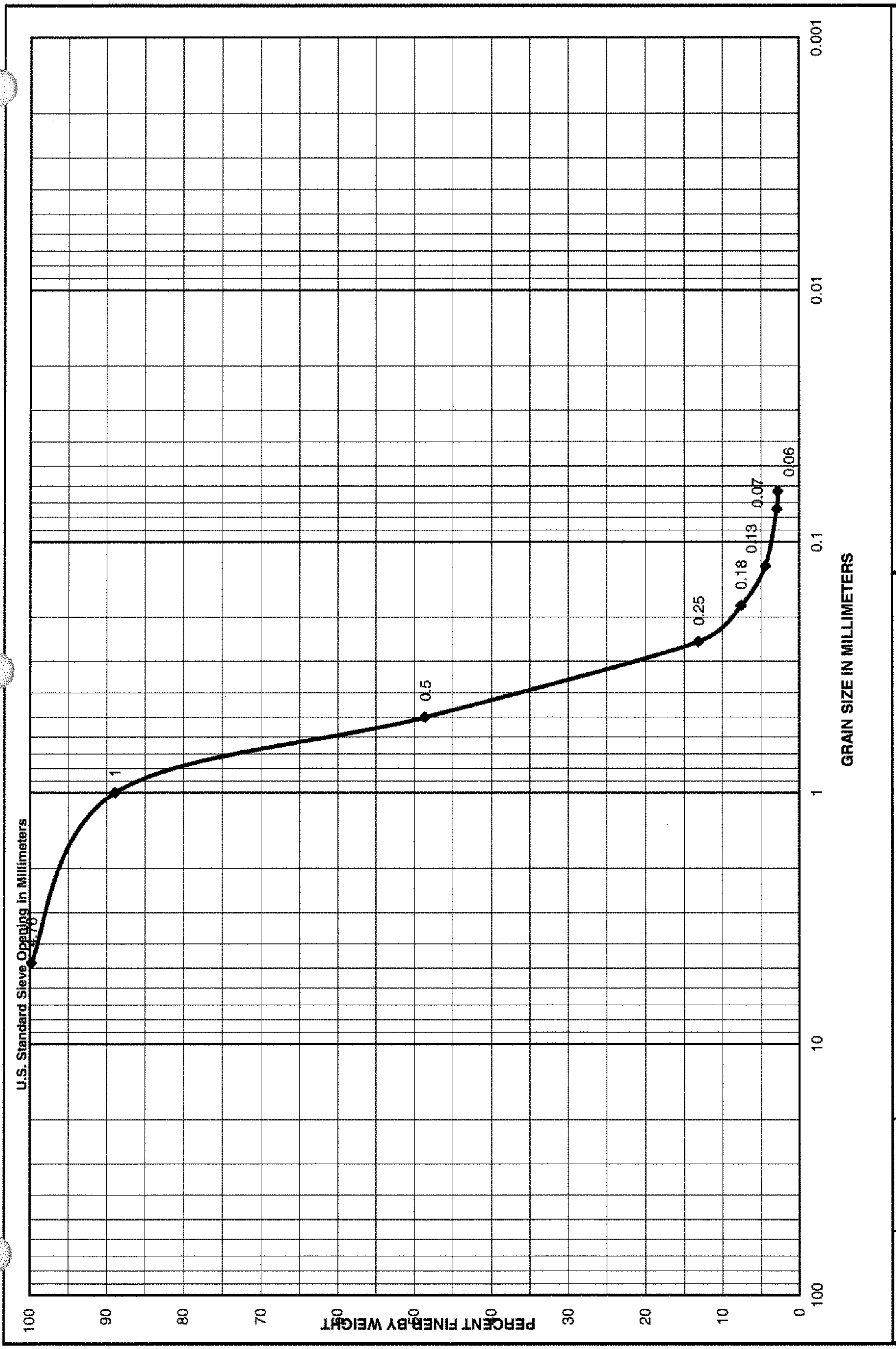
Sample No.	Elevation	Classification
1	39.5 to 41.4	Dark gray clayey sand, SC
		7.3% Shells

Area Wilmington Harbor

CATLIN Geotechnical Laboratory

Boring No. WH12-V-2

Date 10/9/2012



Sample No.	Elevation	Classification
3	57.3 to 59.1	Light/olive gray poorly graded sand, SP

Area Wilmington Harbor

CATLIN Geotechnical Laboratory

Boring No. WH12-V-2

Date 10/8/2012

Hole No.: **WH12-V-3**

Vibratory Drilling Log	DIVISION SAD	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT **WILMINGTON HARBOR**
2. LOCATION N 45,329.0 E 2,299,451.0
3. DRILLING AGENCY WILMINGTON DISTRICT
4. HOLE NO. (As shown on drawing title and file number) WH12-V-3
5. NAME OF DRILLER Talon Smith
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL
7. THICKNESS OF WATER COLUMN 48.8'
8. DEPTH DRILLED INTO ROCK 0.0'
9. TOTAL DEPTH OF HOLE 66.8'
10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 3 UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER N/A
16. DATE HOLE STARTED 7/11/12 COMPLETED 7/11/12
17. ELEVATION TOP OF HOLE 0.0
18. TOTAL CORE RECOVERY FOR BORING N/A
19. SIGNATURE OF INSPECTOR

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	46.0 48.0	🟦	0.0' TO 48.8' WATER OCEAN BOTTOM @48.8'			Time begin vibracoring: 0000 hrs. Soils Field Classified by Zachry Nichols, Civil Engineer NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.
-48.8					48.8	
	50.0 52.0 54.0	🟨	**SC**, Dark gray to gray, clayey sand.		1	VIBRACORE BORING From 0.0' to 19.80' Ran 20' Rec: 20' Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.
-54.8					54.8	
	56.0	🟩	**CL**, Dark gray lean clay, with fine sand.		2	
-56.8					56.8	
	58.0 60.0 62.0 64.0	🟥	**SW**, Grayish tan, well graded sand.		3	LAB CLASSIFICATION Jar Number / Classification 1 SC 2 CL 3 SW Soils are Lab Classified in Accordance with ASTM-D2487 COMPLETION NOTE: Terminated hole at refusal or predetermined depth at 18' below ocean bottom

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MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-3

Drilling Log (Cont Sheet)

ELEVATION TOP OF HOLE 0.0 MLLW

Hole No.: **WH12-V-3**

PROJECT **WILMINGTON HARBOR**

INSTALLATION WILMINGTON DISTRICT

SHEET 2 OF 2 SHEETS

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	66.0	▨	**SW**, Grayish tan, well graded sand. *(continued from previous page)*		3	
-66.8			BOTTOM OF HOLE AT 66.8' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM		66.8	
	68.0					
	70.0					
	72.0					
	74.0					
	76.0					
	78.0					
	80.0					
	82.0					
	84.0					
	86.0					
	88.0					
	90.0					

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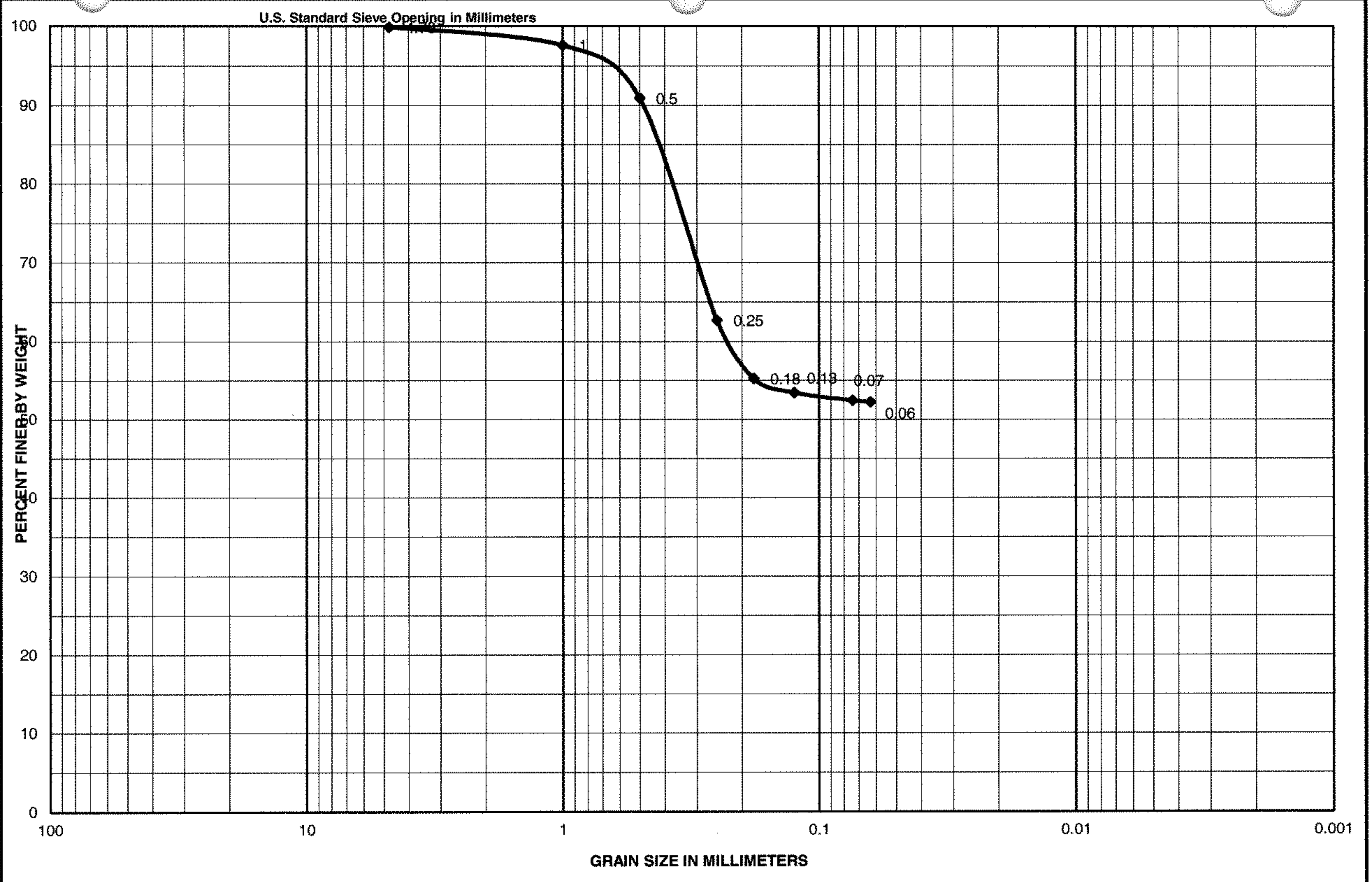
MAR 71

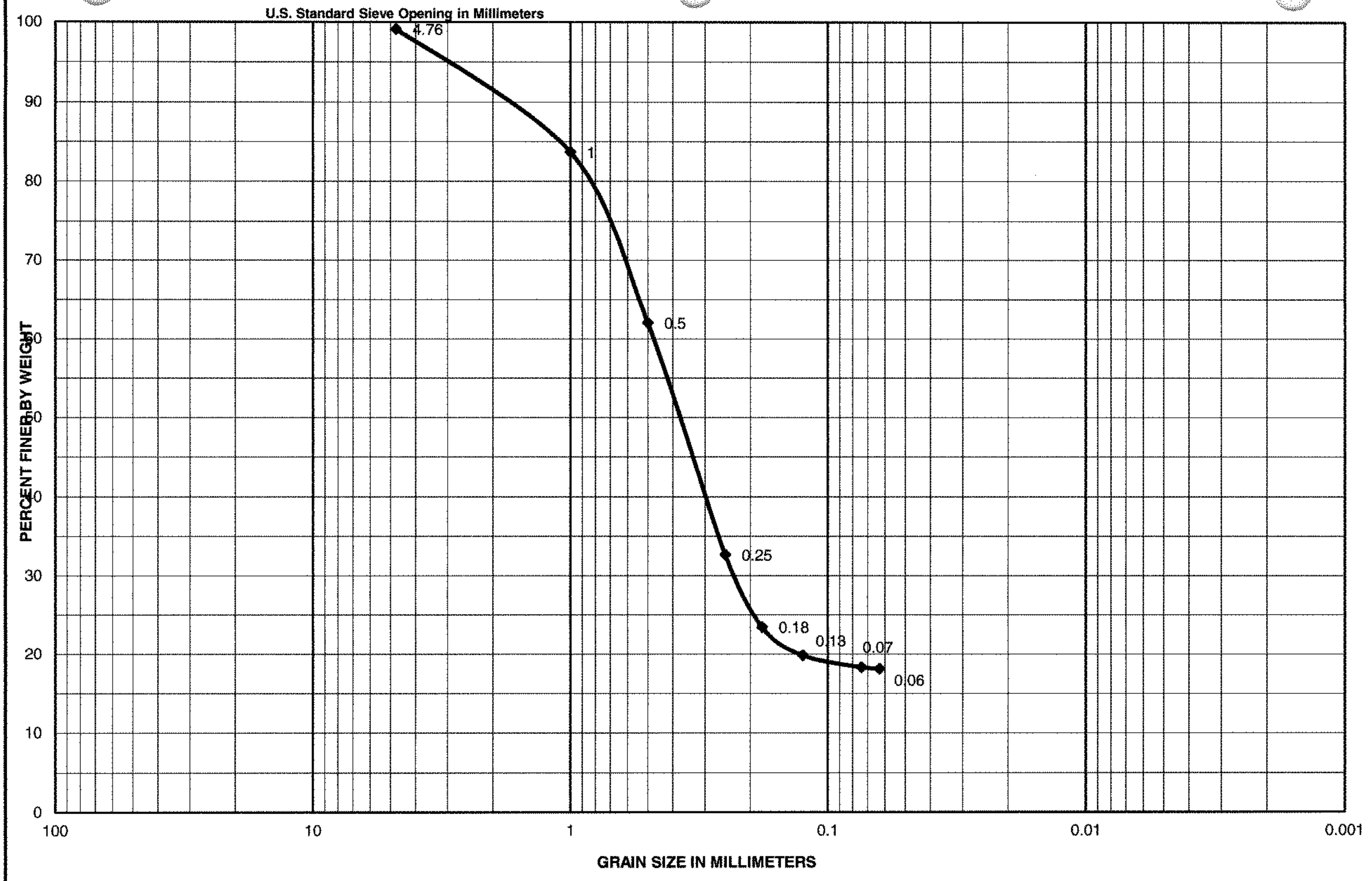
PROJECT WILMINGTON HARBOR

HOLE NO. WH12-V-3

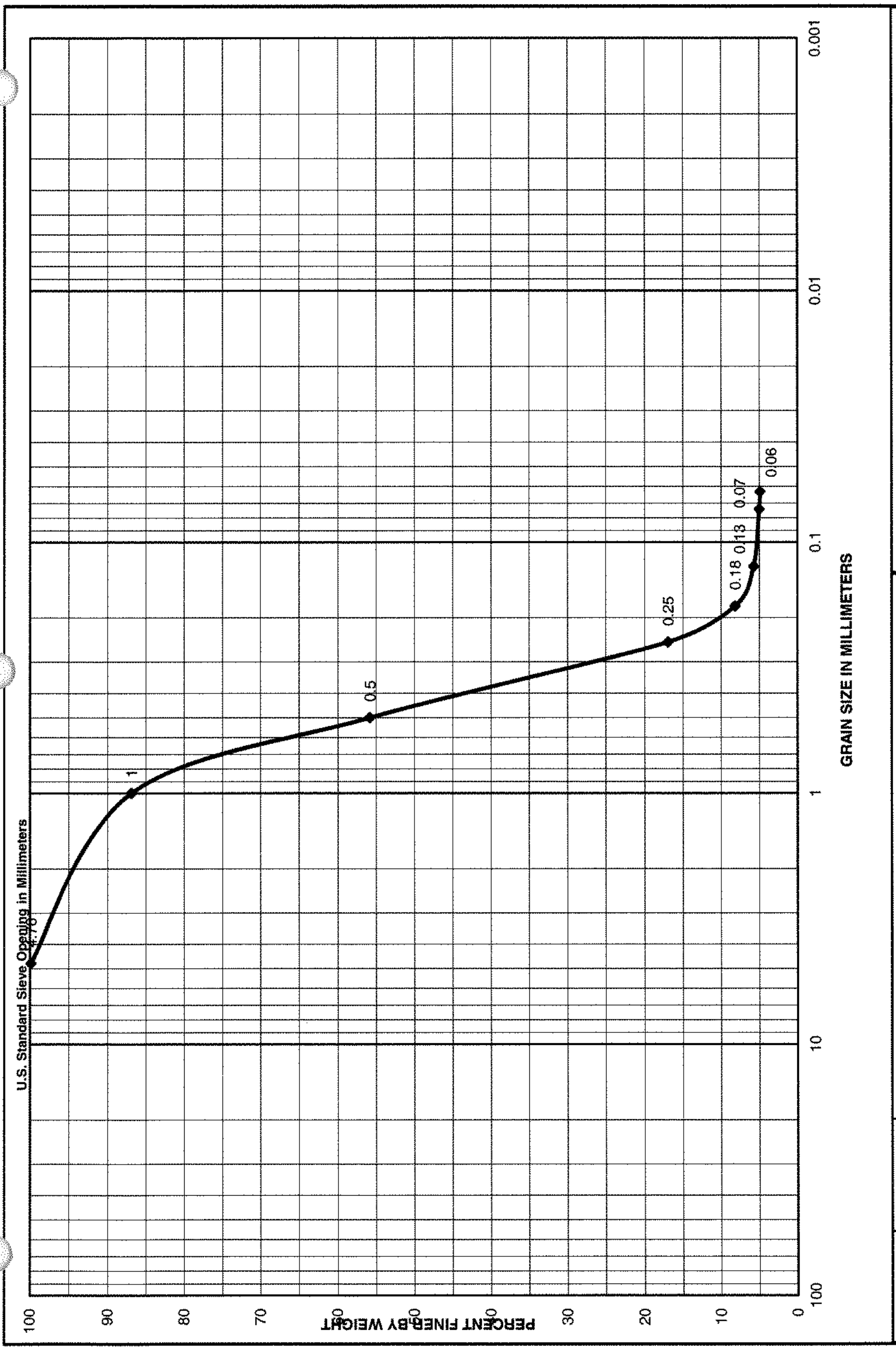


Sample No.	Elevation	Classification
2	54.8 to 56.8	Olive gray sandy lean clay, CL

Area	Wilmington Harbor
CATLIN Geotechnical Laboratory	
Boring No.	WH12-V-3
Date	10/23/12



Sample No.	Elevation	Classification	**Area**	Wilmington Harbor
1	48.8 to 54.8	Olive gray clayey sand with little shells, SC	**CATLIN Geotechnical Laboratory**	
		16.3% Shells	**Boring No.**	WH12-V-3
			Date	10/15/12



Sample No.	Elevation	Classification	Area	Wilmington Harbor
3	56.8 to 66.8	Brown well graded sand, SW	**CATLIN Geotechnical Laboratory**	
			Boring No.	WH12-V-3
			Date	10/16/12

Hole No.: **WH12-V-4**

Vibratory Drilling Log
DIVISION SAD
INSTALLATION WILMINGTON DISTRICT
SHEET 1 OF 2 SHEETS

1. PROJECT **WILMINGTON HARBOR**
2. LOCATION N 45,662.0 E 2,299,564.0
3. DRILLING AGENCY WILMINGTON DISTRICT
4. HOLE NO. (As shown on drawing title and file number) WH12-V-4
5. NAME OF DRILLER Talon Smith
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL
7. THICKNESS OF WATER COLUMN 35.6'
8. DEPTH DRILLED INTO ROCK 0.0'
9. TOTAL DEPTH OF HOLE 54.9'
10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
11. DATUM FOR ELEVATION SHOWN *BM or MSL* MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 7 UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER N/A
16. DATE HOLE STARTED 7/11/12 COMPLETED 7/11/12
17. ELEVATION TOP OF HOLE 0.0
18. TOTAL CORE RECOVERY FOR BORING N/A
19. SIGNATURE OF INSPECTOR

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	34.0	🟦	0.0' TO 35.6' WATER OCEAN BOTTOM @35.6'			
-35.6	36.0	🟥	**SW**, Light gray, well graded sand, with, little shell fragments.		35.6 1	
-37.1	38.0	🟩	**CL**, Dark gray sandy lean clay.		37.1 2	
-40.1	40.0 42.0 44.0	🟨	**SC**, Dark gray, clayey sand.		40.1 3	
-44.5		🟩	**CL**, Dark gray lean clay.		44.5 4	
-45.3	46.0 48.0 50.0	🟥	**SP**, Tan to dark brown, poorly graded sand.		45.3 5	
-51.4	52.0	🟩	**CL**, Dark gray lean clay.		51.4 6	

Time begin vibracoring: 0000 hrs.

Soils Field Classified by Zachry Nichols, Civil Engineer

NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.

VIBRACORE BORING
From 0.0' to 20.90'
Ran 20' Rec: 20'

Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.

LAB CLASSIFICATION

Jar Number	Classification
1	SW
2	SC
3	SC
4	CL
5	SP
6	CL
7	SP-SM

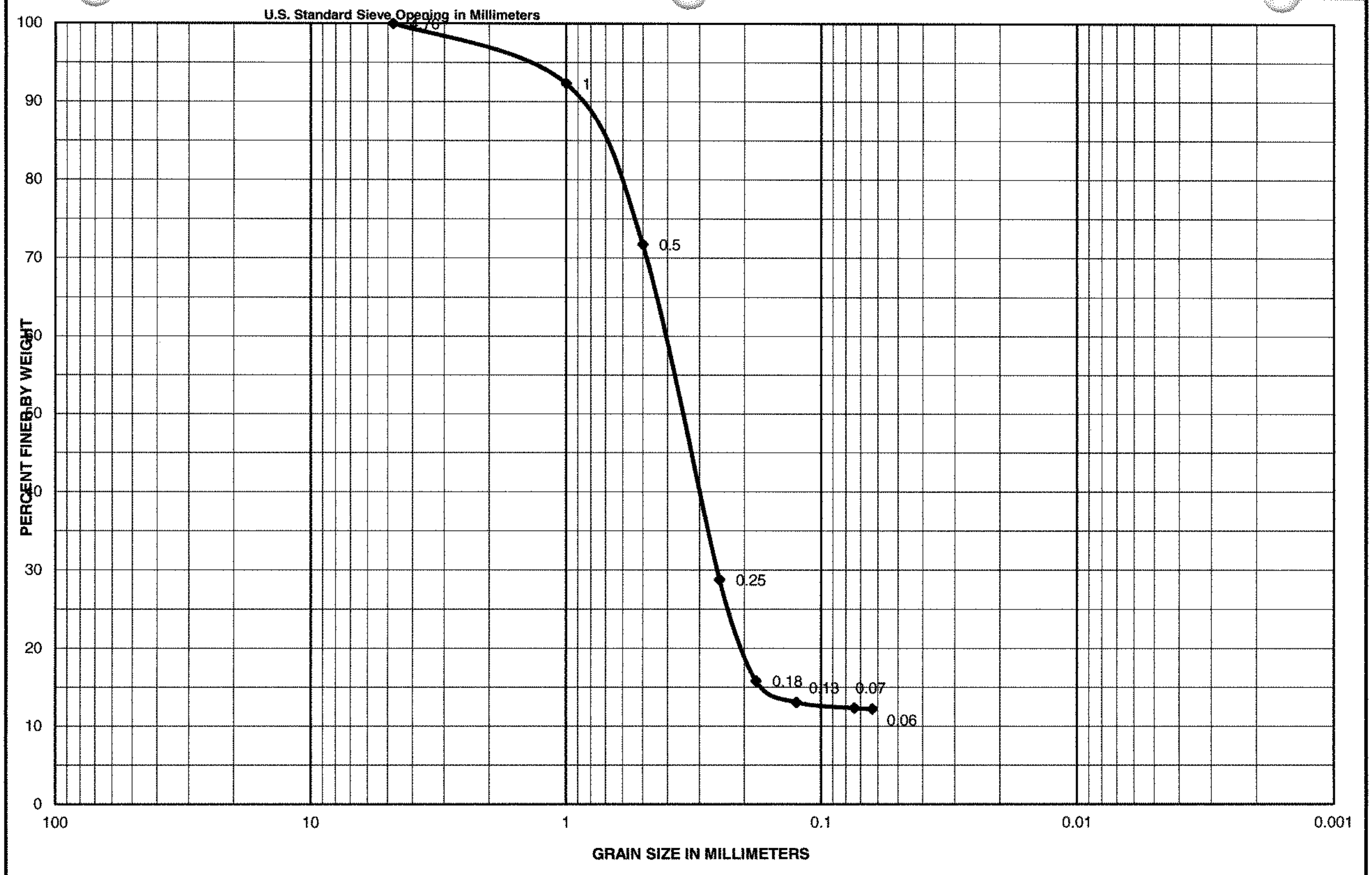
Soils are Lab Classified in Accordance with ASTM-D2487

COMPLETION NOTE: Terminated hole at refusal or predetermined depth at 19.3' below ocean bottom

Drilling Log (Cont Sheet)	ELEVATION TOP OF HOLE 0.0 MLLW	Hole No.: **WH12-V-4**
PROJECT **WILMINGTON HARBOR**	INSTALLATION WILMINGTON DISTRICT	SHEET 2 OF 2 SHEETS

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		🟩	**CL**, Dark gray lean clay. *(continued from previous page)*		6	
-54.1	54.0	🟥	**SP**, Light gray, poorly graded sand.		54.1 7 54.9	
-54.9			BOTTOM OF HOLE AT 54.9' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			
	56.0					
	58.0					
	60.0					
	62.0					
	64.0					
	66.0					
	68.0					
	70.0					
	72.0					
	74.0					
	76.0					

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE MAR 71	PROJECT WILMINGTON HARBOR	HOLE NO. WH12-V-4



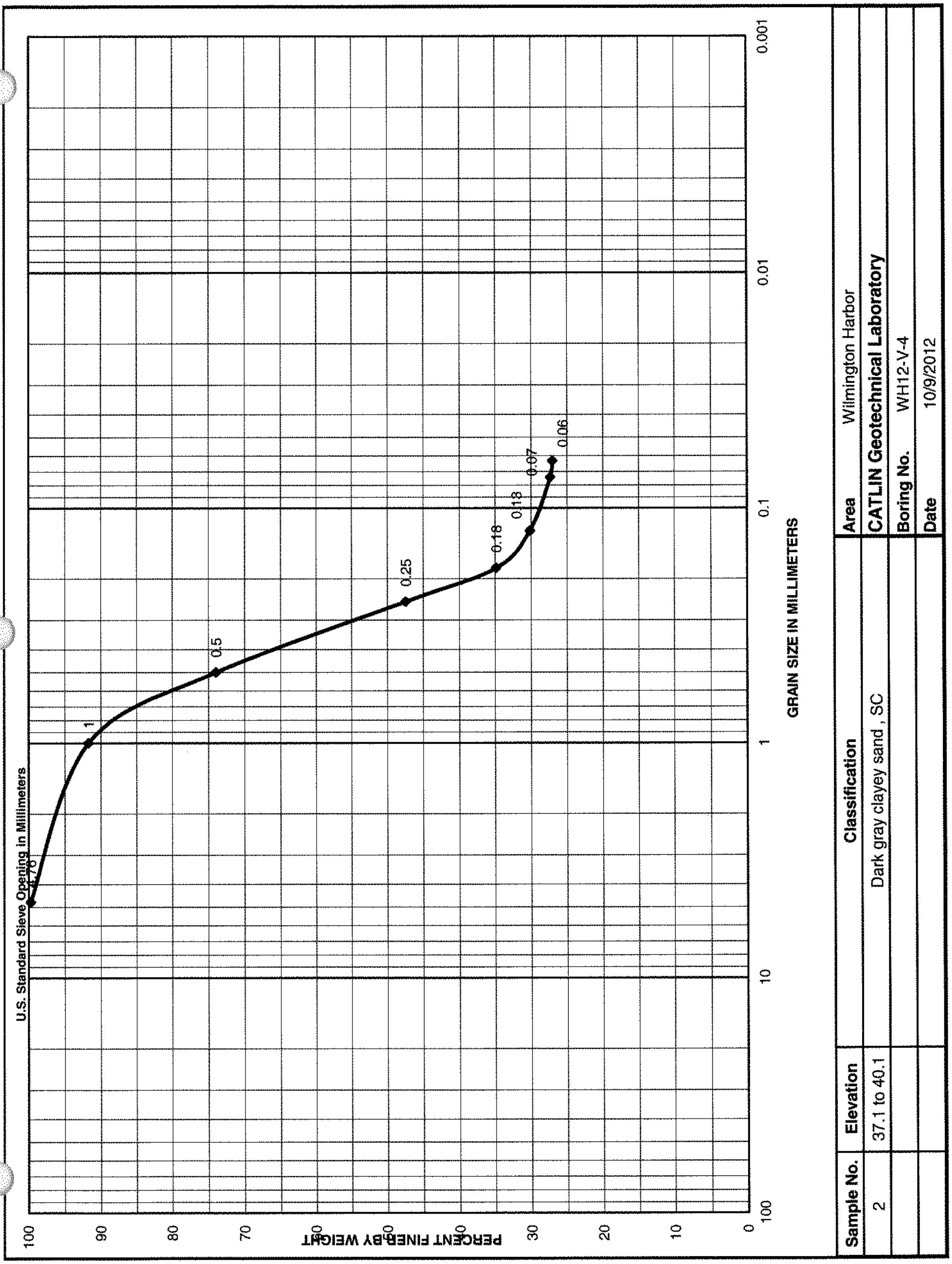
Sample No.	Elevation	Classification
3	40.1 to 44.5	Dark gray clayey sand with little shells and organics, SC
		28.3% Shells and Organics

Area Wilmington Harbor

CATLIN Geotechnical Laboratory

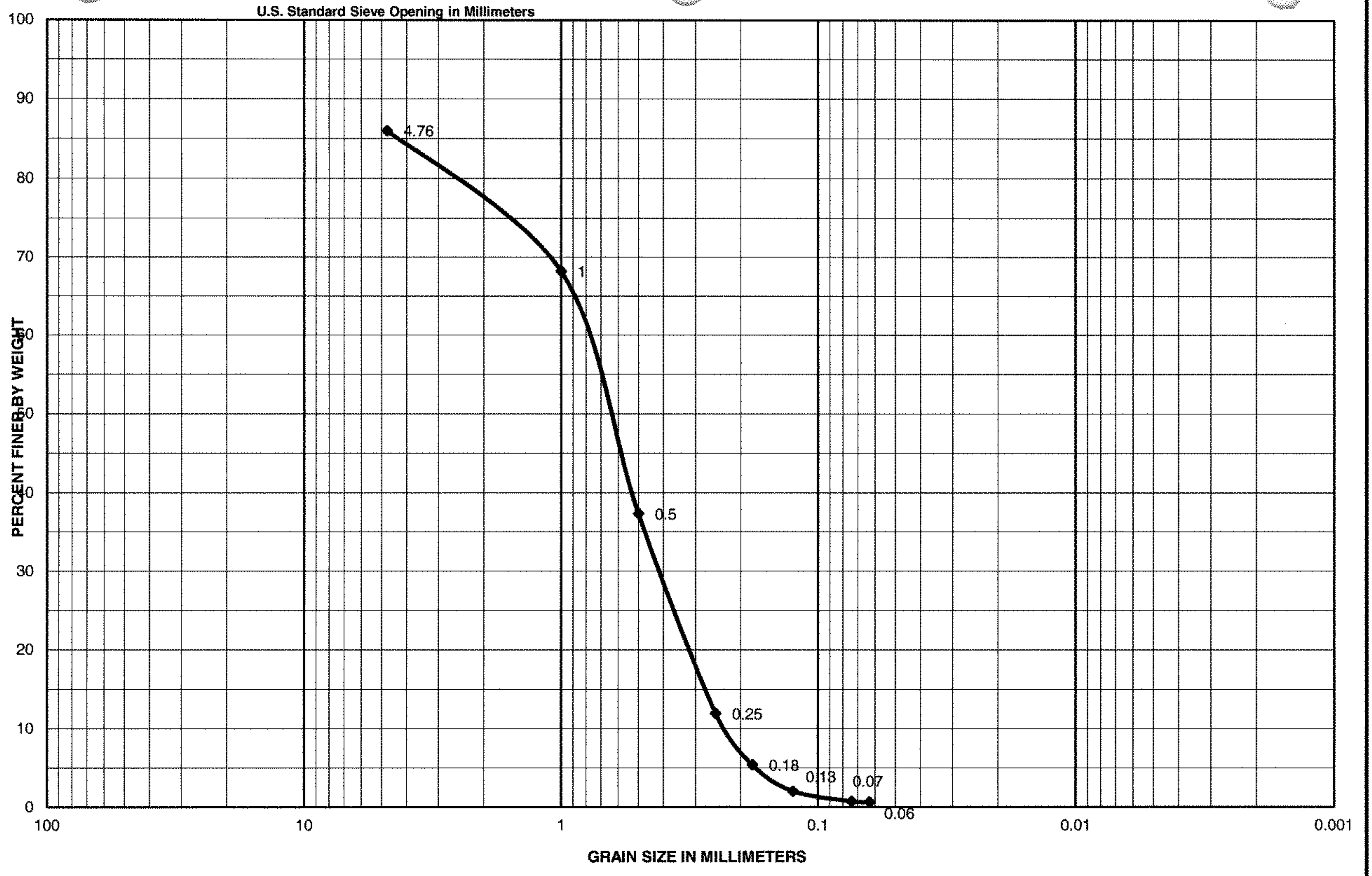
Boring No. WH12-V-4

Date 10/8/2012

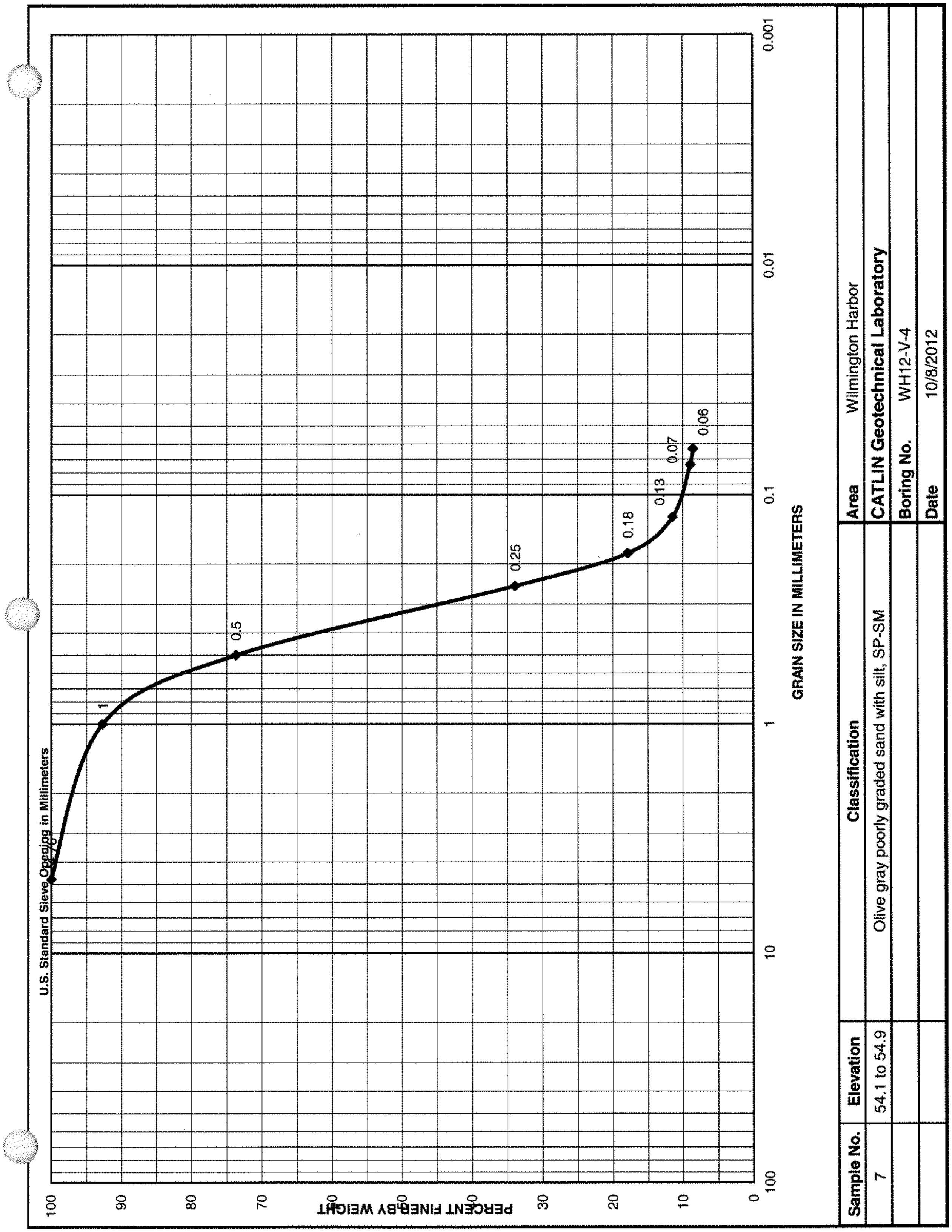


Sample No.	Elevation	Classification
2	37.1 to 40.1	Dark gray clayey sand , SC

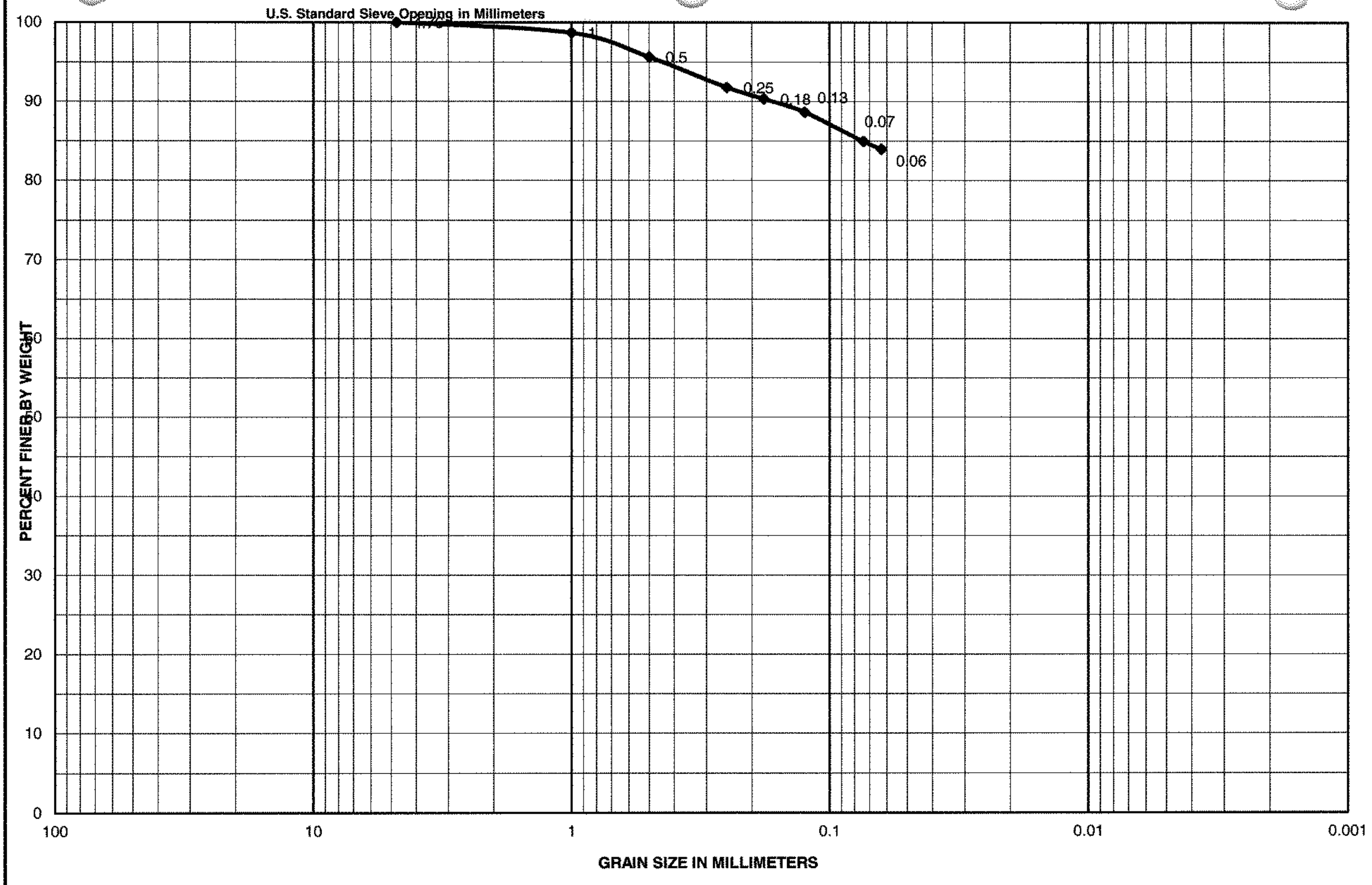
Area	Wilmington Harbor
CATLIN Geotechnical Laboratory	
Boring No.	WH12-V-4
Date	10/9/2012



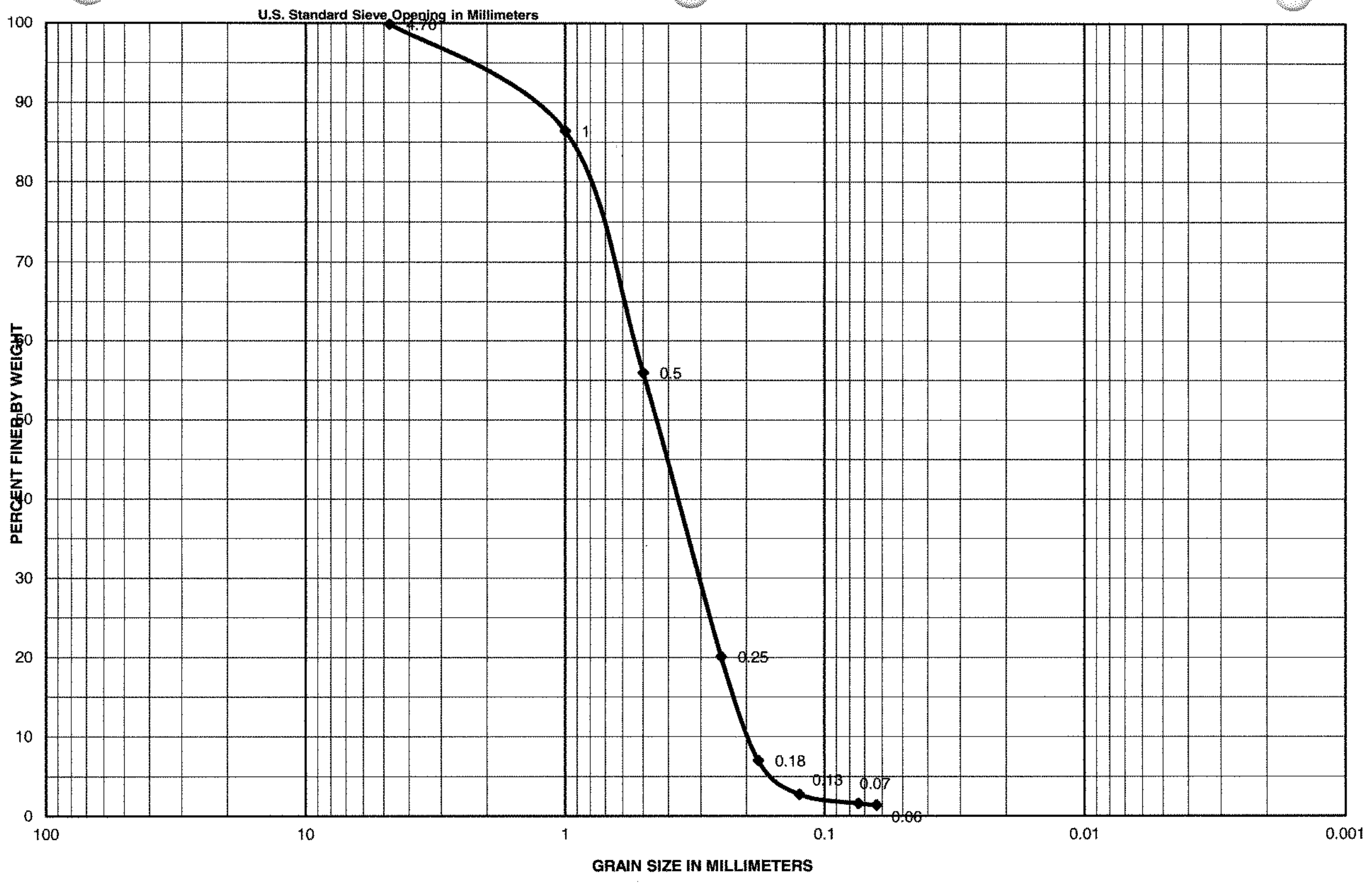
Sample No.	Elevation	Classification	Area	Wilmington Harbor
1	35.6 to 37.1	Olive gray well graded sand with some shells, SW	**CATLIN Geotechnical Laboratory**	
		31.8% Shells	Boring No.	WH12-V-4
			Date	10/12/12



Sample No.	Elevation	Classification	Area	Wilmington Harbor
7	54.1 to 54.9	Olive gray poorly graded sand with silt, SP-SM	**CATLIN Geotechnical Laboratory**	
			Boring No.	WH12-V-4
			Date	10/8/2012



Sample No.	Elevation	Classification	**Area**	Wilmington Harbor
6	51.4 to 54.1	Olive/dark gray lean clay with few organics, CL	**CATLIN Geotechnical Laboratory**	
		8.2% Organics	**Boring No.**	WH12-V-4
			Date	10/8/2012



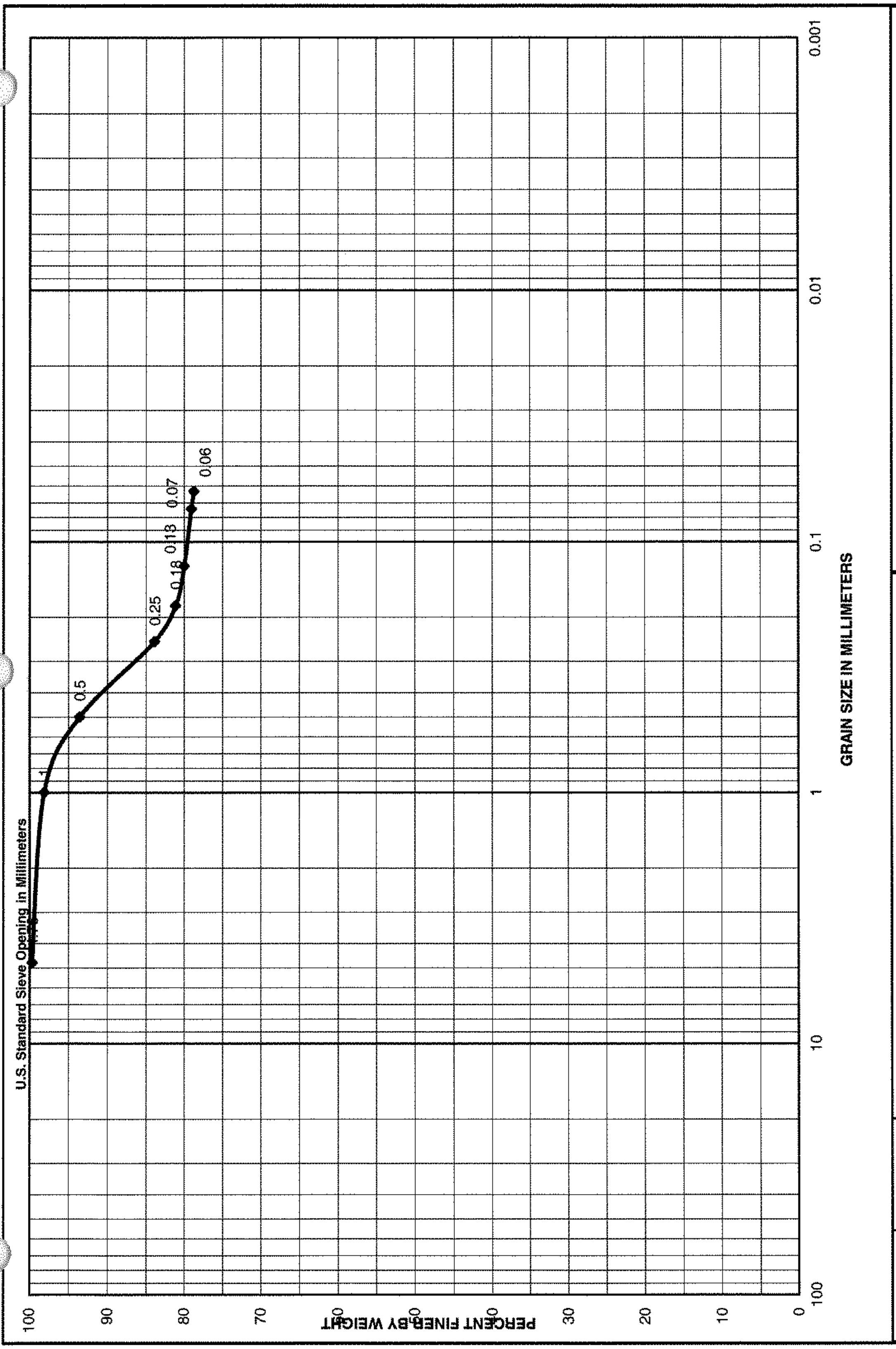
Sample No.	Elevation	Classification
5	45.3 to 51.4	Light brown/olive gray poorly graded sand, SP

Area Wilmington Harbor

CATLIN Geotechnical Laboratory

Boring No. WH12-V-4

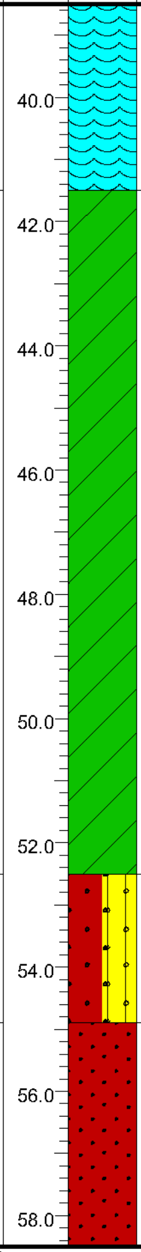
Date 10/12/12



Sample No.	Elevation	Classification	Area	Wilmington Harbor
4	44.5 to 45.3	Olive gray lean clay with sand and trace organics, CL	**CATLIN Geotechnical Laboratory**	
		1.9% Organics	**Boring No.**	WH12-V-4
			Date	10/15/12

Hole No.: **WH12-V-5**

Vibratory Drilling Log	DIVISION SAD
INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS
1. PROJECT **WILMINGTON HARBOR**	10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
2. LOCATION N 45,647.0 E 2,299,799.0	11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW
3. DRILLING AGENCY WILMINGTON DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
4. HOLE NO. (As shown on drawing title and file number) WH12-V-5	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3; UNDISTURBED 0
5. NAME OF DRILLER Talon Smith	14. TOTAL NUMBER CORE BOXES 0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL	15. ELEVATION GROUND WATER N/A
7. THICKNESS OF WATER COLUMN 41.5'	16. DATE HOLE: STARTED 7/11/12; COMPLETED 7/11/12
8. DEPTH DRILLED INTO ROCK 0.0'	17. ELEVATION TOP OF HOLE 0.0
9. TOTAL DEPTH OF HOLE 58.6'	18. TOTAL CORE RECOVERY FOR BORING N/A
	19. SIGNATURE OF INSPECTOR



ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			0.0' TO 41.5' WATER OCEAN BOTTOM @41.5'			Time begin vibracoring: 0000 hrs. Soils Field Classified by Zachry Nichols, Civil Engineer NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.
-41.5			**CL**, Dark gray sandy lean clay.		41.5 1	
-52.5			**SP-SM**, Gray poorly graded sand, with some silt.		52.5 2	
-54.9			**SP**, Gray poorly graded sand.		54.9 3	

VIBRACORE BORING
From 0.0' to 24.60'
Ran 20' Rec: 20'

Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.

LAB CLASSIFICATION

Jar Number	Classification
1	CL
2	SM
3	SP

Soils are Lab Classified in Accordance with ASTM-D2487

COMPLETION NOTE: Terminated hole at refusal or predetermined depth at 17.1' below ocean bottom

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PROJECT WILMINGTON HARBOR | HOLE NO. WH12-V-5

Drilling Log (Cont Sheet)

ELEVATION TOP OF HOLE 0.0 MLLW

Hole No.: **WH12-V-5**

PROJECT **WILMINGTON HARBOR**

INSTALLATION WILMINGTON DISTRICT

SHEET 2 OF 2 SHEETS

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-58.6	58.6		BOTTOM OF HOLE AT 58.6' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			

60.0
62.0
64.0
66.0
68.0
70.0
72.0
74.0
76.0
78.0
80.0
82.0

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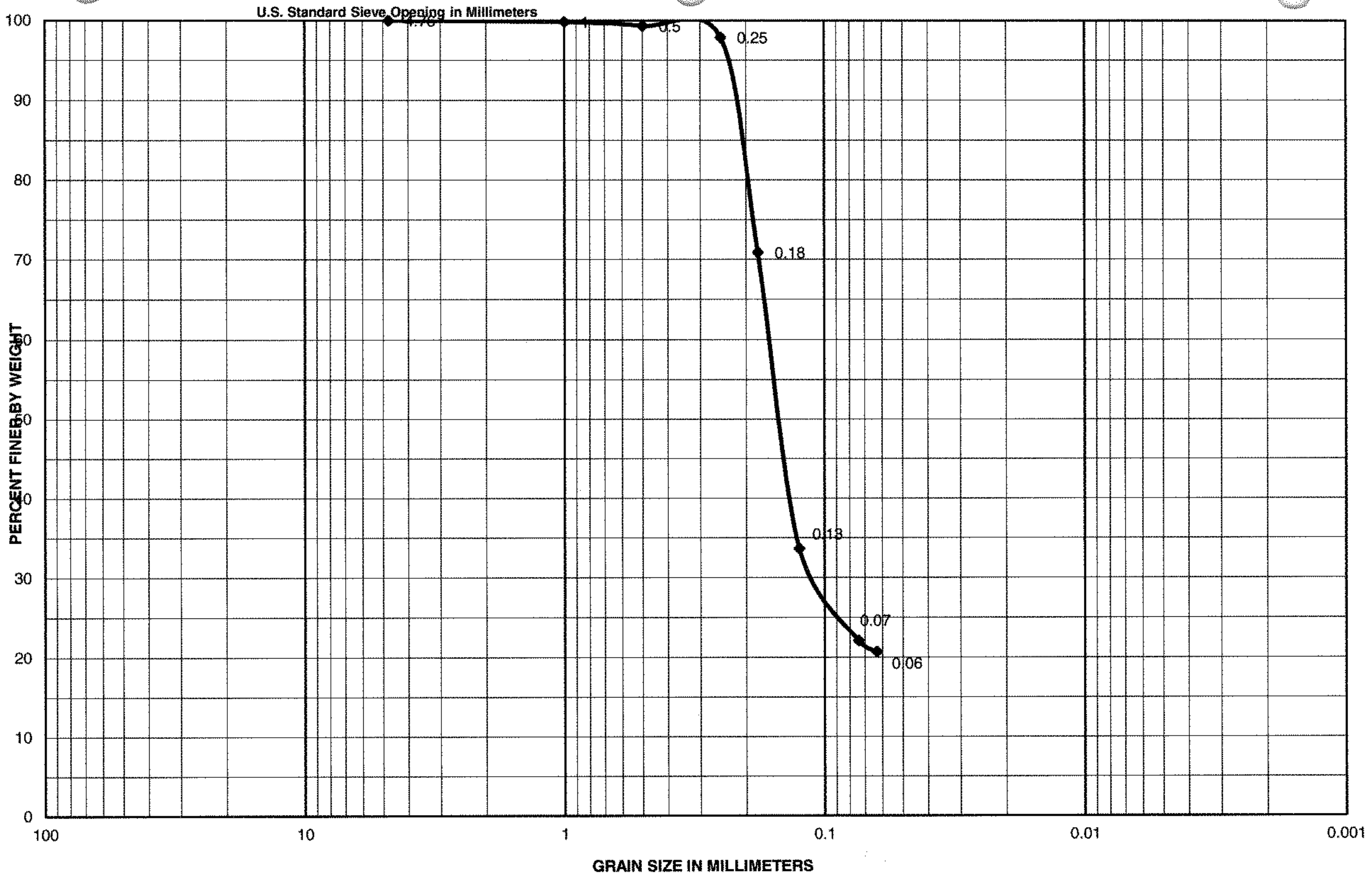
MAR 71

PROJECT WILMINGTON HARBOR

HOLE NO. WH12-V-5



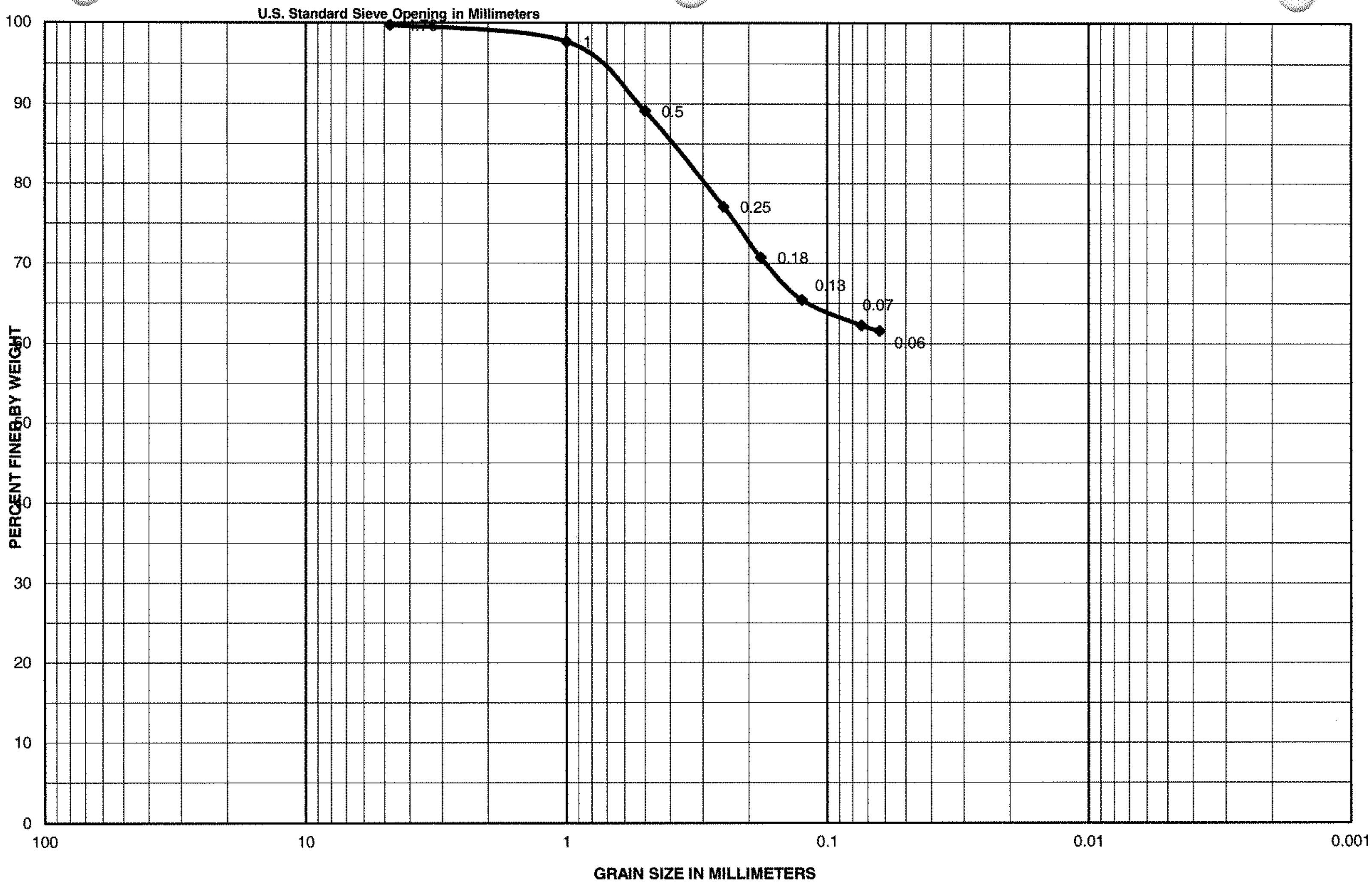
Sample No.	Elevation	Classification
2	52.5 to 54.9	Olive gray silty sand, SM

Area Wilmington Harbor

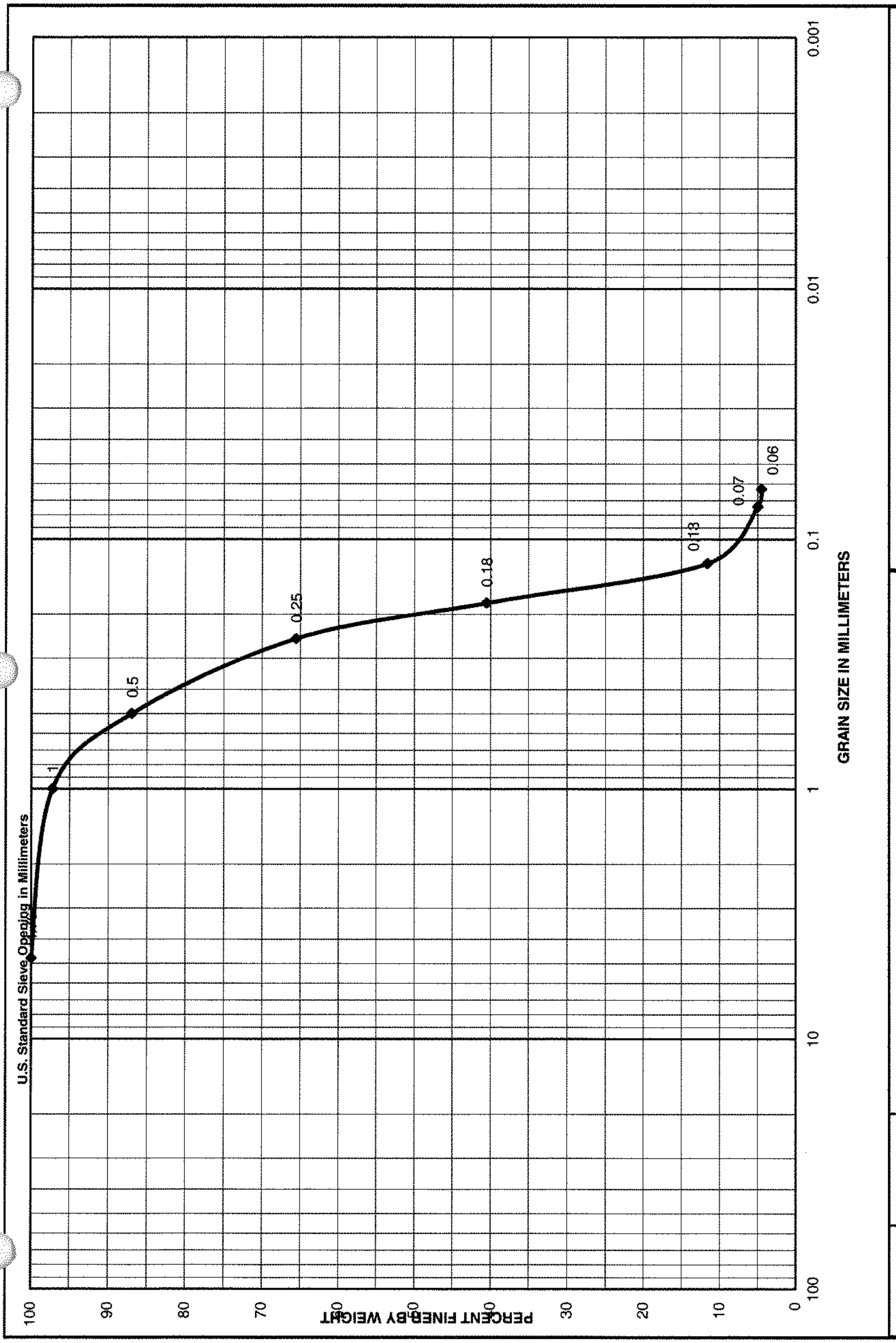
CATLIN Geotechnical Laboratory

Boring No. WH12-V-5

Date 10/15/12



Sample No.	Elevation	Classification		
1	41.5 to 52.5	Olive/dark gray sandy lean clay with trace organics, CL	**Area**	Wilmington Harbor
		2.3% Organics	**CATLIN Geotechnical Laboratory**	
			Boring No.	WH12-V-5
			Date	10/23/12

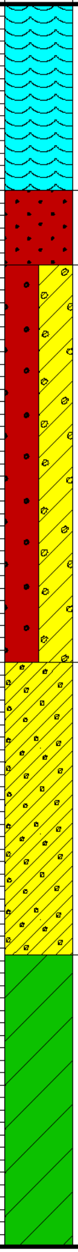


Sample No.	**Elevation**	**Classification**	**Area**	Wilmington Harbor
3	54.9 to 58.6	Olive gray poorly graded sand, SP	**CATLIN Geotechnical Laboratory**	
			Boring No.	WH12-V-5
			Date	10/16/12

Hole No.: **WH12-V-6**

Vibratory Drilling Log
DIVISION SAD
INSTALLATION WILMINGTON DISTRICT
SHEET 1 OF 2 SHEETS

1. PROJECT **WILMINGTON HARBOR**
2. LOCATION N 46,042.0 E 2,299,848.0
3. DRILLING AGENCY WILMINGTON DISTRICT
4. HOLE NO.(As shown on drawing title and file number) WH12-V-6
5. NAME OF DRILLER Talon Smith
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL
7. THICKNESS OF WATER COLUMN 38.6'
8. DEPTH DRILLED INTO ROCK 0.0'
9. TOTAL DEPTH OF HOLE 58.6'
10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
11. DATUM FOR ELEVATION SHOWN *BM or MSL* MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN : DISTURBED 5 : UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER N/A
16. DATE HOLE : STARTED 7/12/12 COMPLETED 7/12/12
17. ELEVATION TOP OF HOLE 0.0
18. TOTAL CORE RECOVERY FOR BORING N/A
19. SIGNATURE OF INSPECTOR ,



ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f
	36.0 38.0		0.0' TO 38.6' WATER OCEAN BOTTOM @38.6'		
-38.6			**SP**, Gray to dark gray, poorly graded sand.		38.6 1
-39.8	40.0 42.0 44.0		**SP-SC**, Dark gray, poorly graded sand, with some clay, trace shell fragments.		39.8 2
-46.2	46.0 48.0 50.0		**SC**, Gray to dark gray, clayey sand.		46.2 3
-50.9	52.0 54.0		**CL**, Dark gray lean clay, with, little wood.		50.9 4

REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g

Time begin vibracoring: 0000 hrs.

Soils Field Classified by Zachry Nichols, Civil Engineer

NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.

VIBRACORE BORING
From 0.0' to 25.90'
Ran 20' Rec: 20'

Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.

LAB CLASSIFICATION

Jar Number	Classification
1	SM
2	MH
3	SC
4	CL
5	SP

Soils are Lab Classified in Accordance with ASTM-D2487

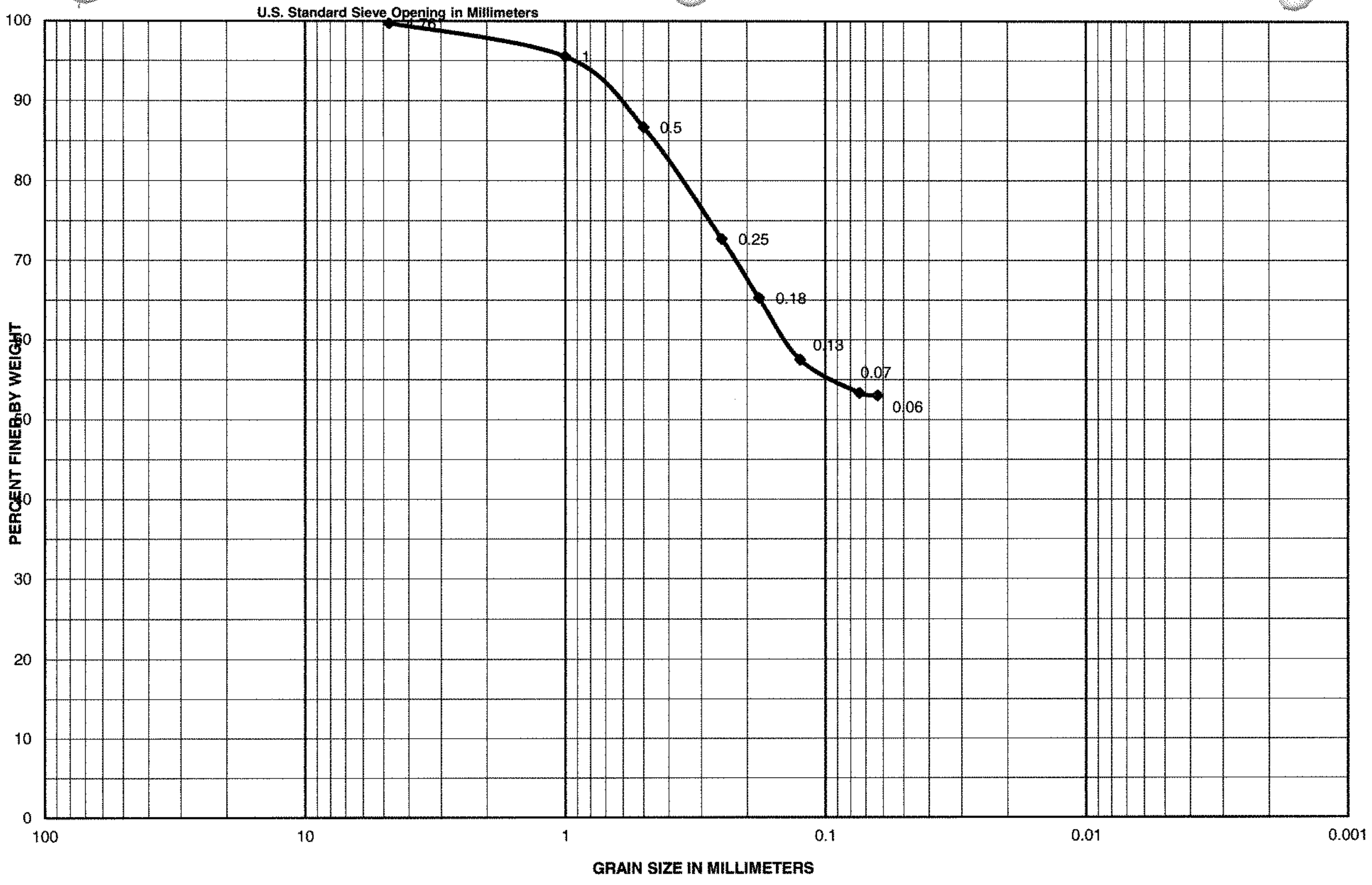
COMPLETION NOTE: Terminated hole at refusal or predetermined depth at 20' below ocean bottom

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-6

Drilling Log (Cont Sheet)
ELEVATION TOP OF HOLE 0.0 MLLW
Hole No.: **WH12-V-6**
PROJECT **WILMINGTON HARBOR**
INSTALLATION WILMINGTON DISTRICT
SHEET 2 OF 2 SHEETS

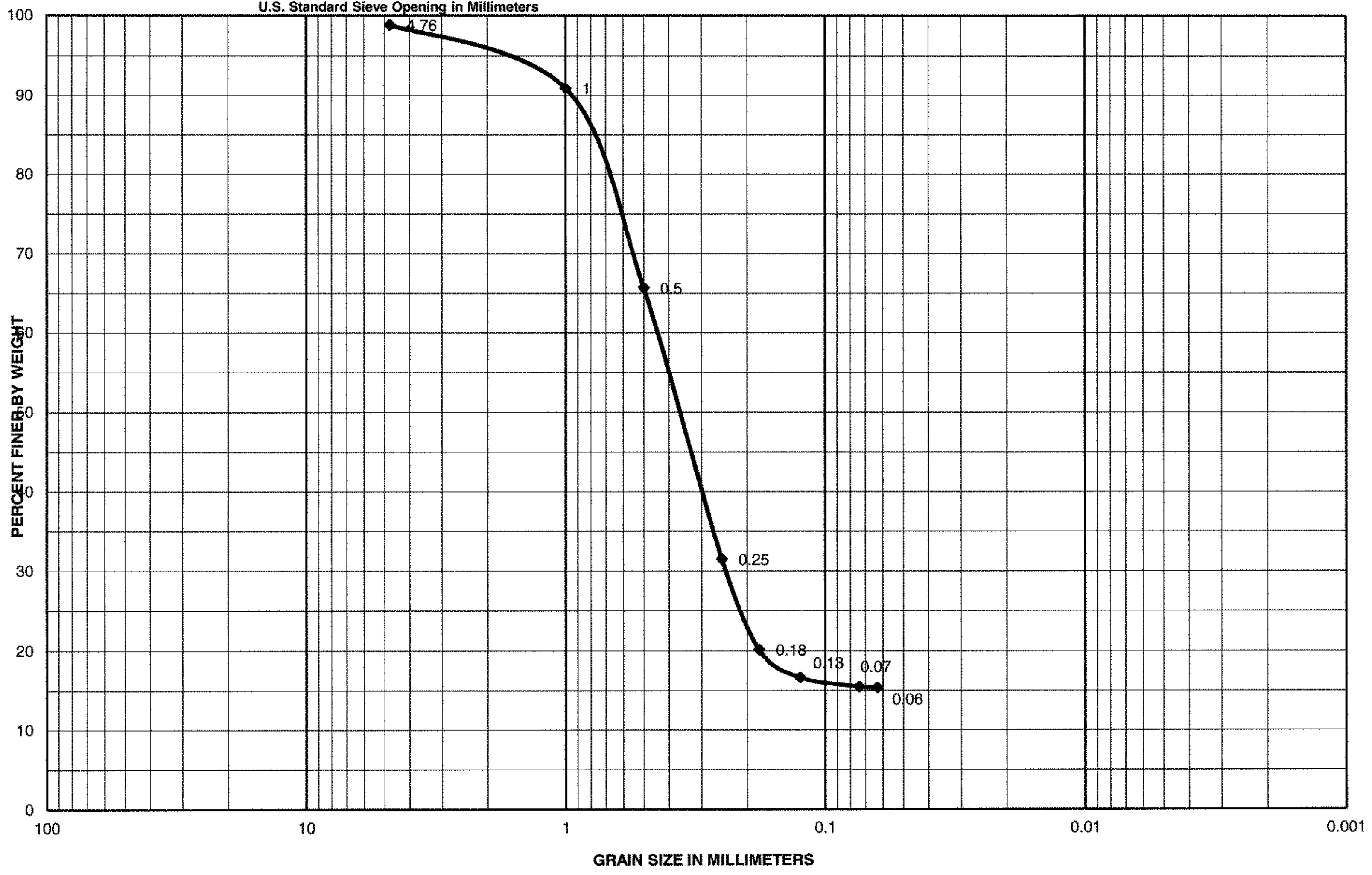
ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	56.0	🟩	**CL**, Dark gray lean clay, with, little wood. *(continued from previous page)*		4	
-56.6					56.6	
		🟥	**SP**, Light gray, poorly graded sand.		5	
	58.0					
-58.6					58.6	
			BOTTOM OF HOLE AT 58.6' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			
	60.0					
	62.0					
	64.0					
	66.0					
	68.0					
	70.0					
	72.0					
	74.0					
	76.0					
	78.0					
	80.0					

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-6

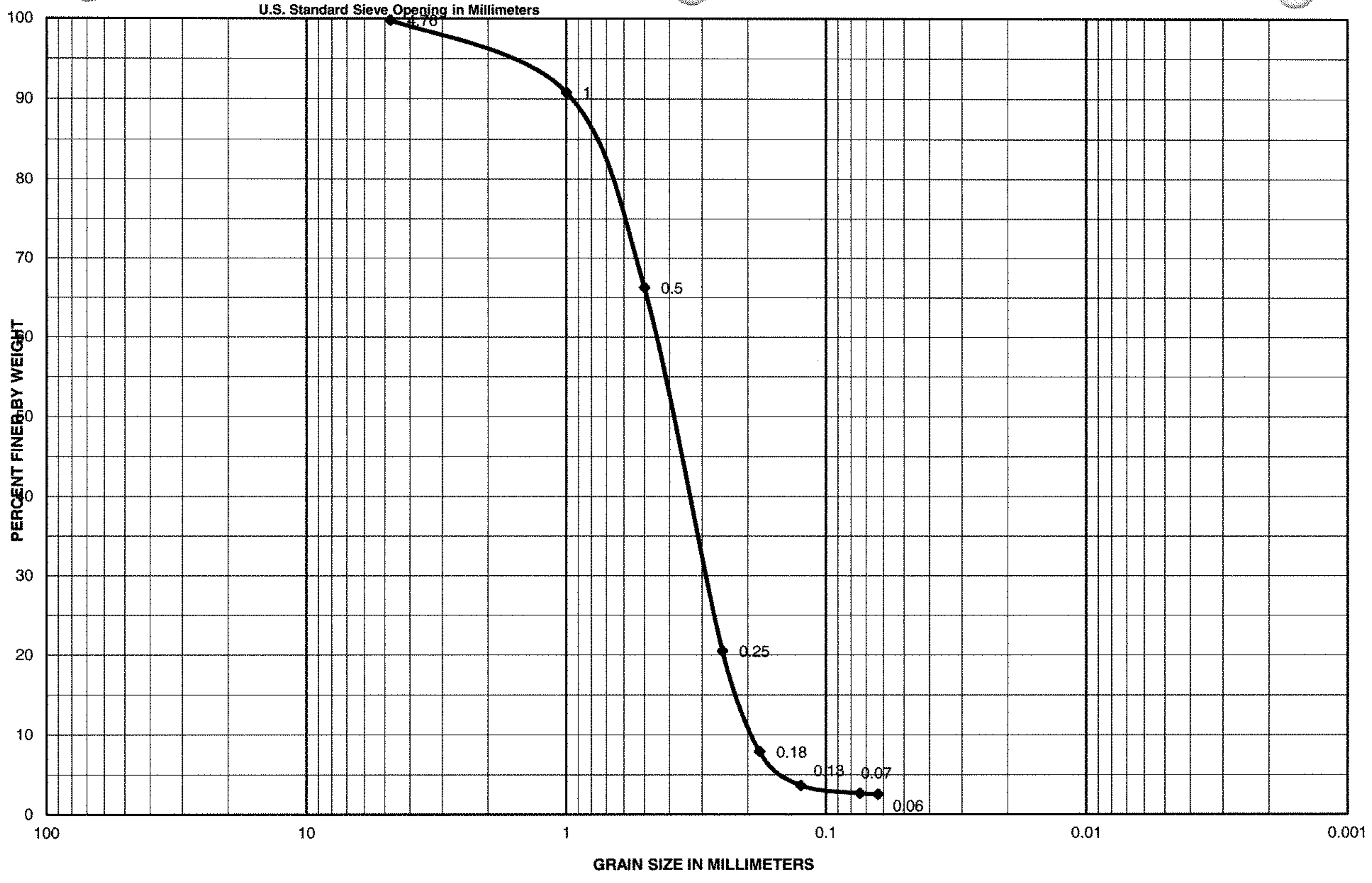


Sample No.	Elevation	Classification
2	39.8 to 46.2	Olive gray sandy elastic silt with trace shells, MH
		4.5% Shells

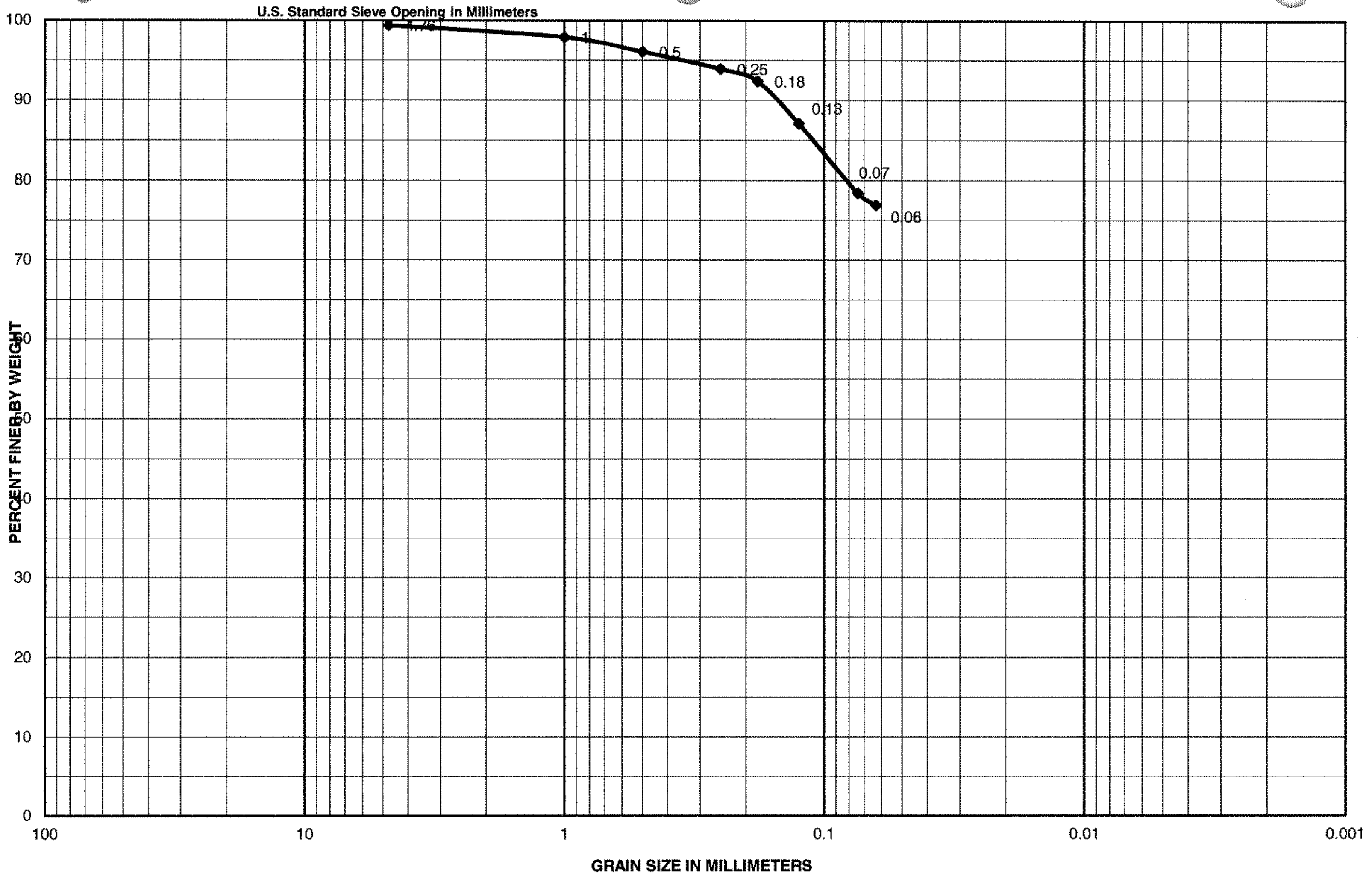
Area	Wilmington Harbor
CATLIN Geotechnical Laboratory	
Boring No.	WH12-V-6
Date	10/15/12



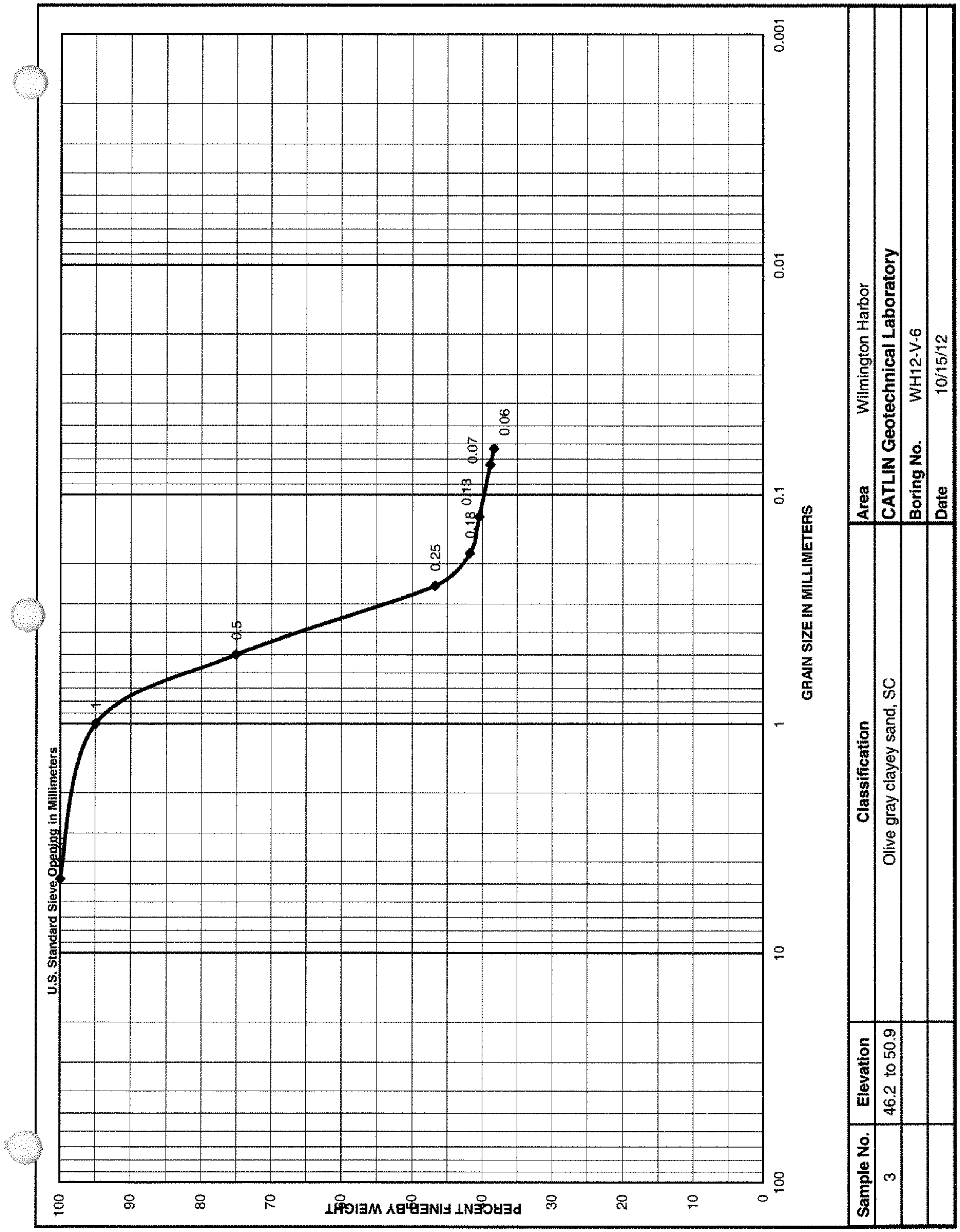
Sample No.	Elevation	Classification	Area	Wilmington Harbor
1	38.6 to 39.8	Olive gray silty sand with some shells, SM	**CATLIN Geotechnical Laboratory**	
		34.3% Shells	Boring No.	WH12-V-6
			Date	10/15/12



Sample No.	Elevation	Classification	Area	Wilmington Harbor
5	56.6 to 58.6	Olive gray poorly graded sand, SP	**CATLIN Geotechnical Laboratory**	
			Boring No.	WH12-V-6
			Date	10/15/12



Sample No.	Elevation	Classification	Area	Wilmington Harbor
4	50.9 to 56.6	Light gray/black sandy lean clay and trace organics, CL	**CATLIN Geotechnical Laboratory**	
		3.9% Organics	**Boring No.**	WH12-V-6
			Date	10/23/12



Sample No.	Elevation	Classification
3	46.2 to 50.9	Olive gray clayey sand, SC

Area Wilmington Harbor

CATLIN Geotechnical Laboratory

Boring No. WH12-V-6

Date 10/15/12

Hole No.: **WH12-V-7**

Vibratory Drilling Log — DIVISION SAD	INSTALLATION WILMINGTON DISTRICT — SHEET 1 OF 2 SHEETS
1. PROJECT **WILMINGTON HARBOR**	10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
2. LOCATION N 47,079.0 E 2,300,574.0	11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW
3. DRILLING AGENCY WILMINGTON DISTRICT	12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
4. HOLE NO.(As shown on drawing title and file number) WH12-V-7	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 5; UNDISTURBED 0
5. NAME OF DRILLER Talon Smith	14. TOTAL NUMBER CORE BOXES 0
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL	15. ELEVATION GROUND WATER N/A
	16. DATE HOLE: STARTED 7/11/12; COMPLETED 7/11/12
7. THICKNESS OF WATER COLUMN 39.5'	17. ELEVATION TOP OF HOLE 0.0
8. DEPTH DRILLED INTO ROCK 0.0'	18. TOTAL CORE RECOVERY FOR BORING N/A
9. TOTAL DEPTH OF HOLE 58.5'	19. SIGNATURE OF INSPECTOR

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f
	38.0	🟦	0.0' TO 39.5' WATER OCEAN BOTTOM @39.5'		
-39.5	40.0	🟥	**SP**, Tannish light gray, poorly graded sand.		39.5 1
-40.7	42.0 44.0	🟥🟨	**SP-SC**, Dark gray, poorly graded sand, with some clay.		40.7 2
-44.5	46.0 48.0 50.0 52.0	🟩	**CL**, Dark gray lean clay.		44.5 3
-52.2	54.0 56.0	🟥	**SP**, Tannish light gray, poorly graded sand.		52.2 52.5 4

REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g

Time begin vibracoring: 0000 hrs.

Soils Field Classified by Zachry Nichols, Civil Engineer

NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.

VIBRACORE BORING
From 0.0' to 21.00'
Ran 20' Rec: 20'

Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.

LAB CLASSIFICATION

Jar Number	Classification
1	SP
2	SC
3	CL
4	SP
5	SC

Soils are Lab Classified in Accordance with ASTM-D2487

COMPLETION NOTE: Terminated hole at refusal or predetermined depth at 19' below ocean bottom

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MAR 71

PROJECT WILMINGTON HARBOR — HOLE NO. WH12-V-7

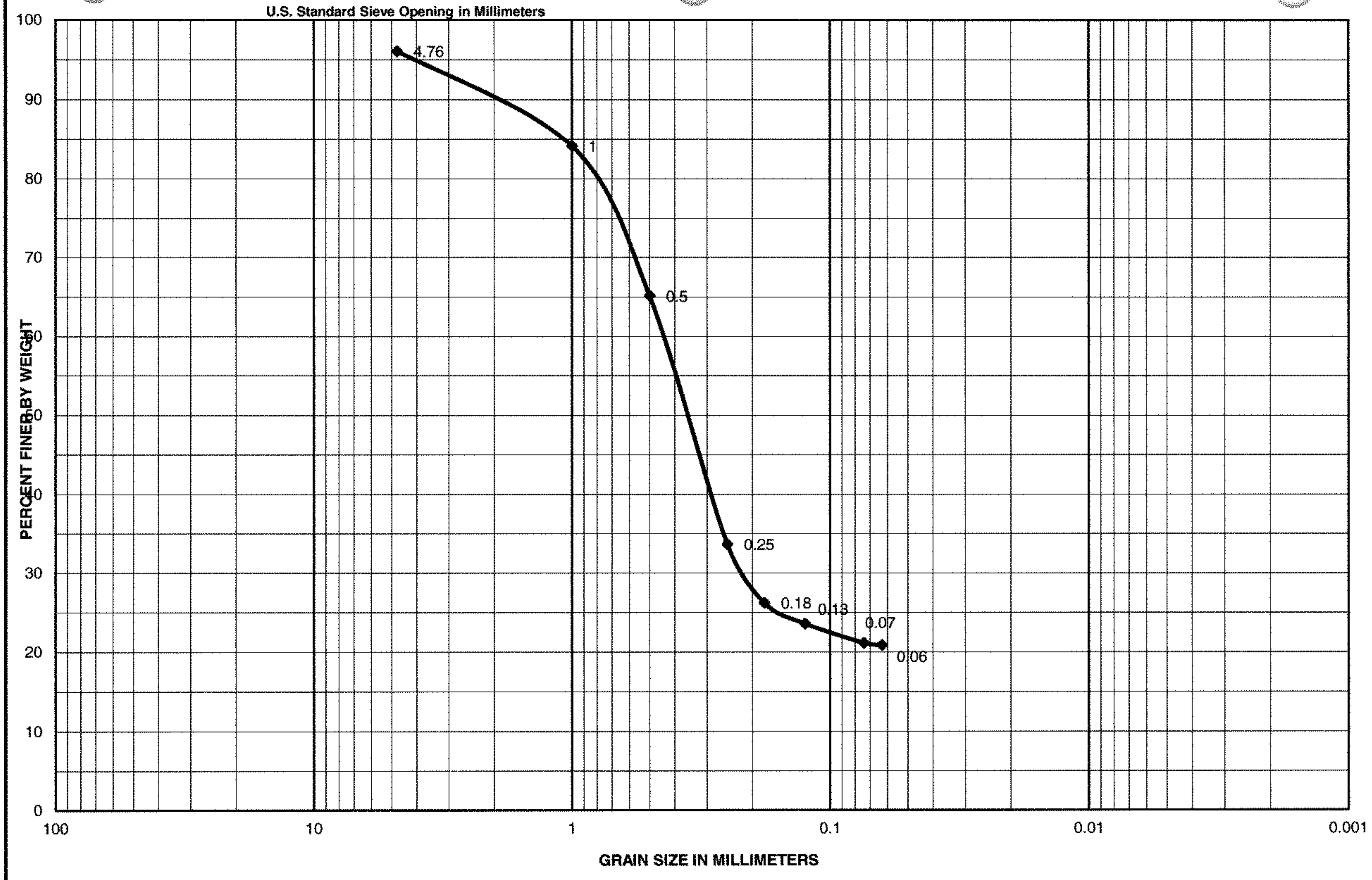
Drilling Log (Cont Sheet) | ELEVATION TOP OF HOLE 0.0 MLLW | Hole No.: **WH12-V-7**

PROJECT **WILMINGTON HARBOR** | INSTALLATION WILMINGTON DISTRICT | SHEET 2 OF 2 SHEETS

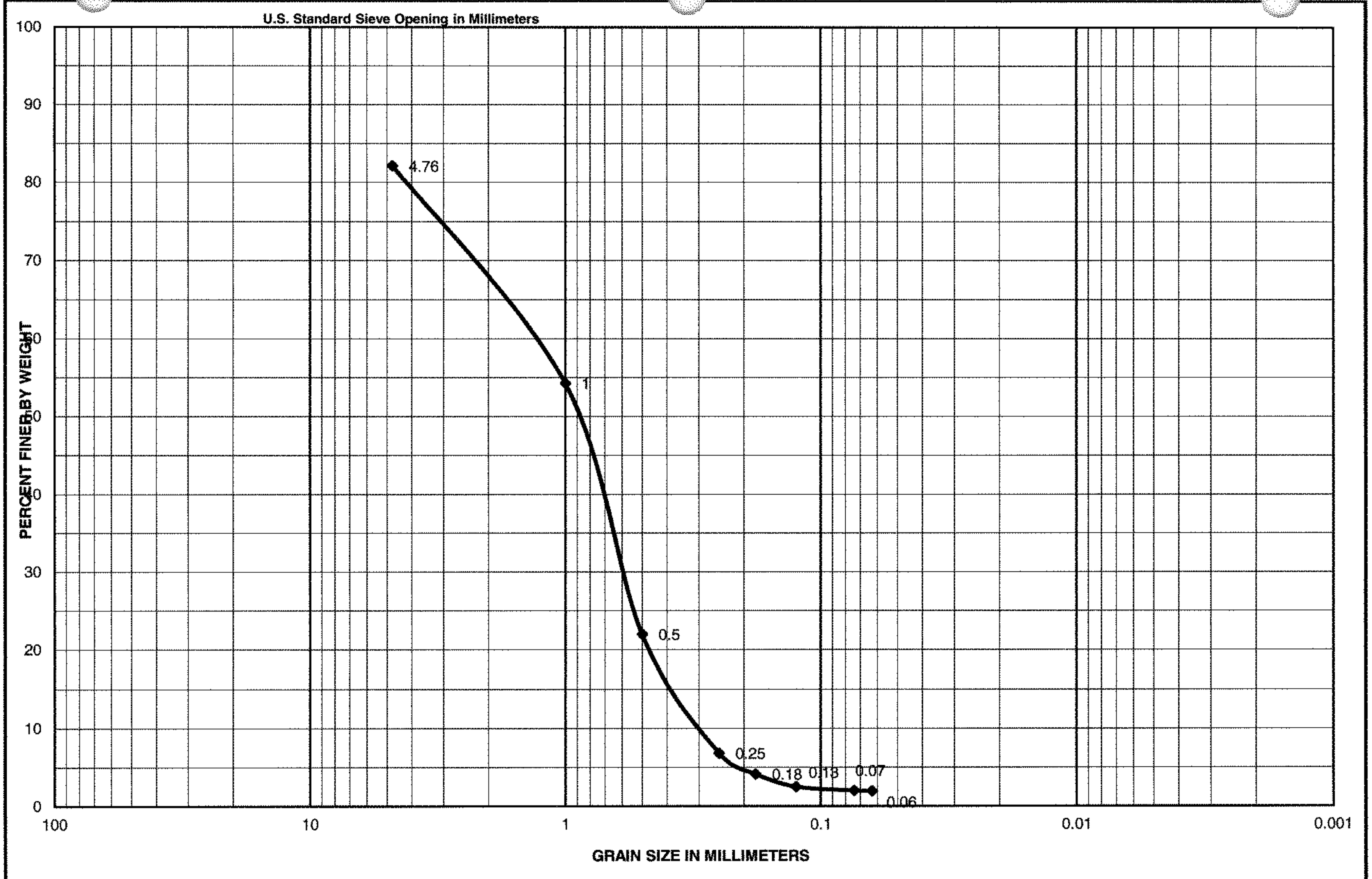
ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		🟥	**SP**, Tannish light gray, poorly graded sand. *(continued from previous page)*		4	
-57.5					57.5	
	58.0	🟩	**CL**, Dark gray lean clay.		5	
-58.5			BOTTOM OF HOLE AT 58.5' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM		58.5	
	60.0					
	62.0					
	64.0					
	66.0					
	68.0					
	70.0					
	72.0					
	74.0					
	76.0					
	78.0					
	80.0					

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71

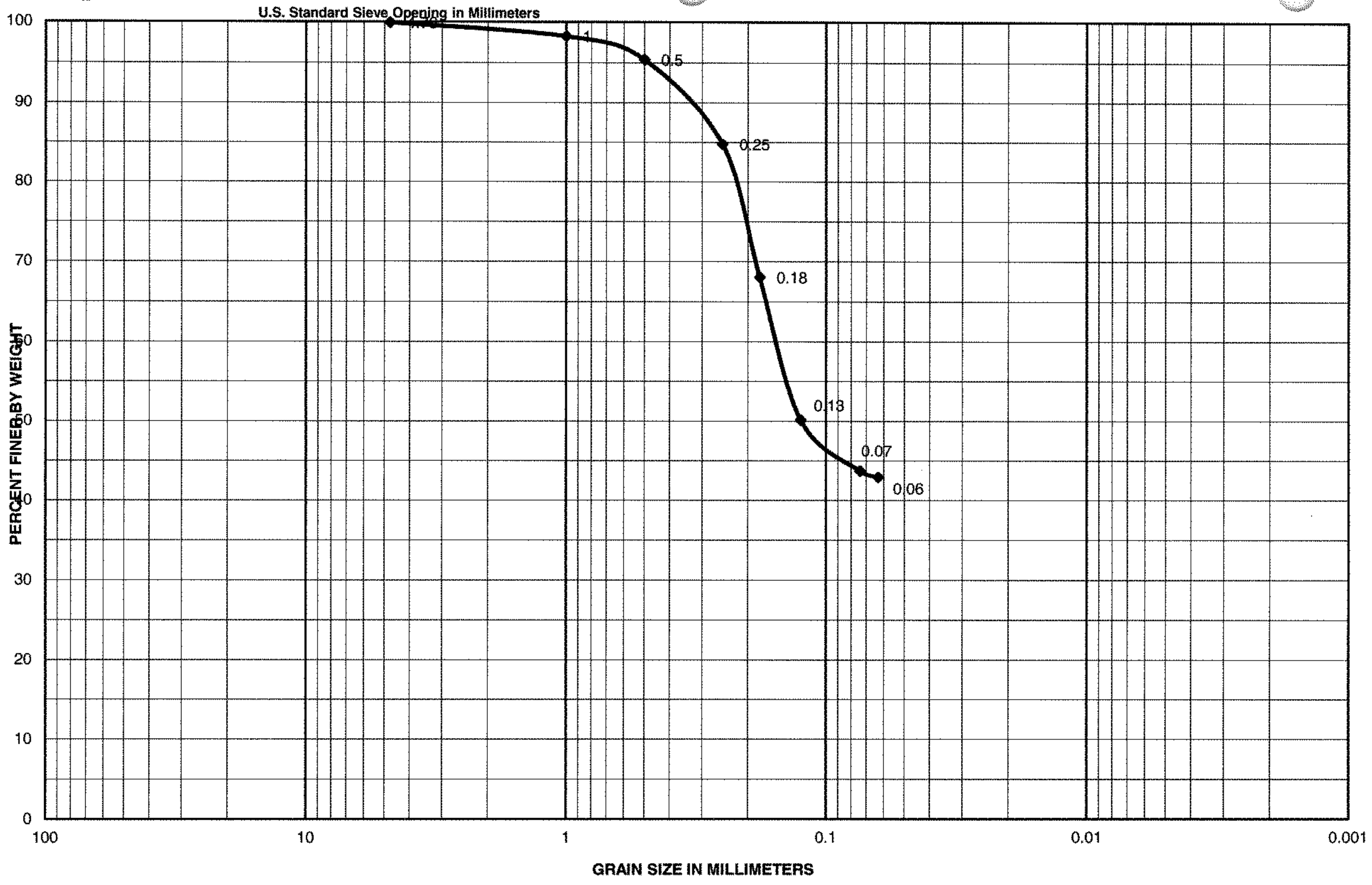
PROJECT WILMINGTON HARBOR | HOLE NO. WH12-V-7



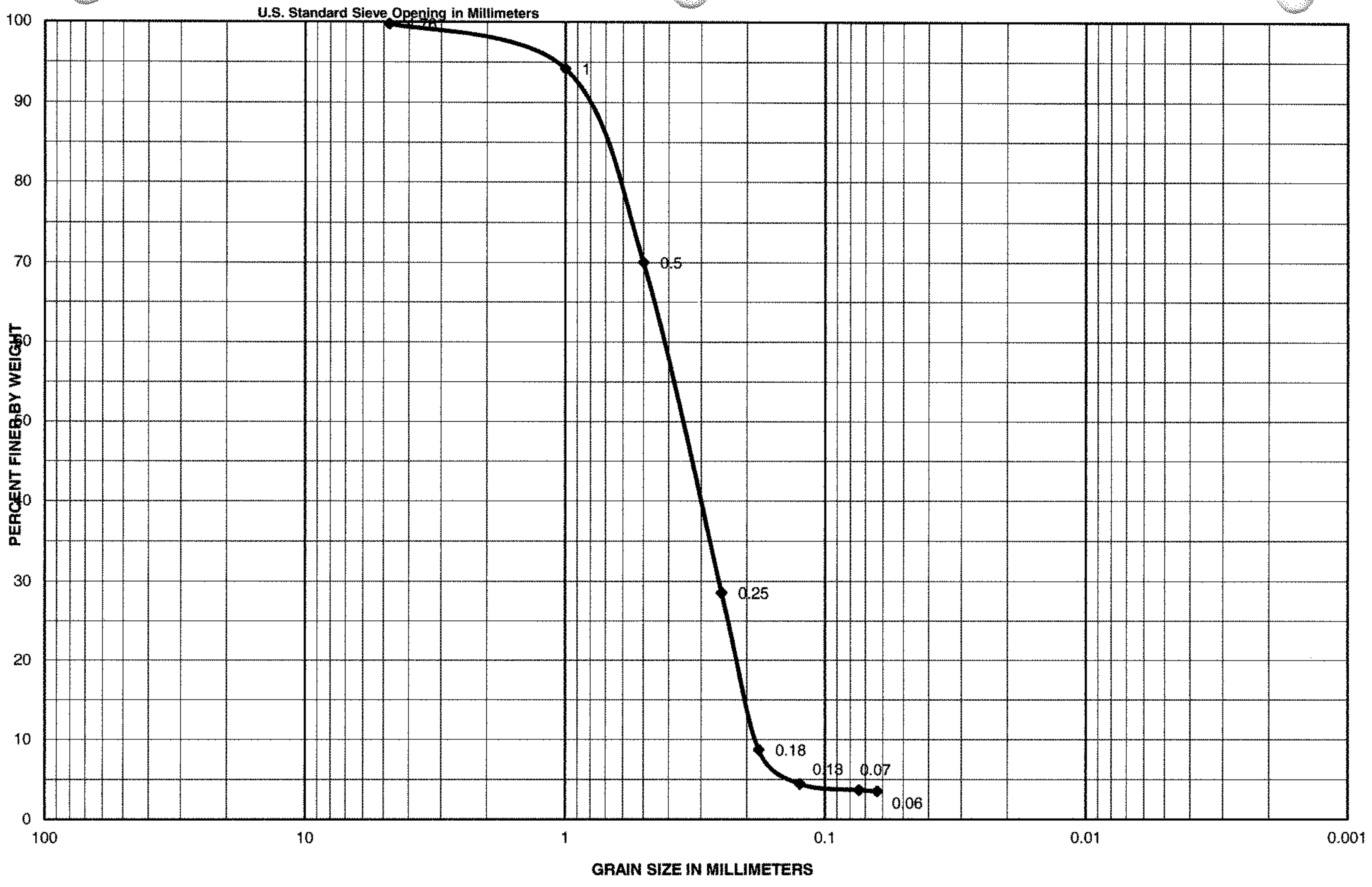
Sample No.	Elevation	Classification	**Area**	Wilmington Harbor
2	40.7 to 44.5	Dark gray clayey sand with little shells, SC	**CATLIN Geotechnical Laboratory**	
		20.6% Shells	**Boring No.**	WH12-V-7
			Date	10/8/2012



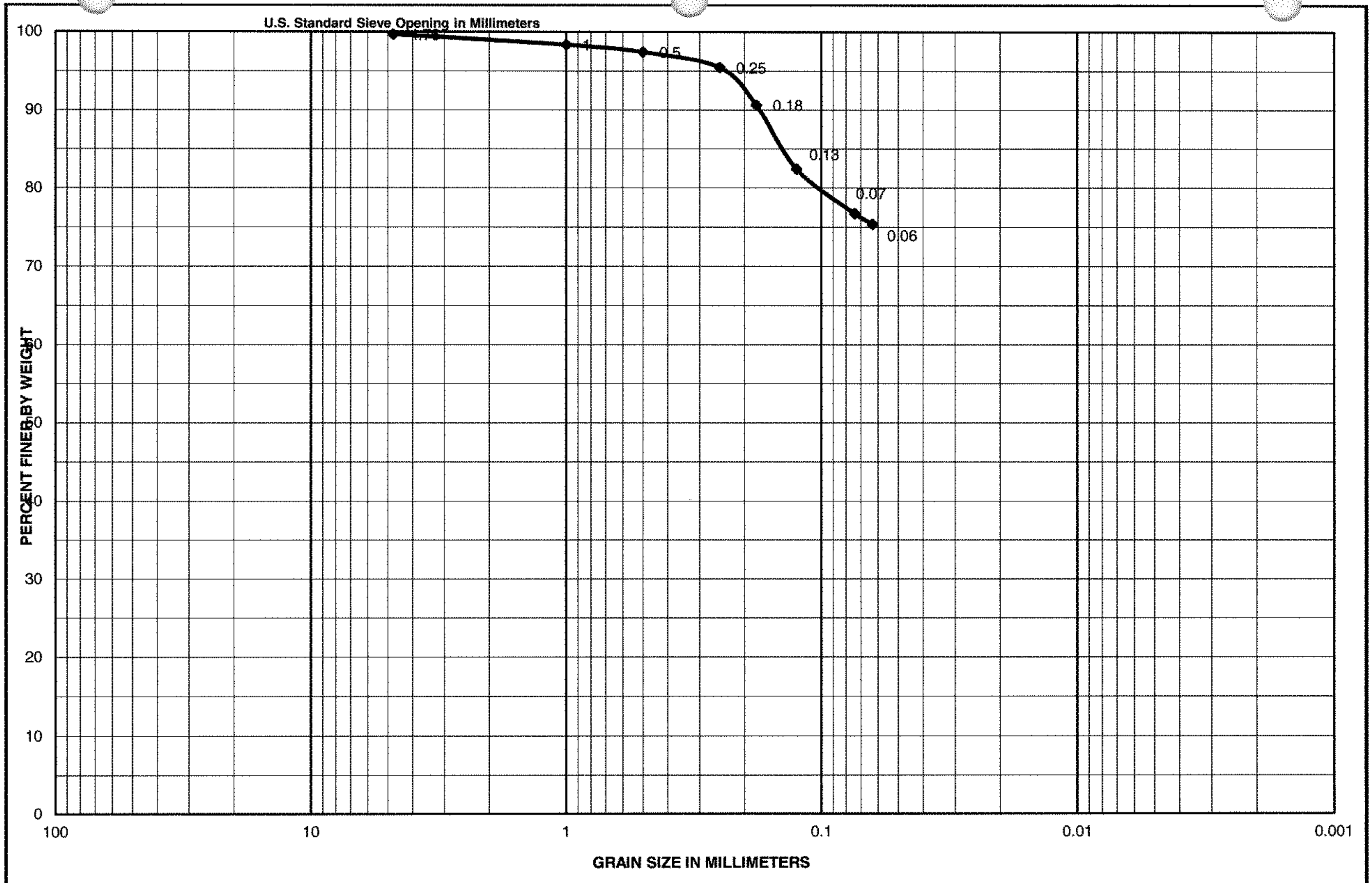
Sample No.	Elevation	Classification	**Area**	Wilmington Harbor
1	39.5 to 40.7	Olive gray poorly graded sand with some shells , SP	**CATLIN Geotechnical Laboratory**	
		45.8% Shells	**Boring No.**	WH12-V-7
			Date	10/9/2012



Sample No.	Elevation	Classification	Area	Wilmington Harbor
5	57.5 to 59.5	Dark gray clayey sand with little organics, SC	**CATLIN Geotechnical Laboratory**	
		15.2 Organics	**Boring No.**	WH12-V-7
			Date	10/15/12



Sample No.	Elevation	Classification	Area	Wilmington Harbor
4	52.2 to 57.5	Olive gray poorly graded sand and trace organics, SP	**CATLIN Geotechnical Laboratory**	
		0.3% Organics	**Boring No.**	WH12-V-7
			Date	10/12/12



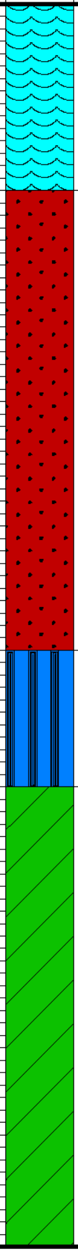
Sample No.	Elevation	Classification
3	44.5 to 52.2	Dark gray lean clay with sand and trace organics, CL
		1.6% Organics

Area	Wilmington Harbor
CATLIN Geotechnical Laboratory	
Boring No.	WH12-V-7
Date	10/15/12

Hole No.: **WH12-V-8**

Vibratory Drilling Log	DIVISION SAD	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT **WILMINGTON HARBOR**
2. LOCATION N 46,693.0 E 2,300,304.0
3. DRILLING AGENCY WILMINGTON DISTRICT
4. HOLE NO.(As shown on drawing title and file number) WH12-V-8
5. NAME OF DRILLER Talon Smith
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL
7. THICKNESS OF WATER COLUMN 32.0'
8. DEPTH DRILLED INTO ROCK 0.0'
9. TOTAL DEPTH OF HOLE 50.0'
10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN : DISTURBED 4 : UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER N/A
16. DATE HOLE : STARTED 7/11/12 COMPLETED 7/11/12
17. ELEVATION TOP OF HOLE 0.0
18. TOTAL CORE RECOVERY FOR BORING N/A
19. SIGNATURE OF INSPECTOR ,



ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f
	30.0	🟦	0.0' TO 32' WATER OCEAN BOTTOM @32'		
-32.0	32.0 34.0 36.0 38.0	🟥	**SP**, Tannish light gray, coarse, poorly graded sand.		32 1
-39.4	40.0	🟦	**MH**, Dark gray elastic silt.		39.4 2
-41.6	42.0 44.0 46.0 48.0	🟩	**CL**, Dark gray sandy, clay.		41.6 3
-49.0					

REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g

Time begin vibracoring: 0000 hrs.

Soils Field Classified by Zachry Nichols, Civil Engineer

NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.

VIBRACORE BORING
From 0.0' to 19.80'
Ran 20' Rec: 20'

Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.

LAB CLASSIFICATION

Jar Number	Classification
1	SP
2	SM
3	CL
4	SC

Soils are Lab Classified in Accordance with ASTM-D2487

COMPLETION NOTE: Terminated hole at refusal or predetermined depth at 18' below ocean bottom

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PROJECT WILMINGTON HARBOR | HOLE NO. WH12-V-8

Drilling Log (Cont Sheet)

ELEVATION TOP OF HOLE 0.0 MLLW

Hole No.: **WH12-V-8**

PROJECT **WILMINGTON HARBOR**

INSTALLATION WILMINGTON DISTRICT

SHEET 2 OF 2 SHEETS

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-50.0	50.0	🟥🟨	**SP-SM**, Light gray, poorly graded silty sand.		49 4 50	
			BOTTOM OF HOLE AT 50' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			
	52.0					
	54.0					
	56.0					
	58.0					
	60.0					
	62.0					
	64.0					
	66.0					
	68.0					
	70.0					
	72.0					

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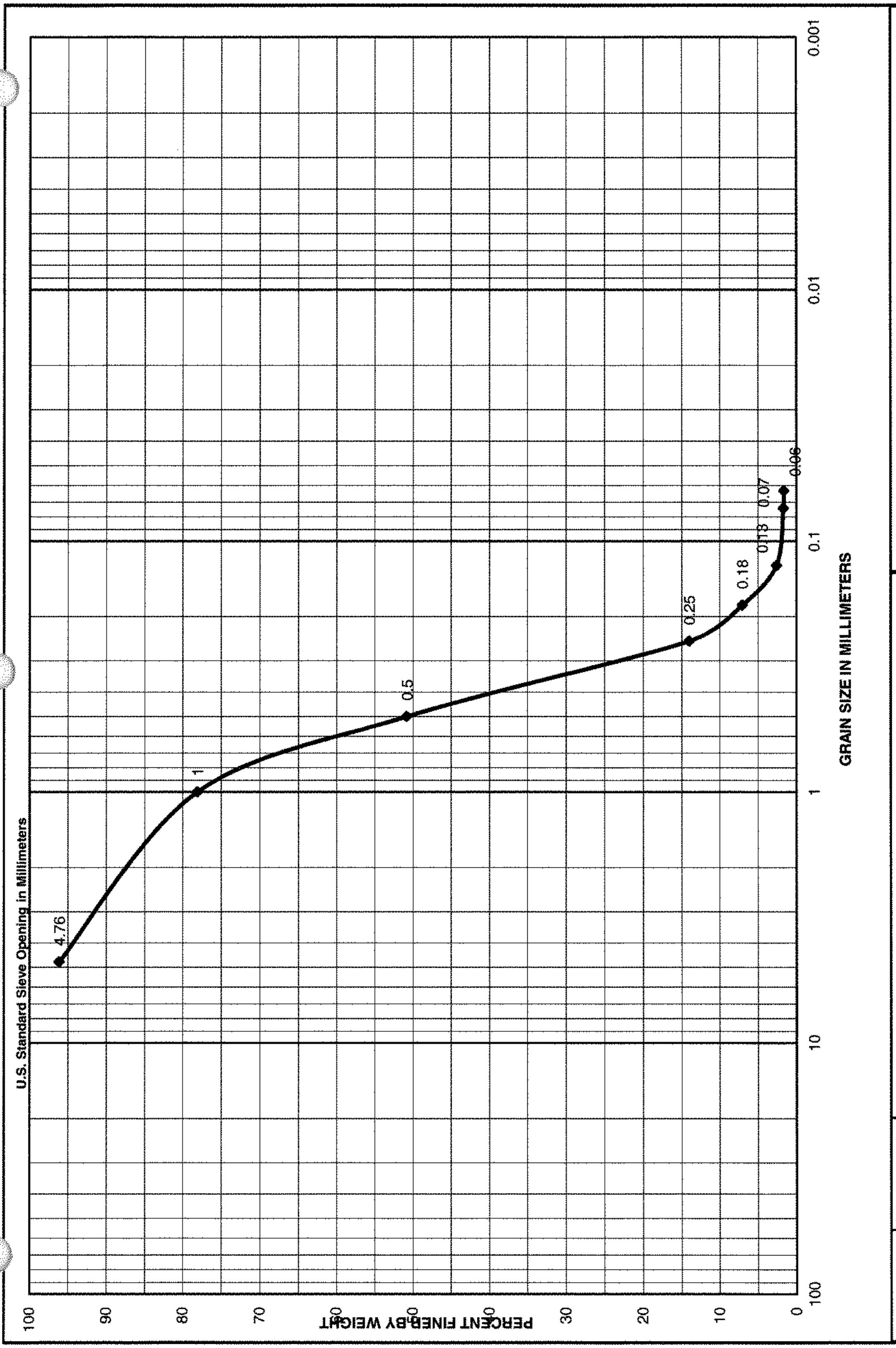
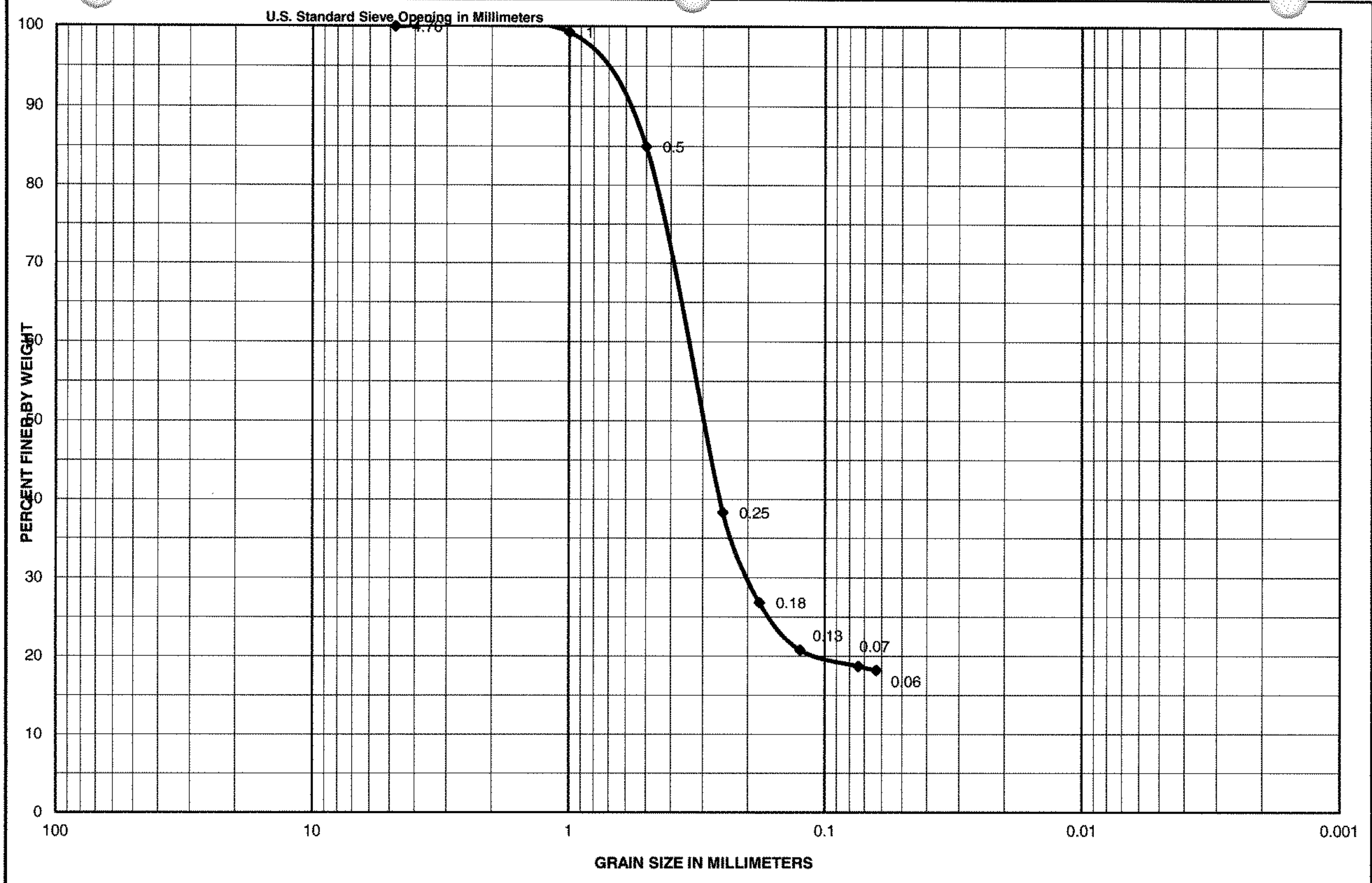
PROJECT WILMINGTON HARBOR

HOLE NO. WH12-V-8



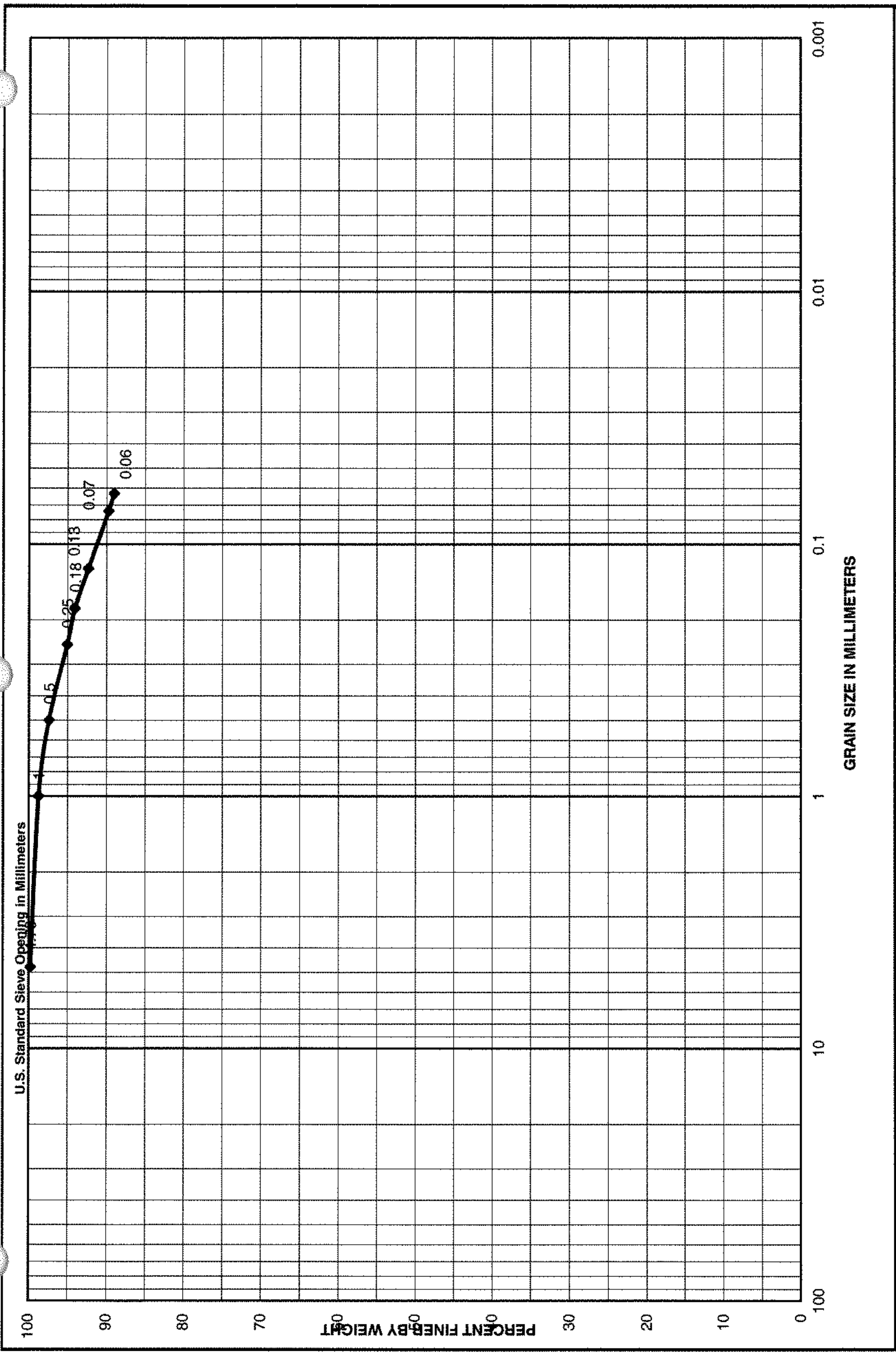
Sample No.	Elevation	Classification
1	32 to 39.4	Olive gray/light brown poorly graded sand with some shells, SP
		49.2% Shells

Area	Wilmington Harbor
CATLIN Geotechnical Laboratory	
Boring No.	WH12-V-8
Date	10/8/2012



Sample No.	Elevation	Classification
4	49.0 to 50.0	Dark gray clayey sand, SC

Area	Wilmington Harbor
CATLIN Geotechnical Laboratory	
Boring No.	WH12-V-8
Date	10/12/12



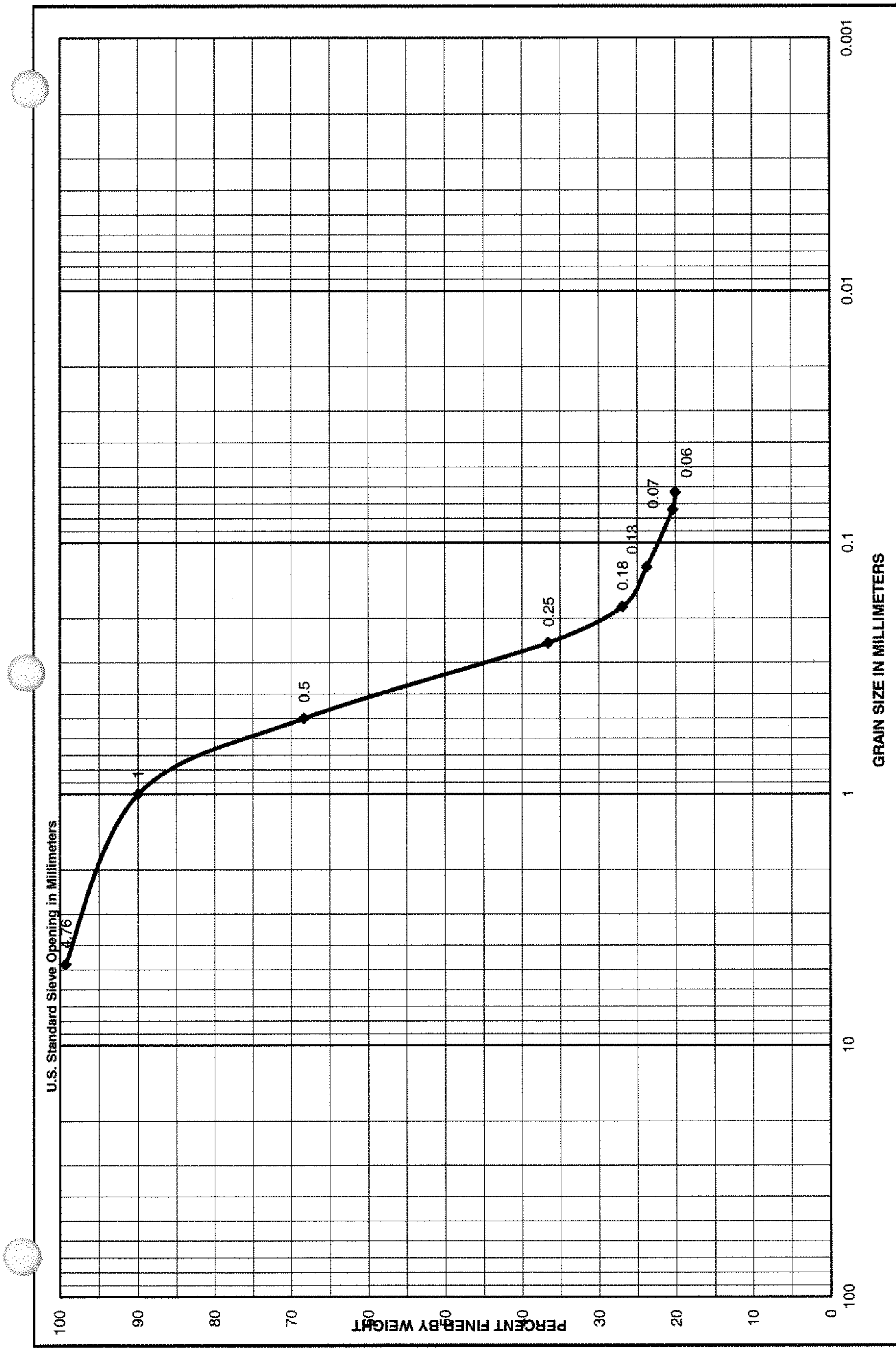
Sample No.	Elevation	Classification
3	41.6 to 49.0	Dark gray lean clay, CL

Area Wilmington Harbor

CATLIN Geotechnical Laboratory

Boring No. WH12-V-8

Date 10/15/12



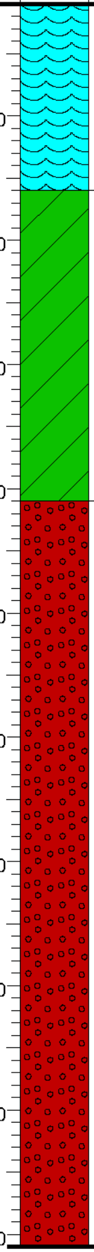
Sample No.	Elevation	Classification	Area	Wilmington Harbor
2	39.4 to 41.6	Dark gray silty sand with few shells , SM	CATLIN Geotechnical Laboratory	
		10.0% Shells	Boring No.	WH12-V-8
			Date	10/9/2012

Hole No.: **WH12-V-9**

Vibratory Drilling Log
DIVISION SAD
INSTALLATION WILMINGTON DISTRICT
SHEET 1 OF 2 SHEETS

1. PROJECT **WILMINGTON HARBOR**
2. LOCATION N 45,974.0 E 2,300,056.0
3. DRILLING AGENCY WILMINGTON DISTRICT
4. HOLE NO. (As shown on drawing title and file number) WH12-V-9
5. NAME OF DRILLER Talon Smith
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL
7. THICKNESS OF WATER COLUMN 39.2'
8. DEPTH DRILLED INTO ROCK 0.0'
9. TOTAL DEPTH OF HOLE 59.2'
10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
11. DATUM FOR ELEVATION SHOWN *BM or MSL* MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 2 UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER N/A
16. DATE HOLE STARTED 7/11/12 COMPLETED 7/11/12
17. ELEVATION TOP OF HOLE 0.0
18. TOTAL CORE RECOVERY FOR BORING N/A
19. SIGNATURE OF INSPECTOR ,

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f
-39.2			0.0' TO 39.2' WATER OCEAN BOTTOM @39.2'		39.2
-44.2			**CL**, Dark brown lean clay, little wood.		1 44.2
			SW, Tannish gray, well graded sand.		2



REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g

Time begin vibracoring: 0000 hrs.

Soils Field Classified by Zachry Nichols, Civil Engineer

NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.

VIBRACORE BORING
From 0.0' to 26.70'
Ran 20' Rec: 20'

Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.

LAB CLASSIFICATION

Jar Number	Classification
1	SC
2	SP

Soils are Lab Classified in Accordance with ASTM-D2487

COMPLETION NOTE: Terminated hole at refusal or predetermined depth at 20' below ocean bottom

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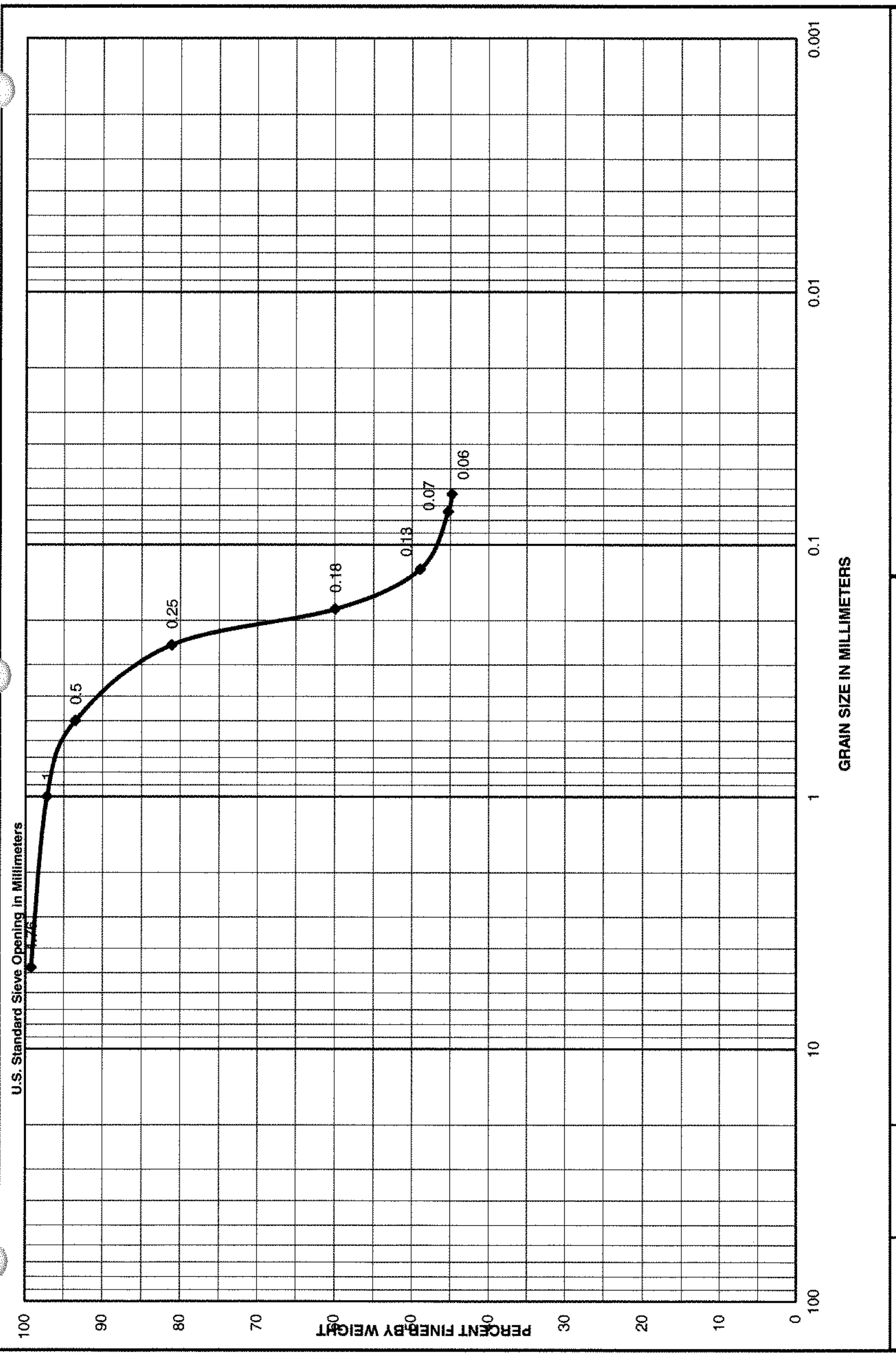
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-9

Drilling Log (Cont Sheet)
ELEVATION TOP OF HOLE 0.0 MLLW
Hole No.: **WH12-V-9**
PROJECT **WILMINGTON HARBOR**
INSTALLATION WILMINGTON DISTRICT
SHEET 2 OF 2 SHEETS

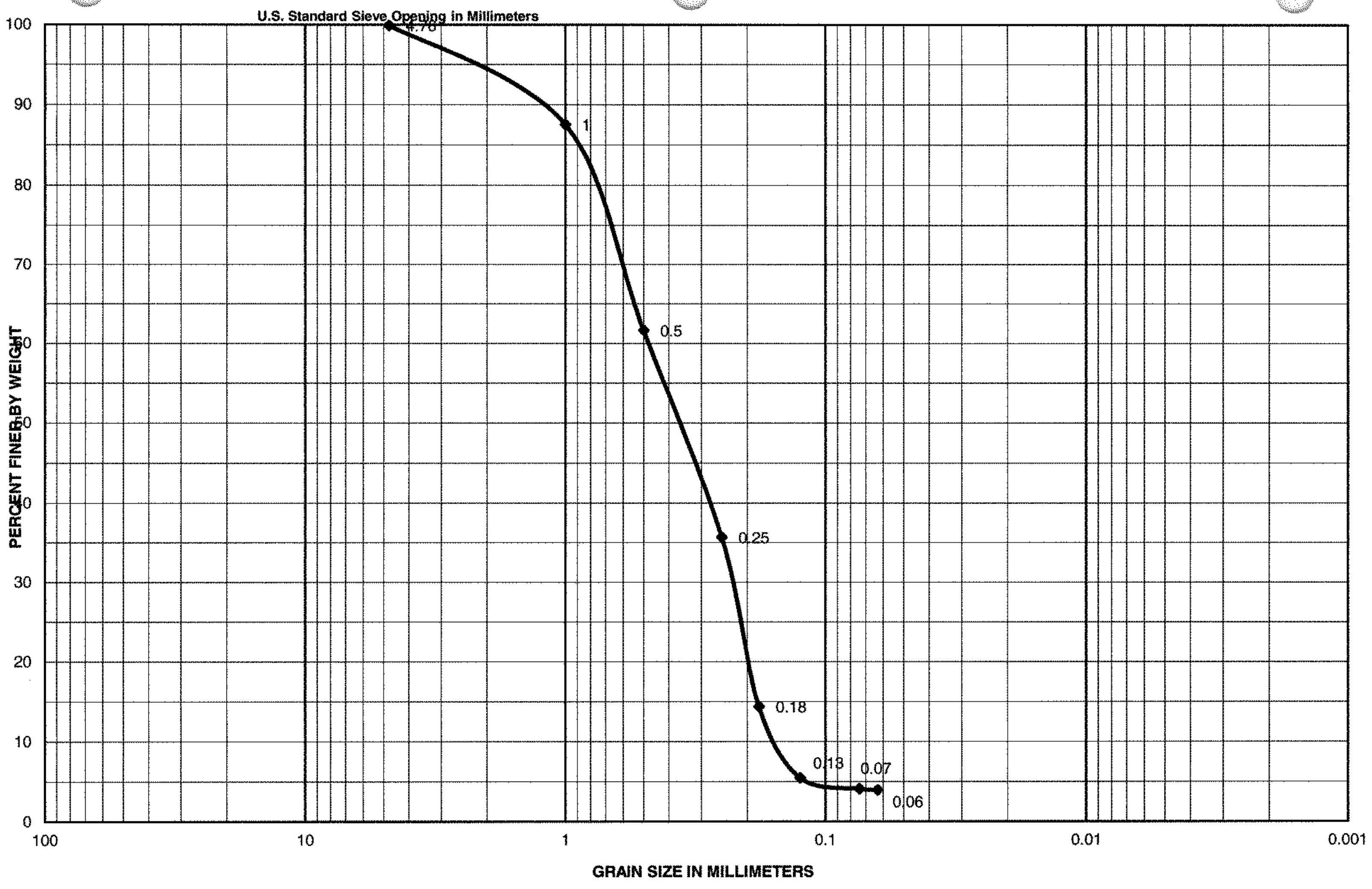
ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-59.2	58.0	▨	**SW**, Tannish gray, well graded sand. *(continued from previous page)*		2 59.2	
	60.0 62.0 64.0 66.0 68.0 70.0 72.0 74.0 76.0 78.0 80.0		BOTTOM OF HOLE AT 59.2' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-9



Sample No.	Elevation	Classification
1	39.2 to 44.2	Dark gray clayey sand with trace organics, SC
		6.5% Organics

Area	Wilmington Harbor
CATLIN Geotechnical Laboratory	
Boring No.	WH12-V-9
Date	10/23/12



Sample No.	Elevation	Classification
2	44.2 to 59.2	Olive gray poorly graded sand, SP

Area Wilmington Harbor

CATLIN Geotechnical Laboratory

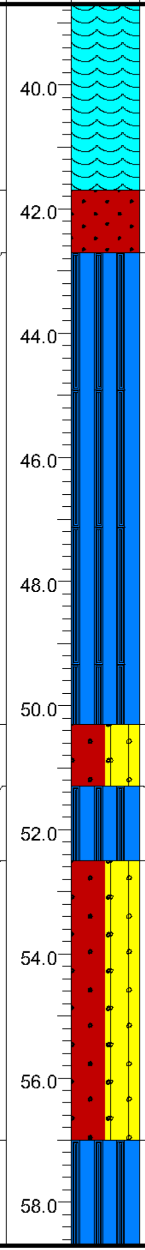
Boring No. WH12-V-9

Date 10/15/12

Hole No.: **WH12-V-10**

Vibratory Drilling Log	DIVISION SAD	INSTALLATION WILMINGTON DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT **WILMINGTON HARBOR**
2. LOCATION N 46,288.0 E 2,300,290.0
3. DRILLING AGENCY WILMINGTON DISTRICT
4. HOLE NO. (As shown on drawing title and file number) WH12-V-10
5. NAME OF DRILLER Talon Smith
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL
7. THICKNESS OF WATER COLUMN 41.7'
8. DEPTH DRILLED INTO ROCK 0.0'
9. TOTAL DEPTH OF HOLE 61.0'
10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
11. DATUM FOR ELEVATION SHOWN *BM or MSL* MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN : DISTURBED 6 : UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER N/A
16. DATE HOLE : STARTED 7/11/12 COMPLETED 7/11/12
17. ELEVATION TOP OF HOLE 0.0
18. TOTAL CORE RECOVERY FOR BORING N/A
19. SIGNATURE OF INSPECTOR



ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		🟦	0.0' TO 41.7' WATER OCEAN BOTTOM @41.7'			Time begin vibracoring: 0000 hrs. Soils Field Classified by Zachry Nichols, Civil Engineer NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.
-41.7		🟥	**SP**, Light gray, coarse, poorly graded sand.		41.7 1	
-42.7		🟦	**MH**, Dark gray elastic silt.		42.7 2	
-50.3		🟥🟨	**SP-SM**, Light gray poorly graded silt, fine to medium sand.		50.3 3	
-51.3		🟦	**MH**, Dark gray elastic silt.		51.3 4	
-52.5		🟥🟨	**SP-SM**, Light gray poorly graded silt, fine to medium sand.		52.5 5	
-57.0		🟦	**MH**, Dark gray silt, with wood.		57 6	

<u>VIBRACORE BORING</u>
From 0.0' to 21.00'
Ran 20' Rec: 20'

Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.

LAB CLASSIFICATION

Jar <u>Number</u>	<u>Classification</u>
1	SM
2	MH
3	SM
4	MH
5	SP-SM
6	MH

Soils are Lab Classified in Accordance with ASTM-D2487

COMPLETION NOTE:
Terminated hole at refusal or predetermined depth at 19.3' below ocean bottom

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MAR 71

PROJECT WILMINGTON HARBOR | HOLE NO. WH12-V-10

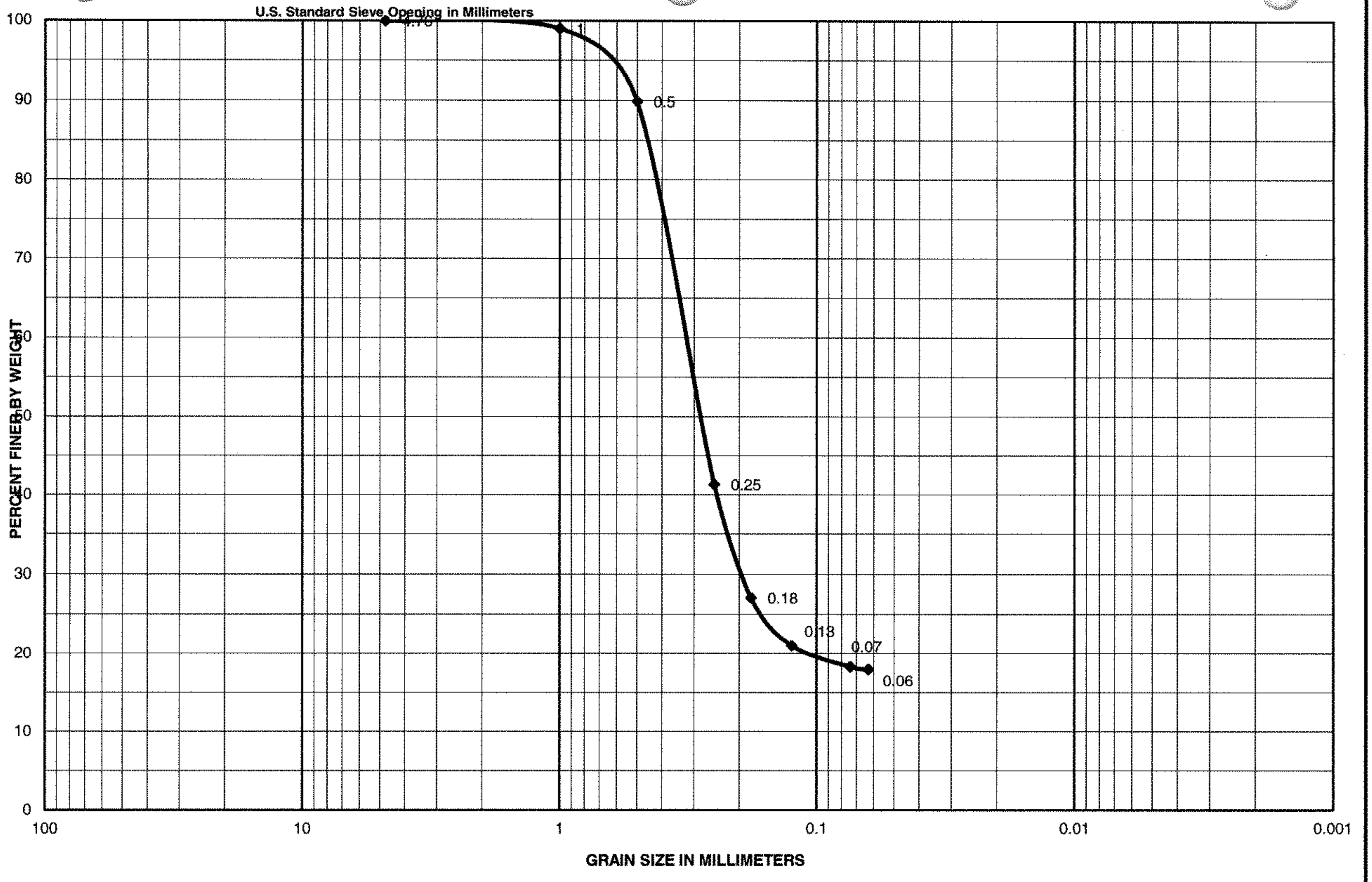
Drilling Log (Cont Sheet) ELEVATION TOP OF HOLE 0.0 MLLW

Hole No.: **WH12-V-10**

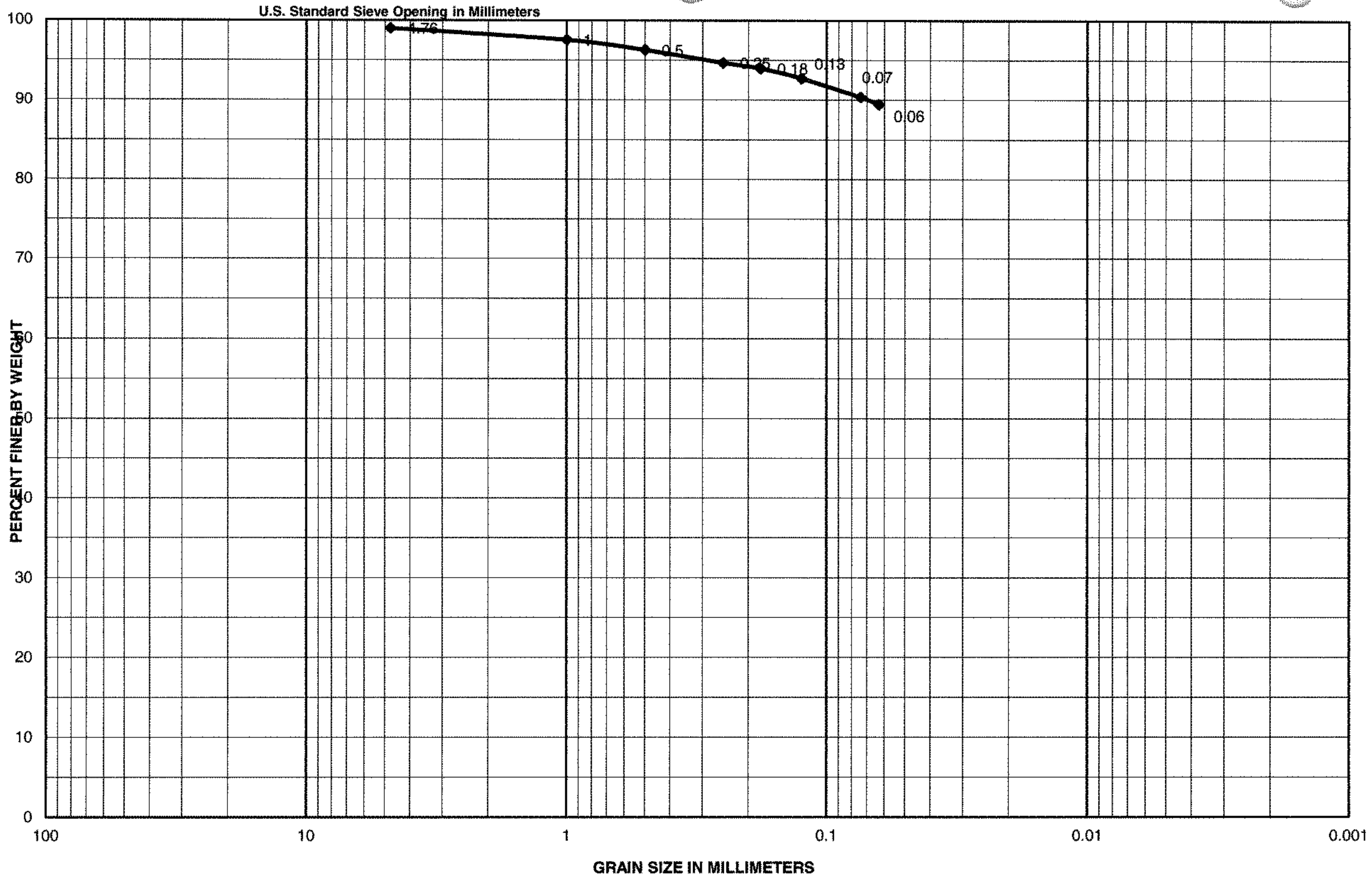
PROJECT **WILMINGTON HARBOR**
INSTALLATION WILMINGTON DISTRICT
SHEET 2 OF 2 SHEETS

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		▨	**MH**, Dark gray silt, with wood. *(continued from previous page)*		6	
	60.0	▨				
-61.0					61	
			BOTTOM OF HOLE AT 61' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			
	62.0					
	64.0					
	66.0					
	68.0					
	70.0					
	72.0					
	74.0					
	76.0					
	78.0					
	80.0					
	82.0					

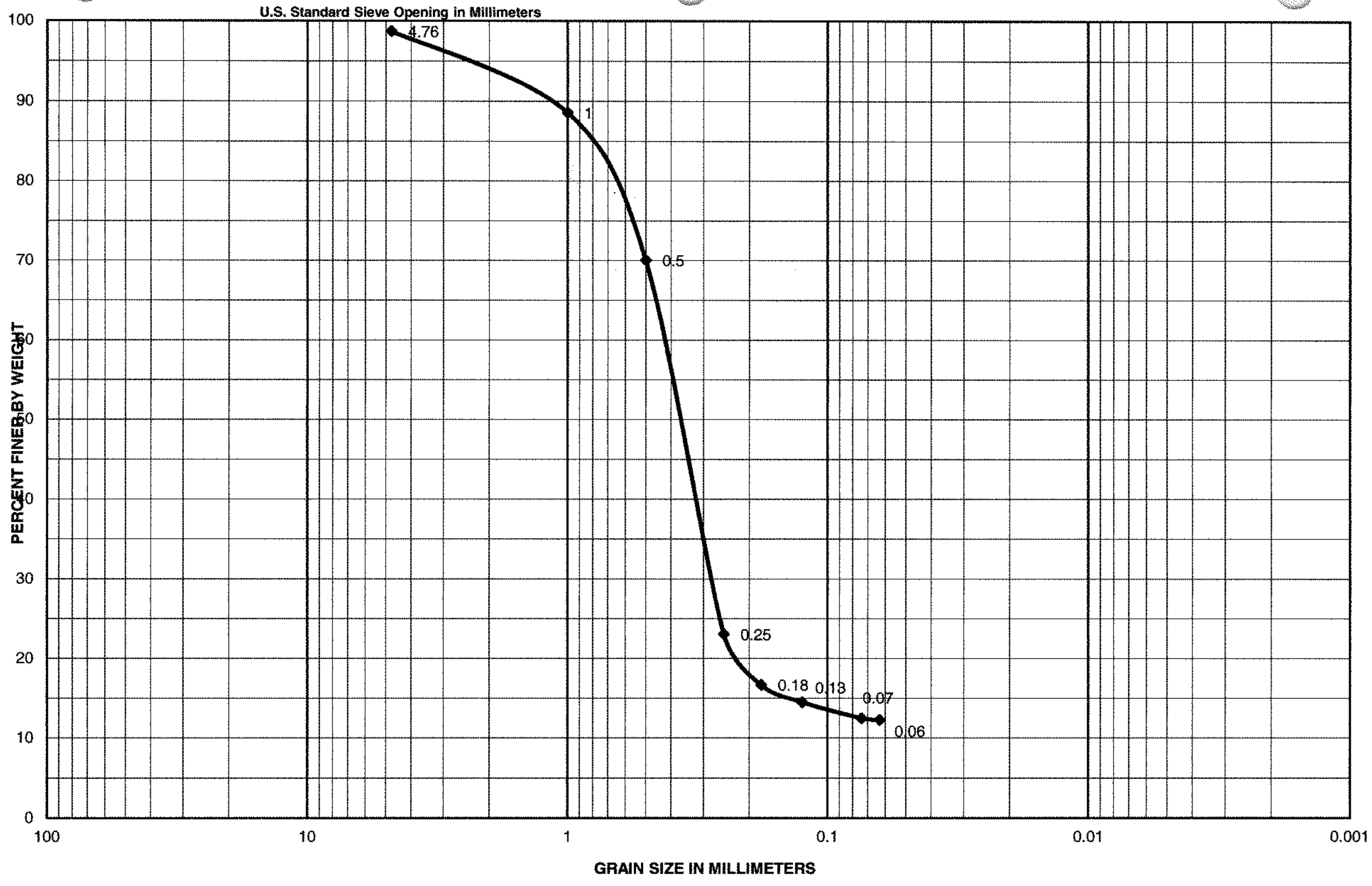
ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-10



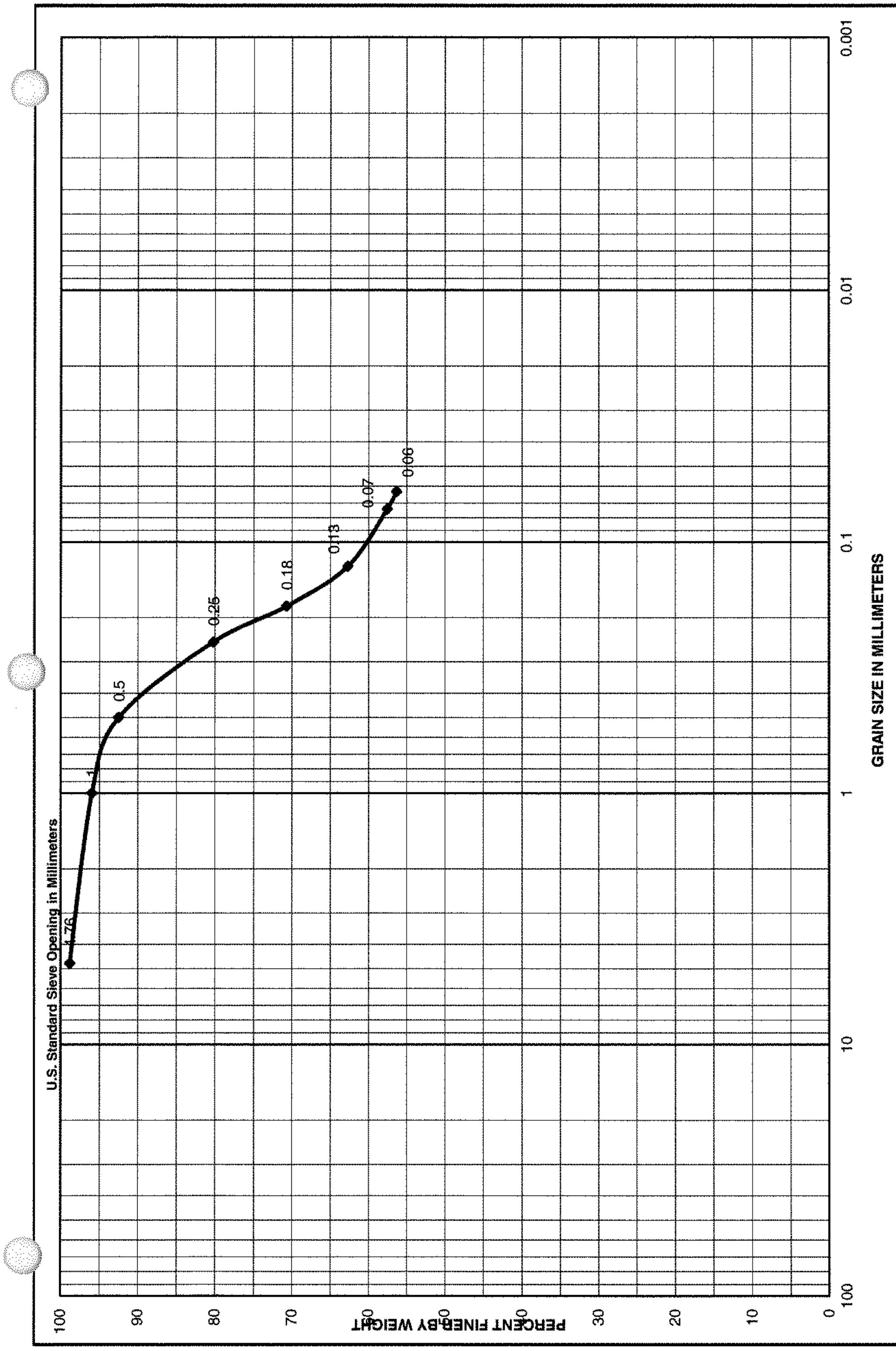
Sample No.	**Elevation**	**Classification**	**Area**	Wilmington Harbor
3	50.3 to 51.3	Olive gray silty sand with trace organics, SM	**CATLIN Geotechnical Laboratory**	
		1.0% Organics	**Boring No.**	WH12-V-10
			Date	10/12/12



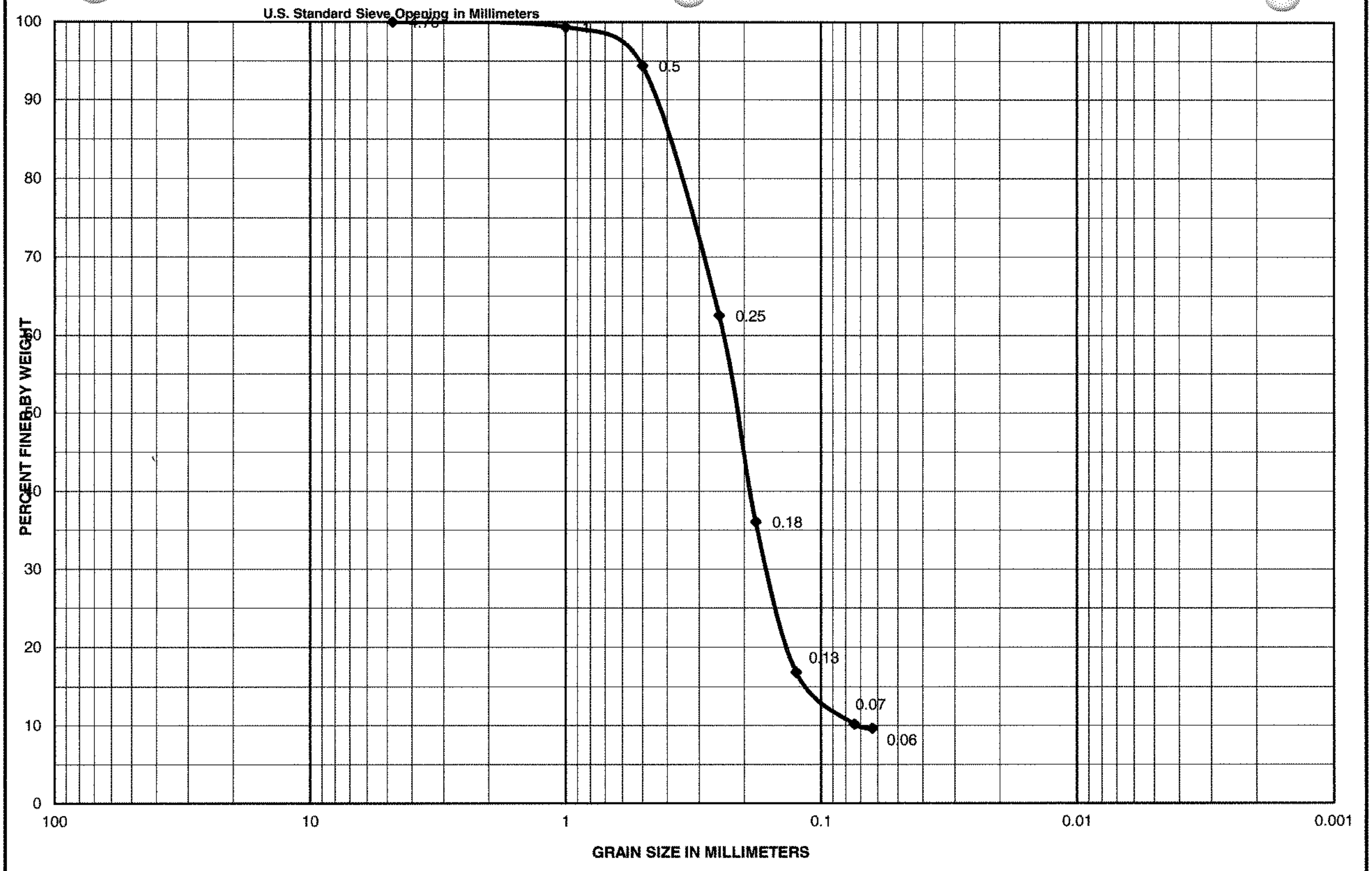
Sample No.	Elevation	Classification	Area Wilmington Harbor
2	42.7 to 50.3	Dark gray elastic silt with trace organics, MH	**CATLIN Geotechnical Laboratory**
		3.8% Organics	**Boring No.** WH12-V-10
			Date 10/15/12



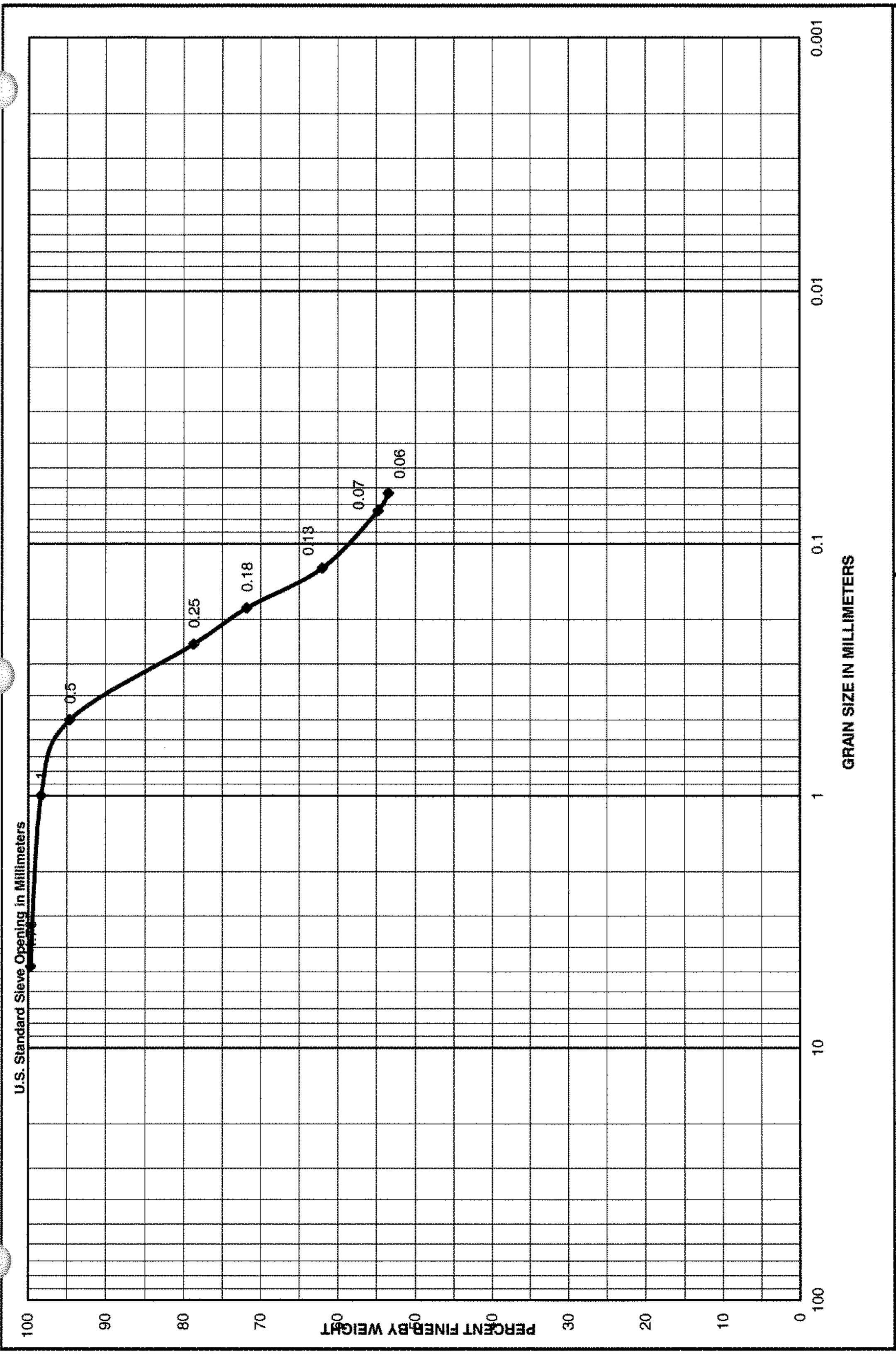
Sample No.	Elevation	Classification	**Area** Wilmington Harbor
1	41.7 to 42.7	Olive gray silty sand with few shells , SM	**CATLIN Geotechnical Laboratory**
		11.4% Shells	**Boring No.** WH12-V-10
			Date 10/9/2012



Sample No.	Elevation	Classification	Area	Wilmington Harbor
6	57.0 to 61.0	Dark gray sandy elastic silt, MH	**CATLIN Geotechnical Laboratory**	
			Boring No.	WH12-V-10
			Date	10/15/12



Sample No.	Elevation	Classification	Area	Wilmington Harbor
5	52.5 to 57.0	Olive gray poorly graded sand with silt and	**CATLIN Geotechnical Laboratory**	
		few shells and organics, SP-SM 5.6% Shells and Organics	**Boring No.**	WH12-V-10
			Date	10/8/2012



Sample No.	Elevation	Classification	Area	Wilmington Harbor
4	51.3 to 52.5	Dark gray sandy elastic silt with trace organics, MH	CATLIN Geotechnical Laboratory	
		1.7% Organics	Boring No.	WH12-V-10
			Date	10/15/12

Hole No.: **WH12-V-11**

Vibratory Drilling Log
DIVISION SAD
INSTALLATION WILMINGTON DISTRICT
SHEET 1 OF 1 SHEETS

1. PROJECT **WILMINGTON HARBOR**
2. LOCATION N 46,357.0 E 2,300,043.0
3. DRILLING AGENCY WILMINGTON DISTRICT
4. HOLE NO. (As shown on drawing title and file number) WH12-V-11
5. NAME OF DRILLER Talon Smith
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL
7. THICKNESS OF WATER COLUMN 32.9'
8. DEPTH DRILLED INTO ROCK 0.0'
9. TOTAL DEPTH OF HOLE 48.2'
10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN : DISTURBED 5 : UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER N/A
16. DATE HOLE : STARTED 7/11/12 COMPLETED 7/11/12
17. ELEVATION TOP OF HOLE 0.0
18. TOTAL CORE RECOVERY FOR BORING N/A
19. SIGNATURE OF INSPECTOR

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	30.0 32.0	🟦	0.0' TO 32.9' WATER OCEAN BOTTOM @32.9'			Time begin vibracoring: 0000 hrs. Soils Field Classified by Zachry Nichols, Civil Engineer NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.
-32.9	34.0	🟥	**SP**, Tan to light brown, poorly graded sand.		32.9 1	
-36.1	36.0 38.0	🟩	**CL**, Dark gray lean clay, with, trace wood.		36.1 2	VIBRACORE BORING From 0.0' to 16.90' Ran 20' Rec: 20' Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.
-39.7	40.0 42.0	🟥🟨	**SP-SM**, Dark gray, poorly graded clayey sand, and decayed wood.		39.7 3	LAB CLASSIFICATION Jar Number Classification 1 SM 2 SC 3 SM 4 CL 5 SM
-43.4	44.0	🟩	**CL**, Dark gray lean clay, clay, trace wood.		43.4 4	Soils are Lab Classified in Accordance with ASTM-D2487
-46.0	46.0	🟨	**SM**, Gray, silty sand.		46 5	
-48.2	48.0		BOTTOM OF HOLE AT 48.2' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOILS CLASSIFICATION SYSTEM		48.2	COMPLETION NOTE: Terminated hole at refusal or predetermined depth at 15.3' below ocean bottom

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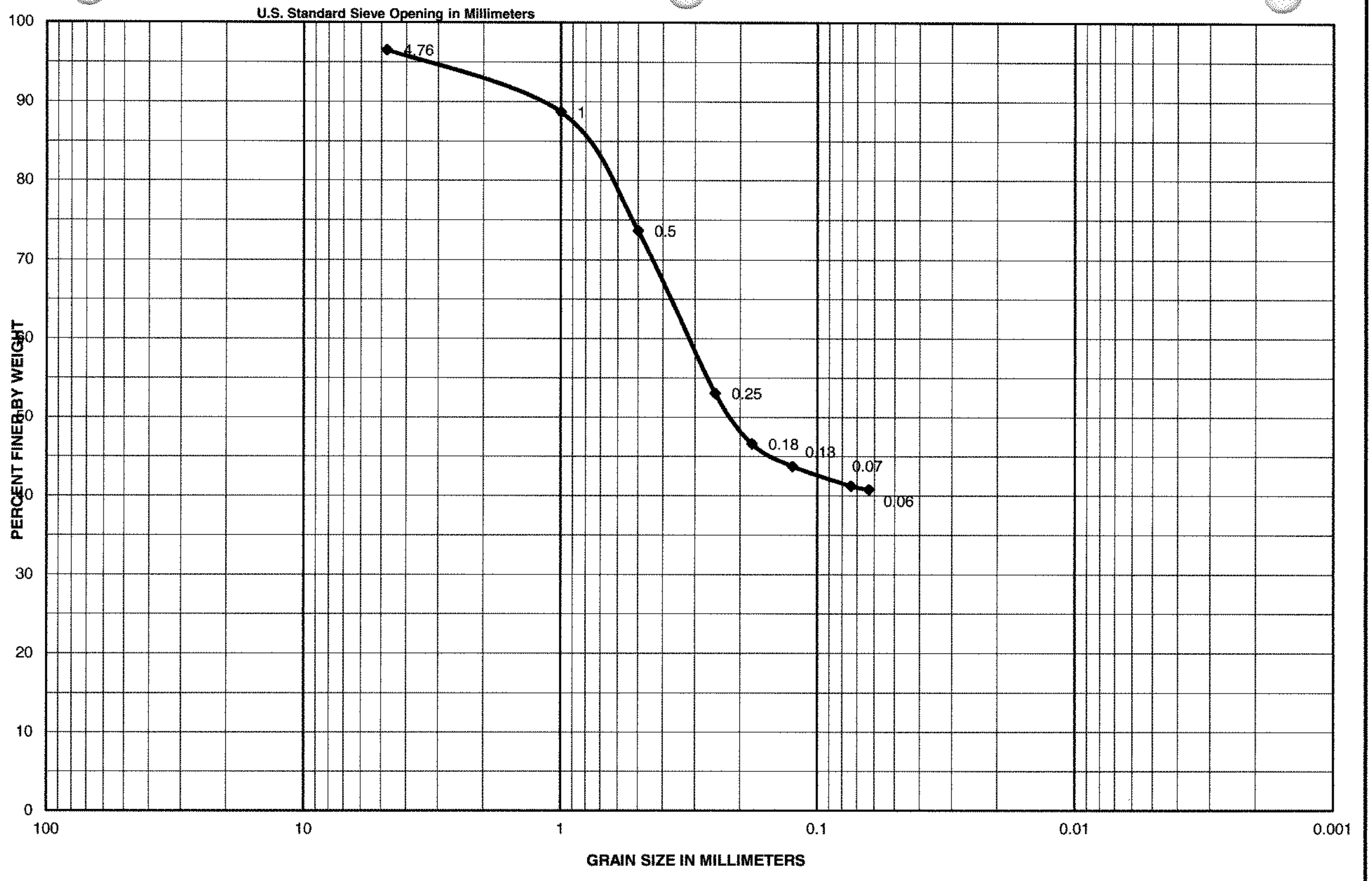
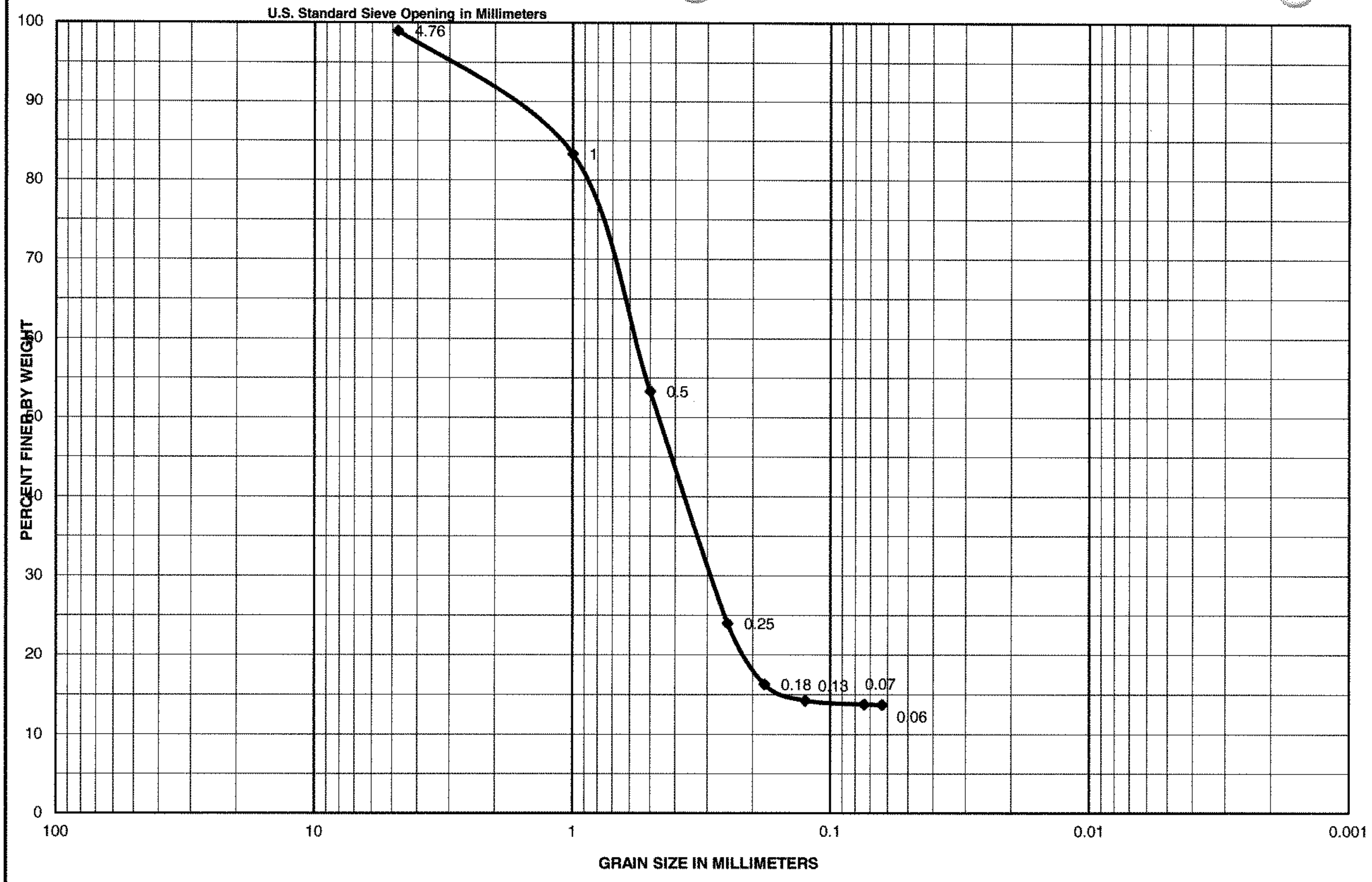
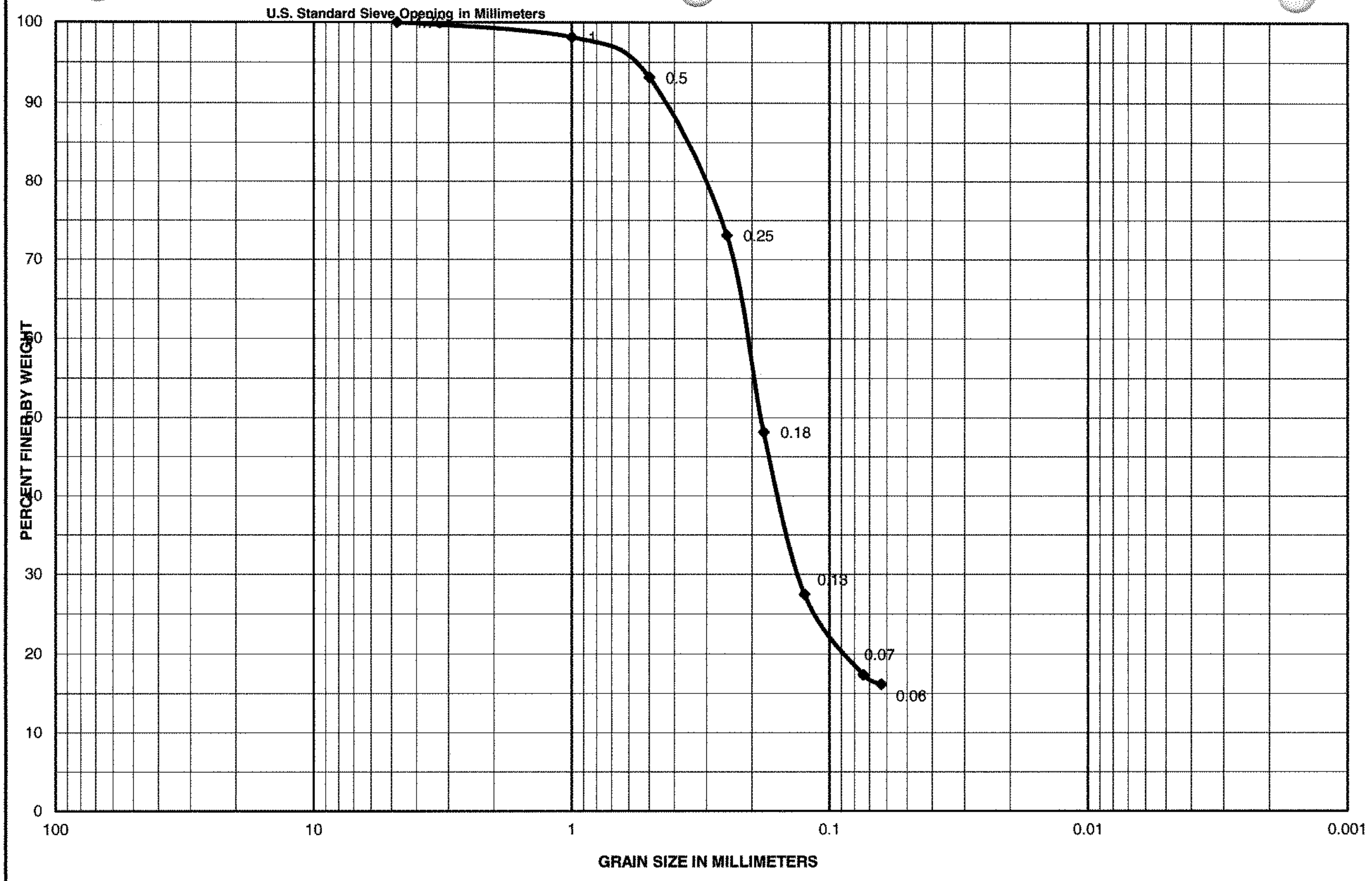
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-11



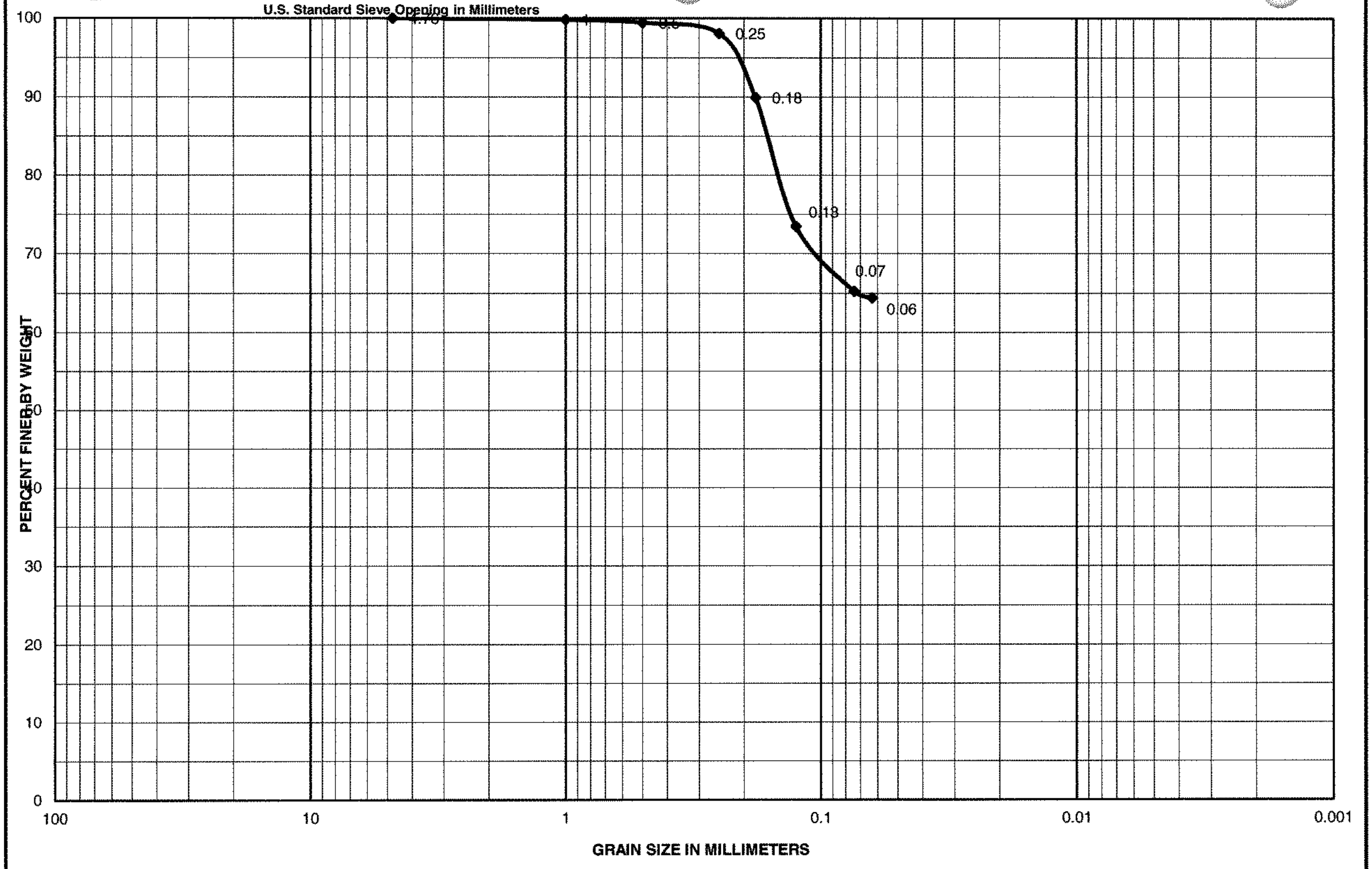
Sample No.	Elevation	Classification	**Area**	Wilmington Harbor
2	36.1 to 39.7	Dark gray clayey sand with little organics, SC	**CATLIN Geotechnical Laboratory**	
		26.4% Organics	**Boring No.**	WH12-V-11
			Date	10/22/12



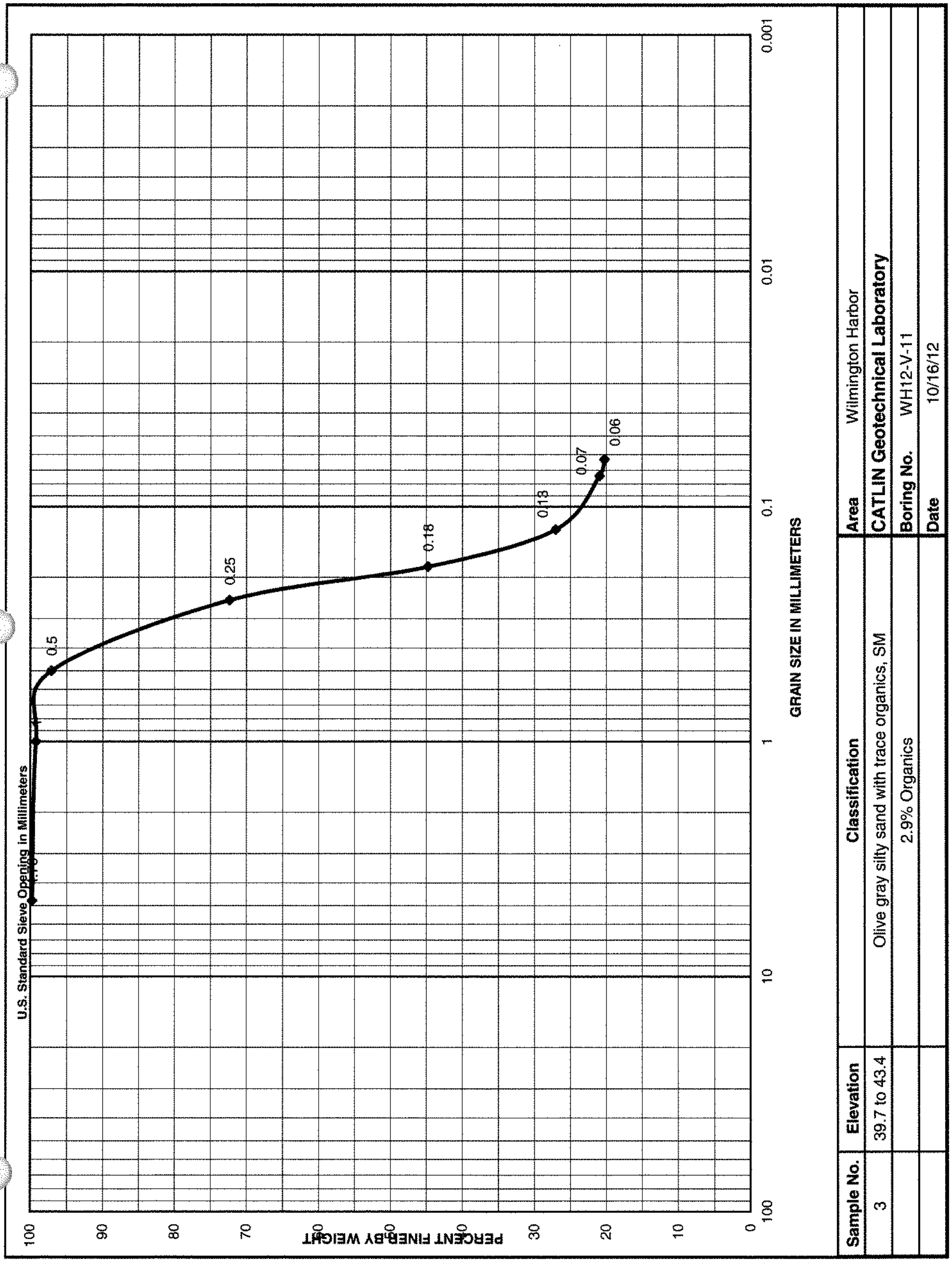
Sample No.	Elevation	Classification	Area	Wilmington Harbor
1	32.9 to 36.1	Olive gray silty sand, SM	**CATLIN Geotechnical Laboratory**	
			Boring No.	WH12-V-11
			Date	10/16/12



Sample No.	Elevation	Classification	**Area**	Wilmington Harbor
5	46 to 48.2	Light gray silty sand, SM	**CATLIN Geotechnical Laboratory**	
			Boring No.	WH12-V-11
			Date	10/8/2012



Sample No.	**Elevation**	**Classification**	**Area**	Wilmington Harbor
4	43.4 to 46	Olive gray sandy lean clay with trace organics, CL	**CATLIN Geotechnical Laboratory**	
		0.6% Organics	**Boring No.**	WH12-V-11
			Date	10/23/12

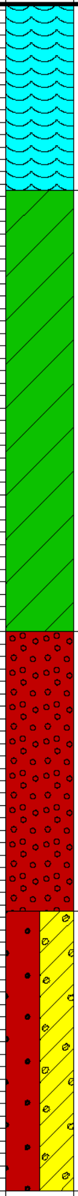


Sample No.	Elevation	Classification	Area	Wilmington Harbor
3	39.7 to 43.4	Olive gray silty sand with trace organics, SM	**CATLIN Geotechnical Laboratory**	
		2.9% Organics	Boring No.	WH12-V-11
			Date	10/16/12

Hole No.: **WH12-V-12**

Vibratory Drilling Log
DIVISION SAD
INSTALLATION WILMINGTON DISTRICT
SHEET 1 OF 1 SHEETS

1. PROJECT **WILMINGTON HARBOR**
2. LOCATION N 45,278.0 E 2,299,221.0
3. DRILLING AGENCY WILMINGTON DISTRICT
4. HOLE NO. (As shown on drawing title and file number) WH12-V-12
5. NAME OF DRILLER Talon Smith
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL
7. THICKNESS OF WATER COLUMN 36.9'
8. DEPTH DRILLED INTO ROCK 0.0'
9. TOTAL DEPTH OF HOLE 53.0'
10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 4 UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER N/A
16. DATE HOLE STARTED 7/11/12 COMPLETED 7/11/12
17. ELEVATION TOP OF HOLE 0.0
18. TOTAL CORE RECOVERY FOR BORING N/A
19. SIGNATURE OF INSPECTOR ,



ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f
	34.0				
	36.0		0.0' TO 36.9' WATER OCEAN BOTTOM @36.9'		
-36.9			**CL**, Gray, silty sand, some clay.		36.9
	38.0				
	40.0				1
	42.0				42.5 2
-44.0	44.0		**SW**, Grayish tan well graded fine to coarse sand.		44
	46.0				3
	48.0				
-48.5			**SP-SC**, Gray to dark gray, poorly graded silty sand, with clay.		48.5
	50.0				4
	52.0				
-53.0			BOTTOM OF HOLE AT 53'		53

REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g

Time begin vibracoring: 0000 hrs.

Soils Field Classified by Zachry Nichols, Civil Engineer

NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.

VIBRACORE BORING
From 0.0' to 18.00'
Ran 20' Rec: 20'

Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.

LAB CLASSIFICATION

Jar Number	Classification
1	SC
2	CL
3	SW-SM
4	SC

Soils are Lab Classified in Accordance with ASTM-D2487

COMPLETION NOTE:
Terminated hole at refusal or predetermined depth at 16.1' below ocean bottom

SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM

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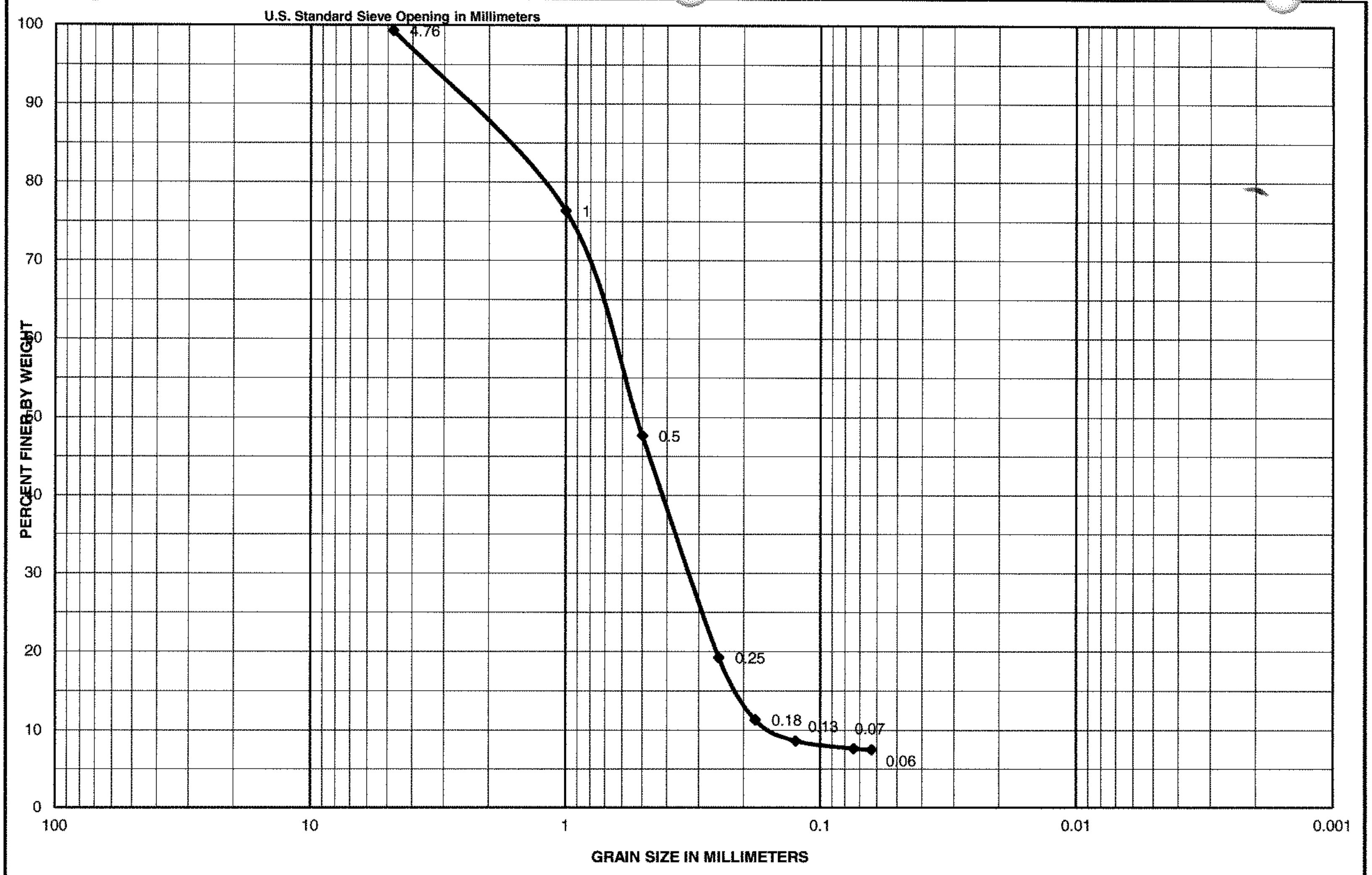
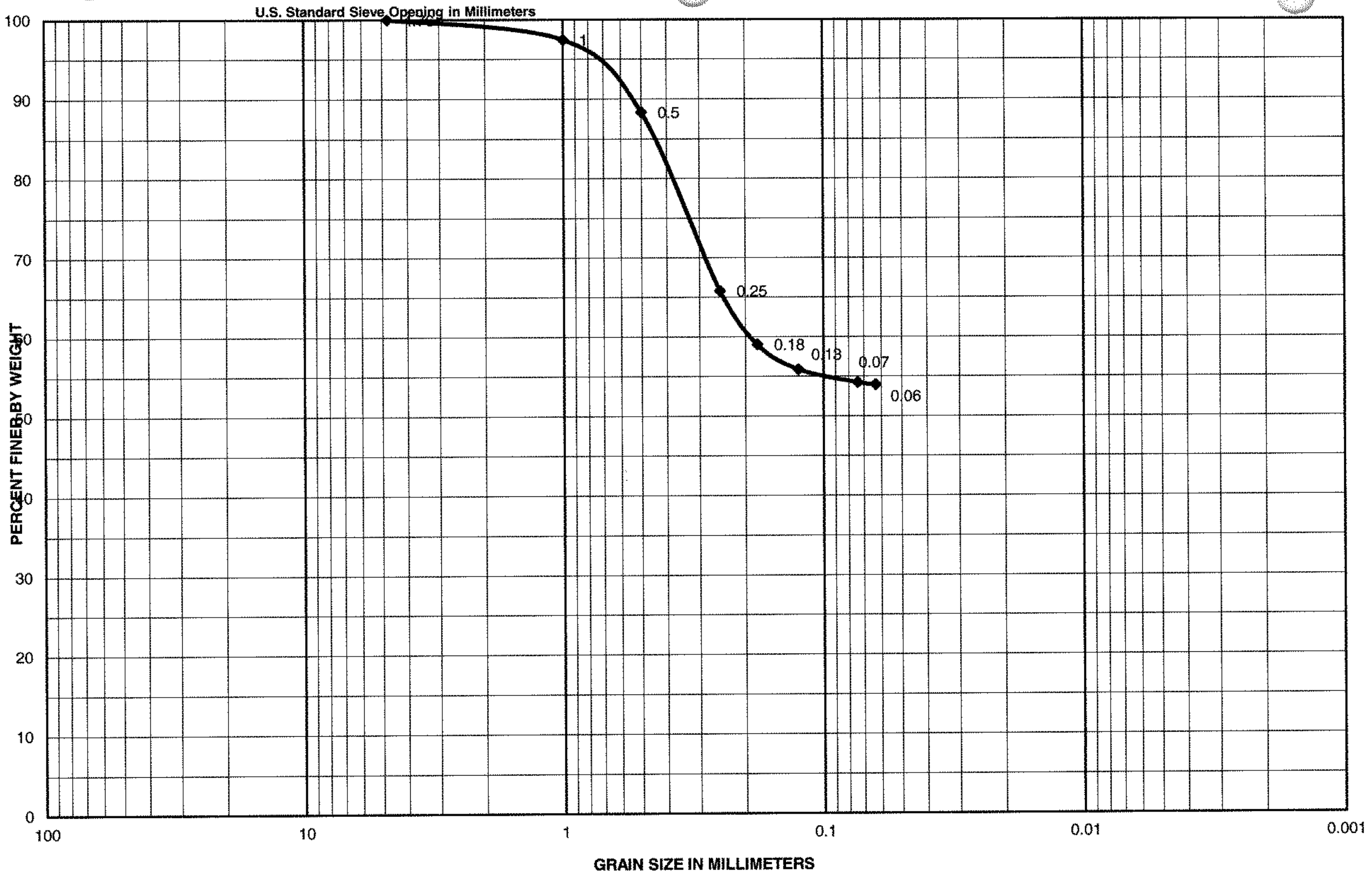
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-12



Sample No.	Elevation	Classification	Area	Wilmington Harbor
3	44.0 to 48.5	Light brown well graded sand with silt, SW-SM	**CATLIN Geotechnical Laboratory**	
			Boring No.	WH12-V-12
			Date	10/12/12



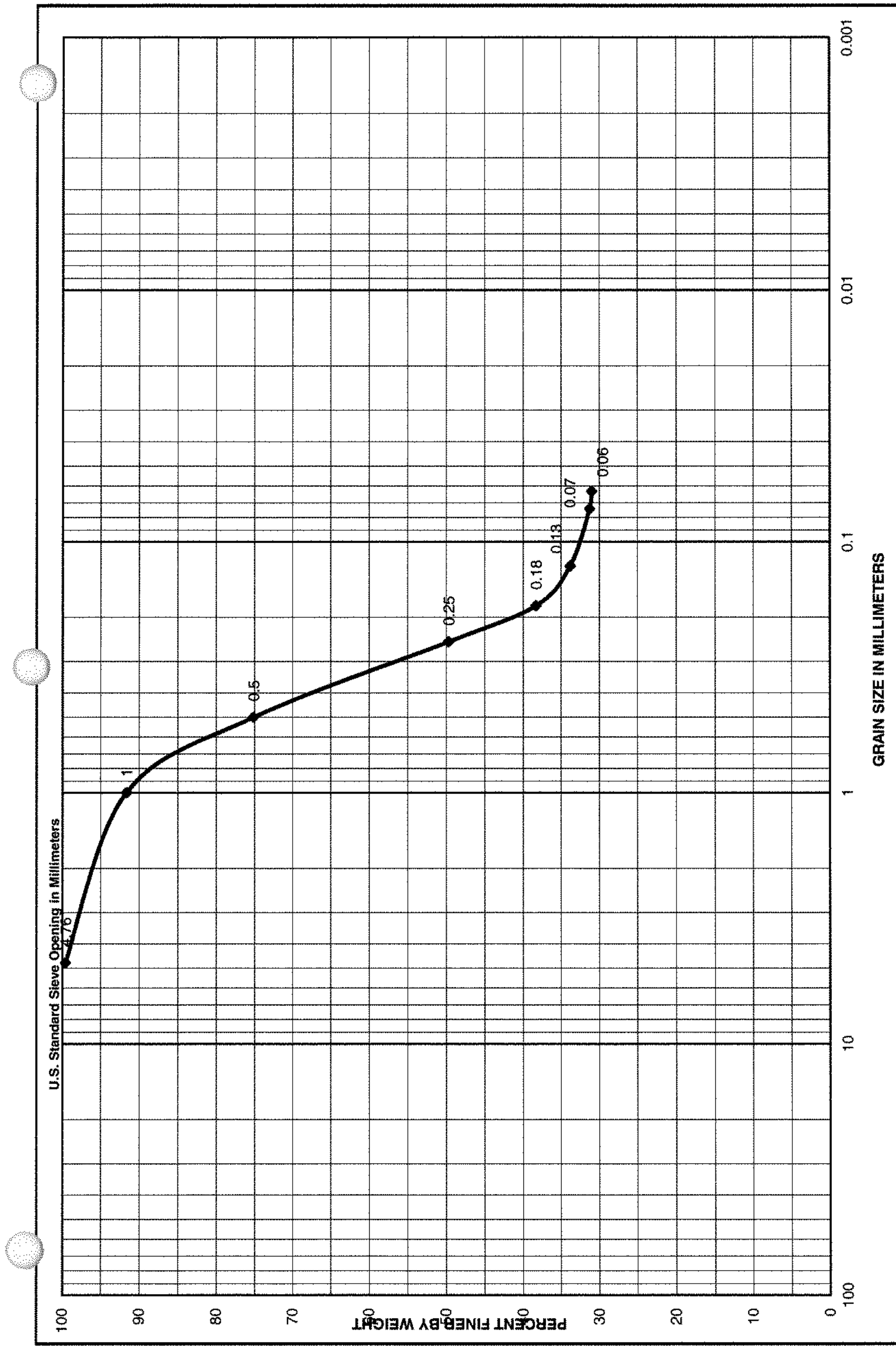
Sample No.	Elevation	Classification
2	42.5 to 44.0	Olive gray sandy lean clay, CL

Area Wilmington Harbor

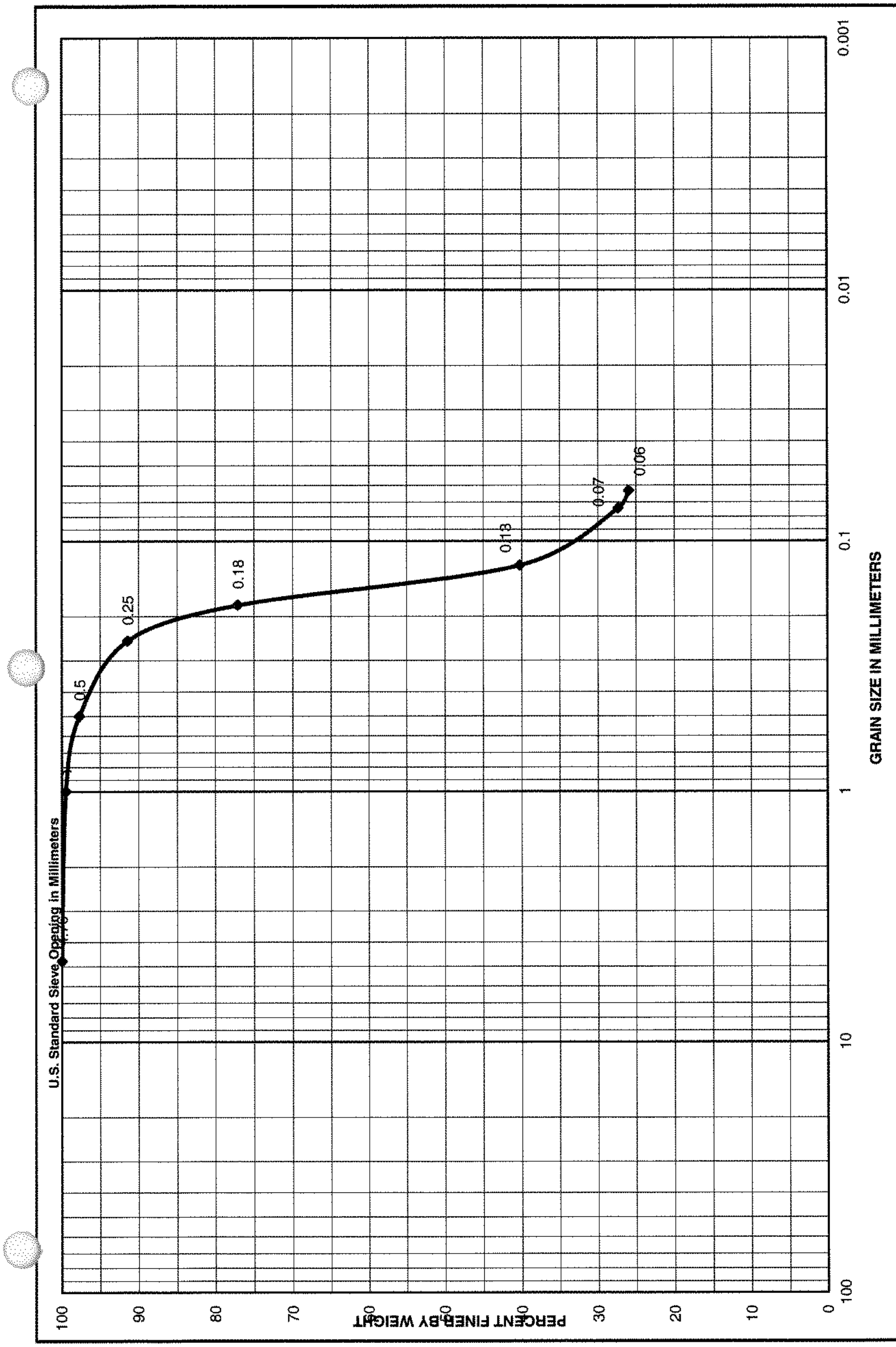
CATLIN Geotechnical Laboratory

Boring No. WH12-V-12

Date 10/16/12



Sample No.	Elevation	Classification	Area	Wilmington Harbor
1	36.9 to 42.5	Dark gray clayey sand with few shells, SC	**CATLIN Geotechnical Laboratory**	
		8.4% Shells	**Boring No.**	WH12-V-12
			Date	10/15/12



Sample No.	Elevation	Classification	Area	Wilmington Harbor
4	48.5 to 53.0	Olive gray clayey sand with trace organics, SC	CATLIN Geotechnical Laboratory	
		2.3% Organics	Boring No.	WH12-V-12
			Date	10/15/12

Hole No.: **WH12-V-13**

Vibratory Drilling Log
DIVISION SAD
INSTALLATION WILMINGTON DISTRICT
SHEET 1 OF 2 SHEETS

1. PROJECT **WILMINGTON HARBOR**
2. LOCATION N 44,972.0 E 2,298,958.0
3. DRILLING AGENCY WILMINGTON DISTRICT
4. HOLE NO.(As shown on drawing title and file number) WH12-V-13
5. NAME OF DRILLER Talon Smith
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL
7. THICKNESS OF WATER COLUMN 36.9'
8. DEPTH DRILLED INTO ROCK 0.0'
9. TOTAL DEPTH OF HOLE 56.1'
10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 5 UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER N/A
16. DATE HOLE STARTED 7/12/12 COMPLETED 7/12/12
17. ELEVATION TOP OF HOLE 0.0
18. TOTAL CORE RECOVERY FOR BORING N/A
19. SIGNATURE OF INSPECTOR

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	34.0 36.0	🟦	0.0' TO 36.9' WATER OCEAN BOTTOM @36.9'			Time begin vibracoring: 0000 hrs. Soils Field Classified by Zachry Nichols, Civil Engineer NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.
-36.9	38.0 40.0	🟨	**SC**, Dark gray, clayey sand.		36.9 1	
-41.4	42.0 44.0 46.0 48.0	🟩	**CL**, Dark gray lean clay.		41.4 2	VIBRACORE BORING From 0.0' to 25.20' Ran 20' Rec: 20' Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered. LAB CLASSIFICATION Jar Number Classification 1 SC 2 CH 3 SM 4 SC 5 SC
-49.6	50.0	🟥	**SW**, Dark gray, well graded sand, trace, wood.		49.6 3	Soils are Lab Classified in Accordance with ASTM-D2487 COMPLETION NOTE: Terminated hole at refusal or predetermined depth at 19.2' below ocean bottom
-52.2	52.0	🟩	**CL**, Dark gray sandy lean clay.		52.2 4	

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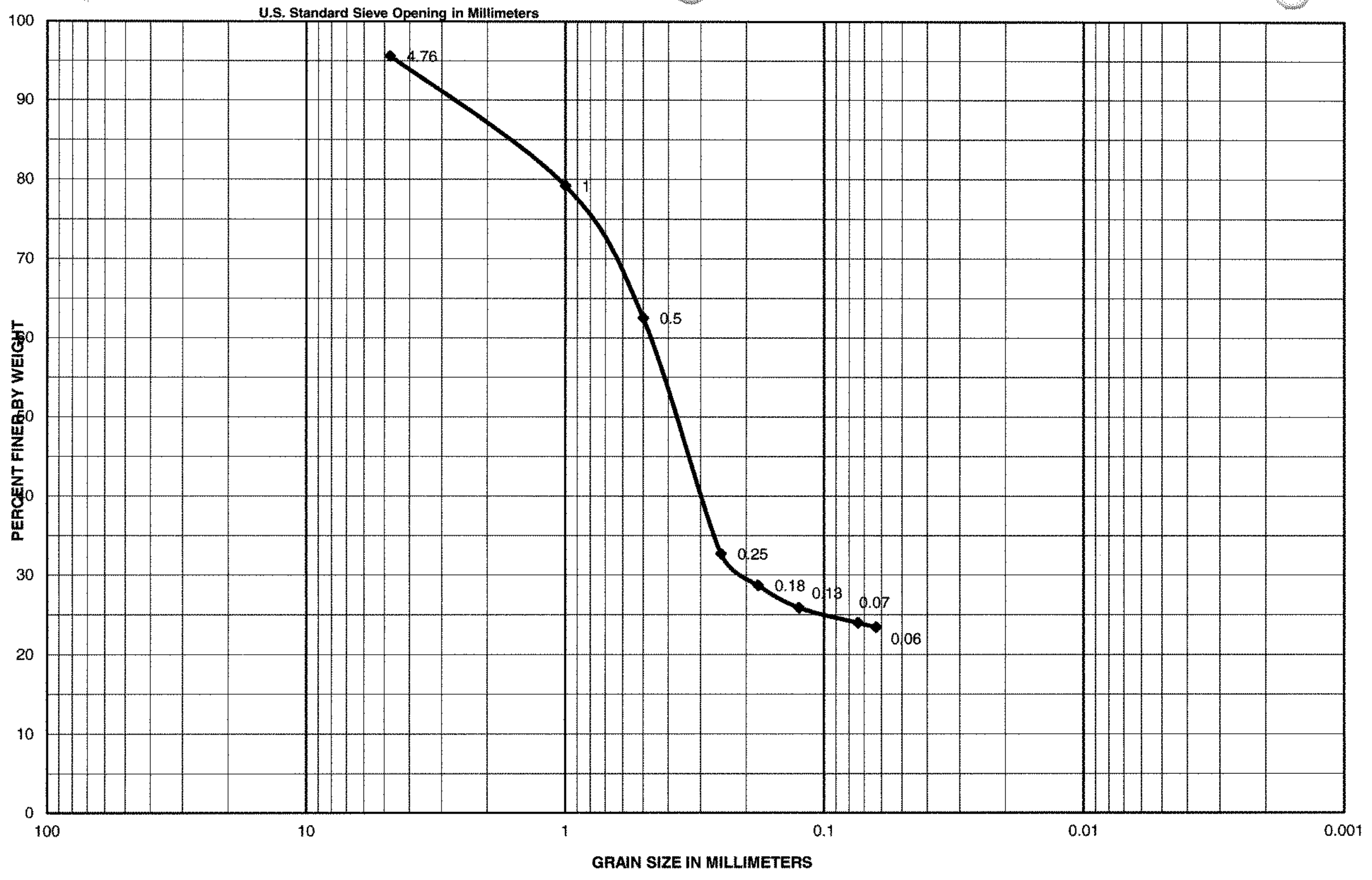
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-13

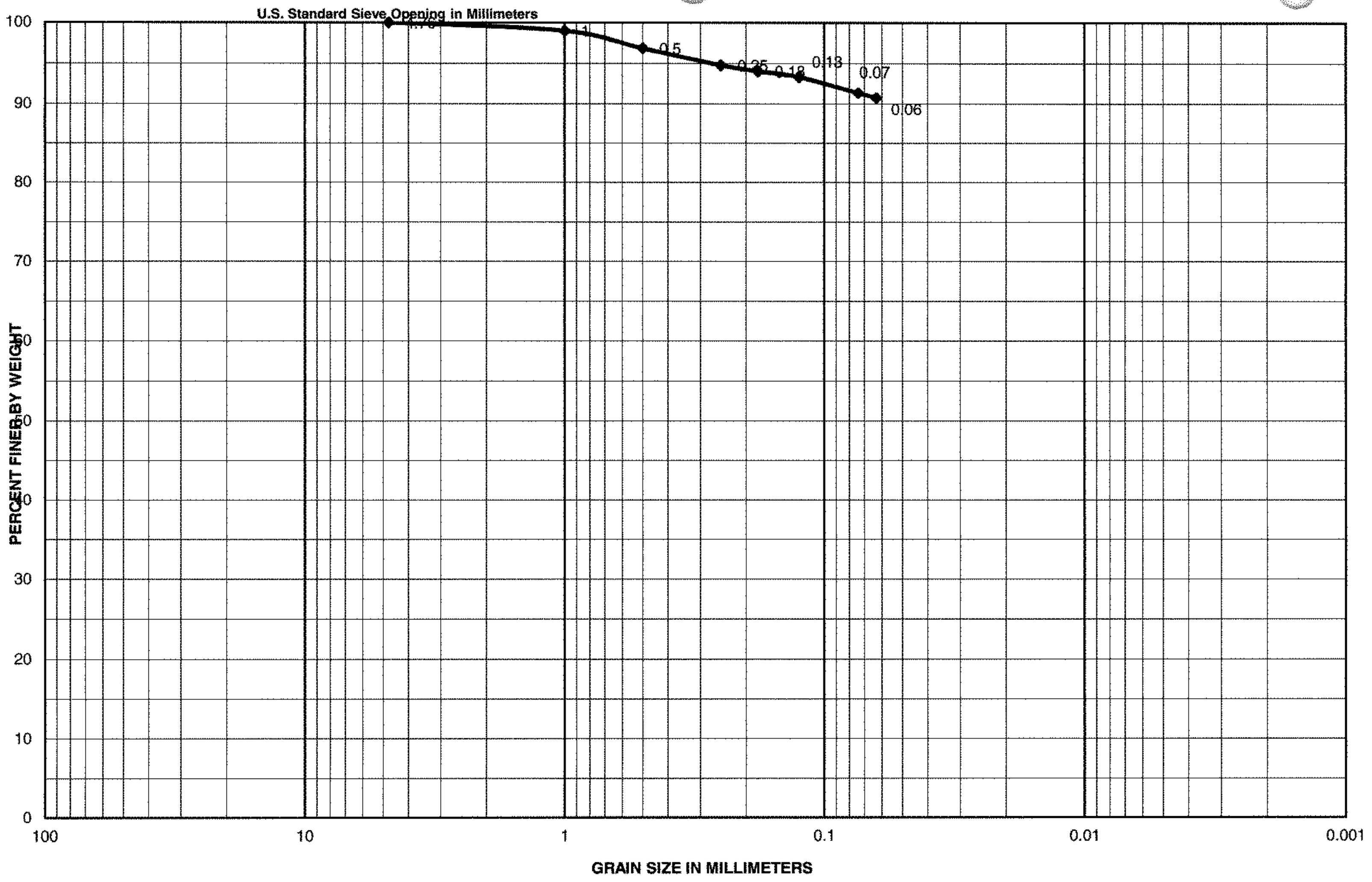
Drilling Log (Cont Sheet)
ELEVATION TOP OF HOLE 0.0 MLLW
Hole No.: **WH12-V-13**
PROJECT **WILMINGTON HARBOR**
INSTALLATION WILMINGTON DISTRICT
SHEET 2 OF 2 SHEETS

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	54.0	🟩	**CL**, Dark gray sandy lean clay. *(continued from previous page)*		4	
-55.7		🟥🟨	**SP-SM**, Dark gray, poorly graded silty sand.		55.7 5 56.1	
	56.0					
-56.1			BOTTOM OF HOLE AT 56.1' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			
	58.0					
	60.0					
	62.0					
	64.0					
	66.0					
	68.0					
	70.0					
	72.0					
	74.0					
	76.0					
	78.0					

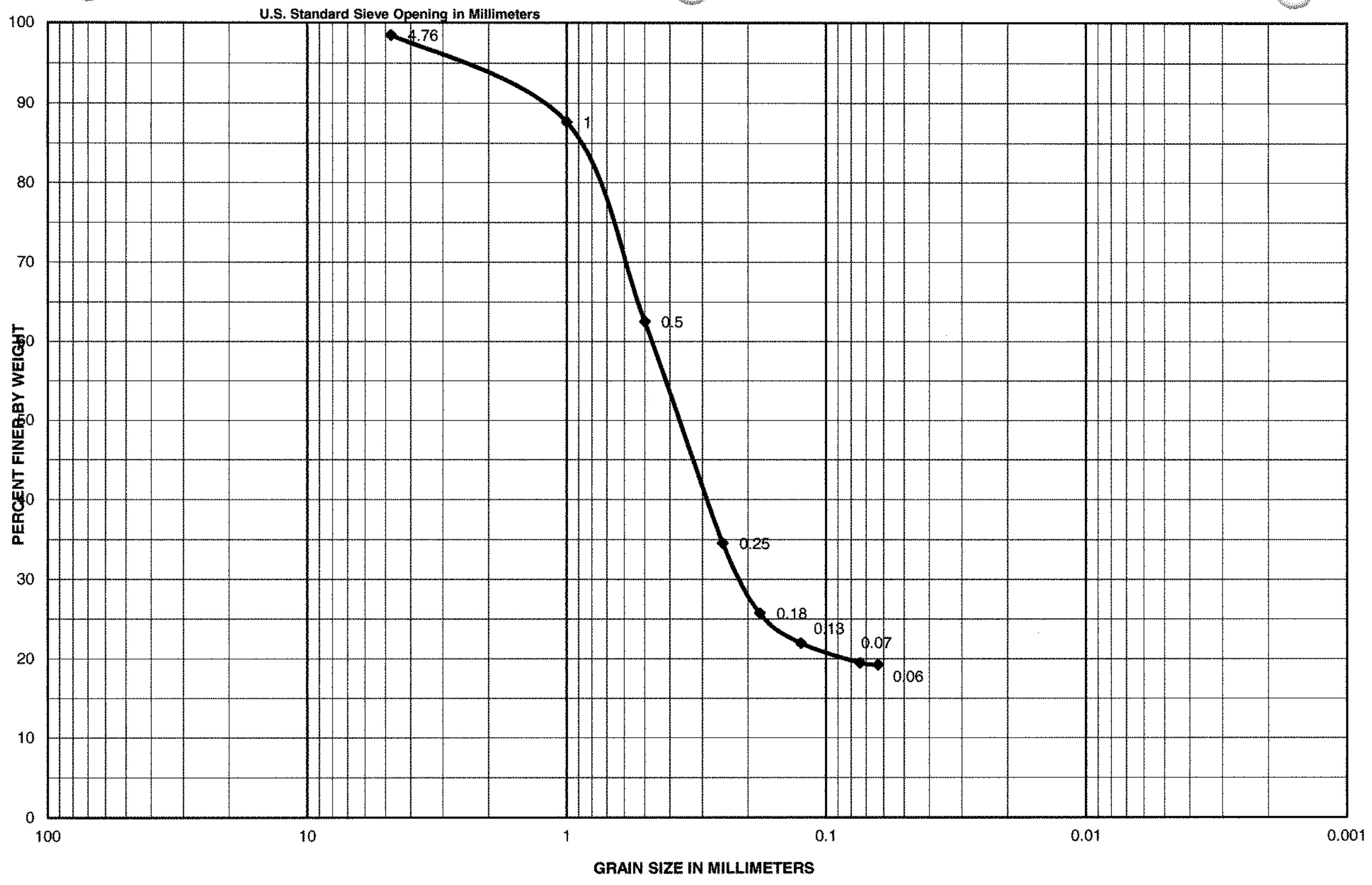
ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-13



Sample No.	Elevation	Classification	Area	Wilmington Harbor
3	49.6 to 52.2	Olive gray silty sand, SM	**CATLIN Geotechnical Laboratory**	
			Boring No.	WH12-V-13
			Date	10/8/2012



Sample No.	Elevation	Classification	Area Wilmington Harbor
2	41.4 to 49.6	Dark gray fat clay with trace organics, CH	**CATLIN Geotechnical Laboratory**
		5.2% Organics	**Boring No.** WH12-V-13
			Date 10/12/12



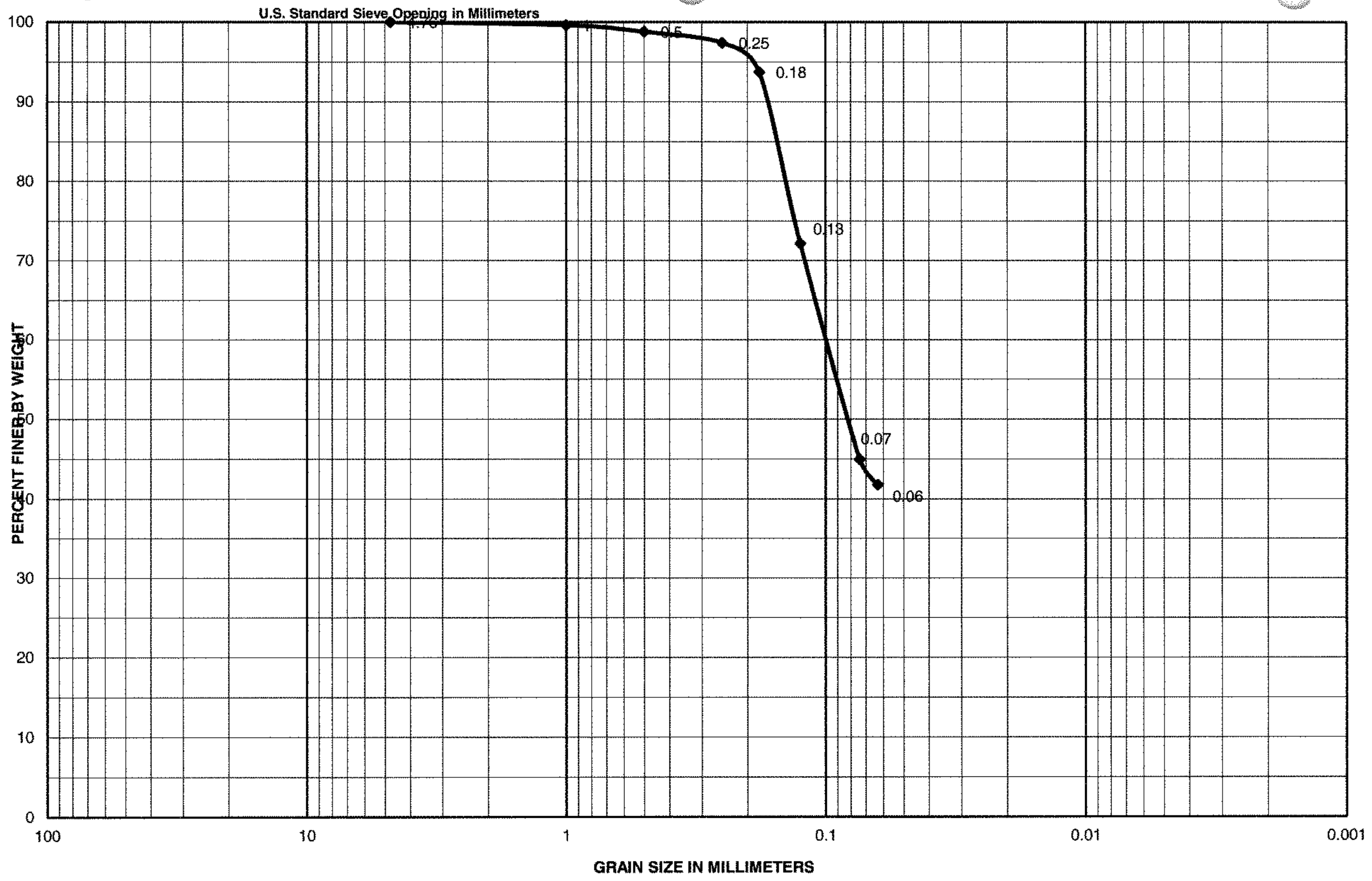
Sample No.	Elevation	Classification
1	36.9 to 41.4	Dark gray clayey sand with some shells and organics, SC
		37.5% Shells and Organics

Area Wilmington Harbor

CATLIN Geotechnical Laboratory

Boring No. WH12-V-13

Date 10/8/2012

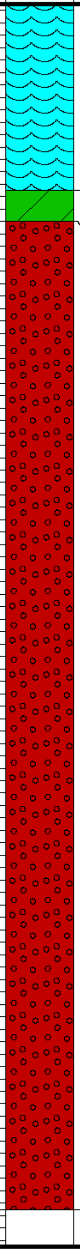


Sample No.	Elevation	Classification	Area	Wilmington Harbor
4	52.2 to 55.7	Light gray clayey sand, SC	**CATLIN Geotechnical Laboratory**	
			Boring No.	WH12-V-13
			Date	10/8/2012

Hole No.: **WH12-V-14**

Vibratory Drilling Log | DIVISION SAD | INSTALLATION WILMINGTON DISTRICT | SHEET 1 OF 1 SHEETS

1. PROJECT **WILMINGTON HARBOR**
2. LOCATION N 45,005.0 E 2,299,211.0
3. DRILLING AGENCY WILMINGTON DISTRICT
4. HOLE NO. (As shown on drawing title and file number) WH12-V-14
5. NAME OF DRILLER Talon Smith
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL
7. THICKNESS OF WATER COLUMN 37.5'
8. DEPTH DRILLED INTO ROCK 0.0'
9. TOTAL DEPTH OF HOLE 53.9'
10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN : DISTURBED 2 : UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER N/A
16. DATE HOLE : STARTED 7/12/12 COMPLETED 7/12/12
17. ELEVATION TOP OF HOLE 0.0
18. TOTAL CORE RECOVERY FOR BORING N/A
19. SIGNATURE OF INSPECTOR ,



ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f
	36.0		0.0' TO 37.5' WATER		
			OCEAN BOTTOM @37.5'		
-37.5			**CL**, Dark gray, silty sand, with clay.		37.5 1 38
-38.0	38.0		**SW**, Tan well graded medium to coarse sand.		
	40.0				
	42.0				
	44.0				
	46.0				2
	48.0				
	50.0				
	52.0				
-53.9	54.0		BOTTOM OF HOLE AT 53.9'		53.9

REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g

Time begin vibracoring: 0000 hrs.

Soils Field Classified by Zachry Nichols, Civil Engineer

NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.

VIBRACORE BORING
From 0.0' to 22.40'
Ran 20' Rec: 20'

Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered.

LAB CLASSIFICATION

Jar Number	Classification
1	SC
2	SW

Soils are Lab Classified in Accordance with ASTM-D2487

COMPLETION NOTE: Terminated hole at refusal or predetermined depth at 16.4' below ocean bottom

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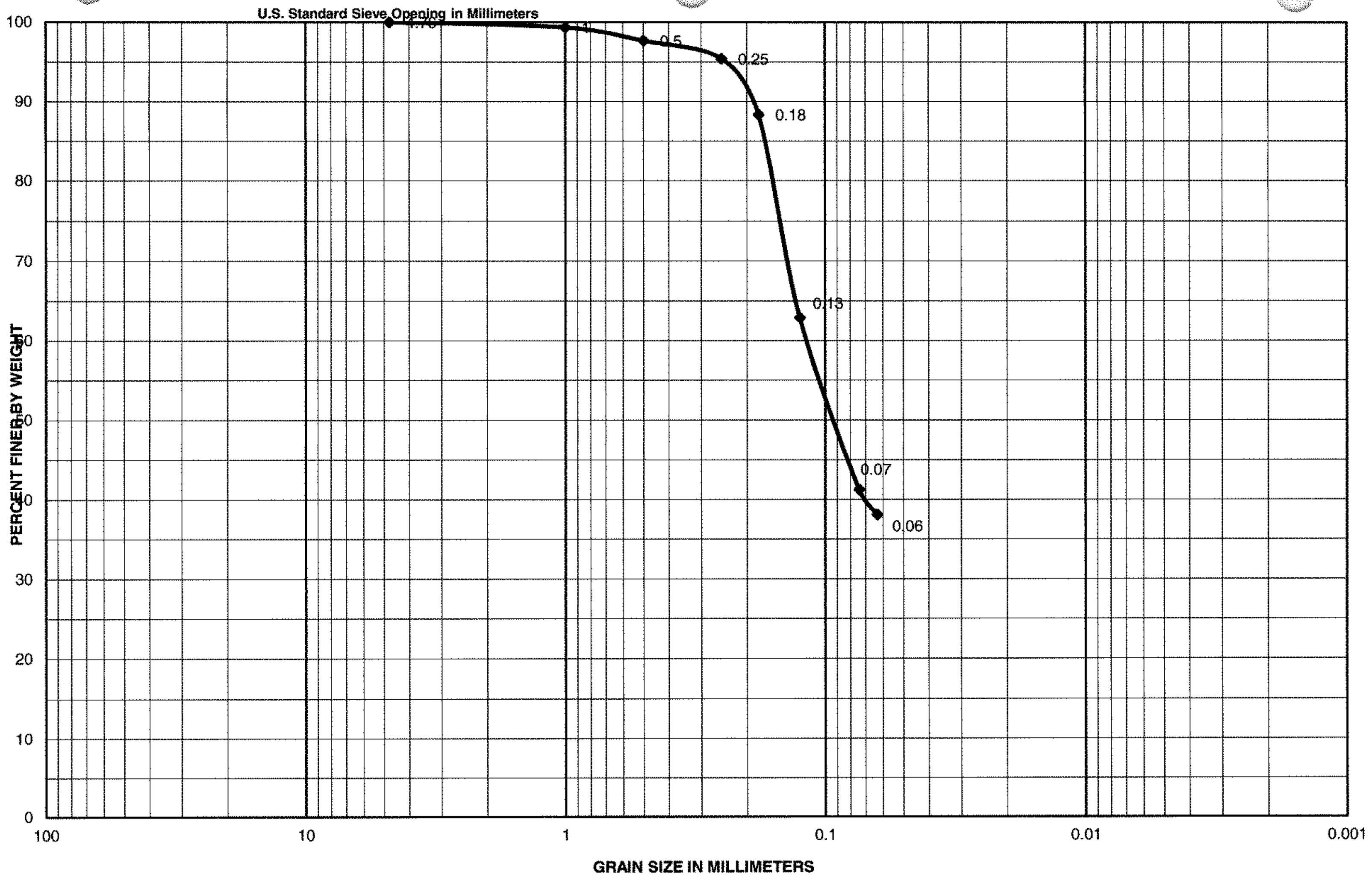
MAR 71

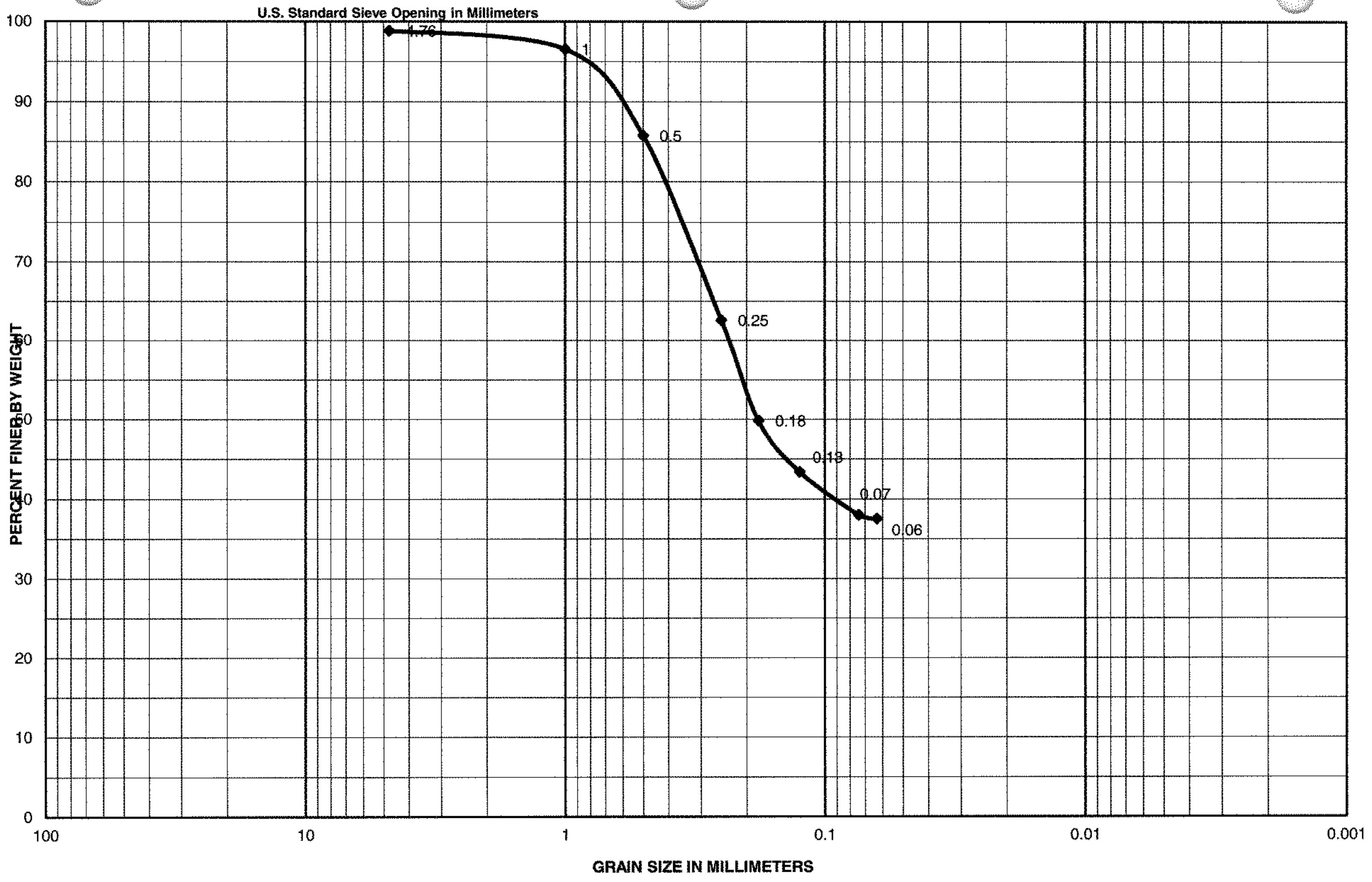
SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM

PROJECT WILMINGTON HARBOR | HOLE NO. WH12-V-14



Sample No.	Elevation	Classification
5	55.7 to 56.1	Olive gray clayey sand, SC

Area	Wilmington Harbor
CATLIN Geotechnical Laboratory	
Boring No.	WH12-V-13
Date	10/8/2012



Sample No.	Elevation	Classification
1	37.5 to 38.0	Olive gray clayey sand with trace shells, SC
		3.5% Shells

Area Wilmington Harbor

CATLIN Geotechnical Laboratory

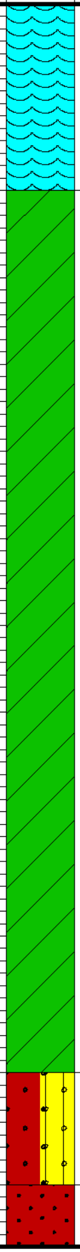
Boring No. WH12-V-14

Date 10/15/12

Hole No.: **WH12-V-15**

Vibratory Drilling Log
DIVISION SAD
INSTALLATION WILMINGTON DISTRICT
SHEET 1 OF 2 SHEETS

1. PROJECT **WILMINGTON HARBOR**
2. LOCATION N 44,630.0 E 2,298,769.0
3. DRILLING AGENCY WILMINGTON DISTRICT
4. HOLE NO.(As shown on drawing title and file number) WH12-V-15
5. NAME OF DRILLER Talon Smith
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERTICAL
7. THICKNESS OF WATER COLUMN 38.0'
8. DEPTH DRILLED INTO ROCK 0.0'
9. TOTAL DEPTH OF HOLE 55.3'
10. SIZE AND TYPE OF BIT 4" DIA VIBRACORE
11. DATUM FOR ELEVATION DATUM SHOWN *BM or MSL* MLLW
12. MANUFACTURER'S DESIGNATION OF DRILL Vibracore Snell
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN : DISTURBED 3 : UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES 0
15. ELEVATION GROUND WATER N/A
16. DATE HOLE : STARTED 7/12/12 COMPLETED 7/12/12
17. ELEVATION TOP OF HOLE 0.0
18. TOTAL CORE RECOVERY FOR BORING N/A
19. SIGNATURE OF INSPECTOR ,



ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	36.0		0.0' TO 38' WATER OCEAN BOTTOM @38'			Time begin vibracoring: 0000 hrs. Soils Field Classified by Zachry Nichols, Civil Engineer NOTE: Top of boring is defined as surface of water and compensation is made for tide such that Top of Hole is 0.0 EL MLLW.
-38.0	38.0 40.0 42.0 44.0 46.0 48.0 50.0 52.0		**CL**, Dark gray, silty sand, trace of wood.		38 1	VIBRACORE BORING From 0.0' to 23.30' Ran 20' Rec: 20' Top of vibracore soil sample is logged as beginning at Ocean Bottom. When Run is greater than Recovery, the difference is depicted as Assumed Not Recovered. LAB CLASSIFICATION Jar Number — Classification 1 — CL 2 — CL 3 — SP-SM Soils are Lab Classified in Accordance with ASTM-D2487
-52.2			**SP-SM**, Gray, poorly graded silty sand.		52.2 2	COMPLETION NOTE: Terminated hole at refusal or predetermined depth at 17.3' below ocean bottom
-54.0	54.0		**SP**, Gray, poorly graded sand.		54 3	

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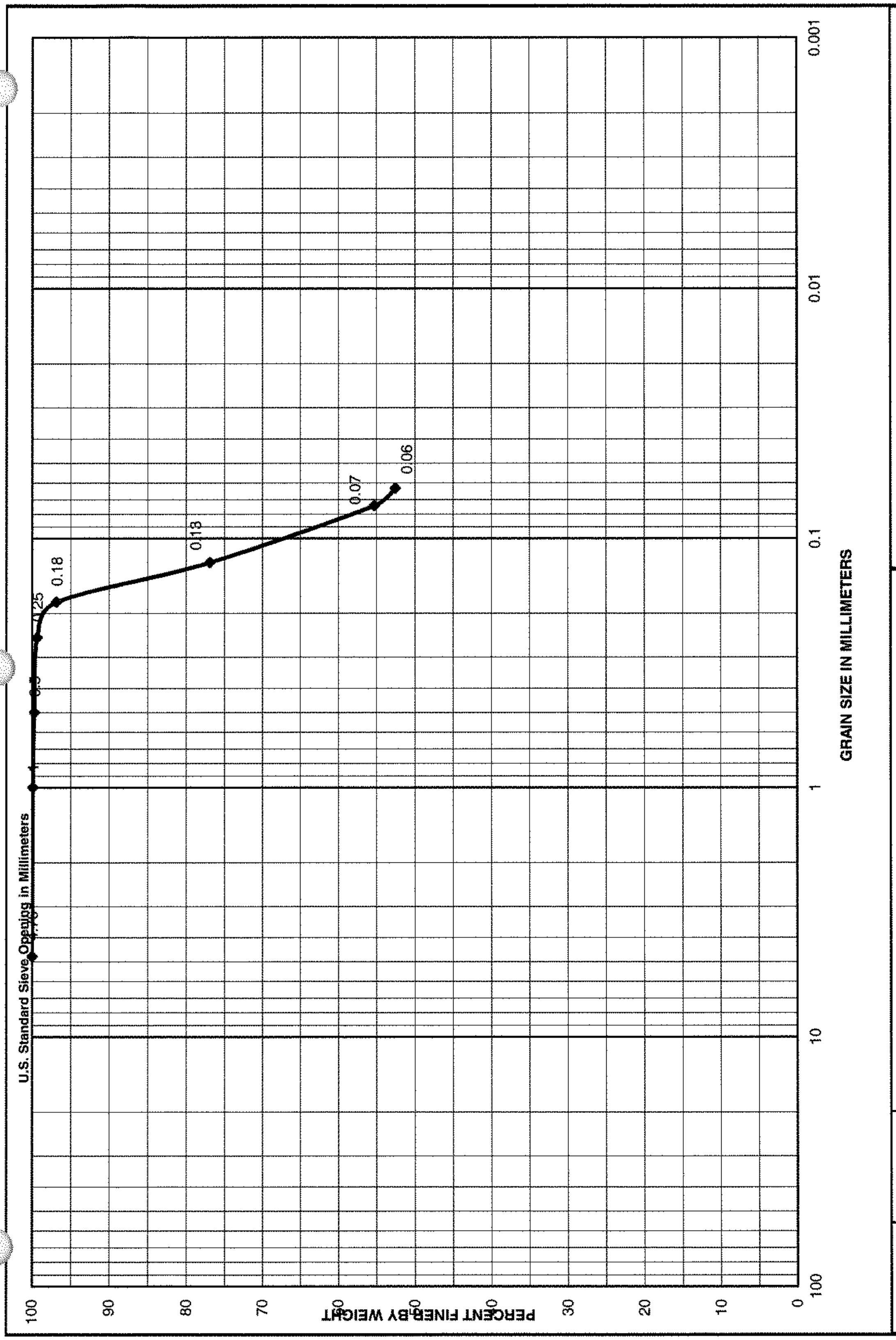
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-15

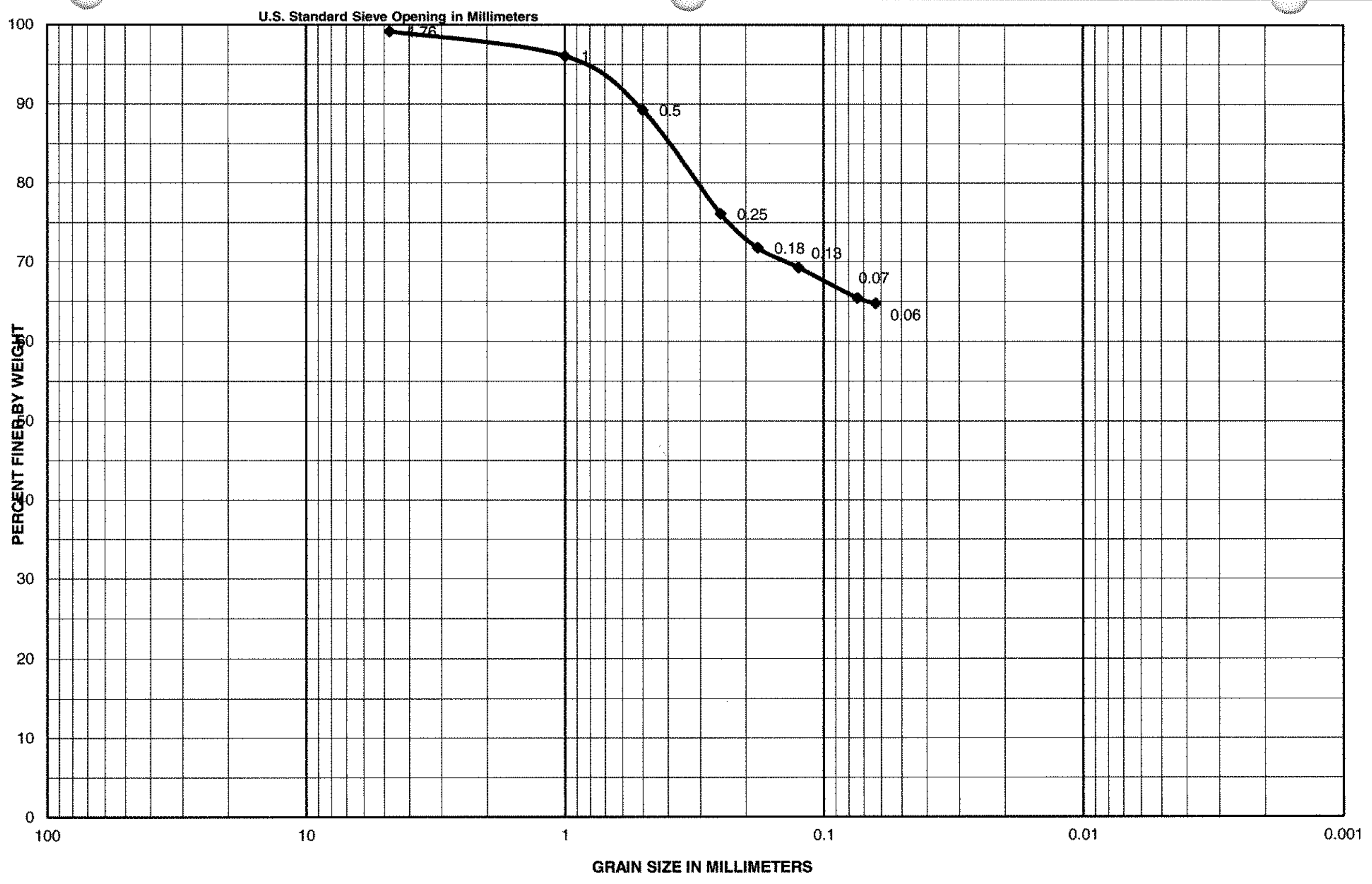
Drilling Log (Cont Sheet)
ELEVATION TOP OF HOLE 0.0 MLLW
Hole No.: **WH12-V-15**
PROJECT **WILMINGTON HARBOR**
INSTALLATION WILMINGTON DISTRICT
SHEET 2 OF 2 SHEETS

ELEVATION (MLLW) a	DEPTH (feet) b	Legend c	CLASSIFICATION OF MATERIALS (Description) d	%CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-55.3		🟥			55.3	
	56.0		BOTTOM OF HOLE AT 55.3' SOILS ARE FIELD VISUALLY CLASSIFIED IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM			
	58.0					
	60.0					
	62.0					
	64.0					
	66.0					
	68.0					
	70.0					
	72.0					
	74.0					
	76.0					
	78.0					

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE
MAR 71
PROJECT WILMINGTON HARBOR
HOLE NO. WH12-V-15



Sample No.	Elevation	Classification	Area	Wilmington Harbor
2	52.2 to 54.0	Olive gray sandy lean clay, CL	**CATLIN Geotechnical Laboratory**	
			Boring No.	WH12-V-15
			Date	10/23/12



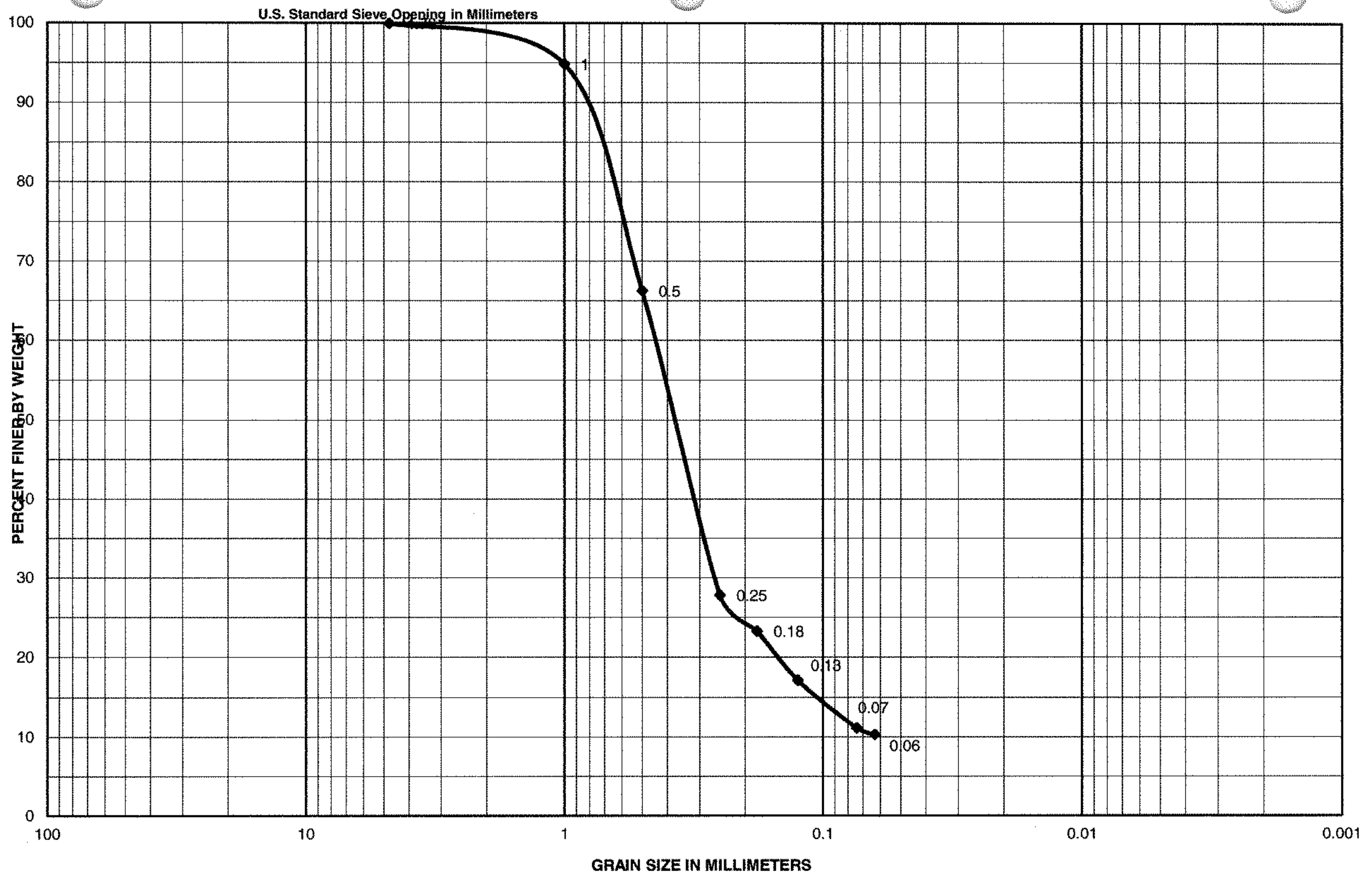
Sample No.	Elevation	Classification
1	38.0 to 52.2	Dark gray sandy lean clay with few shells and organics, CL
		10.8% Shells and Organics

Area Wilmington Harbor

CATLIN Geotechnical Laboratory

Boring No. WH12-V-15

Date 10/23/12



Sample No.	Elevation	Classification	Area	Wilmington Harbor
3	54 to 55.3	Olive gray/light brown poorly graded sand with silt, SP-SM	**CATLIN Geotechnical Laboratory**	
			Boring No.	WH12-V-15
			Date	10/16/12