**W9123626BA011: Sandbridge Beach Renourishment Project DRAFT Specifications**

The following DRAFT specifications are distributed with the pre-solicitation notice for planning purposes. Final specifications will be posted with the solicitation.

United States Army
Corps of Engineers
Norfolk District

# SANDBRIDGE BEACH EROSION AND HURRICANE PROTECTION BEACH RENOURISHMENT PROJECT

Virginia Beach, VA

## Specifications

Final

July 2026

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# LIST OF DRAWINGS
**02/24**

## PART 1 GENERAL

### 1.1 SUMMARY

This section lists the drawings for the project pursuant to contract clause "DFARS 252.236-7001, Contract Drawings and Specifications."

### 1.2 CONTRACT DRAWINGS

Contract drawings are as follows:

| SHEET NO. | TITLE |
|---|---|
| G001 | COVER SHEET, INDEX OF DRAWINGS, VICINITY, AND LOCATION MAP |
| G002 | GENERAL NOTES, DATUM DIAGRAM, AND LEGEND |
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| CN101 | DREDGE AREA LIMITS IN BOEM BORROW AREA A AND BATHYMETRIC SURVEY |
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| CS101 | EXISTING CONDITIONS SITE PLAN (1) |
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| CS103 | EXISTING CONDITIONS SITE PLAN (3) |
| CS104 | EXISTING CONDITIONS SITE PLAN (4) |
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| CS106 | EXISTING CONDITIONS SITE PLAN (6) |
| CS107 | EXISTING CONDITIONS SITE PLAN (7) |
| CS108 | EXISTING CONDITIONS SITE PLAN (8) |
| CS109 | EXISTING CONDITIONS SITE PLAN (9) |
| CS110 | EXISTING CONDITIONS SITE PLAN (10) |
| CS111 | EXISTING CONDITIONS SITE PLAN (11) |
| CS112 | EXISTING CONDITIONS SITE PLAN (12) |

| SHEET NO. | TITLE |
|---|---|
| CB101 | BEACH RENOURISHMENT GRADING PLAN (1) |
| CB102 | BEACH RENOURISHMENT GRADING PLAN (2) |
| CB103 | BEACH RENOURISHMENT GRADING PLAN (3) |
| CB104 | BEACH RENOURISHMENT GRADING PLAN (4) |
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| CB110 | BEACH RENOURISHMENT GRADING PLAN (10) |
| CB111 | BEACH RENOURISHMENT GRADING PLAN (11) |
| CB112 | BEACH RENOURISHMENT GRADING PLAN (12) |
| CB401 | BEACH RENOURISHMENT BERM SECTIONS (1) |
| CB601 | CONSTRUCTION BASELINE AND BERM CREST COORDINATE TABLES |
| BB101 | VIBRACORE SAMPLING LOCATIONS IN BOEM BORROW AREA A |
| BB301 | SCHNABEL BORING LOGS |
| BB302 | SCHNABEL BORING LOGS (CONTD.) |
| BB303 | SCHNABEL BORING LOGS (CONTD.) |
| BB304 | SCHNABEL BORING LOGS (CONTD.) |
| BB305 | SCHNABEL BORING LOGS (CONTD.) |
| BB306 | SCHNABEL BORING LOGS (CONTD.) |

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)
-- End of Document --

# SECTION 01 00 55

# SOIL BORING DATA

## PART 1 GENERAL

### 1.1 Soil Classification

The soil was visually classified in the field according to the "Unified Soil Classification System" and described utilizing the "Burmister's Method of Material Proportions". While it is believed that borings accurately indicate subsurface conditions for boring locations on the date taken, the Government assumes no responsibility for actual conditions which may be encountered in execution of Contract. Should the Contractor rely, for any purpose, upon the accuracy or completeness of said borings, or log thereof, he does so at his own risk. The geotechnical report, including soil boring drilling logs and data, is shown in the 2018 Schnabel Geotechnical Report at the end of the specifications. Soil borings shown in Appendix A, Laboratory Analysis is shown in Appendix B, and Beach Laboratory Analysis data is shown in Appendix C of the Geotechnical Report. All samples contained in the appendices at the end of the specifications were obtained on various dates as designated on the respective boring. Geotechnical analysis data is available for review at Norfolk District, 803 Front Street, Norfolk, VA 23510 (Attention: Matt McKeehan telephone 757-201-7172).

### 1.2 Sampling Method

All boring samples were obtained utilizing a vibracore sampler.

### 1.3 Soil Consistency Determination

Estimated consistencies (med. stiff, soft, etc.) are from Terzaghi & Peck "Soil Mechanics in Engineering Practice".

### 1.4 Boring Elevations and Locations

All boring elevations and locations are approximate and their respective location indicated.

### 1.5 Abbreviations (if applicable)

| | |
|---|---|
| BOH Bottom of Hole | moist moisture |
| bot bottom | MP medium plasticity |
| brk broken | mrb marbled |
| brwn brown | mst moist |
| cly clayey | NP nonplastic |
| const consistency | OD Outside diameter |
| crs, c coarse | org organic |
| dk dark | PI Plastic Index |
| dns dense | PL Plastic Limit |
| fn, f fine | sam sample |
| frac fracture | sat saturated |
| frag fragments (fragmented) | sft soft |
| grn green | slt slight(ly) |
| gry gray | sly silty |

HP high plasticity
hrd hard
hrs hours
len lense
lit little
LL Liquid Limit
LP Low Plasticity
lt light
med, m medium & and
mica micaceous
%200 Minus No. 200 Sieve
sm some
sta station
tr trace
v very
v.f. very fine
w moisture content
w/ with
wd weathered

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

-- End of Section --

# SECTION 01 14 00

# WORK RESTRICTIONS
**11/22, CHG 2: 05/24**

## PART 1 GENERAL

The work consists of dredging beach fill material from the Government furnished borrow site located offshore approximately 3 to 5 miles east of Sandbridge Beach (location shown in the project plans/drawings). The Contractor shall perform the scheduled work with one or more Hopper dredges, and transport the material to a pump out buoy or series of pump out buoys to be provided by the Contractor. The material shall then be carried from the pump out buoy or buoys to the beach by hydraulic pipeline and deposited within the designated beach placement area segments as indicated and specified on the construction plans.

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| EM 1110-1-1005 | (2007) Control and Topographic Surveying |
| EM 1110-2-1003 | (2013) Hydrographic Surveying |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

### 1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Marine Plant Anchorage And Equipment Working Area Plan; G

Prior to commencement of dredging, submit a Plan indicating all work activities proposed for marine plant anchorage, storage, maintenance, refueling, and routine or major repairs to marine plant and equipment that cannot be performed from the beachfront during this contract and planned use of the City Dredge Operations Facility (CDOF), Lake Rudee or Croatan Point.

Notify Commander, East Coast Guard District

Notify National Marine Fisheries Service

Marine Remote Sensing Survey; G, DO

Borrow Area Material Removal Plan; G, DO

## 1.3 CONTRACTOR'S NOTIFICATION

A Dredging Intent Notification shall be prepared and sent to the agencies identified below identifying the dredging locations, placement areas, and dates the Contractor intends to start and complete dredging. When the Contractor sends a Notification to an agency, proper signatures shall be affixed. A copy of all Notifications furnished shall at the same time be provided to the Contracting Officer.

### 1.3.1 Dredging Intent Notifications

a. Notify National Marine Fisheries Service. The Contractor shall notify the National Marine Fisheries Service by email (Incidental.Take@noaa.gov) within 3 days of the commencement of dredging and again within 3 days of the completion of dredging activity.

b. Notify Commander, East Coast Guard District. The Contractor shall notify the Commander, East Coast Guard District of his intended operations to dredge and request that it be published in the Local Notice to Mariners. This Dredging Intent Notification to U.S. Coast Guard must be given in sufficient time so that it appears in the Notice to Mariners at least 21 calendar days prior to the commencement of this contract.

### 1.3.2 Notification Of Beach Fill Operations

The Contractor shall maintain a current register of planned beach fill operations indicating where the beach fill operations will be on a given day, including street locations for the beach fill operations and the pump out facility, and their daily projected locations along the beach fill placement area for the duration of the contract. The register shall be updated daily and provided with the Daily Report of Operations in a format approved by the Contracting Officer for ready release to the public.

## 1.4 CONTRACTOR WORK REQUIREMENTS

The dredging and placement areas are accessible to the general public; however, the Contractor is informed the Government will not undertake to exclude the public or restrict public access to the dredging or placement areas during the work. The Contractor shall be solely responsible for protection of the public at all times for the duration of work performed as a part of the contract and fully comply with the provisions of OSHA safe working practices and the Safety and Accident Prevention requirements of these specifications. The Contractor shall employ the use of signs, barricades, barriers, flagmen, and any other devices and measures required to ensure public and worker safety at the dredging and placement areas at all times. Unless directed otherwise, the Contractor may perform the scheduled dredging and material placement work 24 hours a day, 7 days a week, except for Memorial Day and Independence Day. During actual dredging and material placement operations, the Contractor shall ensure adequate monitoring of operations by competent employees at the placement areas and contact with the dredge by monitoring personnel is maintained at all times.

All lighting associated with the project shall be limited to the immediate area of active construction only. Such lighting shall be shielded, low-pressure sodium vapor lights directed to the maximum extent

practical away from populated areas where applicable and to avoid excessive illumination of the water. Orange or yellow light filters shall be installed on lighting and equipment operating on the beach at night from May 1 through November 15. Light shall comply with OSHA and Corps' Occupational Health and Safety regulations, standards, or technical guidance or otherwise jeopardize or threaten human safety.

### 1.4.1 Order of Work

The Contractor shall perform all required beach fill placement operations, as shown on the drawings commencing from the south (0+00) to the north.

### 1.4.2 Hopper Dredge Seasonal Restrictions

Hopper dredging shall be prohibited between 1 September and 14 November. See 01 57 30 ENVIRONMENTAL PERMIT WORK REQUIREMENTS and the Biological Opinion (attached to the end of these specifications) for more information.

### 1.4.3 Access to Work Site

The contractor shall use all access locations shown on the project construction plans.

The Sandbridge Beach oceanfront is served by an all weather surfaced road network. The Contractor's equipment and vehicular access into the work area will be available from Little Island Park at the South end of the project area. The Contractor shall prepare, as a part of his Accident Prevention Plan and Progress Schedule, his proposed methods for gaining access to the workplace by the designated right-of-way that does not unnecessarily impact convenient and safe access to and from the beach by the public. Access and egress to the work area is the responsibility of the Contractor and is subject to permit approvals required by the City of Virginia Beach. All roads approved for the Contractor's use shall be maintained throughout construction and restored to as good condition as existed prior to their use. The Contractor shall keep all roads free of mud and other foreign materials resulting from his operations. The Contractor's vehicles shall at no time follow a vehicle closer than 50 feet, and all vehicles shall pull off the road and come to a complete stop when meeting emergency vehicles and vehicles with flashing lights. All temporary construction shall be removed and the affected area restored to its original condition. All costs for the use of existing transportation facilities, for the construction of temporary facilities, and for maintenance, repair, removal and restoration shall be borne by the Contractor.

### 1.4.4 Designated Marine Plant Anchorage and Equipment Working Area Restrictions

The City Dredge Operations Facility (CDOF), Lake Rudee and Croatan Point are designated for marine plant anchorage, storage, maintenance, refueling, and routine or major repairs to marine plant and equipment that cannot be performed from the Sandbridge beachfront during this contract. The Contractor shall submit a Marine Plant Anchorage and Equipment Working Area Plan for approval, indicating all proposed plant anchorage and other scheduled activities at the CDOF, Lake Rudee or Croatan Point. The Plan shall be coordinated with the CDOF and include the proposed plant and scheduled activities and be coordinated with the Activity Hazard Analysis and Safety Plan. The Contractor must comply with all rules and regulations

governing use of the CDOF and all costs for use of the facility are the responsibility of the Contractor.

The Contractor is informed the use of Lake Wesley (inside Rudee Inlet to the Southeast of Lake Rudee) will not be allowed for storage, maintenance, refueling, or repairs to marine plant and equipment, or for any other non-emergency purpose. The use of Lake Wesley will only be allowed for anchorage of plant that, due to size and height restrictions, cannot reasonably be stored at the CDOF, Lake Rudee or Croatan Point. If it becomes necessary for the Contractor to request anchorage of plant or to perform other non-emergency functions in Lake Wesley, the Contractor must verify the CDOF, Lake Rudee and Croatan Point are unavailable or otherwise unsuitable for use and shall obtain written permission from the Contracting Officer's Representative at least 48 hours in advance of the use of Lake Wesley.

Prior to commencement of dredging, submit a Marine Plant Anchorage and Equipment Working Area Plan indicating all work activities proposed for marine plant anchorage, storage, maintenance, refueling, and routine or major repairs to marine plant and equipment that cannot be performed from the beachfront during this contract.

### 1.4.5 Contracting Officer Stand By Time

During the contract period, the Government reserves the right to issue stand by orders to the Contractor for periods up to 24 hours at a cost and in a number as reflected in the bid schedule item 0008, in 01 20 00 PRICE AND PAYMENT PROCEDURES. If the Contracting Officer directs that plant be placed in a standby status, the Contractor shall cease all beach fill operations and secure his on beach plant and equipment off the beach in the Contractor’s approved Staging Area. During this period the Contractor will be allowed to perform dredging, but will not be allowed to operate any plant on the beach including operations that utilize the pump out mooring facility. The Contracting Officer will give the Contractor a minimum 72 hour notice before plant is to be placed on standby status. When in standby status, plant will not be moved from the designated location unless approved by the Contracting Officer.

### 1.4.6 Noise Control and Abatement

The Contractor shall employ the use of properly installed and maintained mufflers, silencers, and manufacturer's recommended sound suppressors on all plant, machinery, and equipment used on this work. The use of sound signals such as whistles, horns, or bells shall not be used if two-way radio communication can accomplish the required function. During the time between 7:00pm and 7:00am, the Contractor shall plan and schedule his work operations to minimize operations of plant and equipment on the beach, and in waterways near populated areas. Noise of alarms from the backward use of plant on the beach during this period will not be allowed except to meet safe working practices as prescribed by OSHA. Accordingly, the Contractor shall operate plant in a forward mode and limit beach fill operations to the maximum extent practical during this time. The Contractor shall not use sound signals, with the exception of those signals required for vessel operations by the U.S. Coast Guard, during the time between sunset and sunrise.

## 1.5 PHYSICAL DATA

### 1.5.1 Physical Conditions Information

The physical conditions indicated on the drawings and in the specifications are the result of site investigations and surveys. Information and data furnished or referred to below is furnished for the Contractor's information; however, it shall be expressly understood that the Government will not be responsible for any interpretation or conclusion drawn from this information or data by the Contractor.

### 1.5.2 Site Related Weather Conditions

The locations of the work are in open ocean waters and along the Virginia Beach oceanfront; accordingly, the Contractor shall anticipate that severe weather conditions may occasionally interfere with the progress of work. The area is tidal with a mean range of tide of approximately 3.5 feet based on NOS observations at the Virginia Beach Fishing Center. Currents are normally not of a sufficient velocity to interfere with dredging operations; however, offshore winds and other natural weather events may lead to shoaling hazards. The Contractor shall satisfy himself as to the hazards likely to arise from the weather conditions during the dredging period. Complete weather forecasts, records and reports may be obtained from the National Weather Service in Wakefield, Virginia, telephone (757) 899-4200, Menu selection service or operator assisted as applicable.

### 1.5.3 Additional Information for Local Physical Conditions

The Contractor shall consult the following publications for additional information on local conditions:

a. United States Coast Pilot 4, Atlantic Coast, Cape Henry, Virginia to Key West, Florida, published annually by the National Ocean Service.

b. Tide Tables, High and Low Water Predictions, East Coast of North and South America, published annually by the National Ocean Service.

c. Tide Current Tables, Atlantic Coast of North America, published annually by the National Ocean Service.

d. Local Notice to Mariners, published by the U.S. Coast Guard East District and the broadcast local notice to mariners.

### 1.5.4 Condition of Borrow Areas

The plans for dredging show the condition of the offshore borrow area at the time of the most recent survey. There are no known pipes, bridges, or tunnels that cross the area to be dredged; however, there exist cables in the borrow area and are shown on the borrow plan. The Contractor shall avoid the restricted area shown on the borrow area plan. The contractor shall submitted a Borrow Area Material Removal Plan which will display how the contractor will conduct the dredging activities in the borrow area.

Additional guidelines regarding archaeological finds can be found in paragraph 1.15 of this section.

### 1.5.5 Obstruction of Borrow Areas

The Government will not undertake to keep the vicinity in and around the

borrow areas or offshore areas within the project limits, free from vessels or other obstructions, except to the extent of such regulations, if any, as may be prescribed by the Secretary of the Army, in accordance with the provisions of Section 7 of the River and Harbor Act, approved 3 August 1917. The Contractor will be required to conduct the work in such manner as to obstruct navigation as little as possible, and in case the Contractors' plant so obstructs the water way as to make difficult or endanger the passage of vessels, said plant shall be promptly moved on the approach of any vessel to such an extent as may be necessary to afford a practicable passage. Upon the completion of the work, the Contractor shall promptly remove his plant, including ranges, buoys, piles, and other marks placed by him under this contract in navigable water or on shore.

### 1.5.6 Borrow Area Traffic

Traffic in the borrow area is anticipated to include various commercial, government, military, and fishing vessels as well as pleasure craft.

### 1.5.7 Condition of Beach Fill Areas

The required beach fill areas and quantity estimates specified are based on the condition of the beach at the time of the most recent surveys as indicated. The conditions shown by the surveys and the required beach fill quantities specified are subject to change due to the constantly changing shoreline and the natural forces of wind and waves acting on the beach. The actual quantities to be placed and paid for in each respective beach fill segment will be determined by the Contracting Officer from the surveys and volume computations to be performed by the independent surveyor or engineer as specified immediately before the Contractor commences fill operations in a respective beach fill section. The Contracting Officer may make alterations in the plan dimensions, grade of slopes, or volume of fill per linear foot in a respective beach fill segment in order to increase or decrease the volume of fill placed along the beach. The Contractor shall work closely with the Contracting Officer to ensure that the total quantity of sand allowed under this contract is uniformly distributed along the entire length of the beach fill area in a manner to construct a finished beach berm of constant dimensions along the entire project length. Please refer to SECTION 35 20 24 BEACH FILL for beach fill construction dimensions and tolerances.

#### 1.5.7.1 Globalinx Subsea Conduits

There are four (04) subsurface conduits under the northern end of the beach placement area which daylight in theocean east of Sta 222+00. The location of these conduits and an avoidance area of two hundred (200) feet are shown on the plans. As-built information is available upon request.

### 1.5.8 Oyster Grounds

There are no known oyster grounds in the vicinity of the borrow areas or placement area.

## 1.6 NAVY FIRING AREA

a) A Navy Firing Area (204.52) encompasses the offshore Sandbridge borrow site. The extent of the firing exercises involve mostly small arm ranges, located north of Sandbridge, and are used 5 to 7 days per week. An inactive gun line is also located north of Sandbridge. Both the gun line and small arms range are operated in accordance with 33

CFR 334.390 and 33 CFR 334.380, respectively. Neither of these activities is expected to impact operations within the borrow area.

b) Drone firing exercises, which when conducted require a borrow site shut down, occur on the average twice per month (over a three day period) for a duration of 4 to 6 hours per event. The Contractor shall anticipate these delays and plan his operations accordingly so as to minimize down time.

c) It is the Contractor's responsibility to coordinate all of his borrow area activities so as to prevent conflicts between Navy operations and dredging operations.

For drone firing exercises, please coordinate dredging and beach placement efforts with:

Gilbert Orosco
Atlantic Range & Targets Department
Naval Air Warfare Center
2140 Regulus Avenue, Bldg 481
Virginia Beach, VA 23461
757-492-8399
gilbert.l.orosco.civ@us.navy.mil

For the Navy Firing Area, please coordinate dredging and beach placement efforts with:

Gregory Thomas
Fleet Forces Atlantic Exercises Coordination Center
757-433-1345
gregory.w.thomas.civ@us.navy.mil

d) The contractor is not to spud, anchor, place buoys, or dredge between the two borrow areas and north of the line indicated on the plans.

## 1.7 LAYOUT OF WORK AND SURVEYS

### 1.7.1 General

The Contractor shall be responsible for the expense and layout of all work. When the Contractor's work methods require physical markings to be placed for the purpose of dredged material placement control, including all placement area and easement control points and all range markers and buoys indicated or that otherwise are required to accomplish the work, shall be placed in the field and marked by a licensed Professional Engineer or Surveyor currently licensed in the Commonwealth of Virginia. The licensed Professional Engineer or Surveyor shall have coastal topographic and hydrographic surveying experience. All hydrographic survey techniques shall be in accordance with EM 1110-2-1003. All topographic survey techniques shall be in accordance with EM 1110-1-1005. The markings shall be minimum 1 inch diameter steel pipe marked with orange flagging and orange paint, placed in the immediate work areas only and shall be removed once a work area has been accepted. The Government reserves the right to verify all in-place markings before dredging and placement operations commence, and at any time during the contract.

### 1.7.2 Datum and Bench Marks

The plane of reference for the project is NAVD 88, North American Vertical Datum 1988 as indicated. The bench mark elevations are shown on the drawings for the respective work areas. The government will furnish monument descriptions for these bench marks at the Preconstruction Conference.

### 1.7.3 Responsibility for Tide Measurements

It shall be the responsibility of the Contractor to obtain tide level measurements and predictions as required to conduct his dredging operations for the duration of the work.

### 1.7.4 Contractor Layout for Survey of Beach Requirements

The Contractor shall submit for approval a base line drawing showing all offsets, elevations, reference lines, and range line locations to be utilized for the entire project prior to performing any surveying. This drawing shall be prepared and stamped by the independent Professional Engineer or Surveyor employed as specified above.

## 1.8 CONTINUITY OF BEACH FILL WORK

Placement of the beach fill shall proceed in an orderly and consecutive manner. No payment will be made for work done in any acceptance section of the beach designated by the Contracting Officer until the entire acceptance section is brought to the shape and grade indicated and specified. When the Contractor moves his pipeline upon completion of a beach segment section and commences placing material in a manner that the new beach segment section adjacent to the completed section is tied into the completed section, acceptance for payment purposes will not be made on either section until both sections are completely finished contiguously.

## 1.9 CONTINUITY OF BORROW AREA DREDGING

The Contractor shall submit for approval a Borrow Area Material Removal Plan. The plan shall indicate the operations and procedures he intends to perform in each respective borrow area, work methods to be employed that will result in efficient hydraulic placement of the required amount of materials within the beach fill section, and the proposed station locations where material is to be removed. The material removal operations shall be performed to the maximum extent practical in contiguous sections that do not result in the creation of deep pits or holes in the borrow area.

## 1.10 AGREEMENT WITH BOEM TO USE THE SANDBRIDGE BORROW AREA

A Memorandum of Agreement (MOA) with BOEM authorized the use of sand resources from the Sandbridge Shoal Borrow Area A. The agreement states that USACE or its contractor(s) may only extract, transport, and place such Outer Continental Shelf (OCS) sand resources from the borrow area in accordance with the terms and conditions set forth in the agreement.

This agreement is included as an attachment to these specifications. All conditions within the BOEM MOA are also conditions of this solicitation. Any questions regarding the agreement shall be directed to the USACE Contracting Officer.

### 1.10.1 MOA required Notifications

As part of the agreement to use the borrow area, the following events require notification to BOEM by USACE:

1. 72 hours prior to commencing operations in the borrow area.

2. 24 hours after termination of operations.

3. Immediate notification of any dredging outside of the approved borrow area.

4. Any noncompliant discharges and remedial actions taken in the borrow area.

5. Any encounter of ordnance must be reported to BOEM within 24 hours.

6. If any previously unknown historic or archeological resources are encountered during operations.

In order for USACE to meet these requirements, the Contractor will provide the Contractor will notify the Contracting Officer, the Contracting Officer's Representative (COR), or the Construction Representation of the following events:

1. 96 hours prior to the commencing of operations in the borrow area.

2 - 6. Immediate notification

## 1.11 INSPECTION

### 1.11.1 General Inspection Requirements

The presence of the construction representative shall not relieve the Contractor of responsibility for the proper execution of the work in accordance with the specifications. The Contractor will be required:

a. To furnish, on the request of the Contracting Officer or any construction representative, the use of such boats, boatmen, laborers, and material forming a part of the ordinary and usual equipment and crew of the dredging plant as may be reasonably necessary in inspecting and supervising the dredging.

b. To furnish, on the request of the Contracting Officer or any construction representative, suitable transportation from all points within the placement area, to and from the various pieces of plant and the staging areas, and within the material placement area as may be reasonably necessary in inspecting and supervising the work. Should the Contractor refuse, neglect, or delay compliance with these requirements, the specific facilities may be furnished and maintained by the Contracting Officer, and any resultant cost incurred by the government will be deducted from any amounts due or to become due the Contractor.

c. To furnish the Government construction representative a portable radio capable of communicating with the dredge for the duration of work under this contract. The Contractor shall maintain the radio as required.

d. Hopper dredges shall be provided with a fixed vertical ship ladder system (in compliance with the requirements of ASTM F1166) as the primary means of safe access/egress for works and visitors embarking / disembarking the vessel. A double rung of flat tread Jacob's ladder shall not be used as the vessel's primary means of safe access.

### 1.11.2 Accommodations Aboard Dredge For Construction Representatives

#### 1.11.2.1 Accommodations

Work Space - The Contractor shall furnish regularly to Government construction representatives on board the dredge a suitable working and storage space, equipped and maintained to the satisfaction of the Contracting Officer or his representative. As a minimum the facilities shall include a desk with chair for plan study, and a file drawer, approximately 15" by 24", capable of being locked with a padlock. The working space need not be a separate room, but shall be properly lighted, ventilated, and heated.

#### 1.11.2.2 Costs

The entire cost to the Contractor for furnishing, equipping, and maintaining the foregoing accommodations shall be included in the contract price. If the Contractor fails to meet these requirements, the Contracting Officer will secure the facilities referred to above, and their costs will be deducted from payments due to the Contractor.

## 1.12 SPECIAL COAST GUARD REQUIREMENTS

### 1.12.1 Local Notice To Mariners

The Local Notice To Mariners (LNM) for the East Coast Guard District is available by phone at (757) 398-6367. Additionally, LNM are on the Internet at:

https://www.dco.uscg.mil/Featured-Content/Mariners/Local-Notice-to-Mariners-LNMs/
The LNM is the primary means for disseminating information concerning aids to navigation, hazards to navigation, and other items of marine information of interest to mariners on the waters of the United States, its territories, and possessions. These notices are essential to all navigators for the purpose of keeping their charts, light lists, Coast Pilots and other nautical publications up-to-date. These notices are published weekly. They may be obtained free of charge, by making application to the East Coast Guard District, Federal Building, 431 Crawford Street, Portsmouth, Virginia 23704.

The timeline for notification is outlined in the Memorandum of Agreement with BOEM, which is included as an attachment to these specifications.

If the Contractor encounters any objects on the bottom during dredging operations or transport of his plant that could be a hazard to navigation, he shall notify the Coast Guard immediately as to location and at the same time notify the Contracting Officer.

### 1.12.2 Relocation of Navigation Aids

The Contractor shall not relocate or move any aids to navigation that have been established by the U.S. Coast Guard. If it becomes necessary to have any aid to navigation moved in order to complete dredging operations under

this contract, the Contractor shall notify the U.S. Coast Guard in writing at the address above with a copy to the Contracting Officer not less than 45 calendar days prior to such need for movement. The Contractor shall notify the U.S. Coast Guard of the approximate time the navigation aid may be relocated to its original position. All notifications to the U.S. Coast Guard shall at the same time be provided to the Contracting Officer and recorded in the Daily Report of Operations. In the event that the Contractor disturbs or damages any navigation aid during work operations, which includes during mobilization or demobilization of his plant, the Contractor shall immediately stop the activity which disturbed or damaged the navigation aid, take immediate corrective action to prevent further disturbances or damage, and shall notify the Coast Guard immediately as to location, and at the same time notify the Contracting Officer.

## 1.13 MISS UTILITY

The Contractor shall comply with all requirements of the Virginia Underground Utility Damage Prevention Act § 56-265.14 (the Miss Utility law). The Contractor must call the Miss Utility Notification Center at 811 OR 1-800-552-7001 before commencing any excavation work, including dredging.

The Contractor shall provide to the government, in writing, all Ticket numbers, Miss Utility system responses and other information upon completion of the Contractor's notification process to Miss Utility prior to dredging. Requirements of the law, procedures to followed by the Contractor and other pertinent information for the Contractor's use can be found at http://www.missutilityofvirginia.com (or http://va811.com/lawspolicies/). Each "person" as defined in the Underground Utility Damage Prevention Act must provide their own notice of excavation. Subcontractors may not work under another company's ticket unless they are under the direct supervision of the company that provided the notice of excavation.

The Contractor shall allow a minimum of 48 hours after notifying the Miss Utility notification center and begin excavation only after checking the Positive Response System, and confirm through the Ticket Information Exchange (TIE) System, that all applicable utilities have either marked their underground line locations or reported that no lines are present in the work vicinity. The Contractor shall wait an additional 24 hours before commencing excavation work if any utility operators have failed to respond to the Ticket Information Exchange within the first 48 hours.

## 1.14 ENVIRONMENTAL LITIGATION

### 1.14.1 Litigation

If the performance of all or any part of the work is suspended, delayed, or interrupted due to an order of a court of competent jurisdiction as a result of environmental litigation, as defined below, the Contracting Officer, at the request of the Contractor, shall determine whether the order is due in any part to the acts or omissions of the Contractor or a subcontractor at any tier not required by the terms of this contract. If it is determined that the order is not due in any part to acts or omissions of the Contractor or a subcontractor at any tier other than as required by the terms of this contract, such suspension, delay, or interruption shall be considered as if ordered by the Contracting Officer in the administration of this contract under the terms of the "Suspension of Work" clause of this contract. The period of such suspension, delay,

or interruption shall be considered unreasonable, and an adjustment shall be made for any increase in the cost of performance of this contract (excluding profit) as provided in that clause, subject to all the provisions thereof. The term "environmental litigation" means, a lawsuit alleging that the work will have an adverse effect on the environment or that the Government has not duly considered, either substantively or procedurally, the effect of the work on the environment.

## 1.15 HISTORICAL AND ARCHAEOLOGICAL FINDS

Federal legislation provides for the protection, preservation, and collection of scientific, prehistoric, historic, and archaeological data, including relics and specimens that might otherwise be lost as a result of any Federal construction project. Should the Contractor, or any of the Contractor's employees, or parties operating or associated with the Contractor, in the performance of this contract discover evidence of possible scientific, prehistoric, historic, or archaeological data, the Contractor shall immediately cease work at that location, and notify the Contracting Officer, giving the location and nature of the findings. Contractor shall clearly photograph any suspected resources if pieces are found in the draghead or hopper. Photographs shall be taken from all angles when feasible and provided to the Contracting Officer's Representative.

The Contractor shall retain any suspected resource, or piece of a suspected resource, recovered in the draghead so long as it is safe to do so The Contractor shall forward written confirmation to the Contracting Officer as directed. The Contracting Officer shall notify the districts' Archaeologist, Environmental Manager, and the State Historic Preservation Office if any resources are discovered. USACE will coordinate with VDHR to determine the final disposition of any suspected resource.

The Contractor shall exercise care so as not to disturb or damage shipwrecks, artifacts or fossils uncovered during excavation, dredging and material placement operations, and shall provide such cooperation and assistance as may be necessary to preserve the findings for removal or other disposition. Any person who, without written permission, injures, destroys, excavates, appropriates, moves or removes any historic or prehistoric artifact, object of antiquity, or archaeological resource is subject to arrest and penalty of law. Where appropriate by reason of discovery, the Contracting Officer may order delays in the time of performance or changes in the work, or both. If such delays or changes are ordered, an equitable adjustment will be made in accordance with the applicable clauses of the contract.

### 1.15.1 Avoidance of Historic Resources

Not less than thirty calendar days from the start of dredging operations, the Contractor shall perform a marine remote sensing survey at the site(s) of any booster(s) or Scott's buoy/anchored pumpout buoy locations to ensure that potential historic resources are not located within his work area. If potential resources are identified during the survey, Contractor shall immediately notify the Contracting Officer's Representative, giving the location and nature of the findings. Contractor shall relocate his construction areas and establish a 100-ft buffer around the discovery. Do not anchor or spud in any such historic-resource, buffer zone nor disturb the buffer area in any way.

The proposed revised buoy site or booster location shall be surveyed to

ensure no historic resources are within any revised work area.

A list of Archaeological Avoidance Areas, including location and minimum avoidance radius, is included as an attachment to the project specifications.

## 1.16 SUBCONTRACTS AND WORK COORDINATION

Contract Clauses "SUBCONTRACTS", "PERMITS AND RESPONSIBILITIES", and "MATERIAL AND WORKMANSHIP" are supplemented as follows:

(a) Divisions or sections of specifications are not intended to control the Contractor in dividing the work among subcontractors, or to limit work performed by any trade.

(b) Contractor shall be responsible for coordination of the work of the trades, subcontractors, and materials.

(c) The Government or its representative will not undertake to settle any difference between the Contractor and Contractor's subcontractors, or between subcontractors.

(d) The Government reserves the right to refuse to permit employment on the work or require dismissal from the work of any subcontractor who, by reason of previous unsatisfactory work on Corps of Engineers projects, or for any other reason is considered by the Contracting Officer to be incompetent or otherwise objectionable.

## 1.17 SEAGOING BARGE ACT

All dredges, barges, and vessels used for the transport of dredged material shall meet the applicable requirements of the Seagoing Barge Act (46 U.S.C. et seq). To document compliance with this act, the Contractor shall submit with his bid copies of U.S. Coast Guard Certificate of Inspection for each item of plant. Certification shall also be furnished to the Contracting Officer if additional plant is engaged during the course of the work.

# PART 2 PRODUCTS

Not Used

# PART 3 EXECUTION

Not Used

-- End of Section --

# SECTION 01 20 00

# PRICE AND PAYMENT PROCEDURES
**11/20, CHG 3: 02/23**

## PART 1 GENERAL

This section describes how Line Items will be measured and paid for when making progress payments. Work to be measured is described in specification sections listed for each Line Item. Measurement procedures for payment, required quantity survey or procurement documentation and payment restrictions are described in applicable specification sections. Allocate costs for work not specifically mentioned to the Line Item most closely associated with work involved.

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| EM 1110-1-1005 | (2007) Control and Topographic Surveying |
| EM 1110-2-1003 | (2013) Hydrographic Surveying |

### 1.2 SUBMITTALS

NOT USED.

### 1.3 LUMP SUM PAYMENT ITEMS

Payment items for the work of this contract for which contract lump sum payments will be made are listed in the BIDDING SCHEDULE and described below. All costs for items of work, which are not specifically mentioned to be included in a particular lump sum or unit price payment item, shall be included in the listed lump sum item most closely associated with the work involved. The lump sum price and payment made for each item listed shall constitute full compensation for furnishing all plant, labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, tests and reports, and for performing all work required for which separate payment is not otherwise provided.

#### 1.3.1 Base Bid Payment Item No. 0001 Mobilization and Demobilization

All costs connected with the mobilization and demobilization, inclusive of additional remobilizations and demobilizations for seasonal restriction windows, of the Contractor's plant and equipment for dredging Sandbridge Shoal Borrow Area A and placement on Sandbridge Beach are included in this bid item. Sixty percent of the lump sum price will be paid to the Contractor upon completion of his mobilization at the work site. The remaining forty percent will be paid to the Contractor upon completion of demobilization. In the event the Contracting Officer considers that the amount in this item, sixty percent which represents mobilization and forty percent which represents demobilization, does not bear a reasonable relation to the cost of the work in this contract, the Contracting Officer

may require the Contractor to produce cost data to justify this portion of the bid. Failure to justify such price to the satisfaction of the Contracting Officer will result in payment of actual mobilization costs, as determined by the Contracting Officer, at the completion of mobilization, and actual demobilization costs, as determined by the Contracting Officer, at the completion of demobilization. The determination of the Contracting Officer is not subject to appeal.

All dredging costs are to be incidental to the cost for beach placement. No separate payment will be made for the dredging work performed

1.3.1.1 Mobilization

Mobilization shall include all costs for operations accomplished prior to commencement of actual dredging and beach fill placement operations. This shall include transfer of dredge and attendant plant, booster pumps and pump out buoys, bulldozers and other like equipment and machinery including pipelines associated with beach fill placement operations, preparation of the Contractor's staging area and any long term staging area(s) used for off beach equipment and material storage, and any other associated work that is necessary in advance of the actual dredging and beach fill placement operations.

1.3.1.2 Demobilization

Demobilization shall include general preparation for transfer of dredging and beach fill plant as described in Paragraph "Mobilization" above to its home base, cleanup of the Contractor's long term staging area, and transfer of the dredging and beach fill plant to its home base.

## 1.4 UNIT PRICE PAYMENT ITEMS

Payment items for the work of this contract on which the contract unit price payments will be made are described below. The unit price and payment made for each item listed shall constitute full compensation for furnishing all plant, labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, tests and reports, and for performing all work required for each of the unit price items.

### 1.4.1 Base Bid Payment Item No. 0002 Live Sea Turtle Response with Traumatic Fatal Injuries (Level One)

Payment to be made for this item includes all costs for the collection, handling, transportation, and delivery of a live sea turtle to the Virginia Aquarium & Marine Science Center Stranding Response Team (VAQS)(mailing address: 717 General Booth Blvd, Virginia Beach, Virginia 23451), the payment of the VAQS fee as defined below for their response and rehabilitation, and all other associated costs.

Level One is defined as a live sea turtle that is transferred to the VAQS and is euthanized or dies within 48 hours due to the severity of the injuries resulting from the dredge interaction. The government has negotiated the fee for this item at $1,502.00 and includes the predetermined costs incurred by the VAQS for live response and rehabilitation of a live sea turtle with traumatic fatal injuries (level one).

Live Sea Turtle dredge takes are categorized into one of three fee levels

(1, 2, or 3) and this Payment Item is specific to fee level one. The fee levels will be determined by the VAQS based on the severity of the injury resulting from the dredge interaction. These fees have been negotiated between the Government and VAQS. Once VAQS assesses the turtle and determines the severity of the injury, the Contractor shall be responsible for paying VAQS directly for the predetermined fee associated with the response and care of live sea turtle dredge takes. The Contractor shall submit the invoice from VAQS to the Contracting Officer within 7 days of receipt. Within 30 days of receiving the invoice, the Contractor shall submit payment to VAQS. The Contractor shall submit to the Contracting Officer the Contractor's proof of payment from VAQS along with the Contractor's Invoice for this Payment Item.

The Contractor shall include the level one fee to VAQS for this Payment Item in their bid for this item.

### 1.4.2 Base Bid Payment Item No. 0003 Live Sea Turtle Response and Rehabilitation with Mild to Moderate Traumatic Injuries (Level Two)

Payment to be made for this item includes all costs for the collection, handling, transportation, and delivery of a live sea turtle to VAQS, the payment of the VAQS fee as defined below for their response and rehabilitation, and all other associated costs.

Level Two is defined as a live entrained sea turtle that is transferred to the VAQS with mild to moderate injuries. Injuries associated with this severity of injury are estimated to require up to one year in rehabilitation prior to release. Associated injuries may include but are not limited to: scrapes, cuts, lesions, broken bones associated with mild to moderate trauma. The government has negotiated the fee for this item at $15,133.00 and includes the predetermined costs incurred by the VAQS for live response and rehabilitation of a live sea turtle with mild to moderate traumatic injuries (level two).

Live Sea Turtle dredge takes are categorized into one of three fee levels (1, 2, or 3) and this Payment Item is specific to fee level two. The fee levels will be determined by the VAQS based on the severity of the injury resulting from the dredge interaction. These fees have been negotiated between the Government and VAQS. Once VAQS assesses the turtle and determines the severity of the injury, the Contractor shall be responsible for paying VAQS directly for the predetermined fee associated with the response and care of live sea turtle dredge takes. The Contractor shall submit the invoice from VAQS to the Contracting Officer within 7 days of receipt. Within 30 days of receiving the invoice, the Contractor shall submit payment to VAQS. The Contractor shall submit to the Contracting Officer the Contractor's proof of payment from VAQS along with the Contractor's Invoice for this Payment Item.

The Contractor shall include the level two fee to VAQS for this Payment Item in their bid for this item.

### 1.4.3 Base Bid Payment Item No. 0004 Live Sea Turtle Response and Rehabilitation with Severe Traumatic Injuries (Level Three)

Payment to be made for this item includes all costs for the collection, handling, transportation, and delivery of a live sea turtle to VAQS, the payment of the VAQS fee as defined below for their response and

rehabilitation, and all other associated costs.
Level Three is defined as a live entrained sea turtle that is transferred to the VAQS with severe injuries. Injuries associated with this severity of injury are estimated to require over one year in rehabilitation prior to release. Associated injuries may include but are not limited to: penetrating or crushing wounds, spinal injuries, broken bones associated with severe trauma. The government has negotiated the fee for this item at $61,073.00 and includes the predetermined costs incurred by the VAQS for live response and rehabilitation of a live sea turtle with severe traumatic injuries (level three).

Live Sea Turtle dredge takes are categorized into one of three fee levels (1, 2, or 3) and this Payment Item is specific to fee level three. The fee levels will be determined by the VAQS based on the severity of the injury resulting from the dredge interaction. These fees have been negotiated between the Government and VAQS. Once VAQS assesses the turtle and determines the severity of the injury, the Contractor shall be responsible for paying VAQS directly for the predetermined fee associated with the response and care of live sea turtle dredge takes. The Contractor shall submit the invoice from VAQS to the Contracting Officer within 7 days of receipt. Within 30 days of receiving the invoice, the Contractor shall submit payment to VAQS. The Contractor shall submit to the Contracting

Officer the Contractor's proof of payment from VAQS along with the Contractor's Invoice for this Payment Item.

The Contractor shall include the level three fee to VAQS for this Payment Item in their bid for this item.

### 1.4.4 Base Bid Payment Items No. 0005 Turtle Trawling

Payment for Turtle Trawling shall be made at the "Per-Day" (24 hrs.) rate. This payment item shall include all mobilization / demobilization time of the trawler and all materials, equipment, and labor required to accomplish the intended purpose of this item. Turtle Trawling must meet the conditions set forth in Section 01 57 40 SPECIAL EQUIPMENT AND PROCEDURE REQUIREMENTS FOR PROTECTION OF ENDANGERED SPECIES AND AVOIDANCE OF ARCHEOLOGICAL RESOURCES. Payment for Turtle Trawling will be made for the actual days that trawling takes place. No standby time for the trawlers will be included in this pay item.

### 1.4.5 Base Bid Payment Items No. 0006 Initial Sea Turtle Nest Relocation and VAQS Standby Readiness

Payment to be made for this item includes all costs to relocate the first sea turtle nest within the beach fill template and standby readiness from VAQS during nesting season. The nest relocation fees have been negotiated between the Government and VAQS. The Contractor shall include the negotiated fees in their bid. Once any sea turtle nest within the beach fill template has been relocated, the Contractor shall be responsible for paying VAQS directly for the corresponding predetermined fee. The Contractor shall submit the invoice from VAQS to the Contracting Officer within 7 days of receipt. Within 30 days of receiving the invoice, the Contractor shall submit payment to VAQS. The Contractor shall submit to the Contracting Officer the Contractor's proof of payment from VAQS along with the Contractor's Invoice for this Payment Item. The government has negotiated the fee for the first nest relocation at $4,099. These costs include the predetermined costs incurred by the VAQS for sea turtle nest

relocations and standby readiness from VAQS during nesting season. Nest relocation and payment does not guarantee the nest will be relocated outside of the placement area.

1.4.6 Base Bid Payment Items No. 0007 Additional Sea Turtle Nest Relocation(s)

Payment to be made for this item includes all costs to relocate additional sea turtle nests within the beach fill template. The nest relocation fees have been negotiated between the Government and VAQS. The Contractor shall include the negotiated fees in their bid. After the additional sea turtle nest within the beach fill template has been relocated, the Contractor shall be responsible for paying VAQS directly for the corresponding predetermined fee. The Contractor shall submit the invoice from VAQS to the Contracting Officer within 7 days of receipt. Within 30 days of receiving the invoice, the Contractor shall submit payment to VAQS. The Contractor shall submit to the Contracting Officer the Contractor's proof of payment from VAQS along with the Contractor's Invoice for this Payment Item. The government has negotiated the fee for any additional nest relocations at $221 per nest. These costs include the predetermined costs incurred by the VAQS for sea turtle nest relocations after the first nest. Nest relocation and payment does not guarantee the nest will be relocated outside of the placement area.

1.4.7 Base Bid Payment Items No. 0008 Contracting Officer Directed Standby Time

The contract price per day for Contracting Officer directed standby time shall include the Contractor's costs for holding his plant, equipment, and crew on site until further direction is given by the Contracting Officer. During the contract period, the Government reserves the right to issue stand by orders to the Contractor for periods up to 24 hours. Time will be measured and paid for by the day (24 hours) and calculated to the nearest hour (1/24 day) for payment.

1.4.8 Base Bid Payment Items No. 0009 Dredging/Beach Fill Complete

Payment to be made for this item includes all costs associated with dredging beach fill from the offshore borrow area, transport of the dredged beach fill material to the pump out mooring facility, transferring to the shoreline, construction of the designated beach to the lines and grades indicated, and all other associated costs of removal and placement of material as indicated and specified exclusive of the mobilization and demobilization as defined above. The total cost of these items shall be based on the cubic yard price bid for this item and the computed difference between the Before Placement and After Placement surveys for each beach fill segment/acceptance area. Payment shall be made for volume of material placed under Item 0009, first. All Hydrographic Surveys perform at placement and borrow area shall be in accordance with EM 1110-2-1003. All Topographic Surveys perform at placement area shall be in accordance with EM 1110-1-1005.

1.4.9 Option Bid Payment Items No. 0010 Dredging/Beach Fill Complete

Payment to be made for this item includes all costs associated with dredging beach fill from the offshore borrow area, transport of the dredged beach fill material to the pump out mooring facility, transferring

to the shoreline, construction of the designated beach to the lines and grades indicated, and all other associated costs of removal and placement of material as indicated and specified exclusive of the mobilization and demobilization as defined above. The total cost of these items shall be based on the cubic yard price bid for this item and the computed difference between the Before Placement and After Placement surveys for each beach fill segment/acceptance area. Payment shall be made for volume of material placed under Item 00010, after the placement of Item 0009. All Hydrographic Surveys perform at placement and borrow area shall be in accordance with EM 1110-2-1003. All Topographic Surveys perform at placement area shall be in accordance with EM 1110-1-1005.

1.4.10 Option Bid Payment Items No. 0011 Dredging/Beach Fill Complete

Payment to be made for this item includes all costs associated with dredging beach fill from the offshore borrow area, transport of the dredged beach fill material to the pump out mooring facility, transferring to the shoreline, construction of the designated beach to the lines and grades indicated, and all other associated costs of removal and placement of material as indicated and specified exclusive of the mobilization and demobilization as defined above. The total cost of these items shall be based on the cubic yard price bid for this item and the computed difference between the Before Placement and After Placement surveys for each beach fill segment/acceptance area. Payment shall be made for volume of material placed under Item 0011, after the placement of Item 0010. All Hydrographic Surveys perform at placement and borrow area shall be in accordance with EM 1110-2-1003. All Topographic Surveys perform at placement area shall be in accordance with EM 1110-1-1005.

1.4.11 Option Bid Payment Items No. 0012 Dredging/Beach Fill Complete

Payment to be made for this item includes all costs associated with dredging beach fill from the offshore borrow area, transport of the dredged beach fill material to the pump out mooring facility, transferring to the shoreline, construction of the designated beach to the lines and grades indicated, and all other associated costs of removal and placement of material as indicated and specified exclusive of the mobilization and demobilization as defined above. The total cost of these items shall be based on the cubic yard price bid for this item and the computed difference between the Before Placement and After Placement surveys for each beach fill segment/acceptance area. Payment shall be made for volume of material placed under Item 0012, after the placement of Item 0011. All Hydrographic Surveys perform at placement and borrow area shall be in accordance with EM 1110-2-1003. All Topographic Surveys perform at placement area shall be in accordance with EM 1110-1-1005.

1.4.12 Option Bid Payment Items No. 0013 Onboard MEC Technician

See specification section 01 35 30 GOVERNMENT PROVIDED MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) CONSTRUCTION SUPPORT for details on when these personnel would be required.

The optional bid item will be for onboard required MEC support personnel and will be based on a daily rate. No separate payment will be made for travel time to and from the dredge. All transportation costs to and from the dredge shall be included in the daily rate. Costs will be paid for based on actual time onboard the dredge.

## 1.5 MISPLACED MATERIAL

Any dredged materials deposited at locations other than in areas designated or approved by the Contracting Officer will be considered misplaced material and will not be paid for until the Contractor, at their own expense, removes and deposits such misplaced material where directed. This required removal and redeposit of the misplaced material and any necessary placement site restoration work is not the basis for a time extension or additional compensation under this contract.

## 1.6 MONTHLY PARTIAL PAYMENTS

Monthly partial payments will be based on the total volume of material placed and accepted for each beach fill segment as determined by the Contracting Officer.

# PART 2 PRODUCTS

Not Used

# PART 3 EXECUTION

Not Used

-- End of Section --

# SECTION 01 30 00

# ADMINISTRATIVE REQUIREMENTS
**11/20, CHG 3: 08/23**

## PART 1 GENERAL

### 1.1 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Progress and Completion Pictures

List Of Contact Personnel; G

### 1.2 PROGRESS AND COMPLETION PICTURES

The Contractor shall, during the progress of the work, furnish the Contracting Officer ground and aerial photographs depicting the progress of construction and project completion. A qualified, established commercial photographer shall be retained by the Contractor at his expense to take and provide all photographs throughout the entire life of the project. Aerial photographs shall be taken at an altitude of between 200 feet and 500 feet. Coverage shall cover an area approximately 1 mile north to 1 mile south of the fill area. Aerial photographs shall be taken as a minimum on a monthly basis and at each request for progress payments by the Contractor. The ground photographs shall be taken at each acceptance section in the scheduled work as follows unless directed otherwise by the Contracting Officer:

(1) Immediately prior to filling operations, and

(2) Immediately after filling operations have been completed.

All photographs shall be color prints provided on CD. Each photo shall be identified by showing the date taken. Each CD shall show the contract title and number, and respective acceptance section identification with a brief description of what the photograph depicts. Two copies of each CD shall be furnished to the Contracting Officer in accordance with the above requirements. All photographs shall be 1600x1200x24 bit true color 1200 dpi minimum resolution in JPEG file format. Digital files for all of the above photographs shall be given to and become the property of the Government. No separate payment will be made for the above services and all costs in connection with these services shall be considered incidental to the overall costs of the project.

### 1.3 MINIMUM INSURANCE REQUIREMENTS

Provide the minimum insurance coverage required by FAR 28.307-2 Liability, during the entire period of performance under this contract. Provide

other insurance coverage as required by State law.

## 1.4 SUPERVISION

### 1.4.1 Superintendent Qualifications

The contractor shall follow the requirements in 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS regarding project supervisor qualifications, experience, and training.

### 1.4.2 Minimum Communication Requirements

Have at least one qualified superintendent, or competent alternate, capable of reading, writing, and conversing fluently in the English language, on the job-site at all times during the performance of Contract work. In addition, if a Quality Control (QC) representative is required on the Contract, then that individual must also have fluent English communication skills.

### 1.4.3 Duties

The project superintendent is primarily responsible for managing subcontractors and coordinating day-to-day production and schedule adherence on the project. The superintendent is required to attend partnering meetings, and quality control meetings. The superintendent or qualified alternative must be on-site at all times during the performance of this contract until the work is completed and accepted.

### 1.4.4 Non-Compliance Actions

The Project Superintendent is subject to removal by the Contracting Officer for non-compliance with requirements specified in the contract and for failure to manage the project to ensure timely completion. Furthermore, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders is acceptable as the subject of claim for extension of time for excess costs or damages by the Contractor.

## 1.5 PRECONSTRUCTION CONFERENCE

Prior to commencing any work at the site, coordinate with the Contracting Officer a time and place to meet for the Preconstruction Conference. The purpose of this conference is to discuss and develop a mutual understanding of the administrative requirements of the Contract including but not limited to: daily reporting, invoicing, safety, hot work permits, schedule requirements, quality control, schedule of prices or earned value report, shop drawings, submittals, cybersecurity, prosecution of the work, government acceptance, final inspections and contract close-out. Contractor must present and discuss their basic approach to scheduling the construction work and any required phasing.

As part of the Memorandum of Agreement with BOEM for this project, BOEM representatives will attend the preconstruction meeting.

### 1.5.1 Attendees

Contractor attendees must include the Project Manager, Superintendent, Site Safety and Health Officer (SSHO), Quality Control Manager and major

subcontractors.

1.5.2 Discussion Items

The following is a sample list of items for discussion during the preconstruction conference; however, the Contracting Officer may modify this list or include additional items for discussion as conditions and the work require.

a. Authority of the Contracting Officer's Representative.

b. Contractor's Progress Schedule.

c. Correspondence Procedures.

d. Contractor Labor Standards Provisions.

e. Contract Modifications and Administrative Procedures.

f. Contractor's Administrative, Laydown and Storage Areas.

g. Procedures for Processing Submittals.

h. Payment Estimate Data and Procedures.

i. Contractor Utilities.

j. Security Requirements and Other Regulations, if applicable.

k. Government Furnished Equipment, if applicable.

l. Disposition of Salvage Property, if applicable.

m. Contractor Insurance Requirements.

n. Environmental Protection Plan.

o. Contractor Performance Evaluation.

p. Emergency and Safety Procedures.

q. Plant and Suitability to Perform the Work.

r. Turnover of Placement Areas After Dredging.

s. Contractor Required Notification Procedures.

t. Contractor's Submittal Register.

u. Contractor's Survey and Information Reporting Procedures.

v. Contractor's Quality Control Plan and Activity Hazard Analysis, special emphasis to coordinate the proposed work procedures of the Contractor at the Beach Placement Area and the associated procedures the Contractor intends to employ to protect the public and comply with noise and safety requirements.

w. Submit a List of Contact Personnel and their phone numbers and email addresses.

## 1.6 OTHER MEETINGS DURING THE CONTRACT

Other meetings may be held after the Preconstruction Conference, for the purpose to discuss concerns and deficiencies that may include the following:

a. Contractor's Site Safety and Health Plan.

b. Quality Control Plan.

c. Environmental Protection Plan.

d. Progress Schedule updates.

## 1.7 MINUTES OF MEETINGS

The Contractor will prepare minutes of all meetings.

## 1.8 PARTNERING

To most effectively accomplish this Contract, the Contractor and Government must form a cohesive partnership with the common goal of drawing on the strength of each organization in an effort to achieve a successful project without safety mishaps, conforming to the Contract, within budget and on schedule. The partnering team must consist of personnel from both the Government and Contractor including project level and corporate level leadership positions.

This partnership would be bilateral in make-up and partnership will be totally voluntary. Any cost associated with effectuating this partnership will be agreed to by all parties and will be shared equally with no change in contract price.

### 1.8.1 Team-Led (Informal) Partnering

a. The Contracting Officer will coordinate the initial Team-Led (Informal) Partnering Session with key personnel of the project team, including Contractor and Government personnel. The Partnering Session will be co-led by the Government Construction Manager and Contractor's Project Manager.

b. The Initial Team-led Partnering session may be held concurrently with the meeting. Partnering sessions will be held at a location mutually agreed to by the Contracting Officer and the Contractor, typically at a conference room or at the Contractor's temporary trailer.

c. The Initial Team-Led Partnering Session will be conducted and facilitated using electronic media (a video and accompanying forms) provided by Contracting Officer.

d. The Partners will determine the frequency of the follow-on sessions.

e. Participants will bear their own costs for meals, lodging and transportation associated with Partnering.

## 1.9 COORDINATION WITH OTHER CONTRACTORS

During the period of this contract, other contracts may be in force for

the construction of other features of work on or adjacent to the site of work being accomplished under this contract. The Contractor shall arrange his plant, and shall schedule and perform this work, so as to effectively cooperate with all other contractors and Government agencies. It shall be the responsibility of the Contractor on this contract to be fully informed of the extent of the limits of work to be performed by other contractors. Should there be any conflict between these limits, the Contractor shall immediately notify the Contracting Officer of the conflict, and the Contracting Officer's decision shall be final.

## 1.10 RESPONSIBILITY

The Contractor shall hold and save harmless the United States, its officers, and employees from all claims that may arise as a result of the Contractor's negligence in connection with the work performed under the contract, from noncompliance by the Contractor with the provisions of the contract drawings and specifications, or from the instruction of the Contracting Officer.

# PART 2 PRODUCTS

Not Used

# PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 32 01.00 10

PROJECT SCHEDULE
**08/23**

# PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AACE INTERNATIONAL (AACE)

| | |
|---|---|
| AACE 29R-03 | (2011) Forensic Schedule Analysis |
| AACE 52R-06 | (2006) Time Impact Analysis - As Applied in Construction |

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

| | |
|---|---|
| ASCE 67-17 | (2017) Schedule Delay Analysis |

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| ER 1-1-11 | (2017) Administration -- Project Schedules |
| ER 415-1-15 | (1989) Construction Time Extensions for Weather |

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" classification. Submittals not having a "G" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Project Scheduler Qualifications; G

Preliminary Project Schedule; G

Initial Project Schedule; G

Periodic Schedule Update; G

## 1.3 PROJECT SCHEDULER QUALIFICATIONS

Designate an authorized representative to be responsible for the preparation of the schedule and all required updating and production of reports. The Designated Project Scheduler must have prepared and maintained at least three previous construction schedules for projects of similar size and complexity to this contract, using Primavera P6. Representative must have a comprehensive knowledge of CPM scheduling

principles and application.

# PART 2 PRODUCTS

## 2.1 SOFTWARE

The scheduling software utilized to produce and update the schedules required herein must be capable of meeting all requirements of this specification.

### 2.1.1 Government Default Software

The Government uses Primavera P6. Ensure exported schedule files are compatible with the version of P6 used by the Government.

### 2.1.2 Contractor Software

Scheduling software used by the contractor must be commercially available from the software vendor for purchase with vendor software support agreements available. The software routine used to create the required sdef file must be created and supported by the software manufacturer.

#### 2.1.2.1 Primavera

If Primavera P6 is selected for use, provide the "xer" export file in a version of P6 importable by the Government system. Verify at the SEKO meeting which version of P6 is in use by the Government. Export the schedule in a version of P6 no newer than that used by the Government.

#### 2.1.2.2 Other Than Primavera

If the Contractor chooses software other than Primavera P6, that is compliant with this specification, provide for the Government's use two licenses, two computers, and training for two Government employees in the use of the software. These computers will be stand-alone and not connected to Government network. Computers and licenses will be returned at project completion.

# PART 3 EXECUTION

## 3.1 GENERAL REQUIREMENTS

Prepare for approval a Project Schedule, as specified herein, pursuant to FAR Clause 52.236-15 Schedules for Construction Contracts. Show in the schedule the proposed sequence to perform the work and dates contemplated for starting and completing all schedule activities. The scheduling of the entire project is required. The scheduling of construction is the responsibility of the Contractor. Contractor management personnel must actively participate in its development. Subcontractors, and suppliers working on the project must also contribute in developing and maintaining an accurate Project Schedule. Provide a schedule that is a forward planning as well as a project monitoring tool. Use the Critical Path Method (CPM) of network calculation to generate all Project Schedules. Prepare each Project Schedule using the Precedence Diagram Method (PDM).

### 3.1.1 Scheduling Expectations Kickoff Meeting(SEKO)

In conjunction with the post award conference or pre construction conference the Government and the Contractor will hold a separate and

distinct Scheduling Expectations Kickoff Meeting(SEKO). The intent of this meeting is for the Government to review with the contractor the requirements of the scheduling specification, communicate the Government's expectations regarding schedule development and management, and answer any questions the Contractor may have regarding the schedule requirements.

## 3.2 BASIS FOR PAYMENT AND COST LOADING

The schedule is the basis for determining contract earnings during each update period and therefore the amount of each progress payment. The aggregate value of all activities coded to a contract CLIN must equal the value of the CLIN. Match the progress payment "Pay Period Thru" date in RMS to the schedule data date.

### 3.2.1 Activity Cost Loading

Activity cost loading must be reasonable and without front-end loading. Activities with a negative cost loading is not allowed. Provide additional documentation to demonstrate reasonableness if requested by the Contracting Officer.

### 3.2.2 Withholdings / Payment Rejection

Failure to meet the requirements of this specification may result in the disapproval of the preliminary, initial, or periodic schedule updates and subsequent rejection of payment requests until compliance is met.

In the event that the Contracting Officer directs schedule revisions and those revisions have not been included in subsequent Project Schedule revisions or updates, the Contracting Officer may withhold 10 percent of pay request amount from each payment period until such revisions to the project schedule have been made.

## 3.3 PROJECT SCHEDULE DETAILED REQUIREMENTS

### 3.3.1 Level of Detail Required

Develop the Project Schedule to the appropriate level of detail to address major milestones and to allow for satisfactory project planning and execution. Failure to develop the Project Schedule to an appropriate level of detail will result in its disapproval. The Contracting Officer will consider, but is not limited to, the following characteristics and requirements to determine appropriate level of detail:

### 3.3.2 Activity Durations

Reasonable activity durations are those that allow the progress of ongoing activities to be accurately determined between update periods. Non-procurement activities Original Durations (OD) are not to exceed 20 workdays or 30 calendar days.

### 3.3.3 Procurement Activities

Include in the schedule activities associated with the critical submittals and their approvals, procurement, fabrication, and delivery of long lead materials, equipment, fabricated assemblies, and supplies. Long lead procurement activities are those with an anticipated procurement sequence of over 90 calendar days.

### 3.3.4 Mandatory Activities

Include the following activities in the initial project schedule and all updates.

a. Submission, review and acceptance of SD-01 Preconstruction Submittals (individual activity for each).

b. Submission and approval of as-built drawings.

c. Submission and approval of DD1354 data and installed equipment lists.

d. Final inspection.

### 3.3.5 Government Activities

Show in schedule, Government and other agency activities that could impact progress. These activities include, but are not limited to environmental permit approvals by State regulators, inspections, and Notice to Proceed (NTP) for phasing requirements.

### 3.3.6 Standard Activity Coding Dictionary

Use the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER 1-1-11. This exact structure is mandatory. Develop and assign all Activity Codes to activities as detailed herein.

The SDEF format is as follows:

| Field | Activity Code | Length | Description |
|---|---|---|---|
| 1 | WRKP | 3 | Workers per day |
| 2 | RESP | 4 | Responsible party |
| 3 | AREA | 4 | Area of work |
| 4 | MODF | 6 | Modification Number |
| 5 | BIDI | 6 | Bid Item (CLIN) |
| 6 | PHAS | 2 | Phase of work |
| 7 | CATW | 1 | Category of work |
| 8 | FOW | 20 | Feature of work* |

*Some systems require that FEATURE OF WORK values be placed in several activity code fields. The notation shown is for Primavera P6. Refer to the specific software guidelines with respect to the FEATURE OF WORK field requirements.

#### 3.3.6.1 Workers Per Day (WRKP)

Assign Workers per Day for all field construction or direct work

activities, if directed by the Contracting Officer. Workers per day is based on the average number of workers expected each day to perform a task for the duration of that activity.

3.3.6.2 Responsible Party Coding (RESP)

Assign responsibility code for all activities to the Prime Contractor, Subcontractor(s) or Government agency(ies) responsible for performing the activity.

a. Activities coded with a Government Responsibility code include, but are not limited to: Government approvals, Government design reviews, environmental permit approvals by State regulators, Government Furnished Property/Equipment (GFP) and Notice to Proceed (NTP) for phasing requirements.

b. Activities cannot have more than one Responsibility Code. Examples of acceptable activity code values are: DOR (for the designer of record); ELEC (for the electrical subcontractor); MECH (for the mechanical subcontractor); and GOVT (for USACE).

3.3.6.3 Area of Work Coding (AREA)

Assign Work Area code to activities based upon the work area in which the activity occurs. Define work areas based on resource constraints or space constraints that would preclude a resource, such as a particular trade or craft work crew from working in more than one work area at a time due to restraints on resources or space. Examples of Work Area Coding include different areas within a floor of a building, different floors within a building, and different buildings within a complex of buildings. Activities cannot have more than one Work Area Code.

3.3.6.4 Modification Number (MODF)

Assign a Modification Number Code to any activity or sequence of activities added to the schedule as a result of a Contract Modification, when approved by Contracting Officer. Key all Code values to the Government's modification numbering system. An activity can have only one Modification Number Code.

3.3.6.5 Bid Item Coding (BIDI)

Assign a Bid Item Code to all activities using the Contract Line Item Number (CLIN) to which the activity belongs, even when an activity is not cost loaded. An activity can have only one BIDI Code.

3.3.6.6 Phase of Work Coding (PHAS)

Assign Phase of Work Code to all activities. Examples of phase of work are procurement phase and construction phase. Each activity can have only one Phase of Work code.

a. Code proposed fast track design and construction phases proposed to allow filtering and organizing the schedule by fast track design and construction packages.

b. If the contract specifies phasing with separately defined performance periods, identify a Phase Code to allow filtering and organizing the schedule accordingly.

3.3.6.7 Category of Work Coding (CATW)

Assign a Category of Work Code to all activities. Category of Work Codes include, but are not limited to construction submittal, procurement, fabrication, weather sensitive installation, non-weather sensitive installation, start-up, and testing activities. Each activity can have no more than one Category of Work Code.

3.3.6.8 Feature of Work Coding (FOW)

Assign a Feature of Work Code to appropriate activities based on the Definable Feature of Work to which the activity belongs based on the approved QC plan.

Definable Feature of Work is defined in Section 01 45 00 QUALITY CONTROL. An activity can have only one Feature of Work Code.

3.3.7 Contract Milestones and Constraints

Milestone activities are to be used for significant project events including, but not limited to, project phasing, project start and end activities, or interim completion dates. The use of artificial float constraints such as "zero free float" or "zero total float" are prohibited.

Mandatory constraints that ignore or effect network logic are prohibited. No constrained dates are allowed in the schedule other than those specified herein. Submit additional constraints to the Contracting Officer for approval on a case by case basis.

3.3.7.1 Project Start Date Milestone and Constraint

The first activity in the project schedule must be a start milestone titled "NTP Acknowledged," which must have a "Start On" constraint date equal to the date that the NTP is acknowledged.

3.3.7.2 End Project Finish Milestone and Constraint

The last activity in the schedule must be a finish milestone titled "End Project."

Constrain the project schedule to the Contract Completion Date in such a way that if the schedule calculates an early finish, then the float calculation for "End Project" milestone reflects positive float on the longest path. If the project schedule calculates a late finish, then the "End Project" milestone float calculation reflects negative float on the longest path.

3.3.7.3 Interim Completion Dates and Constraints

Constrain contractually specified interim completion dates to show negative float when the calculated late finish date of the last activity in that phase is later than the specified interim completion date.

3.3.7.3.1 Start Phase

Use a start milestone as the first activity for a project phase. Call the start milestone "Start Phase X" where "X" refers to the phase of work.

3.3.7.3.2 End Phase

Use a finish milestone as the last activity for a project phase. Call the finish milestone "End Phase X" where "X" refers to the phase of work.

3.3.8 Time Extensions For Unusually Severe Weather

This provision specifies the procedure for the determination of time extensions for unusually severe weather in accordance with the Contract Clause entitled "Default: (Fixed Price Construction)". In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

a. The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

b. The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the Contractor.

3.3.8.1 Schedule

The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The Contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY WORK DAYS
BASED ON (5) DAY WORK WEEK

| JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 9 | 8 | 6 | 7 | 7 | 9 | 6 | 5 | 5 | 6 | 9 |

3.3.9 Calendars

Schedule activities on a Calendar to which the activity logically belongs. Develop calendars to accommodate any contract defined work period such as a 7-day calendar for Government Acceptance activities, concrete cure times, etc. Develop the default Calendar to match the physical work plan with non-work periods identified including weekends and holidays. Develop Seasonal Calendar(s) and assign to seasonally affected activities as applicable.

If a weather calendar is used its implementation and execution is to be in accordance with ER 415-1-15

3.3.10 Open Ended Logic

Only two open ended activities are allowed: the first activity "NTP Acknowledged" is to have no predecessor logic, and the last activity -"End Project" is to have no successor logic. Except as noted above all

activities are to have at least a start-to-start or finish-to-start relationship with its predecessor(s) and a finish-to-finish or finish-to-start relationship with its successor(s).

Predecessor open ended logic may be allowed in a time impact analyses upon the Contracting Officer's approval.

### 3.3.11 Default Progress Data Disallowed

Actual Start and Finish dates must not automatically update with default mechanisms included in the scheduling software. Updating of the percent complete and the remaining duration of any activity must be independent functions. Disable program features that calculate one of these parameters from the other. Activity Actual Start (AS) and Actual Finish (AF) dates assigned during the updating process must match those dates provided in the Contractor Quality Control Reports. Failure to document the AS and AF dates in the Daily Quality Control report will result in disapproval of the Contractor's schedule.

### 3.3.12 Out-of-Sequence Progress

Activities that have progressed before all preceding logic has been satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case basis subject to approval by the Contracting Officer. Propose logic corrections to eliminate out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project schedule. Address out of sequence progress or logic changes in the Narrative Report and in the periodic schedule update meetings.

### 3.3.13 Added and Deleted Activities

Do not delete activities from the project schedule or add new activities to the schedule without approval from the Contracting Officer. Activity ID and description changes are considered new activities and cannot be changed without Contracting Officer approval.

### 3.3.14 Original Durations

Activity Original Durations (OD) must be reasonable to perform the work item. OD changes are prohibited unless justification is provided and approved by the Contracting Officer.

### 3.3.15 Leads, Lags, and Start to Finish Relationships

Lags must be reasonable as determined by the Government and not used in place of realistic original durations, must not be in place to artificially absorb or create float, or to replace proper schedule logic.

a. Leads (negative lags) are prohibited.

b. Start to Finish (SF) relationships are prohibited.

### 3.3.16 Retained Logic

Schedule calculations must retain the logic between predecessors and successors ("retained logic" mode) even when the successor activity(s) starts and the predecessor activity(s) has not finished (out-of-sequence progress). Software features that in effect sever the tie between predecessor and successor activities when the successor has started and

the predecessor logic is not satisfied ("progress override") are not be allowed.

3.3.17 Percent Complete

Update the percent complete for each activity started, based on the realistic assessment of earned value. Activities which are complete but for remaining minor punch list work and which do not restrain the initiation of successor activities may be declared 100 percent complete to allow for proper schedule management. Budgeted cost of activity is to be reduced by the amount needed to correct deficiency. The activity referenced in paragraph COST LOADING of CLOSEOUT ACTIVITIES must have its budgeted cost increased by this amount.

3.3.18 Remaining Duration

Update the remaining duration for each activity based on the number of estimated workdays it will take to complete the activity. Remaining duration may not mathematically correlate with percentage found under paragraph entitled Percent Complete. The remaining duration for unstarted activities are not to be less than its orginal duration.

3.3.19 Cost Loading of Closeout Activities

Cost load the "Correction of punch list from Government pre-final inspection" activity(ies) not less than 1 percent of the present contract value. Activity(ies) may be declared 100 percent complete upon the Government's verification of completion and correction of all punch list work identified during Government pre-final inspection(s).

3.3.19.1 As-Built Drawings

If there is no separate contract line item (CLIN) for as-built drawings, cost load the "Submission and approval of as-built drawings" activity not less than $35,000 or 1 percent of the present contract value, which ever is greater, up to $200,000. Activity will be declared 100 percent complete upon the Government's approval.

3.3.19.2 O & M Manuals

Cost load the "Submission and approval of O & M manuals" activity not less than $20,000. Activity will be declared 100 percent complete upon the Government's approval of all O & M manuals.

3.3.20 Early Completion Schedule and the Right to Finish Early

An Early Completion Schedule is an Initial Project Schedule (IPS) that indicates all scope of the required contract work will be completed before the contractually required completion date.

a. No IPS indicating an Early Completion will be accepted without being fully resource-loaded (including crew sizes and manhours) and the Government agreeing that the schedule is reasonable and achievable.

b. The Government is under no obligation to accelerate work items it is responsible for to ensure that the early completion is met nor is it responsible to modify incremental funding (if applicable) for the project to meet the contractor's accelerated work.

## 3.4 PROJECT SCHEDULE SUBMISSIONS

Provide the submissions as described below. The data reports and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS. If the Contractor fails or refuses to furnish the information and schedule updates as set forth herein, the Contractor will be deemed not to have provided an estimate upon which a progress payment can be made.

Review comments made by the Government on the schedule(s) do not relieve the Contractor from compliance with requirements of the Contract Documents.

### 3.4.1 Preliminary Project Schedule Submission

Within 15 calendar days after the NTP is acknowledged, submit the Preliminary Project Schedule defining the planned operations detailed for the first 90 calendar days for approval. Prior to the commencement of construction, USACE must electronically provide BOEM with a summary of the construction schedule consistent with the MOA.

The approved Preliminary Project Schedule will be used for payment purposes not to exceed 90 calendar days after NTP. Completely cost load the Preliminary Project Schedule to balance the contract award CLINS shown on the Price Schedule. The Preliminary Project Schedule may be summary in nature for the remaining performance period. It must be early start and late finish constrained and logically tied as specified. The Preliminary Project Schedule forms the basis for the Initial Project Schedule specified herein and must include all of the required plan and program preparations, submissions and approvals identified in the contract (for example, Quality Control Plan, Safety Plan, and Environmental Protection Plan) as well as design activities, planned submissions of all early design packages, permitting activities, design review conference activities, and other non-construction activities intended to occur within the first 90 calendar days. Government acceptance of the associated design package(s) and all other specified Program and Plan approvals must occur prior to any planned construction activities. Activity code any activities that are summary in nature after the first 90 calendar days with Bid Item (CLIN) code (BIDI), Responsibility Code (RESP) and Feature of Work code (FOW).

### 3.4.2 Initial Project Schedule Submission

Submit the Initial Project Schedule for approval within 42 calendar days after notice to proceed is issued. The schedule must demonstrate a reasonable and realistic sequence of activities which represent all work through the entire contract performance period. No payment will be made for work items not fully detailed in the Project Schedule.

### 3.4.3 Periodic Schedule Updates

Update the Project Schedule on a regular basis, monthly at a minimum. Provide a draft Periodic Schedule Update for review at the schedule update meetings as prescribed in the paragraph PERIODIC SCHEDULE UPDATE MEETINGS. These updates will enable the Government to assess Contractor's progress.

a. Update information including Actual Start Dates (AS), Actual Finish Dates (AF), Remaining Durations (RD), and Percent Complete. Updated information is subject to the approval of the Government at the

meeting.

b. AS and AF dates must match the date(s) reported on the Contractor's Quality Control Report for an activity start or finish.

## 3.5 SUBMISSION REQUIREMENTS

Submit the following items for the Preliminary Schedule, Initial Schedule, and every Periodic Schedule Update throughout the life of the project:

### 3.5.1 Electronic Scheduling Data

Provide electronic scheduling data containing the current project schedule and all previously submitted schedules in the format of the scheduling software (e.g. .xer). Also include the Narrative Report and all required Schedule Reports. The electronic file is to identify the type of schedule (Preliminary, Initial, Update), full contract number, Data Date and schedule file name. Each schedule must have a unique file name and use project specific settings. The file naming convention is to be determined at SEKO meeting.

### 3.5.2 Narrative Report

Provide a Narrative Report with each schedule submission. The Schedule Narrative Report is a "stand alone" report in PDF or Word format. Title the report "Schedule Narrative Report". Show the Report date, schedule name, and contract number on the first page. Indicate who is responsible for the schedule update and narrative report. Provide a brief description of the Project Scope. The Narrative Report is expected to communicate to the Government the thorough analysis of the schedule output and the plans to compensate for problems, either current or potential, which are revealed through that analysis. Include the following information at a minimum in the Narrative Report:

a. Identify and discuss the work scheduled to start in the next update period.

b. Describe activities along the critical path in addition to activities on the next float path after the critical path.

c. Describe current and anticipated problem areas, delaying factors and their impact, and an explanation of corrective actions taken or required to be taken. Identify the party responsible for delay, if applicable.

d. Identify and explain why activities, based on their calculated late dates, should have either started or finished during the update period but did not.

e. Identify and discuss all schedule changes by activity ID and activity name including what specifically was changed and why the change was needed. Include at a minimum new and deleted activities, logic changes, duration changes, calendar changes, lag changes, resource changes, and actual start and finish date changes.

f. Identify and discuss out-of-sequence work.

g. If the longest path changes from a monthly update to the next, provide an explanation of the factors driving the change.

h. Respond to USACE Schedule Review Comments from the previous update(s).

3.5.3 Schedule Reports

The format, filtering, organizing, and sorting for each schedule report will be as directed by the Contracting Officer. Typically, reports contain Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float, Actual Start Date, Actual Finish Date, and Percent Complete. Provide the reports electronically in .pdf format. The following lists typical reports that will be requested:

3.5.3.1 Activity Report

List of all activities sorted according to activity number.

3.5.3.2 Logic Report

List of detailed predecessor and successor activities for every activity in ascending order by activity number.

3.5.3.3 Total Float Report

A list of all incomplete activities sorted in ascending order of total float. List activities which have the same amount of total float in ascending order of Early Start Dates. Do not show completed activities on this report.

3.5.3.4 Earnings Report by CLIN

A compilation of the Total Earnings on the project from the NTP to the data date, which reflects the earnings of activities based on the agreements made in the schedule update meeting defined herein. Provided a complete schedule update has been furnished, this report serves as the basis of determining progress payments. Group activities by CLIN number and sort by activity number. Provide a total CLIN percent earned value, CLIN percent complete, and project percent complete. The printed report must contain the following for each activity: the Activity Number, Activity Description, Original Budgeted Amount, Earnings to Date, Earnings this period, Total Quantity, Quantity to Date, and Percent Complete (based on cost).

3.5.3.5 Scheduling and Leveling Report

Provide a Scheduling/Leveling Report generated from the current project schedule being submitted.

3.5.4 Network Diagram

The Network Diagram is required for the Preliminary, Initial and Periodic Updates. Depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.5.4.1 Continuous Flow

Show a continuous flow from left to right with no arrows from right to

left. Show the activity number, description, duration, and estimated earned value on the diagram.

3.5.4.2 Project Milestone Dates

Show dates on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

3.5.4.3 Critical Path

Show all activities on the critical path. The critical path is defined as the longest path.

3.5.4.4 Grouping and Sorting

Group and sort activities as directed to assist in the understanding of the activity sequence. Typically, this flow will group activities by major elements of work, category of work, work area and/or responsibility.

3.5.4.5 Cash Flow / Schedule Variance Control (SVC) Diagram

With each schedule submission, provide a SVC diagram showing 1) Cash Flow S-Curves indicating planned project cost based on projected early and late activity finish dates, and 2) Earned Value to-date.

3.6 PERIODIC SCHEDULE UPDATE

3.6.1 Periodic Schedule Update Meetings

Conduct periodic schedule update meetings for the purpose of reviewing the proposed Periodic Schedule Update, Narrative Report, Schedule Reports, and progress payment. Conduct meetings at least monthly within five days of the proposed schedule data date. Provide a computer with the scheduling software loaded and a projector which allows all meeting participants to view the proposed schedule during the meeting. The Contractor's authorized scheduler must organize, group, sort, filter, perform schedule revisions as needed and review functions as requested by the Contractor and/or Government. The Contractor scheduler must attend in person unless virtual attendance is approved by Contracting Officer. The meeting is a working interactive exchange which allows the Government and Contractor the opportunity to review the updated schedule on a real time and interactive basis. The meeting will last no longer than 8 hours. Submit schedule file and narrative to the Government a minimum of two workdays in advance of the meeting. The Contractor's Project Manager must attend the meeting with the authorized representative of the Contracting Officer. Superintendents, foremen and major subcontractors must attend the meeting as required to discuss the project schedule and work. Following the schedule update meeting, make corrections to the schedule and resubmit, following the required schedule naming convention. Include only those changes approved by the Government in the schedule review meeting. Only approved schedules may be used to generate invoices for payment.

3.6.2 Update Submission Following Progress Meeting

Submit the complete Periodic Schedule Update of the Project Schedule containing all approved progress, revisions, and adjustments, pursuant to paragraph SUBMISSION REQUIREMENTS not later than 4 workdays after the periodic schedule update meeting.

## 3.7 WEEKLY PROGRESS MEETINGS

Conduct a weekly meeting with the Government (or as otherwise mutually agreed to) between the meetings described in paragraph entitled PERIODIC SCHEDULE UPDATE MEETINGS for the purpose of jointly reviewing the actual progress of the project as compared to the as planned progress and to review planned activities for the upcoming two weeks. Use the current approved schedule update for the purposes of this meeting and for the production and review of reports. At the weekly progress meeting, address the status of RFIs, RFPs and Submittals.

## 3.8 REQUESTS FOR TIME EXTENSIONS

ASCE 67-17 provides delay analysis guidelines. If there is a conflict between the contract and guidance provided in ASCE 67-17, the contract will govern. Provide justification of delay to the Contracting Officer in accordance with the contract provisions and clauses for approval, within 10 days of a delay occuring. Also prepare a time impact analysis for each Government request for proposal (RFP).

### 3.8.1 Justification of Delay

Provide a description of the event(s) that caused the delay and/or impact to the work. As part of the description, identify all schedule activities impacted. Show that the event that caused the delay/impact was the responsibility of the Government. Provide a time impact analysis that demonstrates the effects of the delay or impact on the project completion date, or interim completion date(s). Evaluate multiple impacts chronologically; each with its own justification of delay. With multiple impacts consider any concurrency of delay. A time extension and the schedule fragnet becomes part of the project schedule and all future schedule updates upon approval by the Contracting Officer.

### 3.8.2 Changes That Do Not Cause Delay

If it is determined that a change does not constitute a schedule time extension, a fragnet as described in paragraph FRAGMENTARY NETWORK, is to be created and inserted into the Project schedule.

### 3.8.3 Time Impact Analysis (Prospective Analysis)

Prepare a time impact analysis for approval by the Contracting Officer based on industry standard AACE 52R-06. Utilize a copy of the last approved schedule prior to the first day of the impact or delay for the time impact analysis. If Contracting Officer determines the time frame between the last approved schedule and the first day of impact is too great, prepare an interim updated schedule to perform the time impact analysis. Unless approved by the Contracting Officer, no other changes may be incorporated into the schedule being used to justify the time impact.

### 3.8.4 Forensic Schedule Analysis (Retrospective Analysis)

Prepare an analysis for approval by the Contracting Officer based on methodologies identified in industry standard AACE 29R-03. Identify which methodology was chosen and explain why it is more appropriate than other methodologies available.

### 3.8.5 Fragmentary Network (Fragnet)

Prepare a proposed fragnet for time impact analysis consisting of a sequence of new activities that are proposed to be added to the project schedule to demonstrate the influence of the delay or impact to the project's contractual dates. Clearly show how the proposed fragnet is to be tied into the project schedule including all predecessors and successors to the fragnet activities. The proposed fragnet must be approved by the Contracting Officer prior to incorporation into the project schedule.

### 3.8.6 Time Extension

The Contracting Officer must approve the Justification of Delay including the time impact analysis before a time extension will be granted. No time extension will be granted unless the delay consumes all available Project Float and extends the projected finish date ("End Project" milestone) beyond the Contract Completion Date. The time extension will be in calendar days.

Actual delays that are found to be caused by the Contractor's own actions, which result in a calculated schedule delay, are not a cause for an extension to the performance period, completion date, or any interim milestone date.

### 3.8.7 Impact to Early Completion Schedule

No extended overhead will be paid for delay prior to the original Contract Completion Date for an Early Completion IPS unless the Contractor actually performed work in accordance with that Early Completion Schedule. The Contractor must show that an early completion was achievable had it not been for the impact.

## 3.9 FAILURE TO ACHIEVE PROGRESS

Should the progress fall behind the approved project schedule for reasons other than those that are excusable within the terms of the contract, the Contracting Officer may require provision of a written recovery plan for approval. The plan must detail how progress will be made-up to include which activities will be accelerated by adding additional crews, longer work hours, extra workdays, etc.

### 3.9.1 Artificially Improving Progress

Artificially improving progress by means such as, but not limited to, revising the schedule logic, modifying, or adding constraints, shortening activity durations, or changing calendars in the project schedule is prohibited. Indicate assumptions made and the basis for any logic, constraint, duration, and calendar changes used in the creation of the recovery plan. Any additional resources, manpower, or daily and weekly work hour changes proposed in the recovery plan must be evident at the work site and documented in the daily report along with the Schedule Narrative Report.

### 3.9.2 Failure to Perform

Failure to perform work and maintain progress in accordance with the supplemental recovery plan may result in an interim and final unsatisfactory performance rating and may result in corrective action

directed by the Contracting Officer pursuant to FAR 52.236-15 Schedules for Construction Contracts, FAR 52.249-10 Default (Fixed-Price Construction), and other contract provisions.

### 3.9.3 Recovery Schedule

Should the Contracting Officer find it necessary, submit a recovery schedule pursuant to FAR 52.236-15 Schedules for Construction Contracts.

## 3.10 OWNERSHIP OF FLOAT

Except for the provision given in the paragraph IMPACT TO EARLY COMPLETION SCHEDULE, float available in the schedule, at any time, belongs to the Project and is available for Contractor and Government use. This includes activity and project float. Activity float is the number of workdays that an activity can be delayed without causing a delay to the "End Project" finish milestone. Project float (if applicable) is the number of work days between the projected early finish and the "End Project" finish.

## 3.11 TRANSFER OF SCHEDULE DATA INTO RESIDENT MANAGEMENT SYSTEM

Ensure schedule data is uploaded to RMS. This data is additional supporting data in a form and detail required by the Contracting Officer pursuant to FAR 52.232-5 Payments under Fixed-Price Construction Contracts. The receipt of a proper payment request pursuant to FAR 52.232-27 Prompt Payment for Construction Contracts is contingent upon the Government receiving both acceptable and approvable hard copies and matching electronic versions of the application for progress payment.

## 3.12 PRIMAVERA P6 MANDATORY REQUIREMENTS

Ensure Primavera P6 settings provide a schedule capable of fulfilling the requirements of the contract. The following settings are mandatory and required in all schedule submissions to the Government:

a. Activity Codes must be Project Level, not Global or EPS level.

b. Calendars must be Project Level, not Global or Resource level.

c. Activity Duration Types must be set to "Fixed Duration & Units".

d. Percent Complete Types must be set to "Physical".

e. Time Period Admin Preferences must remain the default "8.0 hr/day, 40 hr/week, 172 hr/month, 2000 hr/year". Set Calendar Work Hours/Day to 8.0 Hour days.

f. Set Schedule Option for defining Critical Activities to "Longest Path".

g. Set Schedule Option for defining progressed activities to "Retained Logic".

h. Set up cost loading using a single lump sum non-labor resource. The Price/Unit must be $1/hr, Default Units/Time must be "8h/d", and settings "Auto Compute Actuals" and "Calculate costs from units" un-selected.

i. Activity ID's must not exceed 10 characters.

j. Activity Names must have a verb-noun structure and contain the most defining and detailed description within the first 30 characters.

k. The daily ending hour for all work calendars must be the same.

-- End of Section --

# SECTION 01 33 00

# SUBMITTAL PROCEDURES
**08/18, CHG 4: 02/21**

## PART 1 GENERAL

### 1.1 SUMMARY

#### 1.1.1 Submittal Information

The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements.

Units of weights and measures used on all submittals are to be the same as those used in the contract drawings.

#### 1.1.2 Project Type

#### 1.1.3 Submission of Submittals

Schedule and provide submittals requiring Government approval before acquiring the material or equipment covered thereby. Pick up and dispose of samples not incorporated into the work in accordance with manufacturer's Safety Data Sheets (SDS) and in compliance with existing laws and regulations.

### 1.2 DEFINITIONS

#### 1.2.1 Submittal Descriptions (SD)

Submittal requirements are specified in the technical sections. Examples and descriptions of submittals identified by the Submittal Description (SD) numbers and titles follow:

SD-01 Preconstruction Submittals

Submittals that are required prior to or at the start of construction (work) or the next major phase of the construction on a multiphase contract.

Government approved Division 01 preconstruction submittals that are required prior to or commencing with the start of work must be submitted within 30 calendar days of contract award unless specified elsewhere in the specifications. Contractor approved Division 01 submittals that are required prior to or commencing with the start of work must be submitted within 45 calendar days of contract award unless specified elsewhere in the specifications.

Preconstruction Submittals include schedules and a tabular list of locations, features, and other pertinent information regarding products, materials, equipment, or components to be used in the work.

Certificates Of Insurance

Surety Bonds

List Of Proposed Subcontractors

List Of Proposed Products

Baseline Network Analysis Schedule (NAS)

Submittal Register

Schedule Of Prices Or Earned Value Report

Accident Prevention Plan

Work Plan

Quality Control (QC) plan

Environmental Protection Plan

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards ensuring work can be judged. Includes assemblies or portions of assemblies that are to be incorporated into the project and those that will be removed at conclusion of the work.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. Unless specified in another section, testing must have been within three years of date of contract award for the project.

Report that includes findings of a test required to be performed on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report that includes finding of a test made at the job site or on

sample taken from the job site, on portion of work during or after installation.

Investigation reports

Daily logs and checklists

Final acceptance test and operational test procedure

SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that the product, system, or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or Subcontractor through Contractor. The document purpose is to further promote the orderly progression of a portion of the work by documenting procedures, acceptability of methods, or personnel qualifications.

Confined space entry permits

Text of posted operating instructions

SD-10 Operation and Maintenance Data

Data provided by the manufacturer, or the system provider, including manufacturer's help and product line documentation, necessary to maintain and install equipment, for operating and maintenance use by facility personnel.

Data required by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

Data incorporated in an operations and maintenance manual or control system.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Submittals required for Guiding Principle Validation (GPV) or Third Party Certification (TPC).

Special requirements necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

1.2.2 Approving Authority

Office or designated person authorized to approve the submittal.

1.2.3 Work

As used in this section, on-site and off-site construction required by contract documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction. In exception, excludes work to produce SD-01 submittals.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or “S” classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submittal Register; G

1.4 SUBMITTAL CLASSIFICATION

1.4.1 Government Approved (G)

Within the terms of the Contract Clause SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION, submittals are considered to be "shop drawings."

1.4.2 For Information Only

Submittals not requiring Government approval will be for information only. Within the terms of the Contract Clause SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION, they are not considered to be "shop drawings."

1.5 PREPARATION

1.5.1 Transmittal Form

Use the ENG Form 4025-R transmittal form for submitting both Government-approved and information-only submittals. Submit in accordance with the instructions on the reverse side of the form. These forms or similar forms are included in the RMS CM software that the Contractor is required to use for this contract. Properly complete this form by filling out all the heading blank spaces and identifying each item submitted. Exercise special care to ensure proper listing of the specification paragraph and sheet number of the contract drawings pertinent to the data submitted for each item.

1.5.2 Submittal Format

1.5.2.1 Format of SD-01 Preconstruction Submittals

When the submittal includes a document that is to be used in the project, or is to become part of the project record, other than as a submittal, do not apply the Contractor's approval stamp to the document itself, but to a separate sheet accompanying the document.

Provide data in the unit of measure used in the contract documents.

1.5.2.2 Format of SD-03 Product Data

Present product data submittals for each section. Include a table of contents, listing the page and catalog item numbers for product data.

Indicate, by prominent notation, each product that is being submitted; indicate the specification section number and paragraph number to which it pertains.

1.5.2.2.1 Product Information

Supplement product data with material prepared for the project to satisfy the submittal requirements where product data does not exist. Identify this material as developed specifically for the project, with information and format as required for submission of SD-07 Certificates.

Provide product data in metric dimensions. Where product data are included in preprinted catalogs with English units only, submit metric dimensions on separate sheet.

Provide product data in units used in the Contract documents. Where product data are included in preprinted catalogs with another unit, submit the dimensions in contract document units, on a separate sheet.

1.5.2.2.2 Standards

Where equipment or materials are specified to conform to industry or technical-society reference standards of such organizations as the American National Standards Institute (ANSI), ASTM International (ASTM), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories (UL), or Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. State on the certificate that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.5.2.2.3 Data Submission

Collect required data submittals for each specific material, product, unit of work, or system into a single submittal that is marked for choices, options, and portions applicable to the submittal. Mark each copy of the product data identically. Partial submittals will not be accepted for expedition of the construction effort.

Submit the manufacturer's instructions before installation.

1.5.2.3 Format of SD-04 Samples

1.5.2.3.1 Sample Characteristics

Furnish samples in the following sizes, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately the same size as specified:

a. Sample of Equipment or Device: Full size.

b. Sample of Materials Less Than 50 by 75 mm 2 by 3 inches: Built up to 210 by 297 mm 8 1/2 by 11 inches.

c. Sample of Materials Exceeding 210 by 297 mm 8 1/2 by 11 inches: Cut down to 210 by 297 mm 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.

d. Sample of Linear Devices or Materials: 250 mm 10 inch length or length to be supplied, if less than 250 mm 10 inches. Examples of linear devices or materials are conduit and handrails.

e. Sample Volume of Nonsolid Materials: 750 ml Pint. Examples of nonsolid materials are sand and paint.

f. Color Selection Samples: 50 by 100 mm 2 by 4 inches. Where samples are specified for selection of color, finish, pattern, or texture, submit the full set of available choices for the material or product specified. Sizes and quantities of samples are to represent their respective standard unit.

g. Sample Panel: 1200 by 1200 mm 4 by 4 feet.

h. Sample Installation: 10 square meters 100 square feet.

1.5.2.3.2 Sample Incorporation

Reusable Samples: Incorporate returned samples into work only if so specified or indicated. Incorporated samples are to be in undamaged condition at the time of use.

Recording of Sample Installation: Note and preserve the notation of any area constituting a sample installation, but remove the notation at the final clean-up of the project.

1.5.2.3.3 Comparison Sample

Samples Showing Range of Variation: Where variations in color, finish, pattern, or texture are unavoidable due to nature of the materials, submit sets of samples of not less than three units showing extremes and middle of range. Mark each unit to describe its relation to the range of the variation.

When color, texture, or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

1.5.2.4 Format of SD-06 Test Reports

By prominent notation, indicate each report in the submittal. Indicate the specification number and paragraph number to which each report pertains.

1.5.2.5 Format of SD-07 Certificates

Provide design data and certificates on 210 by 297 mm 8 1/2 by 11 inch paper.

#### 1.5.2.6 Format of SD-11 Closeout Submittals

When the submittal includes a document that is to be used in the project or is to become part of the project record, other than as a submittal, do not apply the Contractor's approval stamp to the document itself, but to a separate sheet accompanying the document.

Provide data in the unit of measure used in the contract documents.

Provide all dimensions in administrative submittals in metric. Where data are included in preprinted material with English units only, submit metric dimensions on separate sheet.

### 1.5.3 Source Drawings for Shop Drawings

#### 1.5.3.1 Source Drawings

The entire set of source drawing files (DWG) will not be provided to the Contractor. Request the specific Drawing Number for the preparation of shop drawings. Only those drawings requested to prepare shop drawings will be provided. These drawings are provided only after award.

#### 1.5.3.2 Terms and Conditions

Data contained on these electronic files must not be used for any purpose other than as a convenience in the preparation of construction data for the referenced project. Any other use or reuse is at the sole risk of the Contractor and without liability or legal exposure to the Government. The Contractor must make no claim, and waives to the fullest extent permitted by law any claim or cause of action of any nature against the Government, its agents, or its subconsultants that may arise out of or in connection with the use of these electronic files. The Contractor must, to the fullest extent permitted by law, indemnify and hold the Government harmless against all damages, liabilities, or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

These electronic source drawing files are not construction documents. Differences may exist between the source drawing files and the corresponding construction documents. The Government makes no representation regarding the accuracy or completeness of the electronic source drawing files, nor does it make representation to the compatibility of these files with the Contractor hardware or software. The Contractor is responsible for determining if any conflict exists. In the event that a conflict arises between the signed and sealed construction documents prepared by the Government and the furnished source drawing files, the signed and sealed construction documents govern. Use of these source drawing files does not relieve the Contractor of the duty to fully comply with the contract documents, including and without limitation the need to check, confirm and coordinate the work of all contractors for the project. If the Contractor uses, duplicates or modifies these electronic source drawing files for use in producing construction data related to this contract, remove all previous indication of ownership (seals, logos, signatures, initials and dates).

## 1.6 QUANTITY OF SUBMITTALS

### 1.6.1 Number of SD-01 Preconstruction Submittal Copies

Unless otherwise specified, submit two sets of administrative submittals.

### 1.6.2 Number of SD-04 Samples

a. Submit two samples, or two sets of samples showing the range of variation, of each required item. One approved sample or set of samples will be retained by the approving authority and one will be returned to the Contractor.

b. Submit one sample panel or provide one sample installation where directed. Include components listed in the technical section or as directed.

c. Submit one sample installation, where directed.

d. Submit one sample of nonsolid materials.

## 1.7 INFORMATION ONLY SUBMITTALS

Submittals without a "G" designation must be certified by the QC manager and submitted to the Contracting Officer for information-only. Provide information-only submittals to the Contracting Officer a minimum of 14 calendar days prior to the Preparatory Meeting for the associated Definable Feature of Work (DFOW). Approval of the Contracting Officer is not required on information only submittals. The Contracting Officer will mark "receipt acknowledged" on submittals for information and will return only the transmittal cover sheet to the Contractor. Normally, submittals for information only will not be returned. However, the Government reserves the right to return unsatisfactory submittals and require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

## 1.8 PROJECT SUBMITTAL REGISTER

A sample Project Submittal Register showing items of equipment and materials for when submittals are required by the specifications is attached to the end of these specifications."

### 1.8.1 Submittal Management

Prepare and maintain a submittal register, as the work progresses. Do not change data that is output in columns (c), (d), (e), and (f) as delivered by Government; retain data that is output in columns (a), (g), (h), and (i) as approved. As an attachment, provide a submittal register showing items of equipment and materials for which submittals are required by the specifications. This list may not be all-inclusive and additional submittals may be required.

Column (c): Lists specification section in which submittal is

required.

Column (d): Lists each submittal description (SD Number. and type, e.g., SD-02 Shop Drawings) required in each specification section.

Column (e): Lists one principal paragraph in each specification section where a material or product is specified. This listing is only to facilitate locating submitted requirements. Do not consider entries in column (e) as limiting the project requirements.

Thereafter, the Contractor is to track all submittals by maintaining a complete list, including completion of all data columns and all dates on which submittals are received by and returned by the Government.

1.8.2 Preconstruction Use of Submittal Register

Submit the submittal register. Include the QC plan and the project schedule. Verify that all submittals required for the project are listed and add missing submittals. Coordinate and complete the following fields on the register submitted with the QC plan and the project schedule:

Column (a) Activity Number: Activity number from the project schedule.

Column (g) Contractor Submit Date: Scheduled date for the approving authority to receive submittals.

Column (h) Contractor Approval Date: Date that Contractor needs approval of submittal.

Column (i) Contractor Material: Date that Contractor needs material delivered to Contractor control.

1.8.3 Contractor Use of Submittal Register

Update the following fields in the Government-furnished submittal register program or equivalent fields in the program used by the Contractor with each submittal throughout the contract.

Column (b) Transmittal Number: List of consecutive, Contractor-assigned numbers.

Column (j) Action Code (k): Date of action used to record Contractor's review when forwarding submittals to QC.

Column (l) Date submittal transmitted.

Column (q) Date approval was received.

1.8.4 Approving Authority Use of Submittal Register

Update the following fields:

Column (b) Transmittal Number: List of consecutive, Contractor-assigned numbers.

Column (l) Date submittal was received.

Column (m) through (p) Dates of review actions.

Column (q) Date of return to Contractor.

1.8.5 Action Codes

1.8.6 Delivery of Copies

Submit an updated electronic copy of the submittal register to the Contracting Officer with each invoice request. Provide an updated Submittal Register monthly regardless of whether an invoice is submitted.

1.9 VARIATIONS

Variations from contract requirements require Contracting Officer approval pursuant to contract Clause FAR 52.236-21 Specifications and Drawings for Construction, and will be considered where advantageous to the Government.

1.9.1 Considering Variations

Discussion of variations with the Contracting Officer before submission of a variation submittal will help ensure that functional and quality requirements are met and minimize rejections and resubmittals. For variations that include design changes or some material or product substitutions, the Government may require an evaluation and analysis by a licensed professional engineer hired by the contractor.

Specifically point out variations from contract requirements in a transmittal letter. Failure to point out variations may cause the Government to require rejection and removal of such work at no additional cost to the Government.

1.9.2 Proposing Variations

When proposing variation, deliver a submittal, clearly marked as a "VARIATION" to the Contracting Officer, with documentation illustrating the nature and features of the variation including any necessary technical submittals and why the variation is desirable and beneficial to Government. If lower cost is a benefit, also include an estimate of the cost savings. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

The Contracting Officer will indicate an approval or disapproval of the variation request; and if not approved as submitted, will indicate the Government's reasons therefore. Any work done before such approval is received is performed at the Contractor's risk."

Specifically point out variations from contract requirements in a transmittal letter. Failure to point out variations may cause the Government to require rejection and removal of such work at no additional cost to the Government.

Check the column "variation" of ENG Form 4025 for submittals that include variations proposed by the Contractor. Set forth in writing the reason for any variations and note such variations on the submittal. The Government reserves the right to rescind inadvertent approval of

submittals containing unnoted variations.

1.9.3 Warranting that Variations are Compatible

When delivering a variation for approval, the Contractor warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.9.4 Review Schedule Extension

In addition to the normal submittal review period, a period of 14 calendar days will be allowed for the Government to consider submittals with variations.

1.10 SCHEDULING

Schedule and submit concurrently product data and shop drawings covering component items forming a system or items that are interrelated. Submit pertinent certifications at the same time. No delay damages or time extensions will be allowed for time lost in late submittals. .

a. Coordinate scheduling, sequencing, preparing, and processing of submittals with performance of work so that work will not be delayed by submittal processing. The Contractor is responsible for additional time required for Government reviews resulting from required resubmittals. The review period for each resubmittal is the same as for the initial submittal.

b. Submittals required by the contract documents are listed on the submittal register. If a submittal is listed in the submittal register but does not pertain to the contract work, the Contractor is to include the submittal in the register and annotate it "N/A" with a brief explanation. Approval by the Contracting Officer does not relieve the Contractor of supplying submittals required by the contract documents but that have been omitted from the register or marked "N/A."

c. Resubmit the submittal register and annotate it monthly with actual submission and approval dates. When all items on the register have been fully approved, no further resubmittal is required.

Contracting Officer review will be completed within 14 calendar days after the date of submission.

1.11 GOVERNMENT APPROVING AUTHORITY

When the approving authority is the Contracting Officer, the Government will:

a. Note the date on which the submittal was received.

b. Review submittals for approval within the scheduling period specified and only for conformance with project design concepts and compliance with contract documents.

c. Identify returned submittals with one of the actions defined in paragraph REVIEW NOTATIONS and with comments and markings appropriate for the action indicated.

Upon completion of review of submittals requiring Government approval,

stamp and date submittals. Two copies of the submittal will be retained by the Contracting Officer and two copies of the submittal will be returned to the Contractor.

### 1.11.1 Review Notations

Submittals will be returned to the Contractor with the following notations:

a. Submittals marked "approved" or "accepted" authorize proceeding with the work covered.

b. Submittals marked "approved as noted" or "approved, except as noted, resubmittal not required," authorize proceeding with the work covered provided that the Contractor takes no exception to the corrections.

c. Submittals marked "not approved," "disapproved," or "revise and resubmit" indicate incomplete submittal or noncompliance with the contract requirements or design concept. Resubmit with appropriate changes. Do not proceed with work for this item until the resubmittal is approved.

d. Submittals marked "not reviewed" indicate that the submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

e. Submittals marked "receipt acknowledged" indicate that submittals have been received by the Government. This applies only to "information-only submittals" as previously defined.

## 1.12 DISAPPROVED SUBMITTALS

Make corrections required by the Contracting Officer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications, give notice to the Contracting Officer as required under the FAR clause titled CHANGES. The Contractor is responsible for the dimensions and design of connection details and the construction of work. Failure to point out variations may cause the Government to require rejection and removal of such work at the Contractor's expense.

If changes are necessary to submittals, make such revisions and resubmit in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

## 1.13 APPROVED SUBMITTALS

The Contracting Officer's approval of submittals is not to be construed as a complete check, and indicates only that

Approval or acceptance by the Government for a submittal does not relieve the Contractor of the responsibility for meeting the contract requirements or for any error that may exist, because under the Quality Control (QC) requirements of this contract, the Contractor is responsible for ensuring information contained with in each submittal accurately conforms with the

requirements of the contract documents.

After submittals have been approved or accepted by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

## 1.14 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not be construed to change or modify any contract requirements. Before submitting samples, provide assurance that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

Match the approved samples for materials and equipment incorporated in the work. If requested, approved samples, including those that may be damaged in testing, will be returned to the Contractor, at its expense, upon completion of the contract. Unapproved samples will also be returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make as that material. The Government reserves the right to disapprove any material or equipment that has previously proved unsatisfactory in service.

Samples of various materials or equipment delivered on the site or in place may be taken by the Contracting Officer for testing. Samples failing to meet contract requirements will automatically void previous approvals. Replace such materials or equipment to meet contract requirements.

## 1.15 CERTIFICATION OF SUBMITTAL DATA

Certify the submittal data as follows on Form ENG 4025: "I certify that the above submitted items had been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated.

_____NAME OF CONTRACTOR _____ SIGNATURE OF CONTRACTOR

# PART 2 PRODUCTS

Not Used

# PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 33 16.00 10

DESIGN DATA (DESIGN AFTER AWARD)
**05/16**

# PART 1 GENERAL

## 1.1 SUMMARY

After award, develop the accepted proposal into the completed design, as described herein. Use a collaborative, integrated design process for all stages of project delivery with comprehensive performance goals for site development, energy, water, material selection, indoor environmental quality, and waste diversion. Ensure incorporation of these goals in project delivery. Consider all stages of the building lifecycle, including deconstruction, rehabilitation, re-purposing, or demolition.

## 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

| | |
|---|---|
| ISO 19005-3 | (2012) Document Management -- Electronic Document File Format for Long-Term Preservation -- Part 3: Use of ISO 32000-1 with Support for Embedded Files (PDF/A-3) |
| ISO 32000-1 | (2008) Document Management -- Portable Document Format -- Part 1: PDF 1.7 |

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| EM 1110-1-2909 | (2012) Engineering and Design -- Geospatial Data and Systems |
| ERDC/ITL TR-19-6 | (2019) A/E/C Graphics Standard, Release 2.1 |
| ERDC/ITL TR-19-7 | (2019) A/E/C CAD Standard - Release 6.1 |

## 1.3 DEFINITIONS

### 1.3.1 Advanced Modeling

A subset of geospatial technologies as defined in EM 1110-1-2909 to include BIM, CIM, GIS, and CAD. Advanced Modeling is comprised of models and drawings that form a digital representation of the project, or part thereof, that are comprised of model elements with facility data.

### 1.3.2 Model Element

A self-contained graphical element with a unique identification that is used to populate a model, and whose behavior and properties are defined by facility/site data and software processes. Model elements can represent a physical entity, such as a pump, a concrete wall, or a utility vault and range from the simple to the complex and can be custom modified.

### 1.3.3 USACE CAD/BIM Technology Center

The USACE CAD/BIM Technology Center hosts all standard content for USACE. This content can be accessed through the CAD/BIM Technology Center website, https://cadbimcenter.erdc.dren.mil/.

## 1.4 ORDER OF PRECEDENCE

In the event of a conflict or inconsistency between any of the requirements within the Contract, precedence is applied:

a. Any portions of the accepted proposal which both conform to and exceed the requirements of the solicitation.

b. The provisions of the solicitation.

c. All other provisions of the accepted proposal.

d. Any design products including, but not limited to, plans, specifications, engineering studies and analyses, shop drawings, and equipment installation drawings. These are "deliverables" under the contract are not part of the contract itself. Design products must conform to all provisions of the contract, in the order of precedence.

## 1.5 SUBMITTALS

NOT USED.

## 1.6 DELIVERY, STORAGE, AND HANDLING

### 1.6.1 Electronic Design Submittal

Provide identical copies of discs for approval, for each submittal required. Provide quantities and sizes indicated in Section 01 33 00 SUBMITTAL PROCEDURES.Provide submittal files on electronic storage media in compliance with the quality requirements identified in this specification.

#### 1.6.1.1 Malicious Content

Scan all electronic files for malicious viruses using commercially available scanning program that is routinely updated to identify and remove current virus threats.

#### 1.6.1.2 Storage Media

Provide project data on disc-based (DVD±R/RW) media. Provide the full submittal on one single disc whenever possible. When separation of the submittal is required separate deliverables onto separate media. Document any media divisions in the PxP for approval by the Contracting Officer.

a. Directly print identification of contents onto storage media. Do not provide adhesived labels. Include the name of the submittal, project, project location, Contract number, Designer of Record firm/Prime Contractor company's name, title of submission, and security classification (in accordance with the applicable security classification labeling regulations) on the label. If multiple discs are provided, clearly document the contents of each disc on the label.

b. Include the name and contact information of the individual who produced the final data disc to ensure that any problems with the data or media can be easily resolved.

c. When browsed on any computer, the disc displays the following folders and their associated content:

(1) Submittal files (containing all submittal data)

(2) All supporting documents associated with the submittal

(3) Readme containing one TXT, PDF, or HTML file with general use information, organizational instructions, and basic preparer contact information.

### 1.6.2 PDF File Packaging

Utilize PDF file format in accordance with ISO 32000-1 and ISO 19005-3. Provide files from original sources, text-searchable, and saved in "Standard" (uncompressed) resolution whenever possible.

#### 1.6.2.1 Bookmarking

a. Bookmark drawing submittal PDF sets to include one Parent Bookmark per Discipline and one Child Bookmark per sheet within each Discipline. Format Parent Bookmarks as "Discipline" (e.g. Architectural). Format Child Bookmarks as "Sheet ID Sheet Title" (e.g. A-101 First Floor Plan).

b. Bookmark specification submittal PDF sets using the SpecsIntact Print Processing PDF Print/Publish feature, combining processed sections into one PDF document. Insert the Submittal Register into the file where specified by Section 01 33 00 SUBMITTAL PROCEDURES and bookmark.

c. Bookmark design analysis and calculation submittal PDF sets to include one Parent Bookmark per design analysis section and one Child Bookmark per major paragraph per section. Format Parent Bookmarks as "Section" (e.g. Architectural). Format Child Bookmarks as "major paragraph designation Sheet Title" (e.g. 2.1 Primary Facility Functions).

#### 1.6.2.2 Hyperlinking

Hyperlink all reference annotation symbology (e.g. section cut symbology, detail callout symbology, elevation callout symbology) to the sheet referenced by the annotation.

## PART 2 PRODUCTS

### 2.1 DESIGN DRAWINGS

From advanced model files, produce design drawings that describe the scope of the Contract for all required submittals including all interim and final deliverables.

#### 2.1.1 Electronic Drawing Files

Provide electronic drawing files in PDF format for each project drawing in the design set.

### 2.1.2 Drawing Index

Provide an index of drawings sheet as part of the drawing set, and an electronic table of all drawings submitted. Include the electronic file name, the sheet reference number, the sheet number, and the sheet title containing the data for each drawing.

### 2.1.3 Shop Drawings Used as Design Drawings

Design drawings may be prepared similar to shop drawings to minimize construction submittals after the Design Complete Submittals. Prepare and submit with the design drawings, appropriate connection, fabrication, layout, and product specific drawings.

#### 2.1.3.1 Drawing Format For Shop Drawings Used as Design Drawings

Use the Contractor-originated drawings as the basis for the record drawings. Conform shop drawings included as design documents with the same drawing requirements such as drawing format, sheet size, layering, lettering, and title block used in design drawings.

#### 2.1.3.2 Identification of Shop Drawings Used as Design Drawings

Indicate which shop drawings are being submitted as design drawings in the transmittal letter.

### 2.1.4 Seal on Documents

Sign, date and seal all Contractor-originated design drawings by the registered architect or the registered engineer of the respective discipline. This is the seal of the Designer of Record for that drawing. Application of the electronic seal and signature accepts responsibility for the work shown thereon.

## PART 3 EXECUTION

## 3.1 DESIGN PLATFORM AND FILE FORMATS

Design the project using the systems and platforms defined below:

### 3.1.1 CAD

#### 3.1.1.1 Native CAD Authoring Content

All content produced through CAD authoring software outside of any object/element based BIM or CIM platform must be compliant with ERDC/ITL TR-19-6 and ERDC/ITL TR-19-7. Download form the CAD/BIM Technology Center website as part of the A/E/C Work Structure.

-- End of Section --

# SECTION 01 35 26

# GOVERNMENTAL SAFETY REQUIREMENTS
**05/24**

## PART 1 GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

| | |
|---|---|
| ASME B30.5 | (2021) Mobile and Locomotive Cranes |

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

| | |
|---|---|
| ANSI/ASSP A10.34 | (2021) Protection of the Public on or Adjacent to Construction Sites |
| ANSI/ASSP A10.44 | (2020) Control of Energy Sources (Lockout/Tagout) for Construction and Demolition Operations |
| ANSI/ASSP Z244.1 | (2024) Control of Hazardous Energy: Lockout, Tagout |
| ANSI/ASSP Z359.2 | (2023) Fall Protection Program |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM F855 | (2020) Standard Specifications for Temporary Protective Grounds to Be Used on De-energized Electric Power Lines and Equipment |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE 1048 | (2016) Guide for Protective Grounding of Power Lines |
| IEEE C2 | (2023) National Electrical Safety Code |

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

| | |
|---|---|
| ANSI/ISEA Z89.1 | (2014; R 2019) American National Standard for Industrial Head Protection |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 51B | (2024) Standard for Fire Prevention During Welding, Cutting, and Other Hot Work |
| NFPA 70 | (2023; ERTA 7 2023; TIA 23-15) National Electrical Code |

| | |
|---|---|
| NFPA 70E | (2024) Standard for Electrical Safety in the Workplace |
| NFPA 241 | (2022) Standard for Safeguarding Construction, Alteration, and Demolition Operations |
| NFPA 306 | (2024) Standard for the Control of Gas Hazards on Vessels |

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| EM 385-1-1 | (2024) Safety -- Safety and Occupational Health (SOH) Requirements |
| ER 385-1-31 | (2016) The Control of Hazardous Energy |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR 1910 | Occupational Safety and Health Standards |
| 29 CFR 1915 | Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment |
| 29 CFR 1926 | Safety and Health Regulations for Construction |
| CPL 2.100 | (1995) Application of the Permit-Required Confined Spaces (PRCS) Standards, 29 CFR 1910.146 |

U.S. DEPARTMENT OF THE NAVY (DON)

| | |
|---|---|
| 0910-LP-115-1921 | (2016) U.S. Navy Diving Manual, Revision 7 |

Association of Diving Contractors International (ADCI)

| | |
|---|---|
| ADCI Consensus Standards | (2024) International Consensus Standards for Commercial Diving and Underwater Operations, Edition 6.5 |

## 1.2 DEFINITIONS

The following definitions are for the convenience of the reader. If there is a referenced document in the text of this specification section, that is the document that should define terms for that paragraph. If further clarification is needed, contact the Contracting Officer.

### 1.2.1 Site Safety and Health Officer (SSHO)

A Contractor Employee that is responsible for overseeing and ensuring implementation of the prime Contractor's Safety and Occupational Health (SOH) program according to the Contract, EM 385-1-1, applicable federal, state, and local requirements.

#### 1.2.1.1 Level One SSHO

A designated employee with full-time SOH responsibility that meets and

follows the requirements of EM 385-1-1.

1.2.1.2 Level Two SSHO

A designated employee with Level Two SSHO responsibility that meets and follows the requirements of EM 385-1-1. Level Two SSHOs cannot be assigned to projects that have a residual Risk Assessment Code (RAC) of high or extremely high.

1.2.1.3 Level Three SSHO

A designated Qualified Person or Competent Person with SOH responsibility that meets and follows the requirements of EM 385-1-1. Level 3 SSHOs cannot be assigned to projects that have a residual RAC of high or extremely high.

1.2.1.4 Alternate SSHO

An employee that meets the definition of the contract-required level SSHO, but is not the primary SSHO.

1.2.2 Competent Person (CP)

The CP is a person designated in writing, who, through training, knowledge and experience, is capable of identifying, evaluating, and addressing existing and predictable hazards in the working environment or working conditions that are unsanitary, hazardous, or dangerous to personnel, and who has authorization to take prompt corrective measures to eliminate them.

1.2.3 Qualified Person (QP)

The QP is a person designated in writing, who, by possession of a recognized degree, certificate, or professional standing, or extensive knowledge, training, and experience, has successfully demonstrated their ability to solve or resolve problems related to the subject matter, the work, or the project.

1.3 SUBMITTALS

Government Acceptance or Approval does not remove responsibility from the Contractors for their actions or liability.

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP); G

Dive Operations Plan; G

SD-06 Test Reports

Accident Reports; G

LHE Inspection Reports

Monthly Exposure Reports; G

SD-07 Certificates

Crane Operators/Riggers

Activity Hazard Analysis (AHA); G

Certificate of Compliance

Hot Work Permit

Standard Lift Plan; G

Critical Lift Plan; G

Barge Mounted Mobile Crane Lift Plan; G

Naval Architecture Analysis; G, DO

## 1.4 PUBLIC HEALTH EMERGENCIES

In the event of a declared public health emergency, follow safety precautions as required by the Occupational Safety and Health Administration (OSHA) www.osha.gov, the Centers for Disease Control and Prevention (CDC) www.cdc.gov, and as required by federal, state and local requirements.

## 1.5 MONTHLY EXPOSURE REPORTS

Provide a Monthly Exposure Report by the fifth of each month. This report is a compilation of employee-hours worked each month for all site workers, both Prime and subcontractor. Failure to submit the report may result in retention of up to 10 percent of the progress payment.

## 1.6 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this Contract, comply with the most recent edition of USACE EM 385-1-1, and the following federal, state, and local laws, ordinances, criteria, rules and regulations at the date of the Solicitation for this Contract. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern.

### 1.6.1 Subcontractor Safety Requirements

For this contract, neither Contractor nor any subcontractor may enter into contract with any subcontractor that fails to meet the following requirements. The term subcontractor in this and the following paragraphs means any entity holding a contract with the Contractor or with a subcontractor at any tier.

Vendors that are actively using equipment on site may be considered to be acting in a subcontractor capacity. Vendors acting in a subcontractor

capacity entering the site must adhere to the approved site safety and health plan. The contractor is required to enforce the safety and health plan on their vendors.

1.6.1.1 OSHA Days Away from Work, Restricted Duty, or Job Transfer (DART) Rate

Subcontractors on this contract must have a DART rate, calculated from the most recent, complete calendar year, less than or equal to 3.4 when entering into a subcontract agreement with the Prime Contractor or a subcontractor at any tier. The OSHA Dart Rate is calculated using the following formula:

(N/EH) x 200,000

where:

N = number of injuries and illnesses with days away, restricted work, or job transfer

EH = total hours worked by all employees during most recent, complete calendar year

200,000 = base for 100 full-time equivalent workers (working 40 hours per week, 50 weeks per year)

The Prime Contractor may submit a written request for additional consideration to the Contracting Officer where the specified acceptable OSHA Dart rate range cannot be achieved for a particular subcontractor. Relaxation of the OSHA DART rate range will only be considered for approval on a case-by-case basis for special conditions and must not be anticipated as tacit approval. Contractor's Site Safety and Health Officer (SSHO) must collect and maintain self-certified OSHA DART rates for all subcontractors on the project and make them available to the Government at the Government's request.

1.7 SITE QUALIFICATIONS, DUTIES, AND MEETINGS

1.7.1 Site Safety and Health Officer (SSHO)

1.7.1.1 Qualifications of SSHO

All SSHOs will have met the training, experience requirements identified in the EM 385-1-1 and this Contract.

1.7.1.2 Duties of SSHO

All SSHOs will carry out the roles and responsibilities as identified in this Contract and the EM 385-1-1. All SSHOs will be designated on an ENG Form 6282, provided by the Contracting Officer. Superintendent, QC Manager, and SSHO are subject to dismissal if their required duties are not being effectively carried out. If either the Superintendent, QC Manager, or SSHO are dismissed, project work will be stopped and will not be allowed to resume until a suitable replacement is approved and the above duties are again being effectively carried out.

A Contractor Employee that is responsible for overseeing and ensuring implementation of the prime Contractor's Safety and Occupational Health (SOH) program according to the Contract, EM 385-1-1, applicable federal,

state, and local requirements.

Dual-hatting as the SSHO is not permissible. The SSHO shall not serve as the Quality Control Manager, Superintendent, or any other position.

1.7.1.3 Safety Meetings

Conduct safety meetings to review past activities, plan for new or changed operations, review pertinent aspects of appropriate AHA (by trade), establish safe working procedures for anticipated hazards, and provide pertinent Safety and Occupational Health (SOH) training and motivation. Conduct meetings at least once a month for all supervisors at the project location. The SSHO, supervisors, or foremen must conduct meetings at least once a week for the trade workers. Document meeting minutes to include the date, persons in attendance, subjects discussed, and names of individual(s) who conducted the meeting. Maintain documentation on-site and furnish copies to the Contracting Officer on request. Notify the Contracting Officer of all scheduled meetings 7 calendar days in advance.

1.7.2 Roles and Responsibilities of Prime Contractor and SSHO

The Prime Contractor and SSHO must ensure that the requirements of all applicable OSHA and EM 385-1-1 are met for the project. The Prime Contractor must ensure an SSHO or an equally qualified Alternate SSHO(s) is at the worksite at all times to implement and administer the Contractor's safety program and Government accepted Accident Prevention Plan. If the required SSHO has to temporarily (that is, up to 24 hours / 1 day) leave the site of work due to unforeseen or emergency situations, a Level One, Two, or Three SSHO may be used in the interim and must be on the site of work at all times when work is being performed.

If the SSHO must be off-site for a period longer than 24 hours / 1 day, a qualified alternate that meets the contract requirements must be onsite.

a. Prime contractor must ensure all SSHOs will:

(1) Are designated on an ENG Form 6282.

(2) Meet minimum training and experience requirements identified in EM 385-1-1.

(3) Execute roles and responsibilities identified in EM 385-1-1.

1.7.3 Contract Site Safety And Health Officer(s)(SSHOs) Minimum Requirements

Provide a minimum of one Level One SSHO that meets the requirements of EM 385-1-1 for this project.

1.7.4 Contractor Quality Control (QC) Manager:

The Contractor Quality Control Manager cannot be the SSHO on this project, even though the QC has safety inspection responsibilities as part of the QC duties.

### 1.7.5 Competent Person Qualifications

Provide Competent Persons in accordance with EM 385-1-1. Competent Persons for high risk activities include confined space, cranes and rigging, excavation/trenching, fall protection, and electrical work. The CP for these activities must be designated in writing, and meet the requirements for the specific activity (i.e. competent person, fall protection).

The Competent Person identified in the Contractor's Safety and Health Program and accepted Accident Prevention Plan, must be on-site at all times when the work that presents the hazards associated with their professional expertise is being performed. Provide the credentials of the Competent Persons(s) to the Contracting Officer for information in consultation with the Safety Office.

#### 1.7.5.1 Competent Person for Fall Protection

Provide a Competent Person for Fall Protection who meets the requirements of EM 385-1-1, Chapter 21 and herein.

#### 1.7.5.2 Qualified Trainer Requirements

Individuals qualified to instruct the 40 hour contract safety awareness course, or portions thereof, must meet the definition of a Competent Person Trainer, and, at a minimum, possess a working knowledge of the following subject areas: EM 385-1-1, Electrical Standards, Lockout/Tagout, Fall Protection, Confined Space Entry for Construction; Excavation, Trenching and Soil Mechanics, and Scaffolds in accordance with 29 CFR 1926.450, Subpart L.

Instructors are required to:

a. Prepare class presentations that cover construction-related safety requirements.

b. Ensure that all attendees attend all sessions by using a class roster signed daily by each attendee. Maintain copies of the roster for at least five years. This is a certification class and must be attended 100 percent. In cases of emergency where an attendee cannot make it to a session, the attendee can make it up in another class session for the same subject.

c. Update training course materials whenever an update of the EM 385-1-1 becomes available.

d. Provide a written exam of at least 50 questions. Students are required to answer 80 percent correctly to pass.

e. Request, review and incorporate student feedback into a continuous course improvement program.

#### 1.7.5.3 Crane Operators/Riggers

Provide Operators, Signal Persons, and Riggers meeting the requirements in EM 385-1-1, Chapter 15 for Riggers and Chapter 16 for Crane Operators and Signal Persons. In addition, for mobile cranes with Original Equipment Manufacturer (OEM) rated capacities of 22,680 kg 50,000 pounds or greater,

designate crane operators qualified by a source that qualifies crane operators (i.e., union, a Government agency, or an organization that tests and qualifies crane operators). Provide proof of current qualification.

#### 1.7.5.4 Competent Person for Confined Spaced Entry

Provide a CP for Confined Space Entry who meets the requirements of EM 385-1-1 and herein. The CP for Confined Space Entry must supervise the entry into each confined space in accordance with EM 385-1-1.

Since this work involves operations that handle combustible or hazardous materials, this person must have the ability to understand and follow through on the air sampling, Personal Protective Equipment (PPE), and instructions of a Marine Chemist, Coast Guard authorized persons, or Certified Industrial Hygienist. Confined space and enclosed space work must comply with NFPA 306, 29 CFR 1915, "Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment," or as applicable in 29 CFR 1910 for general industry, 29 CFR 1926 for construction.

### 1.7.6 Preconstruction Conference

a. Contractor representatives who have a responsibility or significant role in accident prevention on the project must attend the preconstruction conference. This includes the project superintendent, Site Safety and Occupational Health Officer, quality control manager, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).

b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the Contract. This list of proposed AHAs will be reviewed and an agreement will be reached between the Contractor and the Contracting Officer as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, and Government review of AHAs to preclude project delays. The creation of the APP and Schedule will be created after being given Notice to Proceed.

c. Deficiencies in the submitted APP, identified during the Contracting Officer's review, must be corrected, and the APP re-submitted for review prior to the start of construction. Work is not permitted to begin until an APP is established that is acceptable to the Contracting Officer.

## 1.8 ACCIDENT PREVENTION PLAN (APP)

### 1.8.1 Accident Prevention Plan (APP)

Submit the Accident Prevention Plan (APP) for review and acceptance by the Government at least 15 calendar days prior to the start, after being given Notice to Proceed. A competent person must prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of EM 385-1-1, ENG Form 6293, and herein. The APP must be job-specific and address any unusual or unique aspects of the project or activity for which it is written. The APP must interface with the Contractor's overall safety and occupational health program referenced in the APP in the applicable APP element, and made site-specific. Describe

the methods to evaluate past safety performance of potential subcontractors in the selection process. Also, describe innovative methods used to ensure and monitor safe work practices of subcontractors. The Government considers the Prime Contractor to be the "controlling employer" for all worksite safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the Contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP must be signed in accordance with the APP and ENG Form 6293 Accident Prevention Plan Worksheet. The SSHO must provide and maintain the APP and a log of signatures by each subcontractor foreman, attesting that they have read and understand the APP, and make the APP and log available on-site to the Contracting Officer. If English is not the foreman's primary language, the Prime Contractor must provide an interpreter.

Submit the APP to the Contracting Officer 15 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP. Once reviewed and accepted by the Contracting Officer, the APP and attachments will be enforced as part of the Contract. Disregarding the provisions of this Contract or the accepted APP is cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified. Continuously review and amend the APP, as necessary, throughout the life of the Contract. Changes to the accepted APP must be made with the knowledge and concurrence of the Contracting Officer, project superintendent, SSHO and Quality Control Manager. Incorporate unusual or high-hazard activities not identified in the original APP as they are discovered. Should any severe hazard exposure (i.e., imminent danger) become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the Contracting Officer within 24 hours of discovery. Eliminate and remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ANSI/ASSP A10.34), and the environment.

### 1.8.2 Names and Qualifications

Provide plans in accordance with the requirements outlined in EM 385-1-1, including the following:

a. Names and qualifications (resumes including education, training, experience and certifications) of site safety and health personnel designated to perform work on this project to include the designated Site Safety and Health Officer and other competent and qualified personnel to be used. Specify the duties of each position.

b. As a minimum, designate and submit qualifications of Competent Persons (CP) for each of the following major areas: excavation; scaffolding; fall protection; hazardous energy; confined space; health hazard recognition, evaluation and control of chemical, physical and biological agents; and personal protective equipment and clothing to include selection, use and maintenance. Designate and submit qualifications for additional CPs as applicable to the work performed under this Contract.

1.8.3 Plans

Provide plans in the APP in accordance with the requirements outlined in Appendix A of EM 385-1-1, including the following:

1.8.3.1 Confined Space Entry Plan

Develop a confined or enclosed space entry plan in accordance with EM 385-1-1, applicable OSHA standards 29 CFR 1910, 29 CFR 1915, and 29 CFR 1926, OSHA Directive CPL 2.100, and any other federal, state and local regulatory requirements identified in this Contract. Identify the qualified person's name and qualifications, training, and experience. Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions. Include procedure for rescue by Contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)

1.8.3.2 Standard Lift Plan (SLP)

Plan lifts to avoid situations where the operator cannot maintain safe control of the lift. Prepare a written SLP in accordance with EM 385-1-1, Section 16.A.03, using Form 16-7 for every lift or series of lifts (if duty cycle or routine lifts are being performed). The SLP must be developed, reviewed and accepted by all personnel involved in the lift in conjunction with the associated AHA. Signature on the AHA constitutes acceptance of the plan. Maintain the SLP on the LHE for the current lift(s) being made. Maintain historical SLPs for a minimum of three months.

1.8.3.3 Critical Lift Plan - Crane or Load Handling Equipment

Provide a Critical Lift Plan as required by EM 385-1-1, Section 16.7, using Form 16-3. In addition, Critical Lift Plans are required for the following:

a. Lifts over 50 percent of the capacity of barge mounted mobile crane's hoist.

b. When working around energized power lines where the work will get closer than the minimum clearance distance in EM 385-1-1 Table 11-9.

c. For lifts with anticipated binding conditions.

d. When erecting cranes.

1.8.3.3.1 Critical Lift Plan Planning and Schedule

Critical lifts require detailed planning and additional or unusual safety precautions. Develop and submit a critical lift plan to the Contracting Officer 30 calendar days prior to critical lift. Comply with load testing requirements in accordance with EM 385-1-1, Chapter 16.

1.8.3.3.2 Lifts of Personnel

In addition to the requirements of EM 385-1-1, Chapter 16, for lifts of personnel, demonstrate compliance with the requirements of 29 CFR 1926.1400 and EM 385-1-1, Chapter 16.T.

1.8.3.4 Barge Mounted Mobile Crane Lift Plan

Provide a Naval Architecture Analysis and include an LHE Manufacturer's Floating Service Load Chart in accordance with EM 385-1-1, Section 16.L.03.The Floating Service Load Chart must provide a table of rated load versus boom angle and radius. The Floating Service Load Chart must also provide the maximum allowable machine list and trim associated with the tabular loads and radii provided. If the Manufacturer's Floating Service Load Chart is not available, a floating service load chart may be developed and provided by a qualified Registered Professional Engineer (RPE), competent in the field of floating cranes. The Load Chart must be in accordance with the criteria from the selected standard in EM 385-1-1, Chapter 16.L;provide a table of rated load versus boom angle and radius; provide the
maximum allowable machine list and machine trim associated with the tabular loads and radii provided; and be stamped by a RPE qualified and competent in the field of floating cranes. The RPE, competent in the field of floating cranes must stamp and certify (sign) that the Naval Architectural Analysis (NAA) meets the requirements of EM 385-1-1, Chapter 16.L.03.

1.8.3.5 Fall Protection and Prevention (FP&P) Plan

The plan must be in accordance with the requirements of EM 385-1-1, Chapter 21 and ANSI/ASSP Z359.2, be site specific, and address all fall hazards in the work place and during different phases of construction. Address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above 1.8 m 6 feet. A competent person or qualified person for fall protection must prepare and sign the plan documentation. Include fall protection and prevention systems, equipment and methods employed for every phase of work, roles and responsibilities, assisted rescue, self-rescue and evacuation procedures, training requirements, and monitoring methods. Review and revise, as necessary, the Fall Protection and Prevention Plan documentation as conditions change, but at a minimum every six months, for lengthy projects, reflecting any changes during the course of construction due to changes in personnel, equipment, systems or work habits. Keep and maintain the accepted Fall Protection and Prevention Plan documentation at the job site for the duration of the project. Include the Fall Protection and Prevention Plan documentation in the Accident Prevention Plan (APP).

1.8.3.6 Rescue and Evacuation Plan

Provide a Rescue and Evacuation Plan in accordance with EM 385-1-1 Section 21.N and ANSI/ASSP Z359.2, and include in the FP&P Plan and as part of the APP. Include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility.

1.8.3.7 Hazardous Energy Control Program (HECP)

Develop a HECP in accordance with EM 385-1-1 Section 12, 29 CFR 1910.147, 29 CFR 1910.333, 29 CFR 1915.89, ANSI/ASSP Z244.1, and ANSI/ASSP A10.44. Submit this HECP as part of the Accident Prevention Plan (APP). Conduct a preparatory meeting and inspection with all effected personnel to coordinate all HECP activities. Document this meeting and inspection in accordance with EM 385-1-1, Chapter 12.A.02. Ensure that each employee is familiar with and complies with these procedures.

## 1.9 ACTIVITY HAZARD ANALYSIS (AHA)

Before beginning each activity, task or Definable Feature of Work (DFOW) involving a type of work presenting hazards not experienced in previous project operations, or where a new work crew or subcontractor is to perform the work, the Contractor(s) performing that work activity must prepare an AHA. AHAs must be developed by the Prime Contractor, subcontractor, or supplier performing the work, and provided for Prime Contractor review and approval before submitting to the Contracting Officer. AHAs must be signed by the SSHO, Superintendent, QC Manager and the subcontractor Foreman performing the work. Format the AHA in accordance with EM 385-1-1 or as directed by the Contracting Officer. Submit the AHA for review at least 15 working days prior to the start of each activity task, or DFOW. The Government reserves the right to require the Contractor to revise and resubmit the AHA if it fails to effectively identify the work sequences, specific anticipated hazards, site conditions, equipment, materials, personnel and the control measures to be implemented.

AHAs must identify competent persons required for phases involving high risk activities, including confined entry, crane and rigging, excavations, trenching, electrical work, fall protection, and scaffolding.

### 1.9.1 AHA Management

Review the AHA list periodically (at least monthly) at the Contractor supervisory safety meeting, and update as necessary when procedures, scheduling, or hazards change. Use the AHA during daily inspections by the SSHO to ensure the implementation and effectiveness of the required safety and health controls for that work activity.

### 1.9.2 AHA Signature Log

Each employee performing work as part of an activity, task or DFOW must review the AHA for that work and sign a signature log specifically maintained for that AHA prior to starting work on that activity. The SSHO must maintain a signature log on site for every AHA. Provide employees whose primary language is other than English, with an interpreter to ensure a clear understanding of the AHA and its contents.

## 1.10 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in paragraph REFERENCES. Maintain applicable equipment manufacturer's manuals.

## 1.11 EMERGENCY MEDICAL TREATMENT

Contractors must arrange for their own emergency medical treatment in accordance with EM 385-1-1. The Government has no responsibility to provide emergency medical treatment.

## 1.12 NOTIFICATIONS AND REPORTS

### 1.12.1 Accident Notification

Notify the Contracting Officer in accordance with the EM 385-1-1 Accident Reporting Timeline.

| Table<br>Accident Reporting Required Timeline | | |
|---|---|---|
| **Accident Type** | **Notify KO or COR** | **Complete Final Accident Report on ENG 3394 and provide to KO or COR** |
| Fatality, in-patient hospitalization, amputation, eye loss, or property damage over $600,000. | Immediately, no later than (NLT) 8 Hours | Within 7 Days |
| All other accidents and near misses | Immediately, no later than (NLT) 24 Hours | Within 7 Days |

Within notification include Contractor name; Contract title; type of Contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (for example, type of construction equipment used and PPE used). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted. Assist and cooperate fully with the Government's investigation(s) of any accident or near miss.

1.12.2 Accident Reports

a. Conduct an accident investigation for recordable injuries and illnesses, property damage, and near misses as defined in EM 385-1-1, to establish the root cause(s) of the accident. All accidents are reportable, regardless of whether or not it is recordable. Complete the applicable USACE Accident Report, ENG Form 3394, and provide the report to the Contracting Officer within 7 calendar days of the accident. The Contracting Officer will provide copies of any required or special forms. All accidents are reportable, regardless of whether or not it is recordable.

b. Near Misses: For Army projects, report all "Near Misses" to the Contracting Officer, using local accident reporting procedures, within 24 hours. The Contracting Officer will provide the Contractor the required forms. Near miss reports are considered positive and proactive Contractor safety management actions.

1.12.3 LHE Inspection Reports

Submit LHE inspection reports required in accordance with EM 385-1-1 and as specified herein with Daily Reports of Inspections.

1.12.4 Certificate of Compliance and Pre-lift Plan/Checklist for LHE and Rigging

Provide a Certificate of Compliance for LHE entering an activity under this Contract and in accordance with EM 385-1-1. Post certifications on the crane.

Develop a Standard Lift Plan (SLP) in accordance with EM 385-1-1 and using

Standard Pre-Lift Crane Plan/Checklist for each lift planned. Submit SLP to the Contracting Officer for approval within 15 calendar days in advance of planned lift.

The employer must complete and sign ENG Form 6209 (Certificate of Compliance for Load Handling Equipment and Rigging) (see EM 385-1-1 para 16-10.b) that states that the operator received a physical examination and meets the physical qualifications of the ASME B30.5 standards for the specific type of equipment. Contractors will submit the signed CoC to the KO or COR for acceptance prior to allowing the operator to use the equipment. (EM 385-1-1 16-3.f)

## 1.13 HOT WORK PERMIT

### 1.13.1 Permit and Personnel Requirements

Submit and obtain a written permit prior to performing "Hot Work" (i.e., welding or cutting) or operating other flame-producing/spark producing devices, from the local fire department. A permit is required from the Explosives Safety Office for work in and around where explosives are processed, stored, or handled. Contractors are required to meet all criteria before a permit is issued. Provide at least two 9 kg 20 pound 4A:20 BC rated extinguishers for normal "Hot Work". The extinguishers must be current inspection tagged, and contain an approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch must be trained in accordance with NFPA 51B and remain on-site for a minimum of 1 hour after completion of the task or as specified on the hot work permit.

When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency local fire department phone number. Report any fire, no matter how small, to the responsible local fire department immediately.

### 1.13.2 Work Around Flammable Materials

Obtain permit approval from a NFPA Certified Marine Chemist, or Certified Industrial Hygienist for "Hot Work" within or around flammable materials (such as fuel systems or welding/cutting on fuel pipes) or confined spaces (such as sewer wet wells, manholes, or vaults) that have the potential for flammable or explosive atmospheres.

Whenever these materials, except beryllium and chromium (VI), are encountered in indoor operations, local mechanical exhaust ventilation systems that are sufficient to reduce and maintain personal exposures to within acceptable limits must be used and maintained in accordance with manufacturer's instruction and supplemented by exceptions noted in EM 385-1-1.

## 1.14 CONFINED SPACE ENTRY REQUIREMENTS

Confined space entry must comply with EM 385-1-1, 29 CFR 1926, 29 CFR 1910, and Directive CPL 2.100. Any potential for a hazard in the confined space requires a permit system to be used.

### 1.14.1 Rescue Procedures and Coordination with Local Emergency Responders

Develop and implement an on-site rescue and recovery plan and procedures. The rescue plan must not rely on local emergency responders for rescue

from a confined space.

## 1.15 DIVE SAFETY REQUIREMENTS

Develop a Dive Operations Plan, AHA, emergency management plan, and personnel list that includes qualifications, for each separate diving operation. Submit these documents to the District Dive Coordinator (DDC) via the Contracting Officer, for review and approval at least 15 working days prior to commencement of diving operations. These documents must be at the diving location at all times. Provide each of these documents as a part of the project file.

Though diving services are not required as part of the general scope of work for this project, it is Norfolk District policy to include a section covering commercial diving operations for all construction projects that are conducted on, or near, the water. The reasoning for this is the fact that unforeseen circumstances (such as lost equipment recovery, unknown sunken object investigation/removal, emergency floating plant repairs, etc.) may require the need for commercial diving services. In the event the need for this type of operation occurs, including a commercial diving section in the contract specifications helps to ensure that the Contractor is aware of the requirements for conducting commercial diving operations on USACE Norfolk District projects.

a. All diving performed under this contract shall be in strict accordance with the rules and regulations prescribed by EM 385-1-1 -Chapter 30; ER 385-1-31; 0910-LP-115-1921; 29 CFR 1910 - Subpart T; 29 CFR 1915; and the ADCI Consensus Standards.

b. A Contracting Officer s Representative, will be designated by the Contracting Office at the pre-construction Conference, to act for the Contracting Officer for all submissions, directions and/or acceptances required under the specifications. There will also be an individual designated as the Norfolk District Designated Dive Coordinator (DDC).

Do not schedule or engage in diving operations without the plan being accepted by no less than two of the following Norfolk District personnel: the District Dive Coordinator, the Alternate District Dive Coordinator and/or the Dive Safety Representative.

## 1.16 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must comply with the applicable Storm Plan and:

a. Secure outside equipment and materials and place materials that could be damaged in protected areas.

b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.

c. Ensure that temporary erosion controls are adequate.

## 1.17 BOEM REQUIREMENTS

As part of the signed MOA, the Contractor must ensure compliance with BOEM's requirements regarding occupational or public health, safety, environmental protection, conservation of natural resources, or other use

of the Outer Continental Shelf. These requirements are in the signed MOA which are included as an attachment at the end of these specifications.

## PART 2 PRODUCTS

Not Used

## PART 3 EXECUTION

### 3.1 CONSTRUCTION AND OTHER WORK

Comply with EM 385-1-1, NFPA 70, NFPA 70E, NFPA 241, the APP, the AHA, Federal and State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard prevails.

PPE is governed in all areas by the nature of the work the employee is performing. Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks. Safety glasses must be worn or carried/available on each person. Mandatory PPE includes:

a. Head Protection that meets ANSI/ISEA Z89.1

b. Long Pants

c. Appropriate Safety Footwear

d. Appropriate Class Reflective Vests

#### 3.1.1 Worksite Communication

Employees working alone in a remote location or away from other workers must be provided an effective means of emergency communications (i.e., cellular phone, two-way radios, land-line telephones or other acceptable means). The selected communication must be readily available (easily within the immediate reach) of the employee and must be tested prior to the start of work to verify that it effectively operates in the area/environment. Develop an employee check-in/check-out communication procedure to ensure employee safety.

#### 3.1.2 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this Contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocyanates, lead-based paint, and hexavalent chromium, are prohibited. The Contracting Officer, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials. Low mercury lamps used within fluorescent lighting fixtures are allowed as an exception without further Contracting Officer approval. Notify the Radiation Safety Officer (RSO) prior to excepted items of radioactive material and devices being brought on base.

### 3.1.3 Unforeseen Hazardous Material

Contract documents identify materials such as PCB, lead paint, and friable and non-friable asbestos and other OSHA regulated chemicals (i.e., 29 CFR Part 1910.1000). If material(s) that may be hazardous to human health upon disturbance are encountered during demolition, repair, renovation, or construction operations. Stop that portion of work and notify the Contracting Officer immediately. Within 14 calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification.

## 3.2 UTILITY OUTAGE REQUIREMENTS

Apply for utility outages in sufficient time as to not result in impacts or delays to the project schedule. At a minimum, the written request must include the location of the outage, utilities being affected, duration of outage, any necessary sketches, and a description of the means to fulfill energy isolation requirements in accordance with EM 385-1-1. In accordance with EM 385-1-1, where outages involve Government or Utility personnel, coordinate with the Government on all activities involving the control of hazardous energy.

These activities include, but are not limited to, a review of Hazardous Energy Control Program (HECP) and HEC procedures, as well as applicable Activity Hazard Analyses (AHAs). In accordance with EM 385-1-1 and NFPA 70E, work on energized electrical circuits must not be performed without prior Government authorization. Government permission is considered through the permit process and submission of a detailed AHA. Energized work permits are considered only when de-energizing introduces additional or increased hazard or when de-energizing is infeasible.

## 3.3 OUTAGE COORDINATION MEETING

After the utility outage request is approved and prior to beginning work on the utility system requiring shut-down, conduct a pre-outage coordination meeting in accordance with EM 385-1-1. This meeting must include the Prime Contractor, the Prime and subcontractors performing the work, the Contracting Officer, and the Public Utilities representative. All parties must fully coordinate HEC activities with one another. During the coordination meeting, all parties must discuss and coordinate on the scope of work, HEC procedures (specifically, the lock-out/tag-out procedures for worker and utility protection), the AHA, assurance of trade personnel qualifications, identification of competent persons, and compliance with HECP training in accordance with EM 385-1-1. Clarify when personal protective equipment is required during switching operations, inspection, and verification.

## 3.4 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

Provide and operate a Hazardous Energy Control Program (HECP) in accordance with EM 385-1-1, 29 CFR 1910, 29 CFR 1915, ANSI/ASSP A10.44, NFPA 70E.

### 3.4.1 Safety Preparatory Inspection Coordination Meeting with the Government or Utility

For electrical distribution equipment that is to be operated by Government

or Utility personnel, the Prime Contractor and the subcontractor performing the work must attend the safety preparatory inspection coordination meeting, which will also be attended by the Contracting Officer's Representative, and required by EM 385-1-1. The meeting will occur immediately preceding the start of work and following the completion of the outage coordination meeting. Both the safety preparatory inspection coordination meeting and the outage coordination meeting must occur prior to conducting the outage and commencing with lockout/tagout procedures.

### 3.4.2 Lockout/Tagout Isolation

Where the Government or Utility performs equipment isolation and lockout/tagout, the Contractor must place their own locks and tags on each energy-isolating device and proceed in accordance with the HECP. Before any work begins, both the Contractor and the Government or Utility must perform energy isolation verification testing while wearing required PPE detailed in the Contractor's AHA and required by EM 385-1-1. Install personal protective grounds, with tags, to eliminate the potential for induced voltage in accordance with EM 385-1-1.

### 3.4.3 Lockout/Tagout Removal

Upon completion of work, conduct lockout/tagout removal procedure in accordance with the HECP. In accordance with EM 385-1-1, each lock and tag must be removed from each energy isolating device by the authorized individual or systems operator who applied the device. Provide formal notification to the Government (by completing the Government form if provided by Contracting Officer's Representative), confirming that steps of de-energization and lockout/tagout removal procedure have been conducted and certified through inspection and verification. Government or Utility locks and tags used to support the Contractor's work will not be removed until the authorized Government employee receives the formal notification.

## 3.5 FALL PROTECTION PROGRAM

Establish a fall protection program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify roles and responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures in accordance with EM 385-1-1.

### 3.5.1 Fall Protection Equipment and Systems

Enforce use of personal fall protection equipment and systems designated (to include fall arrest, restraint, and positioning) for each specific work activity in the Site Specific Fall Protection and Prevention Plan and AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in EM 385-1-1.

Provide personal fall protection equipment, systems, subsystems, and components that comply with EM 385-1-1 and 29 CFR 1926.

#### 3.5.1.1 Additional Personal Fall Protection Measures

In addition to the required fall protection systems, other protective measures such as safety skiffs, personal floatation devices, and life

rings, are required when working above or next to water in accordance with EM 385-1-1. Personal fall protection systems and equipment are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall protection systems are required when operating other equipment such as scissor lifts. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, travel, or while performing work.

#### 3.5.1.2 Personal Fall Protection Equipment

Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. The use of body belts is not acceptable. Harnesses must have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Snap hooks and carabineers must be self-closing and self-locking, capable of being opened only by at least two consecutive deliberate actions and have a minimum gate strength of 1633 kg 3,600 lbs in all directions. Use webbing, straps, and ropes made of synthetic fiber. The maximum free fall distance when using fall arrest equipment must not exceed 1.8 m 6 feet, unless the proper energy absorbing lanyard is used. Always take into consideration the total fall distance and any swinging of the worker (pendulum-like motion), that can occur during a fall, when attaching a person to a fall arrest system. Equip all full body harnesses with Suspension Trauma Preventers such as stirrups, relief steps, or similar in order to provide short-term relief from the effects of orthostatic intolerance in accordance with EM 385-1-1.

## 3.6 EQUIPMENT

### 3.6.1 Use of Explosives

Explosives must not be used or brought to the project site without prior written approval from the Contracting Officer. Such approval does not relieve the Contractor of responsibility for injury to persons or for damage to property due to blasting operations.

Storage of explosives, when permitted on Government property, must be only where directed and in approved storage facilities. These facilities must be kept locked at all times except for inspection, delivery, and withdrawal of explosives.

## 3.7 ELECTRICAL

Perform electrical work in accordance with EM 385-1-1.

### 3.7.1 Electrical Work

As described in EM 385-1-1, electrical work is to be conducted in a de-energized state unless there is no alternative method for accomplishing the work. In those cases obtain an energized work permit from the Contracting Officer. The energized work permit application must be accompanied by the AHA and a summary of why the equipment/circuit needs to be worked energized. Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Attach temporary grounds in accordance with ASTM F855 and IEEE 1048. Perform all high voltage cable cutting remotely using hydraulic cutting

tool. When racking in or live switching of circuit breakers, no additional person other than the switch operator is allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method.

When working in energized substations, only qualified electrical workers are permitted to enter. When work requires work near energized circuits as defined by NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety footwear, insulating gloves and electrical arc flash protection for personnel as required by NFPA 70E. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA. Ensure that each employee is familiar with and complies with these procedures and 29 CFR 1910.

### 3.7.2 Qualifications

Electrical work must be performed by QP with verifiable credentials who are familiar with applicable code requirements. Verifiable credentials consist of State, National and Local Certifications or Licenses that a Master or Journeyman Electrician may hold, depending on work being performed, and must be identified in the appropriate AHA. Journeyman/Apprentice ratio must be in accordance with State, Local requirements applicable to where work is being performed.

### 3.7.3 Arc Flash

Conduct a hazard analysis/arc flash hazard analysis whenever work on or near energized parts greater than 50 volts is necessary, in accordance with NFPA 70E.

All personnel entering the identified arc flash protection boundary must be QPs and properly trained in NFPA 70E requirements and procedures. Unless permitted by NFPA 70E, no Unqualified Person is permitted to approach nearer than the Limited Approach Boundary of energized conductors and circuit parts. Training must be administered by an electrically qualified source and documented.

### 3.7.4 Grounding

Ground electrical circuits, equipment and enclosures in accordance with NFPA 70 and IEEE C2 to provide a permanent, continuous and effective path to ground unless otherwise noted by EM 385-1-1.

### 3.7.5 Testing

Temporary electrical distribution systems and devices must be inspected, tested and found acceptable for Ground-Fault Circuit Interrupter (GFCI) protection, polarity, ground continuity, and ground resistance before initial use, before use after modification and at least monthly. Monthly inspections and tests must be maintained for each temporary electrical distribution system, and signed by the electrical CP or QP.

-- End of Section --

SECTION 01 35 30

# GOVERNMENT PROVIDED MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) CONSTRUCTION SUPPORT
**09/11**

## PART 1 GENERAL

### 1.1 SCOPE OF SECTION

The work outlined in this section encompasses the provision of Munitions and Explosives of Concern (MEC) safety support within the borrow area and beach renourishment site, in accordance with DESR 6055.09 Edition 1, Change 2.

### 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| DESR 6055.09 | (2024) Defense Explosive Safety Regulation, Edition 1, Change 2 |
| DDESB TP-18 | (2020) Department of Defense Explosive Safety Board (DDESB) Technical Paper 18, Revision 1 - Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern Related Activities |
| DODM 4715.26 | (2019) DoD Military Munitions Rule Implementation Procedures, Change 2 |
| DODM 4140.72 | (2021) Management of Material Potentially Presenting an Explosive Hazard |

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| EM 385-1-97 | (2013) Explosives Safety and Health Requirements Manual, (Change 1) |
| EM 385-1-1 | (2024) Safety -- Safety and Occupational Health (SOH) Requirements |

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Site Safety And Health Plan (SSHP) MEC Safety Addendum; G, DO

SD-04 Samples

Discharge End Screening Device Inspections; G, COR

## 1.4 ORDNANCE AND EXPLOSIVE SAFETY SPECIALIST (OESS)

OESS shall have the minimum qualifications as specified in DDESB TP-18 to meet or exceed an Unexploded (UXO) Technician III.

### 1.4.1 Land Based OESS

During beach-fill operations, the Government will provide a sufficient number of OESS for 24-hour, 7-days per week MEC support. The OESS shall ensure MEC Training and Awareness is provided to all site workers. An OESS shall inspect both the dredge intake and discharge screening device(s) for damage and presence of MEC.

### 1.4.2 Hopper Dredging Only

If MEC is identified as being dredged from the borrow area in a frequency that interferes with project schedule, crew safety, and emergency response assets that cannot be addressed through mechanical modifications, the Government will determine if the following requirements are necessary.

Provide two OESS per dredge, one of which must be a UXO Technician III qualified. The OESS shall provide 24-hour, 7-days per week MEC support aboard the dredge on a rotating watch basis. The OESS shall provide MEC Training and shall inspect the drag heads MEC screens for damage and presence of MEC after each load has been taken aboard.

The OESS shall determine the classification of MEC-like objects discovered, shall dislodge MEC from the drag head(s) if required, and shall properly safeguard the MEC. Contractor shall provide a dedicated crew boat with crew for transportation of the OESS and MEC to a location as directed by the Government. No contractor personnel other than the designated boat crew, OESS, and/or EOD shall be permitted on the crew boat during transportation of MEC.

If an OESS is required on the vessel, do not continue/commence dredging until the OESS are on-board the dredge.

## 1.5 GOVERNMENT-PROVIDED OESS

### 1.5.1 General

The Corps of Engineers Military Munitions Design Center will assign an OESS to oversee all MEC safety protocols and ensure adequate training is provided to contractor personnel. The OESS will remain on-site, or be available within the project vicinity, to promptly address any issues that may arise throughout the beach-fill placement operations. Should a MEC or suspected MEC item be encountered, the contractor must immediately notify the OESS. The OESS will then issue guidance, coordinate the appropriate emergency response, and ensure all safety measures are followed. Upon direction from the OESS, dredging operations shall cease without delay to allow inspection of intake and discharge screening devices, thereby preventing the inadvertent dredging and deposition of MEC onto the beach.

### 1.5.2 Pre-Construction Meeting

The OESS will attend the preconstruction meeting to answer any of the Contractor's questions concerning MEC.

### 1.5.3 MEC Safety and Work Plan Review (G)

The OESS will review the Contractor's Site Safety And Health Plan (SSHP) MEC Safety Addendum to ensure MEC aspects are adequately addressed. The Contractor's MEC Safety shall communicate the Contractor's understanding of their roles and responsibilities in the management of dredging and dredged material placement operations to prevent MEC from being dredged and placed on the beach. Reference EM 385-1-97 and EM 385-1-1 for additional information.

### 1.5.4 Worker Education (G)

The contractor will conduct MEC safety and awareness recognition training for the dredging vessel and shore-based workers. This training will be provided prior to the start of work on site, and to all newly reporting personnel assigned to the project who have not attended MEC training in the previous twelve months. MEC Training is required once per 12-month period. The MEC training video can be accessed at https://www.3rs.mil/.

### 1.5.5 Quality Assurance

The OESS will conduct periodic monitoring of beach-fill operations and remain on-site, or in the vicinity, to address issues as they arise. If the OESS determines that the intake screening system on the dredge or the discharge screening system on the beach has degraded and is no longer functioning as intended, all work shall immediately cease. Corrective action must be taken to ensure that MEC is not dredged or deposited on the beach during material placement activities. The Contractor shall document the damage and subsequent repairs with photographs and submit them to the COR as part of the daily report.

## 1.6 MEC SAFETY AND WORK PLAN REQUIREMENTS (G)

Prior to commencement of any work, including delivery of any plant, equipment, or construction materials to the site, the following will be reviewed within the Site Safety And Health Plan (SSHP) MEC Safety Addendum, in accordance with EM 385-1-97, DODM 4140.72, DODM 4715.26, and EM 385-1-1:

Shop drawings and detailed descriptions of the required screening devices on the dredge intake and at the discharge end of the pipeline. Also include the materials, equipment, procedures and personnel to be used in the construction, operations and oversight of such devices.

Personnel, equipment, and procedures to be used to perform visual inspections at the discharge end of the pipeline on the beach.

Measures to be followed if oversized material is discovered in the screening devices.

Measures to be followed if oversized material is identified as deposited on the beach.

Measures to be followed if MEC is discovered in the screening devices.

Measures to follow if MEC is identified as deposited on the beach.

Measures to follow if Chemical Warfare Material (CWM) is encountered or an item cannot be positively identified. See the UXO attachments at the end of these specifications.

## 1.7 DREDGE REQUIREMENTS

### 1.7.1 On-board Accommodations

Provide on-board accommodations and meals for OESS personnel. Include as part of the accommodations, internet access, and two bed spaces. Provide an on-board portable magazine/MEC containment vessel, as approved by an OESS, to securely store and transfer collected MEC items.

### 1.7.2 Hopper Dredges

Hopper dredges coming from a previous MEC project must ensure the dredge hopper has been flushed and is clear of residual material. During the dredge intake screen inspections, the hopper shall be inspected to ensure it is free of material. If residual material exists, conduct a hopper flush over a designated area until free of material. Flushing the hopper prior to departure of a MEC project should be conducted as a safe practice not to cross-contaminate material possibly containing MEC.

# PART 2 PRODUCTS (NOT APPLICABLE)

# PART 3 EXECUTION

## 3.1 SCREENING DEVICES

### 3.1.1 General

Prevent MEC from being placed on the beach by using a screening device placed: 1) on the dredge intake or in pipeline section prior to reaching the dredge pump, and 2) at the discharge end of the pipeline on the beach. The required screening devices shall meet the following requirements:

a. The screening device on the dredge intake shall prevent the passage of any material greater than 1.25 inches in its smallest dimension. Openings may be elongated, but no dimension shall exceed 1.25 inches in its smallest axis. The maximum allowable opening is 1.25 inches x 6 inches.

b. Design the Discharge End Screening Device to retain all items 0.75 inches in diameter and larger. The openings on the screening device shall be of uniform dimension (i.e. a grid or a series of round holes; slotted openings will not be permitted).

c. Construct the screening devices (e.g. screening baskets or mechanical screening) using rugged steel or composite material, one-piece or welded members. The devices shall cover the entire cross-sectional area, except where basket type devices are used on the discharge end. Relief windows in basket type devices will be permitted only to the side opposite the inflow and at least 12 inches from the bottom of the basket, or as directed by the OESS. Size and location of windows to prevent large items, and MEC items from escaping screening device during pumping operations. Keep screening devices in a level and

horizontal position when using relief windows, during pumping operations.

d. Screening devices shall be removable for easy replacement if damaged. Ensure screening devices provide a production rate that allows completion of all dredging and beach-fill placement within the contract duration.

e. Prior to commencement of any beach-fill work, provide a working demonstration on-site that intake and discharge screening devices meet all requirements specified herein, and that the devices operate as designed.

f. Maintain adequate replacement parts and/or additional screening devices on site to ensure production does not stop due to damaged devices, or delays in the inspection process.

Provide minor adjustments to screening devices as directed by an OESS to accommodate varying types and amounts of material being screened at the beach, at no additional cost to the Government. As an example, relief windows, other than the required screen apertures, sometimes need to be enlarged, reduced, or relocated to minimize residual biological debris in the basket during the inflow process and for post flow MEC inspection of residual material.

### 3.1.2 Drag Head Modifications

If a hopper dredge is used, design the drag heads to prevent objects greater than 3 inches in diameter from being trapped between drag head teeth or between the drag head teeth and the dredge intake screening device. Make adjustments as necessary in the event objects become trapped in these areas, at no additional cost to the Government. Modifications shall be completed and approved by the COR and OESS prior to resuming dredging operations.

### 3.1.3 Inspection of Oversized Material

a. Design a method for inspection of all oversized material collected during beach-fill pumping operations. Every effort shall be made to flush all sand out of the residual material to allow for 100 percent inspection.

(1) Designed systems that involves inspection of the oversized material at the discharge end screening device will have the following requirements:

(a) allow unrestricted entry or exit during times of inspector access, and

(b) sufficient size to allow the inspector to move around and rake through the material to inspect for MEC.

(2) Contractor shall ensure no loss of oversized material from any system that involves the movement of the screening device or removing or handling of the oversized material to another location for inspection. Minimize the shock of the contents during the transfer to a secondary basket (in the event MEC is present).

(3) Keep uninspected material from commingling with inspected material.

(4) Design any system that involves inspection of oversized material using a secondary basket with the following requirements:

(a) allow unrestricted entry or exit for the purpose of material inspection.

(b) sufficient size to allow the inspector to move around and rake through the material.

(c) The amount of material placed in the secondary basket awaiting inspection shall not exceed 2 inches in depth, unless otherwise directed by the OESS, to enable material to be 100 percent inspected. This maximum depth requirement shall apply consistently to all oversized material handling procedures.

(d) If oversized material/shells are to be reintegrated into the beach fill material, it shall be spread out over an area that can be swept by the OESS with an all-metals detector. The material shall be spread to a depth deemed manageable by the OESS.

b. Upon inspection of the material by an OESS, material can either be reutilized or disposed of off-site.

## 3.2 INSPECTION OF DREDGE INTAKE SCREEN

### 3.2.1 Prior to Start of Project

Prior to commencing dredging operations, an OESS shall conduct an inspection of the MEC screens on the dredge, to verify that the condition and integrity of the screens meet the requirements specified herein. Provide a dedicated crew boat with crew for transportation of the OESS to the dredge for inspection.

### 3.2.2 Screening Device Inspection

Inspect the intake or pipeline screening device a minimum of every 8 hours for pipeline dredging, and every load for hopper dredging to ensure its effectiveness by contractor personnel unless an OESS is available, to verify the screening device is still within specification and no MEC is present.

### 3.2.3 End of Project

Upon completion of dredging operations, conduct post inspections of all MEC screens by an OESS. This will ensure no MEC remains in the screening devices and will ensure no MEC hazards leave the project site.

### 3.2.4 Record Keeping

The contractor will record all inspections, document with photographs, and include in the daily report of operations specified in 35 20 24 BEACH FILL.

## 3.3 VISUAL INSPECTION OF PIPELINE DISCHARGE END

a. At the beginning of the project, prior to commencing beach-fill operations, conduct an inspection of discharge end screening devices by an OESS to verify that the condition and integrity of the screen meet the requirements specified herein.

b. Visual observation by contractor's personnel, shall be performed at all times while material is being placed on the beach.

c. OESS shall perform visual inspections of the interior and exterior of the discharge-end screening device for the presence of MEC after each cycle for hopper dredging, and a minimum of once every 8 hours for pipeline dredging.

d. Temporarily stop hydraulic dredging to allow for these inspections. At the Contractor's option, in-flow of material for hydraulic dredging may be Y valved to an alternate discharge screening device to allow for inspection of the primary screening device. Perform continual visual observations from outside the screening device during pumping of beach-fill material.

e. The Contractor shall not enter any screening device containing material until the device has been fully inspected and formally cleared by an OESS. Under no circumstances may a screening device be emptied prior to inspection and clearance, except when material is being transferred to a designated secondary basket or relocated to an approved area of the beach for subsequent inspection under OESS supervision. Following inspection and clearance, all material may either be reutilized or disposed of off-site, as directed. Temporary on-site storage of material is permitted in a dumpster or roll-off container until final disposition is determined.

f. Upon completion of beach-fill operations, a post inspection of the discharge end screening devices by an OESS shall be performed.

g. Contractor shall record all Discharge End Screening Device Inspections, document with photographs, and included in the daily report of operations specified in 35 20 24 BEACH FILL

## 3.4 DETECTION OF MEC

### 3.4.1 Beach Support

If any MEC larger than 1.25 inches (in its smallest dimension) is detected in a discharge screening device, or any size MEC is detected on the beach, implement the following procedures:

a. Stop dredging and beach-fill work.

b. Notify an OESS.

c. Notify Dredge of a potential breech in the screening device, and an inspection of the device will be conducted before resuming operation.

d. All personnel shall withdraw a minimum of 200 feet from the area where the MEC is detected. If 200 feet is not feasible, the OESS shall

determine the minimum safe distance in accordance with applicable explosive safety regulations.

e. Contractor shall report the incident to the COR.

f. Once a suspect MEC item has been located, an OESS will assess the item for removal. In the event a MEC item cannot be safely removed an OESS will contact supporting EOD unit to respond.

g. If MEC is discovered outside the screening device, the affected area shall be clearly identified and cordoned off. The OESS will then conduct a thorough scan of the area using an all-metals detector until all material presumed to be affected has been fully inspected.

h. Do not resume beach-fill and/or dredging work until all screening devices and affected beach have been scanned and inspected by an OESS.

### 3.4.2 Dredge Support

Upon notification, that MEC is detected in a screening device, drag head, or on the deck, implement the following procedures:

a. Stop dredging and beach-fill work.

b. Do not attempt to dislodge or move suspected MEC item. Take photos, if possible, and contact an OESS.

c. The contractor will notify the COR.

d. Contractor shall make arrangements for a crew boat to transport an OESS to the Dredge. An OESS shall travel to the dredge and assess the potential MEC item. The OESS shall keep the contractor informed of all actions during this process.

e. An OESS will coordinate emergency response if needed after all information is gathered.

## 3.5 CONTRACTOR SUPPORT

The Contractor shall provide assistance as directed by the designated emergency response agency, with all activities coordinated through the OESS. Such assistance may include, but is not limited to, operating equipment to excavate holes for the safe detonation of MEC items and/or supporting perimeter security during emergency response operations. At no time shall the Contractor be required or expected to expose site personnel to hazardous conditions during MEC-related emergency responses at the project site, in accordance with DODM 4715.26.

## 3.6 DETECTION AND REMOVAL OF OVERSIZED MATERIAL

Implement the following procedures when items that exceeds maximum allowable dimensions (1.25 inches) are detected in intake or discharge screening devices, or when found on the beach:

a. Stop dredging and beach-fill work.

b. The contractor will report any incidents of screening device

malfunctions or presence of oversize material to an OESS, and annotate in the daily report.

c. Notify Dredge of a potential breech in the screening device, and an inspection of the device will be conducted before resuming operation.

d. Repair the intake and/or discharge screening devices if necessary. Take digital photos to document damaged screening device(s) and effected repairs to an OESS. Submit photos to the COR with daily reports.

e. Hopper Dredge Only: Prior to resuming dredging operations, backflush the hopper to ensure oversized or MEC items do not remain in the hopper. If dredging has resumed prior to discovery of oversized material or MEC items in the discharge end screening device, the dredge will be allowed to continue the current dredging cycle, pump-out the dredged material, return to the borrow area, and then the hopper shall be back-flushed in the borrow area only.

f. Beach-fill and/or dredging work shall not resume until a root cause analysis has positively identified the problem and steps have been taken to prevent recurrence. Affected area will be inspected for MEC as specified in Paragraph "DETECTION OF MEC".

g. Once a screening device has undergone ten or more repairs, further repairs will no longer be considered sufficient, at that point, a formal corrective action must be implemented.

h. Any potential corrective action must be reviewed, discussed, and approved by the OESS, COR, and the Area Engineer prior to execution.

## 3.7 MEASUREMENT AND PAYMENT

### 3.7.1 Hopper Dredge Modifications

Modifications recommended by an OESS, if required on a Hopper Dredge, will be negotiated in accordance with Contract Clause "CHANGES". All other work recommended in this section will not be measured for payment and all costs in connection therewith shall be included in the contract unit price for the Base Bid Item No. 0009 and Option Bid Items No. 0010 - 0012, Dredging/Beach Fill Complete, as described in 01 20 00 PRICE AND PAYMENT PROCEDURES.

### 3.7.2 MEC Modifications and Monitoring

All costs in connection with MEC modifications and monitoring required in connection with the Base Bid and Option Bid beach-fill work specified in this section shall be included in the applicable contract unit price for the respective bid items titled "Dredging/Beach Fill Complete," as described in 01 20 00 PRICE AND PAYMENT PROCEDURES. All costs associated with any non-production time (down time) related to the work specified in this section will be considered incidental to these bid items.

-- End of Section --

# SECTION 01 42 00

# SOURCES FOR REFERENCE PUBLICATIONS
**05/24**

## PART 1 GENERAL

### 1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization (e.g., ASTM B564 Standard Specification for Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

### 1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided.

AACE INTERNATIONAL (AACE)
726 East Park Avenue #180
Fairmont, WV 26554 USA
Ph: 304-296-8444
Fax: 304-291-5728
Internet: https://web.aacei.org/

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
1801 Alexander Bell Drive
Reston, VA 20191
Ph: 800-548-2723; 703-295-6300
Email: customercare@asce.org
Internet: https://www.asce.org/

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
Two Park Avenue
New York, NY 10016-5990
Ph: 800-843-2763
Fax: 973-882-1717
E-mail: customercare@asme.org
Internet: https://www.asme.org/

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)
520 N. Northwest Highway
Park Ridge, IL 60068
Ph: 847-699-2929
E-mail: customerservice@assp.org
Internet: https://www.assp.org/

Association of Diving Contractors International (ADCI)

5206 Cypress Creek Parkway Ste. 202
Houston, TX 77069

Ph: 281-893-8388
Fax: 281-893-8388
Internet: https://aeic.org/

ASTM INTERNATIONAL (ASTM)
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959
Ph: 610-832-9500
Fax: 610-832-9555
E-mail: service@astm.org
Internet: https://www.astm.org/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
445 and 501 Hoes Lane
Piscataway, NJ 08854-4141
Ph: 732-981-0060 or 800-701-4333
Fax: 732-981-9667
E-mail: onlinesupport@ieee.org
Internet: https://www.ieee.org/

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)
ISO Central Secretariat
BIBC II
Chemin de Blandonnet 8
CP 401 - 1214 Vernier, Geneva
Switzerland
Ph: 41-22-749-01-11
E-mail: central@iso.ch
Internet: https://www.iso.org

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)
1101 Wilson Blvd, Suite 1425
Arlington, VA 22209-1762
Ph: 703-525-1695
Fax: 703-528-2148
Internet: https://safetyequipment.org/

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
1 Batterymarch Park
Quincy, MA 02169-7471
Ph: 800-344-3555
Fax: 800-593-6372
Internet: https://www.nfpa.org

U.S. ARMY CORPS OF ENGINEERS (USACE)
CRD-C DOCUMENTS available on Internet:
http://www.wbdg.org/ffc/army-coe/standards
Order Other Documents from:
Official Publications of the Headquarters, USACE
E-mail: hqpublications@usace.army.mil
Internet: http://www.publications.usace.army.mil/
or
https://www.hnc.usace.army.mil/Missions/Engineering-Directorate/TECHINFO/

U.S. DEPARTMENT OF DEFENSE (DOD)
Order DOD Documents from:
Room 3A750-The Pentagon

1400 Defense Pentagon
Washington, DC 20301-1400
Ph: 703-571-3343
Fax: 215-697-1462
E-mail: customerservice@ntis.gov
Internet: https://www.ntis.gov/
Obtain Military Specifications, Standards and Related Publications from:
Acquisition Streamlining and Standardization Information System (ASSIST)
Department of Defense Single Stock Point (DODSSP)
Document Automation and Production Service (DAPS)
Building 4/D
700 Robbins Avenue
Philadelphia, PA 19111-5094
Ph: 215-697-6396 - for account/password issues
Internet: https://assist.dla.mil/online/start/; account registration required
Obtain Unified Facilities Criteria (UFC) from:
Whole Building Design Guide (WBDG)
National Institute of Building Sciences (NIBS)
1090 Vermont Avenue NW, Suite 700
Washington, DC 20005
Ph: 202-289-7800
Fax: 202-289-1092
Internet:
https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc

U.S. DEPARTMENT OF THE NAVY (DON)
Chief of Information
Attn: US Navy
1200 Navy Pentagon
Washington, DC 20350-1200
Internet: https://www.navy.mil/

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)
1200 New Jersey Ave., SE
Washington, DC 20590
Ph: 202-366-4000
E-mail: ExecSecretariat.FHWA@dot.gov
Internet: https://highways.dot.gov/
Order from:
Superintendent of Documents
U.S. Government Publishing Office (GPO)
732 N. Capitol Street, NW
Washington, DC 20401
Ph: 202-512-1800 or 866-512-1800
Bookstore: 202-512-0132
Internet: https://www.gpo.gov/

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
8601 Adelphi Road
College Park, MD 20740-6001
Ph: 866-272-6272
Internet: https://www.archives.gov/
Order documents from:
Superintendent of Documents
U.S. Government Publishing Office (GPO)
732 N. Capitol Street, NW

Washington, DC 20401
Ph: 202-512-1800 or 866-512-1800
Bookstore: 202-512-0132
Internet: https://www.gpo.gov/

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

-- End of Section --

# SECTION 01 45 00

# QUALITY CONTROL
**08/23, CHG 1: 05/24**

## PART 1 GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D3740 | (2019) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction |
| ASTM E329 | (2023) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection |

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| EM 385-1-1 | (2024) Safety -- Safety and Occupational Health (SOH) Requirements |

### 1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program. Include all associated costs in the applicable Schedule item.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

Contractor Quality Control (CQC) Plan; G

Prior to commencement of work, submit a copy of Quality Control Plan to Contracting Officer indicating plans, procedures, and organization necessary to produce an end product that complies with the contract requirements.

E-Verify Program; G

Prior to commencement and after construction, submit e-verify program to document that legal workers are being utilized.

SD-06 Test Reports

Contractor Quality Control (CQC) Report

Daily quality control reports including preparatory and initial phase minutes shall be submitted on a daily basis as specified in paragraph "DOCUMENTATION".

## 1.4 GENERAL REQUIREMENTS

Establish and maintain an effective quality control (QC) system that complies with FAR 52.246-12 Inspection of Construction. QC is comprised of plans, procedures, and organization necessary to produce an end product that complies with the Contract requirements. The QC system covers all construction operations, both onsite and offsite, and must be keyed to the proposed construction sequence. The Quality Control Manager, Superintendent, Site Safety and Health Officer (SSHO), and all on-site supervisors are responsible for the quality of work and are subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the Contract. The Quality Control Manager must maintain a physical presence at the work site at all times and is the primary individual responsible for all quality control.

## 1.5 QUALITY CONTROL (QC) PROGRAM REQUIREMENTS

Establish and maintain a QC program as described in this section. The QC program consists of a QC Organization, QC Plan, QC Plan Meeting(s), a Coordination and Mutual Understanding Meeting, QC meetings, three phases of control, submittal review and approval, testing, completion inspections, QC certifications, and documentation necessary to provide materials, equipment, workmanship, fabrication, construction and operations that comply with the requirements of this Contract. The QC program must cover on-site and off-site work and be keyed to the work sequence. No construction work or testing may be performed unless the QC Manager is on the work site. The QC Manager must report to an officer of the firm and not be subordinate to the Project Superintendent or the Project Manager. The QC Manager, Project Superintendent and Project Manager must work together effectively. Although the QC Manager is the primary individual responsible for quality control, all individuals will be held responsible for the quality of work on the job.

### 1.5.1 Meetings

#### 1.5.1.1 Quality Control Plan Meeting

Prior to submission of the QC Plan, the Contractor may request a meeting with the Contracting Officer to discuss the QC Plan requirements of this Contract.

The purpose of this meeting is to develop a mutual understanding of the QC Plan requirements prior to plan development and submission and to agree on the Contractor's list of Definable Feature of Work (DFOW).

#### 1.5.1.2 Coordination and Mutual Understanding Meeting

After the  before start of construction, and prior to acceptance by the Government of the CQC Plan, meet with the Contracting Officer and discuss

the Contractor's quality control system. During the meeting, a mutual understanding of the system details must be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting will be prepared by the QC Manager and signed by the Contractor and the Government. Provide a copy of the signed minutes to all attendees and include in the QC Plan. At a minimum the Coordination and Mutual Understanding Meeting must be repeated when a new QC Manager is appointed. There can be other occasions when subsequent conferences will be called by either party to reconfirm mutual understandings or address deficiencies in the CQC system or procedures which can require corrective action by the Contractor.

1.5.1.2.1 Purpose

The purpose of this meeting is to develop a mutual understanding of the QC details, including documentation, administration for on-site and off-site work, design intent, environmental requirements and procedures, coordination of activities to be performed, and the coordination of the Contractor's management, production, and QC personnel. At the meeting, the Contractor must explain in detail how three phases of control will be implemented for each DFOW, as well as how each DFOW will be affected by each management plan or requirement as listed below:

a. Waste Management Plan.

b. Procedures for noise and acoustics management.

c. Environmental Protection Plan.

d. Environmental regulatory requirements.

1.5.1.2.2 Coordination of Activities

Coordinate activities included in various sections to assure efficient and orderly installation of each component. Coordinate operations included under different sections that are dependent on each other for proper installation and operation.

1.5.1.2.3 Attendees

As a minimum, the Contractor's personnel required to attend include an officer of the firm, the Project Manager, Project Superintendent, QC Manager, Alternate QC Manager, Environmental Manager, and subcontractor representatives. Each subcontractor who will be assigned QC responsibilities must have a principal of the firm at the meeting.

1.5.1.3 Quality Control (QC) Meetings

After the start of construction, conduct weekly QC meetings led by the QC Manager at the work site with the Project Superintendent,the QC Specialists, and the other personnel as necessary. The QC Manager is to prepare the minutes of the meeting and provide a copy to the Contracting Officer within 2 working days after the meeting. The Contracting Officer may attend these meetings. As a minimum, accomplish the following at each meeting:

a. Review the minutes of the previous meeting.

b. Review the schedule and the status of work and deficiencies/rework. Review the most current approved schedule (in accordance with schedule specification) and the status of work and deficiencies/rework.

c. Review the status of submittals and Request For Information (RFIs).

d. Review the work to be accomplished in the next 3 weeks as defined by the schedule section paragraph WEEKLY PROGRESS MEETINGS in Section 01 32 01.00 10 PROJECT SCHEDULE and all documentation required for that work.

e. Review Testing Plan and Log including status of tests performed since last QC Meeting.

f. Resolve QC and production problems. Discuss status of pending change orders.

g. Address items that may require revising the QC Plan.

h. Review Accident Prevention Plan (APP) and effectiveness of the safety program.

i. Review environmental requirements and procedures.

j. Review Environmental Management Plan.

k. Review Waste Management Plan.

l. Review the status of training completion.

1.5.2 Contractor Quality Control (CQC) Plan

Submit no later than 30 days after receipt of notice to proceed, the CQC Plan proposed to implement the requirements FAR 52.246-12 Inspection of Construction. The Government will consider an interim plan for the first 30 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan and other Contract requirements or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional work.

1.5.2.1 Content of Contractor Quality Control (CQC) Plan

Provide a CQC Plan, prior to start of construction that includes a table of contents, with major sections identified, pages numbered sequentially, and that documents the proposed methods and responsibilities for accomplishing quality control during the construction of the project. The CQC Plan must at a minimum include the following sections:

a. A description of the quality control organization and acknowledgment that the CQC staff will implement the three phase control system for all aspects of the work specified.

b. An organizational chart showing the quality control organization with individual names and job titles and lines of authority up to an executive of the company at the home office.

c. NAMES AND QUALIFICATIONS: Names and qualifications, in resume format, (including position titles and durations for qualifying experiences) for each person in the QC organization. Include the Construction Quality Management (CQM) for Contractors course certifications for the QC personnel as required by the paragraph CONSTRUCTION QUALITY MANAGEMENT TRAINING.

d. DUTIES, RESPONSIBILITY AND AUTHORITY OF QC PERSONNEL: Duties, responsibilities, and authorities of each person in the QC organization.

e. OUTSIDE ORGANIZATIONS: A listing of outside organizations, such as architectural and consulting engineering firms, that will be employed by the Contractor and a description of the services these firms will provide.

f. APPOINTMENT LETTERS: Letters signed by an officer of the firm appointing the QC Manager and Alternate QC Manager, and stating that they are responsible for implementing and managing the QC program as described in this Contract. Include in this letter the responsibility of the QC Manager and Alternate QC Manager to implement and manage the three phases of control, and their authority to stop work that is not in compliance with the Contract. Letters of direction are to be issued by the QC Manager to all other QC Specialists or quality control representatives outlining their duties, authorities, and responsibilities. Include copies of the letters in the QC Plan.

g. SUBMITTAL PROCEDURES AND INITIAL SUBMITTAL REGISTER: Procedures for reviewing, approving, scheduling, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. Provide the name(s) of the person(s) in the QC organization authorized to review and certify submittals prior to approval. Provide the initial submittal of the Submittal Register as specified in Section 01 33 00 SUBMITTAL PROCEDURES.

h. TESTING LABORATORY INFORMATION: Testing laboratory information required by the paragraph ACCREDITATION REQUIREMENTS, as applicable.

i. TESTING PLAN AND LOG: A Testing Plan and Log that includes the tests required, associated feature of work required, referenced by the specification paragraph number requiring the test, the frequency, and the person responsible for each test.

j. Procedures to complete construction deficiencies from identification through acceptable corrective action. Establish verification procedures that identified deficiencies have been corrected. This phase is performed prior to beginning work on each definable feature of work, after all required plans, documents, materials are approved, and after copies are at the work site.

k. Reporting procedures, including proposed reporting formats.

l. Procedures for submitting and reviewing design changes/variations prior to submission to the Contracting Officer.

m. LIST OF DEFINABLE FEATURES: A Definable Feature of Work (DFOW) is a task that is separate and distinct from other tasks and has control requirements and work crews unique to that task. A DFOW is identified by different trades or disciplines, or it is work by the same trade in

a different environment. A DFOW is by definition any item or activity on the construction schedule, and the schedule specification provides direction regarding how the DFOWs are to be structured. Include in the list of DFOWs for all activities on the Construction Schedule. Although each section of the specifications can generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. Identify the specification section number and schedule activity ID for each DFOW listed. The DFOW list will be reviewed in coordination with the construction schedule and agreed upon during the Coordination of Mutual Understanding Meeting.

n. PROCEDURES FOR PERFORMING AND TRACKING THE THREE PHASES OF CONTROL: Identify procedures used to ensure the three phases of control to manage the quality on this project. For each Definable Feature of Work (DFOW), a Preparatory and Initial phase checklist will be filled out during the Preparatory and Initial phase meetings. Conduct the Preparatory and Initial Phases and meetings with a view towards obtaining quality construction by planning ahead and identifying potential problems for each DFOW.

o. PROCEDURES FOR COMPLETION INSPECTION: Procedures for identifying and documenting the completion inspection process. Include in these procedures the responsible party for punch out inspection, pre-final inspection, and final acceptance inspection.

p. TRAINING PROCEDURES AND TRAINING LOG: Procedures for coordinating and documenting the training of personnel required by the Contract.

q. ORGANIZATION AND PERSONNEL CERTIFICATIONS LOG: Procedures for coordinating, tracking and documenting all certifications required for entities such as subcontractors, testing laboratories, suppliers, and personnel. The QC Manager will ensure that certifications are current, appropriate for the work being performed, and will not lapse during any period of the Contract that the work is being performed.

### 1.5.3 Acceptance of the Quality Control (QC) Plan

The Contracting Officer's acceptance of the Contractor QC Plan, or interim plan applicable to the particular feature of work to be started, is required prior to the start of construction. The Government will consider an interim plan for the first 30 days of operation. Work outside of the accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional work. The Contracting Officer reserves the right to require changes in the QC Plan and operations as necessary, including removal or addition of personnel, to ensure the specified quality of work. The Contracting Officer reserves the right to interview any member of the QC organization at any time to verify the submitted qualifications. All QC organization personnel are subject to acceptance by the Contracting Officer. The Contracting Officer may require the removal of any individual for non-compliance with quality requirements specified in the Contract.

### 1.5.4 Notification of Changes

Notify the Contracting Officer, in writing, of any proposed changes in the QC Plan or changes to the QC organization personnel. Proposed changes are subject to acceptance by the Contracting Officer.

## 1.6 QUALITY CONTROL (QC) ORGANIZATION

### 1.6.1 Personnel Requirements

The requirements for the CQC organization are a Site Safety and Health Officer (SSHO), QC Manager, and enough qualified personnel to ensure safety and Contract compliance. The SSHO reports directly to a senior project (or corporate) official independent from the QC Manager. The SSHO will also serve as a member of the CQC Staff Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly. The CQC staff always maintains a presence at the site during progress of the work and have complete authority and responsibility to take any action necessary to ensure Contract compliance. The CQC staff will be subject to acceptance by the Contracting Officer. Provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Promptly complete and furnish all letters, material submittals, shop drawing submittals, schedules, and all other project documentation to the CQC organization. The CQC organization is responsible for always maintaining these documents and records at the site, except as otherwise acceptable to the Contracting Officer.

### 1.6.2 Quality Control (QC) Manager

#### 1.6.2.1 Duties

Provide a QC Manager at the work site to implement and manage the QC program. The QC Manager must be employed by the Prime Contractor. The only duties and responsibilities of the QC Manager are to manage and implement the QC program on this Contract. The QC Manager must attend the Coordination and Mutual Understanding Meeting, perform the three phases of control, perform submittal review and approval, ensure testing is performed and provide QC certifications and documentation required in this Contract. The QC Manager is responsible for managing and coordinating the three phases of control and documentation performed by testing laboratory personnel and any other inspection and testing personnel required by this Contract. The QC Manager is the manager of all QC activities.

#### 1.6.2.2 Qualifications

The QC Manager must be an individual with a minimum of 5 years combined relevant experience in the following positions: Project Superintendent, QC Manager, Project Manager, Project Engineer or Construction Manager on similar size and type construction Contracts which included the major trades that are part of this Contract. The individual must have at least 2 years experience as a QC Manager. The individual must be familiar with the requirements of EM 385-1-1 and have experience in the areas of hazard identification, safety compliance, and sustainability.

The QC Manager must possess at least a Bachelor's degree in engineering, architecture, or construction management, with a minimum of 5 years dredging experience as a Project Superintendent, QC Manager, Project Manager, Project Engineer or Construction Manager on similar size and type construction work that are part of this Contract. The individual must have at least 2 years experience as a QC Manager. This experience shall include work in environments with similar dredging conditions and compliance with environmental requirements and federal and state permits.

The individual must be familiar with the requirements of EM 385-1-1 and

have experience in the areas of hazard identification, safety compliance, and sustainability.

The QC Manager and all members of the QC organization must be capable of reading, writing, and conversing fluently in the English language.

#### 1.6.2.3 Construction Quality Management Training

In addition to the above experience and education requirements, the QC Manager and all members of the QC team must have completed the CQM for Contractors course. If the QC Manager does not have a current certification, obtain the CQM for Contractors course certification within 90 days of award. This course is periodically offered by the Naval Facilities Engineering Systems Command and the Army Corps of Engineers. Contact the Contracting Officer for information on the next scheduled class.

The Construction Quality Management Training certificate expires after 5 years. If the QC Manager's certificate has expired, retake the course to remain current.

#### 1.6.2.4 Quality Control Requirements for Multiple Work Sites

Provide separate full-time QC Managers at the work sites listed below. Provide a separate full-time QC Manager at the following work sites:

a. Hopper Dredge

b. Beach Placement site as indicated on the plans

The QC Managers for the work sites listed above are each responsible for implementing and managing the QC Program at the designated work site. They must perform the three phases of control, perform submittal review, ensure testing is performed, and prepare QC certifications and documentation required by this Contract. The qualification requirements for the QC Managers at each site are listed in the paragraph QUALIFICATIONS.

### 1.6.3 Organizational Changes

Maintain the QC staff with personnel as required by the specification section at all times. When it is necessary to make changes to the QC staff, revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

## 1.7 SUBMITTAL AND DELIVERABLES REVIEW AND APPROVAL

Procedures for submission, review and approval of submittals are described in Section 01 33 00 SUBMITTAL PROCEDURES. Procedures must include field verification of relevant dimensions and component characteristics by the QC organization prior to submittal being sent to the Contracting Officer. The CQC organization is responsible for certifying that all submittals and deliverables are in compliance with the Contract.

## 1.8 THREE PHASES OF CONTROL

CQC enables the Contractor to ensure that the construction, including that of subcontractors and suppliers, complies with the requirements of the Contract. At least three phases of control must be conducted by the QC

Manager to adequately cover both on-site and off-site work for each definable feature of the construction work as follows:

1.8.1 Preparatory Phase

Document the results of the preparatory phase actions by separate minutes prepared by the QC Manager and attach to the daily CQC report. Instruct applicable workers as to the acceptable level of workmanship required to meet Contract specifications.

Notify the Contracting Officer at least 2 business days in advance of each preparatory phase meeting. The meeting will be conducted by the QC Manager and attended by the Project Superintendent, and the foreman responsible for the DFOW. When the DFOW will be accomplished by a subcontractor, that subcontractor's foreman must attend the preparatory phase meeting. This phase is performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. Perform the following prior to beginning work on each DFOW:

a. Review each paragraph of the applicable specification sections, reference codes, and standards. Make available during the prepatory inspection a copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field. Maintain and make available in the field for use by Government personnel until final acceptance of the work.

b. Review the Contract drawings.

c. Verify that field measurements are as indicated on construction or shop drawings or both before confirming product orders, to minimize waste due to excessive materials.

d. Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required.

e. Review the testing plan and ensure that provisions have been made to provide the required QC testing.

f. Examine the work area to ensure that the required preliminary work has been completed and complies with the Contract and ensure any deficiencies/rework items in the preliminary work have been corrected and confirmed by the Contracting Officer.

g. Review coordination of product/material delivery to designated prepared areas to execute the work.

h. Examine the required materials, equipment and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data and are properly stored.

i. Check to assure that all materials and equipment have been tested, submitted, and approved.

j. Discuss specific controls to be used, construction methods, construction tolerances, workmanship standards, and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each DFOW. Ensure any portion of

the plan requiring separate Contracting Officer acceptance has been approved.

k. Review the APP and appropriate Activity Hazard Analysis (AHA) to ensure that applicable safety requirements are met, and that required Safety Data Sheets (SDS) are submitted.

l. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

m. Discuss schedule and execution of the initial control phase and confirmation or construction quality compliance.

1.8.2 Initial Phase

Notify the Contracting Officer at least 2 business days in advance of each initial phase. When construction crews are ready to start work on a DFOW, conduct the initial phase with the Project Superintendent, and the foreman responsible for that DFOW. Observe the initial segment of the DFOW to ensure that the work complies with Contract requirements. Document the results of the initial phase in the daily CQC Report and in the Initial Phase Checklist. Repeat the initial phase for each new crew to work on-site when acceptable levels of specified quality are not being met. Indicate the exact location of initial phase for definable feature of work for future reference and comparison with follow-up phases. Perform the following for each DFOW:

a. Check work to ensure that it is in full compliance with Contract requirements. Review minutes of the preparatory meeting.

b. Verify adequacy of controls to ensure full Contract compliance. Verify required control inspection and testing comply with the Contract.

c. Establish level of workmanship and verify that it meets the minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

d. Resolve any workmanship issues.

e. Ensure that testing is performed by the approved laboratory.

f. Check work procedures for compliance with the APP and the appropriate AHA to ensure that applicable safety requirements are met.

g. Review project specific work plans (i.e., HAZMAT Abatement, Stormwater Management) to ensure all preparatory work items have been completed and documented.

1.8.3 Follow-Up Phase

Perform the following for on-going DFOW daily, or more frequently as necessary, until the completion of each DFOW. The Final Follow-Up for any DFOW will clearly note in the daily report the DFOW is completed, and all deficiencies/rework items have been completed in accordance with the paragraph DEFICIENCY/REWORK ITEMS LIST. Each DFOW that has completed the Initial Phase and has not completed the Final Follow-up must be included

on each daily report. If no work was performed on that DFOW for the period of that daily report, it must be so noted. Document all Follow-Up activities for DFOWs in the daily CQC Report:

a. Ensure the work including control testing complies with Contract requirements until completion of that particular work feature. Record checks in the CQC documentation.

b. Maintain the quality of workmanship required.

c. Ensure that testing is performed by the approved laboratory.

d. Ensure that deficiencies/rework items are being corrected. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of work which may be affected by the deficient work.

e. Do not build upon nor conceal non-conforming work.

f. Assure manufacturers' representatives have performed necessary inspections if required and perform safety inspections.

1.8.4 Additional Preparatory and Initial Phases

Conduct additional preparatory and initial phases on the same DFOW if the quality of on-going work is unacceptable, if there are changes in the applicable QC organization, if there are changes in the on-site production supervision or work crew, if work on a DFOW has not started within 45 days of the initial preparatory meeting or has resumed after 45 days of inactivity, or if other problems develop.

1.8.5 Notification of Three Phases of Control for Off-Site Work

Notify the Contracting Officer at least 2 weeks prior to the start of the preparatory and initial phases.

1.8.6 Deficiency/Rework Items List

The QC Manager must maintain a list of work that does not comply with the Contract, identifying what items need to be corrected, the activity ID number associated with the item, the date the item was originally discovered, the date the item will be corrected by, and the date the item was corrected.

The QC Manager reviews the list at each weekly QC Meeting:

a. There is no requirement to report a deficiency/rework item that is corrected the same day it is discovered.

b. No successor task may be advanced beyond the preparatory phase meeting until all deficiencies/rework items have been cleared by the QC Manager and concurred with by the Contracting Officer. This must be confirmed as part of the Preparatory Phase activities.

c. Attach a copy of the "Deficiency/Rework Items List" to the last daily CQC Report of each month.

d. The Contractor is responsible for including those items identified by the Contracting Officer.

e. All deficiencies/rework items must be confirmed as corrected by the QC Manager, and concurred by the Contracting Officer, prior to commencement of any completion inspections per paragraph COMPLETION INSPECTIONS unless specifically exempted by the Contracting Officer.

f. Non-Compliance with these requirements is grounds for removal in accordance with paragraph ACCEPTANCE OF THE QUALITY CONTROL (QC) PLAN.

g. All delays, concurrent or related to failure to manage, monitor, control, and correct deficiencies/rework items are entirely the responsibility of the Contractor and can not be made the subject, or any component of any request for additional time or compensation.

## 1.9 TESTING

Perform specified or required tests to verify that control measures are adequate to provide a product which conforms to Contract requirements. Upon request, furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and acceptance tests when specified. Procure the services of an U.S. Army Corps of Engineers approved testing laboratory or establish an approved testing laboratory at the project site or within 250 miles. Perform the following activities and record and provide the following data:

a. Verify that testing procedures comply with Contract requirements.

b. Verify that facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.

d. Verify that recording forms and test identification control number system, including all test documentation requirements, have been prepared.

e. Record results of all tests taken, both passing and failing on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test. If approved by the Contracting Officer, actual test reports are submitted later with a reference to the test number and date taken. Provide an information copy of tests performed by an offsite or commercial test facility directly to the Contracting Officer. Failure to submit timely test reports as stated results in nonpayment for related work performed and disapproval of the test facility for this Contract.

### 1.9.1 Laboratory Accreditation Authorities

All testing laboratories must be validated by the USACE Material Testing Center (MTC) for the tests to be performed. Information on the USACE MTC with web-links to both a list of validated testing laboratories and for the laboratory inspection request for can be found at: https://mtc.erdc.dren.mil

### 1.9.2 Capability Check

The Contracting Officer retains the right to check laboratory equipment in the proposed laboratory and the laboratory technician's testing

procedures, techniques, and other items pertinent to testing, for compliance with the standards set forth in this Contract. Laboratories utilized for testing soils, concrete, asphalt, and steel must meet criteria detailed in ASTM D3740 and ASTM E329.

## 1.10 COMPLETION INSPECTIONS

### 1.10.1 Punch-Out Inspection

Near the completion of all work or any increment thereof, established by a completion time stated in the Contract Clause entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the QC Manager must conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved drawings, specifications, and Contract. Include in the punch list any remaining items on the "Deficiency/Rework Items List", that were not corrected prior to the Punch-Out Inspection as approved by the Contracting Officer in accordance with the paragraph DEFICIENCY/REWORK ITEMS LIST. Include within the punch list the estimated date by which the deficiencies will be corrected. Provide a copy of the punch list to the Contracting Officer.

The QC Manager, or staff, must make follow-on inspections to ascertain that all deficiencies have been corrected. All punch list items must be confirmed as corrected by the QC Manager and concurred by the Contracting Officer. Once this is accomplished, notify the Government that the facility is ready for the Government "Pre-Final Inspection".

### 1.10.2 Pre-Final Inspection

The Government and QC Manager will perform this inspection to verify that the facility is complete and ready to be occupied. A Government "Pre-Final Punch List" will be documented by the QC Manager as a result of this inspection. The QC Manager will ensure that all items on this list are corrected and concurred by the Contracting Officer prior to notifying the Government that a "Final" inspection with the Client can be scheduled. All items noted on the "Pre-Final" inspection must be corrected and concurred by the Contracting Officer in a timely manner and be accomplished before the Contract completion date for the work, or any increment thereof, if the project is divided into increments by separate completion dates unless exceptions are directed by the Contracting Officer.

### 1.10.3 Final Acceptance Inspection

Notify the Contracting Officer at least 14 calendar days prior to the date a final acceptance inspection can be held. State within the notice that all items previously identified on the pre-final punch list will be corrected and acceptable, along with any other unfinished Contract work, by the date of the final acceptance inspection. The Contractor must be represented by the QC Manager, the Project Superintendent, and others deemed necessary. Attendees for the Government will include the Contracting Officer, other Government QA personnel, and personnel representing the Client. Failure of the Contractor to have all Contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the Contract Clause entitled "Inspection of Construction."

## 1.11 QUALITY CONTROL (QC) CERTIFICATIONS

### 1.11.1 Contractor Quality Control (CQC) Report Certification

Contain the following statement within the CQC Report: "On behalf of the Contractor, I certify that this report is complete and correct and equipment and material used, and work performed during this reporting period is in compliance with the Contract drawings and specifications to the best of my knowledge, except as noted in this report."

### 1.11.2 Completion Certification

Upon completion of work under this Contract, the QC Manager must furnish a certificate to the Contracting Officer attesting that "the work has been completed, inspected, tested and is in compliance with the Contract." Provide a copy of this final QC Certification for completion to the preparer of the Operation & Maintenance (O&M) documentation.

## 1.12 DOCUMENTATION AND INFORMATION FOR THE CONTRACTING OFFICER

Maintain current and complete records of on-site and off-site QC program operations and activities.

Contact the Contracting Officer for sample forms or print from RMS-QCS as needed. Prior to commencing work on construction, the Contractor must obtain a copy set of the current report forms. The report forms will consist of the Contractor Quality Control (CQC) Report, CQC Report (Continuation Sheet), Contractor Production Report, Contractor Production Report (Continuation Sheet), Preparatory Phase Checklist, Initial Phase Checklist, Testing Plan and Log, and Rework Items List. Unless otherwise provided by the Contracting Officer, Contractor may use the forms provided as related material located at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-01-45-00.

### 1.12.1 Construction Documentation

Reports are required for each day that work is performed and must be attached to the Contractor Quality Control Report prepared for the same day. Maintain current and complete records of on-site and off-site QC program operations and activities. Reports are required for each day work is performed. Account for each calendar day throughout the life of the Contract.

The Project Superintendent and the QC Manager must prepare and sign the Contractor Production and CQC Reports, respectively. Every space on the forms must be filled in. Use N/A if nothing can be reported in one of the spaces. The reporting of work must be identified by terminology consistent with the construction schedule. In the "Remarks" sections of the reports, enter pertinent information including directions received, problems encountered during construction, work progress and delays, conflicts or errors in the drawings or specifications, field changes, safety hazards encountered, instructions given and corrective actions taken, delays encountered, a record of visitors to the work site, quality control problem areas, deviations from the QC Plan, construction deficiencies encountered, and meetings held. For each entry in the report(s), identify the Schedule Activity No. that is associated with the entered remark.

### 1.12.2 Quality Control Activities

CQC and Contractor Production reports will be prepared daily to maintain current records providing factual evidence that required quality control activities and tests have been performed. Include in these records the work of subcontractors and suppliers on an acceptable form that includes, as a minimum, the following information:

a. The name and area of responsibility of the Contractors and any subcontractors.

b. Operating plant/equipment with hours worked, idle, or down for repair.

c. Work performed each day, giving location, description, and by whom. When a Network Analysis Schedule (NAS) is used, identify each item of work performed each day by NAS activity number.

d. Control phase activities performed. Preparatory, and Initial phase Checklists associated with the DFOW referenced to the construction schedule. Follow-up phase activities identified to the DFOW. If testing or specific QC Specialist activities are associated with the Follow-up phase activities for a specific DFOW note this and include those reports.

e. Test and control activities performed with results and references to specifications and drawings requirements. Identify the control phase (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action in accordance with the paragraph DEFICIENCY/REWORK ITEMS LIST.

f. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications and drawings requirements.

g. Submittals and deliverables reviewed, with Contract reference, by whom, and action taken.

h. Offsite surveillance activities, including actions taken.

i. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

j. Instructions given/received and conflicts in plans and specifications.

### 1.12.3 E-Verify Program

Indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. Cover both conforming and deficient features and include a statement that equipment and materials incorporated in the work and workmanship comply with the Contract.

Furnish the original and one copy of these records in report form to the Government by 10:00 AM the next working day after the date covered by the report. As a minimum, prepare and submit one report for every 7 days of no work and on the last day of a no work period. All calendar days need to be accounted for throughout the life of the Contract. The first report following a day of no work will be for that day only. Reports need to be signed and dated by the QC Manager. Include copies of test reports and

copies of reports prepared by all subordinate quality control personnel within the QC Manager Report.

1.12.4 Quality Control Validation

Establish and maintain the following in an electronic folder. Divide folder into a series of tabbed sections as shown below. Ensure folder is updated at each required progress meeting.

a. CQC Meeting minutes in accordance with paragraph QUALITY CONTROL (QC) MEETINGS.

b. All completed Preparatory and Initial Phase Checklists, arranged by specification section, further sorted by DFOW referenced to the construction schedule. Submit each individual Phase Checklist the day the phase event occurs as part of the CQC daily report.

c. All milestone inspections, arranged by Activity Number referenced to the construction schedule.

d. Copies of all Contract modifications, arranged in numerical order. Also include documentation that modified work was accomplished.

e. An up-to-date copy of the paragraph DEFICIENCY/REWORK ITEMS LIST.

f. Upon commencement of Completion Inspections of the entire project or any defined portion, maintain up-to-date copies of all punch lists issued by the QC staff to the Contractor and subcontractors and all punch lists issued by the Government in accordance with the paragraph COMPLETION INSPECTIONS.

1.12.5 As-Built Drawings

The QC Manager must ensure the as-built drawings, required by Section 01 78 00 CLOSEOUT SUBMITTALS are kept current on a daily basis and marked to show deviations which have been made from the Contract drawings. The as-built drawings document commences with the QC Manager ensuring all amendments, or changes to the Contract prior to Contract award are accurately noted in the initial document set creating the accurate baseline of the Contract prior to any work starting. Ensure each deviation has been identified with the appropriate modifying documentation (e.g., PC No., Modification No., Request for Information No.). The QC Manager must initial each revision. Upon completion of work, the QC Manager will furnish a certificate attesting to the accuracy of the as-built drawings prior to submission to the Contracting Officer.

1.13 NOTIFICATION ON NON-COMPLIANCE

The Contracting Officer will notify the Contractor of any detected non-compliance with the Contract. Take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, is deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders will be made the subject of a claim for extension of time for excess costs or damages by the Contractor.

## 1.14 DELIVERY, STORAGE, AND HANDLING

Designate receiving/storage areas for incoming material to be delivered according to installation schedule and to be placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. Store and handle materials in a manner as to prevent loss from weather and other damage. Keep materials, products, and accessories covered and off the ground, and store in a dry, secure area. Prevent contact with material that may cause corrosion, discoloration, or staining. Protect all materials and installations from damage by the activities of other trades.

# PART 2 PRODUCTS

Not Used

# PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 45 00.15 10

RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM)
**11/23**

# PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| EM 385-1-1 | (2024) Safety -- Safety and Occupational Health (SOH) Requirements |

## 1.2 MEASUREMENT AND PAYMENT

The work of this section is not measured for payment. The Contractor is responsible for the work of this section, without any direct compensation other than the payment received for contract items.

## 1.3 CONTRACT ADMINISTRATION

The Government will use the Resident Management System (RMS) to assist in its monitoring and administration of this contract. The Government accesses the system using the Government Mode of RMS (RMS GM) and the Contractor accesses the system using the Contractor Mode (RMS CM). The term RMS will be used in the remainder of this section for both RMS GM and RMS CM. The joint Government-Contractor use of RMS facilitates electronic exchange of information and overall management of the contract. The Contractor accesses RMS to record, maintain, input, track, and electronically share information with the Government throughout the contract period in the following areas:

Administration
Finances
Quality Control
Submittal Monitoring
Scheduling
Closeout
Import/Export of Data

### 1.3.1 Correspondence and Electronic Communications

For ease and speed of communications, exchange correspondence and other documents in electronic format to the maximum extent feasible. Some documents such as correspondence, including pay requests and payrolls, may be required in paper format with original signatures. Paper documents will govern in the event of discrepancy with the electronic version. Contracting Officer will determine which documents require submission of paper copies.

### 1.3.2 Other Factors

Other portions of this document have a direct relationship to the

reporting accomplished through RMS. Particular attention is directed to FAR 52.236-15 Schedules for Construction Contracts; FAR 52.232-27 Prompt Payment for Construction Contracts; FAR 52.232-5 Payments Under Fixed-Priced Construction Contracts; Section 01 32 01.00 10 PROJECT SCHEDULE; Section 01 33 00 SUBMITTAL PROCEDURES; Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS; and Section 01 45 00 QUALITY CONTROL.

## 1.4 RMS SOFTWARE

RMS is a web based application. Download, install and be able to utilize the latest version of RMS within 7 calendar days of receipt of the Notice to Proceed. RMS software, user manuals, access and installation instructions, program updates and training information are available from the RMS website (https://rms.usace.army.mil). The Government and the Contractor will have different access authorities to the same contract database through RMS. The common database will be updated automatically each time a user finalizes an entry or change.

## 1.5 CONTRACT DATABASE - GOVERNMENT

The Government will enter the basic contract award data in RMS prior to granting the Contractor access. The Government entries into RMS will generally be related to submittal reviews, correspondence status, and Quality Assurance(QA)comments, as well as other miscellaneous administrative information.

## 1.6 CONTRACT DATABASE - CONTRACTOR

Contractor entries into RMS establish, maintain, and update data throughout the duration of the contract. Contractor entries generally include prime and subcontractor information, daily reports, submittals, RFI's, schedule updates and payment requests. RMS includes the ability to import attachments and export reports in many of the modules, including submittals. The Contractor responsibilities for entries in RMS typically include the following items:

### 1.6.1 Administration

#### 1.6.1.1 Contractor Information

Enter all current Contractor administrative data and information into RMS within 7 calendar days of receiving access to the contract in RMS. This includes, but is not limited to, Contractor's name, address, telephone numbers, management staff, and other required items.

#### 1.6.1.2 Subcontractor Information

Enter all missing subcontractor administrative data and information into RMS CM within seven calendar days of receiving access to the Contract in RMS or within seven calendar days of the signing of the subcontractor agreement for agreements signed at a later date. This includes name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor is listed separately for each trade to be performed.

#### 1.6.1.3 Correspondence

Identify all Contractor correspondence to the Government with a serial number. Prefix correspondence initiated by the Contractor's site office

with "S". Prefix letters initiated by the Contractor's home (main) office with "H". Letters are numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C" or "RFP".

1.6.1.4 Equipment

Enter and maintain a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates in accordance with Section 01 45 00 QUALITY CONTROL.

1.6.1.5 Reports

Track the status of the project using the reports available in RMS. The value of these reports reflects the quality of the data input. These reports include but are not limited to the Progress Payment Request worksheet, Quality Control (QC) comments, Deficiency Tracking Log, Submittal Register Status, and Three-Phase Control worksheets in accordance with Sections 01 20 00 PRICE AND PAYMENT PROCEDURES, Section 01 32 01.00 10 PROJECT SCHEDULE, 01 33 00 SUBMITTAL PROCEDURES, and 01 45 00 QUALITY CONTROL.

1.6.1.6 Request For Information (RFI)

Create and track all Requests For Information (RFI) in the RMS Administration Module for Government review and response. Provide status at weekly progress meeting in accordance with Section 01 32 01.00 10 PROJECT SCHEDULE.

1.6.2 Finances

1.6.2.1 Pay Activity Data

Develop and enter a list of pay activities in conjunction with the project schedule in accordance with Section 01 32 01.00 10 PROJECT SCHEDULE. The sum of pay activities equals the total Contract amount, including modifications. Each pay activity must be assigned to a Contract Line Item Number (CLIN). The sum of the activities assigned to a CLIN equals the amount of each CLIN.

1.6.2.2 Payment Requests

Prepare all progress payment requests using RMS. Update the work completed under the Contract at least monthly, measured as percent or as specific quantities. After the update, generate a payment request and prompt payment certification using RMS. Submit the signed prompt payment certification and payment request as well as supporting data, either electronically or by hard copy.

1.6.3 Quality Control (QC)

Enter and track implementation of the 3-phase QC Control System, QC testing, transferred and installed property and warranties in RMS. Link each deficiency and QC test to a pay activity. Prepare daily reports, identify and track deficiencies, document progress of work, and support other Contractor QC requirements in RMS. Maintain all data on a daily basis. Ensure that RMS reflects all quality control methods, tests and actions contained within the Contractor Quality Control (CQC) Plan and Government review comments. Provide within seven calendar days of

Government acceptance of the CQC Plan.

1.6.3.1 Quality Control (QC) Reports

The Contractor's Quality Control (QC) Daily Report in RMS is the official report. The Contractor can use other supplemental formats to record QC data, but information from any supplemental formats are to be consolidated and entered into the RMS QC Daily Report. Any supplemental information may be entered into RMS as an attachment to the report. QC Daily Reports must be finalized and signed in RMS within 24 hours after the date covered by the report.

1.6.3.2 Deficiency Tracking

Use the QC Daily Report Module to enter and track deficiencies. Deficiencies identified and entered into RMS by the Contractor or the Government will be sequentially numbered with a QC or QA prefix for tracking purposes. Enter each deficiency into RMS the same day that the deficiency is identified. Monitor, track and resolve all QC and QA entered deficiencies. A deficiency is not considered to be corrected until the Government indicates concurrence in RMS.

1.6.3.3 Three-Phase Control Meetings

Maintain scheduled and actual dates and times of preparatory and initial control meetings in RMS, and upload meeting minutes of the meetings. Worksheets for the three-phase control meetings are generated within RMS.

1.6.3.4 Labor and Equipment Hours

Enter labor and equipment exposure hours on a daily basis. Roll up the labor and equipment exposure data into a monthly exposure report.

1.6.3.5 Accident/Safety Reporting

Both the Contractor and the Government enter safety related comments in RMS as a deficiency. The Contractor must monitor, track and show resolution for safety issues in the QC Daily Report area of the RMS QC Module. In addition, follow all reporting requirements for accidents and incidents as required in EM 385-1-1, Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS and as required by any other applicable Federal, State or local agencies.

1.6.3.6 Definable Features of Work

Enter each feature of work, as defined in the approved CQC Plan, into the RMS QC Module. A feature of work may be associated with a single or multiple pay activities, however a pay activity is only to be linked to a single feature of work.

1.6.3.7 Activity Hazard Analysis

Import activity hazard analysis electronic document files into the RMS QC Module utilizing the document package manager. Prepare activity hazard analysis in accordance with Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS.

### 1.6.4 Submittal Management

Enter all current submittal register data and information into RMS within seven calendar days of receiving access to the Contract in RMS. The Contractor is responsible for entering Activity Numbers for each submittal item corresponding to their Schedule. Group electronic submittal documents into transmittal packages to send to the Government, except very large electronic files, samples, spare parts, mock ups, color boards, or where hard copies are specifically required. Track transmittals and update the submittal register in RMS on a daily basis throughout the duration of the Contract.

Enter all submittals as listed in the approved design's submittal register within 14 calendar days of design approval for construction.

Contractor may request submittals to be added to RMS throughout the lifecycle of the project. Approval/disapproval of Contractor requests is at the discretion of the Contracting Officer. Submittals entry into RMS must be updated daily or as practical for performance of the Contract, as approved by the Contracting Officer.

### 1.6.5 Schedule

Enter and update the contract project schedule in RMS by either manually entering all schedule data or by importing the Standard Data Exchange Format (SDEF) file, based on the requirements in Section 01 32 01.00 10 PROJECT SCHEDULE.

### 1.6.6 Closeout

Closeout documents, processes and forms are managed and tracked in RMS by both the Contractor and the Government. Ensure that all closeout documents are entered, completed and documented within RMS.

## 1.7 IMPLEMENTATION

Use of RMS as described in the preceding paragraphs is mandatory. Ensure that sufficient resources are available to maintain contract data within the RMS system. RMS is an integral part of the Contractor's required management of quality control.

## 1.8 NOTIFICATION OF NONCOMPLIANCE

Take corrective action within seven calendar days after receipt of notice of RMS non-compliance by the Contracting Officer.

# PART 2 PRODUCTS

Not Used

# PART 3 EXECUTION

Not Used

-- End of Section --

# SECTION 01 50 00

# TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS
**11/20, CHG 2: 08/22**

## PART 1 GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2023; ERTA 7 2023; TIA 23-15) National Electrical Code |
| NFPA 241 | (2022) Standard for Safeguarding Construction, Alteration, and Demolition Operations |

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| EM 385-1-1 | (2024) Safety -- Safety and Occupational Health (SOH) Requirements |

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

| | |
|---|---|
| MUTCD | (2009; Rev 2012) Manual on Uniform Traffic Control Devices |

### 1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Construction Site Plan; G

Traffic Control Plan; G

Contractor Computer Cybersecurity Compliance Statements; G

Contractor Temporary Network Cybersecurity Compliance Statements; G

### 1.3 CONSTRUCTION SITE PLAN

Prior to the start of work, submit for Government approval a site plan showing the locations and dimensions of temporary facilities (including layouts and details, equipment and material storage area (onsite and offsite), and access and haul routes, avenues of ingress/egress to the fenced area and details of the fence installation. Identify any areas

which may have to be graveled to prevent the tracking of mud. Indicate if the use of a supplemental or other staging area is desired. Show locations of safety and construction fences, site trailers, construction entrances, trash dumpsters, temporary sanitary facilities, and worker parking areas.

### 1.3.1 Identification of Employees

The Contractor shall be responsible for furnishing to each employee and for requiring each employee engaged on the work to display identification as approved and directed by the Contracting Officer. Prescribed identification shall immediately be delivered to the Contracting Officer for cancellation upon release of any employee. When required, the Contractor shall obtain and provide fingerprints of persons employed on the project. Contractor and subcontractor personnel shall wear identifying markings on hard hats clearly identifying the company for whom the employee works.

### 1.3.2 Site Transportation

The Contractor shall provide means of waterborne transportation from a designated land location to the area of work. The Contractor shall submit the location and contact information of the personnel charged with providing said transportation for government approval at the preconstruction meeting. The means of transportation and operator shall be made available during any time the contractor is working.

## 1.4 DOD CONDITION OF READINESS (COR)

DOD will set the Condition of Readiness (COR) based on the weather forecast for sustained winds 50 knots (58 mph) or greater. Contact the Contracting Officer for the current COR setting.

Monitor weather conditions a minimum of twice a day and take appropriate actions according to the approved Emergency Plan in the accepted Accident Prevention Plan, EM 385-1-1 Emergency Plan requirements and the instructions below.

Unless otherwise directed by the Contracting Officer, comply with:

a. Condition FOUR (Sustained winds of 58 mph or greater expected within 72 hours): Normal daily jobsite cleanup and good housekeeping practices. Collect and store in piles or containers scrap lumber, waste material, and rubbish for removal and disposal at the close of each work day. Maintain the construction site including storage areas, free of accumulation of debris. Stack form lumber in neat piles less than 3.3 feet high. Remove all debris, trash, or objects that could become missile hazards. Review requirements pertaining to "Condition THREE" and continue action as necessary to attain "Condition FOUR" readiness. Contact Contracting Officer for weather and COR updates and completion of required actions.

b. Condition THREE (Sustained winds of 58 mph or greater expected within 48 hours): Maintain "Condition FOUR" requirements and commence securing operations necessary for "Condition ONE" which cannot be completed within 18 hours. Cease all routine activities which might interfere with securing operations. Commence securing and stow all gear and portable equipment. Make preparations for securing buildings. Reinforce or remove formwork and scaffolding. Secure machinery, tools, equipment, materials, or remove from the jobsite.

Expend every effort to clear all missile hazards and loose equipment from general base areas. Contact Contracting Officer for weather and COR updates and completion of required actions. Review requirements pertaining to "Condition TWO" and continue action as necessary to attain "Condition THREE" readiness.

c. Condition TWO (Sustained winds of 58 mph or greater expected within 24 hours): Secure the jobsite, and leave Government premises.

d. Condition ONE. (Sustained winds of 58 mph or greater expected within 12 hours): Contractor access to the jobsite and Government premises is prohibited.

## 1.5 CYBERSECURITY DURING CONSTRUCTION

Meet the following requirements throughout the construction process.

### 1.5.1 Contractor Computer Equipment

Contractor owned computers may be used for construction. When used, contractor computers must meet the following requirements:

#### 1.5.1.1 Operating System

The operating system must be an operating system currently supported by the manufacturer of the operating system. The operating system must be current on security patches and operating system manufacturer required updates.

#### 1.5.1.2 Anti-Malware Software

The computer must run anti-malware software from a reputable software manufacturer. Anti-malware software must be a version currently supported by the software manufacturer, must be current on all patches and updates, and must use the latest definitions file. All computers used on this project must be scanned using the installed software at least once per day.

#### 1.5.1.3 Passwords and Passphrases

The passwords and passphrases for all computers must be changed from their default values. Passwords must be a minimum of eight characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

#### 1.5.1.4 Contractor Computer Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Computer Cybersecurity Compliance Statements for each company using contractor owned computers. Contractor Computer Cybersecurity Compliance Statements must use the template published at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-01-50-00. Each Statement must be signed by a cybersecurity representative for the relevant company.

### 1.5.2 Temporary IP Networks

Temporary contractor-installed IP networks may be used during construction. When used, temporary contractor-installed IP networks must

meet the following requirements:

#### 1.5.2.1 Network Boundaries and Connections

The network must not extend outside the project site and must not connect to any IP network other than IP networks provided under this project or Government furnished IP networks provided for this purpose. Any and all network access from outside the project site is prohibited.

### 1.5.3 Government Access to Network

Government personnel, as defined, prescribed, and identified by the Contracting Officer, must be allowed to have complete and immediate access to the network at any time in order to verify compliance with this specification. Or if there is a Government agency that's responsible, identify that agency.

### 1.5.4 Temporary Wireless IP Networks

In addition to the other requirements on temporary IP networks, temporary wireless IP (WiFi) networks must not interfere with existing wireless network and must use WPA2 security. Network names (SSID) for wireless networks must be changed from their default values.

### 1.5.5 Passwords and Passphrases

The passwords and passphrases for all network devices and network access must be changed from their default values. Passwords must be a minimum 8 characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

### 1.5.6 Contractor Temporary Network Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Temporary Network Cybersecurity Compliance Statements for each company implementing a temporary IP network. Contractor Temporary Network Cybersecurity Compliance Statements must use the template published at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-01-50-0 Each Statement must be signed by a cybersecurity representative for the relevant company. If no temporary IP networks will be used, provide a single copy of the Statement indicating this.

## PART 2 PRODUCTS

## 2.1 TEMPORARY SIGNAGE

### 2.1.1 Bulletin Board

Prior to the commencement of work activities, provide a clear weatherproof covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the Contract, Wage Rate Information poster, Safety and Health Information as required by EM 385-1-1 and other information approved by the Contracting Officer. Coordinate requirements herein with 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS. Locate the bulletin board at the project site in a conspicuous place easily accessible to all employees, and in location as approved by the Contracting Officer.

### 2.1.2 Project Identification Signs

The requirements for the signs, their content, and location are as indicated. Erect signs within 15 days after receipt of the notice to proceed. Correct the data required by the safety sign daily, with light colored metallic or non-metallic numerals.

### 2.1.3 Warning Signs

Post temporary signs, tags, and labels to give workers and the public adequate warning and caution of construction hazards according to the EM 385-1-1. Attach signs to the perimeter fencing every 150 feet warning the public of the presence of construction hazards. Signs must require unauthorized persons to keep out of the construction site. Correct the data required by safety signs daily. Post signs at all points of entry designating the construction site as a hard hat area.

## 2.2 TEMPORARY TRAFFIC CONTROL

### 2.2.1 Barricades

Erect and maintain temporary barricades to limit public access to hazardous areas. Barricades are required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

## 2.3 FENCING

Provide fencing along the construction site and at all open excavations and tunnels to control access by unauthorized personnel. Safety fencing must be highly visible to be seen by pedestrians and vehicular traffic. All fencing must meet the requirements of EM 385-1-1. Remove the fence upon completion and acceptance of the work.

### 2.3.1 Polyethylene Mesh Safety Fencing

Temporary safety fencing must be a high visibility orange colored, high density polyethylene grid, a minimum of 48 inches high and maximum mesh size of 2 inches. Fencing must extend from the grade to a minimum of 48 inches above the grade and be tightly secured to T-posts spaced as necessary to maintain a rigid and taut fence. Fencing must remain rigid and taut with a minimum of 200 pounds of force exerted on it from any direction with less than 4 inches of deflection.

See 35 20 24 BEACH FILL for additional guidance for pipeline safety on the beach.

### 2.3.2 Chain Link Panel Fencing

Temporary panel fencing must be galvanized steel chain link panels 6 feet high. Multiple fencing panels may be linked together at the bases to form long spans as needed. Each panel base must be weighted down using sand bags or other suitable materials in order for the fencing to withstand anticipated winds while remaining upright. Fencing must remain rigid and

taut with a minimum of 200 pounds of force exerted on it from any direction with less than 4 inches of deflection.

## 2.4 TEMPORARY WIRING

Provide temporary wiring in accordance with EM 385-1-1, NFPA 241 and NFPA 70. Include monthly inspection and testing of all equipment and apparatus.

# PART 3 EXECUTION

## 3.1 EMPLOYEE PARKING

Construction Contract employees must park privately owned vehicles in an area designated by the Contracting Officer.

## 3.2 AVAILABILITY AND USE OF UTILITY SERVICES

### 3.2.1 Temporary Utilities

Provide temporary utilities required for construction. Materials may be new or used, must be adequate for the required usage, not create unsafe conditions, and not violate applicable codes and standards.

### 3.2.2 Payment for Utility Services

a. The Contractor must provide their own utilities.

### 3.2.3 Sanitation

Provide and maintain within the construction area minimum field-type sanitary facilities in accordance with EM 385-1-1. Locate the facilities behind the construction fence or out of the public view. Clean units and empty wastes at least once a week or more frequently into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Obtain approval from the system owner prior to discharge into a municipal, district, or commercial sanitary sewer system. Penalties or fines associated with improper discharge will be the responsibility of the Contractor. Coordinate with the Contracting Officer and follow station regulations and procedures when discharging into the station sanitary sewer system. Maintain these conveniences at all times. Include provisions for pest control and elimination of odors. Government toilet facilities will not be available to Contractor's personnel.

### 3.2.4 Telephone

Make arrangements and pay all costs for telephone facilities desired.

### 3.2.5 Fire Protection

Provide temporary fire protection equipment for the protection of personnel and property during construction. Remove debris and flammable materials daily to minimize potential hazards.

## 3.3 TRAFFIC PROVISIONS

### 3.3.1 Maintenance of Traffic

a. Provide a Traffic Control Plan for Government approval detailing the

proposed controls to traffic movement for approval. The plan must be in accordance with State and local regulations and the MUTCD, Part VI. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the highway authority have been met.

b. Conduct work so as to minimize obstruction of traffic, and maintain traffic on at least half of the roadway width at all times. Obtain approval from the Contracting Officer prior to starting any activity that will obstruct traffic.

c. Provide, erect, and maintain, at Contractor's expense, lights, barriers, signals, passageways, detours, Life Safety Signage, overhead protection, and other items that may be required by the authority having jurisdiction.

d. Provide cones, signs, barricades, lights, or other traffic control devices and personnel required to control traffic. Do not use foil-backed material for temporary pavement marking because of its potential to conduct electricity during accidents involving downed power lines.

### 3.3.2 Protection of Traffic

Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment the work, and the erection and maintenance of adequate warning, danger, and direction signs, will be as required by the State and local authorities having jurisdiction. Provide self-illuminated (lighted) barricades during hours of darkness. All personnel working in roadways will wear brightly-colored vests or other high visibility apparel in accordance with EM 385-1-1. Protect the traveling public from damage to person and property. Minimize the interference with public traffic on roads selected for hauling material to and from the site. Investigate the adequacy of existing roads and their allowable load limit. Contractor is responsible for the repair of damage to roads caused by construction operations.

### 3.3.3 Dust Control

Dust control methods and procedures must be approved by the Contracting Officer. Coordinate dust control methods with 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS.

## 3.4 CONTRACTOR'S TEMPORARY FACILITIES

The Contractor is responsible for security of their property. Provide adequate outside security lighting at the temporary facilities. Trailers must be anchored to resist high winds and meet applicable state or local standards for anchoring mobile trailers. Coordinate anchoring with EM 385-1-1 Section 04. The Contract Clause entitled "FAR 52.236-10, Operations and Storage Areas" and the following apply:

### 3.4.1 Safety

Protect the integrity of any installed safety systems or personnel safety devices. If entrance into systems serving safety devices is required, the Contractor must obtain prior approval from the Contracting Officer. If it

is temporarily necessary to remove or disable personnel safety devices in order to accomplish contract requirements, provide alternative means of protection prior to removing or disabling any permanently installed safety devices or equipment and obtain approval from the Contracting Officer.

### 3.4.2 Administrative Field Offices

Provide and maintain administrative field office facilities within the construction area at the designated site. Government office and warehouse facilities will not be available to the Contractor's personnel.

### 3.4.3 Quality Control Manager Records and Field Office

Provide on the jobsite an office with approximately 200 square feet of useful floor area for the exclusive use of the QC Manager. Provide a weathertight structure with adequate heating and cooling, toilet facilities, lighting, ventilation, a 4 by 8 foot plan table, a standard size office desk and chair, computer station, and working communications facilities. Provide either a 1,500 watt radiant heater and a window-mounted air conditioner rated at 9,000 Btus minimum or a window-mounted heat pump of the same minimum heating and cooling ratings. Provide a door with a cylinder lock and windows with locking hardware. Make utility connections. Locate as directed and approved. File quality control records in the office and make available at all times to the Government. After completion of the work, remove the entire structure from the site.

### 3.4.4 Laydown and Staging Areas

Determine laydown and staging areas from the areas identified on the construction drawings. Additional laydown areas not shown on construction drawings may be considered upon approval from the Contracting Officer or COR. See 01 14 00 WORK RESTRICTIONS for details about Additional Laydown Areas Usage.

Laydown and staging areas shall not impact any wetlands and shall use the appropriate erosion and sediment control measures, per the latest edition of the Virginia Stormwater Management Handbook.

### 3.4.5 Appearance of Trailers

a. Trailers must be roadworthy and comply with all appropriate state and local vehicle requirements. Trailers which are rusted, have peeling paint or are otherwise in need of repair will not be allowed on Installation property. Trailers must present a clean and neat exterior appearance and be in a state of good repair.

b. Maintain the temporary facilities. Failure to do so will be sufficient reason to require their removal at the Contractor's expense.

### 3.4.6 Trailers or Storage Buildings

Trailers or storage buildings will be permitted, where space is available, subject to the approval of the Contracting Officer. The trailers or buildings shall be in good condition, free from visible damage rust and deterioration, and meet all applicable safety requirements. Trailers shall be roadworthy and comply with all appropriate state and local vehicle requirements. Failure to maintain storage trailers or buildings to these standards shall result in the removal of non-complying units at

the Contractor's expense. A sign not smaller than 24 by 24 inches shall be conspicuously placed on the trailer depicting the company name, business phone number, and emergency phone number. Trailers shall be anchored to resist high winds and must meet applicable state of local standards for anchoring mobile trailers.

3.4.7 Maintenance of Storage Area

a. Grassed or unpaved areas, which are not established roadways, will be covered with a layer of gravel as necessary or wooden dunnage for sandy areas to prevent rutting and the tracking of mud onto paved or established roadways, should the Contractor elect to traverse them with construction equipment or other vehicles; gravel gradation will be at the Contractor's discretion. Mow and maintain grass located within the boundaries of the construction site for the duration of the project. Grass and vegetation under trailers, and in areas not accessible to mowers will be edged or trimmed neatly.

b. Cut grass (or annual weeds) within the construction and storage sites to a maximum 4 inch height at least once every two weeks during the growing season unless the grass area is not visible to the public. Maintain grass or weeds on stockpiled earth as described above.

3.4.8 Security Provisions

Provide adequate outside security lighting at the Contractor's temporary facilities. The Contractor will be responsible for the security of its own equipment. In addition, the Contractor will notify the appropriate law enforcement agency and request periodic security checks of the temporary project field office.

3.4.9 Safety Systems

Protect the integrity of all installed safety systems or personnel safety devices. Obtain prior approval from the Contracting Officer if entrance into systems serving safety devices is required. If it is temporarily necessary to remove or disable personnel safety devices in order to accomplish Contract requirements, provide alternative means of protection prior to removing or disabling any permanently installed safety devices or equipment and obtain approval from the Contracting Officer.

3.4.10 Weather Protection of Temporary Facilities and Stored Materials

Take necessary precautions to ensure that roof openings and other critical openings in the building are monitored carefully. Take immediate actions required to seal off such openings when rain or other detrimental weather is imminent, and at the end of each workday. Ensure that the openings are completely sealed off to protect materials and equipment in the building from damage.

3.4.10.1 Building and Site Storm Protection

When a warning of gale force winds is issued, take precautions to minimize danger to persons, and protect the work and nearby Government property. Precautions must include, but are not limited to, closing openings; removing loose materials, tools and equipment from exposed locations; and removing or securing scaffolding and other temporary work. Close openings in the work when storms of lesser intensity pose a threat to the work or any nearby Government property.

3.4.10.2 Hurricane Condition of Readiness

Unless directed otherwise, comply with:

a. Condition FOUR (Sustained winds of 50 knots or greater expected within 72 hours): Normal daily jobsite cleanup and good housekeeping practices. Collect and store in piles or containers scrap lumber, waste material, and rubbish for removal and disposal at the close of each work day. Maintain the construction site including storage areas, free of accumulation of debris. Stack form lumber in neat piles less than 4 feet high. Remove all debris, trash, or objects that could become missile hazards. Contact Contracting Officer for Condition Requirements.

b. Condition THREE (Sustained winds of 50 knots or greater expected within 48 hours): Maintain "Condition FOUR" requirements and commence securing operations necessary for "Condition ONE" which cannot be completed within 18 hours. Cease all routine activities which might interfere with securing operations. Commence securing and stow all gear and portable equipment. Make preparations for securing buildings. Review requirements pertaining to "Condition TWO" and continue action as necessary to attain "Condition THREE" readiness. Contact Contracting Officer for weather and COR updates and completion of required actions.

3.5 GOVERNMENT FIELD OFFICE

3.5.1 Government Engineer's Office

1. Area Engineer's Personal Office: Approximately 200 square feet in floor area (1 person). Office includes executive:

   a. Two (2) chair.
   b. One (1) table that can accommodate at least Arch D size drawings (24" x36").
   c. One (1) computer chair.
   d. One (1) 3'x4' whiteboard.
   e. One (1) 3'x4' corkboard.
   f. One (1) trashcan.
   g. Adequate lighting for reviewing plans.

2. Conference Room: Approximately 300 square feet in floor area. (Flexible seating for up to 20 people). Include a video board of at least 60 inches for presentations and video conferencing. The Contractor will provide signage for the door, labeling the room as "Conference Room." Include a conference table and chairs.

3.5.1.1 Shared Amenities

1. Provide heat, air conditioning, lighting, power for a computer, Internet service, refrigerator, microwave, and a mail slot or lockable mailbox.

3.5.1.2 Temporary Facilities

Prior to the start of work, submit for Government approval a site plan showing the locations and dimensions of temporary facilities. Include

layouts, details, equipment and material storage areas (onsite and offsite), access and haul routes, avenues of ingress/egress to the fenced area, and details of the fence installation.

3.5.1.3 Sanitary Facilities

Provide adequate sanitary facilities, including portable toilets and handwashing stations, for Construction Contract employees at the project site. Locate the facilities as approved by the Contracting Officer.

3.5.1.4 Bulletin Board

Provide a bulletin board at the project site in a conspicuous place easily accessible to all employees, and in a location approved by the Contracting Officer. The bulletin board should be not less than 36 by 48 inches in size and weatherproof.

3.5.1.5 Site Plan

Prior to the start of work, submit for Government approval a site plan showing the locations and dimensions of temporary facilities. The site plan should be drawn to a suitable scale and include relevant details, as required by the Contracting Officer.

3.5.1.6 Utilities

Utilities must be connected and disconnected in accordance with local codes and to the satisfaction of the Contracting Officer. Compliance with safety and appearance requirements for temporary facilities stated in previous paragraphs is required.

3.5.1.7 Signage

1. Door Signage: The Contractor will provide signage for each office door, clearly labeling the title and the name of the occupant. Signage should be professional in appearance and easily readable.

2. Project Identification Signs: Erect signs within 15 days after receipt of the notice to proceed, as indicated in Section 2.1.2.

3. Warning Signs: Post temporary signs, tags, and labels to give workers and the public adequate warning and caution of construction hazards according to EM 385-1-1.

3.5.1.8 Internet Service and Equipment

Provide the following for setting up Communications in the Office:

a. Provide a High-Speed Business Internet line with Speeds of Up to 200 Mbps download and Up to 20 Mbps upload with connectivity brought into the dedicated communications room.

b. Provide router/modem to connect to the High Speed Business internet line with additional wireless access and a 24-port network switch to connect to the router/modem to provide additional ethernet ports for devices that need to be hardwired to have connection back to Norfolk District. This equipment will be located in the dedicated communications room

c. Provide a floor or wall mounted rack for IT equipment and adequate power, lighting and cooling for the room and a UPS backup power supply for IT equipment (minimum of 1500VA w/10 outlet).

d. Installed at each workstation shall be (2) Category 5e or Category 6 cables, unshielded twisted power (UTP) plenum rated 24 AWG extended frequency LAN cable (one for voice and one for data) to include two RJ45 and faceplate jacks.

e. All cable runs shall be continuous from the communications room to the workstation faceplate jack. Data cables shall be terminated to a patch panel rack that can hold 70-90 data lines in the communications room and all data cables shall be tested for Category 5e or Category 6 compliance with a cable test set. Any cables that fail testing shall be repaired or replaced and retested for compliance.

f. Voice cable shall be terminated on either "66" blocks or "110" blocks for 70-90 voice lines. All data and voice cabling shall be properly labeled at both ends of the wire and labeled on the face of the patch panel and the at a jack faceplate.

g. All communication outlets shall be terminated back to the communications room and tested for straight through connectivity.

#### 3.5.1.9 Janitorial Service

Janitorial service shall be provided twice a week to include vacuuming floors, dusting work areas, emptying trash, and cleaning the restrooms and kitchen. The Contractor is also responsible for maintaining a clean and neat exterior appearance at all times and providing lawn maintenance and grass cutting services once a week.

### 3.5.2 Trailer-Type Mobile Office

The option is available to, furnish and maintain a trailer-type mobile office acceptable to the Contracting Officer to meet the requirements of the minimum facilities specified above. Securely anchor the trailer to the ground at all four corners to guard against movement during high winds. Coordinate requirements for proper anchoring with EM 385-1-1 Section 04.

Compliance with safety and appearance requirements for temporary facilities stated in the previous paragraph is required.

### 3.5.3 Office Facilities at Project Completion

At completion of the project, the office will remain the property of the Contractor and be removed from the site.

## 3.6 PLANT COMMUNICATIONS

Whenever the individual elements of the plant are located so that operation by normal voice between these elements is not satisfactory, install a satisfactory means of communication, such as telephone or other suitable devices and make available for use by Government personnel.

## 3.7 TEMPORARY PROJECT SAFETY FENCING

As soon as practicable, but not later than 15 days after the date established for commencement of work, furnish and erect temporary project safety fencing at the work site. Maintain the safety fencing during the life of the Contract and, upon completion and acceptance of the work, remove from the work site.

## 3.8 CLEANUP

Remove construction debris, waste materials, packaging material and the like from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways must be cleaned away. Store all salvageable materials resulting from demolition activities within the fenced area described above or at the supplemental storage area. Neatly stack stored materials not in trailers, whether new or salvaged.

## 3.9 RESTORATION OF STORAGE AREA

Upon completion of the project remove the bulletin board, signs, barricades, haul roads, and all other temporary products from the site. After removal of trailers, materials, and equipment from within the fenced area, remove the fence. Restore areas used during the performance of the Contract to the original or better condition. Remove gravel used to traverse grassed areas and restore the area to its original condition, including top soil and seeding as necessary.

-- End of Section --

SECTION 01 57 19

TEMPORARY ENVIRONMENTAL CONTROLS
**08/22**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| EM 385-1-1 | (2024) Safety -- Safety and Occupational Health (SOH) Requirements |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

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| 29 CFR 1910.1200 | Hazard Communication |
| 40 CFR 68 | Chemical Accident Prevention Provisions |
| 40 CFR 112 | Oil Pollution Prevention |
| 40 CFR 241 | Guidelines for Disposal of Solid Waste |
| 40 CFR 243 | Guidelines for the Storage and Collection of Residential, Commercial, and Institutional Solid Waste |
| 40 CFR 258 | Subtitle D Landfill Requirements |
| 40 CFR 260 | Hazardous Waste Management System: General |
| 40 CFR 261 | Identification and Listing of Hazardous Waste |
| 40 CFR 262 | Standards Applicable to Generators of Hazardous Waste |
| 40 CFR 262.11 | Hazardous Waste Determination and Recordkeeping |
| 40 CFR 263 | Standards Applicable to Transporters of Hazardous Waste |
| 40 CFR 264 | Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities |
| 40 CFR 265 | Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities |
| 40 CFR 266 | Standards for the Management of Specific Hazardous Wastes and Specific Types of |

| | |
|---|---|
| | Hazardous Waste Management Facilities |
| 40 CFR 268 | Land Disposal Restrictions |
| 40 CFR 273.2 | Standards for Universal Waste Management - Batteries |
| 40 CFR 273.3 | Standards for Universal Waste Management - Pesticides |
| 40 CFR 273.4 | Standards for Universal Waste Management - Mercury Containing Equipment |
| 40 CFR 273.5 | Standards for Universal Waste Management - Lamps |
| 40 CFR 273.6 | Applicability - Aerosol Cans |
| 40 CFR 279 | Standards for the Management of Used Oil |
| 40 CFR 300 | National Oil and Hazardous Substances Pollution Contingency Plan |
| 40 CFR 300.125 | National Oil and Hazardous Substances Pollution Contingency Plan - Notification and Communications |
| 40 CFR 302 | Designation, Reportable Quantities, and Notification |
| 40 CFR 355 | Emergency Planning and Notification |
| 40 CFR 403 | General Pretreatment Regulations for Existing and New Sources of Pollution |
| 49 CFR 171 | General Information, Regulations, and Definitions |
| 49 CFR 172 | Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements |
| 49 CFR 173 | Shippers - General Requirements for Shipments and Packagings |
| 49 CFR 178 | Specifications for Packagings |

## 1.2 DEFINITIONS

### 1.2.1 Contractor Generated Hazardous Waste

Contractor generated hazardous waste is materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e., methyl ethyl ketone, toluene), waste thinners, excess paints, excess solvents, waste solvents, excess pesticides, and

contaminated pesticide equipment rinse water.

### 1.2.2 Environmental Pollution and Damage

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally or historically.

### 1.2.3 Environmental Protection

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

### 1.2.4 Hazardous Materials

Hazardous material is any material that: Is defined in 49 CFR 171, listed in 49 CFR 172, regulated as a hazardous material in accordance with 49 CFR 173; or requires a Safety Data Sheet (SDS) in accordance with 29 CFR 1910.1200; or during end use, treatment, handling, packaging, storage, transportation, or disposal meets or has components that meet or have potential to meet the definition of a hazardous waste as defined by 40 CFR 261 Subparts A, B, C, or D. Designation of a material by this definition, when separately regulated or controlled by other sections or directives, does not eliminate the need for adherence to that hazard-specific guidance which takes precedence over this section for "control" purposes. Such material includes ammunition, weapons, explosive actuated devices, propellants, pyrotechnics, chemical and biological warfare materials, medical and pharmaceutical supplies, medical waste and infectious materials, bulk fuels, radioactive materials, and other materials such as asbestos, mercury, and polychlorinated biphenyls (PCBs).

### 1.2.5 Hazardous Waste

Hazardous Waste is any material that meets the definition of a solid waste and exhibits a hazardous characteristic (ignitability, corrosivity, reactivity, or toxicity) as specified in 40 CFR 261, Subpart C, or contains a listed hazardous waste as identified in 40 CFR 261, Subpart D, or meets a state, local, or host nation definition of a hazardous waste.

### 1.2.6 Oily Waste

Oily waste are those materials that are, or were, mixed with Petroleum, Oils, and Lubricants (POLs) and have become separated from that POLs. Oily wastes also means materials, including wastewaters, centrifuge solids, filter residues or sludges, bottom sediments, tank bottoms, and sorbents which have come into contact with and have been contaminated by, POLs and may be appropriately tested and discarded in a manner which is in compliance with other state and local requirements.

This definition includes materials such as oily rags, "kitty litter" sorbent clay and organic sorbent material. These materials may be land filled provided that: It is not prohibited in other state regulations or

local ordinances; the amount generated is "de minimus" (a small amount); it is the result of minor leaks or spills resulting from normal process operations; and free-flowing oil has been removed to the practicable extent possible. Large quantities of this material, generated as a result of a major spill or in lieu of proper maintenance of the processing equipment, are a solid waste. As a solid waste, perform a hazardous waste determination prior to disposal. As this can be an expensive process, it is recommended that this type of waste be minimized through good housekeeping practices and employee education.

### 1.2.7 Regulated Waste

Regulated waste are solid wastes that have specific additional federal, state, or local controls for handling, storage, or disposal.

### 1.2.8 Sediment

Sediment is soil and other debris that have eroded and have been transported by runoff water or wind.

### 1.2.9 Surface Discharge

Surface discharge means discharge of water into drainage ditches, storm sewers, or creeks meeting the definition of "waters of the United States". Surface discharges from construction sites are discrete, identifiable sources and require a permit from the governing agency. Comply with federal, state, and local laws and regulations.

### 1.2.10 Waters of the United States

Waters of the United States means Federally jurisdictional waters, including wetlands, that are subject to regulation under Section 404 of the Clean Water Act or navigable waters, as defined under the Rivers and Harbors Act.

### 1.2.11 Wetlands

Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Solid Waste Management Permit; G

Environmental Protection Plan; G

Prior to commencement of any work, including delivery of any plant, equipment or construction materials to the site, submit a

plan for environmental protection as specified herein.

The paragraph "ENVIRONMENTAL PROTECTION PLAN REQUIREMENTS" below lists personnel requirements and plans to be submitted by the Contractor as part of the Environmental Protection Plan. Although these requirements are listed as individual Plans and personnel requirements that are a part of the contents of the Environmental Protection Plan, all listed individual plans and personnel requirements must be submitted with the entire Environmental Protection Plan for approval.

SD-11 Closeout Submittals

Waste Determination Documentation; G

Disposal Documentation For Hazardous And Regulated Waste; G

Hazardous Waste/Debris Management; G

Project Solid Waste Disposal Documentation Report; G

## 1.4 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection as defined. Plan for and provide environmental protective measures to control pollution that develops during construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Protect the environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire duration of this Contract. Comply with federal, state, and local regulations pertaining to the environment, including water, air, solid waste, hazardous waste and substances, oily substances, and noise pollution.

Tests and procedures assessing whether construction operations comply with Applicable Environmental Laws may be required. Analytical work must be performed by qualified laboratories; and where required by law, the laboratories must be certified.

### 1.4.1 Solid Waste Management Permit

Provide the Contracting Officer with written notification of the quantity of anticipated solid waste or debris that is anticipated or estimated to be generated by construction. Include in the report the locations where various types of waste will be disposed or recycled. Include letters of acceptance from the receiving location or as applicable; submit one copy of the receiving location state and local Solid Waste Management Permit or license showing such agency's approval of the disposal plan before transporting wastes.

## 1.5 ENVIRONMENTAL PROTECTION PLAN

The purpose of the EPP is to present an overview of known or potential environmental issues that must be considered and addressed during construction. Incorporate construction related objectives and targets

from the installation's EMS into the EPP. Include in the EPP measures for protecting natural and cultural resources, required reports, and other measures to be taken. Meet with the Contracting Officer or Contracting Officer Representative to discuss the EPP and develop a mutual understanding relative to the details for environmental protection including measures for protecting natural resources, required reports, and other measures to be taken. Submit the EPP no less than 10 calendar days before the preconstruction meeting. The Contractor will be informed in writing of any revisions as may be required by the Contracting Officer at the Preconstruction Conference and shall submit a final plan for final approval not later than 5 calendar days prior to start of scheduled construction activities. Revise the EPP throughout the project to include any reporting requirements, changes in site conditions, or contract modifications that change the project scope of work in a way that could have an environmental impact.

No requirement in this section will relieve the Contractor of any applicable federal, state, and local environmental protection laws and regulations. During Construction, identify, implement, and submit for approval any additional requirements to be included in the EPP. Maintain the current version onsite.

The EPP includes, but is not limited to, the following elements:

1.5.1 General Overview and Purpose

1.5.1.1 Descriptions

A brief description of each specific plan required by environmental protection plan or elsewhere in this Contract.

1.5.1.2 Duties

The duties and level of authority assigned to the person(s) on the job site who oversee environmental compliance, such as who is responsible for adherence to the EPP, who is responsible for spill cleanup and training personnel on spill response procedures, who is responsible for manifesting hazardous waste to be removed from the site (if applicable), and who is responsible for training the Contractor's environmental protection personnel.

1.5.1.3 Procedures

A copy of any standard or project-specific operating procedures that will be used to effectively manage and protect the environment on the project site.

1.5.1.4 Communications

Communication and training procedures that will be used to convey environmental management requirements to Contractor employees and subcontractors.

1.5.1.5 Contact Information

Emergency contact information contact information (office phone number, cell phone number, and e-mail address).

### 1.5.2 General Site Information

#### 1.5.2.1 Drawings

Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, jurisdictional wetlands, material storage areas, structures, sanitary facilities, storm drains and conveyances, and stockpiles of excess soil.

#### 1.5.2.2 Work Area

Work area plan showing the proposed activity in each portion of the area and identify the areas of limited use or nonuse. Include measures for marking the limits of use areas, including methods for protection of features to be preserved within authorized work areas and methods to control runoff and to contain materials on site, and a traffic control plan.

Show where any fuels, hazardous substances, solvents, or lubricants will be stored. Provide a spill plan to address any releases of those materials.

#### 1.5.2.3 Documentation

A letter signed by an officer of the firm appointing the Environmental Manager and stating that person is responsible for managing and implementing the Environmental Program as described in this contract. Include in this letter the Environmental Manager's authority to direct the removal and replacement of non-conforming work.

### 1.5.3 Contents

a. Name(s) of person(s) within the Contractor's organization who is(are) responsible for ensuring adherence to the Environmental Protection Plan and those who may be delegated with separate responsibilities subject to approval of the CO.

b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable.

c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.

d. Description of the Contractor's environmental protection personnel training program.

e. The Spill Control plan shall include the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, or regulated under State or Local laws and regulations. The Spill Control Plan supplements the requirements of EM 385-1-1. This plan shall include as a minimum:

(1) The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual shall immediately notify the Contracting Officer in addition to the legally required Federal, State, and local reporting channels (including the National Response Center 1-800-424-8802) if a reportable quantity is

released to the environment. The plan shall contain a list of the required reporting channels and telephone numbers.

(2) The name and qualifications of the individual who will be responsible for implementing and supervising the containment and cleanup.

(3) Training requirements for Contractor's personnel and methods of accomplishing the training.

(4) A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.

(5) The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.

(6) The methods and procedures to be used for expeditious contaminant cleanup.

f. A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris. The plan shall include schedules for disposal. The Contractor shall identify any subcontractors responsible for the transportation and disposal of solid waste. Licenses or permits shall be submitted for solid waste disposal sites that are not a commercial operating facility. Evidence of the disposal facility's acceptance of the solid waste shall be attached to this plan during the construction.

g. A recycling and solid waste minimization plan with a list of measures to reduce consumption of energy and natural resources. The plan shall detail the Contractor's actions to comply with and to participate in Federal, State, Regional, and local government sponsored recycling programs to reduce the volume of solid waste at the source.

h. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site.

i. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with Federal, State, and local laws and regulations for storage and handling of these materials. In accordance with EM 385-1-1, a copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be on site at any given time shall be included in the contaminant prevention plan. As new hazardous materials are brought on site or removed from the site, the plan shall be updated.

j. A Historical, Archaeological, Cultural Resources, Biological Resources and Wetlands Plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and/or identifies procedures to be followed if historical, archaeological, cultural resources, or biological resources not previously known to be onsite or in the area are discovered during dredging. Include in the plan methods to assure the protection of

known or discovered resources and identifying lines of communication between Contractor personnel and the Contracting Officer.

## 1.6 ENVIRONMENTAL RECORDS BINDER

Maintain on-site a separate three-ring Environmental Records Binder and submit at the completion of the project. Make separate parts within the binder that correspond to each submittal listed under paragraph CLOSEOUT SUBMITTALS in this section.

# PART 2 PRODUCTS

Not Used

# PART 3 EXECUTION

## 3.1 PROTECTION OF FEATURES

This section supplements the CONTRACT CLAUSE "PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS". The Contractor shall prepare a list of features requiring protection under the provisions of the CONTRACT CLAUSE that are not specifically identified on the drawings or otherwise specified as environmental features requiring protection. The Contractor shall protect those environmental features as indicated and specified, in spite of interference that their preservation may cause to the Contractor's work under the contract.

## 3.2 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

Prior to placing buoys for project operations, perform a scan of the area as discussed in 01 14 00 WORK RESTRICTIONS, 1.15.1, Avoidance of Historical Resources.

If during excavation or other construction activities any previously unidentified or unanticipated historical\archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources will be temporarily suspended. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, immediately notify the Contracting Officer so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. Cease all activities that may result in impact to or the destruction of these resources. Secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

## 3.3 LAND RESOURCES

The Contractor shall confine all activities to areas defined by the drawings and specifications. Prior to the beginning of any construction, the Contractor shall identify any land resources to be preserved within the work area. Except in areas indicated on the drawings or specified to be dredged, the Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval. No ropes, cables, or guys shall be

fastened to or attached to any trees for anchorage unless specifically authorized. The Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Stone, soil, or other materials displaced into uncleared areas shall be removed by the Contractor.

## 3.4 WATER RESOURCES

The Contractor shall monitor construction activities to prevent pollution of surface and ground waters. Toxic or hazardous chemicals shall not be applied to soil or vegetation. All water areas affected by construction activities shall be monitored by the Contractor. The Contractor shall perform monitoring, inspections, sampling and testing, reporting, and record keeping as indicated and specified.

## 3.5 PROTECTION OF MARINE ANIMALS, WILDLIFE AND VEGETATION

The Contractor is informed that the work areas are in a portion of Virginia frequented by migratory birds and is a native habitat for eagles, hawks, egrets, herons, pelicans, terns, and other wildlife that are identified as either endangered species protected by federal law or species of special concern for Commonwealth of Virginia agencies. If, in the performance of this contract, evidence of the possible disturbance to any such migratory bird or listed species may occur, the Contractor shall notify the Contracting Officer immediately, giving the location and nature of the findings. The Contractor shall advise all personnel associated with the operation of the vessels and plant of the civil and criminal provisions of the Endangered Species Act (ESA), the Migratory Bird Act, and the Marine Mammal Protection Act (MMPA). In the event that endangered or protected species are affected by this work, the work under this contract may be suspended or terminated as determined by the Contracting Officer. All crew members of the dredge, attendant plant operators, and those sub-contractors employed on the work shall be required to read and certify in writing they are aware of the contents of this specification and the Contractor's Environmental Protection Plan. Copies of this SECTION and the Environmental Protection Plan, including a posting warning of the civil and criminal liabilities that violators are subject to for non-compliance to the requirements of them, shall be clearly posted with other required postings on-site for employees.

## 3.6 U.S. DEPARTMENT OF AGRICULTURE (USDA) QUARANTINED CONSIDERATIONS

The Contractor shall thoroughly clean all construction equipment at the prior job site in a manner that ensures all residual soil is removed and that egg deposits from plant pests are not present. The Contractor shall consult with the USDA Plant Protection and Quarantine (USDA - PPQ) jurisdictional office for additional cleaning requirements that may be necessary.

## 3.7 WETLANDS AND NATURAL HABITAT

Use of the Contractor's plant to construct the scheduled work, including the associated use of ropes, cables, or guys over wetlands and in natural habitat areas, shall be scheduled in a manner to disturb the wetlands and natural habitat areas to the minimum amount necessary to accomplish the work. Any damage to wetlands or natural habitat areas shall be repaired to original condition at no additional expense to the government. The Contracting Officer will notify the Contractor in writing of any observed

noncompliance with the previously mentioned Federal, State or local laws or regulations, permits, and other elements of the Contractor's environmental protection plan. The Contractor shall, after receipt of such notice, inform the Contracting Officer of proposed corrective action and take such action when approved. If the Contractor fails to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or costs or damages allowed to the Contractor for any such suspensions.

## 3.8 MILITARY MUNITIONS

In the event military munitions, as defined in 40 CFR 260, are discovered or uncovered, the Contractor will immediately inform the Contracting Officer's Representative and take action in accordance with Section: 01 35 30 GOVERNMENT PROVIDED MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) CONSTRUCTION SUPPORT

## 3.9 WASTE MINIMIZATION

Minimize the use of hazardous materials and the generation of waste. Include procedures for pollution prevention/ hazardous waste minimization in the Hazardous Waste Management Section of the EPP. Obtain a copy of the installation's Pollution Prevention/Hazardous Waste Minimization Plan for reference material when preparing this part of the EPP. If no written plan exists, obtain information by contacting the Contracting Officer. Describe the anticipated types of the hazardous materials to be used in the construction when requesting information.

### 3.9.1 Salvage, Reuse and Recycle

Identify anticipated materials and waste for salvage, reuse, and recycling. Describe actions to promote material reuse, resale or recycling. To the extent practicable, all scrap metal must be sent for reuse or recycling and will not be disposed of in a landfill.

Include the name, physical address, and telephone number of the hauler, if transported by a franchised solid waste hauler. Include the destination and, unless exempted, provide a copy of the state or local permit (cover) or license for recycling.

## 3.10 WASTE MANAGEMENT AND DISPOSAL

### 3.10.1 Waste Determination Documentation

Complete a Waste Determination form (provided at the pre-construction conference) for Contractor-derived wastes to be generated. All potentially hazardous solid waste streams that are not subject to a specific exclusion or exemption from the hazardous waste regulations (e.g., scrap metal, domestic sewage) or subject to special rules, (lead-acid batteries and precious metals) must be characterized in accordance with the requirements of 40 CFR 262.11 or corresponding applicable state or local regulations. Base waste determination on user knowledge of the processes and materials used, and analytical data when necessary. Consult with the Contracting Officer and Environmental Manager for guidance on specific requirements. Attach support documentation to the Waste Determination form. As a minimum, provide a Waste Determination form for the following waste (this listing is not exhaustive): oil- and

latex -based painting and caulking products, solvents, adhesives, aerosols, petroleum products, and containers of the original materials.

### 3.10.2 Solid Waste Management

#### 3.10.2.1 Project Solid Waste Disposal Documentation Report

Provide copies of the waste handling facilities' weight tickets, receipts, bills of sale, and other sales documentation. In lieu of sales documentation, a statement indicating the disposal location for the solid waste that is signed by an employee authorized to legally obligate or bind the firm may be submitted. The sales documentation must include the receiver's tax identification number and business, EPA or state registration number, along with the receiver's delivery and business addresses and telephone numbers. For each solid waste retained for the Contractor's own use, submit the information previously described in this paragraph on the solid waste disposal report. Prices paid or received do not have to be reported to the Contracting Officer unless required by other provisions or specifications of this Contract or public law.

#### 3.10.2.2 Control and Management of Solid Wastes

Pick up solid wastes, and place in covered containers that are regularly emptied. Do not prepare or cook food on the project site. Prevent contamination of the site or other areas when handling and disposing of wastes. At project completion, leave the areas clean. Employ segregation measures so that no hazardous or toxic waste will become co-mingled with non-hazardous solid waste. Solid waste disposal offsite must comply with most stringent local, state, and federal requirements, including 40 CFR 241, 40 CFR 243, and 40 CFR 258.

Manage hazardous material used in construction, including but not limited to, aerosol cans, waste paint, cleaning solvents, contaminated brushes, and used rags, in accordance with 49 CFR 173.

### 3.10.3 Control and Management of Hazardous Waste

Do not dispose of hazardous waste on Government property. Do not discharge any waste to a sanitary sewer, storm drain, or to surface waters or conduct waste treatment or disposal on Government property without written approval of the Contracting Officer and Installation Hazardous Waste Manager.

#### 3.10.3.1 Hazardous Waste/Debris Management

Identify construction activities that will generate hazardous waste or debris. Provide a documented waste determination for resultant waste streams. Identify, label, handle, store, and dispose of hazardous waste or debris in accordance with federal, state, and local regulations, including 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, and 40 CFR 268.

Manage hazardous waste in accordance with the approved Hazardous Waste Management Section of the EPP. Store hazardous wastes in approved containers in accordance with 49 CFR 173 and 49 CFR 178. Hazardous waste generated within the confines of Government facilities is identified as being generated by the Government. Prior to removal of any hazardous waste from Government property, hazardous waste manifests must be signed by personnel from the Installation Environmental Office. Do not bring

hazardous waste onto Government property. Provide the Contracting Officer with a copy of waste determination documentation for any solid waste streams that have any potential to be hazardous waste or contain any chemical constituents listed in 40 CFR 372-SUBPART D.

3.10.3.2 Hazardous Waste Disposal

3.10.3.2.1 Responsibilities for Contractor's Disposal

Provide hazardous waste manifest to the Environmental Manager and Contracting Officer for review, approval, and signature prior to shipping waste off.

3.10.3.2.1.1 Services

Provide service necessary for the final treatment or disposal of the hazardous material or waste in accordance with 40 CFR 260 - 40 CFR 279, local, and state, laws and regulations, and the terms and conditions of the Contract within 60 days after the materials have been generated. These services include necessary personnel, labor, transportation, packaging, detailed analysis (if required for disposal or transportation, include manifesting or complete waste profile sheets, equipment, and compile documentation).

3.10.3.2.1.2 Samples

Obtain a representative sample of the material generated for each job done to provide waste stream determination.

3.10.3.2.1.3 Analysis

Analyze each sample taken and provide analytical results to the Contracting Officer. See paragraph WASTE DETERMINATION DOCUMENTATION.

3.10.3.2.1.4 Labeling

During waste accumulation label all containers in accordance with 40 CFR 262. Prior to offering a waste for off-site transport, determine the Department of Transportation's (DOT's) proper shipping names for waste in accordance with 49 CFR 172 (each container requiring disposal) and demonstrate to the Contracting Officer how this determination is developed and supported by the sampling and analysis requirements contained herein. Label all containers of hazardous waste with the words "Hazardous Waste" or other words to describe the contents of the container in accordance with 40 CFR 262 and applicable state or local regulations.

3.10.3.3 Universal Waste Management

Manage the following categories of universal waste in accordance with federal, state, and local requirements and installation instructions:

a. Batteries as described in 40 CFR 273.2

b. Lamps as described in 40 CFR 273.5

c. Mercury-containing equipment as described in 40 CFR 273.4

d. Aerosol cans as described in 40 CFR 273.6

e. Pesticides as described in 40 CFR 273.3

Mercury is prohibited, unless specified otherwise, and with the exception of mercury vapor lamps and fluorescent lamps. Dumping of mercury-containing materials and devices such as mercury vapor lamps, fluorescent lamps, and mercury switches, in rubbish containers is prohibited. Remove without breaking, pack to prevent breakage, and transport out of the activity in an unbroken condition for disposal as directed.

3.10.3.4 Disposal Documentation for Hazardous and Regulated Waste

Contact the Contracting Officer for the facility RCRA identification number that is to be used on each manifest. Submit a copy of the applicable EPA and or state permit(s), manifest(s), or license(s) for transportation, treatment, storage, and disposal of hazardous and regulated waste by permitted facilities. Hazardous or toxic waste manifests must be reviewed, signed, and approved by the Contracting Officer and Environmental Manager before the Contractor may ship waste. To obtain specific disposal instructions, coordinate with the Contracting Officer and Environmental Manager.

3.10.4 Releases/Spills of Oil and Hazardous Substances

3.10.4.1 Response and Notifications

Exercise due diligence to prevent, contain, and respond to spills of hazardous material, hazardous substances, hazardous waste, sewage, regulated gas, petroleum, lubrication oil, and other substances regulated in accordance with 40 CFR 300. Maintain spill cleanup equipment and materials at the work site. In the event of a spill, take prompt, effective action to stop, contain, curtail, or otherwise limit the amount, duration, and severity of the spill/release. In the event of any releases of oil and hazardous substances, chemicals, or gases; immediately (within 15 minutes) notify the Contracting Officer and the state or local authority.

Submit verbal and written notifications as required by the federal ( 40 CFR 300.125 and 40 CFR 355), state, local regulations and instructions. Provide copies of the written notification and documentation that a verbal notification was made within 20 days. Spill response must be in accordance with 40 CFR 300 and applicable state and local regulations. Contain and clean up these spills without cost to the Government.

3.10.4.2 Clean Up

The Contractor is responsible for the clean up of hazardous and non-hazardous waste spills.

However, if in the Government's judgment, spill cleanup is inadequate and the spill remains a threat to human health or the environment or spill cleanup procedures have not begun within one hour of spill discovery/occurrence; the Government may initiate its own spill cleanup procedures, for the Contractor. In this case, the Contractor will fully reimburse the Government for costs incurred including sample analysis materials, clothing, equipment, and labor.

### 3.10.5 Wastewater

#### 3.10.5.1 Disposal of Wastewater

Do not allow wastewater from construction activities to enter waterways or to be discharged prior to being treated to remove pollutants. Dispose of the construction- related waste water in accordance with 40 CFR 403, state, regional, and local laws and regulations.

## 3.11 HAZARDOUS MATERIAL MANAGEMENT

Include hazardous material control procedures in the Safety Plan, in accordance with Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS. Address procedures and proper handling of hazardous materials, including the appropriate transportation requirements. Submit an SDS and estimated quantities to be used for each hazardous material to the Contracting Officer prior to bringing the material on the installation. Typical materials requiring SDS and quantity reporting include, but are not limited to, oil and latex based painting and caulking products, solvents, adhesives, aerosol, and petroleum products. Use hazardous materials in a manner that minimizes the amount of hazardous waste generated. Containers of hazardous materials must have National Fire Protection Association labels or their equivalent. Certify that hazardous materials removed from the site are hazardous materials and do not meet the definition of hazardous waste, in accordance with 40 CFR 261 and state requirements.

## 3.12 PREVIOUSLY USED EQUIPMENT

Clean previously used construction equipment prior to bringing it onto the project site. Equipment must be free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. Consult with the U.S. Department of Agriculture jurisdictional office for additional cleaning requirements.

## 3.13 PETROLEUM, OIL, LUBRICANT (POL) STORAGE AND FUELING

POL products include flammable or combustible liquids, such as gasoline, diesel, lubricating oil, used engine oil, hydraulic oil, mineral oil, and cooking oil. Store POL products and fuel equipment and motor vehicles in a manner that affords the maximum protection against spills into the environment. Manage and store POL products in accordance with EPA 40 CFR 112, and other federal, state, regional, and local laws and regulations. Describe in the EPP (see paragraph ENVIRONMENTAL PROTECTION PLAN) how POL tanks and containers must be stored, managed, and inspected and what protections must be provided.

### 3.13.1 Used Oil Management

Manage used oil generated on site in accordance with 40 CFR 279. Determine if any used oil generated while onsite exhibits a characteristic of hazardous waste. Used oil containing 1,000 parts per million of solvents is considered a hazardous waste and disposed of at the Contractor's expense. Used oil mixed with a hazardous waste is also considered a hazardous waste. Dispose in accordance with paragraph HAZARDOUS WASTE DISPOSAL.

## 3.14 INADVERTENT DISCOVERY OF PETROLEUM-CONTAMINATED SOIL OR HAZARDOUS WASTES

If petroleum-contaminated soil, or suspected hazardous waste is found during construction that was not identified in the Contract documents, immediately notify the Contracting Officer. Do not disturb this material until authorized by the Contracting Officer.

## 3.15 POST CONSTRUCTION CLEANUP

Clean up areas used for construction in accordance with Contract Clause: "Cleaning Up". Unless otherwise instructed in writing by the Contracting Officer, remove traces of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. Grade parking area and similar temporarily used areas to conform with surrounding contours.

-- End of Section --

# SECTION 01 57 30

# ENVIRONMENTAL PERMIT WORK REQUIREMENTS
**10/15**

## PART 1 GENERAL

### 1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Communications Plan; G, DO

### 1.2 GENERAL INFORMATION

This SECTION supplements the Contractor's responsibility under the CONTRACT CLAUSE "PERMITS AND RESPONSIBILITIES" to the extent that the Government has already entered into a binding agreement to remove the sand and obtained an environmental permit for the required borrow area dredging. In addition, the borrow area is a location where sea turtles, whales, and other endangered and threatened species may be encountered during the work.

The Contractor is advised the Government has consulted with the National Marine Fisheries Service (NMFS) regarding the effects of dredging on threatened and endangered species in the dredging area and Fish and Wildlife Service (USFWS) for the impacts to nesting sea turtles on the beach placement areas for this contract. To protect these species, both the NMFS and USFWS have issued separate Biological Opinions and Incidental Take Statements that are included as Appendices to these specifications.

The contract plans and specifications have been prepared to comply with the binding agreement to remove sand, environmental permits and the Biological Opinions and Incidental Take Statement that were established during the planning and development of this project. These special environmental requirements are an outgrowth of environmental commitments made by the Government during the project development and all dredging, transport and placement of dredged material under this contract shall be in strict compliance with the conditions set forth in the agreements that are included as a part of this contract at the end of this SECTION. The Contractor is advised that any deviations from the construction methods and procedures indicated by the plans and specifications that are not prior approved in writing by the Contracting Officer, or any non-compliance with or violation of the conditions stated in the agreements and permit noted herein, shall be cause for the Contracting Officer issuing a stop work order. Any stop work orders issued for any of these causes will not be subject to time extensions or cost recovery by the Contractor. Any non-compliance with or violation of the conditions stated in the agreements noted herein may result in criminal and civil penalties against the Contractor.

### 1.2.1 Training

Prior to placement activities occurring on the beach during sea turtle nesting season (1 May through 15 November), all beach construction crew members will be required to attend a pre-construction environmental training conducted by a qualified USACE biologist. Any additional crew members onboarding or re-assigned to beach construction mid-nourishment must attend environmental training conducted by a qualified USACE biologist prior to beginning beach construction work.The training will focus on required avoidance/minimization measures and conditions of regulatory agency permits and approvals. The training will also include a summary of sensitive species and habitats present within and adjacent to the construction footprint.

## 1.3 SPECIAL PRECAUTIONS FOR SEA TURTLES ON THE BEACH

The Contractor shall be aware that the nesting season for sea turtles within the beach fill area is 1 May through 15 November. During this period, Protected Species Observers approved by the National Marine Fisheries Service shall be employed by the Contractor at his expense to monitor for stranded turtles, turtle trails, and turtle nesting activity. Protected Species Observers monitoring the beach shall have experience identifying adult sea turtles to species, identifying sea turtle tracks on the beach, recognizing signs of a sea turtle nest, and recognizing evidence of a nest boil/hatchling emergence. Protected Species Observers resume(s) and/or Curriculum Vitae (CV) and NMFS approval letter(s) shall be submitted to the Contracting Officer and Environmental Manager for review and approval prior to the start of work. Resume(s) and/or CV and NMFS approval letter(s) for Protected Species Observers brought on after the start of work shall be submitted to the Contracting Officer and Environmental Manager for review and approval prior to their start of work onsite.

The Protected Species Observer shall physically survey every 2 hours, both day and night, for the presence of turtles and turtle nests along the high tide line in one direction, along the tide line in the opposite direction, and a thorough visual inspection in the entire active construction area where the Contractor intends to work, which includes all beach access routes and staging areas between the beach renourishment and construction laydown areas.

When the Contractor performs beach fill placement operations at night, inspections shall be performed as described above by the approved turtle monitor every two hours. The approved turtle monitor shall remain on-call 24 hours a day during this period.

If a sea turtle or sea turtle nesting activity is discovered, all construction/beach nourishment activities will be halted within 500 feet of the turtle and/or evidence of nesting activity or crawls until the sea turtle is in the water and/or the nest is protected for relocation by the properly permitted entity (Virginia Aquarium & Marine Science Center Stranding Response Program (VAQS)). The USFWS Virginia Field Office and the Environmental Manager will be contacted by the Protected Species Observer in accordance with the Communications Plan, and the Virginia Aquarium Stranding Response Program staff may relocate the eggs. Protected Species Observers, regardless of prior experience, are not authorized to relocate nests or alter nesting sea turtle behavior in any way.

Nest relocation decisions are based on ensuring the nest's protection and

viability, rather than on the placement of dredged material along the beach. Relocation outside the project area is not guaranteed. Relocation fees are incurred whenever a nest is relocated within the placement area, and they apply whether the nest is moved outside the placement area or relocated within it. If relocation outside the placement area is not possible, the USFWS will establish required protective buffers around the nest. These buffers may impose restrictions on work activities within their boundaries. Historically, USFWS has required this buffer to be a 500 ft radius in all directions around the nest.

If a turtle nest is dug up by beach construction activities or found by any other means in the area where the Contractor's activities may disturb the nest, the Contractor must stop all activities in the area and protect the discovery until an approved Protected Species Observer is notified and on the scene. Turtles and turtle nests shall only be moved or otherwise be disturbed by the VAQS or other approved entity by the U. S. Fish and Wildlife Service. The Protected Species Observer(s) must prepare an Incident Statement on approved forms for all findings, recording the contract number and title, date and time of discoveries, location and condition of findings, and provide a copy to the Contractor as directed. The turtle monitor shall at the same time forward a signed copy of the Incident Statement within 24 hours to the U. S. Fish and Wildlife Service, Ecological Services Field Office (attention: Troy Andersen), 6669 Short Lane, Glouster, Virginia 23061 and Jean Higgins, Protected Resources Division NMFS Greater Atlantic Fisheries Office, 55 Great Republic Drive Gloucester, MA 01930-2276. The Contractor shall acknowledge the time and date of his receipt of the Incident Statement in his Daily Report of Operations and include a copy in his Daily Report to the Contracting Officer.

Separate from the Protected Species Observers, the Contractor shall work to coordinate and allow for early morning crawl surveys conducted by the Virginia Aquarium Stranding Response Program or other USFWS approved entity from May 1 through November 15. The early morning surveys are conducted daily during this time period and unimpeded, safe egress shall be allowed within the active construction zone, and construction equipment work will be briefly halted as they pass for these surveys. A Communications Plan between USACE, the Contractor, PSOs, USFWS, and VAQS will need to be established at the beginning of nesting season.

If a live stranded sea turtle is observed in the project area any time of year, the Contractor shall stop work within 500 feet of the turtle and immediately notify the VAQ Stranding Response Program (757-385-7575), the Contracting Officer, and the Environmental Manager. Work on the beach will not resume within 500 feet of the turtle until the VAQ Stranding Response Program has recovered the turtle.

If a dead sea turtle is observed on the beach any time of year, the Contractor shall immediately notify the VAQ Stranding Response Program (757-385-7575), the Contracting Officer, and the Environmental Manager and shall halt work within a buffer of the carcass large enough to preserve biological material in the best possible state. Care must be taken in handling any dead specimens to preserve biological material in the best possible state. In conjunction with the preservation of any dead specimens, the Contractor has the responsibility to ensure that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed.

## 1.4 MEASUREMENT AND PAYMENT

No separate payment will be made for work covered under this section. All costs associated with this section must be included in the contract price. During beach placement operations, the Government reserves the right to issue stand by orders in response to sea turtle encounters in the beach placement area until the Contractor is able to establish adequate buffers determined by USFWS as described above. Payment for standby time will be made in accordance with 01 20 00 PRICE AND PAYMENT PROCEDURES.

# PART 2 PRODUCTS (Not Used)

# PART 3 EXECUTION (Not Used)

-- End of Section --

SECTION 01 57 40

# SPECIAL EQUIPMENT AND PROCEDURE REQUIREMENTS FOR PROTECTION OF ENDANGERED SPECIES AND AVOIDANCE OF ARCHEOLOGICAL RESOURCES
**07/11**

## PART 1 GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 50 CFR 224.105 | Speed Restrictions to protect North Atlantic Right Whales |

### 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Operational Plan To Minimize Turtle And Atlantic Sturgeon Takes; G

Hopper Dredge Endangered Species Special Equipment Plan; G

Drawings And Operational Specifications Of All Proposed Endangered Species Drag Head Deflectors, Special Screening, And Lighting Equipment; G

SD-03 Product Data

Invoice From VAQS

Contractor's Invoice Documenting Payment Received From VAQS

ODESS Dredge Load Form

Marine Mammal Observation Data Forms

Sturgeon Incidental Take Data Form

Endangered Species Observer Program, Large Whale Observation Data

SD-04 Samples

Tissue Sample

Protected Species Observers Resume And NMFS Approval Letter; G

Letter Of Approval From NMFS Authorizing Turtle Trawling; G

SD-06 Test Reports

Incidental Take Reports

Paint Test Information; G

SD-10 Operation and Maintenance Data

Final Sea Turtle Trawling Report; G, DO

## 1.3 GENERAL INFORMATION

The Borrow Area is in a location where sea turtles and other endangered and threatened species may be encountered during the work.

The Contractor is advised the Government has consulted with the National Marine Fisheries Service (NMFS) regarding the effects of dredging on threatened and endangered species in the dredging areas for this contract. To protect these species, the NMFS has issued a Biological Opinion and Incidental Take Statement that requires hopper dredges be outfitted year-round with state-of-the-art sea turtle deflectors on the draghead and operated in a manner that will reduce the risk of interactions with sea turtles and/or Atlantic Sturgeon which may be present in the dredging areas. This Biological Opinion is included as a part of this SECTION and the contract plans and specifications have been prepared to comply with this Biological Opinion and Incidental Take Statement that was established during the planning and development of this project. Any non-compliance with or violation of the work conditions to be provided in accordance with the Biological Opinion and Incidental Take Statement noted and other requirements specified herein may result in criminal and civil penalties against the Contractor.

The work involves safety support and avoidance of potential unexploded ordnance and exploded ordnance, inert ordnance, and ordnance fragments and similar explosives debris material (defined and identified in these specifications as "Munitions and Explosives of Concern" (MEC)), within the dredging prism of the borrow area during performance of dredging activities as specified in 01 35 30 MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) CONSTRUCTION SUPPORT.

Additionally, an Archaeological Remote Sensing Survey was conducted in the borrow area during November and December 2006. The list of targets, titled "Archeological Avoidance Areas," is included an an attachment to these specifications. Additionally, the avoidance areas and buffers are noted in the project plans. A detailed Report is available for review at the Norfolk District upon request.

## 1.4 Special Archeological Resource of Historic Concern Avoidance Requirements

Analysis of the remote sensing data indicates Targets 2 through 6 and S1 in Area A were generated by a sunken barge. Also, analysis of data indicates Targets 9 through 14 and S1 in Area B appear to have been generated by a shipwreck. Further, in Area A, Targets 8 through 10, 12 through 17, 19 through 33 and 38 through 42 indicate potential archeological resources of historic concern; in Area B, Targets 18 through 20, 23, 24, 28 through 31 and 35 through 37 indicate potential archeological resources of historic

concern. The Contractor's work activities shall be coordinated to avoid the locations identified for each respective Target as indicated above by a minimum of 200 linear feet in all directions. Most target buffers are 200 ft in radius, but there are targets that require 500 ft radius. The list of the Archaeological Avoidance targets can be found in the attachments section at the end of these specifications.

## PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION

### 3.1 SPECIAL PRECAUTIONS FOR SEA TURTLES AND ATLANTIC STURGEON DURING DREDGING OPERATIONS

The Contractor shall develop a written Operational Plan To Minimize Turtle And Atlantic Sturgeon Takes during dredging work. This Plan shall be prepared in consultation with the National Marine Fisheries Service (NMFS) Northeast Regional Office, Protected Resources, Division (attention: Assistant Regional Administrator), NMFS Greater Atlantic Fisheries Office 55 Great Republic Drive Gloucester, MA 01930-2276. Additionally, all hopper dredge drag heads shall be equipped with rigid sea turtle deflectors that are rigidly attached during this period. The Contractor shall ensure the adequate instruction and training of all personnel associated with the operation of the dredging vessel and other plant employed on the work regarding the possible presence of endangered sea turtles, Atlantic Sturgeon and whales and the need to avoid contact and collisions with these animals.

All sturgeon and turtle captures, injuries or mortalities associated with any dredging activity and any sturgeon and sea turtle sightings in the action area must be reported to the Contracting Officer's Representative and Environmental Manager Mortalities and sightings must be reported within 12 hours. Live captures and/or injuries must be reported immediately. Defer to Refer to 3.1.3 of this Section for specific protocols involving live sea turtle takes.

Any dead sturgeon or sea turtles (or parts thereof) shall be photographed, measured, and preserved in cold storage. Refer to the NMFS External Sturgeon Take Operating Procedure and Sea Turtle Take Procedures documents at the end of the 2018 NMFS Biological Opinion attached to the end of these specifications. The contractor shall be responsible for transport of carcasses and/or parts to a NMFS approved facility.

Any live sturgeon caught must be photographed, weighed, measured and a fin clip taken for DNA sampling. DNA samples must be sent to a NMFS approved laboratory. Once data is taken, the Sturgeon must be immediately released overboard while the dredge is not in operation. Any live sea turtle caught must be photographed, weighed, measured, behaviors and injuries documented. The contractor shall be responsible for transport of live sea turtles to a NMFS approved facility for rehabilitation. Refer to 3.1.3 of this Section and the "Sea Turtle Take Procedures" document found at the end of this section for specific details regarding live sea turtle dredge takes.

The action area will consist of areas in the immediate vicinity of the dredge where sightings and observations from the dredge can occur. A submittal of incident information shall be made into the Operations and Dredging Endangered Species System (ODESS) for sea turtles and sturgeon (dead or alive) taken by hopper dredge. The contractor shall comply with

all hardware, submittal, and training requirements specified in the document titled "Operations and Dredging Endangered Species System (ODESS) Guidance" attached to the end of these specifications.

### 3.1.1 Endangered Species Observers

Two NMFS approved observers , knowledgeable in listed species identification, will be required on board the hopper dredge at all times to inspect the draghead each time it is removed from the water. The Contractor shall be required to submit the resumes of endangered species observer candidates to the NMFS for final approval, as well as have final approval from the NMFS prior to the start of dredging. The Protected Species Observers Resume and NMFS Approval Letter must be submitted to the Government for approval prior to the start of dredging.

The observer shall physically inspect each operating deflector and draghead at the completion of each load for impinged Sea Turtles or Atlantic Sturgeon. The inspection shall only include the draghead and deflector unless the Contracting Officer deems otherwise. The observer **SHALL NOT** physically inspect the inflow cages internal to the hopper dredge when UXO screen(s) are used on the draghead. Each inspection of the dreagheads and deflectors shall be documented. The appropriate observer program load data form, daily report form, and weekly report form shall be completed to document draghead and deflector inspections and bridge watch sightings. Should a Sea Turtle or Atlantic Sturgeon or their parts be found impinged on the draghead or deflector, the incident shall be recorded on the observer programs incident take data report form and the Contracting Officer and Environmental Manager shall be notified immediately. Any dead Sea Turtle or Atlantic Sturgeon or their parts must be held and preserved (refrigerated or frozen) until proper disposal procedures are discussed with NMFS. All requirements of NMFS Incidental Take Statement/Biological Opinion must be complied with the ODESS specifications:

a. Monitoring Reports: The results of the monitoring shall be recorded on the appropriate observation sheets and entered into the ODESS system (See the Biological Opinion attached to the end of these specifications). There is a form for each load and a form for an incident involving a listed species, specific to the species (turtles, sturgeon, etc.). Load forms will be completed regardless of whether any incidents with sturgeon (Gulf, Shortnose or Atlantic), whales, or sea turtles occur. In the event of any sea turtle or sturgeon (Gulf, Atlantic or Shortnose) take by the dredge, appropriate incident reporting forms shall be completed and entered into the ODESS system. Additionally, all specimens shall be photographed with the digital camera built into the ODESS tablet. These photographs shall be uploaded to the respective incident reports on the ODESS. Dredging of subsequent loads shall not commence until all appropriate reports are completed from the previous dredging load to ensure completeness and thoroughness of documentation associated with the Incidental Take Reports. All reports shall be submitted to the Corps within 24-hours of the take. Observer forms may be accessed on the web site indicated in paragraph CONSTRUCTION FORMS AND DETAILS.

b. Digital Photographs: The Contractor shall use a digital camera embedded in the ODESS tablet, with an image resolution capability of at least 300 dpi, in order to photographically report all incidental takes, without regard to species, during dredging operations. Photos taken associated with the take shall be uploaded to the ODESS with the incident information.

### 3.1.2 Disposition of Endangered or Threatened Species Carcass

Upon removal of carcass and/or parts from the draghead or screening, observers shall take photographs as to sufficiently document major characteristics of the carcass or parts including but not limited to dorsal, ventral, anterior, and posterior views. For all photographs taken, a backdrop shall be prepared to document the dredge name, observer company name, contract title, time, date, species, load number, location of dredging, and specific location taken (draghead, screening, etc.).

Carcass/parts shall also be scanned for flipper and Passive Integrated Transponder (PIT) tags. Any identified tags shall be recorded on the "ODESS Turtle Incident Form" or "ODESS Sturgeon Incident Form" (as appropriate) that is included in the ODESS Program Forms available through the ODESS tablet (or on the ODESS website if the tablet is not available). Also, fill out the ODESS Dredge Load Form and take photos for submission. All animal parts on board the dredge shall be preserved by the observer(s) until NMFS has advised on the proper disposition of the remains. All parts shall be kept cold on ice. The remains shall be monitored so they are never sitting in water. Ice must be regularly replenished, and water drained regularly.

The Contractor shall be responsible for the transport of the carcass and/or parts to the local stranding organization if NMFS deems a necropsy is required. A tissue sample shall be collected from any lethally taken sturgeon and submitted under the process stated in the "Procedure for obtaining fin clips from sturgeon for genetic analysis" found in Appendix D of the Biological Opinion which is attached at the end of these specifications. All genetic samples collected shall be submitted to a NMFS approved laboratory within 30 days of collection, and verification of submittal to NMFS shall be provided to the Administrative Contracting Officer and Environmental Manager. After all data collection is complete and the NMFS has determined the disposition of the carcass and/or parts, the carcass/parts should be marked (spray paint works well), weighted down and disposed of, or provided to an agency staff member, in accordance with the direction of the Contracting Officer. No separate payment will be made for this effort.

### 3.1.3 Disposition and Handling of Live Sea Turtle Takes

Incidental take of live sea turtles recovered from draghead, turtle deflector assembly or inside the hopper dredge shall be transferred by the Contractor to the Virginia Aquarium & Marine Science Center Stranding Response Program (VAQS) (mailing address: 717 General Booth Blvd, Virginia Beach, Virginia 23451), a NMFS-approved facility, for health assessment and rehabilitation. The Contractor shall immediately notify the Contracting Officer and Environmental Manager that a live sea turtle has been recovered that will require Contractor transfer to the NMFS-approved facility. Contractor shall immediately coordinate safe delivery of the live sea turtle by contacting the Stranding Response Coordinator at 757-385-7575 (Ask specifically the Stranding Response Coordinator or Live Animal Lead).

Sea turtles must be handled with care and stabilized for transport. Before and during transport, turtles need to be kept on deck, in a shaded secure area, and kept moist by placing a damp towel on carapace. Turtle should not be placed in water. Unresponsive turtles should be placed with their head down and top shell up in an incline position of at least 6 inches.

Pick up turtles by the sides of the shell, not by the flippers. Stabilization techniques shall be discussed with the Stranding Response Coordinator or his/her designee at the time of the call.

Upon receipt of the live sea turtle, the NMFS-approved facility will perform a health intake assessment, document the severity of injuries, and determine the appropriate level of care based on the injuries and expected duration of rehabilitation. Injuries will be categorized into one of three levels (1, 2, or 3) that have predetermined costs. These levels, in descending order of anticipated costs, are:

Level 1 involves a live response with acute injuries resulting in euthanasia or death within 48 hours.

Level 2 involves mild to moderate traumatic injuries with an estimated rehabilitation time of up to one year prior to release.

Level 3 involves severe traumatic injuries with an estimated rehabilitation time of more than one year prior to release.

The Contractor shall be responsible for all costs associated with the transportation and rehabilitation of live sea turtle dredge takes. The rehabilitation costs have been coordinated between the Government and VAQS schedule of rehabilitation costs is included in the bid schedule and 01 20 00 PRICE AND PAYMENT PROCEDURES of the specifications. The Contractor shall submit to the Contracting Officer and USACE sea turtle coordinators the invoice from VAQS. The Contractor shall submit to the Contracting Officer and USACE sea turtle coordinators the Contractor's invoice documenting payment received from VAQS. The government shall reimburse the Contractor in accordance with the bid schedule and the 01 20 00 PRICE AND PAYMENT PROCEDURES of these specifications.

### 3.1.4 Take Report Submission

The Contractor shall submit all details regarding sea turtle and sturgeon takes in ODESS. Any incidents, including sightings, collisions with, injuries, or killing of manatees, sea turtles (not associated with a take via the dredge) or whales occurring during the contract period shall be recorded in a log that will be turned into the Contracting Officer at the end of the project. The Contractor shall maintain paper copies of all forms entered into the ODESS until the project is deemed complete by the Contracting Officer and Environmental Manager.

### 3.1.5 Protected Whales and Other Listed Species Bridge Watch Requirements

The dredging and placement areas are in the NMFS Northeast Region 6. All whales, dolphins and porpoises in the Northeast Region 6 are federally protected by the Marine Mammal Protection Act (MMPA) and most large whales in the Region are further protected under the Endangered Species Act (ESA). Additionally, the right whale is protected by separate State and Federal regulations that prohibit approach within 500 yards of this species.

For the duration of this contract, the Contractor shall maintain a Bridge Watch to monitor vessel operations to ensure the Endangered Species Act 500-yard approach regulations for right whales and a minimum 100-yard approach for other listed species is complied with during vessel dredging, transit, and ancillary vessel operations in the scheduled work areas.

When approved by the Contracting Officer and USACE Sea Turtle Coordinator, the Endangered Species Observer on-duty can serve as the dedicated observer to monitor for whales and other species as specified; however, this monitoring function shall in no way interfere with their required Endangered Species Observer watch duties as specified.

When whales or other listed species are present vessels must avoid intentional approaches closer than 100 yards when in transit, and reduce speeds to below 4 knots if bridge watch identifies a listed species in the immediate vicinity of the dredge. Compliance with the requirements of the Endangered Species Act, Marine Mammal Protection Act, and any Federal or State laws and regulations that supplement these Acts are the responsibility of the Contractor. Failure to comply with these regulations may result in fines or civil penalties of up to $10,000 or criminal penalties of up to $20,000 plus imprisonment and seizure of vessel and other personal property.

If a large whale is observed, both the ODESS Dredge Load Form and the Marine Mammal Observation Data Forms shall be completed and submitted (not to exceed 12 hours after the observation) to the Contracting Officer, environmental manager, and ODESS.

### 3.1.6 Hopper Dredge Endangered Species Special Equipment Submittals

The Contractor shall submit drawings and operational specifications of all proposed endangered species drag head deflectors, special screening, and lighting equipment for the review and approval of the Contracting Officer and USACE Sea Turtle Coordinator. The Contractor shall submit calculations, drawings and operational specifications to ensure the turtle deflectors operate properly for the proposed depth(s) of the scheduled dredging as specified. A written Hopper Dredge Endangered Species Special Equipment Plan indicating those methods the Contractor intends to use in order to satisfy these requirements shall be included in the Environmental Protection Plan and coordinated with the Contractor's Quality Control Plan. The Contractor's submittals shall be provided to reflect proper operations in accordance with dragtender instrument readings and the respective printouts verifying dredging activities are performed as specified. Scaled drawings demonstrating the complete geometry of drag arm, drag head, and turtle deflector shall be submitted in hard copy and electronic format (AutoCAD 2018 or newer).

In the event the Contractor brings additional dredging plants to the site or removes his dredge from the project area once approved for use, the same procedures for approval as specified shall apply for the plant prior to use on the work. The Contractor shall provide the following special equipment on all hopper dredges used on this work:

a. Drag Head Deflectors

All hopper dredge drag heads shall be equipped with rigid, closed faced, sea turtle deflectors that are rigidly attached. Dredging shall not commence without a turtle deflector device that has been inspected and approved by the Contracting Officer and USACE Sea Turtle Coordinator. The drag head(s) and deflector(s) shall be inspected once the drag head(s) and deflector(s) are installed on the dredge and ready for operation. The contractor shall provide a minimum of 14 days notice of the dredges arrival to the Contracting Officer to schedule the required inspection. Reinspection shall be required if any components of the draghead(s) and/or deflector(s) are modified. Keep

the draghead buried a minimum of 6-inches in the sediment during dredging. The turtle deflector device shall be maintained in operational condition for the entire dredging operation. Each deflector, port and starboard as applicable, shall be designed as specified and all testing conducted shall identify port or starboard deflector for all applicable reportable items.

(1) Deflector Design

The leading vee-shaped portion of the deflector shall have an included angle of less than 90 degrees. Internal reinforcement shall be installed in the deflector to prevent structural failure of the device. The leading edge of the deflector shall be designed to have a plowing effect of at least 6 inch depth when the drag head is being operated. Appropriate instrumentation or indicator shall be used and kept in proper calibration to ensure the critical "approach angle" is maintained at all times the pumps are active. If adjustable depth deflectors are installed, they shall be rigidly attached to the drag head using either a hinged aft attachment point or an aft trunnion attachment point in association with an adjustable pin front attachment point with a stop set to obtain the 6 inch plowing effect. This arrangement allows fine-tuning the 6 inch plowing effect for varying depths. After the deflector is properly adjusted there shall be no openings between the deflector, the drag arm and the drag head that are more than 4 inch by 4 inch. Deflectors shall be solid with no openings in the face.

(2) Alternate Deflector Designs

Alternate designs will be considered only if the Contractor provides sufficient information to indicate that a particular modification is effective in minimizing potential turtle takes and Atlantice Sturgeon takes.

USACE technical staff will coordinate with NOAA Fisheries on the effectiveness of this alternate design. A recommendation from USACE technical staff and NOAA Fisheries will be provided to the Contracting Officer for final approval or disapproval of the alternate design. The contractor should not presume that a decision on an alternative design will be provided during the contracting period. The Contractor's unit price shall be based on the original, solid faced deflector design. No adjustment in unit price will be made for the approval or denial of an alternate deflector design.

(3) Paint Test Inspection of Drag head

The Contractor shall perform paint tests to ensure turtle deflector equipment is operating properly. Testing shall be performed as a minimum on a weekly basis and immediately following a failed paint test, turtle take incident, or following equipment modifications (drag heads, turtle deflector, link modifications, and other parts of the dredging apparatus). Additionally, the Government reserves the right to direct paint tests at any time to verify compliance with specified requirements. Photographic documentation of deflector paint test results shall be provided when testing is performed. General procedures for paint test are as follows:

Equipment Preparation:

a. Vertical markings shall be placed on the entire length of the abrasive resistant doubler plate.

b. Fluorescent orange paint shall be used to paint vertical strips the entire height of the abrasive resistant doubler plate with six inch spacing on center for the entire length of the deflector.

Test Procedure:

a. Deflector shall have a minimum plow depth of six inches measured vertically.

b. Deflector shall be in contact with channel bottom for a period of two to three minutes for coarse sediments and four to six minutes for fine sediments then promptly inspected.

Test Results:

a. A paint test shall receive a pass if paint strips indicate wear from sediment scour for a minimum height of six inches for the leading edge of the deflector.

Test Documentation:

a. The Contractor shall document the following Paint Test Information and submit with CQC signature verifying results:

* Load number
* Time of paint test and date
* Duration of paint test
* Material type
* Observed plow depth of the leading edge of the deflector during the paint test
*Observed instrumentation readings used to maintain and insure the deflector plow effect of at least six inch depth during paint test (i.e. approach angle, gimble angle and similar)
*Test result: pass/fail
*Failed test: document corrective action taken for re-test.
*Photo documentation of deflector paint test results.

3.1.7 Hopper Dredge Special Operating Procedures

The Contractor shall operate the hopper dredge to minimize the possibility of taking sea turtles and Atlantic sturgeon. When initiating dredging, the drag head shall be placed on the bottom during priming of the suction pump. If the drag head or drag arm becomes clogged during dredging activity, the pump shall be shut down, the drag arm raised to mid-water column level, and the drag head or drag arm flushed out by trailing the drag arm along side the ship. If plugging conditions persist, the drag head shall be placed on deck and sufficient numbers of water ports opened on the drag head to prevent future plugging. Upon completion of a dredge track line, the drag tender shall coordinate his work practice to:

1) throttle back on the RPMs of the suction pump engine to an idling speed (generally less than 100 RPMs) prior to raising the drag head off the bottom, so that no flow of material is coming through the pipe

into the dredge hopper. Before the drag head is raised, the vacuum gauge on the pipe should read zero, so that no suction exists in the drag arm or drag head, and no suction force exists that can impinge a turtle on the drag head grate;

2) hold the drag head firmly on the bottom with no flow conditions for approximately 10 to 15 seconds before raising the drag head, then, raise the drag head quickly off the bottom and up to a mid-water column level in a manner to further reduce the potential for any adverse interaction with nearby turtles;

3) re-orient the dredge quickly to the next dredge line; and

4) re-position the drag head firmly on the bottom prior to bringing the dredge pump to normal suction speed and re-starting dredging activity.

The Contractor shall not raise the drag head off the bottom to increase suction velocities. The primary adjustment for providing additional mixing water to the suction line shall be through water ports. To ensure that suction velocities do not drop below appropriate levels, the Contractor's personnel shall monitor production meters throughout the loading cycle and adjust primarily the number and opening sizes of water ports. Water port openings on top of the drag head, or on raised stand pipes above the drag head, shall be screened before they are utilized on the dredging project. If a dredge section includes sandy shoals on one end of a tract line and mud sediments on the other end of the tract line, the Contractor shall adjust the equipment to eliminate drag head pick-ups to clear the suction line.

### 3.1.8 Sea Turtle Relocation Trawling

Agreements with environmental agencies require Sea turtle relocation trawling following the take of two (2) turtles (any species) in a 24-hour time period or four (4) turtles within a two month period, or in other circumstances that NMFS deems appropriate. Such circumstances include a large number of cumulative takes during the project (e.g., 1/2 of the anticipated incidental take level for the channel being dredged based on volume to be removed during that dredge cycle), or other evidence indicating that protected species presence is high. Turtle trawling and the relocation survey must be initiated within 24 hours of the incidental take or the CONTRACTOR WILL BE REQUIRED TO SUSPEND DREDGING OPERATIONS AT THEIR OWN EXPENSE until such trawling can be initiated. This does not preclude "Contracting Officer Directed Standby Time." Trawling must continue for at least 5 consecutive days, unless precluded by inclement weather, after which NMFS may continue or suspend the survey.

The results of each trawl shall be recorded on Sea Turtle Trawling Report. A Final Sea Turtle Trawling Report shall be prepared after the completion of all trawling efforts. Both reports shall be submitted in hard copy and electronic format to the Contracting Officer, and shall summarize the results of the trawling (with all forms and including total trawling times, number of trawls and number of captures). Any turtles captured during the survey shall be measured in accordance with standard biological sampling procedures with sampling data recorded on Sea Turtle Relocation Report.

### 3.1.9 Sea Turtle Trawling Procedures

Sea turtle trawling and relocation procedures and equipment shall comply and be conducted in accordance with the Maintenance of Chesapeake Bay Entrance Channels and use of sand borrow areas for beach nourishment (F/NER/2018/14816)Biological Opinion “Sea Turtle Trawling and Relocation Guidelines”. Methods and equipment shall be standardized including data sheets, nets, trawling direction to tide, length of station, length of tow, and number of tows per station. Data on each tow shall be recorded using Sea Turtle Trawling Report The trawler shall be equipped with two 60-foot nets constructed from 8-inch mesh (stretch) fitted with mud rollers and flats as specified in Appendix D of the biological opinion. Paired net tows shall be made for 10 to 12 hours per day or night. Trawling shall be conducted with the tidal flow using repetitive 15-30 minute (total time) tows in the channel. Trawl speeds shall not exceed 3.5 knots. Tows shall be made such that the total width of the dredging area bottom is sampled. Positions at the beginning and end of each tow shall be determined from GPS Positioning equipment. Tow speed shall be recorded at the approximate midpoint of each tow. Refer to COE EM 1110-1-1003, paragraph 5.3 and Table 5-1, for acceptable GPS criteria.

### 3.1.10 Trawling Water Quality and Physical Measurements

Water temperature measurements shall be taken at the water surface each day using a laboratory thermometer. Weather conditions shall be recorded from visual observations and instruments on the trawler. Weather conditions, air temperature, wind velocity and direction, sea state-wave height, and precipitation shall be recorded on the Sea Turtle Trawling Report. High and low tides shall be recorded.

### 3.1.11 Approved Trawling Supervisor

Trawling shall be conducted under the supervision of a biologist approved by the NMFS. A letter of approval from NMFS shall be provided to the Contracting Officer prior to commencement of trawling. At least one (1) crewmember, who is a National Oceanic and Atmospheric Administration (NOAA) Fisheries-approved observer or NMFS approved biologist, shall be on board the trawler during the trawl and act as the sea turtle trawling and relocation supervisor.

### 3.1.12 Trawling Report Submission

Following completion of the project, a copy of the Contractor's log regarding sea turtles shall be forwarded to the Contracting Officer within 10 working days.

### 3.1.13 Turtle taken by relocation trawler

(1) Live turtles – Live sea turtles shall be kept no longer than 12 hours prior to release and shall be released at locations at least 3 nautical miles (nmi) away from the project area, at time intervals designated by the Sea Turtle Trawling and Relocation Supervisor who is proficient in the viable handling and relocating of sea turtles.

(2) Dead turtles – Any turtle found dead in the nets during relocation trawling efforts shall be digitally photographed, measured, weighed (if possible), scanned for tags. The carcass should then be placed on ice and kept cold (but not frozen) as quickly as possible and

the Contracting Officer shall be notified. The Contracting Officer in coordination with NMFS will determine the disposition of the carcass for disposal or necropsy. If the Contracting Officer in coordination with NMFS decides to dispose of the carcass in lieu of necropsy, the carcass should be marked (spray paint works well), weighted down and disposed of in accordance with the direction of the Contracting Officer and Environmental Manager.

### 3.1.14 Turtle Weight / Size Requiements for Trawling

Weight/Size Measurements Turtles shall be measured, and weighed. Turtle measurements shall be recorded and shall include, at a minimum, weight when possible, straight-line length, straight-line width, body depth, and tail length. The Carcass shall also be scanned for flipper and Passive Integrated Transponder (PIT) tags. Any identified tags shall be recorded on the “Sea Turtle Incidental Take Form” that is included in the Endangered Species Observer Program Forms. A tissue sample shall be collected from any lethally taken sea turtle and submitted under the process stated in the “Protocol for Collecting Tissue Samples from Turtles for Genetic Analysis” included in the Biological Opinion.

### 3.1.15 Trawling Permits

The Contractor shall be responsible for obtaining permits related to trawling from the Virginia Marine Resources Commission.

### 3.1.16 Reporting Requirements

In addition to reports specified elsewhere, complete and submit the following Forms when applicable:
- Sturgeon Incidental Take Data Form
- Endangered Species Observer Program, Large Whale Observation Data
- Invoice From VAQS
- Contractor's Invoice Documenting Payment Received From VAQS
- Protected Species Observers Resume And NMFS Approval Letter
- Letter Of Approval From NMFS Authorizing Turtle Trawling

## 3.2 SPEED RESTRICTIONS TO PROTECT NORTH ATLANTIC RIGHT WHALES

The Speed Restriction to protect North Atlantic Right Whales under 50 CFR 224.105 does not apply to vessels operating under contract to the Federal Government, and therefore are not applicable to this contract. Please defer to 3.1.5 Protected Whales and Other Listed Species Bridge Watch Requirements, in this section for contract requirements to protect North Atlantic Right Whales.

-- End of Section --

SECTION 01 78 00

CLOSEOUT SUBMITTALS
**05/19, CHG 1: 08/21**

# PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| ERDC/ITL TR-19-6 | (2019) A/E/C Graphics Standard, Release 2.1 |
| ERDC/ITL TR-19-7 | (2019) A/E/C CAD Standard - Release 6.1 |

## 1.2 DEFINITIONS

### 1.2.1 As-Built Drawings

As-built drawings are the marked-up drawings, maintained by the Contractor on-site, that depict actual conditions and deviations from the Contract Documents. These deviations and additions may result from coordination required by, but not limited to: contract modifications; official responses to submitted Requests for Information (RFI's); direction from the Contracting Officer; design that is the responsibility of the Contractor, and differing site conditions. Maintain the as-builts throughout construction as hard copies on site or PDF files. These files serve as the basis for the creation of the record drawings.

### 1.2.2 Record Drawings

The record drawings are the final compilation of actual conditions reflected in the as-built drawings.

### 1.2.3 USACE CAD/BIM Technology Center

The USACE CAD/BIM Technology Center hosts all standard content for USACE. This content can be accessed through the CAD/BIM Technology Center website, https://cadbimcenter.erdc.dren.mil/.

## 1.3 SOURCE DRAWING FILES

Request the full set of electronic drawings, in the source format, for Record Drawing preparation, after award and at least 30 days prior to required use.

### 1.3.1 Terms and Conditions

Data contained on these electronic files must not be used for any purpose other than as a convenience in the preparation of construction drawings and data for the referenced project. Any other use or reuse is at the sole risk of the Contractor and without liability or legal exposure to the Government. The Contractor must make no claim and waives to the fullest extent permitted by law, any claim or cause of action of any nature

against the Government, its agents or sub consultants that may arise out of or in connection with the use of these electronic files. The Contractor must, to the fullest extent permitted by law, indemnify and hold the Government harmless against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

These electronic CAD drawing files are not construction documents. Differences may exist between the CAD files and the corresponding construction documents. The Government makes no representation regarding the accuracy or completeness of the electronic CAD files, nor does it make representation to the compatibility of these files with the Contractor hardware or software. In the event that a conflict arises between the signed and sealed construction documents prepared by the Government and the furnished Source drawing files, the signed and sealed construction documents govern. The Contractor is responsible for determining if any conflict exists. Use of these Source Drawing files does not relieve the Contractor of duty to fully comply with the contract documents, including and without limitation, the need to check, confirm and coordinate the work of all contractors for the project. If the Contractor uses, duplicates or modifies these electronic source drawing files for use in producing construction drawings and data related to this contract, remove all previous indicia of ownership (seals, logos, signatures, initials and dates).

## 1.4 RECORD DRAWINGS

The Government will provide pdf and or program files at the preconstruction conference that contains one set of "as-designed" electronic CAD files in the specified software and format revised to reflect all amendments and the final contract PDF drawings. The CAD files are provided to enable preparation of as-built or as-constructed drawings. If discrepancies exist between the CAD files and the contract PDF drawings, correct the CAD files to show the contract PDF drawings.

### 1.4.1 Variation with Contract Drawings

The electronic files provided are not part of the contract documents. If there is any discrepancy between the electronic files and the contract drawings, the contract drawings govern. The Government has no responsibility to modify any GFM due to changes in the design that occur after award.

Evaluate the content and quality of the GFM upon receipt. If major discrepancies or omissions occur in the GFM, notify the Contracting Officer and indicate the nature of such variations.

### 1.4.2 Data Loss, Corruption, and Error

Transfer of GFM files may result in corrupted files resulting in data loss and errors. Use of GFM files at own risk. Verify data integrity upon receipt and request a replacement if necessary. Make any adjustment in file structure, format, or software version as needed to make GFM compatible with computer systems and/or software to meet the requirements of the contract.

## 1.5 SUBMITTALS

Government approval is required for submittals with a "G" or "S"

classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-11 Closeout Submittals

As-Built Drawings; G

Record Drawings; G

## 1.6 QUALITY CONTROL

Additions and corrections to the contract drawings must be equal in quality and detail to that of the originals. Line colors, line weights, lettering, layering conventions, and symbols must conform to ERDC/ITL TR-19-7.

## 1.7 PAYMENT

No separate payment will be made for Construction Drawings of Record required under this contract, and all costs accrued in connection with such drawings shall be considered a subsidiary obligation of the Contractor.

# PART 2 PRODUCTS

## 2.1 RECORD DRAWINGS

Prepare the CAD drawing files in a format compatible with a Windows 10 operating system.

### 2.1.1 Additional Drawings

If additional drawings are required, prepare them using the specified electronic file format applying ERDC/ITL TR-19-7 and ERDC/ITL TR-19-6. The title block and drawing border to be used for any new final record drawings must be identical to that used on the contract drawings.

#### 2.1.1.1 Sheet Numbers and File Names

If a sheet needs to be added between two sequential sheets, append a Supplemental Drawing Designator in accordance with ERDC/ITL TR-19-7 Adding a drawing sheet, and ERDC/ITL TR-19-6 Adding or deleting drawing sheets and index sheet procedures.

## 2.2 PDF AS-BUILT FILES

Provide electronic PDF "plots" of all contract drawings sheets associated with the as-built drawing submittal. Compile and organize the PDF set to match the contract drawings. Bookmark and label the pages of the PDF file in accordance with Section 01 33 16.00 10 DESIGN DATA (DESIGN AFTER AWARD).

## 2.3 REDLINES AND MARKUPS

Provide PDFs of the current working redlines and/or markups complying with the as-builts drawing and markup requirements contained in this

specification.

## 2.4 AS-BUILT RE-SUBMISSION REQUIREMENTS

If elements of an as-built submittal package are rejected, provide the following for each re-submission, in addition to any information required in Section 01 33 00 SUBMITTAL PROCEDURES:

a. Re-submit all components required under paragraph As-Builts or Advanced Modeling Package, including a new Advanced Modeling Submittal Checklist and updated content in response to Government comments.

b. Provide a copy of all Government review comments.

c. Provide a disposition/response to each Government review comment for a back-check of the re-submission deliverable.

# PART 3 EXECUTION

## 3.1 AS-BUILT DRAWINGS

Provide and maintain two black line print copies of the PDF contract drawings for As-Built Drawings. Maintain the as-builts with survey data throughout construction as hard copies on site or PDF files. Submit As-Built Drawings 30 days prior to Beneficial Occupancy Date (BOD).

### 3.1.1 Markup Guidelines

Make comments and markup the drawings complete without reference to letters, memos, or materials that are not part of the As-Built drawing. Show what was changed, how it was changed, where item(s) were relocated and change related details. These working as-built markup prints must be neat, legible and accurate as follows:

a. Use base colors of red, green, and blue. Color code for changes as follows:

   (1) Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes.

   (2) Deletions (Red) - Over-strike deleted graphic items (lines), lettering in notes and leaders.

   (3) Additions (Green) - Added items, lettering in notes and leaders.

b. Provide a legend if colors other than the "base" colors of red, green, and blue are used.

c. Add and denote any additional equipment or material facilities, service lines, incorporated under As-Built Revisions if not already shown in legend.

d. Use frequent written explanations on markup drawings to describe changes. Do not totally rely on graphic means to convey the revision.

e. Use legible lettering and precise and clear digital values when marking prints. Clarify ambiguities concerning the nature and application of change involved.

f. Wherever a revision is made, also make changes to related section views, details, legend, profiles, plans and elevation views, schedules, notes and call out designations, and mark accordingly to avoid conflicting data on all other sheets.

g. For deletions, cross out all features, data and captions that relate to that revision.

h. For changes on small-scale drawings and in restricted areas, provide large-scale inserts, with leaders to the applicable location.

i. Indicate one of the following when attaching a print or sketch to a markup print:

(1) Add an entire drawing to contract drawings

(2) Change the contract drawing to show changes on the drawing.

(3) Provided for reference only to further detail the initial design.

j. Incorporate all shop and fabrication drawings into the markup drawings.

### 3.1.2 As-Built Drawings Content

Revise As-Built Drawings and red-lined PDF files in accordance with ERDC/ITL TR-19-6 and ERDC/ITL TR-19-7. Keep these working as-built markup drawings current on a weekly basis and at least one set available on the jobsite at all times. Changes from the contract drawings which are made during construction or additional information which might be uncovered in the course of construction must be accurately and neatly recorded as they occur by means of details and notes. Submit the working as-built markup drawings for approval prior to submission of each monthly pay estimate. For failure to maintain the working and final record drawings as specified herein, the Contracting Officer will withhold 10 percent of the monthly progress payment until approval of updated drawings. Show on the as-built drawings, but not limited to, the following information:

a. Changes or Revisions which result from the final inspection.

b. Where contract drawings or specifications present options, show only the option selected for construction on the working as-built markup drawings.

c. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, furnish a contour map of the final borrow pit/spoil area elevations.

d. Modifications.

e. Unusual or uncharted obstructions that are encountered in the contract work area during construction.

## 3.2 RECORD DRAWING FILES

If additional drawings are required, prepare them using the specified electronic file format applying ERDC/ITL TR-19-7 and ERDC/ITL TR-19-6. The title block and drawing border to be used for any new final record drawings must be identical to that used on the contract drawings.

Accomplish additions and corrections to the contract drawings using CAD files. Provide all program files and hardware necessary to prepare final PDF record drawings. The Contracting Officer will review final PDF record drawings for accuracy and return them to the Contractor for required corrections, changes, additions, and deletions.

### 3.2.1 Rename the CAD Drawing files

Rename the CAD Drawing files using the contract number as the Project Code field,(e.g., W91238-15-C-10A-102.DWGDGN) as instructed in the Pre-Construction conference. Use only those renamed files for the Marked-up changes. Make all changes on the layer/level as the original item.

a. For AutoCAD files (DWG), enter all as-built delta changes and notations on the AS-BUILT layer.

b. When final revisions have been completed, show the wording "RECORD DRAWING AS-BUILTS" followed by the name of the Contractor in letters at least 5 mm 3/16 inch high on the cover sheet drawing. Date RECORD DRAWING AS-BUILTS" drawing revisions in the revision block.

c. Within 20 days after Government approval of all of the working record drawings for a phase of work, prepare the final CAD record drawings for that phase of work and submit PDF drawing files and two sets of prints for review and approval. The Government will promptly return one set of prints annotated with any necessary corrections. Within 10 days revise the CAD files accordingly at no additional cost and submit one set of final prints for the completed phase of work to the Government. Within 20 days of substantial completion of all phases of work, submit the final record drawing package for the entire project. Submit one set of electronic CAD files, and one set of the approved working record PDF and or programfiles with two sets of prints. The CAD files must be complete in all details and identical in form and function to the CAD drawing files supplied by the Government. Prepare AutoCAD files for transmittal using e-Transmit. Make any transactions or adjustments necessary to accomplish this. The Government reserves the right to reject any drawing files it deems incompatible with the customer's CAD system. Paper prints, drawing files and storage media submitted will become the property of the Government upon final approval. Failure to submit final record PDF drawing files, CAD files and marked prints as specified will be cause for withholding any payment due under this contract. Approval and acceptance of final record drawings must be accomplished before final payment is made.

## 3.3 RECORD DRAWINGS

Prepare final record drawings after the completion of each definable phase of work as listed in the Contractor Quality Control Plan. Transfer the changes from the approved working as-built markup drawings to the original electronic CAD drawing files. Modify the as-built CAD drawing files to correctly show the features of the project as-built by bringing the working CAD drawing set into agreement with approved working as-built markup drawings, and adding such additional drawings as may be necessary. Refer to ERDC/ITL TR-19-6. Jointly review the working as-built markup drawings with printouts from working as-built CAD drawing PDF files for accuracy and completeness. Monthly review of working as-built CAD drawing PDF file printouts must cover all sheets revised since the previous review. These PDF drawing files are part of the permanent records of this

project. Any drawings damaged or lost must be satisfactorily replaced at no expense to the Government.

Drawing revisions (include within change order price the cost to change working and final record drawings to reflect revisions) and compliance with the following procedures.

a. Follow directions in the revision for posting descriptive changes.

b. The revision delta size must be 8 mm 5/16 inch unless the area where the delta is to be placed is crowded. Use a smaller size delta for crowded areas.

c. Place a revision delta at the location of each deletion.

d. For new details or sections which are added to a drawing, place a revision delta by the detail or section title.

e. For minor changes, place a revision delta by the area changed on the drawing (each location).

f. For major changes to a drawing, place a revision delta by the title of the affected plan, section, or detail at each location.

g. For changes to schedules or drawings, place a revision delta either by the schedule heading or by the change in the schedule.

### 3.3.1 Final Record Drawing Package

Submit the final record PDF and CAD drawings package for the entire project within 20 days of substantial completion of work. Submit one set of ANSI D size PDF and CAD files, two sets of ANSI D size prints and one set of the approved working record drawings. The package must be complete in all details and identical in form and function to the contract drawing files supplied by the Government.

-- End of Section --

# SECTION 35 20 23

# DREDGING
**08/20**

## PART 1 GENERAL

### 1.1 GENERAL INFORMATION

This Section covers furnishing suitable dredging plant and performing all work required to remove the specified materials from within the prescribed work area limits as indicated, and placement of the dredge material within the prescribed material placement areas. The Contractor is responsible for making their own investigation of submerged, surface, and overhead structures in the work areas and other locations they find necessary to traverse. The exact location, depths, and heights of various structures including, but not limited to submarine cables, pipes, highlines, docks, piers, bulkheads, and bridges (as applicable), are not known and it will be necessary for the Contractor to ascertain interference problems and notify the respective owners in advance of dredging operations. The Contractor is responsible for making necessary arrangements with the respective owners of the structure(s) to assure satisfactory completion of dredging in the vicinity with a minimum interruption of service, and must perform their operations in such a manner as will avoid damage to these facilities.

### 1.2 DEFINITIONS

#### 1.2.1 Maintenance Material

Maintenance material is defined as that comprising shoaling which has occurred since the channel areas were last dredged.

#### 1.2.2 New Work Material

New work material is defined as previously undredged material.

#### 1.2.3 Hard Material

Hard material is defined as material requiring blasting orthe use of special equipment for economical removal, and includes boulders or fragments too large to be removed in one piece by the dredge.

#### 1.2.4 Economic Bin Load

An economic bin load is defined as that hopper load, measured in cubic yards (or tons) of dredged material dredged and hauled during a single dredging cycle which will yield, for the particular dredge, the maximum rate of removal and hopper retention of material from the project area and which will result in a minimum cost per cubic yard (or ton) hauled. The economic load is dredged when the retained cubic yards per minute of total cycle time (i.e. pumping, turning, running to and from dump, and dumping) equals the incremental retained cubic yards per pumping minute.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submit the following in accordance with Section 01 33 00

SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Economic Load Calculation; G

SD-07 Certificates

Protection Plan

Equipment And Machinery Operator Authorization

The Contractor Shall Submit A List Of Designated Personnel Qualified And Authorized To Operate Machinery And Equipment. The List Shall Be Maintained At The Job Site In A Current Status At All Times.

Surveys During Progress Of Work

## 1.4 NATIONAL DREDGING QUALITY MANAGEMENT PROGRAM

NATIONAL DREDGING QUALITY MANAGEMENT PROGRAM is required for all dredges employed on the work. See 35 20 23.23 NATIONAL DREDGING QUALITY MANAGEMENT PROGRAM - HOPPER DREDGE.

## 1.5 METHOD OF COMMUNICATION

Provide a system of communication between the dredge crew and the crew at the placement area. A portable two-way radio is acceptable.

## 1.6 OTHER DREDGING OPERATIONS

While there are no active permits or current permit applications for dredging in the Sandbridge borrow area, the Contractor should anticipate the possibility of concurrent dredging operations, adjacent to or nearby the dredge and placement areas in this contract. Delays should be anticipated in transiting to, and through, the placement sites during concurrent dredging and placement operations. As a standard safety precaution, observe all placement site specific restrictions pertaining to the limit of dredges operating within at any given time. Coordination with other dredge plant in the vicinity of the dredge and placement areas is required. See 01 30 00 ADMINISTRATIVE REQUIREMENTS, regarding coordination with other contractors for additional information.

## 1.7 SECURITY OF WORK AREAS PROTECTION PLAN

### 1.7.1 Placement Site Security and Safety

The placement site is located at the Sandbridge Beach in Virginia Beach, Virginia. This site is owned and operated by the City of Virginia Beach. The Contractor is informed the Government will not undertake to exclude the public or restrict public access to the beach placement site during the work.

See 01 14 00 WORK RESTRICTIONS, paragraph 1.4 regarding work requirements, including, but not limited to, work schedule, lighting requirements, seasonal restrictions, access to the work site, and noise control.

### 1.7.2 Dredge Site Security and Safety

The dredge site is accessible to the general public. The Contractor is informed the Government will not undertake to exclude the public or restrict public access to the dredging site during the work. The Contractor shall be solely responsible for protection of the public within the dredge site at all times for the duration of the contract and fully comply with the provisions of OSHA safe working practices and the Safety and Accident Prevention requirements of these specifications.

## 1.8 LAYOUT OF WORK AND SURVEYS

### 1.8.1 General

The Contractor is responsible for the expense and layout of all work and shall utilize a differential GPS electronic survey and dredge positioning system to perform all scheduled dredging operations with accuracies as specified in the Project Classification Requirements as outlined in U.S. Army Corps of Engineers Hydrographic Survey Manual EM 1110-2-1003. The plane of reference shall be North American Vertical Datum of 1988 (NAVD 88), as established by the National Geodetic Survey (NGS), as used on the drawing and in these specifications.

#### 1.8.1.1 Dredge Electronic Survey and Positioning System

The Contractor shall provide real time positioning on a computer screen during dredging and dredged material disposal operations, and the Contractor shall have the capability of playback in 15 minute intervals. The position must be recorded on a disk every 60 seconds and submitted to the Contracting Officer on a weekly basis. All electronic survey and dredge positioning systems equipment, and the work accomplished with the use of the systems, must render results in the same coordinate system as indicated on the contract drawings. All completed work shall be reviewed and certified as accurate by the Contractor's Quality Control Manager. This signed certification shall be submitted as a part of the Daily Report of Operations in accordance with the requirements of 01 45 00.15 10 RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM) to ensure that all work performed with the use of the equipment and systems meets contract requirements. In the event of a system failure, all disposal operations must cease until the navigational capabilities are restored. Backup systems with the capablities of the main system are acceptable.

#### 1.8.1.2 Datum and Benchmarks

The plane of reference shall be NAVD 88, and identified on the drawings and referenced in these specifications. At the dredging site, tidal values will be determined using tidal zoning values developed by NOS. The government will furnish tidal zoning values developed by NOS and, if necessary, will furnish benchmark descriptions for the project at the Preconstruction Conference.

## 1.9 PLANT

All dredging plant, equipment and machinery and all supporting plant utilized to accomplish the work, shall be subject to inspection and approval by the Government. All plant employed on the work must be kept in good condition at all times. Any leaks or deficiencies shall be promptly and properly repaired.

### 1.9.1 Minimum Plant Requirements and Contractor Required Certifications

Submit a complete List of Floating Plant to be used in the work, including booster pumps, skiffs, barges, and other related equipment prior to award. The list shall include year and manufacturer, operational capacities, safety features, operating and licensing requirements for operators, Equipment and Machinery Operator Authorization and a description where and how the plant or item of equipment will be employed in the work. Clearly indicate on which projects the dredge has been used in similar conditions to dredge similar material at a production rate sufficient to accomplish the work as scheduled for this contract.

#### 1.9.1.1 Certification of Attendant and Auxiliary Plant

In addition to the requirements of EM 385-1-1, all supporting floating plant for dredging operations shall have a current marine survey inspection certificate. The only exceptions to this requirement include pipeline support pontoons or floats and outboard skiffs less than 20 feet in length. The certification shall have been issued by an accredited marine surveyor within the previous 12 months. The marine surveyor must be accredited by either the National Association of Marine Surveyors or the Society of Accredited Marine Surveyors. Attendant plant that does not have a valid certification and is greater than 20 feet in length shall not be used on this contract. The certifications and inspection shall be appropriate for the intended use of the plant in all locations specified in this contract.

#### 1.9.1.2 Pre-Award Survey Evaluation

The Government will conduct a Pre-Award Survey to evaluate the verification documents of the Contractor for compliance to all contract requirements. Unless the Contracting Officer determines otherwise, documentation of the inspection for each piece of plant must be in possession of the Contracting Officer within 10 calendar days after bid opening. Inadequate documentation, insufficient plant certifications to meet requirements, and untimely submittal of required documentation will be cause for rejection of the bid. Additionally, as a part of the Pre-Award Survey, the Contractor must make all intended plant available for inspection and acceptance.

Once the dredge(s) and plant have been inspected and accepted by the Government, and have been mobilized to the project site, they shall not be removed from the project site until all scheduled work for the contract has been satisfactorily performed by the Contractor and accepted by the Government, except by written permission of the Contracting Officer or commencement of a seasonal dredge restriction.

### 1.9.2 Pumping of Bilges

Contractors are warned that pumping oil or bilge water containing oil into navigable waters, or into areas which would permit the oil to flow into such waters, is prohibited by Section 13 of the River and Harbor Act of 1899, approved 3 March 1899 (30 Stat. 1152; 33 U.S.C. 407). Violation of this prohibition is subject to the penalties under the referenced Acts.

### 1.9.3 Fuel Oil Transfer Operations

In accordance with U.S. Coast Guard regulations 33 CFR PART 156.120, couplings used in fuel oil transfer operations on any vessel with a

capacity of 250 or more barrels of oil shall be either a bolted or full-threaded connection, or a quick-connect coupling approved by the Commandant, or an automatic back-pressure shutoff nozzle used to fuel the vessel. An executed fuel oil transfer (Declaration) form signed by the tanker operator shall be submitted to the Contracting Officer for each refueling operation.

### 1.9.4 Signal Lights

The Contractor shall display signal lights and conduct his operations in accordance with the General Regulations of the of the Coast Guard. These regulations govern lights and day signals to be displayed on towing vessels with tows on which no signals can be displayed, on vessels working on wrecks, on dredges, on vessels engaged in laying cables or pipe, on vessels engaged in submarine or bank protection operations, on dredge pipe lines, on vessels of more than 65-feet in length moored or anchored in a fairway or channel, and on vessels passing by other vessels of floating plant working in navigable channels, as approved by the Commandant, U. S. Coast Guard.

### 1.9.5 Bridge-to-Bridge Radio Communication

In order that radio communication may be made with passing vessels, all dredges engaged in work under this contract shall be equipped with bridge-to-bridge radio telephone equipment in accordance with 33 U.S.C. 24, as applicable. The radio telephone equipment shall operate on a single channel very high frequency (VHF), FM, on a frequency of 156.65 megahertz (Channel 13 and 16) with low power output having a communication range of approximately ten miles. The Federal Communications Commission has approved the frequency.

## PART 2 PRODUCTS

### 2.1 CHARACTER OF MATERIAL

The Government does not guarantee that borings indicate actual conditions, except for the exact locations and the time that they were made. The data are available for examination by prospective bidders within the attachments to these specifications.

Elevations shown on the boring logs are approximate. The soils to be dredged for suitable beach fill material are predominantly composed of fine to medium-grained, shelly, poorly graded, quartz sands (SP), medium to coarse-grained, shelly, poorly graded sand with silt/clay (SP-SM or SP-SC), and fine to coarse, well-graded sands (SW) with varying amounts of shell material. Unsuitable beach fill material such as CH, MH and SM may be encountered as thin lenses within the authorized dredging prism. Unsuitable materials such as GW, GP, GM, SM, OH, ML, OL, CL, SC, and CH are present in significant thickness at elevations that lie below the minimum dredge elevations shown in the contract drawings.

The dredging shall be accomplished so that the most suitable material available for beach fill is placed within the prescribed section. Suitable material shall be comprised of materials classified by ASTM D2487 as SW, SP, SP-SM, SP-SC, SW-SM, or SW-SC. This material should be predominantly of sand (SP, SP-SM) with no more than 10% by weight passing the No. 200 sieve, and no more than 5% by weight coarser than the No. 4 sieve. Should the material being placed on the beach contain an excessive amount of silt and clay and considered not suitable for placement on the beach, the

Contractor will be directed by the Contracting Officer or his/her designated representative to move to a more satisfactory location within the indicated borrow area. The Contractor shall be required to mix and cover any excessive amount of fines with suitable material as directed by the Contracting Officer or his/her designated representative.

Objectionable matter such as stumps, roots, logs, or other organic or inorganic debris having a diameter of 2 inches or more and/or a length of 1 foot or more, or accumulations of small vegetative growth or debris shall be collected and placed in a disposal area furnished by the Contractor and approved by the Contracting Officer or his/her designated representative as the work progresses. Objectionable matter such as large clay balls shall be identified to the Contracting Officer or his/her designated representative for a decision on acceptable dispersal or, in the event of an unacceptable number/amount, removal. If removal is not required, the clay balls shall be broken up and dispersed and/or mixed in with the beach fill section by way of tilling or other appropriate method approved by the Contracting Officer or his/her designated representative.

In the event that noticeable amounts of sediments smaller than 0.0625 millimeters (#200 sieve) or larger than 2.0 millimeters (#10 sieve) are observed being disposed of on the beach, the Contractor shall promptly notify the Contracting Officer or his/her Designated Representative to determine appropriate measures to be taken per the Contractor's Noncompliant and Unacceptable Material Contingency Plan.

Should the Contractor encounter rock, high percentage of fines, or objectionable material during dredging operations, the Contractor shall stop dredging and notify the Contracting Officer or his/her designated representative where the unsuitable material is located. The accumulation of too large an amount of fine-grained sediment (silt and clay balls) or shell or rock or objectionable material at any one location on the beach may adversely affect the ability of sea turtles to successfully nest. The Contractor shall promptly notify the Contracting Officer or his/her Designated Representative if the following objectionable soils are inadvertently placed on the beach; soils containing greater than 10% fines (grain sizes < 0.075 mm or passing the #200 sieve) by weight, rock and cobbles, or excessive amounts of shell (No more than 5% coarser than the #4 sieve). The Contracting Officer or his/her designated representative will first determine if the incompatible material can be dispersed over and mixed into previously placed material. The Contractor is advised that in extreme situations where the Contracting Officer or his/her designated representative determines the incompatible material is too dense or too extensive to adequately disperse and mix, in order to prevent adverse impacts to sea turtle nesting, removal of the incompatible material from the beach may be required. The Contractor shall remove the incompatible material at no cost to the Government.

The Government shall not be responsible for any interpretation of, or conclusion drawn from the data or information by the Contractor. Bidders are expected to examine the site of work and after examination decide for themselves the character of material.

The material to be removed is sand. The percentages of the predominant material to be dredged is as follows:

**Table 1**

| Dredge Box | Do Not Exceed Depth - NAVD 88 ft | Target Dredging Elevation - NAVD 88 ft | Percent Fines | Percent Gravel | Percent Sand | Mean (mm) | Overfill | Sand Thick-ness (ft) |
|---|---|---|---|---|---|---|---|---|
| Site A Box 1 | -56 | -55 | 3.3 | 1.6 | 95.0 | 0.50 | 1.15 | 9.0 |
| Site A Box 2 | -58 | -57 | 3.9 | 2.1 | 94.0 | 0.50 | 1.07 | 10.0 |
| Site A Box 3 | -54 | -53 | 4.4 | 0.7 | 94.9 | 0.30 | 1.25 | 11.5 |

Remove hard material as needed to achieve the required template. Use of blasting operations will not be permitted.

The material to be removed is from a borrow area. The material to be removed includes material represented in the geotechnical report as well as the shoaling that has occurred since the borrow area was last sampled. Bidders are expected to examine the sites of work and decide for themselves the character of the materials. A geotechnical report summarizing available geotechnical data for the project is provided as an attachment to these specifications. Local minor variations in the subsurface materials are to be expected and, if encountered, will not be considered as being materially different.

## PART 3 EXECUTION

### 3.1 INSPECTION

Inspect the work, keep records of work performed, and ensure that gages, targets, ranges, and other markers are in place and usable for the intended purpose. Provide, at the request of the Contracting Officer, boats, boatmen, laborers, and materials necessary for inspecting, supervising, and surveying the work. When required, provide transportation for the Contracting Officer and inspectors to and from the placement area and between the dredging plant and adjacent points on shore.

The dredge plant will be inspected by the Contracting Officer, or their representative, prior to beginning work to ensure total dredging plant is in safe working condition. Before any machinery or mechanized equipment is placed in service, it must be inspected and tested by the Contractor and certified to be in safe operating condition.

### 3.2 DREDGING

#### 3.2.1 Interference with Navigation

Minimize interference with the use of channels and passages. The Contractor is responsible for shifting or moving of dredges or the interruption of dredging operations to accommodate the movement of vessels and floating equipment, if necessary. Adhere to Coast Guard Regulations for passing vessels.

### 3.2.2 Lights

Each night, between sunset and sunrise and during periods of restricted visibility, provide lights for floating plants, pipelines, ranges, and markers. Also, provide lights for buoys that could endanger or obstruct navigation. When night work is in progress, maintain lights from sunset to sunrise for the observation of dredging operations. Lighting must conform to United States Coast Guard requirements for visibility and color.

### 3.2.3 Navigation Warnings

Furnish and maintain navigation warning signs along any pipelines. Provide notice to increase public awareness of potential hazards presented by dredge plant equipment by stating the location, date of construction, equipment mooring, marshaling areas, using local newspapers, radios, television, waterway users associations, or other appropriate area specific communication networks. Ensure that an announcement is made through the same networks at the beginning of the dredging operation. Make periodic updates/status announcements at intervals of not more than a month throughout the contract life.

Display a sturdy and prominent warning sign at all public boat marinas within 10 miles of dredging operations or moored equipment. The Contractor is responsible for keeping this sign current with respect to the dredging operations or equipment. The Contractor shall erect and maintain these signs and any other signs necessary to prevent hazards to navigation at their own expense.

### 3.2.4 Ranges, Gages, and Lines

Provide, set, and maintain ranges, buoys, and markers needed to define the work and to facilitate inspection. The Contractor must coordinate with the U.S. Coast Guard prior to placing any buoy or other aid marker in the water. Buoys and aid markers must be maintained throughout the length of the dredging operation and must not be colored, marked, or placed in a manner that will obstruct or be confused with other navigational aids. All buoys and aid markers must conform to U.S. Coast Guard regulations. Establish and maintain gages in locations observable from each part of the work so that the depth may be determined. Suspend dredging when the gages or ranges cannot be seen or followed.

### 3.2.5 Dredge Plant and Equipment

a. The Contractor shall perform the scheduled work using one or more hopper dredges.

b. Maintain all dredge plant and associated equipment such as, but not limited to, coamings, barges, and pipelines, to meet the requirements of the work. Promptly repair leaks or breaks along pipelines.

### 3.2.6 Removal and Transport of Material Dredged From Borrow Area

The Contractor shall remove all material by hopper dredge dredge and transport material dredged from the borrow area to a pump out buoy for deposit by a hydraulic pipeline within the beach fill placement area as indicated. The dredge cuts in the borrow area shall not have side slopes steeper than 1 on 3. As much as is practicable, passes of the dredge shall be made in a continuous manner that avoids creating any pits, holes, or deep ridges. Dredging shall not exceed the depths as indicated on the

plans.

### 3.2.7 Hopper Dredge Material Pump Out Controls

The Contractor shall provide constant monitoring of the material placement operations at the pump out buoy. Qualified monitoring personnel shall have fully functional two-way radio communications with the dredge operator and on-beach monitors at all times when pump out operations are in progress. Requirements for monitoring material discharge on the beach is specified in SECTION 35 20 24. Frequent communication checks shall be made to assure proper discharge of the hopper and material placement during the pump out operations. In the event of any communications failure or improper material placement is determined, all pump out and placement operations shall be immediately suspended until communications are restored as approved by the Contracting Officer, or in the event of pump out problems or improper material placement, until proper material placement procedures are reestablished by the Contractor as approved by the Contracting Officer.

### 3.2.8 Examination of Pump Out Buoy and Pipeline

The pump out buoy and pipeline, including connections at the dredge and those used for a submerged line, shall be examined and determined to be in good condition to reasonably expect them to last throughout the job without wearing to the extent of allowing leaks.

#### 3.2.8.1 Leaks

In the event that leaks occur anywhere during pump out of material from the hopper dredge, the contractor will be required to immediately discontinue using the respective equipment until the leaks are stopped. The contractor shall also be required to recover at no cost to the Government any material improperly placed because of a leak or leaks in the equipment.

### 3.2.9 Examination of Dredge Hopper Bins

The hopper bins shall be examined and determined to be in good condition to reasonably expect them to last throughout the job without wearing to the extent of allowing leaks. In the event that leaks occur anywhere in the hopper bins, the Contractor will be required to immediately discontinue using the respective equipment until the leaks are stopped. The Contractor shall also be required to recover at no cost to the Government any material improperly placed because of a leak or leaks in the equipment.

### 3.2.10 Layout of Work

The Contractor will be provided layout charts for all dredging areas based on the schedule of work, the Contractor's hydrosurvey requests, and/or the results of Government hydrographic survey monitoring. The most current Government hydrosurvey information will be displayed on the dredging layout charts and provided to the Contractor. All depths are measured from NAVD 88. Other pertinent information to be included with each layout package will be: payment method, required and maximum dredging depths, coordinates for the material placement site, distance one-way from dredging location to placement site, specific placement site instructions, supplemental tide gauge information, horizontal control locations, and computed hydrosurvey quantities.

The quantities listed are estimates only. All estimated quantities are subject to FAR 52.211-18 Variation in Estimated Quantity.

3.2.10.1 Side Slopes

Side slopes in the dredge areas within this contract will be measured and paid based on a 3 feet horizontal to 1 feet vertical ratio. Dredging on side slopes must follow, as closely as practicable, the dredge area limits indicated on associated layout drawings. No dredging can occur outside of the dredge area and side slope limits.

3.2.11 Obstructions and Debris

The Government has no knowledge of existing wrecks, wreckage, or other material of such size or character as to require the use of explosives or special or additional plant for its economical removal.

3.2.12 Dredging Requirements

Dredge Areas

The Government will direct the Contractor to dredging areas as indicated on the plans. Dredging depths are noted in the Table 1 in paragraph 2.1 of this section, unless otherwise stated in the layout drawing.

Placement Area

Material placement will be on the beach at Sandbridge Beach as indicated on the plans.

3.2.13 Surveys during Progress of Work

Quality of dredging depth will be determined by soundings or sweepings taken behind the dredge as work progresses. The Contractor will take progress soundings or sweepings.

3.2.14 Skimming of Hoppers

Skimming of hoppers must be performed in compliance with environmental requirements and ABS/USCG load line marks.

3.2.15 Salvaged Material

Anchors, chains, firearms, and other articles of value, which are brought to the surface during dredging operations, must remain or become the property of the Government and will be placed on shore at a convenient location near the site of the work, as directed.

3.2.16 Safety of Structures

The prosecution of work must ensure the stability of piers, bulkheads, and other structures lying on or adjacent to the site of the work, insofar as structures may be jeopardized by dredging operations. Repair damage resulting from dredging operations is the responsibility of the Contractor, insofar as such damage may be caused by variation in locations or depth of dredging, or both, from that indicated or permitted under the contract. The Contractor is responsible for coordinating with the owner of the structure for any necessary repairs.

### 3.2.17 Munitions and Explosives of Concern

Refer to 01 35 30 MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) CONSTRUCTION SUPPORT for special plant requirements for screening MEC and other requirements involving safety support and avoidance of potential unexploded ordnance and exploded ordnance, inert ordnance, and ordnance fragments and similar explosives debris material (defined and identified in these specifications as "Munitions and Explosives of Concern", within the dredging prism of the borrow area during performance of dredging activities.

### 3.2.18 Endangered Species

Refer to 01 57 30 ENVIRONMENTAL PERMIT WORK REQUIREMENTS for required special equipment and operating procedures.

## 3.3 PLACEMENT OPERATONS

See also 35 20 24 BEACH FILL for additional information pertaining to beach nourishment.

### 3.3.1 Method of Placement

Provide for safe transportation and disposal of dredged materials. Transport and dispose of dredged material in the areas indicated in the contract documents. Place all dredged material by the hydraulic process. Pipeline for offloading must discharge into the placement area.

The Contractor shall use an approved dredge positioning system with tolerances specified in Section 35 20 23.23 NATIONAL DREDGING QUALITY MANAGEMENT PROGRAM - HOPPER DREDGE to ensure accurate placement of dredged material in the placement area.

### 3.3.2 Placement in Indicated Site(s)

In placing excavated material for fill, uniformly grade and allow for shrinkage. Provide and maintain necessary bulkheads, dikes, ditches, weirs, spillways, and other construction necessary to confine and retain the fill in the dredge fill area.

### 3.3.3 Misplaced Dredged Material

See 01 20 00 PRICE AND PAYMENT PROCEDURES section 1.5 regarding misplaced materials.

### 3.3.4 Submerged Pipelines

If a leak occurs in the discharge pipeline, immediately discontinue using the line until leaks are repaired. Following a leak, the Contractor should conduct, or request the Government to conduct, a hydrosurvey to ensure that any dredged material discharged through the leak did not accumulate or cause mounding. If accumulation did occur, the Contractor must coordinate with the Government to remove the accumulated material, if deemed necessary. The Contractor is responsible for any resulting costs of repair and restoration.

## 3.4 PAYMENT

See 01 20 00 PRICE AND PAYMENT PROCEDURES regarding full descriptions of payment line items, work to be measured, and measurement procedures for payment.

## 3.5 QUALITY CONTROL

Establish and maintain quality control for operations to ensure compliance with contractual requirements and maintain records of this quality control for dredging operations.

While performing all dredging work control the horizontal positioning of the dredge with electronic positioning.

### 3.5.1 Quality Control for Hydrographic Surveys and Survey Equipment

Hydrographic surveys will be conducted to meet USACE Performance Standards as defined in the Hydrographic Surveying Manual EM 1110-2-1003.

Surveys will be performed by using commercially available Real-Time Kinematic (RTK), in NAD 83, Virginia State Plane - South, U.S. survey feet.

Surveys will be performed by single transducer sounding techniques, multi-beam swath type surveys, or a combination of both at the discretion of the Government.

Bottom soundings will be obtained by the single beam survey fathometer operating at a frequency ranging from 190 to 210 Khz.

When the government utilizes multi-beam technology, the operating frequency will range from 380 to 420 Khz.

All fathometers will be calibrated following procedures outlined in the Hydrographic Surveying Manual EM 1110-2-1003.

#### 3.5.1.1 BOEM Requirements for Bathymetric Surveys

Reference the Memorandum of Agreement with BOEM for additional requirements for bathymetric surveys within the borrow area.

### 3.5.2 Inspections and Testing Requirements

Inspections and testing shall be the responsibility of the Contractor, subject to the approval of the Contracting Officer.

### 3.5.3 Equipment and Machinery Requirements

All measuring equipment, global positioning systems (GPS) and other electronic positioning systems, data plotting and recording equipment, and the procedures associated with each respective item of equipment, shall be subject to the approval of the Contracting Officer. Verification of current calibration for each respective item of equipment, as approved by the Contracting Officer, shall be provided by the Contractor prior to use of the equipment on the work. All records produced by the equipment shall be inspected and certified as complete by the Contractor's Quality Control Representative and included as a part of the Daily Quality Control Report.

### 3.5.4 Miscellaneous Inspections and Test Records

A copy of the records of all inspections and tests, as well as record of corrective action taken, shall be included in the Quality Control Plan and furnished to the Contracting Officer as a part of the Daily Quality Control Report. The Contractor shall establish and maintain quality control for the dredging work and all other operations in connection with the work in the field to ensure compliance with contract requirements. The Contractor shall inspect for compliance with contract requirements and record the inspection of all operations including but not limited to the following:

a. The material is placed to the lines, grade, and tolerances specified.

b. All equipment used in the work is approved and in satisfactory working condition.

c. Checks to ensure safe work practices performed as specified.

d. Ensure all equipment and construction materials have been removed from completed work segments.

e. All results of inspections shall be documented with narrative explanations and photographs as necessary to document the conditions of the field quality. The results and supporting data shall be recorded and provided by the Contractor in the Daily Report of Operations if not otherwise reported via other project requirements.

### 3.5.5 Reporting and Certificates

All measuring, plotting, and recording equipment and procedures shall be subject to the approval of the Contracting Officer. Verification of their calibration, certified by the Contractor's Quality Control Representative, shall be furnished prior to use on the work. All records produced by the equipment shall be authenticated by the authorized representative of the contractor and then provided to the Contracting Officer with the Daily Report of Operations.

## 3.6 DAILY REPORTING REQUIREMENT

The Contractor shall prepare and maintain a Report of Operations and furnish copies daily to the Contracting Officer. A copy of the form prescribed for recording the required information is attached at the end of these specifcations and any further instructions on the preparation of the report will be furnished at the preconstruction conference noted in Section 01 30 00 ADMINISTRATIVE REQUIREMENTS.

## 3.7 ECONOMIC LOADING

### 3.7.1 Dredge Operations - Economic Loading

Conduct hopper dredge operations in a manner that results in the most productive operating cycles and optimizes the amount of material placed in the designated placement site in accordance with economic load. Once the economic load is achieved, the dredge shall discontinue pumping and proceed to the disposal area except that the Contractor may complete the cut in which the dredge is working before proceeding to the placement area.

### 3.7.2 Determining Economic Load

The pumping-time to achieve economic loading shall be determined using the average of the initial three complete cycles for each acceptance section. These determinations shall be used to establish the operating procedures for the hopper dredge throughout the remainder of the applicable acceptance section. Where conditions vary and/or the distance to the placement area is significantly different, a revised Economic Bin Load may be submitted for approval at any time. Methodology for determining Economic Bin Load shall be in accordance with generally accepted industry practice. Eng Form 2590, Economic Load Test, is included as an attachment to these specifications for contractor convenience; however, use of this exact form is not required.

### 3.7.3 Economic Load Calculation

Submit Economic Load calculations for acceptance within 1-week after starting dredging and include current economic load summary data on each daily report. No payment will be made until Economic Load calculations are accepted.

## 3.8 BORROW AREA SURVEYS

### 3.8.1 BOEM MOA Borrow Area Survey Requirements

In accordance with the MOA with BOEM, one hundred percent (100%) coverage using multi-beam bathymetric survey methods is required. Survey lines of the specific dredge area will established at intervals necessary to provide this coverage. All survey lines will extend at least 100 meters ( 328 feet) beyond the borrow area limits as defined in this MOA.

The contractor will submit all bathymetric surveys in NAVD 88.

The BOEM MOA is attached to these specifications.

### 3.8.2 Before Dredge Survey

The Contractor shall be responsible for completing before dredging hydrographic surveys of the borrow site prior to commencing dredging operations. The pre-dredging survey of the Borrow Area will be conducted within 60 days prior to the commencement of dredging. Data shall be submitted to USACE via the Contracting Officer and subsequently provided to BOEM via USACE for review. Timeline for BOEM's review is stated in the MOA attached to the end of the specifications.

### 3.8.3 Progress Surveys

The Contractor shall be responsible for completing progress hydrographic surveys of the borrow area during excavation of borrow material. Progress surveys of the borrow area should be completed at the discretion of the Contracting Officer.

### 3.8.4 After Dredge Survey

The Contractor shall be responsible for completing an after dredging hydrographic survey following completion of dredging operations. The post-dredging survey will be completed within the timeframe outlined by BOEM in the MOA attached to the end of the specifications.

## 3.9 PLANT REMOVAL

Once the dredge(s) and plant have been inspected and accepted by the Government, and have been mobilized to the project site, they shall not be removed from the project site until all all scheduled work for the contract has been satisfactorily performed by the Contractor and accepted by the Government, except by written permission of the Contracting Officer or commencement of a seasonal dredge restriction.

Upon completion of the work, remove all dredging plant, including ranges, buoys, piles, and other markers or obstructions within 15 days.

-- End of Section --

# SECTION 35 20 23.23

# NATIONAL DREDGING QUALITY MANAGEMENT PROGRAM - HOPPER DREDGE
**02/22**

## PART 1 GENERAL

### 1.1 DESCRIPTION

The work under this contract requires use of the National Dredging Quality Management Program (DQM)to monitor the dredge's status at all times during the contract and to manage data history.

This performance-based specification section identifies the minimum required output and the precision and instrumentation requirements. The requirements may be satisfied using equipment and technical procedures selected by the Contractor.

### 1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates

National Dredging Quality Management Program Certification, Norfolk District; G

### 1.3 PAYMENT

Separate payment for installation, operation, and maintenance of the DQM-certified system as specified herein for the duration of the dredging operations is not allowed; all costs in connection therewith are considered a subsidiary obligation of the Contractor and are covered under the contract unit price for beach placement in the bidding schedule.

### 1.4 NATIONAL DREDGING QUALITY MANAGEMENT PROGRAM CERTIFICATION

#### 1.4.1 Certification

The Contractor is required to have a current certification from DQM for the hopper dredge instrumentation system to be used under this contract. Criteria for certification is based on the most recent specification posted on the DQM website: https://www.sam.usace.army.mil/Missions/Spatial-Data-Branch/Dredging-Quality-Managemen Verify compliance with these criteria by annual onsite quality assurance (QA) checks conducted by the DQM Support Center Data Acquisition and Analysis Team and by periodic review of the transmitted data. DQM Certification is valid for one year from the date of the annual QA checks. Certification is contingent upon the system's ability to continuously meet the performance requirements as outlined in paragraph PERFORMANCE REQUIREMENTS. If issues with data quality are not corrected within 48 hours, the system certification will be revoked and additional QA checks by the Data Acquisition and Analysis Team may be necessary.

Annual DQM Certification must be based on the following:

a. A series of quality assurance checks as outlined on the DQM website: https://www.sam.usace.army.mil/Missions/Spatial-Data-Branch/Dredging-Quality-Manag

b. Verification of data acquisition and transfer as described in paragraph Performance Requirements.

c. Review of the Dredge Plant Instrumentation Plan (DPIP) as described in paragraph DREDGE PLANT INSTRUMENTATION PLAN (DPIP).

### 1.4.2 Recertification

The owner or operator of the dredge must contact DQM at https://www.sam.usace.army.mil/Missions/Spatial-Data-Branch/Dredging-Quality-Managemen on an annual basis, or at least three weeks prior to certification expiration, to schedule QA checks for renewal. This notification is meant to make the Data Acquisition and Analysis Team aware of a target date for the annual QA checks for the dredge. At least one week prior to the target date, the Contractor must contact the Data Acquisition and Analysis Team and verbally coordinate a specific date and location. The Contractor must then follow up this conversation with a written email confirmation. The owner/operator must coordinate the QA checks with all local authorities, including but not limited to, the local USACE Contracting Officer's Representative (COR).

Recertification is required for any yard work which produces modification to displacement (change in dredge lines, or repositioning or repainting hull marks), modification to bin volume (change in bin dimensions, or addition or subtraction of structure), or changes in sensor type or location; report these changes in the sensor log section of the DPIP. A system does not have to be transmitting data between jobs; however, in order to retain its certification during this period, the system sensors or hardware should not be disconnected or removed from the dredge. If the system is powered down, retain calibration coefficients.

## 1.5 DREDGE PLANT INSTRUMENTATION PLAN (DPIP)

The Contractor must have a digital copy of the DPIP on file with the DQM Support Center. While working on site, the Contractor must also maintain on the dredge a copy of the DPIP which is easily accessible to Government personnel at all times. This document must describe the sensors used, configuration of the system, how sensor data will be collected, how quality control on the data will be performed, and how sensors/data reporting equipment will be calibrated and repaired if they fail. A description of the computed dredge-specific data and how the sensor data will be transmitted to the DQM database will also be included. A complete list of the required DPIP contents is provided on the DQM website https://www.sam.usace.army.mil/Missions/Spatial-Data-Branch/Dredging-Quality-Managemen

Submit to the DQM Support Center any addendum or modifications made to the plan, subsequent to its original submission, prior to the start of work. Any changes to the computation methods must be approved by the DQM Support Center prior to their implementation.

# PART 2 PRODUCTS

Not used.

# PART 3 EXECUTION

## 3.1 REQUIREMENTS FOR REPORTED DATA

Provide, operate, and maintain all hardware and software to meet these specifications. The Contractor is responsible for replacement, repair, and calibration of sensors and other necessary data acquisition equipment needed to supply the required data. Complete repairs within 48 hours of any sensor failure. Notify the COR upon completion of a repair, replacement, installation, modification, or calibration. The COR may request recalibration of sensors or other hardware components at any time during the contract as deemed necessary.

Keep a log of sensor repair, replacement, installation, modification, and calibration in the dredge's onboard copy of the DPIP. The log must contain a three-year history of sensor maintenance, including the time of the sensor failures (and subsequent repairs), the time and results of sensor calibrations, the time of sensor replacements, and the time that backup sensor systems were initiated to provide required data. It must also contain the name of the person responsible for the sensor work. Install sensors that are capable of collecting parameters within specified accuracies and resolutions indicated in the following subparagraphs. Reported sensor values for ullage, draft, and draghead depth should represent a weighted average with the highest and lowest values not included in the calculated average for the given interval. This information should be documented in the DPIP sections that say "Calculations done external to the instrumentation."

### 3.1.1 Date and Time

Report the date and time to the nearest second and referenced to UTC time based on a 24-hour format: mm/dd/yyyy hh:mm:ss. The reported time must be the time reported by the GPS in the NMEA string.

### 3.1.2 Load Number

A load number must document the end of a disposal event. Load numbering will begin at number 1 at the start of the contract and will be incremented by 1 at the completion of each disposal event or emptying of the hopper. Whenever possible, calculate the load number off of the sensors aboard the dredge, which must be a mathematically repeatable routine. Make efforts to include logic that avoids false load number increments. Do not allow the routine to miss any disposal event. If manual incrementing of the load number is in place, pay extra attention to this value in the quality control process.

### 3.1.3 Horizontal Positioning

Obtain all locations using a positioning system operating with a minimum accuracy level of 1 to 3 meters 3 to 10 feet horizontal Circular Error Probable (CEP). Report positions as Latitude/Longitude WGS 84 in decimal degrees. West Longitude and South Latitude values are reported as negative.

#### 3.1.3.1 Vessel Horizontal Positioning

Record vessel horizontal positioning as geographic coordinates of the vessel as indicated by the location of the GPS antenna.

#### 3.1.3.2 Draghead Horizontal Positioning

Record draghead horizontal positioning as geographic coordinates of the heel on the centerline of the draghead(s). Describe any offset calculations from the GPS antenna in the DPIP.

### 3.1.4 Hull Status

Monitor open/closed status of the hopper dredge, corresponding to the split/non-split condition of a split-hull hopper dredge. For dredges with hopper doors, the status of a single door that is the first opened during normal disposal operations may be monitored. An "open" value indicates that the hopper door is open or, in the case of split-hull dredges, that the hull is split. A "closed" value indicates that the hopper doors are closed or, in the case of split-hull dredges, that the hull is not split.

For this contract, hull status must register closed prior to leaving the disposal area.

### 3.1.5 Dredge Course

Provide dredge course-over-ground (COG) using industry-standard equipment. Provide dredge course-over-ground to the nearest whole degree with values from 000 (true north) to 359 degrees referenced to a clockwise positive direction convention.

### 3.1.6 Dredge Speed

Provide dredge speed-over-ground in knots using industry-standard equipment with a minimum accuracy of 1 knot and resolution to the nearest 0.1 knot.

### 3.1.7 Dredge Heading

Provide dredge heading using industry-standard equipment. The dredge heading must be accurate to within 5 degrees and reported to the nearest whole degree with values from 000 (true north) to 359 degrees referenced to a clockwise positive direction convention.

### 3.1.8 Tide

Obtain tide data using appropriate equipment to give the water level with an accuracy of plus or minus 0.03 meter 0.1 foot and a resolution of 0.003 meter 0.01 foot. Enter tide values above project datum described in the dredging specification with a positive sign and those below with a negative sign.

### 3.1.9 Draft

Report all draft measurements in meters feet, tenths, and hundredths with an accuracy of plus or minus 0.03 meter 0.1 foot relative to observed physical draft readings. Report the measurements at a resolution of two decimal places (hundredths of a meter foot). The reported forward draft value is equal to the sum of the visual forward port and starboard draft mark readings divided by two. The reported aft draft value is equal to the sum of the visual aft port and starboard draft mark readings divided by two. Forward draft, aft draft, and average draft will be reported. Place sensors at an optimum location on the vessel to be reflective of observed physical draft mark readings at any trim or list. Minimum

accuracies are conditional to relatively calm water. The sensor value reported must be an average of at least ten samples per event, with at least one maximum value and one minimum value removed, and the minimum eight remaining values averaged. When the average draft is calculated for the purpose of determining displacement, maintain significant digits for average draft such that if forward draft was 0.15 and aft draft was 0.1, the average draft would be 0.125.

### 3.1.10 Hopper Ullage Sounding

Report all reported ullage soundings in meters feet, tenths, and hundredths with an accuracy of plus or minus 0.03 meter 0.1 foot with respect to the combing and be representative of the forward and aft extents of the hopper as close to the centerline as is possible. Report the measurements at a resolution of two decimal places (hundredths of a foot). Report forward ullage and aft ullage soundings. Mount sensors to avoid discharge flume turbulence, foam, and any structure that could produce sidelobe errors. If sensors must be offset from the centerline of the hopper, they should be offset to opposite sides of the vessel. If more than one fore or one aft sensor are used, place the sensors near the corners of the hopper, and report the average value of the fore sensors and the average value of the aft sensors. The sensor value reported must be an average of at least ten samples per event, with at least one maximum value and one minimum value removed, and the minimum eight remaining values averaged. When the average ullage is calculated for the purpose of determining hopper volume, maintain significant digits for average ullage such that if forward ullage was 0.15 and aft ullage was 0.1, then the average ullage would be 0.125.

### 3.1.11 Hopper Volume

Report hopper volume in cubic meters yards, based on the most accurate method available for the dredge. The minimum standard of accuracy for hopper volume is interpolation from the certified hopper volume table, based on the average fore and aft ullage soundings.

### 3.1.12 Displacement

Report dredge displacement in long tons, based on the most accurate method available for the dredge. The minimum standard of accuracy for displacement is interpolation from the displacement table, based on the average draft. For this contract the density of water used to calculate displacement is 64.21 kg/cubic meter lbs/cubic foot, and it will be used for an additional interpolation between the fresh and salt water tables.

### 3.1.13 Empty Displacement

Report empty displacement in long tons, which is the lightship value of the dredge, or the weight of the dredge with no material in the hopper, adjusted for fuel and water consumption.

### 3.1.14 Draghead Depths

Report draghead depths with an accuracy of plus or minus 0.15 meter 0.5 foot and a resolution to the nearest 0.03 0.1 foot as measured from the surface of the water with no tidal adjustments. Minimum accuracies are conditional to relatively calm water. The sensor value reported must be

an average of at least ten samples per event, with at least one maximum value and one minimum value removed, and the minimum eight remaining values averaged.

### 3.1.15 Slurry Densities

Use a density metering device, calibrated according to the manufacturer's specifications, to record the slurry density of each dragarm to the nearest 0.001 g/cc with an accuracy of plus or minus 0.01 g/cc. If the manufacturer does not specify a frequency of recalibration, conduct calibration prior to commencement of work.

### 3.1.16 Slurry Velocities

Use a flow metering device, calibrated according to the manufacturer's specifications, to record the slurry velocity of each dragarm to the nearest 0.003 mps 0.01 fps with an accuracy of plus or minus 0.15 mps 0.5 fps. If the manufacturer does not specify a frequency of recalibration, conduct calibration prior to commencement of work. Measure the slurry velocity in the same pipeline inside diameter as that used for the slurry density measurement.

### 3.1.17 Pump RPM

Measure the RPM of any pump being used to move material with the highest level of accuracy that is standard on the vessel operational displays, either at the bridge, at the drag tender's controls, or in the engine room. Dredges with multiple pumps per side must report RPM for the pump that best describes the dredging process (typically the outboard pump).

### 3.1.18 Sea Suction Valve for Dragarm

If sea suction can be taken to bypass suction through the draghead, the sea suction location and valve status will be reported. The status of the valve will change from "closed" to "open" when the valve starts to open and will register "closed" when the valve is fully closed. When applicable, the state of the latch will be reported as "true" or "false." Report the sea suction location in a standard non-changing name string of no more than 20 characters. These field values will always occur in the XML string as a set. The DQM system can accommodate only up to four unique sea suction locations. Suggested options for the naming convention can be found in the example dataset in paragraph DATA FORMAT.

### 3.1.19 Pumpout

When the hopper dredge is being pumped out, report a "true" value; when it is not, report a "false" value. The only permissible values are "true" and "false."

## 3.2 NATIONAL DREDGING QUALITY MANAGEMENT PROGRAM SYSTEM REQUIREMENTS

The Contractor's DQM system must be capable of collecting, displaying, and transmitting information to the DQM database. Record the applicable parameters from paragraph REQUIREMENTS FOR REPORTED DATA as events locally and continually transmitted to the DQM database anytime an Internet connection is available. Equip the Dredge with a DQM computer system, consisting of a computer, monitor, keyboard, mouse, data modem, UPS, and network hub. Provide a standalone computer system, exclusive to the DQM monitoring system, and with USACE DQM software installed on it. If a

hardware problem occurs, or if a part of the system is physically damaged, the Contractor is responsible for repairing it within 48 hours of determination of the condition.

### 3.2.1 Computer Requirements

Provide a dedicated onboard computer for use by the DQM system. This computer must run USACE software and receive data from the Contractor's data-reporting interface. This computer must meet or exceed the following performance specifications:

| | |
|---|---|
| CPU: | Intel or AMD processor with a (non-overclocked) clock speed of at least 1.6 gigahertz (GHz) |
| Hard drive: | 250 gigabytes (GB); internal |
| RAM: | 4 gigabytes (GB) |
| Ethernet adapter: | Internal network card with an RJ-45 connector |
| Ports: | 1 free serial port with standard 9-pin connectors; 1 free USB port |
| Other hardware: | Keyboard, mouse, monitor |

Install a fully licensed copy of Windows 10 Professional Operating System or higher on the computer specified above. Also install any necessary manufacturer-provided drivers for the installed hardware. Locate and orient the computer to allow data entry and data viewing, as well as to provide access to data ports for the connection of external hardware.

### 3.2.2 Software

The DQM computer's primary function is to transmit data to the DQM shoreside database. Do not install software which conflicts with this function on this computer. The DQM computer must have the USACE-provided Dredging Quality Management Onboard Software (DQMOBS) installed on it by DQM personnel along with USACE-selected software for remote support and management.

### 3.2.3 UPS

Supply an Uninterruptible Power Supply (UPS) for the computer and networking equipment. The UPS must provide backup power at 1 kVA for a minimum of ten minutes. The UPS must interface with the DQM computer to communicate UPS status. Ensure that sufficient power outlets are available to run all specified equipment.

### 3.2.4 Internet Access

Maintain an Internet connection capable of transmitting real-time data to the DQM server and supporting remote access, as well as enough additional bandwidth to clear historically queued data when a connection is re-obtained. If connectivity is lost, que and transmit unsent data upon restoration of connectivity. Delays in pushing real-time data to the DQM database should not exceed four hours. Exceptions to these requirements may be granted by the DQM Support Center on a case-by-case basis with consideration for contract-specific requirements, site-specific conditions, and extreme weather events.

Acquire and install all necessary hardware and software to make the Internet connection available for data transmission to the DQM web service. Configure the hardware and software to allow the DQM Support Center remote access to this computer. Coordination between the dredging company's IT and the DQM Support Center may be required in order to configure remote access though any security, firewall, router, and telemetry systems. Telemetry systems must be capable of meeting these minimum reporting requirements in all operating conditions.

### 3.2.5 Data Routing Requirements

Onboard sensors must continually monitor dredge conditions, operations and efficiency and route this information into the shipboard dredge-specific system (DSS) computer to assist in guiding dredge operations. Portions of this Contractor-collected information must be routed to the DQM computer on a real-time basis. Use an RS-232 9600- or 19200-baud serial interface to send standard sensor data to the DQM computer. Configure the serial interface as 8 bits, no parity, and no flow control.

### 3.2.6 Data Reporting Frequency

Log data as a series of events. Each event will consist of a dataset containing dredge information in accordance with paragraph REQUIREMENTS FOR REPORTED DATA. Each set of measurements (time, position, etc.) will be considered an event. Collect any required information in paragraph REQUIREMENTS FOR REPORTED DATA that is not an averaged variable (draft and ullage) within 1 second of the reported time. Send a data string for an event to the DQM computer every 6 to 12 seconds. This interval must remain constant throughout the contract; do not transmit data strings more than once per every 5 seconds. Collect and compute any averaged variable within this sampling interval.

### 3.2.7 Data Format

Report data as an extensible Markup Language (W3C standard XML 1.0) document as indicated below. Line breaks and spaces are added for readability, but the carriage return, line feed character combination is added only to delineate records (HOPPER_DREDGING_DATA tag) for actual data transmission.

```
      {?xml version="1.0"?}
      {HOPPER_DREDGING_DATA version = "2.0"}
          <PLANT_IDENTIFIER>integer string</PLANT_IDENTIFIER>
         {DREDGE_NAME} string32 {/DREDGE_NAME}
            {HOPPER_DATA_RECORD}
                {DATE_TIME} time date string {/DATE_TIME}
                {CONTRACT_NUMBER} string32 {/CONTRACT_NUMBER}
                {LOAD_NUMBER} integer string {/LOAD_NUMBER}
                {VESSEL_X coord_type="LL"} floating point string
    {/VESSEL_X}
                {VESSEL_Y coord_type="LL"} floating point string
    {/VESSEL_Y}
            {PORT_DRAG_X coord_type="LL"} floating point string
    {/PORT_DRAG_X}
            {PORT_DRAG_Y coord_type="LL"} floating point string
    {/PORT_DRAG_Y}
            {STBD_DRAG_X coord_type="LL"} floating point string
    {/STBD_DRAG_X}
```

```
                {STBD_DRAG_Y coord_type="LL"} floating point string
     {/STBD_DRAG_Y}
                {HULL_STATUS} OPEN/CLOSED string {/HULL_STATUS}
                {VESSEL_COURSE} floating point string {VESSEL_COURSE}
                {VESSEL_SPEED} floating point string {/VESSEL_SPEED}
                {VESSEL_HEADING} floating point string {/VESSEL_HEADING}
                {TIDE} floating point string {/TIDE}
                {DRAFT_FORE} floating point string {/DRAFT_FORE}
                {DRAFT_AFT} floating point string {/DRAFT_AFT}
                {ULLAGE_FORE} floating point string {/ULLAGE_FORE}
                {ULLAGE_AFT} floating point string {/ULLAGE_AFT}
                {HOPPER_VOLUME} floating point string {/HOPPER_VOLUME}
                {DISPLACEMENT} floating point string {/DISPLACEMENT}
               {EMPTY_DISPLACEMENT} floating point string
     {/EMPTY_DISPLACEMENT}
                {DRAGHEAD_DEPTH_PORT} floating point string
     {/DRAGHEAD_DEPTH_PORT}
                {DRAGHEAD_DEPTH_STBD} floating point string
     {/DRAGHEAD_DEPTH_STBD}
                {PORT_DENSITY} floating point string {/PORT_DENSITY}
                {STBD_DENSITY} floating point string {/STBD_DENSITY}
                {PORT_VELOCITY} floating point string {/PORT_VELOCITY}
                {STBD_VELOCITY} floating point string {/STBD_VELOCITY}
                {PUMP_RPM_PORT} floating point string {/PUMP_RPM_PORT}
                {PUMP_RPM_STBD} floating point string {/PUMP_RPM_STBD}
                {VALVE_1_LOCATION} string32 {VALVE_1_LOCATION}
                {VALVE_1_STATUS} open/closed {/VALVE_1_STATUS}
                {VALVE_1_LATCHED} true/false {/VALVE_1_LATCHED}
                {VALVE_2_LOCATION} string32 {/VALVE_2_LOCATION}
                {VALVE_2_STATUS} open/closed {/VALVE_2_STATUS}
                {VALVE_2_LATCHED} true/false {/VALVE_2_LATCHED}
                {VALVE_3_LOCATION} string32 {/VALVE_3_LOCATION}
                {VALVE_3_STATUS} open/closed {/VALVE_3_STATUS}
                {VALVE_3_LATCHED} true/false {/VALVE_3_LATCHED}
                {VALVE_4_LOCATION} string32 {/VALVE_4_LOCATION}
                {VALVE_4_STATUS} open/closed {/VALVE_4_STATUS}
                {VALVE_4_LATCHED} true/false {/VALVE_4_LATCHED}
                {PUMP_OUT_ON} true/false/unknown string {/PUMP_OUT_ON}
                {/HOPPER_DATA_RECORD}

               {/HOPPER_DREDGING_DATA}
                Carriage Return - ASCII value 13
                Line Feed - ASCII value 10
```

Example

```
     {?xml version="1.0"?}
     {HOPPER_DREDGING_DATA version = "2.0"}
           <PLANT_IDENTIFIER>9999</PLANT_IDENTIFIER>
       {DREDGE_NAME}Essayons{/DREDGE_NAME}
          {HOPPER_DATA_RECORD}
                {DATE_TIME}04/11/2002 13:12:05{/DATE_TIME}
                {CONTRACT_NUMBER}GDSNWP-11-G-0001{/CONTRACT_NUMBER}
                {LOAD_NUMBER}102{/LOAD_NUMBER}
                {VESSEL_X coord_type="LL"}-80.123333{/VESSEL_X}
                {VESSEL_Y coord_type="LL"}10.123345{/VESSEL_Y}
                {PORT_DRAG_X coord_type="LL"}-80.1233371{/PORT_DRAG_X}
                {PORT_DRAG_Y coord_type="LL"}10.12335{/PORT_DRAG_Y}
                {STBD_DRAG_X coord_type="LL"}-80.123339{/STBD_DRAG_X}
```

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{HULL_STATUS}CLOSED{/HULL_STATUS}
{VESSEL_COURSE}258{/VESSEL_COURSE}
{VESSEL_SPEED}3.4{/VESSEL_SPEED}
{VESSEL_HEADING}302{/VESSEL_HEADING}
{TIDE}-0.1{/TIDE}
{DRAFT_FORE}10.05{/DRAFT_FORE}
{DRAFT_AFT}15.13{/DRAFT_AFT}
{ULLAGE_FORE}10.11{/ULLAGE_FORE}
{ULLAGE_AFT}10.22{/ULLAGE_AFT}
{HOPPER_VOLUME}2555.2{/HOPPER_VOLUME}
{DISPLACEMENT}4444.1{/DISPLACEMENT}
{EMPTY_DISPLACEMENT}2345.0{/EMPTY_DISPLACEMENT}
{DRAGHEAD_DEPTH_PORT}55.10{/DRAGHEAD_DEPTH_PORT}
{DRAGHEAD_DEPTH_STBD}53.21{/DRAGHEAD_DEPTH_STBD}
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{STBD_DENSITY}1.03{/STBD_DENSITY}
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{STBD_VELOCITY}23.3/STBD_VELOCITY}
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{PUMP_RPM_STBD}54{/PUMP_RPM_STBD}
{VALVE_1_LOCATION}Starboard Dragarm{VALVE_1_LOCATION}
{VALVE_1_STATUS}open{/VALVE_1_STATUS}
{VALVE_1_LATCHED}true{/VALVE_1_LATCHED}
{VALVE_2_LOCATION}Port Dragarm{/VALVE_2_LOCATION}
{VALVE_2_STATUS}closed{/VALVE_2_STATUS}
{VALVE_2_LATCHED}false{/VALVE_2_LATCHED}
{VALVE_3_LOCATION}Port Sea Chest{/VALVE_3_LOCATION}
{VALVE_3_STATUS}closed{/VALVE_3_STATUS}
{VALVE_3_LATCHED}false{/VALVE_3_LATCHED}
{VALVE_4_LOCATION}Starboard Sea Chest{/VALVE_4_LOCATION}
{VALVE_4_STATUS}open{/VALVE_4_STATUS}
{VALVE_4_LATCHED}false{/VALVE_4_LATCHED}
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{/HOPPER_DATA_RECORD}
{/HOPPER_DREDGING_DATA}
{cr}
{lf}
<?xml version="1.0"?>
<HOPPER_DREDGING_DATA version = "2.0">
<PLANT_IDENTIFIER>9999</PLANT_IDENTIFIER>
{DREDGE_NAME}Essayons{/DREDGE_NAME}
{HOPPER_DATA_RECORD}
{DATE_TIME}04/11/2002 13:12:10{/DATE_TIME}
{CONTRACT_NUMBER}GDSNWP-11-G-0001{/CONTRACT_NUMBER}
{LOAD_NUMBER}102{/LOAD_NUMBER}
{VESSEL_X coord_type="LL"}-80.123334{/VESSEL_X}
{VESSEL_Y coord_type="LL"}10.123346{/VESSEL_Y}
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{PORT_DRAG_Y coord_type="LL"}10.12336{/PORT_DRAG_Y}
{STBD_DRAG_X coord_type="LL"}-80.123340{/STBD_DRAG_X}
{STBD_DRAG_Y coord_type="LL"}10.123348{/STBD_DRAG_Y}
{HULL_STATUS}CLOSED{/HULL_STATUS}
{VESSEL_COURSE}259{/VESSEL_COURSE}
{VESSEL_SPEED}3.5{/VESSEL_SPEED}
{VESSEL_HEADING}300{/VESSEL_HEADING}
{TIDE}-0.1{/TIDE}
{DRAFT_FORE}10.00{/DRAFT_FORE}
{DRAFT_AFT}15.15{/DRAFT_AFT}

```
                    {ULLAGE_FORE}10.15{/ULLAGE_FORE}
                    {ULLAGE_AFT}10.20{/ULLAGE_AFT}
                    {HOPPER_VOLUME}2555.5{/HOPPER_VOLUME}
                    {DISPLACEMENT}4444.0{/DISPLACEMENT}
                    {EMPTY_DISPLACEMENT}2345.0{/EMPTY_DISPLACEMENT}
                    {DRAGHEAD_DEPTH_PORT}55.15{/DRAGHEAD_DEPTH_PORT}
                    {DRAGHEAD_DEPTH_STBD}53.19{/DRAGHEAD_DEPTH_STBD
                    {PORT_DENSITY}1.00{/PORT_DENSITY}
                    {STBD_DENSITY}1.01{/STBD_DENSITY}
                    {PORT_VELOCITY}22.5{/PORT_VELOCITY}
                    {STBD_VELOCITY}23.3/STBD_VELOCITY}
                    {PUMP_RPM_PORT}55{/PUMP_RPM_PORT}
                    {PUMP_RPM_STBD}54{/PUMP_RPM_STBD}
                    {VALVE_1_LOCATION}Starboard Dragarm{VALVE_1_LOCATION}
                    {VALVE_1_STATUS}open{/VALVE_1_STATUS}
                    {VALVE_1_LATCHED}true{/VALVE_1_LATCHED}
                    {VALVE_2_LOCATION}Port Dragarm{/VALVE_2_LOCATION}
                    {VALVE_2_STATUS}closed{/VALVE_2_STATUS}
                    {VALVE_2_LATCHED}false{/VALVE_2_LATCHED}
                    {VALVE_3_LOCATION}Port Sea Chest{/VALVE_3_LOCATION}
                    {VALVE_3_STATUS}closed{/VALVE_3_STATUS}
                    {VALVE_3_LATCHED}false{/VALVE_3_LATCHED}
                    {VALVE_4_LOCATION}Starboard Sea Chest{/VALVE_4_LOCATION}
                    {VALVE_4_STATUS}open {/VALVE_4_STATUS}
                    {VALVE_4_LATCHED} false{/VALVE_4_LATCHED}
                    {PUMP_OUT_ON}false{/PUMP_OUT_ON}
                    {/HOPPER_DATA_RECORD}
      {/HOPPER_DREDGING_DATA}
      {cr}
      {lf}
```

### 3.2.8 Data Reporting

The system must transmit correctly formatted event data XML strings to the DQM database continuously from mobilization until the last USACE post-dredging survey has been accepted. If the Internet connection (paragraph INTERNET ACCESS) is non-operable, perform manual backups from the dredge computer of the XML data string which would have been transmitted to the DQM computer over the serial connection for each day the device is inoperable and submit to the DQM Support Center within 48 hours. This submission does not replace the requirement of correcting the issue affecting the automatic transmission of data. In the event of data transfer, transmission, or hardware failure, maintain a manually recorded disposal log consisting of a series of events. These events are start of dredging, end of dredging, pre-disposal, and post-disposal. Include time stamp (GMT), position (Latitude and Longitude WGS84), draft, ullage, volume, and displacement for each event. Submit disposal logs on a daily basis to the COR during the time when the system is not operational.

### 3.2.9 Contractor Data Backup

Maintain an archive of all data sent to the DQM computer during the dredging contract. The COR may require, at no increase in the contract price, that the Contractor provide a copy of these data covering specified time periods. Provide the data, transmitted to the DQM computer, in the XML format with no line breaks between the parameters and each record string on a separate line. The naming convention for the files is {dredgename}_{StartYYYYMMddhhmmss}_{EndYYYYMMddhhmmss}.txt. Submit data via storage medium acceptable to the COR.

At the end of the dredging contract, contact the DQM Support Center prior to discarding the data. The DQM Support Center will verify that all data has been received and appropriately archived before giving the Contractor discard permission. Record the following information in a separate section at the end of the dredge's onboard copy of the DPIP:

Person who made the call
Date of the call
DQM representative who gave permission to discard

## 3.3 PERFORMANCE REQUIREMENTS

The Contractor's DQM system must be fully operational at the start of dredging operations and fully certified prior to moving dredge material on the contract (see paragraph NATIONAL DREDGING QUALITY MANAGEMENT PROGRAM CERTIFICATION). To meet contract requirements for operability, in addition to certification, the Contractor's system must provide a data string with all values for all parameters while operating, as described in the specifications. Additionally, all hardware must be compliant with hardware requirements (paragraph COMPUTER REQUIREMENTS). Quality data strings are considered to be those providing values for all parameters reported when operating according to the specification. Make repairs necessary to restore data return compliance within 48 hours. Failure by the Contractor to report the required data within the specified time window for dredge measurements (see paragraph DATA REPORTING FREQUENCY and paragraph DATA REPORTING) will result in withholding of up to 10 percent of the contract progress payment per FAR 52.232-5 Payments under Fixed-Price Construction Contracts.

## 3.4 LIST OF ITEMS TO BE PROVIDED BY THE CONTRACTOR

DPIP
https://www.sam.usace.army.mil/Missions/Spatial-Data-Branch/Dredging-Quality-M

DQM System
Sensor instrumentation: paragraph REQUIREMENTS FOR REPORTED DATA
DQM computer: paragraph NATIONAL DREDGING QUALITY MANAGEMENT PROGRAM SYSTEM REQUIREMENTS

Dredge Data
Event documentation: paragraph DATA REPORTING
Dredge data backups: paragraph CONTRACTOR DATA BACKUP

QA Equipment on the Dredge
Dragarm depth chain
Ullage tape
Refractometer
Water sampling device

-- End of Section --

# SECTION 35 20 24

# BEACH FILL
**04/15**

## PART 1 GENERAL

### 1.1 DESCRIPTION

The work covered by this section consists of furnishing all plant, labor, material, equipment and services and performing all operations in connection with placing beach fill in accordance with the Contract Drawings and these specifications. For the purpose of these specifications, the term "beach fill" shall be interpreted to mean sand material placed within the prescribed limits (construction templates) to construct the berm unless otherwise noted.

### 1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| EM 385-1-1 | (2024) Safety -- Safety and Occupational Health (SOH) Requirements |
| EM 1110-2-1003 | (2013) Hydrographic Surveying |
| EM 1110-1-1005 | (2007) Control and Topographic Surveying |

### 1.3 SUBMITTALS

Government approval is required for submittals marked with a "G" designation. Submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Surveyor's Qualifications; G

Provide qualifications of the independent licensed surveyor(s) for topographic and bathymetric surveying prior to commencing any survey work.

Surveying Procedures and Equipment; G

All surveying procedures, methods, and equipment for topographic surveys, hydrographic surveys and tidal monitoring, shall be submitted as specified in this section for review and approved by the Government Survey Point of Contact prior to the start of any type of surveying work.

Pre-Placement Condition Surveys; G

The pre-placement condition survey data for each continuous stretch of beachfill shall be submitted within five (5) business days after completion of the surveys in that area. Data shall be submitted in the format specified herein. This submission shall include the photographic documentation of the surveys, as specified herein.

Beach Fill Placement Plan; G

Accident Prevention Plan; G

Dredge Material Placement Plan; G

Preconstruction Meeting; G

SD-04 Samples

Beach Fill Samples

SD-06 Test Reports

Testing; G

Within 24 hours of conclusion of physical tests, three (3) copies of the test results, including calibration curves and results of the calibration tests.

Sand Fill Material; G

Daily Report of Operations

SD-07 Certificates

Before and After Beachfill Surveys; G

The before-beachfill survey data of a particular station shall be submitted along with the after-beachfill survey of that same station within five (5) business days after completion of that station survey set. Data shall be submitted in HYPACK, ISRP files, and ASCII x,y,z format.

Testing; G

Qualifications of the commercial testing laboratory or Contractor's testing facilities.

Geotechnical Evaluation Report; G, DO

SD-11 Closeout Submittals

Post-Placement Condition Surveys; G

Post-condition surveys shall be completed and submitted for Government review no later than 30 calendar days after acceptance of final beachfill.

Beach Fill Placement Records and Volume Computations; G

## 1.4 QUALITY ASSURANCE

Quality assurance will be conducted, on a minimum of ten percent of the Contractor's survey work, by the District survey office. To accomplish this, the District survey office will either re-survey areas or observe the Contractor in conducting their surveys.

## 1.5 QUALITY CONTROL

### 1.5.1 Geotechnical Engineer

Provide a Professional Geotechnical Engineer to provide services for borrow area dredging, beach fill placement, and laboratory soil testing activities throughout construction. The Geotechnical Engineer is responsible for notifying the COR of any change in borrow area or site conditions and assisting with solutions due to changes in conditions. Submit a monthly Geotechnical Evaluation report, informing the Contractor and Contracting Officer of any present or potential problems. The Contractor is responsible for arranging meetings with the Geotechnical Engineer and Contracting Officer throughout the contract duration.

### 1.5.2 Qualified Technician

Provide a Qualified Technician to inspect, monitor, sample, and perform field testing. The technician qualifications need to be one of the following: a current National Institute for Certification in Engineering Technologies (NICET) Level II minimum certification in Construction Materials Testing Soils; a Geologist-in-Training with minimum one-year experience; an Engineer-in-Training with minimum one-year experience; a Registered Geologist; or a Professional Engineer.

### 1.5.3 Lab Validation

Perform testing by a Corps validated commercial testing laboratory or Contractor established testing laboratory meeting the requirements of Section 01 45 00 QUALITY CONTROL and approved by the Contracting Officer. Submit testing laboratory validation for the testing to be performed. Do not permit work requiring testing until testing facilities have been inspected, Corps validated and approved by the Contracting Officer.

### 1.5.4 Preconstruction Meeting

Conduct a preconstruction meeting at the jobsite at least five business days prior to the start of earthwork operations on the project. The preconstruction meeting is to be arranged by the Contractor and is to follow the written agenda submitted prior to the meeting. The purpose of this meeting is to review the requirements of this specification and the associated plans. The following individuals must be in attendance at this meeting: Contractor's Project Manager and Project Superintendent, earthwork subcontractor's Project Manager and Site Foreman, Contractor's Geotechnical Engineer and Testing Agency, Government Geotechnical Engineer and Civil Engineer, and Government Construction Manager and Engineering Technician.

The minutes of this meeting are to be recorded by the Contractor and published via email within 48 hours to all attendees. The minutes must be re-published within 48 hours via email pending any subsequent comments from the attendees.

## 1.6 HOPPER DREDGE REQUIREMENTS

### 1.6.1 National Dredging Quality Management Program

The work under this contract for using Hopper Dredging requires use of National Dredging Quality Management Program (DQM) System, formerly known as Silent Inspector (SI), to monitor the dredge's status at all times during the contract, and to track trip number, time-position history, instrument readings, vessel state, compute tons dry solids, report data, and manage data history. Refer to SECTION 35 20 23.23 NATIONAL DREDGING QUALITY MANAGEMENT PROGRAM - HOPPER DREDGE to identify the minimum required output and precision and instrumentation requirements.

### 1.6.2 Automated Dredge Quality Assurance Monitoring

Dredging and dredged material disposal monitoring of dredging projects using the National Dredging Quality Management Program (DQM) shall be implemented for this project. The DQM system shall be certified by the SI Support Center within one calendar year prior to the initiation of the dredging/disposal. Additional information about the DQM System can be found at http://dqm.usace.army.mil/. The DQM system shall be operational throughout the dredging and disposal project. Project data shall be submitted to the DQM National Support Center in accordance with the specifications. The data collected by the DQM system shall, upon request be made available to the Operations Branch and Regulatory Branch of the U.S. Army Corps of Engineers, Norfolk District.

## 1.7 QUALIFICATIONS OF SURVEYOR

All surveys shall be performed by an independent survey company. All topographic and hydrographic surveys shall be performed under the direction and supervision of a Professional Licensed Surveyor with a minimum of 5 years current experience in surveying beach profiles. Surveyors shall be Virginia licensed surveyors. The contractor shall submit his Surveying Procedures and Equipment for topographic surveys, hydrographic surveys and tidal monitoring, shall be submitted as specified in this section for review and approved by the Government Survey Point of Contact prior to the start of any type of surveying work.

## 1.8 BEACH CONSTRUCTION AND PLACEMENT MEASUREMENT REQUIREMENTS

Measurement of quantity to be placed for pay purposes will be based on pre-construction and post-construction cross section surveys and volume computations made by a surveyor licensed in the Commonwealth of Virginia for each fill placement segment released to the Contractor for construction. The Contractor shall give written notice to the Contracting Officer a minimum of 3 calendar days prior to performing the pre-construction and post-construction surveys. All surveys performed shall meet criteria outlined in EM 1110-2-1003 and EM 1110-1-1005 as specified, in the presence of the Contracting Officer or his designated representative(s). The results of the surveys and volume computations shall be provided to the Contracting Officer in the format as specified within 24 hours. The Contracting Officer shall utilize the surveys and volume computations to determine the actual quantities of materials to be placed in the respective beach fill placement segment for acceptance. Due to the constantly changing shoreline, the Contracting Officer may make alterations in the plan dimensions or slopes of the fill section in order to increase or decrease the volume of fill placed along the beach so as to

match the total sand quantity allowed under the contract. No separate payment or adjustment in the unit price will be made as a result of these changes so directed by the Contracting Officer since the total cost of the complete work shall be covered by payment for the total cubic yards placed on the beach at the contract price per cubic yard. The Government reserves the right to perform Quality Assurance Surveys at the expense of the Government to verify survey results.

### 1.8.1 Beach Fill Plan

(a) At least ten (10) work days prior to initiation of beach fill operations, the Contractor shall submit in triplicate to the Contracting Officer for approval of his proposed plan for beach fill placement indicating planned beach fill reaches and the direction and order of beach fill. The plan shall include the type of dredge plant to be utilized, the location and type of any booster pump facilities to be utilized, and the order of work for beach fill placement. The plan shall also include his proposed method of borrow area excavation. The Contracting Officer reserves the right to reject any scenario which in his opinion may be detrimental to the stability of the in-place beach fill, or for any other credible reason. Excavation of sand from the existing beach for use as beach fill will not be permitted.

(b) In the event of a breakdown of dredging equipment which causes fill operations to cease in any work area, the Contractor shall provide verbal notification to the Contracting Officer immediately. The Contractor shall document at a minimum the nature of the problem, the time of problem discovery, the expected duration to effect repairs, and the actual times of shutdown and restarting dredging operations. This documentation shall be provided to the Contracting Officer within 24 hours following breakdown.

## 1.9 BEACH FILL SURVEYS

### 1.9.1 Pre-Placement Condition Survey

The beachfill area conditions are dynamic in nature. Conditions existing during preparation of this contract may not accurately represent beachfill area conditions at the commencement of beachfill operations. Consequently, the Contractor shall obtain pre-placement condition survey cross sections of the entire project area. Survey cross-sections shall be taken on parallel profile lines (ranges) spaced at a maximum interval of 500 feet and shall extend from the survey baseline to a minimum of 1,900 feet seaward. Elevations along the cross-sections shall be taken at a maximum interval of 10 feet, with additional elevations taken at breaks in grade and as necessary to describe all hydrographic and topographic features. The pre-placement condition surveys shall be completed and submitted for Government review no later than 30 calendar days after receipt of the Notice to Proceed.

### 1.9.2 Before and After Beach Fill Surveys

Before and After Beach Survey Data shall be taken by the independent professional licensed surveyor, and the Drawings for acceptance shall be provided by the independent professional engineer or surveyor as specified, immediately prior to and after fill placement in a respective beach fill placement segment. Before Beach Fill surveys shall be taken within 3 calendar days before fill placement. The COR reserves the right to

request Before Beach Fill Surveys immediately or in a 24 hour period, if the long shore current/drift is in the direction of the placement area. Surveys will be taken on parallel profile lines (ranges) spaced at a maximum of 100 feet intervals. Elevations along the cross-sections shall be taken at a maximum of 10 foot intervals, with additional elevations taken at breaks in grade and as necessary to describe all hydrographic and topographic features. The surveys should be taken to the closure depth or when the foreshore slope meets the existing surface. After Beach Fill surveys shall be taken within 3 calendar days after placement. The Before Beach Fill survey data of a particular station shall be submitted along with the after-beachfill survey of that same station within five (5) business days after completion of that station survey set. Data shall be submitted in HYPACK and ASCII x,y,z format.

### 1.9.3 Post-Placement Condition Surveys

The post placement condition survey (of the entire beach/project area)shall be completed and submitted for Government review no later than thirty (30) calendar days after acceptance of final beach fill.

### 1.9.4 Beach Fill Placement Records and Survey Data

All original field notes, computations, and other records for the purpose of the layout of surveys and determining volume of the beach fill material placed by the Contractor shall be recorded in duplicating field books, the original pages of which shall be stamped and signed by the licensed surveyor as specified and furnished promptly to the Contracting Officer at the site of the work. The Contractor shall furnish the Contracting Officer the profile data compiled and certified by the licensed surveyor as specified for each respective survey on a computer disk. The survey data shall be recorded digitally on CD-ROM in HYPACK and ASCII x,y,z format. The data shall be submitted to the Government in the following files:

a. ASCII files compatible with the Interactive Survey Reduction Program (ISRP), 2.8 format using distance offset from the baseline (x) and elevation (z).

b. ASCII files having a descriptive header for each profile line followed by three columns: Easting (x), Northing (y) and Elevation (z).

c. Plotted cross section drawings in AutoCAD 2018 or later format and AutoCAD files for each cross section survey taken. Each drawn cross section shall show the station that it was taken from.

d. Each new before/after beachfill survey disc submittal shall contain compilation of all previous survey data submitted.

e. The Government reserves the right to change and revise requirements at the Preconstruction Conference the survey data formats as described above.

## 1.10 REPORTING REQUIREMENTS

The Contractor shall prepare a daily report of operations as applicable on the forms provided and furnish copies thereof in duplicate to the Contracting Officer or designated field representative. An adequate supply of the forms will be furnished to the Contractor at the preconstruction conference, together with additional direction on

preparation or submission.

## 1.11 SAFETY

### 1.11.1 General

The Contractor shall comply with the Contract Clause ACCIDENT PREVENTION EM 385-1-1, 15 Sep 08, subject: SAFETY AND HEALTH REQUIREMENTS MANUAL, is a part of these specifications.

### 1.11.2 Accident Prevention Plan

Prior to the commencement of construction, submit a copy of the Accident Prevention Plan for review and approval by the Contracting Officer or authorized representative. The Contractor shall furnish for review by the Government, no later than 10 days after receipt of Notice to Proceed. The program shall be prepared in the following format:

(a) Administrative Plan

(b) Job Hazard Analysis

(c) A copy of company policy statement of accident prevention and any other guidance statements normally provided new employees.

### 1.11.3 Accident Investigation and Reporting

Accidents shall be investigated by the immediate supervisor of the employee(s) involved and reported to the Contracting Officer or the Government Inspector within one working day after the accident in accordance with Paragraph 02.A.02 of EM 385-1-1.

(a) The Contractor shall ensure that all accidents which involve loss of life, occupational disease of the employee, injury incapacitating any person for normal work beyond the day of injury, or damage to property, materials, supplies, or equipment, of $700.00 or more, and which relate to the dredge, any attendant plant, the dredge working area, or the disposal area, shall be recorded, investigated, and reported to the Contracting Officer or his authorized representative.

(b) Each accident shall be verbally reported to the Government Inspector at the earliest practicable time. Each accident involving loss of life or traumatic injury to any person shall be reported to the Government Inspector verbally, telephonically, or by radio as soon as possible.

(c) The Contractor shall promptly investigate each accident and submit a written, signed report on ENG Form 3394 to the Government Inspector within 48 hours.

(d) A factual record of each accident shall be entered in the Contractor's official daily log book.

### 1.11.4 Daily Inspections

The Contractor shall institute a daily inspection program to assure all safety requirements are being fulfilled. Reports of daily inspections shall be maintained in the Contractor's official daily log book. The reports shall be records of the daily inspections and resulting actions.

Each report will include, as a minimum, the following:

(a) Phase(s) of construction underway during inspection.

(b) Locations of areas inspections were made.

(c) Results of inspection, including nature of deficiencies observed and corrective actions taken, or to be taken, date, and signature of the person responsible for its contents.

## PART 2 PRODUCTS

Not used.

## PART 3 EXECUTION

### 3.1 GENERAL

The purpose of this project is to provide sand to the shoreline/ beach area of the Sandbridge to the locations, lines, grades, and cross sections shown on the drawings. All materials excavated from the borrow area shall be transported to and deposited on the beach area within the aforementioned lines, grades and cross sections in a controlled manner so as to maximize sand retention within the beach fill section and minimize losses to the ocean. This shall be accomplished in a manner acceptable to the Contracting Officer and shall include, but not limited to temporary diking where required, control of the discharge pipe direction and velocity of discharge, and the control of the sand and water mixture.

### 3.2 CONSTRUCTION BASELINE

The Contractor shall stake and flag, every 100 feet, a construction baseline, located such that it provides easy reference by QA and QC personnel. Baseline control coordinates are shown on the contract drawings. The baseline shall be surveyed utilizing surveying procedures and methodology that meet or exceed accuracy tolerances of +/- 0.10 feet in the vertical and +/- 0.10 feet in the horizontal. In addition, stake and flag the limits of work at 50 foot intervals. The location of the construction baseline is subject to the approval of the COR.

### 3.3 PRE-PLACEMENT CONDITION SURVEYS

Prior to commencement of beachfill operations, the Contractor shall complete and submit the pre-placement condition surveys required by paragraph 1.9.1 PRE-PLACEMENT CONDITION SURVEY of this section for Government review and approval. Beachfill operations shall not commence until the required surveys have been submitted and approved by the Government.

### 3.4 PLACEMENT OF BEACH FILL MATERIAL

The beach fill material shall be removed from the borrow area and transported to the shoreline pump buoy as specified in Section 35 20 23 DREDGING. The beach fill material shall be deposited by the hydraulic pipeline in the beach fill placement area segments as indicated and specified.

### 3.4.1 Beach Fill Placement Area Pre and Post Construction Inspections

Prior to commencement and immediately after completion of the dredged material placement operations, a joint inspection by representatives of the Contractor, City of Virginia Beach, and the Contracting Officer will be made. The Contractor shall video the shoreline including areas designated for beach access and egress, seawalls, structures and houses, dunes and vegetation, and the existing beach fill condition during the inspection. The purpose of the inspection is to avoid potential claims that allege damages were caused by construction activities. The complete video inspection record of pre-construction and post-construction conditions shall be provided on CD-ROM/ DVD to the Contracting Officer within 48 hours of each respective inspection.

### 3.4.2 Beach Fill Placement Area Control

(a) The Contractor shall maintain and protect the beach fill in a satisfactory condition at all times until acceptance of the work. Prior to placement of beach fill, the Contractor shall remove from the worksite all snags, driftwood, and similar foreign debris lying within the limits of the beach fill section. All materials removed shall be disposed of in areas provided by and at the expense of the Contractor and as approved by the Contracting Officer.

(b) The Contractor shall coordinate with the Contracting Officer to maintain the scheduled work in beach fill placement segments to provide a 100-foot long pre-construction section and a 100-foot long final acceptance section to be surveyed while a 100-foot long construction section is being constructed in between the two sections being surveyed. The work area for surveys shall be a 100-linear-foot section of beach along the fill reference line beginning with the project limit or last acceptance area. The pre-placement (original) sections shall be maintained at a minimum 100 feet ahead of the work area. The Contractor shall request in writing if longer or shorter acceptance sections are requested due to weather or site conditions. These acceptance reach sections are established for survey and payment control only. The Contractor shall maintain the restricted access zones around the active discharge area in accordance with paragraph 3.4.10, PIPELINE SAFETY ON THE BEACH, of this section.

Acceptance reaches shall be used for the purpose of closely monitoring the accumulative amounts of beach fill placed. Acceptance reaches will also be used to control the timing for pre-placement and post-placement surveys. Acceptance for payment by the Contracting Officer of a reach will not be made until all beach fill placement (design and construction template) is made within an acceptance reach and final surveys have been approved. Separate acceptance for the dune portion of the beach-fill may be made for an acceptance reach upon approval of the Contracting Officer. In no case, however, will the Contractor be paid more than once for sand placed in any space along any acceptance reach should erosion occur before the entire volume of sand is placed. Unless otherwise approved by the Contracting Officer, acceptance reach stationing shall conform to stationing shown on the contract drawings.

(c) The Contractor shall place the sand starting at the south portion of the project limits and proceed to the north direction along the beach. Once the Contractor begins placement in an acceptance reach, placement in that reach must be completed before proceeding to

another acceptance reach. Beach fill placement operations shall proceed in an orderly manner from reach to reach. If more than one dredge and/or pumpout facility is utilized by the Contractor, more than one beach fill operation may be accomplished simultaneously. However, placement of beach fill in more than two locations at any one time will not be permitted unless otherwise specifically approved by the Contracting Officer.

(d) The beach fill placement area control points, including construction staking, gages, range markers, and buoys required to accomplish the work shall be set by an independent professional engineer or surveyor currently registered and licensed in the Commonwealth of Virginia as specified and shall be maintained by him to define the work and to facilitate inspection. The Contractor shall suspend beachfill operations when staking or ranges cannot be seen or followed.

(e) Construction staking used on the beach shall be 1-inch o.d. steel pipe (painted orange) or other approved material that shall be promptly removed as the work areas are accepted by the Government.

(f) Beach fill material shall be placed in a manner to avoid damage or undermining to all existing structures. The Contractor shall be solely responsible for any damage caused by him to, outfalls, breakwaters, walkways, bulkheads, structures, seawalls, unbulkheaded properties, dunes, or any other real property adjacent to the beach fill areas. Any damage to such items due to fault or negligence of the Contractor shall be repaired or replaced at his own expense in a manner as approved by the Contracting Officer. The beach fill material shall be controlled and graded to prevent material from overtopping existing breakwaters, bulkheads, dunes, outfalls or in any way encroaching landward of such structures unless indicated or specified otherwise. The Contractor shall include in his Safety Plan and Environmental Protection Plan to be submitted to the Contracting Officer for approval the details for preventing beach fill material during pipeline placement from flowing westward of the lines indicated and specified. The Contractor shall be responsible for any damage caused by excessive water flowing landward of the beach fill section. Water shall not be permitted to flow westward of the beach fill segment and, to the maximum extent practical, shall not be permitted to pond on the upland side of the beach fill. Any fill sand which is lost in transit or permitted to flow into the offshore waters or onto the upland areas from the point the sand is discharged on the beach will not be subject to payment.

### 3.4.3 Method of Discharge to Temporarily Contain Material Prior to Spreading

The Contractor shall submit to the Contracting Officer or his/her designated representative a Dredge Material Placement Plan. The plan shall include the proposed pipeline route and discharge points. If placement is via controlled effluent, the Dredge Material Placement Plan shall include methods and locations of controlling effluent (i.e. berm locations) to avoid impacts to Government Review and Approval. The Contractor shall include the installing of erosion control measures per the state's standards. Dredge Material Placement Plan shall be submitted to the Government no more than 30 days prior to material placement.

For beach fill placed by discharging the material directly into the

placement sections, the Contractor shall provide temporary longitudinal dikes, spreader and/or pocket pipe as necessary to prevent gullying and erosion of the beach and to retain the material on the beach placement area within the limits of the fill cross section. Longitudinal dikes shall initially be 300 feet long in advance of filling operations. Longer longitudinal dikes shall be constructed as necessary to retain sand on the beach placement area. Shorter lengths may be subsequently used if approved by the Contracting Officer or his/her designated representative.

### 3.4.4 Beach Fill Construction and Grading

The beach fill material shall be placed along the beach front as indicated in the construction drawings.

### 3.4.5 Temporary Protection

If beach fill placement operations are temporarily terminated, the Contractor shall be required to place a protective zone of sand at the end of the last completed acceptance reach for each placement location. The protective zone shall transition from the full section at the end of the last acceptance reach to blend smoothly to the existing beach over a distance of approximately 500 linear feet. The exact length and configuration of the protective zone will depend on the location and shall be constructed as approved or directed by the Contracting Officer. The Contractor is required, however to provide his best efforts in placing material to the designated lines and grades. The contractor shall ensure that there are no undrained areas or abrupt mounds within the completed segments. Any beach/dune fill material that is rehandled or moved and placed in its final position by mechanical methods (i.e. bulldozer, rubber tired loader, pan, etc.) shall be placed in layers not exceeding 3 feet in vertical thickness.

### 3.4.6 Beach Fill Construction, Grading, and Final Acceptance of the Beach Fill Placement Area

The beach fill material shall be placed along the beach front as indicated in the construction drawings. The finished berm shall be constructed at elevation +7.5 feet (NAVD 88) with varying widths as directed by the Contracting Officer for each respective beach fill segment. The remainder of the respective beach fill segment, such as the foreshore graded slope, shall be constructed to slopes shown on the construction drawings. The final graded beach fill segments shall be constructed to an acceptable tolerance of 0.5 foot above or 0.5 foot below the required berm elevation and specified grade. The Contractor shall mark the positions of each grade stake, and remove them after completion of the project. The Contractor shall ensure that there are no undrained areas or abrupt mounds within the completed segments. The Contractor is not required to perform grading in or seaward of the project adjusted mean low water line.

Upon completion of all filling operations in any acceptance reach, the beach fill shall be graded and dressed so as to eliminate any undrained pockets and abrupt mounds or depressions in the beach fill surface as necessary to comply with tolerance requirements specified below. All temporary dikes shall be completely degraded. Final acceptance of each respective beach fill placement area shall include the removal of all dredge discharge pipeline and Contractor equipment, all markings and stakes placed by the Contractor for the control of his work, and clean-up

of all trash and debris from all areas affected by the Contractor's operations. Contractor shall be held responsible for accounting for 100% removal of all grade stakes, as they pose a serious public safety hazard as the fill erodes and any remaining stakes become exposed in the surf. The Contractor is not required to perform grading in or seaward of the project adjusted mean low water line. The Contractor shall take minutes of all on-site inspections, and all parties present shall sign the completed inspection conclusions. Copies of all minutes, photographs and video tapes from inspections shall be included separate of the Daily Report of Operations.

### 3.4.7 Construction in the Vicinity of Little Island Park Pier

The contractor will take appropriate precautions to not damage the Little Island Park pier structure when it is necessary to work within the vicinity of the pier. Do not place fill within 10 feet of the structure. Any damage to the pier structure, due to negligence by the contractor, will be repaired or replaced at the contractor's expense.

### 3.4.8 Sampling and Testing of Materials

#### 3.4.8.1 Sample Storage

The Contractor shall construct a suitable, secure wooden storage container for holding beach fill samples until picked up by Corps laboratory personnel. The storage container shall be located as directed by the Contracting Officer at or near the field office. It shall be waterproof and lockable with a duplicate set of keys furnished to the Contracting Officer. The container shall be of sufficient size to hold at least 50 ten lb. bag samples. No separate payment will be made for construction of the storage container.

#### 3.4.8.2 Sampling Requirements

During the beach fill placement operation the Contractor shall be required to obtain and provide to the Contracting Officer samples of beach fill material from the location of placement. These samples shall be taken as directed by the Contracting Officer's Representative and will contain 7 to 10 lbs of beach fill. Samples shall be placed in canvas or other appropriate bags furnished by the Contracting Officer and labeled on the bag as well as on a tag attached to the bag as Quality Assurance (QA) tests with the sample number, location, and date and time sample was taken. This same information shall be recorded in the Contractor's daily quality control report. The samples shall be delivered to the field office and placed in the locked storage container as soon as possible after sampling. Samples will become the property of the Contracting Officer who will use the samples for testing. No separate payment will be made for the taking of the samples and for providing the samples to the Contracting Officer. It is anticipated that approximately 60 to 80 samples will be required over the course of the project.

#### 3.4.8.3 Gradation Tests

The Contractor shall perform gradation tests on sand fill material placed in the beach fill at the rate of one (1) test for each 500 feet of sand placement. The exact location for taking samples for testing shall be as directed by the Contracting Officer. Sampling procedures shall be as specified in the preceding paragraph for samples to be furnished to the Contracting Officer. Samples shall be labeled as Quality Control (QC)

tests. Gradation tests will be performed in accordance with ASTM D422 and utilized ASTM sieve sizes that correspond to the Wentworth Classifications. Unless otherwise approved the Contracting Officer, the following sieves shall be used at a minimum:

| Wentworth Phi Value | mm Size | Equivalent ASTM Mesh |
|---|---|---|
| -6.2 | 75 | 3 in |
| -5.6 | 50 | 2 in |
| -5.2 | 37.5 | 1.5 in |
| -4.6 | 25 | 1 in |
| -4.2 | 19 | 0.75 in |
| -3.2 | 9.5 | 0.375 in |
| -2.2 | 4.75 | #4 |
| -1.0 | 2 | #10 |
| 0.2 | 0.850 | #20 |
| 1.0 | 0.50 | #35 |
| 1.2 | 0.425 | #40 |
| 2.0 | 0.250 | #60 |
| 3.2 | 0.106 | #140 |
| 3.7 | 0.0750 | #200 |

Hydrometer analysis shall be performed on the No. 230 Sieve if the percentage by weight of the No. 230 Sieve is greater than 10% of the total sample. The results of gradation tests shall be tabulated and plotted on the forms furnished by the Contracting Officer or his authorized representative within 48 hours after sampling. All gradation tests shall be performed by a USACE Validated Testing Laboratory. No separate payment will be made for performing gradation tests and all costs thereof shall be considered a subsidiary obligation of the Contractor.

### 3.4.9 Improperly Placed Beach Fill Material

Any beach fill material placed outside the vertical or horizontal limits of the fill area will not be paid for and shall be regraded or removed as directed by the Contracting Officer at the Contractor's expense.

### 3.4.10 Pipeline Safety on the Beach

The Contractor shall provide as a part of his Safety Plan and Accident Prevention Plan, drawings showing locations of temporary alignment routes of pipeline, placement of booster pumps if used in the work, and proposed location of temporary ramps over the pipeline for pedestrian and emergency vehicle access along the beach. Ramps shall be placed every 500 feet or at every beach access, whichever is shorter. The location of the pipeline shall be limited to the shortest alignment route from the pump out mooring facility to the respective beach fill area under construction. The Contractor shall construct a barrier as specified to keep unauthorized persons at least 250 feet from the discharge end of the pipe in both directions up and down the beach, and no closer than 100 feet from

bulkheads, seawalls, structures, or dune lines unless directed otherwise by the Contracting Officer.

Warning signs shall be posted by the Contractor in conspicuous and strategic places along the pipeline alignment stating "Danger - High Pressure Discharge From Dredge". The signs shall be at least 2 feet square and their final placement location approved by the Contracting Officer. The Barricade shall as a minimum be orange polypropylene fencing not less than four feet in height with sand fencing posts spaced sufficient to prevent access of the public to the immediate site of the work in a manner as approved by the Contracting Officer.

The Contractor shall provide qualified personnel 24-hours per day at the discharge area. At all times during discharge of material on the beach, at least 2 persons shall be assigned on watch duty with whistles, flashlights, and two-way radio communication with the dredge and beach equipment operators whose sole responsibility is to keep the public out of the work area around the discharge pipeline. Work shall not be performed on the beach fill area unless the designated watch persons are on site. Flagmen shall be stationed at each side of the immediate work area near the seaward end of the orange fencing, and shall be capable of communicating with all Contractor equipment operators at all time. The flagmen shall keep the public out of the barricaded work area at all times, and shall inform all Contractor equipment operators immediately if an unauthorized person(s) enters the barricaded work area.

In the event that an unauthorized person(s) enters the barricaded work area, all work shall immediately stop until the person(s) has been removed from the barricaded work area. All costs resulting from suspensions of work as specified above shall be the responsibility of the Contractor and at no additional expense to the Government.

During night time operations, the dredge discharge pipeline and point of discharge, as well as all ramp areas provided as access across the discharge pipeline, shall be clearly marked and well lighted in accordance with OSHA for site lighting and as approved by the Contracting Officer. Any deviation from the approved plan will require approval in writing from the Contracting Officer.

### 3.4.11 Existing Beach Berm Protection

The Contractor shall protect from damage all existing beach berm and sand dunes and maintain in place any existing beach material that is above the required placement elevation for this contract. The Contractor shall not borrow material or grade material from these areas or disturb vegetation on dunes. The operation and movement of vehicles, equipment and personnel on, over, or across sand dunes is specifically prohibited, except at crossing points that have been approved by the Contracting Officer.

## 3.5 FIELD QUALITY CONTROL

The Contractor shall establish and maintain quality control for the beach fill placement work and all other operations in connection with the work in the field to assure compliance with contract requirements. The Contractor shall inspect for compliance with contract requirements and record the inspection of all operations including but not limited to the following:

a. The fill material meets classification requirements and is placed

within the beach segment to the lines, grade, and tolerance specified.

b. Beach fill operations are confined within the limits of the designated work area.

c. The dredge effluent does not flow landward of the fill section or other limits as specified and established by the Contracting Officer.

d. Damage to the existing and newly constructed beach is held to the minimum from Contractor's operations.

e. Adequate control is provided to prevent unnecessary loss of material by seaward flow of pipeline effluent.

f. The pipeline is periodically inspected for leakage as specified.

g. All joints of pipe for discharge line are tight, sound and in a safe condition.

h. All equipment used in the work is approved and in satisfactory working condition.

i. Checks to insure safe work practices around structures and the public is performed at all times as specified.

j. Checks conducted for proper lines, grades and elevations in finished fill area including proper grading and elimination of undrained pockets and abrupt humps.

k. Ensure all equipment and construction materials have been removed from completed work segments.

l. All results of inspections shall be documented with video tapings, narrative explanations and photographs as required to document the conditions of field quality. The results and supporting data shall be recorded and provided by the Contractor in the Daily Report of Operations.

## 3.6 FINAL CLEAN-UP

Final clean-up shall be performed by the Contractor immediately after completion of all work and shall include the removal of all the Contractor's plant and equipment either for disposal or reuse. Plant and/or equipment to be disposed of shall be disposed of in a manner and at a location approved by the Contracting Officer. No separate payment shall be made for final clean-up and all costs thereof shall be considered a subsidiary obligation of the Contractor.

## 3.7 MEASUREMENT AND PAYMENT

### 3.7.1 General

Measurement and payment shall be in accordance with Section01 20 00 PRICE AND PAYMENT PROCEDURES.

-- End of Section --

List of Attachments

1. 2026 Memorandum of Agreement between BOEM, USACE Norfolk District, and the City of Virginia Beach (placeholder until the agreement is signed)
2. 2018 Schnabel Sandbridge Shoal Borrow Site Area A & B
3. 2023 US Fish and Wildlife Service Biological Opinion for Sandbridge Beach Nourishment and Virginia Beach Hurricane Protection Projects and Rudee Inlet Federal Navigation Project, City of Virginia Beach, VA.
4. 2018 NOAA's National Marine Fisheries Service (NMFS) for Construction and Maintenance of Chesapeake Bay Entrance Channels and use of sand borrow areas for beach renourishment.
5. Operations and Dredging Endangered Species System (ODESS) Guidance
6. Archeological Avoidance Areas
7. Engineering Form 2590, Economic Load Test, March 2025
8. Engineering Form 6209, Certificate of Compliance for Load Handling Equipment and Rigging, June 2023
9. Standard Operating Procedures for Land Based UXO Technicians Providing MEC Support
10. Standard Operating Procedures for UXO Technicians Providing MEC Support Aboard Dredges
11. DEQ Letter dated 02 October 2015, Regulation of Dredging and Aquatic Resource Restoration Activities Conducted by the U.S. Army Corps of Engineers in Commonwealth of Virginia Waters
12. VMRC No Permit Required Letter dated 26 June 2026
13. Sandbridge Bid Schedule

Attachment 1 - 2026 Memorandum of Agreement between BOEM, USACE Norfolk District, and the City of Virginia Beach (placeholder until the agreement is signed)

Attachment 2 – 2018 Schnabel Sandbridge Shoal Borrow Site Area A & B

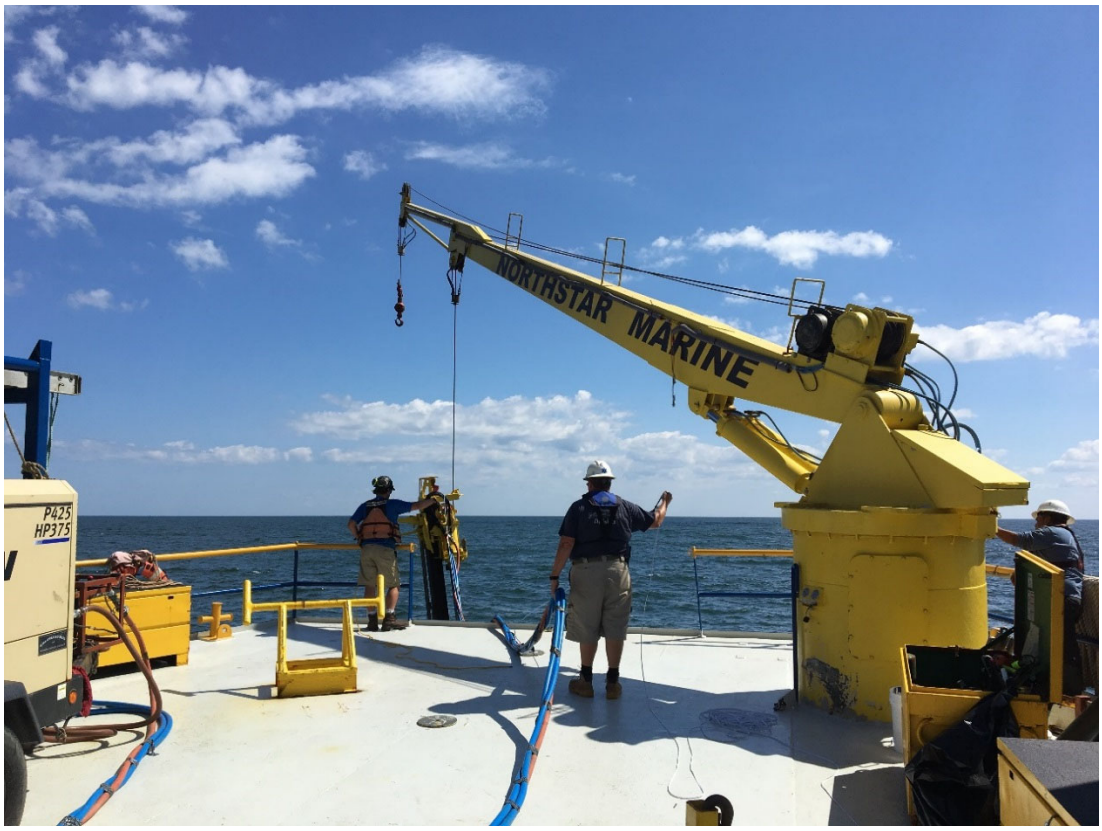
# SANDBRIDGE BEACH RENOURISHMENT PROJECT

# SANDBRIDGE SHOAL BORROW SITE AREAS A & B

## Virginia Beach, Virginia

CONTRACT #W91236-14-D-0025
DO #W9123618F0058

Schnabel Reference 18C13103
December 28, 2018




Schnabel ENGINEERING

Schnabel
ENGINEERING

January 3, 2019

Mr. Jason R. Flowers, P.E.
Chief, Operations Support Section
USACE-Norfolk
803 Front Street
Norfolk, Va. 23501

**Subject:** **Final Report - Sandbridge Beach Renourishment Project, Virginia Beach, Virginia**
**CONTRACT #W91236-14-D-0025; DO #W9123618F0058**

Dear Mr. Flowers:

**SCHNABEL ENGINEERING, LLC** (Schnabel) is pleased to submit our final report presenting the results our hydrographic survey and geotechnical investigation within the limits of the existing Sandbridge Shoal Borrow Site. This final report includes tables, figures, and appendices with relevant data collected for this investigation.

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

Sincerely,

**SCHNABEL ENGINEERING, LLC**

Andrew R. Harrison, C.P.G.
Senior Geologist

Steven P. Pond, C.P.G.
Senior Associate

ARH:SPP

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**SANDBRIDGE BEACH RENOURISHMENT PROJECT**
**SANDBRIDGE SHOAL BORROW SITE AREAS A & B**
**VIRGINIA BEACH, VIRGINIA**

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## APPENDICES

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Appendix B: SSBS Laboratory Data
Appendix C: Sandbridge Beach Laboratory Data
Appendix D: Photographic Documentation (provided electronically)
Appendix E: Hydrographic Survey Data


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## EXECUTIVE SUMMARY

Schnabel Engineering, LLC (Schnabel) was contracted by the Norfolk District of the United States Army Corps of Engineers (USACE) to conduct a hydrographic survey and geotechnical investigation within the limits of the existing Sandbridge Shoal Borrow Site (SSBS) to support beach erosion control and hurricane protection programs. The SSBS is located in the Atlantic Ocean approximately 3.5 to 7.5 miles east of the Sandbridge section of Virginia Beach. The SSBS is comprised of two irregularly shaped sections, borrow areas A and B, that are separated by an approximately two mile “no dredge” area. The smaller of the two sections, SSBS Area B, is located north of Area A and comprised approximately 4.2 square miles. SSBS Area A comprises approximately 5.1 square miles. A Site Map showing the limits of the SSBS is included as Figure 1.

Data from a geotechnical investigation conducted in 1995 was used by USACE to target areas within SSBS areas A and B most likely to contain suitable material for beach renourishment. Since the 1995 investigation several episodes of dredging have occurred and the remaining amount of suitable material within the SSBS is unknown. As such, this investigation was designed to evaluate the amount and distribution of suitable material herein referred to as Target Material. Target Material for the purpose of this investigation is defined as predominantly coarse-grained sediments (less than 10% passing a No. 200 sieve) existing surficially at the mudline with a Target Material sediment thickness greater than or equal to 3.0 feet. A Target Area Map is included as Figure 2.

This investigation included the collection of 72 sediment samples to a maximum depth of 20 feet below the mud line. The specific sample locations for this investigation were identified by utilizing a triangular grid pattern based on a spacing of 1,500 feet for SSBS Area A and 2,500 feet for SSBS Area B within the target areas. As part of this investigation a hydrographic survey of the SSBS was conducted using multi-beam bathymetric survey methods.

This investigation began on August 24, 2018 and was completed on October 11, 2018. The vessel used for the geotechnical investigation was the lift boat L/B Vision owned and operated by Northstar Environmental and Marine Services, Inc. (Northstar) of Clermont, New Jersey. The Vibracore sampling equipment was provided and operated by Ocean Surveys, Inc. (OSI) of Old Saybrook, Connecticut. Schnabel staff were onboard for the investigation to observe and coordinate the investigation, perform sample location confirmation, data measurement and documentation, core processing, sampling, and completion of Vibracore logs.

Eighty-two Vibracore cores were advanced into the ocean floor at 72 defined locations and 10 offset locations using pneumatic vibratory coring (PVC) technology. The target depth for the cores was twenty feet below the mud line or PVC refusal. The average penetration depth for the 72 locations was about 19.4 feet.

Laboratory analysis of sediment samples was conducted by Method ASTM D422 at Schnabel laboratory facilities located in Glen Allen, Charlottesville, and Newport News, Virginia. Schnabel analyzed a total of 188 samples for gradation purposes.

Based on the data gathered during this investigation, Schnabel conservatively estimates about 13.5 million cubic yards (M cy) and 15 M cy of surficial target material to respectively underlie the investigated areas of SSBS Areas A and B.


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## 1.0 SCOPE OF SERVICES

Our proposal dated June 15, 2018 defines the scope of services for this project. The scope of services includes the following:

### Task 1.1 Preparation and Data Gathering

- Evaluation of existing engineering data
- Review of existing plans and specifications
- Review any additional applicable documents provided by the City of Virginia Beach or other available resources to the USACE
- Determine if hydrographic and geotechnical assumptions are adequate to evaluate the borrow site feasibility as a source for beach replenishment

### Task 1.2 Borrow Site Hydrographic Survey

- Hydrographic survey of the borrow site area using multi-beam bathymetric survey methods with survey line spacing of not less than 500 feet
- All survey lines will extend 100 meters beyond the limits of borrow areas A and B
- Navigation control will be achieved utilizing Hypack navigation software
- A video monitor will be located adjacent to the steering console and display the position of the survey vessel relative to the current survey line
- Report all data in an ASCII file that has been corrected for tidal variation using the closest NOAA real time tidal data offset to the work site
- Generate one set of maps (north up) contoured at five foot intervals showing sediment thickness in areas of sand ridges

### Task 1.3 Borrow Site Geotechnical Investigation

- **Sample Collection**
  - Collect Vibracore samples to 20 feet in length across the borrow site Area A and Area B
  - Collect a sufficient number of cores to cover Area A and Area B based on an average spacing of 2,500 feet
  - The total number of cores is estimated to be 100 but the actual number will be based on a systematic approach based on spacing options identified in EM1110-2-1100, Coastal Engineering Manual – Part IV
  - Additional cores may be collected at points of interest identified during the hydrographic survey
- **Sample Handling and Analysis**
  - Divide Vibracore samples into five foot sections labeled at each end with the core number and depth below sea floor
  - Characterize each five foot section of core by measurement, description of color, grain size distribution, and photographed (three photos per five foot section)
  - Measure the sheer strength of cohesive intervals of each sediment core at one foot intervals using a pocket penetrometer


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- Retain one half of each five foot core section (split longitudinally) by sealing it and labeling each end with the core number and depth below the sea floor for a period of one year after the completion of the investigation
- Collect samples of each sandy layer with a minimum thickness of three feet in plastic bags labeled with core number and horizontal and vertical position
- Analyze each sample for grain size by ASTM method D422
- Create logs of each Vibracore in gINT
- Create a fence diagram of the borrow site using the gINT logs

- **Beach Profile**
  - Collect approximately 20 beach sediment samples (sand) from within the project renourishment limits for composite laboratory analysis
  - Characterize the sediment samples from the beach for color and grain size
  - Conduct an analysis of the existing beach profile by performing a level survey along four beach transects
  - Determine compatibility of sediment characteristics between the borrow site material and the existing material on Sandbridge Beach

**<u>Task 1.4 Final Report</u>**

- The final report will contain a summary of all field engineering activities and initial findings to include
  - North up Maps displaying:
    - Water depths contoured at one foot intervals
    - Sandy sediment thickness, contoured at one foot intervals with core locations
    - Any significant man made features
  - Summary of geological data with:
    - Penetration graphs
    - Geological log presented on Engineer Form 1836 (gINT)
    - Grain size analysis results for all the samples
  - Color photographs of all the cores


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# 2.0 INTRODUCTION

## 2.1 Background

A 1995 geotechnical investigation was conducted by Alpine Ocean Seismic Survey, Inc. (Alpine) in the SSBS. The SSBS is divided into three areas; Area A to the south, a middle area that is no longer authorized for dredging use; and Area B to the north. Alpine collected 100 Vibracore samples to a depth of twenty feet below the mud line in Areas A and B. The investigation identified areas of material suitable for beach erosion control and hurricane protection within the limits of SBBS Areas A and B. The results of the geotechnical investigation were detailed in a report titled “Subsurface Investigation by Vibracore for Sandbridge Beach and Virginia Beach Erosion Control and Hurricane Protection Project”.

## 2.2 Purpose and Need

Based on the results of the 1995 geotechnical investigation several dredging events were performed over the past twenty years. These events have apparently exhausted the amount of suitable material identified to the exploration depths of the 1995 investigation. Therefore, additional subsurface data is needed to identify the location and amount of remaining suitable material within the limits of the SSBS Areas A and B.

## 2.3 Regional Geology and Stratigraphy

Review of existing geologic data in our files reveals the site is located within the Coastal Plain physiographic province of Virginia. The Coastal Plain physiographic province in general is characterized by eastward dipping stratified sedimentary river and marine deposits that range in geologic age from recent to Cretaceous. The Coastal Plain extends from the fall zone beneath the waters of the Atlantic Ocean to the continental shelf. According to the Virginia Division of Mineral Resources (VDMR) *Geologic Map and Generalized Cross Sections of the Coastal Plain and Adjacent Parts of the Piedmont, Virginia* (1989), the site area is underlain by undifferentiated Quaternary and Tertiary deposits.

### *2.3.1 Generalized Subsurface Stratigraphy*

We characterized the following generalized subsurface stratigraphy based on the exploration and laboratory test data included in this study.

Water depths (from top of mean water level to mudline) in the Atlantic Ocean at the Vibracore locations within SSBS Areas A and B ranged from 40.7 to 59.6 ft. Top of mean water elevations ranged from MLLW -0.1 to 4.5.

**Stratum A: Marine Sediments – Surficial Target Material**

Below the mudline, we encountered Stratum A, which is comprised of mostly coarse-grained terrigenous sediments and bioclastic (shell) fragments of various concentrations. This stratum is composed of mostly POORLY GRADED SAND (SP), POORLY GRADED SAND WITH SILT (SM) and SILTY SAND (SM) with various fat clay (CH), elastic silt (MH), lean clay (CL), clayey sand (SC), poorly graded gravel (GP) layers and lenses. Decomposed wood and organic silt was encountered in Borings 18SBB-19 and 19A from depths of 1.6 to 2.3 ft. The stratum is derived from marine deposited sediments of recent geologic age.


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Apparent thicknesses of this strata range from 0.6 ft up to 20 ft. This stratum was not encountered in Borings 18SBB-29 and 59.

**Stratum B: Marine Sediments – Covered Non-Target Material**

Below the Stratum A, we encountered Stratum B, which is comprised of mostly fine-grained terrigenous sediments and lesser amounts of bioclastic (shell) fragments of various concentrations. The top of this stratum is generally composed of FAT CLAY (CH), LEAN CLAY (CL), ELASTIC SILT (MH) and SILT (ML) with interlayered poorly graded gravel (GP), silty gravel (GM), poorly graded sand (SP), poorly graded sand with silt (SP-SM) and silty sand (SM) with depth. Boring 18SBB-59 appeared to contain shell hash but recovery was very low. The stratum is derived from marine deposited sediments of recent geologic age.

Apparent thicknesses of this strata range from 0.5 ft up to at least 19.4 ft. This stratum was not encountered in 18SBB-04, 04A, 12, 12A, 17, 17A, 19, 27, 31, 45, 45A, 65 and 71.


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## 3.0 GEOTECHNICAL INVESTIGATION

### 3.1 Vibracore Sampling

Schnabel contracted Northstar, Clermont, New Jersey to provide a vessel for the Vibracore sampling. The specific vessel used for the project was the lift boat Vision (L/B Vision). The L/B Vision is a 70 ft by 39 ft lift boat with 95 ft legs. Schnabel also contracted with OSI, Old Saybrook, Connecticut for Vibracore equipment and equipment operation. The equipment used for the project was an OSI Model 1200 pneumatic vibratory corer configured with a 4-inch steel core barrel and 3½ -inch Lexan clear plastic liners for sample collection. A total of 72 locations were sampled including 59 locations within SSBS Area A and 13 locations within SSBS Area B. A Vibracore Location Map is included as Figure 3.

A Schnabel field representative was onboard during the project and was responsible for review, interpretation, classification, and logging of each Vibracore. The generalized Vibracore sampling protocol is detailed as follows:

- Confirm sample location including the horizontal position and vertical elevation relative to NAD83 and the MLLW.
- Advance each Vibracore to a penetration of 20 feet below the mud line or prior refusal. Refusal is defined as a penetration rate of greater than 20 seconds per 0.1 foot. Measure the rate and depth of penetration of each core in real time on board the vessel.
- Remove the Vibracore liner and scan with a metal detector for potential munitions and explosives of concern (MECs) along two sides of the entire length of the core.
- If no indication of MECs cut the liner into five foot sections and label the end of each section with the core number and depth below sea floor.
- Split each five foot section longitudinally. One half of each section shall be wrapped in a plastic sleeve, labeled with the core number and depth below sea floor at each end, sealed, and transported for storage at an onshore location.
- Characterize each five foot section using unified soil classification system (USGS) terminology including color, grain size distribution. Obtain three photographs of each core section. Include tape measure in each photograph. Obtain pocket penetrometer values along sediments at one foot intervals.
- Collect a sample of each sandy layer with a minimum thickness of three feet but no less than one sample per five feet. Place samples into sealable plastic sample bags and label with the core number and horizontal and vertical position.
- Deliver samples to a Schnabel laboratory for grain size analysis using ASTM method D422.
- Prepare Vibracore logs using gINT (Bentley Software).

A summary of the Vibracore sampling results are shown below in Table 2.


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**Table 2– Summary of Field Measurements for Vibracore Samples**

| *Vibracore Location* | *Borrow Area* | *Penetration Depth (feet)* | *Surficial Sand Thickness (feet)* |
|---|---|---|---|
| 18SBB-01 | A | 20 | 3.9 |
| 18SBB-02 | A | 19.8 | 16.4 |
| 18SBB-03 | A | 20 | 5.0 |
| 18SBB-04 | A | 6 | 5.0 |
| 18SBB-05 | A | 19.8 | 1.6 |
| 18SBB-06 | A | 19.8 | 4.0 |
| 18SBB-07 | A | 20 | 8.2 |
| 18SBB-08 | A | 16.8 | 11.0 |
| 18SBB-09 | A | 18.2 | 14.3 |
| 18SBB-10 | A | 19.7 | 14.5 |
| 18SBB-11 | A | 19.8 | 13.7 |
| 18SBB-12A | A | 19.7 | 18 |
| 18SBB-13 | A | 18.5 | 8.5 |
| 18SBB-14 | A | 19.5 | 4.5 |
| 18SBB-15 | A | 20 | 7 |
| 18SBB-16 | A | 20 | 13.6 |
| 18SBB-17 | A | 16.3 | 6.3 |
| 18SBB-18 | A | 16.2 | 10 |
| 18SBB-19A | A | 19.9 | 0 |
| 18SBB-20 | A | 19.8 | 9.5 |
| 18SBB-21 | A | 19.8 | 6 |
| 18SBB-22 | A | 19.7 | 8 |
| 18SBB-23 | A | 18.6 | 8.5 |
| 18SBB-24 | A | 18 | 13.9 |
| 18SBB-25 | A | 19.8 | 9.5 |
| 18SBB-26 | A | 19.8 | 13 |
| 18SBB-27 | A | 19.4 | 11.8 |
| 18SBB-28 | A | 19.2 | 4.2 |
| 18SBB-29 | A | 19 | 0 |
| 18SBB-30 | A | 19.7 | 0 |
| 18SBB-31 | A | 20 | 20 |
| 18SBB-32 | A | 20 | 3.1 |
| 18SBB-33 | A | 19.8 | 5.1 |
| 18SBB-34 | A | 19.7 | 4 |
| 18SBB-35 | A | 19.8 | 6.2 |
| 18SBB-36 | A | 19.9 | 4.9 |
| 18SBB-37 | A | 19.9 | 3.3 |
| 18SBB-38 | A | 18.3 | 8.3 |
| 18SBB-39 | A | 19.7 | 10.5 |
| 18SBB-40A | A | 19.6 | 0 |
| 18SBB-41 | A | 19.8 | 11.4 |
| 18SBB-42 | A | 20 | 5.8 |
| 18SBB-43 | A | 19.9 | 8.3 |
| 18SBB-44 | A | 20 | 9.2 |
| 18SBB-45A | A | 13.1 | 0 |
| 18SBB-46 | A | 20 | 10 |


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| *Vibracore Location* | *Borrow Area* | *Penetration Depth (feet)* | *Surficial Sand Thickness (feet)* |
|---|---|---|---|
| 18SBB-47 | A | 18.4 | 7.5 |
| 18SBB-48 | A | 17.9 | 7.6 |
| 18SBB-49 | A | 19.5 | 6.9 |
| 18SBB-50 | A | 20 | 5 |
| 18SBB-51 | A | 19.9 | 5.2 |
| 18SBB-52A | A | 18 | 3 |
| 18SBB-53 | A | 20 | 0 |
| 18SBB-54 | A | 20 | 6.4 |
| 18SBB-55 | A | 17.3 | 7.3 |
| 18SBB-56 | A | 19.9 | 0 |
| 18SBB-57 | A | 19.7 | 9 |
| 18SBB-58 | A | 19.7 | 8.9 |
| 18SBB-59A | A | 12.4 | 9.3 |
| 18SBB-60 | B | 20 | 4.6 |
| 18SBB-60.5 | B | 19.6 | 9.6 |
| 18SBB-61 | B | 20 | 4.5 |
| 18SBB-62 | B | 20 | 6.7 |
| 18SBB-63 | B | 20 | 4.5 |
| 18SBB-64 | B | 18.2 | 6.0 |
| 18SBB-65 | B | 20 | 19.6 |
| 18SBB-66 | B | 20 | 4.6 |
| 18SBB-67 | B | 20 | 8.8 |
| 18SBB-68 | B | 19.9 | 5.9 |
| 18SBB-69 | B | 18.1 | 6.0 |
| 18SBB-70 | B | 18.4 | 0 |
| 18SBB-71 | B | 20 | 18.2 |

18SBB-59A = Vibracore locations offset due to shallow penetration

A contour map of surficial sand thickness across SSBA Areas A and B using a one foot contour interval is included as Figure 4. Photographic documentation of the recovered sediments will be submitted electronically as a separate file.

### *3.1.1 Munitions and Explosives of Concern (MEC)*

The "No Dredge" area between SSBS Areas A and B has historically been used as a firing range for the US Navy. Since the presence of MECs in SSBS Areas A and B was a possibility, the USACE required Schnabel to develop a MEC Support Work Plan for the proper and safe handling of vibratory cores if MECs are encountered. A summary of the MEC Support Work Plan executed during exploration is below:

- If the core encountered a solid object and ceased to advance, the Vibracore was returned to the deck and the core sample liner removed for inspection. The location was abandoned and a new core liner was used to sample a new off-set location

- Once a core had penetrated to the required depth on a given run, the Vibracore was returned to the deck and the core sample liner removed for inspection


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- Once the liner was on deck, it was placed in the MEC trough and screened for metal objects using a Garret PinPoint metal detection device. This scanner was used by a Schnabel employee trained in the use of the instrument. When the sample was cleared for the presence of MEC, it was cut into five foot sections, labeled with the core number and depth below sea floor, and securely capped for storage. If evidence of metallic objects was found in the core during screening, the section of the core and a buffer of one foot would be cut out of the core and disposed of at the sampling location. The cores were stored on deck until the vessel returns to the dock. The cores were then transferred to Schnabel personnel on land who were responsible for transporting the cores to the laboratory.

Eighty-two Vibracore samples were collected (including Vibracore offset locations) and screened for MECs. No MECs were identified within the cores.

### *3.1.2 Sample Number and Locations*

A total of 72 Vibracore locations (59 in Area A, 13 in Area B) were plotted using the average spacing between cores of 1,500 feet for Area A, and 2,500 feet for Area B. The Vibracore locations were plotted systematically in accordance with EM 1110-2-1100, Coastal Engineering Manual – Part IV (grid vs. triangular). The number and location of cores were submitted to USACE personnel for approval. The locations were considered sufficient to provide an interpolated conceptual model indicating sediment locations and thickness across the SSBS.

All horizontal data was recorded using the North American Datum of 1983 (NAD '83) Virginia State Plane South, U.S. survey feet. Vertical data was recorded relative to Mean Lower Low Water (MLLW), U.S. survey feet. Navigational equipment used to determine sample locations included a Differential Global Positioning Systems (DGPS) with an accuracy within three feet. Water depths at each Vibracore location are shown in the following table.

**Table 3 – Vibracore Sample Locations and Water Depth**

| Vibracore Boring Identification | Borrow Area | Northing (feet) | Easting (feet) | Depth of Water (feet) |
|---|---|---|---|---|
| 18SBB-01 | A | 3438144 | 12253182 | 45.7 |
| 18SBB-02 | A | 3436990 | 12253674 | 45.3 |
| 18SBB-03 | A | 3436990 | 12255116 | 53 |
| 18SBB-04 | A | 3435599 | 12254132 | 50 |
| 18SBB-05 | A | 3435582 | 12255557 | 51.5 |
| 18SBB-06 | A | 3434191 | 12254844 | 49 |
| 18SBB-07 | A | 3434174 | 12256338 | 50.5 |
| 18SBB-08 | A | 3434174 | 12257763 | 50 |
| 18SBB-09 | A | 3434174 | 12259188 | 49.5 |
| 18SBB-10 | A | 3434123 | 12260715 | 50.7 |
| 18SBB-11 | A | 3434055 | 12262192 | 50 |
| 18SBB-12 | A | 3434123 | 12263625 | 41 |
| 18SBB-13 | A | 3432697 | 12267274 | 58.7 |
| 18SBB-14 | A | 3432731 | 12265848 | 57.2 |


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| Vibracore Boring Identification | Borrow Area | Northing (feet) | Easting (feet) | Depth of Water (feet) |
|---|---|---|---|---|
| 18SBB-15 | A | 3432731 | 12264389 | 52.1 |
| 18SBB-16 | A | 3432799 | 12262964 | 46.6 |
| 18SBB-17 | A | 3432816 | 12261504 | 50.7 |
| 18SBB-18 | A | 3432799 | 12260011 | 51 |
| 18SBB-19 | A | 3432782 | 12258518 | 50.8 |
| 18SBB-20 | A | 3432850 | 12257076 | 51 |
| 18SBB-21 | A | 3432850 | 12255574 | 53 |
| 18SBB-22 | A | 3431459 | 12256304 | 48.5 |
| 18SBB-23 | A | 3431408 | 12257746 | 51.1 |
| 18SBB-24 | A | 3431442 | 12259290 | 52 |
| 18SBB-25 | A | 3431374 | 12260732 | 50.8 |
| 18SBB-26 | A | 3431408 | 12262200 | 49.8 |
| 18SBB-27 | A | 3431391 | 12263659 | 56.1 |
| 18SBB-28 | A | 3431374 | 12265034 | 56.4 |
| 18SBB-29 | A | 3431374 | 12266544 | 58.1 |
| 18SBB-30 | A | 3431357 | 12268012 | 54.4 |
| 18SBB-31 | A | 3431391 | 12269420 | 50.4 |
| 18SBB-32 | A | 3429915 | 12270116 | 54.3 |
| 18SBB-33 | A | 3429965 | 12268707 | 48.8 |
| 18SBB-34 | A | 3429982 | 12267231 | 58.3 |
| 18SBB-35 | A | 3429982 | 12265806 | 57.9 |
| 18SBB-36 | A | 3430033 | 12264380 | 56.1 |
| 18SBB-37 | A | 3429986 | 12262887 | 52.6 |
| 18SBB-38 | A | 3430038 | 12261429 | 51.9 |
| 18SBB-39 | A | 3430055 | 12259988 | 51.8 |
| 18SBB-40 | A | 3430021 | 12258495 | 53.1 |
| 18SBB-41 | A | 3430021 | 12257037 | 47.9 |
| 18SBB-42 | A | 3428701 | 12257714 | 50.9 |
| 18SBB-43 | A | 3428701 | 12259155 | 50.2 |
| 18SBB-44 | A | 3428667 | 12260665 | 54.5 |
| 18SBB-45 | A | 3428667 | 12262089 | 53.5 |
| 18SBB-46 | A | 3428649 | 12263616 | 54.2 |
| 18SBB-47 | A | 3428632 | 12265075 | 55.7 |
| 18SBB-48 | A | 3428597 | 12266533 | 53.5 |
| 18SBB-49 | A | 3428614 | 12267957 | 56.1 |
| 18SBB-50 | A | 3428580 | 12269432 | 51.5 |
| 18SBB-51 | A | 3427278 | 12270040 | 54.3 |
| 18SBB-52 | A | 3427243 | 12268668 | 55.2 |
| 18SBB-53 | A | 3427208 | 12267210 | 59.6 |
| 18SBB-54 | A | 3427278 | 12265787 | 57.6 |


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| Vibracore Boring Identification | Borrow Area | Northing (feet) | Easting (feet) | Depth of Water (feet) |
|---|---|---|---|---|
| 18SBB-55 | A | 3427278 | 12264311 | 56.3 |
| 18SBB-56 | A | 3427295 | 12262835 | 53.5 |
| 18SBB-57 | A | 3427260 | 12261377 | 54.5 |
| 18SBB-58 | A | 3427243 | 12259953 | 55.4 |
| 18SBB-59 | A | 3427295 | 12258443 | 51.5 |
| 18SBB-60 | B | 3449172 | 12249766 | 45.2 |
| 18SBB-60.5 | B | 3448906 | 12250681 | 41.65 |
| 18SBB-61 | B | 3448598 | 12252199 | 43.6 |
| 18SBB-62 | B | 3448024 | 12254633 | 45.5 |
| 18SBB-63 | B | 3447451 | 12257066 | 44.65 |
| 18SBB-64 | B | 3446877 | 12259499 | 43.95 |
| 18SBB-65 | B | 3446303 | 12261933 | 47.55 |
| 18SBB-66 | B | 3451878 | 12249183 | 43.35 |
| 18SBB-67 | B | 3451304 | 12251616 | 40.65 |
| 18SBB-68 | B | 3450730 | 12254049 | 47.2 |
| 18SBB-69 | B | 3450157 | 12256483 | 46 |
| 18SBB-70 | B | 3449583 | 12258916 | 51.7 |
| 18SBB-71 | B | 3449009 | 12261349 | 51.8 |

A contour map of water depths across SSBA Areas A and B using a one foot contour interval is included as Figure 5.

### 3.2 Surficial Sand/Target Material Laboratory Analysis

Our laboratory performed full sieve grain size distribution analysis on the coarse grained sediment samples collected during the geotechnical investigation. The testing aided in the classification of materials encountered in the geotechnical investigation. Selected test results are shown on the boring logs in Appendix A. The Laboratory test data, including gradation test curves, are included in Appendix B. A summary of the Surficial Sand/Target Material laboratory analysis is presented in Table 4.

**Table 4– Summary of Geotechnical Laboratory Analysis of SSBS Vibracore Sediments**

| *Vibracore Location* | *Borrow Area* | *Surficial Sand Thickness (feet)* | *Average Percent Sand and Gravel* |
|---|---|---|---|
| 18SBB-01 | A | 3.9 | 84 |
| 18SBB-02 | A | 16.4 | 96 |
| 18SBB-03 | A | 5.0 | 98 |
| 18SBB-04 | A | 5.0 | 94 |
| 18SBB-05 | A | 1.6 | NS |
| 18SBB-06 | A | 4.0 | 97 |
| 18SBB-07 | A | 8.2 | 97 |
| 18SBB-08 | A | 11.0 | 96 |
| 18SBB-09 | A | 14.3 | 97 |
| 18SBB-10 | A | 14.5 | 94 |


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| *Vibracore Location* | *Borrow Area* | *Surficial Sand Thickness (feet)* | *Average Percent Sand and Gravel* |
|---|---|---|---|
| 18SBB-11 | A | 13.7 | 98 |
| 18SBB-12A | A | 18 | 97 |
| 18SBB-13 | A | 8.5 | 97 |
| 18SBB-14 | A | 4.5 | 95 |
| 18SBB-15 | A | 7 | 94 |
| 18SBB-16 | A | 13.6 | 96 |
| 18SBB-17 | A | 6.3 | 71 |
| 18SBB-18 | A | 10 | 94 |
| 18SBB-19A | A | 0 | NS |
| 18SBB-20 | A | 9.5 | 94 |
| 18SBB-21 | A | 6 | 97 |
| 18SBB-22 | A | 8 | 97 |
| 18SBB-23 | A | 8.5 | 98 |
| 18SBB-24 | A | 13.9 | 97 |
| 18SBB-25 | A | 9.5 | 96 |
| 18SBB-26 | A | 13 | 94 |
| 18SBB-27 | A | 11.8 | 97 |
| 18SBB-28 | A | 4.2 | 77 |
| 18SBB-29 | A | 0 | NS |
| 18SBB-30 | A | 0 | NS |
| 18SBB-31 | A | 20 | 97 |
| 18SBB-32 | A | 3.1 | 96 |
| 18SBB-33 | A | 5.1 | 99 |
| 18SBB-34 | A | 4 | 97 |
| 18SBB-35 | A | 6.2 | 97 |
| 18SBB-36 | A | 4.9 | 95 |
| 18SBB-37 | A | 3.3 | 86 |
| 18SBB-38 | A | 8.3 | 96 |
| 18SBB-39 | A | 10.5 | 98 |
| 18SBB-40A | A | 0 | NS |
| 18SBB-41 | A | 11.4 | 98 |
| 18SBB-42 | A | 5.8 | 98 |
| 18SBB-43 | A | 8.3 | 93 |
| 18SBB-44 | A | 9.2 | 96 |
| 18SBB-45A | A | 0 | NS |
| 18SBB-46 | A | 10 | 96 |
| 18SBB-47 | A | 7.5 | 86 |
| 18SBB-48 | A | 7.6 | 94 |
| 18SBB-49 | A | 6.9 | 87 |
| 18SBB-50 | A | 5 | 92 |
| 18SBB-51 | A | 5.2 | 98 |
| 18SBB-52A | A | 3 | 98 |
| 18SBB-53 | A | 0 | NS |
| 18SBB-54 | A | 6.4 | 89 |
| 18SBB-55 | A | 7.3 | 96 |
| 18SBB-56 | A | 0 | NS |
| 18SBB-57 | A | 9 | 95 |
| 18SBB-58 | A | 8.9 | 97 |
| 18SBB-59A | A | 9.3 | 98 |
| 18SBB-60 | B | 4.6 | 94 |
| 18SBB-60.5 | B | 9.6 | 96 |


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| *Vibracore Location* | *Borrow Area* | *Surficial Sand Thickness (feet)* | *Average Percent Sand and Gravel* |
|---|---|---|---|
| 18SBB-61 | B | 4.5 | 97 |
| 18SBB-62 | B | 6.7 | 97 |
| 18SBB-63 | B | 4.5 | 97 |
| 18SBB-64 | B | 6.0 | 99 |
| 18SBB-65 | B | 19.6 | 97 |
| 18SBB-66 | B | 4.6 | 85 |
| 18SBB-67 | B | 8.8 | 93 |
| 18SBB-68 | B | 5.9 | 93 |
| 18SBB-69 | B | 6.0 | 99 |
| 18SBB-70 | B | 0 | NS |
| 18SBB-71 | B | 18.2 | 94 |

18SBB-70 = Sample does not meet acceptable criteria for target material
NS = not sampled

A contour map of surficial sand thickness across SSBS Areas A and B using a one foot contour interval is included as Figure 4. A cross section index map is included as Figure 6. Cross sections and fence diagrams are included as Figures 7A through 7K.

### 3.3 Sandbridge Beach Laboratory Analysis

A Schnabel geologist plotted potential sample locations along the entire 5.5 mile Sandbridge Beach project area where renourishment efforts are proposed. The sample locations were plotted on a map provided by the City of Virginia Beach titled Condition Survey – Survey of June 2018. This four panel map included 56 evenly spaced elevation transects along the 5.5 mile beach area. A random number generator was used to select 22 sample locations for aliquot sample collection. The aliquots were composited into four samples, one per map panel, and analyzed for gain size to evaluate sediment characteristics between the SSBS material and the existing material on Sandbridge Beach.

Our laboratory performed full sieve grain size distribution analysis on the beach samples. Laboratory test data, including gradation test curves, are included in Appendix C. The results of the grain size analysis show that the exiting beach sand exhibits greater than 98.8 percent sand with varying grain size as shown below in Table 4.

**Table 4 - Summary of Geotechnical Laboratory Analysis of Sandbridge Beach Profile**

| Sandbridge Beach Sample Number | Beach Area | Percent Sand | Description |
|---|---|---|---|
| Composite 1 | Southern | 99.9 | Tan, fine to coarse sand |
| Composite 2 | South Central | 99.9 | Tan, fine to medium sand |
| Composite 3 | North Central | 99.8 | Tan, fine to coarse sand, contains shell fragments |
| Composite 4 | North | 99.8 | Tan, fine to coarse sand |


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## 4.0 HYDROGRAPHIC SURVEY

Schnabel contracted S. T. Hudson Engineers, Inc. (Hudson) of Cherry Hill, New Jersey to perform a Multibeam Hydrographic Survey (Hydro Survey) of Sandbridge Shoal Borrow Site (SSBS) Areas A and B. The Survey included the full geographic limits of SSBS Areas A and B, well beyond targeted areas for subsurface investigation. All data was corrected to Mean Lower Low Water (MLLW) of the survey areas on an AutoCAD Release 2018 drawing highlighting georeferenced tiffs with 5' foot depth contours.

The Hydro Survey was conducted between August 13 and September 21, 2018 with a two person crew using a vessel (STH II) equipped with multibeam sonar equipment. The technical approach for the SSBS Areas A & B Multibeam Hydro Survey was as follows:

- Utilize a commercial broadcasting DGPS network to provide required RTK DGPS correctors during the survey operations. The RTK DGPS correctors were applied to the positioning system on the survey vessel STH II to ensure high resolution vertical and horizontal accuracies for the multibeam survey operations. NAD83 horizontal datum with a VA State Plane South coordinate system (feet), and NAVD88 vertical datum (feet) was used during data acquisition.

- Planned line spacing was adjusted at sea to obtain the required 100% bottom coverage along with real time monitoring of a 0.5 meter grid for quality control and assurance.

- Hydrographic survey equipment and software on STH II included: R2Sonic 2024 multibeam sonar unit, an Applanix POSMV 120 navigation and motion sensor, Valport Mini (SVS) sound velocity profiler located at the sonar head, and a SonTek Castaway (CTD) profiler. Applanix's PosView, POS Pac MMS and Hypack hydrographic data and processing software was used during the acquisition and processing of the bathymetric data.

- Prior to mobilization, Schnabel alerted the US Coast Guard as to the planned use, location, and duration of the Hydro Survey within the SSBS. A sound velocity cast was taken prior to, during, and post survey from onboard the STH II. The sound velocity cast allowed Hudson to obtain the proper sound speed, salinity, and temperature throughout the water column. The bathymetric data was acquired at a frequency of 200 kHz utilizing Hypack's Hysweep software with a real-time 0.5 meter grid for the multibeam portion of the survey.

- Field processing of the bathymetric data was utilized and viewed onboard to ensure proper coverage and quality had been obtained before demobilization. Due to the geographic location RTK drop outs were expected so tidal information was downloaded from the nearest NOAA Tidal Gauge. Quality control of the processing of the multibeam data was controlled utilizing PSOPac MMS software, combining the inertial motion of the vessel and triangulating multiple continually operating reference stations (CORS) within the survey area.

The results of the Hydrographic Survey are provided in Appendix E. They include a set of North up maps showing ocean floor topography referenced to project datum Mean Lower Low Water (MLLW).


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## 5.0 LIMITATIONS

We based the analyses and findings submitted in this report on the information revealed by our exploration. We attempted to provide for normal contingencies, but the possibility remains that material properties will vary between exploration locations. This report has been prepared to aid in the evaluation of this site and to assist in the design of the project. It is intended for use concerning this specific project. We based our recommendations on information on the.

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


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# FIGURES

Figure 1: Site Location Map
Figure 2: Target Area Map
Figure 3A – 3B: Vibracore Location Map (2)
Figure 4: Water Depth Contour Map
Figure 5: Sand Thickness Contour Map
Figure 6: Cross Section Index Map
Figures 7A – 7K: Cross Sections and Fence Diagrams (11)


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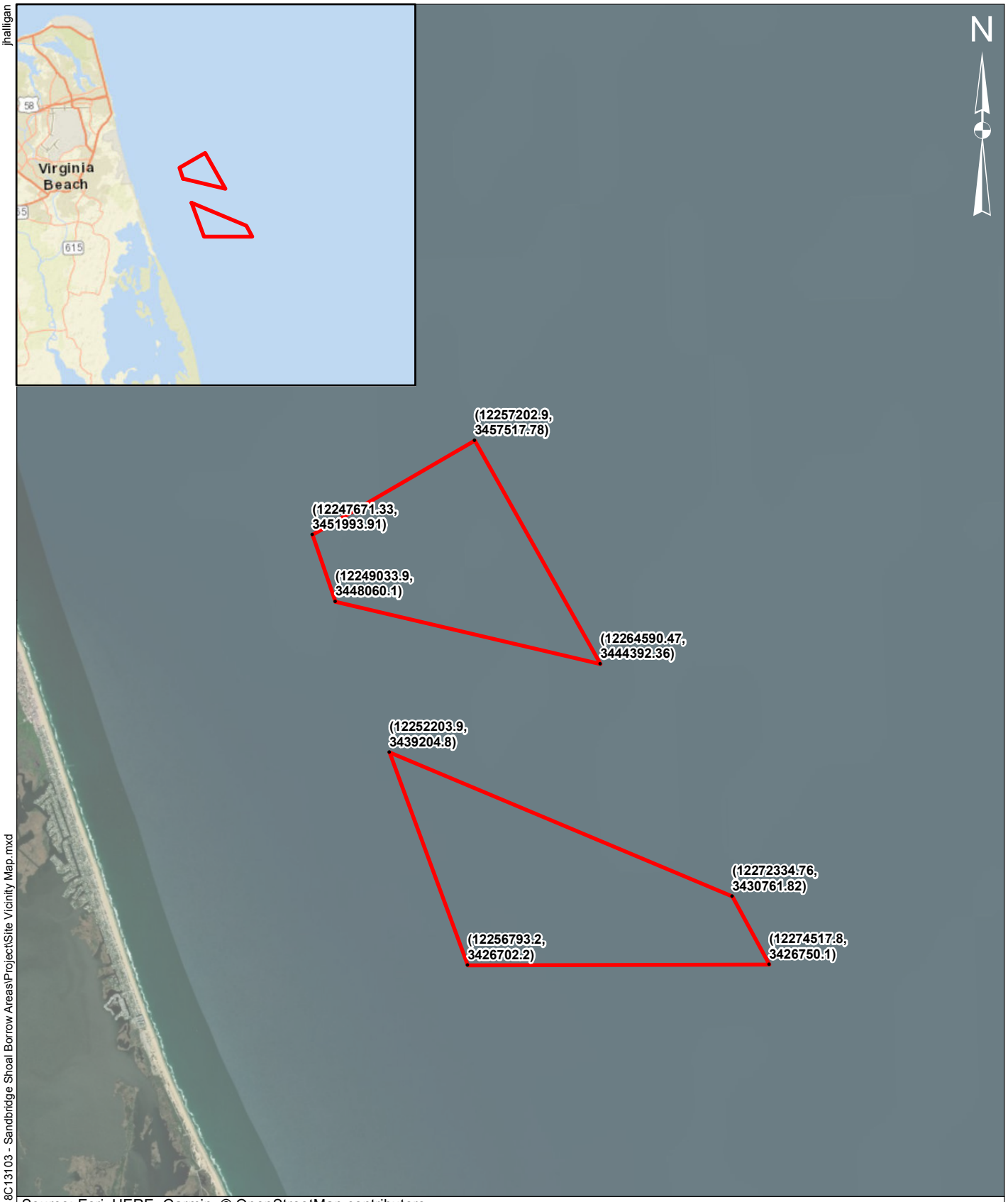


Source: Esri, HERE, Garmin, © OpenStreetMap contributors
Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

8,000 4,000 0 8,000 Feet

Scale: 1 in = 8,000 ft

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SANDBRIDGE SHOAL BORROW AREAS
SANDBRIDGE BEACH RENOURISHMENT PROJECT
CITY OF VIRGINIA BEACH, VIRGINIA
PROJECT NO.18C13103.00

SITE
LOCATION MAP

FIGURE 1

jhalligan

11/12/2018 B:\GIS_Data\2018\18C13103 - Sandbridge Shoal Borrow Areas\Project\Site Vicinity Map.mxd

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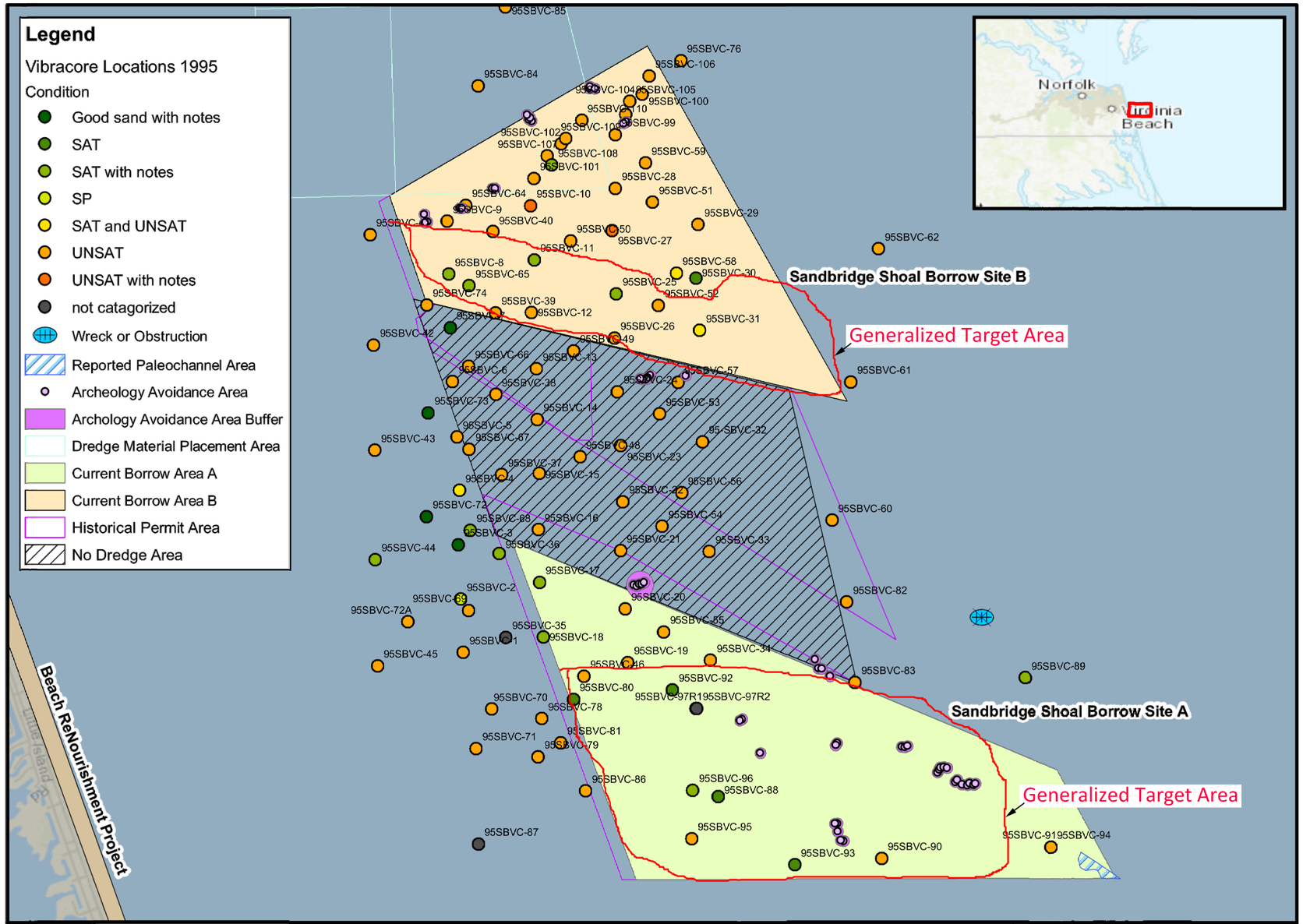


| | | | | |
|---|---|---|---|---|
| Schnabel ENGINEERING | VIRGINIA BEACH RENOURISHMENT SANDBRIDGE SHOAL BORROW SITE OFFSHORE VIRGINIA BEACH, VA | DRAWN BY: CAB | DATE: NOVEMBER 2018 | TARGET AREA MAP |
| | | CHECKED BY: SP | SCALE: AS SHOWN | PROJECT NO. 18C13103.00 FIGURE 2 |

11/13/18 G:\2018 Other Office Projects\18C13103\VIRGINIA\SANDBRIDGE SOUTH FIGURES NOV 2018.dwg

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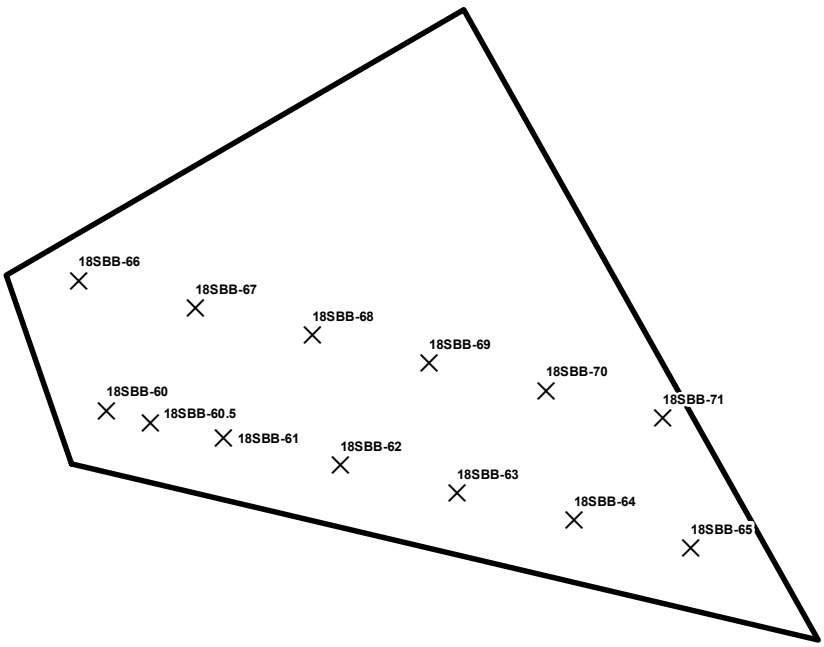


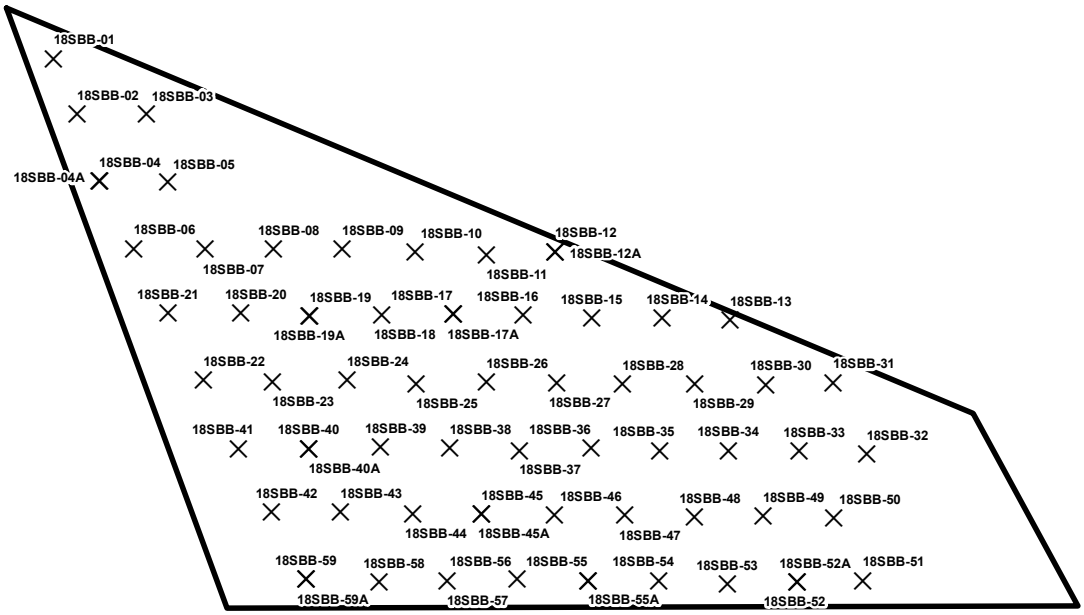


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Scale: 1 in = 4,000 ft

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SANDBRIDGE SHOAL BORROW AREAS
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PROJECT NO.18C13103.00

VIBRACORE
SAMPLE LOCATION
MAP

FIGURE 3

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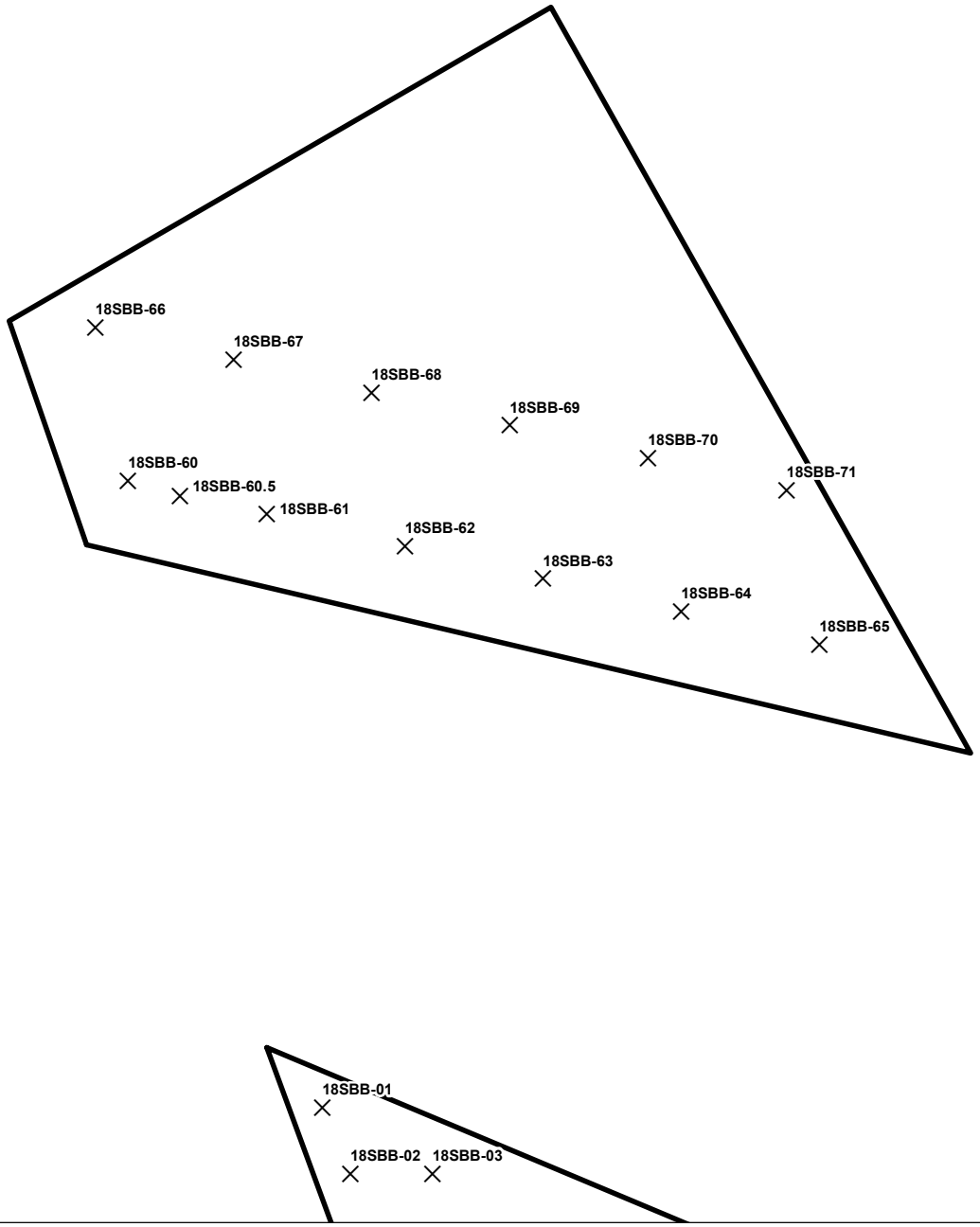


Source:
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Scale: 1 in = 3,200 ft

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SANDBRIDGE SHOAL BORROW AREAS
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PROJECT NO.18C13103.00

VIBRACORE
SAMPLE LOCATION
MAP

FIGURE 3A

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11/12/2018 B:\GIS_Data\2018\18C13103 - Sandbridge Shoal Borrow Areas\Project\Sample Location Map - 3B.mxd

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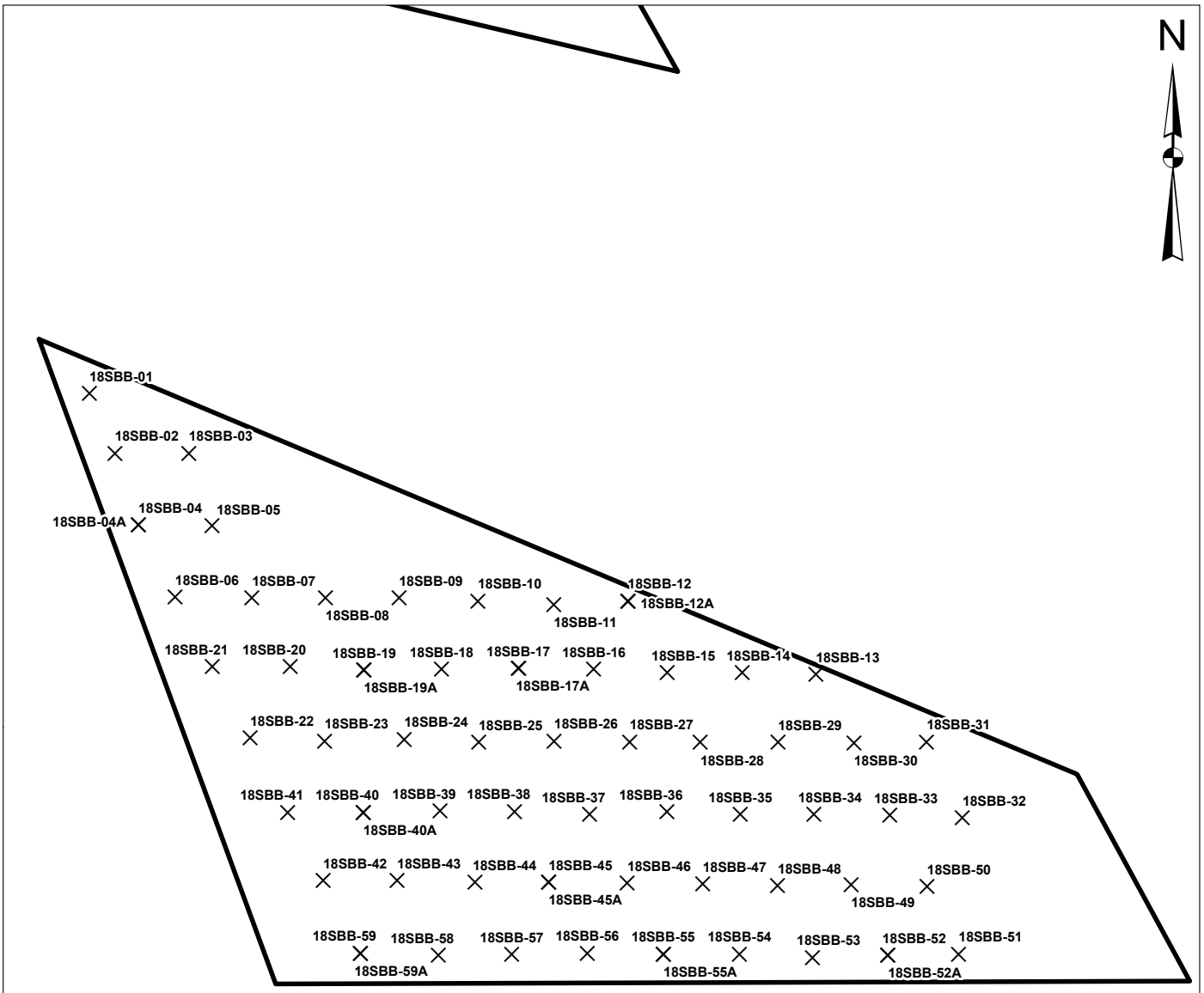


Source:
Projection: NAD 1983 StatePlane Virginia South FIPS 4502 Feet

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Scale: 1 in = 3,200 ft

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SANDBRIDGE BEACH RENOURISHMENT PROJECT
CITY OF VIRGINIA BEACH, VIRGINIA
PROJECT NO.18C13103.00

VIBRACORE
SAMPLE LOCATION
MAP

FIGURE 3B

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11/12/2018 B:\GIS_Data\2018\18C13103 - Sandbridge Shoal Borrow Areas\Project\Sample Location Map - 3B.mxd

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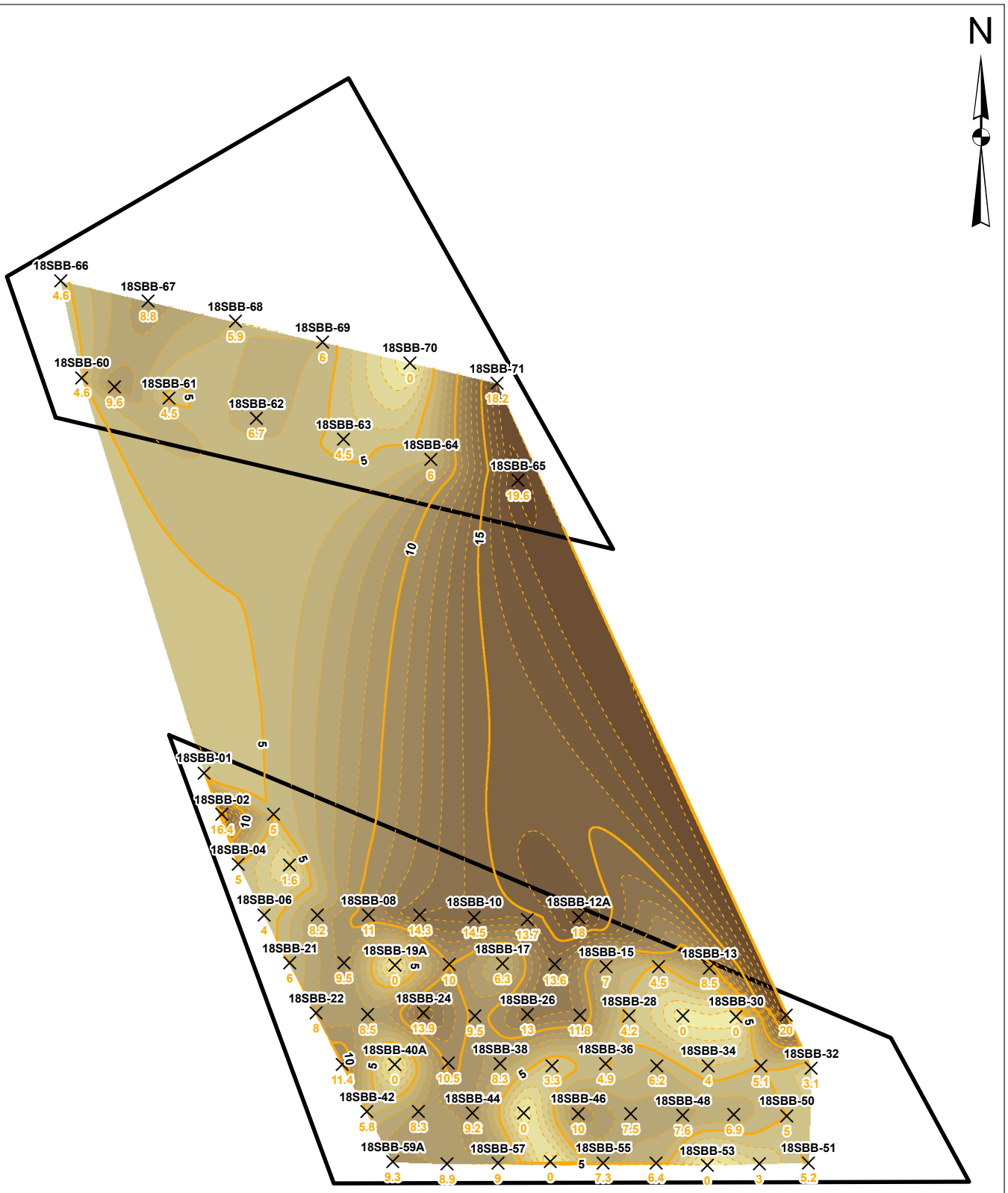


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Projection: NAD 1983 StatePlane Virginia South FIPS 4502 Feet

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Scale: 1 in = 4,000 ft

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CITY OF VIRGINIA BEACH, VIRGINIA
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SURFICIAL SAND THICKNESS CONTOUR MAP

FIGURE 4

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11/6/2018 B:\GIS_Data\2018\Sandbridge Shoal Borrow Areas\Project\Surficial Sand Thickness.mxd

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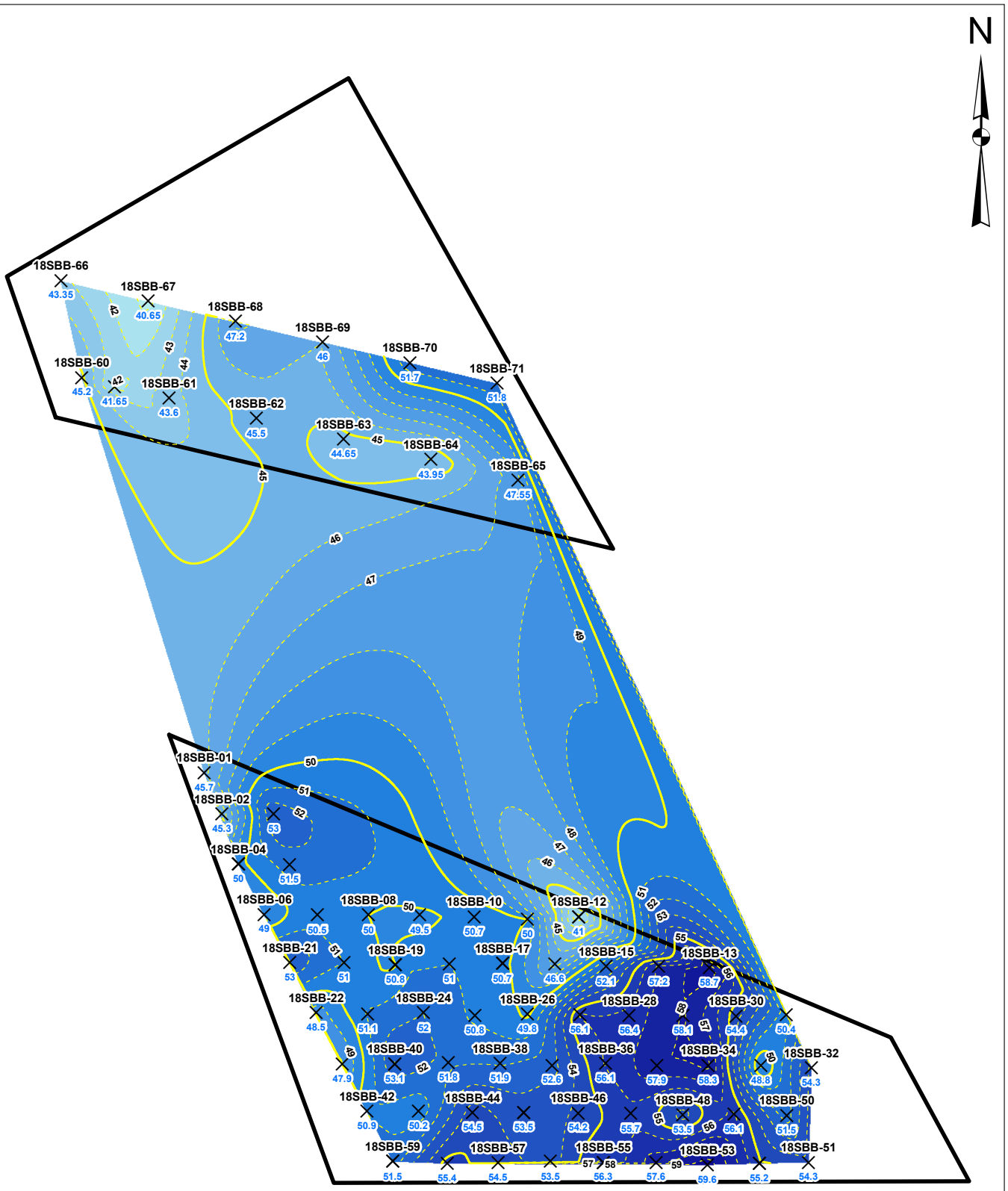


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Scale: 1 in = 4,000 ft

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SANDBRIDGE SHOAL BORROW AREAS
SANDBRIDGE BEACH RENOURISHMENT PROJECT
CITY OF VIRGINIA BEACH, VIRGINIA
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WATER DEPTH CONTOUR MAP

FIGURE 5

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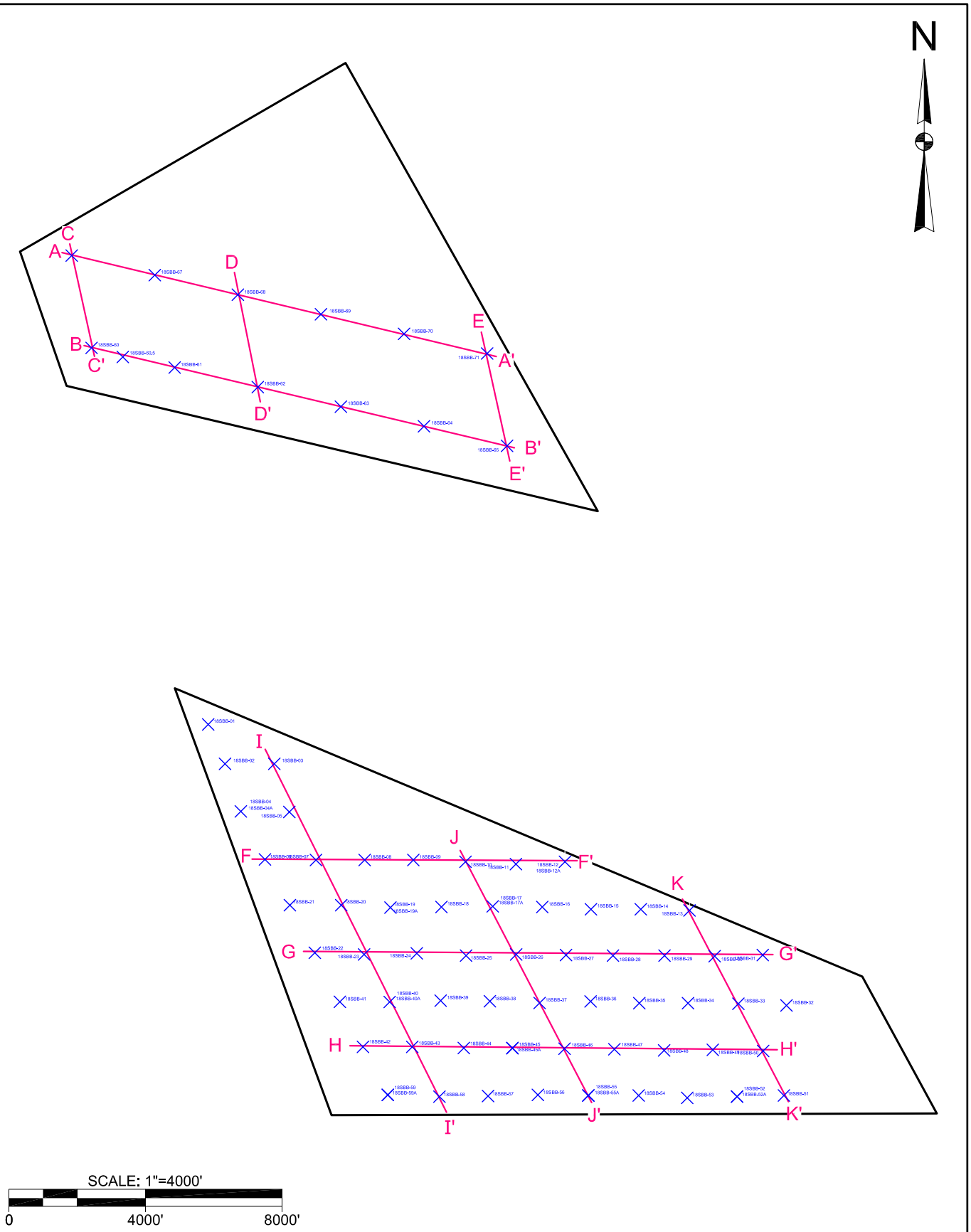


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VIRGINIA BEACH
RENOURISHMENT
SANDBRIDGE SHOAL
BORROW SITE
OFFSHORE VIRGINIA BEACH, VA

CROSS SECTION
INDEX MAP

| Designed: SP | Drawn: CAB | Checked: SP |
|---|---|---|

PROJECT NO. 18C13103.00
FIGURE 6

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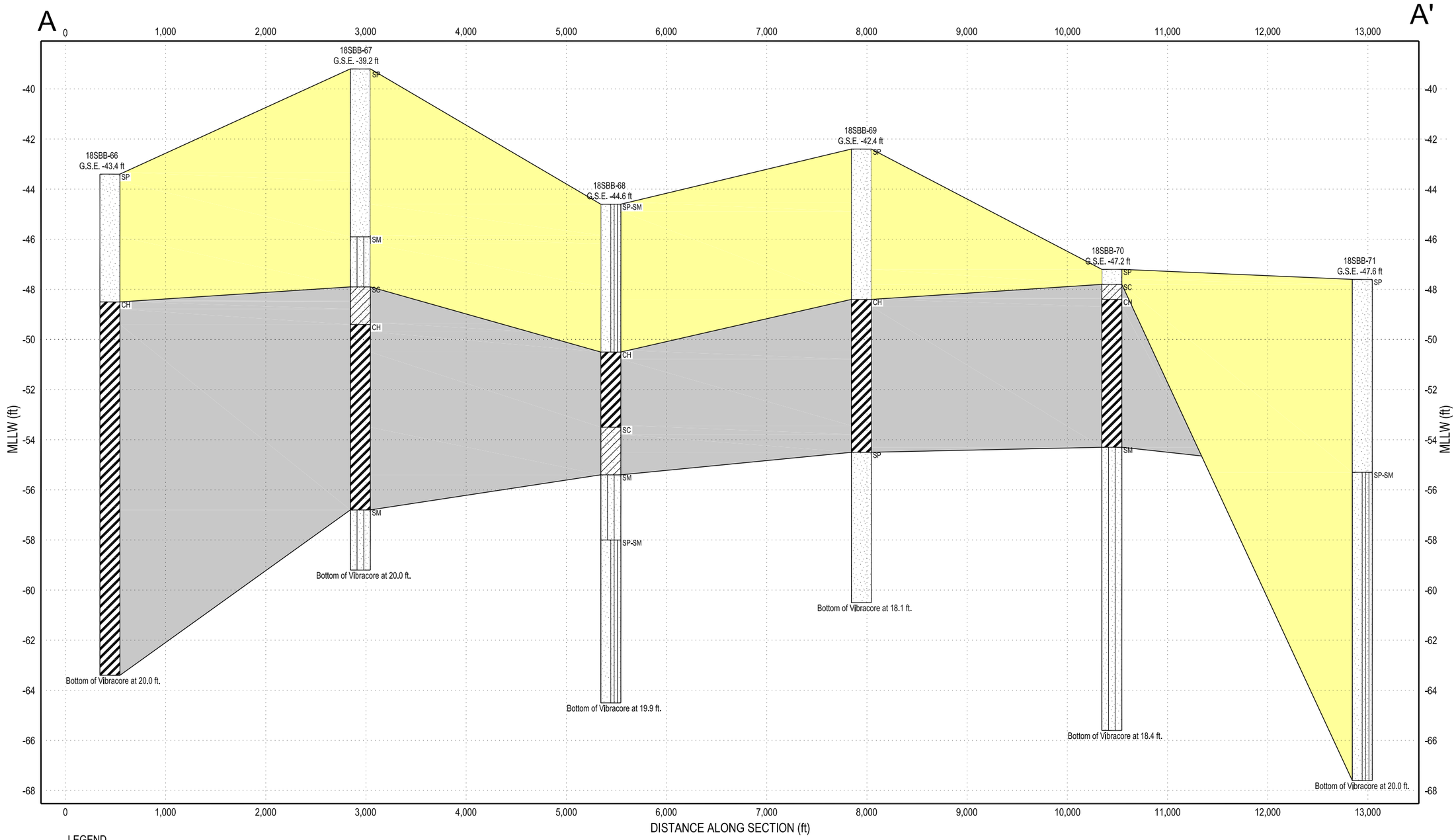


LEGEND

- SP = Poorly Graded Sand
- SP-SM = Poorly Graded Sand with Silt
- SM = Silty Sand
- SC = Clayey Sand
- CH = Fat Clay
- = Surficial Sand
- = Clay and Clayey Sand

SCALE
HORIZONTAL:1"=1,000'
VERTICAL: 1"=4'

1,000 500 0

4 2 0

| | | | | |
|---|---|---|---|---|
| Schnabel ENGINEERING | VIRGINIA BEACH RENOURISHMENT<br>SANDBRIDGE SHOAL<br>BORROW SITE<br>OFFSHORE VIRGINIA BEACH, VA | DRAWN BY:<br>CAB | DATE:<br>NOVEMBER 2018 | CROSS SECTION<br>A – A' |
| | | CHECKED BY:<br>SP | SCALE:<br>AS SHOWN | PROJECT NO. 18C13103.00<br>FIGURE 7A |

11/13/18 G:\2018 Other Office Projects\18C13103\VIRGINIA\SANDBRIDGE SOUTH FIGURES NOV 2018.dwg

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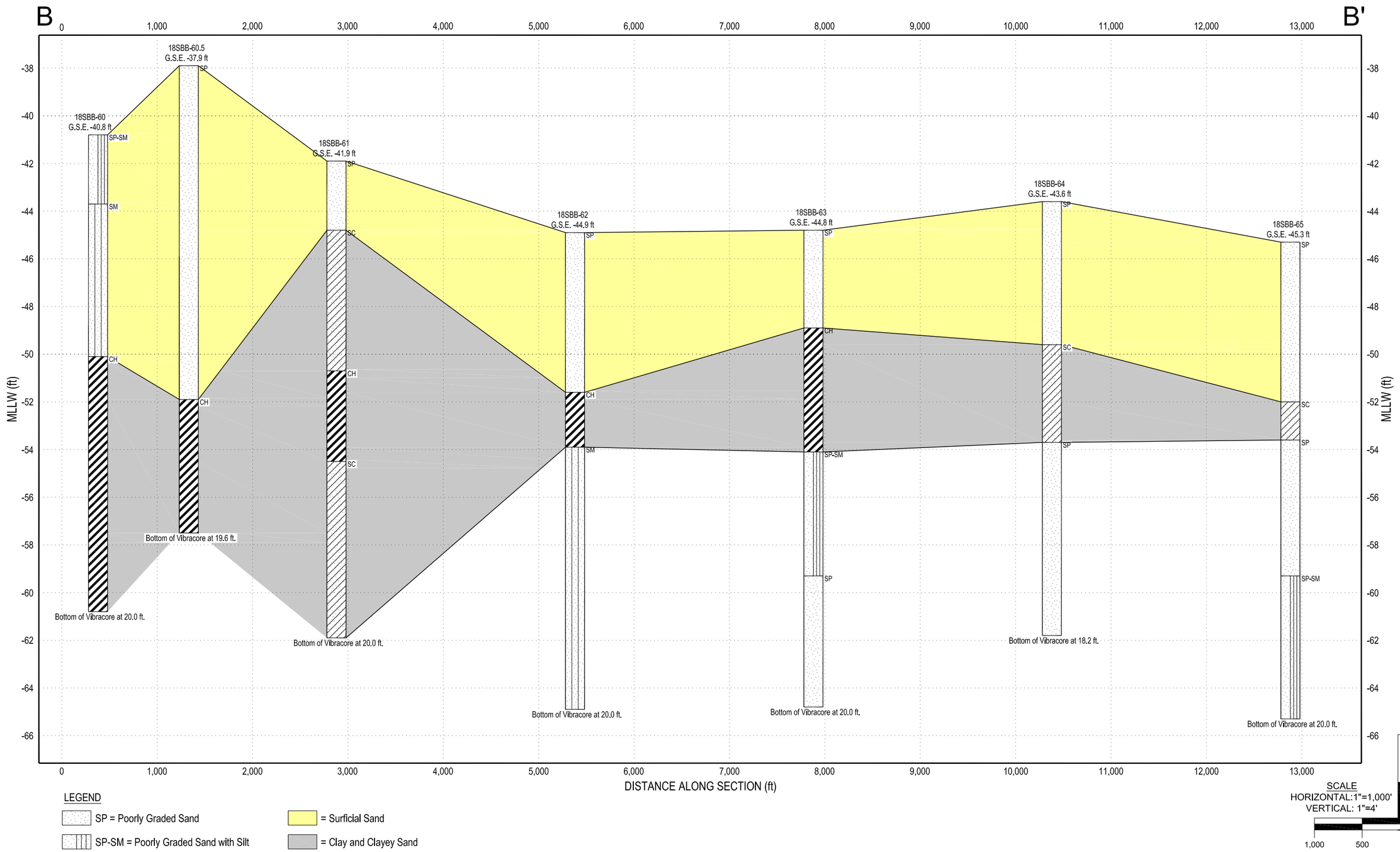


LEGEND

- SP = Poorly Graded Sand
- SP-SM = Poorly Graded Sand with Silt
- SM = Silty Sand
- SC = Clayey Sand
- CH = Fat Clay
- = Surficial Sand
- = Clay and Clayey Sand

| | | | | |
|---|---|---|---|---|
| Schnabel ENGINEERING | VIRGINIA BEACH RENOURISHMENT<br>SANDBRIDGE SHOAL<br>BORROW SITE<br>OFFSHORE VIRGINIA BEACH, VA | DRAWN BY: CAB | DATE: NOVEMBER 2018 | CROSS SECTION<br>B – B' |
| | | CHECKED BY: SP | SCALE: AS SHOWN | PROJECT NO. 18C13103.00<br>FIGURE 7B |

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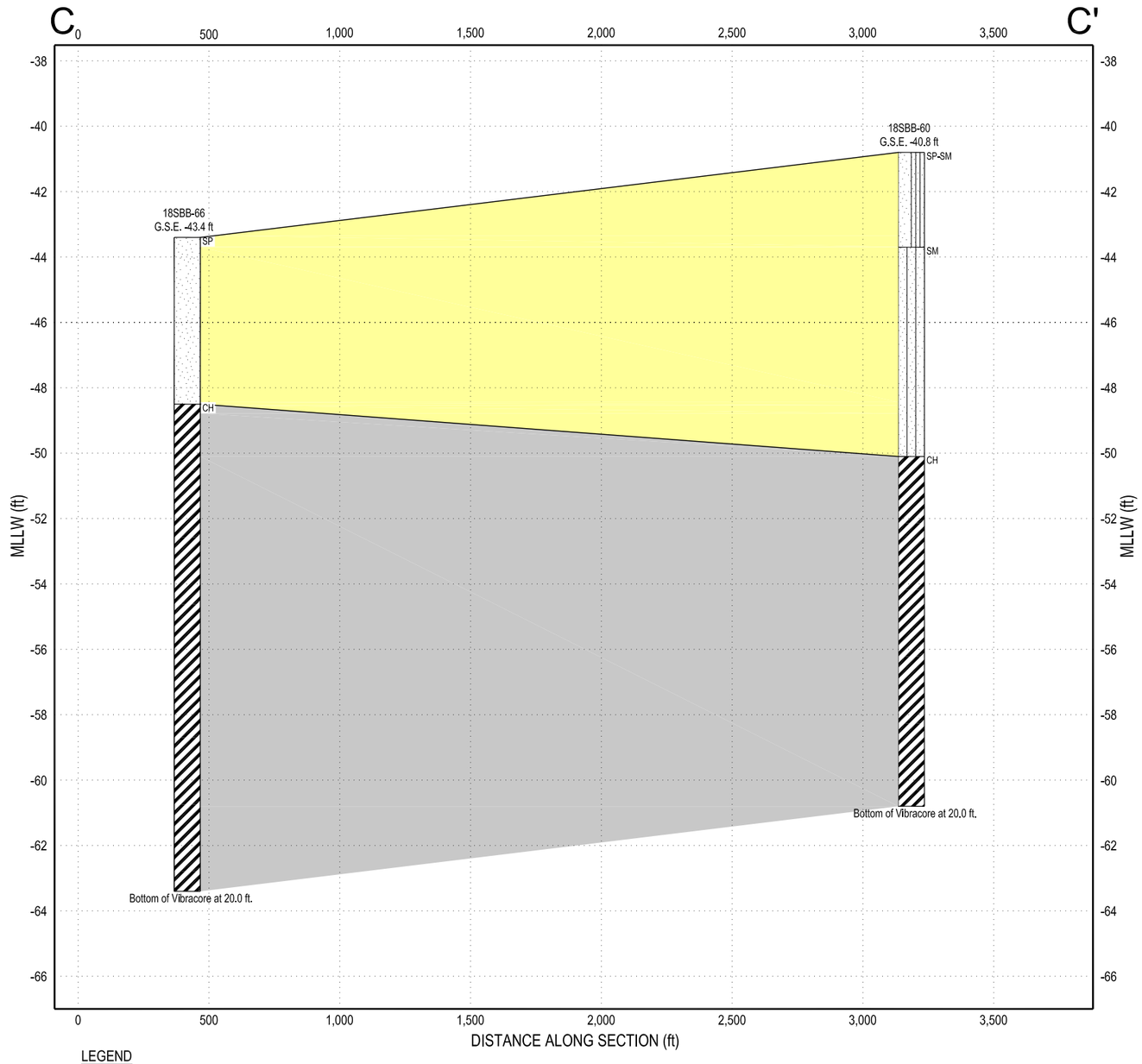
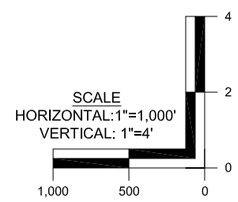



LEGEND

- SP = Poorly Graded Sand
- SP-SM = Poorly Graded Sand with Silt
- SM = Silty Sand
- CH = Fat Clay
- = Surficial Sand
- = Clay and Clayey Sand




| | | | | |
|---|---|---|---|---|
| Schnabel ENGINEERING | VIRGINIA BEACH RENOURISHMENT<br>SANDBRIDGE SHOAL<br>BORROW SITE<br>OFFSHORE VIRGINIA BEACH, VA | DRAWN BY:<br>CAB | DATE:<br>NOVEMBER 2018 | CROSS SECTION<br>C – C' |
| | | CHECKED BY:<br>SP | SCALE:<br>AS SHOWN | PROJECT NO. 18C13103.00<br>FIGURE 7C |

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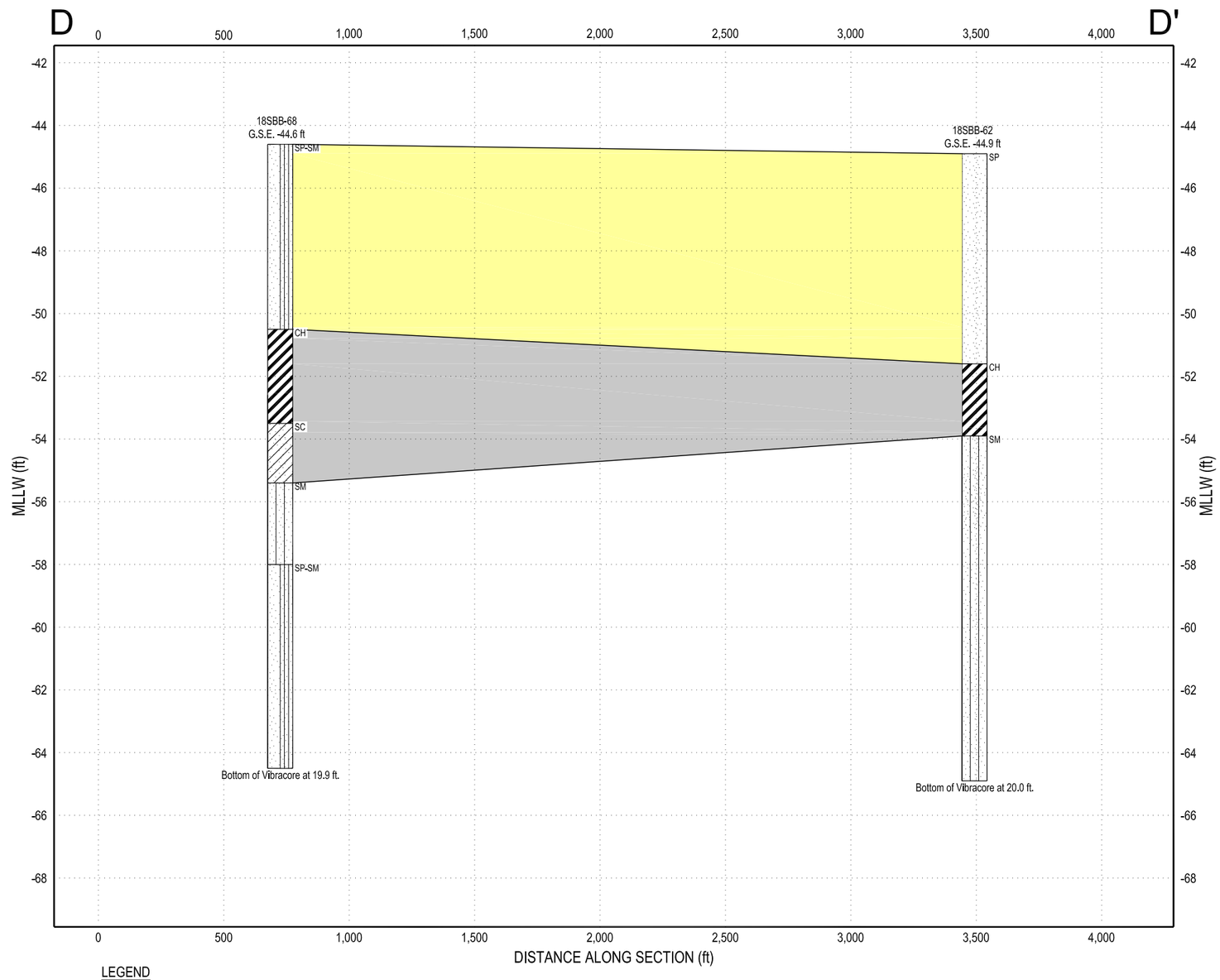
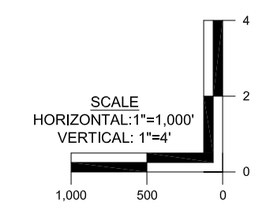



LEGEND

- SP = Poorly Graded Sand
- SP-SM = Poorly Graded Sand with Silt
- SM = Silty Sand
- SC = Clayey Sand
- CH = Fat Clay
- = Surficial Sand
- = Clay and Clayey Sand




| | | | | |
|---|---|---|---|---|
| Schnabel ENGINEERING | VIRGINIA BEACH RENOURISHMENT<br>SANDBRIDGE SHOAL<br>BORROW SITE<br>OFFSHORE VIRGINIA BEACH, VA | DRAWN BY:<br>CAB | DATE:<br>NOVEMBER 2018 | CROSS SECTION<br>D – D' |
| | | CHECKED BY:<br>SP | SCALE:<br>AS SHOWN | PROJECT NO. 18C13103.00<br>FIGURE 7D |

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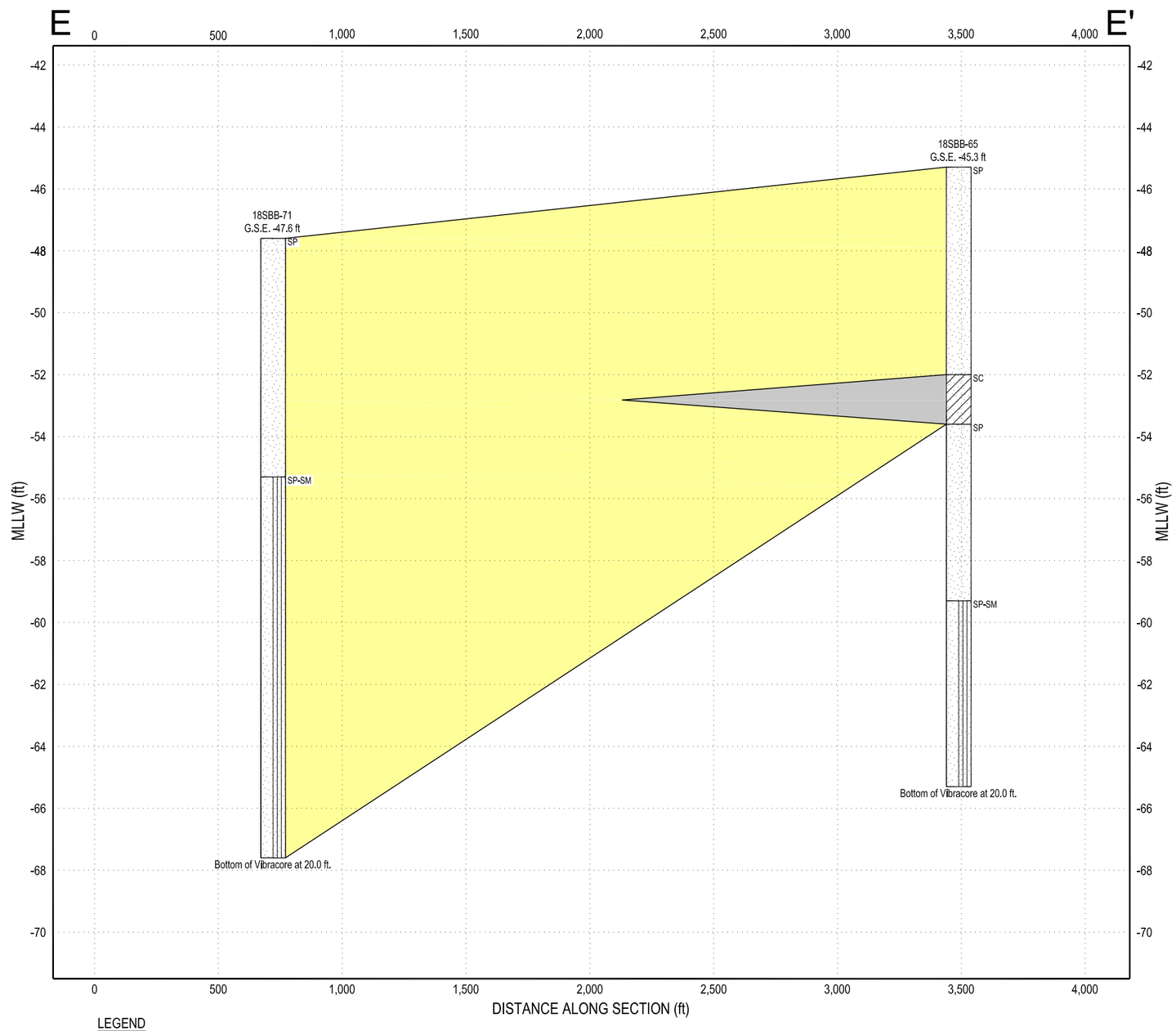
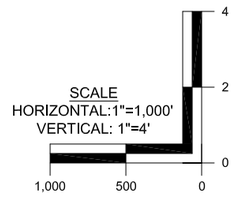
11/13/18 G:\2018 Other Office Projects\18C13103\VIRGINIA\SANDBRIDGE SOUTH FIGURES NOV 2018.dwg




LEGEND

- SP = Poorly Graded Sand
- SP-SM = Poorly Graded Sand with Silt
- SC = Clayey Sand
- = Surficial Sand
- = Clay and Clayey Sand




| | | | | |
|---|---|---|---|---|
| Schnabel ENGINEERING | VIRGINIA BEACH RENOURISHMENT<br>SANDBRIDGE SHOAL<br>BORROW SITE<br>OFFSHORE VIRGINIA BEACH, VA | DRAWN BY:<br>CAB | DATE:<br>NOVEMBER 2018 | CROSS SECTION<br>E – E' |
| | | CHECKED BY:<br>SP | SCALE:<br>AS SHOWN | PROJECT NO. 18C13103.00<br>FIGURE 7E |

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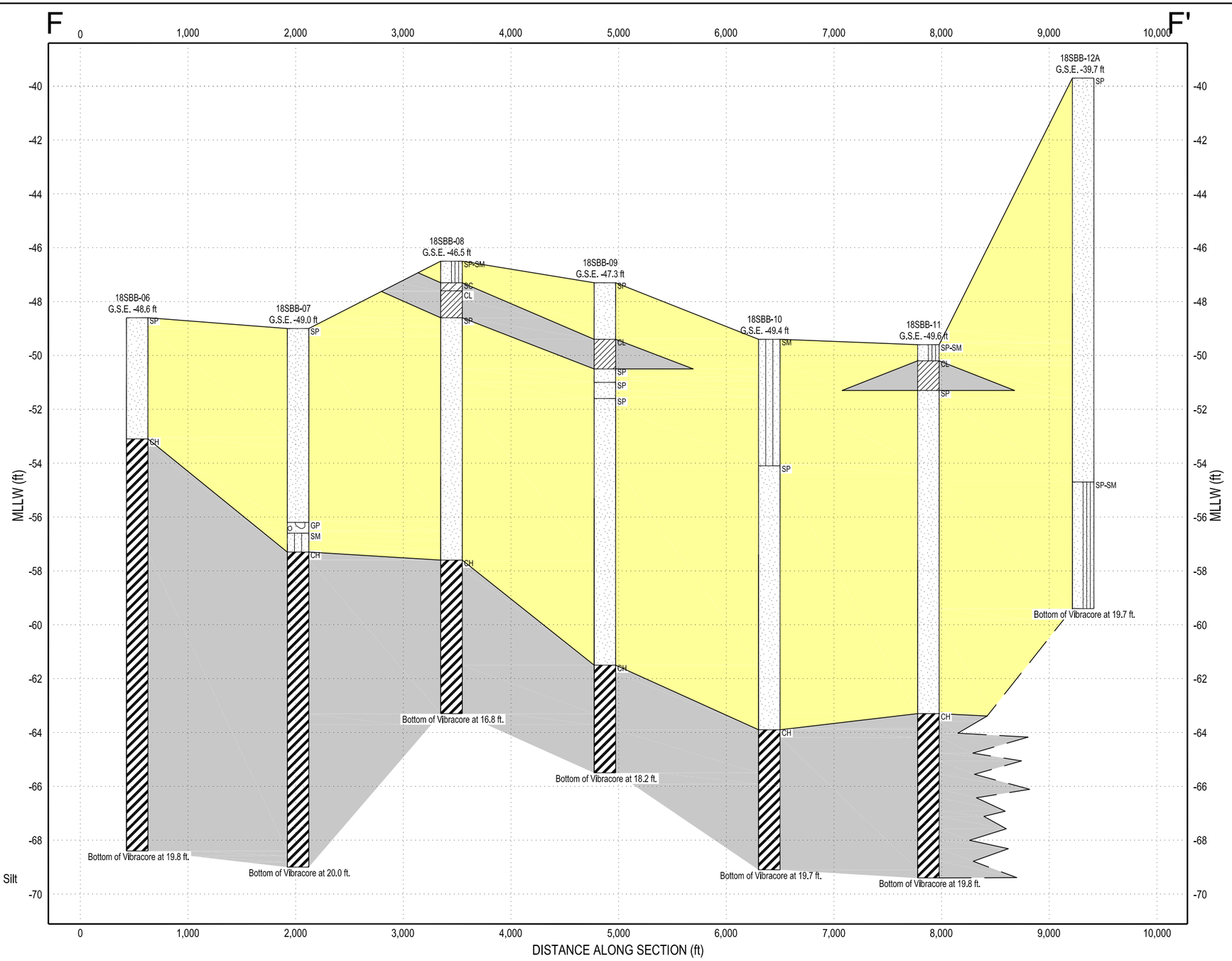


LEGEND

- SP = Poorly Graded Sand
- SP-SM = Poorly Graded Sand with Silt
- SM = Silty Sand
- SC = Clayey Sand
- CH = Fat Clay
- CL = Lean Clay
- GP = Poorly Graded Gravel with Silt

= Surficial Sand

= Clay and Clayey Sand

SCALE
HORIZONTAL:1"=1,000'
VERTICAL: 1"=4'

| | | | | |
|---|---|---|---|---|
| Schnabel ENGINEERING | VIRGINIA BEACH RENOURISHMENT<br>SANDBRIDGE SHOAL<br>BORROW SITE<br>OFFSHORE VIRGINIA BEACH, VA | DRAWN BY: CAB | DATE: NOVEMBER 2018 | CROSS SECTION<br>F – F' |
| | | CHECKED BY: SP | SCALE: AS SHOWN | PROJECT NO. 18C13103.00<br>FIGURE 7F |

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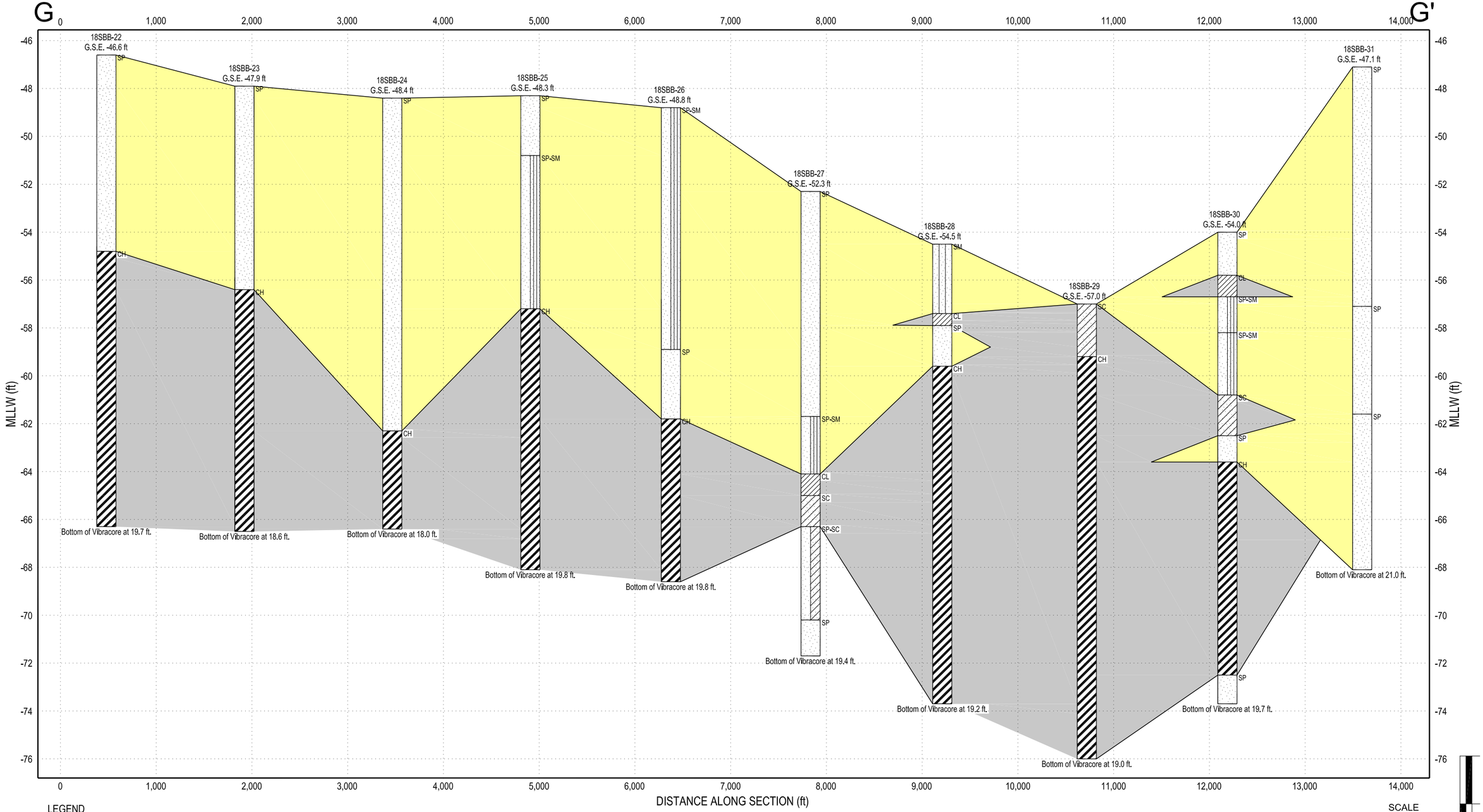
11/13/18 G:\2018 Other Office Projects\18C13103\VIRGINIA\SANDBRIDGE SOUTH FIGURES NOV 2018.dwg




LEGEND

- SP = Poorly Graded Sand
- SP-SM = Poorly Graded Sand with Silt
- SM = Silty Sand
- SC = Clayey Sand
- CH = Fat Clay
- SP-SC = Poorly Graded Sand with Clay
- CL = Lean Clay
- = Surficial Sand
- = Clay and Clayey Sand

SCALE
HORIZONTAL:1"=1,000'
VERTICAL: 1"=4'

Schnabel ENGINEERING

| | | | |
|---|---|---|---|
| VIRGINIA BEACH RENOURISHMENT<br>SANDBRIDGE SHOAL<br>BORROW SITE<br>OFFSHORE VIRGINIA BEACH, VA | DRAWN BY: CAB | DATE: NOVEMBER 2018 | CROSS SECTION<br>G – G' |
| | CHECKED BY: SP | SCALE: AS SHOWN | PROJECT NO. 18C13103.00<br>FIGURE 7G |

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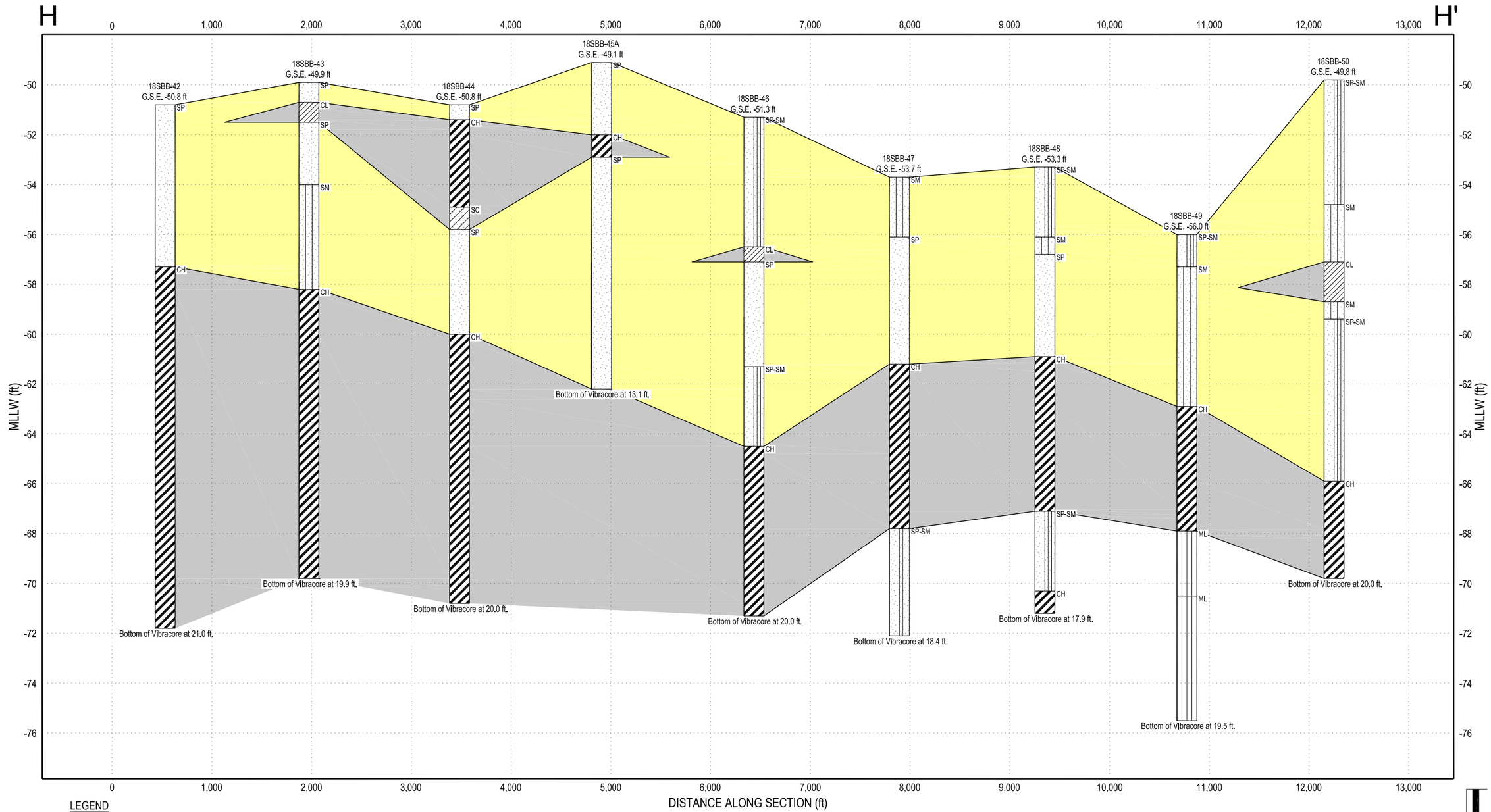
11/13/18 G:\2018 Other Office Projects\18C13103\VIRGINIA\SANDBRIDGE SOUTH FIGURES NOV 2018.dwg




LEGEND

- SP = Poorly Graded Sand
- SP-SM = Poorly Graded Sand with Silt
- SM = Silty Sand
- SC = Clayey Sand
- CH = Fat Clay
- ML = Silt
- CL = Lean Clay
- = Surficial Sand
- = Clay and Clayey Sand

SCALE
HORIZONTAL: 1"=1,000'
VERTICAL: 1"=4'

1,000 500 0

4 2 0

| | | | |
|---|---|---|---|
| Schnabel ENGINEERING | VIRGINIA BEACH RENOURISHMENT<br>SANDBRIDGE SHOAL<br>BORROW SITE<br>OFFSHORE VIRGINIA BEACH, VA | DRAWN BY: CAB<br>CHECKED BY: SP | DATE: NOVEMBER 2018<br>SCALE: AS SHOWN | CROSS SECTION<br>H – H'<br>PROJECT NO. 18C13103.00<br>FIGURE 7H |

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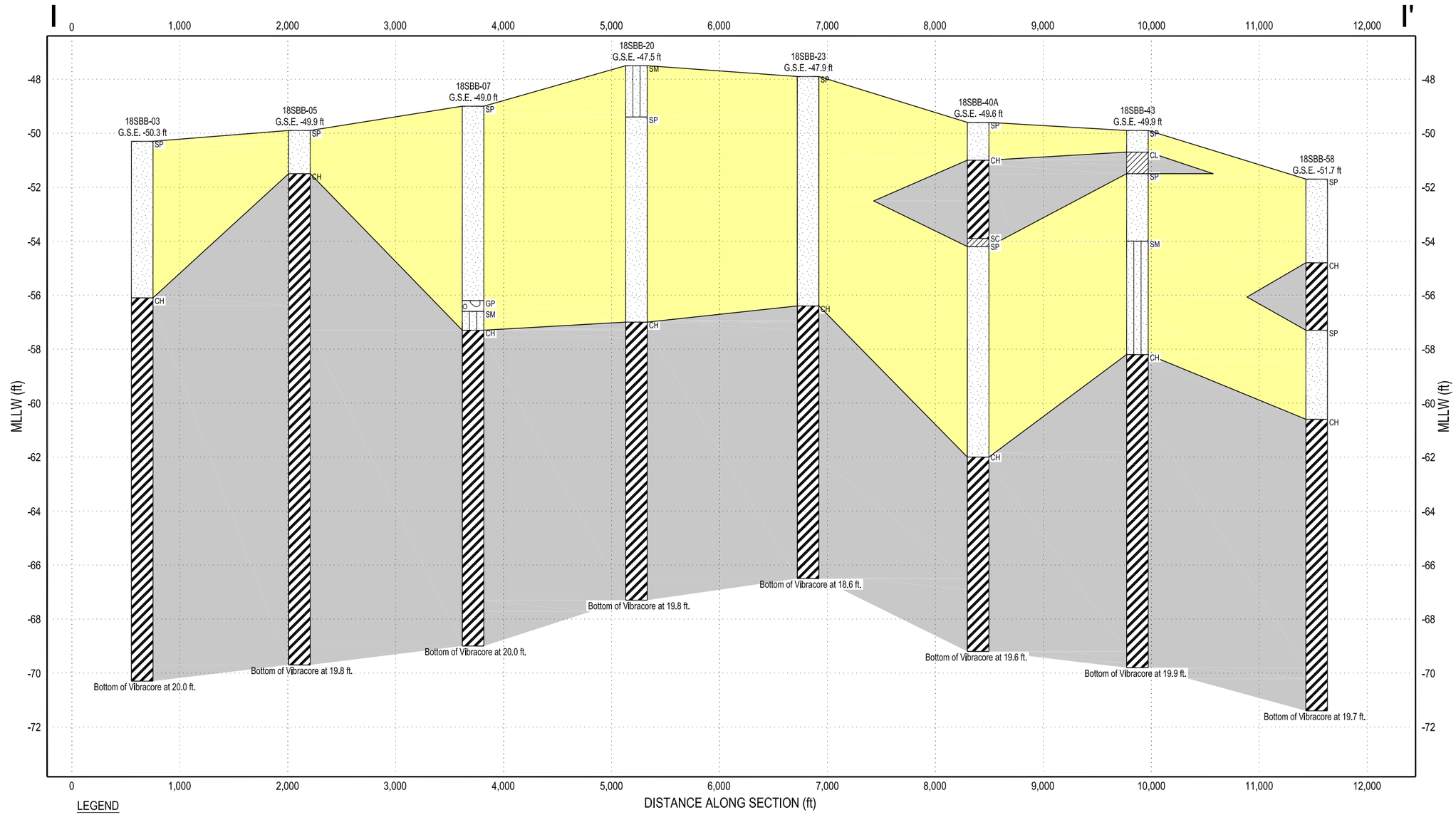
11/13/18 G:\2018 Other Office Projects\18C13103\VIRGINIA\SANDBRIDGE SOUTH FIGURES NOV 2018.dwg




LEGEND

- SP = Poorly Graded Sand
- SP-SM = Poorly Graded Sand with Silt
- SM = Silty Sand
- CL = Lean Clay
- CH = Fat Clay
- GP = Poorly Graded Gravel with Silt
- = Surficial Sand
- = Clay and Clayey Sand

SCALE
HORIZONTAL:1"=1,000'
VERTICAL: 1"=4'

1,000 500 0 — 0 2 4

| | | | | |
|---|---|---|---|---|
| Schnabel ENGINEERING | VIRGINIA BEACH RENOURISHMENT<br>SANDBRIDGE SHOAL<br>BORROW SITE<br>OFFSHORE VIRGINIA BEACH, VA | DRAWN BY:<br>CAB | DATE:<br>NOVEMBER 2018 | CROSS SECTION<br>I – I' |
| | | CHECKED BY:<br>SP | SCALE:<br>AS SHOWN | PROJECT NO. 18C13103.00<br>FIGURE 7I |

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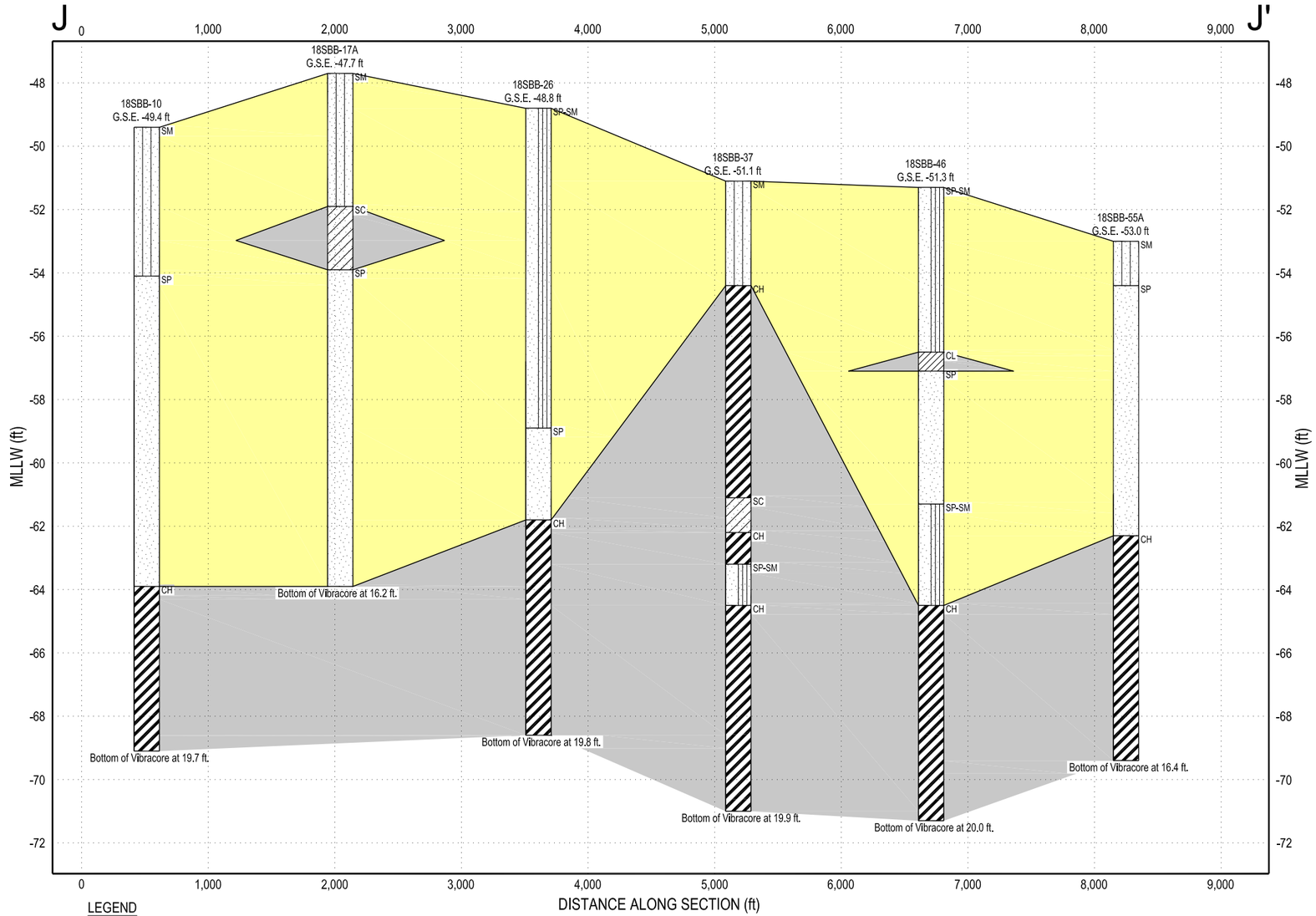


LEGEND

- SP = Poorly Graded Sand
- SP-SM = Poorly Graded Sand with Silt
- SM = Silty Sand
- CL = Lean Clay
- CH = Fat Clay
- SC = Clayey Sand
- = Surficial Sand
- = Clay and Clayey Sand

SCALE
HORIZONTAL:1"=1,000'
VERTICAL: 1"=4'

4
2
0
1,000
500
0

| | | | | |
|---|---|---|---|---|
| Schnabel ENGINEERING | VIRGINIA BEACH RENOURISHMENT<br>SANDBRIDGE SHOAL<br>BORROW SITE<br>OFFSHORE VIRGINIA BEACH, VA | DRAWN BY:<br>CAB | DATE:<br>NOVEMBER 2018 | CROSS SECTION<br>J – J' |
| | | CHECKED BY:<br>SP | SCALE:<br>AS SHOWN | PROJECT NO. 18C13103.00<br>FIGURE 7J |

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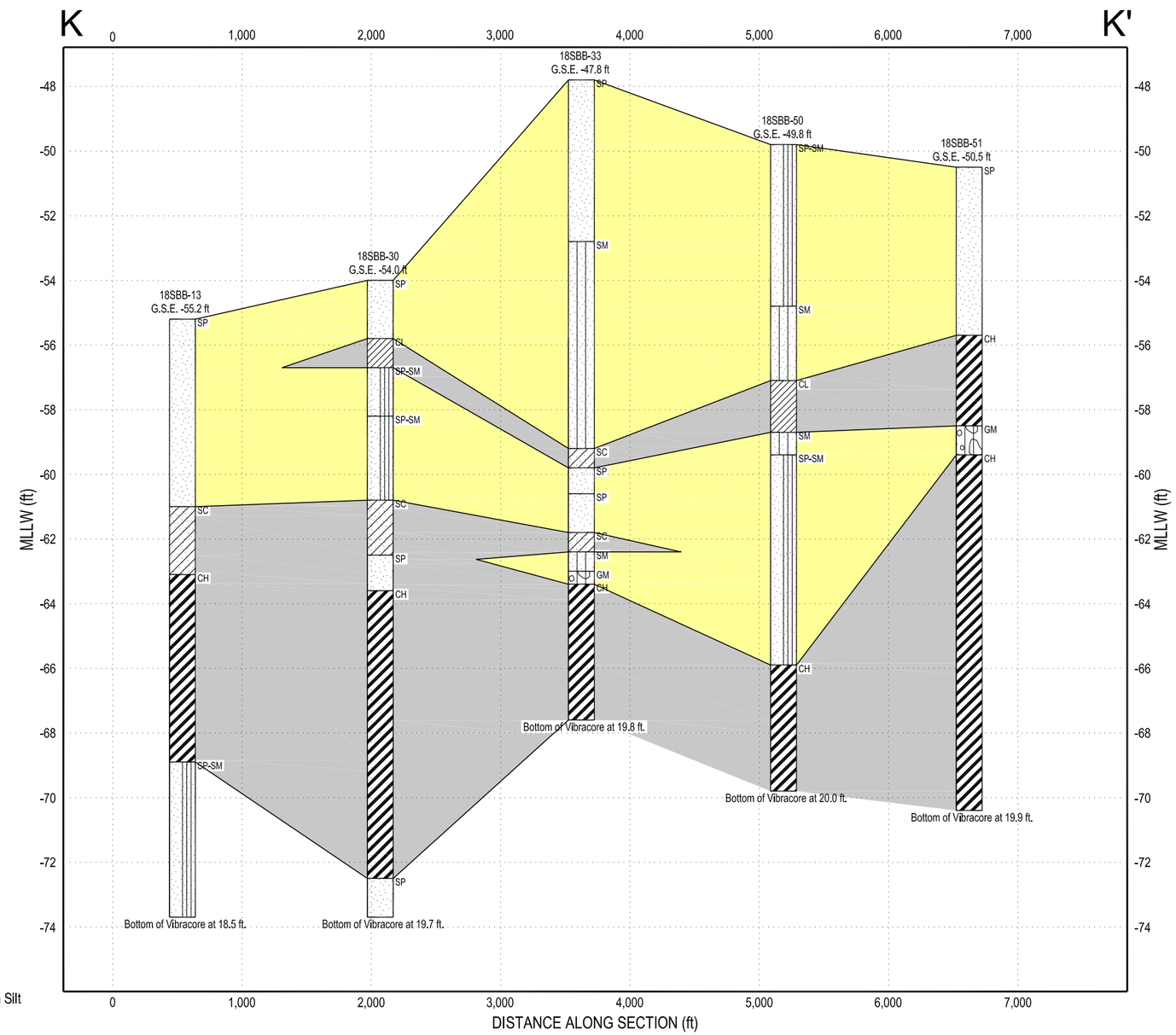


LEGEND

- SP = Poorly Graded Sand
- SP-SM = Poorly Graded Sand with Silt
- SM = Silty Sand
- SC = Clayey Sand
- CL = Lean Clay
- CH = Fat Clay
- GM = Silty Gravel

= Surficial Sand

= Clay and Clayey Sand

SCALE
HORIZONTAL:1"=1,000'
VERTICAL: 1"=4'

1,000 500 0

4 2 0

| | | | | |
|---|---|---|---|---|
| Schnabel ENGINEERING | VIRGINIA BEACH RENOURISHMENT<br>SANDBRIDGE SHOAL<br>BORROW SITE<br>OFFSHORE VIRGINIA BEACH, VA | DRAWN BY:<br>CAB | DATE:<br>NOVEMBER 2018 | CROSS SECTION<br>K – K' |
| | | CHECKED BY:<br>SP | SCALE:<br>AS SHOWN | PROJECT NO. 18C13103.00<br>FIGURE 7K |

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# APPENDIX A

# SUBSURFACE EXPLORATION DATA

Subsurface Exploration Procedures (1 page)
General Notes for Subsurface Exploration Logs (1 page)
Identification of Soil (1 page)
Vibracore Logs 18SBB-01 through 18SBB-71 (83 pages)
Penetration Graphs (3)


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# SUBSURFACE EXPLORATION PROCEDURES

**Vibracore Borings**

Vibracore borings were advanced by a pneumatic hammer for a prescribed distance of about twenty feet below the mud line or prior refusal. At each sampling location the inside of the core barrel is lined with a plastic sleeve and fitted with a shoe at its base. The barrel is then raised via a crane and lowered to the mudline and then vibrated below the mudline to the desired sampling depth. A continuous sediment sample is retained in the plastic sampler sleeve. The core barrel is retracted to the sampling platform where the sleeve is removed and cut into five foot sections and then again along its long axis for classification and sample collection.

**Soil Classification Criteria**

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

**Boring Locations and Elevations**

Vibracore locations were identified by Schnabel and approved by USACE. Coordinates presented in the boring logs were confirmed onsite by differential global positioning system (DGPS) equipment. Approximate locations are shown on Figure 3. Water depths were measured onsite and referenced to MLLW. Locations and elevations should be considered no more accurate than the methods used to determine them.

# GENERAL NOTES FOR SUBSURFACE EXPLORATION LOGS

1. Numbers in sampling data column next to Standard Penetration Test (SPT) symbols indicate penetration rate (in seconds) for pneumatic Vibracore equipment.
2. Visual classification of soil is in accordance with terminology set forth in “Identification of Soil.” The ASTM D2487 group symbols (e.g., CL) shown in the classification column are based on visual observations.
3. Water depths are measured from the deck of the L/B Vision to the mud line and corrected to MLLW.
4. Refusal is defined as a penetration rate of greater than 20 seconds per 0.1 foot.
5. The logs and related information depict subsurface conditions only at the specific locations and at the particular time when drilled or excavated. Soil conditions at other locations may differ from conditions occurring at these locations. Also, the passage of time may result in a change in the subsurface soil and water level conditions at the subsurface exploration location.
6. The stratification lines represent the approximate boundary between soil and rock types as obtained from the subsurface exploration. Some variation may also be expected vertically between samples taken. The soil profile, water level observations and penetration resistances presented on these logs have been made with reasonable care and accuracy and must be considered only an approximate representation of subsurface conditions to be encountered at the particular location.
7. Key to symbols and abbreviations:

| | | |
|---|---|---|
| | S-1, SPT<br>5+10+1 | Sample No., Standard Penetration Test<br>Number of blows in each 6-inch increment |
| | SH-1, SH<br>Rec=24", 100% | Sample No., 2" or 3" Shelby Tube Sample<br>Recovery in inches, Percent Recovery |
| | S-1, GEOPROBE<br>Rec=24", 100% | Sample No., Direct Push Sample<br>Recovery in inches, Percent Recovery |

| | |
|---|---|
| GP | Geostick Penetration Reading (inches) |
| LL | Liquid Limit |
| MC | Moisture Content (percent) |
| PID | Photoionization Detector Reading (ppm) |
| PL | Plastic Limit |
| PP | Pocket Penetrometer Reading (tsf) |
| TPH | Total Petroleum Hydrocarbons |
| %Passing#200 | Percent by weight passing a No. 200 Sieve |

# IDENTIFICATION OF SOIL

## I. DEFINITION OF SOIL GROUP NAMES (ASTM D2487)

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

## II. DEFINITION OF SOIL COMPONENT PROPORTIONS (ASTM D2487)

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

## III. GLOSSARY OF MISCELLANEOUS TERMS

**SYMBOLS** ..... Unified Soil Classification Symbols are shown above as group symbols. A dual symbol "-" indicates the soil belongs to two groups. A borderline symbol "/" indicates the soil belongs to two possible groups.

**FILL**..... Man-made deposit containing soil, rock and often foreign matter.

**PROBABLE FILL**..... Soils which contain no visually detected foreign matter but which are suspect with regard to origin.

**DISINTEGRATED ROCK (DR)**..... Residual materials with a standard penetration resistance (SPT) between 60 blows per foot and refusal. Refusal is defined as an SPT of 100 blows for 2" or less penetration.

**PARTIALLY WEATHERED ROCK (PWR)**..... Residual materials with a standard penetration resistance (SPT) between 100 blows per foot and refusal. Refusal is defined as an SPT of 100 blows for 2" or less penetration.

**BOULDERS & COBBLES**..... Boulders are considered rounded pieces of rock larger than 12 inches, while cobbles range from 3 to 12-inch size.

**LENSES**..... 0 to ½-inch seam within a material in a test pit.

**LAYERS**..... ½ to 12-inch seam within a material in a test pit.

**POCKET** ..... Discontinuous body within a material in a test pit.

**MOISTURE CONDITIONS**..... Wet, moist or dry to indicate visual appearance of specimen.

**COLOR** ..... Overall color, with modifiers such as light to dark or variation in coloration.

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-01
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/24/18 **Finished:** 8/24/18

**North:** 3438144 ft **East:** 12253182 ft

**Coordinate System:** VA State Plane (S)

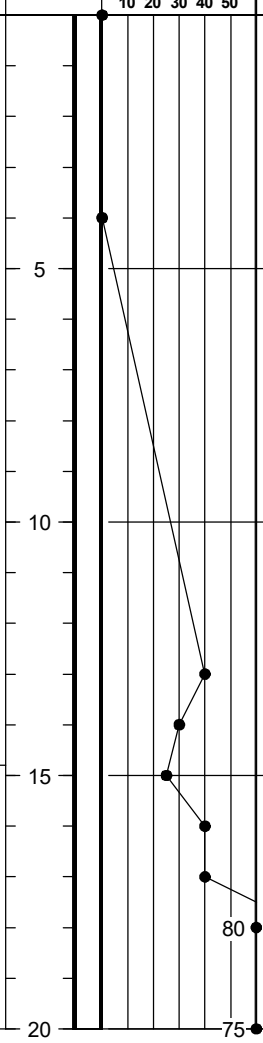
**Mean Low Low Water (MLLW):** -44.4 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/24 | 11:03 AM | 45.7' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | SILTY SAND, fine to coarse grained sand; wet, dark gray and light gray, contains shell fragments | SM | | | % Passing #200 = 16.2 | PP =1.0 tsf<br>PP =3.75 tsf<br>PP =1.25 tsf<br>PP =0.75 tsf |
| 3.9 | LEAN CLAY; wet, dark gray, estimated <5% shell fragments | CL | -48.3 | | | PP =< 0.25 tsf |
| 4.6 | | SC | -49.0 | | | |
| 5.0 | CLAYEY SAND, fine to coarse grained sand; wet, dark gray, estimated 5 - 10% shell fragments | CL | -49.4 | | | PP =0.25 tsf<br>PP =0.25 tsf |
| 6.7 | LEAN CLAY; wet, dark gray, estimated 5 - 10% shell fragments, estimated <5% gravel<br>Change: estimated 15 - 25% shell fragments, contains clayey sand pockets, from 6.4 to 6.7 ft | SP | -51.1 | A | % Passing #200 = 1.9 | PP =1.5 tsf<br>PP =1.5 tsf<br>PP =1.0 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light brown, trace gravel, contains shell fragments | | | | % Passing #200 = 2.6 | PP =0.5 tsf<br>PP =2.0 tsf |
| 11.7 | Change: grayish brown, trace gravel, contains, from 10.2 to 11.7 ft<br>Change: contains lean clay layers, from 11.6 to 11.7 ft | SP | -56.1 | | | PP =0.5 tsf<br>PP =1.75 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, grayish brown, estimated 5 - 10% gravel | | | | | PP =3.0 tsf |
| 14.8 | FAT CLAY; moist, dark gray | CH | -59.2 | B | | PP =0.5 tsf<br>PP =0.5 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf |
| 20.0 | | | -64.4 | | | PP =1 tsf |

SAMPLING DEPTH — PENETRATION TIME (10 20 30 40 50)




Bottom of Vibracore at 20.0 ft.
Penetration Time - 5 minutes: 30 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-02
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut
**Contractor Foreman:** J. Pydeski
**Schnabel Representative:** K. Megginson
**Equipment:** BH8 (Vibracore)
**Method:** 4" O.D. - 20 ft long steel sampler
**Hammer Type:** Pneumatic
**Dates Started:** 8/24/18 **Finished:** 8/24/18
**North:** 3436990 ft **East:** 12253674 ft
**Coordinate System:** VA State Plane (S)
**Mean Low Low Water (MLLW):** -44.2 (ft) **Total Depth:** 19.8 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/24 | 3:09 PM | 45.3' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | SILTY SAND, fine to coarse grained sand; wet, dark gray | SM | | | % Passing #200 = 12.7 | PP =0.25 tsf<br>PP =<0.25 tsf<br>PP =1.25 tsf<br>PP =0.25 tsf |
| 4.1 | POORLY GRADED SAND WITH GRAVEL, fine to coarse grained sand; wet, gray, contains shell fragments | SP | -48.3 | | % Passing #200 = 0.9 | PP =1.25 tsf |
| 5.5 | POORLY GRADED SAND, fine to coarse grained sand; wet, gray, trace gravel | SP | -49.7 | A | % Passing #200 = 1.0 | PP =<0.25 tsf<br>PP =0.5 tsf<br>PP =1.0 tsf<br>PP =0.75 tsf<br>PP =<0.25 tsf<br>PP =<0.25 tsf |
| | | | | | % Passing #200 = 1.6 | PP =0.75 tsf<br>PP =1.25 tsf<br>PP =2.25 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf |
| | | | | | % Passing #200 = 3.3 | PP =1.25 tsf<br>PP =0.5 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf |
| 16.4 | Change: contains coarse gravel, from 16.0 to 16.4 ft<br>FAT CLAY; moist, dark gray | CH | -60.6 | B | | |
| 19.8 | | | -64.0 | | | |

**SAMPLING** — DEPTH (ft) 5, 10, 15; PENETRATION TIME 10 20 30 40 50

Bottom of Vibracore at 19.8 ft.
Penetration Time - 2 minutes: 0 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-03
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/25/18 **Finished:** 8/25/18

**North:** 3436990 ft **East:** 12255116 ft

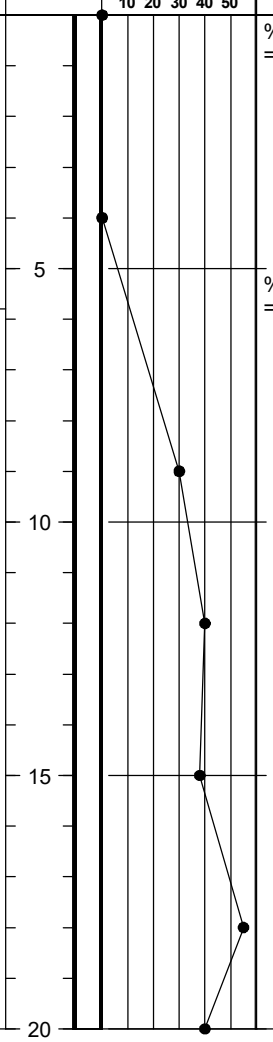
**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -50.3 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/25 | 6:30 AM | 53.0' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light gray, trace gravel | SP | | A | | % Passing #200 = 2.0 | PP =<0.25 tsf<br>PP =1.25 tsf<br>PP =0.75 tsf<br>PP =1.5 tsf |
| | Change: contains wood fragment, from 3.6 to 3.7 ft | | | | | | PP =1.25 tsf |
| 5 | | | | | | % Passing #200 = 4.5 | PP =0.25 tsf |
| 5.8 | FAT CLAY; moist, dark gray, estimated <5% gravel | CH | -56.1 | B | | | PP =0.5 tsf<br>PP =0.75 tsf<br>PP =0.5 tsf<br>PP =0.75 tsf |
| 10 | | | | | | | PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =0.75 tsf |
| 15 | Change: estimated 5 - 10% shell fragments, from 14.5 to 20 ft | | | | | | PP =1.0 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf<br>PP =1.25 tsf<br>PP =1.5 tsf |
| 20.0 | | | -70.3 | | 20 | | PP =1.0 tsf |




Bottom of Vibracore at 20.0 ft.
Penetration Time - 3 minutes: 24 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-04
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/26/18 **Finished:** 8/26/18

**North:** 3435599 ft **East:** 12254132 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -46.7 (ft) **Total Depth:** 6.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/26 | 9:26 AM | 50.0' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | PENETRATION TIME 10 20 30 40 50 | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, dark gray, trace gravel | SP-SM | | A | | | % Passing #200 = 6.4 | PP =<0.25 tsf |
| | Change: estimated 50 - 100% shell fragments, from 1.2 to 1.3 ft | | | | | | | PP =0.5 tsf |
| | Change: light gray, estimated 5 - 10% heavy minerals, below 1.3 ft | | | | | | | PP =0.5 tsf |
| | | | | | | | | PP =0.5 tsf |
| | | | | | | | | PP =0.5 tsf |
| | Change: light grayish brown, estimated 5 - 10% gravel, from 4.8 to 4.9 ft | | | | 5 | | | PP =0.25 tsf |
| 6.0 | | | -52.7 | | | | | PP =0.25 tsf |

Bottom of Vibracore at 6.0 ft.
Penetration Time - 1 minute: 0 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-04A
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/26/18 **Finished:** 8/26/18

**North:** 3435599 ft **East:** 12254137 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -46.7 (ft) **Total Depth:** 6.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/26 | 10:33 AM | 49.7' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | PENETRATION TIME 10 20 30 40 50 | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND WITH SILT, fine to medium grained sand; wet, dark gray, estimated <5% shell fragments | | | | | | | PP =<0.25 tsf |
| | Change: estimated 50 - 100% shell fragments, from 1.3 to 1.4 ft | | | | | | | PP =0.75 tsf |
| | Change: light gray, estimated 5 - 10% heavy minerals, estimated <5% gravel, below 1.5 ft | SP-SM | | A | | | | PP =1.0 tsf |
| | | | | | | | | PP =0.75 tsf |
| | | | | | | | | PP =1.0 tsf |
| | | | | | 5 | | | PP =0.5 tsf |
| 6.0 | | | -52.7 | | | | | PP =0.5 tsf |

Bottom of Vibracore at 6.0 ft.
Penetration Time - 0 minutes: 45 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-05
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/26/18 **Finished:** 8/26/18

**North:** 3435582 ft **East:** 12255557 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -49.9 (ft) **Total Depth:** 19.8 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/26 | 12:34 PM | 51.5' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | PENETRATION TIME 10 20 30 40 50 | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to medium grained sand; wet, light gray with bands of light brown, estimated <5% shell fragments | SP | | A | | | | PP =0.5 tsf |
| 1.6 | | | -51.5 | | | | | PP =1.75 tsf |
| | FAT CLAY; wet, dark gray, estimated <5% shell fragments | | | | | | | PP =0.5 tsf |
| | | | | | | | | PP =0.5 tsf |
| | | | | | | | | PP =0.25 tsf |
| | | | | | 5 | | | PP =0.25 tsf |
| | | | | | | | | PP =0.75 tsf |
| | | | | | | | | PP =0.5 tsf |
| | | | | | | | | PP =0.5 tsf |
| | | | | | | | | PP =0.5 tsf |
| | | | | | 10 | | | PP =0.5 tsf |
| | | CH | | B | | | | PP =0.5 tsf |
| | | | | | | | | PP =0.5 tsf |
| | | | | | | | | PP =0.5 tsf |
| | | | | | | | | PP =0.5 tsf |
| | | | | | 15 | | | PP =0.5 tsf |
| | | | | | | | | PP =0.5 tsf |
| | | | | | | | | PP =0.75 tsf |
| | Change: estimated 5 - 10% shell fragments, from 17.5 to 19.8 ft | | | | | | | PP =0.5 tsf |
| | | | | | | | | PP =0.5 tsf |
| 19.8 | | | -69.7 | | | | | PP =0.25 tsf |

Bottom of Vibracore at 19.8 ft.
Penetration Time - 3 minutes: 36 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-06
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/26/18 **Finished:** 8/26/18

**North:** 3434191 ft **East:** 12254844 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -48.6 (ft) **Total Depth:** 19.8 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/26 | 3:07 PM | 49.0' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | PENETRATION TIME 10 20 30 40 50 | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, gray, trace gravel, contains shell fragments | SP | | A | | | % Passing #200 = 3.3 | PP =0.25 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =0.75 tsf<br>PP =0.5 tsf |
| 4.5 | Change: contains lean clay pockets, from 4.2 to 4.5 ft | | -53.1 | | 5 | | | PP =0.5 tsf |
| | FAT CLAY; moist, dark gray | CH | | B | | | | PP =0.5 tsf<br>PP =0.75 tsf<br>PP =0.5 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf<br>PP =0.5 tsf<br>PP =1.0 tsf<br>PP =0.75 tsf<br>PP =1.0 tsf |
| | Change: estimated 5 - 10% shell fragments, from 15.7 to 19.8 ft | | | | 10<br>15 | 100 | | PP =1.25 tsf<br>PP =1.25 tsf<br>PP =0.5 tsf<br>PP =1.25 tsf<br>PP =1.0 tsf |
| 19.8 | | | -68.4 | | | 70 | | PP =1.25 tsf |

Bottom of Vibracore at 19.8 ft.
Penetration Time - 5 minutes: 12 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-07
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/26/18 **Finished:** 8/26/18

**North:** 3434174 ft **East:** 12256338 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -49.0 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/26 | 5:17 PM | 50.5' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | PENETRATION TIME 10 20 30 40 50 | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, gray, trace gravel, estimated <5% shell fragments | SP | | A | | | % Passing #200 = 1.9 | PP =0.25 tsf<br>PP =0.75 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf<br>PP =0.75 tsf |
| | | | | | 5 | | % Passing #200 = 2.9 | PP =0.5 tsf<br>PP =1.0 tsf |
| 7.2 | | | -56.2 | | | | | PP =0.75 tsf |
| 7.6 | POORLY GRADED GRAVEL WITH SAND, fine to coarse grained sand; wet, light gray | GP | -56.6 | | | | | |
| 8.3 | | SM | -57.3 | | | | | PP =1.5 tsf |
| | SILTY SAND, fine to coarse grained sand; wet, dark gray, estimated <5% gravel, contains clayey sand pockets | | | | | | | PP =0.5 tsf |
| | | | | | 10 | | | PP =0.5 tsf |
| | FAT CLAY; moist, dark gray | | | | | | | PP =0.5 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf |
| | | CH | | B | | | | PP =0.75 tsf |
| | | | | | 15 | | | PP =0.75 tsf<br>PP =0.5 tsf<br>PP =1.0 tsf<br>PP =1.25 tsf |
| | Change: estimated 15 - 25% shell fragments, from 18.3 to 19.5 ft | | | | | | | PP =1.0 tsf |
| 20.0 | | | -69.0 | | 20 | 70 | | PP =0.5 tsf |

Bottom of Vibracore at 20.0 ft.
Penetration Time - 4 minutes: 6 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

| Schnabel ENGINEERING | Project: Sandbridge Borrow Area, Offshore Virginia Beach, Virginia | Vibracore Number: **18SBB-08**<br>Contract Number: 18C13103.00<br>Sheet: 1 of 1 |
|---|---|---|

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/27/18 **Finished:** 8/27/18

**North:** 3434174 ft **East:** 12257763 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -46.5 (ft) **Total Depth:** 16.8 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/27 | 9:44 AM | 50.0' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0.8 | POORLY GRADED SAND WITH SILT AND GRAVEL, fine to coarse grained sand; wet, dark grayish brown, contains shell fragments | SP-SM | -47.3 | | | % Passing #200 = 6.5 | PP =<0.25 tsf |
| 1.1 | | SC | -47.6 | | | | PP =<0.25 tsf |
| 2.1 | Change: black, from 0.6 to 0.8 ft | CL | -48.6 | | | % Passing #200 = 4.4 | PP =0.5 tsf |
| | CLAYEY SAND, fine to coarse grained sand; wet, dark gray, estimated 30 - 45% shell fragments | | | | | | PP =0.5 tsf |
| | LEAN CLAY; wet, dark gray | | | | | | PP =0.25 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, dark gray and gray, trace gravel, contains shell fragments | SP | | A | 5 | | PP =0.75 tsf |
| | | | | | | | PP =0.75 tsf |
| | | | | | | % Passing #200 = 3.6 | PP =0.75 tsf |
| | | | | | | | PP =<0.25 tsf |
| | | | | | | | PP =0.5 tsf |
| | | | | | 10 | | PP =0.75 tsf |
| 11.1 | Change: contains cobbles, from 10.9 to 11.1 ft | | -57.6 | | | | PP =0.5 tsf |
| | FAT CLAY; moist, dark gray | | | | | | PP =0.5 tsf |
| | | CH | | B | | | PP =0.5 tsf |
| | | | | | | | PP =0.5 tsf |
| | Change: estimated 5 - 10% shell fragments, from 14.5 to 16.8 ft | | | | 15 | | PP =0.75 tsf |
| | | | | | | | PP =1.0 tsf |
| 16.8 | | | -63.3 | | | | PP =0.75 tsf |

PENETRATION TIME: 10 20 30 40 50 — 240

Bottom of Vibracore at 16.8 ft.
Time refusal at 16.8 ft.
Penetration Time - 4 minutes: 54 second.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-09
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/27/18 **Finished:** 8/27/18

**North:** 3434174 ft **East:** 12259188 ft

**Coordinate System:** VA State Plane (S)

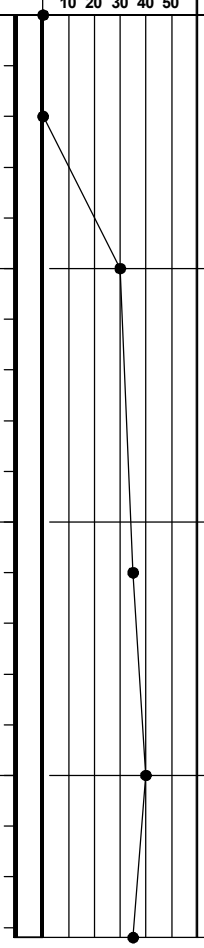
**Mean Low Low Water (MLLW):** -47.3 (ft) **Total Depth:** 18.2 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/27 | 12:04 PM | 49.5' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light brown, trace gravel, contains shell fragments | SP | | | % Passing #200 = 2.3 | PP =<0.25 tsf |
| | Change: dark gray, from 0.5 to 2.1 ft | | | | | PP =0.5 tsf |
| 2.1 | Change: estimated 5 - 10% shell fragments, from 1.4 to 2.1 ft | CL | -49.4 | | | PP =0.5 tsf |
| 3.2 | LEAN CLAY; wet, dark gray | SP | -50.5 | | | PP =0.25 tsf |
| 3.7 | Change: contains clayey sand layer, estimated 5 - 10% shell fragments, from 2.7 to 2.8 ft | SP | -51.0 | | % Passing #200 = 4.2 | |
| 4.3 | POORLY GRADED SAND, fine to coarse grained sand; wet, dark gray, contains shell fragments | | -51.6 | | | PP =0.5 tsf |
| | POORLY GRADED SAND WITH GRAVEL, fine to coarse grained sand; wet, dark gray, contains shell fragments | | | A | | PP =0.5 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light gray, contains shell fragments | SP | | | | PP =0.75 tsf |
| | Change: light gray, from 8.2 to 14.2 ft | | | | % Passing #200 = 1.8 | PP =0.5 tsf |
| | Change: trace gravel, from 11.2 to 14.2 ft | | | | | PP =0.5 tsf |
| | | | | | | PP =0.75 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =0.75 tsf |
| | | | | | % Passing #200 = 1.3 | PP =0.5 tsf |
| 14.2 | FAT CLAY; moist, dark gray | | -61.5 | | | PP =0.5 tsf |
| | Change: contains poorly graded sand lenses, at 15.3 ft and 16.6 ft | CH | | B | | PP =0.5 tsf |
| | | | | | | PP =0.5 tsf |
| | | | | | | PP =0.5 tsf |
| 18.2 | Change: estimated <5% gravel, from 17.8 to 18.2 ft | | -65.5 | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50




Bottom of Vibracore at 18.2 ft.
Penetration Time - 2 minutes: 18 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-10
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/27/18 **Finished:** 8/27/18

**North:** 3434123 ft **East:** 12260715 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -49.4 (ft) **Total Depth:** 19.7 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/27 | 1:21 PM | 50.7' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| | SILTY SAND, fine to coarse grained sand; wet, dark gray, contains shell fragments | SM | | | | % Passing #200 = 14.3 | PP =<0.25 tsf |
| | Change: dark gray, from 0.7 to 3.5 ft | | | | | | PP =<0.25 tsf |
| | Change: estimated 30 - 45% shell fragments, from 1.5 to 2.1 ft | | | | | | PP =0.25 tsf |
| | Change: estimated <5% shell fragments, from 2.1 to 14.5 ft | | | | | | PP =0.5 tsf |
| | Change: light gray and light brown, from 3.5 to 5.0 ft | | | | | | PP =0.5 tsf |
| 4.7 | | | -54.1 | | 5 | % Passing #200 = 1.7 | PP =0.25 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light gray and light brown, contains shell fragments | | | | | | PP =0.75 tsf |
| | Change: estimated <5% wood fragments, at 6.4 ft and 8.0 ft | | | A | | | PP =0.5 tsf |
| | | | | | | | PP =0.5 tsf |
| | | SP | | | | | PP =1.5 tsf |
| | | | | | 10 | % Passing #200 = 1.8 | PP =<0.25 tsf |
| | | | | | | | PP =0.5 tsf |
| | | | | | | | PP =0.5 tsf |
| | | | | | | | PP =0.5 tsf |
| 14.5 | | | -63.9 | | | | PP =0.5 tsf |
| | FAT CLAY; moist, dark gray | | | | 15 | | PP =0.5 tsf |
| | | CH | | B | | | PP =0.75 tsf |
| | | | | | | | PP =1.0 tsf |
| | | | | | | | PP =0.75 tsf |
| 19.7 | | | -69.1 | | | | PP =1.0 tsf |
| | | | | | | | PP =1.0 tsf |

Penetration Time (10 20 30 40 50)

Bottom of Vibracore at 19.7 ft.
Penetration Time - 2 minutes: 48 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-11
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/27/18 **Finished:** 8/27/18

**North:** 3434055 ft **East:** 12262192 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -49.6 (ft) **Total Depth:** 19.8 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/27 | 3:01 PM | 50.0' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| 0.6 | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, dark gray, trace gravel, contains shell fragments | SP-SM | -50.2 | | | % Passing #200 = 5.4 | PP =<0.25 tsf |
| 1.7 | LEAN CLAY; wet, dark gray | CL | -51.3 | | | | PP =0.25 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, gray, trace gravel | | | | | | PP =<0.25 tsf |
| | Change: estimated <5% shell fragments, from 3.0 to 13.7 ft | | | | | | PP =0.5 tsf |
| | Change: contains clayey sand, from 3.3 to 3.4 ft | | | | 5 | % Passing #200 = 1.2 | PP =0.5 tsf |
| | | | | | | | PP =<0.25 tsf |
| | | | | A | | | PP =<0.25 tsf |
| | | SP | | | | | PP =0.5 tsf |
| | Change: contains clay pockets, at 8.3 ft and 9.5 ft | | | | | | PP =0.25 tsf |
| | | | | | | | PP =0.5 tsf |
| | | | | | 10 | % Passing #200 = 0.1 | PP =0.25 tsf |
| | | | | | | | PP =0.5 tsf |
| | Change: estimated <5% gravel, from 12.3 to 13.7 ft | | | | | | PP =0.75 tsf |
| | | | | | | | PP =0.5 tsf |
| 13.7 | FAT CLAY; moist, dark gray | | -63.3 | | | | PP =0.75 tsf |
| | | | | | 15 | | PP =0.5 tsf |
| | | CH | | B | | | PP =0.75 tsf |
| | | | | | | | PP =1.0 tsf |
| | | | | | | | PP =1.0 tsf |
| | | | | | | | PP =1.5 tsf |
| 19.8 | | | -69.4 | | | | PP =1.25 tsf |

PENETRATION TIME: 10 20 30 40 50

Bottom of Vibracore at 19.8 ft.
Penetration Time - 1 minutes: 48 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-12
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/27/18 **Finished:** 8/27/18

**North:** 3434123 ft **East:** 12263625 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -40.5 (ft) **Total Depth:** 10.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/27 | 4:24 PM | 41.0' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | PENETRATION TIME (10 20 30 40 50) | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light brown, estimated <5% shell fragments | | | | | | | PP =<0.25 tsf |
| | | | | | | | | PP =0.5 tsf |
| | Change: light grayish brown, from 2.5 to 10 ft | | | | | | | PP =1.25 tsf |
| | | | | | | | | PP =0.5 tsf |
| | | | | | | | | PP =0.75 tsf |
| | | SP | | A | 5 | | | PP =1.0 tsf |
| | | | | | | | | PP =1.0 tsf |
| | | | | | | | | PP =1.0 tsf |
| | | | | | | | | PP =0.75 tsf |
| | | | | | | 75 | | PP =0.50 tsf |
| 10.0 | | | -50.5 | | 10 | 240 | | PP =<0.25 tsf |

Bottom of Vibracore at 10.0 ft.
Time refusal at 10.0 ft.
Penetration Time - 1 minutes: 48 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-12A
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/27/18 **Finished:** 8/27/18

**North:** 3434123 ft **East:** 12263630 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -39.7 (ft) **Total Depth:** 19.7 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/27 | 5:26 PM | 41.5' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light grayish brown and gray, trace gravel, contains shell fragments | SP | | A | | % Passing #200 = 2.0 | PP =<0.25 tsf |
| | | | | | | | PP =0.5 tsf |
| | | | | | | | PP =1.25 tsf |
| | | | | | | | PP =1.0 tsf |
| | | | | | | | PP =1.25 tsf |
| | | | | | 5 | % Passing #200 = 1.4 | PP =0.25 tsf |
| | | | | | | | PP =0.75 tsf |
| | | | | | | | PP =1.0 tsf |
| | | | | | | | PP =1.0 tsf |
| | | | | | | | PP =1.0 tsf |
| | | | | | 10 | % Passing #200 = 2.1 | PP =<0.25 tsf |
| | | | | | | | PP =0.5 tsf |
| | | | | | | | PP =1.5 tsf |
| | | | | | | | PP =1.5 tsf |
| | | | | | | | PP =1.5 tsf |
| 15.0 | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, light grayish brown and gray, contains shell fragments | SP-SM | -54.7 | | 15 | % Passing #200 = 5.2 | PP =2.25 tsf |
| | | | | | | | PP =1.75 tsf |
| | Change: estimated 15 - 25% shell fragments, from 17.0 to 17.3 ft | | | | | | PP =1.5 tsf |
| | Change: contains clayey sand pockets, from 17.7 to 17.9 ft | | | | | | PP =1.5 tsf |
| 19.7 | Change: estimated <5% gravel, from 17.9 to 19.7 ft | | -59.4 | | | | PP =1.0 tsf |
| | | | | | | | PP =<0.25 tsf |

Bottom of Vibracore at 19.7 ft.
Penetration Time - 2 minutes: 6 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-13
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/3/18 **Finished:** 9/3/18

**North:** 3432697 ft **East:** 12267274 ft

**Coordinate System:** VA State Plane (S)

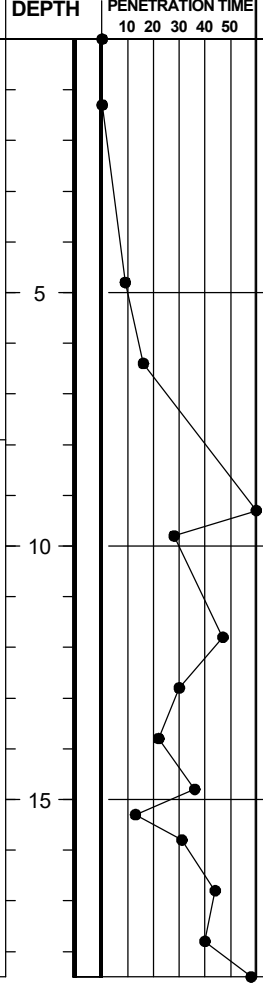
**Mean Low Low Water (MLLW):** -55.2 (ft) **Total Depth:** 18.5 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/3 | 1:24 PM | 58.7' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, grayish brown, contains shell fragments | SP | | A | % Passing #200 = 1.9 | PP =0.25 tsf |
| | Change: contains clayey sand lense, from 1.1 to 1.6 ft | | | | | PP =2.0 tsf |
| | Change: contains lean clay lense, from 1.6 to 1.8 ft | | | | | PP =1.5 tsf |
| | Change: contains silty gravel with sand lense, estimated 30 - 45% shell fragments, from 1.8 to 2.3 ft | | | | | PP =1.0 tsf |
| | Change: contains lean clay lense, from 2.3 to 2.6 ft | | | | % Passing #200 = 3.5 | PP =0.5 tsf |
| 5.8 | Change: contains coarse gravel, from 5.5 to 5.8 ft | SC | -61.0 | | | PP =1.5 tsf |
| | CLAYEY SAND, fine to medium grained sand; wet, gray, contains lean clay and sand lenses | | | | | PP =1.0 tsf |
| 7.9 | FAT CLAY; moist, dark greenish gray | CH | -63.1 | | | PP =0.5 tsf |
| | Change: estimated 5 - 10% organics, from 8.2 to 13.7 | | | | | PP =1.0 tsf |
| | Change: light bluish gray, contains clayey sand lenses, from 10.7 to 13.7 | | | | | PP =1.5 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =2.0 tsf |
| 13.7 | POORLY GRADED SAND WITH SILT, fine to medium grained sand; wet, gray | SP-SM | -68.9 | B | % Passing #200 = 9.0 | PP =1.75 tsf |
| | | | | | | PP =4.0 tsf |
| | | | | | | PP =3.5 tsf |
| | | | | | | PP =3.0 tsf |
| | | | | | | PP =2.5 tsf |
| 18.5 | | | -73.7 | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |

**SAMPLING**




Bottom of Vibracore at 18.5 ft.
Penetration Time - 7 minutes: 14 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-14
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/3/18 **Finished:** 9/3/18

**North:** 3432731 ft **East:** 12265848 ft

**Coordinate System:** VA State Plane (S)

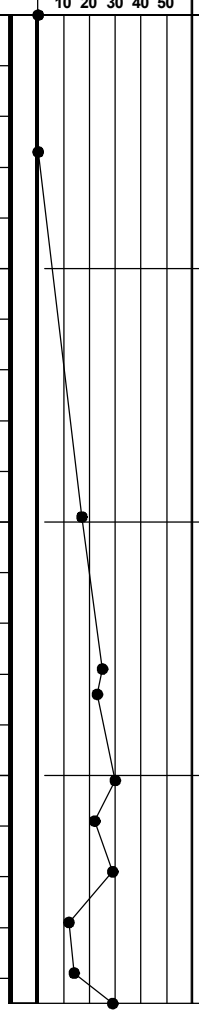
**Mean Low Low Water (MLLW):** -55.2 (ft) **Total Depth:** 19.5 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/3 | 11:05 AM | 57.2' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light grayish brown, contains shell fragments<br>Change: contains clayey sand pockets, from 0.9 to 1.2 ft<br>Change: contains lean clay lenses, estimated <5% gravel, from 2.5 to 2.9 ft | SP | | A | % Passing #200 = 4.7 | PP =<0.25 tsf<br>PP =0.75 tsf<br>PP =1.0 tsf<br>PP =1.75 tsf<br>PP =2.5 tsf |
| 5.2 | FAT CLAY; moist, orangeish brown and light gray<br>Change: dark gray, from 5.3 to 16.5 ft<br>Change: estimated <5% gravel, contains clayey sand lenses, from 10.4 to12.6 ft<br>Change: contains silty sand layers, from 12.6 to 16.5 ft | CH | -60.4 | B | | PP =<0.25 tsf<br>PP =0.5 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.5 tsf<br>PP =0.5 tsf<br>PP =2.5 tsf<br>PP =2.25 tsf<br>PP =2.0 tsf<br>PP =2.0 tsf<br>PP =2.5 tsf |
| 16.5 | SILTY SAND, fine to medium grained sand; wet, dark gray | SM | -71.7 | | | PP =3.0 tsf<br>PP =0.75 tsf |
| 19.5 | | | -74.7 | | | |

SAMPLING — DEPTH — PENETRATION TIME (10 20 30 40 50)




Bottom of Vibracore at 19.5 ft.
Penetration Time - 3 minutes: 24 seconds.
19.5ft of recovered sediment, or 2.7ft (13.85%) greater than total penetration.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-15
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/3/18 **Finished:** 9/3/18

**North:** 3432731 ft **East:** 12264389 ft

**Coordinate System:** VA State Plane (S)

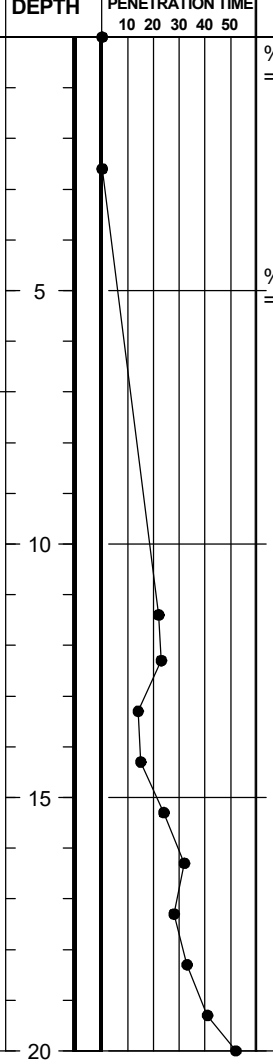
**Mean Low Low Water (MLLW):** -51.5 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/3 | 8:45 AM | 52.1' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, brown, contains shell fragments<br>Change: gray, from 0.7 to 7.0 ft | SP-SM | | A | % Passing #200 = 7.9 | PP =<0.25 tsf<br>PP =2.0 tsf<br>PP =0.75 tsf<br>PP =2.0 tsf |
| 4.4 | POORLY GRADED SAND, fine to coarse grained sand; wet, brown | SP | -55.9 | | % Passing #200 = 3.5 | PP =1.5 tsf<br>PP =2.25 tsf<br>PP =2.25 tsf |
| 7.0 | FAT CLAY; moist, dark gray | CH | -58.5 | B | | PP =1.5 tsf<br>PP =1.5 tsf<br>PP =1.5 tsf<br>PP =1.5 tsf<br>PP =1.5 tsf<br>PP =1.5 tsf<br>PP =1.5 tsf<br>PP =1.5 tsf<br>PP =1.5 tsf<br>PP =2.0 tsf<br>PP =1.75 tsf<br>PP =1.75 tsf<br>PP =1.0 tsf |
| | Change: contains clayey sand lenses, from 16.0 to 20 ft | | | | | |
| 20.0 | | | -71.5 | | | PP =1.0 tsf |

**SAMPLING**




Bottom of Vibracore at 20.0 ft.
Penetration Time - 4 minutes: 42 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-16
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/3/18 **Finished:** 9/3/18

**North:** 3432799 ft **East:** 12262964 ft

**Coordinate System:** VA State Plane (S)

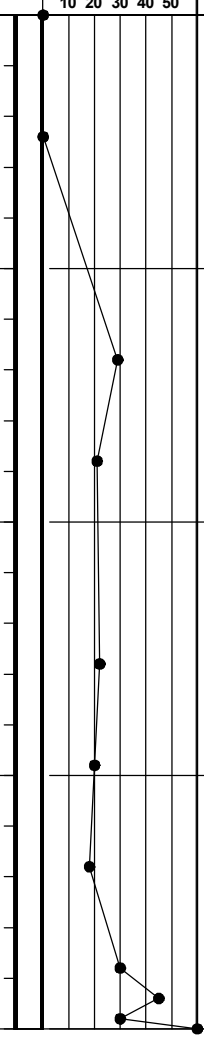
**Mean Low Low Water (MLLW):** -46.0 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/3 | 7:00 AM | 46.6' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, light brown, contains shell fragments | SP-SM | | | % Passing #200 = 8.4 | PP =<0.25 tsf<br>PP =1.75 tsf |
| | Change: contains clayey sand pockets, from 2.4 to 2.6 ft | | | | | PP =1.75 tsf<br>PP =1.75 tsf<br>PP =2.0 tsf |
| 4.9 | Change: contains sandy lean clay lense, from 4.4 to 4.6 ft | | -50.9 | | % Passing #200 = 2.2 | PP =0.25 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, dark gray, trace gravel | SP | | A | | PP =2.0 tsf |
| | Change: contains lean clay lenses, from 5.3 to 5.8 ft | | | | | PP =0.75 tsf |
| | Change: estimated 15 - 25% shell fragments, from 5.8 to 6.8 ft | | | | | PP =1.5 tsf |
| | Change: contains lean clay pockets, from 6.2 to 6.7 ft | | | | | PP =1.5 tsf |
| | Change: estimated <5% shell fragments, from 6.8 to 7.3 ft | | | | % Passing #200 = 1.3 | PP =0.25 tsf |
| | Change: gray, trace gravel, contains shell fragments | | | | | PP =2.0 tsf |
| | Change: estimated <5% gravel, from 11.2 to 13.5 | | | | | PP =2.0 tsf<br>PP =1.0 tsf |
| 13.5<br>13.8 | ELASTIC SILT; moist, greenish gray and orangeish brown | MH | -59.5<br>-59.8 | | | PP =1.0 tsf |
| | FAT CLAY; moist, dark gray | CH | | B | | PP =1.0 tsf<br>PP =1.5 tsf<br>PP =1.25 tsf<br>PP =1.5 tsf<br>PP =1.5 tsf |
| 20.0 | | | -66.0 | | | PP =1.0 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50




Bottom of Vibracore at 20.0 ft.
Penetration Time - 4 minutes: 35 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

| Schnabel ENGINEERING | Project: Sandbridge Borrow Area, Offshore Virginia Beach, Virginia | Vibracore Number: **18SBB-17**<br>Contract Number: 18C13103.00<br>Sheet: 1 of 1 |
|---|---|---|

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** M. Barrett

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/2/18 **Finished:** 9/2/18

**North:** 3432816 ft **East:** 12261504 ft

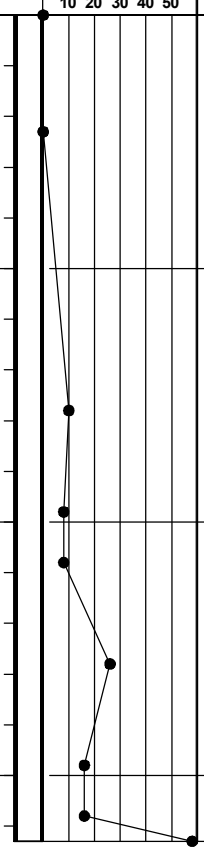
**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -47.4 (ft) **Total Depth:** 16.3 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/2 | 2:59 PM | 50.7' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| | SILTY SAND, fine to coarse grained sand; wet, grayish brown, trace gravel, contains shell fragments | SM | | | | % Passing #200 = 29.2 | PP =0.5 tsf |
| 1.3 | | | -48.7 | | | | PP =1.25 tsf |
| | CLAYEY SAND, fine to coarse grained sand; wet, brown, trace gravel, contains shell fragments | SC | | | | % Passing #200 = 29.2 | PP =1.75 tsf |
| | | | | | | | PP =1.5 tsf |
| | Change: dark gray | | | | | | PP =0.75 tsf |
| 5.4 | | | -52.8 | | 5 | | PP =0.5 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light gray, trace gravel | SP | | A | | % Passing #200 = 1.8 | PP =1.0 tsf |
| | | | | | | | PP =1.5 tsf |
| | | | | | | | PP =1.75 tsf |
| | | | | | | | PP =1.5 tsf |
| | | | | | 10 | | PP =2.0 tsf |
| | | | | | | % Passing #200 = 0.9 | PP =2.0 tsf |
| | | | | | | | PP =1.25 tsf |
| | | | | | | | PP =1.25 tsf |
| | | | | | | | PP =0.75 tsf |
| | Change: estimated 5 - 10% gravel, from 15.0 to 16.3 ft | | | | 15 | | PP =1.5 tsf |
| 16.3 | | | -63.7 | | | | PP =2.0 tsf |
| | | | | | | | PP =2.0 tsf |




Bottom of Vibracore at 16.3 ft.
Time refusal at 16.3 ft.
Penetration Time - 2 minutes: 24 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-17A
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** M. Barrett

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/2/18 **Finished:** 9/2/18

**North:** 3432816 ft **East:** 12261514 ft

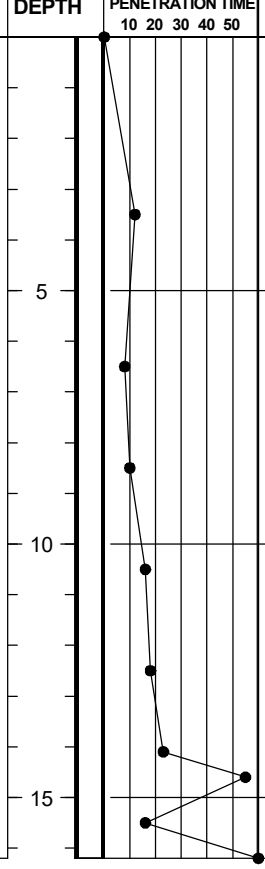
**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -47.7 (ft) **Total Depth:** 16.2 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/2 | 3:59 PM | 50.4' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| | SILTY SAND, fine to coarse grained sand; wet, grayish brown, estimated <5% shell fragments | SM | | | | | PP =0.5 tsf<br>PP =1.75 tsf<br>PP =1.5 tsf<br>PP =2.25 tsf |
| 4.2 | CLAYEY SAND, fine to medium grained sand; wet, dark gray, contains lean clay lenses, estimated <5% shell fragments | SC | -51.9 | | | | PP =2.0 tsf<br>PP =0.25 tsf |
| 6.2 | POORLY GRADED SAND, fine to coarse grained sand; wet, light gray, estimated <5% shell fragments | SP | -53.9 | A | | | PP =0.25 tsf<br>PP =1.25 tsf<br>PP =2.5 tsf<br>PP =2.25 tsf |
| | Change: contains clayey sand pockets, estimated <5% gravel, from 10.0 to 16.2 ft | | | | | | PP =1.5 tsf<br>PP =2.0 tsf |
| | Change: light brown, from 12.5 to 14.3 ft | | | | | | PP =1.25 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf<br>PP =0.25 tsf |
| 16.2 | | | -63.9 | | | | PP =0.25 tsf<br>PP =0.25 tsf |




Bottom of Vibracore at 16.2 ft.
Time refusal at 16.2 ft.
Penetration Time - 3 minutes: 36 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-18
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/29/18 **Finished:** 8/29/18

**North:** 3432799 ft **East:** 12260011 ft

**Coordinate System:** VA State Plane (S)

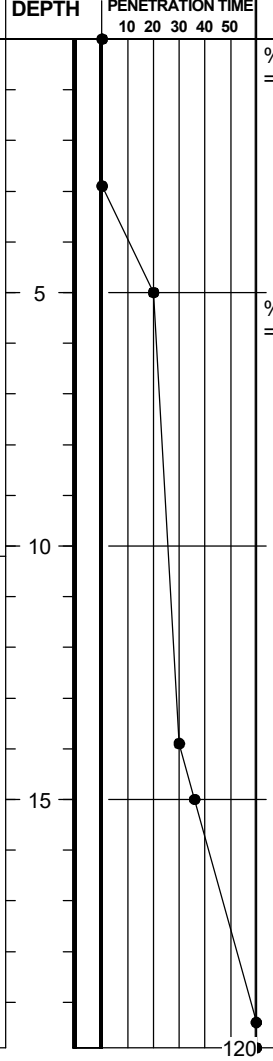
**Mean Low Low Water (MLLW):** -49.3 (ft) **Total Depth:** 19.9 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/29 | 6:54 AM | 51.0' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, light brown, contains shell fragments | SP-SM | | | % Passing #200 = 8.7 | PP =<0.25 tsf |
| | Change: dark gray and black, from 0.3 to 1.5 ft | | | | | PP =0.5 tsf |
| | | | | | | PP =0.75 tsf |
| | Change: estimated 5 - 10% shell fragments, estimated <5% gravel, from 2.8 to 5 ft | | | | | PP =0.75 tsf |
| | | | | | | PP =1.0 tsf |
| 5.0 | POORLY GRADED SAND, fine to coarse grained sand; wet, dark gray, trace gravel | SP | -54.3 | A | % Passing #200 = 3.6 | PP =<0.25 tsf |
| | | | | | | PP =0.5 tsf |
| | | | | | | PP =0.5 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.0 tsf |
| 10.2 | FAT CLAY; moist, dark gray | CH | -59.5 | B | | PP =<0.25 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =0.75 tsf |
| | | | | | | PP =1.5 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.5 tsf |
| | | | | | | PP =1.5 tsf |
| 19.9 | | | -69.2 | | | PP =1.25 tsf |
| | | | | | | PP =1.0 tsf |

SAMPLING




Bottom of Vibracore at 19.9 ft.
Penetration Time - 4 minutes: 24 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-19
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/28/18 **Finished:** 8/28/18

**North:** 3432782 ft **East:** 12258518 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -47.2 (ft) **Total Depth:** 2.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| **Depth of Water** | 8/28 | 10:25 AM | 50.8' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | PENETRATION TIME 10 20 30 40 50 | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|---|
| 2.0 | POORLY GRADED SAND, fine to coarse grained sand; wet, light brown and gray, estimated <5% gravel<br>Change: contains decomposed wood, from 1.0 to 1.6 ft | SP | -49.2 | A | | 69 | | PP =<0.25 tsf<br>PP =0.25 tsf<br>PP =0.25 tsf |

Bottom of Vibracore at 2.0 ft.
Hard refusal at 2.0 ft.
Penetration Time - 1 minute: 12 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-19A
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/28/18 **Finished:** 8/28/18

**North:** 3432782 ft **East:** 12258508 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -46.8 (ft) **Total Depth:** 19.9 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/28 | 12:12 PM | 49.5' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light brown and gray, estimated <5% shell fragments | SP | | | | | PP =<0.25 tsf; PP =0.25 tsf |
| 1.6 | Change: contains decomposed wood, from 0.9 to 1.6 ft | OL | -48.4 | | | | PP =1.0 tsf |
| 2.3 | ORGANIC SILT; wet, dark brown | | -49.1 | | | % Passing #200 = 1.9 | PP =0.25 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light gray, trace gravel | | | | | | PP =0.5 tsf |
| | Change: light grayish brown, from 4.2 to 8.0 ft | | | | 5 | % Passing #200 = 1.2 | PP =<0.25 tsf |
| | | SP | | | | | PP =0.75 tsf |
| | | | | A | | | PP =0.75 tsf |
| | Change: light gray, estimated <5% gravel, from 8.0 to 9.6 ft | | | | | | PP =0.5 tsf; PP =0.5 tsf |
| 9.6 | CLAYEY SAND, fine to medium grained sand; wet, dark gray, contains lean clay layers | SC | -56.4 | | 10 | | PP =<0.25 tsf |
| 11.1 | POORLY GRADED SAND, fine to coarse grained sand; wet, light gray, trace gravel | | -57.9 | | | % Passing #200 = 3.4 | PP =0.75 tsf; PP =1.0 tsf |
| | | SP | | | | | PP =0.5 tsf |
| 14.2 | | SM | -61.0 | | | | PP =0.5 tsf |
| 14.5 | SILTY SAND WITH GRAVEL, fine to coarse grained sand; wet, light gray | | -61.3 | | 15 | | PP =0.5 tsf |
| | FAT CLAY; moist, dark gray | | | | | | PP =0.75 tsf |
| | | CH | | B | | | PP =0.75 tsf; PP =0.75 tsf; PP =1.0 tsf |
| 19.9 | | | -66.7 | | | | PP =0.75 tsf |

Bottom of Vibracore at 19.9 ft.
Penetration Time - 3 minutes: 30 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

| Schnabel ENGINEERING | Project: Sandbridge Borrow Area, Offshore Virginia Beach, Virginia | Vibracore Number: **18SBB-20**<br>Contract Number: 18C13103.00<br>Sheet: 1 of 1 |
|---|---|---|

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/28/18 **Finished:** 8/28/18

**North:** 3432850 ft **East:** 12257076 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -47.5 (ft) **Total Depth:** 19.8 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/28 | 9:19 AM | 51.0' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | SILTY SAND WITH GRAVEL, fine to coarse grained sand; wet, light grayish brown, contains shell fragments | SM | | | % Passing #200 = 14.7 | PP =<0.25 tsf<br>PP =0.25 tsf |
| 1.9 | Change: contains lean clay lense, from 1.0 to 1.1 ft | | -49.4 | | | |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light gray | SP | | A | % Passing #200 = 2.9<br>% Passing #200 = 1.5 | PP =1.25 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf<br>PP =<0.25 tsf<br>PP =0.75 tsf<br>PP =0.5 tsf<br>PP =0.75 tsf<br>PP =0.5 tsf |
| 9.5 | Change: estimated 5 - 10% gravel, from 9.0 to 9.5 ft | | -57.0 | | | |
| | FAT CLAY; moist, dark greenish gray | CH | | B | | PP =0.75 tsf<br>PP =0.75 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =0.75 tsf<br>PP =1.5 tsf |
| | Change: dark gray, from 18.3 to 19.8 ft<br>Change: estimated <5% shell fragments, from 18.7 to 19.8 ft | | | | | |
| 19.8 | | | -67.3 | | | PP =0.75 tsf |

SAMPLING — DEPTH (5, 10, 15) — PENETRATION TIME (10 20 30 40 50) — 123

Bottom of Vibracore at 19.8 ft.
Penetration Time - 4 minutes: 6 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-21
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/28/18 **Finished:** 8/28/18

**North:** 3432850 ft **East:** 12255574 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -50.8 (ft) **Total Depth:** 19.8 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/28 | 7:45 AM | 53.0' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | PENETRATION TIME 10 20 30 40 50 | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light gray | SP | | A | | | % Passing #200 = 2.3 | PP =<0.25 tsf |
| | | | | | | | | PP =0.5 tsf |
| | | | | | | | | PP =1.0 tsf |
| | Change: light brown and light gray, contains clayey sand pockets, from 2.4 to 3.1 ft | | | | | | | PP =0.5 tsf |
| | | | | | | | | PP =1.5 tsf |
| | | | | | 5 | | % Passing #200 = 3.7 | PP =<0.25 tsf |
| 6.0 | Change: contains cobble, from 5.6 to 6.0 ft | | -56.8 | | | | | PP =0.5 tsf |
| | FAT CLAY; moist, dark gray | CH | | B | | | | PP =0.5 tsf |
| | | | | | | | | PP =0.5 tsf |
| | | | | | | | | PP =0.5 tsf |
| | | | | | 10 | | | PP =0.5 tsf |
| | | | | | | | | PP =0.5 tsf |
| | | | | | | | | PP =0.75 tsf |
| | | | | | | | | PP =0.75 tsf |
| | | | | | | | | PP =1.0 tsf |
| | | | | | 15 | | | PP =0.5 tsf |
| | Change: estimated <5% shell fragments, from 16.0 to 19.8 ft | | | | | | | PP =0.75 tsf |
| | | | | | | | | PP =0.5 tsf |
| | | | | | | | | PP =1.0 tsf |
| | | | | | | | | PP =1.5 tsf |
| 19.8 | | | -70.6 | | | | | PP =1.0 tsf |

Bottom of Vibracore at 19.8 ft.
Penetration Time - 5 minutes: 36 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-22
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** J. Pydeski

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/28/18 **Finished:** 8/28/18

**North:** 3431459 ft **East:** 12256304 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -46.6 (ft) **Total Depth:** 19.7 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/28 | 1:31 PM | 48.5' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, dark gray, trace gravel, contains shell fragments | SP | | A | % Passing #200 = 3.4 | PP =<0.25 tsf<br>PP =0.75 tsf<br>PP =1.0 tsf |
| | Change: contains clayey sand pockets, from 3.1 to 3.7 ft | | | | | PP =0.75 tsf<br>PP =1.5 tsf |
| | Change: contains lean clay layers, from 5.2 to 5.3 ft, and from 5.6 to 5.8 ft | | | | % Passing #200 = 2.1 | PP =<0.25 tsf<br>PP =0.5 tsf<br>PP =1.5 tsf |
| 8.2 | FAT CLAY; moist, dark gray | CH | -54.8 | B | | PP =1.0 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf<br>PP =0.75 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf |
| 19.7 | Change: estimated <5% shell fragments, from 18.7 to 19.7 ft | | -66.3 | | | PP =1.25 tsf<br>PP =1.0 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50 — 5, 10, 15, 100

Bottom of Vibracore at 19.7 ft.
Penetration Time - 2 minutes: 42 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-23
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** M. Barrett

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/29/18 **Finished:** 8/29/18

**North:** 3431408 ft **East:** 12257746 ft

**Coordinate System:** VA State Plane (S)

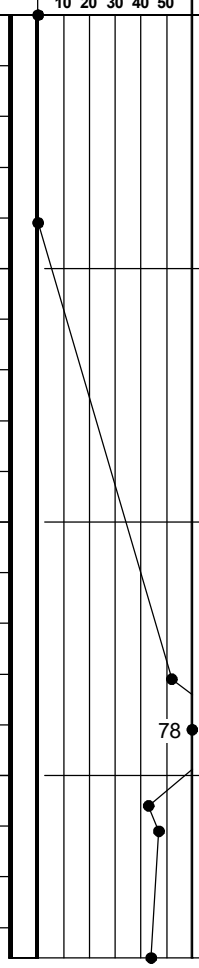
**Mean Low Low Water (MLLW):** -47.9 (ft) **Total Depth:** 18.6 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/29 | 9:17 AM | 51.1' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, dark grayish brown, trace gravel, contains shell fragments | SP | | A | % Passing #200 = 1.4 | PP =<0.25 tsf |
| | Change: gray and light gray, from 1.4 to 8.5 ft | | | | | PP =1.75 tsf |
| | | | | | | PP =0.75 tsf |
| | | | | | | PP =1.5 tsf |
| | | | | | % Passing #200 = 1.7 | PP =0.5 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.5 tsf |
| | | | | | | PP =1.25 tsf |
| 8.5 | Change: contains clayey sand pockets, from 7.8 to 8.5 ft | | -56.4 | | | PP =1.5 tsf |
| | FAT CLAY; moist, dark gray | CH | | B | | PP =0.5 tsf |
| | Change: contains silty sand pockets, from 8.6 to 9.1 ft | | | | | PP =0.5 tsf |
| | | | | | | PP =0.5 tsf |
| | | | | | | PP =0.5 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =0.75 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =0.5 tsf |
| | | | | | | PP =1.0 tsf |
| 18.6 | Change: contains clayey sand lense, from 18.4 to 18.5 ft | | -66.5 | | | PP =1.5 tsf |

SAMPLING DEPTH — PENETRATION TIME (10 20 30 40 50)




Bottom of Vibracore at 18.6 ft.
Penetration Time - 9 minutes: 6 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-24
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** M. Barrett

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/29/18 **Finished:** 8/29/18

**North:** 3431442 ft **East:** 12259290 ft

**Coordinate System:** VA State Plane (S)

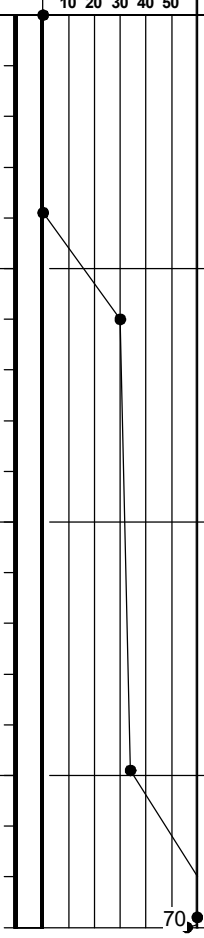
**Mean Low Low Water (MLLW):** -48.4 (ft) **Total Depth:** 18.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/29 | 10:52 AM | 52.0' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; moist, brown, contains shell fragments | SP | | A | % Passing #200 = 2.3 | PP =<0.25 tsf |
| | Change: grayish black, from 0.4 to 1.4 ft | | | | | PP =1.25 tsf |
| | Change: gray, from 1.4 to 9.6 ft | | | | | PP =1.25 tsf |
| | Change: estimated 15 - 25% shell fragments, from 2.1 to 2.6 ft | | | | % Passing #200 = 1.0 | PP =0.75 tsf |
| | Change: trace gravel, below 3 ft | | | | | PP =0.5 tsf |
| 5 | | | | | | PP =0.5 tsf |
| | Change: fine to coarse grained sand; from 5.9 to 13.9 ft | | | | | PP =0.75 tsf |
| | | | | | | PP =0.75 tsf |
| | | | | | % Passing #200 = 2.5 | PP =0.5 tsf |
| | | | | | | PP =0.75 tsf |
| 10 | Change: brown, from 9.6 to 10.2 ft | | | | | PP =0.75 tsf |
| | Change: gray, from 10.2 to 13.9 ft | | | | | PP =1.0 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | % Passing #200 = 4.2 | PP =0.75 tsf |
| 13.9 | FAT CLAY; moist, gray | | -62.3 | | | PP =1.0 tsf |
| 15 | | CH | | B | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.25 tsf |
| 18.0 | | | -66.4 | | | PP =1.0 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50




Bottom of Vibracore at 18.0 ft.
Penetration Time - 3 minutes: 12 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-25
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** M. Barrett

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/29/18 **Finished:** 8/29/18

**North:** 3431374 ft **East:** 12260732 ft

**Coordinate System:** VA State Plane (S)

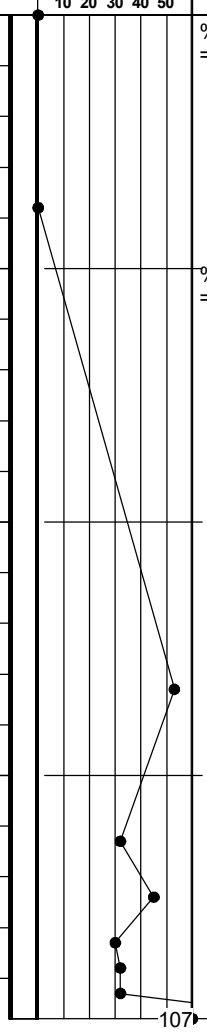
**Mean Low Low Water (MLLW):** -48.3 (ft) **Total Depth:** 19.8 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/29 | 1:20 PM | 50.8' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, brownish gray, trace gravel, contains shell fragments | SP | | | % Passing #200 = 1.4 | PP =<0.25 tsf |
| | Change: dark gray, from 1.0 to 2.5 ft | | | | | PP =1.0 tsf |
| 2.5 | POORLY GRADED SAND WITH SILT; light gray, trace gravel, contains shell fragments | | -50.8 | | | PP =1.5 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | A | | PP =1.0 tsf |
| 5 | | SP-SM | | | % Passing #200 = 7.0 | PP =0.5 tsf |
| | Change: light brown, from 6.5 to 8.4 ft | | | | | PP =1.0 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.5 tsf |
| 8.9 | Change: gray, from 8.4 to 8.9 ft | | -57.2 | | | PP =1.5 tsf |
| | FAT CLAY; moist, gray | | | | | PP =1.25 tsf |
| 10 | | | | | | PP =1.5 tsf |
| | | | | | | PP =1.5 tsf |
| | | | | | | PP =1.5 tsf |
| | | CH | | B | | PP =1.5 tsf |
| 15 | | | | | | PP =1.5 tsf |
| | | | | | | PP =1.5 tsf |
| | | | | | | PP =1.75 tsf |
| | | | | | | PP =1.75 tsf |
| | | | | | | PP =1.75 tsf |
| 19.8 | | | -68.1 | | | PP =1.5 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50




Bottom of Vibracore at 19.8 ft.
Penetration Time - 5 minutes: 30 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

| Schnabel ENGINEERING | Project: Sandbridge Borrow Area, Offshore Virginia Beach, Virginia | Vibracore Number: **18SBB-26**<br>Contract Number: 18C13103.00<br>Sheet: 1 of 1 |
|---|---|---|

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** M. Barrett

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/29/18 **Finished:** 8/29/18

**North:** 3431408 ft **East:** 12262200 ft

**Coordinate System:** VA State Plane (S)

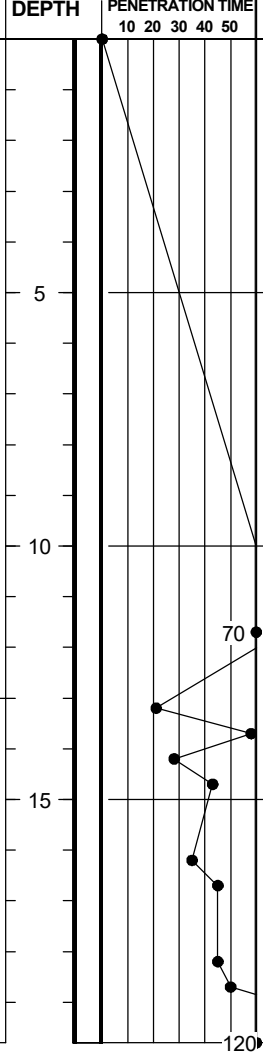
**Mean Low Low Water (MLLW):** -48.8 (ft) **Total Depth:** 19.8 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/29 | 3:03 PM | 49.8' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND WITH SILT, fine to medium grained sand; wet, grayish brown, contains shell fragments | SP-SM | | A | % Passing #200 = 7.6 | PP =<0.25 tsf<br>PP =1.0 tsf<br>PP =1.5 tsf<br>PP =1.25 tsf<br>PP =0.5 tsf |
| | Change: light gray, below 5.1 ft | | | | % Passing #200 = 7.2 | PP =0.5 tsf<br>PP =0.5 tsf<br>PP =2.0 tsf |
| | Change: contains clayey sand pockets, at 8.2 ft | | | | | PP =0.5 tsf<br>PP =1.25 tsf |
| 10.1 | POORLY GRADED SAND, fine to coarse grained sand; wet, dark gray, trace gravel | SP | -58.9 | | % Passing #200 = 3.7 | PP =<0.25 tsf |
| | Change: contains wood, from 11.1 to 11.2 ft | | | | | PP =1.75 tsf<br>PP =1.75 tsf |
| 13.0 | Change: fine to coarse grained sand; estimated <5% gravel, from 12.5 to 13.0 ft | | -61.8 | | | PP =1.0 tsf |
| | FAT CLAY; moist, dark gray | CH | | B | | PP =1.25 tsf<br>PP =1.25 tsf<br>PP =1.25 tsf<br>PP =1.75 tsf<br>PP =1.75 tsf |
| | Change: contains clayey sand, from 18.9 to 19.0, 19.3 to 19.4 and 19.6 to 20.1 ft | | | | | PP =2.0 tsf |
| 19.8 | | | -68.6 | | | PP =1.0 tsf |

**SAMPLING**




Bottom of Vibracore at 19.8 ft.
Penetration Time - 8 minutes: 36 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-27
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** M. Barrett

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/2/18 **Finished:** 9/2/18

**North:** 3431391 ft **East:** 12263659 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -52.3 (ft) **Total Depth:** 19.4 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/2 | 1:32 PM | 56.1' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, gray, trace gravel | SP | | A | % Passing #200 = 2.1 | PP =1.0 tsf<br>PP =1.5 tsf |
| | Change: contains silty sand layer, from 2.0 to 2.6 ft | | | | | PP =0.5 tsf |
| | Change: contains lean clay lenses, from 2.6 to 2.9 ft | | | | | PP =0.75 tsf<br>PP =2.0 tsf |
| 5 | | | | | % Passing #200 = 1.7 | PP =1.0 tsf |
| | Change: contains lean clay pockets, at 5.8 ft | | | | | PP =0.5 tsf<br>PP =1.5 tsf<br>PP =1.0 tsf |
| 9.4 | | | -61.7 | | | PP =1.0 tsf |
| 10 | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet | SP-SM | | | % Passing #200 = 5.8 | PP =1.25 tsf<br>PP =0.5 tsf |
| 11.8 | | | -64.1 | | | PP =0.5 tsf |
| 12.7 | LEAN CLAY; moist, dark gray | CL | -65.0 | | | PP =0.5 tsf |
| | CLAYEY SAND, fine to coarse grained sand; wet, dark gray | SC | | | % Passing #200 = 31.9 | PP =0.5 tsf |
| 14.0 | | | -66.3 | | | PP =0.75 tsf |
| 15 | POORLY GRADED SAND WITH CLAY, fine to coarse grained sand; wet, dark gray | SP-SC | | | % Passing #200 = 5.3 | PP =0.75 tsf<br>PP =0.5 tsf |
| | Change: contains clayey sand lenses, from 16.5 to 17.9 ft | | | | | PP =0.5 tsf |
| 17.9 | | | -70.2 | | | PP =1.0 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, gray, estimated <5% gravel, estimated <5% organics | SP | | | | PP =1.25 tsf |
| 19.4 | | | -71.7 | | | PP =1.25 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50

Bottom of Vibracore at 19.4 ft.
Penetration Time - 1 minutes: 42 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-28
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut
**Contractor Foreman:** M. Barrett
**Schnabel Representative:** K. Megginson
**Equipment:** BH8 (Vibracore)
**Method:** 4" O.D. - 20 ft long steel sampler

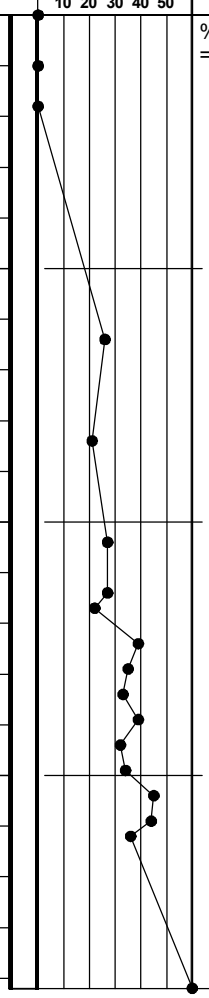
**Hammer Type:** Pneumatic
**Dates Started:** 9/2/18 **Finished:** 9/2/18
**North:** 3431374 ft **East:** 12265034 ft
**Coordinate System:** VA State Plane (S)
**Mean Low Low Water (MLLW):** -54.5 (ft) **Total Depth:** 19.2 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/2 | 10:35 AM | 56.4' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | SILTY SAND WITH GRAVEL, fine to coarse grained sand; wet, gray, contains shell fragments | SM | | A | % Passing #200 = 23.2 | PP =0.5 tsf<br>PP =1.5 tsf<br>PP =1.5 tsf |
| 2.9 | | | -57.4 | | | |
| 3.4 | LEAN CLAY; moist, dark gray | CL | -57.9 | | | PP =<0.25 tsf |
| | POORLY GRADED SAND WITH GRAVEL, fine to coarse grained sand; wet, dark gray, estimated 5 - 10% shell fragments, estimated 5 - 10% coarse gravel | SP | | | | PP =1.75 tsf |
| 5.1 | | | -59.6 | | | PP =0.5 tsf |
| | FAT CLAY; moist, dark gray | CH | | B | | PP =0.5 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.25 tsf<br>PP =1.25 tsf<br>PP =0.25 tsf<br>PP =1.5 tsf<br>PP =1.25 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf |
| | Change: contains clayey sand lenses, from 16.6 to 19.2 ft | | | | | |
| 19.2 | | | -73.7 | | | PP =1.5 tsf<br>PP =1.25 tsf |

SAMPLING — DEPTH — PENETRATION TIME (10 20 30 40 50)




Bottom of Vibracore at 19.2 ft.
Penetration Time - 9 minutes: 6 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-29
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** M. Barrett

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/2/18 **Finished:** 9/2/18

**North:** 3431374 ft **East:** 12266544 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -57.0 (ft) **Total Depth:** 19.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/2 | 8:57 AM | 58.1' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | PENETRATION TIME (10 20 30 40 50) | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | CLAYEY SAND, fine to coarse grained sand; wet, dark gray, estimated 5 - 10% shell fragments | SC | | | | | | PP =0.5 tsf |
| | | | | | | | | PP =0.25 tsf |
| 2.2 | Change: contains lean clay pockets, from 1.5 to 2.2 ft | | -59.2 | | | | | PP =0.5 tsf |
| | FAT CLAY; moist, dark gray | | | | | | | PP =0.75 tsf |
| | | | | | | | | PP =1.0 tsf |
| | | | | | 5 | | | PP =1.0 tsf |
| | | | | | | | | PP =0.75 tsf |
| | | | | | | | | PP =0.75 tsf |
| | | | | | | | | PP =0.75 tsf |
| | | | | B | | | | PP =0.5 tsf |
| | | | | | 10 | | | PP =0.5 tsf |
| | | CH | | | | | | PP =0.75 tsf |
| | Change: estimated <5% organics, from 11.2 to 19.0 ft | | | | | | | PP =1.0 tsf |
| | | | | | | | | PP =0.75 tsf |
| | | | | | | | | PP =1.0 tsf |
| | | | | | 15 | | | PP =0.75 tsf |
| | | | | | | | | PP =1.0 tsf |
| | | | | | | | | PP =1.0 tsf |
| | | | | | | | | PP =0.75 tsf |
| 19.0 | | | -76.0 | | | | | PP =1.0 tsf |

Bottom of Vibracore at 19.0 ft.
Penetration Time - 2 minutes: 18 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-30
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** M. Barrett

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/2/18 **Finished:** 9/2/18

**North:** 3431357 ft **East:** 12268012 ft

**Coordinate System:** VA State Plane (S)

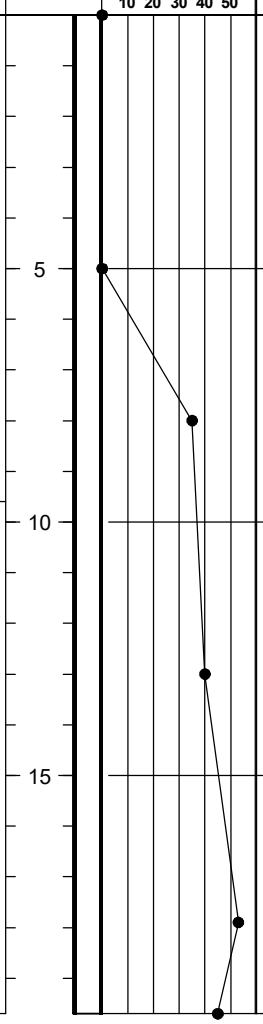
**Mean Low Low Water (MLLW):** -54.0 (ft) **Total Depth:** 19.7 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/2 | 6:55 AM | 54.4' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, brown and gray, estimated <5% shell fragments | SP | | | % Passing #200 = 1.4 | PP =<0.25 tsf<br>PP =1.0 tsf |
| 1.8 | Change: black, contains silty sand lense, from 1.4 to 1.6 ft | CL | -55.8 | | | PP =0.25 tsf |
| 2.7 | LEAN CLAY; wet, dark gray, contains clayey sand lenses | SP-SM | -56.7 | | % Passing #200 = 9.7 | PP =<0.25 tsf |
| 4.2 | POORLY GRADED SAND WITH SILT AND GRAVEL, fine to coarse grained sand; wet, dark gray, contains shell fragments | SP-SM | -58.2 | A | % Passing #200 = 5.2 | PP =3.0 tsf<br>PP =0.75 tsf |
| 6.8 | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, light gray, contains shell fragments<br>Change: estimated 50 - 100% shell fragments, from 5.9 to 6.8 ft | SC | -60.8 | | | PP =3.25 tsf<br>PP =1.75 tsf |
| 8.5 | CLAYEY SAND, fine to coarse grained sand; wet, gray, estimated 5 - 10% gravel, contains lean clay lenses and pockets<br>Change: contains silty gravel with sand layer, from 8.1 to 8.5 ft | SP | -62.5 | | | PP =0.75 tsf<br>PP =0.5 tsf |
| 9.6 | POORLY GRADED SAND, fine to coarse grained sand; wet, light gray<br>Change: estimated <5% gravel, from 9.5 to 9.6 ft | | -63.6 | | | PP =0.75 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf |
| | FAT CLAY; moist, dark gray<br>Change: contains silty sand pockets, from 10.1 to 10.4 ft<br>Change: contains clayey sand layer, from 11.9 to 12.9 ft | CH | | B | | PP =1.5 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.5 tsf |
| 18.5 | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, gray | SP | -72.5 | | | PP =1.25 tsf<br>PP =1.0 tsf |
| 19.7 | | | -73.7 | | | PP =0.5 tsf |

SAMPLING — DEPTH — PENETRATION TIME (10 20 30 40 50)




Bottom of Vibracore at 19.7 ft.
Penetration Time - 2 minutes: 54 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-31
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** M. Barrett

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/1/18 **Finished:** 9/1/18

**North:** 3431391 ft **East:** 12269420 ft

**Coordinate System:** VA State Plane (S)

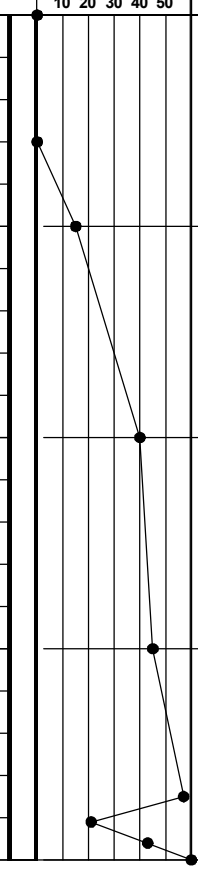
**Mean Low Low Water (MLLW):** -47.1 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/1 | 11:06 AM | 50.4' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light grayish brown, trace gravel, contains shell fragments | SP | | | % Passing #200 = 0.8 | PP =<0.25 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf<br>PP =1.25 tsf<br>PP =0.5 tsf |
| | Change: contains clayey sand lense, at 7.4 ft | | | | % Passing #200 = 2.4 | PP =<0.25 tsf<br>PP =1.0 tsf<br>PP =1.25 tsf<br>PP =1.5 tsf<br>PP =2.75 tsf |
| 10.0 | POORLY GRADED SAND WITH GRAVEL, fine to coarse grained sand; wet, gray, contains shell fragments | SP | -57.1 | A | % Passing #200 = 4.6 | PP =0.5 tsf<br>PP =1.5 tsf<br>PP =2.0 tsf<br>PP =1.5 tsf<br>PP =0.75 tsf |
| | Change: estimated 50 - 100% shell fragments, from 12.0 to 12.9 ft<br>Change: estimated 30 - 45% shell fragments, from 12.9 to 13.5 ft | | | | | |
| 14.5 | Change: estimated 15 - 25% shell fragments, from 13.5 to 13.8 ft<br>Change: estimated 5 - 10% shell fragments, from 13.8 to 14.2 ft<br>Change: contains shell hash, from 14.2 to 14.5 ft | SP | -61.6 | | % Passing #200 = 2.7 | PP =0.5 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light gray | | | | | |
| 20.0 | Change: contains clayey sand lense, from 15.0 to 15.2 ft | | -67.1 | | | PP =1.0 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50




Bottom of Vibracore at 20.0 ft.
Penetration Time - 4 minutes: 42 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-32
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** M. Barrett

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/1/18 **Finished:** 9/1/18

**North:** 3429915 ft **East:** 12270116 ft

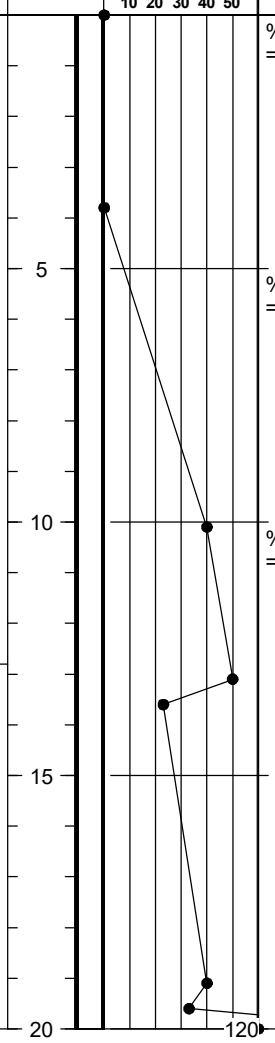
**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -53.3 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/1 | 7:57 AM | 54.3' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, grayish brown, contains shell fragments | SP | | | % Passing #200 = 3.7 | PP =<0.25 tsf<br>PP =1.5 tsf<br>PP =2.25 tsf |
| 3.1 | Change: contains silty sand layer, from 2.8 to 3.1 ft | | -56.4 | | | PP =2.5 tsf |
| | LEAN CLAY; wet, dark gray, contains clayey sand pockets | CL | | | | PP =0.25 tsf |
| 5.0 | Change: contains silty sand lense, from 4.4 to 4.6 ft<br>Change: contains shell hash, from 4.6 to 5.0 | | -58.3 | A | % Passing #200 = 9.2 | PP =0.5 tsf<br>PP =2.25 tsf |
| | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, dark gray | SP-SM | | | | PP =2.0 tsf<br>PP =1.0 tsf<br>PP =1.25 tsf |
| | Change: trace gravel, contains cobbles<br>Change: contains poorly graded gravel with sand layer, from 10.8 to 11.3 ft | | | | % Passing #200 = 9.9 | PP =0.25 tsf<br>PP =1.5 tsf |
| 12.1 | Change: contains clayey sand layer, from 11.8 to 12.1 ft | SC | -65.4 | | | PP =0.5 tsf |
| 12.8 | CLAYEY SAND, fine to medium grained sand; wet, dark gray | | -66.1 | | | PP =0.75 tsf |
| | FAT CLAY; moist, dark gray | CH | | B | | PP =0.75 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf<br>PP =0.5 tsf<br>PP =0.75 tsf<br>PP =1.0 tsf |
| 20.0 | | | -73.3 | | | PP =1.5 tsf |




Bottom of Vibracore at 20.0 ft.
Penetration Time - 5 minutes: 6 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-33
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/31/18 **Finished:** 8/31/18

**North:** 3429965 ft **East:** 12268707 ft

**Coordinate System:** VA State Plane (S)

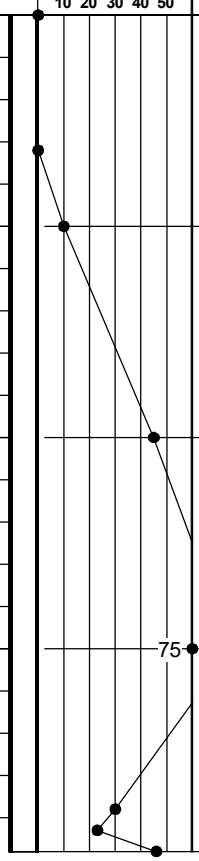
**Mean Low Low Water (MLLW):** -47.8 (ft) **Total Depth:** 19.8 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/31 | 12:00 AM | 48.8' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light brown, contains shell fragments | SP | | A | % Passing #200 = 1.0 | PP =<0.25 tsf<br>PP =0.25 tsf |
| | Change: grayish brown, from 2.0 to 9.6 ft | | | | | PP =0.25 tsf<br>PP =1.5 tsf<br>PP =0.75 tsf |
| 5.0 | SILTY SAND, fine to coarse grained sand; wet, dark gray, contains shell fragments | SM | -52.8 | | % Passing #200 = 18.6 | PP =0.25 tsf<br>PP =0.75 tsf<br>PP =1.75 tsf<br>PP =2.0 tsf |
| | Change: contains lean clay pockets and lenses, from 8.9 to 9.4 ft | | | | | PP =<0.25 tsf |
| | Change: contains shell hash, from 9.6 to 10.0 ft | | | | % Passing #200 = 17.8 | PP =<0.25 tsf |
| 11.4 | Change: contains silty gravel lense, from 11.2 to 11.4 ft | SC | -59.2 | | | PP =0.5 tsf |
| 12.0 | | SP | -59.8 | | | PP =1.75 tsf |
| 12.8 | CLAYEY SAND, fine to coarse grained sand; wet, dark gray, estimated 15 - 25% shell fragments | SP | -60.6 | | | PP =1.0 tsf |
| 14.0 | | SC | -61.8 | | | PP =0.5 tsf |
| 14.6 | | SM | -62.4 | | | |
| 15.2 | POORLY GRADED SAND WITH GRAVEL, fine to coarse grained sand; wet, dark gray, estimated 30 - 45% shell fragments | GM | -63.0 | | | PP =<0.25 tsf |
| 15.6 | | | -63.4 | | | PP =0.75 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, dark gray, estimated 5 - 10% shell fragments | CH | | B | | PP =1.0 tsf<br>PP =0.75 tsf |
| 19.8 | CLAYEY SAND, fine to medium grained sand; wet, dark gray, contains lean clay lenses | | -67.6 | | | PP =1.0 tsf<br>PP =1.0 tsf |
| | SILTY SAND, fine to coarse grained sand; wet, dark gray | | | | | |
| | SILTY GRAVEL WITH SAND, fine to coarse grained sand; wet, dark gray | | | | | |
| | FAT CLAY; moist, dark gray | | | | | |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50




Bottom of Vibracore at 19.8 ft.
Penetration Time - 3 minutes: 42 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-34
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/31/18 **Finished:** 8/31/18

**North:** 3429982 ft **East:** 12267231 ft

**Coordinate System:** VA State Plane (S)

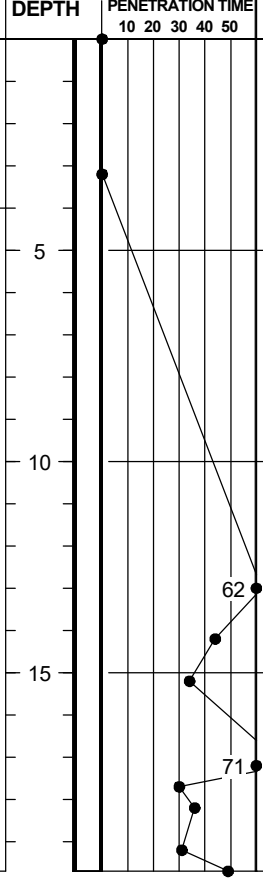
**Mean Low Low Water (MLLW):** -56.2 (ft) **Total Depth:** 19.7 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/31 | 3:24 PM | 58.3' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, gray, trace gravel, contains shell fragments | SP | | | % Passing #200 = 2.6 | PP =<0.25 tsf<br>PP =3.0 tsf |
| 1.6 | POORLY GRADED SAND, fine to coarse grained sand; wet, light gray | SP | -57.8 | A | | PP =0.75 tsf<br>PP =2.0 tsf |
| 4.0 | Change: estimated <5% gravel, from 3.6 to 4.0 ft | | -60.2 | | | PP =1.5 tsf |
| | LEAN CLAY; moist, orangeish brown and light gray<br>Change: dark gray, from 4.1 to 14.0 ft | CL | | | | PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =2.0 tsf<br>PP =1.0 tsf |
| | Change: contains clayey sand layer, from 11.6 to 12.7 ft | | | B | | |
| 14.0 | SILTY SAND, fine to coarse grained sand; wet, dark gray | | -70.2 | | % Passing #200 = 42.2 | PP =1.5 tsf<br>PP =1.0 tsf |
| | Change: contains sandy lean clay lenses, from 15.6 to 18.3 ft | SM | | | | PP =0.75 tsf<br>PP =1.25 tsf<br>PP =1.5 tsf |
| 19.1 | Change: contains silty sand lenses, from 18.3 to 19.1 ft | SP | -75.3 | | | PP =2.75 tsf |
| 19.7 | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, gray, estimated <5% gravel | | -75.9 | | | PP =0.5 tsf |

**SAMPLING**




Bottom of Vibracore at 19.7 ft.
Penetration Time - 6 minutes: 0 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-35
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/31/18 **Finished:** 8/31/18

**North:** 3429982 ft **East:** 12265806 ft

**Coordinate System:** VA State Plane (S)

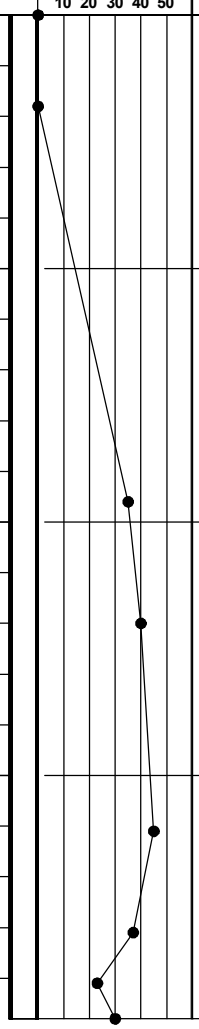
**Mean Low Low Water (MLLW):** -54.5 (ft) **Total Depth:** 19.8 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/31 | 12:57 PM | 57.9' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, gray, trace gravel | SP | | A | % Passing #200 = 2.8 | PP =<0.25 tsf |
| | Change: estimated 15 - 25% shell fragments, from 0.6 to 1.4 ft | | | | | PP =2.0 tsf |
| | Change: estimated <5% shell fragments, from 1.4 to 4.1 ft | | | | | PP =1.5 tsf |
| | | | | | | PP =1.0 tsf |
| | Change: estimated <5% gravel, from 4.1 to 4.8 ft | | | | | PP =1.25 tsf |
| | Change: contains lean clay pockets, from 4.8 to 5.2 ft | | | | % Passing #200 = 3.0 | PP =0.25 tsf |
| 6.2 | | CL | -60.7 | | | PP =2.25 tsf |
| 6.5 | LEAN CLAY; moist, greenish gray | | -61.0 | | | PP =1.0 tsf |
| | Change: light brown, from 6.4 to 6.5 ft | | | | | PP =1.0 tsf |
| | LEAN CLAY; moist, dark gray | | | | | PP =1.0 tsf |
| | | CL | | | | PP =0.5 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =0.75 tsf |
| 12.9 | SANDY LEAN CLAY; wet, dark gray | | -67.4 | B | % Passing #200 = 50.3 | PP =1.75 tsf |
| | | SC | | | | PP =1.75 tsf |
| 15.0 | LEAN CLAY WITH SAND; moist, dark gray | | -69.5 | | % Passing #200 = 72.8 | PP =1.25 tsf |
| | | | | | | PP =1.5 tsf |
| | | CL | | | | PP =2.25 tsf |
| | | | | | | PP =2.5 tsf |
| | | | | | | PP =2.25 tsf |
| 19.8 | | | -74.3 | | | PP =0.5 tsf |

SAMPLING — DEPTH — PENETRATION TIME (10 20 30 40 50)




Bottom of Vibracore at 19.8 ft.
Penetration Time - 3 minutes: 30 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-36
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/31/18 **Finished:** 8/31/18

**North:** 3430033 ft **East:** 12264380 ft

**Coordinate System:** VA State Plane (S)

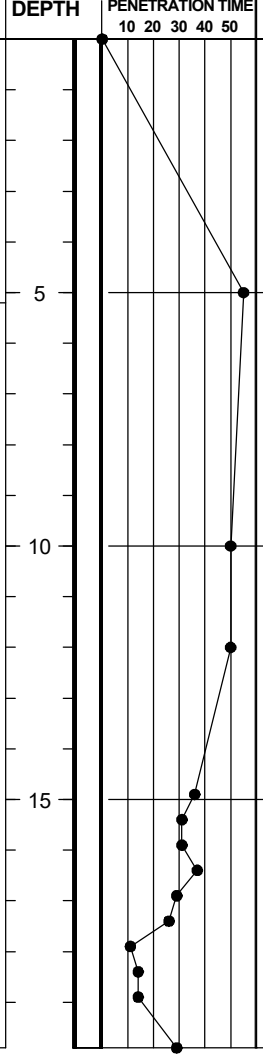
**Mean Low Low Water (MLLW):** -53.0 (ft) **Total Depth:** 19.9 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/31 | 9:40 AM | 56.1' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, dark gray, estimated <5% shell fragments | SP-SM | | | % Passing #200 = 5.2 | PP =0.5 tsf |
| | | | | | | PP =1.5 tsf |
| 2.0 | Change: contains sandy lean clay lense, from 1.5 to 2.0 ft | | -55.0 | A | | PP =0.75 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, gray, estimated <5% shell fragments, estimated <5% gravel | SP | | | | PP =2.0 tsf |
| | | | | | | PP =3.25 tsf |
| 5.2 | FAT CLAY; moist, dark gray | | -58.2 | | | PP =0.25 tsf |
| | Change: contains gravel lense, from 5.4 to 5.6 ft | | | | | PP =1.0 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.0 tsf |
| | | CH | | | | PP =0.75 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | B | | PP =1.5 tsf |
| 13.1 | CLAYEY SAND, fine to medium grained sand; wet, dark gray, contains high % of fines | SC | -66.1 | | | PP =1.0 tsf |
| 14.2 | | | -67.2 | | | PP =1.0 tsf |
| | SILTY SAND, fine to medium grained sand; wet, dark gray | | | | % Passing #200 = 29.2 | PP =0.75 tsf |
| | | SM | | | | PP =2.25 tsf |
| | | | | | | PP =1.75 tsf |
| 18.1 | CLAYEY SAND, fine to medium grained sand; wet, dark gray | SC | -71.1 | | | PP =1.5 tsf |
| | | | | | | PP =1.75 tsf |
| 19.9 | | | -72.9 | | | PP =0.5 tsf |

**SAMPLING**




Bottom of Vibracore at 19.9 ft.
Penetration Time - 6 minutes: 54 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-37
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/31/18 **Finished:** 8/31/18

**North:** 3429986 ft **East:** 12262887 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -51.1 (ft) **Total Depth:** 19.9 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/31 | 8:09 AM | 52.6' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| | SILTY SAND, fine to coarse grained sand; wet, gray, contains shell fragments | SM | | | | % Passing #200 = 14.3 | PP =<0.25 tsf |
| | Change: contains clayey sand lense, from 1.2 to 1.3 ft | | | | | | PP =2.0 tsf |
| | Change: contains poorly graded gravel with sand layer, estimated 15 - 25% shell fragments, from 1.3 to 1.6 ft | | | | | | PP =2.0 tsf |
| 3.3 | Change: estimated <5% gravel, from 1.6 to 3.3 ft | | -54.4 | | | | PP =3.5 tsf |
| | Change: contains silty gravel lense, from 2.9 to 3.3 ft | | | A | 5 | | PP =1.0 tsf |
| | FAT CLAY; moist, dark gray, estimated <5% shell fragments | CH | | | | | PP =1.0 tsf |
| | | | | | | | PP =1.25 tsf |
| | | | | | | | PP =1.0 tsf |
| | | | | | | | PP =1.25 tsf |
| | | | | | | | PP =2.0 tsf |
| 10.0 | CLAYEY SAND, fine to medium grained sand; most, dark gray, contains high % of fines, estimated <5% wood fragments | SC | -61.1 | | 10 | | PP =1.0 tsf |
| 11.1 | FAT CLAY; most, dark gray | CH | -62.2 | | | | PP =2.0 tsf |
| 12.1 | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, dark gray, trace gravel, contains shell fragments | SP-SM | -63.2 | | | % Passing #200 = 7.5 | PP =1.5 tsf |
| 13.4 | FAT CLAY; moist, dark gray | | -64.5 | | | | PP =1.0 tsf |
| | | | | | | | PP =1.25 tsf |
| | | | | B | 15 | 94 | PP =1.0 tsf |
| | | CH | | | | | PP =1.5 tsf |
| | | | | | | | PP =1.5 tsf |
| | | | | | | | PP =1.25 tsf |
| | | | | | | | PP =1.5 tsf |
| 19.9 | | | -71.0 | | | 120 | PP =1.0 tsf |

Bottom of Vibracore at 19.9 ft.
Penetration Time - 8 minutes: 30 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-38
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/30/18 **Finished:** 8/30/18

**North:** 3430038 ft **East:** 12261429 ft

**Coordinate System:** VA State Plane (S)

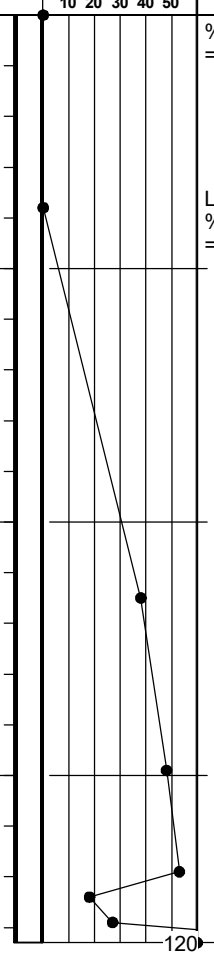
**Mean Low Low Water (MLLW):** -50.9 (ft) **Total Depth:** 18.3 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/30 | 4:17 PM | 51.9' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, brown and dark gray, trace gravel, contains shell fragments | SP | | | % Passing #200 = 4.6 | PP =<0.25 tsf |
| 1.1 | Change: estimated 30 - 45% shell fragments, from 0.8 to 1.1 ft | | -52.0 | | | PP =2.25 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, gray, trace gravel | | | | | PP =1.0 tsf |
| | Change: contains clayey sand pockets, from 1.8 to 1.9, from 2.3 to 2.5 ft, and from 4 to 4.6 ft | SP | | A | LL = NP<br>% Passing #200 = 1.2 | PP =1.5 tsf<br>PP =0.25 tsf |
| | Change: light brown, from 5.0 to 7.6 ft | | | | | PP =1.25 tsf<br>PP =0.25 tsf<br>PP =0.5 tsf |
| 8.5 | Change: black and dark gray, from 7.6 to 8.3 ft | | -59.4 | | | PP =0.5 tsf |
| | Change: contains poorly graded gravel with sand layer, from 8.3 to 8.5 ft | | | | | PP =1.0 tsf |
| | FAT CLAY; moist, dark gray | CH | | B | | PP =0.75 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =0.75 tsf<br>PP =1.0 tsf |
| 18.3 | | | -69.2 | | | PP =0.75 tsf<br>PP =0.75 tsf |

SAMPLING DEPTH — PENETRATION TIME (10 20 30 40 50)




Bottom of Vibracore at 18.3 ft.
Penetration Time - 5 minutes: 6 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

| Schnabel ENGINEERING | Project: Sandbridge Borrow Area, Offshore Virginia Beach, Virginia | Vibracore Number: **18SBB-39**<br>Contract Number: 18C13103.00<br>Sheet: 1 of 1 |
|---|---|---|

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/30/18 **Finished:** 8/30/18

**North:** 3430055 ft **East:** 12259988 ft

**Coordinate System:** VA State Plane (S)

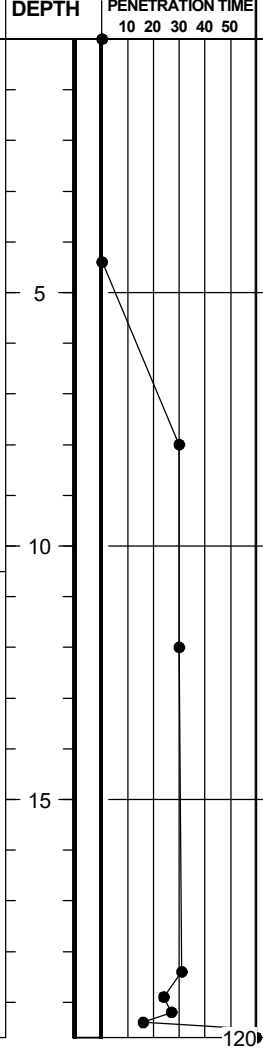
**Mean Low Low Water (MLLW):** -49.5 (ft) **Total Depth:** 19.7 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/30 | 2:32 PM | 51.8' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, brown and dark gray | SP | | A | % Passing #200 = 1.5 | PP =<0.25 tsf |
| | Change: estimated 30 - 45% shell fragments, contains clayey sand pockets, from 1.5 to to 1.9 ft | | | | | PP =1.5 tsf |
| | Change: contains poorly graded gravel layers, estimated <5% shell fragments, from 1.9 to 2.3 ft | | | | | PP =1.25 tsf |
| | Change: gray and dark gray, below 2.3 ft | | | | | PP =1.0 tsf |
| | Change: trace gravel, below 4.2 ft | | | | % Passing #200 = 1.3 | PP =0.75 tsf |
| | | | | | | PP =0.75 tsf |
| | Change: estimated <5% shell fragments, from 6.7 to 10.5 ft | | | | | PP =0.5 tsf |
| | | | | | | PP =0.5 tsf |
| | | | | | | PP =0.25 tsf |
| | Change: contains clayey sand pockets, from 9.1 to 10.5 ft | | | | % Passing #200 = 2.0 | PP =0.5 tsf |
| 10.5 | FAT CLAY; moist, dark gray | CH | -60.0 | B | | PP =0.25 tsf |
| | Change: contains poorly graded sand with gravel layer, from 10.8 to 11.4 ft | | | | | PP =0.5 tsf |
| | | | | | | PP =0.75 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =0.75 tsf |
| | | | | | | PP =0.75 tsf |
| | | | | | | PP =0.75 tsf |
| | | | | | | PP =1.0 tsf |
| 19.7 | | | -69.2 | | | PP =0.75 tsf |
| | | | | | | PP =0.75 tsf |

**SAMPLING**




Bottom of Vibracore at 19.7 ft.
Penetration Time - 4 minutes: 36 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-40
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** M. Barrett

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/30/18 **Finished:** 8/30/18

**North:** 3430021 ft **East:** 12258495 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -49.6 (ft) **Total Depth:** 9.8 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/30 | 10:10 AM | 53.1' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | PENETRATION TIME (10 20 30 40 50) | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, brown and dark gray, estimated <5% shell fragments | SP | | A | | | | PP =<0.25 tsf |
| 1.3 | LEAN CLAY; moist, dark gray, contains clayey sand lenses | CL | -50.9 | B | 5 | | | PP =1.75 tsf<br>PP =0.5 tsf<br>PP =1.25 tsf<br>PP =1.0 tsf<br>PP =0.75 tsf |
| 5.8 | POORLY GRADED SAND WITH SILT, fine to medium grained sand; wet, gray and dark brown, estimated <5% organics | SP-SM | -55.4 | | | | | PP =1.25 tsf<br>PP =1.5 tsf |
| 7.7 | POORLY GRADED SAND, fine to coarse grained sand; wet, light gray<br>Change: contains lean clay lense, from 9.0 to 9.4 ft | SP | -57.3 | | | 69 | | PP =1.25 tsf<br>PP =0.75 tsf |
| 9.8 | Change: contains cobble, at 9.4 ft | | -59.4 | | | 120 | | PP =0.75 tsf |

Bottom of Vibracore at 9.8 ft.
Time refusal at 9.8 ft.
Penetration Time - 5 minutes: 36 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-40A
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/30/18 **Finished:** 8/30/18

**North:** 3430016 ft **East:** 12258495 ft

**Coordinate System:** VA State Plane (S)

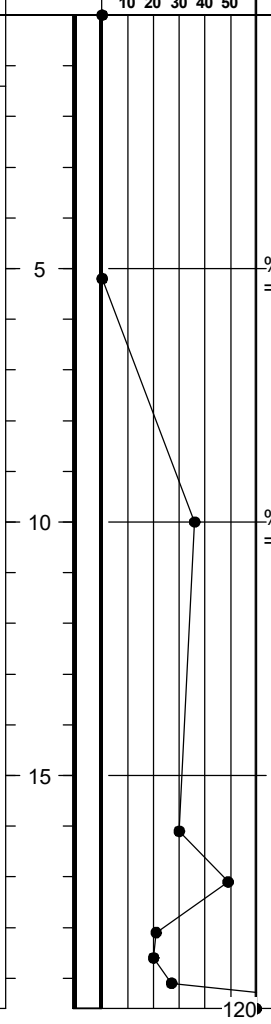
**Mean Low Low Water (MLLW):** -48.9 (ft) **Total Depth:** 19.6 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/30 | 11:54 AM | 52.6' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, brown and dark gray, trace gravel, contains shell fragments | SP | | A | | PP =<0.25 tsf |
| 1.4 | | | -50.3 | | | PP =2.0 tsf |
| | LEAN CLAY; moist, dark gray, contains silty sand pockets, contains clayey sand lenses | CH | | | | PP =1.0 tsf<br>PP =1.25 tsf |
| 4.3 | | | -53.2 | | | PP =1.0 tsf |
| 4.6 | CLAYEY SAND, fine to medium grained sand; wet, dark gray | SC | -53.5 | | % Passing #200 = 1.3 | PP =0.5 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light gray, trace gravel | | | | | PP =0.75 tsf<br>PP =1.25 tsf<br>PP =1.0 tsf |
| | Change: contains poorly graded gravel layer, from 8.7 to 9.1 ft | SP | | | | PP =0.5 tsf |
| | Change: contains wood fragment, from 9.5 to 9.8 ft | | | B | % Passing #200 = 2.6 | PP =0.25 tsf |
| | Change: estimated <5% gravel, from 9.8 to 12.4 ft | | | | | PP =1.75 tsf |
| 12.4 | Change: contains poorly graded gravel lense, from 12.0 to 12.4 ft | | -61.3 | | | PP =1.0 tsf |
| | FAT CLAY; moist, dark greenish gray | | | | | PP =1.0 tsf<br>PP =0.5 tsf |
| | | CH | | | | PP =1.0 tsf<br>PP =1.25 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf |
| 19.6 | | | -68.5 | | | PP =1.0 tsf<br>PP =1.0 tsf |

SAMPLING DEPTH — PENETRATION TIME (10 20 30 40 50)




Bottom of Vibracore at 19.6 ft.
Penetration Time - 5 minutes: 6 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-41
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** M. Barrett

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 8/29/18 **Finished:** 8/29/18

**North:** 3430021 ft **East:** 12257037 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -46.9 (ft) **Total Depth:** 19.8 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 8/29 | 4:37 PM | 47.9' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | PENETRATION TIME 10 20 30 40 50 | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, grayish brown, trace gravel, contains shell fragments<br>Change: light gray, estimated <5% heavy minerals, from 0.9 to 11.4 ft | SP | | A | | | % Passing #200 = 0.8 | PP =<0.25 tsf<br>PP =<0.25 tsf<br>PP =0.25 tsf<br>PP =1.0 tsf<br>PP =1.25 tsf |
| | | | | | 5 | | % Passing #200 = 1.5 | PP =<0.25 tsf<br>PP =0.5 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf<br>PP =0.5 tsf |
| | | | | | 10 | | % Passing #200 = 2.1 | PP =<0.25 tsf |
| 11.4 | Change: estimated <5% fine and coarse gravel, from 11.1 to 11.4 ft<br>FAT CLAY; moist, dark gray | | -58.3 | | | | | PP =0.5 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf |
| | | CH | | B | 15 | | | PP =0.75 tsf<br>PP =0.5 tsf<br>PP =0.75 tsf<br>PP =1.0 tsf |
| 19.8 | | | -66.7 | | | 66.7 | | PP =1.5 tsf<br>PP =0.75 tsf |

Bottom of Vibracore at 19.8 ft.
Penetration Time - 5 minutes: 6 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-42
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/6/18 **Finished:** 9/6/18

**North:** 3428701 ft **East:** 12257714 ft

**Coordinate System:** VA State Plane (S)

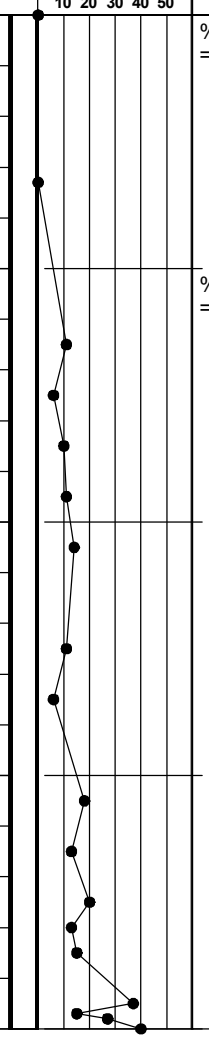
**Mean Low Low Water (MLLW):** -50.8 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/6 | 10:38 AM | 50.9' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light gray | SP | | A | % Passing #200 = 1.7 | PP =<0.25 tsf |
| | | | | | | PP =<0.25 tsf |
| | | | | | | PP =0.25 tsf |
| | | | | | | PP =0.5 tsf |
| | | | | | | PP =0.5 tsf |
| | | | | | % Passing #200 = 1.1 | PP =0.5 tsf |
| | Change: brown, from 5.8 to 6.5 ft | | | | | PP =1.5 tsf |
| 6.5 | FAT CLAY; moist, gray | CH | -57.3 | B | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | Change: estimated <5% shell fragments, from 13.0 to 21 ft | | | | | PP =1.25 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.0 tsf |
| 20.0 | | | -70.8 | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |

SAMPLING DEPTH — PENETRATION TIME (10 20 30 40 50)




Bottom of Vibracore at 20.0 ft.
Penetration Time - 4 minutes: 30 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-43
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/6/18 **Finished:** 9/6/18

**North:** 3428701 ft **East:** 12259155 ft

**Coordinate System:** VA State Plane (S)

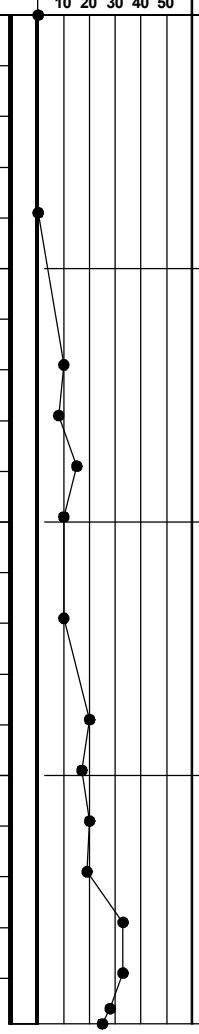
**Mean Low Low Water (MLLW):** -49.9 (ft) **Total Depth:** 19.9 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/6 | 12:59 PM | 50.2' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| 0.8 | POORLY GRADED SAND, fine to coarse grained sand; wet, brown, contains shell fragments | SP | -50.7 | | % Passing #200 = 3.5 | PP =<0.25 tsf |
| 1.6 | Change: dark gray, estimated <5% shell fragments, from 0.5 to 0.8 ft | CL | -51.5 | | | PP =0.25 tsf |
| | LEAN CLAY; wet, dark gray, estimated <5% shell fragments | SP | | | | PP =0.75 tsf |
| | | | | | | PP =1.75 tsf |
| 4.1 | POORLY GRADED SAND, fine to coarse grained sand; wet, grayish brown, estimated 5 - 10% shell fragments, estimated <5% gravel | | -54.0 | A | | PP =2.0 tsf |
| | Change: light brown and light gray, contains clayey sand pockets, from 2.4 to 4.1 ft | SM | | | % Passing #200 = 11.0 | PP =0.25 tsf |
| | | | | | | PP =0.5 tsf |
| | SILTY SAND, fine to coarse grained sand; light gray, trace gravel | | | | | PP =1.5 tsf |
| 8.3 | Change: contains lean clay layer, from 5.5 to 6.0 ft | | -58.2 | | | PP =0.75 tsf |
| | Change: estimated <5% organics, from 6.0 to to 8.3 ft | | | | | PP =1.0 tsf |
| | Change: contains clayey sand layer, contains lean clay pockets, from 7.3 to 7.9 ft | | | | | PP =1.0 tsf |
| | FAT CLAY; moist, gray | | | | | PP =1.5 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.25 tsf |
| | | CH | | B | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.5 tsf |
| | | | | | | PP =1.5 tsf |
| | | | | | | PP =1.5 tsf |
| 19.9 | Change: contains silty sand lense, from 19.3 to 19.6 ft | | -69.8 | | | PP =1.5 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50




Bottom of Vibracore at 19.9 ft.
Penetration Time - 4 minutes: 6 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-44
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/6/18 **Finished:** 9/6/18

**North:** 3428667 ft **East:** 12260665 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -50.8 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/6 | 3:47 PM | 54.5' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | PENETRATION TIME (10 20 30 40 50) | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|---|
| 0.6 | POORLY GRADED SAND, fine to medium grained sand; wet, gray, estimated <5% shell fragments | SP | -51.4 | A | | | | PP =<0.25 tsf |
| | FAT CLAY; wet, gray | CH | | | | | | PP =1.5 tsf<br>PP =1.5 tsf<br>PP =0.5 tsf |
| 4.1 | CLAYEY SAND, fine to medium grained sand; wet, gray | SC | -54.9 | | | | | PP =0.5 tsf |
| 5.0 | POORLY GRADED SAND, fine to coarse grained sand; wet, dark gray<br>Change: light gray, from 5.7 to 9.2 ft | SP | -55.8 | | 5 | | % Passing #200 = 3.5 | PP =1.25 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf |
| 9.2 | Change: contains lean clay lense, from 8.5 to 8.6 ft<br>Change: estimated <5% gravel, from 9.0 to 9.2 ft | | -60.0 | | | | | PP =1.0 tsf |
| | FAT CLAY; moist, gray | CH | | B | 10 | | | PP =1.0 tsf<br>PP =1.0 tsf<br>PP =0.5 tsf<br>PP =1.0 tsf<br>PP =1.25 tsf |
| | | | | | 15 | | | PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.25 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf |
| 20.0 | | | -70.8 | | 20 | | | PP =1.0 tsf |

Bottom of Vibracore at 20.0 ft.
Penetration Time - 3 minutes: 31 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-45
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/6/18 **Finished:** 9/6/18

**North:** 3428667 ft **East:** 12262089 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -49.3 (ft) **Total Depth:** 7.3 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| **Depth of Water** | 9/6 | 5:23 PM | 53.5' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, grayish brown, contains shell fragments | SP | | | | | PP =<0.25 tsf<br>PP =<0.25 tsf<br>PP =0.25 tsf |
| 2.7 | FAT CLAY; wet, gray | CH | -52.0 | A | | | PP =<0.25 tsf |
| 4.0 | SILTY SAND, fine to medium grained sand; wet, gray, estimated <5% shell fragments | SM | -53.3 | | | | PP =<0.25 tsf |
| 5.1 | POORLY GRADED SAND, fine to coarse grained sand; wet, grayish brown | SP | -54.4 | | 5 | | PP =0.5 tsf<br>PP =1.0 tsf<br>PP =0.50 tsf |
| 7.3 | | | -56.6 | | | | PP =0.50 tsf |

Bottom of Vibracore at 7.3 ft.
Hard refusal at 7.3 ft.
Penetration Time - 2 minutes: 48 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-45A
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/6/18 **Finished:** 9/6/18

**North:** 3428662 ft **East:** 12262089 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -49.1 (ft) **Total Depth:** 13.1 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/6 | 6:10 PM | 53.3' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, brownish gray, trace gravel, contains shell fragments<br>Change: gray, from 0.8 to 2.9 ft | SP | | | % Passing #200 = 3.9 | PP =<0.25 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf |
| 2.9 | FAT CLAY; moist, gray | CH | -52.0 | | | PP =0.25 tsf |
| 3.8 | POORLY GRADED SAND, fine to coarse grained sand; wet, brown, contains shell fragments | SP | -52.9 | A | % Passing #200 = 3.4<br>% Passing #200 = 2.4 | PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.5 tsf<br>PP =1.5 tsf<br>PP =1.5 tsf<br>PP =1.0 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf |
| 13.1 | Change: light gray, from 12.2 to 13.1 ft | | -62.2 | | | |

SAMPLING — DEPTH (5, 10) — PENETRATION TIME 10 20 30 40 50 — 72

Bottom of Vibracore at 13.1 ft.
Hard refusal at 13.1 ft.
Penetration Time - 8 minutes: 29 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-46
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/7/18 **Finished:** 9/7/18

**North:** 3428649 ft **East:** 12263616 ft

**Coordinate System:** VA State Plane (S)

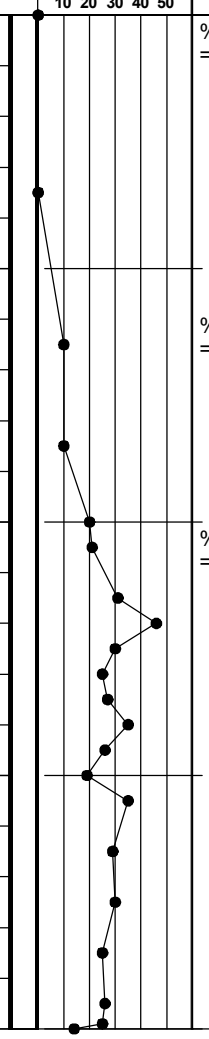
**Mean Low Low Water (MLLW):** -51.3 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/7 | 7:36 AM | 54.2' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, brown, trace gravel, contains shell fragments<br>Change: gray, from 0.3 to 5.2 ft<br>Change: estimated 50 - 100% shell fragments, from 1.5 to 1.7 ft and from 3.1 to 3.6 ft<br>Change: contains clay lense, from 1.7 to 1.8 ft, 3.7 to 3.8 ft, and 4.4 to 4.5 ft | SP-SM | | | % Passing #200 = 5.7 | PP =<0.25 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf<br>PP =1.25 tsf<br>PP =1.5 tsf |
| 5.2 | Change: contains shell hash, from 5.0 to 5.2 ft | CL | -56.5 | | | PP =1.0 tsf |
| 5.8 | LEAN CLAY; wet, gray, estimated <5% shell fragments | | -57.1 | A | % Passing #200 = 3.0 | PP =0.75 tsf<br>PP =1.5 tsf |
| | POORLY GRADED SAND, fine to medium grained sand; wet, gray<br>Change: contains clayey sand lense, from 7.6 to 7.7 ft | SP | | | | PP =1.5 tsf<br>PP =1.5 tsf |
| 10.0 | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; trace gravel | SP-SM | -61.3 | | % Passing #200 = 5.2 | PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.5 tsf |
| 13.2 | FAT CLAY; wet, gray | CH | -64.5 | B | | PP =2.0 tsf<br>PP =1.25 tsf<br>PP =1.25 tsf<br>PP =1.25 tsf<br>PP =1.25 tsf<br>PP =1.25 tsf<br>PP =1.25 tsf |
| 20.0 | | | -71.3 | | | PP =1.25 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50




Bottom of Vibracore at 20.0 ft.
Penetration Time - 8 minutes: 4 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-47
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/7/18 **Finished:** 9/7/18

**North:** 3428632 ft **East:** 12265075 ft

**Coordinate System:** VA State Plane (S)

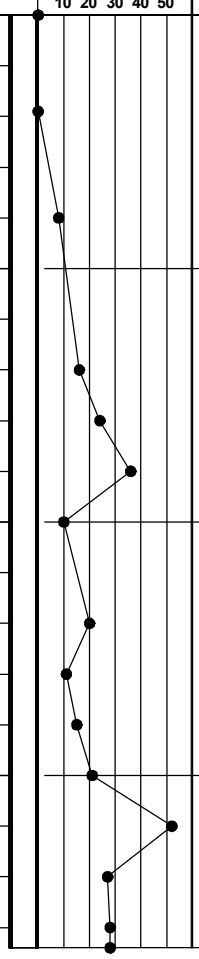
**Mean Low Low Water (MLLW):** -53.7 (ft) **Total Depth:** 18.4 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/7 | 8:57 AM | 55.7' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | SILTY SAND, fine to medium grained sand; wet, gray, trace gravel, contains shell fragments<br>Change: contains lean clay pockets, at 1.4 ft | SM | | | % Passing #200 = 25.0 | PP =0.25 tsf<br>PP =0.5 tsf |
| 2.4 | POORLY GRADED SAND, fine to medium grained sand; wet, light gray | SP | -56.1 | A | % Passing #200 = 3.1 | PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf |
| 7.5 | FAT CLAY; moist, greenish gray<br>Change: dark gray, from 7.7 to 14.1 ft | CH | -61.2 | B | | PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf |
| 14.1 | POORLY GRADED SAND WITH SILT, fine to medium grained sand; wet, dark gray<br>Change: contains lean clay lenses, from 17.0 to 18.4 ft | SP-SM | -67.8 | | % Passing #200 = 6.6 | PP =0.75 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.5 tsf<br>PP =1.5 tsf<br>PP =1.25 tsf |
| 18.4 | | | -72.1 | | | |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50




Bottom of Vibracore at 18.4 ft.
Penetration Time - 4 minutes: 56 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-48
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/7/18 **Finished:** 9/7/18

**North:** 3428597 ft **East:** 12266533 ft

**Coordinate System:** VA State Plane (S)

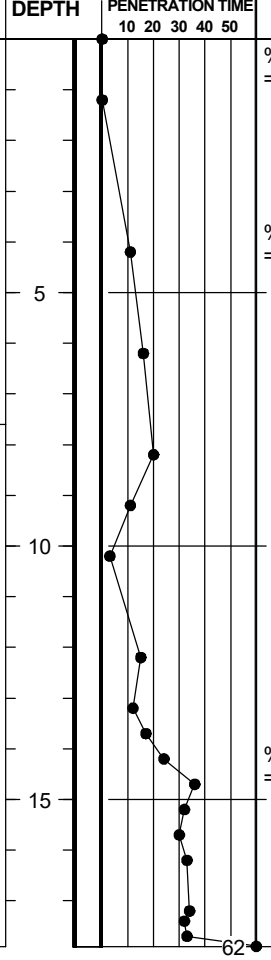
**Mean Low Low Water (MLLW):** -53.3 (ft) **Total Depth:** 17.9 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/7 | 10:30 AM | 53.5' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, brown, contains shell fragments<br>Change: dark gray, estimated <5% shell fragments, from 1.1 to 2.8 ft | SP-SM | | | % Passing #200 = 8.0 | PP =0.25 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf |
| 2.8 | SILTY SAND, fine to medium grained sand; wet, gray, estimated 15 - 25% shell fragments | SM | -56.1 | | | PP =0.75 tsf |
| 3.5 | POORLY GRADED SAND, fine to coarse grained sand; wet, gray<br>Change: contains lean clay lense, from 3.9 to 4.0 ft | SP | -56.8 | A | % Passing #200 = 3.9 | PP =0.75 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf |
| 7.6 | FAT CLAY; moist, gray | CH | -60.9 | B | | PP =0.75 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =0.75 tsf |
| 13.8 | POORLY GRADED SAND WITH SILT, fine to medium grained sand; wet, gray, contains wood fragments<br>Change: contains wood lense, from 15.6 to 15.7 ft, and from 16.6 to 16.7 ft | SP-SM | -67.1 | | % Passing #200 = 5.0 | PP =1.0 tsf<br>PP =1.5 tsf<br>PP =1.5 tsf |
| 17.0 | FAT CLAY; moist, gray | CH | -70.3 | | | PP =1.0 tsf |
| 17.9 | | | -71.2 | | | PP =1.0 tsf |

**SAMPLING**




Bottom of Vibracore at 17.9 ft.
Penetration Time - 7 minutes: 1 second.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-49
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/7/18 **Finished:** 9/7/18

**North:** 3428614 ft **East:** 12267957 ft

**Coordinate System:** VA State Plane (S)

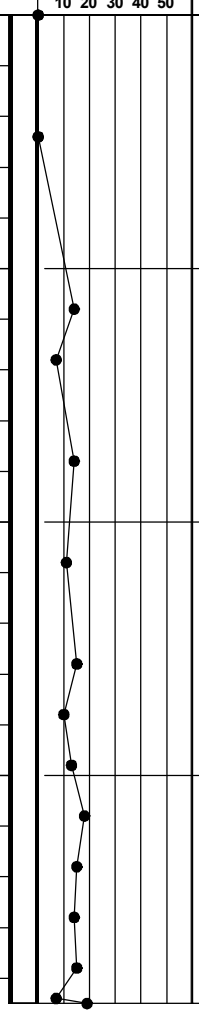
**Mean Low Low Water (MLLW):** -56.0 (ft) **Total Depth:** 19.5 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/7 | 1:03 PM | 56.1' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND WITH SILT, fine to medium grained sand; wet, brown | SP-SM | | | % Passing #200 = 10.4 | PP =0.25 tsf |
| 1.3 | Change: gray, from 0.2 to 11.3 ft | | -57.3 | | | PP =0.25 tsf |
| | SILTY SAND, fine to coarse grained sand; wet, gray, trace gravel, contains shell fragments | | | | | PP =0.25 tsf |
| | Change: contains poorly graded gravel, estimated 15 - 25% shell fragments, from 1.7 to 2.4 ft | SM | | A | | PP =1.0 tsf |
| | Change: gray, trace gravel, contains shell fragments, below 2.4 ft | | | | | PP =0.5 tsf |
| | | | | | % Passing #200 = 15.2 | PP =0.5 tsf |
| | | | | | | PP =0.5 tsf |
| 6.9 | FAT CLAY; moist, gray | | -62.9 | | | PP =0.5 tsf |
| | | | | | | PP =0.75 tsf |
| | | CH | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| 11.9 | SANDY SILT; wet, gray, contains mica | | -67.9 | | % Passing #200 = 68.3 | PP =1.0 tsf |
| | | ML | | B | | PP =1.0 tsf |
| 14.5 | SILT WITH SAND; wet, gray, contains mica, and organic matter | | -70.5 | | | PP =0.75 tsf |
| | | | | | % Passing #200 = 76.2 | PP =1.0 tsf |
| | | ML | | | | PP =0.75 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| 19.5 | | | -75.5 | | | PP =0.75 tsf |
| | | | | | | PP =0.75 tsf |

SAMPLING — DEPTH — PENETRATION TIME (10 20 30 40 50)




Bottom of Vibracore at 19.5 ft.
Penetration Time - 2 minutes: 52 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-50
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/7/18 **Finished:** 9/7/18

**North:** 3428580 ft **East:** 12269432 ft

**Coordinate System:** VA State Plane (S)

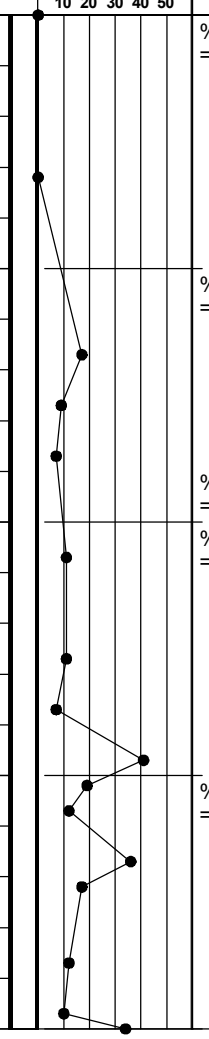
**Mean Low Low Water (MLLW):** -49.8 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/7 | 2:42 PM | 51.5' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, grayish brown, contains shell fragments | SP-SM | | A | % Passing #200 = 7.8 | PP =<0.25 tsf |
| | | | | | | PP =1.25 tsf |
| | Change: dark gray, from 2.1 to 2.4 ft | | | | | PP =2.0 tsf |
| | Change: grayish brown, from 2.4 to 3.3 ft | | | | | PP =2.25 tsf |
| | Change: dark gray, from 3.3 to 7.3 ft | | | | | |
| | Change: contains lean clay lense, from 3.4 to 3.5 ft | | | | | PP =2.5 tsf |
| 5.0 | SILTY SAND, fine to coarse grained sand; wet, dark gray, contains shell fragments | SM | -54.8 | | % Passing #200 = 30.1 | PP =0.25 tsf |
| | | | | | | PP =0.25 tsf |
| | Change: contains lean clay lense, from 5.7 to 6.0 ft | | | | | PP =2.0 tsf |
| 7.3 | Change: estimated <5% gravel, from 6.0 to 7.3 ft | CL | -57.1 | | | PP =0.5 tsf |
| 8.9 | LEAN CLAY; wet, dark gray, contains clayey sand pockets | SM | -58.7 | | % Passing #200 = 19.0 | PP =1.5 tsf |
| 9.6 | SILTY SAND WITH GRAVEL, fine to coarse grained sand; wet, contains shell fragments | | -59.4 | | % Passing #200 = 6.4 | PP =0.25 tsf |
| | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, dark gray, contains shell fragments | SP-SM | | | | PP =0.25 tsf |
| | | | | | | PP =0.75 tsf |
| | Change: contains sandy lean clay lense, from 11.1 to 11.3 ft | | | | | PP =1.0 tsf |
| | Change: trace gravel, below 11.3 ft | | | | | PP =1.5 tsf |
| | | | | | % Passing #200 = 7.0 | PP =0.25 tsf |
| 16.1 | FAT CLAY; moist, dark gray | CH | -65.9 | B | | PP =1.5 tsf |
| | | | | | | PP =0.5 tsf |
| | | | | | | PP =1.5 tsf |
| | | | | | | PP =1.75 tsf |
| 20.0 | | | -69.8 | | | PP =1.0 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50




Bottom of Vibracore at 20.0 ft.
Penetration Time - 4 minutes: 3 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-51
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/3/18 **Finished:** 9/3/18

**North:** 3427278 ft **East:** 12270040 ft

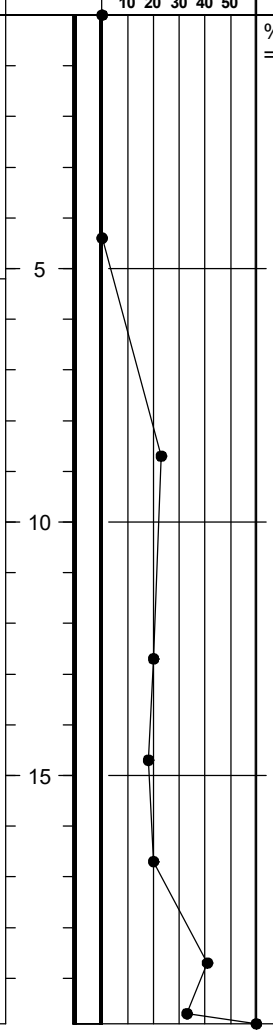
**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -50.5 (ft) **Total Depth:** 19.9 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/3 | 3:41 PM | 54.3' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, brown, contains shell fragments | SP | | A | % Passing #200 = 1.5 | PP =<0.25 tsf |
| | Change: gray, from 1.8 to 5.2 ft | | | | | PP =1.0 tsf |
| | Change: contains clayey sand lense, from 2.5 to 2.6 ft | | | | | PP =1.0 tsf |
| | | | | | | PP =1.5 tsf |
| | | | | | | PP =1.5 tsf |
| 5.2 | FAT CLAY; moist, gray | CH | -55.7 | | | PP =<0.25 tsf |
| | Change: contains shell hash lense, from 5.4 to 5.6 ft | | | | | PP =0.25 tsf |
| | | | | | | PP =<0.25 tsf |
| 8.0 | SILTY GRAVEL, fine to coarse grained sand; wet, gray, estimated <5% shell fragments | GM | -58.5 | | | PP =<0.25 tsf |
| 8.9 | FAT CLAY; moist, gray | CH | -59.4 | B | | PP =0.75 tsf |
| | | | | | | PP =0.75 tsf |
| | | | | | | PP =0.75 tsf |
| | | | | | | PP =0.75 tsf |
| | | | | | | PP =0.75 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.25 tsf |
| 19.9 | | | -70.4 | | | PP =1.25 tsf |




Bottom of Vibracore at 19.9 ft.
Penetration Time - 3 minutes: 35 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-52
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/4/18 **Finished:** 9/4/18

**North:** 3427243 ft **East:** 12268668 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -54.1 (ft) **Total Depth:** 15.5 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/4 | 7:12 AM | 55.2' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | PENETRATION TIME (10 20 30 40 50) | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, brownish gray, trace gravel, contains shell fragments | SP | | A | | | | PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf |
| 3.0 | SILTY SAND WITH GRAVEL, fine to coarse grained sand; wet, gray, contains shell fragments | SM | -57.1 | | | | | PP =1.25 tsf |
| 4.2 | FAT CLAY; moist, gray | CH | -58.3 | B | 5 | | | PP =3.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf |
| | | | | | 10 | | | PP =1.0 tsf<br>PP =1.25 tsf<br>PP =1.25 tsf<br>PP =1.25 tsf<br>PP =1.25 tsf |
| 15.5 | Change: contains clayey sand pockets, from 14.8 to 15.5 ft | | -69.6 | | 15 | | | PP =1.25 tsf<br>PP =1.0 tsf |

Bottom of Vibracore at 15.5 ft.
Time refusal at 15.5 ft.
Penetration Time - 4 minutes: 10 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-52A
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/4/18 **Finished:** 9/4/18

**North:** 3427248 ft **East:** 12268668 ft

**Coordinate System:** VA State Plane (S)

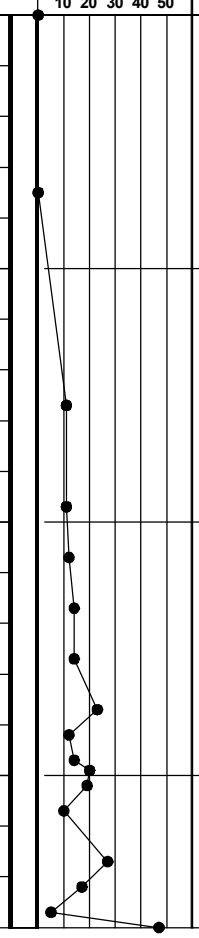
**Mean Low Low Water (MLLW):** -54.5 (ft) **Total Depth:** 18.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/4 | 8:25 AM | 55.1' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, brown, estimated <5% shell fragments<br>Change: light gray, from 0.9 to 3.0 ft | SP | | A | % Passing #200 = 1.8 | PP =<0.25 tsf<br>PP =1.0 tsf<br>PP =1.5 tsf |
| 3.0 | SILTY SAND WITH GRAVEL, fine to medium grained sand; wet, gray, contains shell fragments<br>Change: estimated 5 - 10% gravel, from 3.8 to 5.3 ft | SM | -57.5 | | % Passing #200 = 33.3 | PP =1.0 tsf<br>PP =3.0 tsf |
| 5.3 | FAT CLAY; moist, gray | CH | -59.8 | B | | PP =2.5 tsf<br>PP =1.5 tsf<br>PP =1.5 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.25 tsf<br>PP =1.25 tsf<br>PP =1.25 tsf<br>PP =1.5 tsf |
| 16.0 | SILTY SAND, fine to medium grained sand; wet, gray, contains lean clay lenses | SM | -70.5 | | | |
| 18.0 | | | -72.5 | | | PP =1.0 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50




Bottom of Vibracore at 18.0 ft.
Penetration Time - 4 minutes: 16 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-53
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/4/18 **Finished:** 9/4/18

**North:** 3427208 ft **East:** 12267210 ft

**Coordinate System:** VA State Plane (S)

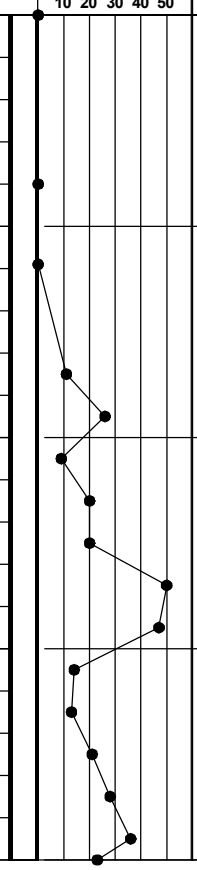
**Mean Low Low Water (MLLW):** -56.8 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/4 | 12:45 PM | 59.6' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| 0.2 | SILTY SAND, fine grained sand; wet, gray, contains mica | SM | -57.0 | | | PP =0.25 tsf |
| | FAT CLAY; moist, gray | CH | | A | | PP =0.5 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf |
| 11.9 | SILTY SAND, fine grained sand; wet, gray, contains mica | SM | -68.7 | | % Passing #200 = 45.5 | PP =0.75 tsf<br>PP =1.0 tsf<br>PP =0.5 tsf<br>PP =0.5 tsf |
| 16.1 | FAT CLAY; moist, gray | CH | -72.9 | B | | PP =<0.25 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf |
| 19.8 | Change: contains coarse gravel, from 19.5 to 19.8 ft | SM | -76.6 | | | |
| 20.0 | SILTY SAND, fine to medium grained sand; wet, gray | | -76.8 | | | PP =0.75 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50




Bottom of Vibracore at 20.0 ft.
Penetration Time - 5 minutes: 18 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-54
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/4/18 **Finished:** 9/4/18

**North:** 3427278 ft **East:** 12265787 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -53.7 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/4 | 3:12 PM | 57.6' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, gray, trace gravel | SP-SM | | | % Passing #200 = 10.9 | PP =0.5 tsf |
| 1.3 | Change: brown, estimated 5 - 10% shell fragments, estimated <5% gravel, from 0.4 to 1.3 ft | | -55.0 | | | PP =0.5 tsf |
| | POORLY GRADED SAND, fine to medium grained sand; wet, light gray | SP | | A | | PP =1.5 tsf |
| | Change: contains clayey sand lense, from 3.0 to 3.1 ft | | | | | PP =1.0 tsf |
| | | | | | | PP =1.5 tsf |
| | | | | | | PP =0.75 tsf |
| 6.4 | FAT CLAY; moist, gray | | -60.1 | | | PP =0.75 tsf |
| | | CH | | B | | PP =1.5 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
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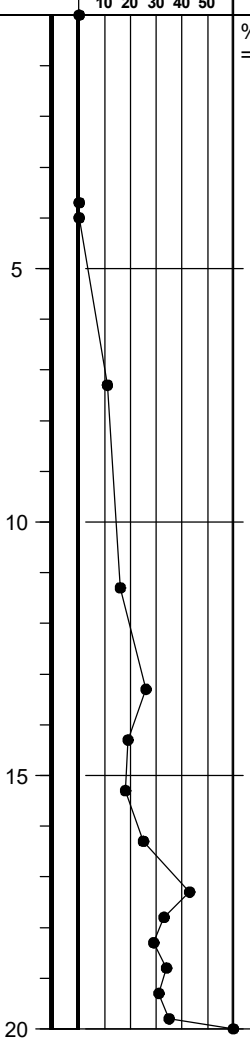
| | | | | | | PP =1.0 tsf |
| 20.0 | | | -73.7 | | | PP =1.0 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50




Bottom of Vibracore at 20.0 ft.
Penetration Time - 6 minutes: 20 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-55
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/4/18 **Finished:** 9/4/18

**North:** 3427278 ft **East:** 12264311 ft

**Coordinate System:** VA State Plane (S)

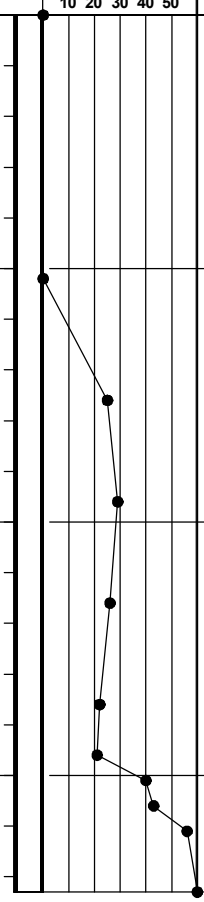
**Mean Low Low Water (MLLW):** -52.8 (ft) **Total Depth:** 17.3 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/4 | 4:57 PM | 56.3' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND WITH SILT AND GRAVEL, fine to coarse grained sand; wet, gray, contains shell fragments | SP-SM | | | % Passing #200 = 6.9 | PP =<0.25 tsf |
| 1.1 | | CL | -53.9 | | | PP =0.25 tsf |
| 1.8 | LEAN CLAY; moist, gray, estimated <5% shell fragments | GP | -54.6 | | | PP =0.5 tsf |
| 2.5 | POORLY GRADED GRAVEL, fine to coarse grained sand; moist, gray, estimated <5% shell fragments | | -55.3 | | % Passing #200 = 0.4 | PP =0.5 tsf |
| | Change: contains lean clay lense, from 1.9 to 2.1 ft | | | | | PP =0.5 tsf |
| | | | | A | | PP =0.75 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, brownish gray, trace gravel | SP | | | | PP =1.5 tsf |
| | | | | | | PP =1.5 tsf |
| | Change: estimated 5 - 10% fine and coarse gravel, from 7.7 to 7.9 ft | | | | % Passing #200 = 1.1 | PP =0.75 tsf |
| | | | | | | PP =0.5 tsf |
| 9.8 | FAT CLAY; moist, gray | | -62.6 | | | PP =1.25 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.25 tsf |
| | | CH | | B | | PP =1.0 tsf |
| | | | | | | PP =1.5 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.5 tsf |
| 17.3 | | | -70.1 | | | PP =1.5 tsf |
| | | | | | | PP =1.5 tsf |

SAMPLING DEPTH — PENETRATION TIME (10 20 30 40 50)




Bottom of Vibracore at 17.3 ft.
Penetration Time - 5 minutes: 22 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-55A
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** K. Megginson

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/5/18 **Finished:** 9/5/18

**North:** 3427278 ft **East:** 12264316 ft

**Coordinate System:** VA State Plane (S)

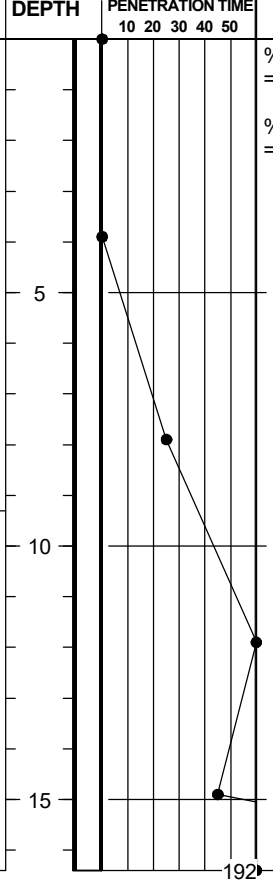
**Mean Low Low Water (MLLW):** -53.0 (ft) **Total Depth:** 16.4 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/5 | 7:07 AM | 54.9' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | SILTY SAND, fine to coarse grained sand; wet, dark gray, contains shell fragments | SM | | | % Passing #200 = 26.4 | PP =<0.25 tsf |
| 1.4 | Change: contains lean clay lense, from 1.2 to 1.5 ft | | -54.4 | | | PP =0.25 tsf |
| | POORLY GRADED SAND WITH GRAVEL, fine to coarse grained sand; wet, light grayish brown | SP | | A | % Passing #200 = 0.6 | PP =1.0 tsf |
| | | | | | | PP =0.25 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.0 tsf |
| 9.3 | FAT CLAY; moist, dark gray | | -62.3 | | | PP =1.0 tsf |
| | | CH | | B | | PP =0.75 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.5 tsf |
| | | | | | | PP =1.5 tsf |
| 16.4 | | | -69.4 | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |

**SAMPLING**




Bottom of Vibracore at 16.4 ft.
Time refusal at 16.4 ft.
Penetration Time - 5 minutes: 24 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-56
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/5/18 **Finished:** 9/5/18

**North:** 3427295 ft **East:** 12262835 ft

**Coordinate System:** VA State Plane (S)

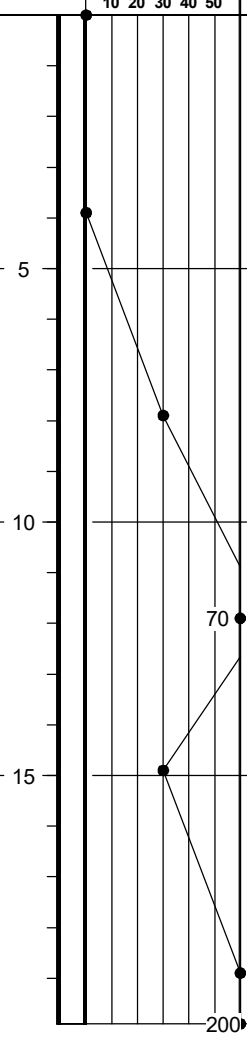
**Mean Low Low Water (MLLW):** -50.7 (ft) **Total Depth:** 19.9 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/5 | 1:53 PM | 53.5' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to medium grained sand; wet, gray, estimated <5% shell fragments | SP | | | | PP =<0.25 tsf<br>PP =1.0 tsf |
| 1.9 | SILTY SAND, fine to medium grained sand; wet, gray, estimated 5 - 10% shell fragments | SM | -52.6 | | | PP =0.5 tsf |
| 2.9 | Change: contains shell hash layer, from 2.0 to 2.6 ft | CL | -53.6 | | | PP =0.5 tsf<br>PP =0.5 tsf |
| 5.2 | LEAN CLAY; moist, gray<br>Change: contains clayey sand lense, from 4.4 to 4.5 ft | SM | -55.9 | | | PP =1.0 tsf |
| 5.9 | SILTY SAND, fine to medium grained sand; wet, gray | | -56.6 | | % Passing #200 = 5.3 | PP =0.75 tsf |
| | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, gray | SP-SM | | A | | PP =0.75 tsf<br>PP =0.75 tsf<br>PP =1.25 tsf |
| 10.0 | POORLY GRADED SAND, fine and coarse grained sand; wet, gray, contains shell fragments | SP | -60.7 | | % Passing #200 = 1.3 | PP =1.25 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf |
| | Change: estimated <5% gravel, from 13.2 to 14.4 ft | | | | | |
| 14.4 | FAT CLAY; moist, gray | CH | -65.1 | B | | PP =1.0 tsf<br>PP =0.75 tsf<br>PP =0.75 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf<br>PP =1.0 tsf |
| 19.9 | | | -70.6 | | | PP =1.0 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50




Bottom of Vibracore at 19.9 ft.
Penetration Time - 6 minutes: 30 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-57
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/5/18 **Finished:** 9/5/18

**North:** 3427260 ft **East:** 12261377 ft

**Coordinate System:** VA State Plane (S)

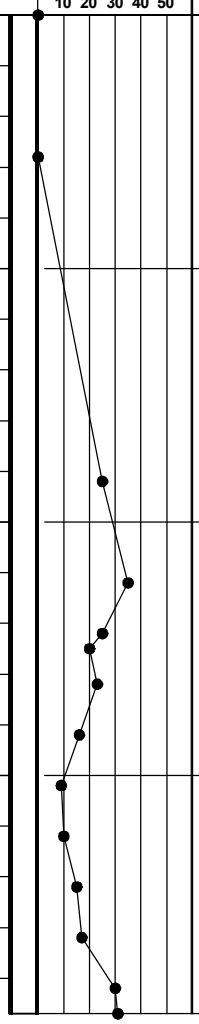
**Mean Low Low Water (MLLW):** -50.9 (ft) **Total Depth:** 19.7 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/5 | 3:35 PM | 54.5' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, light brownish gray, trace gravel, contains shell fragments | SP-SM | | | % Passing #200 = 7.5 | PP =<0.25 tsf |
| | | | | | | PP =<0.25 tsf |
| 2.0 | Change: contains clay lense, from 0.9 to 1.0 ft | SM | -52.9 | | | PP =1.0 tsf |
| 2.6 | Change: light gray, from 1.0 to 2.0 ft | | -53.5 | | | PP =1.5 tsf |
| | Change: contains clayey sand lense, from 1.8 to 2.0 ft | | | | | PP =1.5 tsf |
| | SILTY SAND, fine to medium grained sand; wet, gray | | | A | % Passing #200 = 2.3 | PP =1.0 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, gray, trace gravel | SP | | | | PP =1.0 tsf |
| | Change: contains clayey sand layer, from 3.8 to 4.7 ft | | | | | PP =1.0 tsf |
| | Change: fine to coarse grained sand; light brownish gray, from 4.7 to 9.0 ft | | | | | PP =1.0 tsf |
| 9.0 | Change: estimated <5% gravel, from 8.8 to 9.0 ft | | -59.9 | | | PP =1.0 tsf |
| | FAT CLAY; moist, gray | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.25 tsf |
| | | CH | | B | | PP =1.25 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.25 tsf |
| 19.7 | | | -70.6 | | | PP =1.25 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50




Bottom of Vibracore at 19.7 ft.
Penetration Time - 4 minutes: 16 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-58
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/5/18 **Finished:** 9/5/18

**North:** 3427243 ft **East:** 12259953 ft

**Coordinate System:** VA State Plane (S)

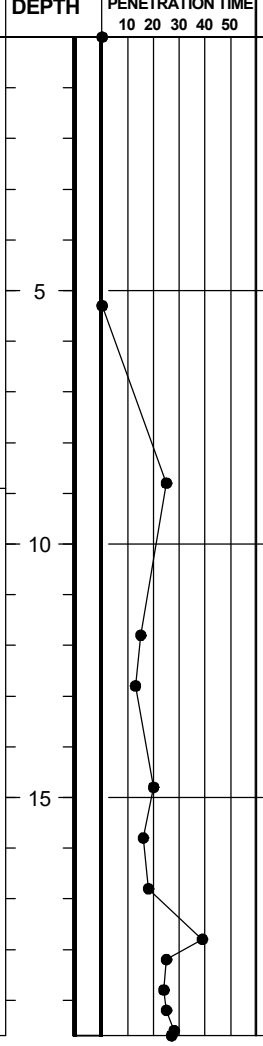
**Mean Low Low Water (MLLW):** -51.7 (ft) **Total Depth:** 19.7 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/5 | 5:54 PM | 55.4' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND WITH GRAVEL, fine to coarse grained sand; wet, gray, contains shell fragments | SP | | | % Passing #200 = 4.4 | PP =<0.25 tsf |
| | Change: contains lean clay lense, from 0.5 to 0.8 ft | | | | | PP =1.0 tsf |
| | Change: light gray, no shell fragments, from 0.9 to 1.3 ft | | | | | PP =1.0 tsf |
| 3.1 | Change: light brown, no shell fragments, from 1.3 to 3.1 ft | CH | -54.8 | A | | PP =1.0 tsf |
| | Change: contains hard silt lense, from 2.9 to 3.1 ft | | | | | PP =1.0 tsf |
| 5.6 | FAT CLAY; moist, gray | | -57.3 | | % Passing #200 = 1.5 | PP =1.0 tsf |
| | POORLY GRADED SAND WITH GRAVEL, fine to coarse grained sand; wet, gray, contains shell fragments | SP | | | | PP =1.25 tsf |
| | | | | | | PP =1.25 tsf |
| | | | | | | PP =1.0 tsf |
| 8.9 | FAT CLAY; moist, gray | | -60.6 | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | CH | | B | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| 19.7 | | | -71.4 | | | PP =1.0 tsf |

**SAMPLING**




Bottom of Vibracore at 19.7 ft.
Penetration Time - 4 minutes: 35 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-59
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/6/18 **Finished:** 9/6/18

**North:** 3427295 ft **East:** 12258443 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -49.5 (ft) **Total Depth:** 7.4 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| **Depth of Water** | 9/6 | 7:42 AM | 51.5' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | PENETRATION TIME 10 20 30 40 50 | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | Shell Hash | | | B | 5 | | | |
| 7.4 | | | -56.9 | | | | | |

Bottom of Vibracore at 7.4 ft.
Hard refusal at 7.4 ft.
Penetration Time - 2 minutes: 10 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-59A
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 9/6/18 **Finished:** 9/6/18

**North:** 3427295 ft **East:** 12258438 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -49.5 (ft) **Total Depth:** 12.4 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 9/6 | 7:42 AM | 51.5' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| 0.6 | POORLY GRADED SAND, fine to coarse grained sand; wet, gray | SP | -50.1 | | | PP =0.25 tsf |
| 1.2 | Change: trace gravel, from 0.2 to 0.6 ft | CL | -50.7 | | | PP =0.25 tsf |
| | LEAN CLAY; wet, gray, estimated <5% shell fragments | | | | % Passing #200 = 2.1 | PP =0.75 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, brown, estimated <5% shell fragments | | | | % Passing #200 = 0.6 | PP =1.0 tsf |
| | Change: fine to coarse grained sand; grayish brown, from 3.0 to 9.3 ft | SP | | A | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| | Change: contains lean clay pocket, from 7.1 to 7.4 ft | | | | % Passing #200 = 2.0 | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| 9.3 | Change: estimated <5% gravel, from 9.0 to 9.3 ft | | -58.8 | | | PP =1.25 tsf |
| | FAT CLAY; moist, gray | CH | | B | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |
| 12.4 | | | -61.9 | | | PP =1.0 tsf |
| | | | | | | PP =1.0 tsf |

SAMPLING — DEPTH (5, 10) — PENETRATION TIME 10 20 30 40 50 — 75

Bottom of Vibracore at 12.4 ft.
Time refusal at 12.4 ft.
Penetration Time - 5 minutes: 42 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-60
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 10/9/18 **Finished:** 10/9/18

**North:** 3449172 ft **East:** 12249766 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -40.8 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 10/9 | 8:55 AM | 45.2' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND WITH SILT, fine to medium grained sand; wet, light tan and light gray, contains shell fragments | SP-SM | | | | % Passing #200 = 5.7 | PP =<0.25 tsf |
| | Change: contains lean clay pockets, from 1.4 to 1.5 ft | | | | | | PP =1.0 tsf |
| 2.9 | Change: contains lean clay pockets, from 2.3 to 2.4 ft | | -43.7 | | | | PP =2.0 tsf |
| | SILTY SAND, fine to coarse grained sand; wet, dark gray, contains shell fragments | SM | | A | 5 | % Passing #200 = 21.7 | PP =2.75 tsf |
| | | | | | | | PP =3.0 tsf |
| | | | | | | | PP =1.5 tsf |
| | | | | | | | PP =2.0 tsf |
| | | | | | | | PP =2.0 tsf |
| | | | | | | | PP =2.0 tsf |
| 9.3 | Change: contains fat clay pockets, from 8.5 to 9.1 ft | | -50.1 | | | | PP =<0.25 tsf |
| | FAT CLAY; wet, gray, estimated <5% shell fragments | CH | | B | 10 | | PP =0.5 tsf |
| | Change: contains fine to medium sand lense, from 9.6 to 9.9 ft | | | | | | PP =0.5 tsf |
| | Change: contains clayey sand lense, from 10.2 to 10.5 ft | | | | | | PP =1.0 tsf |
| | | | | | | | PP =<0.25 tsf |
| | Change: estimated 50 - 100% shell fragments, from 13.7 to 14.7 ft | | | | | | PP =1.5 tsf |
| | | | | | 15 | | PP =1.0 tsf |
| | Change: contains clayey sand lense, from 16.3 to 16.5 ft | | | | | | PP =1.5 tsf |
| | | | | | | | PP =1.0 tsf |
| | | | | | | | PP =1.0 tsf |
| | | | | | | | PP =0.75 tsf |
| 20.0 | Change: estimated <5% shell fragments, from 19.5 to 20.0 ft | | -60.8 | | 20 | | PP =0.50 tsf |

Bottom of Vibracore at 20.0 ft.
Penetration Time - 3 minutes: 30 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-60.5
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 10/9/18 **Finished:** 10/9/18

**North:** 3448906 ft **East:** 12250681 ft

**Coordinate System:** VA State Plane (S)

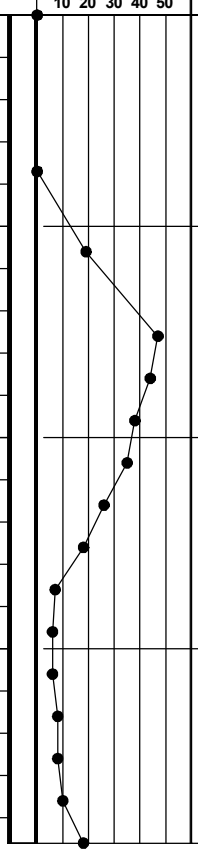
**Mean Low Low Water (MLLW):** -37.9 (ft) **Total Depth:** 19.6 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 10/9 | 10:13 AM | 41.7' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light brown, estimated <5% shell fragments | SP | | A | % Passing #200 = 1.2 | PP =<0.25 tsf |
| | Change: light brownish gray, from 1.1 to 2.0 ft | | | | | PP =1.25 tsf |
| | Change: brown and dark gray, from 2.0 to 3.0 ft | | | | | PP =2.0 tsf |
| | Change: light brown, from 3.0 to 3.3 ft | | | | | PP =2.5 tsf |
| | Change: light gray, from 3.3 to 14.0 ft | | | | | PP =2.5 tsf |
| 5 | | | | | % Passing #200 = 6.7 | PP =0.75 tsf |
| | | | | | | PP =2.5 tsf |
| | | | | | | PP =3.0 tsf |
| | Change: contains fat clay lense, from 7.7 to 7.8 ft | | | | | PP =2.5 tsf |
| | Change: contains fat clay lense, from 8.3 to 8.4 ft | | | | | PP =3.0 tsf |
| 10 | Change: estimated 50 - 100% shell fragments, from 8.6 to 8.8 ft | | | | % Passing #200 = 23.5 | PP =2.5 tsf |
| | Change: estimated 30 - 45% shell fragments, from 9.3 to 9.4 ft | | | | | PP =2.5 tsf |
| | Change: estimated 30 - 45% shell fragments, from 11.6 to 11.7 ft | | | | | PP =1.0 tsf |
| 14.0 | Change: contains clayey sand lense, from 11.7 to 12.2 ft | | -51.9 | | | PP =0.25 tsf |
| | Change: estimated 30 - 45% shell fragments, from 13.2 to 13.4 ft | | | | | PP =0.5 tsf |
| 15 | | | | | | PP =1.5 tsf |
| | FAT CLAY; wet, gray, estimated 5 - 10% shell fragments | CH | | B | | PP =0.5 tsf |
| | Change: estimated 30 - 45% shell fragments, below 14.2 ft | | | | | PP =1.0 tsf |
| | | | | | | PP =0.75 tsf |
| 19.6 | | | -57.5 | | | PP =<0.25 tsf |
| | | | | | | PP =0.5 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50



Bottom of Vibracore at 19.6 ft.
Penetration Time - 4 minutes: 48 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

| Schnabel ENGINEERING | Project: Sandbridge Borrow Area, Offshore Virginia Beach, Virginia | Vibracore Number: **18SBB-61**<br>Contract Number: 18C13103.00<br>Sheet: 1 of 1 |
|---|---|---|

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 10/9/18 **Finished:** 10/9/18

**North:** 3448598 ft **East:** 12252199 ft

**Coordinate System:** VA State Plane (S)

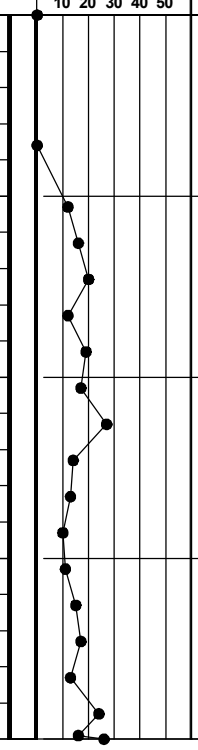
**Mean Low Low Water (MLLW):** -41.9 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 10/9 | 11:31 AM | 43.6' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light gray, contains shell fragments | SP | | A | % Passing #200 = 2.7 | PP =0.25 tsf<br>PP =0.5 tsf<br>PP =1.75 tsf |
| 2.9 | Change: light grayish brown, from 1.9 to 2.9 ft | | -44.8 | | | PP =2.0 tsf |
| | CLAYEY SAND, fine to coarse grained sand; wet, gray, contains shell fragments<br>Change: light brown, from 4.8 to 5.8 ft<br>Change: light gray, from 5.8 to 7.2 ft<br>Change: contains lean clay lenses and pockets, from 6.7 to 8.2 ft | SC | | | % Passing #200 = 22.8 | PP =2.25 tsf<br>PP =1.0 tsf<br>PP =1.5 tsf<br>PP =0.5 tsf |
| 8.8 | Change: light brown, from 7.2 to 7.4 ft<br>Change: light gray, from 7.4 to 8.8 ft<br>Change: estimated 30 - 45% shell fragments, from 8.4 to 8.8 ft | | -50.7 | | | PP =0.25 tsf<br>PP =0.75 tsf<br>PP =0.25 tsf |
| | FAT CLAY; wet, gray, estimated <5% shell fragments | CH | | B | | PP =0.5 tsf |
| 12.6 | Change: contains fine to medium sand lense, from 9.0 to 9.2 ft<br>Change: estimated 30 - 45% shell fragments, from 9.8 to 12.6 ft | | -54.5 | | | PP =0.25 tsf<br>PP =0.25 tsf<br>PP =0.5 tsf |
| | CLAYEY SAND, fine to medium grained sand; wet, gray, estimated 30 - 45% shell fragments<br>Change: contains fat clay layer, from 13.7 to 14.4 ft | SC | | | % Passing #200 = 15.7 | PP =0.25 tsf<br>PP =0.25 tsf<br>PP =1.0 tsf<br>PP =1.5 tsf |
| 20.0 | Change: fine to coarse grained sand; from 15.4 to 20.0 ft | | -61.9 | | | PP =3.0 tsf |
| | Change: contains fat clay lense, from 18.2 to 18.4 ft<br>Change: contains fat clay lense, from 18.5 to 18.6 ft<br>Bottom of Vibracore at 20.0 ft. | | | | | PP =2.0 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50




Penetration Time - 4 minutes: 42 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-62
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 10/9/18 **Finished:** 10/9/18

**North:** 3448024 ft **East:** 12254633 ft

**Coordinate System:** VA State Plane (S)

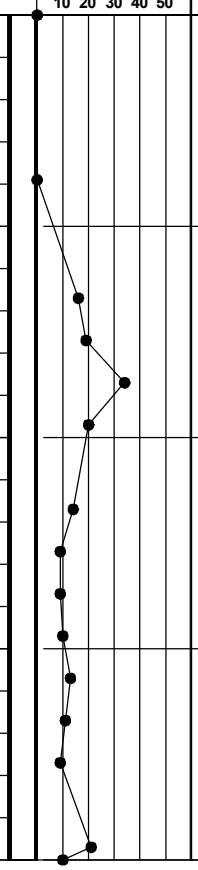
**Mean Low Low Water (MLLW):** -44.9 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 10/9 | 1:10 PM | 45.5' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light brown, contains shell fragments | SP | | A | % Passing #200 = 1.5 | PP =0.5 tsf |
| | Change: light gray, from 1.8 to 2.8 ft | | | | | PP =10 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =2.5 tsf |
| | | | | | | PP =2.5 tsf |
| | | | | | % Passing #200 = 5.1 | PP =2.0 tsf |
| 6.7 | Change: contains fat clay lense, from 6.2 to 6.3 ft | | -51.6 | | | PP =2.0 tsf |
| | FAT CLAY; wet, gray, estimated <5% shell fragments | CH | | | | PP =0.5 tsf |
| | | | | | | PP =1.25 tsf |
| 9.0 | Change: contains poorly graded sand lense, estimated 15 - 25% shell fragments, from 8.2 to 8.4 ft | | -53.9 | | | PP =0.25 tsf |
| | | | | | % Passing #200 = 22.0 | PP =1.0 tsf |
| | Change: contains clayey sand lenses, estimated 5 - 10% shell fragments, from 8.4 to 8.7 ft | | | | | PP =0.5 tsf |
| | SILTY SAND, fine to coarse grained sand; wet, gray, contains mica | SM | | B | | PP =0.5 tsf |
| | | | | | | PP =2.5 tsf |
| | Change: estimated 15 - 25% shell fragments, from 10.2 to 10.3 ft | | | | | PP =1.25 tsf |
| | Change: no shell fragments, no fine gravel, from 10.3 to 12.8 ft | | | | % Passing #200 = 15.1 | PP =1.75 tsf |
| | Change: fine to medium grained sand; from 12.8 to 20.0 ft | | | | | PP =1.25 tsf |
| | | | | | | PP =2.25 tsf |
| | Change: contains fat clay pocket, from 13.2 to 13.3 ft | | | | | PP =1.0 tsf |
| | Change: contains fat clay layer, from 13.7 to 14.3 ft | | | | | PP =1.75 tsf |
| 20.0 | Change: contains fat clay lenses, below 15 ft | | -64.9 | | | PP =1.5 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50




Bottom of Vibracore at 20.0 ft.
Penetration Time - 3 minutes: 18 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-63
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 10/9/18 **Finished:** 10/9/18

**North:** 3447451 ft **East:** 12257066 ft

**Coordinate System:** VA State Plane (S)

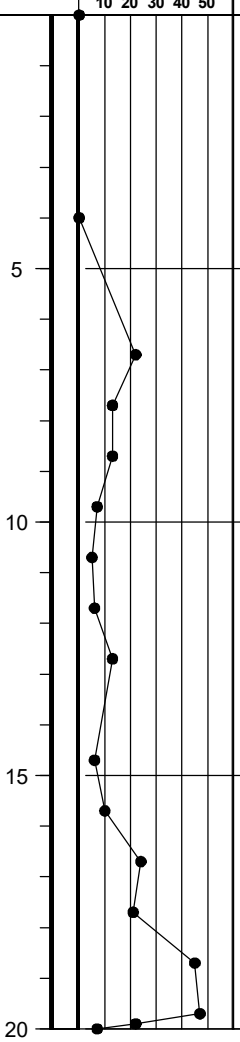
**Mean Low Low Water (MLLW):** -44.8 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 10/9 | 2:36 PM | 44.7' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, dark gray, contains shell fragments | SP | | A | % Passing #200 = 3.3 | PP =1.0 tsf<br>PP =2.0 tsf<br>PP =2.5 tsf<br>PP =3.0 tsf |
| 4.1 | Change: contains fat clay lense, from 3.5 to 3.8 ft | | -48.9 | | | PP =3.0 tsf |
| | FAT CLAY; wet, gray, contains shell fragments | CH | | | | PP =1.0 tsf<br>PP =0.75 tsf<br>PP =0.25 tsf<br>PP =1.0 tsf |
| 9.3 | | | -54.1 | | | PP =1.0 tsf |
| | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, gray, contains shell fragments | SP-SM | | B | % Passing #200 = 10.4 | PP =0.25 tsf<br>PP =0.50 tsf<br>PP =0.25 tsf<br>PP =0.50 tsf |
| 14.5 | | | -59.3 | | | PP =1.0 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, dark gray, contains shell fragments<br>Change: fine to medium grained sand; light brown and gray, from 14.7 to 15.1 ft<br>Change: gray, from 15.1 to 20.0 ft<br>Change: contains lean clay lense, from 15.2 to 15.3 ft<br>Change: contains lean clay lense, from 16.1 to 16.5 ft | SP | | | % Passing #200 = 2.2 | PP =2.0 tsf<br>PP =3.0 tsf<br>PP =3.0 tsf<br>PP =3.0 tsf<br>PP =3.0 tsf |
| 20.0 | | | -64.8 | | | PP =3.0 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50




Bottom of Vibracore at 20.0 ft.
Penetration Time - 4 minutes: 24 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

| Schnabel ENGINEERING | Project: Sandbridge Borrow Area, Offshore Virginia Beach, Virginia | Vibracore Number: **18SBB-64**<br>Contract Number: 18C13103.00<br>Sheet: 1 of 1 |
|---|---|---|

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 10/9/18 **Finished:** 10/9/18

**North:** 3446877 ft **East:** 12259499 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -43.6 (ft) **Total Depth:** 18.2 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 10/9 | 3:59 PM | 44.0' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light brown, contains shell fragments | SP | | A | | % Passing #200 = 0.9 | PP =0.25 tsf<br>PP =0.75 tsf<br>PP =1.5 tsf<br>PP =1.5 tsf |
| | Change: light brown, from 4.5 to 6.0 ft | | | | 5 | % Passing #200 = 1.9 | PP =2.0 tsf<br>PP =2.0 tsf |
| 6.0 | CLAYEY SAND, fine to medium grained sand; wet, gray, estimated <5% shell fragments | SC | -49.6 | | | | PP =1.50 tsf<br>PP =0.25 tsf |
| | Change: contains fat clay layer, from 6.3 to 7.0 ft<br>Change: estimated 5 - 10% shell fragments, from 7.0 to 7.5 ft | | | | | | PP =0.50 tsf<br>PP =1.0 tsf |
| 10.1 | Change: estimated 30 - 45% shell fragments, from 7.5 to 7.7 ft<br>Change: contains fat clay lense, from 7.9 to 8.1 ft<br>Change: contains cobble, from 9.0 to 9.3 ft<br>Change: contains fat clay lense, from 9.7 to 10.0 ft | | -53.7 | B | 10 | % Passing #200 = 3.1 | PP =1.0 tsf<br>PP =2.0 tsf<br>PP =2.0 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light gray | SP | | | | % Passing #200 = 3.8 | PP =2.25 tsf<br>PP =1.0 tsf |
| | Change: fine to medium grained sand; from 13.2 to 18.2 ft | | | | 15 | | PP =3.0 tsf |
| | Change: contains fat clay lense, from 13.9 to 14.0 ft | | | | | | PP =2.50 tsf<br>PP =2.75 tsf |
| 18.2 | Change: contains fat clay lense, from 17.4 to 17.5 ft | | -61.8 | | | | PP =2.0 tsf<br>PP =1.75 tsf |

PENETRATION TIME: 10 20 30 40 50

Bottom of Vibracore at 18.2 ft.
Penetration Time: 3 minutes: 6 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-65
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 10/9/18 **Finished:** 10/9/18

**North:** 3446303 ft **East:** 12261933 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -45.3 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 10/9 | 5:55 PM | 47.6' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, brown, contains shell fragments | | | | | % Passing #200 = 1.2 | PP =<0.25 tsf |
| | | | | | | | PP =1.0 tsf |
| | Change: brown and blackish gray, from 2.5 to 5.6 ft | SP | | | | | PP =2.0 tsf |
| | | | | | | | PP =2.0 tsf |
| | | | | | | | PP =2.0 tsf |
| | | | | | 5 | % Passing #200 = 2.1 | PP =1.5 tsf |
| 6.7 | Change: contains organic material (wood fragments), from 6.6 to 6.7 ft | SC | -52.0 | | | | PP =1.5 tsf |
| | | | | | | | PP =0.25 tsf |
| 8.3 | CLAYEY SAND, fine to medium grained sand; wet, gray, estimated 15 - 25% fine and coarse gravel, estimated <5% shell fragments | | -53.6 | | | | PP =1.5 tsf |
| | | | | | | | PP =2.0 tsf |
| | | | | A | 10 | % Passing #200 = 3.7 | PP =2.5 tsf |
| | Change: contains cobble, from 7.9 to 8.2 ft | SP | | | | | PP =2.25 tsf |
| | POORLY GRADED SAND, fine to coarse grained sand; wet, gray | | | | | | PP =2.25 tsf |
| | Change: contains fat clay lenses, below 10.3 ft | | | | | | PP =0.75 tsf |
| 14.0 | | | -59.3 | | | | PP =2.5 tsf |
| | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, gray | | | | 15 | % Passing #200 = 5.0 | PP =2.0 tsf |
| | Change: contains fat clay lenses, below 15.3 ft | | | | | | PP =2.25 tsf |
| | | SP-SM | | | | | PP =1.0 tsf |
| | | | | | | | PP =2.5 tsf |
| | | | | | | | PP =2.5 tsf |
| 20.0 | | | -65.3 | | 20 | | PP =2.5 tsf |

Penetration Time (10 20 30 40 50)

Bottom of Vibracore at 20.0 ft.
Penetration Time - 3 minutes: 53 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-66
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 10/10/18 **Finished:** 10/10/18

**North:** 3451878 ft **East:** 12249183 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -43.4 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 10/10 | 2:41 PM | 43.4' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | PENETRATION TIME 10 20 30 40 50 | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to medium grained sand; wet, light brown and light gray, estimated <5% shell fragments | SP | | A | | | % Passing #200 = 14.7 | PP =0.25 tsf |
| | Change: fine to coarse grained sand; light brown, from 1.6 to 2.1 ft | | | | | | | PP =1.0 tsf |
| | Change: gray, from 2.1 to 5.1 ft | | | | | | | PP =1.5 tsf |
| | Change: contains silty sand layer, from 3.4 to 4.1 ft | | | | | | | PP =1.0 tsf |
| | Change: estimated 5 - 10% shell fragments, from 4.1 to 4.5 ft | | | | | | | PP =0.75 tsf |
| 5.1 | Change: contains silty sand layer, estimated 5 - 10% shell fragments, from 4.7 to 5.1 ft | | -48.5 | | 5 | | | PP =1.0 tsf |
| | FAT CLAY; wet, gray | CH | | B | | | | PP =1.0 tsf |
| | Change: estimated <5% shell fragments, from 5.5 to 6.9 ft | | | | | | | PP =0.25 tsf |
| | Change: estimated 30 - 45% shell fragments, from 6.9 to 8.7 ft | | | | | | | PP =1.0 tsf |
| | Change: contains fine to medium sand pockets, from 9.4 to 9.9 ft | | | | 10 | | | PP =0.75 tsf |
| | Change: contains fine to medium sand lense, from 11.6 to 11.7 ft | | | | | | | PP =0.5 tsf |
| | Change: contains fine to medium sand lense, from 13.5 to 13.9 ft | | | | | | | PP =1.0 tsf |
| | Change: contains fine to medium sand lense, from 14.8 to 15.0 ft | | | | 15 | | | PP =1.5 tsf |
| | Change: contains fine to medium sand lense, from 17.8 to 18.1 ft | | | | | | | PP =1.5 tsf |
| | Change: contains fine to coarse sand lense, from 19.2 to 19.5 ft | | | | | | | PP =1.5 tsf |
| 20.0 | | | -63.4 | | 20 | | | PP =1.75 tsf |
| | | | | | | | | PP =1.5 tsf |
| | | | | | | | | PP =1.0 tsf |

Bottom of Vibracore at 20.0 ft.
Penetration Time - 3 minutes: 54 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-67
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 10/10/18 **Finished:** 10/10/18

**North:** 3451304 ft **East:** 12251616 ft

**Coordinate System:** VA State Plane (S)

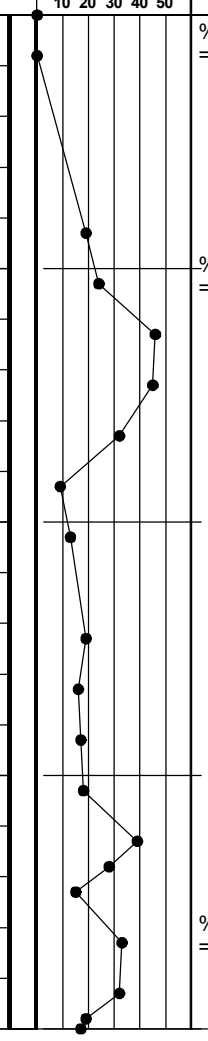
**Mean Low Low Water (MLLW):** -39.2 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 10/10 | 1:26 PM | 40.7' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, dark gray | SP | | A | % Passing #200 = 0.7 | PP =0.25 tsf |
| | | | | | | PP =0.50 tsf |
| | | | | | | PP =1.75 tsf |
| | | | | | | PP =2.25 tsf |
| | | | | | | PP =2.25 tsf |
| 5 | | | | | % Passing #200 = 11.6 | PP =1.25 tsf |
| | | | | | | PP =1.5 tsf |
| 6.7 | SILTY SAND, fine to coarse grained sand; wet, dark gray, contains shell fragments | SM | -45.9 | | | PP =2.0 tsf |
| | | | | | | PP =1.0 tsf |
| 8.7 | CLAYEY SAND, fine to medium grained sand; wet, gray, estimated <5% shell fragments | SC | -47.9 | | | PP =0.75 tsf |
| 10 | | | | | | |
| 10.2 | FAT CLAY; wet, gray, contains shell fragments | CH | -49.4 | B | | PP =<0.25 tsf |
| | | | | | | PP =<0.25 tsf |
| | | | | | | PP =1.0 tsf |
| | | | | | | PP =0.5 tsf |
| | | | | | | PP =0.25 tsf |
| 15 | | | | | | |
| | Change: contains fine to coarse sand lense, from 15.2 to 15.3 ft | | | | | PP =0.75 tsf |
| | | | | | | PP =1.0 tsf |
| 17.6 | Change: estimated 50 - 100% shell fragments, from 16.9 to 17.6 ft | | -56.8 | | | PP =1.0 tsf |
| | SILTY SAND, fine to medium grained sand; wet, dark gray | SM | | | % Passing #200 = 17.7 | PP =1.0 tsf |
| | | | | | | PP =1.75 tsf |
| 20 | | | | | | |
| 20.0 | | | -59.2 | | | PP =2.25 tsf |

SAMPLING DEPTH — PENETRATION TIME 10 20 30 40 50



Bottom of Vibracore at 20.0 ft.
Penetration Time - 7 minutes: 41 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

| Schnabel ENGINEERING | Project: Sandbridge Borrow Area, Offshore Virginia Beach, Virginia | Vibracore Number: **18SBB-68**<br>Contract Number: 18C13103.00<br>Sheet: 1 of 1 |
|---|---|---|

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 10/10/18 **Finished:** 10/10/18

**North:** 3450730 ft **East:** 12254049 ft

**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -44.6 (ft) **Total Depth:** 19.9 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 10/10 | 11:53 AM | 47.2' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, dark gray, contains shell fragments | SP-SM | | A | % Passing #200 = 6.8 | PP =<0.25 tsf |
| | Change: fine to medium grained sand; from 1.2 to 5.9 ft | | | | | PP =0.75 tsf |
| | | | | | | PP =1.5 tsf |
| | Change: gray, from 3.3 to 5.9 ft | | | | | PP =1.75 tsf |
| | | | | | | PP =2.25 tsf |
| | | | | | % Passing #200 = 6.7 | PP =0.5 tsf |
| 5.9 | Change: contains fat clay lense, from 5.5 to 5.7 ft | | -50.5 | | | PP =0.25 tsf |
| | FAT CLAY; wet, gray, estimated <5% shell fragments | CH | | | | PP =0.75 tsf |
| | Change: estimated 30 - 45% shell fragments, from 6.4 to 7.0 ft | | | | | PP =0.5 tsf |
| 8.9 | Change: contains fine to medium sand pockets, from 7.5 to 8.4 ft | | -53.5 | | | PP =0.75 tsf |
| | CLAYEY SAND, fine to coarse grained sand; wet, gray, estimated 5 - 10% shell fragments | SC | | | | PP =1.25 tsf |
| 10.8 | | | -55.4 | | % Passing #200 = 13.0 | PP =2.0 tsf |
| | SILTY SAND, fine to coarse grained sand; wet, dark gray, contains shell fragments, contains trace gravel | SM | | B | | PP =2.0 tsf |
| 13.4 | | | -58.0 | | | PP =1.75 tsf |
| | POORLY GRADED SAND WITH SILT, fine to medium grained sand; wet, dark gray, contains mica | | | | | PP =1.5 tsf |
| | | | | | % Passing #200 = 9.9 | PP =1.5 tsf |
| | | | | | | PP =1.75 tsf |
| | Change: contains fat clay lense, from 16.6 to 16.7 ft | SP-SM | | | | PP =2.25 tsf |
| | Change: contains fat clay lense, from 17.4 to 17.5 ft | | | | | PP =2.25 tsf |
| | Change: contains fat clay lense, from 18.7 to 18.8 ft | | | | | PP =2.0 tsf |
| 19.9 | | | -64.5 | | | PP =2.0 tsf |

SAMPLING DEPTH — PENETRATION TIME (10 20 30 40 50); depth scale 5, 10, 15

Bottom of Vibracore at 19.9 ft.
Penetration Time - 3 minutes: 14 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-69
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 10/10/18 **Finished:** 10/10/18

**North:** 3450157 ft **East:** 12256483 ft

**Coordinate System:** VA State Plane (S)

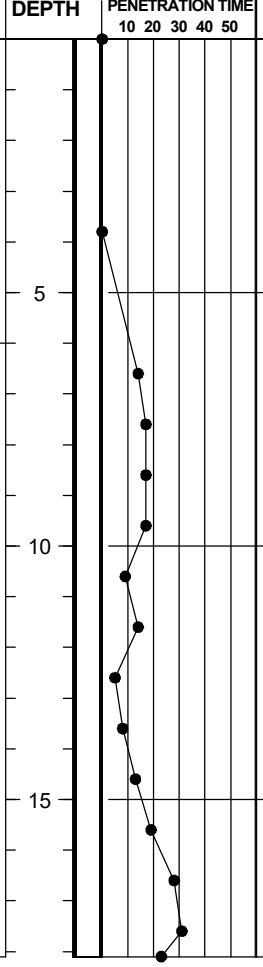
**Mean Low Low Water (MLLW):** -42.4 (ft) **Total Depth:** 18.1 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 10/10 | 10:38 AM | 46.0' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, brown, contains shell fragments | SP | | A | % Passing #200 = 1.0 | PP =0.25 tsf |
| | Change: orangeish brown and gray, from 0.3 to 1.5 ft | | | | | PP =1.0 tsf |
| | Change: brown, from 1.5 to 6.0 ft | | | | | PP =2.0 tsf |
| | | | | | % Passing #200 = 0.9 | PP =1.0 tsf |
| | | | | | | PP =1.5 tsf |
| | | | | | | PP =1.5 tsf |
| 6.0 | Change: contains coarse gravel, from 5.9 to 6.0 ft | | -48.4 | | | PP =0.75 tsf |
| | FAT CLAY; wet, gray, estimated <5% shell fragments | CH | | | | PP =1.0 tsf |
| | Change: estimated 50 - 100% shell fragments, from 7.7 to 7.8 ft | | | | | PP =1.0 tsf |
| | Change: estimated 50 - 100% shell fragments, from 8.9 to 9.2 ft | | | | | PP =1.0 tsf |
| | Change: estimated 50 - 100% shell fragments, from 9.6 to 9.7 ft | | | | | PP =1.5 tsf |
| | | | | | | PP =1.0 tsf |
| 12.1 | POORLY GRADED SAND, fine to coarse grained sand; wet, dark gray, contains trace gravel | | -54.5 | B | | PP =1.0 tsf |
| | | | | | % Passing #200 = 1.7 | PP =1.5 tsf |
| | | | | | | PP =2.0 tsf |
| | | SP | | | | PP =1.5 tsf |
| | Change: estimated 30 - 45% shell fragments, from 15.5 to 16.2 ft | | | | | PP =1.5 tsf |
| | | | | | | PP =2.0 tsf |
| 18.1 | | | -60.5 | | | PP =2.0 tsf |
| | | | | | | PP =2.0 tsf |

**SAMPLING**




Bottom of Vibracore at 18.1 ft.
Penetration Time - 3 minutes: 55 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-70
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 10/10/18 **Finished:** 10/10/18

**North:** 3449583 ft **East:** 12258916 ft

**Coordinate System:** VA State Plane (S)

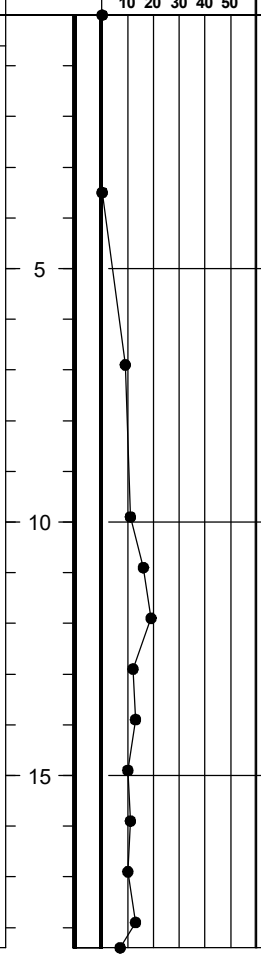
**Mean Low Low Water (MLLW):** -47.2 (ft) **Total Depth:** 18.4 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 10/10 | 9:04 AM | 51.7' | --- | --- |

| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | TESTS | REMARKS |
|---|---|---|---|---|---|---|
| 0.6 | POORLY GRADED SAND, fine to coarse grained sand; wet, brown, estimated <5% shell fragments | SP | -47.8 | A | | PP =1.0 tsf |
| 1.2 | CLAYEY SAND, fine to medium grained sand; wet, light gray, estimated <5% shell fragments | SC | -48.4 | | | PP =0.25 tsf |
| | FAT CLAY; wet, gray, contains clayey sand pockets | CH | | | | PP =0.5 tsf<br>PP =1.5 tsf<br>PP =0.75 tsf |
| | Change: estimated 50 - 100% shell fragments, from 4.8 to 5.2 ft | | | | | PP =1.0 tsf<br>PP =1.0 tsf |
| 7.1 | Change: estimated 50 - 100% shell fragments, from 6.5 to 6.7 ft | | -54.3 | | | PP =2.5 tsf |
| | SILTY SAND, fine to coarse grained sand; wet, dark gray, contains shell fragments | SM | | B | % Passing #200 = 15.7 | PP =2.0 tsf<br>PP =1.0 tsf |
| | Change: estimated 15 - 25% shell fragments, from 10.1 to 10.9 ft | | | | | PP =1.5 tsf<br>PP =1.5 tsf<br>PP =1.25 tsf |
| | Change: estimated 15 - 25% shell fragments, from 13.3 to 14.3 ft | | | | % Passing #200 = 17.2 | PP =1.5 tsf<br>PP =1.25 tsf |
| | Change: fine to medium grained sand; gray, from 14.3 to 18.4 ft | | | | | PP =2.0 tsf<br>PP =2.0 tsf<br>PP =2.0 tsf |
| 18.4 | Change: contains lean clay pocket, from 17.6 to 17.7 ft | | -65.6 | | | PP =2.0 tsf<br>PP =2.0 tsf |

**SAMPLING**




Bottom of Vibracore at 18.4 ft.
Penetration Time - 2 minutes: 12 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

# VIBRACORE LOG

Schnabel ENGINEERING

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, Virginia

**Vibracore Number:** 18SBB-71
**Contract Number:** 18C13103.00
**Sheet:** 1 of 1

**Contractor:** Ocean Survey, Inc.
Old Saybrook, Connecticut

**Contractor Foreman:** E. Shalagan

**Schnabel Representative:** A. Schlotterer

**Equipment:** BH8 (Vibracore)

**Method:** 4" O.D. - 20 ft long steel sampler

**Hammer Type:** Pneumatic

**Dates Started:** 10/10/18 **Finished:** 10/10/18

**North:** 3449009 ft **East:** 12261349 ft

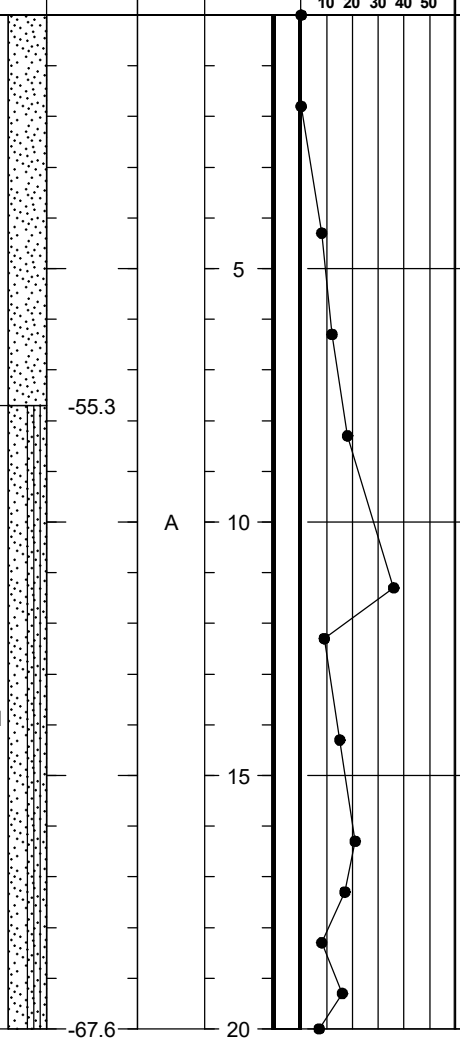
**Coordinate System:** VA State Plane (S)

**Mean Low Low Water (MLLW):** -47.6 (ft) **Total Depth:** 20.0 ft

**Groundwater Observations**

| | Date | Time | Depth | Casing | Caved |
|---|---|---|---|---|---|
| Depth of Water | 10/10 | 7:41 AM | 51.8' | --- | --- |

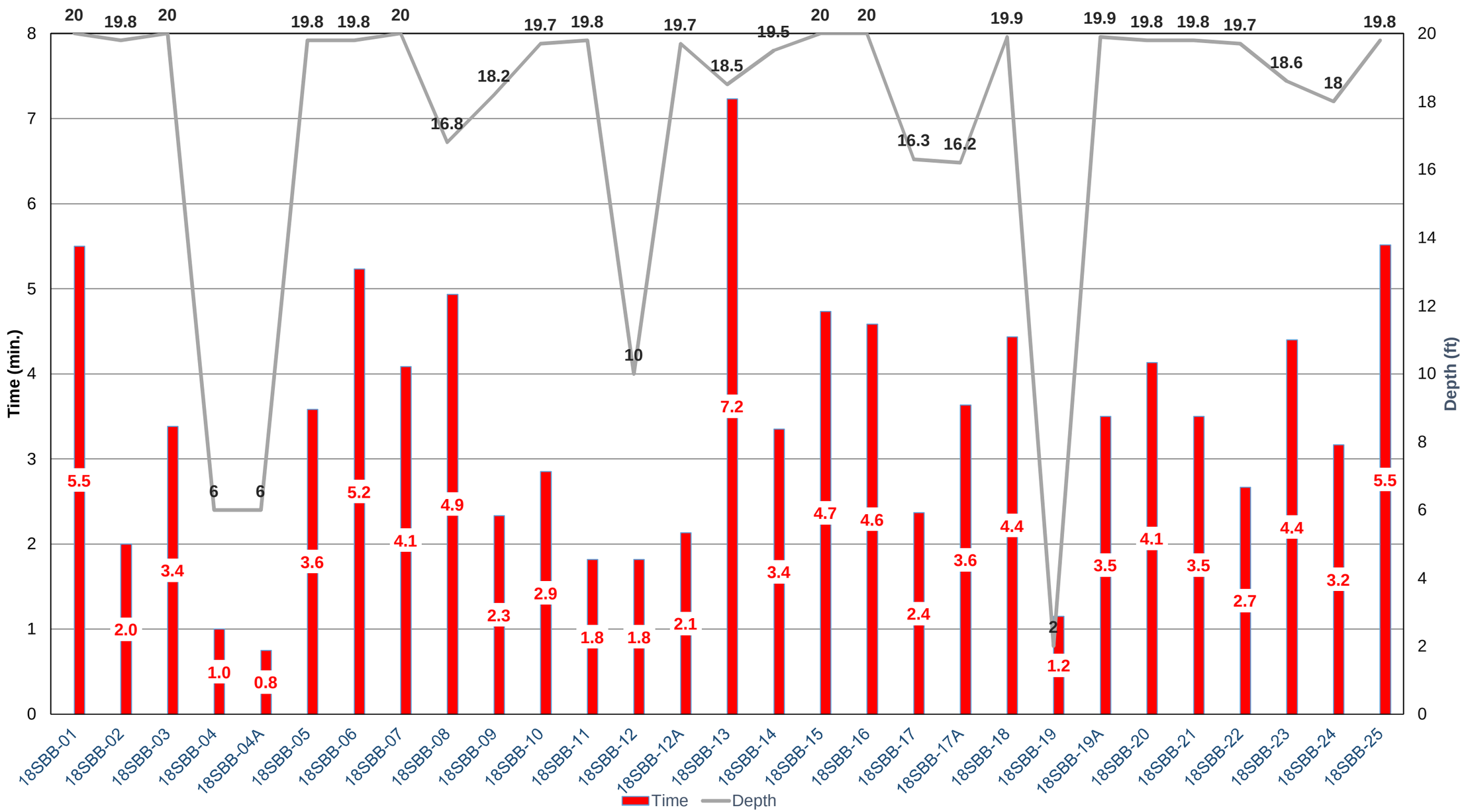
| DEPTH (ft) | MATERIAL DESCRIPTION | SYMBOL | MLLW (ft) | STRATUM | SAMPLING DEPTH | TESTS | REMARKS |
|---|---|---|---|---|---|---|---|
| | POORLY GRADED SAND, fine to coarse grained sand; wet, light brown and gray, contains shell fragments | SP | | | | % Passing #200 = 1.6 | PP =0.25 tsf |
| | Change: fine to medium grained sand; from 1.3 to 2.8 ft | | | | | | PP =0.75 tsf |
| | Change: contains fat clay lense, from 1.6 to 1.7 ft | | | | | | PP =1.5 tsf |
| | Change: estimated 5 - 10% gravel, estimated 30 - 45% shell fragments, from 2.3 to 2.9 ft | | | | | | PP =1.5 tsf |
| | Change: gray, from 2.8 to 7.7 ft | | | | 5 | % Passing #200 = 2.9 | PP =2.0 tsf |
| | | | | | | | PP =2.0 tsf |
| | | | | | | | PP =1.75 tsf |
| 7.7 | | | -55.3 | | | | PP =2.0 tsf |
| | POORLY GRADED SAND WITH SILT, fine to coarse grained sand; wet, gray, contains shell fragments | SP-SM | | | | | PP =2.5 tsf |
| | | | | | | | PP =2.5 tsf |
| | | | | A | 10 | % Passing #200 = 10.4 | PP =2.0 tsf |
| | | | | | | | PP =1.75 tsf |
| | Change: contains lean clay pockets, from 11.8 to 12.2 ft | | | | | | PP =0.5 tsf |
| | Change: contains fat clay lense, from 12.8 to 12.9 ft | | | | | | PP =2.0 tsf |
| | Change: contains fat clay lense, from 13.6 to 13.9 ft | | | | | | PP =0.5 tsf |
| | Change: fine to medium grained sand; dark gray, from 14.0 to 20.0 ft | | | | 15 | % Passing #200 = 10.0 | PP =1.5 tsf |
| | Change: contains fat clay lense, from 15.9 to 16.0 ft | | | | | | PP =1.0 tsf |
| | | | | | | | PP =1.5 tsf |
| | Change: contains fat clay lense, from 17.5 to 17.6 ft | | | | | | PP =1.5 tsf |
| | | | | | | | PP =1.5 tsf |
| 20.0 | | | -67.6 | | 20 | | PP =1.5 tsf |



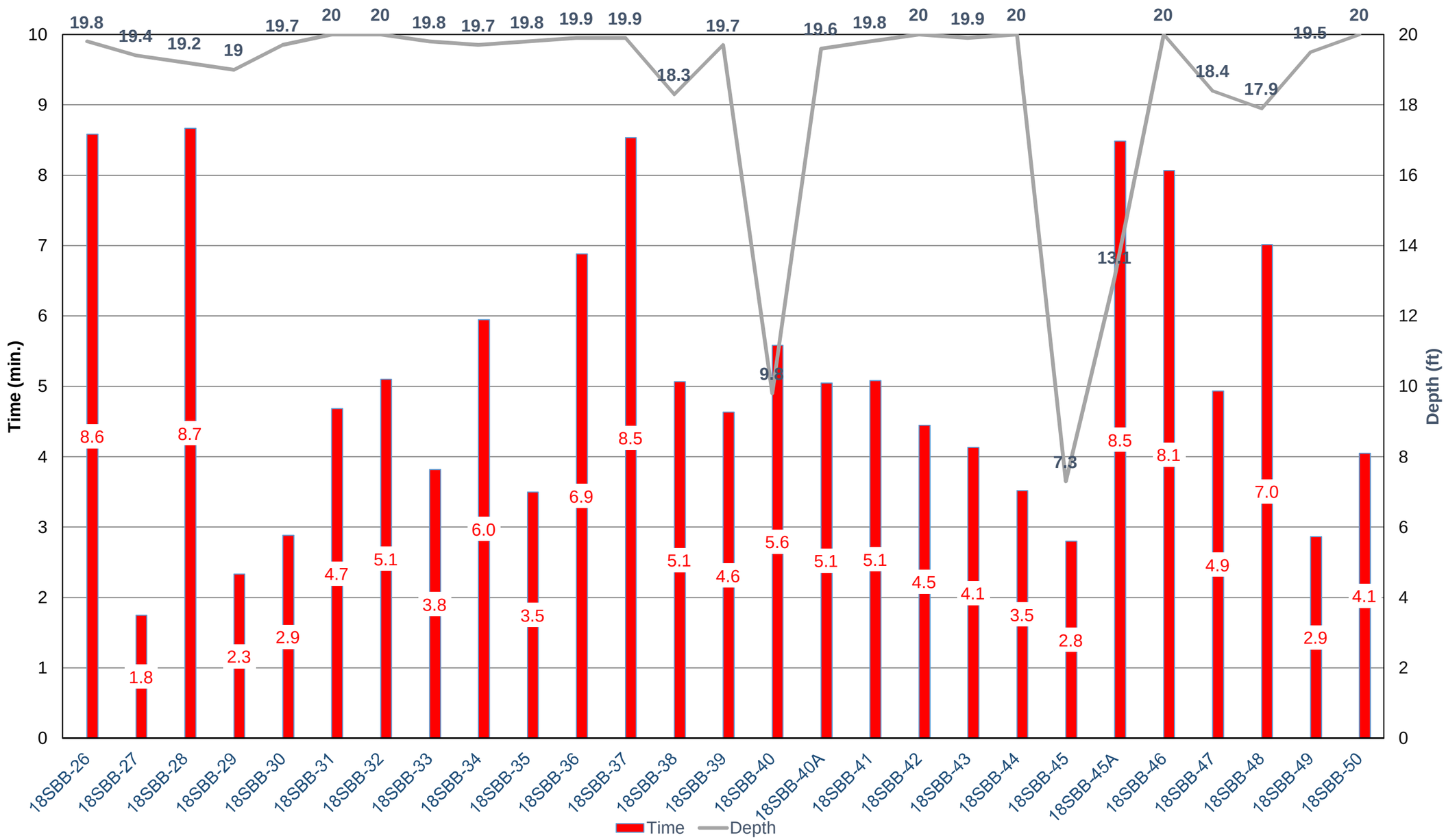

Bottom of Vibracore at 20.0 ft.
Penetration Time - 2 minutes: 48 seconds.
NOAA Reference Wave Buoy: Cape Henry 44099
Vertical Datum: MLLW
Horizontal Datum: NAD83

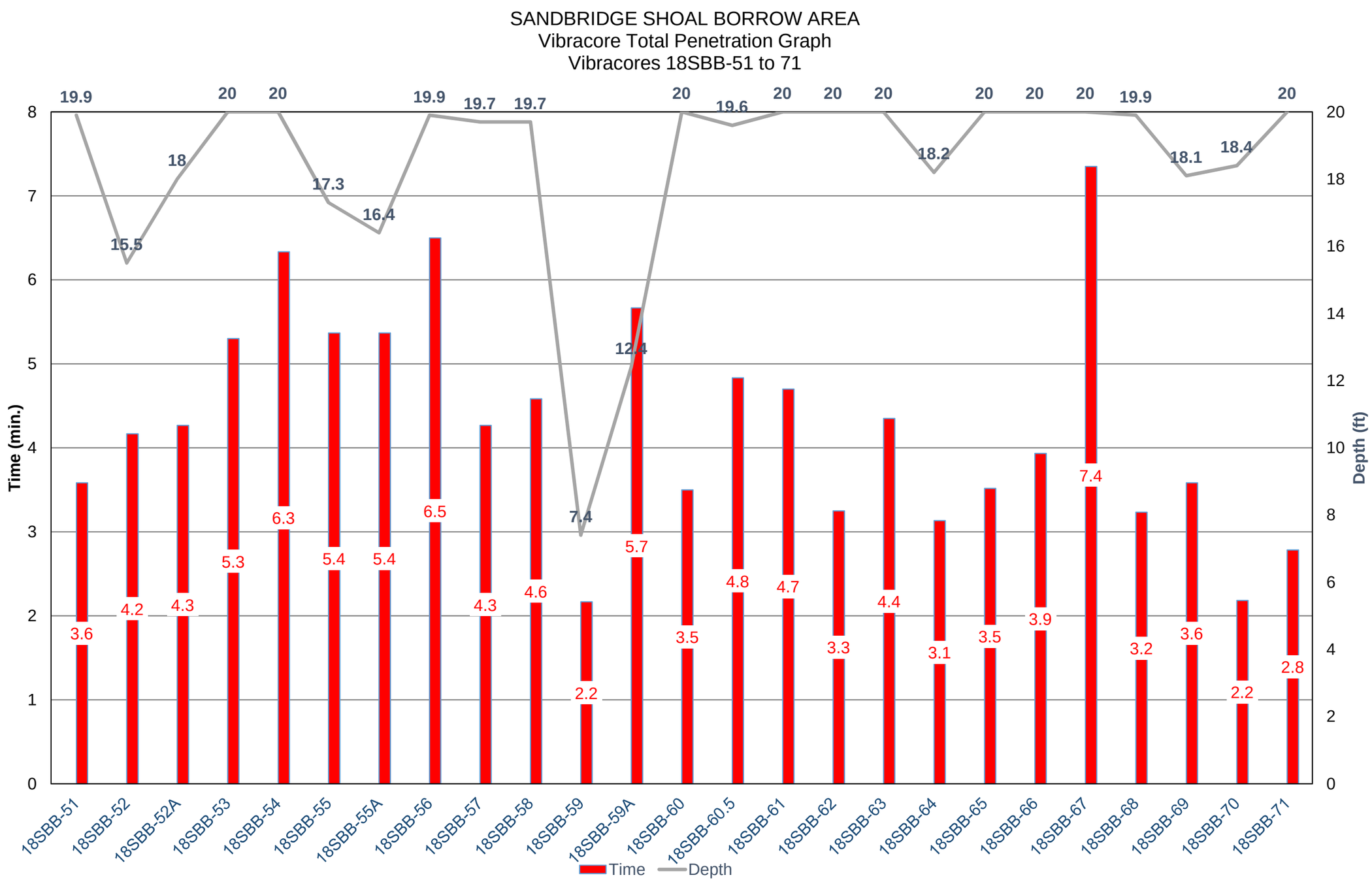
TEST BORING LOG VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 11/13/18

SANDBRIDGE SHOAL BORROW AREA
Vibracore Total Penetration Graph
Vibracores 18SBB-01 to 25



SANDBRIDGE SHOAL BORROW AREA
Vibracore Total Penetration Graph
Vibracores 18SBB-26 to 50




SANDBRIDGE SHOAL BORROW AREA
Vibracore Total Penetration Graph
Vibracores 18SBB-51 to 71
Time (min.)
Depth (ft)
Time
Depth
18SBB-51
18SBB-52
18SBB-52A
18SBB-53
18SBB-54
18SBB-55
18SBB-55A
18SBB-56
18SBB-57
18SBB-58
18SBB-59
18SBB-59A
18SBB-60
18SBB-60.5
18SBB-61
18SBB-62
18SBB-63
18SBB-64
18SBB-65
18SBB-66
18SBB-67
18SBB-68
18SBB-69
18SBB-70
18SBB-71

# APPENDIX B

# SSBS AREA A AND AREA B LABORATORY ANALYSIS

Grain Size Analysis (193 pages)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# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-01 | 0.0 - 3.9 / -44.4 - -48.3 | Bag | SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, dark gray | 83.8 | 16.2 | 16.2 | 96.1 | 0.0 |
| 18SBB-01 | 6.4 - 10.0 / -50.8 - -54.4 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, light brown | 97.9 | 1.9 | 1.9 | 51.2 | 0.2 |
| 18SBB-01 | 10.0 - 14.8 / -54.4 - -59.2 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, gray | 87.0 | 2.6 | 2.6 | 30.8 | 10.4 |
| 18SBB-02 | 0.0 - 4.1 / -44.2 - -48.3 | Bag | SILTY SAND (SM), fine to coarse grained sand, dark gray | 87.3 | 12.7 | 12.7 | 95.7 | 0.0 |
| 18SBB-02 | 4.1 - 5.5 / -48.3 - -49.7 | Bag | POORLY GRADED SAND WITH GRAVEL (SP), fine to coarse grained sand, contains shell fragments, gray | 78.5 | 0.9 | 0.9 | 33.7 | 20.6 |
| 18SBB-02 | 5.5 - 10.0 / -49.7 - -54.2 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 96.3 | 1.0 | 1.0 | 52.7 | 2.7 |
| 18SBB-02 | 10.0 - 15.0 / -54.2 - -59.2 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, gray | 98.4 | 1.6 | 1.6 | 63.1 | 0.0 |

Notes:
1. Soil tests in general accordance with ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed

Schnabel ENGINEERING

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-02 | 15.0 - 16.4 / -59.2 - -60.6 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, gray | 96.7 | 3.3 | 3.3 | 65.8 | 0.0 |
| 18SBB-03 | 0.0 - 5.0 / -50.3 - -55.3 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 97.3 | 2.0 | 2.0 | 38.4 | 0.7 |
| 18SBB-03 | 5.0 - 5.8 / -55.3 - -56.1 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 94.0 | 4.5 | 4.5 | 38.4 | 1.5 |
| 18SBB-04 | 0.0 - 5.0 / -46.7 - -51.7 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, gray | 93.2 | 6.4 | 6.4 | 77.6 | 0.4 |
| 18SBB-06 | 0.0 - 4.0 / -48.6 - -52.6 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, gray | 96.3 | 3.3 | 3.3 | 64.4 | 0.4 |
| 18SBB-07 | 0.0 - 5.0 / -49.0 - -54.0 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, gray | 94.8 | 1.9 | 1.9 | 51.5 | 3.3 |
| 18SBB-07 | 5.0 - 8.2 / -54.0 - -57.2 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 95.4 | 2.9 | 2.9 | 64.6 | 1.7 |

Notes:
1. Soil tests in general accordance with ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed

Schnabel ENGINEERING

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-08 | 0.0 - 1.2 / -46.5 - -47.7 | Bag | POORLY GRADED SAND WITH SILT AND GRAVEL (SP), fine to coarse grained sand, contains shell fragments, gray | 78.5 | 6.5 | 6.5 | 34.4 | 15.0 |
| 18SBB-08 | 2.1 - 6.8 / -48.6 - -53.3 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 88.6 | 4.4 | 4.4 | 68.5 | 7.0 |
| 18SBB-08 | 6.8 - 11.1 / -53.3 - -57.6 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 95.8 | 3.6 | 3.6 | 71.3 | 0.6 |
| 18SBB-09 | 0.0 - 2.1 / -47.3 - -49.4 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, light gray | 97.2 | 2.3 | 2.3 | 59.5 | 0.5 |
| 18SBB-09 | 3.2 - 8.2 / -50.5 - -55.5 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light gray | 95.0 | 4.2 | 4.2 | 84.3 | 0.8 |
| 18SBB-09 | 8.2 - 13.2 / -55.5 - -60.5 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light gray | 98.2 | 1.8 | 1.8 | 51.4 | 0.0 |
| 18SBB-09 | 13.2 - 14.2 / -60.5 - -61.5 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, light gray | 92.3 | 1.3 | 1.3 | 42.5 | 6.4 |

Notes:
1. Soil tests in general accordance with ASTM standards.
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# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-10 | 0.0 - 4.7 / -49.4 - -54.1 | Bag | SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, light gray | 83.8 | 14.3 | 14.3 | 78.3 | 1.9 |
| 18SBB-10 | 4.7 - 9.7 / -54.1 - -59.1 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light gray | 98.3 | 1.7 | 1.7 | 81.4 | 0.0 |
| 18SBB-10 | 9.7 - 14.5 / -59.1 - -63.9 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light gray | 98.1 | 1.8 | 1.8 | 52.3 | 0.1 |
| 18SBB-11 | 0.0 - 5.0 / -49.6 - -54.6 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, contains shell fragments, gray | 92.5 | 5.4 | 5.4 | 79.2 | 2.1 |
| 18SBB-11 | 5.0 - 10.0 / -54.6 - -59.6 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 97.4 | 1.2 | 1.2 | 49.5 | 1.4 |
| 18SBB-11 | 10.0 - 13.7 / -59.6 - -63.3 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 99.3 | 0.1 | 0.1 | 59.5 | 0.6 |
| 18SBB-12A | 0.0 - 5.0 / -39.7 - -44.7 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, brown | 98.0 | 2.0 | 2.0 | 90.5 | 0.0 |

Notes:
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Schnabel ENGINEERING

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Offshore Virginia Beach, VA

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# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-12A | 5.0 - 10.0 / -44.7 - -49.7 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light brown | 98.4 | 1.4 | 1.4 | 78.5 | 0.2 |
| 18SBB-12A | 10.0 - 15.0 / -49.7 - -54.7 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light brown | 97.8 | 2.1 | 2.1 | 94.4 | 0.1 |
| 18SBB-12A | 15.0 - 20.0 / -54.7 - -59.7 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, light gray | 94.1 | 5.2 | 5.2 | 84.3 | 0.7 |
| 18SBB-13 | 0.0 - 3.5 / -55.2 - -58.7 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, dark gray | 93.7 | 1.9 | 1.9 | 66.2 | 4.4 |
| 18SBB-13 | 3.5 - 8.5 / -58.7 - -63.7 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, dark gray | 86.4 | 3.5 | 3.5 | 72.8 | 10.1 |
| 18SBB-13 | 13.7 - 18.5 / -68.9 - -73.7 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to bedim grained sand, dark gray | 91.0 | 9.0 | 9.0 | 99.8 | 0.0 |
| 18SBB-14 | 0.0 - 4.5 / -55.2 - -59.7 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, dark gray | 92.4 | 4.7 | 4.7 | 80.0 | 2.9 |

Notes:
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# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-15 | 0.0 - 4.4 / -51.5 - -55.9 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, dark gray | 89.6 | 7.9 | 7.9 | 87.7 | 2.5 |
| 18SBB-15 | 4.4 - 7.0 / -55.9 - -58.5 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, gray | 96.5 | 3.5 | 3.5 | 89.7 | 0.0 |
| 18SBB-16 | 0.0 - 4.9 / -46.0 - -50.9 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, dark gray | 91.5 | 8.4 | 8.4 | 85.6 | 0.1 |
| 18SBB-16 | 4.9 - 9.9 / -50.9 - -55.9 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, dark gray | 96.8 | 2.2 | 2.2 | 63.1 | 1.0 |
| 18SBB-16 | 9.9 - 13.6 / -55.9 - -59.6 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, dark gray | 96.6 | 1.3 | 1.3 | 31.6 | 2.1 |
| 18SBB-17 | 0.0 - 1.3 / -47.4 - -48.7 | Bag | SILTY SAND (SM), fine to coarse grained sand, trace gravel, contains shell fragments, grayish brown | 70.6 | 29.2 | 29.2 | 71.5 | 0.2 |
| 18SBB-17 | 1.3 - 6.3 / -48.7 - -53.7 | Bag | CLAYEY SAND (SC), fine to coarse grained sand, trace gravel, contains shell fragments brown {Visual} | 64.9 | 29.2 | 29.2 | 75.9 | 5.9 |

Notes:
1. Soil tests in general accordance with ASTM standards.
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**Project:**
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Offshore Virginia Beach, VA

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# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-17 | 6.3 - 11.3 / -53.7 - -58.7 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 94.3 | 1.8 | 1.8 | 32.3 | 3.9 |
| 18SBB-17 | 11.3 - 16.3 / -58.7 - -63.7 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 85.8 | 0.9 | 0.9 | 27.4 | 13.3 |
| 18SBB-18 | 0.0 - 5.0 / -49.3 - -54.3 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, gray | 91.3 | 8.7 | 8.7 | 83.0 | 0.0 |
| 18SBB-18 | 5.0 - 10.0 / -54.3 - -59.3 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 94.9 | 3.6 | 3.6 | 66.7 | 1.5 |
| 18SBB-19A | 2.3 - 5.0 / -49.1 - -51.8 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 97.6 | 1.9 | 1.9 | 52.5 | 0.5 |
| 18SBB-19A | 5.0 - 9.6 / -51.8 - -56.4 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, light brown and gray | 98.5 | 1.2 | 1.2 | 56.2 | 0.3 |
| 18SBB-19A | 11.1 - 14.5 / -57.9 - -61.3 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 89.5 | 3.4 | 3.4 | 68.6 | 7.1 |

Notes:
1. Soil tests in general accordance with ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
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DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-20 | 0.0 - 1.9 / -47.5 - -49.4 | Bag | SILTY SAND WITH GRAVEL (SM), fine to coarse grained sand, contains shell fragments, dark gray | 44.6 | 14.7 | 14.7 | 27.3 | 40.7 |
| 18SBB-20 | 1.9 - 5.0 / -49.4 - -52.5 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, dark gray | 97.1 | 2.9 | 2.9 | 95.1 | 0.0 |
| 18SBB-20 | 5.0 - 9.5 / -52.5 - -57.0 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, light brown and gray | 91.2 | 1.5 | 1.5 | 36.4 | 7.3 |
| 18SBB-21 | 0.0 - 5.0 / -50.8 - -55.8 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, light gray | 95.7 | 2.3 | 2.3 | 82.1 | 2.0 |
| 18SBB-21 | 5.0 - 6.0 / -55.8 - -56.8 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light gray | 95.9 | 3.7 | 3.7 | 86.9 | 0.4 |
| 18SBB-22 | 0.0 - 5.0 / -46.6 - -51.6 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light gray | 94.5 | 3.4 | 3.4 | 60.4 | 2.1 |
| 18SBB-22 | 4.8 - 8.0 / -51.4 - -54.6 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, trace gravel, gray | 96.7 | 2.1 | 2.1 | 51.2 | 1.2 |

Notes:
1. Soil tests in general accordance with ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed

Schnabel ENGINEERING

**Project:**
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Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-23 | 0.0 - 3.6 / -47.9 - -51.5 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, trace gravel, gray | 96.2 | 1.4 | 1.4 | 62.4 | 2.4 |
| 18SBB-23 | 3.6 - 8.5 / -51.5 - -56.4 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, light gray | 98.3 | 1.7 | 1.7 | 88.7 | 0.0 |
| 18SBB-24 | 0.0 - 3.0 / -48.4 - -51.4 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, gray | 95.7 | 2.3 | 2.3 | 82.1 | 2.0 |
| 18SBB-24 | 3.0 - 8.0 / -51.4 - -56.4 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 98.4 | 1.0 | 1.0 | 43.1 | 0.6 |
| 18SBB-24 | 8.0 - 13.0 / -56.4 - -61.4 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 90.4 | 2.5 | 2.5 | 19.5 | 7.1 |
| 18SBB-24 | 13.0 - 13.9 / -61.4 - -62.3 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 62.9 | 4.2 | 4.2 | 24.3 | 32.9 |
| 18SBB-25 | 0.0 - 4.8 / -48.3 - -53.1 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 98.3 | 1.4 | 1.4 | 57.4 | 0.3 |

Notes:
1. Soil tests in general accordance with ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed

Schnabel ENGINEERING

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-25 | 4.8 - 9.5 / -53.1 - -57.8 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, gray | 92.1 | 7.0 | 7.0 | 62.4 | 0.9 |
| 18SBB-26 | 0.0 - 5.1 / -48.8 - -53.9 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to medium grained sand, dark gray | 92.4 | 7.6 | 7.6 | 98.6 | 0.0 |
| 18SBB-26 | 5.1 - 10.1 / -53.9 - -58.9 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to medium grained sand, dark gray | 92.8 | 7.2 | 7.2 | 99.7 | 0.0 |
| 18SBB-26 | 10.1 - 13.0 / -58.9 - -61.8 | Jar | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, dark gray | 95.9 | 3.7 | 3.7 | 97.4 | 0.4 |
| 18SBB-27 | 0.0 - 4.4 / -52.3 - -56.7 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 96.8 | 2.1 | 2.1 | 67.7 | 1.1 |
| 18SBB-27 | 4.4 - 9.4 / -56.7 - -61.7 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, gray | 98.3 | 1.7 | 1.7 | 61.6 | 0.0 |
| 18SBB-27 | 9.4 - 11.8 / -61.7 - -64.1 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, gray | 94.2 | 5.8 | 5.8 | 84.8 | 0.0 |

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Schnabel ENGINEERING

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-27 | 12.7 - 14.4 / -65.0 - -66.7 | Bag | CLAYEY SAND (SC), fine to coarse grained sand, dark gray {Visual} | 68.1 | 31.9 | 31.9 | 92.8 | 0.0 |
| 18SBB-27 | 14.4 - 19.4 / -66.7 - -71.7 | Bag | POORLY GRADED SAND WITH CLAY (SP-SC), fine to coarse grained sand, dark gray {Visual} | 94.7 | 5.3 | 5.3 | 96.4 | 0.0 |
| 18SBB-28 | 0.0 - 4.2 / -54.5 - -58.7 | Bag | SILTY SAND WITH GRAVEL (SM), fine to coarse grained sand, contains shell fragments, dark gray | 54.2 | 23.2 | 23.2 | 42.0 | 22.6 |
| 18SBB-30 | 0.0 - 1.8 / -54.0 - -55.8 | Bag | POORLY GRADED SAND (SP), fine to carse grained sand, contains shell fragments, dark gray | 98.1 | 1.4 | 1.4 | 68.5 | 0.5 |
| 18SBB-30 | 2.7 - 4.7 / -56.7 - -58.7 | Bag | POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM), fine to coarse grained sand, contains shell fragments, dark gray | 71.1 | 9.7 | 9.7 | 35.1 | 19.2 |
| 18SBB-30 | 4.7 - 9.6 / -58.7 - -63.6 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, dark gray | 94.8 | 5.2 | 5.2 | 62.4 | 0.0 |
| 18SBB-31 | 0.0 - 5.0 / -47.1 - -52.1 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, brownish gray | 98.4 | 0.8 | 0.8 | 58.9 | 0.8 |

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Schnabel ENGINEERING

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-31 | 5.0 - 10.0 / -52.1 - -57.1 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, brownish gray | 97.3 | 2.4 | 2.4 | 97.0 | 0.3 |
| 18SBB-31 | 10.0 - 15.0 / -57.1 - -62.1 | Bag | POORLY GRADED SAND WITH GRAVEL (SP), fine to coarse grained sand, contains shell fragments, gray | 66.1 | 4.6 | 4.6 | 39.5 | 29.3 |
| 18SBB-31 | 15.0 - 20.0 / -62.1 - -67.1 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, gray | 97.3 | 2.7 | 2.7 | 81.0 | 0.0 |
| 18SBB-32 | 0.0 - 3.1 / -53.3 - -56.4 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, dark gray | 94.8 | 3.7 | 3.7 | 92.4 | 1.5 |
| 18SBB-32 | 5.0 - 10.0 / -58.3 - -63.3 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, dark gray | 88.0 | 9.2 | 9.2 | 65.8 | 2.8 |
| 18SBB-32 | 10.0 - 11.8 / -63.3 - -65.1 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, gray | 77.2 | 9.9 | 9.9 | 58.2 | 12.9 |
| 18SBB-33 | 0.0 - 5.1 / -47.8 - -52.9 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, dark brown | 97.8 | 1.0 | 1.0 | 54.6 | 1.2 |

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Schnabel ENGINEERING

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-33 | 5.1 - 10.1 / -52.9 - -57.9 | Bag | SILTY SAND (SP), fine to coarse grained sand, contains shell fragments, brownish gray | 80.5 | 18.6 | 18.6 | 75.5 | 0.9 |
| 18SBB-33 | 10.1 - 15.1 / -57.9 - -62.9 | Bag | SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, dark gray | 80.1 | 17.8 | 17.8 | 87.6 | 2.1 |
| 18SBB-34 | 0.0 - 4.0 / -56.2 - -60.2 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, dark gray | 94.6 | 2.6 | 2.6 | 64.6 | 2.8 |
| 18SBB-34 | 14.0 - 19.8 / -70.2 - -76.0 | Bag | SILTY SAND (SM), fine to coarse grained sand, dark gray | 57.8 | 42.2 | 42.2 | 85.8 | 0.0 |
| 18SBB-35 | 0.0 - 5.0 / -54.5 - -59.5 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, dark gray | 88.8 | 2.8 | 2.8 | 47.1 | 8.4 |
| 18SBB-35 | 5.0 - 6.2 / -59.5 - -60.7 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 91.1 | 3.0 | 3.0 | 71.0 | 5.9 |
| 18SBB-35 | 12.9 - 15.0 / -67.4 - -69.5 | Bag | SANDY LEAN CLAY (CL), dark gray {Visual} | 49.7 | 50.3 | 50.3 | 98.7 | 0.0 |

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Schnabel ENGINEERING

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-35 | 15.0 - 19.3 / -69.5 - -73.8 | Bag | LEAN CLAY WITH SAND (CL), dark gray {Visual} | 27.2 | 72.8 | 72.8 | 98.9 | 0.0 |
| 18SBB-36 | 0.0 - 4.9 / -53.0 - -57.9 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, dark gray | 85.0 | 5.2 | 5.2 | 60.9 | 9.8 |
| 18SBB-36 | 14.2 - 19.9 / -67.2 - -72.9 | Bag | SILTY SAND (SM), fine to medium grained sand, dark gray | 70.8 | 29.2 | 29.2 | 99.6 | 0.0 |
| 18SBB-37 | 0.0 - 3.3 / -51.1 - -54.4 | Bag | SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, dark gray | 78.7 | 14.3 | 14.3 | 80.2 | 7.0 |
| 18SBB-37 | 12.1 - 13.4 / -63.2 - -64.5 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, contains shell fragments, gray | 85.1 | 7.5 | 7.5 | 66.4 | 7.4 |
| 18SBB-38 | 0.0 - 3.3 / -50.9 - -54.2 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, dark gray | 82.0 | 4.6 | 4.6 | 56.4 | 13.4 |
| 18SBB-38 | 3.3 - 8.3 / -54.2 - -59.2 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 96.1 | 1.2 | 1.2 | 33.9 | 2.7 |

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Schnabel ENGINEERING

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-39 | 0.0 - 4.2 / -49.5 - -53.7 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand ,dark gray | 98.5 | 1.5 | 1.5 | 35.5 | 0.0 |
| 18SBB-39 | 4.2 - 9.2 / -53.7 - -58.7 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, dark gray | 98.1 | 1.3 | 1.3 | 21.8 | 0.6 |
| 18SBB-39 | 9.2 - 10.5 / -58.7 - -60.0 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, brown | 97.1 | 2.0 | 2.0 | 18.2 | 0.9 |
| 18SBB-40A | 4.6 - 9.6 / -53.5 - -58.5 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, dark gray | 85.6 | 1.3 | 1.3 | 35.9 | 13.1 |
| 18SBB-40A | 9.6 - 12.4 / -58.5 - -61.3 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, gray | 97.4 | 2.6 | 2.6 | 72.2 | 0.0 |
| 18SBB-41 | 0.0 - 5.0 / -46.9 - -51.9 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, trace gravel, gray | 94.6 | 0.8 | 0.8 | 51.5 | 4.6 |
| 18SBB-41 | 5.0 - 10.0 / -51.9 - -56.9 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, trace gravel, gray | 98.3 | 1.5 | 1.5 | 66.0 | 0.2 |

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Schnabel ENGINEERING

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-41 | 10.0 - 11.4 / -56.9 - -58.3 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, trace gravel, gray | 96.7 | 2.1 | 2.1 | 47.7 | 1.2 |
| 18SBB-42 | 0.0 / -50.8 | Jar | POORLY GRADED SAND (SP), fine to coarse grained sand, light brown | 98.0 | 1.7 | 1.7 | 62.2 | 0.3 |
| 18SBB-42 | 5.0 / -55.8 | Jar | POORLY GRADED SAND (SP), fine to coarse grained sand, light brown | 98.6 | 1.1 | 1.1 | 54.5 | 0.3 |
| 18SBB-43 | 0.0 - 4.9 / -49.9 - -54.8 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, gray | 95.7 | 3.5 | 3.5 | 91.0 | 0.8 |
| 18SBB-43 | 4.9 - 8.3 / -54.8 - -58.2 | Bag | SILTY SAND (SM), fine to coarse grained sand, trace gravel, gray | 85.7 | 11.0 | 11.0 | 64.4 | 3.3 |
| 18SBB-44 | 5.0 / -55.8 | Jar | POORLY GRADED SAND (SP), fine to coarse grained sand, gray | 95.4 | 3.5 | 3.5 | 62.3 | 1.1 |
| 18SBB-45A | 0.0 - 2.9 / -49.1 - -52.0 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, dark brown | 95.0 | 3.9 | 3.9 | 47.7 | 1.1 |

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Schnabel ENGINEERING

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-45A | 3.8 - 8.1 / -52.9 - -57.2 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, brown | 96.6 | 3.4 | 3.4 | 35.0 | 0.0 |
| 18SBB-45A | 8.1 - 13.1 / -57.2 - -62.2 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, dark brown | 97.6 | 2.4 | 2.4 | 46.1 | 0.0 |
| 18SBB-46 | 0.0 - 5.0 / -51.3 - -56.3 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, contains shell fragments, gray | 92.6 | 5.7 | 5.7 | 89.6 | 1.7 |
| 18SBB-46 | 5.8 - 10.0 / -57.1 - -61.3 | Bag | POORLY GRADED SAND (SP), fine to medium grained sand, gray and brown | 97.0 | 3.0 | 3.0 | 81.9 | 0.0 |
| 18SBB-46 | 10.0 - 13.2 / -61.3 - -64.5 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, gray and brown | 91.0 | 5.2 | 5.2 | 60.6 | 3.8 |
| 18SBB-47 | 0.0 - 3.4 / -53.7 - -57.1 | Bag | SILTY SAND (SM), fine to medium grained sand, trace gravel, contains shell fragments, gray | 73.7 | 25.0 | 25.0 | 97.6 | 1.3 |
| 18SBB-47 | 3.4 - 7.5 / -57.1 - -61.2 | Bag | POORLY GRADED SAND (SP), fine to medium grained sand, light brown | 96.9 | 3.1 | 3.1 | 99.8 | 0.0 |

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**Project:**
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DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-47 | 14.1 - 18.4 / -67.8 - -72.1 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to medium grained sand, dark gray | 93.4 | 6.6 | 6.6 | 97.5 | 0.0 |
| 18SBB-48 | 0.0 / -53.3 | Jar | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, dark gray | 91.5 | 8.0 | 8.0 | 79.9 | 0.5 |
| 18SBB-48 | 3.5 / -56.8 | Jar | POORLY GRADED SAND (SP), fine to coarse grained sand, light gray | 95.7 | 3.9 | 3.9 | 85.6 | 0.4 |
| 18SBB-48 | 13.8 / -67.1 | Jar | POORLY GRADED SAND WITH SILT (SP-SM), fine to medium grained sand, contains wood fragments, dark gray | 95.0 | 5.0 | 5.0 | 98.2 | 0.0 |
| 18SBB-49 | 0.0 - 4.5 / -56.0 - -60.5 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to medium grained sand, grayish brown | 89.6 | 10.4 | 10.4 | 93.6 | 0.0 |
| 18SBB-49 | 4.5 - 6.9 / -60.5 - -62.9 | Bag | SILTY SAND (SM), fine to coarse grained sand, trace gravel, contains shell fragments, grayish brown | 83.5 | 15.2 | 15.2 | 58.6 | 1.3 |
| 18SBB-49 | 11.9 - 14.5 / -67.9 - -70.5 | Bag | SANDY SILT (ML), contains mica, dark gray | 31.7 | 68.3 | 68.3 | 97.9 | 0.0 |

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Schnabel ENGINEERING

**Project:**
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Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-49 | 14.5 - 19.5 / -70.5 - -75.5 | Bag | SILT WITH SAND (ML), contains mica and organic matter, dark gray | 23.8 | 76.2 | 76.2 | 98.6 | 0.0 |
| 18SBB-50 | 0.0 - 5.0 / -49.8 - -54.8 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, gray | 91.9 | 7.8 | 7.8 | 93.5 | 0.3 |
| 18SBB-50 | 5.0 - 7.3 / -54.8 - -57.1 | Bag | SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, gray | 68.8 | 30.1 | 30.1 | 92.9 | 1.1 |
| 18SBB-50 | 8.9 - 10.0 / -58.7 - -59.8 | Bag | SILTY SAND WITH GRAVEL (SM), fine to coarse grained sand, contains shell fragments, gray | 61.9 | 19.0 | 19.0 | 53.5 | 19.1 |
| 18SBB-50 | 10.0 - 15.0 / -59.8 - -64.8 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, gray | 92.1 | 6.4 | 6.4 | 61.1 | 1.5 |
| 18SBB-50 | 15.0 - 16.0 / -64.8 - -65.8 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, gray | 91.5 | 7.0 | 7.0 | 59.3 | 1.5 |
| 18SBB-51 | 0.0 / -50.5 | Jar | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light brown | 98.4 | 1.5 | 1.5 | 89.7 | 0.1 |

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DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-52A | 0.0 - 3.0 / -54.5 - -57.5 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, brown | 93.0 | 1.8 | 1.8 | 66.7 | 5.2 |
| 18SBB-52A | 3.0 - 5.3 / -57.5 - -59.8 | Bag | SILTY SAND WITH GRAVEL (SM), fine to coarse grained sand, contains shell fragments, dark gray | 32.5 | 33.3 | 33.3 | 38.8 | 34.2 |
| 18SBB-53 | 11.9 - 15.0 / -68.7 - -71.8 | Bag | SILTY SAND (SM), fine grained sand, contains mica, dark gray | 54.5 | 45.5 | 45.5 | 99.5 | 0.0 |
| 18SBB-54 | 0.0 / -53.7 | Jar | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, light gray | 88.8 | 10.9 | 10.9 | 82.4 | 0.3 |
| 18SBB-55 | 0.0 - 2.3 / -52.8 - -55.1 | Bag | POORLY GRADED SAND WITH SILT AND GRAVEL (SP), fine to coarse grained sand, contains shell fragments, gray | 62.1 | 6.9 | 6.9 | 29.6 | 31.0 |
| 18SBB-55 | 2.3 - 7.3 / -55.1 - -60.1 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 95.4 | 0.4 | 0.4 | 23.8 | 4.2 |
| 18SBB-55 | 7.3 - 9.8 / -60.1 - -62.6 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 98.5 | 1.1 | 1.1 | 29.8 | 0.4 |

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DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-55A | 0.0 - 1.4 / -53.0 - -54.4 | Bag | SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, dark gray | 73.4 | 26.4 | 26.4 | 89.6 | 0.2 |
| 18SBB-55A | 1.4 - 6.4 / -54.4 - -59.4 | Bag | POORLY GRADED SAND WITH GRAVEL (SP), fine to coarse grained sand, grayish brown | 96.1 | 0.6 | 0.6 | 23.4 | 3.3 |
| 18SBB-56 | 5.9 / -56.6 | Jar | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, gray | 94.7 | 5.3 | 5.3 | 73.8 | 0.0 |
| 18SBB-56 | 10.0 / -60.7 | Jar | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light gray | 88.6 | 1.3 | 1.3 | 32.7 | 10.1 |
| 18SBB-57 | 0.0 - 4.7 / -50.9 - -55.6 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, contains shell fragments, brownish gray | 88.2 | 7.5 | 7.5 | 65.9 | 4.3 |
| 18SBB-57 | 4.7 - 9.0 / -55.6 - -59.9 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, light brownish gray | 88.5 | 2.3 | 2.3 | 59.3 | 9.2 |
| 18SBB-58 | 0.0 - 4.7 / -51.7 - -56.4 | Bag | POORLY GRADED SAND WITH GRAVEL (SP), fine to coarse grained sand, gray | 95.0 | 4.4 | 4.4 | 90.6 | 0.6 |

Notes:
1. Soil tests in general accordance with ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed

Schnabel ENGINEERING

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-58 | 5.6 - 8.9 / -57.3 - -60.6 | Bag | POORLY GRADED SAND WITH GRAVEL (SP), fine to coarse grained sand, contains shell fragments, gray | 81.9 | 1.5 | 1.5 | 30.2 | 16.6 |
| 18SBB-59A | 1.2 - 2.4 / -50.7 - -51.9 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 95.5 | 2.1 | 2.1 | 26.7 | 2.4 |
| 18SBB-59A | 2.4 - 7.4 / -51.9 - -56.9 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 97.9 | 0.6 | 0.6 | 19.4 | 1.5 |
| 18SBB-59A | 7.4 - 9.3 / -56.9 - -58.8 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray | 96.0 | 2.0 | 2.0 | 77.1 | 2.0 |
| 18SBB-60 | 0.0 - 4.6 / -40.8 - -45.4 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, gray | 93.8 | 5.7 | 5.7 | 95.1 | 0.5 |
| 18SBB-60 | 4.6 - 9.3 / -45.4 - -50.1 | Bag | SILTY SAND (SM), fine to coarse grained sand, trace gravel, contains shell fragments, dark gray | 78.1 | 21.7 | 21.7 | 78.5 | 0.2 |
| 18SBB-60.5 | 0.0 - 4.6 / -37.9 - -42.5 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, dark gray | 98.8 | 1.2 | 1.2 | 89.1 | 0.0 |

Notes:
1. Soil tests in general accordance with ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed

Schnabel ENGINEERING

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-60.5 | 4.6 - 9.6<br>-42.5 - -47.5 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, contains shell fragments, gray | 92.7 | 6.7 | 6.7 | 89.5 | 0.6 |
| 18SBB-60.5 | 9.6 - 14.0<br>-47.5 - -51.9 | Bag | SILTY SAND (SM), fine to coarse grained sand, trace gravel, contains shell fragments, dark gray | 76.2 | 23.5 | 23.5 | 89.8 | 0.3 |
| 18SBB-61 | 0.0 - 4.5<br>-41.9 - -46.4 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, dark gray | 97.3 | 2.7 | 2.7 | 98.5 | 0.0 |
| 18SBB-61 | 4.5 - 8.8<br>-46.4 - -50.7 | Bag | CLAYEY SAND (SC), fine to coarse grained sand, contains shell fragments, gray | 75.5 | 22.8 | 22.8 | 69.7 | 1.7 |
| 18SBB-61 | 15.4 - 19.5<br>-57.3 - -61.4 | Bag | CLAYEY SAND (SC), fine to coarse grained sand, gray | 84.3 | 15.7 | 15.7 | 98.4 | 0.0 |
| 18SBB-62 | 0.0 - 4.6<br>-44.9 - -49.5 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, brown | 98.3 | 1.5 | 1.5 | 77.1 | 0.2 |
| 18SBB-62 | 4.6 - 6.7<br>-49.5 - -51.6 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, contains shell fragments, dark gray | 94.8 | 5.1 | 5.1 | 93.3 | 0.1 |

Notes:
1. Soil tests in general accordance with ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed

Schnabel ENGINEERING

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-62 | 9.6 - 14.6 / -54.5 - -59.5 | Bag | SILTY SAND (SM), fine to coarse grained sand, contains mica, dark gray | 78.0 | 22.0 | 22.0 | 99.7 | 0.0 |
| 18SBB-62 | 14.6 - 19.6 / -59.5 - -64.5 | Bag | SILTY SAND (SM), fine to medium grained sand, dark gray | 84.9 | 15.1 | 15.1 | 99.7 | 0.0 |
| 18SBB-63 | 0.0 - 4.5 / -44.8 - -49.3 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, dark gray | 95.8 | 3.3 | 3.3 | 79.0 | 0.9 |
| 18SBB-63 | 9.5 - 14.5 / -54.3 - -59.3 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, contains shell fragments, gray | 83.5 | 10.4 | 10.4 | 48.2 | 6.1 |
| 18SBB-63 | 14.5 - 19.5 / -59.3 - -64.3 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, dark gray | 97.5 | 2.2 | 2.2 | 90.7 | 0.3 |
| 18SBB-64 | 0.0 - 3.2 / -43.6 - -46.8 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light brown | 97.5 | 0.9 | 0.9 | 61.9 | 1.6 |
| 18SBB-64 | 3.2 - 6.0 / -46.8 - -49.6 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, gray | 97.9 | 1.9 | 1.9 | 83.2 | 0.2 |

Notes:
1. Soil tests in general accordance with ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed

Schnabel ENGINEERING

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-64 | 10.1 - 13.2 / -53.7 - -56.8 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, light gray | 96.7 | 3.1 | 3.1 | 90.7 | 0.2 |
| 18SBB-64 | 13.2 - 18.2 / -56.8 - -61.8 | Bag | POORLY GRADED SAND (SP), fine to medium grained sand, gray | 96.2 | 3.8 | 3.8 | 99.3 | 0.0 |
| 18SBB-65 | 0.0 - 4.5 / -45.3 - -49.8 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, brown | 98.6 | 1.2 | 1.2 | 71.2 | 0.2 |
| 18SBB-65 | 4.6 - 9.6 / -49.9 - -54.9 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, gray | 97.7 | 2.1 | 2.1 | 96.7 | 0.2 |
| 18SBB-65 | 9.6 - 14.6 / -54.9 - -59.9 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, gray | 96.3 | 3.7 | 3.7 | 99.4 | 0.0 |
| 18SBB-65 | 14.6 - 19.6 / -59.9 - -64.9 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, gray | 95.0 | 5.0 | 5.0 | 99.6 | 0.0 |
| 18SBB-66 | 0.0 - 4.6 / -43.4 - -48.0 | Bag | | 85.2 | 14.7 | 14.7 | 85.8 | 0.1 |

Notes:
1. Soil tests in general accordance with ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed

Schnabel ENGINEERING

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-67 | 0.0 - 4.6 / -39.2 - -43.8 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, dark gray | 99.1 | 0.7 | 0.7 | 81.5 | 0.2 |
| 18SBB-67 | 4.6 - 8.8 / -43.8 - -48.0 | Bag | SILTY SAND (SM), fine to coarse grained sand, trace gravel, contains shell fragments, dark gray | 87.2 | 11.6 | 11.6 | 89.5 | 1.2 |
| 18SBB-67 | 17.6 - 19.6 / -56.8 - -58.8 | Bag | SILTY SAND (SM), fine to medium grained sand, dark gray | 82.3 | 17.7 | 17.7 | 99.8 | 0.0 |
| 18SBB-68 | 0.0 - 4.4 / -44.6 - -49.0 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, dark gray | 93.2 | 6.8 | 6.8 | 93.6 | 0.0 |
| 18SBB-68 | 4.4 - 5.9 / -49.0 - -50.5 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, contains shell fragments, dark gray | 90.5 | 6.7 | 6.7 | 87.2 | 2.8 |
| 18SBB-68 | 10.8 - 14.4 / -55.4 - -59.0 | Bag | SILTY SAND (SM), fine to coarse grained sand, trace gravel, dark gray | 86.5 | 13.0 | 13.0 | 98.8 | 0.5 |
| 18SBB-68 | 14.4 - 19.4 / -59.0 - -64.0 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to medium grained sand, contains mica, dark gray | 90.1 | 9.9 | 9.9 | 99.8 | 0.0 |

Notes:
1. Soil tests in general accordance with ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed

Schnabel ENGINEERING

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 11/12/18

# Summary Of Laboratory Tests



| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-69 | 0.0 - 2.6 / -42.4 - -45.0 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, brown | 99.0 | 1.0 | 1.0 | 68.6 | 0.0 |
| 18SBB-69 | 2.6 - 6.0 / -45.0 - -48.4 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, brown | 99.1 | 0.9 | 0.9 | 68.0 | 0.0 |
| 18SBB-69 | 12.6 - 17.6 / -55.0 - -60.0 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, dark gray | 94.8 | 1.7 | 1.7 | 95.5 | 3.5 |
| 18SBB-70 | 8.0 - 13.0 / -55.2 - -60.2 | Bag | SILTY SAND (SM), fine to coarse grained sand, trace gravel, contains shell fragments, dark gray | 82.5 | 15.7 | 15.7 | 80.8 | 1.8 |
| 18SBB-70 | 13.0 - 18.0 / -60.2 - -65.2 | Bag | SILTY SAND (SM), fine to medium grained sand, gray | 82.8 | 17.2 | 17.2 | 99.8 | 0.0 |
| 18SBB-71 | 0.0 - 5.0 / -47.6 - -52.6 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, gray | 97.8 | 1.6 | 1.6 | 70.8 | 0.6 |
| 18SBB-71 | 5.0 - 10.0 / -52.6 - -57.6 | Bag | POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, gray | 96.3 | 2.9 | 2.9 | 85.5 | 0.8 |

Notes:
1. Soil tests in general accordance with ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed

Schnabel ENGINEERING

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 11/12/18

# Summary Of Laboratory Tests


Project Number: 18C13103.00

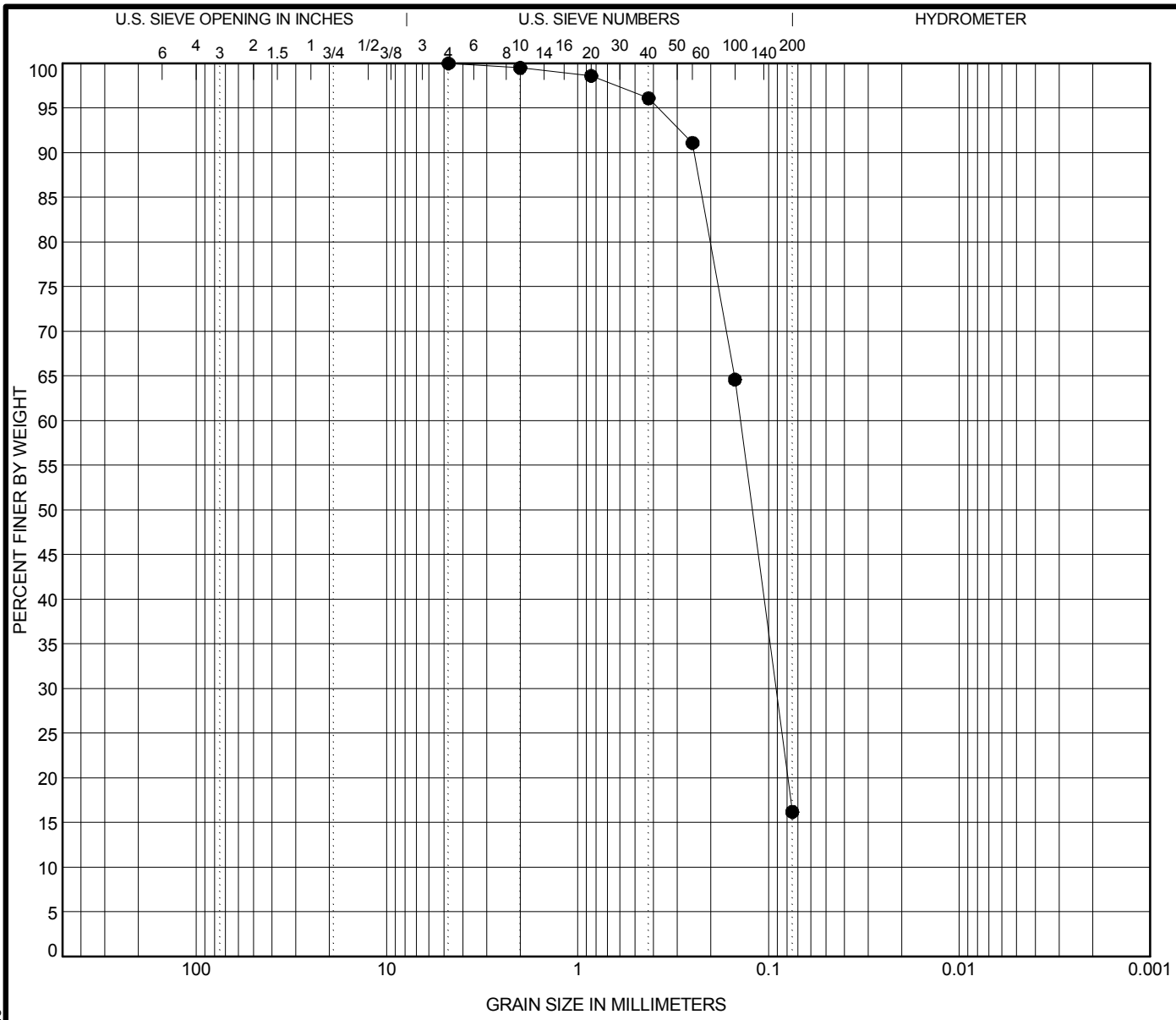
| Boring No. | Sample Depth ft / Elevation ft | Sample Type | Description of Soil Specimen | Percent Sand | Percent Fines | % Passing No. 200 Sieve | % Passing No. 40 Sieve | Percent Gravel |
|---|---|---|---|---|---|---|---|---|
| 18SBB-71 | 10.0 - 15.0<br>-57.6 - -62.6 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, contains shell fragments, gray | 89.4 | 10.4 | 10.4 | 97.1 | 0.2 |
| 18SBB-71 | 15.0 - 20.0<br>-62.6 - -67.6 | Bag | POORLY GRADED SAND WITH SILT (SP-SM), fine to medium grained sand, dark gray | 90.0 | 10.0 | 10.0 | 98.8 | 0.0 |

Notes:
1. Soil tests in general accordance with ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed

Schnabel ENGINEERING

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

DYNAMIC LAB SUMMARY VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 11/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-01 | 0.0 ft | **SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, dark gray** | **NP** | **NP** | **NP** | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.14** | **0.091** | **--** | **0.0** | **83.8** | **16.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 16.2 | 64.6 | 91.1 | 96.1 | 98.6 | 99.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AB | 8/30/18 | |

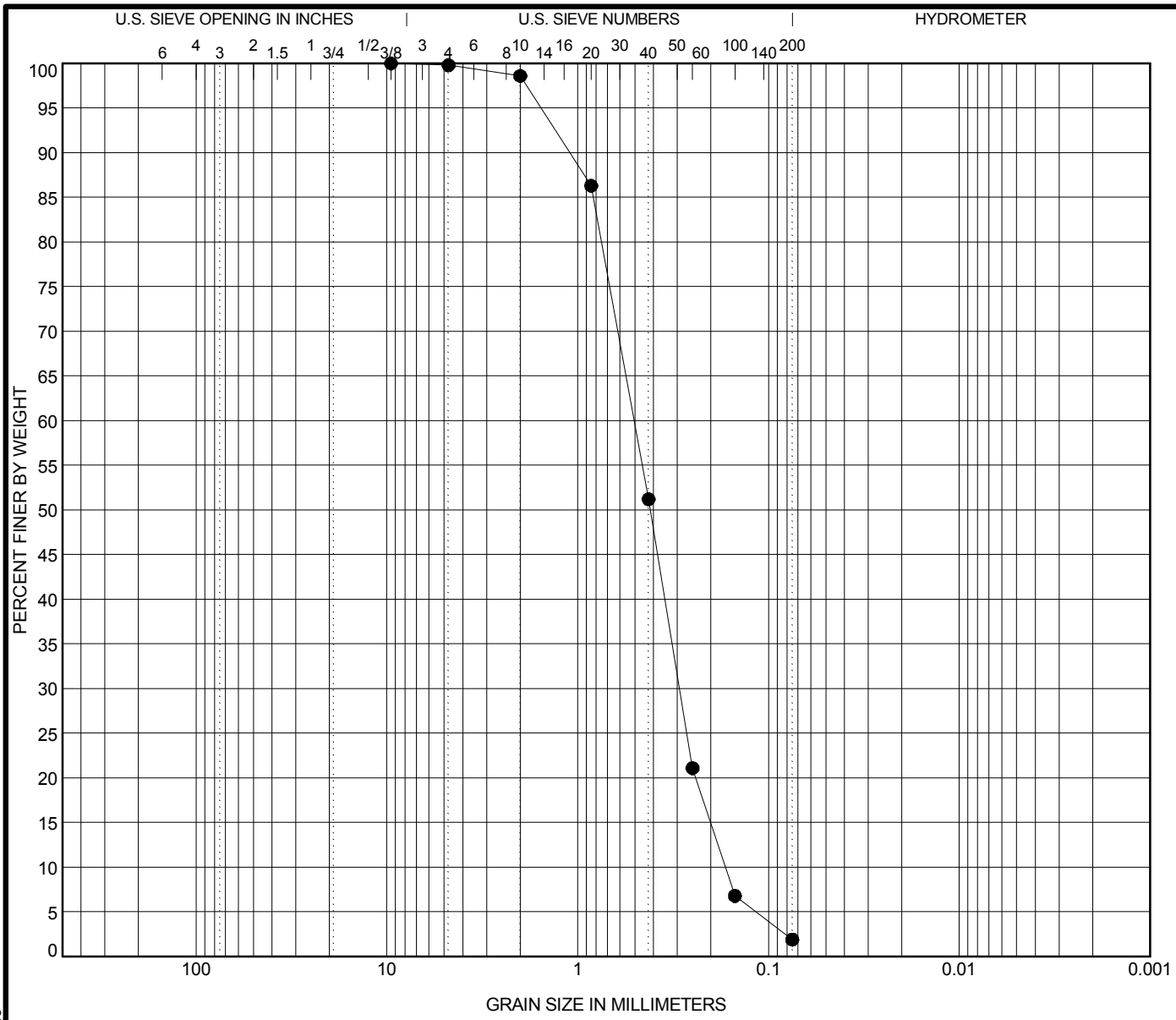
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/6/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-01 | 6.4 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, light brown** | **NP** | **NP** | **NP** | **1.01** | **3.01** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.506** | **0.292** | **0.168** | **0.2** | **97.9** | **1.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 1.9 | 6.8 | 21.1 | 51.2 | 86.3 | 98.6 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AB | 8/30/18 | |

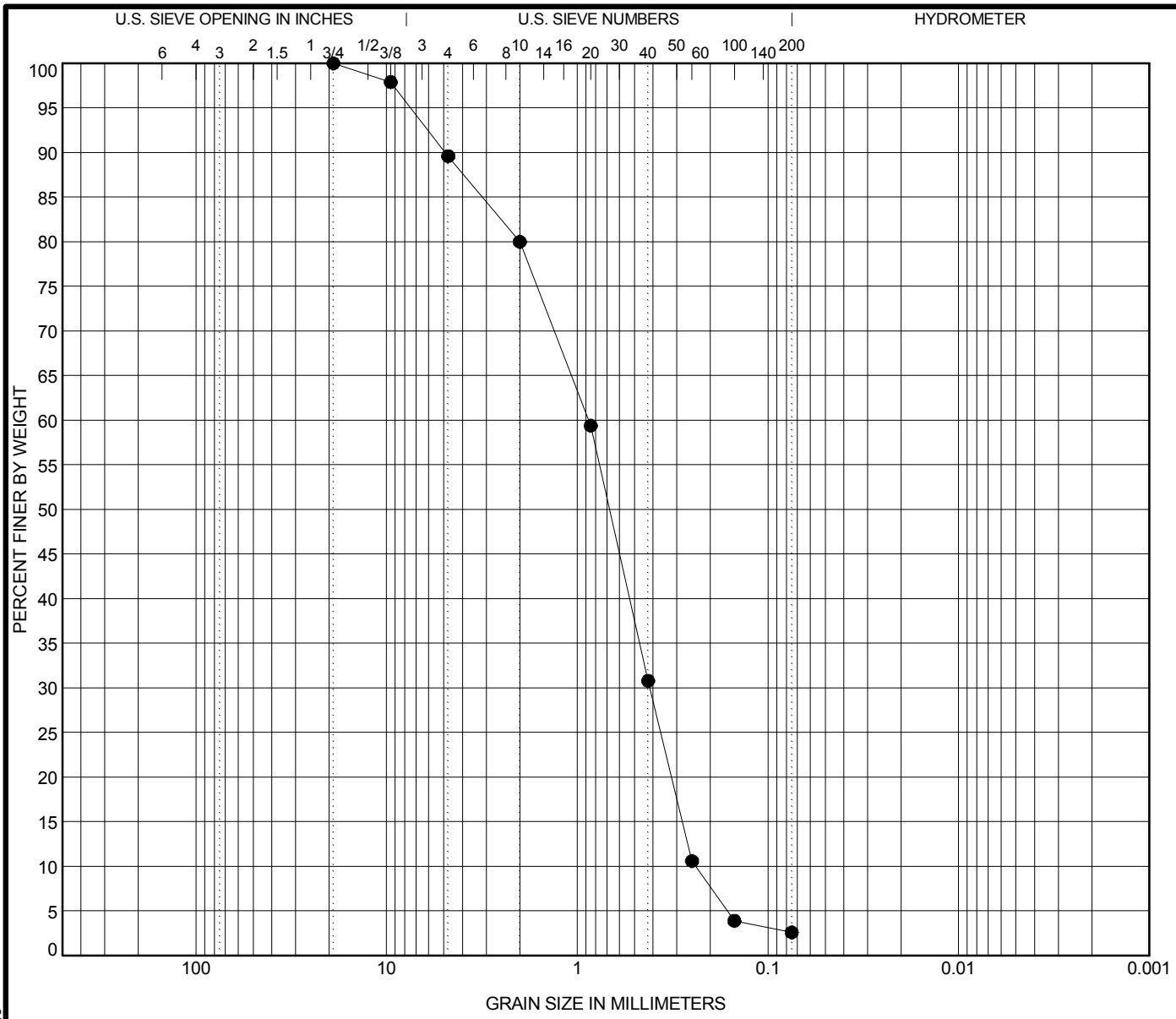
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/6/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-01 | 10.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, gray** | **NP** | **NP** | **NP** | **0.83** | **3.65** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.871** | **0.416** | **0.239** | **10.4** | **87.0** | **2.6** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 2.6 | 3.9 | 10.6 | 30.8 | 59.4 | 80.0 | 89.6 | 97.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AB | 8/30/18 | |

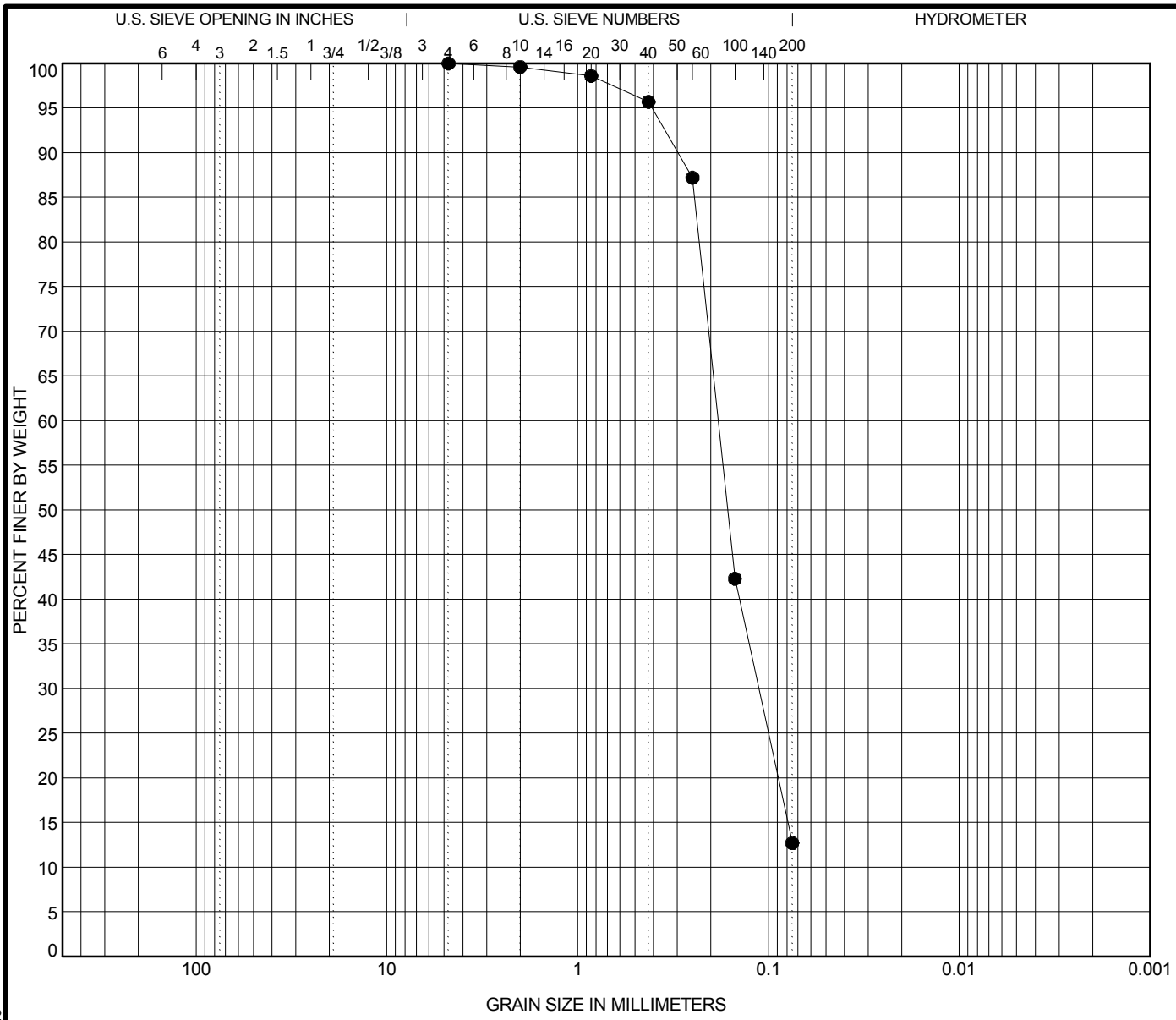
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/6/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-02 | 0.0 ft | **SILTY SAND (SM), fine to coarse grained sand, dark gray** | **NP** | **NP** | **NP** | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.183** | **0.112** | **--** | **0.0** | **87.3** | **12.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 12.7 | 42.3 | 87.2 | 95.7 | 98.6 | 99.6 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / DS | 8/30/18 | |

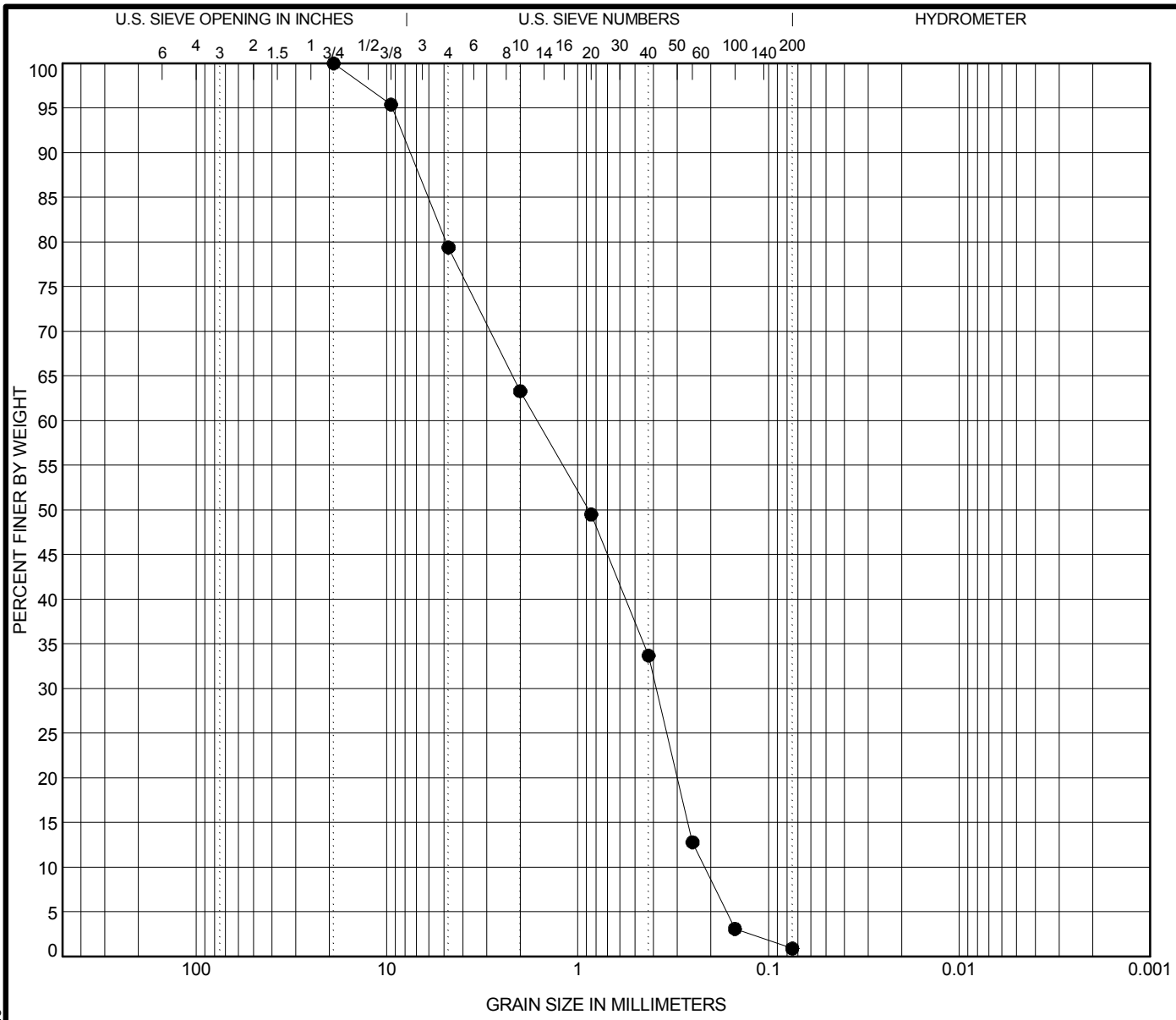
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/6/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-02 | 4.1 ft | **POORLY GRADED SAND WITH GRAVEL (SP), fine to coarse grained sand, trace gravel, contains shell fragments, gray** | **NP** | **NP** | **NP** | **0.43** | **7.56** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **1.63** | **0.387** | **0.216** | **20.6** | **78.5** | **0.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 0.9 | 3.1 | 12.8 | 33.7 | 49.5 | 63.3 | 79.4 | 95.4 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AB | 8/30/18 | |

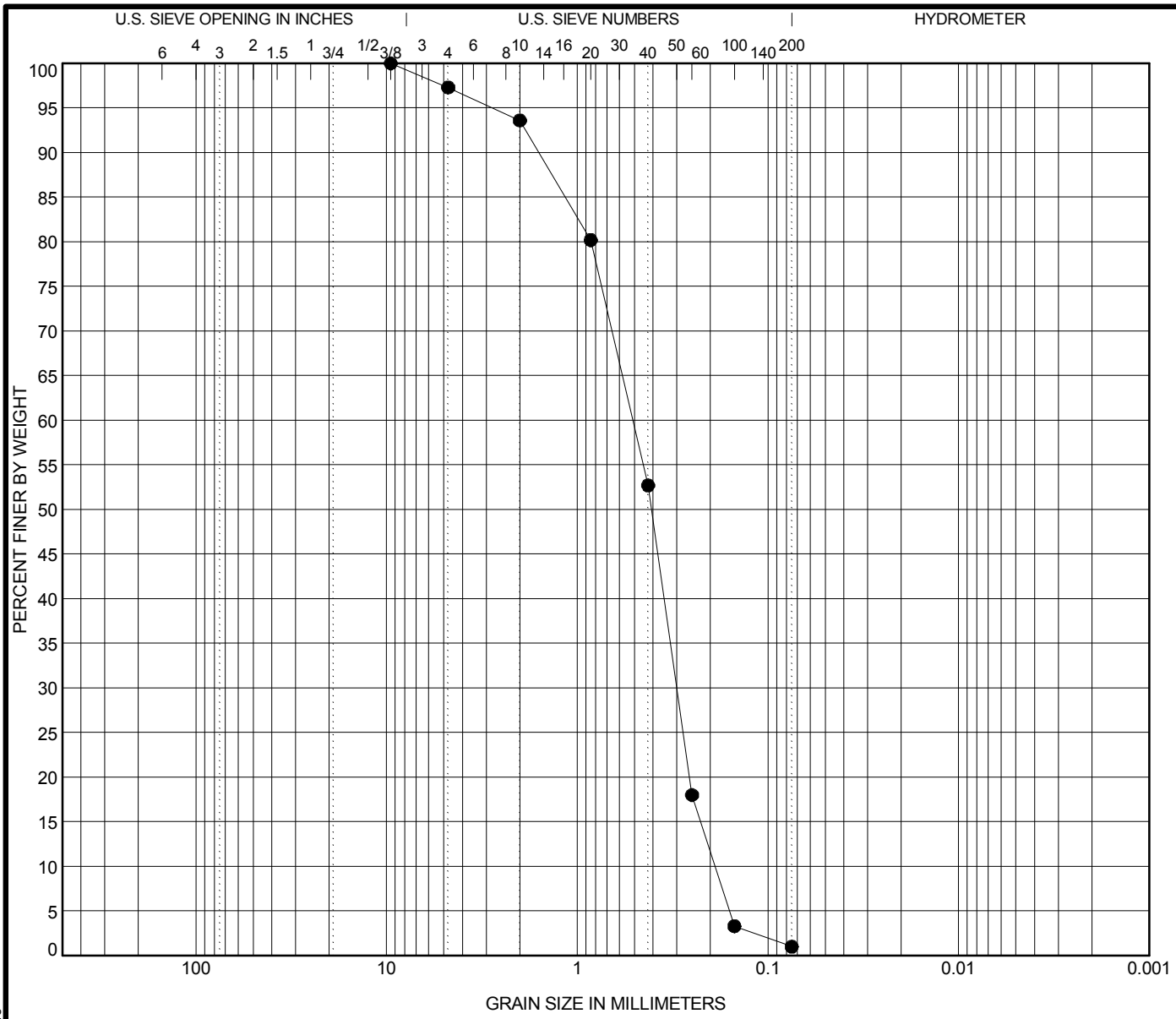
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/6/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-02 | 5.5 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | **NP** | **NP** | **NP** | **0.93** | **2.70** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.511** | **0.3** | **0.189** | **2.7** | **96.3** | **1.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 1.0 | 3.3 | 18.0 | 52.7 | 80.2 | 93.6 | 97.3 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AB | 8/30/18 | |

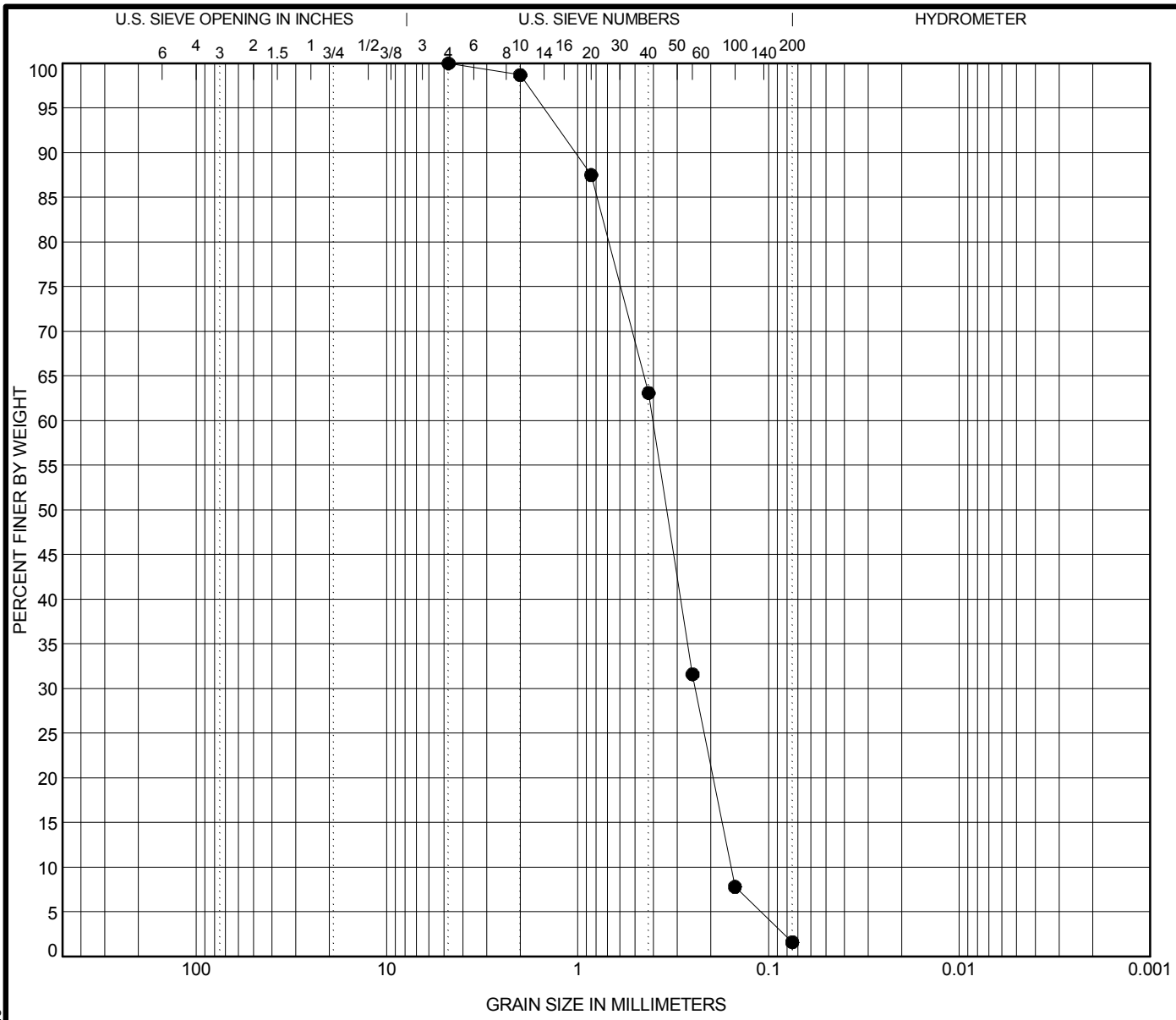
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/6/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-02 | 10.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, gray** | **NP** | **NP** | **NP** | **0.92** | **2.57** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.403** | **0.242** | **0.157** | **0.0** | **98.4** | **1.6** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 1.6 | 7.8 | 31.6 | 63.1 | 87.5 | 98.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AB | 8/30/18 | |

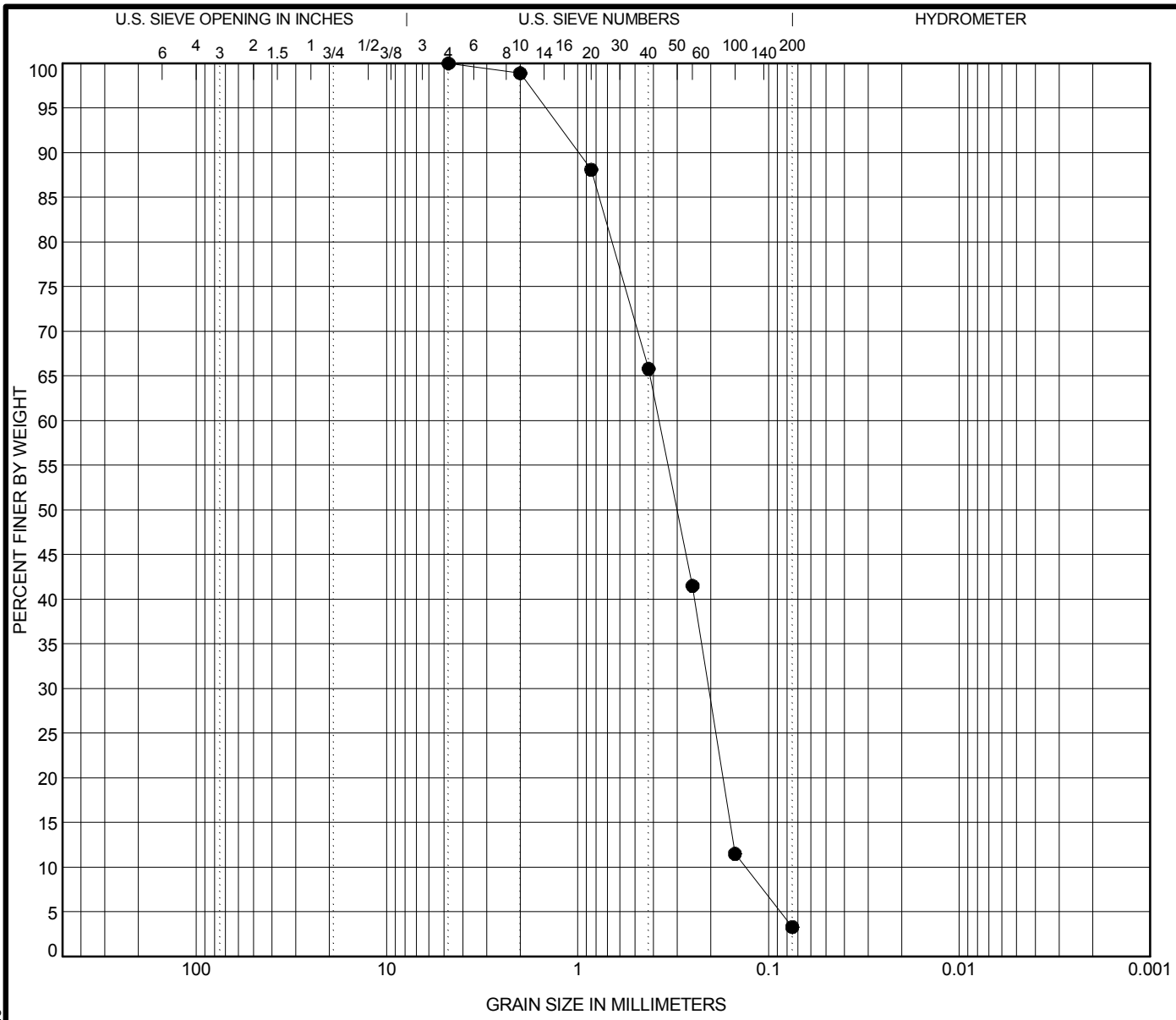
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/6/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-02 | 15.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, gray** | -- | -- | -- | **0.85** | **2.83** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.374** | **0.206** | **0.132** | **0.0** | **96.7** | **3.3** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 3.3 | 11.5 | 41.5 | 65.8 | 88.1 | 98.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / DS | 8/30/18 | |

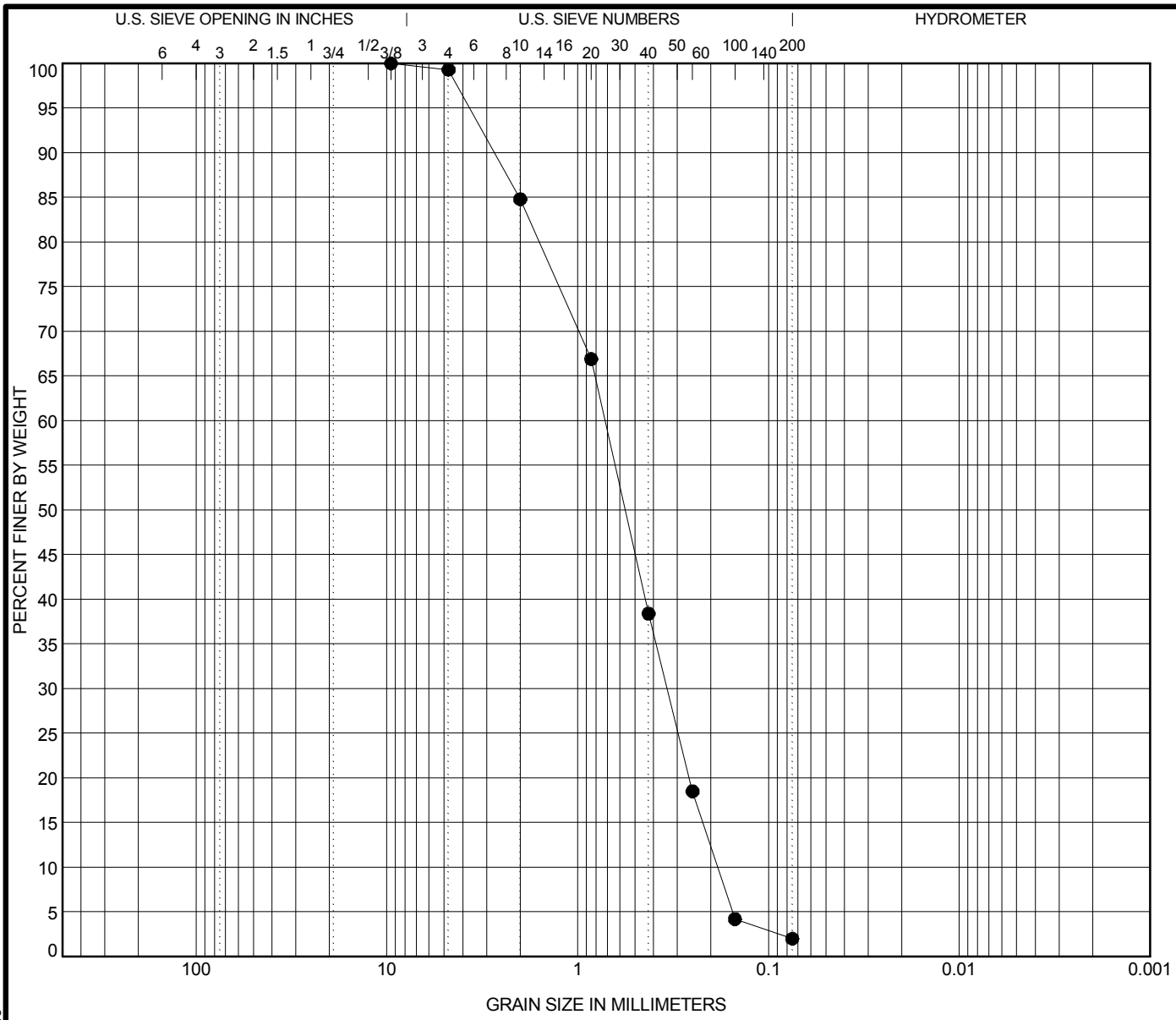
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/6/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-03 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | **NP** | **NP** | **NP** | **0.87** | **3.89** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.719** | **0.34** | **0.185** | **0.7** | **97.3** | **2.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 2.0 | 4.2 | 18.5 | 38.4 | 66.9 | 84.8 | 99.3 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / DS | 8/30/18 | |

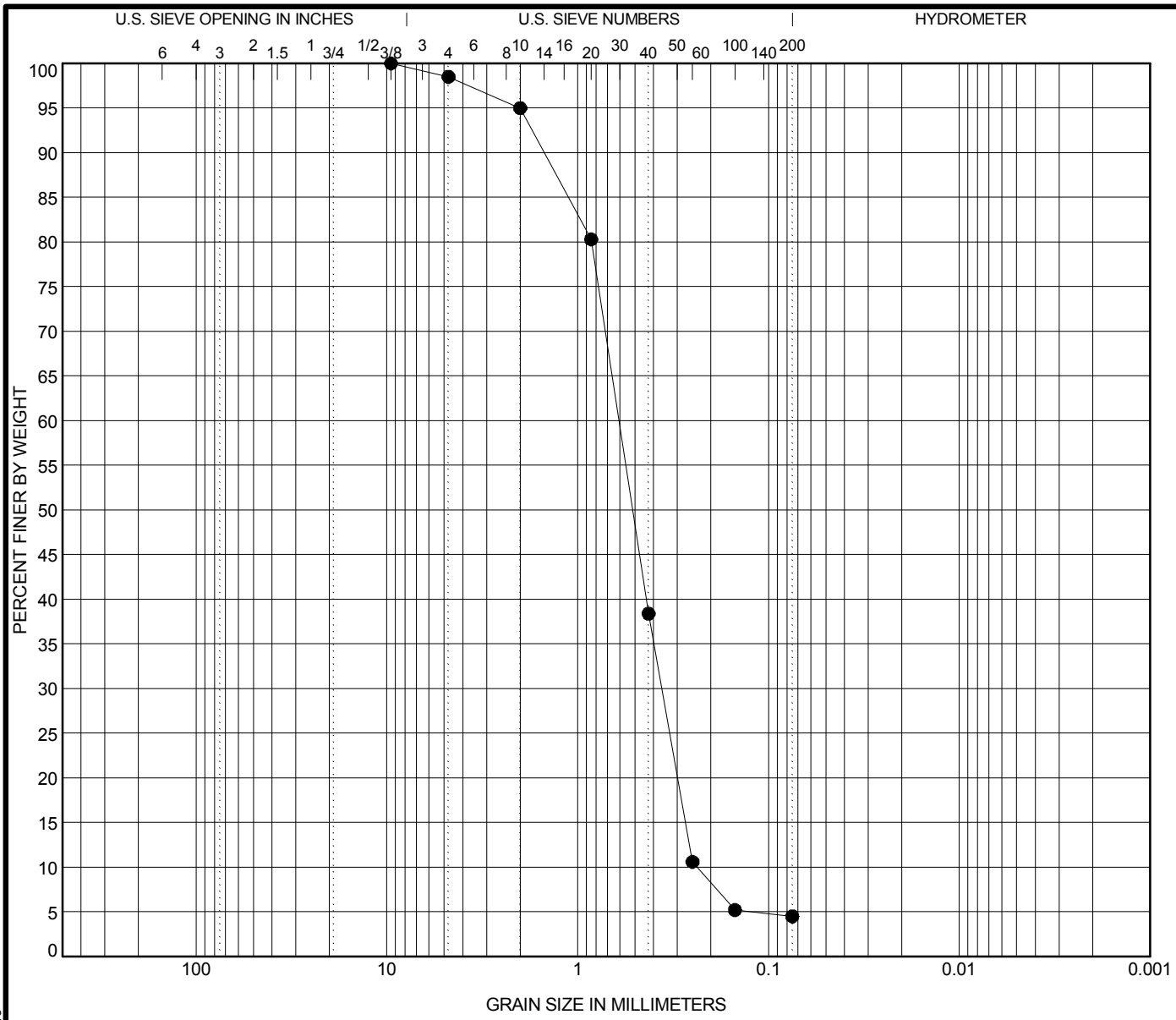
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/6/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-03 | 5.0 ft | **POORLY GRADED SAND WITH SILT (SP), fine to coarse grained sand, trace gravel, gray** | **NP** | **NP** | **NP** | **0.91** | **2.57** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.608** | **0.362** | **0.236** | **1.5** | **94.0** | **4.5** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 4.5 | 5.2 | 10.6 | 38.4 | 80.3 | 95.0 | 98.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AB | 8/30/18 | |

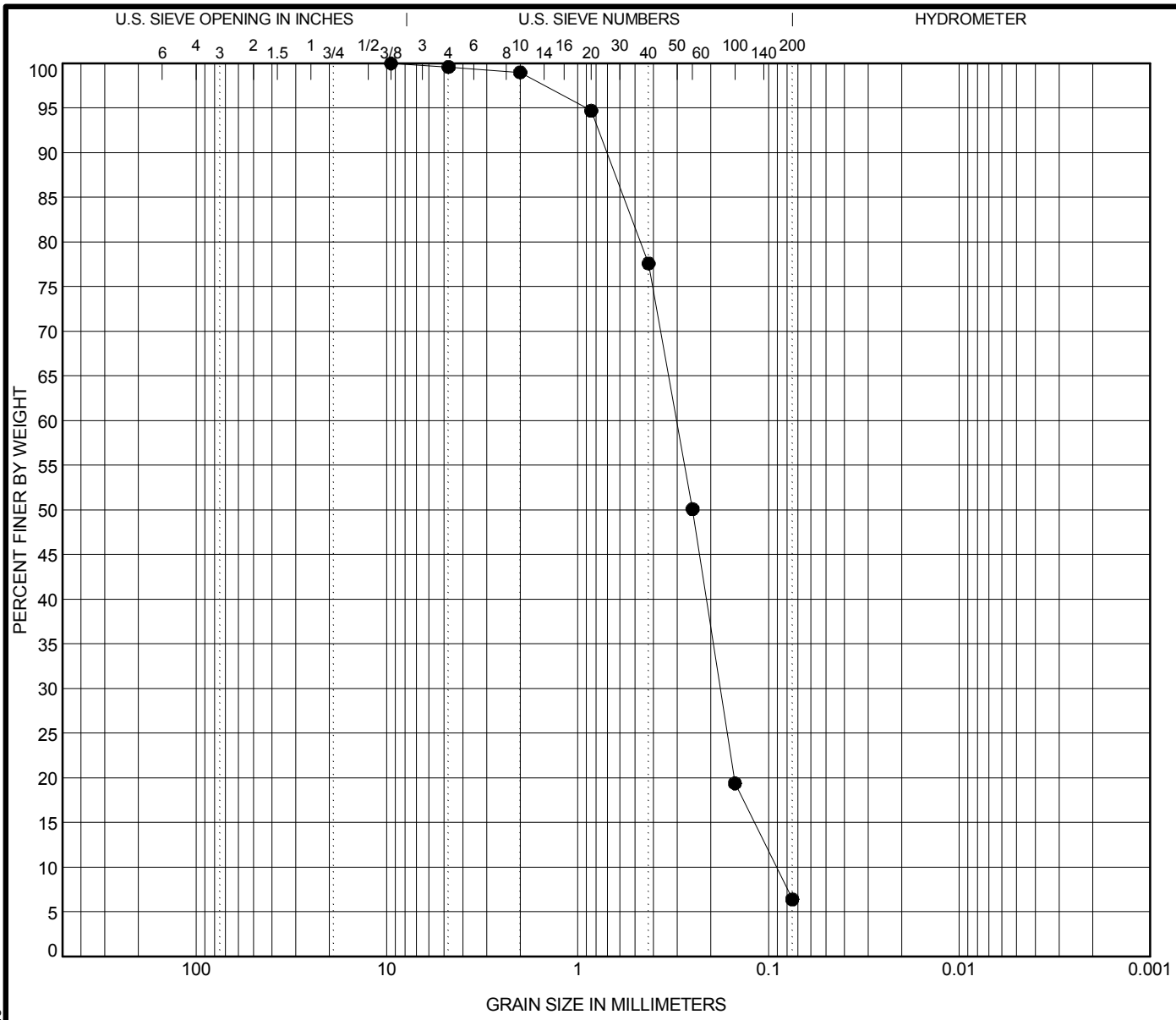
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/6/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-04 | 0.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, gray** | **NP** | **NP** | **NP** | **1.16** | **3.33** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.303** | **0.179** | **0.091** | **0.4** | **93.2** | **6.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 6.4 | 19.4 | 50.1 | 77.6 | 94.7 | 99.0 | 99.6 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| Rg / AB | 8/30/18 | |

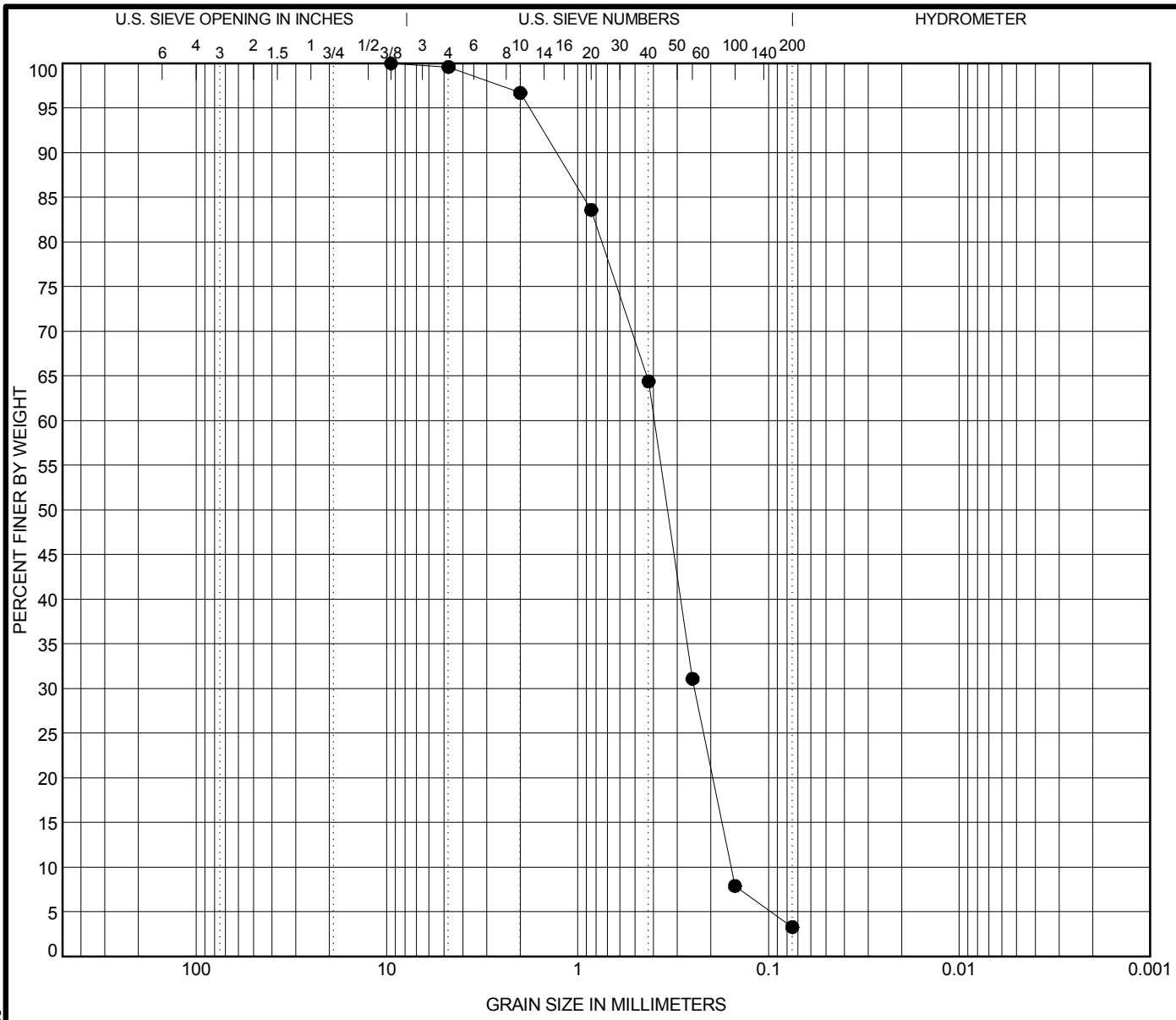
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/6/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-06 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, gray** | **NP** | **NP** | **NP** | **0.96** | **2.52** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.396** | **0.244** | **0.157** | **0.4** | **96.3** | **3.3** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 3.3 | 7.9 | 31.1 | 64.4 | 83.6 | 96.7 | 99.6 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AB | 8/30/18 | |

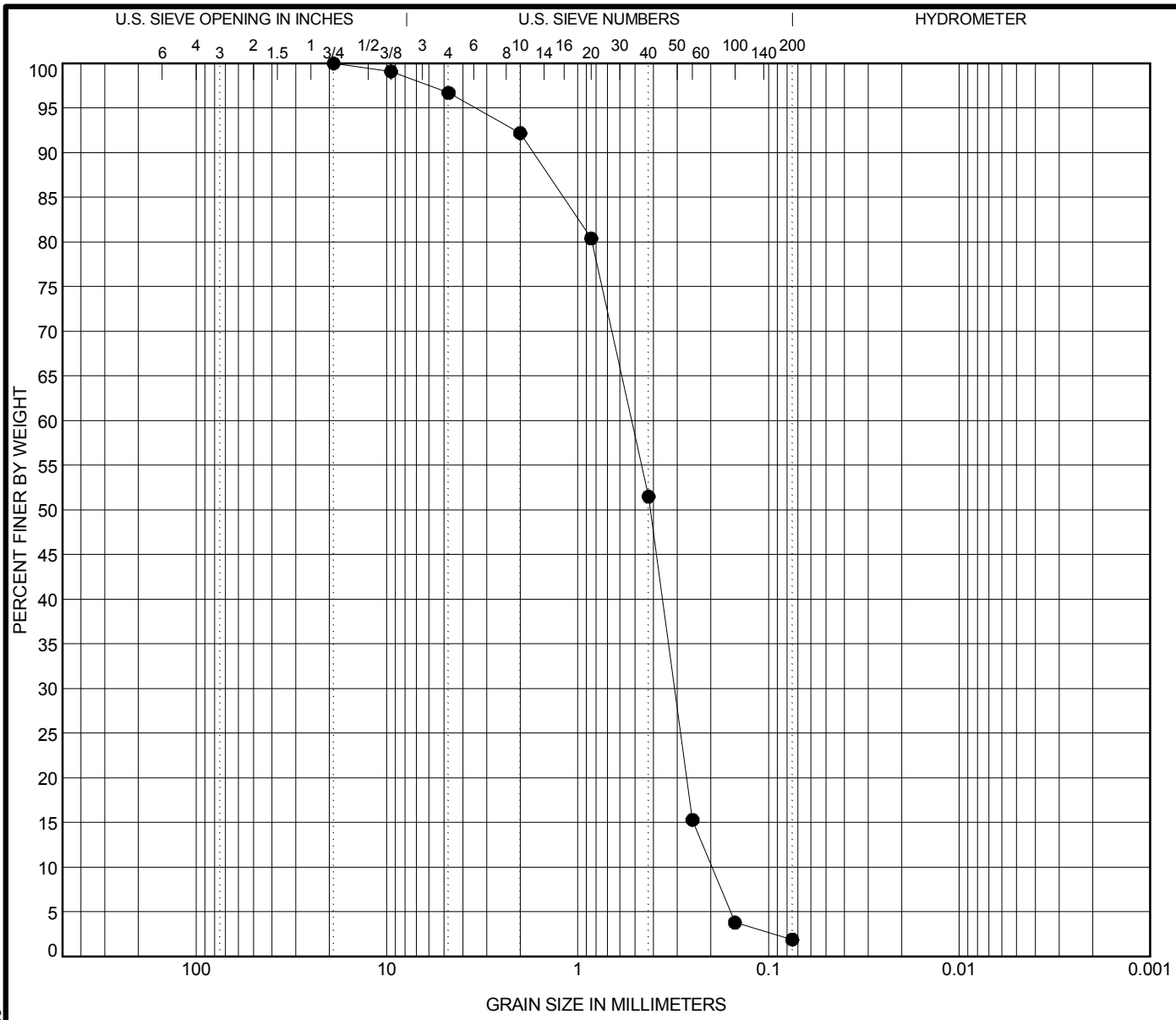
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/6/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-07 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, gray** | **NP** | **NP** | **NP** | **0.93** | **2.64** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.521** | **0.31** | **0.198** | **3.3** | **94.8** | **1.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 1.9 | 3.8 | 15.3 | 51.5 | 80.4 | 92.2 | 96.7 | 99.1 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AB | 8/30/18 | |

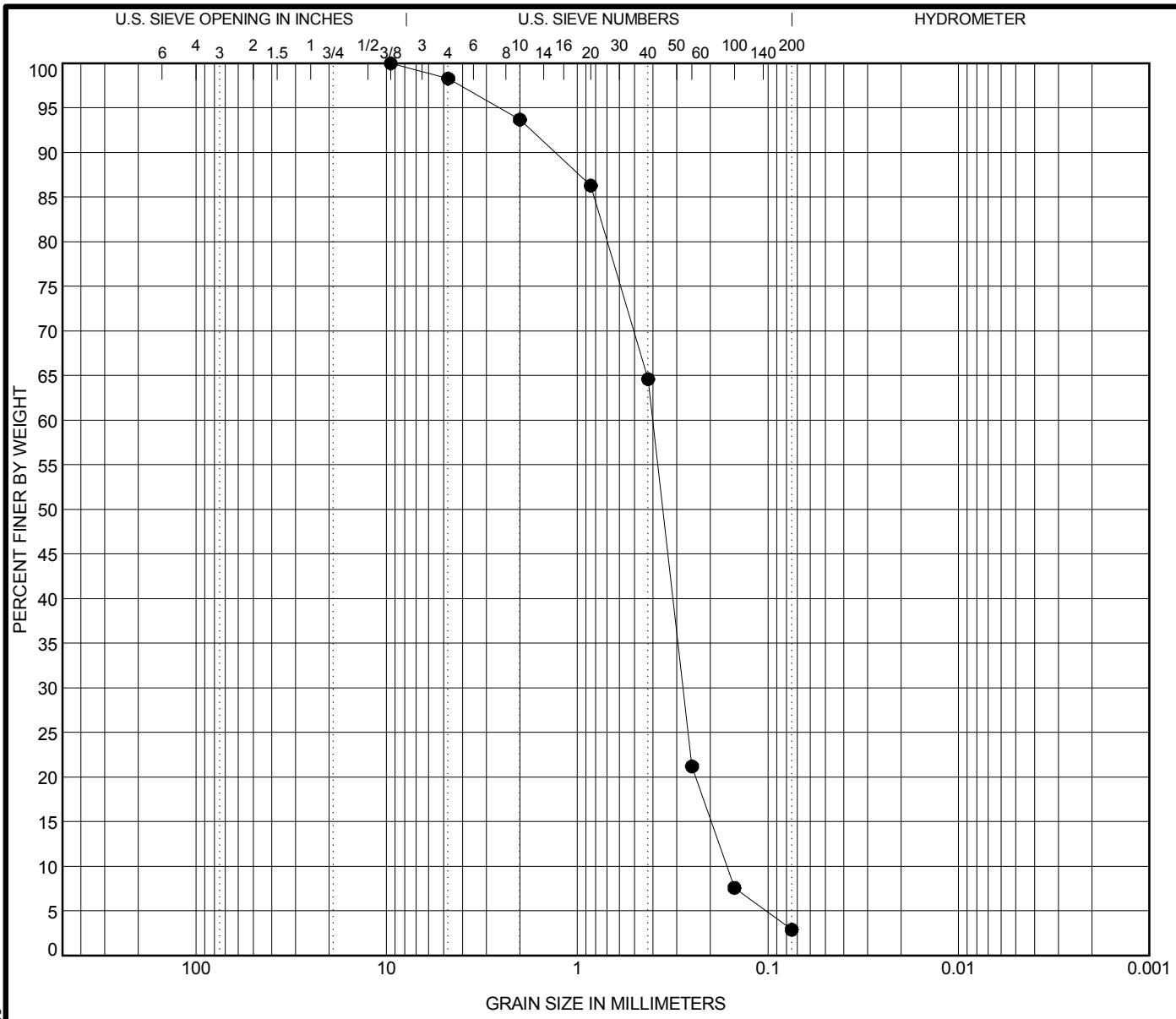
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/6/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-07 | 5.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | **NP** | **NP** | **NP** | **1.18** | **2.45** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.402** | **0.278** | **0.164** | **1.7** | **95.4** | **2.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 2.9 | 7.6 | 21.2 | 64.6 | 86.3 | 93.7 | 98.3 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / DS | 8/30/18 | |

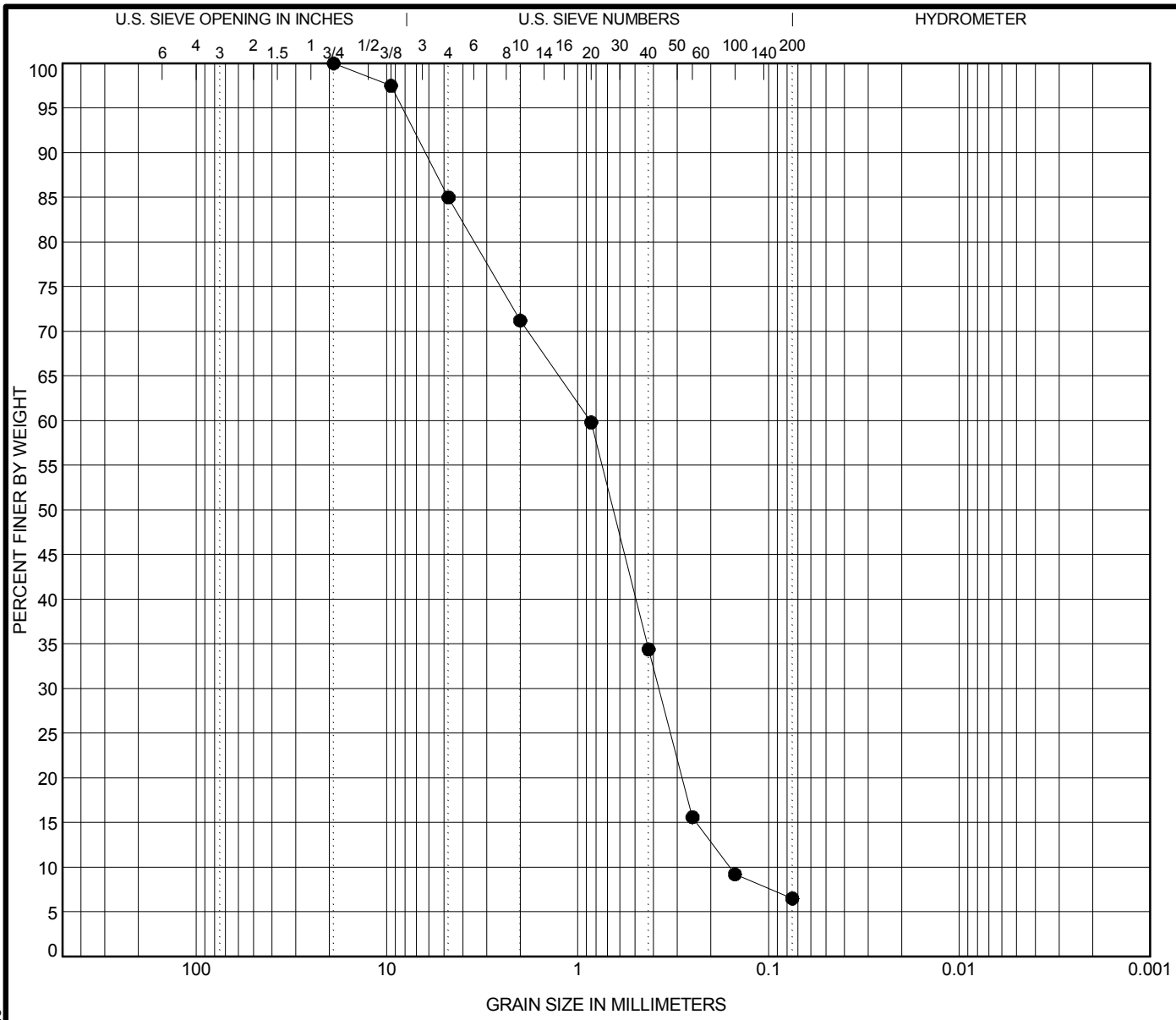
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/6/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-08 | 0.0 ft | **POORLY GRADED SAND WITH SILT AND GRAVEL (SP), fine to coarse grained sand, contains shell fragments, gray** | **NP** | **NP** | **NP** | **1.02** | **5.40** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.863** | **0.375** | **0.16** | **15.0** | **78.5** | **6.5** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 6.5 | 9.2 | 15.6 | 34.4 | 59.8 | 71.2 | 85.0 | 97.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AB | 8/30/18 | |

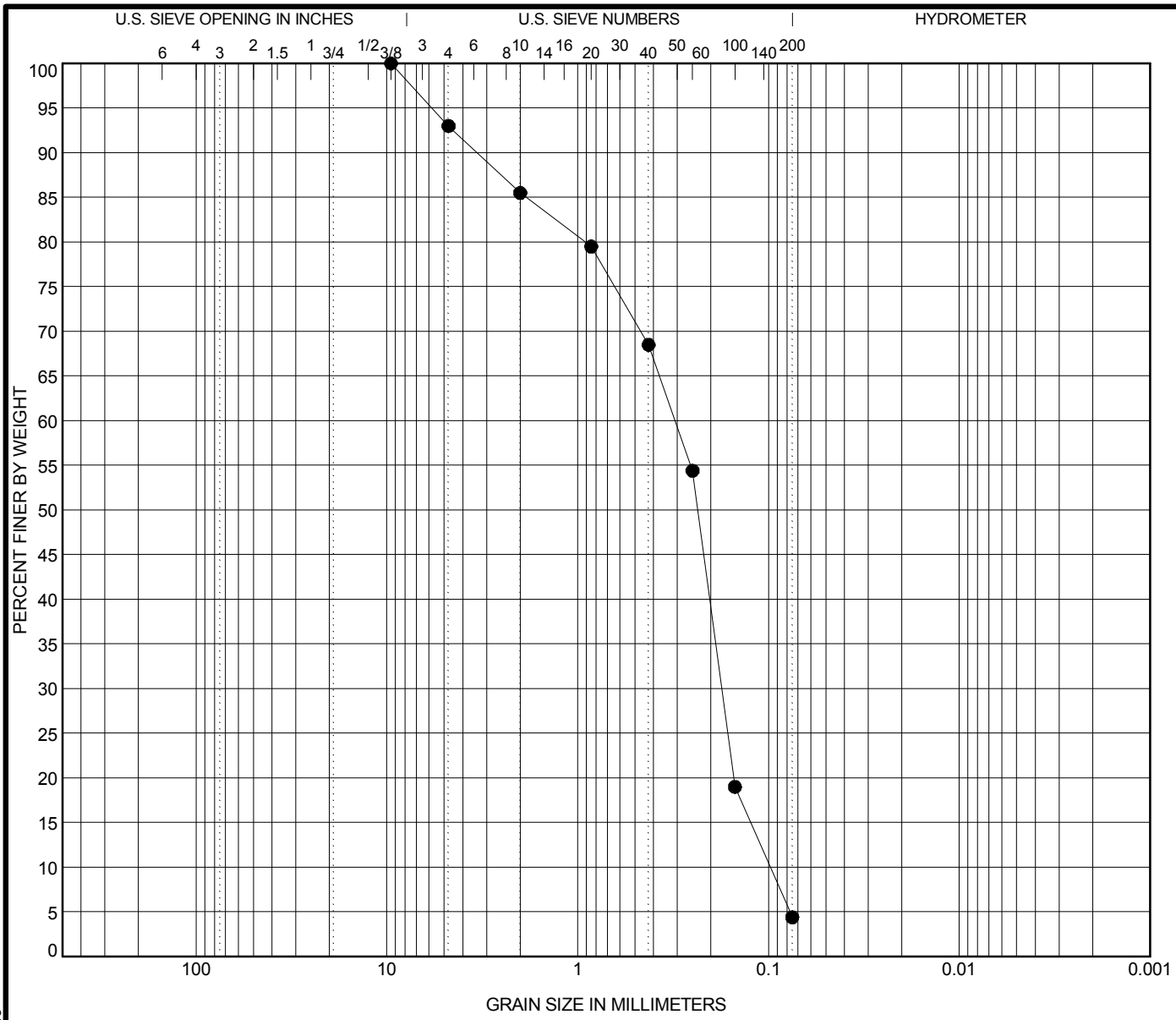
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/6/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-08 | 2.1 ft | **POORLY GRADED SAND WITH SILT (SP), fine to coarse grained sand, trace gravel, gray** | **NP** | **NP** | **NP** | **1.02** | **3.15** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.309** | **0.176** | **0.098** | **7.0** | **88.6** | **4.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 4.4 | 19.0 | 54.4 | 68.5 | 79.5 | 85.5 | 93.0 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AB | 8/30/18 | |

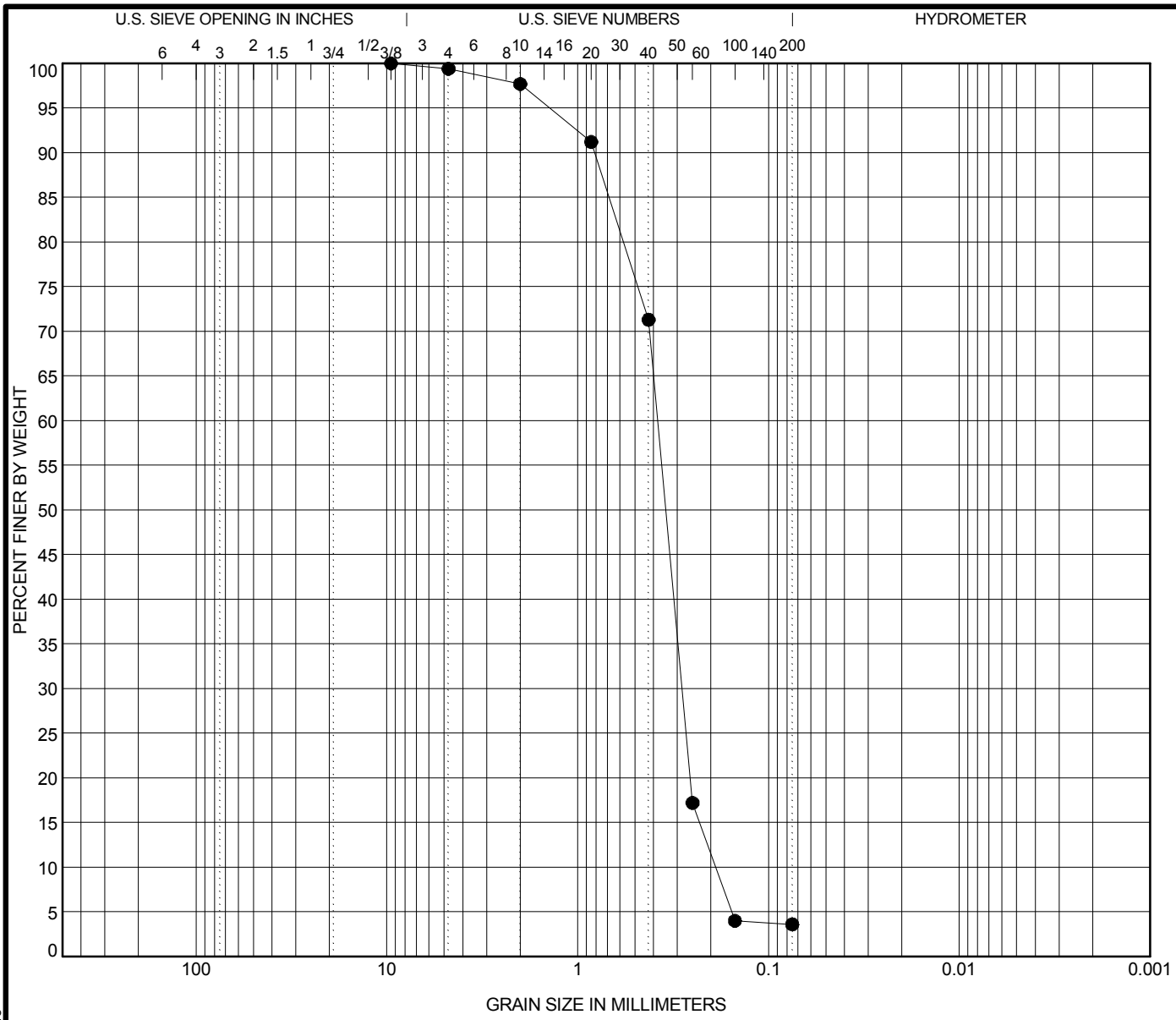
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/6/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-08 | 6.8 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | **NP** | **NP** | **NP** | **1.12** | **2.01** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.38** | **0.283** | **0.189** | **0.6** | **95.8** | **3.6** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 3.6 | 4.0 | 17.2 | 71.3 | 91.2 | 97.7 | 99.4 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / DS | 8/30/18 | |

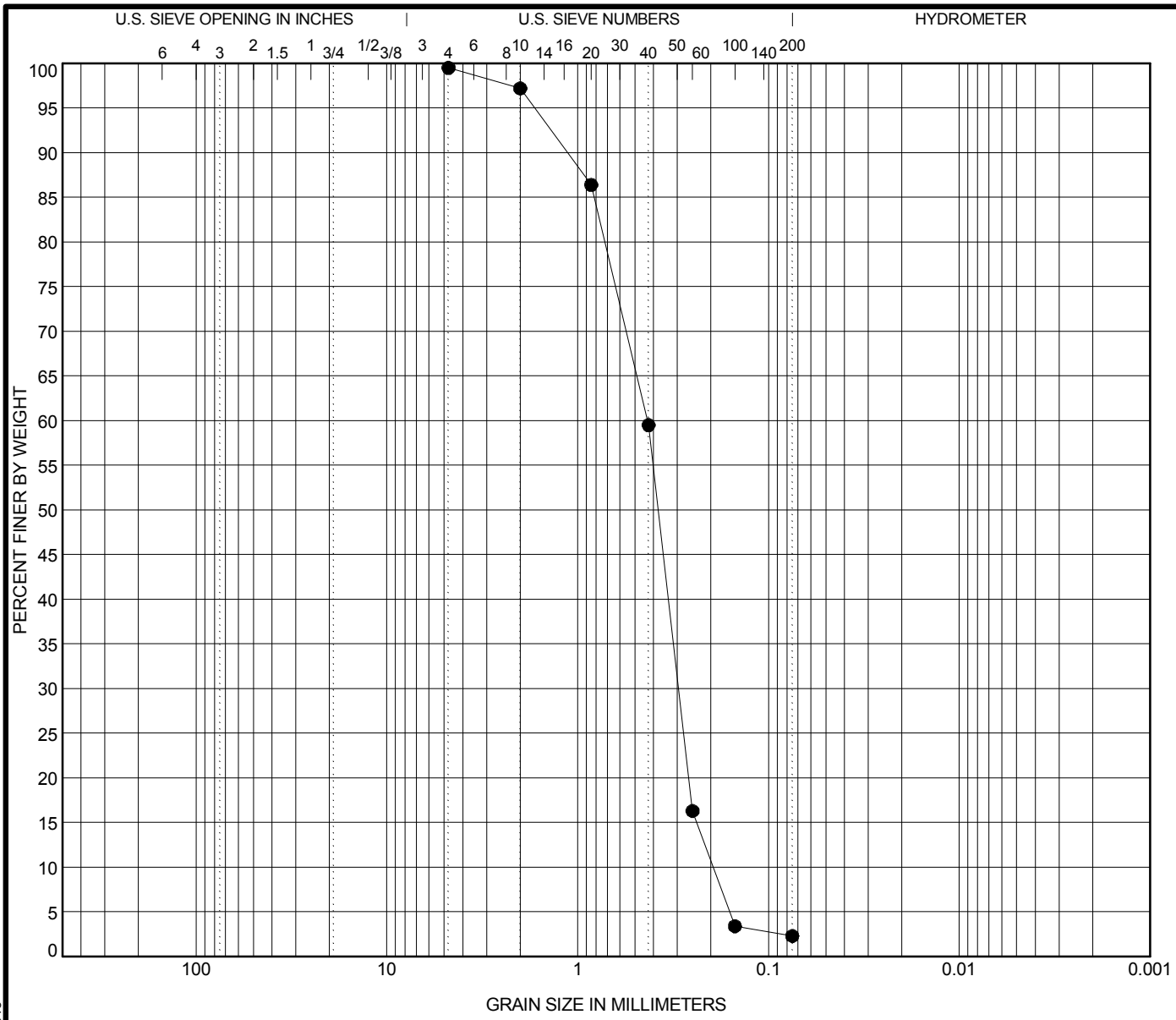
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/6/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-09 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, light gray** | -- | -- | -- | **1.04** | **2.21** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.431** | **0.296** | **0.195** | **0.5** | **97.2** | **2.3** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 2.3 | 3.4 | 16.3 | 59.5 | 86.4 | 97.2 | 99.5 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | DS |

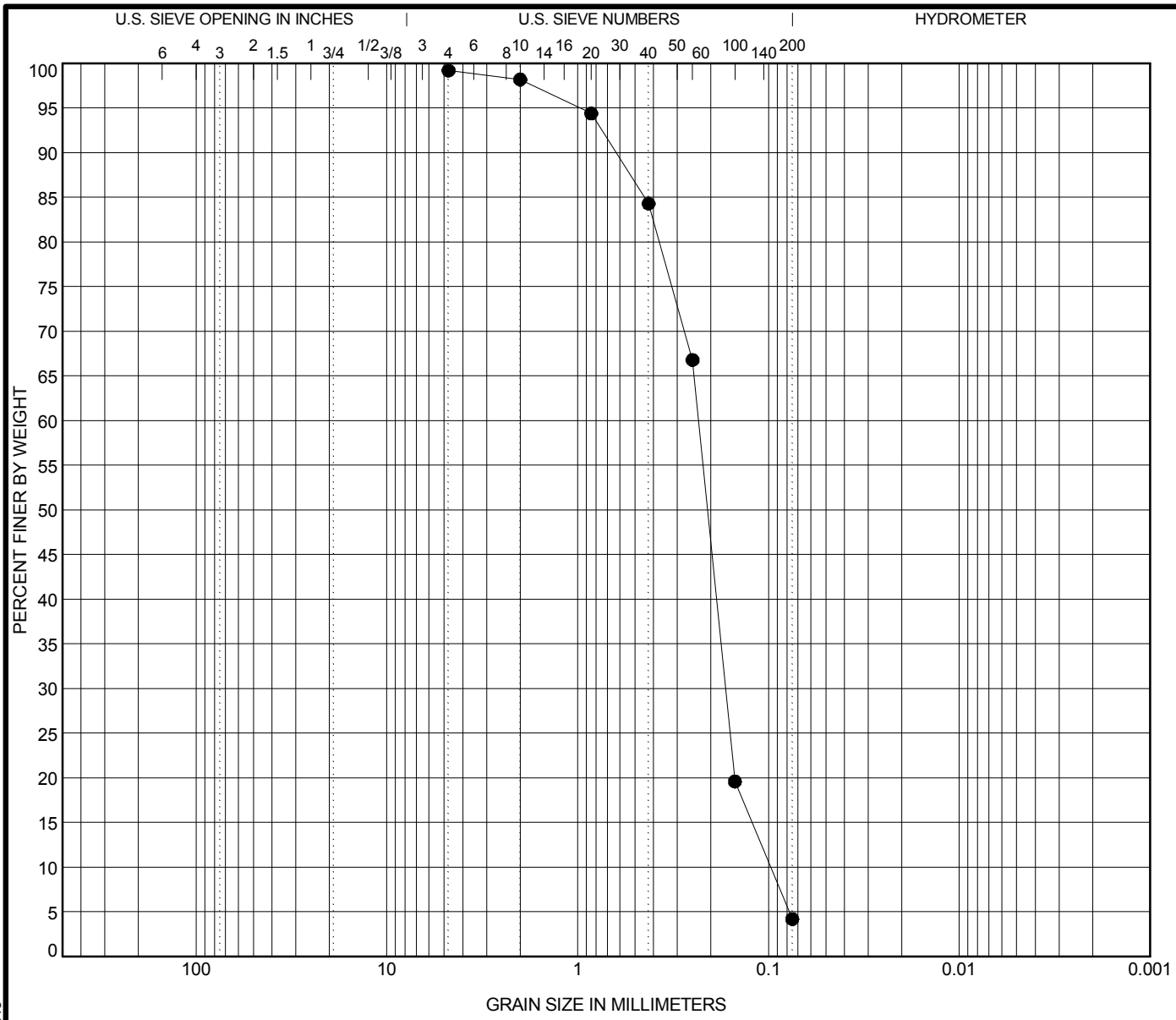
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILL

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-09 | 3.2 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light gray** | -- | -- | -- | **1.25** | **2.39** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.232** | **0.168** | **0.097** | **0.8** | **95.0** | **4.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 4.2 | 19.6 | 66.8 | 84.3 | 94.4 | 98.2 | 99.2 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | DS |

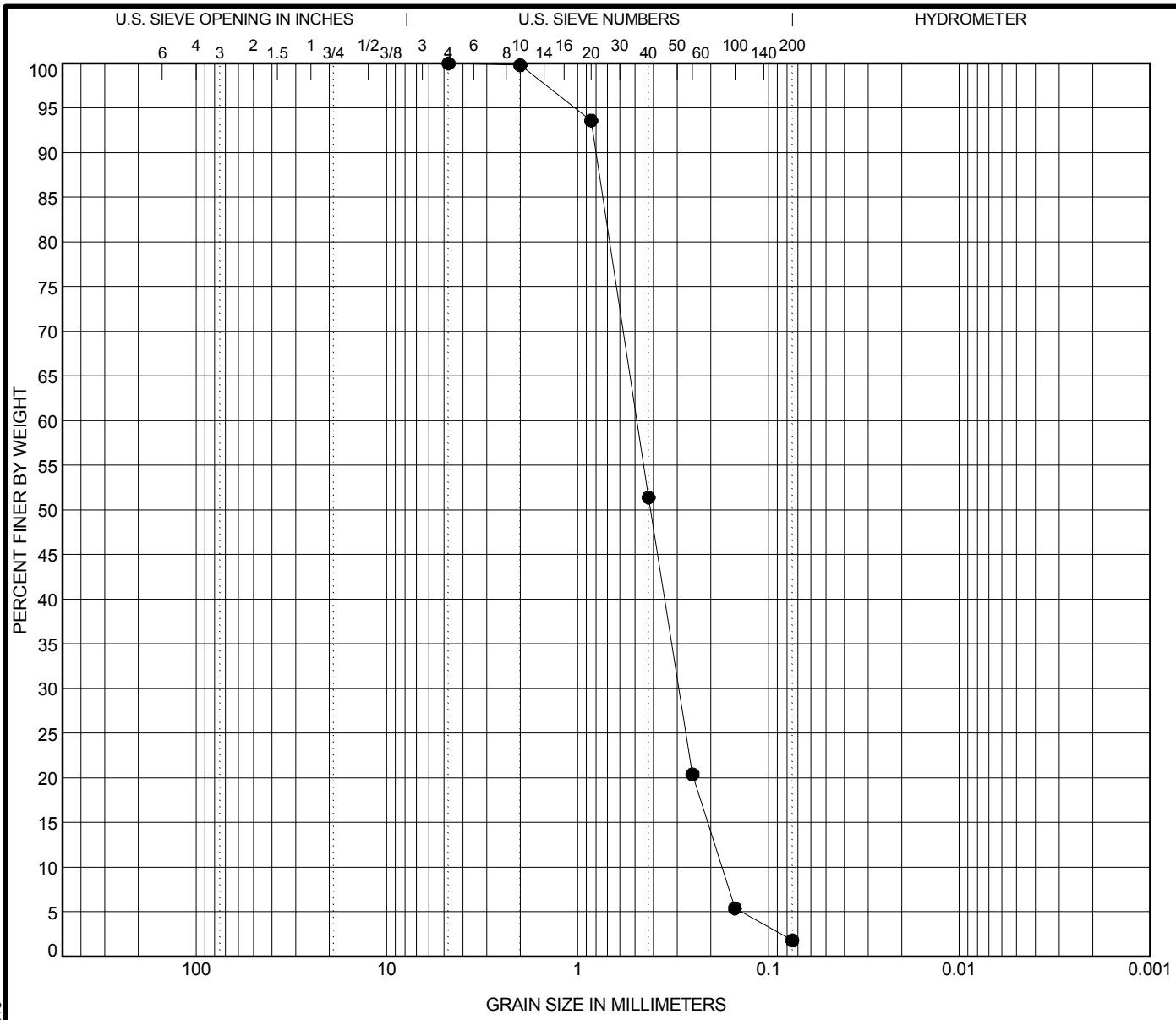
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILL

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-09 | 8.2 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light gray** | -- | -- | -- | **1.01** | **2.79** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.489** | **0.295** | **0.175** | **0.0** | **98.2** | **1.8** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 1.8 | 5.4 | 20.4 | 51.4 | 93.6 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | DS |

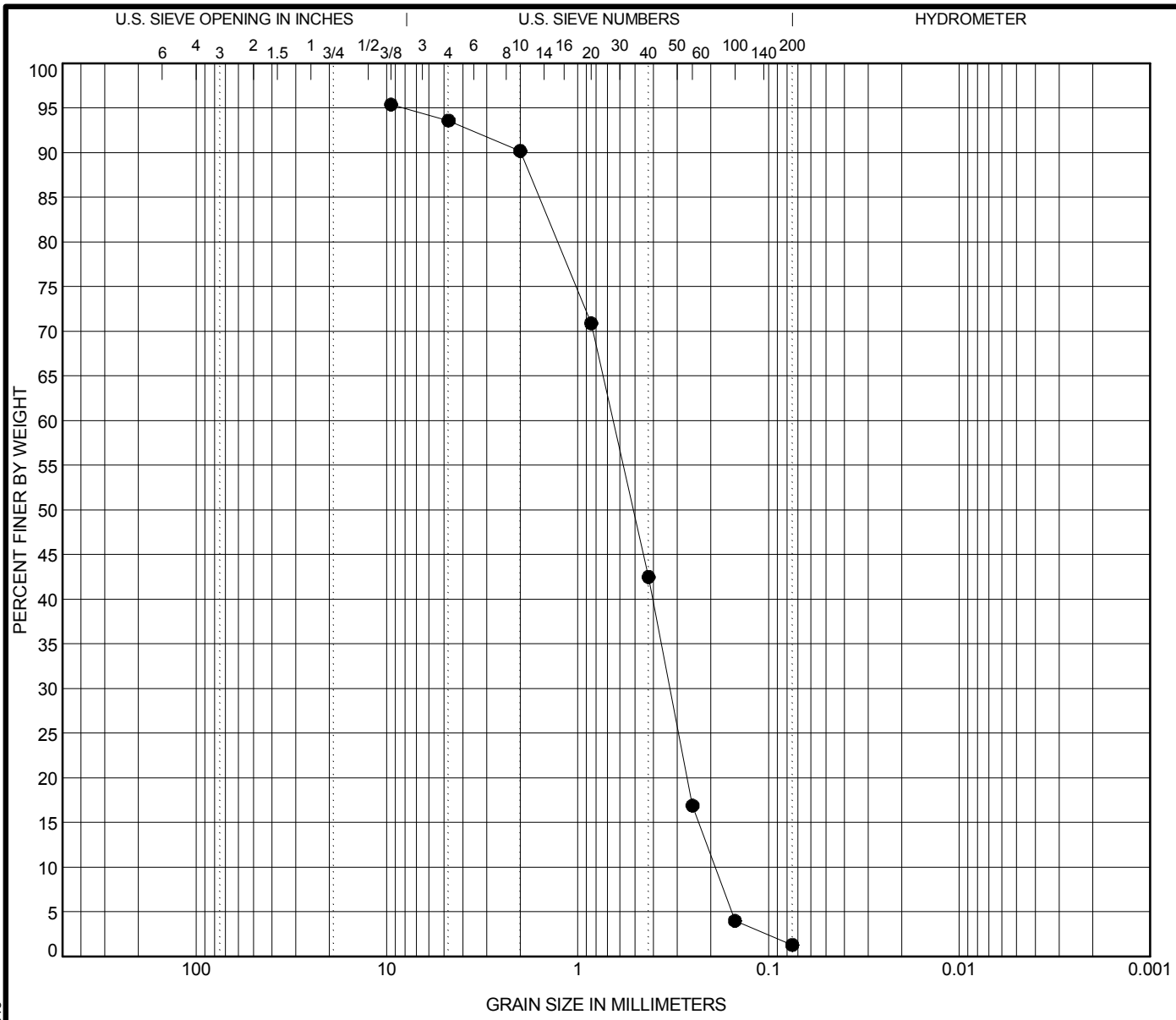
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILL

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-09 | 13.2 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, light gray** | -- | -- | -- | **0.87** | **3.42** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.651** | **0.328** | **0.19** | **6.4** | **92.3** | **1.3** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 1.3 | 4.0 | 16.9 | 42.5 | 70.9 | 90.2 | 93.6 | 95.4 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | DS |

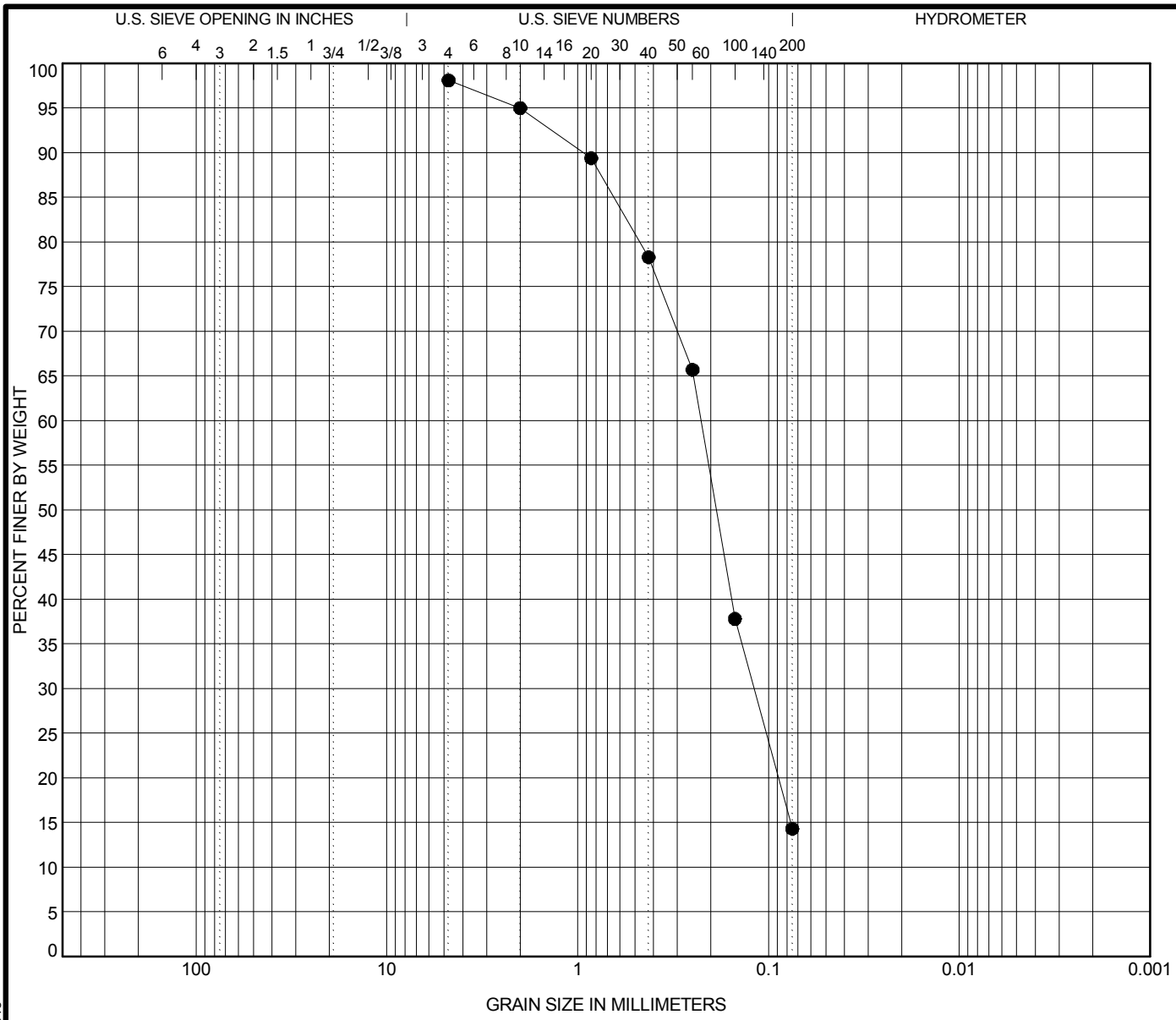
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILL

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | | |
|---|---|---|---|---|---|---|---|
| ● 18SBB-10 | 0.0 ft | **SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, light gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D1140** | | | | | **1.9** | **83.8** | **14.3** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 14.3 | 37.8 | 65.7 | 78.3 | 89.4 | 95.0 | 98.1 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | |

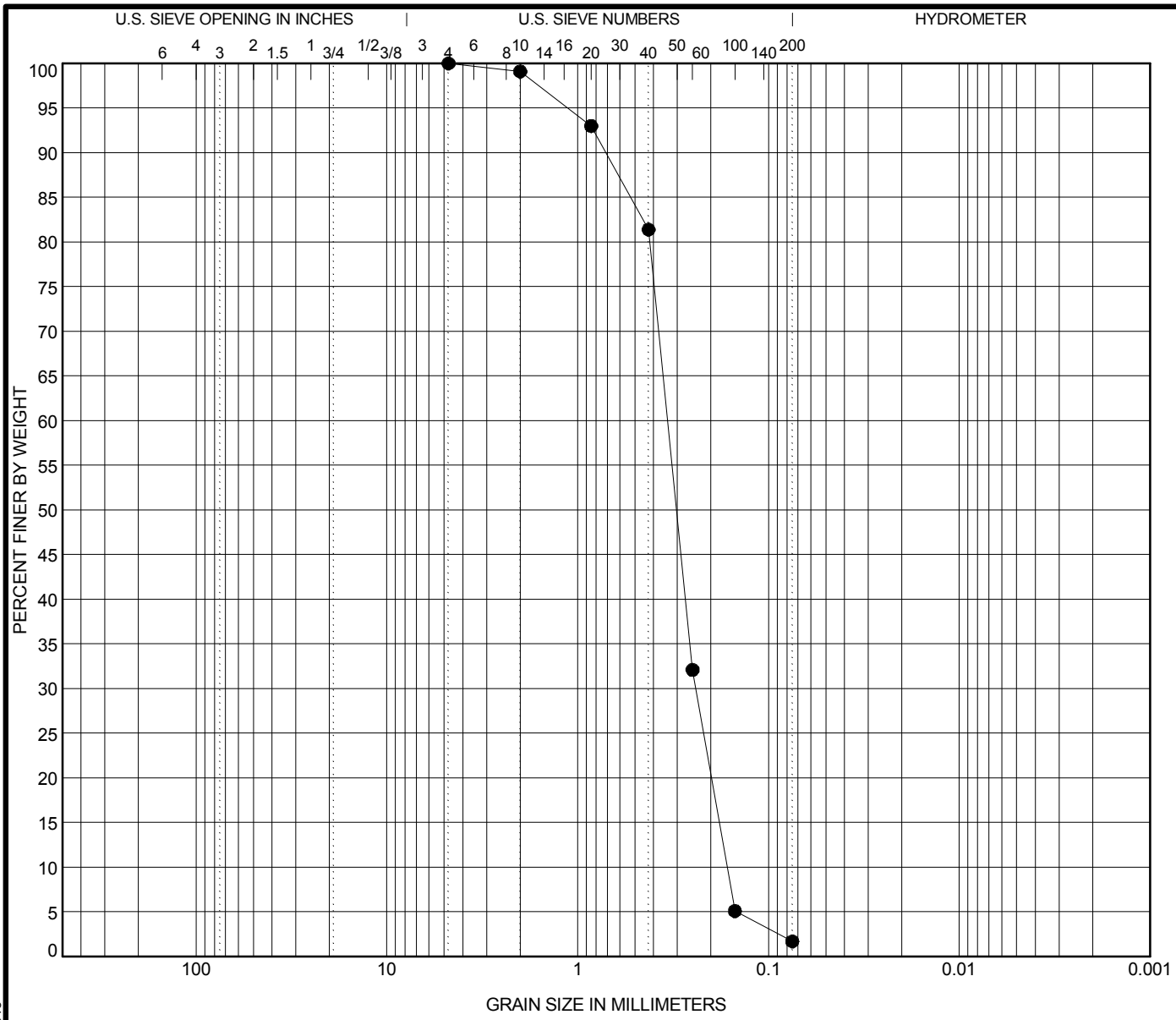
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILLE

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-10 | 4.7 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D1140** | | | | | **0.0** | **98.3** | **1.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 1.7 | 5.1 | 32.1 | 81.4 | 93.0 | 99.1 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | |

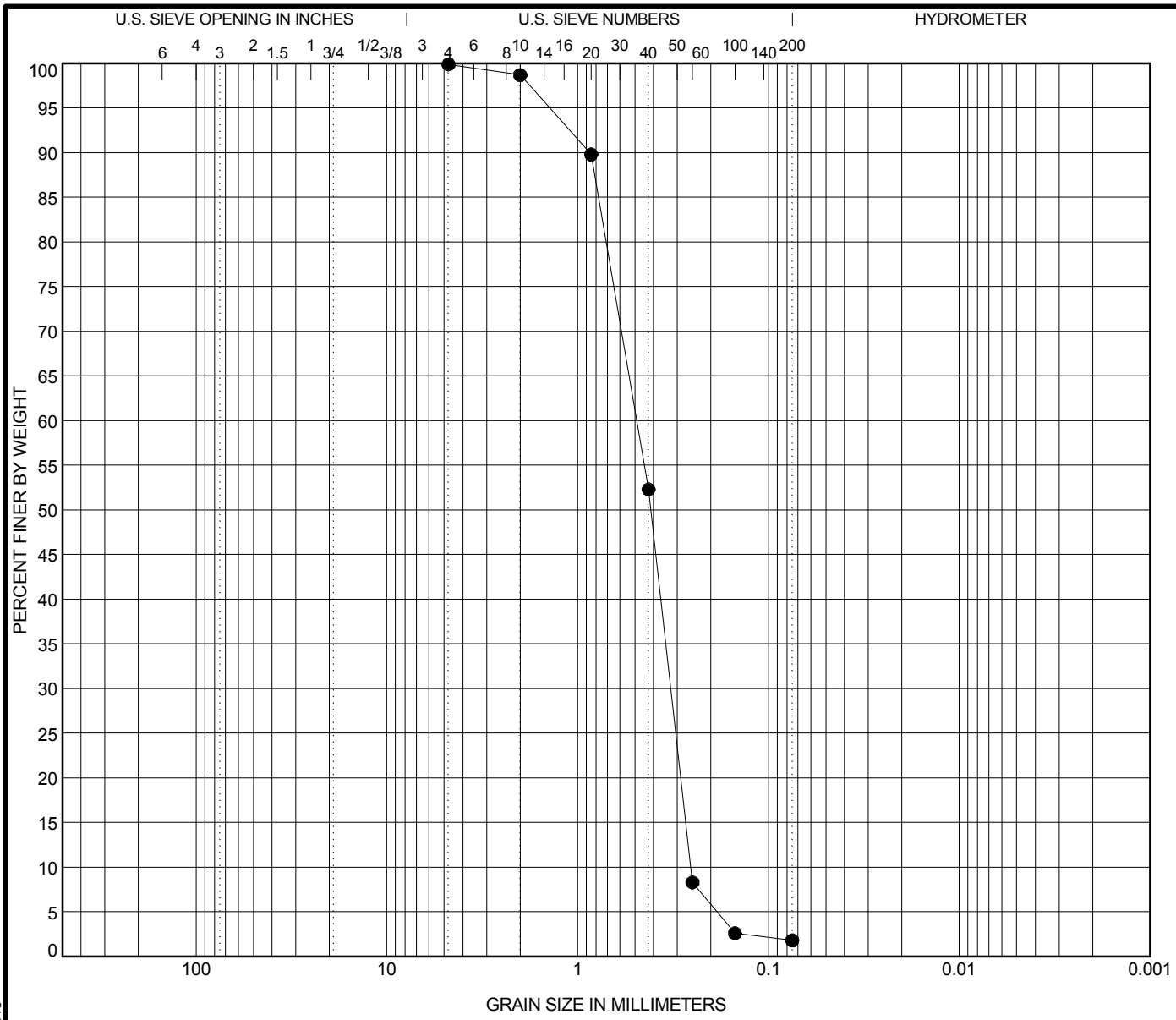
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILLE

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | | |
|---|---|---|---|---|---|---|---|
| ● 18SBB-10 | 9.7 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, light gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D1140** | | | | | **0.1** | **98.1** | **1.8** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 1.8 | 2.6 | 8.3 | 52.3 | 89.8 | 98.7 | 99.9 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | |

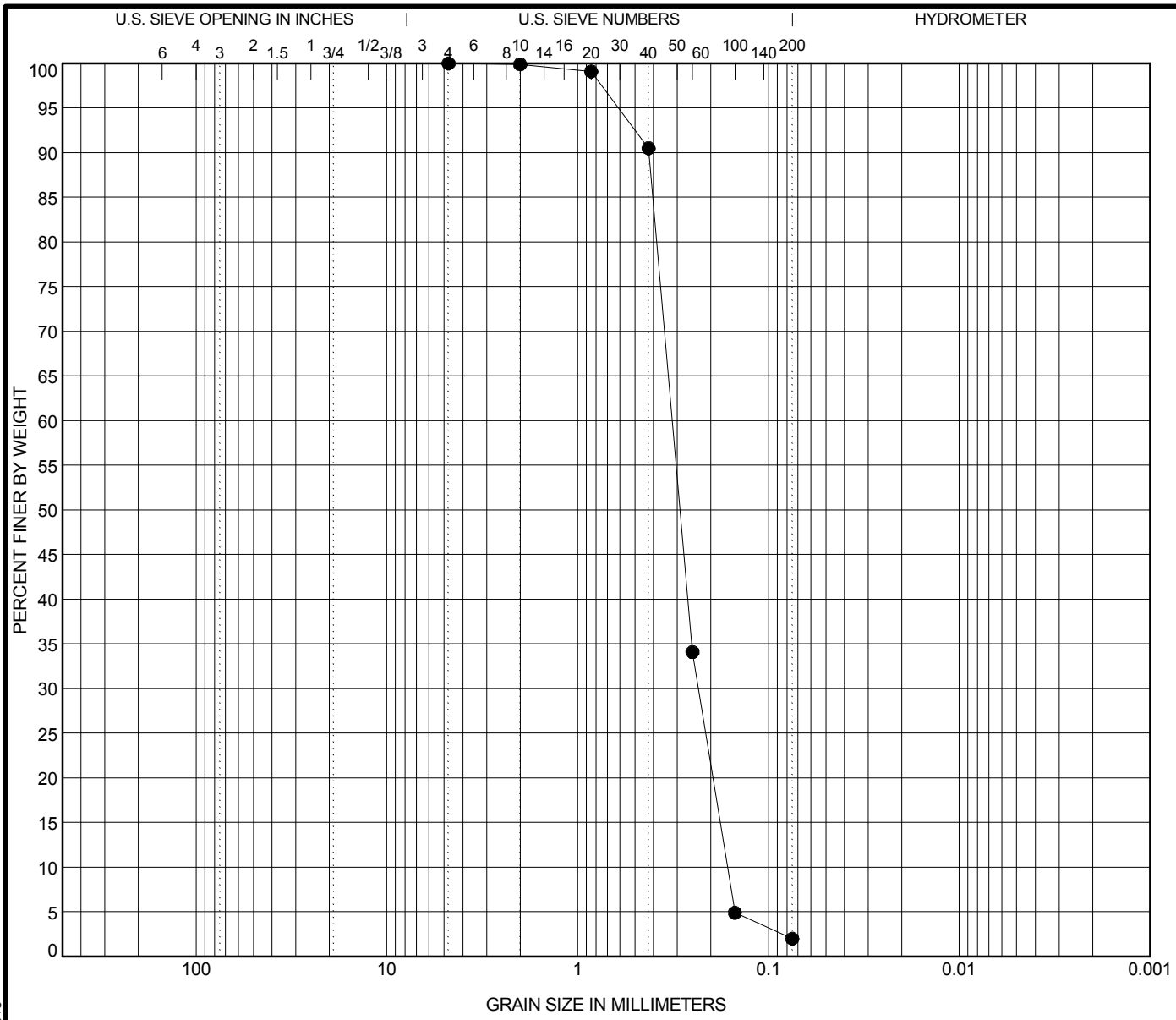
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILLE

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-12A | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, brown** | -- | -- | -- | **1.04** | **1.95** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.319** | **0.233** | **0.164** | **0.0** | **98.0** | **2.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 2.0 | 4.9 | 34.1 | 90.5 | 99.1 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | DS |

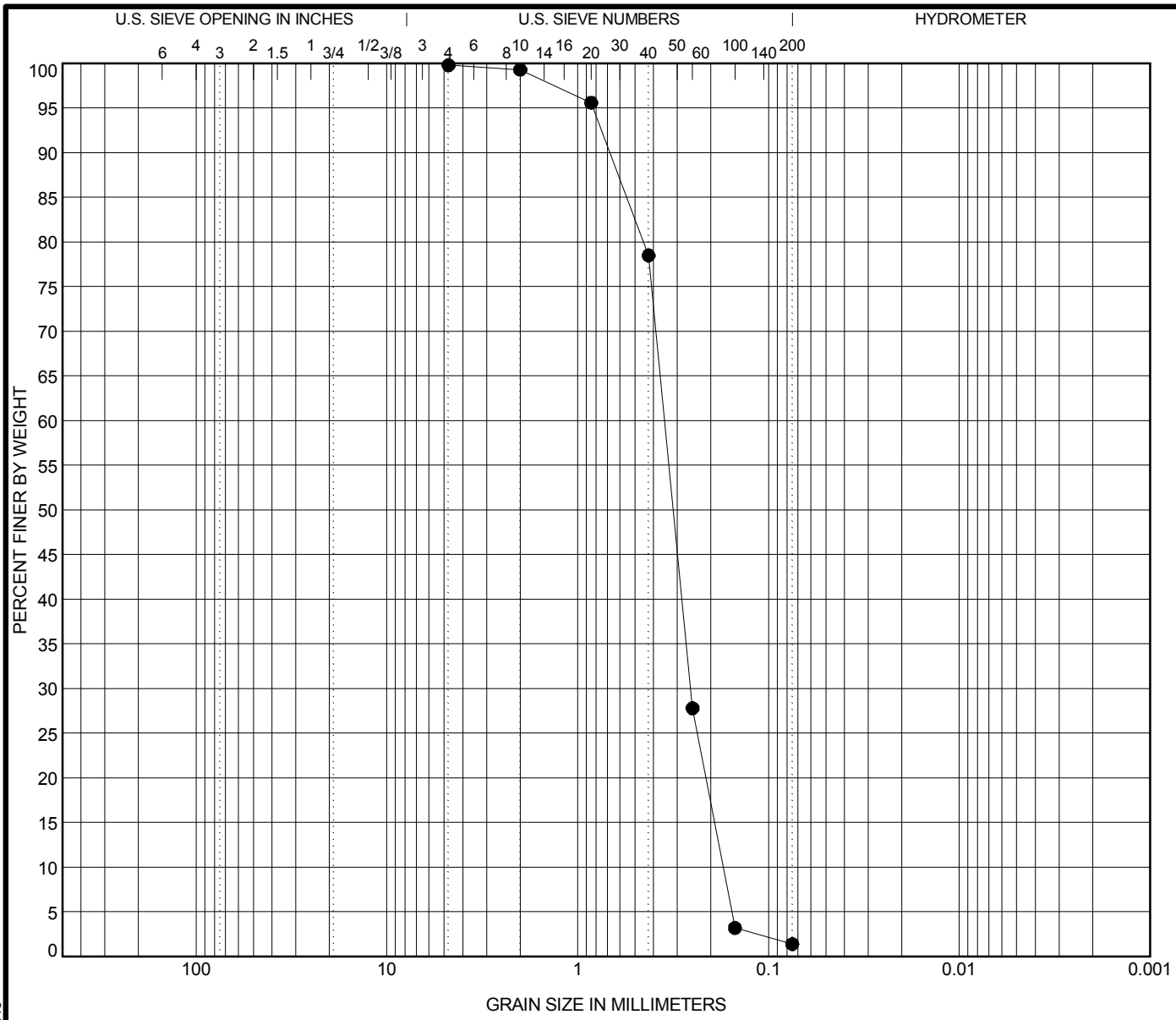
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILL

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-12A | 5.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light brown** | -- | -- | -- | **1.08** | **2.03** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.35** | **0.256** | **0.173** | **0.2** | **98.4** | **1.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 1.4 | 3.2 | 27.8 | 78.5 | 95.6 | 99.3 | 99.8 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | DS |

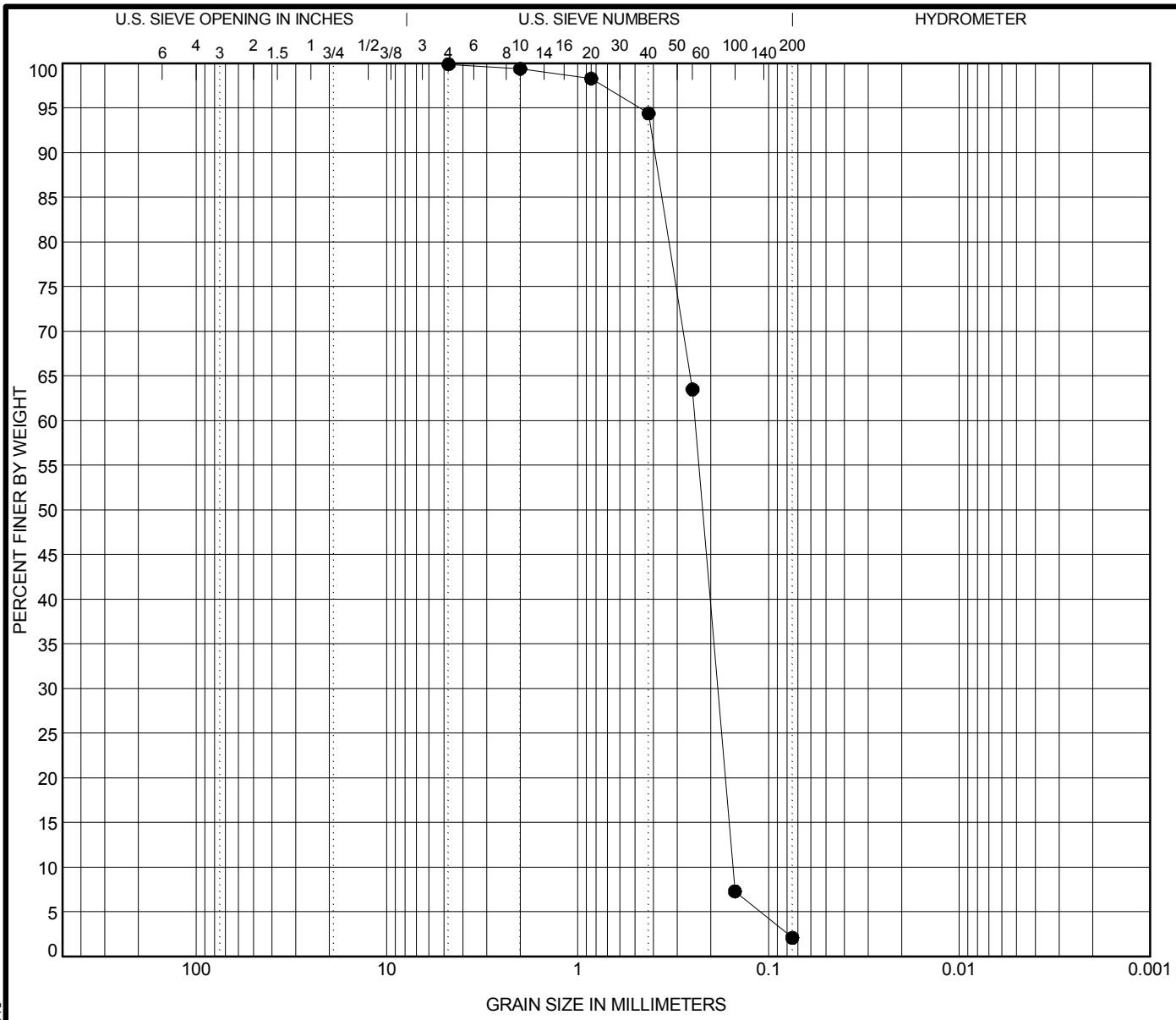
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILL

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-12A | 10.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light brown** | -- | -- | -- | **0.91** | **1.58** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.242** | **0.184** | **0.154** | **0.1** | **97.8** | **2.1** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 2.1 | 7.3 | 63.5 | 94.4 | 98.3 | 99.4 | 99.9 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | DS |

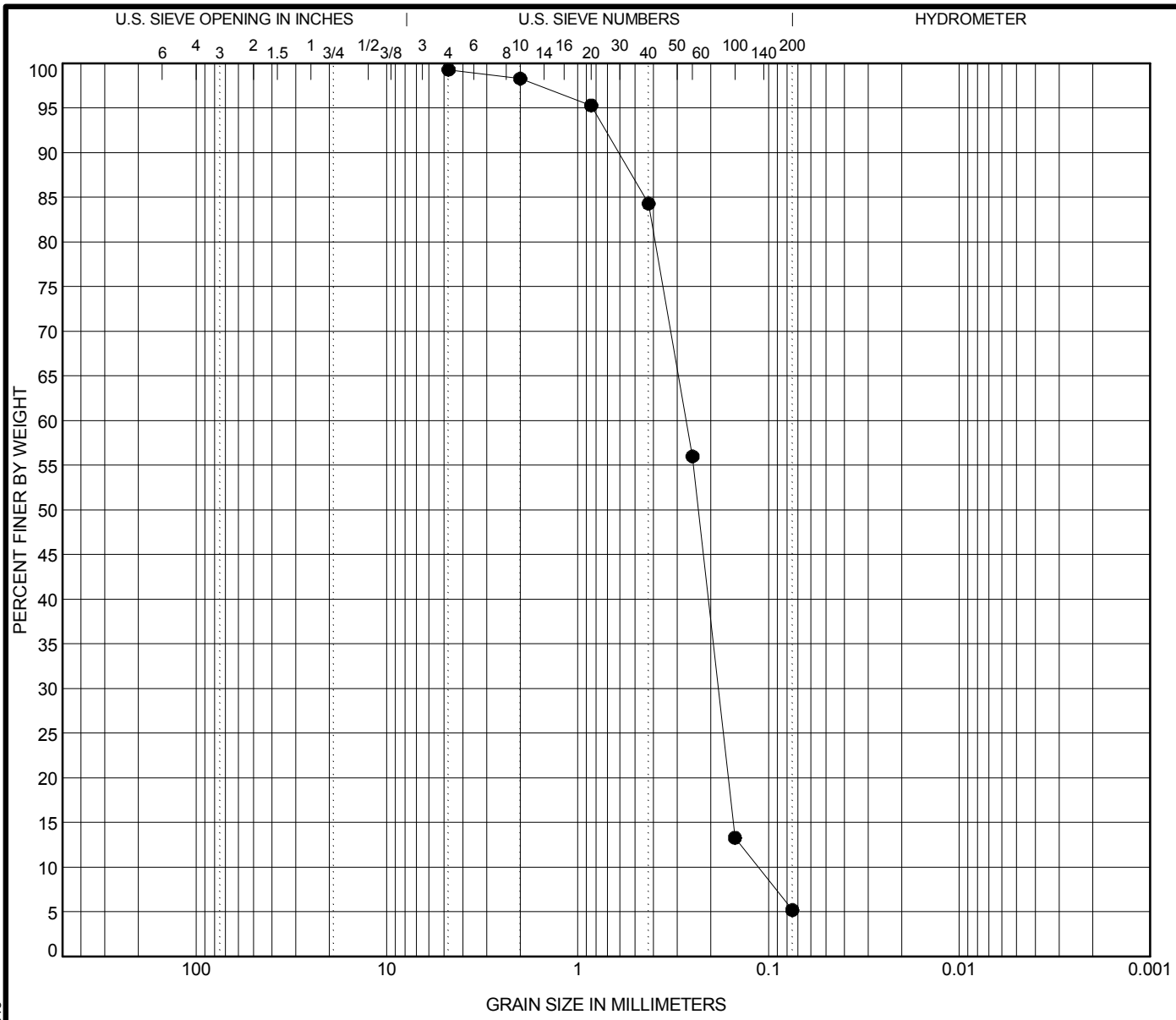
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILL

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-12A | 15.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, light gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D1140** | | | | | **0.7** | **94.1** | **5.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 5.2 | 13.3 | 56.0 | 84.3 | 95.3 | 98.3 | 99.3 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | DS |

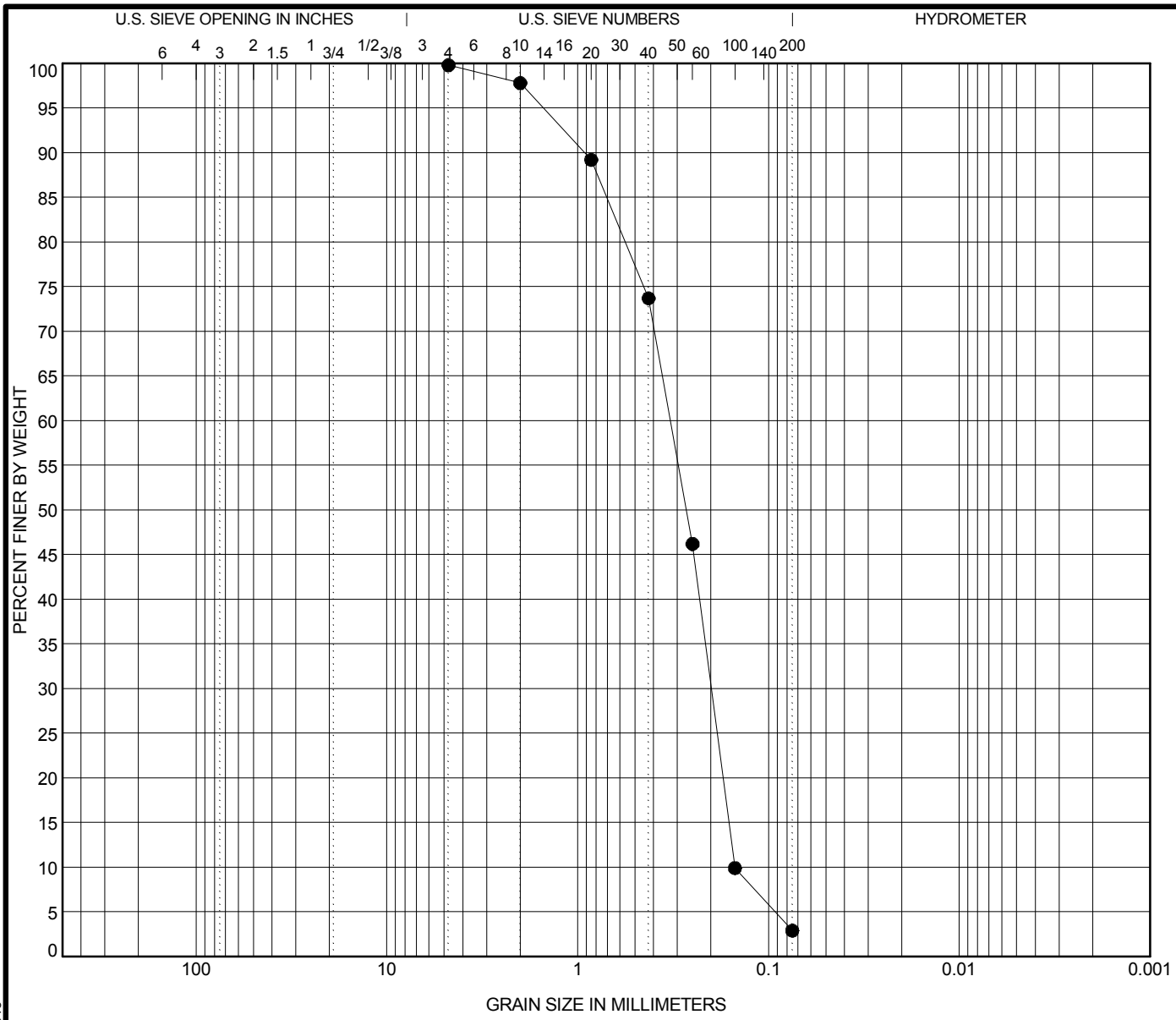
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILL

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-21 | 0.0 ft | **POORLY GRADED SAND (SP}, fine to coarse grained sand, light gray** | -- | -- | -- | **0.81** | **2.17** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.326** | **0.199** | **0.15** | **0.2** | **96.9** | **2.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 2.9 | 9.9 | 46.2 | 73.7 | 89.2 | 97.8 | 99.8 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | DS |

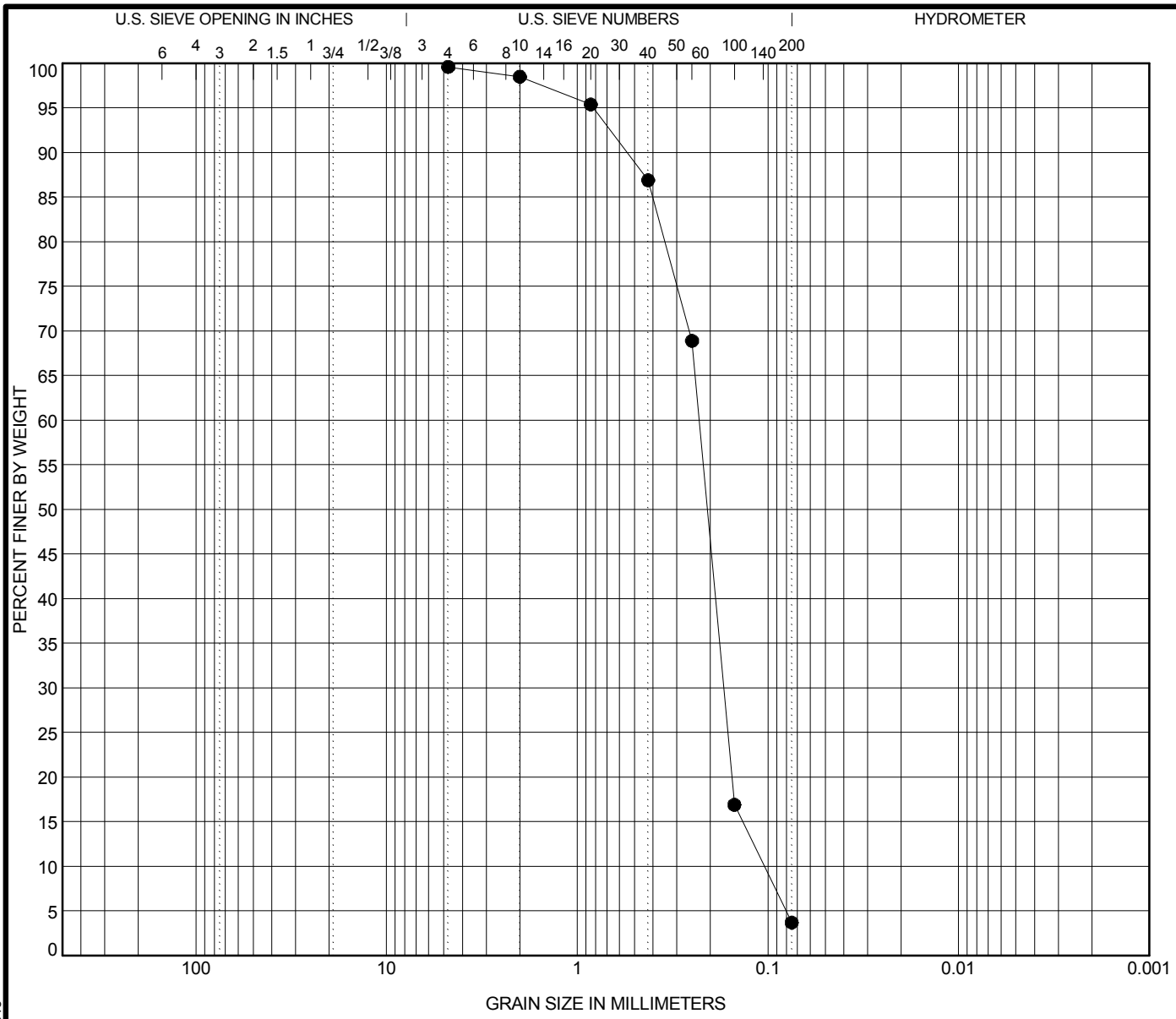
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILLE

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-21 | 5.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light gray** | -- | -- | -- | **1.22** | **2.19** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.229** | **0.171** | **0.104** | **0.4** | **95.9** | **3.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 3.7 | 16.9 | 68.9 | 86.9 | 95.4 | 98.5 | 99.6 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | DS |

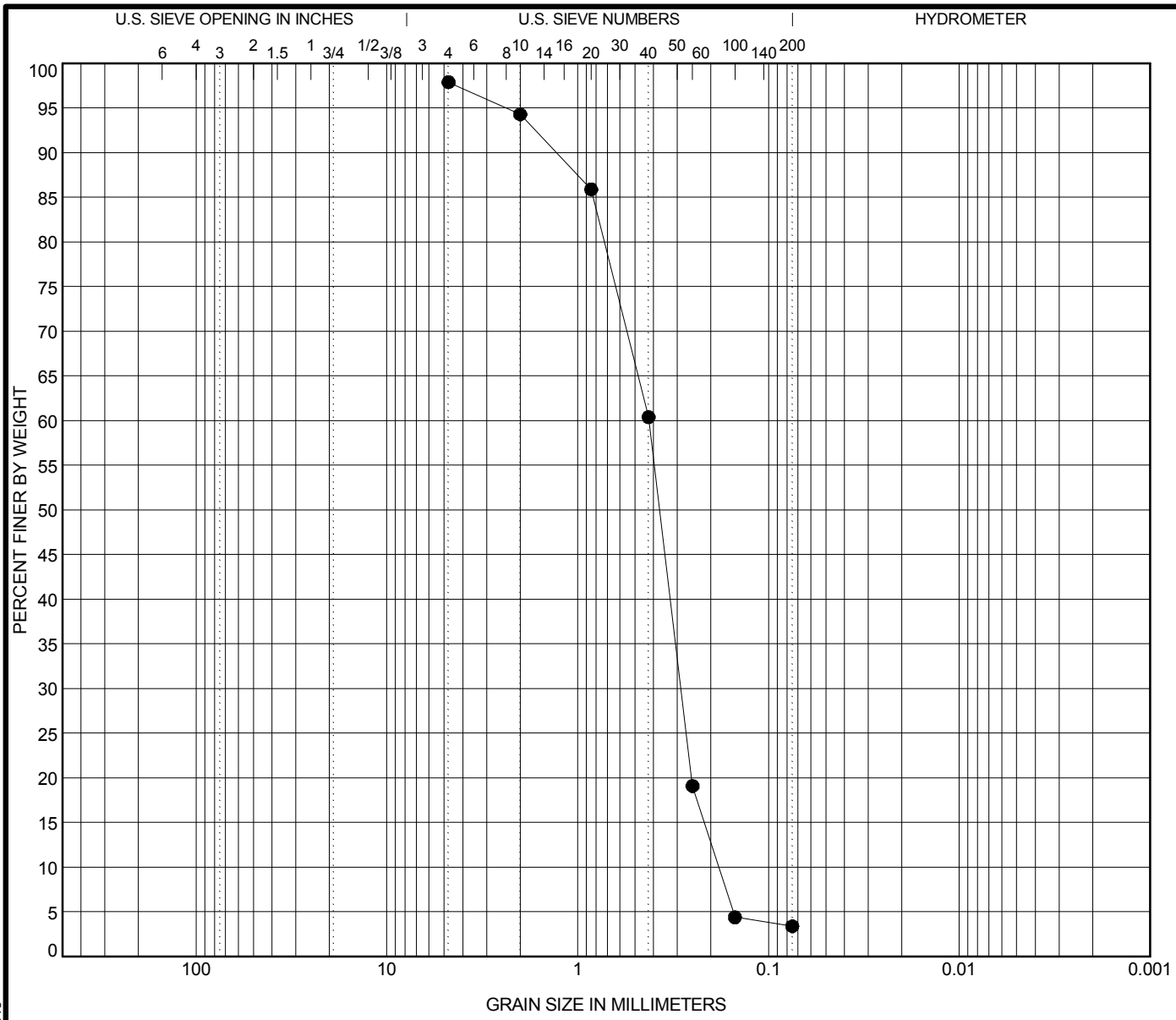
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILLE

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-22 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light gray** | -- | -- | -- | **1.07** | **2.32** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.423** | **0.288** | **0.182** | **2.1** | **94.5** | **3.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 3.4 | 4.4 | 19.1 | 60.4 | 85.9 | 94.3 | 97.9 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | DS |

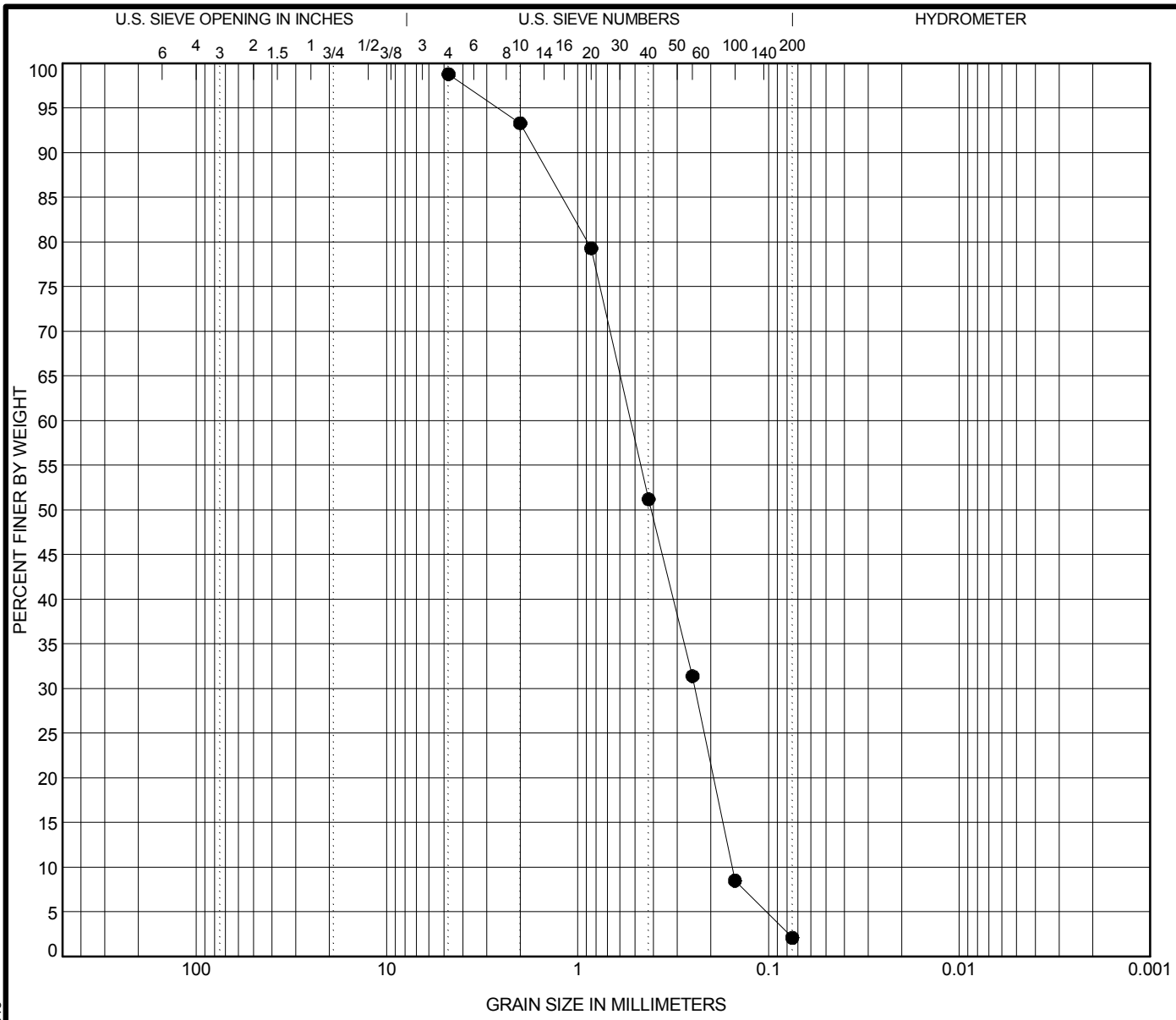
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILLE

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-22 | 4.8 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, trace gravel, gray** | -- | -- | -- | **0.72** | **3.40** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.528** | **0.242** | **0.155** | **1.2** | **96.7** | **2.1** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 2.1 | 8.5 | 31.4 | 51.2 | 79.3 | 93.3 | 98.8 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | DS |

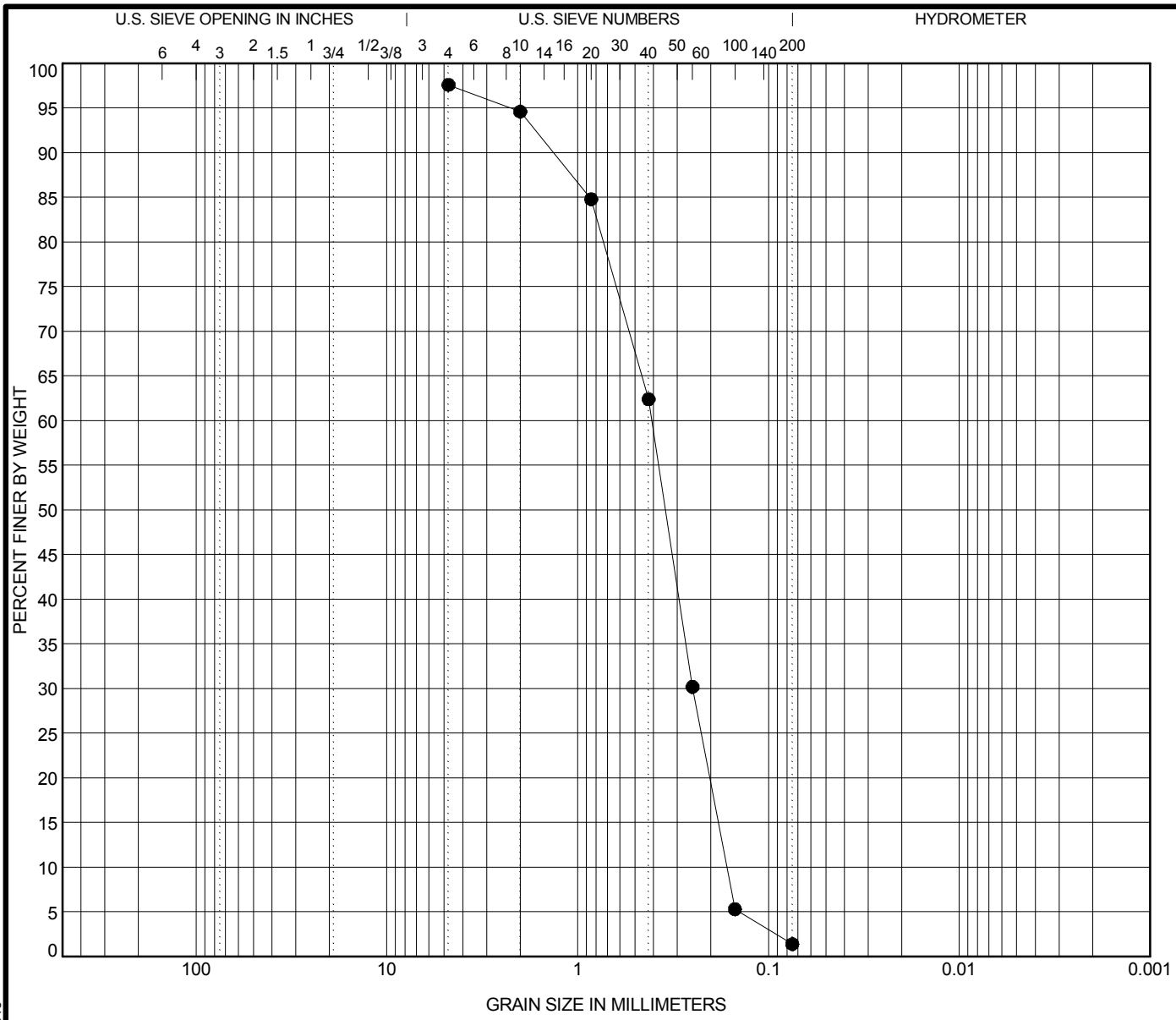
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILLE

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-23 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, trace gravel, gray** | -- | -- | -- | **0.92** | **2.47** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.409** | **0.249** | **0.165** | **2.4** | **96.2** | **1.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 1.4 | 5.3 | 30.2 | 62.4 | 84.8 | 94.6 | 97.6 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | |

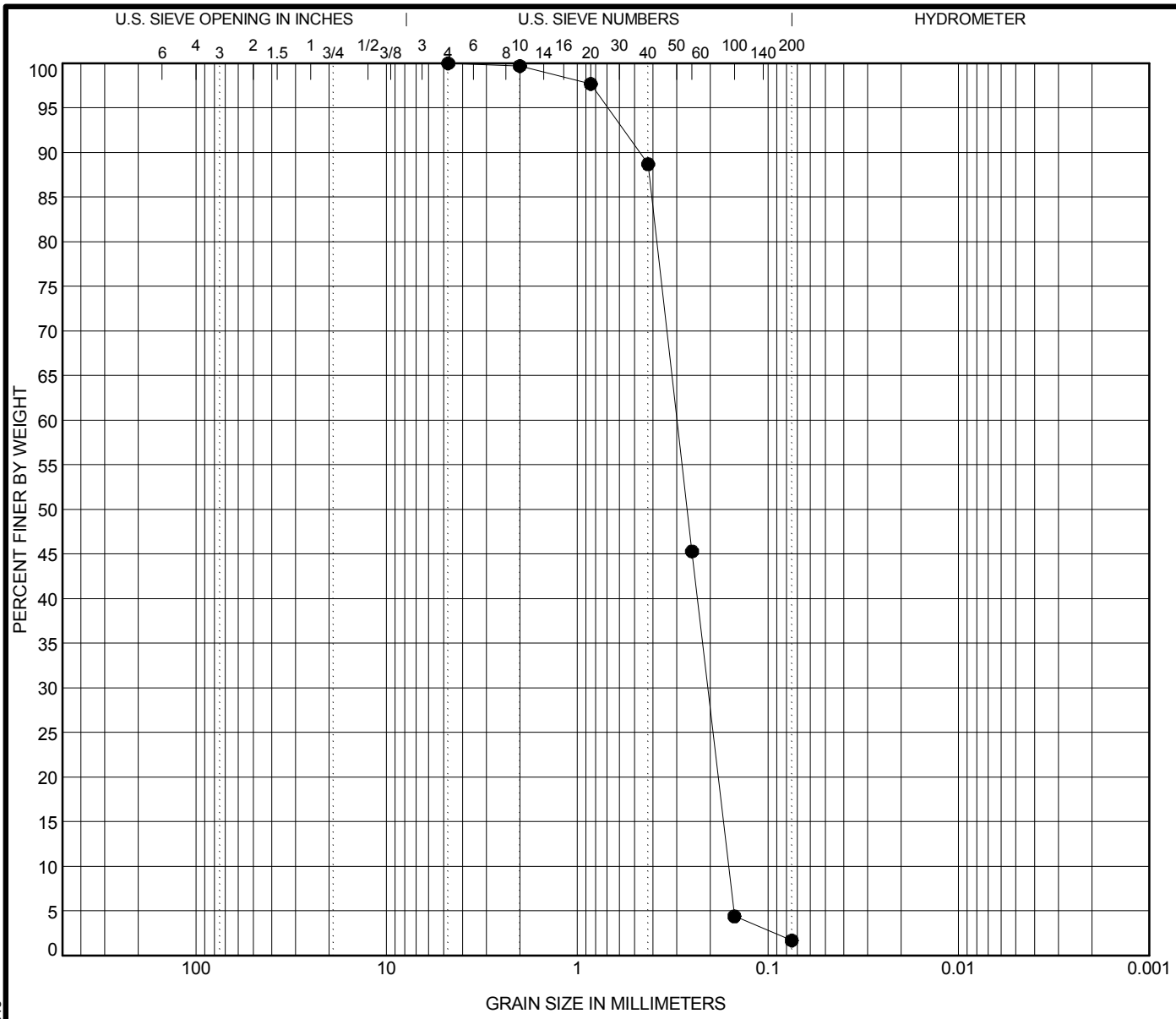
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILL

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-23 | 3.6 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, light gray** | -- | -- | -- | **0.89** | **1.86** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.299** | **0.207** | **0.161** | **0.0** | **98.3** | **1.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 1.7 | 4.4 | 45.3 | 88.7 | 97.7 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | |

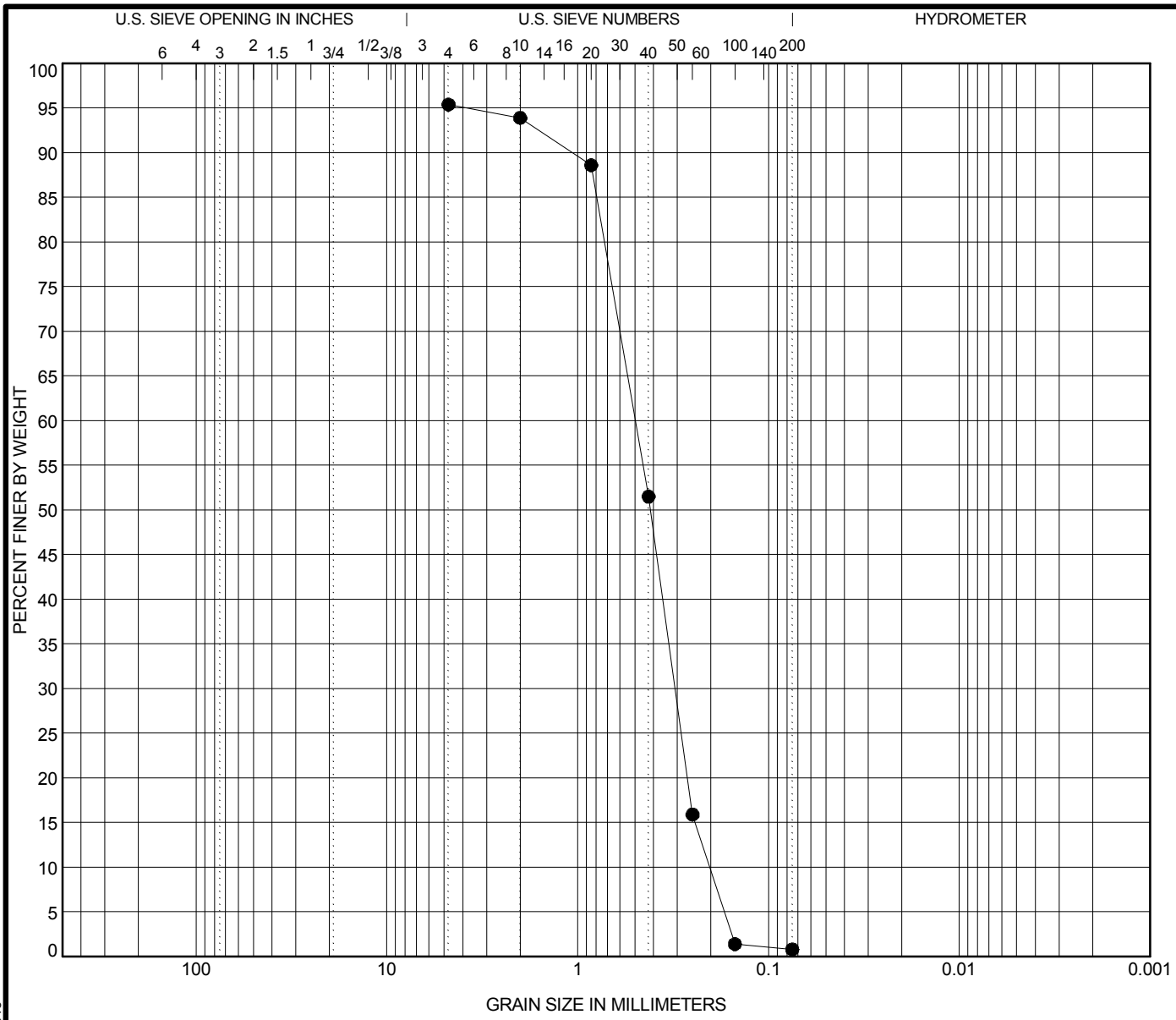
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILL

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-41 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, trace gravel, gray** | -- | -- | -- | **0.94** | **2.45** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.498** | **0.308** | **0.203** | **4.6** | **94.6** | **0.8** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 0.8 | 1.4 | 15.9 | 51.5 | 88.6 | 93.9 | 95.4 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | DS |

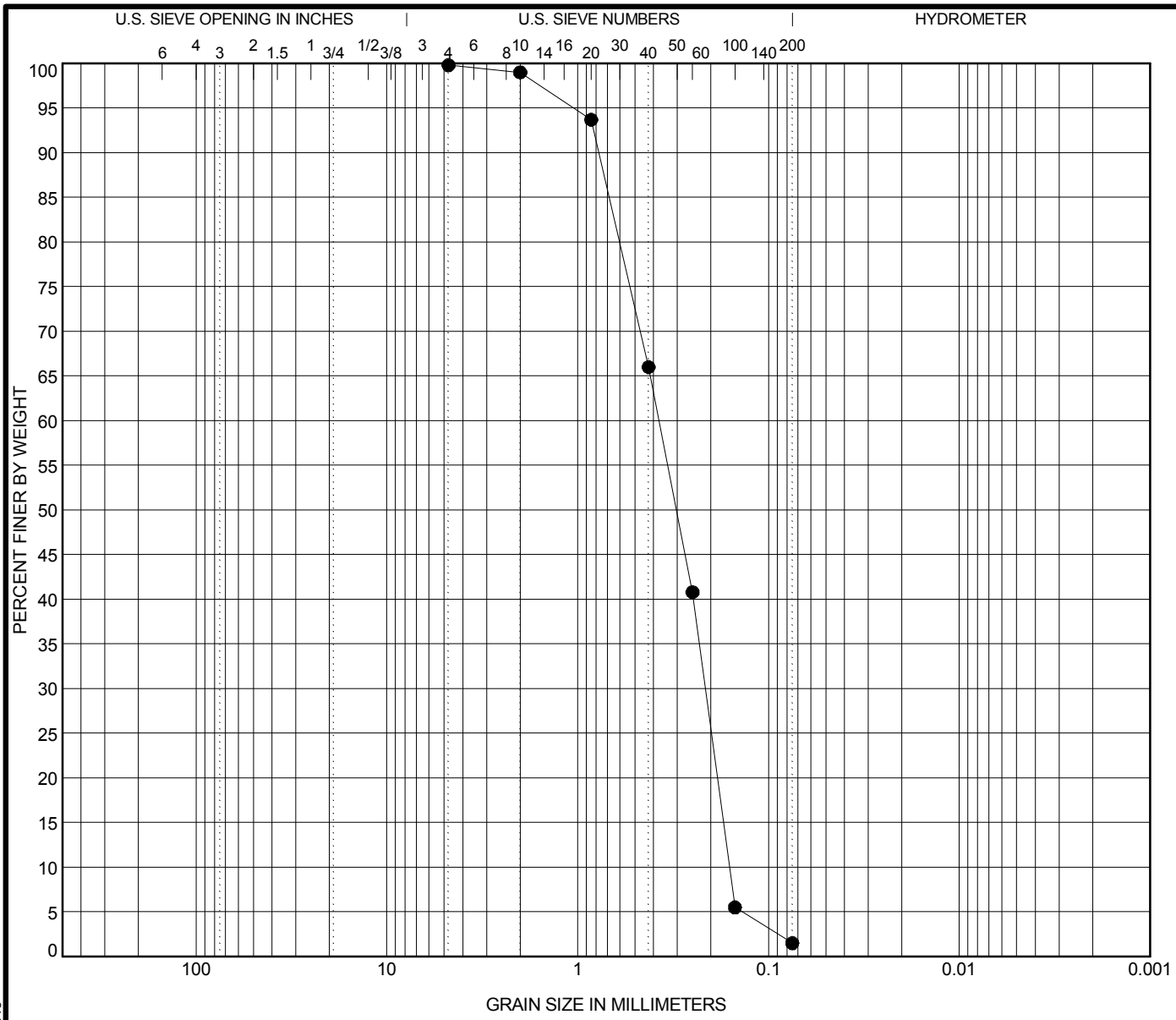
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILL

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-41 | 5.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, trace gravel, gray** | -- | -- | -- | **0.76** | **2.34** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.375** | **0.214** | **0.16** | **0.2** | **98.3** | **1.5** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 1.5 | 5.5 | 40.8 | 66.0 | 93.7 | 99.0 | 99.8 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | DS |

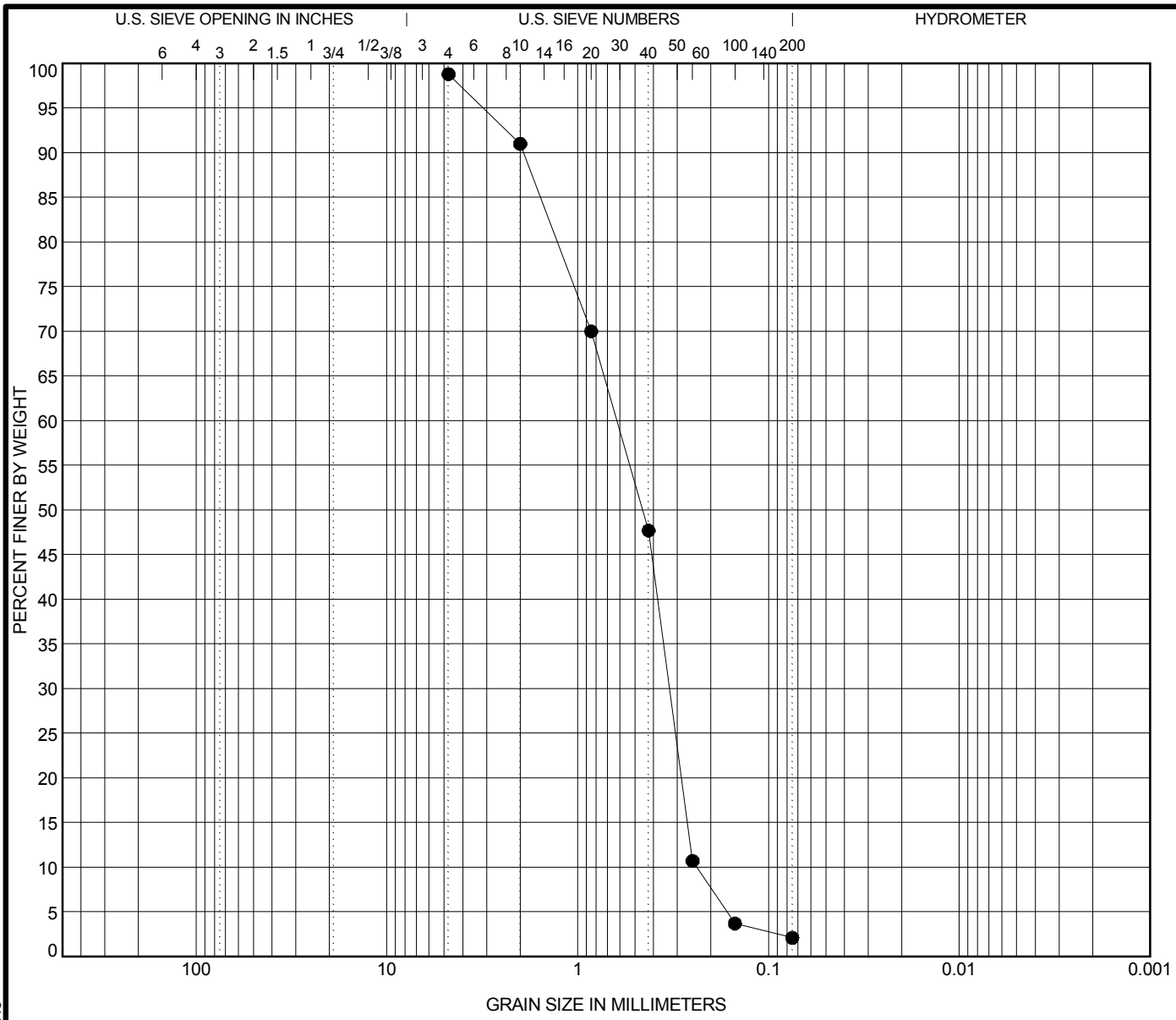
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILL

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-41 | 10.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, trace gravel, gray** | -- | -- | -- | **0.73** | **2.62** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.623** | **0.33** | **0.238** | **1.2** | **96.7** | **2.1** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 2.1 | 3.7 | 10.7 | 47.7 | 70.0 | 91.0 | 98.8 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| CK | 9/10/18 | DS |

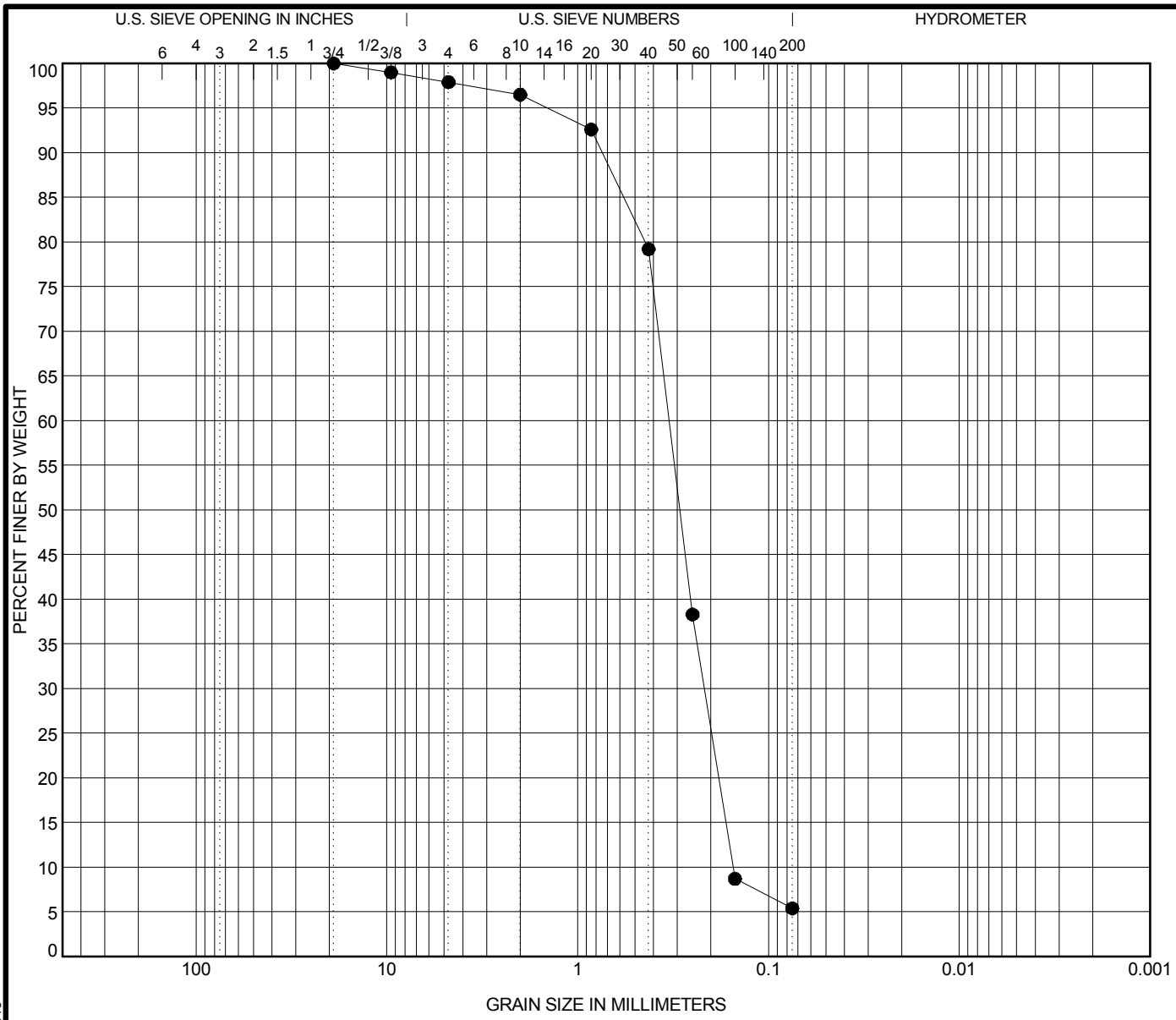
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** CVILL

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/19/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-11 | 0.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, contains shell fragments, gray** | -- | -- | -- | **0.92** | **2.16** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.331** | **0.217** | **0.153** | **2.1** | **92.5** | **5.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 5.4 | 8.7 | 38.3 | 79.2 | 92.6 | 96.5 | 97.9 | 99.0 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/7/18 | DS |

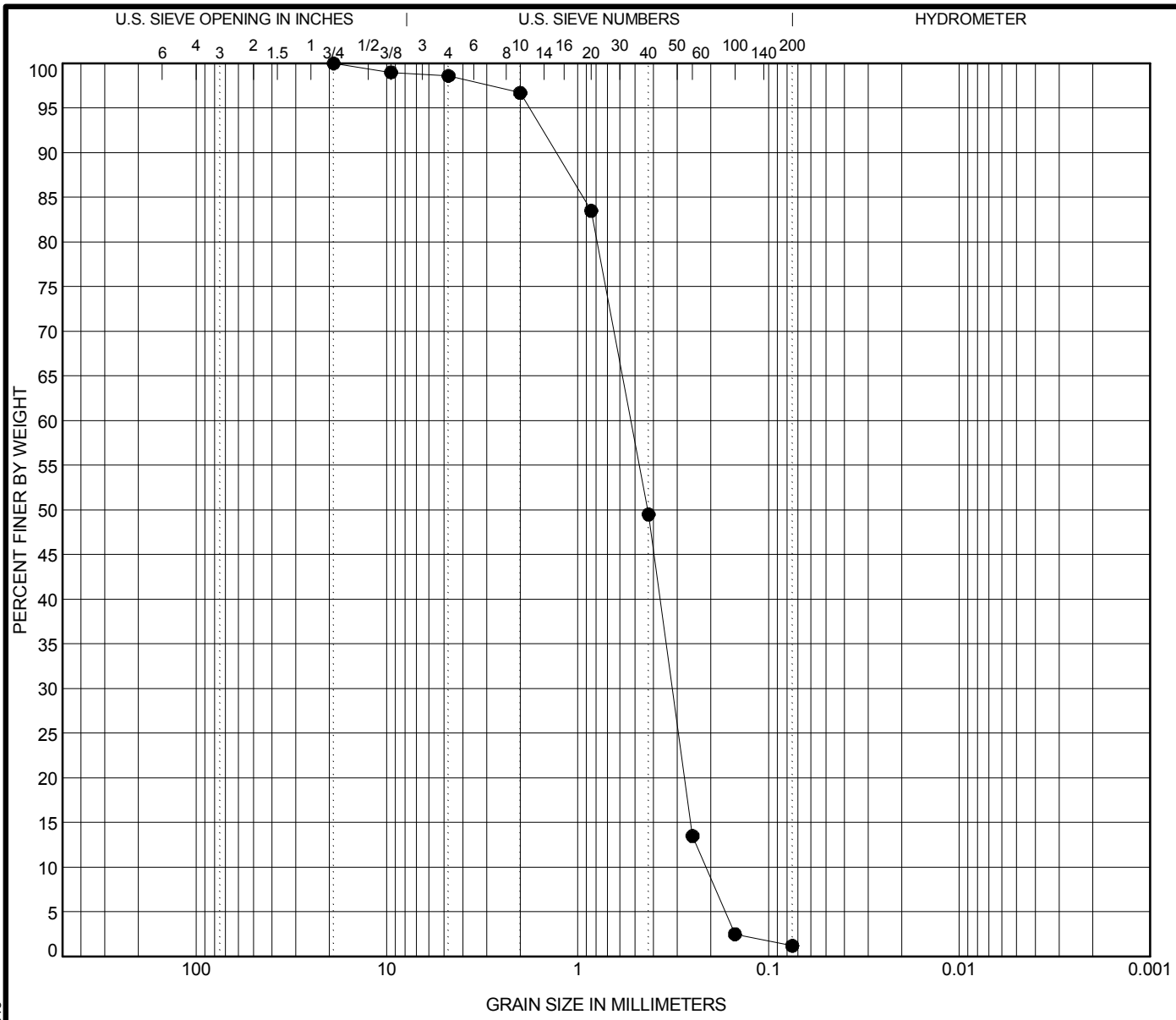
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/10/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-11 | 5.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- | **0.91** | **2.48** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.526** | **0.319** | **0.212** | **1.4** | **97.4** | **1.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 1.2 | 2.5 | 13.5 | 49.5 | 83.5 | 96.7 | 98.6 | 99.0 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/7/18 | DS |

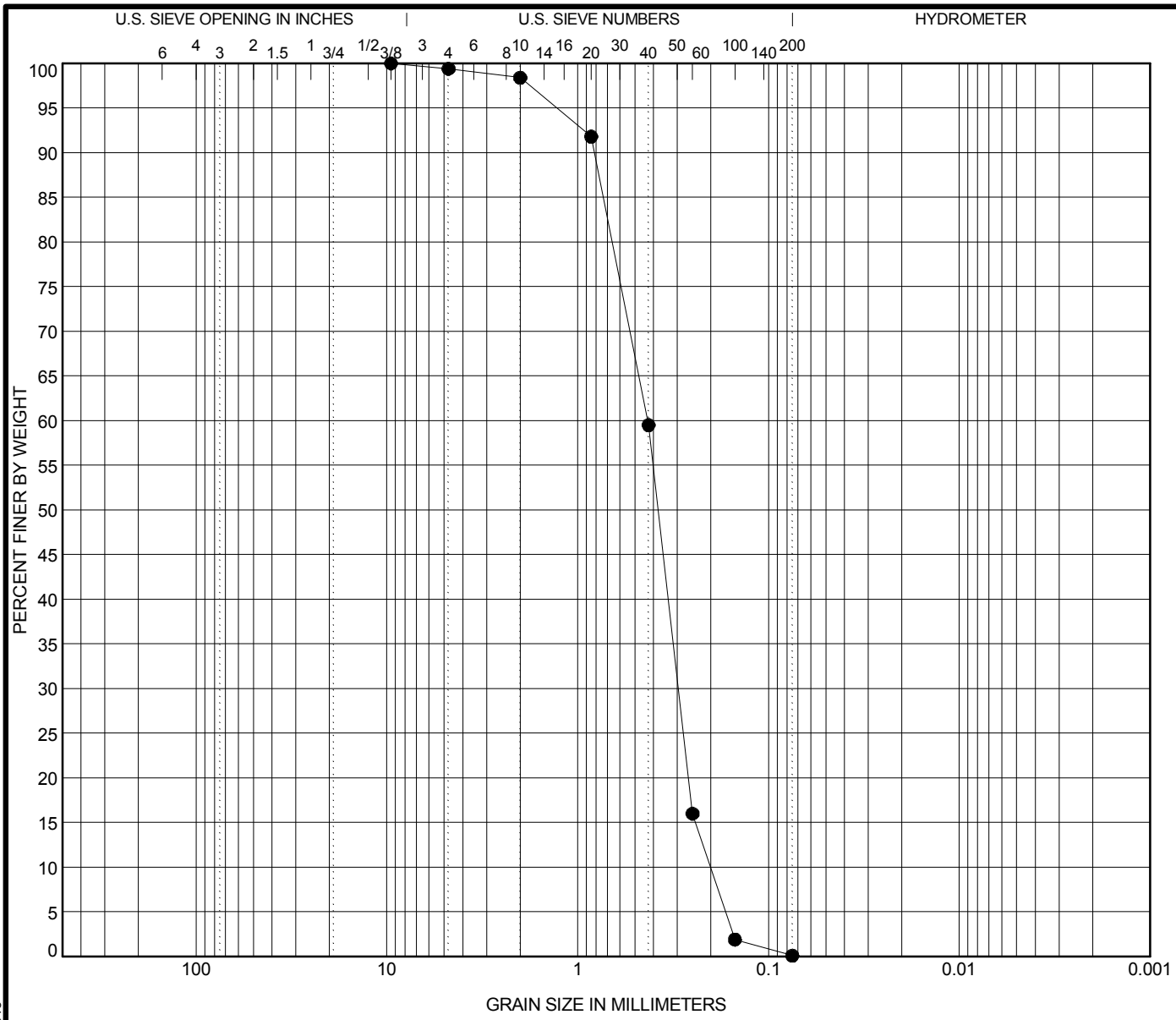
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/10/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-11 | 10.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- | **1.02** | **2.14** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.43** | **0.297** | **0.201** | **0.6** | **99.3** | **0.1** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 0.1 | 1.9 | 16.0 | 59.5 | 91.8 | 98.4 | 99.4 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/7/18 | DS |

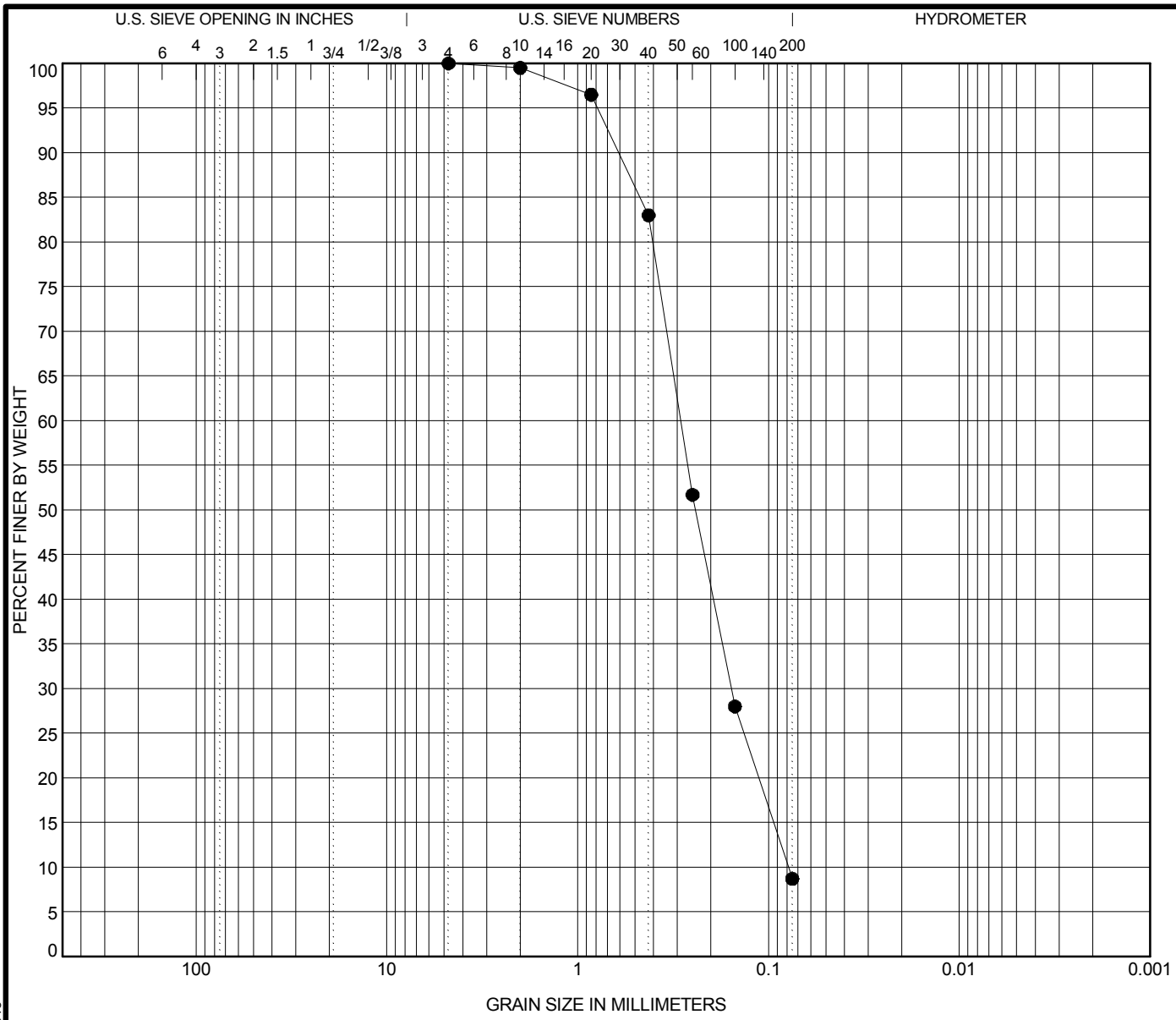
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/10/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-18 | 0.0 ft | **POORLY GRADED SAND SILT (SP-SM), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.288** | **0.157** | **0.079** | **0.0** | **91.3** | **8.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 8.7 | 28.0 | 51.7 | 83.0 | 96.5 | 99.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/7/18 | |

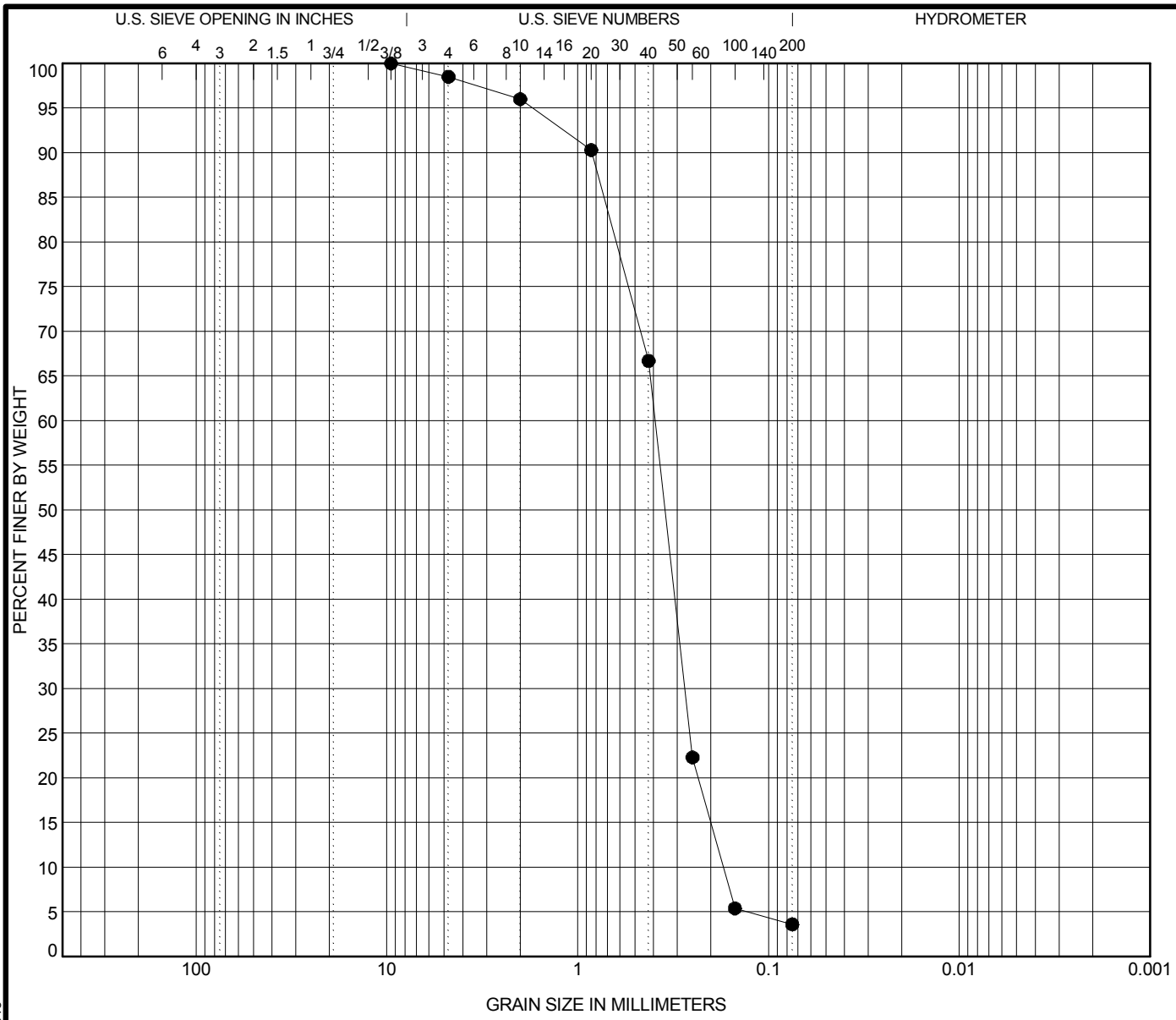
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/10/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-18 | 5.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.392** | **0.274** | **0.172** | **1.5** | **94.9** | **3.6** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 3.6 | 5.4 | 22.3 | 66.7 | 90.3 | 96.0 | 98.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/7/18 | |

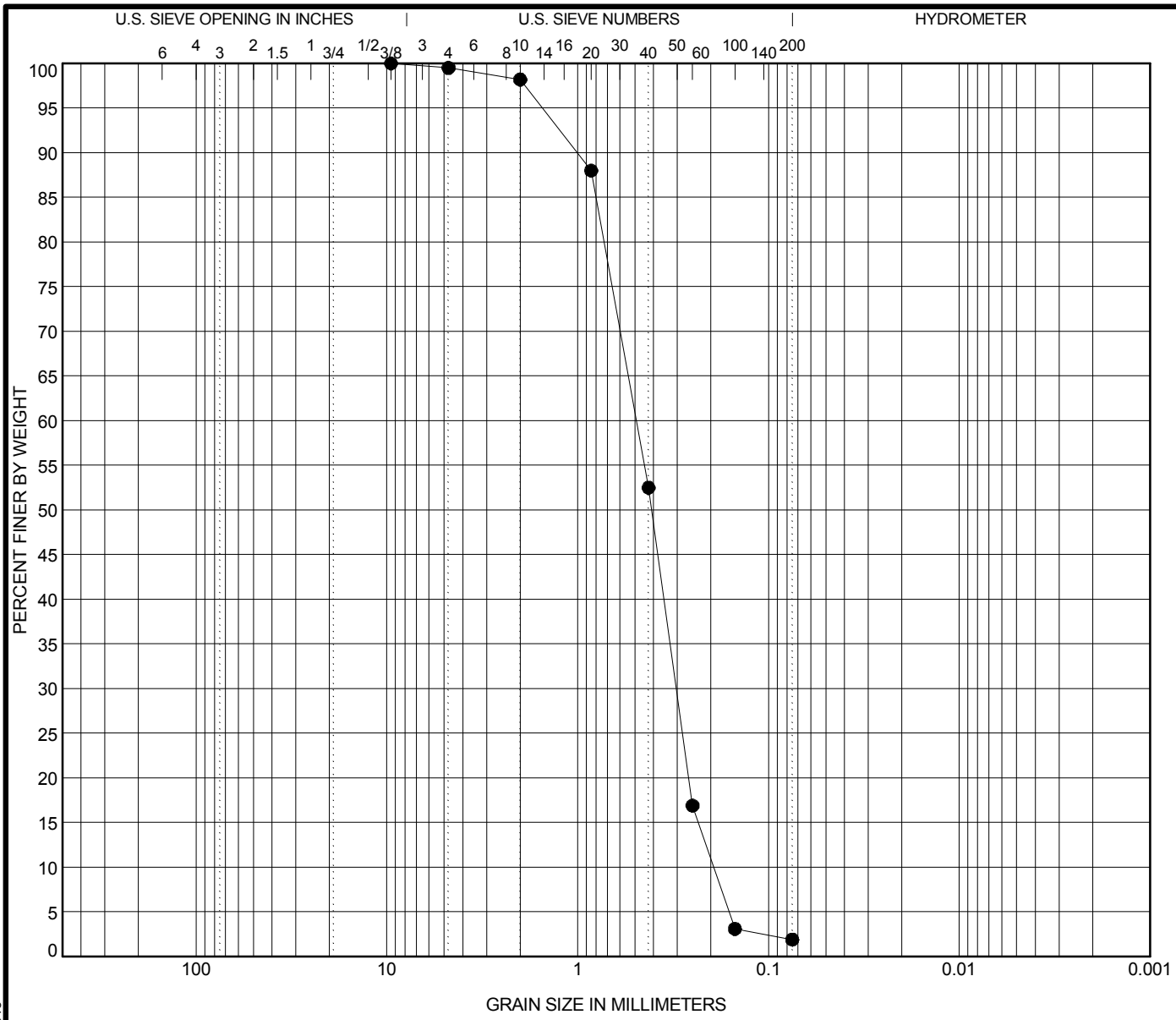
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/10/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-19A | 2.3 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- | **0.97** | **2.54** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.492** | **0.304** | **0.194** | **0.5** | **97.6** | **1.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 1.9 | 3.1 | 16.9 | 52.5 | 88.0 | 98.2 | 99.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/7/18 | DS |

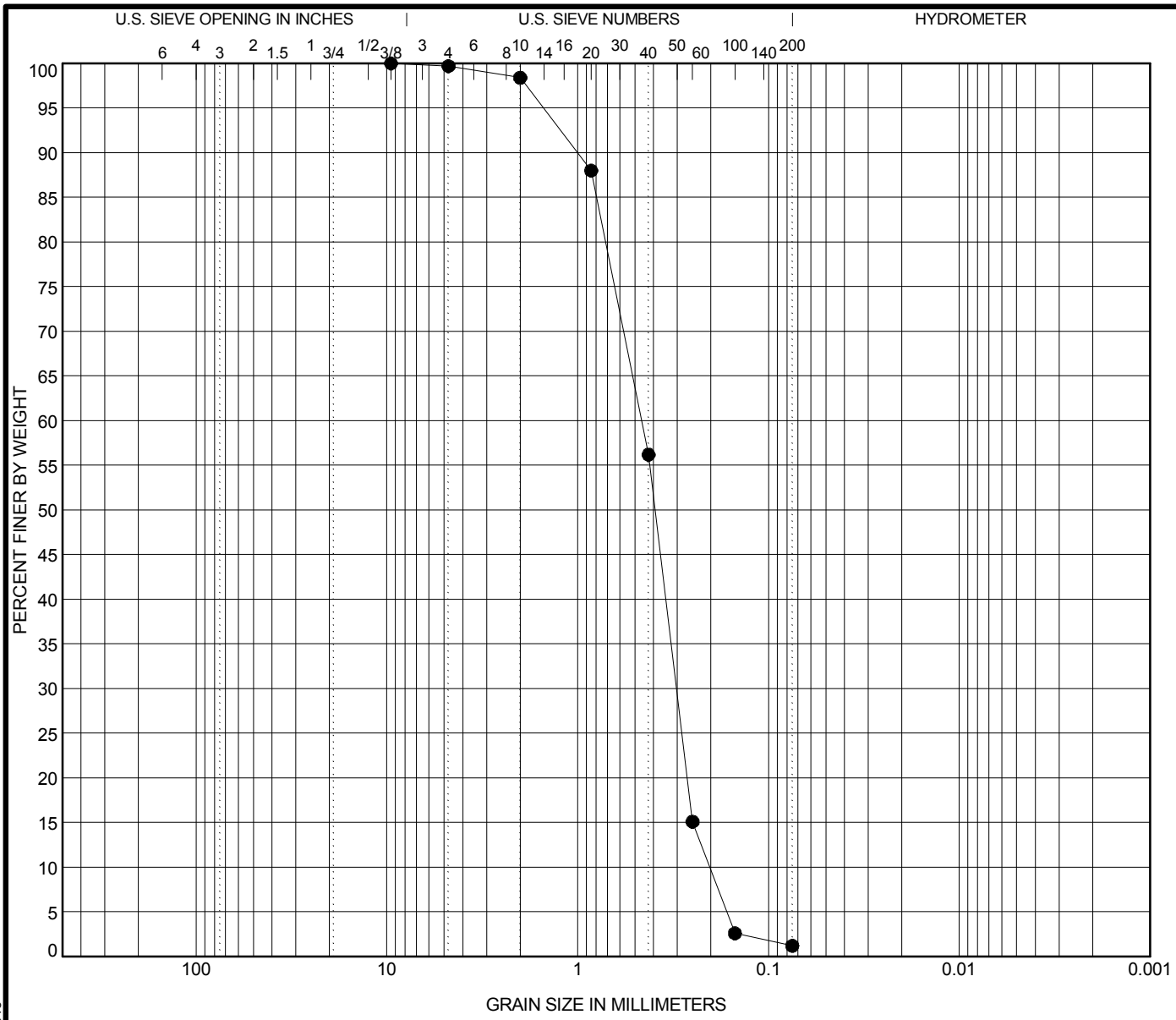
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/10/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-19A | 5.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, light brown and gray** | -- | -- | -- | **0.98** | **2.27** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.462** | **0.303** | **0.203** | **0.3** | **98.5** | **1.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 1.2 | 2.6 | 15.1 | 56.2 | 88.0 | 98.4 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/7/18 | DS |

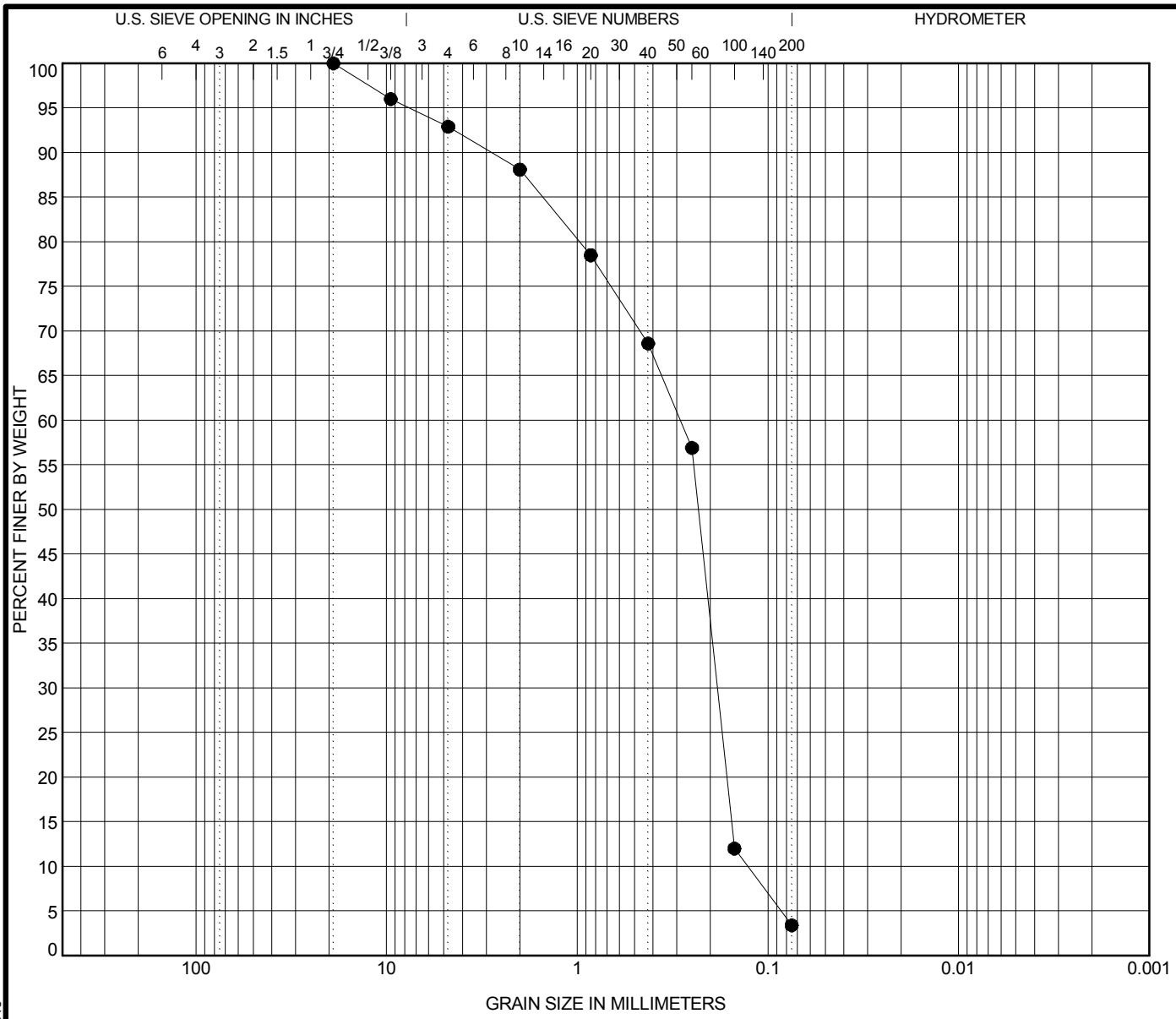
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/10/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-19A | 11.1 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- | **0.92** | **2.25** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.288** | **0.184** | **0.128** | **7.1** | **89.5** | **3.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 3.4 | 12.0 | 56.9 | 68.6 | 78.5 | 88.1 | 92.9 | 96.0 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/7/18 | DS |

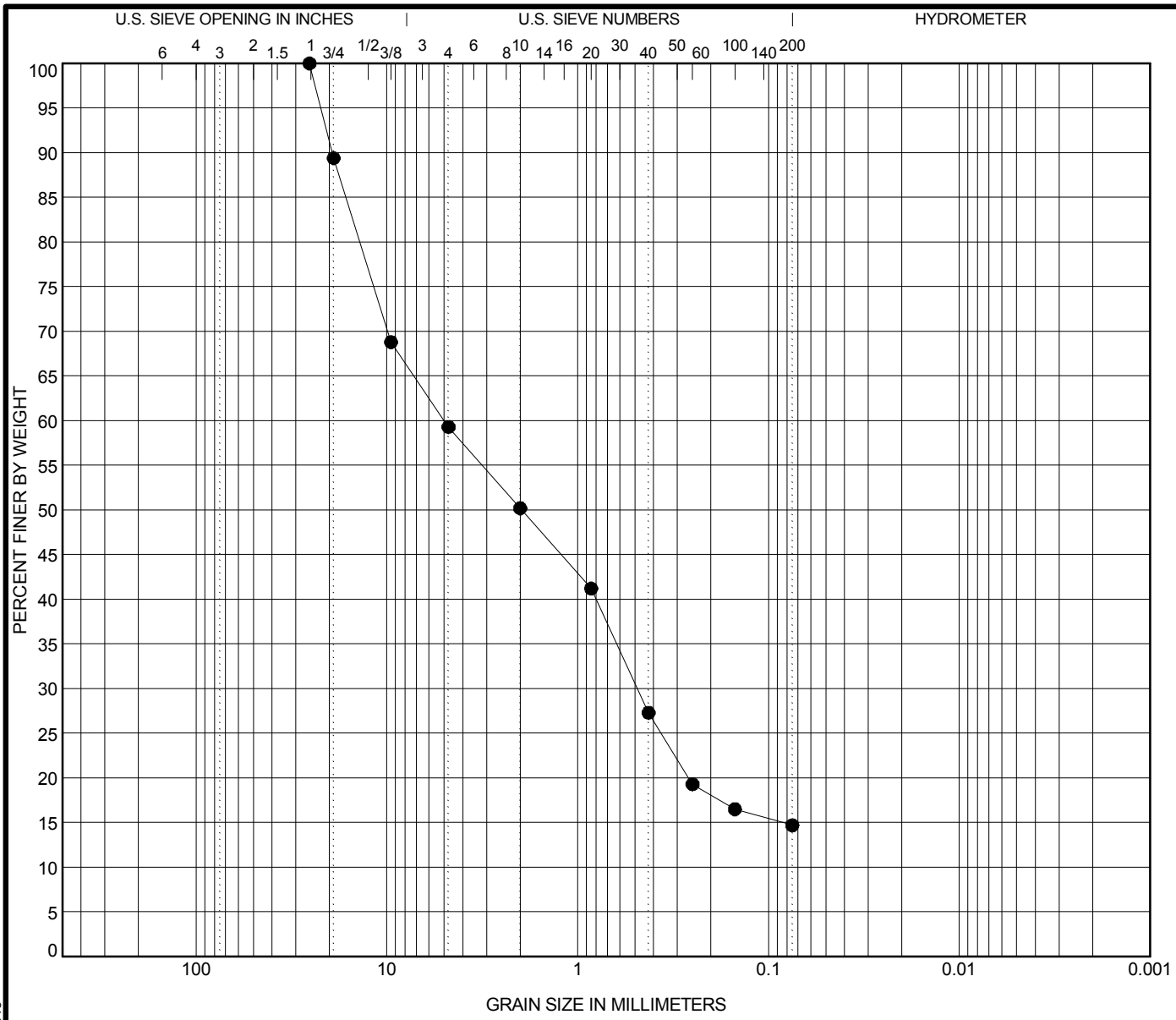
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/10/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-20 | 0.0 ft | **SILTY SAND WITH GRAVEL (SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **25.4** | **4.999** | **0.486** | **--** | **40.7** | **44.6** | **14.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" | 1" |
|---|---|---|---|---|---|---|---|---|---|---|
| % Finer | 14.7 | 16.5 | 19.3 | 27.3 | 41.2 | 50.2 | 59.3 | 68.8 | 89.4 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/7/18 | DS |

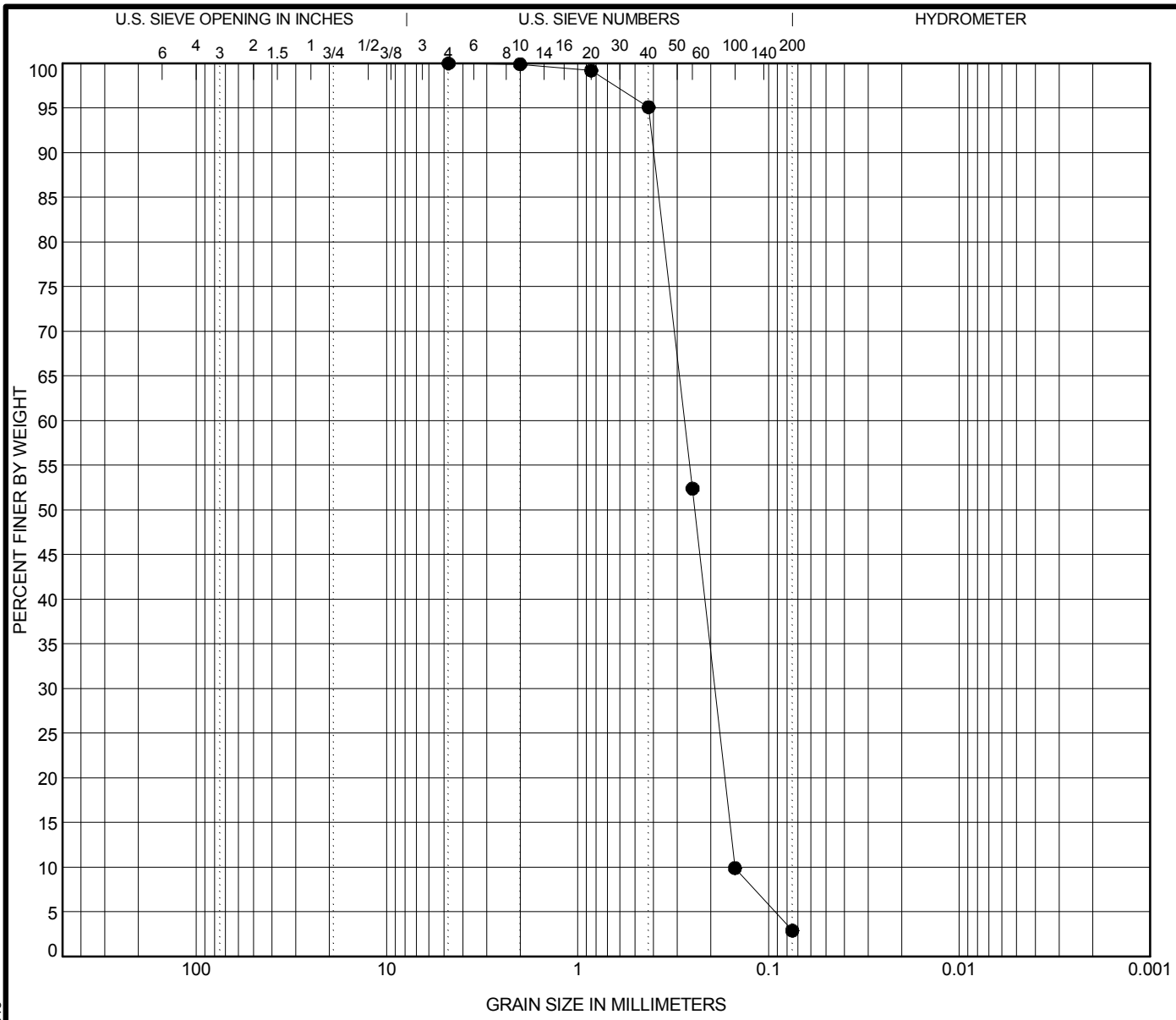
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/10/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-20 | 1.9 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, dark gray** | -- | -- | -- | **0.88** | **1.83** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.275** | **0.191** | **0.15** | **0.0** | **97.1** | **2.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 2.9 | 9.9 | 52.4 | 95.1 | 99.2 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/7/18 | DS |

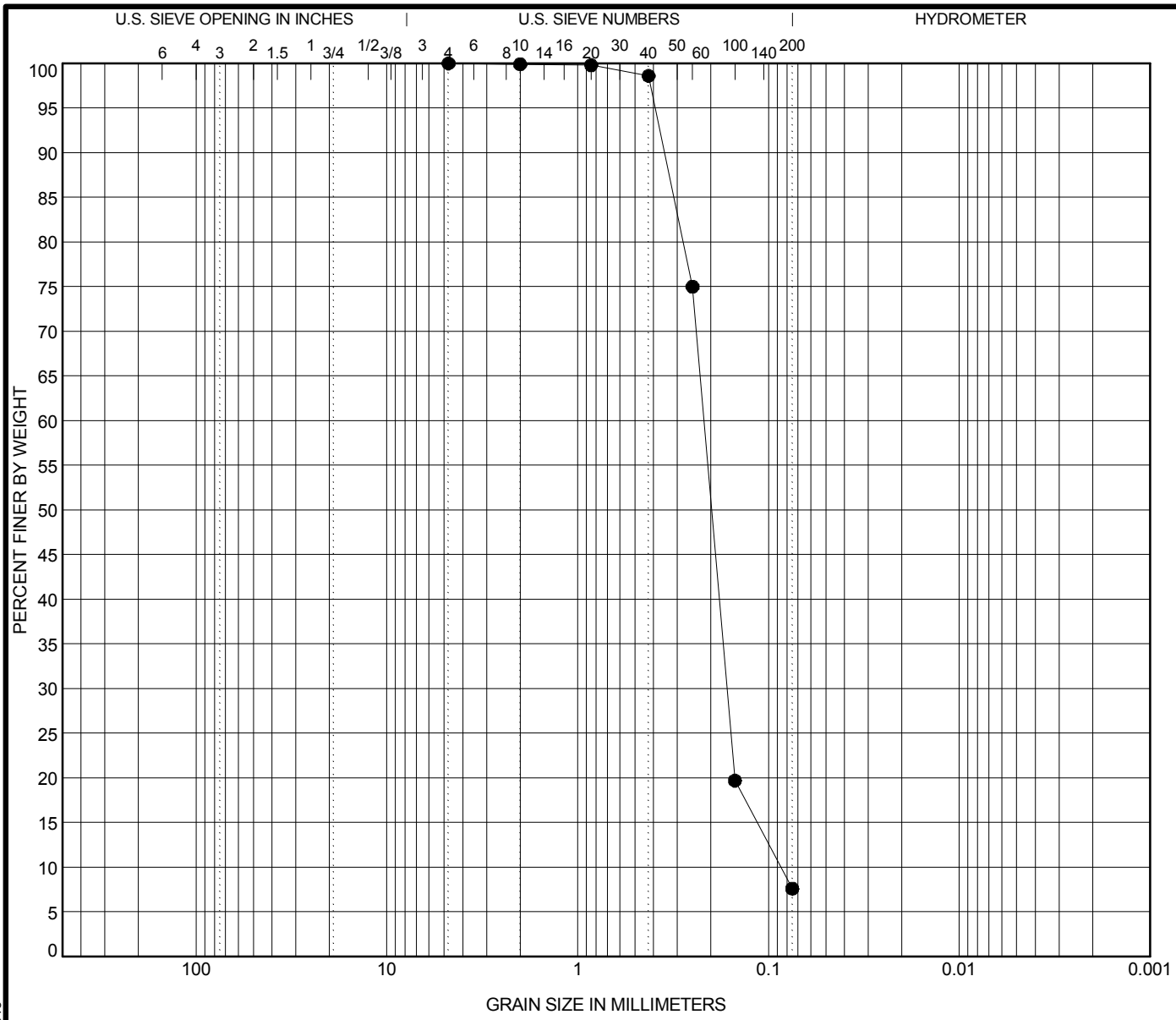
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/10/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-26 | 0.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to medium grained sand, dark gray** | -- | -- | -- | **1.45** | **2.53** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.218** | **0.165** | **0.086** | **0.0** | **92.4** | **7.6** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 7.6 | 19.7 | 75.0 | 98.6 | 99.8 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/7/18 | DS |

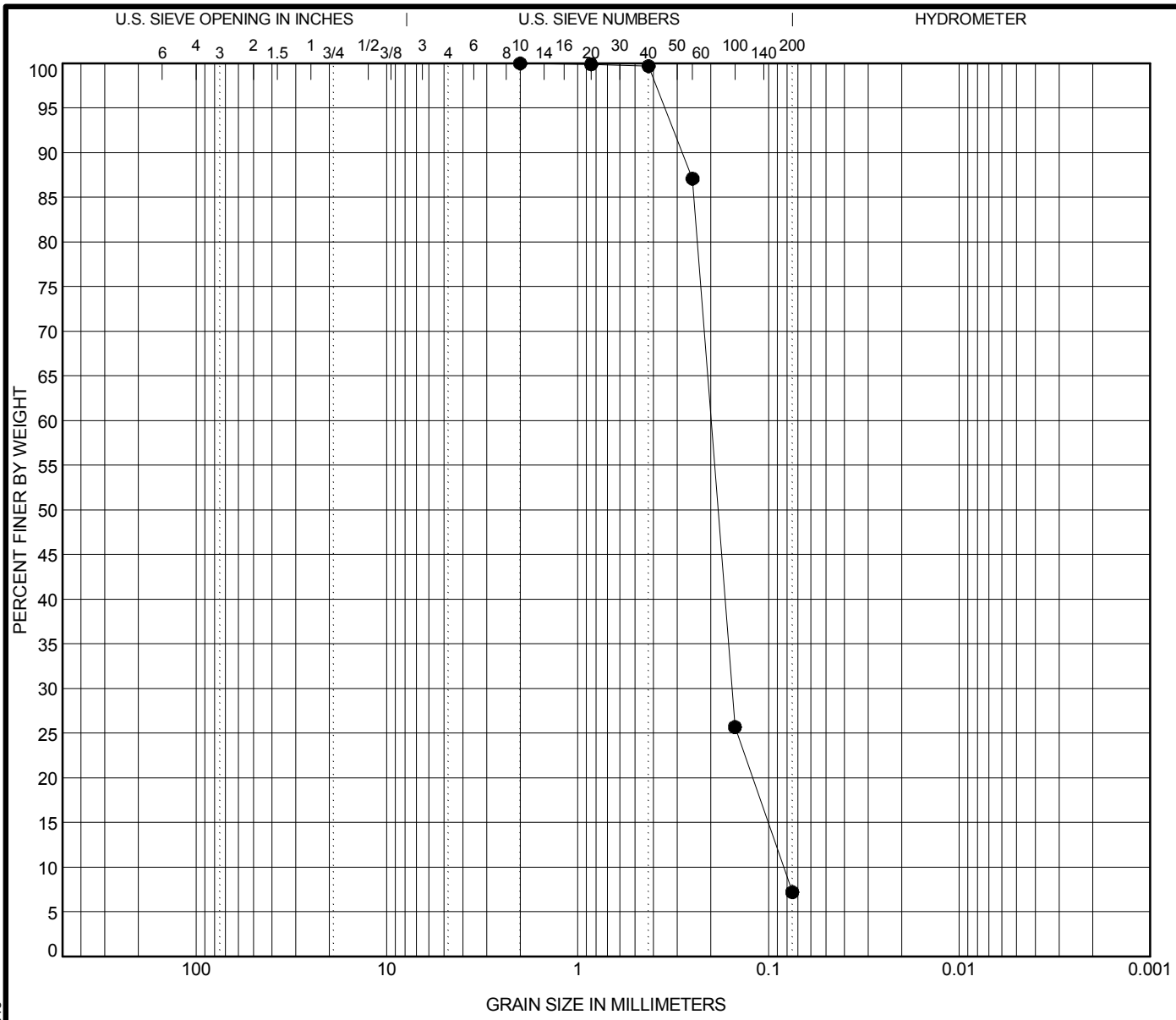
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-26 | 5.1 ft | **POORLY GRADED SAND (SP), fine to medium grained sand, dark gray** | -- | -- | -- | **1.45** | **2.40** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **2** | **0.2** | **0.155** | **0.083** | **0.0** | **92.8** | **7.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 |
|---|---|---|---|---|---|---|
| % Finer | 7.2 | 25.7 | 87.1 | 99.7 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/7/18 | DS |

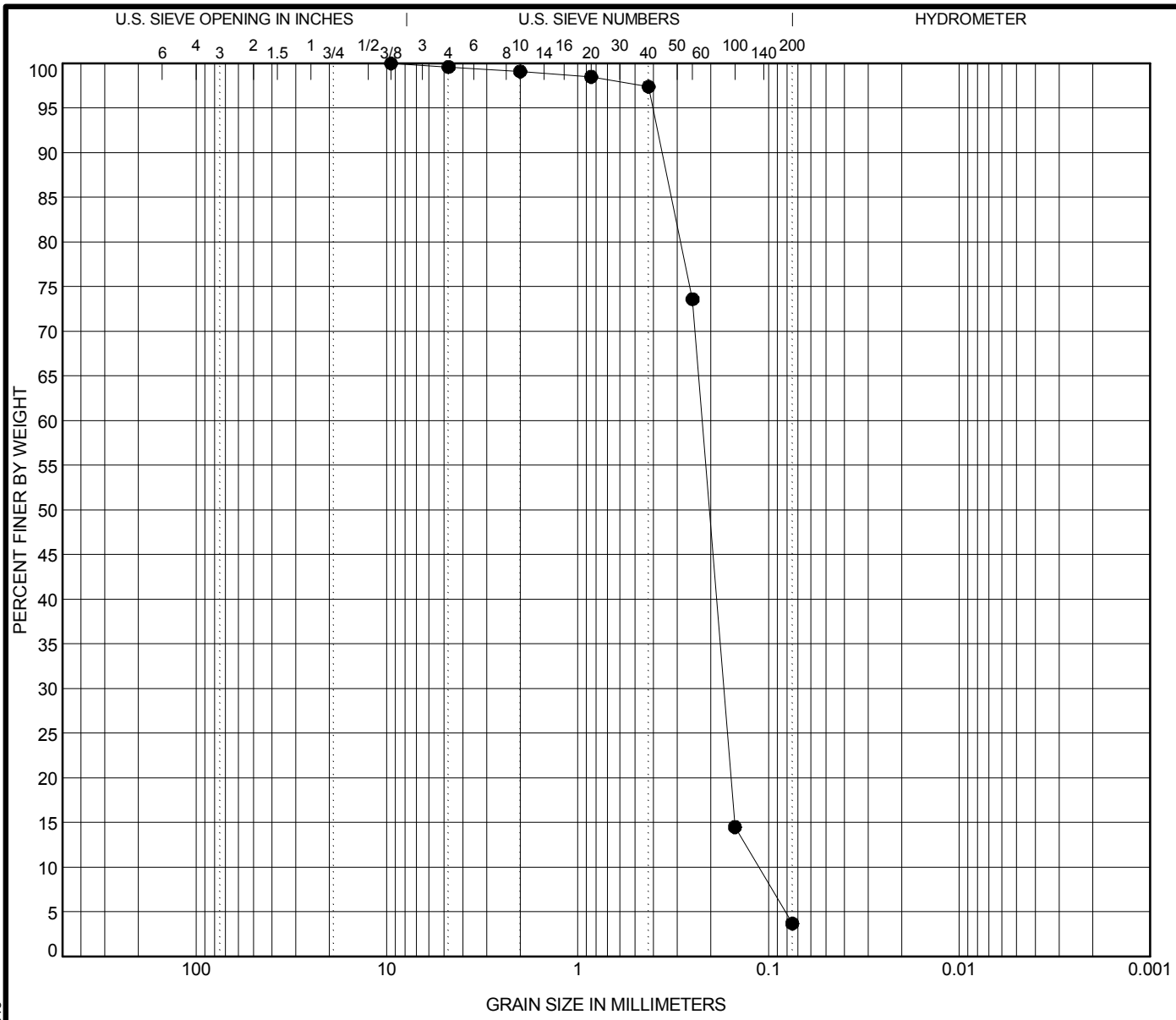
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-26 | 10.1 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, dark gray** | -- | -- | -- | **1.18** | **1.98** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.222** | **0.172** | **0.112** | **0.4** | **95.9** | **3.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 in. |
|---|---|---|---|---|---|---|---|---|
| % Finer | 3.7 | 14.5 | 73.6 | 97.4 | 98.5 | 99.1 | 99.6 | 100.0 |

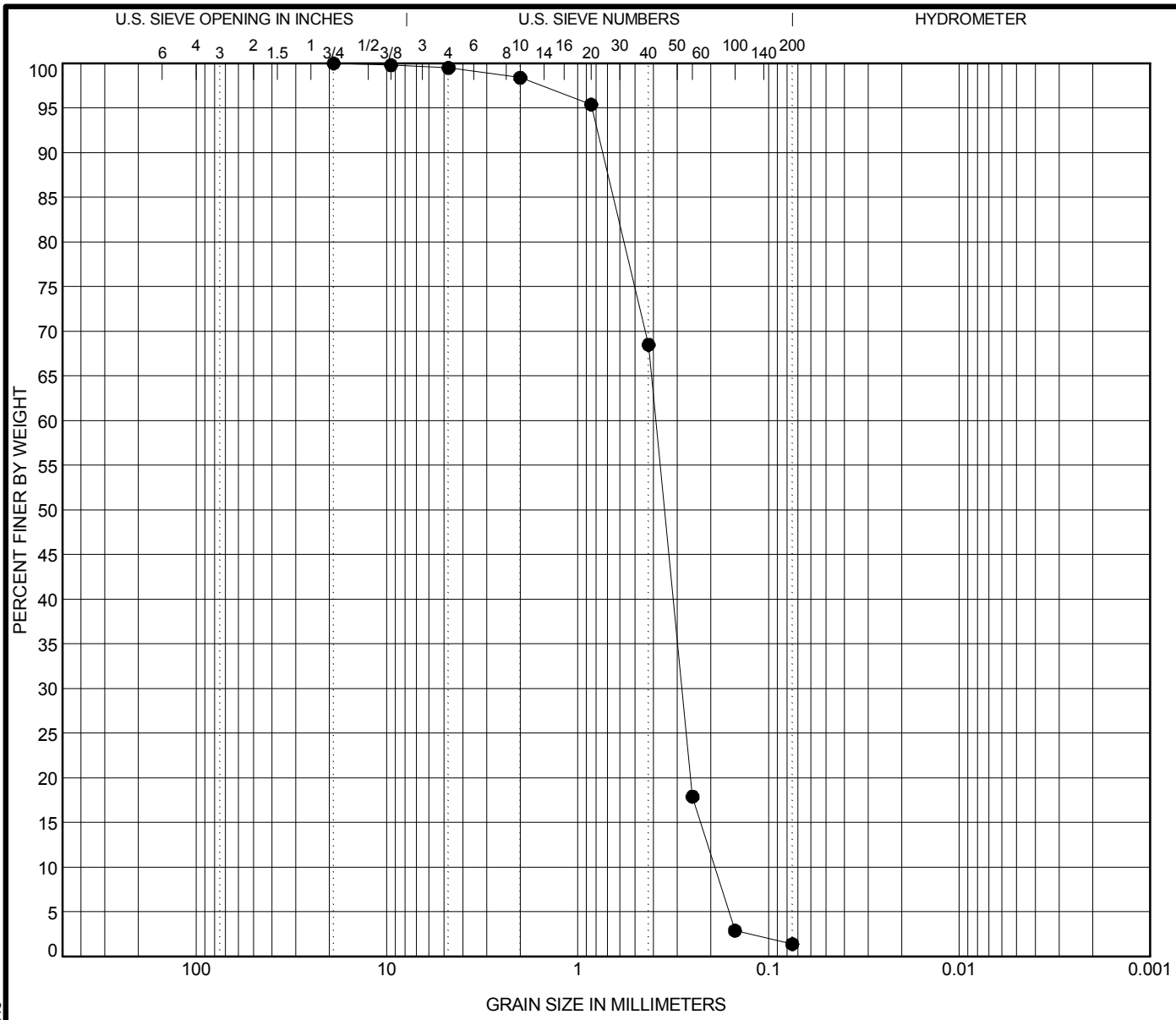
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:**

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-30 | 0.0 ft | **POORLY GRADED SAND (SP), fine to carse grained sand, contains shell fragments, dark gray** | -- | -- | -- | **1.08** | **2.04** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.389** | **0.284** | **0.191** | **0.5** | **98.1** | **1.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 1.4 | 2.9 | 17.9 | 68.5 | 95.4 | 98.4 | 99.5 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/7/18 | DS |

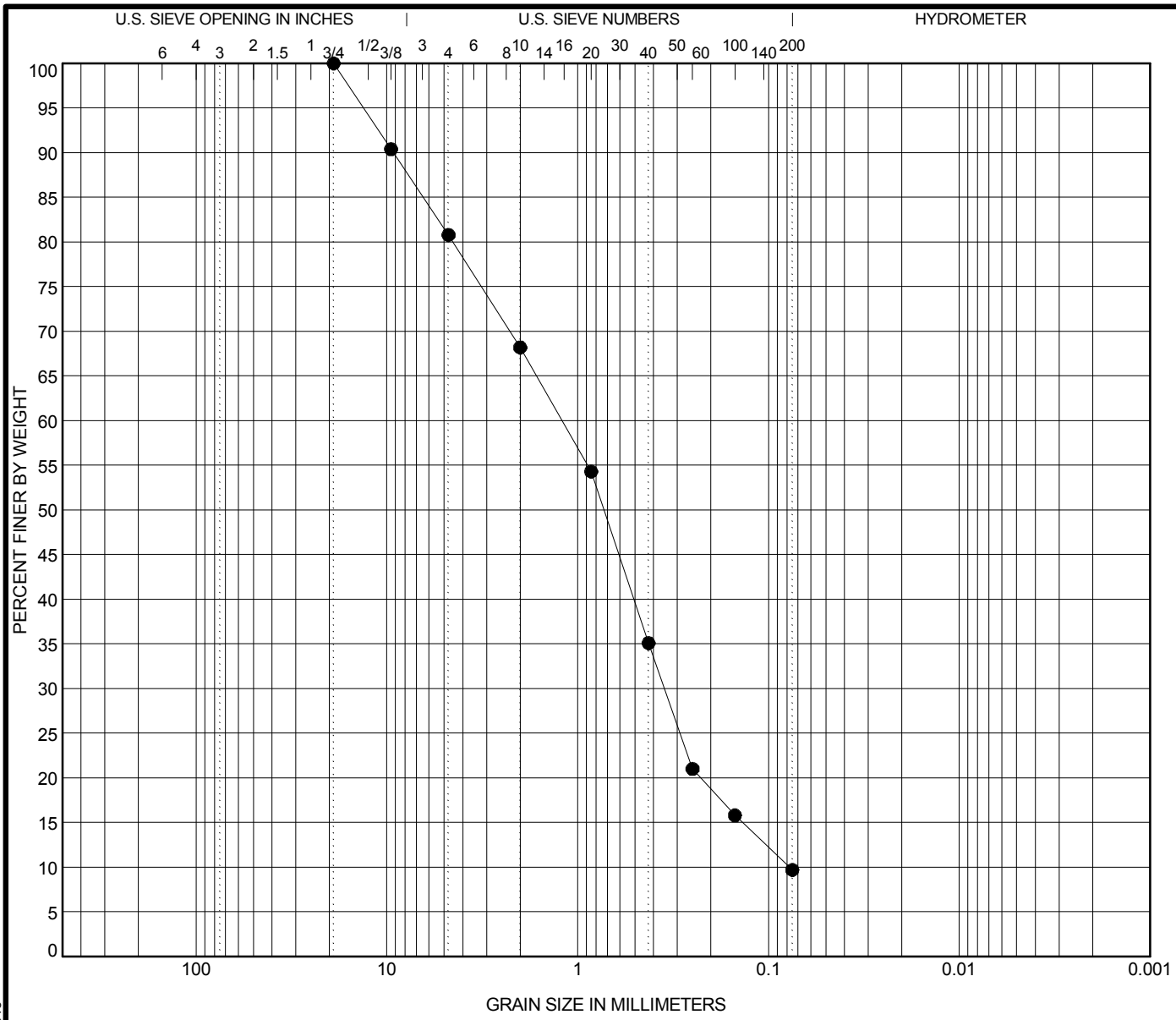
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-30 | 2.7 ft | **POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | **1.31** | **15.56** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **1.207** | **0.351** | **0.078** | **19.2** | **71.1** | **9.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 9.7 | 15.8 | 21.0 | 35.1 | 54.3 | 68.2 | 80.8 | 90.4 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/7/18 | |

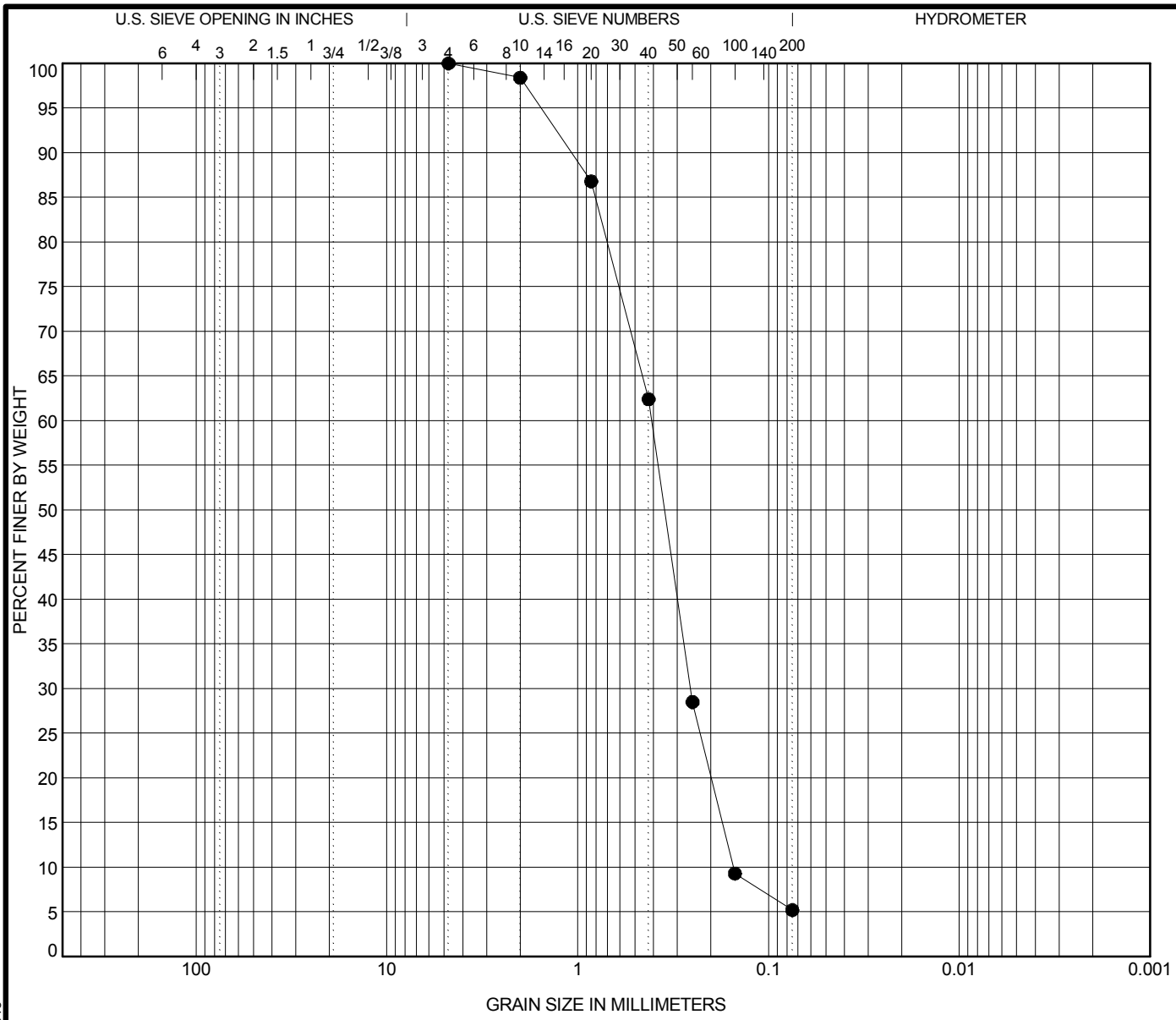
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-30 | 4.7 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, dark gray** | -- | -- | -- | **1.05** | **2.68** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.409** | **0.256** | **0.153** | **0.0** | **94.8** | **5.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 5.2 | 9.3 | 28.5 | 62.4 | 86.8 | 98.4 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/7/18 | DS |

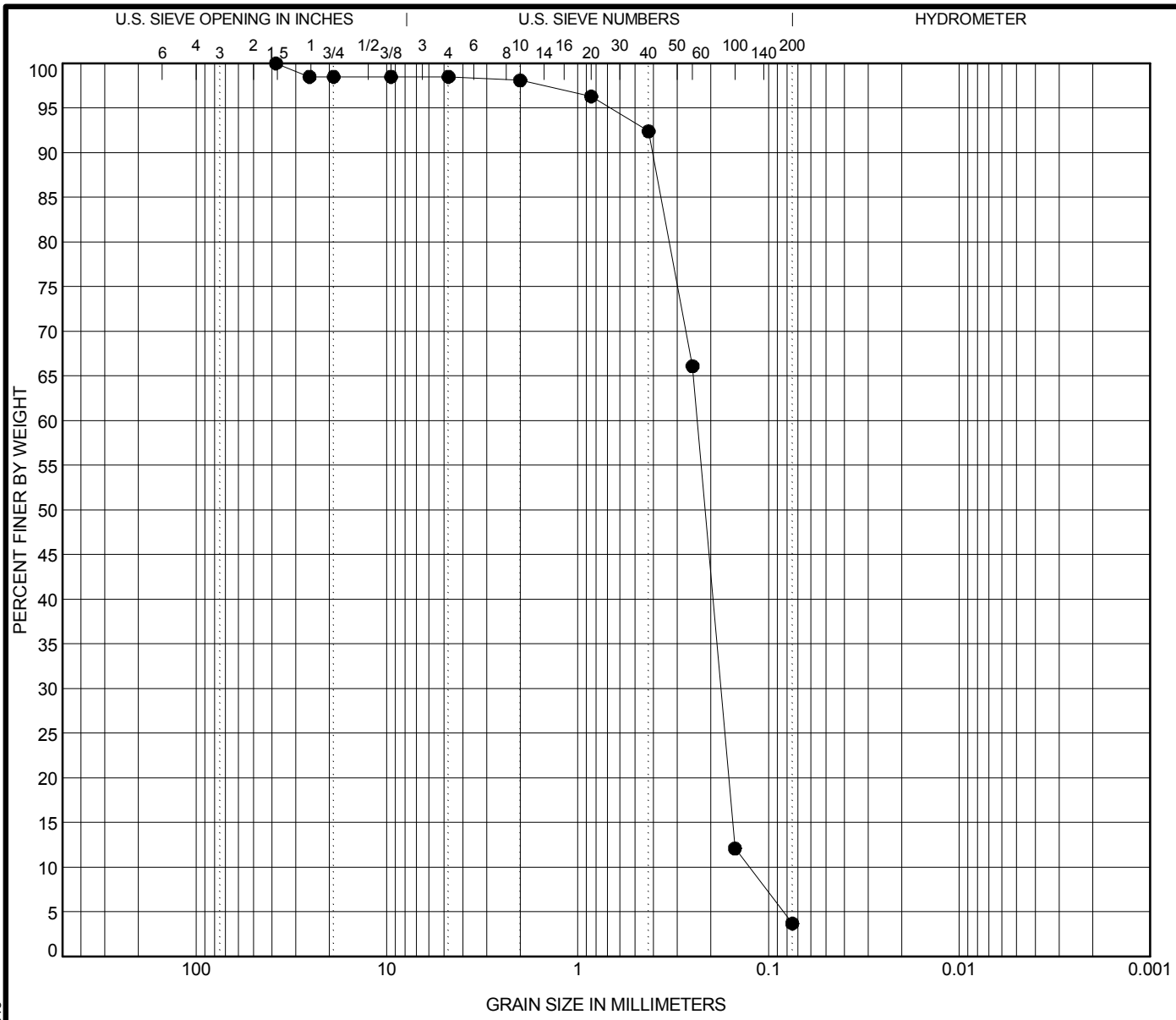
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-32 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | **1.06** | **1.87** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **38.1** | **0.236** | **0.178** | **0.126** | **1.5** | **94.8** | **3.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 | 1 | 1.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| % Finer | 3.7 | 12.1 | 66.1 | 92.4 | 96.3 | 98.1 | 98.5 | 98.5 | 98.5 | 98.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB/AE | 9/7/18 | DS |

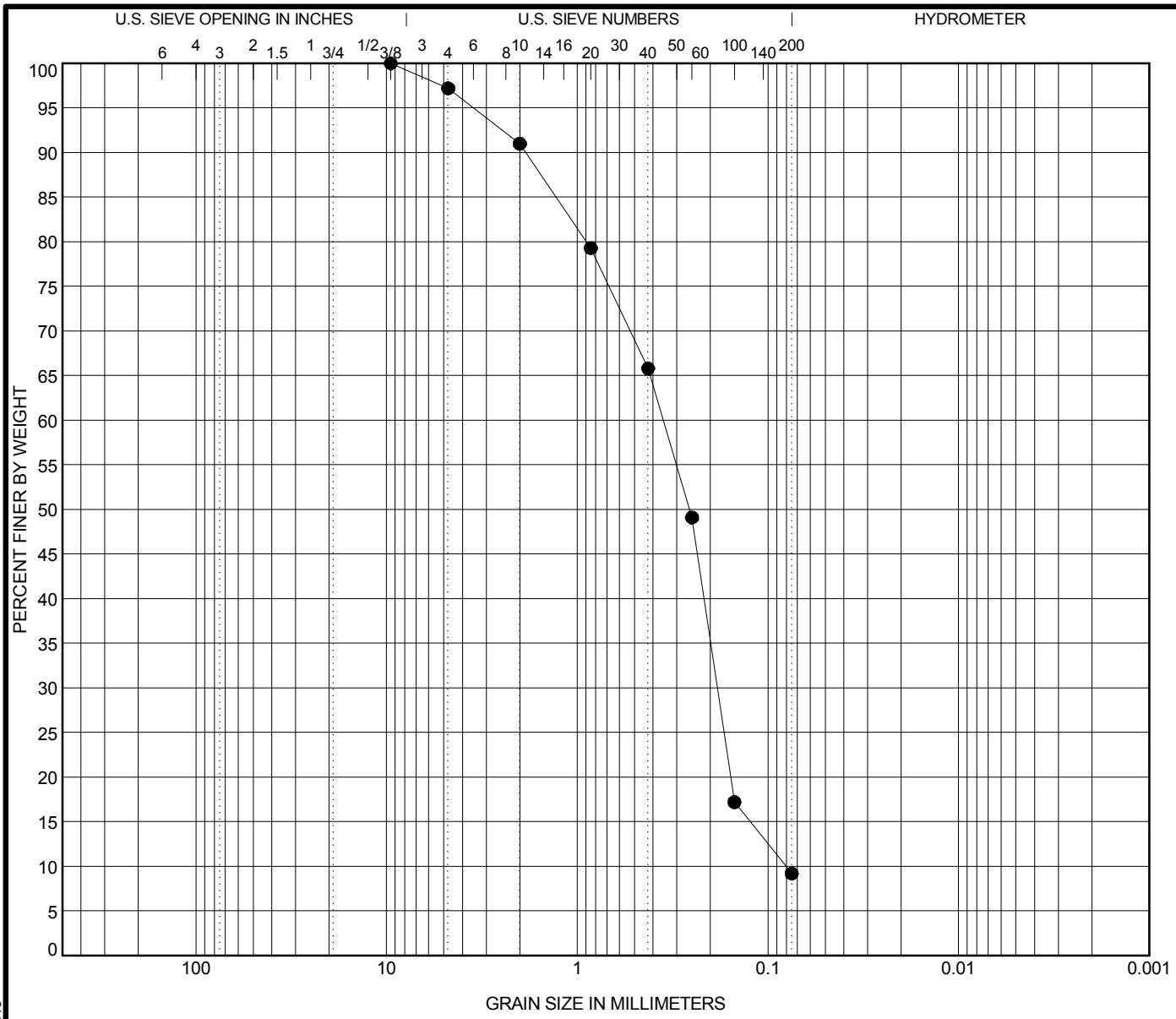
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-32 | 5.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, dark gray** | -- | -- | -- | **1.19** | **4.40** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.353** | **0.184** | **0.08** | **2.8** | **88.0** | **9.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 9.2 | 17.2 | 49.1 | 65.8 | 79.3 | 91.0 | 97.2 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB/AE | 9/7/18 | DS |

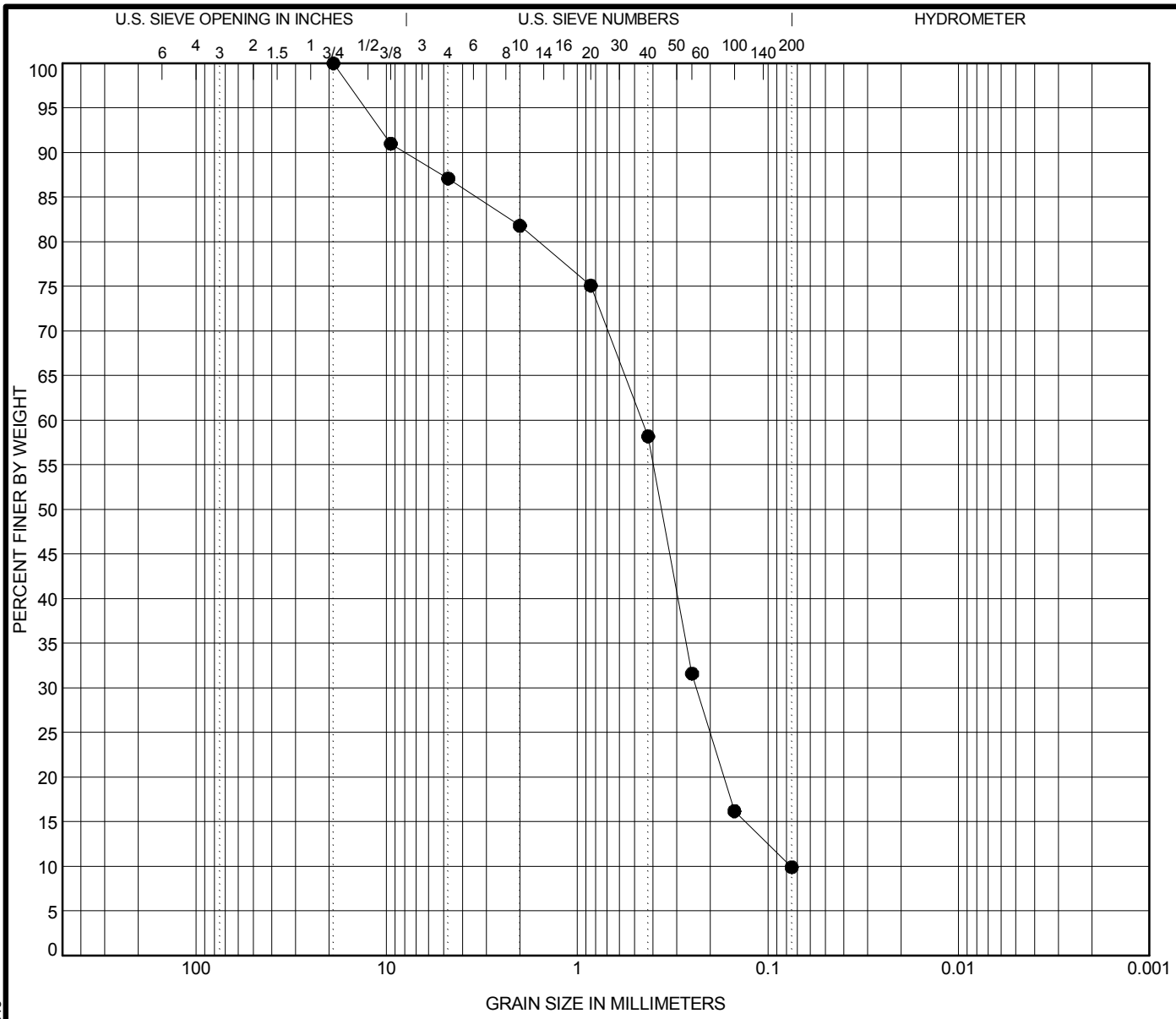
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-32 | 10.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- | **1.62** | **6.03** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.458** | **0.237** | **0.076** | **12.9** | **77.2** | **9.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 9.9 | 16.2 | 31.6 | 58.2 | 75.1 | 81.8 | 87.1 | 91.0 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB | 9/7/18 | DS |

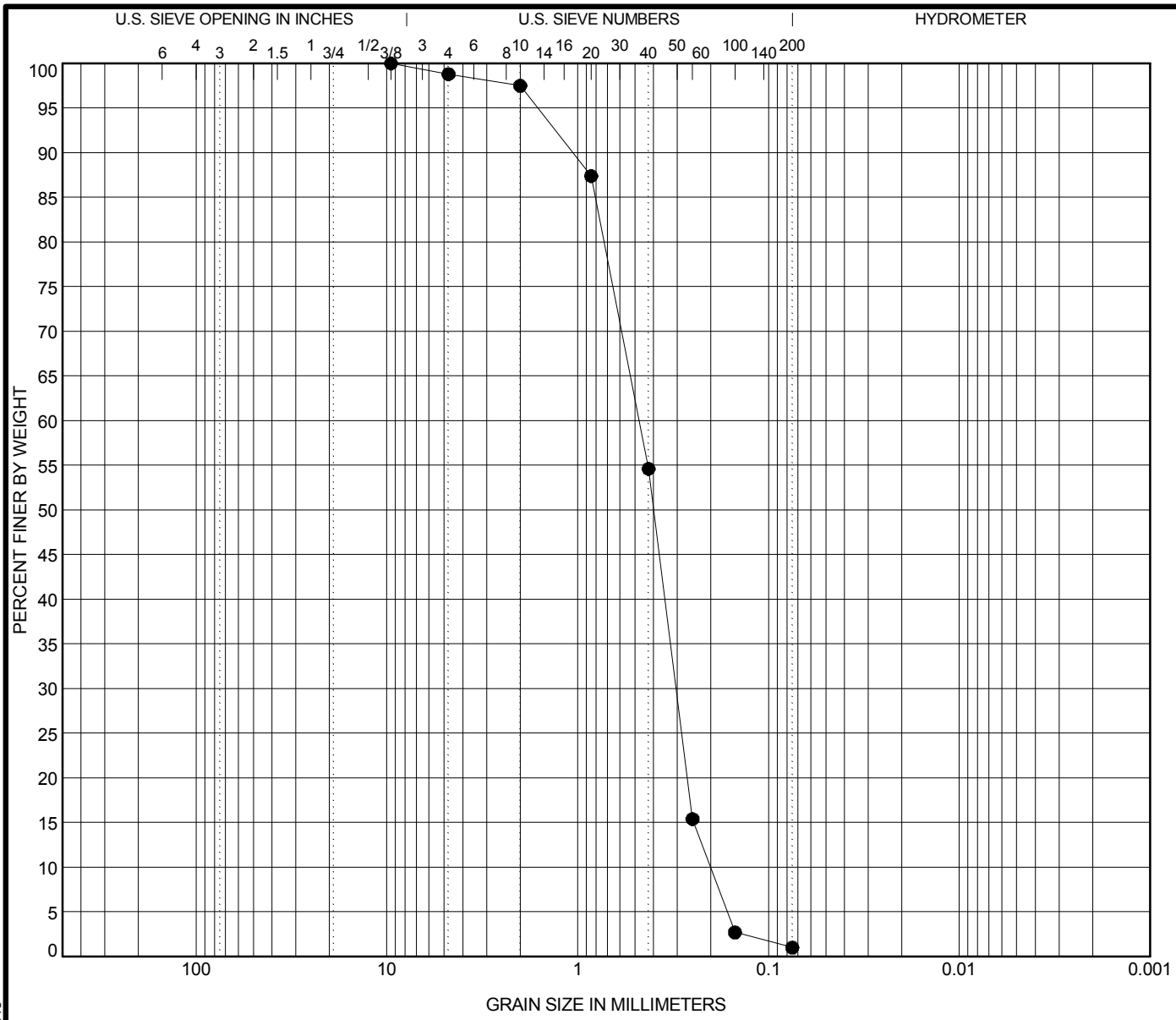
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-33 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, dark brown** | -- | -- | -- | **0.97** | **2.37** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.476** | **0.305** | **0.201** | **1.2** | **97.8** | **1.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 1.0 | 2.7 | 15.4 | 54.6 | 87.4 | 97.5 | 98.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/7/18 | DS |

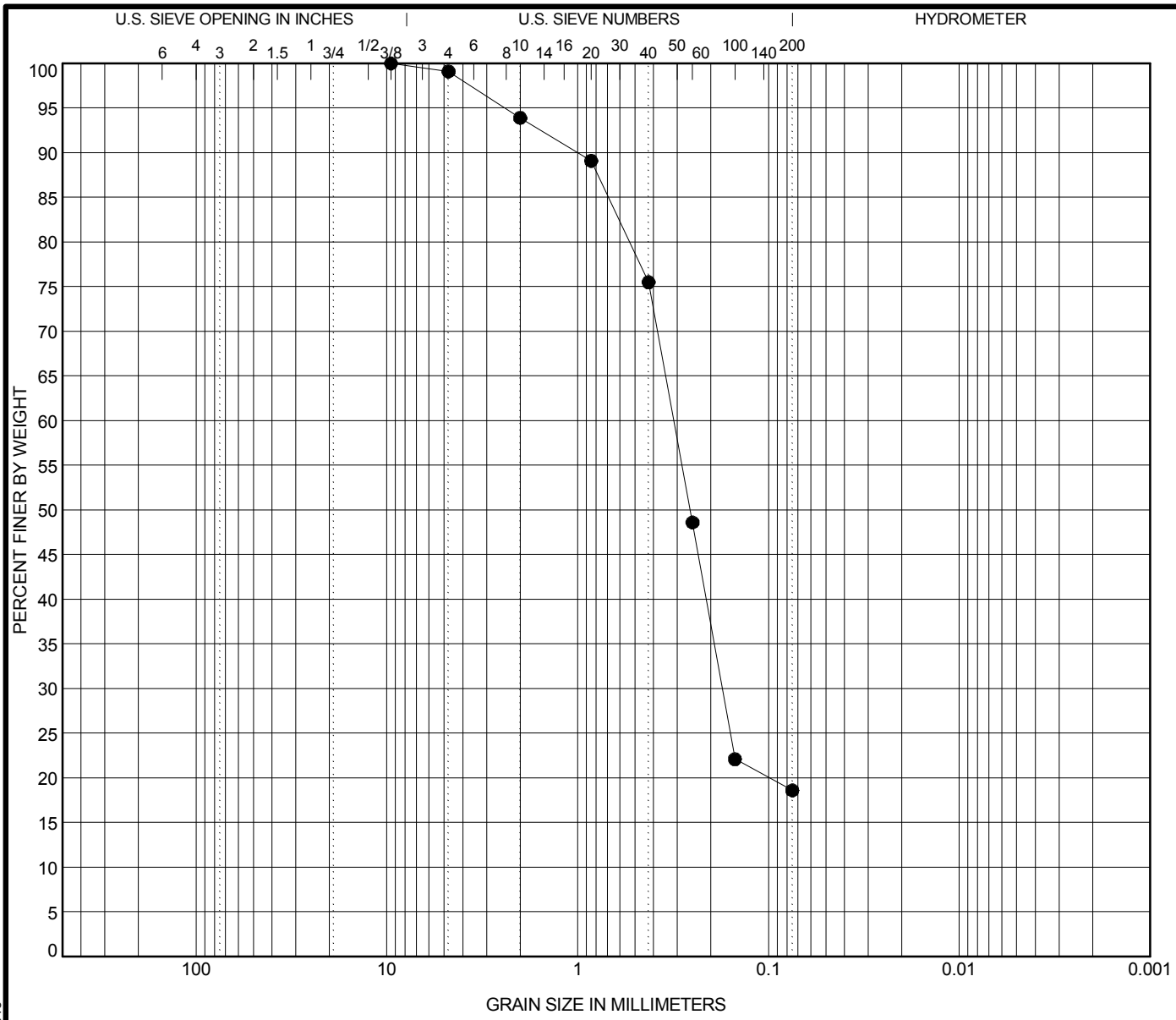
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-33 | 5.1 ft | **SILTY SAND (SP), fine to coarse grained sand, contains shell fragments, brownish gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.313** | **0.175** | **--** | **0.9** | **80.5** | **18.6** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 18.6 | 22.1 | 48.6 | 75.5 | 89.1 | 93.9 | 99.1 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/7/18 | DS |

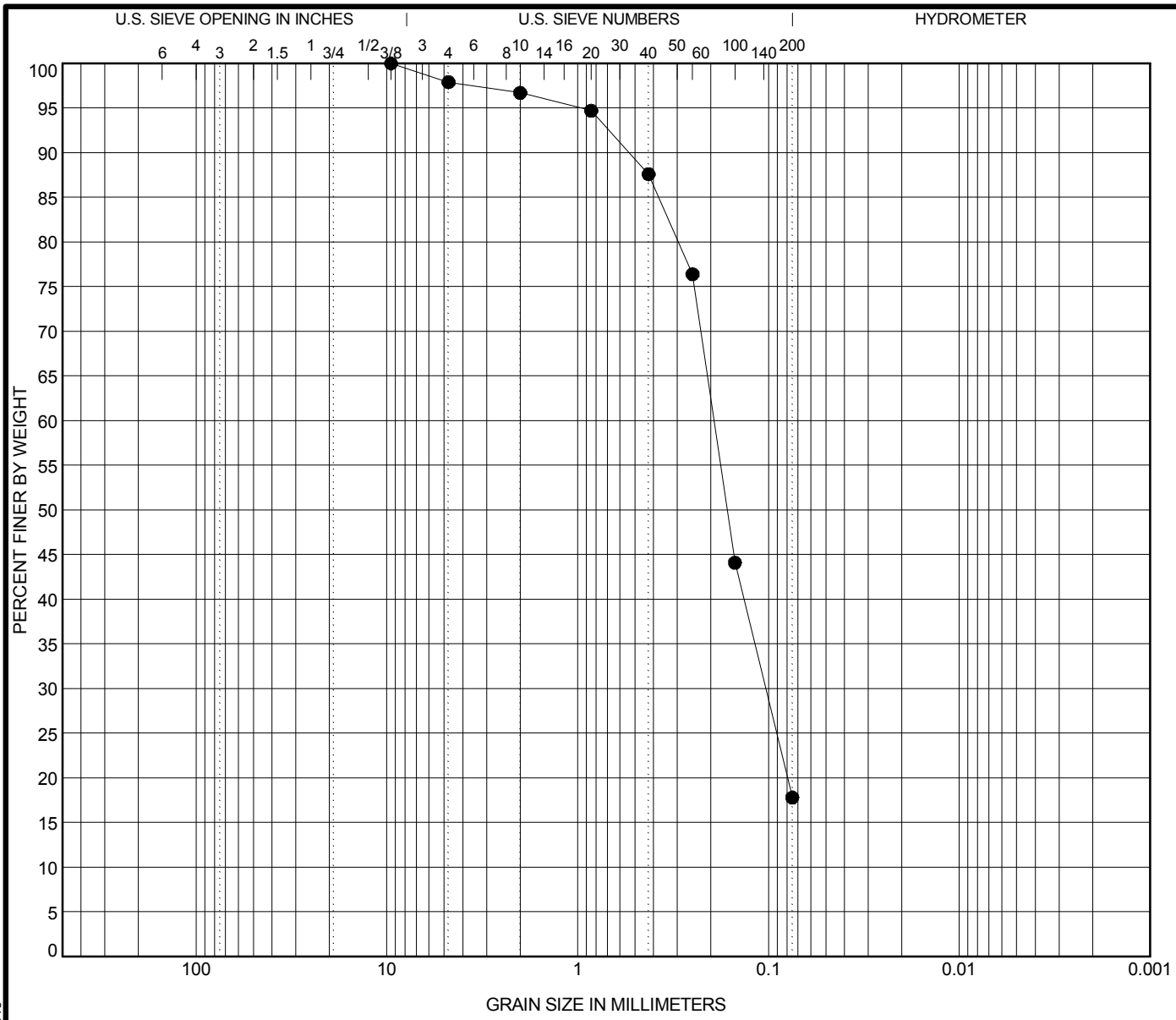
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-33 | 10.1 ft | **SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.193** | **0.103** | **--** | **2.1** | **80.1** | **17.8** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 17.8 | 44.1 | 76.4 | 87.6 | 94.7 | 96.7 | 97.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/7/18 | DS |

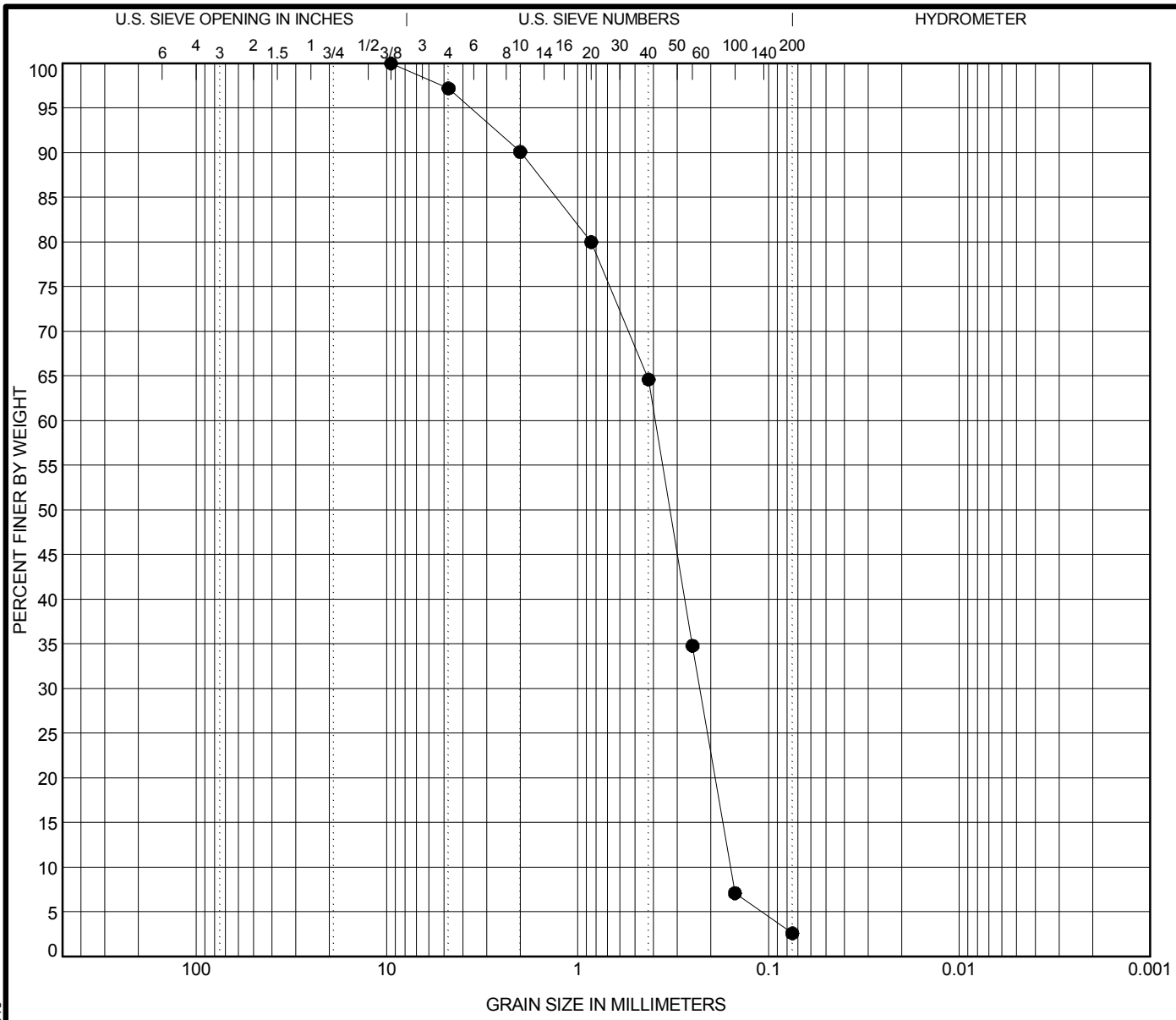
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-34 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, dark gray** | -- | -- | -- | **0.85** | **2.47** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.392** | **0.229** | **0.158** | **2.8** | **94.6** | **2.6** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 2.6 | 7.1 | 34.8 | 64.6 | 80.0 | 90.1 | 97.2 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/7/18 | DS |

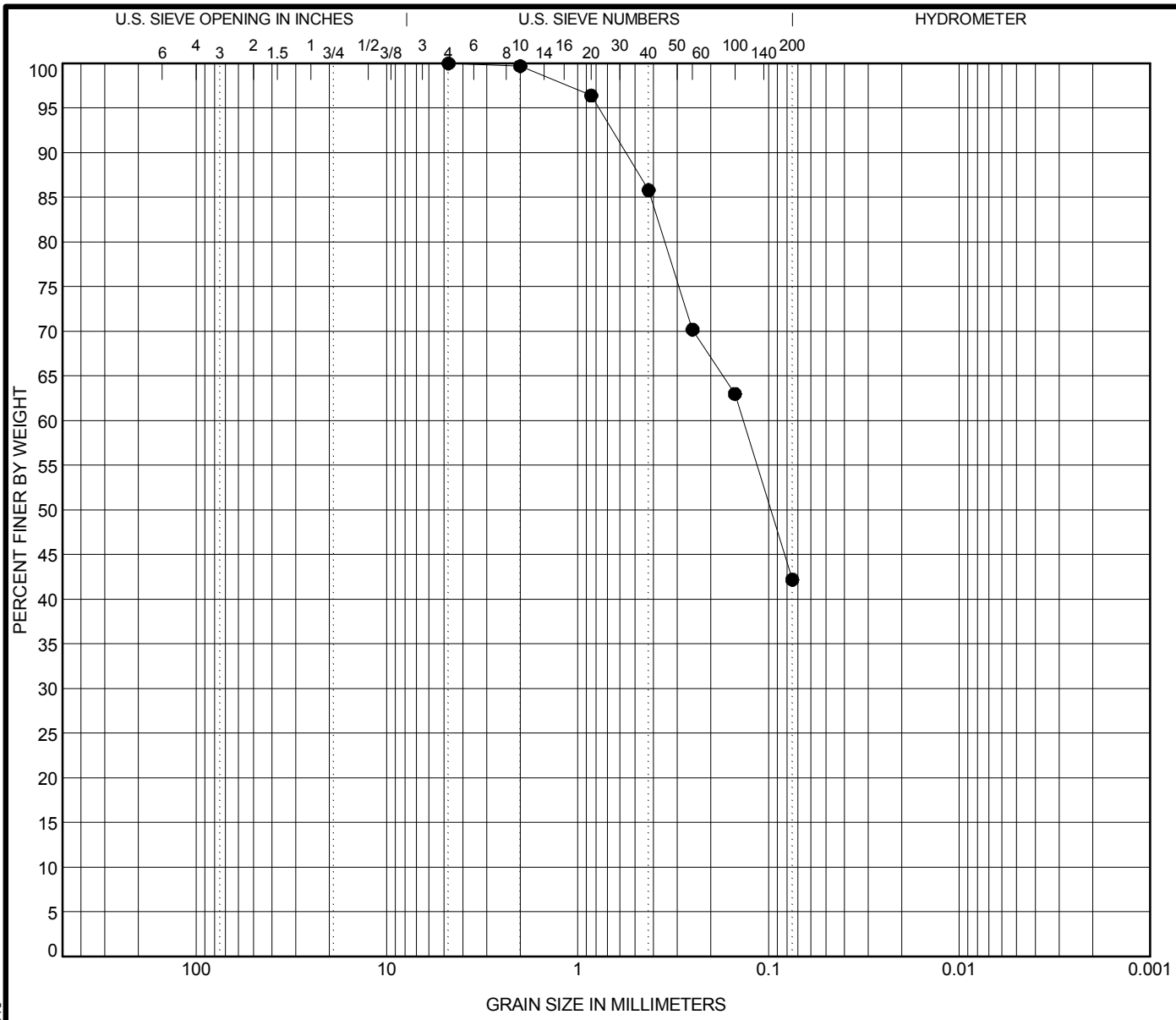
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-34 | 14.0 ft | **SILTY SAND (SM), fine to coarse grained sand, dark gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.136** | **--** | **--** | **0.0** | **57.8** | **42.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 42.2 | 63.0 | 70.2 | 85.8 | 96.4 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/7/18 | DS |

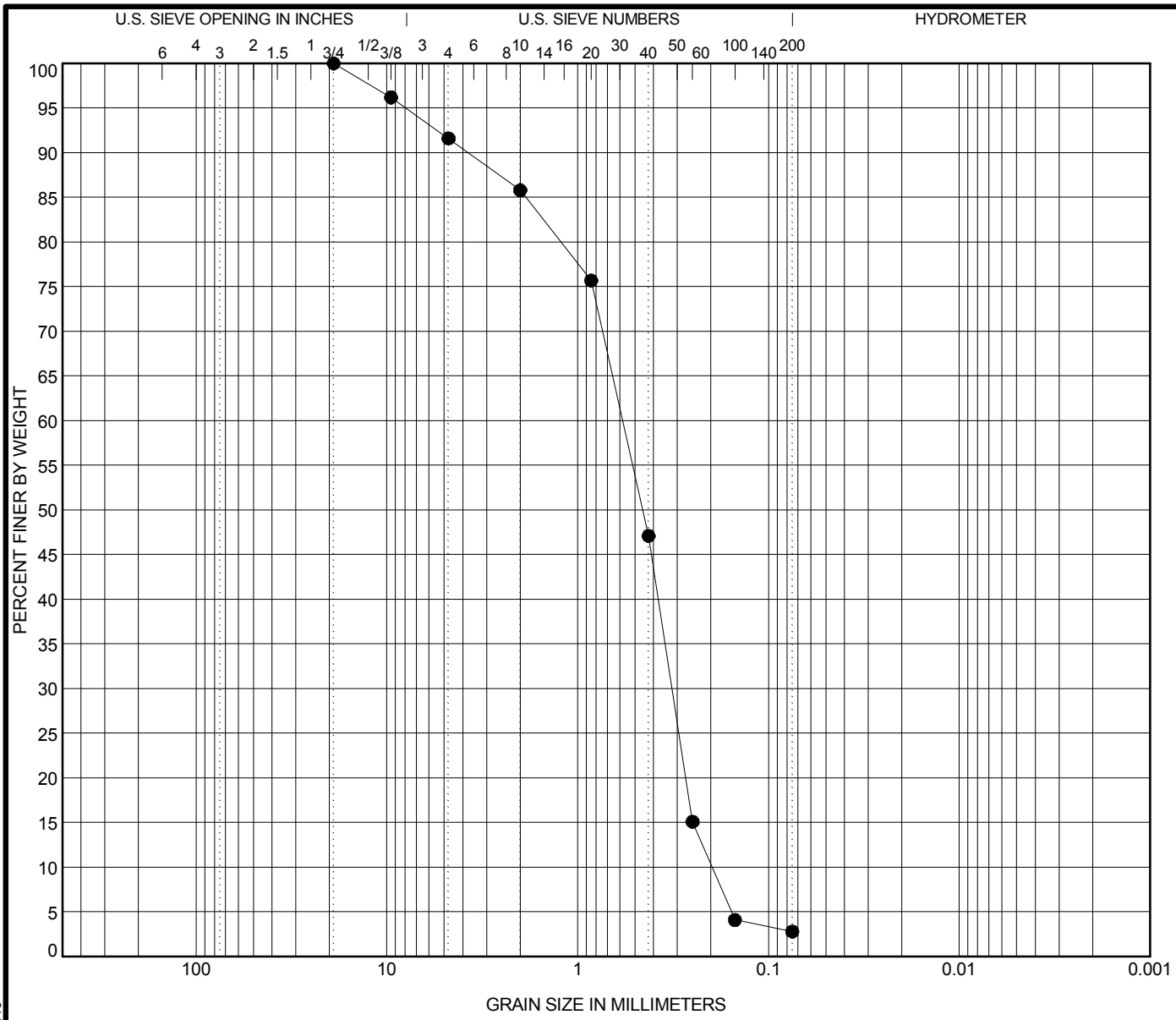
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-35 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, dark gray** | -- | -- | -- | **0.89** | **2.95** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.581** | **0.32** | **0.197** | **8.4** | **88.8** | **2.8** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 2.8 | 4.1 | 15.1 | 47.1 | 75.7 | 85.8 | 91.6 | 96.2 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB, AE | 9/7/18 | DS |

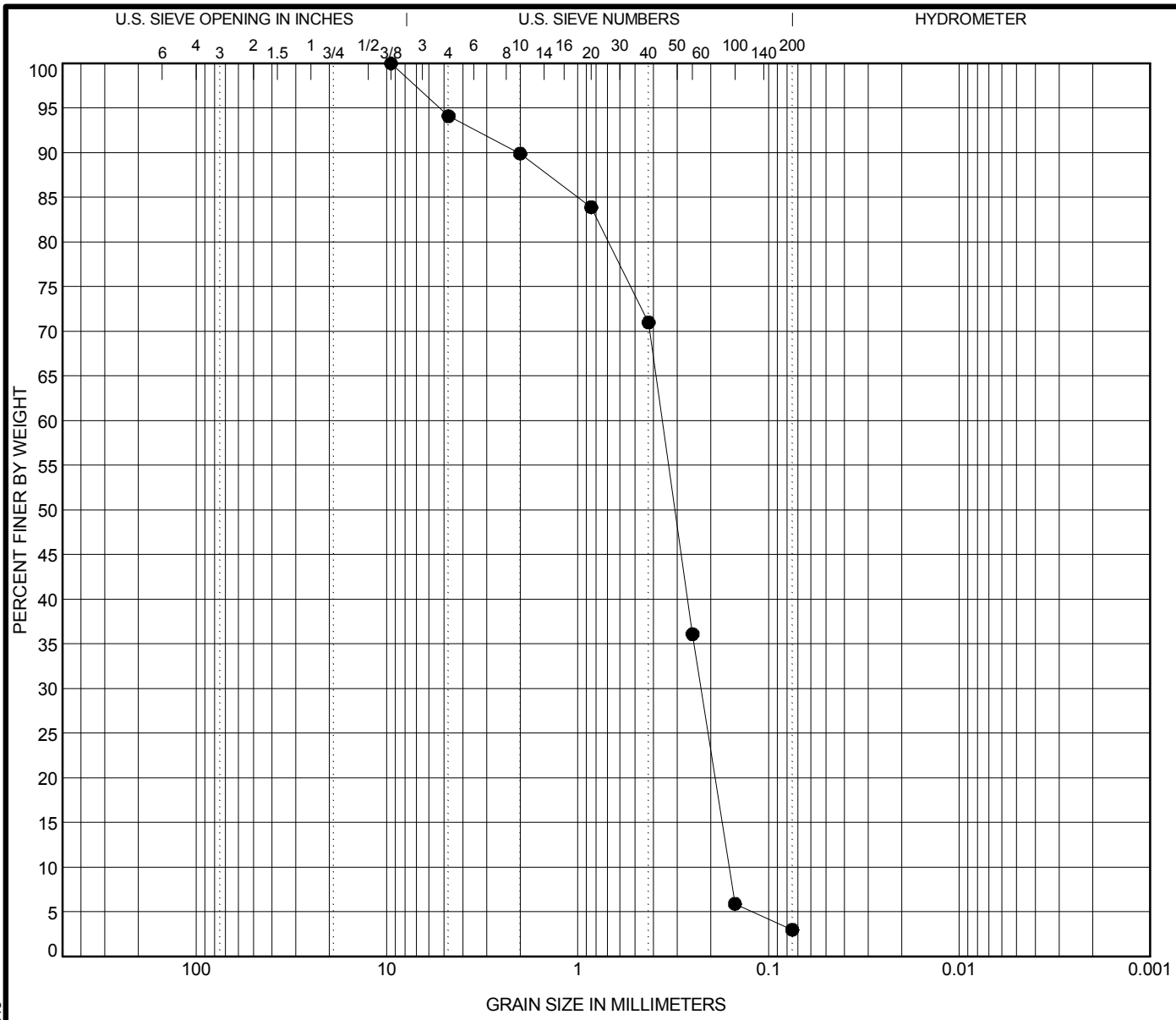
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-35 | 5.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- | **0.88** | **2.24** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.36** | **0.225** | **0.161** | **5.9** | **91.1** | **3.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 3.0 | 5.9 | 36.1 | 71.0 | 83.9 | 89.9 | 94.1 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB, AE | 9/7/18 | DS |

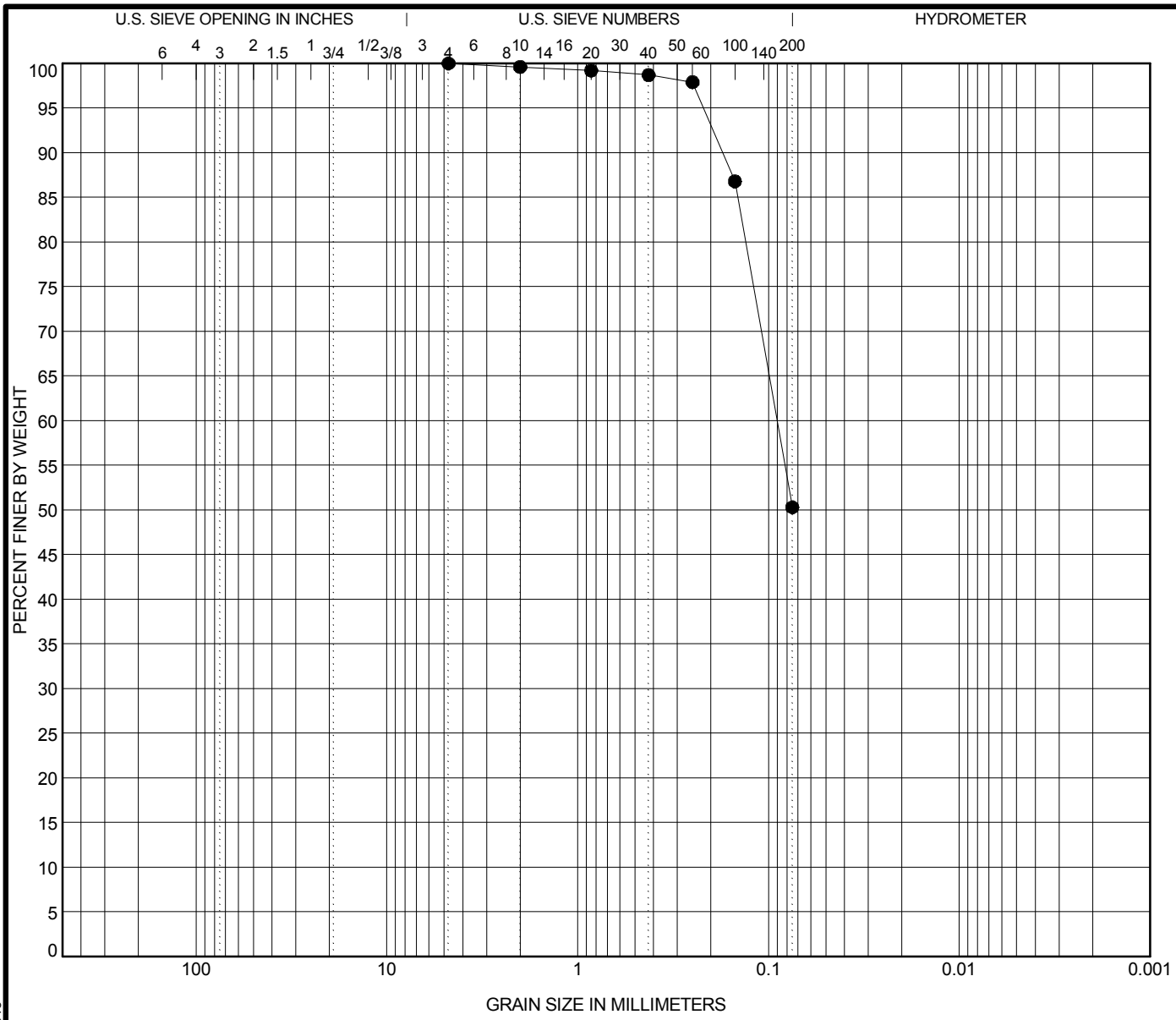
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-35 | 12.9 ft | **SANDY LEAN CLAY (CL), dark gray {Visual}** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.09** | **--** | **--** | **0.0** | **49.7** | **50.3** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 50.3 | 86.8 | 97.9 | 98.7 | 99.2 | 99.6 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB | 9/7/18 | DS |

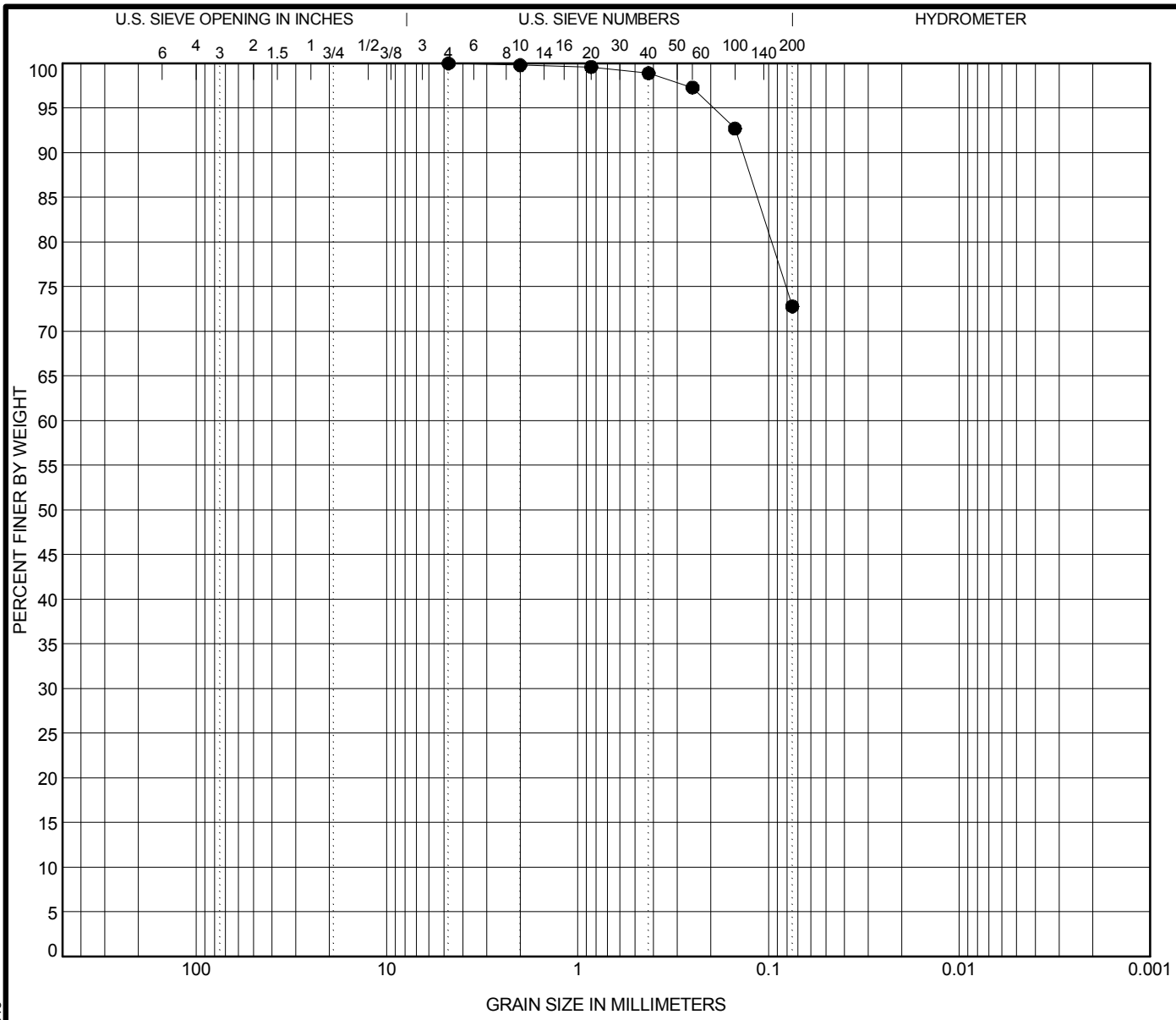
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-35 | 15.0 ft | **LEAN CLAY WITH SAND (CL), dark gray {Visual}** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **--** | **--** | **--** | **0.0** | **27.2** | **72.8** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 72.8 | 92.7 | 97.3 | 98.9 | 99.6 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB/AE | 9/7/18 | DS |

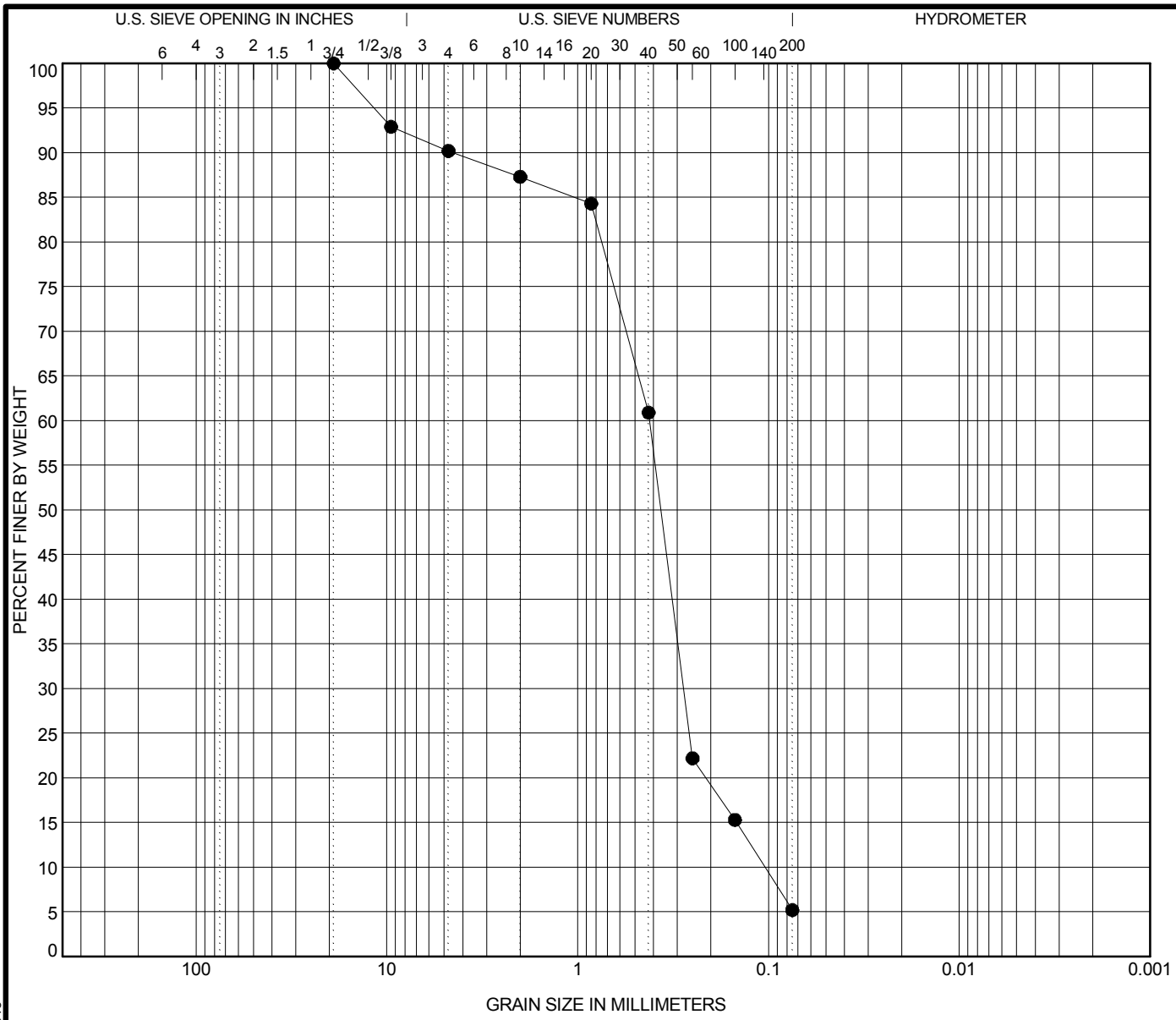
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-36 | 0.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | **1.77** | **4.03** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.42** | **0.278** | **0.104** | **9.8** | **85.0** | **5.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 5.2 | 15.3 | 22.2 | 60.9 | 84.3 | 87.3 | 90.2 | 92.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/7/18 | DS |

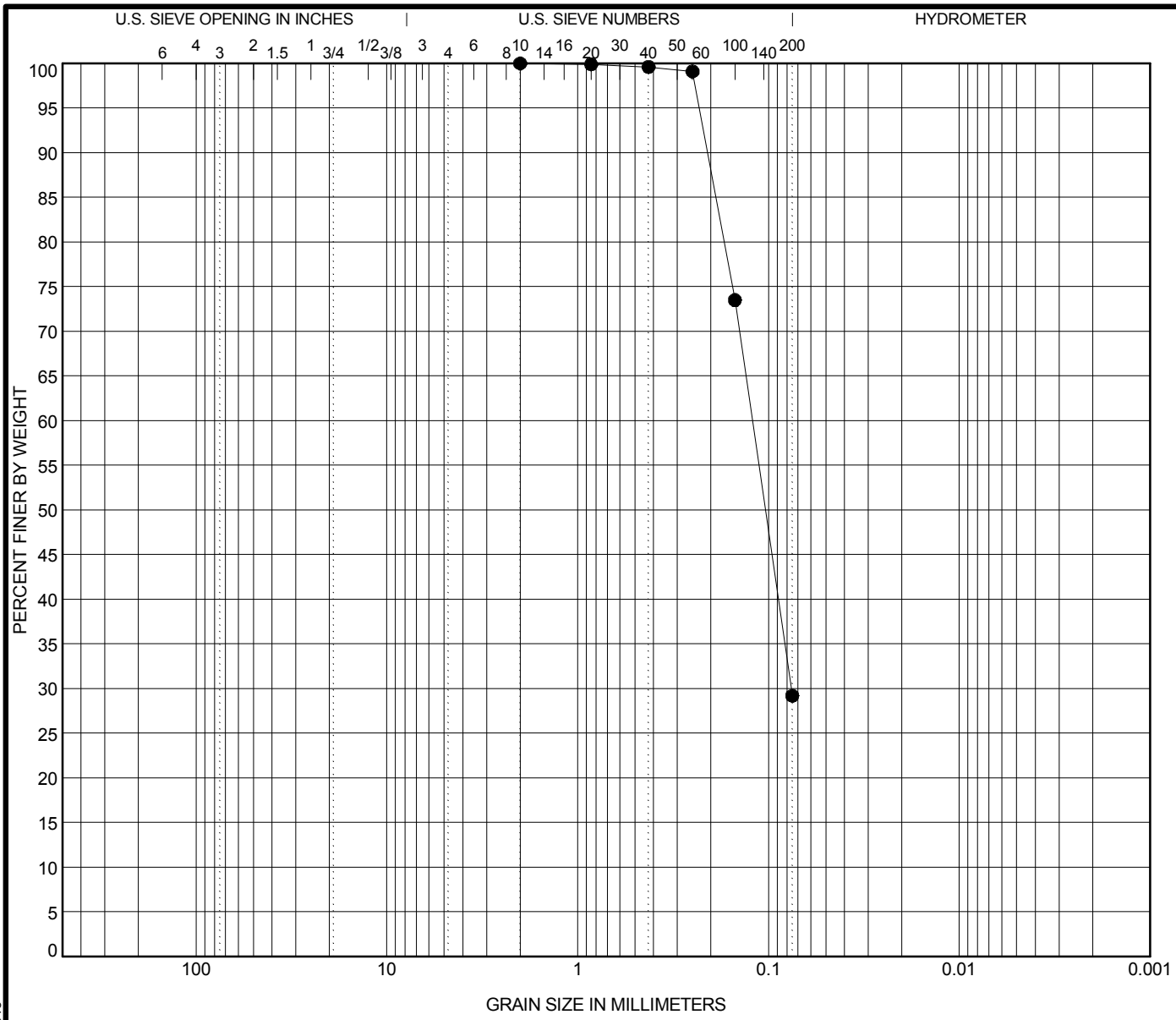
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-36 | 14.2 ft | **SILTY SAND (SM), fine to medium grained sand, dark gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **2** | **0.121** | **0.076** | **--** | **0.0** | **70.8** | **29.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 |
|---|---|---|---|---|---|---|
| % Finer | 29.2 | 73.5 | 99.1 | 99.6 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/7/18 | DS |

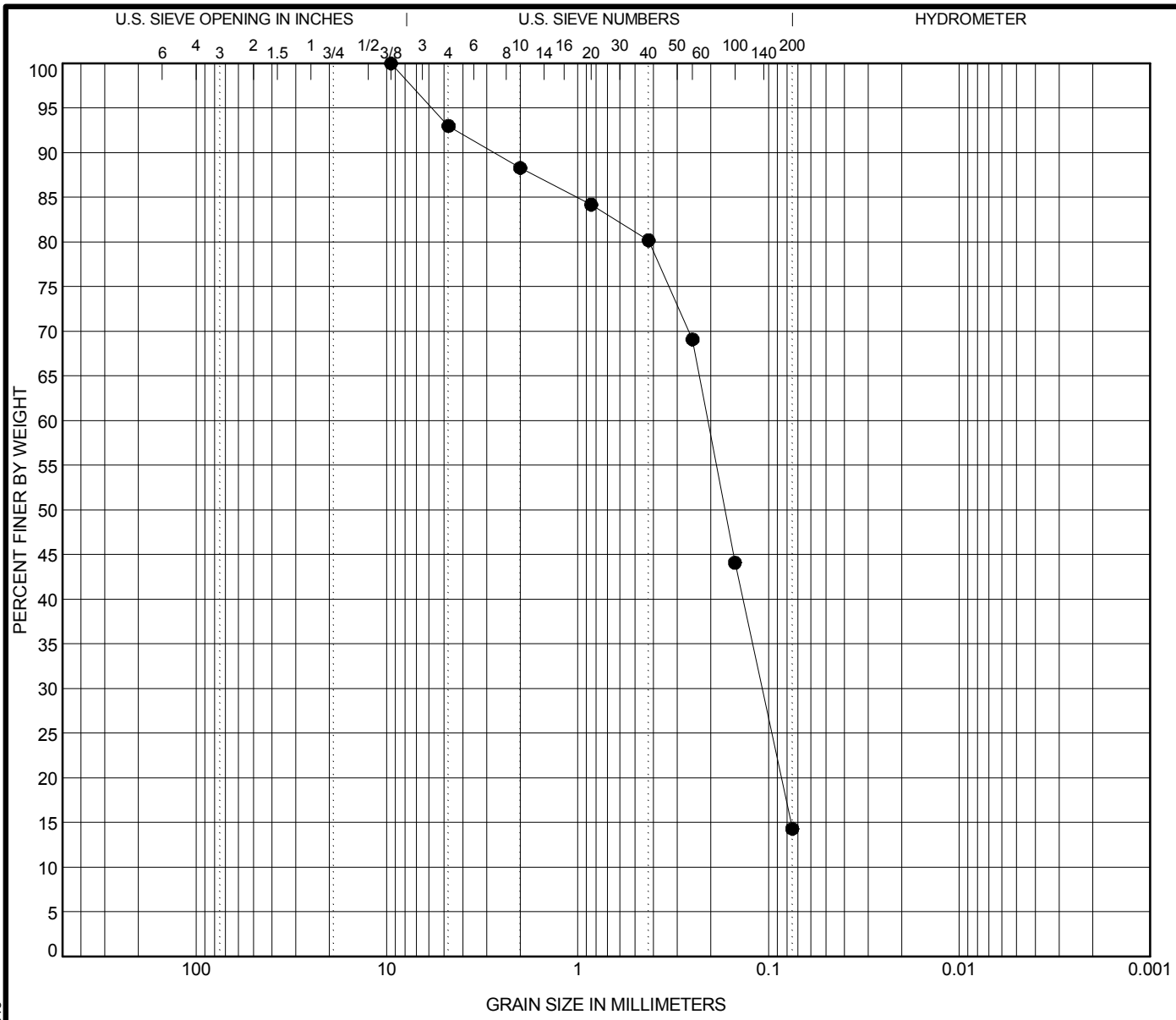
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-37 | 0.0 ft | **SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.208** | **0.108** | **--** | **7.0** | **78.7** | **14.3** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 14.3 | 44.1 | 69.1 | 80.2 | 84.2 | 88.3 | 93.0 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/7/18 | DS |

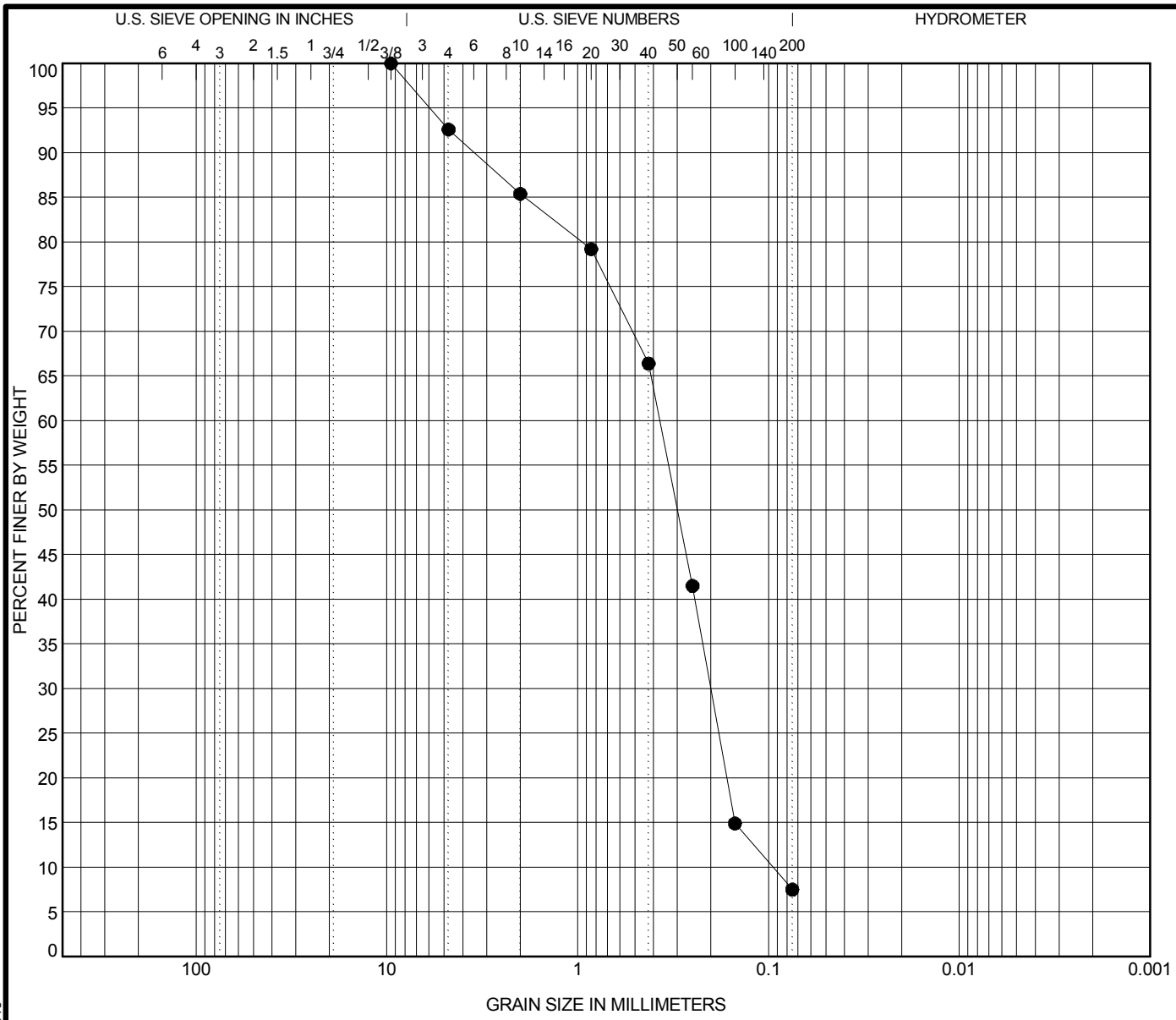
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-37 | 12.1 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, contains shell fragments, gray** | -- | -- | -- | **1.14** | **3.91** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.371** | **0.2** | **0.095** | **7.4** | **85.1** | **7.5** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 7.5 | 14.9 | 41.5 | 66.4 | 79.2 | 85.4 | 92.6 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/7/18 | DS |

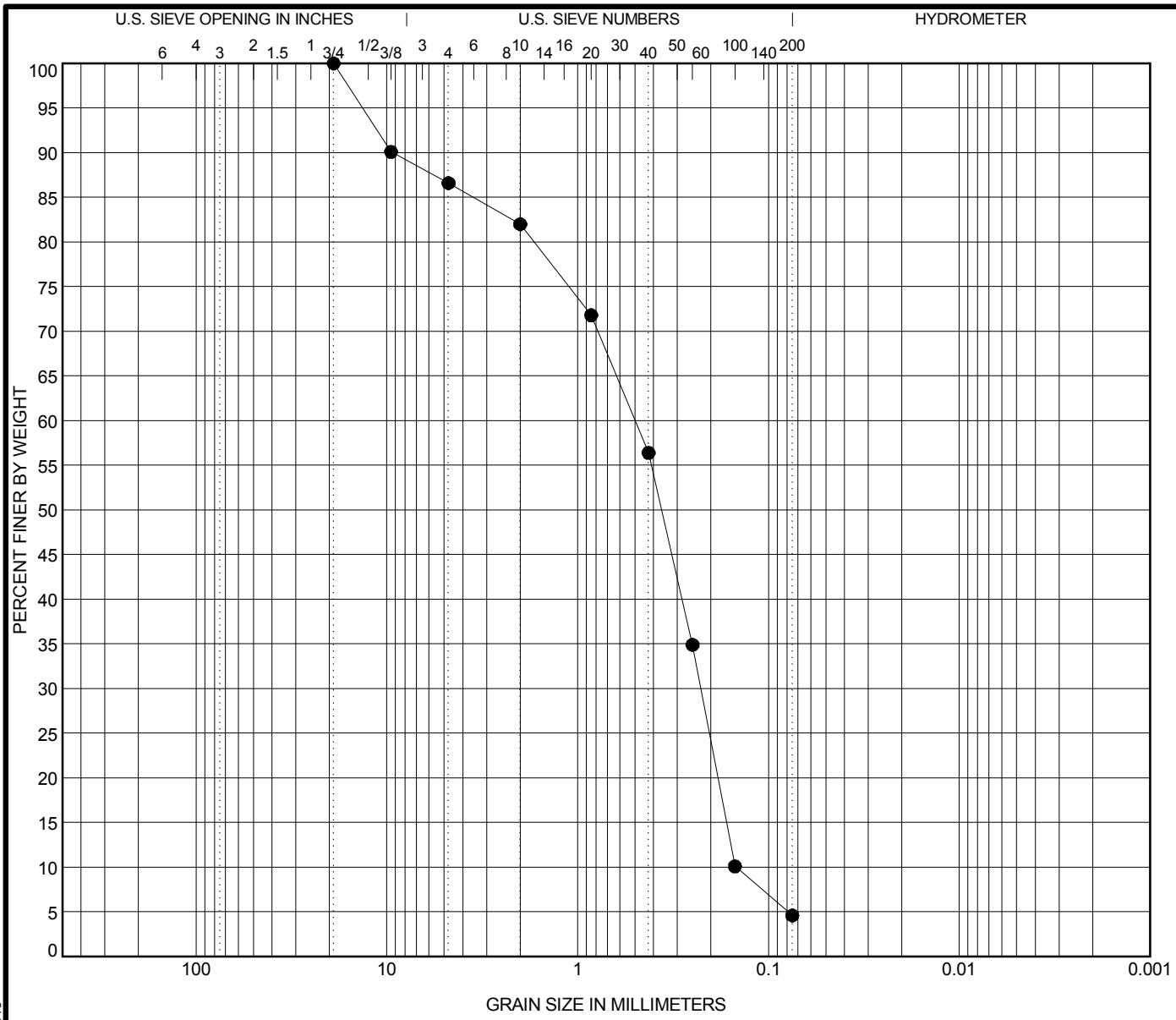
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-38 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, dark gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.5** | **0.226** | **0.148** | **13.4** | **82.0** | **4.6** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 4.6 | 10.1 | 34.9 | 56.4 | 71.8 | 82.0 | 86.6 | 90.1 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/7/18 | |

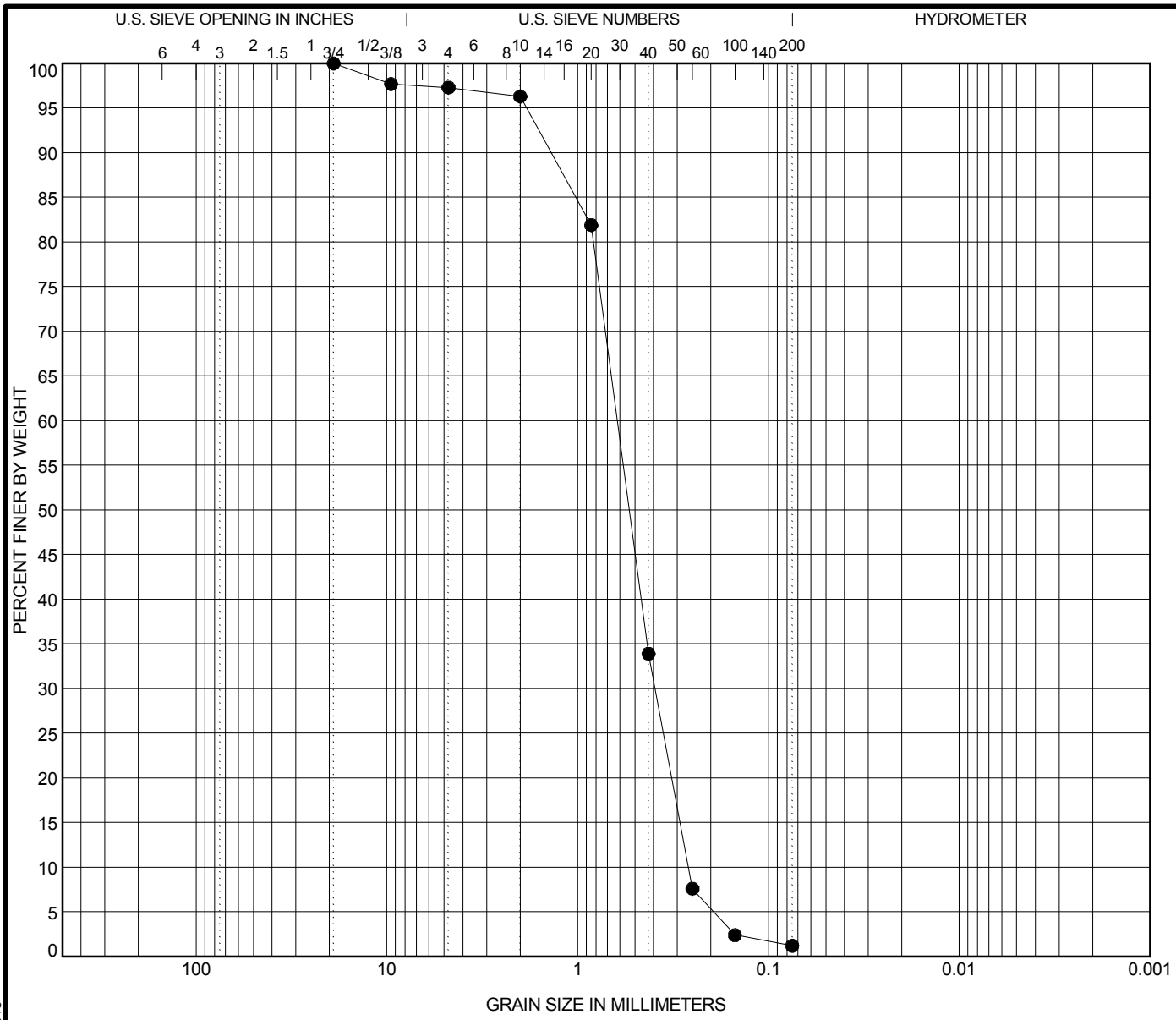
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-38 | 3.3 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.62** | **0.393** | **0.262** | **2.7** | **96.1** | **1.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 1.2 | 2.4 | 7.6 | 33.9 | 81.9 | 96.3 | 97.3 | 97.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/7/18 | |

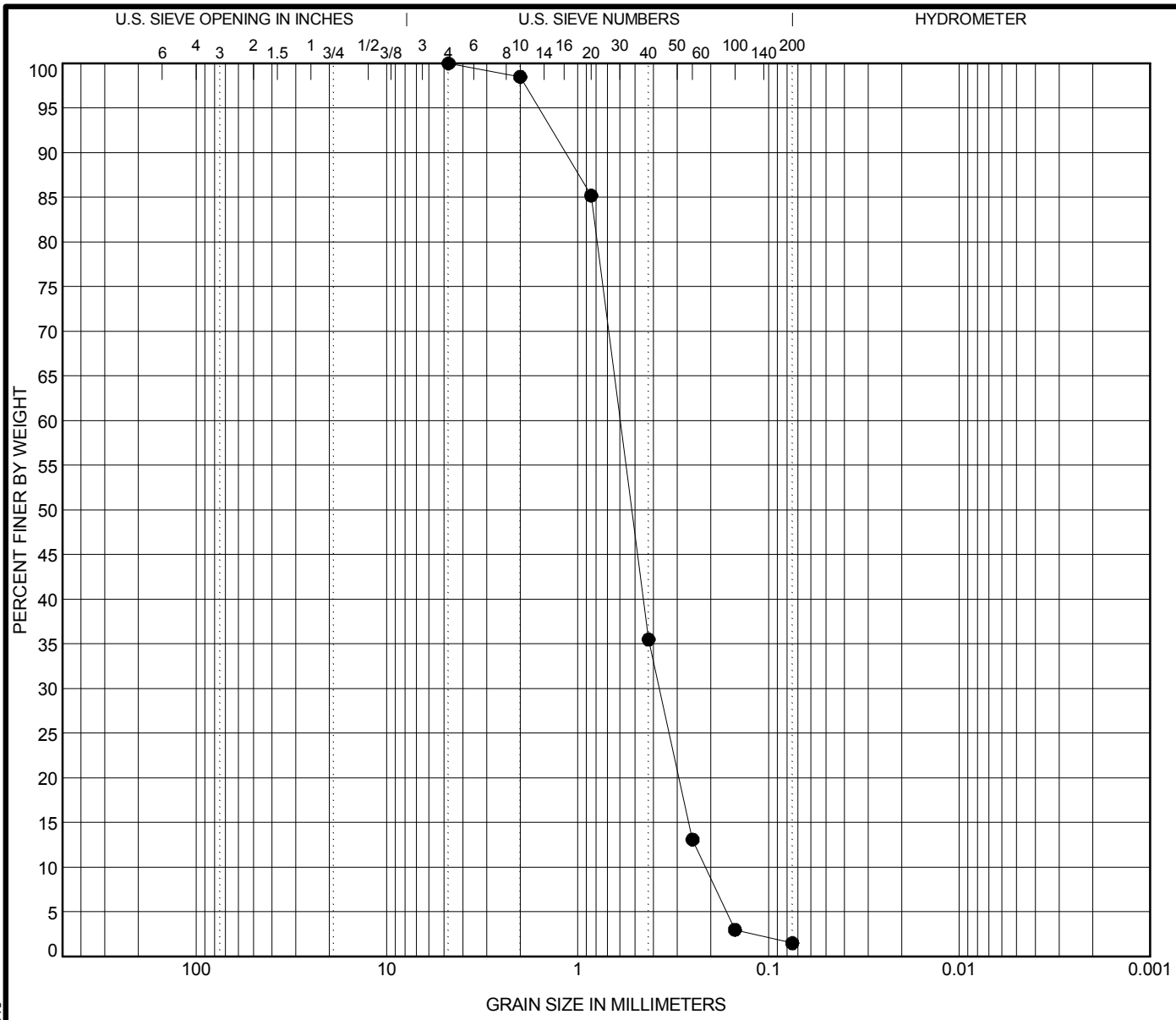
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-39 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand ,dark gray** | -- | -- | -- | **1.09** | **2.80** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.598** | **0.373** | **0.214** | **0.0** | **98.5** | **1.5** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 1.5 | 3.0 | 13.1 | 35.5 | 85.2 | 98.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/7/18 | DS |

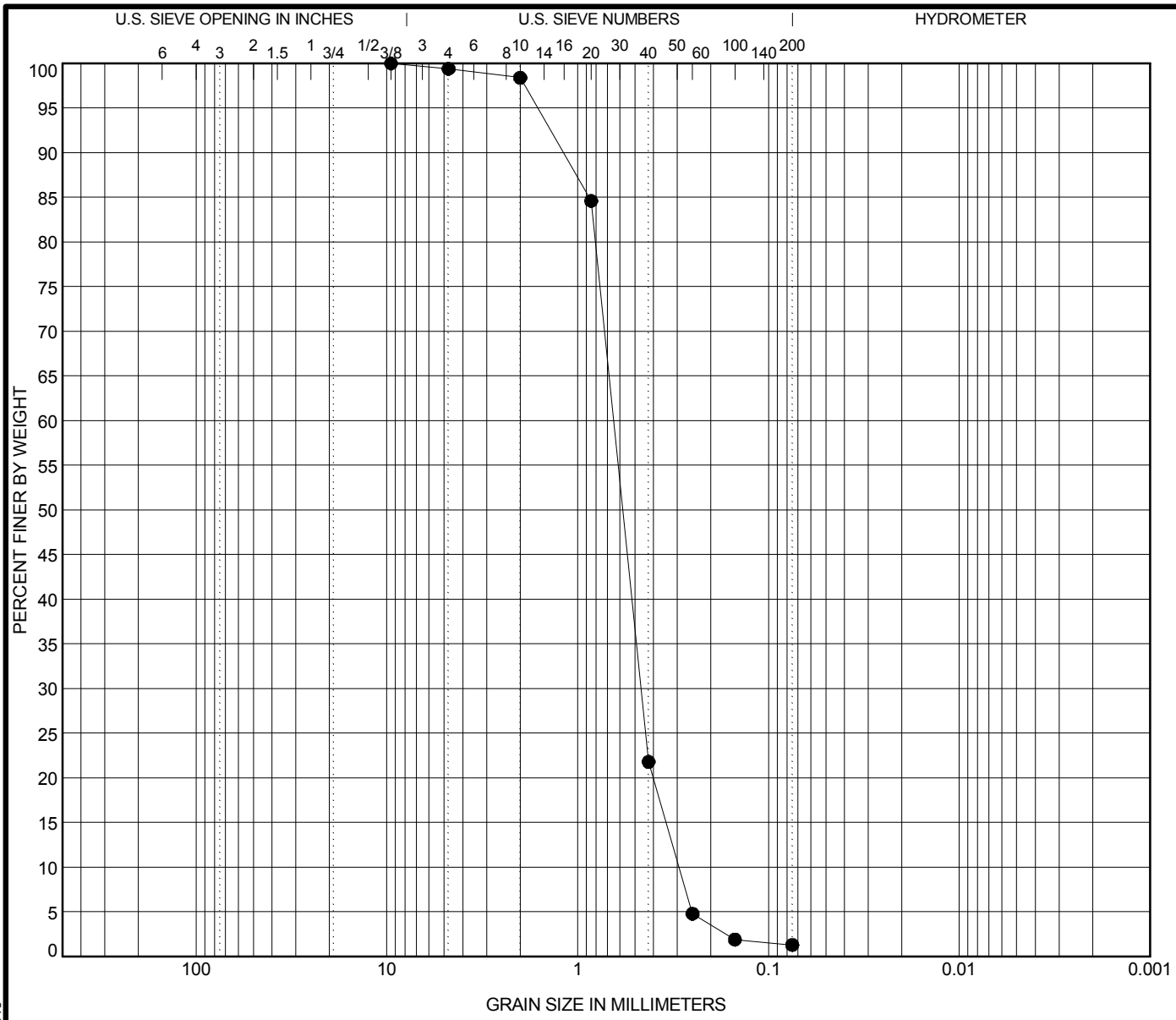
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-39 | 4.2 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand ,dark gray** | -- | -- | -- | **1.14** | **2.20** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.648** | **0.465** | **0.294** | **0.6** | **98.1** | **1.3** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 1.3 | 1.9 | 4.8 | 21.8 | 84.6 | 98.4 | 99.4 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/7/18 | DS |

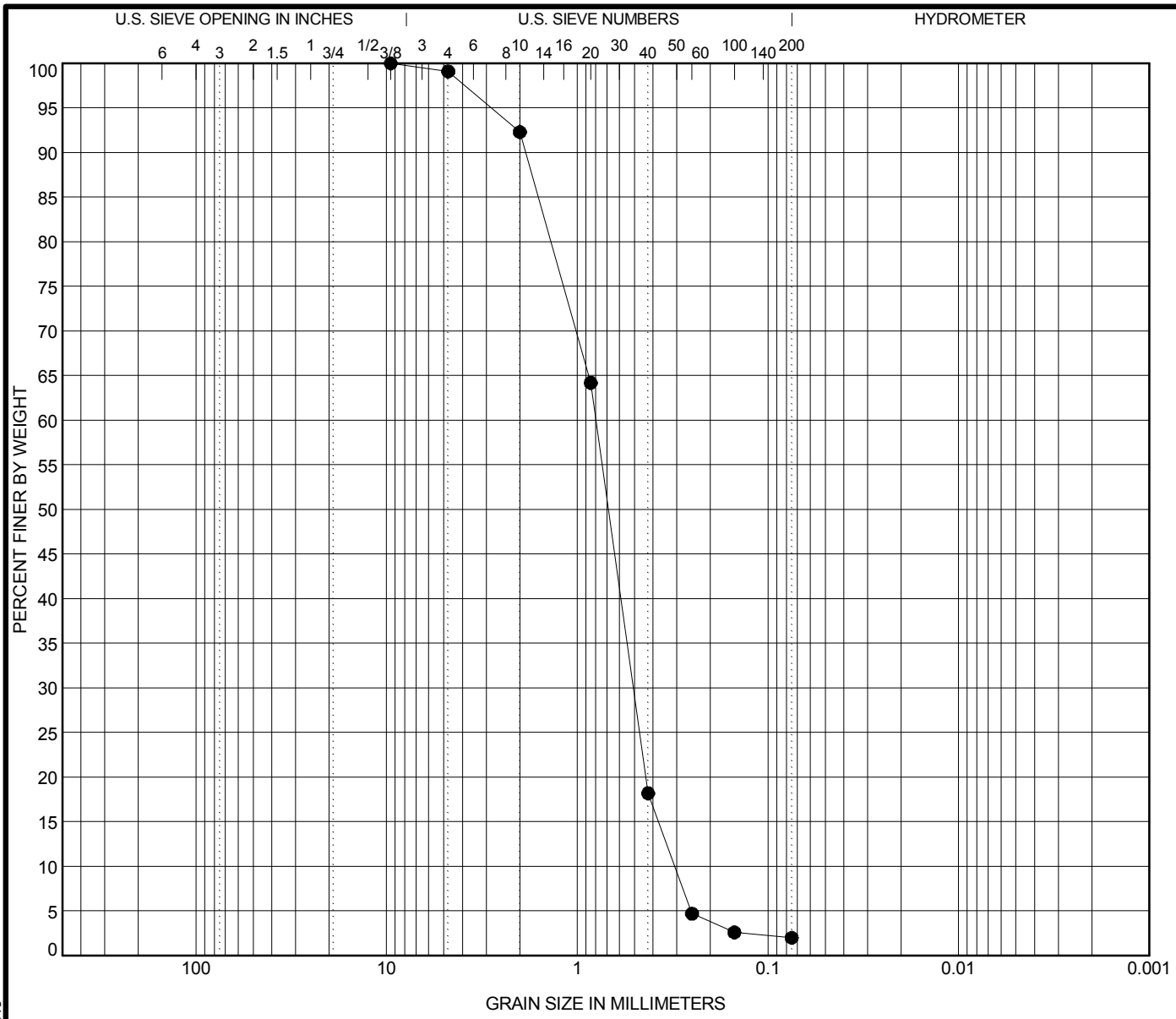
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-39 | 9.2 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, brown** | -- | -- | -- | **1.05** | **2.59** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.798** | **0.508** | **0.308** | **0.9** | **97.1** | **2.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 2.0 | 2.6 | 4.7 | 18.2 | 64.2 | 92.3 | 99.1 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT, AB | 9/7/18 | DS |

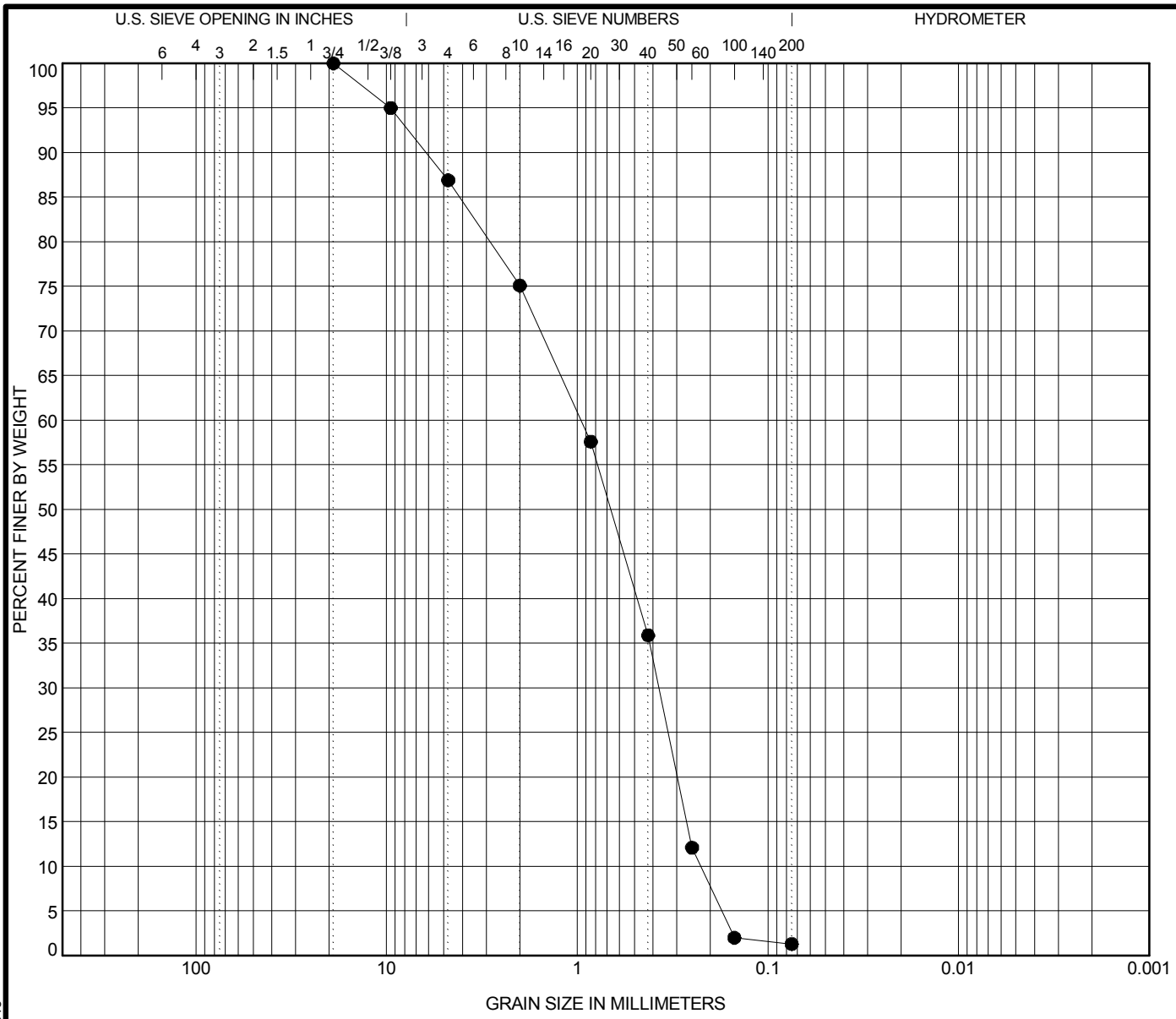
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-40A | 4.6 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, dark gray** | -- | -- | -- | **0.65** | **4.25** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.956** | **0.373** | **0.225** | **13.1** | **85.6** | **1.3** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 1.3 | 2.0 | 12.1 | 35.9 | 57.6 | 75.1 | 86.9 | 95.0 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB | 9/7/18 | DS |

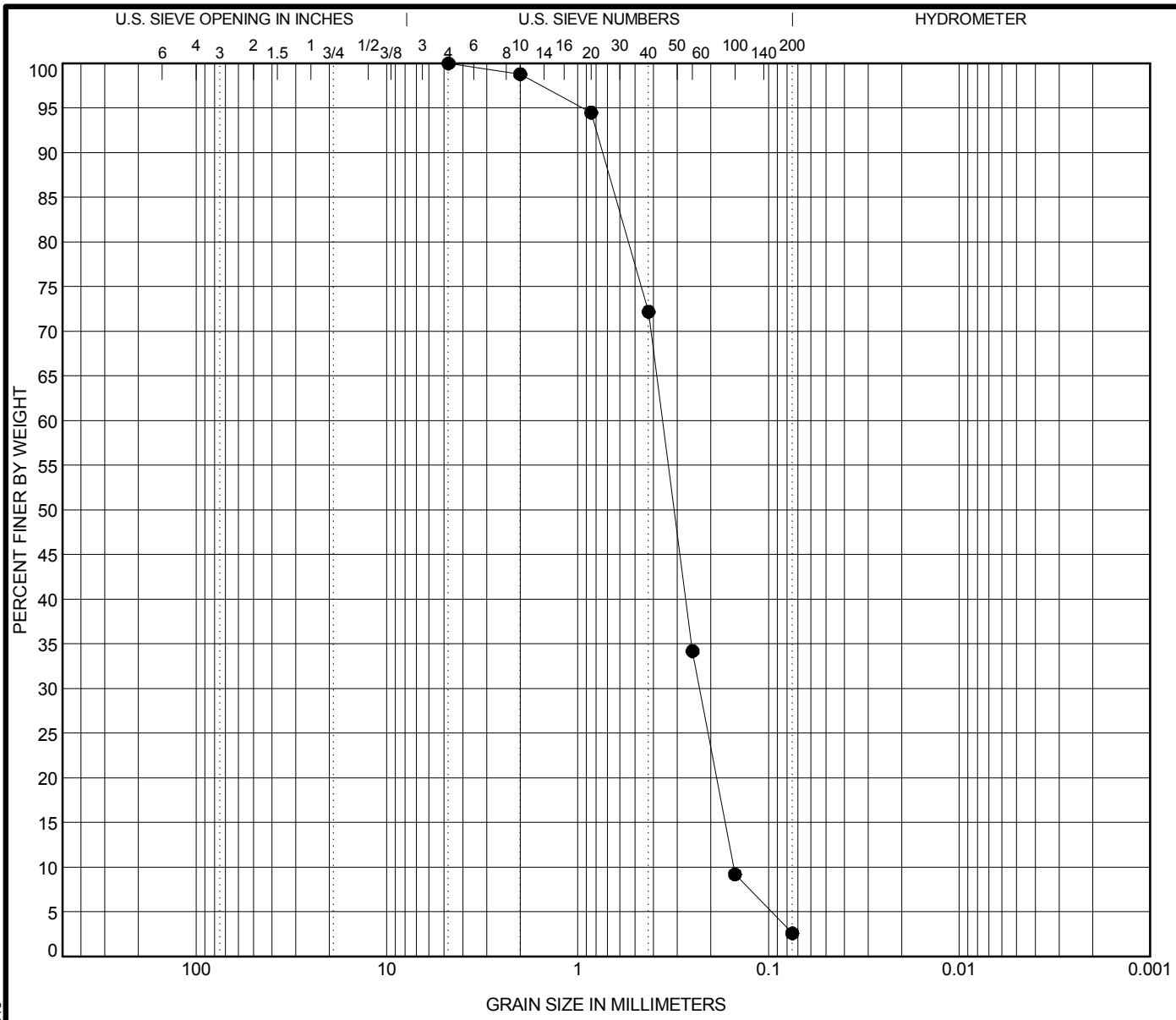
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-40A | 9.6 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, gray** | -- | -- | -- | **0.96** | **2.35** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.358** | **0.229** | **0.152** | **0.0** | **97.4** | **2.6** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 2.6 | 9.2 | 34.2 | 72.2 | 94.5 | 98.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB | 9/7/18 | DS |

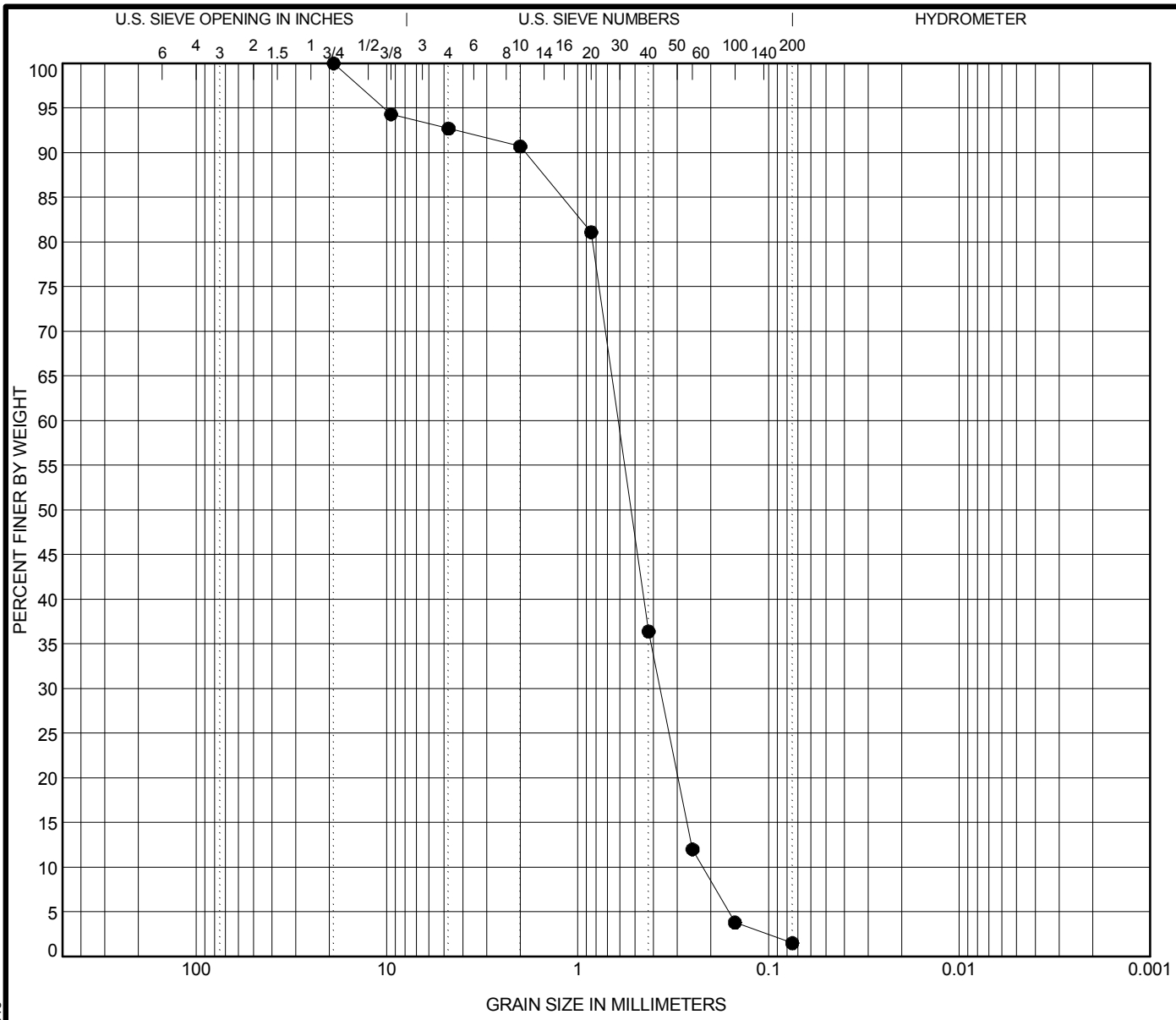
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/12/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-20 | 5.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, light brown and gray** | -- | -- | -- | **1.01** | **2.78** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.613** | **0.37** | **0.221** | **7.3** | **91.2** | **1.5** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 1.5 | 3.8 | 12.0 | 36.4 | 81.1 | 90.7 | 92.7 | 94.3 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/7/18 | DS |

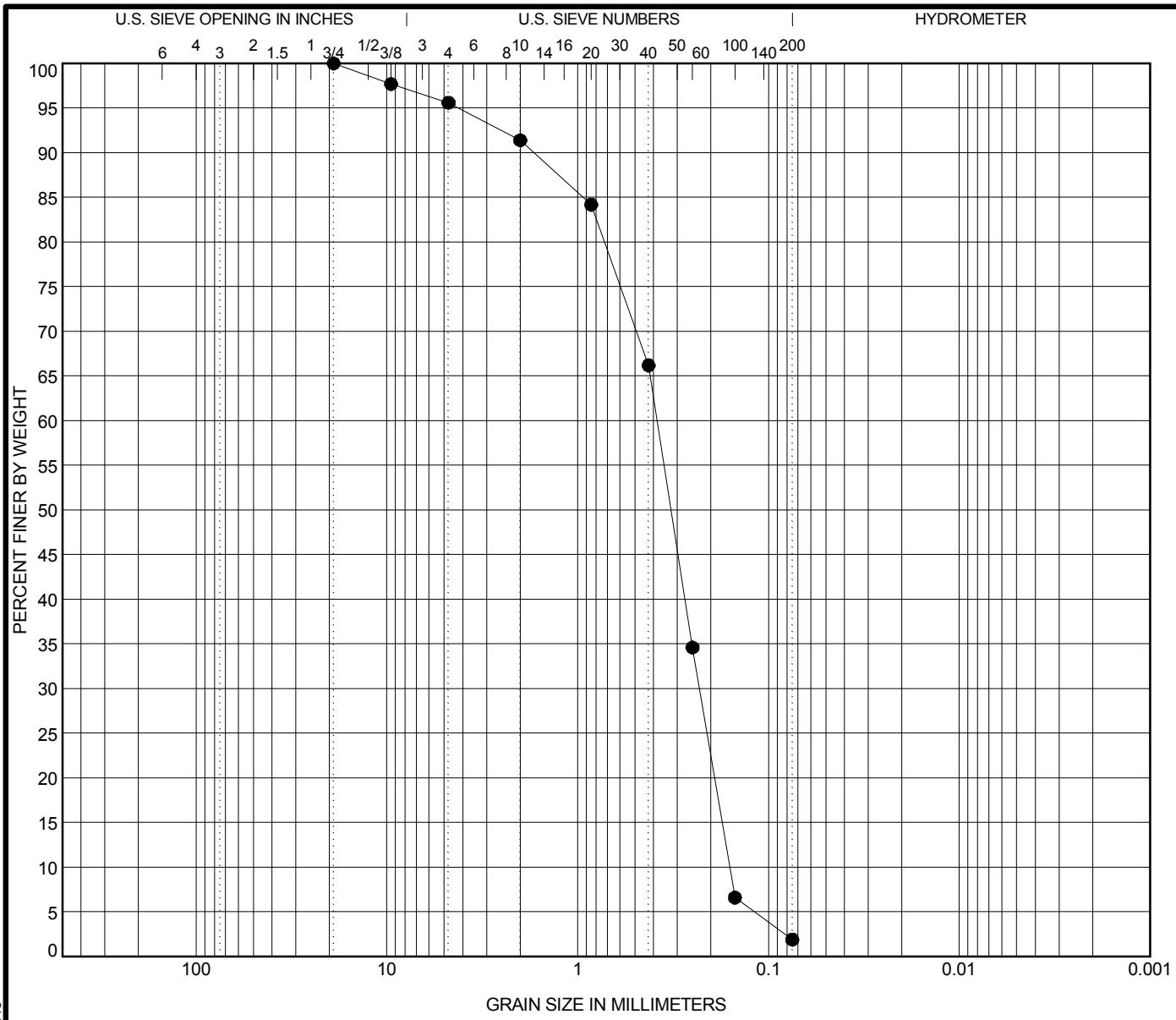
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/10/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-13 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, dark gray** | -- | -- | -- | **0.86** | **2.40** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.383** | **0.23** | **0.16** | **4.4** | **93.7** | **1.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 1.9 | 6.6 | 34.6 | 66.2 | 84.2 | 91.4 | 95.6 | 97.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/10/18 | DS |

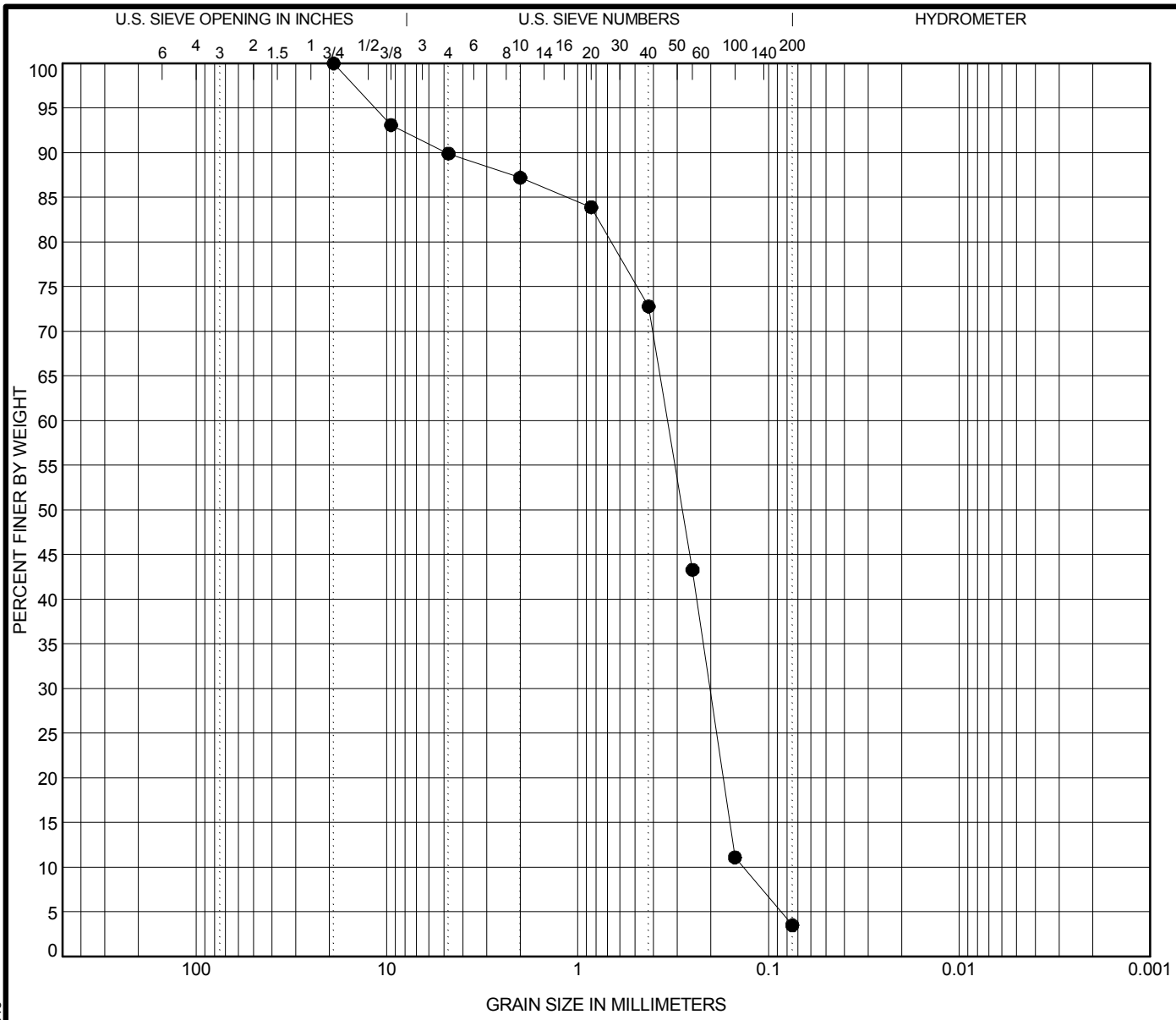
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-13 | 3.5 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | **0.89** | **2.49** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.338** | **0.202** | **0.136** | **10.1** | **86.4** | **3.5** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 3.5 | 11.1 | 43.3 | 72.8 | 83.9 | 87.2 | 89.9 | 93.1 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/10/18 | DS |

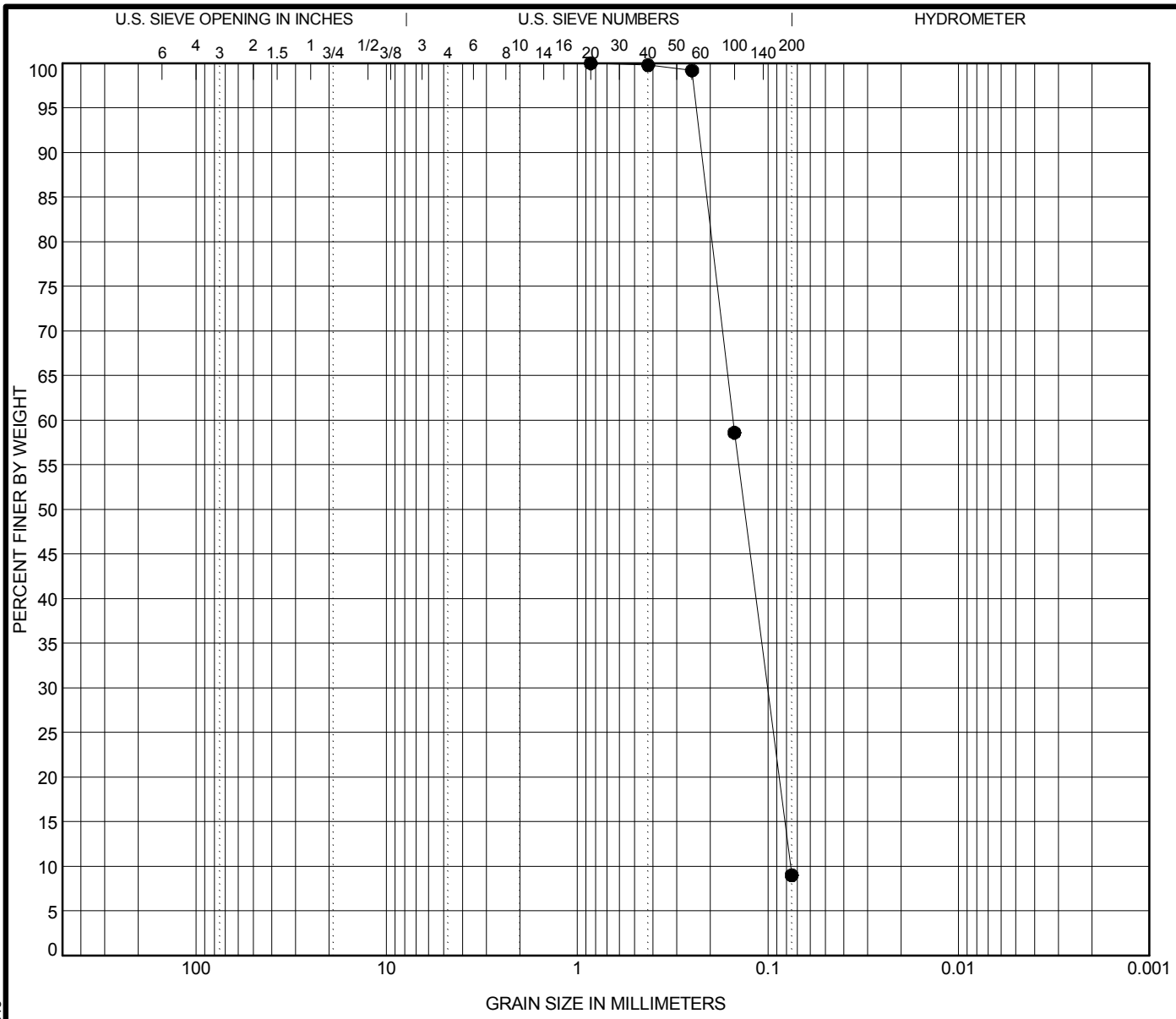
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-13 | 13.7 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to bedim grained sand, dark gray** | -- | -- | -- | **0.87** | **2.01** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **0.85** | **0.153** | **0.101** | **0.076** | **0.0** | **91.0** | **9.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 |
|---|---|---|---|---|---|
| % Finer | 9.0 | 58.6 | 99.2 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/10/18 | DS |

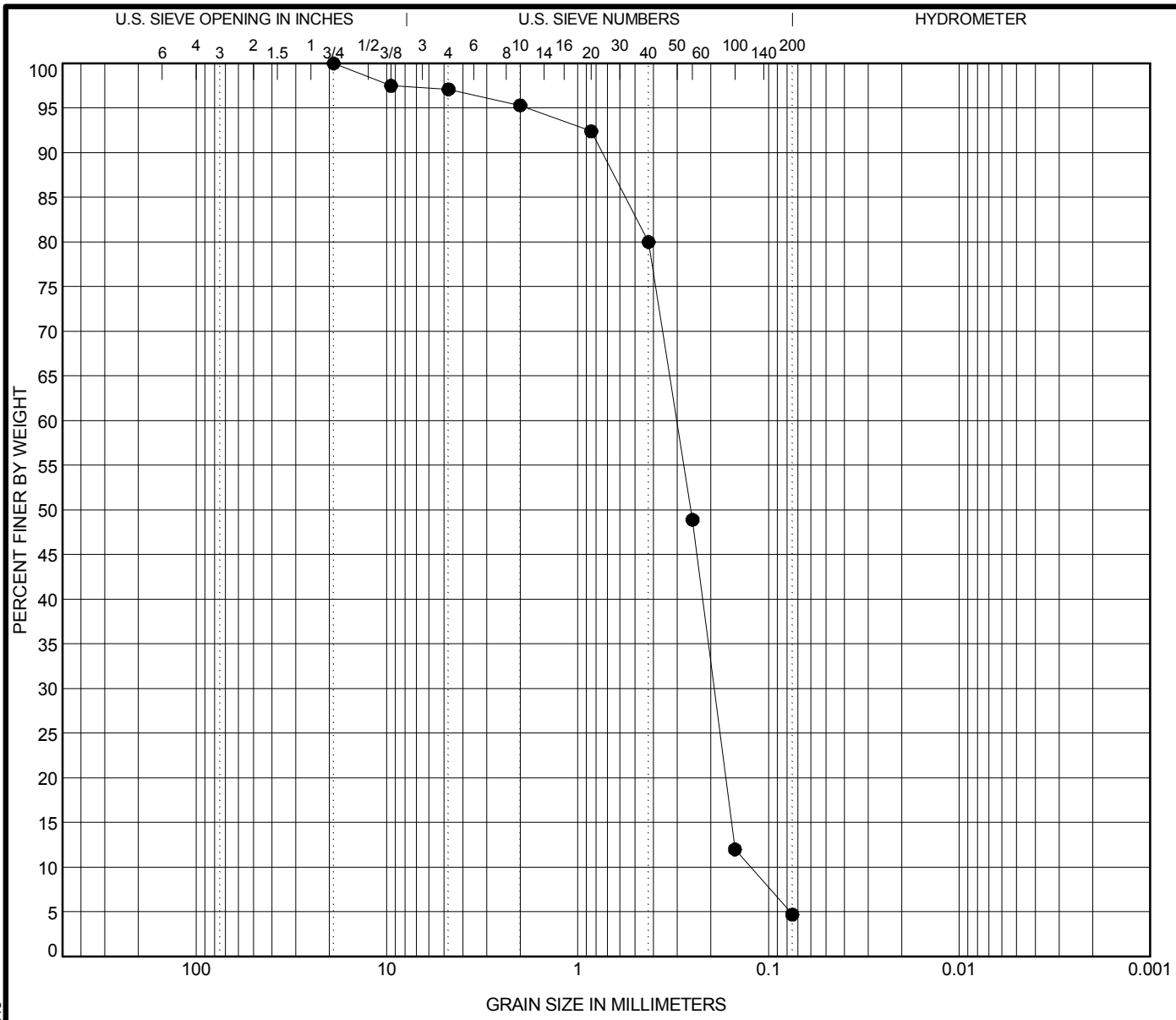
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-14 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | **0.99** | **2.44** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.302** | **0.192** | **0.124** | **2.9** | **92.4** | **4.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 4.7 | 12.0 | 48.9 | 80.0 | 92.4 | 95.3 | 97.1 | 97.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/10/18 | DS |

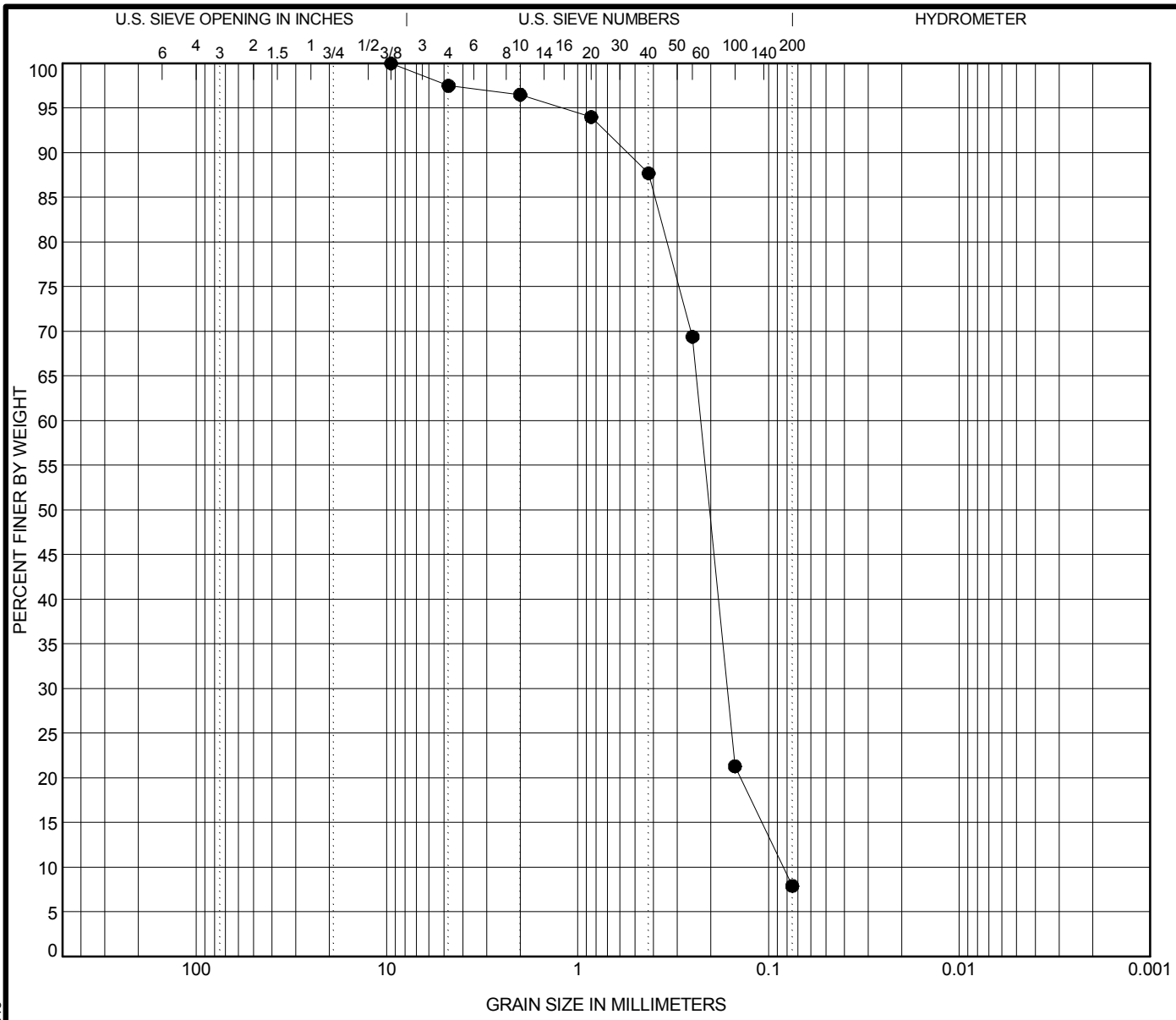
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-15 | 0.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | **1.43** | **2.71** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.226** | **0.165** | **0.084** | **2.5** | **89.6** | **7.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 7.9 | 21.3 | 69.4 | 87.7 | 94.0 | 96.5 | 97.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/10/18 | DS |

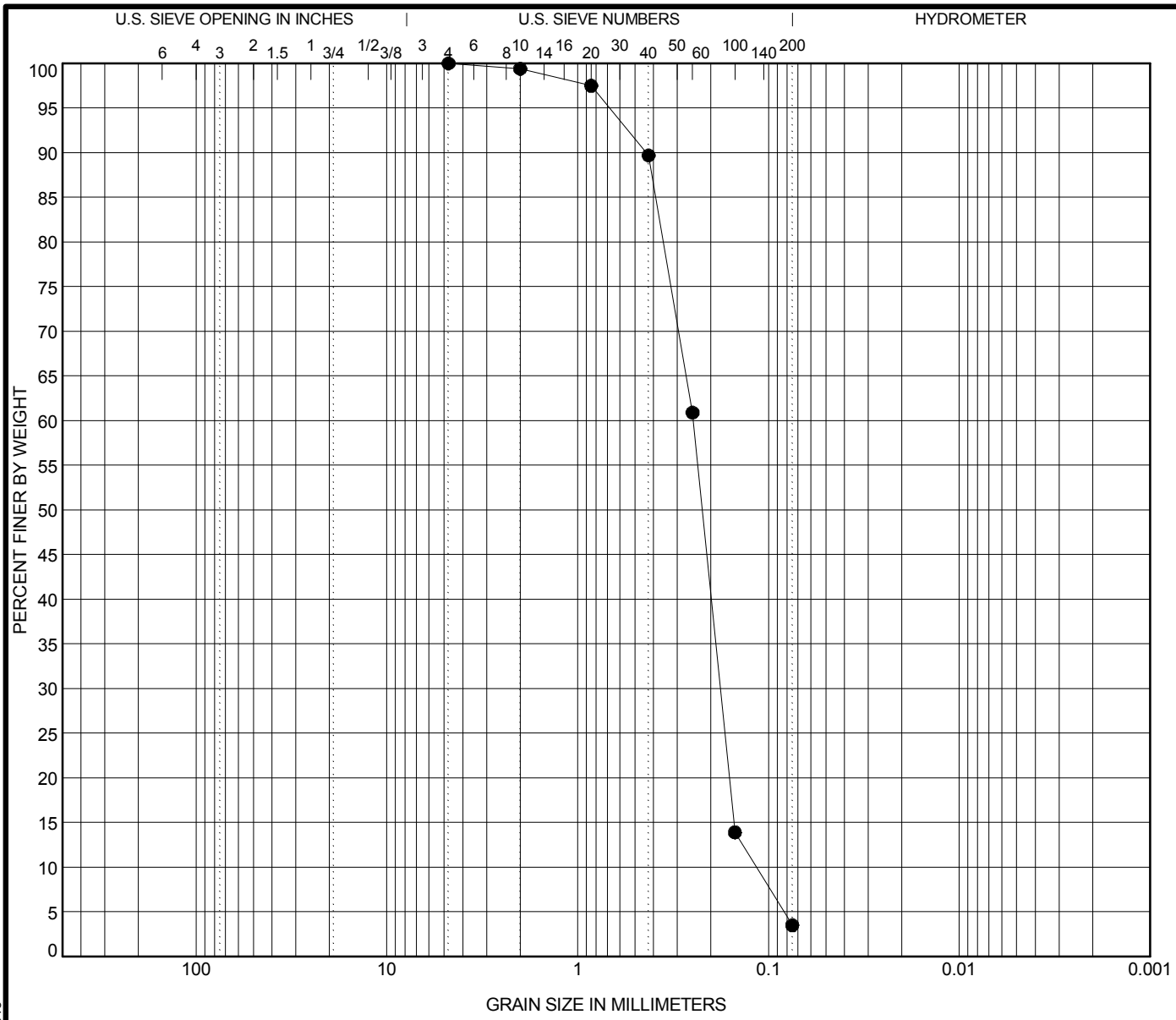
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-15 | 4.4 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, gray** | -- | -- | -- | **1.12** | **2.14** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.248** | **0.179** | **0.116** | **0.0** | **96.5** | **3.5** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 3.5 | 13.9 | 60.9 | 89.7 | 97.5 | 99.4 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/10/18 | DS |

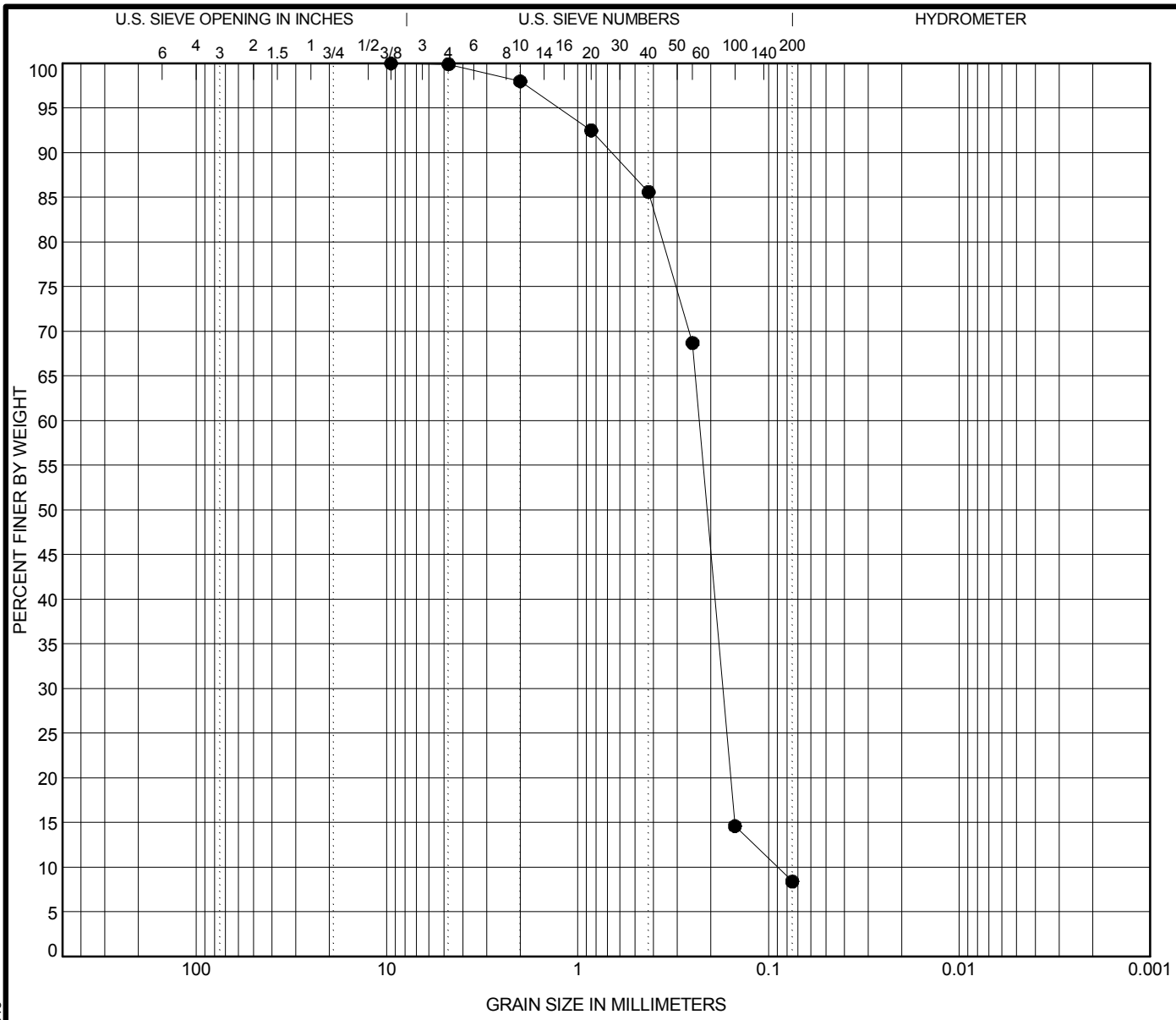
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-16 | 0.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.23** | **0.173** | **0.09** | **0.1** | **91.5** | **8.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 8.4 | 14.6 | 68.7 | 85.6 | 92.5 | 98.0 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/10/18 | |

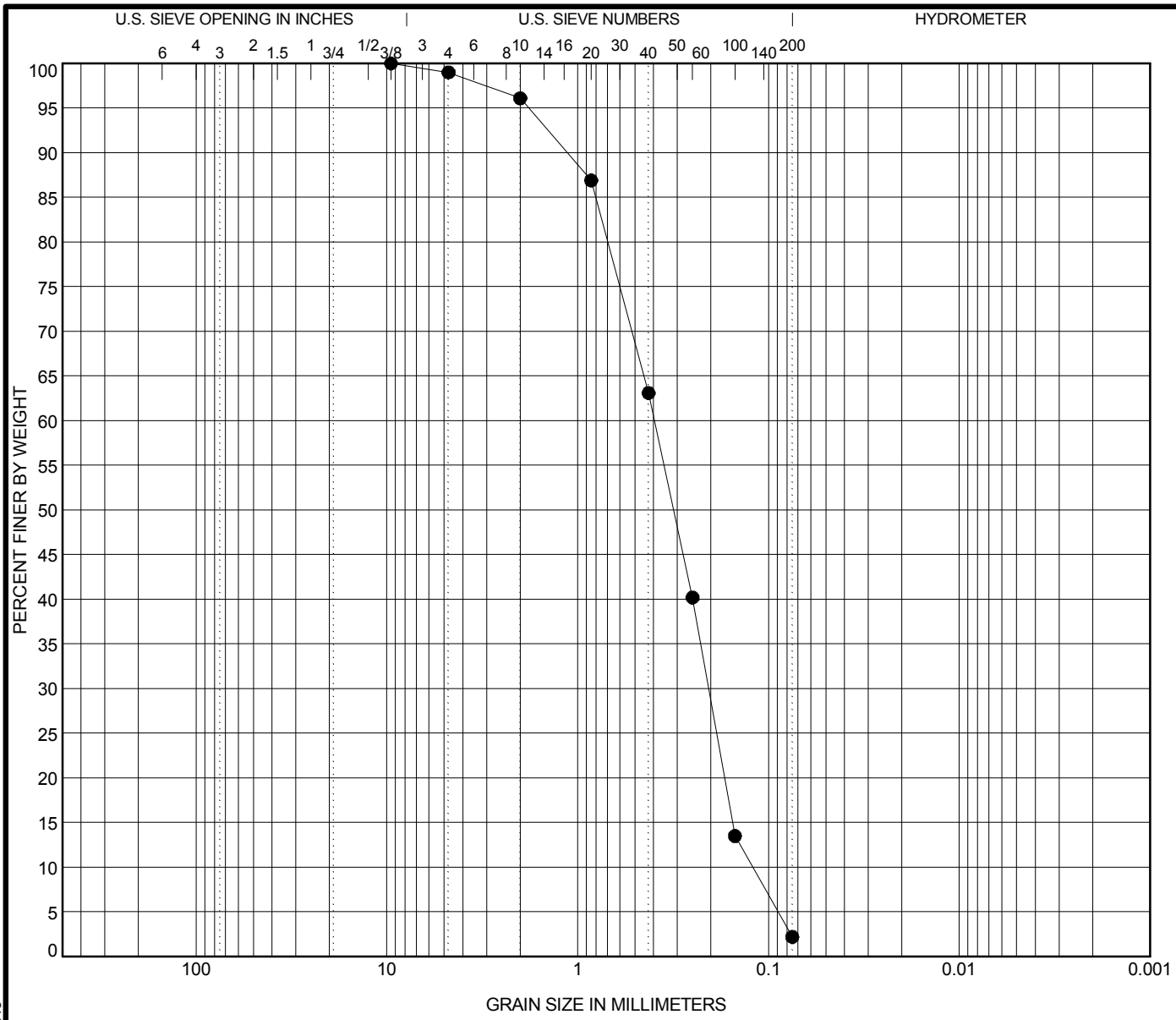
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-16 | 4.9 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, dark gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.396** | **0.206** | **0.121** | **1.0** | **96.8** | **2.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 2.2 | 13.5 | 40.2 | 63.1 | 86.9 | 96.1 | 99.0 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/10/18 | |

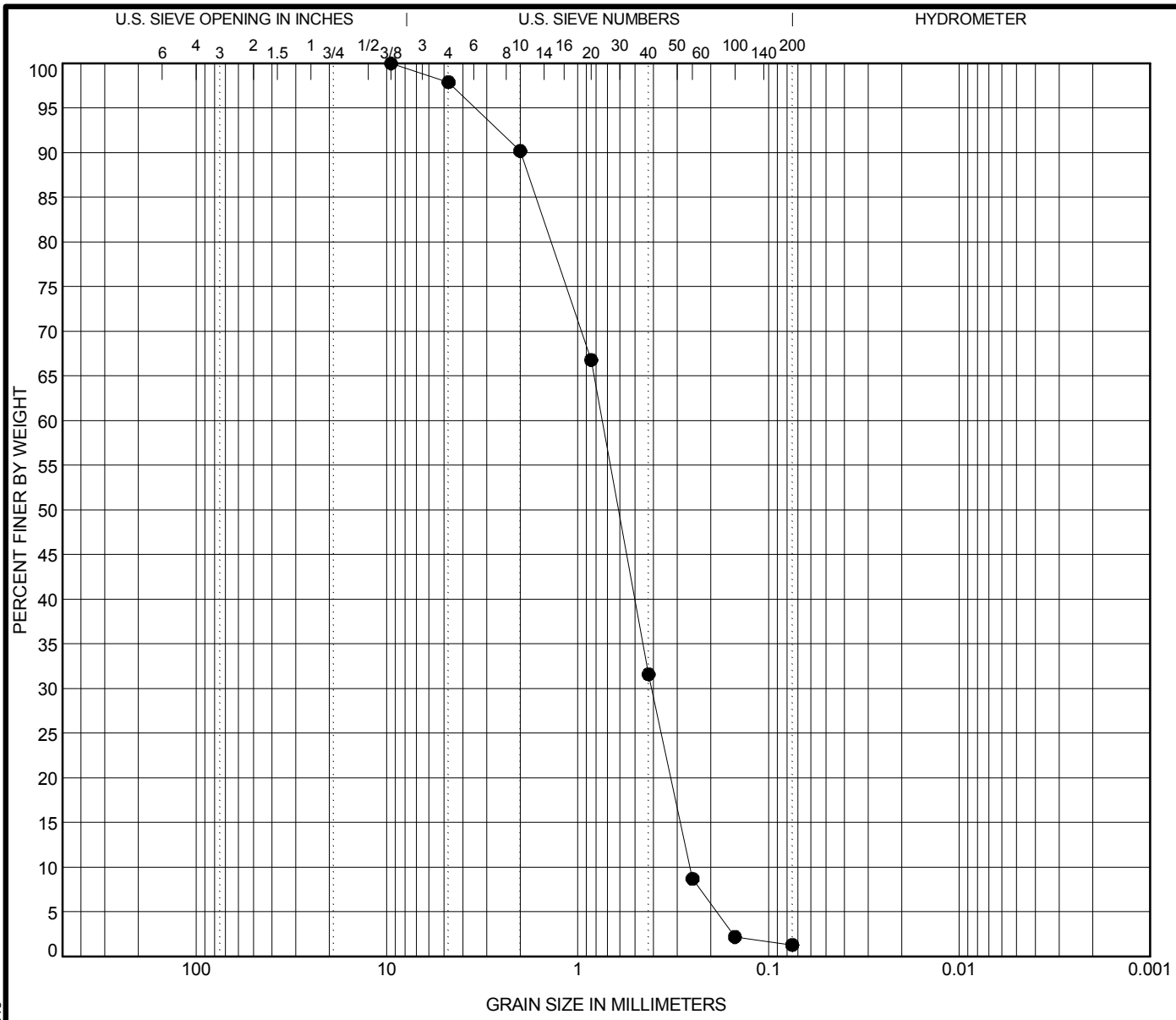
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-16 | 9.9 ft | **SILTY SAND WITH GRAVEL (SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.743** | **0.41** | **0.258** | **2.1** | **96.6** | **1.3** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 1.3 | 2.2 | 8.7 | 31.6 | 66.8 | 90.2 | 97.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/10/18 | |

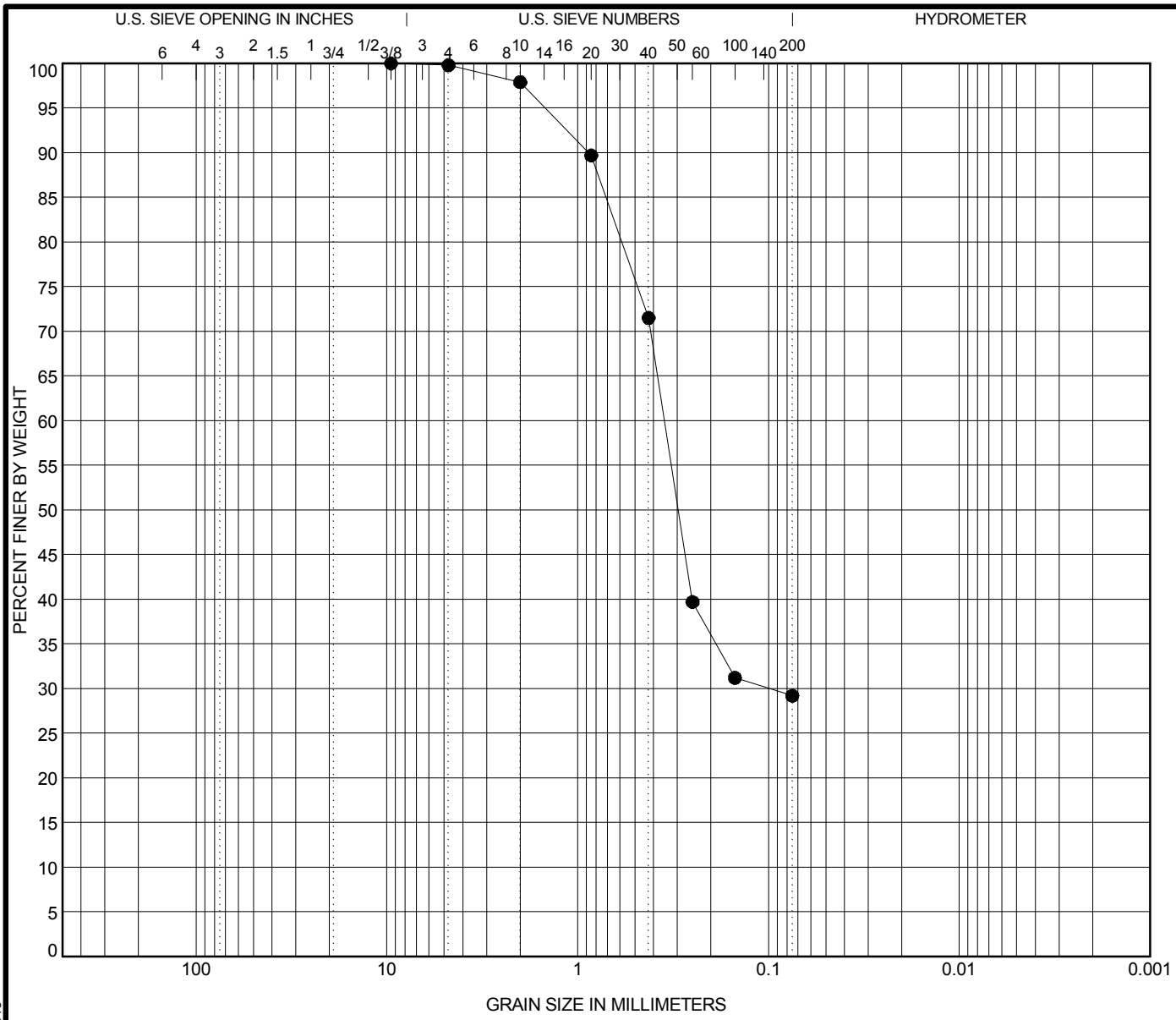
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-17 | 0.0 ft | **SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, grayish brown** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.351** | **0.099** | **--** | **0.2** | **70.6** | **29.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 29.2 | 31.2 | 39.7 | 71.5 | 89.7 | 97.9 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/10/18 | DS |

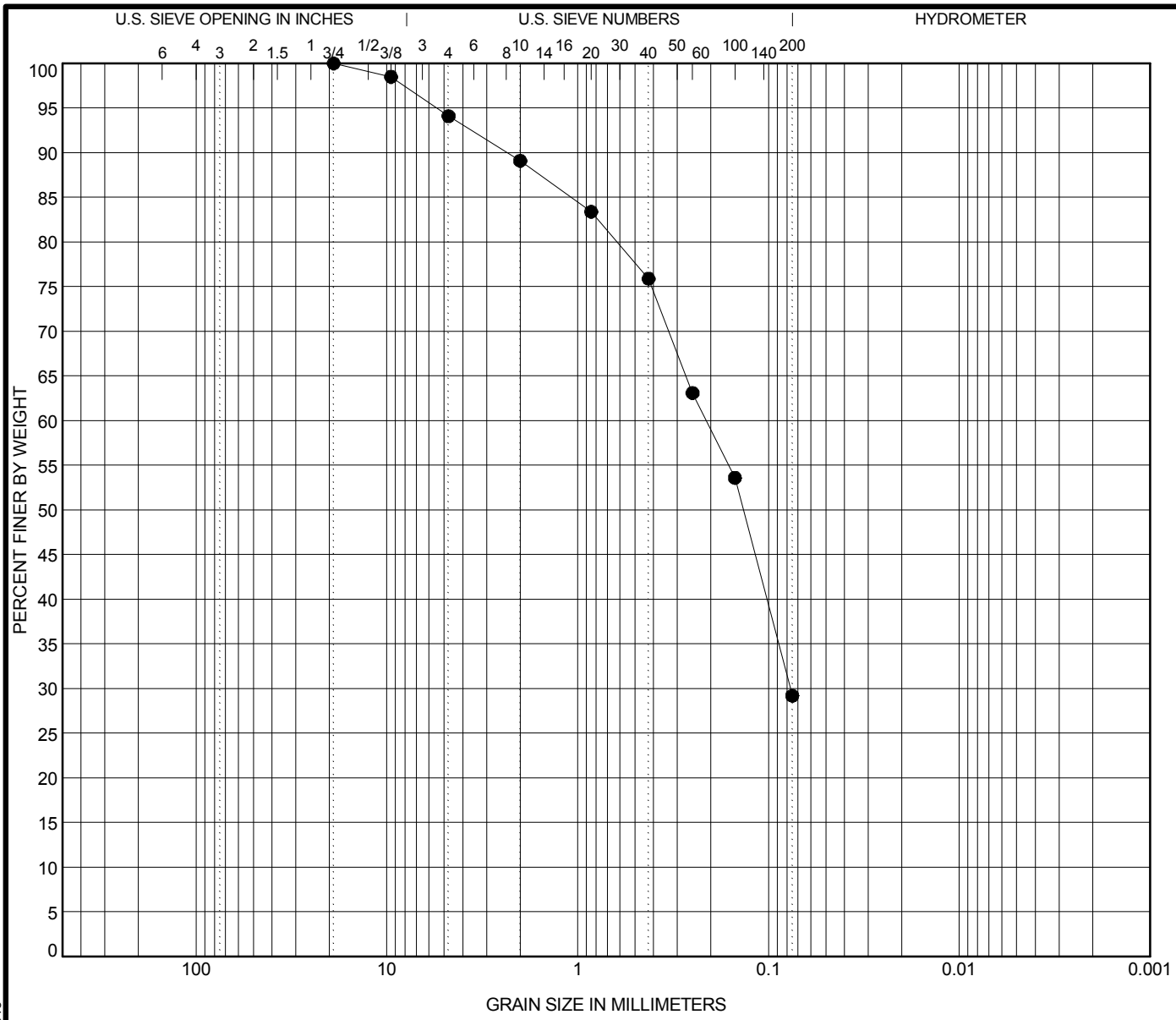
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-17 | 1.3 ft | **CLAYEY SAND (SC), fine to coarse grained sand, trace gravel, contains shell fragments brown {Visual}** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.212** | **0.077** | **--** | **5.9** | **64.9** | **29.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 29.2 | 53.6 | 63.1 | 75.9 | 83.4 | 89.1 | 94.1 | 98.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/10/18 | |

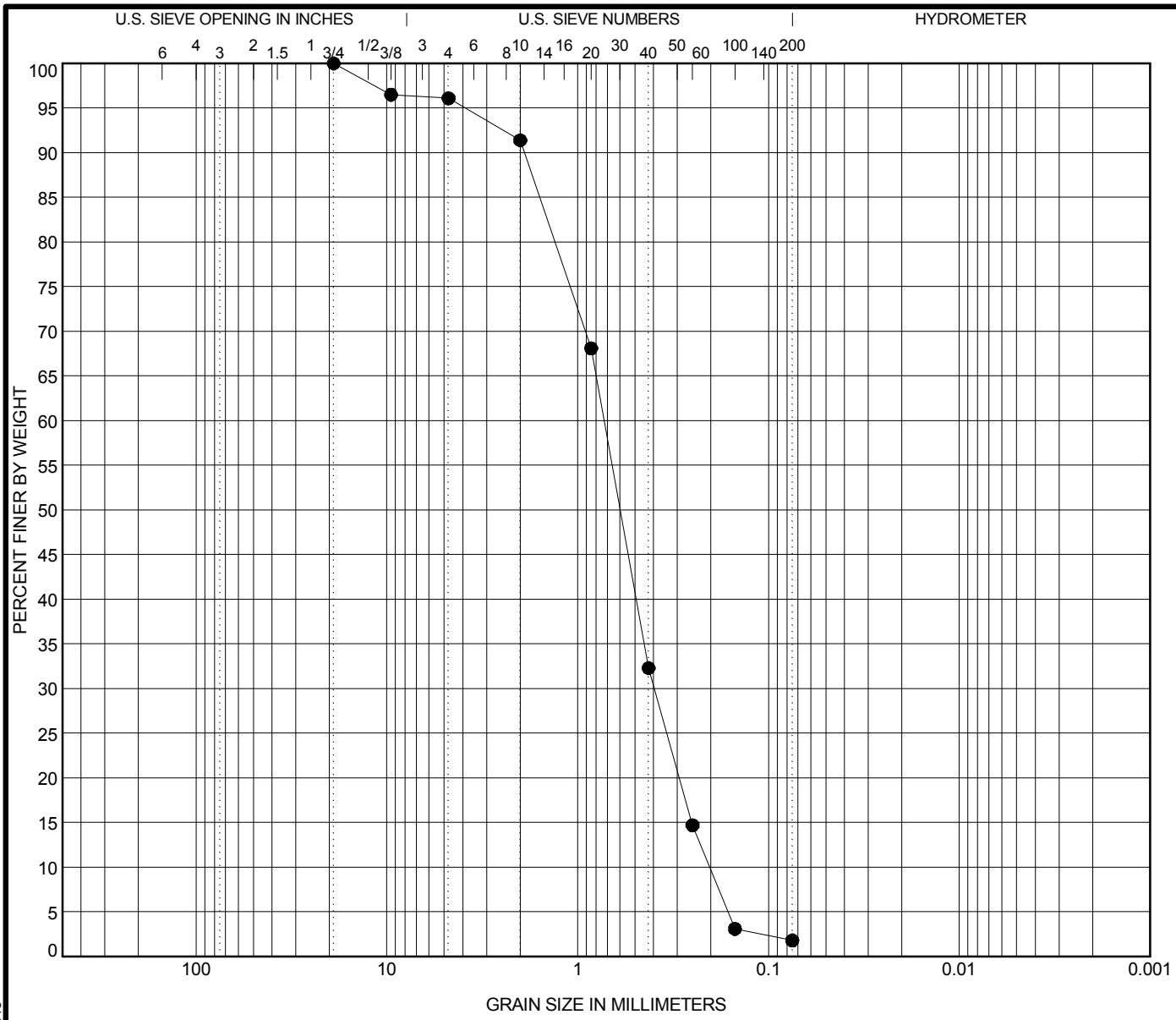
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-17 | 6.3 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.727** | **0.397** | **0.203** | **3.9** | **94.3** | **1.8** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 1.8 | 3.1 | 14.7 | 32.3 | 68.1 | 91.4 | 96.1 | 96.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/10/18 | |

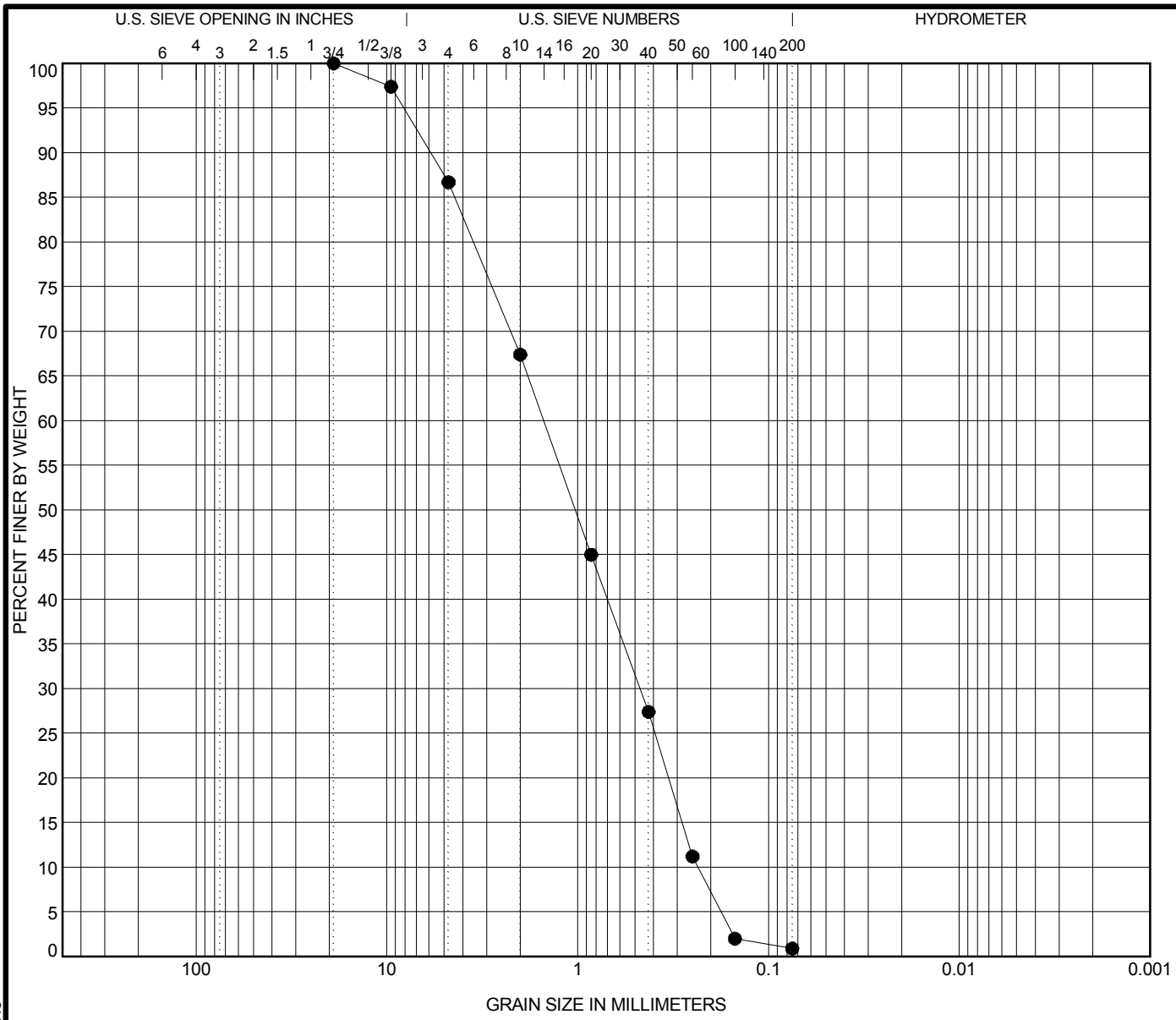
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-17 | 11.3 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **1.508** | **0.471** | **0.234** | **13.3** | **85.8** | **0.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 0.9 | 2.0 | 11.2 | 27.4 | 45.0 | 67.4 | 86.7 | 97.4 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/10/18 | |

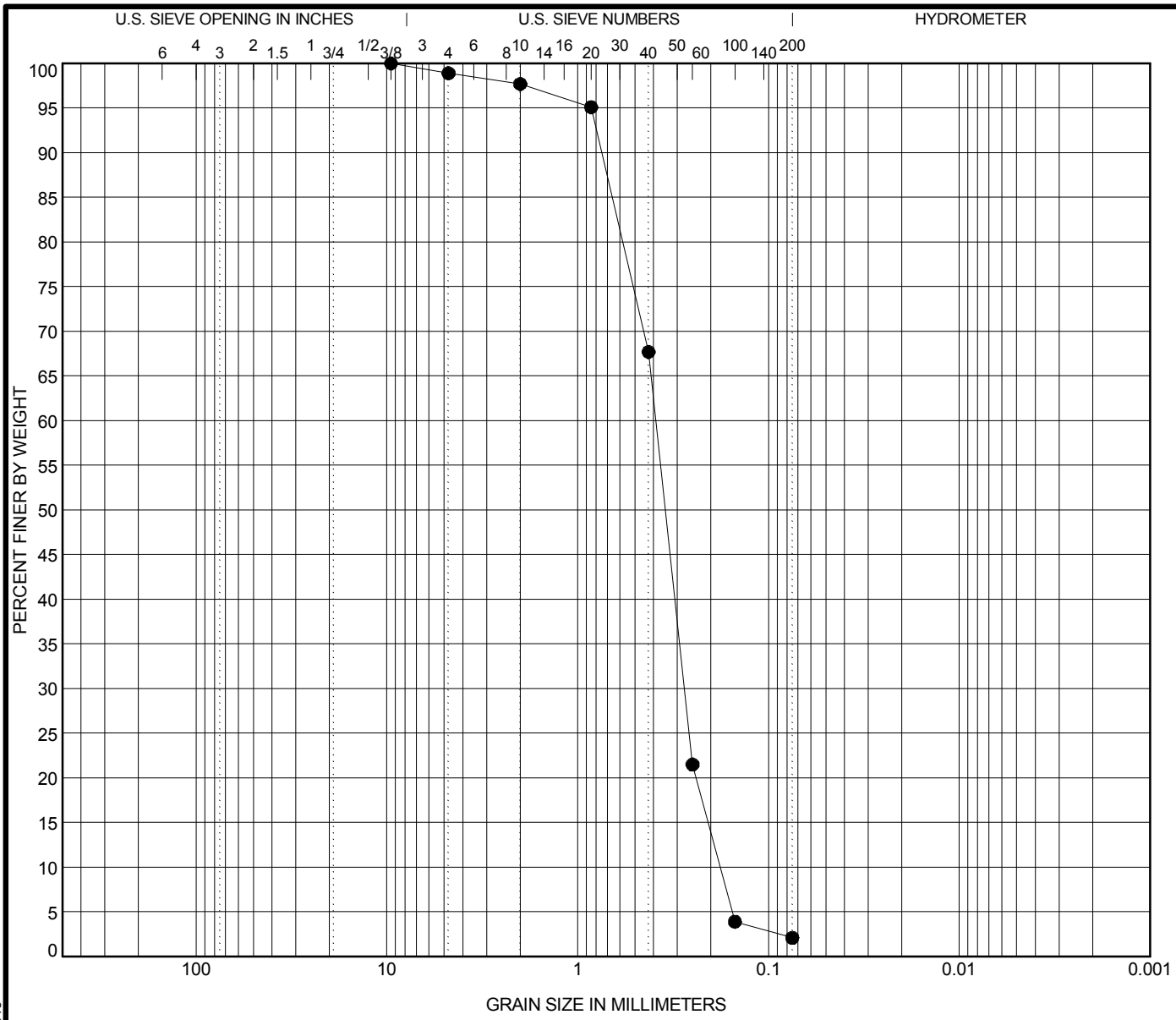
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-27 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- | **1.09** | **2.17** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.389** | **0.276** | **0.179** | **1.1** | **96.8** | **2.1** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 2.1 | 3.9 | 21.5 | 67.7 | 95.1 | 97.7 | 98.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/10/18 | DS |

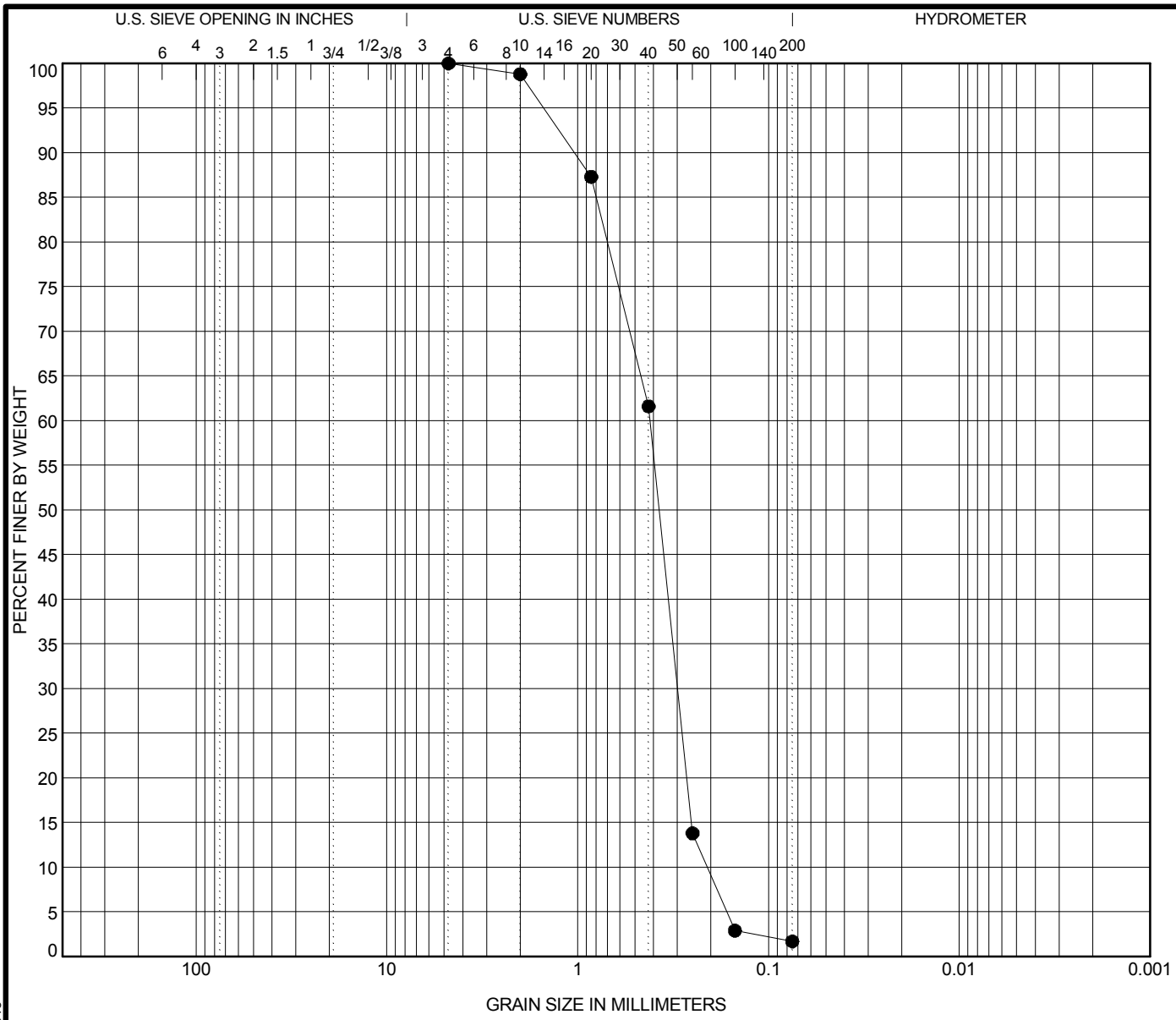
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-27 | 4.4 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, gray** | -- | -- | -- | **1.03** | **2.00** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.418** | **0.299** | **0.209** | **0.0** | **98.3** | **1.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 1.7 | 2.9 | 13.8 | 61.6 | 87.3 | 98.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/10/18 | DS |

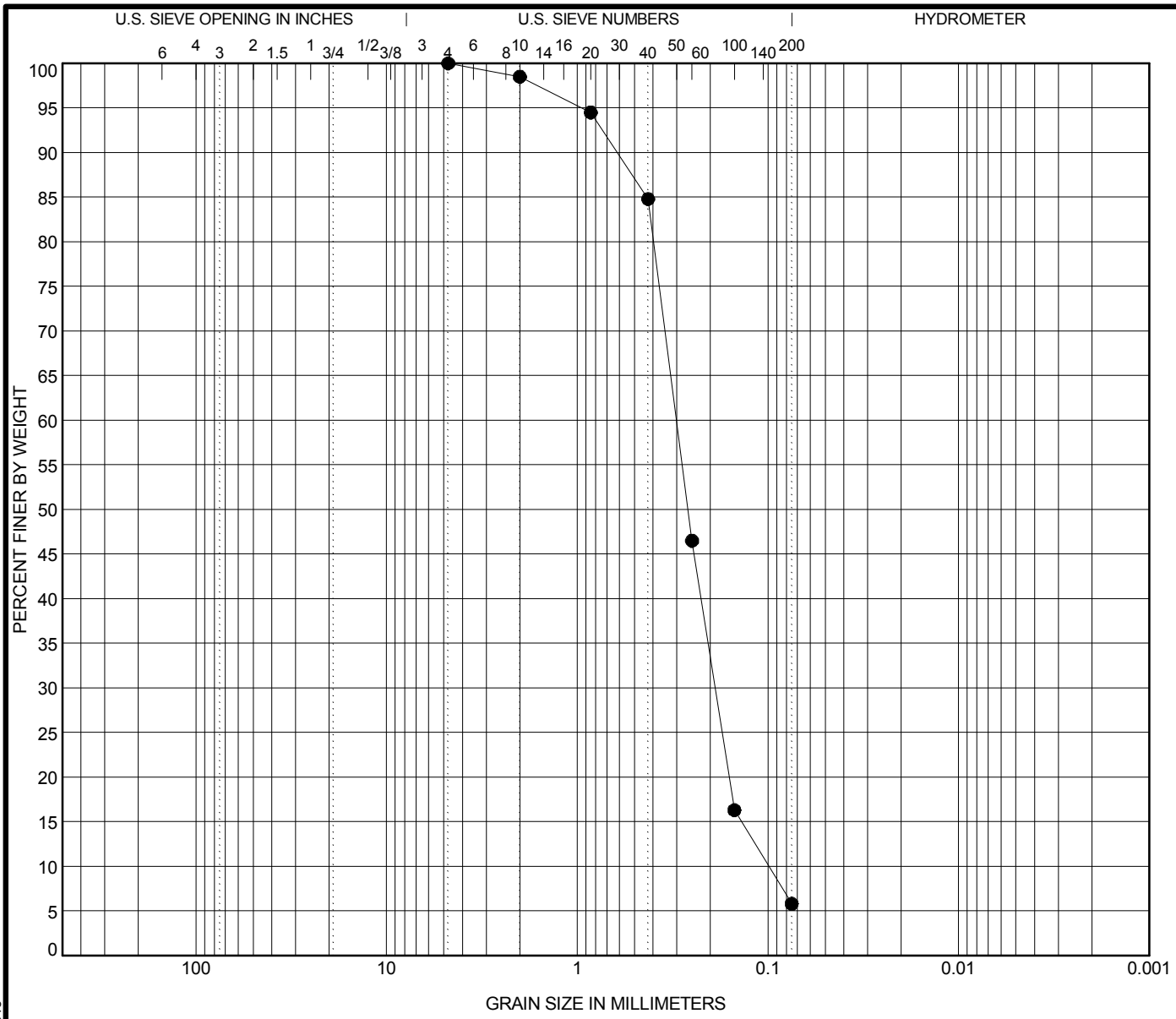
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-27 | 9.4 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, gray** | -- | -- | -- | **1.20** | **3.05** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.301** | **0.189** | **0.099** | **0.0** | **94.2** | **5.8** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 5.8 | 16.3 | 46.5 | 84.8 | 94.5 | 98.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/10/18 | DS |

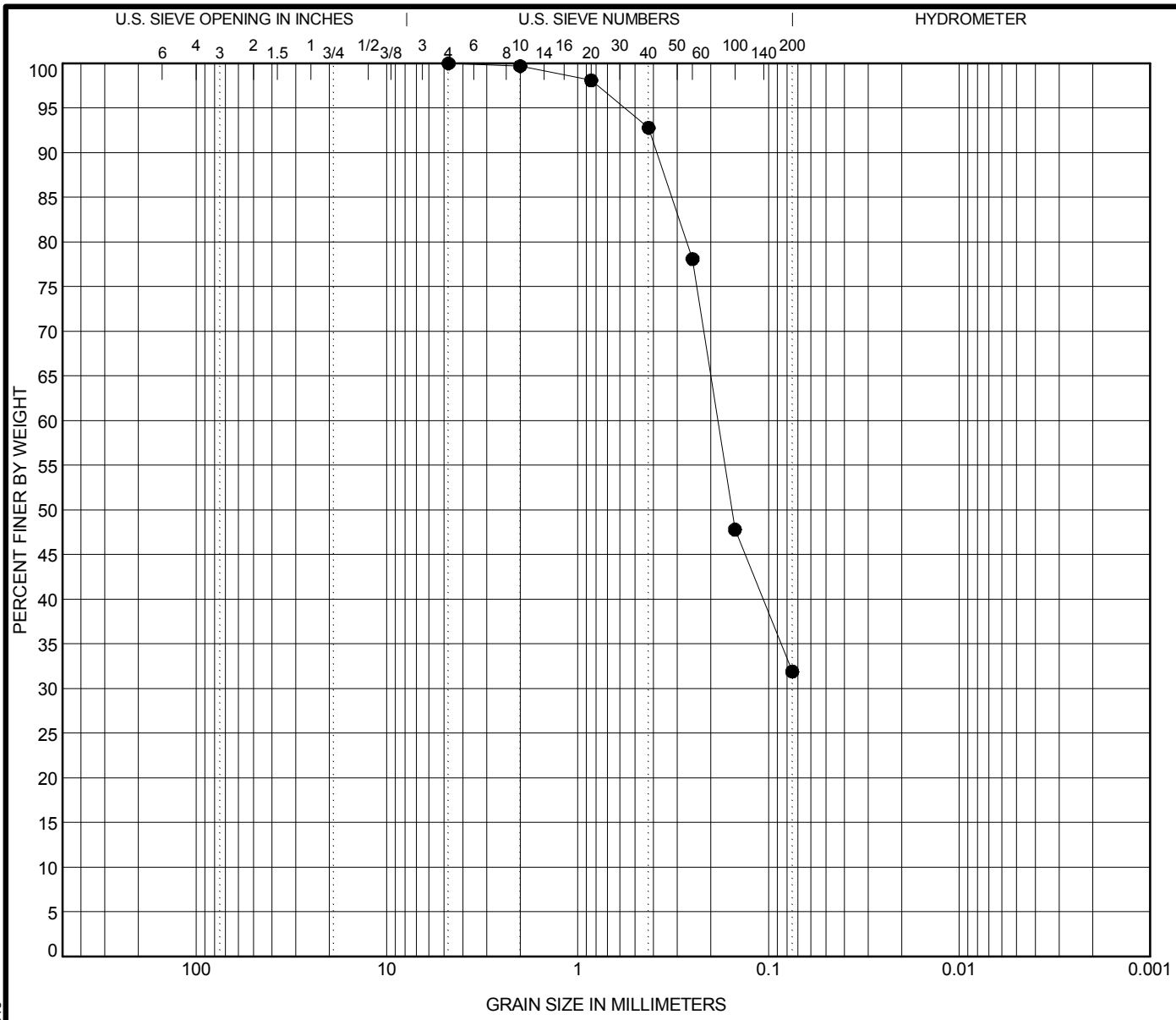
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-27 | 12.7 ft | **CLAYEY SAND (SC), fine to coarse grained sand, dark gray {Visual}** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.184** | **--** | **--** | **0.0** | **68.1** | **31.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 31.9 | 47.8 | 78.1 | 92.8 | 98.1 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/10/18 | DS |

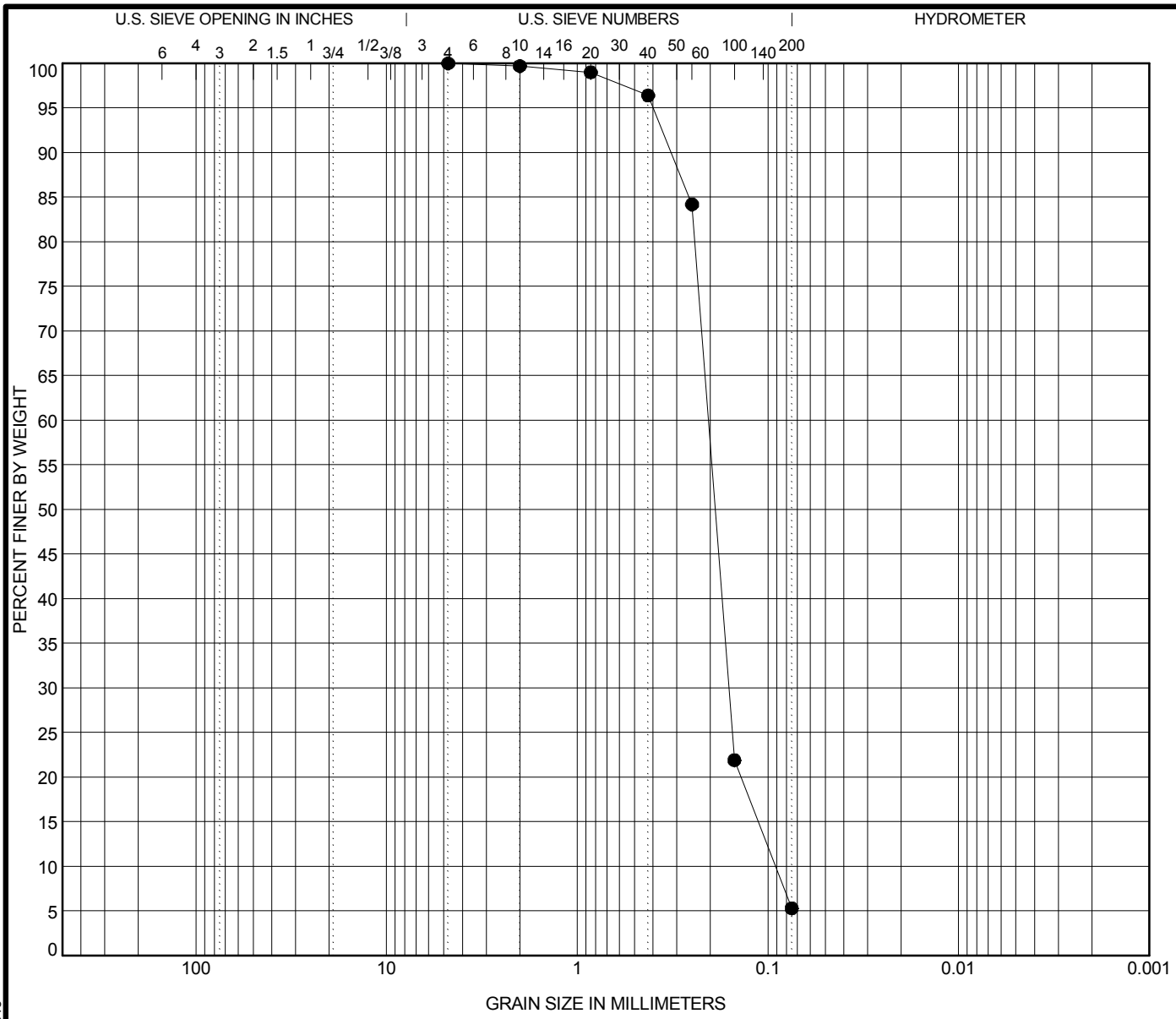
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-27 | 14.4 ft | **POORLY GRADED SAND WITH CLAY (SP-SC), fine to coarse grained sand, dark gray {Visual}** | -- | -- | -- | **1.37** | **2.25** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.205** | **0.16** | **0.091** | **0.0** | **94.7** | **5.3** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 5.3 | 21.9 | 84.2 | 96.4 | 99.0 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/10/18 | DS |

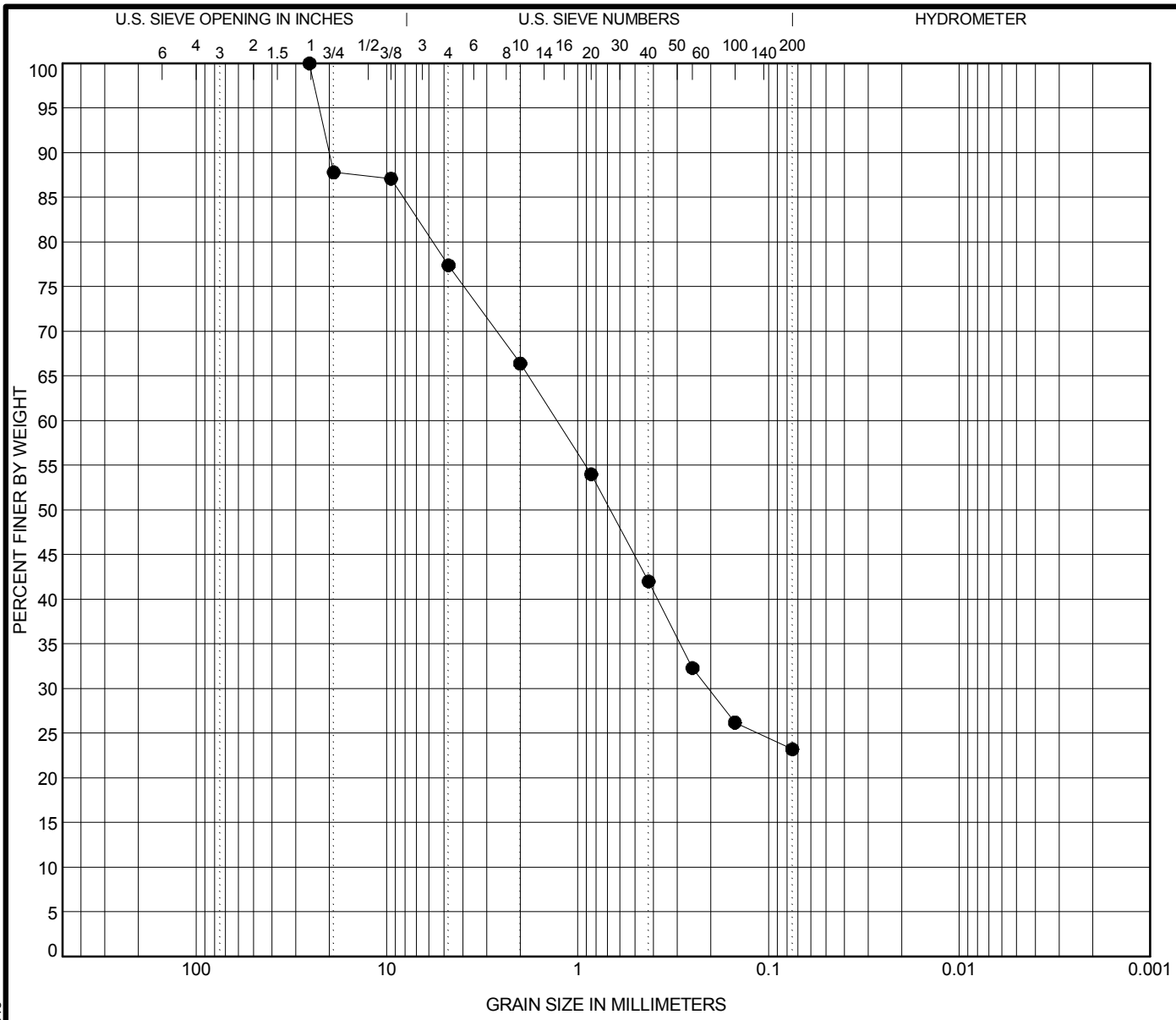
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-28 | 0.0 ft | **SILTY SAND WITH GRAVEL (SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **25.4** | **1.286** | **0.206** | **--** | **22.6** | **54.2** | **23.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| % Finer | 23.2 | 26.2 | 32.3 | 42.0 | 54.0 | 66.4 | 77.4 | 87.1 | 87.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 9/10/18 | |

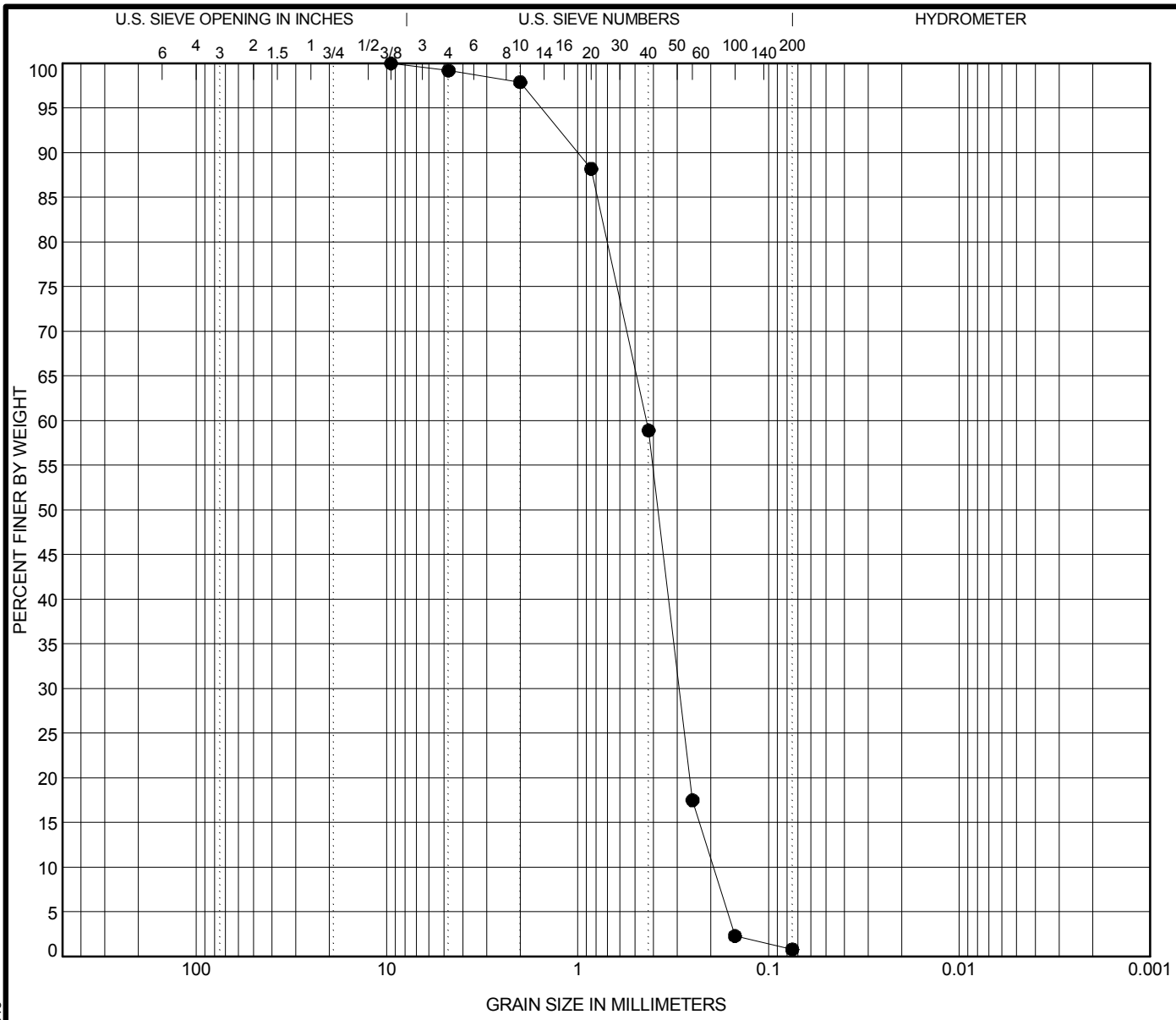
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-31 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, brownish gray** | -- | -- | -- | **1.02** | **2.24** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.436** | **0.293** | **0.194** | **0.8** | **98.4** | **0.8** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 0.8 | 2.3 | 17.5 | 58.9 | 88.2 | 97.9 | 99.2 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/10/18 | DS |

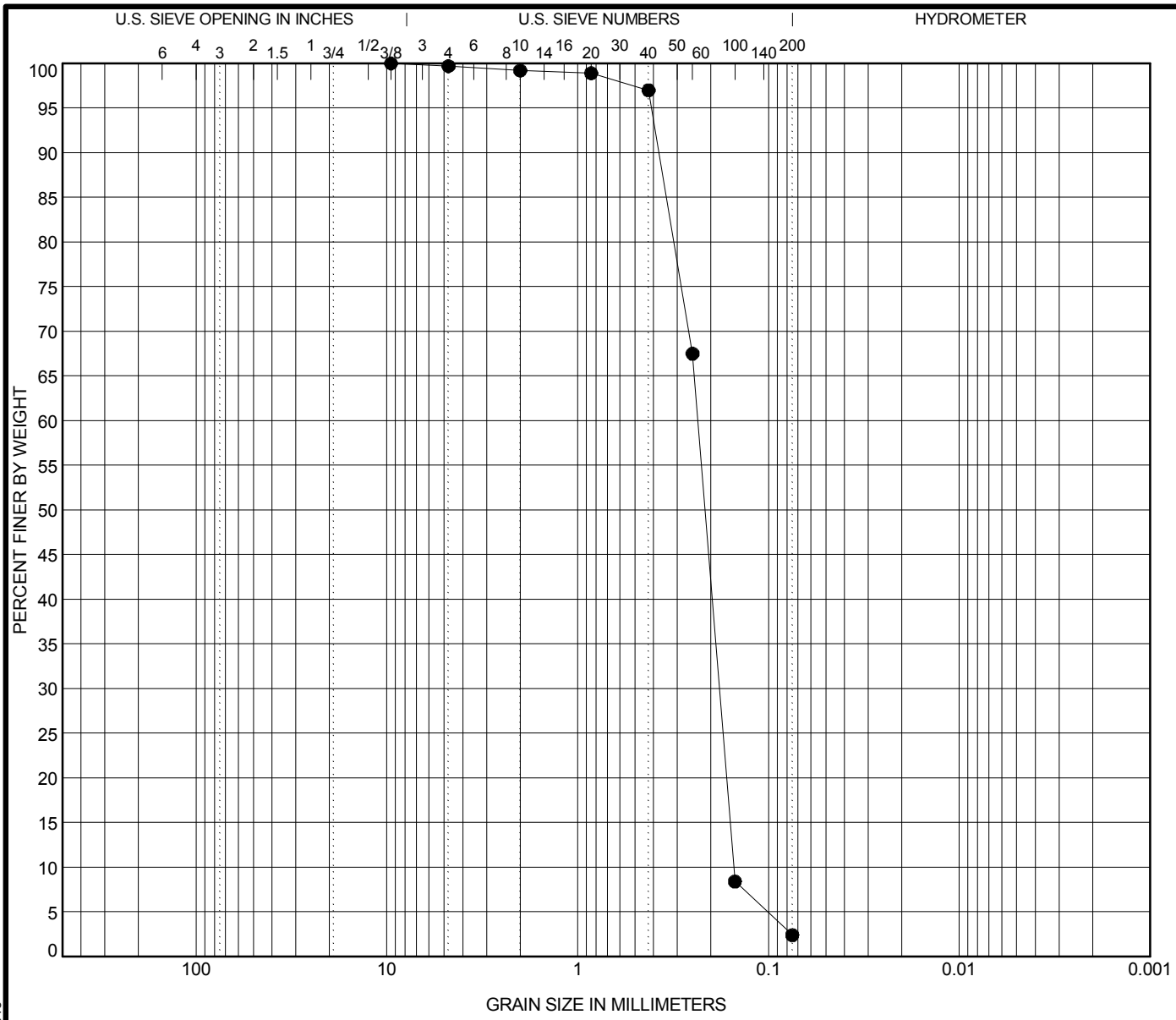
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-31 | 5.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, brownish gray** | -- | -- | -- | **0.92** | **1.54** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.234** | **0.181** | **0.152** | **0.3** | **97.3** | **2.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 2.4 | 8.4 | 67.5 | 97.0 | 98.9 | 99.2 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/10/18 | DS |

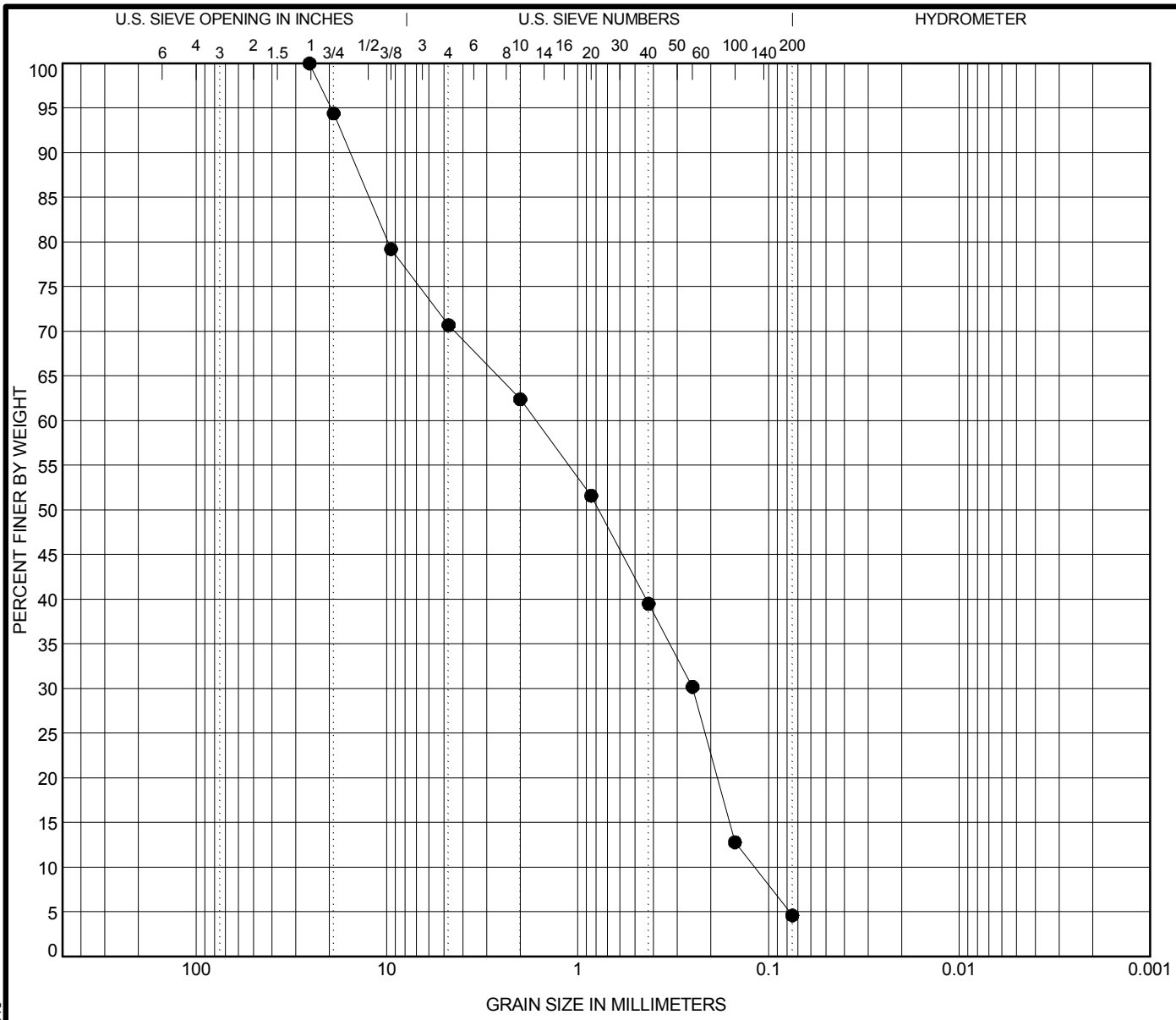
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-31 | 10.0 ft | **POORLY GRADED SAND WITH GRAVEL (SP), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- | **0.32** | **13.97** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **25.4** | **1.654** | **0.249** | **0.118** | **29.3** | **66.1** | **4.6** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" | 1" |
|---|---|---|---|---|---|---|---|---|---|---|
| % Finer | 4.6 | 12.8 | 30.2 | 39.5 | 51.6 | 62.4 | 70.7 | 79.2 | 94.4 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/10/18 | DS |

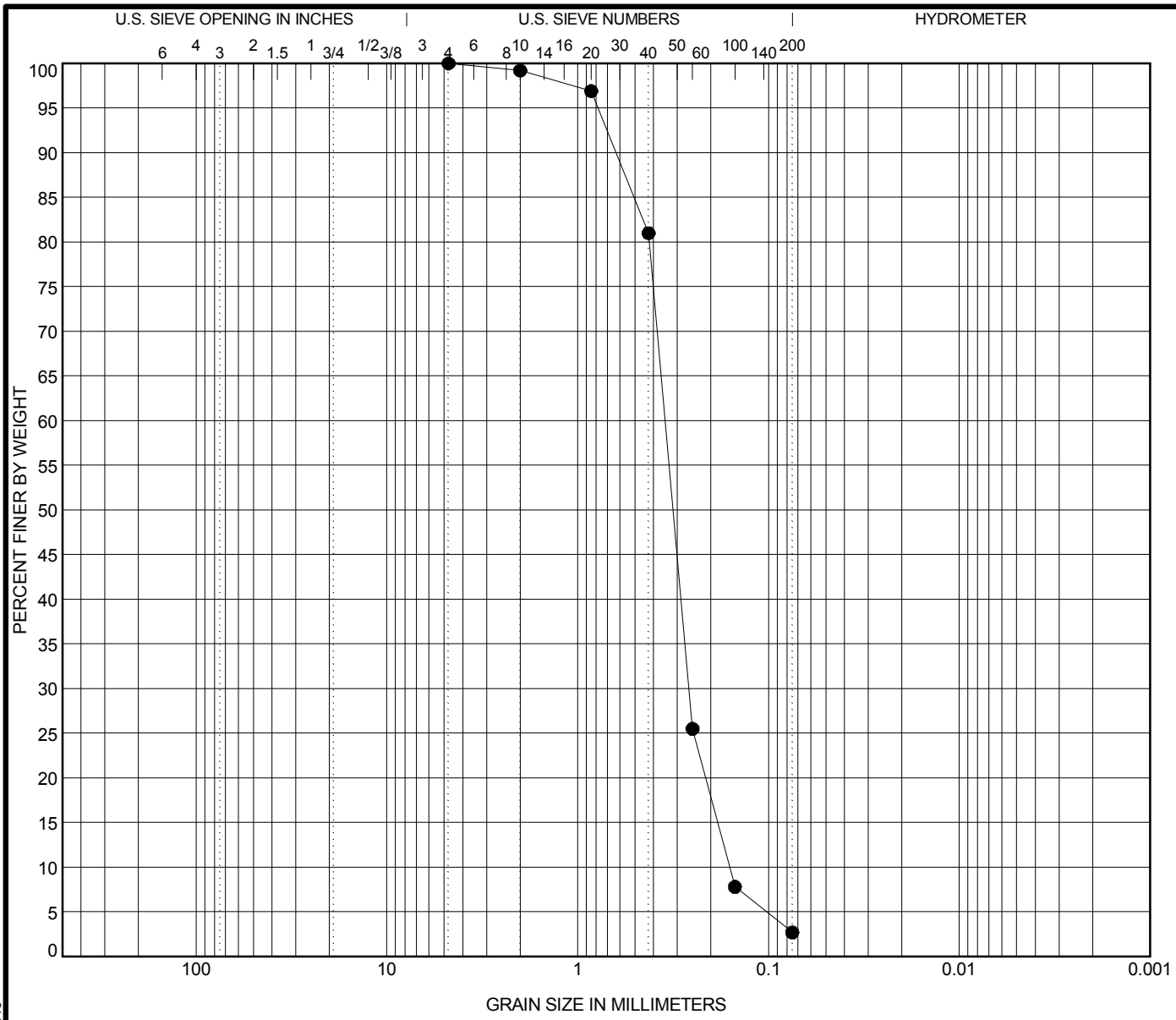
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-31 | 15.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, gray** | -- | -- | -- | **1.23** | **2.18** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.348** | **0.261** | **0.16** | **0.0** | **97.3** | **2.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 2.7 | 7.8 | 25.5 | 81.0 | 96.9 | 99.2 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/10/18 | DS |

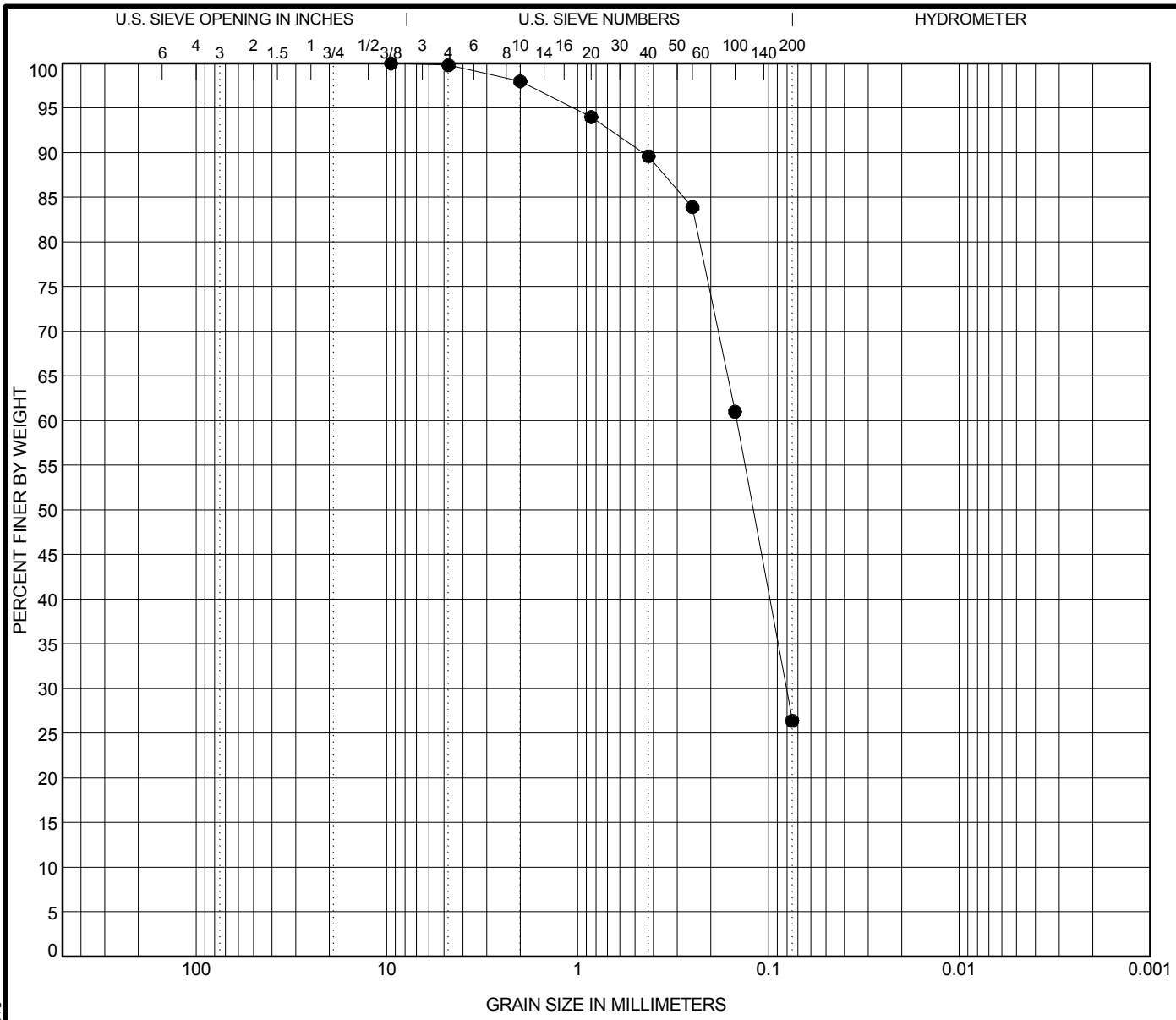
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-55A | 0.0 ft | **SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.147** | **0.081** | **--** | **0.2** | **73.4** | **26.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 26.4 | 61.0 | 83.9 | 89.6 | 94.0 | 98.0 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/10/18 | DS |

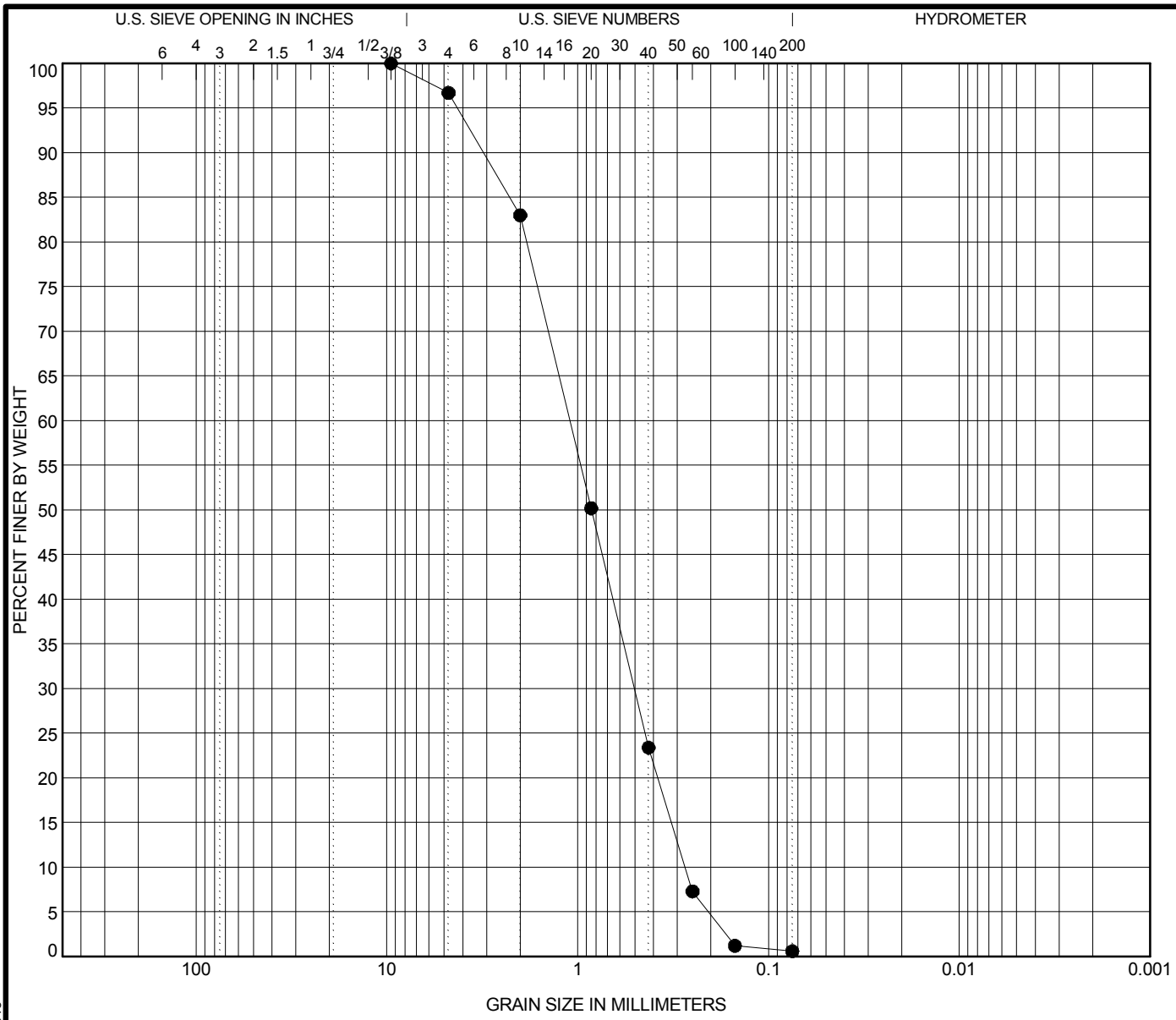
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-55A | 1.4 ft | **POORLY GRADED SAND WITH GRAVEL (SP), fine to coarse grained sand, grayish brown** | -- | -- | -- | **0.85** | **4.02** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **1.098** | **0.504** | **0.273** | **3.3** | **96.1** | **0.6** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 0.6 | 1.2 | 7.3 | 23.4 | 50.2 | 83.0 | 96.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/10/18 | DS |

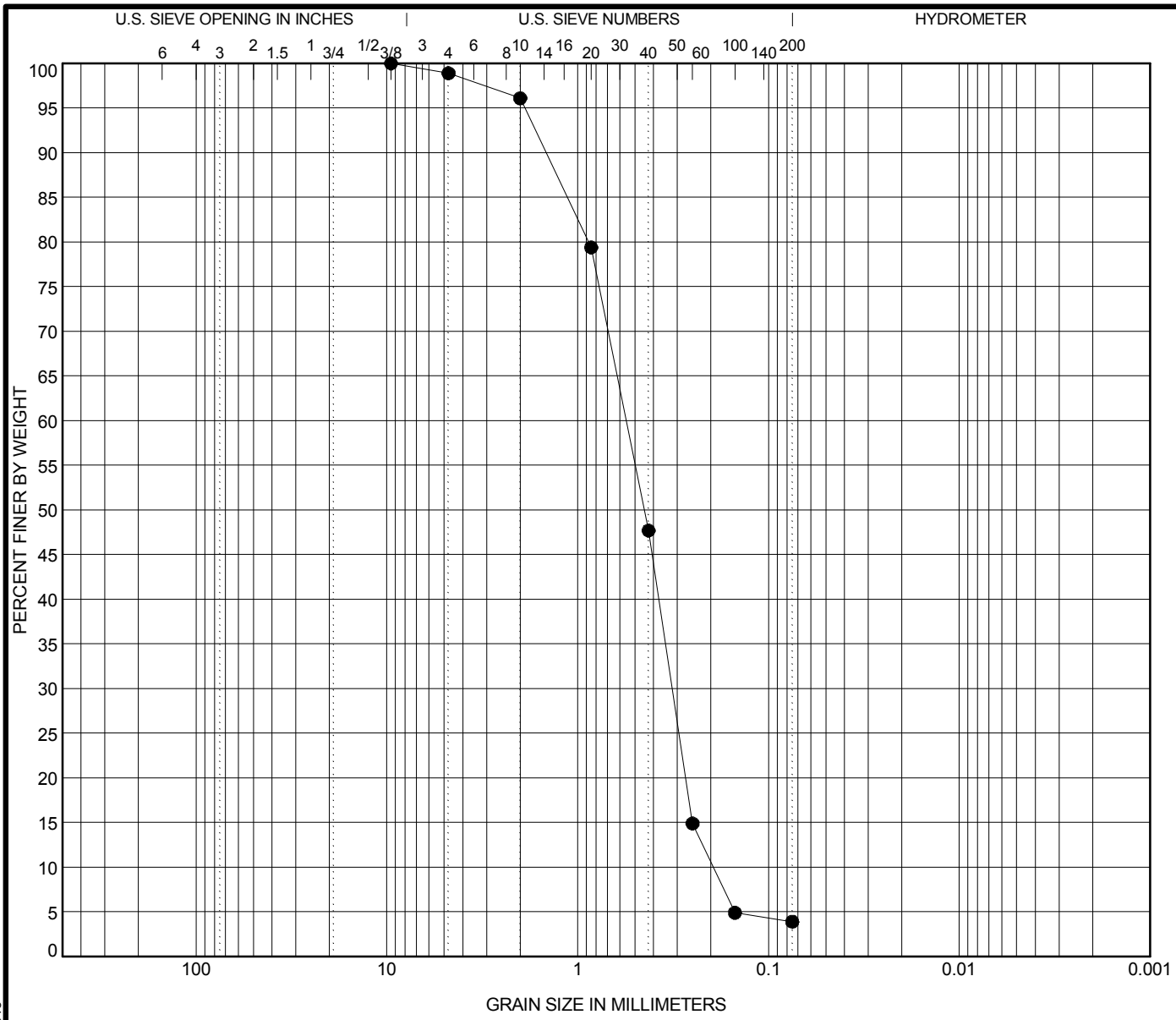
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02 **Testing Lab:** RICH

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/13/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-45A | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, dark brown** | -- | -- | -- | **0.94** | **2.86** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.556** | **0.319** | **0.195** | **1.1** | **95.0** | **3.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 3.9 | 4.9 | 14.9 | 47.7 | 79.4 | 96.1 | 98.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | DS |

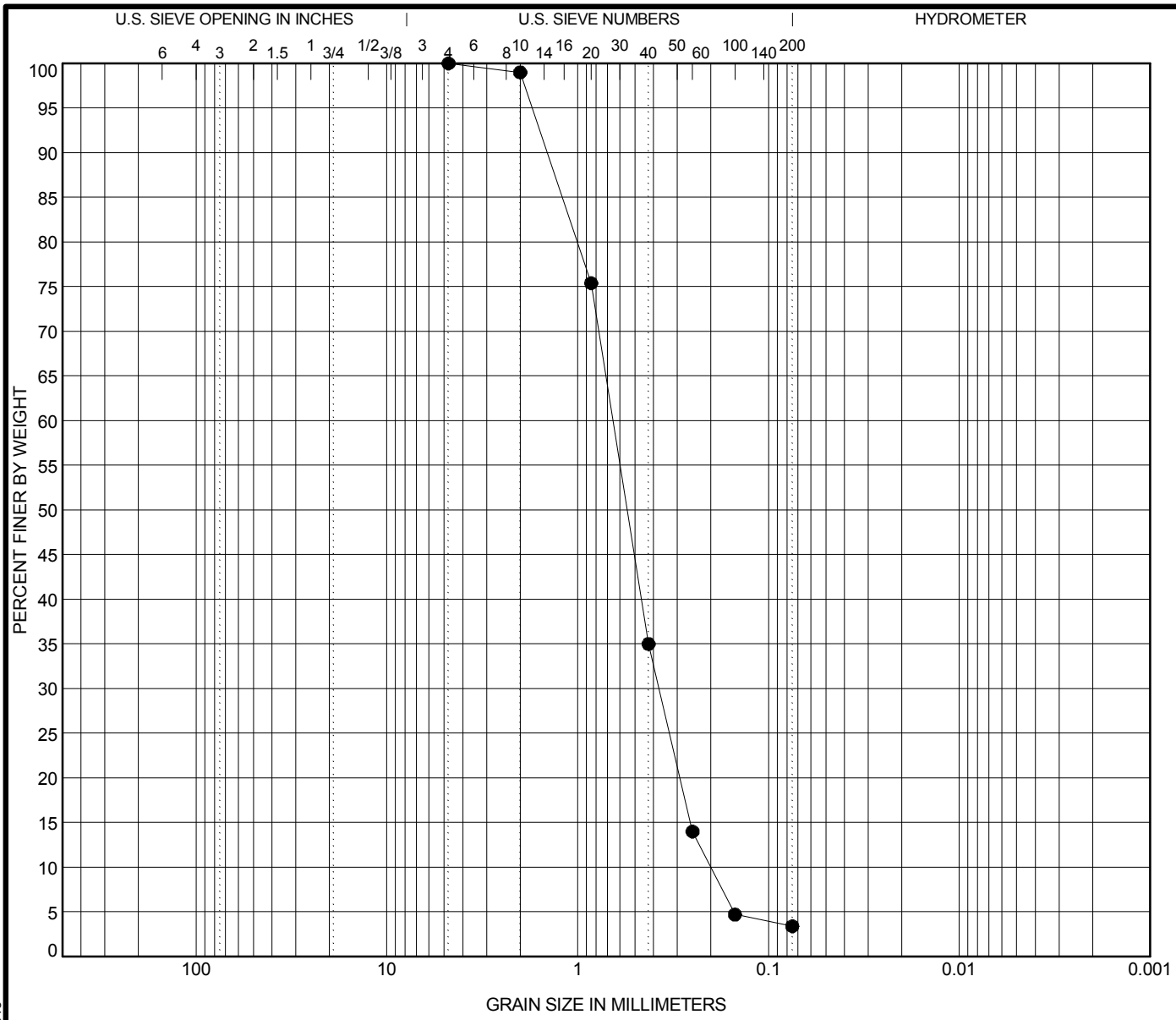
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-45A | 3.8 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, orangish brown** | -- | -- | -- | **1.07** | **3.25** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.653** | **0.375** | **0.201** | **0.0** | **96.6** | **3.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 3.4 | 4.7 | 14.0 | 35.0 | 75.4 | 99.0 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | DS |

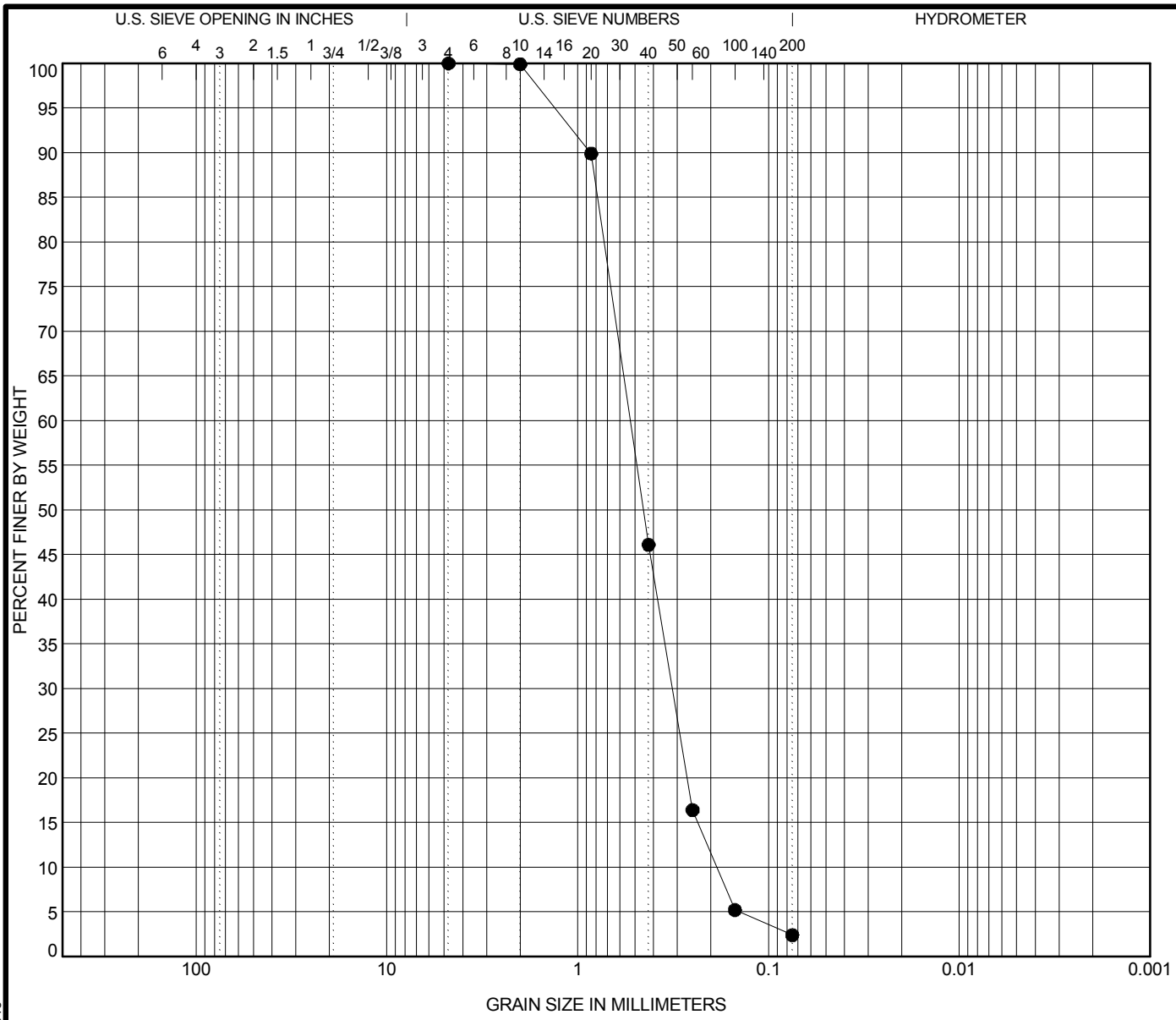
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-45A | 8.1 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, dark brown** | -- | -- | -- | **1.03** | **2.84** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.53** | **0.319** | **0.187** | **0.0** | **97.6** | **2.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 2.4 | 5.2 | 16.4 | 46.1 | 89.9 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | DS |

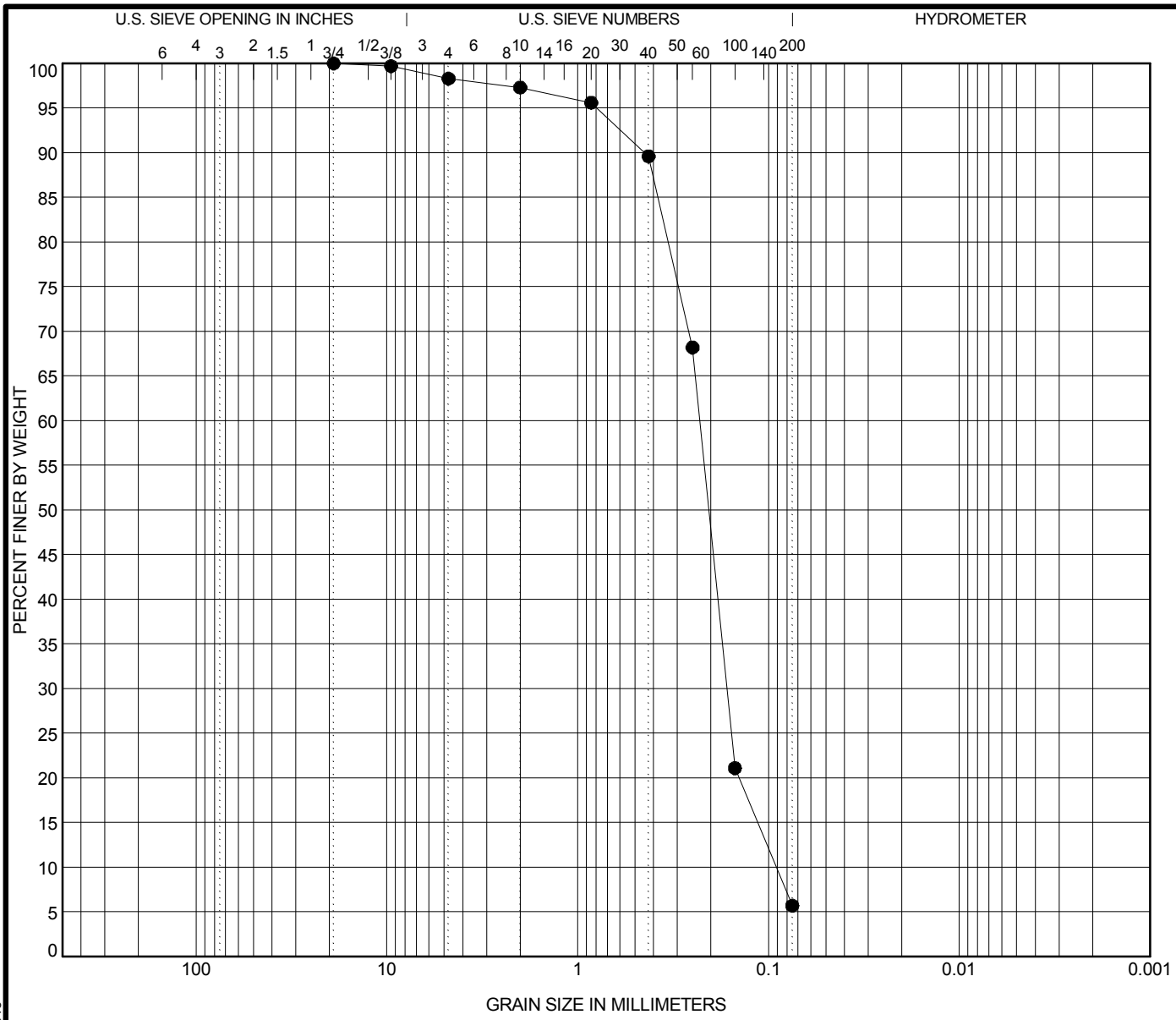
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-46 | 0.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, contains shell fragments, gray** | -- | -- | -- | **1.31** | **2.51** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.229** | **0.165** | **0.091** | **1.7** | **92.6** | **5.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 5.7 | 21.1 | 68.2 | 89.6 | 95.6 | 97.3 | 98.3 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | DS |

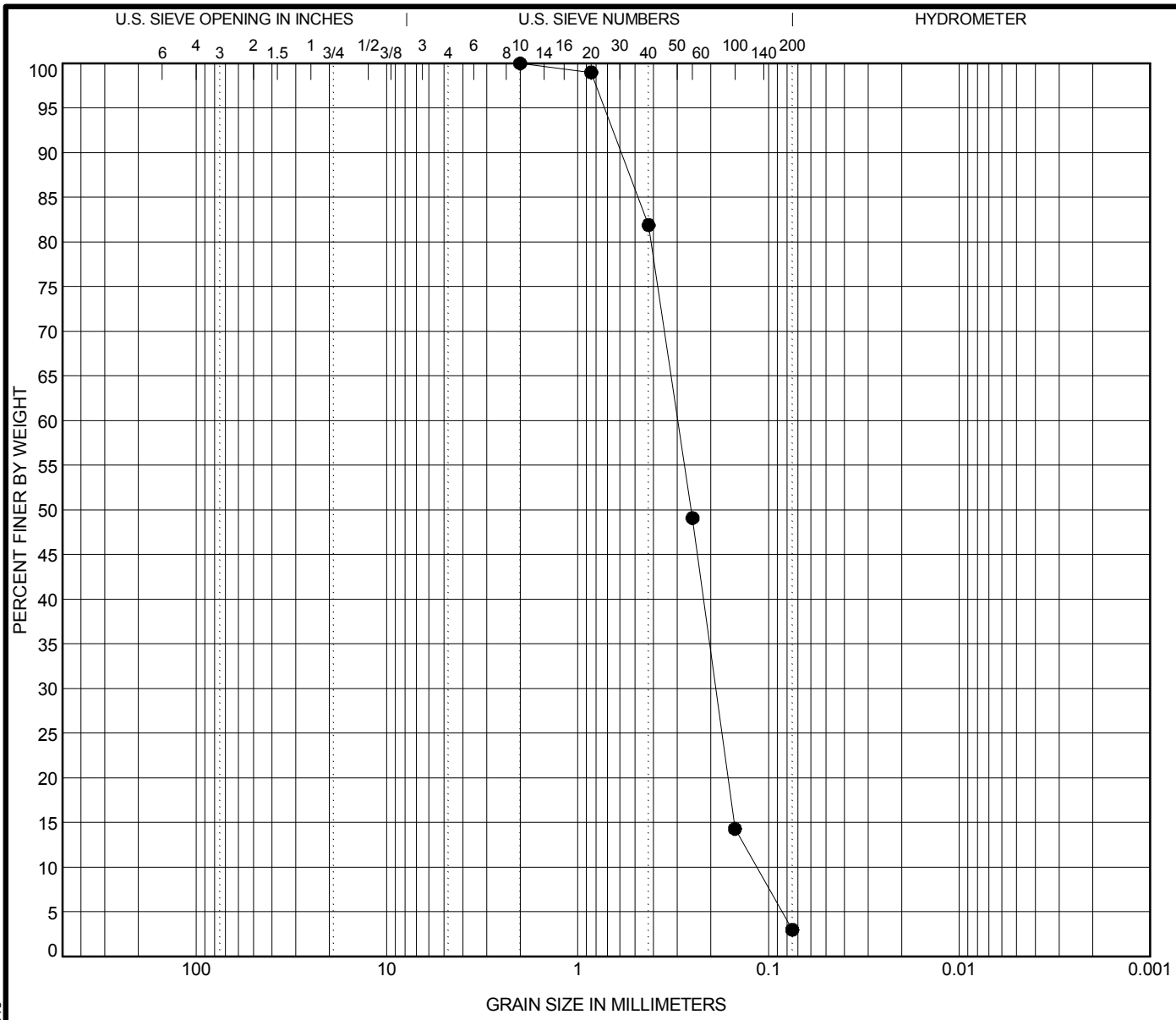
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-46 | 5.8 ft | **POORLY GRADED SAND (SP), fine to medium grained sand, gray and brown** | -- | -- | -- | **1.04** | **2.59** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **2** | **0.298** | **0.189** | **0.115** | **0.0** | **97.0** | **3.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 |
|---|---|---|---|---|---|---|
| % Finer | 3.0 | 14.3 | 49.1 | 81.9 | 99.0 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | DS |

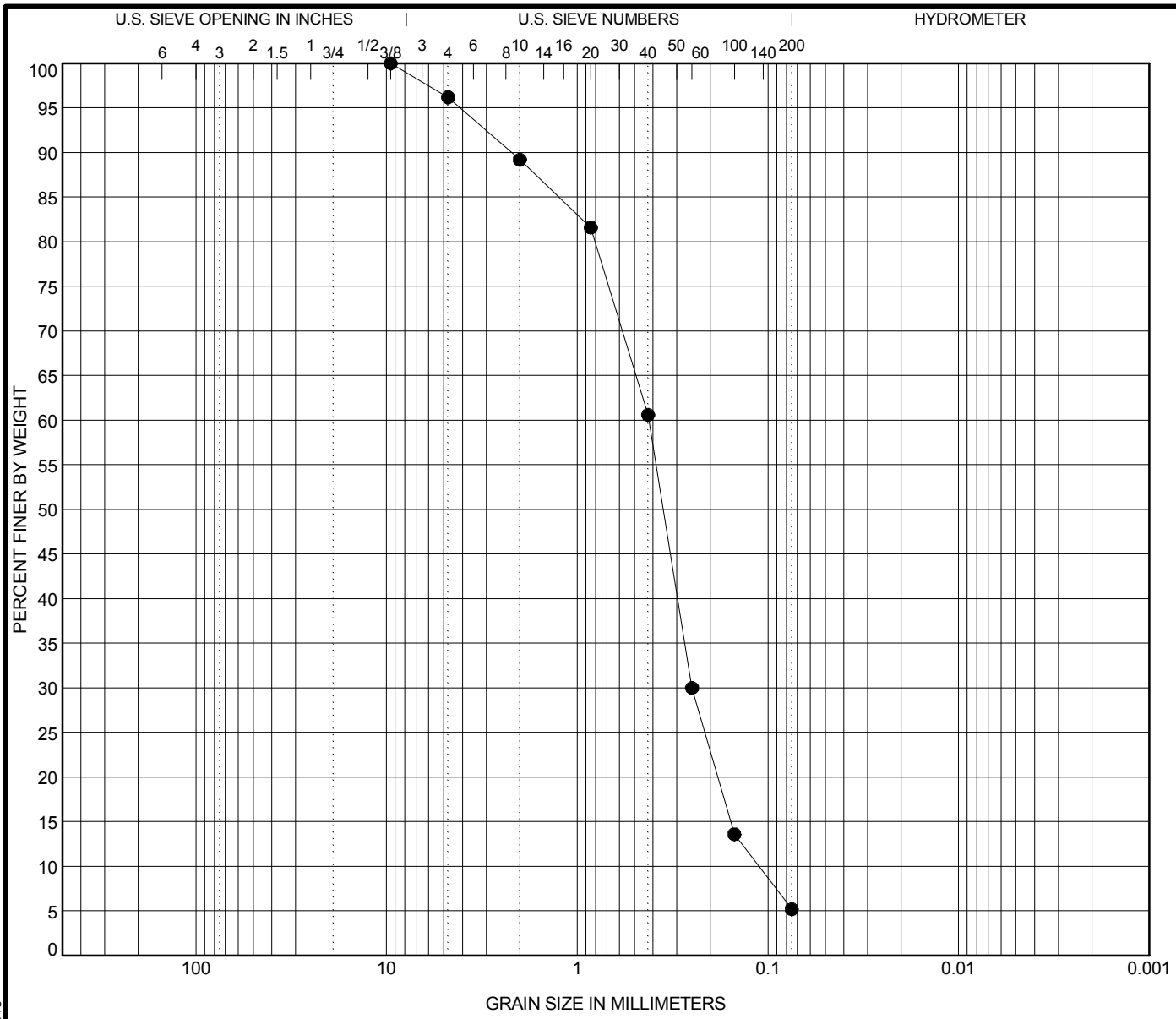
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-46 | 10.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray and brown** | -- | -- | -- | **1.33** | **3.77** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.421** | **0.25** | **0.111** | **3.8** | **91.0** | **5.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 5.2 | 13.6 | 30.0 | 60.6 | 81.6 | 89.2 | 96.2 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | DS |

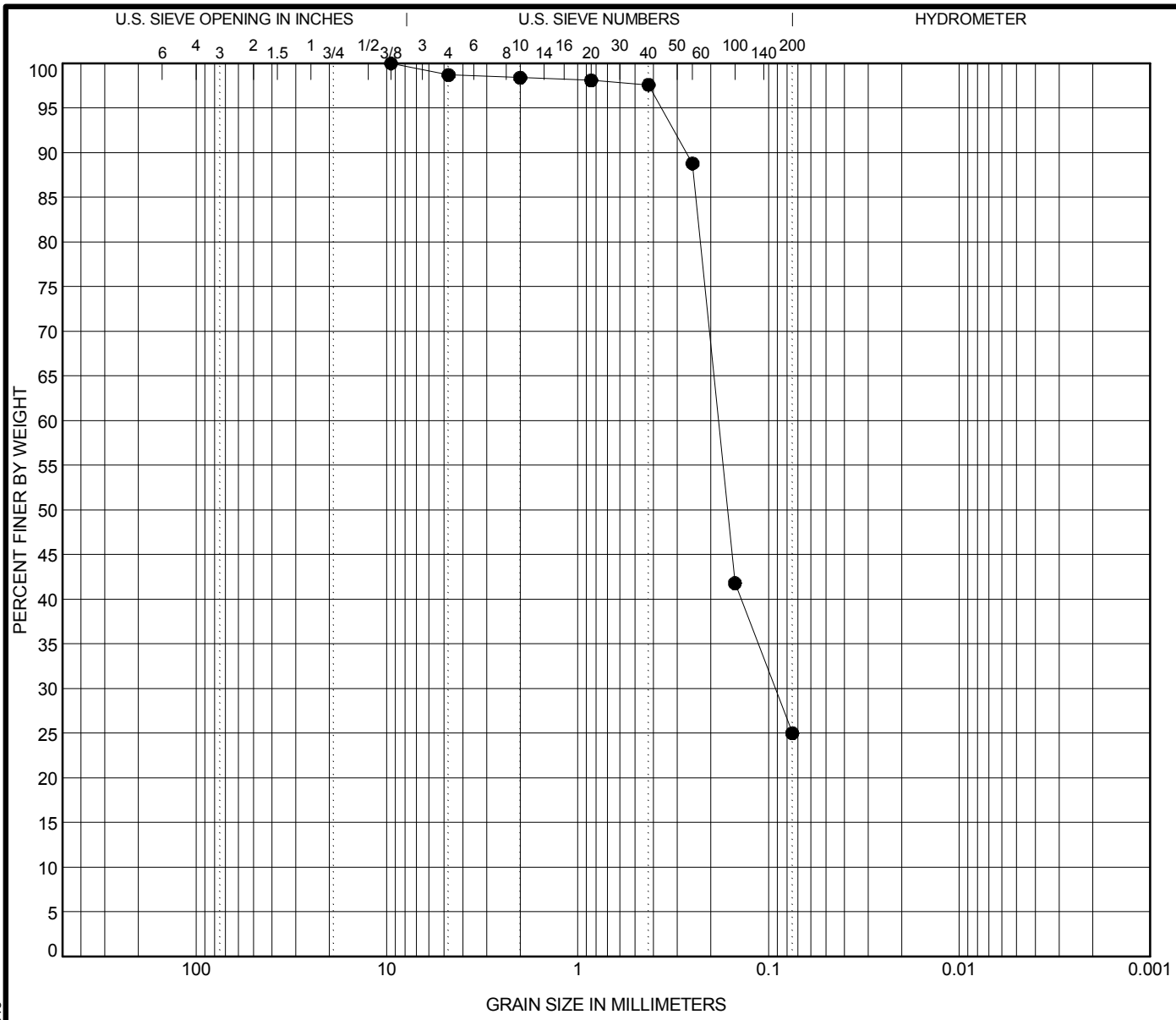
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-47 | 0.0 ft | **SILTY SAND (SM), fine to medium grained sand, trace gravel, contains shell fragments, gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.183** | **0.092** | **--** | **1.3** | **73.7** | **25.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 25.0 | 41.8 | 88.8 | 97.6 | 98.1 | 98.4 | 98.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | DS |

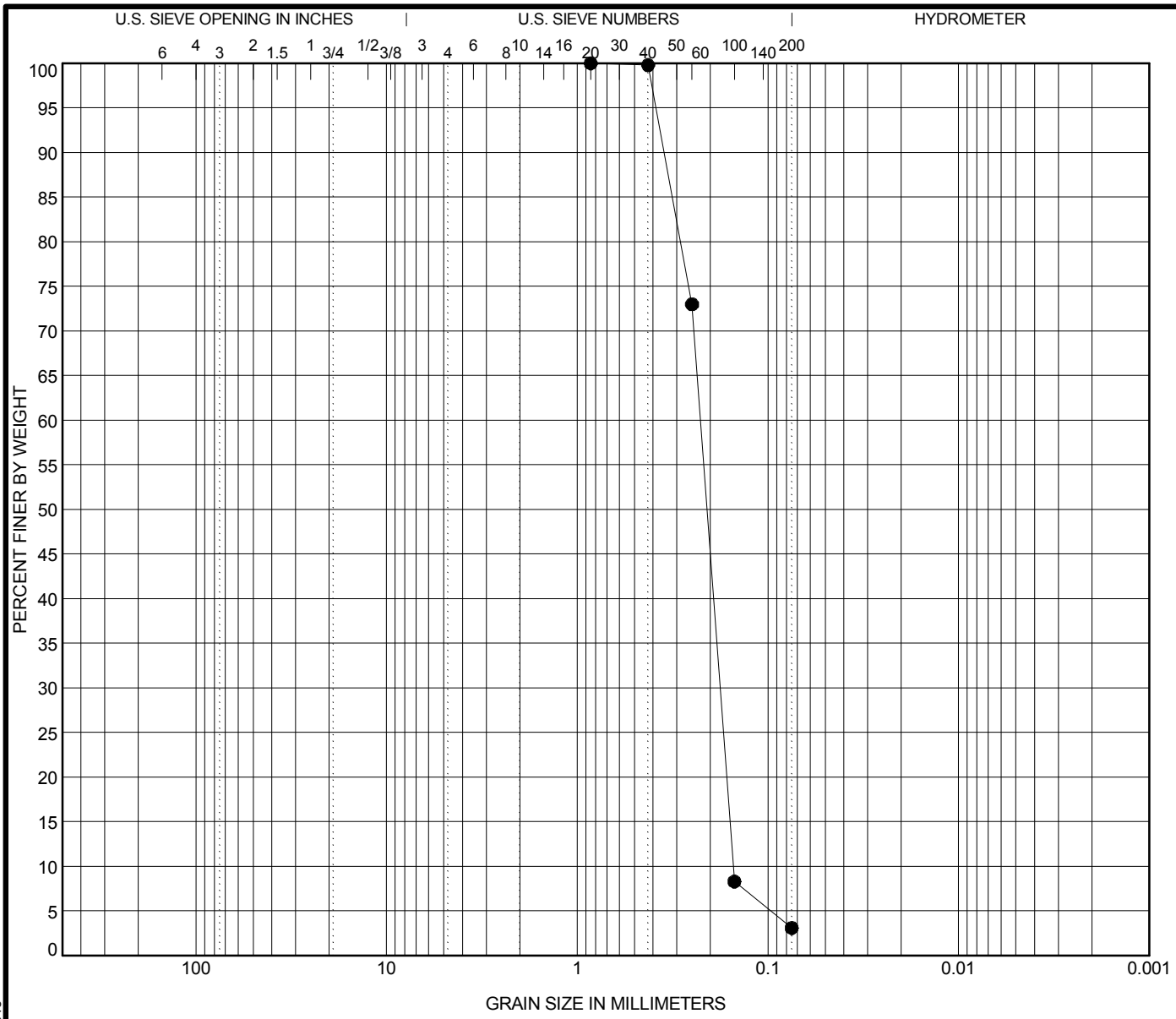
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-47 | 3.4 ft | **POORLY GRADED SAND (SP), fine to medium grained sand, light brown** | -- | -- | -- | **0.92** | **1.48** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **0.85** | **0.226** | **0.178** | **0.152** | **0.0** | **96.9** | **3.1** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 |
|---|---|---|---|---|---|
| % Finer | 3.1 | 8.3 | 73.0 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | DS |

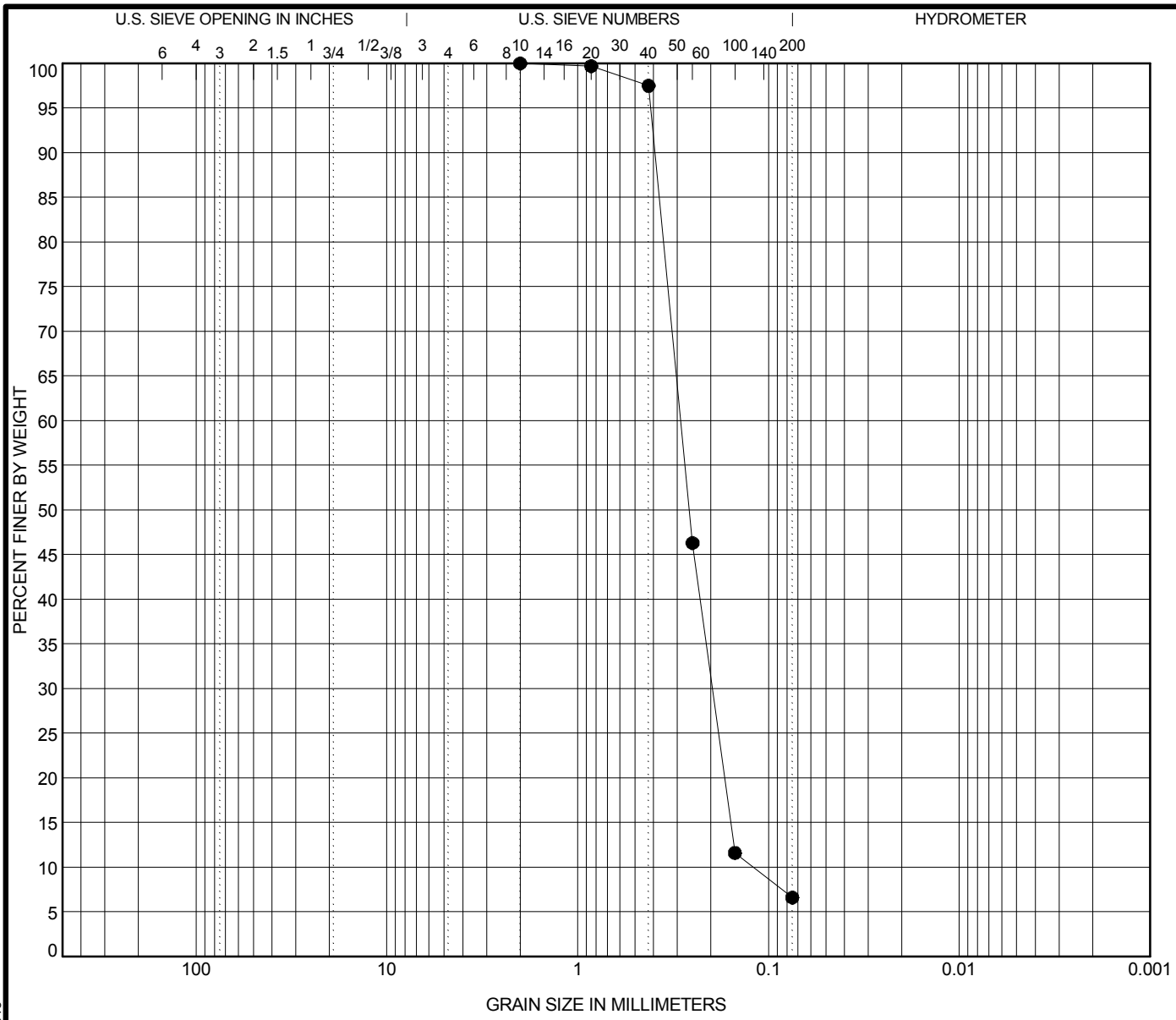
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-47 | 14.1 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to medium grained sand, dark gray** | -- | -- | -- | **1.12** | **2.40** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **2** | **0.288** | **0.197** | **0.12** | **0.0** | **93.4** | **6.6** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 |
|---|---|---|---|---|---|---|
| % Finer | 6.6 | 11.6 | 46.3 | 97.5 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | DS |

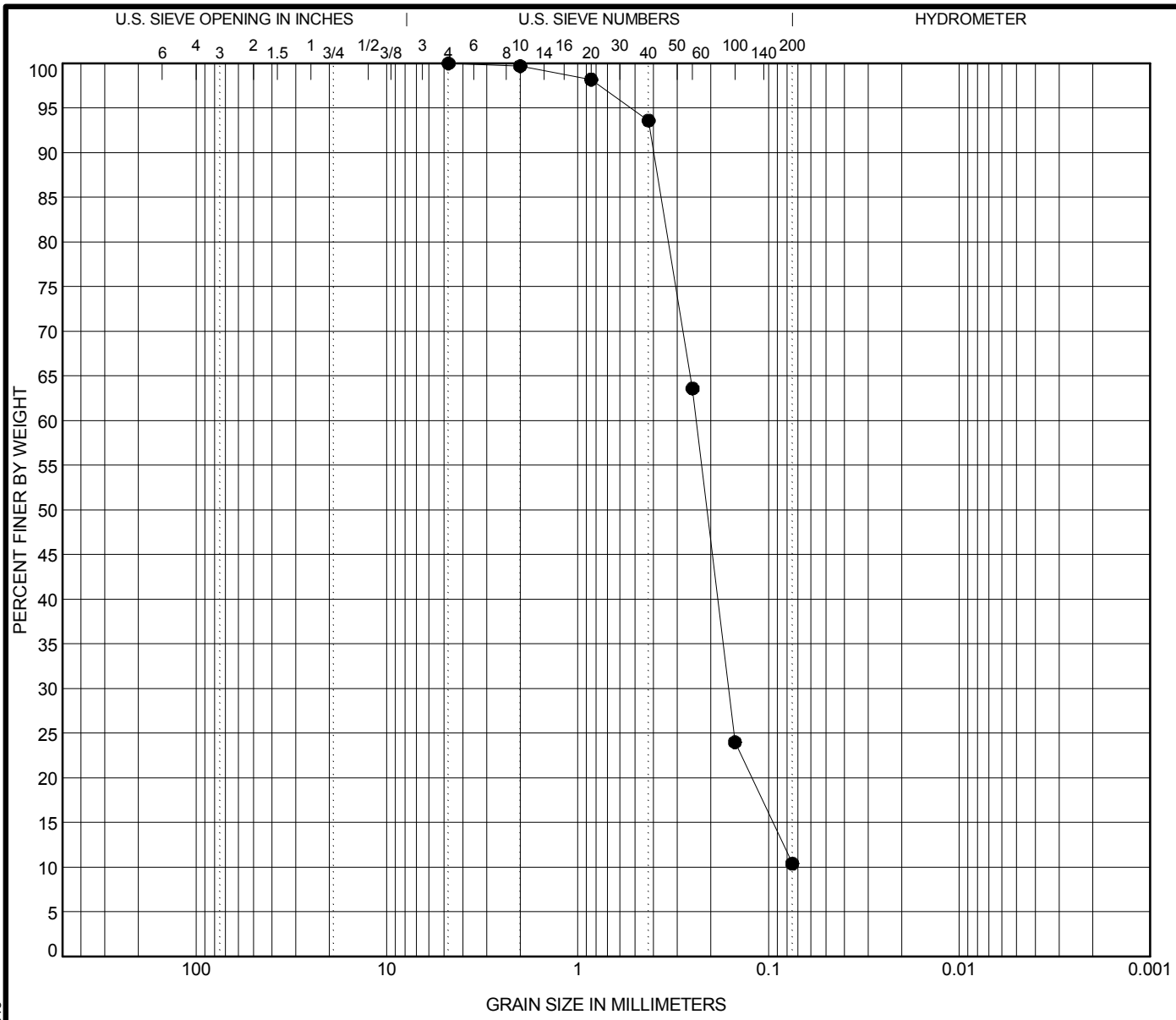
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-49 | 0.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to medium grained sand, grayish brown** | -- | -- | -- | **1.50** | **3.25** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.239** | **0.162** | **--** | **0.0** | **89.6** | **10.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 10.4 | 24.0 | 63.6 | 93.6 | 98.2 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | DS |

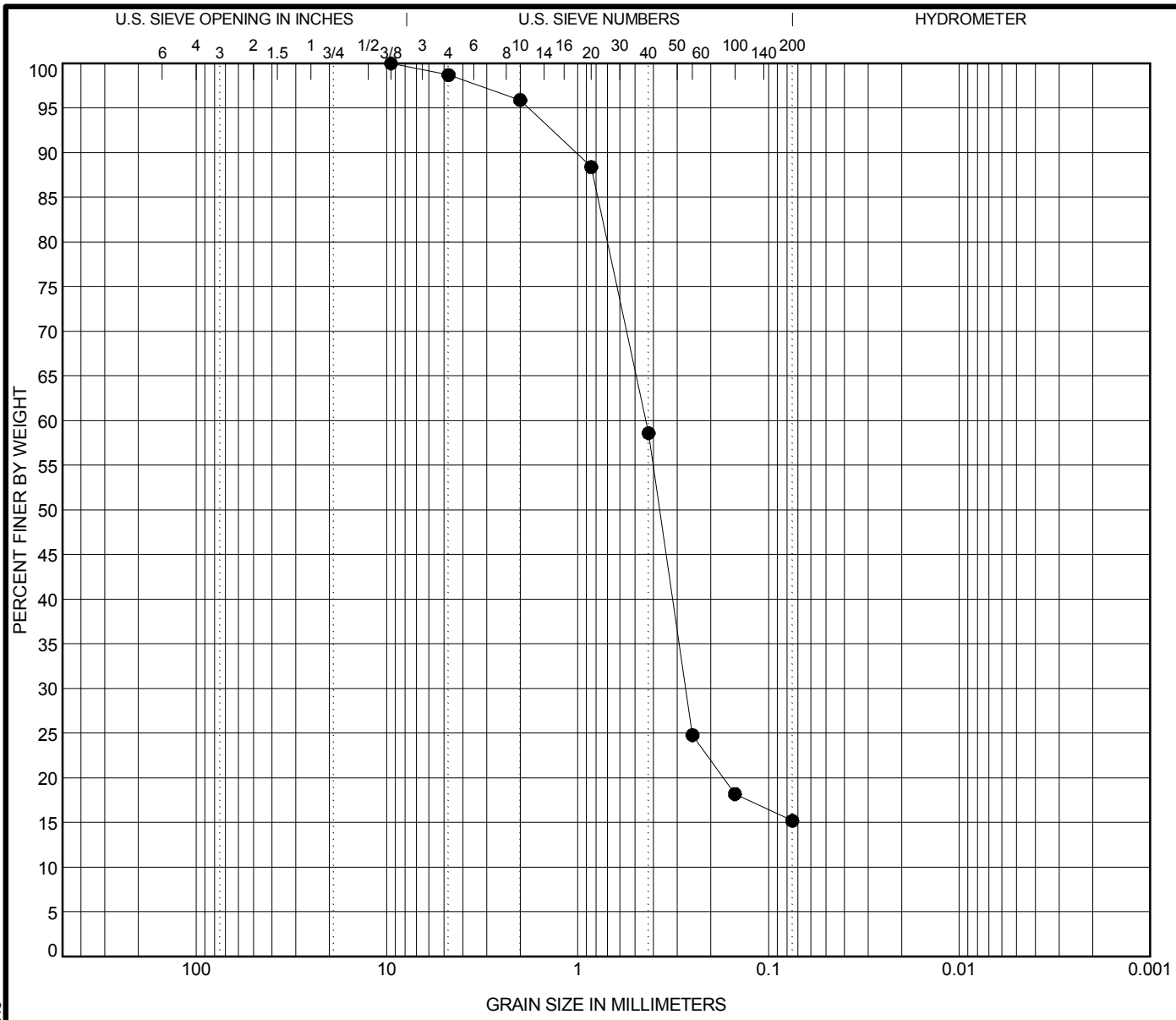
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-49 | 4.5 ft | **SILTY SAND (SM), fine to coarse grained sand, trace gravel, contains shell fragments, grayish brown** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.439** | **0.271** | **--** | **1.3** | **83.5** | **15.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 15.2 | 18.2 | 24.8 | 58.6 | 88.4 | 95.9 | 98.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | DS |

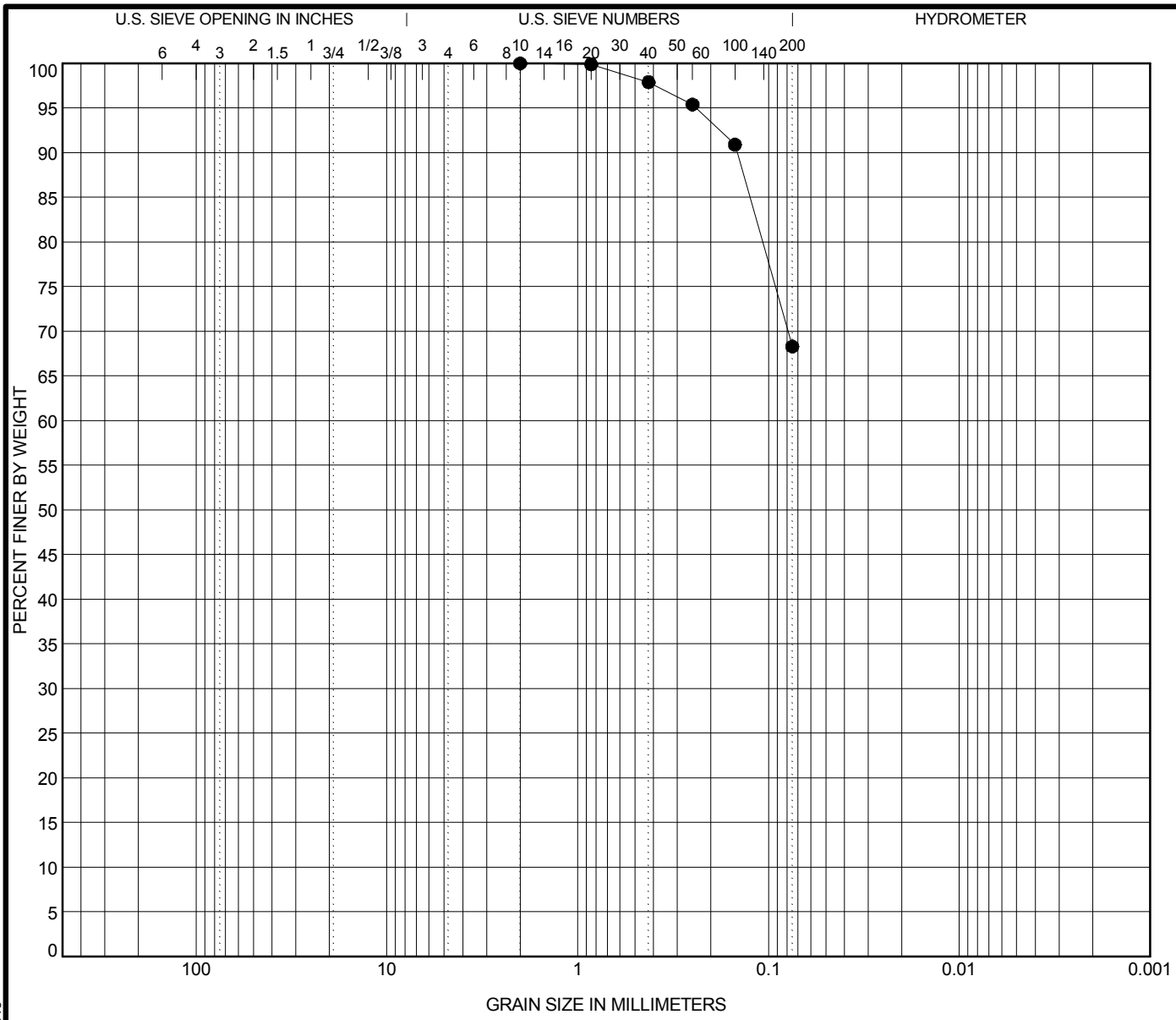
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-49 | 11.9 ft | **SANDY SILT (ML), contains mica, dark gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **2** | **--** | **--** | **--** | **0.0** | **31.7** | **68.3** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 |
|---|---|---|---|---|---|---|
| % Finer | 68.3 | 90.9 | 95.4 | 97.9 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | DS |

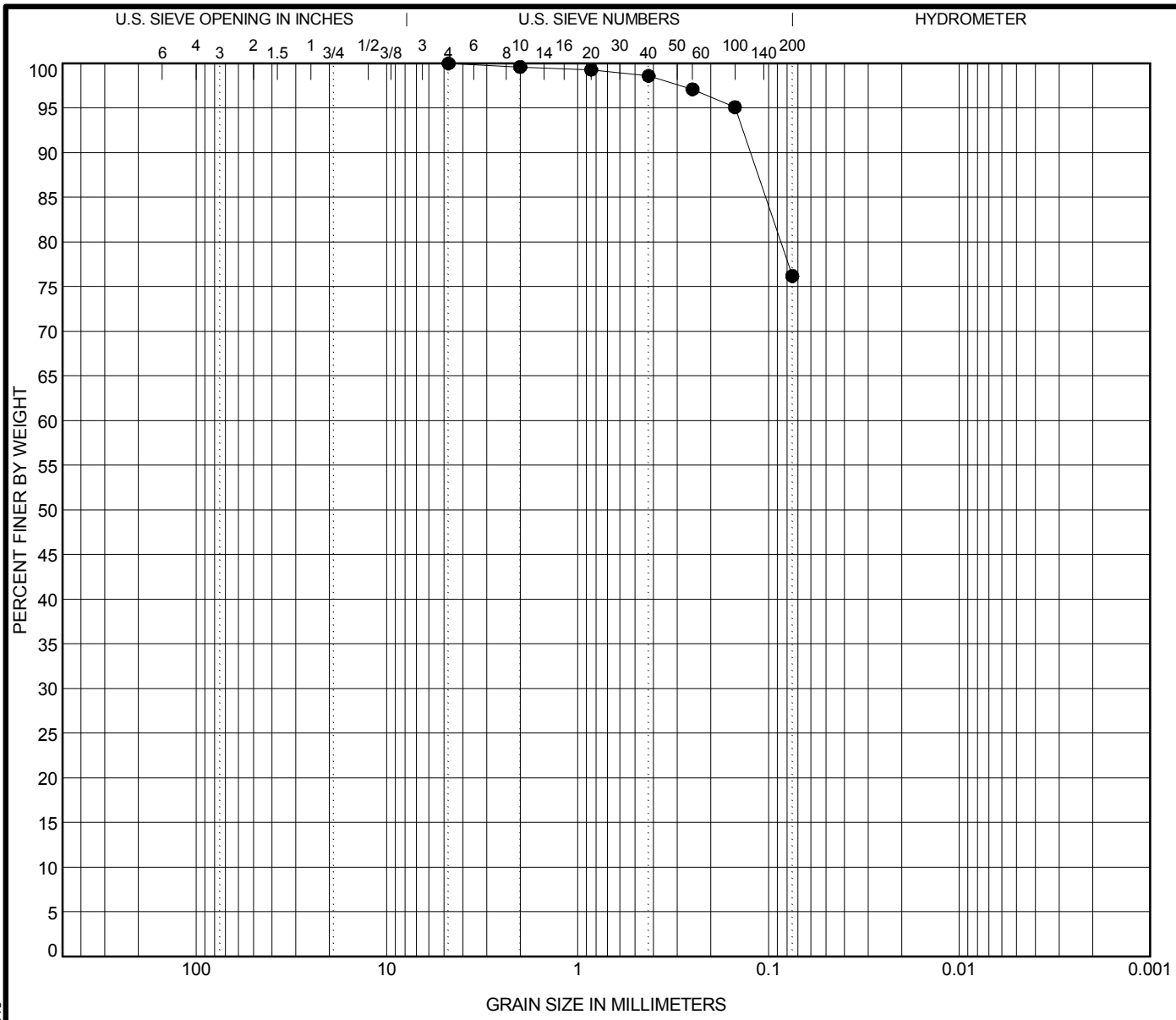
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-49 | 14.5 ft | **SILT WITH SAND (ML), contains mica and organic matter, dark gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **--** | **--** | **--** | **0.0** | **23.8** | **76.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 76.2 | 95.1 | 97.1 | 98.6 | 99.3 | 99.6 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | DS |

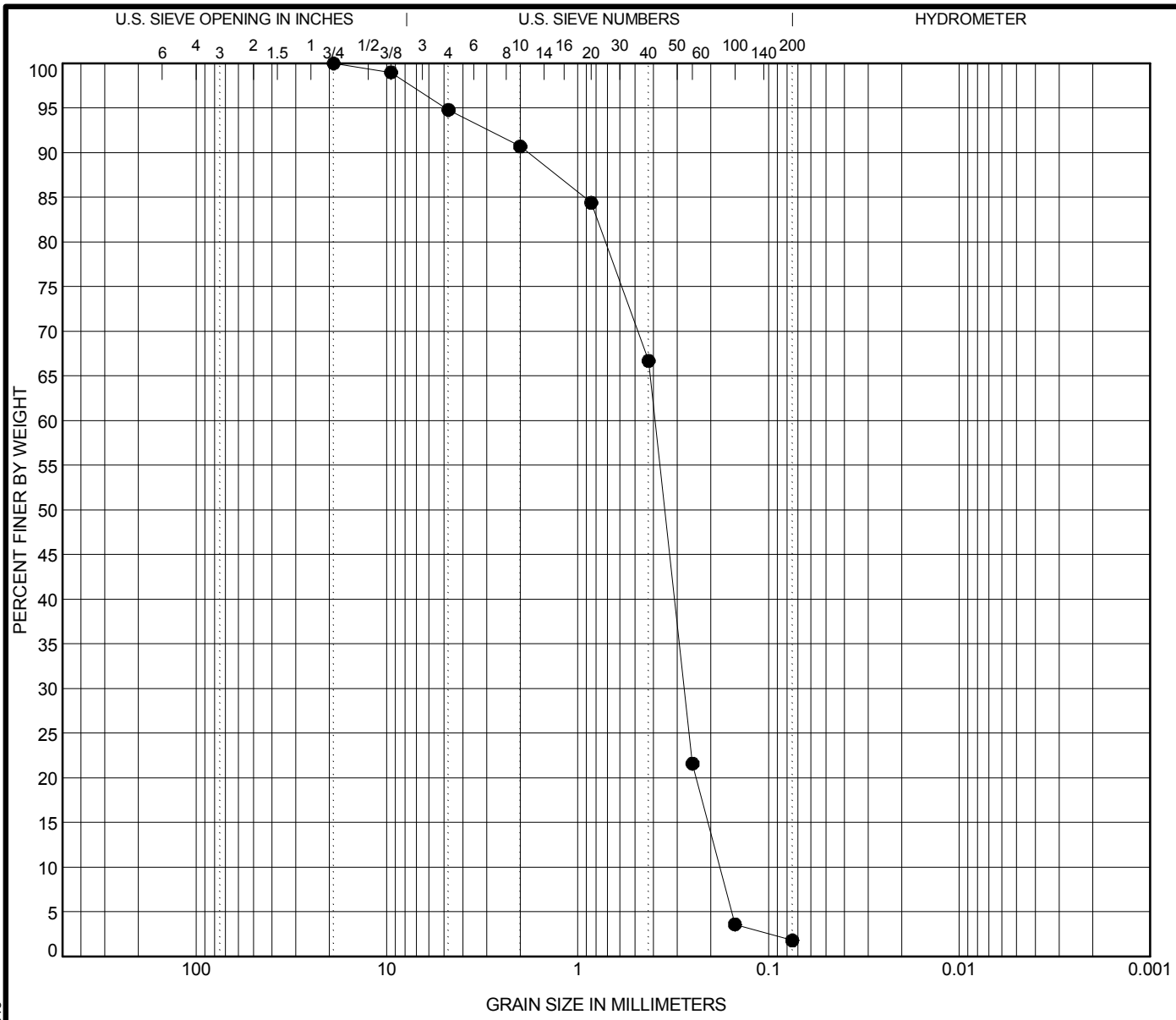
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-52A | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, contains shell fragments, brown** | -- | -- | -- | **1.08** | **2.18** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.393** | **0.276** | **0.18** | **5.2** | **93.0** | **1.8** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 1.8 | 3.6 | 21.6 | 66.7 | 84.4 | 90.7 | 94.8 | 99.0 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | DS |

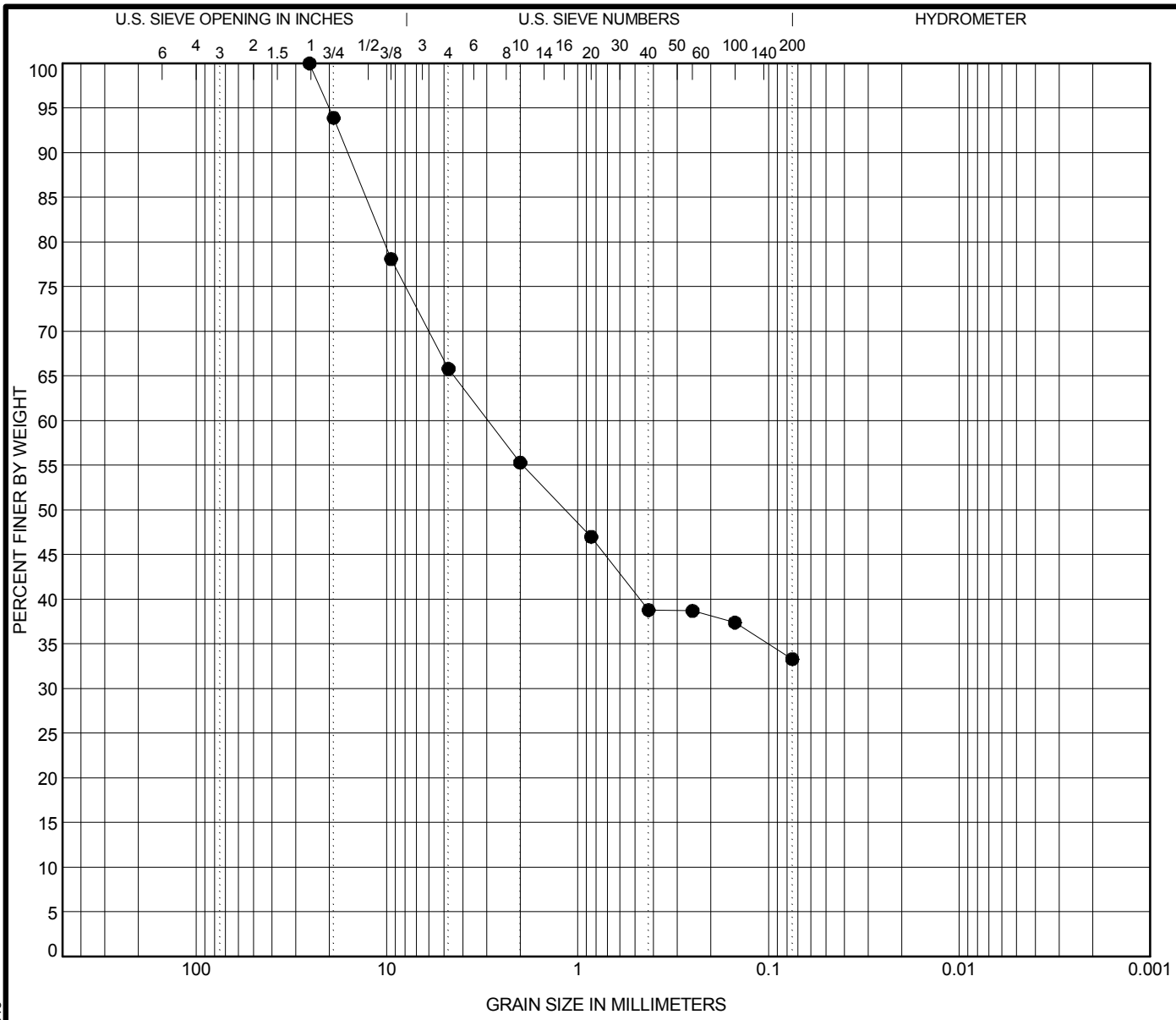
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-52A | 3.0 ft | **SILTY SAND WITH GRAVEL (SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **25.4** | **2.946** | **--** | **--** | **34.2** | **32.5** | **33.3** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| % Finer | 33.3 | 37.4 | 38.7 | 38.8 | 47.0 | 55.3 | 65.8 | 78.1 | 93.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | DS |

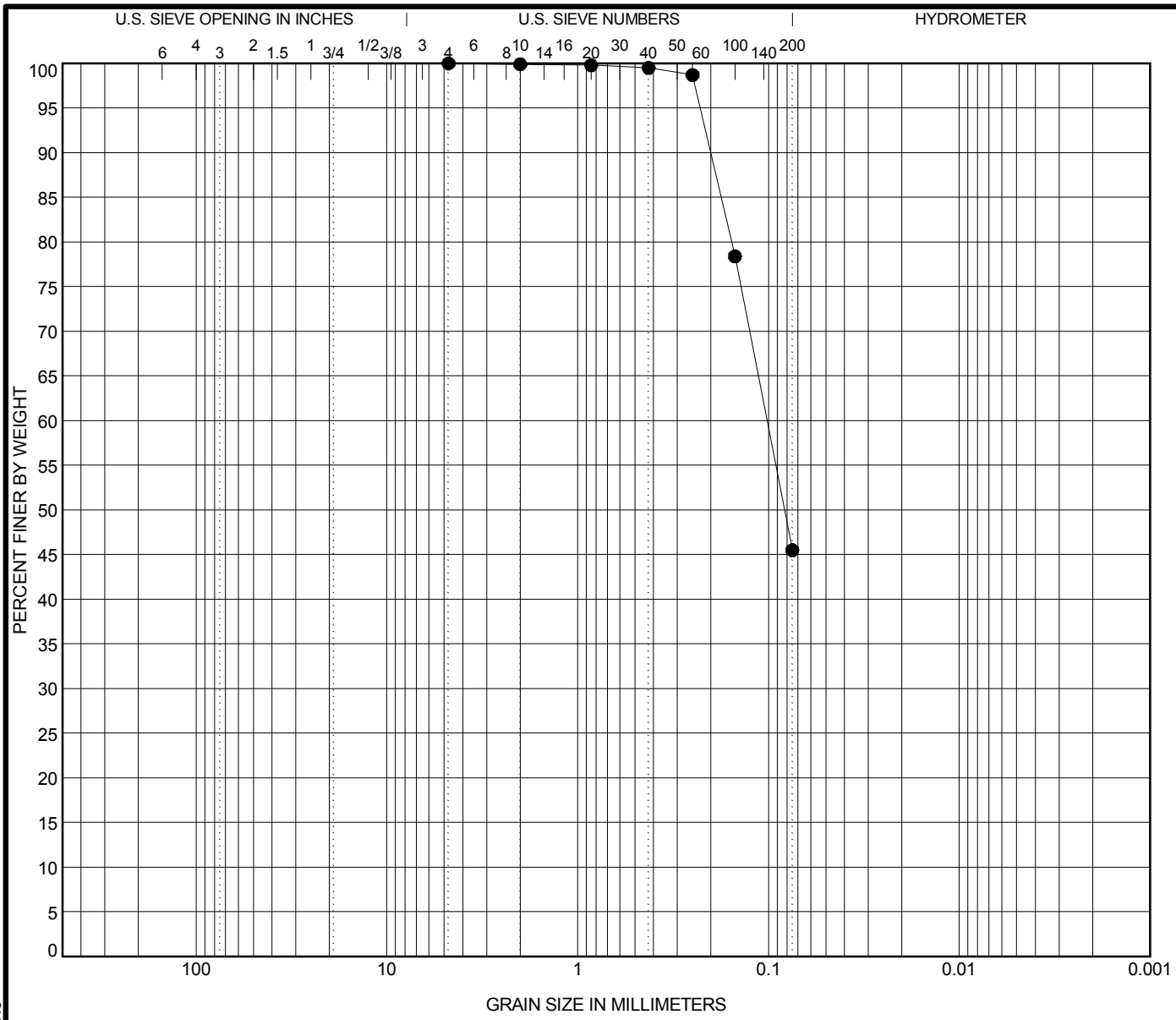
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-53 | 11.9 ft | **SILTY SAND (SM), fine grained sand, contains mica, dark gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.102** | **--** | **--** | **0.0** | **54.5** | **45.5** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 45.5 | 78.4 | 98.7 | 99.5 | 99.8 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | |

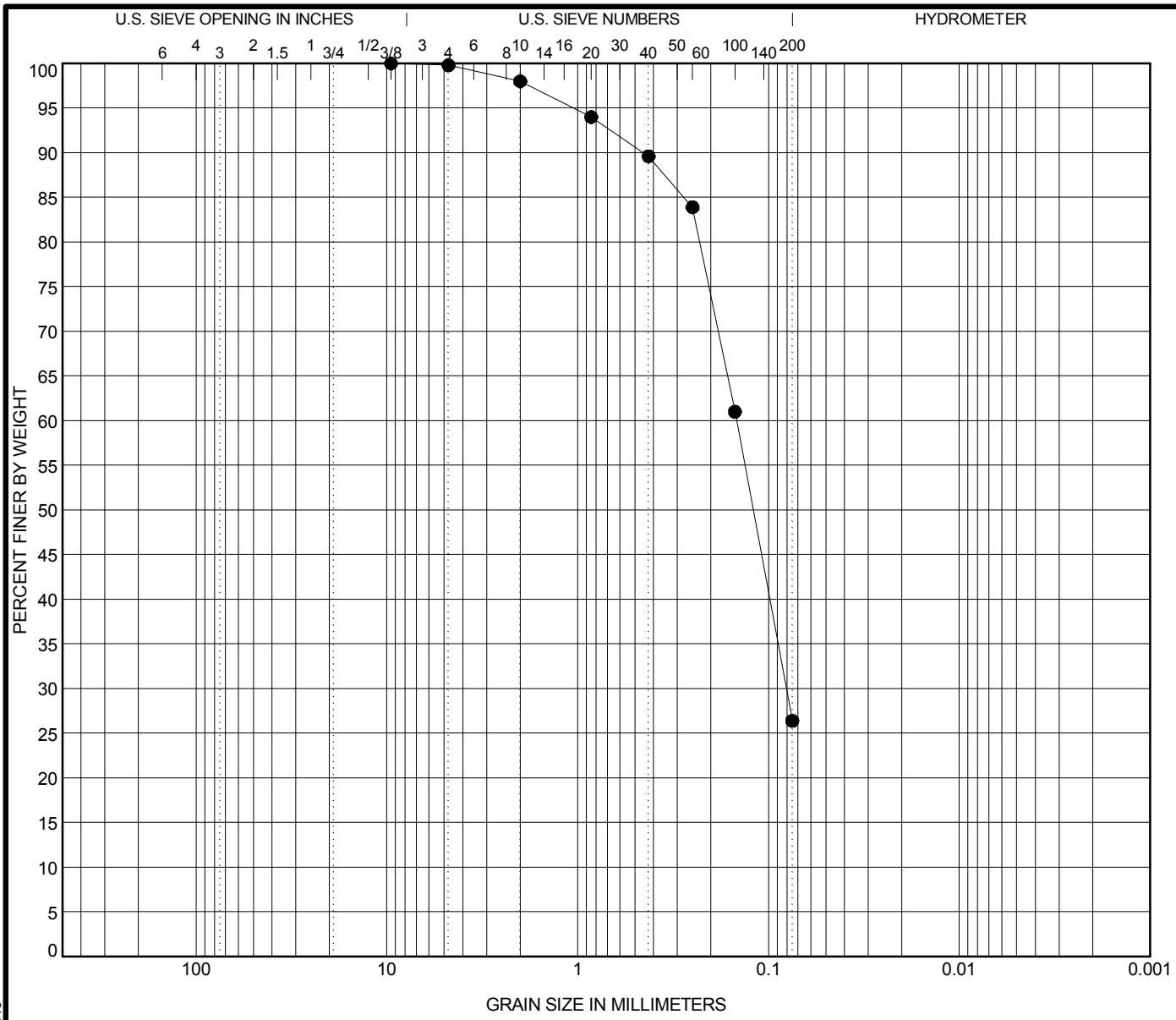
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-55A | 0.0 ft | **SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.147** | **0.081** | **--** | **0.2** | **73.4** | **26.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 26.4 | 61.0 | 83.9 | 89.6 | 94.0 | 98.0 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/10/18 | DS |

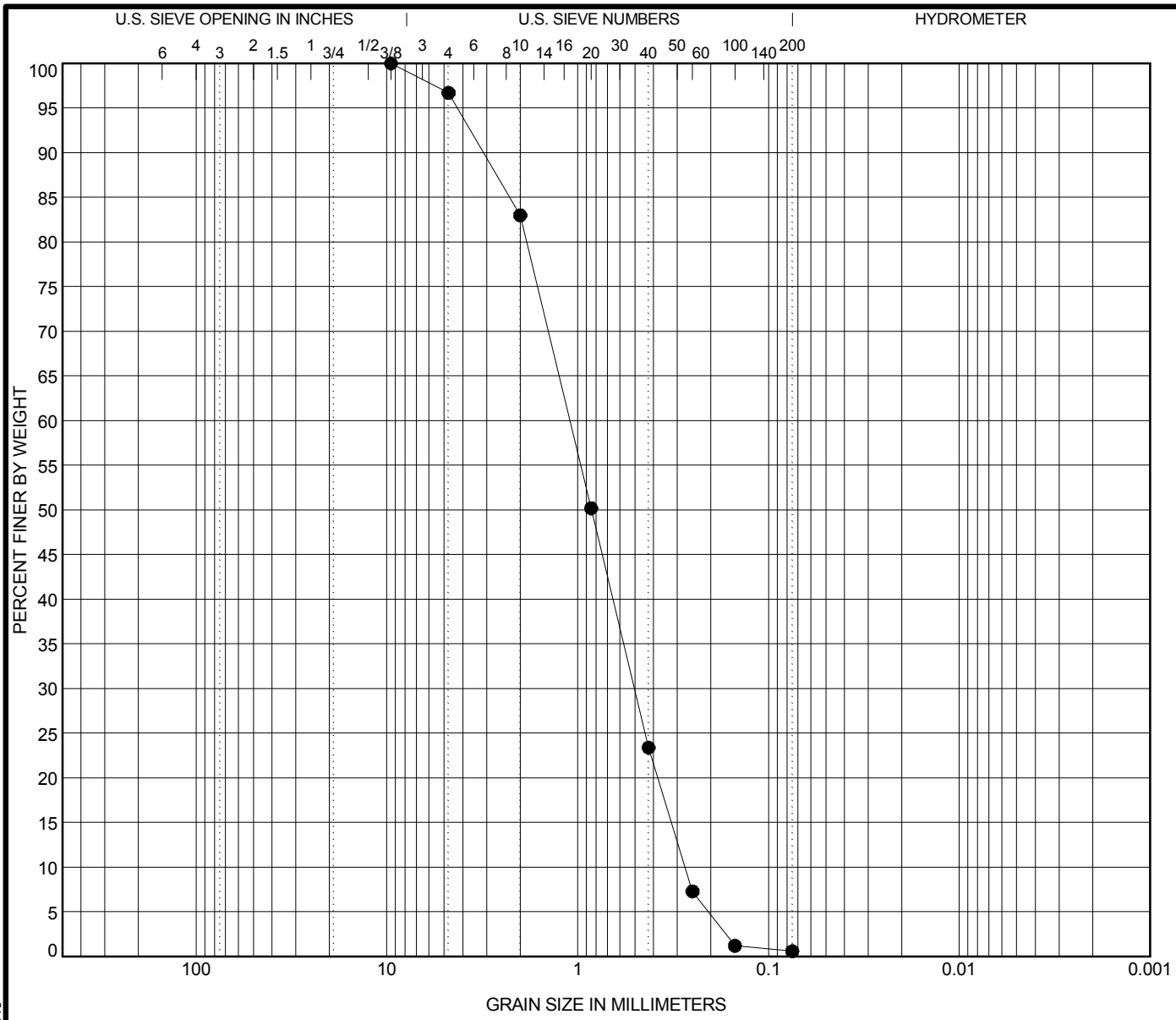
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-55A | 1.4 ft | **POORLY GRADED SAND WITH GRAVEL (SP), fine to coarse grained sand, grayish brown** | -- | -- | -- | **0.85** | **4.02** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **1.098** | **0.504** | **0.273** | **3.3** | **96.1** | **0.6** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 0.6 | 1.2 | 7.3 | 23.4 | 50.2 | 83.0 | 96.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG | 9/10/18 | DS |

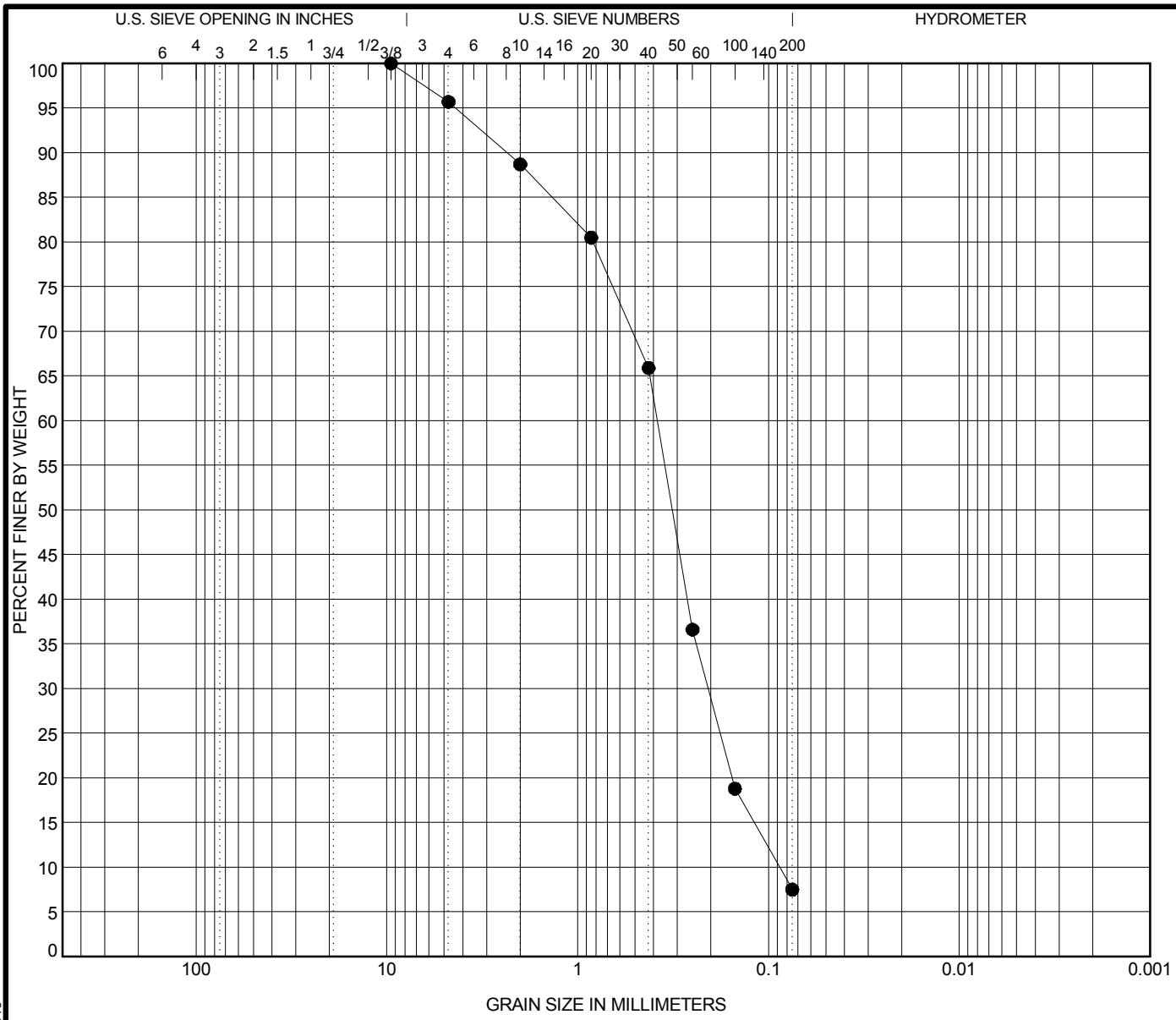
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-57 | 0.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, contains shell fragments, brownish gray** | -- | -- | -- | **1.28** | **4.37** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.382** | **0.207** | **0.087** | **4.3** | **88.2** | **7.5** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 7.5 | 18.8 | 36.6 | 65.9 | 80.5 | 88.7 | 95.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | DS |

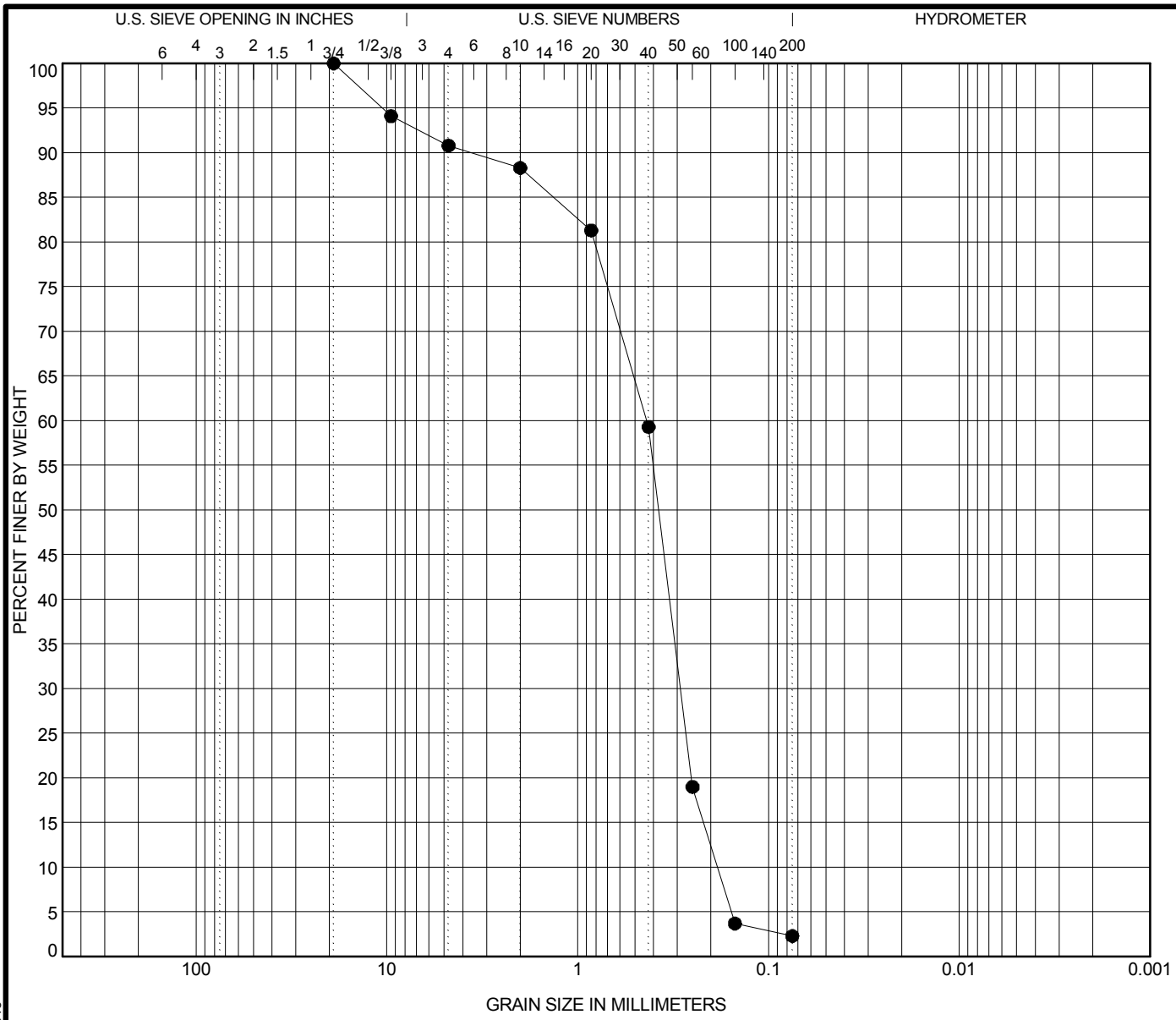
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-57 | 4.7 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, light brownish gray** | -- | -- | -- | **1.04** | **2.35** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.434** | **0.289** | **0.185** | **9.2** | **88.5** | **2.3** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 2.3 | 3.7 | 19.0 | 59.3 | 81.3 | 88.3 | 90.8 | 94.1 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | DS |

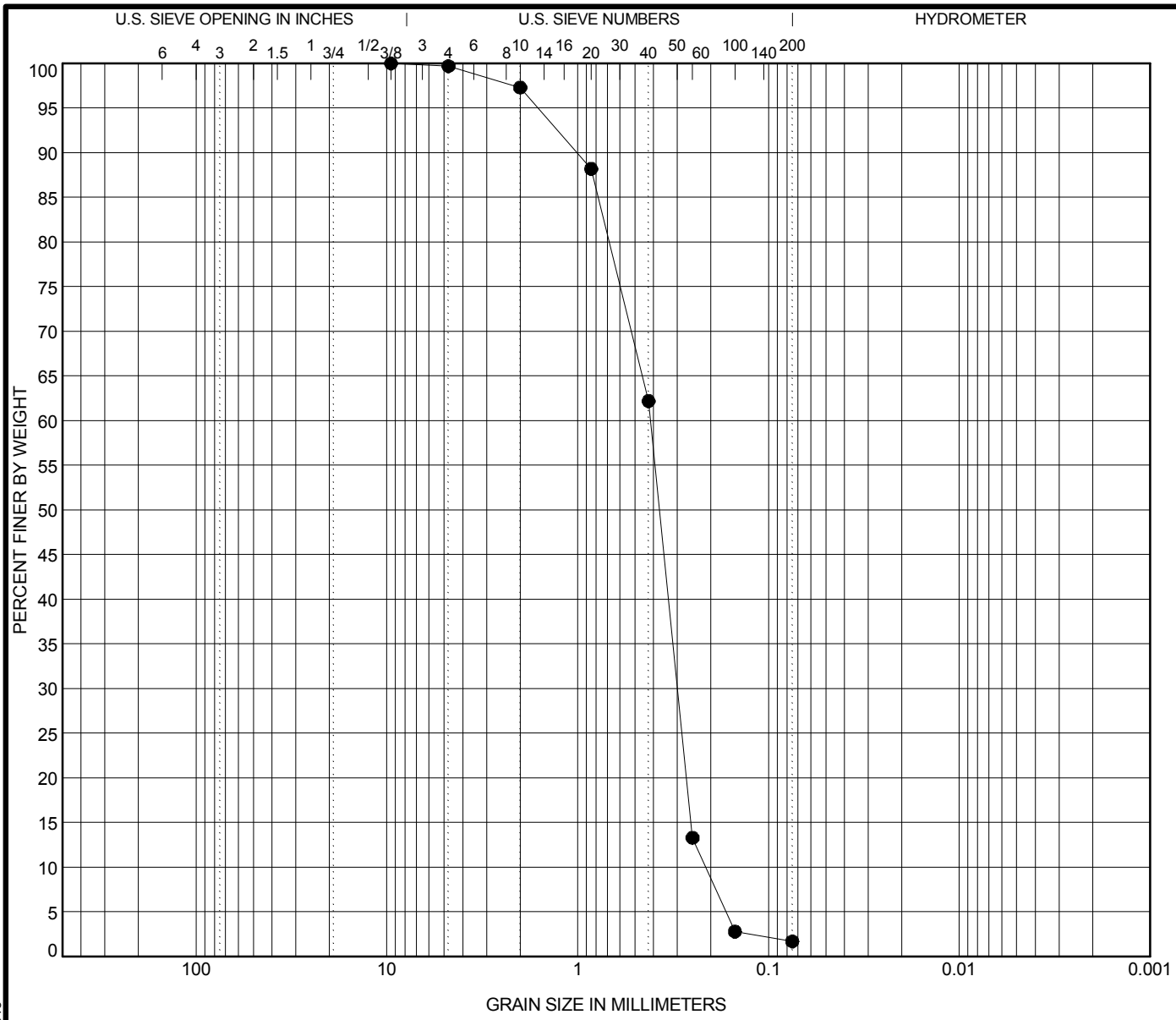
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 9/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-42 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, light brown** | -- | -- | -- | **1.02** | **1.95** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.415** | **0.3** | **0.213** | **0.3** | **98.0** | **1.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 in. |
|---|---|---|---|---|---|---|---|---|
| % Finer | 1.7 | 2.8 | 13.3 | 62.2 | 88.2 | 97.3 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| WS | 9/21/18 | |

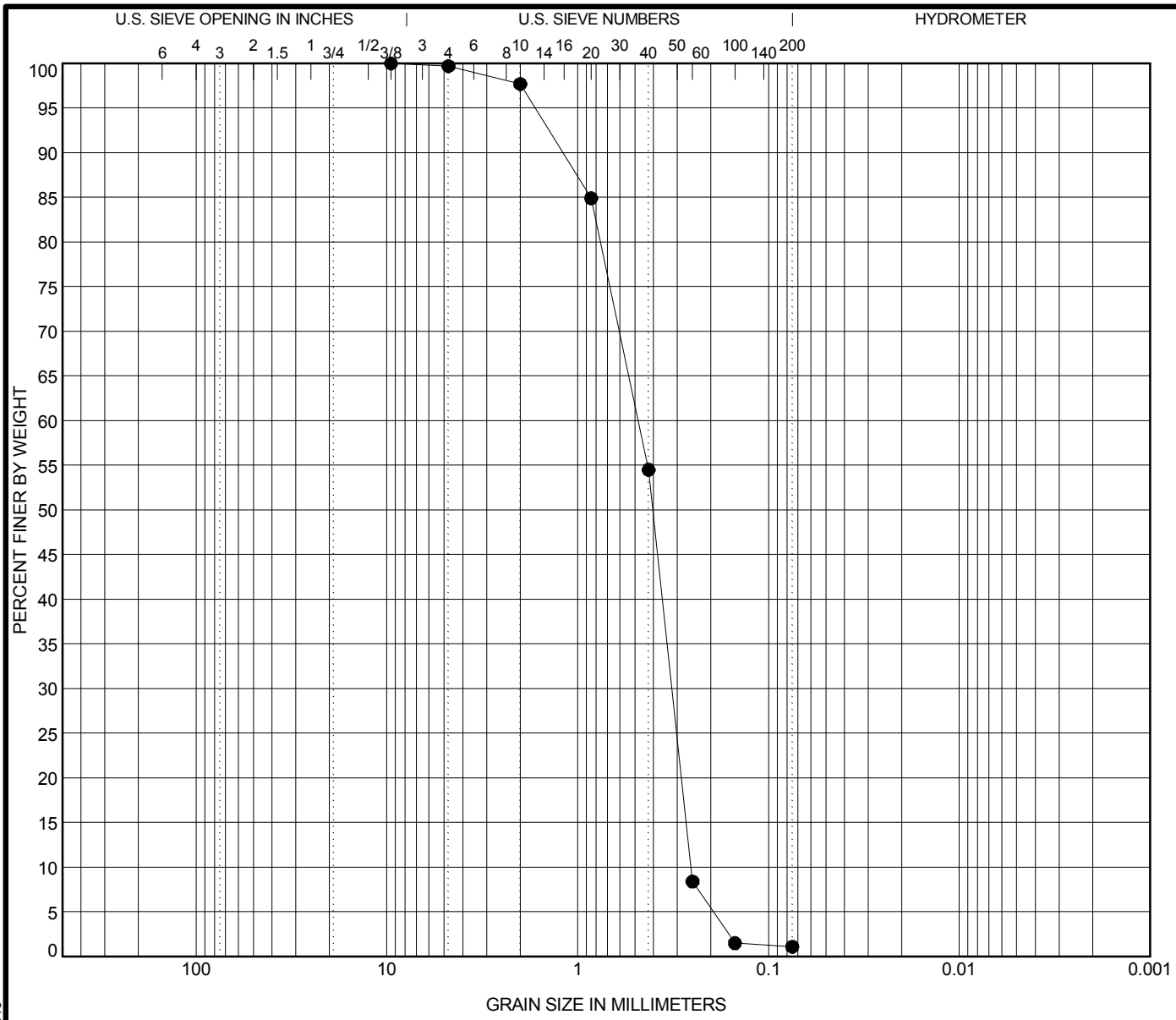
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-42 | 5.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, light brown** | -- | -- | -- | **0.84** | **1.89** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.482** | **0.321** | **0.255** | **0.3** | **98.6** | **1.1** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 in. |
|---|---|---|---|---|---|---|---|---|
| % Finer | 1.1 | 1.5 | 8.4 | 54.5 | 84.9 | 97.7 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| WS | 9/21/18 | |

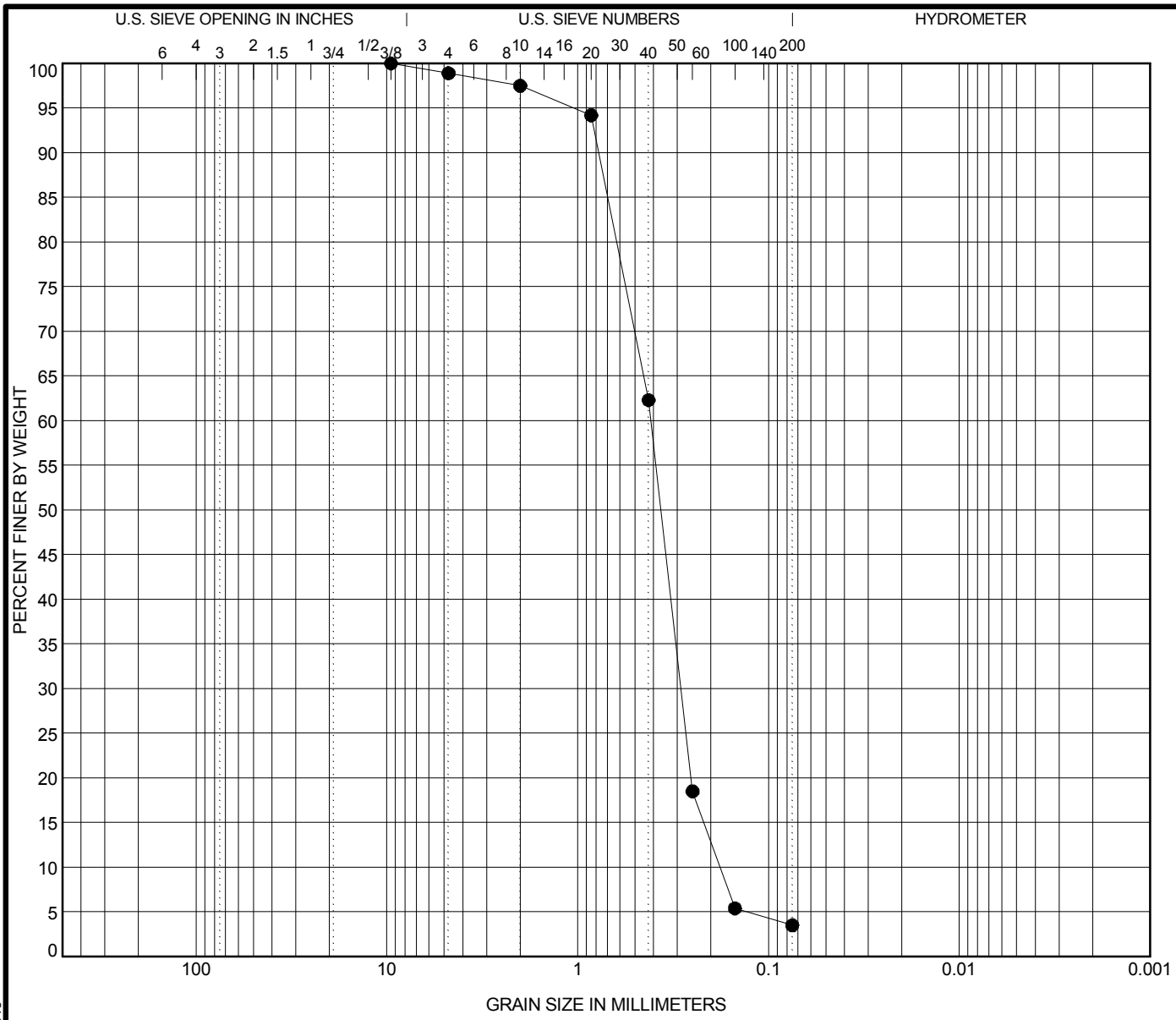
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-44 | 5.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, gray** | -- | -- | -- | **1.11** | **2.30** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.413** | **0.287** | **0.179** | **1.1** | **95.4** | **3.5** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 in. |
|---|---|---|---|---|---|---|---|---|
| % Finer | 3.5 | 5.4 | 18.5 | 62.3 | 94.2 | 97.5 | 98.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| WS | 9/21/18 | DS |

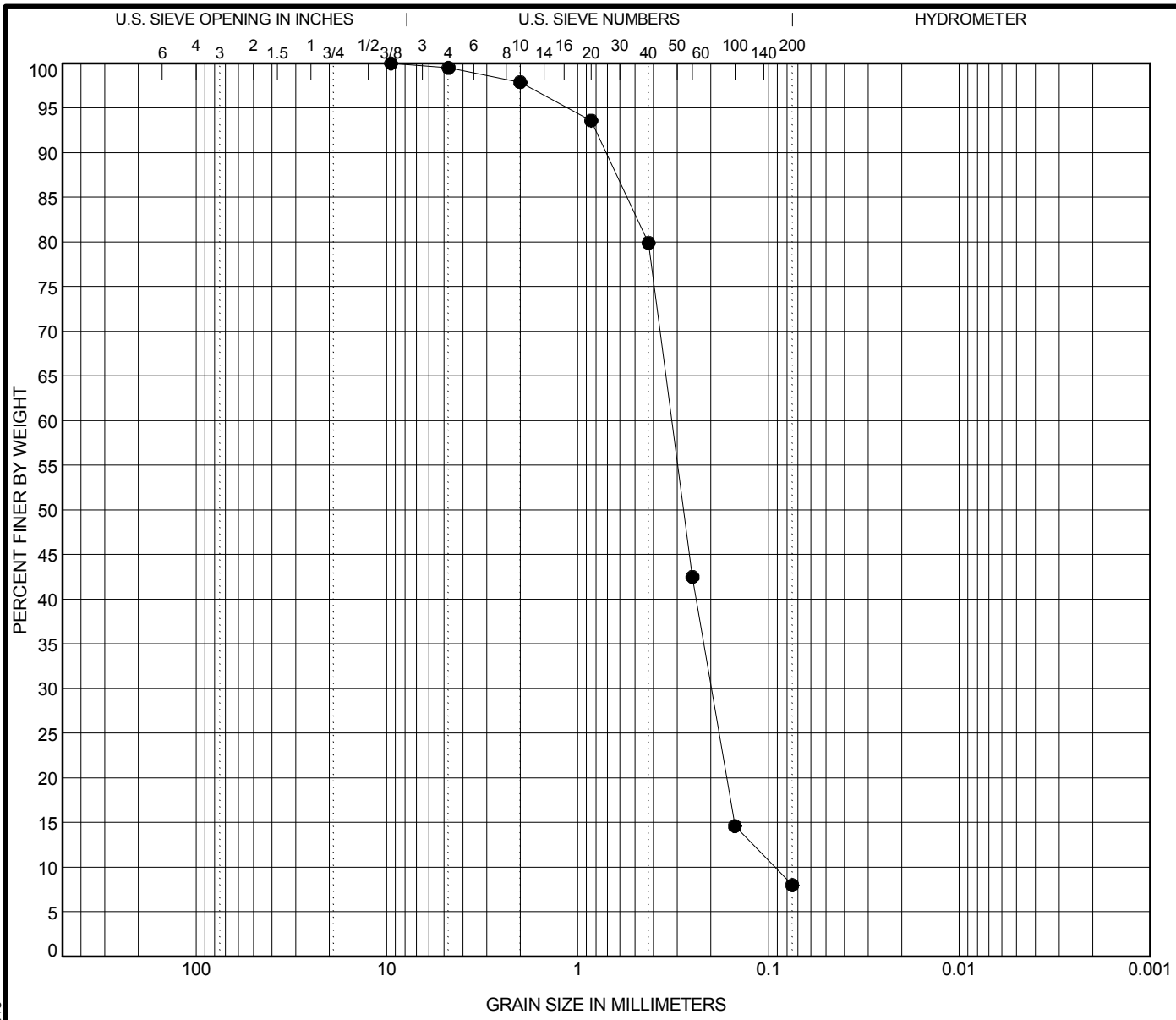
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-48 | 0.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | **1.33** | **3.46** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.32** | **0.199** | **0.093** | **0.5** | **91.5** | **8.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 in. |
|---|---|---|---|---|---|---|---|---|
| % Finer | 8.0 | 14.6 | 42.5 | 79.9 | 93.6 | 97.9 | 99.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| WS | 9/21/18 | DS |

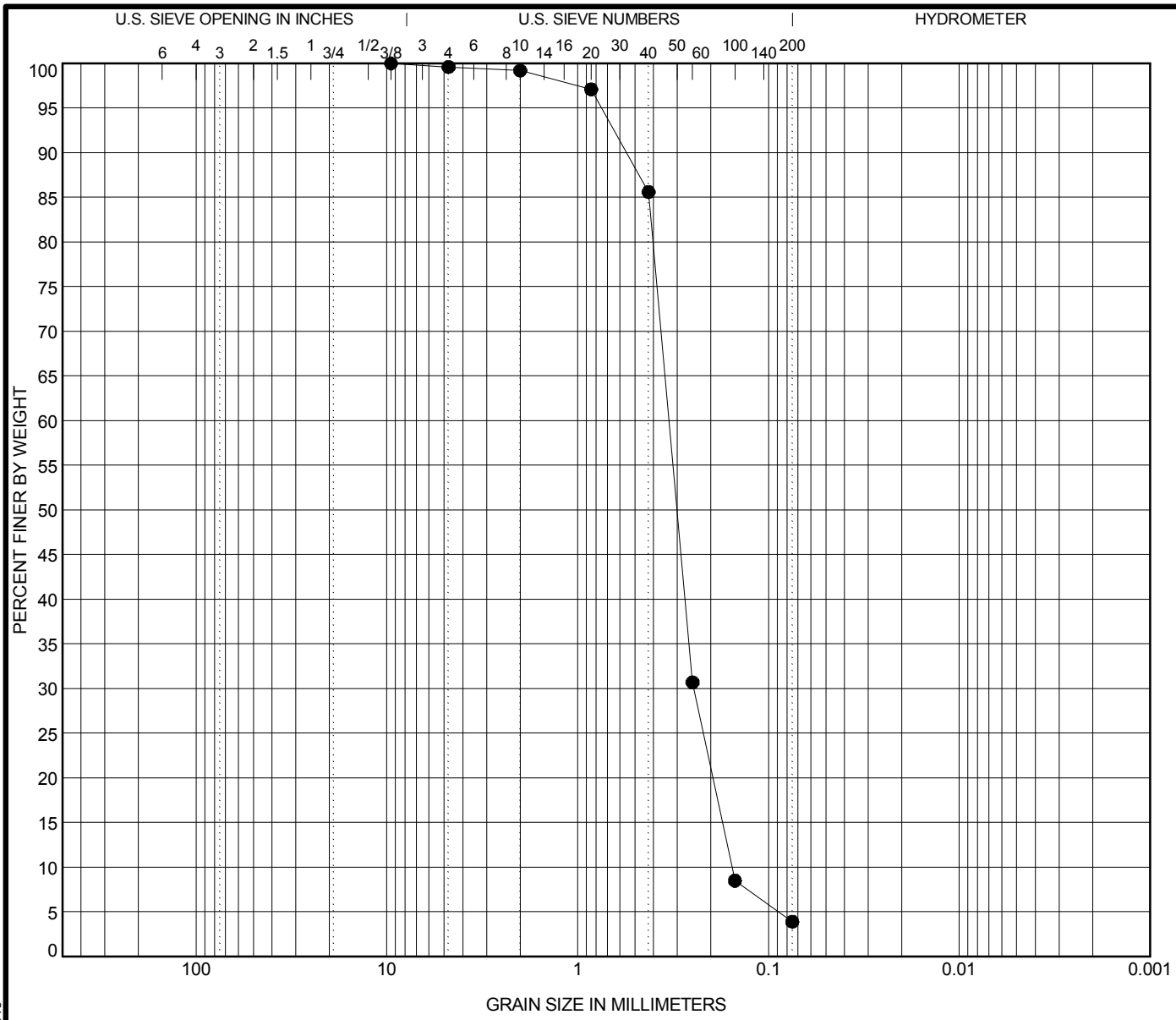
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-48 | 3.5 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, light gray** | -- | -- | -- | **1.17** | **2.14** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.332** | **0.246** | **0.155** | **0.4** | **95.7** | **3.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 in. |
|---|---|---|---|---|---|---|---|---|
| % Finer | 3.9 | 8.5 | 30.7 | 85.6 | 97.1 | 99.2 | 99.6 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| WS | 9/21/18 | DS |

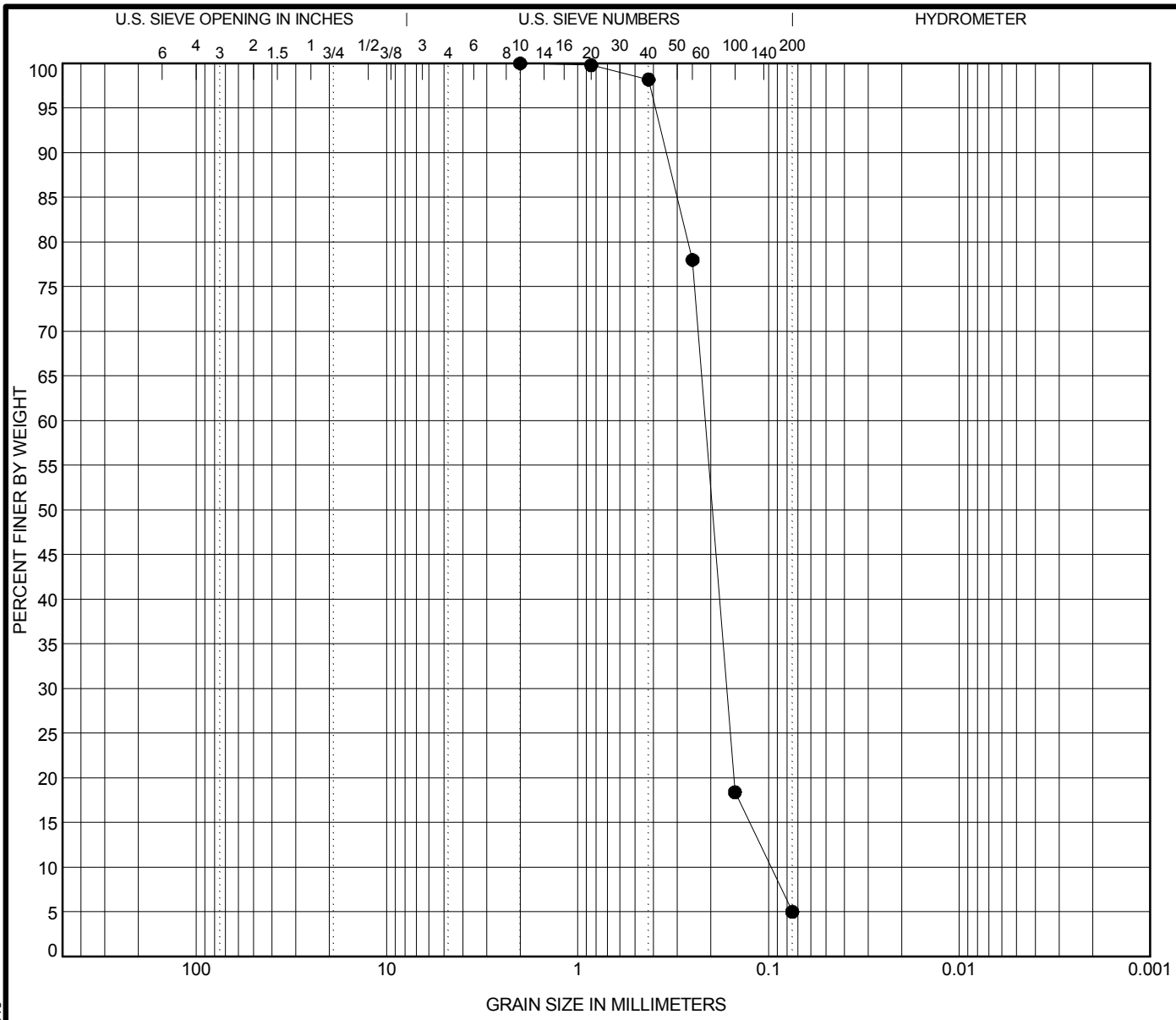
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-48 | 13.8 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to medium grained sand, contains wood fragments, dark gray** | -- | -- | -- | **1.32** | **2.21** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **2** | **0.214** | **0.166** | **0.097** | **0.0** | **95.0** | **5.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 |
|---|---|---|---|---|---|---|
| % Finer | 5.0 | 18.4 | 78.0 | 98.2 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| WS | 9/21/18 | DS |

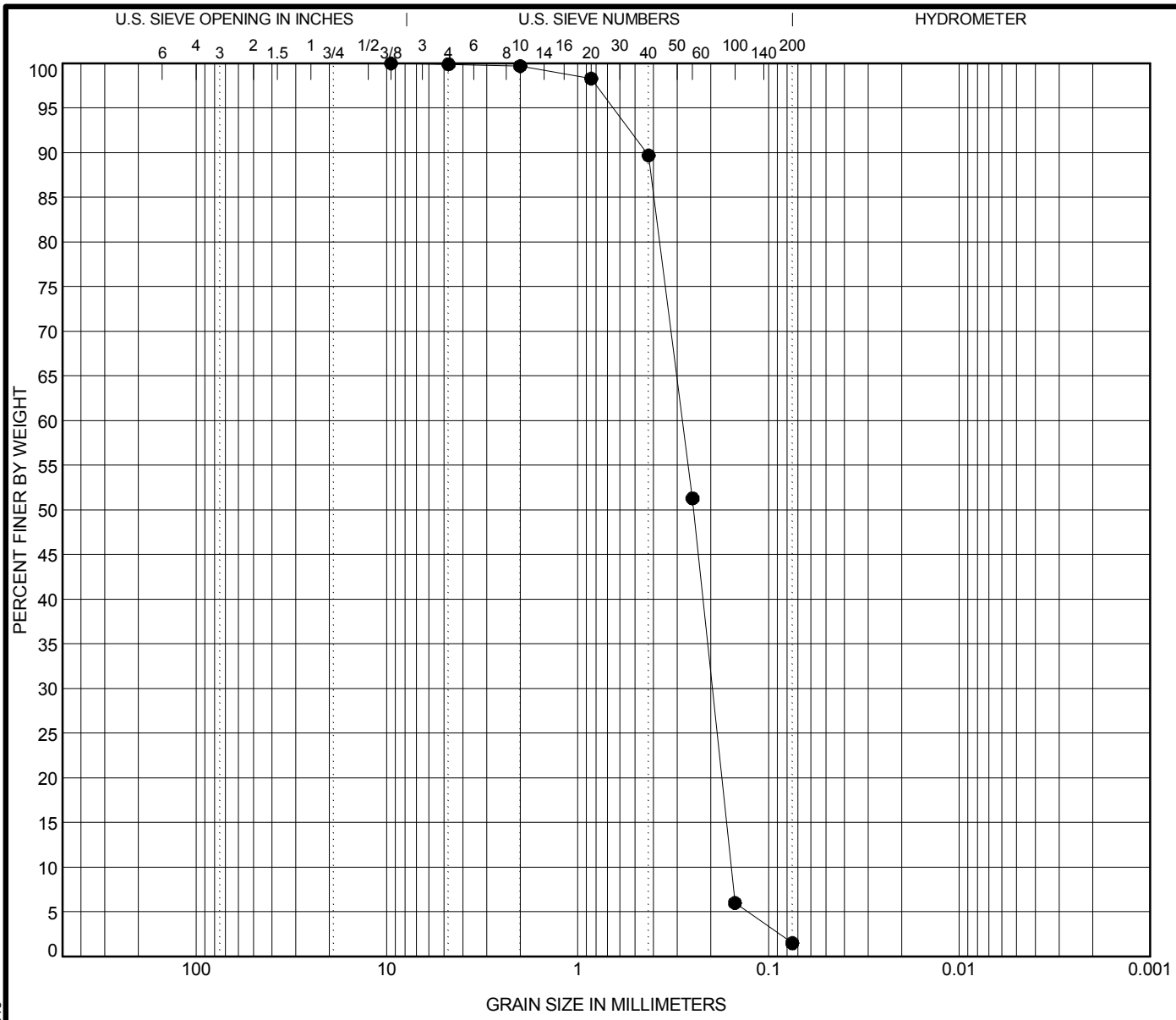
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-51 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light brown** | -- | -- | -- | **0.87** | **1.80** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.282** | **0.197** | **0.157** | **0.1** | **98.4** | **1.5** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 in. |
|---|---|---|---|---|---|---|---|---|
| % Finer | 1.5 | 6.0 | 51.3 | 89.7 | 98.3 | 99.7 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| WS | 9/21/18 | DS |

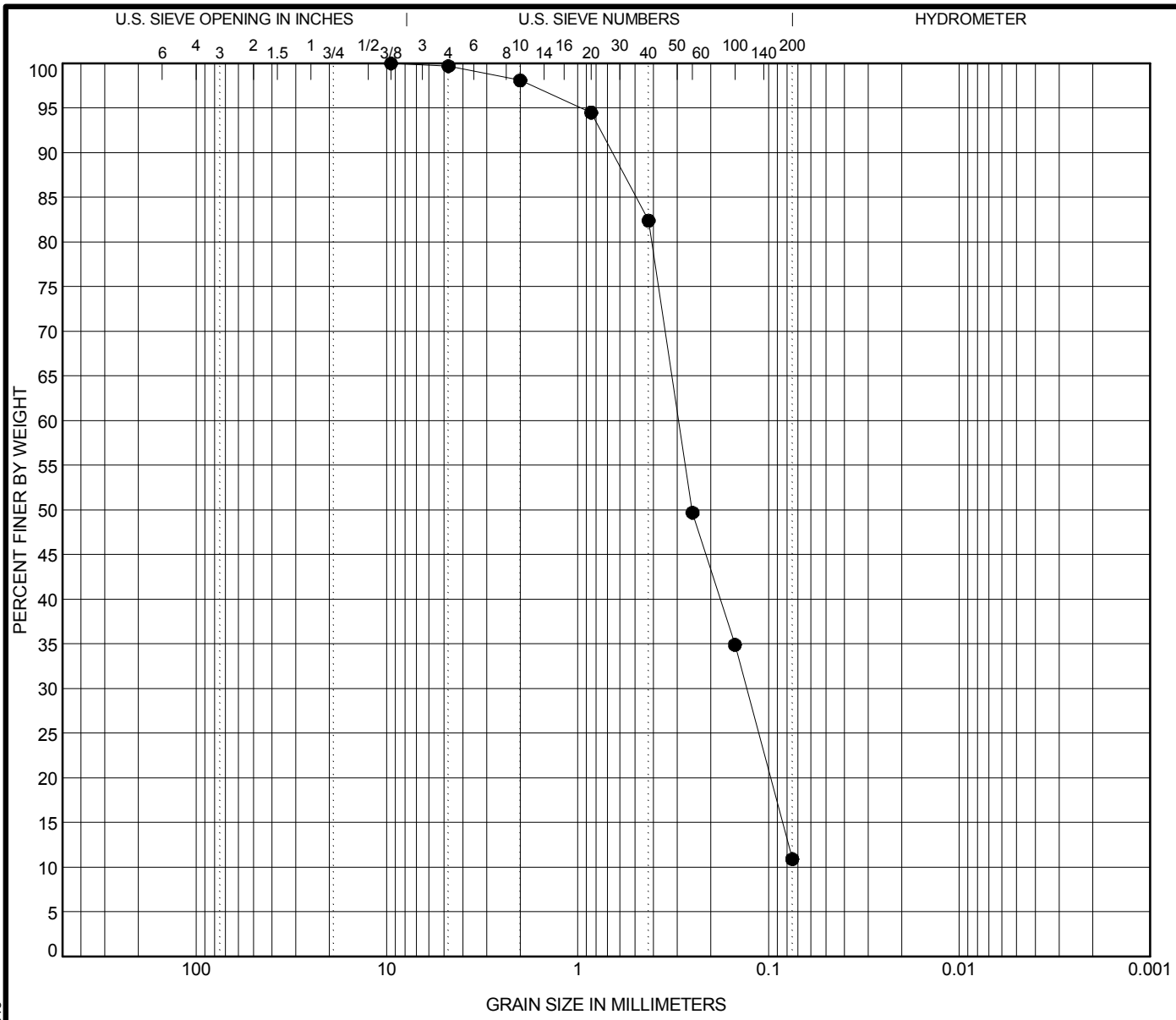
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-54 | 0.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, light gray** | -- | -- | -- | **0.79** | **4.04** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.295** | **0.13** | **--** | **0.3** | **88.8** | **10.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 in. |
|---|---|---|---|---|---|---|---|---|
| % Finer | 10.9 | 34.9 | 49.7 | 82.4 | 94.5 | 98.1 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| WS | 9/21/18 | DS |

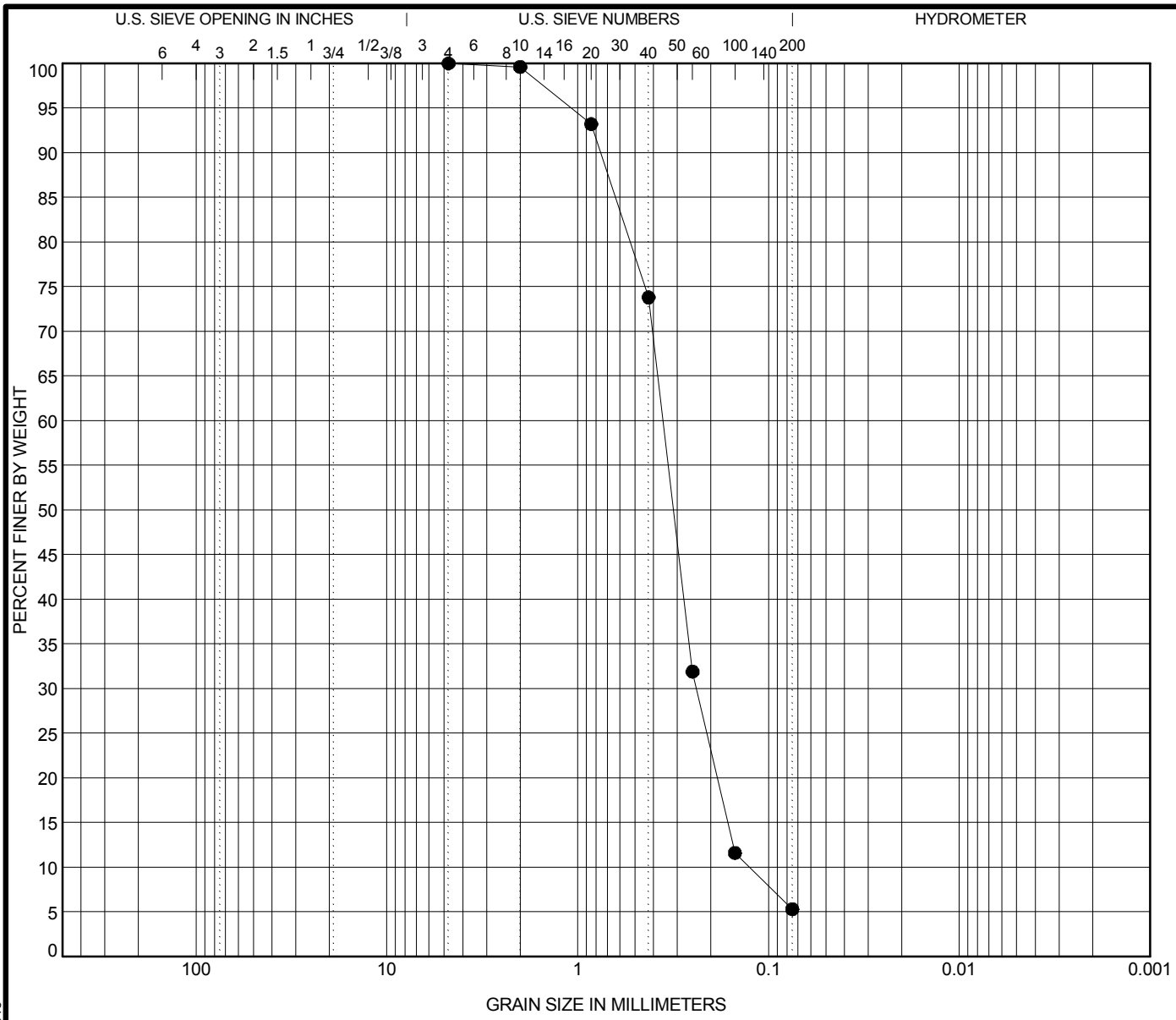
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-56 | 5.9 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, gray** | -- | -- | -- | **1.27** | **2.84** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.357** | **0.238** | **0.126** | **0.0** | **94.7** | **5.3** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 5.3 | 11.6 | 31.9 | 73.8 | 93.2 | 99.6 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| WS | 9/21/18 | DS |

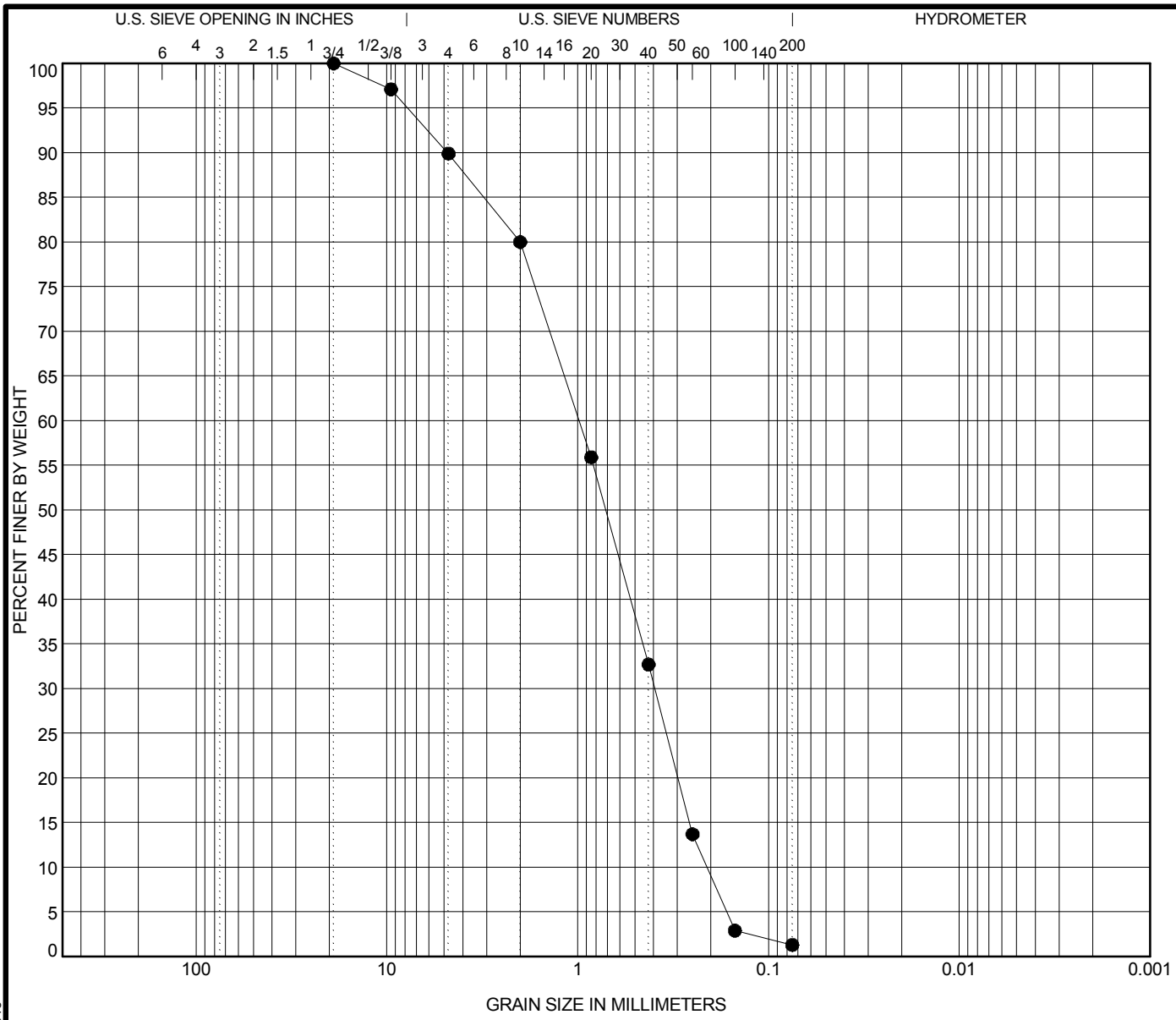
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-56 | 10.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light gray** | -- | -- | -- | **0.75** | **4.68** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.983** | **0.394** | **0.21** | **10.1** | **88.6** | **1.3** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 in. | 3/4 in. |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 1.3 | 2.9 | 13.7 | 32.7 | 55.9 | 80.0 | 89.9 | 97.1 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| WS | 9/21/18 | DS |

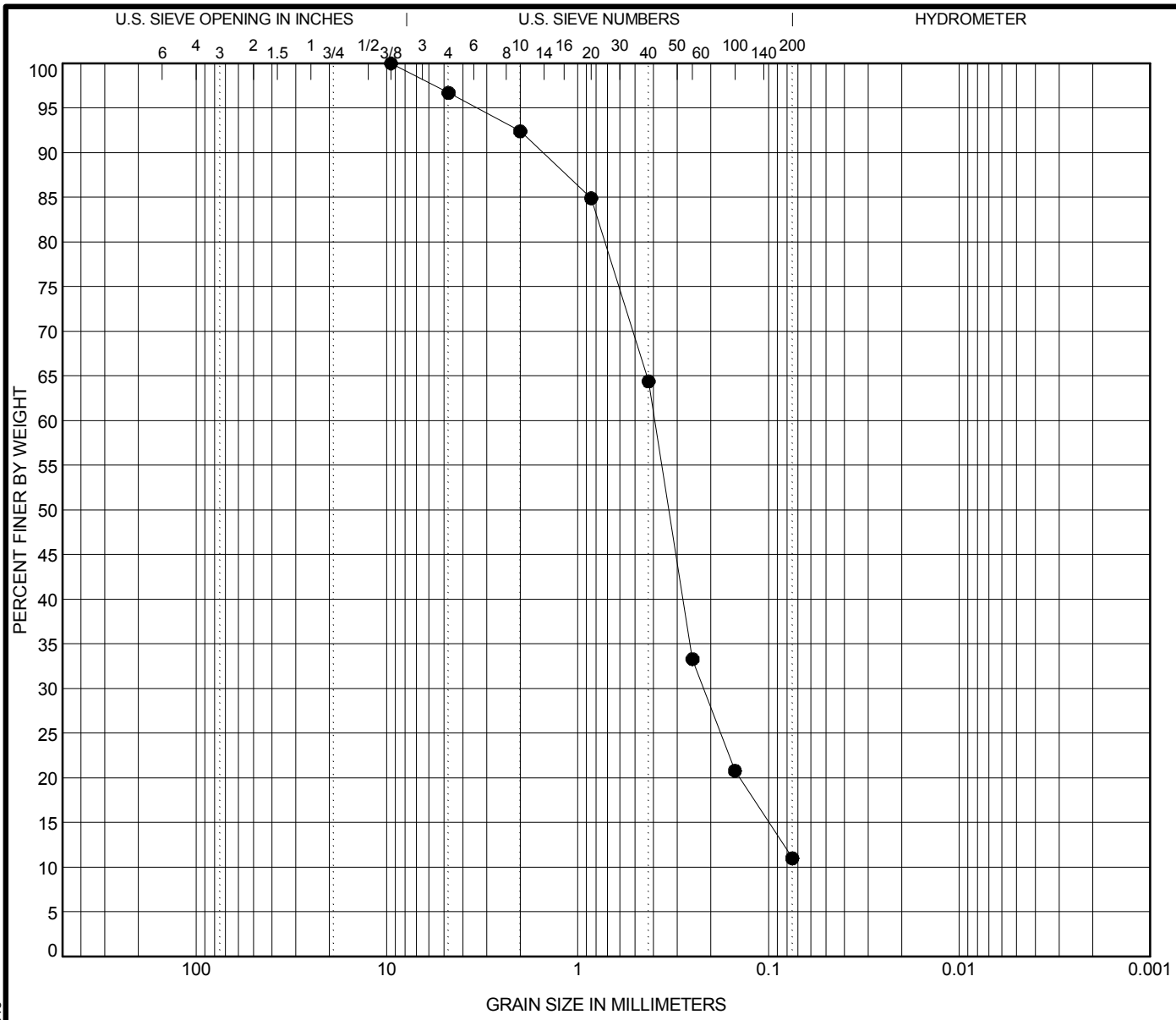
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-43 | 4.9 ft | **SILTY SAND (SM), fine tocoarse grained sand, trace gravel, gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.394** | **0.218** | **--** | **3.3** | **85.7** | **11.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 11.0 | 20.8 | 33.3 | 64.4 | 84.9 | 92.4 | 96.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/20/18 | |

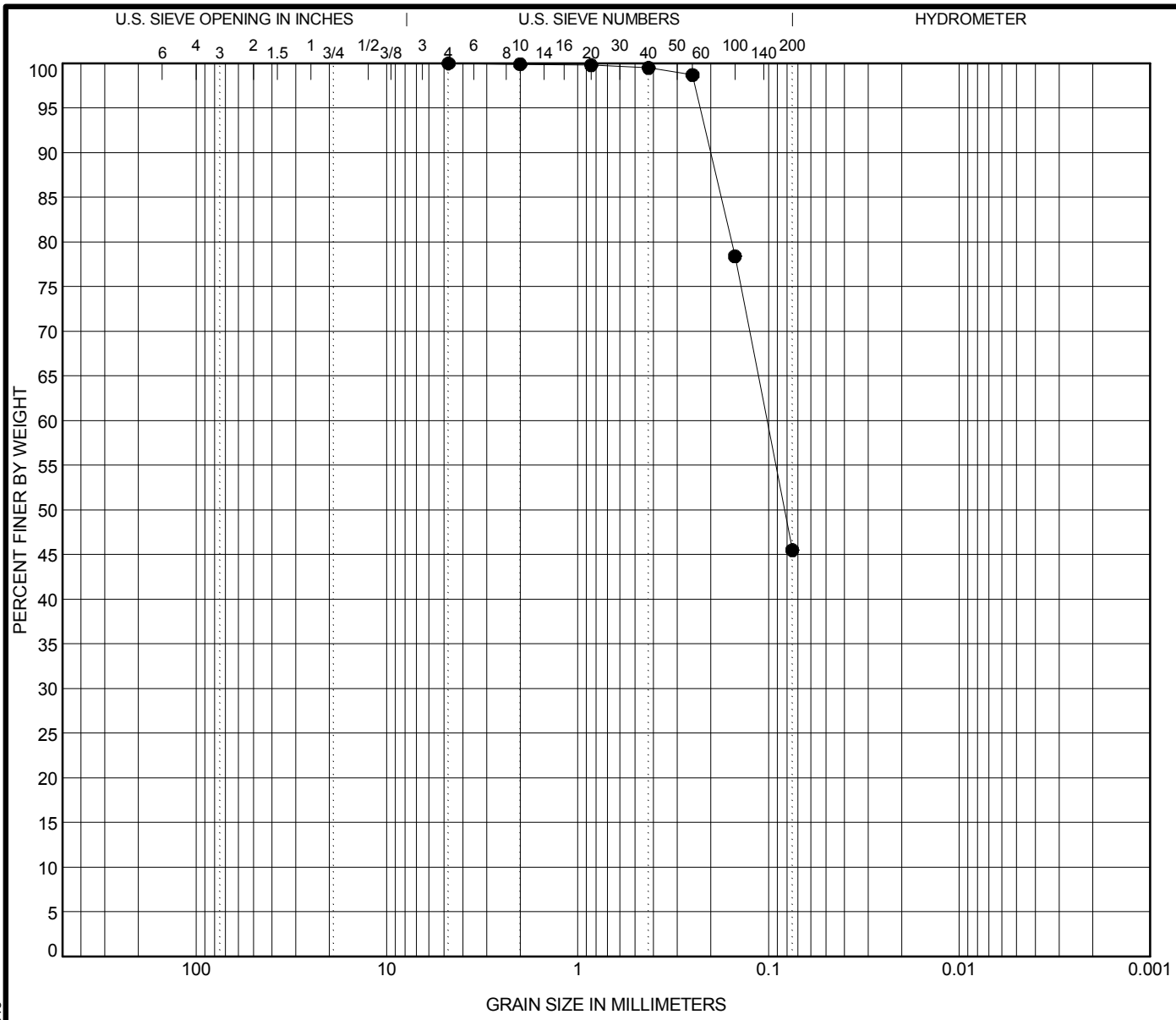
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-53 | 11.9 ft | **SILTY SAND (SM), fine grained sand, contains mica, dark gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.102** | **--** | **--** | **0.0** | **54.5** | **45.5** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 45.5 | 78.4 | 98.7 | 99.5 | 99.8 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KR | 9/20/18 | |

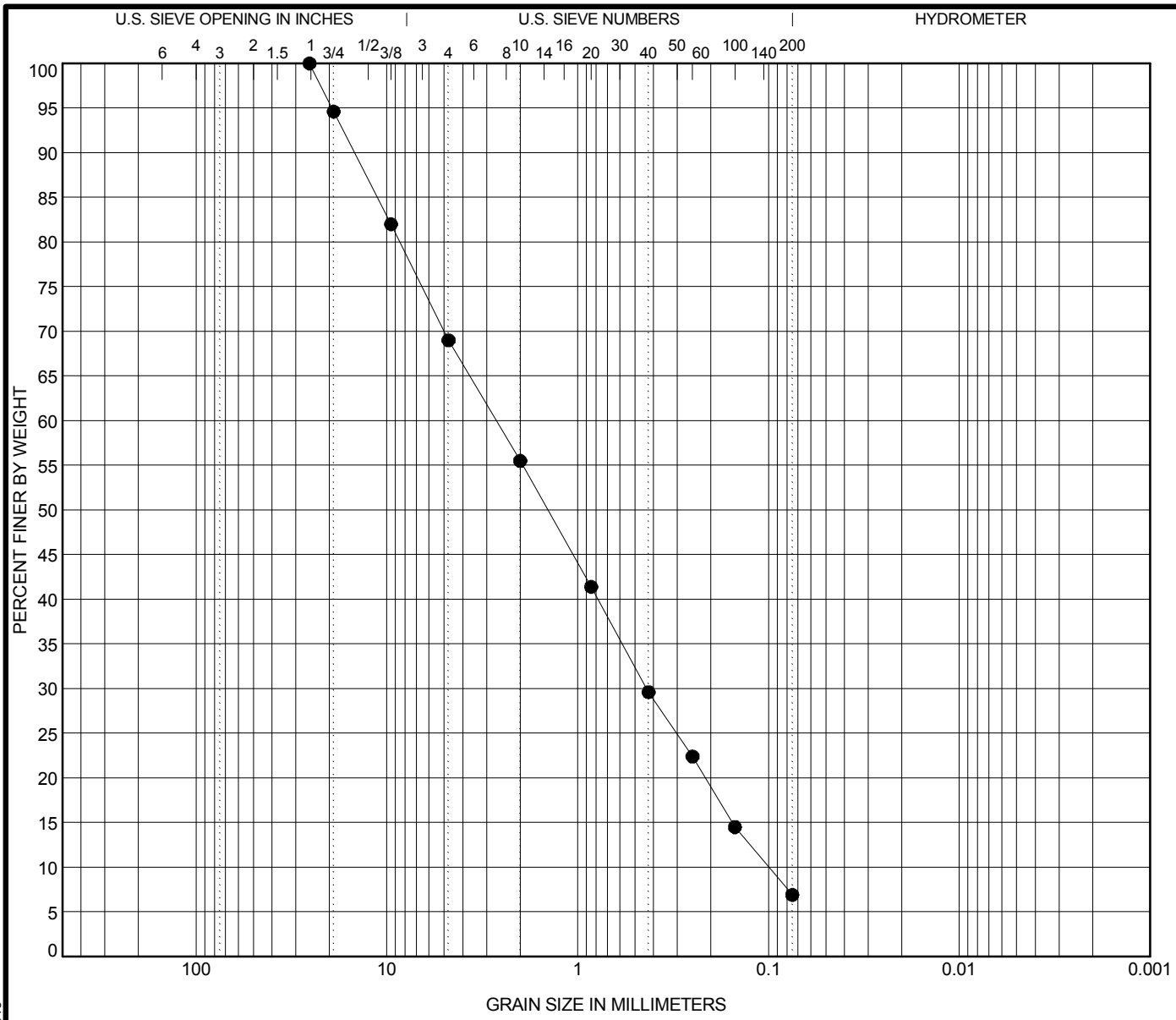
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-55 | 0.0 ft | **POORLY GRADED SAND WITH SILT AND GRAVEL (SP), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- | **0.71** | **26.82** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **25.4** | **2.668** | **0.435** | **0.1** | **31.0** | **62.1** | **6.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| % Finer | 6.9 | 14.5 | 22.4 | 29.6 | 41.4 | 55.5 | 69.0 | 82.0 | 94.6 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/20/18 | DS |

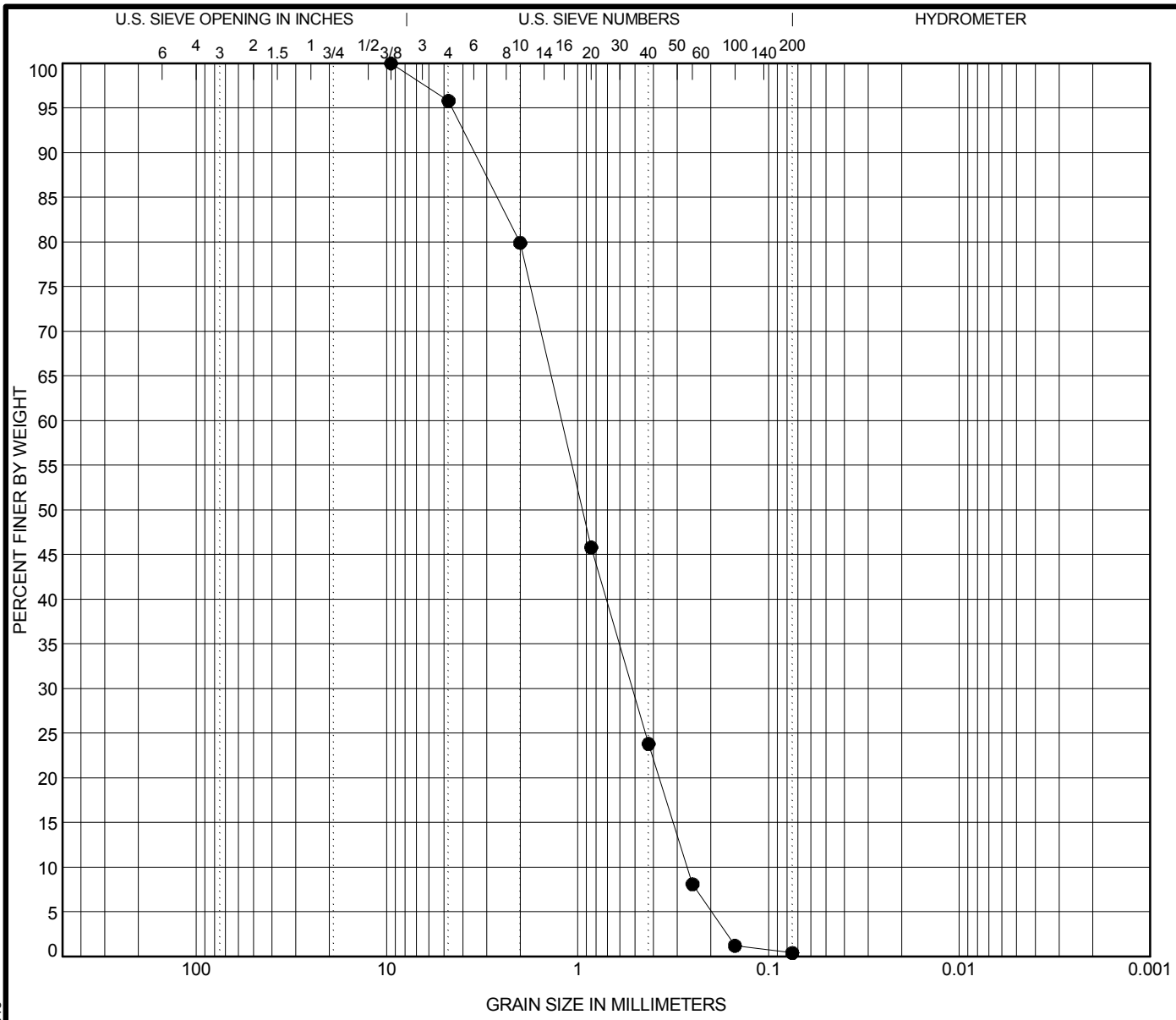
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-55 | 2.3 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- | **0.83** | **4.55** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **1.214** | **0.517** | **0.267** | **4.2** | **95.4** | **0.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 0.4 | 1.2 | 8.1 | 23.8 | 45.8 | 79.9 | 95.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/20/18 | DS |

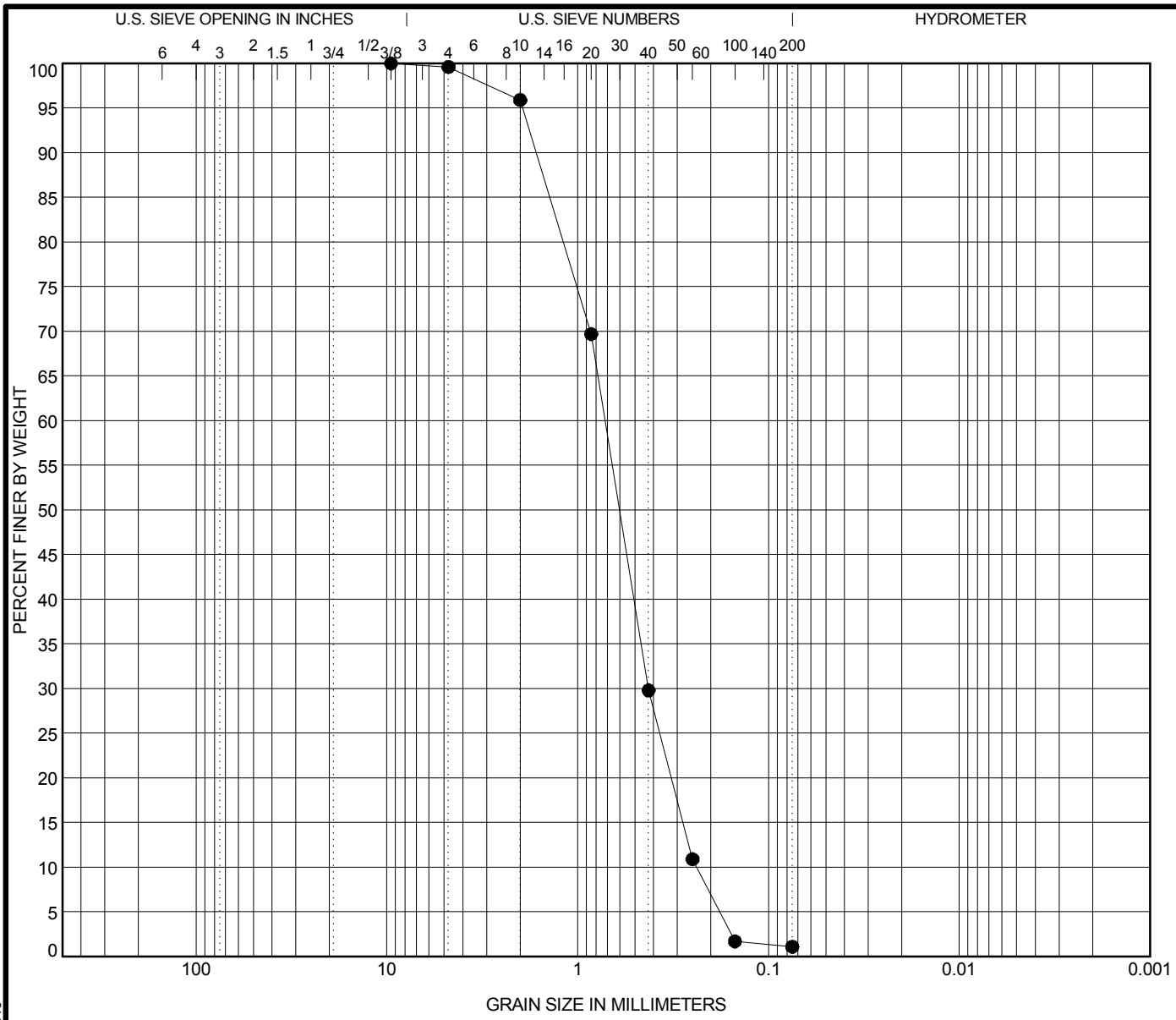
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-55 | 7.3 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- | **1.06** | **3.02** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.718** | **0.426** | **0.238** | **0.4** | **98.5** | **1.1** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 1.1 | 1.7 | 10.9 | 29.8 | 69.7 | 95.9 | 99.6 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/20/18 | DS |

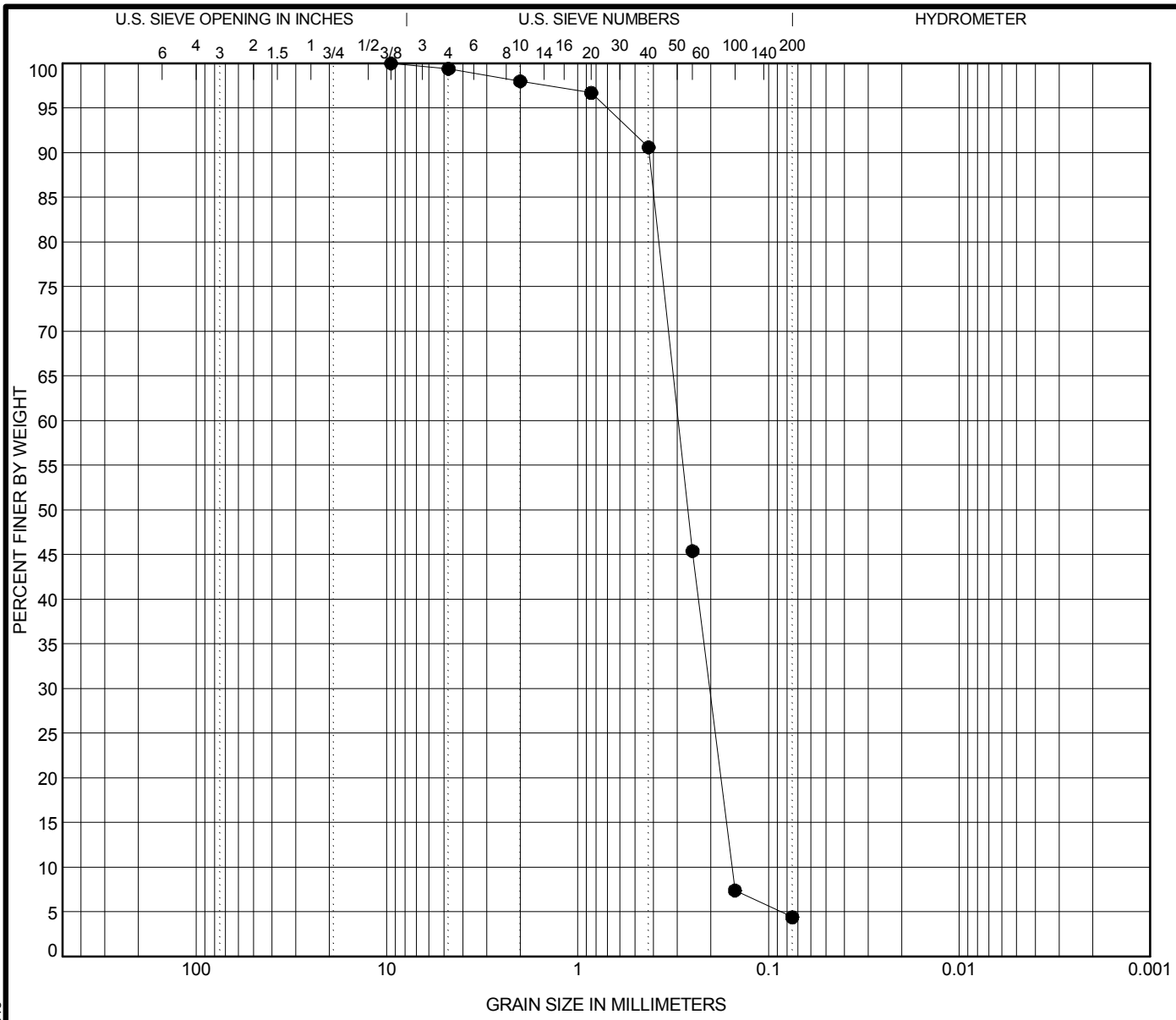
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-58 | 0.0 ft | **POORLY GRADED SAND WITH GRAVEL (SP), fine to coarse grained sand, gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.297** | **0.203** | **0.155** | **0.6** | **95.0** | **4.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 4.4 | 7.4 | 45.4 | 90.6 | 96.7 | 98.0 | 99.4 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/20/18 | |

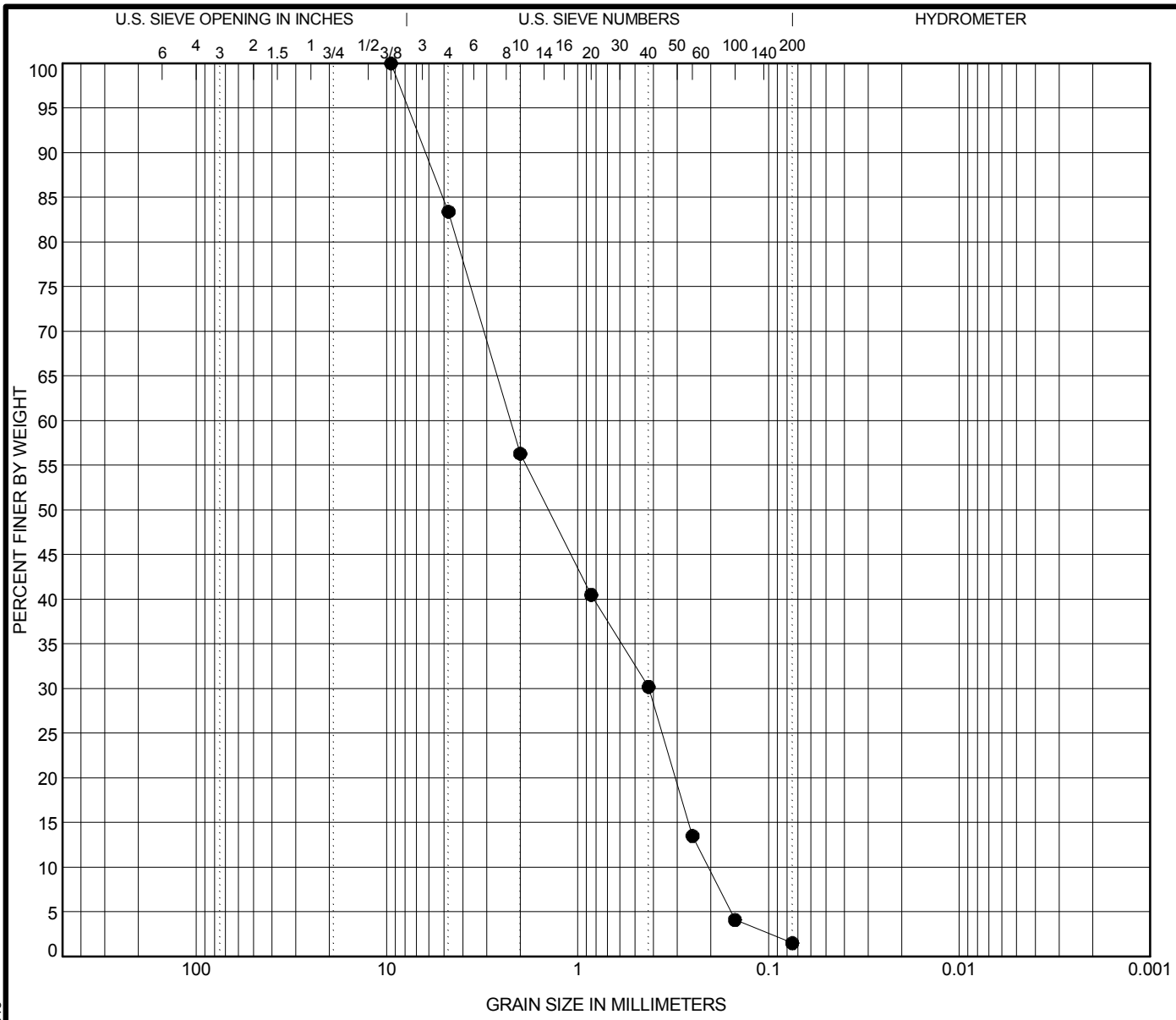
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-58 | 5.6 ft | **POORLY GRADED SAND WITH GRAVEL (SP), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **2.251** | **0.422** | **0.207** | **16.6** | **81.9** | **1.5** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 1.5 | 4.1 | 13.5 | 30.2 | 40.5 | 56.3 | 83.4 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/20/18 | |

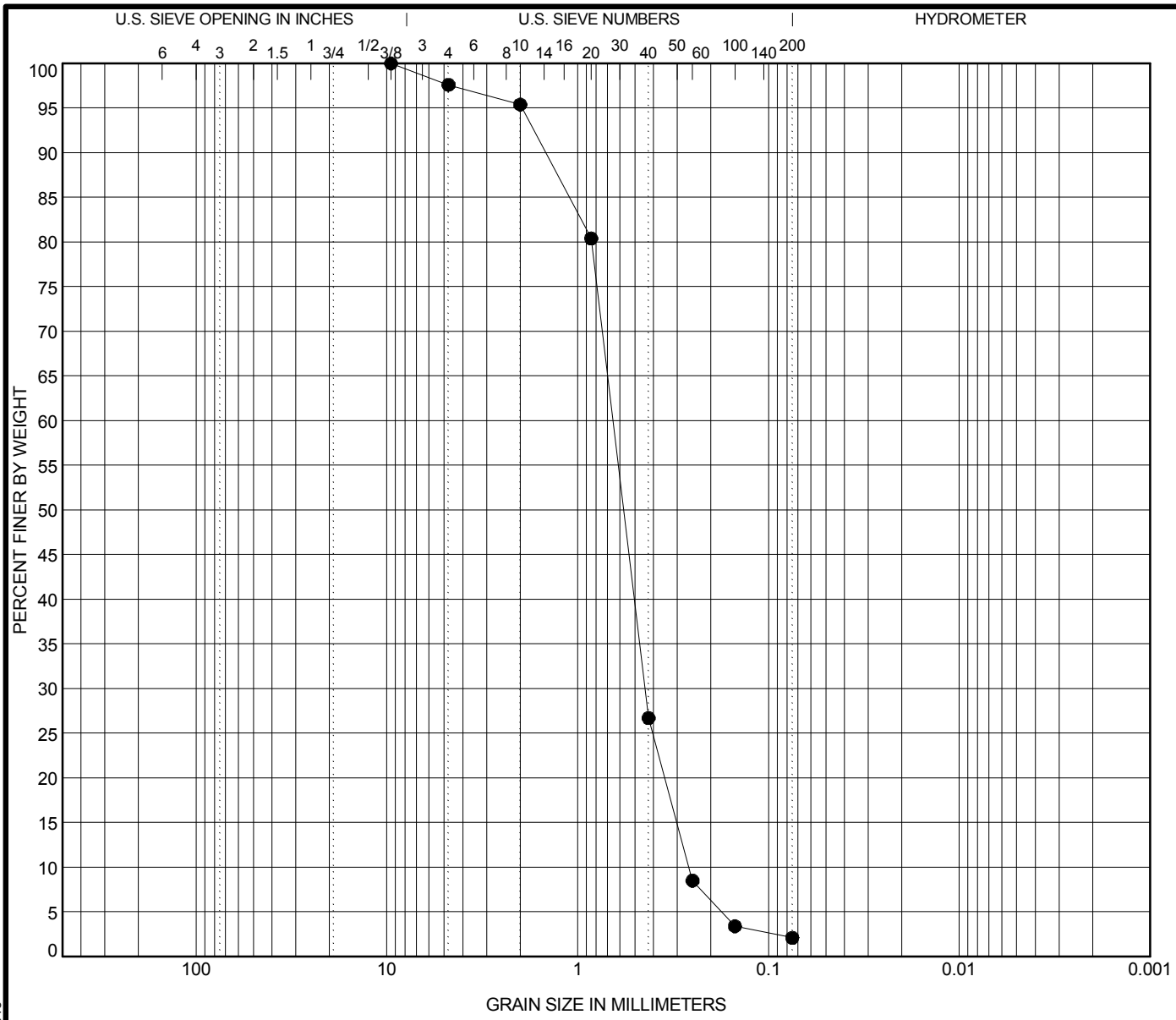
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-59A | 1.2 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- | **1.15** | **2.50** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.653** | **0.443** | **0.261** | **2.4** | **95.5** | **2.1** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 2.1 | 3.4 | 8.5 | 26.7 | 80.4 | 95.4 | 97.6 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/20/18 | DS |

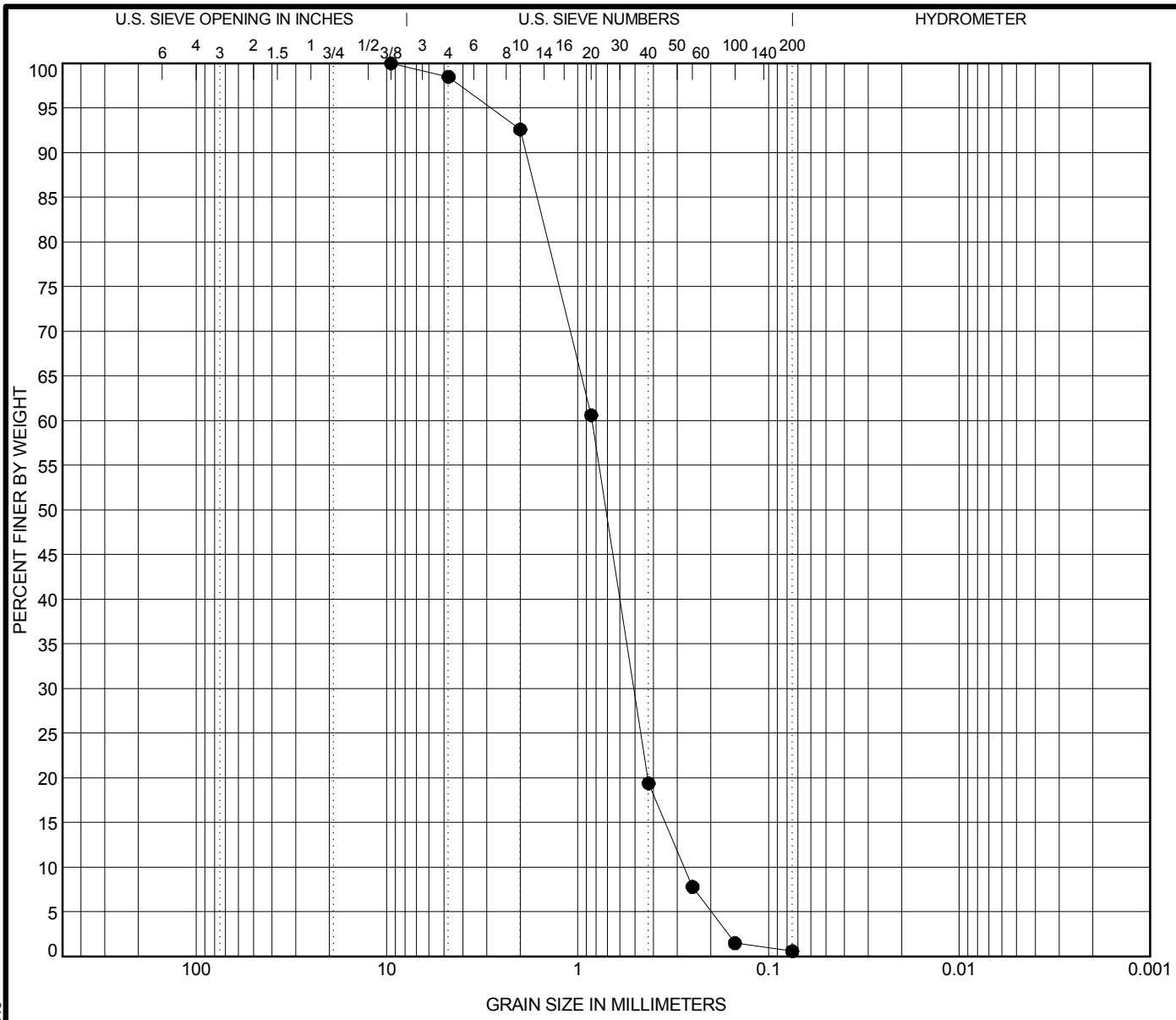
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-59A | 2.4 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- | **1.11** | **3.04** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.841** | **0.508** | **0.276** | **1.5** | **97.9** | **0.6** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 0.6 | 1.5 | 7.8 | 19.4 | 60.6 | 92.6 | 98.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/20/18 | DS |

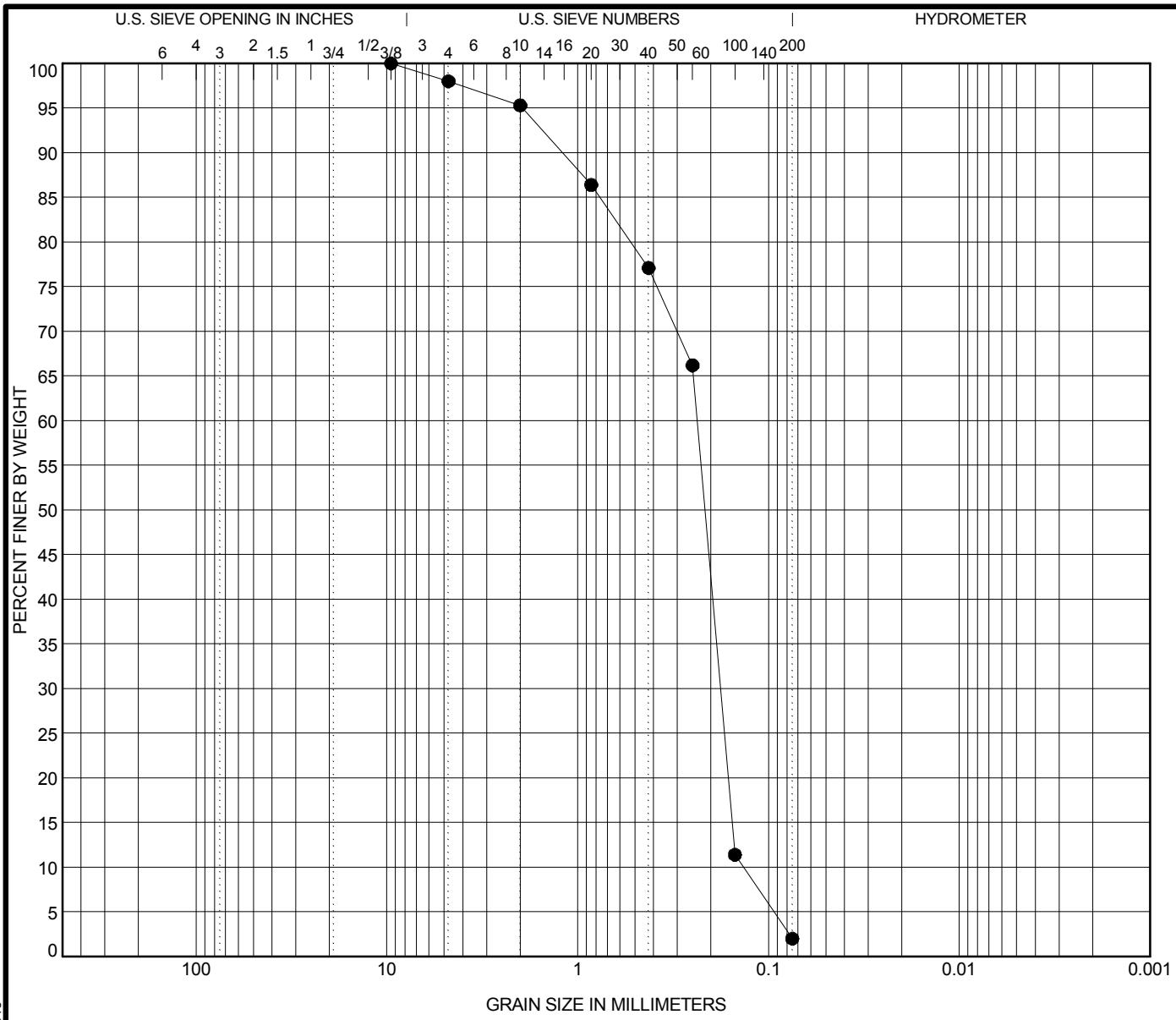
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-59A | 7.4 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- | **1.00** | **1.74** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.236** | **0.178** | **0.135** | **2.0** | **96.0** | **2.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 2.0 | 11.4 | 66.2 | 77.1 | 86.4 | 95.3 | 98.0 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/21/18 | DS |

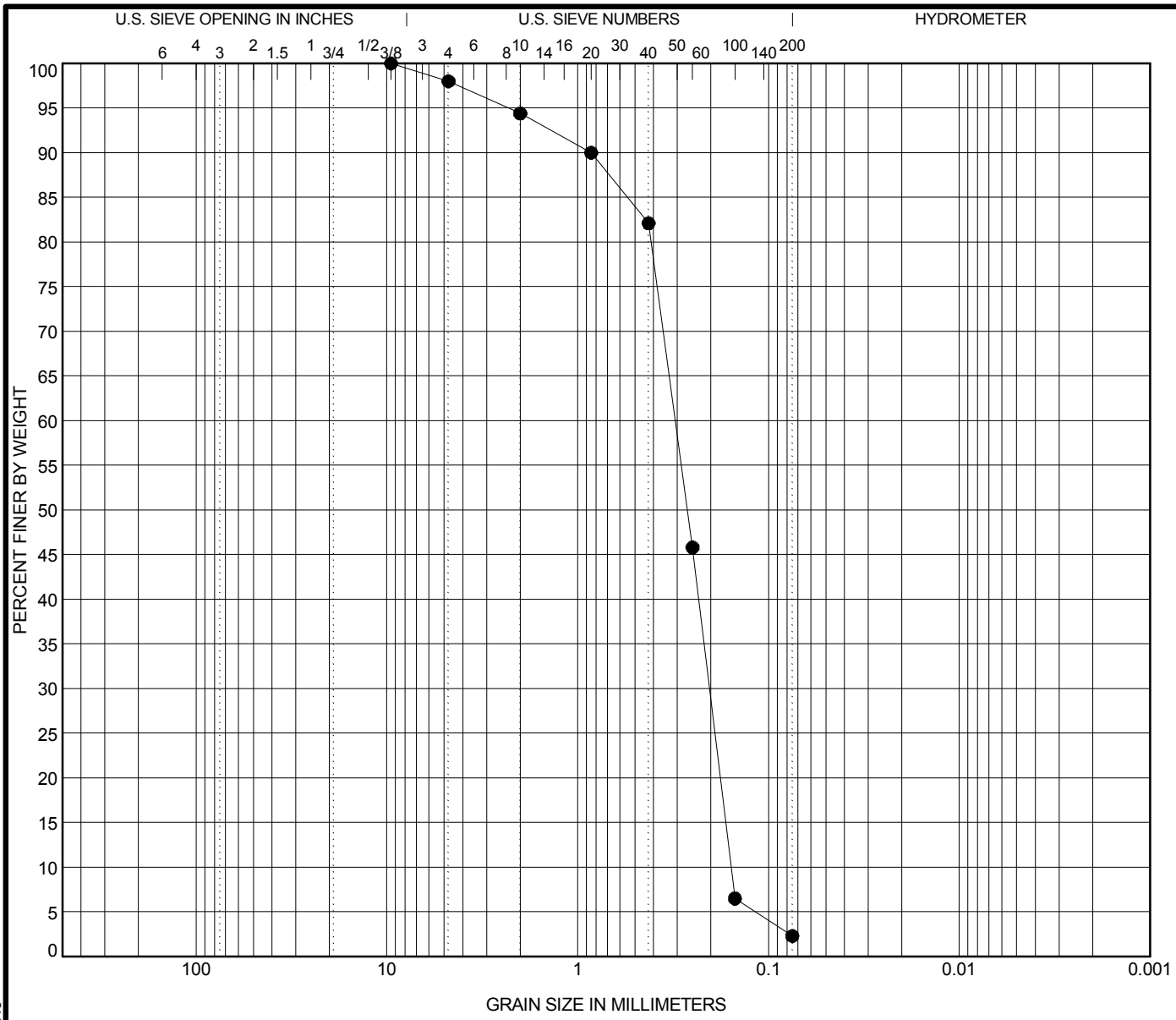
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-24 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- | **0.86** | **1.96** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.308** | **0.204** | **0.157** | **2.0** | **95.7** | **2.3** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 2.3 | 6.5 | 45.8 | 82.1 | 90.0 | 94.4 | 98.0 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/21/18 | |

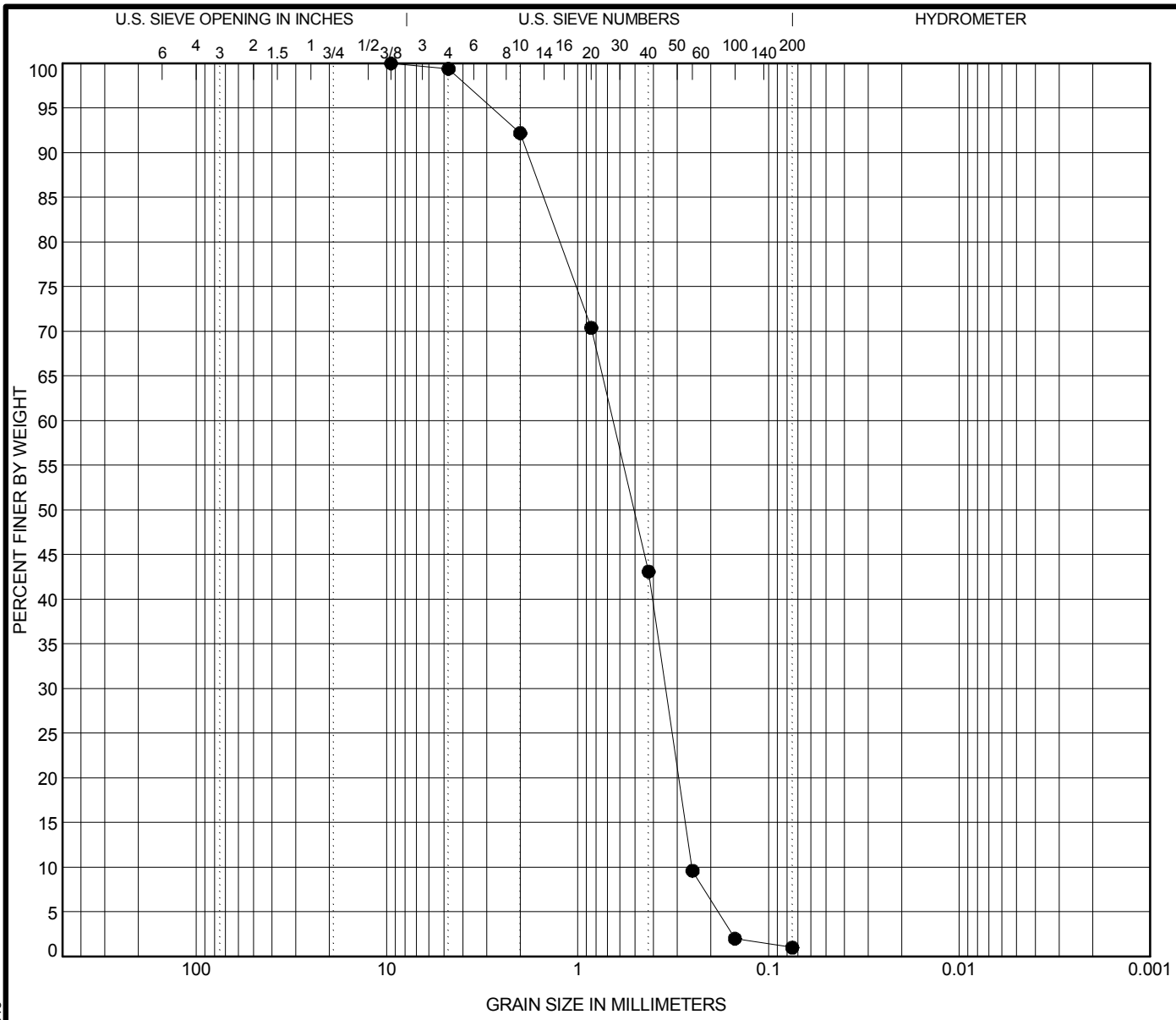
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-24 | 3.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- | **0.73** | **2.59** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.653** | **0.345** | **0.252** | **0.6** | **98.4** | **1.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 1.0 | 2.0 | 9.6 | 43.1 | 70.4 | 92.2 | 99.4 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/21/18 | |

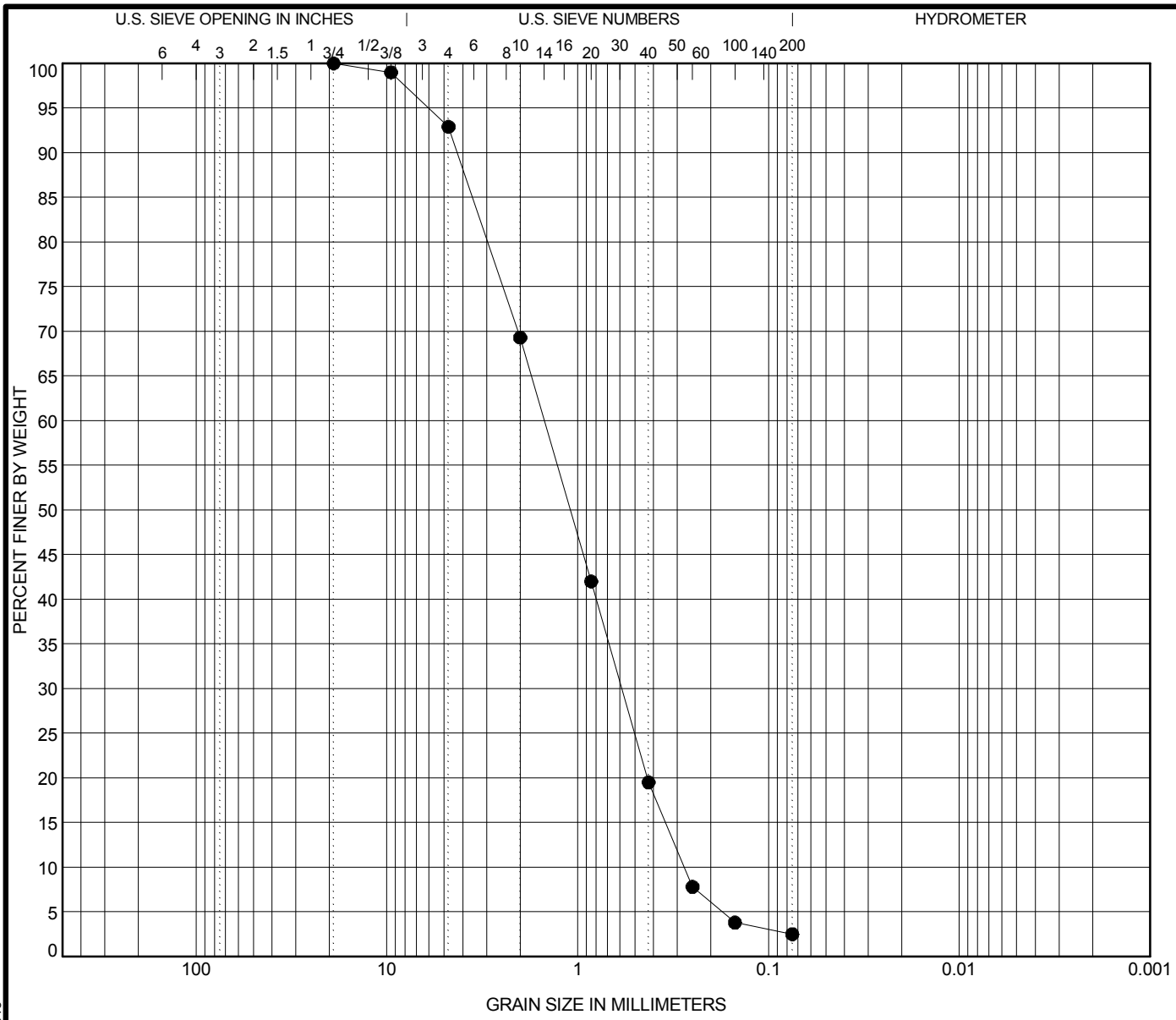
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-24 | 8.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- | **0.84** | **5.41** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **1.494** | **0.587** | **0.276** | **7.1** | **90.4** | **2.5** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 2.5 | 3.8 | 7.8 | 19.5 | 42.0 | 69.3 | 92.9 | 99.0 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/21/18 | |

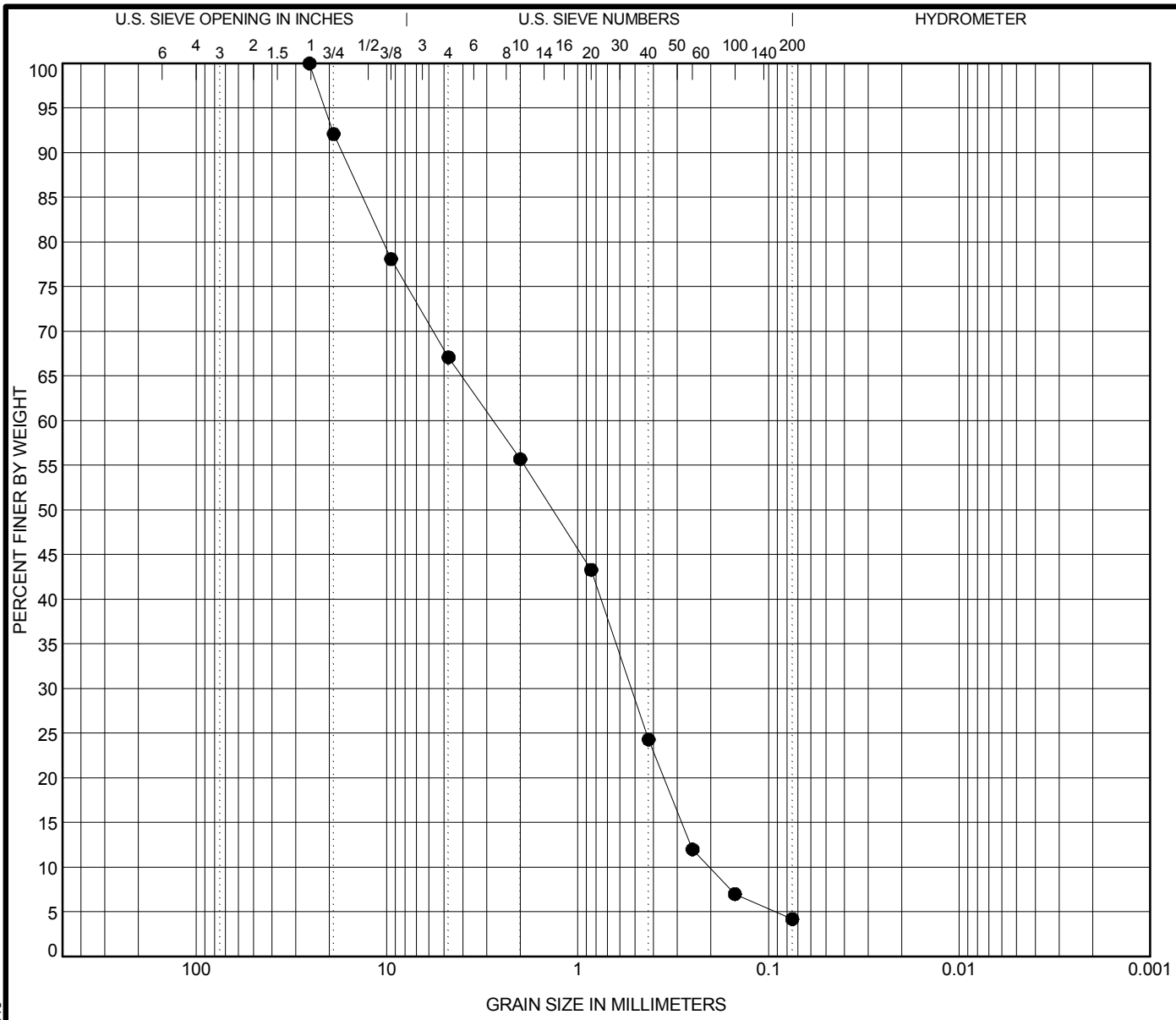
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-24 | 13.0 ft | **POORLY GRADED SAND (SP), tine to coarse grained sand, trace gravel, gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **25.4** | **2.772** | **0.523** | **0.204** | **32.9** | **62.9** | **4.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| % Finer | 4.2 | 7.0 | 12.0 | 24.3 | 43.3 | 55.7 | 67.1 | 78.1 | 92.1 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/21/18 | |

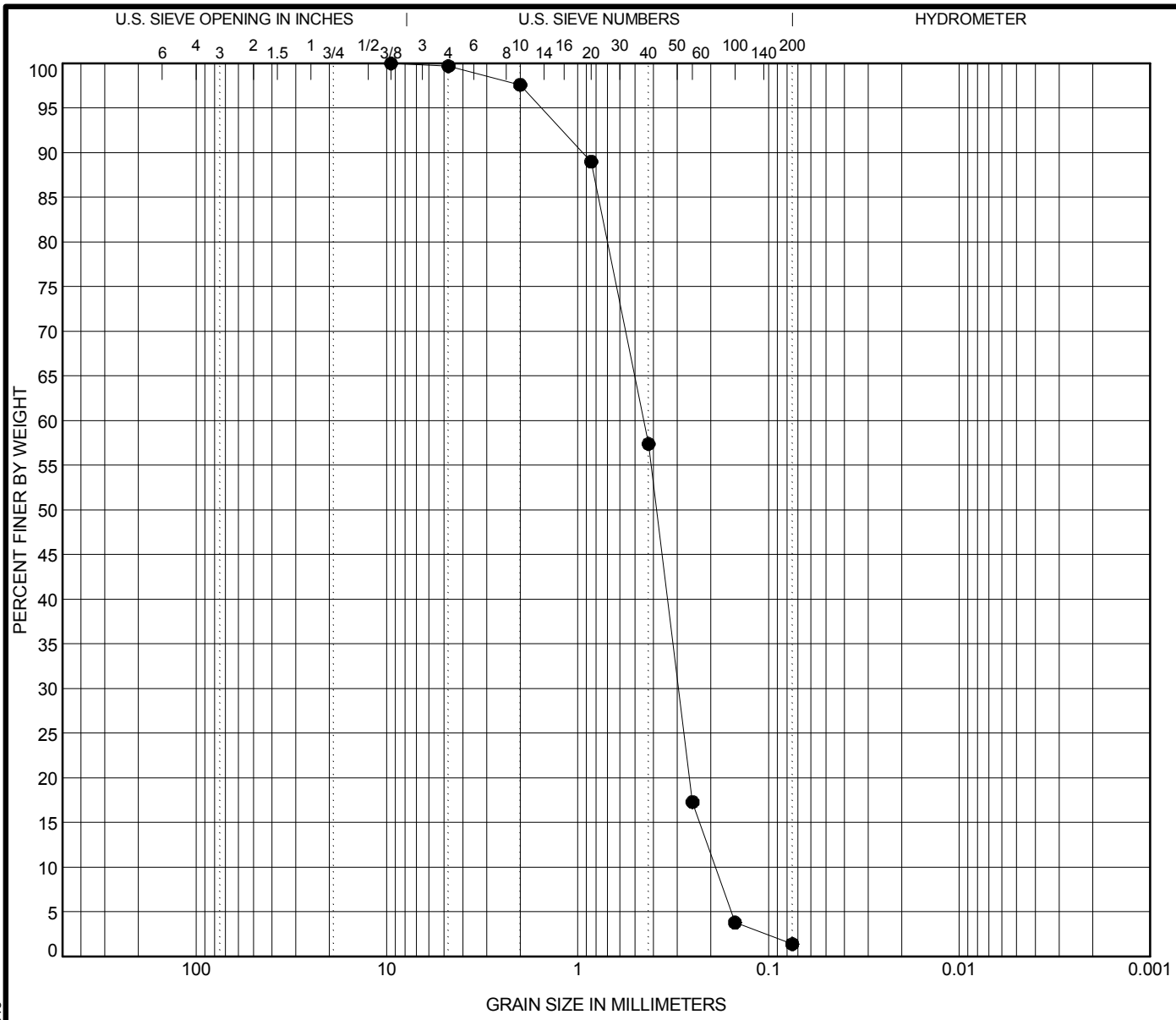
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-25 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- | **1.02** | **2.37** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.45** | **0.296** | **0.19** | **0.3** | **98.3** | **1.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 1.4 | 3.8 | 17.3 | 57.4 | 89.0 | 97.6 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/21/18 | DS |

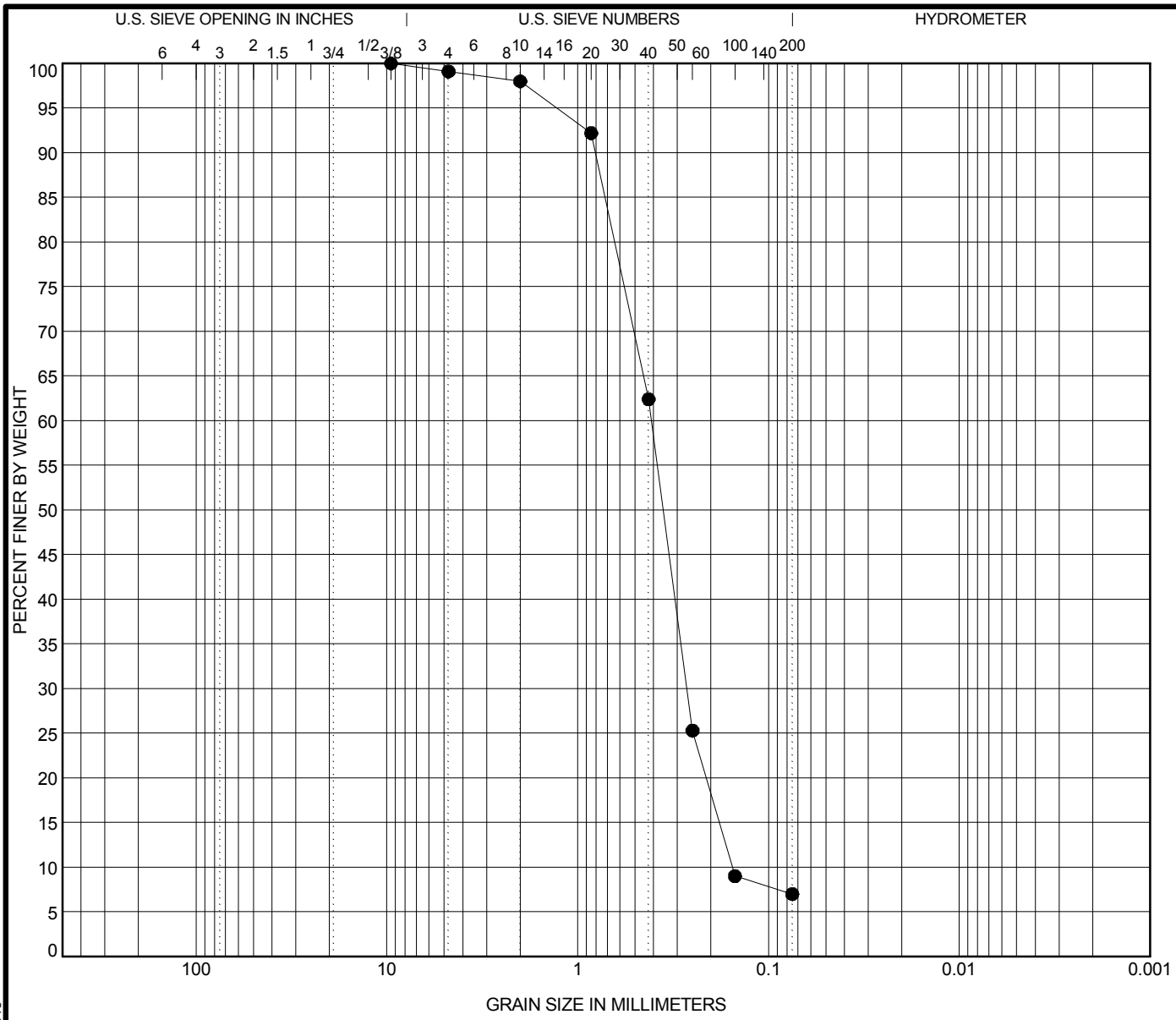
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-25 | 4.8 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- | **1.12** | **2.65** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.411** | **0.267** | **0.155** | **0.9** | **92.1** | **7.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 7.0 | 9.0 | 25.3 | 62.4 | 92.2 | 98.0 | 99.1 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/21/18 | DS |

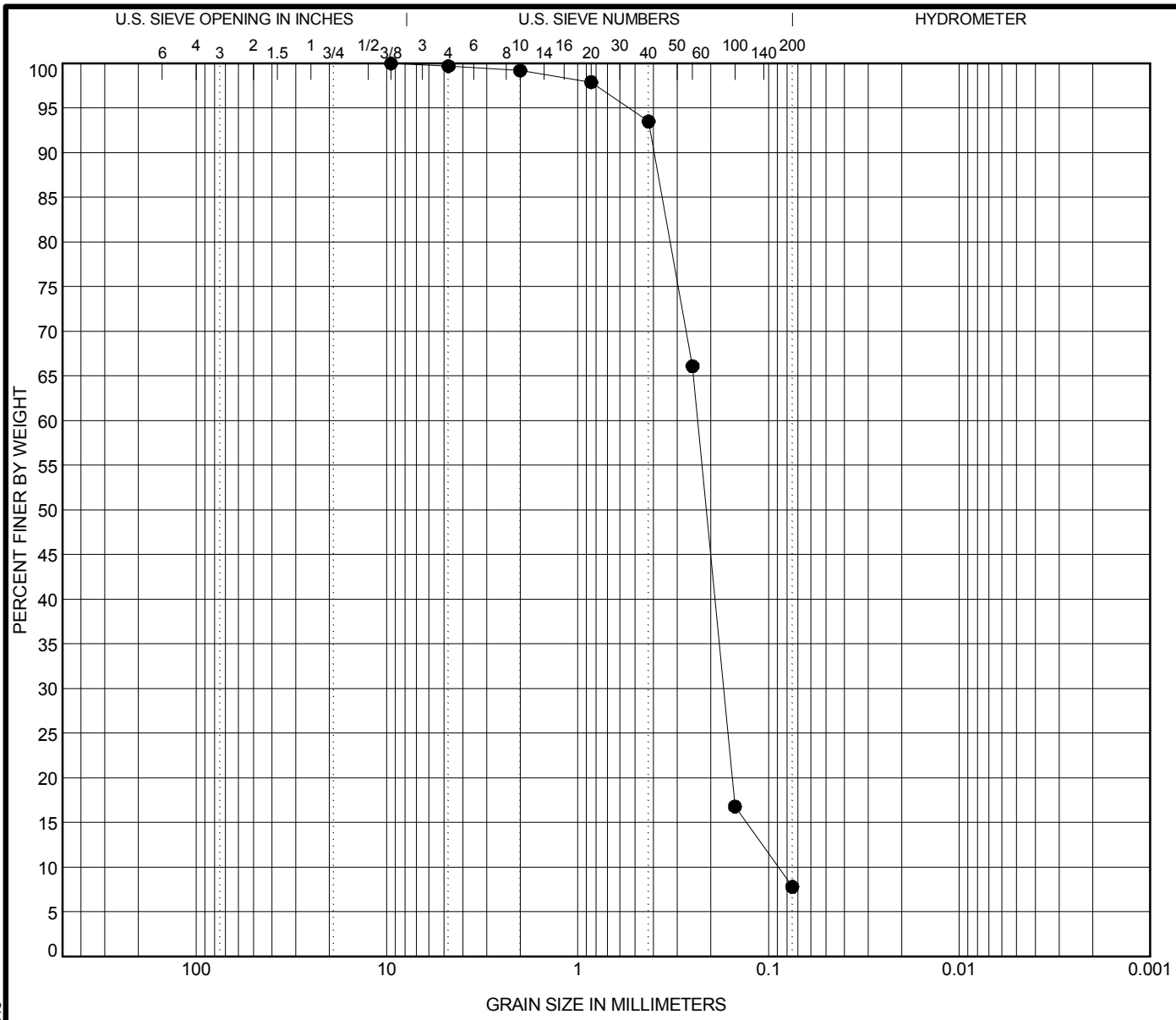
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-50 | 0.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- | **1.42** | **2.64** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.235** | **0.172** | **0.089** | **0.3** | **91.9** | **7.8** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 7.8 | 16.8 | 66.1 | 93.5 | 97.9 | 99.2 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/21/18 | DS |

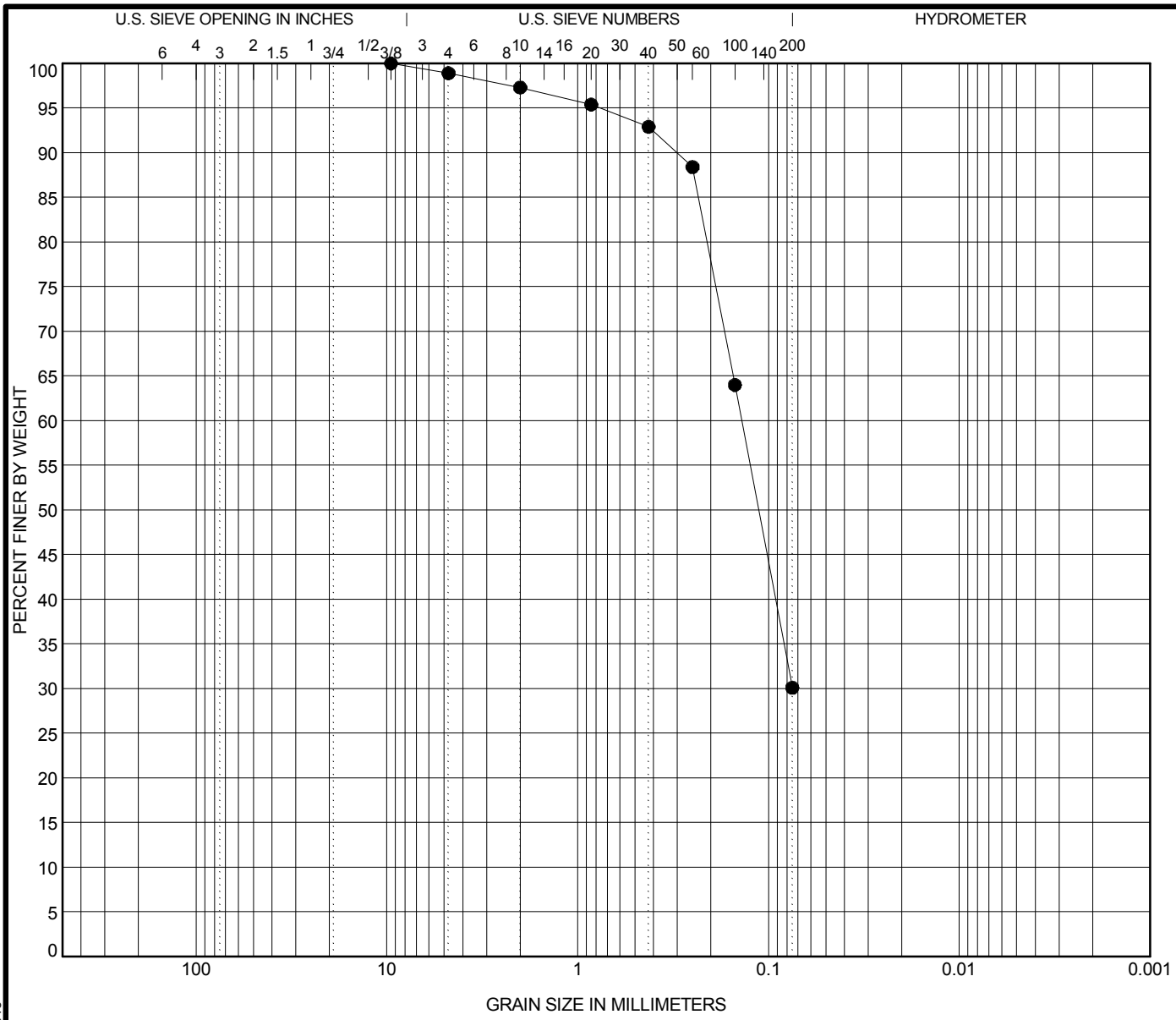
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-50 | 5.0 ft | **SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.138** | **--** | **--** | **1.1** | **68.8** | **30.1** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 30.1 | 64.0 | 88.4 | 92.9 | 95.4 | 97.3 | 98.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/21/18 | DS |

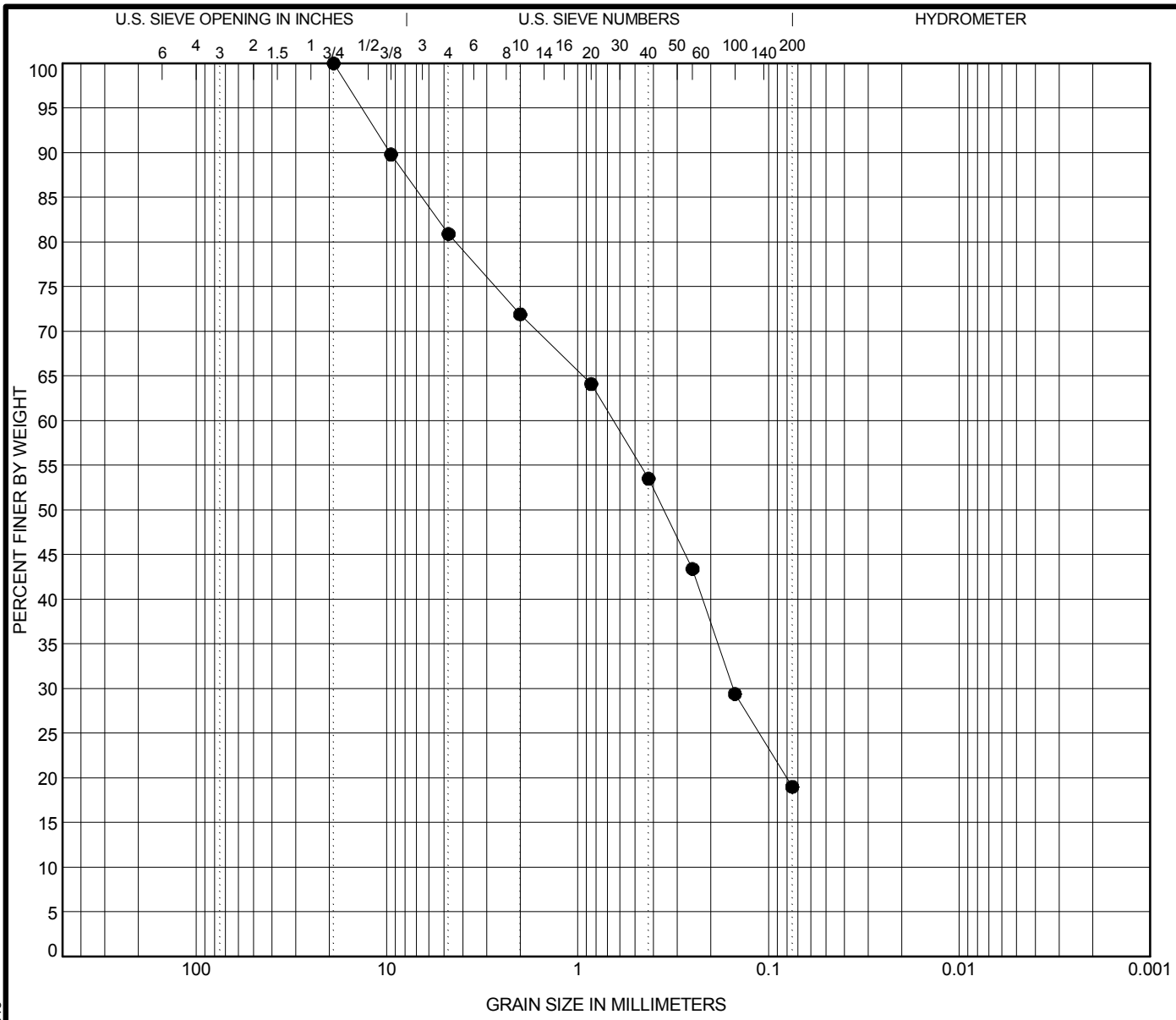
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-50 | 8.9 ft | **SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.65** | **0.153** | **--** | **19.1** | **61.9** | **19.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 19.0 | 29.4 | 43.4 | 53.5 | 64.1 | 71.9 | 80.9 | 89.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/21/18 | DS |

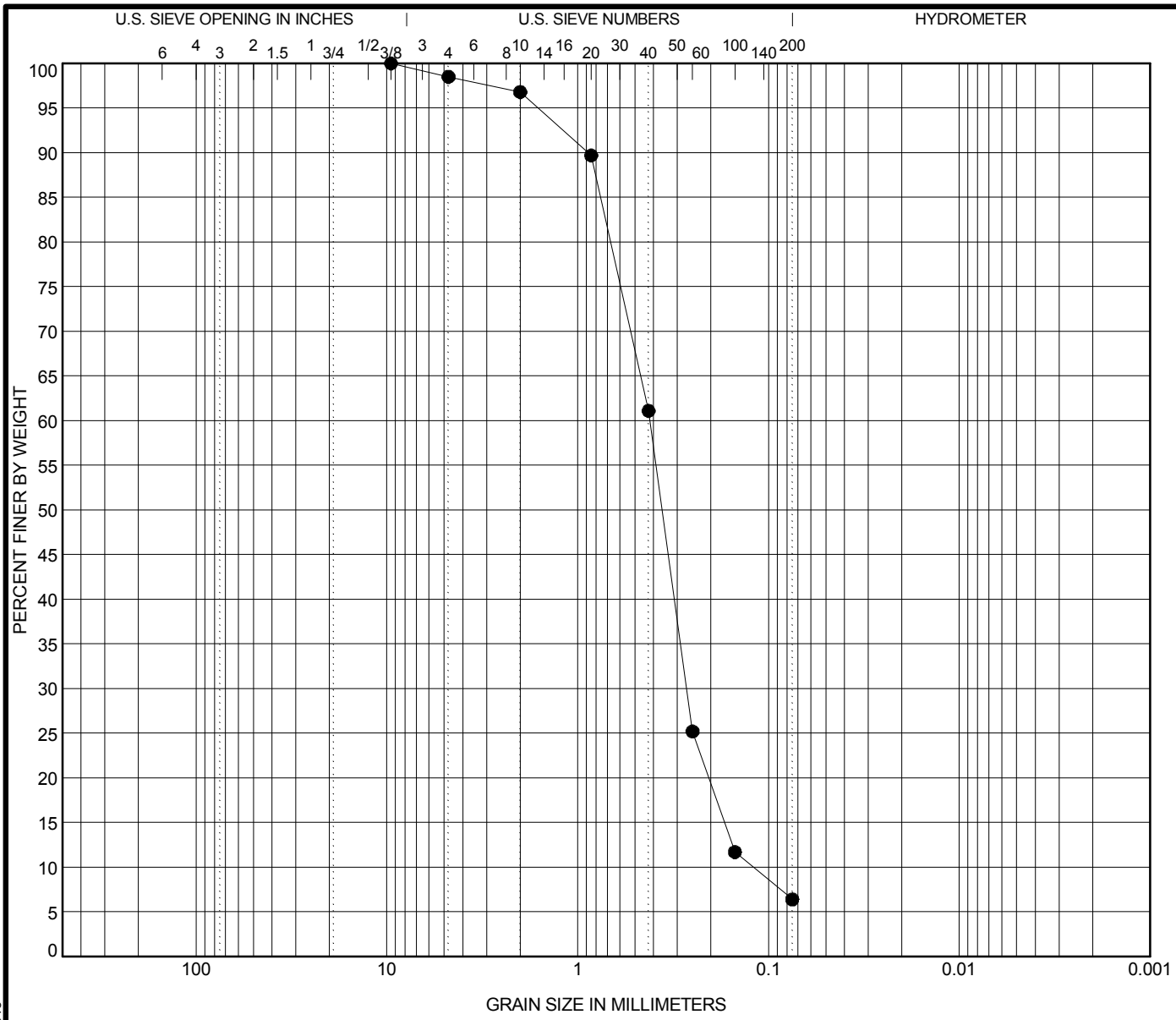
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-50 | 10.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- | **1.43** | **3.48** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.418** | **0.268** | **0.12** | **1.5** | **92.1** | **6.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 6.4 | 11.7 | 25.2 | 61.1 | 89.7 | 96.8 | 98.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/21/18 | DS |

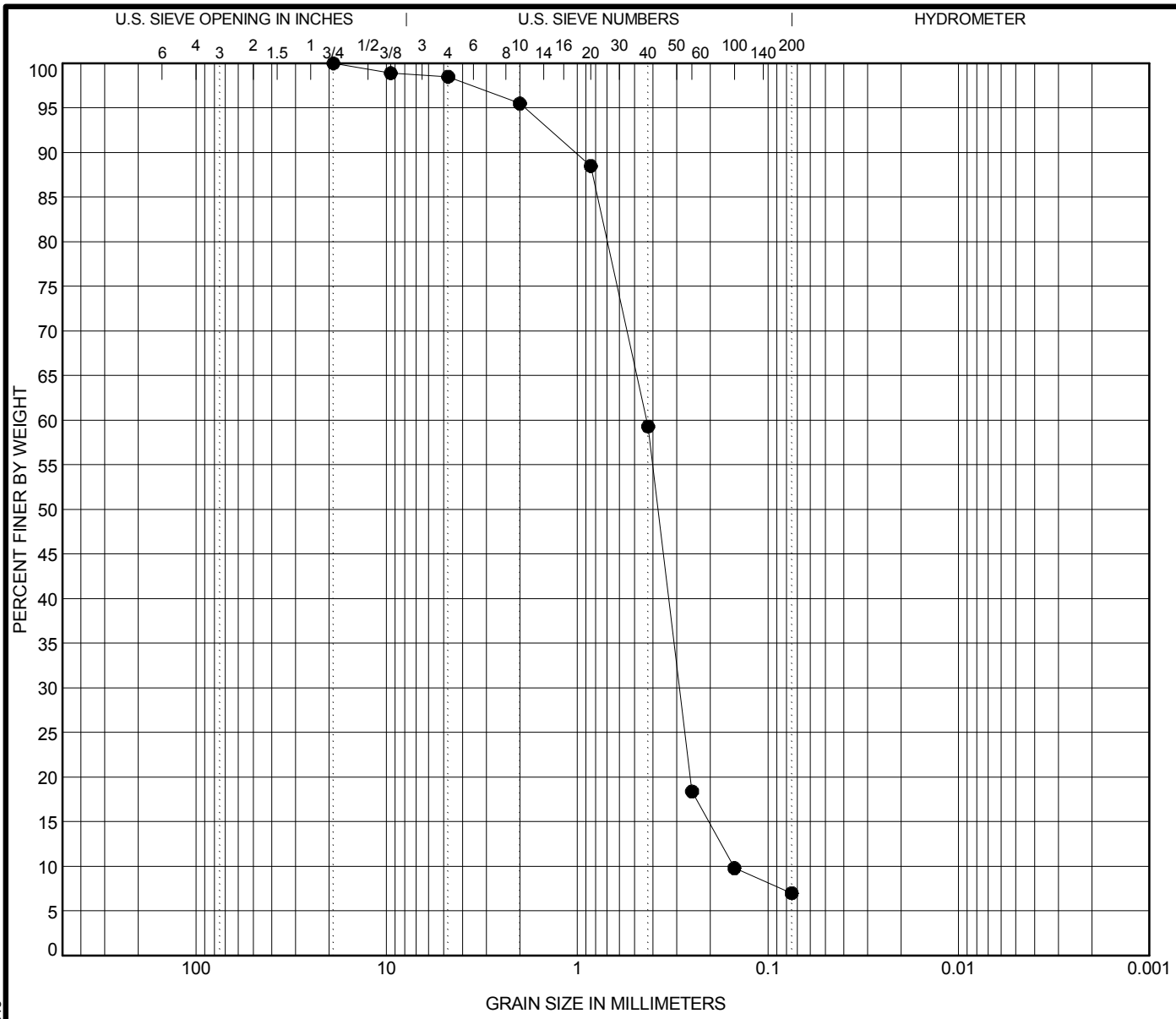
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-50 | 15.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, trace gravel, gray** | -- | -- | -- | **1.29** | **2.85** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.432** | **0.291** | **0.152** | **1.5** | **91.5** | **7.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 7.0 | 9.8 | 18.4 | 59.3 | 88.5 | 95.5 | 98.5 | 98.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| RG / AE | 9/21/18 | DS |

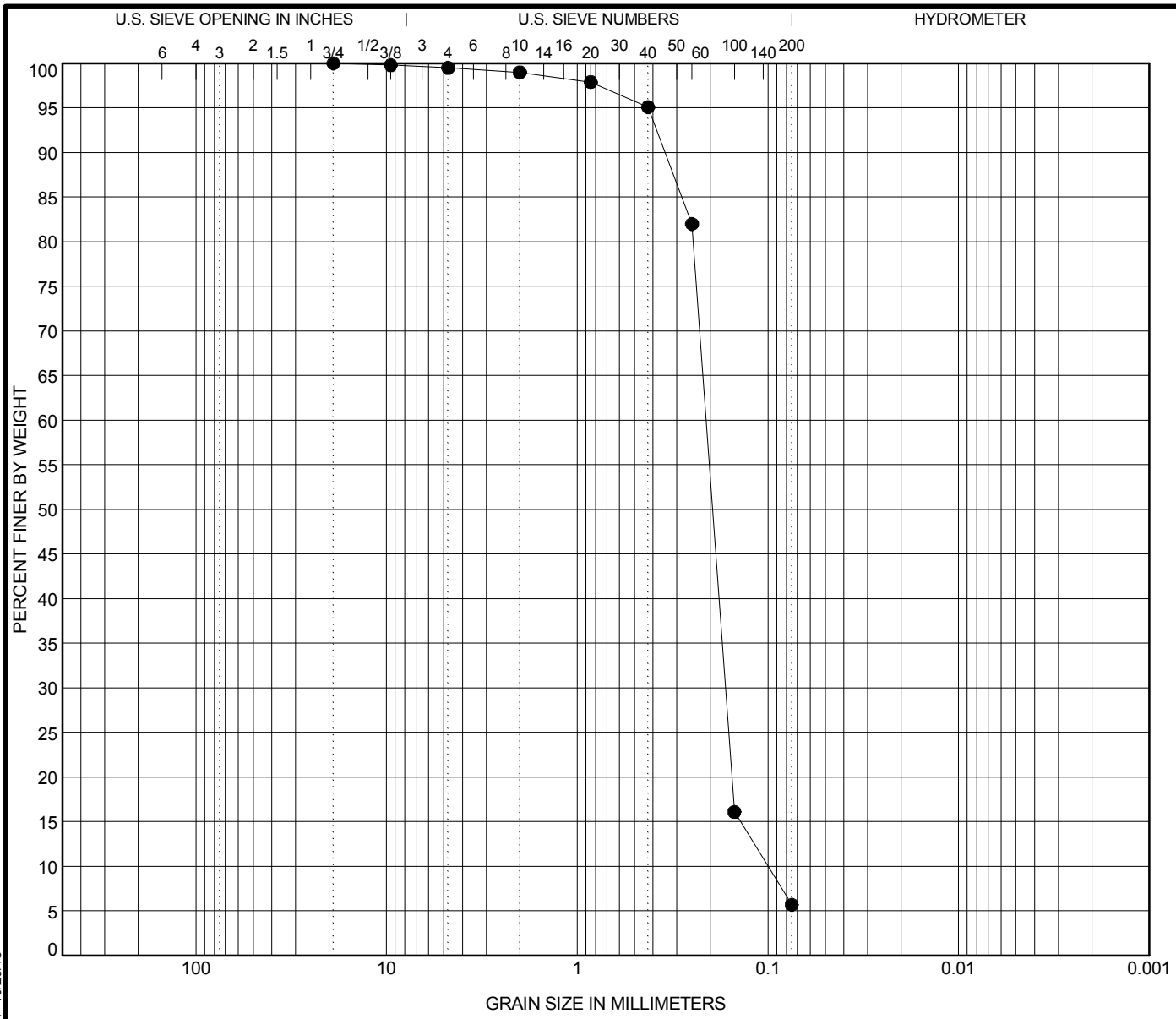
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** VA Beach Renourishment
Virginia Beach, VA

**Contract:** 18C13103.02

SIEVE 1/SHEET 18C13103.02 LAB DATA.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/1/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-60 | 0.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- | **1.33** | **2.11** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.211** | **0.167** | **0.1** | **0.5** | **93.8** | **5.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 5.7 | 16.1 | 82.0 | 95.1 | 97.9 | 99.0 | 99.5 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB | 10/19/18 | DS |

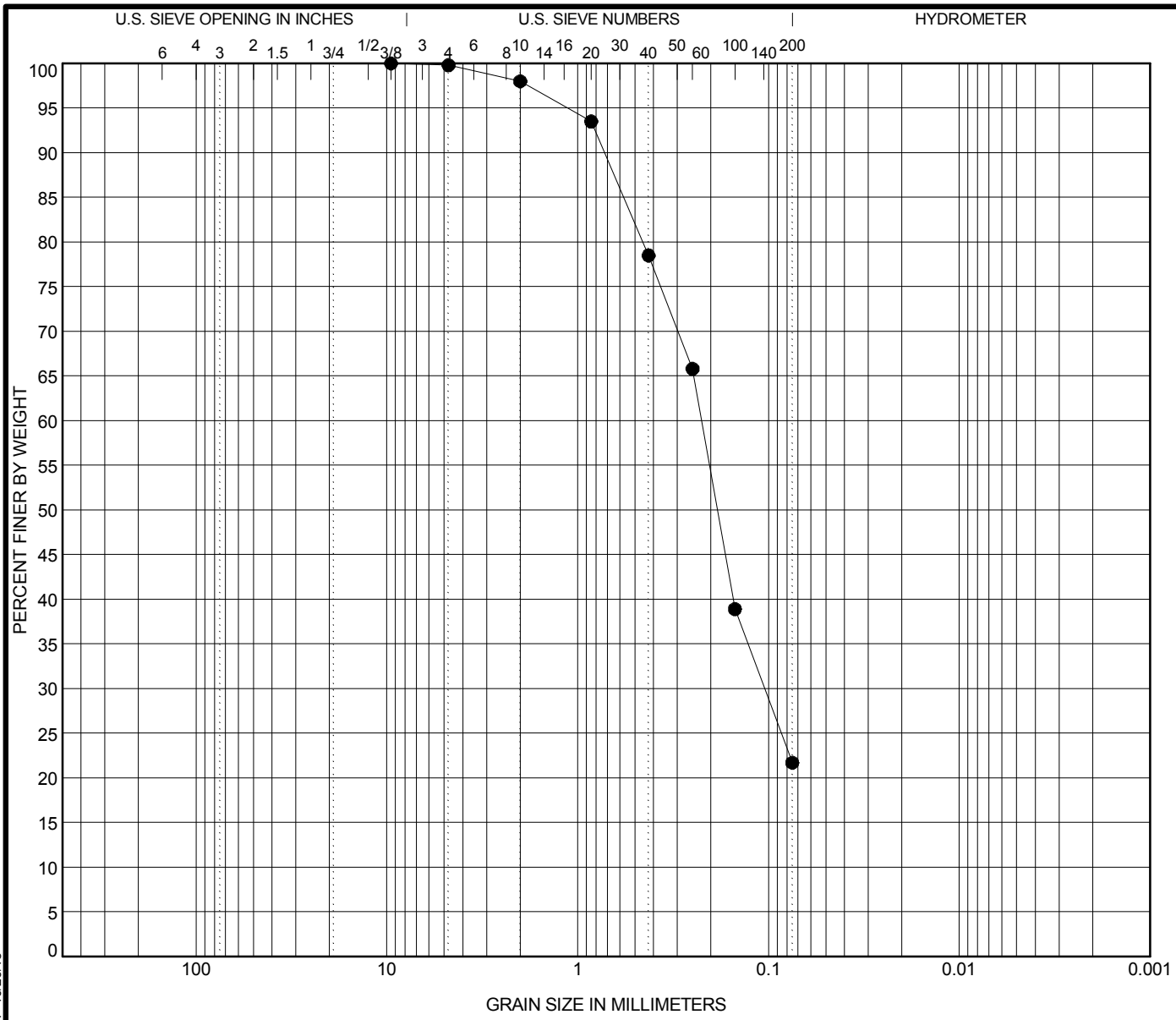
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-60 | 4.6 ft | **SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.224** | **0.105** | **--** | **0.2** | **78.1** | **21.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 21.7 | 38.9 | 65.8 | 78.5 | 93.5 | 98.0 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB | 10/19/18 | DS |

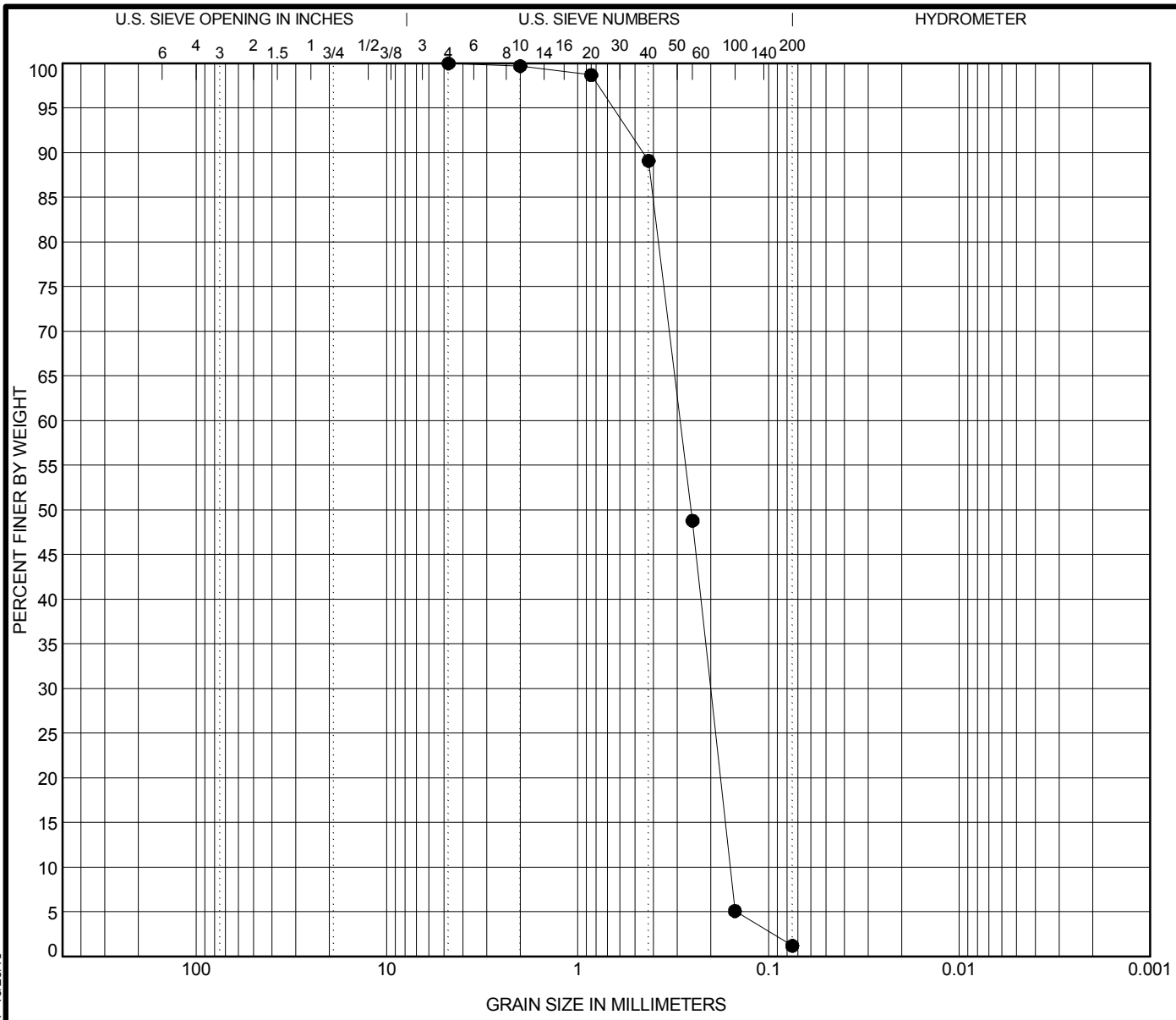
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-60.5 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | **0.88** | **1.82** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.29** | **0.201** | **0.159** | **0.0** | **98.8** | **1.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 1.2 | 5.1 | 48.8 | 89.1 | 98.7 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB | 10/19/18 | DS |

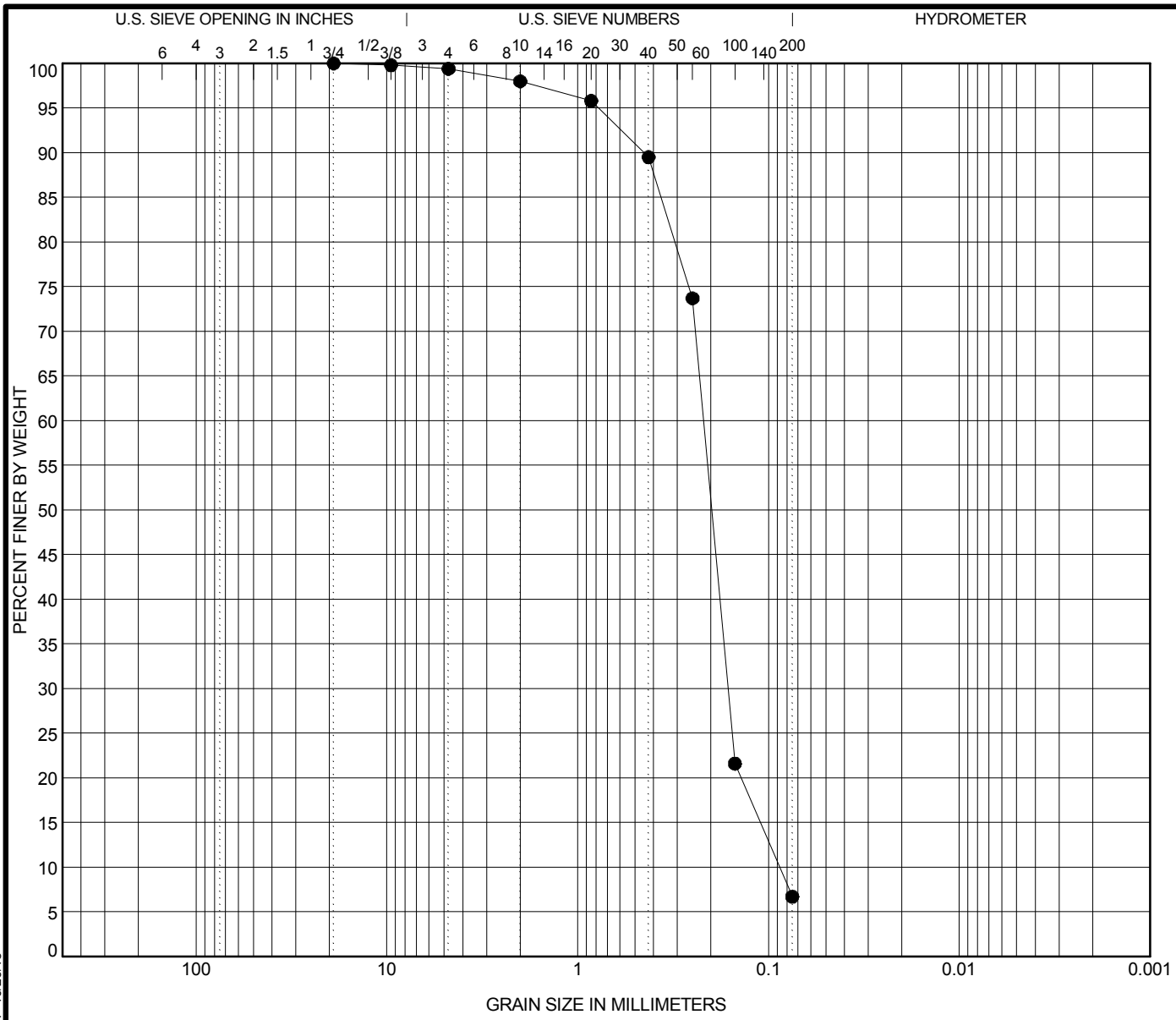
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-60.5 | 4.6 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- | **1.39** | **2.50** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.219** | **0.163** | **0.087** | **0.6** | **92.7** | **6.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 6.7 | 21.6 | 73.7 | 89.5 | 95.8 | 98.0 | 99.4 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB | 10/19/18 | DS |

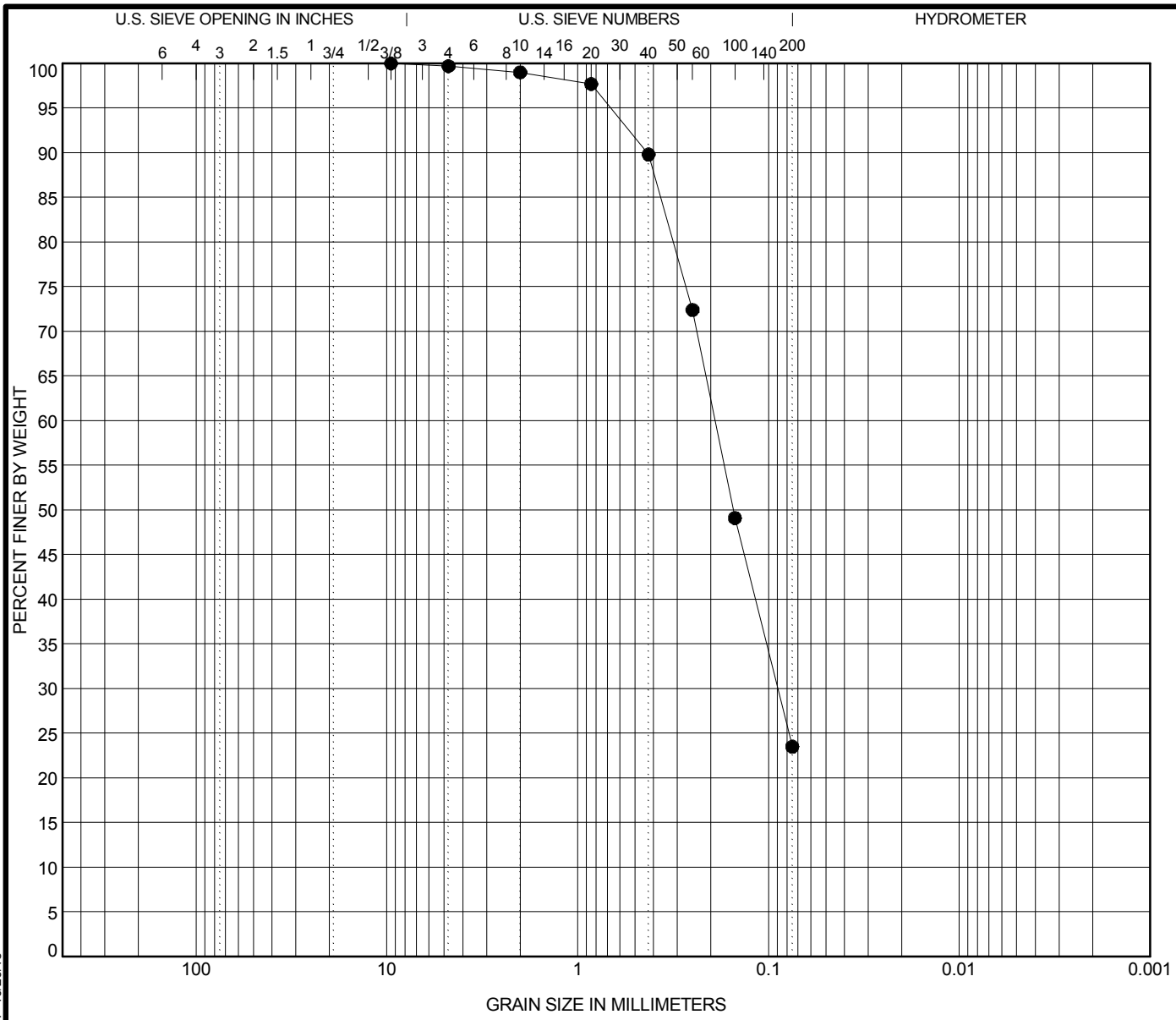
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-60.5 | 9.6 ft | **SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.19** | **0.089** | **--** | **0.3** | **76.2** | **23.5** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 23.5 | 49.1 | 72.4 | 89.8 | 97.7 | 99.0 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB | 10/23/18 | DS |

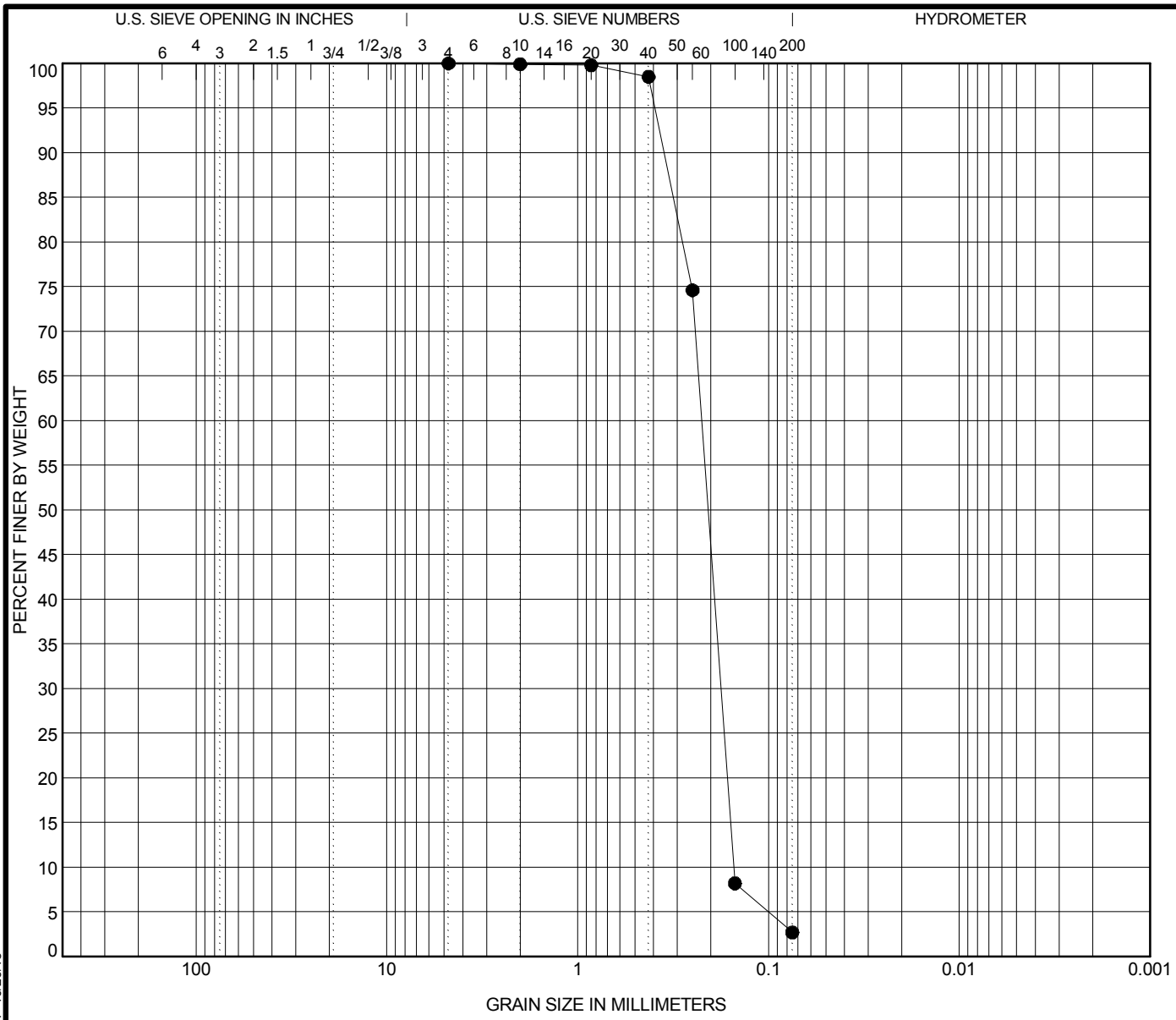
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-61 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | **0.93** | **1.47** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.223** | **0.177** | **0.152** | **0.0** | **97.3** | **2.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 2.7 | 8.2 | 74.6 | 98.5 | 99.8 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

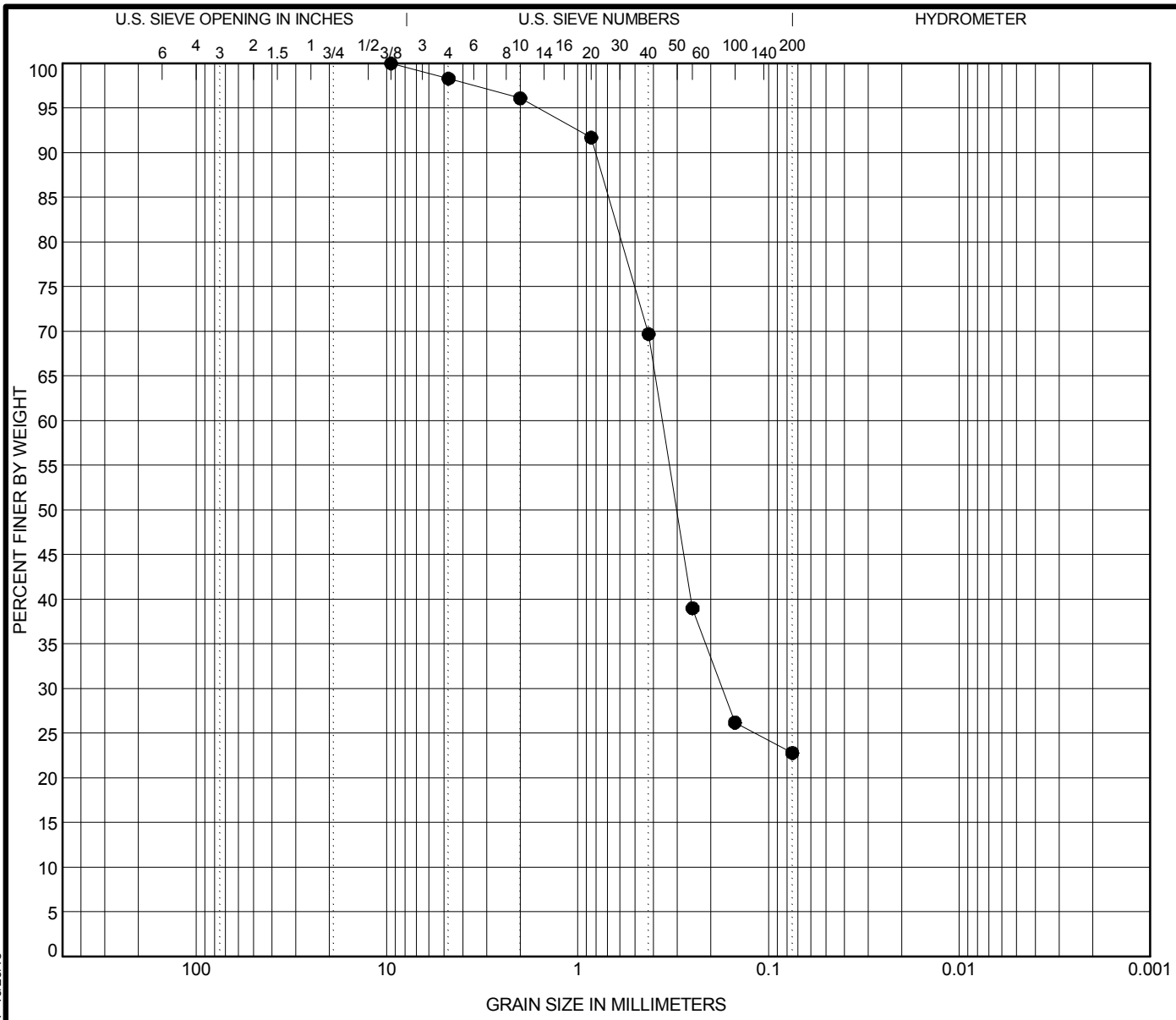
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-61 | 4.5 ft | **CLAYEY SAND (SC), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.359** | **0.175** | **--** | **1.7** | **75.5** | **22.8** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 22.8 | 26.2 | 39.0 | 69.7 | 91.7 | 96.1 | 98.3 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

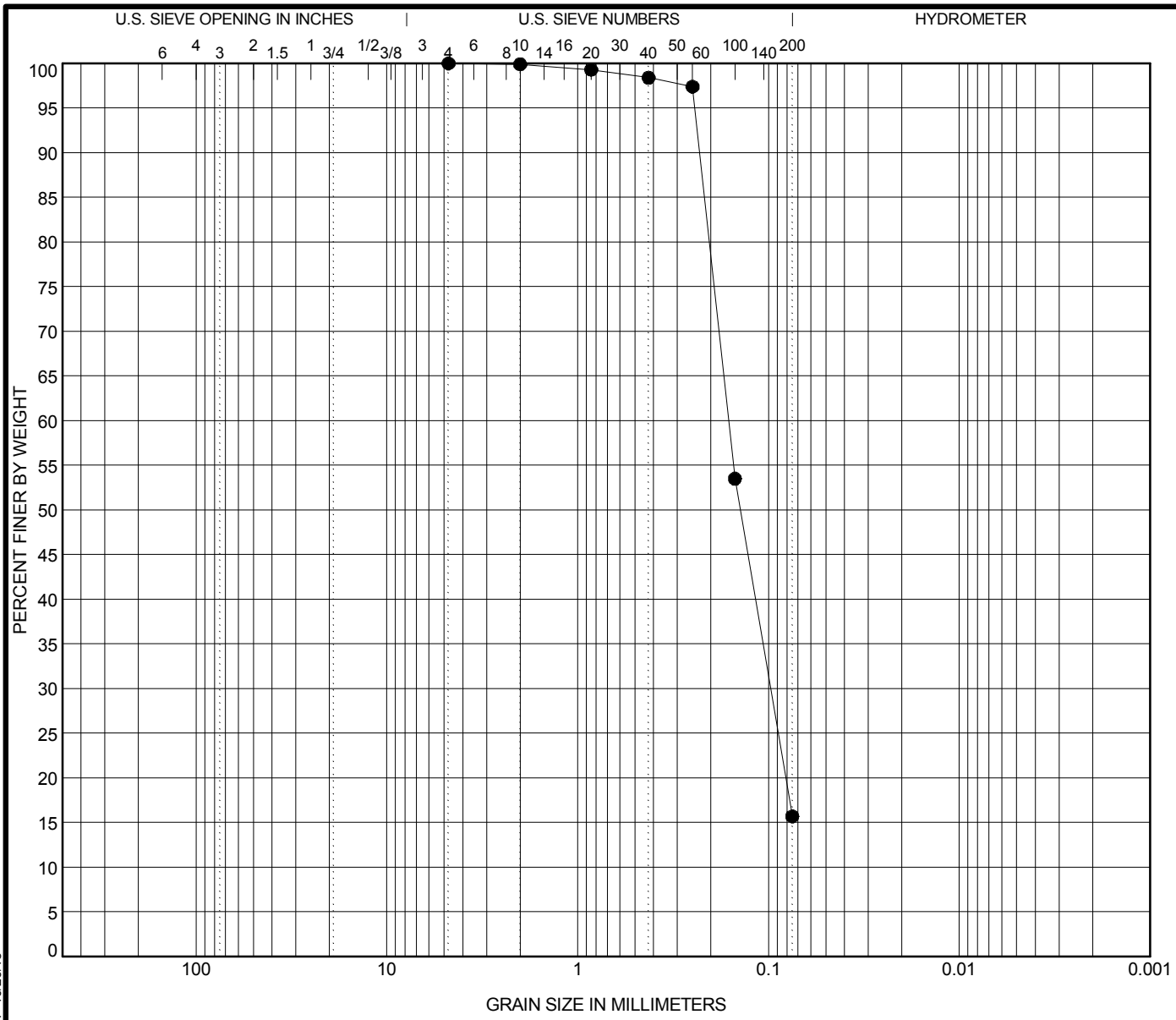
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-61 | 15.4 ft | **CLAYEY SAND (SC), fine to coarse grained sand, gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.162** | **0.097** | **--** | **0.0** | **84.3** | **15.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 15.7 | 53.5 | 97.4 | 98.4 | 99.3 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

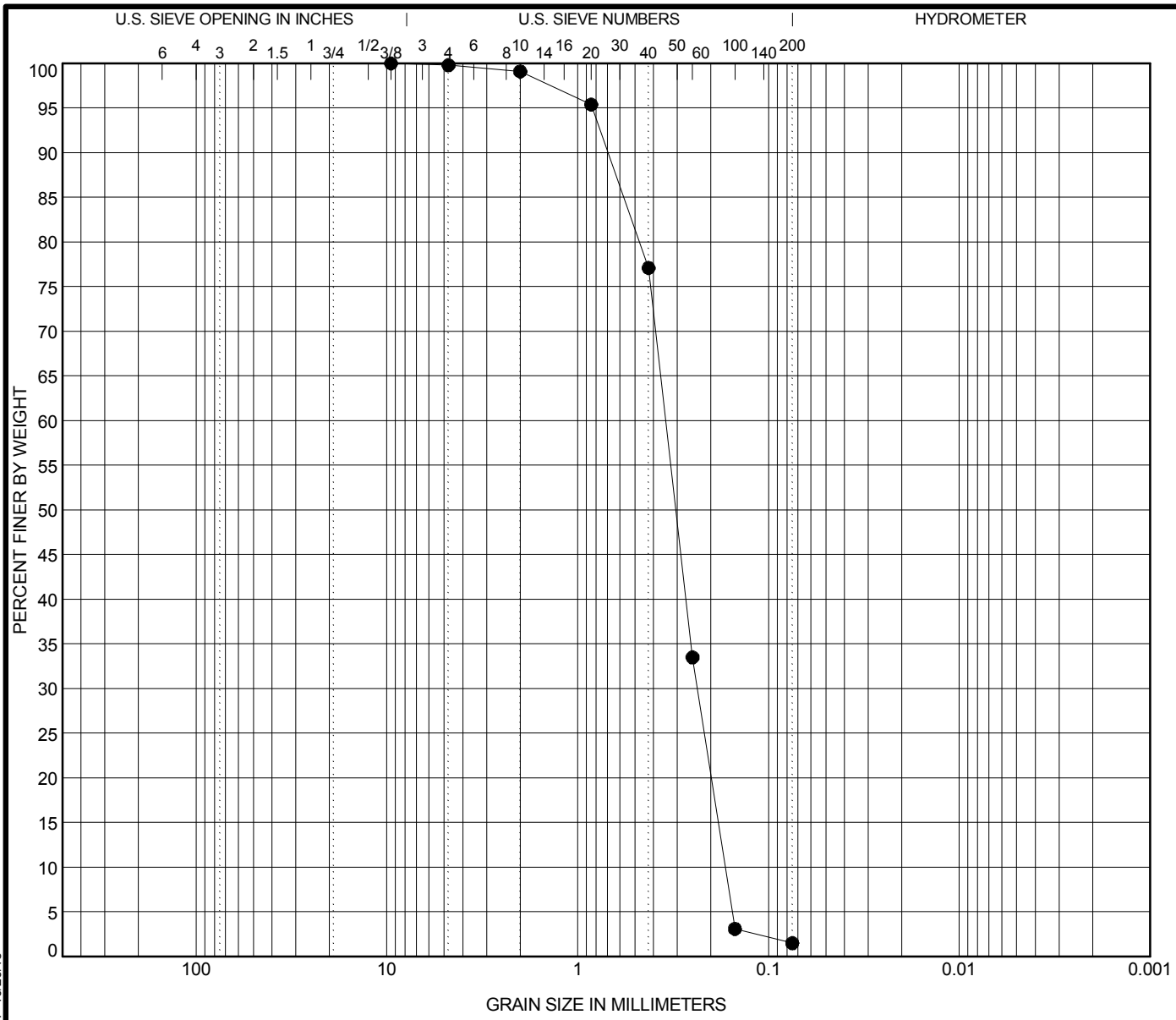
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-62 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, brown** | -- | -- | -- | **0.96** | **2.05** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.345** | **0.236** | **0.168** | **0.2** | **98.3** | **1.5** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 1.5 | 3.1 | 33.5 | 77.1 | 95.4 | 99.1 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

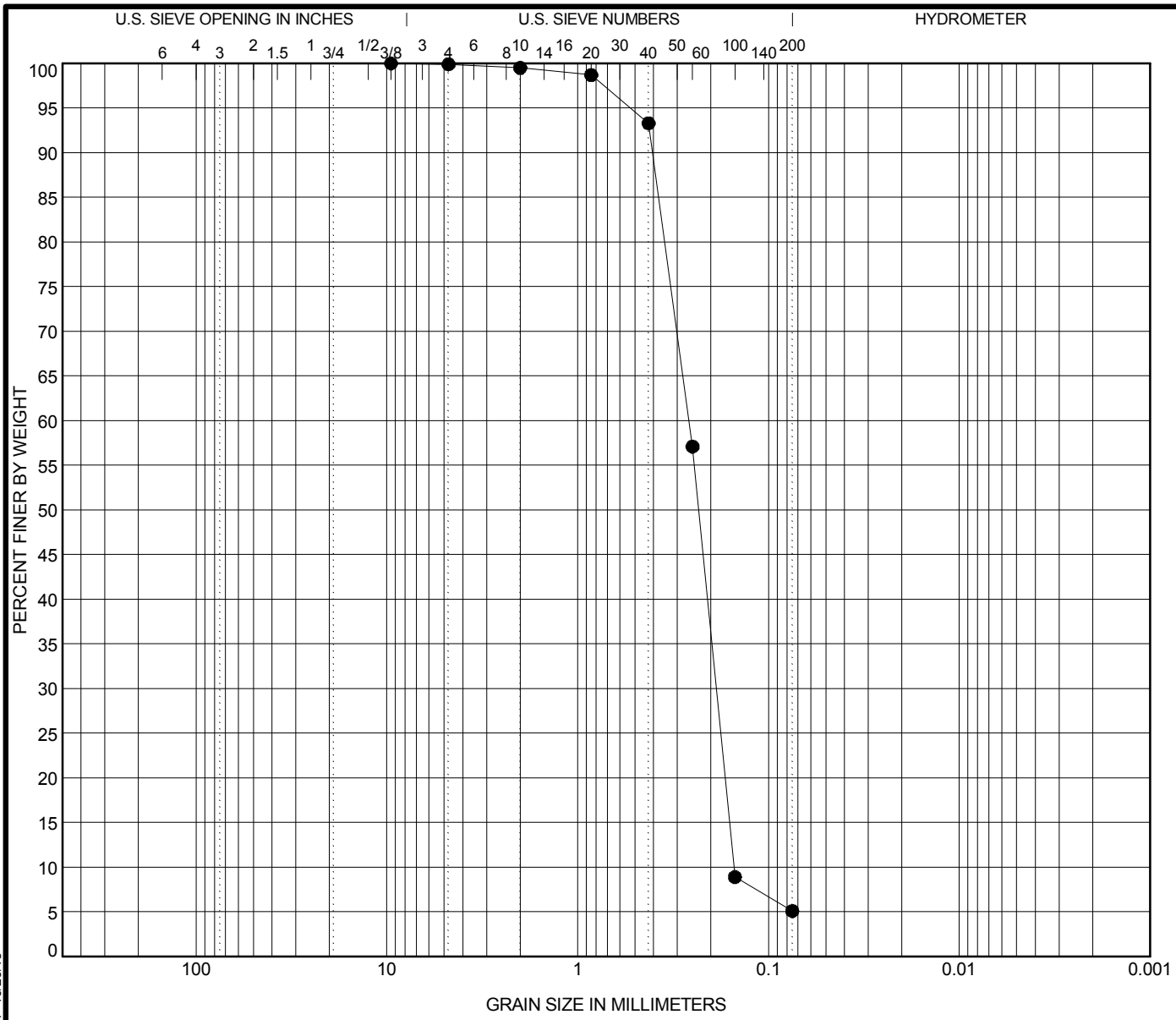
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-62 | 4.6 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | **0.89** | **1.72** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.261** | **0.188** | **0.152** | **0.1** | **94.8** | **5.1** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 5.1 | 8.9 | 57.1 | 93.3 | 98.7 | 99.5 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

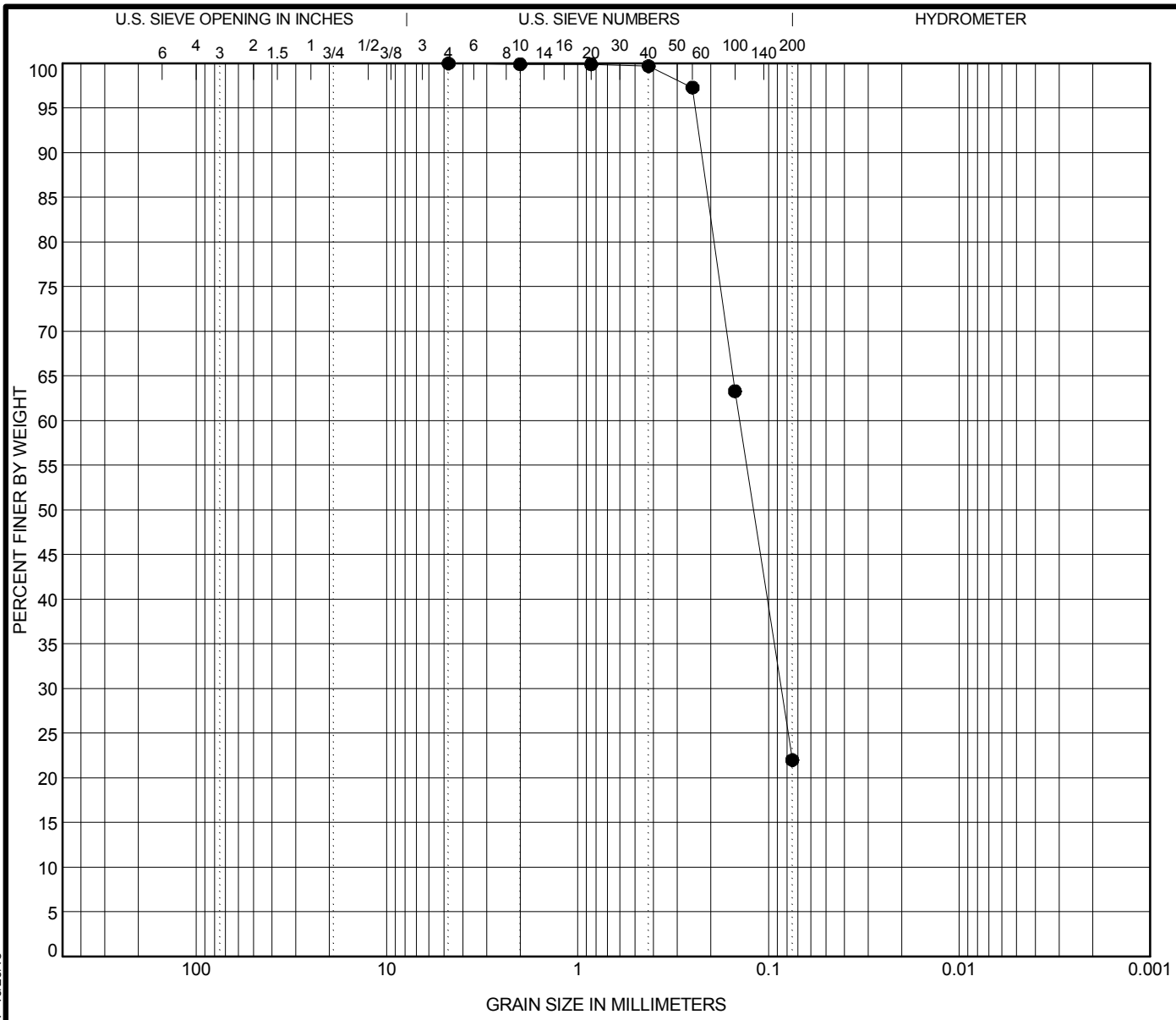
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-62 | 9.6 ft | **SILTY SAND (SM), fine to coarse grained sand, contains mica, dark gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.142** | **0.086** | **--** | **0.0** | **78.0** | **22.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 22.0 | 63.3 | 97.3 | 99.7 | 99.9 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

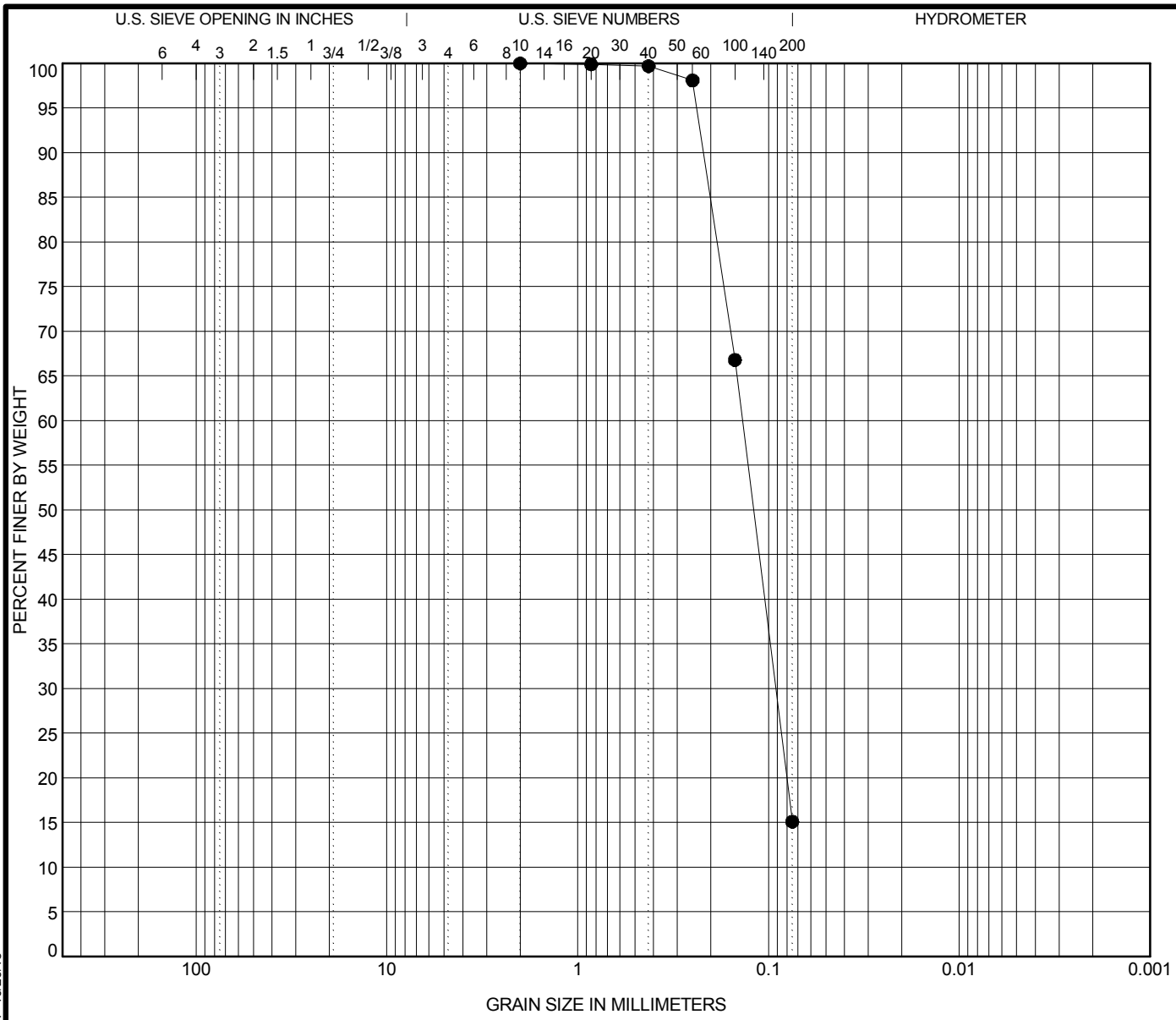
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-62 | 14.6 ft | **SILTY SAND (SM), fine to medium grained sand, dark gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **2** | **0.137** | **0.092** | **--** | **0.0** | **84.9** | **15.1** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 |
|---|---|---|---|---|---|---|
| % Finer | 15.1 | 66.8 | 98.1 | 99.7 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

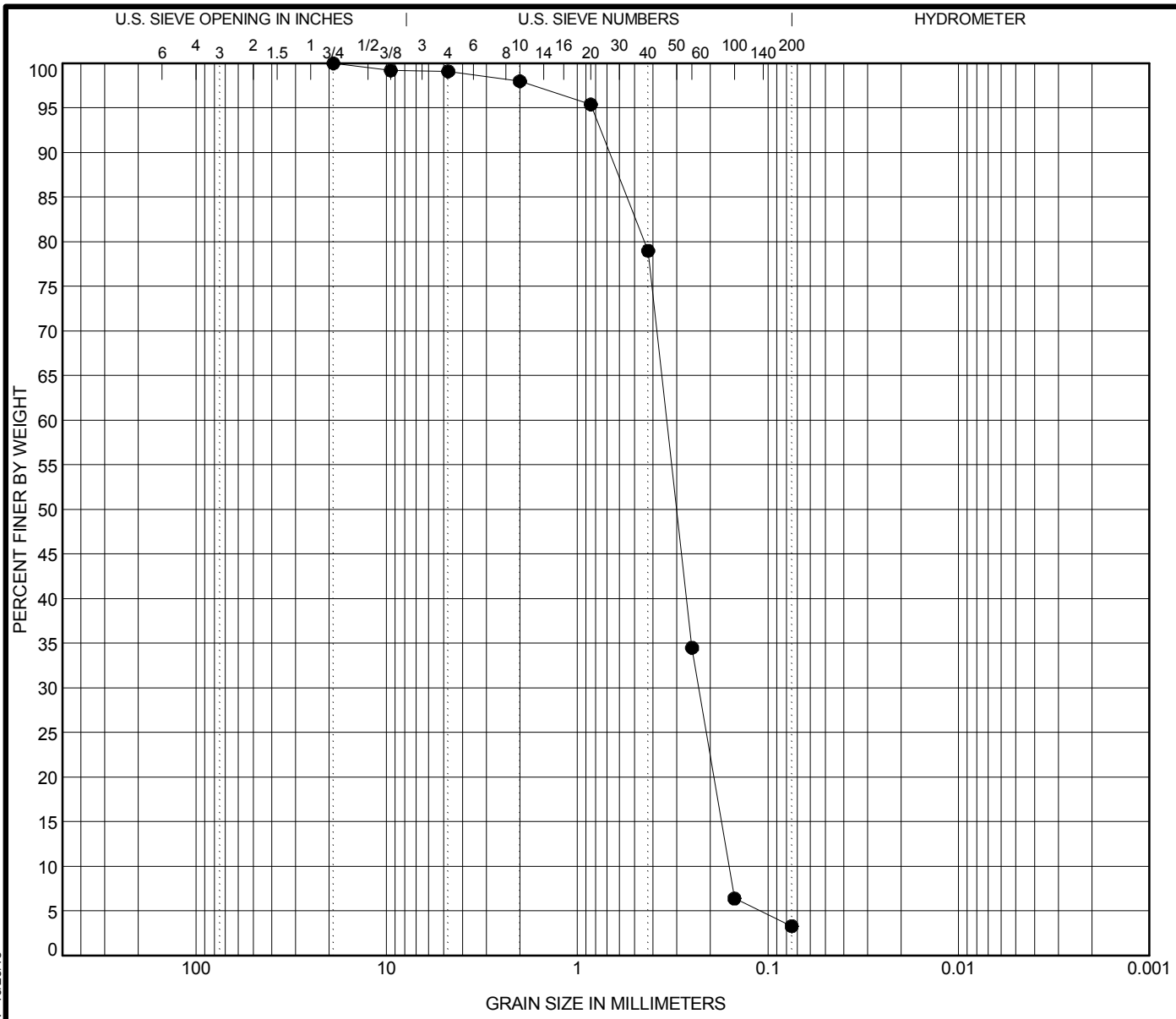
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-63 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | **0.98** | **2.12** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.339** | **0.23** | **0.16** | **0.9** | **95.8** | **3.3** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 3.3 | 6.4 | 34.5 | 79.0 | 95.4 | 98.0 | 99.1 | 99.2 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

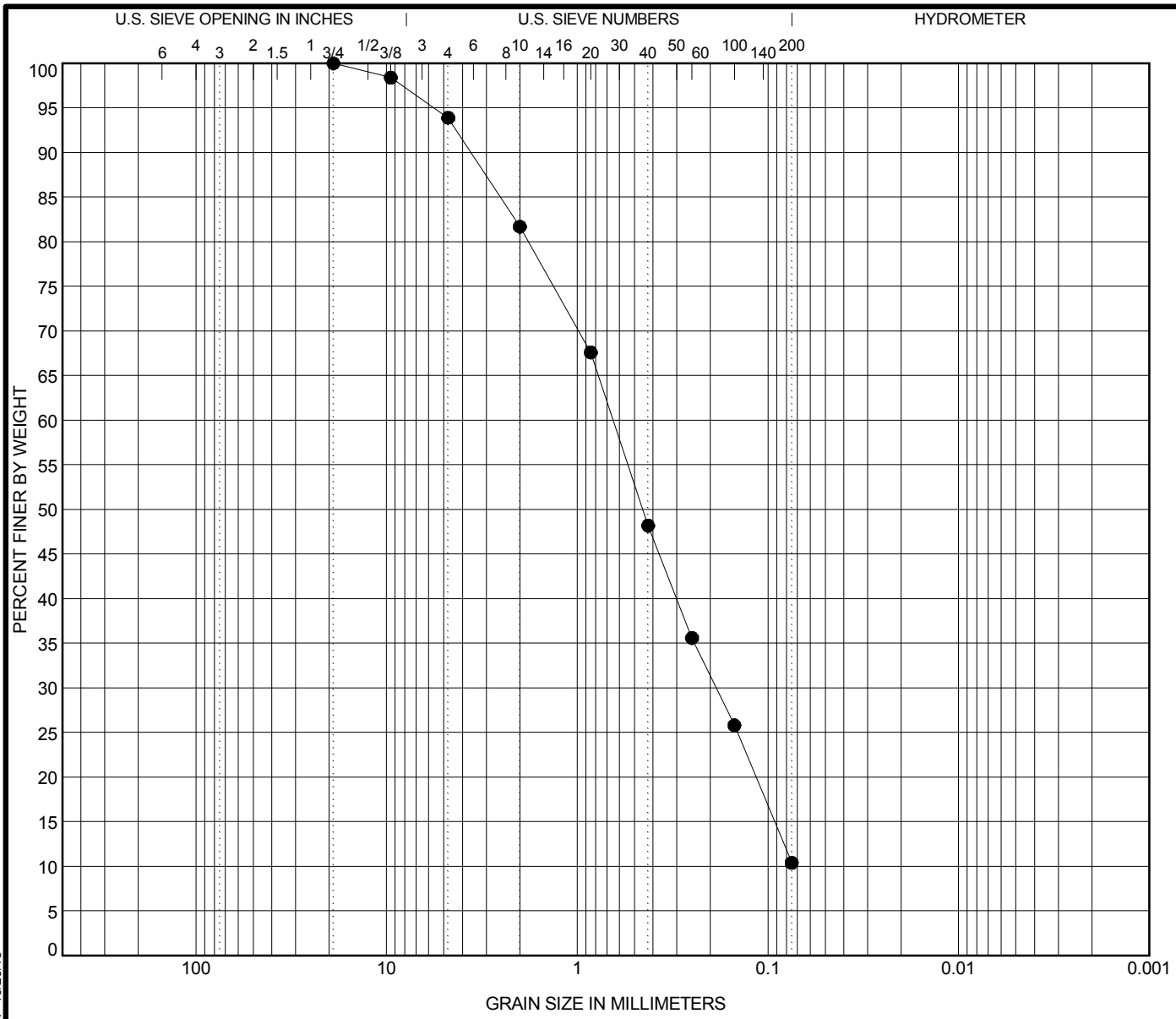
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-63 | 9.5 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- | **0.73** | **8.80** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.648** | **0.187** | **--** | **6.1** | **83.5** | **10.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 | 3/4 |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 10.4 | 25.8 | 35.6 | 48.2 | 67.6 | 81.7 | 93.9 | 98.4 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

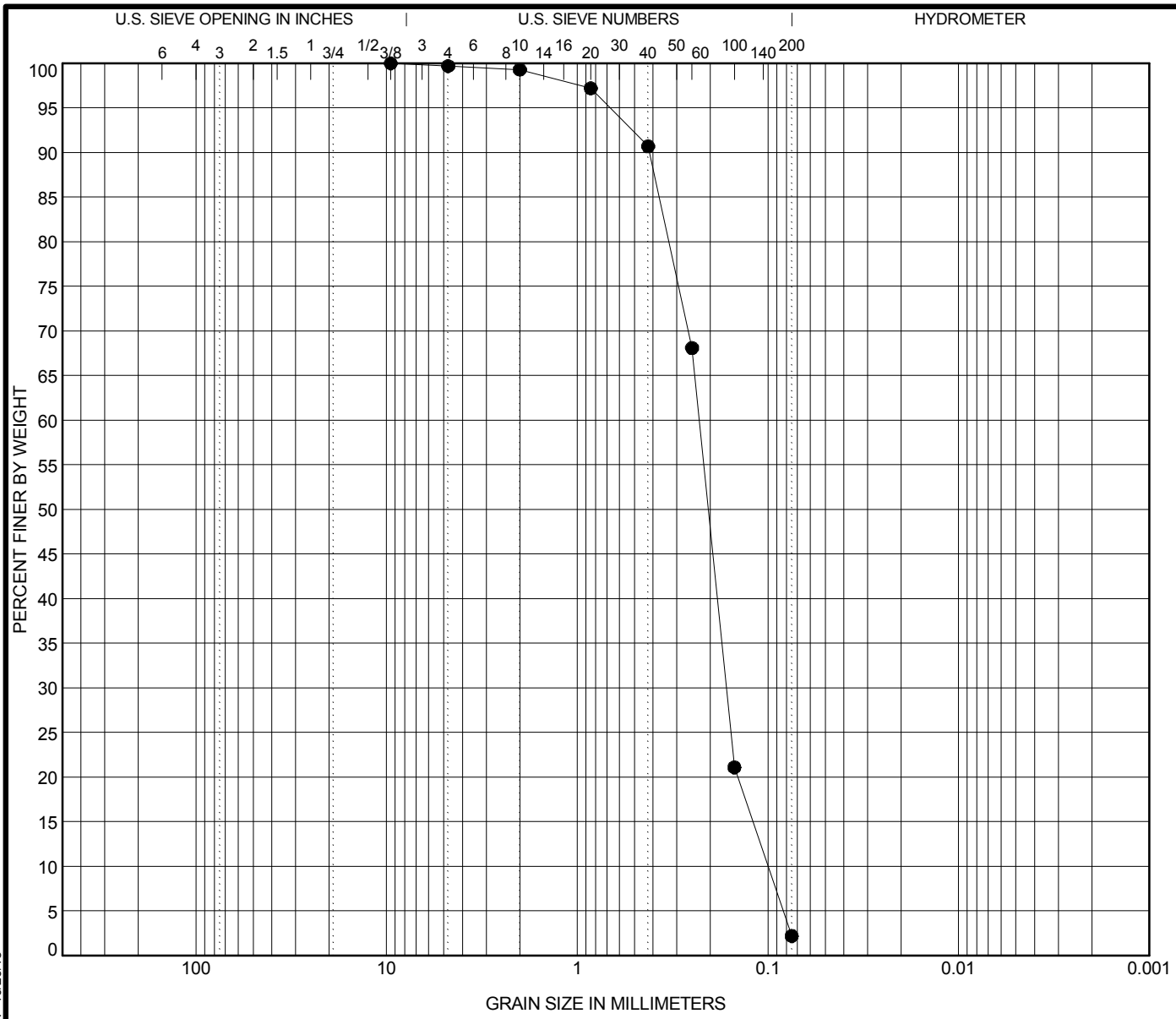
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-63 | 14.5 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | **1.19** | **2.29** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.229** | **0.165** | **0.1** | **0.3** | **97.5** | **2.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 2.2 | 21.1 | 68.1 | 90.7 | 97.2 | 99.3 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

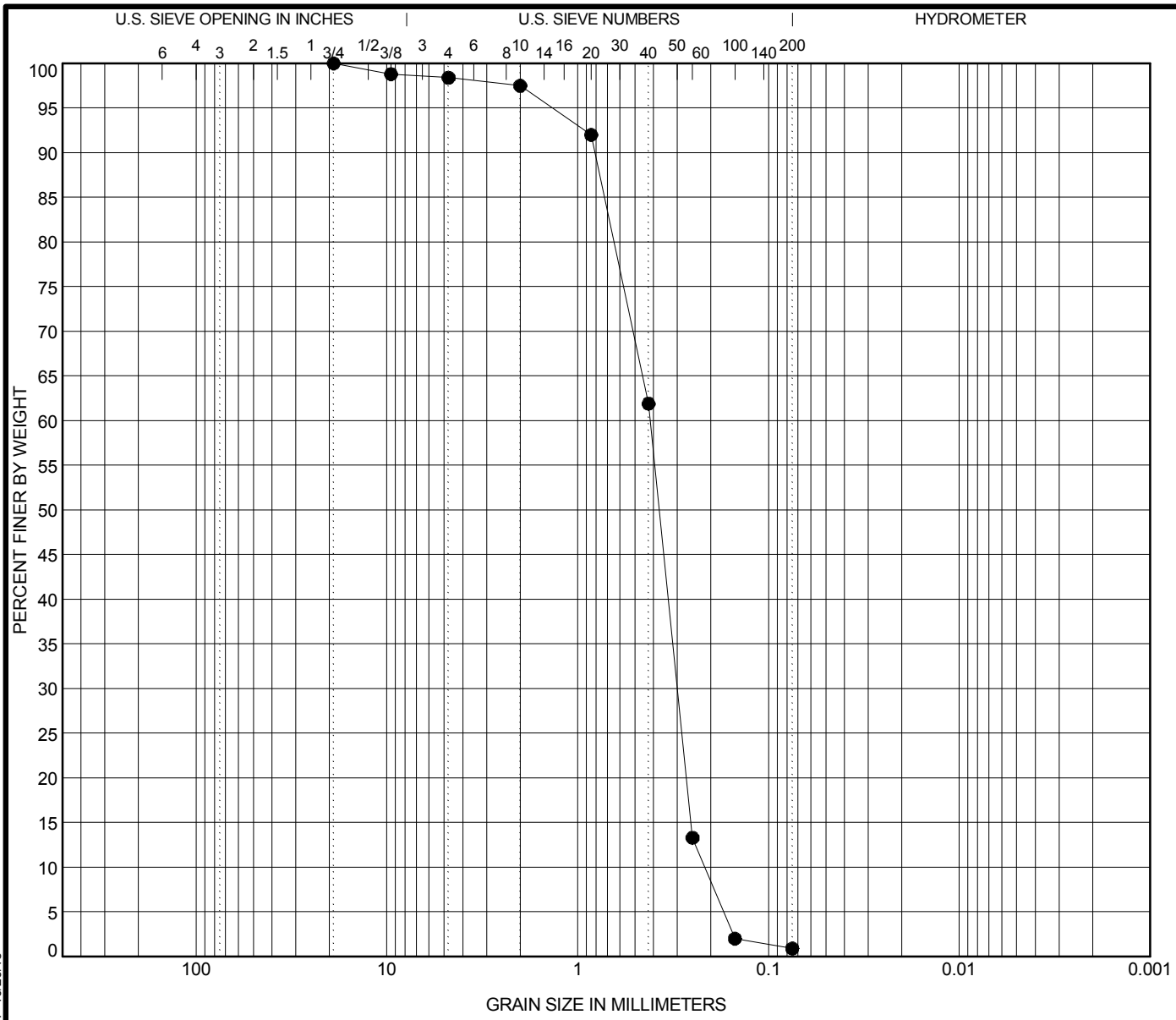
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-64 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, light brown** | -- | -- | -- | **1.00** | **1.93** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.416** | **0.3** | **0.215** | **1.6** | **97.5** | **0.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 0.9 | 2.0 | 13.3 | 61.9 | 92.0 | 97.5 | 98.4 | 98.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB | 10/19/18 | DS |

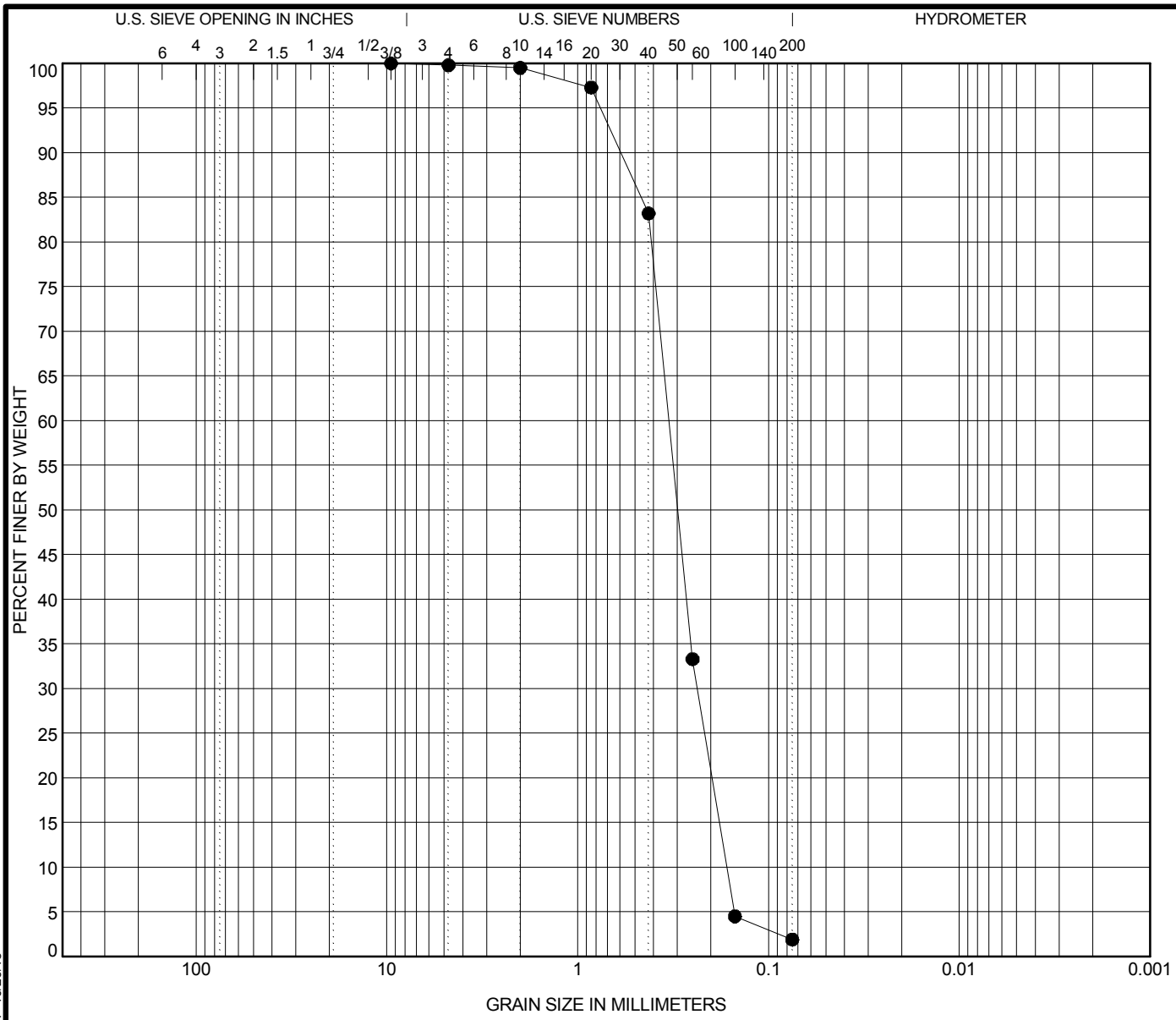
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-64 | 3.2 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- | **1.01** | **2.01** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.332** | **0.236** | **0.165** | **0.2** | **97.9** | **1.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 1.9 | 4.5 | 33.3 | 83.2 | 97.3 | 99.5 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB | 10/23/18 | DS |

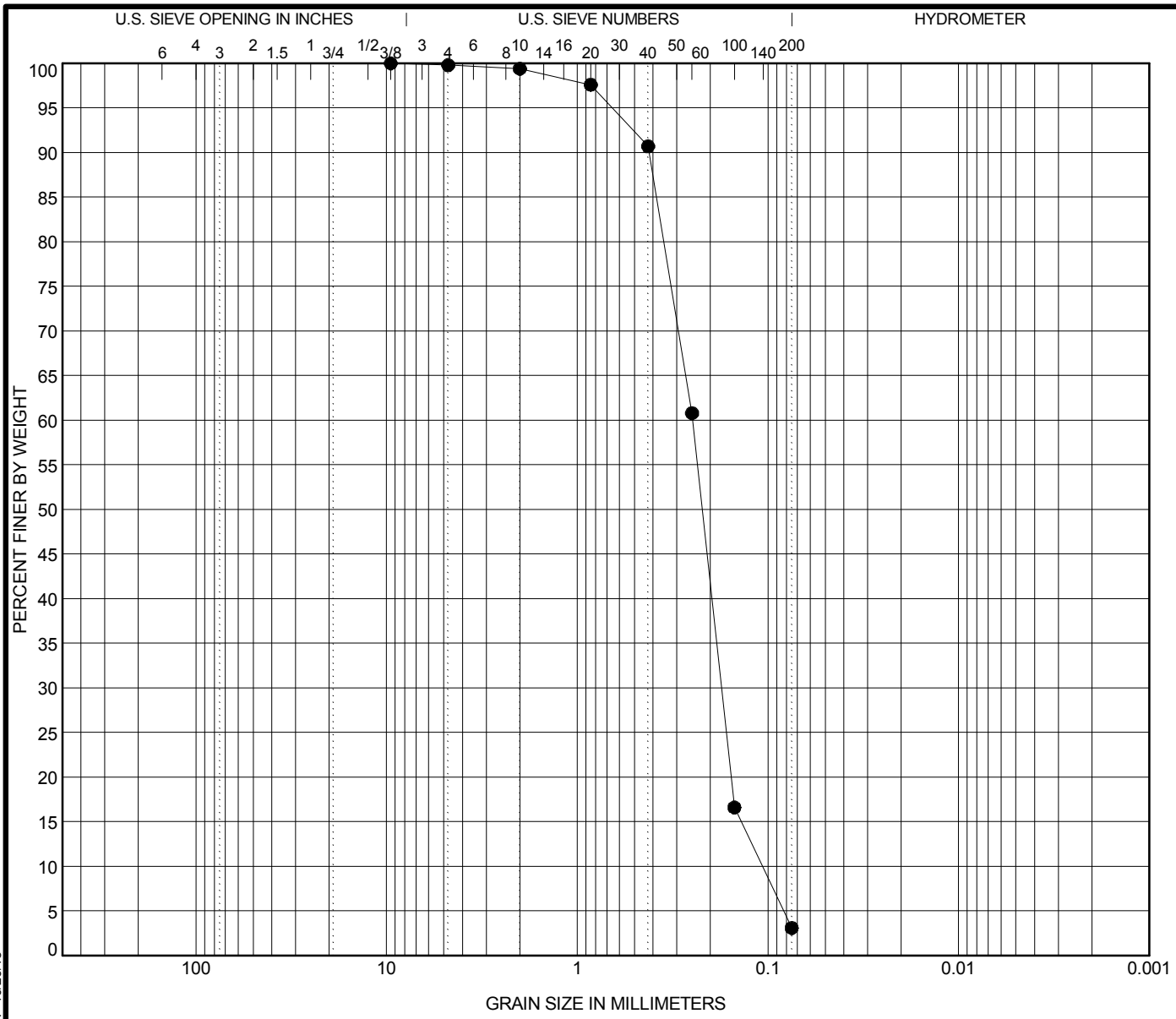
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-64 | 10.1 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, light gray** | -- | -- | -- | **1.16** | **2.32** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.248** | **0.175** | **0.107** | **0.2** | **96.7** | **3.1** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 3.1 | 16.6 | 60.8 | 90.7 | 97.6 | 99.4 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB | 10/23/18 | DS |

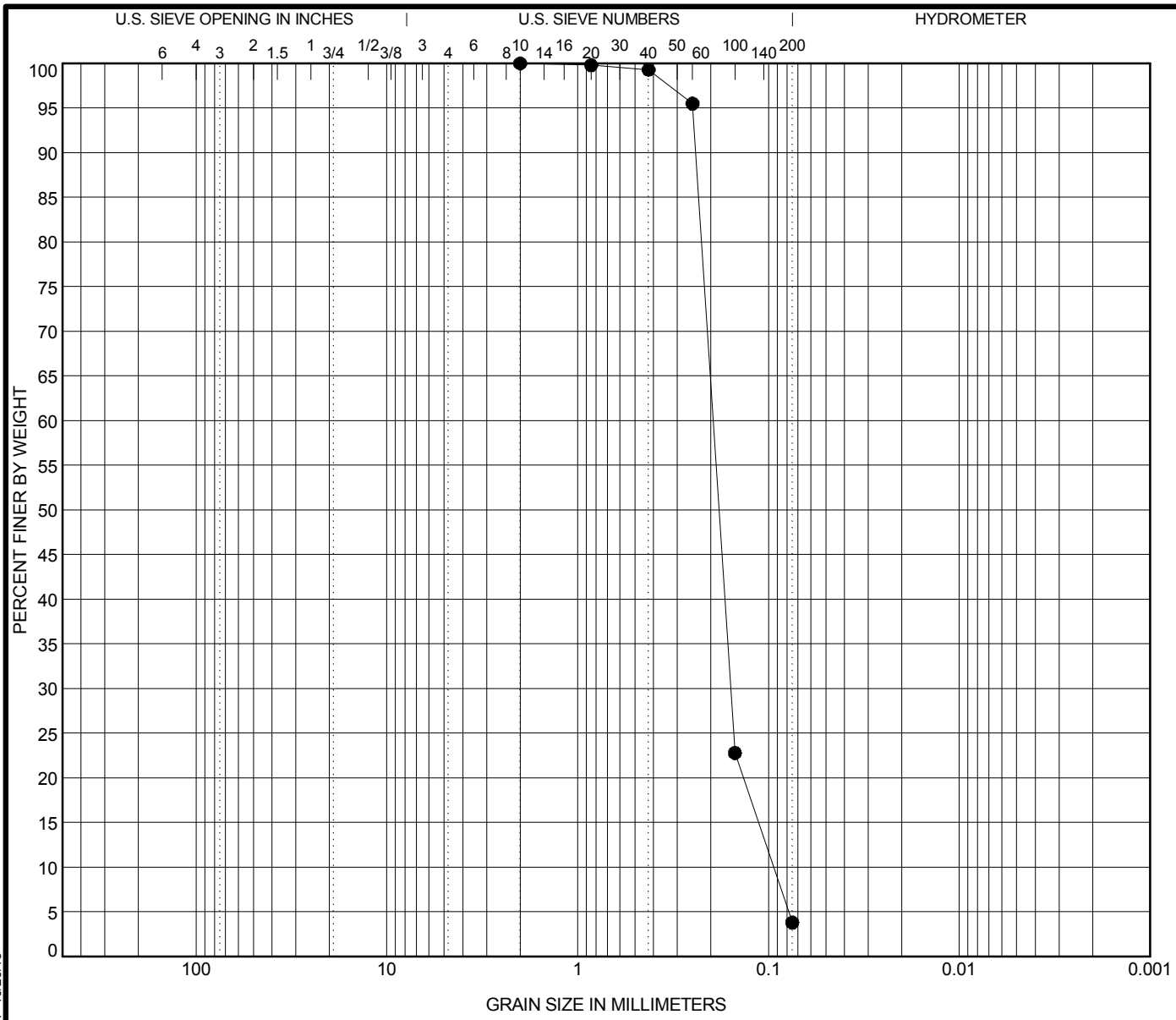
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-64 | 13.2 ft | **POORLY GRADED SAND (SP), fine to medium grained sand, gray** | -- | -- | -- | **1.36** | **2.07** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **2** | **0.195** | **0.158** | **0.094** | **0.0** | **96.2** | **3.8** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 |
|---|---|---|---|---|---|---|
| % Finer | 3.8 | 22.8 | 95.5 | 99.3 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB | 10/19/18 | DS |

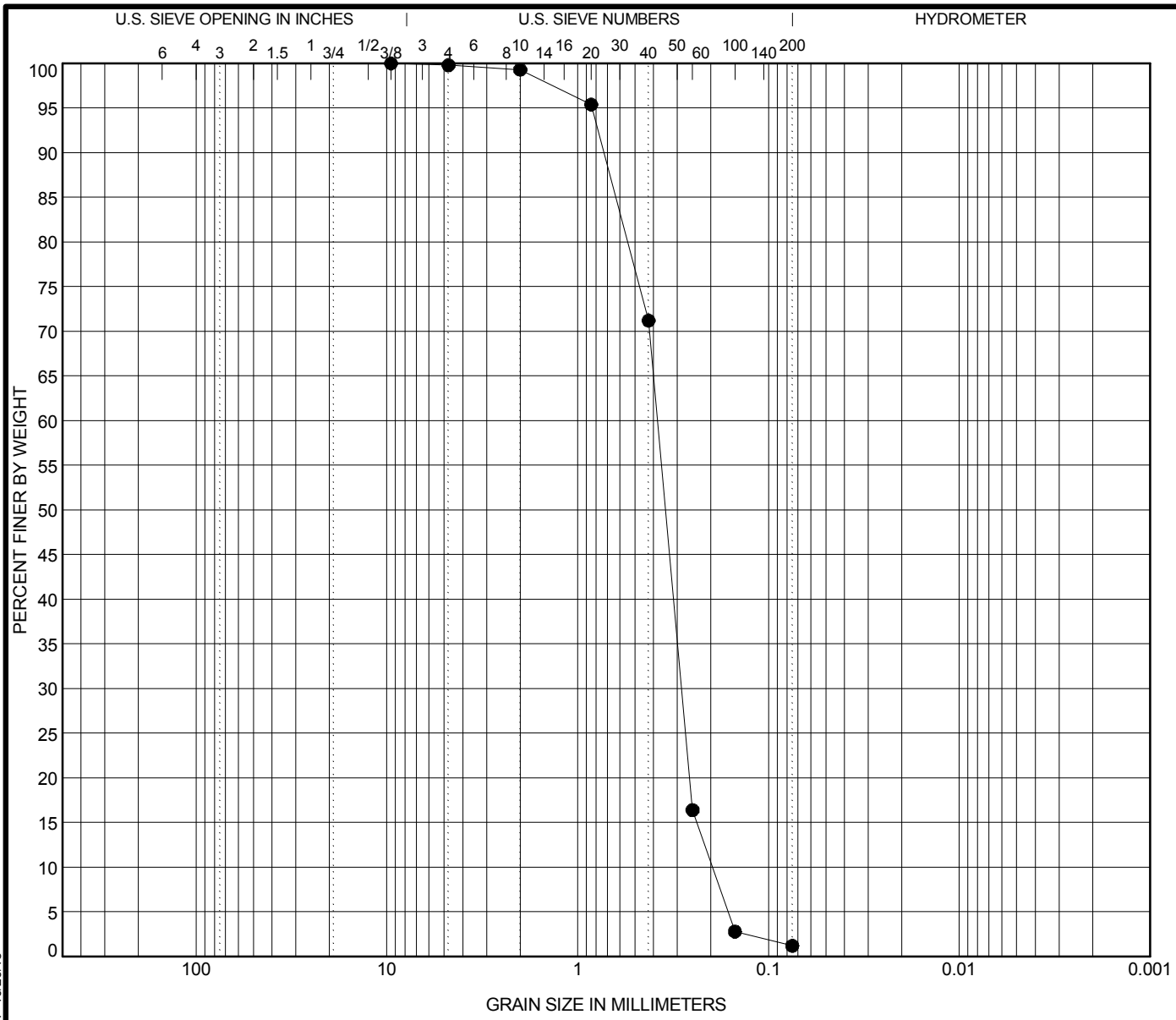
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-65 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, brown** | -- | -- | -- | **1.09** | **1.94** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.381** | **0.285** | **0.197** | **0.2** | **98.6** | **1.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 1.2 | 2.8 | 16.4 | 71.2 | 95.4 | 99.3 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/18/19 | DS |

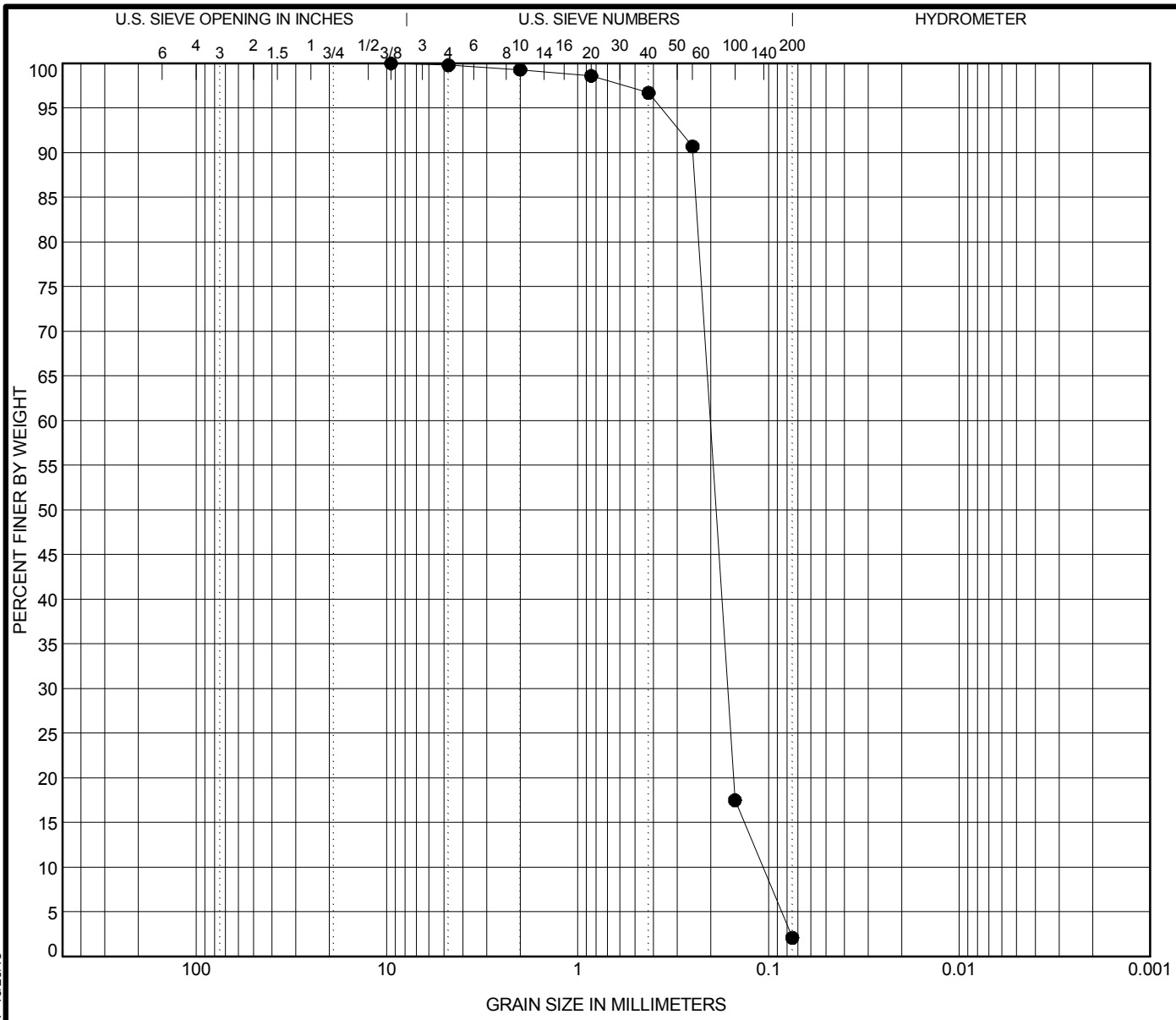
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-65 | 4.6 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- | **1.24** | **1.89** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.202** | **0.164** | **0.107** | **0.2** | **97.7** | **2.1** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 2.1 | 17.5 | 90.7 | 96.7 | 98.6 | 99.3 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

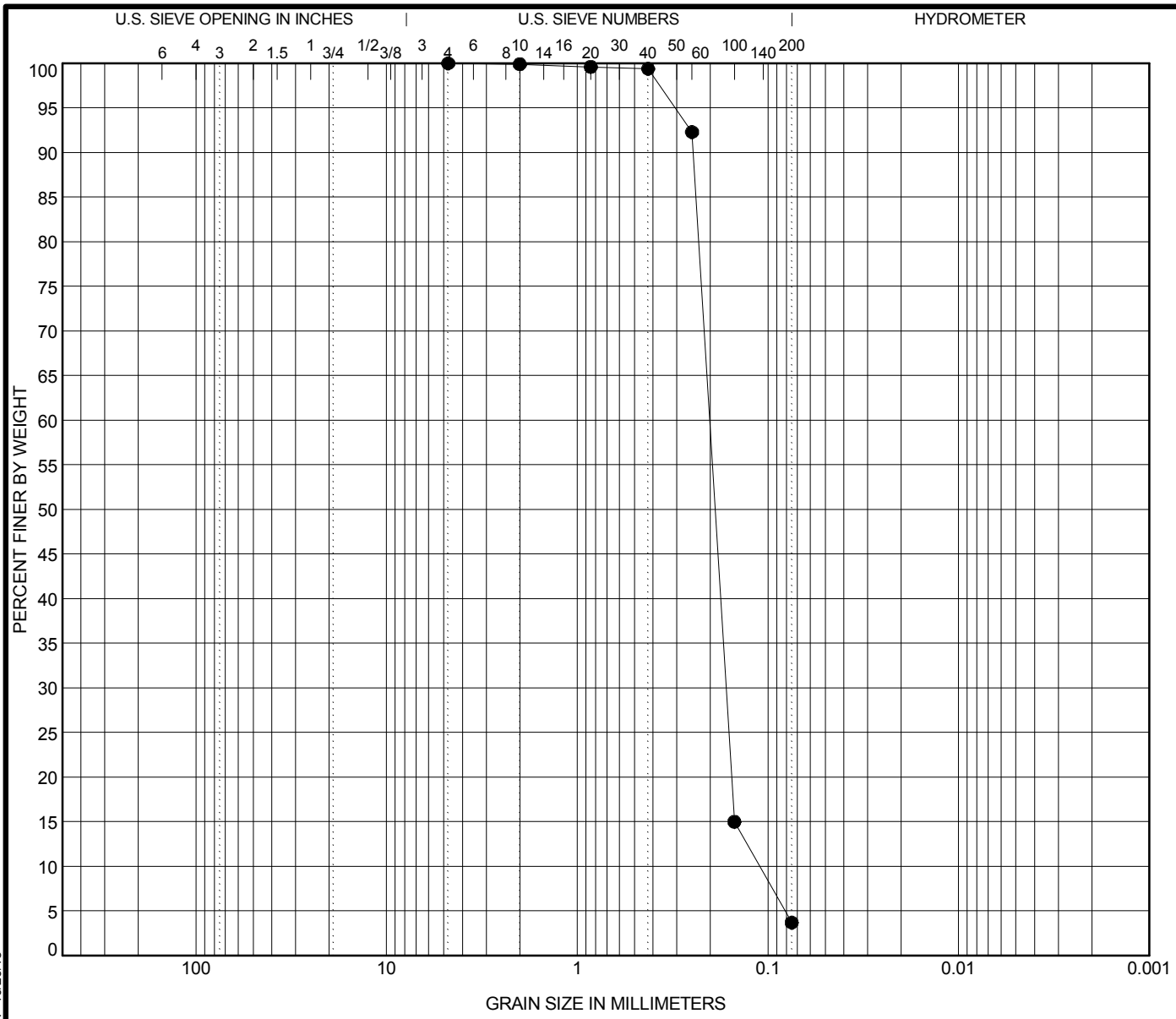
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-65 | 9.6 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, gray** | -- | -- | -- | **1.23** | **1.83** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.202** | **0.166** | **0.11** | **0.0** | **96.3** | **3.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 3.7 | 15.0 | 92.3 | 99.4 | 99.6 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB | 10/19/18 | DS |

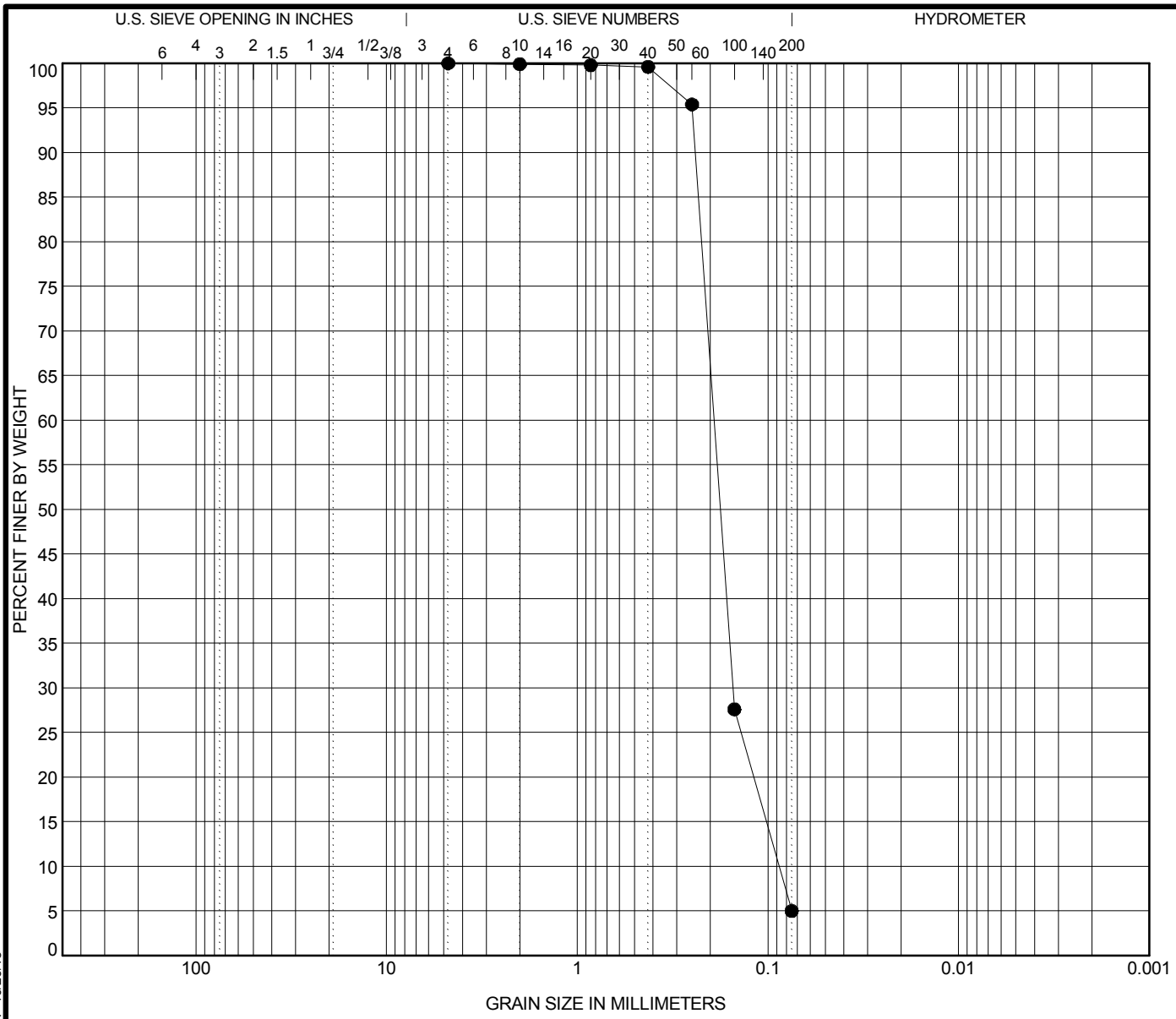
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-65 | 14.6 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, gray** | -- | -- | -- | **1.39** | **2.19** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.191** | **0.153** | **0.087** | **0.0** | **95.0** | **5.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 5.0 | 27.6 | 95.4 | 99.6 | 99.8 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

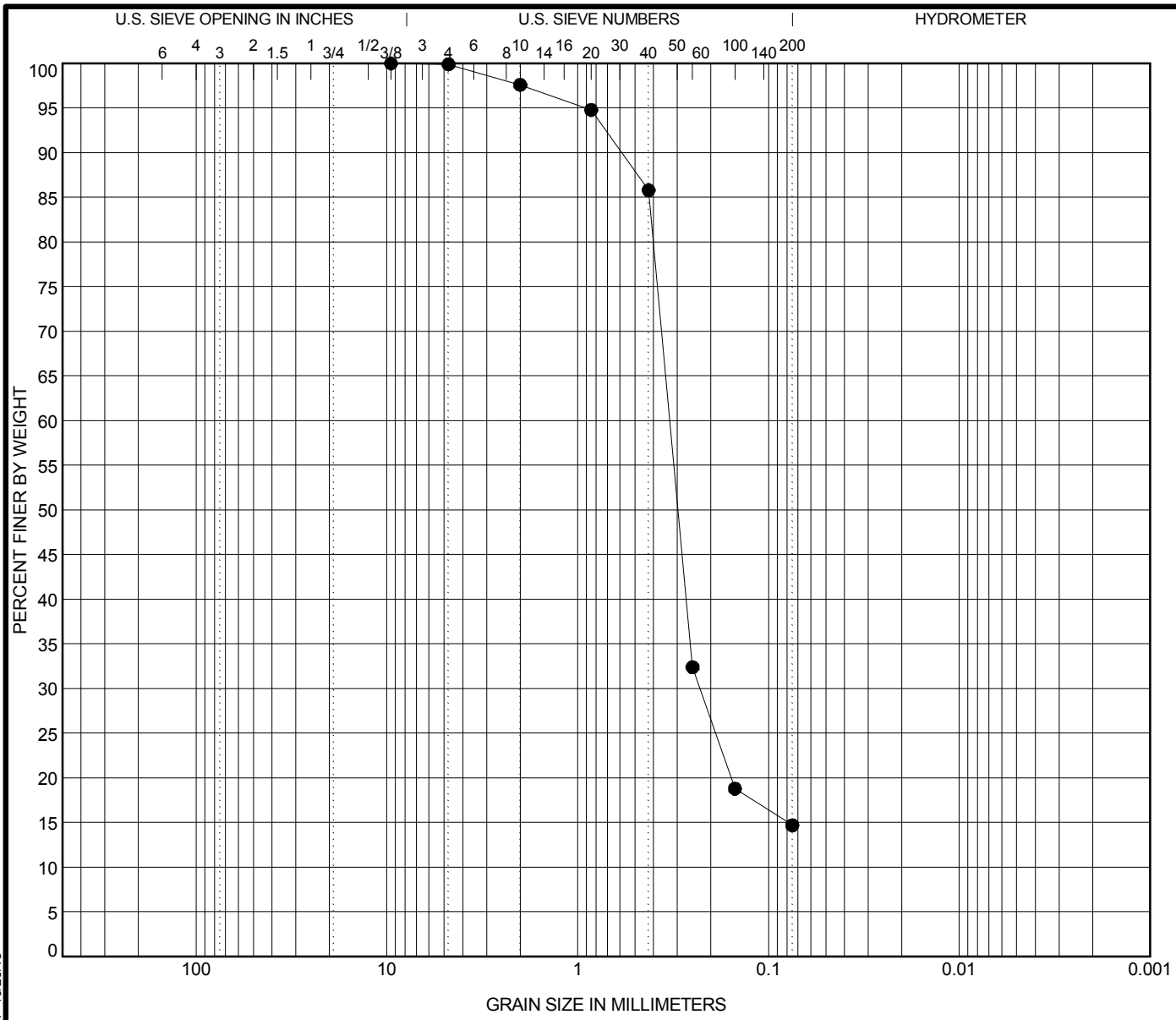
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-66 | 0.0 ft | | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.329** | **0.228** | **--** | **0.1** | **85.2** | **14.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 14.7 | 18.8 | 32.4 | 85.8 | 94.8 | 97.6 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AB | 10/23/18 | DS |

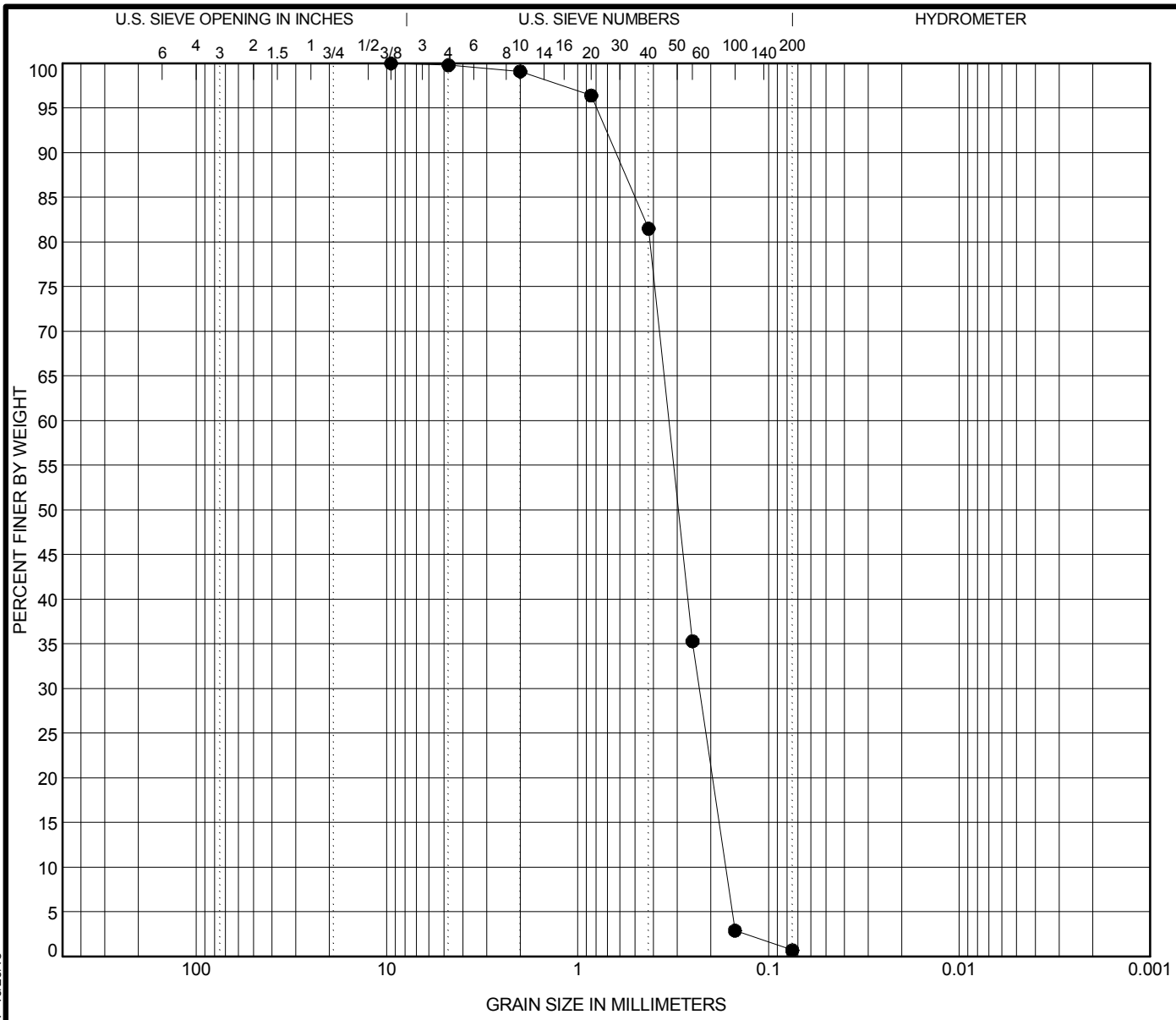
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-67 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | **0.95** | **1.98** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.332** | **0.23** | **0.168** | **0.2** | **99.1** | **0.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8 |
|---|---|---|---|---|---|---|---|---|
| % Finer | 0.7 | 2.9 | 35.3 | 81.5 | 96.4 | 99.1 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | |

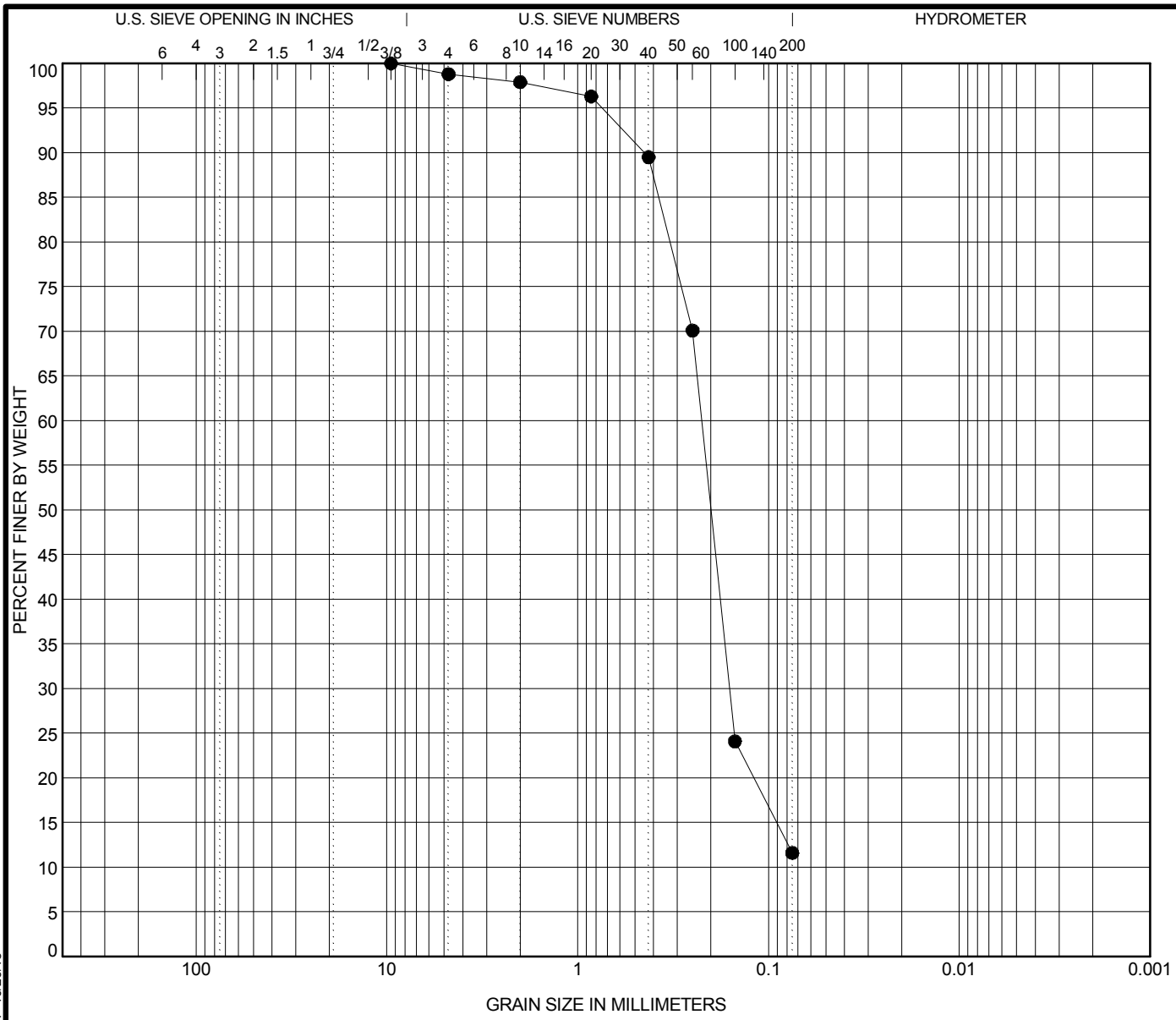
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-67 | 4.6 ft | **SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | **1.67** | **3.26** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.223** | **0.16** | **--** | **1.2** | **87.2** | **11.6** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 11.6 | 24.1 | 70.1 | 89.5 | 96.3 | 97.9 | 98.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | |

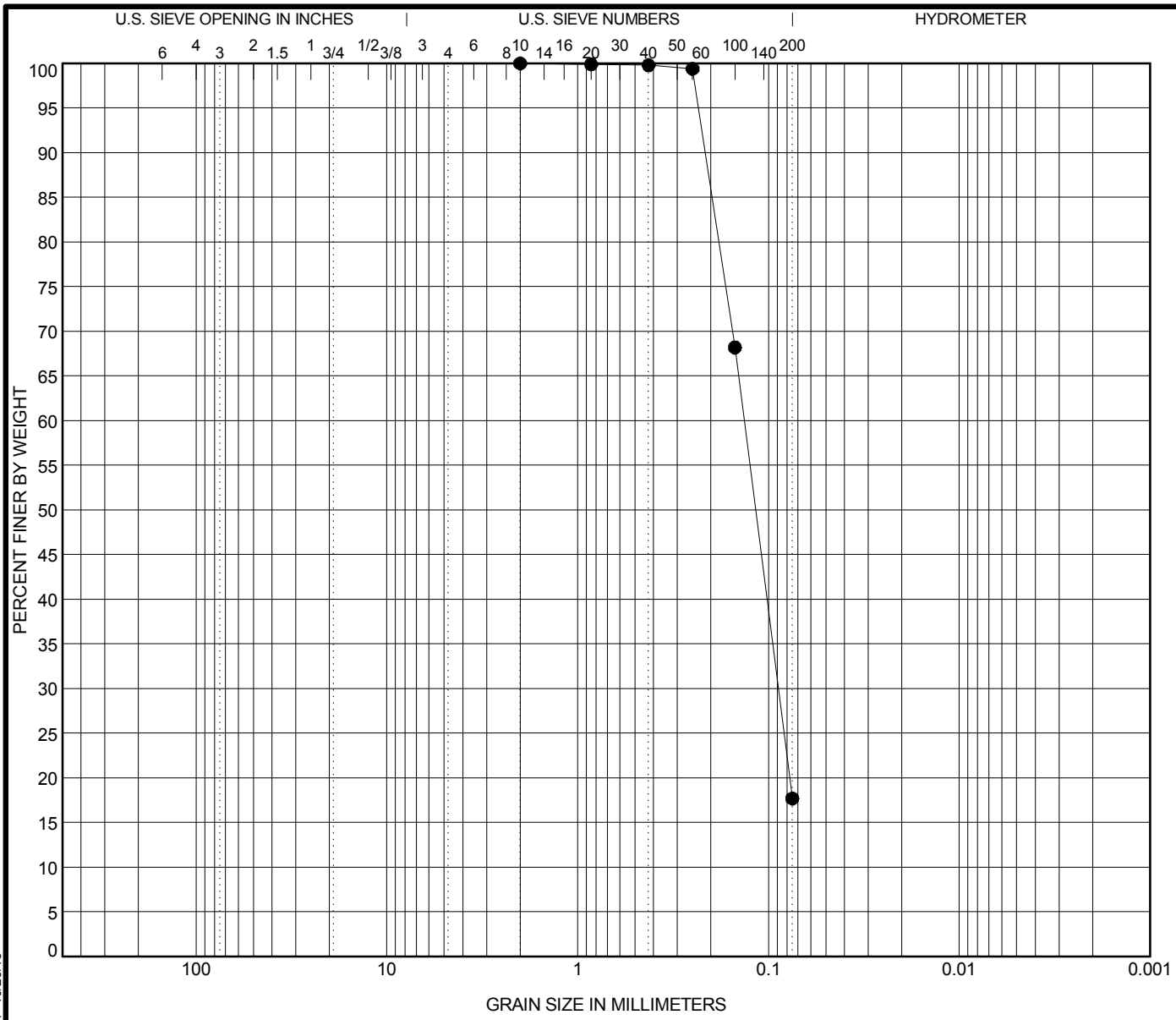
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-67 | 17.6 ft | **SILTY SAND (SM), fine to medium grained sand, dark gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **2** | **0.134** | **0.089** | **--** | **0.0** | **82.3** | **17.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 |
|---|---|---|---|---|---|---|
| % Finer | 17.7 | 68.2 | 99.4 | 99.8 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | |

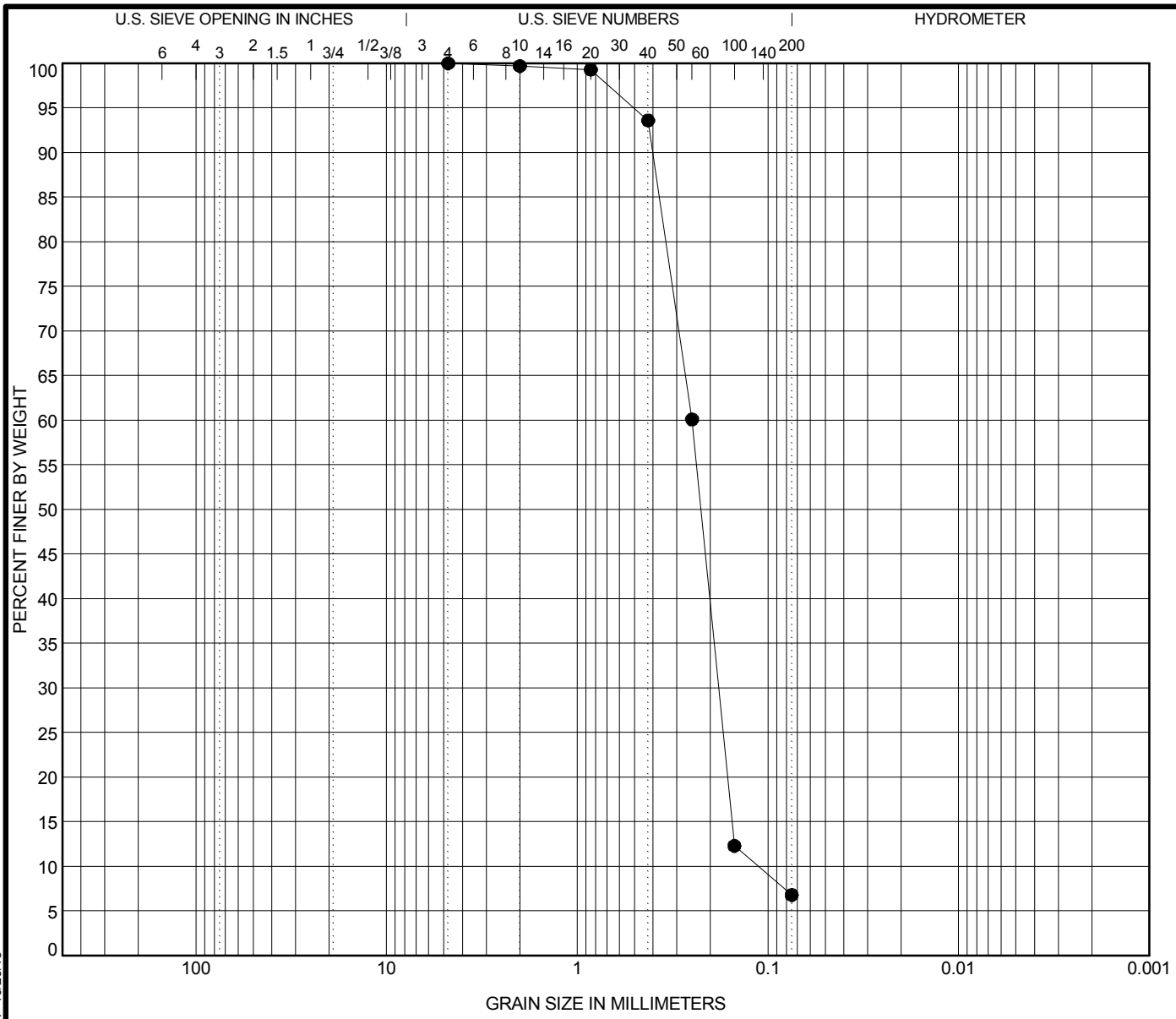
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-68 | 0.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | **1.17** | **2.22** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.25** | **0.181** | **0.112** | **0.0** | **93.2** | **6.8** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 6.8 | 12.3 | 60.1 | 93.6 | 99.3 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

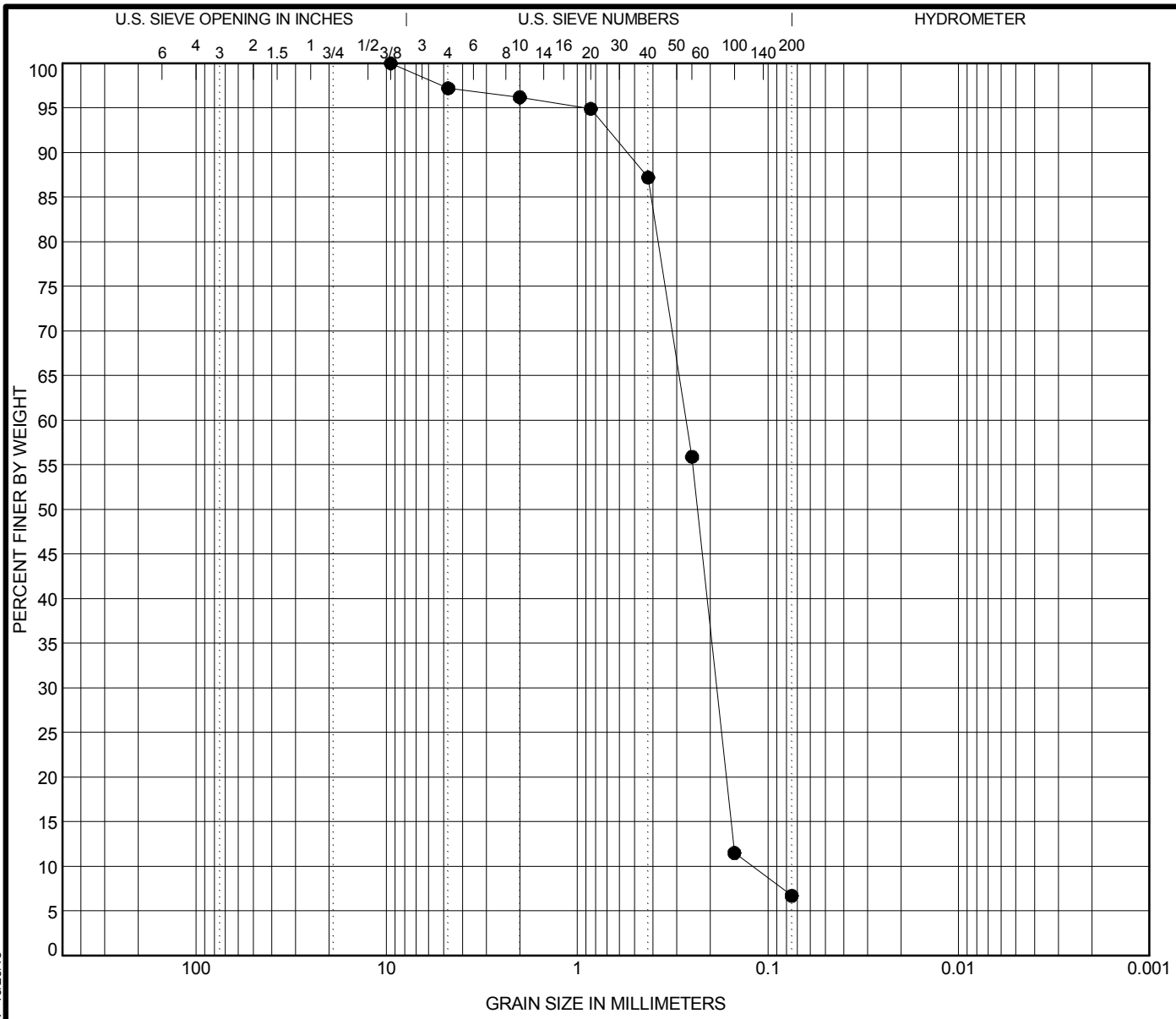
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-68 | 4.4 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | **1.06** | **2.22** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.268** | **0.186** | **0.121** | **2.8** | **90.5** | **6.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 6.7 | 11.5 | 55.9 | 87.2 | 94.9 | 96.2 | 97.2 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

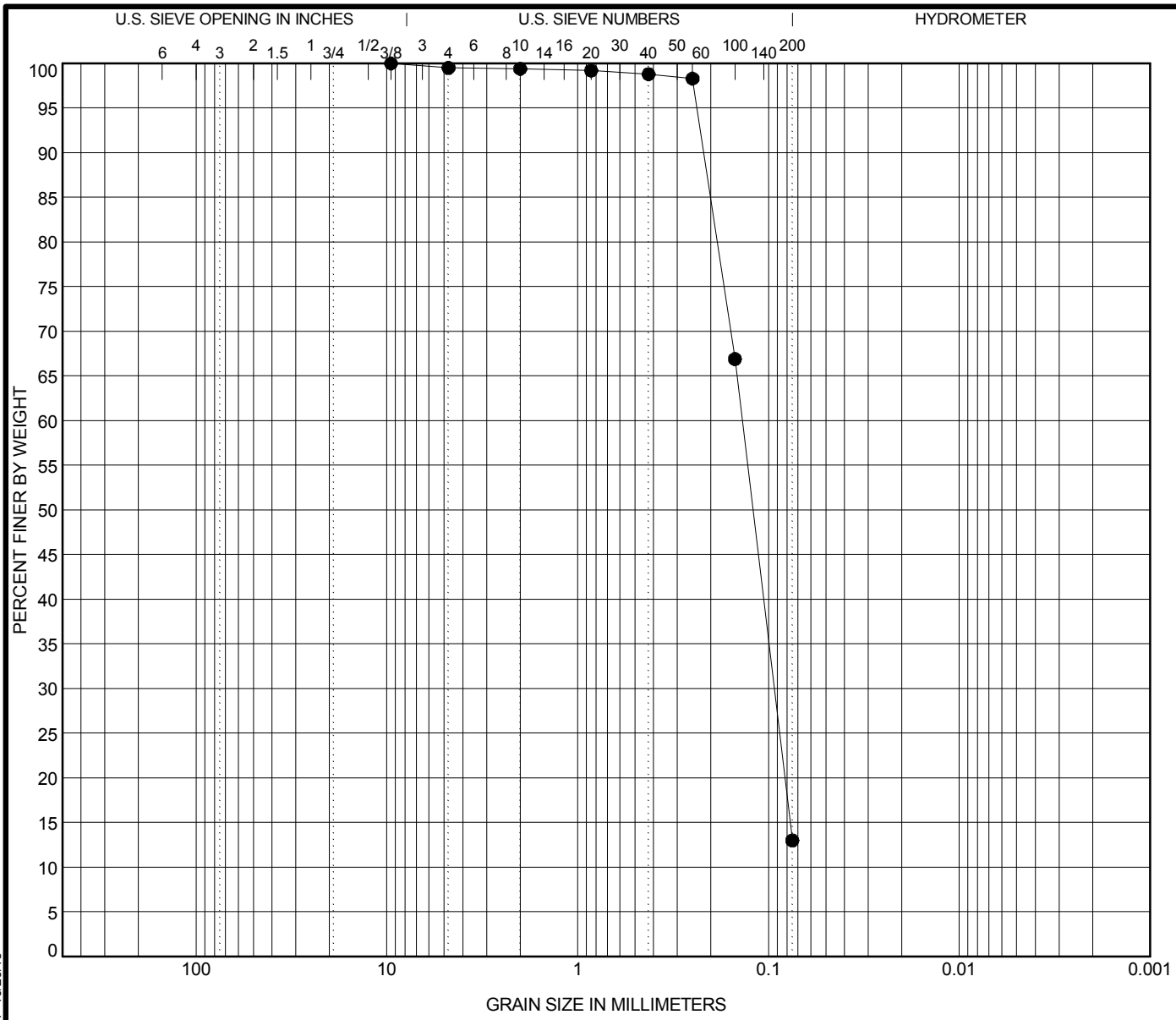
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-68 | 10.8 ft | **SILTY SAND (SM), fine to coarse grained sand, trace gravel, dark gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.137** | **0.093** | **--** | **0.5** | **86.5** | **13.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 13.0 | 66.9 | 98.3 | 98.8 | 99.2 | 99.4 | 99.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

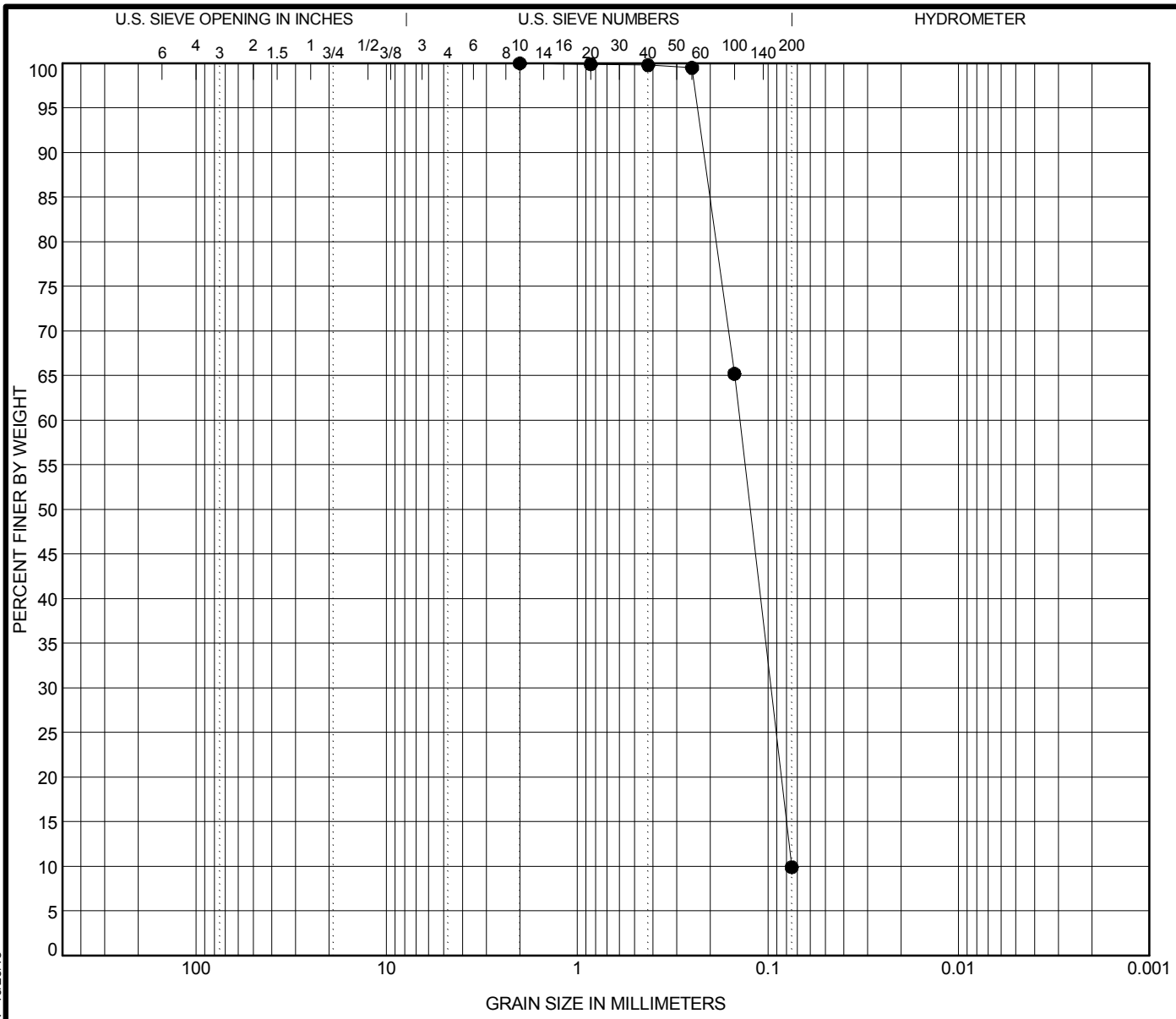
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-68 | 14.4 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to medium grained sand, contains mica, dark gray** | -- | -- | -- | **0.88** | **1.87** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **2** | **0.141** | **0.096** | **0.075** | **0.0** | **90.1** | **9.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 |
|---|---|---|---|---|---|---|
| % Finer | 9.9 | 65.2 | 99.5 | 99.8 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

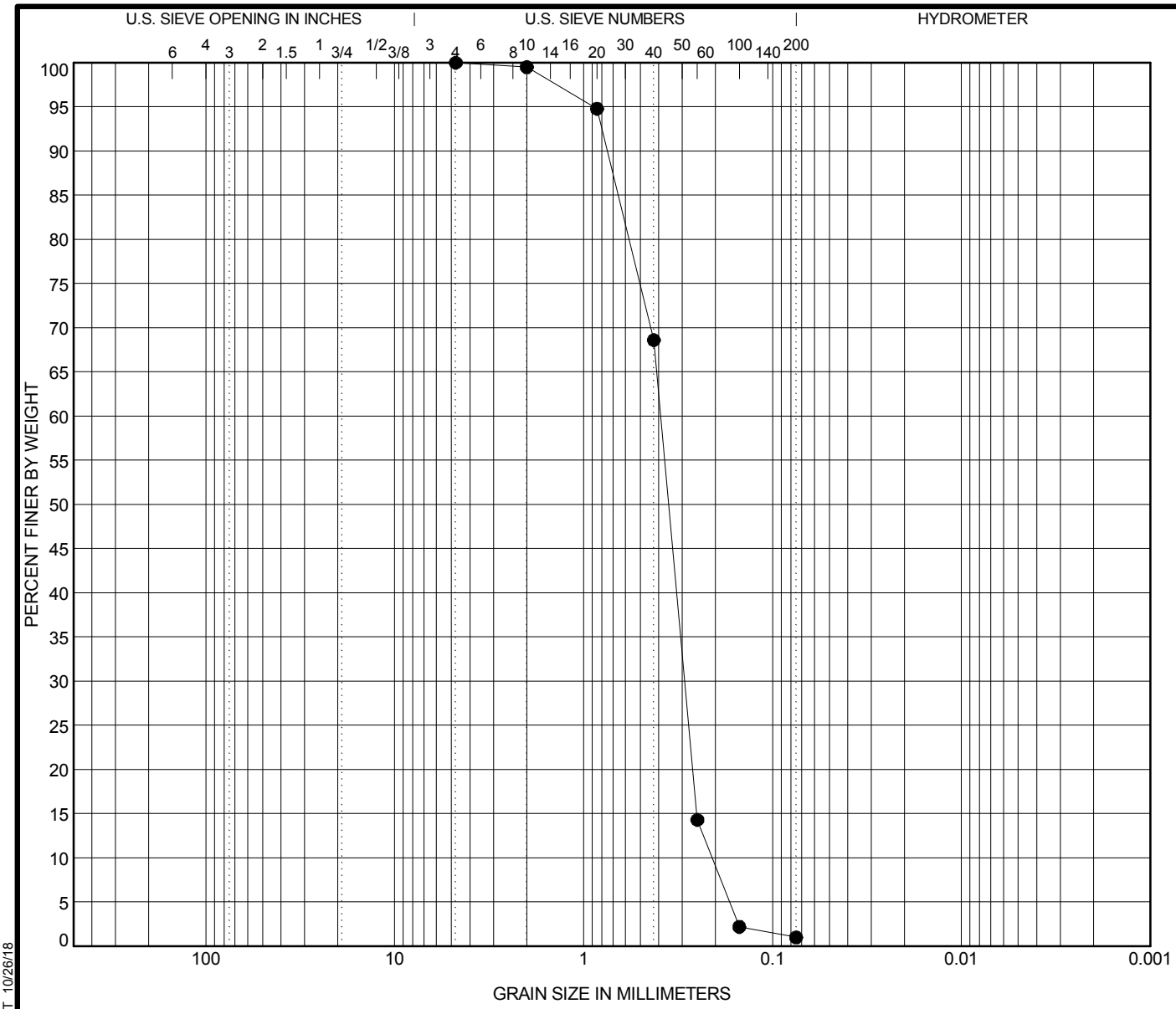
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-69 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, brown** | -- | -- | -- | **1.04** | **1.87** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.391** | **0.291** | **0.208** | **0.0** | **99.0** | **1.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 1.0 | 2.2 | 14.3 | 68.6 | 94.8 | 99.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

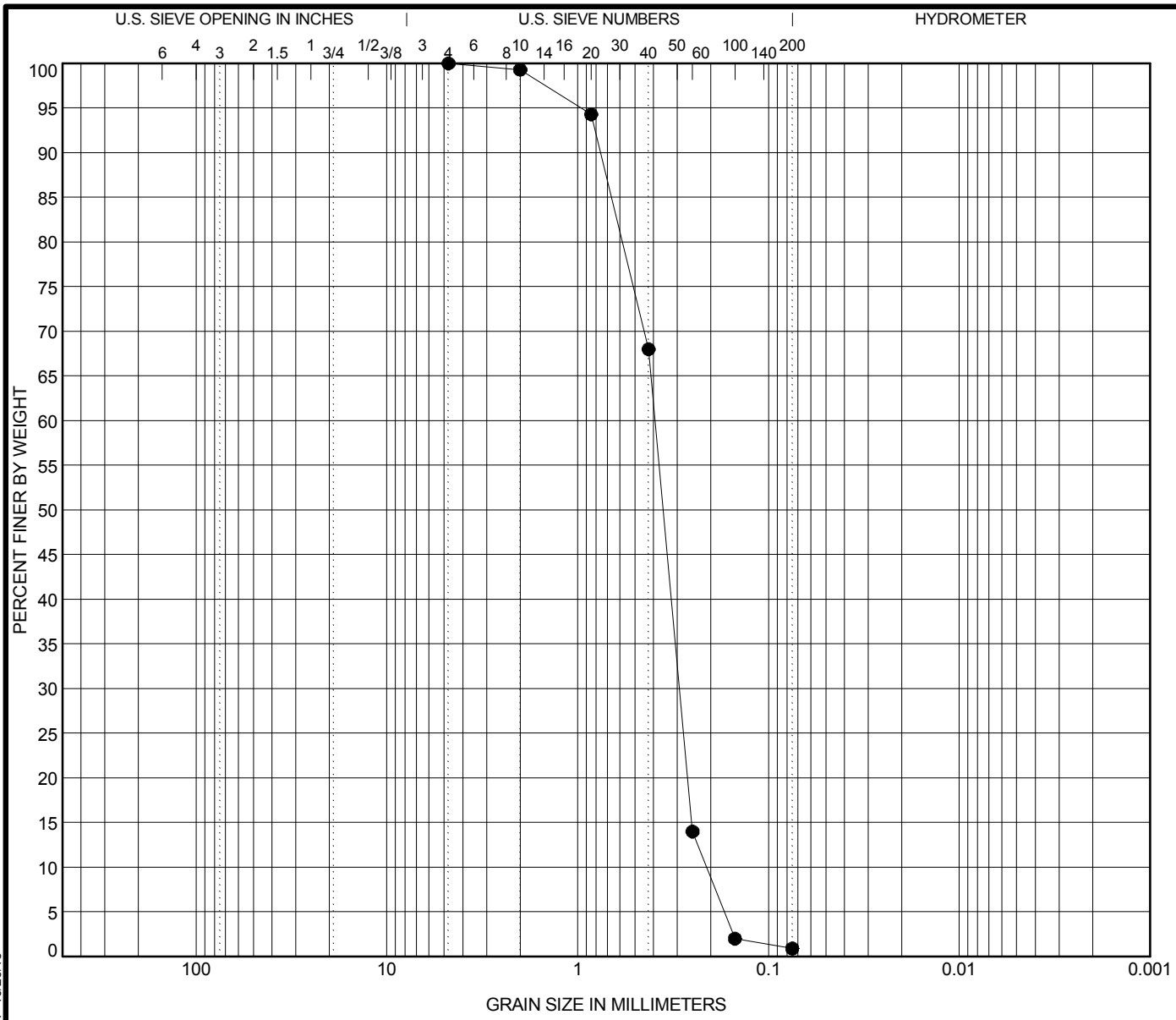
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-69 | 2.6 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, brown** | -- | -- | -- | **1.03** | **1.86** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.393** | **0.293** | **0.211** | **0.0** | **99.1** | **0.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 0.9 | 2.0 | 14.0 | 68.0 | 94.3 | 99.3 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

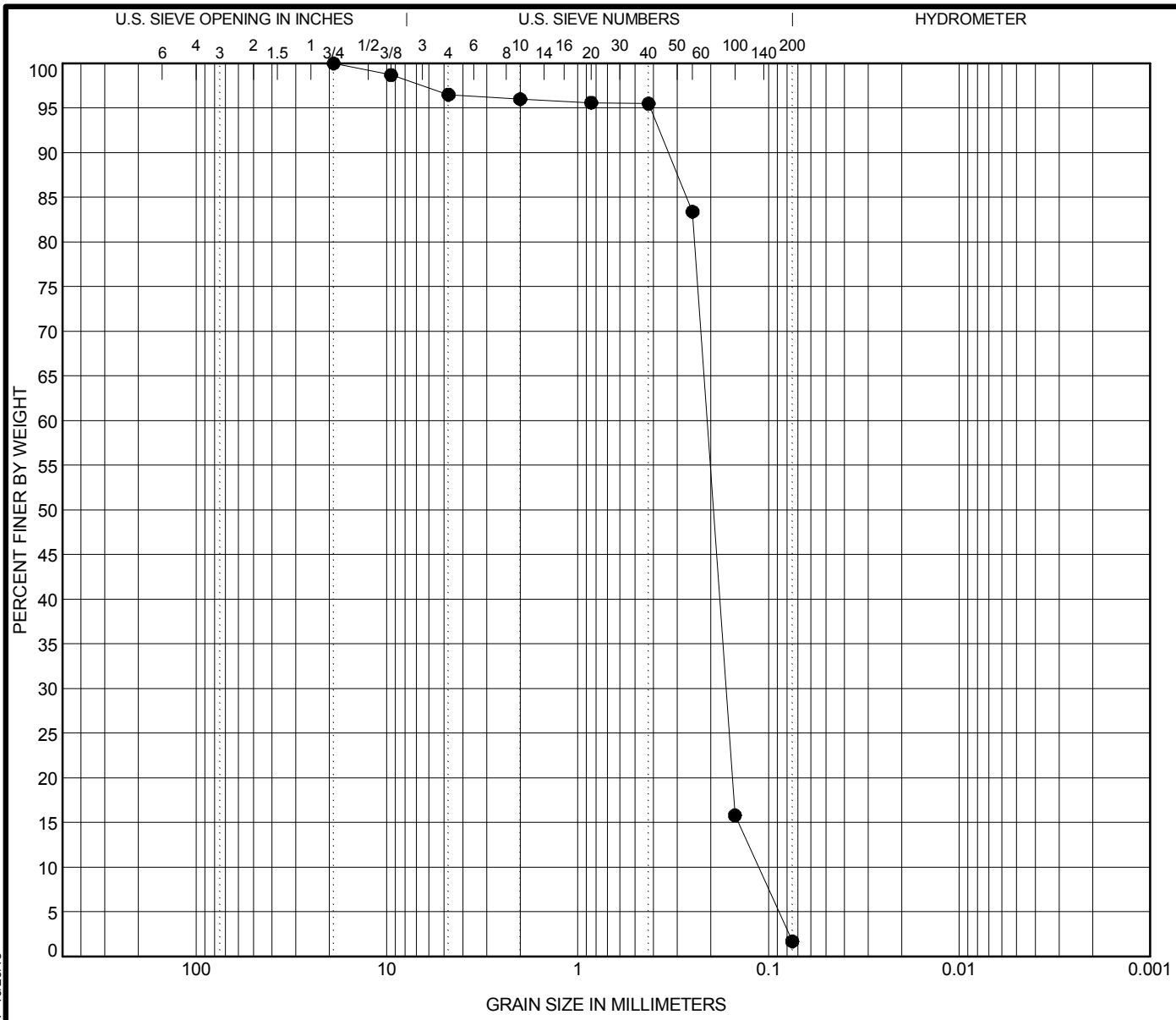
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-69 | 12.6 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, trace gravel, dark gray** | -- | -- | -- | **1.18** | **1.86** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.209** | **0.167** | **0.113** | **3.5** | **94.8** | **1.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 1.7 | 15.8 | 83.4 | 95.5 | 95.6 | 96.0 | 96.5 | 98.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

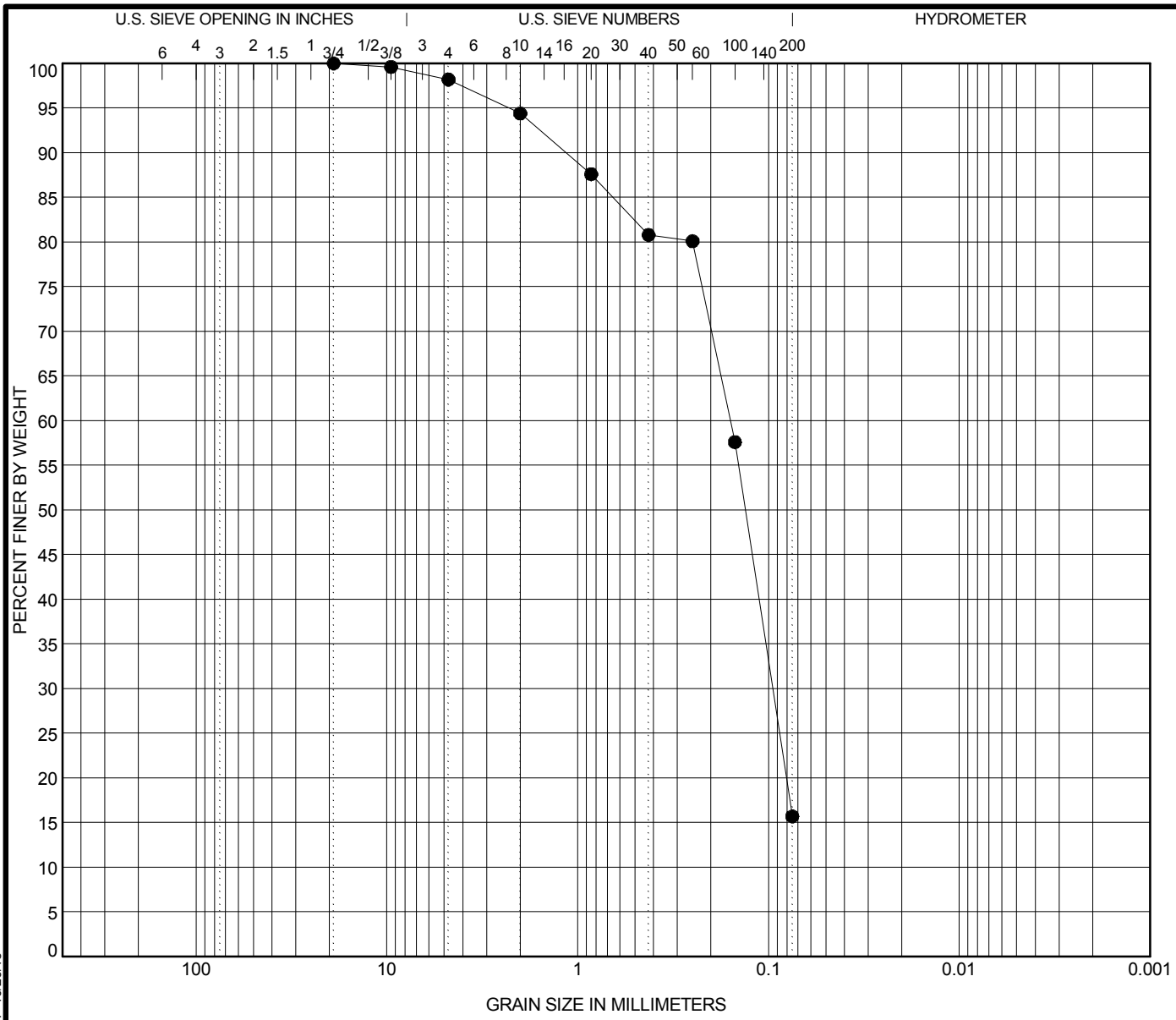
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-70 | 8.0 ft | **SILTY SAND (SM), fine to coarse grained sand, contains shell fragments, dark gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.158** | **0.095** | **--** | **1.8** | **82.5** | **15.7** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 15.7 | 57.6 | 80.1 | 80.8 | 87.6 | 94.4 | 98.2 | 99.6 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

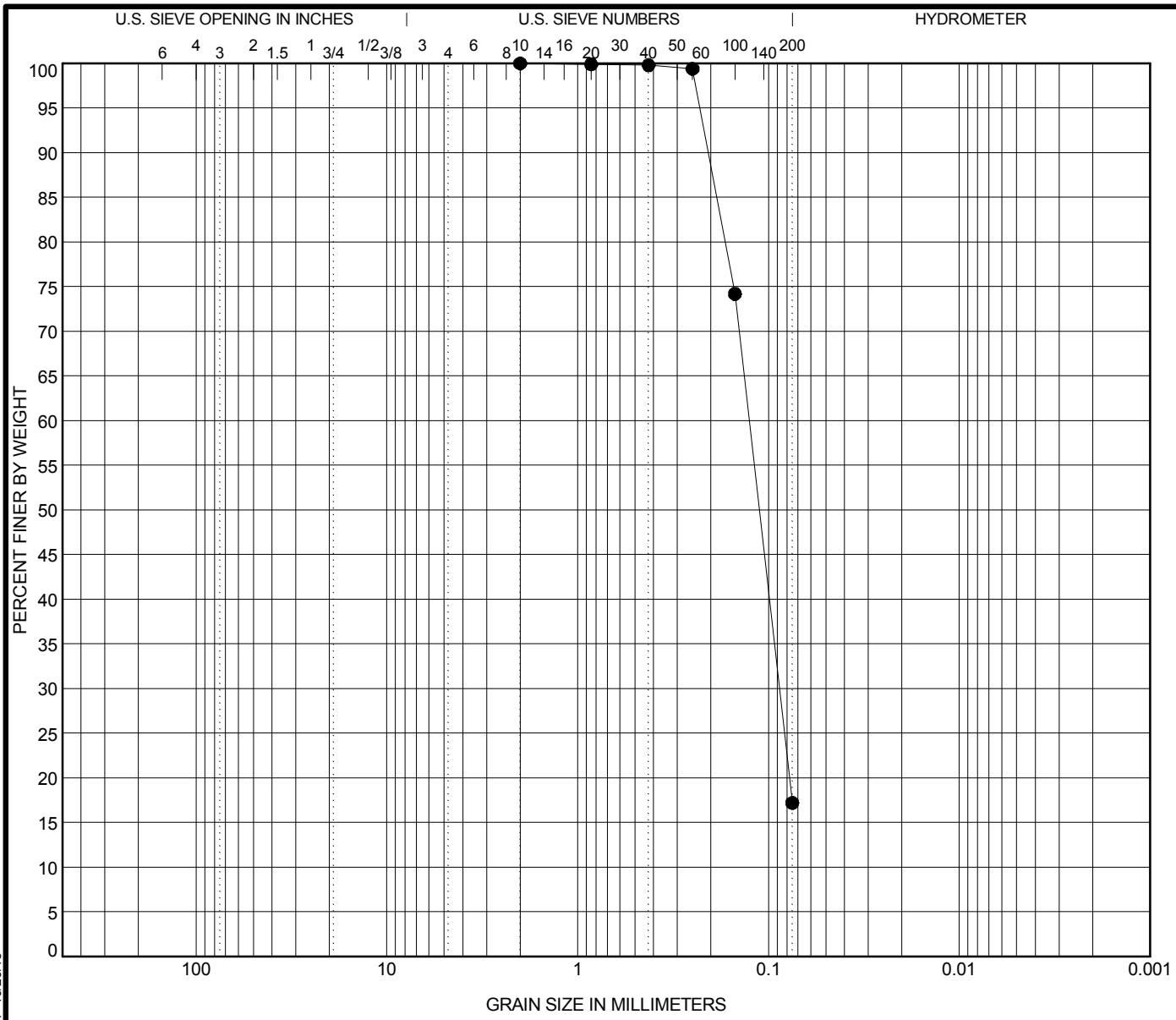
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-70 | 13.0 ft | **SILTY SAND (SM), fine to medium grained sand, gray** | -- | -- | -- | | |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **2** | **0.126** | **0.088** | **--** | **0.0** | **82.8** | **17.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 |
|---|---|---|---|---|---|---|
| % Finer | 17.2 | 74.2 | 99.4 | 99.8 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

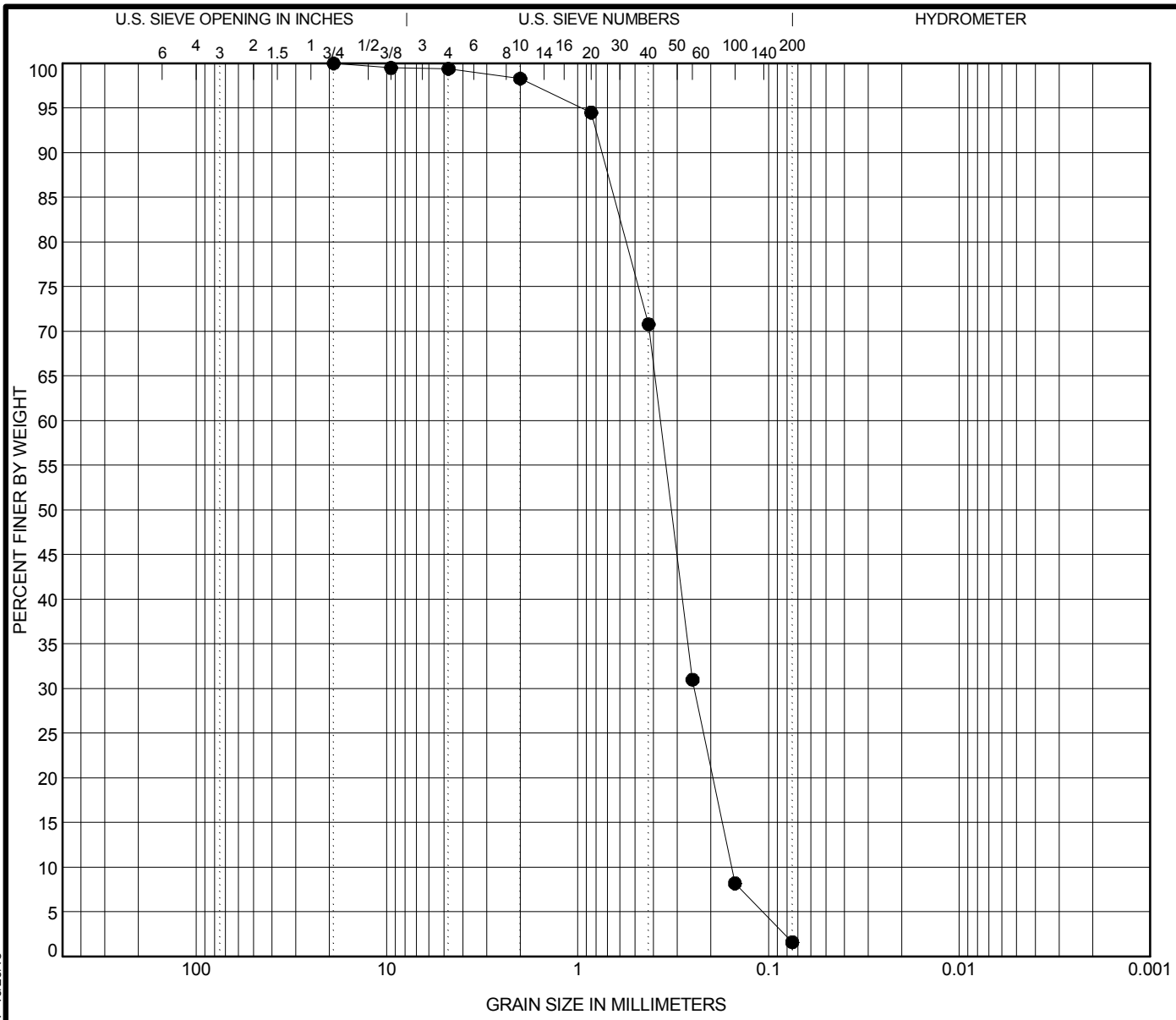
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI |
|---|---|---|---|---|---|
| ● 18SBB-71 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **19** | **0.368** | **0.244** | **0.156** | **0.6** | **97.8** | **1.6** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" | 3/4" |
|---|---|---|---|---|---|---|---|---|---|
| % Finer | 1.6 | 8.2 | 31.0 | 70.8 | 94.5 | 98.3 | 99.4 | 99.5 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

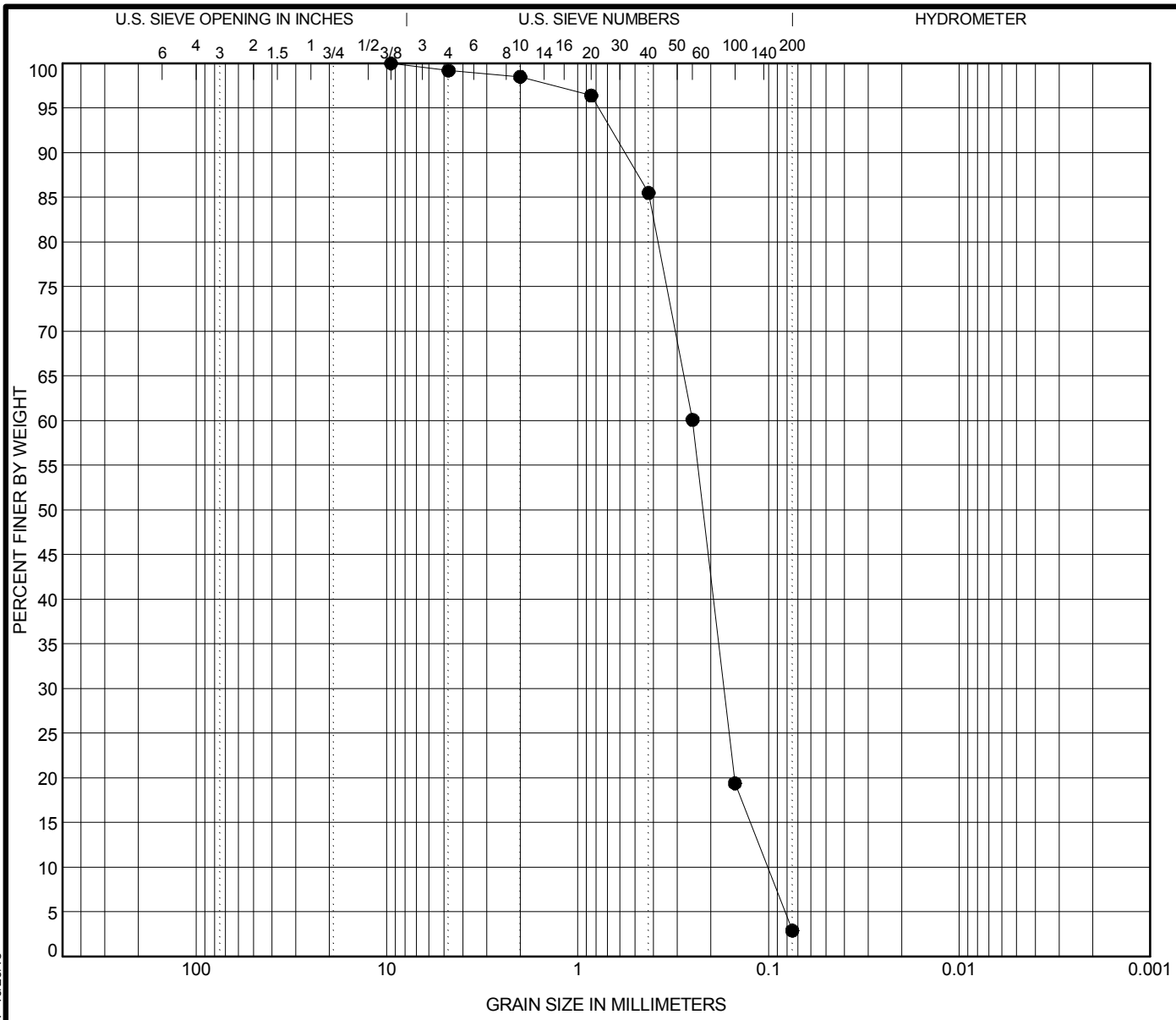
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-71 | 5.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- | **1.16** | **2.47** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.25** | **0.171** | **0.101** | **0.8** | **96.3** | **2.9** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 2.9 | 19.4 | 60.1 | 85.5 | 96.4 | 98.5 | 99.2 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

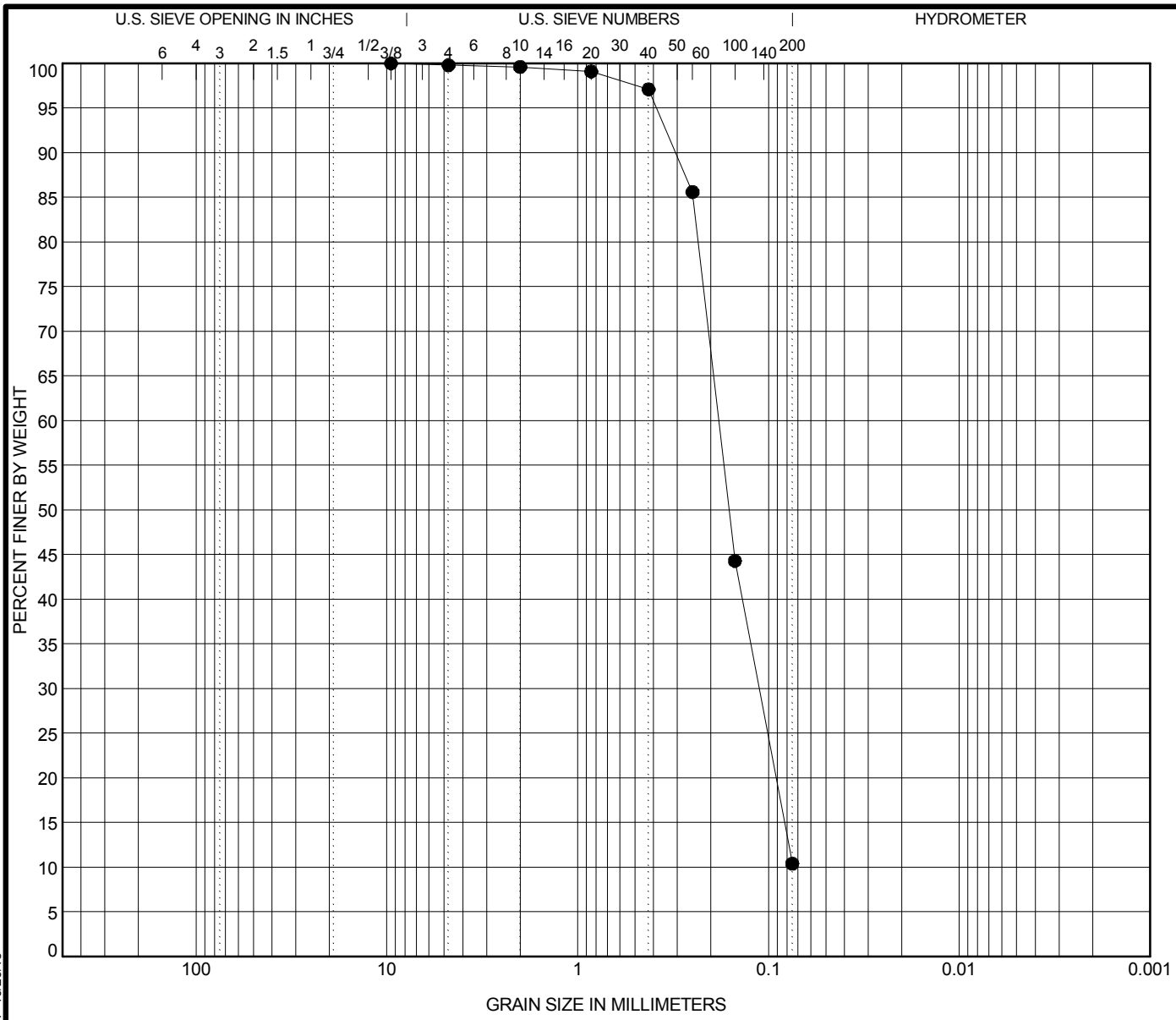
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | 18SBB-71 | 10.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to coarse grained sand, contains shell fragments, gray** | -- | -- | -- | **0.93** | **2.45** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.182** | **0.112** | **--** | **0.2** | **89.4** | **10.4** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 10.4 | 44.3 | 85.6 | 97.1 | 99.1 | 99.6 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

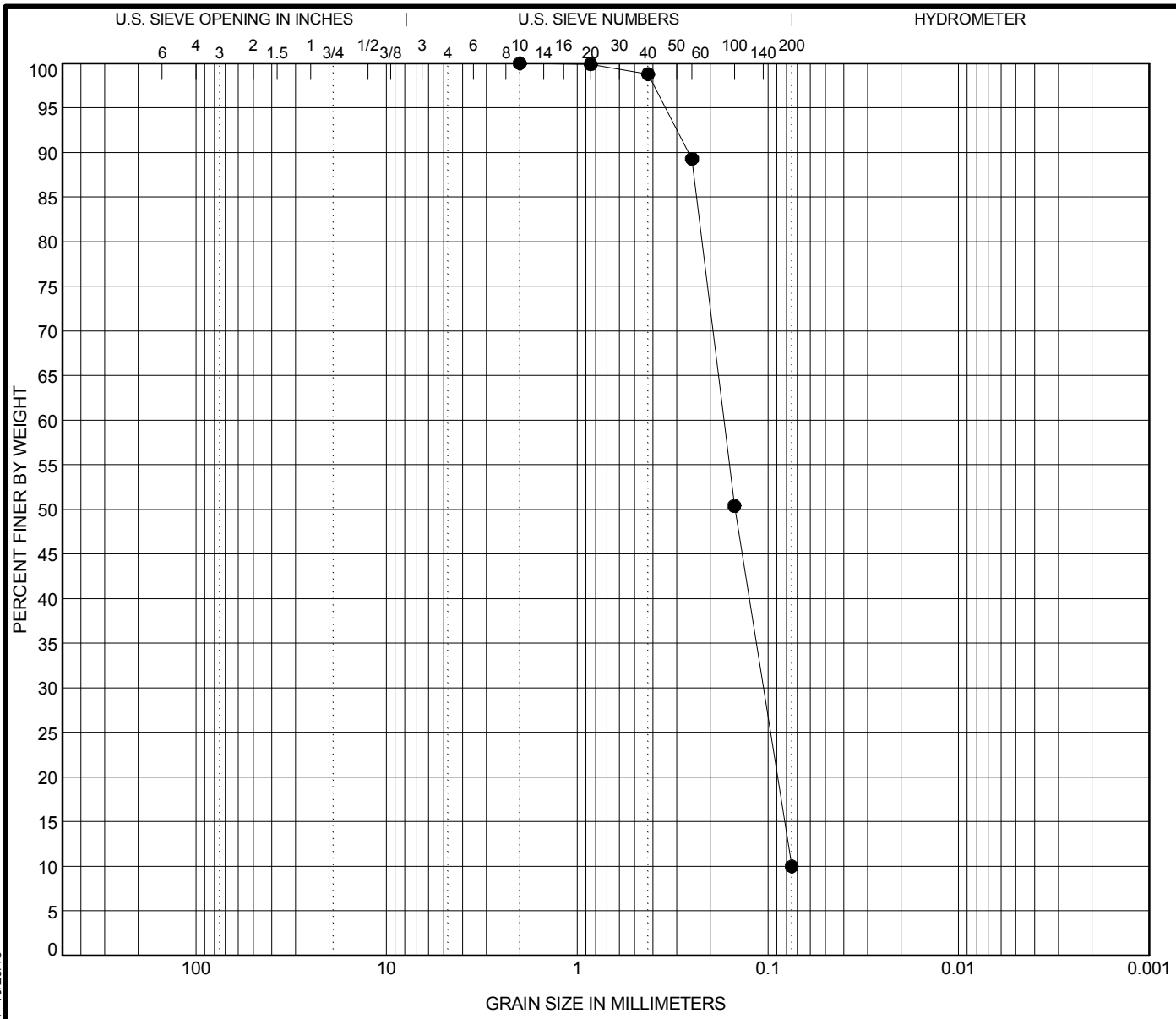
Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● 18SBB-71 | 15.0 ft | **POORLY GRADED SAND WITH SILT (SP-SM), fine to medium grained sand, dark gray** | -- | -- | -- | **0.88** | **2.27** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **2** | **0.17** | **0.106** | **0.075** | **0.0** | **90.0** | **10.0** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 |
|---|---|---|---|---|---|---|
| % Finer | 10.0 | 50.4 | 89.3 | 98.8 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| KT | 10/19/18 | DS |

Schnabel ENGINEERING

# GRADATION CURVE

**Project:**
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/26/18

# APPENDIX C

# SANDBRIDGE BEACH LABORATORY ANALYSIS

Full Grain Size Analysis (5 pages)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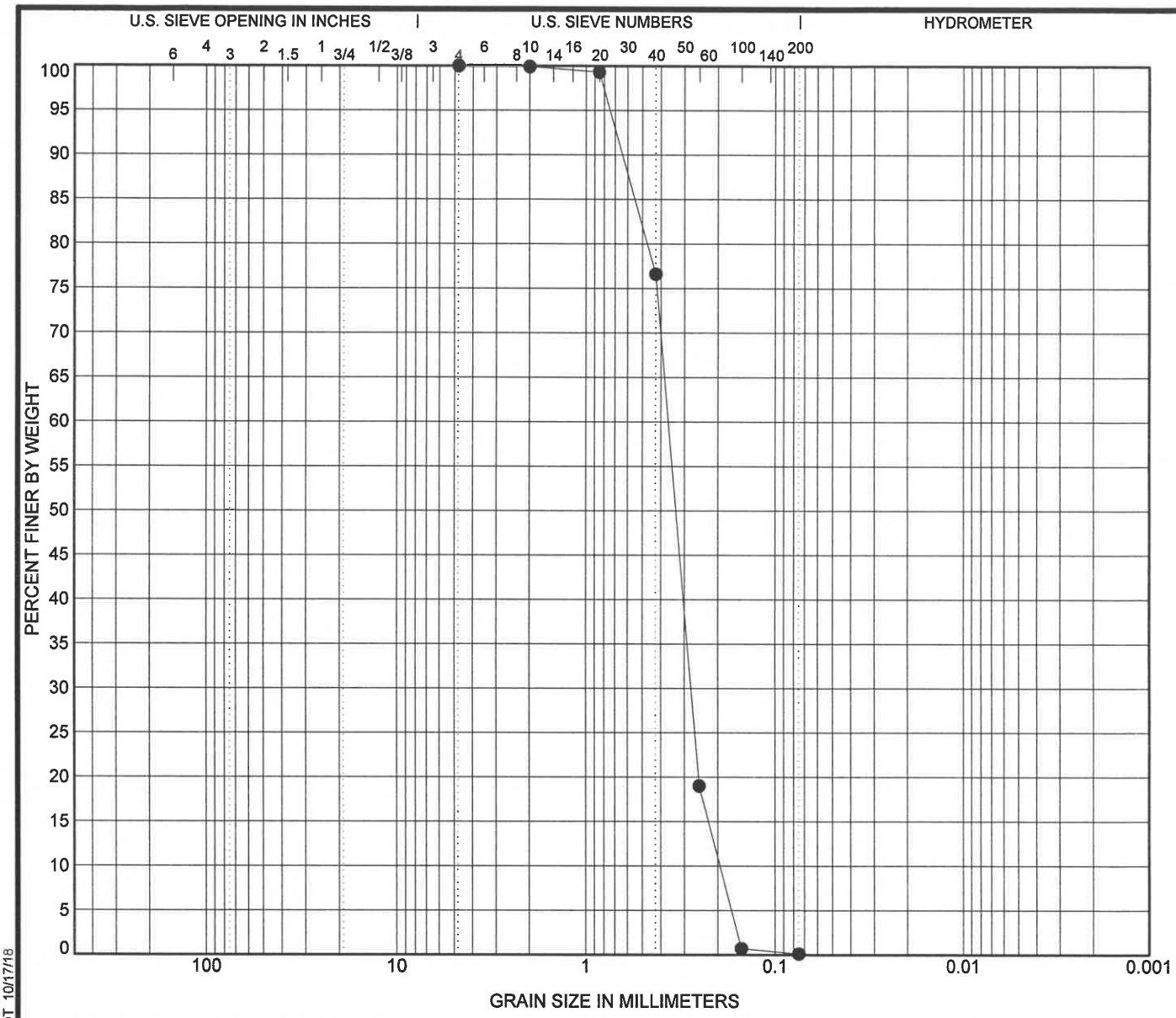



| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● Composite 1 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, light brown** | -- | -- | -- | **1.08** | **1.88** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.365** | **0.277** | **0.194** | **0.0** | **99.9** | **0.1** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 0.1 | 0.7 | 19.0 | 76.6 | 99.3 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AE / RG | 10/15/18 | DS |

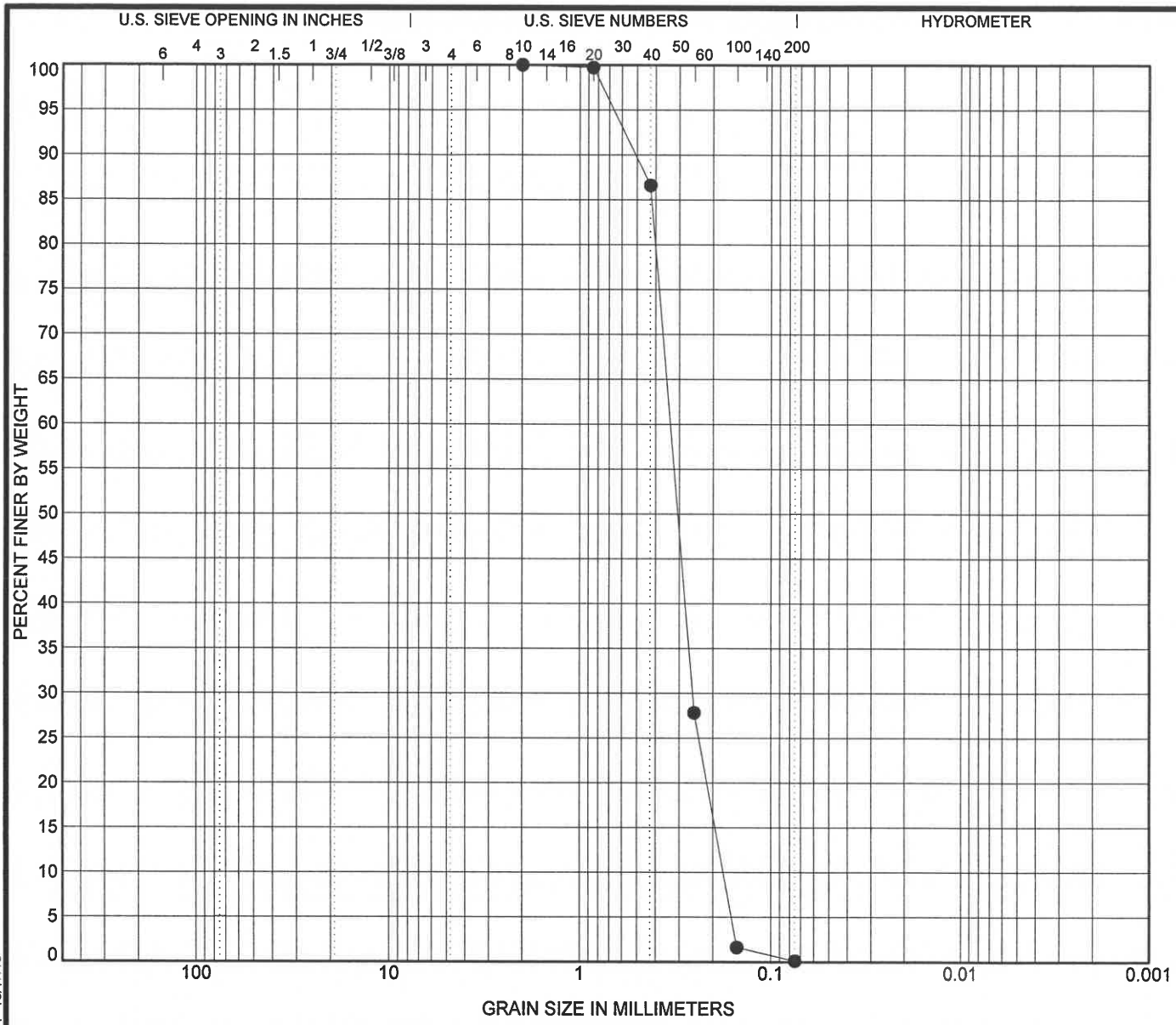
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** Virginia Beach Renourishment
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/17/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● Composite 2 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, light brown** | -- | -- | -- | **1.10** | **1.89** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **2** | **0.334** | **0.255** | **0.177** | **0.0** | **99.9** | **0.1** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 |
|---|---|---|---|---|---|---|
| % Finer | 0.1 | 1.6 | 27.8 | 86.6 | 99.7 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AE / RG | 10/15/18 | DS |

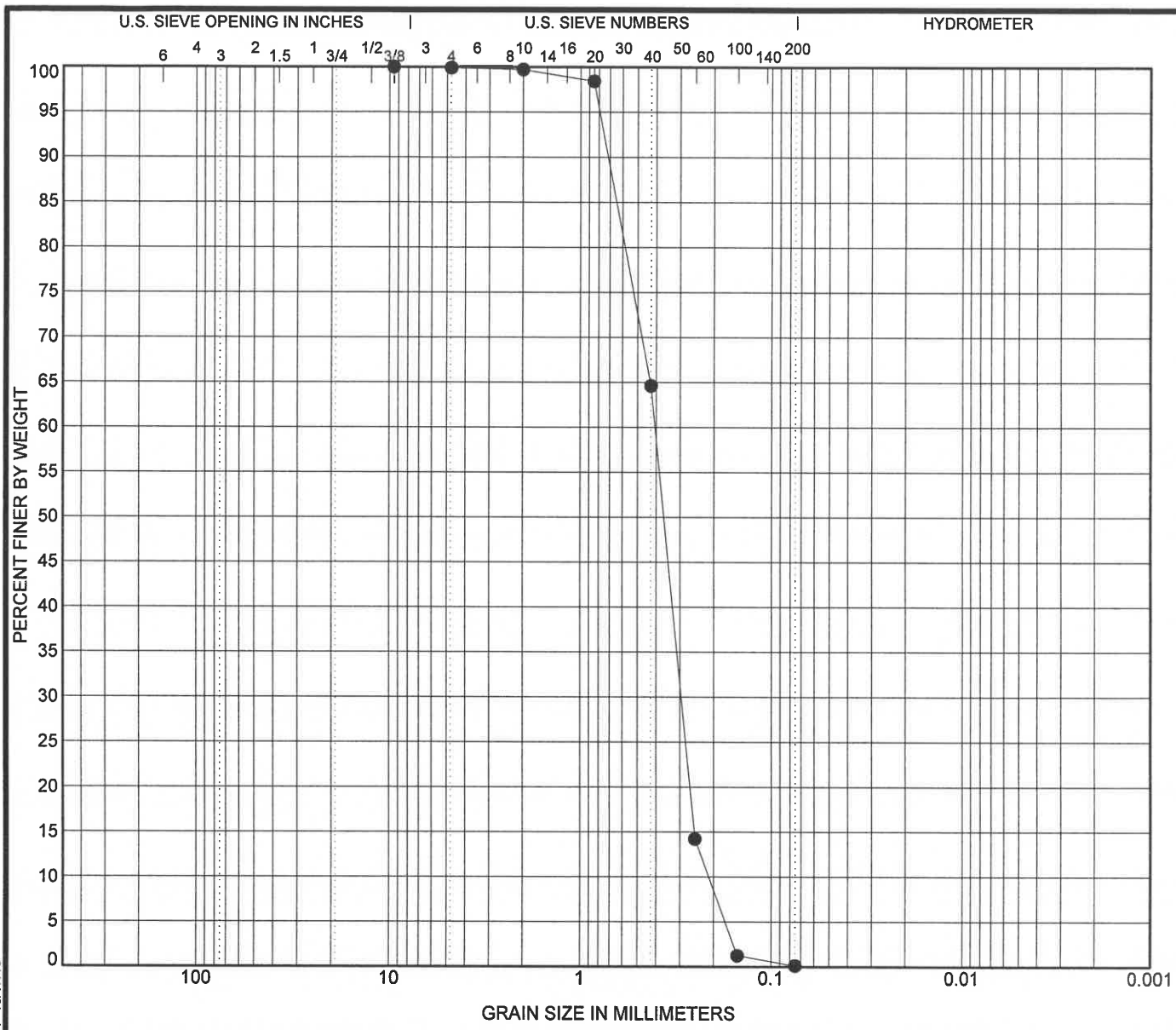
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** Virginia Beach Renourishment
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/17/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● Composite 3 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, light brown** | -- | -- | -- | **1.02** | **1.91** |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **9.5** | **0.405** | **0.295** | **0.212** | **0.1** | **99.8** | **0.1** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 | 3/8" |
|---|---|---|---|---|---|---|---|---|
| % Finer | 0.1 | 1.2 | 14.2 | 64.6 | 98.4 | 99.7 | 99.9 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AE / RG | 10/15/18 | DS |

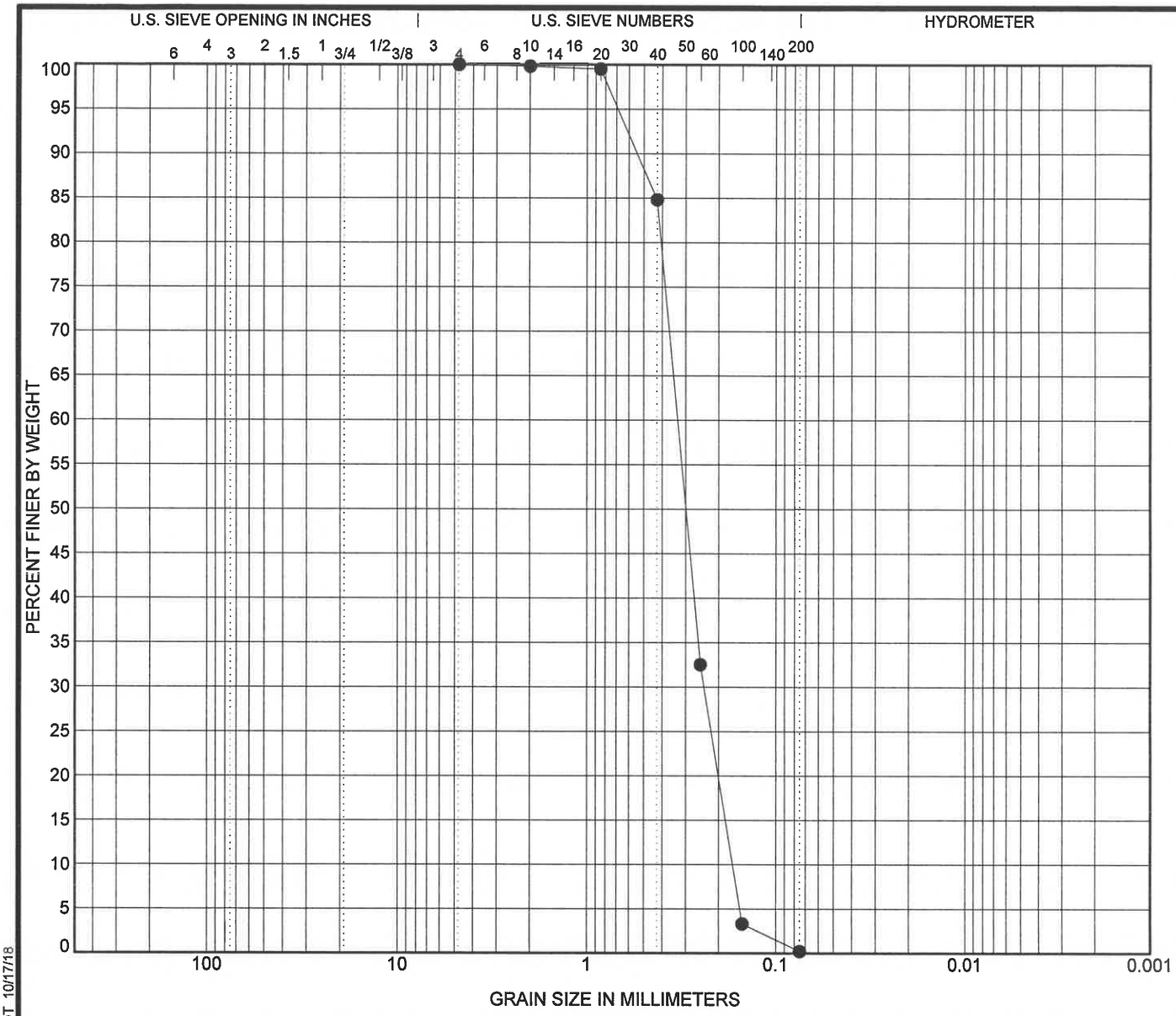
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** Virginia Beach Renourishment
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010_02_25.GDT 10/17/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|
| ● Composite 4 | 0.0 ft | **POORLY GRADED SAND (SP), fine to coarse grained sand, light brown** | -- | -- | -- | 1.03 | 1.96 |

| Test Method | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|
| **ASTM D422** | **4.75** | **0.33** | **0.239** | **0.169** | **0.0** | **99.8** | **0.2** | |

**Percent Finer**

| Sieve Size | No. 200 | No. 100 | No. 60 | No. 40 | No. 20 | No. 10 | No. 4 |
|---|---|---|---|---|---|---|---|
| % Finer | 0.2 | 3.3 | 32.5 | 84.8 | 99.5 | 99.8 | 100.0 |

| Tested By | Tested Date | Reviewed By |
|---|---|---|
| AE / RG | 10/15/18 | DS |

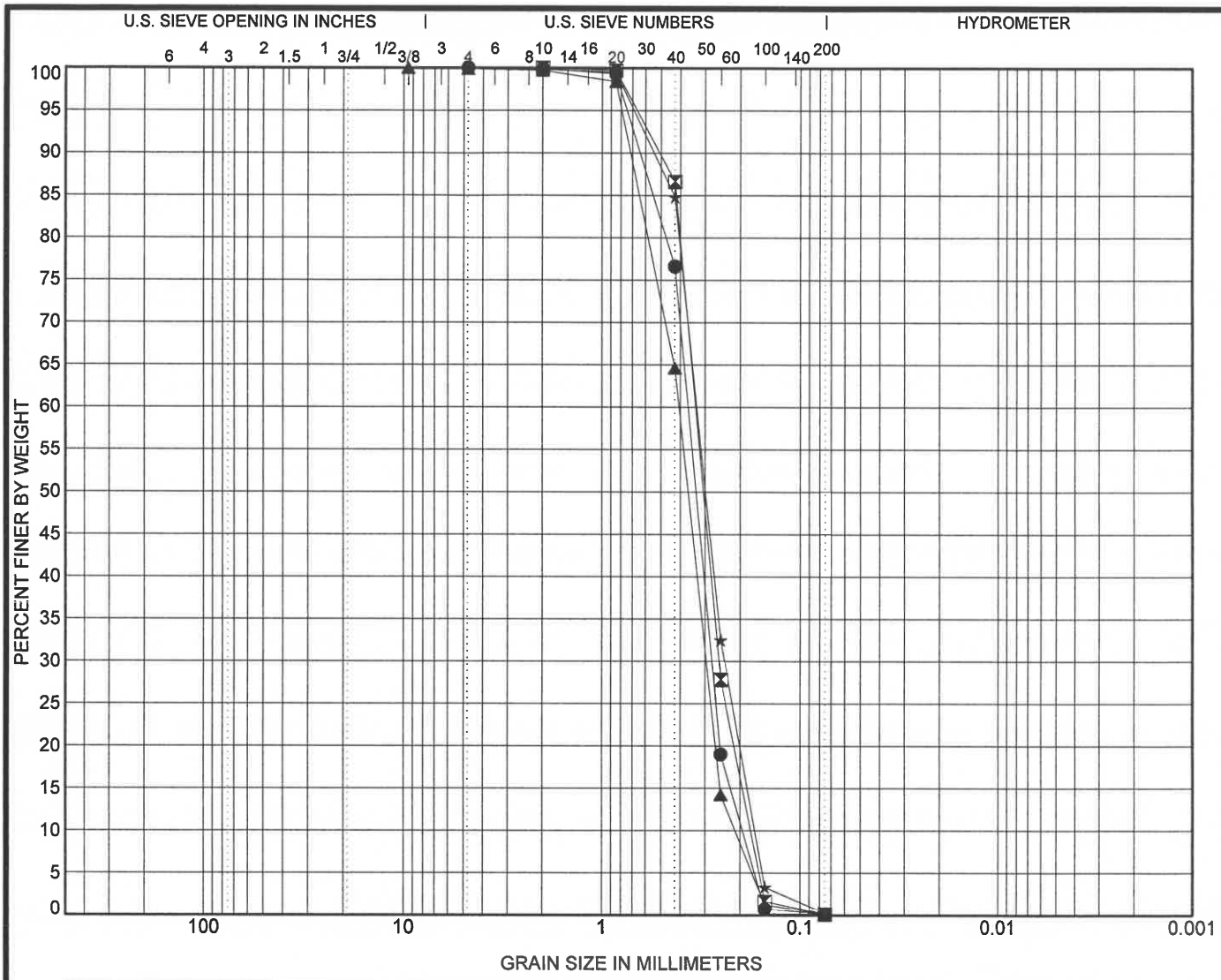
Schnabel ENGINEERING

# GRADATION CURVE

**Project:** Virginia Beach Renourishment
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00 **Testing Lab:** RICH

SIEVE 1/SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/17/18




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| | Specimen | | Sample Description | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|
| ● | Composite 1 | 0.0 ft | POORLY GRADED SAND (SP), fine to coarse grained sand, light brown | -- | -- | -- | 1.08 | 1.88 |
| ⊠ | Composite 2 | 0.0 ft | POORLY GRADED SAND (SP), fine to coarse grained sand, light brown | -- | -- | -- | 1.10 | 1.89 |
| ▲ | Composite 3 | 0.0 ft | POORLY GRADED SAND (SP), fine to coarse grained sand, light brown | -- | -- | -- | 1.02 | 1.91 |
| ★ | Composite 4 | 0.0 ft | POORLY GRADED SAND (SP), fine to coarse grained sand, light brown | -- | -- | -- | 1.03 | 1.96 |

| | Specimen | | Test Method | Testing Lab | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ● | Composite 1 | 0.0 ft | ASTM D422 | RICH | 4.75 | 0.36 | 0.28 | 0.194 | 0.0 | 99.9 | 0.1 | |
| ⊠ | Composite 2 | 0.0 ft | ASTM D422 | RICH | 2 | 0.33 | 0.26 | 0.177 | 0.0 | 99.9 | 0.1 | |
| ▲ | Composite 3 | 0.0 ft | ASTM D422 | RICH | 9.5 | 0.4 | 0.3 | 0.212 | 0.1 | 99.8 | 0.1 | |
| ★ | Composite 4 | 0.0 ft | ASTM D422 | RICH | 4.75 | 0.33 | 0.24 | 0.169 | 0.0 | 99.8 | 0.2 | |

Schnabel ENGINEERING

# GRADATION CURVES

**Project:** Virginia Beach Renourishment
Sandbridge Borrow Area
Offshore Virginia Beach, VA

**Contract:** 18C13103.00

SIEVE 5 SHEET VA BEACH RENOURISHMENT.GPJ SCHNABEL DATA TEMPLATE 2010 02 25.GDT 10/17/18

# APPENDIX D

# PHOTOGRAPHIC DOCUMENTATION
## (PROVIDED ELECTRONICALLY)



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# APPENDIX E

# HYDROGRAPHIC SURVEY DATA



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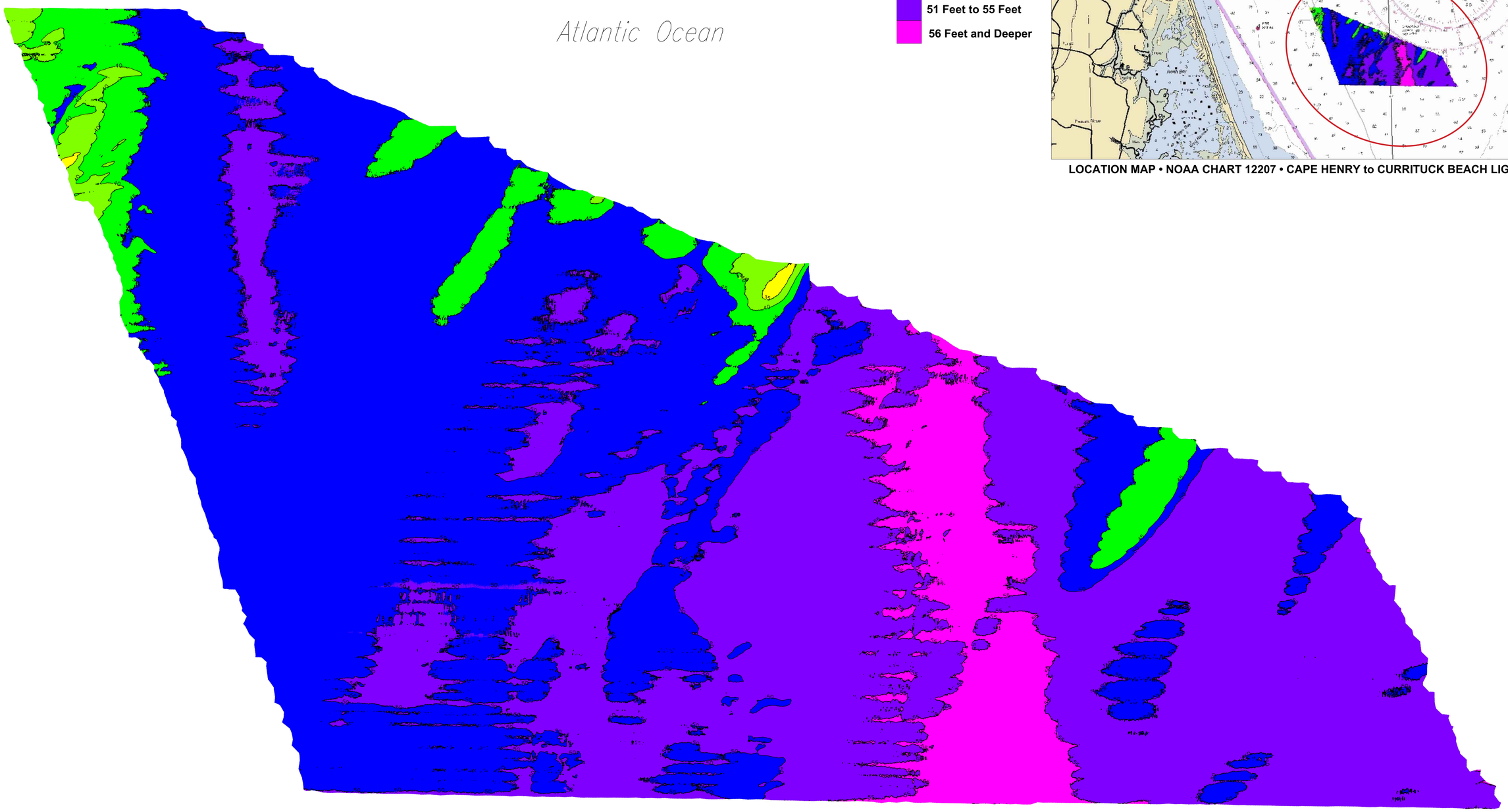
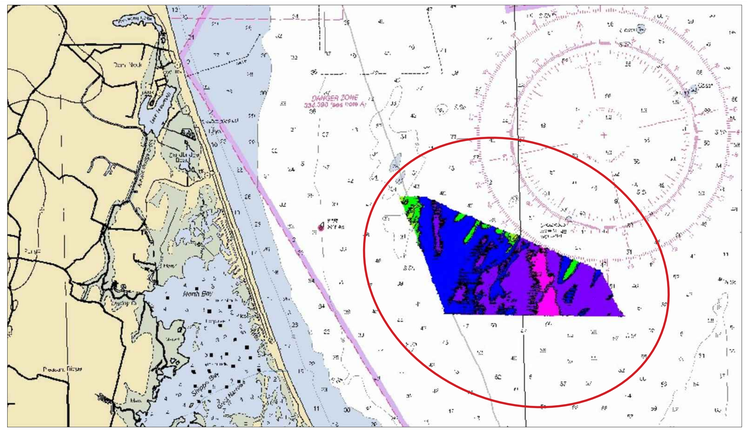



- 0 Feet to 35 Feet
- 36 Feet to 40 Feet
- 41 Feet to 45 Feet
- 46 Feet to 50 Feet
- 51 Feet to 55 Feet
- 56 Feet and Deeper



LOCATION MAP • NOAA CHART 12207 • CAPE HENRY to CURRITUCK BEACH LIGHT

# BORROW AREA A

## SITE PLAN

SCALE: 1" = 650.0'

0 650 1300 1950

## MULTI-BEAM HYDROGRAPHIC SURVEY NOTES:

1. ALL SOUNDINGS WERE CONDUCTED USING:
   - APPLANIX POS MV 120 NAVIGATION AND MOTION SENSOR FOR POSITIONING, HEADING, ATTITUDE, HEAVE AND VELOCITY, BLENDING GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) WITH AN INERTIAL MEASUREMENT UNIT (MU) AND GPS AZIMUTH MEASUREMENT SYSTEM (GAMS), AND APPLANIX POSPac MMS (MOBILE MAPPING SUITE),
   - HYPACK HYSWEEP SOFTWARE 2017A,
   - R2SONIC 2024 (400 kHz) MULTIBEAM SONAR SYSTEM UNIT,
   - VALEPORT *mini*SVS (SOUND VELOCITY SENSOR) LOCATED AT THE SONAR HEAD MOUNT
   - SONTEK CASTAWAY CTD (CONDUCTIVITY, TEMPERATURE AND DEPTH), FOR SOUND VELOCITY CAST.
2. SOUNDINGS WERE CONDUCTED ON FRIDAY, AUGUST 24, SATURDAY, AUGUST 25, WEDNESDAY AUGUST 29, THURSDAY, AUGUST 30, AND FRIDAY, SEPTEMBER 21, 2018.
3. THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULTS OF SURVEYS CONDUCTED ON THE DATES INDICATED, AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITIONS EXISTING AT THAT TIME.
4. SOUNDINGS ARE REFERENCED TO MEAN LOWER LOW WATER (MLLW)
5. HORIZONTAL CONTROL IS BASED ON VIRGINIA STATE PLANE SOUTH COORDINATES, NAD 83, AS ESTABLISHED IN THE FIELD AND SOLELY FOR THE USE OF THIS HYDROGRAPHIC SURVEY.
6. VERTICAL CONTROL WAS OBTAINED FROM KEYNET GPS (TRIMBLE VIRTUAL REFERENCE STATION [VRS] NETWORK) REAL-TIME KINEMATIC (RTK) CORRECTIONS TO NORTH AMERICAN VERTICAL DATUM of 1988 (NAVD88). DATA WAS POST PROCESSED WITH POSPac MMS 8 UTILIZING KEYNET STATION WLP2.
7. CONTOURS WERE INTERPOLATED WITH HYPACK 2017A. CONTOURS ARE AT ONE-HALF FOOT (½') INTERVALS, WITH FIVE FOOT (5') INTERVALS IN BOLD.
8. BORROW AREA A LOCATION WAS PROVIDED BY SCHNABEL ENGINEERING.
9. V-DATUM 2.3' BELOW NAVD 88.

| rev. | date | description | by | appr. |
|---|---|---|---|---|
| | | | | |

approvals

| approved by | for | date |
|---|---|---|
| | | |

seal | seal

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GLEN ALLEN, VIRGINIA 23059

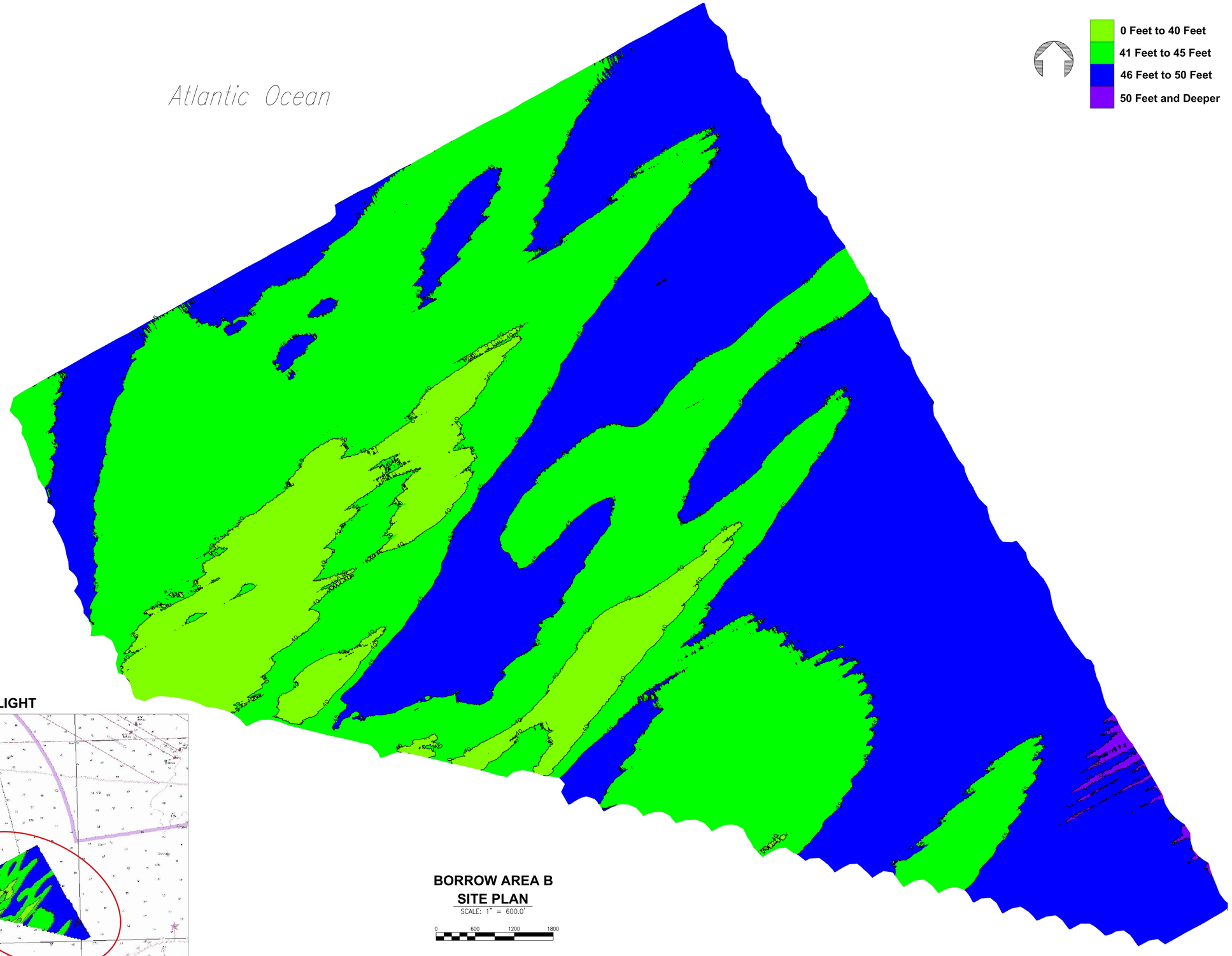
drawn jrh
checked
drftg. approval ADS
date 9/26/2018
FILE S-1161
contract H-767-01

BORROW AREA A

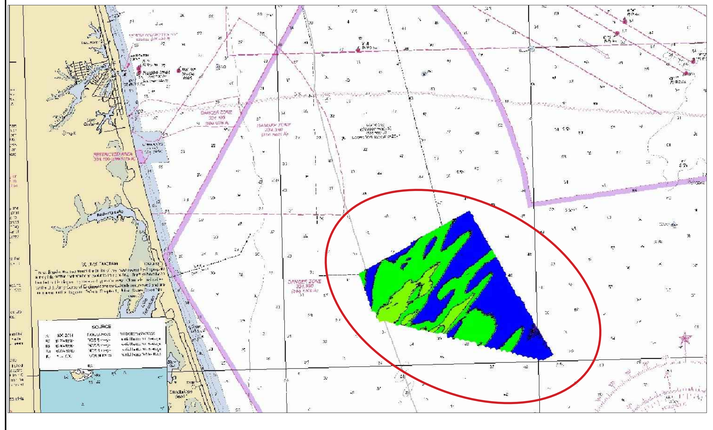
MULTIBEAM HYDROGRAPHIC SURVEY

dwg. no. 1
rev. 0

ISSUED PRINTS




## LOCATION MAP • NOAA CHART 12207
## CAPE HENRY to CURRITUCK BEACH LIGHT



## BORROW AREA B
## SITE PLAN

SCALE: 1" = 600.0'

0 600 1200 1800

## MULTI-BEAM HYDROGRAPHIC SURVEY NOTES:

1. ALL SOUNDINGS WERE CONDUCTED USING:
   - APPLANIX POS MV 120 NAVIGATION AND MOTION SENSOR FOR POSITIONING, HEADING, ATTITUDE, HEAVE AND VELOCITY, BLENDING GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) WITH AN INERTIAL MEASUREMENT UNIT (IMU) AND GPS AZIMUTH MEASUREMENT SYSTEM (GAMS), AND APPLANIX POSPac MMS (MOBILE MAPPING SUITE).
   - HYPACK HYSWEEP SOFTWARE 2017A,
   - R2SONIC 2024 (400 kHz) MULTIBEAM SONAR SYSTEM UNIT,
   - VALEPORT miniSVS (SOUND VELOCITY SENSOR) LOCATED AT THE SONAR HEAD MOUNT
   - SONTEK CASTAWAY CTD (CONDUCTIVITY, TEMPERATURE AND DEPTH), FOR SOUND VELOCITY CAST.
2. SOUNDINGS WERE CONDUCTED ON MONDAY, AUGUST 13, TUESDAY, AUGUST 14, AND WEDNESDAY AUGUST 15, 2018.
3. THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULTS OF SURVEYS CONDUCTED ON THE DATES INDICATED, AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITIONS EXISTING AT THAT TIME.
4. SOUNDINGS ARE REFERENCED TO MEAN LOWER LOW WATER (MLLW)
5. HORIZONTAL CONTROL IS BASED ON VIRGINIA STATE PLANE SOUTH COORDINATES, NAD 83, AS ESTABLISHED IN THE FIELD AND SOLELY FOR THE USE OF THIS HYDROGRAPHIC SURVEY.
6. VERTICAL CONTROL WAS OBTAINED FROM KEYNET GPS (TRIMBLE VIRTUAL REFERENCE STATION [VRS] NETWORK) REAL-TIME KINEMATIC (RTK) CORRECTIONS TO NORTH AMERICAN VERTICAL DATUM of 1988 (NAVD88). DATA WAS POST PROCESSED WITH POSPac MMS 8 UTILIZING KEYNET STATION WLP2.
7. CONTOURS WERE INTERPOLATED WITH HYPACK 2017A. CONTOURS ARE AT ONE-HALF FOOT (½') INTERVALS, WITH FIVE FOOT (5') INTERVALS IN BOLD.
8. BORROW AREA B LOCATION WAS PROVIDED BY SCHNABEL ENGINEERING.
9. V-DATUM 2.3' BELOW NAVD 88.

9/26/2018

| rev. | date | description | by | appr. |
|---|---|---|---|---|
| | | | | |

approvals

| approved by | for | date |
|---|---|---|
| | | |

seal seal

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GLEN ALLEN, VIRGINIA 23059

| | | | |
|---|---|---|---|
| drawn jrh | date 9/26/2018 | contract | |
| checked | FILE S-1160 | H-767-01 | |
| drftg. approval ADS | | | |

BORROW AREA B

MULTIBEAM HYDROGRAPHIC SURVEY

dwg. no. 1 rev. 0

Attachment 3 – 2023 US Fish and Wildlife Service Biological Opinion for Sandbridge Beach Nourishment and Virginia Beach Hurricane Protection Projects and Rudee Inlet Federal Navigation Project, City of Virginia Beach, VA.

# United States Department of the Interior

FISH AND WILDLIFE SERVICE

Virginia Field Office
6669 Short Lane
Gloucester, VA 23061


March 14, 2023

Lesley Dobbins-Noble
U.S. Army Corps of Engineers, Norfolk District
Fort Norfolk
803 Front Street
Norfolk, VA 23510-1011

Re: Sandbridge Beach Nourishment and Virginia Beach Hurricane Protection Projects and Rudee Inlet Federal Navigation Project, City of Virginia Beach, VA, Project Code: 2022-0034807

Dear Lesley Dobbins-Noble:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion (Opinion) based on our review of the referenced project and its effects on the federally listed endangered Kemp's ridley sea turtle (*Lepidochelys kempii*), federally listed threatened Northwest Atlantic distinct population segment (DPS) of the loggerhead sea turtle (*Caretta caretta*), and federally listed threatened North Atlantic DPS of the green sea turtle (*Chelonia mydas*) in accordance with Section 7 of the Endangered Species Act (16 U.S.C. 1531-1544, 87 Stat. 884), as amended (ESA). Your May 25, 2022, request for formal consultation was received on June 8, 2022.

This Opinion is based on information provided in the U.S. Army Corps of Engineers (Corps) May 2022 biological assessment (BA), telephone conversations, email correspondence, field investigations, and other sources of information. The consultation history is located after the literature cited. A complete administrative record of this consultation is on file in this office.

The BA and May 25, 2022, letter included a request for Service concurrence with "not likely to adversely affect" determinations. The Corps determined the proposed action is not likely to adversely affect the federally listed threatened piping plover (*Charadrius melodus*) because the species is rarely observed on or near Virginia Beach or Sandbridge Beach and all known nesting

activity in Virginia is restricted to the Eastern Shore. We concur with this determination because any unlikely occurrences of piping plovers foraging within the action area will result in the birds being flushed to a different location outside of the active construction footprint, the effects of which will be insignificant and discountable. The Corps also determined the proposed action is not likely to adversely affect the federally listed endangered roseate tern (*Sterna dougallii dougallii*) because the species is rarely seen in the vicinity of Virginia Beach and no nesting populations exist in Virginia. We concur with this determination because any unlikely occurrences of roseate terns within the action area will result in the birds being flushed to a different location outside of the active construction footprint, the effects of which will be insignificant and discountable. The Corps also determined the proposed action is not likely to adversely affect the federally listed threatened red knot (*Calidris canutus rufa*) because the species does not nest in the area and disturbances to foraging behavior would be temporary. We concur with this determination because any red knots foraging within the action area would be flushed to a different location outside of the active construction footprint, and the likelihood of repeated flushing is low; therefore, the effects are insignificant and discountable. The Corps determined that the proposed action is not likely to adversely affect the federally listed threatened/proposed endangered northern long-eared bat (*Myotis septentrionalis*) because the coastal shoreline does not provide suitable roosting habitat or hibernacula for the species. We concur with this determination because there does not appear to be suitable habitat for the northern long-eared bat within the action area.

In addition, the Corps determined the proposed action may affect the federally listed endangered leatherback sea turtle (*Dermochelys coriacea*) because this species has previously nested in North Carolina, and Virginia beaches may provide habitat for nesting leatherbacks in the future. We have determined that the proposed action is not likely to adversely affect the leatherback sea turtle because the current northern extent of its nesting range does not include Virginia. Further, in the unlikely event that a stranded leatherback sea turtle is found within the action area during project construction, the proposed avoidance and minimization measures will avoid effects to the species.

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## BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

As defined in the ESA Section 7 regulations (50 CFR 402.02), "action" means "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas."

The following is a summary of the proposed action and a detailed description can be found in the BA.

The Corps is responsible for the ongoing maintenance of the Sandbridge Beach Nourishment and Hurricane Protection Project (Sandbridge), the Virginia Beach Hurricane Protection Project (Virginia Beach), and the Rudee Inlet Federal Navigation Project (Rudee Inlet) as authorized by Congress. The proposed action involves regular construction phases for the maintenance of renourished beaches and the associated material placement at both Sandbridge and Virginia Beach. Nourishment activities at Sandbridge and Virginia Beach may occur at any time of year based on dredge availability. The duration of beach nourishment for these projects is typically 3 to 4 months based on the volume of material placed. The current authorization for Sandbridge is a 50-year term of periodic nourishment beginning in 1998 and ending in 2048, contingent on funding availability. The current authorization for Virginia Beach is a 50-year term of periodic nourishment beginning in 2002 and ending in 2052. The current authorization for Rudee Inlet is a 50-year term beginning in 1991 and ending in 2041.

This Opinion is valid for the referenced projects until the year for which they have been individually authorized (2041: Rudee Inlet, 2048: Sandbridge, 2052: Virginia Beach).

**Sandbridge Beach Nourishment and Hurricane Protection Project**
Sandbridge Beach extends from the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck in the north to the Service's Back Bay National Wildlife Refuge (BBNWR) in the south (Figure 1). Beach nourishment events here occur on a 3-6 year cycle, with the most recent event occurring in spring of 2020. Nourishment frequency depends on weather conditions (i.e., increased erosion due to more storms may require more frequent renourishment), funding availability, and the behavior of subsequently placed material at the project site. The nourishment area is approximately 5.25 miles long and 125 feet (ft) wide. The project dimensions include a 50-ft-wide berm at an elevation of 6 ft North American Vertical Datum (NGVD) with a foreshore slope of approximately 1 vertical foot to 20 horizontal feet along approximately 5 miles (mi) of shoreline. Mean grain size at the placement site ranges between 0.25 millimeter (mm) and 0.35 mm, defined as medium-grained sand. Approximately 2.2 million cubic yards (cy) of material will be placed per renourishment cycle.

Laydown areas for equipment typically measure 40 ft by 30 ft. The main construction staging and laydown area has historically been located in the Little Island Park parking lot at the southern end of Sandbridge Beach, but additional staging areas on the beach will be selected during the project design for each nourishment cycle with input from the City of Virginia Beach. Previously, staging areas were located in paved parking areas that also provided beach access, and the contractor was allowed to store pipeline on the beach.

Appropriate beach-quality sands will be dredged from Sandbridge Shoal Areas A and B and future sand borrow areas coordinated with the Bureau of Ocean Energy Management (BOEM); navigation channels including but not limited to entrance channels to the Chesapeake Bay, including Thimble Shoal Channel, Atlantic Ocean Channel, and Cape Henry Channel; and the Rudee Inlet. The Corps consulted with the National Marine Fisheries Service (NMFS) for the marine portion of the Sandbridge project on December 21, 2017.

**Virginia Beach Hurricane Protection Project**
The beach nourishment area for Virginia Beach extends from 89$^{th}$ Street in the north to Rudee Inlet in the south (Figure 1). The beach nourishment events are expected to occur every 4 or 5 years, with the most recent event occurring in 2019. The nourishment area is approximately 6.60 mi long and 200 ft wide. The renourishment area is predominantly commercial within its southern two-thirds and primarily residential along its northern third. A seawall stretches along the entire commercial segment. The project dimensions include a 100-ft-wide berm at an elevation of 8 ft NGVD with a foreshore slope of approximately 1 vertical foot to 20 horizontal feet. Mean grain size at the placement site ranges between 0.28 mm and 0.46 mm. Approximately 2.0 million cy of material will be placed at Virginia Beach per renourishment cycle. Construction staging and laydown areas are on the beach and may be in different locations with each nourishment event.

Appropriate beach-quality sands will be dredged from Thimble Shoal Channel and the surrounding area, Cape Henry Channel, Atlantic Ocean Channel, Rudee Inlet Channel, and other federal navigation channels and/or future sand borrow areas coordinated with BOEM. As with Sandbridge, the Corps has completed Section 7 consultation with NMFS for the marine portion of this project.

**Rudee Inlet Federal Navigation Project**

The proposed action involves maintenance dredging of the Rudee Inlet Federal Navigation Channel removing approximately 350,000 cy per maintenance cycle dependent on funding, navigation needs, and dredge plant availability. Dredging will occur on at least a quarterly basis to provide safe access to the Atlantic Ocean. Beach-quality sand could be beneficially placed on the adjacent Virginia Beach to the north of Rudee Inlet several times per year, but would only occur over a 2- or 3-week duration per maintenance cycle. Sand may also be placed for beach nourishment and hurricane protection along Sandbridge Beach if coordinated with BOEM. As this activity will occur at least quarterly, sand placement will occur on the beach during a portion of sea turtle nesting seasons over the next 10-year period, and would occur on a more frequent basis, although for a shorter duration, than the Virginia Beach Hurricane Protection nourishment project.

Dredged sand may also be placed nearshore in the surf zone approximately 50 ft off of the Virginia Beach Oceanfront between 1st and 47th Streets, or downdrift of the channel, or at the Lake Rudee or Lake Wesley placement areas depending on the quality of the sand; however, these locations would not impact sea turtles under the Service's jurisdiction.

**Dredging and Material Placement on Beach**

For both Sandbridge and Virginia Beach, a trailing sucker hopper dredge, hydraulic cutterhead dredge, or mechanical dredge may be used. For Rudee Inlet, sandy dredged material would be removed by a small capacity coastal hopper dredge, hydraulic cutterhead dredge, or side cast dredge. Multiple dredges may be used during each cycle. If a hopper or cutterhead dredge is used, material would be hydraulically pumped through a discharge pipeline to the beach construction area; one or more sublines would run along the ocean floor perpendicular to the beach and connect to a discharge pipeline on the beach through which sands are pumped to the beach fill areas. Either one discharge pipeline would extend on shore, approximately mid-beach and parallel to the shoreline, to distribute sand as the constructed beach berm progresses to further areas of the placement site, or multiple sublines may be installed to provide more direct access to sections of the placement area and to minimize pipeline laydown on the beach. At the commercial section of Virginia Beach the discharge pipeline is usually placed along the seawall (i.e., backbeach).

Once the material is placed on the beach, bulldozers and graders distribute the material in areas adjacent to the discharge pipeline. As sand is pumped onto the beach and distributed and graded, additional sections of discharge pipeline are added such that the dredged material outflow is to areas that have yet to be renourished. Therefore, the discharge pipeline only extends across the beach for short periods of time from each subline, which is variable depending on the dredge

type and size, production rates, site conditions, weather conditions, etc. Based on project history and production rates, it is estimated that the Sandbridge and Virginia Beach discharge pipelines would be advanced on average 500 and 200 linear feet per day, respectively. When multiple dredges are used, as is common for these projects, placement is relatively continuous and advancement along the beach occurs more quickly. The typical maximum extent of the discharge pipeline on both Sandbridge and Virginia Beach is approximately 1 mi. During construction, the contractor may choose to construct training dikes on 1 or both sides of the discharge pipeline to contain the dredged material within the beach fill template. Training dikes would be temporary and are generally graded into the beach fill template within 24 hours of being established. Sands in the placement area are graded to meet contract specifications.

**Conservation Measures**

The following conservation measures (CMs) are proposed as part of the action, and will avoid, minimize, and/or offset effects of the proposed action on Kemp's ridley, loggerhead, and green sea turtles.

CM1. Early morning crawl surveys for sea turtle nesting activity will be performed by BBNWR (on Sandbridge Beach) or the Virginia Aquarium (VAQ) Stranding Response Program (on Virginia Beach) regardless of beach nourishment activities occurring; unimpeded egress will be allowed within the active construction zone, and construction equipment work will be briefly halted within the immediate area of an active early morning crawl survey as the surveyor(s) pass.

CM2. The active construction zone, which includes all beach access routes and staging areas between the beach renourishment and construction laydown areas, will be inspected by a NMFS-qualified Protected Species Observer[1] for turtle activity every 2 hours, day and night, between May 1 and November 15, before any equipment crosses the area. Prior to beginning work or if there is a change in the Protected Species Observer during the contract term, the resumes or CVs of each Protected Species Observer will be reviewed by the Corps to ensure they have the appropriate experience with nesting sea turtles. The Corps will also send the resumes to the Service's Virginia Field Office (VAFO) for their records. The Protected Species Observers will have the authority to temporary halt work if evidence of a sea turtle is found on the beach (see CM3).

CM3. If a sea turtle or sea turtle nesting activity is discovered either during a morning crawl survey or during the active construction patrols, all construction/beach nourishment activities will be halted within 500 ft of the turtle and/or evidence of nesting activity or crawls until the sea turtle is in the water and/or the nest is protected for relocation by the properly permitted entity. The VAFO will be contacted by the Protected Species Observer and BBNWR staff (Sandbridge) or VAQ Stranding Response Program staff (Virginia Beach) will relocate the eggs to a previously determined location. Locations for relocated nests will be determined based on where

[1] Qualified Protected Species Observers will have experience identifying adult sea turtles to species, identifying sea turtle tracks on the beach, recognizing signs of a sea turtle nest, and recognizing evidence of a nest boil/hatchling emergence.

the construction activity will be occurring in a given year to avoid passes by construction equipment and be away from the active work area. Contact information and nest relocation locations will be identified in communication plan.

CM4. When night work is performed, all on-beach lighting associated with the project will be limited to the immediate area of active construction. Such lighting will consist of shielded, low pressure, sodium vapor lights or equivalent lighting that conforms with Occupational Safety and Health Administration (OSHA) standards for worker safety. In addition, to minimize impacts to nesting and/or hatchling sea turtles, orange or yellow light filters will be installed on lighting and equipment operating on the beach to the maximum extent practicable from May 1 through November 15 and/or to the extent that it does not conflict with OSHA and Corps' Occupational Health and Safety regulations, standards, or technical guidance or otherwise jeopardize or threaten human safety.

CM5. The beach will be graded to minimize ruts from vehicles, equipment, pipeline, or construction as soon as practicable after construction equipment has been removed from an area. Active construction patrols (i.e., CM2) by Protected Species Observers will continue in these locations until grading is completed.

CM6. Prior to construction activities occurring within the beach environment during sea turtle nesting season, a qualified Corps biologist will conduct pre-construction environmental training for all construction crew members, and additionally those onboarding mid-renourishment event during turtle nesting season. The training will focus on required avoidance/minimization measures and conditions of regulatory agency permits and approvals. The training will also include a summary of sensitive species and habitats present within and adjacent to the construction footprint.

CM7. All non-hazardous solid waste will be properly disposed of within covered receptacles and emptied at regular intervals to avoid attracting predators that may depredate sea turtle eggs and hatchlings. Construction debris, waste materials, packaging material, etc. will be removed from the work site daily.

CM8. All equipment maintenance and staging and dispensing of fuel, oil, coolant, or any other toxic substances will occur in developed or otherwise designated non-sensitive areas. These areas will have best management practices implemented to prevent toxic substances from entering the beach environment, such as secondary catchment pans under parked equipment. If a spill occurs outside of a designated area, the cleanup will be immediate and documented.

CM9. USACE will coordinate with VAFO, Back Bay National Wildlife Refuge (Sandbridge), and VAQS (Virginia Beach) to establish a standard operating procedure including a predetermined, flat rate cost for nest relocation specific to nests threatened by beach nourishment activities within the federal project limits during active beach nourishment construction. Once this standard operating procedure is agreed upon, USACE will reimburse the appropriately permitted entity accordingly.

Figure 1. Vicinity map with project sites (from BA).

## ACTION AREA

The action area is defined (50 CFR 402.02) as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." The Service has determined that the action area for this Opinion consists of the beach placement areas at Sandbridge Beach and Virginia Beach, construction staging/laydown areas at both locations, and routes for equipment from staging/laydown areas to construction areas. This includes all terrestrial areas both within the intertidal and above the high tide line on Sandbridge Beach between the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck and BBNWR, as well as on Virginia Beach between 89th Street and Rudee Inlet.

## STATUS OF THE SPECIES

Per ESA Section 7 regulations (50 CFR 402.14(g)(2)), it is the Service's responsibility to "evaluate the current status of the listed species or critical habitat." To assess the current status of the species, it is helpful to understand the species' conservation needs. The Service frequently describes conservation needs via the conservation principles of resiliency (ability of species/populations to withstand stochastic events which is measured in metrics such as numbers, growth rates), redundancy (ability of a species to withstand catastrophic events which is measured in metrics such as number of populations and their distribution), and representation (variation/ability of a species to adapt to changing conditions which may include behavioral, morphological, genetics, or other variation) (collectively known as the three Rs) (Wolf et al. 2015, Smith et al. 2018). The Service can then apply the appropriate regulatory framework and standards to these principals to address a variety of ESA-related decisions (e.g., listing status, recovery criteria, jeopardy and adverse modification analysis). For Section 7(a)(2) purposes, the 3 Rs can be translated into the reproduction, numbers, and distribution (RND) of a species.

### Kemp's Ridley Sea Turtle

The Service listed the Kemp's ridley sea turtle as endangered on December 2, 1970 (35 FR 18319). The following is a summary of the species' general life history drawn from the final listing rule 2015 5-year review (NMFS and Service 2015), the 2011 recovery plan (35 FR 18319, NMFS et al. 2011), and other literature. For a more detailed account of the species description, life history, population dynamics, threats, and conservation needs, refer to https://ecos.fws.gov/ecp/species/5523.

The Kemp's ridley is the smallest of all sea turtle species with adults reaching about 2 feet in length. It is olive-grey in color, approximately the same color as a sandy beach. They are distributed throughout the Gulf of Mexico and along the Gulf Stream of the U.S. Atlantic seaboard.

Nesting typically occurs on the Gulf Coast beaches of Mexico and Texas from April to July; however, they occasionally nest elsewhere within the Gulf of Mexico and along the Gulf Stream as far north as southern Virginia (Keinath et al. 1994, Godfrey 1996, Foote and Mueller 2002, Frey et al. 2008, NMFS et al. 2011, VDWR 2021, unpublished data). Unlike other sea turtles that

primarily nest at night, Kemp's ridleys usually nest during daylight hours (Miller 1997). Nests have an average of 104 eggs per clutch, which incubate for 50 to 55 days before hatching (Marquez-Millan 1994). Sea turtles lay many eggs, but studies estimate that between 62 and 80 percent of Kemp's ridleys nests actually hatch and have hatchlings successfully reach the water (NMFS et al. 2011). Of these, most do not survive past the hatchling stage and reach adulthood. Their survival rate increases as they grow. Temperatures prevailing during the middle third of the incubation period determine the sex of hatchlings; higher temperatures produce more females and lower temperatures produce more males (Morreale et al. 1982, Miller 1997). When they emerge (usually in the early morning hours; Chavez et al. 1968), hatchlings use multiple environmental cues including natural light from the rising sun on the water to navigate the beach to the water's edge, then make their way through currents to open water using wave and magnetic orientation to find foraging and development habitat as oceanic-stage juveniles (Manzella et al. 1991, Morreale and Standora 2005).They migrate up and down the Gulf Stream before the vast majority return to nest in Tamaulipas, Mexico. Females reach sexual maturity at 10 to 17 years (Snover et al. 2007). Individuals may nest up to three times during a nesting season, but typically only nest every second or third year (NMFS et al. 2011).

The 2011 recovery plan identified conditions that we believed would result in recovering the species (see NMFS et al. 2011 for more details). The primary actions to address these criteria include protection of nesting habitat, nest predation prevention, reducing fisheries interactions, community socioeconomic programs in nesting areas, and monitoring programs. The primary factors influencing the status include egg mortality from predation and collection, and fisheries bycatch of neritic and oceanic-stage hatchlings and juveniles caught in shrimp trawls. The recovery plan does list beach nourishment as a potential threat to the species; however, this activity is unlikely to occur at their main nesting beach in Mexico, and thus not a significant threat overall. Another common threat is the development of nesting beaches and the ensuing light pollution that can disorient hatchlings and result in their death. The 2011 recovery plan was optimistic that the species could soon be downlisted with the exponential growth we had observed until that time. Since then, nesting population numbers (which we use to infer the population as a whole) has leveled off and both increased and decreased in recent years.

Population abundance estimates of Kemp's ridleys have been focused on their main nesting beaches in Mexico where 99% of the species nests. Kemp's ridley population status and trends have been measured by annual numbers of nests and hatchlings released. Although there has been a substantial increase in the Kemp's ridley population since the mid-1980s, the number of nesting females is still below the number of nesting females per season required for downlisting (n=10,000), although population estimates have approached this number several times in the past 10 years (Caillouet 2021), and the number of hatchlings released in a season (n=300,000) needed for downlisting has been exceeded. Only a very small subset of Kemp's ridleys nest on the Atlantic seaboard and the degree to which migrants along the Atlantic coast contribute to the overall breeding population is not well understood (NMFS and Service 2015). Overall results from population modeling indicate the population is not recovering and cannot meet recovery goals unless survival rates improve (NMFS and Service 2015).

The Service considers the entirety of the Kemp's ridley species as one large population; juveniles tagged while foraging in nearshore Atlantic waters have been subsequently observed nesting on the primary nesting beach in Mexico (Schmid 1995, Chaloupka and Zug 1997, Schmid and Witzell 1997, Schmid and Woodhead 2000), indicating their recruitment to the adult stage in the Gulf of Mexico. This fact makes it nearly impossible to reach redundancy, representation, and resiliency for the species.

In summary, as a whole, the rangewide status of the species is stable and the Service recommended maintaining the current classification as an endangered species in its last 5-year review (NMFS and Service 2015).

**Loggerhead Sea Turtle**

The Service listed the Northwest Atlantic DPS of the loggerhead sea turtle as threatened on September 22, 2011 (76 FR 58867); however, it was previously listed as threatened throughout its worldwide range on July 28, 1978 (43 FR 32800). The following is a summary of the loggerhead sea turtle's general life history drawn from the final listing rule and recovery plan (NMFS and Service 2008) and other literature. For a more detailed account of the species description, life history, population dynamics, threats, and conservation needs, refer to https://ecos.fws.gov/ecp/species/1110.

The loggerhead Northwest Atlantic Ocean DPS occurs within the Northwest Atlantic along the coasts of North America, Central America, northern South America, the Antilles, and the Bahamas, but nesting is concentrated in the southeastern U.S. and on the Yucatan Peninsula in Mexico. The Northwest Atlantic Ocean DPS is further broken into 5 recovery units. The Northern Recovery Unit occurs within the proposed action area and includes loggerheads originating from nesting beaches from the Florida-Georgia border north to Virginia and Maryland (Graham 1973, NMFS and Service 2008).

As with other sea turtle species, loggerheads nest on sandy beaches by burying eggs in the sand, typically at night. Mean clutch size varies among loggerhead populations but the average range for the Northwest Atlantic Ocean DPS is 100-128 eggs per clutch along the southeast U.S. coast (Dodd 1988). The percentage of these that successfully hatch, emerge, and reach the water is much lower. Of these, most do not survive past the hatchling stage and reach adulthood. Their survival rate increases as they grow. Nests incubate for variable periods of time depending on nest temperature but typically incubation takes 50-70 days. As with other species, temperatures prevailing during the middle third of the incubation period determine the sex of hatchlings; higher temperatures produce more females and lower temperatures produce more males (Morreale et al. 1982, Miller 1997). The pivotal temperature (the constant incubation temperature of eggs that will produce equal numbers of males and females) in loggerheads is approximately 29°C (Limpus et al. 1985, Mrosovsky 1988, Leblanc et al. 2012). When they emerge (typically at night), hatchlings use multiple environmental cues including natural light from the moon on the water to navigate the beach to the water's edge, then make their way through currents to open water using wave and magnetic orientation to find foraging and development habitat as oceanic-stage juveniles (Bolten 2003, Morreale and Standora 2005).

They spend several years there before returning to nearshore waters of the U.S. Atlantic coast to forage and continue to mature as neritic-stage juveniles. Age to maturity for loggerheads is estimated at 32-35 years (Snover 2002). Females in the Northern Recovery Unit lay an average of 2-5 nests per season, each 12-16 days apart (Addison 1996, Webster and Cook 2001); they typically have high site fidelity and will return to beaches within 20 kilometers from where they hatched to nest once they reach reproductive age (Bowen et al. 2005, Shamblin et al. 2017). Females do not nest every year; Northwest Atlantic loggerheads have a mean remigration interval of 2-4 years.

To meet the goal of recovery of the loggerhead Northwest Atlantic Ocean DPS, the recommendation for the Northern Recovery Unit is at least a 2% annual rate of increase over a generation time of 50 years, resulting in 14,000 or more nests annually as a result of a corresponding increase in the number of nesting females (NMFS and Service 2008). The primary actions to address these criteria include monitoring population trends, minimizing nesting beach alteration/destruction, minimizing fisheries bycatch, reducing vessel interactions, and working with foreign nations on regulations and enforcement. The primary factors influencing the status include nesting habitat modification/destruction and mortality associated with bycatch in shrimp trawl, longline and other fisheries.

In summary, as a whole, the status of the DPS is stable; the most current nesting trend for the Northwest Atlantic Ocean DPS, from 1989 to 2010, is very slightly negative, but the rate of decline is not statistically different from zero (76 FR 58867). The DPS maintains multiple nesting populations over a broad and diverse geographic range contributing to its redundancy and representation, and therefore overall viability.

**Green Sea Turtle**

The Service listed the North Atlantic DPS of the green sea turtle as threatened on April 6, 2016 (81 FR 20057); however, the green sea turtle was previously listed throughout its worldwide range on July 28, 1978 (43 FR 32800). The following is a summary of the green sea turtle North Atlantic DPS life history drawn from the status review (Seminoff et al. 2015) and proposed (80 FR 15271) and final listing rules. For a more detailed account of the species description, life history, population dynamics, threats, and conservation needs, refer to https://ecos.fws.gov/ecp/species/C00S.

Green sea turtles nest on tropical ocean-facing sandy beaches by burying eggs in the sand; clutch size varies widely among green turtle populations but the average is between 100 and 136 eggs per clutch (Hirth 1997, Witherington and Ehrhart 1989). Studies estimate that between 62 and 92 percent of North Atlantic green sea turtle eggs actually hatch (Seminoff et al. 2015). Of these, a smaller percentage successfully reach the water. Most do not survive past the hatchling stage and reach adulthood. Their survival rate increases as they grow. Green sea turtle nests incubate for variable periods of time depending on nest temperature but typically incubation takes 50-70 days. Temperatures prevailing during the middle third of the incubation period determine the sex of hatchlings; higher temperatures produce more females and lower temperatures produce more males (Morreale et al. 1982, Miller 1997). The pivotal temperature in green sea turtles varies

with population, ranging from approximately 28.0–30.3°C (Broderick et al. 2001, Godfrey and Mrosovsky 2006). As with all sea turtles, when they emerge, hatchlings use multiple environmental cues including natural light from the moon on the water to navigate the beach to the water's edge, then make their way through currents to open water using wave and magnetic orientation to find foraging and development habitat as oceanic-stage juveniles (Witherington et al. 2012, Vander Zanden et al. 2013). They spend several years there before returning to nearshore waters to forage and continue to mature as neritic-stage juveniles. In the Atlantic, green sea turtles reach sexual maturity at 35-50 years old (Goshe et al. 2010). Females lay multiple nests per season, on average 10-17 days apart (Miller 1997); they typically have high site fidelity and will return to their natal beaches to nest once they reach reproductive age. Females do not nest every year; green sea turtles have a mean remigration interval of 2-5 years (Miller 1997).

The range of the North Atlantic DPS includes areas of the Caribbean, Central America and North America and extends across the Atlantic to the east to the coats of Europe and Africa. The DPS exhibits high nesting abundance, with an estimated total of 167,424 females at 73 nesting sites. Nesting data indicate long-term increases at all major nesting sites. There is little genetic substructure within the DPS, and turtles from multiple nesting beaches share common foraging areas. Nesting is geographically widespread and occurs at a diversity of mainland and insular sites (81 FR 20057).

NMFS and the Service finalized a recovery plan for the species in 1991. However, the final listing rule for the North Atlantic DPS (81 FR 20057) has more current information. The final rule cites the following conservation needs for the green sea turtle North Atlantic DPS: nesting and foraging habitat protection and restoration, reduction or elimination of harvest, reduction in the incidence of fibropapillomatosis, and comprehensive and effective protective regulations. The primary factors influencing the status include the current and projected destruction and modification of its habitat; legal and illegal harvest of turtles and eggs; disease and predation; inadequacy of regulatory mechanisms to regulate the underlying threats; and other factors (i.e., fisheries bycatch, channel dredging, marine debris, cold stunning, and climate change).

In summary, as a whole, the status of the DPS is improving; high nesting abundance, increasing trends, connectivity, and spatial diversity provide the DPS with resilience against current threats, while its wide geographic range and spatial diversity add redundancy and representation to its overall viability (81 FR 20057).

**Climate Change**

Climate change has numerous documented and projected effects on sea turtles throughout their ranges affecting all life stages (Hawkes et al. 2007). Because climate change is likely to have similar general effects on all three species, this section is not broken out by species to avoid repetition, however information specific to individual species is noted as such. In this section, climate change effects are summarized from the Kemp's ridley recovery plan (NMFS et al.

2011), the Service's final rule to list 11 DPSs of the green sea turtle as endangered or threatened (81 FR 20058), and the Service's final critical habitat designation for the loggerhead sea turtle Northwest Atlantic Ocean DPS (79 FR 39756). Species with high fecundity and low juvenile survival, such as sea turtles, are the most vulnerable to climate change and elevated levels of environmental variability (Cavallo et al. 2015, Halley et al. 2018). Temperature changes and sea level rise are likely to change ocean currents and the movements of hatchlings, surface-pelagic juveniles, and adults (Hamann et al. 2007, Hawkes et al. 2009, Poloczanska et al. 2009, Cavallo et al. 2015).

Increasing air and sea surface temperatures are strongly correlated to sand temperatures (Fuentes et al. 2011, Santos et al. 2017). In these species, where temperature determines the sex of the developing embryo, even a few degrees change in beach temperatures over the next decade will cause a strong shift toward more female hatchlings being produced. Data suggest that a female bias may be present in the Kemp's ridley population and would be advantageous to the short-term recovery of this sea turtle, but manipulation of natural sex ratios may have long-term, unknown positive or negative consequences. Increasing sand temperatures could lead to embryonic mortality at 35 °C (Ackerman 1997) and the loss of male hatchlings at 30.3 °C (Godfrey and Mrosovsky 2006, Fuentes et al. 2011).

As climate change progresses (i.e., temperatures increase, ocean acidification increases, sea level rises, and storms increase in frequency and intensity), sea turtles that nest on low-lying beaches with inhospitable sand temperatures will produce less viable offspring than previously and as compared to those nesting at higher elevations and on beaches with sand temperatures conducive to embryonic development. This adaptation scenario will have a net effect of reducing the overall abundance of sea turtle populations in the future (e.g., reduced production at the low-lying beaches and constant production at the higher elevation beaches). The capacity for green sea turtles to quickly adapt is questionable because they are long-lived and late-maturing, and the species has previously evolved in a climate that changed at a much slower rate than projections suggest for the next 100 years (Hamann et al. 2007, Hawkes et al. 2009, Poloczanska et al. 2009). Slow evolutionary rates (Avise et al. 1992) and smaller population sizes (as a result of previous declines and relative to pre-exploitation populations; McClenachan et al. 2006) may further limit the species' ability to adapt (Hawkes et al. 2009). Therefore, adaptation by natural selection for green sea turtles is likely to be limited and may not match the rate of climate change impacts within the foreseeable future. In response to climate change, green sea turtles may alter their behavior; for example, nesting females may use beaches with higher elevation or cooler sands (Santos et al. 2017).

Sea level rise is likely to reduce the availability and increase the erosion rates of nesting beaches, particularly on low-lying, narrow coastal and island beaches (Fish et al. 2005, Hawkes et al. 2009, Fuentes et al. 2010). On undeveloped and unarmored beaches with no landward infrastructure, a typical beach profile may maintain its configuration but will be translated landward and upward (Bruun 1962); however, along developed coastlines, and especially in areas where erosion control structures have been constructed to limit shoreline movement, sea level rise is likely to cause severe effects on nesting females and their eggs (Hawkes et al. 2009,

Poloczanska et al. 2009). Hurricanes and severe storms can remove embryonic and primary dunes, or create wash-over channels, thereby reducing suitable habitat for egg deposition and incubation. Incubating eggs and emerging hatchlings can be killed due to prolonged exposure to seawater over the top of the nest, by accretion of sand above the nest, or by the eggs being unearthed and washed out to sea (NMFS et al. 2011). In the case of the Kemp's ridley where most of the critical nesting beaches are undeveloped, beaches may shift landward and still be available for nesting. Impacts from climate change, especially due to global warming, are likely to become more apparent in future years (Intergovernmental Panel on Climate Change 2007). Although rapid changes in sea level are predicted, estimated timeframes and resulting water levels vary due to the uncertainty about global temperature projections and the rate of ice sheets melting and slipping into the ocean (Bindoff et al. 2007, Witt et al. 2010).

## STATUS OF CRITICAL HABITAT

No critical habitat has been designated for the Kemp's ridley sea turtle.

Critical habitat for the Northwest Atlantic Ocean DPS of the loggerhead sea turtle has been designated in portions of North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi; however, this action does not affect any of those areas, and will not be further discussed within this Opinion.

Critical habitat for the North Atlantic DPS of the green sea turtle has been designated in Puerto Rico; however, this action does not affect this area, and will not be further discussed within this Opinion.

## ENVIRONMENTAL BASELINE

In accordance with 50 CFR 402.02, the environmental baseline refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

The southern two-thirds of Virginia Beach is heavily developed, and the sand environment is denuded due to heavy foot traffic from tourism and the presence of the seawall. Hydraulic data from the Corps indicate that the shoreline at Virginia Beach from 89$^{th}$ Street to Rudee Inlet experiences moderate to severe erosion (2-3 ft per year). The average erosion rates for the Sandbridge shoreline ranges from 2-10 ft per year. Several major storms, nor'easters, and hurricanes have struck the area in recent years, causing severe losses of sand and coastal

flooding. The ocean front is susceptible to wave erosion on the beach berm and dunes during storm events and high wind events, hence the need for beach renourishment. Since at least 2002, beach nourishment projects have occurred along Sandbridge and Virginia Beach (Service 2001).

The Virginia Department of Wildlife Resources (VDWR) has tracked sea turtle nesting activity through an ongoing database maintained since 1970, although regular patrols during the nesting season did not begin until the late 1970s, so the record is incomplete. Virginia generally is the northernmost extent of nesting range for all 3 sea turtle species. As such, it is considered to be on the periphery of their nesting habitat (i.e., outside core nesting habitat). From late May through the end of August, BBNWR staff and volunteers patrol Sandbridge and surrounding beaches, and the VAQ staff and volunteers patrol Virginia Beach and surrounding beaches, by ATV or 4WD vehicle for evidence of sea turtle nesting (see CM1 above). During these patrols, any stranded sea turtles are documented and reported to the VAQ Stranding Center which maintains the local sea turtle stranding database.

The information reported below is not exclusively within the action area (Sandbridge and Virginia Beaches) because while sea turtles generally exhibit nest site fidelity, they may come back to nest site locations approximately 3 mi away (Miller 1997), which could result in nesting attempts either inside or outside the action area.

**Status of the Species within the Action Area**

Kemp's Ridley Sea Turtle

Kemp's ridleys have been recorded off the coast of southeastern Virginia throughout the year. Strandings generally peak in June and the fall (Barco and Swingle 2014). In 2021, 26 Kemp's ridleys stranded on Virginia's southeastern shore, 7 of which were recovered alive (Costidis at al. 2022) and in 2020, 18 Kemp's ridley's stranded on Virginia's southeastern shore, 6 of which were recovered alive (Costidis at al. 2021); it is likely that a live Kemp's ridley will strand within the action area during the lifetime of this project. Most Kemp's ridleys that strand in Virginia are juveniles (less than 6 years of age) (Barco and Swingle 2014).

Three Kemp's ridley nests have been recorded in Virginia since 1970: in 2012, 2014, and most recently on Sandbridge Beach in 2021 (VDWR 2021 unpublished data). Therefore, while the action area is outside the species' usual nesting beaches in Mexico, it is likely that a Kemp's ridley will nest within the action area during the remaining duration of either the Sandbridge or Virginia Beach project (with end dates of 2048 and 2052, respectively). As the Kemp's ridley population continues to increase, we may continue to see more outliers nesting far outside their usual range.

Loggerhead Sea Turtle

The Northwest Atlantic DPS of loggerheads is present in waters off Virginia's coast throughout the year. Loggerhead strandings usually peak in May and June (Barco and Swingle 2014). In 2021, 32 loggerhead sea turtles stranded on Virginia's southeastern shore, 2 of which were recovered alive (Costidis et al. 2022) and in 2020, 45 loggerheads stranded on Virginia's

southeastern shore, 7 of which were recovered alive (Costidis et al. 2021); it is likely that a live loggerhead sea turtle will strand within the action area during the lifetime of the project. Most loggerheads that strand in Virginia are juveniles (Barco and Swingle 2014).

A total of 151 loggerhead nests have been recorded on southeastern Virginia beaches (i.e., south of the Chesapeake Bay Bridge-Tunnel) since 1970 (VDWR 2021, unpublished data). Additional nests have likely not been recorded in this time period. In addition to successful nesting attempts, there were 65 false crawls within the vicinity of the action area, during which the female is on the beach and subject to the various threats discussed below in the effects analysis. False crawls are a fairly common occurrence in which the female does not successfully nest, and happen due to either human interference or other unknown causes. During 2012-2021, 1 to 10 confirmed loggerheads nests were recorded each year within the vicinity of the action area (VDWR 2021, unpublished data), for an average of 5.5 nests per year. These nests had an average 112 eggs and a hatching success rate of 72%, when adjusted for extenuating circumstances, such as predation and overwashing from storm events when total clutches were lost[2] (VDWR 2021, unpublished data). We anticipate that, as effective recovery actions are implemented and this DPS begins to experience positive population growth, there will be more nesting females looking for suitable nesting habitat within the vicinity of the action area. We also anticipate that as climate change effects increase (discussed in more detail at the end of this section and in the previous section), nesting activity may begin to shift north to areas that become more suitable while southern portions of nesting habitat become less suitable.

Green Sea Turtle

The North Atlantic DPS of the green sea turtle is present in waters off Virginia's coast throughout the year. Strandings have been recorded in the action area during summer and fall (Barco and Swingle 2014). In 2021, 3 green sea turtles stranded on Virginia's southeastern shore; however, 0 were recovered alive (Costidis et al. 2022) and in 2020, 6 green sea turtles stranded on Virginia's southeastern shore, 1 of which was recovered alive (Costidis et al. 2021). Most green sea turtles that strand in Virginia are juveniles (Barco and Swingle 2014). Six green sea turtle nests have been recorded in Virginia since 1970, all in the extreme southeast portion of the state, including 1 on Sandbridge Beach (VDWR 2021, unpublished data). As with Kemp's ridleys, the frequency of green sea turtle nesting in Virginia appears to be increasing and 5 of the 6 nests have been found within the past 5 years. We anticipate that green sea turtles will continue to nest within the action area within the duration of the beach nourishment projects, and they may increase in numbers/frequency as climate change effects occur.

Climate change may cause all 3 species of sea turtle to alter their behavior by seeking out cooler sand in which to nest, or we may see higher survival rates of eggs and hatchlings in cooler sand resulting in more adults returning to those areas to nest (Fisher et al. 2014). Since the action area is at the northern extent of the recorded nesting activity for all 3 species, as more southern beaches warm, nests may experience increased egg mortality and nesting activity may shift in a northerly direction. In addition, some southern nesting beaches have been producing highly female-skewed sex ratios for decades (e.g., Hanson et al. 1998), thus northern beaches that

[2] Nests were relocated into a confined hatchery setting until 2015.

produce more males for each population may become more important. As noted above, the extent to which sea turtles will be able to adapt to changing environmental conditions is unknown given their long lifespan and slow evolutionary rates.

## EFFECTS OF THE ACTION

In accordance with 50 CFR 402.02, effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see § 402.17).

The potential effects of the proposed action are described in Table 1. We expect that effects to all 3 sea turtles will be the same, as their life history needs within the beach environment are the same (namely, for reproduction). As such, the effects analysis within Table 1 applies to all 3 species. Those components of the proposed action determined to result in "not likely to adversely affect" are described in Table 1 and will not be further discussed in this Opinion. Components of the project that are likely to adversely affect all 3 species of sea turtle are described in Table 1 and include:

- Construction Equipment Operation
- Addition of Sand
- Artificial Lighting of Construction Area

The relocation of nests out of the construction area will introduce some inherent risks to the eggs; however, the likelihood of survival is much greater than if the nest were left *in situ* where beach nourishment is still occurring. Only individuals having the appropriate federal permits will perform nest management procedures. Because Service permits issued to these individuals/entities have already undergone ESA Section 7 consultation, effects to sea turtles from nest locating, nest relocation, and nest monitoring conducted by these permittees will not be analyzed further in this Opinion.

Table 1. Potential effects of the proposed action on Kemp's ridley, loggerhead, and green sea turtles.

| Activity | Environmental Impact or Threat | Stressors | Stressor Pathway | Exposure (Resource Affected) | Range of Response | Conservation Need Affected | Demographic Consequences | NLAA or LAA |
|---|---|---|---|---|---|---|---|---|
| Construction Equipment Operation | physical impacts to eggs, hatchlings, juveniles, adults; habitat disturbance | crushing, burial, entrapment, energy expenditure, desiccation, predation, disturbance, stress, toxicity | Vehicle strike of nesting or stranded adult may crush turtle. Vehicle running over nest may crush or bury eggs. Vehicle running over nest may cause compaction. Vehicle running over nest may crush or bury hatchlings. Emerged hatchlings may become trapped in vehicle ruts leading to energy expenditure, desiccation, and predation. Construction noise may deter or stress nesting females. | habitat, individual (all life stages), population | Harm, wound, kill | Breeding, sheltering | Numbers; reproduction | LAA |
| | **Comments:** Most of the above effects will be minimized through implementation of CMs 2, 3, and 5. Construction equipment will be traversing the beach from staging areas to active work sites at all hours of the day and night, which increases the risk of running over stranded or nesting adults and hatchlings (wounding or killing). There is a small possibility that a nesting female may be struck or deterred from nesting by a vehicle if she enters the beach in between times the Protected Species Observer is patrolling that section of the beach, or that a nest is missed completely and as a result, left *in situ* where construction will occur; Protected Species Observers will inspect the active construction zone every 2 hours but cannot patrol/inspect all of the beach at once. If a nest is left *in situ* and hatchling sea turtles encounter a large vehicle rut on their way to the ocean, they will most likely be unable to exit. This will lead to the use of energy stores meant to use to reach the ocean and will decrease their chance of survival. Becoming stuck in large vehicle ruts may also expose hatchlings to daytime temperatures and direct sunlight, which may kill them before they can reach the ocean (Hosier et al. 1981, Aguilera et al. 2019). This would also make them more susceptible to both aerial and terrestrial predators, which may wound or kill them. Nesting females may be deterred from entering beach by excessive noise or construction activities but would likely nest in a different location nearby; this would result in an unnecessary energy expenditure. Likewise, a nesting female may be disturbed by construction activities and abandon a nesting attempt, leaving to nest elsewhere. If nests are missed and left *in situ*, construction equipment may run over nests, causing compaction which in turn may lead to changes in moisture, gas exchange, and temperature in the nest chamber, leading to egg mortality (Ackerman 1980, Ackerman 1997, Carthy et al. 2003). The nesting habitat will temporarily be disturbed while construction equipment is on the beach but will return to habitable conditions upon project completion. | | | | | | | |
| Equipment Staging | physical impacts to adults | energy expenditure | Equipment may present obstacle to nesting adult | Individual (adult) | N/A | N/A | N/A | NLAA |
| | **Comments:** We expect in some years beach renourishment will occur outside the active nesting season and these effects will not occur. Equipment concentrated in 1 location on the beach may prevent a nesting adult from continuing to nest, resulting in a false crawl (wasted energy); however, she would be able to nest elsewhere, and the amount of area blocked by the staged equipment will be minimal. Therefore, effects to sea turtles are expected to be insignificant and discountable. | | | | | | | |
| Addition of Sand | physical impacts to adults and hatchlings; habitat disturbance; habitat alteration; addition of beach area | energy expenditure, displacement, desiccation, predation, disturbance, reduced nest success | Obstructions on beach may cause adult to waste energy. Emerged hatchlings may become displaced, leading to desiccation and predation. Changes to existing substrate may lead to less hatching success. | habitat, individual (all life stages), population | Harm, wound, kill | Breeding, sheltering | Numbers, reproduction | LAA |

| Activity | Environmental Impact or Threat | Stressors | Stressor Pathway | Exposure (Resource Affected) | Range of Response | Conservation Need Affected | Demographic Consequences | NLAA or LAA |
|---|---|---|---|---|---|---|---|---|
| | **Comments:** Most of the above effects will be avoided or minimized through implementation of CMs 2, 3, and 5. Nesting females may be prevented from continuing up the beach by either the discharge pipeline running parallel to the beach or by the training dikes, and they would either return to the water to then nest in a different location nearby or would nest on the shoreline-side of the pipeline/dike, resulting in an unnecessary energy expenditure. Additionally, the pipeline may block up to a mile of habitat, resulting in the female needing to make multiple nesting attempts. There is a small possibility that a nest is missed and left *in situ* despite having CM3 in place; Protected Species Observers will inspect the active construction zone every 2 hours but cannot patrol/inspect all of the beach at once. If a nest is left *in situ,* emerged hatchlings that encounter a pipeline or dike running parallel to the beach may use energy stores meant to use to reach the ocean, decreasing their chance of survival (harm). Obstacles blocking the hatchlings from reaching the ocean may also expose them to daytime temperatures and direct sunlight which may kill them through desiccation. Obstacles will also make them more susceptible to both aerial and terrestrial predators, which may wound or eat them before they can reach the ocean.<br><br>Changes to the existing beach substrate may lead to sand compaction; changes in moisture, gas exchange, and temperature in the nest chamber; changes in nest site selection; and less hatching success (Crain et al. 1995). Significant sand compaction can also increase the length of time females are on the beach excavating a nest, causing increased physiological stress and exposure to predators. However, the Corps has taken steps to prevent these scenarios by targeting offshore sediment strata that consist of beach quality sand of similar grain size and composition for both Sandbridge and Virginia Beach. Previous observations at both locations during and after renourishment activities have indicated that compaction has not been an issue at these project sites. The Corps estimates that any changes in the beach composition or profile will be short-term (about 1 year post-construction) following each nourishment event. The addition of sand to the beach profile is both a temporary disturbance and a long-term alteration to the sea turtle nesting environment.<br><br>The addition of beach area may increase habitat for nesting adults and result in fewer nests overwashed by tides, which could result in more successful nesting attempts and an increase in the local population of nesting turtles (a beneficial effect). However, the addition of beach area may also lead to more beachfront development that may increase human presence, trash, lighting, and structures on the beach, which in turn may cause detrimental effects to individual sea turtles at all life stages. | | | | | | | |
| Artificial Lighting of Construction Area | physical impacts to adults and hatchlings; disturbance | disorientation, energy expenditure, entrapment, crushing, dehydration, predation | Artificial lighting at night may disorient nesting adults. Artificial lighting may deter adults from nesting in that location, resulting in a false crawl (wasted energy). Artificial lighting may disorient hatchlings, leading to entrapment, desiccation, and predation. | Individual (adult and hatchling) | Harm, wound, kill | Breeding, sheltering | Numbers, reproduction | LAA |
| | **Comments:** All of the above effects will be minimized with the implementation of CM4. Adult females may become disoriented by beach lighting at night, and may leave to nest elsewhere, resulting in unnecessary energy expenditure (Witherington and Martin 2003). Hatchlings are known to travel in the direction of light sources rather than towards the water and there is a small possibility that a nest will be missed and left *in situ* despite having CM3 in place; Protected Species Observers will inspect the active construction zone every 2 hours but cannot patrol/inspect all of the beach at once. If a nest is left *in situ*, emerged hatchlings may travel away from the ocean towards the brighter light source, expending energy stores needed to reach offshore shelter and decreasing their chance of survival (harm); they may become trapped and subject to desiccation and predation (Witherington 1991, Lohmann and Lohmann 2003); and/or may be crushed by vehicles if attracted to their lights, all of which would wound or kill them. | | | | | | | |

## CUMULATIVE EFFECTS

Cumulative effects are those "effects of future State or private activities, not involving federal activities, that are reasonably certain to occur within the action area" considered in this Opinion (50 CFR 402.02). The Service is not aware of any future State, tribal, local, or private actions that are reasonably certain to occur within the action area at this time; therefore, no cumulative effects are anticipated.

## JEOPARDY ANALYSIS

Section 7(a)(2) of the ESA requires that federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species.

### Jeopardy Analysis Framework

"Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02). In accordance with policy and regulation, the jeopardy analysis in this Opinion relies on 4 components: (1) Status of the Species, which evaluates the species rangewide condition, the factors responsible for that condition, and its survival and recovery needs; (2) Environmental Baseline, which evaluates the status of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species, (3) Effects of the Action, which determines impacts of the proposed action, and (4) Cumulative Effects, which evaluates the effects of future, non-federal activities in the action area on the species. The jeopardy analysis in this Opinion emphasizes the rangewide survival and recovery needs of the listed species and the role of the action area in providing for those needs. It is within this context that we evaluate the significance of the proposed federal action, taken together with cumulative effects, for purposes of making the jeopardy determination (see 50 CFR 402.14(g)).

In this section, we add the effects of the action and the cumulative effects to the status of the species and critical habitat and to the environmental baseline to formulate our Opinion as to whether the proposed action is likely to appreciably: (1) reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing the RND of that species; or (2) appreciably diminish the value of critical habitat for both the survival and recovery of a listed species.

Per the Service's consultation handbook (Service and NMFS 1998), survival is defined as "the species' persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a

sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter."

Per the Service's consultation handbook (Service and National Marine Fisheries Service 1998), recovery is defined as "improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the ESA." The "criteria set out in Section 4(a)(1)" means determining when a species no longer meets the definition of an "endangered species" or a "threatened species" because of any of the following factors:

(A) present or threatened destruction, modification, or curtailment of habitat or range;
(B) overutilization for commercial, recreational, scientific, or educational purposes;
(C) disease or predation;
(D) inadequate existing regulatory mechanisms; and
(E) other natural or manmade factors affecting the species continued existence.

An endangered species is "in danger of extinction throughout all or a significant portion of its range" (see ESA Section 3(6)). A threatened species is "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (see ESA Section 3(20)).

To conduct this analysis, we begin by assessing whether there are effects to any individuals of the species of interest (as discussed in the effects analysis section above). If all effects are insignificant, discountable, or wholly beneficial, no further consultation is required. In other words, if we conclude that individuals are *not* likely to experience reductions in reproductive success or survival likelihood, fitness consequences for the species rangewide would not be expected as well. In this case, the agency has ensured that their action is not likely to jeopardize the continued existence of the species and our analysis is completed. Conversely, if we are unable to show that individuals are unlikely to experience reductions in their reproductive success or survival likelihood, we are required to assess how those effects are or are not anticipated to result in an appreciable reduction in the likelihood of both the survival and recovery <u>of the species</u>. We do not assess appreciable reduction of reproduction, numbers or distribution at an individual level because we do not assess appreciable reduction of <u>survival and recovery</u> at an individual level.

Because many species are composed of multiple populations and there may be meaningful differences in those populations (e.g., genetics, morphology, size) to the overall species survival and recovery, it is a logical intermediate step to evaluate the effects of impacts to individuals on the population(s) they are associated with. If our analyses indicate that reductions in the fitness of the population(s) are not likely to occur then there can be no appreciable reductions in reproduction, numbers, or distribution at a species level and we conclude that the agency has ensured that their action is not likely to jeopardize the continued existence of the species. If there are reductions in the fitness of the population(s) impacted, we then assess whether those changes affect the overall species survival and recovery rangewide based on the importance of the

population(s) for species level representation, resiliency and redundancy, the level of impact, and the status of the species.

**Analysis for Jeopardy**

*Impacts to Individuals* – In this step we determine whether any individuals of the species will be exposed to stressors from the various activities that are part of the proposed action. If exposure is likely, the next step is to determine the fitness consequences of individuals exposed to those stressors. The fitness of an individual can be measured by its reproductive success (which is determined by vital rates such as fertility rates, age at first reproduction, and reproductive intervals) and its survival likelihood. To assess whether fitness consequences may occur, we determine whether and how individuals are likely to respond[3] upon exposure to the stressors and beneficial actions associated with the proposed action. As the response of individuals upon exposure depends upon their condition (i.e., their health and resiliency), we must first establish the baseline conditions for those individuals. If the baseline condition of the individuals is unknown, generally we can use information about the status of the population or of the species as a whole (depending on the information available) to infer the degree of resiliency possessed by the individuals.

As discussed in the Effects of the Action, these actions include effects to individual Kemp's ridley, loggerhead, and green sea turtles present within the action area during nesting season or while stranded on the beach (Table 1). The proposed action includes impacts from construction equipment operation, the addition of beach sand, and artificial lighting of the construction area. Potential effects would be the same to individuals of all 3 species and include avoidance, disorientation, reduced nesting success, nest failure, and physical impacts such as crushing individuals. We do not have information about individual sea turtles, except to assume that those stranded are in some sort of distress and thus would have reduced resiliency. These sea turtles may be exposed to crushing by construction equipment, regardless of their state of health. Those adult sea turtles able to enter the beach environment for nesting are assumed to possess adequate health and resiliency as their baseline condition; however, their survival and/or reproductive rate may be reduced as a result of the proposed action. However, these effects will be avoided or minimized by having a Protected Species Observer on the beach between May 1 and November 15 who can halt work if a sea turtle or nest is located (CM2), and by relocating all nests outside of the current or future construction footprint (CM3). In summary, we anticipate impacts to individual Kemp's ridley, loggerhead, and/or green sea turtles in either their survival or reproductive rates.

[3] There are many possible biological responses (such as startle, alarm, flee, avoid, abandon/displace, reduced feeding success, reduced growth, reduced reproductive success, reproductive failure, and increased mortality) and many of these represent a form of take and thus must be expressed and evaluated in our Opinions. For our jeopardy analyses, however, reproductive success and survival are two metrics that may lead to population level consequences and are thus most relevant.

*Impacts to Populations* – In this section, we evaluate the aggregated consequences of the reductions in the fitness of individuals on the populations to which those individuals belong. Specifically, we are analyzing how the reductions in individual fitness affect the population's abundance, reproduction, or growth rates to make inferences about the population's future reproductive success and its viability. Whether a population can withstand the consequences of aggregated fitness reductions in individuals depends upon its baseline status (i.e., its resiliency). Thus, our analysis entails defining the populations the individuals comprise and determining the current and future baseline condition of that population.

As we have concluded that individual Kemp's ridley, loggerhead, and/or green sea turtles are likely to experience some reductions in their annual survival or reproductive rates, we need to assess the aggregated consequences of the anticipated impacts on the populations to which these individuals belong.

<u>Kemp's ridley sea turtle</u>
As discussed, there is only 1 population of Kemp's ridley sea turtle rangewide, of which 99% of the population nests in Mexico. The few Kemp's ridleys found nesting on Virginia's beaches have been extreme outliers far to the north and east of their usual nesting range. There is potential for Kemp's ridleys to increase nesting frequency within the term of this. The nesting females that may experience adverse effects due to the proposed action, which will be minimal with implementation of the CMs, are expected to have no appreciable effect on the overall population's RND due to the extremely low numbers of individual turtles anticipated to be impacted that are outside the core of the species nesting range.

<u>Loggerhead sea turtle</u>
Loggerheads nesting within the vicinity of the action area are at the northern extent of the DPS nesting range, and nest in fewer numbers than those further south towards the Florida-Georgia border. We may see increased nesting within the vicinity of the action area as temperatures increase due to climate change, and as numbers of nesting adults increase due to effective recovery actions. However, even if numbers increase, we do not anticipate appreciable effects to this population's RND because we expect minimal impacts to individuals will occur due to the CMs.

<u>Green sea turtle</u>
Few green sea turtles, belonging to the North Atlantic DPS, have been recorded nesting in the vicinity of the action area. The action area is the extreme northern extent of the DPS nesting range. The green sea turtle's DPS status has been improving. We expect that we may see an increase in green sea turtle nesting within the vicinity of the action area, as temperatures increase due to climate change, and as evidenced by the recent increase in nesting within the past 5 years. However, even if numbers increase, we do not anticipate appreciable effects to this population's RND because we expect minimal impacts to individuals will occur due to the CMs.

*Impacts to Species* – The final step in our analysis is to ascertain whether the anticipated impacts on the populations or recovery unit are likely to reduce the likelihood of both survival and recovery of the species by impacting its RND. Our analysis evaluates how the population-level effects determined above influence the likelihood of progressing towards or maintaining the conservation needs of the species rangewide. To complete this analysis we need to first determine the rangewide status of the species and then compare 1) what the species needs, 2) what it has, and 3) what the future expected status is. Here we connect the relative importance of the impacted population(s) to the rangewide status of the species to the impacts (positive and negative) from the proposed action.

If our analyses indicate that appreciable reductions in numbers, reproduction, and distribution are likely to occur, we conclude that the action is likely to jeopardize the continued existence of the species. Appreciable reduction means that it impacts the species in a meaningful and consequentially negative way that is more than "background" noise of the species' population dynamics. If the population-level reductions do not appreciably (i.e., meaningfully) reduce the likelihood of progressing towards or maintaining one or more of the species' conservation needs, then the action is not likely to appreciably reduce the likelihood of both survival and recovery of the species, and our analysis is complete and a non-jeopardy determination is required.

As we have concluded that the Kemp's ridley sea turtle population, Northwest Atlantic Ocean DPS of loggerhead sea turtle, and North Atlantic DPS of green sea turtle are unlikely to experience reductions in fitness, there will be no reduction in RND on the species or DPS as a whole.

## CONCLUSION

Kemp's ridley sea turtle

We considered the current overall stable rangewide status of the Kemp's ridley sea turtle and the improving condition of the species within the action area (environmental baseline). We then assessed the effects of the proposed action and the potential for cumulative effects in the action area on individuals, populations, and the species as a whole. As stated in the Jeopardy Analysis, we do not anticipate any reductions in the overall RND of the Kemp's ridley sea turtle. It is the Service's opinion that the Sandbridge Beach Nourishment and Virginia Beach Hurricane Protection Projects, and Rudee Inlet Federal Navigation Project, as proposed, are not likely to jeopardize the continued existence of the Kemp's ridley sea turtle.

Loggerhead sea turtle

We considered the current overall stable status of the Northwest Atlantic DPS of loggerhead sea turtle and the stable condition of the DPS within the action area (environmental baseline). We then assessed the effects of the proposed action and the potential for cumulative effects in the action area on individuals, populations, and the DPS as a whole. As stated in the Jeopardy Analysis, we do not anticipate any reductions in the overall RND of the Northwest Atlantic DPS of loggerhead sea turtle. It is the Service's opinion that the Sandbridge Beach Nourishment and Virginia Beach Hurricane Protection Projects, and Rudee Inlet Federal Navigation Project, as

proposed, are not likely to jeopardize the continued existence of the Northwest Atlantic DPS of loggerhead sea turtle.

Green sea turtle

We considered the current overall improving status of the North Atlantic DPS of green sea turtle and the improving condition of the DPS within the action area (environmental baseline). We then assessed the effects of the proposed action and the potential for cumulative effects in the action area on individuals, populations, and the DPS as a whole. As stated in the Jeopardy Analysis, we do not anticipate any reductions in the overall RND of the North Atlantic DPS of green sea turtle. It is the Service's opinion that the Sandbridge Beach Nourishment and Virginia Beach Hurricane Protection Projects, and Rudee Inlet Federal Navigation Project, as proposed, are not likely to jeopardize the continued existence of the North Atlantic DPS of green sea turtle.

## INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to Section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined in Section 3 of the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering (50 CFR § 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement (ITS).

The measures described below are non-discretionary and must be undertaken by the Corps so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in Section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this ITS. If the Corps: (1) fails to assume and implement the terms and conditions or (2) fails to require the applicant to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit or grant document, the protective coverage of Section 7(o)(2) may lapse. To monitor the impact of incidental take, the Corps or applicant must report the progress of the action and its impact on the species to the Service as specified in the ITS [50 CFR 402.14(i)(3)].

## AMOUNT OR EXTENT OF TAKE ANTICIPATED

The Service analyzed the effects to the species above.

The Service has used available data to quantify and numerically express anticipated incidental take of Kemp's ridley, loggerhead, and green sea turtles. This numerical estimate provides a

clear limit on the incidental take of Kemp's ridley, loggerhead, and green sea turtles anticipated and authorized in this Opinion. However, based on the difficulties associated with monitoring take in terms of affected individuals (adults, eggs, and hatchlings), the Service also uses surrogates to provide an additional, alternative means of monitoring take of Kemp's ridley, loggerhead, and green sea turtles. Under this approach, reinitiation of consultation will be triggered if the incidental take from the project exceeds the number of adult or juvenile Kemp's ridley, loggerhead, and green sea turtles specified below or exceeds, in any amount or manner, the surrogates specified below.

50 CFR 402.14(i)(1)(i) states that surrogates may be used to express the amount or extent of anticipated take provided the Opinion or ITS: (1) describes the causal link between the surrogate and take of the listed species; (2) describes why it is not practical to express the amount of anticipated take or to monitor take-related impacts in terms of individuals of the listed species; and (3) sets a clear standard for determining when the amount or extent of the taking has been exceeded.

**Numeric Estimate of Anticipated Incidental Take**

Kemp's ridley sea turtle

The Service anticipates incidental take of 3 adult or juvenile Kemp's ridley sea turtle as a result of this proposed action. The numerical estimate of incidental take was calculated based on the frequency of the action (i.e., beach nourishment at either Sandbridge or Virginia Beach is unlikely to occur every year based on the schedule provided in the project description), an estimate of the number of adult Kemp's ridleys that nest within the action area (0-1 each year), as well as the number of live (usually) juvenile Kemp's ridley's that may strand within the action area (7 in the most recent year). While CMs will minimize the potential for wounding or killing individuals, it may not be completely avoided. The incidental take is expected to be in the form of wound or kill. The anticipated take is described in Table 2.

The Service also anticipates incidental take of 312 eggs or 249 hatchlings. The numerical estimate of incidental take was calculated based on an estimate of 3 Kemp's ridley sea turtle nests within the action area, which contains an average of 104 eggs. Of these 104 eggs, 62 to 80% successfully hatch and reach the water, which is equivalent to 65 to 83 hatchlings. Therefore, we anticipate incidental take may occur to approximately 312 eggs or 249 hatchlings as a result of this action. This numerical estimate of incidental take was based on the frequency of the action and the number of Kemp's ridley nests found within the action area (0-1 each year). While CMs will minimize the potential for harm to, or wounding or killing of most individuals, it may not be completely avoided. The incidental take is expected to be in the form of kill, wound, or harm, including lethal harm in some instances. The anticipated take is described in Table 2.

Loggerhead sea turtle

The Service anticipates incidental take of 6 adult of juvenile loggerhead sea turtles as a result of the proposed action. The numerical estimate of incidental take was calculated based on the

frequency of the action, an estimate of the number of adult loggerheads that nest within the vicinity of the action area (1-10 each year, an average of 5.5), and the number of live (usually) juvenile loggerheads that may strand within the action area (7 in 2020). While CMs will minimize the potential for wounding or killing individuals, it may not be completely avoided. The anticipated take is described in Table 2.

The Service also anticipates incidental take of 672 eggs or 486 hatchlings. The numerical estimate of incidental take was calculated based on an estimate of 6 loggerhead sea turtle nests within the action area, which contain an average of 112 eggs. Of these 112 eggs, an average of 72% successfully hatched, which is equivalent to 81 hatchlings. Therefore, we anticipate incidental take may occur to 6 nests of 112 eggs or 81 hatchlings as a result of this action (i.e., a total of 672 eggs or 486 hatchlings). The number of nests taken was based on the infrequency of the action and the number of loggerhead sea turtle nests found within the action area (1-10 each year, an average of 5.5 nests). While CMs will minimize the potential for harm to, or wounding or killing of most individuals, it may not be completely avoided. The anticipated take is described in Table 2.

<u>Green sea turtle</u>
The Service anticipates incidental take of 3 adult or juvenile green sea turtle as a result of the proposed action. The numerical estimate of incidental take was calculated based on the frequency of the action, an estimate of the number of adult greens sea turtles that nest within the action area (0-1 each year), as well as the number of live (usually) juvenile green sea turtles that may strand within the action area (1 in 2020). While CMs will minimize the potential for wounding or killing individuals, it may not be completely avoided. The anticipated take is described in Table 2.

The Service also anticipates incidental take of 408 eggs or 375 hatchlings. The numerical estimate of incidental take was calculated based on the estimate of 3 green sea turtle nest within the action area, which contains between 100 and 136 eggs. Of these 100-136 eggs, 62- 92% successfully hatch among the North Atlantic DPS, which is equivalent to 62-125 hatchlings. Therefore, we anticipate incidental take may occur to approximately 408 eggs or 375 hatchlings as a result of this action. This numerical estimate of incidental take was based on the number of green sea turtle nests found within the action area (0-1 each year). While CMs will minimize the potential for harm to, or wounding or killing of most individuals, it may not be completely avoided. The anticipated take is described in Table 2.

**Surrogate for Monitoring Take**

It is not practical to monitor take-related impacts in terms of individuals of the 3 sea turtle species for the following reasons: if a nest is overlooked that nest may be buried, resulting in eggs and hatchlings being crushed and hatchlings being trapped within the nest; emerging hatchlings may become trapped by vehicle ruts or become disoriented away from the ocean by construction lighting, and be predated before we can observe the evidence. We do expect to accurately monitor take for adult and juvenile individuals of each species, as they are large in

size, and there will be a Protected Species Observer on the beach throughout the nesting season. However, there is still the possibility of an adult or juvenile being missed and the take has also been included in the surrogate. If injury (resulting in wounding or killing) happens to a juvenile or adult sea turtle of any species when the Protected Species Observer is not on site outside of nesting season, it is the duty of the action agency to report this specimen (see Monitoring and Reporting Requirements #2)).

Linear miles of beach habitat is being used as a surrogate to monitor the extent of authorized take related to beach nourishment activities (i.e., placement of sand, operating equipment) because it is not practical to monitor take-related impacts in terms of individuals. We calculated the area impacted for beach nourishment activities as follows. The surrogate will vary based on the location where sand will be placed in a given year. Sandbridge Beach extends from the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck in the north to BBNWR in the south (Figure 1), encompassing 5.25 linear miles of beach habitat along which 2.2 million cy of material will be placed per renourishment cycle. The beach nourishment area for Virginia Beach extends from 89$^{th}$ Street in the north to Rudee Inlet in the south (Figure 1), encompassing 6.60 miles of linear beach habitat along which 2.0 million cy of material will be placed per renourishment cycle. The Virginia Beach nourishment area also encompasses where sand would be placed from the Rudee Inlet Federal Navigation Project. These impacted areas are described in the Effects of the Action section and depicted in Figure 1. The 5.25 linear miles and 6.60 linear miles of beach habitat sets a clear, enforceable standard, and linear miles of beach habitat related to beach nourishment activities outside of that specific area exceeds take. The anticipated take is described in Table 2.

Table 2. Amount and type of anticipated incidental take.

| Species | Amount of Take Anticipated (Number of Individuals) | Amount of Take Anticipated (Surrogate) | Life Stage when Take is Anticipated | Type of Take | Take is Anticipated as a Result of |
|---|---|---|---|---|---|
| Kemp's ridley sea turtle | 3 | 5.25 linear miles of beach habitat on Sandbridge Beach and 6.60 linear miles of beach habitat on Virginia Beach | Juvenile or adult | Harm, wound, kill | • Injury or death may occur if construction equipment strikes a Kemp's ridley sea turtle<br>• Females may be deterred from nesting by equipment or activity |
| Kemp's ridley sea turtle | 312 eggs and/or 249 hatchlings | | Eggs or hatchlings | Harm, wound, kill | • Change to beach substrate may occur through compaction or toxic chemical leak resulting in harm to the eggs.<br>• Hatchlings may become disoriented by artificial construction lights, resulting in harm.<br>• Both eggs and hatchlings may be crushed, buried, desiccated, resulting in injury or death.<br>• Hatchlings may become depredated if unable to reach ocean, resulting in injury or death. |
| Loggerhead sea turtle Northwest Atlantic DPS | 6 | | Juvenile or adult | Harm, wound, kill | • Injury or death may occur if construction equipment strikes a loggerhead sea turtle<br>• Females may be deterred from nesting by equipment or activity |
| Loggerhead sea turtle Northwest Atlantic DPS | 672 eggs and/or 486 hatchlings | | Eggs or hatchlings | Harm, wound, kill | • Change to beach substrate may occur through compaction or toxic chemical leak resulting in harm to the eggs.<br>• Hatchlings may become disoriented by artificial construction lights, resulting in harm.<br>• Both eggs and hatchlings may be crushed, buried, desiccated, resulting in injury or death.<br>• Hatchlings may become depredated if unable to reach ocean, resulting in injury or death. |
| Green sea turtle North Atlantic DPS | 3 | | Juvenile or adult | Harm, wound, kill | • Injury or death may occur if construction equipment strikes a green sea turtle<br>• Females may be deterred from nesting by equipment or activity |
| Green sea turtle North Atlantic DPS | (408 eggs and/or 375 hatchlings | | Eggs or hatchlings | Harm, wound, kill | • Change to beach substrate may occur through compaction or toxic chemical leak resulting in harm to the eggs.<br>• Hatchlings may become disoriented by artificial construction lights, resulting in harm.<br>• Both eggs and hatchlings may be crushed, buried, desiccated, resulting in injury or death.<br>• Hatchlings may become depredated if unable to reach ocean, resulting in injury or death. |

## REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of all 3 sea turtle species:

1. Implement projects in a manner that minimizes disturbance to Kemp's ridley, loggerhead, and green sea turtles.

### TERMS AND CONDITIONS

In order to be exempt from the prohibitions of Section 9 of the ESA, the Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

1. If a live stranded sea turtle is observed on the beach by construction personnel outside of the nesting season, they will halt work within 500 feet of the turtle and immediately notify the VAQ Stranding Response Program. Work on the beach will not resume within 500 feet of the turtle until the VAQ Stranding Response Program indicates it is appropriate to do so. If a dead sea turtle is observed on the beach by construction personnel outside the nesting season, they will immediately notify the VAQ Stranding Response Program and will halt work within a buffer of the construction personnel's discretion.

### MONITORING AND REPORTING REQUIREMENTS

1. In years when beach nourishment will be conducted, notify the Service of the anticipated construction start and end dates no later than March 1, so that our agencies can coordinate a written Communication Plan in advance of the construction start date. Back Bay National Wildlife Refuge and VAQ will have significant input to and will be kept apprised of the current year's Communication Plan. The written Communication Plan will contain the following:
    a. Names and contact information of Protected Species Observers who will patrol the beach during the construction period (provided prior to the start of construction).
    b. Name and contact information for Back Bay National Wildlife Refuge (Sandbridge Beach) and VAQ (Virginia Beach) staff who should be contacted in case of sea turtle nesting or stranding activity during the construction period.
    c. Name and contact information for the Corps biologist reporting/coordinating sea turtle nesting or stranding activities during the construction period.
    d. Name and contact information for the Service biologist who should be contacted if sea turtle nesting or a stranding has occurred within the action area during the construction period.
    e. The way in which the Protected Species Observer, the morning crawl surveyor, and/or the properly permitted entity who can relocate nests will be able to contact and effectively communicate with the active construction crew on the beach. This should include safety communication protocols while working around large construction equipment, which will include wearing appropriate Personal Protective Equipment as cited in the project's contract (e.g., hard hat, reflective vest).
    f. The location(s) where nests will be relocated to, depending on where they are laid on either Sandbridge or Virginia Beach.

2. In years when beach nourishment activities take place, an annual report from the Protected Species Observer will be provided by December 31 of that year, summarizing construction activities that occurred, start and end dates, locations, and status of all sea turtle activity (number of nests relocated, false crawls, disorientation events, and if any nests were missed/left in situ) within the active construction zone during the project term. This report should quantify take of adults, eggs, or hatchlings, if any occurs within the year. Reports should include project start and end dates, what specific project activities occurred, verify that the surrogate was not exceeded and all conservation measures were followed. Reports will be provided to the VAFO in digital format, at the email address provided below.

3. In years when beach nourishment are not conducted, a report indicating this will be provided by December 31 of that year that includes any projected start and end dates of upcoming projects. Reports will be provided to the VAFO in digital format, at the email address provided below.

4. Hold coordination meetings that include the Service (BBNWR and VAFO), VDWR, and VAQ annually between November 1 and March 1, which may be email coordination in years when beach nourishment will not occur. These meetings will discuss any upcoming beach nourishment plans, updates to be made to the Communication Plan, and sea turtle nesting in Virginia.

5. Care must be taken in handling any dead specimens of proposed or listed species to preserve biological material in the best possible state. In conjunction with the preservation of any dead specimens, the finder has the responsibility to ensure that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. The finding of dead specimens does not imply enforcement proceedings pursuant to the ESA. The reporting of dead specimens is required to enable the Service to determine if take is reached or exceeded and to ensure that the terms and conditions are appropriate and effective. Upon locating a dead sea turtle or nest disturbed, injured, or killed, the VAQ Sea Turtle Stranding hotline (757-385-7575), the Service's Virginia Law Enforcement Office (804-771-2883), and the VAFO will be notified (phone number provided below).

**CONSERVATION RECOMMENDATIONS**

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. Work with the City of Virginia Beach to develop and implement a plan to reduce light pollution on sea turtle nesting beaches.
    - Where lighting ordinances have been adopted and enforced such as Brevard County, FL, hatchling disorientation and misorientation have been drastically reduced. All coastal counties and communities with nesting beaches should adopt lighting ordinances during sea turtle nesting season that address both direct and indirect (e.g., sky glow, uplighting) artificial lighting on nesting beaches.

2. Ensure sand compaction levels following beach sand placement do not hinder sea turtle nesting or hatchling productivity. Implement multi-year sand compaction monitoring for beach nourishment and dune building projects.
    - Evaluate sand compaction levels on native beaches across the entire beach profile to determine thresholds for tilling. Tilling a nourished beach may reduce sand compaction

to levels comparable to unnourished beaches. Tilling should be conducted to a minimum depth of 36 inches.

- Investigate alternative methods for monitoring sand compaction. Cone penetrometers may not be the best tool for accurately measuring beach compaction. Other tools are available; however, their applicability in assessing the suitability of a beach for turtle nesting is still unknown.

3. Implement escarpment leveling and/or profile adjustment on constructed beaches as needed.
    - On constructed beaches, steep escarpments may develop along the water line interface as the beach adjusts from the construction profile to a more natural beach profile. These escarpments can hamper or prevent access of female turtles to suitable nesting sites. Leveling escarpments prior to or during (if deemed appropriate) the nesting season should be conducted to minimize this impact.

4. Design and evaluate beach construction profiles to more closely mimic natural beaches.
    - Traditionally constructed beaches tend to be wide and flat, whereas heavily nested natural beaches are often relatively narrow and steeply sloped. Reduced nesting and increased nest loss to erosion typically reduce hatchling production on constructed beaches relative to natural beaches. Conduct research to determine the aspects of beaches that make them good nesting habitat and, to the greatest extent practicable, alternative construction templates should be designed, built, and monitored to mimic those conditions.

5. Re-establish natural dune structure and native vegetation during sand placement projects.
    - Beach nourishment projects should include dune restoration, and appropriate native salt-resistant dune vegetation should be established on the restored dunes. This will enhance beach stability and nesting habitat and require less frequent sand placement activities.

6. Monitor and reduce impacts from hopper dredging activities.
    - Some types of dredges, particularly the hopper dredge, have been shown to kill or wound sea turtles. The Corps implemented sea turtle deflector devices, relocation trawling, and dredging windows for hopper dredges in 1992. The Corps is currently working, and should continue to work, on new technologies to reduce interactions. The Corps should implement seasonal restrictions on hopper dredge use, use adequate observer coverage, and use appropriate screening on all hopper dredge operations to reduce and document associated mortality.

For the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

## REINITIATION NOTICE

This concludes formal consultation on the actions outlined in the request. As provided in 50 CFR 402.16, reinitiation of consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

If you have any questions regarding this Opinion, or our shared responsibilities under the ESA, please contact Emily Argo of this office at 804-824-2405 or emily_argo@fws.gov.

Sincerely,

FOR

Cindy Schulz
Field Supervisor
Virginia Ecological Services

cc: Back Bay NWR, Virginia Beach, VA (Attn: Lauren Mowbray)
VDWR, Machipongo, VA (Attn: Ruth Boettcher)
Virginia Aquarium, Virginia Beach, VA (Attn: Alexander M. Costidis, Erin Bates)

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## CONSULTATION HISTORY

| | |
|---|---|
| 12-13-19 | The Corps and Service met to discuss the Sandbridge Beach Nourishment and Hurricane Protection Project. The Service indicated that initiation of formal consultation would be required if work must be done during the sea turtle nesting time-of-year restriction (15 May – 31 August of any given year). |
| 05-26-22 | The Corps requested initiation of formal consultation and provided the BA and accompanying appendices via email. |
| 06-08-22 | The Service received the Corps' request to initiate formal consultation. |
| 08-08-22 | The Service provided a letter to the Corps acknowledging receipt of the Corps' request to initiate formal consultation. |
| 09-01-22 | The Service sent the Corps an email requesting an extension of the due date for the delivery of the biological opinion. |
| 09-07-22 | The Corps and Service held a conference call, during which the Corps stated that 02-13-23 was the latest acceptable date for a final biological opinion due to project timelines and contract needs. In addition, they would need the Service to provide the draft CMs no later than December 2022 so Corps Norfolk District staff and Office of Counsel would have sufficient time for technical and legal review. |
| 12-06-22 | The Corps provided a letter via email, formalizing the above discussion and reiterating the dates by which they would need the final biological opinion and draft CMs. |
| 12-19-22 | The Service provided the Corps with the draft CMs, reasonable and prudent measures, and terms and conditions via email for Corps review. |
| 01-13-23 | The Corps provided a letter via email returning comments on draft CMs, reasonable and prudent measures, and terms and conditions. |
| 02-09-23 | The Service provided the Corps the preliminary draft non-jeopardy biological opinion for review. |
| 03-02-23 | The Corps provided a letter via email returning comments on the preliminary draft non-jeopardy biological opinion. |

Attachment 4 – 2018 NOAA's National Marine Fisheries Service (NMFS) for Construction and Maintenance of Chesapeake Bay Entrance Channels and use of sand borrow areas for beach renourishment.

**NATIONAL MARINE FISHERIES SERVICE**
**ENDANGERED SPECIES ACT**
**BIOLOGICAL OPINION**

| | |
|---|---|
| **Action Agencies:** | Army Corps of Engineers (USACE), Norfolk District (lead)<br>USACE Baltimore District<br>Bureau of Ocean Energy Management<br>U.S. Environmental Protection Agency<br>U.S. Navy |
| **Activity Considered:** | Construction and Maintenance of Chesapeake Bay Entrance Channels and use of sand borrow areas for beach nourishment<br>**F/NER/2018/14816** |
| **Conducted by:** | National Marine Fisheries Service<br>Greater Atlantic Regional Fisheries Office |
| **Date Issued:** | 10/5/18 |
| **Approved by:** | |

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## 1.0 INTRODUCTION

This constitutes the biological opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) issued pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended, on the effects of the following projects:

- Cape Henry Channel;
- York Spit Channel;
- Rappahannock Shoal;
- York River Entrance Channel;
- Sandbridge Beach Nourishment and Hurricane Protection Project;
- Virginia Beach Hurricane Protection Project;
- Thimble Shoals Channel;
- Atlantic Ocean Channel;
- Norfolk Harbor Channels;
- Craney Island Eastward Expansion; and,
- Dredged Material Disposal Areas: Dam Neck Ocean Disposal Site, Wolf Trap Alternate Placement Site, Rappahannock Shoal Deep Alternate Open Water Site, Craney Island Dredged Material Management Area, and, Norfolk Ocean Dredged Material Disposal Site.

The basis for this Opinion come from information provided in the Biological Assessments (BAs) dated March 2018, past consultations with the USACE Norfolk and Baltimore Districts and scientific papers and other sources of information as cited in this Opinion. We will keep a complete administrative record of this consultation at our Greater Atlantic Regional Fisheries Office. This Opinion replaces the following Opinion, which is hereby withdrawn: Maintenance of Chesapeake Bay Entrance Channels and Use of Sand Borrow Areas for Beach Nourishment (October 16, 2012). This consultation was initiated on March 14, 2018. A draft of the Reasonable and Prudent Measures and Terms and Conditions was sent to you on June 20, 2018. A complete draft of the Opinion was provided to you on June 26, 2018 and September 24, 2018.

## 2.0 CONSULTATION HISTORY

Consultation between USACE and NMFS on effects of dredging in the Chesapeake Bay navigation channels and borrow areas has been ongoing since the 1980s. We have completed numerous consultations, culminating in four separate biological opinions, most of which have been reinitiated multiple times (see below for detailed history). In all of these Opinions we concluded that the proposed dredging was likely to adversely affect, but not likely to jeopardize any species of listed sea turtle and was not likely to adversely affect any species of listed whales. In February 2012, we published two final rules listing five Distinct Population Segments (DPS) of Atlantic sturgeon. The New York Bight, Chesapeake Bay, South Atlantic and Carolina DPSs

are listed as endangered and the Gulf of Maine DPS is listed as threatened. Reinitiation of consultation is required if: (a) the amount or extent of taking specified in the ITS is exceeded; (b) new information reveals effects of these actions that may affect listed species or critical habitat in a manner or to an extent not previously considered; (c) any of the identified actions are subsequently modified in a manner that causes an effect to the listed species that was not considered in the Opinion; or (d) a new species is listed or critical habitat designated that may be affected by the identified actions (50 CFR § 402.16).

Following the listing of Atlantic sturgeon, you prepared BAs to supplement the BAs prepared previously for the channels and dredged material disposal areas listed in Section 1.0. These BAs were submitted to us along with requests to reinitiate consultation and produce new Biological Opinions. Because the actions considered in those Opinions were similar, they took place in the same geographic area, and affected the same species in the same manner, we determined it would be most efficient to combine the analysis of effects of continued dredging of these channels and borrow areas into one consultation. As such, while there were seven independent actions considered (i.e., dredging Baltimore Harbor Entrance Channels, York River Entrance Channel, Sandbridge Shoal, Virginia Beach Nourishment, Port of Norfolk Entrance Channels, Norfolk Harbor Channels and Craney Island Eastward Expansion), we produced one Biological Opinion. This type of "multi-action" consultation is contemplated in the NMFS-USFWS Section 7 Consultation Handbook (see page 5-5), and is referred to as a Batch Opinion. Further below, we detail the consultation history for each of these activities.

Additionally, on August 17, 2017, we published a final rule designating critical habitat for all five DPSs of Atlantic sturgeon (82 FR 39160; effective date September 18, 2017). A portion of the action area for this consultation overlaps with the James River unit of critical habitat designated for the Chesapeake Bay DPS, the effects to which are analyzed in this Opinion.

On September 28, 2017, and December 20, 2017, we received your Biological Assessments and letters requesting reinitiation of formal consultation to assess the potential impacts of dredging and placement activities associated with the Craney Island Eastward Expansion Project and Norfolk Harbor Navigation Improvements Project, respectively. In your requests, you stated that reinitiation had been triggered due to changes in the project that introduce effects not previously considered as well as the need to consider Atlantic sturgeon critical habitat that was designated in August, 2017 (not included in the Batch Opinion in 2012). In emails dated January 4, 2018, and February 5, 2018, we requested additional information from you before we could initiate consultation. We received a revised BA for the Norfolk Harbor Navigation Improvement Project on March 5, 2018. We received the revised BA for the Craney Island Eastward Expansion Project on March 14, 2018. On April 12, 2018, we sent you a letter with our determination that we had received all of the information necessary to reinitiate consultation on the Norfolk Harbor Navigation Improvement Project and the Craney Island Eastward Expansion Project with updates to the remainng project included in the 2012 Batch Opinion. We determined that we initiated consultation on March 14, 2018.

## 2.1 Norfolk Harbor -- Thimble Shoals and Atlantic Ocean Channel

Previous consultations for Thimble Shoals Channel regarding maintenance dredging operations were conducted on April 16, 1984, March 14, 1985, March 20, 1985, and March 10, 1986 and

were concluded informally due to scheduling of dredging outside of the time of year when sea turtles would be present. Formal consultation for dredging activities in Thimble Shoals Channel (TSC) and Atlantic Ocean Channel (AOC) was initiated on April 14, 1999; a biological opinion was issued on February 7, 2001. Consultation was re-initiated on March 30, 2001 to account for sand borrow for beach nourishment in Atlantic Ocean Channel and associated impacts to listed sea turtles and other listed species. An amendment to the February 7, 2001 biological opinion was issued on May 30, 2001. You requested re-initiation of consultation on August 15, 2001 due to a change in the scope of the project; a revised biological opinion was issued on September 6, 2001. On December 4, 2001, you re-initiated consultation on the 50-foot deepening of the Norfolk Harbor and Channels project, which would require the removal of a total of up to 7.5 million cubic yards in the inner Norfolk Harbor and 5 million cubic yards of dredged material from TSC and AOC. In response to the request for re-initiation, we issued a biological opinion on April 25, 2002. In this biological opinion, we concluded that the proposed dredging may adversely affect but is not likely to jeopardize the continued existence of any listed species. An ITS was included with this biological opinion, exempting the lethal take of up to 18 loggerhead and 4 Kemp's ridley sea turtles during each dredge event and the non-lethal capture of an "unquantifiable" number of loggerheads and Kemp's ridleys during each relocation trawling event. Most recently, we issued a biological opinion in response to a request for re-initiation on October 16, 2012. In this biological opinion, we concluded that the proposed dredging may adversely affect but is not likely to jeopardize the continued existence of any listed species. An ITS was included with the 2012 biological opinion, exempting the lethal take of up to 151 loggerhead, 13 Kemp's ridley and 3 green sea turtles, and 25 Atlantic sturgeon, incidental to hopper dredging activities at Thimble Shoals and the Atlantic Ocean Channel over the course of 50 years.

## 2.2 Baltimore Harbor Entrance Channels and York River Entrance Channel

Formal consultation for dredging activities in Cape Henry Channel (CHC), York Spit Channel (YSC), Rappahannock Shoal Channel (RSC), and York River Entrance Channel (YEC) was initiated on May 18, 1993. We issued a biological opinion on October 6, 1993. Consultation was re-initiated on October 12, 2001, to account for greater dredging quantities, project durations, and associated impacts to listed sea turtles; we issued a new biological opinion on January 24, 2002. In letters dated January 15 and February 6, 2003, you requested re-initiation of consultation as the exempted level of take was exceeded in 2002. We issued a new biological opinion on July 24, 2003. We concluded that the proposed dredging was not likely to jeopardize the continued existence of any listed species. An ITS was included, exempting the annual lethal take of up to 18 loggerhead, up to 4 Kemp's ridley and 1 green sea turtle, depending on the volume of material removed from the channels. The ITS also exempted the capture of up to 120 sea turtles (loggerhead, Kemp's ridley and green) and one lethal take of a loggerhead, Kemp's ridley or green sea turtle during each relocation trawling event. Most recently, we issued a biological opinion in response to a request for re-initiation on October 16, 2012. In this biological opinion, we concluded that the proposed dredging may adversely affect but is not likely to jeopardize the continued existence of any listed species. An ITS was included with this biological opinion, exempting the lethal take of up to 194 loggerheads, 17 Kemp's ridleys, 4 greens, and 32 Atlantic sturgeon incidental to hopper dredging activities at the Baltimore Harbor Entrance Channels over the course of 50 years. In addition, the ITS exempted

the lethal take of 20 loggerheads, 2 Kemp's ridleys, and 3 Atlantic sturgeon incidental to hopper dredging activities in the York River Entrance Channel.

## 2.3 Sandbridge Shoal

Formal consultation for the use of the Sandbridge Shoal borrow area was initiated in May 1992. We issued a biological opinion on April 2, 1993. This biological opinion was amended by letter issued August 20, 2001, to account for greater dredging quantities, project durations, and associated impacts to listed sea turtles. In 2007, you requested that we waive the requirement for 100% endangered species observer coverage for dredging planned for 2007. This request was due to the presence of unexploded ordinance in the area to be dredged and the placement of screening on the dragheads. We granted that request by letter and determined that the use of UXO screening did not require reinitiation of the consultation. The 1993 biological opinion, as amended in 2001, concluded that dredging in Sandbridge Shoal was not likely to jeopardize the continued existence of any species of whale or sea turtle. An ITS was included with the biological opinion, exempting the lethal take of five loggerhead sea turtles and one Kemp's ridley or green sea turtle for each biennial dredge event. This consultation was re-initiated in 2012. In September 2012, we issued a new biological opinion on effects of proposed dredging at Sandbridge Shoal in 2012-2013 with placement of 1.5-2 million cubic yards of sand along Sandbridge Beach. We concluded that the proposed action was not likely to jeopardize any DPS of Atlantic sturgeon or any species of listed sea turtle, and not likely to adversely affect any species of listed whale. The ITS exempted the lethal take of six loggerheads and one Kemp's ridley or green and one Atlantic sturgeon from any of the five DPSs. On October 16, 2012, we replaced the September 2012 biological opinion in response to a request for re-initiation. An ITS was included with this biological opinion, exempting the lethal take of up to 38 loggerheads, 3 Kemp's ridleys, 1 green sea turtle, and 6 Atlantic sturgeon incidental to hopper dredging activities at Sandbridge Shoal over the course of 50 years. Use of the Sandbridge Shoal borrow areas requires coordination with the Bureau of Ocean Energy Management (BOEM); the USACE's Norfolk District was designated the lead agency for purposes of complying with ESA requirements per 50 C.F.R 5402.07 and served as the lead agency for biological consultation.

## 2.4 Virginia Beach Nourishment and Hurricane Protection Project

Formal consultation for dredging activities at the Thimble Shoals Surround borrow area (TSS) and the Atlantic Ocean Offshore borrow area (AOO) was initiated with your submittal of a BA in January 2005. We issued a biological opinion on December 2, 2005. In this biological opinion, we concluded that the proposed dredging may adversely affect but is not likely to jeopardize the continued existence of loggerhead and Kemp's ridley sea turtles and is not likely to adversely affect leatherback or green sea turtles or right, humpback or fin whales. An ITS was included with this biological opinion, exempting the lethal take of 4 loggerheads and 1 Kemp's ridley during each dredge event and the non-lethal capture of 45 sea turtles (loggerhead, Kemp's ridley and green) during each relocation trawling event. The ITS also exempted one lethal take of a loggerhead, Kemp's ridley or loggerhead sea turtle during each relocation trawling event. We issued a biological opinion in response to a request for re-initiation on October 16, 2012. An ITS was included with this biological opinion, exempting the lethal take of up to 13 loggerheads, 2 Kemp's ridleys or greens, and 22 Atlantic sturgeon incidental to hopper dredging activities for the Virginia Beach Hurricane Project over the course of 50 years.

## 2.5 Norfolk Harbor Channels

We previously considered effects of maintenance dredging and deepening of the Norfolk Harbor inner channels. These actions were considered in the biological opinion dated April 25, 2002 described in Section 2.1 above. In the biological opinion, we determined that dredging in the inner channels was not likely to adversely affect any species of sea turtles because a hydraulic cutterhead or mechanical dredge would be used and these dredge types are not known to capture, injure or kill sea turtles. We issued a biological opinion in response to a request for re-initiation on October 16, 2012. In this biological opinion, we concluded that the proposed dredging was not likely to adversely affect any species of sea turtles. An ITS was included with this biological opinion, exempting the lethal take of up to 1 Atlantic sturgeon incidental to mechanical dredging activities at the Norfolk Harbor Channels over the course of 50 years.

## 2.6 Craney Island Eastward Expansion

We completed informal consultation with you on the Craney Island Eastward Expansion project in 2006. In a letter dated June 15, 2006, we concluded that the proposed action was not likely to adversely affect any species of sea turtle. This conclusion was based on the use of mechanical or hydraulic dredges for dredged material removal and the lack of benthic prey at the site. We issued a biological opinion in response to a request for re-initiation on October 16, 2012. In this biological opinion, we concluded that the proposed dredging was not likely to adversely affect any species of sea turtles. An ITS was included with this biological opinion, exempting the lethal take of up to 1 Atlantic sturgeon incidental to mechanical dredging activities at the Craney Island Eastward Expansion project over the course of 50 years.

# 3.0 DESCRIPTION OF THE PROPOSED ACTION

This Opinion considers the effects of proposed new dredging, continued maintenance dredging, and sand borrow operations in several Federal navigation channels located in the Chesapeake Bay and Atlantic Ocean. The Opinion also evaluates the placement and disposal of dredged material at the Craney Island Dredged Material Management Area (CIDMMA) and open ocean disposal sites, the Dam Neck Ocean Disposal Site (DNODS) and the Norfolk Ocean Disposal Site (NODS). The Opinion considers that dredged material could also be potentially placed at beneficial use sites or upland disposal sites. Construction is scheduled to being in 2023, but is contingent on funding availability. Construction of the Norfolk Harbor and Channels Deepening Project will take approximately 3.5 to 4 years to complete. Table 2 provides the approximate schedule for maintenance dredging, which is also subject to change based on funding availability.

These activities are carried out by you and your contractors as independent actions, as detailed below. The Norfolk District in coordination with the Baltimore District maintains the Port of Baltimore Approach Channels. Additionally, authorization with BOEM, in the form of a lease, is required for use of the Sandbridge Shoal borrow area. The U.S. EPA has regulatory authority over the designation of the ocean disposal sites considered in this Opinion. While you requested consultation on the Craney Island Eastward Expansion Project and Norfolk Harbor Navigation Improvements Project, we are including updates on all projects batched under the 2012

biological opinion, which are reflected in the sections below.

### 3.1 Port of Hampton Roads Approach Channels – Thimble Shoals and Atlantic Ocean Channel

The Atlantic Ocean Channel (AOC) and Thimble Shoals Channel (TSC) make up the approach channels to the Port of Hampton Roads, Virginia. These channels provide access for all ships calling on port facilities, naval bases, and shipyards in the Hampton Roads area. All commercial tonnage entering and leaving the Port of Hampton Roads passes through these channels. The USACE Norfolk District is responsible for maintaining these Federal navigation channels to ensure safe passage for all vessel traffic. To provide depths needed for safe navigation of large vessels, maintenance dredging of these Federal navigation channels must occur before shoaling causes draft restrictions and/or other safety concerns. The location of TSC and AOC is depicted in Appendix A.

The proposed action involves continued ongoing sand borrow operations, maintenance and new dredging of the AOC and TSC and the use of the associated dredged material placement sites. The project includes the entire footprint of these channels and the shoals contained within each channel, plus the entire footprint of the associated dredged material placement sites. Dredged material would be placed at the DNODS and/or the NODS. Other potential placement sites could include CIDMMA or upland disposal sites (if needed). Material could potentially be used for beneficial use projects as well. The AOC and TSC are preferred sand borrow sources for beach nourishment and port development projects in the Hampton Roads region. You are proposing to borrow from the TSC and AOC for the following projects: the Craney Island Eastward Expansion, Virginia Beach Hurricane Protection Project, Willoughby Spit and Vicinity Hurricane Protection Project, and JEB Fort Story Beach Replenishment Project (U.S. Navy).

The AOC and TSC normally require maintenance dredging every two to five years but dredging is typically located in distinct shoaled areas within the channels. These shoaled areas vary from year to year, but are often located along the toe of the channel. New dredging may also occur when Congress authorizes and appropriates funding for channel improvements. The duration of dredging, the amount of material removed from each shoal, and the frequency in which each shoal is dredged is dependent on several factors. These factors include, but are not limited to: environmental conditions, funding, whether it is new work or maintenance dredging, location, length of time after the last dredging cycle, time of year conservation measures, availability of suitable dredge plant, emergencies, and others. It is important to note that the areas within the channel that are dredged during each maintenance cycle are typically relatively small in comparison to the total channel dimensions. The primary objective is to provide vessels with safe, navigable passage to the Port of Hampton Roads in support of commerce and national defense.

*Atlantic Ocean Channel Federal Navigation Project*

The Water Resources Development Act (WRDA) of 1986 authorized the AOC. The WRDA authorized the USACE to construct the AOC, which consists of a channel 11.1 miles long, 1,300 feet wide, and -57 feet deep located 3-4 miles east of the Thimble Shoal Channel, in the Atlantic Ocean at the mouth of the Chesapeake Bay off the coast of Virginia Beach, Virginia. As part of the -50-foot inbound construction effort in 2006, the channel was deepened to provide for a

depth and width of -52 feet and 1,300 feet, respectively. The AOC is part of the Port of Virginia and Baltimore system of channels, and is the segment providing access for all ships calling on port facilities, naval bases, and shipyards in the Hampton Roads, York River, and Baltimore areas. All commercial tonnage entering and leaving the Ports of Virginia and Baltimore pass through this channel. The channel is currently maintained to full width and a depth of -52 feet to enable loaded colliers, container ship, and military vessels to transit the channel with ship drafts as great as -50 feet. The proposed action would deepen the AOC to a required depth of approximately -59 feet. The AOC is managed by the USACE Norfolk District.

Material is typically dredged via hopper dredge from this channel. Dredged material is placed at Dam Neck Ocean Disposal Site (DNODS). Dredged material also has been used for beneficial uses for the Virginia Beach Hurricane Protection project and the Craney Island Eastern Expansion (CIEE) Project. The sediment composition in this channel segment is largely fine sand (85%) with some silt (15%). The channel has been utilized as a sand borrow source for hurricane protection projects and port development projects, therefore maintenance of the channel has not been required.

*Thimble Shoal Federal Navigation Project*

The TSC is located in the southern part of the Chesapeake Bay, just off the shoreline of the City of Norfolk and City of Virginia Beach, east of the Craney Island Dredged Material Management Area. The TSC was originally authorized by the River and Harbor Act of August 8, 1917. The authorized channel dimensions are 13.4 miles long, 1,000 feet wide, betwenn the 55-foot contours, to a depth of -55. Although the channel is authorized to be dredged to 55 feet, the channel is currently maintained to a required depth of -50 feet. Thimble Shoal Channel extends from the deep water to the east of Hampton Roads to the deep water at the mouth of the Chesapeake Bay.

The proposed action would authorize a new depth of -61 feet, deepen the TSC from -50 feet to a required depth of approximately -56 feet, and widen the channel east of the Chesapeake Bay Bridge Tunnel to approximately 1,300 feet. The Thimble Shoal Channel is managed by the Norfolk District.

As part of the proposed action, the existing 10 feet of sand cover over the Chesapeake Bay Bridge Tunnel in the Thimble Shoal Channel would be reduced to approximately five feet. The materials covering the tunnel would be sand or potentially sand and rock.

Material dredging is via hopper dredging. Dredged material is placed at the DNODS. The sediments of Thimble Shoal Channel to the west of the Chesapeake Bay Bridge Tunnel are predominantly clays and silts (50-75%). In contrast, sediments in the eastern portion of channel are largely fine to medium-grained sand (75-90%).

## 3.2 Port of Baltimore Approach Channels

Cape Henry Channel (CHC), York Spit Channel (YSC) and Rappahannock Shoals Channel (RSC) make up the Chesapeake Bay approach channels to the Port of Baltimore. All commercial tonnage entering and leaving the Port of Baltimore pass through these channels. The Norfolk District maintains these Federal navigation channels in coordination with Baltimore District.

In order to provide depths needed for safe navigation of large vessels, maintenance dredging of these Federal navigation channels must occur before shoaling causes draft restrictions and/or other safety concerns. All of these channels and placement sites are depicted in Appendix A.

The proposed project involves continued ongoing maintenance dredging of the CHC, YSC and RSC and the use of the associated dredged material placement sites. New work dredging may also occur when Congress authorizes and appropriates funding for channel improvements. The project includes the entire footprint of these channels and the shoals contained within each channel, plus the entire footprint of the associated dredged material placement sites. The CHC, YSC and RSC normally require dredging every two to five years; dredging is typically located in distinct shoaled areas within the channels and not through the entirety of the channel. These shoaled areas vary from year to year, but are often located along the toe of the channel. The duration of dredging, the amount of material removed from each shoal, and the frequency at which each shoal is dredged is dependent on several factors. These factors include, but are not limited to: environmental conditions, funding, location of the shoal, degree of shoaling, time of year conservation measures, availability of suitable dredge plant, navigation emergencies, and others.

*Cape Henry Federal Navigation Project*
The CHC was authorized under the River and Harbor Act of 1945 and Section 101 of the River and Harbor Act of 1970 as part of the Baltimore District - USACE 50-Foot Project. The River & Harbor Act of 1945 authorized increasing the channel depth to -39 feet deep and 1,000 feet wide in the CHC and YSC in Virginia. The River and Harbor Act of 1970 authorized a uniform main channel 50 feet deep, and generally 800 (in Maryland) or 1,000 (in Virginia) feet wide through the Chesapeake Bay from the Virginia Capes to Fort McHenry in the Port of Baltimore, a distance of 175 miles. The CHC Federal Navigation Channel is a 1,000 foot wide channel approximately 4.7 nautical miles long located between the -50 foot contours at the entrance to the Chesapeake Bay just south of the Chesapeake Bay Bridge Tunnel. The Norfolk District in coordination with the Baltimore District maintains the CHC.

*Rappahannock Shoal Federal Navigation Project*
The RSC was authorized under Section 101 of the River and Harbor Act of 1970 as part of the Baltimore District - USACE 50-Foot Project. The River and Harbor Act of 1970 authorized a uniform main channel -50 feet deep, and generally 800 (in Maryland) or 1,000 (in Virginia) feet wide through the Chesapeake Bay from the Virginia Capes to Fort McHenry in the Port of Baltimore, a distance of 175 miles, which includes the RSC. Dredging of the initial phase reduced the channel widths in the RSC from 1,000 to 800 feet wide. The RSC is -50 feet deep, 800 feet wide and approximately 10.3 nautical miles long and traverses the Rappahannock Shoal from southeast to northwest. The Norfolk District in coordination with the Baltimore District maintains the RSC.

*York Spit Federal Navigation Project*
The YSC was authorized to a depth of -37 feet under the River and Harbor Act of 1930. After World War II, the River & Harbor Act of 1945 authorized increasing the channel depth to -39

feet deep and 1,000 feet wide in the CHC and YSC in Virginia. Finally, the YSC was authorized to -50 feet via Section 101 of the River and Harbor Act of 1970, as part of the Baltimore District USACE 50-Foot Project, which authorized a uniform main channel -50 feet deep, and generally 800 (in Maryland) or 1,000 (in Virginia) feet wide through the Chesapeake Bay from the Virginia Capes to Fort McHenry in the Port of Baltimore, a distance of 175 miles. Dredging of the initial phase reduced the channel widths in the YSC from 1,000 to 800 feet wide. The YSC is 800 feet wide, -52 feet deep and is approximately 18.4 nautical miles long. The YSC is located between the -50 foot contours, just north of the Chesapeake Bay Bridge Tunnel and is maintained by the Norfolk District in coordination with the Baltimore District.

### 3.3 York River Entrance Channel Federal Navigation Project

The Norfolk District is responsible for maintenance dredging the York River Entrance Channel (YREC) Federal Navigation Project. In order to provide depths needed for safe navigation of larger vessels, maintenance dredging of this Federal navigation channel must occur on or before shoaling causes draft restrictions and/or other safety concerns. The location of YREC is depicted in Appendix A.

The proposed project does not include continued ongoing maintenance dredging of YREC and the use of the associated dredged material placement sites. During the consultation, you informed us that there is no planned federal action for YREC. The federal project is not funded and no maintenance dredging is planned at this time. Should project plans change, further coordination with us should be pursued.

The YREC was first dredged in 1951 and 1952, when the natural entrance channel into the York River was deepened by the USACE for the Department of the Navy. The original channel dimensions provided for a 39-foot deep channel at mean low water, 750 feet wide at the bottom, and approximately 11 miles long. There was no dredging of the YREC between 1952 and 1998. In 1995, the Chief of Engineers authorized dredging under Section 107 of the River and Harbor Act of 1960. The YREC project consisted of a channel 37 feet deep at mean lower low water (mllw), 750 feet wide at the bottom, and approximately 23 miles long. New work was authorized in 1995, and the channel was dredged to its current dimensions in 1999. The channel begins at the 38-foot contour in the Chesapeake Bay and ends at a point adjacent to the piers at the Yorktown U.S. Naval Weapons Station, approximately 8 miles above the river mouth.

### 3.4 Virginia Beach Nourishment and Hurricane Protection Project

The Virginia Beach Hurricane Protection Project is conducted under authority of the WRDA of 1986, as modified by the WRDA of 1992 and 1996. The project was authorized in Section 102 of the WRDA of 1992 (Public Law [P.L.] 102-580) as amended in 1996, and is funded by the Federal Government and the city of Virginia Beach, Virginia, acting as the project's non-Federal sponsor.

The hurricane protection site is located at Cape Henry, Virginia Beach, Virginia, as generally described in the "Beach Erosion Control and Hurricane Protection Study Virginia Beach, Virginia General Reevaluation Report Main Report and Appendices," dated September 1993 and revised January 1994, and approved by the Assistant Secretary of the Army for Civil Works on February l, l994, and as further defined by Draft plans and Specifications which are incorporated

herein by reference. The authorized duration of the initial project of hurricane protection is 50 years, including initial construction and periodic nourishment. Sand to be placed at the hurricane protection site may be obtained from Federal navigation channels or the Thimble Shoals Channel Borrow Area (TSS) and the Atlantic Ocean Channel Borrow Area (AOO). The location of these borrow areas are illustrated in Appendix A.

The TSS area is a rectangle surrounding a short reach of the Thimble Shoals Channel located in the lower Chesapeake Bay between deep water in Hampton Roads and the Atlantic Ocean. It is approximately 2 miles off the Chesapeake Bay shoreline, with its western terminus approximately 5,400 feet east of the Chesapeake Bay Bridge Tunnel. The TSS is about 5,700 feet in length and approximately 1,200 feet wide, totaling about 1,960 acres. Depths in the area range from about 35 to 50 feet and do not include the Thimble Shoals Channel.

The AOO area is roughly triangular in shape and is located in the Atlantic Oceanoff Cape Henry, Virginia. It encompasses about 9,253 acres and extends southeasterly from a point due east of the Cape Henry lighthouse and in the direction of the continental slope. It is bounded to the east by the Atlantic Ocean Channel deepwater route east of the Virginia Beach oceanfront. This borrow site does not include any section of the Atlantic Ocean Channel deepwater route. This borrow site is located about 5 miles from the TSS borrow area.

Maintenance of the hurricane protection project will require that approximately 1,000,000 cubic yards (cy) of sand be dredged and placed on the beach during the initial maintenance, with an additional 2,000,000 cy to be dredged and placed every 3 to 4 years.

The maintenance borrow activities may be rotated among these sites over the 50-year period. Approximately 12.5 million cy of sand may be dredged and used for beach nourishment over the 50-year period, with approximately 8.125 MCY (66%) of the volume to be removed from Atlantic Ocean Channel and Thimble Shoals Channel. The remaining 4.375 MCY is likely to be removed from the AOO and TSS. Dredging will be accomplished via hopper dredge, although there is a possibility that a hydraulic cutterhead dredge may be used in the AOO. Dredged beach-quality sand may be placed on the site by means of hydraulically pumping from the dredging site directly to the beach via a hydraulic dredge and pipeline, if the sand source is less than 2 miles from the beach; or, if the sand source is more than 2 miles from the beach, a hopper dredge may be used.

### 3.5 Sandbridge Beach Nourishment and Hurricane Protection

The Advanced Engineering and Design Study for Beach Erosion and Hurricane Protection at Virginia Beach, Virginia, including Sandbridge Beach, was authorized by Section 1(a) of the Water Resources Development Act of 1974 (Public Law 93-251, 93'd Congress, H.R. 10203.7 March 1974). The applicable portion of the authorizing act is as follows:

"Sec. I (a) The Secretary of the Army, acting through the Chief of Engineers, is hereby authorized to undertake the Phase I Design Memorandum stage of advanced engineering and design of the following multi-purpose water resources development projects, substantially in accordance with, and subject to the conditions recommended by the Chief of Engineers in the reports here in after designated."

Middle Atlantic Coastal Area

"The project for hurricane-flood protection at Virginia Beach, Virginia: House Document Numbered 92-365, at an estimated cost of $8,954,000 (1974 dollars)."

BOEM will authorize the use of sand from an OCS sand borrow area for the project under the OCS Lands Act, 43 U.S.C. §1337(k). In 1994, OCSLA was amended to allow BOEM to convey, on a noncompetitive basis, the rights to OCS sand, gravel, or shell resources for use in a program for shore protection, beach restoration, or coastal wetlands restoration undertaken by a Federal, State, or local government agency (43 U.S.C.§ 1337(k)(2)(A)(i)). An agreement will be negotiated between BOEM, the USACE Norfolk District, and the City of Virginia Beach for the dredging and relocation of the sand.

The beach nourishment will occur along a five mile stretch of the Sandbridge Beach between the Back Bay National Wildlife Refuge (NWR) at the southern most extent (36.698017 N, - 75.924196 W-WSG84 datum) and the U.S. Naval Fleet Anti-Air Warfare Training Center at the northern most extent (36.760823 N, - 75.948829 W) along the beach. The borrow areas (A and B) are located about three miles offshore at Sandbridge Shoal perpendicular to the beach nourishment reach (Appendix A). A no dredging zone separates the two borrow areas to protect underground cable lines. The coordinates for these borrow areas start at the three miles state waters boundary from east to west and are approximate as follows:

Area A: 36.7396 N, - 75.8762 W; 36.7235 N, - 75.8315 W
Area B: 36.7638 N, - 75.8860 W; 36.7537 N, - 75.8387 W

The proposed action would involve beach nourishment at the Sandbridge oceanfront, an area approximately 5 miles long and 725 feet wide (as illustrated in Appendix A). The specific beach area covered extends from the U.S. Naval Fleet Anti-Air Warfare Training Center at Dam Neck to the north to Back Bay NWR to the south. The project dimensions include a 50-foot wide berm at an elevation of 6 feet North American Vertical Datum (NAVD) with a foreshore slope of approximately 1:20 (one vertical value to 20 horizontal) for a distance of approximately 5 miles. The designated borrow area is Sandbridge Shoal (Appendix A), located approximately 3 nautical miles from the shoreline, outside of Virginia's territorial sea. There are two selected borrow areas within Sandbridge Shoal, Area B to the north and Area A to the south; depths range from 30 to 65 feet. The area between the two borrow areas is restricted due to the presence of a buried Navy submarine communications cable. Beach quality sand would most likely be removed by trailing suction hopper dredge with the possibility of using a hydraulic pipeline dredge (i.e. cutterhead).

As previously mentioned, the proposed action will utilize either a hopper style dredge or a hydraulic pipeline dredge to borrow beach quality sand from authorized sites along Sandbridge Shoals to renourish the beach at Sandbridge Beach via the placement of dredged material onto the beach.

### 3.6 Norfolk Harbor Channels

The Norfolk Harbor Channels are part of the larger Port of Hampton Roads complex and intially included the deep draft channels in the Elizabeth River and Hampton Roads. Portions of the Norfolk Harbor project have been authorized and modified by the Rivers and Harbors Act of July 5, 1884, 2 March 1907, 25 June 1910, 4 March 1913, 8 August 1917, 3 March 1925, 30 August 1935, 2 March 1945, 24 July 1946, 30 June 1948, 3 September 1954, 27 October 1965, the Flood Control Act of 1965, and the WRDA of 1986. On April 16, 2018, you requested informal consultation on the Elizabeth River Southern Branch Navigation Improvements project, which had previously been included as part of the Norfolk Harbor Channels complex. On June 25, 2018, we responded with a letter that concurred with your determination that the proposed action was not likely to adversely affect ESA-listed species under our jurisdiction. The June 2018 consultation included the following channel sections that now comprise the Elizabeth River Southern Branch Navigation Improvements Project:

- A channel 45-feet deep over its 375 feet to 750-foot width from Lamberts Point to the N&W Railroad Bridge (Norfolk Harbor Channel - Lamberts Bend to Paradise Creek);
- A channel 40-feet deep over its 250 to 500-foot width to the U.S. Routes 460 and 13 Highway Bridge (Norfolk Harbor - Southern Branch Channel); hence a channel 35-feet deep over its 250 feet to 300 feet width to a point 0.8-mile above Interstate 64 high level bridge;
- A channel 25-feet deep over its 200 feet to 500 feet width from the junction with the southern Branch of the Elizabeth River to the N&W Railroad Bridge on the eastern Branch of the Elizabeth River (Norfolk Harbor – Eastern Branch Channel);
- A channel 18 feet deep over its 150 feet to 300 feet width and 1.72 mile length on the western Branch of the Elizabeth River (Norfolk Harbor – Western Branch Channel);
- A channel 12 feet deep, 100 feet wide, and 0.73 mile in length in Scotts Creek (Norfolk Harbor – Scotts Creek Channel);

The project considered in this consultation includes the following:

- A channel 55 feet deep over its 800 to 1,500-foot width from the 55-foot contour in Hampton Roads to Lamberts Point (Norfolk Harbor Channel - Sewells Point to Lamberts Bend);
- Sewells Point Anchorages and 50-foot Anchorages;
- A channel 55 feet deep and 800 feet wide from Norfolk Harbor Channel in Hampton Roads to Newport News (Channel to Newport News);
- Newport News Anchorages;
- Craney Island Dredged Material Management Area (CIDMMA) consist of a 2,500 acre upland confined disposal facility for the placement of navigation related dredged material from Norfolk Harbor and adjacent waters.

The Norfolk District is responsible for maintaining these Federal navigation channels and anchorages to ensure safe passage for all vessel traffic. A specific description of the channel reaches, anchorages, and dredged material placement sites serving the greater port of Hampton Roads follows and is depicted in Appendix A.

The Norfolk Harbor Channels provide access for all ships calling on port facilities, naval bases, and shipyards in the Hampton Roads area. All commercial tonnage entering and leaving the Port of Hampton Roads passes through one or more of these channels. The Norfolk District is responsible for maintaining these Federal navigation channels to ensure safe passage for all vessel traffic utilizing the port. In order to provide depths needed for safe navigation of larger vessels, maintenance dredging of these Federal navigation channels must occur before shoaling causes draft restrictions and/or other safety concerns. The proposed project activity will involve ongoing maintenance and future new dredging of the Norfolk Harbor channels and the use of the associated dredged material placement sites. The project includes the entire footprint of these channels and the shoals contained within each channel, plus the entire footprint of the associated dredged material placement sites. Portions of these channels require maintenance dredging annually, but dredging is typically located in distinct shoaled areas within the channels. The duration of dredging, the amount of material removed from each channel reach and the frequency in which each shoal is dredged is dependent on several factors. These factors include, but are not limited to: new dredging (deepening) to authorized depths, environmental conditions and time of year windows, funding, location of the shoal, length of time after the last dredging cycle, availability of suitable dredge plant, emergencies, and others. It is important to note that the areas within the channel that are maintenance dredged during each cycle are relatively small in comparison to the total channel dimensions. However, new dredging projects – such as the proposed deepening and widening - that are initiated to deepen navigation channels to Congressionally-authorized depths involve dredging a large part of the channel to establish required channel depths. The amount of dredged material removed during a period of new deepening may exceed average maintenance dredging volumes, and may also be dependent on how Congress funds the project for the fiscal year. The primary objective of maintenance and new dredging is to provide vessels with safe, navigable passage to the Port of Hampton Roads in support of commerce and national defense.

*Channel to Newport News and Anchorages*

The Channel to Newport News is located from Norfolk Harbor Channel in Hampton Roads to Newport News. The Channel to Newport News Federal Navigation Project was authorized by the River and Harbor Act of 25 June 1910 and modified by the River and Harbor Acts of 8 August 1917, 21 January 1927, 27 October 1965, and the WRDA of 1986. The project is authorized to a depth of 55 feet and 800 feet wide from Norfolk Harbor Channel in Hampton Roads to Newport News and the Newport News Anchorages, a distance of about 5.4 miles, and two deep-draft anchorage berths opposite Newport News 45 feet deep over a 1,200-foot swinging radius. Material dredged from this area is then placed at the CIDMMA. The proposed action would deepen the Newport News Channel to a required depth of approximately 55 feet. The proposed action would deepen the Anchorage F to a required depth of 51 feet and widen the Anchorage F to 3,620 feet and its associated approach area. Material dredged from this area is then placed at the CIDMMA and could also potentially be placed at the NODS. Dredged material could also be disposed of at upland disposal sites (if needed). Material could potentially be used for beneficial use projects as well.

*Norfolk Harbor Channel – Sewells Point to Lamberts Bend and Norfolk Harbor Anchorages*

The Sewells Point to Lamberts Bend reach of the Norfolk Harbor Project is located in Norfolk between Sewells Point and Lamberts Bend. This segment of the project is approximately 8 miles long and varies in width between 800 feet to 1,200 feet. The reach also consists of: Anchorage F, Sewells Point East Anchorage (includes the Naval Maneuvering Area and Approach Areas), Sewells Point West Anchorage and (Approach Area), Anchorage G, and all approach areas. The proposed action would deepen Anchorage F to a required depth of 51 feet and widen it to approximately 3,620 feet (and associated modifications to the Approach Area).

The authorized project dimensions for this reach include a channel 55 feet deep and 1,200 feet wide from that depth in Hampton Roads to a point approximately 6 miles upstream from the Hampton Roads Bridge-Tunnel; then 55 feet deep and 800 feet wide to Lamberts Point. The Sewells Point to Lamberts Bend Channel is currently maintained to a required depth of 50 feet MLLW from the 55-foot contour in Hampton Roads (near the Hampton Roads Bridge Tunnel) to Lamberts Point. The proposed action would deepen the Norfolk Harbor Channel and the Norfolk Harbor Entrance Channel to a required depth of 55 feet.

Material is dredged from this area via hydraulic cutterhead pipeline dredge and/or mechanical dredge. Material dredged from this area is then placed at the CIDMMA. The consistency of the dredged material in the Sewells Point to Lamberts Bend Channel is primarily silt and clay (85%), with some sand (15%). The consistency of the Elizabeth River sediment is predominantly clay in the Town Point area of Norfolk. However, as you travel south along the Elizabeth River (towards Chesapeake), the sediments become increasingly more coarse and sandy.

### 3.7 Craney Island Eastward Expansion

The Craney Island Eastward Expansion (CIEE) project is located on the east side of the existing CIDMMA. The project activities are bounded by the CIDMMA on the west and the Norfolk Harbor Channel – Sewells Point to Lamberts Bend to the east. The CIEE is a water resources development project in the Port of Hampton Roads complex. The project consists of construction of a new 522-acre dredged material containment cell and marine terminal. CIEE was congressionally authorized in the WRDA of 2007 (Public Law 110-114), Section 1001 (45), which became law on November 8, 2007. The CIEE project consists of multiple construction elements within Hampton Roads and the Elizabeth River. The location of the project is illustrated in Appendix A.

In 2012, we formally consulted with you on multiple navigation channels and hurricane protection project sites within Chesapeake Bay and the Atlantic Ocean, including the CIEE project. However, the schedule and timing of the proposed action at the CIEE site was not considered under the previous formal consultation. To address the potential effects, you prepared a new Biological Assessment for hopper dredging activities for the purpose of sand borrow throughout the year, including the period from April 1 to November 30.

The Craney Island Eastward Expansion Project is a dual purpose project that provides a new dredged material containment cell for additional dredged material placement capacity for dredging projects in the Port of Hampton Roads and, at the completion of filling of the containment cell, a new marine terminal. The site may also serve as a logistical and tactical area supporting deployment of national defense forces. Dredging operations are proposed in the

Atlantic Ocean Channel, Thimble Shoals Channel, Cape Henry Channel, and the Thimble Shoals Surround Borrow Area to borrow suitable sand as back-fill material for the main dike footprint and sand fill in the south and north perimeter dike and division dike.

The proposed project will involve multiple construction phases of dredging for sand borrow and associated sand placement of approximately 19,500,000 million cubic yards (MCY). The sand borrow placement is expected to occur over a period of approximately 20 years, contingent upon funding availability. The project area includes the entire footprint of the Atlantic Ocean Channel, Cape Henry Channel, Thimble Shoals Channel east of the Chesapeake Bay Bridge Tunnel (CBBT), and the Thimble Shoals Surround Borrow Area. The sand fill project area includes the CIEE main dike footprint, the south and north containment dike, and the division dike located in the Port of Hampton Roads and Elizabeth River. The estimated volumes of new dredging and fill activities for each construction element are presented in Table 1.

Construction of the CIEE new containment cell will occur in two phases creating a 197-acre south sub-containment cell (south cell) and 325-acre north sub-containment cell (north cell). The south cell will be constructed first. Once the dikes of the south cell are completed it will become the primary placement site for dredged material inflows from Port of Hampton Roads. After the south cell is filled, it will be turned over to the Virginia Port Authority for marine terminal construction. Construction of the north cell will follow completion of the south cell. The work will be accomplished by the Norfolk District and the Virginia Port Authority. A description of the construction elements follows and is depicted in Appendix A.

**Table 1**. Borrow/Fill Activity at CIEE

| **Fill Activity** | **Total Volume** |
|---|---|
| CIEE – Main Dike fill (5,500 linear feet), North Cell Construction | 15,000,000 |
| CIEE – South Perimeter Dike fill | 1,500,000 |
| CIEE – North Perimeter Dike fill | 1,500,000 |
| CIEE – Division Dike fill | 1,500,000 |
| ***TOTAL FILL VOLUME 19,500,000*** | |

*Sand Borrow and Backfill of Main Dike Footprint*

The proposed action involves the dredging, by hopper dredge, of approximately 19.5 MCY of sediments for the purpose of sand borrow. Sand will be borrowed from a combination of the Atlantic Ocean Channel, Cape Henry Channel, Thimble Shoals Channel (east of the CBBT), and the Thimble Shoals Surround Borrow Area. The total volume of sand dredged from each channel or borrow source will be contingent on the availability of suitable sand volume at the time of dredging. These channels and borrow areas have historically and are currently a shared

source of suitable sand for other local hurricane protection and beach nourishment projects. Continued maintenance of these projects will affect the available volume of sand at each channel or borrow area over time. Additionally, the amount of sand borrowed from the channels and borrow area during each dredging event will be contingent on federal and state funding.

The borrowed sand will be placed on the CIEE main dike footprint that extends approximately 8,500 feet running north-south, forming the east perimeter of the CIEE project. Sand placement in this area will occur after the dredging of the main dike footprint to remove unsuitable marine clays that comprise the Norfolk geologic formation. Dredging of the main dike will range from a depth of -90 feet to -130 feet and construct a 120 feet wide trench bottom. The main dike will be located approximately 2,500 feet east of the existing CIDMMA. The main dike footprint will require approximately 15 MCY of sand backfill. The length of the main dike that will be constructed with the south cell is approximately 3,000 linear feet. The remaining 5,500 linear feet of main dike will be constructed in a late phase during construction of the north cell.

*Construction of Perimeter and Division Dikes*
The construction of the south and north perimeter dikes and the division dike for the new containment cell will require placement of 4.5 MCY of suitable sand fill (i.e., 1.5 MCY each). The south, north and division dikes will be approximately 2,500 linear feet in length and approximately 240 feet top width.

## 3.8 Dredged Material Borrow and Disposal Areas

*Thimble Shoals Surround Borrow Area*
The Thimble Shoals Surround Borrow Area (TSS) is a rectangle surrounding a short reach of the Thimble Shoals Channel located in the lower Chesapeake Bay between deep water in Hampton Roads and the Atlantic Ocean. It is approximately 2 miles off the Chesapeake Bay shoreline, with its western terminus approximately 5,400 feet east of the Chesapeake Bay Bridge Tunnel. The TSS is about 5,700 feet in length and approximately 1,200 feet wide, totaling about 19,600 acres. Depths in the area range from about 35 to 50 feet and do not include the Thimble Shoals Channel. The area has previously served as a sand borrow source for the Virginia Beach Hurricane Protection Project, Fort Story Hurricane Protection Project (U.S. Navy), and the Willoughby Spit Hurricane Protection Project.

Any material that is not used for dike construction at Craney Island or hurricane protection projects at Virginia Beach, Sandbridge Beach or Ft. Story could be placed at one of the ocean disposal sites noted below.

*Dam Neck Ocean Disposal Site*
The Dam Neck Ocean Disposal Site (DNODS) site was officially designated as an ocean placement site in 1993, pursuant to Section 102 (c) of the Marine Protection, Research, and Sanctuaries Act of 1972 (as amended, 33 U.S.C. 1401 *et seq*). The administrator of the Environmental Protection Agency (EPA) designated this ocean placement site in March of 1988 (53 FR 10382). This site is authorized to receive dredged material from the Atlantic Ocean Channel, the Cape Henry Channel, and the Thimble Shoal Channel. An Environmental Impact Statement and related Supplements, titled “Final Supplement 1 to the Final Environmental Impact Statement and Appendix: Dam Neck Ocean Disposal Site and Site Evaluation Study,

Norfolk Harbor and Channels, Virginia, Deepening and Disposal" was finalized in May of 1985. The initial deepening of Thimble Shoal Channel by the USACE triggered a need for a placement site relatively close to the dredge site. The DNODS disposal site was developed in 1967 to accommodate the deepening work in Thimble Shoal Channel (-45 feet). The DNODS has an area of about 8-square nautical miles. Water depths at DNODS vary between -31 and -49 feet deep with an average water depth in the placement site of about -40 feet. An estimated 1.5 million cubic yards of dredged material are placed at this site every two years from the aforementioned navigation projects. The remaining capacity at DNODS is estimated to be about 63 million cubic yards. Placement activities at DNODS placement area are performed primarily by hopper dredge. The DNODS is located approximately 3 nautical miles east of Virginia Beach, Virginia.

The DNODS boundary coordinates are as follows:

36.856694 N, - 75.9115 W;
36.856694 N, -75.884139 W;
36.774278 N, - 75.860889 W;
36.774306 N, - 75.905278 W;
36.834861 N, - 75.905278 W.

*Wolf Trap Alternate Placement Site*

The Wolf Trap Alternative Placement Site (WTA) is a 2,300-acre (4,500 acres with the designated buffer zone) area located in the Chesapeake Bay, east of New Point Comfort and south of Wolf Trap light, east of Mathews County. Water depths over the site range from -32.0 to -37.0 feet mean low low water. As a result of monitoring efforts from both the Virginia Institute of Marine Science and the Waterways Experiment Station from 1987 to 1991, the area was classified into six equally divided cells. It is intended that all six cells be utilized for placement of dredged material, and that the material be placed in a manner consistent within the criteria established in the project's environmental assessment published in July 1992. This placement site is currently used for the periodic maintenance dredging of the York River Entrance and York Spit Channels. The WTA is a 2,300-acre (4,400 acres with the designated buffer zone) area located in the Chesapeake Bay near Mathews County, east of New Point Comfort and south of Wolf Trap light.

The WTA boundary coordinates are as follows:

37.363063 N, -76.178684 W;
37.363063 N, -76.157913 W;
37.274736 N, -76.194135 W;
37.274736 N, -76.173363 W.

*Rappahannock Shoal Deep Alternate Open Water Site*

The Rappahannock Shoal Alternative Placement Site (RSA) is an area approximately 4.5 nautical miles by 0.8 nautical miles in dimension, has an area of approximately 3,100 acres in size, and is the primary placement site for dredged material from RSC. The site is located approximately 1-mile west of the RSC. The average water depth is -39 feet. The site has capacity to manage dredged material over a 20-year planning period, the site has not been utilized for dredged material placement since 1989. The RSA boundary coordinates are as follows:

37.666797 N,-76.174662 W;

37.666796 N,-76.191337 W;
37.591797 N,-76.191321 W;
37.591799 N,76.174662 W.

*Norfolk Ocean Dredged Material Disposal Site*
The NODS was officially designated by the Environmental Protection Agency (EPA) pursuant to Section 102(c) of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended, as suitable for ocean disposal of dredged material on July 2, 1993 (FR. Vol. 5a No. 126). NODS is located in the Atlantic Ocean approximately 17 miles east of Cape Henry and is approximately 50 square nautical miles in size. The site is circular with a radius of 4 nautical miles and the water depth ranges from 43 to 85 feet. The center point coordinate of the site is north latitude 36° 59' and west longitude 75° 39'. The site is authorized to receive dredged materials from the lower Chesapeake Bay. The site is also authorized to receive dredged material from the Thimble Shoal, Cape Henry, Atlantic Ocean Channel, Hampton Roads, and York Spit channels. Up to approximately 250 million cubic yards of dredged material (public and private dredging projects) may be disposed at the site over the next 49 years; however, only material that meets ocean dumping criteria may be disposed at the site.

*Craney Island Dredged Material Management Area and Facilities*
The Craney Island Dredged Material Management Area (CIDMMA) was authorized by the Rivers and Harbors act of 1946. It was constructed on 2,500 acres of river bottom in Hampton Roads in the City of Portsmouth, Virginia. CIDMMA is the primary dredged material placement area for construction and maintenance of navigation channels in the Hampton Roads port complex. It provides essential dredged material placement capacity for the Federal navigation channels, U.S. Navy facilities, Virginia Port Authority facilities and other commercial port facilities in Hampton Roads. The CIDMMA is an upland confined placement area that is enclosed by a perimeter containment dike and divided into three sub-containment cells by two division dikes.

The CIDMMA receives dredged materials in two different ways. It is either pumped directly into one of three upland containment cells or it is deposited in the rehandling basin and then pumped into the facility. The Craney Island Rehandling Basin (CIRB) is located to the east of the upland containment area and consists of a subaqueous rectangular area 1,400 feet in length by 1,100 feet in width and 40 feet in depth. The CIRB is connected by two access channels being 1,500 feet in length, 20 feet in depth and 200 feet wide. The basin is meant for the deposit of dredged material from dump scows from mechanical dredging operations. The project also provides for a debris channel, a segment of channel that connects the rehandling basin to the CIDMMA bulkhead. The debris channel is 80 feet wide and 13 feet deep. To date, the CIDMMA has received, on average, 3.5 million cubic yards of dredged material per year; however, there have been several years when it has received more than 10 million cubic yards. You estimate that the facility has a realistic lifespan up to 2030, but this may be subject to change as newer technologies and/or new management techniques are employed at the site.

## 3.9 Information on Dredges That May Be Used

Nearly all dredging in the Chesapeake Bay considered in this Opinion will occur with a hydraulic hopper dredge. However, other dredging methods could include mechanical dredging and also hydraulic cutterhead dredging.

### *3.9.1 Self-Propelled Hopper Dredges*

Hopper dredges are typically self-propelled seagoing vessels. They are equipped with propulsion machinery, sediment containers (i.e., hoppers), dredge pumps, and other specialized equipment required to excavate sediments from the channel bottom. Hopper dredges have propulsion power adequate for required free-running speed and dredging against strong currents.

A hopper dredge removes material from the bottom of the channel in thin layers, usually 2-12 inches, depending on the density and cohesiveness of the dredged material (Taylor, 1990). Pumps within the hull, but sometimes mounted on the dragarm, create a region of low pressure around the dragheads; this forces water and sediment up the dragarm and into the hopper. The more closely the draghead is maintained in contact with the sediment, the more efficient the dredging (i.e., the greater the concentration of sediment pumped into the hopper). In the hopper, the slurry mixture of sediment and water is managed to settle out the dredged material solids and overflow the supernatant water. When a full load is achieved, the vessel suspends dredging, the dragarms are heaved aboard, and the dredge travels to the placement site where dredged material is disposed of.

### *3.9.2 Hydraulic Cutterhead Pipeline Dredges*

The cutterhead dredge is essentially a barge hull with a moveable rotating cutter apparatus surrounding the intake of a suction pipe (Taylor, 1990). By combining the mechanical cutting action with the hydraulic suction, the hydraulic cutterhead has the capability of efficiently dredging a wide range of material, including clay, silt, sand, and gravel.

The largest hydraulic cutterhead dredges have 30 to 42 inch diameter pumps with 15,000 to 20,000 horsepower. The dredge used for this project is expected to have a pump and pipeline with approximately 30” diameter[1]. These dredges are capable of pumping certain types of material through as much as 5-6 miles of pipeline, though up to 3 miles is more typical. The cutterhead pipeline plant employs spuds and anchors in a manner similar to floating mechanical dredges.

### *3.9.3 Mechanical Dredges*

Mechanical dredging will be used in association with CIEE and in some of the Norfolk Harbor Channels. Mechanical dredges are relatively stationary. While operating, the dredge swings slowly in an arc across the channel cut as material is excavated. This is accomplished by pivoting the dredge on vertical pilings called spuds that are alternately raised and lowered from the stern corners of the dredge. Cables to anchors, set roughly perpendicular to the forward section of the dredge, are used to shift the lateral position of the digging area. Periodically, as

1 While 30” dredge is possible for this project, historically a 20-24 inch cutterhead dredge has been used to perform work in the area due to the inflow constraints at Craney Island.

the cut advances, the anchors are reset. Bucket dredging entails lowering the open bucket through the water column, closing the bucket after impact on the bottom, lifting the bucket up through the water column, and emptying the bucket into a barge. An environmental clamshell dredge differs from traditional dredging buckets by having an outer covering that seals when the bucket is closed. Water passes through its top moveable vents as it submerges, thereby reducing turbidity. Once it lifts off the bottom and closes, the covering seals over the bucket and minimizes overspill as the dredge bucket moves back up through the water column.

### 3.10 Bed Leveling Devices

You have indicated that in certain circumstances, a dredge contractor may employ a bed-leveler device to smooth the channel bottom or to reduce the isolated shoals or ridges in the channel that cannot be economically or effectively dredged with a hopper dredge. Since 2012, bed-leveling has been used on multiple contracts including Thimble Shoals Channel, York Spit Channel, and Cape Henry Channel located in the action area. Bed-leveling may be a preferred alternative during certain phases of the dredging operations (i.e. clean-up phase) and it is possible that a bed leveler will be used in upcoming dredging cycles.

Bed leveling techniques have been documented as far back as 1565 (USACE, 2006). However, the use of bed-levelers in U.S. waters is not well documented. The devices are typically used during final clean-up operations when localized mounds or ridges exist shallower than required dredging depths. Passage of a draghead can create ridges up to two feet high and can require multiple passes to reduce the height during clean-up operations. Often these areas cannot be efficiently or economically dredged to specified depths and make it difficult to maintain hard contact between the draghead and channel bottom. Bed-leveler devices may consist of a large customized plow or a box beam suspended from a work-barge that can be pushed or towed by a tug. The bed-leveler may be towed by a short or long towing line depending on the sea-state. Bed-leveler size and geometry can vary but are typically thirty and fifty feet in width and may weigh from twenty-five to fifty tons. Bed-levelers are generally towed at speeds ranging from 1-2 knots. Bed-leveler operation can be affected by sea state conditions and generally require longer towing line in rougher waters.

The USACE-ERDC has performed an engineering evaluation on various configurations of bed-leveler prototypes to determine their performance aspects for production rates (i.e. ability to remove target material), ability to deflect model turtles, and bed-leveler construction and operation in the field. Model studies were performed at Texas A&M. The study tested conceptual designs using a conventional straight square tube box-beam, a 90-degree raked plow (i.e. inclined), a 90-degree square tube box beam plow, a 130- degree box square tube box beam plow. Model study results indicated that the straight square tube box beam design provided the highest production rate moving sediment in the direction of the bed leveler device but provided the least turtle shedding capability. The 90-degree raked (inclined) plow produced an increased vertical downward force on the towing cables resulting in some operational difficulty. In general, the increase in the sweep angle increased the side-spilling or side-casting of sediment which also accounted for the designs ability to shed model turtles from in front of the bed-leveler device. The 130-degree box beam plow likely provides the optimal mix of production, turtle shedding capability, and operational deployment. The conceptual bed-leveling designs tested in the model study are presented in Appendix B of this Opinion.

## 3.11 Interrelated or Interdependent Actions

Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR § 402.02; see also 1998 FWS-NMFS Joint Consultation Handbook, pp. 4-26 to 4-28). We have identified the potential effects of larger vessesls coming into port as a reslt of the channel deepening as an interrelated or interdependent action.

## 3.12 Summary of Proposed Action

The proposed construction to deepen and widen the existing channels is scheulded to commence in approximately 2023 and will take approximately 3.5 to 4 years to complete. Following construction, maintenance dredging will continue for approximately the next 50 years. In the remaining channels, maintence dredging has been ongoing since 2012 and has a 50-year project life. Due to the multiple overlapping timelines for ongoing dredging, construction, and future maintenance dredging, and in recognition of the fact that projects may encounter unanticipated delays, throughout the Opinion we will generally refer to the "project life" or "life span of the project," which are intended to encompass all temporal components of the action. The action considered here includes dredging, as summarized in the table below, as well as fill activities associated with the CIEE and continued use of several dredged material disposal sites and placement of sand on Virginia Beach and Sandbridge Beach as well as at the U.S. Navy's Fort Story Facility.

The following tables summarize the anticipated dredging during this period:

**Table 2**. Anticipated dredging considered in this consultation

| **Channel** | **Type of Dredge** | **Typical Volume Removed** | **Frequency of Dredge Events** | **Number of events over the project life** | **Volume Removed over the project life** |
|---|---|---|---|---|---|
| **Baltimore Harbor Entrance Channels** | | | | | |
| *Cape Henry* | *H* | *1.1 mcy* | *1-2 years* | *25-50* | *Up to 50 mcy* |
| *York Spit Channel* | *H* | *0.5 mcy* | *2 years* | *25* | *12.5 mcy* |
| *Rappahannock Shoals Channel* | *H* | *no maintenance dredging to date* | *Every 20 years* | *2* | *Up to 2 mcy* |
| **Total: 64.5 MCY** | | | | | |
| **VA Beach Hurricane Protection** | **H** | **0.27 mcy** | **Every 3 years** | **16** | **4.4 mcy** |
| **Sandbridge** | **H or C** | **0.5 mcy** | **Every 2 years** | **25** | **12.5 mcy** |
| **Craney Island Eastward Expansion** | | | | | |
| CIEE – Main Dike dredging (8,500 linear feet) | *C or M* | *Subject to Federal Funding* | *Subject to Federal Funding* | *Subject to Federal Funding* | 22,400,000 |
| CIEE – Access Channel dredging | *C or M* | *Subject to Federal Funding* | *Subject to Federal Funding* | *Subject to Federal Funding* | 1,600,000 |
| CIEE – Wharf Access dredging | *C or M* | *Subject to Federal Funding* | *Subject to Federal Funding* | *Subject to Federal Funding* | 7,300,000 |
| **Total: 31.3 mcy (6.8 mcy cutterhead; 24.5 mcy mechanical)** | | | | | |

| | | Construction | | | | Maintenance over the life of the project | | Construction + Maintenance | |
|---|---|---|---|---|---|---|---|---|---|
| **Channel** | **Required Depth (ft)** | **Est. Max Depth (ft)** | **Est. Max Volume (cy)** | **Est. Max Duration (months)** | **Est. Max Bottom Disturbance (sq ft)** | **Est. Total Volume (cy)** | **Est. Total Duration (months)** | **Est. Max Volume (cy)** | **Est. Max Duration (months)** |
| Atlantic Ocean | 59 | 64 | 16,074,736 | 42 | 78,738,613 | 15,191,112 | 62 | 31,265,848 | 104 |
| Thimble Shoals | 56 | 61 | 18,069,823 | 57 | 119,644,916 | 24,331,540 | 210 | 42,401,363 | 276 |
| Thimble Shoals Meeting Areas #1 & #2 | 56 | 61 | 7,191,000 | 23 | 13,388,000 | 3,640,924 | 31 | 10,831,924 | 54 |
| Sewell's Point to Lamberts Bend | 55 | 60 | 12,147,318 | 11 | 57,012,805 | 42,346,689 | 78 | 54,494,008 | 89 |
| Anchorage F | 55 | 60 | 1,914,788 | 14 | 25,222,454 | 7,590,328 | 15 | 9,505,116 | 30 |
| Newport News | 55 | 60 | 4,906,284 | 4 | 29,272,754 | 6,676,305 | 16 | 11,582,589 | 19 |
| **Total** | | | **60,303,949** | **151** | **323,279,542** | **99,776,899** | **412** | **160,080,647** | **564** |

## 3.13 Action Area

The action area is defined in 50 CFR § 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The action area for this consultation is the area affected by dredging and disposal activities as well as the area transited by dredges, dredged material disposal vessels, and vessels using the navigation channels. The action area, therefore, is the entirety of the navigation channels, borrow areas and disposal areas noted above. The action area will also encompass the underwater area where dredging will result in increased suspended sediment. The size of the sediment plume will vary depending on the type of dredge used and is detailed below.

### *3.13.1 Physical Characteristics of the Action Area*

The Chesapeake Bay is approximately 320 km (200 m) long and extends from Cape Henry and Cape Charles to Havre de Grace, Maryland. It is 4.5 km (2.8 m) wide at its narrowest (between Kent County's Plum Point near Newtown and the Harford County shore near Romney Creek) and 48 km (30 miles) at its widest (just south of the mouth of the Potomac River). Water depth in the bay averages 6.4 m (21 feet), reaching a maximum depth of 53 m (174 feet).

The lower Chesapeake Bay attained its current configuration after the end of the last Ice Age and it has been relatively stable for the last several thousand years (Bratton et al. 2002), although waters have continued to slowly rise over this time, due to glacial rebound and now the addition of human-induced climate change (Schulte et al. 2015) (Figure 2-15). The Norfolk Harbor has been in use since shipping into and out of Chesapeake Bay began, and has been deepened to accommodate larger ships over the decades. This channel was formed naturally as river valleys (in this case the James/Susquehanna). This dredging has not significantly altered the tidal prism of the lower Chesapeake Bay, due to the small size of the channel relative to the size of the Chesapeake Bay. It has been deepened by prior dredging efforts, with initial dredging to ensure at least -40 feet of depth occurring during 1917-1927 (VIMS 1993). Additional deepening to -45 feet occurred in 1967. In 1986, the channel was authorized to be deepened to -50 feet. The current authorized depth at this time is -55 feet, though most of the channel is at -50 feet at this time. The main shipping channel follows the natural bathymetry of lower Chesapeak Bay. This natural channel, however, has been deepened where needed to accommodate larger vessels.

The typical tidal range in the action area, including the Elizabeth River and nearby open waters of lower Chesapeake Bay, is approximately 2.85 feet, though this varies significantly with time of the month (spring and neap tides) as well as due to storm activity, which can create significant storm surges well beyond the normal tidal range. Tides are diurnal in the Chesapeake Bay, with two high and low tides per day. The mean discharge rate of Chesapeake Bay is approximately 2,500 m3 /sec, over 80% of which is supplied by three rivers (the Susquehanna, Potomac, and James Rivers) (Goodrich 1988). Salinity typically ranges from 20-30 ppt (parts per thousand) in the action area, which covers a broad area from the mouth of Chesapeake Bay into the lower James River. These areas are sufficiently mixed so that anoxic waters are not typical within the action area. Such deep channels can go anoxic in the summer, particularly in the mid to upper Chesapeake Bay, causing a significant "dead zone" of hypoxic waters. The bathymetry of the action area ranges from intertidal shallows to the deep channels, which generally lie within the immediate action area where dredging is proposed and typically range in depth from

approximately -20 feet in side and/or natural and unmaintained channels to -50 feet within the channel itself.

The landforms surrounding the project area are comprised primarily of geologically recent (Pleistocene and Holocene) sediments, primarily fine sands, silts, with small amounts of small gravel (College of William and Mary 2006). The subaqueous terrain of the project area is of similar material, with sand, fine sand, shell, mud, with some pebbles or gravel that were deposited during interglacial periods under conditions similar to those that exist in the modern Chesapeake Bay and its tidal tributaries (College of William and Mary 2006).

Frequent dredged material placement and subsequent consolidation results in varying topography throughout the CIDMMA. Although not anticipated, any dredged material unsuitable for open water placement or placement at CIDMMA would likely be dewatered in accordance with Federal and state water quality requirements, and transported to a permitted, upland disposal facility. Dredged material placement and dynamic hydraulic processes at the DNODS and the NODS result in varying topography throughout the sites.

## 4.0 STATUS OF LISTED SPECIES AND CRITICAL HABITAT

Several ESA-listed species under our jurisdiction occur in the action area for this consultation. We have determined that the proposed action being considered in this Opinion may affect the following ESA-listed species in a manner that will likely result in adverse effects:

| **Common name** | **Scientific name** | **ESA Status** |
|---|---|---|
| Loggerhead sea turtle - NWA DPS[2] | *Caretta caretta* | Threatened |
| Kemp's ridley sea turtle | *Lepidochelys kempii* | Endangered |
| Green sea turtle - North Atlantic DPS[3] | *Chelonia mydas* | Threatened |
| Atlantic sturgeon | *Acipenser oxyrinchus oxyrinchus* | |
| Gulf of Maine (GOM) DPS | | Threatened |
| New York Bight (NYB) DPS | | Endangered |
| Chesapeake Bay (CB) DPS | | Endangered |
| Carolina DPS | | Endangered |
| South Atlantic (SA) DPS | | Endangered |

We have determined that the proposed action being considered in this Opinion is not likely to adversely affect North Atlantic right whales (*Eubalaena glacialis*), fin whales (*Balaenoptera physalus*), sei whales (*Balaenoptera borealis*), sperm whales (*Physeter macrocephalus*), blue whales (*Balaenoptera musculus*), hawksbill sea turtles (*Eretmochelys imbricata*), leatherback sea turtles (*Dermochelys coriacea*), or shortnose sturgeon (*Acipenser brevirostrum*), all of which are listed as endangered under the ESA. We have also determined that the proposed action being considered in this Opinion is not likely to adversely affect the James and York River Units of the designated critical habitat for the Chesapeake Bay DPS of Atlantic sturgeon. The following discussions are our rationale for these determinations.

[1] NWA DPS = Northwest Atlantic DPS, the only loggerhead sea turtle DPS expected to occur in the action area.
[2] The North Atlantic DPS is the only green sea turtle DPS expected to occur in the action area.

## 4.1 Species and Critical Habitat Not Likely to be Adversely Affected by the Proposed Action

Federally endangered North Atlantic right whales and fin whales are expected to occur in Virginia nearshore and coastal waters of the action area, including Chesapeake Bay, while federally endangered sei, sperm, and blue whales are not, due to their primarily offshore distribution in the Atlantic Ocean. Transient individual right and fin whales may occasionally be present in the lower Bay and nearshore waters of Virginia for brief periods during annual migrations or during the summer months, but no whales are known to be resident in this area and even transient whales are considered rare within the action area .

Whales in the action area will be exposed to effects of the proposed actions including vessel traffic, increased turbidity/suspended sediment (which may affect prey), and potential removal of prey during dredging. All sand will be placed on beaches or in nearshore shallow areas adjacent to beaches. Whales do not occur in these areas; therefore, no whales will be exposed to effects of sand placement.

There have not been any reports of dredge vessels colliding with listed species but contact injuries resulting from dredge movements could occur at or near the water surface and could therefore involve any of the listed species present in the area. Because the dredge is unlikely to be moving at speeds greater than three knots during dredging operations, blunt trauma injuries resulting from contact with the hull are unlikely during dredging. It is more likely that contact injuries during actual dredging would involve the propeller of the vessel. Contact injuries with the dredge are more likely to occur when the dredge is moving from the dredging area to port, or between dredge locations. While the distance between these areas is relatively short (up to approximately 30 miles), the dredge in transit would be moving at faster speeds (9.8 – 10.8 mph) than during dredging operations (2 – 3 mph), particularly when empty while returning to the borrow area.

Large whales, particularly right whales, are vulnerable to injury and mortality from ship strikes. Ship strike injuries to whales take two forms: (1) propeller wounds characterized by external gashes or severed tail stocks; and (2) blunt trauma injuries indicated by fractured skulls, jaws, and vertebrae, and massive bruises that sometimes lack external expression (Laist *et al*. 2001). Collisions with smaller vessels may result in propeller wounds or no apparent injury, depending on the severity of the incident. Laist *et al*. (2001) reports that of 41 ship strike accounts that reported vessel speed, no lethal or severe injuries occurred at speeds below ten knots, and no collisions have been reported for vessels traveling less than six knots. A majority of whale ship strikes seem to occur over or near the continental shelf, probably reflecting the concentration of vessel traffic and whales in these areas (Laist *et al*. 2001).

Most ship strikes have occurred at vessel speeds of 13-15 knots or greater (Jensen and Silber 2003; Laist *et al*. 2001). An analysis by Vanderlaan and Taggart (2006) showed that at speeds greater than 15 knots, the probability of a ship strike resulting in death increases asymptotically to 100%. At speeds below 11.8 knots, the probability decreases to less than 50%, and at ten knots or less, the probability is further reduced to approximately 30%. As noted above, the

speed of the dredge is not expected to exceed 2.6 knots while dredging and 10 knots while transiting to and from the disposal sites. In addition, all vessels will have lookouts on board and operators will receive training on prudent vessel operating procedures to avoid vessel strikes with all protected species. All project related vessels will slow down or alter course if whales are sighted and no vessel will approach within 500 meters of a whale. With these measures in place, interactions between the dredge vessels and any listed whales are extremely unlikely. Therefore, the effects of vessel strike are discountable.

Dredging operations cause sediment to be suspended in the water column. This results in a sediment plume in the water, typically present from the dredge site and decreasing in concentration as sediment falls out of the water column as distance increases from the dredge site. The nature, degree, and extent of sediment suspension around a dredging operation are controlled by many factors including: the particle size distribution, solids concentration, and composition of the dredged material; the dredge type and size, discharge/cutter configuration, discharge rate, and solids concentration of the slurry; operational procedures used; and the characteristics of the hydraulic regime in the vicinity of the operation, including water composition, temperature and hydrodynamic forces (i.e., waves, currents, etc.) causing vertical and horizontal mixing (USACE 1983).

Resuspension of fine-grained dredged material during hopper dredging operations is caused by the dragheads as they are pulled through the sediment, turbulence generated by the vessel and its prop wash, and overflow of turbid water during hopper filling operations. During the filling operation, dredged material slurry is often pumped into the hoppers after they have been filled with slurry in order to maximize the amount of solid material in the hopper. The lower density turbid water at the surface of the filled hoppers overflows and is usually discharged through ports located near the waterline of the dredge. In the vicinity of hopper dredge operations, a near-bottom turbidity plume of resuspended bottom material may extend 2,300 to 2,400 ft down current from the dredge (USACE 1983). In the immediate vicinity of the dredge, a well-defined upper plume is generated by the overflow process. Approximately 1,000 ft behind the dredge, the two plumes merge into a single plume (USACE 1983). Suspended solid concentrations may be as high as several tens of parts per thousand (ppt; grams per liter) near the discharge port and as high as a few parts per thousand near the draghead. In a study done by Anchor Environmental (2003), nearfield concentrations ranged from 80.0-475.0 mg/l. Turbidity levels in the near-surface plume appear to decrease exponentially with increasing distance from the dredge due to settling and dispersion, quickly reaching concentrations less than 1 ppt. By a distance of 4,000 feet from the dredge, plume concentrations are expected to return to background levels (USACE 1983). Studies also indicate that in almost all cases, the vast majority of resuspended sediments resettle close to the dredge within one hour, and only a small fraction takes longer to resettle (Anchor Environmental 2003).

Total suspended sediment (TSS) is most likely to affect whales if a plume causes a barrier to normal behaviors or if elevated levels of suspended sediment affects prey. As whales are highly mobile, individuals are likely to be able to avoid any sediment plume that is present and any effect on their movements or behavior is likely to be insignificant. In addition, the total suspended sediment levels expected (80 – 475 mg/L) are below those shown to have an adverse effect on fish (580.0 mg/L for the most sensitive species, with 1,000.0 mg/L more typical

(Breitburg 1988 in Burton 1993; Summerfelt and Moiser 1976 and Combs 1979 in Burton 1993)). The whales that may be present in the action area feed on krill and small schooling fish. No impacts to these forage fish are likely to result from exposure to increased suspended sediment during dredging operations. Given this information, effects to whales from increased turbidity is extremely unlikely; effects to listed whales will be discountable.

We have also determined that the proposed action will not have any adverse effects on the availability of prey for right, fin, sei, sperm, and blue whales. Right and sei whales feed on copepods. The proposed action will not affect the availability of copepods for foraging right and sei whales because copepods are very small organisms that live in the water column and not in the bottom sediment affected by dredging. Fin and blue whales feed on pelagic krill as well as small schooling fish (e.g., sand lance, herring, mackerel) (Aguilar 2002; Sears 2002), while sperm whales feed on larger organisms that inhabit the deeper ocean regions such as mesopelagic squid (Whitehead 2002). Because there organisms either live pelagically and are highly mobile, or are not located in the actiona area (i.e., mesopelagic squid), effects of dredging and vessels related to the project will not present a pathway of effects to these prey. As a result, the proposed action will not affect the availability of the often pelagic and deepwater prey of foraging sei, sperm, and blue whales.

In addition, the proposed action does not occur in low latitude waters where the overwhelming majority of calving and nursing occurs for these five large whale species (Aguilar 2002; Horwood 2002; Kenney 2002; Sears 2002; Whitehead 2002). Therefore, the proposed action will not affect the oceanographic conditions that are conducive for calving and nursing.

Based on the analysis above, we have determined that the proposed action is not likely to adversely affect these endangered species of whales, and we will not assess them further in this Opinion.

The hawksbill sea turtle is listed as endangered. This species is uncommon in the waters of the continental U.S. Hawksbills prefer coral reef habitats, such as those found in the Caribbean and Central America. Mona Island (Puerto Rico) and Buck Island (St. Croix, U.S. Virgin Islands) contain especially important foraging and nesting habitat for hawksbills. Within the continental U.S., nesting is restricted to the southeast coast of Florida and the Florida Keys, but nesting is rare in these areas. Hawksbills have been recorded from all Gulf of Mexico states and along the U.S. east coast as far north as Massachusetts, but sightings north of Florida are rare. Many of the strandings in states north of Florida have been observed after hurricanes or offshore storms. Aside from Florida, Texas is the only other U.S. state where hawksbills are sighted with any regularity. Since hawksbill sea turtles are extremely unlikely to be present in the action area, impacts to this species as a result of the proposed action are discountable. The lack of any captures of hawksbill sea turtles during dredging operations to date supports this determination.

The leatherback sea turtle is listed as endangered. Adult leatherback sea turtles engage in routine migrations between northern temperate and tropical waters (NMFS and USFWS 1992). Leatherbacks are frequently thought of as a pelagic species that feed on jellyfish (*e.g., Stomolophus, Chryaora*, and *Aurelia* species) and tunicates (*e.g.*, salps, pyrosomas) (Rebel 1974; Davenport and Balazs 1991); however, leatherbacks are also known to use coastal waters of the

U.S. continental shelf (James *et al.* 2005a; Eckert *et al.* 2006; Murphy *et al.* 2006. Leatherbacks are present in the action area between April and November as they migrate to and from southern tropical waters. If suitable forage is present, foraging is expected to occur. Nesting occurs outside of the action area and the presence of leatherbacks in the action area is limited to large juveniles and adults.

Leatherback sea turtles in the action area will be exposed to effects of the proposed actions including vessel traffic and increased turbidity/suspended sediment (which may affect prey. Leatherbacks in the action area are too large to be vulnerable to impingement or entrainment in a dredge. As reported by you, no leatherback sea turtles have been entrained in hopper dredge operations operating along the U.S. Atlantic coast (USACE Sea Turtle Warehouse, 2017). No leatherback sea turtles are likely to be captured during relocation trawling.

Although little is known about a sea turtle's reaction to vessel traffic, it is generally assumed that turtles are more likely to avoid injury from slower-moving vessels since the turtle has more time to maneuver and avoid the vessel. The speed of the dredge is not expected to exceed 3 knots while dredging or while transiting to the pump out site with a full load and it is expected to operate at a maximum speed of 10 knots while empty. In addition, the risk of ship strike will be influenced by the amount of time the animal remains near the surface of the water. For the proposed action, the greatest risk of vessel collision will occur during transit between shore and the areas to be dredged. The presence of an experienced endangered species observer who can advise the vessel operator to slow the vessel or maneuver safely when sea turtles are spotted will further reduce the potential risk for interaction with vessels. To date, there have not been any reports of dredge vessels colliding with leatherback sea turtles. The addition of one to two slow moving vessels in the action area have an insignificant effect on the risk of interactions between leatherback sea turtles and vessels in the action area.

Suspended sediments are most likely to affect leatherback sea turtles if a plume causes a barrier to normal behaviors. As leatherback sea turtles are highly mobile, individuals are likely to be able to avoid any sediment plume that is present and any effect on their movements or behavior is likely to be insignificant due to the small, temporary disruption of normal movements that may result from avoiding the sediment plume are expected to be so small as to not be susceptible to meaningful measurement or detection. Since dredging involves removing the bottom material down to a specified depth, only the benthic environment will be impacted by dredging operations. No effects to the prey base of leatherback sea turtles are anticipated because their preferred prey – jellyfish – are located in the water column.

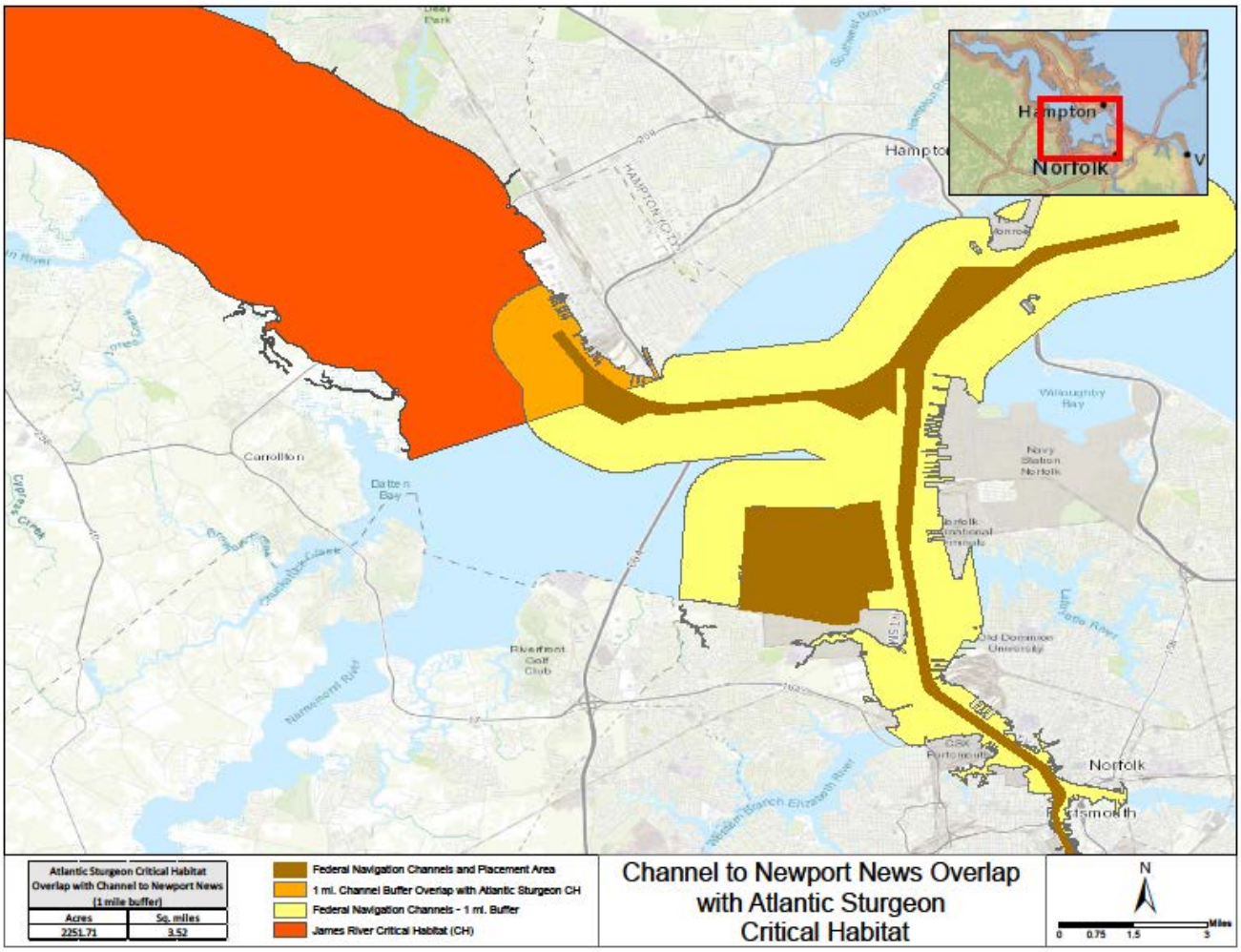
As all effects to leatherback sea turtles from the proposed actions are likely to be too small to be meaningfully measured or detected or extremely unlikely and, therefore, insignificant or discountable, these actions are not likely to adversely affect this species. We do not anticipate any incidental take of any leatherback sea turtles from any of the activities considered in this Opinion.

Shortnose sturgeon are benthic fish that occur in large coastal rivers of eastern North America. They range from as far south as the St. Johns River, Florida (possibly extirpated from this system) to as far north as the Saint John River in New Brunswick, Canada. The species is

anadromous in the southern portion of its range (*i.e.*, south of Chesapeake Bay), while some northern populations are amphidromous (NMFS 1998a), and mostly remain in their native rivers. In Chesapeake Bay, shortnose sturgeon are most often found in Maryland waters of the mainstem bay and tidal tributaries such as the Susquehanna, Potomac, and Rappahannock Rivers (Spells 1998; Litwiler 2001; Kynard et al. 2007, 2009; SSSRT 2010). Documented modern use of Virginia waters of Chesapeake Bay is limited to two individual shortnose sturgeon: one captured in 2016 anda second sturgeon (a confirmed gravid female) caught in 2018. Given the range of the species (remaining mostly in the river systems, with some coastal migrations between rivers), its general restriction to the upper part of Chesapeake Bay (Maryland portion), and the proposed action mostly occurring within the entrance channels of large rivers within the southern portion of Chesapeake Bay, shortnose sturgeon are expected to be extremely rare in areas where the action may occur. As shortnose sturgeon are extremely unlikely to be present in the action area, except for rare transient occurrences, impacts to this species as a result of the proposed action are discountable.

On August 17, 2017, we issued a final rule to designate critical habitat for the threatened Gulf of Maine DPS of Atlantic sturgeon, the endangered New York Bight DPS of Atlantic sturgeon, the endangered Chesapeake Bay DPS of Atlantic sturgeon, the endangered Carolina DPS of Atlantic sturgeon, and the endangered South Atlantic DPS of Atlantic sturgeon (82 FR 39160). The rule was effective on September 18, 2017. The action area for this consultation overlaps slightly with the river mouth of the James River, which is designated as critical habitat for the Chesapeake Bay DPS of Atlantic sturgeon. A portion of the York River Entrance Channel overlaps the York River critical habitat unit; however, during the consultation, you informed us that there is no planned federal action for the channel because the project is not funded and, therefore, no maintenance dredging is planned at this time. Should project plans change or new information become available, further coordination should be pursued.

**Figure 1. Channel to Newport News Overlap with Atlantic Sturgeon Critical Habitat**




The conservation objective identified in the final rule is to increase the abundance of each DPS by facilitating increased successful reproduction and recruitment to the marine environment. We designated five critical habitat units to achieve this objective for the Chesapekae Bay DPS: (1) Potomac River from the Little Falls Dam downstream to where the main stem river discharges at its mouth into the Chesapeake Bay; (2) Rappahannock River from the U.S. Highway 1 Bridge, downstream to where the river discharges at its mouth into Chesapeake Bay; (3) York River from its confluence with the Mattaponi and Pamunkey rivers downstream to where the main stem river discharges at its mouth into Chesapeake Bay as well as the waters of the Mattaponi River from its confluence with the York River and upstream to the Virginia State Route 360 Brige of the Mattaponi River, and waters of the Pamunkey River from its confluence with the York River and upstream to the Nelson's Bridge Road Route 615 crossing of the Pamunkey River; (4) James River from Boshers Dam downstream to where the main stem river discharges at its mouth into Chesapeake Bay at Hampton Roads; and (5) Nanticoke River from the Maryland State Route 313 Bridge crossing near Sharptown, MD to where the main stem discharges at its mouth into Chesapeake Bay as well as Marshyhope Creek from its confluence with the Nanticoke River and upriver to the Maryland State Route 318 Bridge crossing near

Federalsburg, MD. In total, these designations encompass approximately 773 kilometers (480 miles) of aquatic habitat.

As identified in the final rule, the physical and biological features (PBFs) that are essential to the conservation of the species and that may require special management considerations or protection are:

1) Hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0 to 0.5 parts per thousand (ppt) range) for settlement of fertilized eggs, refuge, growth, and development of early life stages;
2) Aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 ppt and soft substrate (e.g., sand, mud) between the river mouth and spawning sites for juvenile foraging and physiological development;
3) Water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support:
   (i) Unimpeded movement of adults to and from spawning sites;
   (ii) Seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and
   (iii) Staging, resting, or holding of subadults or spawning condition adults.

   Water depths in main river channels must also be deep enough (e.g., at least 1.2 m) to ensure continuous flow in the main channel at all times when any sturgeon life stage would be in the river.
4) Water, between the river mouth and spawning sites, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support:
   (i) Spawning;
   (ii) Annual and interannual adult, subadult, larval, and juvenile survival; and
   (iii) Larval, juvenile, and subadult growth, development, and recruitment (*e.g.,*13 °C to 26 °C for spawning habitat and no more than 30 °C for juvenile rearing habitat, and 6 milligrams per liter (mg/L) dissolved oxygen (DO) or greater for juvenile rearing habitat).

The action area for the proposed work considered in this Opinion overlaps the lower portions of the James Rivercritical habitat unit. Specifically, the northern end of the Newport News Channel and adjacent Newport News anchorage. The total area of the channel and anchorage that overlaps critical habitat in the James River is approximately 0.38 square miles (0.99 square kilometers). To account for potential dredging impacts (e.g., a temporary increase in suspended sediments) in the James River, you included a one mile radius buffer zone around the channel and anchorage, which totals approximately 3.52 square miles (9.12 square kilometers). The critical habitat designation is bank-to-bank within the James River. We have estimated that the total area of the James River critical habitat unit is approximately 166 square miles or 106,240 acres. While the majority of the proposed work in designated critical habitat takes place within

the Federal navigation channel, indirect effects from turbidity extend as far as 1,000 feet (305 meters) (cutterhead dredge turbidity plume). If you were to assume a worst-case scenario where a dredge event occurred in the center of the river and the plume extended in a 305 m radius around the dredge (note: we would generally expect the plume to extend only downcurrent of the dredge), the action area would encapsulate a 610 m width of the river. In the overlapping stretch of the James designated as critical habitat, the river is approximately 4.4 miles (7.14 km) wide. The section of the navigation channel and anchorage area that extends into the James River critical habitat unit is approximately 1.5 miles long. Therefore, the action area overlaps with just the southeastern corner of the bank-to-bank critical habitat designation. Each critical habitat unit contains all four of the physical features (referred to as physical or biological features (PBF); however, the action area only contains three PBFs: PBF 2, 3, and 4, as PBF 1 is not present because the salinity level present at the river mouth exceeds that identified in PBF 1.

We have analyzed the potential impacts of the proposed action on this designated critical habitat, inclusive of the three physical and biological features (PBFs) present that have been deemed essential to the conservation of the species and which may require special management considerations or protections. For each PBF, we identify those activities that may affect the PBF. For each feature that may be affected by the action, we then determine whether any effects to the feature are adverse, insignificant, discountable, or entirely beneficial. In making this determination, we consider the action's potential to affect how each PBF supports Atlantic sturgeon's conservation needs in the action area. Part of this analysis is consideration of whether the action will have effects on the ability of Atlantic sturgeon to access the feature, temporarily or permanently, and consideration of the effect of the action on the action area's ability to develop the feature over time. We have determined that the effects to these PBFs from the proposed action will be insignificant or discountable for the following reasons.

*PBF 2: Transitional salinity zone with soft substrate for juvenile foraging and physiological development*

In considering effects to PBF 2, we consider whether the proposed action will have any effect on areas of soft substrate within transitional salinity zones between the river mouth and spawning sites for juvenile foraging and physiological development; therefore, we consider effects of the action on soft substrate, salinity and any change in the ability of the feature to support juvenile foraging and physiological development. We also consider the effects to PBF 2 in light of the value it provides to the conservation of the species in the action area. Finally, we consider whether the action will have effects on access to this feature, temporarily or permanently, and on the action area's ability to develop the feature over time.

In order to successfully complete their physiological development, Atlantic sturgeon must have access to a gradual gradient of salinity from freshwater to saltwater. Atlantic sturgeon move along this gradient as their tolerance to increased salinity increases with age. PBF 2 occurs from approximately the mouth of the James River upstream to the downstream median range of the salt front. Salinity levels in the river are dynamic, and the salt front[4] is defined by a lower

4 The salt front in an estuary is the line between brackish water and freshwater. The location of the salt front changes with the tide cycle and the season. Daily, as the tide in the ocean rises, it brings saltier ocean water into the

concentration (0.25 ppt) than the salinity level of PBF 2 (0.5 ppt), but in the summer and fall RKM 95 is a reasonable approximation given the lack of real time data and the very small difference we would expect between the area where salinity is 0.5 ppt and 0.25 ppt. The action area that overlaps with critical habitat in the James River is between RKM 15 and RKM 18. In the James River critical habitat unit, the only activity that overlaps with PBF 2 is dredging of the portion of the Newport News channel and anchorage. Using the one mile radius zone around the channel and anchorage, we estimate that there are 2,252 acres of unconsolidated soft substrates within the salinity gradient for juvenile foraging and physiological development potentially meeting the criteria for PBF 2 within critical habitat in the action area.

Here we consider whether those activities may affect PBF 2 and if so, whether the dredging described herein are adverse, insignificant, discountable or entirely beneficial.

In the James River, the proposed action involves the deepening of the Newport News channel and subsequent maintenance dredging of non-continguos shoaled areas every five years. We do not anticipate that the dredging will result in a change in the type of substrate. The portion of the navigation channel and anchorage within critical habitat in the James River is approximately 244 acres. We expect that dredging of the area will result in reduction in benthic habitat through the removal of soft substrate and increased turbidity in the area surrounding the dredge footprint to a 305 meter radius. The area of soft substrate designated as part of PBF 2, and affected by the dredging activities may be slightly larger than 244 acres in the James River, as areas outside of the dredge footprint impacted by sedimentation from the nearfield turbidity plume of dredges may experience a loss of benthic life from burial/suffocation. As stated above, if you were to assume a worst-case scenario where a dredge event occurred in the center of the river and the plume extended in a 305m radius around the dredge (note: we would generally expect the plume to extend only downcurrent of the dredge), the area impacted would be approximately 610 meters wide. We do not expect dredging to impact salinity levels, the other applicable attribute in PBF 2, to an extent that would influence the movement or seasonal location of the salt front. Accoridingly, the salinity gradient feature that is a component of PBF 2 would continue to perform its function to faciltitate the physiologoical development of juveniles. This is explained further, below under PBF 4.

Dredging is likely to entrain and kill at least some potential sturgeon forage items. Turbidity and suspended sediments from dredging activities may also affect benthic resources in those areas where increased turbidity and suspended sediments settle out and result in burial or suffocation of immobile organisms. The TSS levels expected for all of the proposed activities (ranging from 5 mg/L to 475 mg/L) are mostly below those shown to have adverse effects on benthic communities (390 mg/L (EPA 1986). Benthic sampling done by O'Herron and Hastings (1985) in association with past USACE maintenance dredging in the Delaware River found that *Corbicula* recolonized the dredge areas during the subsequent growing season. Until the areas recover and are repopulated by neighboring colonies of benthic invertebrates, juvenile sturgeon will be able to access these areas during their development, but will not be able to use these areas

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estuary and pushing the salt front further up the river estuary. As the tide recedes, the salt front occurs further downriver. Seasonally, higher freshwater flow (e.g., in the spring) pushes the salt front further downriver in the estuary. During times of less freshwater input (e.g., during the summer), the salt front is further upriver in the estuary.

for foraging. Sturgeon may be exposed to a temporary reduction in forage in these noncontiguous shoaled areas where dredging occurs for one to two seasons immediately following dredging (O'Herron and Hastings 1985). As the Newport News channel may require maintenance dredging of non-contiguous areas every 5 years, areas dredged in one cycle are expected to fully recover their value for juvenile foraging for two to three years before being dredged again. During this time, sturgeon will be able to access and transit through the area and use it for other aspects of their development.

Soft substrate within the navigation channels and anchorage may also be disturbed on a daily basis by large, deep draft, commercial vessels. Channels requiring maintenance dredging are particularly vulnerable to disturbance from vessels, as once sediments build up (which occurs over time after dredging), they can be close enough to the keels and propellers of large vessels to be a navigation hazard. Given the dynamic nature of the substrates that form these channels, the impacts of natural factors that lead to the accumulation of sediments in these channels, and the disturbance of at least the top layer of sediment when large ships pass overhead, these areas may not support the same abundance of benthic resources as areas outside of the channels do, where the disturbance regime is not as frequent. However, given that Atlantic sturgeon forage on a variety of benthic invertebrates, including worms tht bury into the substrate, it is not entirely clear what impact the disturbance regime has on the ability of these shoaled areas to support the foraging and development of juvenile Atlantic sturgeon. While we do not have fine scale information on sturgeon forage items or sturgeon distribution that we could use to make a conclusive determination about foraging in the channel versus outside the channel, it is reasonable to assume that areas outside the channel that are not subject to disturbance as frequently are more likely to support forage species. Accordingly, the value of PBF 2 outside the channel is greater to the conservation of the species.

In conclusion, although the dredging in the James River of up to 244 acres will affect benthic intvertebrates throughout the life of the project, by removing them with the dredged sediment and limiting the feature's ability to permanently improve in value in the future (the intermittent removal of substrates to maintain the channel depth will affect the availability of forage species while areas are recolonized by benthic invertebrates that juvenile Atlantic sturgeon would otherwise feed on), the area will continue to consist of soft bottom substrate. In addition, the dredging footprint represents a small (up to approximately 0.23% of the James River critical habitat unit potentially supporting PBF 2) and non-contiguous amount of the available soft bottom substrate within the subset of the action area that overlaps critical habitat. Furthermore, the non-contiguous areas of PBF 2 will not be impacted at the same times during dredging events. Considering these factors, as well as the naturally dynamic nature of these areas which may limit their ability to support foraging juvenile Atlantic sturgeon (except for opportunistically), i.e., the function of PBF 2 in the action area even if dredging did not occur, the effects of dredging this small amount of habitat on juvenile foraging or physiological development will be so small that they cannot be meaningfully measured, evaluated, or detected. Therefore, any effects on the value of PBF 2 in the action area to the conservation of the species are insignificant.

*PBF 3: Water absent physical barriers to passage between the river mouth and spawning sites*

In considering effects to PBF 3, we consider whether the proposed action will have any effect on water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support: unimpeded movements of adults to and from spawning sites; seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary, and; staging, resting, or holding of subadults or spawning condition adults. We also consider whether the proposed action will affect water depth or water flow, because if water is too shallow it can be a barrier to sturgeon movements, and an alteration in water flow could similarly impact the movements of sturgeon in the river. Therefore, we consider effects of the action on water depth and water flow and whether the action results in barriers to passage that impede the movements of Atlantic sturgeon. We also consider whether the action will have effects on access to this feature, temporarily or permanently and consider the effect of the action on the action area's ability to develop the feature over time.

Unlike some southern rivers, given the extent of tidal flow, geomorphology and naturally deep depths of the James River, it is not vulnerable to natural reductions in water flow or water depth that can result in barriers to sturgeon movements; also, we are not aware of any impacts from this action that reduce water depth or water flow in a way that impact sturgeon movements. We are not aware of any complete barriers to passage for Atlantic sturgeon in the James River; that is, we do not know of any structures or conditions that prevent sturgeon from moving up or downstream within the river. There are areas in the James River critical habitat unit where sturgeon movements are affected by water quality (e.g., thermal plumes discharged from power plant outfalls) and noise (e.g., during pile driving at ongoing in-water construction projects); however, impacts on movements are normally temporary and/or intermittent and best available data suggests there is always a zone of passage through the affected river reach. Here we consider whether the dredging activities in the Newport News channels and anchorage may affect PBF 3 and whether those effects are adverse, insignificant, discountable or entirely beneficial.

A study conducted in the James River by Reine et al. (2014) found no evidence that would suggest that the presence of an active dredge represented a physical barrier to sturgeon movement. Similarly, the above referenced dredging project within the Newport News channels and anchorage portion of the James River will not create physical barriers within the river that will impede Atlantic sturgeon movements or use of the river. In areas where the channel is being deepened, the new depth still falls within a range suitable for Atlantic sturgeon use. As stated in other sections, even during times of active dredging, Atlantic sturgeon can still access and use the surrounding area. While some studies indicate that Atlantic sturgeon tend to avoid areas of active dredging (Hatin et al. 2007), other studies (Reine et al. 2014) state that Atlantic sturgeon showed neither attraction to nor avoidance of active dredging activities. Moser and Ross (1993) found that both shortnose and Atlantic sturgeon occupied both undisturbed and regularly dredged areas during concurrent dredging operations with no negative impact. A study by Cameron (2012) showed that sturgeon exhibited no signs of impeded movement up or downriver due to the physical presence of a dredge. Fish were actively tracked freely moving past the dredge during full production mode and showed no signs of avoidance response (e.g., due to noise

generated by the dredge) as indicated by the amount of time spent in close proximity to the dredge after release (3.5 – 21.5 hours). In addition, tagged fish showed no evidence of attraction to the dredge. Brundage (personal communication with USACE, 2017) has noted reduced catches in the Marcus Hook Anchorage in the Delaware River when hydraulic dredging was occurring in the adjacent navigation channel. It is not known, however, if the noise produced by pumping the dredged material through the pipeline was causing an avoidance response or if the physical presence of the pipeline and general disturbance of the area may have also contributed to the sturgeon moving away.

In sum, the proposed action may have temporary effects on PBF 3 by creating temporary in-water stressors from construction activities (i.e., presence of dredge and turbidity plumes); however, none of the proposed activities will be barriers to the movement of adult, subadult or juvenile Atlantic sturgeon (because of the salinity levels in the action area, early life stages of Atlantic sturgeon will not be present). Based on our assessment, these impediments to movement are extremely unlikely to affect the value of PBF 3 to the conservation of the species in the action area; that is, it is extremely unlikely that the habitat alterations will create barriers that will affect the movement of Atlantic sturgeon in the action area generally. Specifically, it is extremely unlikely that the habitat alterations will impede the movement of adults to and from spawning sites or the seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary or impede the staging, resting, or holding of subadults or spawning condition adults; therefore, the effects are discountable.

*PBF 4: Water with the temperature, salinity, and oxygen values that, combined, provide for dissolved oxygen values that support successful reproduction and recruitment and are within the temperature range that supports the habitat function*

In considering effects to PBF 4, we consider whether the proposed action will have any effect on water quality, between the river mouth and spawning sites, especially in the bottom meter of the water column with the temperature, salinity, and oxygen values that, combined, support: spawning; annual and interannual adult, subadult, larval, and juvenile survival; and larval, juvenile, and subadult growth, development, and recruitment. Therefore, we consider effects of the action on temperature, salinity and dissolved oxygen needs for Atlantic sturgeon spawning and recruitment. These water quality conditions are interrelated and both temperature and salinity influence the dissolved oxygen saturation for a particular area. We also consider whether the action will have effects to access to this feature, temporarily or permanently and consider the effect of the action on the action area's ability to develop the feature over time.

As defined, water quality factors of temperature, salinity and dissolved oxygen are interrelated environmental variables, and in a river system such as the James, are constantly changing from influences of the tide, weather, season, etc. The area with PBF 4 (water between the river mouth and spawning sites, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that combined support spawning, survival, and larval, juvenile, and subadult development and recruitment), may be present throughout the extent of critical habitat designated in the James River (depending on the life stage); therefore, PBF 4 overlaps with the action area.

Many factors influence salinity in the James River, including stream flow, ocean salinity, sea level, wind stress, and human activities (e.g., dredging activities). Deepening and maintenance dredging in the navigation channel have the potential to affect the spatial and temporal salinity distribution in the action area. However, Ross et al. (2015) stated that dredging in the Delaware River (i.e., increased depth to 45 ft) has not influenced long-term salinity trends (statistical models did not detect a significant salinity trend in the area following completed deepening). While we do expect salt water intrusion further into the James River over time due to climate change, the relative effects of dredging on salinity levels and location (spatial and temporal), in addition to baseline conditions, will be too small to be meaningfully measured or detected

The only pathway for the proposed dredging to impact DO is through increased suspended sediments and turbidity. Sediments suspended during dredging may have minor, temporary, localized effects on DO levels, but we expect sediment to settle out of the water column within an hour before effects would impact the value of the feature for any lifestage of Atlantic sturgeon[5]. While proposed deepening activities in the Newport News channel may have minor effects to the temperature in that section of navigation channel, the area requiring deepening is a small non-contingous portion of the action area that overlaps with critical habitat (up to 10%), and we do not expect any minor changes in temperature to alter how various life stages of Atlantic sturgeon use those respective sections of the river for spawning, rearing, and development.

To summarize, we expect the effects of dredging in the action area on the value of PBF 4 to the conservation of the species (i.e., the current and future development of this feature to provide the temperature, salinity, and oxygen values that, combined, support: spawning; annual and interannual adult, subadult, larval, and juvenile survival; and larval, juvenile, and subadult growth, development, and recruitment) to be too small to be meaningfully measured or detected, and are therefore, insignificant.

## 4.2 Species Likely to be Adversely Affected by the Proposed Action

This section will focus on the status of the various ESA-listed species likely to be adversely affected within the action area, summarizing information necessary to establish the environmental baseline and to assess the effects of the proposed action.

### *4.2.1 Status of Sea Turtles*

With the exception of loggerheads and greens, sea turtles are listed under the ESA at the species level rather than as subspecies or DPSs. Therefore, information on the range-wide status of Kemp's ridley sea turtles is included to provide the status of each species overall. Information on the status of loggerhead and green sea turtles will only be presented for the DPS affected by this action. Additional background information on the range-wide status of these species can be found in a number of published documents, including sea turtle status reviews and biological reports (NMFS and USFWS 1995, 2007a, 2007b, 2013; 2015; Hirth 1997; Marine Turtle Expert Working Group [TEWG] 1998, 2000, 2007, 2009; Conant *et al.* 2009; Seminoff *et al.* 2015), and

5 We only expect adult, sub-adult, and juvenile lifestages of Altantic sturgeon in the action area; early life stages will not be present due to the salinity levels.

recovery plans for the loggerhead sea turtle (NMFS and USFWS 2008), Kemp's ridley sea turtle (NMFS *et al.* 2011), and green sea turtle (NMFS and USFWS 1991)).

*2010 BP Deepwater Horizon Oil Spill*

The April 20, 2010, explosion of the Deepwater Horizon (DWH) oil rig affected sea turtles in the Gulf of Mexico. This extensive oiling event contaminated important sea turtle foraging, migratory, and breeding habitats at the surface, in the water column, on the ocean bottom, and on beaches throughout the northern Gulf of Mexico in areas used by different life stages. Sea turtles were exposed to oil when in contaminated water or habitats; breathing oil droplets, oil vapors, and smoke; ingesting oil-contaminated water and prey; and potentially by maternal transfer of oil compounds to embryos (DWH NRDA Trustees 2016). Response activities and shoreline oiling also directly injured sea turtles and disrupted or deterred sea turtle nesting in the Gulf.

During direct at-sea capture events, more than 900 turtles were sighted, 574 of which were captured and examined for oiling (Stacy 2012). Of the turtles captured during these operations, greater than 80% were visibly oiled (DWH NRDA Trustees 2016). Most of the rescued turtles were taken to rehabilitation facilities; more than 90% of the turtles admitted to rehabilitation centers eventually recovered and were released (Stacy 2012; Stacy and Innis 2012). Recovery efforts also included relocating nearly 300 sea turtle nests from the northern Gulf to the east coast of Florida in 2010, with the goal of preventing hatchlings from entering the oiled waters of the northern Gulf. Approximately 14,000 hatchlings were released off the Atlantic coast of Florida, 95% of which were loggerheads (http://www.nmfs.noaa.gov/pr/health/oilspill/gulf2010.htm).

Direct observations of the effects of oil on turtles obtained by at-sea captures, sightings, and strandings only represent a fraction of the scope of the injury. As such, the DWH NRDA (Natural Resource and Damage Assessment) Trustees used expert opinion, surface oiling maps, and statistical approaches to apply the directly observed adverse effects of oil exposure to turtles in areas and at times that could not be surveyed. The Trustees estimated that between 4,900 and up to 7,600 large juvenile and adult sea turtles (Kemp's ridleys, loggerheads, and hard-shelled sea turtles not identified to species), and between 55,000 and 160,000 small juvenile sea turtles (Kemp's ridleys, green turtles, loggerheads, hawksbills, and hard-shelled sea turtles not identified to species) were killed by the DWH oil spill (DWH NRDA Trustees 2016). Nearly 35,000 hatchling sea turtles (loggerheads, Kemp's ridleys, and green turtles) were also injured by response activities. Despite uncertainties and some unquantified injuries to sea turtles (e.g., unrealized reproduction), the Trustees conclude that this assessment adequately quantifies the nature and magnitude of injuries to sea turtles caused by the DWH oil spill and related activities.

Based on this quantification of sea turtle injuries caused by the DWH oil spill, sea turtles from all life stages and all geographic areas were lost from the northern Gulf of Mexico ecosystem. The DWA NRDA Trustees (2016) conclude that the recovery of sea turtles in the northern Gulf of Mexico from injuries caused by the DWH oil spill will require decades of sustained efforts to reduce the most critical threats and enhance survival of turtles at multiple life stages. The ultimate population level effects of the spill and impacts of the associated response activities are likely to remain unknown for some period into the future.

*4.2.1.1 Status of Loggerhead Sea Turtles – Northwest Atlantic DPS*

The loggerhead is the most abundant species of sea turtle in U.S. waters. Loggerhead sea turtles are found in temperate and subtropical waters and occupy a range of habitats including offshore waters, continental shelves, bays, estuaries, and lagoons. They are also exposed to a variety of natural and anthropogenic threats in the terrestrial and marine environment.

*Listing History*

Loggerhead sea turtles were listed as threatened throughout their global range on July 28, 1978. Since that time, several status reviews have been conducted to review the status of the species and make recommendations regarding its ESA listing status. Based on a 2007 five-year status review of the species, which discussed a variety of threats to loggerheads including climate change, NMFS and USFWS (2007a) determined that loggerhead sea turtles should not be delisted or reclassified as endangered. However, it was also determined that an analysis and review of the species should be conducted in the future to determine whether DPSs should be identified for the loggerhead (NMFS and USFWS 2007a). Genetic differences exist between loggerhead sea turtles that nest and forage in the different ocean basins (Bowen 2003; Bowen and Karl 2007). Differences in the maternally inherited mitochondrial DNA also exist between loggerhead nesting groups that occur within the same ocean basin (TEWG 2000; Pearce 2001; Bowen 2003; Bowen *et al.* 2005; Shamblin 2007; TEWG 2009; NMFS and USFWS 2008). Site fidelity of females to one or more nesting beaches in an area is believed to account for these genetic differences (TEWG 2000; Bowen 2003).

In part to evaluate those genetic differences, in 2008, NMFS and USFWS established a Loggerhead Biological Review Team (BRT) to assess the global loggerhead population structure to determine whether DPSs exist and, if so, the status of each DPS. The BRT evaluated genetic data, tagging and telemetry data, demographic information, oceanographic features, and geographic barriers to determine whether population segments exist. The BRT report was completed in August 2009 (Conant *et al.* 2009). In this report, the BRT identified the following nine DPSs as being discrete from other conspecific population segments and significant to the species: (1) North Pacific Ocean, (2) South Pacific Ocean, (3) North Indian Ocean, (4) Southeast Indo-Pacific Ocean, (5) Southwest Indian Ocean, (6) Northwest Atlantic Ocean, (7) Northeast Atlantic Ocean, (8) Mediterranean Sea, and (9) South Atlantic Ocean.

The BRT concluded that although some DPSs are indicating increasing trends at nesting beaches (Southwest Indian Ocean and South Atlantic Ocean), available information about anthropogenic threats to juveniles and adults in neritic and oceanic environments indicate possible unsustainable additional mortalities. According to an analysis using expert opinion in a matrix model framework, the BRT report stated that all loggerhead DPSs have the potential to decline in the foreseeable future. Based on the threat matrix analysis, the potential for future decline was reported as greatest for the North Indian Ocean, Northwest Atlantic Ocean, Northeast Atlantic Ocean, Mediterranean Sea, and South Atlantic Ocean DPSs (Conant *et al.* 2009). The BRT concluded that the North Pacific Ocean, South Pacific Ocean, North Indian Ocean, Southeast Indo-Pacific Ocean, Northwest Atlantic Ocean, Northeast Atlantic Ocean, and Mediterranean Sea DPSs were at risk of extinction. The BRT concluded that although the Southwest Indian Ocean and South Atlantic Ocean DPSs were likely not currently at immediate risk of extinction, the extinction risk was likely to increase in the foreseeable future.

On March 16, 2010, NMFS and USFWS published a proposed rule (75 FR 12598) to divide the worldwide population of loggerhead sea turtles into nine DPSs, as described in the 2009 Status Review. Two of the DPSs were proposed to be listed as threatened and seven of the DPSs, including the Northwest Atlantic Ocean DPS, were proposed to be listed as endangered. NMFS and USFWS accepted comments on the proposed rule through September 13, 2010 (75 FR 30769, June 2, 2010). On March 22, 2011 (76 FR 15932), NMFS and USFWS extended the date by which a final determination on the listing action would be made to no later than September 16, 2011. This action was taken to address the interpretation of the existing data on status and trends and its relevance to the assessment of risk of extinction for the Northwest Atlantic Ocean DPS, as well as the magnitude and immediacy of the fisheries bycatch threat and measures to reduce this threat. New information or analyses to help clarify these issues were requested by April 11, 2011.

On September 22, 2011, NMFS and USFWS issued a final rule (76 FR 58868), determining that the loggerhead sea turtle is composed of nine DPSs (as defined in Conant *et al*. 2009) that constitute species that may be listed as threatened or endangered under the ESA. Five DPSs were listed as endangered (North Pacific Ocean, South Pacific Ocean, North Indian Ocean, Northeast Atlantic Ocean, and Mediterranean Sea), and four DPSs were listed as threatened (Northwest Atlantic Ocean, South Atlantic Ocean, Southeast Indo-Pacific Ocean, and Southwest Indian Ocean). Note that the Northwest Atlantic Ocean (NWA) DPS and the Southeast Indo-Pacific Ocean DPS were originally proposed as endangered. The NWA DPS was determined to be threatened based on review of nesting data available after the proposed rule was published, information provided in public comments on the proposed rule, and further discussions within the agencies. The two primary factors considered were population abundance and population trend. NMFS and USFWS found that an endangered status for the NWA DPS was not warranted given the large size of the nesting population, the overall nesting population remains widespread, the trend for the nesting population appears to be stabilizing, and substantial conservation efforts are underway to address threats. This final listing rule became effective on October 24, 2011.

The September 2011 final rule also noted that critical habitat for the two DPSs occurring within the U.S. (NWA DPS and North Pacific DPS) would be designated in a future rulemaking. Information from the public related to the identification of critical habitat, essential physical or biological features for this species, and other relevant impacts of a critical habitat designation was solicited. On July 10, 2014, the USFWS and NMFS published two separate final rules in the Federal Register designating critical habitat for the NWA DPS of loggerhead sea turtles under the ESA (79 FR 39755 for nesting beaches under FWS jurisdiction; 79 FR 39856 for marine areas under NMFS jurisdiction). Effective August 11, 2014, NMFS's final rule for marine areas designated 38 occupied areas within the at-sea range of the DPS. These designated marine areas of critical habitat contain one or a combination of: nearshore reproductive habitat, overwintering habitat, breeding habitat, migratory habitat, and *Sargassum* habitat.

*Presence of Loggerhead Sea Turtles in the Action Area*

The effects of the proposed action are only experienced within Virginia's nearshore and coastal waters and its portion of Chesapeake Bay and associated river mouths. We have considered the available information on the distribution of the nine DPSs to determine the origin of any

loggerhead sea turtles that may occur in the action area. As noted in Conant *et al.* (2009), the range of the four DPSs occurring in the Atlantic Ocean are as follows: NWA DPS – north of the equator, south of 60° N latitude, and west of 40° W longitude; Northeast Atlantic Ocean (NEA) DPS – north of the equator, south of 60° N latitude, east of 40° W longitude, and west of 5° 36' W longitude; South Atlantic DPS – south of the equator, north of 60° S latitude, west of 20° E longitude, and east of 60° W longitude; Mediterranean DPS – the Mediterranean Sea east of 5° 36' W longitude. These boundaries were determined based on oceanographic features, loggerhead sightings, thermal tolerance, fishery bycatch data, and information on loggerhead distribution from satellite telemetry and flipper tagging studies. While adults are highly structured with no overlap, there may be some degree of overlap by juveniles of the NWA, NEA, and Mediterranean DPSs on oceanic foraging grounds (Laurent *et al.* 1993, 1998; Bolten *et al.* 1998; LaCasella *et al.* 2005; Carreras *et al.* 2006, Monzón-Argüello *et al.* 2006; Revelles *et al.* 2007). Previous literature (Bowen *et al.* 2004) has suggested that there is the potential, albeit small, for some juveniles from the Mediterranean DPS to be present in U.S. Atlantic coastal foraging grounds. These conclusions must be interpreted with caution however, as they may be representing a shared common haplotype and lack of representative sampling at Eastern Atlantic rookeries rather than an actual presence of Mediterranean DPS turtles in U.S. Atlantic coastal waters. A re-analysis of the data by the Atlantic Loggerhead Turtle Expert Working Group has found that that it is unlikely that U.S. fishing fleets are interacting with either the NEA or Mediterranean DPS (Peter Dutton, NMFS, Marine Turtle Genetics Program, Program Leader, personal communication, September 10, 2011). Given that the action area is a very small subset of the area fished by U.S. fleets, it is reasonable to assume that based on this analysis, no individuals from the NEA or Mediterranean DPS would be present in the action area. Sea turtles of the South Atlantic DPS do not inhabit the action area of this consultation (Conant *et al.* 2009). As such, the remainder of this consultation will focus on the NWA DPS, listed as threatened.

*Distribution and Life History*

Ehrhart *et al.* (2003) provided a summary of the literature identifying known nesting habitats and foraging areas for loggerheads within the Atlantic Ocean. Detailed information is also provided in the five-year status review for loggerheads (NMFS and USFWS 2007a), the TEWG (2009) report, and the final revised recovery plan for loggerheads in the Northwest Atlantic Ocean (NMFS and USFWS 2008), which is a second revision to the original recovery plan that was approved in 1984 and subsequently revised in 1991.

In the western Atlantic, waters as far north as the Gulf of Maine and the Canadian Maritimes are used for foraging by juveniles as well as adults (Shoop 1987; Shoop and Kenney 1992; Ehrhart *et al.* 2003; Mitchell *et al.* 2003; NEFSC 2011a). In U.S. Atlantic waters, loggerheads commonly occur throughout the inner continental shelf from Florida to Cape Cod, Massachusetts and in the Gulf of Mexico from Florida to Texas, although their presence varies with the seasons due to changes in water temperature (Shoop and Kenney 1992; Epperly *et al.* 1995a, 1995b; Braun and Epperly 1996; Mitchell *et al.* 2003; Braun-McNeill *et al.* 2008). Loggerheads have been observed in waters with surface temperatures of 7°C to 30°C, but water temperatures ≥11°C are most favorable (Shoop and Kenney 1992; Epperly *et al.* 1995b). The presence of loggerhead sea turtles in U.S. Atlantic waters is also influenced by water depth. Aerial surveys of continental shelf waters north of Cape Hatteras, North Carolina indicated that loggerhead sea turtles were most commonly sighted in waters with bottom depths ranging from 22 to 49 meters

deep (Shoop and Kenney 1992). However, more recent survey and satellite tracking data support that they occur in waters from the beach to beyond the continental shelf (Mitchell *et al.* 2003; Braun-McNeill and Epperly 2004; Mansfield 2006; Blumenthal *et al.* 2006; Hawkes *et al.* 2006; McClellan and Read 2007; Mansfield *et al.* 2009).

Loggerhead sea turtles occur year round in ocean waters off North Carolina, South Carolina, Georgia, and Florida. In these areas of the South Atlantic Bight, water temperature is influenced by the proximity of the Gulf Stream. As coastal water temperatures warm in the spring, loggerheads begin to migrate to inshore waters of the Southeast U.S. (e.g., Pamlico and Core Sounds) and also move up the U.S. Atlantic coast (Epperly *et al.* 1995a, 1995b, 1995c; Braun-McNeill and Epperly 2004), occurring in Virginia foraging areas as early as April/May and on the most northern foraging grounds in the Gulf of Maine in June (Shoop and Kenney 1992). The trend is reversed in the fall as water temperatures cool. The large majority leave the Gulf of Maine by mid-September but some turtles may remain in Mid-Atlantic and Northeast areas until late fall. By December, loggerheads have migrated from inshore and more northern coastal waters to waters offshore of North Carolina, particularly off of Cape Hatteras, and waters further south where the influence of the Gulf Stream provides temperatures favorable to sea turtles (Shoop and Kenney 1992; Epperly *et al.* 1995b).

Recent studies have established that the loggerhead's life history is more complex than previously believed. Rather than making discrete developmental shifts from oceanic to neritic environments, research is showing that both adults and (presumed) neritic stage juveniles continue to use the oceanic environment and will move back and forth between the two habitats (Witzell 2002; Blumenthal *et al.* 2006; Hawkes *et al.* 2006; McClellan and Read 2007; Mansfield *et al.* 2009). One of the studies tracked the movements of adult post-nesting females and found that differences in habitat use were related to body size with larger adults staying in coastal waters and smaller adults traveling to oceanic waters (Hawkes *et al.* 2006). A tracking study of large juveniles found that the habitat preferences of this life stage were also diverse with some remaining in neritic waters and others moving off into oceanic waters (McClellan and Read 2007). However, unlike the Hawkes *et al.* (2006) study, there was no significant difference in the body size of turtles that remained in neritic waters versus oceanic waters (McClellan and Read 2007).

Pelagic and benthic juveniles are omnivorous and forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd 1988; NMFS and USFWS 2008). Sub-adult and adult loggerheads are primarily coastal dwelling and typically prey on benthic invertebrates such as mollusks and decapod crustaceans in hard bottom habitats (NMFS and USFWS 2008). As presented below, Table 3 from the 2008 loggerhead recovery plan (Table 3 in this Opinion) highlights the key life history parameters for loggerheads nesting in the U.S.

**Table 3. Typical values of life history parameters for loggerheads nesting in the U.S**.

| Life History Parameter | Data |
|---|---|
| Clutch size | 100-126 eggs[1] |
| Egg incubation duration (varies depending on time of year and latitude) | 42-75 days[2,3] |
| Pivotal temperature (incubation temperature that produces an equal number of males and females) | 29.0°C[5] |
| Nest productivity (emerged hatchlings/total eggs) x 100 (varies depending on site specific factors) | 45-70%[2,6] |
| Clutch frequency (number of nests/female/season) | 3-5.5 nests[7] |
| Internesting interval (number of days between successive nests within a season) | 12-15 days[8] |
| Juvenile (<87 cm CCL) sex ratio | 65-70% female[4] |
| Remigration interval (number of years between successive nesting migrations) | 2.5-3.7 years[9] |
| Nesting season | late April-early September |
| Hatching season | late June-early November |
| Age at sexual maturity | 32-35 years[10] |
| Life span | >57 years[11] |

1 Dodd 1988.
2 Dodd and Mackinnon (1999, 2000, 2001, 2002, 2003, 2004).
3 Blair Witherington, FFWCC, personal communication, 2006 (information based on nests monitored throughout Florida beaches in 2005, n=865).
4 National Marine Fisheries Service (2001); Allen Foley, FFWCC, personal communication, 2005.
5 Mrosovsky (1988).
6 Blair Witherington, FFWCC, personal communication, 2006 (information based on nests monitored throughout Florida beaches in 2005, n=1,680).
7 Murphy and Hopkins (1984); Frazer and Richardson (1985); Ehrhart, unpublished data; Hawkes *et al*. 2005; Scott 2006; Tony Tucker, Mote Marine Laboratory, personal communication, 2008.
8 Caldwell (1962), Dodd (1988).
9 Richardson *et al*. (1978); Bjorndal *et al*. (1983); Ehrhart, unpublished data.
10 Melissa Snover, NMFS, personal communication, 2005; see Table A1-6.
11 Dahlen *et al*. (2000).

*Population Dynamics and Status*

By far, the majority of Atlantic nesting occurs on beaches of the southeastern U.S. (NMFS and USFWS 2007a). For the past decade or so, the scientific literature has recognized five distinct nesting groups, or subpopulations, of loggerhead sea turtles in the Northwest Atlantic, divided geographically as follows: (1) a northern group of nesting females that nest from North Carolina to northeast Florida at about 29° N latitude; (2) a south Florida group of nesting females that nest from 29° N latitude on the east coast to Sarasota on the west coast; (3) a Florida Panhandle group of nesting females that nest around Eglin Air Force Base and the beaches near Panama City, Florida; (4) a Yucatán group of nesting females that nest on beaches of the eastern Yucatán Peninsula, Mexico; and (5) a Dry Tortugas group that nests on beaches of the islands of the Dry Tortugas, near Key West, Florida and on Cal Sal Bank (TEWG 2009). Genetic analyses of mitochondrial DNA, which a sea turtle inherits from its mother, indicate that there are genetic differences between loggerheads that nest at and originate from the beaches used by each of the

five identified nesting groups of females (TEWG 2009). However, analyses of microsatellite loci from nuclear DNA, which represents the genetic contribution from both parents, indicates little to no genetic differences between loggerheads originating from nesting beaches of the five Northwest Atlantic nesting groups (Pearce and Bowen 2001; Bowen 2003; Bowen *et al.* 2005; Shamblin 2007). These results suggest that female loggerheads have site fidelity to nesting beaches within a particular area, while males provide an avenue of gene flow between nesting groups by mating with females that originate from different nesting groups (Bowen 2003; Bowen *et al.* 2005). The extent of such gene flow, however, is unclear (Shamblin 2007).

The lack of genetic structure makes it difficult to designate specific boundaries for the nesting subpopulations based on genetic differences alone. Therefore, the Loggerhead Recovery Team recently used a combination of geographic distribution of nesting densities, geographic separation, and geopolitical boundaries, in addition to genetic differences, to reassess the designation of these subpopulations to identify recovery units in the 2008 recovery plan.

In the 2008 recovery plan, the Loggerhead Recovery Team designated five recovery units for the Northwest Atlantic population of loggerhead sea turtles based on the aforementioned nesting groups and inclusive of a few other nesting areas not mentioned above. The first four of these recovery units represent nesting assemblages located in the Southeast U.S. The fifth recovery unit is composed of all other nesting assemblages of loggerheads within the Greater Caribbean, outside the U.S., but which occur within U.S. waters during some portion of their lives. The five recovery units representing nesting assemblages are: (1) the Northern Recovery Unit (NRU: Florida/Georgia border through southern Virginia), (2) the Peninsular Florida Recovery Unit (PFRU: Florida/Georgia border through Pinellas County, Florida), (3) the Dry Tortugas Recovery Unit (DTRU: islands located west of Key West, Florida), (4) the Northern Gulf of Mexico Recovery Unit (NGMRU: Franklin County, Florida through Texas), and (5) the Greater Caribbean Recovery Unit (GCRU: Mexico through French Guiana, Bahamas, Lesser Antilles, and Greater Antilles).

More recently, Shamblin *et al.* (2011, 2012) evaluated expanded mitochondrial sequences and identified additional genetic diversity in the North Atlantic. Specifically, based on genetics, the PFRU can be subdivided into further discrete units (Shamblin et al. 2011). This expanded genetic assessment found that the Northwest Atlantic loggerhead turtle rookeries can be subdivided into 10 management units, corresponding to the beaches from (1) Virginia through northeastern Florida, (2) central eastern Florida, (3) southeastern Florida, (4) Dry Tortugas, Florida, (5) Cay Sal, Bahamas, (6) southwestern Cuba, (7) Quintana Roo, Mexico, (8) southwestern Florida, (9) central western Florida, and (10) northwestern Florida (Shamblin et al. 2012).

The Loggerhead Recovery Team evaluated the status and trends of the Northwest Atlantic loggerhead population for each of the five recovery units, using nesting data available as of October 2008 (NMFS and USFWS 2008). The level and consistency of nesting coverage varies among recovery units, with coverage in Florida generally being the most consistent and thorough over time. Since 1989, nest count surveys in Florida have occurred in the form of statewide surveys (a near complete census of entire Florida nesting) and index beach surveys (Witherington *et al.* 2009). Index beaches were established to standardize data collection

methods and maintain a constant level of effort on key nesting beaches over time.

NMFS and USFWS (2008), Witherington *et al.* (2009), and TEWG (2009) analyzed the status of the nesting assemblages within the NWA DPS using standardized data collected over periods ranging from 10-23 years. These analyses used different analytical approaches, but found the same finding that there had been a significant, overall nesting decline within the NWA DPS. However, with the addition of nesting data from 2008 to 2017, the trend line changes, showing a strong positive trend since 2007 (http://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). The nesting data presented in the Recovery Plan (through 2008) is described below, with updated trend information through 2014 for two recovery units.

From the beginning of standardized index surveys in 1989 until 1998, the PFRU, the largest nesting assemblage in the Northwest Atlantic by an order of magnitude, had a significant increase in the number of nests. However, from 1998 through 2008, there was a 41% decrease in annual nest counts from index beaches, which represent an average of 70% of the statewide nesting activity (NMFS and USFWS 2008). From 1989-2008, the PFRU had an overall declining nesting trend of 26% (95% CI: -42% to -5%; NMFS and USFWS 2008). With the addition of nesting data through 2010, the nesting trend for the PFRU does not show a nesting decline statistically different from zero (76 FR 58868, September 22, 2011). Further, annual nest counts on Florida index beaches have shown an increase over the last six years (FFWC 2015). Florida Fish and Wildlife Commission researchers examined the period between the high count nesting season in 1998 and the most recent nesting season (2014) and found a slight but non-significant increase. The overall change in nest counts from 1989 to 2014 is positive (FFWC 2015, http://www.myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trends/).

The NRU, the second largest nesting assemblage of loggerheads in the U.S., has been declining at a rate of 1.3% annually since 1983 (NMFS and USFWS 2008). The NRU dataset included 11 beaches with an uninterrupted time series of coverage of at least 20 years; these beaches represent approximately 27% of NRU nesting (in 2008). Since that 2008 analysis, nesting has increased substantially on North Carolina, South Carolina, and Georgia beaches, with record highs in 2013 (M. Dodd, 2015, pers. comm.). A recent analysis, including nesting data through 2014, indicates no significant trend in NRU nesting for the 32 year time period (M. Dodd, 2015, pers. comm.).

Evaluation of long-term nesting trends for the NGMRU is difficult because of changed and expanded beach coverage. However, the NGMRU has shown a significant declining trend of 4.7% annually since index nesting beach surveys were initiated in 1997 (NMFS and USFWS 2008). The trend was analyzed using nesting data available as of October 2008.

No statistical trends in nesting abundance can be determined for the DTRU because of the lack of long-term data. Similarly, statistically valid analyses of long-term nesting trends for the entire GCRU are not available because there are few long-term standardized nesting surveys representative of the region. Additionally, changing survey effort at monitored beaches and scattered and low-level nesting by loggerheads at many locations currently precludes comprehensive analyses (NMFS and USFWS 2008).

Sea turtle census nesting surveys are important in that they provide information on the relative abundance of nesting each year, and the contribution of each nesting group to total nesting of the species. Nest counts can also be used to estimate the number of reproductively mature females nesting annually. The 2008 recovery plan compiled information on mean number of loggerhead nests and the approximated counts of nesting females per year for four of the five identified recovery units (i.e., nesting groups). This information is dated, but still represents the most comprehensive number of nests per year that is publicly available. They are: (1) for the NRU, a mean of 5,215 loggerhead nests per year (1989-2008) with approximately 1,272 females nesting per year; (2) for the PFRU, a mean of 64,513 nests per year (1989-2007) with approximately 15,735 females nesting per year; (3) for the DTRU, a mean of 246 nests per year (1995-2004, excluding 2002) with approximately 60 females nesting per year; and (4) for the NGMRU, a mean of 906 nests per year (1995-2007) with approximately 221 females nesting per year. For the GCRU, the only estimate available for the number of loggerhead nests per year is from Quintana Roo, Yucatán, Mexico, where a range of 903-2,331 nests per year was estimated (1987-2001) (NMFS and USFWS 2007a). There are no annual nest estimates available for the Yucatán since 2001 or for any other regions in the GCRU, nor are there estimates of the number of nesting females per year for any nesting assemblage in this recovery unit. The above values for average nesting females per year were based upon 4.1 nests per female per Murphy and Hopkins (1984).

Genetic studies of juvenile and a few adult loggerhead sea turtles collected from Northwest Atlantic foraging areas (beach strandings, a power plant in Florida, and North Carolina fisheries) show that the loggerheads that occupy U.S. East Coast waters originate from these Northwest Atlantic nesting groups; primarily from the nearby nesting beaches of southern Florida, as well as the northern Florida to North Carolina beaches, and finally from the beaches of the Yucatán Peninsula, Mexico (Rankin-Baransky *et al.* 2001; Witzell *et al.* 2002; Bass *et al.* 2004; Bowen *et al.* 2004). The contribution of these three nesting assemblages varies somewhat among the foraging habitats and age classes surveyed along the east coast. The distribution is not random and bears a significant relationship to the proximity and size of adjacent nesting colonies (Bowen *et al.* 2004). Bass *et al.* (2004) attribute the variety in the proportions of sea turtles from loggerhead nesting assemblages documented in different east coast foraging habitats to a complex interplay of currents and the relative size and proximity of nesting beaches. More recently, ongoing work at SWFSC (Dutton and LaCasella, unpublished data) provides preliminary results for loggerhead bycatch samples (n=141) from Northeast fisheries from 2003-2012. The preliminary Mixed-Stock Analysis indicates that the majority of the Northeast bycatch is composed of turtles from Florida rookeries in the Northwest Atlantic. The combined central eastern Florida and southeastern Florida Management Units (MU) comprise the majority (79%) of the mean estimated stock composition. The remainder was made up primarily of western Florida MUs (southwestern Florida, central western Florida, northwestern Florida, Dry Tortugas), the northern US MU and to a lesser extent, Mexico. There is great uncertainty around point estimates, due to widespread shared haplotypes; however, there is no significant evidence of contribution from the Mediterranean or South Atlantic MUs (Dutton and LaCasella, unpublished data).

Unlike nesting surveys, in-water studies of sea turtles typically sample both sexes and multiple age classes. In-water studies have been conducted in some areas of the Northwest Atlantic and

provide data by which to assess the relative abundance of loggerhead sea turtles and changes in abundance over time (Maier *et al.* 2004; Morreale *et al.* 2005; Mansfield 2006; Ehrhart *et al.* 2007; Epperly *et al.* 2007). The TEWG (2009) used raw data from six in-water study sites to conduct trend analyses. They identified an increasing trend in the abundance of loggerheads from three of the four sites located in the Southeast U.S., one site showed no discernible trend, and the two sites located in the northeast U.S. showed a decreasing trend in abundance of loggerheads. The 2008 loggerhead recovery plan also includes a full discussion of in-water population studies for which trend data have been reported, and a brief summary will be provided here.

Maier *et al.* (2004) used fishery-independent trawl data to establish a regional index of loggerhead abundance for the southeast coast of the U.S. (Winyah Bay, South Carolina to St. Augustine, Florida) during the period 2000-2003. A comparison of loggerhead catch data from this study with historical values suggested that in-water populations of loggerhead sea turtles along the southeast U.S. coast appear to be larger, possibly an order of magnitude higher than they were 25 years ago, but the authors caution a direct comparison between the two studies given differences in sampling methodology (Maier *et al.* 2004). A comparison of catch rates for sea turtles in pound net gear fished in the Pamlico-Albemarle Estuarine Complex of North Carolina between the years 1995-1997 and 2001-2003 found a significant increase in catch rates for loggerhead sea turtles for the latter period (Epperly *et al.* 2007). A long-term, on-going study of loggerhead abundance in the Indian River Lagoon System of Florida found a significant increase in the relative abundance of loggerheads over the last four years of the study (Ehrhart *et al.* 2007). However, there was no discernible trend in loggerhead abundance during the 24-year time period of the study (1982-2006) (Ehrhart *et al.* 2007). At St. Lucie Power Plant, data collected from 1977-2004 show an increasing trend of loggerheads at the power plant intake structures (FPL and Quantum Resources 2005).

In contrast to these studies, Morreale *et al.* (2005) observed a decline in the percentage and relative numbers of loggerhead sea turtles incidentally captured in pound net gear fished around Long Island, New York during the period 2002-2004 in comparison to the period 1987-1992, with only two loggerheads (of a total 54 turtles) observed captured in pound net gear during the period 2002-2004. This is in contrast to the previous decade's study where numbers of individual loggerheads ranged from 11 to 28 per year (Morreale *et al.* 2005). No additional loggerheads were reported captured in pound net gear in New York through 2007, although two were found cold-stunned on Long Island bay beaches in the fall of 2007 (Memo to the File, L. Lankshear, December 2007). Potential explanations for this decline include major shifts in loggerhead foraging areas and/or increased mortality in pelagic or early benthic stage/age classes (Morreale *et al.* 2005). Using aerial surveys, Mansfield (2006) also found a decline in the densities of loggerhead sea turtles in Chesapeake Bay over the period 2001-2004 compared to aerial survey data collected in the 1980s. Significantly fewer loggerheads ($p<0.05$) were observed in both the spring (May-June) and the summer (July-August) of 2001-2004 compared to those observed during aerial surveys in the 1980s (Mansfield 2006). A comparison of median densities from the 1980s to the 2000s suggested that there had been a 63.2% reduction in densities during the spring residency period and a 74.9% reduction in densities during the summer residency period (Mansfield 2006). The decline in observed loggerhead populations in Chesapeake Bay may be related to a significant decline in prey, namely horseshoe crabs and blue

crabs, with loggerheads redistributing outside of Bay waters (NMFS and USFWS 2008). A more recent aerial survey effort by the Virginia Aquarium & Marine Science Center found preliminary abundance estimates in 2011-2013 significantly higher than annual estimates for the lower Chesapeake Bay generated from 2001-2004 (Mansfield 2006, VAQ 2014). The 2011-2013 estimates, while preliminary, also suggest that ocean waters may be more important for this species than the waters of Chesapeake Bay.

As with other turtle species, population estimates for loggerhead sea turtles are difficult to determine, largely given their life history characteristics. However, a recent loggerhead assessment using a demographic matrix model estimated that the loggerhead adult female population in the western North Atlantic ranges from 16,847 to 89,649, with a median size of 30,050 (SEFSC 2009). The model results for population trajectory suggest that the population is most likely declining, but this result was very sensitive to the choice of the position of the parameters within their range and hypothesized distributions. The pelagic stage survival parameter had the largest effect on the model results. As a result of the large uncertainty in our knowledge of loggerhead life history, at this point predicting the future populations or population trajectories of loggerhead sea turtles with precision is very uncertain. It should also be noted that additional analyses are underway which will incorporate any newly available information.

As part of the Atlantic Marine Assessment Program for Protected Species (AMAPPS), line transect aerial abundance surveys and turtle telemetry studies were conducted along the Atlantic Coast and annual reports for 2010, 2011, 2012, and 2013 have been produced. AMAPPS is a multi-agency initiative to assess marine mammal, sea turtle, and seabird abundance and distribution in the Atlantic. As presented in NMFS NEFSC (2011a), the 2010 survey found a preliminary total surface abundance estimate within the entire study area of about 60,000 loggerheads (CV=0.13) or 85,000, if a portion of unidentified hard-shelled sea turtles were included (CV=0.10). Surfacing times were generated from the satellite tag data collected during the aerial survey period, resulting in a 7% (5%-11% inter-quartile range) median surface time in the South Atlantic area and a 67% (57%-77% inter-quartile range) median surface time to the north. The calculated preliminary regional abundance estimate is about 588,000 loggerheads along the U.S. Atlantic coast, with an inter-quartile range of 382,000-817,000 (NMFS NEFSC 2011a). The estimate increases to approximately 801,000 (inter-quartile range of 521,000-1,111,000) when based on known loggerheads and a portion of unidentified turtle sightings. The density of loggerheads was generally lower in the north than the south; based on number of turtle groups detected, 64% were seen south of Cape Hatteras, NC, 30% in the southern Mid-Atlantic Bight, and 6% in the northern Mid-Atlantic Bight. These estimates of loggerhead abundance over the U.S. Atlantic continental shelf are considered very preliminary. A more thorough analysis will be completed pending the results of further studies related to improving estimates of regional and seasonal variation in loggerhead surface time (by increasing the sample size and geographical area of tagging) and other information needed to improve the biases inherent in aerial surveys of sea turtles (e.g., research on depth of detection and species misidentification rate). This survey effort represents the most comprehensive assessment of sea turtle abundance and distribution in many years. Additional aerial and vessel surveys as well as tagging research to improve abundance estimates of loggerheads have continued through 2017.

*Threats*

The diversity of a loggerhead sea turtle's life history leaves them susceptible to many natural and human impacts, including impacts while they are on land, in the neritic environment, and in the oceanic environment. The five-year status review and 2008 recovery plan provide a summary of natural as well as anthropogenic threats to loggerhead sea turtles (NMFS and USFWS 2007a, 2008). Amongst those of natural origin, hurricanes are known to be destructive to sea turtle nests. Sand accretion, rainfall, and wave action that result from these storms can appreciably reduce hatchling success. Other sources of natural mortality include cold-stunning, biotoxin exposure, and native species predation.

Anthropogenic factors that impact hatchlings and adult females on land, or the success of nesting and hatching include: beach erosion, beach armoring, and nourishment; artificial lighting; beach cleaning; beach pollution; increased human presence; recreational beach equipment; vehicular and pedestrian traffic; coastal development/construction; exotic dune and beach vegetation; removal of native vegetation; and poaching. An increased human presence at some nesting beaches or close to nesting beaches has led to secondary threats such as the introduction of exotic fire ants, feral hogs, dogs, and an increased presence of native species (e.g., raccoons, armadillos, and opossums), which raid nests and feed on turtle eggs (NMFS and USFWS 2007a, 2008). Although sea turtle nesting beaches are protected along large expanses of the Northwest Atlantic coast (in areas like Merritt Island, Archie Carr, and Hobe Sound National Wildlife Refuges), other areas along these coasts have limited or no protection. Sea turtle nesting and hatching success on unprotected high density East Florida nesting beaches from Indian River to Broward County are affected by all of the above threats.

Loggerheads are affected by a completely different set of anthropogenic threats in the marine environment. These include oil and gas exploration, coastal development, and transportation; marine pollution; pile driving and underwater explosions; hopper dredging; offshore artificial lighting; power plant entrainment and/or impingement; entanglement in and ingestion of marine debris; marina and dock construction and operation; boat collisions; poaching; and fishery interactions (including both commercial and recreational fisheries).

A 1990 National Research Council (NRC) report concluded that for juveniles, subadults, and breeding adults in coastal waters, the most important source of human caused mortality in U.S. Atlantic waters was fishery interactions. The sizes and reproductive values of sea turtles taken by fisheries vary significantly, depending on the location and season of the fishery, and size-selectivity resulting from gear characteristics. Therefore, it is possible for fisheries that interact with fewer, more reproductively valuable turtles to have a greater detrimental effect on the population than one that takes greater numbers of less reproductively valuable turtles (Wallace *et al.* 2008). The Loggerhead Biological Review Team determined that the greatest threats to the NWA DPS of loggerheads result from cumulative fishery bycatch in neritic and oceanic habitats (Conant *et al.* 2009). Attaining a more thorough understanding of the characteristics, as well as the quantity of sea turtle bycatch across all fisheries is of great importance.

Finkbeiner *et al.* (2011) compiled cumulative sea turtle bycatch information in U.S. fisheries from 1990 through 2007, before and after implementation of bycatch mitigation measures. Information was obtained from peer reviewed publications and NMFS documents (e.g., Opinions

and bycatch reports). In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures). Kemp's ridleys interacted with fisheries most frequently, with the highest level of mean annual mortality (2,700), followed by loggerheads (1,400), greens (300), and leatherbacks (40). The Southeast/Gulf of Mexico shrimp trawl fishery was responsible for the vast majority of U.S. interactions (up to 98%) and mortalities (more than 80%). While this provides an initial cumulative bycatch assessment, there are a number of caveats that should be considered when interpreting this information, such as sampling inconsistencies and limitations.

Of the many fisheries known to adversely affect loggerheads, the U.S. South Atlantic and Gulf of Mexico shrimp fisheries were considered to pose the greatest threat of mortality to neritic juvenile and adult age classes of loggerheads (NRC 1990, Finkbeiner *et al.* 2011). Significant changes to the U.S. South Atlantic and Gulf of Mexico shrimp fisheries have occurred since 1990, and the effects of these shrimp fisheries on ESA-listed species, including loggerhead sea turtles, have been assessed several times through section 7 consultation. There is also a lengthy regulatory history with regard to the use of Turtle Excluder Devices (TEDs) in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries (Epperly and Teas 2002; NMFS 2002; Lewison *et al.* 2003). A section 7 consultation on the U.S. South Atlantic and Gulf of Mexico shrimp fisheries completed in 2002 estimated the total annual level of loggerhead interactions to be 163,160 (the total number of turtles that enter a shrimp trawl, which may then escape through the TED or fail to escape and be captured) with 3,948 of those being lethal (NMFS 2002).

In addition to improvements in TED designs and TED enforcement, interactions between loggerheads and the shrimp fishery have also been declining because of reductions in fishing effort unrelated to fisheries management actions. The 2002 Opinion take estimates were based in part on fishery effort levels. In recent years, low shrimp prices, rising fuel costs, competition with imported products, and the impacts of recent hurricanes in the Gulf of Mexico have all impacted the shrimp fleets; in some cases reducing fishing effort by as much as 50% for offshore waters of the Gulf of Mexico (GMFMC 2007). As a result, loggerhead interactions and mortalities in the Gulf of Mexico have been substantially less than were projected in the 2002 Opinion. In 2008, the NMFS Southeast Fisheries Science Center (SEFSC) estimated annual number of interactions between loggerheads and shrimp trawls in the Gulf of Mexico shrimp fishery to be 23,336, with 647 (2.8%) of those interactions resulting in mortality (Memo from Dr. B. Ponwith, Southeast Fisheries Science Center to Dr. R. Crabtree, Southeast Region, PRD, December 2008). However, the section 7 consultation on the shrimp fishery, completed in May 2012, was unable to estimate the total annual level of loggerhead interactions at present. Instead, it qualitatively estimated that the shrimp fishery, as currently operating, would result in at least thousands and possibly tens of thousands of interactions annually, of which at least hundreds and possibly thousands are expected to be lethal (NMFS 2012a).

Loggerhead sea turtles are also known to interact with non-shrimp trawl, gillnet, longline, dredge, pound net, pot/trap, and hook and line fisheries. The NRC (1990) report stated that other U.S. Atlantic fisheries collectively accounted for 500 to 5,000 loggerhead deaths each year, but recognized that there was considerable uncertainty in the estimate. The reduction of sea turtle captures in fishing operations is identified in recovery plans and five-year status reviews as a priority for the recovery of all sea turtle species. In the threats analysis of the loggerhead

recovery plan, trawl bycatch is identified as the greatest source of mortality. Loggerhead bycatch in U.S. Mid-Atlantic bottom otter trawl gear has been previously estimated for the periods of 1996-2004 (Murray 2008) and 2005-2008 (Warden 2011), with the most recent bycatch analysis estimating the number of loggerhead sea turtle interactions with U.S. Mid-Atlantic bottom trawl gear from 2009-2013 (Murray 2015a). From 2009-2013, 1,156 loggerheads (95% CI: 908-1,488) were estimated to have interacted with bottom trawl gear in the U.S. Mid-Atlantic, of which 479 resulted in mortality. The total number of estimated interactions was equivalent to 166 adults, of which 68 resulted in mortality (Murray 2015a). That equates to an annual average of 231 loggerhead interactions (95% CI: 182-298) for the period of 2009-2013. The trawl fishery targeting Atlantic croaker in the southern Mid-Atlantic had the highest turtle interactions among fisheries investigated, which may be due to larger mesh sizes in the mouth of the trawl and high headline height of the gear. Murray (2015a) found that retained catch, depth, latitude, and sea surface temperature (SST) were associated with the interaction rate, with the rates being highest south of 37°N latitude in warm, shallow (<50 meters deep) waters. This estimate is a decrease from the average annual loggerhead bycatch in U.S. Mid-Atlantic bottom otter trawls during the 1996-2004 and 2005-2008 time periods, which were estimated to be 616 (95% CI: 367-890) and 352 turtles (95% CI: 276-439), respectively (Murray 2008; Warden 2011; Murray 2015a).

There have been several published estimates of the number of loggerheads interacting annually with the dredge fishery for Atlantic sea scallops, ranging from a low of zero in 2005 (Murray 2007) to a high of 749 in 2003 (Murray 2004). Murray (2011) re-evaluated loggerhead sea turtle interactions in scallop dredge gear from 2001-2008. In that paper, the average number of annual observable interactions of hard-shelled sea turtles in the Mid-Atlantic scallop dredge fishery prior to the implementation of chain mats (January 1, 2001 through September 25, 2006) was estimated to be 288 turtles (95% CI: 209-363) [equivalent to 49 adults], 218 of which were loggerheads [equivalent to 37 adults]. After the implementation of chain mats, the average annual number of observable interactions was estimated to be 20 hard-shelled sea turtles (95% CI: 3-42), 19 of which were loggerheads. If the rate of observable interactions from dredges without chain mats had been applied to trips with chain mats, the estimated number of observable and inferred interactions of hard-shelled sea turtles after chain mats were implemented would have been 125 turtles per year (95% CI: 88-163) [equivalent to 22 adults], 95 of which were loggerheads [equivalent to 16 adults]. Interaction rates of hard-shelled turtles were correlated with SST, depth, and use of a chain mat. Results from that analysis suggested that chain mats and fishing effort reductions contributed to the decline in estimated loggerhead sea turtle interactions with scallop dredge gear after 2006 (Murray 2011). A more recent analysis has indicated that the average annual observable sea turtle interactions in the Mid-Atlantic scallop dredge fishery plus unobserved, quantifiable interactions was 22 loggerheads per year (95% CI: 4-67), 9-19 of which were lethal (Murray 2015b). The 22 interactions equate to two adult equivalents per year and 1-2 adult equivalent mortalities. Thus, estimated interactions in the scallop dredge fishery have decreased relative to 2001-2008, although the utility of observers as a monitoring tool for turtle interactions in the fishery seems to be decreasing (Murray 2015b).

An estimate of the number of loggerheads interacting annually with U.S. Mid-Atlantic gillnet fisheries has also recently been published (Murray 2013). From 2007-2011, an annual average

of 95 hard-shelled sea turtles (95% CI: 60-138) and 89 loggerheads (equivalent to nine adults) were estimated to have interacted with U.S. Mid-Atlantic gillnet gear. An estimated 52 annual loggerhead interactions (equivalent to five adults) were considered to result in mortality. Gillnet trips landing monkfish had the highest estimated number of loggerhead and hard-shelled sea turtle interactions during 2007-2011. Estimated rates and interactions have decreased relative to those from 1996-2006. Bycatch rates were correlated with latitude, SST, and mesh size. High interaction rates are estimated in the southern Mid-Atlantic, in warm surface temperature water, and in large-mesh gillnets; findings which are consistent with prior loggerhead bycatch analyses (Murray 2013).

The U.S. tuna and swordfish longline fisheries that are managed under the Highly Migratory Species (HMS) Fishery Management Plan (FMP) are estimated to capture 1,905 loggerheads (no more than 339 mortalities) for each three-year period starting in 2007 (NMFS 2004b). NMFS has mandated gear changes for the HMS fishery to reduce sea turtle bycatch and the likelihood of death from those incidental takes that would still occur (Garrison and Stokes 2017). In 2015, there were 30 observed interactions between loggerhead sea turtles and longline gear used in the HMS fishery (Garrison and Stokes 2017). All of the loggerheads were released alive, with 14 out of 30 (47%) released with all gear removed. A total of 242.6 (95% CI: 161.9-363.6) loggerhead sea turtles were estimated to have interacted with the longline fisheries managed under the HMS FMP in 2015 based on the observed bycatch events (Garrison and Stokes 2017).

Including the 2015 estimate, loggerhead interactions since 2000 have been below the historical highs that occurred in the mid-1990s (Garrison and Stokes 2017). Following the implementation of regulations, the bycatch dropped in 2005, but rebounded to be similar to the pre-regulation period. There appears to be a cyclical pattern in loggerhead bycatch rate occurring at four-year intervals since 1996 with a generally increasing trend over a four-year period, followed by a sharp decline. This cycle continued during the 2010-2015 period. The 2014 and 2015 estimates remain relatively low and seem to be consistent with an overall downward trend since the late 1990s. Notably, the estimate for 2015 was consistent with that from 2014 despite a sharp decline in fishing effort (Garrison and Stokes 2017). This fishery represents just one of several longline fisheries operating in the Atlantic Ocean. Lewison *et al*. (2004) estimated that 150,000-200,000 loggerheads were taken in all Atlantic longline fisheries in 2000 (including the U.S. Atlantic tuna and swordfish longline fisheries as well as others).

Documented interactions also occur in other fishery gear types and by non-fishery mortality sources (e.g., hopper dredges, power plants, vessel collisions), although quantitative/qualitative estimates are only available for activities on which NMFS has consulted.

The most recent Recovery Plan for loggerhead sea turtles as well as the 2009 Status Review Report identifies global climate change as a threat to loggerhead sea turtles. However, trying to assess the likely effects of climate change on loggerhead sea turtles is extremely difficult given the uncertainty in all climate change models and the difficulty in determining the likely rate of temperature increases and the scope and scale of any accompanying habitat effects. Additionally, no significant climate change-related impacts to loggerhead sea turtle populations have been observed to date. Over the long-term, climate change related impacts are expected to influence biological trajectories on a century scale (Parmesan and Yohe 2003). As noted in the

2009 Status Review (Conant *et al*. 2009), impacts from global climate change induced by human activities are likely to become more apparent in future years (IPCC 2007). Climate change related increasing temperatures, sea level rise, changes in ocean productivity, and increased frequency of storm events may affect loggerhead sea turtles.

Increasing temperatures are expected to result in rising sea levels (Titus and Narayanan 1995 in Conant *et al*. 2009), which could result in increased erosion rates along nesting beaches. Sea level rise could result in the inundation of nesting sites and decrease available nesting habitat (Daniels *et al*. 1993; Fish *et al*. 2005; Baker *et al*. 2006). The BRT noted that the loss of habitat as a result of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis *et al*. 2006; Baker *et al*. 2006; both in Conant *et al*. 2009). Along developed coastlines, and especially in areas where erosion control structures have been constructed to limit shoreline movement, rising sea levels may cause severe effects on nesting females and their eggs as nesting females may deposit eggs seaward of the erosion control structures potentially subjecting them to repeated tidal inundation. However, if global temperatures increase and there is a range shift northwards, beaches not currently used for nesting may become available for loggerhead sea turtles, which may offset some loss of accessibility to beaches in southern portions of the range.

Climate change also has the potential to result in changes at nesting beaches that may affect loggerhead sex ratios. Loggerhead sea turtles exhibit temperature-dependent sex determination. Rapidly increasing global temperatures may result in warmer incubation temperatures and highly female-biased sex ratios (e.g., Glen and Mrosovsky 2004; Hawkes *et al*. 2009); however, to the extent that nesting can occur at beaches further north where sand temperatures are not as warm, these effects may be partially offset. The BRT specifically identified climate change as a threat to loggerhead sea turtles in the neritic/oceanic zone where climate change may result in future trophic changes, thus impacting loggerhead prey abundance and/or distribution. In the threats matrix analysis, climate change was considered for oceanic juveniles and adults as well as for eggs/hatchlings. The report states that for oceanic juveniles and adults, "although the effect of trophic level change from…climate change…is unknown it is believed to be very low." For eggs/hatchlings, the report states that total mortality from anthropogenic causes, including sea level rise resulting from climate change, is believed to be low relative to the entire life stage. However, only limited data are available on past trends related to climate effects on loggerhead sea turtles; current scientific methods are not able to reliably predict the future magnitude of climate change, associated impacts, whether and to what extent some impacts will offset others, or the adaptive capacity of this species.

While there is a reasonable degree of certainty that certain climate change related effects will be experienced globally (e.g., rising temperatures and changes in precipitation patterns), due to a lack of scientific data, the specific effects to sea turtles resulting from climate change, and the severity of and rate at which these impacts will occur, are not predictable or quantifiable at this time (Hawkes *et al*. 2009). Nonetheless, it is likely that once climate change impacts get to a certain level, there will be feedback loops that may cause indications of climate change (e.g., increases in greenhouse gas concentrations, rising global temperatures, and sea level rise) to get much worse much more quickly (Torn and Harte 2006).

In terms of "climate forcing" (which is different from what we are defining as "climate change," in that it also factors in the effects of cyclical climate patterns such as the North Atlantic and Pacific Decadal Oscillations in addition to ongoing effects from anthropogenically-induced changes in climate under Intergovernmental Panel on Climate Change [IPCC] projections), Van Houtan and Halley (2011) recently developed climate-based models to investigate loggerhead nesting in the Northwest Atlantic and North Pacific. These models, which considered juvenile recruitment and breeding remigration, found that climate conditions/oceanographic influences explain loggerhead nesting variability, with climate models alone explaining an average of 60% (range 18%-88%) of the observed nesting changes over the past several decades. Hindcasts indicate that climatic conditions may have been a factor in past nesting declines in both the Atlantic and Pacific. However, in terms of future nesting projections, modeled climate data show a future positive trend for Atlantic nesting in Florida, with substantial increases through 2040 as a result of the Atlantic Multidecadal Oscillation signal (Van Houton and Halley 2011). Thus, independent of any dramatic losses of sea turtle nesting habitat in the Northwest Atlantic due to climate change, NWA DPS loggerheads are expected to increase their nesting output over the next few decades. Van Houton and Halley (2011) did not project nesting trends in the Northwest Atlantic beyond 2040 as forecasting beyond that point was not deemed possible given their methods. Much like our analyses of climate change, climate forcing analyses can only predict so far into the future.

*Summary of Status for the Northwest Atlantic DPS of Loggerhead Sea Turtles*

Loggerheads continue to be affected by many factors occurring on nesting beaches and in the water. These include poaching, habitat loss, and nesting predation that affects eggs, hatchlings, and nesting females on land, as well as fishery interactions, vessel interactions, marine pollution, and non-fishery (e.g., dredging) operations affecting all sexes and age classes in the water (NRC 1990; NMFS and USFWS 2007a, 2008). As a result, loggerheads still face many of the original threats that were the cause of their listing under the ESA.

As mentioned previously, a final revised recovery plan for loggerhead sea turtles in the Northwest Atlantic was published by NMFS and USFWS in December 2008. The revised recovery plan is significant in that it identifies five unique recovery units, which comprise the population of loggerheads in the Northwest Atlantic, and describes specific recovery criteria for each recovery unit. The recovery plan noted a decline in annual nest counts for three of the five recovery units for loggerheads in the Northwest Atlantic, including the PFRU, which is the largest (in terms of number of nests laid) in the Atlantic Ocean. The nesting trends for the other two recovery units could not be determined due to an absence of long term data.

NMFS convened a new Loggerhead Turtle Expert Working Group (TEWG) to review all available information on Atlantic loggerheads in order to evaluate the status of this species in the Atlantic. A final report from the Loggerhead TEWG was published in July 2009. In this report, the TEWG indicated that it could not determine whether the decreasing annual numbers of nests among the Northwest Atlantic loggerhead subpopulations were due to stochastic processes resulting in fewer nests, a decreasing average reproductive output of adult females, decreasing numbers of adult females, or a combination of these factors. Many factors are responsible for past or present loggerhead mortality that could impact current nest numbers; however, no single

mortality factor stands out as a likely primary factor. It is likely that several factors compound to create the current decline, including incidental capture (in fisheries, power plant intakes, and dredging operations), lower adult female survival rates, increases in the proportion of first-time nesters, continued directed harvest, and increases in mortality due to disease. Regardless, the TEWG stated that "it is clear that the current levels of hatchling output will result in depressed recruitment to subsequent life stages over the coming decades" (TEWG 2009). However, the report does not provide information on the rate or amount of expected decrease in recruitment but goes on to state that the ability to assess the current status of loggerhead stocks is limited due to a lack of fundamental life history information and specific census and mortality data.

While several documents reported the decline in nesting numbers in the NWA DPS (NMFS and USFWS 2008, TEWG 2009), when nest counts through 2010 are analyzed, the nesting trends from 1989-2010 are not significantly different than zero for all recovery units within the NWA DPS for which there are enough data to analyze (76 FR 58868, September 22, 2011). The SEFSC (2009) estimated the number of adult females in the NWA DPS at 30,000, and if a 1:1 adult sex ratio is assumed, the result is 60,000 adults in this DPS. Based on the reviews of nesting data, as well as information on population abundance and trends, NMFS and USFWS determined in the September 2011 listing rule that the NWA DPS should be listed as threatened. They found that an endangered status for the NWA DPS was not warranted given the large size of the nesting population, the overall nesting population remains widespread, the trend for the nesting population appears to be stabilizing, and substantial conservation efforts are underway to address threats. On July 10, 2014, we published a final rule designating critical habitat for NWA DPS (79 FR 39856). Specific areas designated include 38 occupied marine areas within the range of the Northwest Atlantic Ocean DPS. These areas contain one or a combination of habitat types: nearshore reproductive habitat, winter area, breeding areas, constricted migratory corridors, and/or *Sargassum* habitat.

#### *4.2.1.2 Status of Kemp's Ridley Sea Turtles*

*Listing History*

The Kemp's ridley sea turtle was listed as endangered on December 2, 1970 (35 FR 18319). The most recent status review was completed in 2015; no change in listing status was recommended. NMFS and USFWS were petitioned to designate critical habitat for Kemp's ridleys on February 17, 2010; no listing determination has been made.

*Distribution and Life History*

The Kemp's ridley is one of the least abundant of the world's sea turtle species. In contrast to loggerhead, green, and leatherback sea turtles, which are found in multiple oceans of the world, Kemp's ridleys typically occur only in the Gulf of Mexico and the northwestern Atlantic Ocean (NMFS *et al.* 2011); a very small number of individuals have been documented in the Mediterranean Sea (Tomas and Raga 2008).

Kemp's ridleys likely mature at 10-18 years of age (Caillouet *et al.* 1995; Schmid and Witzell 1997; Shaver and Wibbels 2007; Snover *et al.* 2007; NMFS and USFWS 2015). Nesting occurs from April through July each year with hatchlings emerging after 45-58 days (NMFS *et al.* 2011). Females lay an average of 2.5 clutches within a season (TEWG 1998, 2000) and the

mean remigration interval for adult females is two years (Márquez *et al.* 1982; TEWG 1998, 2000).

Once they leave the nesting beach, hatchlings presumably enter the Gulf of Mexico where they feed on available S*argassum* and associated infauna or other epipelagic species (NMFS *et al.* 2011). The presence of juvenile turtles along both the U.S. Atlantic and Gulf of Mexico coasts, where they are recruited to the coastal benthic environment, indicates that post-hatchlings are distributed in both the Gulf of Mexico and Atlantic Ocean (TEWG 2000).

The location and size classes of dead turtles recovered by the Sea Turtle Stranding and Salvage Network (STSSN) suggests that benthic immature developmental areas occur along the U.S. coast and that these areas may change given resource quality and quantity (TEWG 2000). Developmental habitats are defined by several characteristics, including coastal areas sheltered from high winds and waves such as embayments and estuaries, and nearshore temperate waters shallower than 50 meters (NMFS and USFWS 2015). The suitability of these habitats depends on resource availability, with optimal environments providing rich sources of crabs and other invertebrates. Kemp's ridleys consume a variety of crab species, including *Callinectes*, *Ovalipes*, *Libinia*, and *Cancer* species. Mollusks, shrimp, and fish are consumed less frequently (Bjorndal 1997). A wide variety of substrates have been documented to provide good foraging habitat, including seagrass beds, oyster reefs, sandy and mud bottoms, and rock outcroppings (NMFS and USFWS 2015).

Foraging areas documented along the U.S. Atlantic coast include Charleston Harbor, Pamlico Sound (Epperly *et al.* 1995c), Chesapeake Bay (Musick and Limpus 1997), Delaware Bay (Stetzar 2002), and Long Island Sound (Morreale and Standora 1993; Morreale *et al.* 2005). For instance, in the Chesapeake Bay, Kemp's ridleys frequently forage in submerged aquatic grass beds for crabs (Musick and Limpus 1997). Upon leaving Chesapeake Bay in the fall, juvenile Kemp's ridleys migrate down the coast, passing Cape Hatteras in December and January (Musick and Limpus 1997). These larger juveniles are joined by juveniles of the same size from North Carolina and smaller juveniles from New York and New England to form one of the densest concentrations of Kemp's ridleys outside of the Gulf of Mexico (Epperly *et al.* 1995a, 1995b; Musick and Limpus 1997).

Adult Kemp's ridleys are found in the coastal regions of the Gulf of Mexico and southeastern U.S., but are typically rare in the northeastern U.S. waters of the Atlantic (TEWG 2000). Adults are primarily found in nearshore waters of 68 meters or less (mean 33.2 ± 25.3 kilometers from shore) that are rich in crabs and have a sandy or muddy bottom (NMFS and USFWS 2015).

*Population Dynamics and Status*

The majority of Kemp's ridleys nest along a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; NMFS *et al.* 2011; NMFS and USFWS 2015). There is a limited amount of scattered nesting to the north and south of the primary nesting beach (NMFS and USFWS 2015). Nesting often occurs in synchronized emergences termed *arribadas*. The number of recorded nests reached an estimated low of 702 nests in 1985, estimated to be fewer than 250 adult females nesting in that season (TEWG 2000; NMFS *et al.* 2011; NMFS and USFWS 2015). Conservation efforts by Mexican and U.S. agencies have aided this species by

eliminating egg harvest, protecting eggs and hatchlings, and reducing at-sea mortality through fishing regulations (TEWG 2000). From the mid-1980s to the early 2000s, the number of nests observed at Rancho Nuevo and nearby beaches increased 14-16% per year (Heppell *et al.* 2005), allowing cautious optimism that the population was on its way to recovery. The total number of nests for all of Mexico was 22,458 in 2012 (the highest nesting total recorded since 1947), but fell back to 16,944 in 2013 and 12,060 in 2014. Based on an average of 2.5 nests per female per nesting season (NMFS *et al.* 2011), the total number of nests on Mexico beaches represented about 8,984 nesting females in 2012, 6,778 in 2013, and 4,824 in 2014 (NMFS and USFWS 2015). Similar to Mexico, Texas also experienced an overall increase in the number of nests since 2000. At Padre Island National Seashore, the number of observed nests hit an all-time high of 209 in 2012, but then fell back to 153 in 2013 and 119 in 2014 (NMFS and USFWS 2015). The most recent five-year review (NMFS and USFWS 2015) suggests that the population growth rate (measured by numbers of nests) stopped abruptly after 2009, possibly due to the Deepwater Horizon oil spill and other anthropogenic factors such as fisheries bycatch and climate change. Given the lower nesting numbers from 2009-2014, the population was not projected to grow at former rates in 2015. Recent data, however, indicates an increase in nesting. In 2015, there were 14,006 recorded nests in Mexico, and in 2016 overall numbers increased to 18,354 recorded nests (Gladys Porter Zoo 2016). Preliminary information indicates a record high nesting season in 2017, with 24,570 nests recorded on Mexican beaches (J. Pena, pers. comm., 2017). At this time, it is unclear if future Kemp's ridley nesting will steadily and continuously increase, similar to what occurred from 1990-2009, or if nesting will continue to exhibit sporadic declines and increases as recorded in the past eight years.

A small nesting population is also emerging in the U.S., primarily at Padre Island National Seashore in Texas, rising from six nests in 1996, to 42 in 2004, to a record high of 353 nests in 2017 (https://www.nps.gov/pais/learn/nature/2017-nesting-season.htm). It is worth noting that nesting in Texas has paralleled the trends observed in Mexico, with an overall increase in nests from 2000-2009, a significant decline in 2010, an all-time high in 2012, followed by a second decline in 2013-2014, and a rebound from 2015-2017 (NMFS and USFWS 2015).

*Threats*

Kemp's ridley sea turtles face many of the same natural threats as loggerheads, including destruction of nesting habitat from storm events, predators, and oceanographic-related events such as cold-stunning. Although cold-stunning can occur throughout the range of the species, it may be a greater risk for Kemp's ridleys that use the more northern habitats of Cape Cod Bay and Long Island Sound. From 2009-2013, the number of cold-stunned Kemp's ridleys on Massachusetts beaches averaged 185 turtles (NMFS unpublished data). The numbers ranged from a low of 132 in 2011 to a high of 235 in 2012. However, in 2014, the number of cold-stunned Kemp's ridleys documented in Massachusetts skyrocketed to 1,179, of which 466 died (NMFS unpublished data). As evidenced by this drastic increase, annual cold stun events can vary greatly in magnitude. The extent of episodic major cold stun events may be associated with numbers of sea turtles utilizing Northeast U.S. waters in a given year, oceanographic conditions, and/or the occurrence of storm events in the late fall. Although many cold-stunned turtles can survive if they are found early enough, these events represent a significant source of natural mortality for Kemp's ridley sea turtles.

Like other sea turtle species, the severe decline in the Kemp's ridley population appears to have been heavily influenced by a combination of exploitation of eggs and impacts from fishery interactions. From the 1940s through the early 1960s, nests from Ranch Nuevo were heavily exploited, but beach protection in 1967 helped to curtail this activity (NMFS *et al.* 2011). Following World War II, there was a substantial increase in the number of trawl vessels, particularly shrimp trawlers, in the Gulf of Mexico where adult Kemp's ridley sea turtles occur. Information from fisheries observers helped to demonstrate the high number of turtles captured in these shrimp trawls (USFWS and NMFS 1992). Subsequently, NMFS has worked with the industry to reduce sea turtle captures in shrimp trawls and other trawl fisheries, including the development and use of TEDs. As described above, there is lengthy regulatory history on the use of TEDs in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries (NMFS 2002; Epperly 2003; Lewison *et al.* 2003). The 2002 Opinion on shrimp trawling in the southeastern U.S. concluded that 155,503 Kemp's ridley sea turtles would be captured annually in the fishery with 4,208 of the captures resulting in mortality (NMFS 2002).

Although modifications to shrimp trawls have helped to reduce mortality of Kemp's ridleys, a recent assessment found that the Southeast/Gulf of Mexico shrimp trawl fishery remained responsible for the vast majority of U.S. fishery interactions (up to 98%) and mortalities (more than 80%). Finkbeiner *et al.* (2011) compiled cumulative sea turtle bycatch information in U.S. fisheries from 1990 through 2007, before and after implementation of bycatch mitigation measures. Information was obtained from peer reviewed publications and NMFS documents (e.g., Opinions and bycatch reports). In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures). Kemp's ridleys interacted with fisheries most frequently, with the highest level of mean annual mortality (2,700), followed by loggerheads (1,400), greens (300), and leatherbacks (40). While this provides an initial cumulative bycatch assessment, there are a number of caveats that should be considered when interpreting this information, such as sampling inconsistencies and limitations. The most recent section 7 consultation on the shrimp fishery, completed in May 2012, was unable to estimate the total annual level of Kemp's ridley interactions occurring in the fishery. Instead, it qualitatively estimated that the shrimp fishery, as currently operating, would result in at least tens of thousands and possibly hundreds of thousands of interactions annually, of which at least thousands and possibly tens of thousands are expected to be lethal (NMFS 2012a).

This species is also affected by other sources of anthropogenic impact (fishery and non-fishery related), similar to those discussed above. One Kemp's ridley capture in Mid-Atlantic trawl fisheries was documented by NMFS observers between 2009 and 2013 (Murray 2015b), and five Kemp's ridleys were documented by NMFS observers in Mid-Atlantic sink gillnet fisheries between 2007 and 2011 (Murray 2013). Additionally, in the spring of 2000, five Kemp's ridley carcasses were recovered from the same North Carolina beaches where 275 loggerhead carcasses were found. The cause of death for most of the turtles recovered was unknown, but the mass mortality event was suspected by NMFS to have been from a large-mesh gillnet fishery for monkfish and dogfish operating offshore in the preceding weeks (67 FR 71895, December 3, 2002). The five Kemp's ridley carcasses that were found are likely to have been only a minimum count of the number of Kemp's ridleys that were killed or seriously injured as a result of the fishery interaction, since it is unlikely that all of the carcasses washed ashore. The NEFSC

also documented 14 Kemp's ridleys entangled in or impinged on Virginia pound net leaders from 2002-2005. Note that bycatch estimates for Kemp's ridleys in various fishing gear types (e.g., trawl, gillnet, dredge) are not available at this time, largely due to the low number of observed interactions precluding a robust estimate. Kemp's ridley interactions in non-fisheries have also been observed; for example, the Oyster Creek Nuclear Generating Station in Barnegat Bay, New Jersey, recorded a total of 56 Kemp's ridleys (36 of which were found alive) impinged or captured on their intake screens from 1992-2011 (NMFS 2011).

The recovery plan for Kemp's ridley sea turtles (NMFS *et al*. 2011) identifies climate change as a threat; however, as with the other species discussed above, no significant climate change-related impacts to Kemp's ridley sea turtles have been observed to date. Atmospheric warming could cause habitat alteration which may change food resources such as crabs and other invertebrates. It may increase hurricane activity, leading to an increase in debris in nearshore and offshore waters, which may result in an increase in entanglement, ingestion, or drowning. In addition, increased hurricane activity may cause damage to nesting beaches or inundate nests with sea water. Atmospheric warming may change convergence zones, currents, and other oceanographic features that are relevant to Kemp's ridleys, as well as change rain regimes and levels of nearshore runoff.

Considering that the Kemp's ridley has temperature-dependent sex determination (Wibbels 2003) and the vast majority of the nesting range is restricted to the State of Tamaulipas, Mexico, global warming could potentially shift population sex ratios towards females and thus change the reproductive ecology of this species. A female bias is presumed to increase egg production (assuming that the availability of males does not become a limiting factor) (Coyne and Landry 2007) and increase the rate of recovery; however, it is unknown at what point the percentage of males may become insufficient to facilitate maximum fertilization rates in a population. If males become a limiting factor in the reproductive ecology of the Kemp's ridley, then reproductive output in the population could decrease (Coyne 2000). Low numbers of males could also result in the loss of genetic diversity within a population; however, there is currently no evidence that this is a problem in the Kemp's ridley population (NMFS *et al*. 2011). Models (Davenport 1997, Hulin and Guillon 2007, Hawkes *et al*. 2007, all referenced in NMFS *et al*. 2011) predict very long-term reductions in fertility in sea turtles due to climate change, but due to the relatively long life cycle of sea turtles, reductions may not be seen until 30 to 50 years in the future.

Another potential impact from global climate change is sea level rise, which may result in increased beach erosion at nesting sites. Beach erosion may be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents. In the case of the Kemp's ridley where most of the critical nesting beaches are undeveloped, beaches may shift landward and still be available for nesting. The Padre Island National Seashore shoreline is accreting, unlike much of the Texas coast, and with nesting increasing and sand temperatures slightly cooler than at Rancho Nuevo, Padre Island could become an increasingly important source of males for the population.

As with the other sea turtle species discussed in this section, while there is a reasonable degree of certainty that certain climate change related effects will be experienced globally (e.g., rising temperatures and changes in precipitation patterns), due to a lack of scientific data, the specific

effects of climate change on this species are not predictable or quantifiable at this time (Hawkes *et al*. 2009). Based on the most recent five-year status review (NMFS and USFWS 2015), and following from the climate change discussion on loggerheads, significant impacts from climate change in the future are to be expected, but the severity of and rate at which these impacts will occur is currently unknown.

*Summary of Status for Kemp's Ridley Sea Turtles*

The majority of Kemp's ridleys nest along a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; NMFS *et al.* 2011; NMFS and USFWS 2015). The number of nesting females in the Kemp's ridley population declined dramatically from the late 1940s through the mid-1980s, with an estimated 40,000 nesting females in a single *arribada* in 1947 and fewer than 300 nesting females in the entire 1985 nesting season (TEWG 2000; NMFS *et al.* 2011). However, the total annual number of nests at Rancho Nuevo gradually began to increase in the 1990s and 2000s (NMFS and USFWS 2015). Based on an average of 2.5 nests per female per nesting season (NMFS *et al.* 2011), the total number of nests on Mexico beaches represented about 4,824 nesting females in 2014 (NMFS and USFWS 2015).The number of adult males in the population is unknown, but sex ratios of hatchlings and immature Kemp's ridleys suggest that the population is female-biased, suggesting that the number of adult males is less than the number of adult females (NMFS and USFWS 2015). While there is still potential for recovery, factors such as the Deepwater Horizon oil spill, an overall decrease in the number of nests since 2009, climate change, and stranding events associated increased skimmer trawl use and poor TED compliance in the northern Gulf of Mexico may have dampened recent population growth.

As with the other sea turtle species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like dredging, pollution, and habitat destruction also contribute to annual human caused mortality, but the levels are unknown. A revised bi-national recovery plan was published in September 2011 by the NMFS, USFWS, and the Secretary of Environment and Natural Resources, Mexico (SEMARNAT) to address these ongoing threats. Based on their recent five-year status review of the species, NMFS and USFWS (2015) determined that Kemp's ridley sea turtles should remain classified as endangered under the ESA and that the Recovery Priority Number for the species be changed from a '5' to a '1.' A recovery priority 1 is defined as a species whose extinction is almost certain in the immediate future because of a rapid population decline or habitat destruction, whose limiting factors and threats are well understood and the needed management actions are known and have a high probability of success, and is a species that is in conflict with construction or other developmental projects or other forms of economic activity.

*4.2.1.3 Status of Green Sea Turtles – North Atlantic DPS*

Green sea turtles are distributed circumglobally, occurring throughout tropical, subtropical waters, and, to a lesser extent, temperate waters. They can be found in the Pacific, Indian, and Atlantic Oceans as well as the Mediterranean Sea (NMFS and USFWS 1991, 2007b; Seminoff 2004; Seminoff *et al.* 2015). Their movements within the marine environment are not fully understood, but it is believed that green sea turtles inhabit coastal waters of over 140 countries (Groombridge and Luxmoore 1989).

*Listing History*
The green sea turtle was originally listed under the ESA on July 28, 1978 (43 FR 32800). Breeding populations of the green sea turtle in Florida and along the Pacific coast of Mexico were listed as endangered; while all other populations were listed as threatened. The major factors contributing to its status at the time included human encroachment and associated activities on nesting beaches; commercial harvest of eggs, subadults, and adults; predation; lack of comprehensive and consistent protective regulations; and incidental take in fisheries. Marine critical habitat for the green sea turtle was designated on September 2, 1998, for the waters surrounding Culebra Island, Puerto Rico, and its outlying keys (63 FR 46693).

On April 6, 2016, the NMFS and USFWS issued a final determination that the green sea turtle is comprised of eleven DPSs, constituting the "species," to be listed as threatened or endangered under the ESA (81 FR 20058). Effective May 6, 2016, three DPSs were listed as endangered, eight as threatened. The April 2016 final rule replaced the 1978 global listing of green sea turtles.

In the final ESA listing decision, the NMFS and USFWS listed eleven green sea turtle DPSs distributed globally: (1) North Atlantic (threatened), (2) Mediterranean (endangered), (3) South Atlantic (threatened), (4) Southwest Indian (threatened), (5) North Indian (threatened), (6) East Indian-West Pacific (threatened), (7) Central West Pacific (endangered), (8) Southwest Pacific (threatened), (9) Central South Pacific (endangered), (10) Central North Pacific (threatened), and (11) East Pacific (threatened) (81 FR 20058; April 6, 2016). Based on the best available scientific and commercial data, only one listed DPS is likely to occur in the action area, the threatened North Atlantic DPS. The range of the North Atlantic DPS extends from the boundary of South and Central America, north along the coast to include Panama, Costa Rica, Nicaragua, Honduras, Belize, Mexico, and the U.S. It extends due east across the Atlantic Ocean at 48°N and follows the coast south to include the northern portion of the Islamic Republic of Mauritania (Mauritania) on the African continent to 19°N. It extends west at 19°N to the Caribbean basin to 65.1°W, then due south to 14°N, 65.1°W, then due west to 14°N, 77°W, and due south to 7.5°N, 77°W, the boundary of South and Central America. It includes Puerto Rico, the Bahamas, Cuba, Turks and Caicos Islands, Republic of Haiti, Dominican Republic, Cayman Islands, and Jamaica. The North Atlantic DPS includes the Florida breeding population, which was originally listed as endangered under the ESA (43 FR 32800; July 28, 1978).

In regards to discreteness, North Atlantic DPS populations of green sea turtles exhibit minimal mixing with the adjacent South Atlantic DPS and no mixing with the adjacent Mediterranean DPS. Occasionally, juvenile turtles from the North Atlantic may settle into foraging grounds in the South Atlantic or Mediterranean, while adult turtles nesting at sites in the equatorial region of the North Atlantic may travel to, and reside at, foraging grounds in the South Atlantic (Troëng *et al*. 2005). However, the reverse (i.e., turtles from the South Atlantic or Mediterranean DPS settling in North Atlantic waters) has yet to be documented. Furthermore, green sea turtles from the Mediterranean DPS appear to be spatially separated from populations in the Atlantic Ocean (Seminoff *et al*. 2015).

*Distribution and Life History*
Green sea turtles were once the target of directed fisheries in the U.S. and throughout the Caribbean. In 1890, over one million pounds of green sea turtles were captured in a directed fishery in the Gulf of Mexico (Doughty 1984). However, declines in the turtle fishery throughout the Gulf of Mexico were evident by 1902 (Doughty 1984).

In the North Atlantic, large juvenile and adult green sea turtles are largely herbivorous, occurring in habitats containing benthic algae and seagrasses from Massachusetts to Central America, including the Gulf of Mexico and Caribbean (Wynne and Schwartz 1999). Green sea turtles occur seasonally in U.S. Mid-Atlantic and Northeast waters such as Chesapeake Bay and Long Island Sound (Musick and Limpus 1997; Morreale and Standora 1998; Morreale *et al.* 2005), which serve as foraging and developmental habitats.

Some of the principal feeding areas in the North Atlantic Ocean include the upper west coast of Florida, the Florida Keys, and the northwestern coast of the Yucatán Peninsula. Additional important foraging areas in the western Atlantic include the Mosquito and Indian River Lagoon systems and nearshore wormrock reefs between Sebastian and Fort Pierce Inlets in Florida, Florida Bay, the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Mosquito Coast of Nicaragua, and the Caribbean coast of Panama (Hirth 1971).

Age at maturity for green sea turtles is estimated to be 20-50 years (Balazs 1982; Frazer and Ehrhart 1985; Seminoff 2004). Adult females may nest multiple times in a season (average three nests/season with approximately 100 eggs/nest) and typically do not nest in successive years (NMFS and USFWS 1991; Hirth 1997).

*Population Dynamics and Status*
Nest count information for green sea turtles provides information on the relative abundance of nesting, and the contribution of each nesting group to total nesting of the species. Nest counts can also be used to estimate the number of reproductively mature females nesting annually. The North Atlantic DPS contains an estimated 167,424 females nesting at 73 sites (81 FR 20058).

In 2015, the Green Turtle Status Review Team (SRT) identified those 73 nesting sites within the North Atlantic DPS, although some represent numerous individual beaches. There are four regions that support high density nesting concentrations for which data were available: Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, and Quintana Roo), U.S. (Florida), and Cuba. Nester abundance was assessed by the SRT for 48 nesting sites within the North Atlantic DPS. Abundance was estimated using the best scientific information available. Remigration intervals and clutch frequencies were used to estimate total nester abundance when counts of nesters were not available. In terms of nester distribution, the largest nesting site (Tortuguero, Costa Rica) hosts 79% of total nester abundance (167,528 nesters). There were also 26 nesting sites for which there were qualitative reports of nesting activity but no nesting data: three in the Bahamas, three in Belize, one in Costa Rica, four in Cuba, one in the Dominican Republic, one in Haiti, six in Honduras, two in Jamaica, one in Mauritania, one in Panama, and three in the Turks and Caicos Islands (Seminoff *et al.* 2015). Green turtle nesting populations in the North Atlantic are some of the most studied in the world, with time series exceeding 40 years in Costa Rica and 35

years in Florida. There are seven sites for which ten years or more of recent data are available for annual nester abundance.

By far, the most important nesting concentration for green sea turtles in the North Atlantic DPS is in Tortuguero, Costa Rica (Seminoff *et al.* 2015). This population has been studied since the 1950s and nesting has increased markedly since the early 1970s. From 1971 to 1975, there were approximately 41,250 nesting emergences per year and from 1992 to 1996 there were approximately 72,200 nesting emergences per year (Bjorndal *et al.* 1999). From 1999 to 2003, about 104,411 nests/year were deposited, which corresponds to approximately 17,402-37,290 nesting females each year (Troëng and Rankin 2005). An estimated 180,310 nests were laid during 2010, the highest level of green sea turtle nesting estimated since the start of nesting track surveys in 1971. This equates to 30,052-64,396 nesters in 2010. This increase has occurred despite substantial human impacts to the population at the nesting beach and at foraging areas (Troëng 1998; Campbell and Lagueux 2005; Troëng and Rankin 2005). The number of females nesting per year on beaches in Mexico, Florida, and Cuba number in the hundreds to low thousands, depending on the site (Seminoff *et al.* 2015).

The 2015 status review also evaluated the status of the Florida breeding population (Seminoff *et al.* 2015). In Florida, nesting occurs in coastal areas of all regions except the Big Bend area of west central Florida. The bulk of nesting occurs along the Atlantic coast of eastern central Florida, where a mean of 5,055 nests were deposited each year from 2001 to 2005 (Meylan *et al.* 2006) and 10,377 each year from 2008 to 2012 (B. Witherington, Florida Fish and Wildlife Conservation Commission, pers. comm., 2013). Nesting has increased substantially over the last 20 years and peaked in 2011 with 15,352 nests statewide (Chaloupka *et al.* 2008; B. Witherington, Florida Fish and Wildlife Conservation Commission, pers. comm., 2013). The estimated total nester abundance for Florida is 8,426 turtles.

The pattern of green sea turtle nesting shows biennial peaks in abundance, with a generally positive trend since establishment of the Florida index beach surveys in 1989. This trend is perhaps due to increased protective legislation throughout the Caribbean (Meylan *et al.* 1995), as well as protections in Florida and throughout the U.S. (Seminoff *et al.* 2015). The statewide Florida index beach surveys (1989-2017) have shown that green sea turtle nest counts have increased over one hundredfold since 1989, from a low of 267 to a high of almost 39,000 in 2017 (http://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). The last four odd-numbered years (2011, 2013, 2015, and 2017) have all broken previous records for the highest numbers of green sea turtle nests on Florida's index beaches.

Most nesting occurs along the east coast of Florida, but occasional nesting has been documented along the Gulf coast of Florida, at Southwest Florida beaches, as well as the beaches in the Florida Panhandle (Meylan *et al.* 1995). More recently, green sea turtle nesting occurred on Bald Head Island, North Carolina (just east of the mouth of the Cape Fear River), Onslow Island, and Cape Hatteras National Seashore. One green sea turtle nested on a beach in Delaware in 2011, although its occurrence was considered very rare.

Similar to the nesting trend found in Florida, in-water studies in Florida have also recorded increases in green sea turtle captures at the Indian River Lagoon site, with a 661% increase over

24 years (Ehrhart *et al.* 2007), and the St Lucie Power Plant site, with a significant increase in the annual rate of capture of immature green sea turtles (SCL<90 centimeters) from 1977 to 2002 or 26 years (3,557 green sea turtles total; Witherington *et al.* 2006).

*Threats*

Green sea turtles face many of the same natural threats as loggerhead and Kemp's ridley sea turtles. In addition, green sea turtles appear to be particularly susceptible to fibropapillomatosis, an epizootic disease producing lobe-shaped tumors on the soft portion of a turtle's body. Juveniles appear to have the highest incidence of disease and the most extensive lesions, whereas lesions in nesting adults are rare. Also, green sea turtles frequenting nearshore waters, areas adjacent to large human populations, and areas with low water turnover, such as lagoons, have a higher incidence of the disease than individuals in deeper, more remote waters. The occurrence of fibropapilloma tumors may result in impaired foraging, breathing, or swimming ability, leading potentially to death (George 1997).

Incidental fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches. Witherington *et al.* (2009) observed that because green sea turtles spend a shorter time in oceanic waters, and as older juveniles occur on shallow seagrass pastures (where benthic trawling is unlikely), they avoid high mortalities in pelagic longline and benthic trawl fisheries. Although the relatively low number of observed green sea turtle captures makes it difficult to estimate bycatch rates and annual levels of interactions, green sea turtles have been observed captured in the pelagic driftnet, pelagic longline, southeast shrimp trawl, and Mid-Atlantic trawl and gillnet fisheries. Two green sea turtle captures in Mid-Atlantic trawl fisheries was documented by NMFS observers between 2009 and 2013, and there were 12 observed captures of green sea turtles in Mid-Atlantic sink gillnet gear between 2007 and 2011 (Murray 2009, 2015b).

Finkbeiner *et al.* (2011) compiled cumulative sea turtle bycatch information in U.S. fisheries from 1990 through 2007, before and after implementation of bycatch mitigation measures. Information was obtained from peer reviewed publications and NMFS documents (e.g., Opinions and bycatch reports). In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures). Kemp's ridleys interacted with fisheries most frequently, with the highest level of mean annual mortality (2,700), followed by loggerheads (1,400), greens (300), and leatherbacks (40). The Southeast/Gulf of Mexico shrimp trawl fishery was responsible for the vast majority of U.S. interactions (up to 98%) and mortalities (more than 80%). While this provides an initial cumulative bycatch assessment, there are a number of caveats that should be considered when interpreting this information, such as sampling inconsistencies and limitations. The most recent section 7 consultation on the shrimp fishery, completed in May 2012, was unable to estimate the total annual level of green sea turtle interactions occurring in the fishery. Instead, it qualitatively estimated that the shrimp fishery, as currently operating, would result in at least hundreds and possibly low thousands of interactions annually, of which hundreds are expected to be lethal (NMFS 2012a).

Other activities like channel dredging, marine debris, pollution, vessel strikes, power plant impingement, and habitat destruction account for an unquantifiable level of other mortality.

Stranding reports indicate that between 200-400 green sea turtles strand annually along the eastern U.S. coast from a variety of causes most of which are unknown (STSSN database).

The most recent five-year status review for green sea turtles (Seminoff *et al.* 2015) notes that global climate change is affecting the species and will likely continue to be a threat. There is an increasing female bias in the sex ratio of green sea turtle hatchlings. While this is partly attributable to imperfect egg hatchery practices, global climate change is also implicated as a likely cause, as warmer sand temperatures at nesting beaches are likely to result in the production of more female embryos. Climate change may also impact nesting beaches through sea level rise which may reduce the availability of nesting habitat and increase the risk of nest inundation. Loss of appropriate nesting habitat may also be accelerated by a combination of other environmental and oceanographic changes, such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion. Oceanic changes related to rising water temperatures could result in changes in the abundance and distribution of the primary food sources of green sea turtles, which in turn could result in changes in behavior and distribution of this species. Seagrass habitats may suffer from decreased productivity and/or increased stress due to sea level rise, as well as salinity and temperature changes (Short and Neckles 1999; Duarte 2002).

As noted above, the increasing female bias in green sea turtle hatchlings is thought to be at least partially linked to increases in temperatures at nesting beaches. However, due to a lack of scientific data, the specific future effects of climate change on green sea turtles species are not predictable or quantifiable to any degree at this time (Hawkes *et al*. 2009). For example, information is not available to predict the extent and rate to which sand temperatures at the nesting beaches used by green sea turtles may increase in the short-term future and the extent to which green sea turtles may be able to cope with this change by selecting cooler areas of the beach or shifting their nesting distribution to other beaches at which increases in sand temperature may not be experienced. Based on the most recent five-year status review (Seminoff *et al.* 2015), and following from the climate change discussions on the other hard-shelled sea turtle species, significant impacts from climate change in the future are to be expected, but the severity of and rate at which these impacts will occur is currently unknown.

*Summary of Status for the North Atlantic DPS of Green Sea Turtles*

In the North Atlantic, nesting groups are considered to be doing relatively well (i.e., the number of sites with increasing nesting are greater than the number of sites with decreasing nesting) (Seminoff *et al.* 2015). However, given the late age to maturity for green sea turtles, caution is urged regarding the status of nesting groups in the North Atlantic DPS since no area has a dataset spanning a full green sea turtle generation (Seminoff *et al.* 2015).

Seminoff *et al.* (2015) concluded that green sea turtle abundance is increasing for four nesting sites in the North Atlantic. They also concluded that nesting at Tortuguero, Costa Rica represents the most important nesting area for green sea turtles in the North Atlantic and that nesting at Tortuguero has increased markedly since the 1970s (Seminoff *et al.* 2015). However, the five-year status review also noted that the Tortuguero nesting stock continues to be affected by ongoing directed captures at their primary foraging area in Nicaragua. The breeding

population in Florida appears to be increasing rapidly in recent years based upon index nesting data from 1989-2015.

As with the other sea turtle species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like hopper dredging, pollution, and habitat destruction also contribute to human caused mortality, though the level is unknown.

### *4.2.2 Status of Atlantic Sturgeon*

The section below describes the Atlantic sturgeon listing, provides life history information that is relevant to all DPSs of Atlantic sturgeon, and then provides information specific to the status of each DPS of Atlantic sturgeon. Below, we also provide a description of the Atlantic sturgeon DPSs likely to occur in the action area and their use of the action area.

The Atlantic sturgeon is a subspecies of sturgeon distributed along the east coast of North America from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida (Scott and Scott 1988; ASSRT 2007). We have delineated U.S. populations of Atlantic sturgeon into five DPSs: Gulf of Maine (GOM), New York Bight (NYB), Chesapeake Bay (CB), Carolina, and South Atlantic (SA) (77 FR 5880 and 77 FR 5914; Figure 4)[6]. The results of genetic studies suggest that natal origin influences the distribution of Atlantic sturgeon in the marine environment (Wirgin and King 2011). However, satellite tracking and tagging data along with other genetic data demonstrate that Atlantic sturgeon from all five DPSs and Canada occur throughout the full range of the subspecies. Therefore, Atlantic sturgeon originating from any of the five DPSs can be affected by threats in the marine, estuarine, and riverine environment that occur far from natal spawning rivers.

At present, the NYB, CB, Carolina, and SA DPSs are listed as endangered, while the GOM DPS is listed as threatened (77 FR 5880 and 77 FR 5914; February 6, 2012). The effective date of the listings was April 6, 2012. The DPSs do not include Atlantic sturgeon that are spawned in Canadian rivers. Therefore, Canadian spawned fish are not included in the listings. As described below, individuals originating from all five listed DPSs are likely to occur in the action area. Information general to all Atlantic sturgeon as well as information specific to each DPS is provided below.

*Life history*

Atlantic sturgeon are long lived (approximately 60 years), late maturing, estuarine dependent, anadromous[7] fish (Bigelow and Schroeder 1953; Vladykov and Greeley 1963; Mangin 1964; Pikitch *et al.* 2005; Dadswell 2006; ASSRT 2007). They are relatively large fish, even amongst sturgeon species (Pikitch *et al.* 2005) and can grow to over 14 feet and weigh up to 800 pounds. Atlantic sturgeon are bottom feeders that suck food into a ventral protruding mouth (Bigelow and Schroeder 1953). Four barbels in front of the mouth assist the sturgeon in locating prey

[6] To be considered for listing under the ESA, a group of organisms must constitute a "species." A "species" is defined in section 3 of the ESA to include "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature."

[7] Anadromous refers to a fish that is born in freshwater, spends most of its life in the sea, and returns to freshwater to spawn (NEFSC FAQ's, available at http://www.nefsc.noaa.gov/faq/fishfaq1a.html, modified June 16, 2011)

(Bigelow and Schroeder 1953). Diets of adult and migrant subadult Atlantic sturgeon include mollusks, gastropods, amphipods, annelids, decapods, isopods, and fish such as sand lance (Bigelow and Schroeder 1953; ASSRT 2007; Guilbard *et al.* 2007; Savoy 2007). Juvenile Atlantic sturgeon feed on aquatic insects, larvae, and other invertebrates (Bigelow and Schroeder 1953; ASSRT 2007; Guilbard *et al.* 2007). The life history of Atlantic sturgeon can be divided into five general categories as described in Table 4 below (adapted from ASSRT 2007).

**Figure 2. Map Depicting the 5 Atlantic Sturgeon DPSs**

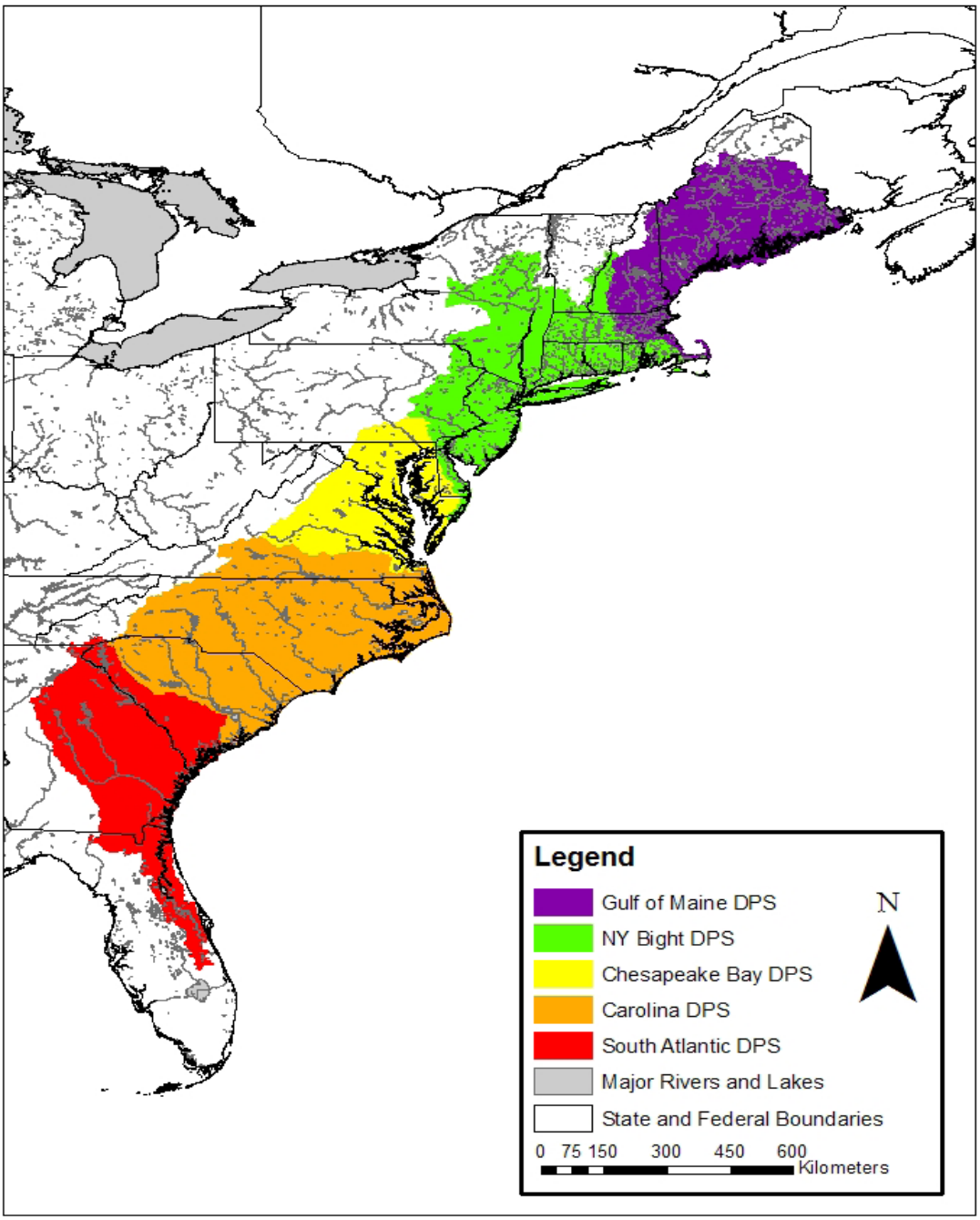


**Table 4. Descriptions of Atlantic sturgeon life history stages.**

| Age Class | Size | Description |
|---|---|---|
| **Egg** | | Fertilized or unfertilized |
| **Larvae** | | Negative photo-taxic, nourished by yolk sac |
| **Young-of-the-Year (YOY)** | **0.3 grams; <41 cm TL** | Fish that are > 3 months and < one year; capable of capturing and consuming live food |
| **Sub-adults** | **>41 cm and <150 cm TL** | Fish that are at least age 1 and are not sexually mature |
| **Adults** | **>150 cm TL** | Sexually mature fish |

Rate of maturation is affected by water temperature and gender. In general: (1) Atlantic sturgeon that originate from southern systems grow faster and mature sooner than Atlantic sturgeon that originate from more northern systems; (2) males grow faster than females; (3) fully mature females attain a larger size (i.e., length) than fully mature males. The largest recorded Atlantic sturgeon was a female captured in 1924 that measured approximately 4.26 meters (Vladykov and Greeley 1963). Dadswell (2006) reported seeing seven fish of comparable size in the St. John River estuary from 1973 to 1995. Observations of large-sized sturgeon are particularly important given that egg production is correlated with age and body size (Smith *et al.* 1982; Van Eenennaam *et al.* 1996; Van Eenennaam and Doroshov 1998; Dadswell 2006). The lengths of Atlantic sturgeon caught since the mid-late 20$^{th}$ century have typically been less than three meters (Smith *et al.* 1982, Smith and Dingley 1984; Smith 1985; Scott and Scott 1988; Young *et al.* 1998; Collins *et al.* 2000; Caron *et al.* 2002; Dadswell 2006; ASSRT 2007; Kahnle *et al.* 2007; DFO 2011). While females are prolific, with egg production ranging from 400,000 to four million eggs per spawning year, females spawn at intervals of two to five years (Vladykov and Greeley 1963; Smith *et al.* 1982; Van Eenennaam *et al.* 1996; Van Eenennaam and Doroshov 1998; Stevenson and Secor 1999; Dadswell 2006). Given spawning periodicity and a female's relatively late age to maturity, the age at which 50% of the maximum lifetime egg production is achieved is estimated to be 29 years (Boreman 1997). Males exhibit spawning periodicity of one to five years (Smith 1985; Collins *et al.* 2000; Caron *et al.* 2002). While long-lived, Atlantic sturgeon are exposed to a multitude of threats prior to achieving maturation and have a limited number of spawning opportunities once mature.

Water temperature plays a primary role in triggering the timing of spawning migrations (Greene *et al.* 2009). Spawning migrations generally occur during February-March in southern systems, April-May in Mid-Atlantic systems, and May-July in Canadian systems (Murawski and Pacheco 1977; Smith 1985; Bain 1997; Smith and Clugston 1997; Caron *et al.* 2002). Male sturgeon begin upstream spawning migrations when waters reach approximately 6°C (43°F) (Smith *et al.* 1982; Dovel and Berggren 1983; Smith 1985; Greene *et al.* 2009), and remain on the spawning grounds throughout the spawning season (Bain 1997). Females begin spawning migrations when temperatures are closer to 12° to 13°C (54° to 55°F) (Dovel and Berggren 1983; Smith 1985; Collins *et al.* 2000), make rapid spawning migrations upstream, and quickly depart following spawning (Bain 1997).

The spawning areas in most U.S. rivers have not been well defined. However, the habitat characteristics of spawning areas have been identified based on historical accounts of where fisheries occurred, tracking and tagging studies of spawning sturgeon, and physiological needs of early life stages. Spawning is believed to occur in flowing water between the salt front of estuaries and the fall line of large rivers, when and where optimal flows are 46-76 centimeters/ second and depths are 3-27 meters (Borodin 1925; Dees 1961; Leland 1968; Scott and Crossman 1973; Crance 1987; Shirey *et al.* 1999; Bain *et al.* 2000; Collins *et al.* 2000; Caron *et al.* 2002; Hatin *et al.* 2002; Greene *et al*. 2009). Sturgeon eggs are deposited on hard bottom substrate such as cobble, coarse sand, and bedrock (Dees 1961; Scott and Crossman 1973; Gilbert 1989; Smith and Clugston 1997; Bain *et al.* 2000; Collins *et al.* 2000; Caron *et al.* 2002; Hatin *et al.* 2002; Mohler 2003; Greene *et al.* 2009), and become adhesive shortly after fertilization (Murawski and Pacheco 1977; Van den Avyle 1984; Mohler 2003). Incubation time for the eggs increases as water temperature decreases (Mohler 2003). At temperatures of 20° and 18°C, hatching occurs approximately 94 and 140 hours, respectively, after deposition (ASSRT 2007).

Larval Atlantic sturgeon (i.e., less than four weeks old, with TL less than 30 millimeters; Van Eenennaam *et al.* 1996) are assumed to mostly live on or near the bottom and inhabit the same riverine or estuarine areas where they were spawned (Smith *et al.* 1980; Bain *et al.* 2000; Kynard and Horgan 2002; Greene *et al.* 2009). Studies suggest that age-0 (i.e., YOY), age-1, and age-2 juvenile Atlantic sturgeon occur in low salinity waters of the natal estuary (Haley 1999; Hatin *et al.* 2007; McCord *et al.* 2007; Munro *et al.* 2007) while older fish are more salt tolerant and occur in higher salinity waters as well as low salinity waters (Collins *et al.* 2000). Atlantic sturgeon remain in the natal estuary for months to years before emigrating to open ocean as subadults (Holland and Yelverton 1973; Dovel and Berggen 1983; Waldman *et al.* 1996; Dadswell 2006; ASSRT 2007).

After emigration from the natal estuary, subadults and adults travel within the marine environment, typically in waters less than 50 meters in depth, using coastal bays, sounds, and ocean waters (Vladykov and Greeley 1963; Murawski and Pacheco 1977; Dovel and Berggren 1983; Smith 1985; Collins and Smith 1997; Welsh *et al.* 2002; Savoy and Pacileo 2003; Stein *et al.* 2004a; Laney *et al.* 2007; Dunton *et al.* 2010; Erickson *et al.* 2011; Wirgin and King 2011). Tracking and tagging studies reveal seasonal movements of Atlantic sturgeon along the coast. Satellite-tagged adult sturgeon from the Hudson River concentrated in the southern part of the Mid-Atlantic Bight at depths greater than 20 meters during winter and spring, and in the northern portion of the Mid-Atlantic Bight at depths less than 20 meters in summer and fall (Erickson *et al.* 2011). A similar movement pattern for juvenile Atlantic sturgeon has been found based on recaptures of fish originally tagged in the Delaware River (C. Shirey, Delaware Department of Fish and Wildlife, unpublished data reviewed in Greene *et al.* 2009). After leaving the Delaware River estuary during the fall, juvenile Atlantic sturgeon were recaptured by commercial fishermen in nearshore waters along the Atlantic coast as far south as Cape Hatteras from November through early March. In the spring, a portion of the tagged fish re-entered the Delaware River estuary. However, many fish continued a northerly coastal migration through the Mid-Atlantic as well as into southern New England waters where they were recovered throughout the summer months. Movements as far north as Maine were documented. A southerly coastal migration was apparent from tag returns reported in the fall. The majority of

these tag returns were reported from relatively shallow nearshore fisheries with few fish reported from waters in excess of 25 meters (C. Shirey, Delaware Department of Fish and Wildlife, unpublished data reviewed in Greene *et al.* 2009). Areas where migratory Atlantic sturgeon commonly aggregate include the Bay of Fundy (e.g., Minas and Cumberland Basins), Massachusetts Bay, Connecticut River estuary, Long Island Sound, New York Bight, Delaware Bay, Chesapeake Bay, and waters off of North Carolina from the Virginia/North Carolina border to Cape Hatteras at depths up to 24 meters (Dovel and Berggren 1983; Dadswell *et al.* 1984; Johnson *et al.* 1997; Rochard *et al.* 1997; Kynard *et al.* 2000; Eyler *et al.* 2004; Stein *et al.* 2004a; Wehrell 2005; Dadswell 2006; ASSRT 2007; Laney *et al.* 2007). These sites may be used as foraging sites and/or thermal refugia.

*Determination of DPS Composition in the Action Area*

As explained above, the range of all five DPSs overlaps and extends from Canada through Cape Canaveral, Florida. The Chesapeake Bay is known to be used by Atlantic sturgeon originating from all five DPSs. We have considered the best available information from a recent mixed stock analysis to determine from which DPSs individuals in the action area are likely to have originated. We have determined that Atlantic sturgeon in the action area likely originate from the five DPSs at the following frequencies: NYB 51.7%; SA 21.9%; CB 11.8%; GOM 10.1%; and Carolina 2.4%. Approximately 2.2% of the Atlantic sturgeon in the action area originate from Canadian rivers or management units. These percentages are based on genetic sampling of all individuals (n=173) captured during observed fishing trips along the Atlantic coast from Maine through North Carolina, and the results of the genetic analyses for these 173 fish were compared against a reference population of 411 fish and results for an additional 790 fish from other sampling efforts. Therefore, they represent the best available information on the likely genetic makeup of individuals occurring in the action area. The genetic assignments have corresponding 95% confidence intervals. However, for purposes of section 7 consultation, we have selected the reported values without their associated confidence intervals. The reported values, which approximate the mid-point of the range, are a reasonable indication of the likely genetic makeup of Atlantic sturgeon in the action area. These assignments and the data from which they are derived are described in detail in Wirgin *et al.* (2015).

*Distribution and Abundance*

Atlantic sturgeon underwent significant range-wide declines from historical abundance levels due to overfishing in the mid to late 19$^{th}$ century when a caviar market was established (Scott and Crossman 1973; Taub 1990; MNRPD 1993; Smith and Clugston 1997; Dadswell 2006; ASSRT 2007). Abundance of spawning-aged females prior to this period of exploitation was predicted to be greater than 100,000 for the Delaware River, and at least 10,000 females for other spawning stocks (Secor and Waldman 1999; Secor 2002). Historical records suggest that Atlantic sturgeon spawned in at least 35 rivers prior to this period. Currently, only 17 U.S. rivers are known to support spawning (i.e., presence of YOY or gravid Atlantic sturgeon documented within the past 15 years) (ASSRT 2007). While there may be other rivers supporting spawning for which definitive evidence has not been obtained (e.g., in the Penobscot and York Rivers), the number of rivers supporting spawning of Atlantic sturgeon are approximately half of what they were historically. In addition, only five rivers (Kennebec, Androscoggin, Hudson, Delaware, and James) are known to currently support spawning from Maine through Virginia, where historical records show that there used to be 15 spawning rivers (ASSRT 2007). Thus, there are

substantial gaps between Atlantic sturgeon spawning rivers amongst northern and Mid-Atlantic States, which could make recolonization of extirpated populations more difficult.

There are no current, published population abundance estimates for any of the currently known spawning stocks or for any of the five DPSs of Atlantic sturgeon. An estimate of 863 mature adults per year (596 males and 267 females) was calculated for the Hudson River based on fishery-dependent data collected from 1985-1995 (Kahnle *et al.* 2007). An estimate of 343 spawning adults per year is available for the Altamaha River, Georgia, based on fishery-independent data collected in 2004 and 2005 (Schueller and Peterson 2006). Using the data collected from the Hudson and Altamaha Rivers to estimate the total number of Atlantic sturgeon in either subpopulation is not possible, since mature Atlantic sturgeon may not spawn every year (Vladykov and Greeley 1963; Smith 1985; Van Eenennaam *et al.* 1996; Stevenson and Secor 1999; Collins *et al.* 2000; Caron *et al.* 2002), the age structure of these populations is not well understood, and stage to stage survival is unknown. In other words, the information that would allow us to take an estimate of annual spawning adults and expand that estimate to an estimate of the total number of individuals (e.g., yearlings, subadults, and adults) in a population is lacking. The ASSRT presumed that the Hudson and Altamaha Rivers had the most robust of the remaining U.S. Atlantic sturgeon spawning populations and concluded that the other U.S. spawning populations were likely less than 300 spawning adults per year (ASSRT 2007).

Lacking complete estimates of population abundance across the distribution of Atlantic sturgeon, the NEFSC developed a virtual population analysis model with the goal of estimating bounds of Atlantic sturgeon ocean abundance. The NEFSC suggested that cumulative annual estimates of surviving fishery discards could provide a minimum estimate of abundance. The objectives of producing the Atlantic Sturgeon Production Index (ASPI) were to characterize uncertainty in abundance estimates arising from multiple sources of observation and process error and to complement future efforts to conduct a more comprehensive stock assessment (Table 4). The ASPI provides a general abundance metric to assess risk for actions that may affect Atlantic sturgeon in the ocean; however, it is not a comprehensive stock assessment. In general, the model uses empirical estimates of post-capture survivors and natural survival, as well as probability estimates of recapture using tagging data from the USFWS sturgeon tagging database, and federal fishery discard estimates from 2006 to 2010 to produce a virtual population. The USFWS sturgeon tagging database is a repository for sturgeon tagging information on the Atlantic coast. The database contains tag release and recapture information from state and federal researchers. The database records recaptures by the fishing fleet, researchers, and researchers on fishery vessels.

In additional to the ASPI, a population estimate was derived from the NEAMAP trawl surveys (Table5). The NEAMAP trawl surveys are conducted from Cape Cod, Massachusetts to Cape Hatteras, North Carolina in nearshore waters at depths up to 18.3 meters (60 feet) during the fall since 2007 and spring since 2008. Each survey employs a spatially stratified random design with a total of 35 strata and 150 stations. The Atlantic States Marine Fisheries Commission (ASMFC) has initiated a new stock assessment with the goal of completing it in the near future. NMFS will be partnering with them to conduct the stock assessment, and the ocean population abundance estimates produced by the NEFSC will be shared with the stock assessment committee for consideration in the stock assessment.

**Table 5. Description of the ASPI model and NEAMAP survey based area estimate method.**

| Model Name | Model Description |
|---|---|
| A. ASPI | Uses tag-based estimates of recapture probabilities from 1999 to 2009. Natural mortality based on Kahnle *et al.* (2007) rather than estimates derived from tagging model. Tag recaptures from commercial fisheries are adjusted for non-reporting based on recaptures from observers and researchers. Tag loss assumed to be zero. |
| B. NEAMAP Swept Area | Uses NEAMAP survey-based swept area estimates of abundance and assumed estimates of gear efficiency. Estimates based on average of ten surveys from fall 2007 to spring 2012. |

Atlantic sturgeon are frequently encountered during the NEAMAP surveys. The information from these surveys can be used to calculate minimum swept area population estimates within the strata swept by the surveys. The estimate from fall surveys ranges from 6,980 to 42,160 with coefficients of variation between 0.02 and 0.57, and the estimates from spring surveys ranges from 25,540 to 52,990 with coefficients of variation between 0.27 and 0.65 (Table 6). These are considered minimum estimates because the calculation makes the assumption that the gear will capture (i.e., net efficiency) 100% of the sturgeon in the water column along the tow path and that all sturgeon are with the sampling domain of the survey. We define catchability as: 1) the product of the probability of capture given encounter (i.e., net efficiency), and 2) the fraction of the population within the sampling domain. Catchabilities less than 100% will result in estimates greater than the minimum. The true catchability depends on many factors including the availability of the species to the survey and the behavior of the species with respect to the gear. True catchabilities much less than 100% are common for most species. The average ASPI estimate of 417,934 fish implies a catchability of between 6% and 13% for the spring NEAMAP surveys, and a catchability of between 2% and 10% for the fall NEAMAP surveys. If the availability of Atlantic sturgeon in the areas sampled by the spring NEAMAP surveys were say 50%, then the implied range of net efficiencies for this survey would double to 12% and 26%. The ratio of total sturgeon habitat to area sampled by the NEAMAP surveys is unknown, but is certainly greater than one.

The NEAMAP-based estimates do not include YOY fish and juveniles in the rivers; however, those segments of the Atlantic sturgeon populations are at minimal risk from the proposed action since they are rare to absent within the action area. The NEAMAP surveys are conducted in waters that include the preferred depth ranges of subadult and adult Atlantic sturgeon and take place during seasons that coincide with known Atlantic sturgeon coastal migration patterns in the ocean. Therefore, the NEAMAP estimates are minimum estimates of the ocean population of Atlantic sturgeon but are based on sampling throughout the action area, in known sturgeon coastal migration areas during times that sturgeon are expected to be migrating north and south.

**Table 6. Annual minimum swept area estimates for Atlantic sturgeon during the spring and fall NEAMAP surveys. Estimates provided by Dr. Chris Bonzek (VIMS) and assume 100% net efficiencies.**

| Year | Fall Number | CV | Spring Number | CV |
|---|---|---|---|---|
| 2007 | 6,981 | 0.015 | | |
| 2008 | 33,949 | 0.322 | 25,541 | 0.391 |
| 2009 | 32,227 | 0.316 | 41,196 | 0.353 |
| 2010 | 42,164 | 0.566 | 52,992 | 0.265 |
| 2011 | 22,932 | 0.399 | 52,840 | 0.480 |
| 2012 | | | 28,060 | 0.652 |

Available data do not support estimation of true catchability (i.e., net efficiency x availability) of the NEAMAP trawl survey for Atlantic sturgeon. Thus, the NEAMAP swept area biomass estimates were produced and presented for catchabilities from 5% to 100%. Assuming the NEAMAP surveys have been 100% efficient would require the unlikely assumption that the survey gear captures all Atlantic sturgeon within the path of the trawl and all sturgeon are within the sampling area of the NEAMAP survey. The 50% efficiency assumption seems to reasonably account for the robust, yet not complete sampling of the Atlantic sturgeon oceanic temporal and spatial ranges and the documented high rates of encounter with NEAMAP survey gear and Atlantic sturgeon. For this Opinion, we have determined that the best available data at this time are the population estimates derived from NEAMAP swept area biomass resulting from the 50% catchability rate (Table 7). The estimates are derived directly from empirical data with fewer assumptions than have been required to model Atlantic sturgeon populations to date.

**Table 7. Modeled results from the ASPI and NEAMAP Atlantic sturgeon estimation methods.**

| Model Run | Model Years | 95% low | Mean | 95% high |
|---|---|---|---|---|
| A. ASPI | 1999-2009 | 165,381 | 417,934 | 744,597 |
| B.1 NEAMAP Survey, swept area assuming 100% efficiency | 2007-2012 | 8,921 | 33,888 | 58,856 |
| B.2 NEAMAP Survey, swept area assuming 50% efficiency | 2007-2012 | 13,962 | 67,776 | 105,984 |
| B.3 NEAMAP Survey, swept area assuming 10% efficiency | 2007-2012 | 89,206 | 338,882 | 588,558 |

The ocean population abundance of 67,776 fish estimated from the NEAMAP surveys assuming 50% efficiency (based on net efficiency and the fraction of the total population exposed to the survey) was subsequently partitioned by DPS based on genetic frequencies of occurrence in he sampled area (Table 8). Given the proportion of adults to subadults in the observer database (approximate ratio of 1:3), we have also estimated a number of subadults originating from each DPS. However, this cannot be considered an estimate of the total number of subadults because it only considers those subadults that are of a size vulnerable to capture in commercial sink gillnet and otter trawl gear in the marine environment and are present in the marine environment, which is only a fraction of the total number of subadults.

**Table 8. Summary of calculated population estimates based upon the NEAMAP survey swept area model assuming 50% efficiency.**

| DPS | Estimated Ocean Population Abundance | Estimated Ocean Population of Adults | Estimated Ocean Population of Subadults (of size vulnerable to capture in fisheries) |
|---|---|---|---|
| **GOM** | 7,455 | 1,864 | 5,591 |
| **NYB** | 34,566 | 8,642 | 25,925 |
| **CB** | 8,811 | 2,203 | 6,608 |
| **Carolina** | 1,356 | 339 | 1,017 |
| **SA** | 14,911 | 3,728 | 11,183 |
| **Canada** | 678 | 170 | 509 |

The ASMFC released a new benchmark stock assessment for Atlantic sturgeon in October 2017 (ASMFC 2017). The assessment used both fishery-dependent and fishery-independent data, as well as biological and life history information. Fishery-dependent data came from commercial fisheries that formerly targeted Atlantic sturgeon (before the moratorium), as well as fisheries that catch sturgeon incidentally. Fishery-independent data were collected from scientific research and survey programs.

**Table 9: Stock status determination for the coastwide stock and DPSs (from the ASMFC's Atlantic Sturgeon Stock Assessment Overview, October 2017)**

| | Mortality Status | Biomass/Abundance Status | |
|---|---|---|---|
| **Population** | **Probability that $Z > Z_{50\%EPR}$ 80%** | **Relative to Historical Levels** | **Average probability of terminal year of indices > 1998* value** |
| Coastwide | 7% | Depleted | 95% |
| Gulf of Maine | 74% | Depleted | 51% |
| New York Bight | 31% | Depleted | 75% |
| Chesapeake Bay | 30% | Depleted | 36% |
| Carolina | 75% | Depleted | 67% |
| South Atlantic | 40% | Depleted | Unknown (no suitable indices) |

* For indices that started after 1998, the first year of the index was used as the reference value.

At the coastwide and DPS levels, the stock assessment concluded that Atlantic sturgeon are depleted relative to historical levels. The low abundance of Atlantic sturgeon is not due solely to effects of historic commercial fishing, so the 'depleted' status was used instead of 'overfished.' This status reflects the array of variables preventing Atlantic sturgeon recovery (e.g., bycatch, habitat loss, and ship strikes).

As described in the Assessment Overview, Table 9 shows "the stock status determination for the coastwide stock and DPSs based on mortality estimates and biomass/abundance status relative to historic levels, and the terminal year (i.e., the last year of available data) of indices relative to the start of the moratorium as determined by the ARIMA[8] analysis."

Despite the depleted status, the assessment did include signs that the coastwide index is above the 1998 value (95% chance). The GOM, NYB, and Carolina DPS indices also all had a greater than 50% chance of being above their 1998 value; however, the index from the CB DPS (highlighted red) only had a 36% chance of being above the 1998 value. There were no representative indices for the SA DPS. Total mortality from the tagging model was very low at the coastwide level. Small sample sizes made mortality estimates at the DPS level more difficult. The NYB, CB, and SA DPSs all had a less than 50% chance of having a mortality rate higher than the threshold. The GOM and Carolina DPSs (highlighted red) had 74%-75% probability of being above the mortality threshold (ASMFC 2017).

*Threats*

Atlantic sturgeon are susceptible to over exploitation given their life history characteristics (e.g., late maturity, dependence on a wide-variety of habitats). Similar to other sturgeon species (Vladykov and Greeley 1963; Pikitch *et al.* 2005), Atlantic sturgeon experienced range-wide declines from historical abundance levels due to overfishing (for caviar and meat) and impacts to habitat in the 19$^{th}$ and 20$^{th}$ centuries (Taub 1990; Smith and Clugston 1997; Secor and Waldman 1999).

Because a DPS is a group of populations, the stability, viability, and persistence of individual populations affects the persistence and viability of the larger DPS. The loss of any population within a DPS could result in: (1) a long-term gap in the range of the DPS that is unlikely to be recolonized; (2) loss of reproducing individuals; (3) loss of genetic biodiversity; (4) loss of unique haplotypes; (5) loss of adaptive traits; and (6) reduction in total number. The loss of a population will negatively impact the persistence and viability of the DPS as a whole, as fewer than two individuals per generation spawn outside their natal rivers (Secor and Waldman 1999). The persistence of individual populations, and in turn the DPS, depends on successful spawning and rearing within the freshwater habitat, emigration to marine habitats to grow, and return of adults to natal rivers to spawn.

Based on the best available information, we have concluded that unintended catch in fisheries, vessel strikes, poor water quality, freshwater availability, dams, lack of regulatory mechanisms for protecting the fish, and dredging are the most significant threats to Atlantic sturgeon (77 FR 5880 and 77 FR 5914; February 6, 2012). While all the threats are not necessarily present in the same area at the same time, given that Atlantic sturgeon subadults and adults use ocean waters from Labrador, Canada to Cape Canaveral, Florida, as well as estuaries of large rivers along the U.S. East Coast, activities affecting these water bodies are likely to impact more than one Atlantic sturgeon DPS. In addition, because Atlantic sturgeon depend on a variety of habitats, every life stage is likely affected by one or more of the identified threats.

8 "The ARIMA (Auto-Regressive Integrated Moving Average) model uses fishery-independent indices of abundance to estimate how likely an index value is above or below a reference value" (ASMFC 2017).

Atlantic sturgeon are particularly sensitive to bycatch mortality because they are a long-lived species, have an older age at maturity, have lower maximum fecundity values, and a large percentage of egg production occurs later in life. Based on these life history traits, Boreman (1997) calculated that Atlantic sturgeon can only withstand the annual loss of up to 5% of their population to bycatch mortality without suffering population declines. Mortality rates of Atlantic sturgeon taken as bycatch in various types of fishing gear range between 0% and 51%, with the greatest mortality occurring in sturgeon caught by sink gillnets. Atlantic sturgeon are particularly vulnerable to being caught in sink gillnets; therefore, fisheries using this type of gear account for a high percentage of Atlantic sturgeon bycatch. Fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may access multiple river systems, they are subject to being caught in multiple fisheries throughout their range. In addition, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins and low dissolved oxygen). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

As a wide-ranging, anadromous species, Atlantic sturgeon are subject to numerous Federal (U.S. and Canadian), state and provincial, and inter-jurisdictional laws, regulations, and agency activities. While these mechanisms, including the prohibition on possession, have addressed impacts to Atlantic sturgeon through directed fisheries, there are currently insufficient mechanisms in place to address the significant risk posed to Atlantic sturgeon from commercial bycatch.

An ASMFC interstate fishery management plan for sturgeon (Sturgeon FMP) was developed and implemented in 1990 (Taub 1990). In 1998, the remaining Atlantic sturgeon fisheries in U.S. state waters were closed per Amendment 1 to the FMP. NMFS implemented complementary regulations in 1999 that prohibited fishing for, harvesting, possessing, or retaining Atlantic sturgeon or their parts in or from the U.S. Exclusive Economic Zone (EEZ) in the course of a commercial fishing activity.

Commercial fisheries for Atlantic sturgeon still exist in Canadian waters (DFO 2011). Sturgeon belonging to one or more of the DPSs may be harvested in the Canadian fisheries. In particular, the Bay of Fundy fishery in the Saint John estuary may capture sturgeon of U.S. origin given that sturgeon from the GOM and the NYB DPSs have been incidentally captured in other Bay of Fundy fisheries (DFO 2011; Wirgin and King 2011). Because Atlantic sturgeon are listed under Appendix II of the Convention on International Trade in Endangered Species (CITES), the U.S. and Canada are currently working on a conservation strategy to address the potential for captures of U.S. fish in Canadian directed Atlantic sturgeon fisheries and of Canadian fish incidentally captured in U.S. commercial fisheries. At this time, there are no estimates of the number of individuals from any of the DPSs that are captured or killed in Canadian fisheries each year. Based on geographic distribution, most U.S. Atlantic sturgeon that are intercepted in Canadian fisheries are likely to originate from the GOM DPS, with a smaller percentage from the NYB DPS.

Fisheries bycatch in U.S. waters is the primary threat faced by all five DPSs. At this time, we have an estimate of the number of Atlantic sturgeon captured and killed in sink gillnet and otter trawl fisheries authorized by Federal FMPs (NEFSC 2011b) in the Greater Atlantic Region but do not have a similar estimate for Southeast fisheries. We also do not have an estimate of the number of Atlantic sturgeon captured or killed in state fisheries. At this time, we are not able to quantify the effects of other significant threats (e.g., vessel strikes, poor water quality, water availability, dams, and dredging) in terms of habitat impacts or loss of individuals. While we have some information on the number of mortalities that have occurred in the past in association with certain activities (e.g., mortalities in the Delaware and James Rivers that are thought to be due to vessel strikes), we are not able to use those numbers to extrapolate effects throughout one or more DPS. This is because of (1) the small number of data points and, (2) lack of information on the percent of incidences that the observed mortalities represent.

As noted above, the NEFSC prepared an estimate of the number of encounters of Atlantic sturgeon in fisheries authorized by Northeast FMPs (NEFSC 2011b). The analysis estimates that from 2006-2010 there were averages of 1,548 and 1,569 encounters per year in observed gillnet and trawl fisheries, respectively, with an average of 3,118 encounters combined annually. Mortality rates in gillnet gear were approximately 20%. Mortality rates in otter trawl gear were generally lower at approximately 5%.

Based on the results of a NEFSC climate vulnerability analysis, diadromous fish are amongst the functional groups with the highest overall climate vulnerability (data quality is moderate; Hare et al. 2016). Specifically, the overall vulnerability of Atlantic sturgeon to climate change is very high (Hare et al. 2016). The contributing factors to climate exposure included ocean surface temperature, air temperature and ocean acidification, and contributing biological sensitivity attributes included stock status, population growth rate, habitat specialization, and dispersal and early life history (Hare et al. 2016). Hare et al. (2016) noted some of the following studies related to climate change effects on abundance and distribution: 1) juvenile metabolism and survival were impacted by increasing hypoxia in combination with increasing temperature (Secor and Gunderson; 1998); and 2) a 1°C temperature increase reduced productivity by 65% when a multivariable bioenergetics and survival model was used to generate spatially explicit maps of potential production in the Chesapeake Bay (Niklitschek and Secor, 2005).

*4.2.2.1 Gulf of Maine DPS of Atlantic sturgeon*

The GOM DPS includes the following: all anadromous Atlantic sturgeon that spawn or are spawned in the watersheds from the Maine/Canadian border and, extending southward, all watersheds draining into the Gulf of Maine as far south as Chatham, Massachusetts. The marine range of Atlantic sturgeon from the GOM DPS extends from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the GOM DPS and the adjacent portion of the marine range are shown in Figure 2. Within this range, Atlantic sturgeon historically spawned in the Androscoggin, Kennebec, Merrimack, Penobscot, and Sheepscot Rivers (ASSRT 2007). Spawning still occurs in the Kennebec and Androscoggin Rivers, and it is possible that it still occurs in the Penobscot River as well. Spawning in the Androscoggin River was just recently confirmed by the Maine Department of Marine Resources when they captured a larval Atlantic sturgeon during the 2011 spawning season below the Brunswick Dam. There is no evidence of recent spawning in the remaining rivers. In the 1800s, construction of the Essex Dam on the

Merrimack River at river kilometer (rkm) 49 blocked access to 58% of Atlantic sturgeon habitat in the river (Oakley 2003; ASSRT 2007). However, the accessible portions of the Merrimack seem to be suitable habitat for Atlantic sturgeon spawning and rearing (i.e., nursery habitat) (Kieffer and Kynard 1993). Therefore, the availability of spawning habitat does not appear to be the reason for the lack of observed spawning in the Merrimack River. Studies are on-going to determine whether Atlantic sturgeon are spawning in the Penobscot and Saco Rivers. Atlantic sturgeon that are spawned elsewhere continue to use habitats within all of these rivers as part of their overall marine range (ASSRT 2007).

At its mouth, the Kennebec River drains an area of 24,667 square kilometers, and is part of a large estuarine system that includes the Androscoggin and Sheepscot Rivers (ASMFC 1998a; ASSRT 1998; Squiers 1998). The Kennebec and Androscoggin Rivers flow into Merrymeeting Bay, a tidal freshwater bay, and exit as a combined river system through a narrow channel, flowing approximately 32 kilometers (20 miles) to the Atlantic Ocean as the tidal segment of the Kennebec River (Squiers 1998). This lower tidal segment of the Kennebec River forms a complex with the Sheepscot River estuary (ASMFC 1998a; Squiers 1998).

Substrate type in the Kennebec estuary is largely sand and bedrock (Fenster and FitzGerald 1996; Moore and Reblin 2010). Main channel depths at low tide typically range from 17 meters (58 feet) near the mouth to less than 10 meters (33 feet) in the Kennebec River above Merrymeeting Bay (Moore and Reblin 2010). Salinities range from 31 parts per thousand at Parker Head (five kilometers from the mouth) to 18 parts per thousand at Doubling Point during summer low flows (ASMFC 1998a). The 14-kilometer river segment above Doubling Point to Chops Point (the outlet of Merrymeeting Bay) is an area of transition (mid estuary) (ASMFC 1998a). The salinities in this section vary both seasonally and over a tidal cycle. During spring freshets this section is entirely fresh water but during summer low flows, salinities can range from two to three parts per thousand at Chops Point to 18 ppt at Doubling Point (ASMFC 1998a). The river is essentially tidal freshwater from the outlet of Merrymeeting Bay upriver to the site of the former Edwards Dam (ASMFC 1998a). Mean tidal amplitude ranges from 2.56 meters at the mouth of the Kennebec River estuary to 1.25 meters in Augusta near the head of tide on the Kennebec River (in the vicinity of the former Edwards Dam) and 1.16 meters at Brunswick on the Androscoggin River (ASMFC 1998a).

Bigelow and Schroeder (1953) surmised that Atlantic sturgeon likely spawned in Gulf of Maine Rivers in May-July. More recent captures of Atlantic sturgeon in spawning condition within the Kennebec River suggest that spawning more likely occurs in June-July (Squiers *et al.* 1981; ASMFC 1998a; ASSRT 1998). Evidence for the timing and location of Atlantic sturgeon spawning in the Kennebec River includes: (1) the capture of five adult male Atlantic sturgeon in spawning condition (i.e., expressing milt) in July 1994 below the (former) Edwards Dam; (2) the capture of 31 adult Atlantic sturgeon from June 15 through July 26, 1980, in a small commercial fishery directed at Atlantic sturgeon from the South Gardiner area (above Merrymeeting Bay) that included at least four ripe males and one ripe female captured on July 26, 1980; and, (3) the capture of nine adults during a gillnet survey conducted from 1977-1981, the majority of which were captured in July in the area from Merrymeeting Bay and upriver as far as Gardiner, Maine (ASSRT 1998; ASMFC TC 2007). The low salinity values for waters above Merrymeeting Bay

are consistent with values found in other rivers where successful Atlantic sturgeon spawning is known to occur.

Age to maturity for GOM DPS Atlantic sturgeon is unknown. However, Atlantic sturgeon riverine populations exhibit clinal variation with faster growth and earlier age to maturity for those that originate from southern waters, and slower growth and later age to maturity for those that originate from northern waters (75 FR 61872; October 6, 2010). Age at maturity is 11 to 21 years for Atlantic sturgeon originating from the Hudson River (Young *et al.* 1998), and 22 to 34 years for Atlantic sturgeon that originate from the Saint Lawrence River (Scott and Crossman 1973). Therefore, age at maturity for Atlantic sturgeon of the GOM DPS likely falls within these values. Of the 18 sturgeon examined from the commercial fishery that occurred in the Kennebec River in 1980, all of which were considered mature, age estimates for the 15 males ranged from 17-40 years, and from 25-40 years old for the three females (Squiers *et al.* 1981).

Several threats play a role in shaping the current status of GOM DPS Atlantic sturgeon. Historical records provide evidence of commercial fisheries for Atlantic sturgeon in the Kennebec and Androscoggin Rivers dating back to the 17$^{th}$ century (Squiers *et al.* 1979). In 1849, 160 tons of sturgeon was caught in the Kennebec River by local fishermen (Squiers *et al.* 1979). After the collapse of sturgeon stock in the 1880s, the sturgeon fishery was almost non-existent. All directed Atlantic sturgeon fishing as well as retention of Atlantic sturgeon bycatch has been prohibited since 1998. Nevertheless, mortalities associated with bycatch in fisheries in state and Federal waters still occurs. In the marine range, GOM DPS Atlantic sturgeon are incidentally captured in Federal and state-managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein *et al.* 2004b; ASMFC TC 2007). As explained above, we have estimates of the number of subadults and adults that are killed as a result of bycatch in fisheries authorized under Northeast FMPs. At this time, we are not able to quantify the impacts from other threats or estimate the number of individuals killed as a result of other anthropogenic threats. Habitat disturbance and direct mortality from anthropogenic sources are the primary concerns.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and also altering the benthic forage base. Many rivers in the GOM DPS have navigation channels that are maintained by dredging. Dredging outside of Federal channels and in-water construction occurs throughout the GOM DPS. While some dredging projects operate with observers present to document fish mortalities, many do not. To date we have not received any reports of Atlantic sturgeon killed during dredging projects in the Gulf of Maine region. At this time, we do not have any information to quantify the number of Atlantic sturgeon killed or disturbed during dredging or in-water construction projects are also not able to quantify any effects to habitat.

Connectivity is disrupted by the presence of dams on several rivers in the Gulf of Maine region, including the Penobscot and Merrimack Rivers. While there are also dams on the Kennebec, Androscoggin, and Saco Rivers, these dams are near the site of historical natural falls and likely represent the maximum upstream extent of sturgeon occurrence even if the dams were not present. Because no Atlantic sturgeon occur upstream of any hydroelectric projects in the Gulf of Maine region, passage over hydroelectric dams or through hydroelectric turbines is not a

source of injury or mortality in this area. The extent that Atlantic sturgeon are affected by operations of dams in the Gulf of Maine region is currently unknown; however, the documentation of an Atlantic sturgeon larvae downstream of the Brunswick Dam in the Androscoggin River suggests that Atlantic sturgeon spawning may be occurring in the vicinity of at least that project and therefore, may be affected by project operations. The range of Atlantic sturgeon in the Penobscot River is limited by the presence of the Milford Dam, at the base of which is the presumed historical spawning habitat. Atlantic sturgeon are known to occur in the Penobscot River, but it is unknown if spawning is currently occurring in this river. The Essex Dam on the Merrimack River blocks access to approximately 58% of historically accessible habitat in this river. Atlantic sturgeon occur in the Merrimack River but spawning has not been documented. As with the Penobscot, it is unknown how the Essex Dam affects the likelihood of spawning in this river.

GOM DPS Atlantic sturgeon may also be affected by degraded water quality. In general, water quality has improved in the Gulf of Maine over the past decades (Lichter *et al.* 2006; EPA 2008). Many rivers in Maine, including the Androscoggin River, were heavily polluted in the past from pulp and paper mill industrial discharges. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds, as developing eggs and larvae are particularly susceptible to exposure to contaminants.

There are no direct in-river abundance estimates for the GOM DPS. The Atlantic Sturgeon Status Review Team (ASSRT 2007) presumed that the GOM DPS was comprised of less than 300 spawning adults per year, based on extrapolated abundance estimates from the Hudson and Altamaha riverine populations of Atlantic sturgeon. Surveys of the Kennebec River over two time periods, 1977-1981 and 1998-2000, resulted in the capture of nine adult Atlantic sturgeon (Squiers 2004). However, since the surveys were primarily directed at capture of shortnose sturgeon, the capture gear used may not have been selective for the larger-sized, adult Atlantic sturgeon; several hundred subadult Atlantic sturgeon were caught in the Kennebec River during these studies. As described earlier in Section 4.2.2, we have estimated that there are a minimum of 7,455 GOM DPS adult and subadult Atlantic sturgeon of size vulnerable to capture in U.S. Atlantic waters We note further that this estimate is predicated on the assumption that fish in the GOM DPS would be available for capture in the NEAMAP surveys which extend from Block Island Sound, Rhode Island southward. Recoveries of tagged sturgeon do not support this migration pattern.

*Summary of the Gulf of Maine DPS*

Spawning for the GOM DPS is known to occur in two rivers (Kennebec and Androscoggin). Spawning may be occurring in other rivers, such as the Sheepscot, Merrimack, and Penobscot, but has not been confirmed. There are indications of potential increasing abundance of Atlantic sturgeon belonging to the GOM DPS. Atlantic sturgeon continue to be present in the Kennebec River; in addition, they are captured in directed research projects in the Penobscot River, and are observed in rivers where they were unknown to occur or had not been observed to occur for many years (e.g., Saco, Presumpscot, and Charles Rivers). These observations suggest that abundance of the GOM DPS of Atlantic sturgeon is sufficient such that recolonization to rivers historically suitable for spawning may be occurring. However, despite some positive signs, there

is not enough information to establish a trend for this DPS.

Some of the impacts from the threats that contributed to the decline of the GOM DPS have been removed (e.g., directed fishing), or reduced as a result of improvements in water quality and removal of dams (e.g., the Edwards Dam on the Kennebec River in 1999 and the Veazie Dam on the Penobscot River in 2013). In Maine state waters, there are strict regulations on the use of fishing gear that incidentally catches sturgeon. In addition, in the last several years there have been reductions in fishing effort in state and Federal waters, which most likely would result in a reduction in bycatch mortality of Atlantic sturgeon. A significant amount of fishing in the Gulf of Maine is conducted using trawl gear, which is known to have a much lower mortality rate for Atlantic sturgeon caught in the gear compared to sink gillnet gear (ASMFC TC 2007). Atlantic sturgeon from the GOM DPS are not commonly taken as bycatch in areas south of Chatham, Massachusetts, with only 8% (e.g., 7 of 84 fish) of interactions observed south of Chatham being assigned to the GOM DPS (Wirgin and King 2011). Tagging results also indicate that GOM DPS fish tend to remain within the waters of the Gulf of Maine and only occasionally venture to points south.

Data on Atlantic sturgeon incidentally caught in trawls and intertidal fish weirs fished in the Minas Basin area of the Bay of Fundy (Canada) indicate that approximately 35% originated from the GOM DPS (Wirgin *et al.* 2012). Thus, a significant number of the GOM DPS fish appear to migrate north into Canadian waters where they may be subjected to a variety of threats including bycatch.

As noted previously, studies have shown that in order to rebuild, Atlantic sturgeon can only sustain low levels of bycatch and other anthropogenic mortality (Boreman 1997; ASMFC TC 2007; Kahnle *et al*. 2007; Brown and Murphy 2010). We have determined that the GOM DPS is at risk of becoming endangered in the foreseeable future throughout all of its range (i.e., is a threatened species) based on the following: (1) significant declines in population sizes and the protracted period during which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect recovery.

*4.2.2.2 New York Bight DPS of Atlantic sturgeon*

The NYB DPS includes the following: all anadromous Atlantic sturgeon that spawn or are spawned in the watersheds that drain into coastal waters from Chatham, Massachusetts to the Delaware-Maryland border on Fenwick Island. Within this range, Atlantic sturgeon historically spawned in the Connecticut, Delaware, Hudson, and Taunton Rivers (Murawski and Pacheco, 1977; Secor, 2002; ASSRT, 2007). Spawning still occurs in the Delaware and Hudson Rivers, but there is no recent evidence of spawning in the Taunton Rivers (ASSRT, 2007); several age-0 Atlantic sturgeon were captured in the Connecticut in June 2014, suggesting that occassional successful spawning may occur in the Connecticut River (Savoy *et al.* 2017). Atlantic sturgeon that are spawned elsewhere continue to use habitats within the Connecticut and Taunton Rivers as part of their overall marine range (ASSRT 2007; Savoy 2007; Wirgin and King 2011).

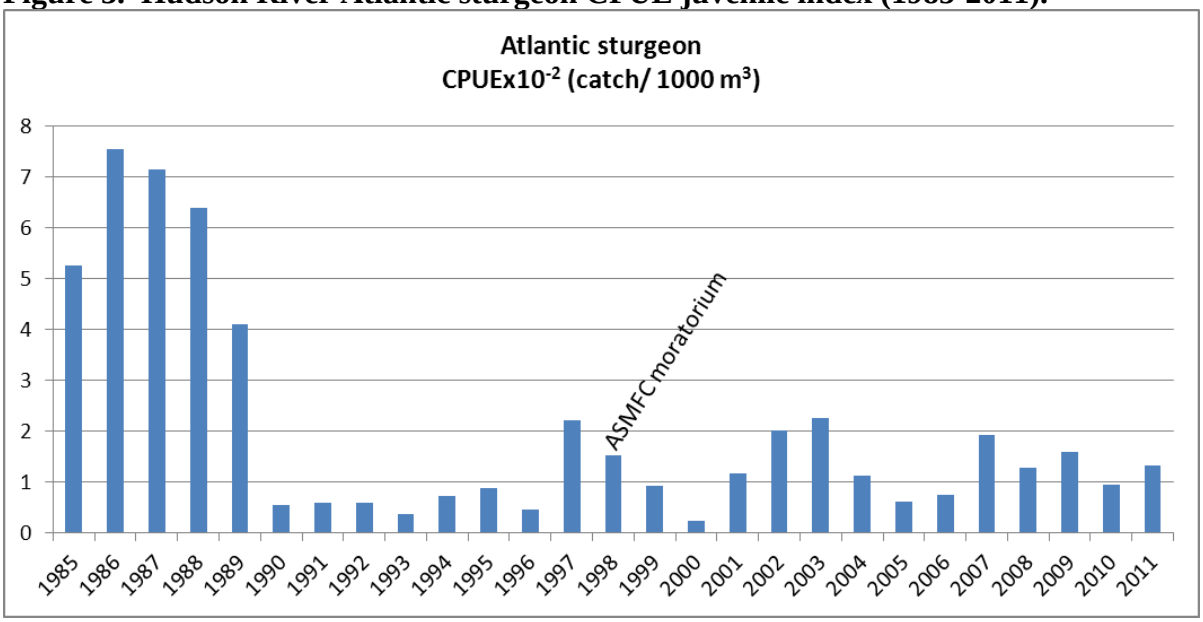
The abundance of the Hudson River Atlantic sturgeon riverine population before the over-exploitation of the 1800s is unknown, but has been conservatively estimated at 6,000 adult

females (Secor 2002). Current abundance is likely at least one order of magnitude smaller than historical levels (Secor 2002; ASSRT 2007; Kahnle *et al.* 2007). As described above, an estimate of the mean annual number of mature adults (863 total; 596 males and 267 females) was calculated for the Hudson riverine population based on fishery-dependent data collected from 1985-1995 (Kahnle *et al.* 2007). Kahnle *et al.* (1998, 2007) also showed that the level of fishing mortality from the Hudson River Atlantic sturgeon fishery during the period of 1985-1995 exceeded the estimated sustainable level of fishing mortality for the riverine population and may have led to reduced recruitment. All available data on abundance of juvenile Atlantic sturgeon in the Hudson River Estuary indicate a substantial drop in production of young since the mid-1970s (Kahnle *et al.* 1998). A decline appeared to occur in the mid to late 1970s followed by a secondary drop in the late 1980s (Kahnle *et al.* 1998; Sweka *et al.* 2007; ASMFC 2010). Catch-per-unit-effort (CPUE) data suggests that recruitment has remained depressed relative to catches of juvenile Atlantic sturgeon in the estuary during the mid-late 1980s (Sweka *et al.* 2007; ASMFC 2010). The CPUE data from 1985-2011 show significant fluctuations. There appears to be a decline in the number of juveniles between the late 1980s and early 1990s and then a slight increase in the 2000s, but, given the significant annual fluctuation, it is difficult to discern any trend. Despite the CPUEs from 2000-2011 being slightly higher than those from 1990-1999, they are low compared to the late 1980s (Figure 3). There is currently not enough information regarding any life stage to establish a trend for the Hudson River population.

There is no overall, empirical abundance estimate for the Delaware River population of Atlantic sturgeon. Harvest records from the 1800s indicate that this was historically a large population with an estimated 180,000 adult females prior to 1890 (Secor and Waldman 1999; Secor 2002). Sampling in 2009 to target YOY Atlantic sturgeon in the Delaware River (i.e., natal sturgeon) resulted in the capture of 34 YOY, ranging in size from 178 to 349 millimeters TL (Fisher 2009), and the collection of 32 YOY Atlantic sturgeon in a separate study (Brundage and O'Herron 2009 in Calvo *et al.* 2010). Genetics information collected from 33 of these YOY indicates that at least three females successfully contributed to the 2009 year class (Fisher 2011). Therefore, while the capture of YOY in 2009 provides evidence that successful spawning still occurs in the Delaware River, the relatively low numbers suggest the existing riverine population is small.

Several threats play a role in shaping the current status and trends observed in the Delaware River and Estuary. In-river threats include habitat disturbance from dredging, and impacts from historical pollution and impaired water quality. A dredged navigation channel extends from Trenton seaward through the tidal river (Brundage and O'Herron 2009), and the river receives significant shipping traffic. Vessel strikes have been identified as a threat in the Delaware River and may be detrimental to the long-term viability of the NYB DPS, as well as other DPSs (Brown and Murphy 2010).

**Figure 3. Hudson River Atlantic sturgeon CPUE juvenile index (1985-2011).**




*Summary of the New York Bight DPS*

Atlantic sturgeon originating from the NYB DPS have been documented to spawn in the Hudson and Delaware Rivers and may spawn in the Connecticut and Housatonic Rivers, although that has not been confirmed. While genetic testing can differentiate between individuals originating from the Hudson or Delaware River, the available information suggests that the straying rate is relatively high between these rivers. Some of the impact from the threats that contributed to the decline of the NYB DPS have been removed (e.g., directed fishing) or reduced as a result of improvements in water quality since passage of the Clean Water Act (CWA). In addition, there have been reductions in fishing effort in state and Federal waters, which may result in a reduction in bycatch mortality of Atlantic sturgeon. Nevertheless, areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in state and federally-managed fisheries, and vessel strikes remain significant threats to the NYB DPS.

In its marine range, NYB DPS Atlantic sturgeon are incidentally captured in Federal and state-managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein *et al.* 2004a; ASMFC TC 2007). Based on mixed stock analysis results presented by Wirgin and King (2011), more than 40% of the Atlantic sturgeon bycatch interactions in the Mid-Atlantic Bight region were sturgeon from the NYB DPS. Individual-based assignment and mixed stock analysis of samples collected from sturgeon captured in Canadian fisheries in the Bay of Fundy indicated that approximately 1%-2% were from the NYB DPS (Wirgin *et al*. 2012). At this time, we are not able to quantify the impacts from threats other than fisheries or estimate the number of individuals killed as a result of other anthropogenic threats.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and also altering the benthic forage base. Both the Hudson and Delaware Rivers have navigation channels that are maintained by dredging. Dredging is also used to maintain channels in the nearshore marine environment. Dredging outside of Federal channels and in-water construction occurs throughout the New York Bight region. While some dredging projects

operate with observers present to document fish mortalities, many do not. We have reports of one Atlantic sturgeon entrained during hopper dredging operations in Ambrose Channel, New Jersey, and four entrained during hopper dredging operations aboard the McFarland in the Delaware River. We have recently consulted on two Army Corps of Engineers (ACOE) dredging projects: (1) the Deepening and Maintenance of the Delaware River Federal Navigation Channel and (2) the New York and New Jersey Harbor Deepening Project. In both cases, we determined that while the proposed actions may adversely affect Atlantic sturgeon, they were not likely to jeopardize the continued existence of any DPS of Atlantic sturgeon.

In the Hudson and Delaware Rivers, dams do not block access to historical habitat. The Holyoke Dam on the Connecticut River blocks passage past the dam at Holyoke; however, the extent that Atlantic sturgeon would historically have used habitat upstream of Holyoke is unknown. The first dam on the Taunton River may block access to historical spawning habitat. Connectivity also may be disrupted by the presence of dams on several smaller rivers in the New York Bight region. Because no Atlantic sturgeon occur upstream of any hydroelectric projects in the New York Bight region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area. The extent to which Atlantic sturgeon are affected by operations of dams in the New York Bight region is currently unknown. Atlantic sturgeon may also be impinged or entrained at power plants in the Hudson and Delaware Rivers, and may be adversely affected by the operation of the power plants, but the power plants have not been found to jeopardize their continued existence.

NYB DPS Atlantic sturgeon may also be affected by degraded water quality. Rivers in the New York Bight region, including the Hudson and Delaware, have been heavily polluted by industrial and sewer discharges. In general, water quality has improved in the Hudson and Delaware over the past several decades (Lichter *et al.* 2006; EPA 2008). While water quality has improved and most discharges are limited through regulations, it is likely that pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds, where developing eggs and larvae are particularly susceptible to exposure to contaminants.

Vessel strikes are known to occur in the Delaware River and may also be occurring in the Hudson and other New York Bight rivers. Twenty-nine mortalities believed to be the result of vessel strikes were documented in the Delaware River from 2004-2008, and at least 13 of these fish were large adults. Additionally, 138 sturgeon carcasses were observed on the Hudson River and reported to the NYSDEC between 2007 and 2015. Of these, 69 are suspected of having been killed by vessel strike. Genetic analysis has not been completed on any of these individuals to date, given that the majority of Atlantic sturgeon in the Hudson River belong to the New York Bight DPS, we assume that the majority of the dead sturgeon reported to NYSDEC belonged to the New York Bight DPS. Given the time of year in which the fish were observed (predominantly May through July, with two in August), it is likely that many of the adults were migrating through the river to the spawning grounds. Because we do not know the percent of total vessel strikes that the observed mortalities represent, we are not able to quantify the number of individuals likely killed as a result of vessel strikes in the NYB DPS.

Studies have shown that to rebuild, Atlantic sturgeon can only sustain low levels of anthropogenic mortality (Boreman 1997; ASMFC TC 2007; Kahnle *et al.* 2007; Brown and Murphy 2010). There are no empirical abundance estimates of the number of Atlantic sturgeon in the NYB DPS. As described in Section 4.2.2, we have estimated that there are a minimum of 34,566 NYB DPS adult and subadult Atlantic sturgeon of size vulnerable to capture in U.S. Atlantic waters. We have determined that the NYB DPS is currently at risk of extinction due to: (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and (3) the impacts and threats that have and will continue to affect population recovery.

*4.2.2.3 Chesapeake Bay DPS of Atlantic sturgeon*

The CB DPS includes the following: all anadromous Atlantic sturgeon that spawn or are spawned in the watersheds that drain into the Chesapeake Bay and into coastal waters from the Delaware-Maryland border on Fenwick Island to Cape Henry, Virginia. The marine range of Atlantic sturgeon from the CB DPS extends from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the CB DPS and the adjacent portion of the marine range are shown in Figure 2. Within this range, Atlantic sturgeon historically spawned in the Susquehanna, Potomac, James, York, Rappahannock, and Nottoway Rivers (ASSRT 2007). Based on the review by Oakley (2003), 100% of Atlantic sturgeon habitat is currently accessible in these rivers since most of the barriers to passage (i.e., dams) are located upriver of where spawning is expected to have historically occurred (ASSRT 2007). Spawning still occurs in the James River, and the presence of juvenile and adult sturgeon in the York River suggests that spawning may occur there as well, specifically within the Pamunkey River (a tributary of the York River) (Musick *et al.* 1994; ASSRT 2007; Greene *et al*. 2009). The recent capture of an adult sturgeon in spawning condition suggests that spawning may occur in Marshyhope Creek, a tributary to the Nanticoke River (Bruce et al. 2016). However, conclusive evidence of current spawning is only available for the James River, where a study found evidence of Atlantic sturgeon spawning in the fall (Balazik *et al*. 2012). Atlantic sturgeon that are spawned elsewhere are known to use the Chesapeake Bay (Vladykov and Greeley 1963; Wirgin *et al.* 2000; ASSRT 2007; Grunwald *et al.* 2008).

Age to maturity for CB DPS Atlantic sturgeon is unknown. However, Atlantic sturgeon riverine populations exhibit clinal variation with faster growth and earlier age to maturity for those that originate from southern waters, and slower growth and later age to maturity for those that originate from northern waters (75 FR 61872; October 6, 2010). Age at maturity is five to 19 years for Atlantic sturgeon originating from South Carolina rivers (Smith *et al.* 1982) and 11 to 21 years for Atlantic sturgeon originating from the Hudson River (Young *et al.* 1998). Therefore, age at maturity for Atlantic sturgeon of the CB DPS likely falls within these values.

Several threats play a role in shaping the current status of CB DPS Atlantic sturgeon. Historical records provide evidence of the large-scale commercial exploitation of Atlantic sturgeon from the James River and Chesapeake Bay in the 19$^{th}$ century (Hildebrand and Schroeder 1928; Vladykov and Greeley 1963; ASMFC 1998b; Secor 2002; Bushnoe *et al.* 2005; ASSRT 2007) as well as subsistence fishing and attempts at commercial fisheries as early as the 17$^{th}$ century (Secor 2002; Bushnoe *et al.* 2005; ASSRT 2007; Balazik *et al.* 2010). Habitat disturbance caused by in-river work, such as dredging for navigational purposes, is thought to have reduced

available spawning habitat in the James River (Holton and Walsh 1995; Bushnoe *et al.* 2005; ASSRT 2007). At this time, we do not have information to quantify this loss of spawning habitat.

Decreased water quality also threatens Atlantic sturgeon of the CB DPS, especially since the Chesapeake Bay system is vulnerable to the effects of nutrient enrichment due to a relatively low tidal exchange and flushing rate, large surface-to-volume ratio, and strong stratification during the spring and summer months (Pyzik *et al.* 2004; ASMFC 1998a; ASSRT 2007; EPA 2008). These conditions contribute to reductions in dissolved oxygen levels throughout the Bay. The availability of nursery habitat, in particular, may be limited given the recurrent hypoxia (low dissolved oxygen) conditions within the Bay (Niklitschek and Secor 2005, 2010). Heavy industrial development during the 20$^{th}$ century in rivers inhabited by sturgeon impaired water quality and impeded these species' recovery.

Although there have been improvements in the some areas of the Bay's health, the ecosystem remains in poor condition. The EPA gave the overall health of the Bay a grade of 45% based on goals for water quality, habitats, lower food web productivity, and fish and shellfish abundance (EPA CBP 2010). This was a 6% increase from 2008. According to the EPA, the modest gain in the health score was due to a large increase in the adult blue crab population, expansion of underwater grass beds growing in the Bay's shallows, and improvements in water clarity and bottom habitat health as highlighted below:

- 12% of the Bay and its tidal tributaries met CWA standards for dissolved oxygen between 2007 and 2009, a decrease of 5% from 2006 to 2008,
- 26% of the tidal waters met or exceeded guidelines for water clarity, a 12% increase from 2008,
- Underwater bay grasses covered 9,039 more acres of the Bay's shallow waters for a total of 85,899 acres, 46% of the Bay-wide goal,
- The health of the Bay's bottom dwelling species reached a record high of 56% of the goal, improving by approximately 15% Bay-wide, and
- The adult blue crab population increased to 223 million, its highest level since 1993.

At this time, we do not have sufficient information to quantify the extent that degraded water quality effects habitat or individuals in the James River or throughout the Chesapeake Bay.

Vessel strikes have been observed in the James River (ASSRT 2007). Eleven Atlantic sturgeon were reported to have been struck by vessels from 2005-2007. Several of these were mature individuals. Because we do not know the percent of total vessel strikes that the observed mortalities represent, we are not able to quantify the number of individuals likely killed as a result of vessel strikes in the CB DPS.

In the marine and coastal range of the CB DPS from Canada to Florida, fisheries bycatch in federally and state-managed fisheries poses a threat to the DPS, reducing survivorship of subadults and adults and potentially causing an overall reduction in the spawning population (Stein *et al.* 2004b; ASMFC TC 2007; ASSRT 2007).

*Summary of the Chesapeake Bay DPS*
Known spawning for the CB DPS occurs only in the James and Pamunkey Rivers (a triburary of the York River. Spawning may be occurring in other rivers, such as the mainstem York, Rappahannock, Potomac, Nanticoke, and Susquehanna, but has not been confirmed for any of those. There are anecdotal reports of increased sightings and captures of Atlantic sturgeon in the James River. However, this information has not been comprehensive enough to develop a population estimate for the James River or to provide sufficient evidence to confirm increased abundance. Some of the impact from the threats that facilitated the decline of the CB DPS have been removed (e.g., directed fishing) or reduced as a result of improvements in water quality since passage of the CWA. As described in Section 4.2.2, we have estimated that there are a minimum of 8,811 CB DPS adult and subadult Atlantic sturgeon of size vulnerable to capture in U.S. Atlantic waters.

Areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in U.S. state and federally-managed fisheries, Canadian fisheries, and vessel strikes remain significant threats to the CB DPS of Atlantic sturgeon. Of the 35% of Atlantic sturgeon incidentally caught in the Bay of Fundy, about 1% were CB DPS fish (Wirgin *et al.* 2012). Studies have shown that Atlantic sturgeon can only sustain low levels of bycatch mortality (Boreman 1997; ASMFC TC 2007; Kahnle *et al.* 2007). The CB DPS is currently at risk of extinction given (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect the potential for population recovery.

*4.2.2.4 Carolina DPS of Atlantic sturgeon*
The Carolina DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) from Albemarle Sound southward along the southern Virginia, North Carolina, and South Carolina coastal areas to Charleston Harbor. The marine range of Atlantic sturgeon from the Carolina DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the Carolina DPS and the adjacent portion of the marine range are shown in Figure 2. Sturgeon are commonly captured 40 miles offshore (Dewayne Fox, Delaware State University, pers. comm.). Records providing fishery bycatch data by depth show the vast majority of Atlantic sturgeon bycatch via gillnets is observed in waters less than 50 meters deep (Stein *et al*. 2004b, ASMFC TC 2007), but Atlantic sturgeon are recorded as bycatch out to 500 fathoms.

Rivers known to have current spawning populations within the range of the Carolina DPS include the Roanoke, Tar-Pamlico, Cape Fear, Waccamaw, and Pee Dee Rivers. We determined spawning was occurring if YOY were observed or mature adults were present in freshwater portions of a system (Table 10). However, in some rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development. There may also be spawning populations in the Neuse, Santee, and Cooper Rivers, though it is uncertain. Historically, both the Sampit and Ashley Rivers were documented to have spawning populations at one time. However, the spawning population in the Sampit River is believed to be extirpated, and the current status of the spawning population in the Ashley River is unknown. Both rivers may be used as nursery

habitat by young Atlantic sturgeon originating from other spawning populations. Fish from the Carolina DPS likely use other river systems than those listed here for their specific life functions.

Historical landings data indicate that between 7,000 and 10,500 adult female Atlantic sturgeon were present in North Carolina prior to 1890 (Armstrong and Hightower 2002; Secor 2002). Secor (2002) estimates that 8,000 adult females were present in South Carolina during that same time frame. Prior reductions from the commercial fishery and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the Carolina DPS. Currently, the Atlantic sturgeon spawning population in at least one river system within the Carolina DPS has been extirpated, with potential extirpation in an additional system. The abundances of the remaining river populations within the DPS, each estimated to have fewer than 300 spawning adults, are estimated to be less than 3% of what they were historically (ASSRT 2007). As described in Section 4.2.2, we have estimated that there are a minimum of 1,356 Carolina DPS adult and subadult Atlantic sturgeon of size vulnerable to capture in U.S. Atlantic waters.

**Table 10. Major rivers, tributaries, and sounds within the range of the Carolina DPS and currently available data on the presence of an Atlantic sturgeon spawning population in each system.**

| River/Estuary | Spawning Population | Data |
|---|---|---|
| Roanoke River, VA/NC; Albemarle Sound, NC | Yes | collection of 15 YOY (1997-1998); single YOY (2005) |
| Tar-Pamlico River, NC; Pamlico Sound | Yes | one YOY (2005) |
| Neuse River, NC; Pamlico Sound | Unknown | |
| Cape Fear River, NC | Yes | upstream migration of adults in the fall, carcass of a ripe female upstream in mid-September (2006) |
| Waccamaw River, SC; Winyah Bay | Yes | age-1, potentially YOY (1980s) |
| Pee Dee River, SC; Winyah Bay | Yes | running ripe male in Great Pee Dee River (2003) |
| Sampit, SC; Winyah Bay | Extirpated | |
| Santee River, SC | Unknown | |
| Cooper River, SC | Unknown | |
| Ashley River, SC | Unknown | |

*Threats*

The Carolina DPS was listed as endangered under the ESA as a result of a combination of habitat curtailment and modification, overutilization (i.e., being taken as bycatch) in commercial fisheries, and the inadequacy of regulatory mechanisms in ameliorating these impacts and threats.

The modification and curtailment of Atlantic sturgeon habitat resulting from dams, dredging, and degraded water quality is contributing to the status of the Carolina DPS. Dams have curtailed Atlantic sturgeon spawning and juvenile developmental habitat by blocking more than 60% of the historical sturgeon habitat upstream of the dams in the Cape Fear and Santee-Cooper River systems. Water quality (velocity, temperature, and dissolved oxygen) downstream of these dams, as well as on the Roanoke River, has been reduced, which modifies and curtails the extent of spawning and nursery habitat for the Carolina DPS. Dredging in spawning and nursery grounds modifies the quality of the habitat and is further curtailing the extent of available habitat in the Cape Fear and Cooper Rivers, where Atlantic sturgeon habitat has already been modified and curtailed by the presence of dams. Reductions in water quality from terrestrial activities have modified habitat used by the Carolina DPS. In the Pamlico and Neuse systems, nutrient-loading and seasonal anoxia are occurring, associated in part with concentrated animal feeding operations (CAFOs). Heavy industrial development and CAFOs have also degraded water quality in the Cape Fear River. Water quality in the Waccamaw and Pee Dee Rivers has been affected by industrialization and riverine sediment samples contain high levels of various toxins, including dioxins. Additional stressors arising from water allocation and climate change threaten to exacerbate water quality problems that are already present throughout the range of the Carolina DPS. Twenty interbasin water transfers in existence prior to 1993, averaging 66.5 million gallons per day (mgd), were authorized at their maximum levels without being subjected to an evaluation for certification by the North Carolina Department of Environmental and Natural Resources and other resource agencies. Since the 1993 legislation requiring certificates for transfers took effect, almost 170 mgd of interbasin water withdrawals have been authorized, with an additional 60 mgd pending certification. The removal of large amounts of water from the system will alter flows, temperature, and dissolved oxygen. Existing water allocation issues will likely be compounded by population growth and potentially climate change. Climate change is also predicted to elevate water temperatures and exacerbate nutrient-loading, pollution inputs, and lower dissolved oxygen, all of which are current stressors to the Carolina DPS.

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations in the Southeast in the mid- to late 19$^{th}$ century, from which they have never rebounded. Continued bycatch of Atlantic sturgeon in commercial fisheries is an ongoing impact to the Carolina DPS. More robust fishery independent data on bycatch are available for the Northeast and Mid-Atlantic than in the Southeast where high levels of bycatch underreporting are suspected.

Although there are statutory and regulatory regulations that authorize reducing the impact of dams on riverine and anadromous species, these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Water quality continues to be a problem in the Carolina DPS, even with existing controls on some pollution sources. Current regulatory regimes are not effective in controlling water allocation issues (e.g., no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution, etc.).

The recovery of Atlantic sturgeon along the Atlantic Coast, especially in areas where habitat is limited and water quality is severely degraded, will require improvements in the following areas: (1) elimination of barriers to spawning habitat either through dam removal, breaching, or

installation of successful fish passage facilities; (2) operation of water control structures to provide appropriate flows, especially during spawning season; (3) imposition of dredging restrictions including seasonal moratoriums and avoidance of spawning/nursery habitat; and (4) mitigation of water quality parameters that are restricting sturgeon use of a river (i.e., dissolved oxygen). Additional data regarding sturgeon use of riverine and estuarine environments are needed.

The concept of a viable population able to adapt to changing environmental conditions is critical to Atlantic sturgeon, and the low population numbers of every river population in the Carolina DPS put them in danger of extinction throughout their range; none of the populations are large or stable enough to provide with any level of certainty for the continued existence of Atlantic sturgeon in this part of its range. Although the largest impact that caused the precipitous decline of the species has been curtailed (directed fishing), the population sizes within the Carolina DPS have remained relatively constant at greatly reduced levels (approximately 3% of historical population sizes) for 100 years. Small numbers of individuals resulting from drastic reductions in populations, such as that which occurred due to the commercial fishery, can remove the buffer against natural demographic and environmental variability provided by large populations (Berry 1971; Soulé 1980; Shaffer 1981). Recovery of depleted populations is an inherently slow process for late-maturing species such as Atlantic sturgeon, and they continue to face a variety of other threats that contribute to their risk of extinction. Their late age at maturity provides more opportunities for individual Atlantic sturgeon to be removed from the population before reproducing. While a long life-span also allows multiple opportunities to contribute to future generations, it also increases the timeframe over which exposure to the multitude of threats facing the Carolina DPS can occur. The viability of the Carolina DPS depends on having multiple self-sustaining riverine spawning populations and maintaining suitable habitat to support the various life functions (spawning, feeding, growth) of Atlantic sturgeon populations.

*Summary of the Status of the Carolina DPS of Atlantic Sturgeon*

Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon. Their late age at maturity provides more opportunities for individuals to be removed from the population before reproducing. While a long life-span also allows multiple opportunities to contribute to future generations, this is hampered within the Carolina DPS by habitat alteration and bycatch. This DPS was severely depleted by past directed commercial fishing, and faces ongoing impacts and threats from habitat alteration or inaccessibility, bycatch, and the inadequacy of existing regulatory mechanisms to address and reduce habitat alterations and bycatch that have prevented river populations from rebounding and will prevent their recovery.

The presence of dams has resulted in the loss of more than 60% of the historical sturgeon habitat on the Cape Fear River and in the Santee-Cooper system. Dams are contributing to the status of the Carolina DPS by curtailing the extent of available spawning habitat and further modifying the remaining habitat downstream by affecting water quality parameters (such as depth, temperature, velocity, and dissolved oxygen) that are important to sturgeon. Dredging is also contributing to the status of the Carolina DPS by modifying Atlantic sturgeon spawning and nursery habitat. Habitat modifications through reductions in water quality are contributing to the status of the Carolina DPS due to nutrient-loading, seasonal anoxia, and contaminated sediments.

Interbasin water transfers and climate change threaten to exacerbate existing water quality issues. Bycatch is also a current threat to the Carolina DPS that is contributing to its status. Fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may use multiple river systems for nursery and foraging habitat in addition to their natal spawning river, they are subject to being caught in multiple fisheries throughout their range. In addition to direct mortality, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins). This may result in either reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality. While many of the threats to the Carolina DPS have been ameliorated or reduced due to existing regulatory mechanisms, such as the moratorium on directed fisheries for Atlantic sturgeon, bycatch and habitat alterations are currently not being addressed through existing mechanisms. Further, despite NMFS's authority under the Federal Power Act to prescribe fish passage and existing controls on some pollution sources, access to habitat and improved water quality continues to be a problem. The inadequacy of regulatory mechanisms to control bycatch and habitat alterations is contributing to the status of the Carolina DPS.

*4.2.2.5 South Atlantic DPS of Atlantic sturgeon*

The SA DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) of the Ashepoo, Combahee, and Edisto Rivers (ACE) Basin southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida. The marine range of Atlantic sturgeon from the SA DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the SA DPS and the adjacent portion of the marine range are shown in Figure 2. Sturgeon are commonly captured 40 miles offshore (Dewayne Fox, Delaware State University, pers. comm.). Records providing fishery bycatch data by depth show the vast majority of Atlantic sturgeon bycatch via gillnets is observed in waters less than 50 meters deep (Stein *et al.* 2004b, ASMFC TC 2007), but Atlantic sturgeon are recorded as bycatch out to 500 fathoms (900 meters).

Rivers known to have current spawning populations within the range of the South Atlantic DPS include the Combahee, Edisto, Savannah, Ogeechee, Altamaha, and Satilla Rivers. We determined spawning was occurring if YOY were observed, or mature adults were present, in freshwater portions of a system. However, in some rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development. Historically, the Broad-Coosawatchie was documented to have spawning populations; there is also evidence that spawning may have occurred in the St. Johns River or one of its tributaries. However, the historical spawning population present in the St. Johns is believed to be extirpated, and the status of the spawning population in the Broad-Coosawatchie is unknown. The St. Johns River is used as nursery habitat by young Atlantic sturgeon originating from other spawning populations. The use of the Broad-Coosawatchie by sturgeon from other spawning populations is unknown at this time. The presence of historical and current spawning populations in the Ashepoo River has not been documented; however, this river may currently be used for nursery habitat by young Atlantic sturgeon originating from other spawning populations. This represents our current knowledge of the river systems utilized by the South Atlantic DPS for specific life functions, such as spawning,

nursery habitat, and foraging; however, fish from the SA DPS likely use other river systems than those listed here for their specific life functions.

Secor (2002) estimates that 8,000 adult females were present in South Carolina before the 1890. Prior to the collapse of the fishery in the late 1800s, the sturgeon fishery was the third largest fishery in Georgia. Secor (2002) estimated from U.S. Fish Commission landing reports that approximately 11,000 spawning females were likely present in the state prior to 1890. Reductions from the commercial fishery and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the South Atlantic DPS. Currently, the Atlantic sturgeon spawning population in at least two river systems within the South Atlantic DPS has been extirpated. The Altamaha River population of Atlantic sturgeon, with an estimated 343 adults spawning annually, is believed to be the largest population in the Southeast, yet is estimated to be only 6 percent of its historical population size. The ASSRT estimated the abundances of the remaining river populations within the DPS, each estimated to have fewer than 300 spawning adults, to be less than 1 percent of what they were historically (ASSRT 2007).

*Threats*

The SA DPS was listed as endangered under the ESA as a result of a combination of habitat curtailment and modification, overuse (i.e., being taken as bycatch) in commercial fisheries, and the inadequacy of regulatory mechanisms in ameliorating these impacts and threats.

The modification and curtailment of Atlantic sturgeon habitat resulting from dredging and degraded water quality is contributing to the status of the SA DPS. Dredging is a present threat to the SA DPS and is contributing to its status by modifying the quality and availability of Atlantic sturgeon habitat. Maintenance dredging is currently modifying Atlantic sturgeon nursery habitat in the Savannah River and modeling indicates that the proposed deepening of the navigation channel will result in reduced dissolved oxygen and upriver movement of the salt wedge, curtailing spawning habitat. Dredging is also modifying nursery and foraging habitat in the St. Johns Rivers. Reductions in water quality from terrestrial activities have modified habitat used by the SA DPS. Low dissolved oxygen is modifying sturgeon habitat in the Savannah due to dredging, and non-point source inputs are causing low dissolved oxygen in the Ogeechee River and in the St. Marys River, which completely eliminates juvenile nursery habitat in summer. Low dissolved oxygen has also been observed in the St. Johns River in the summer. Sturgeon are more sensitive to low dissolved oxygen and the negative (metabolic, growth, and feeding) effects caused by it increase when water temperatures are concurrently high, as they are within the range of the SA DPS. Additional stressors arising from water allocation and climate change threaten to exacerbate water quality problems that are already present throughout the range of the SA DPS. Large withdrawals of over 240 million gallons per day mgd of water occur in the Savannah River for power generation and municipal uses. However, permits for users withdrawing less than 100,000 gallons per day (gpd) are not required to get permits, so actual water withdrawals from the Savannah and other rivers within the range of the SA DPS are unknown, but likely much higher. The removal of large amounts of water from the system will alter flows, temperature, and dissolved oxygen. Water shortages and “water wars” are already occurring in the rivers occupied by the SA DPS and will likely be compounded in the future by population growth and, potentially, by climate change. Climate change is also predicted to

elevate water temperatures and exacerbate nutrient-loading, pollution inputs, and lower dissolved oxygen, all of which are current stressors to the SA DPS.

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations in the Southeast, from which they have never rebounded. Further, continued overutilization of Atlantic sturgeon as bycatch in commercial fisheries is an ongoing impact to the South Atlantic DPS. The loss of large subadults and adults as a result of bycatch impacts Atlantic sturgeon populations because they are a long-lived species, have an older age at maturity, have lower maximum fecundity values, and a large percentage of egg production occurs later in life. Little data exists on bycatch in the Southeast and high levels of bycatch underreporting are suspected. Further, a total population abundance for the DPS is not available, and it is therefore not possible to calculate the percentage of the DPS subject to bycatch mortality based on the available bycatch mortality rates for individual fisheries. However, fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may access multiple river systems, they are subject to being caught in multiple fisheries throughout their range. In addition, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins and low DO). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

As a wide-ranging anadromous species, Atlantic sturgeon are subject to numerous Federal (U.S. and Canadian), state and provincial, and inter-jurisdictional laws, regulations, and agency activities. While these mechanisms have addressed impacts to Atlantic sturgeon through directed fisheries, there are currently no mechanisms in place to address the significant risk posed to Atlantic sturgeon from commercial bycatch. Though statutory and regulatory mechanisms exist that authorize reducing the impact of dams on riverine and anadromous species, such as Atlantic sturgeon, and their habitat, these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Further, water quality continues to be a problem in the South Atlantic DPS, even with existing controls on some pollution sources. Current regulatory regimes are not necessarily effective in controlling water allocation issues (e.g., no permit requirements for water withdrawals under 100,000 gpd in Georgia, no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution.)

The recovery of Atlantic sturgeon along the Atlantic coast, especially in areas where habitat is limited and water quality is severely degraded, will require improvements in the following areas: (1) elimination of barriers to spawning habitat either through dam removal, breaching, or installation of successful fish passage facilities; (2) operation of water control structures to provide appropriate flows, especially during spawning season; (3) imposition of dredging restrictions including seasonal moratoriums and avoidance of spawning/nursery habitat; and (4) mitigation of water quality parameters that are restricting sturgeon use of a river (i.e., dissolved oxygen). Additional data regarding sturgeon use of riverine and estuarine environments is needed.

A viable population able to adapt to changing environmental conditions is critical to Atlantic sturgeon, and the low population numbers of every river population in the South Atlantic DPS put them in danger of extinction throughout their range. None of the populations are large or stable enough to provide with any level of certainty for continued existence of Atlantic sturgeon in this part of its range. Although the largest impact that caused the precipitous decline of the species has been curtailed (directed fishing), the population sizes within the South Atlantic DPS have remained relatively constant at greatly reduced levels for 100 years. Small numbers of individuals resulting from drastic reductions in populations, such as occurred with Atlantic sturgeon due to the commercial fishery, can remove the buffer against natural demographic and environmental variability provided by large populations (Berry, 1971; Shaffer, 1981; Soulé, 1980). Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon, and they continue to face a variety of other threats that contribute to their risk of extinction. While a long life-span also allows multiple opportunities to contribute to future generations, it also increases the timeframe over which exposure to the multitude of threats facing the South Atlantic DPS can occur.

*Summary of the Status of the South Atlantic DPS of Atlantic Sturgeon*

The South Atlantic DPS is estimated to number a fraction of its historical abundance. There are an estimated 343 spawning adults per year in the Altamaha and less than 300 spawning adults per year (total of both sexes) in each of the other major river systems occupied by the DPS in which spawning still occurs, whose freshwater range occurs in the watersheds (including all rivers and tributaries) of the ACE Basin southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida. Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon. While a long life-span also allows multiple opportunities to contribute to future generations, this is hampered within the SA DPS by habitat alteration, bycatch, and from the inadequacy of existing regulatory mechanisms to address and reduce habitat alterations and bycatch.

Dredging is contributing to the status of the SA DPS by modifying spawning, nursery, and foraging habitat. Habitat modifications through reductions in water quality and dissolved oxygen are also contributing to the status of the SA DPS, particularly during times of high water temperatures, which increase the detrimental effects on Atlantic sturgeon habitat. Interbasin water transfers and climate change threaten to exacerbate existing water quality issues. Bycatch also contributes to the SA DPS's status. Fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may use multiple river systems for nursery and foraging habitat in addition to their natal spawning river, they are subject to being caught in multiple fisheries throughout their range. In addition to direct mortality, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality. While many of the threats to the SA DPS have been ameliorated or reduced due to the existing regulatory mechanisms, such as the moratorium on directed fisheries for Atlantic sturgeon, bycatch and habitat alteration are currently not being addressed through existing mechanisms. Further, access to habitat and good water quality continues to be a problem even with NMFS's authority under the Federal Power Act to prescribe fish passage and

existing controls on some pollution sources. There is a lack of regulation for some large water withdrawals, which threatens sturgeon habitat. Current regulatory regimes do not require a permit for water withdrawals under 100,000 gpd in Georgia and there are no restrictions on interbasin water transfers in South Carolina. Existing water allocation issues will likely be compounded by population growth, drought, and, potentially, climate change. The inadequacy of regulatory mechanisms to control bycatch and habitat alterations is contributing to the status of the SA DPS.

## 5.0 ENVIRONMENTAL BASELINE

Environmental baselines for biological opinions include the past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR § 402.02). The environmental baseline for this Opinion includes the effects of several activities that may affect the survival and recovery of the listed species in the action area. The activities that shape the environmental baseline in the action area of this consultation generally include: commercial and recreational fisheries, hopper dredging operations, sand mining and beach nourishment activities, commercial shipping and other vessel activities, military operations, scientific research, projects affecting water quality and pollution, global climate change, and recovery activities associated with reducing impacts to listed species.

### 5.1 Federal Actions that have Undergone Section 7 Consultation

We have undertaken a number of section 7 consultations to address the effects of Federal actions on threatened and endangered species in the action area. Each of those consultations sought to develop ways to reduce the probability of adverse impacts of the action on listed species.

#### *5.1.1 Authorization of Fisheries through Fishery Management Plans*

We authorize the operation of several nearshore fisheries in the action area under the authority of the Magnuson-Stevens Fishery Conservation Act and through FMPs and their implementing regulations. Commercial and recreational fisheries in the action area employ gear that is known to harass, injure, and/or kill sea turtles and Atlantic sturgeon.

In the Greater Atlantic Region (Maine through Virginia), a formal ESA section 7 consultation has been conducted on the batched Northeast multispecies, monkfish, spiny dogfish, Northeast skate complex, Atlantic bluefish, Atlantic mackerel/squid/butterfish, and summer flounder/scup/black sea bass fisheries, the last three of which may overlap in part with the action area for the proposed action. This consultation considered adverse effects to loggerhead, green, Kemp's ridley, and leatherback sea turtles. In the batched fisheries biological opinion, we concluded that the seven fisheries were likely to adversely affect but were not likely to jeopardize the continued existence of any sea turtle species. The biological opinion included an ITS exempting a certain amount of lethal or non-lethal take resulting from interactions with the fisheries. The ITS is summarized in the table below (Table 11).

**Table 11. Sea turtle incidental take information from the most recent NMFS GARFO Biological Opinion for seven federally managed fisheries, three of which (in bold) overlap with the action area.**

| Opinion | Date | Loggerhead | Kemp's ridley | Green | Leatherback |
|---|---|---|---|---|---|
| Northeast Multispecies, Monkfish, Spiny Dogfish, **Atlantic Bluefish**, Northeast Skate Complex, **Atlantic Mackerel/Squid/Butterfish**, and **Summer Flounder/ Scup/Black Sea Bass** (Batched Fisheries) | December 16, 2013 (ITS amended March 10, 2016) | 1,345 (835 lethal) every 5 years in gillnets; 1,020 (335 lethal) every 5 years in bottom trawls; 1 (lethal or non-lethal) annually in pot/trap gear | 4 (3 lethal) annually in gillnets; 3 (2 lethal) annually in bottom trawls | 4 (3 lethal) annually in gillnets; 3 (2 lethal) annually in bottom trawls | 4 (3 lethal) annually in gillnets; 4 (2 lethal) annually in bottom trawls; 4 (lethal or non-lethal) annually in pot/trap gear |

Although there are documented incidental takes of sea turtles in these Federal fisheries, the action area for them includes the entire EEZ along the U.S. Atlantic coast from Maine through Florida. The nearshore and coastal waters of Virginia and those inside Chesapeake Bay represent a tiny fraction of the action area assessed and for which interactions of sea turtles are anticipated in the batched fisheries biological opinion. Thus, the amount of incidental take of sea turtles that occurs in Virginia state waters as a result of Federal fisheries is also a tiny fraction of the amount exempted in that biological opinion. Furthermore, very little commercial and recreational fishing effort for those species occurs in Virginia state waters, and even less occurs within Chesapeake Bay. Scup and summer flounder have a larger state waters recreational component, but that effort is often prosecuted offshore and outside of the bay. In the batched fisheries biological opinion, we also concluded that the potential for interactions (i.e., vessel strikes) between sea turtles and fishing vessels was extremely low and similarly that any effects to their prey and/or habitat would be insignificant and discountable.

Atlantic sturgeon originating from each the five listed DPSs are known to be captured and killed in otter trawl, sink gillnet, and hook and line fisheries operating in the action area. At the time of this writing, the batched fisheries biological opinion covers Atlantic sturgeon interactions in the Greater Atlantic Region. As noted in the *Status of the Species* section above, the NEFSC prepared a bycatch estimate for Atlantic sturgeon captured in sink gillnet and otter trawl fisheries operated from Maine through Virginia. This estimate indicates that, based on data from 2006-2010, annually, an average of 3,118 Atlantic sturgeon are captured in these fisheries with 1,569 in sink gillnet and 1,548 in otter trawls. The mortality rate in sink gillnets is estimated at approximately 20% and the mortality rate in otter trawls is estimated at 5%. Based on this estimate, a total of 391 Atlantic sturgeon are estimated to be killed annually in these fisheries that are prosecuted in the Greater Atlantic Region. We are currently in the process of determining the effects of this annual loss to each of the DPSs. Again, nearshore and coastal waters of Virginia and those inside Chesapeake Bay represent a tiny fraction of the action area assessed and for which interactions of Atlantic sturgeon are anticipated in the batched fisheries Opinion. Nonetheless, any Federal fisheries that use sink gillnets, otter trawls, or hook and line gear are likely to interact with Atlantic sturgeon and be an additional, albeit minor, source of

incidental take and mortality in the action area. An updated Atlantic sturgeon bycatch estimate in Northeast sink gillnet and otter trawl fisheries for 2011-2015 was prepared in mid-2016 but is not yet publically available.

### *5.1.2 Hopper Dredging, Sand Mining, and Beach Nourishment*

The construction and maintenance of Federal navigation channels, sand mining ("borrow") activities, beach nourishment, and shoreline restoration/stabilization projects have been identified as sources of sea turtle and Atlantic sturgeon incidental take and mortality in the action area. The majority of these projects in the action area are authorized and carried out by the U.S. Army Corps of Engineers (USACE), with a few facility-specific ones overseen by the National Aeronautics and Space Administration (NASA) and U.S. Navy. In the action area, USACE projects are under the jurisdiction of the Norfolk District of the North Atlantic Division. From 1993-2017, hopper dredging projects in the Norfolk District have resulted in the recorded incidental take of 66 loggerheads, six Kemp's ridleys, one green, and four unidentified hard shell turtles. To date, nearly all of these interactions have occurred in nearshore coastal waters with very few interactions in the open ocean. Few interactions between hopper dredges and Atlantic sturgeon have been reported, with just two records documenting interactions between hopper dredges and Atlantic sturgeon in the action area (in Virginia near the Chesapeake Bay entrance).

We have completed several ESA section 7 consultations with you to consider effects of these dredging, sand mining, and nourishment projects on listed sea turtles and Atlantic sturgeon. Many of these consultations – including this one - are in the process of being reinitiated to consider effects to Atlantic sturgeon critical habitat. In our 2012 biological opinion, over the 50-year period of your maintenance dredging of the Chesapeake Bay entrance channels and use of sand borrow areas for beach nourishment from 2012-2062, we anticipated that up to 937 loggerhead (452 lethal), 275 Kemp's ridley (48 lethal), and 38 green (11 lethal) sea turtles would be incidentally taken. We also anticipated up to 800 Atlantic sturgeon would be incidentally taken during the same action over the same period.

Recently, the U.S. Navy's Dam Annex Shoreline Protection System Repairs operations and NASA's Wallops Island Shoreline Restoration/Infrastructure Protection Program were determined to cause the entrainment of up to one Atlantic sturgeon from any of the five DPSs for approximately every 9.4 million cubic yards of material removed from the borrow areas. This equated to one and two captures, respectively, from any of the five DPSs over the course of the two projects. Three additional biological opinions (two Navy projects and one ACOE project) were also completed in 2012 to assess Atlantic sturgeon interactions in dredging operations in the action area. Table 12 below provides information on biological opinions covering dredging, beach nourishment, and shoreline restoration/stabilization projects in the action area and the associated ITSs for sea turtles (unless otherwise noted, take estimates are per dredge cycle). Takes of sea turtles and Atlantic sturgeon during relocation trawling activities are also included in these consultations. Relocation trawling has been successful at temporarily displacing loggerhead, Kemp's ridley, leatherback, and green sea turtles from channels and nearshore mining areas in both the Atlantic and Gulf of Mexico during periods when hopper dredging was imminent or ongoing.

**Table 12. Information on NMFS GARFO consultations for dredging, nourishment, and shoreline restoration/stabilization projects that occur in the action area, and their ITSs for sea turtles.**

| Project | Date of Opinion | Loggerhead | Kemp's ridley | Green | Leatherback | Notes |
|---|---|---|---|---|---|---|
| U.S. Navy Shoreline Restoration and Protection Project, JEB Little Creek/ Fort Story, VA Beach | 7/13/2012 | 1 loggerhead or Kemp's ridley | | 0 | 0 | |
| U.S. Navy Shoreline Protection Sys Repairs, Naval Air Station Oceana, Dam Neck Annex, VA Beach | 7/20/2012 | 1 loggerhead or Kemp's ridley | | 0 | 0 | |
| NASA Wallops Isl Shoreline Restoration/ Infrastructure Protection Program | 8/3/2012 | up to 9 | no more than 1 | 0 | 0 | total takes over 50-year project life |
| ACOE Dredging of Chesapeake Bay Entrance Channels and Beach Nourishment | 10/16/2012 | 937 non-lethal captures, 452 mortalities | 275 non-lethal captures, 48 mortalities | 38 non-lethal captures, 11 mortalities | 0 | total takes over 50-year project life |
| | | Relocation Trawling: up to 938 captures (37 mortalities) of loggerheads, 275 captures (11 mortalities) of Kemp's ridleys, and 37 captures (2 mortalities) of green sea turtles | | | | |

### *5.1.3 Vessel Activity and Military Operations*

Potential sources of adverse effects to sea turtles and Atlantic sturgeon from Federal vessel operations in the action area include operations of the U.S. Navy (USN) and the U.S. Coast Guard (USCG), which maintain the largest Federal fleets, as well as the Bureau of Ocean Energy Management (BOEM), Maritime Administration (MARAD), Environmental Protection Agency (EPA), NOAA, and ACOE. We have conducted formal consultations with the USN, USCG, EPA, and NOAA on their vessel-based operations. We have also conducted section 7 consultations with BOEM and MARAD on vessel traffic related to energy projects in the Greater Atlantic Region and implemented conservation measures. Through the section 7 process, where applicable, we have and will continue to establish conservation measures for all these agency vessel operations to avoid or minimize adverse effects to listed species. To date, ocean-going vessels and military activities have not been identified as significant threats to Atlantic sturgeon.

However, the possibility exists for interactions between vessels and these species in marine, estuarine, and riverine environments. However, because of a lack of information on the effects of these activities on sturgeon, the discussion below focuses on sea turtles.

Although consultations on individual Navy and USCG activities have been completed, only a few formal consultations on overall military activities along the U.S. Atlantic coast have been completed at this time. In June 2009, we prepared a biological opinion on Navy activities in each of their four training range complexes along the U.S. Atlantic coast—Northeast, Virginia Capes, Cherry Point, and Jacksonville (NMFS 2009). The Virginia Capes Operating Area overlaps with the action area for this consultation. In August 2017, NMFS prepared an Opinion on the operation of the Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active (LFA) sonar onboard four Navy vessels (NMFS 2017). In addition, the following biological opinions for the Navy (NMFS 1996, 1997, 2008b) and USCG (NMFS 1995, 1998b) contain details on the scope of vessel operations for these agencies and the conservation measures that are being implemented as standard operating procedures. In the U.S. Atlantic, the operation of USCG boats and cutters is estimated to take no more than one individual sea turtle, of any species, per year (NMFS 1995).

Military activities such as ordnance detonation also affect listed species of sea turtles. A section 7 consultation was conducted in 1997 for Navy aerial bombing training in the ocean off the southeast U.S. coast, involving drops of live ordnance (500 and 1,000-lb bombs). The resulting biological opinion for this consultation determined that the activity was likely to adversely affect sea turtles but would not jeopardize their continued existence. In the ITS included within the biological opinion, these training activities were estimated to have the potential to injure or kill, annually, 84 loggerheads, 12 leatherbacks, and 12 greens or Kemp's ridleys, in combination (NMFS 1997).

We have also conducted recent section 7 consultations on Navy explosive ordnance disposal, mine warfare, sonar testing (e.g., AFTT, SURTASS LFA), and other major training exercises (e.g., bombing, Naval gunfire, combat search and rescue, anti-submarine warfare, and torpedo and missile exercises) in the Atlantic Ocean. These consultations have determined that the proposed Navy activities may adversely affect but would not jeopardize the continued existence of ESA-listed sea turtles (NMFS 2008b, 2009, 2017). We estimated that five loggerhead and six Kemp's ridley sea turtles were likely to be harmed as a result of training activities in the Virginia Capes Range Complex from June 2009 to June 2010, and that nearly 1,500 sea turtles, including ten leatherbacks, were likely to experience harassment (NMFS 2009). For SURTASS LFA sonar testing, we were unable to estimate the number of sea turtles of each species occurring in USN mission areas that could be incidentally taken, although all takes were expected to result in behavioral harassment rather than serious injury or mortality (NMFS 2017).

Similarly, operations of vessels by other Federal agencies within the action area (BOEM, MARAD, EPA, and ACOE) may adversely affect sea turtles and Atlantic sturgeon. However, vessel activities of those agencies are often limited in scope, as they operate a limited number of vessels or are engaged in research/operational activities that are unlikely to contribute a significant amount of risk.

### *5.1.4 Research and Other Permitted Activities*

Research activities either conducted or funded by Federal agencies within the action area may adversely affect ESA-listed sea turtles and fish, and may require a section 7 consultation. Several section 7 consultations on research activities have recently been completed, as described below.

*Fish Surveys funded by the USFWS*

USFWS Region 5 provides funds to 13 states and the District of Columbia under the Dingell-Johnson Sport Fish Restoration Grant program and the State Wildlife Grant Program. Vermont and West Virginia are the only two Northeast states that do not use these funds to conduct ongoing surveys in marine, estuarine or riverine waters where NMFS listed species are present. The eleven other states (Maine, New Hampshire, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia) and the District of Columbia carry out a total of approximately 80-90 studies, mostly on an annual basis. There are several broad categories of fisheries surveys including: hook and line; beach seine; bottom trawl; fishway trap; boat electrofishing; long line; fyke net; gill net; haul seine; push net; and, backpack electrofishing. These surveys occur in state waters (rivers, estuaries, and in nearshore ocean waters), generally from Maine through Virginia, with several studies occurring in Virginia state waters including juvenile fish trawl surveys, juvenile striped bass beach seine surveys, and the Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP) surveys. These surveys have resulted in the non-lethal capture of both sea turtles (eight loggerheads and one Kemp's ridley) and Atlantic sturgeon (seven total) since 2013.

We completed a biological opinion in 2013 which bundled the eleven independent actions carried out by USFWS (i.e., awarding of each grant fund to each state is an independent action). The biological opinion provides an ITS by activity and provided a summary by state. Overall, we anticipate that the surveys described in the biological opinion, to be funded by USFWS and carried out by the states will result in the capture of up to two sea turtles of any species and 140 Atlantic sturgeon (no more than three lethal) over a five-year period. The only mortalities that we anticipate for Virginia state waters are three Atlantic sturgeon (originating from any of the five DPSs) during striped bass and shad gillnet surveys in the action area.

*Section 10(a)(1)(A) Permits*

We have issued additional research permits under section 10(a)(1)(A) of the ESA, which authorizes activities for scientific purposes or to enhance the propagation or survival of the affected species. The permitted activities do not operate to the disadvantage of the species and are consistent with the purposes of the ESA, as outlined in section 2 of the Act. A total of 13 section 10(a)(1)(A) permits are currently in effect for sea turtles and Atlantic sturgeon within the action area for this consultation.

*Section 10(a)(1)(B) Permits*

Section 10(a)(1)(B) of the ESA authorizes us, under some circumstances, to permit non-Federal parties to take otherwise prohibited fish and wildlife if such taking is "incidental to, and not the purpose of carrying out otherwise lawful activities" (50 CFR 217-222). As a condition for issuance of a permit, the permit applicant must develop a conservation plan that minimizes negative impacts to the species. There are currently no active Section 10(a)(1)(B) permits in the

action area for this consultation, although on August 14, 2017, we published a notice in the Federal Register announcing the receipt of an application from Dominion Virginia Power for a section 10(a)(1)(B) permit, which is discussed in more detail below. In addition, most coastal Atlantic states are either in the process of applying for permits or considering applications for state fisheries. Active permits and permit applications are posted online for all ESA-listed species as they become available at http://www.nmfs.noaa.gov/pr/permits/esa_review.htm.

### *5.1.5 Coal Burning Power Stations*

*Chesterfield Power Station – James River*

The Chesterfield Power Station (CPS) is a coal-fired power plant operated by Dominion Virginia Power (Dominion). The CPS began operations in 1945 and has been operating at its current level since 1992. The station is located at river mile 82 (RKM 132 of the James River in Chesterfield, VA. The six power-generating units at CPS utilize a once-through cooling water system that withdraws water directly from the James River though five cooling water intake structures. The operation of the CPS has resulted in the take of Atlantic sturgeon. An Atlantic sturgeon presumed to be an adult based on its size (no measurements available), was impinged on "trash racks" of the CPS on October 3, 2015. The sturgeon was injured, but returned alive to the James River. Also in October 2015, two yolk-sac Atlantic sturgeon larvae were captured during entrainment sampling conducted pursuat to section 316(b) of the Clean Water Act. After the incidental take of the two larvae, Dominion suspended entrainment sampling on March 2, 2016, prior to the spring spawning of Atlantic sturgeon in the Jams River. On April 10, 2017, we received a complete application from Dominion requesting an Incidental Take Permit (ITP) to take Atlantic sturgeon over a 10-year period. Dominion estimates the take of up to 846 Atlantic sturgeon per year from the Cheseapeake Bay DPS due to entrainment in the CPS cooling water intakes. Dominion also estimates the take of up to two juvenile, sub-adult, or adult Atlantic sturgeon from the Chesapeake Bay DPS over a 10-year period as a result of impingement at the CPS intakes.

## 5.2 Non-Federally Regulated Fisheries

Sea turtles and Atlantic sturgeon may be vulnerable to capture, injury, and mortality in fisheries occurring in Virginia state waters. Information on the number of sea turtles and Atlantic sturgeon captured or killed in Virginia state fisheries is extremely limited and as such, efforts are currently underway to obtain more information on the numbers of these species captured and killed in state water fisheries. We are currently working with the Northeast Fisheries Observer Program (NEFOP), Atlantic States Marine Fisheries Commission (ASMFC), the Virginia Marine Resources Commission (VMRC), and the Virginia Aquarium and Marine Science Center to assess the impacts of state authorized fisheries on sea turtles and Atlantic sturgeon. We are also currently working with Virginia on applications for ESA section 10(a)(1)(B) Incidental Take Permits to cover their fisheries; however, to date, no permit applications have been submitted. Below, we discuss the different fisheries authorized by the state of Virginia and any available information on interactions between these fisheries and sea turtles/Atlantic sturgeon.

*American eel fishery*

American eel is exploited in fresh, brackish, and coastal waters from the southern tip of Greenland to northeastern South America. Eel fisheries are conducted primarily in tidal and

inland waters. Eels are typically caught with hook and line or with eel traps and may also be caught with fyke nets. Sturgeon and sea turtles are not known to interact with the eel fishery.

*Atlantic croaker fishery*
An Atlantic croaker fishery using trawl and gillnet gear also occurs within the action area and sea turtle interactions have been observed in the fishery. The average annual bycatch of loggerhead sea turtles in bottom otter trawl gear used in the Atlantic croaker fishery was estimated to be 92 loggerhead sea turtles (with a 95% CI of 63-121) from 2009-2013 (Murray 2015a). Additional information on sea turtle interactions with gillnet gear used in the Atlantic croaker fishery has also been recently published by Murray (2013). The average annual bycatch of loggerhead sea turtles in gillnet gear used in the Atlantic croaker fishery, based on VTR data from 2007-2011, was estimated to be 6 per year with a 95% CI of 2-10 (Murray 2013). These estimates encompass the bycatch of loggerheads in the Atlantic croaker fishery in both state and Federal waters.

Atlantic sturgeon interactions have also been observed in the Atlantic croaker fishery, but a quantitative assessment of the number of Atlantic sturgeon captured in the croaker fishery is not available. A mortality rate of Atlantic sturgeon in commercial trawls has been estimated at 5%. A review of the NEFOP database indicates that from 2006-2010, 60 Atlantic sturgeon (out of a total of 726 observed interactions) were captured during observed trips where the trip target was identified as croaker. This represents a minimum number of Atlantic sturgeon captured in the croaker fishery during this time period as it only considers trips that included a NEFOP observer onboard.

*Weakfish fishery*
The weakfish fishery occurs in both state and Federal waters, but the majority of commercially and recreationally caught weakfish are caught in state waters (ASMFC 2002). The dominant commercial gears include gillnets, pound nets, haul seines, flynets, and trawls, with the majority of landings occurring in the fall and winter months (ASMFC 2002). Weakfish landings were dominated by the trawl fishery through the mid-1980s, after which gillnet landings began to account for most weakfish landed (ASMFC 2002). Virginia has ranked second among U.S. Atlantic states in annual landings since 1972 (ASMFC 2002). Sea turtle bycatch in the weakfish fishery has occurred (Murray 2013, 2015a) and NMFS originally assessed the impacts of the fishery on sea turtles in an Opinion in 1997 (NMFS 1997b). Currently, the average annual bycatch of loggerhead sea turtles in bottom otter trawl gear used in the weakfish fishery is estimated to be 0 loggerheads (with a 95% CI of 0-1) from 2009-2013 (Murray 2015a). Additional information on loggerhead sea turtle interactions with gillnet gear has also been recently published by Murray (2009a, 2009b). The average annual bycatch of loggerhead sea turtles in gillnet gear used in the weakfish fishery, based on VTR data from 2002-2006, was estimated to be one per year with a 95% CI of 0-1 (Murray 2009b), although the more recent Murray (2013) gillnet bycatch estimate for 2007-2011 does not include a loggerhead bycatch estimate for the weakfish gillnet fishery. These estimates encompass the bycatch of loggerheads in the weakfish fishery in both state and Federal waters.

A quantitative assessment of the number of Atlantic sturgeon captured in the weakfish fishery is not available. A mortality rate of Atlantic sturgeon in commercial trawls has been estimated at

5%. A review of the NEFOP observer database indicates that from 2006-2010, 36 Atlantic sturgeon (out of a total of 726 observed interactions) were captured during observed trips where the trip target was identified as weakfish. This represents a minimum number of Atlantic sturgeon captured in the weakfish fishery during this time period as it only considers observed trips, and most inshore fisheries are not observed. An earlier review of bycatch rates and landings for the weakfish fishery reported that the weakfish-striped bass fishery had an Atlantic sturgeon bycatch rate of 16% from 1989-2000; the weakfish-Atlantic croaker fishery had an Atlantic sturgeon bycatch rate of 0.02%, and the weakfish fishery had an Atlantic sturgeon bycatch rate of 1.0% (ASSRT 2007).

*Whelk fishery*

A whelk fishery using pot/trap gear is known to occur in Virginia waters of Chesapeake Bay. Whelk pots, which unlike lobster traps are not fully enclosed, have been suggested as a potential source of entrapment for loggerhead sea turtles that may be enticed to enter the trap to get the bait or whelks caught in the trap (Mansfield *et al*. 2001). Loggerhead, leatherback, and green sea turtles are known to become entangled in lines associated with pot/trap gear used in several fisheries including lobster, whelk, and crab species (SEFSC 2001; Dwyer *et al*. 2002: NMFS 2007b). Whelk fisheries in Virginia have been verified as the fisheries involved in a handful of loggerhead, leatherback, and green sea turtle entanglements since 2001, averaging around one per year (Northeast Region Sea Turtle Disentanglement Network [STDN] database). Whelk pots are not known to interact with Atlantic sturgeon.

*Crab fisheries*

Various crab fisheries, such as horseshoe crab and blue crab, also occur in Virginia state waters. Loggerhead, leatherback, and green sea turtles are known to become entangled in lines associated with pot/trap gear used in several fisheries including lobster, whelk, and crab species (SEFSC 2001; Dwyer *et al*. 2002: NMFS 2007b). The Virginia blue crab fishery has been verified as the fishery involved in a handful of loggerhead and leatherback sea turtle entanglements since 2001 (Northeast Region STDN database). In 2017, crab fisheries in Virginia accounted for two live and possibly one dead leatherbacks entangled in vertical lines of the gear.

The crab fisheries may have detrimental impacts on sea turtles beyond entanglement in the fishing gear itself. Loggerheads are known to prey on crab species, including horseshoe and blue crabs. In a study of the diet of loggerhead sea turtles in Virginia waters from 1983 to 2002, Seney and Musick (2007) found a shift in the diet of loggerheads in the area from horseshoe and blue crabs to fish, particularly menhaden and Atlantic croaker. The authors suggested that a decline in the crab species have resulted in the shift and loggerheads are likely foraging on fish captured in fishing nets or on discarded fishery bycatch (Seney and Musick 2007). The physiological impacts of this shift are uncertain although it was suggested as a possible explanation for the declines in loggerhead abundance noted by Mansfield (2006). Other studies have detected seasonal declines in loggerhead abundance coincident with seasonal declines of horseshoe and blue crabs in the same area (Maier *et al*. 2005). While there is no evidence of a decline in horseshoe crab abundance in the Southeast during the period 1995-2003, declines were evident in some parts of the Mid-Atlantic (ASMFC 2004; Eyler *et al*. 2007). Given the variety of loggerheads prey items (Dodd 1988; Burke *et al*. 1993; Bjorndal 1997; Morreale and Standora

1998) and the differences in regional abundance of horseshoe crabs and other prey items (ASMFC 2004; Eyler *et al*. 2007), a direct correlation between loggerhead sea turtle abundance and horseshoe crab and blue crab availability cannot be made at this time. Nevertheless, the decline in loggerhead abundance in Virginia waters (Mansfield 2006), coincident with noted declines in the abundance of horseshoe crab and other crab species, raises concerns that crab fisheries may be impacting the forage base for loggerheads in some areas of their range.

Atlantic sturgeon are known to be caught in state water horseshoe crab fisheries, which currently operate in all Northeast U.S. states except New Jersey. Along the U.S. East Coast, hand, trawl, and dredge fisheries account for more than 85% of the commercial horseshoe crab landings in the bait fishery. Other methods used are gillnets, pound nets, and traps (ASMFC 2011a). State waters from Delaware to Virginia are closed to horseshoe crab harvest and landing from January 1 to June 7 (ASMFC 2011a). The majority of horseshoe crab landings in 2010 came from Massachusetts, Virginia, and Delaware. Stein *et al*. (2004) examined bycatch of Atlantic sturgeon using the NMFS sea-sampling/observer database (1989-2000) and found that the bycatch rate for horseshoe crabs was low, at 0.05%. An Atlantic sturgeon "reward program," where commercial fishermen were provided monetary rewards for reporting captures of Atlantic sturgeon in the Maryland waters of Chesapeake Bay, operated from 1996 to 2012 (Mangold *et al*. 2007).[9] The data from this program during the 11-year period of 1996-2006 show that one of 1,395 wild Atlantic sturgeon was found caught in a crab pot (Mangold *et al*. 2007).

*Fish trap, seine, and channel net fisheries*

Incidental captures of loggerheads in fish traps have been reported from several states along the U.S. Atlantic coast (Shoop and Ruckdeschel 1989; W. Teas, NMFS, pers. comm.), while leatherbacks have been documented as entangled in the buoy line systems of conch and sea bass traps off Massachusetts (Northeast Region STDN database). Long haul seines, purse seines, and channel nets are also known to incidentally capture sea turtles in sounds and other inshore waters along the U.S. Atlantic coast, although no lethal interactions have been reported (SEFSC 2001). No information on interactions between Atlantic sturgeon and fish traps, long haul seines, purse seines, or channel nets is currently available; however, depending on where this gear is set and the mesh size, the potential exists for Atlantic sturgeon to be entangled or captured in this gear.

*Striped bass fishery*

The striped bass fishery occurs in only in state waters, as Federal waters have been closed to the harvest and possession of striped bass since 1990, except that possession is allowed in a defined area around Block Island, Rhode Island (ASMFC 2011b). The ASMFC has managed striped bass since 1981, and provides guidance to states from Maine to North Carolina through an ISFMP. All states are required to have recreational and commercial size limits, recreational creel limits, and commercial quotas. The commercial striped bass fishery is closed in Maine, New Hampshire, and Connecticut, but open in Massachusetts (hook and line only), Rhode Island, New Jersey (hook and line only), Delaware, Maryland, Virginia, and North Carolina. Recreational striped bass fishing occurs all along the U.S. East Coast.

Several states have reported incidental catch of Atlantic sturgeon (NMFS Sturgeon Workshop 2011). Data from the Atlantic Coast Sturgeon Tagging Database (2000-2004) shows that the

[9] The program was terminated in February 2012, with the listing of Atlantic sturgeon under the ESA.

striped bass fishery accounted for 43% of Atlantic sturgeon recaptures (ASSRT 2007). The striped bass-weakfish fishery also had one of the highest bycatch rates of 30 directed fisheries according to NMFS Observer Program data from 1989-2000 (ASSRT 2007). However, greater rates of bycatch do not necessarily translate into high mortality rates. Other factors, such as gear, season, and soak times, may be important variables in understanding Atlantic sturgeon mortality.

*State gillnet fisheries*

Two 10- to 14-inch (25.6- to 35.9-centimeter) mesh gillnet fisheries, the black drum and sandbar shark gillnet fisheries, occur in Virginia state waters along the tip of the eastern shore. Given the gear type, these fisheries may capture or entangle sea turtles. Entanglements of sea turtles in gillnet sets targeting and/or landing both species have been recorded in the NEFOP database. Similarly, sea turtles are thought to be vulnerable to capture in small mesh gillnet fisheries occurring in Virginia state waters. During May-June 2001, NMFS observed 2% of the Atlantic croaker fishery and 12% of the dogfish fishery (which represent approximately 82% of Virginia's total small mesh gillnet landings from offshore and inshore waters during this time), yet no sea turtle captures were observed (NMFS 2004c). Based on gear type (i.e., gillnets), it is likely that Atlantic sturgeon would be vulnerable to capture in these fisheries. An Atlantic sturgeon "reward program" where fishermen were provided monetary rewards for reporting captures of Atlantic sturgeon, operated in the late 1990s in Virginia. The majority of reports of Atlantic sturgeon captures were in drift gillnets and pound nets. No quantitative information on the number of Atlantic sturgeon captured or killed in Virginia fisheries is currently available.

*Poundnet Fishery*

This fishery is managed by the states, except for regulations NMFS issued under the authority of the ESA to protect sea turtles. Pound nets with large mesh and stringer leaders set in the Chesapeake Bay have been observed to lethally take turtles as a result of entanglement in the leader. Virginia sea turtle strandings during the spring are consistently high, and given the best available information, including observer reports, the nature and location of the turtle strandings, the type of fishing gear in the vicinity of the greatest number of strandings, and the known interactions between sea turtles and large mesh and stringer pound net leaders, pound nets were considered to be a likely contributor to high sea turtle strandings in 2001 (and likely every spring). NMFS conducted pound net monitoring during the spring of 2002 and 2003. This monitoring documented 23 sea turtles either entangled in or impinged on pound net leaders, 18 of which were in leaders with less than 12 inches (30.5 cm) stretched mesh. Nine animals were found entangled in leaders, of which 7 were dead, and 14 animals were found impinged on leaders, of which one was dead. In this situation, impingement refers to a sea turtle being held against the leader by the current, apparently unable to release itself under its own ability.

In 2004 and 2005, NMFS implemented a coordinated research program with pound net industry participants and other interested parties to develop and test a modified pound net leader design with the goal of eliminating or reducing sea turtle interactions while retaining an acceptable level of fish catch. During the 2-year study, the modified leader was found effective in reducing sea turtle interactions as compared to the unmodified leader. The final results of the 2004 study found that out of eight turtles impinged on or entangled in pound net leaders, seven were in an unmodified leader. One leatherback turtle was found entangled in the vertical lines of a modified leader. In response to the leatherback entanglement, the gear was further modified by increasing

the stiffness of the vertical lines for the 2005 experiment. In 2005, 15 turtles entangled in or impinged on the leaders of unmodified leaders, and no turtles were found entangled in or impinged on modified leaders. In addition, there have been documented interactions between pound nets and Atlantic sturgeon; however, neither an interaction rate or mortality rate is currently available.

On February 9, 2015, we published a final rule amending the Bottlenose Dolphin Take Reduction Plan (BDTRP) and its implementing regulations under the Marine Mammal Protection Act (MMPA) to require year-round use of modified leaders for offshore Virginia pound nets in specified waters of the lower mainstem Chesapeake Bay and coastal state waters (80 FR 6925). Seasonality of modified leader use as previously required under the ESA regulations remains in place. Under both the MMPA and ESA, the final rule also included a one-time compliance training for fishermen using modified leaders, new and revised Virginia pound net-related definitions, and requirements to fish all sections of the gear at the same time.

The modified pound net leader regulations issued in the early 2000s reduced the number of interactions compared to the time period before the regulations were in place. To date, only leatherback sea turtles have been documented as entangled in modified pound net leaders in Virginia waters, and all of them but one have occurred in the Cape Henry area of Chesapeake Bay. Sixteen leader entanglements have been documented from 2013-2017, with two of those being lethal. The VMRC also disentangled an unidentified sea turtle in an inshore leader in September 2017. Atlantic sturgeon are known to become entrapped in pound nets and were routinely observed in Maryland waters, primarily through the USFWS reward program (U.S. FWS 2007). We have only anecdotal reports of Atlantic sturgeon entrapped in pound nets in Virginia.

We completed a biological opinion in 2018 on the gear regulations implemented by NMFS for the pound net fishery operating in nearshore coastal and estuarine waters of Virginia, including waters inside Chesapeake Bay. The biological opinion provides an ITS, which exempts the annual incidental take by entrapment, impingement, or entanglement of sea turtles and Atlantic sturgeon. Overall, we anticipate that the activities described in the biological opinion, will result in the take of up to 806 loggerhead sea turtles (up to 2 lethal), 162 Kemp's ridley sea turtles (up to 2 lethal), 17 green sea turtles (up to 2 lethal), 8 leatherback sea turtles (up to 4 lethal), and 13 Atlantic sturgeon (up to 1 lethal).

*State recreational fisheries*

Observations of state recreational fisheries in Virginia have shown that loggerhead, leatherback, Kemp's ridley, and green sea turtles are known to bite baited hooks, and loggerheads frequently ingest the hooks. Hooked sea turtles have been reported by the public fishing from boats, piers, beaches, banks, and jetties, and from commercial fishermen fishing with both single rigs and bottom longlines (SEFSC 2001). A summary of known impacts of hook-and-line captures on loggerhead sea turtles can be found in the TEWG (1998, 2000, 2009) reports. Stranding data also provide some evidence of interactions between recreational hook-and-line gear and sea turtles, but assigning the gear to a specific fishery is rarely, if ever, possible. In 2017, the Northeast STDN documented one dead Kemp's ridley sea turtle in Virginia waters with a circle hook in its mouth and wrapped around the neck in monofilament line, strong indications that a recreational fisherman may have been at fault.

Atlantic sturgeon have also been observed captured in hook-and-line gear, yet the number of interactions that occur annually is unknown. While most Atlantic sturgeon are likely to be released alive, we currently have no information on post-release survival. Although we do not currently have adequate information to quantifly the level of take that occurs in state fisheries due to the lack of a the federal nexus, we expect that take does occur and will continue to occur into the future. NMFS is currently working on a project to assess the extent of sea turtle interactions that occur in recreational fisheries of the Southeast (North Carolina to Florida) and believes that the survey platform and questionnaire may also be applicable for determining the amount of Atlantic sturgeon interactions as well.

## 5.3 Other Activities

### *5.3.1 Maritime Industry*

Private and commercial vessels, including fishing vessels, operating in the action area of this consultation also have the potential to interact with sea turtles and Atlantic sturgeon. The effects of fishing vessels, recreational vessels, or other types of commercial vessels on ESA-listed species may involve disturbance or injury/mortality due to collisions or entanglement in anchor lines. During 2007-2010, researchers documented 31 carcasses of adult Atlantic sturgeon in the tidal freshwater portion of the James River, Virginia. Twenty-six of the carcasses had gashes from vessel propellers, and the remaining five carcasses were too decomposed to allow determination of the cause of death. The types of vessels responsible for these mortalities were not explicitly demonstrated. Most (84%) of the carcasses were found in a relatively narrow reach that was modified to increase shipping efficiency (Balazik *et al*. 2012). Listed species may also be affected by fuel oil spills resulting from vessel accidents. Fuel oil spills could affect animals through the food chain. However, these spills typically involve small amounts of material that are unlikely to adversely affect listed species. Larger oil spills may result from severe accidents, although these events would be rare and involve small areas. No direct adverse effects on listed sea turtles and Atlantic sturgeon resulting from fishing vessel fuel spills have been documented.

### *5.3.2 Pollution*

Anthropogenic sources of marine pollution, while difficult to attribute to a specific Federal, state, local, or private action, may affect sea turtles and Atlantic sturgeon in the action area. Sources of pollutants in the action area include atmospheric loading of pollutants such as PCBs; storm water runoff from coastal towns, cities, and villages; runoff into rivers emptying into bays; groundwater discharges; wastewater and sewage treatment plant effluents; and oil spills. The pathological effects of oil spills on sea turtles have been documented in several laboratory studies (Vargo *et al.* 1986). Nutrient loading from land-based sources, such as coastal communities and agricultural operations, is known to stimulate plankton blooms in closed or semi-closed estuarine systems. The effect to larger embayments is unknown. Contaminants could degrade habitat if pollution and other factors reduce the food available to sea turtles and Atlantic sturgeon. The effects from pollution are long term and ongoing.

### *5.3.3 Coastal Development*

Beachfront development, lighting, and beach erosion control all are ongoing activities along the Mid- and South Atlantic coastlines of the U.S. These activities potentially reduce or degrade sea turtle nesting habitats or interfere with hatchling movement to sea. Nocturnal human activities along nesting beaches may also discourage sea turtles from nesting sites. The extent to which these activities reduce sea turtle nesting and hatchling production is unknown. However, more and more coastal counties are adopting stringent protective measures to protect hatchling sea turtles from the disorienting effects of beach lighting. Coastal development may also impact sea turtles and Atlantic sturgeon if it disturbs or degrades foraging habitats or otherwise affects the ability of these species to use coastal habitats. At present, only limited nesting of sea turtles occurs on Virginia beaches, primarily in the southernmost part of the state. Virginia represents the northernmost extreme of loggerhead sea turtle nesting along the U.S. Atlantic coast. From 1970-2015, 166 loggerhead nests have been documented on Virginia's ocean-facing beaches. The state's first and only green sea turtle nest was reported in 2005 and its first and second Kemp's ridley nests were documented in 2012 and 2014, respectively (Virginia DGIF 2016).

### *5.3.4 Global Climate Change and Ocean Acidification*

In addition to the information on climate change presented in the *Status of the Species* section for sea turtles and Atlantic sturgeon, the discussion below presents further background information on global climate change as well as past and projected effects of global climate change throughout the range of the ESA-listed species considered in this Opinion. Below is the available information on projected effects of climate change in the action area and how listed sea turtles and Atlantic sturgeon may be affected by those projected environmental changes. The effects are summarized on the time span of the proposed action, for which we can realistically analyze impacts, yet are discussed and considered for longer time periods when feasible.

In its Fifth Assessment Report (AR5) from 2013, the Intergovernmental Panel on Climate Change (IPCC) stated that the globally averaged combined land and ocean surface temperature data has shown a warming of 0.85°C (likely range: 0.65° to 1.06°C) over the period of 1880-2012. Similarly, the total increase between the average of the 1850-1900 period and the 2003-2012 period is 0.78°C (likely range: 0.72° to 0.85°C). On a global scale, ocean warming has been largest near the surface, with the upper 75 meters of the world's oceans having warmed by 0.11°C (likely range: 0.09° to 0.13°C) per decade over the period of 1971-2010 (IPCC 2013). The mean rate of global averaged sea level rise was 1.7 millimeters/year (likely range: 1.5 to 1.9 millimeters/year) between 1901 and 2010, 2.0 millimeters/year (likely range: 1.7 to 2.3 millimeters/year) between 1971 and 2010, and 3.2 millimeters/year (likely range: 2.8 to 3.6 millimeters/year) between 1993 and 2010.

Climate model projections exhibit a wide range of plausible scenarios for both temperature and precipitation over the next several decades. The global mean surface temperature change for the period 2016-2035 relative to 1986-2005 will likely be in the range of 0.3° to 0.7°C (medium confidence). This assessment is based on multiple lines of evidence and assumes there will be no major volcanic eruptions or secular changes in total solar irradiance. Relative to natural internal variability, near-term increases in seasonal mean and annual mean temperatures are expected to be larger in the tropics and subtropics than in mid- and high latitudes (high confidence). This temperature increase will very likely be associated with more extreme

precipitation and faster evaporation of water, leading to greater frequency of both very wet and very dry conditions. Climate warming has also resulted in increased river discharge and glacial and sea-ice melting (Greene *et al.* 2008). The strongest ocean warming is projected for the surface in tropical and Northern Hemisphere subtropical regions. At greater depths, the warming will be most pronounced in the Southern Ocean (high confidence). Best estimates of ocean warming in the top 100 meters are about 0.6° to 2.0°C, and about 0.3° to 0.6°C at a depth of about 1,000 meters by the end of the 21st century (IPCC 2013).

Under Representative Concentration Pathway (RCP) 8.5, the climate change scenario where emission levels continue to rise throughout the 21st century, the projected change in global mean surface air temperature and global mean sea level rise for the mid- and late 21st century relative to the reference period of 1986-2005 is as follows. Global average surface temperatures are likely to be 2.0°C higher (likely range: 1.4° to 2.6°C) from 2046-2065 and 3.7°C higher (likely range: 2.6° to 4.8°C) from 2081-2100. Global mean sea levels are likely to be 0.30 meters higher (likely range: 0.22 to 0.38 meters) from 2046-2065 and 0.63 meters higher (likely range: 0.45 to 0.82 meters) from 2081-2100, with a rate of sea level rise during 2081-2100 of 8 to 16 millimeters/year (medium confidence). There is uncertainty about the magnitude of global sea level rise, projected to rise .30 to 1.22 meters by 2100, as it is primarily dependent on the dynamics of ice sheet melting (Melillo *et al.*, 2014).

The past three decades have witnessed major changes in ocean circulation patterns in the Arctic, and these were accompanied by climate associated changes as well (Greene *et al.* 2008). Shifts in atmospheric conditions have altered Arctic Ocean circulation patterns and the export of freshwater to the North Atlantic (IPCC 2007; Greene *et al.* 2008). With respect specifically to the North Atlantic Oscillation (NAO), changes in salinity and temperature are thought to be the result of changes in the Earth's atmosphere caused by anthropogenic forces (IPCC 2007). The NAO impacts climate variability throughout the Northern Hemisphere (IPCC 2007). Data from the 1960s through the 2000s showed that the NAO index increased from minimum values in the 1960s to strongly positive index values in the 1990s and somewhat declined since (IPCC 2007). This warming extends over 1,000 meters deep and is deeper than anywhere in the world's oceans and is particularly evident under the Gulf Stream/North Atlantic Current system (IPCC 2007). On a global scale, large discharges of freshwater into the North Atlantic subarctic seas can lead to intense stratification of the upper water column and a disruption of North Atlantic Deepwater (NADW) formation (IPCC 2007; Greene *et al.* 2008). There is evidence that the NADW has already freshened significantly (IPCC 2007). This in turn can lead to a slowing down of the global ocean thermohaline (large-scale circulation in the ocean that transforms low-density upper ocean waters to higher density intermediate and deep waters and returns those waters back to the upper ocean), which can have climatic ramifications for the entire world (Greene *et al.* 2008).

There is a high confidence, based on substantial new evidence, that observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. Ocean acidification resulting from massive amounts of carbon dioxide and pollutants released into the air can have major adverse impacts on the calcium balance in the oceans. Changes to the marine ecosystem due to climate change include shifts in ranges and changes in algal, plankton, and fish abundance (IPCC 2007). These trends have been most apparent over the past few decades, although this may also be due to increased

research. Below, we discuss information on future impacts of climate change in the action area.

While predictions are available regarding potential effects of climate change globally, it is more difficult to assess the potential effects of climate change over the next few decades on coastal and marine resources on smaller geographic scales, such as the action area, especially as climate variability is a dominant factor in shaping coastal and marine systems. The effects of future change will vary greatly in diverse coastal regions of the U.S. Warming is very likely to continue in the U.S. over the life span of the project regardless of reduction in greenhouse gases, due to emissions that have already occurred (NAST 2000). It is very likely that the magnitude and frequency of ecosystem changes will continue to increase during the life of the project, and it is possible that they will accelerate. Climate change can cause or exacerbate direct stress on ecosystems through high temperatures, a reduction in water availability, and altered frequency of extreme events and severe storms. Water temperatures in streams and rivers are likely to increase as the climate warms and are very likely to have both direct and indirect effects on aquatic ecosystems. Changes in temperature will be most evident during low flow periods when they are of greatest concern (NAST 2000). In some marine and freshwater systems, shifts in geographic ranges and changes in algal, plankton, and fish abundance are associated with high confidence with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels and circulation (IPCC 2007).

Expected consequences of climate change for river systems could be a decrease in the amount of dissolved oxygen in surface waters and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing rate (Murdoch *et al.* 2000). Because many rivers are already under a great deal of stress due to excessive water withdrawal or land development, and this stress may be exacerbated by changes in climate, anticipating and planning adaptive strategies may be critical (Hulme 2005). A warmer-wetter climate could ameliorate poor water quality conditions in places where human-caused concentrations of nutrients and pollutants currently degrade water quality (Murdoch *et al.* 2000). Increases in water temperature and changes in seasonal patterns of runoff will very likely disturb fish habitat and affect recreational uses of lakes, streams, and wetlands. Surface water resources along the U.S. Atlantic coast are intensively managed with dams and channels and almost all are affected by human activities; in some systems water quality is either below recommended levels or nearly so. A global analysis of the potential effects of climate change on river basins indicates that due to changes in discharge and water stress, the area of large river basins in need of reactive or proactive management interventions in response to climate change will be much higher for basins impacted by dams than for basins with free-flowing rivers (Palmer *et al.* 2008). Human-induced disturbances also influence coastal and marine systems, often reducing the ability of the systems to adapt so that systems that might ordinarily be capable of responding to variability and change are less able to do so. Because stresses on water quality are associated with many activities, the impacts of the existing stresses are likely to be exacerbated by climate change.

While debated, researchers anticipate: 1) the frequency and intensity of droughts and floods will change across the nation; 2) a warming of about 0.2$^{o}$C per decade; and 3) a rise in sea level (NAST 2000). Sea level is expected to continue rising; during the 20th century global sea level has increased 15 to 20 centimeters. It is also important to note that ocean temperature in the U.S. Northeast Shelf and surrounding Northwest Atlantic waters have warmed faster than the global

average over the last decade (Pershing *et al.* 2015). New projections for the U.S. Northeast Shelf and Northwest Atlantic Ocean suggest that this region will warm two to three times faster than the global average and thus existing projections from the IPCC may be too conservative (Saba *et al.* 2015). Hare *et al.* (2016b) provides a literature summary of other aspects of the climate system that is changing on the U.S. Northeast Shelf including a high rate of sea-level rise, as well as increases in annual precipitation and river flow, magnitude of extreme precipitation events, magnitude and frequency of floods, and dissolved $CO_2$.

*Effects on sea turtles and Atlantic sturgeon globally*

Sea turtles

Sea turtle species have persisted for millions of years and throughout this time have experienced wide variations in global climate conditions and have successfully adapted to these changes. As such, climate change at normal rates (thousands of years) is not thought to have historically been a problem for sea turtle species. As explained in the *Status of the Species* sections above, sea turtles are most likely to be affected by climate change due to (1) changing air temperature and rainfall at nesting beaches, which in turn could impact nest success (hatching success and hatchling emergence rate) and sex ratios among hatchlings; (2) sea level rise, which could result in a reduction or shift in available nesting beach habitat and increased risk of nest inundation; (3) changes in the abundance and distribution of forage species, which could result in changes in the foraging behavior and distribution of sea turtle species; and (4) changes in water temperature, which could possibly lead to a northward shift in their range and changes in phenology (timing of nesting seasons, timing of migrations). Over the time period of this action considered in this Opinion, sea surface temperatures are expected to rise less than 1°C. It is unknown if that is enough of a change to contribute to shifts in the range, distribution, and recruitment of sea turtles. Theoretically, we expect that as waters in the action area warm, more sea turtles could be present or sea turtles could be present for longer periods of time.

The nesting range of some sea turtle species may shift northward. Nesting in the Mid-Atlantic generally is extremely rare and no nesting has been documented at any beach in the Northeast. In 2010, one green sea turtle came up on the beach in Sea Isle City, New Jersey; however, it did not lay any eggs. In August 2011, a loggerhead came up on the beach in Stone Harbor, New Jersey, but did not lay any eggs. On August 18, 2011, a green sea turtle laid one nest at Cape Henlopen Beach in Lewes, Delaware, near the entrance to Delaware Bay. The nest contained 190 eggs and was transported indoors to an incubation facility on October 7. A total of 12 eggs hatched, with eight hatchlings surviving. In December, seven of the hatchlings were released in Cape Hatteras, North Carolina. In September 2017, about 100 baby loggerheads successfully emerged from nests on the Maryland side of Assateague Island. It is important to consider that in order for nesting to be successful in the Mid-Atlantic, fall and winter temperatures need to be warm enough to support the successful rearing of eggs and sea temperatures must be warm enough for hatchlings to survive when they enter the water. The projected increase in ocean temperature over the next fifty years is unlikely to allow for more successful rearing of sea turtle eggs in the action area. However, if increased nesting activity is detected, that would constitute new information that may require reinitiation of this Opinion.

As noted above, sea level rise has the potential to remove possible beach nesting habitat. A recent study by the U.S. Geological Survey found that sea levels in a 620-mile "hot spot" along the East Coast are rising three to four times faster than the global average (Sallenger *et al.* 2012). The disproportionate sea level rise is due to the slowing of Atlantic currents caused by fresh water from the melting of the Greenland Ice Sheet. Sharp rises in sea levels from North Carolina to Massachusetts could threaten wetland and beach habitats, and negatively affect sea turtle nesting along the North Carolina coast. If warming temperatures moved favorable nesting sites northward, it is possible that rises in sea level could constrain the availability of nesting sites on existing beaches. In the next 100 years, the study predicted that sea levels will rise an additional 20-27 centimeters along the Atlantic coast "hot spot" (Sallenger *et al.* 2012).

Warming sea temperatures are likely to result in a shift in the seasonal distribution of sea turtles in the action area, such that sea turtles may begin northward migrations from their southern overwintering grounds earlier in the spring and thus would be present in the action area earlier in the year. Likewise, if water temperatures were warmer in the fall, sea turtles could remain in the action area later in the year.

Changes in water temperature may also alter the forage base and thus, foraging behavior of sea turtles. Changes in the foraging behavior of sea turtles in the action area could lead to either an increase or decrease in the number of sea turtles in the action area, depending on whether there was an increase or decrease in the forage base and/or a seasonal shift in water temperature. For example, if there was a decrease in sea grasses in the action area resulting from increased water temperatures or other climate-change related factors, it is reasonable to expect that there may be a decrease in the number of foraging green sea turtles in the action area. Likewise, if the prey base for loggerhead, Kemp's ridley, or leatherback sea turtles is affected, there may be changes in the abundance and distribution of these species in the action area. However, as noted above, because we do not know the adaptive capacity of these individuals or how much of a change in temperature would be necessary to cause a shift in distribution, it is not possible to predict future changes to the foraging behavior of sea turtles. If sea turtle distribution shifted along with prey distribution, it is likely that there would be minimal, if any, impact on the availability of food. Similarly, if sea turtles shifted to areas where different forage was available and sea turtles were able to obtain sufficient nutrition from that new source of forage, any effect would be minimal. The greatest potential for effect to forage resources would be if sea turtles shifted to an area or time where insufficient forage is available; however, the likelihood of this happening seems low because sea turtles feed on a wide variety of species and in a wide variety of habitats. Finally, it is important to note that ocean temperature in the U.S. Northeast continental shelf and surrounding Northwest Atlantic waters have warmed faster than the global average over the last decade (Pershing *et al.* 2015).

<u>Atlantic sturgeon</u>

As there is significant uncertainty in the rate and timing of change as well as the effect of any changes that may be experienced in the action area due to climate change, it is difficult to predict the impact of these changes on Atlantic sturgeon. We have analyzed the available information,

however, to consider likely impacts to sturgeon and their habitat in the action area. We consider here, likely effects of climate change during the life span of the project.

Atlantic sturgeon have persisted for millions of years and have experienced wide variations in global climate conditions, to which they have successfully adapted. Climate change at historical rates (thousands of years) is not thought to have been a problem for sturgeon species. However, at the current rate of global climate change, future effects to sturgeon are possible. Rising sea level may result in the salt wedge moving upstream in affected rivers. Atlantic sturgeon spawning occurs in fresh water reaches of rivers because early life stages have little to no tolerance for salinity. Similarly, juvenile sturgeon have limited tolerance to salinity and remain in waters with a salinity gradient that they adapt to over time. If the salt wedge moves further upstream, sturgeon spawning and rearing habitat could be restricted. In river systems with dams or natural falls that are impassable by sturgeon, the extent that spawning or rearing may be shifted upstream to compensate for the shift in the movement of the salt wedge would be limited. While there is an indication that an increase in sea level rise would result in a shift in the location of the salt wedge, at this time there are no predictions on the timing or extent of any shifts that may occur; thus, it is not possible to predict any future loss in spawning or rearing habitat. However, in all river systems, spawning occurs miles upstream of the salt wedge. It is unlikely that shifts in the location of the salt wedge would eliminate freshwater spawning or rearing habitat. If habitat was severely restricted, productivity or survivability may decrease.

The increased rainfall predicted by some models in some areas may increase runoff and scour spawning areas and flooding events could cause temporary water quality issues. Rising temperatures predicted for all of the U.S. could exacerbate existing water quality problems with dissolved oxygen (DO) and temperature. While this occurs primarily in rivers in the southeast U.S. and the Chesapeake Bay, it may start to occur more commonly in the northern rivers. Atlantic sturgeon are tolerant to water temperatures up to approximately 28°C (82.4°F); these temperatures are experienced naturally in some areas of rivers during the summer months. If river temperatures rise and temperatures above 28°C are experienced in larger areas, sturgeon may be excluded from some habitats.

Increased droughts (and water withdrawal for human use) predicted by some models in some areas may cause loss of habitat including loss of access to spawning habitat. Drought conditions in the spring may also expose eggs and larvae in rearing habitats. If a river becomes too shallow or flows become intermittent, all sturgeon life stages, including adults, may become susceptible to strandings or habitat restriction. Low flow and drought conditions are also expected to cause additional water quality issues. Any of the conditions associated with climate change are likely to disrupt river ecology causing shifts in community structure and the type and abundance of prey. Additionally, cues for spawning migration and spawning could occur earlier in the season causing a mismatch in prey that are currently available to developing sturgeon in rearing habitat.

Atlantic sturgeon in the action area are most likely to experience the effects of global climate change in warming water temperatures, which could change their range and migratory patterns. Warming temperatures predicted to occur over the next 100 years would likely result in a northward shift/extension of their range (i.e., into the St. Lawrence River, Canada) while truncating the southern distribution, thus affecting the recruitment and distribution of sturgeon

rangewide. The increase in sea surface temperature over the life of the proposed action is expected to be minimal, and thus, it is unlikely that this expanded range will be observed in the near future. If any shift does occur, it is likely to be minimal and thus, it seems unlikely that this small increase in temperature will cause a significant effect to shortnose and Atlantic sturgeon or a significant modification to the number of sturgeon likely to be present in the action area over the life of the proposed action. However, even a small increase in temperate can affect DO concentrations. A one degree change in temperature in Chesapeake Bay could make parts of Chesapeake Bay inaccessible to sturgeon due to decreased levels of DO (Batiuk *et al.* 2009) and projections, from global climate models representing a wide range of potential futures, suggest water temperature increases in the bay of 2-5.5°C (3.5-9°F) by the end of the 21$^{st}$ century (Muhling et al. 2018).

Although the action area does not include spawning grounds for Atlantic sturgeon, sturgeon are migrating through the action area to reach their natal rivers to spawn. Elevated temperatures could modify cues for spawning migration, resulting in an earlier spawning season, and thus, altering the time of year sturgeon may or may not be present within the action area. This may cause an increase or decrease in the number of sturgeon present in the action area. However, because spawning is not triggered solely by water temperature, but also by day length (which would not be affected by climate change) and river flow (which could be affected by climate change), it is not possible to predict how any change in water temperature will affect the seasonal movements of sturgeon through the action area.

In addition, changes in water temperature may also alter the forage base and thus, foraging behavior of sturgeon. Any forage species that are temperature-dependent may also shift in distribution as water temperatures warm and cause a shift in the distribution of sturgeon. However, because we do not know the adaptive capacity of these species or how much of a change in temperature would be necessary to cause a shift in distribution, it is not possible to predict how these changes may affect foraging sturgeon. If sturgeon distribution shifted along with prey distribution, it is likely that there would be minimal, if any, impact on the availability of food. Similarly, if sturgeon shifted to areas where different forage was available and sturgeon were able to obtain sufficient nutrition from that new source of forage, any effect would be minimal. The greatest potential for effect to forage resources would be if sturgeon shifted to an area or time where insufficient forage was available; however, the likelihood of this happening seems low because sturgeon feed on a wide variety of species and in a wide variety of habitats.

## 5.4 Reducing Threats to ESA-listed Species

### *5.4.1 Education and Outreach Activities*

Education and outreach activities are considered some of the primary tools that will effectively reduce the threats to all protected species. For example, NMFS has been active in public outreach to educate fishermen about handling and resuscitation techniques for sea turtles and sturgeon, and educates recreational fishermen and boaters on how to avoid interactions with these species. NMFS also has a program called “SCUTES” (Student Collaborating to Undertake Tracking Efforts for Sturgeon), which offers educational programs and activities about the movements, behaviors, and threats to sturgeon. NMFS intends to continue these outreach efforts

in the action area in an attempt to reduce interactions with protected species, and to reduce the likelihood of injury to protected species when interactions do occur.

### *5.4.2 Stranding and Salvage Programs*

The Sea Turtle Stranding and Salvage Network (STSSN) we manage does not directly reduce the threats to sea turtles. However, the extensive network of STSSN participants along the Atlantic and Gulf of Mexico coasts not only collects data on dead sea turtles, but also rescues and rehabilitates live stranded turtles, reducing mortality of injured or sick animals. Data collected by the STSSN are used to monitor stranding levels, to identify areas where unusual or elevated mortality is occurring, and to identify sources of mortality. These data are also used to monitor incidence of disease, study toxicology and contaminants, and conduct genetic studies to determine population structure. All of the states that participate in the STSSN tag live turtles when encountered (either via the stranding network through incidental takes or in-water studies). Tagging studies help improve our understanding of sea turtle movements, longevity, and reproductive patterns, all of which contribute to our ability to reach recovery goals for the species.

A salvage program is also in place for sturgeon. Sturgeon carcasses can provide pertinent life history data and information on new or evolving threats. Their use in scientific research studies can reduce the need to collect live sturgeon. Our Sturgeon Salvage Program is a network of individuals qualified to retrieve and/or use sturgeon carcasses and parts for scientific research and education. All carcasses and parts are retrieved opportunistically and participation in the network is voluntary.

### *5.4.3 Sea Turtle Disentanglement Network*

We established the Northeast Sea Turtle Disentanglement Network (STDN) in 2002 in response to the high number of leatherback sea turtles found entangled in pot gear along the U.S. Northeast Atlantic coast. The STDN is a component of the larger STSSN program, and it operates in all states in the region. The STDN responds to entangled sea turtles and disentangles and releases live animals, thereby reducing serious injury and mortality. In addition, the STDN collects data on live and dead sea turtle entanglement events, providing valuable information for management purposes. We oversee the STDN program and manage the STDN database. As knowledge of the network and number of participants involved in the network has increased, so have reports of sea turtle entanglements in Virginia waters increased over the past several years. In 2017, the STDN documented eleven sea turtle entanglements in the state of Virginia in gears such as pound nets, the vertical lines of crab traps, and monofilament or unknown line.

### *5.4.4 Regulatory Measures for Sea Turtles*

Numerous efforts are ongoing to reduce threats to listed sea turtles. Below, we detail efforts that are ongoing within the action area. The majority of these activities are related to regulations that have been implemented to reduce the potential for incidental mortality of sea turtles from commercial fisheries. These include sea turtle release gear requirements for TEDs in the southern part of the summer flounder trawl fishery and mesh size restrictions in Virginia's gillnet fisheries. The summaries below discuss all of these measures in more detail.

*Large Mesh Gillnet Requirements in the Mid-Atlantic*
In March 2002, NMFS published new restrictions for the use of gillnets with larger than 8-inch (20.3 cm) stretched mesh, in Federal waters (3-200 nautical miles) off of North Carolina and Virginia. These restrictions were published in an interim final rule under the authority of the ESA (67 FR 13098) and were implemented to reduce the impact of the monkfish and other large-mesh gillnet fisheries on ESA-listed sea turtles in areas where sea turtles are known to concentrate. Following review of public comments submitted on the interim final rule, NMFS published a final rule on December 3, 2002, that established the restrictions on an annual basis. As a result, gillnets with larger than 8-inch (20.3 cm) stretched mesh are not allowed in Federal waters (3-200 nautical miles) in the areas described as follows: (1) North of the North Carolina/South Carolina border at the coast to Oregon Inlet at all times; (2) north of Oregon Inlet to Currituck Beach Light, NC from March 16 through January 14; (3) north of Currituck Beach Light, NC, to Wachapreague Inlet, VA, from April 1 through January 14; and (4) north of Wachapreague Inlet, VA, to Chincoteague, VA, from April 16 through January 14. On April 26, 2006, NMFS published a final rule (71 FR 24776) that included modifications to the large-mesh gillnet restrictions. The new final rule revised the gillnet restrictions to apply to stretched mesh that is ≥7 inches (17.9 cm). Federal waters north of Chincoteague, VA, remain unaffected by the large-mesh gillnet restrictions. These measures are in addition to the HPTRP measures that prohibit the use of large-mesh gillnets in southern Mid-Atlantic waters (territorial and Federal waters from Delaware through North Carolina out to 72°30'W longitude) from February 15 through March 15, annually. The measures are also in addition to comparable North Carolina and Virginia regulations for large-mesh gillnet fisheries in their respective state waters that were enacted in 2005.

*Modified Scallop Dredge Gear in the Mid-Atlantic Sea Scallop Fishery*
To reduce post-interaction mortality to sea turtles resulting from capture in the sea scallop dredge bag, NMFS has required the use of a chain-mat modified dredge in the Atlantic sea scallop fishery since 2006 (71 FR 50361, August 25, 2006; 71 FR 66466, November 15, 2006; 73 FR 18984, April 8, 2008; 74 FR 20667, May 5, 2009). Federally permitted scallop vessels south of 41°09'N from the shoreline to the outer boundary of the EEZ are required to modify their dredge gear by adding an arrangement of horizontal and vertical chains (a "chain mat") over the opening of the dredge bag from of May 1 through November 30 each year. This modification is not expected to reduce the overall number of sea turtle interactions with gear. However, it is expected to reduce the severity of the interactions.

Since May 1, 2013, all limited access scallop vessels, as well as Limited Access General Category vessels with a dredge width of 10.5 feet or greater, have been required to use a Turtle Deflector Dredge (TDD) in the Mid-Atlantic (west of 71°W) from May 1 through October 31 each year (77 FR 20728, April 6, 2012). The purpose of the TDD requirement is to deflect sea turtles over the dredge frame and bag rather than under the cutting bar, so as to reduce sea turtle injuries due to contact with the dredge frame on the ocean bottom (including being crushed under the dredge frame). The TDD has specific components that are defined in the regulations. When combined with the effects of chain mats, which decrease captures in the dredge bag, the TDD should provide greater sea turtle benefits by reducing post-interaction mortality due to interactions with the dredge frame, compared to a standard New Bedford dredge.

To eliminate confusion, the seasons and areas for these two gear measures designed to protect sea turtles were later aligned through the final rule for Framework 26 to the Atlantic Sea Scallop FMP (80 FR 22119; April 21, 2015). Following the enactment of the final rule, sea turtle chain mats and TDDs are now required west of 71°W longitude from May through November.

*TED Requirements for the Summer Flounder Fishery*
As mentioned above, significant measures have been developed to reduce the incidental take of sea turtles in summer flounder trawls and trawls that meet the definition of a summer flounder trawl (which would include fisheries for other species like scup and black sea bass) by requiring TEDs in trawl nets used in the area of greatest turtle bycatch off the North Carolina and part of the Virginia coast from North Carolina/South Carolina border to Cape Charles, Virginia. The TED requirements for the summer flounder trawl fishery do not, however, require the use of larger TEDs that are required in the U.S. Southeast shrimp trawl fisheries.

*Sea Turtle Entanglements and Rehabilitation*
A final rule (70 FR 42508) published on July 25, 2005, allows any agent or employee of NMFS, USFWS, USCG, or any other Federal land or water management agency, or any agent or employee of a state agency responsible for fish and wildlife, when acting in the course of his or her official duties, to take endangered sea turtles encountered in the marine environment if such taking is necessary to aid a sick, injured, or entangled endangered sea turtle, or dispose of a dead endangered sea turtle, or salvage a dead endangered sea turtle that may be useful for scientific or educational purposes. NMFS already affords the same protection to sea turtles listed as threatened under the ESA (50 CFR 223.206(b)).

### *5.4.5 Regulatory Measures for Atlantic Sturgeon*

*Sturgeon Recovery Planning*
Several conservation actions aimed at reducing threats to Atlantic sturgeon are currently ongoing. In the near future, we will be convening a recovery team and drafting a recovery plan which will outline recovery goals and criteria and steps necessary to recover all Atlantic sturgeon DPSs. Numerous research activities are underway for sturgeon, involving us and other Federal, state, and academic partners, to obtain more information on the distribution and abundance of sturgeon throughout their range, including in the action area. Efforts are also underway to better understand threats faced by sturgeon and ways to minimize these threats, including bycatch and water quality. Fishing gear research is underway to design fishing gear that minimizes interactions with Atlantic sturgeon while maximizing retention of targeted fish species. Several states are in the process of preparing ESA section 10 Habitat Conservation Plans aimed at minimizing the effects of state fisheries on Atlantic sturgeon.

*Research Activity Guidelines*
Research activities aid in the conservation of listed species by furthering our understanding of the species' life history and biological requirements. We recognize, however, that many scientific research activities involve capture and may pose some level of risk to individuals or to the species. Therefore, it is necessary for research activities to be carried out in a manner that minimizes the adverse impacts of the activities on individuals and the species while obtaining crucial information that will benefit the species. Guidelines developed by sturgeon researchers in cooperation with NMFS staff (Moser *et al.* 2000; Damon-Randall *et al.* 2010; Kahn and

Mohead 2010) provide standardized research protocols that minimize the risk to sturgeon from capture, handling, and sampling. These guidelines must be followed by any entity receiving a federal permit to do research on Atlantic sturgeon.

*Protections for the GOM DPS of Atlantic Sturgeon*
The prohibitions listed under section 9(a)(1) of the ESA automatically apply when a species is listed as endangered but not when listed as threatened. When a species is listed as threatened, section 4(d) of the ESA requires the Secretary of Commerce (Secretary) to issue regulations, as deemed necessary and advisable, to provide for the conservation of the species. The Secretary may, with respect to any threatened species, issue regulations that prohibit any act covered under section 9(a)(1). Whether section 9(a)(1) prohibitions are necessary and advisable for a threatened species is largely dependent on the biological status of the species and the potential impacts of various activities on the species. On June 10, 2011, we proposed protective measures for the GOM DPS of Atlantic sturgeon (76 FR 34023). On November 19, 2013 we published a final rule that applied all prohibitions of section 9(a)(1) to the GOM DPS beginning on December 19, 2013 (78 FR 69310).

## 5.5 Summary of Available Information on Listed Species Likely to be Adversely Affected by the Proposed Action in the Action Area

### *5.5.1 Sea Turtles*

As described in sections 4.2.1.1 - 4.2.1.3, the occurrence of loggerhead, Kemp's ridley, and green sea turtles along the U.S. Atlantic coast is primarily temperature dependent (Thompson 1984; Keinath *et al.* 1987; Shoop and Kenney 1992; Musick and Limpus 1997; Morreale and Standora 1998, 2005; Mitchell *et al.* 2003; Braun-McNeill and Epperly 2004; James *et al.* 2005a). In general, sea turtles move up the U.S. Atlantic coast from southern wintering areas as water temperatures warm in the spring (Keinath *et al.* 1987; Shoop and Kenney 1992; Musick and Limpus 1997; Morreale and Standora 1998, 2005; Mitchell *et al.* 2003; Braun-McNeill and Epperly 2004; James *et al.* 2005a). The trend reverses in the fall as water temperatures cool. By December, sea turtles have passed Cape Hatteras, returning to more southern waters for the winter (Keinath *et al.* 1987; Shoop and Kenney 1992; Musick and Limpus 1997; Morreale and Standora 1998, 2005; Mitchell *et al.* 2003; Braun-McNeill and Epperly 2004; James *et al.* 2005a). Recreational anglers have reported sightings of sea turtles in waters defined as inshore waters (bays, inlets, rivers, or sounds; Braun-McNeill and Epperly 2004) as far north as New York as early as March-April, but in relatively low numbers (Braun-McNeill and Epperly 2004). Greater numbers of loggerheads, Kemp's ridleys, and greens are found in inshore, nearshore, and offshore waters of North Carolina and Virginia from May through November and in inshore, nearshore, and offshore waters of New York from June through October (Keinath *et al.* 1987; Morreale and Standora 1993; Braun-McNeill and Epperly 2004). The hard-shelled sea turtles (loggerheads, Kemp's ridleys, and greens) appear to be temperature limited to water no further north than Cape Cod.

Extensive survey effort of the continental shelf from Cape Hatteras to Nova Scotia, Canada in the 1980s (CeTAP 1982) revealed that loggerheads were observed at the surface in waters from the beach to waters with bottom depths of up to 4,481 meters. However, they were generally found in waters where bottom depths ranged from 22-49 meters deep (the median value was 36.6

meters; Shoop and Kenney 1992). However, 84.5% of loggerhead sightings occurred in waters where the bottom depth was less than 80 meters (Shoop and Kenney 1992). The CeTAP study did not include Kemp's ridley and green sea turtle sightings, given the difficulty of sighting these smaller sea turtle species (CeTAP 1982).

Sea turtles are generally present in Virginia waters from May to November each year, with the highest number of individuals present from June to October. Sea turtles occur throughout the Virginia portion of Chesapeake Bay, from shallow waters along the shoreline and near river mouths to deeper waters in the bay's interior and near its confluence with the Atlantic Ocean. One of the main factors influencing sea turtle presence in Mid-Atlantic waters is seasonal temperature patterns (Ruben and Morreale 1999). Temperature is correlated with the time of year, with warmer waters in the late spring, summer, and early fall being the most suitable for cold-blooded sea turtles. Sea turtles are most likely to occur in the action area when water temperatures are above 11°C, although depending on seasonal weather patterns and prey availability, they could be also present in months when water temperatures are cooler (as evidenced by fall and winter cold stunning records as well as year round stranding records). Sea turtles have also been documented in the action area through aerial and vessel surveys, satellite tracking programs, and by fisheries observers. The majority of sea turtle observations in the Chesapeake Bay and vicinity are of loggerhead sea turtles, yet all four species of sea turtles have been recorded in the action area.

To some extent, water depth also dictates the number of sea turtles occurring in a particular area. Satellite tracking studies of sea turtles in the Northeast U.S. found that foraging turtles mainly occurred in areas where the water depth was between approximately 16 and 49 feet (Ruben and Morreale 1999). This depth was interpreted not to be as much an upper physiological depth limit for turtles, as a natural limiting depth where light and food are most suitable for foraging turtles (Morreale and Standora 1990). The action area and the depths preferred by sea turtles do overlap, suggesting that if suitable forage is present, adult and juvenile loggerheadand green sea turtles as well as juvenile Kemp's ridley sea turtles may be foraging in the areas where the proposed action will occur.

### *5.5.2 Atlantic Sturgeon*

The marine and estuarine range of all five Atlantic sturgeon DPSs overlaps and extends from Canada through Cape Canaveral, Florida. Based on the best available information, Atlantic sturgeon originating from any of five DPSs could occur in the Virginia waters of Chesapeake Bay. The dredging activities associated with the proposed action will not typically occur upstream of the mouths of major Chesapeake Bay rivers, so eggs and early life stages will not be present in the action area. Juvenile, subadult, and adult Atlantic sturgeon are likely to occur in the Virginia portion of Chesapeake Bay as they are known to be present throughout the bay in spring, summer, and fall. Atlantic sturgeon are known to use the Chesapeake Bay for life functions such as spawning migrations, foraging, and as juvenile nursery habitat prior to entering marine waters as subadults.

Diets of adult and subadult Atlantic sturgeon include mollusks, gastropods, amphipods, annelids, decapods, isopods, and fish such as sand lance (Bigelow and Schroeder 1953; ASSRT 2007; Guilbard *et al.* 2007; Savoy 2007). Juvenile Atlantic sturgeon feed on aquatic insects, insect

larvae, and other invertebrates (Bigelow and Schroeder 1953; ASSRT 2007; Guilbard *et al.* 2007). Because of the benthic nature of their prey, it is likely that foraging Atlantic sturgeon could swim into and ultimately be entrapped during dredging operations in the action area.

Atlantic sturgeon from all five DPSs can be found in Virginia nearshore and coastal waters and within Chesapeake Bay, typically from spring through fall. Migratory behaviors occur from April to November for adults and subadults and year round for juveniles (Dovel and Berggren 1983; Secor *et al.* 2000; Welsh *et al.* 2002; Horne and Stence 2016). Each of these life stages are expected to wander among coastal and estuarine habitats of the bay. Foraging behaviors typically occur in areas where suitable forage and appropriate habitat conditions are present. These areas include tidally influenced flats and mud, sand, and mixed cobble substrates (Stein *et al.* 2004). The areas to be dredged and the depths preferred by Atlantic sturgeon do overlap, suggesting that if suitable forage and/or habitat features are present, adult and subadults from any of the five listed DPSs and Chesapeake Bay DPS juveniles may be foraging or undertaking migrations in the areas where the proposed action will occur.

## 6.0 EFFECTS OF THE ACTION

This section of the Opinion assesses the direct and indirect effects of the proposed action on threatened and endangered species or critical habitat, together with the effects of other activities that are interrelated or interdependent (50 CFR § 402.02). Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR§402.02). We have identified the use of the deeper channels by larger vessels as an interdependent or interrelated action. The action area for this consultation overlaps slightly with the river mouths of the James and York Rivers, which are designated as critical habitat for the Chesapeake Bay DPS of Atlantic sturgeon. In section 4.1, we determined the effects of the proposed action are not likely to adversely affect critical habitat.

This Opinion examines the likely effects (direct and indirect) of the proposed action on five DPSs of Atlantic sturgeon and four species of sea turtles and their habitat in the action area within the context of the species current status, the environmental baseline and cumulative effects. As explained in the Description of the Action, the action under consideration in this Opinion is the continued use of sand borrow areas for beach nourishment and hurricane protection as well as maintenance of federal navigation channels over the life of these projects. Additionally, we consider the effects of the use of dredged material disposal sites (onshore and offshore) as well as the CIEE.

The effects of dredging on listed species will be different depending on the type of dredge used. As such, the following discussion of effects of dredging will be organized by dredge type. Below, the discussion will consider the effects of dredging, including the risk of entrainment or capture of Atlantic sturgeon and sea turtles. We also consider effects of dredging and disposal on water quality, including turbidity/suspended sediment. Last, there is a discussion of other effects that are not specific to the type of equipment used. This includes effects on prey and foraging, changes in the characteristics of the dredged area and effects of dredge vessel traffic.

## 6.1 Hopper Dredge

### *6.1.1 Interactions with Hopper Dredges – Sea Turtles*

As outlined above, sea turtles are likely to occur in Chesapeake Bay from April through mid-November each year with the largest numbers present from June through October of any year. The majority of sea turtles in the Chesapeake Bay are juvenile loggerheads; however, adult loggerheads, juvenile Kemp's ridley, and adult green sea turtles have also been documented in the area. The Chesapeake Bay is an important foraging area for sea turtles and an important developmental habitat for juvenile sea turtles, particularly loggerheads.

Entrainment is the direct uptake of aquatic organisms by the suction field generated at the draghead. Hydraulic dredges operate for prolonged periods underwater, with minimal disturbance, but generate continuous flow fields of suction forces while dredging. Loggerhead, Kemp's ridley and green sea turtles are vulnerable to entrainment in the draghead of the hopper dredge. Given their large size, leatherback sea turtles are not vulnerable to entrainment. As reported by you, no leatherback sea turtles have been entrained in hopper dredge operations operating along the U.S. Atlantic coast (USACE Sea Turtle Warehouse, 2017). Sea turtles are likely to be feeding on or near the bottom of the water column during the warmer months, with loggerhead and Kemp's ridley sea turtles being the most common species in these waters. Although not expected to be as numerous as loggerheads and Kemp's ridleys, green sea turtles are also likely to occur seasonally in the Bay.

Most sea turtles are able to escape from the oncoming draghead due to the slow speed that the draghead advances (up to 3 mph or 4.4 feet/second); however, dead sea turtles have been reported impailed on the draghead. For example, on July 23, 2018, you reported to us the lethal take of an adult loggerhead sea turtle, which was observed impailed on the teeth of the starboard draghead during hopper dredging in the Cape Henry channel. Interactions with a hopper dredge result primarily from crushing when the draghead is placed on the bottom or when an animal is unable to escape from the suction of the dredge and becomes stuck on the draghead (impingement). Entrainment occurs when organisms are sucked through the draghead into the hopper. Mortality most often occurs when animals are sucked into the dredge draghead, pumped through the intake pipe and then killed as they cycle through the centrifugal pump and into the hopper.

Interactions with the draghead can also occur if the suction is turned on while the draghead is in the water column (i.e., not seated on the bottom). Procedures are implemented to minimize the operation of suction when the draghead is not properly seated on the bottom sediments, which reduces the risk of these types of interactions.

Sea turtles may become entrained in hopper dredges as the draghead moves along the bottom. Because entrainment is believed to occur primarily while the draghead is operating on the bottom, it is likely that only those species feeding or resting on or near the bottom would be vulnerable to entrainment. Turtles can also be entrained if suction is created in the draghead by current flow while the device is being placed or removed, or if the dredge is operating on an uneven or rocky substrate and rises off the bottom. Recent information from you suggests that the risk of entrainment is highest when the bottom terrain is uneven or when the dredge is conducting "clean up" operations at the end of a dredge cycle when the bottom is trenched and

the dredge is working to level out the bottom. In these instances, it is difficult for the dredge operator to keep the draghead buried in the sand and sea turtles near the bottom may be more vulnerable to entrainment.

There is some evidence to indicate that turtles can become entrained in trunions or other water intakes (see Nelson and Shafer 1996). For example, a large piece of a loggerhead sea turtle was found in a UXO screening basket on Virginia Beach in 2013. The hopper dredge was operated with UXO screens on the draghead designed to prevent entrainment of any material with a diameter greater than 1.25 inchces. The pieces of turtle found were significantly larger. Because an inspection of the UXO screens revealed no damage, it is suspected that the sea turtle was entrained in another water intake port. There are also several examples of relatively large sturgeon (2-3' length) detected in inflow screening alive and relatively uninjured. Given the damage anticipated from passing through the pumps, it is possible that these sturgeon were entrained somewhere other than the draghead. You are currently investigating potential sources of entrainment and exploring the use of screening to minimize possible entrainment in areas other than the draghead.

Sea turtles have been found resting in deeper waters, which could increase the likelihood of interactions from dredging activities. In 1981, observers documented the take of 71 loggerheads by a hopper dredge at the Port Canaveral Ship Channel, Florida (Slay and Richardson 1988). This channel is a deep, low productivity environment in the Southeast Atlantic where sea turtles are known to rest on the bottom, making them extremely vulnerable to entrainment. The large number of turtle mortalities at the Port Canaveral Ship Channel in the early 1980s resulted in part from turtles being buried in the soft bottom mud, a behavior known as brumation. Since 1981, 77 loggerhead sea turtles have been taken by hopper dredge operations in the Port Canaveral Ship Channel, Florida. Chelonid turtles have been found to make use of deeper, less productive channels as resting areas that afford protection from predators because of the low energy, deep water conditions. Sea turtle brumation has not been documented in the Chesapeake Bay.

*6.1.1.1 Background Information on Sea Turtles Interactions with Hopper Dredges*

Sea turtles have been killed in hopper dredge operations along the East and Gulf coasts of the US. Documented turtle mortalities during dredging operations in the USACE South Atlantic Division (SAD; i.e., south of the Virginia/North Carolina border) are more common than in the USACE North Atlantic Division (NAD; Virginia-Maine) presumably due to the greater abundance of turtles in these waters and the greater frequency of hopper dredge operations. For example, in the USACE SAD, over 400 sea turtles have been entrained in hopper dredges since 1980 and in the Gulf Region over 160 sea turtles have been killed since 1995. Records of sea turtle entrainment in the USACE NAD began in 1994. Through October 2015, 85 sea turtles deaths (see Table 13) related to hopper dredge activities have been recorded in waters north of the North Carolina/Virginia border (USACE Sea Turtle Database[10]); the majority of these turtles have been entrained in dredges operating in Chesapeake Bay, but sea turtles can also be killed by direct contact with the draghead.

Before 1994, endangered species observers were not required on board hopper dredges and

10 The USACE Sea Turtle Data Warehouse is maintained by the USACE's Environmental Laboratory and contains information on USACE dredging projects conducted since 1980 with a focus on information on interactions with sea turtles.

dredge baskets were not inspected for sea turtles or sea turtle parts. The majority of sea turtle takes in the NAD have occurred in the Norfolk District. This is largely a function of the large number of loggerhead and Kemp's ridley sea turtles that occur in the Chesapeake Bay each summer and the intense dredging operations that are conducted to maintain the Chesapeake Bay entrance channels and for beach nourishment projects at Virginia Beach. Since 1992, the take of 10 sea turtles (all loggerheads) has been recorded during hopper dredge operations in the Philadelphia, Baltimore and New York Districts. Hopper dredging is relatively rare in New England waters where sea turtles are known to occur, with most hopper dredge operations being completed by the specialized Government owned dredge Currituck which operates at low suction and has been demonstrated to have a very low likelihood of entraining or impinging sea turtles. To date, no hopper dredge operations (other than the Currituck) have occurred in the New England District in areas or at times when sea turtles are likely to be present.

**Table 13. Sea Turtle Takes in USACE NAD Dredging Operations**

| Project Location | Year of Operation | Cubic Yardage Removed | Observed Takes |
|---|---|---|---|
| Cape Henry Channel | 2018 | n/a | 1 loggerhead |
| Thimble Shoals Channel | 2016 | 1,098,514 | 1 loggerhead |
| York Spit Channel | 2015 | 815,979 | 6 loggerheads |
| Cape Henry Channel | 2014 | 2,165,425 | 3 loggerheads<br>1 Kemp's ridley |
| Sandbridge Shoal | 2013 | 815,842 | 1 loggerhead[11] |
| Cape Henry Channel | 2012 | 1,190,004 | 1 loggerhead |
| York Spit | 2012 | 145,332 | 1 Loggerhead |
| Thimble Shoal Channel | 2009 | 473,900 | 3 Loggerheads |
| York Spit | 2007 | 608,000 | 1 Kemp's Ridley |
| Cape Henry | 2006 | 447,238 | 3 Loggerheads |
| Thimble Shoal Channel | 2006 | 300,000 | 1 loggerhead |
| Delaware Bay | 2005 | 50,000 | 2 Loggerheads |
| Thimble Shoal Channel | 2003 | 1,828,312 | 7 Loggerheads<br>1 Kemp's ridley<br>1 unknown |
| Cape Henry | 2002 | 1,407,814 | 6 Loggerheads<br>1 Kemp's ridley<br>1 green |
| VA Beach Hurricane Protection Project (Cape Henry) | 2002 | 1,407,814 | 1 Loggerhead |

11 Sea turtle observed in cage on beach (material pumped directly to beach from dredge).

| | | | |
|---|---|---|---|
| York Spit Channel | 2002 | 911,406 | 8 Loggerheads<br>1 Kemp's ridley |
| Cape Henry | 2001 | 1,641,140 | 2 loggerheads<br>1 Kemp's ridley |
| VA Beach Hurricane Protection Project (Thimble Shoals) | 2001 | 4,000,000 | 5 loggerheads<br>1 unknown |
| Thimble Shoal Channel | 2000 | 831,761 | 2 loggerheads<br>1 unknown |
| York River Entrance Channel | 1998 | 672,536 | 6 loggerheads |
| Atlantic Coast of NJ | 1997 | 1,000,000 | 1 Loggerhead |
| Thimble Shoal Channel | 1996 | 529,301 | 1 loggerhead |
| Delaware Bay | 1995 | 218,151 | 1 Loggerhead |
| Cape Henry | 1994 | 552,671 | 4 loggerheads<br>1 unknown |
| York Spit Channel | 1994 | 61,299 | 4 loggerheads |
| Delaware Bay | 1994 | NA | 1 Loggerhead |
| Cape May NJ | 1993 | NA | 1 Loggerhead |
| Off Ocean City MD | 1992 | 1,592,262 | 3 Loggerheads |
| | | | ***TOTAL = 88 Turtles*** |

It should be noted that the observed takes may not be representative of all the turtles killed during dredge operations. Typically, endangered species observers are required to observe a total of 50% of the dredge activity (i.e., 6 hours on watch, 6 hours off watch). As such, if the observer was off watch or the cage was emptied and not inspected or the dredge company either did not report or was unable to identify the turtle incident, there is the possibility that a turtle could be taken by the dredge and go unnoticed. Additionally, in older biological opinions (i.e., prior to 1995), we frequently only required 25% observer coverage and monitoring of the overflows which has since been determined to not be as effective as monitoring of the intakes. These conditions may have led to sea turtle takes going undetected.

We raised this issue with you during the 2002 season, after several turtles were taken in the Cape Henry and York Spit Channels, and expressed the need for 100% observer coverage. On September 30, 2002, you informed the dredge contractor that when the observer was not present, the cage should not be opened unless it is clogged. This modification was to ensure that any sea turtles that were taken and on the intake screen (or in the cage area) would remain there until the observer evaluated the load. Your letter further stated, "crew members will only go into the cage and remove wood, rocks, and man-made debris; any aquatic biological material is left in the cage for the observer to document and clear out when they return on duty. In addition, the observer is the only one allowed to clean off the overflow screen. This practice provides us with 100% observation coverage and shall continue." Theoretically, all sea turtle parts were observed under this scheme, but the frequency of clogging in the cage is unknown at this time. The most effective way to attain 100% observer coverage is to have a NMFS-approved endangered species observer monitoring all loads at all times. This level of observer coverage would document all

turtle interactions and better quantify the impact of dredging on turtle populations.

It is likely that not all sea turtles killed by dredges are observed onboard the hopper dredge. Several sea turtles stranded on Virginia shores with crushing type injuries from May 25 to October 15, 2002. The Virginia Aquarium and Marine Science Center (formerly the Virginia Marine Science Museum (VMSM)) found 10 loggerheads, 2 Kemp's ridleys, and 1 leatherback exhibiting injuries and structural damage consistent with what they have seen in animals that were known dredge takes. While in some cases it may not be conclusively determined that these strandings were the result of dredge interactions, the link is possible given the location of the strandings (e.g., in the southern Chesapeake Bay near ongoing dredging activity), the time of the documented strandings in relation to dredge operations, the lack of other ongoing activities which may have caused such damage, and the nature of the injuries (e.g., crushed or shattered carapaces and/or flipper bones, black mud in mouth). Additionally, in 1992, three dead sea turtles were found on an Ocean City, Maryland beach while dredging operations were ongoing at a borrow area located 3 miles offshore. Necropsy results indicate that the deaths of all three turtles were dredge related. It is unknown if turtles observed on the beach with these types of injuries were crushed by the dredge and subsequently stranded on shore or whether they were entrained in the dredge, entered the hopper and then were discharged onto the beach with the dredge spoils.

A dredge could crush an animal as it was setting the draghead on the bottom, or if the draghead was lifting on and off the bottom due to uneven terrain, but the actual cause of these crushing injuries cannot be determined at this time. Further analyses need to be conducted to better understand the link between crushed strandings and dredging activities, and if those strandings need to be factored into an incidental take level. As mentioned above, necropsy results can determine whether the cause of death was due to an interaction with dredge gear. When necessary, we believe that necropsies on stranded sea turtles will help determine not only whether the death was due to dredging activities, but also relevant information about the nature of the interaction (i.e., the specific dredging activity that led to the interaction). Regardless, it is possible that dredges are taking animals that are not observed on the dredge, which may result in strandings on nearby beaches.

Due to the nature of interactions between listed species and dredge operations, it is difficult to predict the number of interactions that are likely to occur from a particular dredging operation. Projects that occur in an identical location with the same equipment year after year may result in interactions in some years and none in other years as noted above in the examples of sea turtle takes. Dredging operations may go on for months, with sea turtle takes occurring intermittently throughout the duration of the action. For example, dredging occurred at Cape Henry over 160 days in 2002 with 8 sea turtle takes occurring over 3 separate weeks while dredging at York Spit in 1994 resulted in 4 sea turtle takes in one week. In Delaware Bay, dredge cycles have been conducted during the May-November period with no observed entrainment; in contrast, as many as two sea turtles have been entrained in as little as three weeks. Even in locations where thousands of sea turtles are known to be present (i.e., Chesapeake Bay) and where dredges are operating in areas with preferred sea turtle depths and forage items (as evidenced by entrainment of these species in the dredge), the numbers of sea turtles entrained is an extremely small percentage of the likely number of sea turtles in the action area. This is likely due to the

distribution of individuals throughout the action area, the relatively small area which is affected at any given moment and the ability of some sea turtles to avoid the dredge even if they are in the immediate area.

The number of interactions between dredge equipment and sea turtles seems to be best associated with the volume of material removed, which is closely correlated to the length of time dredging takes, with a greater number of interactions associated with a greater volume of material removed and a longer duration of dredging. The number of interactions is also heavily influenced by the time of year dredging occurs (with more interactions correlated to times of year when more sea turtles are present in the action area) and the type of dredge plant used (sea turtles are apparently capable of avoiding pipeline and mechanical dredges as no takes of sea turtles have been reported with these types of dredges). The number of interactions may also be influenced by the terrain in the area being dredged, with interactions more likely when the draghead is moving up and off the bottom frequently. Interactions are also more likely at times and in areas when sea turtle forage items are concentrated in the area being dredged, as sea turtles are more likely to be spending time on the bottom while foraging.

We have compiled a dataset representing all of the hopper dredge projects in the Norfolk District that have reported the cubic yardage removed as well as the number of takes observed. The table below includes records for all projects in the Norfolk District since 1994 and indicates the volume of material removed during “sea turtle season” (i.e., April - November).

**Table 14. Projects in Norfolk District since 1994.**

| Project Location | Dredging Dates | CY of Material Removed | % during sea turtle season | Volume Removed during turtle season | total sea turtles | Log | KR | green | unknown |
|---|---|---|---|---|---|---|---|---|---|
| Cape Henry Channel | 7/23/18 | n/a | 1.000 | 1.000 | 1 | 1 | 0 | 0 | 0 |
| Thimble Shoals Channel | 4/26/17-8/31/17 | 1,098,514 | 1.000 | 1,098,514 | 1 | 1 | 0 | 0 | 0 |
| York Spit Channel | 5/23/15 – 8/4/15 | 815,979 | 1.000 | 815,979 | 6 | 6 | 0 | 0 | 0 |
| Cape Henry Channel | 4/2/15 – 6/1/15 | 478,566 | 1.000 | 478,566 | 0 | 0 | 0 | 0 | 0 |
| Cape Henry Channel | 4/23/14 – 9/5/14 | 1,686,859 | 1.000 | 1,686,859 | 4 | 3 | 1 | 0 | 0 |
| Thimble Shoals Channel | 4/23/14 – 7/31/14 | 863,933 | 1.000 | 863,933 | 0 | 0 | 0 | 0 | 0 |
| VA Beach Hurricane Protection (Thimble Shoal Channel) | 6/26/13 – 8/1/13 | 724,290 | 1.000 | 724,290 | 0 | 0 | 0 | 0 | 0 |
| Sandbridge Beach | 3/14/13 – 6/25/13 | 851,842 | 0.35 | 851,842 | 1 | 1 | 0 | 0 | 0 |
| VA Beach Hurricane Protection (Atlantic Ocean Channel) | 1/6/13-3/3/13 | 716,000 | 0.00 | - | 0 | 0 | 0 | 0 | 0 |
| Craney Island | 12/30/12-3/31/13, 4/1/13 – | 1,534,123 | 0.05 | 188,123 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 4/12/13 | | | | | | | | |
| Cape Henry Channel | 1/29/12 - 4/12/12 | 1,190,004 | 0.162 | 192,780.65 | 1 | 1 | 0 | 0 | 0 |
| York Spit | 3/1/12 - 3/8/12, 4/3/12 - 4/5/2012 | 145,332 | 0.200 | 29,066.40 | 1 | 1 | 0 | 0 | 0 |
| Cape Henry Channel | 2/9/11- 5/10/11 | 957,996 | 0.444 | 425,350.22 | 0 | 0 | 0 | 0 | 0 |
| York Spit | 1/9/11- 4/24/11 | 1,503,517 | 0.153 | 230,038.10 | 0 | 0 | 0 | 0 | 0 |
| Thimble Shoals | 12/19/10- 2/27/11; 4/19/11- 4/21/11 | 368,104 | 0.000 | - | 0 | 0 | 0 | 0 | 0 |
| Thimble Shoals | 4/4/09- 5/20/09 | 370,412 | 1.000 | 370,412.00 | 3 | 3 | 0 | 0 | 0 |
| York Spit | 6/18/07- 7/03/07; 7/13/07- 08/05/07 | 415,626 | 1.000 | 415,626.00 | 1 | 0 | 1 | 0 | 0 |
| Atlantic Ocean Channel (Deepening) | 12/24/05- 04/8/06; 4/16/06- 4/19/06 | 1,185,436 | 0.109 | 129,212.52 | 0 | 0 | 0 | 0 | 0 |
| Cape Henry Channel | 6/15/06- 7/21/06 | 447,238 | 1.000 | 447,238.00 | 3 | 3 | 0 | 0 | 0 |
| Thimble Shoal Channel | 6/13/06- 6/30/06; 7/10/06- 7/27/06 | 419,624 | 1.000 | 419,624.00 | 1 | 1 | 0 | 0 | 0 |
| York Spit Channel | 04/01/04- 04/06/04; 5/23/04- | 93,665 | 1.000 | 93,665.00 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 5/28/04 | | | | | | | | |
| Thimble Shoal Channel | 4/5/04-4/20/04; 4/30/04-5/01/04; 5/29/04-6/16/04 | 426,588 | 1.000 | 426,588.00 | 0 | 0 | 0 | 0 | 0 |
| York River Entrance Channel | 9/9/03-9/11/03; 10/17/03-11/30/03 | 268,641 | 1.000 | 268,641.00 | 0 | 0 | 0 | 0 | 0 |
| Sandbridge Beach | 05/1/03-5/25/03 | 1,500,000 | 1.000 | 1,500,000.00 | 0 | 0 | 0 | 0 | 0 |
| Thimble Shoal Channel (VA Beach) | 8/24/03-12/28/03 | 1,300,223 | 0.778 | 1,011,573.49 | 9 | 7 | 1 | 0 | 1 |
| Cape Henry Channel | 4/12/02-8/19/02; 10/21/02-11/02/02 | 2,449,285 | 1.000 | 2,449,285.00 | 8 | 6 | 1 | 1 | 0 |
| York Spit Channel | 8/20/02-10/21/02; 11/03/02-11/05/02 | 978,846 | 1.000 | 978,846.00 | 9 | 8 | 1 | 0 | 0 |
| Cape Henry Channel | 09/17/01-01/14/02 | 1,641,140 | 0.622 | 1,020,789.08 | 3 | 2 | 1 | 0 | 0 |
| VA Beach Hurricane Protection (Thimble Shoal Channel) | 6/26/01-11/30/01 | 4,000,000 | 1.000 | 4,000,000.00 | 6 | 5 | 0 | 0 | 1 |
| Cape Henry Channel | 04/08/00-06/02/00 | 541,037 | 1.000 | 541,037.00 | 0 | 0 | 0 | 0 | 0 |
| Thimble Shoal | 6/22/00- | 1,370,316 | 0.667 | 914,000.77 | 3 | 2 | 0 | 0 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Channel | 7/31/00; 8/13/00-9/19/00; 12/16/99-1/23/00 | | | | | | | | |
| Cape Henry Channel | 1/5/98-3/25/98 | 1,169,639 | 0.000 | - | 0 | 0 | 0 | 0 | 0 |
| York River Entrance Channel | 8/22/98-11/03/98 | 853,743 | 1.000 | 853,743.00 | 6 | 6 | 0 | 0 | 0 |
| York Spit Channel | 3/26/98-5/31/98 | 371,200 | 0.924 | 342,988.80 | 0 | 0 | 0 | 0 | 0 |
| Cape Henry Channel | 1/05/98-3/25/98 | 1,169,639 | 0.000 | - | 0 | 0 | 0 | 0 | 0 |
| Thimble Shoal Channel | 05/07/96-06/03/96 | 282,431 | 1.000 | 282,431.00 | 1 | 1 | 0 | 0 | 0 |
| Cape Henry Channel | 02/19/95-5/16/95 | 534,362 | 0.409 | 218,554.06 | | | | | |
| Cape Henry Channel | 4/11/94-5/12/94; 5/27/94-6/20/94 | 739,642 | 1.000 | 739,642.00 | 5 | 4 | 0 | 0 | 1 |
| York Spit Channel | 6/21/94-6/28/94 | 141,434 | 1.000 | 141,434.00 | 4 | 4 | 0 | 0 | 0 |
| | | | **TOTAL:** | **25,150,672** | ***77*** | **66** | **6** | **1** | **4** |

*6.1.1.2 Predicted Entrainment in Proposed Hopper Dredging*

Based on the data in Table 14, we calculate that an average of one sea turtle is entrained for approximately every 320,000 cubic yards (cy) removed (25,150,672 CY removed April – November divided by 77 sea turtles). This calculation has been based on a number of assumptions including the following: that sea turtles are evenly distributed throughout all channel reaches for which takes have occurred, that all dredges will take an identical number of sea turtles, and that sea turtles are equally likely to be encountered throughout the April to November time frame. Based on these calculations, we expect that for any hopper dredging project in any of the channels or borrow areas considered in this Opinion during the time of year when sea turtles are likely to be present, one sea turtle is likely to be entrained for every 320,000 cy of material removed by a hopper dredge. While this estimate is based on several assumptions, it is reasonable because it uses the best available information on entrainment of sea turtles from past dredging operations in the action area, includes multiple projects over several years, and all of the projects have had observer coverage.

Of the 77 entrained sea turtles, 73 have been identifiable to species; 66 were loggerheads, 6 Kemp's ridley and 1 green. Overall, of those identified to species, 90% were loggerheads, 8% Kemp's ridley and 2% green. The high percentage of loggerheads is likely due to several factors including their tendency to forage on the bottom where the dredge is operating and the fact that this species is the most numerous of the sea turtle species in Northeast and Mid-Atlantic waters. It is likely that the documentation of only one green sea turtle entrainment in Virginia dredging operations is a reflection of the low numbers of green sea turtles that occur in waters north of North Carolina.

Based on the above information, it is reasonable to expect that one sea turtle is likely to be injured or killed for approximately every 320,000 cy of material removed from the channels and borrow areas considered in this Opinion when dredging is carried out between April and November, and that 90% will be loggerheads, 8% will be Kemp's ridley and 2% will be green. Because sea turtles do not occur in the action area from December – March, we do not expect any entrainment during these months. Based on the information outlined above and the volume of material estimated to be removed from each reach during the time of year when sea turtles are likely to be present (in parentheses below), we anticipate the following levels of entrainment during hopper dredge activities:

**Table 15. Estimated Sea Turtle Takes During Construction**

| Project | Total Volume | Number of Interactions | | | |
|---|---|---|---|---|---|
| | | Total Sea Turtles | Loggerhead | Kemp's ridley | Green |
| Atlantic Ocean Channel | 16,074,736 | 50 | 45 | 4 | 1 |
| Thimble Shoals Channel | 18,069,823 | 56 | 50 | 4 | 2 |
| Thimble Shoals Channel Meeting Area #1 & #2 | 7,191,000 | 22 | 20 | 2 | 0 |
| Sewells Point to Lamberts Bend | 12,147,318 | 38 | 34 | 3 | 1 |
| Anchorage F | 1,914,788 | 6 | 5 | 1* | 1* |
| Newport News Channel | 4,906,284 | 15 | 14 | 1 | 0 |
| CIEE | 19,500,000 | 61 | 55 | 5 | 1 |
| | | **TOTAL:** | **223** | **20** | **6** |

*1 Kemp's ridley or green

**Table 16. Estimated Sea Turtle Takes During Maintenance Dredging**

| Project | Total Volume (cubic yards) | Number of Interactions | | | |
|---|---|---|---|---|---|
| | | Total Sea Turtles | Loggerhead | Kemp's ridley | Green |
| Atlantic Ocean Channel | 15,191,112 | 47 | 42 | 4 | 1 |
| Thimble Shoals Channel | 24,331,540 | 76 | 68 | 6 | 2 |
| Thimble Shoals Channel Meeting Area #1 & #2 | 3,640,924 | 11 | 10 | 1 | 0 |
| Sewells Point to Lamberts Bend | 42,346,689 | 132 | 119 | 10 | 3 |
| Anchorage F | 7,590,328 | 24 | 22 | 2 | 0 |
| Newport News Channel | 6,676,305 | 21 | 19 | 2 | 0 |
| | | **TOTAL:** | **280** | **25** | **6** |

| Project | Total Volume (cubic yards) | Number of Interactions | | | |
|---|---|---|---|---|---|
| | | Total Sea Turtles | Loggerhead | Kemp's ridley | green |
| Baltimore Harbor Entrance Channels | 64,500,000 | 215 | 194 | 17 | 4 |
| Virginia Beach Hurricane Project (TSS and AO borrow areas) | 4,400,000 | 15 | 13 | 1* | 1* |
| Sandbridge Shoal | 12,500,000 | 42 | 38 | 3 | 1 |
| | | **TOTAL:** | **245** | **21** | **6** |

*1 Kemp's ridley or green

### *6.1.2 Hopper Dredge Entrainment – Atlantic Sturgeon*

Atlantic sturgeon are vulnerable to entrainment in hopper dredges. Entrainment is believed to occur primarily when the draghead is not in firm contact with the channel bottom, so the potential exists that sturgeon feeding or resting on or near the bottom may be vulnerable to entrainment. Additionally, the size and flow rates produced by the suction power of the dredge, the condition of the channel being dredged, and the method of operation of the dredge and draghead all relate to the potential of the dredge to entrain sturgeon (Reine and Clarke 1998). These parameters also govern the ability of the dredge to entrain other species of fish, sea turtles, and shellfish.

The risk of interactions is related to both the amount of time sturgeon spend on the bottom and the behavior the fish are engaged in (i.e., whether the fish are overwintering, foraging, resting or migrating) as well as the intake velocity and swimming abilities of sturgeon in the area (Clarke 2011). Intake velocities at a typical large self-propelled hopper dredge are 11 feet per second. As noted above, exposure to the suction of the draghead intake is minimized by not turning on the suction until the draghead is properly seated on the bottom sediments and by maintaining contact between the draghead and the bottom.

A significant factor influencing potential entrainment is based upon the swimming stamina and size of the individual fish at risk (Boysen and Hoover 2009). Swimming stamina is positively correlated with total fish length. Entrainment of larger sturgeon is less likely due to the increased swimming performance and the relatively small size of the draghead opening. Juvenile entrainment is possible depending on the location of the dredging operations and the time of year in which the dredging occurs. Typically, major concerns of juvenile entrainment relate to fish below 200 mm (Hoover *et al.*, 2005; Boysen and Hoover, 2009). Juvenile sturgeon are not as powerful swimmers as older, larger fish and they are prone to bottom-holding behaviors, which make them more vulnerable to entrainment when in close proximity to dragheads (Hoover *et al.*, 2011).

In general, entrainment of large mobile animals, such as sturgeon, is relatively rare. Several factors are thought to contribute to the likelihood of entrainment. In areas where animals are present in high density, the risk of an interaction is greater because more animals are exposed to the potential for entrainment. The risk of entrainment is likely to be higher in areas where the movements of animals are restricted (e.g., in narrow rivers or confined bays) where there is limited opportunity for animals to move away from the dredge than in unconfined areas such as wide rivers or open bays. The hopper dredge draghead operates on the bottom and is typically at least partially buried in the sediment. Sturgeon are benthic feeders and are often found at or near the bottom while foraging or while moving within rivers. Sturgeon at or near the bottom could be vulnerable to entrainment if they were unable to swim away from the draghead.

Entrainment of Atlantic sturgeon during hopper dredging operations in Federal navigation channels appears to be relatively rare. From 1990-2012, USACE documented 28 incidents of sturgeon entrainment on monitored hopper dredges (see Appendix C). Of these, 20 were Atlantic sturgeon, five were shortnose and two were Gulf sturgeon (one unknown). Since that report was generated, one Atlantic sturgeon was entrained in the Ambrose Channel, New York

(October 2012; alive); one Atlantic sturgeon was entrained in the Delaware River in May 2013 (released alive); five sturgeon were entrained in the Delaware River by hopper dredges in 2014; and two sturgeon were entrained in 2017. USACE-Norfolk District and Baltimore District hopper dredging projects have been monitored in the Chesapeake Bay from 1994 to present. During this period, observers have been present during the removal of more than 18 million cubic yards of dredged material from the channels considered in this consultation (see Table 14 above) with only two documented entrainments of Atlantic sturgeon.

As explained above, since 1994, endangered species observers have been present for at least a portion of all hopper dredging done during the April – November time frame in the action area. Only two entrained Atlantic sturgeon have been documented during any hopper dredge activity in the action area, both in YSC in April 2011. Additionally, during sea turtle relocation trawling conducted in the fall of 2003 in conjunction with the 50-foot deepening of the inbound element of the Thimble Shoal Channel, 14 Atlantic sturgeon were captured by the trawler and released live in and around the channel; no incidental takes of Atlantic sturgeon by hopper dredge were observed during this period.

On a hopper dredge, it is possible to monitor entrainment because the dredged material is retained on the vessels as opposed to the direct placement of dredged material both overboard or in confined disposal facilities by a hydraulic pipeline dredge. A hopper dredge contains screened inflow cages from which an observer can inspect recently dredged contents. Typically, the observer inspection is performed at the completion of each load while the vessel is transiting to the authorized placement area and does not impact production of the dredging operations.

In the fall of 2003, the Norfolk District captured fourteen Atlantic sturgeon during sea turtle relocation trawling activities supporting hopper dredging operations in Thimble Shoals Channel in the Chesapeake Bay. The Atlantic sturgeon were captured in the immediate vicinity of the dredging operation with no entrainment observed by NMFS approved observers onboard the hopper dredge before, during or after the relocation trawling where Atlantic sturgeon were captured.

Given the large size of adults (greater than 150cm) and the size of the openings on the dragheads, adult Atlantic sturgeon are unlikely to be vulnerable to entrainment. USACE reports that from 1990-2012, 37 confirmed interactions with sturgeon occurred during dredge operations (see Appendix C). Of these, 22 were reported as Atlantic sturgeon (20 individuals; two individuals were observed in 2 separate pieces), with 19 of these entrained in hopper dredges. Of the entrained Atlantic sturgeon for which size is available, all were subadults (larger than 50cm but less than 150cm). Information on these interactions is presented in Table 17. Most of these interactions occurred within rivers and harbors.

**Table 17. USACE Atlantic Sturgeon Entrainment Records from Hopper Dredge Operations 1990-2012**

| Project Location | Corps Division/District * | Month/Year Interaction Observed | Cubic Yards Removed | Observed** Entrainment |
|---|---|---|---|---|
| Winyah Bay, Georgetown (SC) | SAD/SAC | Oct-90 | 517,032 | 1 |
| Savannah Harbor (GA) | SAD/SAS | Jan-94 | 2,202,800 | 1 |
| Savannah Harbor | SAD/SAS | Dec-94 | 2,239,800 | 2 |
| Wilmington Harbor, Cape Fear River (NC) | SAD/SAW | Sep-98 | 196,400 | 1 |
| Charleston Harbor (SC) | SAD/SAC | Mar-00 | 5,627,386 | 2 |
| Brunswick Harbor (GA) | SAD/SAS | Feb-01 | 1,459,630 | 1 |
| Charleston Harbor | SAD/SAC | Jan-04 | 1,449,234 | 1 |
| Brunswick Harbor | SAD/SAS | Mar-05 | 966,000 | 1 |
| Brunswick Harbor | SAD/SAS | Dec-06 | 1,198,571 | 1 |
| Savannah Entrance Channel | SAD/SAS | Jan-07 | 973,463 | 1 |
| Savannah Entrance Channel | SAD/SAS | Mar-09 | 261,780 | 1 |
| Brunswick Entrance Channel | SAD/SAS | Feb-10 | 1,728,339 | 3 |
| Wilmington Harbor | SAD/SAW | Dec-10 | 857,726 | 1 |
| York Spit (VA) | NAD/NAN | Apr-11 | 1,630,713 | 2 |
| Charleston Harbor | SAD/SAC | Mar-12 | 1,100,000 | 1 |
| | | **Total** | **22,408,874** | **20** |

* SAD= South Atlantic Division; NAD= North Atlantic Division; SAC=Charleston District; SAS=Savannah District; SAW=Wilmington District; NANY=New York District; NAN=Norfolk District.

** Records based on sea turtle observer reports which record listed species entrained as well as all other organisms entrained during dredge operations.

The only instances of observed Atlantic sturgeon entrainment in hopper dredges in our Gretaer Atlantic Region are two sturgeon entrained at York Spit, VA in 2011 (both were killed), one live Atlantic sturgeon entrained in Sandy Hook, NJ in 2008, one dead Atlantic sturgeon entrained in Ambrose Channel, NY in 2012, and seven in the Delaware River between 2013 and 2017. As

described in the discussion of sea turtles above, many other hopper dredge projects have occurred in our Greater Atlantic Region; nearly all of which overlap with times and areas where Atlantic sturgeon are known to be present. Because observers have been present on these dredges and we expect that any interactions with Atlantic sturgeon would have been reported to us, the interaction rate between hopper dredges and Atlantic sturgeon seems to be very low (1 Atlantic sturgeon for every 9 mcy removed for the action area, just considering the volume of material removed when observers were present). Even just considering the projects listed in Table 17, where entrainment was recorded, we calculate an entrainment rate of one Atlantic sturgeon for approximately every 1.2 million cy of material removed. If we consider all projects in the action area where observers were present (see table 14) as well as projects outside the action area where interactions with Atlantic sturgeon were recorded (see table 17), we calculate an entrainment rate of 1 Atlantic sturgeon for every 2 mcy removed.

The entrainment estimate generated above using all projects in the Chesapeake Bay where observers have been present plus all projects in rivers and bays where entrained Atlantic sturgeon have been observed is an overestimate because it does not consider other projects outside the action area where no entrainment occurred. However, at this time, it is the best available estimate of entrainment rates for Atlantic sturgeon and hopper dredges. Just using the projects within the Chesapeake Bay (table 14) is likely to be an underestimate because there has only been observer coverage between April and November and Atlantic sturgeon may be present year round.

Based on the above information, we expect one Atlantic sturgeon to be entrained for approximately every two mcy of material removed with a hopper dredge. Given the size of adult Atlantic sturgeon (greater than 150cm) and the size of observed entrained sturgeon (less than 150cm), we do not anticipate the entrainment of any adult Atlantic sturgeon. Given the location of the channels and borrow areas to be dredged, juveniles, subadults, and adults will be present; therefore, we anticipate that all entrained Atlantic sturgeon will be juveniles and subadults less than 150cm in size.

There is evidence that some Atlantic sturgeon, particularly juveniles and small subadults, could be entrained in the dredge and survive. However, as the extent of internal injuries and the likelihood of survival is unknown, and the size of the fish likely to be entrained is impossible to predict, it is reasonable to conclude that any Atlantic sturgeon entrained in the hopper dredge are likely to be killed. Based on the NEFOP mixed-stock analysis, we have determined that Atlantic sturgeon in the action area likely originate from the five DPSs at the following frequencies: NYB 49%; South Atlantic 20%; Chesapeake Bay 14%; Gulf of Maine 11%; and Carolina 4%; we anticipate that entrained Atlantic sturgeon will occur at similar frequencies.

**Table 18. Expected Entrainment of Atlantic sturgeon in hopper dredges during construction**

| Project | Total Volume | Number of Interactions | | | | | |
|---|---|---|---|---|---|---|---|
| | | Total Atlantic sturgeon | NYB DPS | SA DPS | CB DPS | GOM DPS | Carolina DPS |
| Atlantic Ocean Channel | 16,074,736 | 8 | 4 | 2 | 1 | 1 | 0 |
| Thimble Shoals Channel | 18,069,823 | 9 | 5 | 2 | 1 | 1 | 0 |
| Thimble Shoals Meeting Areas #1 & #2 | 7,191,000 | 4 | 2 | 1 | 1 | 0 | 0 |
| Sewell's Point to Lamberts Bend | 12,147,318 | 6 | 3 | 1 | 1 | 1 | 0 |
| Anchorage F | 1,914,788 | 1 | 1* | 1* | 1* | 1* | 1* |
| Newport News Channel | 4,906,284 | 3 | 1 | 1 | 1* | 1* | 1* |
| CIEE | 19,500,000 | 10 | 5 | 2 | 1 | 1 | 1 |
| | | **Total:** | **21** | **10** | **7** | **6** | **3** |

**Table 19. Expected Entrainment of Atlantic sturgeon in hopper dredges during maintenance over the life of the project.**

| Project | Total Volume | Number of Interactions | | | | | |
|---|---|---|---|---|---|---|---|
| | | Total Atlantic sturgeon | NYB DPS | SA DPS | CB DPS | GOM DPS | Carolina DPS |
| Atlantic Ocean Channel | 15,191,112 | 8 | 4 | 2 | 1 | 1 | 0 |
| Thimble Shoals Channel | 24,331,540 | 12 | 6 | 2 | 2 | 1 | 1 |
| Thimble Shoals Meeting Areas #1 & #2 | 3,640,924 | 2 | 1 | 1* | 1* | 1* | 1* |
| Sewell's Point to Lamberts Bend | 42,346,689 | 21 | 11 | 4 | 3 | 2 | 1 |
| Anchorage F | 7,590,328 | 4 | 2 | 1 | 1 | 0 | 0 |
| Newport News Channel | 6,676,305 | 3 | 3 | 1 | 1* | 1* | 1* |
| | | **Total:** | **27** | **11** | **9** | **6** | **4** |

| Project | Total Volume | Number of Interactions | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Total Atlantic sturgeon** | **NYB DPS** | **SA DPS** | **CB DPS** | **GOM DPS** | **Carolina DPS** |
| Baltimore Harbor Entrance Channels | 64,500,000 | 32 | 16 | 6 | 5 | 4 | 1 |
| Virginia Beach Hurricane Project | 4,400,000 | 2 | 1 | 1* | 1* | 1* | 1* |
| Sandbridge Shoal | 12,500,000 | 6 | 3 | 1 | 1 | 1* | 1* |
| | | **Total:** | **20** | **8** | **7** | **6** | **3** |

*Using the 1 fish per 2 mil cy of dredge material method for estimating takes from entrainment in hopper dredges described above, we estimated take of <1 sturgeon, so using our mixed-stock analysis the individual could originate from any one of the these DPSs.

### *6.1.3 Interactions with the Sediment Plume - Hopper Dredge*

Physical and biological impairments to the water column can occur from increases in turbidity which can alter light penetration. The proposed dredging will cause temporary increases in turbidity and suspension of sediments during dredging operations. As a result, the increase in turbidity can impact primary productivity and respiration of organisms within the project area. The re-suspension of sediments from dredging and dredged material placement can prevent or reduce gas-water exchanges in the gills of fish (Germano and Cary, 2005; Clarke and Wilber, 2000). The amount of impact that this can have on a species is dependent on the sensitivity of that species. This increase in turbidity can also impact prey species' predator avoidance response ability due to the decreased clarity in the water column.

Increased suspended sediment resulting from dredging can also reduce dissolved oxygen. Low dissolved oxygen conditions can be generated by the dredging operations from the resuspension of sediments and the biochemical oxygen demand of the surrounding water (Johnston, 1981). This can be particularly important during the summer months when water temperatures are warmer and less capable of holding dissolved oxygen. Dredging during the warmer months can exacerbate low dissolved oxygen conditions (Hatin *et al*., 2007a).

Dredging operations cause sediment to be suspended in the water column. This results in a

sediment plume in the water, typically present from the dredge site and decreasing in concentration as sediment falls out of the water column as distance increases from the dredge site. The nature, degree, and extent of sediment suspension around a dredging operation are controlled by many factors including: the particle size distribution, solids concentration, and composition of the dredged material; the dredge type and size, discharge/cutter configuration, discharge rate, and solids concentration of the slurry; operational procedures used; and the characteristics of the hydraulic regime in the vicinity of the operation, including water composition, temperature and hydrodynamic forces (i.e., waves, currents, etc.) causing vertical and horizontal mixing (USACE 1983).

Resuspension of fine-grained dredged material during hopper dredging operations is caused by the dragheads as they are pulled through the sediment, turbulence generated by the vessel and its prop wash, and overflow of turbid water during hopper filling operations. During the filling operation, dredged material slurry is often pumped into the hoppers after they have been filled with slurry in order to maximize the amount of solid material in the hopper. The lower density, turbid water at the surface of the filled hoppers overflows and is usually discharged through ports located near the waterline of the dredge. Use of this "overflow" technique results in a larger sediment plume than if no overflow is used. In 1998, a study was done of overflow and nonoverflow hopper dredging using the McFarland hopper dredge (USACE 2013). Monitoring of the sediment plumes was accomplished using a boat-mounted 1,200-kHz Broad-Band Acoustic Doppler Current Profiler (ADCP). The instrument collects velocity vectors in the water column together with backscatter levels to determine the position and relative intensity of the sediment plume. Along with the ADCP, a MicroLite recording instrument with an Optical Backscatterance (OBS) Sensor was towed by the vessel at a depth of 15 ft. The MicroLite recorded data at 0.5-sec intervals. Navigation data for monitoring were obtained by a Starlink differential Global Positioning System (GPS). The GPS monitors the boat position from the starting and ending points along each transect.

Transects were monitored in the test area to obtain the background levels of suspended materials prior to dredging activities. A period of 8 minutes following the dredge passing during non-overflow dredging showed the level of suspended material to be returning to background levels. No lateral dispersion of the plume out of the channel was observed during the non-overflow dredging operation. During overflow dredging, a wider transect was performed to determine the lateral extent of the plume. No significant change above background levels could be detected. At 1-hr elapsed time following the end of the overflow dredging operation, the levels of suspended material returned to background conditions. Again, no lateral dispersion of the plume out of the channel area was observed.

Overall, water quality impacts are anticipated to be minor and temporary in nature. Once dredging operations are complete the project area will soon return to ambient conditions due to the dilution or re-deposition of suspended sediments along with the strong littoral currents of the Chesapeake Bay, its river mouths, and the Atlantic Ocean.

No information is available on the effects of total suspended solids (TSS) on juvenile and adult sea turtles. TSS is most likely to affect sea turtles if a plume causes a barrier to normal behaviors or if sediment settles on the bottom affecting sea turtle prey. As sea turtles are highly mobile they are likely to be able to avoid any sediment plume, which is expected to be limited to the

navigation channel and for no more than 8 minutes. Any effect on sea turtle movements between foraging areas or while migrating through the action area is likely to be so small that it cannot be meaningfuly measured or detected and is therefore insignificant.

Studies of the effects of turbid water on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). The TSS levels expected for all of the proposed activities (ranging from 5 mg/L to 475 mg/L) are below those shown to have adverse effect on fish (580 mg/L for the most sensitive species, with 1,000 mg/L more typical; see summary of scientific literature in Burton 1993) and benthic communities (390 mg/L (EPA 1986)). With the exception of near field hopper dredge impacts, TSS levels will not reach levels that are toxic to benthic communities. We expect elevated levels of TSS to settle out of the water column in about an hour. Mobile prey items will likely be able to uncover themselves from any deposited sediment, while a small percentage of non-mobile prey in the near field range of a hopper may be buried/suffocated. Therefore, effects to sturgeon and sea turtle foraging opportunities from TSS impacts to benthic communities in the navigation channel are largely temporary and limited to a small area (i.e., the near-field range of where remaining hopper dredge deepening and maintenance dredging of shoals will occur). Using the data you have provided, the total area subject to deepening and maintance dredging is approximately 7,492 acres. The additional area potentially impacted by near field hopper dredging plumes beyond the area to be dredged would be slightly larger, as turbidity plumes extend away from the dredge footprint. This area is approximately .26% of the area in Chesapeake Bay. Effects on sturgeon and sea turtle fitness from reduced prey in these small areas relative to available foraging areas in the rest of the action area are too small to be meaningfully measured or detected, and are insignificant.

The life stages of sturgeon most vulnerable to increased sediment are eggs and non-mobile larvae, which are subject to burial and suffocation. As noted above, because of the distance of the projects from the spawning grounds, no Atlantic sturgeon eggs and/or larvae will be present in the action area. Any Atlantic sturgeon in the action area during dredging would be capable of avoiding any sediment plume by swimming around it. Laboratory studies (Niklitschek 2001 and Secor and Niklitschek 2001) have demonstrated shortnose and Atlantic sturgeon are able to actively avoid areas with unfavorable water quality conditions and that they will seek out more favorable conditions when available. While the increase in suspended sediments may cause sturgeon to alter their normal movements, any change in behavior will only involve movement further up in the water column, or movement to an area just outside of the navigation channel. Based on the best available information, we will not be able to meaningfully detect, evaluate, or measure the effects of re-suspended sediment on sturgeon resulting from proposed activities when added to baseline conditions. Therefore, effects on mobile sturgeon are insignificant.

## 6.2 Hydraulic Cutterhead Dredge

Hydraulic pipeline dredges tend to be more efficient than the hopper style dredges because the pipeline conveys sand directly to the placement site. However, hydraulic pipeline dredges are not well-adapted to work in environments with high wave energy. Most pipeline dredges have a cutterhead on the suction end. A cutterhead is a mechanical device that has rotating blades or teeth to break up or loosen the bottom material so that it can be sucked through the dredge. Some cutterheads are rugged enough to break up rock for removal. Pipeline dredges are

mounted (fastened) to barges and are not usually self-powered, but are towed to the dredging site and secured in place by special anchor piling, called spuds. To move the dredge, the operator's raises and lowers opposite spuds to crab crawl the dredge along at a much slower pace than hopper style dredges and are subsequently less maneuverable. A hydraulic pipeline dredge removes material by controlling the dragline on which the suction cutterhead is attached. This style of dredge works more efficiently when it can move slowly and remove deeper materials as it moves along using the spuds. Material is directly mixed with water as it is sucked into the pipeline and hydraulically pumped and sent directly to the spoil disposal site. This makes this style dredge more efficient that a hopper style dredge that is required to move to a pump-out site to dispose of material. The suction is created by hydraulic pumps either located on board or in route along the pipeline acting as a booster and creates the same low pressure around the drag heads as a hopper dredge to force the material along the pipeline. As with the hopper style dredge, the more closely the cutterhead is maintained in contact with the sediment, the more efficient the dredging.

Sea turtles are not known to be vulnerable to entrainment in cutterhead dredges. This is thought to be due to the size of sea turtles and their swimming ability that allows them to escape the intake velocity near a cutterhead. There are no records of any sea turtles being entrained in cutterhead dredges in the Chesapeake Bay or anywhere else. Based on the available information, we do not anticipate any entrainment of sea turtles any time a cutterhead dredge is used.

### *6.2.1 Available Information on the Risk of Entrainment of Sturgeon in Cutterhead Dredge*

As noted above, a cutterhead dredge operates with the dredge head buried in the sediment; however, a flow field is produced by the suction of the operating dredge head. The amount of suction produced is dependent on linear flow rates inside the pipe and the pipe diameter (Clausner and Jones 2004). High flow rates and larger pipes create greater suction velocities and wider flow fields. The suction produced decreases exponentially with distance from the dredge head (Boysen and Hoover 2009). With a cutterhead dredge, material is pumped directly from the dredged area to a disposal site. As such, there is no opportunity to monitor for biological material on board the dredge; rather, observers work at the disposal site to inspect material.

It is generally assumed that sturgeon are mobile enough to avoid the suction of an oncoming cutterhead dredge and that any sturgeon (with the exception of eggs and immobile larvae) in the vicinity of such an operation would be able to avoid the intake and escape. However, in mid-March 1996, two shortnose sturgeon were found in a dredge discharge pool on Money Island, near Newbold Island in the upper Delaware River. The dead sturgeon were found on the side of the spoil area into which the hydraulic pipeline dredge was pumping. An assessment of the condition of the fish indicated that the fish were likely alive and in good condition prior to entrainment and that they were both adult females. The area where dredging was occurring was a known overwintering area for shortnose sturgeon and large numbers of shortnose sturgeon were known to be concentrated in the general area. A total of 509,946 cy were dredged between Florence and the upper end of Newbold Island during this dredge cycle. Since that time, dredging occurring in the winter months in the Newbold – Kinkora range of the Delaware River required that inspectors conduct daily inspections of the dredge spoil area in an attempt to detect the presence of any sturgeon. In January 1998, three shortnose sturgeon carcasses were

discovered in the Money Island Disposal Area. The sturgeon were found on three separate dates: January 6, January 12, and January 13. Dredging was being conducted in the Kinkora and Florence ranges at this time which also overlaps with the shortnose sturgeon overwintering area. A total of 512,923 cy of material was dredged between Florence and upper Newbold Island during that dredge cycle. While it is possible that not all shortnose sturgeon killed during dredging operations were observed at the dredge disposal pool, USACE has indicated that due to flow patterns in the pool, it is expected that all large material (i.e., sturgeon, logs etc.) will move towards the edges of the pool and be readily observable. Monitoring of dredge disposal areas used for deepening of the Delaware River with a cutterhead dredge has occurred. Dredging in Reach C occurred from March – August 2010 with 3,594,963 cy of material removed with a cutterhead dredge. Dredging in Reach B occurred in November and December 2011, with 1,100,000 cy of material removed with a cutterhead dredge. In both cases, the dredge disposal area was inspected daily for the presence of sturgeon. No sturgeon were detected.

In an attempt to understand the behavior of sturgeon while dredging is ongoing, the USACE worked with sturgeon researchers to track the movements of tagged Atlantic and shortnose sturgeon while cutterhead dredge operations were ongoing in Reach B (ERC 2011). The movements of acoustically tagged sturgeon were monitored using both passive and active methods. Passive monitoring was performed using 14 VEMCO VR2 and VR2W single-channel receivers, deployed through the study area. These receivers are part of a network that was established and cooperatively maintained by Environmental Research and Consulting, Inc. (ERC), Delaware State University (DSU), and the Delaware Department of Natural Resources and Environmental Control (DNREC). Nineteen tagged Atlantic sturgeon and three tagged shortnose sturgeon (all juveniles) were in the study area during the time dredging was ongoing. Eleven of the 19 juvenile Atlantic sturgeon detected during this study remained upriver of the dredging area and showed high fidelity to the Marcus Hook anchorage. Three of the juvenile sturgeon detected during this study (Atlantic sturgeons 13417, 1769; shortnose sturgeon 58626) appeared to have moved through Reach B when the dredge was working. The patterns and rates of movement of these fish indicated nothing to suggest that their behavior was affected by dredge operation. The other sturgeon that were detected in the lower portion of the study area either moved through the area before or after the dredging period (Atlantic sturgeons 2053, 2054), moved through Reach B when the dredge was shut down (Atlantic sturgeons 1774, 58628, 58629), or moved through the channel on the east side of Cherry Island Flats (shortnose sturgeon 2090, Atlantic sturgeon 2091) opposite the main navigation channel. It is unknown whether some of these fish chose behaviors (routes or timing of movement) that kept them from the immediate vicinity of the operating dredge. In the report, Brundage speculates that this could be to avoid the noisy area near the dredge but also states that on the other hand, the movements of the sturgeon reported here relative to dredge operation could simply have been coincidence.

A similar study was carried out in the James River (Virginia) (Cameron 2012). Dredging occurred with a cutterhead dredge between January 30 and February 19, 2009 with 166,545 cy of material removed over 417.6 hours of active dredge time. Six subadult Atlantic sturgeon (77.5 – 100 cm length) were caught, tagged with passive and active acoustic tags, and released at the dredge site. The study concluded that: tagged fish showed no signs of impeded up- or downriver movement due to the physical presence of the dredge; fish were actively tracked freely moving past the dredge during full production mode; fish showed no signs of avoidance response (e.g.,

due to noise generated by the dredge) as indicated by the amount of time spent in close proximity to the dredge after release (3.5 – 21.5 hours); and, tagged fish showed no evidence of attraction to the dredge.

Several scientific studies have been undertaken to understand the ability of sturgeon to avoid cutterhead dredges. Hoover *et al.* (2011) demonstrated the swimming performance of juvenile lake sturgeon and pallid sturgeon (12 – 17.3 cm FL) in laboratory evaluations. The authors compared swimming behaviors and abilities in water velocities ranging from 10 to 90 cm/second (0.33-3.0 feet per second). Based on the known intake velocities of several sizes of cutterhead dredges. At distances more than 1.5 meters from the dredges, water velocities were negligible (10 cm/s). The authors conclude that in order for a sturgeon to be entrained in a dredge, the fish would need to be almost on top of the drag head and be unaffected by associated disturbance (e.g., turbidity and noise). The authors also conclude that juvenile sturgeon are only at risk of entrainment in a cutterhead dredge if they are in close proximity, less than 1 meter, to the cutterhead.

Boysen and Hoover (2009) assessed the probability of entrainment of juvenile white sturgeon by evaluating swimming performance of young of the year fish (8-10 cm TL). The authors determined that within 1.0 meter of an operating dredge head, all fish would escape when the pipe was 61 cm (2 feet) or smaller. Fish larger than 9.3 cm (about 4 inches) would be able to avoid the intake when the pipe was as large as 66 cm (2.2 feet). The authors concluded that regardless of fish size or pipe size, fish are only at risk of entrainment within a radius of 1.5 – 2 meters of the dredge head; beyond that distance, velocities decrease to less than 1 foot per second.

Clarke (2011) reports that a cutterhead dredge with a suction pipe diameter of 36” (larger than the one to be used for this project) has an intake velocity of approximately 95 cm/s at a distance of 1 meter from the dredge head and that the velocity reduces to approximately 40cm/s at a distance of 1.5 meters, 25cm/s at a distance of 2.0 meters and less than 10cm/s at a distance of 3.0 meters. Clarke also reports on swim tunnel performance tests conducted on juvenile and subadult Atlantic, white and lake sturgeon. He concludes that there is a risk of sturgeon entrainment only within 1 meter of a cutterhead dredge head with a 36” pipe diameter and suction of 4.6m/second.

### *6.2.2 Predicted Entrainment of Atlantic sturgeon in a cutterhead dredge*

The risk of an individual sturgeon being entrained in a cutterhead dredge is difficult to calculate. While a large area overall will be dredged, the dredge operates in an extremely small area at any given time (i.e., the river or ocean bottom in the immediate vicinity of the intake). None of the dredging is proposed in habitat where sturgeon are known to aggregate (i.e., deep holes). An individual would need to be in the immediate area where the dredge is operating to be entrained (i.e., within 1 meter of the dredge head). The overall risk of entrainment is low. It is likely that the nearly all Atlantic sturgeon in the action area will never encounter the dredge as they would not occur within 1 meter of the dredge. Information from the tracking studies in the James and Delaware River supports these assessments of risk, as none of the tagged sturgeon were attracted to or entrained in the operating dredges.

The entrainment of five sturgeon in the upper Delaware River indicates that entrainment of sturgeon in cutterhead dredges is possible. However, there are several factors that may increase the risk of entrainment in that area of the river as compared to the areas where cutterhead dredging will occur for this action. All five entrainments occurred during the winter months in an area where shortnose sturgeon are known to concentrate in dense aggregations; sturgeon in these aggregations rest on the bottom and exhibit little movement and may be slow to respond to stimuli such as an oncoming dredge. Additionally, the area where dredging was occurring is fairly narrow and constricted which may limit the ability of sturgeon to avoid the oncoming dredge. These conditions are not present in any of the areas where a cutterhead dredge will be used.

Because the only entrainment of Atlantic or shortnose sturgeon in cutterhead dredges in the United States has been the five shortnose sturgeon found at the disposal site in the upper Delaware River it is difficult to predict the number of Atlantic sturgeon that are likely to be entrained during cutterhead dredging in the action area. Based on the available information presented here, entrainment in a cutterhead dredge is likely to be rare, and would only occur if a sturgeon was within 1 meter of the dredge head. However, because we know that entrainment is possible, we expect that over the project life considered here, some entrainment with a cutterhead dredge will occur. Based on the predicted rarity of the entrainment event, we expect that no more than one Atlantic sturgeon will be entrained each year that a cutterhead dredge is used for dredging in one of the channels discussed herein; this expected amount of entrainment is inclusive of the use of a cutterhead dredge in Norfolk Harbor and the CIEE expansion. Due to the suction, travel through up to several miles of pipe and any residency period in the disposal area, all entrained Atlantic sturgeon are expected to be killed.

Based on the mixed stock analysis, it is likely that most of the entrained Atlantic sturgeon will originate from the New York Bight DPS but could also originate from the Gulf of Maine, Chesapeake Bay or South Atlantic DPS. Given the mixed stock percentages presented above and an estimate of no more than one mortality per year, we expect the following mortality of Atlantic sturgeon in cutterhead dredges:

**Table 20. Expected Takes of Atlantic Sturgeon by Cutterhead Dredges**

| Number of Atlantic Sturgeon over the life span of the Project | DPS |
|---|---|
| 25 | New York Bight |
| 10 | South Atlantic |
| 8 | Chesapeake Bay |
| 5 | Gulf of Maine |
| 2 | Carolina |

### *6.2.3 Interactions with the Sediment Plume from Cutterhead Dredges*

The increased turbidity and suspended sediments related to the cutterhead dredging and placement activities are anticipated to have short term, temporary impacts to water quality. Placement of sand at the designated beach nourishment site will be via hydraulic pipeline. Sand will be deposited directly on the beach and graded to profile. Fine particles that may be present in the sand will be transported and dispersed in the swash zone.

Dredging operations cause sediment to be suspended in the water column. This results in a sediment plume in the waterway, typically present from the dredge site and decreasing in concentration as sediment falls out of the water column as distance increases from the dredge site. Dredging with a pipeline dredge minimizes the amount of material re-suspended in the water column as the material is essentially vacuumed up and transported to the disposal site in a pipe.

As reported by you, a near-field water quality modeling of dredging operations in the Delaware River was conducted in 2001. The purpose of the modeling was to evaluate the potential for sediment contaminants released during the dredging process to exceed applicable water quality criteria. The model predicted suspended sediment concentrations in the water column at downstream distances from a working cutterhead dredge in fine-grained dredged material. Suspended sediment concentrations were highest at the bottom of the water column, and returned to background concentrations within 100 meters downstream of the dredge.

In 2005, FERC presented us with an analysis of results from the DREDGE model used to estimate the extent of any sediment plume associated with the proposed dredging at the Crown Landing LNG berth (FERC 2005). The model results indicated that the concentration of suspended sediments resulting from hydraulic dredging would be highest close to the bottom and would decrease rapidly downstream and higher in the water column. Based on a conservative (i.e., low) TSS background concentration of 5mg/L, the modeling results indicated that elevated TSS concentrations (i.e., above background levels) would be present at the bottom 2 meters of the water column for a distance of approximately 1,150 feet. Based on these analyses, elevated suspended sediment levels are expected to be present only within 1,150 feet of the location of the cutterhead. Turbidity levels associated with cutterhead dredge sediment plumes typically range from 11.5 to 282 mg/L with the highest levels detected adjacent to the cutterhead and concentrations decreasing with greater distance from the dredge (see U. Washington 2001).

No information is available on the effects of total suspended solids (TSS) on juvenile and adult sea turtles. Of the effects causing increased levels of TSS discussed above, sea turtles may be exposed to sediment plumes from cutterhead dredging. TSS is most likely to affect sea turtles if a plume causes a barrier to normal behaviors or if sediment settles on the bottom affecting sea turtle prey. In all cases where sea turtles would be exposed to increased TSS resulting from proposed activities in this Opinion (mainly the lower Chesapeake Bay), the area is sufficiently wide for the highly mobile sea turtles to avoid any sediment plume with minor movements. Any effect on sea turtle movements is likely to be too small to be meaningfully measured or detected, and is therefore, insignificant.

Studies of the effects of turbid waters on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). The studies reviewed by Burton demonstrated lethal effects to fish at concentrations of 580mg/L to 700,000mg/L depending on species. Sublethal effects have been observed at substantially lower turbidity levels. For example, prey consumption was significantly lower for striped bass larvae tested at concentrations of 200 and 500 mg/L compared to larvae exposed to 0 and 75 mg/L (Breitburg 1988 in Burton 1993). Studies with striped bass adults showed that pre-spawners did not avoid concentrations of 954 to 1,920 mg/L to reach spawning sites (Summerfelt and Moiser 1976 and Combs 1979 in Burton 1993).

The life stages of sturgeon most vulnerable to increased sediment are eggs and non-mobile larvae, which are subject to burial and suffocation. As noted above, no sturgeon eggs and/or larvae will be present in the action area. Juvenile, subadult, and adult Atlantic sturgeon are frequently found in turbid water and would be capable of avoiding any sediment plume by swimming higher in the water column. All sturgeon in the action area would be sufficiently mobile to avoid any sediment plume. Therefore, any Atlantic sturgeon in the action area during dredging would be capable of avoiding any sediment plume by swimming around it.

## 6.3 Mechanical Dredge

Mechanical dredging will be used in association with CIEE and in some of the Norfolk Harbor Channels. Aquatic species can be captured in dredge buckets and may be injured or killed from entrapment in the bucket or burial in sediment during dredging and/or when sediment is deposited into the dredge scow. Fish captured and emptied out of the bucket could suffer stress or injury, which could also lead to mortality.

### *6.3.1 Impacts to Sea Turtles*

No sea turtles have been captured in mechanical dredges in the action area. You have no records of any sea turtles being captured in mechanical dredges anywhere. Most mobile organisms, including adult and juvenile sea turtles, are able to avoid mechanical dredge buckets. The slow movement of the dredge bucket through the water column and the relatively small area of bottom impacted by each pass of the bucket makes the likelihood of interaction between a dredge bucket and an individual fish relatively low. Based on all available evidence, the risk of sea turtles being captured in a mechanical dredge is extremely unlikely and, therefore, discountable. As such, we do not anticipate any capture of sea turtles during any mechanical dredging considered here.

### *6.3.2 Capture of Atlantic sturgeon in the dredge bucket*

In rare occurrences sturgeon have been captured in dredge buckets and placed in the scow. Very few mechanical dredge operations have employed observers to document interactions between sturgeon and the dredge; because of that we do not know if the lack of observations is a result of fish not being captured at other projects or that captures occur but are not observed. Captures of two shortnose and one Atlantic sturgeon have been documented at the Bath Iron Works (BIW) facility in the Kennebec River, Maine. It is unknown if these observations are the result of a unique situation in this river or whether interactions have occurred elsewhere but have just been undocumented. Observer coverage at dredging operations at BIW has been 100% for approximately 15 years and three observations of captured sturgeon have been documented. Dredging occurs every one to two years at this location. An Atlantic sturgeon was killed in the Cape Fear River in a bucket and barge operation (NMFS 1998).

Due to the nature of interactions between listed species and dredge operations, it is difficult to predict the number of interactions that are likely to occur from a particular dredging operation. Projects that occur in an identical location with the same equipment year after year may result in interactions in some years and none in other years. For example, dredging in the BIW sinking basin prior to 2003 resulted in no interactions with shortnose sturgeon but one shortnose sturgeon

was killed by the clamshell dredge in the last hour of the last day of dredging of a dredge event running from April 7 to April 30, 2003. An additional shortnose sturgeon was captured in this area in 2009, but none were captured between 2003 and 2009 or 2009-2011. Based on all available evidence, the risk of capture in a mechanical dredge is low due to the slow speed at which the bucket moves and the relatively small area of the bottom it interacts with at any one time. Atlantic sturgeon are highly mobile and it is anticipated that they will be able to avoid the dredge bucket in nearly all instances.

Based on the occurrence of Atlantic sturgeon in the area where mechanical dredging will take place and the documented vulnerability of this species to capture with mechanical dredges, it is likely that a small number of sturgeon will be captured by mechanical dredges working at CIEE or the Norfolk Harbor channels. Due to the relatively low level of risk that an individual Atlantic sturgeon would be captured in the slow moving dredge bucket, no more than one Atlantic sturgeon is likely to be captured during dredging at CIEE and no more than one during dredging in the Norfolk Harbor channels.

Atlantic sturgeon captured in the dredge bucket could be injured or killed. Sources of mortality include injuries suffered during contact with the dredge bucket or burial in the dredge scow. Of the three captures of sturgeon with mechanical dredges in the Kennebec River (two shortnose (in 2003 and 2009), one Atlantic (in 2001)), one of the shortnose sturgeon was killed. This fish was killed during the last hour of a 24-hour a day dredging operation that had been ongoing for approximately four weeks. This fish suffered from a large laceration, likely experienced due to contact with the dredge bucket. Of the other two fish, both were observed alive in the dredge scow and were released, with no visible external injuries. Assuming that the risk of mortality once captured is similar across dredging projects, we expect a similar mortality in the action area as has been observed at BIW. Therefore, we expect no more than one of the two captured Atlantic sturgeon to be injured or killed during dredging operations. Due to the potential co-occurrence of juvenile, sub-adult, and adult sturgeon, captured sturgeon could be from any one of these three life stages. Injury or mortality could result from contact with the dredge bucket or through suffocation due to burial in the scow. The dead Atlantic sturgeon could originate from any of the five DPSs; however, any juvenile Atlantic sturgeon would be from the Chesapeake Bay DPS.

### *6.3.3 Interactions with the Sediment Plume from Mechanical Dredges*

Mechanical dredges include many different bucket designs (e.g., clamshell, closed versus open bucket, level-cut bucket) and backhoe dredges, representing a wide range of bucket sizes. TSS concentrations associated with mechanical clamshell bucket dredging operations have been shown to range from 105 mg/L in the middle of the water column to 445 mg/L near the bottom (210 mg/L, depth-averaged) (USACE 2001). Furthermore, a study by Burton (1993) measured TSS concentrations at distances of 500, 1,000, 2,000 and 3,300 feet (152, 305, 610 and 1006 meters) from dredge sites in the Delaware River and were able to detect concentrations between 15 mg/L and 191 mg/L up to 2,000 feet (610 meters) from the dredge site. In support of the New York/New Jersey Harbor Deepening Project, the U.S. Army Corps of Engineers conducted extensive monitoring of mechanical dredge plumes (USACE 2015). The dredge sites included Arthur Kill, Kill Van Kull, Newark Bay, and Upper New York Bay. Although briefly addressed in the report, the effect of currents and tides on the dispersal of suspended sediment were not

thoroughly examined or documented. Independent of bucket type or size, plumes dissipated to background levels within 600 feet (183 meters) of the source in the upper water column and 2,400 feet (732 meters) in the lower water column. Based on these studies, elevated suspended sediment concentrations at several hundreds of mg/L above background may be present in the immediate vicinity of the bucket, but would settle rapidly within a 2,400- foot (732 meter) radius of the dredge location.

## 6.4 Habitat Impacts from Dredging

### *6.4.1 Effects on Sea Turtle Foraging*

Since dredging involves removing the bottom material down to a specified depth, the benthic environment will be impacted by dredging operations. No sea grass beds occur in the areas to be dredged with a hopper dredge, therefore green sea turtles will not use the areas as foraging areas. Thus, we anticipate that the dredging activities are not likely to disrupt normal feeding behaviors for green sea turtles. Records from previous dredge events occurring in the action area indicate that some benthic resources, including whelks, horseshoe crabs, blue crabs and rock crabs are entrained during dredging. Other sources of information indicate that potential sea turtle forage items are present in the channel, including jellyfish, clams, mussels, sea urchins, whelks, horseshoe crabs, blue crabs and rock crabs.

Of the listed species found in the action area, loggerhead and Kemp's ridley sea turtles are the most likely to utilize the channel areas for feeding, foraging mainly on benthic species, namely crabs and mollusks (Morreale and Standora 1992, Bjorndal 1997). As noted above, suitable sea turtle forage items occur in some of the areas to be dredged. However, at least some areas of soft substrate in the channel experience daily disturbance (sedimentation from propellers/prop wash); we expect that this has some impact on the ability of these areas to support an abundant and diverse community of benthic invertebrates. This may mean that areas outside the channel are more likely to be used by foraging sea turtles; however, we do not have fine scale information on sea turtle forage items or sea turtle distribution that we could use to make a conclusive determination about foraging in the channel versus outside the channel. This disturbance is more likely to disturb or displace non-mobile organisms that occur at the surface of the sediment and is less likely to impact mobile prey (such as crabs) or benthic invertebrates that bury deep into the substrate (such as worms).

Dredging can effect sea turtles by reducing prey species through the alteration of the existing biotic assemblages; this occurs through the entrainment of prey items as well as displacement or crushing under the cutterhead pipeline that lies on the bottom and transports dredged material to the disposal site. Some of the prey species targeted by turtles, including crabs, are mobile; therefore, some individuals are likely to avoid the dredge. However, there is likely to be some entrainment of mobile sea turtle prey items as well as benthic invertebrates that do not have sufficient (or any) mobility to avoid the dredge.

Previous studies in the upper Chesapeake Bay have demonstrated rapid recovery and resettlement by benthic biota and similar biomass and species diversity to pre-dredging conditions (Johnston, 1981; Diaz, 1994). Similar studies in the lower portions of the Chesapeake Bay produced rapid resettlement of dredging and placement areas by infauna (Sherk, 1972).

McCauley et al. (1977) observed that while infauna populations declined significantly after dredging, infauna at dredging and placement areas recovered to pre-dredging conditions within 28 and 14 days, respectively. Therefore, the effects to benthic communities are anticipated to be short term. Rapid recovery and resettlement of benthic species is expected.

While there is likely to be some reduction in the amount of prey, these losses are limited in space and time. That is, these reductions will only be experienced in the areas being dredged and will only last as long as it takes benthic resources to return to the area. Given the small portion of the total habitat available for foraging sea turtles, and the temporary nature of these impacts, any effects on foraging from remaining deepening, periodic maintenance dredging of shoaled areas, and temporarily removing habitat under cutterhead pipelines are too small to be meaningfully measured or detected, and are therefore insignificant. We do not expect that these reductions in forage will have impacts on the fitness of any sea turtles.

Based on this analysis, while there will be a small reduction in sea turtle prey due to dredging, these effects will be too small to be meaningfully measured, detected, or evaluated and are, therefore, insignificant to foraging loggerhead and Kemp's ridley sea turtles. No effects to the prey base of green sea turtles is anticipated.

### *6.4.2 Effects on Atlantic Sturgeon Foraging*

Atlantic sturgeon feed on a variety of benthic invertebrates; primarily soft bodied invertebrates such as worms (Guilbard *et al.* in Munro *et al.* 2007; Savoy in Munro *et al.* 2007). The proposed dredging will occur in the navigation channel and adjacent anchorage areas. As explained in the discussion above about effects on sea turtle foraging, we expect the daily disturbance in the navigation channel (e.g., sedimentation from propellers/prop wash) to have some impact on the ability of these areas to support an abundant and diverse community of benthic invertebrates; however, we expect that this disturbance is more likely to disturb or displace non-mobile organisms that occur at the surface of the sediment and is less likely to impact mobile invertebrates (such as crabs) or benthic invertebrates that bury deep into the substrate (such as worms). Dredging is likely to entrain and kill at least some of these potential forage items. Turbidity and suspended sediments from dredging activities, as well as the placement of sand at the beneficial use sites may affect benthic resources in those areas. As noted in Section 6.5.1, the TSS levels expected for all of the proposed activities (ranging from 5 mg/L to 500 mg/L) are expected to have some adverse effects on some benthic communities (390 mg/L (EPA 1986).

Sturgeon may forage in the full extent of the action area, primarily over soft substrates. Using the data you have provided, the combined areas that are subject to frequent maintenance dredging and the areas remaining to be deepened/widened are approximately 7,492 acres. This area is approximately .26% of the area in Chesapeake Bay.

Impacts from the placement of the cutterhead dredge pipe during beach nourishment will be minor and temporary. In sum, there is likely to be some permanent reduction in the amount of sturgeon prey in frequently dredged shoaling areas, as well as a temporary removal of habitat under the cutterhead pipeline. Given the limited area where benthic resources will be removed or displaced, effects on sturgeon from reductions in benthic resources in a limited area and for

limited periods of time, will be too small to be meaningfully measured or detected, and are therefore insignificant.

### *6.4.3 Effects of Deepening and Maintenance Dredging on Substrate/Habitat Type*

During the consultation process, we requested information on the potential of the proposed deepening to alter the substrate type in areas to be dredged. If substrate type was altered, the benthic community that recolonizes the dredged area could be fundamentally different than the original community and this could affect the availability of forage items for listed species. However, you have indicated that the remaining sub-surface strata below the dredging pay-prism is consistent with the maintenance material removed during a typical dredging operation (USACE 2012; USACE 2017c). The maintenance material removed from this project historically consists of a mixture of sand and mud. Typical material densities vary in range from silt/mud between 1137 (g/l) to 1337 (g/l) and sands 1526 (g/l) to 1874 (g/l). You have indicated that the same ratio is anticipated as a result of the deepening project and that no alterations in the type of sediment occurring in the dredged areas will result from the proposed action.

Based on the information provided by you and confirmation sampling that has occurred to date, no changes in substrate type are anticipated to result from dredging. Effects to forage items are considered in sections 7.4, 7.8.2, and 7.8.3.

### *6.4.4 Effects of Deepening on Salinity*

Salinity is the concentration of inorganic salts (total dissolved solids, or "TDS") by weight in water, and is commonly expressed in units of "psu" (practical salinity units) or "ppt" (parts per thousand). For example, ocean water with a salinity of 30 ppt contains ~30 grams of salt per 1,000 grams of water. The action area experiences a wide variety of salinity influenced by multiple factors. Also, the salinity gradient effects the distribution of listed species in the action area with sea turtles less likely to occur as salinity decreases and Atlantic sturgeon juveniles more prevalent in the low salinity reaches. Here, we consider whether the proposed deepening could alter the salinity regime in the estuary.

#### *6.4.4.1 Existing Salinity Conditions in the Chesapeake Bay*

The distribution of salinity in the Chesapeake estuary exhibits significant variability on both spatial and temporal scales, and at any given time reflects the opposing influences of freshwater inflow from tributaries (and groundwater) versus saltwater inflow from the Atlantic Ocean. Saltwater inflow from the ocean is in turn dependent on the tidal discharge and the ocean salinity. Salinity at the bay mouth typically ranges from about 25 to 30 ppt. Tributary inflows by definition have "zero" salinity in the sense of ocean-derived salt; however, these inflows contain small but finite concentrations of dissolved salts, typically in the range of 100 to 250 parts per million (ppm) or from 0.1 to 0.25 ppt TDS.

A longitudinal salinity gradient is a permanent feature of salt distribution in the Chesapeake Bay estuary. That is, salinity is always higher at the mouth and downstream end of the system and decreases in the upstream direction. Salinty concentrations can also vary by season. The winter average varies from over 23 ppt at the mouth of the Bay to less than 2 ppt near the head of the estuary at the Susquehanna flats. In spring, salinity levels generally decrease throughout the Bay

and tributaries. In summer, surface salinity distribution is similar to winter levels. Surface salinity levels are highest in the Fall – approximately 29 ppt at the mouth of the Bay.

There is also a lateral salinity gradient present in the bay portion of the estuary, with higher salinities on the eastern shrore and fresher water on the western shore. This lateral salinity gradient also occurs in the tidal rivers that flow into the Bay due to the Coriolis effect. For example, in the James River where there is one primary source of fresh water, there is lower salinity on the western shore than on the eastern shore because of the effects of the Earth's rotation. Under most conditions in the estuary, there is only a small vertical salinity gradient, due to the dominance of tidal circulation and mixing relative to the normal freshwater inflow. However, under prolonged high-flow conditions, such as during the spring freshet, vertical salinity gradients of as much as 5 ppt can occur in the lower bay, with corresponding smaller vertical gradients at locations further upstream to the limit of the salt line. At any given point in the estuary between the bay mouth and the location of the salt line, the salinity of the water column will vary directly with the phase of the tidal currents. Maximum salinity at a point occurs around the time of slack water after high tide, and minimum salinity occurs at the time of slack after low. This condition reflects the significant role played by tidal currents in advecting higher salinity water in the upstream direction during flood flow, with lower salinity water being advected in the downstream direction during ebb. For periods longer than a single tidal cycle, the salinity at a given location varies in response to other important forcing functions, including the short-term and seasonal changes in freshwater inflow, wind forcing over the estuary and adjacent portions of the continental shelf, and salinity and water level changes at the bay mouth. Over longer periods (years to decades and longer), sea level changes and modifications to the geometry of the estuary also affect the long-term patterns of salinity distribution.

The four longitudinal salinity zones within the Chesapeake Estuary, starting at the downstream end, are referred to as: polyhaline (18 - 30 ppt) at the mouth of the bay; mesohaline (5 - 18 ppt) in the mid-bay; oligohaline (0.5 - 5 ppt) and fresh (0.0 - 0.5 ppt) in the upper bay. Although these zones are useful to describe the long-term average distribution of salinity in the estuary, the longitudinal salinity gradient is dynamic and subject to short and long-term changes caused by variations in freshwater inflows, tides, storm surge, weather (wind) conditions, etc. These variations can cause a specific salinity value (isohaline) to move upstream or downstream by as much as 16 km in a day due to semi-diurnal tides, and by more than 32 km over periods ranging from a day to weeks or months due to storm and seasonal effects on freshwater inflows.

*6.4.4.2 Effects of Salinity Changes on sturgeon*

Changes in salinity could affect the distribution of shortnose and Atlantic sturgeon in the bay. In the Chesapeake Bay, Atlantic sturgeon are known to congregate and overwinter within brackish river waters (Bushnoe and Musick, 2006). Previous studies have noted that subadult Atlantic sturgeon typically occupy both the oligohaline and moderately mesohaline (<10ppt) environments (Dovel and Berggren, 1983; Kiefer and Kynard, 1993; Moser and Ross, 1995; Simpson, 2008). For both of these species, early life stages (i.e., eggs and larvae) have little to no tolerance to salinity and therefore, spawning occurs in fresh water. Tolerance to salinity increases with age and size (Jenkins *et al.* 1993, McEnroe and Cech 1985). During at least the first year, shortnose and Atlantic sturgeon are limited in distribution to fresh water; as a result

their distribution is typically upstream of the "salt wedge." If the salt wedge moved further upstream, there could be a reduction in available spawning or rearing habitat.

Given the availability and location of spawning habitat in the river, it is unlikely that the salt front would shift far enough upstream to result in a significant restriction of spawning or nursery habitat. Atlanitic sturgeon fall spawning habitat in the James River (between RKM 105 and the fall line near Richmond, VA) is approximately 10 km upstream of the current median range of the salt front (RKM 95). Atlantic sturgeon spring spawning habitat in the James River (RKM 90-95) is approximately 40 km upstream of the current median range of the salt front (RKM 47.5). However, without an upstream barrier to passage, and spawning habitat extending to Richmond, VA, it is unlikely that salt front movement upstream would significantly limit spawning and nursery habitat. The available habitat for juvenile sturgeon of both sturgeon species could decrease over time; however, even if the salt front shifted several miles upstream, it seems unlikely that the decrease in available habitat would have a significant effect on juvenile sturgeon.

Overall, the effects of remaining deepening on salinity and resulting changes to sturgeon habitat use, above baseline conditions, are too small to be meaningfully measured or detected, and are therefore, insignificant.

*6.4.4.3 Effects of Salinity Change on Sea Turtles*

Sea turtles occur in saline water. Sea turtles do not occur in the reaches of the river where we expect salinity changes resulting from the deepening project. No impacts to sea turtles from increase in salinity will occur.

### *6.4.5 Effects of Deepening on Dissolved Oxygen*

Atlantic sturgeon are known to be more sensitive to low dissolved oxygen levels than many other fish species and juvenile sturgeon are particularly sensitive to low dissolved oxygen levels. In comparison to other fishes, sturgeon have a limited behavioral and physiological capacity to respond to hypoxia (multiple references reviewed and cited in Secor and Niklitschek 2001, 2003). Sturgeon basal metabolism, growth, consumption and survival are all very sensitive to changes in oxygen levels, which may indicate their relatively poor ability to oxyregulate. Sturgeon may be negatively affected, primarily through changes in behavior and distribution, when dissolved oxygen levels are below 5mg/l, particularly at times when water temperatures are higher than 28ºC (see Flourney *et al.*1992; Campbell and Goodman 2004).

In certain areas and during certain times of year, dissolved oxygen levels in the Chesapeake Bay may be stressful to sturgeon. As sea turtles are air breathers, they are not directly affected by dissolved oxygen levels; however, if dissolved oxygen levels affect sea turtle prey, sea turtles could be affected as well. We have considered whether the deepening project and subsequent maintenance are likely to affect dissolved oxygen levels in the action area. Dissolved oxygen levels could be affected due to increases in suspended sediment and if submerged aquatic vegetation was affected.

There will be small, short-term increases in suspended sediment and turbidity near where dredging and beach nourishment. However, given the short duration and limited geographic

extent of these increases in suspended sediment and turbidity any effects to dissolved oxygen are similarly likely to be limited to small areas and for short periods of time. As such, any effects to sea turtles or Atlantic sturgeon will be insignificant and discountable.

## 6.5 On Shore Dredged Material Disposal

We have considered whether the disposal of sand at Sandbridge Beach, Virginia Beach and Ft. Story would impact sea turtles. Limited loggerhead sea turtle nesting (less than 10 nests per year) occurs on Virginia Beach; no nesting is known to occur on Sandbridge Beach or at Ft. Story. However, as noted above, there is the potential for a northward shift in nesting by sea turtles. The disposal of material at these beaches is meant to stabilize and restoring eroding habitats and maintain existing beach. None of the activity is likely to reduce the suitability of these beaches for potential future nesting.

As indicated above, all material removed by cutterhead dredge will be disposed of at a beach location. When a cutterhead dredge is used, the material is piped directly from the intake to an onshore disposal area. The pipe will extend up to 3 miles, depending on the distance between the dredge site and the disposal site. The pipe will be approximately 30" in diameter and be laid on the ocean bottom. While the presence of the pipe will cause a small amount of benthic habitat to be unavailable to sturgeon and sea turtles, the effects from the loss of this area of potential forage will be too small to be meaningfully measured, detected or evaluated. In addition, while the discharge of sediment could cause a small increase in suspended sediment in the immediate vicinity of sand placement, any effects are likely to be minor and temporary. Impacts associated with this action include a short term localized increase in turbidity during disposal operations. During the discharge of sediment at a disposal site, suspended sediment levels have been reported as high as 500mg/L within 250 feet of the disposal vessel and decreasing to background levels (i.e., 15-100mg/L depending on location) within 1000-6500 feet (USACE 1983). For this project, you report that because the dredged material is clean sand, the material will settle out within minutes and any sediment plume will be localized and temporary. Any sea turtles or sturgeon (juvenile, sub-adult, and adults) in the vicinity of the beach disposal sites during disposal may alter their movements to temporarily avoid the disposal area; however, as any effects to movements will be temporary and too small to be meaningfully measured, detected, or evaluatated; therefore, these effects will be insignificant.. Effects of disposal on prey resources are considered below in section 6.6.3.

## 6.6 Use of Offshore/Ocean Dredged Material Disposal Sites

The use of offshore dredged material disposal sites can affect sea turtles and sturgeon by: exposing them to increased levels of turbidity and suspended sediments; increasing the potential for exposure to contaminants; affecting benthic resources; and, increasing vessel traffic in the area. Vessel traffic is discussed in Section 6.8. Other impacts are discussed here.

### *6.6.1 Turbidity and Suspended Sediments*

Dredged material placement operations at the ocean disposal sites are anticipated to have localized and temporary impacts to water quality. Dredged material designated for placement at these sites will be transported to the ocean placement site via bottom dump scow or split hull barges. Upon release from the barge, dredged material will enter the water column as a dense

fluid plume, which will descend vertically. The dense fluid plume will descend to the bottom at a high velocity, leaving behind a low-density turbidity cloud, which will contain a small amount of total solids and settle within a few hours (USACE, 2010a). This temporary increase in turbidity in the water column when dredged material is released will cause short-term impacts that may include lower levels of dissolved oxygen for a few hours following material placement at the immediate site.

During the discharge of sediment at offshore disposal sites, suspended sediment levels have been reported as high as 500.0 mg/l within 250 feet of the disposal vessel and decreasing to background levels (i.e., 15.0-100.0 mg/l depending on location and sea conditions) within 1,000-6,500 feet (USACE 1983). Total suspended solids near the center of the dredged material placement plume body have been observed to reach near background levels in 35 to 45 minutes (Battele 1994 in USACE and USEPA 2009).

TSS is most likely to affect sea turtles and Atlantic sturgeon if a plume causes a barrier to normal behaviors or if sediment settles on the bottom and affects benthic prey. As sea turtles and adult/sub-adult Atlantic sturgeon are highly mobile, individuals are likely to be able to avoid any sediment plume that is present and any effect on their movements or behavior is likely to be insignificant due to the small, temporary disruption of normal movements that may result from avoiding the sediment plume are expected to be so small as to not be susceptible to meaningful measurement or detection.

### *6.6.2 Contaminants*

In order to be eligible for ocean disposal, material must meet stringent criteria as required by the Clean Water Act and Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (as described in the EPA/USACE joint testing guidelines, available at http://water.epa.gov/type/oceb/oceandumping/dredgedmaterial/upload/gbook.pdf; last accessed July 7, 2018). By law and regulation, the disposal of dredged material must have no unacceptable adverse effects. All dredged material disposal sites, including the ones considered here, are required to have and are managed under a dredged material monitoring and management plan that assesses the health and well-being of the site and surrounding environment. Monitoring of the disposal site is a part of this plan, which is designed to ensure that any degradation of resources or alteration in seafloor characteristics are identified and corrective actions implemented by permitting agencies (USEPA 2004).

The testing of dredged material is overseen by EPA and the USACE. Sediments are tested for possible contamination prior to any planned dredging to ensure that proposed dredging and the dredge material disposal are conducted in a way that minimizes the potential pathways for contaminant exposure. EPA and the USACE have jointly developed comprehensive testing procedures, which may include physical, chemical and biological tests, to evaluate dredged material placed into ocean waters.

Laboratory and evaluation methods that apply to dredged material proposed for ocean disposal in accordance with the Marine Protection, Research and Sanctuaries Act (MPRSA) are published in the 1991 USEPA/USACE guidance document entitled "Ecological Evaluation for Dredged Material Proposed for Ocean Disposal in the Marine Environment." An overview of the

Dredged Material Testing Framework is contained in EPA's Ocean Dumping Program Update (1996). As described by EPA, "the acute toxicity of a sediment is determined by quantifying the mortality of appropriately sensitive organisms that are put into contact with the sediment, under either field or laboratory conditions, for a specified period." Also, bioacummulation is described as, "the accumulation of contaminants in the tissues of organisms through any route, including respiration, ingestion, or direct contact with contaminated sediment or water" (EPA 1996). The regulations require that bioaccumulation be considered as part of the environmental evaluation of dredged material proposed for ocean dumping. This consideration involves predicting whether there will be a cause-and-effect relationship between an animal's presence in the area influenced by the dredged material and an environmentally important elevation of its tissue content or body burden of contaminants above that in similar animals not influenced by the disposal of the dredged material."

In order for the dredged material to be disposed of at an in-water disposal site, it must be tested in accordance with the USACE and EPA procedures for suitability. Material that can be disposed of at the disposal site cannot be acutely toxic to any aquatic species. Further, the material must not present a risk of bioaccumulation; that is, even if it is not acutely toxic, it must not increase the potential for bioaccumulation of toxins in higher trophic level species that may prey upon benthic organisms present at the disposal site. In the BAs, you report that water column bioassay testing of dredged material from the areas considered in this Opinion, using sensitive benchmark water column species were conducted in accordance with Section 103 of the Marine Protection, Research, and Sanctuary Act (MPRSA). Test results have shown that the discharge of dredged material at designated placement sites complies with the limiting permissible concentration (LPC) defined in Section 103 of the MPRSA and is not acutely toxic to sensitive benchmark organisms and no unacceptable adverse effects were observed from the liquid phase or liquid and particulate phase of the dredged material. The high flushing rate (due to the water exchange and tidal fluctuations) of the Chesapeake Bay and Atlantic Ocean is anticipated to minimize potential dredging plumes and cause them to be more quickly dispersed, minimizing long term impacts to water quality.

For purposes of this consultation, we consider that sediment that is suitable for ocean disposal would not be toxic to marine life and would not be likely to cause adverse effects to sea turtles, Atlantic sturgeon or their prey. Because the material to be disposed was tested to ensure it is not acutely toxic and will not increase the risk of bioaccumulation of toxins or contaminants in any marine species, effects to sea turtles and Atlantic sturgeon will be too small to be meaningfully, measured, detected, or evaluated and are, therefore, insignificant.

### *6.6.3 Effects to the Benthic Environment*

Disposal operations can also affect foraging animals by burying benthic prey. Direct impacts to fish or other mobile species during placement of the dredged material would be expected to be minimal due to the small contact footprint of the fluidized sediments as they leave the barge (typically 50 foot by 100 foot). Given the small area impacted by each disposal event, mobile species are expected to be able to avoid the falling sediment and would not be subject to burial. The only species that are likely to be buried are immobile benthic organisms. Sea grasses and macroalgae that green sea turtles forage on are not present at the dispsosal sites. Some species of mollusks and gastropods that loggerheads and Atlantic sturgeon feed on have limited mobility

and could be buried during disposal operations.

The loss of potential benthic prey species would be minimized spatially and temporally through use of a grid system for the placement of dredged material. Some buried animals will be able to unbury themselves. Areas where dredged material will be placed are expected to be recolonized by individuals from nearby similar habitats. Because the characteristics of the sediment from the project would be similar to those in and around the disposal sites, benthic invertebrates would be expected to quickly recolonize the cells used for the placement of this material. Thus, any reduction in benthic prey at the disposal site will be temporary and limited to the small area where dredged material will be placed. Green sea turtles will not have any reduction in prey. The potential loss of prey for loggerhead and Kemp's ridley sea turtles will be extremely small, as only a fraction of the benthic species that loggerheads and Kemp's ridleys prey on will be affected, and those losses will occur in a very small area. Effects to foraging loggerhead and Kemp's ridley sea turtles will be too small to meaningfully measure, detect, or evaluate and are, therefore, insignificant.

The temporary localized increase in sediment loading within the water column at the dredging and placement area (NODS) has the potential to directly impact demersal species, such as the Atlantic sturgeon. Deposition of suspended sediments may induce impacts to demersal eggs and larvae through deposition and or smothering, especially in the dredging and placement areas (Johnston, 1981). There are no anticipated impacts to Atlantic sturgeon eggs and/or larvae because the project site and placement site are not located within known spawning grounds of the sturgeon and consist of soft marine clay substrate in marine waters and sturgeon spawn in freshwater over hard bottom substrate. Although other demersal species may be impacted initially, impacts over the duration of the project are not anticipated after disposal operations cease. The high flushing rate, small area of impact during actual disposal will minimize water quality impacts to non-motile demersal organisms. Effects to demersal species will be too small to meaningfully measure, detect, or evaluate and are, therefore, insignificant.

## 6.7 Craney Island Eastward Expansion

Dredged material removal and fill activities at the CIEE project site will permanently convert approximately 522-acres of subaqueous benthic habitat in the footprint of the containment cell to uplands and provide the foundation for a future marine terminal. As reported in the BA, an assessment of the benthic habitat conducted for the project using the Benthic Index of Biotic Integrity (B-IBI) indicates much of the existing benthic habitat within the project site is degraded (USACE, 2006a). The proposed activities will temporarily disrupt the benthic community processes in the access channel and wharf dredging areas and permanently effect benthic processes in the footprint of the containment cell and marine terminal. New work dredging and fill activities will result in the permanent loss of the benthic community in the footprint of the new containment cell and result in a conversion of shallow water benthic habitat to a deep-water benthic habitat with similar sediment characteristics (access channels and wharf access area) potentially altering the benthic species composition at the site based on bathymetry preferences. Future maintenance dredging events in the access channels and wharf access area will temporarily and locally disrupt the benthic community through removal of shoaled material and result in periodic re-colonization of the channel and wharf area. Here, we consider the

permanent loss of the benthic substrate. Other effects of the CIEE (dredging, turbidity, etc.) are considered in other sections of this Opinion.

As noted in Section 2.6, we previously determined that the dredged material removal and fill activities at the CIEE were not likely to adversely affect listed sea turtles. Green sea turtles feed primarily on seagrasses (Bjorndal 1997) while loggerhead and Kemp's ridleys feed primarily on crustaceans and mollusks. You have indicated that there is a total absence of submerged aquatic vegetation (SAV) at the site of the proposed expansion. The lack of SAV eliminates the potential for this site to be used by foraging green sea turtles. Kemp's ridley's also typically forage near SAV beds (Musick and Limpus 1997). You have also indicated that sampling at the proposed expansion site has demonstrated that the presence of crustaceans and mollusks is rare. As such, this area is not likely to be used by foraging loggerhead and Kemp's ridleys. Given the degraded nature of this habitat, the effects to listed sea turtles from the loss of benthic habitat, i.e., the loss of potentially opportunistic foraging grounds that will result from the conversion to uplands, will be so small they cannot be meaningfully measured, detected or evaluated and are, therefore, insignificant.

Atlantic sturgeon are likely to forage nearly anywhere where suitable benthic resources are present. However, given the nature of the habitats in the CIEE area (i.e., no SAV, degraded benthic communities), it is unlikely that this area is used by foraging Atlantic sturgeon. As such, effects from the loss of future benthic foraging opportunities that will result from the conversion of this habitat to uplands, are extremely unlikely and, therefore, discountable.

## 6.8 Vessel Traffic

*Dredge and Disposal Vessels*

Deepening and maintenance dredging activities require the use of dredge and support vessels. Hopper and cutterhead dredges are autonomous vessels, while some mechanical dredging takes place from a barge with a mounted excavator. Barges typically require one or two tug boats to position them. Mechanical dredging also involves a scow vessel where contractors deposit the dredged material. A maximum of four project vessels (combination of barge, tug boats, and scows) would likely be needed for any of the deepening or maintenance dredging activities.

There have not been any reports of dredge vessels colliding with listed species but although they do not possess characteritics commonly associated with vessel strikes (e.g., deep drafts and high speed) contact injuries resulting from dredge movements could occur at or near the water surface and; therefore, involve any of the listed species present in the area. Because the dredge is unlikely to be moving at speeds greater than three knots during dredging operations, blunt trauma injuries resulting from contact with the hull are unlikely during dredging. It is more likely that contact injuries during actual dredging would involve the propeller of the vessel. Contact injuries with the dredge are more likely to occur when the dredge is moving from the dredging area to port, or between dredge locations. While the distance between these areas is relatively short, the dredge in transit would be moving at faster speeds than during dredging operations, particularly when empty while returning to the borrow area.

The dredge vessel may collide with sea turtles when they are at the surface. Sea turtles have been documented with injuries consistent with vessel interactions. It is reasonable to believe that

the dredge vessels considered in this Opinion could inflict such injuries on sea turtles, should they collide. As mentioned, sea turtles are found distributed throughout the action area in the warmer months, generally from May through mid-November.

Interactions between vessels and sea turtles occur and can take many forms, from the most severe (death or bisection of an animal or penetration to the viscera), to severed limbs or cracks to the carapace which can also lead to mortality directly or indirectly. Sea turtle stranding data for the U.S. Gulf of Mexico and Atlantic coasts, Puerto Rico, and the U.S. Virgin Islands show that between 1986 and 1993, about 9% of living and dead stranded sea turtles had propeller or other boat strike injuries (Lutcavage et al. 1997). According to 2001 STSSN stranding data, at least 33 sea turtles (loggerhead, green, Kemp's ridley and leatherbacks) that stranded on beaches within the northeast (Maine through North Carolina) were struck by a boat. This number underestimates the actual number of boat strikes that occur since not every boat struck turtle will strand, every stranded turtle will not be found, and many stranded turtles are too decomposed to determine whether the turtle was struck by a boat. It should be noted, however, that it is not known whether all boat strikes were the cause of death or whether they occurred post-mortem (NMFS SEFSC 2001). More recently, boat strike wounds were confirmed to be ante-mortem in over 75% of sea turtles that were found dead or stranded along the U.S. Atlantic coast (B. Stacy, NMFS, pers. comm., 2017) and a majority of sea turtles struck in Virginia waters were healthy prior to those collisions (Barco *et al.* 2016).

Information is lacking on the type or speed of vessels involved in turtle vessel strikes. However, there does appear to be a correlation between the number of vessel struck turtles and the level of recreational boat traffic (NRC 1990). Although little is known about a sea turtle's reaction to vessel traffic, it is generally assumed that turtles are more likely to avoid injury from slower-moving vessels since the turtle has more time to maneuver and avoid the vessel. The speed of the dredge is not expected to exceed 3 knots while dredging or while transiting to the pump out site with a full load and it is expected to operate at a maximum speed of 10 knots while empty. In addition, the risk of ship strike will be influenced by the amount of time the animal remains near the surface of the water. For the proposed action, the greatest risk of vessel collision will occur during transit between shore and the areas to be dredged. The presence of an experienced endangered species observer who can advise the vessel operator to slow the vessel or maneuver safely when sea turtles are spotted will further reduce the potential risk for interaction with vessels. The addition of one to two slow moving vessels in the action area have an insignificant effect on the risk of interactions between sea turtles and vessels in the action area.

Information regarding the risk of vessel strikes to Atlantic sturgeon is discussed in the Status of the Species and Environmental Baseline sections above. As explained there, we have limited information on vessel strikes and many variables likely affect the potential for vessel strikes in a given area. Assuming that the risk of vessel strike increases with an increase in vessel traffic, we have considered whether an increase in vessel traffic in the action area during dredging and disposal (one to two slow moving vessels per day) would increase the risk of vessel strike for Atlantic sturgeon in this area. Given the large volume of traffic in the action area and the wide variability in traffic in any given day, the increase in risk from the addition of one to two vessels per day in addition to the baseline is too small to be meaningfully measured, detected, or evaluated and the increased risk to Atlantic sturgeon is insignificant.

*Deepening and Widening of Federal Navigation Channels*
Throughout the consultation process on the Norfolk Harbor Channels and Craney Island Eastward Expansion projects, you have maintained that the project was formulated, evaluated, and authorized by Congress based on the parameter that no tonnage will be induced or attracted to the port's facilities as a direct result of the proposed deepening and widening of the channels. Increasing the depth of the channel will allow segments of the current container and dry bulk vessel fleets to carry more cargo as well as allowing the fleets to shift to more efficient sized vessels. Therefore, the new channel depth will improve the economic efficiency of ships moving through the Chesapeake Bay ports, resulting in a reduction in total vessel trips. The number of vessel calls of the largest twenty-foot equivalent unit (TEU) ships is not anticipated to increase in the future; however, the number of smaller sized ships in the deep draft fleet (e.g., Panamax-size ships) may decrease due to the increased efficiency of cargo loading in the future (USACE 2018). These vessels will continue to carry the same tonnage from the origin ports but will be able to operate more efficiently in the Chesapeake Bay with a deepened channel from reduced lightering. These factors will more efficiently apportion operating costs for the same amount of total tonnage and further reduce total vessel trips through the port (USACE 2011).

Similarly, beyond the use of project vessels discussed above, we do not expect maintenance dredging of the channels to increase baseline levels of vessel traffic in the Chesapeake Bay. The effects of baseline (i.e., non-project related vessels) vessel traffic is included in the discussion of threats facing the species as addressed in the *Status of the Species* and *Environmental Baseline* sections of this Opinion. Accordingly, the increase in risk of a vessel strike from the addition of project vessels, including maintenance vessels, to baseline conditions is so small it cannot be meaningfully measured, detected or evaluated and is, therefore, insignificant.

## 6.9 Unexploded Ordinance and Munitions of Concern

The United States Army Environmental Command (USAEC) defines unexploded ordnance (UXO) or munitions of explosive concern (MEC) as military munitions that have been (1) primed, fused, armed or otherwise prepared for action; (2) fired, dropped, launched, projected, or placed in such a manner to constitute a hazard to operations, installations, personnel, or material, and (3) remain unexploded either by malfunction, design, or any other case. UXO/MEC comes in many shapes and sizes, may be completely visible or partially or completely buried, and may be easy or virtually impossible to recognize as a military munition. UXO/MEC can be found in the ocean. UXO/MEC may look like a bullet or bomb, or be in many pieces, but even small pieces of UXO/MEC can be dangerous. If disturbed, (touched, picked up, played with, kicked, thrown, etc.) UXO/MEC may explode without warning, resulting in serious injury or even death. Sandbridge Shoal borrow area occurs in an area associated with past and current military activities and has produced UXO/MEC during dredging operations.

The presence of UXO in dredged material presents two unique challenges. First, it poses a potential explosive safety hazard to dredging or observer personnel and potential damage to equipment and vessel. Second, any subsequent beneficial use of dredged material must also address the possibility of the presence of UXO and/or its removal.

The presence of UXO was documented during the previous Sandbridge Hurricane Protection Projects constructed in 2002 and 2007. Over 100 UXO were recovered during dredging operations and were transported to and properly disposed of at an undisclosed naval installation. Recent dredging of the Cape Henry Channel, documented UXO/MEC in the observer cages on April 15, 2011 and May 8, 2011. On April 1, 2006, the Dredge Padre Island operated by the Great Lakes Dredge & Dock Company was conducting maintenance dredging activities in the Atlantic Ocean Channel (AOC) when it suffered a ruptured dredge clean out section and severed drag head as a result of an explosion presumed to be from an ordnance device that was pumped into the draghead and associated lines. Unexploded ordnance had been previously retrieved from the draghead on three different occasions in February 2006. During the last dredging cycle of the AOC in February 2011, it was documented that UXO/MEC was encountered four times, mostly 5-inch shells, two of which were determined to be live ordnance. A UXO/MEC device also is presumed to be the cause of an explosion on a hydraulic cutter-head dredge conducting maintenance dredging in Norfolk Harbor in April 2005 rupturing the primary pump casing on the dredge. The Coast Guard rendered assistance to the dredge plant to provide additional pump-out capacity for the incoming water and stabilize the plant. Fortunately, in most incidents ordnance has not detonated and has been safely removed or jettisoned from the vessel.

As a safety precaution, in any area where UXO may be encountered (including some if not all portions of Sandbridge Shoal), you will install special intake screening to be permanently placed over the drag head or cutterhead to effectively prevent any UXO from entering the dredge and/or being subsequently placed within the associated placement site. Additionally, you will install screening at the point where the material is discharged onto the beach. Special intake screening for UXO/MEC will be specified and installed to prevent entrainment of any material greater than 1-1/4 inches in diameter. Typical allowable openings specified by USACE-Norfolk District are 1-1/4 inches x 6 inches. While use of this screening poses challenges for monitoring interactions with listed species (see section 10 below), its use is not expected to change the entrainment rates calculated above. That is because, while it may prevent turtles or sturgeon from entering the intake pipes, it does not change the way the dredge operates or the suction power at the intake. So, while sea turtles or sturgeon may be less likely to be sucked through the dredge plant (as this could be prevented by the small size of the intakes as caused by the screening), the risk of an interaction does not change, and our analysis remains the same.

### 6.10 Bed Leveling Devices

Bed-leveling is often associated with hopper dredging (and other types of dredging) operations. Bed-levelers redistribute sediments, rather than removing them. Plows, I-beams, or other seabed-leveling mechanical dredging devices are used to lower high spots left in channel bottoms and dredged material deposition areas by hopper dredges or other type dredges. Leveling devices typically weigh about 30 to 50 tons, are fixed with cables to a derrick mounted on a barge pushed or pulled by a tugboat at about one to two knots.

We have considered the potential for sea turtles to be crushed as the leveling device passes over a turtle which fails to move or is not pushed out of the way by the sediment wedge “wave” generated by and pushed ahead of the device. Sea turtles at Brunswick Harbor, Georgia, may have been crushed and killed in 2003 by bed-leveling which commenced after the hopper dredge finished its work in a particular area. Brunswick Harbor is a site where sea turtles captured by

relocation trawlers sometimes show evidence of brumating (over-wintering) in the muddy channel bottom, which could explain why, if they were in fact crushed, they failed to react quickly enough to avoid the bed-leveler.

You have engaged in efforts to design bed leveler devices that are more likely to push sea turtles out of the way (much like a deflector on a hopper dredge); it is thought that this would reduce any potential for crushing. The available information on bed leveling and sea turtles indicates that crushing is extremely unlikely outside of areas where sea turtles are brumating. Brumation is not known to occur in the action area. Additionally, the proposed modifications (i.e., integrated deflector configurations) to traditional bed-levelers are expected to further reduce the potential for impacts to sea turtles; therefore, any effects to sea turtles are discountable.

Atlantic sturgeon are likely to be able to avoid being crushed by a bed-leveler. These fish are highly mobile. The bed leveler will be pushing a sand wave in front of it that should cause sturgeon to relocate out of the path of the bed leveler. In addition, the bed leveler will be moving very slowly at approximately one to two knots. The low rate of entrainment of this species in any type of dredge suggests an ability to avoid interactions with dredge gear, including bed levelers. No reports of injured or dead sturgeon have been reported in association with any bed leveling activities. Therefore, we believe that any effects of the bed leveler on Atlantic sturgeon are extremely unlikely and will be discountable. As such, we do not anticipate any Atlantic sturgeon to be injured or killed if a bed leveler is used.

### 6.11 Effects of relocation trawling as required by the Incidental Take Statement

In the Incidental Take Statement accompanying this Biological Opinion (see Section 10), consistent with past Opinions considering dredging in these channels and borrow areas, we have determined that relocation trawling is necessary and appropriate when certain conditions are met to minimize the number of sea turtles captured and killed during dredging operations. The effects of relocation trawling on listed species in the action area are outlined below.

Relocation trawling is undertaken with the goal of moving sea turtles out of the area being dredged and placing them in area outside of the dredge area. There is evidence to suggest that relocation trawling can be effective at minimizing dredge interactions when the density of sea turtles in the dredge area is high. Relocation trawling has occurred occasionally in the Chesapeake Bay. Research is currently ongoing by the USACE to determine if “captureless” trawling can be as effective or more effective at displacing sea turtles from the path of the dredge. This technique uses an open bag that is thought to displace turtles from the path of the dredge without the stress of capturing the turtles and relocating them. Preliminary information available from use of captureless trawling in association with dredging activities in the Southeastern U.S. shows promise. However, the unintentional mortality of sea turtles during this type of trawling suggests that great care needs to be taken to ensure that the trawl is fishing properly. Relocation trawling can also capture species other than sea turtles. Atlantic sturgeon have been captured in relocation trawling activities in the action area.

Relocation trawling will be required if two sea turtles are entrained in one 24-hour period, or four sea turtles are entrained in a two month period, or in other circumstances where entrainment

indicates that the density of sea turtles in the action area is high and would result in entrainment at a higher rate than predicted.

### *6.11.1 Past Relocation Trawling in the Action Area*

Relocation trawling occurred in the action area in 2001, 2002 and 2003. No relocation trawling has occurred since the Fall of 2003. Relocation trawling occurred in Thimble Shoal Channel from September 6 to October 17, 2001. Twelve turtles (9 loggerheads and 3 Kemp's ridleys) were caught and released during this time period. Trawling in the Cape Henry Channel was conducted from October 13 to November 12, 2001, for 12 hours per day and with 15-30 minute tow times. Four turtles (three loggerheads and one green) were caught in water temperatures ranging from approximately 15.5 to 19°C. The turtles were relocated approximately four miles off the Virginia coast.

In 2002, several incidents of relocation trawling were initiated in Cape Henry and York Spit Channels as a result of triggering a term and condition from the January 2002 BO. From May 26 to June 6, trawling was conducted in Cape Henry, and two loggerheads were captured (in 174 30-minute tows). From September 20-25, trawling was performed in York Spit and no turtles were captured (in 103 30-minute tows). No turtles were taken by the dredge during this time. From October 10 to November 3, trawling was conducted in York Spit and Cape Henry Channels (in whichever channel the dredge was operating) with 15-30 minute tow times for 12 hours a day. Fifteen turtles were relocated (11 loggerheads, 3 Kemp's ridleys, and 1 green), and an additional Kemp's ridley turtle was found dead in the trawl. During the October to November trawling period, 5 turtles were captured by the dredge, but 2 of these incidents involved decomposed turtle parts (i.e., cause of death determined not to be related to the current dredging operations).

Relocation trawling also occurred in Thimble Shoals in 2003. Trawling occurred September 15 and 16 (20 30-minute tows, no turtles), September 20 – 22 (31 30-minute tows, 1 loggerhead) and from September 30 – October 22 (234 30-minute tows, 16 loggerheads and 5 Kemp's ridleys) and November 10 – November 28 (2 loggerheads, 1 Kemp's ridley). A total of 25 turtles were relocated during this time period. During this period of relocation trawling, fourteen Atlantic sturgeon were captured and released alive within and nearby the channel.

Most recently, the Baltimore District conducted relocation trawling during maintenance dredging of Cape Henry Channel in 2014. The relocation trawling was conducted over a 5-day period, 24 -27 July 2014 and 30 July 2014. A total of zero turtles were relocated during this time period.

The maximum number of turtles relocated in one year was 25 live uninjured turtles in 2003 (September 15-16, 20-22, September 30-October 22 and November 10-28). Only one mortality has been observed. The only incidence of Atlantic sturgeon capture in relocation trawling was in the fall of 2003 with 14 individuals captured.

### *6.11.2 Effects of Relocation Trawling on Sea Turtles*

Relocation trawling conducted in association with dredging activities is specifically targeting sea turtles and as such, we expect sea turtles to be captured in the trawls. It is difficult to determine

the magnitude, or the frequency, of these interactions, but potential capture levels can be estimated by previous capture rates from Virginia relocation trawling.

The maximum number of turtles caught in one year was 25, with the maximum in one month being 15. As it cannot be foreseen as to whether relocation trawling will occur in any given year or month, this anticipated capture level for relocation trawling associated with this project has been estimated with the assumption that trawling could occur every month whenever sea turtles are present and dredging occurs. Relocation trawling could therefore occur any time from April 1 to November 30 when the dredge is operating. Considering that a maximum of 15 turtles have been captured in one month of relocation trawling, if trawling occurred for all eight months that sea turtles were present, a maximum of 120 sea turtles could be captured annually during relocation trawling. We recognize that because relocation trawling is not likely to be required for every project, and even when required is unlikely to occur continuously for an 8-month period, this annual estimate is likely significantly higher than the number of relocation captures that would reasonably occur in a typical year. Therefore, we believe our best assessment of the maximum number of turtles that would be captured during relocation trawling in any given year is 25. Most of the captured sea turtles are likely to be loggerheads; however, we expect that some will be Kemp's ridley and greens. Of the 59 sea turtles captured during past relocation trawling, 44 were loggerheads, 13 Kemp's ridleys and 2 greens. We expect future relocation trawling to capture these species in a similar ratio (75% loggerhead, 22% Kemp's ridley and 3% green). No leatherback sea turtles are anticipated to be captured during relocation trawling due to the rarity of this species in the area and the lack of documented captures during other relocation trawling operations in the action area.

With an estimate of 25 captures per year (the maximum number of turtles caught in one year) for the duration of construction and maintenance dredging and the ratio of species noted above, we expect the following total number of captures over the life span of the project:

**Table 21. Maximum sea turtle takes by relocation trawling**

| Species | Number of Captures |
|---|---|
| Loggerhead | 937 |
| Kemp's Ridley | 275 |
| Green | 38 |

The relocation trawling capture estimation uses the best available information, but makes several assumptions. First, this estimation assumes that turtle distribution in the action area is not variable by month. The number used for the calculations were determined by a fall trawling event, and it is possible that turtle and/or sturgeon abundance in the action area will be higher or lower in the spring and summer. Second, this estimation assumes that turtle and sturgeon distribution will be relatively constant over the years. Relocation trawling has been conducted in Virginia only three years, and this limited amount of data was used to generate this estimated take level (e.g., one year of data noting the maximum number of turtles taken). This take estimation was based upon the best available data, but it is possible that turtle distribution may increase or decrease in future years, changing the number of turtles taken in the trawl from what was anticipated. Third, the estimated capture rate was generated under the assumption that relocation trawling would be conducted for 12 hours/day as it has in the past. If the frequency of

trawling is increased beyond 12 hours/day, more turtles could be taken (e.g., if trawling is completed 24 hours/day, the capture rates could double. Fourth, this assumes that trawling will need to be completed each week that dredging occurs and that all dredging will be conducted during the April to November time frame. It is highly unlikely that this will occur, as the term and condition requiring trawling may not be triggered for every project or dredging may not need to be completed during the entire "turtle season." Finally, this estimation assumes that different trawl companies and trawlers do not have any variation in turtle catch rates. This take level was generated with one company's trawl data, and if a different vessel is more or less successful at catching turtles, the anticipated take amount may be different. However, a standardized trawling protocol is required of all relocation trawling activities, so it is unlikely that the various trawl companies would have significantly different capture rates.

Relocation trawling moves animals out of their preferred environment, which may result in additional stress on the animal. While the effects of this relocation are not fully known or quantifiable, if the sea turtle is not injured or its swimming ability impaired, it is likely that the turtle could find other suitable foraging habitat or move to its desired location. Typically sea turtles are relocated at least 3 miles from the capture location. Some turtles captured during relocation trawling operations return to the dredge site and are subsequently recaptured. The likelihood of recapture may be related to where the animal was relocated, relocation distance, duration of dredging projects, and an individual turtle's preferences or site fidelity. In Canaveral Channel in the early 1980s toward the end of a 90-day dredging project, about 25-33% of the turtles caught in a given day were recaptures of turtles previously relocated in the project. Relocation sites were 5 miles north, 5 miles south, and 5 miles east of the channel. One of those turtles was caught and relocated on 7 different occasions. One was caught and removed one night and taken again on the following night. Some turtles appear to return to the area regardless of where they are moved, while others are never seen again (E-mails, C. Oravetz to E. Hawk, T. Henwood to E. Hawk, September 27, 2002). In any event, relocating animals out of the channels may subject them to stress and require the turtles to undergo extra effort to migrate back to their intended habitat.

Sea turtles forcibly submerged in any type of restrictive gear can eventually suffer fatal consequences from prolonged anoxia and/or seawater infiltration of the lung (Lutcavage *et al.*1997). A study examining the relationship between tow time and sea turtle mortality in the shrimp trawl fishery showed that mortality was strongly dependent on trawling duration, with the proportion of dead or comatose sea turtles rising from 0% for the first 50 minutes of capture to 70% after 90 minutes of capture (Henwood and Stuntz 1987). However, metabolic changes that can impair a sea turtle's ability to function can occur within minutes of a forced submergence. While most voluntary dives appear to be aerobic, showing little if any increases in blood lactate and only minor changes in acid-base status, the story is quite different in forcibly submerged sea turtles, where oxygen stores are rapidly consumed, anaerobic glycolysis is activated, and acid-base balance is disturbed, sometimes to lethal levels (Lutcavage and Lutz 1997). Forced submergence of Kemp's ridley sea turtles in shrimp trawls resulted in an acid-base imbalance after just a few minutes (times that were within the normal dive times for the species) (Stabenau *et al.*1991). Conversely, recovery times for acid-base levels to return to normal may be prolonged. Henwood and Stuntz (1987) found that it took as long as 20 hours for the acid-base levels of loggerhead sea turtles to return to normal after capture in shrimp trawls for less than 30

minutes. This effect is expected to be worse for sea turtles that are recaptured before metabolic levels have returned to normal.

Following the recommendations of the NRC to reexamine the association between tow times and sea turtle deaths, the data set used by Henwood and Stuntz (1987) was updated and re-analyzed (Epperly *et al.*2002; Sasso and Epperly 2006). Seasonal differences in the likelihood of mortality for sea turtles caught in trawl gear were apparent. For example, the observed mortality exceeded 1% after 10 minutes of towing in the winter (defined in Sasso and Epperly (2006) as the months of December-February), while the observed mortality did not exceed 1% until after 50 minutes in the summer (defined as March-November; Sasso and Epperly 2006). In general, tows of short duration (<10 minutes) in either season have little effect on the likelihood of mortality for sea turtles caught in the trawl gear and would likely achieve a negligible mortality rate (defined by the NRC as <1%). Intermediate tow times (10-200 minutes in summer and 10-150 minutes in winter) result in a rapid escalation of mortality, and eventually reach a plateau of high mortality, but will not equal 100%, as a sea turtle caught within the last hour of a long tow will likely survive (Epperly *et al.*2002; Sasso and Epperly 2006). However, in both seasons, a rapid escalation in the mortality rate did not occur until after 50 minutes (Sasso and Epperly 2006) as had been found by Henwood and Stuntz (1987). Although the data used in the reanalysis were specific to bottom otter trawl gear in the U.S. south Atlantic and Gulf of Mexico shrimp fisheries, the authors considered the findings to be applicable to the impacts of forced submergence in general (Sasso and Epperly 2006).

Sea turtle behaviors may influence the likelihood of them being captured in bottom trawl gear. Video footage recorded by the NMFS, Southeast Fisheries Science Center (SEFSC), Pascagoula Laboratory indicated that sea turtles will keep swimming in front of an advancing shrimp trawl, rather than deviating to the side, until they become fatigued and are caught by the trawl or the trawl is hauled up (NMFS 2002a). Sea turtles have also been observed to dive to the bottom and hunker down when alarmed by loud noise or gear (Memo to the File, L. Lankshear, December 4, 2007), which could place them in the path of bottom gear such as a bottom otter trawl. With respect to oceanographic features, a review of the data associated with the 11 sea turtles captured by the scallop dredge fishery in 2001 concluded that the sea turtles appeared to have been near the shelf/slope front (D. Mountain, pers. comm.).

Tows for relocation trawling will be less than 30 minutes in duration. Based on the analysis by Sasso and Epperly (2006) and Epperly *et al.*(2002) as well as information on captured sea turtles from past NJ trawl surveys, the NEAMAP and NEFSC trawl surveys, and the NEFSC FSB observer program, a 30-minute tow time for the trawl gear to be used will likely eliminate the risk of death from forced submergence for sea turtles caught in the trawl gear.

During spring and fall bottom otter trawl surveys conducted by the NEFSC from 1963-2009, 71 loggerhead sea turtles were observed captured. Only one of the 71 loggerheads suffered injuries (cracks to the carapace) causing death (Wendy Teas, SEFSC, pers. comm. to Linda Despres, NEFSC, 2007). All others were alive and returned to the water unharmed. The one leatherback sea turtle captured in the NEFSC trawl survey was released alive and uninjured. NEFSC trawl survey tows are approximately 30 minutes in duration. All sea turtles captured in the NEAMAP surveys as well as the NJ trawl surveys have also been released alive and uninjured.

Only one mortality of a sea turtle during relocation trawling has been recorded in the action area. On November 3, 2002, during relocation trawling conducted in York Spit Channel (with 15-30 minute tows), a dead Kemp's ridley sea turtle was recovered (REMSA 2002). The fresh dead turtle was bleeding with wounds to the head. VMSM conducted a necropsy and concluded that the animal appeared to be a healthy, fresh dead juvenile Kemp's ridley with the only noted abnormalities to the head. This suggests that the cause of death could have been trawl related. Mortality of sea turtles during relocation trawling is expected to be very rare. As such, we anticipate that during each year that relocation trawling occurs, no more than 1 sea turtle will be seriously injured or killed. We expect mortalties to occur in proportion to the ratio of species captured. Therefore, we expect 75% of the mortalities to be loggerheads, 22% to be Kemp's ridleys and 3% to be greens. As such, we expect the following mortalities during relocation trawling over the 50-year period considered here: 37 loggerheads, 11 Kemp's ridleys, and 2 greens.

### *6.11.3 Effects of Relocation Trawling on Atlantic sturgeon*

The capture of Atlantic sturgeon in otter trawls used for commercial fisheries is well documented (see for example, Stein *et al.*2004 and ASMFC 2007). Atlantic sturgeon are also captured incidentally in trawls used for scientific studies. Atlantic sturgeon can occur in the action area year round. While it is possible that relocation trawling may be beneficial in removing these fish from the channels being dredged, we have no information to determine if it is reasonable to expect this to occur. Relocation trawling occurred in 2001, 2002 and 2003; however, Atlantic sturgeon were captured during only one of these relocation trawl events. Fourteen Atlantic sturgeon were captured during relocation trawling in November 2003.

Because Atlantic sturgeon are known to be vulnerable to capture in trawls and Atlantic sturgeon have been captured during past relocation trawling in the action area, it is reasonable to expect that Atlantic sturgeon will be captured during future relocation trawling events. Based on past events, we expect that no more than 14 Atlantic sturgeon are likely to be captured in any year that relocation trawling is required. We expect the Atlantic sturgeon that will be captured to consist of individuals from the five DPSs at the following frequencies: NYB 49%; South Atlantic 20%; Chesapeake Bay 14%; Gulf of Maine 11%; and Carolina 4%.

The short duration of the tow and careful handling of any sturgeon once on deck is likely to result in a low potential for mortality. None of the 14 Atlantic sturgeon captured in past relocation trawling had any evidence of injury or mortality. We reviewed results of short-tow trawl surveys (i.e., 20-30 minute tow time surveys carried out by NEFSC, VIMS (NEAMAP), and the States of New Jersey and Connecticut). None of the more than six hundred Atlantic sturgeon captured during these trawl surveys have been injured or killed. Based on this information, we expect that all Atlantic sturgeon captured during relocation trawling will be alive and will be released uninjured.

### *6.11.4 Summary of Effects of Relocation Trawling*

Relocation trawling is only required when the risk of entrainment of sea turtles is higher than normal and is undertaken to minimize the potential for injury and mortality of sea turtles in the dredge. The short tow times and relocation of turtles away from the active dredge site have the goal of benefiting sea turtles. As noted above, there is the potential for some stress and a very low potential for injury or mortality. We have estimated the following maximum annual levels of capture and mortality due to relocation trawling:

**Table 22. Maximum annual and total takes over the proect life from relocation trawling**

| **Species** | **Number Captured Per Year** | **Number of Mortalities per Year** | **Number Captured** | **Number of Mortalities** |
|---|---|---|---|---|
| ***Sea Turtles*** | ***25 total*** | ***1*** | ***1,250*** | ***50*** |
| Loggerhead | 19 | 1* | 937 | 37 |
| Kemp's Ridley | 5 | 1* | 275 | 11 |
| Green | 1 | 1* | 38 | 2 |
| ***Atlantic sturgeon*** | ***14 total*** | ***0*** | ***700 total*** | ***0*** |
| NYB DPS | ≤ 7 | 0 | ≤350 | 0 |
| SA DPS | ≤ 3 | 0 | ≤150 | 0 |
| CB DPS | ≤ 2 | 0 | ≤100 | 0 |
| GOM DPS | ≤ 2 | 0 | ≤100 | 0 |
| Carolina DPS | ≤ 1 | 0 | ≤50 | 0 |

*1 loggerhead, Kemp's ridley or green annually

We expect that one turtle (either a loggerhead, Kemp's ridley, or green turtle) may be killed during relocation trawling activities each dredge cycle. In addition, a number of sea turtles (loggerheads, Kemp's ridley and green) are likely to be captured during relocation trawling and released uninjured. While this action may temporarily disrupt normal foraging and migratory behaviors, these displaced turtles are likely to rapidly resume normal behaviors. As such, the capture and displacement of live, uninjured sea turtles is not likely to have any significant effect on sea turtles in the Chesapeake Bay or the species as a whole. We have also required that any live sea turtles captured during the relocation trawling be weighed and measured. While this requirement will cause additional handling of these individuals and may cause stress, this is likely to be temporary and there are no known lasting effects of taking these measurements. As such, the weighing and measuring of live, uninjured sea turtles is not likely to have any significant effect on sea turtles in the Chesapeake Bay or the species as a whole.

At this time, we have only preliminary information regarding the potential for captureless trawling to successfully minimize entrainment of sea turtles during dredging. Potential benefits to this trawling method are that the trawler can operate closer to the dredge, and therefore potentially intercept animals in the immediate pathway to the dredge; there may be less "down time" for the trawler as it does not need to stop operating every 30 minutes to haul in the trawl, handle and relocate animals, which means that the trawl is operating for a greater percentage of

time, and there may be less stress and potential for injury to animals "caught" in the trawl. Potential disadvantages are that by merely disturbing animals off the bottom and not moving them outside the area being dredged, the "relocation" may be less effective and because the animals are not being brought on board the trawl vessel there is no means to monitor the number of turtles encountered so it would be difficult to gauge the success of the trawling operation (other than in any reduction in entrainment). As such, at this time, we expect that future relocation trawling will use a traditional capture methodology. If in the future you proposes to use captureless relocation trawling in the action area, we will review the proposal to determine if it will: (1) achieve the same expected reduction in sea turtle entrainment as traditional relocation trawling, and (2), if it is likely to cause any effects to sea turtles or sturgeon not considered in this Opinion. If we determine that captureless trawling is at least as effective as traditional relocation trawling, that it will not cause any effects to sea turtles or sturgeon not considered in this Opinion, and takes can be monitored to ensure that the number of exempted takes are not exceeded, then no further consultation is likely to be necessary and the proposed "captureless" trawling will be considered to be within the scope of this consultation.

### 6.12 Tissue Sampling

Genetic samples will be taken from all captured fish. This will be done by taking a small (1 $cm^2$) tissue sample, clipped with surgical scissors from a section of soft fin rays. This procedure does not appear to impair the sturgeon's ability to swim and is not thought to have any long-term adverse impact (Kahn and Mohead 2010). Many researchers have removed tissue samples according to this same protocol reporting no adverse effects (Wydoski and Emery 1983); therefore, we do not anticipate any long-term adverse effects to the sturgeon from this activity.

## 7.0 CUMULATIVE EFFECTS

Cumulative effects as defined in 50 CFR 402.02 include the effects of future State, tribal, local, or private actions that are reasonably certain to occur within the action area considered in this Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Effects of ongoing Federal activities, are considered in the *Environmental Baseline* and *Status of the Species* sections above and are also factored into the *Integration and Synthesis of Effects* section below.

Sources of human-induced mortality, injury, and/or harassment of sea turtles and Atlantic sturgeon in the action area that are reasonably certain to occur in the future include interactions in state-regulated and recreational fishing activities, vessel collisions, ingestion of plastic debris, pollution, underwater noise, and global climate change. While the combination of these activities may affect sea turtles and Atlantic sturgeon, preventing or slowing a species' recovery, the magnitude of these effects is currently unknown.

*State Water Fisheries*

Future recreational and commercial fishing activities in state waters may capture, injure, or kill sea turtles and sturgeon. However, it is not clear to what extent these future activities would affect listed species differently than the current state fishery activities described in the *Environmental Baseline* section. Atlantic sturgeon are captured and killed in fishing gear

operating in the action area; however, at this time we are not able to quantify the number of interactions that occur. However, this Opinion assumes effects in the future would be similar to those in the past and are, therefore, reflected in the anticipated trends described in the *Status of the Species* and *Environmental Baseline* sections.

Fishing activities are considered one of the most significant causes of death and serious injury for sea turtles. Finkbeiner *et al*. (2011) compiled cumulative sea turtle bycatch information in U.S. fisheries from 1990 through 2007, before and after implementation of bycatch mitigation measures. In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures). Kemp's ridleys interacted with fisheries most frequently, with the highest level of mean annual mortality (2,700), followed by loggerheads (1,400), greens (300), and leatherbacks (40). The Southeast/Gulf of Mexico shrimp trawl fishery was responsible for the vast majority of U.S. interactions (up to 98%) and mortalities (more than 80%). Fishing gear in state waters, including bottom trawls, gillnets, trap/pot gear, and pound nets, interacts with sea turtles each year. NMFS is working with state agencies to address the bycatch of sea turtles in state water fisheries within the action area of this consultation where information exists to show that these fisheries capture sea turtles. Action has been taken by some states to reduce or remove the likelihood of sea turtle bycatch and/or the likelihood of serious injury or mortality in one or more gear types. However, given that state managed commercial and recreational fisheries along the U.S. Atlantic coast are reasonably certain to occur within the action area in the foreseeable future, additional interactions of sea turtles with these fisheries are anticipated. There is insufficient information to quantify the number of sea turtle interactions with state water fisheries as well as the number of sea turtles injured or killed as a result of these interactions. While actions have been taken to reduce sea turtle bycatch in some state water fisheries, the overall effect of these actions is unknown, and the future effects of state water fisheries on sea turtles cannot be quantified. However, this Opinion assumes effects in the future would be similar to those in the past and are, therefore, reflected in the anticipated trends described in the *Status of the Species* and *Environmental Baseline* sections.

*Vessel Interactions*

Our STSSN data indicate that vessel interactions are responsible for a number of sea turtle strandings within the action area each year. In the U.S. Atlantic from 1997-2005, 14.9% of all stranded loggerheads were documented as having sustained some type of propeller or collision injuries (NMFS and USFWS 2007a). The incidence of propeller wounds rose from approximately 10% in the late 1980s to a record high of 20.5% in 2004 (STSSN database). Such collisions are reasonably certain to continue into the future. Collisions with boats can stun, injure, or kill sea turtles, and many live-captured and stranded sea turtles have obvious propeller or collision marks (Dwyer *et al*. 2003). However, it is not always clear whether the collision occurred pre- or post-mortem. We believes that vessel interactions with sea turtles will continue in the future. An estimate of the number of sea turtles that will likely be killed by vessels is not available at this time. Similarly, we are unable at this time to assess the risk that vessel operations in the action area pose to Atlantic sturgeon. While vessel strikes have been documented in several rivers, the extent that interactions occur in the marine environment is currently unknown. However, this Opinion assumes effects in the future would be similar to those in the past and are, therefore, reflected in the anticipated trends described in the *Status of*

*the Species* and *Environmental Baseline* sections.

*Debris, Pollution, and Contaminants*
Human activities in the action area causing marine debris and pollution are reasonably certain to continue in the future, as are impacts from them on sea turtles and Atlantic sturgeon. However, the level of impacts cannot be projected. Sources of contamination in the action area include atmospheric loading of pollutants, stormwater runoff from coastal development, groundwater discharges, and industrial development. Chemical contamination may have effects on listed species' reproduction and survival. Excessive turbidity due to coastal development and/or construction sites could influence sea turtle or sturgeon foraging ability. Marine debris (e.g., discarded fishing line or lines from boats, plastics) also has the potential to entangle ESA-listed species in the water or to be consumed by them. Sea turtles commonly ingest plastic or mistake debris for food and sometimes this may lead to asphyxiation. This Opinion assumes effects in the future would be similar to those in the past and are therefore reflected in the anticipated trends described in the *Status of the Species* and *Environmental Baseline* sections.

In the future, global climate change is expected to continue and may impact ESA-listed species and their habitat in the action area. As noted in the *Status of the Species* and *Environmental Baseline* sections, the likely rate of change associated with climate impacts is on a century scale, which makes the ability to discern changes in the abundance, distribution, or behavior of these species in the action area as a result of climate change impacts challenging in the short term.

## 8.0 INTEGRATION AND SYNTHESIS OF EFFECTS

In the effects analysis outlined above, we considered potential effects from construction and maintenance dredging in several channels and borrow areas in the Chesapeake Bay and near its entrance as well as the CIEE. These effects include: (1) dredging with mechanical, cutterhead and hopper dredges; (2) bed leveling; and, (3) physical alteration of the action area including disruption of benthic communities. In addition to these categories of effects, we considered the potential for collisions between listed species and project vessels as well as the effect of taking fin clip samples from Atlantic sturgeon for genetic testing. We anticipate the mortality of loggerhead, Kemp's ridley and green sea turtles and Atlantic sturgeon from the five DPSs. Mortality of sea turtles will result from entrainment in hopper dredges operating in the Bay and as a result of relocation trawling. We also anticipate non lethal take of sea turtles and Atlantic sturgeon from relocation trawling. Mortality of Atlantic sturgeon will occur from entrainment in hopper and/or cutterhead dredges and capture in mechanical dredges. As explained in the *Effects of the Action* section, effects of the dredging and disposal on habitat and benthic resources will be insignificant and discountable. We do not anticipate any take of sea turtles or Atlantic sturgeon due to any of the other effects including vessel traffic and dredge disposal.

We have determined that the proposed action is likely to result in the following levels of capture and mortality over the life of these projects:

**Table 23. Total non-lethal and lethal takes**

| Species | Non-lethal Capture | Mortality |
|---|---|---|
| NWA DPS of Loggerhead sea turtle | 937 | 785 (748 in hopper dredge; 37 in trawl) |
| Kemp's ridley sea turtle | 275 | 77 (66 in hopper dredge; 11 in trawl) |
| North Atlantic DPS of Green sea turtle | 38 | 20 (18 in hopper dredge; 2 in trawl) |
| NYB DPS of Atlantic sturgeon | 350 | 94 (68 hopper, 25 cutterhead, 1 mechanical) |
| SA DPS of Atlantic sturgeon | 150 | 40 (29 hopper, 10 cutterhead, 1 mechanical) |
| CB DPS of Atlantic sturgeon | 100 | 34 (23 hopper, 8 cutterhead, 1 mechanical) |
| GOM DPS of Atlantic sturgeon | 100 | 24 (18 hopper, 5 cutterhead, 1 mechanical) |
| Carolina DPS of Atlantic sturgeon | 50 | 13 (10 hopper, 2 cutterhead, 1 mechanical) |

In the discussion below, we consider whether the effects of the proposed actions reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the listed species in the wild by reducing the reproduction, numbers, or distribution of the listed species that will be adversely affected by the action. The purpose of this analysis is to determine whether the proposed actions, in the context established by the status of the species, environmental baseline, and cumulative effects, would jeopardize the continued existence of any listed species. In the NMFS/USFWS Section 7 Handbook, for the purposes of determining jeopardy, survival is defined as:

> "the species' persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said in another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter."

Recovery is defined as, "improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act." We summarize below the status of the species and consider whether the proposed action will result in reductions in reproduction, numbers or distribution of these species and then consider whether any reductions in reproduction, numbers or distribution resulting from the proposed action would reduce appreciably the likelihood of both the survival and recovery of these species, as those terms are defined for purposes of the Endangered Species Act.

## 8.1 Atlantic sturgeon

As explained above, the proposed actions are likely to result in the mortality of a total of 205 Atlantic sturgeon from the Gulf of Maine, New York Bight, Chesapeake Bay, South Atlantic and Carolina DPSs over the project life. Based on the proposed dredge schedule and known maintenance and nourishment needs, in a typical year we expect that no more than two Atlantic sturgeon would be entrained. We do not anticipate the mortality of any early life stages because the high salinities in the action area preclude these life stages from being present. We do not anticipate any mortality of adults because these fish are large enough to avoid entrainment in the dredge. The proposed action is also likely to result in the capture of up to 700 Atlantic sturgeon during sea turtle relocation trawling; these captures could be subadults or adults. No mortality due to capture in relocation trawling is anticipated. All other effects to Atlantic sturgeon, including effects to habitat and prey due to dredging and dredge material disposal, will be insignificant and discountable.

### *8.1.1 Determination of DPS Composition*

We have considered the best available information to determine from which DPSs individuals that will be affected by the proposed actions are likely to have originated. Using mixed stock analysis explained above, we have determined that Atlantic sturgeon in the action area likely originate from the five DPSs at the following frequencies: NYB 49%; South Atlantic 20%; Chesapeake Bay 14%; Gulf of Maine 11%; and Carolina 4%. Given these percentages, we expect that in the worst case that all 205 sturgeon likely to be killed during dredging were Atlantic sturgeon, 94 will originate from the New York Bight DPS, 40 from the South Atlantic DPS, 34 from the Chesapeake Bay DPS, 24 from the Gulf of Maine DPS, and 13 from the Carolina DPS.

### *8.1.2 Gulf of Maine DPS*

The GOM DPS is listed as threatened. While Atlantic sturgeon occur in several rivers in the GOM DPS, recent spawning has only been documented in the Kennebec; spawning is suspected to also occur in the Androscoggin River. No total population estimates are available for any river population or the DPS as a whole. As discussed in section 4.2.2.1, we have estimated a total of 7,455 GOM DPS adults and subadults in the ocean (1,864 adults and 5,591 subadults).This estimate is the best available at this time and represents only a percentage of the total GOM DPS population as it does not include young of the year or juveniles and does not include all adults and subadults. GOM origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. While there are some indications that the status of the GOM DPS may be improving, there is currently not enough information to establish a trend for any life stage or for the DPS as a whole.

Based on mixed-stock analysis, we expect that 11% of the sub-adult and adult Atlantic sturgeon in the action area will originate from the GOM DPS. While some adults from the GOM DPS are expected to be present in the action area, we do not anticipate any mortality of adult Atlantic sturgeon from the GOM DPS. Over the life of the project, we anticipate the mortality of up to 24

subadult GOM DPS Atlantic sturgeon and the non-lethal capture of up to 100 subadult and adult GOM DPS Atlantic sturgeon.

Capture during relocation trawling will temporarily prevent captured sturgeon from carrying out normal behaviors such as foraging and migrating. However, these behaviors are expected to resume as soon as the fish are returned to the water. The capture of live Atlantic sturgeon is not likely to reduce the numbers of GOM DPS Atlantic sturgeon. Similarly, as the capture of live GOM DPS Atlantic sturgeon will not affect the fitness of any individual, no effects to reproduction are anticipated. The capture of live GOM DPS Atlantic sturgeon is also not likely to affect the distribution of GOM DPS Atlantic sturgeon throughout their range. As any effects to individual GOM DPS Atlantic sturgeon captured during relocation trawling and temporarily removed from the water will be minor and temporary there are not anticipated to be any population level impacts.

The number of subadult GOM DPS Atlantic sturgeon we expect to be killed due to the proposed action (24 between now and the conclusion of the proposed action) represents an extremely small percentage of the GOM DPS. While the death of 24 GOM DPS Atlantic sturgeon over this period will reduce the number of GOM DPS Atlantic sturgeon compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this species as this loss represents a very small percentage of the GOM DPS population of subadults and an even smaller percentage of the overall DPS as a whole. Even if there were only 5,591 subadults in the GOM DPS, the loss would represent only 0.43% of the subadults in the DPS. The percentage would be much less if we also considered the number of young of the year, juveniles, adults, and other subadults not included in the NEAMAP-based oceanic population estimate.

Because there will be no loss of adults, the reproductive potential of the GOM DPS will not be affected in any way other than through a reduction in numbers of individual future spawners as opposed to current spawners. The loss of 24 female subadults would have the effect of reducing the amount of potential reproduction, as any dead GOM DPS Atlantic sturgeon would have no potential for future reproduction. This small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. The loss of 24 male subadults may have less of an impact on future reproduction as other males are expected to be available to fertilize eggs in a particular year. The proposed action will also not affect the spawning grounds within the rivers where GOM DPS fish spawn.

The proposed action is not likely to reduce distribution because while sturgeon may temporarily avoid areas where dredging or disposal activities are underway, all of these changes in distribution will be temporary and limited to movements to relatively nearby areas. We do not anticipate that any impacts to habitat will impact how GOM DPS sturgeon use the action area. Additionally, given the small percentage of the species that will be killed as a result of the proposed actions, there is not likely to be any loss of unique genetic haplotypes and no loss of

genetic diversity

Based on the information provided above, the death of up to 24 sub-adult GOM DPS Atlantic sturgeon over the life of the proposed action, will not appreciably reduce the likelihood of survival of the GOM DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect GOM DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of 24 subadult GOM DPS Atlantic sturgeon represents an extremely small percentage of the population of the DPS; (2) the death of 24 GOM DPS Atlantic sturgeon will not change the status or trends of the DPS as a whole; (3) the loss of 24 GOM DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of 24 subadult GOM DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the DPS; (5) the action will have only a minor and temporary effect on the distribution of GOM DPS Atlantic sturgeon in the action area and no effect on the distribution of the DPS throughout its range; and, (6) the action will have no effect on the ability of GOM DPS Atlatnic sturgeon to shelter andonly an insignificant effect on foraging GOM DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that the GOM DPS will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer warranted. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that the GOM DPS of Atlantic sturgeon can rebuild to a point where it is no longer in danger of becoming endangered within the foreseeable future throughout all or a significant portion of its range.

A Recovery Plan for the GOM DPS has not yet been developed. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained, would allow the species to be delisted. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. In order for that to happen for GOM Atlantic sturgeon, individuals must have access to enough habitat in suitable condition for foraging, migrating, resting, and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. For Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that

individuals can migrate between important habitats without delays that impact their fitness. Here, we consider whether this proposed action will affect the GOM DPS likelihood of recovery. The proposed actions are not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of GOM DPS Atlantic sturgeon and since it will not affect the overall distribution of GOM DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed actions will result in an extremely small amount of mortality annually (one individual) and a subsequent small reduction in future reproductive output. For these reasons, it is not expected to affect the persistence of the GOM DPS of Atlantic sturgeon. These actions will not change the status or trend of the GOM DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed actions will not reduce the likelihood of improvement in the status of the GOM DPS of Atlantic sturgeon. The effects of the proposed actions will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed actions will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed actions will not appreciably reduce the likelihood that the GOM DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed actions are not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual GOM DPS Atlantic sturgeon inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed actions, resulting in the mortality of 24 subadult GOM DPS Atlantic sturgeon and the non-lethal capture of up to 100 subadult and adult GOM DPS Atlantic sturgeon over the life span of the project, are not likely to appreciably reduce the survival and recovery of this species.

### *8.1.3 New York Bight DPS*

The NYB DPS is listed as endangered. While Atlantic sturgeon occur in several rivers in the NYB DPS, recent spawning has only been documented in the Delaware and Hudson rivers. The capture of age-0 Atlantic sturgeon in the Connecticut River indicates that spawning, at least in some years, is likely occurring in that river as well. Based on Mixed Stock Analysis, we expect that 49% of the subadult and adult Atlantic sturgeon in the action area will originate from the NYB DPS.

NYB origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance (e.g., impingement at water intakes, dredging, bycatch in commercial and recreational fisheries, in-water construction activities, vessel traffic) throughout the riverine and marine portions of their range. As discussed in section 4.2.2.2, we have estimated a total of 34,566 NYB DPS adults and subadults in the ocean (8,642 adults and 25,925 subadults). This estimate is the best available at this time and represents only a percentage of the total NYB DPS

population as it does not include young of the year or juveniles and does not include all adults and subadults. The largest single source of mortality appears to be capture as bycatch in commercial fisheries operating in the marine environment. A bycatch estimate provided by NEFSC indicates that approximately 376 Atlantic sturgeon die as a result of bycatch each year. While there are some indications that the status of the NYB DPS may be improving, there is currently not enough information to establish a trend for any life stage or for the DPS as a whole.

Based on mixed-stock analysis, we expect that 49% of the sub-adult and adult Atlantic sturgeon in the action area will originate from the NYB DPS. While some adults from the NYB DPS are expected to be present in the action area, we do not anticipate any mortality of adult Atlantic sturgeon from the NYB DPS. Because juveniles do not leave their natal rivers, they are not impacted by the proposed action.

Over the life of the proposed action, we anticipate the mortality of up to 94 subadult NYB DPS Atlantic sturgeon. These sturgeon could be killed due to entrainment in a hopper or cutterhead dredge, or capture in a mechanical dredge. These fish could be subadults originating from the Delaware or Hudson River. While it is possible that entrained fish could survive, we assume here that these fish will be killed.

Capture during relocation trawling will temporarily prevent captured sturgeon from carrying out normal behaviors such as foraging and migrating. However, these behaviors are expected to resume as soon as the fish are returned to the water. The capture of live Atlantic sturgeon is not likely to reduce the numbers of NYB DPS Atlantic sturgeon. Similarly, as the capture of live NYB DPS Atlantic sturgeon will not affect the fitness of any individual, no effects to reproduction are anticipated. The capture of live NYB DPS Atlantic sturgeon is also not likely to affect the distribution of NYB DPS Atlantic sturgeon throughout their range. As any effects to individual NYB DPS Atlantic sturgeon captured during relocation trawling and temporarily removed from the water will be minor and temporary there are not anticipated to be any population level impacts.

While overall we anticipate the death of 94 subadult Atlantic sturgeon from the NYB DPS over the life span of the project, we do not anticipate that there would be a loss of more than 1 NYB DPS subadult in most years and never more than 2 NYB DPS Atlantic sturgeon killed per year. Here, we consider the effect of the loss of these subadults on the reproduction, numbers and distribution of the NYB DPS.

Any New York Bight DPS subadults could originate from the Delaware or Hudson River. We have limited information from which to determine the percentage of NYB DPS fish in the Chesapeake Bay that are likely to originate from the Delaware vs. the Hudson River. Given the sizes of the two populations, the worst case scenario is that all 94 NYB fish that are killed are Delaware River fish (rather than some Delaware River, some Hudson River); however, that appears to be unlikely. Individual assignments of NYB DPS Atlantic sturgeon that have undergone genetic testing indicates that in the oceanic environment, approximately 91% of NYB individuals originate from the Hudson River. This is likely due to the greater number of Hudson River origin Atlantic sturgeon than Delaware River Atlantic sturgeon. Thus, of the 94 NYB Atlantic sturgeon likely to be killed, eight are likely to originate from the Delaware River and 86 from the Hudson River.

Some Delaware River fish have a unique genetic haplotype (the A5 haplotype); however, whether there is any evolutionary significance or fitness benefit provided by this genetic makeup is unknown. Genetic evidence indicates that while spawning continued to occur in the Delaware River and in some cases Delaware River origin fish can be distinguished genetically from Hudson River origin fish, there is free interchange between the two rivers. This relationship is recognized by the listing of the New York Bight DPS as a whole and not separate listings of a theoretical Hudson River DPS and Delaware River DPS. Thus, while we can consider the loss of Delaware River fish on the Delaware River population and the loss of Hudson River fish on the Hudson River population, it is more appropriate, because of the interchange of individuals between these two populations, to consider the effects of these mortalities on the New York Bight DPS as a whole.

While overall we anticipate the death of 94 subadult Atlantic sturgeon from the NYB DPS over the life spand of the project, we do not anticipate that there would be a loss of more than 2 NYB DPS subadult per year. The mortality of 2 subadult Atlantic sturgeon from the NYB DPS each year represents a very small percentage of subadult population (*i.e.*, approximately 0.08% of the population, just considering the minimum estimated number of subadults; the percentage would be much less if the number of YOY, juveniles and adults was considered). While the death of these subadult Atlantic sturgeon will reduce the number of NYB DPS Atlantic sturgeon compared to the number that would have been present absent the proposed actions, it is not likely that this reduction in numbers will change the status of this species as this loss represents a very small percentage of the subadult population and an even smaller percentage of the overall population of the DPS (juveniles, subadults and adults combined). Even when converting these fish to adult equivalents[12] (using a conversion rate of 0.48 considering the adult equivalent), and assuming no growth in the adult population, the annual mortality of 1 subadult represents an extremely small percentage of the adult population (approximately 0.11%).

Because there will be no loss of adults, the reproductive potential of the NYB DPS will not be affected in any way other than through a reduction in numbers of individual future spawners. The loss of 94 subadults over a 50-year period would have the effect of reducing the amount of potential reproduction as any dead NYB DPS Atlantic sturgeon would have no potential for future reproduction. This small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed actions, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. The proposed actions will also not affect the spawning grounds within the Hudson River or Delaware River where NYB DPS fish spawn. There will be no effects to spawning adults and therefore no reduction in individual fitness or any future reduction in spawning by these individuals.

The proposed action is not likely to reduce distribution. Although the action will temporarily affect the distribution of individual sturgeon by displacing sturgeon captured with the trawl from

[12] The "adult equivalent" rate converts a number of subadults to adult equivalents (the number of subadults that would, through natural mortality, live to be adults; for Atlantic sturgeon, this is calculated as 0.48).

one area and relocating them to an alternate area and sturgeon may temporarily avoid areas where dredging or disposal activities are underway, all of these changes in distribution will be temporary and limited to movements to relatively nearby areas. We do not anticipate that any impacts to habitat will permanently impact how sturgeon use the action area. Further, the action is not expected to reduce the river by river distribution of Atlantic sturgeon. Additionally, given the small percentage of the species that will be killed as a result of the proposed actions, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity

Based on the information provided above, the death of up to 94 NYB DPS Atlantic sturgeon over the project life considered here, will not appreciably reduce the likelihood of survival of the New York Bight DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The actions will not affect NYB DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of 94 subadult NYB DPS Atlantic sturgeon represents an extremely small percentage of the poplation of the DPS; (2) the death of 94 subadult NYB DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (3) the loss of 94 subadult NYB DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of 94 subadult NYB DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; (5) the actions will have only a minor and temporary effect on the distribution of NYB DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (6) the actions will have no effect on the ability of NYB DPS Atlantic sturgeon to shelter and only an insignificant effect on individual foraging NYB DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that the NYB DPS will survive in the wild. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that the NYB DPS of Atlantic sturgeon shortnose sturgeon can rebuild to a point where it is no longer in danger of extinction through all or a significant part of its range.

A Recovery Plan for the NYB DPS has not yet been developed. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging,

resting, migrating, and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. For Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. Here, we consider whether this proposed action will affect the NYB DPS likelihood of recovery.

The proposed actions are not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of NYB DPS Atlantic sturgeon and since it will not affect the overall distribution of NYB DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed actions will result in a small amount of mortality (no more than two individuals per year) and a subsequent small reduction in future reproductive output. For these reasons, it is not expected to affect the persistence of the NYB DPS of Atlantic sturgeon. These actions will not change the status or trend of the NYB DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed actions will not reduce the likelihood of improvement in the status of the NYB DPS of Atlantic sturgeon. The effects of the proposed actions will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed actions will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed actions will not appreciably reduce the likelihood that the NYB DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as endangered. Based on the analysis presented herein, the proposed actions are not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual NYB DPS Atlantic sturgeon inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. Based on the analysis presented herein, the proposed actions, resulting in the mortality of up to 94 subadult NYB DPS Atlantic sturgeon and the non-lethal capture of up to 350 subadult and adult NYB DPS Atlantic sturgeon over the life span of the project, is not likely to appreciably reduce the survival and recovery of this species.

#### *8.1.4 Chesapeake Bay DPS*

The CB DPS is listed as endangered. Individuals originating from the CB DPS are likely to occur in the action area. While Atlantic sturgeon occur in several rivers in the CB DPS, recent spawning has only been documented in the James River and York River systems. Chesapeake Bay DPS origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance (e.g., impingement at water intakes, dredging, bycatch in commercial and recreational fisheries, in-water construction activities, vessel traffic) throughout the riverine and marine portions of their range. No total population estimates are available for any river population or the DPS as a whole. As discussed in section 4.2.2.3, we have estimated a total of 8,811 CB DPS adults and subadults in the ocean (2,203 adults and 6,608 subadults). This

estimate is the best available at this time and represents only a percentage of the total CB DPS population as it does not include young of the year or juveniles and does not include all adults and subadults. There is currently not enough information to establish a trend for any life stage or for the DPS as a whole.

Based on our mixed-stock analysis, we expect that 14% of the Atlantic sturgeon in the action area will originate from the CB DPS. Over the 50-year period considered here, we anticipate the mortality of up to 34 subadult and juvenile CB DPS Atlantic sturgeon. These sturgeon could be killed due to entrainment in a hopper or cutterhead dredge, or capture in a mechanical dredge. While it is possible that entrained/entrapped fish could survive, we assume here that these fish will be killed. We also anticipate the non-lethal capture of up to 100 subadult,adult, and juvenile CB DPS Atlantic sturgeon.

Capture during relocation trawling will temporarily prevent captured sturgeon from carrying out normal behaviors such as foraging and migrating. However, these behaviors are expected to resume as soon as the fish are returned to the water. The capture of live Atlantic sturgeon is not likely to reduce the numbers of CB DPS Atlantic sturgeon. Similarly, as the capture of live CB DPS Atlantic sturgeon will not affect the fitness of any individual, no effects to reproduction are anticipated. The capture of live CB DPS Atlantic sturgeon is also not likely to affect the distribution of CB DPS Atlantic sturgeon throughout their range. As any effects to individual CB DPS Atlantic sturgeon captured during relocation trawling and temporarily removed from the water will be minor and temporary there are not anticipated to be any population level impacts.

While overall we anticipate the death of 34 juvenile and subadult Atlantic sturgeon from the CB DPS over the life span of the projecct, we do not anticipate that there would be a loss of more than 1 CB DPS subadult or juvenile in any year. Here, we consider the effect of the loss of a total of these subadults on the reproduction, numbers and distribution of the CB DPS.

The reproductive potential of the CB DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of a total of 34 juvenile and subadults, with no more than one per year, would have the effect of reducing the amount of potential reproduction as any dead CB DPS Atlantic sturgeon would have no potential for future reproduction. However, this small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed actions, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. Reproductive potential of other captured or injured individuals is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed actions will also not affect the spawning grounds within the rivers where CB DPS fish spawn. The actions will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by CB DPS fish.

Because we do not have a population estimate for the CB DPS, it is difficult to evaluate the effect of the mortality caused by these actions on the species. However, because the proposed action will result in the loss of only one individual per year, with a total of no more than 34, it is unlikely that these deaths will have a detectable effect on the numbers and population trend of the CB DPS.

The proposed action is not likely to reduce distribution. Although the action will temporarily affect the distribution of individual sturgeon by displacing sturgeon captured with the trawl from one area and relocating them to alternate area and sturgeon may temporarily avoid areas where dredging or disposal activities are underway, all of these changes in distribution will be temporary and limited to movements to relatively nearby areas. We do not anticipate that any impacts to habitat will permanently impact how sturgeon use the action area. Further, the action is not expected to reduce the river by river distribution of Atlantic sturgeon. Additionally, given the small percentage of the species that will be killed as a result of the proposed actions, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity

Based on the information provided above, the death of up to 34 CB DPS Atlantic sturgeon over the life span of the project, will not appreciably reduce the likelihood of survival of the CB DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The actions will not affect CB DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of one juvenile or subadult CB DPS Atlantic sturgeon in any year and the total loss of 34 juvenile and subadults will not change the status or trends of the species as a whole; (2) the death of 34 juvenile and subadule CB DPS Atlatnic sturgeon represents and extremenly small percentage of the species; (3) the loss of 34 juvenile and subadult CB DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of 34 juvenile and subadult CB DPS Atlantic sturgeon over the life span of the project will not result in the loss of any age class; (5) the actions will have only a minor and temporary effect on the distribution of CB DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (6) the actions will have no effect on the ability of CB DPS Atlantic sturgeon to shelter and only an insignificant effect on any foraging CB DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the CB DPS of Atlantic sturgeon will survive in the wild. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that the CB DPS of Atlantic sturgeon shortnose

sturgeon can rebuild to a point where it is no longer in danger of extinction through all or a significant part of its range.

A Recovery Plan for the CB DPS has not yet been developed. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, migrating, resting, and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. For Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. Here, we consider whether this proposed action will affect the CB DPS likelihood of recovery.

The proposed actions are not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of CB DPS Atlantic sturgeon and since it will not affect the overall distribution of CB DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed actions will result in an extremely small amount of mortality (on average, less than one individual per year) and a subsequent small reduction in future reproductive output. For these reasons, it is not expected to affect the persistence of the CB DPS of Atlantic sturgeon. These actions will not change the status or trend of the CB DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed actions will not reduce the likelihood of improvement in the status of the CB DPS of Atlantic sturgeon. The effects of the proposed actions will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed actions will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed actions will not appreciably reduce the likelihood that the CB DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as endangered. Based on the analysis presented herein, the proposed actions, are not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual CB DPS Atlantic sturgeon inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed actions, resulting in the mortality of 34 juvenile and subadult CB DPS Atlantic sturgeon and the non-lethal capture of up to 100 subadult and adult CB DPS Atlantic sturgeon over the life span of the project, is not likely to appreciably reduce the survival and recovery of this species.

### *8.1.5 Carolina DPS*

We expect that 4% of the Atlantic sturgeon in the action area will originate from the CA DPS. Individuals originating from the CA DPS are likely to occur in the action area. The CA DPS is listed as endangered. The CA DPS consists of Atlantic sturgeon originating from at least five rivers where spawning is still thought to occur. Carolina DPS origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage, for any of the spawning populations or for the DPS as a whole. Over the 50-year period considered here, we anticipate the mortality of up to 13 subadult CA DPS Atlantic sturgeon and the non-lethal capture of up to 50 subadult and adult CA DPS Atlantic sturgeon.

Capture during relocation trawling will temporarily prevent captured sturgeon from carrying out normal behaviors such as foraging and migrating. However, these behaviors are expected to resume as soon as the fish are returned to the water. The capture of live Atlantic sturgeon is not likely to reduce the numbers of CA DPS Atlantic sturgeon. Similarly, as the capture of live CA DPS Atlantic sturgeon will not affect the fitness of any individual, no effects to reproduction are anticipated. The capture of live CA DPS Atlantic sturgeon is also not likely to affect the distribution of CA DPS Atlantic sturgeon throughout their range. As any effects to individual CA DPS Atlantic sturgeon captured during relocation trawling and temporarily removed from the water will be minor and temporary there are not anticipated to be any population level impacts.

While overall we anticipate the death of 13 subadult Atlantic sturgeon from the CA DPS over a 50-year period, we do not anticipate that there would be a loss of more than 1 CA DPS subadult in any year. Here, we consider the effect of the loss of a total of these subadults on the reproduction, numbers and distribution of the CA DPS.

The reproductive potential of the CA DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of a total of 13 subadults, with no more than one per year, would have the effect of reducing the amount of potential reproduction as any dead CA DPS Atlantic sturgeon would have no potential for future reproduction. However, this small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed actions, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. Reproductive potential of other captured or injured individuals is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed actions will also not affect the spawning grounds within the rivers where CA DPS fish spawn. The actions will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by CA DPS fish.

Because we do not have a population estimate for the CA DPS, it is difficult to evaluate the effect of the mortality caused by these actions on the species. However, because the proposed actions will result in the loss of only one individual per year, with a total of no more than 13, it is unlikely that these deaths will have a detectable effect on the numbers and population trend of the CA DPS.

The proposed action is not likely to reduce distribution because while the action will temporarily affect the distribution of individual sturgeon by displacing sturgeon captured with the trawl from one area and relocating them to alternate area and sturgeon may temporarily avoid areas where dredging or disposal activities are underway, all of these changes in distribution will be temporary and limited to movements to relatively nearby areas. We do not anticipate that any impacts to habitat will permanently impact how sturgeon use the action area. Further, the action is not expected to reduce the river by river distribution of Atlantic sturgeon. Additionally, given the small percentage of the species that will be killed as a result of the proposed actions, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity

Based on the information provided above, the death of up to 13 CA DPS Atlantic sturgeon over the life of the project, will not appreciably reduce the likelihood of survival of the CA DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The actions will not affect CA DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of 13 subadult CA DPS Atlantic sturgeon represents and extremely small percentage of the species; (2) the death of one subadult CA DPS Atlantic sturgeon in any year and the total loss of 13 subadults is likely to have a small effect on reproductive output and will not change the status or trends of the species as a whole; (3) the loss of 13 subadult CA DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the actions will have only a minor and temporary effect on the distribution of CA DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (5) the actions will have no effect on the ability of CA DPS Atlantic sturgeon to shelter and only an insignificant effect on any foraging CA DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the CA DPS of Atlantic sturgeon will survive in the wild. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed

action will appreciably reduce the likelihood that CA DPS of Atlantic sturgeon can rebuild to a point where it is no longer in danger of extinction through all or a significant part of its range.

A Recovery Plan for the CA DPS has not yet been developed. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting and migrations of all individuals. For Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. Here, we consider whether this proposed action will affect the CA DPS likelihood of recovery.

The proposed actions is not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of CA DPS Atlantic sturgeon and since it will not affect the overall distribution of CA DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed actions will result in an extremely small amount of mortality (13 individuals over the life of the project) and a subsequent small reduction in future reproductive output. For these reasons, it is not expected to affect the persistence of the CA DPS of Atlantic sturgeon. These actions will not change the status or trend of the CA DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed actions will not reduce the likelihood of improvement in the status of the CA DPS of Atlantic sturgeon. The effects of the proposed actions will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed actions will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed actions will not appreciably reduce the likelihood that the CA DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as endangered. Based on the analysis presented herein, the proposed actions, is not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual CA DPS Atlantic sturgeon inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed actions, resulting in the mortality of 13 subadult CA DPS Atlantic sturgeon and the non-lethal capture of up to 50

subadult and adult CA DPS Atlantic sturgeon over the life of the project, is not likely to appreciably reduce the survival and recovery of this species.

### *8.1.6 South Atlantic DPS*

Individuals originating from the SA DPS are likely to occur in the action area. The SA DPS is listed as endangered. We expect that 20% of the subadult and adult Atlantic sturgeon in the action area will originate from the SA DPS. Most of these fish are expected to be subadults, with few adults from the SA DPS expected to be present. SA DPS origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance (e.g., impingement at water intakes, dredging, bycatch in commercial and recreational fisheries, in-water construction activities, vessel traffic) throughout the riverine and marine portions of their range.

Over the life span of the project, we anticipate the mortality of up to 40 subadult SA DPS Atlantic sturgeon. These sturgeon could be killed due to entrainment in a hopper or cutterhead dredge, or capture in a mechanical dredge. While it is possible that entrained/entrapped fish could survive, we assume here that these fish will be killed. In addition, we expect the non-lethal capture of up to 150 subadult and adult SA DPS Atlantic sturgeon.

Capture during relocation trawling will temporarily prevent captured sturgeon from carrying out normal behaviors such as foraging and migrating. However, these behaviors are expected to resume as soon as the fish are returned to the water. The capture of live Atlantic sturgeon is not likely to reduce the numbers of SA DPS Atlantic sturgeon. Similarly, as the capture of live SA DPS Atlantic sturgeon will not affect the fitness of any individual, no effects to reproduction are anticipated. The capture of live SA DPS Atlantic sturgeon is also not likely to affect the distribution of SA DPS Atlantic sturgeon throughout their range. As any effects to individual SA DPS Atlantic sturgeon captured during relocation trawling and temporarily removed from the water will be minor and temporary there are not anticipated to be any population level impacts.

The number of SA DPS Atlantic sturgeon we expect to be killed (40 subadults) due to the deepening and maintenance of the navigation channels represents an extremely small percentage of the SA DPS. While we anticipate the death of 40 subadult Atlantic sturgeon from the SA DPS over the life span of the project, we do not anticipate that there would be a loss of more than 1 SA DPS subadult in any year. Here, we consider the effect of the loss of a total of these subadults on the reproduction, numbers and distribution of the SA DPS.

No total population estimates are available for any river population or the SA DPS as a whole. As discussed in section 4.2.2.5, we have estimated a total of 14,911 SA DPS adults and subadults in the ocean (3,728 adults and 11,183 subadults). This estimate is the best available at this time and represents only a percentage of the total SA DPS population as it does not include young of the year or juveniles and does not include all adults and subadults. SA origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage or for the DPS as a whole.

While the death of 40 SA DPS Atlantic sturgeon over the life of the project will reduce the

number of SA DPS Atlantic sturgeon compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this species as this loss represents a very small percentage of the SA DPS population of subadults and an even smaller percentage of the DPS as a whole. Even if there were only 11,183 subadults in the SA DPS, the loss of up to 40 would represent less than 0.36% of the subadults in the DPS. The percentage would be much less if we also considered the number of young of the year, juveniles, adults, and other subadults not included in the NEAMAP-based oceanic population estimate.

The reproductive potential of the SA DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of a total of 40 subadults, with no more than one per year, would have the effect of reducing the amount of potential reproduction as any dead SA DPS Atlantic sturgeon would have no potential for future reproduction. However, this small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed actions, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. Reproductive potential of other captured or injured individuals is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed actions will also not affect the spawning grounds within the rivers where SA DPS fish spawn. The actions will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by SA DPS fish.

The proposed action is not likely to reduce distribution because while the action will temporarily affect the distribution of individual sturgeon by displacing sturgeon captured with the trawl from one area and relocating them to alternate area and sturgeon may temporarily avoid areas where dredging or disposal activities are underway, all of these changes in distribution will be temporary and limited to movements to relatively nearby areas. We do not anticipate that any impacts to habitat will permanently impact how sturgeon use the action area. Further, the action is not expected to reduce the river by river distribution of Atlantic sturgeon. Additionally, given the small percentage of the species that will be killed as a result of the proposed actions, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity

Based on the information provided above, the death of up to 40 SA DPS Atlantic sturgeon over the life of the project, will not appreciably reduce the likelihood of survival of the SA DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The actions will not affect SA DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of 40

subadult SA DPS of Atlantic sturgeon represents and extremely small percentage of the species; (2) the death of one subadult SA DPS Atlantic sturgeon in any year and the total loss of 40 subadults is likely to have a small effect on reproductive output and will not change the status or trends of the species as a whole; (3) the loss of 40 subadult SA DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the actions will have only a minor and temporary effect on the distribution of SA DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (5) the actions will have no effect on the ability of SA DPS Atlantic sturgeon to shelter and only an insignificant effect on individual foraging SA DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the SA DPS of Atlantic sturgeon will survive in the wild. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that SA DPS of Atlantic sturgeon can rebuild to a point where it is no longer in danger of extinction through all or a significant part of its range.

A Recovery Plan for the SA DPS has not yet been developed. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting and migrations of all individuals. For Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. Here, we consider whether this proposed action will affect the SA DPS likelihood of recovery.

The proposed actions are not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of SA DPS Atlantic sturgeon and since it will not affect the overall distribution of SA DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed actions will result in an extremely small amount of mortality (on average, less than one individual per year) and a subsequent small reduction in future reproductive output. For these reasons, it is not expected to affect the persistence of the SA DPS of Atlantic sturgeon. These actions will not change the status or trend of the SA DPS of Atlantic

sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed actions will not reduce the likelihood of improvement in the status of the SA DPS of Atlantic sturgeon. The effects of the proposed actions will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed actions will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed actions will not appreciably reduce the likelihood that the SA DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as endangered. Based on the analysis presented herein, the proposed actions, are not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual SA DPS Atlantic sturgeon inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed actions, resulting in the mortality of 40 subadult SA DPS Atlantic sturgeon and the non-lethal capture of up to 150 subadult and adult SA DPS Atlantic sturgeon over the life of the project, is not likely to appreciably reduce the survival and recovery of this species.

## 8.2 North Atlantic DPS of Green sea turtles

The North Atlantic DPS of green sea turtles is listed as threatened under the ESA. North Atlantic DPS green sea turtles face numerous threats on land and in the water that affect the survival of all age classes, as is the case with other sea turtle species.

The greatest abundance of green sea turtle nesting in the North Atlantic occurs on beaches in Tortuguero, Costa Rica. Nesting in the area has increased considerably since the 1970s and nest count data from 1999-2003 suggested that 17,402-37,290 females nested there per year Seminoff *et al*. 2015). In 2010, an estimated 180,310 nests were laid at Tortuguero, the highest level of green sea turtle nesting estimated since the start of nesting track surveys in 1971. This equated to somewhere between 30,052 and 64,396 nesters in 2010 (Seminoff *et al*. 2015).

The results of genetic analyses show that green sea turtles in the Atlantic do not contribute to green sea turtle nesting elsewhere in the species' range (Bowen and Karl 2007). Therefore, increased nesting by green sea turtles in the Atlantic is not expected to affect green sea turtle abundance in other ocean basins in which the species occurs. We recognize that the nest count data available for green sea turtles in the Atlantic clearly indicates increased nesting at many sites. However, we also recognize that the nest count data, including data for green sea turtles in the Atlantic, only provides information on the number of females currently nesting, and is not necessarily a reflection of the number of mature females available to nest or the number of immature females that will reach maturity and nest in the future. Given the late age to maturity for green sea turtles (20 to 50 years) (Balazs 1982; Frazer and Ehrhart 1985; Seminoff 2004), caution is urged regarding the trend for any of the nesting groups since no area has a dataset spanning a full green sea turtle generation (NMFS and USWS 2007b).

In this Opinion, we have considered the potential impacts of the proposed action on green sea turtles. We expect the mortality of 20 green sea turtles and the non-lethal capture of 38 green sea turtles over the life of the project. As there will be very few mortalities to green sea turtles as a result of the proposed action and no effects to the prey base that would cause sea turtles to leave the action area to forage elsewhere, the proposed action is not likely to reduce the numbers of green sea turtles in the action area or the DPS as a whole. Similarly, no effects to reproduction are anticipated. Despite the threats faced by individual green sea turtles inside and outside of the action area, the proposed action will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. Over the time period of this action considered in this Opinion, sea surface temperatures are expected to rise less than 1°C. It is unknown if that is enough of a change to contribute to shifts in the range, distribution, and recruitment of sea turtles. Theoretically, we expect that as waters in the action area warm, more sea turtles could be present or sea turtles could be present for longer periods of time. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and have concluded that even with the ongoing impacts of these activities and conditions, the conclusions reached above do not change.

As described in the *Status of the Species, Environmental Baseline, and Cumulative Effects* sections above, green sea turtles in the action area continue to be affected by multiple anthropogenic impacts including bycatch in commercial and recreational fisheries, habitat alteration and other factors that result in mortality of individuals at all life stages.

In this Opinion, we determined that green sea turtles could be entrained in a hopper dredge operating in any of the channels or borrow areas considered in this consultation and could also be captured and killed during relocation trawling. We have estimated that the proposed actions are likely to result in the mortality of 20 green sea turtles and the non-lethal capture of 38 green sea turtles over the project life. We determined that all other effects of these actions on this species will be insignificant and discountable. This estimate is based on the best available information, and the following assumptions: (1) that all dredging will occur in the April – November time period when sea turtles are present in the action area; and, (2) that any dredging that could occur with a hopper or cutterhead dredge, occurs with a hopper dredge. The number of mortalities would be less than 20 if some of the dredging occurred between December and March and if more of it was carried out with a cutterhead dredge. No mortalities of green sea turtles are expected whenever a cutterhead dredge is used. No green turtles are present in the action area from December – March, therefore, hopper dredging that occurs during this time of year will not result in the mortality of any green sea turtles.

Based on the proposed dredge schedule and known maintenance and nourishment needs, in a typical year during the initial construction period, approximately 1 million cubic yards of material will be removed from the channels and borrow areas considered here; in the worst case, if all channels and borrow areas were dredged in one year, up to 5 million cubic yards of material could be removed. However, it is extremely unlikely that this would happen given the cost of such an operation and the limited number of dredges that are available for this kind of work. Therefore, in a typical year, we expect that no more than 1 green sea turtle would be entrained. All other effects to greens, including effects to habitat and prey due to dredging and dredge disposal, will be insignificant and discountable.

The lethal removal of 20 green sea turtles from the action area over the life spand of the project would reduce the number of green sea turtles as compared to the number of green sea turtles that would have been present in the absence of the proposed actions (assuming all other variables remained the same). However, this does not necessarily mean that the species will experience reductions in reproduction, numbers or distribution in response to these effects to the extent that survival and recovery would be appreciably reduced.

The lethal removal of one green sea turtle in a particular year and a total of 20 over the life of the project, whether males or females, immature or mature animals, would reduce the number of green sea turtles as compared to the number of green that would have been present in the absence of the proposed actions assuming all other variables remained the same; the loss of one green sea turtles represents a very small percentage of the species as a whole. Even compared to the number of nesting females (17,000-37,000), which represent only a portion of the number of greens worldwide, the mortality of 20 greens represents approximately 0.12% of the nesting population. The loss of these sea turtles would be expected to reduce the reproduction of green sea turtles as compared to the reproductive output of green sea turtles in the absence of the proposed action. As described in the *Status of the Species* section above, we consider the trend for green sea turtles to be stable. However, as explained below, the death of these green sea turtles will not appreciably reduce the likelihood of survival for the species for the following reasons.

While generally speaking, the loss of a small number of individuals from a subpopulation or species may result in an appreciable reduction on the numbers, reproduction and distribution of the species; this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of greens because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of greens is likely to be increasing and at worst is stable. These actions are not likely to reduce distribution of greens because the actions will not impede greens from accessing foraging grounds or cause more than a temporary disruption to other migratory behaviors.

Based on the information provided above, the death of 20 green sea turtles over the life span of the project will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The actions will not affect green sea turtles in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent green sea turtles from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the species' nesting trend is stable; (2) the death of 20 green sea turtles represents an extremely small percentage of the species as a whole; (3) the loss of 20 green sea turtles will not change the status or trends of the species as a whole; (4) the loss of 20 green sea turtles is not likely to have an effect on the levels of genetic heterogeneity in the population; (5) the loss of 20 green sea turtles is likely to have an

undetectable effect on reproductive output of the species as a whole; (6) the actions will have no effect on the distribution of greens in the action area or throughout its range; and (7) the actions will have no effect on the ability of green sea turtles to shelter and only an insignificant effect on individual foraging green sea turtles.

In certain instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that green sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that the species can rebuild to a point where listing is no longer appropriate. A Recovery Plan for Green sea turtles was published by NMFS and USFWS in 1991. The plan outlines the steps necessary for recovery and the criteria, which, once met, would ensure recovery. In order to qualify for delisting, green sea turtles must experience sustained population growth, as measured in the number of nests laid per year, over time. Additionally, "priority one" recovery tasks must be achieved and nesting habitat must be protected (through public ownership of nesting beaches) and stage class mortality must be reduced. Here, we consider whether these proposed actions will affect the population size and/or trend in a way that would affect the likelihood of recovery.

The proposed actions will not appreciably reduce the likelihood of survival of green sea turtles. Also, it is not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of green sea turtles in any geographic area and since it will not affect the overall distribution of green sea turtles other than to cause minor temporary adjustments in movements in the action area. As explained above, the proposed actions are likely to result in the mortality of up to 20 green sea turtles, with the loss of no more than one per year; however, the loss of these individuals over this time period is not expected to affect the persistence of green sea turtles or the species trend. The actions will not affect nesting habitat and will have only an extremely small effect on mortality. The effects of the proposed actions will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the actions will not prevent the species from growing in a way that leads to recovery and the actions will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of greens and a small reduction in the amount of potential reproduction due to the loss of 20 individuals, these effects will be undetectable over the long-term and the action is not expected to have long term impacts on the future growth of the population or its potential for recovery. Therefore, based on the analysis presented above, the proposed actions will not appreciably reduce the likelihood that green sea turtles can be brought to the point at which they are no longer listed as endangered or threatened.

In addition to the threats faced by individual green sea turtles inside and outside of the action area, the proposed actions may increase the vulnerability of individual sea turtles to these threats and exposure to ongoing threats may increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of cumulative effects explained above, including climate change, and has concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based

on the analysis presented herein, the proposed actions, resulting in the mortality of 20 green sea turtles and nonlethal capture of 38 sea turtles over the life span of the project, is not likely to appreciably reduce the survival and recovery of this species.

### 8.3 Kemp's ridley sea turtles

Kemp's ridley sea turtles are listed as a single species classified as "endangered" under the ESA. Kemp's ridleys occur in the Atlantic Ocean and Gulf of Mexico. The only major nesting site for Kemp's ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; U.S. FWS and NMFS 1992; NMFS and U.S. FWS 2015).

Nest count data provides the best available information on the number of adult females nesting each year. As is the case with the other sea turtles species discussed above, nest count data must be interpreted with caution given that these estimates provide a minimum count of the number of nesting Kemp's ridley sea turtles. In addition, the estimates do not account for adult males or juveniles of either sex. Without information on the proportion of adult males to females, and the age structure of the Kemp's ridley population, nest counts cannot be used to estimate the total population size (Meylan 1982; Ross 1996; Zurita *et al.* 2003; Hawkes *et al.* 2005; letter to J. Lecky, NMFS Office of Protected Resources, from N. Thompson, NMFS Northeast Fisheries Science Center, December 4, 2007). Nevertheless, the nesting data does provide valuable information on the extent of Kemp's ridley nesting and the trend in the number of nests laid. Estimates of the adult female nesting population reached a low of approximately 250-300 in 1985 (U.S. FWS and NMFS 1992; TEWG 2000). From 1985 to 1999, the number of nests observed at Rancho Nuevo and nearby beaches increased at a mean rate of 11.3% per year (TEWG 2000). Recent population abundance for Kemp's ridleys, based on nests and hatchling recruitment, was estimated by Gallaway *et al*. (2013). They estimated the female population size for age-2 and older in 2012 to be 188,713 (SD = ±32,529). Assuming females comprise 76% (sex ratio = 0.76; TEWG 1998, 2000) of the population, they estimated the total population (males and females) of age 2 years and over at 248,307. Based on the number of hatchlings released in 2011 and 2012 (1+ million) and recognizing mortality over the first two years is high, Gallaway *et al.* (2013) thought the total population, including hatchlings younger than 2 years, may exceed 1 million turtles (NMFS and USFWS 2015).

The most recent five-year review of the Kemp's ridley suggests that the population growth rate (as measured by numbers of nests) stopped abruptly after 2009. Given the recent lower nest numbers, the population is not projected to grow at former rates. As a result, the status review team determined that the population is not recovering and cannot meet recovery goals unless survival rates improve (NMFS and U.S. FWS 2015). However, some positive outlooks for the species include recent conservation actions (including the protection of females, nests, and hatchlings on nesting beaches since the 1960s) and the enhancement of survival in marine habitats through the implementation of TEDs in the early 1990s and a decrease in the amount of shrimping off the coast of Tamaulipas and in the Gulf of Mexico (NMFS and U.S. FWS 2015). There is also the recent record nesting year in Mexico and Texas for Kemp's ridleys in 2017.

In this Opinion, we determined that Kemp's ridley sea turtles could be entrained in a hopper dredge operating in any of the channels or borrow areas considered in this consultation and could also be captured and killed during relocation trawling. We have estimated that the proposed

actions are likely to result in the mortality of 77 Kemp's ridley sea turtles and the non-lethal capture of 275 Kemp's ridley sea turtles over the project life. We determined that all other effects of the actions on this species will be insignificant and discountable. While this estimate is based on the best available information, and the following assumptions: (1) that all dredging will occur in the April – November time period when sea turtles are present in the action area; and, (2) that any dredging that could occur with a hopper or cutterhead dredge, occurs with a hopper dredge. The number of mortalities would be less than 77 if some of the dredging occurred between December and March and if any of it was carried out with a cutterhead dredge.

The mortality of 77 Kemp's ridleys over the project time period represents a very small percentage of the Kemp's ridleys worldwide. Even taking into account just nesting females, the death of 77 Kemp's ridley represents less than 1% of the population; considering that there is not likely to be more than 1 mortality of a Kemp's ridley per year, the annual impact is less than 0.014% of the population. While the death of 77 Kemp's ridley will reduce the number of Kemp's ridleys compared to the number that would have been present absent the proposed actions, it is not likely that this reduction in numbers will change the status of this species as this loss represents a very small percentage of the population. Reproductive potential of Kemp's ridleys is not expected to be affected in any other way other than through a reduction in numbers of individuals.

A reduction in the number of Kemp's ridleys would have the effect of reducing the amount of potential reproduction as any dead Kemp's ridleys would have no potential for future reproduction. While the species is thought to be female biased, there are likely to be several thousand adult males as well. Given the number of nesting adults, it is unlikely that the loss of 1 Kemp's ridley per year or 77 over the life span of the project would affect the success of nesting in any year. Additionally, this small reduction in potential nesters is expected to result in a small reduction in the number of eggs laid or hatchlings produced in future years and similarly, a very small effect on the strength of subsequent year classes. Even considering the potential future nesters that would be produced by the individuals that would be killed as a result of the proposed actions, any effect to future year classes is anticipated to be very small and would not change the current trend of this species. Additionally, the proposed actions will not affect nesting beaches in any way or disrupt migratory movements in a way that hinders access to nesting beaches or otherwise delays nesting.

The proposed actions are not likely to reduce distribution because the actions will not impede Kemp's ridleys from accessing foraging grounds or cause more than a temporary disruption (due to relocation trawling) to other migratory behaviors. Additionally, given the small percentage of the species that will be killed as a result of the proposed actions, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity. The capture of live Kemp's ridley sea turtles is also not likely to affect the distribution of Kemp's ridley sea turtles in the action area or affect the distribution of sea turtles throughout their range. As any effects to individual live Kemp's ridley sea turtles temporarily removed from the water will be minor and temporary there are not anticipated to be any population level impacts.

While generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the

species this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of Kemp's ridleys because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of Kemp's ridleys is likely to be stable and at worst is growing a slower rates than the pre 2009 growth rate.

Based on the information provided above, the death of 77 Kemp's ridley sea turtles over the life span of the project will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The actions will not affect Kemp's ridleys in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent Kemp's ridleys from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of 77 Kemp's ridleys represents an extremely small percentage of the species as a whole; (2) the death of 77 Kemp's ridleys will not change the status or trends of the species as a whole; (3) the loss of these Kemp's ridleys is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of these Kemp's ridleys is likely to have such a small effect on reproductive output of the species; (5) the actions will have only a minor and temporary effect on the distribution of Kemp's ridleys in the action area and no effect on the distribution of the species throughout its range; and, (6) the actions will have no effect on the ability of Kemp's ridleys to shelter and only an insignificant effect on individual foraging Kemp's ridleys.

In certain instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that Kemp's ridley sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that Kemp's ridleys can rebuild to a point where listing is no longer appropriate. In 2011, NMFS and the USFWS issued a recovery plan for Kemp's ridleys (NMFS and USFWS 2011). The plan includes a list of criteria necessary for recovery. These include:

1. An increase in the population size, specifically in relation to nesting females[13];
2. An increase in the recruitment of hatchlings[14];
3. An increase in the number of nests at the nesting beaches;
4. Preservation and maintenance of nesting beaches (i.e. Rancho Nuevo, Tepehuajes, and Playa Dos); and,

[13]A population of at least 10,000 nesting females in a season (as measured by clutch frequency per female per season) distributed at the primary nesting beaches in Mexico (Rancho Nuevo, Tepehuajes, and Playa Dos) is attained in order for downlisting to occur; an average of 40,000 nesting females per season over a 6-year period by 2024 for delisting to occur

[14] Recruitment of at least 300,000 hatchlings to the marine environment per season at the three primary nesting beaches in Mexico (Rancho Nuevo, Tepehuajes, and Playa Dos).

5. Maintenance of sufficient foraging, migratory, and inter-nesting habitat.

Although Kemp's ridleys have not continued to grow at the pre 2009 rates a trend over the last several years, as explained above, the loss of one Kemp's ridley per year during the proposed actions will not affect the population trend. The number of Kemp's ridleys likely to die because of the proposed actions is an extremely small percentage of the species. This loss will not affect the likelihood that the population will reach the size necessary for recovery or the rate at which recovery will occur. As such, the proposed actions will not affect the likelihood that criteria one, two or three will be achieved or the timeline on which they will be achieved. The action area does not include nesting beaches; therefore, the proposed actions will have no effect on the likelihood that recovery criteria four will be met. All effects to habitat will be insignificant and discountable; therefore, the proposed actions will have no effect on the likelihood that criteria five will be met.

The effects of the proposed actions will not hasten the extinction timeline or otherwise increase the danger of extinction. Further, the actions will not prevent the species from growing in a way that leads to recovery and the actions will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of Kemp's ridleys and a small reduction in the amount of potential reproduction due to the average loss of one individual per year, these effects will be undetectable over the long-term and the actions are not expected to have long term impacts on the future growth of the population or its potential for recovery. Therefore, based on the analysis presented above, the proposed actions will not appreciably reduce the likelihood that Kemp's ridley sea turtles can be brought to the point at which they are no longer listed as endangered or threatened.

In addition to the threats faced by individual Kemp's ridley sea turtles inside and outside of the action area, the proposed actions may increase the vulnerability of individual sea turtles to these threats and exposure to ongoing threats may increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed actions, resulting in the mortality of one Kemp's ridley sea turtle per year, is not likely to appreciably reduce the survival and recovery of this species.

## 8.4 Northwest Atlantic DPS of Loggerhead sea turtles

The Northwest Atlantic DPS of loggerhead sea turtles is listed as "threatened" under the ESA. It takes decades for loggerhead sea turtles to reach maturity. Once they have reached maturity, females typically lay multiple clutches of eggs within a season, but do not typically lay eggs every season (NMFS and USFWS 2008). There are many natural and anthropogenic factors affecting the survival of loggerheads prior to their reaching maturity as well as for those adults who have reached maturity. As described in the *Status of the Species*, *Environmental Baseline* and *Cumulative Effects* sections above, loggerhead sea turtles in the action area continue to be affected by multiple anthropogenic impacts including bycatch in commercial and recreational fisheries, habitat alteration, dredging, power plant intakes and other factors that result in mortality of individuals at all life stages. Negative impacts causing death of various age classes

occur both on land and in the water. Many actions have been taken to address known negative impacts to loggerhead sea turtles. However, many remain unaddressed, have not been sufficiently addressed, or have been addressed in some manner but the success of which cannot be quantified.

The SEFSC (2009) estimated the number of adult females in the NWA DPS at 30,000, and if a 1:1 adult sex ratio is assumed, the result is 60,000 adults in this DPS. Based on the reviews of nesting data, as well as information on population abundance and trends, NMFS and USFWS determined in the September 2011 listing rule that the NWA DPS should be listed as threatened. They found that an endangered status for the NWA DPS was not warranted given the large size of the nesting population, the overall nesting population remains widespread, the trend for the nesting population appears to be stabilizing, and substantial conservation efforts are underway to address threats. This stable trend is expected to continue over the time period considered in this Opinion.

In this Opinion, we determined that loggerheads could be entrained in a hopper dredge operating in any of the channels or borrow areas considered in this consultation. We have estimated that, over the life span of the project considered here, the proposed actions are likely to result in the mortality of 785 NWA DPS loggerhead sea turtles and the non-lethal capture of 937 loggerheads. We determined that all other effects of the action on this species will be insignificant and discountable. This estimate is based on the best available information, and the following assumptions: (1) that all dredging will occur in the April – November time period when sea turtles are present in the action area; and, (2) that any dredging that could occur with a hopper or cutterhead dredge, occurs with a hopper dredge. The number of mortalities would be less than 748 if some of the dredging occurred between December and March and if any of it was carried out with a cutterhead dredge. No mortalities of sea turtles are expected whenever a cutter head dredge is used.

As stated above, we expect the lethal entrainment of 785 loggerheads over the time period considered here; with an average mortality rate of approximately 9 loggerheads per year. The lethal removal of up to 785 loggerhead sea turtles from the action area over this time period would be expected to reduce the number of loggerhead sea turtles from the recovery unit of which they originated as compared to the number of loggerheads that would have been present in the absence of the proposed actions (assuming all other variables remained the same). However, this does not mean that these recovery units will experience reductions in reproduction, numbers or distribution in response to these effects to the extent that survival and recovery would be appreciably reduced. The 2008 recovery plan compiled the most recent information on the mean number of loggerhead nests and the approximated counts of nesting females per year for four of the five identified recovery units (i.e., nesting groups). They are: (1) for the NRU, a mean of 5,215 nests per year with approximately 1,272 females nesting per year; (2) for the PFRU, a mean of 64,513 nests per year with approximately 15,735 females nesting per year; (3) for the DTRU, a mean of 246 nests per year with approximately 60 females nesting per year; and (4) for the NGMRU, a mean of 906 nests per year with approximately 221 females nesting per year. For the GCRU, the only estimate available for the number of loggerhead nests per year is from Quintana Roo, Yucatán, Mexico, where a range of 903-2,331 nests per year was estimated from 1987-2001 (NMFS and USFWS 2007a). There are no annual nest estimates available for the

Yucatán since 2001 or for any other regions in the GCRU, nor are there any estimates of the number of nesting females per year for any nesting assemblage in this recovery unit. However, the 2008 recovery plan indicates that the Yucatán nesting aggregation has at least 1,000 nesting females annually. It should be noted here, that the above numbers only include nesting females (i.e., do not include non-nesting adult females, adult males, or juvenile males or females in the population).

It is likely that the loggerhead sea turtles in Chesapeake Bay originate from several of the recovery units. Limited information is available on the genetic makeup of loggerheads in an area as extensive as the action area.

Genetic analysis of samples collected from immature loggerheads captured in pound nets in the Pamlico-Albemarle Estuarine Complex in North Carolina between 1995-1997 indicated that 80% of the juveniles and sub-adults utilizing the foraging habitat originated from the south Florida nesting stock, 12% from the northern nesting stock, 6% from the Yucatán nesting stock, and 2% from other rookeries (including the Florida Panhandle, Dry Tortugas, Brazil, Greece, and Turkey nesting stocks) (Bass *et al*. 2004). In a separate study, genetic analysis of samples collected from loggerheads from Massachusetts to Florida also found that all five western Atlantic loggerhead stocks were represented (Bowen *et al.* 2004). However, earlier studies by Rankin-Baransky *et al*. (2001) and Witzell *et al*. (2002) indicated that only a few nesting stocks were represented along the U.S. Atlantic coast: south Florida (59% and 69% of the loggerheads sampled, respectively), northern (25% and 10%, respectively), and Mexico (16% and 20%, respectively). Most recently, Haas *et al.* (2008) found that 89% of the loggerheads captured in the U.S. Atlantic scallop fishery from 1996-2005 originated from the south Florida nesting stock, 4% were from the Mexican stock, 3% were from the northern (northeast Florida to North Carolina) stock, 1% were from the northwest Florida stock, and 0% were from the Dry Tortugas stock. The remaining 3% of loggerheads sampled were attributed to nesting stocks in Greece. However, a re-analysis of loggerhead genetics data by the Atlantic Loggerhead TEWG has found that it is unlikely that U.S. fishing fleets are interacting with the Mediterranean DPS (Peter Dutton, NMFS, pers. comm.) and that loggerheads from Greek nesting stocks are unlikely to occur in the action area.

The previously defined loggerhead nesting stocks do not share the exact delineations of the recovery units identified in the 2008 recovery plan. However, the PFRU encompasses the south Florida stock, the NRU is roughly equivalent to the northern nesting stock, the northwest Florida stock is included in the NGMRU, the Mexico stock is included in the GCRU, and the DTRU encompasses the Dry Tortugas stock. Based on the genetic analysis presented in Haas *et al.* (2008), which is the most recent and one of the most comprehensive (in terms of the area from which samples were acquired) of the loggerhead genetics studies referenced above, the vast majority of the loggerheads in the action area are likely to originate from the PFRU (90%), with the remainder originating from the NRU (3%), GCRU (5%), NGMRU (1.5%), and DTRU (0.5%). Therefore, we expect that 707 of the loggerheads will be from the PFRU, 24 from the NRU, 39 from the GCRU, 12 from the NGMRU, and 4 from the DTRU. The best available information indicates that the proportion of the interactions from each recovery unit are consistent with the relative sizes of the recovery units, and we conclude, based on the available evidence, that none of the recovery units will be disproportionately impacted by the proposed

actions. Thus, genetic heterogeneity should be maintained in the species even in the face of this level of mortality resulting from the proposed actions.

The loss of 707 loggerheads over the life span of the project (approximately 8 per year) represents an extremely small percentage of the number of sea turtles in the PFRU. Even if the total population was limited to 15,735 loggerheads (the number of nesting females), the annual average loss of up to 8 individuals would represent approximately 0.05% of the population. Similarly, the loss of no more than 1 loggerhead from the NRU over 24 years represents an extremely small percentage of the recovery unit. Even if the total population was limited to 1,272 sea turtles (the number of nesting females), the loss of 1 individual in a given year would represent approximately 0.08% of the population. The loss of no more than 1 loggerhead over years from the GCRU, which is expected to support at least 1,000 nesting females, represents less than 0.1% of the population, even just considering the number of adult nesting females, which is only a fraction of the total population. The loss of no more than 1 loggerhead over 12 years from the NGMRU, represents 0.5% of the population, even just considering the apppoximately 221 adult nesting females, which is only a fraction of the total population. The loss of no more than 1 loggerhead over 4 from the DTRU, which is expected to support at least 60 nesting females, represents 1.6% of the population, even just considering the number of adult nesting females, which is only a fraction of the total population and an even smaller percentage of the DPS as a whole.

The loss of such a small percentage of the individuals from any of these recovery units represents an even smaller percentage of the species as a whole. The impact of these losses is even less when considering that these losses will occur over a span of many years. Considering the extremely small percentage of the populations that will be killed, it is unlikely that these deaths will have a detectable effect on the numbers and population trends of loggerheads in these recovery units or the number of loggerheads in the population as a whole.

All of the loggerheads that are expected to be killed will be juveniles. Thus, any effects on reproduction are limited to the loss of these individuals on their year class and the loss of future reproductive potential. Given the number of nesting adults in each of these populations, it is unlikely that the expected loss of loggerheads would affect the success of nesting in any year. Additionally, this small reduction in potential nesters is expected to result in a small reduction in the number of eggs laid or hatchlings produced in future years and similarly, a very small effect on the strength of subsequent year classes. Even considering the potential future nesters that would be produced by the individuals that would be killed as a result of the proposed actions, any effect to future year classes is anticipated to be very small and would not change the stable trend of this species. Additionally, the proposed actions will not affect nesting beaches in any way or disrupt migratory movements in a way that hinders access to nesting beaches or otherwise delays nesting.

The proposed action is not likely to reduce distribution because while the action will temporarily affect the distribution of individual loggerheads by displacing sea turtles captured with the trawl from one area and relocating them to alternate area, changes in distribution will be temporary and limited to movements to relatively nearby areas. We do not anticipate that any impacts to habitat will permanently impact how loggerheads use the action area. Further, the action is not

expected to reduce the distribution of loggerhead sea turtles. Additionally, given the small percentage of the species that will be killed as a result of the proposed actions, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity

While generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of loggerheads because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of loggerheads is likely to be stable or increasing over the time period considered here.

Based on the information provided above, the death of up to 785 loggerheads over the life span of the project will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The actions will not affect loggerheads in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent loggerheads from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of these loggerheads represents an extremely small percentage of the species as a whole; (2) the death of these loggerheads will not change the status or trends of the species as a whole; (3) the loss of these loggerheads is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of these loggerheads is likely to have a small effect on reproductive output; (5) the actions will have only a minor and temporary effect on the distribution of loggerheads in the action area and no effect on the distribution of the species throughout its range; and, (6) the actions will have no effect on the ability of loggerheads to shelter and only an insignificant effect on individual foraging loggerheads.

In certain instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that loggerhead sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that the NWA DPS of loggerheads can rebuild to a point where listing is no longer appropriate. In 2008, NMFS and the USFWS issued a recovery plan for the Northwest Atlantic population of loggerheads (NMFS and USFWS 2008). The plan includes demographic recovery criteria as well as a list of tasks that must be accomplished. Demographic recovery criteria are included for each of the five recovery units. These criteria focus on sustained increases in the number of nests laid and the number of nesting females in each recovery unit, an increase in abundance on foraging grounds, and ensuring that trends in neritic strandings are not increasing at a rate greater than trends in in-water abundance. The recovery tasks focus on protecting habitats, minimizing and managing predation and disease, and minimizing anthropogenic mortalities.

Loggerheads have a stable trend; as explained above, the loss of 785 loggerheads over the life span of the proposed actions will not affect the population trend. The number of loggerheads likely to die as a result of the proposed actions is an extremely small percentage of any recovery unit or the DPS as a whole. This loss will not affect the likelihood that the population will reach the size necessary for recovery or the rate at which recovery will occur. As such, the proposed actions will not affect the likelihood that the demographic criteria will be achieved or the timeline on which they will be achieved. The action area does not include nesting beaches; all effects to habitat will be insignificant and discountable; therefore, the proposed actions will have no effect on the likelihood that habitat based recovery criteria will be achieved. The proposed actions will also not affect the ability of any of the recovery tasks to be accomplished.

The effects of the proposed actions will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the actions will not prevent the species from growing in a way that leads to recovery and the actions will not change the rate at which recovery can occur.

In summary, the effects of the proposed actions will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the actions will not prevent the species from growing in a way that leads to recovery and the actions will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of loggerheads and a small reduction in the amount of potential reproduction due to the loss of these individuals, these effects will be undetectable over the long-term and the actions are not expected to have long term impacts on the future growth of the population or its potential for recovery. Therefore, based on the analysis presented above, the proposed actions will not appreciably reduce the likelihood that loggerhead sea turtles can be brought to the point at which they are no longer listed as threatened.

In addition to the threats faced by individual loggerhead sea turtles inside and outside of the action area, the proposed actions may increase the vulnerability of individual sea turtles to these threats and exposure to ongoing threats may increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of other threats, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change. Based on the analysis presented herein, the proposed actions are not likely to appreciably reduce the survival and recovery of the NWA DPS of loggerhead sea turtles.

## 9.0 CONCLUSION

After reviewing the best available information on the status of endangered and threatened species under our jurisdiction, the environmental baseline for the action area, the effects of the action, and the cumulative effects, it is our biological opinion that the proposed action may adversely affect but is not likely to jeopardize the continued existence of any DPS of Atlantic sturgeon, Kemp's ridley or green sea turtles or the Northwest Atlantic DPS of loggerhead sea turtles and is not likely to adversely affect leatherback sea turtles, hawksbill sea turtles, shortnose sturgeon, fin whales, sei whales, blue whale, sperm whales, and North Atlantic right whales. As described above, it is our biological opinion that the proposed action is not likely to adversely affect critical habitat for the Chesapeake Bay DPS of Atlantic sturgeon designated in the action area.

## 10.0 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species of fish and wildlife. "Fish and wildlife" is defined in the ESA "as any member of the animal kingdom, including without limitation any mammal, fish, bird (including any migratory, non-migratory, or endangered bird for which protection is also afforded by treaty or other international agreement), amphibian, reptile, mollusk, crustacean, arthropod or other invertebrate, and includes any part, product, egg, or offspring thereof, or the dead body or parts thereof." 16 U.S.C. 1532(8). "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by us to include any act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. "Otherwise lawful activities" are those actions that meet all State and Federal legal requirements except for the prohibition against taking in ESA Section 9 (51 FR 19936, June 3, 1986), which would include any state endangered species laws or regulations. Section 9(g) makes it unlawful for any person "to attempt to commit, solicit another to commit, or cause to be committed, any offense defined [in the ESA.]" 16 U.S.C. 1538(g). See also 16 U.S.C. 1532(13)(definition of "person"). Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by you so that they become binding conditions for the exemption in section 7(o)(2) to apply. You have a continuing duty to regulate the activity covered by this Incidental Take Statement. If you (1) fail to assume and implement the terms and conditions or (2) fail to require any contractors to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added contracts or other documents as appropriate, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, you must report the progress of the action and its impact on the species to us as specified in the Incidental Take Statement [50 CFR §402.14(i)(3)] (See U.S. Fish and Wildlife Service and National Marine Fisheries Service's Joint Endangered Species Act Section 7 Consultation Handbook (1998) at 4-49).

### 10.1 Amount or Extent of Incidental Take

The proposed dredging project has the potential to directly affect green, loggerhead and Kemp's ridley sea turtles, and individuals from the New York Bight, Gulf of Maine, Chesapeake Bay, South Atlantic and Carolina DPSs of Atlantic sturgeon which may become entrained in or interact with the dredge. These interactions are likely to cause mortality. This level of take is expected to occur over the duration of the project and is not likely to jeopardize the continued existence of listed species.

This ITS exempts the following incidental take over the life span of the project:

| **Species** | **Non-lethal Capture** | **Mortality** |
|---|---|---|
| NWA DPS of Loggerhead sea turtle | 937 | 748 |
| Kemp's ridley sea turtle | 275 | 66 |
| North Atlantic DPS of Green sea turtle | 38 | 18 |
| NYB DPS of Atlantic sturgeon | 350 | 68 |
| SA DPS of Atlantic sturgeon | 150 | 29 |
| CB DPS of Atlantic sturgeon | 100 | 23 |
| GOM DPS of Atlantic sturgeon | 100 | 18 |
| Carolina DPS of Atlantic sturgeon | 50 | 10 |

The tables below illustrate our expectations of where these takes will occur:

***Hopper Dredging***

**Sea Turtle Takes Incidental to Construction Dredging**

| **Project** | **Total Volume** | **Number of Interactions** | | | |
|---|---|---|---|---|---|
| | | **Total Sea Turtles** | **Loggerhead** | **Kemp's ridley** | **Green** |
| Atlantic Ocean Channel | 16,074,736 | 50 | 45 | 4 | 1 |
| Thimble Shoals Channel | 18,069,823 | 56 | 50 | 4 | 2 |
| Thimble Shoals Channel Meeting Area #1 & #2 | 7,191,000 | 22 | 20 | 2 | 0 |
| Sewells Point to Lamberts Bend | 12,147,318 | 38 | 34 | 3 | 1 |
| Anchorage F | 1,914,788 | 6 | 5 | 1* | 1* |
| Newport News Channel | 4,906,284 | 15 | 14 | 1 | 0 |
| CIEE | 19,500,000 | 61 | 55 | 5 | 1 |
| | | **TOTAL:** | **223** | **20** | **6** |

*1 Kemp's ridley or green

## Sea Turtle Take Incidental to Maintenance Dredging over the Project Life Span

| Project | Total Volume (cubic yards) | Number of Interactions | | | |
|---|---|---|---|---|---|
| | | Total Sea Turtles | Loggerhead | Kemp's ridley | Green |
| Atlantic Ocean Channel | 15,191,112 | 47 | 42 | 4 | 1 |
| Thimble Shoals Channel | 24,331,540 | 76 | 68 | 6 | 2 |
| Thimble Shoals Channel Meeting Area #1 & #2 | 3,640,924 | 11 | 10 | 1 | 0 |
| Sewells Point to Lamberts Bend | 42,346,689 | 132 | 119 | 10 | 3 |
| Anchorage F | 7,590,328 | 24 | 22 | 2 | 0 |
| Newport News Channel | 6,676,305 | 21 | 19 | 2 | 0 |
| | | **TOTAL:** | **280** | **25** | **6** |

| Project | Total Volume (cubic yards) | Number of Interactions | | | |
|---|---|---|---|---|---|
| | | Total Sea Turtles | Loggerhead | Kemp's ridley | green |
| Baltimore Harbor Entrance Channels | 64,500,000 | 215 | 194 | 17 | 4 |
| Virginia Beach Hurricane Project (TSS and AO borrow areas) | 4,400,000 | 15 | 13 | 1* | 1* |
| Sandbridge Shoal | 12,500,000 | 42 | 38 | 3 | 1 |
| | | **TOTAL:** | **245** | **21** | **6** |

*1 Kemp's ridley or green

**Atlantic Sturgeon Takes Incidental to Construction Dredging**

| Project | Total Volume | Number of Interactions | | | | | |
|---|---|---|---|---|---|---|---|
| | | Total Atlantic sturgeon | NYB DPS | SA DPS | CB DPS | GOM DPS | Carolina DPS |
| Atlantic Ocean Channel | 16,074,736 | 8 | 4 | 2 | 1 | 1 | 0 |
| Thimble Shoals Channel | 18,069,823 | 9 | 5 | 2 | 1 | 1 | 0 |
| Thimble Shoals Meeting Areas #1 & #2 | 7,191,000 | 4 | 2 | 1 | 1 | 0 | 0 |
| Sewell's Point to Lamberts Bend | 12,147,318 | 6 | 3 | 1 | 1 | 1 | 0 |
| Anchorage F | 1,914,788 | 1 | 1* | 1* | 1* | 1* | 1* |
| Newport News Channel | 4,906,284 | 3 | 1 | 1 | 1* | 1* | 1* |
| CIEE | 19,500,000 | 10 | 5 | 2 | 1 | 1 | 1 |
| | | **Total:** | **21** | **10** | **7** | **6** | **3** |

*Using the 1 fish per 2 mil cy of dredge material method for estimating takes from entrainment in hopper dredges described above, we estimated take of <1 sturgeon, so using our mixed-stock analysis the individual could originate from any one of the these DPSs.

**Atlantic Sturgeon Takes Incidental to Maintenance Dredging over the Project Life Span**

| Project | Total Volume (cubic yards) | Number of Interactions | | | | | |
|---|---|---|---|---|---|---|---|
| | | Total Atlantic sturgeon | NYB DPS | SA DPS | CB DPS | GOM DPS | Carolina DPS |
| Atlantic Ocean Channel | 15,191,112 | 8 | 4 | 2 | 1 | 1 | 0 |
| Thimble Shoals Channel | 24,331,540 | 12 | 6 | 2 | 2 | 1 | 1 |
| Thimble Shoals Meeting Areas #1 & #2 | 3,640,924 | 2 | 1 | 1* | 1* | 1* | 1* |
| Sewell's Point to Lamberts Bend | 42,346,689 | 21 | 11 | 4 | 3 | 2 | 1 |
| Anchorage F | 7,590,328 | 4 | 2 | 1 | 1 | 0 | 0 |
| Newport News Channel | 6,676,305 | 3 | 3 | 1 | 1* | 1* | 1* |
| | | **Total:** | **27** | **11** | **9** | **6** | **4** |

*Using the 1 fish per 2 mil cy of dredge material method for estimating takes from entrainment in hopper dredges described above, we estimated take of <1 sturgeon, so using our mixed-stock analysis the individual could originate from any one of the these DPSs.

**Atlantic Sturgeon Takes Incidental to Maintenance Dredging over the Project Life Span**

| Project | Total Volume (cubic yards) | Number of Interactions | | | | | |
|---|---|---|---|---|---|---|---|
| | | Total Atlantic sturgeon | NYB DPS | SA DPS | CB DPS | GOM DPS | Carolina DPS |
| Baltimore Harbor Entrance Channels | 64,500,000 | 32 | 16 | 6 | 5 | 4 | 1 |
| Virginia Beach Hurricane Project | 4,400,000 | 2 | 1 | 1* | 1* | 1* | 1* |
| Sandbridge Shoal | 12,500,000 | 6 | 3 | 1 | 1 | 1* | 1* |
| | | **Total:** | **20** | **8** | **7** | **6** | **3** |

*Using the 1 fish per 2 mil cy of dredge material method for estimating takes from entrainment in hopper dredges described above, we estimated take of <1 sturgeon, so using our mixed-stock analysis the individual could originate from any one of the these DPSs.

### *Cutterhead Dredging*

| DPS | Number of Atlantic Sturgeon over Project Period |
|---|---|
| New York Bight | 25 |
| South Atlantic | 10 |
| Chesapeake Bay | 8 |
| Gulf of Maine | 5 |
| Carolina | 2 |

### *Mechanical Dredging*

One Atlantic sturgeon (any DPS) at CIEE and one (any DPS) in Norfolk Harbor

### *Relocation Trawling*

| Species | Number Captured over project period | Number of Mortalities over project period |
|---|---|---|
| ***Sea Turtles*** | ***1,250*** | ***50*** |
| Loggerhead | 938 | 37 |
| Kemp's Ridley | 275 | 11 |
| Green | 37 | 2 |
| ***Atlantic sturgeon*** | ***700 total*** | ***0*** |
| NYB DPS | ≤350 | 0 |
| SA DPS | ≤150 | 0 |
| CB DPS | ≤100 | 0 |
| GOM DPS | ≤100 | 0 |
| Carolina DPS | ≤50 | 0 |

When a hopper dredge is used, NMFS-approved endangered species observers are typically required on board the dredge to monitor for the entrainment of sea turtles and sturgeon. The endangered species observer program has been in place on hopper dredges since 1994 and is effective at monitoring take during hopper dredge operations. The use of observers relies on screening placed on the draghead being large enough to allow large sized pieces of biological material to pass through and be caught in cages that retain material that is then inspected by the observer. When UXO screening is in place on the draghead, the size of material that can pass through the dredge is significantly smaller, making detection by an observer extremely unlikely. As described in the *Description of the Action* section, due to safety concerns, you are likely to require UXO screening for dredges working in the following areas: Thimble Shoals Channel; Atlantic Ocean Channel; Cape Henry Channel; Thimble Shoal Surround Borrow Area; and Sandbridge Shoal. It is likely that only internal soft tissue (e.g., intestine) or small, fragmented, external parts (e.g., pieces of shell) of the crushed/impinged animal would be entrained. These parts are extremely unlikely to be detected by ESA observers, and if detected, are likely to be too small to be identifiable as a particular species (pers. comm. Chris Slay, Coast Wise Consulting, Inc.; Trish Bargo, East Coast Observers, Inc.; April 4, 2012).

Additionally, animals may impinge on the UXO screens. Animals impinged on the UXO screen may free or dislodge themselves from the screen once the suction of the dredge has been turned off. Animals that free themselves may suffer severe injuries that may result in death. As the entire interaction occurs underwater, it would not be observed by an on-board observer. As such, in these cases, we have determined that it is not reasonable and appropriate to require endangered species observers on the dredge. As there is no practical way for on board endangered species observers to monitor the impingement/entrainment of listed species during hopper dredging operations with UXO screening in place, we explored several alternatives, for monitoring the interactions as described below.

We considered the following alternatives to (1) monitor take of listed species during hopper dredge operations with UXO screening in place or (2) modify the activity to eliminate the potential for take, thereby eliminating the need to monitor take.

1. Install a camera near the draghead: A camera installed on a draghead would allow users at the surface to observe underwater interactions. However, there are technical challenges to using video, including visibility due to water clarity and available light, improper focus, inappropriate camera angle, and the range of the viewing field. The use of video would require additional resources, and it is unlikely that it would be effective for monitoring this type of dredge work. For these dredges, turbidity levels (i.e., up to 450 mg/l) near the draghead while dredging operations are underway are too high to visually detect any animal impinged on or within the vicinity of the draghead. Therefore, this is not a reasonable and appropriate means to monitor take.

2. Use of sonar/fish finder: Sonar can be used to detect animals within the water and within the vicinity of the dredge. However, studies would need to take place to establish the signatures of sea turtles and sturgeon so that they could be readily identified electronically; this information is not currently available. As such, at this time, sonar alone could not indicate the take of an individual animal or identify the species

potentially being taken. As such, the use of such devices would not be reasonable or appropriate for monitoring take.

3. Placement of observers on the shoreline: Observers placed on the shoreline may be able to detect stranded animals either in the water or on the shore. However, animals may not strand in the direct vicinity of the operation or at a time concurrent with when the operations are active. Typically, injured or deceased animal do not immediately float to the surface and it may take days for the animal to wash up on the shore. While the fortuitous reporting of stranded sea turtles and subsequent necropsy to determine cause of death is a good method to monitor take, it is not a reasonable and appropriate means to observe for take during dredging operations.

4. Relocation trawling: While relocation could reduce the number of sea turtles and Atlantic sturgeon in the area being dredged and therefore minimize take, using relocation trawling would not serve to monitor the number of animals affected during dredging. Additionally, while relocation trawling can minimize the number of animals in the area to be dredged and minimize the potential for take, it does not eliminate the potential for take. Therefore, we could not require relocation trawling and assume that no interactions with the dredge would occur.

5. Time of year restriction: If there was a time of year when no listed species were likely to occur in the action area, dredging could be scheduled to occur in that time of year. This would eliminate the potential for take and negate the need for monitoring. However, because Atlantic sturgeon occur in the action area year round and safety and navigational concerns require dredging year-round, this is not practicable.

6. Use of alternate dredge types: The use of a mechanical dredge would eliminate the potential for sea turtle takes and would greatly reduce the number of Atlantic sturgeon takes; similar benefits could be obtained by requiring the use of a cutterhead dredge. However, you choose the type of dredge based on practical and technological constraints, including water depth, oceanic conditions, vessel traffic and maneuverability, substrate type and distance to the disposal area. Therefore, while use of alternate dredge types may minimize take, it is not practicable to require that mechanical or cutterhead dredges be used in all instances.

Both agencies agreed that none of these methods would serve to eliminate the potential for take or were reasonable or appropriate for monitoring take. In situations where individual takes cannot be observed, a proxy must be considered. This proxy must be rationally connected to the taking and provide a clear standard for when the authorized level of take has been exceeded, thus, triggering reinitiation of consultation. As explained in section 6.0 of this Opinion, the estimated number of sea turtles and Atlantic sturgeon to be adversely affected by this action is related to the volume of material removed via dredge, the time of year and the duration of dredging activity.

Therefore, the volume of material removed from the action area can serve as a proxy for monitoring actual take. As explained in the *Effects of the Action*, one sea turtle is entrained for

every 320,000 cy of material dredged; one Atlantic sturgeon is entrained for every 2 mcy. This estimate provides a proxy for monitoring the amount of incidental take during hopper and cutterhead dredging operations when UXO screening is in place and direct observations of impingements cannot occur. This will be used as the primary method of determining whether incidental take has occurred; that is, we will consider that one sea turtle (Kemp's ridley or loggerhead) has been taken for every 320,000 cubic yards material removed during hopper dredging operations involving a UXO screen. Similarly, we will consider that one subadult Atlantic sturgeon has been taken for every 2.0 million cubic yards of material removed during hopper dredging operations involving a UXO screen or each time that a cutterhead dredge is used. In addition, there is a possibility that a sea turtle or an Atlantic sturgeon may remain impinged on UXO screens after the suction has been turned off. These animals can be visually observed, via a lookout, when the draghead is lifted above the water. Animals documented on the draghead by the lookout will be considered a take and this monitoring will be considered as a part of the monitoring of the actual take level. Similarly, if we receive any reports of injured or killed sea turtles or sturgeon in the area (i.e., via the STSSN) and we determine that interaction with the hopper dredge operating during this project was the cause of death, we will consider those animals to be taken by this action.

Once you reach the authorized number of sea turtles or Atlantic sturgeon takes provided in this Incidental Take Statement (either through observed takes or by proxy, or a combination of the two), any additional entrainment of a sea turtle or Atlantic sturgeon will exceed the exempted level of take and reinitiation is required.

If a cutterhead dredge is used without UXO screening, inspectors will visually inspect the area where sand is being placed; this is expected to detect any Atlantic sturgeon entrained in the cutterhead dredge.

## 10.2 Reasonable and Prudent Measures

The following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize and monitor impacts of incidental take resulting from the proposed actions. In order to be exempt from prohibitions of section 9 of the ESA, you must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize and monitor the impact of incidental take that might otherwise result from the proposed actions. Specifically, these RPMs and Terms and Conditions will keep us informed of when and where dredging activities and relocation trawling are taking place and will require you to report any take in a reasonable amount of time, as well as implement measures to monitor for entrainment during dredging and relocation trawling. The third column below explains why each of these RPMs and Terms and Conditions are necessary and appropriate to minimize or monitor the level of incidental take associated with the proposed action and how they represent only a minor change to the action as proposed by you.

RPMs, TCs, and Justifications Applicable to Norfolk Harbor Channels and Craney Island Eastward Improvements Projects

| **Reasonable and Prudent Measures (RPMs)** | **Terms and Conditions (TCs)** | **Justifications for RPMs & TCs** |
|---|---|---|
| ***RPMs Applicable for All Dredge Activities*** | | |
| 1. We must be contacted prior to the commencement of dredging and again upon completion of the dredging activity. | 1. You must contact us at incidental.take@noaa.gov 3 days before the commencement of each dredging activity and again within 3 days of the completion of the activity. This correspondence will serve both to alert us of the commencement and cessation of dredging activities and to give us an opportunity to provide you with any updated contact information or reporting forms.<br><br>At the start of dredging activities, you must include the total volume and area you anticipate removing, the Reach where dredging will occur (with RKMs) and the type of dredge to be used. At the end of the dredging event, you must report to us the actual volume and area removed, location where dredging occurred (with RKMs), and the equipment used (type of dredge). | These RPMs and TCs are necessary and appropriate because they serve to ensure that we are aware of the dates and locations of all dredging that may result in take.<br><br>This will allow us to monitor the duration and seasonality of dredging activities as well as give us an opportunity to provide you with any updated species information or contact information for our staff. This is only a minor change because it is not expected to result in any delay to the project and will merely involve occasional e-mails between you and our staff. |
| 2. All dredges must be operated in a manner that will reduce | 2. If sea turtles are present during dredging or material transport, vessels transiting the area must post a bridge watch, avoid | These RPMs and TCs are necessary and appropriate as they will require that dredge operators use best |

| | | |
|---|---|---|
| the risk of interactions with listed species. | intentional approaches closer than 100 yards when in transit, and reduce speeds to below 4 knots if bridge watch identifies a listed species in the immediate vicinity of the dredge as determined by the line of sight from the vessel bridge. | management practices, including slowing down to 4 knots should listed species be observed, that will minimize the likelihood of take. This represents only a minor change as following these procedures should not increase the cost of the dredging operation or result in any delays of reduction of efficiency of the dredging project. |
| 3. All Atlantic sturgeon captured must have a fin clip taken for genetic analysis. This sample must be transferred to a NMFS-approved laboratory capable of performing the genetic analysis. | 3. You must ensure that fin clips are taken (according to the procedure outlined in Appendix D) of any Atlantic sturgeon captured during the project (including relocation trawling) and that the fin clips are sent to a NMFS approved laboratory capable of performing genetic analysis. Fin clips must be taken prior to preservation of other fish parts or whole bodies. To the extent authorized by law, you are responsible for the cost of the genetic analysis. | These RPMs and TCs are necessary and appropriate to ensure the proper handling and documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. This is essential for monitoring the level of incidental take associated with the proposed action. Genetic analysis must be conducted on Atlantic sturgeon samples to determine the appropriate DPS of origin and accurately record take of this species. These RPMs and TCs represent only a minor change as compliance will not result in delay of the project or decrease in the |

| | | |
|---|---|---|
| | | efficiency of the dredging operations. |
| 4. Any dead sturgeon must be transferred to us or to an appropriately permitted research facility identified by us so that a necropsy can be undertaken to attempt to determine the cause of death. Sturgeon should be held in cold storage. | 4. In the event of any lethal takes of Atlantic sturgeon, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with us. The form included as Appendix F (sturgeon salvage form) must be completed and submitted to us. | These RPMs and TCs are necessary and appropriate to ensure the proper handling and documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. This is essential for monitoring the level of incidental take associated with the proposed action. These RPMs and TCs represent only a minor change as compliance will not result in any increased cost, delay of the project or decrease in the efficiency of the dredging operations. |
| 5. Any dead sea turtles must be held until proper disposal procedures can be discussed with us. Turtles should be held in cold storage. | 5. In the event of any lethal takes of sea turtles, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with us.<br>If a decomposed turtle or turtle part is captured or entrained during dredging operations, an incident report must be completed and the specimen must be photographed. Any turtle parts that are considered 'not fresh' (i.e., they were | These RPMs and TCs are necessary and appropriate to ensure the documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. In some cases, when the cause of death is uncertain, a necropsy may be necessary to aid in the determination of whether or not a mortality should count toward the |

| | | |
|---|---|---|
| | obviously dead prior to the dredge take and you anticipate that they will not be counted towards the ITS) must be frozen and transported to a nearby stranding or rehabilitation facility for review. You must ensure that the observer submits the incident report for the decomposed turtle part, as well as photographs, to us within 24 hours of the take (see Appendix G) and request concurrence that this take should not be attributed to the Incidental Take Statement. We shall have the final say in determining if the take should count towards the Incidental Take Statement. | ITS. This is essential for monitoring the level of incidental take associated with the proposed action. These RPMs and TCs represent only a minor change as compliance will not result in any increased cost, delay of the project or decrease in the efficiency of the dredging operations |
| 7. All sturgeon captures, injuries, or mortalities in the immediate dredging area must be reported to us within 24 hours. | 6. In the event of any captures or entrainment of Atlantic sturgeon (lethal or non-lethal), you must follow the Sturgeon Take Standard Operating Procedures (SOPs) found at: www.greateratlanticfisheries.noaa.gov/protected/section7/reporting.html)<br><br>We shall have the final say in determining if the take should count towards the Incidental Take Statement.<br><br>7. If the cause of death is unknown (e.g., dead sturgeon incidentally collected during dredging or relocation trawlng | These RPMs and TCs are necessary and appropriate to ensure the documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. In some cases, when the cause of death is uncertain, a necropsy may be necessary to aid in the determination of whether or not a mortality should count toward the ITS. This is essential for monitoring the level of incidental take associated with the proposed action. These RPMs and TCs represent |

| | | |
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| | in the Norfolk Harbor Navigation Channels) NMFS will have the mortality assigned to the incidental take statement if a necropsy determines that the death was due to injuries sustained from an interaction with dredge gear. | only a minor change as compliance will not delay of the project or decrease in the efficiency of the dredging operations. |
| 8. All sea turtle captures, injuries, or mortalities and any sea turtle sightings in the immediate dredging area must be reported to us within 12 hours. | 9. In the event of any captures or entrainment of sea turtles (lethal or non-lethal), you must follow the Sea Turtle Take Standard Operating Procedures (SOPs) found at: www.greateratlanticfisheries.noaa.gov/protected/section7/reporting.html)<br><br>We shall have the final say in determining if the take should count towards the Incidental Take Statement.<br>10. If the cause of death is unknown, dead sea turtles found along the coastline (e.g., beaches) within two weeks of when dredge operations occurred in the Norfolk Harbor Navigation Channels and in an area where the carcass reasonably could have drifted from dredge operations, will have the mortality assigned to the incidental take statement if a necropsy determines that the death was due to injuries sustained from an interaction with dredge gear (using the process | These RPMs and TCs are necessary and appropriate to ensure the documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. In some cases, when the cause of death is uncertain, a necropsy may be necessary to aid in the determination of whether or not a mortality should count toward the ITS. This is essential for monitoring the level of incidental take associated with the proposed action. These RPMs and TCs represent only a minor change as compliance will not result in delay of the project or decrease in the efficiency of the dredging operations |

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| | outlined in Appendix L, the November 27, 2017, stranding/dredge take memo).<br>Sea turtle injuries consistent with hopper dredge interactions may include:<br>- crushing wounds/injuries;<br>- partial carapace or body part;<br>- jagged edges to injury;<br>- internal organs completely or partially missing or displaced;<br>- excoriated skin injuries; or<br>- peeling or missing scutes, not related to decomposition, around injury area | |
| 8. You shall implement measures that would reduce the number of sea turtles in the dredging channel so that the possibility of entrainment would be minimized. | 11. Sea turtle relocation trawling must be initiated following the take of two (2) turtles (any species) in a 24-hour time period or four (4) turtles within a two month period, or in other circumstances that we deem appropriate. Such circumstances include a large number of cumulative takes during the project (e.g., ½ of the anticipated incidental take level for the channel being dredged reached before the anticiapated amount of volume is removed that dredge cycle), or other evidence indicating that protected species presence is high. All trawls must follow the standard protocol described in Appendix H. The trawling and relocation survey | These RPMs and TCs are necessary and appropriate as they will serve to minimize risk of long term injury and mortality during dredging. This represents only a minor change as following these procedures should not increase the cost of the dredging operation or result in any delays of reduction of efficiency of the dredging project. |

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| | must be initiated within 24 hours of the incidental take or you must suspend dredging operations until such trawling can be initiated. Trawling must continue for at least 5 consecutive days, unless precluded by inclement weather, after which we may continue or suspend the survey. After the trawling survey is completed, we shall immediately discuss with you the results of the trawling to determine if additional measures are needed to relocate turtles found in the channel.<br>12. The results of each turtle take from the relocation trawl trawling survey must be recorded on the Sea Turtle Relocation Trawling Data Report (Appendix I), or a similar form including the same information. The preliminary results of the trawling survey must be submitted to us immediately after the survey is completed so that we can determine if additional trawling is warranted. A final report summarizing the results of the trawling and any takes of listed species must be submitted to us within 30 working days of completion of the trawling survey. | |
| ***RPMs Applicable for All Hopper Dredges*** | | |

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| 9. You shall ensure that all hopper dredges are outfitted with state-of-the-art sea turtle deflectors on the draghead and operated in a manner that will reduce the risk of interactions with sea turtles. | 13. All hopper dredges must be equipped with the rigid deflector draghead as designed by your Engineering Research and Development Center, formerly the Waterways Experimental Station (WES), or if that is unavailable, a rigid sea turtle deflector attached to the draghead. Deflectors must be checked and/or adjusted by a designated expert prior to a dredge operation to insure proper installation and operation during dredging. The deflector must be checked after every load throughout the dredge operation to ensure that proper installation is maintained. Since operator skill is important to the effectiveness of the WES-developed draghead, operators must be properly instructed in its use. Dredge inspectors must ensure that all measures to protect sea turtles are being followed during dredge operations. | These RPMs and TCs are necessary and appropriate as the use of draghead deflectors is accepted standard practice for hopper dredges operating in places and at times of year when sea turtles are known to be present and has been documented to reduce the risk of entrainment for sea turtles, thereby minimizing the potential for take of these species. This represents only a minor change as all of the hopper dredges likely to be used for this project, including the McFarland which may be used for maintenance dredging, already have draghead deflectors, dredge operators are already familiar with their use, and the use will not affect the efficiency of the dredging operation. Additionally, maintenance of the existing channel is conducted with draghead deflectors in place. |
| ***RPMs for when UXO Screening Not In Place on Hopper Dredge*** | | |
| 10. For all hopper dredge operations where UXO screening is not in place, a NMFS-approved observer must be present on board the hopper dredge any time it is operating. You shall ensure | 14. You must ensure that all contracted personnel involved in operating hopper dredges receive thorough training on measures of dredge operation that will minimize takes of sea turtles. Training shall include measures discussed in Appendix J. | These RPMs and TCs are necessary and appropriate because they require that you have sufficient observer coverage to ensure the detection of any interactions with listed species. This is necessary for |

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| that dredges are equipped and operated in a manner that provides endangered/threatened species observers with a reasonable opportunity for detecting interactions with listed species and that provides for handling, collection, and resuscitation of turtles injured during project activity. Full cooperation with the endangered/threatened species observer program is essential for compliance with the ITS. | 15. When UXO screening is not in place, observer coverage on hopper dredges must be sufficient for 100% monitoring of hopper dredging operations. This monitoring coverage must involve the placement of a NMFS-approved observer on board the dredge for every day that dredging is occurring. You must ensure that your dredge operators and/or any dredge contractor adhere to the attached "Monitoring Specifications for Hopper Dredges" with trained NMFS-approved observers, in accordance with the attached "Observer Protocol" and "Observer Criteria" (Appendix J). No observers can be deployed to the dredge site until you have written confirmation from us that they have met the qualifications to be a "NMFS-approved observer" as outlined in Appendix J. If substitute observers are required during dredging operations, you must ensure that our approval is obtained before those observers are deployed on dredges.<br>16. You shall require of the dredge operator that, when the observer is off watch, the cage shall not be opened unless it is clogged. You shall also require that if it is necessary to clean the cage when the observer is off | the monitoring of the level of take associated with the proposed action.<br><br>The inclusion of these RPMs and TCs is only a minor change as you included some level of observer coverage in the original project description and the increase in coverage (i.e., the addition of any months/activities that were not previously subject to observer coverage) will represent only a small increase in the cost of the project and will not result in any delays. These also represent only a minor change as in many instances they serve to clarify the duties of the inspectors or observers. |

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| | watch, any aquatic biological material is left in the cage for the observer to document and clear out when he/she returns on duty. In addition, the observer shall be the only one allowed to clean off the overflow screen. | |
| 11. You shall ensure that all measures are taken to protect any turtles or sturgeon that survive entrainment in a hopper dredge. | 17. The procedures for handling live sea turtles must be followed in the unlikely event that a sea turtle survives entrainment in the dredge (Appendix K). Any live sturgeon must be photographed, weighed and measured if possible, and released immediately overboard while the dredge is not operating.<br><br>You must make arrangements with a NMFS-approved facility that agrees to receive any sea turtles injured during dredging. This arrangement must include procedures for transferring these turtles to the care of the facility. To the extent authorized by law, arrangements must address funding of any necessary care and/or rehabilitation. This plan must be developed in cooperation with our Sea Turtle Stranding Coordinator and is subject to approval by us. This plan must be in place and approved before December 31, 2019. | These RPMs and TCs are necessary and appropriate as they will require that dredge operators use best management practices that will minimize the likelihood of take. This represents only a minor change as following these procedures should not result in any delays of reduction of efficiency of the dredging project.<br><br>Further, they are necessary and appropriate to ensure that any sea turtles or sturgeon that survive entrainment in a hopper dredge are given the maximum probability of remaining alive and not suffering additional injury or subsequent mortality through inappropriate handling. This represents only a minor change as following these procedures will not result in any delays to the proposed project. |
| ***RPMs for UXO Screening on Hopper Dredge*** | | |

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| 12. You shall ensure that for all dredge operations where UXO screening is in place, a lookout/bridge watch, knowledgeable in listed species identification, will be present on board the hopper dredge at all times to inspect the draghead each time it is removed from the water. | 18. The lookout will inspect the draghead for impinged sea turtles or Atlantic sturgeon each time it is brought up from completing a dredge cycle. Should a sea turtle or Atlantic sturgeon be found impinged on the draghead, the incident should be recorded (Appendix G) and we must contacted within 24 hours. | These RPMs and TCs are necessary and appropriate to ensure the documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. This is essential for monitoring the level of incidental take associated with the proposed action. These RPMs and TCs represent only a minor change as compliance will not result in any increased cost, delay of the project or decrease in the efficiency of the dredging operations. |
| ***RPMs for UXO Screening on Hopper or Cutterhead Dredge*** | | |
| 13. For all hopper or cutterhead dredge operations where UXO screening is in place, you shall provide monthly reports to us regarding the status of dredging and interactions or observations of listed species. | 19. You will provide us with reports every 30 days, via email (brian.d.hopper@noaa.gov and incidental.take@noaa.gov) recording the days that dredging occurred, summaries of the bridge watch reports on draghead inspection, the volume of material removed during the previous 30 day period and any observations of listed species. | These RPMs and TCs are necessary and appropriate to ensure the documentation of any interactions with listed species as well as requiring that these interactions are reported to us in a timely manner with all of the necessary information. This is essential for monitoring the level of incidental take associated with the proposed action. These RPMs and TCs represent only a minor change as compliance will not result in any |

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| | | increased cost, delay of the project or decrease in the efficiency of the dredging operations. |
| ***RPMs for when UXO Screening Not in Place on Cutterhead Dredge*** | | |
| 14. Prior to finalizing contract specifications and initiating contract solicitation processes for new cutterhead dredging projects, you must work with us to develop monitoring plans for cutterhead dredges and/or dredged material disposal sites. | 20. You will schedule a meeting with us prior to finalizing contract specifications and initiating contract solicitation processes for new cutterhead dredging projects to determine the scope of a monitoring plan. This monitoring plan must be agreed to by us prior to initiation of contracting processes and must be implemented in all subsequent cutterhead dredge contracts, unless modified by agreement of USACE and NMFS. The goal of the monitoring plan will be to accurately determine entrainment of Atlantic sturgeon in future cutterhead dredging projects when no UXO screening is in place; however, physical screening of dredge material by observers is not required. | These RPMs and TCs are necessary and appropriate as they serve to ensure that sturgeon have a minimized risk of injury or mortality from cutterhead dredging activities when UXO screening is not in place. The Norfolk District has been monitoring/screening inflow from cutterhead dredges at Craney Island since 2012 with no observed Atlantic sturgeon during the period; therefore, we have agreed that this does not need to be included in the monitoring plan. The monitoring plan represents only a minor change as it will not result in any significant delays to dredging or significant modifications of the dredge plan and any increased cost will be very small in comparison to the total costs of the project.or changes to dredging operations. |
| ***RPMs for Mechanical Dredging*** | | |

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| 15. A lookout/bridge watch must be present to observe all mechanical dredging activities where dredged material will be deposited for any capture of sturgeon. | 21. For mechanical dredging you must require a lookout to watch for captured sturgeon in the dredge bucket and to monitor the scow/hopper for sturgeon. Any interactions with sturgeon must be reported to us. | These RPMs and TCs are necessary and appropriate because they require that you have sufficient observer coverage to ensure the detection of any interactions with listed species. This is necessary for the monitoring of the level of take associated with the proposed action.<br><br>The inclusion of these RPMs and TCs is only a minor change as you included some level of observer coverage in the original project description and the increase in coverage (i.e., the addition of any months/activities that were not previously subject to observer coverage) will represent only a small increase in the cost of the project and will not result in any delays. These also represent only a minor change as in many instances they serve to clarify the duties of the inspectors or observers. |
| 16. You must ensure that all measures are taken to protect any sturgeon that survive capture in the mechanical dredge. | 22. Any sturgeon observed in the dredge scow/hopper during mechanical dredging operations must be removed with a net and, if alive, returned to the water away from the dredge site. | These RPMs and TCs are necessary and appropriate to ensure that any sturgeon that survive capture in a mechanical dredge are given the maximum probability of remaining alive and not suffering additional injury or subsequent mortality through inappropriate handling. This represents only a minor change |

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| | | as following these procedures will not result in an increase in cost or any delays to the proposed project. |

RPMs, TCs, and Justifications Applicable to Baltimore Harbor Entrance Channels, York River Entrance Channel, Sandbridge Shoal, and Virginia Beach Nourishment Projects

| **Reasonable and Prudent Measures (RPMs)** | **Terms and Conditions (TCs)** | **Justifications for RPMs & TCs** |
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| ***RPMs Applicable for All Dredge Activities*** | | |
| 1. NMFS must be contacted prior to the commencement of dredging and again upon completion of the dredging activity. | 1. To implement RPM #1, the USACE must contact NMFS (Brian D. Hopper: by email (brian.d.hopper@noaa.gov) or phone (410) 573-4592) within 3 days of the commencement of each dredging cycle and again within 3 days of the completion of dredging activity. This correspondence will serve both to alert NMFS of the commencement and cessation of dredging activities and to give NMFS an opportunity to provide USACE with any updated contact information or reporting forms. | The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize and monitor the impact of incidental take that might otherwise result from the proposed action. Specifically, these RPMs and Terms and Conditions will keep us informed of when and where dredging activities are taking place and will require USACE to report any take in a reasonable amount of time, as well as implement measures to monitor for entrainment during dredging. USACE has reviewed the RPMs and Terms and Conditions outlined above and has agreed to implement all of these measures as described herein and in the referenced Appendices. We have determined that all of these RPMs and Terms and Conditions are necessary and appropriate to minimize or monitor the level of incidental take associated with the |
| 2. All dredges must be operated in a manner that will reduce the risk of interactions with sea turtles. | 2. To implement RPM #2, if sea turtles are present during dredging or material transport, vessels transiting the area must post a bridge watch, avoid intentional approaches closer than 100 yards when in transit, and reduce speeds to below 4 knots if bridge watch identifies a listed species in the immediate vicinity of the dredge. | |

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| 3. All (alive or dead) Atlantic sturgeon must have a fin clip taken for genetic analysis. This sample must be transferred to NMFS. | 3. To implement RPM #3, the USACE must ensure that fin clips are taken (according to the procedure outlined in Appendix D) of any sturgeon captured during the project and that the fin clips are sent to NMFS for genetic analysis. Fin clips must be taken prior to preservation of other fish parts or whole bodies. | proposed action and represent only a minor change to the action as proposed by the USACE. |
| 4. Any dead sturgeon must be transferred to us or to an appropriately permitted research facility identified by us so that a necropsy can be undertaken to attempt to determine the cause of death. Sturgeon should be held in cold storage. | 4. To implement RPM #4, in the event of any lethal takes of Atlantic sturgeon, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS. The form included as Appendix F (sturgeon salvage form) must be completed and submitted to NMFS. | |
| 5. Any dead sea turtles must be held until proper disposal procedures can be discussed with us. Turtles should be held in cold storage. | 5. To implement RPM #5, in the event of any lethal takes of sea turtles, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS.<br>6. To implement RPM #5, if a decomposed turtle or turtle part is entrained during dredging operations, an incident report must be completed and the specimen must be photographed. Any turtle parts that are | |

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| | considered 'not fresh' (i.e., they were obviously dead prior to the dredge take and USACE anticipates that they will not be counted towards the ITS) must be frozen and transported to a nearby stranding or rehabilitation facility for review. USACE must ensure that the observer submits the incident report for the decomposed turtle part, as well as photographs, to NMFS within 24 hours of the take (see Appendix G) and request concurrence that this take should not be attributed to the Incidental Take Statement. NMFS shall have the final say in determining if the take should count towards the Incidental Take Statement. | |
| 6. All sturgeon and turtle captures, injuries or mortalities associated with any dredging activity and any sturgeon and sea turtle sightings in the action area must be reported to NMFS within 24 hours. | 7. To implement RPM #6, the USACE must contact NMFS within 24 hours of any interactions with sturgeon or sea turtles, including non-lethal and lethal takes. NMFS will provide updated contact information when alerted of the start of dredging activity. Until alerted otherwise, the USACE should provide reports by e-mail (brian.d.hopper@noaa.gov) or phone (410) 573-4592 or the Section 7 Coordinator by phone (978) 281-9306 or fax 978-281-9394). Take information should also be reported | |

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| | by e-mail to: incidental.take@noaa.gov.<br><br>8. To implement RPM #6, the USACE must photograph and measure any sturgeon or sea turtles observed during project operations (including whole sturgeon or sea turtles or body parts observed at the disposal location or on board the dredge, hopper or scow) and the corresponding form (Appendix G) must be completed and submitted to NMFS within 24 hours by fax (978-281-9394) or e-mail (incidental.take@noaa.gov).<br><br>9. To implement RPM #6, any time that take is greater than the estimated level of take for a particular project (e.g. annual estimate for a channel or borrow area based on the volume of material removed), USACE must immediately contact NMFS to review the situation. At that time, USACE will discuss with NMFS whether any new management measures could be implemented to prevent the total incidental take level from being exceeded and will work with NMFS to determine whether the level of take during that year represents new information revealing | |

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| | effects of the action that may not have been previously considered.<br><br>10. To implement RPM #6, the USACE must submit a final report summarizing the results of dredging and any takes of listed species to NMFS within 30 working days of the completion of each dredging contract (by mail to the attention of the Section 7 Coordinator, NMFS Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930). | |
| 7. You shall implement measures that would reduce the number of sea turtles in the dredging channel so that the possibility of entrainment would be minimized. | 11. To implement RPM#7, sea turtle relocation trawling must be initiated following the take of two (2) turtles (any species) in a 24-hour time period or four (4) turtles within a two month period, or in other circumstances that NMFS deems appropriate. Such circumstances include a large number of cumulative takes during the project (e.g., ½ of the anticipated incidental take level for the channel being dredged based on volume to be removed that dredge cycle), or other evidence indicating that protected species presence is high. All trawls must follow the standard protocol described in Appendix H. The trawling and | |

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| | relocation survey must be initiated within 24 hours of the incidental take or the ACOE must suspend dredging operations until such trawling can be initiated. Trawling must continue for at least 5 consecutive days, unless precluded by inclement weather, after which NMFS may continue or suspend the survey. After the trawling survey is completed, the NMFS and ACOE shall immediately discuss the results of the trawling to determine if additional measures are needed to relocate turtles found in the channel.<br><br>12. To implement RPM #7, the results of each turtle take from the relocation trawl trawling survey must be recorded on the Sea Turtle Relocation Trawling Data Report (Appendix I), or a similar form including the same information. The preliminary results of the trawling survey must be submitted to NMFS immediately after the survey is completed so that NMFS can determine if additional trawling is warranted. A final report summarizing the results of the trawling and any takes of listed species must be submitted to NMFS | |

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| | within 30 working days of completion of the trawling survey. | |
| ***RPMs Applicable for All Hopper Dredges*** | | |
| 8. The USACE shall ensure that all hopper dredges are outfitted with state-of-the-art sea turtle deflectors on the draghead and operated in a manner that will reduce the risk of interactions with sea turtles. | 13. To implement RPM #8, all hopper dredges must be equipped with the rigid deflector draghead as designed by the USACE Engineering Research and Development Center, formerly the Waterways Experimental Station (WES), or if that is unavailable, a rigid sea turtle deflector attached to the draghead. Deflectors must be checked and/or adjusted by a designated expert prior to a dredge operation to insure proper installment and operation during dredging. The deflector must be checked after every load throughout the dredge operation to ensure that proper installation is maintained. Since operator skill is important to the effectiveness of the WES-developed draghead, operators must be properly instructed in its use. Dredge inspectors must ensure that all measures to protect sea turtles are being followed during dredge operations. | |
| ***RPMs for when UXO Screening Not In Place on Hopper Dredge*** | | |

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| 9. For all hopper dredge operations where UXO screening is not in place, a NMFS-approved observer must be present on board the hopper dredge any time it is operating. The USACE shall ensure that dredges are equipped and operated in a manner that provides endangered/threatened species observers with a reasonable opportunity for detecting interactions with listed species and that provides for handling, collection, and resuscitation of turtles injured during project activity. Full cooperation with the endangered/threatened species observer program is essential for compliance with the ITS. | 14. To implement RPM #9, the USACE must ensure that all contracted personnel involved in operating hopper dredges receive thorough training on measures of dredge operation that will minimize takes of sea turtles. Training shall include measures discussed in Appendix J.<br><br>15. To implement RPM #9, when UXO screening is not in place, observer coverage on hopper dredges must be sufficient for 100% monitoring of hopper dredging operations. This monitoring coverage must involve the placement of a NMFS-approved observer on board the dredge for every day that dredging is occurring. The observer must work a shift schedule appropriate to allow for the observation of at least 50% of the dredge loads (e.g., 12 hours on, 12 hours off). The USACE must ensure that USACE dredge operators and/or any dredge contractor adhere to the attached "Monitoring Specifications for Hopper Dredges" with trained NMFS-approved observers, in accordance with the attached "Observer Protocol" and "Observer Criteria" (Appendix J). No observers can be deployed to the dredge site until USACE has written | |

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| | confirmation from NMFS that they have met the qualifications to be a "NMFS-approved observer" as outlined in Appendix J. If substitute observers are required during dredging operations, USACE must ensure that NMFS approval is obtained before those observers are deployed on dredges.<br><br>16. To implement RPM #9, the USACE shall require of the dredge operator that, when the observer is off watch, the cage shall not be opened unless it is clogged. The USACE shall also require that if it is necessary to clean the cage when the observer is off watch, any aquatic biological material is left in the cage for the observer to document and clear out when they return on duty. In addition, the observer shall be the only one allowed to clean off the overflow screen. | |
| 10. The USACE shall ensure that all measures are taken to protect any turtles or sturgeon that survive entrainment in a hopper dredge. | 17. To implement RPM #10, the procedures for handling live sea turtles must be followed in the unlikely event that a sea turtle survives entrainment in the dredge (Appendix K). Any live sturgeon must be photographed, weighed and measured if possible, and released | |

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| | immediately overboard while the dredge is not operating. | |
| ***RPMs for UXO Screening on Hopper Dredge*** | | |
| 11. The USACE shall ensure that for all dredge operations where UXO screening is in place, a lookout/bridge watch, knowledgeable in listed species identification, will be present on board the hopper dredge at all times to inspect the draghead each time it is removed from the water. | 18. To implement RPM #11, the lookout will inspect the draghead for impinged sea turtles or Atlantic sturgeon each time it is brought up from completing a dredge cycle. Should a sea turtle or Atlantic sturgeon be found impinged on the draghead, the incident should be recorded (Appendix G) and NMFS contacted. | |
| ***RPMs for UXO Screening on Hopper or Cutterhead Dredge*** | | |
| 12. For all hopper or cutterhead dredge operations where UXO screening is in place, USACE shall provide monthly reports to NMFS regarding the status of dredging and interactions or observations of listed species. | 19. To implement RPM #12, USACE will provide us with reports every 30 days, via email (brian.d.hopper@noaa.gov and incidental.take@noaa.gov) recording the days that dredging occurred, summaries of the bridge watch reports on draghead inspection, the volume of material removed during the previous 30 day period and any observations of listed species. | |

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| ***RPMs for when UXO Screening Not in Place on Cutterhead Dredge*** | | |
| 13. Prior to finalizing contract specifications and initiating contract solicitation processes for new cutterhead dredging projects scheduled for calendar year 2013, the USACE must work with NMFS to develop monitoring plans for cutterhead dredges and/or dredged material disposal sites. | 20. To implement RPM #13, USACE will schedule a meeting with NMFS prior to finalizing contract specifications and initiating contract solicitation processes for new cutterhead dredging projects to determine the scope of a monitoring plan. This monitoring plan must be agreed to by us prior to initiation of contracting processes and must be implemented in all subsequent cutterhead dredge contracts, unless modified by agreement of USACE and NMFS. The goal of the monitoring plan will be to accurately determine entrainment of Atlantic sturgeon in future cutterhead dredging projects when no UXO screening is in place. | |
| ***RPMs for Mechanical Dredging*** | | |
| 14. A lookout/bridge watch must be present to observe all mechanical dredging activities where dredged material will be deposited for any capture of sturgeon. | 21. To implement RPM#14, for mechanical dredging USACE must require a lookout to watch for captured sturgeon in the dredge bucket and to monitor the scow/hopper for sturgeon. Any interactions with sturgeon must be reported to us. | |
| 15. The USACE must ensure that all measures are taken | 22. To implement RPM #15, any sturgeon observed in the dredge | |

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| to protect any sturgeon that survive capture in the mechanical dredge. | scow/hopper during mechanical dredging operations must be removed with a net and, if alive, returned to the water away from the dredge site. | |

## 11.0 CONSERVATION RECOMMENDATIONS

In addition to Section 7(a)(2), which requires agencies to ensure that all projects will not jeopardize the continued existence of listed species, Section 7(a)(1) of the ESA places a responsibility on all federal agencies to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species." Conservation Recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. As such, we recommend that you consider the following Conservation Recommendations:

(1) To the extent practicable, you should avoid dredging in the spring (March-May) and fall (September – November) when listed species are most likely to occur in the action area.

(2) You should conduct studies in conjunction with cutterhead dredging where disposal occurs on the beach to assess the potential for improved screening to: (1) establish the type and size of biological material that may be entrained in the cutterhead dredge, and (2) verify that monitoring the disposal site without screening is providing an accurate assessment of entrained material.

(3) You should support studies to determine the effectiveness of using a sea turtle deflector to minimize the potential entrainment of sturgeon during hopper dredging.

(4) You should explore alternative means for monitoring for interactions with listed species when UXO screening is in place including exploring the potential for video or other electronic monitoring.

(5) You should conduct studies using a VEMCO Positioning System (VPS) to determine what life stages of sturgeon occur in the navigation channels and the extent to which sturgeon use the navigation channels throughout the year.

## 12.0 REINITIATION OF CONSULTATION

This concludes formal consultation on the Norfolk Harbor Navigation Improvements and Craney Island Eastward Expansion projects. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may not have been previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, the federal agency must reinitiate Section 7 consultation immediately. Consultation may be reinitiated by meeting any one or more of the above-identified triggers.

This is a batched biological opinion because it involves multiple projects and multiple action agencies. Whether one project, multiple projects or all projects meet a reinitiation trigger, any future consultations will be completed with the production of one consultation document (i.e., a batch biological opinion). For example, as in this case, if you or another action agency proposes

new construction in a navigation channel (trigger #3), in addition to addressing the impacts from the new activity, the new batch biological opinion would provide updates on all of the remaining projects. Our batch biological opinion will include a new analysis for the reinitiated projects as well as any necessary updates to the other projects and will replace the prior biological opinion. In addition, a batch biological opinion may include new reasonable and prudent measures (RPMs) and terms and conditions (TCs), which will only apply to the projects being reinitiated, except by written agreement. Alternatively, it may be necessary to reinitiate consultation with all action agencies on all activities, in which case new RPMs and TCs for all projects may be warranted. For example, if a new species is listed that may be affected by dredging activities throughout the action area, it would be necessary for all action agencies to coordinate and reinitiate consultation on all of the activities. The production of one biological opinion, as described above, will be the default whenever one project, multiple projects, or all projects covered under this batched biological opinion meet a reinitiation trigger. However, a circumstance may arise where NMFS and the action agencies agree to carry out a standalone consultation on an individual project covered under this batch biological opinion, which would result in a separate biological opinion for that project. Under such circumstances, this batched biological opinion will need to be revised, updated, or replaced to account for the removal of that project from the impact analysis contained herein.

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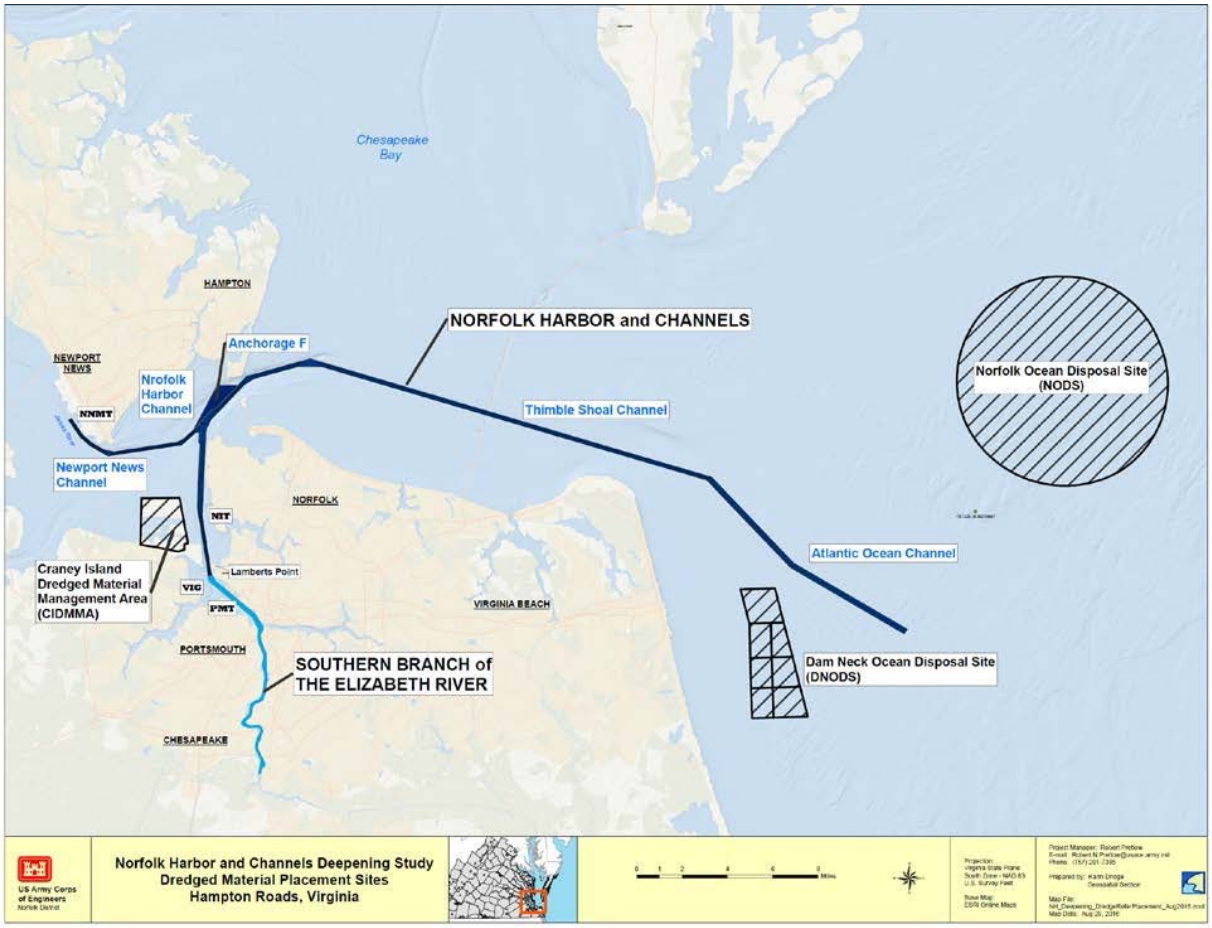
# APPENDIX A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NNMT
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Newport News Channel
NORFOLK
NIT
Lamberts Point
Craney Island Dredged Material Management Area (CIDMMA)
VIG
PMT
VIRGINIA BEACH
Atlantic Ocean Channel
PORTSMOUTH
SOUTHERN BRANCH of THE ELIZABETH RIVER
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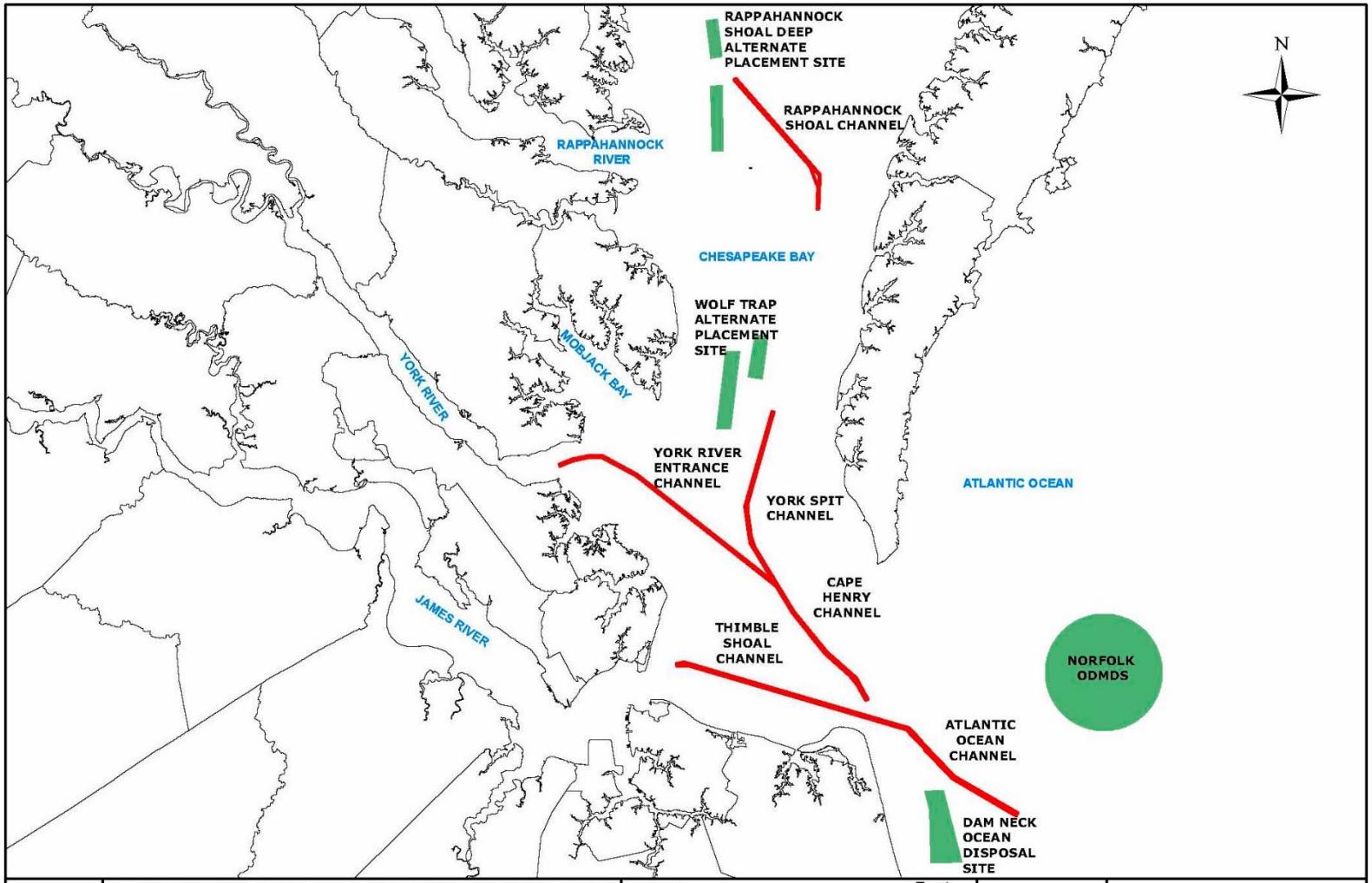



US Army Corps of Engineers
Norfolk District

**LOWER CHESAPEAKE BAY FEDERAL NAVIGATION PROJECT CHANNELS AND DREDGED MATERIAL PLACEMENT SITES: ATLANTIC OCEAN CHANNEL, CAPE HENRY CHANNEL, RAPPHANNOCK SHOAL CHANNEL, THIMBLE SHOAL CHANNEL, YORK RIVER ENTRANCE CHANNEL, YORK SPIT CHANNEL AND DAM NECK OCEAN DISPOSAL SITE, NORFOLK OCEAN DREDGED MATERIAL DISPOSAL SITE, WOLF TRAP ALTERNATE PLACEMENT SITE, AND RAPPAHANNOCK SHOAL DEEP ALTERNATE PLACEMENT SITE**

Feet
0 47,500 95,000
1 inch = 53,750 feet

**Legend**
- Lower Chesapeake Bay Channels
- Dredged Material Placement Sites

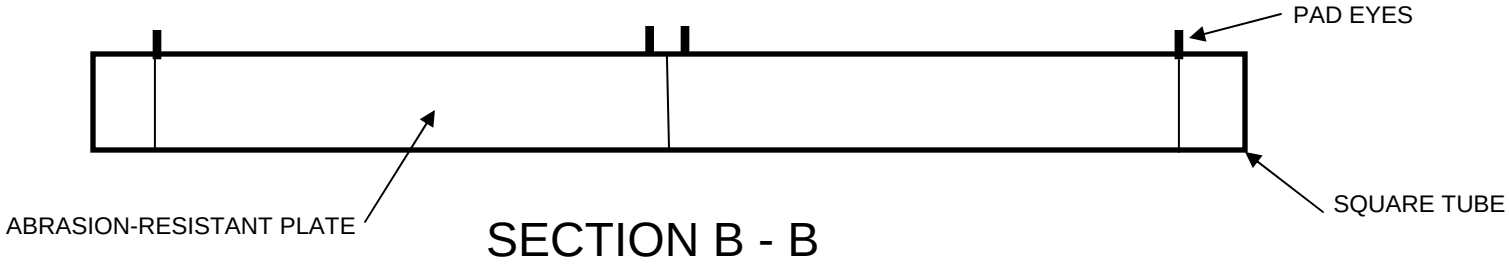
Projection:
Virginia State Plane
South Zone - NAD 83
U.S. Survey Feet

Data Source: Operations Branch GIS Data

Project Manager: Keith Lockwood
E-mail: keith.b.lockwood@usace.army.mil
Phone: (757) 201-7004

Prepared by: Katy Damico
CENAO-WR-OT

Map File: Lower_ChesBay_Channels_Map.mxd
Map Date: 13 JUNE 2011

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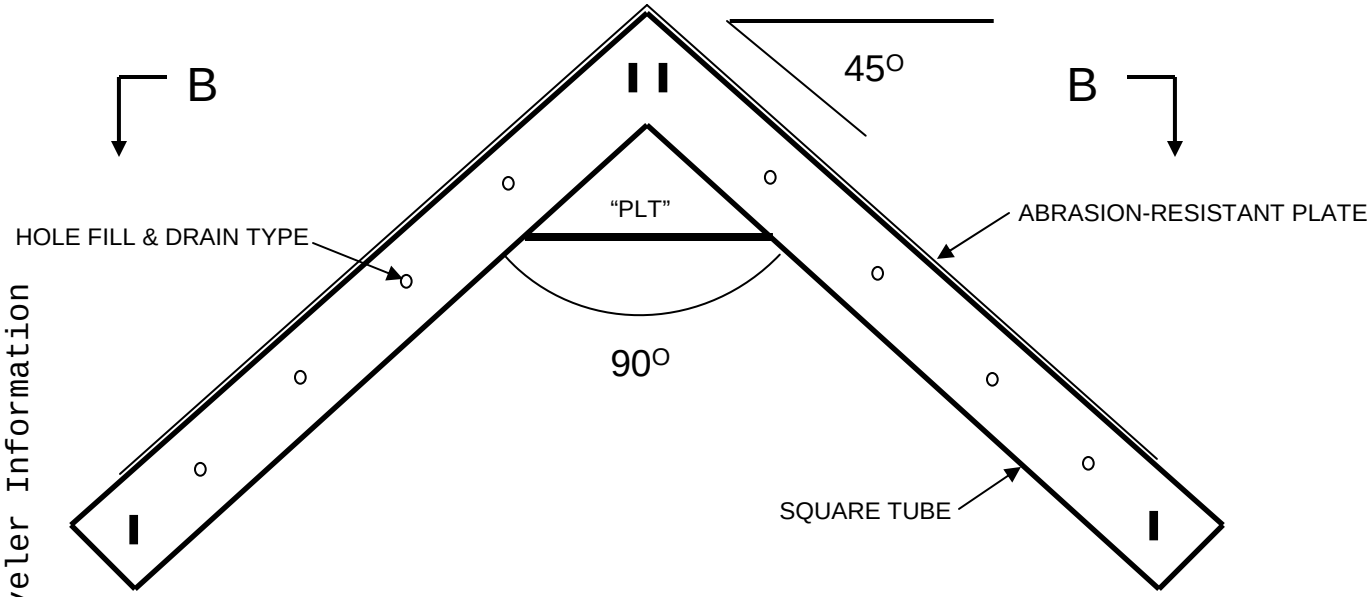
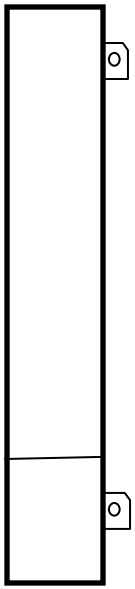



PLAN VIEW

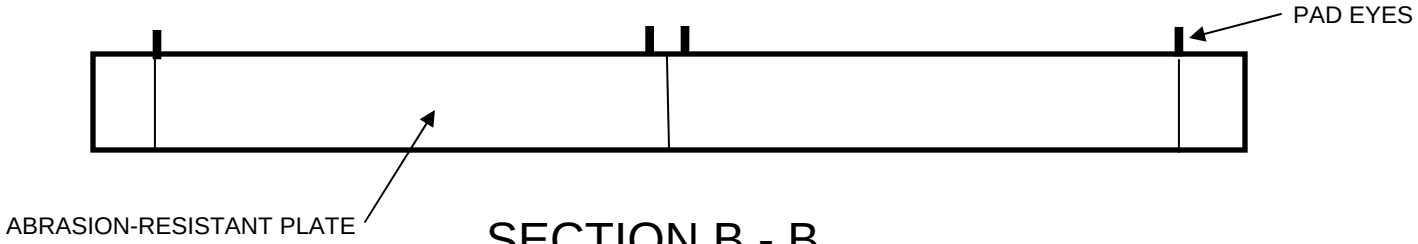


LEFT SIDE VIEW



**90 DEGREE BED LEVELER CONCEPTUAL DESIGN**

# 90 DEGREE BED LEVELER MODEL PHOTOGRAPHS

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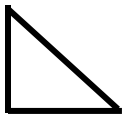

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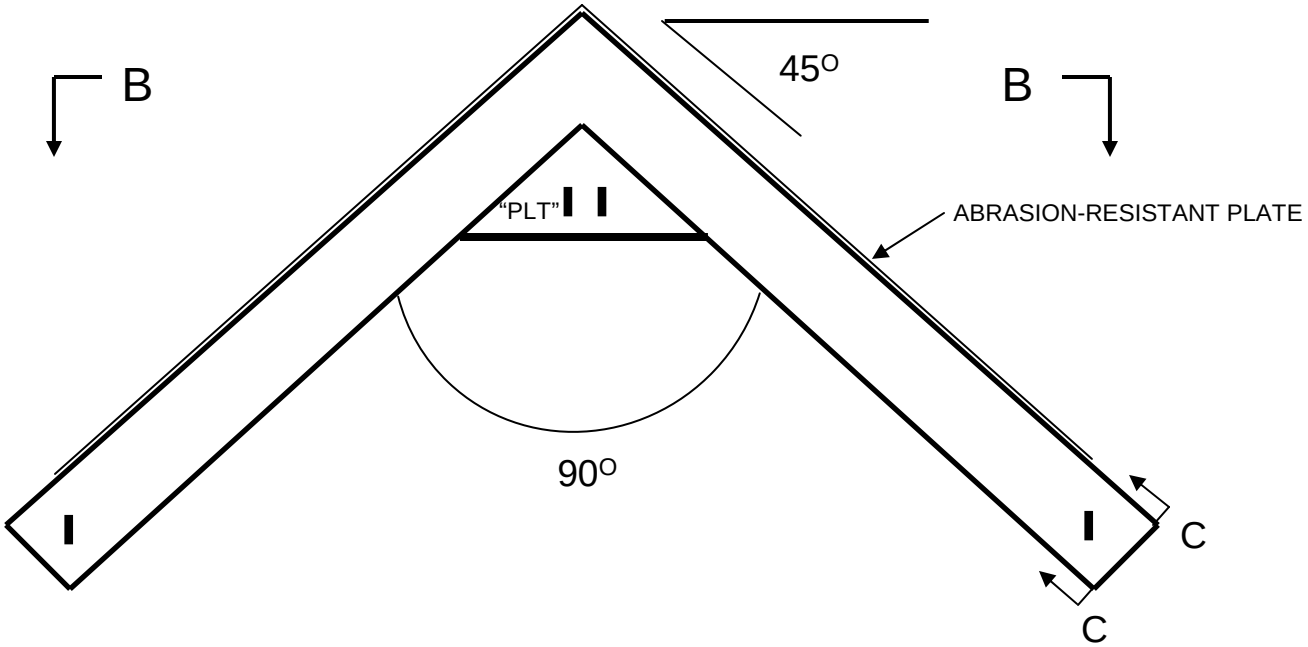


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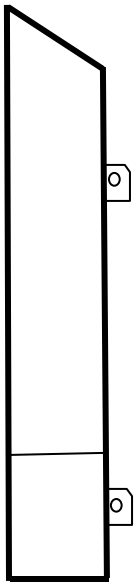
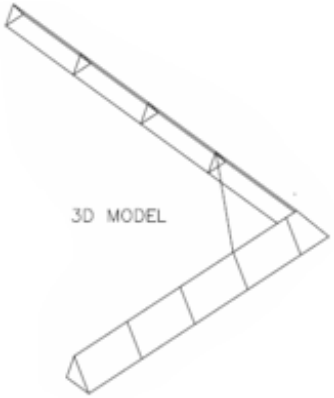


LEFT SIDE VIEW




# 90 DEGREE RAKED BED LEVELER CONCEPTUAL DESIGN

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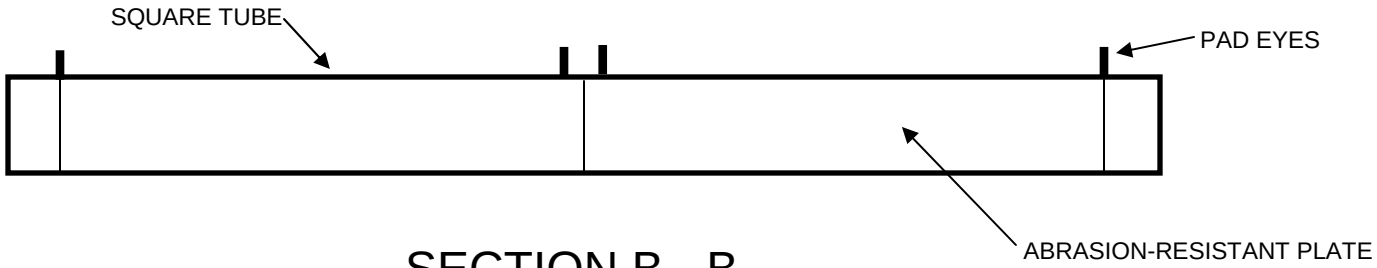


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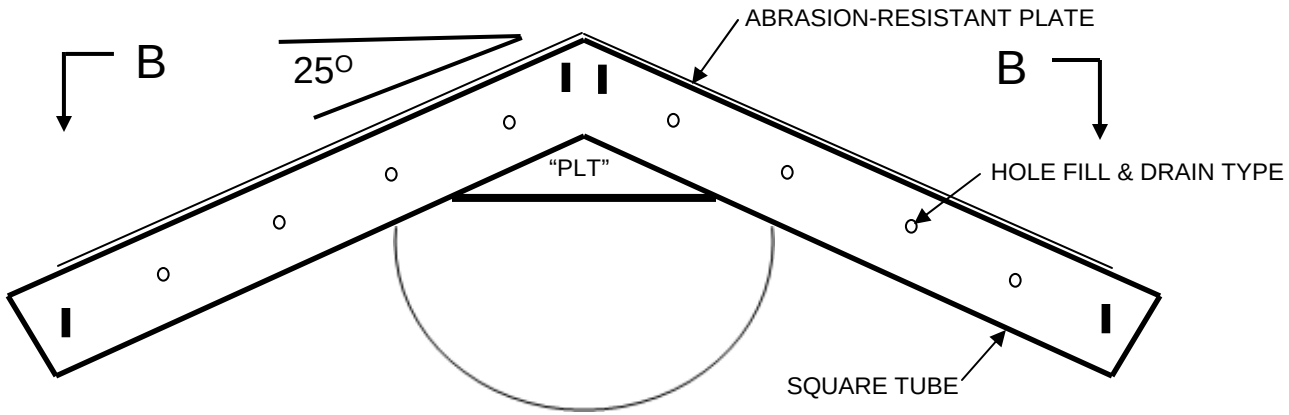


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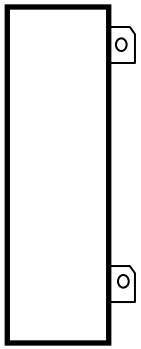
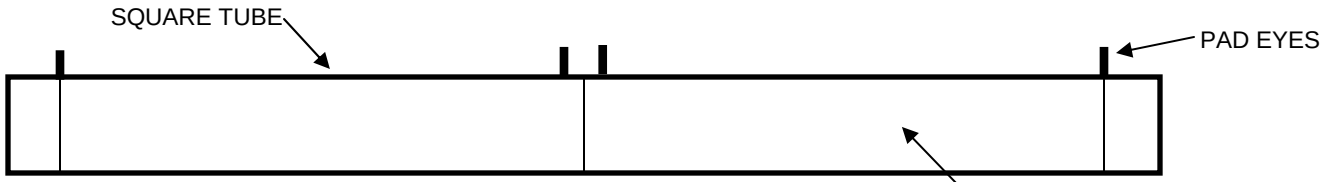


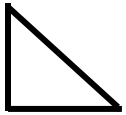
LEFT SIDE VIEW

# 130 DEGREE BED LEVELER CONCEPTUAL DESIGN

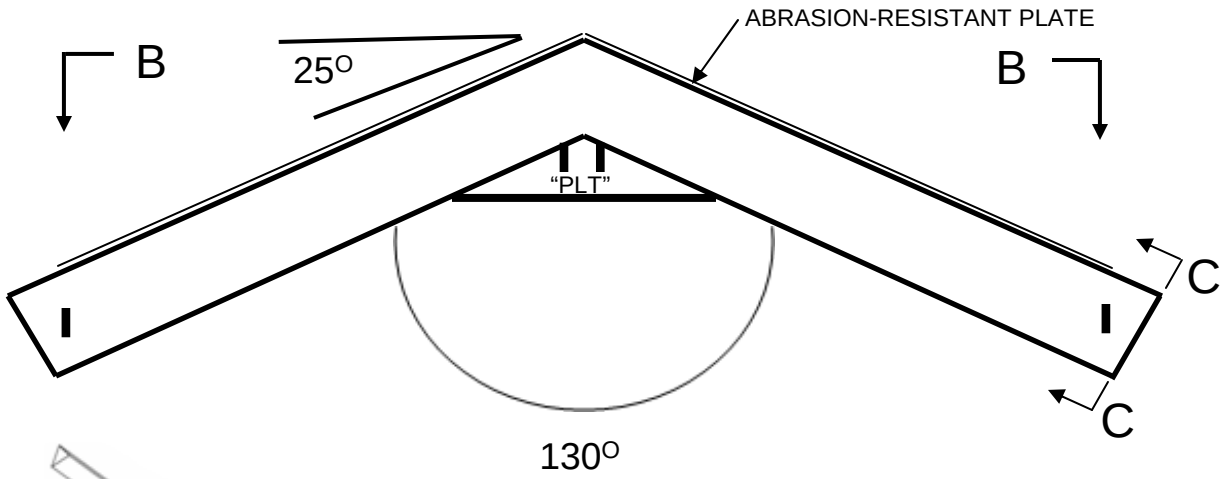
# 130 DEGREE BED LEVELER MODEL PHOTOGRAPHS



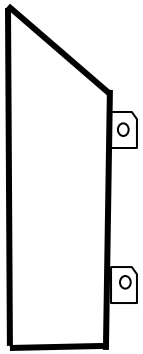

SECTION B - B



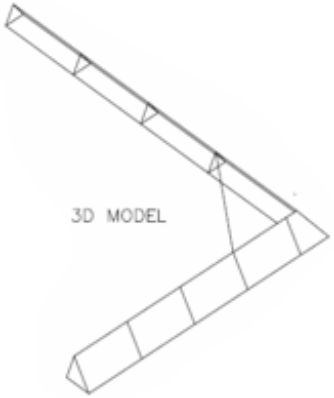
SECTION C-C




PLAN VIEW



LEFT SIDE VIEW




# 130 DEGREE RAKED BED LEVELER CONCEPTUAL DESIGN

## Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

| Take # | Date | Corps District | Location | Sp | Dredge Type/ Name | Status | Specimen Description | Notes | Photos | Documentation |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 30 Oct 90 | SAC | Winyah Bay Georgetown | A | H *Ouchita* | Dead | ~69cm, rear half | Overflow Screening | N | Chris Slay pers com<br>Observer report<br>DACW 60-90-C-0067 |
| 2 | 15 Jan 94 | SAS | Savannah Harbor | A | H *RN Weeks* | NA | NA | Found by Turtle observer | No | Steve Calver pers com 14 Jun 05<br>Observer load sheet and final rpt<br>#DACW21-93-C-0072 |
| 3 | 07 Dec 94 | SAS | Savannah Harbor | A | H *Dodge Island* | Live released | 71cm, whole fish | Starboard Skimmer Screening | Yes We have efile | Chris Slay pers com<br>Observer report |
| 4 | 07 Dec 94 Different Load | SAS | Savannah Harbor | A | H *Dodge Island* | Dead | 77.5cm, whole fish | Starboard Skimmer Screening | Yes We have efile | Chris Slay pers com<br>Observer report |
| 5 | Feb 96 | NAP | Delaware River Newbold Island | S | P *Ozark* | Dead | 83cm, female w/eggs | In DMA Money Island | | NMFS memo for record<br>From Laurie Silva 19 Apr 96 |
| 6 | Feb 96 | NAP | Delaware River Newbold Island | S | P *Ozark* | Dead | 63cm, mature male | In DMA Money Island | | NMFS memo for record<br>From Laurie Silva<br>19 Apr 96 |
| 7 | 06 Jan 98 | NAP | Delaware River Kinkora Range | S | P *??* | Dead | Either 657mm or 573mm **???** | In DMA Money Island | Y Not e-file | Memo for file 20 Jan 98<br>From Greg Wacik NAP |
| 8 | 12 Jan 98 | NAP | Delaware River Florence Range | S | P *??* | Dead | Either 657mm or 573mm **???** | In DMA Money Island | Y Not e-file | Memo for file 20 Jan 98<br>From Greg Wacik NAP |
| 9 | 13 Jan 98 | NAP | Delaware River Florence Range | S | P *??* | Dead | Either 657mm or 573mm **???** | In DMA Money Island | Y Not e-file | Memo for file 20 Jan 98<br>From Greg Wacik NAP |
| 10 | 7 Sep 98 | SAW | Wilmington Har Cape Fear River | A | H *McFarland* | Dead | Head only (1 ft long) | In turtle Inflow screen | | Observer incident report<br>Pers com Bill Adams- SAW 26 Jul 04 |
| 11 | 01 Mar 00 | SAC | Charleston Harbor | A | H *Stuyvesant* | Dead | Missing head and tail | Main Overflow Screening | No | Chris Slay pers com<br>Observer reporting forms |
| 12 | 12 Apr 00 | SAC | Charleston Harbor | A | H *Stuyvesant* | Dead | 71.6cm, whole fish | Starboard Overflow screening | No | Chris Slay pers com<br>Observer reporting forms |
| 13 | 03 Dec 00 | SAW | Wilmington Har MOTSU | A | C *New York* | Dead | 82.5cm, whole fish decomposing | In bucket | Y Not e-file Payonk? ? | Chris Slay pers com<br>Phil Payonk pers com<br>30 Jul 04<br>Bill Adams pers com<br>28 Jul 04<br>#DACW54-00-C-0013 |

## Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

| Take # | Date | Corps District | Location | Sp | Dredge Type/ Name | Status | Specimen Description | Notes | Photos | Documentation |
|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 24 Feb 01 | SAS | Brunswick Harbor | A | H<br>*RN Weeks* | Dead | Head only | Just mentions take on all forms, no other info. | No | Daily and Weekly Reports, Load sheet. |
| 15 | 19 Jun 01 | NAE | Kennebec River Bath Iron Works | A | C *??* | Live released | | Put in scow, released unharmed | | Julie Crocker NMFS pers com 19 Jul 04<br>2003 Chesapeake BA, Section 7.2 Normandeau Associates, Inc 2001 |
| 16 | 30 Apr 03 | NAE | Kennebec River Bath Iron Works | S | C<br>Reed and Reed dredge company | Dead | Fish nearly cut in half | | Y<br>We have e-file | Julie Crocker NMFS pers com 19 Jul 04<br>2003 Chesapeake BA, Section 7.2 Normandeau Associates, Inc 2001 |
| 17 | 6 Oct 03 | NAE | Kennebec River Doubling Point | S | H<br>*Padre Island* | Dead | 38.1inches | In hopper | Y<br>We have e-file | Observer incident report Kennebec River BA Jul 04<br>Memo for Commander, from Bill Kavanaugh, 1 Jul 04<br>Bill Kavanaugh pers com 15 Jul 04<br>Julie Crocker pers com 19 Jul 04 |
| 18 | 6 Oct 03 | NAE | Kennebec River Doubling Point | S | H<br>*Padre Island* | Dead | 37.0 inches | In hopper<br>Did not dive<br>Probably died | Y<br>We have e-file | Observer incident report Kennebec River BA Jul 04<br>Memo for Commander, from Bill Kavanaugh, 1 Jul 04<br>Bill Kavanaugh pers com 15 Jul 04<br>Julie Crocker pers com 19 Jul 04 |
| 19 | 6 Oct 03 | NAE | Kennebec River Doubling Point | S | H<br>*Padre Island* | Live | Swam away | In hopper | Y<br>We have e-file | Observer incident report Kennebec River BA Jul 04<br>Memo for Commander, from Bill Kavanaugh, 1 Jul 04<br>Bill Kavanaugh pers com 15 Jul 04<br>Julie Crocker pers com 19 Jul 04 |

## Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

| Take # | Date | Corps District | Location | Sp | Dredge Type/ Name | Status | Specimen Description | Notes | Photos | Documentation |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| 20 | 06 Oct 03 | NAE | Kennebec River Doubling Point | S | H *Padre Island* | Dead | Found alive | In hopper | Y We have e-file | Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04 |
| 21 | 08 Oct 03 | NAE | Kennebec River Doubling Point | S | H *Padre Island* | Live | Good condition | In hopper | Y We have e-file | Observer incident report Kennebec River BA Jul 04 Memo for Commander, from Bill Kavanaugh, 1 Jul 04 Bill Kavanaugh pers com 15 Jul 04 Julie Crocker pers com 19 Jul 04 |
| 22 | 07 Jan 04 | SAC | Charleston Harbor | A | H *Manhattan Island* | Live | Whole fish 49 inches total length May have died later when released | Found by Coastwise turtle observers | Yes (We Have e-file) | Robert Chappell pers com 28 Jun 04 Observer daily report 7 Jan 04 |
| 23 | 13 Dec 04 | SAM | Gulfport Harbor Channel | G | H *Bayport* | Dead | Trunk of fish 59.5cm | Found by turtle observers | | Observer incident report Susan Rees pers com 7 Jan 05 |
| 24a | 28 Dec 04 | SAM | Mobile Bar Channel | G | H *Padre Island* | Dead | Trunk of fish 2 ft, 1inch | Found by Turtle observers | Yes (We Have e-file) | Observer incident report Susan Rees pers com 7 Jan 05 #W91278-04-C-0049 |
| 24b | 01 Jan 05 | SAM | Mobile Bar Channel | G | H *Padre Island* | Dead | Head only of fish 22.5cm | 2nd part of take on 28 Dec 04 | Yes taken But we Have not received | Observer incident report Susan Rees pers com 7 Jan 05 #W91278-04-C-0049 |
| 25 | 2 Mar 05 | SAS | Brunswick Harbor | A | H *RN Weeks* | Dead | Posterior section only 60 cm section w/tail | Found by turtle observer | Yes (We Have e-file) | Chris Slay pers com 7 Jun 05 Steve Calver pers com 14 Jun 05 |
| 26 | 26 Dec 06 | SAS | Brunswick | A | H *Newport* | Dead | Head only | Caught in port screen and | Black and | Incident and load report |

## Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

| Take # | Date | Corps District | Location | Sp | Dredge Type/ Name | Status | Specimen Description | Notes | Photos | Documentation |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | turtle part caught in starboard screen | White | |
| 27 | 17 Jan 07 | SAS | Savannah Entrance Channel | A | H *Glenn Edwards* | Dead | Whole fish, FL 104 cm | Fresh Dead, 60 Horseshoe crab in with load | Coastwise took photo | Incident and Load report |
| 28 | 2 Mar 09 | SAS | Savannah Entrance Channel | A | H *Dodge Island* | Dead | Total Length 111 cm | Fresh Dead, found in starboard aft inflow box, load #42 | | Incident, Load and Daily report |
| 29 | 6 Feb 10 | SAS | Brunswick Entrance Channel | A | H *Glenn Edwards* | Dead | No measurements | Fore screen contents, Load #19 with 12 Horseshoe crab | | No incident report, just listed on load sheet and daily summary |
| 30 | 7 Feb 10 | SAS | Brunswick Entrance Channel | A | H *Glenn Edwards* | Dead | No measurements | Fore screen contents, Load #25 with 20 Horseshoe crab | | No incident report, just listed on load sheet and daily summary |
| 31 | 2 Feb 10 | SAS | Brunswick Entrance Channel | A | H *Bayport* | Dead | No measurements, head to mid body in load #193 and mid body to tail recovered in load #194. | Stbd screen contents, load #193 and overflow screen in #194, | | No incident report, just listed on load sheet and daily summary |
| 32 | 7 Dec 10 | SAW | Wilmington Harbor | A | H Terrapin Island | Dead | Whole fish, FL 61 cm | Fresh Dead, water temp 12 C, air 2 C, load 6 | Coastwise took photo | Incident and Load report |
| 33 | 10 Apr 11 | NAO | York Spit Channel | A | H Terrapin Island | Dead | Total Length 24.5” in, Fork Length 13.5”, Middle of anus to Anal Fin 3.8” | During Clean up. Torn in half, only posterior from pectoral region to tail, no head. Fins and tail torn but complete | | Hopper daily report from, QCR, e-mail, incident report, daily report, load sheets |

## Sturgeon Take Records from Dredging Operations 1990 - Mar 2012

| Take # | Date | Corps District | Location | Sp | Dredge Type/ Name | Status | Specimen Description | Notes | Photos | Documentation |
|---|---|---|---|---|---|---|---|---|---|---|
| 34 | 11Apr 11 | NAO | York Spit Channel | A | H Liberty Island | Dead | | During cleanup. Another piece taken on 4/13/11 matches perfectly. | Y | E-mail |
| 35 | 14 Mar 12 | SAC | Charleston Harbor Channel | A | H Glenn Edwards | Dead | Fresh dead, body part 26”-30” long X 13” width, no head or tail | Load 129 (0024-0345) found in starboard draghead, during cleanup mode. Given to South Carolina DNR | Yes | E-mail, load sheet, incident report |
| NT | 25 May 05 | NAO | York Spit Channel | ? | H *McFarland* | Dead | Approx. 2 ft estimate from photos | Too decomposed to identify | Yes (We Have e-file) | Observer final report, REMSA 2004 |
| NDNEF | 26 Jun 96 | NAN | East Rock Away Long Island | ? | H Dodge Island | Dead | (~3'), couldn't identify and doesn't mention condition (fresh or dead already)? Chris Starbird. | Load sheet states Carp or sturgeon | No | Load sheet, Daily and Weekly Summary mentions. No way to confirm. |
| NDNEF | About 98 | SAW | Wilmington Har Cape Fear River | A | P ?? | Dead | | | | NMFS 1998 Shortnose Recovery Plan p. 53 |
| NDNEF | About 98 | SAW | Wilmington Har Cape Fear River | A | C | Dead | | | | NMFS 1998 Shortnose Recovery Plan p. 53 |
| NDNEF | About 98 | SAJ or SAS | Kings Bay | A | H ?? | Dead | | | | NMFS 1998 Shortnose Recovery Plan p. 52 Chris Slay pers com |

Sp=sturgeon species
A=Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*)
S=Shortnose sturgeon (*Acipenser brevirostrum*)
G=Gulf sturgeon (*Acipenser oxyrhynchus desotoi*)
NT = Non-take incident by dredge
SAC=Charleston

SAW=Wilmington
SAS=Savannah
SAJ=Jacksonville
SAM=Mobile
NAE=New England
NAO=Norfolk
NAN=New York
NAP=Philadelphia
H=Hopper
P=Hydraulic Cutterhead pipeline
C=Mechanical clamshell or bucket, bucket and barge
DMA=Dredged material disposal area
NDNEF=No documentation, no evidence found to confirm citation

## APPENDIX D

### Procedure for obtaining fin clips from sturgeon for genetic analysis

1. Wash hands and use disposable gloves. Ensure that any knife, scalpel or scissors used for sampling has been thoroughly cleaned and wiped with alcohol to minimize the risk of contamination.
2. For any sturgeon, after the specimen has been measured and photographed, take a one-cm square clip from the pelvic fin.
3. Place fin clips in small screw top vials (2 ml screw top plastic vials are preferred) with preservative. Avoid using glass vials.
4. Label each vial with fish's unique ID number that matches the ID number you record on the metadata sheet. This is critical for accurate tracking and record keeping .
5. RNAlater™ is the preferred preservative and is not hazardous. Ninety-five percent absolute ETOH (un-denatured) is an accepted alternative. Note that ETOH is a Class 3 Hazardous Material due to its flammable nature.
6. If non-screw top vials are used, seal individual vials with leak proof positive measure (e.g., tape).
7. Package vials together (e.g., in one box) with an absorbent material within a double-sealed container (e.g., zip lock baggie).
8. If using excepted quantities of ETOH, follow DOT and IATA packaging regulations, including affixing ETOH warning label to air package. Accepted quantities of ETOH is 30 mL per inner package and 1 L for the total package.
9. A sub-sample of the fin clip must be sent to the sturgeon genetics archive at the USGS facility in Leetown, WV.
   a. Submit sample metadata to rjohnson1@usgs.gov with a cc to incidental.take@noaa.gov. Electronic metadata must be provided in order to properly identify and archive samples. A copy of the electronic metadata was emailed to the Federal agency point of contact for this Opinion and a list of the metadata fields is included below. Retain a copy of metadata sheets for your records.
   b. Mail samples to:

Robin Johnson
U.S. Geological Survey
Leetown Science Center
Aquatic Ecology Branch
11649 Leetown Road
Kearneysville, WV 25430

10. Send a subsample and associated metadata to the NMFS-approved lab for processing to determine DPS or river of origin per the agreement you have with that facility.

Metadata to be recorded for each genetic sample submitted to USGS and other NMFS-approved lab:

- Collection Date
- Species (ATS/SNS)
- Collector
- Collector Email
- Collector Phone Number
- Permit/Biological Opinion Number
- Permit Holder, Responsible Party (RP), or Principal Investigator (PI)
- Holder, RP, or PI Email
- Holder, RP, or PI Phone Number
- Unique Fish ID
- PIT Tag Number
- Location Collected
- Latitude
- Longitude
- Fork Length (mm)
- Total Length (mm)
- Weight (g)
- Sex
- Preservative
- Tag Info Available (Y/N)
- Tag Info
- Mortality (Y/N)
- Mortality Type
- Release of Information to Interested Party
- Recapture (Y/N)
- Comments

## APPENDIX E
## Protocol for Collecting Tissue from Sea Turtles for Genetic Analysis

### Materials for Collecting Genetic Tissue Samples

< surgical gloves
< alcohol swabs
< betadine swabs
< sterile disposable biopsy punches
< sterile disposable scalpels
< permanent marker to externally label the vials
< scotch tape to protect external labels on the vials
< pencil to write on internal waterproof label
< waterproof label, 1/4" x 4"
< screw-cap vial of saturated NaCl with 20% DMSO*, wrapped in parafilm
< piece of parafilm to wrap the cap of the vial after sample is taken
< vial storage box

* The 20% DMSO buffer within the vials is nontoxic and nonflammable. Handling the buffer without gloves may result in exposure to DMSO. This substance soaks into skin very rapidly and is commonly used to alleviate muscle aches. DMSO will produce a garlic/oyster taste in the mouth along with breath odor. The protocol requires that you wear gloves each time you collect a sample and handle the buffer vials. DO **NOT** store the buffer where it will experience extreme heat. The buffer must be stored at room temperature or cooler, such as in a refrigerator.

Please collect two small pieces of muscle tissue from all live, comatose, and dead stranded loggerhead, green, leatherback, and hybrid sea turtles (and any hawksbills, although this would be a rare incident). A muscle sample can be obtained no matter what stage of decomposition a carcass is in. Please utilize the equipment in these kits for genetic sampling of **turtles only** and contact the NMFS sea turtle stranding coordinator when you need additional biopsy supplies.

### Sampling Protocol for Dead Turtles

1. Put on a pair of surgical gloves. The best place to obtain the muscle sample is on the ventral side where the front flippers insert near the plastron. It is not necessary to cut very deeply to get muscle tissue.

2. Using a new (sterile and disposable) scalpel cut out two pieces of muscle of a size that will fit in the vial.

3. Transfer both samples directly from the scalpel to a single vial of 20% DMSO saturated with salt.

4. Use the pencil to write the stranding ID, date, species ID and SCL on the waterproof label and place it in the vial with the samples.

5. Label the outside of the vial using the permanent marker with stranding ID, date, species ID and SCL .

6. Apply a piece of clear scotch tape over the what you have written on the outside of the vial to protect the label from being erased or smeared.

7. Wrap parafilm around the cap of the vial by stretching as you wrap.

8. Place the vial in the vial storage box.

9. Complete the Sea Turtle Biopsy Sample Collection Log.

10. Attach a copy of the STSSN form to the Collection Log - be sure to indicate on the STSSN form that a genetic sample was taken.

11. Dispose of the used scalpel and gloves. It is very important to use a new scalpel for each animal to avoid cross contamination.

**At the end of the calendar year submit all genetic samples to:**

**Sea Turtle Stranding Coordinator**
**NMFS Protected Resources Division**
**55 Great Republic Drive**
**Gloucester, MA 01930**
**(978)281-9328**

APPENDIX F

# STURGEON SALVAGE FORM

For use in documenting dead sturgeon in the wild under ESA permit no. 17273 (version 7-24-2015)

INVESTIGATORS'S CONTACT INFORMATION
Name: First _____ Last _____
Agency Affiliation _____ Email_____
Address _____
_____
Area code/Phone number _____

UNIQUE IDENTIFIER (Assigned by NMFS)

DATE REPORTED:
Month ☐☐ Day☐☐ Year 20☐☐
DATE EXAMINED:
Month ☐☐ Day☐☐ Year 20☐☐

SPECIES: (check one)
☐ shortnose sturgeon
☐ Atlantic sturgeon
☐ Unidentified *Acipenser* species
*Check "Unidentified" if uncertain* .
See reverse side of this form for aid in identification.

LOCATION FOUND: ☐Offshore (Atlantic or Gulf beach) ☐Inshore (bay, river, sound, inlet, etc)
River/Body of Water_____ City_____ State ____
Descriptive location (be specific)_____
_____
_____
Latitude _____N (Dec. Degrees) Longitude _____ W (Dec. Degrees)

CARCASS CONDITION at time examined: (check one)
☐ 1 = Fresh dead
☐ 2 = Moderately decomposed
☐ 3 = Severely decomposed
☐ 4 = Dried carcass
☐ 5 = Skeletal, scutes & cartilage

SEX:
☐ Undetermined
☐ Female ☐ Male
How was sex determined?
☐ Necropsy
☐ Eggs/milt present when pressed
☐ Borescope

MEASUREMENTS: Circle unit
Fork length _____ cm / in
Total length _____ cm / in
Length ☐ actual ☐ estimate
Mouth width (inside lips, see reverse side) _____ cm / in
Interorbital width (see reverse side) _____ cm / in
Weight ☐ actual ☐ estimate _____ kg / lb

TAGS PRESENT? Examined for external tags including fin clips? ☐ Yes ☐ No Scanned for PIT tags? ☐ Yes ☐ No

| Tag # | Tag Type | Location of tag on carcass |
|---|---|---|
| | | |
| | | |

CARCASS DISPOSITION: (check one or more)
☐1 = Left where found
☐2 = Buried
☐3 = Collected for necropsy/salvage
☐4 = Frozen for later examination
☐5 = Other (describe) _____

Carcass Necropsied?
☐Yes ☐No
Date Necropsied:_____
Necropsy Lead:
_____

PHOTODOCUMENTATION:
Photos/vide taken? ☐ Yes ☐ No
Disposition of Photos/Video:_____
_____
_____

SAMPLES COLLECTED? ☐ Yes ☐ No

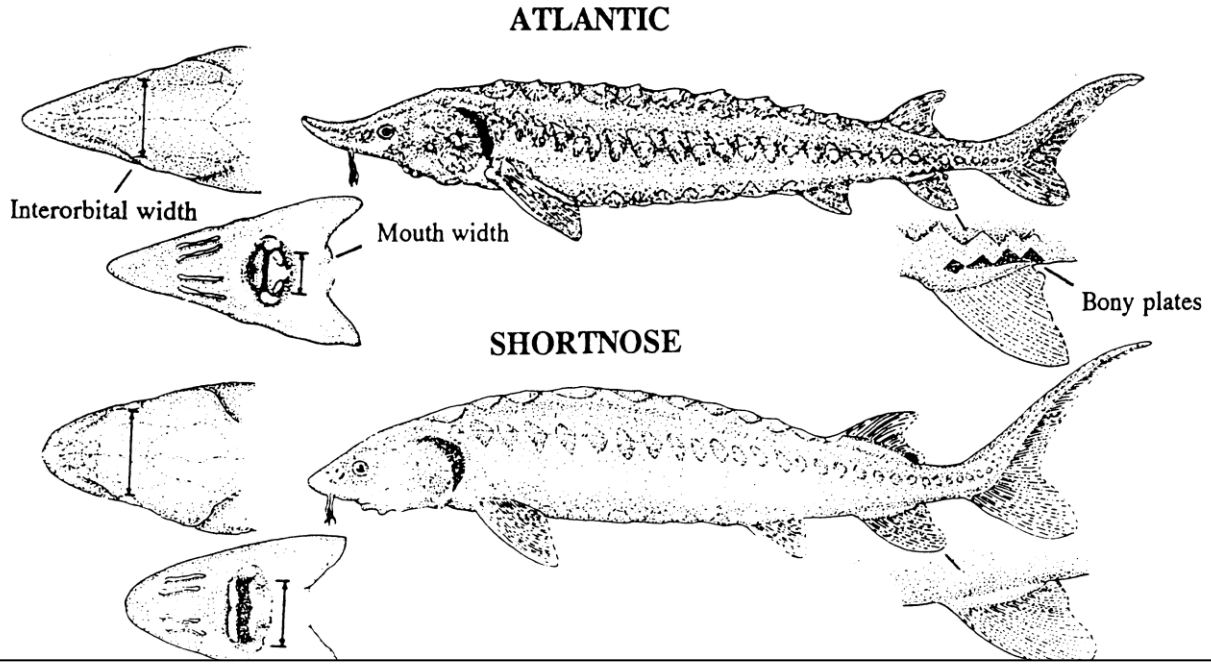
| Sample | How preserved | Disposition (person, affiliation, use) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Comments:
_____
_____
_____

Distinguishing Characteristics of Atlantic and Shortnose Sturgeon (version 7-24-2015)

| Characteristic | Atlantic Sturgeon, *Acipenser oxyrinchus* | Shortnose Sturgeon, *Acipenser brevirostrum* |
|---|---|---|
| Maximum length | > 9 feet/ 274 cm | 4 feet/ 122 cm |
| Mouth | Football shaped and small. Width inside lips < 55% of bony interorbital width | Wide and oval in shape. Width inside lips > 62% of bony interorbital width |
| *Pre-anal plates | Paired plates posterior to the rectum & anterior to the anal fin. | 1-3 pre-anal plates almost always occurring as median structures (occurring singly) |
| Plates along the anal fin | Rhombic, bony plates found along the lateral base of the anal fin (see diagram below) | No plates along the base of anal fin |
| Habitat/Range | Anadromous; spawn in freshwater but primarily lead a marine existence | Freshwater amphidromous; found primarily in fresh water but does make some coastal migrations |

* From Vecsei and Peterson, 2004




Describe any wounds / abnormalities (note tar or oil, gear or debris entanglement, propeller damage, etc.). Please note if no wounds / abnormalities are found.

_____

_____

_____

_____

_____

Data Access Policy: Upon written request, information submitted to National Marine Fisheries Service (NOAA Fisheries) on this form will be released to the requestor provided that the requestor credit the collector of the information and NOAA Fisheries. NOAA Fisheries will notify the collector that these data have been requested and the intent of their use.

**Submit completed forms (within 30 days of date of investigation) to**: **Greater Atlantic Regional Fisheries Office Contacts** – Edith Carson (Edith.Carson@noaa.gov , 978-282-8490) or Lynn Lankshear (Lynn.Lankshear@noaa.gov, 978-282-8473); **Southeast Region Contact**- Stephania Bolden (Stephania.Bolden@noaa.gov, 727-551-5768).

**APPENDIX G**

# Take Report Form for ESA-Listed Species

**Use one form per individual animal taken**

**Biological Opinion PCTS No.**

**Species taken:**

- ☐ **Green sea turtle**
- ☐ **Kemp's ridley sea turtle**
- ☐ **Leatherback sea turtle**
- ☐ **Loggerhead sea turtle**
- ☐ **Unknown sea turtle**
- ☐ **Atlantic sturgeon**
- ☐ **Shortnose sturgeon**
- ☐ **Unknown sturgeon**
- ☐ **Atlantic salmon**

**Condition when taken (select one):**

☐ Alive ☐ Fresh Dead ☐ Moderately Decomposed

☐ Severely Decomposed ☐ Dried ☐ Skeletal

**Date take observed:**

**Animal was:**

- ☐ Released alive with no visible injuries
- ☐ Released alive with visible injuries
- ☐ Released dead
- ☐ Held for Necropsy
- ☐ Transferred to rehabilitation (sea turtles only)

Date: _____

Rehabilitation facility:

**SPECIES CONDITION KEY**

Fresh dead – no foul smell
Moderately decomposed – scutes and skin are intact or just beginning to peel, internal organs intact
Severely decomposed – foul smell with scutes lifting or gone, skin peeling, internal organs beginning to liquefy
Dried carcass – leathery, internal organs have decomposed
Skeletal remains - bones only

**Location of the take:**

Latitude and Longitude in Decimal Degrees to six places:

Latitude:

Longitude:

Sediment type in area (e.g., SAV, cobble, silt/mud, shellfish present):

**Body of water where take occurred:**

- ☐ Atlantic Ocean
- ☐ River (name): _____
- ☐ Bay or Sound (name): _____
- ☐ Creek (name): _____

**Take activity (select all that apply):**

- ☐ Pile Driving
- ☐ Bridge/Road Construction
- ☐ Dredging
- ☐ Beach Renourishment
- ☐ Vessel Operation
- ☐ Relocation trawling
- ☐ Blasting

**If dredging project:**

Type of dredge/name:

Load number:

Location on dredge mechanism where specimen was found (screen, hopper):

Was draghead deflector used: ☐ Yes ☐ No

Was rigid deflector used: ☐ Yes ☐ No

Condition of deflector:

Condition of screening or UXO screen:

**If construction project:**

Vessel or Rig Name: Exclusion Zone, if required:

If installing or extracting piles:

Tools: ☐ Impact Hammer

☐ Vibratory Hammer

☐ Other (specify) _____

If pile driving:

| Pile Type | Diameter | Number |
|---|---|---|
| | | |
| | | |

If using explosives:

| Type | Size | Number |
|---|---|---|
| | | |
| | | |

**Refer to your Biological Opinion for guidance on handling and resuscitating live animals**

**Indicate type and location of visible injuries (see diagrams). Check all that apply:**

| Type of Injury | Dorsal Surface | Ventral Surface - |
|---|---|---|
| Cuts/Gashes (not severed) | ☐ | ☐ |
| Severed body, limbs, or organs | ☐ | ☐ |

Describe injuries and list any missing body parts:

**For live animals - indicate behavior when taken:**

☐ Active (alert, moving head, fins or flippers)

☐ Slow and lethargic (minimal movement and responsiveness)

☐ No movement but may or may not respond to reflex test

**For dead animals, does the BiOp require necropsy:**

☐ Yes ☐ No

**Was resuscitation attempted:**

☐ Yes, length of time _____ hours Outcome: ☐ Alive ☐ Dead

☐ No ☐ N/A, animal confirmed dead, or alive and moving when taken

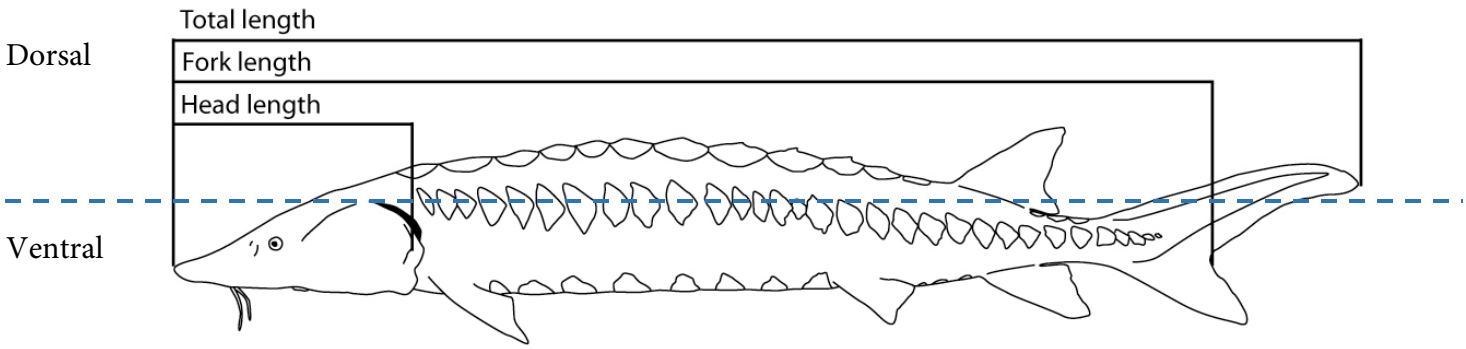
**Fish measurements in centimeters – measurements should be exact.**
**Provide the reason for any estimated measure (e.g., tail missing)**

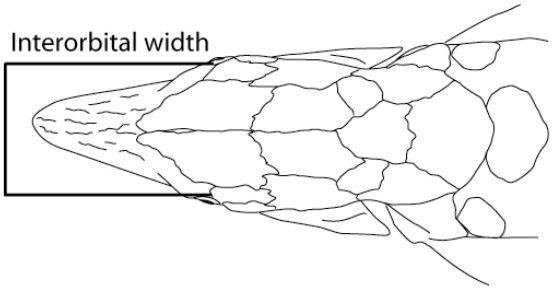
| | Exact | Estimated | Reason for Estimated Measure |
|---|---|---|---|
| Total Length: _____ cm | ☐ | ☐ | _____ |
| Fork Length: _____ cm | ☐ | ☐ | _____ |
| Mouth Width: _____ cm | ☐ | ☐ | _____ |
| Interorbital Width: _____ cm | ☐ | ☐ | _____ |

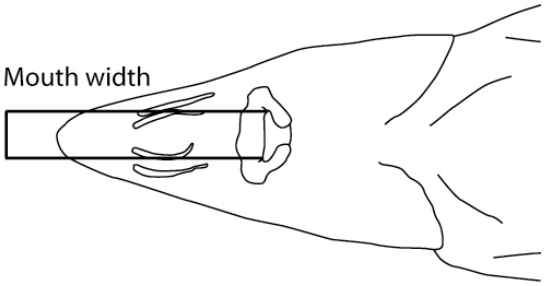
**Turtle measurements in centimeters – measurements should be exact.**
**Provide the reason for any estimated measure (e.g., shell crushed and flattened)**

| | Exact | Estimated | Reason for Estimated Measure |
|---|---|---|---|
| Curved Carapace Length: _____ cm (notch to tip length with measuring tape) | ☐ | ☐ | _____ |
| Straight Carapace Length: _____ cm (notch to tip length with calipers) | ☐ | ☐ | _____ |
| Straight Carapace Width: _____ cm (widest points with calipers) | ☐ | ☐ | _____ |
| Weight: _____ kg | ☐ | ☐ | _____ |

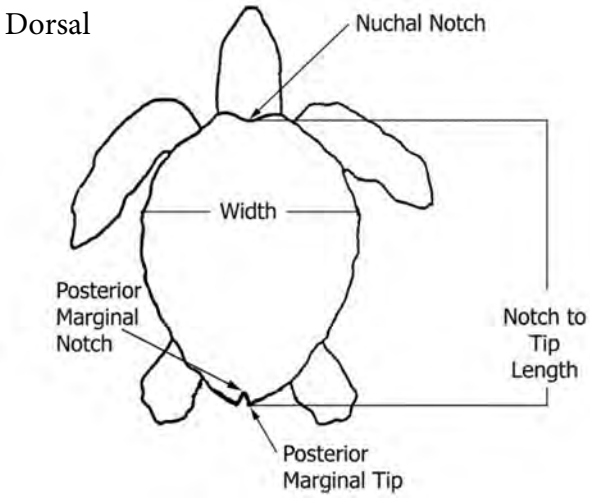
# Shortnose and Atlantic Sturgeon -

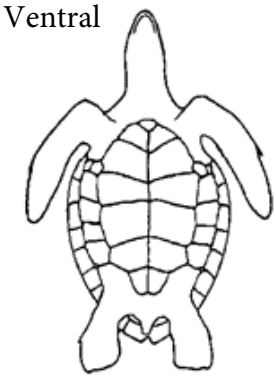



# Sea Turtles -



**Checklist for samples required to be collected and submitted per the BiOp's Standard Operating Procedures, RPMs, and T&Cs**

**Photographs and/or Video:** Submit with this form to **incidental.take@noaa.gov**

**Biopsy punch (sea turtles):** Current Disposition (person/affiliation):

**Fin Clip (fish):** Current Disposition (person/affiliation):

**Tags present[1]:**

| Type (e.g., PIT, flipper) | Number | Location on animal |
|---|---|---|
| | | |
| | | |
| | | |

**Tags inserted or applied[1]:**

| Type (e.g., PIT, flipper) | Number | Location on animal |
|---|---|---|
| | | |
| | | |
| | | |

**[1] For sturgeon, also send PIT tag #, date, location, and length to Mike_mangold@fws.gov.**

**Contact information for person completing this form**

Name:

Email:

Phone Number:

Agency/Organization name if other than the Federal Action Agency for the BiOp:

**APPENDIX H**

## Sea Turtle Trawling and Relocation Guidelines

(as derived from ACOE South Atlantic Division protocol)

Note that: In this BO, NMFS has determined that relocation trawling is necessary to minimize the take of sea turtles in dredging operations. NMFS has also determined that handling and measuring as outlined in the ITS is necessary to monitor the take of sea turtles. Additionally, NMFS has determined that genetic sampling of dead sea turtles is necessary to monitor take. However, external or internal sampling procedures (e.g., flipper tagging, PIT tagging, blood letting, skin tag sampling, laparoscopies, gastric lavages, mounting satellite or radio transmitters, genetics sampling, etc.) performed on live sea turtles are not permitted under this BO unless the observer holds a valid sea turtle research permit (obtained pursuant to section 10 of the ESA, from the NMFS' Office of Protected Resources, Permits Division) authorizing sampling, either as the permit holder, or as designated agent of the permit holder.

**Sea turtle trawling procedures**

1. Trawling shall be conducted under the supervision of a biologist approved by the NMFS. A letter stating that NMFS has approved the supervising biologist must be obtained prior to the commencement of trawling.

2. Sea turtles captured pursuant to relocation trawling shall be handled in a manner designed to ensure their safety and viability, and shall be released over the side of the vessel, away from the propeller, and only after ensuring that the vessel's propeller is in the neutral, or disengaged, position (i.e., not rotating). Captured turtles shall be kept moist, and shaded whenever possible, until they are released. Resuscitation guidelines are included in part in Appendix C.

3. Any turtles captured during the survey shall be measured in accordance with standard biological sampling procedures prior to release, and weighed when possible. Sampling data shall be recorded on the Sea Turtle Relocation Report (Appendix I).

4. Turtles shall be kept no longer than 12 hours prior to release and shall be released at least 3 miles away from the dredge site (if it can be done safely, turtles may be transferred onto another vessel for transport to the release area to enable the relocation trawler or relative abundance trawler to keep sweeping the dredge site without interruption).

7. The trawler will be equipped with two 60-foot nets constructed from 8-inch mesh (stretch) fitted with mud rollers and flats as specified in the Turtle Trawl Nets Specifications. Paired net tows will be made for 10 to 12 hours per day or night. Trawling will be conducted with the tidal flow using repetitive 15-30 minute (total time) tows in the channel. Tows will be made in the center, green and red sides of the channel such that the total width of the channel bottom is sampled. Positions at the beginning and end of each tow will be determined from GPS Positioning equipment. Trawl speeds shall not exceed 3.5 knots. Tow speed will be recorded at the approximate midpoint of each tow.

7. Methods and equipment will be standardized including data sheets, nets, trawling direction to tide, length of station, length of tow, and number of tows per station. Water temperature measurements will be taken at the water surface each day using a laboratory thermometer. Data on each tow, including weather conditions, air temperature, wind velocity and direction, sea state-wave height, and precipitation, will be recorded on the Sea Turtle Trawling Report.

8. Before trawling begins, the necessary state permits for trawling in Virginia state waters must be obtained from the appropriate party (e.g., State of Virginia, Virginia Marine Resources Commission).

## Turtle Trawl Nets Specifications

**DESIGN:** 4 seam, 4 legged, 2 bridal trawl net
**WEBBING:** 4 inch bar, 8 inch stretch
top - 36 gauge twisted nylon dipped
side - 36 gauge twisted nylon dipped
bottom - 84 gauge braided nylon dipped
**NET LENGTH:** 60 ft from cork line to cod end
**BODY TAPER:** 2 to 1
**WING END HEIGHT:** 6 ft
**CENTER HEIGHT:** Dependent on depth of trawl 14 to 18 ft
**COD END:** Length 50 meshes x 4" = 16.7 ft
Webbing 2 inch bar, 4 inch stretch, 84 gauge braid nylon dipped, 80 meshes around, 40 rigged meshes with 1/4 x 2 inch choker rings, 1 each ½ x 4 inch at end
cod end cover - none
chaffing gear - none
**HEAD ROPE:** 60 ft ½ inch combination rope (braid nylon with stainless cable center)
**FOOT ROPE:** 65 ft ½ inch combination rope
**LEG LINE:** top - 6 ft, bottom 6 - ft
**FLOATS:** size - tuna floats (football style), diameter - 7 inch length - 9 inch, number - 12 each, spacing - center on top net 2 inches apart
**MUD ROLLERS:** size 5 inch diameter 5.5 inch length, number - 22 each, spacing - 3 ft attached with 3/8 inch polypropelene rope (replaced with snap on rollers when broken)
**TICKLER CHAINS:** NONE (discontinued- but previously used 1/4 inch x 74 ft galvanized chain)
**WEIGHT:** 20 ft of 1/4 inch galvanized chain on each wing, 40 ft per net looped and tied
**DOOR SIZE:** 7 ft x 40 inches (or 8 ft x 40 inches), Shoe - 1 inch x 6 inch, bridles - 3/8 inch high test chain
**CABLE LENGTH** (bridle length, total): 7/16 inch x 240-300 ft varies with bottom conditions
**FLOAT BALL:** none
**LAZY LINES:** 1 inch nylon
**PICKUP LINES:** 3/8 inch polypropelene
**WHIP LINES:** 1 inch nylon

**APPENDIX I**

## RELOCATION TRAWLING REPORT

### Part 1 - Sea Turtle Relocation Report

(*Note that any other reporting form submitted for turtles taken in trawling activities related to maintenance dredging should include the following information.*)

Channel: _____ Date: _____
Tow #:_____ Net (circle): Port Starboard
Day of trawling effort (e.g., 3rd day) _____ Hour of trawling effort (that day) _____
Water depth_____ Water temperature _____
Other environmental
conditions_____

Describe capture location (include state, county, lat and long): _____
_____
Describe capture method and/or type of gear in use when turtle was caught:_____
_____

**Species Information**: *(please designate cm/m or inches.)*
Species _____ Weight (kg or lbs)_____
Sex (circle): Male Female Unknown How was sex determined? _____
Straight carapace length _____ Straight carapace width _____
Curved carapace length _____ Curved carapace width _____
Plastron length _____ Plastron width _____
Tail length _____ Head width _____
Condition of specimen/description of animal_____
_____

**Existing Flipper Tag Information**
Left _____ Right _____
PIT Tag # _____

**Miscellaneous:**
Genetic biopsy taken: YES NO
Photos Taken: YES NO Is this a Recapture: YES NO

**Turtle Release Information:**
Date _____ Time _____
Lat _____ Long _____
State _____ County _____

**Remarks:** (note if turtle was involved with tar or oil, gear or debris entanglement, wounds or mutilations, propellor damage, papillomas, old tag locations, etc.)
_____
_____

Part 2-

**Sturgeon Relocation Form**

Channel: _____ Date: _____

Tow #:_____ Net (circle): Port Starboard

Day of trawling effort (e.g., 3rd day) _____ Hour of trawling effort (that day) _____

Water depth_____ Water temperature _____

Other environmental conditions_____

Describe capture location (include state, county, lat and long): _____

_____

Describe capture method and/or type of gear in use when turtle was caught:_____

_____

**Species Information**: *(please designate cm/m or inches.)*

Species _____ Weight (kg or lbs)_____

Length (TL) _____ Length (FL) _____

Condition of specimen/description of animal_____

_____

**Existing Tag Information**

PIT Tag # _____

**Other Tags: _____**

**Miscellaneous:**

Fin clip taken: YES NO

Photos Taken: YES NO Is this a Recapture: YES NO

**Release Information:**

Date _____ Time _____

Lat _____ Long _____

State _____ County _____

**Remarks:** (note if fish was involved with tar or oil, gear or debris entanglement, wounds or mutilations, propellor damage, old tag locations, etc.)

_____

_____

**APPENDIX J**

# MONITORING SPECIFICATIONS FOR DREDGES

## Part 1. – HOPPER DREDGES

## I. EQUIPMENT SPECIFICATIONS

A. Baskets or screening

Baskets or screening must be installed over the hopper inflows with openings no smaller than 4 inches by 4 inches to provide 100% coverage of all dredged material and shall remain in place during all dredging operations. Baskets/screening will allow for better monitoring by observers of the dredged material intake for sea turtles, sturgeon and their remains. The baskets or screening must be safely accessible to the observer and designed for efficient cleaning.

B. Draghead

The draghead of the dredge shall remain on the bottom **at all times** during a pumping operation, except when:

1) the dredge is not in a pumping operation, and the suction pumps are turned completely off;
2) the dredge is being re-oriented to the next dredge line during borrow activities; and
3) the vessel's safety is at risk (i.e., the dragarm is trailing too far under the ship's hull).

At initiation of dredging, the draghead shall be placed on the bottom during priming of the suction pump. If the draghead and/or dragarm become clogged during dredging activity, the pump shall be shut down, the dragarms raised, whereby the draghead and/or dragarm can be flushed out by trailing the dragarm along side the ship. If plugging conditions persist, the draghead shall be placed on deck, whereby sufficient numbers of water ports can be opened on the draghead to prevent future plugging.

Upon completion of a dredge track line, the drag tender shall:

1) throttle back on the RPMs of the suction pump engine to an idling speed (e.g., generally less than 100 RPMs) **prior to** raising the draghead off the bottom, so that no flow of material is coming through the pipe into the dredge hopper. Before the draghead is raised, the vacuum gauge on the pipe should read zero, so that no suction exists both in the dragarm and draghead, and no suction force exists that can impinge a turtle on the draghead grate;
2) hold the draghead firmly on the bottom with no flow conditions for approximately 10 to 15 seconds before raising the draghead; then, raise the draghead quickly off the bottom and up to a mid-water column level, to further reduce the potential for any adverse interaction with nearby turtles;

3) re-orient the dredge quickly to the next dredge line; and

4) re-position the draghead firmly on the bottom prior to bringing the dredge pump to normal pumping speed, and re-starting dredging activity.

C. Floodlights

Floodlights must be installed to allow the NMFS-approved observer to safely observe and monitor the baskets or screens.

D. Intervals between dredging

Sufficient time must be allotted between each dredging cycle for the NMFS-approved observer to inspect and thoroughly clean the baskets and screens for sea turtles and/or turtle parts and document the findings. Between each dredging cycle, the NMFS-approved observer should also examine and clean the dragheads and document the findings.

## II. OBSERVER PROTOCOL

A. Basic Requirement

A NMFS-approved observer with demonstrated ability to identify sea turtle and sturgeon species must be placed aboard the dredge(s) being used, starting immediately upon project commencement to monitor for the presence of listed species and/or parts being entrained or present in the vicinity of dredge operations.

B. Duty Cycle

Observers are required at times and locations outlined in the ITS. While onboard, the observer must work a shift schedule appropriate to allow for the observation of at least 50% of the dredge loads (e.g., 12 hours on, 12 hours off). The USACE shall require of the dredge operator that, when the observer is off watch, the cage shall not be opened unless it is clogged. The USACE shall also require that if it is necessary to clean the cage when the observer is off watch, any aquatic biological material is left in the cage for the observer to document and clear out when they return on duty. In addition, the observer shall be the only one allowed to clean off the overflow screen.

C. Inspection of Dredge Spoils

During the required inspection coverage, the trained NMFS-approved observer shall inspect the galvanized screens and baskets at the completion of each loading cycle for evidence of sea turtles or shortnose sturgeon. The Endangered Species Observation Form shall be completed for each loading cycle, whether listed species are present or not. If any whole (alive or dead) or turtle parts are taken incidental to the project(s), NMFS Protected Resources Division must be contacted by phone (978-281-9328) or e-mail (incidental.take@noaa.gov) within 24 hours of the take. An incident report for sea turtle/shortnose sturgeon take (Appendix E) shall also be completed by the observer and sent via FAX (978) 281-9394 or e-mail (incidental.take@noaa.gov) within 24 hours of the take. Incident reports shall be completed for

every take regardless of the state of decomposition. NMFS will determine if the take should be attributed to the incidental take level, after the incident report is received. Every incidental take (alive or dead, decomposed or fresh) should be photographed, and photographs shall be sent to NMFS either electronically (incidental.take@noaa.gov) or through the mail. Weekly reports, including all completed load sheets, photographs, and relevant incident reports, as well as a final report, shall be submitted to NMFS NER, Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930-2298.

D. Information to be Collected

For each sighting of any endangered or threatened marine species (including whales as well as sea turtles), record the following information on the Endangered Species Observation Form (Appendix E):

1) Date, time, coordinates of vessel
2) Visibility, weather, sea state
3) Vector of sighting (distance, bearing)
4) Duration of sighting
5) Species and number of animals
6) Observed behaviors (feeding, diving, breaching, etc.)
7) Description of interaction with the operation

E. Disposition of Parts

If any whole turtles or sturgeon (alive or dead, decomposed or fresh) or turtle or shortnose sturgeon parts are taken incidental to the project(s), NMFS Protected Resources must be contacted within 24 hours of the take (phone: 978-281-9328 or e-mail (incidental.take@noaa.gov). All whole dead sea turtles or sturgeon, or turtle or shortnose sturgeon parts, must be photographed and described in detail on the Incident Report of Sea Turtle Mortality (Appendix E). The photographs and reports should be submitted by email (incidental.take@noaa.gov) or mail (Attn: Section 7 Coordinator, NMFS, Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930-2298). After NMFS is notified of the take, it may instruct the observer to save the animal for future analysis if there is freezer space. Disposition of dead sea turtles/ sturgeon will be determined by NMFS at the time of the take notification. If the species is unidentifiable or if there are entrails that may have come from a turtle, the subject should be photographed, placed in plastic bags, labeled with location, load number, date and time taken, and placed in cold storage.

Live turtles (both injured and uninjured) should be held onboard the dredge until transported as soon as possible to the appropriate stranding network personnel for rehabilitation (Appendix C). No live turtles should be released back into the water without first being checked by a qualified veterinarian or a rehabilitation facility. The NMFS Stranding Network Coordinator ((978) 282-8470) should also be contacted immediately for any marine mammal injuries or mortalities.

## III. OBSERVER REQUIREMENTS

Submission of resumes of endangered species observer candidates to NMFS for final approval ensures that the observers placed onboard the dredges are qualified to document takes of endangered and threatened species, to confirm that incidental take levels are not exceeded, and to provide expert advice on ways to avoid impacting endangered and threatened species. NMFS does not offer certificates of approval for observers, but approves observers on a case-by-case basis.

A. Qualifications

Observers must be able to:

1) differentiate between leatherback (*Dermochelys coriacea*), loggerhead *Caretta caretta*), Kemp's ridley *(Lepidochelys kempii*), green (*Chelonia mydas*), and hawksbill *(Eretmochelys imbricata*) turtles and their parts, and shortnose (*Acipenser brevirostrum*) and Atlantic (*Acipenser oxyrinchus oxyrinchus*) sturgeon and their parts;
2) handle live sea turtles and sturgeon and resuscitate and release them according accepted procedures;
3) correctly measure the total length and width of live and whole dead sea turtle and sturgeon species;
4) observe and advise on the appropriate screening of the dredge's overflow, skimmer funnels, and dragheads; and
5) identify marine mammal species and behaviors.

B. Training

Ideally, the applicant will have educational background in marine biology, general experience aboard dredges, and hands-on field experience with the species of concern. For observer candidates who do not have sufficient experience or educational background to gain immediate approval as endangered species observers, the below observer training is necessary to be considered admissible by NMFS. We can assist the USACE by identifying groups or individuals capable of providing acceptable observer training. Therefore, at a minimum, observer training must include:

1) instruction on how to identify sea turtles and sturgeon and their parts;
2) instruction on appropriate screening on hopper dredges for the monitoring of sea turtles and sturgeon (whole or parts);
3) demonstration of the proper handling of live sea turtles and sturgeon incidentally captured during project operations. Observers may be required to resuscitate sea turtles according to accepted procedures prior to release;
4) instruction on standardized measurement methods for sea turtle and sturgeon lengths and widths; and

5) instruction on how to identify marine mammals; and
6) instruction on dredging operations and procedures, including safety precautions onboard a vessel.

**Part 2. MECHANICAL DREDGES**

I. EQUIPMENT SPECIFICATIONS

A. Floodlights

Should dredging occur at night or in poor lighting conditions, floodlights must be installed to allow the NMFS-approved observer to safely observe and monitor dredge bucket and scow.

B. Intervals between dredging

Sufficient time must be allotted between each dredging cycle for the NMFS-approved observer to inspect the dredge bucket and scow for shortnose sturgeon and/or sturgeon parts and document the findings.

II. OBSERVER PROTOCOL

A. Basic Requirement

A NMFS-approved observer with demonstrated ability to identify shortnose sturgeon must be placed aboard the dredge(s) being used; starting immediately upon project commencement to monitor for the presence of listed species and/or parts being taken or present in the vicinity of dredge operations.

B. Duty Cycle

A NMFS-approved observer must be onboard during dredging until the project is completed. While onboard, observers shall provide the required inspection coverage to provide 100% coverage of all dredge-cycles.

C. Inspection of Dredge Spoils

During the required inspection coverage, the NMFS-approved observer shall observe the bucket as it comes out of the water and as the load is deposited into the scow during each dredge cycle for evidence of shortnose sturgeon. If any whole sturgeon (alive or dead) or sturgeon parts are taken incidental to the project(s), NMFS must be contacted **within 24 hours** of the take (phone: 978-281-9328 or email (incidental.take@noaa.gov). An incident report for sturgeon take shall also be completed by the observer and sent to NMFS via FAX (978) 281-9394 or e-mail (incidental.take@noaa.gov) within 24 hours of the take. Incident reports shall be completed for every take regardless of the state of decomposition. Every incidental take (alive or dead, decomposed or fresh) must be photographed. A final report including all completed load sheets,

photographs, and relevant incident reports are to be submitted to the attention of the Section 7 Coordinator, NMFS Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930.

D. Inspection of Disposal

The NMFS-approved observer shall observe all disposal operations to inspect for any whole sturgeon or sturgeon parts that may have been missed when the load was deposited into the scow. If any whole sturgeon (alive or dead) or sturgeon parts are observed during disposal operation, the procedure for notification and documentation outlined above should be completed.

E. Disposition of Parts

As required above, NMFS must be contacted as soon as possible following a take. Any dead sturgeon should be refrigerated or frozen until disposition can be discussed with NMFS. Under no circumstances should dead sturgeon be disposed of without confirmation of disposition details with NMFS.

III. OBSERVER REQUIREMENTS

Submission of resumes of endangered species observer candidates to NMFS for final approval ensures that the observers placed onboard the dredges are qualified to document takes of endangered and threatened species, to confirm that incidental take levels are not exceeded, and to provide expert advice on ways to avoid impacting endangered and threatened species. NMFS does not offer certificates of approval for observers, but approves observers on a case-by-case basis.

A. Qualifications

Observers must be able to:

1) differentiate between shortnose (*Acipenser brevirostrum*) and Atlantic (*Acipenser oxyrinchus oxyrinchus*) sturgeon and their parts;
2) handle live sturgeon;
3) correctly measure the total length and width of live and whole dead sturgeon species;

B. Training

Ideally, the applicant will have educational background in biology, general experience aboard dredges, and hands-on field experience with the species of concern. For observer candidates who do not have sufficient experience or educational background to gain immediate approval as endangered species observers, we note below the observer training necessary to be considered admissible by NMFS. We can assist the USACE by identifying groups or individuals capable of providing acceptable observer training. Therefore, at a minimum, observer training must include:

1) instruction on how to identify sturgeon and their parts;

2) instruction on appropriate screening on hopper dredges for the monitoring of sturgeon(whole or parts);

3) demonstration of the proper handling of live sturgeon incidentally captured during project operations;

4) instruction on standardized measurement methods for sturgeon lengths and widths; and

5) instruction on dredging operations and procedures, including safety precautions onboard.

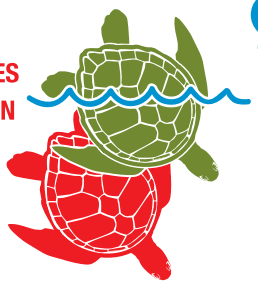
# SEA TURTLE HANDLING AND RESUSCITATION REQUIREMENTS

***IF YOU ENCOUNTER AN ENTANGLED, INJURED OR UNRESPONSIVE SEA TURTLE, please immediately call the National Marine Fisheries Service Northeast Region Hotline:***

## *866-755-NOAA (6622)*

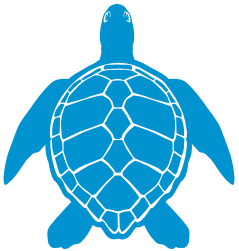
**Any sea turtle taken incidentally during fishing must be handled with care to prevent injury, observed for activity, and returned to the water according to the following procedures:**

**A A SEA TURTLE THAT IS ACTIVELY MOVING OR IS DEAD (THAT IS, IF MUSCLES ARE STIFF AND/OR THE FLESH HAS BEGUN TO ROT) MUST BE RELEASED OVER THE VESSEL'S STERN ONLY:**



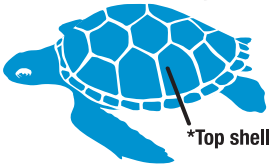
- When fishing gear is not in use,
- When the engine is in neutral, and
- In areas where the turtle is unlikely to be recaptured or injured by vessels.

**OTHERWISE, YOU MUST CONSIDER THE TURTLE UNRESPONSIVE AND ATTEMPT RESUSCITATION AS DESCRIBED IN B.**



You are strongly encouraged to read the full regulation, which can be found at 50 CFR 223.206(d)(1).

**B YOU MUST ATTEMPT RESUSCITATION ON SEA TURTLES THAT ARE UNRESPONSIVE AS FOLLOWS:**




**1 Place the turtle top shell up* and elevate its hindquarters at least 6" (or 15-30°) for at least 4 hours and up to 24 hours.**

- The amount of elevation depends on the turtle's size; larger turtles require greater elevation.
- In warm weather (over 60 °F), keep the turtle shaded and moist, preferably by placing a damp towel over the head, shell, and flippers. You must NOT place the turtle into a container of water.

**2 Periodically rock the turtle gently side to side by holding the outer edge of the shell and lifting one side about 3", then alternate to the other side.**

**3 Periodically gently touch the eye and pinch the tail (reflex tests) to see if there is a response.**

**C IF THE TURTLE REVIVES AND BECOMES ACTIVE DURING RESUSCITATION EFFORTS, you must release it over the vessel's stern as described in A. If the turtle does not respond to the reflex test (as described in B 3) or move within 4 hours (up to 24 hours, if possible), you must return the turtle to the water in the same manner.**

**APPENDIX K**

**Sea turtle handling and resuscitation measures as found at 50 CFR 223.206(d)(1).**

(d) (1) (i) Any specimen taken incidentally during the course of fishing or scientific research activities must be handled with due care to prevent injury to live specimens, observed for activity, and returned to the water according to the following procedures.

(A) Sea turtles that are actively moving or determined to be dead as described in (d)(1)(i)(C) of this section must be released over the stern of the boat. In addition, they must be released only when fishing or scientific collection gear is not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by vessels.

(B) Resuscitation must be attempted on sea turtles that are comatose, or inactive, as determined in paragraph (d)(1) of this section by:

(1) placing the turtle on its bottom shell (plastron) so that the turtle is right side up, and elevating its hindquarters at least 6 inches (15.2 cm) for a period of 4 up to 24 hours. The amount of the elevation depends on the size of the turtle; greater elevations are needed for larger turtles. Periodically, rock the turtle gently left to right and right to left by holding the outer edge of the shell (carapace) and lifting one side about 3 inches (7.6 cm) then alternate to the other side. Gently touch the eye and pinch the tail (reflex test) periodically to see if there is a response.

(2) sea turtles being resuscitated must be shaded and kept damp or moist but under no circumstance be placed into a container holding water. A water-soaked towel placed over the head, neck, and flippers is the most effective method in keeping a turtle moist.

(3) sea turtles that revive and become active must be released over the stern of the boat only when fishing or scientific collection gear is not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by vessels. Sea turtles that fail to respond to the reflex test or fail to move within 4 hours (up to 24, if possible) must be returned to the water in the same manner as that for actively moving turtles.

© A turtle is determined to be dead if the muscles are stiff (rigor mortis) and/or the flesh has begun to rot; otherwise the turtle is determined to be comatose or inactive and resuscitation attempts are necessary.

APPENDIX L

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930-2276

NOV 27 2017

**MEMORANDUM FOR:** The File

**FROM:** Julie Crocker Julie E. Crocker
Acting Assistant Regional Administrator for Protected Resources

**SUBJECT:** Characteristics and process for when strandings should be considered hopper dredge takes

Sea turtles are occasionally taken in hopper dredging activities. Observers are typically placed on hopper dredges to monitor the intake for turtles or turtle parts. Turtles that interact with hopper dredges often have the same characteristics. Sometimes, strandings are found with injuries that are consistent with those seen by observers onboard hopper dredges. Such strandings can involve dead turtles washed up on the beach, found in the dredge material or pipeline, or found floating in nearshore waters. In the Greater Atlantic Region, most of the sea turtle/hopper dredge interactions have occurred in Virginia. The Incidental Take Statement (ITS) of the 2012 Biological Opinion on the maintenance of Chesapeake Bay Entrance Channels notes that "...should we receive any reports of injured or killed sea turtles or sturgeon in the area (i.e., via the STSSN [Sea Turtle Stranding and Salvage Network]) and necropsy documents that interactions with the hopper dredge operating during this project was the cause of death, we will consider those animals to be taken by this action." As such, it is important to explore the characteristics of hopper dredge interactions in order to determine when a dredge can be positively identified as the cause of death in a stranding. This information is critical for monitoring sea turtle takes against the authorized takes contained in the ITS of a Biological Opinion.

The characteristics outlined below have been observed in sea turtle interactions with hopper dredges; however, not every dredge interaction shows all of these characteristics. The Virginia Aquarium and Marine Science Center previously explored this issue to determine whether trauma in stranded turtles is consistent with observed dredge takes (Trapani *et al.* 2008). We referred to this information in the development of these criteria. The 2012 Chesapeake Bay dredging Biological Opinion notes that a necropsy is needed to document dredging as the cause of death. We will share these criteria with the appropriate STSSN partner and work with them to ensure necropsies are conducted, whenever possible, on strandings that exhibit potential dredge-related injuries (as outlined below). A necropsy isn't necessarily required to determine a stranding was related to dredge activity (through the process outlined below); however, a necropsy may be needed to attribute the take towards the ITS in some Biological Opinions (e.g., Chesapeake Bay dredging). These criteria will apply to all areas where suspect dredge strandings are found, not only in Virginia.

## Characteristics

### Injury type

To assign take of a turtle with an unknown cause of death to a dredge ITS, the turtle must exhibit injuries inconsistent with another mortality source (e.g., no ligature injuries or serial parallel wounds as would be seen in fishery interactions or vessel strikes, respectively). The types of injuries occurring from hopper dredge interactions may include:

- Crushing wounds/injuries;
- Partial carapace or body part[1];
- Jagged edges to injury;
- Internal organs completely or partially missing or displaced;
- Excoriated skin injuries; or
- Peeling or missing scutes, not related to decomposition, around injury area.

### Other characteristics

- Heavy inundation of the body cavity, organs, and/or tissue (especially open wounds) by mud, silt, or other sediment; or
- Hopper dredging occurring in the area within the last one to two weeks.

  When evaluating whether a stranding would be attributable to a dredging ITS, all possible mortality sources will be considered. Any mortality source that may result in characteristics similar to those outlined here will be reviewed. Current and past hopper dredging activity and location (within two states of the stranding location) will be documented and environmental conditions (e.g., currents, wind patterns) will be evaluated to determine if a stranding in a certain location may be related to local dredge activity. The condition of the stranding in relation to the location of the dredging activity will also be considered.

## Process

When a stranding is documented with one or more of the injury characteristics noted above, the following steps will occur in order to ascertain whether the dredge was the cause of turtle death.

- STSSN responder will fill out the STSSN form and note on the top of the form that the case is a suspect dredge interaction.
- STSSN responder will perform a necropsy, if possible.
- The STSSN form and any necropsy results will be forwarded to the GARFO STSSN coordinator within three working days.
- A team of three GARFO Protected Resources Division biologists[2] will review the case, considering the characteristics presented in this memo, as well as the STSSN data. If a necropsy was not completed, the team will review all relevant information available, as the completion of a necropsy should not preclude a determination.
- The team will discuss the case and make a consensus determination as to whether the stranding represents a dredge take and should be counted towards an ITS. The relevant ITS will also be identified.

---

[1] A partial carapace or body part may also be seen with vessel strikes, so this injury descriptor would need to be evaluated in conjunction with the other injury types.

[2] The team will include two sea turtle biologists and one section 7 biologist. While staff may change, the team currently includes Zach Jylkka, Kate Sampson, and Carrie Upite (lead).

- A memo from the team lead to the GARFO Assistant Regional Administrator for Protected Resources will be prepared with the team's rationale.
- GARFO section 7 staff will inform and distribute the associated rationale to the lead action agency (typically the Army Corps of Engineers).
- If determined to be a dredge take, the interaction will be included in the respective incidental take reporting logs.

**Literature Cited**

Trapani, C.M., D.D. Boyd and P.D. Bargo. 2008. Sea Turtle/Dredge Interactions in Virginia, USA: A Diagnostic View of Observed Takes vs. Strandings. Page 131 in: Kalb, H., Rohde, A., Gayheart, K. and Shanker, K., compilers. Proceedings of the Twenty-Fifth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-582. 204 pp.

# Attachment 5 – Operations and Dredging Endangered Species System (ODESS) Guidance

# Operations and Dredging Endangered Species System (ODESS)
# Guidance

***This guidance should be incorporated into Section 01 57 20, “Environmental Protection,” of the dredging specification based on the specific contract requirements and the discretion of USACE personnel. It is designed for both the dredging Contractor and the Endangered Species Observers responsible for monitoring the potential presence of sea turtles, sturgeon, and large whales.***

## MONITORING ENDANGERED SPECIES

Maintenance of US waterways for navigation is essential for national and international trade, job creation, and national security as well as for hydropower, flood protection, municipal water supply, agricultural irrigation, recreation, and regional development.

Typically, cutterhead pipeline, hopper, and mechanical dredges are used to maintain navigation depths in these channels and to construct new waterways. However, hopper dredging in the southeastern US potentially impacts five species of threatened or endangered sea turtles (Kemp’s ridley, leatherback, loggerhead, green, hawksbill) and three species of sturgeon (shortnose, gulf, and atlantic).

To monitor these impacts and assist in the evaluation of these data, the US Army Corps of Engineers (USACE) Engineer Research and Development Center (ERDC) created the Sea Turtle Data Warehouse (STDW) in 1992. The database was designed as a central repository for current and historical data on impacted sea turtles.

In 2014 the US Army Corps of Engineers, National Dredging Quality Management Program (DQM), at the request of USACE Headquarters (HQUSACE), partnered with ERDC; the US Army Corps of Engineers, Mobile District, Spatial Data Branch (CESAM-OP-J) and Bowhead to develop a new and enhanced STDW database and website. This new Program is referred to as the Operations & Dredging Endangered Species System (ODESS) Program. The use of ODESS will facilitate enhanced monitoring and data collection, enable faster transmittal of information, and meet threatened and endangered species reporting requirements to the National Marine Fisheries Service (NMFS).

In order to monitor dredging impacts on threatened and endangered aquatic species, the dredge shall be equipped with a dedicated tablet computer running ODESS software to track and document the presence of sea turtle, sturgeon, and marine mammal species during dredging operations.

The ODESS system, which consists of a tablet computer with an Internet connection, shall be a standalone system, exclusive to other systems, and shall have USACE ODESS data collection and reporting software, referred to as the ODESS Field Collector (FC) tool, installed by USACE ODESS support personnel. In the event hardware or software problems prevent the storage or transmission of the collected data, paper copies of the latest ODESS forms and information shall be maintained and submitted to ODESS Support and the USACE Inspector or Contracting Officer according to the schedule outlined in the contract specifications.

## OBSERVER QUALIFICATIONS AND TRAINING

Prior to the initiation of the project, Observers shall be familiar with the operation of the ODESS FC tool and proficient in its use so as to be able to prepare and transmit the results of their observations. ODESS system webinar training can be requested by contacting ODESS Support at ODESS@usace.army.mil or 1.877.840.8024.

Depending on the target audience (Observer, dredging Contractor, USACE District personnel, or other Federal agencies), ODESS training could, in addition to the webinar training, consist of demonstrating the steps involved in setting up the FC tool on the dredge, loading Observer-collected data and attachments into the FC tool, submitting these data and attachments to the ODESS database, and/or navigating around the ODESS public website to view and pull down data and/or decision-making information for later analysis.

## OBSERVER DATA COLLECTION AND REPORTING

Observers shall record the results of the threatened and endangered species monitoring (described in Section 3.1.5.1, “Endangered Species Protection” of Section 01 57 20, “Environmental Protection,” of this specification) in the ODESS system by filling in the appropriate electronic forms on the ODESS FC tool and transmitting the data to the ODESS database. If there is an issue with recording data straight to the FC tool due the logistical nature of how the Observer is collecting this data, paper copies of these forms can be downloaded from the ODESS public website (http://dqm.usace.army.mil/odess/#/download) and later entered into the FC tool when the Observer has the best opportunity.

### *Start of the Project*

Prior to the start of dredging, Observers shall verify that the ODESS FC tool is installed and operational on a dredge’s dedicated tablet computer and that a viable Internet connection is available. In addition, before a project is initiated, on the ODESS FC tool homepage Observers shall retrieve (or “pull down”) project-specific information from the ODESS database and perform a one-time setup of the dredging project by establishing the dredge name and time zone.

## *During the Project*

The following forms shall be used in the FC tool and submitted to the ODESS database at the indicated reporting frequency.

### Load Data Form

Observers shall complete the Load Data Form, including a description of screen contents and sea conditions, based on their observations. This form shall be completed and transmitted to the ODESS database for each load. At the end of each Observer shift, or when an Internet signal is available (not to exceed 24 hours from the start of the shift), the Observer shall submit all of his/her Load Data Forms. If this is not possible due to hardware or software problems, the Observer shall revert to email submission of the forms to ODESS@usace.army.mil.

### Sea Turtle Incidental Data Form

If a sea turtle or its remains are identified during a load inspection, after the appropriate parties are notified (according to the requirements identified in the endangered species compliance section of the contract specification), a Sea Turtle Incidental Data Form shall be completed and submitted to the ODESS database as soon as possible (not to exceed 12 hours after the incident). Any applicable documentation (scanned copies of the paper Observer load and incident forms, species photos, etc.) shall be included as electronic attachments (.JPG or .PDF) and submitted using the FC tool.

### Sturgeon Incidental Data Form

If a sturgeon or sturgeon parts are identified during a load, after the appropriate parties are notified (according to the requirements identified in the endangered species compliance section of the contract specification), a Sturgeon Incidental Data Form shall be completed and submitted to the ODESS database as soon as possible (not to exceed 12 hours after the incident). Any applicable documentation (scanned copies of the paper Observer load and incident forms, species photos, etc.) shall be included as electronic attachments (.JPG or .PDF) and submitted using the FC tool.

### Marine Mammal Observation Data Form

If a large whale is observed, both the Dredge Load and the Marine Mammal Observation Data Forms shall be completed and submitted (not to exceed 12 hours after the observation) to ODESS Support at ODESS@usace.army.mil consistent with the endangered species compliance section of the contract specification (Section 3.1.5.1, “Endangered Species Protection” of Section 01 57 20, “Environmental Protection”).

***Observers are required to use the FC tool to send all incident attachments and any necessary documentation (i.e., pictures, etc). Do not send attachments via personal email unless the FC tool is unavailable. Also, the paper forms, if needed, should be used as either a “scratch pad” for data collection notes or used any time the FC tool becomes unavailable. The FC tool is the **primary** means of observer data collection and reporting **not** the paper forms. It is not required to scan, attach and submit a copy of the load and incident paper forms as part of the electronic incident record unless it is needed to support the electronic incident record (e.g., species diagram markups).***

### *End of the Project*

At the completion of project, the dredging Contractor shall coordinate with a designated USACE district QA/QC point of contact (POC) to determine whether electronic or paper copies of all applicable Observer paper forms will be submitted for the project. Information previously entered on the Post Hopper Dredging Checklist will be available on the ODESS public website (http://dqm.usace.army.mil/odess) for the dredging project.

## HARDWARE REQUIREMENTS

The dredge shall be equipped and the Contractor is responsible for an ODESS hardware system consisting of a tablet computer, wireless keyboard, wireless mouse and data modem (or equivalent onboard internet connection) along with a proper tote bag and setup location for the afore mentioned hardware components. If a hardware problem occurs, or if a part of the system is physically damaged, the Contractor shall be responsible for repairing it within 48 hours of determination of the condition. The Contractor shall also keep ODESS personnel updated on the status of the onboard ODESS system and the progress of any repairs.

### *Computer*

The Contractor shall provide a dedicated onboard tablet computer for use by the observers and shall have ODESS software installed on it prior to project initiation. This computer shall be located and oriented to allow data entry and data viewing. It must meet or exceed the following specifications:

| Tablet Hardware Component | Specification |
|---|---|
| **CPU** | Intel or AMD processor with a (non-overclocked) clock speed of at least 2.4 gigahertz (GHz) |
| **Hard Disk** | 128 gigabytes (GB); solid state internal storage |
| **RAM** | 4 gigabytes (GB) |
| **Network Adapter** | Internal wired or wireless network hardware to match internet connection |
| **Video Adapter** | Support for 1024x768 resolution at 16-bit color depth |
| **Display** | >= 10.8 in. |
| **Integrated Camera** | 2MP HD webcam (front); 8MP (back) |
| **Ports** | 1 free USB port |

### *Internet Access*

The Contractor shall maintain an Internet connection capable of transmitting data to the ODESS database. The telemetry system shall always be available and have connectivity in the contract area. If connectivity is lost, unsent data shall be stored locally within the FC tool and transmitted upon restoration of connectivity. The Contractor shall acquire and install all necessary hardware and software to make the Internet connection available for data

transmission to the ODESS database. The hardware and software must be configured to allow remote access to the computer by USACE ODESS personnel. Coordination between the dredging company's IT and ODESS Support may be required in order to configure remote access though any security, firewall, router, and telemetry systems. Telemetry systems must be capable of meeting these minimum reporting requirements in all operating conditions.

## SOFTWARE REQUIREMENTS

ODESS personnel shall be responsible for installing and testing all ODESS software tools on the dedicated onboard ODESS tablet computer. No other software which conflicts with the ODESS function of recording and transmitting data shall be installed on the tablet computer. The Contractor shall be responsible for installing and/or maintaining any necessary manufacturer-provided software for the installed hardware. If any software problem occurs, the Contractor shall contact ODESS Support at ODESS@usace.army.mil or 1.877.840.8024.

The ODESS tablet computer shall have the following minimum software installed in support of the ODESS system.

| **Software Component** | **Specification** |
|---|---|
| **Operating System** | Windows 10, Contractor-installed |
| **Browser**** | Chrome, Internet Explorer, Contractor-installed |
| **ODESS Software** | Field Collector (FC) tool, USACE ODESS Support-installed |
| **Remote Access Software** | Team Viewer, USACE ODESS Support-installed |
| **Latest version recommended, Chrome is preferred. | |

# Operations & Dredging Endangered Species System (ODESS)

## Dredge Load

US Army Corps of Engineers®

District

Project

Contract

Dredge

Dredging Company

Load Number (*Required*)/Date

Start Date (*Required*)

Start Time (*24 hours*) (*Required*)

Stop Date (*Required*)

Stop Time (*24 hours*) (*Required*)

Port Screen Condition
- ☐ Excellent
- ☐ Good
- ☐ Fair
- ☐ Bad

Starboard Screen Condition
- ☐ Excellent
- ☐ Good
- ☐ Fair
- ☐ Bad

Overflow Screen Condition
- ☐ Excellent
- ☐ Good
- ☐ Fair
- ☐ Bad

Inflow Screen Percent
- ☐ 25%
- ☐ 50%
- ☐ 75%
- ☐ 100%

Overflow Screen Percent
- ☐ 25%
- ☐ 50%
- ☐ 75%
- ☐ 100%

Other Screen Percent
- ☐ 25%
- ☐ 50%
- ☐ 75%
- ☐ 100%

# Dragheads Used

Draghead Length (*ft*)

Draghead Width (*ft*)

Draghead Type
- ☐ California Style
- ☐ IHC
- ☐ IHC + Water Injection
- ☐ Wild Dragon
- ☐ Other (Specify)

Deflector Condition
- ☐ Good
- ☐ Fair
- ☐ Poor
- ☐ None

UXO Screening in Use?
- ☐ Yes
- ☐ No

Material Type
- ☐ Clay
- ☐ Consolidated Material
- ☐ Mud
- ☐ Other
- ☐ Rock
- ☐ Sand - Course
- ☐ Sand - Fine
- ☐ Sand - Medium
- ☐ Sand - Mixed
- ☐ Shell
- ☐ Silt
- ☐ Unknown

Weather Conditions
- ☐ Sunny
- ☐ Cloudy
- ☐ Partly Cloudy

Beaufort Sea Scale
- ☐ 0 (0-1 kn, 0-0 ft)
- ☐ 1 (1-3 kn, 0-1 ft)
- ☐ 2 (4-6 kn, 1-2 ft)
- ☐ 3 (6-10 kn, 2-3.5 ft)
- ☐ 4 (10-16 kn, 3.5-6 ft)
- ☐ 5 (16-21 kn, 6-9 ft)
- ☐ 6 (21-27 kn, 9-13 ft)
- ☐ 7 (27-33 kn, 13-19 ft)
- ☐ 8 (33-40 kn, 19-25 ft)
- ☐ 9 (40-47 kn, 25-32 ft)
- ☐ 10 (47-55 kn, 32-41 ft)
- ☐ 11 (55-63 kn, 41-52 ft)
- ☐ 12 (>63 kn, >52 ft)

Wave Height (*ft*)

Wind Speed (*K*)

Wind Direction (°)

Tide
- ☐ High
- ☐ Low
- ☐ Slack
- ☐ Rising
- ☐ Falling
- ☐ Unknown

Air Temp (℃)

Surface Water Temp (℃)

Mid-Depth Water Temp (℃)

Bottom Water Temp (℃)

Trawling Being Conducted?
- ☐ Yes
- ☐ No

Any Incidents Involving Endangered or Protected Species?
- ☐ Yes
- ☐ No

If Yes, Which Species? (*Complete a Turtle or Sturgeon Incident form*)
- ☐ Marine Mammal
- ☐ Sea Turtle
- ☐ Sturgeon
- ☐ Other
- ☐ Unknown

Whale Sighting Notification Received?
- ☐ Yes
- ☐ No

Alert Sent to District?
- ☐ Yes
- ☐ No

Screen Contents

1 Port Screen Contents (*incl. # of each item*)

2 Starboard Screen Contents (*incl. # of each item*)

3 Overflow Screens Contents (*incl. # of each item*)

4 Other Screen or Location (*Specify*) Contents (*incl. # of each item*)

5 Port Draghead Contents (*incl. # of each item*)

6 Starboard Draghead Contents (*incl. # of each item*)

Comments

# Observers Used/24 Hours

% Monitoring/Project
- ☐ None
- ☐ 25%
- ☐ 50%
- ☐ 75%
- ☐ 100%

Observer(s) Name(s) (*Req; Print*)

Observer(s) Signature(s)

Observer(s) Company

**Notes**:
- Screen Contents—Examples include sea turtle (sp.), sturgeon (sp.), shark (sp.), ray (sp.), other fish of note (sp.), horseshoe crab, blue crab, other crab species, coral, jellyballs, other species of note, environmental debris, and trash.

**ENDANGERED SPECIES OBSERVER PROGRAM**

# DAILY REPORT

**USACE DISTRICT:** _____

**PROJECT NAME:** _____ **DREDGE NAME:** _____

**Date:** _____ **Load #s:** _____ **Areas dredge worked:** _____

**Weather conditions:** _____

_____

**Beaufort Sea State:** 0 1 2 3 4 5 6 7 8 9 10 11 12

**AIR TEMP:** _____ $^{o}$ C/$^{o}$ F (ºF = 9/5 (ºC) + 32; ºC = 5/9 (ºF - 32))

**WATER TEMP: Surface** _____ $^{o}$ C /$^{o}$ F **Column (mid-depth)** _____ $^{o}$ C /$^{o}$ F **Bottom** _____ $^{o}$ C /$^{o}$ F

**Condition of deflector:**_____ **Condition of screening:** _____

**Bed lever in use? YES** ____ **NO** ____ **Unknown** ____

**Were there incidents involving endangered or protected species? YES** ____ **NO** ____

**Which species? (complete incident form(s))**_____

**Comments (type of material, biological specimens, unusual circumstances, etc):** _____

_____

_____

_____

_____

_____

_____

_____

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_____

_____

_____

_____

_____

## BRIDGE WATCH SUMMARY

| Time | Species | # Sightings/# Animals | Location/Comments |
|---|---|---|---|
| | | /_____ | |
| | | /_____ | |
| | | /_____ | |
| | | /_____ | |
| | | /_____ | |
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| | | /_____ | |
| | | /_____ | |
| | | /_____ | |
| | | /_____ | |
| | | /_____ | |

**Observer name** _____

**ENDANGERED SPECIES OBSERVER PROGRAM**

# WEEKLY SUMMARY

**USACE DISTRICT:** _____

**PROJECT NAME:** _____ **DREDGE NAME:** _____

**Dates:** _____ - _____ **Load #s:** _____

**Areas dredge worked:** _____

**Bed lever in use? YES ____ NO ____ Unknown ____ Dates:** _____

**Were there incidents involving endangered or protected species? YES ____ NO ____**

**Which species?** _____

**Comments:** _____

## BRIDGE WATCH SUMMARY

| Date/Time | Species | # Sightings/# Animals | Location/Comments |
|---|---|---|---|
| | | / | |
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| | | / | |

**Observer name** _____

# Operations & Dredging Endangered Species System (ODESS)

## Turtle Incident

US Army Corps of Engineers®

District

Project

Contract

Dredge

Dredging Company

Species (*Required*)
- ☐ Green
- ☐ Hawksbill
- ☐ Kemp's Ridley
- ☐ Leatherback
- ☐ Loggerhead
- ☐ Unknown

Load Number (*Required*)/Date

Is this a Take? (*Required*)
- ☐ Yes
- ☐ No

Project Incident # (*Required*)

Recovery Date (*Required*)

Recovery Time (*24 hours*) (*Required*)

Incident/Take Description

Air Temp (℃)

Surface Water Temperature (℃)

Mid-Depth Water Temperature (℃)

Bottom Water Temperature (℃)

Location Specimen Recovered
- ☐ Deck
- ☐ Draghead
- ☐ Inflow Cage (*Circle one*) Starboard/Port/Other
- ☐ Hopper
- ☐ Overflow Screen (*Circle one*) Starboard/Port/Other
- ☐ Pipe

Location Comment

Age Class
- ☐ Juvenile (*10.1-80 cm*)
- ☐ Sub-Adult (*80.1-87 cm*)
- ☐ Adult (*>87 cm*)
- ☐ Unknown

Gender
- ☐ Female
- ☐ Male
- ☐ Unknown

Specimen Condition
- ☐ Alive
- ☐ Dead
- ☐ Fresh Dead
- ☐ Moderately Decomposed
- ☐ Severely Decomposed
- ☐ Skeleton
- ☐ Skeleton Old Bone
- ☐ Undetermined

Tag Type
- ☐ Flipper
- ☐ Pit
- ☐ Other (*Specify*)

Head Width (*cm/in*)

How Gender Determined
- ☐ Tail Length
- ☐ Eggs Observed
- ☐ Other

Photo Attached? (*If Yes, label the species, date, geographic site, and dredge name on the photo*)
- ☐ Yes
- ☐ No

Tag Number

Plastron Length (*cm/in*)

Carapace Straight Length (*cm/in*)

Carapace Curved Length (*cm/in*)

Tag Date

Plastron Width (*cm/in*)

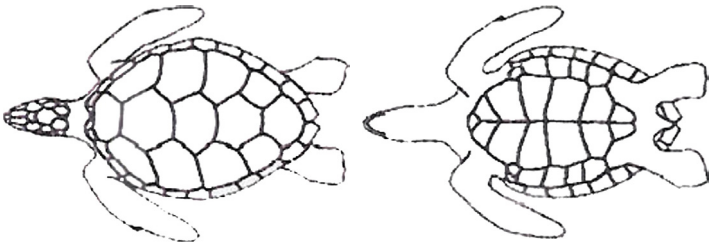
Carapace Straight Width (*cm/in*)

Carapace Curved Width (*cm/in*)

Genetic Samples Taken?
- ☐ Yes
- ☐ No

Final Disposition of Specimen

Use these diagrams to illustrate the specimen/part that was recovered.



Comments

Observer(s) Name(s) (*Required; Print*)

Observer(s) Signature(s)

Observer(s) Company

# Operations & Dredging Endangered Species System (ODESS)

## Sturgeon Incident

US Army Corps of Engineers®

District

Project

Contract

Dredge

Dredging Company

Species (*Required*)
- ☐ Atlantic
- ☐ Gulf
- ☐ Unknown
- ☐ Green
- ☐ Shortnose

Load Number (*Required*)/Date

Recovery Date (*Required*)

Recovery Time (*24 hours*) (*Required*)

Is this a Take? (*Required*)
- ☐ Yes
- ☐ No

Incident/Take Description

Location Specimen Recovered
- ☐ Deck
- ☐ Draghead
- ☐ Inflow Cage (*Circle one*) Starboard/Port/Other
- ☐ Hopper
- ☐ Overflow Screen (*Circle one*) Starboard/Port/Other
- ☐ Pipe

Specimen Condition
- ☐ Alive
- ☐ Dead
- ☐ Fresh Dead
- ☐ Moderately Decomposed
- ☐ Severely Decomposed
- ☐ Skeleton
- ☐ Skeleton Old Bone
- ☐ Undetermined

Rows of Preanal Shields (*SSN = 1/ATL = 2*)

Location Comment

# Dorsal Scutes (*SSN = 8-13/ATL = 7-16*)

# Lateral Scutes (*SSN = 22-33/ATL = 24-35*)

# Ventral Scutes (*SSN = 7-11/ATL = 6-9*)

Fork Length (*cm/in*)

Standard Length (*cm/in*)

Total Length (*cm/in*)

Mouth Width (*cm/in*)

Head Width at Eyes (*cm/in*)

Other (*cm/in*)

Genetic Samples Taken?
- ☐ Yes
- ☐ No

Samples Frozen/Preserved?
- ☐ Yes
- ☐ No

Photo Attached?
(*If Yes, label the species, date, geographic site, and dredge name on the photo*)
- ☐ Yes
- ☐ No

Comments

Use these diagrams to illustrate the specimen/part that was recovered.

Observer(s) Name(s) (*Required; Print*)

Observer(s) Signature(s)

Observer(s) Company

# Operations & Dredging Endangered Species System (ODESS)

## Marine Mammal Observation

US Army Corps of Engineers®

District

Project

Contract

Dredge

Dredging Company

Load Number (*Required*)/Date

Start Date (*Required*)

Start Time (*24 hours*) (*Required*)

End Date (*Required*)

End Time (*24 hours*) (*Required*)

Beaufort Sea State

- ☐ 0 (0-1 kn, 0-0 ft)
- ☐ 1 (1-3 kn, 0-1 ft)
- ☐ 2 (4-6 kn, 1-2 ft)
- ☐ 3 (6-10 kn, 2-3.5 ft)
- ☐ 4 (10-16 kn, 3.5-6 ft)
- ☐ 5 (16-21 kn, 6-9 ft)
- ☐ 6 (21-27 kn, 9-13 ft)
- ☐ 7 (27-33 kn, 13-19 ft)
- ☐ 8 (33-40 kn, 19-25 ft)
- ☐ 9 (40-47 kn, 25-32 ft)
- ☐ 10 (47-55 kn, 32-41 ft)
- ☐ 11 (55-63 kn, 41-52 ft)
- ☐ 12 (>63 kn, >52 ft)

Species Observed (*Required*)

- ☐ Bryde's/Sei Whale #____ Est. Length (*ft.*) ____
- ☐ Fin Whale #____ Est. Length (*ft.*) ____
- ☐ Humpback Whale #____ Est. Length (*ft.*) ____
- ☐ Manatee #____ Est. Length (*ft.*) ____
- ☐ Minke Whale #____ Est. Length (*ft.*) ____
- ☐ Pilot Whale #____ Est. Length (*ft.*) ____
- ☐ Right Whale #____ Est. Length (*ft.*) ____
- ☐ Unknown #____ Est. Length (*ft.*) ____

Air Temp (℃)

Water Temp (℃)

Winds (*K*)

Seas (*ft*)

Cloud Cover (%)

Magnetic Bearing to Sighting

Estimated Distance

Vessel's Heading

Heading of Animal(s)

Coloration

Fins or Flippers Observed

Behaviors Observed

Surfacing Intervals Time

Surfacing Intervals Distance

Comments (*Was the behavior of the animal(s) affected by the vessel? How far did the animal(s) move? Who was notified?*)

Observer(s) Name(s) (*Required; Print*)

Observer(s) Signature(s)

Observer(s) Company

# Operations & Dredging Endangered Species System (ODESS)

## Trawling Report

US Army Corps of Engineers®

Date_____ Dredge Site_____ Dredge _____

Trawler _____ Biologist(s) _____ Captain _____

Tide (Time/High or Low) _____ Hrs ☐ H ☐ L _____ Hrs ☐ H ☐ L _____ Hrs ☐ H ☐ L _____ Hrs ☐ H ☐ L

Water Temperature (°C) _____ Air Temperature (°C) _____ Wind Speed/Direction _____ Wave Height _____

Bottom Type _____ Station #s _____

| Tow # | Start Time | Start Lat/Long dd mm.mm | Stop Time | Stop Lat/Long dd mm.mm | Tide: Ebb/Flood | Water Depth | Vessel Heading/Speed | Turtles? Sturgeon? Species? | By-catch/Comments (Change in Weather/Water Temperature, Net Damage, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
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# Operations & Dredging Endangered Species System (ODESS)

US Army Corps of Engineers®

## Relocation Trawl Daily Report

Project Name: _____

Trawler Name: _____

Trawling for Dredge(s): _____

---

Date (*mm*/dd/*yyyy*): _____ Tow Numbers: _____ Total Tows: _____

Project Captures: _____ By Species: Cc _____ Lk _____ Cm _____ Dc _____

Start Time First Tow (*24 hrs*): _____ End Time Last Tow (*24 hrs*): _____

---

Ops Area: _____

Ops Borrow Area Designation

Ops Area Lat/Long (Shoreward): N _____ ° _____ . _____ BA - _____

W _____ ° _____ . _____

Ops Area Lat/Long (Seaward): N _____ ° _____ . _____ BA - _____

W _____ ° _____ . _____

---

Beaufort Sea State: 0 1 2 3 4 5 6 7 Air Temperature: _____ °C/°F

Wind Direction: _____ Wind Speed: _____ Wave Height: _____

Water Temperature (*1 fathom*): _____°C/°F Bottom Type: _____

---

ENDANGERED SPECIES CAPTURED, Total for the Day: _____

Species: _____ Tow #: _____ End Time: _____

Species: _____ Tow #: _____ End Time: _____

Species: _____ Tow #: _____ End Time: _____

General Release Location Lat/Long: N _____ ° _____. _____

W _____ ° _____. _____

---

Bycatch and Other Comments (including dredge presence/absence from the job site:

_____

_____

_____

_____

_____

Biologist: _____

# Operations & Dredging Endangered Species System (ODESS)

## Sea Turtle Tagging Report

Turtle # _____

US Army Corps of Engineers®

Channel: _____ Date: _____ Vessel: _____

Tow #: _____ Time: _____ Net: ☐ Port ☐ Starboard

Species: _____ Sex: ☐ Male ☐ Female ☐ Unknown

**Capture Information**

Capture Location: Channel: _____ State: _____

Lat: _____ Long: _____

Capture Method: _____

**Flipper Tag Information**

Left: _____ Right: _____

PIT Tag #: _____ PIT Tag Sticker: _____

**Species Information**

Straight Carapace Length: SCLmin: _____ SCLn-t: _____ SCLt-t: _____

Straight Carapace Width: _____

Curved Carapace Length: CCLmin: _____ CCLn-t: _____ CCLt-t: _____

Curved Carapace Width: _____

Condition of Specimen: _____

**Miscellaneous**

Biospy Taken: ☐ Yes ☐ No Location: _____

Photos: ☐ Yes ☐ No Frame #s _____ Camera: ☐ Digital ☐ Film ☐ Video

Tag Scars: ☐ Yes ☐ No Magnetic Wires: ☐ Yes ☐ No Living Tag (Kemps Only): ☐ Yes ☐ No

Recapture: ☐ Yes ☐ No This Project: ☐ Yes ☐ No Non-ECO Project: ☐ Yes ☐ No

Organization Tagging: _____

Biologist(s): _____

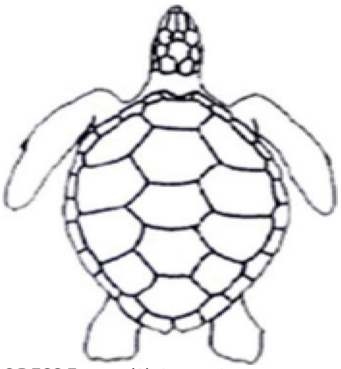
**Turtle Release Information**

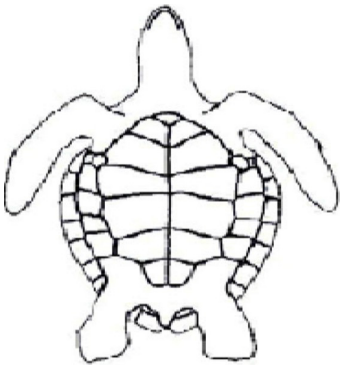
Date: _____ Time: _____

Lat: _____ Long: _____

Location: _____

**Remarks**: Note injuries, gear or debris entanglement, wounds or mutations, propeller damage, papillomas, tag locations/tag scar locations, etc. Shade missing portions.





# Operations & Dredging Endangered Species System (ODESS)

## Sturgeon Capture & Relocation Data Form

US Army Corps of Engineers®

**Date** _____

Project Name: _____ USACE District: _____
Trawler Name: _____ Biologist: _____
Captain(s): _____ Trawling for Dredge: _____

**Weather Conditions**

$H_2O$ Temperature: _____ °C Tide/Time: _____ ☐ High ☐ Low Tide/Time: _____ ☐ High ☐ Low
Air Temperature: _____ Wind Speed/Direction: _____ Wave Height: _____ Bottom Type: _____
Beaufort Sea State: 0 1 2 3 4 5 6 7 8 9 10 11 12

**Tow Information**

Tow #: _____ Time (24 hrs)/Start: _____ Time (24 hrs)/End: _____
Tow Start/Latitude: _____ Tow Start/Longitude: _____
Tow End/Latitude: _____ Tow End/Longitude: _____
Nets: ☐ Port ☐ Starboard Bib Nets: ☐ Yes ☐ No Rollers: ☐ Yes ☐ No

**Species Information**

Species: ☐ Atlantic ☐ Shortnose ☐ Gulf
Condition: _____ Project Capture #: _____
Measurements:
Total Length: _____ cm Fork Length: _____ cm
Mouth Width (inside lips): _____ cm Interorbital Width: _____ cm

**Miscellaneous Information**

Genetic Sample Taken: ☐ Yes ☐ No Photos Taken: ☐ Yes ☐ No
Scars Present: _____

**Tag Information**

Previously Tagged: ☐ Yes ☐ No Pit Tag Scan: ☐ Yes ☐ No
Previous Tag ID: PIT _____ Tags Applied ID: PIT _____

**Release Information**

Condition: _____
Time: _____ Latitude: _____ Longitude: _____

**Comments**

_____
_____
_____
_____
_____

Trawl Supervisor: _____

# Operations and Dredging Endangered Species System (ODESS)
# USACE Sea Turtle Deflector Checklist for Hopper Dredges for USACE and USACE/Army-Permitted Projects

1. Read the contract plans and specs and/or all applicable permits (Dept. of the Army Permit, State Permits) to determine the contract or permit requirements for the protection of endangered sea turtles. (Each District spec or permit may be different.)

2. Read the Biological Opinion and any USACE Protocol, if available.

3. Develop a list of inspection requirements:

   a. Deflector leading edge angle (90° or less).

   b. Approach angle or leading edge plowing depth (6" or more).

   c. Aft rigid attachment of the deflector to the draghead (hinged or trunnion).

   d. Forward deflector attachment point (adjustable pinned or cable/chain with stop).

   e. Opening between draghead and deflector (4" x 4" max).

   f. Dredged material screening requirement (yes/no).

   g. Screen type requirement (inflow, overflow, or both).

   h. Inflow basket screen openings (4" x 4" max) and dredged material screening (100%).

   i. Lighting of the inflow and overflow screens and proper access for cleaning (must meet EM 385-1-1).

   j. UXO (Unexploded Ordnance) screening in use (yes/no).

   k. Structural design of the deflector (per the approved deflector submittal).

   l. Dredge operational requirements (starting/stopping the dredge pump, draghead plugging, raising the draghead, turning the dredge).

m. Dredging Quality Management (DQM) dredging data recording requirement. Is dredging data recording (drag elevation, slurry density, and velocity) required by specs or permit? If so, is it being collected, is DQM turned on, and is data being submitted?

n. Turtle trawling requirement. Is turtle trawling required by specs or permit? If so, is it being performed?

o. Turtle observer requirements (12 or 24 hours).

p. A copy of the approved turtle deflector submittal is on board the vessel.

q. Copies of the contract plans and specs or the Dept. of the Army permit are on board the vessel.

4. Review the turtle deflector submittal. (Do not allow dredging to start until the submittal is approved.)

   a. Structural soundness.

   b. Deflector leading edge angle (90° or less).

   c. Approach angles submitted for the project's dredging depths.

   d. 4" x 4" opening between the deflector and the draghead.

   e. Aft rigid deflector attachment to draghead (hinged or trunnion).

   f. Forward deflector attachment point (adjustable pinned or cable/chain with stop).

5. Ensure that the Contractor Quality Control (CQC) performs a pre-dredging inspection. The CQC is required to review and inspect all items in section 3.

6. Ensure that the CQC performs a startup-dredging inspection:

   a. The CQC is required to check the turtle deflector to see if the deflector is installed and adjusted for the required dredge depth of the project in accordance with the approved deflector submittal.

   b. The CQC is required to ensure that the drag tenders are operating the dredge pump and draghead in accordance with the specs/permit.

   c. The CQC should perform a paint test to ensure that the deflector is plowing at least 6" into the dredge material while the dragtender is consistently maintaining the submitted and approved approach angle to a tolerance of +0 to -4°.

   d. The CQC should note the inspection results in the Quality Control (QC) Daily Report.

7. Quality Assurance (QA) should perform a dredging operation inspection soon after the dredge starts dredging:

   a. Review and inspect all items in section 3.

b. Inspect the turtle deflector to ensure that the deflector is installed and adjusted for the required dredge depth of the project in accordance with the approved deflector submittal.

c. Require the contractor to perform a paint test to ensure that the deflector is plowing at least 6" into the dredge material while the dragtender is consistently maintaining the submitted and approved approach angle to a tolerance of +0 to -4°. (While over-penetration of the deflector may reduce production and increase fuel consumption of the dredge, it is allowed.)

d. Ride the dredge through at least one dredging cycle (from dredging to the dump and then back to the dredge site).

e. Watch the dragtender to ensure that he/she is operating the dredging equipment in accordance with the plans and specs:

   i Starting the dredge pump only when the draghead is firmly on the bottom by watching the slurry specific gravity and swell compensator.

   ii Reducing the slurry velocity to the dredge pump idle speed velocity before raising the draghead off the bottom.

   iii Consistently maintaining the approach angle to a tolerance of +0 to -4° whenever the draghead is on the bottom and the dredge pump is operating

   iv Raising the draghead off the bottom due to draghead plugging or ship crabbing.

f. Ensure that the lockout tagout procedure for cleaning the inflow and overflow screens meets EM 385-1-1.

g. Talk to the turtle observers to ensure that they are aware of contract and permit requirements and that they are inspecting the screens and deflectors and reporting any required maintenance to the dredge personnel. Also ensure that correct turtle observer forms are being used and filled out properly.

h. Talk to the dredge Captain about maintaining the screens and deflectors.

i. Ensure that DQM data is being sent to the National Dredging Quality Management Program.

j. Note all pre-dredge/post-dredge and followup inspections in the QA and the QC Daily Reports.

Project Name: _____

Project Location: _____

Contract No.: _____

Dept. of the Army Permit No.: _____

Dredging Company Name: _____

Dredge Name: _____

Contractor CQC Inspector's Name: _____

USACE Inspector Name: _____

Office Symbol: _____ Date of Inspection: _____

Comments: _____

# Take Report Form for ESA-Listed Species

**Use one form per individual animal taken**

**Biological Opinion PCTS No.**

**Species taken:**

- ☐ **Green sea turtle**
- ☐ **Kemp's ridley sea turtle**
- ☐ **Leatherback sea turtle**
- ☐ **Loggerhead sea turtle**
- ☐ **Unknown sea turtle**
- ☐ **Atlantic sturgeon**
- ☐ **Shortnose sturgeon**
- ☐ **Unknown sturgeon**
- ☐ **Atlantic salmon**

**Condition when taken (select one):**

☐ Alive ☐ Fresh Dead ☐ Moderately Decomposed

☐ Severely Decomposed ☐ Dried ☐ Skeletal

**Date take observed:**

**Animal was:**

- ☐ Released alive with no visible injuries
- ☐ Released alive with visible injuries
- ☐ Released dead
- ☐ Held for Necropsy
- ☐ Transferred to rehabilitation (sea turtles only)

Date: _____

Rehabilitation facility:

**SPECIES CONDITION KEY**

Fresh dead – no foul smell
Moderately decomposed – scutes and skin are intact or just beginning to peel, internal organs intact
Severely decomposed – foul smell with scutes lifting or gone, skin peeling, internal organs beginning to liquefy
Dried carcass – leathery, internal organs have decomposed
Skeletal remains - bones only

**Location of the take:**

Latitude and Longitude in Decimal Degrees to six places:

Latitude:

Longitude:

Sediment type in area (e.g., SAV, cobble, silt/mud, shellfish present):

**Body of water where take occurred:**

- ☐ Atlantic Ocean
- ☐ River (name): _____
- ☐ Bay or Sound (name): _____
- ☐ Creek (name): _____

**Take activity (select all that apply):**

- ☐ Pile Driving
- ☐ Bridge/Road Construction
- ☐ Dredging
- ☐ Beach Renourishment
- ☐ Vessel Operation
- ☐ Relocation trawling
- ☐ Blasting

**If dredging project:**

Type of dredge/name:

Load number:

Location on dredge mechanism where specimen was found (screen, hopper):

Was draghead deflector used: ☐ Yes ☐ No

Was rigid deflector used: ☐ Yes ☐ No

Condition of deflector:

Condition of screening or UXO screen:

**If construction project:**

Vessel or Rig Name: Exclusion Zone, if required:

If installing or extracting piles:

Tools: ☐ Impact Hammer

☐ Vibratory Hammer

☐ Other (specify) _____

If pile driving:

| Pile Type | Diameter | Number |
|---|---|---|
| | | |
| | | |

If using explosives:

| Type | Size | Number |
|---|---|---|
| | | |
| | | |

**Refer to your Biological Opinion for guidance on handling and resuscitating live animals**

**Indicate type and location of visible injuries (see diagrams). Check all that apply:**

| Type of Injury | Dorsal Surface | Ventral Surface - |
|---|---|---|
| Cuts/Gashes (not severed) | ☐ | ☐ |
| Severed body, limbs, or organs | ☐ | ☐ |

Describe injuries and list any missing body parts:

**For live animals - indicate behavior when taken:**

☐ Active (alert, moving head, fins or flippers)

☐ Slow and lethargic (minimal movement and responsiveness)

☐ No movement but may or may not respond to reflex test

**For dead animals, does the BiOp require necropsy:**

☐ Yes ☐ No

**Was resuscitation attempted:**

☐ Yes, length of time _____ hours Outcome: ☐ Alive ☐ Dead

☐ No ☐ N/A, animal confirmed dead, or alive and moving when taken

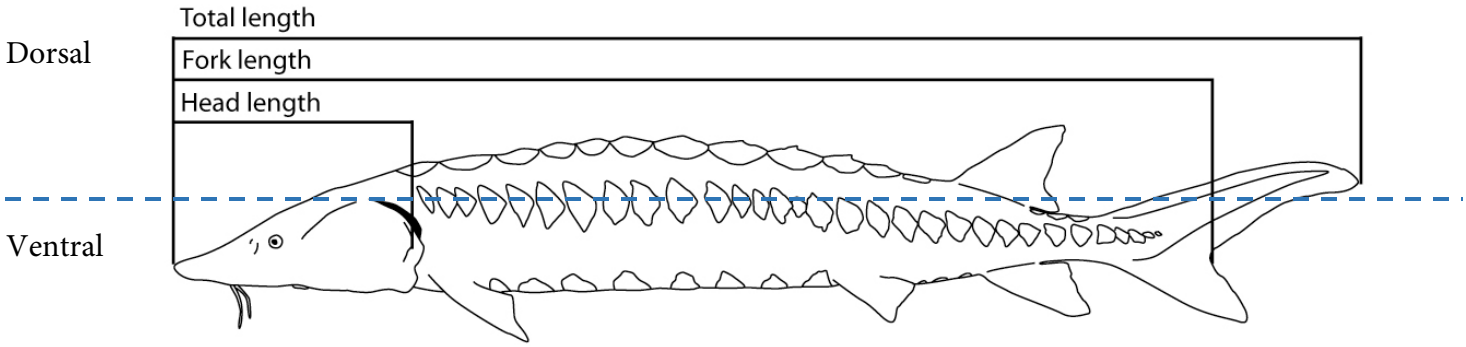
**Fish measurements in centimeters – measurements should be exact.**
**Provide the reason for any estimated measure (e.g., tail missing)**

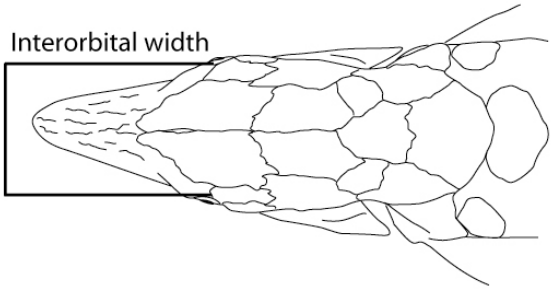
| | Exact | Estimated | Reason for Estimated Measure |
|---|---|---|---|
| Total Length: _____ cm | ☐ | ☐ | _____ |
| Fork Length: _____ cm | ☐ | ☐ | _____ |
| Mouth Width: _____ cm | ☐ | ☐ | _____ |
| Interorbital Width: _____ cm | ☐ | ☐ | _____ |

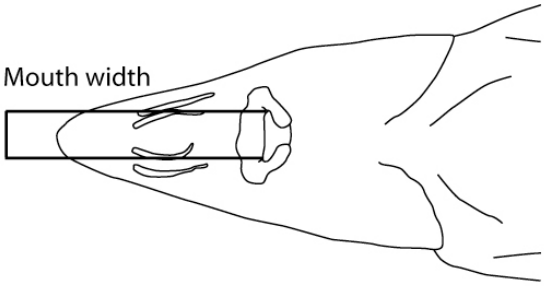
**Turtle measurements in centimeters – measurements should be exact.**
**Provide the reason for any estimated measure (e.g., shell crushed and flattened)**

| | Exact | Estimated | Reason for Estimated Measure |
|---|---|---|---|
| Curved Carapace Length: _____ cm (notch to tip length with measuring tape) | ☐ | ☐ | _____ |
| Straight Carapace Length: _____ cm (notch to tip length with calipers) | ☐ | ☐ | _____ |
| Straight Carapace Width: _____ cm (widest points with calipers) | ☐ | ☐ | _____ |
| Weight: _____ kg | ☐ | ☐ | _____ |

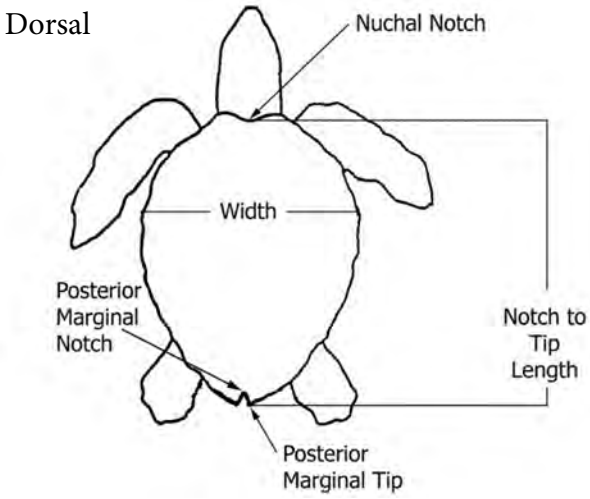
# Shortnose and Atlantic Sturgeon -

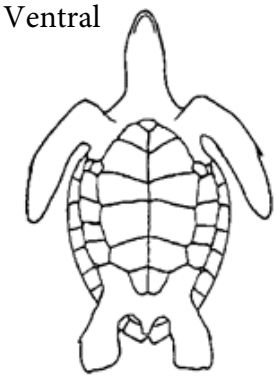



# Sea Turtles -



**Checklist for samples required to be collected and submitted per the BiOp's Standard Operating Procedures, RPMs, and T&Cs**

**Photographs and/or Video:** Submit with this form to **incidental.take@noaa.gov**

**Biopsy punch (sea turtles):** Current Disposition (person/affiliation):

**Fin Clip (fish):** Current Disposition (person/affiliation):

**Tags present[1]:**

| Type (e.g., PIT, flipper) | Number | Location on animal |
|---|---|---|
| | | |
| | | |
| | | |

**Tags inserted or applied[1]:**

| Type (e.g., PIT, flipper) | Number | Location on animal |
|---|---|---|
| | | |
| | | |
| | | |

**[1] For sturgeon, also send PIT tag #, date, location, and length to Mike_mangold@fws.gov.**

**Contact information for person completing this form**

Name:

Email:

Phone Number:

Agency/Organization name if other than the Federal Action Agency for the BiOp:

# External Sturgeon Take SOPs

You must follow the RPMs and T&Cs in your Biological Opinion for every take of a live or dead sturgeon. Within 24 hours of the take, you must send information and photos to incidental.take@noaa.gov. Follow the steps below and return live sturgeon to the water ASAP. Do not complete any step that is not required by the RPMs and T&Cs of your BiOp.

## STURGEON PRESUMED ALIVE BUT UNRESPONSIVE

Resuscitate the sturgeon if it is alive and unresponsive. Follow procedures for "LIVE" once it is responsive or, if the fish is unresponsive after 30 minutes of resuscitation, follow procedures for "DEAD".

## LIVE STURGEON

1. Check for any tags, including PIT tags, and record tag numbers.
2. PIT tag sturgeon if none present and if authorized by the BiOp.
3. Measure and photograph sturgeon.
4. Obtain fin clip sample (See BiOp T&Cs for details).
5. If authorized by the BiOp T&Cs, administer anesthesia and surgically implant internal tags.
6. Ensure the sturgeon is responsive and return it to the water as described in the BiOp.

## DEAD STURGEON

1. Check for any tags, including PIT tags, and record tag numbers.
2. Measure and photograph sturgeon.
3. Obtain fin clip sample.
4. Do the BiOp T&Cs require a necropsy?

**UNKNOWN**

Refrigerate sturgeon or put sturgeon on ice (do NOT freeze). Coordinate with Section 7 contact. Within 3 days, NMFS Section 7 contact will confirm whether a necropsy is required and, if yes, will send you (the Action Agency) the contact information for the pathology lab.

**YES**

Refrigerate sturgeon or put sturgeon on ice (do NOT freeze). Then, follow the Necropsy Plan in the BiOp.

**NO**

Freeze sturgeon for possible salvage. Within 7 days, NMFS Section 7 contact will: advise you to properly dispose of the carcass; OR notify you that a Salvage Network member will contact you for transport of the carcass or parts at their expense.

## Within 24 hours of the take:

- Send Take Report Form and photos to incidental.take@noaa.gov (one form per fish). See Section 7 website for form: https://www.greateratlantic.fisheries.noaa.gov/protected/section7/reporting.html
- Send PIT tag #, date, location, and length to mike_mangold@fws.gov.
- Store fin clips until designated time to send to USGS (see BiOp T&Cs for details).

Properly dispose of carcass if you do not receive a reply from the NMFS Section 7 contact within 3 days for refrigerated/iced carcasses or within 7 days for frozen carcasses.

**SEA TURTLE TAKE PROCEDURES**

**Action Agency should refer to BiOp and always follow the RPMs and T&Cs. If BiOp does not include one of these steps, then you are not covered under the BiOp to perform that step. Skip that step and move onto the next step. See BiOp for specific instructions.**

**START: Take Occurs**
**Is the sea turtle alive or dead?**

## ALIVE

Handle and, if needed, resuscitate turtle properly.

If resuscitation is needed and turtle does not respond after 24 hours, proceed to DEAD protocol.

Record measurements and photograph/video turtle, including injuries and behavior.

Is the turtle alert and visibly uninjured?

- YES, turtle is visibly uninjured
  - Check the turtle for tags. Is the turtle PIT or flipper tagged?
    - YES
      - Record tag numbers.
    - NO
  - Determine whether additional handling/sampling is required, depending on BiOp. Check with NMFS if unclear what is allowed.
    - YES
      - If authorized, obtain biopsy/genetic samples and apply PIT and/or flipper tags (if no tags present).
    - NO
  - Safely release turtle to water
  - Fill out Incidental Take Form (one per turtle). Submit form and photos to incidental.take@noaa.gov within 72 **hours** of take occurring.

    **END**
- NO, turtle is injured or inactive
  - Place turtle in resuscitation position if necessary.

    Call NMFS stranding hotline 866-755-NOAA, extension 0 to coordinate transport to rehabilitation. The **Action Agency** is responsible for paying for rehab.

    Be prepared to give the following details:
    (1) Project name and vessel name;
    (2) GPS coordinates for the location of the interaction (in decimal degrees);
    (3) type of interaction involved (e.g., bottom trawl, hopper dredge);
    (4) time and date of the interaction; (5) species identification and
    (6) description of injuries.
  - Fill out Incidental Take Form (one per turtle). Submit form and photos to incidental.take@noaa.gov within **72 hours** of take occurring.

    **END**

## DEAD

Within 12 hours of take occurring, notify NMFS by email - incidental.take@noaa.gov or calling stranding hotline 866-755-NOAA, extension 0.

Be prepared to give the following details:
(1) Project name and vessel name;
(2) GPS coordinates for the location of the interaction (in decimal degrees);
(3) type of interaction involved (e.g., bottom trawl, hopper dredge);
(4) time and date of the interaction; (5) species identification and
(6) description of injuries.

Record measurements and photograph turtle, including injuries.

Check the turtle for tags. Is the turtle PIT or flipper tagged?

- YES
  - Record tag numbers.
- NO
- Determine whether additional handling/sampling is required, depending on BiOp. Check with NMFS if unclear what is allowed.
  - YES
    - If authorized, obtain biopsy/genetic samples (Check BiOp for details)
  - NO
- Put turtle on ice (do NOT freeze)
- Within 72 hours, **NMFS** will make a determination and contact you if a necropsy is required.
  If no answer within 72 hours, spray paint and dispose of carcass.
  - Necropsy Required
    - Continue leaving turtle on ice (do NOT freeze). **NMFS** will send you the contact information for the **Stranding Responder**.

      The **Action Agency** is responsible for transporting the carcass and paying for the necropsy.
  - No Necropsy Required
    - Either **NMFS** will advise you to spray paint and discard the carcass, or a **Stranding Responder** will contact you and will arrange the transport of the carcass for salvage.

      The **Action Agency** is not responsible for transporting the carcass and paying for the necropsy.
- Fill out Incidental Take Form (one per turtle). Submit form and photos to incidental.take@noaa.gov within **72 hours** of take occurring.

  **END**

Updated 10/25/17

# Attachment 6 – Archeological Avoidance Areas

## Archaeological Avoidance Areas

| BORROW AREA A | | | | | | |
|---|---|---|---|---|---|---|
| Acoustic Target | Magnetic Anomaly | Amplitude (gammas) | Duration (feet) | Coordinates (Virginia State Plane South (feet) | | Avoidance Radius (min.) |
| | | | | X | Y | |
| SI * | | | | 12256940.7 | 3437605.9 | 500 ft. |
| | 2 | 3 | 463 | 12256709.6 | 3437606.9 | 200 ft. |
| | 3 | 5 | 453 | 12256819.1 | 3437554.5 | 200 ft. |
| | 4 | 272 | 546 | 12256918.1 | 3437626.7 | 200 ft. |
| | 5 | 26 | 619 | 12257008.2 | 3437637.3 | 200 ft. |
| | 6 | 2 | 300 | 12257096.2 | 3437689.5 | 200 ft. |
| | 8 | 28 | 495 | 12260717.0 | 3432643.4 | 200 ft . |
| | 9 | 4 | 252 | 12260634.5 | 3432591.8 | 200 ft. |
| | 10 | 14 | 443 | 12261395.0 | 3431380.2 | 200 ft. |
| | 12 | I I | 135 | 12263418.7 | 3434834.3 | 200 ft. |
| | 13 | 4 | 244 | 12263546.1 | 3434493.2 | 200 ft. |
| | 14 | 12 | 307 | 12263666.0 | 3434478.5 | 200 ft. |
| | 15 | 3 | 198 | 12263975.7 | 3434203.5 | 200 ft. |
| | 16 | 4 | 458 | 12264229.0 | 3431737.7 | 200 ft. |
| | 17 | 3 | 172 | 12264175.8 | 3431651.4 | 200 ft. |
| | 19 | 3 | 222 | 12266620.8 | 3431595.0 | 200 ft. |
| | 20 | 4 | 454 | 12266734.4 | 3431581.4 | 200 ft. |
| | 21 | 2 | 408 | 12266833.3 | 3431624.1 | 200 ft. |
| | 22 | 3 | 496 | 12267942.0 | 3430655.4 | 200 ft. |
| | 23 | 3 | 646 | 12267997.8 | 3430756.9 | 200 ft. |
| | 24 | 3 | 551 | 12268042.0 | 3430832.0 | 200 ft. |
| | 25 | 4 | 504 | 12268177.2 | 3430851.4 | 200 ft. |
| | 26 | 2 | 383 | 12268297.5 | 3430815.0 | 200 ft. |
| | 27 | 5 | 296 | 12268593.5 | 3430305.5 | 200 ft. |
| | 28 | 4 | 338 | 12268666.4 | 3430372.2 | 200 ft. |
| | 29 | 4 | 681 | 12268841.9 | 3430202.4 | 200 ft. |
| | 30 | 3 | 544 | 12269047.6 | 3430184.1 | 200 ft. |
| | 31 | 4 | 575 | 12269124.8 | 3430246.1 | 200 ft. |
| | 32 | 6 | 540 | 12269277.2 | 3430190.4 | 200 ft. |
| | 33 | 5 | 645 | 12269339.3 | 3430238.9 | 200 ft. |
| | 38 | 4 | 254 | 12264480.2 | 3428114.3 | 200 ft. |
| | 39 | 2 | 203 | 12264369.9 | 3428137.7 | 200 ft. |
| | 40 | 2 | 279 | 12264255.3 | 3428465.4 | 200 ft. |
| | 41 | 3 | 319 | 12264239.7 | 3428763.7 | 200 ft. |
| | 42 | 2 | 263 | 12264149.8 | 3428750.2 | 200 ft. |
| **BORROW AREA B** | | | | | | |
| SI * | | | | 12257160.4 | 3445201 .9 | 500 ft. |
| | 9 | 8 | 352 | 12257325.7 | 3445352.3 | 200 ft. |
| | 10 | 54 | 553 | 12257220.1 | 3445252.3 | 200 ft. |
| | 11 | 58 | 569 | 12257171.6 | 3445205.3 | 200 ft. |
| | 12 | 10 | 349 | 12257047.4 | 3445197.0 | 200 ft. |
| | 13 | 3 | 441 | 12256953.5 | 3445222.4 | 200 ft. |
| | 3 | *9* | 238 | 12256433.5 | 3454709.9 | 200 ft. |
| | 4 | 4 | 185 | 12256328.1 | 3454653.0 | 200 ft. |
| | 14 | 5 | 315 | 12258632.9 | 3445331.6 | 200 ft. |
| | 18 | 10 | 183 | 12249073.0 | 3451014.7 | 200 ft. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 19 | 4 | 189 | 12248995.4 | 3450988.1 | 200 ft. |
| | 20 | 12 | 285 | 12248971.4 | 3451293.6 | 200 ft. |
| | 21 | 1 | 165 | 12250283.9 | 3451516.4 | 200 ft. |
| | 22 | 5 | 270 | 12250363.4 | 3451514.4 | 200 ft. |
| | 23 | 2 | 148 | 12251484.1 | 3452248.7 | 200 ft. |
| | 24 | 25 | 312 | 12251579.6 | 3452256.9 | 200 ft. |
| | 28 | 3 | 126 | 12252931.5 | 3454745.4 | 200 ft. |
| | 29 | 2 | 180 | 12252834.9 | 3454807.3 | 200 ft. |
| | 30 | 3 | 109 | 12252871.7 | 3454871.5 | 200 ft. |
| | 31 | 3 | 87 | 12252768.9 | 3454974.4 | 200 ft. |
| | 35 | 10 | 262 | 12255056.8 | 3455949.9 | 200 ft. |
| | 36 | 2 | 98 | 12255087.8 | 3456011.7 | 200 ft. |
| | 37 | 6 | 202 | 12255269.4 | 3455941.4 | 200 ft. |

Attachment 7 – Engineering Form 2590, Economic Load Test, March 2025

U.S. Army Corps of Engineers (USACE)

# ECONOMIC LOAD TEST

For use of this form, see EM 1125-2-312; the proponent agency is CECW-CO.

| | | | |
|---|---|---|---|
| 1. HOPPER DREDGE ☐ a. MAINTENANCE ☐ b. NEW WORK | 2. DISTANCE TO DUMP MILES | 4. LOAD NUMBER | 5. DATE *(YYYYMMDD)* |
| | 3. VOLUME OF BIN WATER C.Y. | | |

| | | |
|---|---|---|
| 6. LOCATION | 7. TYPE OF DRAGS | 10. GAS ENJECTION ☐ OFF ☐ ON |
| | 8. AVERAGE LENGTH OF CUT *(FT.)* | 11. DRAFT, LIGHT FORWARD AFT |
| | 9. AVERAGE SPEED *(FT. / MIN.)* | 12. DRAFT, LOADED FORWARD AFT |

13. CHARACTER OF MATERIAL

a. ABSOLUTE DENSITY *(GMS. / LITER)* b. IN PLACE DENSITY *(GMS. / LITER)* c. WATER DENSITY *(GMS. / LITER)*

d. VOID RATIO e. GRAIN SIZES: D20 *(MM)* D50 *(MM)* D80 *(MM)*

| 14. | a. TIME | | | b. MINUTES | | | | | c. | d. | e. | f. CUBIC YARDS | | | g. CHECK ONE *(X)* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MEASUREMENT NUMBER | (1) MEASUREMENT TAKEN | (2) PUMPS STARTED | (3) PUMPS STOPPED | (1) PUMPING | (2) TURNING | (3) TOTAL LOADING | (4) AVERAGE OR ESTIMATED DISPOSAL | (5) TOTAL CYCLE | LENGTH OF CUT *(Feet)* | SPEED *(FT/MIN)* | HEIGHT OF TIDE | (1) MEASURED LOAD | (2) RETAINED PER MIN. TOTAL CYCLE TIME | (3) RETAINED PER INCREMENTAL PUMPING MIN. | (1) UNDER PUMPING (14) > (15) | (2) OVER PUMPING (14) < (15) | (3) ECONOMIC LOADING (14) = (15) |
| | | | | | | | | | | | | | | | ☐ | ☐ | ☐ |
| | | | | | | | | | | | | | | | ☐ | ☐ | ☐ |
| | | | | | | | | | | | | | | | ☐ | ☐ | ☐ |
| | | | | | | | | | | | | | | | ☐ | ☐ | ☐ |
| | | | | | | | | | | | | | | | ☐ | ☐ | ☐ |
| | | | | | | | | | | | | | | | ☐ | ☐ | ☐ |
| | | | | | | | | | | | | | | | ☐ | ☐ | ☐ |
| | | | | | | | | | | | | | | | ☐ | ☐ | ☐ |
| | | | | | | | | | | | | | | | ☐ | ☐ | ☐ |

15. REMARKS AND SUMMARY

Attachment 8 – Engineering Form 6209, Certificate of Compliance for Load Handling Equipment and Rigging, June 2023

Print Form | Save As

U.S. Army Corps of Engineers (USACE)

# CERTIFICATE OF COMPLIANCE FOR LOAD HANDLING EQUIPMENT AND RIGGING

For use of this form, see EM 385-1-1; the proponent agency is CESO.

**Purpose**: This form designates and certifies that LHE, Rigging, and Operator(s) meet all applicable regulatory requirements.

This certificate must be signed by the official of the company that provides Load Handling Equipment (LHE)/Cranes and rigging gear for any application under this contract. Prior to the start of all LHE/crane activities, the completed certificate must be submitted to, and accepted by, the Contracting Officer according to Section 16-7 of the EM 385-1-1.

| | | |
|---|---|---|
| Project Name | | Contract Number |
| Contracting Officer's Name | | Phone Number |
| Prime Contractor Name | | Phone Number |
| Sub-Contractor Name | | Phone Number |
| SSHO or QC Name | | Phone Number |
| LHE Manufacturer | LHE Type | LHE Capacity |

LHE Operator(s) Name(s)

I certify that the:

- ☐ LHE identified above and all rigging gear conform to the EM 385-1-1, applicable ASME standards, manufacturer's instructions, federal, state, and local requirement to include inspections and tests.
- ☐ Operator(s) identified above are trained, qualified, and designated to operate the LHE identified above.
- ☐ Operator(s) identified above are trained not to bypass safety devices during LHE operations.
- ☐ Operator(s) identified above received a physical examination within the past three years and meets the physical qualifications of ASME B30.5.
- ☐ Operator(s), rigger(s), and company official (staff) understand the requirement that all accidents will be immediately reported to the Contracting Officer.
- ☐ This completed and signed CoC will be posted and maintained with each Crane/LHE.

| | |
|---|---|
| Name of Company's Official Representative: | Title of Company's Official Representative |
| Signature of Company's Official Representative | Date |

# Attachment 9 – Standard Operating Procedures for Land Based UXO Technicians Providing MEC Support

# ATTACHMENT B
# STANDARD OPERATING PROCEDURES FOR
# LAND BASED UXO TECHNICIANS PROVIDING MEC SUPPORT

## 1. UXO TECHNICIAN QUALIFICATIONS:

A UXO Tech III (I.A.W. DDESB TP 18) is required at dredging projects placing material at shore sites. The UXO Tech III may be supported by additional UXO Techs when multiple shifts each day and/or multiple shore side screening sites are located within the project area that are more than one UXO Tech can support. UXO Tech I's can only work under the direct supervision of a UXO Tech III or II. A UXO Tech III must be available for consultation when using UXO Tech II's.

## 2. Pre and Post inspections:

All Screening Devices on the Dredges and on the Beach will be inspected to meet Specifications outlined in Section 01 35 30 Munitions and Explosives of Concern (MEC) Construction Support prior to dredging operation start. The inspections at a minimum will be conducted by a Qualified UXO III Technician. In addition the screens will be inspected prior to departure of the project by a qualified UXO III to ensure no MEC items have been lodged within the screening devices. These inspections will be documented and photographed in the daily reports and sent to the COR.

## 3. TRAINING:

UXO Technicians shall provide MEC Recognition and Safety Training to project personnel. The MEC Training video can be found at (https://www.denix.osd.mil/uxo/). Newly reporting personnel will be given the MEC Training before starting work. MEC Training is valid for 12 months. A legible roster of MEC Training attendees shall be maintained by the contractor.

## 4. DISCHARGE SCREEN INSPECTIONS:

a. Discharge screen/grate spacing shall be checked to ensure compliance with contract specifications after each in-flow cycle during hopper dredge operations, and a minimum of once every eight hours during hydraulic dredge operations. Out of specification discharge screens shall be removed from service until they are repaired.

b. A UXO Tech shall observe the transfer of captured material into a secondary container, such as a secondary screen or dumpster, to ensure transfer of 100 percent of that material.

c. A UXO Tech is required to conduct a 100 percent inspection of material captured in the beach screening basket at the end of

each inflow cycle for MPPEH or MEC. This shall normally include the use of hand-tools (rakes, shovel, hoe etc.). If MPPEH or MEC are located they shall be handled appropriately. The captured material may be transferred to a secondary basket for inspection.

d. The UXO Tech shall be especially vigilant when inspecting the captured debris for the presence of material greater than 1.25 inches in its smallest diameter. The presence of this type of material in the beach screen is a positive indicator that there is damage to or a malfunction of the dredge screen on the intake side (the material could be MEC 37mm or larger, rocks, bricks or other types of hardened debris). The dredge must be notified as soon as possible to cease operations and to determine the cause of the oversize material in the beach screening basket.

5. FAILURE OF BEACH SCREENING EQUIPMENT OR PROCEDURES:

In the event that unscreened material or material not inspected by a UXO Tech is placed with the beachfill material that material shall be inspected by the UXO Tech using an appropriate metal detector.

6. MEC PROCEDURES:

a. Chemical warfare materiel (CWM). If a munition is identified as CWM, a liquid filled munition, or if a MEC item cannot be positively identified, all persons will retreat up wind (minimum 300 feet if possible). Be alert for unusual odors such as garlic or fresh mown grass. Secure the area and contact the COR and OESS. The Government Ordnance and Explosive Safety Specialist (OESS) will contact Explosive Ordnance Disposal for response. If someone shows signs of being sick after being around the MEC item seek medical attention immediately.

b. The UXO Tech shall advise the OESS if UXO is encountered as soon as possible. A digital photo of the UXO item(s) shall be provided to the OESS by the UXO Technician.

c. All MEC items shall be inventoried and tracked on a daily basis. A running total shall be kept and included in the contractor’s daily report.

d. All MEC items shall be secured in an ATF approved Type 3 storage container. Items shall not be allowed to shift within storage containers. Sand may be utilized to stabilize items.

e. All operations involving MEC shall be done using the buddy system. If only one UXO Technician is available then a member of the shore crew shall be utilized as a safety watch.

f. The UXO Tech shall make frequent QC checks of the placed material, using a suitable metal detector, as soon as the dredging equipment has moved out of the way down the beach for the presence of MEC and MPPEH. If MEC is found on the beach contact the OESS for further guidance.

g. The UXO Tech shall be prepared to recover all MPPEH, MEC, and munitions debris from the beach screening baskets. The contractor is responsible for inspection and certification of all MPPEH, and for final disposal of MD (or MDAS), and small arms projectiles and casings.

h. The OESS will coordinate the disposal of any and all MEC with the responding emergency response agencies (EOD). The UXO Tech shall provide two copies of the MEC inventory to the OESS when turnover of MEC items to EOD forces is arranged.

# Attachment 10 – Standard Operating Procedures for UXO Technicians Providing MEC Support Aboard Dredges

ATTACHMENT C
STANDARD OPERATING PROCEDURES FOR
UXO TECHNICIANS PROVIDING MEC SUPPORT ABOARD DREDGES

1. TRAINING:

a. MEC Recognition and Safety Training. UXO Technicians shall provide MEC Recognition and Safety Training for the Contractor's dredge and shore based personnel as directed by the OESS. The MEC training video can be accessed at https://www.denix.osd.mil/uxo/. MEC training is valid for 12 months. Newly reporting crew members shall be given the MEC training aboard the dredge if they have not received the MEC training within the previous twelve months. A legible roster of MEC Training attendees shall be maintained by the Contractor.

b. Operational Training. UXO Technicians will be provided operational training by the dredge crew immediately when they report aboard the dredge. This training will consist of basic training that the Contractor provides to regular crew members (i.e. man overboard, fire, inclement weather and etc.). UXO Technicians shall comply with the dredge Captains orders while aboard the dredge.

2. DRAGHEAD SCREEN INSPECTIONS: Ensure the draghead is put into a safe position for inspection, before any activity is performed.

a. UXO Technicians shall inspect the dragheads for damage and for the presence of MEC after each load is taken aboard. The Contractor shall inspect the dragheads for damage, and shall photograph each draghead before any work is performed on the dragheads if MEC is discovered during inspection.

(1) MEC items that can be removed by hand, shall be removed first; MEC items that are jammed, shall be removed last.

(2) MEC items jammed in the grate shall be extracted utilizing a pry bar to widen the grate width to allow item to fall freely into hands of UXO Technician. Large items the UXO tech may use a netting system directly underneath to catch the item or a system that does not allow the item to fall to the deck of the ship. Positive control of items must be maintained.

(3) MEC that cannot be positively identified or deemed unsafe to remove contact the OESS and EOD will respond to the dredge.

b. Check draghead screen/grate spacing to ensure compliance with Contract Specifications. Notify dredge personnel if the screen/grate spacing is determined to be out of compliance.

c. The UXO Technician shall advise the OESS if UXO is encountered as soon as possible. The UXO Technician shall provide a digital photo of the UXO item(s) to the OESS. Further guidance will be at the digression of the OESS on reporting and photos.

3. MEC PROCEDURES:

a. Chemical warfare materiel (CWM). If a munition is identified as CWM, a liquid filled munition, or if a MEC item cannot be positively identified, **all persons will retreat from area do not attempt to dislodge from Draghead.** Be alert for unusual odors such as garlic or fresh mown grass. Secure the area and contact the COR and OESS. The OESS will contact Explosive Ordnance Disposal for response. If someone shows signs of being sick after being around the MEC item seek medical attention immediately.

b. Inventory and track all MEC items on a daily report. Keep a running total of all MEC items each day and include in the daily report. Provide the daily report to the OESS by email (depending on email access on board the dredge).

c. Secure all MEC items onboard the dredge in a securable area/container. Prevent the items from shifting within the storage containers. Sandbags and cargo straps may be utilized to stabilize items and container.

d. The Lead UXO Technician shall make a report to the OESS daily. Include in the report the MEC types and the numbers of different items.

e. Transfer MEC items from ship to dedicated crew boat consisting of essential personnel and escort by a UXO Technician to the shore where items shall be transferred to the OESS or EOD with inventory sheet (2 copies). Place MEC items in a lightweight, flexible, securable container (such as a military kit bag, or duffel bag). Spare containers shall be kept on hand to replace damaged containers. Containers will be returned to the UXO Technicians after MEC items are turned over for disposal by responding EOD. If the seas are too rough to transfer personnel, the transfer container shall be secured by line to the dredge during the transfer to the crew boat. Inform the boat crew that MEC items will be secured to the deck of the crew boat during the transit to the shore. Smoking is not allowed within 50 feet of the MEC items during the transfer operation. Transfer operations shall normally occur during daylight hours, unless directed by the OESS. Coordinate with the dredge captain for the dedicated crew boat. The UXO technician shall then return to ship.

f. All operations involving MEC shall be done using the buddy system. If only one UXO Technician is available then a member of the dredge crew shall be utilized as a safety watch.

g. Prime contractor shall provide 72hrs notice to OESS prior to refueling or returning to port. MEC cannot be stowed on the dredge ship while at port or fueling station. If severe weather or

unforeseen conditions arise that require the dredge ship to dock before an EOD response can be coordinated, the ship will dock at prime contractor's shipyard where all on-site personnel are deemed essential to the project, and an EOD response will be coordinated by OESS to that location.

4. PERSONNEL NOTIFICATION: The OESS shall be kept apprised of who the UXO Technicians are on the dredge, and who and when the replacement(s) will be. Coordination between all parties concerned is imperative.

Attachment 11 – DEQ Letter dated 02 October 2015, Regulation of Dredging and Aquatic Resource Restoration Activities Conducted by the U.S. Army Corps of Engineers in Commonwealth of Virginia Waters

# COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
*Street address:* 629 East Main Street, Richmond, Virginia 23219
*Mailing address:* P.O. Box 1105, Richmond, Virginia 23218
www.deq.virginia.gov

Molly Joseph Ward
Secretary of Natural Resources

David K. Paylor
Director

(804) 698-4000
1-800-592-5482


October 2, 2015

Colonel Jason E. Kelly
U.S. Army Corps of Engineers
Norfolk District
803 Front Street
Norfolk, Virginia 23510

Colonel Edward P. Chamberlayne
U.S. Army Corps of Engineers
Baltimore District
City Crescent Building
10 South Howard Street
Baltimore, Maryland 21201

**RE: Regulation of Dredging and Aquatic Resource Restoration Activities Conducted by the U.S. Army Corps of Engineers in Commonwealth of Virginia Waters**

Dear Colonel Kelly and Colonel Chamberlayne:

The Department of Environmental Quality (DEQ) appreciates the long-standing role that the U.S. Army Corps of Engineers (the Corps) has played as the federal agency responsible for the Nation's navigation system. The Corps' navigation projects include waterway channels, anchorages, turning basins, locks and dams, harbor areas, protective jetties and breakwaters, and the maintenance of harbor access channels for commerce, recreation, and naval activities. My purpose in writing is to clarify when dredging and aquatic resource restoration activities conducted by the U.S. Army Corps of Engineers are under our statutory authority. Virginia Water Protection (VWP) permit regulations do not specifically define "maintenance dredging." DEQ permits for various types of dredging are governed by the VWP permit regulations (9 VAC 25-210 *et seq.*) as well as Chapters 12 and 13 of Title 28.2 of the Code of Virginia.

**Dredging Activities:**

While the Commonwealth of Virginia holds submerged aquatic lands in the public trust, DEQ acknowledges the National benefits of commerce, recreation, and naval operations. Maintenance dredging undertaken by the Corps of an existing Federal Navigation Channel already has, or should have, a Federal Consistency Determination (FCD) concurrence from DEQ. An approved FCD from DEQ means that a Corps dredging project is consistent with all of the Enforceable Policies, including nontidal wetlands. For these projects, no VWP permit or permit fee will be required; including reissuance of any expired VWP permit. For Corps capital dredging projects that do not have a FCD, any water quality or habitat concerns will be identified and addressed through the FCD process, and no further VWP permit or permit fee will be required. As the lead Federal agency, it is the Corps' responsibility to submit the necessary FCD information to DEQ's Office of Environmental Impact Review for review prior to undertaking the project. Other Corps dredging projects (i.e., those projects undertaken by the Corps, or where the Corps would otherwise be viewed as "an applicant" or "a permittee") will also follow this decision process. Overboard disposal of dredge materials associated with Corps dredging projects will not require a VWP permit or permit fee. DEQ's regulatory decision process does not eliminate the need, if appropriate, for other permits from the Virginia Marine Resources Commission (VMRC) or other federal, state, or local regulations and ordinances.

Through State Water Control Law and the Virginia Coastal Program, DEQ is responsible for maintaining the water quality and coastal resources for the Commonwealth. Should there be any alleged violations of state water quality standards from these types of projects, DEQ will investigate the matter through our normal enforcement processes, and work with the Corps to correct any identified deficiencies.

**Aquatic Resource Restoration Activities**

DEQ agrees with and supports restoration of habitat to improve aquatic species, which will provide an overall benefit to water quality. While many of these types of projects do not impact State Waters, some projects do impact State Waters, albeit for a greater good. DEQ will review Corps restoration projects on a case-by-case basis to determine if a VWP permit will be required. If a permit is required, no permit fee will be assessed. DEQ's regulatory decision process does not eliminate the need, if appropriate, for other permits from the VMRC or other federal, state, or local regulations and ordinances. A FCD will be required if the project meets the appropriate criteria.

I hope this helps to clarify when permits from DEQ will or will not be required for dredging and aquatic resource restoration projects. Should you have specific, project-related questions, please contact Mr. Dave Davis at 804-698-4105 or dave.davis@deq.virginia.gov.

Sincerely,

David K. Paylor

cc: Mr. Tony Watkinson, VMRC Habitat Division
Ms. Bettina R. Sullivan, DEQ Office of Environmental Impact Review
DEQ Regional VWP Permit Managers

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY
P.O. BOX 1105
RICHMOND, VIRGINIA 23218-1105

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Colonel Jason E. Kelly
U.S. Army Corps of Engineers
Norfolk District
803 Front Street
Norfolk, Virginia 23510

Attachment 12 – VMRC No Permit Required Letter dated

26 June 2026

Outlook

## [Non-DoD Source] VMRC #2026-0165, Army Corps of Engineers - No Permit Necessary

**From** Birge, Tiffany (MRC) <Tiffany.Birge@mrc.virginia.gov>
**Date** Fri 6/26/2026 12:31 PM
**To** Bennett, Laura E CIV USARMY CENAO (USA) <Laura.E.Bennett@usace.army.mil>; Ryan R. Firenze <rfirenze@vbgov.com>
**Cc** Boyd, Teresa (MRC) <Teresa.Boyd@mrc.virginia.gov>; Lapenta, Kristy (MRC) <Kristy.Lapenta@mrc.virginia.gov>; Heaven L. Manning (hmanning@vbgov.com) <hmanning@vbgov.com>; Whitney K. McNamara (wmcnamar@vbgov.com) <wmcnamar@vbgov.com>; Grace A. Smith <grasmith@vbgov.com>; Pruhs, Robert S CIV USARMY CENAO (USA) <Robert.S.Pruhs@usace.army.mil>; Kelly O. Mills (kmills@vbgov.com) <kmills@vbgov.com>; James D. White (jawhite@vbgov.com) <jawhite@vbgov.com>

Good afternoon,
We have reviewed your application requesting authorization to place approximately two (2) million cubic yards of beach-quality sand along the five (5) mile stretch of Sandbridge Beach, situated along the Atlantic Ocean in Virginia Beach. Beach nourishment will include sand hydraulically pumped from the Sandbridge Shoals borrow area, located approximately three (3) nautical miles offshore, to the beach area between the Navy's Dam Neck Fleet Training Center to the north and Back Bay National Wildlife Refuge to the south.

Please be advised that no authorization is necessary for the proposed dredging activities given that all work will be occurring outside of the limits of Virginia's Territorial Sea (3 nautical miles) and is therefore, not within the jurisdiction of the Marine Resources Commission. Furthermore, based upon your application and drawings, please be advised that the dredge material (sand) placement portion of your project qualifies for the statutory authorization outlined in §28.2-1203(A)3 of the Code of Virginia pertaining to Congressionally authorized flood-control projects. Accordingly, no Commission permit is required provided the sand placement is restricted to the limits of the Congressionally authorized nourishment footprint of Sandbridge Beach. However, if the placement area changes, a Commission permit for its placement may then be required.
For your information, you may need additional authorization from the City of Virginia Beach. Feel free to reach out if I may be of further assistance.
Respectfully,
Tiffany Birge
Environmental Specialist II, Habitat Management
Virginia Marine Resources Commission
Building 96, 380 Fenwick Road
Ft. Monroe, VA 23651
Tiffany.birge@mrc.virginia.gov, 757-247-2254

**Effective September 1, 2025, the US Army Corps of Engineers (USACE) will become the central point of receipt of all requests in the Commonwealth of Virginia (instead of the Virginia Marine Resources Commission) as the result of a federal mandate. Regulatory Request System (RRS) will be the only way to submit your application and any revisions to all 3 of the permitting agencies (USACE, Virginia Department of Environmental Quality, and the Virginia Marine Resources Commission) and to your local wetlands board. To access the RRS, visit this link: https://rrs.usace.army.mil/rrs**

**If you have questions regarding this permanent change, contact Barry Spence at barry.l.spence@usace.army.mil.**

# Attachment 13 – Sandbridge Bid Schedule

# SUBMITTAL REGISTER

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| | | 01 14 00 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |
| | | | Marine Plant Anchorage And | 1.4.4 | G | | | | | | | | | | | | | |
| | | | Equipment Working Area Plan | | | | | | | | | | | | | | | |
| | | | Notify Commander, East Coast | 1.3.1 | | | | | | | | | | | | | | |
| | | | Guard District | | | | | | | | | | | | | | | |
| | | | Notify National Marine Fisheries | 1.3.1 | | | | | | | | | | | | | | |
| | | | Service | | | | | | | | | | | | | | | |
| | | | Marine Remote Sensing Survey | 1.15.1 | G | DO | | | | | | | | | | | | |
| | | | Borrow Area Material Removal | 1.5.4 | G | DO | | | | | | | | | | | | |
| | | | Plan | | | | | | | | | | | | | | | |
| | | 01 30 00 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |
| | | | Progress and Completion | 1.2 | | | | | | | | | | | | | | |
| | | | Pictures | | | | | | | | | | | | | | | |
| | | | List Of Contact Personnel | 1.5.2 | G | | | | | | | | | | | | | |
| | | 01 32 01.00 10 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |
| | | | Project Scheduler Qualifications | 1.3 | G | | | | | | | | | | | | | |
| | | | Preliminary Project Schedule | 3.4.1 | G | | | | | | | | | | | | | |
| | | | Initial Project Schedule | 3.4.2 | G | | | | | | | | | | | | | |
| | | | Periodic Schedule Update | 3.6.2 | G | | | | | | | | | | | | | |
| | | 01 33 00 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |
| | | | Submittal Register | 1.8 | G | | | | | | | | | | | | | |
| | | 01 35 26 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |
| | | | Accident Prevention Plan (APP) | 1.8 | G | | | | | | | | | | | | | |
| | | | Dive Operations Plan | 1.15 | G | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | |
| | | | Accident Reports | 1.12.2 | G | | | | | | | | | | | | | |

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| | | 01 35 26 | LHE Inspection Reports | 1.12.3 | | | | | | | | | | | | | | |
| | | | Monthly Exposure Reports | 1.5 | G | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | |
| | | | Crane Operators/Riggers | 1.7.5.3 | | | | | | | | | | | | | | |
| | | | Activity Hazard Analysis (AHA) | 1.9 | G | | | | | | | | | | | | | |
| | | | Certificate of Compliance | 1.12.4 | | | | | | | | | | | | | | |
| | | | Hot Work Permit | 1.13 | | | | | | | | | | | | | | |
| | | | Standard Lift Plan | 1.8.3.2 | G | | | | | | | | | | | | | |
| | | | Standard Lift Plan | 1.12.4 | G | | | | | | | | | | | | | |
| | | | Critical Lift Plan | 1.8.3.3 | G | | | | | | | | | | | | | |
| | | | Barge Mounted Mobile Crane Lift | 1.8.3.4 | G | | | | | | | | | | | | | |
| | | | Plan | | | | | | | | | | | | | | | |
| | | | Naval Architecture Analysis | 1.8.3.4 | G | DO | | | | | | | | | | | | |
| | | 01 35 30 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |
| | | | Site Safety And Health Plan | 1.5.3 | G | DO | | | | | | | | | | | | |
| | | | (SSHP) MEC Safety Addendum | | | | | | | | | | | | | | | |
| | | | Site Safety And Health Plan | 1.6 | G | DO | | | | | | | | | | | | |
| | | | (SSHP) MEC Safety Addendum | | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | |
| | | | Discharge End Screening Device | 3.3 | G | COR | | | | | | | | | | | | |
| | | | Inspections | | | | | | | | | | | | | | | |
| | | 01 45 00 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |
| | | | Contractor Quality Control (CQC) | 1.5.2 | G | | | | | | | | | | | | | |
| | | | Plan | | | | | | | | | | | | | | | |
| | | | E-Verify Program | 1.12.3 | G | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | |

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| | | 01 45 00 | Contractor Quality Control (CQC) | 1.12 | | | | | | | | | | | | | | |
| | | | Report | | | | | | | | | | | | | | | |
| | | 01 50 00 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |
| | | | Construction Site Plan | 1.3 | G | | | | | | | | | | | | | |
| | | | Traffic Control Plan | 3.3.1 | G | | | | | | | | | | | | | |
| | | | Contractor Computer | 1.5.1.4 | G | | | | | | | | | | | | | |
| | | | Cybersecurity Compliance | | | | | | | | | | | | | | | |
| | | | Statements | | | | | | | | | | | | | | | |
| | | | Contractor Temporary Network | 1.5.6 | G | | | | | | | | | | | | | |
| | | | Cybersecurity Compliance | | | | | | | | | | | | | | | |
| | | | Statements | | | | | | | | | | | | | | | |
| | | 01 57 19 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |
| | | | Solid Waste Management Permit | 1.4.1 | G | | | | | | | | | | | | | |
| | | | Environmental Protection Plan | 1.5 | G | | | | | | | | | | | | | |
| | | | SD-11 Closeout Submittals | | | | | | | | | | | | | | | |
| | | | Waste Determination | 3.10.1 | G | | | | | | | | | | | | | |
| | | | Documentation | | | | | | | | | | | | | | | |
| | | | Disposal Documentation For | 3.10.3.4 | G | | | | | | | | | | | | | |
| | | | Hazardous And Regulated Waste | | | | | | | | | | | | | | | |
| | | | Hazardous Waste/Debris | 3.10.3.1 | G | | | | | | | | | | | | | |
| | | | Management | | | | | | | | | | | | | | | |
| | | | Project Solid Waste Disposal | 3.10.2.1 | G | | | | | | | | | | | | | |
| | | | Documentation Report | | | | | | | | | | | | | | | |
| | | 01 57 30 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |
| | | | Communications Plan | 1.3 | G | DO | | | | | | | | | | | | |
| | | 01 57 40 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |

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| | | 01 57 40 | Operational Plan To Minimize | 3.1 | G | | | | | | | | | | | | | |
| | | | Turtle And Atlantic Sturgeon Takes | | | | | | | | | | | | | | | |
| | | | Hopper Dredge Endangered | 3.1.6 | G | | | | | | | | | | | | | |
| | | | Species Special Equipment Plan | | | | | | | | | | | | | | | |
| | | | Drawings And Operational | 3.1.6 | G | | | | | | | | | | | | | |
| | | | Specifications Of All Proposed | | | | | | | | | | | | | | | |
| | | | Endangered Species Drag Head | | | | | | | | | | | | | | | |
| | | | Deflectors, Special Screening, And | | | | | | | | | | | | | | | |
| | | | Lighting Equipment | | | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | |
| | | | Invoice From VAQS | 3.1.16 | | | | | | | | | | | | | | |
| | | | Contractor's Invoice Documenting | 3.1.16 | | | | | | | | | | | | | | |
| | | | Payment Received From VAQS | | | | | | | | | | | | | | | |
| | | | ODESS Dredge Load Form | 3.1.2 | | | | | | | | | | | | | | |
| | | | ODESS Dredge Load Form | 3.1.5 | | | | | | | | | | | | | | |
| | | | Marine Mammal Observation | 3.1.5 | | | | | | | | | | | | | | |
| | | | Data Forms | | | | | | | | | | | | | | | |
| | | | Sturgeon Incidental Take Data | 3.1.16 | | | | | | | | | | | | | | |
| | | | Form | | | | | | | | | | | | | | | |
| | | | Endangered Species Observer | 3.1.16 | | | | | | | | | | | | | | |
| | | | Program, Large Whale | | | | | | | | | | | | | | | |
| | | | Observation Data | | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | |
| | | | Tissue Sample | 3.1.14 | | | | | | | | | | | | | | |
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| | | 01 57 40 | Protected Species Observers | 3.1.16 | G | | | | | | | | | | | | | |
| | | | Resume And NMFS Approval | | | | | | | | | | | | | | | |
| | | | Letter | | | | | | | | | | | | | | | |
| | | | Letter Of Approval From NMFS | 3.1.16 | G | | | | | | | | | | | | | |
| | | | Authorizing Turtle Trawling | | | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | |
| | | | Incidental Take Reports | 3.1.1 | | | | | | | | | | | | | | |
| | | | Paint Test Information | 3.1.6 | G | | | | | | | | | | | | | |
| | | | SD-10 Operation and Maintenance | | | | | | | | | | | | | | | |
| | | | Data | | | | | | | | | | | | | | | |
| | | | Final Sea Turtle Trawling Report | 3.1.8 | G | DO | | | | | | | | | | | | |
| | | 01 78 00 | SD-11 Closeout Submittals | | | | | | | | | | | | | | | |
| | | | As-Built Drawings | 3.1 | G | | | | | | | | | | | | | |
| | | | Record Drawings | 3.3 | G | | | | | | | | | | | | | |
| | | 35 20 23.23 | SD-07 Certificates | | | | | | | | | | | | | | | |
| | | | National Dredging Quality | 1.4 | G | | | | | | | | | | | | | |
| | | | Management Program Certification | | | | | | | | | | | | | | | |
| | | 35 20 24 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |
| | | | Qualifications | 1.7 | G | | | | | | | | | | | | | |
| | | | Surveying Procedures and | 1.7 | G | | | | | | | | | | | | | |
| | | | Equipment | | | | | | | | | | | | | | | |
| | | | Pre-Placement Condition Surveys | 3.3 | G | | | | | | | | | | | | | |
| | | | Beach Fill Placement | 1.8.1 | G | | | | | | | | | | | | | |
| | | | Beach Fill Placement | 1.9.2 | G | | | | | | | | | | | | | |
| | | | Accident Prevention Plan | 1.11.2 | G | | | | | | | | | | | | | |
| | | | Dredge Material Placement Plan | 3.4.3 | G | | | | | | | | | | | | | |

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| | | 35 20 24 | Preconstruction Meeting | 1.5.4 | G | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | |
| | | | Beach Fill Samples | 3.4.8.1 | | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | |
| | | | Testing | 3.4.8 | G | | | | | | | | | | | | | |
| | | | Testing | 3.4.8.2 | G | | | | | | | | | | | | | |
| | | | Sand Fill Material | 3.4.8.3 | G | | | | | | | | | | | | | |
| | | | Daily Report of Operations | 1.10 | | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | |
| | | | Before and After Beachfill | 1.9.2 | G | | | | | | | | | | | | | |
| | | | Surveys | | | | | | | | | | | | | | | |
| | | | Testing | 3.4.8 | G | | | | | | | | | | | | | |
| | | | Testing | 3.4.8.2 | G | | | | | | | | | | | | | |
| | | | Geotechnical Evaluation Report | 1.5.1 | G | DO | | | | | | | | | | | | |
| | | | SD-11 Closeout Submittals | | | | | | | | | | | | | | | |
| | | | Post-Placement Condition | 1.9.3 | G | | | | | | | | | | | | | |
| | | | Surveys | | | | | | | | | | | | | | | |
| | | | Beach Fill Placement Records | 1.9.4 | G | | | | | | | | | | | | | |