CAPE COD CANAL & SANDWICH BEACHES

SHORE DAMAGE MITIGATION STUDY

APPENDIX A1

ENVIRONMENTAL CORRESPONDENCE

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DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
696 VIRGINIA ROAD
CONCORD MA 01742-2751

November 17, 2017

Planning Division

Mark Murray-Brown
Section 7 Coordinator
Protected Resources Division
NOAA National Marine Fisheries Service
55 Great Republic Drive
Gloucester Massachusetts 01930

Dear Mr. Murray-Brown,

The U.S. Army Corps of Engineers (Corps), New England District (NAE) and the Town of Sandwich, would like to formally invite a member of your staff to a coordinated site visit in Sandwich, Massachusetts, on Tuesday, December 12, 2017 (details below). We will be meeting to discuss a study to consider the alternatives for the mitigation of shore damages caused by the Corps' Cape Cod Canal Federal Navigation Project (FNP) in the town of Sandwich, Massachusetts, under the Continuing Authorities Program, Section 111 (authorized by the River and Harbor Act of 1986, as amended). The purpose of this letter and site visit is to obtain your comments on the proposed project. Attachment 1 is a location map enclosed to aid you in your preliminary review.

The town of Sandwich is located on Cape Cod, on the southwestern shore of Cape Cod Bay, in Barnstable County. The beaches in the town of Sandwich, including Town Neck Beach and Spring Hill Beach have a history of erosion due to storm events and sea level rise. Since 1906 erosion has occurred at an approximate rate of 2-3 feet per year and this rate appears to have accelerated to 6.5 feet per year in recent years. The beaches, which are comprised of a mix of sand, gravel, and cobble with dunes, are down drift of the Cape Cod Canal east entrance.

The Cape Cod Canal provides safe and efficient passage for commercial and recreational vessels wishing to transit between Cape Cod Bay and Buzzards Bay. However, the Canal's east entrance jetties appear to interrupt the natural longshore sediment transport from northwest to southeast and appear to be the primary cause of erosion along the Town's beaches. Foreseeable impacts caused by continued erosion include damages to shorefront properties, Sandwich Great Marsh, and flooding of the historic downtown Sandwich area. Consequently, Town of Sandwich officials have expressed concern and an interest in conducting an investigation to develop long term strategies for managing erosion problems along Town Neck and Spring Hill beaches.

The study will evaluate various alternatives, including the No Action alternative. Other alternatives include various sources of sand and bypass measures to rebuild the beach and provide long term replenishment of sand to the downdrift beaches. Potential sources of sand include the area of accumulation updrift of the northern jetty and from periodic maintenance dredging of the Canal as well as other offshore sources identified in the course of the study. Structural alternatives to be studied include construction of a breakwater along Town Neck Beach; construction of a seawall or stone revetment along both Town Neck and Spring Hill Beaches; adjustment of the north jetty by either removal, shortening, lowering, or adding a spur jetty; lengthening the south jetty to match then length as the north jetty; the construction of T-shaped groins; and the removal or adjustment of existing groins.

USACE will be preparing an Environmental Assessment (EA) and Clean Water Act, Section 404(b)(1) evaluation and obtaining a Water Quality Certificate to address impacts to the environment from the alternatives listed above. In order to obtain agency input to the study and alternatives, the Corps is planning a coordinated site visit with interested state and federal agencies, town officials and non-governmental organizations. The purpose of the meeting will be to explain the proposed project and to elicit agency concerns and suggestions. Your agency's participation at this meeting would be appreciated. We will meet at the Sandwich Town Hall located at 130 Main Street, Sandwich, Massachusetts and then proceed to Town Neck Beach on Tuesday, December 12, 2017 at 10:00 am rain or shine.

We are requesting written preliminary comments on the proposed project (which will be described in more detail during the site visit) from your agency within 30 days of the meeting. Comments should include any concerns that need to be addressed during the planning of the proposed project specifically with regards to the Fish and Wildlife Coordination Act and the Endangered Species Act. Comments in support of the project as presented are also requested.

We look forward to your contribution towards this project. Please feel free to contact me at (978) 318-8685 (Michael.S.Riccio@usace.army.mil), or the project ecologist, Grace Moses at (978) 318-8717 (C.Grace.Moses@usace.army.mil) if you have any questions about this project.

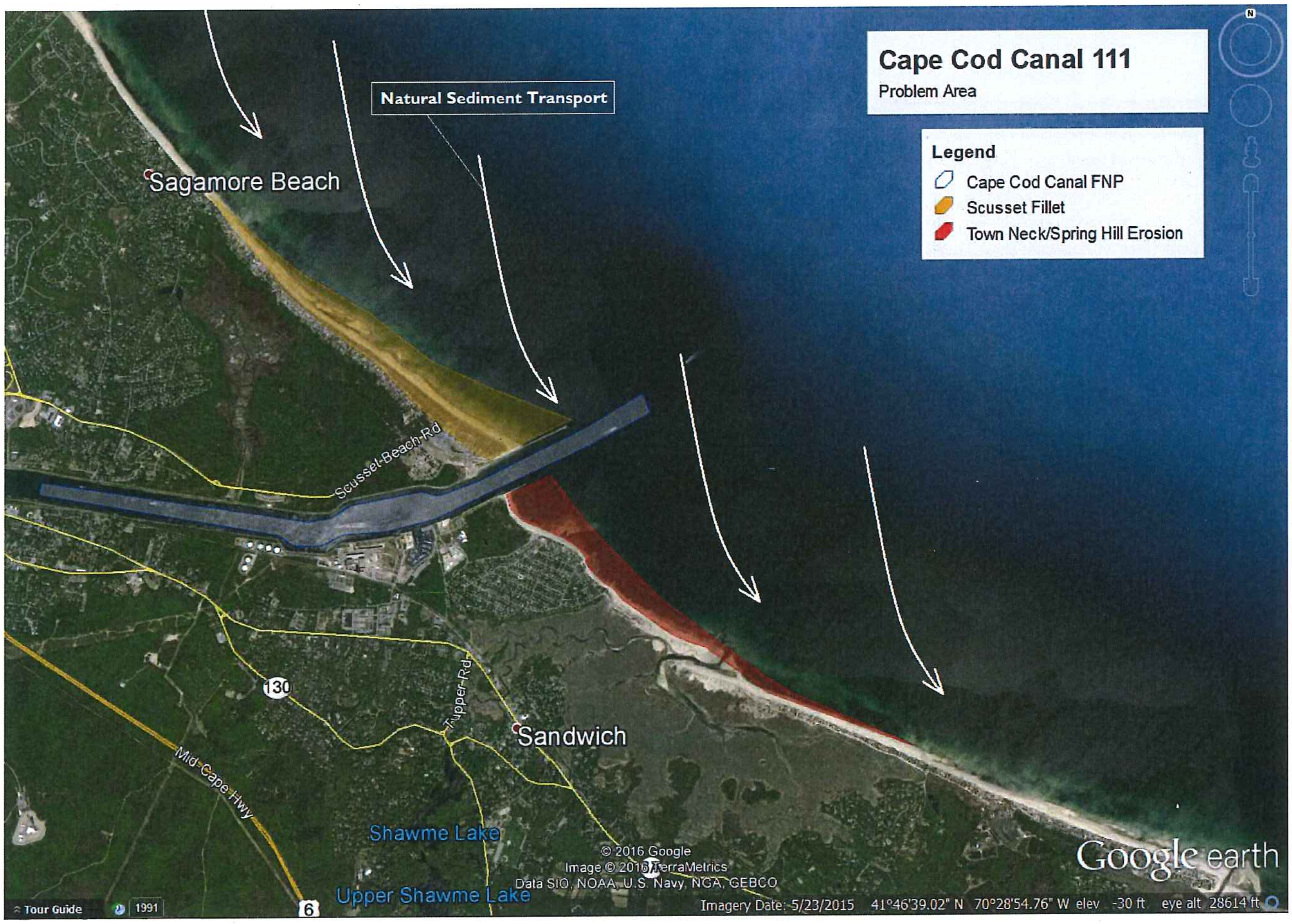
Sincerely,

Michael Riccio
Project Manager

Enclosure

Copies Furnished
Mr. Zach Jylkka: Zachary.jylkka@noaa.gov

Attachment 1. Sandwich Section 111 study area and sediment transport.



Similar letters were sent to the following agencies:

Mr. Robert Boeri The Massachusetts Office of Coastal Zone Management 251 Causeway Street, Suite 800 Boston, MA 02114-2138	Ms. Regina Lyons U.S EPA New England, Region 1 5 Post Office Square, Suite 100 Boston, MA 02109-3912
Mr. Tom Chapman U.S. Fish and Wildlife Service New England Field Office 70 Commercial Street, Suite 300 Concord, NH 03301	Ms. Bettina Washington Tribal Historic Preservation Officer Wampanoag Tribe of Gay Head (Aquinnah) 20 Black Brook Rd. Aquinnah, MA 02535
Ms. Jackie Leclaire Wetlands Protection Unit U.S EPA New England, Region 1 5 Post Office Square, Suite 100 Boston, MA 02109-3912	Mr. Thomas French Assistant Director Division of Fisheries and Wildlife Natural Heritage and Endangered Species Program 100 Hartwell Street, Suite 230 West Boylston, MA 01583
Mr. Ronald Amidon Commissioner Department of Fish and Game 251 Causeway St, Suite 400 Boston, MA. 02114-2152	Ms. Millie Garcia-Serrano Regional Director Massachusetts Department of Environmental Protection Southeast Regional Office 20 Riverside Drive Lakeville, MA 02347
Ms. Ramona Peters Tribal Historic Preservation Officer Mashpee Wampanoag Tribe 483 Great Neck Road South Mashpee, MA 02649	Ms. Brona Simon Executive Director Massachusetts Historical Commission 220 Morrissey Blvd. Boston, MA 02114

Mr. Lou Chiarella NOAA Fisheries Service Northeast Regional Office Habitat Conservation Division 55 Great Republic Drive Gloucester, MA 01930	Mr. David Schrader Sandwich Historical Commission 16 Jan Sebastian Drive Sandwich, MA 02563

From:	Moses, Catherine G CIV USARMY CENAE (US)
To:	Riccio, Michael S CIV USARMY CENAE (US); ddeconto@townofsandwich.net; dlapp@townofsandwich.net; Stephen.mckenna@state.ma.us; robert.boeri@state.ma.us; Nelson.ericp@epa.gov; Colarusso.phil@epa.gov; Reiner.ed@epa.gov; Eileen.feeney@state.ma.gov; Alison.verkade@noaa.gov; gdunham@townofsandwich.net; lhassler@kinlingrover.com; Dwalsh@whgrp.com; Kbosma@whgrp.com; Jim.mahala@state.ma.us; Susi_vonoettingen@fws.gov; Paiva, Marcos A CIV USARMY CENAE (USA); Wong, David W (DEP); Rosenberg, Eric C CIV USARMY CENAE (USA); Winter, Lisa R CIV USARMY CENAE (US); Zachary Jylkka - NOAA Federal; lfiends@whgrp.com; hharper@sandwichmass.org
Subject:	USACE Sandwich Section 111 Expanded Borrow Site Meeting
Start:	Wednesday, July 1, 2020 1:00:00 PM
End:	Wednesday, July 1, 2020 3:00:00 PM
Location:	Webex

Good afternoon all,

Thank you for your participation in the Doodle poll for the Scusset Beach expanded borrow site footprint meeting. Material from the borrow site is anticipated to be used for nourishment of Town Neck Beach under the Corp's Section 111 program. Please mark your calendars for July 1 from 1-3pm for a webex meeting. Doodle is not allowing me to see everyone who was unable to participate in the poll so please forward this invite to anyone I might have missed and has an interest in this project.

Thank you,

Grace Moses
Biologist
U.S. Army Corps of Engineers
New England District
978-318-8717

-- Do not delete or change any of the following text. --

When it's time, join your Webex meeting here.

Meeting number: 146 661 9636

Meeting password: 1234

Join meeting <https://usace.webex.com/usace/j.php?MTID=m49aeb634d1caffb3dfd53528991e8822>

Join by phone
Tap to call in from a mobile device (attendees only)
Call-in number (ATT Audio Conference): 1-2132702124 (US) <tel:%2B1-2132702124,,*00*5098899%23,,,%23>
Call-in toll-free number (ATT Audio Conference): 1-8882733658 (US) <tel:1-8882733658,,*00*5098899%23,,,%23>
Show global numbers <https://www.teleconference.att.com/servlet/glbAccess?process=1&accessNumber=8882733658&accessCode=5098899&accessNumber2=2132702124>
Access Code: 509 889 9

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From:	Moses, Catherine G CIV USARMY CENAE (US)
To:	Moses, Catherine G CIV USARMY CENAE (US)
Subject:	FW: USACE Sandwich Section 111 Expanded Borrow Site Meeting
Date:	Thursday, November 12, 2020 4:06:55 PM

From: Riccio, Michael S CIV USARMY CENAE (US) <Michael.S.Riccio@usace.army.mil>
Sent: Tuesday, June 30, 2020 4:33 PM
To: Moses, Catherine G CIV USARMY CENAE (US) <C.Grace.Moses@usace.army.mil>; ddeconto@townofsandwich.net; dlapp@townofsandwich.net; Stephen.mckenna@state.ma.us; robert.boeri@state.ma.us; Nelson.ericp@epa.gov; Colarusso.phil@epa.gov; Reiner.ed@epa.gov; Eileen.feeney@state.ma.gov; Alison.verkade@noaa.gov; gdunham@townofsandwich.net; lhassler@kinlingrover.com; Dwalsh@whgrp.com; Kbosma@whgrp.com; Jim.mahala@state.ma.us; Susi_vonoettingen@fws.gov; Paiva, Marcos A CIV USARMY CENAE (USA) <Marcos.A.Paiva@usace.army.mil>; Wong, David W (DEP) <david.w.wong@state.ma.us>; Rosenberg, Eric C CIV USARMY CENAE (USA) <Eric.C.Rosenberg@usace.army.mil>; Winter, Lisa R CIV USARMY CENAE (US) <Lisa.R.Winter@usace.army.mil>; Zachary Jylkka - NOAA Federal <zachary.jylkka@noaa.gov>; lfiends@whgrp.com; hharper@sandwichmass.org
Cc: Bosma Kirk <kbosma@woodsholegroup.com>; Engler, Lisa (ENV) <lisa.engler@state.ma.us>; Walsh David <dwalsh@woodsholegroup.com>; Deconto, Dave <ddeconto@sandwichmass.org>; Dunham, George <gdunham@sandwichmass.org>; Robinson, David S (ENV) <david.s.robinson@state.ma.us>
Subject: RE: USACE Sandwich Section 111 Expanded Borrow Site Meeting

Good Afternoon Everyone,

Thank you in advance for your participation in tomorrow's discussion regarding the Cape Cod Canal/Town Neck Beach Section 111 feasibility study. I've attached a slide deck that we'll be working off of during the discussion. Many of you are probably familiar with the problems and opportunities at this site so we'll likely be able to skim through some of the context but I didn't want to omit those slides either, in case we did want to take a closer look at any of the background info. The primary purpose of the meeting is to give you an early look at the recommended plan, explain how we came to that recommendation and then most importantly, hear your initial thoughts in concerns with respect to environmental impacts to the sensitive resources we know exist on site. With that in mind I would imagine much of the focus would be on the last ten slides or so

Agenda

1305: Opening Remarks and Roll call

1310-1345: Project Briefing from USACE

1345 – 1500: Resource agency questions and comments.

Mike Riccio

Study Manager

U.S. Army Corps of Engineers

New England District

978.318.8685

P.S. For those of you who are unable to participate, this meeting is intended to be an early opportunity to discuss the study findings with you prior to the actual Public Notice period. To that end there will be more opportunities to discuss this in the future and we're happy to speak with any/all of you individually as you'd like. Just let us know and we'll make sure we coordinate a conversation that better fits your calendar.

DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
696 VIRGINIA ROAD
CONCORD MA 01742-2751

July 16, 2019

NOAA National Marine Fisheries Service
Protected Resources Division
55 Great Republic Drive
Gloucester, Massachusetts 01930

Attn: Michael J. Asaro, PhD

Re: NAE-2016-00624 – Town of Sandwich, Massachusetts

Dear Dr. Asaro,

This letter is to request Endangered Species Act (ESA) concurrence from your office for application NAE-2016-00624 from the Town of Sandwich, Massachusetts to excavate sand from a borrow site in Cape Cod Bay off Scusset Beach and place the sand on Town Neck Beach. We have made the determination that the proposed activity may affect, but is not likely to adversely affect, species listed as threatened or endangered by NMFS under the ESA of 1973, as amended. Our supporting analysis is provided below.

Proposed Project

A Department of the Army permit application has been submitted to excavate up to 224,500 cubic yards of sand and gravel materials from a 23 acres subtidal borrow site offshore of Scusset Beach, Sandwich, Massachusetts. The borrow site is a 17,000' long by 600' wide rectangle with a proposed project depth of -18' MLLW. The excavation depth will be from 1' to 11'. This material will be either hydraulically dredged with a cutterhead dredge or mechanically dredged with a clamshell bucket. Scows will transport the sand approximately 1 ⅓ miles to Town Neck Beach. Once there, the sand will be hydraulically pumped out of the scows onto the beach, dewatered in a bermed pit, and used for dune and beach reconstruction. The excavation and nourishment is expected to take three months. The disposal at Town Neck Beach is covered by permit NAE-2014-00259.

The material to be dredged was found suitable for unconfined disposal at Town Neck Beach based upon the results of physical testing conducted in accordance with the testing and evaluation requirements of Section 404 of the Clean Water Act. Ten sediment samples were taken from the proposed borrow pit and analyzed for grain size. The sediments were found to be predominantly mixtures of gravels and sands, with % fines ranging from 0.7% to 2.2%.

The Time of Year (TOY) restriction in the Combined Chapter 19 and 401 Water Quality Certification issued on August 2, 2018 (MA DEP, SE 66-1768) is from April 1st to October 31st.

Proposed Compensatory Mitigation

No mitigation is proposed. The project proposes to excavate an area of sand accretion and use it to nourish an eroding beach. Both the area of accretion and the area of erosion appear to be exacerbated by, if not caused by, the jetties at the mouth of the Cape Cod Canal.

Proposed Special Conditions

The following special conditions are proposed as part of the final permit to ensure that the proposed dredging project is not likely to adversely affect any listed species or critical habitat:

1. Dredge slurry shall be dewatered in a dewatering pit/trench constructed on Town Neck Beach. This will allow the suspended sediment to settle and the water to percolate through the sand back into Cape Cod Bay. The scheduling of dredging and dewatering shall be such that the capacity of the dewatering pit/trench is not exceeded under any circumstances.
2. Disposal vessels, such as tugs and scows, transiting between the borrow site and the Town Neck Beach disposal area shall operate at speeds not to exceed 10 knots. Disposal is not permitted if these requirements cannot be met due to weather or sea conditions. In that regard, the permittee and contractor shall be aware of predicted conditions before departing for the disposal site. For unanticipated conditions, a vessel may operate at a speed necessary to maintain safe maneuvering speed instead of the required less-than 10 knots. This alternative speed is justified only when the vessel is in an area where oceanographic, hydrographic and/or meteorological conditions severely restrict the maneuverability of the vessel and the need to operate at such speed is confirmed by the vessel captain. If a deviation from the 10-knot speed limit is necessary, the reasons for the deviation, the speed at which the vessel is operated, the latitude and longitude of the area, and the time and duration of such deviation shall be entered into the logbook of the vessel. The master of the vessel shall attest to the accuracy of the logbook entry by signing and dating it. The intent of this condition is to reduce the potential for vessel collisions with endangered turtles and whales.
3. A marine mammal/turtle observer with written approval from the National Marine Fisheries Service (NMFS) (https://www.greateratlantic.fisheries.noaa.gov/protected/esaobserver/index.html), and contracted and paid for by the permittee, must be present aboard disposal vessels for all transportation and disposal activities. The name of the observer must be recorded in the logbook and is required to be on lookout for marine mammals and sea turtles for the duration of the trip. If a cold-stunned turtle is discovered, the observer shall contact the Massachusetts Audubon Wellfleet Bay Wildlife Sanctuary at 508349-2615 x6104 as soon as possible and the work site or scow route will be altered for four hours to avoid it. Also, report the detection within 12 hours to NMFS Protected Resources Division (Zachary.Jylkka@noaa.gov).
4. The permittee or approved observer shall:
    a. Check https://portal.nrwbuoys.org/ab/dash/ or https://www.nefsc.noaa.gov/psb/surveys before the initial dredging operation to determine the potential presence of whales in the area; and

   b. Report whale and turtle sightings immediately to the NMFS Marine Animal Response Hotline at (866) 755-NOAA; and
   c. Report any interactions with listed species immediately to the NMFS Marine Animal Response Hotline at (866) 755-NOAA or USCG via CH-16 and immediately report any injured or dead marine mammals to NMFS at (866) 755-NOAA.
5. The vessel captain shall:
   a. Ensure that a marine mammal/turtle observer is onboard for every disposal trip;
   b. Avoid transit and disposal when visibility is lessened (e.g., at night, fog) to an extent that would preclude an endangered species observer from spotting a whale within 1,500 feet or a sea turtle within 600 feet.
   c. Employ its searchlight in low visibility situations such as stormy weather for the benefit of the observer when disposal vessels have left the borrow site and are traveling to, at, or returning from, the disposal site;
   d. Avoid harassment of or direct impact to turtles or whales except when precluded by safety considerations; and
   e. Ensure that the disposal vessel restricts approaches within 1,500 feet (500 yards) of a right whale or fin whale and 600 feet of a sea turtle.
6. No dredging shall occur from January 1st to May 15th of any year, to avoid impacts to North Atlantic Right Whales.
7. A beach monitor shall be provided by the permittee to inspect Town Neck Beach for cold-stranded turtles starting each morning before the start of daily nourishment h continuing throughout the day. If a turtle is found, it shall be removed by certified personnel and sent to an appropriate rehabilitation facility. Contact the Massachusetts Audubon Wellfleet Bay Wildlife Sanctuary at 508-349-2615 x6104 for help with stranded turtles. Also, report the stranding within 12 hours to NMFS Protected Resources Division (Zachary.Jylkka@noaa.gov).
8. The First Coast Guard District, Local Notice to Mariners Office, (617) 223-8356, and Aids to Navigation Office, (617) 223-8347, shall be notified at least ten working days in advance of the intended start date of the location and estimated duration of the dredging and disposal operations.
9. The U.S. Coast Guard, Sector Southeastern New England, Waterways Management Division, (401) 435-2351, shall be notified at least ten working days in advance of the intended start date of the location and estimated duration of the dredging and disposal operations. An alternate contact is the Coast Guard Sector Southeastern New England Command Center, Woods Hole, (508) 457-3211.
10. For the initiation of disposal activity and any time disposal operations resume after having ceased for one month or more, the permittee or the permittee's representative must notify the Corps at least ten working days before the date that disposal operations are expected to begin or resume (see below for contact and submittal information). It is not necessary to wait ten days before starting disposal operations.

Description of the Action Area

The action area includes all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. [50 CFR §402.02]. The Corps has determined the limits of the Federal undertaking and our associated "action area" for the overall maintenance dredging project. For the purpose of our Section 7 review, the Corps Federal undertaking is limited to areas below the mean high water line at the borrow site in Cape Cod Bay offshore of Scusset Beach, Sandwich, Massachusetts where dredging is proposed; the vessel travel route to and from the borrow site to the disposal beach (approximately 1 1/3 miles), and the travel route for the dredging equipment to and from the project area.

As stated above, the material to be excavated is predominately sands and gravels, with very little fines (from 2.2% to 0.7%). Therefore, there will not be increased turbidity or total suspended solids (TSS) at the borrow site except within a few feet of the cutterhead during excavation activity. There could be somewhat more turbidity at the dredge site if a clamshell bucket dredge is used. In either case, any turbidity caused by the excavation will drop back to background levels within a few hours of ceasing work.

The habitat in this part of Cape Cod Bay is described as marine subtidal with a shifting sand bottom and water depths ranging from -7' MLW to -17' MLW. The proposed dredge area does not contain any submerged aquatic vegetation (eelgrass). The project site has been identified as possible habitat for multiple federally-managed species, including Atlantic cod (*Gadus morhua*). The site is adjacent to the Cape Cod Canal.

The proposed disposal site is the beach nourishment area on Town Neck Beach, Sandwich, Massachusetts, which is permitted by Permit NAE-2014-00259.

NMFS Listed Species and Critical Habitat in the Action Area

There are two species of whales, four species of sea turtles, and two species of fish listed under the Endangered Species Act (ESA) that occur or have the potential to occur in the action area. There is North Atlantic Right Whale Critical Habitat in the action area. The ESA species are:

Whales
North Atlantic Right Whale (*Eubalaena glacialis*) (73 FR 12024; Recovery plan: NMFS 2005)
Fin Whale (*Balaenoptera physalus*) (35 FR 18319; Recovery plan: NMFS 2010)

Sea Turtles
Kemp's Ridley Turtle (*Lepidochelys kempii*) (35 FR 18319; Recovery plan: NMFS *et al.* 2011)
Leatherback Turtle (*Dermochelys coriacea*) (35 FR 849; Recovery plan: NMFS & USFWS 1992)
Loggerhead Turtle (*Caretta caretta*) (76 FR 58868; Recovery plan: NMFS & USFWS 2008)
Green Turtle (*Chelonia mydas*) (81 FR 20057; Recovery plan: NMFS & USFWS 1991)

Fish
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) (77 FR 5880 and 77 FR 5914)
Shortnose Sturgeon (*Acipenser brevirostrum*) (32 FR 4001; Recovery plan: NMFS 1998)

Critical Habitat
North Atlantic Right Whale Critical Habitat (81 FR 4837)

Sea Turtles
Four species of federally listed threatened or endangered sea turtles may be seasonally found in coastal waters of New England, including the action area. These species include the threatened Northwest Atlantic Ocean distinct population segment (DPS) of loggerhead turtles *(Caretta caretta)* and North Atlantic DPS of green turtles *(Chelonia mydas),* and the endangered Kemp's ridley turtles *(Lepidochelys kempii)* and leatherback turtles *(Dermochelys coriacea).* Sea turtles are generally distributed in coastal Atlantic waters from Florida to New England. As water temperatures of coastal New England rise in the spring, turtles begin to migrate north from their overwintering waters in the south. Sea turtles are expected to be found in the action area during the summer and fall months (May-November) when the water temperatures are at least 59° F (Shoop and Kenney 1992) with the highest concentrations of turtles from June through October (Morreale 1999; Morreale and Standora 2005). Juvenile turtles are known to use shallow water benthic areas as forage habitat. One study of juvenile Kemp's ridley turtles in Long Island Sound off New York found that the dominant dietary component was various crab species (Burke *et al.* 1994). Juvenile green and loggerhead turtles are generally omnivorous and leatherbacks prefer pelagic jellyfish.

Like other reptiles, most sea turtles are poikilothermous. As these turtles migrate south beginning in October, some do not leave the northern latitudes before the water temperatures drop below 60° F and they have a hypothermic reaction, which causes lethargy, shock, pneumonia, and often death. Many of these "cold-stunned" turtles wash ashore on Cape Cod beaches (see Figures 1 and 4, (Massachusetts Audubon Society, 2018)).

ESA-listed sea turtles may be migrating through the action area from late October to December. Cold-stunned juvenile Kemp's ridley, loggerhead, and green sea turtles have been found on the disposal beach from late October through December (See Figures 2, 3, and 5, (Massachusetts Audubon Society 2018)). Stranded sea turtles found in November or December are not likely to be found alive or responsive to rehabilitation efforts (Mark Fahey, Massachusetts Audubon). In last weeks of November 2018, 227 sea turtles were found on Cape Cod beaches. Of these, 76% (173) died and 24% (54) survived. (Katz, 2018) Of turtles that stranded earlier in the 2018 season, 20% died and 80% survived (Nett, 2018). Leatherback turtles are rarely found cold-stunned, as this species is facultative endothermic. A mid-October through December TOY restriction would prevent impacts to cold-stunned turtles. However, this TOY restriction, in conjunction with the other TOY restrictions required by other agencies, would make it nearly impossible for the applicants to perform their dredging and beach nourishment. Therefore, the Corps is proposing to allow this work to occur between October 15th and December 31th and has proposed special conditions to avoid impacts to sea turtles during this time period.

Atlantic Sturgeon

There are four DPSs where Atlantic sturgeon are listed as endangered (New York Bight, Chesapeake Bay, Carolina, and South Atlantic) and one DPS (Gulf of Maine) where they are listed as threatened under the ESA. The marine range for all five DPSs includes marine waters, coastal bays, and estuaries from the Labrador Inlet in Labrador, Canada to Cape Canaveral, Florida. Available information on the distribution of Atlantic sturgeon indicates that a majority of the Atlantic sturgeon in the action area will be from the Gulf of Maine (GOM) DPS with a small chance of the individuals from the New York Bight (NYB) DPS occurring in the action area (Damon-Randall *et al.* 2012).

Atlantic sturgeon are bottom feeders that draw food into a ventrally located, protrusable mouth (Bigelow and Schroeder 1953). The diet of adult and subadult Atlantic sturgeon includes mollusks, gastropods, amphipods, decapods, isopods, and fish (Bigelow and Schroder 1953; ASSRT 2007; Guilbard *et al.* 2007; Savoy 2007). Atlantic sturgeon presence is strongly associated with the availability of prey and, as a result, sturgeon may occur in any marine location where suitable forage and habitat are available. Multiple studies have shown that soft substrates, such as sand and mud, and the proximity to the salt front of tidally influenced rivers constitute ideal forage conditions for Atlantic sturgeon (Bigelow and Schroeder 1953; Brunage and Meadows 1982; Johnson *et al.* 1997; Collins *et al.* 2000; Savoy and Pacileo 2003; Guilbard *et al.* 2007; Savoy 2007; Dzaugis 2013; McLean *et al.* 2013). The project site provides the preferred soft substrates for foraging with its sand substrate but is not near to any tidally influenced rivers. The vessel travel route likely does contain preferred soft substrates, but does not have proximity to any tidally influenced rivers.

Atlantic sturgeon spawning and early life stages occur in freshwater rivers. Early life stages and young of the year have limited tolerance to salinity and can tolerate salinity levels no more than 0.5 parts per thousand (ppt). Early life stages and young of the year remain in the freshwater reaches of their natal river until reaching the subadult stage when individuals have a higher tolerance for salinities between 0.5 ppt and 30 ppt. No spawning or early life stages of Atlantic sturgeon occur in any part of the action area waters as these environments all have a salinity higher than 0.5 ppt.

Due to the presence of possible foraging areas throughout the action areas, it is possible that Atlantic sturgeon could occupy the action area within the dredge footprint and vessel travel routes. Subadult and adult Atlantic sturgeon could be found in the action areas year round as they migrate through or opportunistically feed.

Shortnose Sturgeon

Shortnose sturgeon occur in rivers and estuaries along the east coast of the U.S. and Canada (SSSRT, 2010). There are 19 documented populations of shortnose sturgeon, with the population closest to the action area occurring more than 20 miles north of the project site in the Merrimack River. Recent research has demonstrated that shortnose sturgeon leave their natal estuaries, undergo coastal migrations, and use other river systems to a greater extent than previously thought. Within the Gulf of Maine, a portion of adults make seasonal migrations along the coast, traveling between the Penobscot, Kennebec and Merrimack rivers and making short stops in smaller coastal rivers along this route (Zydlewski et al. 2011). Outside the Gulf of Maine, marine migrations have only rarely been documented. Some shortnose sturgeon captured and/or tagged in the Connecticut River have been recaptured, detected, or were previously tagged in the Housatonic River (T. Savoy, CT DEP, pers. comm. 2015), the Hudson River (Savoy 2004), and the Merrimack River (M. Kieffer, USGS, pers. comm. 2015). At this time, the available tagging and tracking information is too limited to determine if Hudson River and Connecticut River shortnose sturgeon are making regular movements outside of their natal rivers and whether movement as far as the Merrimack River is a normal behavior. We expect shortnose sturgeon to overwinter in the rivers, so the time of year for coastal migrations would be roughly from April 1-November 30. These coastal migrations may occur within the 164 foot (50 meter) depth contour.

As with the Atlantic sturgeon, spawning and early life stages of the shortnose sturgeon only occur in freshwater habitats. Therefore, no life stages other than salinity tolerant adults should occur in the action area. It is possible that migrating or opportunistically feeding shortnose sturgeon may be present in the action area, but due to the lack of documented shortnose sturgeon coastal migrations in the area, their presence is expected to be rare.

Whales

Two species of federally listed endangered whales are found in coastal waters of New England. These species are the North Atlantic right whale *(Eubalaena glacialis)* and fin whale *(Balaenoptera physalus)*. Sei whales *(Balaenoptera borealis)* and sperm whales *(Physeter macrocephalus)* are also seasonally present in New England waters but are typically found in waters further offshore than those in the action area, and therefore are not considered in this consultation. Fin whales are generally present in the waters of Massachusetts Bay year round, but are at their highest densities from March to August. Right whales are generally present in Massachusetts waters year round, but are at their highest densities from January to April when foraging. The seasonal presence of right whales in Massachusetts waters is closely associated with the seasonal presence of zooplankton *(Calanus finmarchicus)*.

Right whales are regularly sighted in Cape Cod Bay and occasionally along the vessel route that will be utilized by the dredging scow to Town Neck Beach. (NOAA NEFSC 2019). NOAA GARFO-PRD recommended a January 1 to May 15 TOY restriction to avoid impacts to right whales.

Right Whale Critical Habitat

The action area associated with the borrow site and the route that the transiting scow will take to the beach disposal site is located within designated North Atlantic Right Whale Critical Habitat. Critical habitat is defined by Section 3 of the ESA as "(1) the specific areas within the geographical area occupied by the species, at the time it is listed, on which are found those physical or biological features (a) essential to the conservation of the species and (b) which may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time it is listed, upon a determination by the Secretary that such areas are essential for the conservation of the species (NOAA, 2016)."

The final rule (81 FR 4837) identifies the following four physical and biological features of foraging habitat that are essential to the conservation of the right whale: (1) The physical oceanographic conditions and structures of the Gulf of Maine and Georges Bank region that combine to distribute and aggregate *Calanus finmarchicus* for right whale foraging, namely prevailing currents and circulation patterns, bathymetric features (basins, banks, and channels), oceanic fronts, density gradients, and temperature regimes; (2) Low flow velocities in the Jordan, Wilkinson, and Georges Basins that allow diapausing *C. finmarchicus* to aggregate passively below the convective layer so that the copepods are retained in the basins; (3) Late stage *C. finmarchicus* in dense aggregations in the Gulf of Maine and Georges Bank region; and (4) Diapausing *C. finmarchicus* in aggregations in the Gulf of Maine and Georges Bank region.

While the action area overlaps with designated critical habitat, only one of the four physical and biological features essential to right whale foraging, as described above, may occur (i.e., feature 1, the physical oceanographic conditions and structures of the Gulf of Maine and Georges Bank region that combine to distribute and aggregate *Calanus finmarchicus).* This project won't change or impact essential features of the conservation of the North Atlantic North Whale.

Effects Determination

<u>Vessel Traffic</u>

Collisions

Collisions with vessels are a significant source of anthropogenic mortality for sea turtles, whales, and sturgeon. The risks of collisions during the project work and after the work is completed were evaluated. The following is the analysis.

We evaluated whether an increase in vessel traffic during the work due to the transport of dredged material for disposal at Town Neck Beach would increase the risk of interactions between ESA-listed species and scows, in comparison with baseline conditions. The proposed project will cause a small and temporary increase in vessel traffic for the area.

The area of Cape Cod Bay in the vicinity of the Cape Cod Canal is already subject to moderate vessel traffic. In the period from 2014 to 2018, averages of 664 vessels in October, 624 vessels in November and 555 vessels in December transited the Cape Cod Canal (Phoebe Chu, CENAE-ODC, personal communication, 2019). Note that CENAE only tracks vessels longer than 65' long; there will be many smaller vessels transiting the canal in these months that are not represented by these data. The Sandwich Marina informed us that about 40 fishing vessels would be running daily in and out of the end of the canal until about the 1st to 2nd week of December when they pull their traps for the season. The marina contact also said they have about 10 pleasure craft that intermittently transit the area at that time of year (personal communication, 2019). The applicants anticipate that the dredge scow will travel to and from the dredge site and the beach site ~75 times over the course of 3 months (12 weeks) during dredge disposal operations. This is an increase of vessel traffic of 2.9% over these 3 months[1]. Special conditions (including observer presence on trips to the beach) listed in a previous section will be incorporated into the final permit to reduce the potential of NMFS-listed species being struck by the scow. When added to baseline conditions, the slight increase in risk associated with vessel traffic as part of the proposed project in the waters within Cape Cod Bay, will be too small to be meaningfully measured or detected and therefore have an insignificant impact on listed species.

After the work is completed, the proposed project will lead neither to a permanent increase in the area used for recreational vessel traffic nor to a permanent increase in vessel traffic in the Action Area. Therefore, there will be no increase in risk of vessel strikes when the work is completed.

We also evaluated different methods for reducing the possibilities of vessel strikes on cold-stunned sea turtles. These methods included using observers, divers, underwater cameras, drones, side-scan sonar, TOY restrictions, using an underwater pipeline for discharging the sand onto the beach, and using a trawl to capture stranded turtles. The following is a discussion of each.

There are no accepted, well-researched methods to avoid vessel strikes of cold-stunned turtles in New England waters. Researchers in the field, Dena Dickerson (USACE-ERDC), Lisa Finn (USACE-SWG), and Donna Shaver (National Park Service, Padre Island National Seashore), have remarked that they are unfamiliar with any Corps district requiring or using a TOY restriction to protect cold-stunned turtles (personal communications, May 2019).

Nevertheless, we examined the effectiveness of using divers, and/or underwater cameras to observe turtles in the water.

Dena Dickerson (personal conversation, 2019) did not recommend the use of acoustic cameras in this project. She said that this technique is not ready for routine use while dredging. Another A problem with both of these techniques is what to do if a stunned turtle were observed. Recovering the turtle would be difficult, possibly dangerous to the boat crew, and would be considered an unpermitted "take".

A side-scan sonar survey could potentially be able to detect turtles on the bottom in the turbid water at the excavation site and along the path to the disposal beach. Sonar surveys are considered a useful preliminary detection tool for large aquatic reptiles but do not directly facilitate identification or capture (Davy & Fenton, 2013). Based on discussions with Dena

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[1] The applicants estimate that during the three month dredge season they will have to make 75 round trips between the borrow pit and beach or 150 trips in total. The CENAE-ODC data give a 5-year average of 1907.6 canal vessel trips for the three month dredge season (675.4. for October, 622.8 for November, and 609.4 for December). (Note that these averages do not include trips by vessels less than 65' long or by the MV Viking, which gives sightseeing cruises of the Canal but doesn't leave it.) The Sandwich Marina estimates that about 80 round trips per day during October and November. When these 80 round trips per day are multiplied by 20 work days per month and by 2 months, the total vessel trips is 3200. When the CENAE-ODC three-month average is added to the total from Sandwich Marina, there is a total of 5107.6 vessel trips into Cape Cod Bay. The 150 scow trips will increase this total by 2.9%. Note that this estimated total of 5107.6 vessel trips is probably lower than the actual number, as the CENAE-ODC data does not count vessels shorter than 65' long.

Dickerson, any sea turtle found on the bottom during the proposed time of year is likely to be drowned as a result of being cold-stunned and so a side-scan sonar survey would not be practical.

In addition, because of the general poor visibility in New England inshore waters (20' to 40'maximum, Personal observation, Phillip Nimeskern), trying to observe turtles in the water using divers, underwater cameras, or drones would be ineffective or impracticable.

Limiting the number of vessel trips for disposal was also evaluated. An underwater pipeline to carry the dredge slurry from the excavation site to the disposal beach could lessen the likelihood of vessel strikes. However, it would be not be practical for this distance, in that it would need booster pumps to move the sand along a 1 mile long pipe and may not even work. The pipeline would also have to cross a Federal Navigation Project channel and would likely interfere with navigation.

Using a trawl to capture and remove stunned turtles, as performed in the southeastern states during summer dredging projects, at first appeared to be a method to preemptively avoid strikes and to remove cold stunned turtles to a rehabilitation center (Bargo, et al., 2005; personal communication, Kara Dodge). Bycatch could be minimized by having appropriate netting size and net design. However, this procedure would be very dangerous to cold-stunned turtles. It is physiologically stressful to even healthy turtles because it drags them around underwater. In addition, any turtle captured would be considered an unpermitted "take" and the cost would be high, considering the relatively low concentration of sea turtles in the action area. We are not presently considering this alternative

Based on the above discussion, observers on disposal vessels appear to be the best alternative to reduce the likelihood of a vessel strike.

Entrapment in Hydraulic Cutterhead or Mechanical Dredges

Sea turtles

Sea turtles are known to be vulnerable to capture in hydraulic hopper dredges, in particular, loggerhead, green, and Kemp's ridley turtles, because of their life histories and behavioral patterns. However, due to the operational nature of hydraulic cutterhead dredges, fewer than 5 sea turtle entrainment incidents have been documented from this type of dredging equipment in over 35 years of monitoring dredging impacts on sea turtles. The slow-moving dredging head for a cutterhead dredge must be buried into the sediment to allow the dredging action to happen. Therefore, pelagic turtles or even turtles swimming near the ocean floor would not be vulnerable to being entrained by these type of equipment. (Personal communication, Dena Dickerson, (USACE ERDC)).

Although sea turtles (leatherback, loggerhead, green, and Kemp's ridley) can be found in New England waters, they usually migrate south in the fall. A few hardshelled marine turtles, between 1 and 5 during a five-year period, have been found cold-stunned on the beach adjacent to the proposed borrow pit from late October to December (See Figure 1). Thus, a sea turtle could be present at the dredge site during dredging operations in the late fall or winter. If the applicants use a hydraulic cutterhead dredge, floating cold-stunned turtles won't be vulnerable to being entrained by the dredging action of this type of dredge (Personal communication, Dena Dickerson; NMFS, 2013). Cold-stunned sea turtles may in be at or near the bottom of the water column. However, given that only a few sea turtles have stranded in the action area each year, we assume that if present, they would be sparsely distributed in the dredge area. Also, in order to be entrained, sea turtles would have to be in the direct path of the dredge, be essentially on the substrate and not show a startle response to avoid the dredge. Therefore, the chances of an interaction with a live turtle are extremely unlikely, and discountable.

Sea turtles are unlikely to be captured in clamshell bucket dredges, even if cold-stunned. This method of dredging has been shown to reduce or eliminate the take of sea turtles (Henwood, 1990). For a turtle to be captured, it would have to be directly underneath the bucket as it is dropped through the water column to the bottom. If the turtle is healthy, it would be easy for the animal to detect and avoid the noisy and slow moving bucket (NMFS, 2013). If it is cold-stunned, a floating turtle could be avoided by the crane operator and a turtle on the bottom would most likely be dead. In addition, the probability is low that a cold-stunned turtle would be found in the project area. Therefore, capture by clamshell bucket is unlikely and discountable.

During the same five-year period, between 1 and 21 turtles were found cold-stunned on or near the Town Neck Beach (See Figure 2). Cold-stunned turtles found on beaches are under the authority of the US Fish and Wildlife Service. If the receiving beach were nourished during the months of October through December, cold-stunned turtles that had beached themselves would be at risk of being buried. The risk of such burial could be minimized by having a turtle observer inspect the beach before the start of each day's disposal. This observer would contact the sea turtle stranding network if a stranded turtle were found. The permit will be so conditioned.

Sturgeon

Entrapment by hydraulic hopper dredges may kill or injure sturgeon. However, the applicant would be using a hydraulic cutterhead dredge. The slow-moving dredging head for a cutterhead dredge must be buried deep into the sediment to allow the dredging action to happen. In order for sturgeon to be captured by the dredge, they would have to be on the bottom directly below and in front of the cutterhead as it impacts the substrate and to remain stationary. Sturgeon do occur on the bottom, especially when engaging in foraging behaviors. Based on past interactions between dredges and sturgeon, we believe the greatest risk of capture is when dredging occurs in areas where sturgeon are densely aggregated with sedentary behavior in overwintering areas. We do not expect either species of sturgeon to overwinter in the action area, as shortnose generally overwinter in the freshwater portions of rivers (most being rivers with shortnose sturgeon spawning populations), and Atlantic sturgeon usually overwinter in offshore areas deeper than the borrow pit area. Based on this information, it is extremely unlikely that a sturgeon would be captured by a hydraulic cutterhead dredge head operating within the Action Area. Therefore, effects of entrapment of sturgeon from the proposed project are discountable.

Entrapment by clamshell bucket dredges could kill or injure sturgeon. In order for sturgeon to be captured by the dredge, they would have to be on the bottom directly below clamshell as it impacts the substrate and to remain stationary. Based on past interactions between dredges and sturgeon, we believe the greatest risk of capture is when dredging occurs in areas where sturgeon are densely aggregated with sedentary behavior in overwintering areas. We do not expect either species of sturgeon to overwinter in the action area, as discussed in the previous paragraph. Based on this information, it is extremely unlikely that a sturgeon would be captured by a clamshell bucket dredge operating within the Action Area. Therefore, effects of entrapment of sturgeon from using a clamshell bucket are discountable.

Whales
Although whales could be found in the vicinity of the borrow pit, they are too large to be at risk of entrapment or impingement and will not be affected.

Water Quality Effects from Dredging and Disposal

This sandy material will be dredged at the borrow site and transported by scow to Town Neck Beach, where it will be pumped out onto the beach, dewatered, and used for dune and beach reconstruction. Total Suspended Solids (TSS) concentrations associated with cutterhead dredging operations have been shown to increase above background levels only in the immediate vicinity of the cutter, when dredging fine grain material (USACE 2015). Thickness of the cut, rate of swing, and cutterhead rotation rates all appear to cause increases of suspended sediment at the dredge site (USACE 2015). Little of the turbidity caused by the cutterhead goes up into the upper water column (USACE 2015). Based on these studies, elevated suspended sediment concentrations at few hundreds of mg/L above background could be present in the immediate vicinity of the cutterhead, but would reach background concentration levels within approximately 239 feet (73 meters) of the dredge location, if fine-grained sediments were being dredged. As only sands and fine gravels will be dredged in this project, which contains much less silt and clay than the materials in the above studies, we can expect background levels to be reached within even smaller distances. No dewatering of scows will be allowed during dredging so we don't anticipate any additional turbidity from this source.

Clamshell dredging operations have been shown to increase turbidity levels above background levels at the dredge site, particularly when fine grain material (USACE 2015). This increase in turbidity comes from four major sources: sediment suspension occurring upon bucket impact and withdrawal from the bottom; loss of material from the top and sides of a bucket as it is pulled up through the water column; spillage of turbid water out of the bucket when it breaks the water surface; and inadvertent spillage of material during barge loading or intentional overflow operations intended to increase barge effective load. The amount of turbidity caused by a clamshell dredge is subject to a number of variables, such as sediment type, bucket size and type, volume of sediment dredged, hoisting speed, and hydrodynamic conditions at the dredging site (USACE 2015). Two turbidity plumes can be caused by a clamshell dredge; one near the surface and the other near the bottom (USACE 2015). In the surface plumes, suspended sediment concentrations of less than 500 mg/L above background been recorded in the immediate vicinity of the dredge, but would reach background concentration levels within approximately 239 feet (73 meters) of the dredge location, if fine-grained sediments were being dredged. A general pattern for the spatial extent of sediment suspension from a clamshell bucket is that a downstream turbidity plume extends 1,000 feet (300 meters) at the surface and 1,600 feet (500 meters) at the bottom (depth dependent). Average surface water column concentrations are generally less than 100 mg/L, while near-bottom concentrations are usually higher (USACE 2015). As only sands and fine gravels will be dredged in this project, which contains much less silt and clay than the materials in the above studies, we can expect background levels to be reached within even smaller distances. No dewatering of scows will be allowed during dredging so we don't anticipate any additional turbidity from this source.

At the receiving beach, the sand will be hydraulically pumped from the scows to a bermed dewatering area, which will remove any suspended solids from the return water. The beach nourishment activity should not cause significant turbidity.

Sturgeon
The life stages of sturgeon most vulnerable to increased sediment are eggs and non-mobile larvae, which are subject to burial and suffocation. As discussed above, the action area for this project is composed of entirely saline waters that are not suitable for any sturgeon life stages other than subadults and adults. Therefore, neither sturgeon eggs nor non-mobile larvae will be present.

Elevated total suspended solids (TSS) levels could affect adult sturgeon if a plume causes a barrier to normal behaviors, but effects to sturgeon from exposure to the sediment plume are expected to be limited to behavioral responses. Sturgeon are highly mobile and they can avoid a sediment plume with minor movements to alter course out of the sediment plume. The proposed project will dredge predominantly sands and gravels which will not elevate TSS to levels or the length of time cause a plume detectable beyond the dredge area. In addition, the project is thus not likely to permanently alter the habitat in any way that prevents sturgeon from using any portion of the action area. Based on this information, any effects on sturgeon of suspended sediment resulting from the proposed dredging and disposal activities would be too small to be meaningfully measured or detected when added to the existing conditions, and are insignificant.

Studies on the effects of turbid waters on fish suggest that concentrations of total suspended solids will reach thousands of milligrams per liter before an acute toxic reaction is expected. The TSS levels we can expect for this dredging project are below those shown to have an adverse effect on fish, which generally range from 580 mg/L for sensitive fish to 1,000 mg/L for non-sensitive fish (Burton 1993). As the highest levels of TSS from this project will not reach these injurious levels, adverse effects will not occur.

Sea Turtles
No information is available on the effects of TSS on juvenile and adult sea turtles. Turtles are air-breathing vertebrates that have eyelids which they can blink to protect their eyes. Elevated TSS levels could affect sea turtles if a plume causes a barrier to normal behaviors. If migrating or foraging sea turtles are exposed to sediment plumes from the dredging, effects are anticipated to only be behavioral, as the sea turtles could make minor movements to avoid the sediment plumes. In addition, the material to be dredged consists of sands and gravels and very little TSS causing fines. Based on this information, the effect of any minor movements to avoid sediment plumes, which will be thin and small, on the species' fitness or essential behaviors are too small to be meaningfully measured or detected, and are therefore insignificant.

Whales

No information is available on the effects of TSS on juvenile and adult whales. Whales breathe air and have eyelids and Harderian glands which protect their eyes from suspended particulates (Ocean Adventures 2017). Elevated TSS levels could affect whales if a plume causes a barrier to normal behaviors. If migrating and foraging whales are exposed to sediment plumes from the excavation, effects are anticipated to only be behavioral as the whales could make minor movements to avoid the plumes. Based on this information, the effect of any minor movements to avoid sediment plumes on the species' fitness or essential behaviors are too small to be meaningfully measured or detected, and are therefore insignificant.

Habitat Modification

Effects to listed species can be caused by disturbance to the bottom such that the availability of prey species is reduced or that the composition of forage is altered. Activities that may alter the sea floor, reduce availability of prey species, or alter the composition of forage include the dredging of the borrow site (23 acres). The action area has been shown to contain suitable habitat for shellfish and consists of substrate that would support small benthic organisms. Both sea turtles and sturgeon could opportunistically utilize the dredge area and the subtidal potion of the disposal area for foraging based on current conditions. Fin whales and right whales are both filter feeders that feed on aggregations of pelagic organisms. The shallowness of the project area (1' to 17' deep) does not provide good foraging for whales and the dredging of the borrow pit will not make it better or worse.

Some TSS levels that could be found as a result of dredging (up to 445 mg/L) are above those shown to have adverse effect on benthic communities (390.0 mg/L, (EPA, 1986)). Studies done by Wilbur and Clarke (2007) demonstrated that benthic communities in temperate regions occupying shallow waters with substrate of sand, silt, or clay show recovery times between 1 and 11 months after dredging. We can expect that benthic communities within the dredged area will recover within a year of dredging and the proposed project will not result in permanent removal of foraging resources in the area. We do not expect the project to negatively impact eelgrass beds. In addition, there are a variety of foraging resources in the action area immediately outside of the dredge footprint in Cape Cod Bay which sea turtles and sturgeon will still be able to utilize while the benthic communities within the action area recover. Taking these factors into consideration, effects from the dredging of the area when added to the baseline will be too small to be meaningfully measured or detected, and are therefore insignificant on the sea turtle, sturgeon and whale habitats.

Project plans require the placement of sand at Town Neck Beach to be on and above the intertidal area so that the vegetated rocky intertidal areas are not directly impacted. While there is likely to be some temporary reduction in the amount of prey in, and directly adjacent to, Town Neck Beach, this action will result in the temporary loss of only a small portion of the available forage in the action area. Therefore, sturgeon and sea turtles will be able to opportunistically forage throughout the rest of the action area, where intertidal benthic communities have not been impacted. This activity will not impact foraging for whales. In summary, the effects of dredge material disposal at the Town Neck Beach on food resources for sea turtles, sturgeon, and whales are too small to be meaningfully measured or detected and are therefore, insignificant.

North Atlantic Right Whale Critical Habitat
As stated above, physical and biological feature #1 of designated North Atlantic right whale critical habitat (i.e., the physical oceanographic conditions and structures of the Gulf of Maine and Georges Bank region that combine to distribute and aggregate *Calanus finmarchicus*) may occur in the action area. The disposal scow transiting from the dredge site to the disposal beach will not result in environmental effects including increased turbidity, disturbance of benthic communities, elevated sound pressure, and resuspension of contaminants and toxins. The proposed excavation of gravelly and sandy material is anticipated to have a temporary effect on the site as a result of slightly and temporarily increased turbidity and disturbance to benthic communities, but this effect is anticipated to last no more than a maximum of a few hours post disposal, and will not affect whale foraging areas. Based on the best available information, we conclude that the proposed action will not affect physical and biological feature #1, or any of the other physical and biological features for right whale critical habitat.

Conclusions

Based on the analysis that all effects of the proposed action, when added to the baseline and with the special conditions included, will be insignificant and/or discountable, the Corps has determined that the proposed action is not likely to adversely affect any listed species and will have no effect on critical habitat under NMFS' jurisdiction. We certify that we have used the best scientific and commercial data available to complete this analysis. We request your concurrence with this determination.

If you have any questions, please contact Phillip Nimeskern of my staff at (978) 318-8660 or phillip.w.nimeskern@usace.army.mil.

Sincerely,

Barbara H. Newman

Barbara H. Newman
Chief, Permits & Enforcement Branch
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Copy furnished:

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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

REC
JUL 3 1 2019
BY:

Barbara Newman
Chief, Permits and Enforcement Branch, Regulatory Division
Department of the Army, Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742-2751

Re: NAE-2018-00624 Town of Sandwich Dredging and Beach Nourishment

Dear Ms. Newman:

We have completed our consultation under section 7 of the Endangered Species Act (ESA) in response to your letter received on July 18, 2019, and email providing additional information received July 24, 2019, regarding the above-referenced proposed project. We reviewed your consultation request document and related materials. Because you made a "no effect" determination for North Atlantic right whale critical habitat, we will not consider right whale critical habitat in this consultation. Based on our knowledge, expertise, and your materials, we concur with your conclusion that the proposed action is not likely to adversely affect any National Marine Fisheries Service (NMFS) ESA-listed species. Therefore, no further consultation pursuant to section 7 of the ESA is required.

Based on your email received July 24, 2019, all in-water work will occur from October 1 through December 31. You anticipate that the project may begin as soon as the fall of 2019; however, the permit will extend through the fall of 2021. Based on the assessment of Kate Sampson (NMFS Sea Turtle Stranding and Disentanglement Coordinator) and Bob Prescott (Director, Mass Audubon Wellfleet Bay Wildlife Sanctuary), we disagree with your assessment that any sea turtles found at or near the bottom of the water column from October 1 through December 31 are likely to be drowned (p. 9-10). However, we agree that cold-stunned sea turtles have not been found in high concentrations in the action area, and that an interaction between a sea turtle and a mechanical or cutterhead dredge is extremely unlikely to occur. Therefore, effects are discountable.

Reinitiation of consultation is required and shall be requested by the lead federal agency or by us, where discretionary federal involvement or control over the action has been retained or is authorized by law and: (a) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in the consultation; (b) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this consultation; or, (c) If a new species is listed or critical habitat designated that may be affected by the identified action. No take is anticipated or exempted. If there is any incidental take of a listed species, reinitiation would be required. Should you have any questions about this correspondence please contact Zachary Jylkka at (978) 282-8467 or by email (Zachary.Jylkka@noaa.gov). For questions related to Essential Fish Habitat, please contact Alison Verkade with our Habitat Conservation Division at (978)-281-9266 or at Alison.Verkade@noaa.gov.

Sincerely,

Michael J. Asaro, PhD
Acting Assistant Regional Administrator
for Protected Resources

EC:	Verkade, NMFS/HCD; Newman, USACE
ECO:	GARFO-2019-01943
File Code:	H:\Section 7 Team\Section 7\Non-Fisheries\ACOE\Informal\2019\New England\NAE-2018-00624 Town of Sandwich Dredging and Beach Nourishment

DEPARTMENT OF THE ARMY
US ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
696 VIRGINIA ROAD
CONCORD MA 01742-2751

July 22, 2020

Planning Division
Environmental Branch

Ms. Brona Simon, Executive Director and State Historic Preservation Officer
Massachusetts Historical Commission
The Massachusetts State Archives Building
220 Morrissey Boulevard
Boston, Massachusetts 02125

Dear Ms. Simon:

The U.S. Army Corps of Engineers (USACE), New England District is preparing an Environmental Assessment for a Section 111 Mitigation of Damage Caused by a Federal Navigation Project Feasibility Study at the Town Neck area in Sandwich, Massachusetts (see enclosures). We would like your formal comments in accordance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended.

The purpose of the study is to evaluate options for mitigating the impacts of erosion directly attributable to the Cape Cod Canal and its influence on sediment migration through the littoral system, specifically at Town Neck Beach and downtown Sandwich. The study area encompasses the shoreline from Scusset Beach south to Springhill Beach, and the town of Sandwich is the study sponsor.

Jetties at the mouth of the Canal interrupt natural alongshore sediment transport resulting in erosion to the downdrift shoreline. The continued erosion now presents an imminent threat to both public and private property and infrastructure. Structures along the shoreline are vulnerable to catastrophic failure including the downtown public infrastructure. Additionally, the 600+ acre natural salt marsh habitat behind the beach is vulnerable to failure if the dune were to be breached.

The USACE has evaluated a number of both structural (seawalls, revetments, breakwaters, groins and jetties) and non-structural (elevation, flood proofing, and acquisition/buyouts) alternatives, including beach nourishment. The recommended plan is the placement of approximately 388,000 cubic yards of sand onto Town Neck Beach, material that will be dredged from the nearshore borrow site off Scusset Beach.

A review of the historic and archaeological site files from the Massachusetts Cultural Resources Information System (MACRIS) online database identified several historic properties within the project's area of potential effect (APE). One site, 19-BN-547 Town Neck Road, is listed as a pre-Contact archaeological site along the shoreline and extending inland, just south of the Canal. No further information is available. Several National Register historic districts are located inland including the Jarvesville, Town Hall Square, and Spring Hill Historic Districts as well as local districts including Town Neck and the Old King's Highway Regional Historic District.

A brick kiln or brickyard site is depicted on the 1857 Walling map at Town Neck and available on the Town of Sandwich Historical Commission's website (https://sandwichhistory.org/a-brickyard-at-town-neck/). According to the Town, "a lens of fine clay suitable for brick making was discovered, perhaps as early 1790 when construction of houses and mills picked up in earnest." Bricks and ash from the brick kiln have been exposed along the shore by erosion and were reported in 2015. The placement of sand along Town Neck Beach as beach nourishment should help protect any existing remnants from the brickyard while addressing the erosion of the shoreline.

A review of shipwreck databases identified several submerged historic properties well off the coast of Sandwich. One unknown wreck is depicted off Scusset Beach in the vicinity of the proposed borrow area. Gray and Pape conducted a remote sensing archaeological survey in 2016 as part of the permitting process for the current borrow area. No submerged historic properties were identified. No visible remains of the unknown wreck above were noted in the field. No further investigations were recommended.

Therefore, we believe that the placement of beach nourishment material along Town Neck Beach obtained from the Scusset Beach nearshore borrow site will have no adverse effect upon significant historic properties as defined by Section 106 of the NHPA and implementing regulations 36 CFR 800. We would appreciate your concurrence with this determination.

If you have any questions, please contact Mr. Marc Paiva, Archaeologist of the Environmental Branch at 978-318-8796 or by email at: Marcos.A.Paiva@usace.army.mil or Mr. Michael Riccio, Study Manager at 978-318-8685 or by email at Michael.S.Riccio@usace.army.mil.

Sincerely,

John R. Kennelly
Chief, Planning Division

Enclosures

Email copies to be furnished (with enclosures):

Mr. David S. Robinson, Chief Archaeologist/State Underwater Archaeologist
Massachusetts Board of Underwater Archaeological Resources
251 Causeway Street, Suite 800
Boston, Massachusetts 02114-2199

Mr. David Weeden, Tribal Historic Preservation Officer
Mashpee Wampanoag Tribe
483 Great Neck Road South
Mashpee, Massachusetts 02649

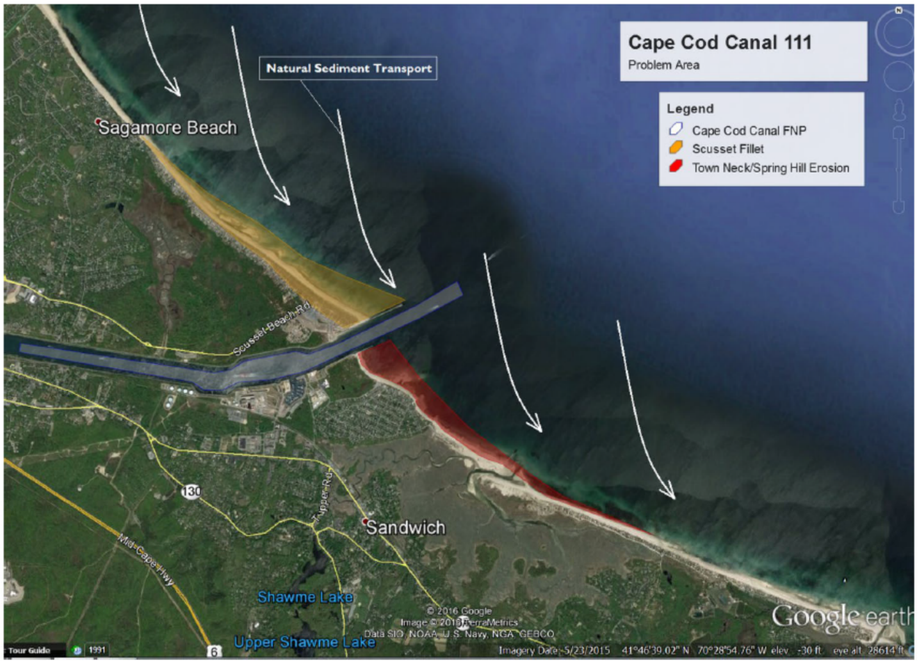
Ms. Bettina Washington, Tribal Historic Preservation Officer
Wampanoag Tribe of Gay Head (Aquinnah)
20 Black Brook Road
Aquinnah, Massachusetts 02135

Sandwich Historical Commission
Attn: Town Archivist
142 Main Street
Sandwich, Massachusetts 02563


3
PROBLEMS/OPPORTUNITIES
U.S.ARMY
Scusset Beach
Town Neck Beach
Old Sandwich Harbor Inlet
Spring Hill Beach
Great Marsh
Route 6A
(Historic Downtown Sandwich

4

PROBLEMS/OPPORTUNITIES



Jetties at the mouth of the Canal interrupt natural alongshore sediment transport resulting in significant erosion to the downdrift shoreline. The continued erosion now presents an imminent threat to both public and private, property and infrastructure.


42
RECOMMENDED PLAN
Scusset Borrow Area
Alternative 1 A/E
Beach Nourishment at Town Neck Beach
Footprint: 388,000 cy
Source: Scusset Beach
Town Neck Beach
Placement Area
Google Earth

7

PROBLEMS/OPPORTUNITIES

CAPE COD CANAL & SANDWICH BEACHES

SHORE DAMAGE MITIGATION STUDY

APPENDIX A2

PRELIMINARY COASTAL ZONE MANAGEMENT CONSISTENCY DETERMINATION

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Cape Cod Canal and Sandwich Beaches
Section 111 Shore Damage Mitigation Study
Preliminary Coastal Zone Management Consistency Determination

Below are the applicable enforceable policies of the Massachusetts Coastal Zone Management Program along with a Summary Statement below each Policy. Below each Policy and Summary Statement is pertinent information relative to the U.S. Army Corps of Engineers (USACE) proposal to dredge material from the Scusset borrow site and place it on Town Neck Beach in Sandwich, Massachusetts. This consistency determination is preliminary as all details of the project are not yet final. A final CZM consistency determination will be prepared and provided during the next phase of the project. A map of the proposed project locations is provided in Figure 1.

<u>COASTAL HAZARDS POLICY #1</u> - *Preserve, protect, restore, and enhance the beneficial functions of storm damage prevention and flood control provided by natural coastal landforms, such as dunes, beaches, barrier beaches, coastal banks, land subject to coastal storm flowage, salt marshes, and land under the ocean.*

Town Neck Beach has a history of erosion which has long been assumed to be caused by the construction of jetties at the east end of the Cape Cod Canal in 1906. The USACE's Cape Cod Canal Section 111 Coastal Shore Damage Mitigation Study has now demonstrated that the Canal jetties cause an interruption in the natural longshore sediment transport from northwest to southeast. The influence of the Canal jetties has limited the sediment supply to the downdrift beaches such that the system cannot maintain a healthy beach and dune complex. Over time, the dunes have narrowed and now offer a minimal amount of remaining sediment. Hundreds of thousands of cubic yards of sand that would naturally transport onto Sandwich's beaches have been trapped at the western jetty, or within the Cape Cod Canal, and subsequently been dredged and disposed offshore. Without natural sediment transport, Town Neck Beach has eroded leading to increased damages from coastal storms and sea-level rise, and an increased potential for community-wide flooding in downtown Sandwich. Beach erosion has also reduced valuable habitat for threatened shorebirds that nest on the beach.

A long-term (1952-2018) shoreline change analysis by the Woods Hole Group (2019) showed erosion along 3.2 miles of shoreline on the eastern side of the Cape Cod Canal FNP jetties. The highest rates of erosion have occurred on both sides of the Old Sandwich Harbor inlet, and along Town Neck Beach. Lower rates of erosion occurred along Springhill Beach and immediately downdrift of the Cape Cod Canal. Similar trends were seen over the short-term period between 2000 and 2018; however, the rates of erosion along Springhill Beach and updrift of Old Sandwich Harbor were higher (perhaps due to a dwindling sediment supply), and an area of shoreline accretion is shown immediately downdrift of the Canal (Figure 2).

Information developed during the shoreline change analysis was also used to estimate a future shoreline position assuming that the rates of erosion determined from the long-term analysis remained constant over the next 50 years, and that the latest sea level rise projections are consistent with those being applied across the Commonwealth of Massachusetts and published by Massachusetts Coastal Zone Management. Using these assumptions, a projected shoreline for the Town of Sandwich was generated 50 years from 2018 (WHG, 2019). These projections are depicted in Figure 3.

One of the primary causes of coastal erosion is a deficit of sediment within the coastal littoral cell. To offset this deficit, the USACE is proposing to nourish the beach with compatible sediment placement as a logical means of improving the longevity of the shoreline. Beach nourishment does not stop erosion, but the damage to landward areas is postponed by extending the shoreline toward the ocean. As such, periodic renourishment is likely necessary. At this time, the USACE has no plans for a long-term nourishment program but is encouraging further investigation of using material dredged from the Cape Cod Canal FNP which has been subject to policy constrictions related to the Federal base plan standard. If it becomes possible for the USACE to use material dredged from the Canal FNP for beach nourishment on Town Neck Beach prior to or in conjunction with material placement from this study, then a separate CZM consistency determination would be prepared and coordinated with the Massachusetts Office of Coastal Zone Management prior to navigational dredging. Given the policy constraints previously mentioned, the beneficial use of dredged material from the Canal FNP is not expected at this time, thus this preliminary determination considers the impacts of fully nourishing Town Neck Beach with material dredged from the Scusset borrow site.

Beach nourishment is intended to widen the beach, as well as provide added storm protection, increased recreational area, and in some cases, added habitat area. Although nourished sand is eventually displaced alongshore or transported offshore, the nourished sand that is eroded takes the place of the upland area that would normally have been lost or eroded during a storm event. Therefore, beach nourishment serves a significant role in storm protection. In addition, beach nourishment is the only alternative analyzed in the project's Integrated Feasibility Report and Environmental Assessment that introduces additional sand into the system. For coastlines with a dwindling sediment supply, such as Town Neck Beach, this is critical for long-term success.

The USACE's proposal of beach nourishment has already been designed and permitted as part of a previous project developed by the Town of Sandwich (EEA #15213); however, the Town's permit was for a lesser amount of sand than is currently proposed. As part of the original Town-designed project, a dune and beach restoration template was developed that offered a holistic approach by encompassing the entire Town Neck beach and dune system. The existing jetty structures around Old Sandwich Harbor Inlet and the existing groins will be left in place. Since that time, more erosion has occurred requiring a greater amount of sediment. Therefore, the USACE's beach nourishment and dune creation project proposes the dredging and placement of approximately 388,000 cubic yards (cy) of beach compatible sediment within the same previously permitted nourishment footprint. The design and total amount to be dredged from the Scusset borrow area will be worked out in the next phase of the study.

The nourishment will primarily be used to stabilize, strengthen and rebuild weak and eroded beach and dune reaches throughout the Town Neck Beach system. The nourishment will also serve as a feeder system for eroding beaches downdrift of Town Neck Beach (e.g. Springhill Beach). The proposed project will create additional beach and dune resources expanding critical habitat area for endangered bird species, and serving the protectable interests of storm damage prevention and flood control. Figure 4 illustrates the footprint of the proposed nourishment placement area and Figure 5 depicts the proposed Scusset borrow site.

The material will be placed along approximately 5,000 linear feet of shoreline, beginning 1,000 feet southeast of the Cape Cod Canal in the west, and extending to within 600 feet of the Old Sandwich Harbor Inlet covering an approximate area of 41.1 acres (1,792,300 sq ft). The crest of the newly created dune will be at an elevation of approximately 15 to 21 ft (NAVD88), with a width ranging from 50 to 150 ft depending upon location. For the eastern barrier beach portion of the project, the beach berm will be increased in width by at least 100 ft at an elevation of 6 ft (NAVD88), and then extend seaward at a slope of 1V:20H to approximately –4 ft to –10 ft NAVD88 depending upon existing grade. Dunes will have a slope of 1V:10H to 1V:15H to meet habitat requirements for endangered and threatened shorebirds and will be graded to match existing slopes. At the western end of the project area, the design was constrained by the presence of rocky intertidal shore. Dunes at this end of the project will have a slope of 1V:5H, and the beach will slope seaward from the toe of dune at a slope of 1V:10H. At both ends of the project, the sand will be graded to feather in with the existing grades of the coastal beach and dune. American beachgrass (*Ammophila breviligulata*) will be planted on the dunes in the western end of the project area as well as in any dune areas that are disturbed for construction access.

Beach nourishment projects are designed to optimize storm damage reduction benefits relative to costs. Designing a project to protect against any and all storms is not economically feasible. Extreme conditions and severe storms could exceed the capacity of a beach nourishment project to protect property. Therefore, a reasonable storm damage protection goal is typically established, defined for this study as the critical width. The critical width for this project is defined as the minimum beach width remaining after nourishment before which a 10-year storm event would jeopardize upland infrastructure (e.g., homes, buildings, etc.). The assumption is that once the beach width reaches the critical width, a maintenance nourishment would be required to provide protection against a 10-year storm event, even though a substantial amount of the existing nourishment may still be remaining. To assess critical width, WHG (2019) developed a cross-shore profile adjustment model to evaluate the storm protection provided by the design nourishment template. The assessment indicated that once the initial nourishment has decayed to a width of approximately 30 feet, a 10-year storm event could cause significant overtopping of the dune system and potential upland damage. The 2019 WHG Feasibility Report reported that the estimated renourishment interval was calculated to be approximately every 9 years.

Based on the foregoing, the proposed project consists of the placement of potentially approximately 388,000 cy of clean sand onto Town Neck Beach within the specified footprint

(Figure 4). Sand from the Scusset borrow site will be hydraulically (cutterhead) or mechanically (bucket) dredged and then transported to Town Neck Beach, where it will be pumped out onto the beach for dune and beach reconstruction and restoration. Material will be placed above the Mean High Water (MHW) line to dewater allowing suspended sediment to settle. After dewatering, the material will be reshaped to final design specifications and slopes using heavy equipment. The sediment removal phase of the project is expected to take three months to complete, and will be done between October 1 and December 31 of the year(s) in which funding is received.

The proposed project will restore the buffering capability of Town Neck Beach to storm waters and flooding, restore sediments to the eroding beaches and dune resources, be a source of additional dune and beach sediments, and increase the area of bird habitat and recreational space. The placement of this material increases the jurisdictional shoreline resources of coastal beach and coastal dune and enhances their associated functions, values and interests. Therefore, this project is preliminarily consistent to the maximum extent practicable with this policy.

Figure 1. Location map of project areas.

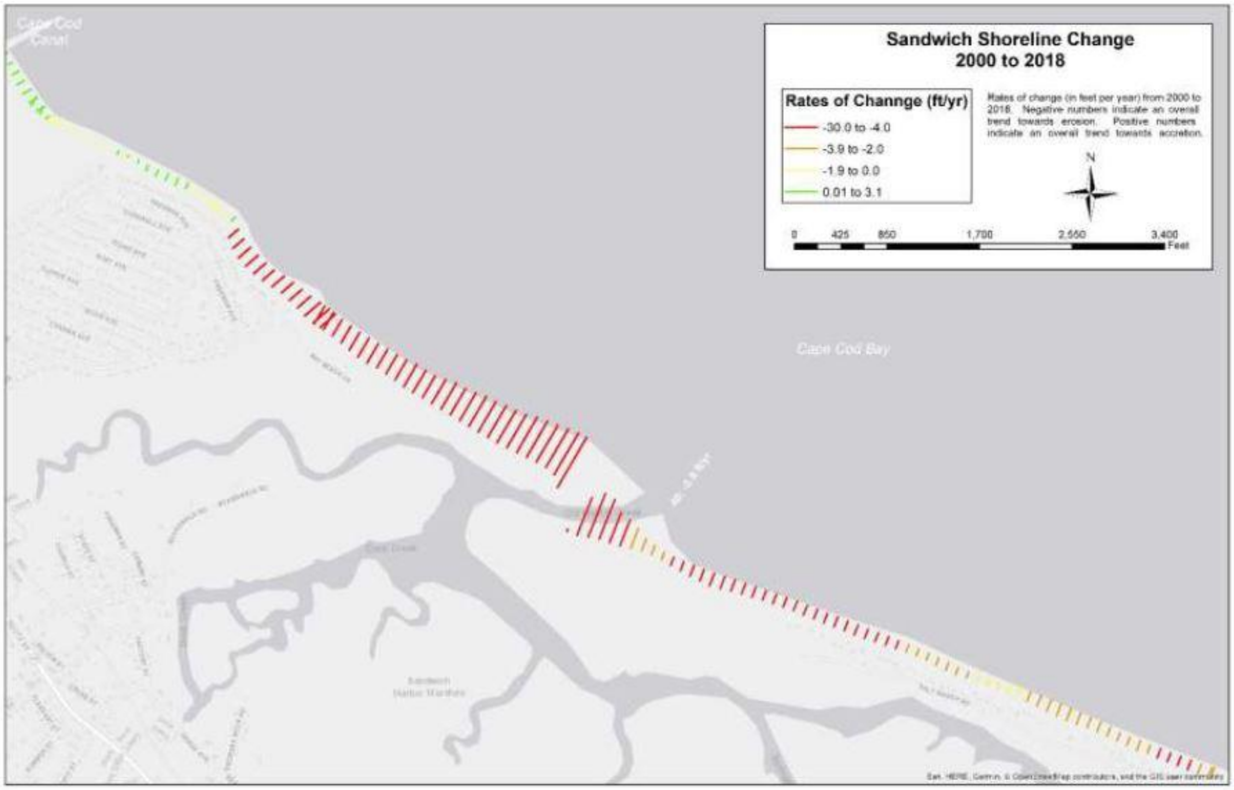

Figure 2. Short-term (2000-2018) shoreline change downdrift of the Cape Cod Canal to Springhill Beach (WHG, 2019).

Figure 3. Projected 50-year shoreline position downdrift of the Cape Cod Canal to Old Harbor Inlet (WHG, 2019).

Figure 4. Proposed nourishment footprint on Town Neck Beach.

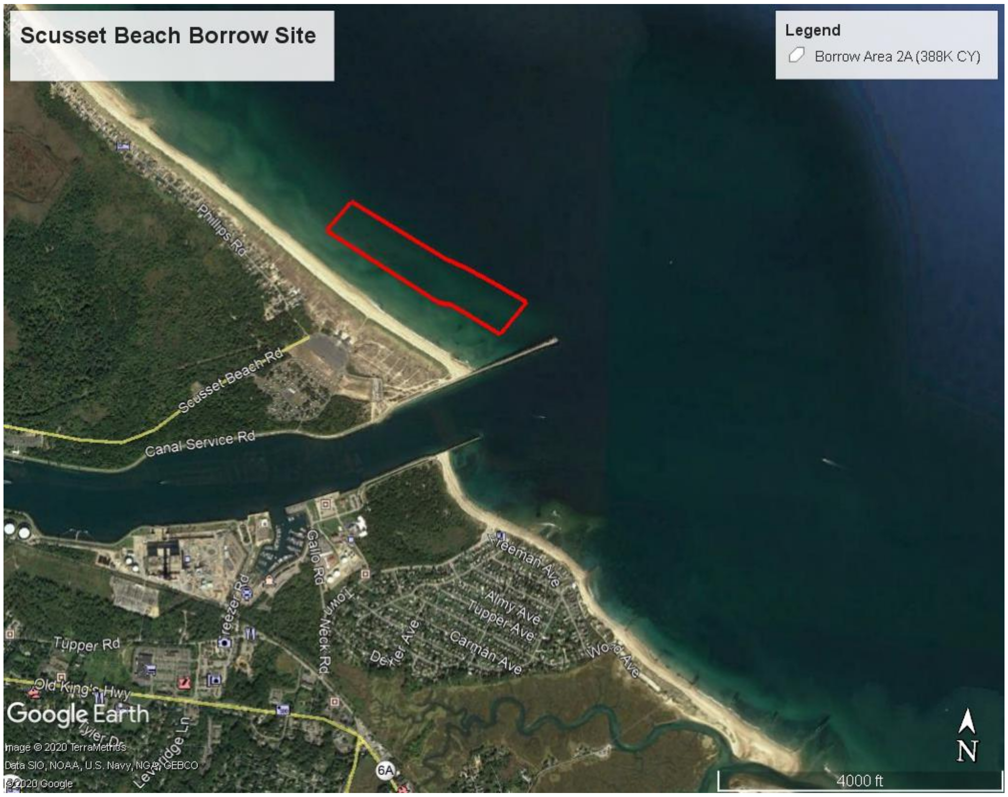

Figure 5. Proposed Scusset borrow site footprint.

COASTAL HAZARDS POLICY #2 - *Ensure that construction in water bodies and contiguous land areas will minimize interference with water circulation and sediment transport. Flood or erosion control projects must demonstrate no significant adverse effects on the project site or adjacent or downcoast areas.*

This project proposal involves dredging sand that has accreted alongside the western jetty of the Cape Cod Canal FNP adjacent to Scusset Beach. Material will be dredged from the Scusset borrow area and then placed on Town Neck Beach to address erosion that has occurred as a result of the Cape Cod Canal FNP jetties' interruption of natural longshore sand transport. Approximately 388,000 cy of sand materials from a 39-acre subtidal borrow site off Scusset Beach will be dredged for this project. The currently proposed borrow site is an approximately 3,000 ft long by 600 ft wide rectangle and the average excavation depth across the site is approximately 5.7 ft; however, the boundaries and excavation depth are subject to change. These details will be finalized in the next phase of the project. The coordinates for the preliminary borrow site corners are: 41.780007°, -70.492398°; 41.781303°, -70.491074°; 41.784985°, -70.500636°; and 41.783793°, -70.501867°.

Material placement onto Town Neck Beach will positively affect an area that has been sand-starved and eroded by adding sand that would naturally transport down the beach if the FNP jetties were not present. The MHW line will move seaward with the placement of sand on Town Neck Beach. This will decrease the extent of storm surge landward due to the increased elevations of the beach and dunes reducing storm and flood damages to properties. Regional water circulation and wave climatology will remain the same. On Scusset Beach, sand extraction will impact wave transformation with a relatively small increase in wave heights (<0.05 meters) during the majority of storm simulations (WHG, 2017). During the 50-year storm, maximum wave heights of 0.6 and 0.7 meters at various locations on the Scusset shoreline were recorded during model runs by the WHG. Modeling has not been conducted of the borrow site's expanded footprint under this preliminary proposal. Any necessary wave and/or sediment transport modeling will be conducted in the next phase of the project and details will be provided with the final consistency determination. It is our preliminary determination that increased wave energy is not anticipated to adversely affect the beach that fronts the Scusset Beach Reservation, or the homes located to the west of the reservation. The impact to wave heights will dissipate over time as the borrow site naturally fills with sand.

COASTAL HAZARDS POLICY #3 - *Ensure that state and federally funded public works projects proposed for location within the coastal zone will:*
• Not exacerbate existing hazards or damage natural buffers or other natural resources.
• Be reasonably safe from flood and erosion-related damage.
• Not promote growth and development in hazard-prone or buffer areas, especially in velocity zones and Areas of Critical Environmental Concern.
• Not be used on Coastal Barrier Resource Units for new or substantial reconstruction of structures in a manner inconsistent with the Coastal Barrier Resource/Improvement Acts.

The proposed project is preliminarily consistent with this policy. It will address existing hazards and damage to natural buffers by adding sand to an eroded beach which has been starved by the Canal jetties. This will not cause growth or development because the area is already fully developed. Although a portion of Town Neck Beach is within a Coastal Barrier Resource System (CBRS) Unit (Unit MA-14P), the unit is designated as an "Otherwise Protected Area" which is not subject to Federal spending prohibitions except for the receipt of Federal flood insurance. Therefore, the proposed action of beach nourishment will not violate provisions of the Coastal Barrier Resources Act. Nourishment of Town Neck Beach will provide protection for and enhance the CBRS unit by addressing erosion caused by the Canal FNP jetties. Beach nourishment will ensure that the marsh and the portion of Town Neck Beach that is within the CBRS unit are stable and available for recreation and bird habitat. Sand extraction from the Scusset borrow site is not anticipated to cause or exacerbate coastal hazards in the surrounding area.

COASTAL HAZARD POLICY #4 - *Prioritize acquisition of hazardous coastal areas that have high conservation and/or recreation values and relocation of structures out of coastal* *high-hazard areas, giving due consideration to the effects of coastal hazards at the location to the use and manageability of the area.*

This policy is not applicable.

ENERGY POLICY #1 - *For coastally dependent energy facilities, assess siting in alternative coastal locations. For non-coastally dependent energy facilities, assess siting in areas outside of the coastal zone. Weigh the environmental and safety impacts of locating proposed energy facilities at alternative sites.*

This policy is not applicable.

ENERGY POLICY #2 - *Encourage energy conservation and the use of renewable sources such as solar and wind power in order to assist in meeting the energy needs of the Commonwealth.*

This policy is not applicable.

GROWTH MANAGEMENT POLICY #1 – *Encourage sustainable development that is consistent with state, regional, and local plans and supports the quality and character of the community.*

This policy is not applicable.

GROWTH MANAGEMENT POLICY #2 - *Ensure that state and federally funded infrastructure projects in the coastal zone primarily serve existing developed areas, assigning highest priority to projects that meet the needs of urban and community development centers.*

The project will protect infrastructure including downtown Sandwich, an existing developed area.

GROWTH MANAGEMENT POLICY #3 – *Encourage the revitalization and enhancement of existing development centers in the coastal zone through technical assistance and financial support for residential, commercial, and industrial development.*

This policy is not applicable.

HABITAT POLICY #1 – *Protect coastal, estuarine, and marine habitats—including salt marshes, shellfish beds, submerged aquatic vegetation, dunes, beaches, barrier beaches, banks, salt ponds, eelgrass beds, tidal flats, rocky shores, bays, sounds, and other ocean habitats—and coastal freshwater streams, ponds, and wetlands to preserve critical wildlife habitat and other important functions and services including nutrient and sediment attenuation, wave and storm damage protection, and landform movement and processes.*

The project will restore a 5,000 foot long sand starved and severely eroded section of Town Neck Beach in front of properties along Freeman Avenue, White Path Lane, and Bay Beach Lane. This will result in coastal storm protection for structures and shorefront land parcels along and behind the project's footprint. Absent any beach renourishment, we estimate that Town Neck Beach will continue to erode at a rate of 2-6 feet per year and eventually the homes along the beach will be lost.

No significant adverse impacts are anticipated to any salt marshes, shellfish beds, banks, salt ponds, tidal flats, bays, sounds, vegetation, dunes, beaches, barrier beaches, banks or ocean habitats as a result of the project. However, in order to restore the upland portion of the beach, some rocky intertidal habitat will be impacted (i.e. buried) resulting in a decrease in rocky intertidal habitat and macroalgae as a result of direct beach placement. It should be noted that some of this rocky intertidal habitat was exposed due in large part to the continued erosion of the beach and dune system in this area. The nourishment footprint has been designed to avoid the majority of rocky intertidal habitat on Town Neck Beach so this habitat type with attached macroalgae will still be available in other unimpacted areas for use by organisms. Nourishment of the beach will result in an increase in additional sandy habitat which could add nesting area for threatened piping plovers and state-listed least terns which nest on the eastern end of Town Neck Beach.

The most recent eelgrass survey conducted by the Town of Sandwich in 2020 found that no eelgrass is present within the nourishment footprint. Therefore, no eelgrass will be directly impacted by sand placement. Dredged sand that is pumped onto the beach will be dewatered prior to grading thus allowing suspended sediments to settle before the sand is reworked on the beach. This will minimize increased levels of water column turbidity which could otherwise cause sedimentation or water clarity issues for the eelgrass beds outside of the placement area. Erosion of the beach over time is not expected to cause any deleterious effects to eelgrass since it is adapted to shifting sands and should not be adversely affected by the natural movement of placed sand within the littoral zone. No pipes or construction equipment will be allowed within areas of eelgrass, and the nourishment footprint will be adjusted if eelgrass beds are discovered in the project footprint prior to construction. Therefore, no direct and only minimal indirect impacts to eelgrass beds are anticipated as a result of the project. No eelgrass beds exist within or adjacent to the Scusset borrow site.

According to a survey conducted by WHG in 2014, no shellfish were found within the nourishment site, thus the proposed action should have no direct effects to shellfish resources on Town Neck Beach. Lobsters and other shellfish may use the eelgrass beds and rocky habitat outside of the nourishment footprint which will be subject to the movement of sediment as the placed sand erodes off the beach over time. These areas are adapted to the natural fluctuations of sand transport and are not expected to experience any significant adverse effects. WHG and the MADMF surveyed the Scusset borrow site for shellfish in 2016 and found no substantial communities (WHG, 2017). The MADMF assessed that the borrow site would likely recover within one year following project activities. Therefore, no significant adverse impacts to shellfish resources are anticipated as a result of the proposed action.

The project will provide wave and storm damage protection by increasing the beach width and dune heights on Town Neck Beach that are within the nourishment footprint. This will not only provide protection for the homes on Town Neck Beach, but also the marsh located behind it. Continued erosion of Town Neck Beach will eventually lead to the encroachment of the MHW line into the marsh system behind Town Neck Beach. This encroachment would lead to increased levels of storm surge in the marsh that may then inundate downtown Sandwich. The Scusset borrow site's boundaries are not yet finalized and modeling of an expanded site has not been conducted. It is preliminarily anticipated that the project as proposed will be consistent with this policy to the maximum extent practicable. This determination will be finalized in the next phase of the project.

HABITAT POLICY #2 - *Advance the restoration of degraded or former habitats in coastal and marine areas.*

The project will address the erosion caused by the Canal jetties which have led to the degradation of Town Neck Beach. If erosion is allowed to continue, the MHW line will migrate into the marsh behind the beach which will then become subject to wave activity and greater storm surge levels. This could cause direct erosion of the marsh and inundation, leading to potential migration of the lower and upper marsh zones into upland areas or drowning of the marsh where migration cannot occur. Beach nourishment will restore the beach, albeit temporarily, and provide coastal storm protection for properties over the project's design life. The project has been designed to minimize and avoid impacts to sensitive resources such as eelgrass, winter flounder and threatened/endangered species.

OCEAN RESOURCES POLICY #1 – *Support the development of sustainable aquaculture, both for commercial and enhancement (public shellfish stocking) purposes. Ensure that the review process regulating aquaculture facility sites (and access routes to those areas) protects significant ecological resources (salt marshes, dunes, beaches, barrier beaches, and salt ponds) and minimizes adverse effects on the coastal and marine environment and other water-dependent uses.*

The policy is not applicable.

OCEAN RESOURCES POLICY #2 – *Except where such activity is prohibited by the Ocean Sanctuaries Act, the Massachusetts Ocean Management Plan, or other applicable provision of law, the extraction of oil, natural gas, or marine minerals (other than sand and gravel) in or affecting the coastal zone must protect marine resources, marine water quality, fisheries, and navigational, recreational and other uses.*

The policy is not applicable.

OCEAN RESOURCES POLICY #3 – *Accommodate offshore sand and gravel extraction needs in areas and in ways that will not adversely affect marine resources, navigation, or shoreline areas due to alteration of wave direction and dynamics. Extraction of sand and gravel, when and where permitted, will be primarily for the purpose of beach nourishment or shoreline stabilization.*

The extraction of sand from the Scusset borrow site is not expected to adversely affect marine resources, navigation, or shoreline areas. Benthic resources from within the borrow site will be removed by dredging, but these resources are anticipated to recover within one to eleven months following dredging (Wilbur and Clarke, 2007). Following shellfish surveys of the borrow site, the MADMF assessed that the site would likely recover within one year following project activities. Project controls such as the use of a National Marine Fisheries Service (NMFS)-approved endangered species observer and vessel speed restrictions will minimize the chance that the project will adversely affect Federally-listed marine turtles and whales that could be within the project area. Please see Coastal Hazards Policy #2 for more information regarding anticipated changes to wave dynamics as well as Section I of the Town of Sandwich's Notice of Project Change (EEA #15213) filed in 2017. No changes to wave direction are expected with the extraction of sand from the site. However, any necessary modeling will be undertaken during the design phase of the project.

PORTS AND HARBORS POLICY #1 – *Ensure that dredging and disposal of dredged material minimize adverse effects on water quality, physical processes, marine productivity, and public health and take full advantage of opportunities for beneficial re-use.*

The dredging and placement of coarse sand from the Scusset borrow site will not significantly impact water quality, physical processes, marine resources, or public health. Dredging and placement of material will impact existing benthic resources in the project footprint, but recolonization of benthic species from adjacent areas will allow the impacted areas to quickly recover to pre-dredge conditions. Based on benthic sampling conducted by the Town of Sandwich in October 2014 the beach hosts has a low density and low diversity of benthic invertebrates (WHG, 2014).

Water quality impacts at the borrow site and Town Neck Beach will be limited to short-term increases in turbidity. During the dredging and placement process, water column turbidity will increase within and adjacent to the borrow site and nourishment area. However, these increases are expected to be localized and short-term given that the material is sand which will settle out of the water column rapidly. Burlas et al. (2001) found that the turbidity plume and elevated TSS levels were expected to be limited to a narrow area of the swash zone up to 1,640 feet down-current from the discharge pipe. Five years later, Wilber et al. (2006) reported that elevated total suspended sediment (TSS) concentrations associated with an active beach nourishment site were limited to within 1,312 feet of the discharge pipe in the swash zone which is defined as the area of the nearshore that is intermittently covered and uncovered by waves. Based on this and the fact that the material to be dredged and placed is sand which should settle rapidly, TSS concentrations created by beach nourishment operations are expected to be between 34.0-64.0 mg/L; limited to an area approximately 1,640 feet down-current from the discharge pipe; and, settle within several hours after discharge cessation. The TSS levels expected for beach nourishment (up to 64.0 mg/L) are below those shown to have adverse effect on fish (typically up to 1,000.0 mg/L; see summary of scientific literature in Burton, 1993; Wilber and Clarke, 2001) and benthic communities (390.0 mg/L (EPA, 1986)). Furthermore, dredged sand that is pumped onto Town Neck Beach will be dewatered prior to reworking. This will allow suspended sediments to settle out above the MHW line limiting increased levels of water column turbidity in the nearshore waters of Town Neck Beach.

It is unknown at this time what type of dredge will be used to excavate sand from the Scusset borrow site. Based on cost estimations, the dredging method will likely be mechanical or hydraulic. If the methodology is hydraulic, then a cutterhead pipeline dredge would be used. TSS concentrations above background levels are expected to be present throughout the bottom six feet of the water column for a distance of approximately 1,000 feet from the cutterhead (USACE, 1983). TSS concentrations associated with cutterhead dredge sediment plumes typically range from 11.5 to 282.0 mg/L with the highest levels (550.0 mg/L) detected adjacent to the cutterhead dredge and concentrations decreasing with greater distance from the dredge (Nightingale and Simenstad, 2001; USACE, 2005; 2010; 2015). 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). The TSS levels expected for both mechanical (up to 445.0 mg/L) and cutterhead dredging (up to 550.0 mg/L) are below those shown to have adverse effect on fish (typically up to 1,000.0 mg/L; see summary of scientific literature in Burton, 1993; Wilber and Clarke, 2001).

Once placed, the sand will erode off of Town Neck Beach at a rate consistent with the long-term rate which was measured at -1.1 ft/year in the project area (WHG, 2014). The borrow site is expected to infill at a rate of 105 cy/day which is not anticipated to cause adverse impacts to the water quality of the area. Therefore, no significant impacts to marine water quality are anticipated as a result of the proposed action.

PORTS AND HARBORS POLICY #2 - *Obtain the widest possible public benefit from channel dredging and ensure that Designated Port Areas and developed harbors are given highest priority in the allocation of resources.*

This policy is not applicable.

PORTS AND HARBORS POLICY #3 – *Preserve and enhance the capacity of Designated Port Areas to accommodate water-dependent industrial uses and prevent the exclusion of such uses from tidelands and any other DPA lands over which an EEA agency exerts control by virtue of ownership or other legal authority.*

This policy is not applicable.

PORTS AND HARBORS POLICY #4 – *For development on tidelands and other coastal waterways, preserve and enhance the immediate waterfront for vessel-related activities that require sufficient space and suitable facilities along the water's edge for operational purposes.*

This policy is not applicable.

<u>PORTS AND HARBORS POLICY #5</u> - *Encourage, through technical and financial assistance, expansion of water-dependent uses in Designated Port Areas and developed harbors, re-development of urban waterfronts, and expansion of physical and visual access.*

The policy is not applicable.

<u>PROTECTED AREAS POLICY #1</u> – *Preserve, restore, and enhance coastal Areas of Critical Environmental Concern (ACEC), which are complexes of natural and cultural resources of regional or statewide significance.*

This policy is not applicable. No ACEC's are located within the project area.

<u>PROTECTED AREAS POLICY #2</u> - *Protect state and locally designated scenic rivers and state classified scenic rivers in the coastal zone.*

The policy is not applicable; no scenic rivers will be impacted by this project.

<u>PROTECTED AREAS POLICY #3</u> - *Ensure that proposed developments in or near designated or registered historic places respect the preservation intent of the designation and that potential adverse effects are minimized.*

A review of the historic and archaeological site files from the Massachusetts Cultural Resources Information System (MACRIS) online database identified several historic properties within the project's area of potential effect (APE). One site, 19-BN-547 Town Neck Road, is listed as a pre-Contact archaeological site along the shoreline and extending inland, just south of the Canal. No further information is available. Several National Register historic districts are located inland including the Jarvesville, Town Hall Square, and Spring Hill Historic Districts as well as local districts including Town Neck and the Old King's Highway Regional Historic District.

A brick kiln or brickyard site is depicted on the 1857 Walling map at Town Neck and available on the Town of Sandwich Historical Commission's website (https://sandwichhistory.org/a-brickyard-at-town-neck/). According to the town, "a lens of fine clay suitable for brick making was discovered, perhaps as early 1790 when construction of houses and mills picked up in earnest." Bricks and ash from the brick kiln have been exposed along the shore by erosion and were reported in 2015. The placement of sand along Town Neck Beach as beach nourishment should help protect any existing remnants from the brickyard while addressing the erosion of the shoreline.

A review of shipwreck databases identified several submerged historic properties well off the coast of Sandwich. One unknown wreck is depicted off Scusset Beach in the vicinity of the proposed borrow area. Gray and Pape conducted a remote sensing archaeological survey in 2016 as part of the town's permitting process for the borrow area. No submerged historic properties were identified. No visible remains of the unknown wreck above were noted in the field. No further investigations were recommended. Therefore, the placement of material on Town Neck Beach obtained from the Scusset borrow site is not expected to have any adverse effects upon significant historic properties as defined by Section 106 of the National Historic Preservation Act and implementing regulations 36 CFR 800.

PUBLIC ACCESS POLICY #1 – *Ensure that development (both water-dependent and nonwater-dependent) of coastal sites subject to state waterways regulation will promote general public use and enjoyment of the water's edge, to an extent commensurate with the Commonwealth's interests in flowed and filled tidelands under the Public Trust Doctrine.*

The proposed project represents fill in tidelands which will provide greater benefit than detriment to the rights of the public. Nourishment of Town Neck Beach will widen the beach providing more area for recreation and enjoyment of the water's edge to the general public.

PUBLIC ACCESS POLICY #2 - *Improve public access to existing coastal recreation facilities and alleviate auto traffic and parking problems through improvements in public transportation and trail links (land- or water-based) to other nearby facilities. Increase capacity of existing recreation areas by facilitating multiple use and by improving management, maintenance, and public support facilities. Ensure that the adverse impacts of developments proposed near existing public access and recreation sites are minimized.*

Sand nourishment of Town Neck Beach will increase the width of the beach thereby increasing the amount of available area above MHW and within the intertidal area where the public can recreate. The project will not decrease or increase available parking or affect transportation.

PUBLIC ACCESS POLICY #3 - *Expand existing recreation facilities and acquire and develop new public areas for coastal recreational activities, giving highest priority to regions of high need or limited site availability. Provide technical assistance to developers of both public and private recreation facilities and sites that increase public access to the shoreline to ensure that both transportation access and the recreation facilities are compatible with social and environmental characteristics of surrounding communities.*

The proposed project is consistent with this policy, see Public Access Policy 2.

WATER QUALITY POLICY #1 - *Ensure that point-source discharges and withdrawals in or affecting the coastal zone do not compromise water quality standards and protect designated uses and other interests.*

This proposal involves pumping dredged coarse sand material onto Town Neck Beach, which will create a discharge of water runoff into State waters. This discharge is not considered a "point-source discharge" by conventional standards; however, MACZM regulations require that the discharge of dredged material be coordinated with them. The material to be dredged from the Scusset borrow site has undergone physical analysis and has been found to be clean, coarsegrained sand compatible with the sediments on Town Neck Beach. The pumping of clean sand onto Town Neck Beach in Sandwich will temporarily increase turbidity in the waters adjacent to the beach; however, impacts will be short-term and localized and will not significantly affect water quality in the vicinity of the site. This proposal will be coordinated with the appropriate Federal and state resource agencies including, but not limited to, the U.S. Environmental Protection Agency and the Massachusetts Department of Environmental Protection (MADEP). A request for 401 Water Quality Certification for the discharge of dredged material into State waters will be submitted to the MADEP in the design phase to ensure that Massachusetts Surface Water Quality Standards are met.

WATER QUALITY POLICY #2 - *Ensure the implementation of nonpoint source pollution controls to promote the attainment of water quality standards and protect designated uses and other interests.*

Not applicable.

WATER QUALITY POLICY #3 - *Ensure that subsurface waste discharges conform to applicable standards, including the siting, construction, and maintenance requirements for on-site wastewater disposal systems, water quality standards, established Total Maximum Daily Load limits, and prohibitions on facilities in high-hazard areas.*

Not applicable.

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WHG. 2018. Letter to Phillip Nimeskern, USACE, RE: NAE-2016-00624, Town of Sandwich, Sand Bypassing Program: Assessment of Rocky Intertidal, Complex Bottom and Eelgrass Habitat in the Vicinity of the Nourishment Template at Town Neck Beach, Sandwich, MA. Dated 10 October 2018.

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CAPE COD CANAL & SANDWICH BEACHES

SHORE DAMAGE MITIGATION STUDY

APPENDIX A3

ESSENTIAL FISH HABITAT ASSESSMENT

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Cape Cod Canal and Sandwich Beaches
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Essential Fish Habitat Assessment

1. Introduction

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act require that an Essential Fish Habitat (EFH) consultation be conducted for activities that may adversely affect important habitats of Federally managed marine and anadromous fish species. EFH includes "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The proposed project areas (Scusset Beach borrow site, Town Neck Beach, and surrounding waters) occurs in designated EFH areas, thus an assessment of the proposed project's impacts is contained herein.

2. Proposed Action: Dredging and Placement

The Cape Cod Canal (the Canal) is a 17-mile manmade waterway bisecting Cape Cod (the Cape) from the mainland of Massachusetts. The Canal is a Federal Navigation Project (FNP), owned and operated by the U.S. Army Corps of Engineers (USACE) that was constructed in the early 20th century. The Canal significantly improved navigational safety to and from Massachusetts Bay by creating a direct route through the 'arm' of the Cape that eliminated 135 miles of open-ocean travel around the Cape. In order to help maintain a navigable waterway, two stone jetties were constructed at the east end entrance that would interrupt alongshore sediment transport and prevent shoaling of the entrance channel. The jetties have served their intended purpose, but as an unintended consequence, the interruption to alongshore sediment transport has prevented sediment from reaching the downdrift shoreline in Sandwich, Massachusetts. Erosion of the downdrift shoreline that has taken place since the Canal was constructed, specifically along Town Neck Beach, has presumably been the result of a sand-starved littoral zone caused by the jetties. The erosion has continued and progressed to the point where public and private infrastructure and resources are now imminently threatened by coastal storms and are expected to sustain significant and even catastrophic damages if the problem is left unaddressed.

Due to the presumed cause and effect relationship between the jetties and the downdrift erosion, the USACE has undertaken a study under the Section 111 authority of the Continuing Authorities Program (CAP). Section 111 of the CAP program authorizes the USACE to study, plan and implement structural or nonstructural measures to prevent or mitigate damage to non-Federal public and privately-owned shorelines to the extent that such damages can be directly attributable to an FNP. The focus area of this feasibility study is the shoreline of Sandwich, Massachusetts and the east entrance of the Canal. Sandwich, Massachusetts is a small coastal town (population ~20k) located 50 miles southeast of Boston, on the north shore of Cape Cod. The shoreline itself generally faces northeast towards Cape Cod Bay and is bisected by the Canal. On the west/updrift side of the Canal is Scusset Beach and on the east/downdrift side of the Canal is Town Neck Beach. Figure 1 depicts these areas.

Figure 1: Location map of project areas

A long-term (1952-2018) shoreline change analysis by the Woods Hole Group (2019) showed erosion along 3.2 miles of shoreline on the eastern side of the Canal jetties. The highest rates of erosion have occurred on both sides of the Old Sandwich Harbor inlet, and along Town Neck Beach. Lower rates of erosion occurred along Springhill Beach and immediately downdrift of the Canal. Similar trends were seen over the short-term period between 2000 and 2018; however, the rates of erosion along Springhill Beach and updrift of Old Sandwich Harbor were higher (perhaps due to a dwindling sediment supply), and an area of shoreline accretion is shown immediately downdrift of the Canal (Figure 2).

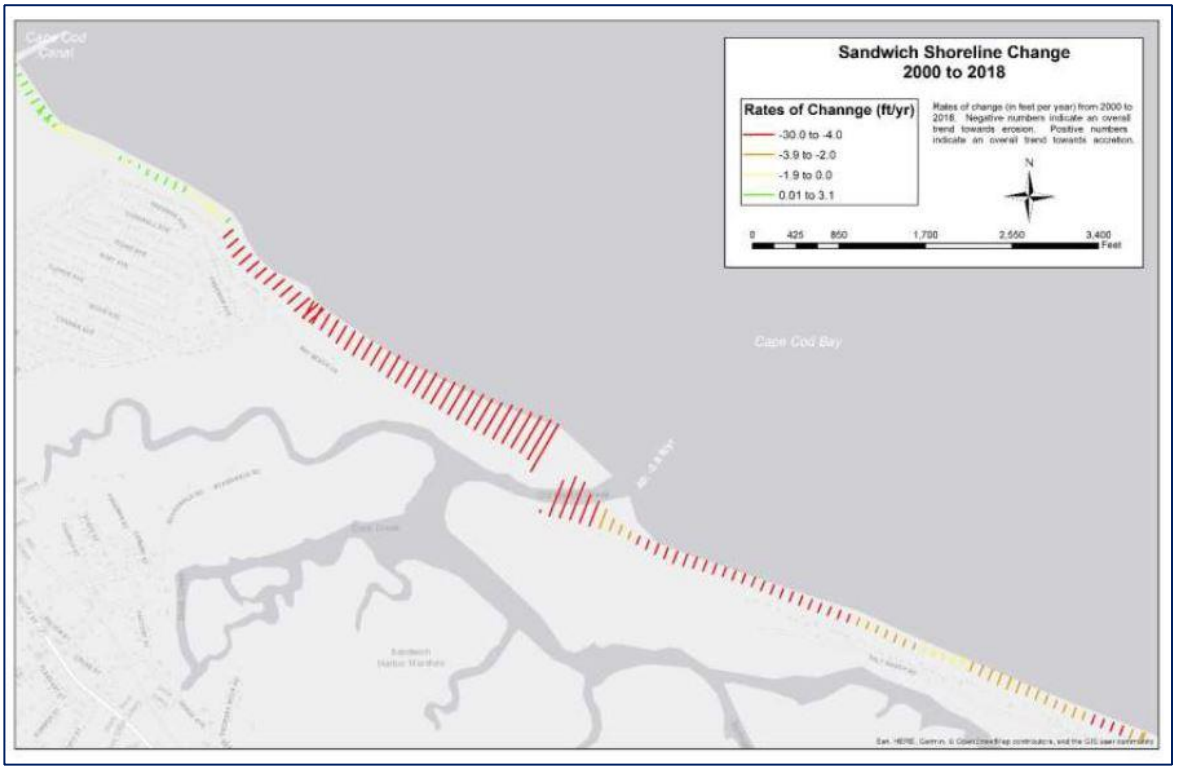

Figure 2: Short-term (2000-2018) shoreline change downdrift of the Cape Cod Canal to Springhill Beach (WHG, 2019)

Information developed during the shoreline change analysis was also used to estimate a future shoreline position assuming that the rates of erosion determined from the long-term analysis remained constant over the next 50 years, and that the latest sea level rise projections are consistent with those being applied across the Commonwealth of Massachusetts and published by Massachusetts Coastal Zone Management. Using these assumptions, a projected shoreline for the Town of Sandwich was generated 50 years from 2018 (WHG, 2019). These projections are depicted in Figure 3.

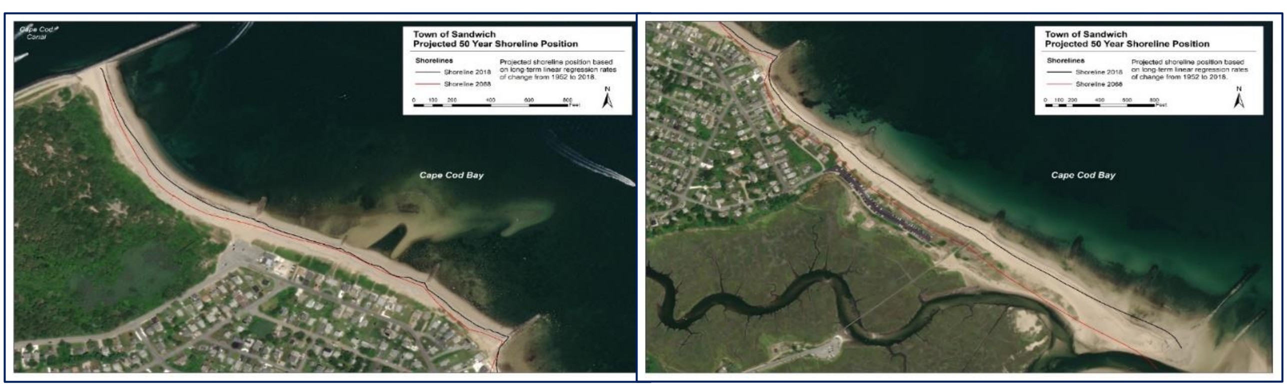

Figure 3: Projected 50-year shoreline position downdrift of the Cape Cod Canal to Old Harbor Inlet (WHG, 2019)

One of the primary causes of coastal erosion is a deficit of sediment within the coastal littoral cell. To offset this deficit, the USACE is proposing to nourish Town Neck Beach with compatible sediment placement as a logical means of improving the longevity of the shoreline. Beach nourishment does not stop erosion, but the damage to landward areas is postponed by extending the shoreline toward the ocean. As such, periodic renourishment is likely necessary. At this time, the USACE has no plans for a long-term nourishment program but is encouraging further investigation of using material dredged from the Cape Cod Canal FNP which has been subject to policy constrictions related to the Federal base plan standard. If it becomes possible for the USACE to use material dredged from the Canal FNP for beach nourishment on Town Neck Beach prior to or in conjunction with material placement from this study, then impacts to EFH would be considered in a separate EFH assessment and coordinated with the National Marine Fisheries Service (NMFS) prior to navigational dredging. Given the policy constraints previously mentioned, the beneficial use of dredged material from the Canal FNP is not expected at this time, thus this assessment considers the impacts of fully nourishing Town Neck Beach with material dredged from the Scusset borrow site.

The USACE's proposal of beach nourishment has already been designed and permitted as part of a previous project developed by the Town of Sandwich (NAE-2016-00624); however, the Town's permit was for a lesser amount of sand than is currently proposed. As part of the original Town-designed project, a dune and beach restoration template was developed that offered a holistic approach by encompassing the entire Town Neck beach and dune system (WHG, 2014). The existing jetty structures around Old Sandwich Harbor Inlet and the existing groins will be left in place. Since that time, more erosion has occurred requiring a greater amount of sediment. Therefore, the USACE's beach nourishment and dune creation project proposes the dredging and placement of approximately 388,000 cubic yards (cy) of beach compatible sediment within the same previously permitted nourishment footprint. The design and total amount to be dredged from the Scusset borrow area will be worked out in the pre-construction engineering and design phase of the study.

The proposed nourishment will primarily be used to stabilize, strengthen and rebuild weak and eroded beach and dune reaches throughout the Town Neck Beach system. The nourishment will also serve as a feeder system for eroding beaches downdrift of Town Neck Beach (e.g. Springhill Beach). Figure 4 illustrates the footprint of the proposed nourishment placement area and the Scusset borrow site.

Figure 4: Overview of the proposed project

The material will be placed along approximately 5,000 linear feet of shoreline, beginning 1,000 feet southeast of the Canal in the west, and extending to within 600 feet of the Old Sandwich Harbor Inlet covering an approximate area of 41.1 acres (1,792,300 sq ft). The crest of the newly created dune will be at an elevation of approximately 15 to 21 ft (NAVD88), with a width ranging from 50 to 150 ft depending upon location. For the eastern barrier beach portion of the project, the beach berm will be increased in width by at least 100 ft at an elevation of 6 ft (NAVD88), and then extend seaward at a slope of 1V:20H to approximately –4 ft to –10 ft NAVD88 depending upon existing grade. Dunes will have a slope of 1V:10H to 1V:15H to meet habitat requirements for endangered and threatened shorebirds and will be graded to match existing slopes. At the western end of the project area, the design was constrained by the presence of rocky intertidal shore. Dunes at this end of the project will have a slope of 1V:5H, and the beach will slope seaward from the toe of dune at a slope of 1V:10H. At both ends of the project, the sand will be graded to feather in with the existing grades of the coastal beach and dune. American beachgrass (*Ammophila breviligulata*) will be planted on the dunes in the western end of the project area as well as in any dune areas that are disturbed for construction access.

The proposed project consists of the placement of approximately 388,000 cy of clean sand onto Town Neck Beach within the specified footprint (Figure 4). The initial placement material will be dredged from the Scusset borrow area. The sand from the Scusset borrow site will be hydraulically (cutterhead) or mechanically (bucket) dredged and then transported to

Town Neck Beach, where it will be pumped out onto the beach for dune and beach reconstruction and restoration. Material will be placed above the Mean High Water (MHW) line to dewater allowing suspended sediment to settle. After dewatering, the material will be reshaped to final design specifications and slopes using heavy equipment. The sediment removal phase of the project is expected to take three months to complete and will be done between October 1 and December 31 of the year(s) in which funds are received.

3. Project Site Characteristics and Analysis of EFH Impacts

Impacts to EFH are based on the potential adverse effect(s) resulting from the proposed project. The EFH provisions in the MSA define adverse effect as:

> *Any impact that reduces quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH* (MSA § 600.910).

These impacts include physical alterations to the useable habitat for each species as well as impacts to the forage species of designated species in the form of displacement, temporary loss of forage species habitat, and/or temporary loss of forage species individuals. Adverse impacts range from short-term (ex. temporarily increased turbidity) to longer term impacts, such as changes in substrate and water depth. Cumulative impacts are those impacts to the habitat of designated species resulting from the proposed project in combination with other activities in the area that collectively affect EFH.

3.1. Physical and Chemical Environment

The Scusset borrow site is an approximately 39-acre area located entirely in subtidal habitat. Water depths in the site range from 10 to 20 feet at Mean Lower Low Water (MLLW) and the tidal range at Scusset Beach is approximately 9 feet. The area offshore Scusset Beach is characteristic of a dynamic nearshore sedimentary environment that is dominated by wave energy (WHG, 2017).

The placement site on Town Neck Beach is approximately 41.1 acres consisting of private and public parcels. Within the placement site, approximately 15.5 acres of supratidal (above MHW) land, approximately 12.7 acres of intertidal (between MHW and MLW) land, and approximately 12.9 acres of subtidal (below MLW) land will be impacted by the sand nourishment. The depth contours along the shoreline on Town Neck Beach are generally parallel to shore with a gradual slope towards the offshore (WHG, 2014).

3.1.1. Water Quality

The coastal waters offshore of Town Neck Beach and Scusset Beach (including the borrow site) are classified as SA waters by the Commonwealth of Massachusetts. Class SA waters are designated as an excellent habitat for fish, other aquatic life and wildlife, including their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation (314 CMR 4.00). Shellfish harvesting is indefinitely prohibited from within the Canal (Rausch, 2018).

Water quality impacts at the Scusset borrow site and Town Neck Beach will be limited to short-term increases in turbidity. During the dredging and placement process, water column turbidity will increase within and adjacent to the borrow site and nourishment area. However, these increases are expected to be localized and short-term given that the material is sand which will settle out of the water column rapidly. Burlas et al. (2001) found that the turbidity plume and elevated TSS levels were expected to be limited to a narrow area of the swash zone up to 1,640 feet downcurrent from the discharge pipe. Five years later, Wilber et al. (2006) reported that elevated TSS concentrations associated with an active beach nourishment site were limited to within 1,312 feet of the discharge pipe in the swash zone which is defined as the area of the nearshore that is intermittently covered and uncovered by waves. Based on this and the fact that the material to be dredged and placed is sand which should settle rapidly, TSS concentrations created by beach nourishment operations are expected to be between 34.0-64.0 mg/L; limited to an area approximately 1,640 feet down-current from the discharge pipe; and, settle within several hours after discharge cessation. The TSS levels expected for beach nourishment (up to 64.0 mg/L) are below those shown to have adverse effect on fish (typically up to 1,000.0 mg/L; see summary of scientific literature in Burton, 1993; Wilber and Clarke, 2001) and benthic communities (390.0 mg/L (USEPA, 1986)). Dredged sand that is pumped onto Town Neck Beach will be dewatered prior to reworking. This will allow suspended sediments to settle out above the MHW line limiting increased levels of water column turbidity in the nearshore waters of Town Neck Beach.

Based on the cost estimates prepared for this study, the recommended plan includes the use of a mechanical dredge to excavate material from the Scusset Beach borrow site. However, the specifications pertaining to dredge type are expected to be refined during the design and implementation phase of this project. Consequently, the work could ultimately include use of a hydraulic dredge if that proves to be a more cost-effective option. TSS concentrations above background levels are expected to be present throughout the bottom six feet of the water column for approximately 1,000 feet from the cutterhead (USACE, 1983). TSS concentrations associated with cutterhead dredge sediment plumes typically range from 11.5 to 282.0 mg/L with the highest levels (550.0 mg/L) detected adjacent to the cutterhead dredge and concentrations decreasing with greater distance from the dredge (Nightingale and Simenstad, 2001; USACE, 2005; 2010; 2015). 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). The TSS levels expected for both mechanical (up to 445.0 mg/L) and cutterhead dredging (up to 550.0 mg/L) are below those shown to have adverse effect on fish (typically up to 1,000.0 mg/L; see summary of scientific literature in Burton, 1993; Wilber and Clarke, 2001).

Once placed, the sand will erode off of Town Neck Beach at a rate consistent with the long-term rate which was measured at -1.1 ft/year in the project area (WHG, 2014). The borrow site is expected to infill at a rate of approximately 100 cy/day which is not anticipated to cause adverse impacts to the water quality of the area. Therefore, no significant impacts to marine water quality are anticipated as a result of the proposed action.

3.1.2. Bathymetry/Water Depth

Other impacts from the proposed project include changes in the bathymetry of the areas to be dredged and at the placement site. Extraction of sand from the Scusset borrow site will result in increased depths throughout the site. The average excavation depth across the site is estimated at approximately 5.7 ft with side slopes grading up to a 1V:3H slope to meet the surrounding grade. The majority of the site will be dredged to an excavation depth of approximately -26 ft NAVD88; however, the excavation depth is subject to change based on the quantity of sediment to be dredged. This will be refined in the next phase of the study. According to WHG studies of sediment transport, the infilling rate for the Scusset borrow area will be about 102-105 cy/day (WHG, 2017). Therefore, the borrow area is expected to fill in over a period of approximately 10 years to its existing depth.

Depths will also change within the intertidal areas and surf zone in affected areas of Town Neck Beach where the dredged material is proposed to be placed. The beach fill along 5,000 linear feet of Town Neck Beach's shoreline will cover an approximate area of 41.1 acres of upland, intertidal, and subtidal habitat. As a result of the sand placement, the MHW and Mean Low Water (MLW) line will be relocated seaward of their current positions. The nourishment footprint will be refined in the pre-construction engineering and design phase of the study.

3.1.3. Sediments

Fifteen sediment cores taken from within the Scusset borrow site in 2016 show that the site's sediments are predominantly sand (average of 96% sand). The sediments were classified as poorly graded sand (WHG, 2017). Twelve sediment samples taken within the nourishment footprint on Town Neck Beach in 2016 were characterized as primarily poorly graded sand and poorly graded sand with gravel by WHG. Most of the samples were sand, and sand and gravel (WHG, 2014). In general, the sediments found along Town Neck Beach are coarser than the material present in the nearshore area at Scusset Beach. Presumably, continued erosion of the downdrift shoreline has influenced the composition of sediment grain size along the downdrift shoreline. Appendix A5 of the Draft Integrated Feasibility Report and Environmental Assessment (DIFR/EA) contains the grain size results from both project areas.

Complex and rocky bottom habitat is in the intertidal and subtidal zone off the western end of the nourishment footprint on Town Neck Beach. Additionally, a smaller patch of complex rocky bottom habitat is in the intertidal zone at the far eastern end of the nourishment site. Figure 5 shows the WHG's most recent (2018) mapping of complex bottom habitat within the study area as well as the most recent eelgrass survey results from 2019 with the previously permitted nourishment footprint.

The project will avoid covering ecologically significant essential fish habitat at the western end of the site created by rocky intertidal and complex bottom habitat, and eelgrass resources. At the eastern end of the site, approximately 2.23 acres of rocky intertidal habitat and approximately 1.75 acres of complex bottom habitat will be covered by the sand placement. According to WHG surveys from 2018, the ecological value of resources in this area is low, and the beach width has narrowed to the extent that the nourishment footprint cannot be adjusted without negatively affecting project performance. Prior to construction, the most recent surveys of complex rocky habitat will be used in the design of the final nourishment template. These surveys will be used to avoid as much complex bottom habitat as possible will still accomplishing the project purpose.

Figure 5: WHG 2018 complex bottom habitat and 2019 eelgrass survey results

Placed sediment will eventually erode off of Town Neck Beach without additional sand input. It is anticipated that the placement of 388,000 cy of sand will take approximately 9 years to reach a point at which the beach fill is 70% of the original design. At this point, it is estimated that renourishment would occur either by the Town and/or through other USACE projects (e.g. beneficial use of dredged material from the Canal FNP).

Sediments in the borrow area are anticipated to infill within about 10 years following dredging. Sediment transport potential will not significantly change at the Scusset borrow site with the extraction (WHG, 2017). Most of the sediment being carried through nearshore sediment transport processes is sand, thus, it is unlikely that the dredged borrow area will accumulate different material (i.e. fines) than it currently contains (WHG, 2017). Removal of the sediments from the borrow site will not significantly change the character of the substrate.

Dredging and placement activities may alter dissolved oxygen (DO); however, any changes will be temporary and limited to the immediate project areas. It is expected that any changes in dissolved oxygen levels will return to ambient conditions upon cessation of operational activities given that the area of dredging is continually flushed by tidal flows and currents. No appreciable changes in the salinity regime, tidal flows, current, or wave patterns are expected as a result of the proposed project.

3.2. Biological Environment

3.2.1. Prey Species

Benthic organisms serve as prey items for EFH-managed species. Although a site-specific benthic survey was not conducted for this project, common invertebrates associated with sandy nearshore assemblages would likely inhabit the borrow site and placement area. Polychaetes such as *Nephtys* and *Spio* spp. along with bivalve mollusks such as *Macoma balthica* and *Gemma gemma* are common in New England sand substrates similar to that present in the borrow site and subtidal area off of Town Neck Beach.

Dredging and placement operations for the project will have short-term, temporary negative effects on the benthic organisms in the immediate dredging and placement areas. The dredge will entrain benthic organisms associated with the borrow site sediments during its operation. Many organisms will experience mortality or injury during the process; taxa with hard shells or tube-dwellers may have a better chance of survival (Maurer et al., 1979). The dredging will remove benthic organisms from the Scusset borrow site and redeposit them at the placement site. Those that can tolerate the dredging operation will continue to inhabit the placement area if habitat conditions allow. Settling of suspended sediments may indirectly impact any benthic organisms in adjacent areas as well. These organisms are not expected to be significantly affected though because benthic organisms inhabiting intertidal and surf zone areas are well adapted to and tolerant of considerable changes in their environment (Naqvi and Pullen, 1982).

The sediments in the Scusset borrow site and placement location are similar in grain size thus promoting rapid recolonization by organisms from adjacent areas. Recovery of the benthos in intertidal or nearshore environments may occur in as little as two to seven months (Nelson, 1993; USACE, 2001) depending on the season of disturbance (Reilly and Bellis, 1983; Versar, 2004). Slower recovery is expected from organisms that spend their entire life history (brood eggs and young) on the beach such as with some *Haustorius* species of amphipods (Reilly and Bellis, 1983). Wilbur and Clarke (2007) demonstrated that benthic communities in temperate regions occupying shallow waters with substrate of sand, silt, or clay show recovery times between one and eleven months after dredging. Overall, the benthic communities in the borrow site and placement area are anticipated to recover over time and no long-term adverse effects are expected. Therefore, most impacts to fish species using these areas for forage, would be expected to be temporary.

Any benthic species inhabiting intertidal rock areas that are completely covered by sand will suffer mortality. The conversion of rock to sand will not provide suitable living habitat for those species to recolonize. Instead, benthic prey species that live in sand will eventually colonize the covered areas. Surrounding areas hosting rocky substrate will continue to provide habitat for benthic species exclusive to those substrates and EFH-managed species will continue to be able to utilize those areas for forage. Therefore, only a minimal impact to rocky benthic foraging area is anticipated.

Prey species that live in the water column are also likely to be impacted during construction. The temporary increased suspended sediments resulting from dredging and placement activities have the potential to impact planktonic species in the vicinity of any elevated suspended sediment plumes in the water column. However, given the short-lived and transient nature of these water column disturbances, it is expected that any impacts would be of a temporary nature and return to ambient conditions upon cessation of operational activities. Thus, any impacts would be temporary and not be expected to have any significant long-term effects on prey species within the project area.

3.2.2. Shellfish

Shellfish also serve as prey items for EFH-managed species. Shellfish suitability areas, as delineated by the Massachusetts Division of Marine Fisheries (MADMF), for blue mussels (*Mytilus edulis*) and Atlantic surf clams (*Spisula solidissima*) are mapped along Town Neck Beach. Suitable habitat for blue mussels, soft-shelled clams (*Mya arenaria*), and quahog (*Mercenaria mercenaria*) is present in the marsh and throughout the Old Harbor Inlet. Blue mussel habitat is mapped in the Scusset borrow area as well (MADMF, 2011). Figure 6 shows these areas with the shellfish suitability map.

Woods Hole Group (WHG) performed shellfish surveys of both the placement and borrow sites in 2014 and 2016, respectively. No shellfish were found in or near the Town Neck Beach placement site (WHG, 2014). Within the borrow site, surf clams were found in densities ranging from 0.1 to 0.01 per square foot and no blue mussels were observed (WHG, 2017). The MADMF provided an assessment to the WHG that the borrow area is not a productive shellfish habitat and that recovery of the surf clam community would likely occur within one year following sand extraction.

Turbidity is not expected to have a negative impact to shellfish species because they are adapted to increases in suspended sediments and other stresses following coastal storms and other perturbations. Several studies have demonstrated that shellfish are capable of withstanding elevated turbidity levels for short time periods (i.e., days) with no significant metabolic consequences or mortality (Wilbur and Clarke 2001; Norkko et al. 2006). The project's time of year (October 1 to December 31) will avoid the shellfish spawning season in the area. Therefore, no long-term or significant impacts to shellfish resources in the project area are expected as a result of the project.

Lobsters and other shellfish like crabs may use the eelgrass beds and rocky habitat outside of the nourishment footprint. From December to May, adult lobsters are largely offshore and move inshore for spawning between May and August. Adult lobsters remain in nearshore areas in highest abundance between May and December. The preferred habitat for protection from predators is complex substrate, particularly cobble, but eelgrass and peat reefs have also been noted (Palma et al., 1998). Early benthic phase lobsters are associated with cobble/rock substrate. Although lobsters occur at all depths, from shallow subtidal areas to deep offshore waters near Georges Bank and the Continental shelf, the juveniles are generally found in shallow water (less than 50 feet). Lobsters are expected to avoid the area if project activities cause disturbance. The rocky habitat areas where juvenile lobsters may be present will be subject to the movement of sediment as the placed sand erodes off the beach over time. Impacts to lobsters from temporarily increased turbidity due to project activities are not expected to be significant since the material is sand which will settle from the water column within a short time. Furthermore, lobsters are accustomed to turbidity created by storm activity and passing vessels and should have the ability to move from the area should conditions warrant (i.e. if the turbidity is too severe).

The MADMF suggests a time of year restriction between May 31 and July 31 for all of the project areas for the protection of egg-bearing females. Construction will take place outside of that time of year. Adult lobsters are mobile and capable of avoiding the dredge and pipeline's areas of temporarily increased turbidity; therefore, only minimal impacts to adult lobsters are anticipated as a result of project activities.

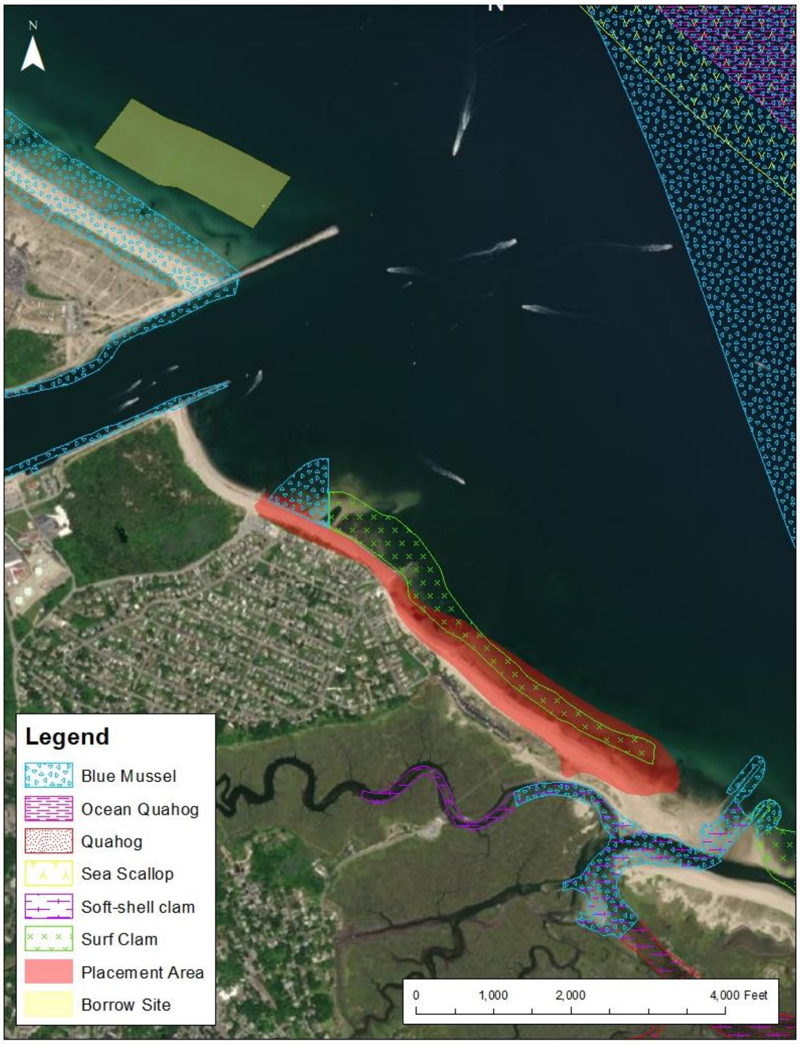

Figure 6: Shellfish Suitability Areas, Sandwich (MADMF, 2011)

3.2.3. Submerged Aquatic Vegetation

The intertidal and subtidal area of Town Neck Beach hosts a myriad of submerged aquatic vegetation (SAV) and macroalgae attached to rocks and growing in sandy substrate. Eelgrass (*Zostera marina*) makes up the majority of the plant community growing in the subtidal area off of Town Neck Beach. Many forms of macroalgae, including Irish moss (*Chondrus crispus*), bladder wrack (*Fucus vesiculosus*), and other species of rockweeds (*Ascophyllum nodosum* and *Fucus* spp.) grow on rocks and boulders in the intertidal and subtidal area of Town Neck Beach (WHG, 2018).

Rockweeds are seaweeds that attach to rocky substrates. They typically have branching fronds, and the larger species can grow up to 6 feet in length. Rockweed serves as both a food source and as shelter by marine organisms. Eelgrass is a saltwater angiosperm found in estuaries and shallow coastal areas. Eelgrass beds provide shelter, a rich variety of primary and secondary food resources, and form a nursery habitat for the life history stages of numerous fish (Thayer et al., 1984). Eelgrass beds filter excess nutrients out of the water and help prevent shoreline flooding and erosion by stabilizing sediment and buffering wave action.

Between the period of 1995-2012, eelgrass bed locations were mapped in the Cape Cod Bay area by the Massachusetts Department of Environmental Protection (MADEP) as part of the MADEP Eelgrass Mapping Project. Surveys were performed using aerial photography to delineate eelgrass extents. The data from MADEP indicate that eelgrass resources have been declining over the years in Cape Cod Bay. Factors contributing to the decline are increased water pollution, a fatal infection called wasting disease, increased shoreline development, scouring from boat traffic, and damage caused by storms (USFWS, 2011).

In 2015, the WHG surveyed the Scusset Beach borrow site area for SAV and found no eelgrass or SAV growing within the borrow area or its surroundings (WHG, 2017). Surveys of the eelgrass bed’s extent along the nourishment site on Town Neck Beach have been carried out by WHG annually from 2014-2019 for the Town of Sandwich. The most recent survey took place in 2019 and the results are shown in Figure 5 along with the results of the complex rocky habitat survey conducted in 2018. The most recent survey in 2019 was the third year of annual monitoring by WHG of the entire length of the project area, including inside and offshore the permitted nourishment footprint. The 2019 survey methodology consisted of two separate survey methods: a wading survey was conducted by WHG on 7 August 2019 and a boat-based survey was conducted by the MADMF on 24 July 2019. Methodology is contained in the 2019 WHG Eelgrass Memo to MADEP (WHG, 2019).

Eelgrass was observed in the nearshore area of the nourishment site with 99.9% of the eelgrass observed outside of the nourishment footprint (Figure 5). The total area of eelgrass mapped by WHG in 2019 was 29.8 acres, representing a 7.5% increase from 2018. The increase was attributed to growth within an area at the western end of the surveyed area as well as growth along the seaward edges of the larger eelgrass meadow (WHG, 2019).

Additional eelgrass surveys will continue to be performed in accordance with the special condition in the Town of Sandwich's MEPA certificate. Prior to final project design, the USACE will conduct an additional SAV survey of the beach nourishment area, if deemed necessary. The nourishment footprint has been and will continue to be designed to avoid direct impacts to eelgrass resources. The placement of material outside of a 100-foot buffer around eelgrass beds will also attempt to be achieved, however, in some areas this buffer may not be possible. Due to the narrow width of the existing beach which has been subject to extensive erosion, and the numerous residential properties that are highly vulnerable to storm damage, the nourishment template may require a buffer width closer than 100 feet to eelgrass resources in certain areas.

The material to be dredged and placed on Town Neck Beach is 96% sand. Given that the material will be dewatered above the MHW line before being reworked, sedimentation and light attenuation impacts to eelgrass caused by the placement are expected to be minimal. Eelgrass is subject to shifting sands and wave action causing localized water column turbidity. Thus, the eelgrass growing along Town Neck Beach can withstand these temporary increases in turbidity and is not expected to be adversely impacted by the project. The contractor will not be permitted to place equipment, run pipelines, or anchor within areas of eelgrass. Therefore, no appreciable direct or indirect impacts to eelgrass are anticipated as a result of the proposed maintenance dredging.

3.3. Habitat Areas of Particular Concern (HAPC)

The project areas are located within an identified HAPC for Atlantic cod juveniles (inshore, 20 m). The HAPC recognizes the importance of structurally complex rocky-bottom habitat in inshore areas. These habitats contain emergent epifauna and benthic invertebrates that provide prey for Atlantic cod, and the structural complexity is used as refuge areas from predators (NEFMC, 2017). The WHG has continually monitored and mapped complex and intertidal rocky habitat alongside and within the nourishment template. These habitat types fit the description of the inshore juvenile cod HAPC. Their latest map from 2018 is presented in Figure 5.

Approximately 2.23 acres of rocky intertidal habitat and approximately 1.75 acres of complex bottom habitat will be covered by the sand placement on Town Neck Beach; however, these areas have relatively minor ecological function compared with areas further seaward and those outside of the nourishment footprint. According to the WHG's (2018) accompanying report assessing rocky intertidal and complex bottom habitat in the vicinity of the project area, the majority of high value habitat will be avoided by the current configuration of the placement footprint (WHG, 2018). For further information about the habitat within and adjacent to the project area as well as measures to reduce impact to high value areas that provide diverse macroalgae and substrate types, please refer to the 2018 WHG report. The USACE will also seek to avoid high value areas when designing the final nourishment footprint in the next phase of the study. The most recent maps of intertidal and complex rocky habitat will be used to inform the final design. Sand placement will cover some areas of rocky intertidal and complex habitat, but these areas have been deemed essential for placement given the narrow width of the beach and the proximity of threatened homes. The ecological function of the habitat in these areas is not as robust as the surrounding areas that will be avoided by the project, thus, the impact to juvenile cod HAPC is not considered significant.

4. EFH Species Designations

Table 1 lists the designated EFH for Federally managed species and life stages for the Town Neck Beach placement site (indicated by an "A") and the Scusset borrow site (indicated by a "B"). This list was generated using NMFS's EFH Mapper as well as the EFH GIS shapefiles and the Final Omnibus Essential Fish Habitat Amendment 2.

Table 1: EFH species designations for the Town Neck Beach placement area (designated by "A") and the Scusset Borrow Site (designated by "B")

Species	Eggs	Larvae	Juveniles	Adults
American plaice (*Hippoglossoides platessoides*)	A B	A B	A B	A B
Atlantic cod (*Gadus morhua*)	A B	A B	A B	A B
Atlantic wolffish (*Anarhichas lupus*)	A B	A B	A B	A B
Ocean pout (*Macrozoarces americanus*)	A B	A B	A B	A B
Pollock (*Pollachius virens*)		A B	A B	A B
White hake (*Urophycis tenuis*)	A B	A B	A B	A B
Windowpane flounder (*Scophthalmus aquosus*)	A B	A B	A B	A B
Winter flounder (*Pseudopleuronectes americanus*)	A B	A B	A B	A B
Yellowtail flounder (*Limanda ferruginea*)	A B	A B	A B	A B
Silver hake (*Merluccius bilinearis*)	A B	A B		A B
Red hake (*Urophycis chuss*)	A B	A B	A B	A B
Monkfish (*Lophius americanus*)	A B	A B		
Thorny skate (*Amblyraja radiata*)			A B	
Little skate (*Leucoraja erinacea*)			A B	A B
Winter skate (*Leucoraja ocellata*)			A B	A B
Atlantic sea scallops (*Placopecten magellanicus*)	A B	A B	A B	A B
Atlantic herring (*Clupea harengus*)		A B	A B	A B
Albacore tuna (*Thunnus alalunga*)			A B	A B
Bluefin tuna (*Thunnus thynnus*)				A B
Basking shark (*Cetorhinus maximus*)			B	B
White shark (*Carcharodon carcharias*)			A B	A B
Smoothhound shark (*Mustelus mustelus*)			B	B
Sand tiger shark (*Carcharias taurus*)			B	

5. EFH Impact Assessment

The following assessment used NMFS source documents (NMFS, n.d.) and the Final Omnibus Essential Fish Habitat Amendment 2, Volume 2: EFH and HAPC Designation Alternatives and Environmental Impacts (Preferred EFH Designations) (NEFMC, 2017) as references. Please note that these references are not cited throughout the text since they were used extensively. Citations for any references other than these documents are provided in the text.

5.1. Spawning Habitat

The project areas (Scusset borrow site and waters within the placement site on Town Neck Beach) have the potential to offer spawning habitat for ocean pout, windowpane flounder, winter flounder, and Atlantic sea scallops. Species with the EFH designation for the egg life stage (Table 1) that were determined not to have spawning habitat in the project area based on preferred habitat characteristics compared to the characteristics of the project areas, and would not be affected based on the time of year proposed for work (October 1 to December 31) are: American plaice, Atlantic cod, Atlantic wolffish, white hake, yellowtail flounder, silver hake, red hake, and monkfish.

EFH for ocean pout eggs occurs over rocky bottom habitats. Ocean pout are nearshore species that inhabit hard bottom substrates with salinities greater than 30%. Ocean pout egg development takes two to three months during late fall and winter. Although the project will take place when ocean pout eggs may be present at the placement area, only minimal effects to ocean pout are anticipated. Rocky habitat that will be covered by the project area is minimal and primarily located in the intertidal zone where ocean pout eggs are not anticipated to be. Further, placed sand will be dewatered above the MHW line prior to reworking which will minimize increased water column turbidity in the nearshore waters of the placement area. Therefore, only minimal impacts to ocean pout spawning habitat is anticipated.

The eggs of windowpane flounder are buoyant and typically found in the water column at water depths of 3 to 230 feet. Windowpane flounder spawn year-round, but the majority of eggs were collected in spring through autumn (March-November) meaning that peak egg abundance generally occurs outside of the project window.

Winter flounder are found in a variety of habitats from brackish riverine waters to saline coastal environments and have been documented from mean low water to 16 feet from Cape Cod to Absecon Inlet, New Jersey and as deep as 230 feet on George’s Bank and in the Gulf of Maine. Inshore stocks of winter flounder move to shallow, protected waters in late fall/early winter, and spawn in early spring often over sandy or muddy substrates. Spawning is thought to begin around the minimal seasonal water temperature, just before temperatures begin to rise. The eggs of winter flounder are demersal, adhesive and stick together in clusters. The eggs of winter flounder have been shown to be susceptible to sedimentation and burial by dredged sediment (Suedel et al., 2017). Hatching occurs within two to three weeks depending on temperature. Based on the project's time of year, only minimal impacts to winter flounder EFH are expected to occur.

Atlantic sea scallop spawning generally occurs between late September and early October with spatfall occurring about one month after spawning. Eggs remain of the sea floor until they develop into free-swimming larvae. No Atlantic sea scallops have been documented in or adjacent to the Scusset borrow site or the placement area. Although the project's timing may overlap spawning, the project will take place in areas where sea scallops are not known to exist; therefore, no impacts to Atlantic sea scallops are anticipated as a result of construction.

5.2. Nursery Habitat

Species that have the potential to use the project areas for nursery habitat include ocean pout, Atlantic herring, windowpane flounder, winter flounder, and Atlantic sea scallops. Nursery habitat for the following species will not be affected by the proposed project based on the species' habitat requirements and those of the project area and the time of year proposed for construction: American plaice, Atlantic cod, Atlantic wolffish, white hake, yellowtail flounder, silver hake, red hake, monkfish, and pollock.

There is no true larval stage for ocean pout, but the eggs and juveniles of this species are found over habitat like that found within and offshore of the placement site on Town Neck Beach. The preferred larval habitat contains hard bottoms. Juveniles are typically found in intertidal and subtidal benthic habitats over a variety of substrates in the high salinity zones north of Cape Cod. There should be minimal impacts to the rocky habitat in the subtidal waters adjacent to the beach placement area and juveniles should be able to avoid any potential direct impacts because of their mobility. The project has been designed to largely avoid placement of material on hard bottom and complex habitat leading to only a minimal effect to the nursery habitat of ocean pout in the project area.

The larval life stage of Atlantic herring is long, lasting 4-8 months, and the larvae are transported long distances in that time period. Atlantic herring larvae metamorphose into early stage juveniles in the spring within intertidal and subtidal habitats out to 985 feet. Juveniles and adults are most frequently found in the Gulf of Maine from spring to autumn. Given that the project will take place outside of the time of year that the species is likely present within the project area, construction is not anticipated to cause adverse effects to Atlantic herring nursery habitat.

Windowpane flounder larvae are pelagic, and juveniles are found in intertidal and subtidal benthic habitats in estuarine, coastal marine, and continental shelf waters along the east coast. EFH for juvenile windowpane flounder is on mud and sand substrates and extends from the intertidal zone to a depth of 196 feet. Seasonal occurrences in the project area are generally from February to November, with peaks occurring in May and October. Although construction will overlap with the potential presence of this species in the project area, larvae are not anticipated to be impacted since they are pelagic and juveniles will have the ability to leave the area to seek out suitable habitat or use adjacent areas that will be unaffected by the work. Increased water column turbidity as a result of dredging and placement is expected to be localized and temporary leading to only minimal impacts to windowpane flounder nursery habitat.

The larvae of winter flounder are found in estuarine, coastal, and continental shelf waters from the shoreline to a depth of 230 feet from the Gulf of Maine to Absecon Inlet in New Jersey. Larvae hatch in nearshore waters and estuaries or are transported shoreward where they metamorphose and settle to the bottom as juveniles. They are initially planktonic but become increasingly less buoyant and occupy the lower water column as they get older. Juveniles are found over a variety of bottom habitats including sand, rocky substrates with attached macroalgae, and eelgrass. Hatching occurs after 2-3 weeks depending on temperature; thus, the larvae of winter flounder would be present in the project area likely in late winter after the project has concluded. Although juveniles may be present in the area, they are able to move to avoid disturbances and can use adjacent habitat. Only minimal impacts to nursery habitat for windowpane flounder is expected since the majority of rocky habitat will be avoided, and no placement will occur on eelgrass beds.

Peak spawning for Atlantic sea scallops occurs in September and October; eggs remain on the sea floor until they develop into free-swimming larvae. The first two larval stages are planktonic for over one month after hatching and the distribution of the early larval stages is dependent upon the currents in the area. The larvae metamorphose into spat and settle on bottom habitats with a substrate of gravelly sand, shell fragments, and pebbles, or on various red algae, hydroids, amphipod tubes and bryozoans. Juvenile scallops (5-12 mm shell height) leave the original substrate on which they have settled and attach themselves to shells and bottom debris, preferring gravel. In general, juveniles are found on bottom habitats with a substrate of cobble, shells and silt in water depths from 59 to 361 feet. Because scallops have not been found within or adjacent to the borrow site or placement area, no impacts to scallop nursery habitat are anticipated.

5.3. Foraging and Living Habitat

The project areas provide forage and living habitat for the following EFH-designated species: American plaice, ocean pout, Atlantic cod, pollock, red hake, silver hake, white hake, Atlantic herring, Atlantic sea scallops, little skate, winter skate, thorny skate, albacore tuna, bluefin tuna, basking shark, white shark, smoothhound shark, and sand tiger shark. Based on the species' habitat characteristics and those of the project area, no impacts to Atlantic wolffish foraging and living habitat are anticipated as a result of the proposed project.

EFH for American plaice juveniles and adults is in Cape Cod Bay over a variety of substrates. Plaice diets are dominated by echinoderms, arthropods, annelids, and mollusks. Ocean pout juveniles occur in shallow coastal waters around rocks and attached algae. Juvenile and adult ocean pout encompasses many different substrates including sand and soft sediments, and they are benthic feeders. Their depth preference is between 3 and 656 ft, but are mainly found between 49 and 360 ft.

Structurally complex habitats, including eelgrass, mixed sand and gravel, and rocky habitats (gravel pavements, cobble, and boulder) with and without attached macroalgae and emergent epifauna, are essential habitats for juvenile cod. Older juveniles move into deeper water and are associated with gravel, cobble, and boulder habitats, particularly those with attached organisms. Adult cod are typically found in deeper waters (98-525 ft) but are also present over complex hard bottom habitats with and without emergent epifauna and macroalgae and over sandy substrates. Cod have a varied diet. Juvenile pollock are present in the shallow intertidal zone of bays and estuaries at all stages of the tide throughout the summer. They have been reported over substrates varying from sand, mud, rocky bottom or aquatic vegetation. Adults show little preference for bottom type and they inhabit a wide range of depths from 115 to 1,197 feet.

Red hake is a demersal fish and the juveniles and adults are often found associated with depressions in softer sediments or in shell beds. Red hake make seasonal migrations to follow preferred temperature ranges and are more common inshore in warmer months. Their diet consists predominantly of benthic and pelagic crustaceans, but adults also consume fish and squid. Silver hake are often found in bottom depressions or in association with sand waves and shell fragments. Juvenile and adult silver hake migrate to deeper waters of the continental shelf as water temperatures decline in the autumn and return to shallow waters in spring and summer to spawn. Silver hake feed on fish, crustaceans, and squid, but young silver hake prey on euphausiids, shrimp, and amphipods. Eelgrass provides important habitat for demersal juvenile white hake. Both juveniles and adults prey on polychaetes, small shrimps and other crustaceans and are found on muddy and fine-grained sandy bottom sediment.

Winter flounder are found in a variety of habitats from brackish riverine waters to marine coastal environments and have been documented from depths of less than 3 feet in coastal embayments to 269 feet on George's Bank. Inshore stocks of winter flounder move to shallow, protected waters in late fall/early winter. They prey on amphipods, polychaetes, bivalves or siphons, capelin eggs, and crustaceans. Yellowtail flounder are typically found in waters between 16 and 410 feet on sand and gravel substrates. Their diet consists of benthic macrofauna. Catches of yellowtail flounder are high around Cape Cod during spring and autumn, and adults and juveniles migrate away from coastal areas off southern New England during late autumn. Windowpane flounder juveniles and adults are most common in nearshore areas and estuaries between spring and autumn. They feed on polychaetes and small crustaceans especially mysids.

Atlantic herring juveniles and adults are most frequently found in the Gulf of Maine from spring to autumn. Juveniles and adults are pelagic, with adults only becoming demersal during spawning. Atlantic sea herring prey on pelagic zooplankton. Juveniles Atlantic sea scallops are found on gravel, small rocks, shells, and silts with adults preferring coarse substrate.

Several species of skate (little, winter, and thorny) have EFH that occurs on sand, gravel, and mud substrates. Each of the species makes seasonal migrations although there is evidence that some skates are found in inshore waters at all times of year. Little and winter skate feed on invertebrates such as decapod crustaceans, amphipods, and polychaetes whereas thorny skate feed on hydrozoans, gastropods, bivalves, squids, etc.

Albacore and bluefin tuna are highly migratory species that would likely be in the project areas in the summer months, if present. They feed near the top of the food chain on fish, squid, and crustaceans. Multiple species of sharks: basking, white, smoothhound, and sand tiger also have EFH designated for juvenile and adult life stages at the project sites. All of these sharks are highly migratory species that would be present in the project areas during the summer months only. Most of these sharks are top predators feeding on bony fishes, small sharks, rays, squids, crabs, and lobsters; basking sharks are filter-feeders. Based on these species' diets and time of year for the project, no effects to forage and living habitat EFH for any of these species is anticipated.

Foraging and living habitat for all the aforementioned species may be temporarily reduced and/or disturbed as a result of the project. Prey species that live in the water column have the potential to be temporarily impacted during dredging and placement activities. The increased suspended sediments resulting from dredging and disposal have the potential to decrease the depth at which photosynthesis can take place thereby disrupting photosynthesis by phytoplankton (Harris and Vinobaba, 2012). However, given the short-term and transient nature of these water column disturbances, we expect that any impacts will be temporary in nature and the water column will quickly return to ambient conditions upon cessation of operational activities. Hence, no significant long-term effects on planktonic prey species within the project area is anticipated.

Impacts resulting from the disturbance of mobile forage organisms may occur as a result of the project. Behaviors of fish when exposed to increased levels of suspended sediments vary due to different foraging strategies for different species. Colby and Hoss (2004) found that prey availability interacts with total suspended sediment concentrations to affect fish feeding success on a species by species basis. Species which prey on mobile demersal and pelagic fish and squid would need to follow their prey species to other suitable areas as some prey species may avoid the active in-water work areas. Although studies have shown impacts to organism behavior (Wilber and Clarke, 2001), coastal and estuarine organisms are exposed to suspended sediments from tidal flows, currents, and storms, therefore, they have adaptive behavioral and physiological mechanisms for dealing with this feature of the habitat. Major storms can displace larger amounts of sediments than dredging operations and dredging affects much smaller regions (i.e. a localization of impacts) than these major storms (Wilber and Clarke, 2001). As a result, only minimal impacts to mobile forage organisms are expected as a result of the proposed action.

Dredging and placement operations for the project will have temporary, negative effects on benthic organisms in the immediate dredging and placement areas affecting the forage habitat for EFH-managed species that are benthic feeders. The abundance and/or distribution of benthic prey items will be temporarily reduced or displaced. Full benthic recovery is expected within one year following construction (Wilbur and Clarke, 2007). The borrow site and placement areas are high energy, unstable environments and as a result do not promote stable long-term benthic communities regardless of project activities. Because the placement area on Town Neck Beach is subject to erosion, elevated turbidities and winnowing of sand from the beach will continue after completion of the project impacting the surrounding benthic habitats. However, these disturbances will be similar to the naturally occurring conditions experienced in this high energy environment. Therefore, impacts to benthic forage habitat in the immediate areas of the project will be temporarily negatively affected, but not significantly adversely impacted by the proposed project.

Demersal species that are within the dredging and placement areas will likely avoid these areas during dredging resulting in only minor, temporary impacts to their living habitat. This determination is based on the fact that dredging will impact the project area for a relatively short time (three months) when the majority of fish are not present in the area. Impacts to pelagic fish or those migrating to access forage and living habitat outside of the project area are expected to be minimal. Due to the wide expanse of area surrounding the borrow site and placement area there will be sufficient room for fish to transit around project activities and avoid any associated elevated turbidities within the water column.

The proposed project is expected to occur between October 1 and December 31 which generally avoids the time of year that EFH-designated species would utilize the project areas for forage and living habitat. Also, the project areas represent a small amount of commonly available foraging and living habitat. The project will not cause significant adverse impacts to the surrounding habitat nor prevent EFH-designated species from accessing that habitat. Given this information, the proposed work is not anticipated to significantly adversely affect foraging and living habitat for EFH-designated species.

6. Cumulative Effects

Cumulative impacts are those resulting from the incremental impact of the proposed project when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The latest past actions in the project area include the placement of 120,000 cy of sand on Town Neck Beach from maintenance dredging of the Cape Cod Canal FNP in 2016. Both the Town of Sandwich and the USACE have a history of investigating and/or attempting to address erosion of the Sandwich shoreline downdrift of the Canal over the past 25-50 years. Prior to that, approximately 65,000 cy of sand dredged from the approach channel of Mirant Canal, LLC was placed on Town Neck Beach in 2004. In 1990, the town rebuilt the dunes at the eastern end of the beach using 45,000 cy of sand dredged from the Canal. Additionally, the town and private homeowners have nourished Town Neck Beach through numerous small, separately permitted projects. These previous small-scale projects were conducted at the expense of the Town and private homeowners and used upland sand sources brought in by truck. Other past actions in the project area include the development of the neighborhood adjacent to Town Neck Beach, the construction of groins along the beach as well as use of the beach for recreation and as nesting habitat for protected species.

Present actions in the project area are consistent with its residential, coastal setting and primarily consist of recreation and tourism. Future activities in the study area are anticipated to remain similar to present actions. The placement of approximately 388,000 cubic yards of sand on Town Neck Beach will create more opportunities for recreation which may slightly increase as a result of the project.

Future activities also include continued maintenance dredging of the Canal which occurs approximately once every seven years. This study proposes further investigation into the potential for long term beneficial use of the dredged material with placement on the Sandwich shoreline instead of offshore per the current Federal base plan. Future activities may therefore include beach placement of material dredged from the eastern end of the Cape Cod Canal. Regardless of the outcome of those future investigations, the Town of Sandwich will likely pursue options for nourishment and shoreline stabilization of Town Neck Beach to address continued erosion and sea level rise. The town may also pursue the dredging of Old Harbor Inlet in future years.

The effects of these future actions have been or will be documented in environmental assessments/impact statements and will be subject to Federal, state, and local permitting. Generally, most of the cumulative impacts related to the range of present and future actions will occur on land (e.g., construction-related impacts) and in the water column (e.g., impacts from dredging). However, the majority of impacts to these areas are short-term in nature and should not significantly contribute to a decline in the ecological or socioeconomic importance of the project area. The direct effects of this project are not anticipated to magnify the impacts from other actions in the area. Therefore, no significant cumulative impacts to EFH are projected as a result of the proposed project.

7. Conclusions

The surface waters, water column, intertidal, and benthic habitat of the project areas have the potential to experience localized, temporary impacts as a result of the proposed project. The benthic habitats and biological community found directly in the project footprints will be subject to removal and burial by sediments from dredging and placement operations. The project will also cause short-term increases in turbidity in the vicinity of the dredging and placement areas. The material to be dredged is sand which will rapidly settle out of the water column under the influence of gravity; thus, only a localized area in the vicinity of the dredge and placement sites is likely to be impacted by elevated concentrations of suspended sediments.

The project is not expected to significantly adversely affect spawning habitat, nursery habitat, forage and living habitat, or the Atlantic cod Habitat Area of Particular Concern. This determination is based on the sediment characteristics of the dredged material, and the localized nature and temporary duration of the project. Project activities are expected to occur within the work window of October 1 to December 31, which would avoid the period of time that EFH-designated species are present and utilizing the project areas as habitat. Impacts to transiting and migrating fish as a result of turbidity are expected to be minimal. Project activities will take place in Cape Cod Bay so there will be sufficient area for fish to transit and avoid any project related activity and localized increases in turbidity within the water column. Although studies have shown that turbidity impacts organism behavior, coastal and estuarine organisms are exposed to suspended sediments from tidal flows, currents, and storms; therefore, they have adaptive behavioral and physiological mechanisms for dealing with this feature of the habitat.

Some of the rocky intertidal habitat adjacent to the beach will be directly impacted by placement activities, but most of the intertidal rocky habitat will be avoided. The adjacent shallow subtidal habitat provides the same functional value with as much or more complexity due to the associated macroalgae providing additional coverage for protection and forage. Direct placement of material will not occur on eelgrass and the USACE will use the most recent eelgrass surveys to ensure that no direct impacts occur.

The abundance and/or distribution of benthic and phytoplankton prey species will be temporarily impacted during and immediately following project activities. However, the short-term and transient nature of water column disturbances will not cause substantial or long-term effects to planktonic prey species. Impacts to the benthic prey community of EFH-designated species will also be temporary. Full benthic recovery is expected within months to a year after dredging and placement activities. Further, these areas are high energy, unstable environments and as a result do not promote stable long-term benthic communities regardless of project activities. For all of the aforementioned reasons, the proposed project will not significantly adversely affect essential fish habitat.

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CAPE COD CANAL & SANDWICH BEACHES

SHORE DAMAGE MITIGATION STUDY

APPENDIX A4

RECORD OF NON-APPLICABILITY

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DRAFT RECORD OF NON-APPLICABILITY (RONA)

March 1, 2021

Project/Action Name: Cape Cod Canal and Sandwich Beaches Section 111 Shore Damage Mitigation Study

Project/Action Point of Contact: Grace Moses Phone: 978-318-8717

Begin Date: October 2022

End Date: December 2022

1. The project described above has been evaluated for Section 176 of the Clean Air Act. Project related emissions associated with the Federal action were estimated to evaluate the applicability of General Conformity regulations (40CFR§93 Subpart B).
2. Total direct and indirect emissions from this project have been estimated (NOx = 18.24 tons per year and VOC = 2.58 tons per year), and are below the conformity threshold value of NOx = 100 tons per year and VOC = 50 tons per year (40CFR§93.153(b)(1) & (2)).
3. The project/action is not considered regionally significant under 40CFR§93.153(i).
4. Supporting documentation and emissions estimates are attached.

Date: ____________________ Signed: ______________________________________

(Name/Title of Environmental Coordinator)

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Actual Work Days of Construction

Assumptions:

Project construction period is	13	weeks	3	months
Project construction occurs 7 days per week.	91			
There are 10 holidays in a calendar year.	4			
There are 30 weather days (no work) in a year.	7			

Actual work days = construction duration (days) **-** weekend days off **-** holidays off **-** weather days off.

Specify Duration	Calculated Weekend days off	Specifiy Holidays	Specify Weather days
91	0	4	7

Actual work days = 80

General Conformity Review and Emission Inventory for the Cape Cod Canal and Sandwich Beaches Section 111

Estimates from Project Manager

9-Sep-20

1	2	3	4	5	6	7	8	9	10	11
							NOx Emission Estimates		VOC Emission Estimates	
	Project Emission Sources and Estimated Power						NOx	NOx	VOC	VOC
Equipment/Engine Category	# of Engines	hp	LF	hrs/day	Days of Operation	hp-hr	EF (g/hp-hr)	Emissions (tons)	EF (g/hp-hr)	Emissions (tons)
Cutterhead suction dredge	1	800	1.00	12	80	768,000	9.200	7.79	1.300	1.10
Front end loader, track	1	200	1.00	12	80	192,000	9.200	1.95	1.300	0.28
Dozer, universal blade	1	300	1.00	12	80	288,000	9.200	2.92	1.300	0.41
Dozer, universal blade	1	300	1.00	12	80	288,000	9.200	2.92	1.300	0.41
TRK, HWY 8,600lb GVW, 4x2 2 Axel 3/4T pickup	1	137	1.00	12	80	131,520	9.200	1.33	1.300	0.19
TRK, HWY 8,800lb GVW, 4x4 2 Axel 3/4T pickup	1	137	1.00	12	80	131,520	9.200	1.33	1.300	0.19
Total Emissions							**NOx Total**	**18.24**	**VOC Total**	**2.58**
Total Emissions Per Year							**NOx Total**	**18.24**	**VOC Total**	**2.58**

Horsepower Hours

hp-hr = # of engines*hp*LF*hrs/day*days of operation

Load Factors

Load Factor (LF) represents the average percentage of rated horsepower used during a source's operational profile. For this worst case estimate, LF is held at 1 for all equipment. Typical is 0.4 to 0.6

Emission Factors

NOx Emissions Factor for Off-Road Construction Equipment is 9.20 g/hp-hr

VOC Emissions Factor for Off-Road Construction Equipment is 1.30 g/hp-hr

Emissions (g) = Power Demand (hp-hr) * Emission Factor (g/hp-hr)

Emissions (tons) = Emissions (g) * (1 ton/907200 g)

CAPE COD CANAL & SANDWICH BEACHES

SHORE DAMAGE MITIGATION STUDY

APPENDIX A5

GRAIN SIZE ANALYSIS

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SCUSSET BEACH BORROW SITE

GRAIN SIZE RESULTS

*The borrow site is located in the vicinity of Stations 1-4 and 9-11 in Figure E-6 on the next page.

Table E-4. Grain size results from cores collected off Scusset Beach on May 20, 2016.

Station #	Latitude	Longitude	Core Length (ft)	Sample # (section length, feet)	Gravel %	Sand %	Silt&Clay %	D_{50} (mm)	ASTM Classification
1	41.780773	-70.491875	11.3	1A (0-6.04’)	0.5	98.7	0.8	0.23	Poorly Graded Sand
				1B (6.04-11.34’)	1	98.2	0.8	0.24	Poorly Graded Sand
2	41.781548	-70.494111	11.2	2A (0-6.6’)	0	99.1	0.9	0.21	Poorly Graded Sand
				2B (6.6-11.16’)	4.3	93.5	2.2	0.23	Poorly Graded Sand
3	41.781896	-70.495801	11.9	3A (0-6.18’)	0	99	1	0.19	Poorly Graded Sand
				3B (6.18-11.9)	0	98.3	1.7	0.18	Poorly Graded Sand
4	41.782971	-70.497861	12.8	4A (0-7.08’)	0	99.1	1	0.19	Poorly Graded Sand
				4B (7.08-12.78’)	0.8	97.6	1.6	0.20	Poorly Graded Sand
5	41.784118	-70.500238	6.6	5 (complete)	6.8	92.5	0.7	0.21	Poorly Graded Sand
6	41.785105	-70.501956	7.3	6 (complete)	0	99	1	0.19	Poorly Graded Sand
7	41.786866	-70.504516	7.2	7 (complete)	1.5	97.2	1.3	0.18	Poorly Graded Sand
8	41.788111	-70.506453	7	8 (complete)	17.8	81.4	0.8	0.25	Poorly Graded Sand with Gravel
9	41.780293	-70.492386	7.9	9 (complete)	10.3	88.1	1.6	0.20	Poorly Graded Sand
10	41.781175	-70.491633	5.6	10 (complete)	0	99.2	0.8	0.20	Poorly Graded Sand
11	41.781068	-70.494411	1.9	11 (complete)	0.3	98.6	1.1	0.22	Poorly Graded Sand

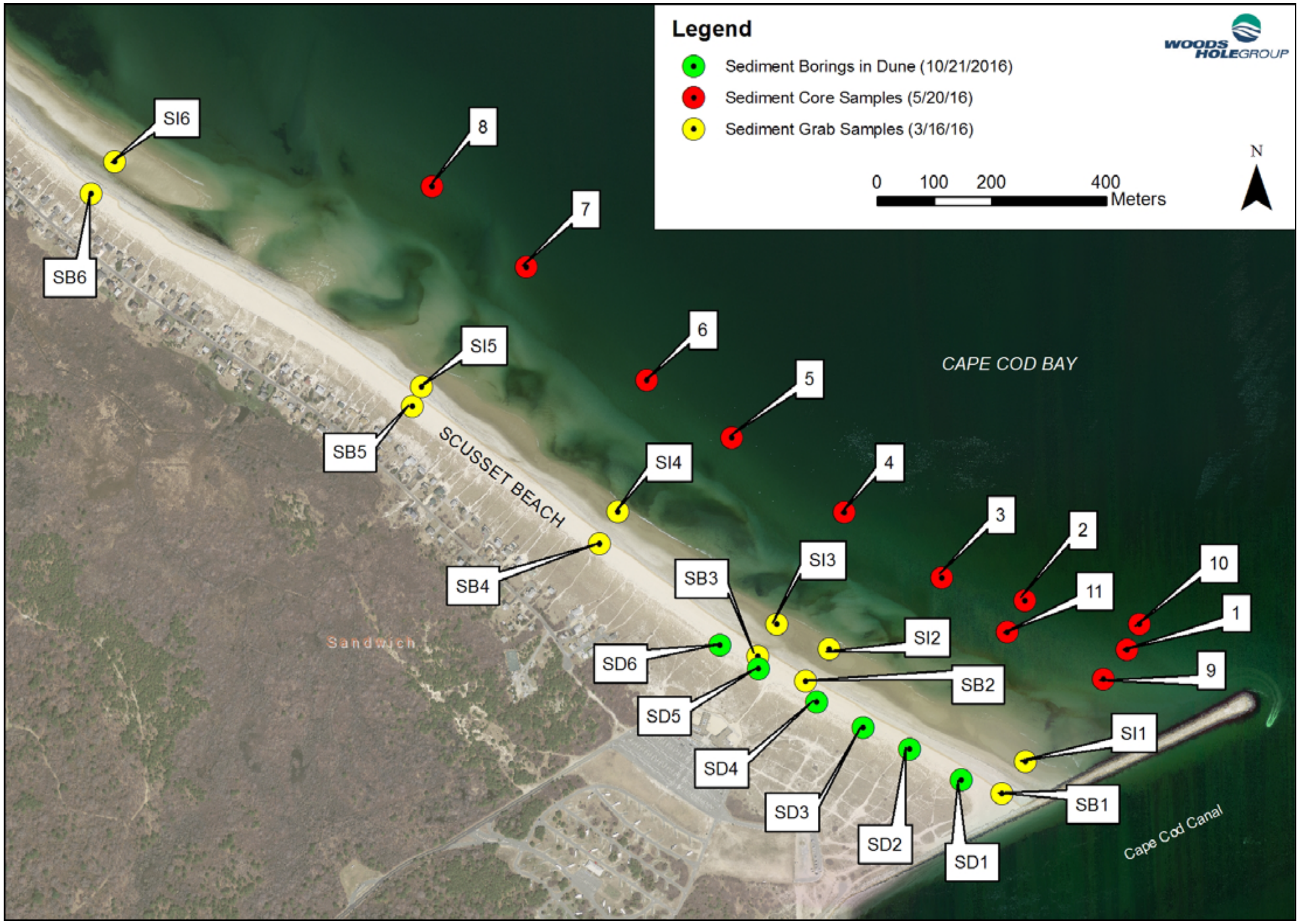


Figure E-6. Upper panel plots sediment samples collected on Scusset Beach and offshore in March and May of 2016. Grabs (yellow) are located on the beach and intertidal areas, cores (red) are offshore, and dune hand borings (green) were perform in October 2016.

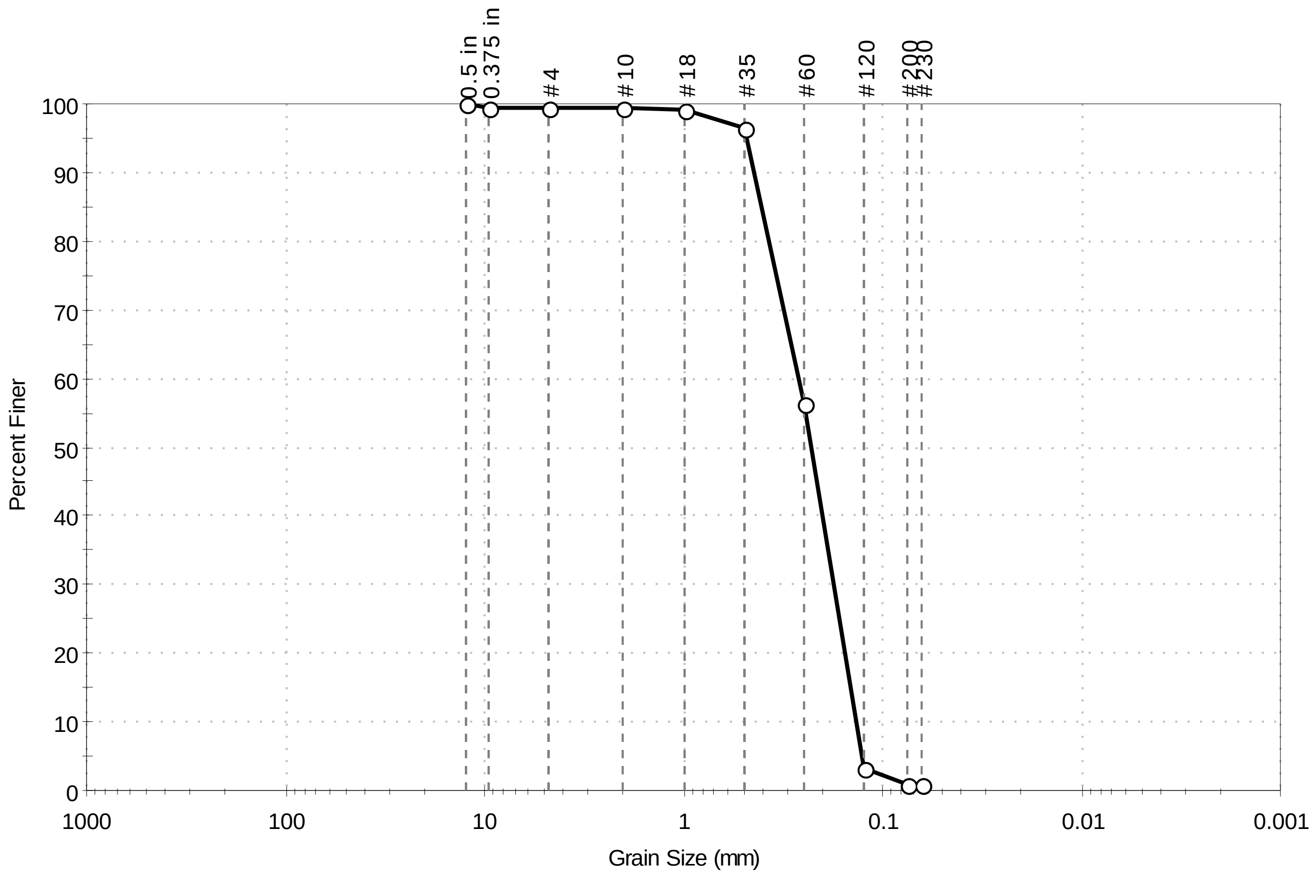
Client:	Woods Hole Group		
Project:	Scusset		
Location:	Sagamore, MA	Project No:	GTX-304835
Boring ID: ---	Sample Type: bag	Tested By:	jbr
Sample ID: Sample #1A	Test Date: 06/09/16	Checked By:	emm
Depth : ---	Test Id: 380328		

Test Comment: ---

Visual Description: Moist, light brown sand

Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.5	98.7	0.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	99		
#18	1.00	99		
#35	0.50	96		
#60	0.25	56		
#120	0.12	3		
#200	0.075	0.8		
#230	0.063	1		

Coefficients

D_{85} = 0.4101 mm D_{30} = 0.1772 mm

D_{60} = 0.2661 mm D_{15} = 0.1458 mm

D_{50} = 0.2300 mm D_{10} = 0.1366 mm

C_u = 1.948 C_c = 0.864

Classification

ASTM Poorly graded sand (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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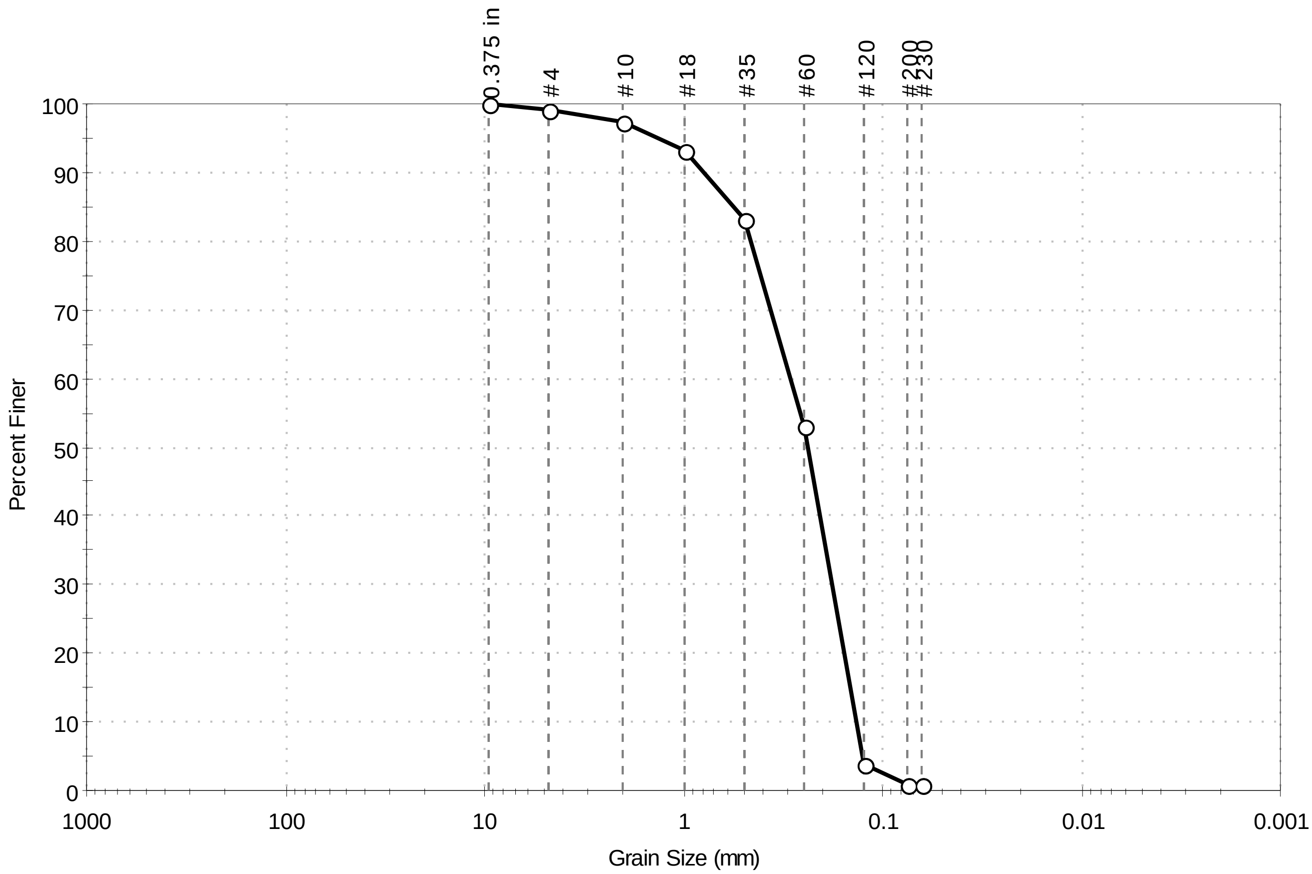
GeoTesting EXPRESS

Client:	Woods Hole Group		
Project:	Scusset		
Location:	Sagamore, MA	Project No:	GTX-304835
Boring ID: ---	Sample Type: bag	Tested By:	jbr
Sample ID: Sample #1B	Test Date: 06/09/16	Checked By:	emm
Depth : ---	Test Id: 380329		
Test Comment:	---		
Visual Description:	Moist, light gray sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	1.0	98.2	0.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	99		
#10	2.00	97		
#18	1.00	93		
#35	0.50	83		
#60	0.25	53		
#120	0.12	4		
#200	0.075	0.8		
#230	0.063	1		

Coefficients

D_{85} = 0.5630 mm | D_{30} = 0.1806 mm

D_{60} = 0.2934 mm | D_{15} = 0.1461 mm

D_{50} = 0.2396 mm | D_{10} = 0.1362 mm

C_u = 2.154 | C_c = 0.816

Classification

ASTM Poorly graded sand (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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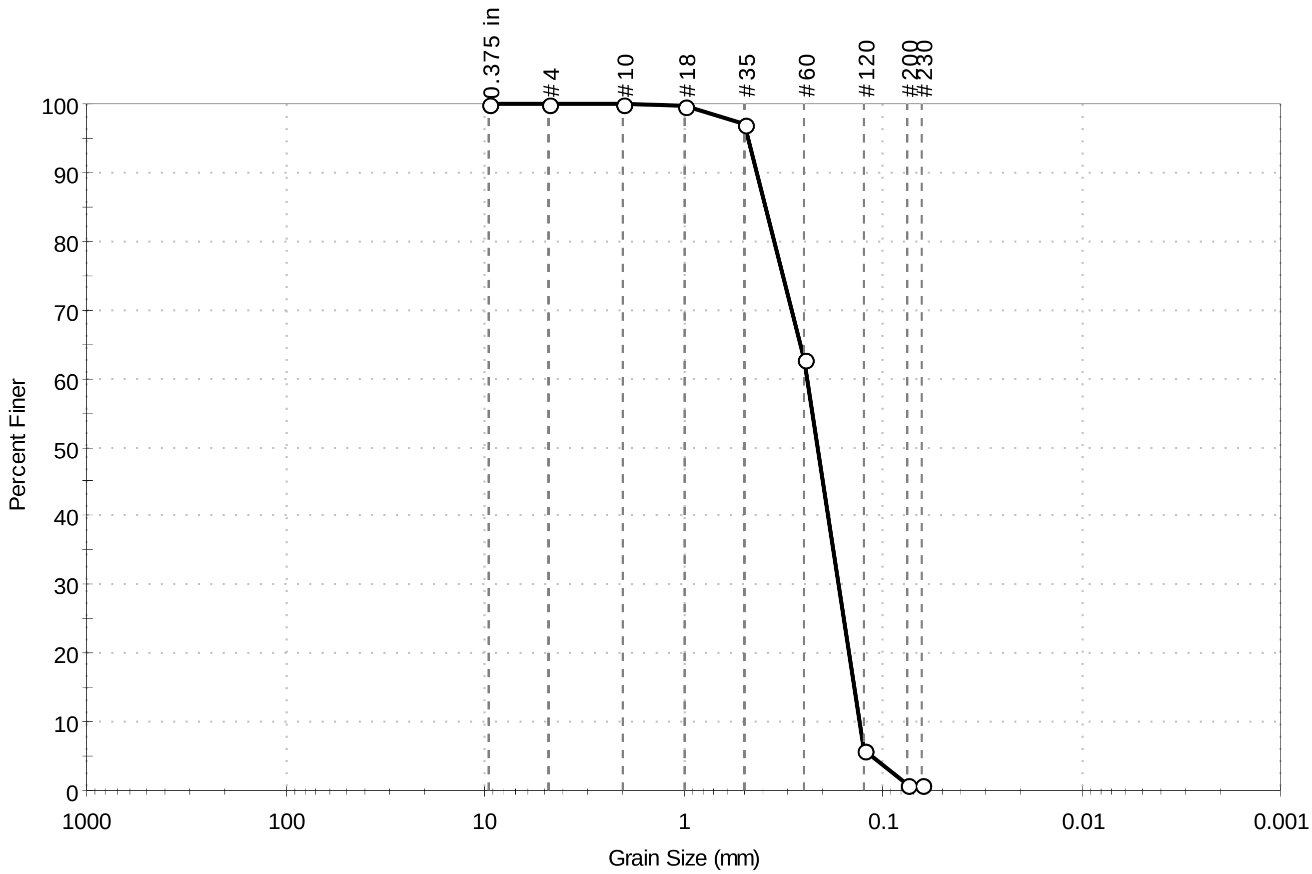
Client:	Woods Hole Group				
Project:	Scusset				
Location:	Sagamore, MA			Project No:	GTX-304835
Boring ID:	---	Sample Type:	bag	Tested By:	jbr
Sample ID:	Sample #2A	Test Date:	06/09/16	Checked By:	emm
Depth :	---	Test Id:	380330		

Test Comment: ---

Visual Description: Moist, light brown sand

Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	99.1	0.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	100		
#18	1.00	100		
#35	0.50	97		
#60	0.25	63		
#120	0.12	6		
#200	0.075	0.9		
#230	0.063	1		

Coefficients

D_{85} = 0.3911 mm D_{30} = 0.1675 mm

D_{60} = 0.2413 mm D_{15} = 0.1396 mm

D_{50} = 0.2136 mm D_{10} = 0.1314 mm

C_u = 1.836 C_c = 0.885

Classification

ASTM Poorly graded sand (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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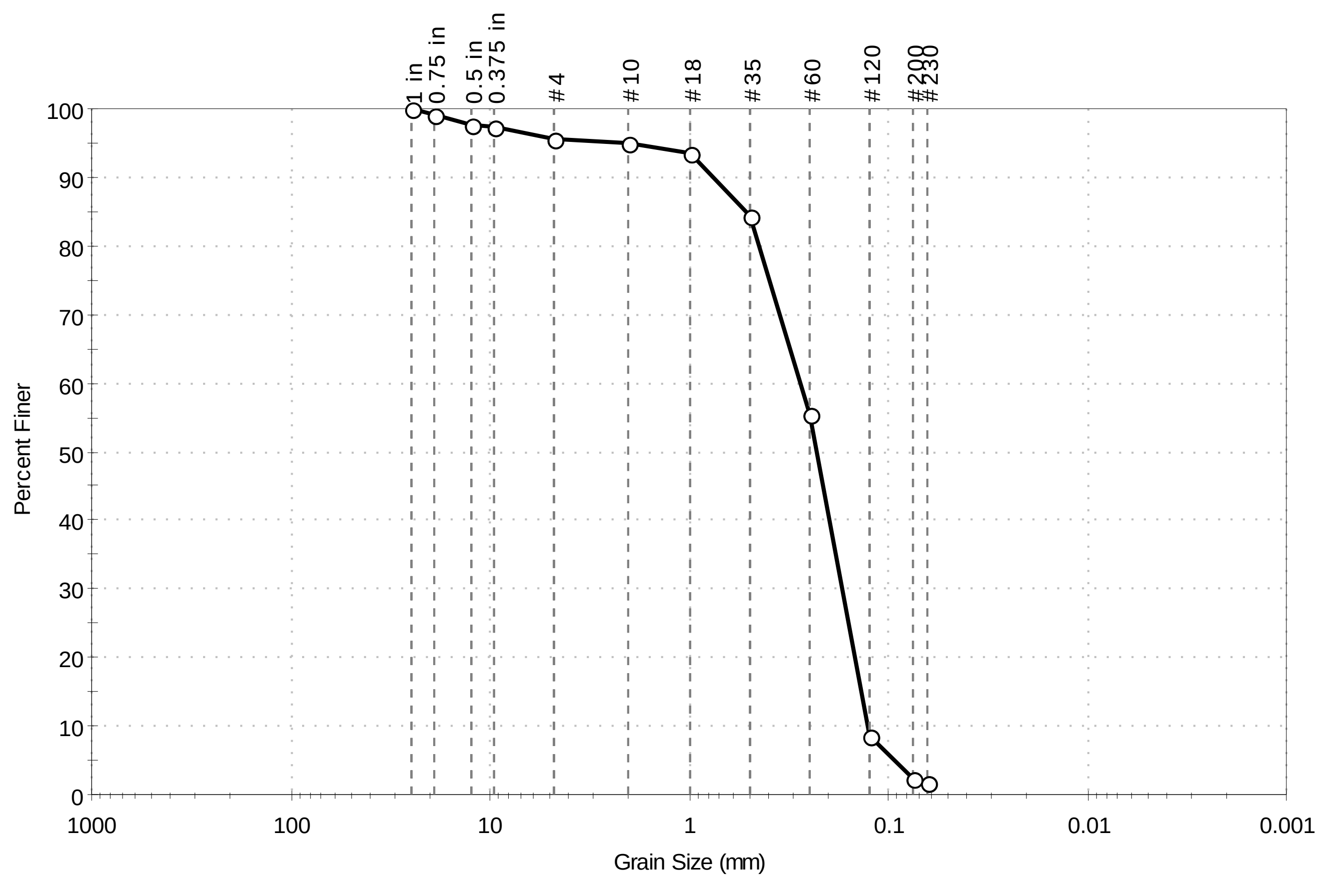
Client:	Woods Hole Group		
Project:	Scusset		
Location:	Sagamore, MA	Project No:	GTX-304835
Boring ID: ---	Sample Type: bag	Tested By:	jbr
Sample ID: Sample #2B	Test Date: 06/10/16	Checked By:	emm
Depth : ---	Test Id: 380331		

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

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	4.3	93.5	2.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	99		
0.5 in	12.50	98		
0.375 in	9.50	97		
#4	4.75	96		
#10	2.00	95		
#18	1.00	93		
#35	0.50	85		
#60	0.25	56		
#120	0.12	9		
#200	0.075	2.2		
#230	0.063	2		

Coefficients

D_{85} = 0.5192 mm | D_{30} = 0.1715 mm
D_{60} = 0.2779 mm | D_{15} = 0.1375 mm
D_{50} = 0.2302 mm | D_{10} = 0.1277 mm
C_u = 2.176 | C_c = 0.829

Classification

ASTM Poorly graded sand (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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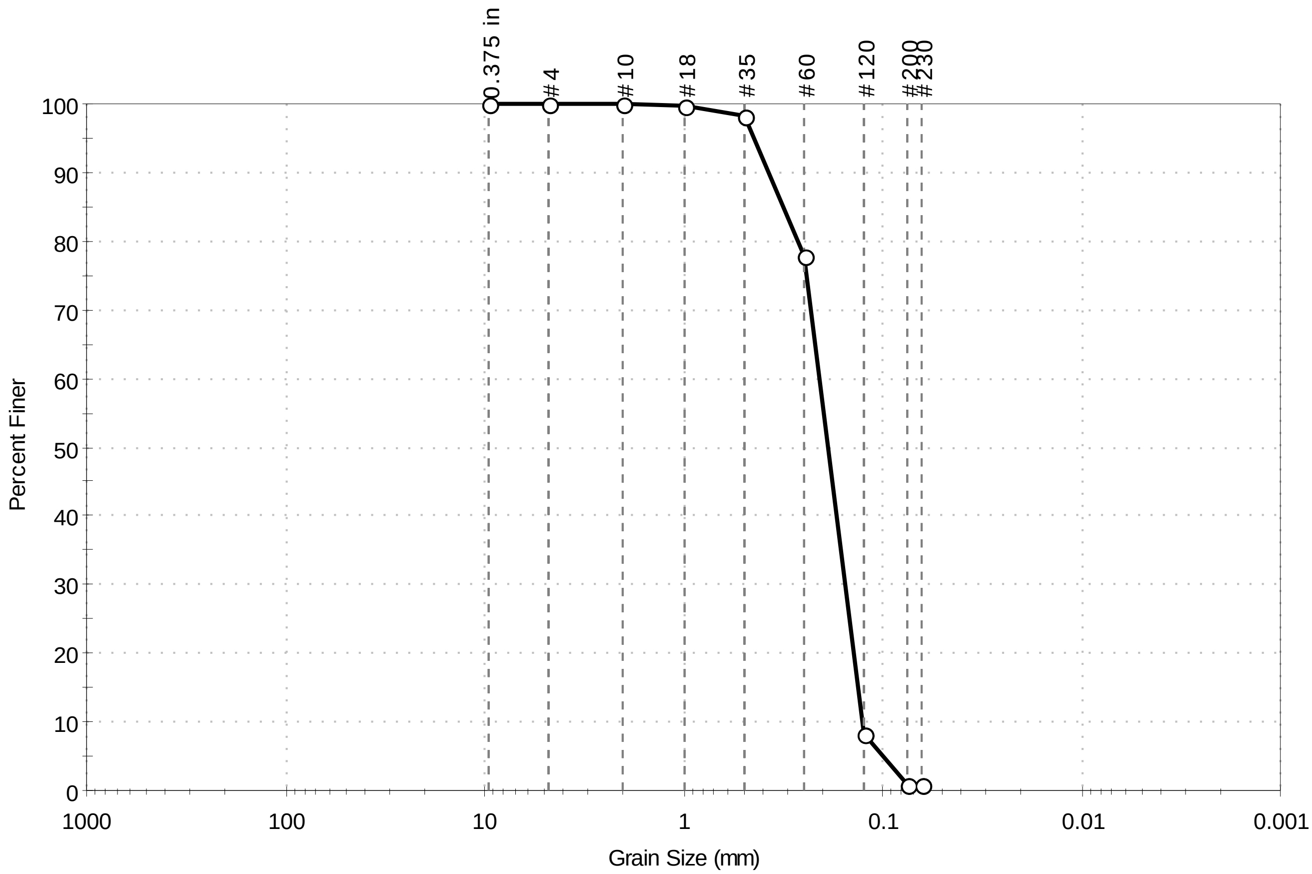
Client:	Woods Hole Group				
Project:	Scusset				
Location:	Sagamore, MA			Project No:	GTX-304835
Boring ID:	---	Sample Type:	bag	Tested By:	jbr
Sample ID:	Sample #3A	Test Date:	06/09/16	Checked By:	emm
Depth :	---	Test Id:	380332		
Test Comment:	---				
Visual Description:	Moist, light brown sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	99.0	1.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	100		
#18	1.00	100		
#35	0.50	98		
#60	0.25	78		
#120	0.12	8		
#200	0.075	1.0		
#230	0.063	1		

Coefficients

D_{85} = 0.3196 mm | D_{30} = 0.1551 mm

D_{60} = 0.2093 mm | D_{15} = 0.1335 mm

D_{50} = 0.1894 mm | D_{10} = 0.1270 mm

C_u = 1.648 | C_c = 0.905

Classification

ASTM: Poorly graded sand (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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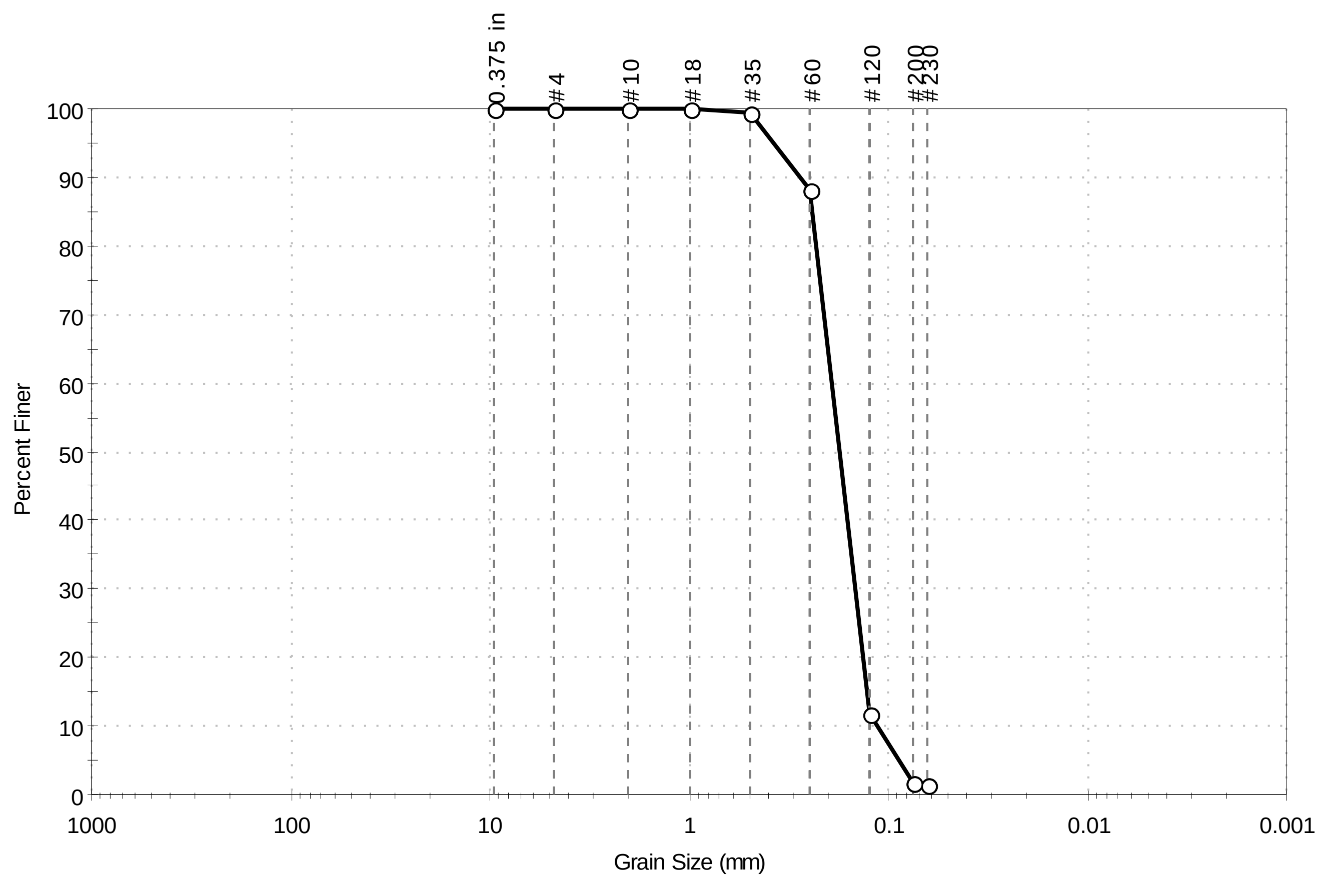
Client:	Woods Hole Group
Project:	Scusset
Location:	Sagamore, MA
Project No:	GTX-304835
Boring ID:	---
Sample Type:	bag
Tested By:	jbr
Sample ID:	Sample #3B
Test Date:	06/09/16
Checked By:	emm
Depth :	---
Test Id:	380333
Test Comment:	---
Visual Description:	Moist, light brown sand
Sample Comment:	---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	98.3	1.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	100		
#18	1.00	100		
#35	0.50	99		
#60	0.25	88		
#120	0.12	12		
#200	0.075	1.7		
#230	0.063	1		

Coefficients

D_{85} = 0.2431 mm
D_{30} = 0.1475 mm
D_{60} = 0.1937 mm
D_{15} = 0.1288 mm
D_{50} = 0.1769 mm
D_{10} = 0.1145 mm
C_u = 1.692
C_c = 0.981

Classification

ASTM Poorly graded sand (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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GeoTesting EXPRESS

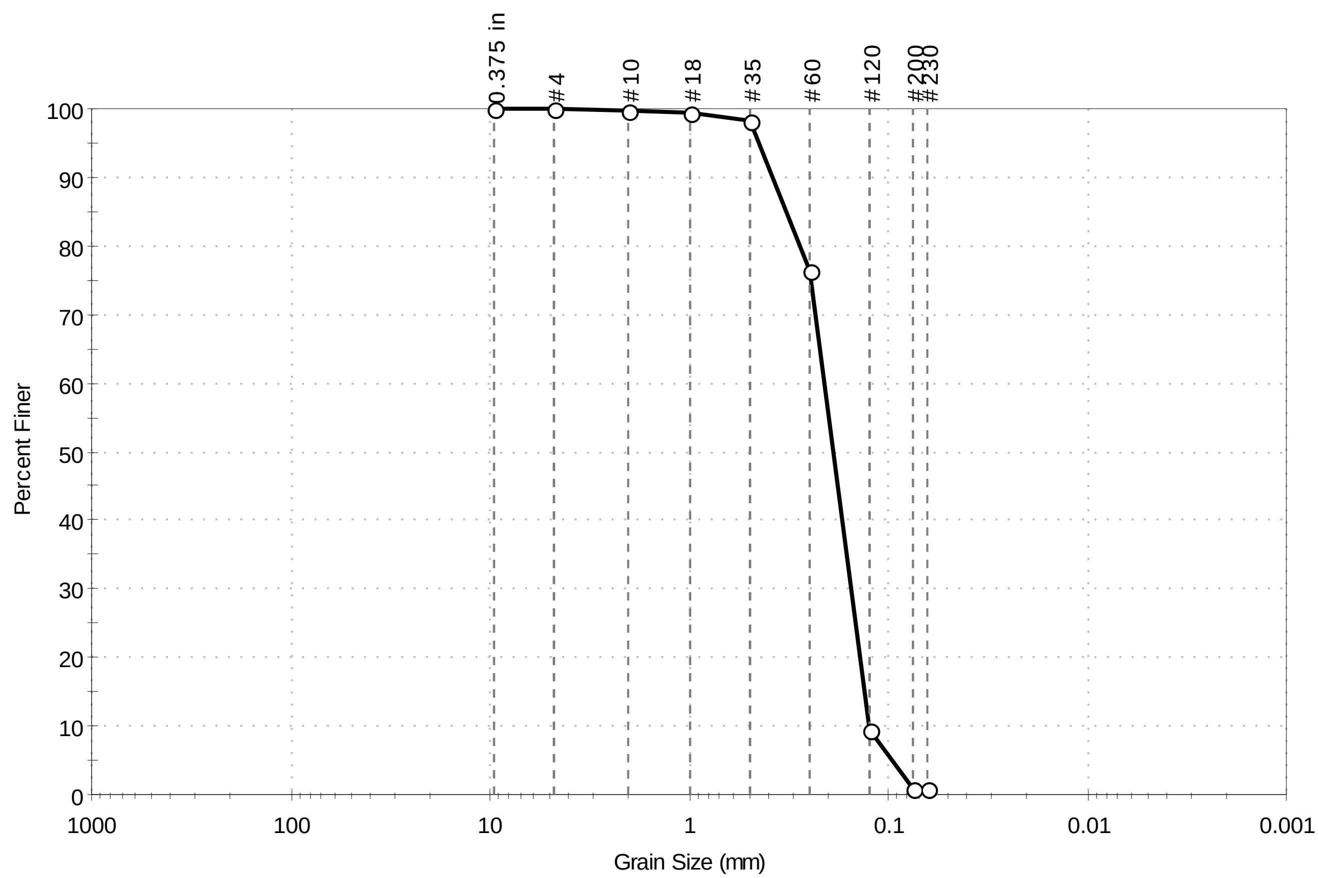
Client:	Woods Hole Group				
Project:	Scusset				
Location:	Sagamore, MA			Project No:	GTX-304835
Boring ID:	---	Sample Type:	bag	Tested By:	jbr
Sample ID:	Sample #4A	Test Date:	06/09/16	Checked By:	emm
Depth :	---	Test Id:	380334		

Test Comment: ---

Visual Description: Moist, light gray sand

Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	99.0	1.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	100		
#18	1.00	100		
#35	0.50	98		
#60	0.25	76		
#120	0.12	9		
#200	0.075	1.0		
#230	0.063	1		

Coefficients

D_{85} = 0.3282 mm — D_{30} = 0.1547 mm

D_{60} = 0.2109 mm — D_{15} = 0.1325 mm

D_{50} = 0.1902 mm — D_{10} = 0.1258 mm

C_u = 1.676 — C_c = 0.902

Classification

ASTM Poorly graded sand (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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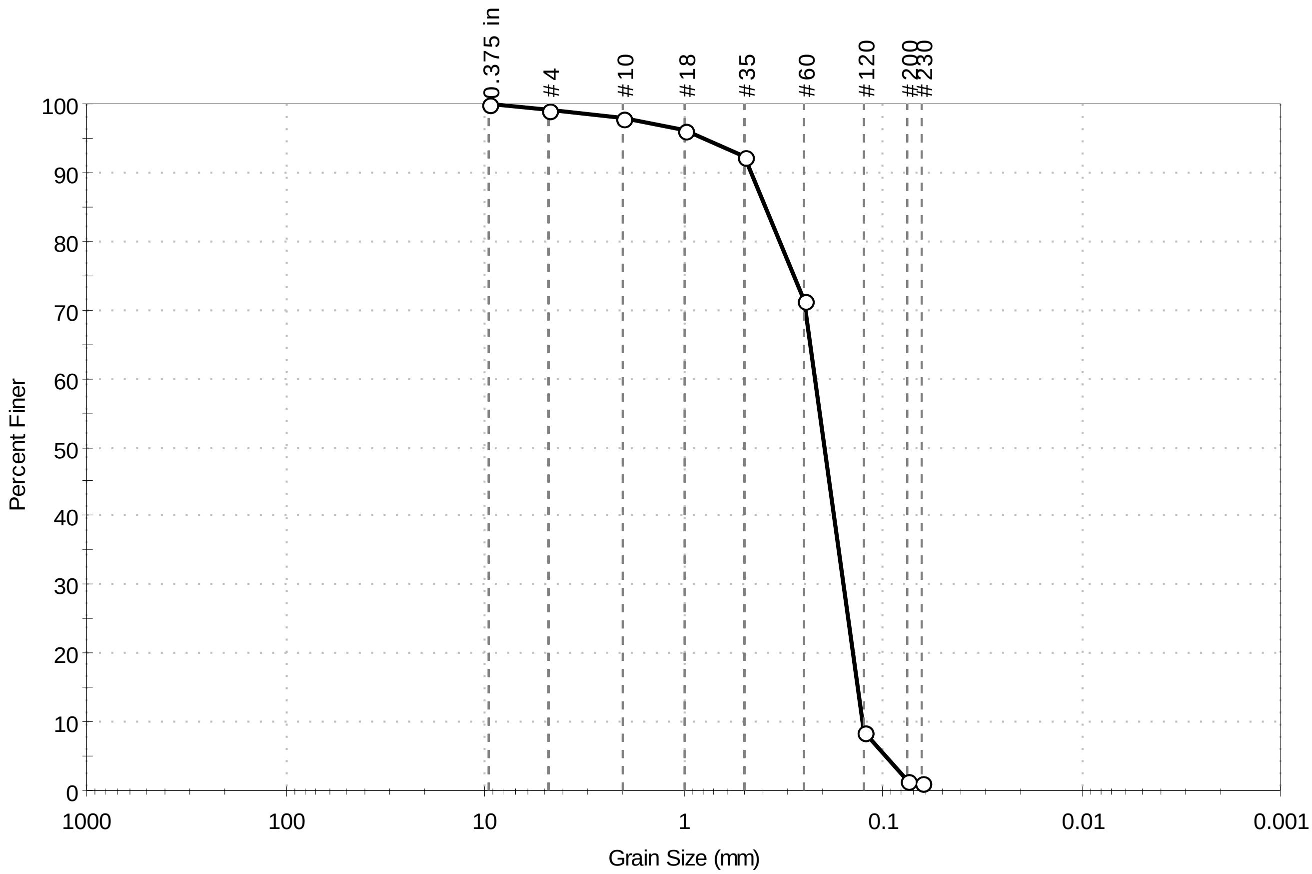
Client:	Woods Hole Group		
Project:	Scusset		
Location:	Sagamore, MA	Project No:	GTX-304835
Boring ID: ---	Sample Type: bag	Tested By:	jbr
Sample ID: Sample #4B	Test Date: 06/09/16	Checked By:	emm
Depth : ---	Test Id: 380335		

Test Comment: ---

Visual Description: Moist, light brown sand

Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.8	97.6	1.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	99		
#10	2.00	98		
#18	1.00	96		
#35	0.50	92		
#60	0.25	72		
#120	0.12	8		
#200	0.075	1.6		
#230	0.063	1		

Coefficients

D_{85} = 0.3922 mm D_{30} = 0.1584 mm

D_{60} = 0.2203 mm D_{15} = 0.1343 mm

D_{50} = 0.1973 mm D_{10} = 0.1271 mm

C_u = 1.733 C_c = 0.896

Classification

ASTM Poorly graded sand (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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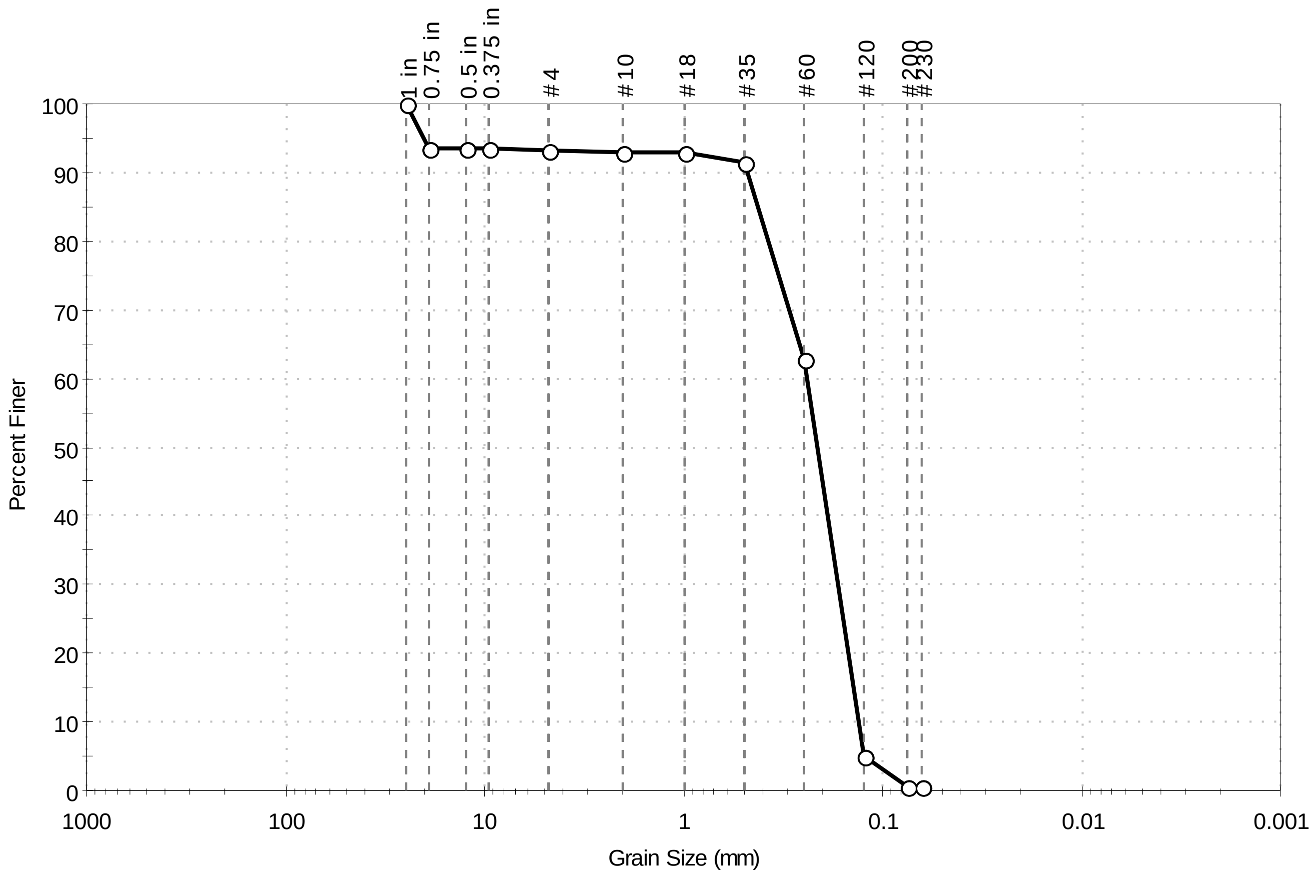
Client: Woods Hole Group			
Project: Scusset			
Location: Sagamore, MA		Project No:	GTX-304835
Boring ID: ---	Sample Type: bag	Tested By:	jbr
Sample ID: Sample #5	Test Date: 06/09/16	Checked By:	emm
Depth : ---	Test Id: 380336		
Test Comment: ---			
Visual Description: Moist, light gray sand			
Sample Comment: ---			

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	6.8	92.5	0.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	94		
0.5 in	12.50	94		
0.375 in	9.50	94		
#4	4.75	93		
#10	2.00	93		
#18	1.00	93		
#35	0.50	91		
#60	0.25	63		
#120	0.12	5		
#200	0.075	0.7		
#230	0.063	1		

Coefficients

D_{85} = 0.4285 mm | D_{30} = 0.1686 mm

D_{60} = 0.2420 mm | D_{15} = 0.1408 mm

D_{50} = 0.2145 mm | D_{10} = 0.1325 mm

C_u = 1.826 | C_c = 0.887

Classification

ASTM Poorly graded sand (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

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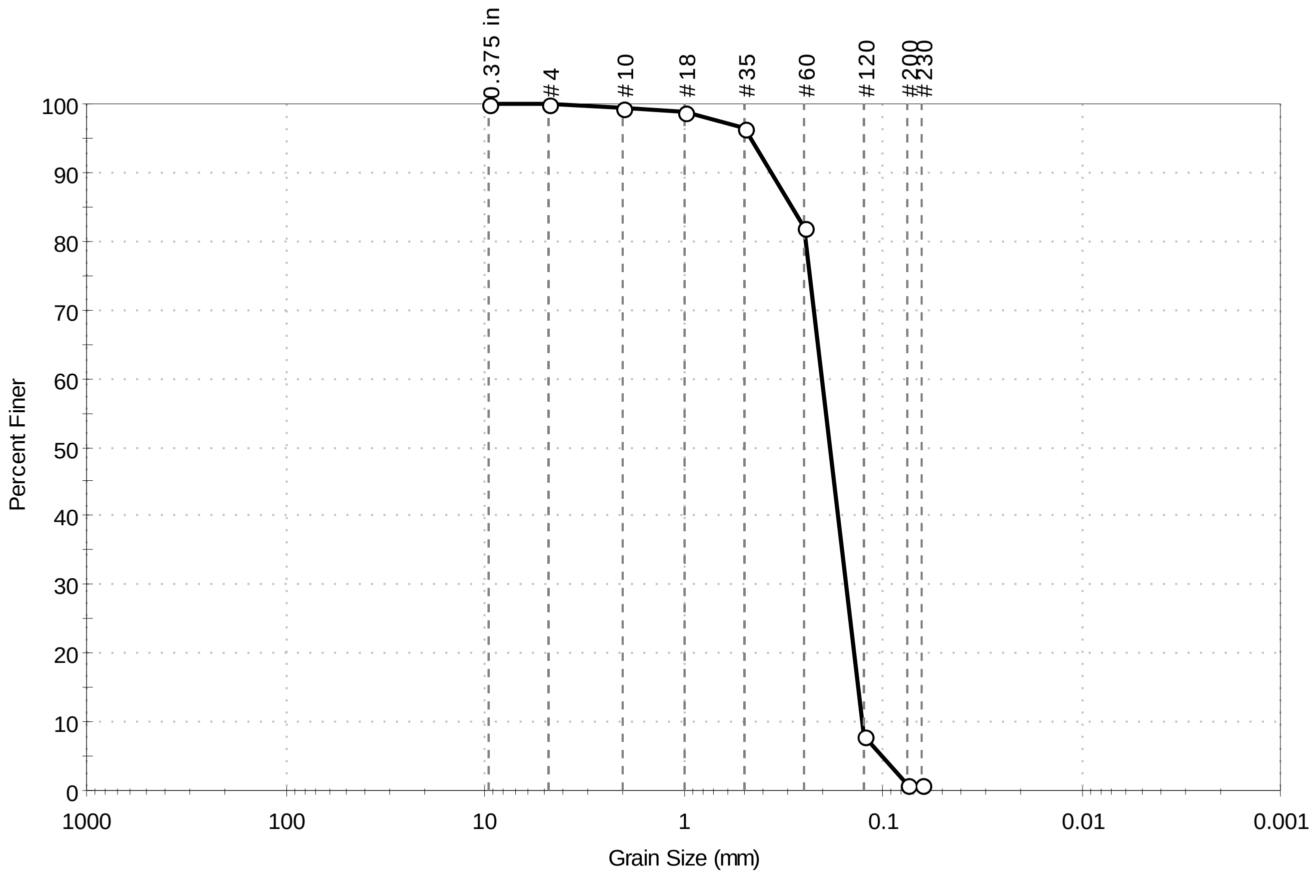
Client:	Woods Hole Group
Project:	Scusset
Location:	Sagamore, MA
Project No:	GTX-304835
Boring ID:	---
Sample Type:	bag
Tested By:	jbr
Sample ID:	Sample #6
Test Date:	06/09/16
Checked By:	emm
Depth :	---
Test Id:	380337
Test Comment:	---
Visual Description:	Moist, light brown sand
Sample Comment:	---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	99.0	1.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	100		
#18	1.00	99		
#35	0.50	96		
#60	0.25	82		
#120	0.12	8		
#200	0.075	1.0		
#230	0.063	1		

Coefficients

D_{85} = 0.2893 mm | D_{30} = 0.1538 mm
D_{60} = 0.2036 mm | D_{15} = 0.1337 mm
D_{50} = 0.1854 mm | D_{10} = 0.1275 mm
C_u = 1.597 | C_c = 0.911

Classification

ASTM Poorly graded sand (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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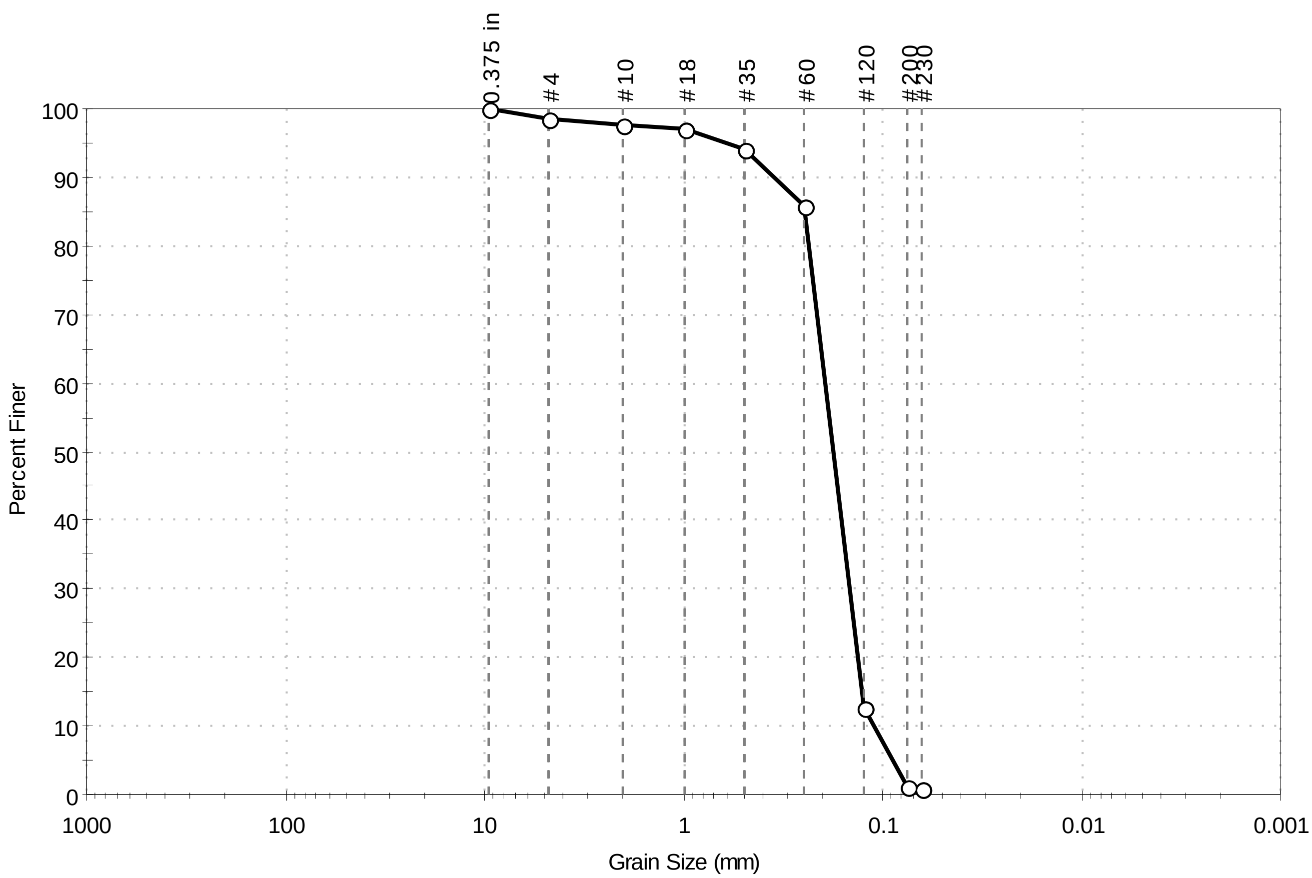
Client:	Woods Hole Group		
Project:	Scusset		
Location:	Sagamore, MA	Project No:	GTX-304835
Boring ID:	---	Sample Type: bag	Tested By: jbr
Sample ID:	Sample #7	Test Date: 06/09/16	Checked By: emm
Depth :	---	Test Id: 380338	
Test Comment:	---		
Visual Description:	Moist, light grayish brown sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	1.5	97.2	1.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	98		
#10	2.00	98		
#18	1.00	97		
#35	0.50	94		
#60	0.25	86		
#120	0.12	13		
#200	0.075	1.3		
#230	0.063	1		

Coefficients

D_{85} = 0.2478 mm
D_{30} = 0.1474 mm
D_{60} = 0.1957 mm
D_{15} = 0.1279 mm
D_{50} = 0.1780 mm
D_{10} = 0.1113 mm
C_u = 1.758
C_c = 0.997

Classification

ASTM Poorly graded sand (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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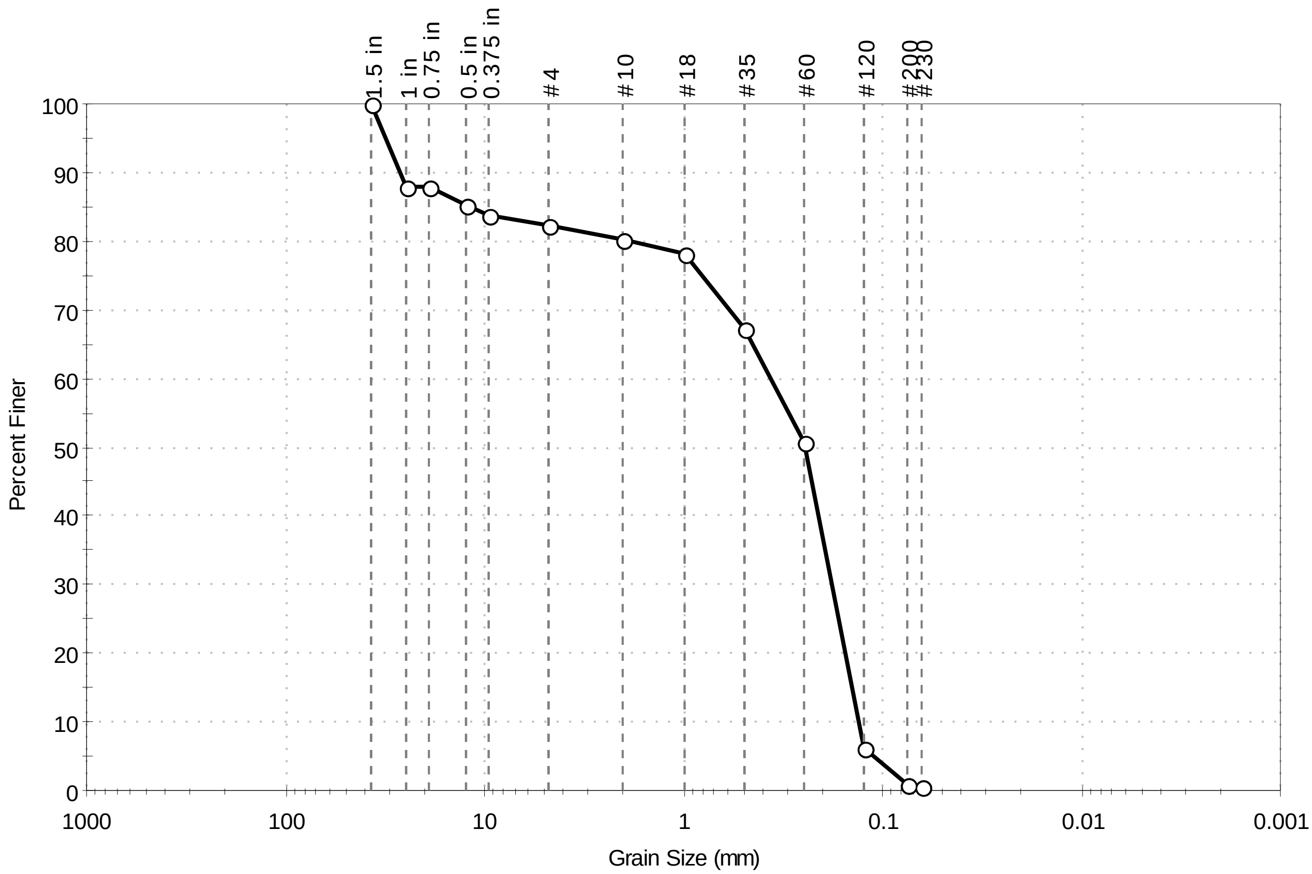
Client:	Woods Hole Group		
Project:	Scusset		
Location:	Sagamore, MA	Project No:	GTX-304835
Boring ID: ---	Sample Type: bag	Tested By:	jbr
Sample ID: Sample #8	Test Date: 06/09/16	Checked By:	emm
Depth : ---	Test Id: 380339		
Test Comment:	---		
Visual Description:	Moist, light gray sand with gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	17.8	81.4	0.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	88		
0.75 in	19.00	88		
0.5 in	12.50	85		
0.375 in	9.50	84		
#4	4.75	82		
#10	2.00	80		
#18	1.00	78		
#35	0.50	67		
#60	0.25	51		
#120	0.12	6		
#200	0.075	0.8		
#230	0.063	1		

Coefficients

D_{85} = 11.6963 mm D_{30} = 0.1808 mm

D_{60} = 0.3686 mm D_{15} = 0.1432 mm

D_{50} = 0.2467 mm D_{10} = 0.1324 mm

C_u = 2.784 C_c = 0.670

Classification

ASTM Poorly graded sand with gravel (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

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GeoTesting EXPRESS

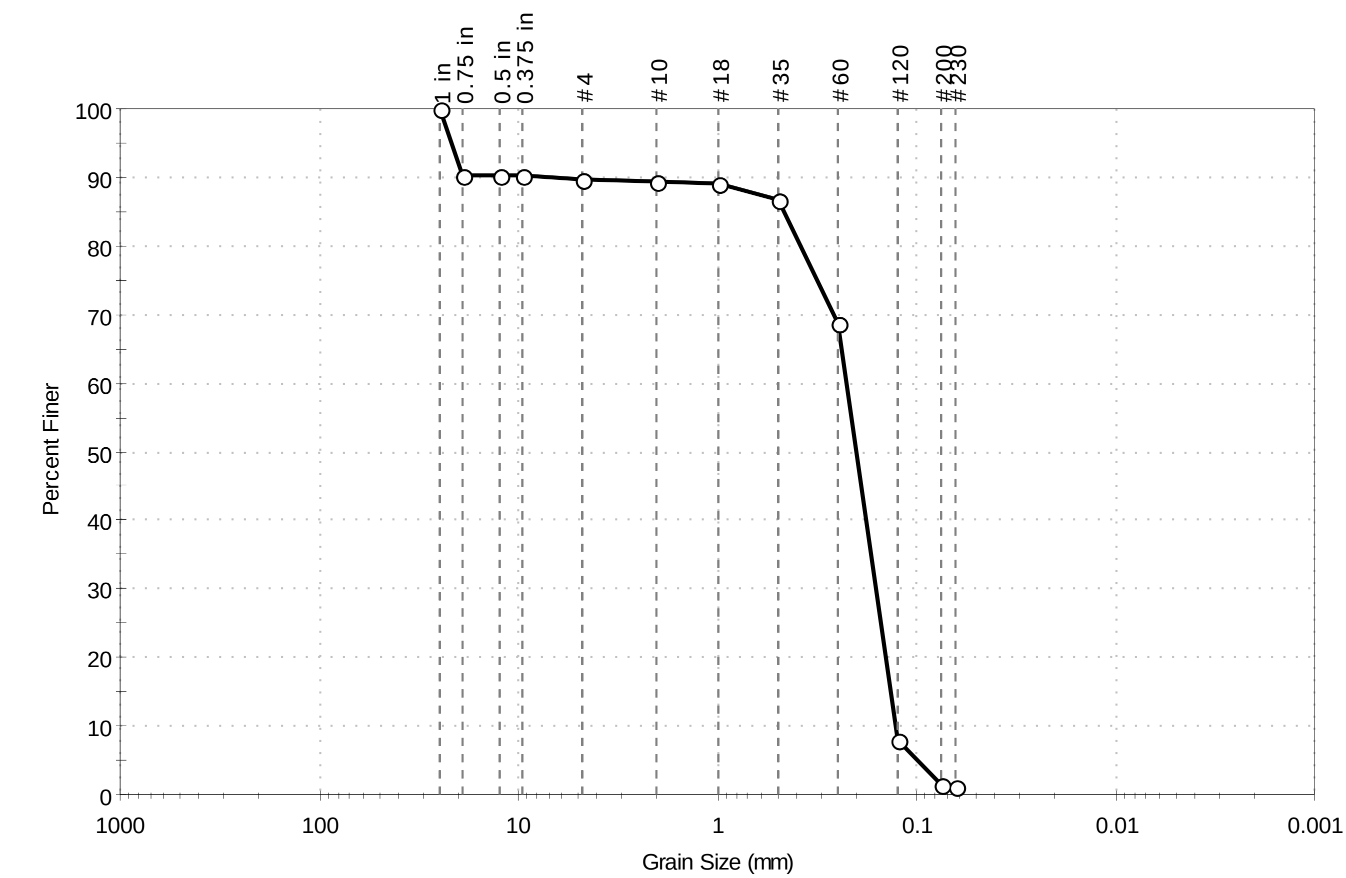
Client:	Woods Hole Group		
Project:	Scusset		
Location:	Sagamore, MA	Project No:	GTX-304835
Boring ID: ---	Sample Type: bag	Tested By:	jbr
Sample ID: Sample #9	Test Date: 06/09/16	Checked By:	emm
Depth : ---	Test Id: 380340		

Test Comment: ---

Visual Description: Moist, light brown sand

Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	10.3	88.1	1.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	90		
0.5 in	12.50	90		
0.375 in	9.50	90		
#4	4.75	90		
#10	2.00	89		
#18	1.00	89		
#35	0.50	87		
#60	0.25	69		
#120	0.12	8		
#200	0.075	1.6		
#230	0.063	1		

Coefficients

D_{85} = 0.4654 mm　D_{30} = 0.1605 mm

D_{60} = 0.2260 mm　D_{15} = 0.1353 mm

D_{50} = 0.2016 mm　D_{10} = 0.1278 mm

C_u = 1.768　C_c = 0.892

Classification

ASTM　Poorly graded sand (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ROUNDED

Sand/Gravel Hardness : HARD

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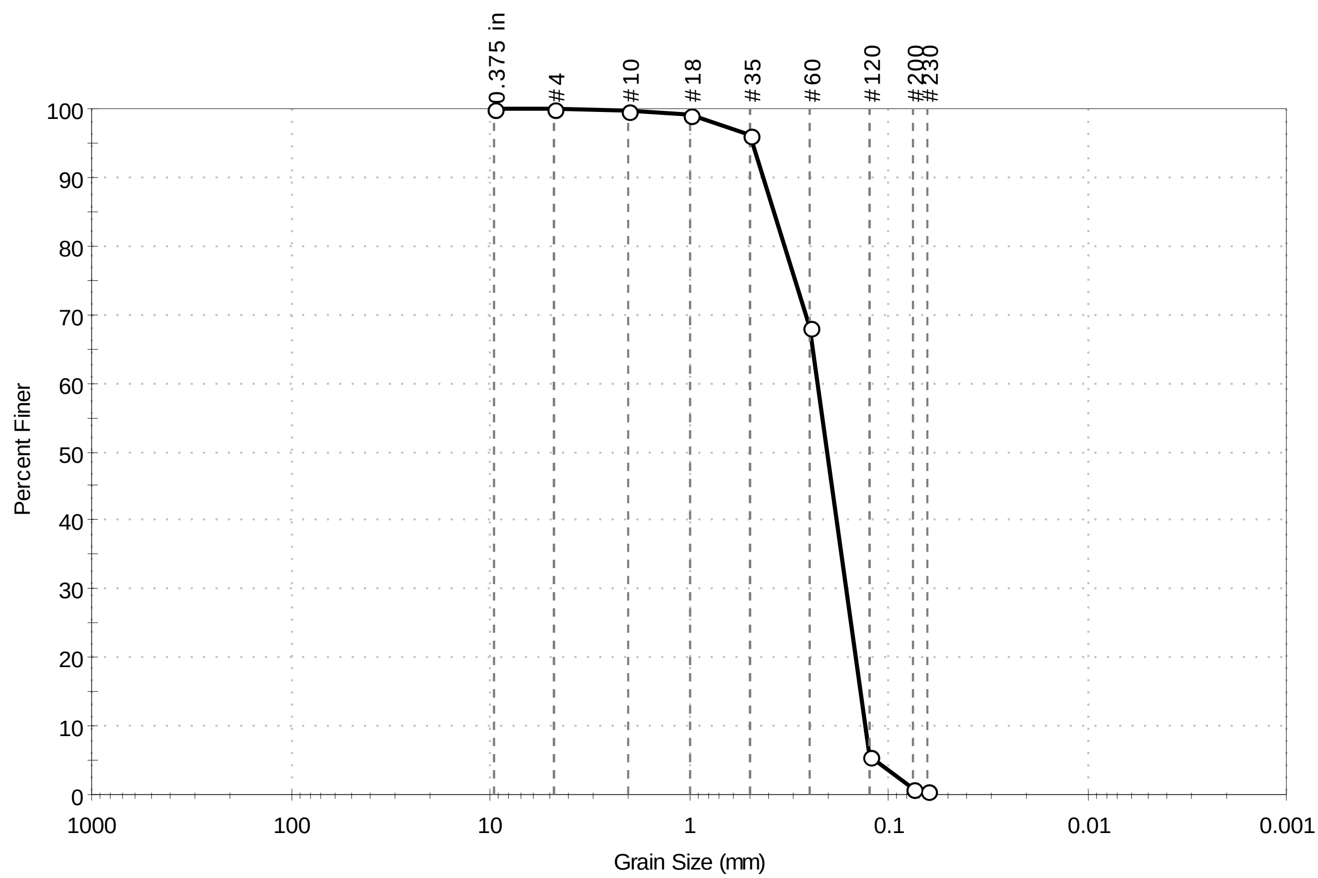
GeoTesting EXPRESS

Client:	Woods Hole Group				
Project:	Scusset				
Location:	Sagamore, MA			Project No:	GTX-304835
Boring ID:	---	Sample Type:	bag	Tested By:	jbr
Sample ID:	Sample #10	Test Date:	06/09/16	Checked By:	emm
Depth :	---	Test Id:	380341		
Test Comment:	---				
Visual Description:	Moist, light brown sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	99.2	0.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	100		
#18	1.00	99		
#35	0.50	96		
#60	0.25	68		
#120	0.12	5		
#200	0.075	0.8		
#230	0.063	1		

Coefficients

D_{85} = 0.3805 mm
D_{30} = 0.1640 mm
D_{60} = 0.2287 mm
D_{15} = 0.1389 mm
D_{50} = 0.2047 mm
D_{10} = 0.1314 mm
C_u = 1.740
C_c = 0.895

Classification

ASTM Poorly graded sand (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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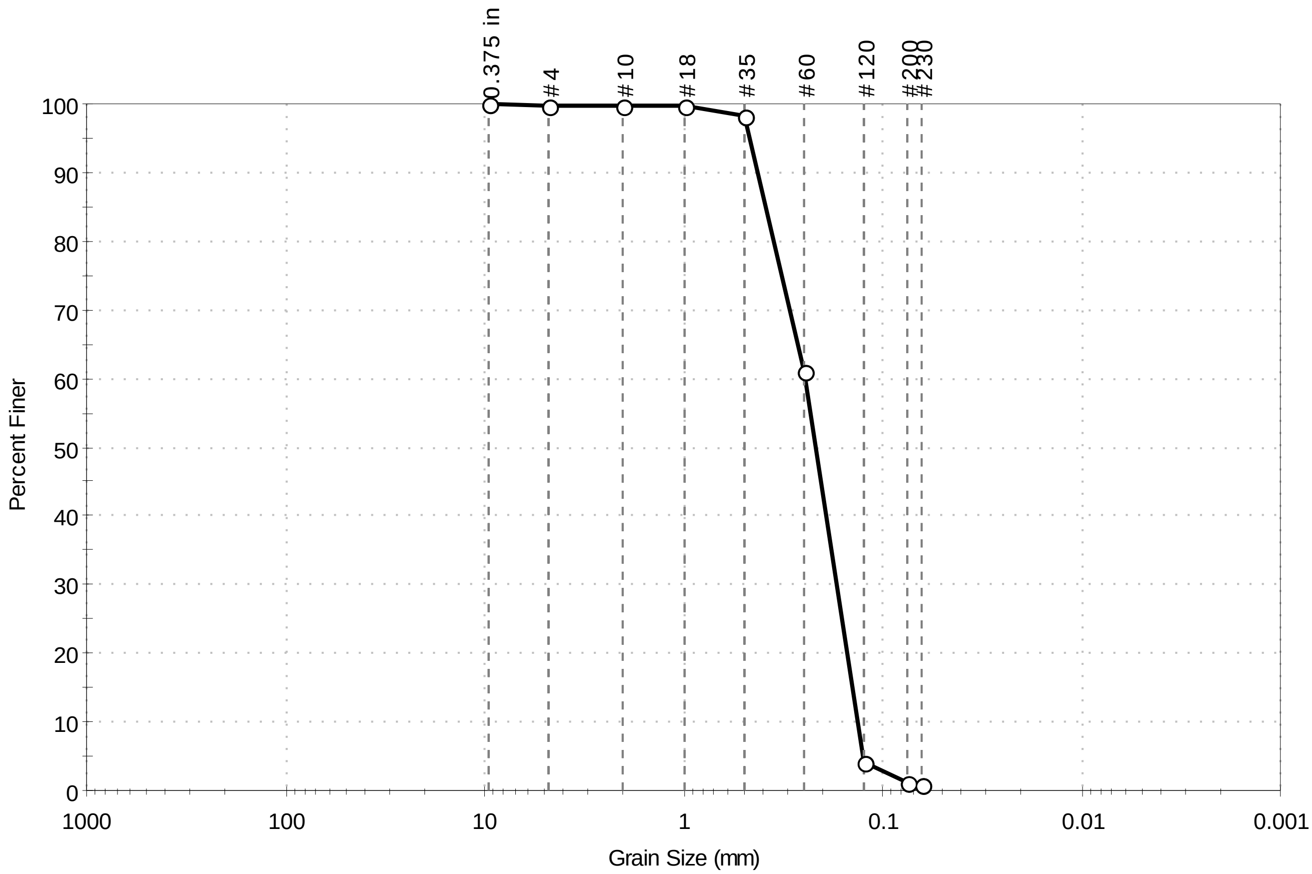
Client:	Woods Hole Group		
Project:	Scusset		
Location:	Sagamore, MA	Project No:	GTX-304835

Boring ID:	---	Sample Type:	bag	Tested By:	jbr
Sample ID:	Sample #11	Test Date:	06/21/16	Checked By:	emm
Depth :	---	Test Id:	381289		

Test Comment: ---
Visual Description: Moist, light brownish gray sand
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.3	98.6	1.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	100		
#18	1.00	100		
#35	0.50	98		
#60	0.25	61		
#120	0.12	4		
#200	0.075	1.1		
#230	0.063	1		

Coefficients

D_{85} = 0.3901 mm D_{30} = 0.1711 mm
D_{60} = 0.2464 mm D_{15} = 0.1426 mm
D_{50} = 0.2182 mm D_{10} = 0.1342 mm
C_u = 1.836 C_c = 0.885

Classification

ASTM Poorly graded sand (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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TOWN NECK BEACH PLACEMENT SITE

GRAIN SIZE RESULTS

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Table E-2. Grain size results from Town Neck Beach samples Collected on March 17, 2016.

Sample ID	Latitude Actual	Longitude Actual	Gravel %	Sand %	Silt&Clay %	D_{50} (mm)	ASTM Classification
TB1	N41 46.346	W70 29.491	44.2	55.7	0.1	2.15	Poorly graded sand with gravel
TB2	N41 46.164	W70 29.220	1	98.2	0.8	0.55	Poorly graded sand
TB3	N41 46.028	W70 28.987	1	97.9	1.1	0.61	Poorly graded sand
TB4	N41 45.920	W70 28.768	0	100	0	0.61	Poorly graded sand
TB5	N41 46.187	W70 29.240	0.4	98.9	0.7	0.51	Poorly graded sand
TB6	N41 46.274	W70 29.321	0.2	99.7	0.1	0.71	Poorly graded sand
TI1	N41 46.360	W70 29.479	70.9	29.1	0	8.14	Well-graded gravel with sand
TI2	N41 46.175	W70 29.193	1.1	98.2	0.7	0.35	Poorly graded sand
TI3	N41 46.044	W70 28.965	16.7	82.9	0.4	1.10	Poorly graded sand with gravel
TI4	N41 45.942	W70 28.748	25.2	74.4	0.4	1.44	Poorly graded sand with gravel
TI5	N41 46.196	W70 29.210	0.2	98.9	0.9	0.35	Poorly graded sand
TI6	N41 46.289	W70 29.304	44.5	55.5	0	4.19	Poorly graded sand with gravel

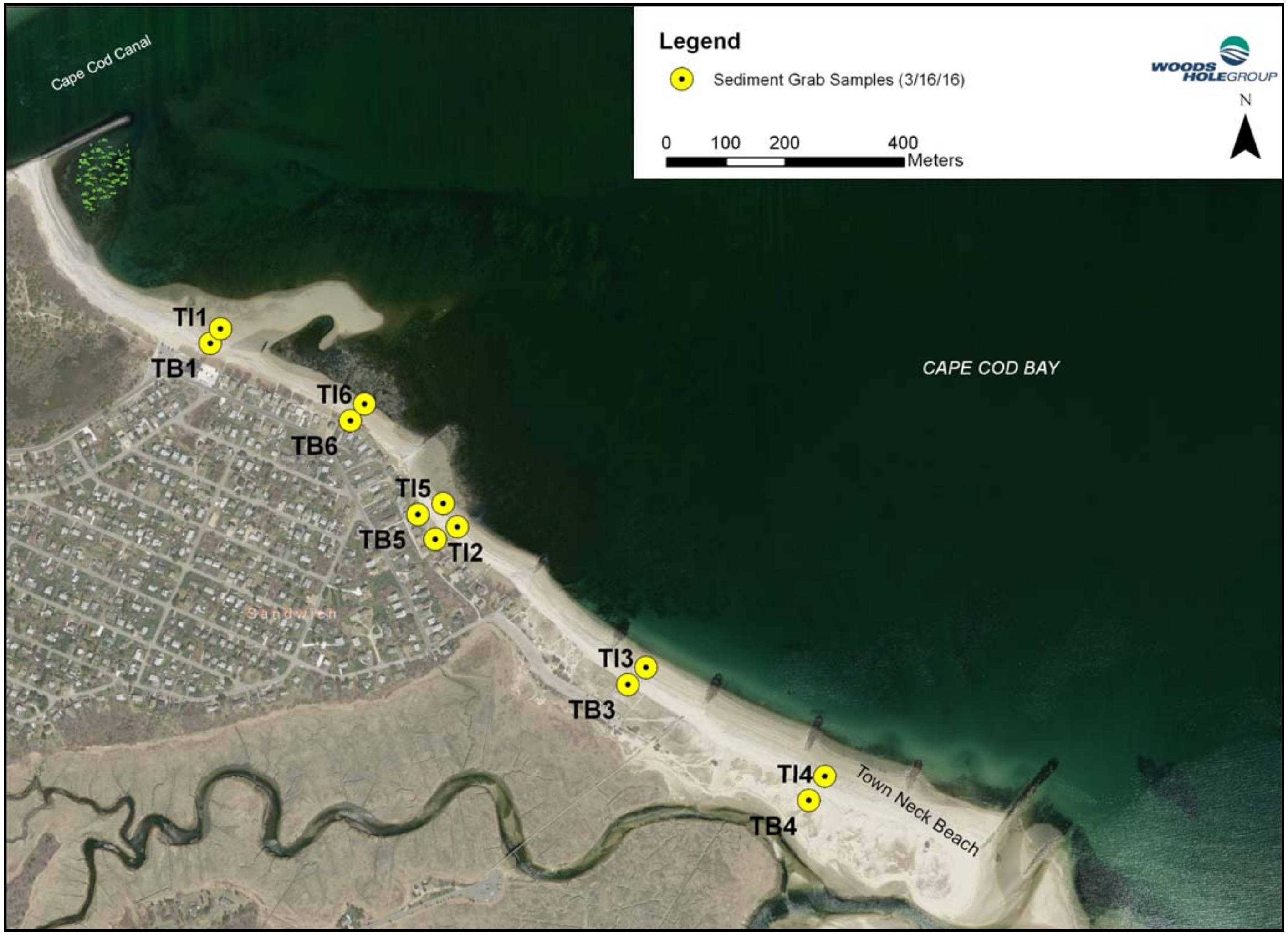

Figure E-7. Sediment samples collected on Town Neck Beach in March 2016. Grabs (yellow) are located on the beach and intertidal areas.

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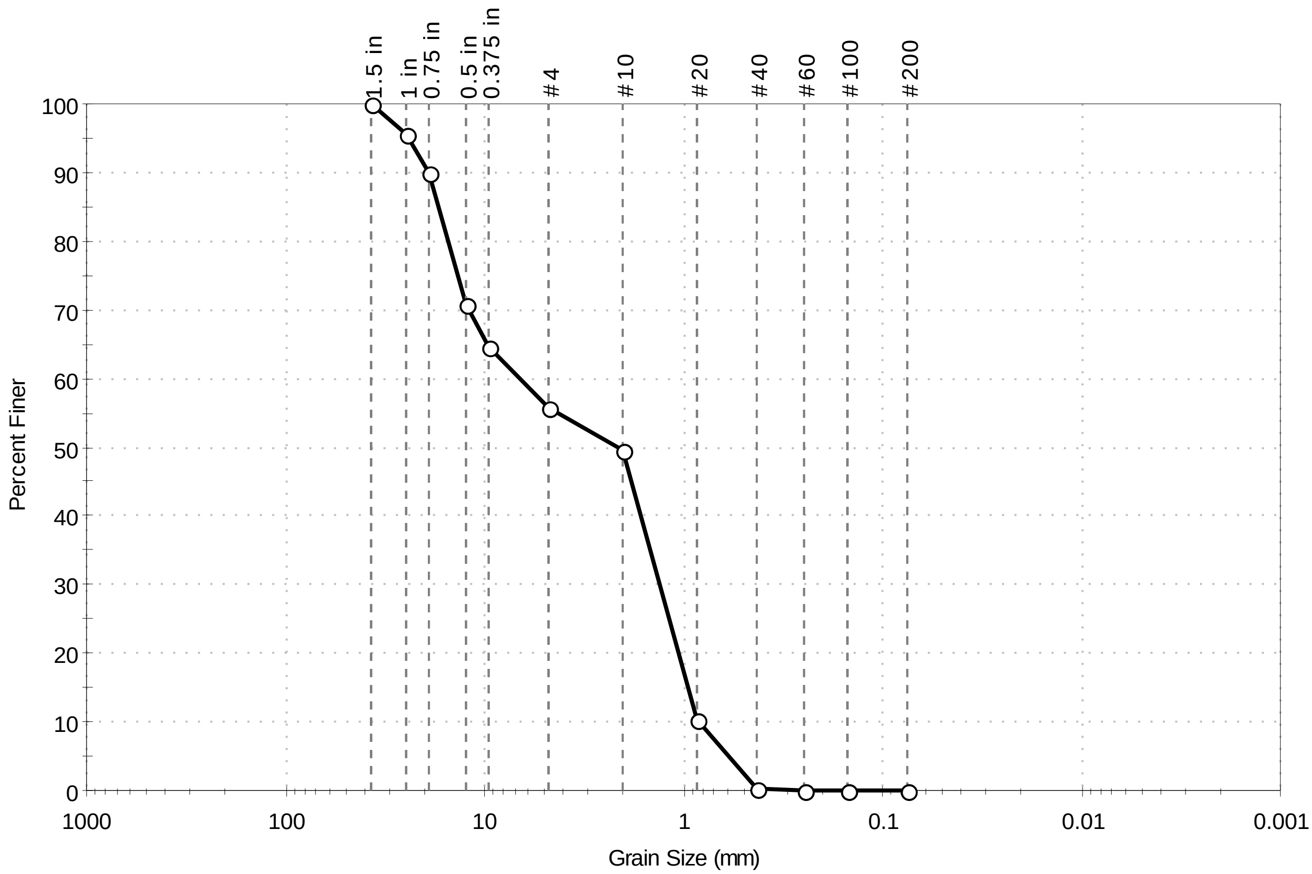
Client:	Woods Hole Group			
Project:	Sandwich Offshore Borrow Site			
Location:	Sandwich, MA		Project No:	GTX-304511
Boring ID: ---	Sample Type:	bag	Tested By:	jbr
Sample ID: TB1	Test Date:	03/25/16	Checked By:	emm
Depth : ---	Test Id:	370124		
Test Comment:	---			
Visual Description:	Moist, very pale brown sand with gravel			
Sample Comment:	---			

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	44.2	55.7	0.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	96		
0.75 in	19.00	90		
0.5 in	12.50	71		
0.375 in	9.50	65		
#4	4.75	56		
#10	2.00	49		
#20	0.85	10		
#40	0.42	0		
#60	0.25	0		
#100	0.15	0		
#200	0.075	0.1		

Coefficients

D_{85} = 17.0525 mm D_{30} = 1.3054 mm

D_{60} = 6.6300 mm D_{15} = 0.9400 mm

D_{50} = 2.1467 mm D_{10} = 0.8266 mm

C_u = 8.021 C_c = 0.311

Classification

ASTM   Poorly graded sand with gravel (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

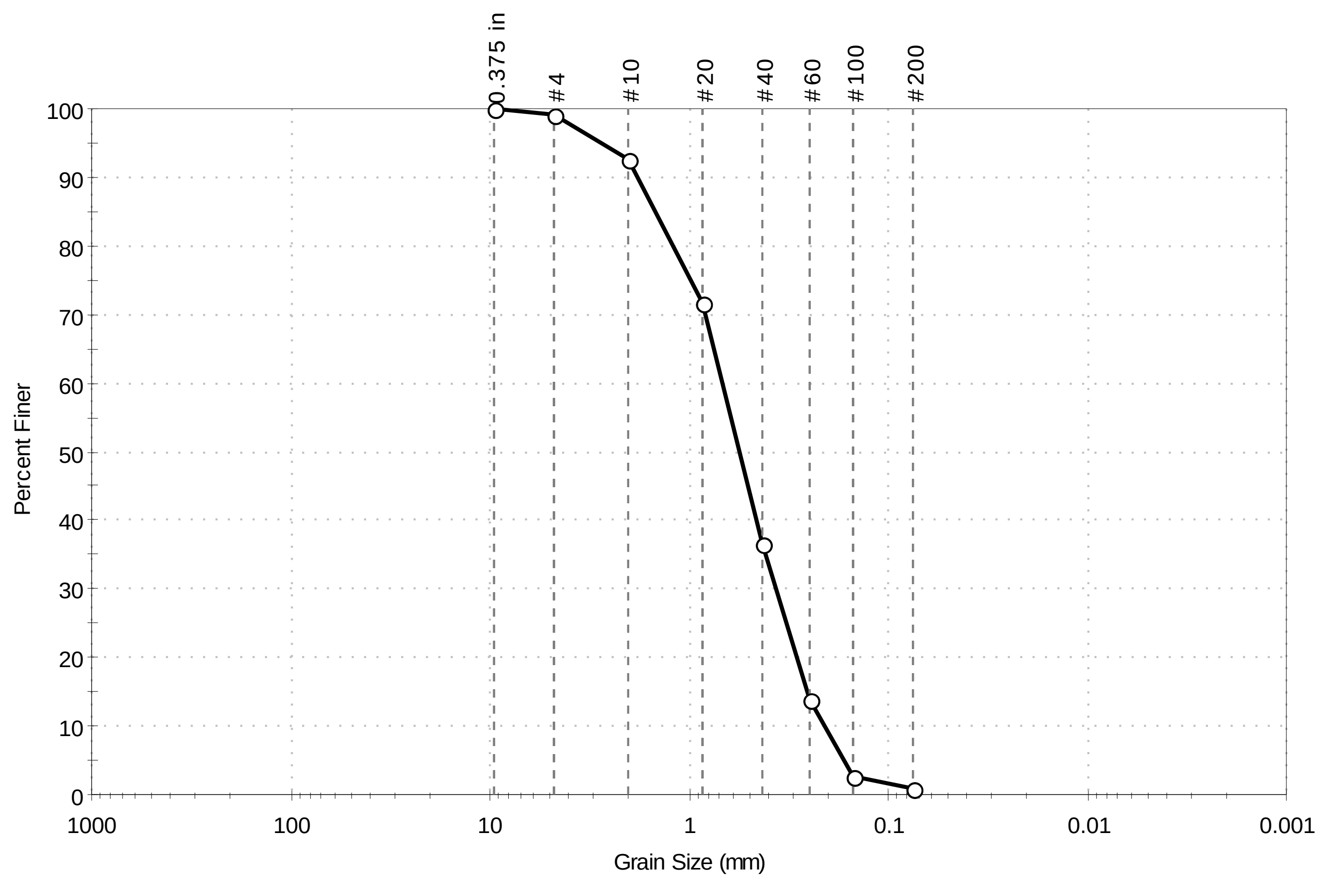
printed 3/29/2016 11:17:11 AM

Client:	Woods Hole Group		
Project:	Sandwich Offshore Borrow Site		
Location:	Sandwich, MA	Project No:	GTX-304511

Boring ID:	---	Sample Type:	bag	Tested By:	jbr
Sample ID:	TB2	Test Date:	03/25/16	Checked By:	emm
Depth :	---	Test Id:	370125		

Test Comment:	---
Visual Description:	Moist, light brown sand
Sample Comment:	---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	1.0	98.2	0.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	99		
#10	2.00	93		
#20	0.85	72		
#40	0.42	37		
#60	0.25	14		
#100	0.15	3		
#200	0.075	0.8		

Coefficients

D_{85} = 1.4699 mm D_{30} = 0.3651 mm

D_{60} = 0.6758 mm D_{15} = 0.2574 mm

D_{50} = 0.5547 mm D_{10} = 0.2102 mm

C_u = 3.215 C_c = 0.938

Classification

ASTM   Poorly graded sand (SP)

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

Sample/Test Description

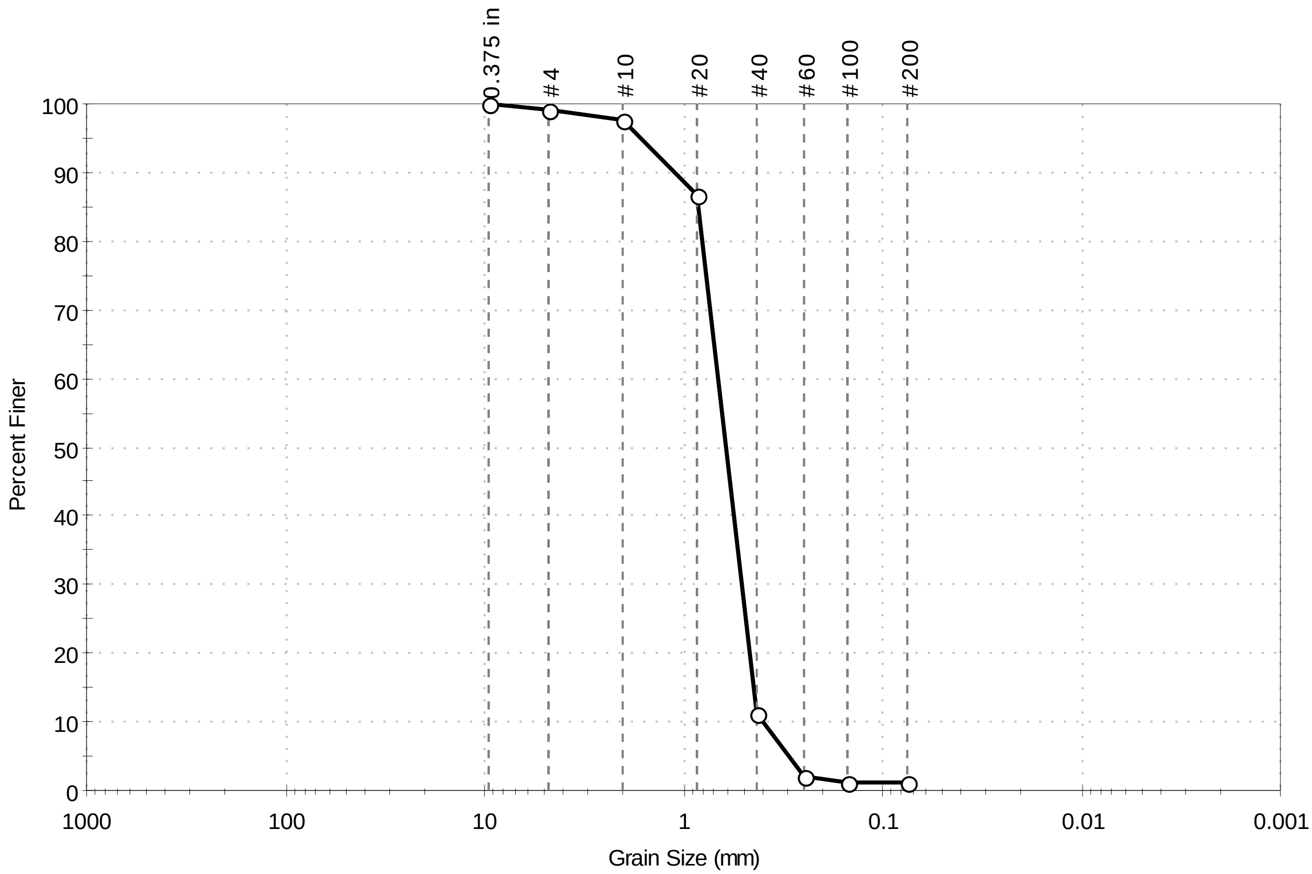
Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

printed 3/29/2016 11:17:11 AM

Client:	Woods Hole Group		
Project:	Sandwich Offshore Borrow Site		
Location:	Sandwich, MA	Project No:	GTX-304511
Boring ID: ---	Sample Type: bag	Tested By:	jbr
Sample ID: TB3	Test Date: 03/25/16	Checked By:	emm
Depth : ---	Test Id: 370126		
Test Comment:	---		
Visual Description:	Moist, light brown sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	1.0	97.9	1.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	99		
#10	2.00	98		
#20	0.85	87		
#40	0.42	11		
#60	0.25	2		
#100	0.15	1		
#200	0.075	1.1		

Coefficients

D_{85} = 0.8356 mm D_{30} = 0.5051 mm

D_{60} = 0.6647 mm D_{15} = 0.4403 mm

D_{50} = 0.6065 mm D_{10} = 0.3977 mm

C_u = 1.671 C_c = 0.965

Classification

ASTM   Poorly graded sand (SP)

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

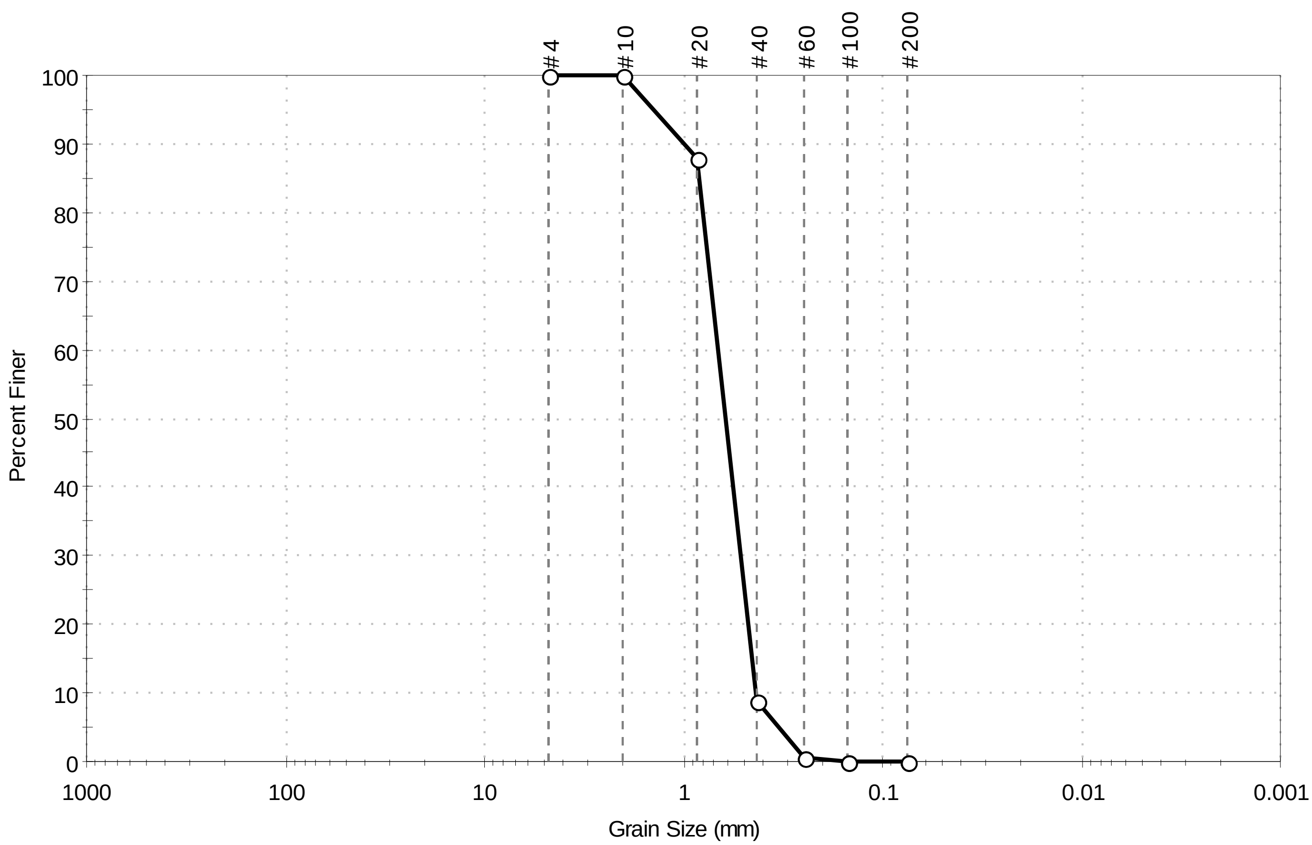
Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Client:	Woods Hole Group			
Project:	Sandwich Offshore Borrow Site			
Location:	Sandwich, MA		Project No:	GTX-304511
Boring ID: ---		Sample Type: bag	Tested By:	jbr
Sample ID: TB4		Test Date: 03/25/16	Checked By:	emm
Depth : ---		Test Id: 370127		
Test Comment:	---			
Visual Description:	Moist, very pale brown sand			
Sample Comment:	---			

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.0	100.0	0.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	88		
#40	0.42	9		
#60	0.25	1		
#100	0.15	0		
#200	0.075	0.0		

Coefficients

D_{85} = 0.8279 mm D_{30} = 0.5116 mm

D_{60} = 0.6653 mm D_{15} = 0.4487 mm

D_{50} = 0.6095 mm D_{10} = 0.4295 mm

C_u = 1.549 C_c = 0.916

Classification

ASTM Poorly graded sand (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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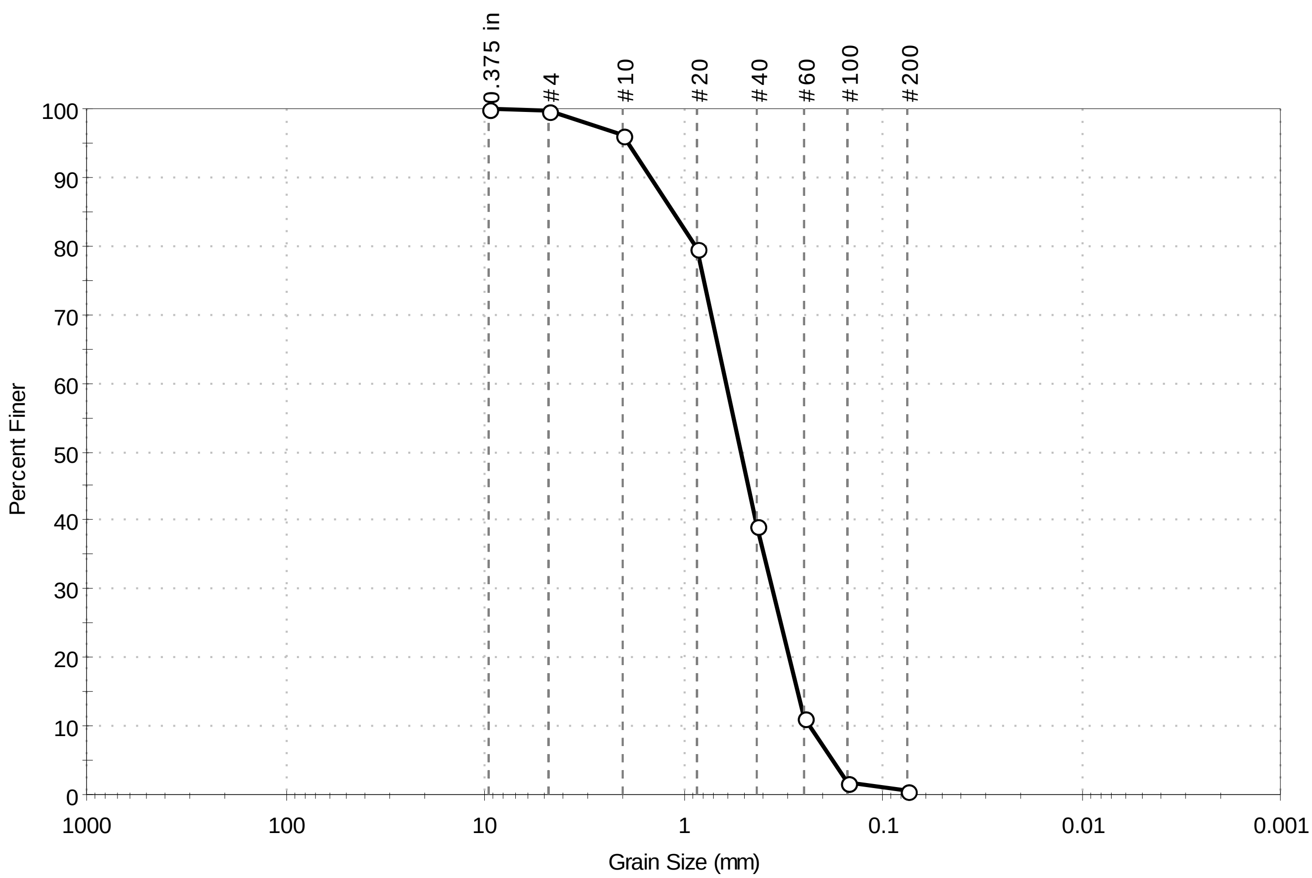
Client:	Woods Hole Group		
Project:	Sandwich Offshore Borrow Site		
Location:	Sandwich, MA	Project No:	GTX-304511
Boring ID: ---	Sample Type: bag	Tested By:	jbr
Sample ID: TB5	Test Date: 03/25/16	Checked By:	emm
Depth : ---	Test Id: 370128		
Test Comment:	---		
Visual Description:	Moist, very pale brown sand		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.4	98.9	0.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	96		
#20	0.85	80		
#40	0.42	39		
#60	0.25	11		
#100	0.15	2		
#200	0.075	0.7		

Coefficients

D_{85} = 1.1200 mm | D_{30} = 0.3560 mm

D_{60} = 0.6063 mm | D_{15} = 0.2679 mm

D_{50} = 0.5105 mm | D_{10} = 0.2327 mm

C_u = 2.606 | C_c = 0.898

Classification

ASTM Poorly graded sand (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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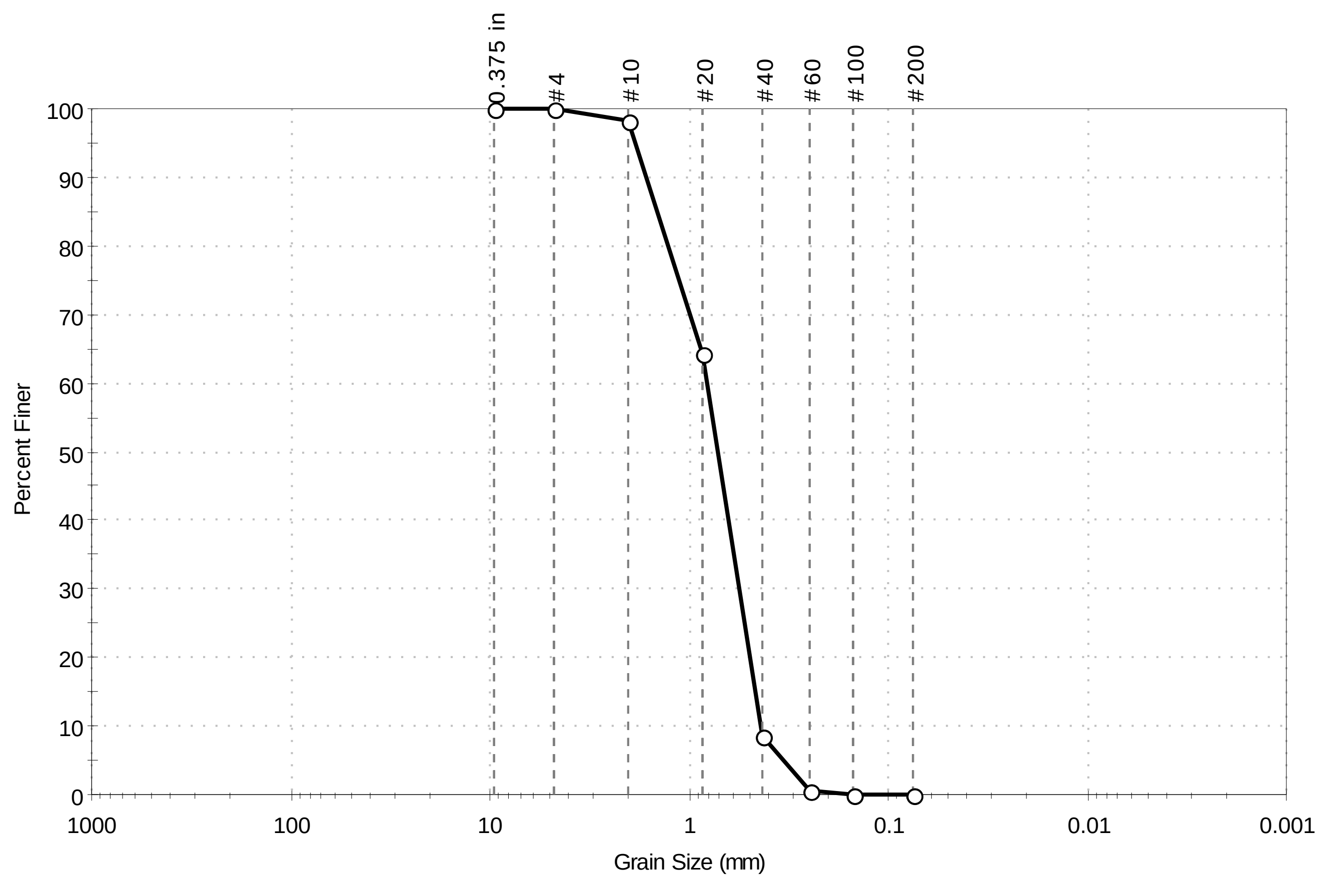
Client:	Woods Hole Group				
Project:	Sandwich Offshore Borrow Site				
Location:	Sandwich, MA			Project No:	GTX-304511
Boring ID:	---	Sample Type:	bag	Tested By:	jbr
Sample ID:	TB6	Test Date:	03/25/16	Checked By:	emm
Depth :	---	Test Id:	370129		
Test Comment:	---				
Visual Description:	Moist, light brown sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.2	99.7	0.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	98		
#20	0.85	64		
#40	0.42	9		
#60	0.25	1		
#100	0.15	0		
#200	0.075	0.1		

Coefficients

D_{85} = 1.4320 mm
D_{30} = 0.5545 mm
D_{60} = 0.8052 mm
D_{15} = 0.4601 mm
D_{50} = 0.7110 mm
D_{10} = 0.4324 mm
C_u = 1.862
C_c = 0.883

Classification

ASTM Poorly graded sand (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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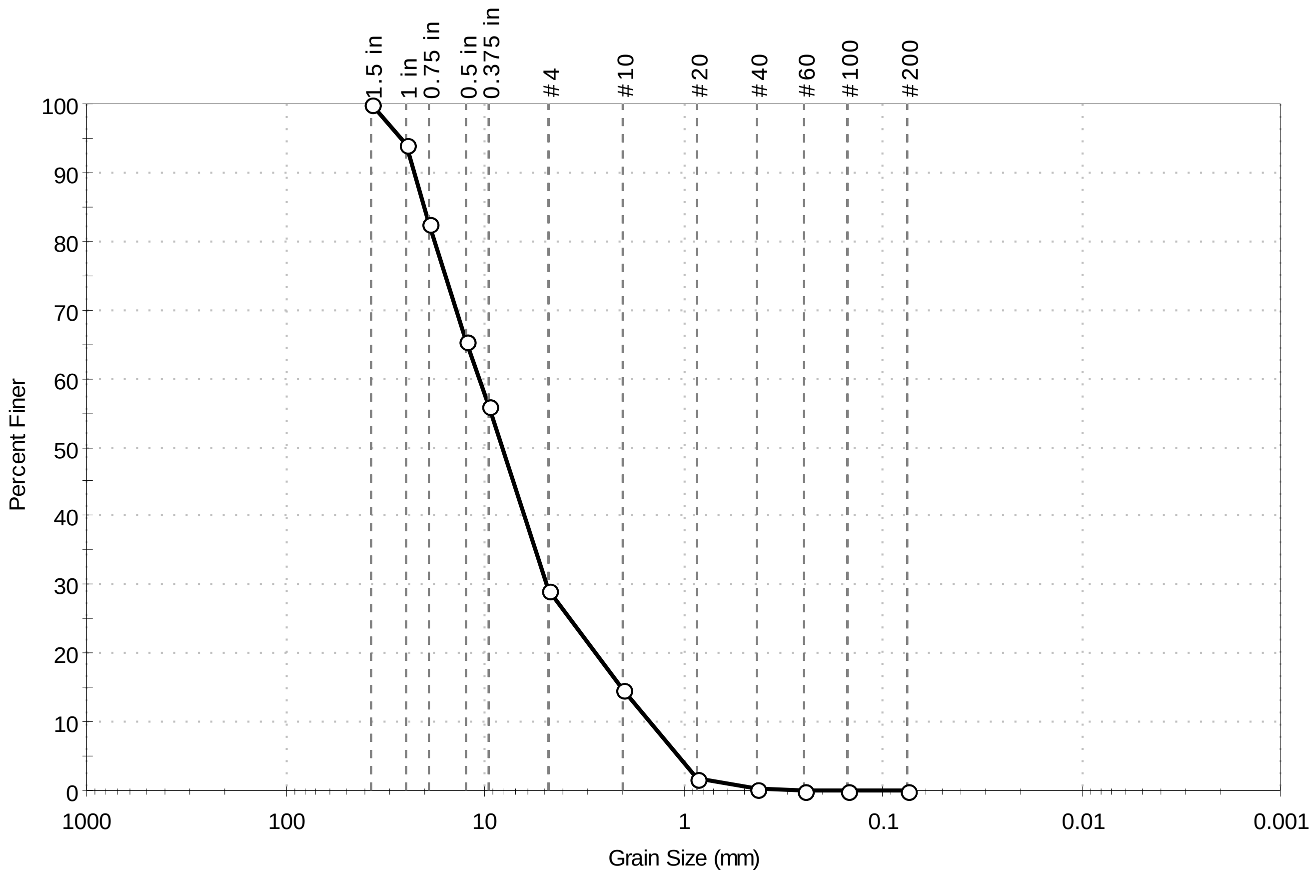
Client:	Woods Hole Group				
Project:	Sandwich Offshore Borrow Site				
Location:	Sandwich, MA			Project No:	GTX-304511
Boring ID:	---	Sample Type:	bag	Tested By:	jbr
Sample ID:	TI1	Test Date:	03/25/16	Checked By:	emm
Depth :	---	Test Id:	370130		

Test Comment: ---

Visual Description: Moist, grayish brown gravel with sand

Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	70.9	29.1	0.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	94		
0.75 in	19.00	82		
0.5 in	12.50	66		
0.375 in	9.50	56		
#4	4.75	29		
#10	2.00	15		
#20	0.85	2		
#40	0.42	0		
#60	0.25	0		
#100	0.15	0		
#200	0.075	0.0		

Coefficients

D_{85} = 20.1719 mm D_{30} = 4.8578 mm

D_{60} = 10.6602 mm D_{15} = 2.0179 mm

D_{50} = 8.1415 mm D_{10} = 1.4541 mm

C_u = 7.331 C_c = 1.522

Classification

ASTM Well-graded gravel with sand (GW)

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

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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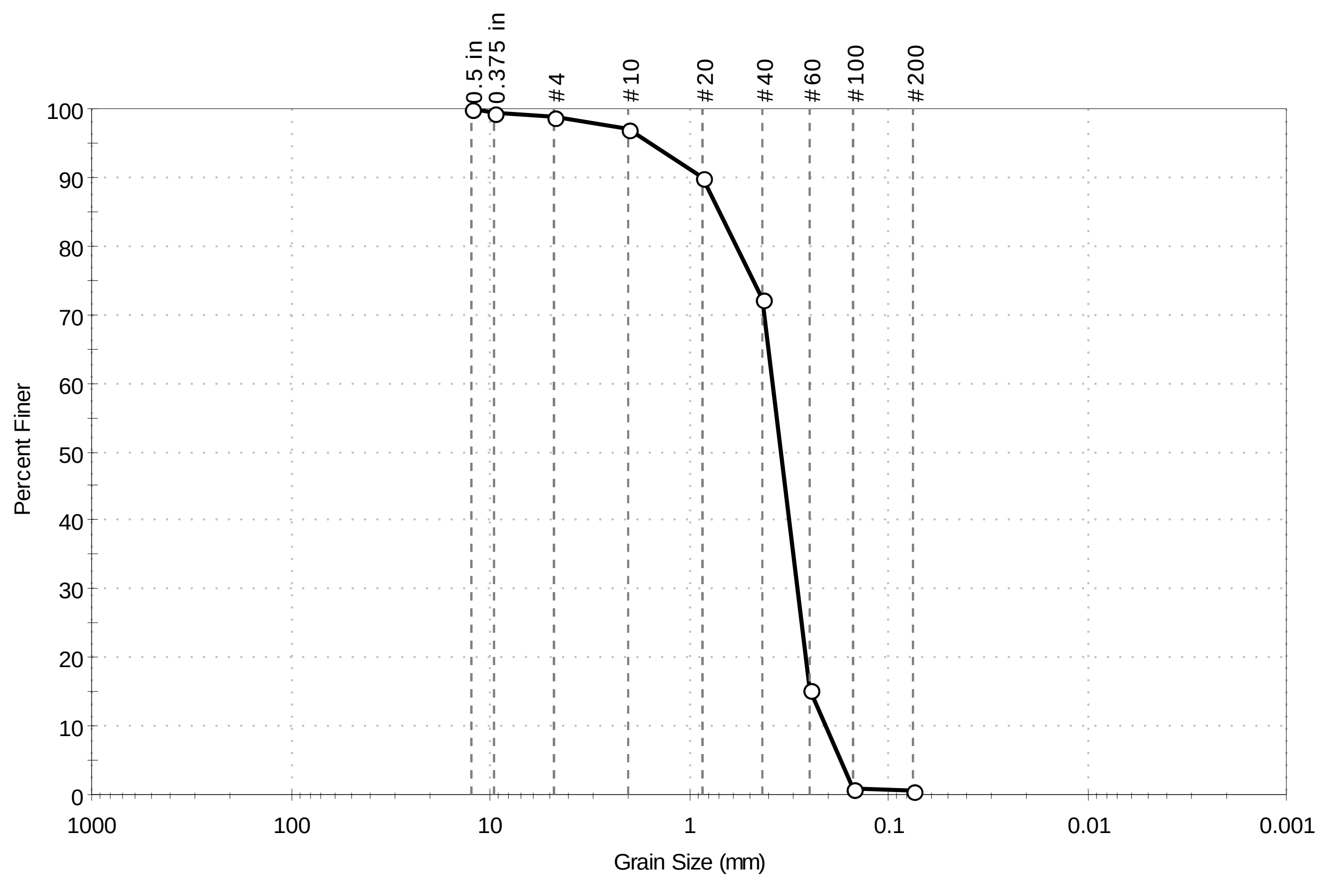
Client:	Woods Hole Group				
Project:	Sandwich Offshore Borrow Site				
Location:	Sandwich, MA			Project No:	GTX-304511
Boring ID:	---	Sample Type:	bag	Tested By:	jbr
Sample ID:	TI2	Test Date:	03/25/16	Checked By:	emm
Depth :	---	Test Id:	370131		
Test Comment:	---				
Visual Description:	Moist, pale yellow sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	1.1	98.2	0.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	99		
#4	4.75	99		
#10	2.00	97		
#20	0.85	90		
#40	0.42	72		
#60	0.25	15		
#100	0.15	1		
#200	0.075	0.7		

Coefficients

D_{85} = 0.6970 mm	D_{30} = 0.2865 mm
D_{60} = 0.3788 mm	D_{15} = 0.2468 mm
D_{50} = 0.3451 mm	D_{10} = 0.2070 mm
C_u = 1.830	C_c = 1.047

Classification

ASTM Poorly graded sand (SP)

AASHTO Fine Sand (A-3 (1))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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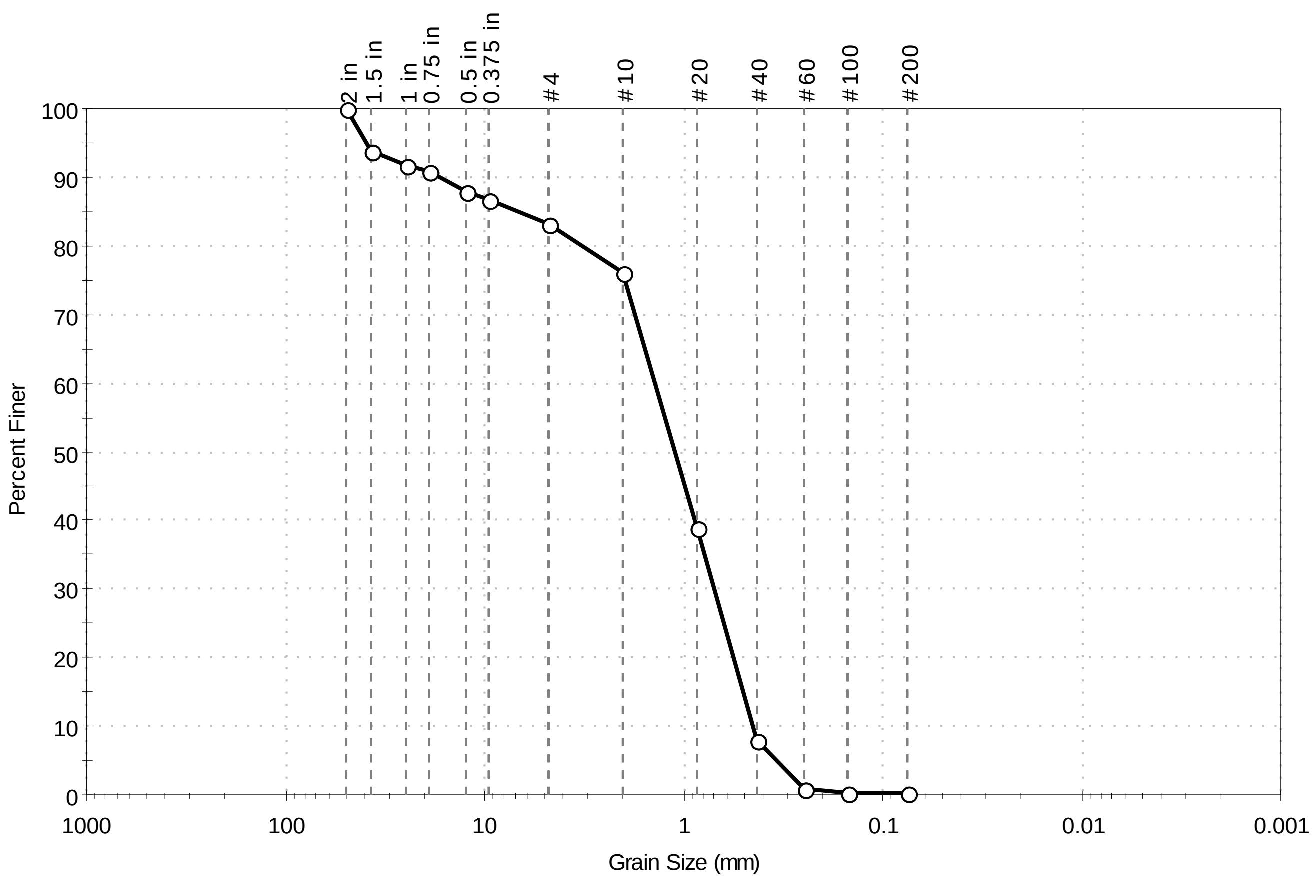
GeoTesting EXPRESS

Client:	Woods Hole Group				
Project:	Sandwich Offshore Borrow Site				
Location:	Sandwich, MA			Project No:	GTX-304511
Boring ID:	---	Sample Type:	bag	Tested By:	jbr
Sample ID:	TI3	Test Date:	03/25/16	Checked By:	emm
Depth :	---	Test Id:	370132		
Test Comment:	---				
Visual Description:	Moist, pale yellow sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	16.7	82.9	0.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
2 in	50.00	100		
1.5 in	37.50	94		
1 in	25.00	92		
0.75 in	19.00	91		
0.5 in	12.50	88		
0.375 in	9.50	87		
#4	4.75	83		
#10	2.00	76		
#20	0.85	39		
#40	0.42	8		
#60	0.25	1		
#100	0.15	0		
#200	0.075	0.4		

Coefficients

D_{85} = 6.6368 mm
D_{30} = 0.6981 mm
D_{60} = 1.3834 mm
D_{15} = 0.4991 mm
D_{50} = 1.0995 mm
D_{10} = 0.4462 mm
C_u = 3.100
C_c = 0.790

Classification

ASTM Poorly graded sand with gravel (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

printed 3/29/2016 11:17:14 AM

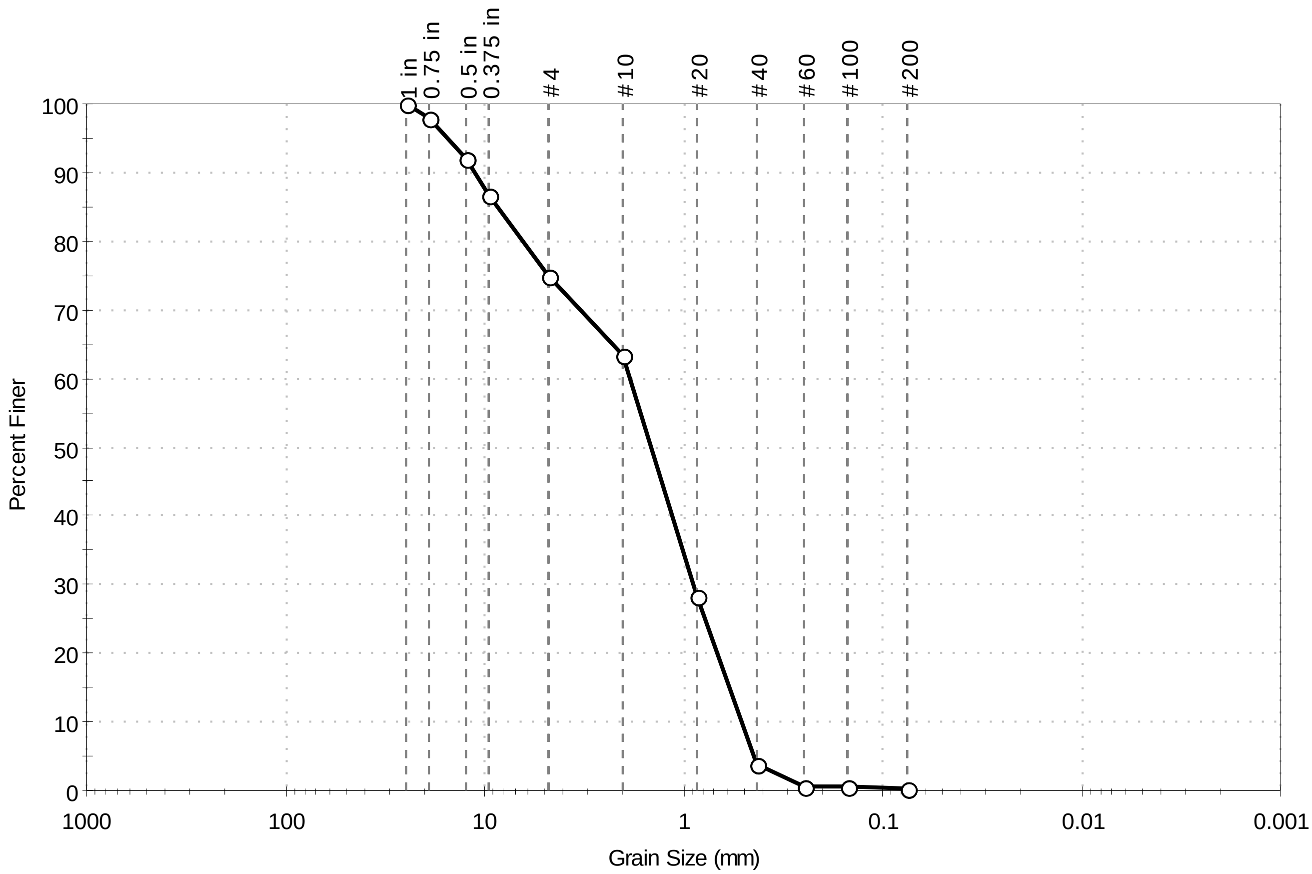
Client:	Woods Hole Group				
Project:	Sandwich Offshore Borrow Site				
Location:	Sandwich, MA			Project No:	GTX-304511
Boring ID:	---	Sample Type:	bag	Tested By:	jbr
Sample ID:	TI4	Test Date:	03/25/16	Checked By:	emm
Depth :	---	Test Id:	370133		

Test Comment: ---

Visual Description: Moist, light brown sand with gravel

Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	25.2	74.4	0.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	98		
0.5 in	12.50	92		
0.375 in	9.50	87		
#4	4.75	75		
#10	2.00	63		
#20	0.85	28		
#40	0.42	4		
#60	0.25	1		
#100	0.15	0		
#200	0.075	0.4		

Coefficients

D_{85} = 8.6468 mm | D_{30} = 0.8837 mm

D_{60} = 1.8407 mm | D_{15} = 0.5811 mm

D_{50} = 1.4413 mm | D_{10} = 0.5042 mm

C_u = 3.651 | C_c = 0.841

Classification

ASTM Poorly graded sand with gravel (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

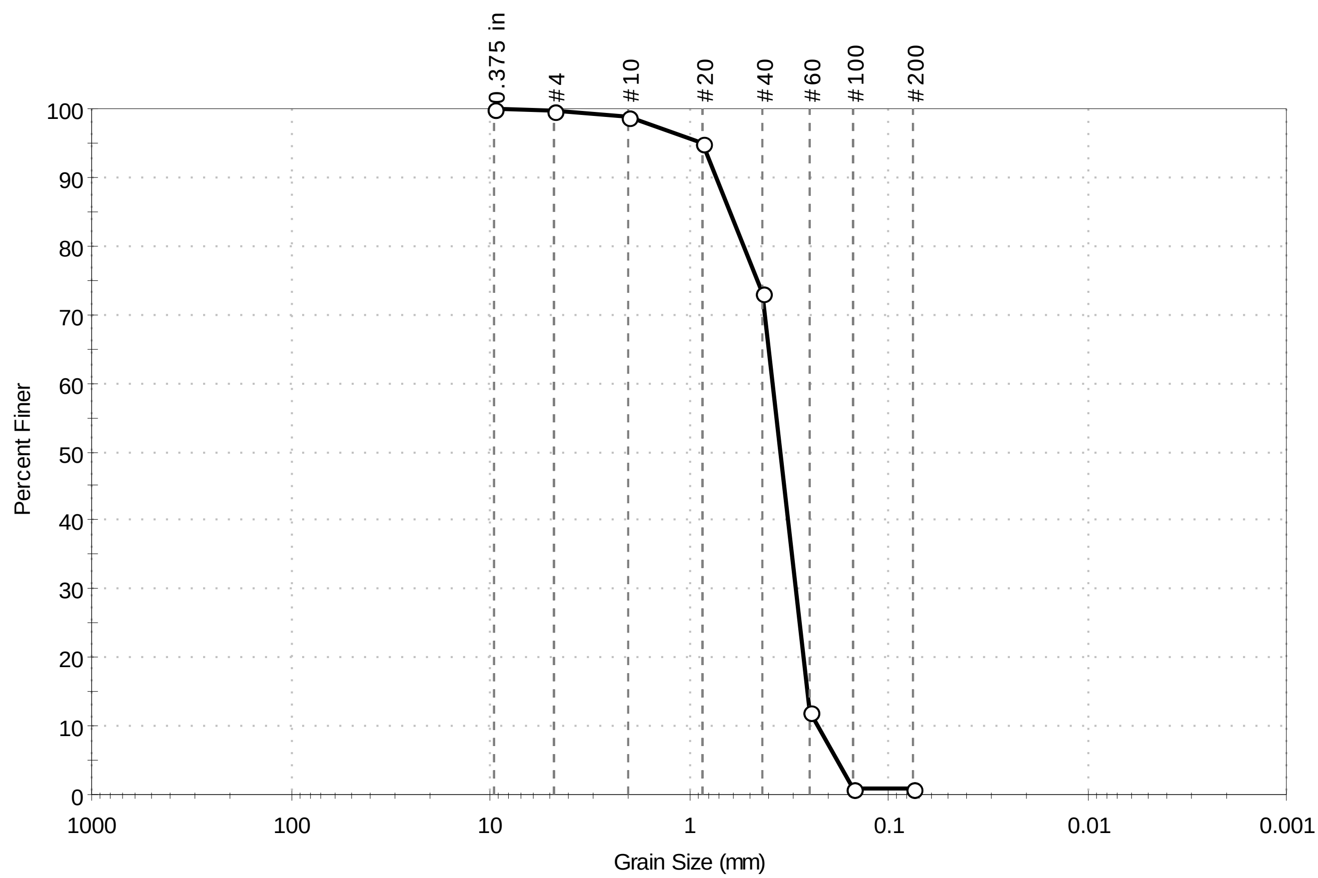
Sand/Gravel Hardness : HARD

printed 3/29/2016 11:17:15 AM

Client:	Woods Hole Group				
Project:	Sandwich Offshore Borrow Site				
Location:	Sandwich, MA			Project No:	GTX-304511
Boring ID:	---	Sample Type:	bag	Tested By:	jbr
Sample ID:	TI5	Test Date:	03/25/16	Checked By:	emm
Depth :	---	Test Id:	370134		

Test Comment: ---
Visual Description: Moist, pale yellow sand
Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	0.2	98.9	0.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	99		
#20	0.85	95		
#40	0.42	73		
#60	0.25	12		
#100	0.15	1		
#200	0.075	0.9		

Coefficients

D_{85} = 0.6194 mm　　D_{30} = 0.2922 mm
D_{60} = 0.3790 mm　　D_{15} = 0.2566 mm
D_{50} = 0.3475 mm　　D_{10} = 0.2280 mm
C_u = 1.662　　C_c = 0.988

Classification

ASTM　Poorly graded sand (SP)

AASHTO　Fine Sand (A-3 (1))

Sample/Test Description

Sand/Gravel Particle Shape : ---

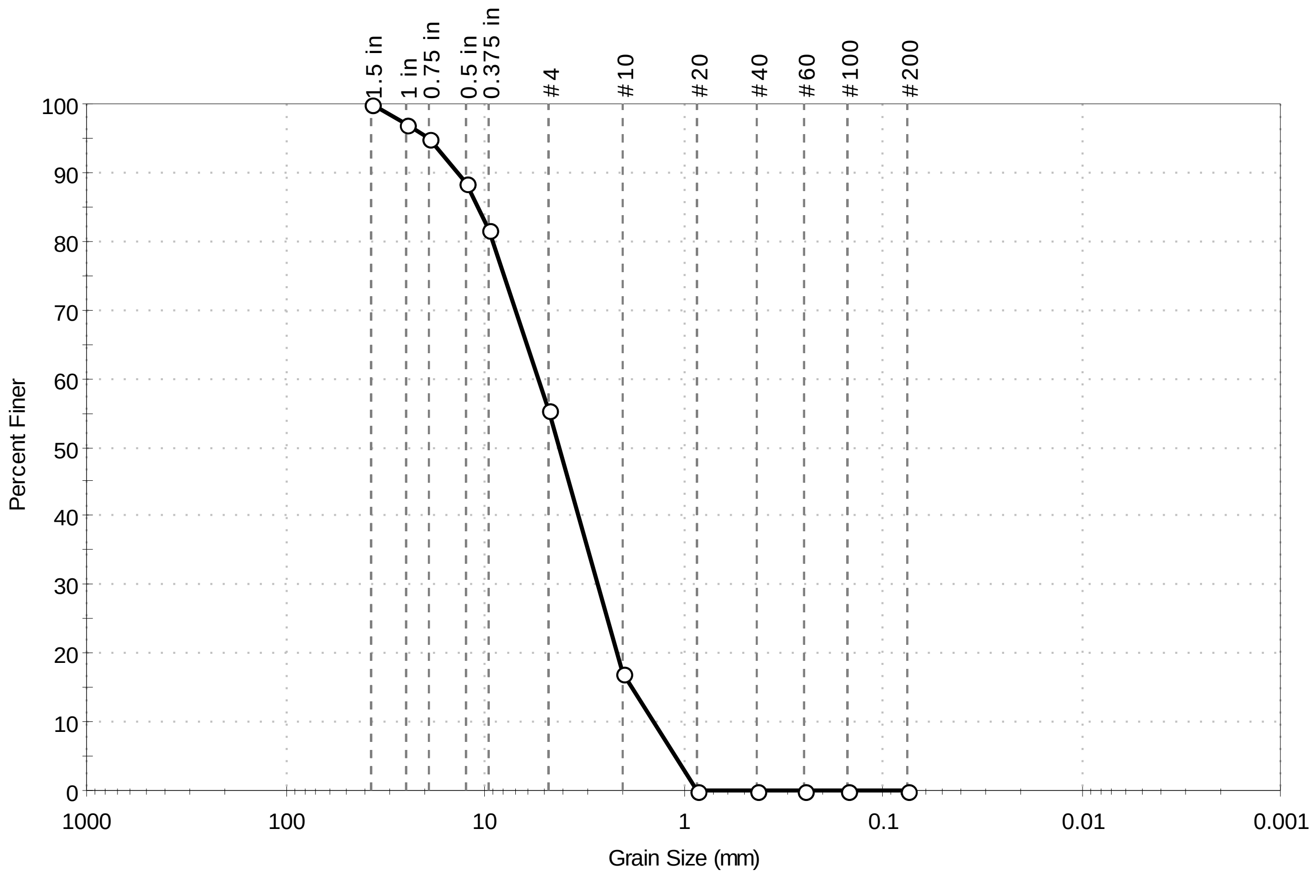
Sand/Gravel Hardness : ---

printed 3/29/2016 11:17:15 AM

GeoTesting EXPRESS

Client:	Woods Hole Group		
Project:	Sandwich Offshore Borrow Site		
Location:	Sandwich, MA	Project No:	GTX-304511
Boring ID: ---	Sample Type: bag	Tested By:	jbr
Sample ID: TI6	Test Date: 03/25/16	Checked By:	emm
Depth : ---	Test Id: 370135		
Test Comment:	---		
Visual Description:	Moist, grayish brown sand with gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
---	44.5	55.5	0.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1.5 in	37.50	100		
1 in	25.00	97		
0.75 in	19.00	95		
0.5 in	12.50	89		
0.375 in	9.50	82		
#4	4.75	56		
#10	2.00	17		
#20	0.85	0		
#40	0.42	0		
#60	0.25	0		
#100	0.15	0		
#200	0.075	0.0		

Coefficients

D_{85} = 10.8153 mm | D_{30} = 2.6780 mm

D_{60} = 5.3422 mm | D_{15} = 1.8093 mm

D_{50} = 4.1935 mm | D_{10} = 1.4050 mm

C_u = 3.802 | C_c = 0.955

Classification

ASTM Poorly graded sand with gravel (SP)

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

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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