APPENDIX D –

ESSENTIAL FISH HABITAT

CONSULTATION

Kisak, Natalie

From:	Miller, Shari (WFF-2500) <shari.a.miller@nasa.gov>
Sent:	Friday, February 17, 2023 1:31 PM
To:	David OBrien - NOAA Federal
Cc:	Emily A. Hein; Bahnson, Sara E CIV USARMY CENAO (US); Karen Greene; Meyer, T J (WFF-2500); Brittingham, Alan L. (WFF-013.0)[Virginia Commercial Space Flight Authority]; Levine, Lori (GSFC-2500)
Subject:	RE: [EXTERNAL] NASA Wallops Island Northern Development; EFH assessment response
Attachments:	NASA WIND EFH letter_Response_17Feb2023.pdf

Good afternoon, Dave,

Please find attached NASA's letter in response to your letter dated February 13, 2023, providing comment and recommendations on a previously submitted consultation letter and essential fish habitat (EFH) assessment, dated December 13, 2022, for the proposed Wallops Island Northern Development project.

Thank you for your participation in NASA's EA process for the proposed project. If you have any additional questions prior to publication of the Final EA, please contact me at Shari.A.Miller@nasa.gov.

Shari A. Miller
Center NEPA Manager and
Environmental Planning Lead
NASA GSFC Wallops Flight Facility
Wallops Island, VA 23337
(757) 824-2327
Shari.A.Miller@nasa.gov
Environmental Planning & Impact Assessment (nasa.gov)

"A single act of kindness throws out roots in all directions and the roots spring up and make new trees." – Amelia Earhart

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From: David OBrien - NOAA Federal <david.l.obrien@noaa.gov>
Sent: Monday, February 13, 2023 12:17 PM
To: Miller, Shari (WFF-2500) <shari.a.miller@nasa.gov>
Cc: Emily A. Hein <eahein@vims.edu>; Bahnson, Sara E CIV USARMY CENAO (US) <Sara.E.Bahnson@usace.army.mil>; Karen Greene <karen.greene@noaa.gov>
Subject: [EXTERNAL] NASA Wallops Island Northern Development; EFH assessment response

Hello Shari,

Attached here please find our response letter to the EFH assessment submitted by NASA for the WIND MARS Port project.

Please feel free to contact me if you have any questions.

Best regards,
Dave

David L. O'Brien
Fisheries Biologist
NOAA Fisheries Service
P.O. Box 1346
1370 Greate Rd.
Gloucester Point, VA 23062
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david.l.obrien@noaa.gov

National Aeronautics and Space Administration

Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337

Reply to Attn of: 250.W February 17, 2023

Mr. David O'Brien
Fisheries Biologist
NOAA Fisheries
P.O. Box 1346
1370 Greate Road
Gloucester Point, VA 23062

Re: Essential Fish Habitat Assessment: NASA Wallops Island Northern Development Project, Accomack County, Virginia

Dear Mr. O'Brien:

This letter is in response to your letter dated February 13, 2023, providing comment and recommendations on a previously submitted consultation letter and essential fish habitat (EFH) assessment, dated December 13, 2022. In accordance with Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the National Aeronautics and Space Administration (NASA) is providing a written response to the EFH conservation recommendations contained within your response.

As described in the previous consultation letter, NASA and the Virginia Commercial Space Flight Authority (VCSFA) are proposing to construct a pier for barge access and berthing and to dredge a vessel approach channel connecting to the Chincoteague Inlet Federal Channel at the northern end of NASA's Wallops Island. NASA has prepared an Environmental Assessment (EA) in accordance with the National Environmental Policy Act (NEPA) to analyze the potential effects of the proposed action on the environment. This EA has been tiered from the May 2019 *NASA Wallops Flight Facility Site-Wide Programmatic Environmental Impact Statement*, in which NASA evaluated the environmental consequences of constructing and operating new facilities and infrastructure at Wallops Flight Facility (WFF).

NASA will include the following EFH conservation recommendations provided by NOAA Fisheries in the Final EA to address and minimize potential impacts to EFH and other aquatic resources:

- Conduct all dredging during stages of the tide that allows the sandy dredge material to settle quickly from the water column; e.g. during slack tide or when tidal currents will carry resuspended sediment away from shellfish resources.
- Employ other means to reduce turbidity moving away from the dredge such as turbidity curtains or operational best management practices (i.e., reduced bucket ascent rates) to help protect shellfish resources.

- Employ impact hammer ‘soft-start’ procedure at reduced hammer energy when installing 24-inch square, pre-stressed concrete piles during pier construction.
- Compensate for the 0.37 acres of tidal wetland (permanent) impacts in accordance with the USACE/EPA 2008 Compensatory Mitigation Rule as proposed.
- Restore 1.64 acres of tidal wetland (temporary) impacts to pre-construction conditions and revegetate if necessary as proposed. Monitor wetland vegetation to ensure successful restoration of these areas.

Additionally, NASA plans to make every effort to implement the following recommendation, but notes that the ability to do so will be contingent on the availability of funding for each phase of the proposed project:

- Place all Phase 1 beach-quality, sandy dredge material at the North Wallops Island beach borrow area for beneficial use as proposed. Coordinate Phase 2 and Phase 3 dredging operations with ongoing WFF shoreline renourishment actions.

NASA understands that these recommendations are important to minimize potential adverse resource impacts, and plans to implement these recommendations to the extent practicable to avoid, mitigate, or offset potential impacts to EFH or other aquatic resources resulting from the proposed project. Should the project plans change or new information become available, NASA acknowledges that consultation would need to be reinitiated.

NASA thanks NOAA Fisheries for its participation in the EA process for the proposed project. If you have any additional questions prior to publication of the Final EA, please contact Ms. Shari Miller at NASA WFF, via phone at (757) 824-2327, or email at Shari.A.Miller@nasa.gov.

Sincerely,

Shari A. Miller
Center NEPA Manager

cc:
250/Ms. K. Finch
250/Mr. T. Meyer
MARAD/Mr. A. Finio
USACE/Mr. S. Bahnson
VCSFA/Mr. A. Brittingham

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

February13, 2023

Shari A. Miller
Center NEPA Manager
NASA Wallops Flight Facility
34200 Fulton Street
Building F-160 / Room C-165
Wallops Island, VA 23337

Re: Essential Fish Habitat Assessment: NASA Wallops Island Northern Development Project

Dear Ms. Miller:

We have reviewed the essential fish habitat assessment and supporting materials for the Wallops Island Northern Development (WIND) project on the northern end of NASA's Wallops Island located in Accomack County, Virginia. The project includes the construction of a port facility that includes a pier and operations area to provide barge access and berthing to offload large launch vehicle components and related equipment for NASA and the Mid-Atlantic Regional Spaceport (MARS). Though the WIND project will be phased, elements of the MARS Port project include:

- construction of a 1,305 ft. long fixed-pier (624 ft. Phase 1, 676 ft. extension Phase 2),
- dredging 200-ft. radius turning basin (Phase 1 and 2),
- dredging a vessel approach channel approximately 12,800 ft. long and 100 ft. wide to connect to Chincoteague Federal Navigation Channel (Phases 1 and 3),
- construction of a second hanger at the unmanned aerial systems (UAS) runway
- construction of a new support building; and
- improvements to the access road, culvert pipe and utilities supporting UAS airstrip and MARS Port.

Project Background

The MARS Port project includes construction of a fixed pier using 24-inch square, pre-stressed concrete piles at the northwest terminus of the Wallops Island Unmanned Aerial Systems Airstrip. Phase 1 of the project includes constructing a 30 ft. wide by 624 ft. long pier with boat ramp and travel lift. It also includes dredging 34 acres of subaqueous bottom to create the new access channel will connect the MARS pier located in Bogues Bay to the inner and outer Chincoteague Inlet Channels, which are two contiguous federal navigation channels connecting Bogues Bay to the Atlantic Ocean. Approximately 57,000 cu. yds. of material (Phase 1) will be dredged to create the 100 ft. wide by 12,800 ft. long access channel and 200 ft. radius turning basin to an initial depth of -9 ft. MLLW. All dredging will be conducted using a mechanical clamshell dredge and placed directly into scows. Based on geotechnical sampling and analysis, the material to be dredged contains approximately 95% sand. The beach-quality, sandy dredge material will be transported via scows to the North Wallops Island beach borrow area and placed for beneficial use. Ultimately, the access channel will be dredged to -12 ft. MLLW (additional 37,800 cu. yds.) during Phase 3 to match the authorized depth of the Chincoteague Inlet Channels. Phase 3 construction will be driven by the need for the additional navigable depth and available funding.

Magnuson Stevens Fishery Conservation and Management Act (MSA)

The MSA requires federal agencies, such as NASA, to consult with us on any action or proposed action authorized, funded, or undertaken, by such agency that may adversely affect EFH identified under the MSA. This process is guided by the requirements of our EFH regulation at 50 CFR 600.905, which mandates the preparation of EFH assessments and generally outlines each agency's obligations in the consultation process. The level of detail in an EFH assessment should be commensurate with the complexity and magnitude of the potential adverse effects of the action.

The Atlantic Ocean, Bogues Bay, Chincoteague Inlet and the surrounding coastal bays, creeks, and marshes have been designated essential fish habitat (EFH) for a variety of life stages of fish managed by the New England Fishery Management Council (NEFMC), Mid-Atlantic Fishery Management Council (MAFMC), South Atlantic Fishery Management Council (SAFMC), and NOAA Fisheries because these areas provide feeding, resting, nursery, and staging habitat for a variety of commercially, recreationally, and ecologically important species. Species for which EFH has been designated in the proposed project area include Atlantic butterfish (*Peprilus triacanthus*), bluefish (*Pomatomus saltatrix*), black sea bass (*Centropristis striata*), scup (*Stenotomus chrysops*), summer flounder (*Paralichthys dentatus*), windowpane flounder (*Scophthalmus aquosus*), clearnose skate (*Raja eglanteria*), and winter skate (*Leucoraja ocellata*). The project area is also designated EFH for several Atlantic highly migratory species (tuna, swordfish, billfish, small and large coastal sharks, and pelagic sharks) including albacore tuna (*Thunnus alalunga*), sandbar shark (*Carcharhinus plumbeus*), smoothhound shark complex (Atlantic stock), and sand tiger shark (*Carcharias taurus*). NOAA has listed the sand tiger shark as a Species of Concern. Species of Concern are those species for which we have concerns regarding status and threats. The goal of listing a species as a Species of Concern is to promote proactive conservation efforts to help preclude the need to list them under the Endangered Species Act in the future. Furthermore, coastal inlets such as Chincoteague Inlet are designated as EFH for Spanish mackerel (*Scomberomorus maculatus*) and king mackerel (*Scomberomorus cavalla*).

As stated in the EFH assessment, the project will result in impacts to EFH. These impacts include temporary (1.64 acres) and permanent (0.37 acres) impacts to tidal wetlands resulting from shading impacts of the pier and extension of the tidal road culvert. Additional impacts include the direct removal of the benthic community and temporary increases in turbidity during mechanical dredging. Suspended sediment may result in turbidity plumes carried over and settling upon public and private shellfish beds. Eastern oyster (*Crassotrea virginica*) and hard clams (*Mercenaria mercenaria*) provide important environmental benefits by removing excess nutrients and improving water quality. Underwater noise will also be generated during dredging and pile driving which could adversely affect the movement of resident and transient species through the project area.

EFH Conservation Recommendations

The new channel lies immediately adjacent to extensive public and private shellfish grounds in Bogues Bay. Based on previous studies cited in our Regional turbidity table we are concerned that the potential turbidity plume generated by a mechanical dredge may result in sediment moving onto shellfish grounds. http://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effect-analysis-turbidity-greater-atlantic-region

Therefore, pursuant to Section 305(b)(4)(A) of the MSA, we recommend you adopt the following EFH conservation recommendations to minimize impacts from dredging and other construction activities to EFH and other aquatic resources, including shellfish:

1. Conduct all dredging during stages of the tide that allows the sandy dredge material to settle quickly from the water column; e.g. slack tide or when tidal currents will carry resuspended sediment away from shellfish resources.
2. In locations where recommendation 1 is not practical, employ other means to reduce turbidity moving away from the dredge such as turbidity curtains or operational BMPs (i.e. reduced bucket ascent rates) to help protect shellfish resources.
3. Employ impact hammer 'soft-start' procedure at reduced hammer energy when installing 24-inch square, pre-stressed concrete piles during pier construction.
4. Place all Phase 1 beach-quality, sandy dredge material at the North Wallops Island beach borrow area for beneficial use as proposed (Option 4). Coordinate Phase 2 and Phase 3 dredging operations with ongoing WFF shoreline renourishment actions.
5. Compensate for the 0.37 acres of tidal wetland (permanent) impacts in accordance with the USACE/EPA 2008 Compensatory Mitigation Rule as proposed.
6. Restore 1.64 acres of tidal wetland (temporary) impacts to pre-construction conditions and revegetate if necessary as proposed. Monitor wetland vegetation to ensure successful restoration of these areas.

Please note that Section 305(b)(4)(B) of the MSA requires you to provide a written response to us within 30 days after receiving our EFH conservation recommendations. The response must include a description of measures proposed for avoiding, mitigating, or offsetting the impact of the activity on EFH, as required by section 305(b)(4)(B) of the MSA and 50 CFR 600.920(j). In the case of a response that is inconsistent with our conservation recommendations, you must explain your reasons for not following the recommendations, including the scientific justification for any disagreements with us over the anticipated effects of the action or the measures needed to avoid, minimize, mitigate, or offset such effects. Please also note that further EFH consultation must be reinitiated pursuant to 50 CFR 600.920(j) if new information becomes available, or if the project is revised in such a manner that affects the basis for the above determination.

Other NOAA Trust Resources

Federally listed species may be present in the project area. Consultation, pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, may be necessary. When project plans are complete, you should submit their determination of effects, along with justification for the determination, and a request for concurrence to nmfs.gar.esa.section7@noaa.gov. After reviewing this information, our Protected Resources Division would then be able to conduct a consultation under Section 7 of the ESA, if necessary. Please contact Mr. Brian Hopper, NOAA Protected Resources Division (brian.d.hopper@noaa.gov, 240-628-5420) if you have any questions about the ESA consultation process of to discuss potential impacts to federally listed species under our jurisdiction.

Thank you for the opportunity to review the EFH assessment prepared for the NASA Wallops Island Northern Development, MARS Port project. Please contact Mr. David O'Brien in our Virginia field office (david.l.obrien@noaa.gov, 804-684-7828) if you have any questions.

Sincerely,

Louis A. Chiarella
Assistant Regional Administrator
for Habitat and Ecosystem Services

cc: Emily Hein, VIMS
Sara Bahnson, NAO Corps

Kisak, Natalie

From:	Miller, Shari (WFF-2500) <shari.a.miller@nasa.gov>
Sent:	Tuesday, December 13, 2022 4:33 PM
To:	Karen.Greene@noaa.gov
Cc:	Finio, Alan (MARAD); Brian Hopper (Brian.D.Hopper@noaa.gov); Finch, Kimberly (GSFC-2500); Meyer, T J (WFF-2500); David O'Brien (david.l.obrien@noaa.gov); Levine, Lori (GSFC-2500); Brittingham, Alan L. (WFF-013.0)[Virginia Commercial Space Flight Authority]; Bahnson, Sara E CIV USARMY CENAO (USA)
Subject:	RE: Project Review Request, Wallops Island Northern Development, NASA WFF
Attachments:	NASA WFF WIND - NOAA_EFH Consult Ltr_121322.pdf
Follow Up Flag:	Follow up
Flag Status:	Flagged

Dear Ms. Greene:

Based upon public comments received on the draft Wallops Island Northern Development Environmental Assessment (WIND EA) and your agency's comments on the Essential Fish Habitat (EFH) consultation letter, NASA Wallops Flight Facility and the Virginia Commercial Space Flight Authority (VCSFA, VA Space) are resubmitting the attached consultation. NASA and VA Space propose to construct of a pier for barge access and berthing and to dredge a vessel approach area connecting to the Chincoteague Inlet Federal Channel. NASA is the lead agency for the National Environmental Policy Act (NEPA) process and for this Endangered Species Act (ESA) consultation. As the Department of Transportation's Maritime Administration (MARAD) and the U.S. Army Corps of Engineers (USACE) are serving as Cooperating Agencies on this project, this consultation also serves to fulfil their requirements.

Based on the attached EFH assessment, NASA has determined that the effects of the Proposed Action on EFH would not be substantial. I certify that we have used the best scientific and commercial data available to complete this assessment and request your concurrence with this determination. If you have any questions or require additional information, please contact me at Shari.A.Miller@nasa.gov or (757) 824-2327.

Thank you.

Shari A. Miller
Center NEPA Manager and
Natural Resources Lead
NASA GSFC Wallops Flight Facility
Wallops Island, VA 23337
(757) 824-2327
Shari.A.Miller@nasa.gov
https://code200-external.gsfc.nasa.gov/250-wff/

"The smallest act of kindness is worth more than the grandest intention." – Oscar Wilde

From: Miller, Shari A. (WFF-2500)
Sent: Wednesday, November 10, 2021 12:05 PM
To: Karen.Greene@noaa.gov
Cc: Nate Overby <nathan.overby@vaspace.org>; Finio, Alan (MARAD) <alan.finio@dot.gov>; brian.c.denson@usace.army.mil; Brian Hopper (Brian.D.Hopper@noaa.gov) <Brian.D.Hopper@noaa.gov>; Finch, Kimberly (GSFC-2500) <kimberly.s.finch@nasa.gov>; TJ Meyer <theodore.j.meyer@nasa.gov>; David O'Brien (david.l.obrien@noaa.gov) <david.l.obrien@noaa.gov>; Levine, Lori M. (GSFC-2500) <lori.m.levine@nasa.gov>
Subject: Project Review Request, Wallops Island Northern Development, NASA WFF

Dear Ms. Greene:

The National Aeronautics and Space Administration (NASA) Wallops Flight Facility (WFF) and the Virginia Commercial Space Flight Authority (VCSFA, VA Space) propose to construct a pier for barge access and berthing and to dredge a vessel approach channel connecting to the Chincoteague Inlet Federal Channel. NASA is the lead agency for the National Environmental Policy Act (NEPA) process and for this Essential Fish Habitat (EFH) consultation. As the Department of Transportation's Maritime Administration (MARAD) and the U.S. Army Corps of Engineers (USACE) are serving as Cooperating Agencies on this project, this consultation also serves to fulfil their requirements.

Based on the attached EFH assessment, NASA has determined that the effects of the Proposed Action on EFH would not be substantial. I certify that we have used the best scientific and commercial data available to complete this assessment and request your concurrence with this determination. If you have any questions or require additional information, please contact me at Shari.A.Miller@nasa.gov or (757) 824-2327.

Thank you.

Shari A. Miller
Center NEPA Manager &
Natural Resources Manager
NASA GSFC Wallops Flight Facility
Wallops Island, VA 23337
(757) 824-2327
Shari.A.Miller@nasa.gov
https://code200-external.gsfc.nasa.gov/250-wff/

"Remember there's no such thing as a small act of kindness. Every act creates a ripple with no logical end." —Scott Adams

National Aeronautics and Space Administration

Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337

Reply to Attn of: 250.W December 13, 2022

Ms. Karen Greene
Mid-Atlantic Field Office Supervisor and EFH Coordinator
Greater Atlantic Regional Fisheries Office
NOAA Fisheries
55 Great Republic Drive
Gloucester, MA 01930

Subject: Project Review Request, Wallops Island Northern Development, NASA Wallops Flight Facility, Accomack County, Virginia

Dear Ms. Greene:

The National Aeronautics and Space Administration (NASA) Wallops Flight Facility (WFF) and the Virginia Commercial Space Flight Authority (VCSFA, VA Space) propose to construct a pier for barge access and berthing and to dredge a vessel approach channel connecting to the Chincoteague Inlet Federal Channel (**Figures 1 and 2**). NASA is the lead agency for the National Environmental Policy Act (NEPA) process and for this Essential Fish Habitat (EFH) consultation. As the Department of Transportation's Maritime Administration (MARAD) and the U.S. Army Corps of Engineers (USACE) are serving as Cooperating Agencies on this project, this consultation also serves to fulfill their requirements.

NASA is preparing an Environmental Assessment (EA) in compliance with NEPA to analyze the potential effects of the proposed action on the environment. The EA will be tiered from the May 2019 *NASA WFF Site-Wide Programmatic Environmental Impact Statement* (PEIS), in which NASA evaluated the environmental consequences of constructing and operating new facilities and infrastructure at WFF.

The purpose of this letter is to provide information about the proposed project and to request your concurrence with our determination regarding potential effects on EFH. NASA has evaluated the potential for the project to adversely affect EFH in accordance with the Magnuson-Stevens Fishery Conservation and Management Act (MSA). NASA used the Greater Atlantic Regional Fisheries Office EFH Assessment Worksheet to evaluate potentially affected EFH, and we are submitting our evaluation and findings for your review. The EFH Assessment Worksheet is provided in Attachment 1. We have determined that the impact of the Proposed Action on EFH would not be substantial and request an abbreviated EFH consultation.

Background

The goal of the MARAD Marine Highway Program is to expand the use of America's navigable waterways; to develop and increase marine highway service options; and to facilitate their further integration into the current U.S. surface transportation system, especially where water-based transport is the most efficient, effective, and sustainable option (MARAD 2019a). The M-95 Marine Highway Corridor includes the Atlantic Ocean coastal waters; Atlantic Intracoastal Waterway; and connecting commercial navigation channels, ports, and harbors spanning 15 states including Virginia. The proposed Wallops Island M-95 Intermodal Barge Service project has the potential to support the growth of existing operations at WFF, enhance science, technology, engineering, and math (STEM) research opportunities, and spur high-tech/high-paying jobs in a predominantly rural area (MARAD 2019b).

VCSFA was created in 1995 by the General Assembly of the Commonwealth of Virginia to promote the development of the commercial space flight industry, economic development, aerospace research, and STEM education throughout the Commonwealth. In 1997, the VCSFA entered into a Reimbursable Space Act Agreement with NASA, which permitted the use of land on Wallops Island for launch pads. VCSFA also applied for and was granted a Federal Aviation Administration (FAA) license for launches to orbital trajectories. This led to the establishment of the Mid-Atlantic Regional Spaceport (MARS) which is owned and operated by VCSFA.

Development of a port and operations area to support the activities of NASA, WFF tenants, and MARS at the north end of Wallops Island was evaluated at a programmatic level of detail in the 2019 *Final Site-wide PEIS* (NASA 2019). NASA has several long-term tenants and customers that use the WFF research airport and Wallops Island launch range, its facilities, and airspace.

Description of the Proposed Action

Under the Proposed Action, the MARS Port, including a 398-meters (m) (1,305-feet [ft]) fixed pier and turning basin, would be constructed adjacent to the unmanned aerial system (UAS) airstrip located at the north end of Wallops Island (**Figures 1 and 2**). The MARS Port would provide a port and operations area along with associated capabilities for VCSFA, NASA WFF, and other customers. The MARS Port would also serve as a new intermodal facility as part of the MARAD M-95 Marine Highway Corridor. Infrastructure (new upland facilities and improvements to the existing access road, airstrip, and utilities) would likewise be constructed or installed as part of the Proposed Action. Access road improvements would include widening of an existing culvert. Although shown for completeness in **Figure 2**, upland activities that would not affect essential fish habitat are not discussed further.

The Proposed Action would also include the dredging of a new and existing channel to enhance the vessel approach to the pier (**Figure 3**). Mechanical dredging (i.e., clamshell bucket dredge) would be utilized for all dredging activities associated with the Proposed Action. The dredging process consists of lowering the bucket to the channel or basin floor, closing the bucket and raising it back to the water surface, and depositing the dredged material into a scow. The vessel approach channel, which interfaces with two Federal waterways, the Chincoteague Inlet Channel and the Chincoteague Inlet to Bogues Bay connecting waters would initially be used by a variety of shallow-draft vessels. Ultimately, the proposed channel would have a length of approximately 3,900 m (12,800 ft), a width of 30 m (100 ft), and a final depth of 3.7 m (12 ft) below mean lower low water (MLLW). Components of the Proposed Action are further described below.

Purpose and Need for the Proposed Action

The mission of WFF is to provide unique expertise, facilities, and carriers (e.g., manned and unmanned aircraft, surface and subsurface vessels, balloons, sounding and orbital rockets) to enable rapid-response, frequent, low-cost flight opportunities for a diverse customer base. This mission drives its programs and objectives, which in turn drive its facilities and infrastructure. In addition to fulfilling its own mission, WFF provides unique services to NASA, civil and commercial customers, defense, and academia, many of which are guided at some level by the 2020 U.S. National Space Policy. Construction of a port, which includes a pier and operations area (MARS Port), would provide barge access and berthing to offload large launch vehicle components and related equipment for MARS and NASA. The MARS Port would also be part of MARAD's M-95 Marine Highway Corridor and is a portion of this proposed Wallops Island north end development project.

The purpose of the Proposed Action is to increase safety and security while reducing costs, traffic, congestion, and air emissions by removing potentially hazardous transportation operations from roadways. Water transportation has a much lower rate of fatalities than railroad or highway transportation, is the most fuel-efficient method of transportation, and has far lower emissions than railcars or trucks. This is partly due to the greater carrying capacity of a barge over a semi-tractor/trailer or railcar. The Proposed Action would also help to eliminate damage done to roads by transportation vehicles carrying large space assets, which can often exceed the level of structural capacity on the affected roadways.

Additional proposed components of the Proposed Action would provide dedicated spaces for work, laboratory, and storage to support research and testing of UAS, autonomous underwater vessels/autonomous surface vehicles (AUV/ASV), and unmanned ground systems (UGS). These improvements would enhance operational capabilities for NASA and its partners and customers such as VCFSA, the Navy, National Oceanic and Atmospheric Administration (NOAA), and the U.S. Coast Guard (USCG). Operating these aquatic vehicles from the proposed port and access channel would permit direct access to the Navy's offshore Virginia Capes Operating Area test range via the USACE maintained federal navigation channel (Chincoteague Inlet Channel).

Rocket components, spacecraft, and autonomous systems are often corporate or academic proprietary or national security classified assets. The MARS Port would create a dedicated, secure facility to accept these systems, without having to traverse public roadways.

The following items encompass the underlying need for expanding WFF operational capacities, including the development of the MARS Port:

1. Growing U.S. focus on commercial space;
2. More frequent partnerships with DoD agencies;

3. Continued role in academia, civil space science, exploration, and discovery;
4. Safely and securely increasing operation frequency on Wallops Island; and
5. Replacing aging or inadequate infrastructure.

The construction and operation of the MARS Port would assist with meeting these needs by supporting AUV/ASV testing and operational capabilities for the USCG, Navy, NOAA, and other customers.

The associated channel dredging and new infrastructure construction associated with the Proposed Action would contribute to improving aging or inadequate infrastructure. The current infrastructure at WFF cannot sustain the proposed increase in operational capacities associated with the MARS Port. The proposed infrastructure improvements are critical to ensure the capability of moving space freight and/or test vehicles from sea to land to air, which would make the MARS Port a true intermodal facility.

The expanded operational capability provided by the MARS Port would support the anticipated increase in WFF launch frequency and meets the need of commercial launch service providers to barge rocket components, payloads, and hardware directly to Wallops Island. These commercial providers would also gain the ability to recover spent rocket cores, stages, and/or boosters and barge them directly back to WFF for possible reuse in future launches.

The remote and secluded nature of the project location meets the need to support highly secure DoD missions and research that cannot embark from or dock at public facilities. The MARS Port would allow vessels with classified or sensitive programs to be docked and operated in a secure environment.

The MARS Port also meets VCSFA’s need to host and support large-scale aquatic testing in a port setting without impacting barging schedules, capacity, or production limitations that may occur at private or commercial ports. Additionally, it would allow AUV/ASV customers to develop and test their vehicles either alone or in concert with the existing UAS airstrip. The dredging of an approach channel to a final depth of 3.7 m (12 ft) below MLLW is the optimal depth to allow the ultimate opportunities for usage of the MARS Port.

Construction and operation of the MARS Port would enable oversized equipment and potentially hazardous vehicles to be delivered directly to Wallops Island by sea. This meets the need to remove a portion of the heavy loads that stress existing roads and the Wallops Island causeway bridge, presently the sole access route to Wallops Island. Removing hazardous loads from public roadways would also provide a buffer zone away from the public, thereby increasing the safety of WFF operations.

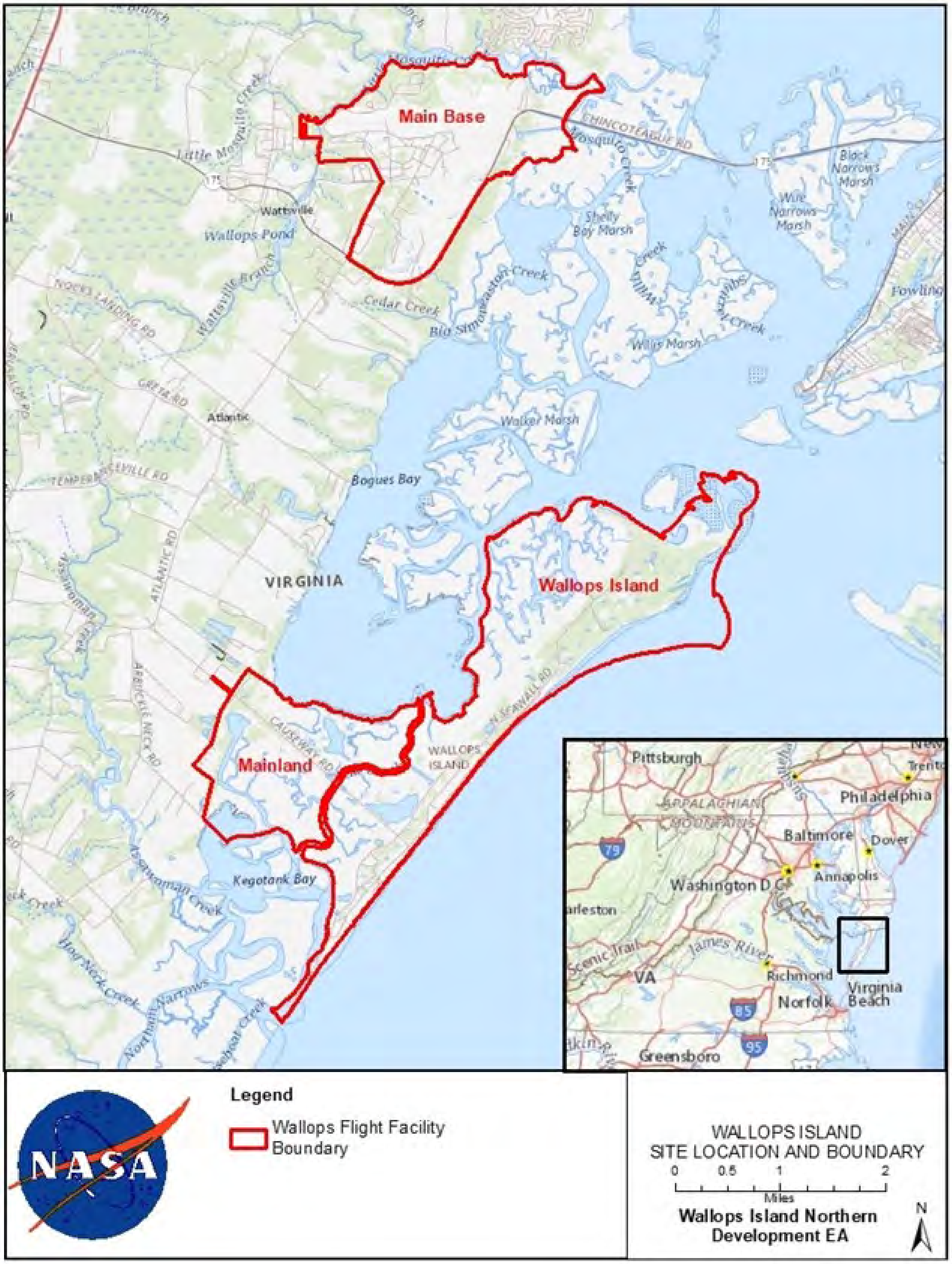

Figure 1: NASA WFF Location

Figure 2: Proposed MARS Port and Infrastructure Components

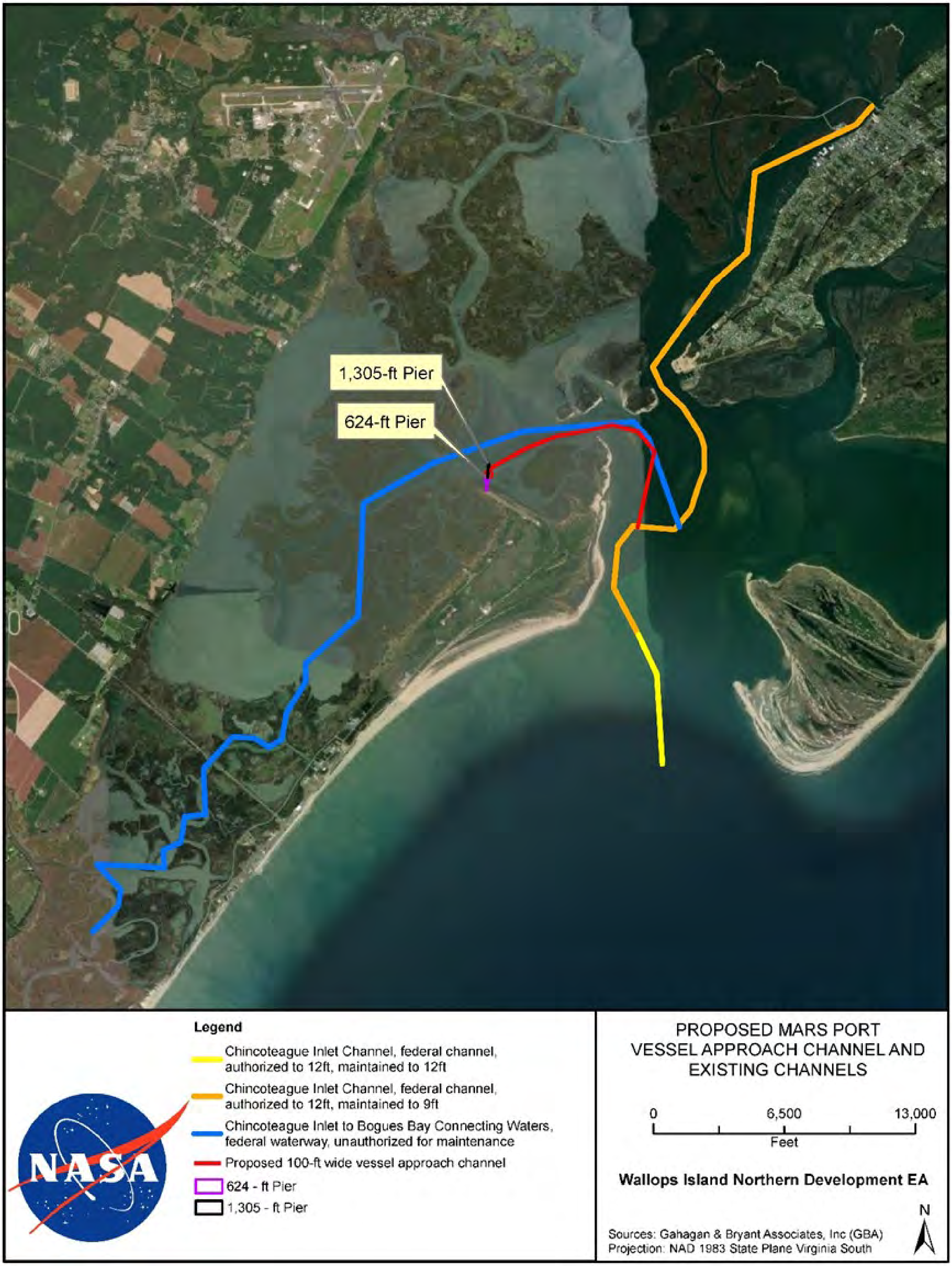

Figure 3: Proposed MARS Port Vessel Approach Channel and Existing Channels

Proposed Action In-Water Components

The MARS Port, including a 398-m (1,305-ft) fixed pier and turning basin would be constructed on (and within the vicinity of) the UAS airstrip located at the north end of Wallops Island. The MARS Port would provide a port and operations area along with associated capabilities for MARS, NASA WFF, and other customers. The MARS Port would also serve as a new part of the MARAD M-95 Marine Highway Corridor. The Proposed Action would be constructed in phases, which would be driven by customer need and would ultimately be tied to funding.

The Proposed Action would also include the dredging of an existing channel for enhanced vessel approach purposes. The vessel approach channel, which would interface with both the Chincoteague Inlet Federal Channel and the Bogues Bay connecting waterways, would be used by a variety of manned and unmanned vessels. It would be approximately 3,900 m (12,800 ft) ft long, 30 m (100 ft) wide, and would have a final depth of 3.7 m (12 ft) below MLLW.

Construction of the Proposed Action would be carried out in three phases:

- **Phase 1** would be construction of a 190-m (624-ft) fixed pier, a 61-m (200-ft) -radius turning basin 2.7 m (9 ft) deep below MLLW, and dredging of the vessel approach channel to a final depth of 1.5-m to 2.7-m (5-ft to 9-ft) below MLLW (red outline in **Figure 4**). The area dredged would total approximately 13.8 ha (34 ac). Additionally, improvements would be made to the existing paved UAS airstrip access road and a temporary wastewater holding tank would be installed adjacent to a new onshore hangar. A 40-m (130-ft) long segment of the access road would be widened from 4.5 m to 9 m (15 ft to 30 ft) in conjunction with the widening of the culvert over which the road crosses a headwater drainage channel to Cow Gut.
- **Phase 2** would be construction of a 206-m (676-ft) extension of the fixed pier to a total length of 398 m (1,305 ft) and dredging of a 61-m (200-ft)-radius turning basin (located at the end of the pier extension; shaded pink on **Figure 4**) to a final depth of 2.7 m (9 ft) below MLLW. The area dredged would total approximately 4 ac.
- **Phase 3** of construction would be additional dredging of the turning basin and vessel approach channel to a final depth of 3.7 m (12 ft) below MLLW, specifically the portion of the channel from the Phase 2 turning basin to where it meets the Chincoteague Inlet Federal Channel (shaded blue on **Figure 4**). The previously dredged area that would be dredged again to increase its depth would total approximately 13.4 hectare (ha) (33 acre [ac]).

Phases for the Proposed Action would be driven by customer need, which would increase operational tempo, and ultimately be tied to available funding. Each phase would help to expand the operational capability provided by the MARS Port to support the anticipated increase in WFF launch frequency and meet the need of commercial launch service providers to barge rocket components, payloads, and hardware directly to Wallops Island.

The portion of the channel shown in pink on **Figure 4**, which connects the vessel approach channel to the Phase 2 turning basin, is naturally deeper than 2.7 m (9 ft) below MLLW and, therefore, would not require any dredging during Phase 2. The estimated timeline for construction of the Proposed Action would have Phase 1 beginning in 2022 and being completed by 2024, with subsequent phases occurring approximately 1 to 2 years after completion of the prior phase. Thus, construction of the Proposed Action would take a total of between 22.5 months and 24 months of active work to complete (not including the lag time between phases), depending on whether pier construction and dredging activities would occur concurrently or consecutively.

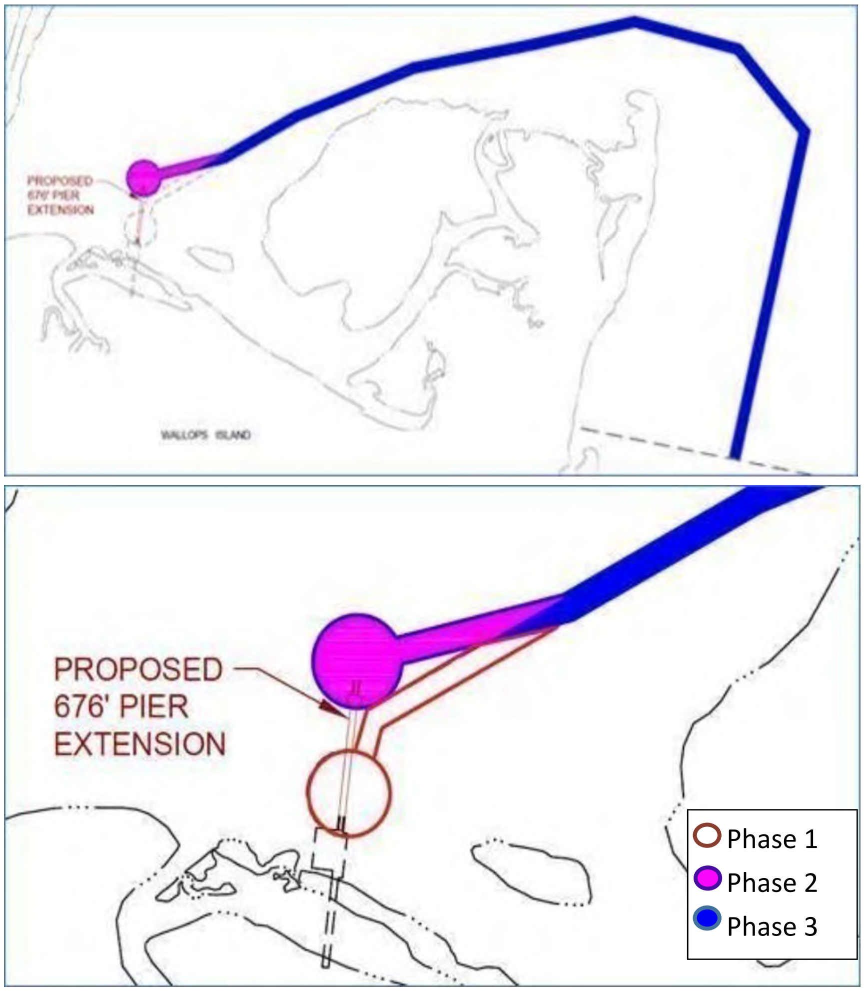

Figure 4: Diagram of Proposed Phased Construction

Typical equipment used during pier construction would include crane barges, material barges, dredging vessels, tugboat, vibratory pile hammer, diesel impact hammer, concrete truck, concrete pump truck, concrete vibrator, generator, welding machines, cutting torches, and various small tools. Concrete pilings would be installed using a soft-start procedure. The soft-start method involves initially driving the pile with a low hammer energy that is gradually increased to allow fish and other mobile animals (e.g., marine mammals) that may be in the Project Area to detect the presence of noise-producing activities and depart the area before full-power pile-driving begins. The soft-start procedure would not begin until the exclusion zone surrounding the project location is monitored/cleared for the presence of marine mammals and sea turtles.

Figure 5 and **Figure 6** show the preliminary schematics of the Proposed Action pier layout and elevation for Phase 1 and Phase 2, respectively.

A variety of shallow-draft (0.6- to 1.2-m [2- to 4-ft]), manned and unmanned vessels would be serviced by the port. The major navigational service would be a tug and barge configuration of an approximately 45-m by 12-m (150-ft by 40-ft) deck barge propelled by a tugboat requiring approximately 2.4 m (8 ft) of draft. Vessels originating from overseas or from the Ports of New York/New Jersey, Norfolk (Virginia), Baltimore (Maryland), Philadelphia (Pennsylvania), or Wilmington (Delaware) would enter the Chincoteague Inlet Federal Channel and the Bogues Bay connecting waterways to the proposed approach channel and turning basin for the pier (**Figure 3**). The proposed width of the approach channel, approximately 30 m (100 ft), is consistent with the dimensions of the Federal Channel. Estimated dredging volumes for the vessel approach channel and turning basin are provided in **Table 1**.

Table 1. Estimated Dredging Volumes

	Phase 1	**Phase 2**	**Phase 3**
Channel area (depth below MLLW)	2.7 m (9 ft)	2.7 m (9 ft)	3.6 m (12 ft)
Channel length	3,900 m (12,800 ft)	3,600 m (11,800 ft)	3,600 m (11,800 ft)
Channel dredging volume	11,500 m^3 (15,100 yd^3)	0	26,500 m^3 (34,600 yd^3)
Turning basin dredging volume	31,000 m^3 (40,500 yd^3)	600 m^3 (800 yd^3)	2,500 m^3 (3,200 yd^3)
Total volume per phase	42,500 m^3 (55,600 yd^3)	600 m^3 (800 yd^3)	29,000 m^3 (37,800 yd^3)
		Total Volume (Phases 1–3):	**72,100 m^3 (94,200 yd^3)**

m^3 = cubic meters, yd^3 = cubic yards

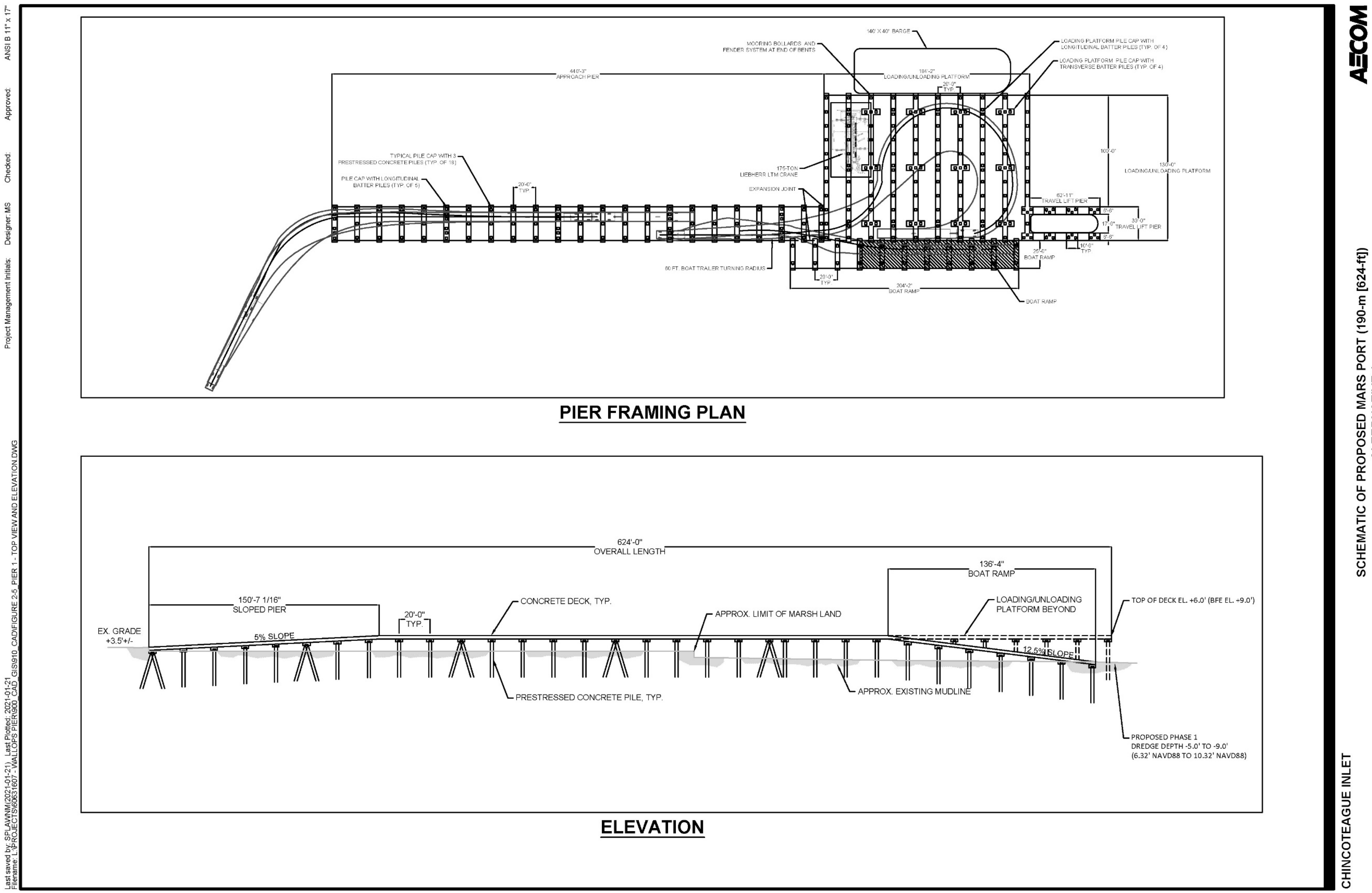

Figure 5: Preliminary Schematic of Proposed MARS Port – Phase 1

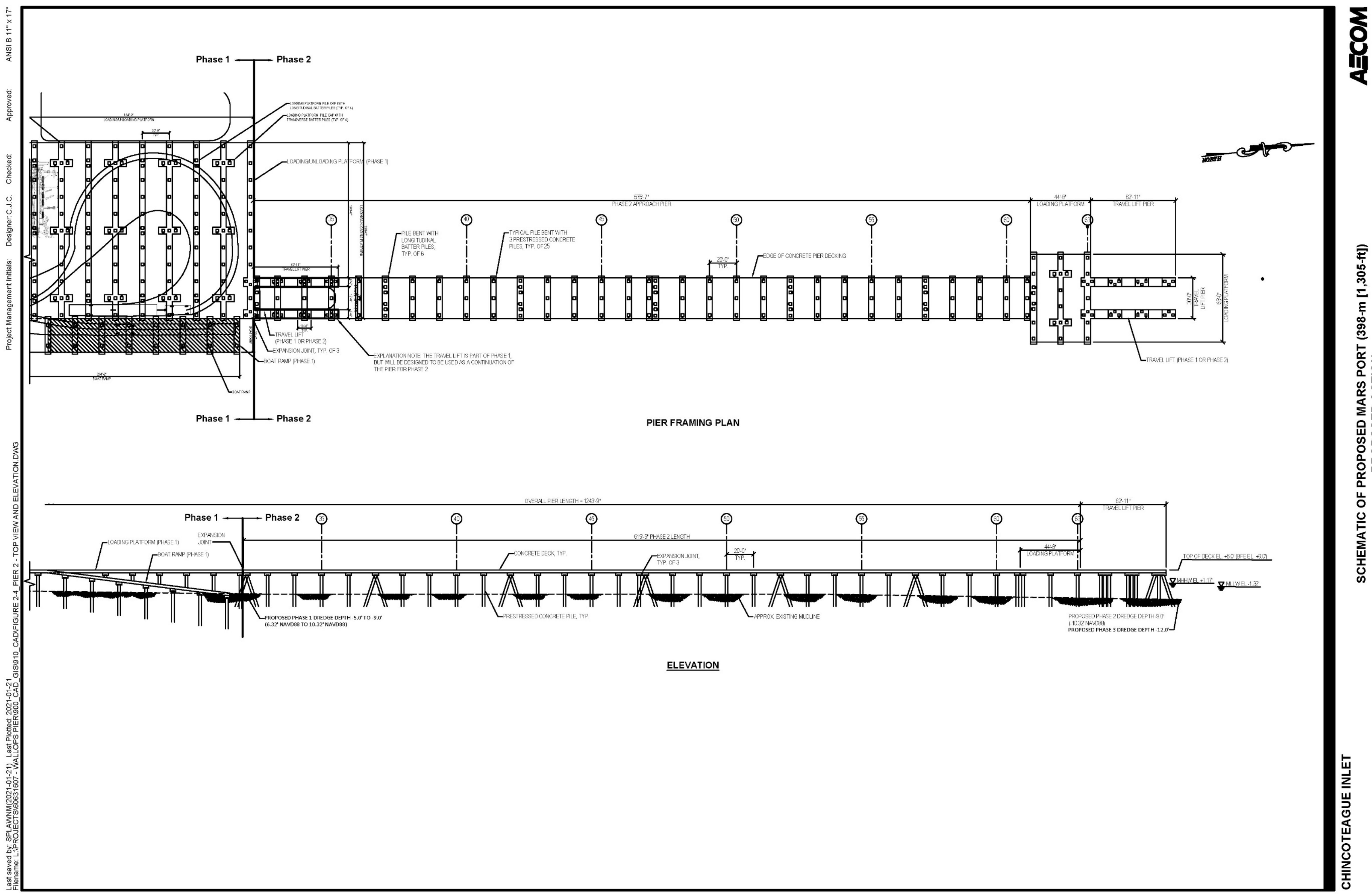

Figure 6: Preliminary Schematic of Proposed MARS Port – Phase 2

Dredged Material Placement Decision

The five potential sites considered for the placement of dredged material are summarized in **Table 2** and shown on **Figure 7**. The Proposed Action (Phases 1, 2, and 3) would result in a total volume of 72,100 m^3 (94,200 yd^3) of dredged material requiring placement. VCSFA intends to utilize Option 4, the Wallops Island Shoreline Protection Placement, as the preferred dredged material placement option. While Option 1 is the most economical solution as it offers the lowest estimated mobilization costs as well as the lowest unit costs for dredging, transport, and placement, Option 4 is the most beneficial reuse of the material. The dredged material placed on Wallops Island is required to have the same physical characteristics (90%+ sand) as the natural beach, and anything with a higher fine-grained content would not be suitable. Based on the geotechnical borings for the proposed project, the material is composed of approximately 95% sand and, therefore, would be suitable for shoreline renourishment. The geotechnical report for the MARS Port is provided as Attachment 2.

The material dredged during Phase 1 (between 42,000 m^3 and 43,000 m^3 [56,000 yd^3 and 57,000 yd^3]) would be placed into the North Wallops Island beach borrow area to speed the recovery of this area for shoreline habitat. This borrow area was used as the source of sand to renourish the beach along the shoreline infrastructure protection area that was analyzed in the Final EA for the NASA WFF Shoreline Enhancement and Restoration Project (SERP) (NASA 2019c). For the Phase 2 and Phase 3 dredging and future maintenance dredging, NASA and MARS may work with the schedule for dredging events so that they coincide with ongoing shoreline renourishment actions as part of the SRIPP, and the material would be placed somewhere within the SERP Area. The SERP area includes the Wallops Island shoreline infrastructure protection area and the North Wallops Island beach borrow area.

Maintenance dredging of the basin and channel would be repeated periodically as necessary to maintain the required depth and is expected to be infrequent and of short duration. Estimates of future maintenance dredging requirements have been made using historic dredge records made available by the Norfolk District of the USACE (Attachment 3). It was assumed that the proposed channel could be maintained at a navigable depth of 2.7 m (9 ft) or 3.6 m (12 ft) MLLW, and that different regions of the proposed channel would have different dredging requirements because of location and wave influence. The estimated dredging volume and interval is highly variable because federal navigation channel dredging records indicate that channel migration has occurred historically. Further, 2019 and 2021 survey data show large naturally occurring changes in the bathymetry (Attachment 4) that can require dredging to maintain the proposed channel alignment. Therefore, future dredging events could range from every 3 to 6 years with annualized dredge volumes ranging from 1,100 to 9,200 cubic meters per year (m^3/yr) (1,400 to 12,000 cubic yards per year [yd^3/yr]), depending on the depth and location(s) that need to be dredged.

Table 2. Potential Dredged Material Placement Sites							
Option	**Site**	**Description**	**Sail Distance from Basin[1]**	**Pipe Distance from Basin[2]**	**Sail Distance from Channel**	**Pipeline Distance from Channel**	**Description**
1	Wallops Open Ocean Dredge Material Placement Area	Open water placement site, closer than Lewis Creek or Norfolk Ocean disposal sites	9.8 km (6.1 mi)	--	7.1 km (4.4 mi)	--	This area is located just offshore of Wallops Island with a transportation distance of the dredged material of approximately 7.4 km (4 nautical mi). Open water placement options typically present the lowest cost dredging option and allows for the widest array of dredging equipment ranging from clamshell dredges to barge-mounted excavators, supplying dump barges or specially modified deck barges that are towed by tugboats to the dredged material placement site. Open water placement locations are controlled by the USACE and a CWA Section 404 permit would be required for the use of this site
2	Wallops Island Flood Protection/ Upland Placement	Reuse of material for flood mitigation through upland placement at site identified by NASA	--	850 m (2,800 ft)	--	3,700 m (12,040 ft)	This option involves the beneficial reuse of material for flood mitigation through upland placement in low lying areas on Wallops Island. For example, there are low lying areas in the vicinity of the culvert crossing the main access road to the UAS airstrip. This option was evaluated based on having a cutter suction dredge pump the material into this area. This option would also require development of containment measures for the dredged material in the form of containment dikes and the channeling of the effluent and its return into Bogues Bay. This effluent is the water that is used in the dredging process to transport the dredged material in slurry form to the placement location. Other alternatives could include thin layer placement for marsh enhancement in marsh areas a similar distance to the dredging location, or the use of geotubes, or synthetic membranes, for containing the dredged material.

Table 2. Potential Dredged Material Placement Sites							
Option	**Site**	**Description**	**Sail Distance from Basin[1]**	**Pipe Distance from Basin[2]**	**Sail Distance from Channel**	**Pipeline Distance from Channel**	**Description**
3	Greenbackville, VA, Dredged Material Containment Facility (DMCF)	Upland DMCF run by USACE, requires both navigation of Chincoteague Channel and pumping on location	18.2 km (11.3 mi)	--	15.3 km (9.5 mi)	200 m (650 ft)	The third dredged material placement option identified is the use of the upland Dredged Material Containment Facility (DMCF) owned and managed by the USACE. The USACE places material dredged from the upper reaches of the Chincoteague Channel into this DMCF. This option would utilize a mechanical dredge to load the dredged material removed from the approach channel into barges. These barges would then be towed approximately 18.5 km (10 nautical mi) to the DMCF. A specialized hydraulic unloader would be required to discharge the dredged material from the transport barges and pump the material into the DMCF.

Table 2. Potential Dredged Material Placement Sites

Option	Site	Description	Sail Distance from Basin[1]	Pipe Distance from Basin[2]	Sail Distance from Channel	Pipeline Distance from Channel	Description
4	Wallops Island Shoreline Protection Placement	Reuse of material for shoreline protection and beach repair	12.1 km (7.5 mi)	--	9.7 km (6 mi)	--	This option would involve the beneficial reuse of clean, compatible sand from the dredged material to repair and protect areas of the shoreline on Wallops Island. Based on the March 2021 geotechnical borings for the proposed project, the material is anticipated to be composed of approximately 95 percent sand and, therefore, would be suitable for shoreline renourishment. The material could be placed into the North Wallops Island beach borrow area to speed the recovery of this area for shoreline habitat. This borrow area was used as the source of sand to renourish the beach along the shoreline infrastructure protection area that was analyzed in the Final EA for the NASA WFF Shoreline Enhancement and Restoration Project (SERP) (NASA 2019c). This action was part of the WFF Shoreline Restoration and Infrastructure Protection Program (SRIPP) (NASA 2010b) which involves the beneficial reuse of clean, compatible sand to repair and protect areas of the shoreline within the Launch Range area on Wallops Island. For the Phase 2 and Phase 3 dredging and future maintenance dredging, NASA and MARS may work with the schedule for dredging events so that they coincide with ongoing shoreline renourishment actions as part of the SRIPP, and the material would be placed somewhere within the SERP Area. The SERP area includes the Wallops Island shoreline infrastructure protection area and the North Wallops Island beach borrow area (**Figure 7**). Option 4 would require using a mechanical dredge to load the dredged material removed from the approach channel into barges. These barges would then be towed approximately 11 km (6 nautical mi) to the shoreline. A specialized hydraulic unloader would be required to discharge the dredged material from the transport barges and pump the material onto the placement areas.

Table 2. Potential Dredged Material Placement Sites

Option	Site	Description	Sail Distance from Basin[1]	Pipe Distance from Basin[2]	Sail Distance from Channel	Pipeline Distance from Channel	Description
T5	Chincoteague National Wildlife Refuge Swan Cove Placement	Reuse of material for habitat restoration	-	9 km (5.6 mi)	-	6.9 km (4.3 mi)	This option would involve the beneficial reuse of the dredged material for the Swan Cove Pool Restoration Project located in the Chincoteague National Wildlife Refuge (NWR). If dredged material is determined to be compatible with the Swan Cove Pool Restoration Project design criteria, it would be used by USFWS to create berms and enhance and/or restore currently degraded areas of the estuarine-salt marsh habitat that have been negatively impacted by an under-sized culvert restricting sediment deposition and tidal flow. Although USFWS would prefer material with a high proportion of sand, they would also accept dredge material containing high organic matter content. This option was evaluated based on having a cutter suction dredge pump the material to this area. Once pumped, USFWS would assume responsibility for sediment placement and securing appropriate permits.

[1] Sail distance = the length of the path via water required to reach the placement site from the centroid of dredging in the proposed turning basin or approach channel (statute miles)
[2] Pipe distance = the length of pipe required to reach the placement site from the centroid of dredging or from the anchorage for a vessel loaded with dredged material

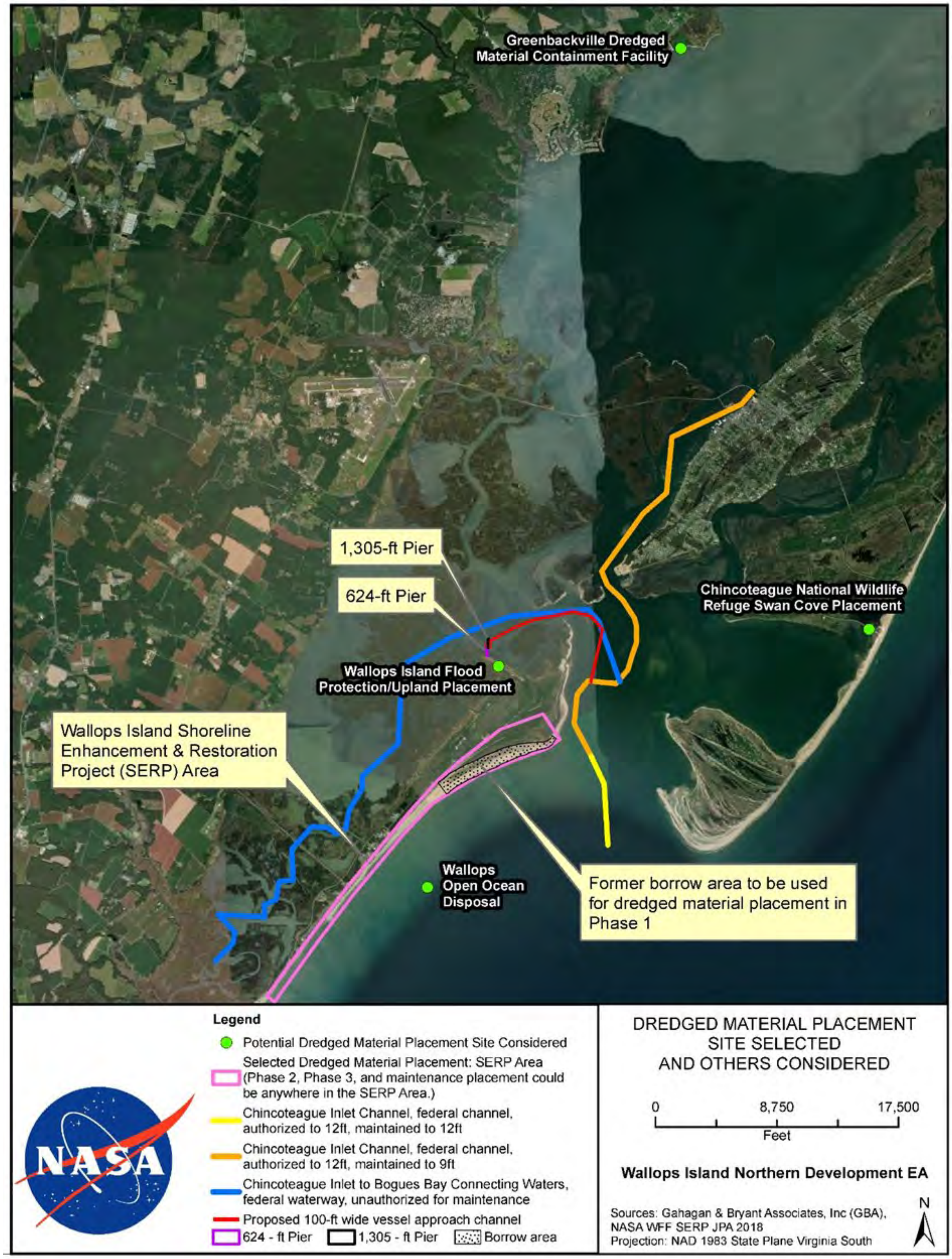

Figure 7: Dredged Material Placement Site Selected and Others Considered

Summary of Proposed Action Construction Activities

Construction of the Proposed Action would involve: (1) construction of onshore and pier components that would make up the MARS Port, (2) mechanical dredging of the vessel approach channel and turning basin, (3) placement of dredged material, and (4) construction or improvement of the proposed onshore facilities and infrastructure.

The estimated timeframe for construction of the Proposed Action would have Phase 1 beginning in 2022 and being completed by 2024, with subsequent phases occurring approximately 1 to 2 years after completion of the prior phase. With two crews (10 persons each), working 5 days per week (10-hour days), construction of the 190-m (624-ft) long pier under Phase 1 would take approximately 12 months to complete and construction of the 206-m (676-ft) long pier extension under Phase 2 (for a total pier length 398 m [1,305 ft]) would take approximately 9.5 months to complete.

Phase 1 dredging activities (turning basin and channel) would take approximately 30 days to complete, Phase 2 dredging (turning basin) would take approximately 7 days, and Phase 3 dredging (turning basin and channel) would take 30 days. Work would be performed 24 hours/day, 7 days/week, with two crews each working 12-hour shifts.

In addition to in-water components of the Proposed Action, onshore facilities and infrastructure would be constructed or upgraded, including installation of a temporary wastewater holding tank from which wastewater would be periodically collected and pumped into the NASA wastewater system for treatment. In accordance with the WFF Integrated Contingency Plan, precautions would be taken prior to and during collection from the temporary tank and while pumping into the wastewater collection system. It is assumed that construction of all proposed onshore project components and infrastructure would be completed during Phase 1.

Typical equipment used during construction would include crane barges, material barges, tugboat, vibratory pile hammer, diesel impact hammer, concrete truck, concrete pump truck, concrete vibrator, generator, welding machines, cutting torches, and various small tools.

Summary of Wetland Impacts

Three estuarine emergent wetlands and a small tidal stream were delineated within the Project footprint (**Figure 8**). The vegetation of these tidal wetlands is dominated by erect, rooted, herbaceous, usually perennial, species. Dominant species include saltmarsh cordgrass (*Spartina alterniflora*) in the low marsh zone and saltmeadow hay (*Spartina patens*) in the high marsh. USACE preliminary jurisdictional determinations have been received for all wetlands.

The proposed MARS Port components at the UAS airstrip have been designed to avoid and/or minimize impacts to wetlands to the maximum extent practicable. However, culvert improvements for widening of the UAS airstrip access road, port access road, and the approach pier from the end of the port access road would result in permanent and temporary wetland impacts. A summary of the temporary and permanent impacts on wetlands associated with the Proposed Action is shown in **Table 3**.

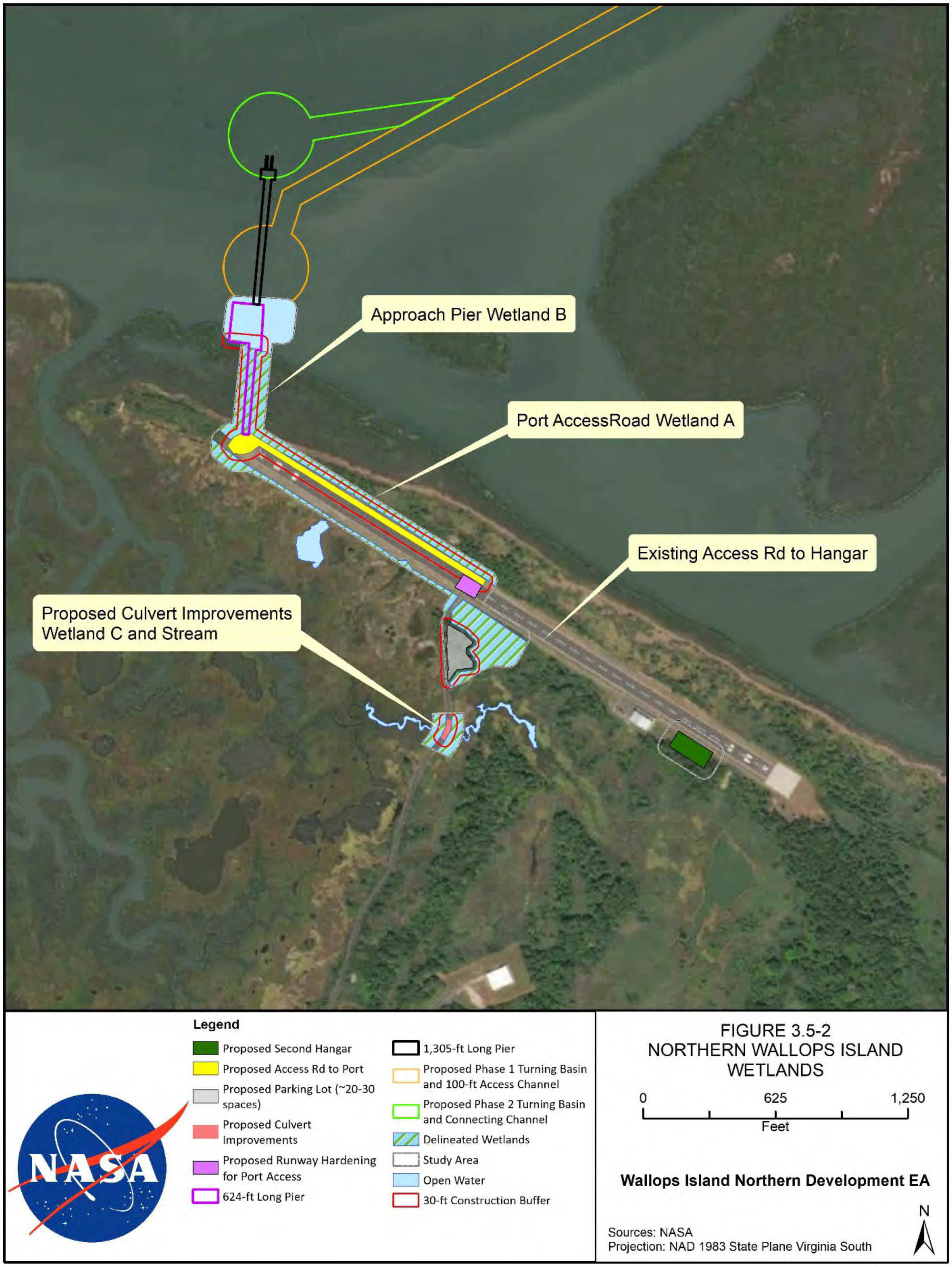

Figure 8: Northern Wallops Island Wetlands

Table 3. Direct Wetland Impacts for the MARS Port			
Impact Area	**Feature**	**Temporary Impact (Hectares / Acres)**	**Permanent Impact (Hectares / Acres)**
Port access road	Wetland A	0.35 / 0.86	0.02 / 0.05
Approach pier	Wetland B	0.24 / 0.59	0.12 / 0.30
Culvert improvement	Wetland C	<0.07 / <0.18	<0.01 / <0.01
Culvert improvement	Stream	<0.01 / <0.01	<0.01 / <0.01
	Total	**0.67 / 1.64**	**0.16 / 0.37**

Permanent impacts would result from the conversion or removal of the affected wetland areas. Areas of *Spartina* marsh beneath the pier would be shaded, and this linear area of marsh likely would be permanently impacted by limited sunlight that would result in reduced vegetation density.

Temporary direct impacts could include rutting, soil compaction, and vegetation damage from the placement and removal of matting, along with equipment movement and use during the construction activities. The area of temporary impact was determined by assuming a 9-m (30-ft) buffer area around the area of permanent impact. Areas of temporary disturbance would be restored to the extent practicable after the construction activities are complete. Synthetic composite mats, used as temporary vehicle "roadways," would be placed in areas of ground-disturbing activities to minimize adverse impacts on wetlands. If soil disturbance impacts wetland areas, the disturbed surfaces would be removed in layers and replaced in the order they are removed such that seeds and roots would remain in the top layer. Layers would be hand smoothed and, once work was completed, any bare areas would be seeded or sprigged with a native mix of species observed at the site; native vegetation would be re-planted within 30 days from the completion of activities. Soils, substrate, and contours of temporarily disturbed wetlands would be restored to pre-construction conditions to the extent practicable.

Specific wetland permits could also include requirements for mitigation and/or monitoring. Mitigation of wetland impacts occurs in the following order: avoidance, minimization, then compensatory mitigation for unavoidable impacts. NASA will follow the 2008 Compensatory Mitigation Rule under CWA Section 404, including the use of USACE approved mitigation banks, in-lieu fee programs, and permittee-responsible mitigation. NASA and VCSFA would conduct construction and post-construction monitoring to identify and document if and when disturbed areas achieve final stabilization as specified in any permits; corrective action measures (e.g., additional grading, vegetation planting) would be implemented such that permit requirements are met.

Summary of Proposed Action Operational Activities

VCSFA/MARS currently has a facilities team that mows grass once per week, monitors for eagles twice per week during nesting season, periodically removes tree and weed growth, and inspects the infiltration trench and fencing. During summer months, a mosquito fogging service truck sprays the airfield once every two weeks. Additionally, the pier structure would require quarterly structural inspections.

Potential usage of the MARS Port facility during its operation is provided in **Table 4**.

Table 4. Potential MARS Port Operations/Facility Usage

Potential Facility Usage	Vessel Type	Quantity Assumptions	Total Barge / Vessel Trips	Phase Associated with Usage
Medium Class ELV 1st stage (core) and 2nd stage	Shallow Draft Deck Barge & Inland Pushboat	3 launches per year; each comes w/ ~4-6 truckloads of parts and equipment plus 2 heavy haulers	3	1
Venture Class ELV	Shallow Draft Deck Barge & Inland Pushboat	Potential for 12 launches per year; 3 trucks per launch	12	1
Venture Class 2 ELV	Shallow Draft Deck Barge & Inland Pushboat	9 launches per year; 1 truck per stage, 3-5 trucks for equipment	9	1
Venture Class Heavy ELV	Deck Barge & 1000-1200 HP Tugboat	3 launches per year, 3 first stage cores per launch w/ 1 truck each plus 3-5 trucks for equipment	3	2
Minotaur Class	Deck barge & 1000-1200 HP tugboat	4 launches per year, 3 stage/cores per launch w/ 1 truck each; 3-5 additional trucks for equipment	4	2
Recovery effort	Shallow-draft deck barge & inland push boat	1 per launch	12	1
Autonomous Surface Vehicle (ASV)	Trailered vessel	1 deployment per month; each deployment has 5-10 vehicles included	12	1
Autonomous Underwater Vehicle (AUV)	Trailered vessel	1 deployment every other month; each deployment has 5-10 vehicles included	6	1
Miscellaneous usage	Shallow-draft vessel	1 deployment every other month	6	2
Research usage	Small research vessel	1 deployment every 4 months; each deployment has 5-10 vehicles included	3	2

Table 4. Potential MARS Port Operations/Facility Usage				
Potential Facility Usage	**Vessel Type**	**Quantity Assumptions**	**Total Barge / Vessel Trips**	**Phase Associated with Usage**
Other government research & testing	Trailered vessel	1 deployment every other month	12	2
Other Site-wide PEIS construction/expansion	Deck barge & ocean tug	2 large/oversized deliveries per year	1	2
Commodity delivery	Deck barge & ocean tug	16 total barges	16	3
Total Barge / Vessel Trips			**99**	

EFH Assessment

The MSA defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity," and it requires federal agencies to consult with NOAA Fisheries when proposing activities that may adversely affect EFH. To facilitate consultation, NOAA Fisheries provides an online mapping tool (the EFH Mapper) that can be queried to identify designated EFH species and life stages potentially occurring near the proposed project area (NOAA Fisheries 2022). Information provided by the EFH Mapper for the action area is included in Attachment 5.

In accordance with the EFH Final Rule published in the *Federal Register* on 17 January 2002, federal agencies may incorporate an EFH assessment into documents prepared for another purpose, such as an EA, provided the EFH assessment is clearly identified as a separate and distinct section of the document. The information presented in this letter is based on the analysis provided in the EA for this Proposed Action as well as the EFH Assessment Worksheet (NOAA Fisheries 2020b) prepared for this consultation (Attachment 1). The four primary elements of the EFH assessment are summarized below:

1. A description of the Proposed Action.

   Provided below; a more detailed description is provided in the EA prepared by NASA for the Proposed Action, in compliance with NEPA.

2. An analysis of the potential adverse effects of the Proposed Action on EFH and the managed species.

Briefly summarized in the EFH Assessment Worksheet (Attachment 1) and discussed in more detail below.

EFH in the Project Area

The Proposed Action includes the construction of a pier and dredging of channels and turning basins in open tidal waters off the north end of Wallops Island. The action area is defined as "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). For this project, the action area includes the north end of Wallops Island surrounding the UAS airstrip, including the surrounding waters from Chincoteague Inlet to the east and north to Bogues Bay to the west – the offshore areas potentially affected by pier construction, dredging of channels and turning basins, and vessels transiting between the proposed pier and the existing Chincoteague Inlet Federal Channel. As described above, the option selected for the placement of dredged material from construction dredging and long-term maintenance dredging is the pumping of the material from transport barges onto the Wallops Island beach in the SERP area (**Figure 5**). The elements of the ongoing SERP activities to protect Wallops Island shoreline infrastructure through beach renourishment are described in detail in the *2019 SERP EA* (NASA 2019c), which includes its own EFH assessment and NOAA Fisheries concurrence.

The Proposed Action area is geographically coincident with EFH for one or more life stages of 11 federally-managed fish species (NOAA Fisheries 2022). These species and life stages are listed in **Table 5**.

Table 5. Species and Life Stages with Designated EFH in Waters of the Action Area

Species	Eggs	Larvae/ Neonates[1]	Juveniles	Adults
Atlantic butterfish (*Peprilus triacanthus*)			X	X
Atlantic herring (*Clupea harengus*)				X
Black sea bass (*Centropristis striata*)			X	X
Bluefish (*Pomatomus saltatrix*)			X	X
Clearnose skate (*Raja eglanteria*)			X	X
Sand tiger shark (*Carcharias taurus*)[2]		X	X	X
Sandbar shark (*Charcharinus plumbeus*)[2]		X	X	
Smoothhound shark complex – Atlantic stock (*Mustelus canis*)[2]		X	X	X
Summer flounder (*Paralicthys dentatus*)			X	X
Windowpane flounder (*Scophthalmus aquosus*)				X
Winter skate (*Leucoraja ocellata*)			X	X

Notes:
1. An "X" indicates that EFH has been designated within the project area for that species and life stage.
2. The three shark species bear live young (neonates) and thus, do not have a free-swimming larval stage.

Source: NOAA Fisheries (2022)

The offshore habitats within the action area include tidal marsh communities and the estuarine surface waters of Chincoteague Inlet, Bogues Bay, Ballast Narrows, and other waterways. The nearest beds of submerged aquatic vegetation are approximately 4.8 km (3 miles) north of the project area.

The benthic invertebrate community of the Project Area may be an important EFH component that provides a food source for managed fish species. A benthic macroinvertebrate survey was performed in July 2020 to characterize the existing community in a portion of the Project Area at the north end of Wallops Island. Sediment samples were collected at six locations along an east-west transect through the area where the proposed pier would be constructed. These locations were considered to be representative of the area that includes the pier and the areas to be dredged for the turning basins and the western end of the approach channel. The benthic samples were collected from subtidal areas at locations ranging from approximately 40 m to 285 m (130 ft to 930 ft) offshore of the tidal marsh. The *Benthic Infauna Community Assessment* (AECOM 2021) completed for the MARS Port is included as Attachment 6.

The six samples collected had a hydrogen sulfide odor that suggested the sediments were either anoxic or hypoxic at the time they were sampled. Hypoxia is not uncommon in intertidal and shallow subtidal estuaries along the eastern U.S. coastline due to high levels of organic content in the sediment due to excess nitrogen from decaying salt marsh peat material and possibly anthropogenic sources. The benthic infaunal community of the Project Area was low in abundance of organisms and diversity of taxa.

Infaunal organisms identified from the six benthic samples collected were representative of typical estuarine habitat. The six benthic samples had a total of 540 individuals from 34 different taxonomic groups. Some individual organisms were readily identifiable to the species level while others remained at a higher classification to expedite sample analysis while balancing level of taxonomic effort. Annelida (Polychaeta) were the dominant taxonomic group and comprised 55% of the identified individuals. Bivalves were the second most abundant and comprised 26% of the identified individuals. The three polychaete Families Capitellidae, Spionidae Cirratulidae and one mollusk Family Tellinidae were consistently present within the six samples.

The majority of the polychaetes identified were threadlike capitellids and small spinonidae, and although they composed approximately 40 percent of the individual organisms counted, they made up only a small percentage of the overall biomass in the samples. Therefore, they are unlikely to be a substantial component of the diet of bottom-feeding fish (AECOM 2021). These two taxa are well documented as being typically found in areas of anthropogenic disturbance, have high tolerance to dredging and disposal, are some of the first species to recolonize areas following anoxic events, and are able to repopulate habitats that experience extreme fluctuations in conditions (AECOM 2021).

The next most abundant taxa were bivalve mollusks (26 percent of identified individuals), followed by amphipods. These organisms live in and on the bottom sediment, where they consume bacteria and detritus in the sediment and can be prey for higher-trophic-level predators. The overall abundance and diversity of these organisms were low, which is typical for estuarine and anthropogenically disturbed environments.

Waters in the Project Area contain public and private harvesting areas for shellfish (oysters and clams). These aquaculture areas are mapped in **Figure 7**. The VMRC promotes and regulates clam and oyster farming and gardening, also known as shellfish aquaculture, in the subaqueous lands of Virginia. VMRC issues oyster ground leases to individuals who wish to conduct aquaculture in approved areas and issues permits and licenses depending on location, aquaculture method, and whether the shellfish will be sold commercially (VMRC 2019). In addition to issuing private aquaculture leases, Virginia committed to maintain public access to the natural oyster beds identified in the 1890s by James Baylor of the U.S. Coast and Geodetic Survey. These public areas are designated by VMRC as Baylor Grounds and are mandated to be "… held in trust for the benefit of the people of the Commonwealth." Waters near the Project Area contain public and private shellfish harvesting areas (VRMC 2019), the closest of which are the following:

- Private oyster grounds in Ballast Narrows and Chincoteague Channel.
- Public clamming grounds along the east side of Walker Marsh, north of Wallops Island.

Sand material from the dredging of turning basins and channels during project construction and long-term maintenance would be placed on Wallops Island beaches in conjunction with the ongoing restoration activities of the SERP. Beach habitat on Wallops Island consists of upper beaches and overwash flats, which are areas above the high tide line that are occasionally flooded by storm surges and high spring tides. Air-breathing crustaceans, such as ghost crabs (*Ocypode quadrata*), dominate the uppermost zone of the Wallops Island beach, while the swash zone is dominated by isopods, amphipods, polychaetes, and mole crabs (*Emerita talpoida*). Below the mid-tide line is the surf zone, where coquina clams (*Donax variabilis*) and a variety of amphipods are prevalent. All such organisms are important prey species for a variety of waterbirds and fish (NASA 2019c).

Figure 9. Aquaculture Areas Near Wallops Island

Construction and Operations Impacts

A 398-m (1,305-ft) fixed pier would be constructed in the northwest portion of the Project Area that would extend from salt marsh/intertidal habitat through subtidal habitat and into estuarine habitat. A turning basin would be constructed around the pier, impacting estuarine habitat. A vessel approach channel approximately 3,900-m (12,800-ft) long and 30 m (100 ft) wide would be dredged to a final depth of 3.7 m (12 ft) below MLLW in estuarine habitat.

As discussed above and quantified under *Summary of Wetland Impacts*, the salt marsh and estuarine habitat within the footprint of the pilings supporting the pier would be permanently converted. These habitats beneath the pier would be shaded, inhibiting plant growth and reducing the presence of wetland and underwater vegetation that may provide fish habitat. The submerged structure of the pier would provide substrate for colonization by invertebrates and shelter and foraging habitat for fish. Pier construction and channel/basin dredging could result in temporary, localized impacts from increased noise, turbidity, and sedimentation.

Portions of the EFH surrounding Ballast Narrows could be disturbed by the movement and anchoring of barges. Barges would be positioned, and barge anchors deployed in such a manner as to avoid disturbance to oyster beds to the maximum extent practicable. Disturbance of the subaqueous bottom would not affect the long-term viability of the benthic community or associated EFH in those areas.

A small area of EFH would be affected by a proposed improvement to a road. A 40-m (130-ft) segment of the existing paved access road for the UAS airstrip would be widened from 4.5 m to 9 m (15 ft to 30 ft) and, in conjunction, the culvert over which the road crosses a drainage channel to Cow Gut would be widened (lengthened). The diameter of the culvert would remain the same. This proposed construction would result in less than 0.01 ha (<0.01 ac) of impacts to the stream, and would result in temporary turbidity and noise impacts to EFH. Following construction, the culvert extension would maintain the hydrologic connection of the stream on either side of the roadway and would not interfere with fish passage within this headwater drainage. Overall, the culvert would have a negligible impact on EFH.

The onshore construction contractor(s) would use erosion and sediment control measures in upland areas to minimize or prevent the erosion of exposed soils by wind and water and corresponding sedimentation of receiving water bodies. Accidental spills of fuel, oil, hydraulic fluid, or other potentially hazardous substances would be prevented or minimized through the contractor’s adherence to project-specific Spill Prevention Control and Countermeasures Plan, good housekeeping, and Best Management Practices (BMPs), as specified in WFF’s *Integrated Contingency Plan*.

A temporary wastewater holding tank would be installed adjacent to a new onshore hangar. Wastewater would be periodically collected and pumped into the NASA wastewater system for treatment. Impact to nearby EFH, would be prevented or minimized through the contractor’s adherence to spill prevention and control measures, as specified in WFF’s *Integrated Contingency*

Plan, prior to and during collection from the temporary tank and while pumping into the wastewater collection system.

Dredging Impacts

The benthic community and associated EFH would be disturbed in the vicinity of the proposed pier and dredging of turning basins and channels. The area of marsh and open water bottom beneath the pier would be approximately 0.4 ha (1 ac) in Phase 1 and 0.6 ha (1.5 ac) in Phase 3. The areas to be dredged, including turning basins and channels, would be approximately 13.8 ha (34 ac) in Phase 1, 1.6 ha (4 ac) in Phase 2, and 13.4 ha (33 ac) in Phase 3. In Phase 3, previously dredged areas would be re-dredged to increase their depth. Thus, the maximum area of bottom to be directly removed by dredging through all construction phases of the Proposed Action would be approximately 13.8 ha (34 ac), and the total area affected by both the pier and dredging would be approximately 14.4 ha (35.5 ac).

As discussed above, maintenance dredging of the basin and channel would be repeated periodically as necessary to maintain the required depth. Estimates of future maintenance dredging requirements have been made using historic dredge records, indicating that future dredging events could range from every 3 to 6 years with annualized dredge volumes ranging from 1,100 m^3/yr to 9,200 m^3/yr (1,400 yd^3/yr to 12,000 yd^3/yr), depending on the depth and location(s) that need to be dredged.

Dredging impacts to fish and benthic invertebrate prey would occur from direct entrainment (being captured by the dredge bucket). Eggs, larval stages, and sessile or sedentary prey species typically are the most susceptible to entrainment. Entrainment rates for the proposed clamshell bucket dredging tend to be lower and less problematic than in continuous cutter/suction dredging. Nevertheless, some fish species can be captured in clamshell dredge buckets and may be injured or killed from entrapment in the bucket or burial in sediment during dredging and deposition of sediment into the dredge scow. Fish captured and emptied out of the bucket could suffer severe stress or injury, which could also lead to mortality (Hopper 2021).

Dredging and pile-driving during construction of the Proposed Action and maintenance dredging during operation of the pier facility would resuspend sediment in the water column and produce turbidity due to suspended particles and subsequent sedimentation. Generally, high levels of suspended solids and long exposure times produce the greatest mortality. Decreased visibility from increased turbidity could lead to increased predation risk for some species and could impact species that rely on phytoplankton and filter feeding by damaging feeding structures or reducing feeding efficiency (Erftemeijer and Lewis 2006). Temporary turbidity and sedimentation effects from dredging along the channel and basin may impact nearby privately leased oyster beds (aquaculture).

During channel and turning basin dredging, sediment disturbance and total suspended solids (TSS) concentrations could vary greatly depending on factors such as the equipment used, currents, and tides. Mechanical dredges would be used (e.g., clamshell). TSS concentrations associated with clamshell bucket dredging operations have been found to range from 105 milligrams per liter (mg/L) in the middle of the water column to 445 mg/L near the bottom (210 mg/L, depth-averaged). A study that measured TSS concentrations at distances of approximately 150, 300, 610, and 1,000 m (500, 1,000, 2,000, and 3,300 ft) from dredge sites in the Delaware River detected concentrations between 15 mg/L and 191 mg/L up to 610 m (2,000 ft) from the dredge site. In support of the New York/New Jersey Harbor Deepening Project, USACE conducted extensive monitoring of mechanical dredge plumes and found that plumes dissipated to background levels within 180 m (600 ft) of the source in the upper water column and 730 m (2,400 ft) in the lower water column regardless of bucket type. Based on these studies, elevated TSS concentrations (several hundred mg/L above background) may be present in the immediate vicinity of the bucket but would settle rapidly within a 730-m (2,400-ft) radius of the dredge location. The TSS levels found to be associated with mechanical dredging (up to 445 mg/L) are below those shown to have adverse effects on fish (typically up to 1,000 mg/L). (NOAA Fisheries 2020)

The re-suspension of anoxic sediments can also reduce dissolved oxygen content in the immediate vicinity of the dredging operation, with deeper areas typically having lower dissolved oxygen than surface areas (LaSalle et al. 1991). This impact is generally short-lived due to mixing. Relatively immobile fish larvae or benthic invertebrate prey could be adversely impacted if extended periods of low dissolved oxygen occur.

Adverse impacts on shellfish from turbidity and sedimentation are unlikely, as the dredging activity would be short in duration and would not cover a large area of shellfish habitat. Additionally, increases in turbidity from dredging are generally similar to those that occur during strong storm events and estuarine organisms have adapted to a wide range of turbidities (NOAA Fisheries 2020b).

It is expected that there would be minor, temporary impacts on benthic invertebrate prey within the area of dredging and pile-driving activities as a result of turbidity, sediment deposition, and re-suspension of anoxic sediments. As discussed above, the benthic infaunal community of the Project Area is low in abundance of organisms and diversity of taxa. The community is dominated by opportunistic species, mainly polychaete worms, that can rapidly recolonize disturbed habitat (AECOM 2021). Therefore, it is anticipated that this area would be recolonized within a short period of time after completion of the project. Additionally, water quality conditions would return to a pre-disturbance state once particles disperse in the water column and/or settle to the bottom. Any effects on water quality from construction activities or increases in turbidity would be highly localized and temporary. Because the disturbance of benthic habitat would affect a relatively small amount of the Project Area and given the temporary nature of the disturbance, the Proposed Action is expected to result in negligible reductions in benthic invertebrate populations that may be prey for managed fish species. (NOAA Fisheries 2020b).

The sandy, dredged material is anticipated to settle quickly; however, turbidity control measures, such as turbidity curtains (also referred to as sediment curtains) could be implemented to prevent suspended sediments from exceeding water quality standards beyond the immediate project area. The use of turbidity curtains around the pier construction area and the basin and access channel dredging areas could reduce or eliminate the potential impacts from sediments that may be released at the point of construction. If the use of turbidity curtains is not possible due to current velocities, dredging would be conducted during slack tides (i.e., on the western portion of the channel during flood tides and the eastern portion of the channel during ebb tides.) Thus, the areas of EFH that would be affected by turbidity from the Proposed Action would be minimized, and effects on EFH that may occur in the Project Area would be of short duration.

Noise Impacts

Ambient noise levels would increase near construction and dredging locations. Some fish and invertebrate prey may be directly affected through their avoidance of noise. Abundance of prey species may also be altered temporarily within the Project Area as prey species migrate away from the construction and dredging activities. Noise effects on aquatic species would be temporary and would occur during limited periods while the equipment is being operated. However, impacts would be temporary and confined to EFH in the immediate vicinity of activities in Ballast Narrows and Chincoteague Inlet.

3. Conclusions regarding the effects of the Proposed Action on EFH.
   - Provided in the EFH Assessment Worksheet (**Attachment 1**) and briefly summarized as follows: NASA has determined that potential adverse effects on EFH from the Proposed Action would be minimal and temporary. The overall determination is that adverse effects on EFH would not be substantial.
4. Proposed mitigation measures.
   - In accordance with wetland permitting requirements, wetland mitigation may be required to compensate for impacts to tidal marsh within the footprint of the proposed pier. The summary of wetland impact above describes the areal extent of temporary and permanent wetland impacts and the potential mitigation that may be required.
   - NASA would implement BMPs, described above, to minimize temporary adverse effects, which are briefly summarized as follows:
     - Impacts from sedimentation and erosion would be prevented or minimized through BMPs, which could include turbidity curtains, silt fence, and/or other approved measures to control erosion, turbidity, and sedimentation.
     - If the use of turbidity curtains is not possible, dredging would be conducted during slack tides (i.e., on the western portion of the channel during flood tides and the eastern portion of the channel during ebb tides.)
     - NASA would employ spill prevention measures, as detailed in WFF's *Integrated Contingency Plan* and project-specific Spill Prevention Control and Countermeasure Plan.
     - Revegetation of areas in the salt marsh using onsite excavated plant material disturbed by construction or materials staging, or new sprigging would further minimize potential adverse effects on EFH.

Conclusions

Based on this assessment, NASA has determined that the effects of the Proposed Action on EFH would not be substantial. I certify that we have used the best scientific and commercial data available to complete this assessment and request your concurrence with this determination.

If you have any questions or require additional information, please contact me at Shari.A.Miller@nasa.gov or (757) 824-2327.

Sincerely,

Shari A. Miller
Center NEPA Manager and
Environmental Planning Lead

Enclosures:
Attachment 1: EFH Assessment Worksheet
Attachment 2: Geotechnical Report for MARS Port
Attachment 3: Dredging Estimates Memorandum
Attachment 4: Bathymetry Information
Attachment 5: EFH Mapper and Species List
Attachment 6: Benthic Community Assessment

cc:
250/Ms. K. Finch
250/Mr. T. Meyer
MARAD/Mr. A. Finio
NMFS/Mr. D. O’Brien
NMFS/Mr. B. Hopper
USACE/Mr. S. Bahnson
VCSFA/Mr. A. Brittingham

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ATTACHMENT 1: EFH WORKSHEET

EFH Mapper Report

EFH Data Notice

Essential Fish Habitat (EFH) is defined by textual descriptions contained in the fishery management plans developed by the regional fishery management councils. In most cases mapping data can not fully represent the complexity of the habitats that make up EFH. This report should be used for general interest queries only and should not be interpreted as a definitive evaluation of EFH at this location. A location-specific evaluation of EFH for any official purposes must be performed by a regional expert. Please refer to the following links for the appropriate regional resources.

Greater Atlantic Regional Office
Atlantic Highly Migratory Species Management Division

Query Results

Degrees, Minutes, Seconds: Latitude = 37º 53' 28" N, Longitude = 76º 33' 36" W
Decimal Degrees: Latitude = 37.891, Longitude = -75.440

The query location intersects with spatial data representing EFH and/or HAPCs for the following species/management units.

*** W A R N I N G ***

Please note under "Life Stage(s) Found at Location" the category "ALL" indicates that all life stages of that species share the same map and are designated at the queried location.

EFH

Link	Data Caveats	Species/Management Unit	Lifestage(s) Found at Location	Management Council	FMP
		Atlantic Herring	Adult	New England	Amendment 3 to the Atlantic Herring FMP
		Windowpane Flounder	Adult	New England	Amendment 14 to the Northeast Multispecies FMP
		Winter Skate	Adult Juvenile	New England	Amendment 2 to the Northeast Skate Complex FMP
		Clearnose Skate	Adult Juvenile	New England	Amendment 2 to the Northeast Skate Complex FMP
		Sandbar Shark	Juvenile Neonate	Secretarial	Amendment 10 to the 2006 Consolidated HMS FMP: EFH
		Smoothhound Shark Complex (Atlantic Stock)	ALL	Secretarial	Amendment 10 to the 2006 Consolidated HMS FMP: EFH
		Sand Tiger Shark	Neonate/Juvenile Adult	Secretarial	Amendment 10 to the 2006 Consolidated HMS FMP: EFH
		Bluefish	Adult Juvenile	Mid-Atlantic	Bluefish
		Atlantic Butterfish	Adult Juvenile	Mid-Atlantic	Atlantic Mackerel, Squid,& Butterfish Amendment 11
		Summer Flounder	Juvenile Adult	Mid-Atlantic	Summer Flounder, Scup, Black Sea Bass
		Black Sea Bass	Juvenile Adult	Mid-Atlantic	Summer Flounder, Scup, Black Sea Bass

Salmon EFH

No Pacific Salmon Essential Fish Habitat (EFH) were identified at the report location.

HAPCs

Link	Data Caveats	HAPC Name	Management Council

Link	Data Caveats	HAPC Name	Management Council
⚠	?	Summer Flounder	Mid-Atlantic

EFH Areas Protected from Fishing

No EFH Areas Protected from Fishing (EFHA) were identified at the report location.

Spatial data does not currently exist for all the managed species in this area. The following is a list of species or management units for which there is no spatial data. ****For links to all EFH text descriptions see the complete data inventory: open data inventory -->**
All spatial data is currently available for the Mid-Atlantic and New England councils, **Secretarial EFH**, Bigeye Sand Tiger Shark, Bigeye Sixgill Shark, Caribbean Sharpnose Shark, Galapagos Shark, Narrowtooth Shark, Sevengill Shark, Sixgill Shark, Smooth Hammerhead Shark, Smalltail Shark

EFH Mapper Report

EFH Data Notice

Essential Fish Habitat (EFH) is defined by textual descriptions contained in the fishery management plans developed by the regional fishery management councils. In most cases mapping data can not fully represent the complexity of the habitats that make up EFH. This report should be used for general interest queries only and should not be interpreted as a definitive evaluation of EFH at this location. A location-specific evaluation of EFH for any official purposes must be performed by a regional expert. Please refer to the following links for the appropriate regional resources.

Greater Atlantic Regional Office
Atlantic Highly Migratory Species Management Division

Query Results

Degrees, Minutes, Seconds: Latitude = 37º 52' 55" N, Longitude = 76º 33' 38" W
Decimal Degrees: Latitude = 37.882, Longitude = -75.439

The query location intersects with spatial data representing EFH and/or HAPCs for the following species/management units.

***** W A R N I N G *****

Please note under "Life Stage(s) Found at Location" the category "ALL" indicates that all life stages of that species share the same map and are designated at the queried location.

EFH

Link	Data Caveats	Species/Management Unit	Lifestage(s) Found at Location	Management Council	FMP
		Atlantic Herring	Adult	New England	Amendment 3 to the Atlantic Herring FMP
		Windowpane Flounder	Adult	New England	Amendment 14 to the Northeast Multispecies FMP
		Winter Skate	Adult Juvenile	New England	Amendment 2 to the Northeast Skate Complex FMP
		Clearnose Skate	Adult Juvenile	New England	Amendment 2 to the Northeast Skate Complex FMP
		Bluefish	Adult Juvenile	Mid-Atlantic	Bluefish
		Atlantic Butterfish	Adult	Mid-Atlantic	Atlantic Mackerel, Squid,& Butterfish Amendment 11
		Summer Flounder	Juvenile Adult	Mid-Atlantic	Summer Flounder, Scup, Black Sea Bass
		Black Sea Bass	Juvenile Adult	Mid-Atlantic	Summer Flounder, Scup, Black Sea Bass

Salmon EFH

No Pacific Salmon Essential Fish Habitat (EFH) were identified at the report location.

HAPCs

No Habitat Areas of Particular Concern (HAPC) were identified at the report location.

EFH Areas Protected from Fishing

No EFH Areas Protected from Fishing (EFHA) were identified at the report location.

Spatial data does not currently exist for all the managed species in this area. The following is a list of species or management units for which there is no spatial data. ****For links to all EFH text descriptions see the complete data inventory: open data inventory -->**
All spatial data is currently available for the Mid-Atlantic and New England councils, **Secretarial EFH**, Bigeye Sand Tiger Shark, Bigeye Sixgill Shark, Caribbean Sharpnose Shark, Galapagos Shark, Narrowtooth Shark, Sevengill Shark, Sixgill Shark, Smooth Hammerhead Shark, Smalltail Shark

ATTACHMENT 2: GEOTECHNICAL REPORT

JOHN D. HYNES & ASSOCIATES, INC.

Geotechnical and Environmental Consultants
Monitoring Well Installation
Construction Inspection and Materials Testing

March 31, 2021

William A. Murchison
Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland 21237

Re: Report of Subsurface Exploration and Geotechnical Consulting Services
Wallops Island M95 Intermodal Barge Service Project
Wallops Island, Virginia
Project No.: JDH-10/20/145

Dear Mr. Murchison:

John D. Hynes & Associates, Inc. has completed the authorized subsurface exploration and geotechnical engineering evaluations for the proposed Wallops Island M95 Intermodal Barge Service project located in Wallops Island, Virginia. Our services were performed, generally, in accordance with our contract dated September 12, 2019.

This report describes the exploration methods employed, exhibits the data obtained, and presents our evaluations and recommendations with regard to dock pile foundations. The report includes a discussion of the field work, the soil and groundwater conditions encountered during the exploration for the dredging and deepening of the proposed Wallops channel and turning basin and the construction of barge deck. The barge deck is to be supported on deck pier bents and pier bents are supported on pier bent pile foundations. We provide recommendations for vertical and battered piles for pier bent pile foundations for the proposed Wallops Island M95 Intermodal Barge Service project.

We appreciate the opportunity to be of service to you. If you have any questions regarding the contents of this report or if we may be of further assistance, please contact our office.

Respectfully,
JOHN D. HYNES & ASSOCIATES, INC.

Duowen Ding
Project Engineer

John D. Hynes, P.E.
President

DD: JDH/jsl

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Email: jdh@jdhynesinc.com

HYNES

REPORT OF SUBSURFACE EXPLORATION AND GEOTECHNICAL CONSULTING SERVICES

WALLOPS ISLAND M95 INTERMODAL BARGE SERVICE PROJECT
WALLOPS ISLAND, VIRGINIA

PREPARED FOR
GAHAGAN & BRYANT ASSOCIATES, INC.

MARCH 31, 2021
PROJECT NO.: JDH-10/20/145

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PURPOSE AND SCOPE

The subsurface exploration study was performed to evaluate the subsurface conditions with respect to the following:

1. Soil and groundwater conditions encountered at the site;
2. Channel deepening and dredging;
3. Pier bent pile foundation capacities and installation depths;
4. Pile foundation construction and inspection procedures;
5. Location of groundwater and Chincoteague Bay water; and
6. Other aspects of the design and construction for the proposed structures indicated by the exploration.

An evaluation of the site is included. The inspection is considered necessary both to confirm the subsurface conditions and to verify that the soils related construction phases are performed properly.

EXISTING SITE CONDITIONS

As shown on the Project Location Map (Drawing JDH-10/20/145-A) in the Appendix, the project site is located at the Wallops Island, Virginia. The site includes an on land side area, a marsh area and a water side (mud and overdredge) area. The on land side area is beyond the end of the pavement/runway at the edge of the marsh. The marsh area is generally surrounded by the runway and Chincoteague Bay water. The water side area is along the water channel and turning basin in the Chincoteague Bay. The site includes on land side, marsh, water side areas and is generally along the shoreline of Chincoteague Bay water and Wallops Island.

PROJECT CHARACTERISTICS

Proposed for development on the site is the construction of Wallops Island M95 Intermodal barge service waterfront facilities. Hynes & Associates evaluated the site for the deck foundations. The deck will be supported on bents which are, in turn, supported on pile foundations. Based on information provided by the WBCM, LLC, we understand that the maximum compression load of 140 tons and the maximum uplift load of 90 tons will be considered in the pile analyses. Piles considered for support are 24 inches square prestressed concrete piles and 20 inches square prestressed concrete piles. We understand that the Phase 1 mudline depth at Boring P-3 is -10.3 NAVD88. The Phase 3 mudline depth at Boring P-5 is -13.3 NAVD88. We have evaluated 24 inch and 20 inch square vertical and battered piles to support the pier bent deck. We will provide recommendations for alternative foundations, upon request.

FIELD EXPLORATION AND STUDY

In order to determine the nature of the subsurface conditions at the site, sixteen (16) test borings, designated as L-1, P-1 through P-5, D-2, D-4, D-6, D-9, D-11, D-13, D-15, E-2, E-4, and E-7, were drilled on November 13, 2020 to January 5, 2021, at the approximate locations shown on the Exploration Location Plan (Drawing JDH-10/20/145-B) in the Appendix. Land test boring L-1 was drilled to a depth of 90.5 feet below existing grade. Pier test borings P-1 through P-5 were drilled to depths of 90.5 to 120.5 feet below existing grade. Channel deepening test borings D-2, D-4, D-6, D-9, D-11, D-13, and D-15 were drilled to depths of 4 to 18 feet below existing grade. Dredging test borings E-2, E-4 and E-7 were drilled to depths of 8 feet below existing grade. The test borings were drilled using track-mounted Geoprobe 3230 and 7822 DT drill rigs, and a Mobile B-47 HD drill rig.

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Soil sampling and testing were carried out in accordance with ASTM Specification D-1586. A brief description of the field procedures is included in the Appendix. The results of all boring and sampling operations are shown on the boring log in the Appendix.

Samples of the subsurface soils were examined by our engineering staff and were visually classified in accordance with the Unified Soil Classification System (USCS) and ASTM Specification D-2488. The estimated USCS symbols appear on the boring log and a key to the system nomenclature is provided in the Appendix of this report. Also included are reference sheets which define the terms and symbols used on the boring log and explain the Standard Penetration Test procedures.

We note that the test boring records represent our interpretation of the field data based on visual examination and selected soil classification tests. Indicated interfaces between materials may be gradual.

The field exploration data was supplemented with laboratory testing data. The laboratory at John D. Hynes & Associates, Inc. performed six (6) moisture content tests, fourteen (14) particle size distribution tests including ten (10) hydrometer tests, and eleven (11) Atterberg limits test. The test results are presented in a table in the Appendix.

We collected two Shelby tubes in a soft cohesive soil layers. A third Shelby Tube was attempted at 32 to 34 feet in Boring P-4. The sampling retrieved in no recovery. Two tube samples was sent to EBA Engineering in Laurel, Maryland for unconfined compressive strength testing, unit weight determination, moisture content testing, and Atterberg Limits testing. The samples were taken at 22 to 24 in Boring L-1 and 42 to 44 in Boring P-5. The Shelby tube sample L-1 from Boring L-1 at depths 22 to 24 feet was very soft and could not stand properly to be tested. So, EBA could not perform UU-triaxial test on the Shelby tube sample L-1. EBA performed the other tests on the Shelby tube sample L-1 except the UU-triaxial test. Shelby tube test results and sample identifications, locations and depths are included in the Appendix. The EBA Engineering data sheets are included in the Appendix.

Six pressuremeter tests were performed by In-Situ Soil Testing, L.C. in the field at locations P-2 and P-2A. The test at 12.9 feet at B-2 was rerun at B-2A at 14 feet because the data was in question. The data was verified. The results of this testing are included in the Appendix of this report.

SUBSURFACE CONDITIONS

At the time of our field work, 6 inches of organic bearing soil was encountered at the ground surface at the boring location L-1. Sediments were encountered at the other boring locations. Varying thicknesses of organic bearing soils or other surficial materials in varying thicknesses may be encountered at other locations on site.

The soils encountered were visually classified in accordance with the USCS and consisted of interbedded layers of SAND (SP and SP-SM), Silty SAND (SM), Clayey SILT (ML and ML-MH), Clayey Elastic SILT (MH), Clayey Organic SILT (MH-OH), CLAY and SAND (CL-SC), CLAY (CL), Silty CLAY and Fat CLAY (CL-CH), and Silty Fat CLAY (CH) to the boring termination depths. Standard Penetration Test (SPT) values (N-values) in the sand layers ranged from 2 to 47 blows per foot, indicating in-place relative densities of very loose to dense. The SPT values in the cohesive soil layers ranged from 3 to more than 91 blows per foot, indicating in-place consistencies of very soft to hard.

Groundwater was encountered at depths of 3 feet below the ground surface during drilling operations at Boring L-1. Groundwater elevations may vary at other times during the year depending upon the amount of local precipitation, tidal fluctuations in the Chincoteague Bay at boring L-1. The water level in the Bay was at grade in boring P-1 at the

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time the boring was drilled. Water depths varied from 2.25 feet to 16 feet in the other test borings that were drilled from a barge.

RECOMMENDATIONS

The following recommendations and considerations are based on our understanding of the proposed construction, the data obtained from the exploration, and our previous experience with similar subsurface conditions and projects. If there are any significant changes to the project characteristics, such as structural loadings differing significantly from those noted above, structure geometry, structure location, foundation type, elevations, etc., we request that this office be advised so the recommendations of this report can be re-evaluated.

A. Turning Basin and Channel Deepening and Dredging

Deepening and dredging for the construction of the proposed channel and turning basin will be required. Based on boring information, it is anticipated that the depth of deepening and dredging in earth materials will likely be up to 8 to 18 feet deep. The materials that will be encountered in the deepening and dredging include SAND (SP and SP-SM), and CLAY and SAND (CL-SC) materials. Standard Penetration Test (SPT) values (N-values) in the sand layers ranged from 3 to 37 blows per foot, indicating in-place relative densities of very loose to dense. It is anticipated that earth deepening and dredging can generally be performed using conventional deepening and dredging equipment in proper working condition.

B. Driven Prestressed Concrete Piles

Based on the proposed loads and subsurface soil conditions at the site, we recommend supporting the deck pier bents on prestressed concrete pile foundations. Hynes & Associates' pile recommendations are based upon local site characteristics, the subsurface soil parameters determined from the field exploration, pressuremeter test results and the physical characteristics of the piles. We provide recommendations for 24 inch square and 20 inch square prestressed concrete piles. Assuming conformance to the embedment requirements, the assigned pile capacities may be used by the Structural Engineer for pile spacing according to the structure design and the loads to be applied. Total elastic settlement of the piles is anticipated to be less than ½ inch. Considering the subsurface soil characteristics and the parameters used in our assignment of pile embedments, long term settlement of the pile foundations is expected to be minimal if the recommendations of this report are followed. The pile properties are shown in the Appendix (Drawing JDH-10/20/145-D. We understand that the Phase 1 mudline depth at Boring P-3 is -10.3 NAVD88. The Phase 3 mudline depth at Boring P-5 is -13.3 NAVD88.

Based upon the above, we will provide pile embedments and allowable capacities of prestressed concrete piles with square sections, dimensions of 24 in. by 24 in. and 20 in. by 20 in. the land side area, marsh and water areas. The pile capacities will be presented in a supplement to this report.

The compression design capacity of each prestressed concrete pile production pile should be confirmed by the geotechnical engineer or an experienced pile inspector during the pile driving operations by using an acceptable pile driving formula such as the Engineering News Formula. In instances where the design capacity cannot be obtained within the production pile lengths, additional piles would be required.

The characteristics of the prestressed concrete pile groups should be designed for adequate structural requirements as specified by the Structural Engineer. These requirements should include the strengh of the piles under static, dynamic, uplift and lateral loads, where applicable.

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The installation of all piles should be in accordance with local code requirements. In addition, the installation of all piles should be inspected by a qualified Geotechnical Engineer or foundation inspector. The inspector should verify and record all aspects of the installation including pile sizes, pile length before driving, cut-off length, tip installation depth and the driving data.

We recommend that at least one pile load test be performed for each capacity of vertical pile at locations as decided by the Structural and Geotechnical Engineers. The pile load test should be in accordance with ASTM D-1143 Standard Test Method for Piles Under Static Axial Compressive Load. The piles should be loaded to 200 percent of the design load. The load tests should be required to verify the capacity of the piles at the selected embedment depth and capacity. As an alternative, Dynamic Pile Load testing may be performed.

ADDITIONAL SERVICES RECOMMENDED

Additional engineering, testing and consulting services recommended for this project are summarized below.

Driven Pile Inspections

The Geotechnical Engineer should verify all driven length embedments. The geotechnical engineer or experienced foundation inspector should verify and record all aspects of installation including pile dimensions, pile length, tip elevation, top elevation and the driving data. The inspecting engineer should verify that the driving data indicates that the design compression, uplift, and lateral capacity of each pile had been achieved.

REMARKS

This report has been prepared solely and exclusively for Gahagan & Bryant Associates, Inc. to provide guidance to design professionals in developing facilities plans for the proposed Wallops Island M95 Intermodal Barge Service Project located in Wallops Island, Virginia. It has not been developed to meet the needs of others, and application of this report for other than its intended purpose could result in substantial difficulties. The Consulting Engineer cannot be held accountable for any problems which occur due to the application of this report to other than its intended purpose.

These analyses and recommendations are, of necessity, based on the concepts made available to us at the time of the writing of this report, and on-site conditions, surface and subsurface that existed at the time the exploratory borings were drilled. Further assumption has been made that the limited exploratory borings, in relation both to the areal extent of the site and to depth, are representative of conditions across the site. It is also recommended that we be given the opportunity to review all plans for the project in order to comment on the interaction of soil conditions as described herein and the design requirements.

Our professional services have been performed, our findings obtained and our recommendations prepared in accordance with generally accepted engineering principles and practices.

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HYNES

APPENDIX

1. Investigative Procedures
2. Project Location Map
3. Boring Location Plan
4. Proposed Pier Plan and Elevation
5. Pile Properties Sketch
6. Boring Logs
7. Hynes & Associates: Grain Size Distribution Graphs
8. EBA: Soil Testing
9. Pressuremeter Test Results
10. Unified Soil Classification Sheet
11. Field Classification Sheet
12. Important Information Sheet

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INVESTIGATIVE PROCEDURES

SOIL TEST BORINGS

Soil drilling and sampling operations were performed in accordance with ASTM Specification D-1586. The borings were advanced by mechanically turning continuous hollow stem auger flights into the ground. At regular intervals, samples were obtained with a standard 1.4 inch I.D., 2.0 inch O.D. splitspoon sampler. The sampler was first seated 6 inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot is the "Standard Penetration Resistance". The penetration resistance, when properly evaluated, is an index to the soil's strength, density and behavior under applied loads. The soil descriptions and penetration resistances for each boring are presented on the Test Boring Records in the Appendix.

SOIL CLASSIFICATION

Soil classifications provide a general guide to the engineering properties of various soil types and enable the engineer to apply his past experience to current problems. In our investigation, jar samples obtained during drilling operations are examined in our laboratory and visually classified by the geotechnical engineer in accordance with ASTM Specification D-2488. The soils are classified according to the Unified Classification System (ASTM D-2487). Each of these classification systems and the in-place physical soil properties provides an index for estimating the soil's behavior.

SIEVE ANALYSIS

Gradational analysis tests were performed to determine the particle size and distribution of the samples tested. The grain size distribution of soils coarser than a No. 200 sieve is determined by passing the sample through a standard set of nested sieves. The percentage of materials passing the No. 200 sieve is determined by washing the material over a No. 200 sieve. These tests are in accordance with ASTM D-421, D-422 and D-1140. The results are presented in the Appendix to our report.

NATURAL MOISTURE

Portions from representative soil samples obtained during drilling operations were selected for Natural Moisture Content tests. The Natural Moisture Content Test determines the water content of soils by drying into an oven with a standard drying temperature of 110°C. The lost of mass drying the sample, determines the water content into the soil. The water content of the sample is calculated in percentage. The water content of soils (natural moisture) is determined in accordance with ASTM Specification D-2216.

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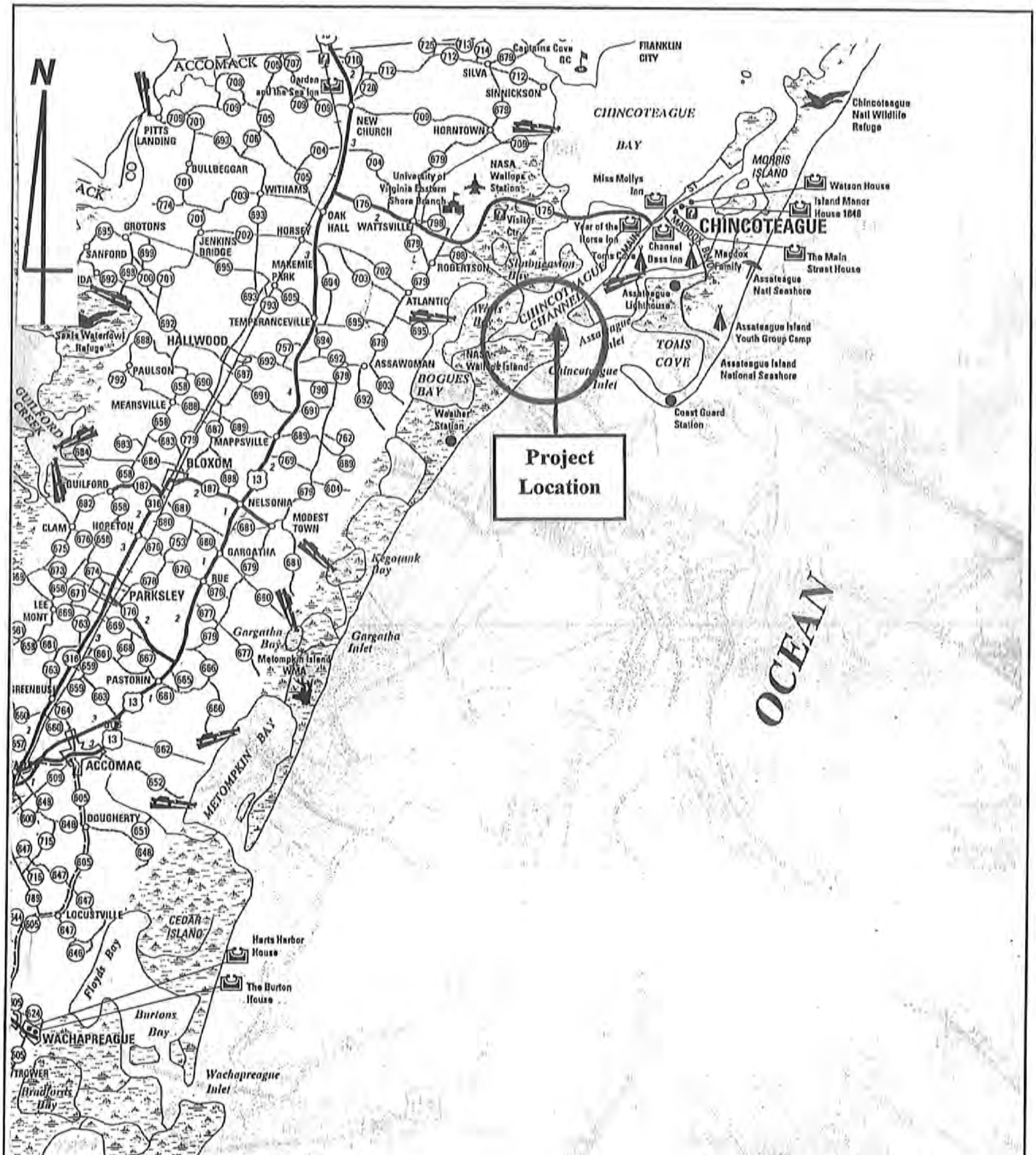

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Project Location Map Wallops Island M95 Intermodal Barge Wallops Island, Virginia	Date: November 25, 2020 Scale: 1 in. = 2,000 ft. Drawn: ADC Map DWG. No. JDH-10/20/145-A

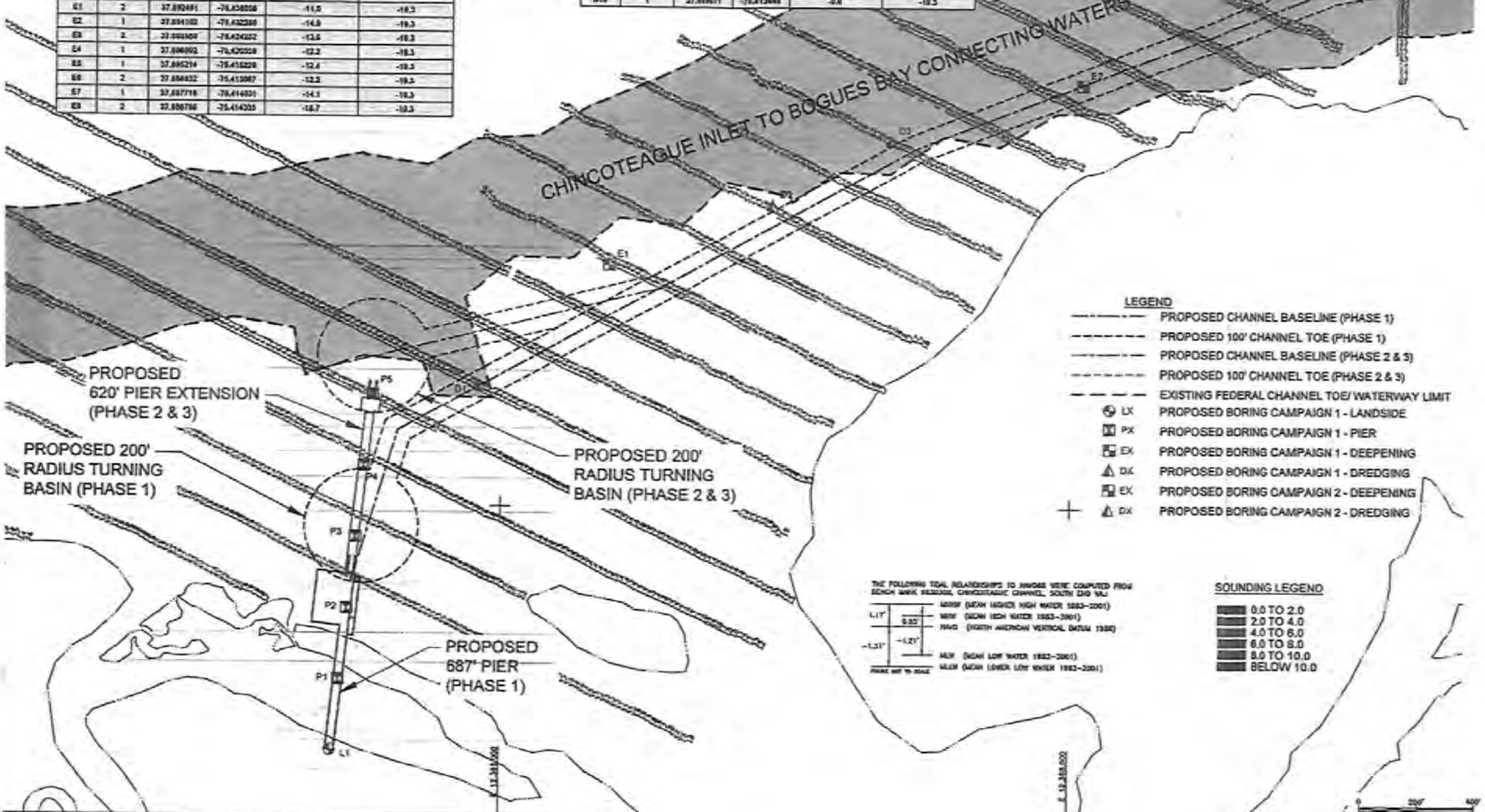
PIER BORINGS

NAME	CAMPAIGN	LATITUDE	LONGITUDE	GROUND SURFACE ELEVATION (NAVD88)	BORING DEPTH ELEVATION (NAVD88)
P1	1	37.888559	-75.441494	NO DATA	-91.3
P2	1	37.889044	-75.441367	NO DATA	-91.3
P3	1	37.889535	-75.441239	-2.6	-91.3
P4	1	37.890565	-75.441132	-3.3	-91.3
P5	1	37.891301	-75.440964	-7.8	-91.3

DEEPENING BORINGS

NAME	CAMPAIGN	LATITUDE	LONGITUDE	GROUND SURFACE ELEVATION (NAVD88)	BORING DEPTH ELEVATION (NAVD88)
E1	2	37.892491	-75.436058	-11.5	-19.3
E2	1	37.894102	-75.432289	-14.9	-19.3
E3	2	37.895509	-75.424252	-13.6	-19.3
E4	1	37.896092	-75.420328	-12.2	-19.3
E5	1	37.895214	-75.415228	-12.4	-19.3
E6	2	37.886432	-75.413067	-12.3	-19.3
E7	1	37.887718	-75.414031	-14.1	-19.3
E8	2	37.886786	-75.414333	-18.7	-19.3

D3	2	37.895600	-75.434930	-9.6	-19.3
D4	1	37.894680	-75.432290	-15.5	-19.3
D5	2	37.894053	-75.419938	-10.7	-19.3
D6	1	37.889674	-75.417999	-8.3	-19.3
D7	2	37.889426	-75.416695	-10.1	-19.3
D8	2	37.894618	-75.414632	-12.0	-19.3
D9	1	37.893874	-75.413605	-8.4	-19.3
D10	2	37.893099	-75.413131	-8.2	-19.3
D11	1	37.892145	-75.412361	-8.2	-19.3
D12	2	37.891526	-75.413013	-4.6	-19.3
D13	1	37.890897	-75.412812	-5.9	-19.3
D14	2	37.890287	-75.413370	-7.2	-19.3
D15	1	37.889511	-75.413444	-9.6	-19.3



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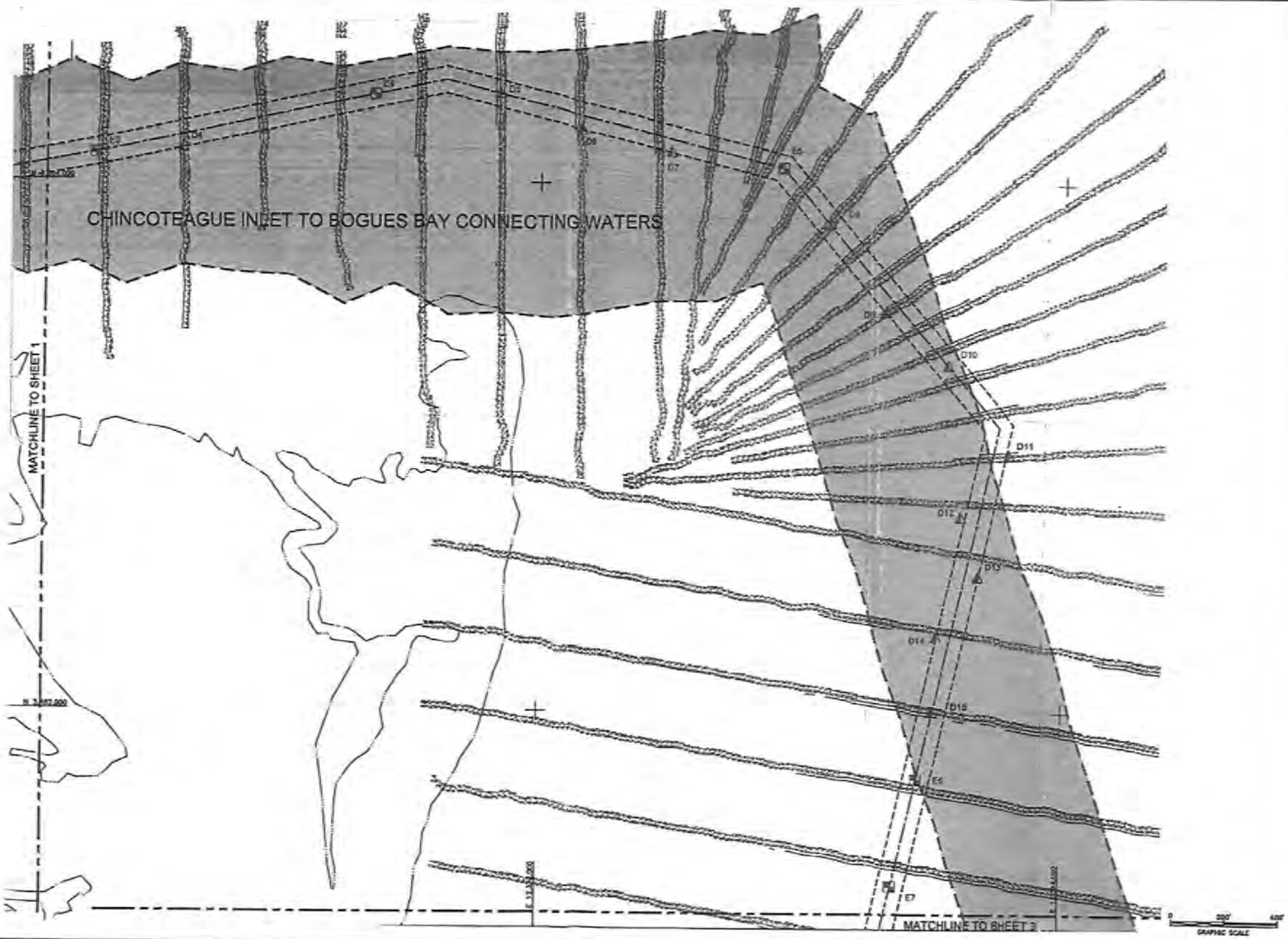
Boring Location Plan
Wallops Island M95 Intermodal Barge
Wallops Island, Virginia

Date: January 18, 2021	
Scale: As Shown	
Drawn: GBA Engineering	
DWG. No. JDH-10/20/145-B-1	



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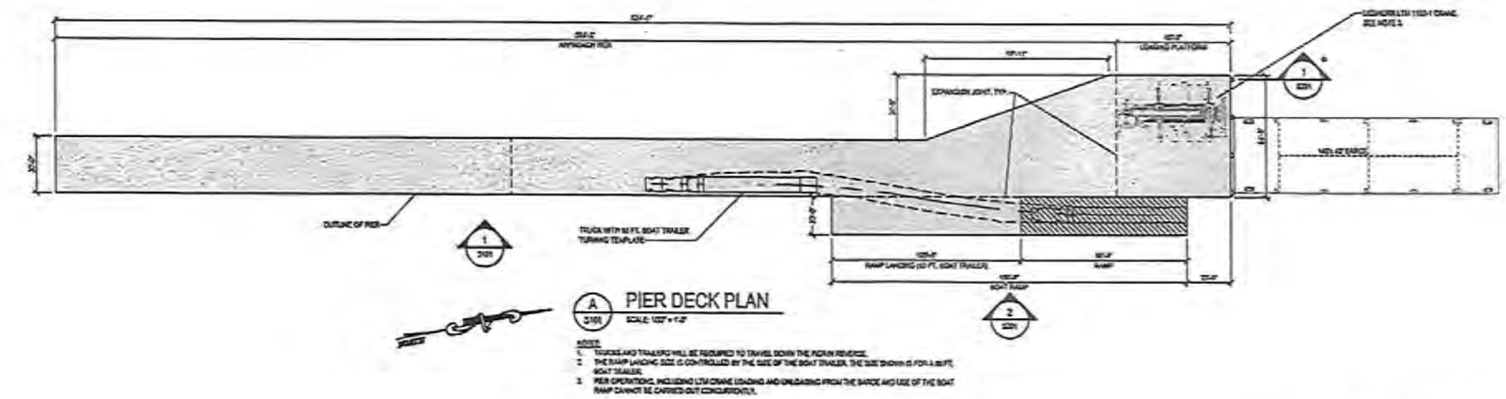
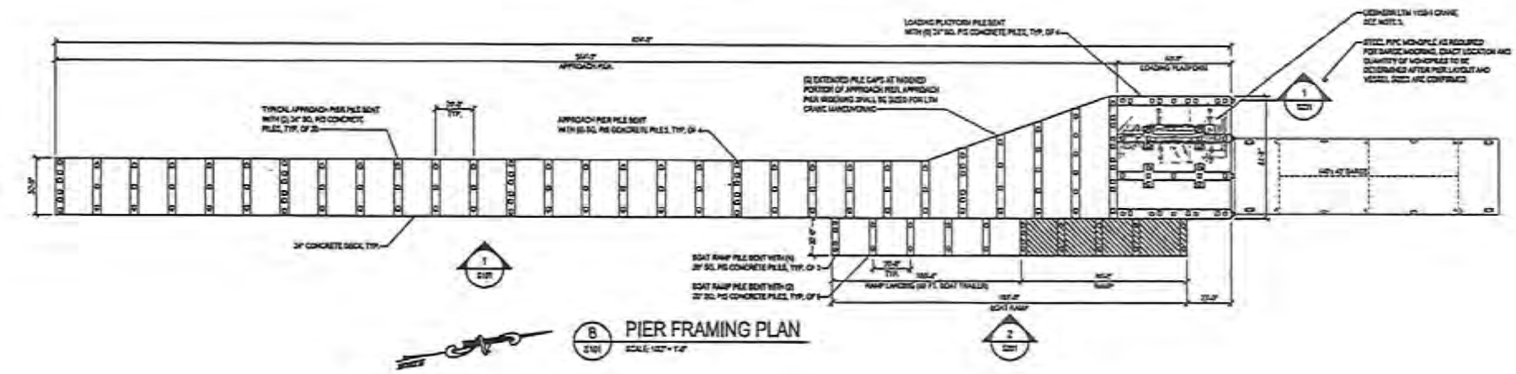
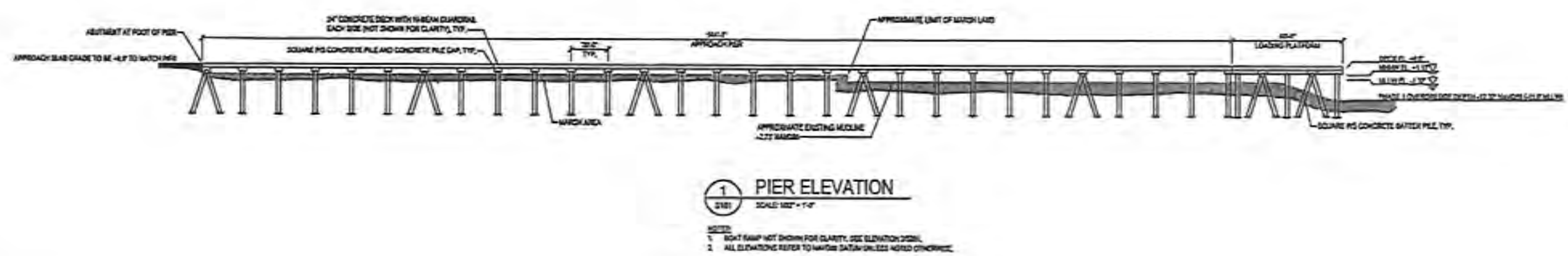
Boring Location Plan
Wallops Island M95 Intermodal Barge
Wallops Island, Virginia

Date: January 18, 2021
Scale: As Shown
Drawn: GBA Engineering
DWG. No. JDH-10/20/145-B-2







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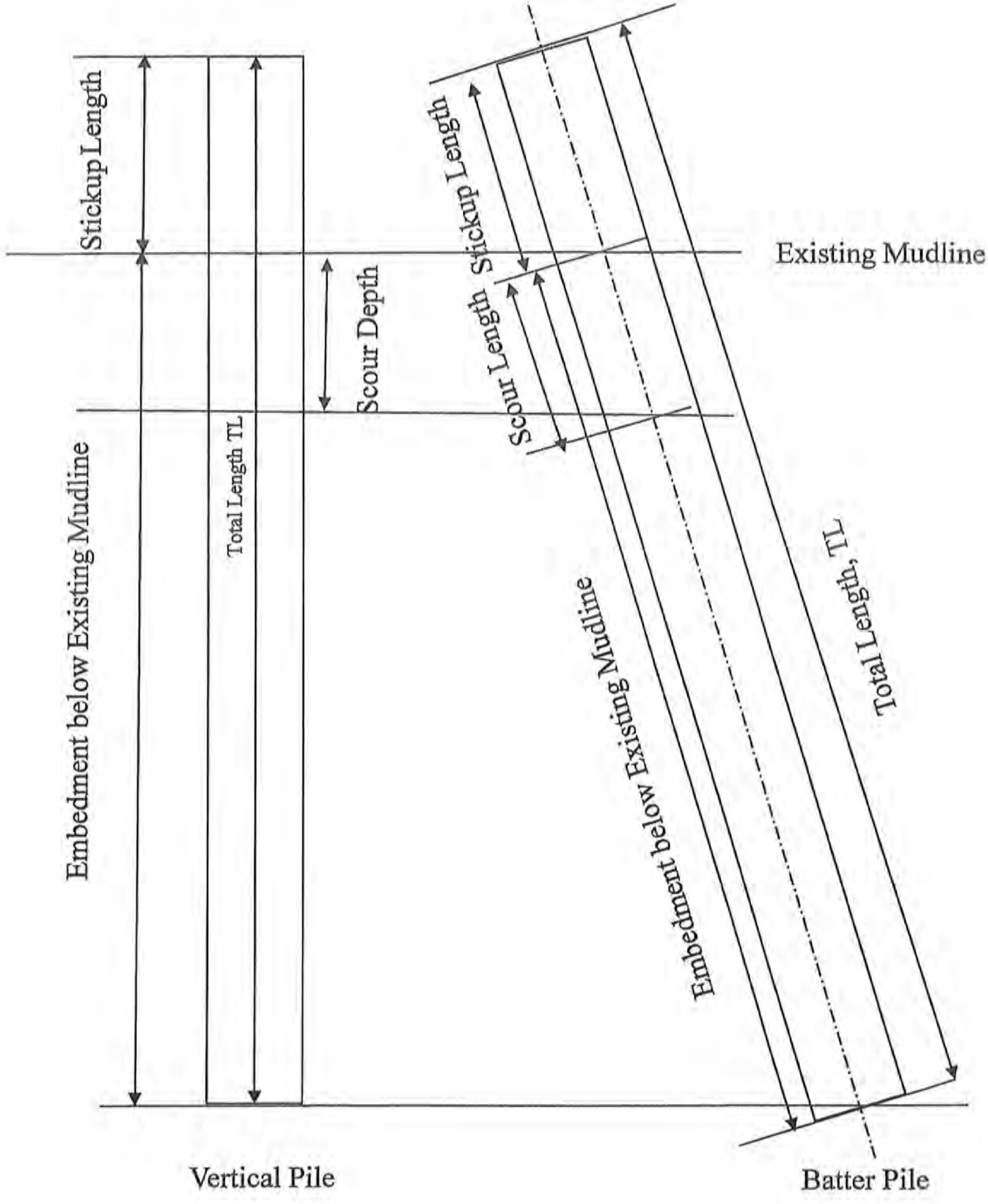
Proposed Pier Plan and Elevation
Wallops Island M95 Intermodal Barge
Wallops Island, Virginia

Date: March 10, 2021	
Scale: As Shown	
Drawn: GBA Engineering	
DWG. No. JDH-10/20/145-C	



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Pile Properties Wallops Island M95 Intermodal Barge Service Project Wallops Island, Virginia	Date: March 10, 2021 Scale: N/A Drawn: DD DWG. No. JDH-10/20/145-D

HYNES & ASSOCIATES

LOG OF BORING L-1

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed:	: November 13, 2020
Logged By:	: J. Lindsey
Drilled By:	: B. Hynes
Drilling Method:	: HSA (Geoprobe 3230 DT)
Total Depth:	: 90.5 feet

Depth in Feet	Surf. Elev. 4.40	DESCRIPTION	USCS	Sample No.	Blows per 6 inches	Pocket Penetrometer Readings (tons/sq./ft.)
0	4.4	Brown, wet, very loose, fine to medium SAND, with trace silt	SP	1	1-1-2-2	
2	2.4	Dark brown, wet to saturated, very soft, clayey organic SILT, with trace fine sand	MH-OH	2	1-2-1	0.0
4	.4					
6	-1.6			3	1-1-2	
8	-3.6	Gray, saturated, loose to very loose, fine to medium SAND, with trace silt	SP	4	2-4-2	
10	-5.6					
12	-7.6					
14	-9.6			5	1-1-1	
16	-11.6					
17		Gray, saturated, very loose, fine to medium SAND, with some silt, trace to little clay	SM			
18	-13.6					
20	-15.6			6	1-2-1	
22	-17.6					
24	-19.6			7	1-2-2	
26	-21.6					
27		Gray, saturated, very soft, clayey SILT, with trace fine sand, trace organic silt	CH			
28	-23.6					
30	-25.6			8	WOH/18"	
32	-27.6	Gray, saturated, medium stiff to stiff, silty CLAY	CH			
34	-29.6			9	4-5-5	2.0
36	-31.6					
38	-33.6					
40	-35.6			10	3-6-6	2.0
42	-37.6	Brown, saturated, soft, clayey SILT, with trace fine sand	ML			
44	-39.6			11	1-2-2	1.5
46	-41.6					
47		Gray, saturated, very loose, fine to medium SAND, with little silt, trace clay, trace shell fragments	SM			
48	-43.6					
50				12	1-1-2	

REMARKS

Scale 1" ~ 7.4 feet

Approximately 6 inches of organic bearing soil was encountered at the ground surface.

Shelby Tube sample was pushed from 22 to 24 feet.

Groundwater was encountered at 3 feet during drilling operations.

Laboratory Test Results

Sample No. 3
From 6 to 7.5 feet

Natural Moisture = 36.3%

Sample No. 6
From 19 to 20.5 feet

Sieve Analysis

Sieve Size	Passing %
3/8"	100
No. 4	99.1
No. 10	98.5
No. 20	97.9
No. 40	97.4
No. 60	96.1
No. 100	63.8
No. 200	30.1
USCS:	SM

Natural Moisture = 25.1%

Sample No. 8
From 29 to 30.5 feet

Atterberg Limits

Liquid Limit = 57
Plasticity Index = 24
USCS: CH
Natural Moisture = 51.3%

NAD 83 VA State Plane South
Easting: 12365404
Northing: 3861122

HYNES & ASSOCIATES

LOG OF BORING L-1

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed: : November 13, 2020
Logged By: : J. Lindsey
Drilled By: : B. Hynes
Drilling Method: : HSA (Geoprobe 3230 DT)
Total Depth: : 90.5 feet

Depth in Feet	Surf. Elev. 4.40	DESCRIPTION	GRAPHIC	USCS	Sample No.	Blows per 6 inches	Pocket Penetrometer Readings (tons/sq./ft.)	REMARKS
50	-45.6	Gray, saturated, very loose, fine to medium SAND, with little silt, trace clay, trace shell fragments		SM	12	1-1-2		The tidal relationship MLLW = -1.31' NAVD88 was determined at NOAA Station 8630308, Chincoteague Channel, South End, VA for the 1983-2001 Epoch.
52	-47.6							
54	-49.6	Gray, saturated, medium stiff, clayey SILT, with little fine sand, trace shell fragments		ML	13	1-2-4		
56	-51.6							
58	-53.6							
60	-55.6				14	1-2-6		
62	-57.6	Gray, saturated, medium stiff to stiff, clayey SILT, with little fine sand, trace shell fragments		MH				
64	-59.6				15	1-2-4		
66	-61.6							
68	-63.6							
70	-65.6				16	2-4-4		
72	-67.6							
74	-69.6				17	2-4-7		
76	-71.6							
78	-73.6	Gray, saturated, medium dense, fine to medium SAND, with little silt, trace shell fragments		SM				
80	-75.6				18	6-9-12		
82	-77.6	Gray, saturated, dense, fine to medium SAND, with trace to little silt		SP-SM				
84	-79.6				19	8-18-23		
86	-81.6							
88	-83.6							
90	-85.6	Boring terminated at 90.5 feet.			20	9-16-24		
92	-87.6							
94	-89.6							
96	-91.6							
98	-93.6							
100								

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HYNES & ASSOCIATES

LOG OF BORING P-1

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed: : November 24, 2020
Logged By: : A. Kus
Drilled By: : M. Hynes
Drilling Method: : HSA (Geoprobe 7822 DT)
Total Depth: : 90.5 feet

Depth in Feet	Surf. Elev. -0.40
0	-.4
2	-2.4
4	-4.4
6	-6.4
8	-8.4
10	-10.4
12	-12.4
14	-14.4
16	-16.4
18	-18.4
20	-20.4
22	-22.4
24	-24.4
26	-26.4
28	-28.4
30	-30.4
32	-32.4
34	-34.4
36	-36.4
38	-38.4
40	-40.4
42	-42.4
44	-44.4
46	-46.4
48	-48.4
50	

DESCRIPTION	GRAPHIC	USCS	Sample No.	Blows per 6 inches
Gray, saturated, organic SILT, with trace fine to medium sand, trace clay		OL	1	HA
Gray, saturated, medium dense, fine to medium SAND, with trace silt		SP	2	4-6-5
Gray, saturated, medium dense, fine to medium SAND, with trace organic silt		SP	3	3-6-6
Gray, saturated, loose, fine to medium SAND, with trace organic silt		SP	4	2-3-3
Gray, saturated, very loose, fine to medium SAND, with little silt, trace organic silt		SM	5	1-2-1
Gray, saturated, very soft, SILT, with little fine to medium sand, trace clay		ML	6	1-1-2
Gray, saturated, medium dense, fine to medium SAND, with trace silt		SP	7	2-5-6
			8	3-5-8
Gray, saturated, loose to medium dense, fine to medium SAND, with trace silt		SP	9	3-4-4
			10	3-5-7
			11	3-6-10
Gray, saturated, medium dense to dense, fine to medium SAND, with little to trace silt		SM	12	17-19-20

REMARKS

Scale 1" ~ 7.4 feet

No organic bearing soil was encountered at the ground surface.

Groundwater was not encountered during drilling operations.

Laboratory Test Results

Sample No. 2
From 3 to 4.5 feet

Natural Moisture = 25.6%

Sample No. 12
From 49 to 50.5 feet

Sieve Analysis

Sieve Size	Passing %
No. 10	100
No. 20	99.9
No. 40	99.5
No. 60	93.6
No. 100	42.2
No. 200	12.6
USCS:	SM

Natural Moisture = 23.7%

Sample No. 17
From 74 to 75.5 feet

Natural Moisture = 55.7%

NAD 83 VA State Plane South
Easting: 12365439
Northing: 3861379

The tidal relationship MLLW = -1.31' NAVD88 was determined at NOAA Station 8630308, Chincoteague Channel, South End, VA for the 1983-2001 Epoch.

HYNES & ASSOCIATES

LOG OF BORING P-1

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed: : November 24, 2020
Logged By: : A. Kus
Drilled By: : M. Hynes
Drilling Method: : HSA (Geoprobe 7822 DT)
Total Depth: : 90.5 feet

Depth in Feet	Surf. Elev. -0.40	DESCRIPTION	GRAPHIC	USCS	Sample No.	Blows per 6 inches	REMARKS
50	-50.4	Gray, saturated, medium dense to dense, fine to medium SAND, with little to trace silt		SP-SM	12	17-19-20	
52	-52.4						
54	-54.4				13	6-8-11	
56	-56.4						
58	-58.4						
60	-60.4				14	5-6-8	
62	-62.4						
64	-64.4				15	15-17-19	
66	-66.4						
68	-68.4						
70	-70.4				16	12-18-24	
72	-72.4	Gray, saturated, very dense, fine to medium SAND, with little to trace silt		SP-SM			
74	-74.4				17	20-24-27	
76	-76.4						
78	-78.4	Gray, saturated, dense, fine to medium SAND, with little to trace silt		SP-SM			
80	-80.4				18	7-15-19	
82	-82.4						
84	-84.4				19	7-15-18	
86	-86.4						
88	-88.4						
90	-90.4				20	8-16-19	
92	-92.4	Boring terminated at 90.5 feet.					
94	-94.4						
96	-96.4						
98	-98.4						
100							

03-31-2021 J:\Mtech 2010\Wallops Island M95 Intermodal Barge Service Project-20145\P-1.bor

HYNES & ASSOCIATES

LOG OF BORING P-2

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed:	: December 18, 2020
Logged By:	: R. Rhoads
Drilled By:	: M. Hynes
Drilling Method:	: HSA/Rotary (Mobile B-47 HD)
Total Depth:	: 90.5 feet

Depth in Feet	Surf. Elev. -2.80	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count
0	-2.8	Dark gray, saturated, medium dense, fine to medium SAND and SILT, with trace clay, trace organic silt		SM	1	1-6-6
2	-4.8					
4	-6.8	Gray, saturated, medium dense, fine to medium SAND, with little silt		SM	2	6-9-10
6	-8.8					
8	-10.8	Dark gray, saturated, medium dense, fine to medium SAND and SILT, with trace clay, trace organic silt		SM		
10	-12.8				3	3-4-8
12	-14.8					
14	-16.8				4	4-4-7
16	-18.8					
18	-20.8	Dark gray, saturated, medium dense, fine to medium SAND and SILT, with trace clay		SM		
20	-22.8				5	9-7-8
22	-24.8					
24	-26.8				6	8-10-13
26	-28.8					
28	-30.8					
30	-32.8				7	5-8-11
32	-34.8	Gray, saturated, medium dense, fine to medium SAND, with little silt, trace shell fragments		SM		
34	-36.8				8	12-13-15
36	-38.8					
38	-40.8					
40	-42.8				9	12-12-10
42	-44.8	Dark gray, saturated, medium dense, fine to medium SAND and SILT, with trace clay		SM		
44	-46.8				10	2-5-7
46	-48.8					
48	-50.8	Gray, saturated, stiff, silty CLAY, with trace fine sand, trace shell fragments		CL-ML		
50					11	4-5-7

REMARKS

Scale 1" ~ 7.4 feet

No organic bearing soil was encountered at the ground surface.

Water Depth: 3.7 ft.

Laboratory Test Results

Sample No. 11
From 49 to 50.5 feet

Atterberg Limits

Liquid Limit = 28
Plasticity Index = 7
USCS: CL-ML
Natural Moisture = 31.4%

NAD 83 VA State Plane South
Easting: 12365462
Northing: 3861627

The tidal relationship MLLW = -1.31' NAVD88 was determined at NOAA Station 8630308, Chincoteague Channel, South End, VA for the 1983-2001 Epoch.

HYNES & ASSOCIATES	LOG OF BORING P-2 (Page 2 of 2)

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed:	: December 18, 2020
Logged By:	: R. Rhoads
Drilled By:	: M. Hynes
Drilling Method:	: HSA/Rotary (Mobile B-47 HD)
Total Depth:	: 90.5 feet

Depth in Feet	Surf. Elev. -2.80	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
50	-52.8	Gray, saturated, stiff, CLAY and SILT, with trace fine sand, trace shell fragments		CL-ML	11	4-5-7	
52	-54.8	Gray, saturated, very stiff, silty CLAY, with some to little fine sand, trace shell fragments		CL	12	4-8-9	
54	-56.8						
56	-58.8						
58	-60.8	Gray, saturated, stiff, silty CLAY, with little to trace fine sand		CL	13	4-6-8	
60	-62.8						
62	-64.8				14	6-7-8	
64	-66.8						
66	-68.8						
68	-70.8	Gray, saturated, very stiff, silty CLAY, with some fine to coarse sand, little shell fragments		CL	15	9-10-13	
70	-72.8						
72	-74.8	Gray, saturated, dense, fine to coarse SAND, with some silt, little shell fragments		SM	16	12-17-28	
74	-76.8						
76	-78.8						
78	-80.8	Gray, saturated, dense, fine to medium SAND, with some clay, some silt		SC	17	9-12-19	
80	-82.8						
82	-84.8	Gray, saturated, very dense, fine to coarse SAND, with some to little silt, trace clay, trace shell fragments		SM	18	20-50/5"	
84	-86.8						
86	-88.8						
88	-90.8	Gray, saturated, very dense, fine to coarse SAND, with some gravel, trace silt		SP	19	30-37-43	
90	-92.8	Boring terminated at 90.5 feet.					
92	-94.8						
94	-96.8						
96	-98.8						
98	-100.8						
100							

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HYNES & ASSOCIATES

LOG OF BORING P-3

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed:	: December 17, 2020
Logged By:	: A. Kus
Drilled By:	: M. Hynes
Drilling Method:	: HSA/Rotary (Mobile B-47 HD)
Total Depth:	: 90.5 feet

Depth in Feet	Surf. Elev. -2.70	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count
0	-2.7	Gray, saturated, loose, SILT, with little fine to medium sand, trace clay		ML	1	1-4-6
2	-4.7					
4	-6.7	Gray, saturated, medium dense, fine to medium SAND, with trace silt		SP	2	8-11-11
6	-8.7					
8	-10.7					
10	-12.7	Gray, saturated, loose, fine to medium SAND, with some to little silt, trace clay		SM	3	6-3-6
12	-14.7	Gray, saturated, medium dense, fine to medium SAND, with little to trace silt		SP-SM		
14	-16.7				4	3-7-7
16	-18.7					
18	-20.7					
20	-22.7				5	8-8-12
22	-24.7					
24	-26.7				6	9-13-18
26	-28.7					
28	-30.7	Gray, saturated, medium dense, fine to medium SAND, with little silt, trace clay		SM		
30	-32.7				7	10-10-11
32	-34.7	Gray, saturated, medium dense, fine to medium SAND, with little to trace silt		SP-SM		
34	-36.7				8	10-8-11
36	-38.7					
38	-40.7					
40	-42.7				9	9-14-11
42	-44.7	Gray, saturated, medium dense, fine to medium SAND, with some to little silt, trace clay		SM		
44	-46.7				10	7-12-15
46	-48.7					
48	-50.7	Gray, saturated, stiff, clayey SILT, with little fine to medium sand, trace shell fragments		ML		
50					11	4-6-6

REMARKS

Scale 1" ~ 7.4 feet

No organic bearing soil was encountered at the ground surface.

Water Depth: 4.5 ft. at 12:00 pm

Laboratory Test Results

Sample No. 2
From 4 to 5.5 feet

Sieve Analysis

Sieve Size	Passing %
No. 20	100
No. 40	99.5
No. 60	85.6
No. 100	86.1
No. 200	5.5
USCS:	SP

Natural Moisture = 23.1%

Sample No. 8
From 34 to 35.5 feet

Natural Moisture = 23.5%

Sample No. 12
From 54 to 55.5 feet

Atterberg Limits

Liquid Limit =	33
Plasticity Index =	20
USCS:	CL
Natural Moisture =	25.5%

Sample No. 16
From 74 to 75.5 feet

Atterberg Limits

Liquid Limit =	60
Plasticity Index =	28
USCS:	CH
Natural Moisture =	39.1%

NAD 83 VA State Plane South
Easting: 12365490
Northing: 3861891

HYNES & ASSOCIATES

LOG OF BORING P-3

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed:	: December 17, 2020
Logged By:	: A. Kus
Drilled By:	: M. Hynes
Drilling Method:	: HSA/Rotary (Mobile B-47 HD)
Total Depth:	: 90.5 feet

Depth in Feet	Surf. Elev. -2.70	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
50	-52.7	Gray, saturated, stiff, clayey SILT, with little fine to medium sand, trace shell fragments		ML	11	4-6-6	The tidal relationship MLLW = -1.31' NAVD88 was determined at NOAA Station 8630308, Chincoteague Channel, South End, VA for the 1983-2001 Epoch.
52	-54.7	Gray, saturated, very stiff, silty CLAY, with little fine to medium sand, little shell fragments		CL			
54	-56.7				12	6-8-10	
56	-58.7						
58	-60.7						
60	-62.7				13	8-8-10	
62	-64.7	Gray, saturated, very stiff, clayey SILT, with little fine to medium sand, trace shell fragments		ML			
64	-66.7				14	7-8-11	
66	-68.7						
68	-70.7	Gray, saturated, very stiff, silty CLAY, with little fine to medium sand, trace shell fragments		CL			
70	-72.7				15	10-11-10	
72	-74.7	Gray, saturated, very stiff, clayey SILT, with trace fine to medium sand		CH			
74	-76.7				16	8-12-14	
76	-78.7						
78	-80.7	Gray, saturated, very stiff, clayey SILT, with little fine to coarse sand, trace shell fragments		ML/MH			
80	-82.7				17	9-13-14	
82	-84.7	Gray, saturated, dense, fine to medium SAND, with little silt, trace clay		SM			
84	-86.7				18	14-24-30	
86	-88.7						
88	-90.7	Gray, saturated, very dense, fine to coarse SAND, with trace silt		SP			
90	-92.7	Boring terminated at 90.5 feet.			19	20-29-39	
92	-94.7						
94	-96.7						
96	-98.7						
98	-100.7						
100							

HYNES & ASSOCIATES

LOG OF BORING P-4

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed:	: December 23, 2020
Logged By:	: D. Csanda
Drilled By:	: B. Hynes
Drilling Method:	: HSA/Rotary (Mobile B-47 HD)
Total Depth:	: 120.5 feet

Depth in Feet	Surf. Elev. -2.70	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count
0	-2.7	Gray, saturated, loose, fine to medium SAND, with trace silt		SP	1	1-4-6
2	-4.7	Gray, saturated, medium dense, fine to medium SAND, with trace silt		SP	2	8-8-10
4	-6.7					
6	-8.7					
8	-10.7	Gray, saturated, very loose, fine to medium SAND, with little silt		SM	3	1-1-2
10	-12.7					
12	-14.7	Gray, saturated, medium dense, fine to medium SAND, with little silt		SM	4	3-8-8
14	-16.7					
16	-18.7					
18	-20.7				5	12-12-17
20	-22.7					
22	-24.7	Gray, saturated, medium dense, fine to medium SAND, with little silt, trace shell fragments		SM	6	17-17-10
24	-26.7					
26	-28.7					
28	-30.7	Gray to brown, saturated, very stiff, silty CLAY		CL	7	5-8-11
30	-32.7					
32	-34.7	Gray, saturated, very stiff, silty CLAY, with trace fine to medium sand		CL	8	7-10-13
34	-36.7					
36	-38.7					
38	-40.7	Gray, saturated, soft, silty CLAY, with trace fine to medium sand, trace shell fragments		CL	9	3-2-2
40	-42.7					
42	-44.7	Gray, saturated, very stiff, silty CLAY, with trace fine to meidum sand, trace shell fragments		CL	10	3-7-10
44	-46.7					
46	-48.7					
48	-50.7	Gray, saturated, hard to stiff, silty CLAY, with some fine to medium sand, trace shell fragments		CL	11	7-14-18
50						

REMARKS

Scale 1" ~ 7.4 feet

No organic bearing soil was encountered at the ground surface.

Water Depth: 2 ft. 3 in. at 8:30 am

Shelby Tube sample was pushed from 32 to 34 feet with no recovery.

Laboratory Test Results

Sample No. 11
From 49 to 50.5 feet

Atterberg Limits

Liquid Limit = 33
Plasticity Index = 14
USCS: CL
Natural Moisture = 25.7%

Sample No. 23
From 109 to 110.5 feet

Atterberg Limits

Liquid Limit = 49
Plasticity Index = 17
USCS: ML
Natural Moisture = 34.9%

NAD 83 VA State Plane South
Easting: 12365519
Northing: 3862142

The tidal relationship MLLW = -1.31' NAVD88 was determined at NOAA Station 8630308, Chincoteague Channel, South End, VA for the 1983-2001 Epoch.

HYNES & ASSOCIATES

LOG OF BORING P-4

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed: : December 23, 2020
Logged By: : D. Csanda
Drilled By: : B. Hynes
Drilling Method: : HSA/Rotary (Mobile B-47 HD)
Total Depth: : 120.5 feet

Depth in Feet	Surf. Elev. -2.70	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
50	-52.7	Gray, saturated, hard to stiff, silty CLAY, with some fine to medium sand, trace shell fragments		CL	11	7-14-18	
52	-54.7						
54	-56.7				12	14-18-20	
56	-58.7						
58	-60.7						
60	-62.7				13	12-6-6	
62	-64.7	Gray, saturated, stiff, silty CLAY, with trace shell fragments		CL			
64	-66.7				14	4-6-8	
66	-68.7						
68	-70.7						
70	-72.7				15	5-6-7	
72	-74.7	Gray, saturated, hard, silty CLAY, with trace fine to medium sand		CL			
74	-76.7				16	17-21-33	
76	-78.7						
78	-80.7	Gray, saturated, very stiff to hard, silty CLAY, with some fine to medium sand, little shell fragments		CL			
80	-82.7				17	10-17-25	
82	-84.7						
84	-86.7				18	10-13-18	
86	-88.7						
88	-90.7						
90	-92.7				19	10-14-15	
92	-94.7						
94	-96.7				20	17-24-34	
96	-98.7						
98	-100.7	Gray, saturated, hard, silty CLAY, with trace fine to medium sand		CL			
100					21	14-16-21	

HYNES & ASSOCIATES

LOG OF BORING P-4

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed:	: December 23, 2020
Logged By:	: D. Csanda
Drilled By:	: B. Hynes
Drilling Method:	: HSA/Rotary (Mobile B-47 HD)
Total Depth:	: 120.5 feet

Depth in Feet	Surf. Elev. -2.70	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
100	-102.7	Gray, saturated, hard, silty CLAY, with trace fine to medium sand		CL	21	14-16-21	
102	-104.7						
104	-106.7				22	10-21-30	
106	-108.7						
108	-110.7	Gray, saturated, hard, clayey SILT, with trace fine to medium sand		ML			
110	-112.7				23	22-40-50/4"	
112	-114.7	Gray, saturated, hard, silty CLAY, with trace fine to medium sand		CL			
114	-116.7				24	18-32-48	
116	-118.7						
118	-120.7						
120	-122.7				25	20-41-50/5"	
122	-124.7	Boring terminated at 120.5 feet.					
124	-126.7						
126	-128.7						
128	-130.7						
130	-132.7						
132	-134.7						
134	-136.7						
136	-138.7						
138	-140.7						
140	-142.7						
142	-144.7						
144	-146.7						
146	-148.7						
148	-150.7						
150							

HYNES & ASSOCIATES

LOG OF BORING P-5

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed:	: December 21, 2020
Logged By:	: D. Csanda
Drilled By:	: B. Hynes
Drilling Method:	: HSA/Rotary (Mobile B-47 HD)
Total Depth:	: 110.5 feet

Depth in Feet	Surf. Elev. -10.50	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count
0	-10.5	Gray, saturated, very loose, fine to medium SAND and SILT, with trace organic silt		SM	1	1-2-2
2	-12.5	Gray, saturated, medium dense, fine to medium SAND, with trace silt, trace organic silt				
4	-14.5				2	7-7-10
6	-16.5			SP	3	8-9-9
8	-18.5					
10	-20.5				4	7-8-8
12	-22.5	Gray, saturated, medium dense, fine to medium SAND, with trace shell fragments				
14	-24.5			SP	5	10-8-10
16	-26.5					
18	-28.5	Gray, saturated, very soft, clayey SILT, with trace fine to medium sand				
20	-30.5			ML	6	1-2-2
22	-32.5	Gray to brown, saturated, stiff, silty CLAY, with trace fine to medium sand				
24	-34.5				7	1-4-8
26	-36.5					
28	-38.5			CL-CH		
30	-40.5				8	3-6-8
32	-42.5	Brown, saturated, stiff, silty CLAY, with trace fine to medium sand				
34	-44.5			CL	9	5-6-9
36	-46.5					
38	-48.5	Gray, saturated, very stiff, silty CLAY, with trace fine to medium sand, trace shell fragments				
40	-50.5			CL	10	2-3-4
42	-52.5	Gray, saturated, stiff to very stiff, silty CLAY, with some fine to medium sand, trace shell fragments				
44	-54.5				11	4-4-10
46	-56.5			CL		
48	-58.5					
50					12	4-10-11

REMARKS

Scale 1" ~ 7.4 feet

No organic bearing soil was encountered at the ground surface.

Water Depth: 12 ft. at 10:30 am

Shelby Tube sample was pushed from 42 to 44 feet.

Laboratory Test Results

Sample No. 3
From 6 to 7.5 feet

Natural Moisture = 27.6%

Sample No. 2
From 4 to 5.5 feet

Sieve Analysis

Sieve Size	Passing %
No. 20	100
No. 40	99.7
No. 60	83.3
No. 100	32.9
No. 200	4.8
USCS:	SP

Natural Moisture = 25.3%

Sample No. 8
From 29 to 30.5 feet

Atterberg Limits

Liquid Limit = 50
Plasticity Index = 27
USCS: CL-CH
Natural Moisture = 32.1%

Sample No. 14
From 59 to 60.5 feet

Atterberg Limits

Liquid Limit = 67
Plasticity Index = 40
USCS: CH
Natural Moisture = 43.2%

HYNES & ASSOCIATES

LOG OF BORING P-5

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed: : December 21, 2020
Logged By: : D. Csanda
Drilled By: : B. Hynes
Drilling Method: : HSA/Rotary (Mobile B-47 HD)
Total Depth: : 110.5 feet

Depth in Feet	Surf. Elev. -10.50	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count
50	-60.5	Gray, saturated, stiff to very stiff, silty CLAY, with some fine to medium sand, trace shell fragments		CL	12	4-10-11
52	-62.5					
54	-64.5	Gray, saturated, very stiff, silty CLAY, with trace shell fragments		CL	13	5-10-12
56	-66.5					
58	-68.5	Gray, saturated, very stiff, silty CLAY		CH		
60	-70.5				14	6-8-11
62	-72.5	Gray, saturated, very stiff, silty CLAY, with some fine to medium sand, trace shell fragments		CL		
64	-74.5				15	8-8-10
66	-76.5					
68	-78.5	Gray, saturated, dense, fine to medium SAND and SILT, with trace clay, trace shell fragments		SM		
70	-80.5				16	11-13-20
72	-82.5					
74	-84.5				17	13-14-19
76	-86.5					
78	-88.5	Gray, saturated, medium dense, fine to medium SAND, with some silt, trace shell fragments		SM		
80	-90.5				18	6-11-18
82	-92.5	Gray, saturated, hard, silty CLAY		CL		
84	-94.5				19	9-13-21
86	-96.5					
88	-98.5					
90	-100.5				20	16-21-30
92	-102.5	Gray, saturated, hard, silty CLAY, with trace fine to medium sand		CL		
94	-104.5				21	17-24-38
96	-106.5					
98	-108.5	Gray, saturated, hard, silty CLAY		CL		
100					22	18-31-43

REMARKS

Sample No. 23
From 104 to 105.5 feet

Natural Moisture = 39.2%

NAD 83 VA State Plane South
Easting: 12365548
Northing: 3862392

The tidal relationship MLLW = -1.31' NAVD88 was determined at NOAA Station 8630308, Chincoteague Channel, South End, VA for the 1983-2001 Epoch.

HYNES & ASSOCIATES

LOG OF BORING P-5

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed: : December 21, 2020
Logged By: : D. Csanda
Drilled By: : B. Hynes
Drilling Method: : HSA/Rotary (Mobile B-47 HD)
Total Depth: : 110.5 feet

Depth in Feet	Surf. Elev. -10.50	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
100	-110.5	Gray, saturated, hard, silty CLAY			22	18-31-43	
102	-112.5						
104	-114.5			CL	23	19-36-47	
106	-116.5						
108	-118.5						
110	-120.5				24	20-34-47	
		Boring terminated at 110.5 feet.					
112	-122.5						
114	-124.5						
116	-126.5						
118	-128.5						
120	-130.5						
122	-132.5						
124	-134.5						
126	-136.5						
128	-138.5						
130	-140.5						
132	-142.5						
134	-144.5						
136	-146.5						
138	-148.5						
140	-150.5						
142	-152.5						
144	-154.5						
146	-156.5						
148	-158.5						
150							

LOG OF BORING D-2

HYNES & ASSOCIATES

(Page 1 of 1)

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed:	: December 28, 2020
Logged By:	: D. Csanda
Drilled By:	: M. Hynes
Drilling Method:	: HSA (Mobile B-47 HD)
Total Depth:	: 14 feet

Depth in Feet	Surf. Elev. -10.30	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count
0	-10.3	Gray, saturated, medium dense, fine to medium SAND, with trace silt, trace clay		SP	1	7-6-6-7
2	-12.3				2	7-7-7-8
4	-14.3	Gray, saturated, loose, fine to medium SAND, with little to trace silt		SP-SM	3	11-4-4-5
6	-16.3				4	6-4-4-3
8	-18.3	Gray, saturated, loose, fine to medium SAND, with trace silt, trace clay		SP	5	8-2-4-5
10	-20.3	Gray, saturated, medium dense, fine to medium SAND, with little to trace silt		SP-SM	6	5-6-6-8
12	-22.3	Gray, saturated, medium dense, fine to medium SAND, with trace silt, trace shells		SP	7	12-6-5-8
14	-24.3	Boring terminated at 14 feet.				
16	-26.3					
18	-28.3					
20						

REMARKS

Scale 1" ~ 3 feet

No organic bearing soil was encountered at the ground surface.

Water Depth: 13.0 ft.

Laboratory Test Results

Sample No. 5
From 8 to 10 feet

Hydrometer Analysis (See Graph)
USCS: SP
Natural Moisture = 20.0%

NAD 83 VA State Plane South
Easting: 12366943
Northing: 3863058

The tidal relationship MLLW = -1.31' NAVD88 was determined at NOAA Station 8630308, Chincoteague Channel, South End, VA for the 1983-2001 Epoch.

HYNES & ASSOCIATES

LOG OF BORING D-4

(Page 1 of 1)

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed: : December 28, 2020
Logged By: : D. Csanda
Drilled By: : M. Hynes
Drilling Method: : HSA (Mobile B-47 HD)
Total Depth: : 10 feet

Depth in Feet	Surf. Elev. -11.40	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
0	-11.4	Gray, saturated, very loose, fine to medium SAND, with trace shells		SP	1	4-2-2-3	Scale 1" ~ 3 feet No organic bearing soil was encountered at the ground surface.
2	-13.4	Gray, saturated, medium dense, fine to medium SAND, with trace shells		SP	2	7-3-7-5	Water Depth: 11.5 ft. Laboratory Test Results
4	-15.4				3	6-6-7-7	Sample No. 5 From 8 to 10 feet Hydrometer Analysis (See Graph) USCS: ML Natural Moisture = 31.0%
6	-17.4	Gray, saturated, very loose, fine to medium SAND, with little to trace silt, trace clay		SP-SM	4	1-1-2-3	NAD 83 VA State Plane South Easting: 12370656 Northing: 3864121
8	-19.4	Gray, saturated, soft, SILT, with some fine to medium sand, little clay		ML	5	1-1-2-3	The tidal relationship MLLW = -1.31' NAVD88 was determined at NOAA Station 8630308, Chincoteague Channel, South End, VA for the 1983-2001 Epoch.
10	-21.4	Boring terminated at 10 feet.					
12	-23.4						
14	-25.4						
16	-27.4						
18	-29.4						
20							

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HYNES & ASSOCIATES

LOG OF BORING D-6

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed: : December 31, 2020
Logged By: : D. Csanda
Drilled By: : M. Hynes
Drilling Method: : HSA (Mobile B-47 HD)
Total Depth: : 10 feet

Depth in Feet	Surf. Elev. -10.10	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
0	-10.1	Gray, saturated, medium dense, fine to medium SAND, with trace silt		SP	1	24-9-8-8	Scale 1" ~ 3 feet No organic bearing soil was encountered at the ground surface. Water Depth: 16.0 ft.
2	-12.1				2	18-20-27-15	Laboratory Test Results Sample No. 1 From 0 to 2 feet
4	-14.1	Gray, saturated, dense, fine to medium SAND, with trace silt, trace shells		SP	3	16-15-18-18	Hydrometer Analysis (See Graph) USCS: SP Natural Moisture = 24.9%
6	-16.1				4	12-14-19-20	Sample No. 3 From 4 to 6 feet Hydrometer Analysis (See Graph) USCS: SP Natural Moisture = 17.0%
8	-18.1				5	17-15-22-24	NAD 83 VA State Plane South Easting: 12372163 Northing: 3864201
10	-20.1	Boring terminated at 10 feet.					The tidal relationship MLLW = -1.31' NAVD88 was determined at NOAA Station 8630308, Chincoteague Channel, South End, VA for the 1983-2001 Epoch.
12	-22.1						
14	-24.1						
16	-26.1						
18	-28.1						
20							

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HYNES & ASSOCIATES

LOG OF BORING D-9

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed:	: January 5, 2021
Logged By:	: D. Csanda
Drilled By:	: M. Hynes
Drilling Method:	: HSA (Mobile B-47 HD)
Total Depth:	: 18 feet

Depth in Feet	Surf. Elev. -3.10	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
0	-3.1	Brown, saturated, loose, fine to medium SAND, with trace shells, trace silt		SP	1	13-5-5-4	Scale 1" ~ 3 feet
2	-5.1				2	15-6-5-5	No organic bearing soil was encountered at the ground surface. Water Depth: 4.3 ft. Laboratory Test Results
4	-7.1	Brown to gray, saturated, loose to medium dense, fine to medium SAND, with trace silt, trace shells		SP	3	8-2-5-4	Sample No. 7 From 12 to 14 feet Hydrometer Analysis (See Graph) USCS: SP Natural Moisture = 17.9%
6	-9.1				4	6-7-5-5	NAD 83 VA State Plane South Easting: 12373304 Northing: 3863541
8	-11.1				5	7-4-5-7	The tidal relationship MLLW = -1.31' NAVD88 was determined at NOAA Station 8630308, Chincoteague Channel, South End, VA for the 1983-2001 Epoch.
10	-13.1				6	15-5-6-7	
12	-15.1	Gray, saturated, dense, fine to medium SAND, with trace silt		SP	7	17-17-19-20	
14	-17.1	Gray, saturated, dense, fine to medium SAND, with trace silt, trace shells		SP	8	20-16-19-21	
16	-19.1				9	15-17-20-22	
18	-21.1	Boring terminated at 18 feet.					
20							

HYNES & ASSOCIATES

LOG OF BORING D-11

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed: : January 5, 2021
Logged By: : D. Csanda
Drilled By: : M. Hynes
Drilling Method: : HSA (Mobile B-47 HD)
Total Depth: : 10 feet

Depth in Feet	Surf. Elev. -10.90	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
0	-10.9	Brown, saturated, medium dense, fine to medium SAND, with trace silt		SP	1	12-11-6-7	Scale 1" ~ 3 feet No organic bearing soil was encountered at the ground surface. Water Depth: 15.7 ft. Laboratory Test Results Sample No. 5 From 8 to 10 feet Hydrometer Analysis (See Graph) USCS: SP Natural Moisture = 23.1% NAD 83 VA State Plane South Easting: 12373834 Northing: 3863013 The tidal relationship MLLW = -1.31' NAVD88 was determined at NOAA Station 8630308, Chincoteague Channel, South End, VA for the 1983-2001 Epoch.
2	-12.9	Brown, saturated, medium dense, fine to medium SAND, with trace silt, trace shells		SP	2	8-11-12-11	
4	-14.9	Brown, satuarated, medium dense, fine to medium SAND, with trace silt		SP	3	6-7-7-4	
6	-16.9				4	8-9-11-13	
8	-18.9	Gray, saturated, loose, fine to medium SAND, with trace silt		SP	5	4-3-4-6	
10	-20.9	Boring terminated at 10 feet.					
12	-22.9						
14	-24.9						
16	-26.9						
18	-28.9						
20							

HYNES & ASSOCIATES

LOG OF BORING D-13

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed: : January 4, 2021
Logged By: : D. Csanda
Drilled By: : M. Hynes
Drilling Method: : HSA (Mobile B-47 HD)
Total Depth: : 4 feet

Depth in Feet	Surf. Elev. -7.70	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
0	-7.7	Brown, saturated, loose, fine to medium SAND, with trace silt		SP	1	5-4-4-4	Scale 1" ~ 3 feet No organic bearing soil was encountered at the ground surface. Water Depth: 10.0 ft. NAD 83 VA State Plane South Easting: 12373678 Northing: 3862510 The tidal relationship MLLW = -1.31' NAVD88 was determined at NOAA Station 8630308, Chincoteague Channel, South End, VA for the 1983-2001 Epoch.
2	-9.7	Brown, saturated, medium dense, fine to medium SAND, with trace silt, trace shells		SP	2	15-9-9-10	
4	-11.7	Boring terminated at 4 feet.					
6	-13.7						
8	-15.7						
10	-17.7						
12	-19.7						
14	-21.7						
16	-23.7						
18	-25.7						
20							

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LOG OF BORING D-15

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed: : January 4, 2021
Logged By: : D. Csanda
Drilled By: : M. Hynes
Drilling Method: : HSA (Mobile B-47 HD)
Total Depth: : 10 feet

Depth in Feet	Surf. Elev. -10.40	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
0	-10.4	Brown, saturated, medium dense, fine to medium SAND, with trace silt		SP	1	2-5-5-6	Scale 1" ~ 3 feet No organic bearing soil was encountered at the ground surface. Water Depth: 10.0 ft.
2	-12.4	Gray, saturated, medium dense, fine to medium SAND, with trace silt		SP	2	6-4-4-7	Laboratory Test Results Sample No. 5 From 8 to 10 feet
4	-14.4	Brown to gray, satuarated, dense, fine to medium SAND, with trace silt, trace shells		SP	3	9-11-17-20	Hydrometer Analysis (See Graph) USCS: SP Natural Moisture = 17.0%
6	-16.4	Brown to gray, saturated, medium dense, fine to medium SAND, with trace silt, trace shells		SP	4	7-8-13-14	NAD 83 VA State Plane South Easting: 12373512 Northing: 3862000
8	-18.4				5	9-10-14-15	The tidal relationship MLLW = -1.31' NAVD88 was determined at NOAA Station 8630308, Chincoteague Channel, South End, VA for the 1983-2001 Epoch.
10	-20.4	Boring terminated at 10 feet.					
12	-22.4						
14	-24.4						
16	-26.4						
18	-28.4						
20							

HYNES & ASSOCIATES

LOG OF BORING E-2

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed: : December 28, 2020
Logged By: : D. Csanda
Drilled By: : M. Hynes
Drilling Method: : HSA (Mobile B-47 HD)
Total Depth: : 8 feet

Depth in Feet	Surf. Elev. -17.50	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
0	-17.5	Gray, saturated, medium dense, fine to medium SAND, with trace shells		SP	1	8-7-6-5	Scale 1" ~ 3 feet No organic bearing soil was encountered at the ground surface. Water Depth: 16.0 ft.
2	-19.5	Gray, saturated, medium dense, fine to medium SAND, with trace shells		SP	2	10-5-5-8	Laboratory Test Results Sample No. 2 From 2 to 4 feet
4	-21.5				3	19-5-7-7	Hydrometer Analysis (See Graph) USCS: SP Natural Moisture = 22.4%
6	-23.5				4	11-6-6-8	NAD 83 VA State Plane South Easting: 12368034 Northing: 3863493
8	-25.5	Boring terminated at 8 feet.					The tidal relationship MLLW = -1.31' NAVD88 was determined at NOAA Station 8630308, Chincoteague Channel, South End, VA for the 1983-2001 Epoch.
10	-27.5						
12	-29.5						
14	-31.5						
16	-33.5						
18	-35.5						
20							

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HYNES & ASSOCIATES

LOG OF BORING E-4

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

Date Completed:	: December 28, 2020
Logged By:	: D. Csanda
Drilled By:	: M. Hynes
Drilling Method:	: HSA (Mobile B-47 HD)
Total Depth:	: 8 feet

Depth in Feet	Surf. Elev. -12.00	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
0	-12	Brown, saturated, loose, fine to medium SAND, with little to trace silt, trace clay		SP	1	4-3-3-3	Scale 1" ~ 3 feet No organic bearing soil was encountered at the ground surface. Water Depth: 11.0 ft. Laboratory Test Results Sample No. 4 From 6 to 8 feet Hydrometer Analysis (See Graph) USCS: SP Natural Moisture = 18.4% NAD 83 VA State Plane South Easting: 12371382 Northing: 3864328 The tidal relationship MLLW = -1.31' NAVD88 was determined at NOAA Station 8630308, Chincoteague Channel, South End, VA for the 1983-2001 Epoch.
2	-14	Gray, saturated, loose to medium dense, fine to medium SAND, with trace shells		SP	2	5-5-4-5	
4	-16				3	6-8-3-5	
6	-18				4	6-6-10-11	
8	-20	Boring terminated at 8 feet.					
10	-22						
12	-24						
14	-26						
16	-28						
18	-30						
20							

HYNES & ASSOCIATES

LOG OF BORING E-7

Gahagan & Bryant Associates, Inc.
9008 Yellow Brick Road, Unit O
Baltimore, Maryland

Wallops Island M95 Intermodal Barge Service

Project No.: JDH-10/20/145

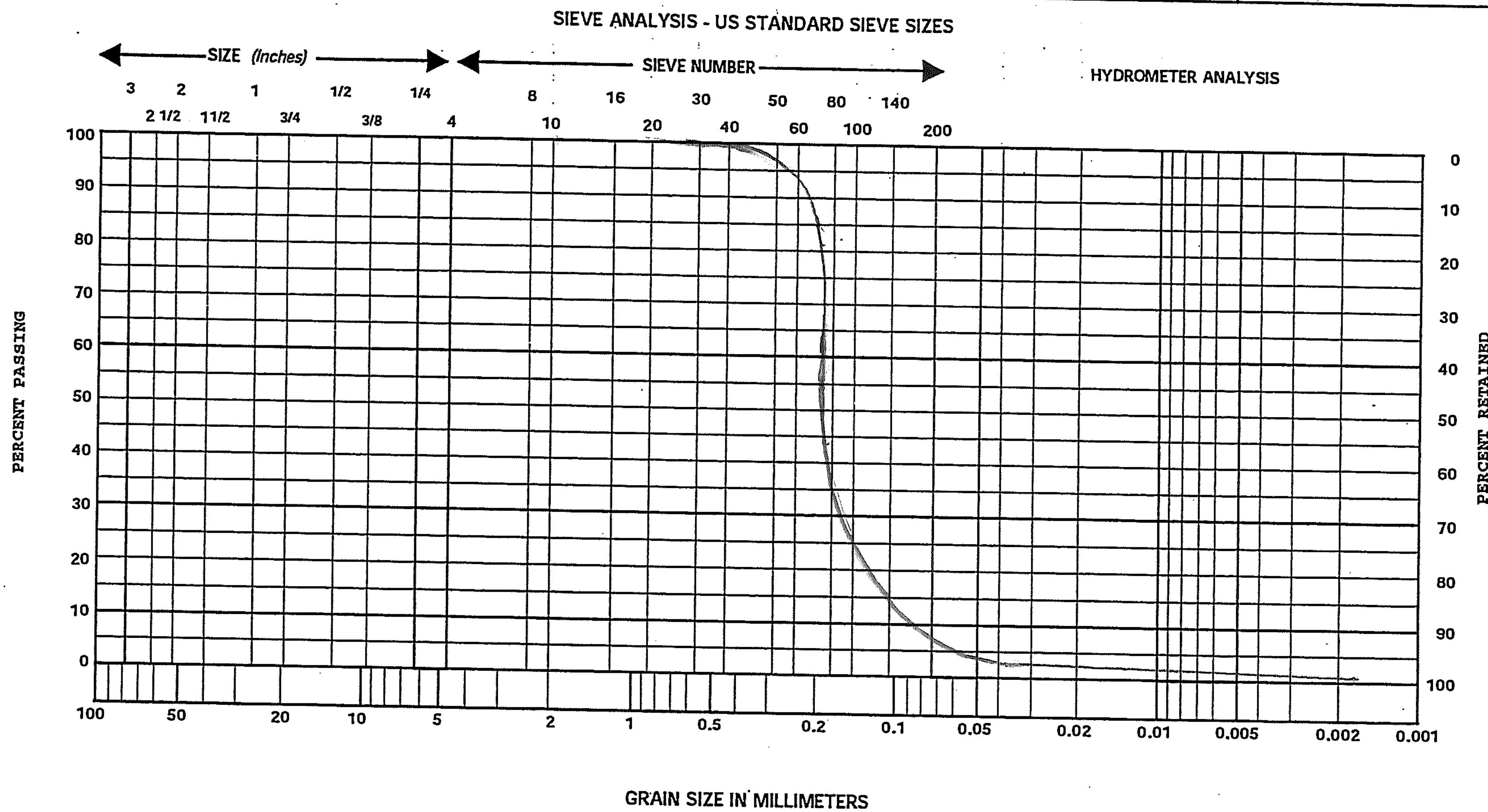
Date Completed:	: January 4, 2021
Logged By:	: D. Csanda
Drilled By:	: M. Hynes
Drilling Method:	: HSA (Mobile B-47 HD)
Total Depth:	: 6 feet

Depth in Feet	Surf. Elev. -16.00	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
0	-16	Brown, saturated, medium dense, fine to medium SAND, with trace silt		SP	1	3-4-5-6	Scale 1" ~ 3 feet No organic bearing soil was encountered at the ground surface. Water Depth: 13.0 ft.
2	-18				2	7-5-6-8	Laboratory Test Results Sample No. 2 From 2 to 4 feet
4	-20	Brown to gray, satuarated, dense, fine to medium SAND, with trace silt, trace shells		SP	3	11-14-17-19	Hydrometer Analysis (See Graph) USCS: SP Natural Moisture = 23.1%
6	-22	Boring terminated at 6 feet.					NAD 83 VA State Plane South Easting: 12373364 Northing: 3861342 The tidal relationship MLLW = -1.31' NAVD88 was determined at NOAA Station 8630308, Chincoteague Channel, South End, VA for the 1983-2001 Epoch.
8	-24						
10	-26						
12	-28						
14	-30						
16	-32						
18	-34						
20							

GRAIN SIZE DISTRIBUTION GRAPH - AGGREGATE GRADATION CHART

1. PROJECT Wallops Island M95 Intermodal Barge Service

2. DATE 1/25/21



EXCAVATION NUMBER	SAMPLE NUMBER	LL	PL	PI	Cu (D_{60}/D_{10})	Cc $(D_{30})^2/(D_{60} \times D_{10})$	SOIL DESCRIPTION/REMARKS	CLASSIFICATION (USCS)
E2	S2	NP	NP	NP				SP

3. TECHNICIAN (Signature) [signature]

4. PLOTTED BY (Signature) [signature]

5. CHECKED BY (Signature) [signature]

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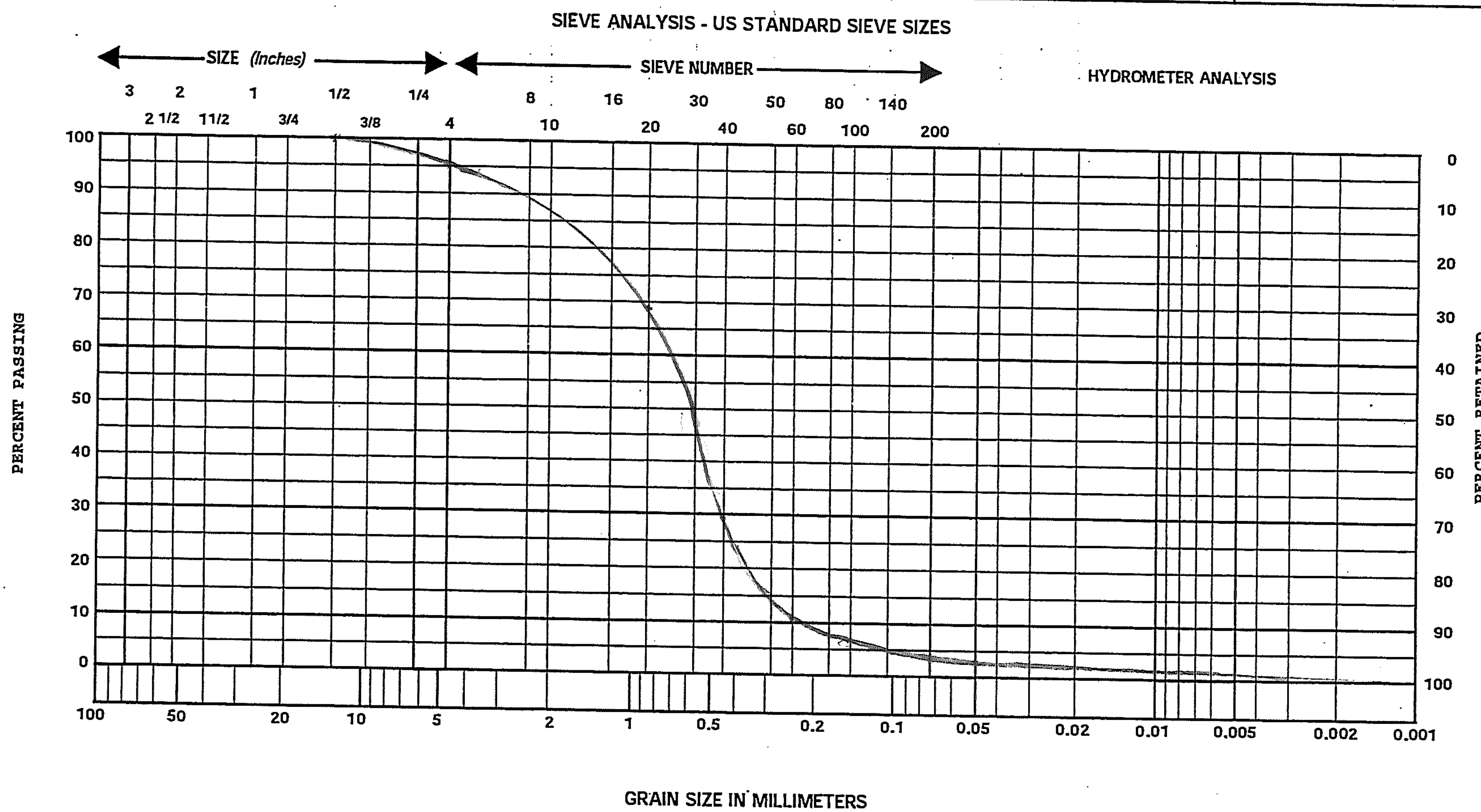
GRAIN SIZE DISTRIBUTION GRAPH - AGGREGATE GRADATION CHART

1. PROJECT Wallops Island M95 Intermodal Barge Service	2. DATE 1/25/21



EXCAVATION NUMBER	SAMPLE NUMBER	LL	PL	PI	Cu (D_{60}/D_{10})	Cc $(D_{30})^2/(D_{60} \times D_{10})$	SOIL DESCRIPTION/REMARKS	CLASSIFICATION (USCS)
E4	S4	NP	NP	NP				SP

3. TECHNICIAN (Signature)	4. PLOTTED BY (Signature)	5. CHECKED BY (Signature)
Joe Long	[signature]	[signature]

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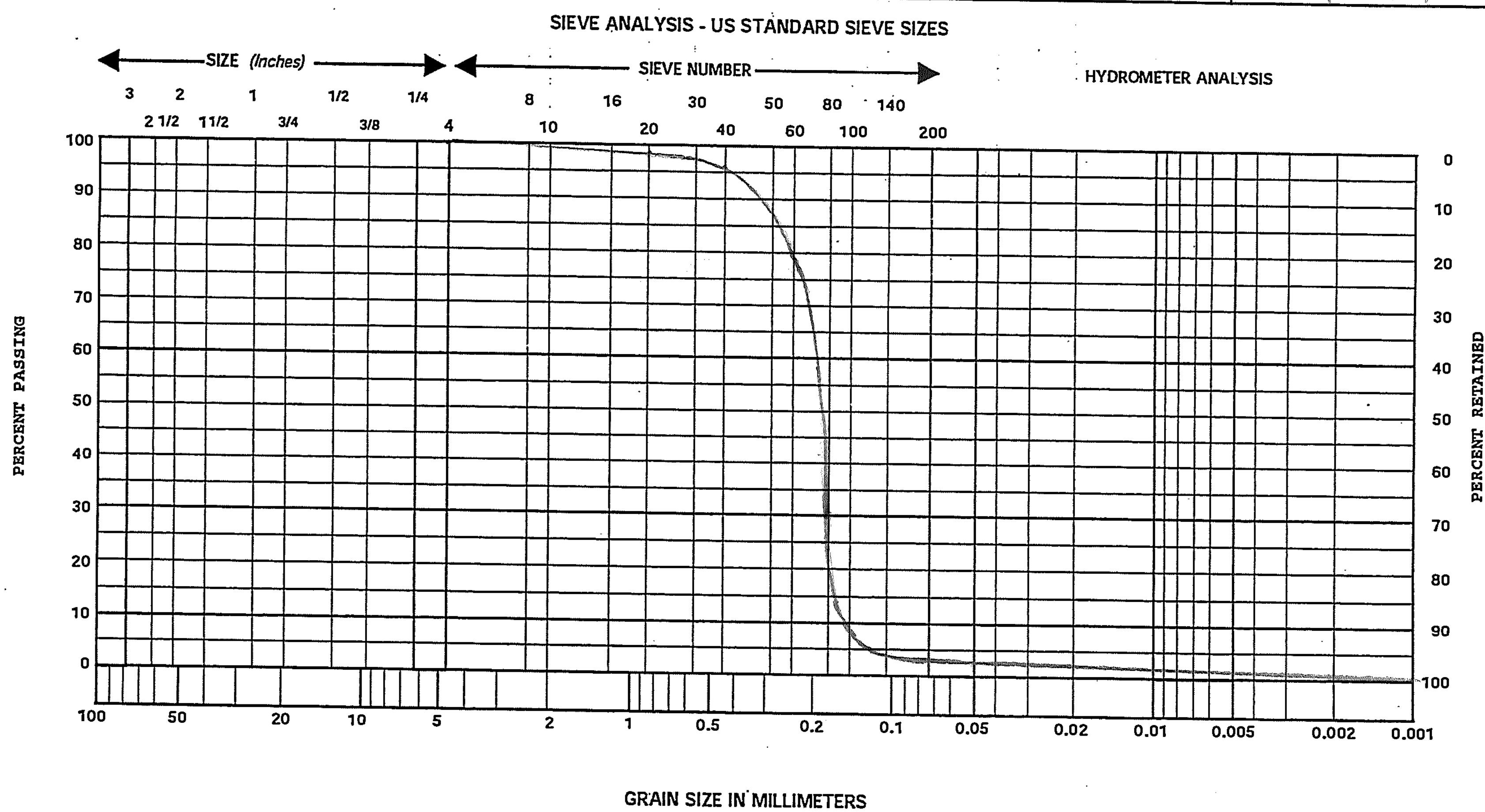
GRAIN SIZE DISTRIBUTION GRAPH - AGGREGATE GRADATION CHART

1. PROJECT Wallops Island M95 Intermodal Barge Service

2. DATE 1/25/21



EXCAVATION NUMBER	SAMPLE NUMBER	LL	PL	PI	Cu (D_{60}/D_{10})	Cc $(D_{30})^2/(D_{60} \times D_{10})$	SOIL DESCRIPTION/REMARKS	CLASSIFICATION (USCS)
E7	S2	NP	NP	NP				SP

3. TECHNICIAN (Signature) [signature]

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GRAIN SIZE DISTRIBUTION GRAPH - AGGREGATE GRADATION CHART

1. PROJECT Wallops Island Intermodal Barge Service

2. DATE 1/25/21

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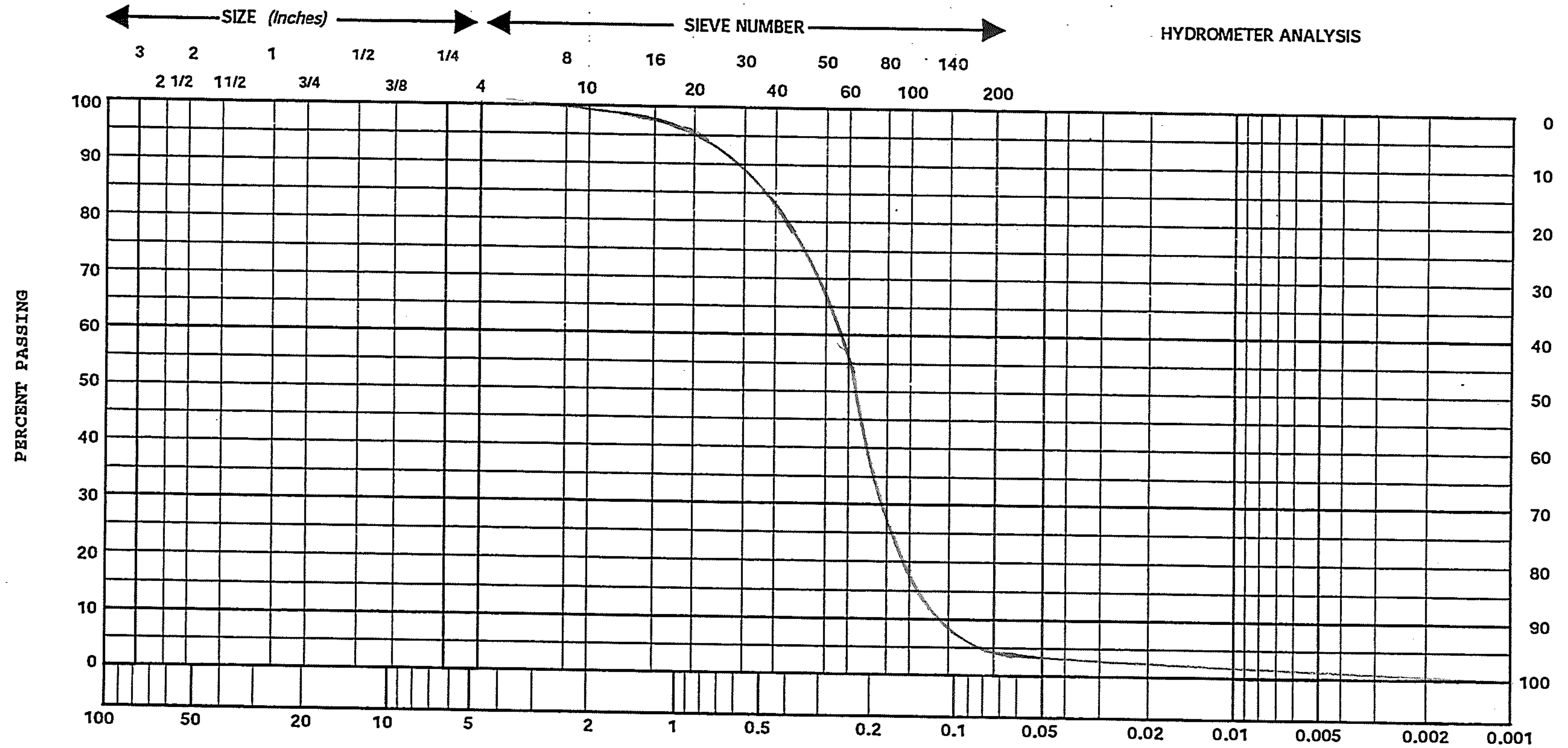

EXCAVATION NUMBER	SAMPLE NUMBER	LL	PL	PI	Cu (D_{60}/D_{10})	Cc $(D_{30})^2/(D_{60} \times D_{10})$	SOIL DESCRIPTION/REMARKS	CLASSIFICATION (USCS)
D2	S5	NP	NP	NP				SP

3. TECHNICIAN *(Signature)* Joe Long

4. PLOTTED BY *(Signature)* [signature]

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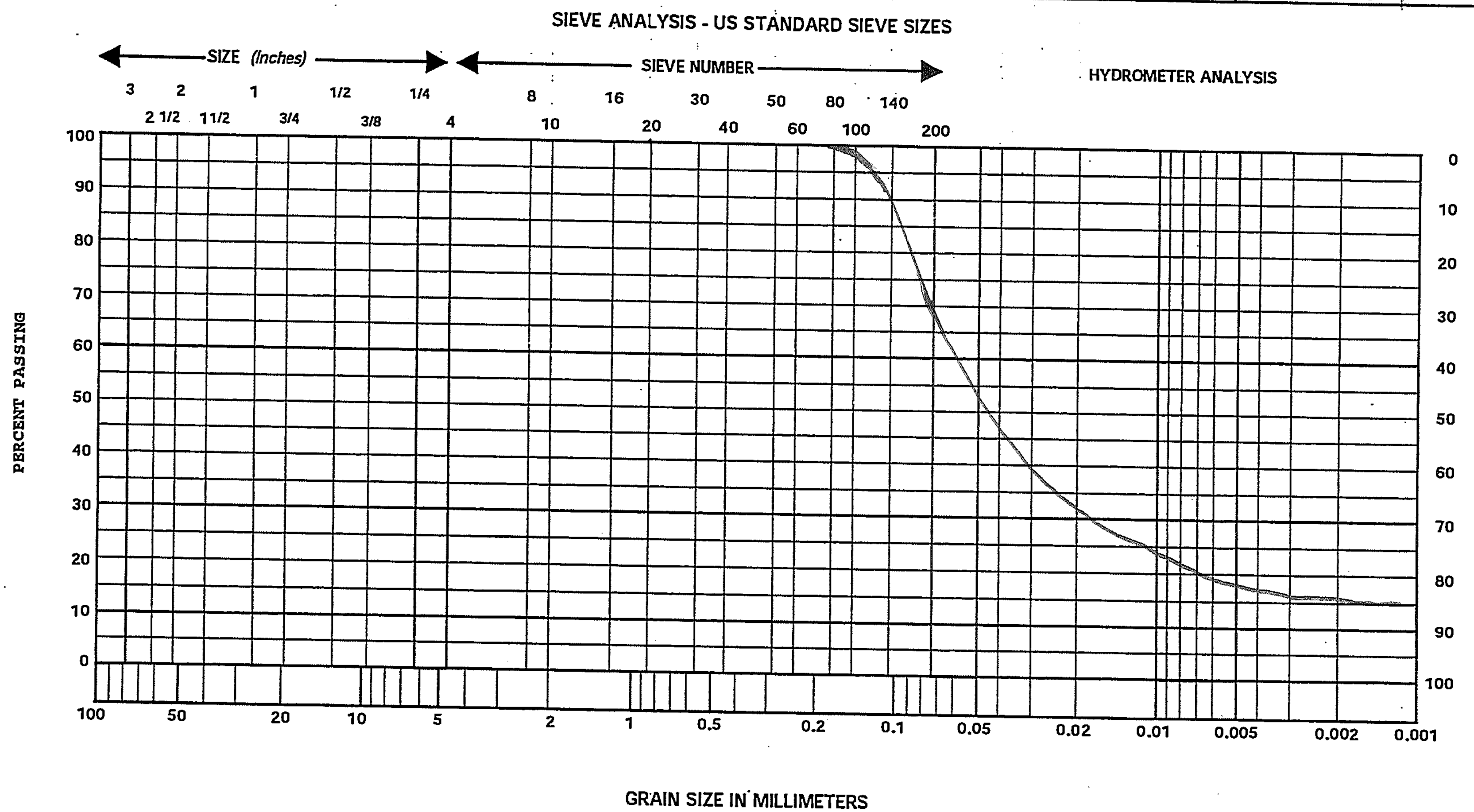
GRAIN SIZE DISTRIBUTION GRAPH - AGGREGATE GRADATION CHART

1. PROJECT Wallops Island M95 Intermodal Barge Service

2. DATE 1/25/21



EXCAVATION NUMBER	SAMPLE NUMBER	LL	PL	PI	Cu (D_{60}/D_{10})	Cc $(D_{30})^2/(D_{60} \times D_{10})$	SOIL DESCRIPTION/REMARKS	CLASSIFICATION (USCS)
D4	S5	—	—	—				ML

3. TECHNICIAN (Signature) Joe Long

4. PLOTTED BY (Signature) [signature]

5. CHECKED BY (Signature) [signature]

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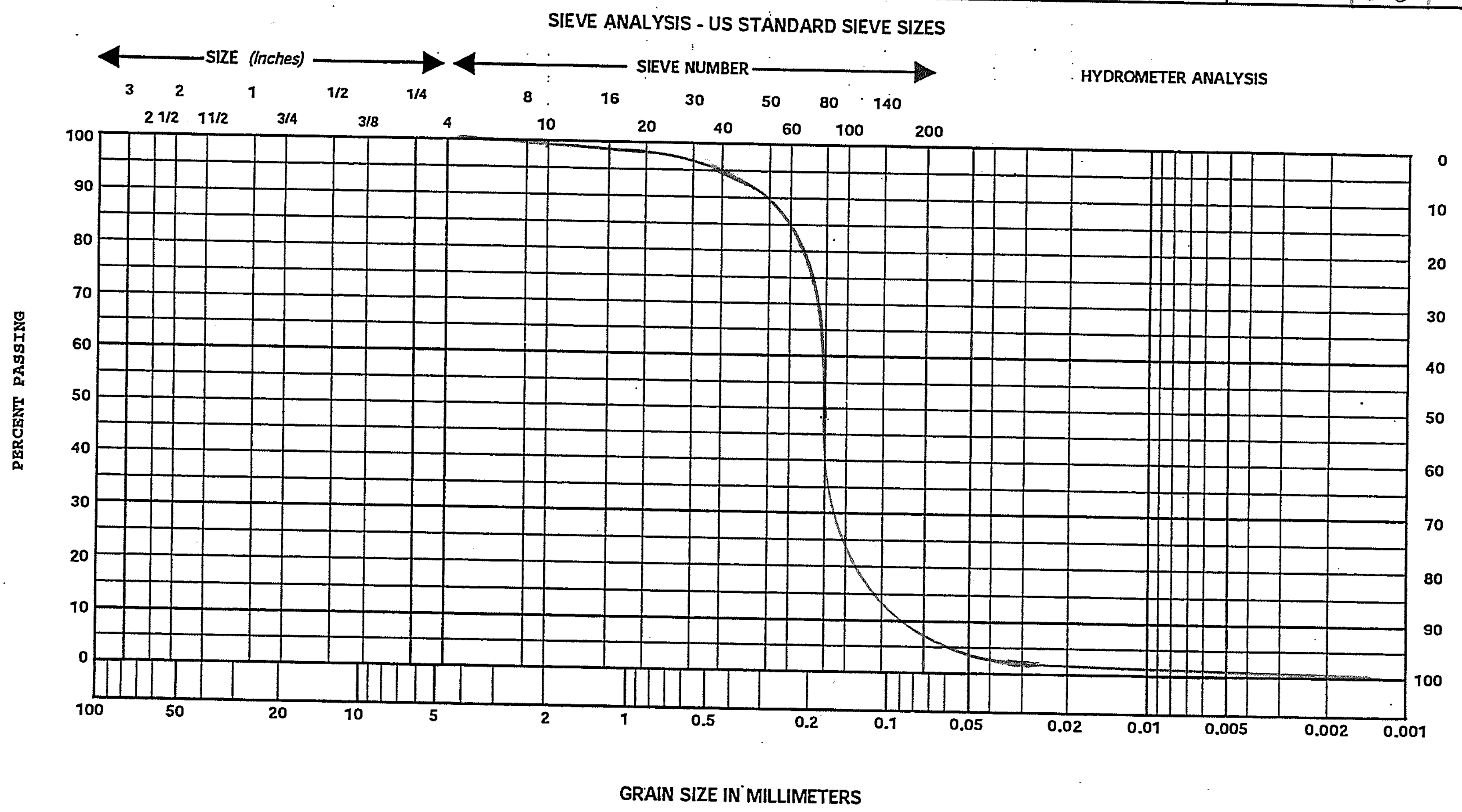
GRAIN SIZE DISTRIBUTION GRAPH - AGGREGATE GRADATION CHART

1. PROJECT Wallops Island M95 Intermodal Barge Service

2. DATE 1/25/24



EXCAVATION NUMBER	SAMPLE NUMBER	LL	PL	PI	Cu (D_{60}/D_{10})	Cc $(D_{30})^2/(D_{60} \times D_{10})$	SOIL DESCRIPTION/REMARKS	CLASSIFICATION (USCS)
D6	S1	NP	NP	NP				SP

3. TECHNICIAN (Signature) [signature]

4. PLOTTED BY (Signature) [signature]

5. CHECKED BY (Signature) [signature]

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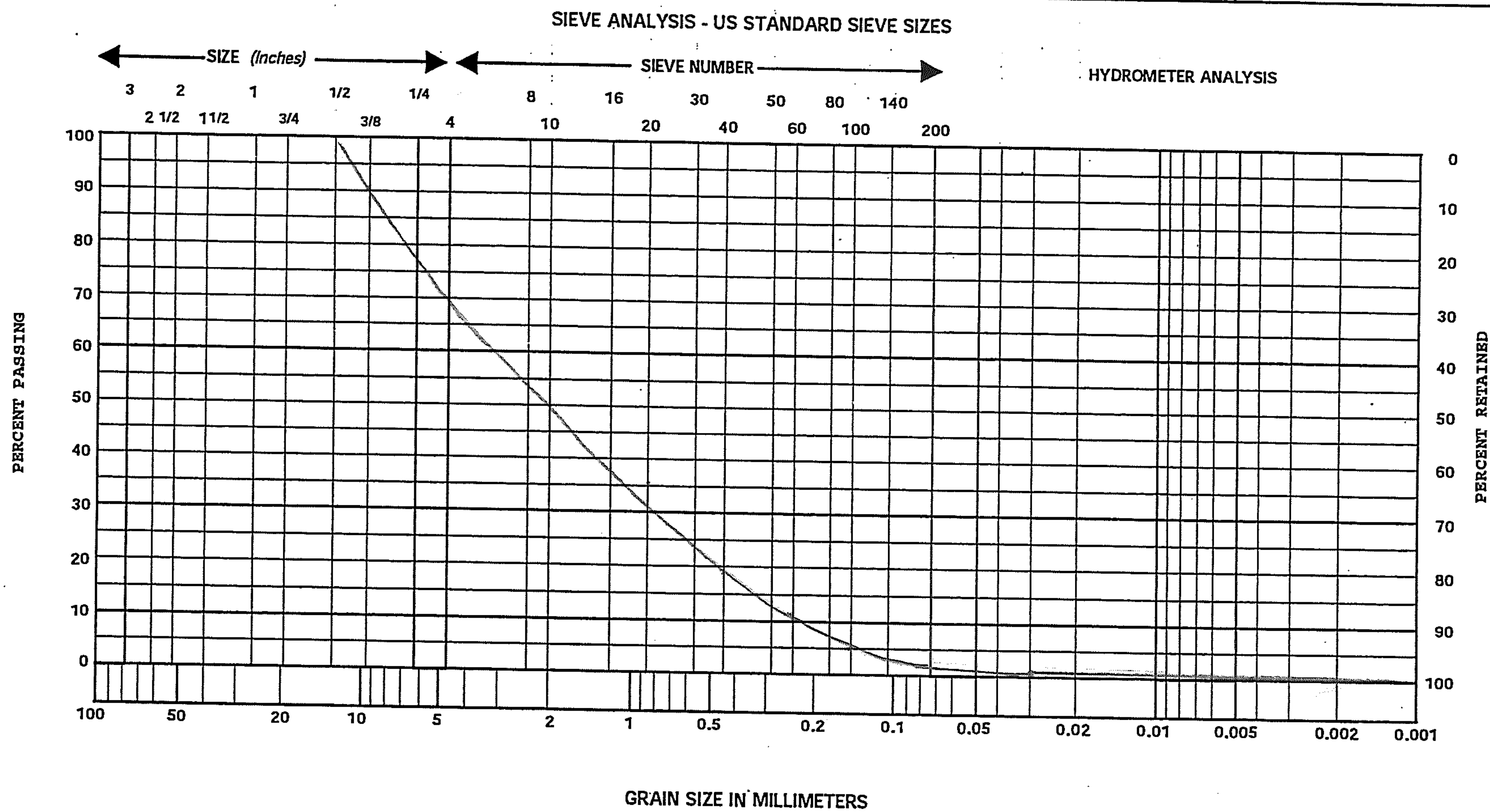
GRAIN SIZE DISTRIBUTION GRAPH - AGGREGATE GRADATION CHART

1. PROJECT Wallops Island MQ5 Intermodal Barge Service

2. DATE 1/29/21



EXCAVATION NUMBER	SAMPLE NUMBER	LL	PL	PI	Cu (D_{60}/D_{10})	Cc $(D_{30})^2/(D_{60} \times D_{10})$	SOIL DESCRIPTION/REMARKS	CLASSIFICATION (USCS)
D6	S3	NP	NP	NP				SP

3. TECHNICIAN *(Signature)* Joe Lowy

4. PLOTTED BY *(Signature)* [signature]

5. CHECKED BY *(Signature)* [signature]

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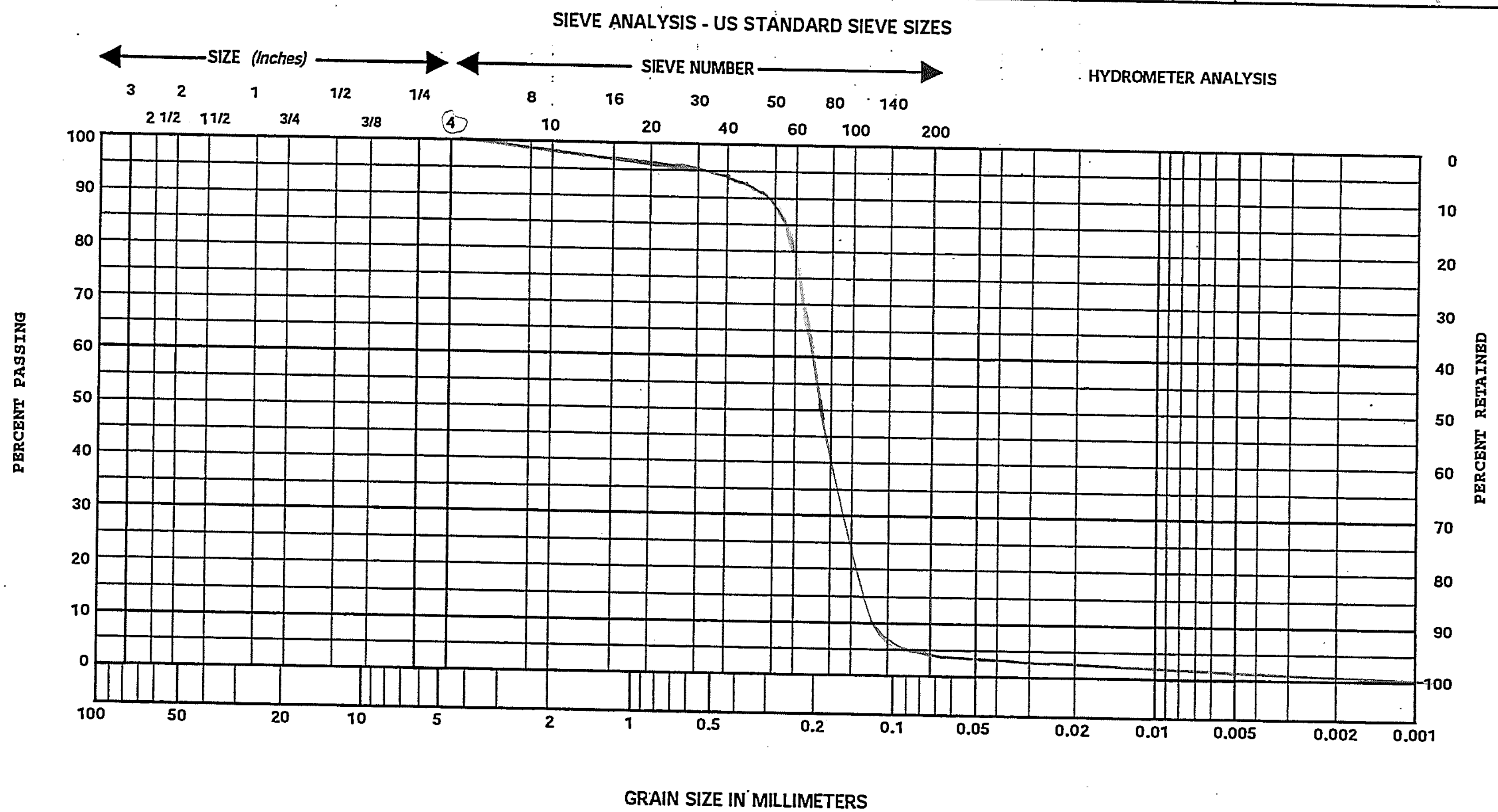
GRAIN SIZE DISTRIBUTION GRAPH - AGGREGATE GRADATION CHART

1. PROJECT: Wallops Island M95 Intermodal Barge Services

2. DATE: 1/29/21



EXCAVATION NUMBER	SAMPLE NUMBER	LL	PL	PI	Cu (D_{60}/D_{10})	Cc $(D_{30})^2/(D_{60} \times D_{10})$	SOIL DESCRIPTION/REMARKS	CLASSIFICATION (USCS)
D9	S7	NP	NP	NP				SP

3. TECHNICIAN *(Signature)* [signature]

4. PLOTTED BY *(Signature)* [signature]

5. CHECKED BY *(Signature)* [signature]

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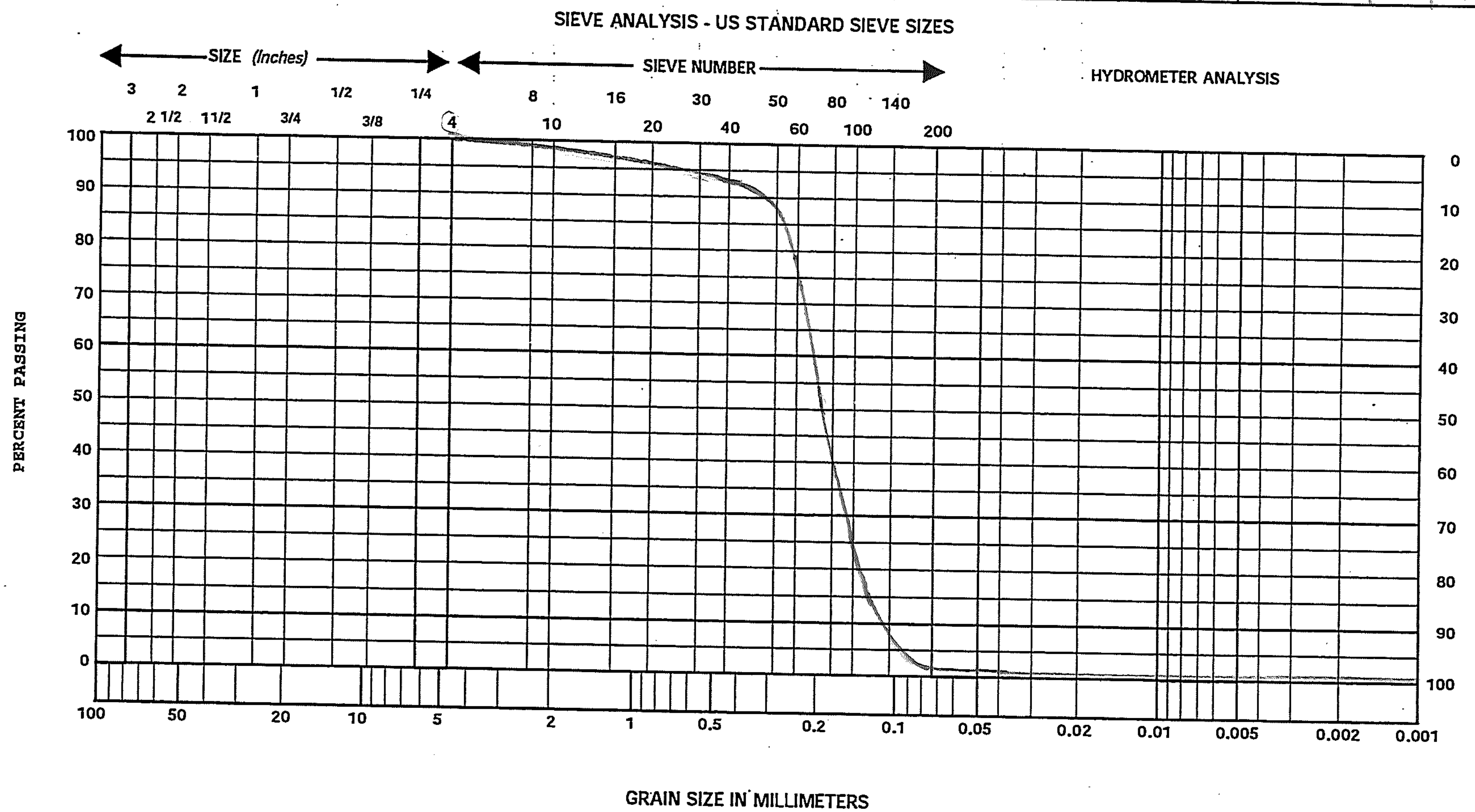
GRAIN SIZE DISTRIBUTION GRAPH - AGGREGATE GRADATION CHART

1. PROJECT Wallops Island M95 Intermodal Barge Service

2. DATE 1/29/21



EXCAVATION NUMBER	SAMPLE NUMBER	LL	PL	PI	Cu (D_{60}/D_{10})	Cc $(D_{30})^2/(D_{60} \times D_{10})$	SOIL DESCRIPTION/REMARKS	CLASSIFICATION (USCS)
D11	S5	NP	NP	NP				SP

3. TECHNICIAN (Signature) Joe Long

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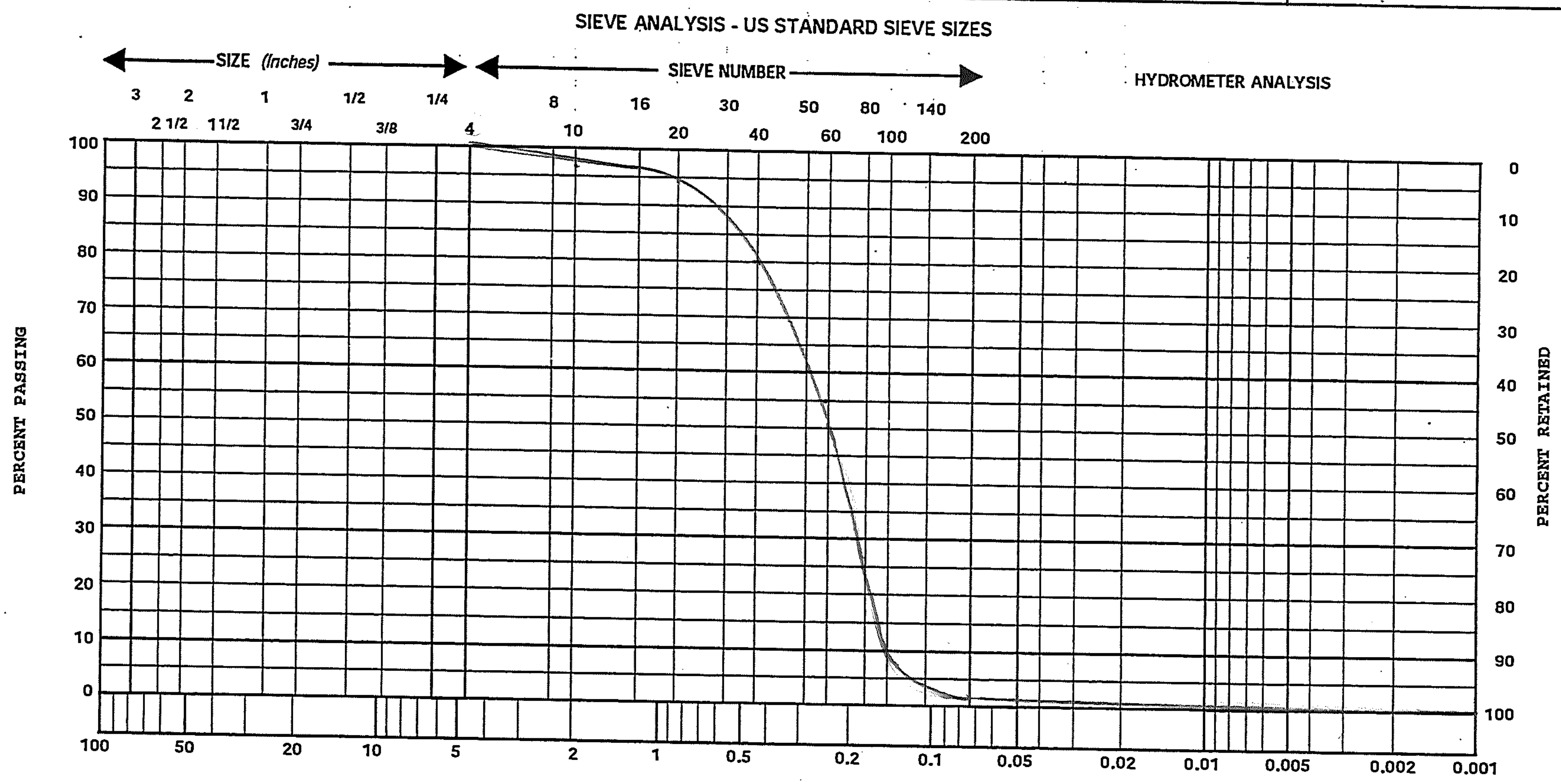
GRAIN SIZE DISTRIBUTION GRAPH - AGGREGATE GRADATION CHART

1. PROJECT Wallops Island M95 Intermodal Barge Service

2. DATE 1/25/21



EXCAVATION NUMBER	SAMPLE NUMBER	LL	PL	PI	Cu (D_{60}/D_{10})	Cc $(D_{30})^2/(D_{60} \times D_{10})$	SOIL DESCRIPTION/REMARKS	CLASSIFICATION (USCS)
D15	S5	NP	NP	NP				SP

3. TECHNICIAN (Signature) Joe Long

4. PLOTTED BY (Signature)

5. CHECKED BY (Signature)

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EBA ENGINEERING

Project: Wallops Island M-95 Intermodal

Client: John D Hynes & Associates, Inc. **Purchase Order #** 13363

EBA Project Number: 4629-00-035

SOIL TESTING SUMMARY

Boring No.	JDH Sample Date	Depth (ft)	Specific Gravity	Moisture Content	Atterberg Limits		Dry Unit Weight
			AASHTO T100	ASTM D2166	ASTM D4813		ASTM D7262
				%	LL	PL	pcf
L-1	11/13/2020	22'-24'	2.672	26.1	NP	NP	98.0

Submitted by: Rita Patel

EBA Laboratory Chief Technician

EBA ENGINEERING

Project: Wallops Island M-95 Intermodal

Client: John D Hynes & Associates, Inc. **Purchase Order #** 13398

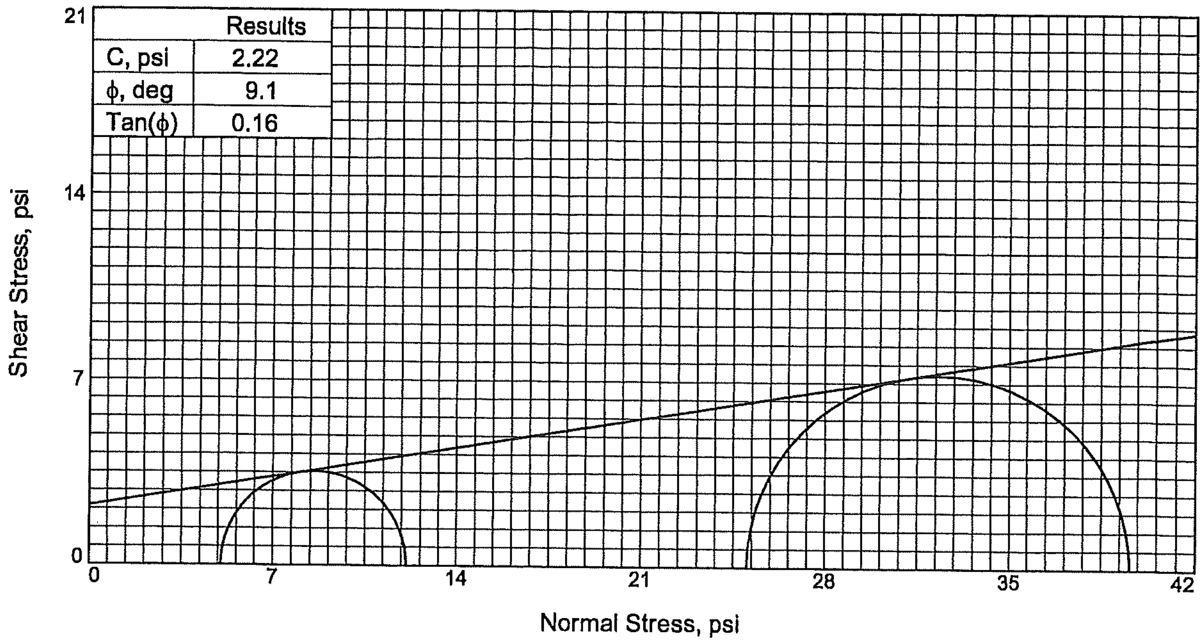
EBA Project Number: 4629-00-035

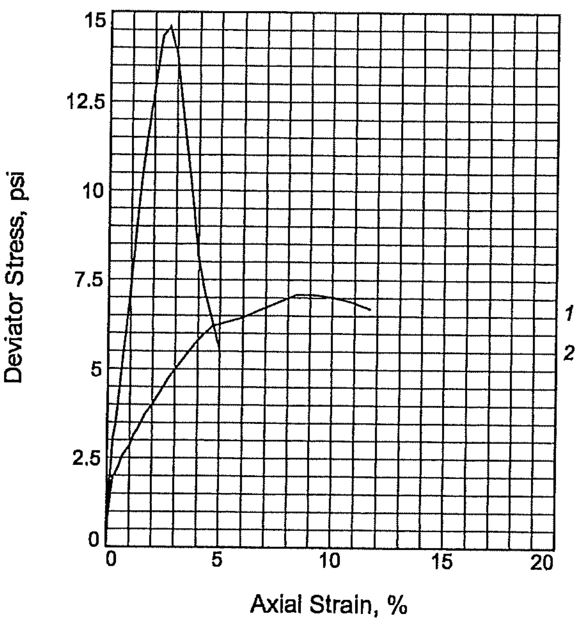
SOIL TESTING SUMMARY

Boring No.	JDH Sample Date	Depth (ft)	Specific Gravity	Moisture Content	Atterberg Limits		Dry Unit Weight
			AASHTO T100	ASTM D2166	ASTM D4813		ASTM D7262
				%	LL	PL	pcf
P-5	12/21/2020	42'-44'	2.714	42.6	36	17	78.6

Submitted by: Rita Patel

EBA Laboratory Chief Technician





Sample No.		1	2
Initial	Water Content, %	41.5	36.7
	Dry Density, pcf	78.6	83.8
	Saturation, %	97.5	97.6
	Void Ratio	1.1563	1.0211
	Diameter, in.	2.89	2.86
	Height, in.	6.00	6.02
At Test	Water Content, %	42.6	37.6
	Dry Density, pcf	78.6	83.8
	Saturation, %	100.0	100.0
	Void Ratio	1.1563	1.0211
	Diameter, in.	2.89	2.86
	Height, in.	6.00	6.02
Strain rate, in./min.		0.045	0.045
Back Pressure, psi		0.0	0.0
Cell Pressure, psi		5.0	25.0
Fail. Stress, psi		7.1	14.6
Ult. Stress, psi			
σ_1 Failure, psi		12.1	39.6
σ_3 Failure, psi		5.0	25.0

Type of Test:
Unconsolidated Undrained
Sample Type: Undisturbed Shelby tube
Description: Visual classification: sandy lean clay

LL= 36 **PL=** 17 **PI=** 19
Specific Gravity= 2.714
Remarks: Date tested: 12/29/2020

Figure ________

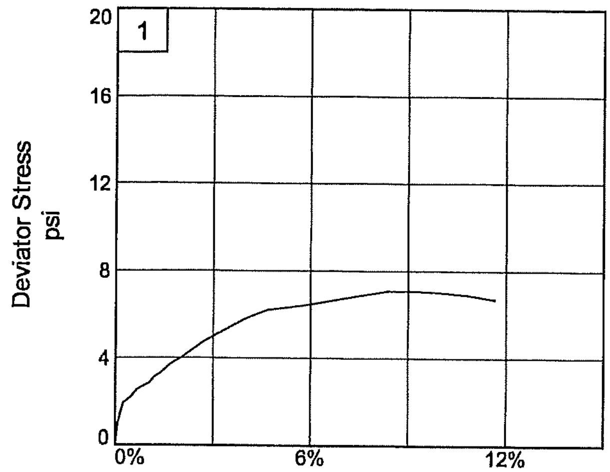
Client: JDH

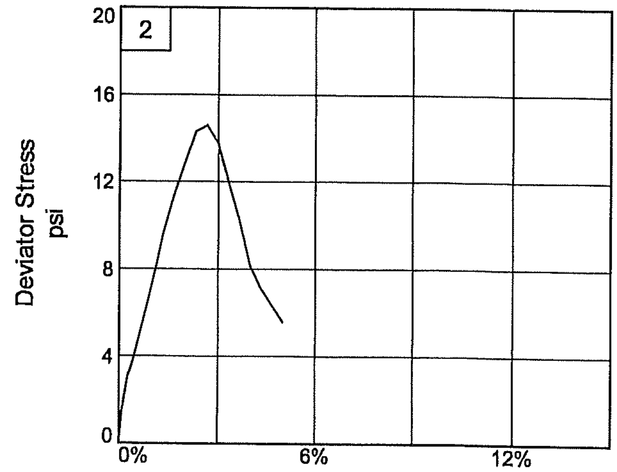
Project: Wallops Island M-95 Intermodal

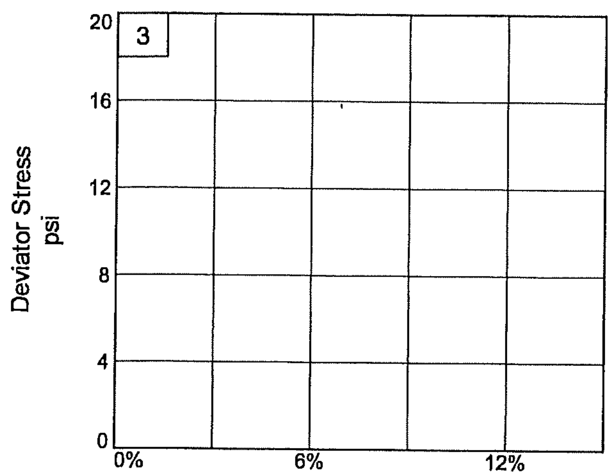
Source of Sample: P-5 **Depth:** 42'-44'
Sample Number: P-5
Proj. No.: 4629-00-035 **Date Sampled:** 12/21/2020

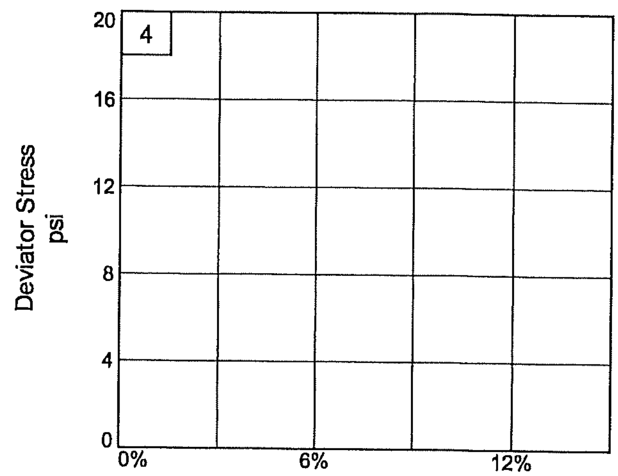
TRIAXIAL SHEAR TEST REPORT
EBA Engineering, Inc.
Laurel, MD

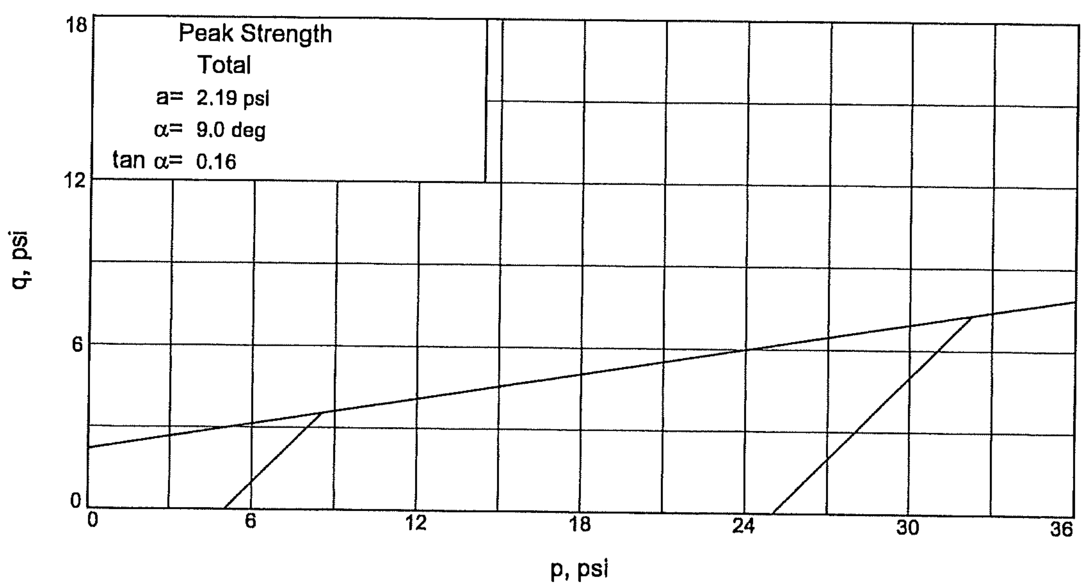
Tested By: RD **Checked By:** JK











Client: JDH
Project: Wallops Island M-95 Intermodal
Source of Sample: P-5 **Depth:** 42'-44' **Sample Number:** P-5
Project No.: 4629-00-035 **Figure** ________

EBA Engineering, Inc.

Tested By: RD **Checked By:** JK

PRESSUREMETER TEST REPORT

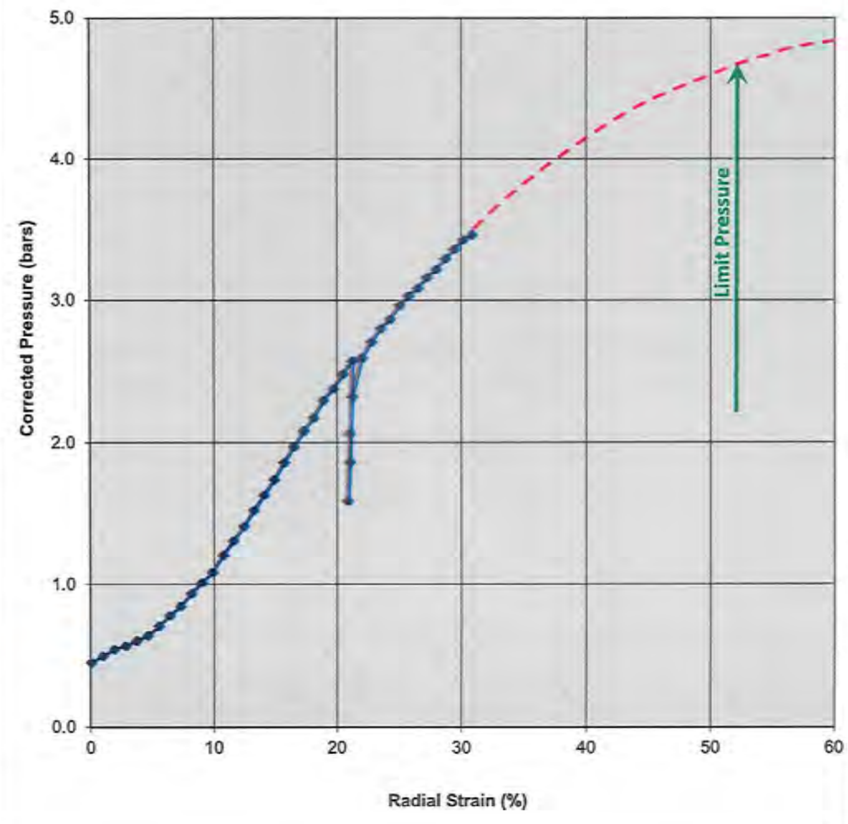
PROJECT:	Wallops Island Northern Development	BORING:	P-2
LOCATION:	Wallops Island, Virginia	TEST #:	1
IN-SITU SOIL TESTING, L.C.		DEPTH:	12.9 ft
ENGINEER:	Roger A. Failmezger, P.E., F. ASCE, D GE	TEST DATE:	December 29, 2020

Note: ***Depth*** refers to the distance from the ground surface to center of NX Probe.

Pressure Bar	Volume cm^3	$\Delta R/R_o$ %	Selected
0.45	0	0.00	
0.50	40	0.93	
0.55	80	1.85	
0.57	120	2.76	
0.61	160	3.67	
0.64	200	4.56	
0.71	240	5.45	
0.78	280	6.33	
0.85	319	7.21	
0.93	359	8.08	
1.01	399	8.94	
1.08	439	9.79	
1.21	479	10.64	
1.31	519	11.48	
1.41	559	12.31	
1.52	599	13.14	
1.63	639	13.96	
1.74	679	14.78	E0a
1.86	719	15.59	
1.97	759	16.39	
2.08	799	17.19	
2.17	839	17.99	
2.30	878	18.77	E0b
2.38	918	19.56	
2.48	958	20.34	
2.57	998	21.11	E1a
1.86	989	20.92	
1.59	979	20.73	E1b
2.06	989	20.92	
2.32	998	21.11	E1c
2.59	1038	21.88	
2.71	1078	22.64	
2.80	1118	23.40	
2.87	1158	24.15	
2.96	1198	24.90	
3.03	1238	25.65	
3.08	1278	26.39	
3.16	1318	27.13	
3.22	1358	27.86	
3.29	1398	28.59	
3.36	1438	29.31	
3.42	1478	30.03	
3.46	1518	30.75	

	Interpreted Pressuremeter Parameters		
	P_o	0.8	bar
	Limit Pressure Strain	52.0%	
	P_L	4.7	bar
	P_L^*	3.9	bar
	E_o	22	bar
	E_o/P_L^*	5.6	bar
Loop #	Unload Modulus	Reload Modulus	
1	422	313	bar
2	#DIV/0!	#DIV/0!	bar
3	#DIV/0!	#DIV/0!	bar

Corrected Pressuremeter Test Results



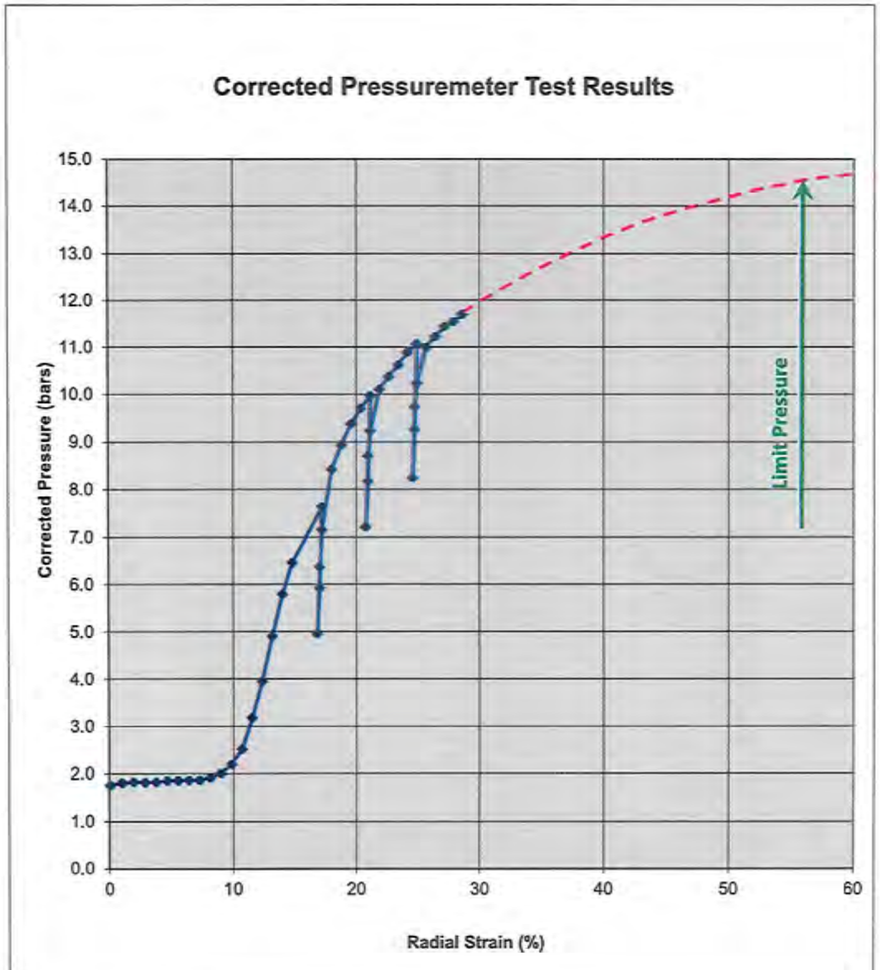
PRESSUREMETER TEST REPORT

PROJECT:	Wallops Island Northern Development	BORING:	P-2
LOCATION:	Wallops Island, Virginia	TEST #:	1
IN-SITU SOIL TESTING, L.C.		DEPTH:	55.5 ft
ENGINEER:	Roger A. Failmezger, P.E., F. ASCE, D GE	TEST DATE:	December 29, 2020

Note: ***Depth*** refers to the distance from the ground surface to center of NX Probe.

Pressure Bar	Volume cm³	ΔR/R₀ %	Selected
1.76	0	0.00	
1.81	40	0.93	
1.83	80	1.85	
1.82	120	2.76	
1.83	160	3.67	
1.85	200	4.56	
1.86	240	5.46	
1.86	280	6.34	
1.87	320	7.21	
1.92	360	8.08	
2.00	400	8.94	
2.20	439	9.79	
2.52	479	10.64	
3.18	519	11.47	
3.96	558	12.30	E0a
4.91	598	13.11	
5.80	637	13.92	E0b
6.46	677	14.73	
7.63	796	17.14	E1a
5.94	787	16.95	
4.97	777	16.77	E1b
6.37	787	16.95	
7.15	796	17.14	E1c
8.43	835	17.92	
8.94	875	18.70	
9.38	915	19.48	
9.70	954	20.26	
9.97	994	21.03	E2a
8.18	985	20.86	
7.22	976	20.68	E2b
8.71	985	20.85	
9.23	995	21.04	E2c
10.11	1034	21.80	
10.38	1074	22.56	
10.62	1114	23.32	
10.89	1154	24.07	
11.06	1194	24.82	E3a
9.27	1184	24.65	
8.25	1175	24.48	E3b
9.74	1184	24.65	
10.23	1194	24.83	E3c
10.99	1234	25.57	
11.22	1273	26.31	
11.43	1313	27.04	
11.54	1353	27.78	
11.69	1393	28.50	

	Interpreted Pressuremeter Parameters		
	P_o	2.0	bar
	Limit Pressure Strain	55.8%	
	P_L	14.5	bar
	P_L^*	12.5	bar
	E_o	170	bar
	E_o/P_L^*	13.6	bar
Loop #	Unload Modulus	Reload Modulus	
1	1123	906	bar
2	1244	887	bar
3	1355	929	bar

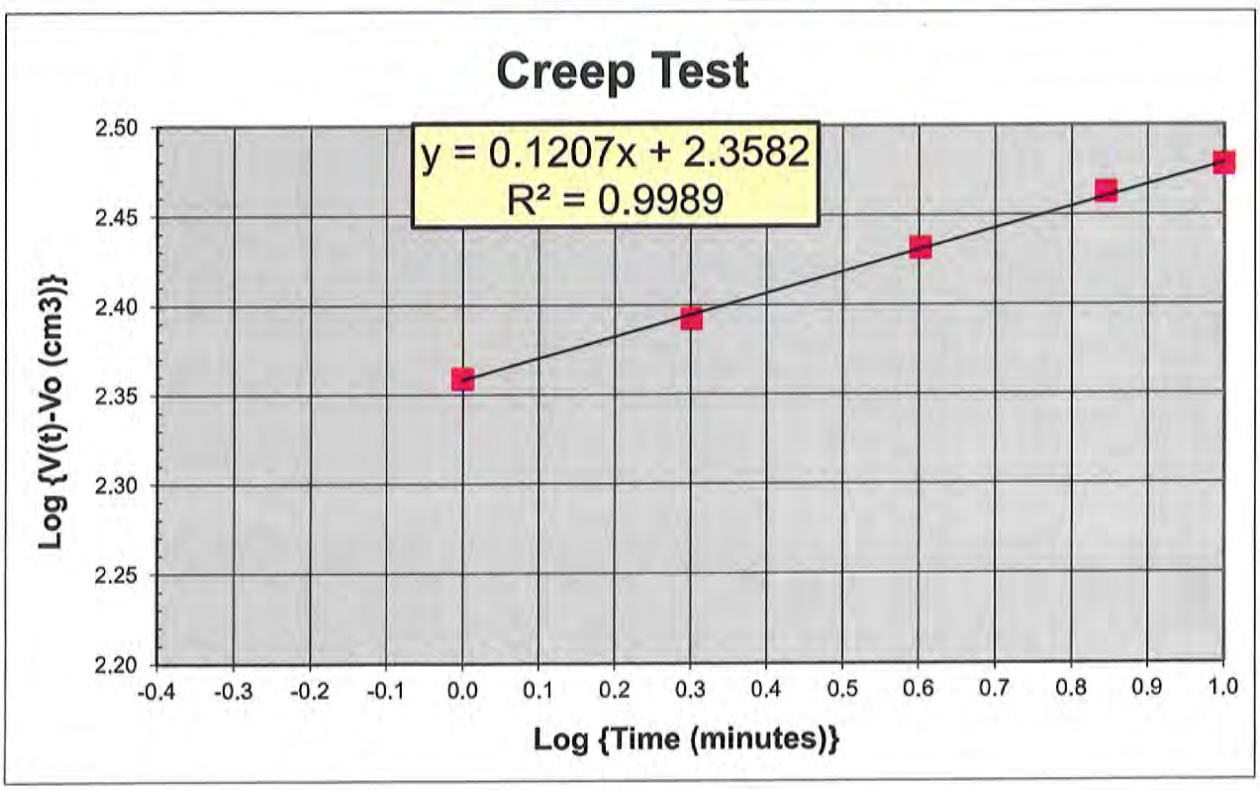


Pressuremeter Creep Test

Project: Wallops Island Northern Development
Sounding No.: P-2
Test Depth: 55.5 feet
Holding Gauge Pressure = 5.15 bars
Corrected Pressure = 6.42 bars
Initial Probe Radius = 3.69 cm
Initial Probe Length = 50 cm
Initial Volume of Probe = 2139 cm^3
Probe Radius Contacting Borehole = 4.08 cm
Initial Borehole Volume, Vo = 2612 cm^3

Time (minutes)	Log (Time) (minutes)	Volume Increase (cm^3)	Total Probe Volume (cm^3)	$V(t)-V_0$ (cm^3)	Log $[V(t)-V_0]$ (cm^3)
1	0.000	701.38	2840.19	228.65	2.359
2	0.301	719.65	2858.46	246.92	2.393
4	0.602	742.73	2881.54	270.00	2.431
7	0.845	762.58	2901.39	289.85	2.462
10	1.000	773.07	2911.88	300.34	2.478

$$E_0(t)/E_0(t=1\text{ min}) = \{t/1\}^{-n}$$
n = 0.1207

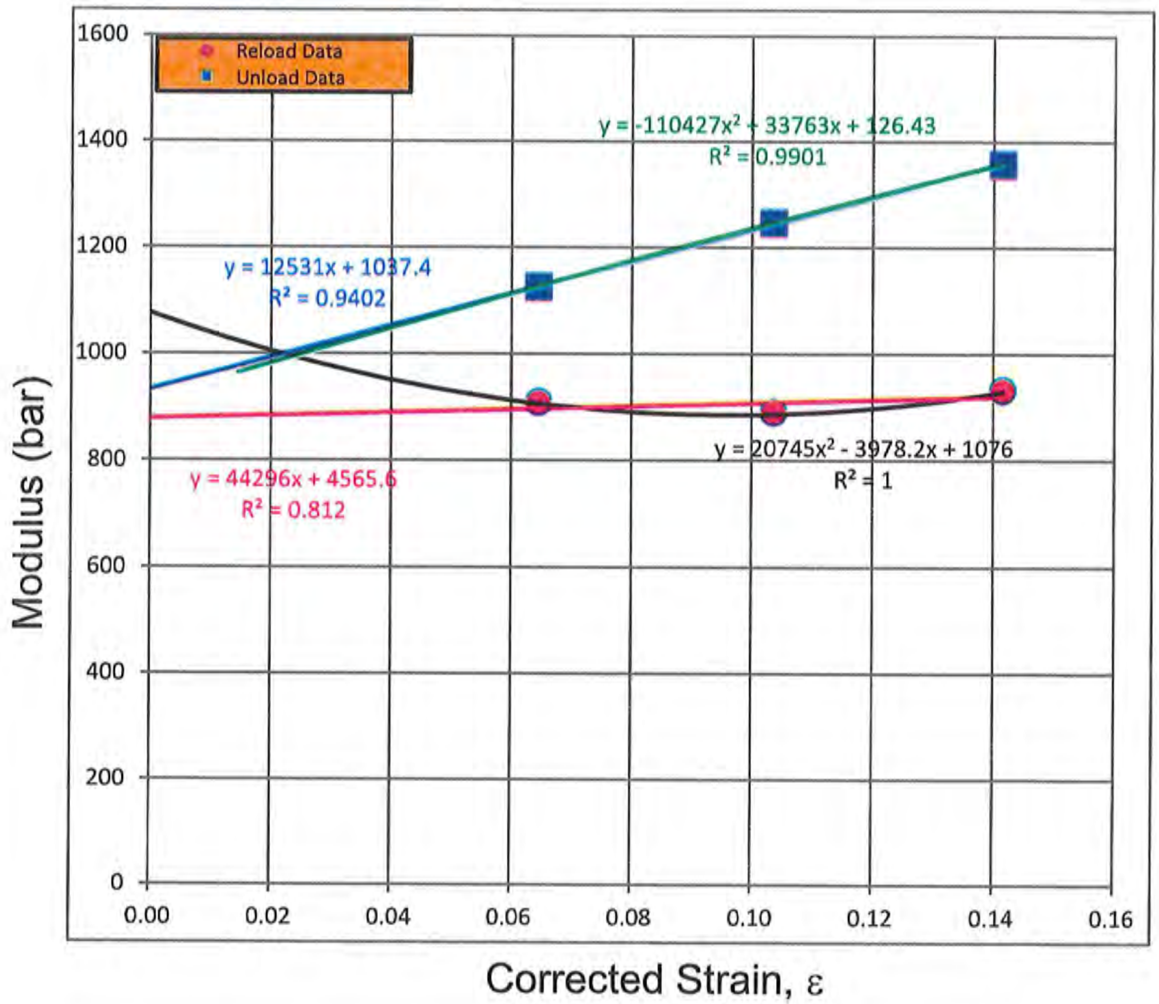


RELOAD/UNLOAD MODULUS ANALYSES

PROJECT:	Wallops Island Northern Development	BORING:	P-2
LOCATION:	Wallops Island, Virginia	TEST #:	1
IN-SITU SOIL TESTING, L.C.		DEPTH:	55.5 ft
ENGINEER:	Roger A. Failmezger, P.E., F. ASCE, D GE	TEST DATE:	12/29/2020

Strain to contact borehole = 0.105

Average Strain	Corrected Strain	Reload Modulus	Average Strain	Corrected Strain	Unload Modulus
0.1695	0.0645	906	0.1695	0.0645	1123
0.2086	0.1036	887	0.2085	0.1035	1244
0.2465	0.1415	929	0.2465	0.1415	1355



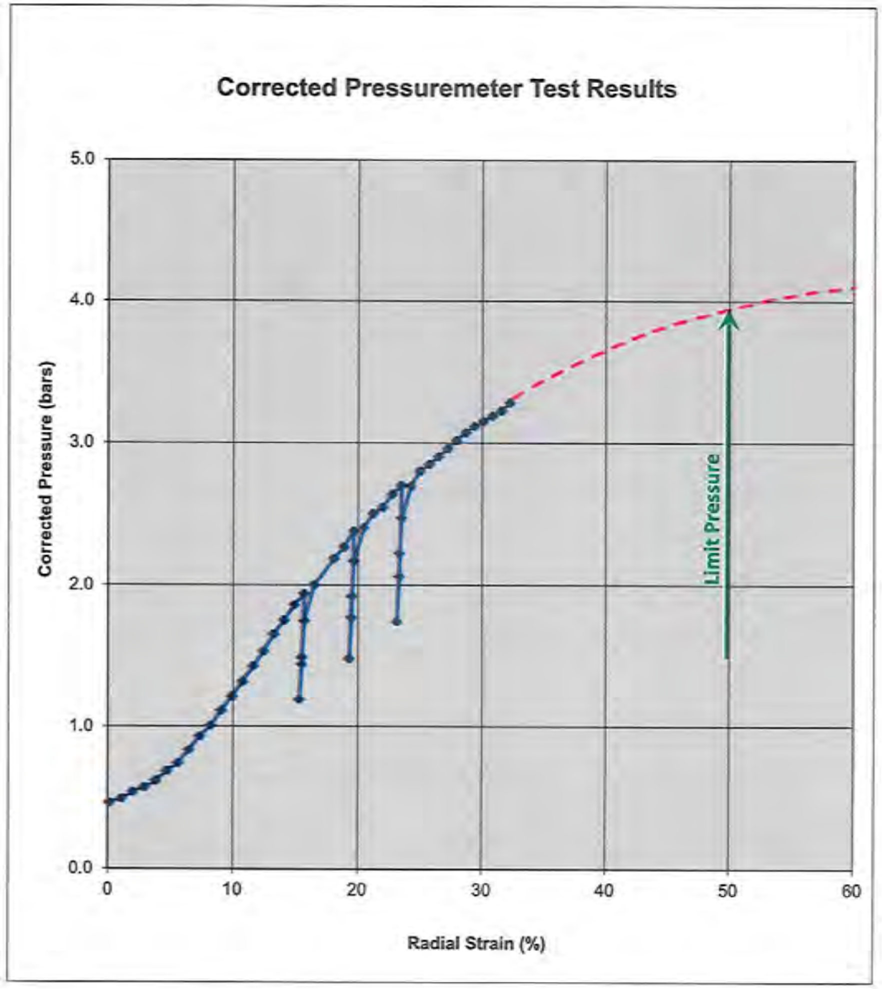
PRESSUREMETER TEST REPORT

PROJECT: Wallops Island Northern Development		BORING:	P-2A
LOCATION: Wallops Island, Virginia		TEST #:	1
IN-SITU SOIL TESTING, L.C.		DEPTH:	14.0 ft
ENGINEER: Roger A. Failmezger, P.E., F. ASCE, D GE		TEST DATE:	December 30, 2020

Note: ***Depth*** refers to the distance from the ground surface to center of NX Probe.

Pressure Bar	Volume cm^3	$\Delta R/R_o$ %	Selected
0.46	0	0.00	
0.49	40	0.93	
0.54	80	1.85	
0.57	120	2.76	
0.62	160	3.67	
0.68	200	4.56	
0.74	240	5.45	
0.83	280	6.33	
0.93	319	7.21	
1.01	359	8.08	
1.11	399	8.94	
1.22	439	9.79	
1.32	479	10.64	
1.43	519	11.48	
1.53	559	12.31	E0a
1.65	599	13.14	
1.75	639	13.96	
1.86	679	14.78	E0b
1.94	719	15.59	E1a
1.44	709	15.39	
1.19	699	15.19	E1b
1.49	709	15.39	
1.75	719	15.59	E1c
2.00	759	16.39	
2.19	839	17.99	
2.27	879	18.78	
2.38	918	19.56	E2a
1.77	909	19.37	
1.48	899	19.18	E2b
1.92	909	19.37	
2.17	919	19.56	E2c
2.40	958	20.34	
2.50	998	21.11	
2.55	1038	21.88	
2.64	1078	22.64	
2.70	1118	23.40	E3a
2.06	1109	23.22	
1.74	1099	23.03	E3b
2.22	1109	23.22	
2.47	1118	23.41	E3c
2.70	1158	24.16	
2.80	1198	24.91	
2.85	1238	25.65	
2.91	1278	26.39	
2.96	1318	27.13	
3.02	1358	27.86	
3.07	1398	28.59	
3.12	1438	29.32	
3.16	1478	30.04	
3.19	1518	30.75	
3.23	1558	31.47	
3.28	1598	32.18	

	Interpreted Pressuremeter Parameters		
	P_o	0.8	bar
	Limit Pressure Strain	49.7%	
	P_L	3.9	bar
	P_L^*	3.1	bar
	E_o	20	bar
	E_o/P_L^*	6.5	bar
Loop #	Unload Modulus	Reload Modulus	
1	289	214	bar
2	373	283	bar
3	426	321	bar

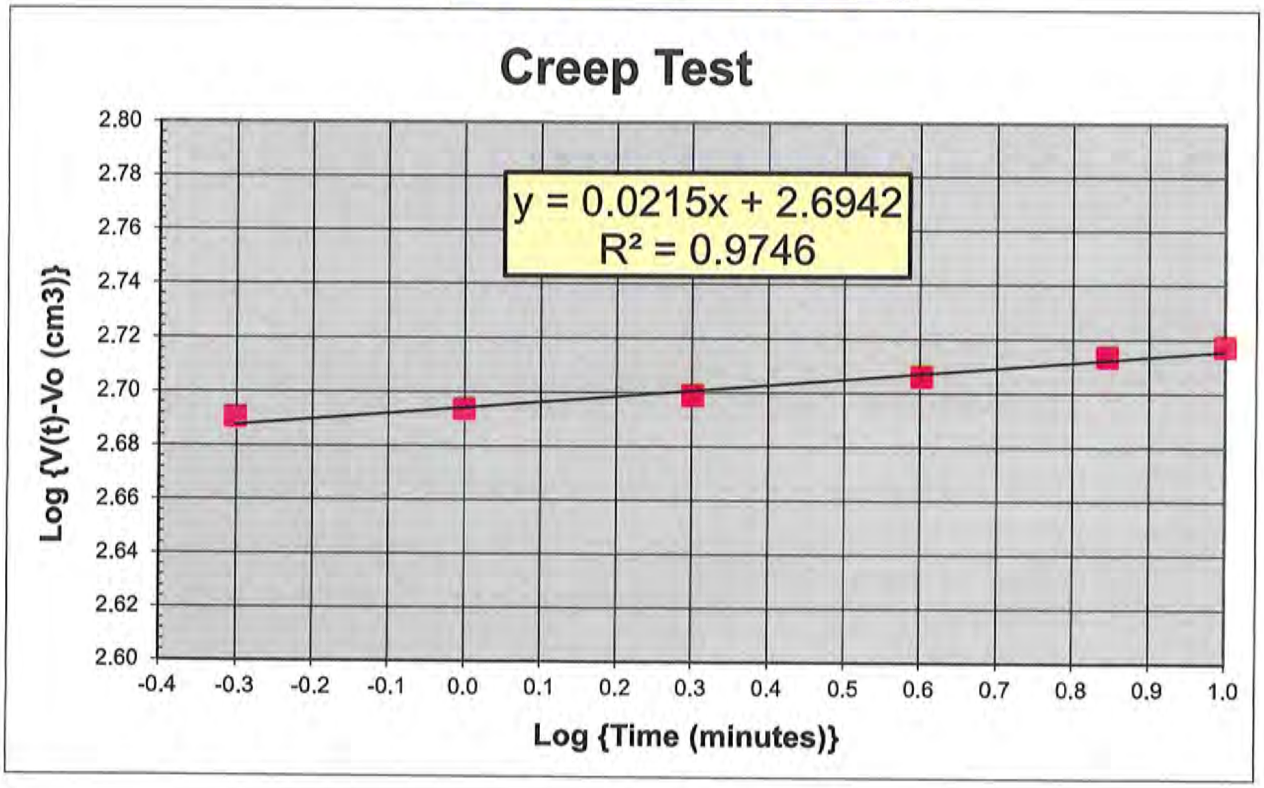


Pressuremeter Creep Test

Project: Wallops Island Northern Development
Sounding No.: P-2A
Test Depth: 14.0 feet
Holding Gauge Pressure = 1.95 bars
Corrected Pressure = 2.00 bars
Initial Probe Radius = 3.69 cm
Initial Probe Length = 50 cm
Initial Volume of Probe = 2139 cm^3
Probe Radius Contacting Borehole = 3.92 cm
Initial Borehole Volume, Vo = 2412 cm^3

Time (minutes)	Log (Time) (minutes)	Volume Increase (cm^3)	Total Probe Volume (cm^3)	$V(t)-V_0$ (cm^3)	Log $[V(t)-V_0]$ (cm^3)
0.5	-0.301	763.12	2901.93	489.69	2.690
1	0.000	766.85	2905.66	493.42	2.693
2	0.301	772.87	2911.68	499.44	2.698
4	0.602	781.23	2920.04	507.80	2.706
7	0.845	789.98	2928.79	516.55	2.713
10	1.000	794.72	2933.53	521.29	2.717

$E_0(t)/E_0(t=1\ min) = \{t/1\}^{-n}$
n = 0.0215

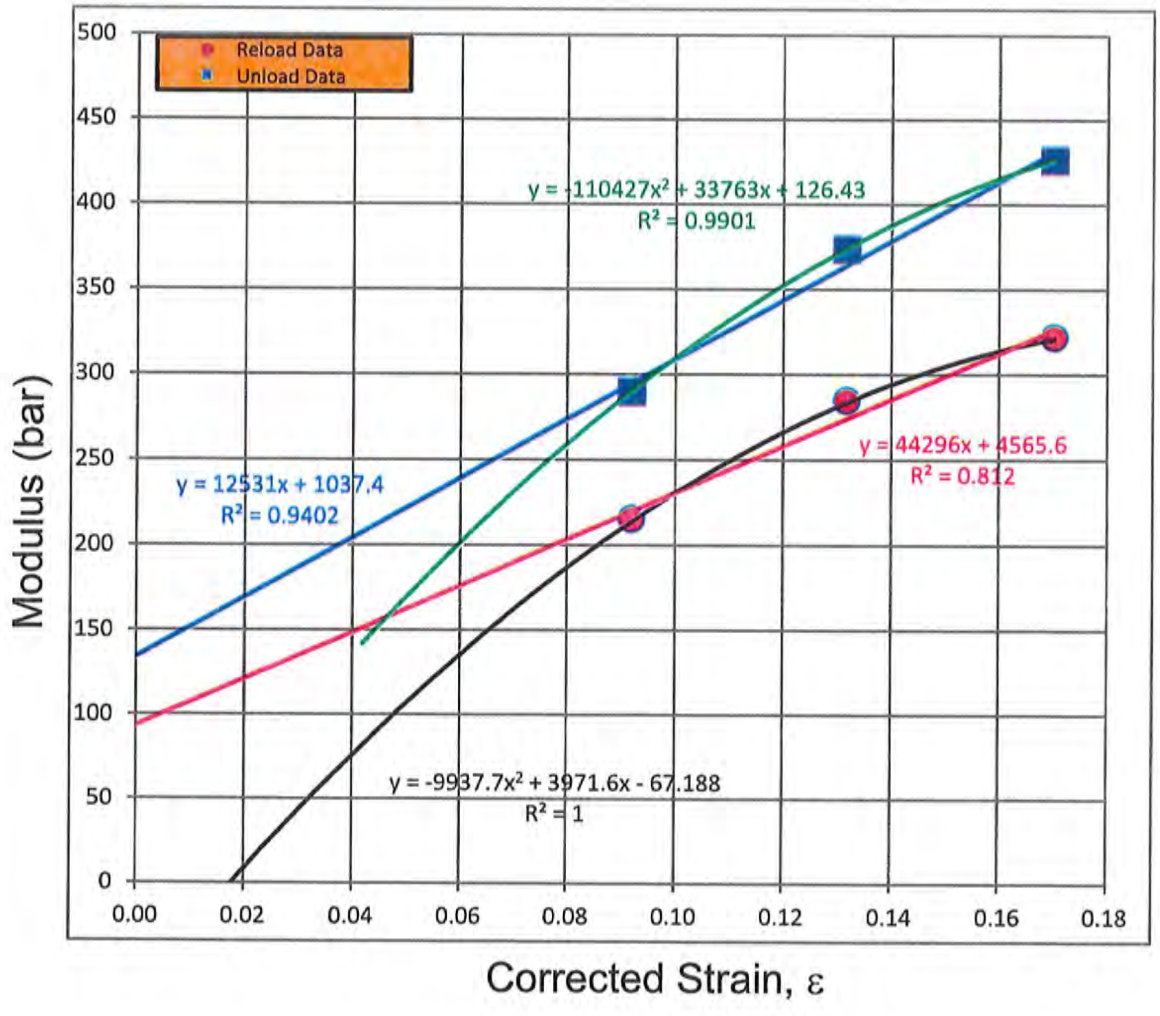


RELOAD/UNLOAD MODULUS ANALYSES

PROJECT:	Wallops Island Northern Development	BORING:	P-2A
LOCATION:	Wallops Island, Virginia	TEST #:	1
IN-SITU SOIL TESTING, L.C.		DEPTH:	14.0 ft
ENGINEER:	Roger A. Failmezger, P.E., F. ASCE, D GE	TEST DATE:	12/30/2020

Strain to contact borehole = 0.062

Average Strain	Corrected Strain	Reload Modulus	Average Strain	Corrected Strain	Unload Modulus
0.1539	0.0919	214	0.1539	0.0919	289
0.1937	0.1317	283	0.1937	0.1317	373
0.2322	0.1702	321	0.2322	0.1702	426



PRESSUREMETER TEST REPORT

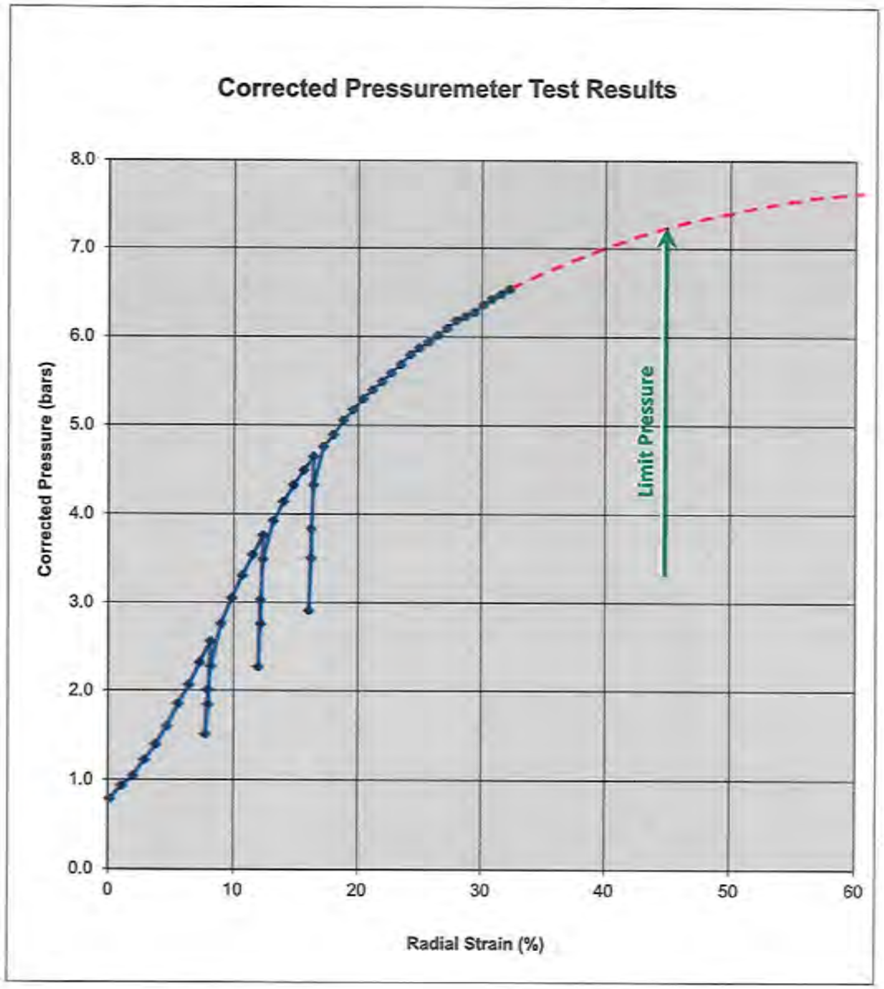
PROJECT:	Wallops Island Northern Development	BORING:	P-2A
LOCATION:	Wallops Island, Virginia	TEST #:	2
IN-SITU SOIL TESTING, L.C.		DEPTH:	24.0 ft
ENGINEER:	Roger A. Failmezger, P.E., F. ASCE, D GE	TEST DATE:	December 30, 2020

Note: ***Depth*** refers to the distance from the ground surface to center of NX Probe.

Pressure Bar	Volume cm³	$\Delta R/R_o$ %	Selected
0.78	0	0.00	
0.93	40	0.93	
1.04	80	1.85	
1.22	120	2.76	
1.40	159	3.66	
1.60	199	4.55	E0a
1.86	239	5.44	
2.07	279	6.32	
2.33	319	7.19	E0b
2.56	359	8.06	E1a
1.85	349	7.85	
1.51	339	7.64	E1b
2.02	349	7.85	
2.28	359	8.06	E1c
2.76	398	8.92	
3.05	438	9.77	
3.31	478	10.61	
3.54	518	11.45	
3.76	558	12.29	E2a
2.76	548	12.09	
2.27	539	11.89	E2b
3.03	548	12.09	
3.49	558	12.29	E2c
3.92	598	13.11	
4.14	638	13.93	
4.33	677	14.75	
4.50	717	15.56	
4.65	757	16.36	E3a
3.50	748	16.17	
2.91	738	15.98	E3b
3.83	748	16.17	
4.33	757	16.37	E3c
4.76	797	17.16	
4.89	837	17.95	
5.06	877	18.74	
5.18	917	19.53	
5.30	957	20.30	
5.40	997	21.08	
5.49	1037	21.85	
5.60	1077	22.61	
5.69	1116	23.37	
5.80	1156	24.12	
5.87	1196	24.87	
5.94	1236	25.62	
6.01	1276	26.36	
6.09	1316	27.10	
6.18	1356	27.83	
6.22	1396	28.56	
6.27	1436	29.28	
6.35	1476	30.00	
6.42	1516	30.72	
6.48	1556	31.43	
6.53	1596	32.14	

Interpreted Pressuremeter Parameters		
P_o	1.2	bar
Limit Pressure Strain	44.5%	
P_L	7.2	bar
P_L^*	6.0	bar
E_o	39	bar
E_o/P_L^*	6.4	bar

Loop #	Unload Modulus	Reload Modulus	
1	360	262	bar
2	555	450	bar
3	702	566	bar

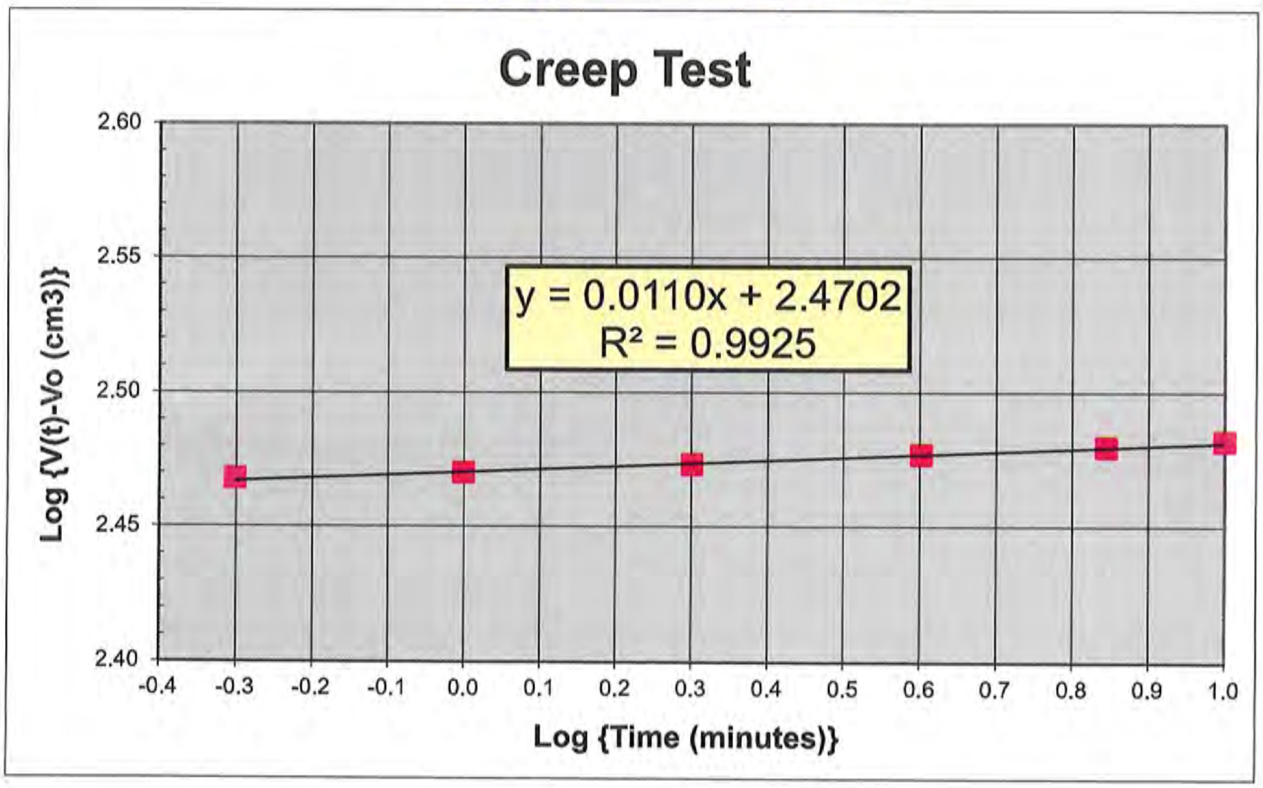


Pressuremeter Creep Test

Project: Wallops Island Northern Development
Sounding No.: P-2A
Test Depth: 24.0 feet
Holding Gauge Pressure = 2.33 bars
Corrected Pressure = 2.76 bars
Initial Probe Radius = 3.69 cm
Initial Probe Length = 50 cm
Initial Volume of Probe = 2139 cm^3
Probe Radius Contacting Borehole = 3.78 cm
Initial Borehole Volume, Vo = 2247 cm^3

Time (minutes)	Log (Time) (minutes)	Volume Increase (cm^3)	Total Probe Volume (cm^3)	$V(t)-V_0$ (cm^3)	Log $[V(t)-V_0]$ (cm^3)
0.5	-0.301	401.73	2540.54	293.45	2.468
1	0.000	403.28	2542.09	295.00	2.470
2	0.301	405.41	2544.22	297.13	2.473
4	0.602	407.93	2546.74	299.65	2.477
7	0.845	409.85	2548.66	301.57	2.479
10	1.000	411.44	2550.25	303.16	2.482

$E_0(t)/E_0(t=1\text{ min}) = \{t/1\}^{-n}$
n = 0.0110

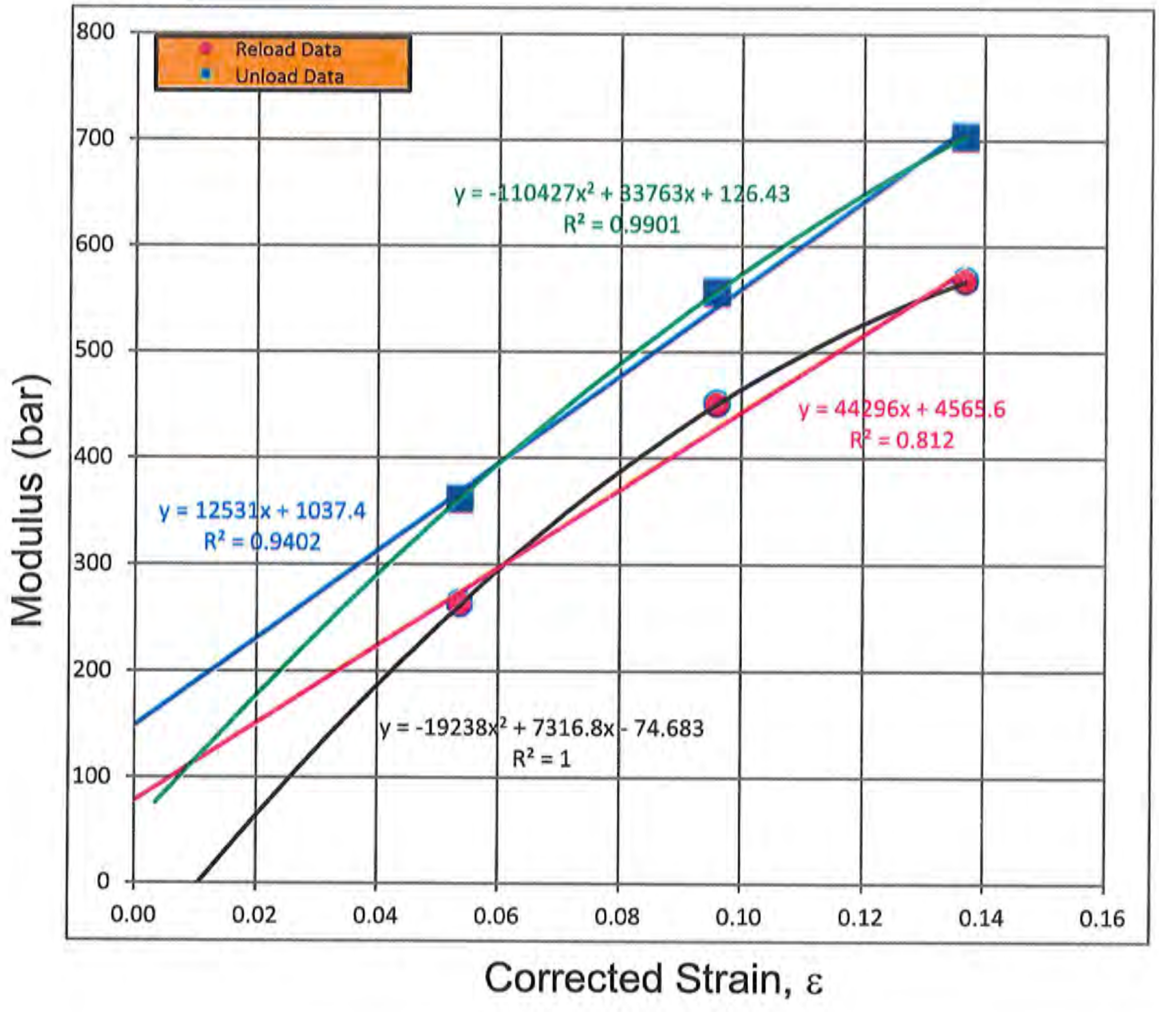


RELOAD/UNLOAD MODULUS ANALYSES

PROJECT:	Wallops Island Northern Development	BORING:	P-2A
LOCATION:	Wallops Island, Virginia	TEST #:	2
IN-SITU SOIL TESTING, L.C.		DEPTH:	24.0 ft
ENGINEER:	Roger A. Failmezger, P.E., F. ASCE, D GE	TEST DATE:	12/30/2020

Strain to contact borehole = 0.025

Average Strain	Corrected Strain	Reload Modulus	Average Strain	Corrected Strain	Unload Modulus
0.0785	0.0535	262	0.0785	0.0535	360
0.1209	0.0959	450	0.1209	0.0959	555
0.1617	0.1367	566	0.1617	0.1367	702



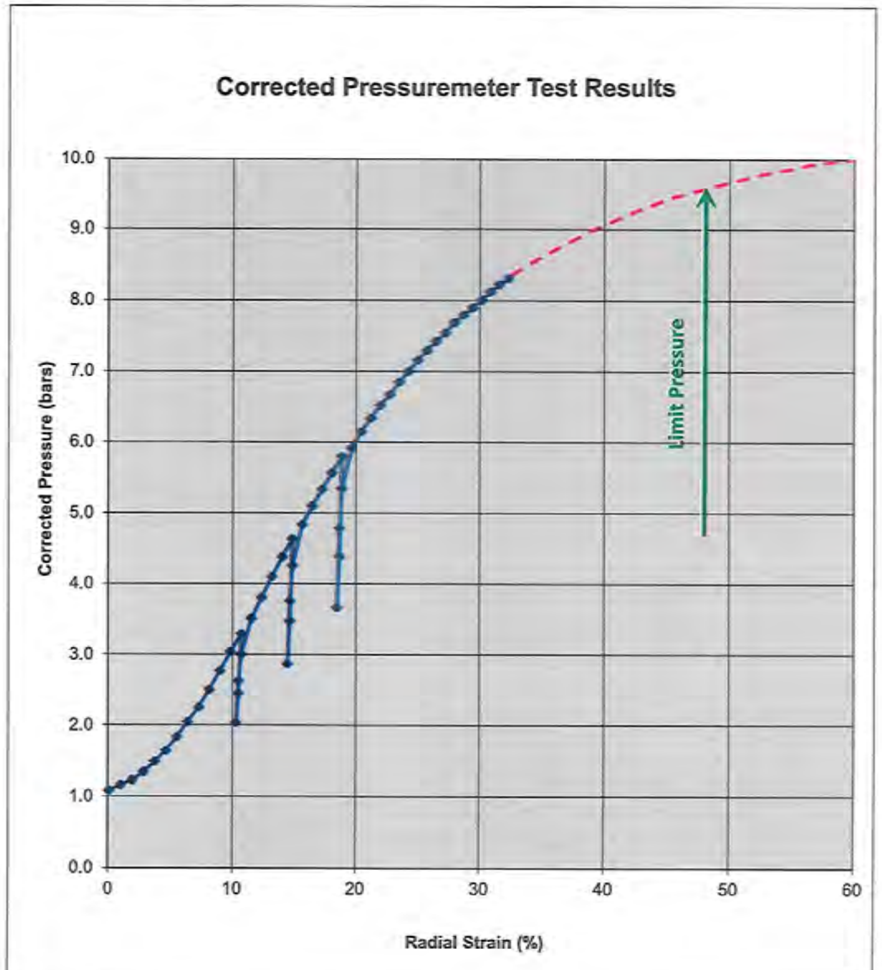
PRESSUREMETER TEST REPORT

PROJECT: Wallops Island Northern Development		BORING:	P-2A
LOCATION: Wallops Island, Virginia		TEST #:	3
IN-SITU SOIL TESTING, L.C.		DEPTH:	35.0 ft
ENGINEER: Roger A. Failmezger, P.E., F. ASCE, D GE		TEST DATE:	December 30, 2020

Note: ***Depth*** refers to the distance from the ground surface to center of NX Probe.

Pressure Bar	Volume cm^3	$\Delta R/R_o$ %	Selected
1.08	0	0.00	
1.16	40	0.93	
1.23	80	1.85	
1.34	120	2.76	
1.49	160	3.66	
1.64	199	4.56	
1.84	239	5.45	
2.05	279	6.33	
2.26	319	7.20	E0a
2.50	359	8.06	
2.77	399	8.92	
3.04	438	9.77	E0b
3.30	478	10.62	E1a
2.45	469	10.42	
2.04	459	10.21	E1b
2.63	469	10.42	
3.01	479	10.62	E1c
3.52	518	11.46	
3.81	558	12.29	
4.10	598	13.11	
4.38	638	13.93	
4.64	677	14.75	E2a
3.48	668	14.56	
2.87	658	14.36	E2b
3.76	668	14.56	
4.26	678	14.75	E2c
4.84	717	15.56	
5.10	757	16.36	
5.33	797	17.16	
5.56	837	17.95	
5.80	877	18.74	E3a
4.39	867	18.55	
3.67	858	18.37	E3b
4.79	867	18.55	
5.35	877	18.74	E3c
5.92	917	19.52	
6.15	956	20.30	
6.34	996	21.07	
6.52	1036	21.84	
6.68	1076	22.60	
6.85	1116	23.36	
7.01	1156	24.11	
7.16	1196	24.86	
7.30	1236	25.61	
7.42	1276	26.35	
7.54	1315	27.08	
7.69	1355	27.82	
7.79	1395	28.54	
7.90	1435	29.27	
8.00	1475	29.99	
8.12	1515	30.70	
8.23	1555	31.42	
8.31	1595	32.12	

Loop #	Interpreted Pressuremeter Parameters		
	P_o	1.5	bar
	Limit Pressure Strain	47.8%	
	P_L	9.6	bar
	P_L^*	8.1	bar
	E_o	44	bar
	E_o/P_L^*	5.5	bar
Loop #	Unload Modulus	Reload Modulus	
1	452	344	bar
2	694	537	bar
3	906	703	bar



Pressuremeter Creep Test

Project: Wallops Island Northern Development

Sounding No.: P-2A

Test Depth: 35.0 feet

Holding Gauge Pressure = 2.78 bars

Corrected Pressure = 3.52 bars

Initial Probe Radius = 3.69 cm

Initial Probe Length = 50 cm

Initial Volume of Probe = 2139 cm^3

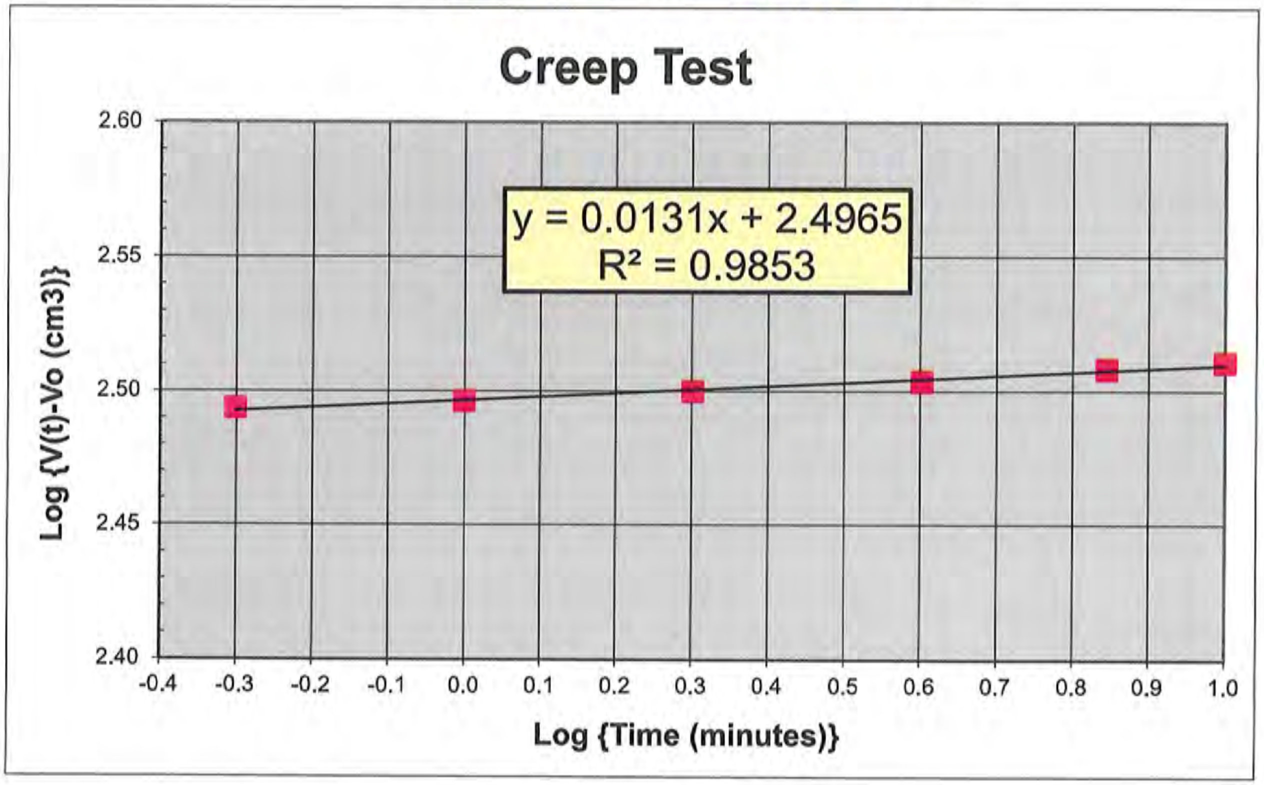
Probe Radius Contacting Borehole = 3.87 cm

Initial Borehole Volume, Vo = 2349 cm^3

Time (minutes)	Log (Time) (minutes)	Volume Increase (cm^3)	Total Probe Volume (cm^3)	$V(t)-V_0$ (cm^3)	Log $[V(t)-V_0]$ (cm^3)
0.5	-0.301	521.79	2660.60	311.54	2.494
1	0.000	523.73	2662.54	313.48	2.496
2	0.301	526.27	2665.08	316.02	2.500
4	0.602	529.04	2667.85	318.79	2.503
7	0.845	532.35	2671.16	322.10	2.508
10	1.000	534.21	2673.02	323.96	2.510

$$E_0(t)/E_0(t=1\ min) = \{t/1\}^{-n}$$

n = 0.0131

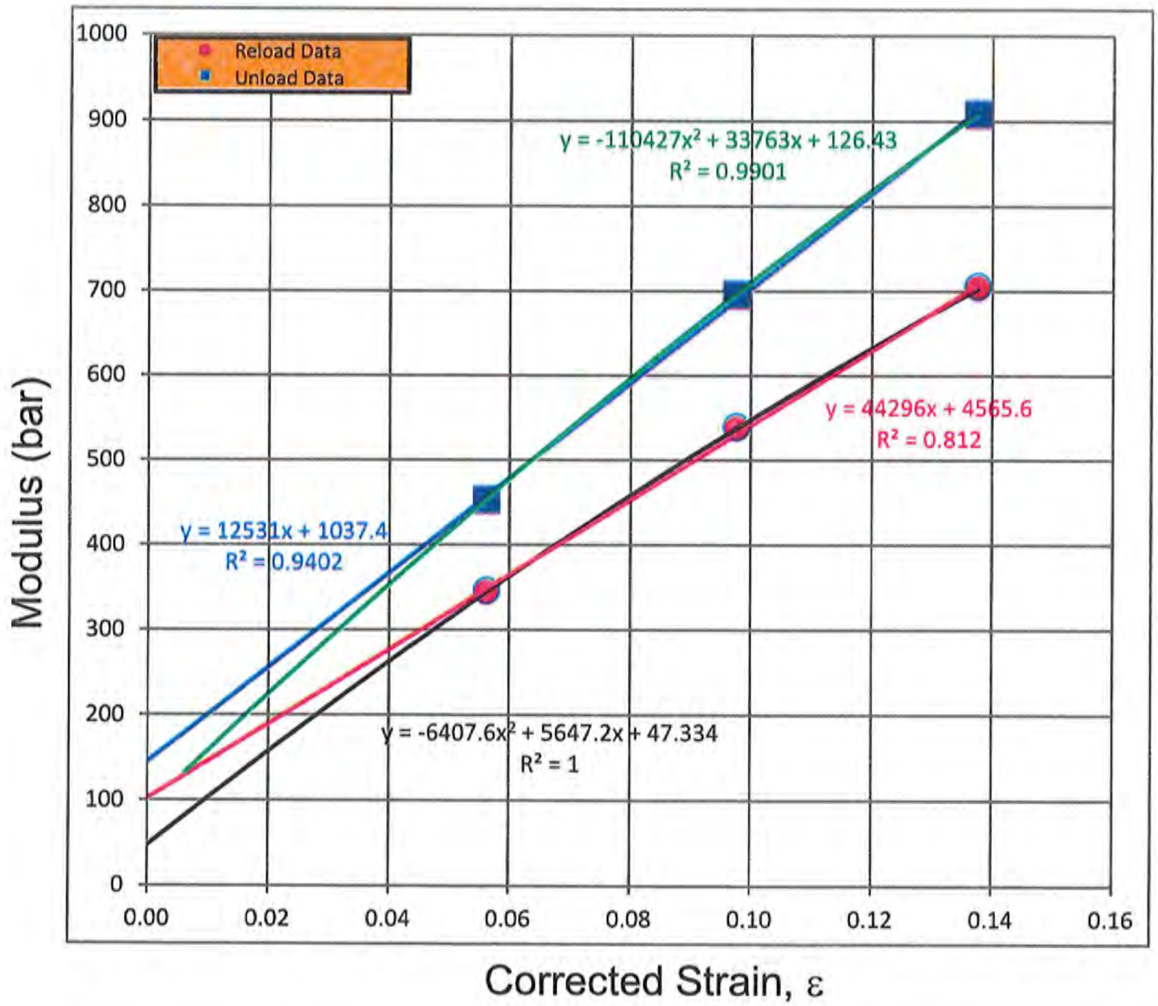


RELOAD/UNLOAD MODULUS ANALYSES

PROJECT:	Wallops Island Northern Development	BORING:	P-2A
LOCATION:	Wallops Island, Virginia	TEST #:	3
IN-SITU SOIL TESTING, L.C.		DEPTH:	35.0 ft
ENGINEER:	Roger A. Failmezger, P.E., F. ASCE, D GE	TEST DATE:	12/30/2020

Strain to contact borehole = 0.048

Average Strain	Corrected Strain	Reload Modulus	Average Strain	Corrected Strain	Unload Modulus
0.1042	0.0562	344	0.1041	0.0561	452
0.1456	0.0976	537	0.1455	0.0975	694
0.1856	0.1376	703	0.1855	0.1375	906



PRESSUREMETER TEST REPORT

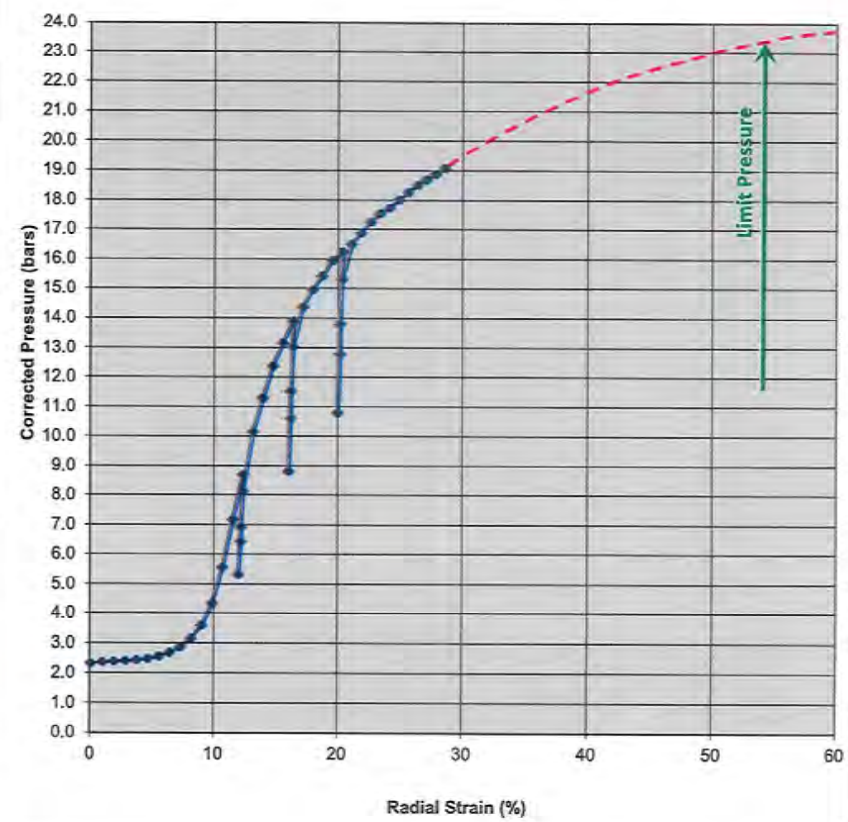
PROJECT: Wallops Island Northern Development		BORING:	P-2A
LOCATION: Wallops Island, Virginia		TEST #:	4
IN-SITU SOIL TESTING, L.C.		DEPTH:	76.0 ft
ENGINEER: Roger A. Failmezger, P.E., F. ASCE, D GE		TEST DATE:	December 30, 2020

Note: *Depth* refers to the distance from the ground surface to center of NX Probe.

Pressure Bar	Volume cm^3	$\Delta R/R_o$ %	Selected
2.32	0	0.00	
2.36	40	0.93	
2.38	80	1.85	
2.40	120	2.76	
2.43	160	3.67	
2.48	200	4.56	
2.56	240	5.45	
2.68	280	6.33	
2.87	319	7.21	
3.14	359	8.07	
3.58	399	8.93	E0a
4.32	438	9.77	
5.57	478	10.60	
7.17	517	11.42	E0b
8.69	556	12.24	E1a
6.43	547	12.05	
5.32	538	11.86	E1b
6.93	547	12.05	
8.13	556	12.25	E1c
10.14	595	13.05	
11.27	634	13.86	
12.36	673	14.66	
13.15	713	15.46	
13.89	752	16.26	E2a
10.61	744	16.09	
8.81	735	15.92	E2b
11.52	744	16.09	
13.01	753	16.27	E2c
14.36	792	17.06	
14.95	831	17.84	
15.42	871	18.63	
15.94	911	19.41	
16.23	951	20.18	E3a
12.77	942	20.02	
10.79	934	19.86	E3b
13.80	942	20.02	
15.31	951	20.20	E3c
16.50	990	20.96	
16.87	1030	21.72	
17.24	1070	22.48	
17.53	1110	23.24	
17.72	1150	23.99	
18.01	1189	24.74	
18.26	1229	25.49	
18.50	1269	26.23	
18.69	1309	26.96	
18.87	1349	27.70	
19.07	1389	28.42	

Loop #	Interpreted Pressuremeter Parameters		
	P_o	2.8	bar
	Limit Pressure Strain	53.4%	
	P_L	23.3	bar
	P_L^*	20.5	bar
	E_o	211	bar
	E_o/P_L^*	10.3	bar
Loop #	Unload Modulus	Reload Modulus	
1	1336	1092	bar
2	2284	1827	bar
3	2645	2122	bar

Corrected Pressuremeter Test Results

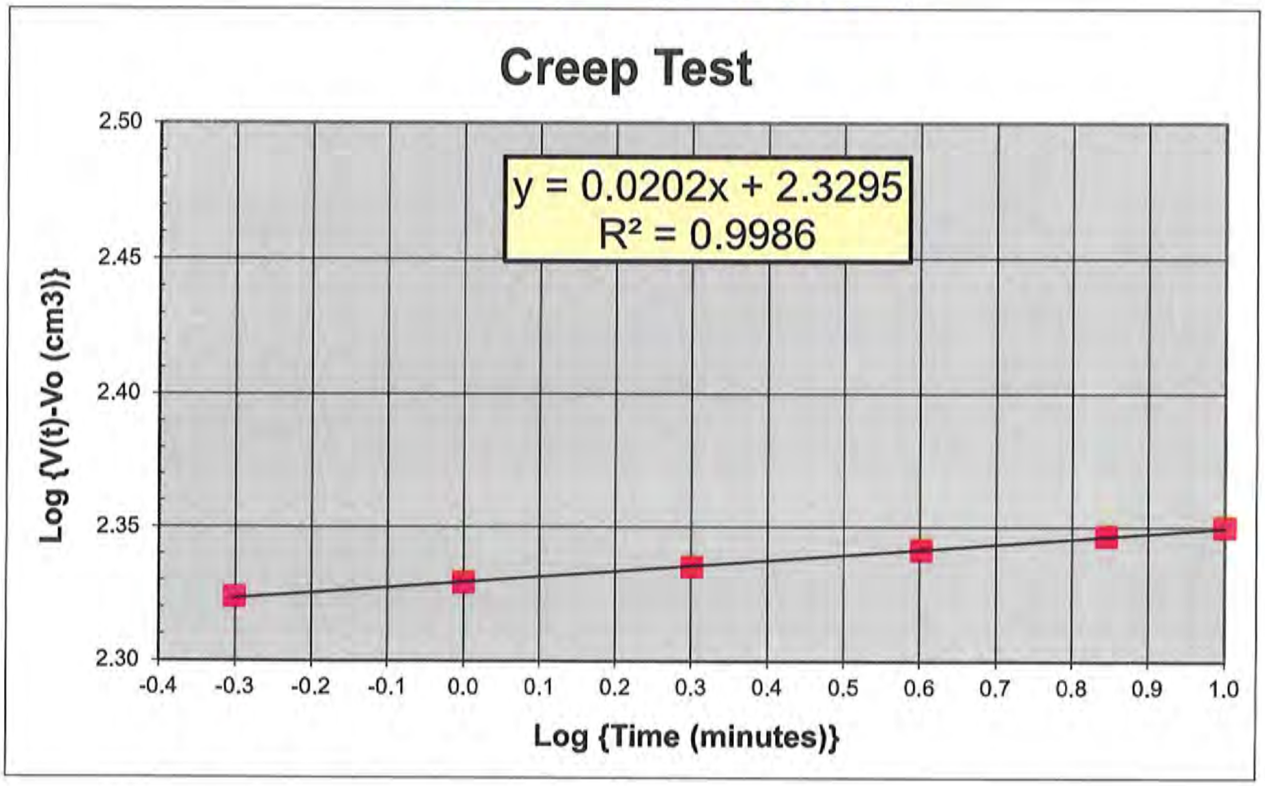


Pressuremeter Creep Test

Project: Wallops Island Northern Development
Sounding No.: P-2A
Test Depth: 76.0 feet
Holding Gauge Pressure = 8.19 bars
Corrected Pressure = 10.14 bars
Initial Probe Radius = 3.69 cm
Initial Probe Length = 50 cm
Initial Volume of Probe = 2139 cm^3
Probe Radius Contacting Borehole = 4.01 cm
Initial Borehole Volume, Vo = 2532 cm^3

Time (minutes)	Log (Time) (minutes)	Volume Increase (cm^3)	Total Probe Volume (cm^3)	$V(t)-V_0$ (cm^3)	Log $[V(t)-V_0]$ (cm^3)
0.5	-0.301	603.80	2742.61	210.81	2.324
1	0.000	606.46	2745.27	213.47	2.329
2	0.301	609.26	2748.07	216.27	2.335
4	0.602	612.51	2751.32	219.52	2.341
7	0.845	615.15	2753.96	222.16	2.347
10	1.000	616.85	2755.66	223.86	2.350

$E_0(t)/E_0(t=1\text{ min}) = \{t/1\}^{-n}$
n = 0.0202

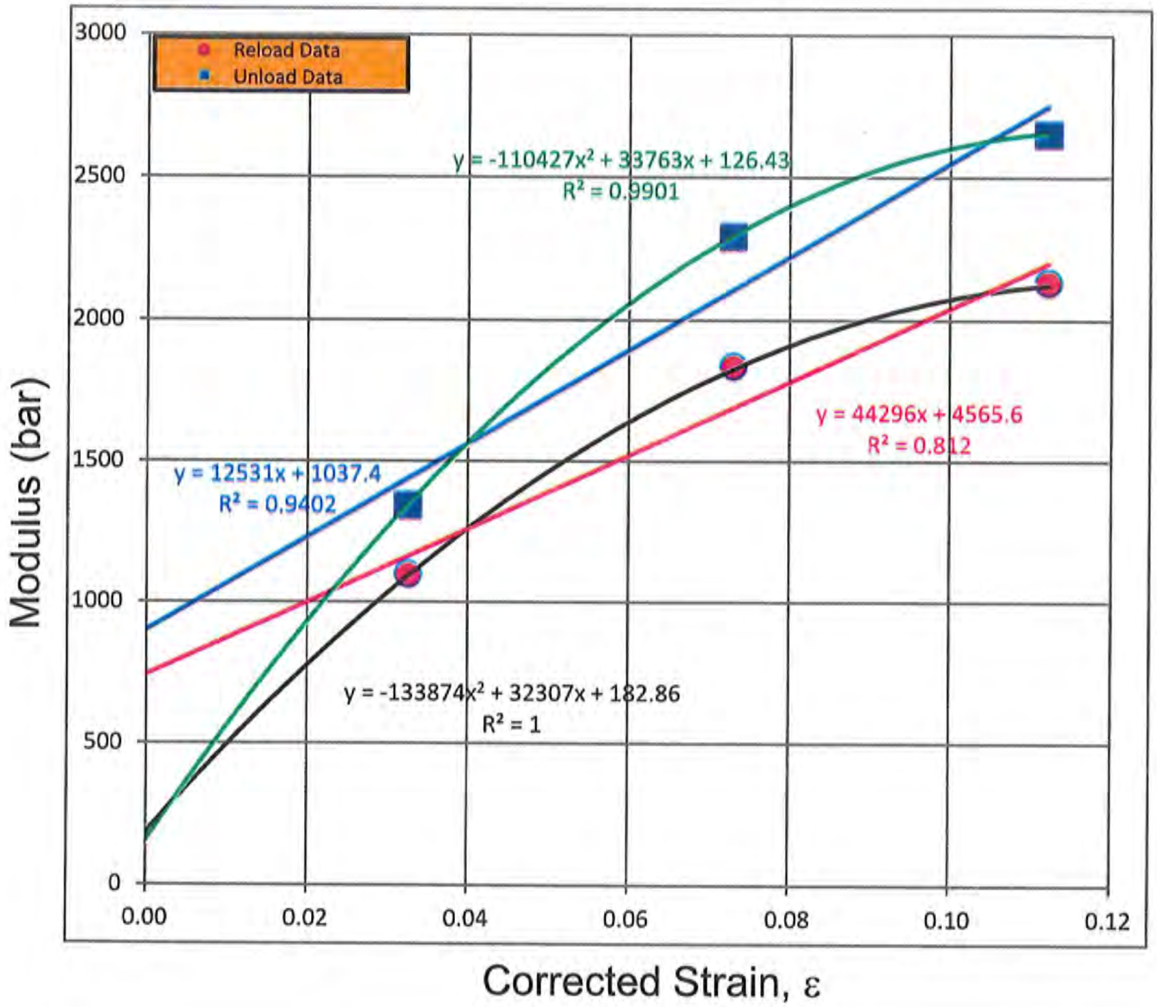


RELOAD/UNLOAD MODULUS ANALYSES

PROJECT:	Wallops Island Northern Development	BORING:	P-2A
LOCATION:	Wallops Island, Virginia	TEST #:	4
IN-SITU SOIL TESTING, L.C.		DEPTH:	76.0 ft
ENGINEER:	Roger A. Failmezger, P.E., F. ASCE, D GE	TEST DATE:	12/30/2020

Strain to contact borehole = 0.088

Average Strain	Corrected Strain	Reload Modulus	Average Strain	Corrected Strain	Unload Modulus
0.1205	0.0325	1092	0.1205	0.0325	1336
0.1609	0.0729	1827	0.1609	0.0729	2284
0.2003	0.1123	2122	0.2002	0.1122	2645



HYNES

John D. Hynes & Associates, Inc.

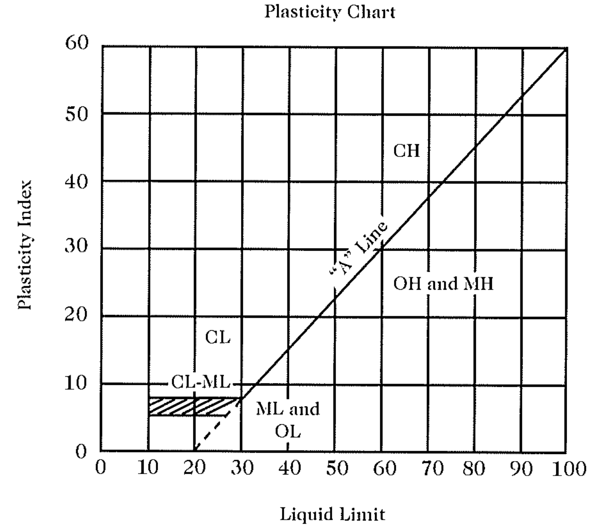
Geotechnical and Environmental Consultants
Monitoring Well Installation
Construction Inspection and Materials Testing

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions			*Group Symbols*	*Typical Names*	*Laboratory Classification Criteria*	
Coarse-grained soils (More than half of material is larger than No 200 sieve size)	Gravels (More than half of coarse fraction is larger than No 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	Poorly graded gravels, gravel sand mixtures, little or no fines	Not meeting all graduation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM[a] d / u	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above "A" line with P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands,	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	Poorly graded sands, gravelly sands, little or no fines	Not meeting all graduation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM[a] d / u	Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols.
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above "A" line with P.I. greater than 7	
Fine-grained soils (More than half of material is smaller than No 200 sieve)	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
			OL	Organic silts and organic silty clays of low plasticity		
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts		
			CH	Inorganic clays of high plasticity, fat clays		
			OH	Organic clays of medium to high plasticity, organic silts		
Highly organic soils			Pt	Peat and other highly organic soils		

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No 200 sieve size), coarse grained soils are classified as follows:
Less than 5 percent — GW, GP, SW, SP
More than 12 percent — GM, GC, SM, SC
5 to 12 percent — *Borderline cases requiring dual symbols*[b]

Plasticity Chart



32185 Beaver Run Drive • Salisbury, Maryland 21804 • 410-546-6462 • Fax 410-548-5346
E-mail - jdhynes@aol.com

HYNES

FIELD CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

NON-COHESIVE SOILS
(Silt, Sand, Gravel and Combinations)

DENSITY

Very Loose	- 5 blows/ft. or less
Loose	- 6 to 10 blows/ft.
Medium Dense	- 11 to 30 blows/ft.
Dense	- 31 to 50 blows/ft.
Very Dense	- 51 blows/ft. or more

RELATIVE PROPORTIONS

Descriptive Term	Percent
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

PARTICLE SIZE IDENTIFICATION

Boulders	- 8 inch diameter or more
Cobbles	- 3 to 8 inch diameter
Gravel	- Coarse - 1 to 3 inch
	- Medium - 1/2 to 1 inch
	- Fine - 4.75 mm to 1/2 inch
Sand	- Coarse - 2.0 mm to 4.75 mm
	- Medium - 0.425 mm to 2.0 mm
	- Fine - 0.075 mm to 0.425 mm
Silt	- 0.075 mm to 0.002 mm

COHESIVE SOILS
(Clay, Silt and Combinations)

CONSISTENCY

Very Soft	- 3 blows/ft. or less
Soft	- 4 to 5 blows/ft.
Medium Stiff	- 6 to 10 blows/ft.
Stiff	- 11 to 15 blows/ft.
Very Stiff	- 16 to 30 blows/ft.
Hard	- 31 blows/ft. or more

PLASTICITY

Degree of Plasticity	Plasticity Index
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	over 22

Classification on logs are made by visual inspection of samples unless a sample has been subjected to laboratory classification testing.

Standard Penetration Test - Driving a 2.0" O.D., 1-3/8" I.D., splitspoon sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. It is customary to drive the spoon 6 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and making the test are recorded for each 6 inches of penetration on the drill log (Example - 6/8/9). The standard penetration test value (N - value) can be obtained by adding the last two figures (i.e. 8 + 9 = 17 blows/ft.). (ASTM D-1586)

Strata Changes - In the column "Soil Descriptions," on the drill log, the horizontal lines represent strata changes. A solid line (—) represents an actually observed change, a dashed line (----) represents an estimated change.

Groundwater - Observations were made at the times indicated. Porosity of soil strata, weather conditions, site topography, etc. may cause changes in the water levels indicated on the logs.

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410-546-6462 • Fax 410-548-5346

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@geoprofessional.org www.geoprofessional.org

JOHN D. HYNES & ASSOCIATES, INC.

Geotechnical and Environmental Consultants
Monitoring Well Installation
Construction Inspection and Materials Testing

March 31, 2021

Roland E. Holland, P.E.
George, Miles & Buhr, LLC
206 West Main Street
Salisbury, Maryland 21801

Re: Report of Subsurface Exploration and Geotechnical Consulting Services
Wallops Island UAS Runway and Port Integration Project
Wallops Island, Virginia
Project No.: JDH-10/20/271

Dear Mr. Holland:

John D. Hynes & Associates, Inc. has completed the authorized subsurface exploration and geotechnical engineering evaluations for proposed Wallops Island UAS Runway and Port Integration project located in Wallops Island, Virginia. Our services were performed, generally, in accordance with our proposals dated December 18, 2020.

This report describes the exploration methods employed, exhibits the data obtained and presents our evaluations and recommendations. This report presents the findings of our exploration and provides recommendations for the design and construction of the proposed foundations for new pre-engineering buildings; lateral earth pressures for culvert; and pavements for the access road of runway and pavement for a new parking lot.

We appreciate the opportunity to be of service to you. If you have any questions regarding the contents of this report or if we may be of further assistance, please contact our office.

Respectfully,
JOHN D. HYNES & ASSOCIATES, INC.

for: Alycen E. Kus
Environmental Staff

Richard D. Rhoads
Project Geologist

Duowen Ding
Project Engineer

John D. Hynes, P.E
President

AEK: RDR: DD: JDH/jsl

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REPORT OF
SUBSURFACE EXPLORATION
AND
GEOTECHNICAL CONSULTING SERVICES

WALLOPS ISLAND UAS RUNWAY
AND
PORT INTEGRATION PROJECT
WALLOPS ISLAND, VIRGINIA

PREPARED FOR
GEORGE, MILES & BUHR, LLC

MARCH 31, 2021
PROJECT NO.: JDH-10/20/271

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HYNES

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PURPOSE AND SCOPE

The subsurface exploration study was performed to evaluate the subsurface conditions with respect to the following:

1. General site and subgrade preparation;
2. Fill and backfill construction;
3. Foundation recommendations, including allowable bearing capacity, estimated settlement, and embedment depths of spread footings;
4. Foundation construction and inspection procedures;
5. Floor slab support;
6. Seismic site classification;
7. Lateral earth pressure requirements for culvert below grade walls;
8. Pavement subgrade preparation and cross-section design;
9. Location of groundwater and applicable construction dewatering control procedures; and
10. Other aspects of the design and construction for the proposed structures indicated by the exploration.

An evaluation of the site, with respect to potential construction problems and recommendations dealing with earthwork and inspection during construction, is included. The inspection is considered necessary both to confirm the subsurface conditions and to verify that the soils related construction phases are performed properly.

EXISTING SITE CONDITIONS

As shown on the Project Location Map (Drawing JDH-10/20/271-A) in the Appendix, the project site is part of the Wallops Island Flight facility located in Wallops Island, Virginia. At the time of our field work, the site was developed with the Wallops Island UAS Runway and associated access roadway and culvert. The project area is located northeast of the North Seawall Road, at the north end of Wallops Island.

PROJECT CHARACTERISTICS

We understand that the project includes improvements to the existing runway and access path at the north end of Wallops Island to compliment the new port project at the northeast end of the runway area. A parking area is, also, proposed south of the existing runway. The project, also, includes the replacement of a culvert located on the access roadway to the runway. A hanger building is, also, proposed.

The site improvements include construction of a parking lot, and improvements to and extension of the runway access path. George, Miles & Buhr, LLC provided CBR test data for a previous study that was completed at the project site. In addition, replacement of an existing culvert will be required to span an approximately channel along the existing access path to the south of the runway.

Potential future improvements include construction of an addition to the existing hangar structure on the facility. GMB indicated column loads would be 50 kips for the structure.

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FIELD EXPLORATION AND STUDY

In order to determine the nature of the subsurface conditions at the site, a total of 13 test borings were drilled at the site on February 22 and 23, 2021 at the approximate locations shown on the Boring Location Plans (Drawing No. JDH-10/20/271-B1, B2 and B3) in the Appendix. The borings were designated as B-3 through B-15. We note that borings B-1 and B-2 were previously drilled during completion of a separate project.

The current exploration included 7 borings, designated as B-3 through B-9, at the proposed location of an access roadway on the north side of the existing runway. The borings were drilled to depths of 5 feet below the ground surface. Boring B-10 was drilled at the location of a proposed parking area to support runway operations. The boring was drilled to a depth of 20 feet below the ground surface. Borings B-11 and B-12 were drilled in the area of the proposed culvert relocation. The borings were drilled to depths of 40 feet below the ground surface. Borings B-13, B-14 and B-15 were drilled at the location of a future hangar building on the project site. Borings B-13 and B-15 were drilled to depths of 20 feet below the ground surface and boring B-14 was drilled to a depth of 50.5 feet. Borings B-10 through B-15 were drilled using a Mobile B-47 HD drill rig. Borings B-3 through B-9 were drilled using a hand auger.

Soil sampling and testing were carried out in accordance with ASTM Specification D-1586. A brief description of our field procedures is included in the Appendix. The results of all boring and sampling operations are shown on the boring logs.

Samples of the subsurface soils were examined by our engineering staff and were visually classified in accordance with the Unified Soil Classification System (USCS). The USCS system nomenclature (CL, SM, etc.) is noted on the log sheets. Also included are reference sheets, which define the USCS terms and symbols used on the boring logs.

We note that the test boring records represent our interpretation of the field data based on visual examination and selected soil classification tests. Indicated interfaces between materials may be gradual.

The field exploration data was supplemented with laboratory testing data. The laboratory at John D. Hynes & Associates, Inc. performed 3 Atterberg Limits (Liquid and Plastic) tests, one Sieve Analysis test, and 4 Natural Moisture Content tests. The test results are presented on the boring logs in the Appendix. Results from 12 CBR tests from a previous site evaluation were provided to Hynes & Associates.

SUBSURFACE CONDITIONS

At the time of our field exploration, approximately 2 to 4 inches of organic bearing soil was encountered at the ground surface at the boring locations B-3 through B-10. We encountered 2 to 4 inches of gravel at the ground surface at boring locations B-11 through B-15. Varying thickness of organic bearing soil, or other surficial materials and material thicknesses may be encountered at other locations on site.

The subsurface soils were visually classified in accordance with the USCS as interbedded layers of SAND (SP, SP-SM), Silty SAND (SM), SAND and SILT (SM-ML), Clayey SILT (ML), and Silty CLAY (CL, CH) to the boring termination depths. In the borings, sands were characterized by Standard Penetration Test (SPT) values (N-values) ranging from 5 to 32 blows per foot. This range of penetration resistance indicates in-place relative densities of very loose to dense. In the cohesive soils, N-values ranging from WOH/18 inches to 20 blows per foot were encountered, indicating in-place consistencies of very soft to very stiff.

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Groundwater was encountered during drilling operations at depths ranging from 1 to 4.5 feet below existing grade. Groundwater elevations may vary at other times during the year depending upon the amount of local precipitation and the water level in the adjacent bay, channels, and the Atlantic Ocean.

RECOMMENDATIONS

The following recommendations and considerations are based on our understanding of the proposed construction, the data obtained from the exploration, and our previous experience with similar subsurface conditions and projects. If there are any significant changes to the project characteristics, such as revised structural loadings, building geometry, building locations, elevations, etc., we request that this office be advised so the recommendations of this report can be re-evaluated. Additional recommendation will be provided for the channel crossing structure, upon request.

A. Site Preparation

Prior to the construction of foundations, ground slabs, pavements, or the placement of fill in any structural areas, all existing organic materials, frozen or wet, excessively soft or loose soils, root mats, debris, and other deleterious materials should be removed and wasted. The existing organic bearing soil should be stripped from the structural areas and can be stockpiled for reuse in landscape areas. If perched surface water is encountered during any grading or excavation process, Hynes & Associates should be consulted for additional recommendations regarding the stabilization of the bases of the excavations and backfilling.

If temporary trenches or excavations deeper than 4 feet are required for utilities or foundation elements, these should be sloped back at least to 1.5H:1V slope to prevent failure that can be experienced at vertical excavations. The contractor may, also, implement the requirements stipulated by OSHA for support of excavations. Refer to OSHA 29 CFR Part 1926 for the requirements.

After the stripping operations have been completed, the exposed subgrade soils should be inspected. The inspector should verify that organic matter, and debris have been removed from structural subgrade areas. The inspector should require the exposed subgrade materials be proofrolled utilizing a heavily loaded dump truck or other pneumatic tired vehicle of similar size and weight. The purpose of proofrolling would be to provide surficial densification and to locate any isolated areas of soft or loose soils requiring undercutting. Proofrolling is not advised in wet areas which may deteriorate under repeated vehicular loading. Wet areas should be drained and allowed to dry prior to proofrolling. Precipitation may result in standing water (perched water) at low areas. If the water is allowed to pond, the natural soils may deteriorate and overexcavation or subgrade improvements may be necessary at those areas. The Geotechnical Engineer should be consulted to evaluate poor subgrade conditions during construction.

Care should be exercised during the grading operations at the site. Shallow SP, SP-SM, and SM materials were identified at the boring locations. These materials are slightly (SP, SP-SM) to moderately (SM) sensitive to changes in moisture conditions and should therefore be protected. Most native shallow soils are SP-SM and SM materials. If earthwork is performed in the presence of moisture, the traffic of heavy equipment, including heavy compaction equipment, may create pumping and a general deterioration of the subgrade soils. Construction traffic should be minimized at structural subgrade areas. If subgrade problems arise, the Geotechnical Engineer should be consulted for an evaluation of the conditions. Overexcavated areas resulting from the removal of organic matter, debris, abandoned utility lines, or otherwise unacceptable materials should be backfilled with properly compacted materials in accordance with the procedures discussed in the following section.

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B. Fill Selection, Placement and Compaction

It is recommended that all materials to be used as structural fill be inspected, tested and approved by the Geotechnical Engineer prior to use. The native SM, SP-SM, and SP soils can be reused for structural fill. Acceptable borrow material should include GW, SM, SW, SP and SM classified in accordance with the USCS. Furthermore, the material to be utilized as structural fill should have a Plasticity Index (PI) less than 20.

The importation of high quality, granular material should be allowed, and acceptable unit rates for importation and placement should be established. Sand, gravel or sand/gravel mixtures would be appropriate for wet weather placement. Otherwise, the materials noted above will be acceptable for use as structural fill. Native or imported SM soils will be sensitive to alteration in moisture content and will become unworkable during and following periods of precipitation. For this reason, if earthwork is attempted in late autumn, winter or early spring, the above mentioned high quality imported granular material should be limited to those soils better than SM. SM materials become unworkable at moisture contents greater than 3 percentage points above optimum. The contractor would have to dry these SM materials or set them aside for use in landscaping areas.

Structural fill should be placed in lifts which are 8 inches or less in loose thickness and should be compacted to at least 95 percent of the Modified Proctor maximum dry density (ASTM D-1557). Adjustments to the natural moisture content of the soils may be required in order to obtain specified compaction levels. Should utility construction be performed after earthwork, the Contractor should be responsible for achieving 95 percent compaction in all trench backfill. These guidelines should be set for all structural fill at the site including, but not limited to building, ground slab and pavement fills.

For the proofrolling and fill compaction operations, fill limits should be extended at least 5 feet beyond the building exterior walls, exterior columns, and pavement boundaries. A sufficient number of in-place density tests should be performed by an engineering technician to verify that the proper degree of compaction is being obtained in all fill soils.

C. Pre-Engineering Building Foundations

The proposed project includes the construction of a pre-engineered metal building. The new building will be situated on the south side of the runway at the area of test borings B-13, B-14 and B-15. The pre-engineered building will be a one-story building with a rigid frame, and have a concrete slab on grade. George, Miles & Buhr indicated that maximum column loads will not exceed 50 kips.

Based on the subsurface conditions found in test borings B-13, B-14 and B-15, we recommend that the building be supported by spread footing foundations. The spread footings may be proportioned based upon a maximum allowable soil bearing pressure not in excess of 2,500 psf. If our recommendations are followed, we estimate total settlements of 1 inch or less. Footings may bear on firm natural soils or controlled structural fill.

Some locations may be encountered where less than the required bearing is available. At those locations, compaction in the footing excavations may be necessary or minor overexcavation may yield greater soil support. For this reason, the inspection of the footing excavations by the Geotechnical Engineer is advised.

Minimum dimensions of 30 inches for square footings and 24 inches for continuous or rectangular footings should be used in foundation design to minimize the possibility of a local shear failure. All foundation excavations should be inspected by the Geotechnical Engineer or his approved representative prior to the

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placement of concrete. The purpose of the inspection would be to verify that the exposed bearing materials are acceptable for the design soil bearing pressure and that loose, wet, frozen or compressible soils are not present.

Spread footings should be located at a depth of at least 24 inches to bottom of footing below the outside final grade to provide adequate frost cover protection. Soils exposed at the bases of all satisfactory foundation excavations should be protected against any detrimental change in condition, such as disturbance from rain or frost. Surface runoff should be drained away from the excavations and not be allowed to pond.

D. Floor Slab Support

Ground supported slabs for the building may be supported on firm, natural soils or on a layer of controlled, structural fill. The subgrade should be prepared in accordance with the procedures described in Sections A and B of this report. It is, also, recommended that a 4 to 6 inch clean, granular, leveling and load-distributing material such as washed gravel, or screened crushed stone, be used beneath the building floor slabs. These materials will require acquisition from off-site sources. Prior to placing the leveling and load distributing material, the building slab subgrade should be free of standing water or mud. An acceptable moisture barrier should also be provided for the store building slab. These procedures will help to prevent capillary rise and damp floor slab conditions. For native soil or fill material placed and compacted according to the procedures outlined in this report, we recommend using a value of modulus of subgrade reaction of 200 pounds per cubic inch.

E. Seismic Site Classification

Hynes & Associates is providing below, the seismic site classification in accordance with the International Building Code (IBC) 2015. The code stipulates that we evaluate the strength of soil to a depth of 100 feet below grade. We used the soil properties indicated in the test boring which was drilled to a depth of 50.5 feet, and our experience locally. In consideration of the test boring data, it is our opinion that the average properties of the soils in the upper 100 feet of the local subsurface stratigraphy meet Site Classification "E" criteria.

We recommend using the following spectral design coefficients for seismic design for the Wallops Island site:

Seismic Design Coefficients for Wallops Island, Virginia	
F_a=	2.5
F_v=	3.5
S_S=	0.081
S_1=	0.042
S_{DS}=	0.135
S_{D1}=	0.099

These values were obtained and calculated in accordance with the IBC 2015 and ASCE 7. These are site specific design values and are based on a Site Classification of E.

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F. Lateral Earth Pressures for the Culvert Walls/Bridge Abutments

The proposed project includes the construction of a culvert over an existing creek. Test borings, designated as B-11 and B-12, were drilled on each side of the creek to depths of 50.5 feet below the ground surface. Below the surficial organic bearing soils, borings identified Silty SAND (SM), SAND and SILT (SM-ML) and Silty CLAY (CL, CH). In the borings, sands were characterized by Standard Penetration Test (SPT) values (N-values) ranging from 4 to 12 blows per foot. This range of penetration resistance indicates in-place relative densities of very loose to medium dense. In the cohesive soils, N-values ranging from WOH/18 inches to 16 blows per foot were encountered, indicating in-place consistencies of very soft to very stiff.

For the design of the below grade culvert walls/bridge abutments, we recommend using an equivalent fluid density of 60 pounds per cubic foot (pcf) for soils behind that the walls/abutments that are above the water table. Soil used as backfill behind the walls/abutments should be a clean, granular backfill having the following geotechnical engineering properties and lateral earth pressure coefficients:

Total Unit Weight (pcf)	Friction Angle	K_O	K_A	K_P
125	30°	0.5	0.33	3

The culvert foundation walls/bridge abutments should be designed to support surcharge loads from anticipated loads adjacent to the walls, and vehicular traffic. A lateral surcharge loading should, also, be applied in wall/abutment designs to account for all construction and future traffic loading to be applied adjacent to the walls/abutments. Please see sketch (Drawing No. JDH-10/20/176-C) in the Appendix for loading parameters for the undrained condition.

Backfill immediately behind walls should be relatively clean, granular material containing less than 10 percent passing the No. 200 sieve (0.074 mm). In addition, the compaction behind these walls should be 92 to 95 percent of the Modified Proctor maximum dry density in accordance with ASTM D-1557. Since excessive compaction may cause yielding or damage to foundation and retaining walls, hand operated equipment should be used near the walls/abutments.

G. Truck Access Pavement

The project includes a new access road on the north side of the existing runway for passenger cars and LH-93 trucks. Test borings, designated as B-3 through B-9, were drilled in pavement areas to depths of 5 feet below the ground surface. Below the surficial organic bearing soils, borings identified SAND (SP and SP-SM), and Silty SAND (SM) in the upper 5.5 feet of the subgrade.

CBR test results were provided by GMB. The CBR test results ranged from 14.2 to 20.5. We used a design CBR of 14.3 (2/3 of the average CBR value).

Groundwater was encountered during drilling operations at depths ranging from 4 to 5 feet below existing grade at the boring locations of B-3 through B-9.

We understand that the traffic will be approximately 3 trucks (LH-93) per day, and light trucks and cars. For the noted traffic and the CBR values provided, we recommend the following pavement cross section:

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Surface Course (SM-1/SM-2, 9.5 MM)	1.5 inches
Base Course (IM-1, 19.00 mm)	3.5 inches
Subbase Stone (21A)	6 inches

If modifications to the pavement system are required or if actual traffic usage significantly differs from that described above, we request that this office be advised so that our recommendations can be re-evaluated.

The pavement materials and construction should be in accordance with the Virginia Department of Transportation (VDOT) standards, and this report. The aggregate subbase should be compacted to a minimum 95 percent of the Modified Proctor (ASTM D 1557, AASHTO T180) maximum dry density. All pavement subgrade areas should be inspected, proofrolled and tested by the Geotechnical Engineer.

The pavement subgrade and pavement layers should be graded such that surface water is carried off the pavement areas and away from the runway areas. The surface water should not be allowed to pond. Runoff onto adjacent properties should be controlled property.

H Parking Lot Pavement

The pavement materials and construction should be in accordance with the Virginia Department of Transportation, State Highway Administration, STANDARD SPECIFICATIONS FOR CONSTRUCTION AND MATERIALS latest edition, and this report. The aggregate subbase should be compacted to a minimum 95 percent of the Modified Proctor (ASTM D 1557, AASHTO T180) maximum dry density prior to the placement of Hot Mix Asphalt (HMA). All pavement subgrade areas should be inspected, proofrolled and tested by the Geotechnical Engineer.

The pavement subgrade and pavement layers should be graded such that surface water is carried off of the pavement areas and away from runway areas. The surface water should not be allowed to pond. Runoff onto adjacent properties should be controlled property.

The project includes parking areas for passenger cars and light trucks. One test boring, designated as B-10 , was drilled in pavement areas to depths of 20 feet below the ground surface. Below the surficial organic bearing soils, the boring identified Silty SAND (SM) in the upper 5 feet of the subgrade. Groundwater was encountered during drilling operations at a depth of 1 foot below existing grade at the boring locations. We recommend raising the grade at least 1 foot at the pavement area.

Note that GMB provided 10 CBR test results. The average CBR was 21.4. We used a design CBR of 14.3.

Our recommendations our based on our assumed traffic loading of passenger cars, and light trucks. The following pavement section recommendations are provided assuming an improved compacted subgrade (top 12 inches compacted to 95 percent of the Modified Proctor maximum dry density); approved subgrade soil types and the indicated traffic usage:

PAVEMENT SECTION – RESTRICTED CAR AND LIGHT TRUCK TRAFFIC

Surface Course (SM-1/SM-2, 9.5 MM)	1.5 inches
Base Course (IM-1, 19.00 mm)	2.5 inches
Subbase Stone (21A)	4 inches

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If modifications to the pavement system are required or if actual traffic usage significantly differs from that described above, we request that this office be advised so that our recommendations can be re-evaluated.

The pavement materials and construction should be in accordance with the Virginia Department of Transportation (VDOT) standards, and this report. The aggregate subbase should be compacted to a minimum 95 percent of the Modified Proctor (ASTM D-1557, AASHTO T180) maximum dry density. All pavement subgrade areas should be inspected, proofrolled and tested by the Geotechnical Engineer.

The pavement subgrade and pavement layers should be graded such that surface water is carried off the pavement areas and away from the runway areas. The surface water should not be allowed to pond. Runoff onto adjacent properties should be controlled property.

I. Groundwater and Drainage

As noted under "SUBSURFACE CONDITIONS" above, groundwater was encountered during drilling operations at depths ranging from 2 to 11 feet below existing grade at the majority of the test boring locations. Groundwater was encountered at depths of 8.5 to 11 feet in the building area test borings. Relative to building foundations, the contractor will likely not experience construction problems relating to groundwater. The Contractors should be prepared to dewater the lowest excavations due to the infiltration of precipitation or perched water. These methods may include sumping and pumping, etc.

Efforts should be made to keep exposed subgrade areas dry during construction, primarily because the soils will be susceptible to deterioration and loss of strength in the presence of moisture. Adequate drainage should be provided at the site to minimize any increase in moisture content of the foundation and pavement subgrade soils. All pavements should be sloped away from the building to prevent ponding of water around it. The final site drainage should, also, be designed such that run-off onto adjacent properties is controlled properly.

ADDITIONAL SERVICES RECOMMENDED

Additional engineering, testing and consulting services recommended for this project are summarized below.

A. Site Preparation and Proofrolling Monitoring

The Geotechnical Engineer or experienced soils inspector should inspect the site after it has been stripped and excavated. The inspector should determine if any undercutting or in-place densification is necessary to prepare a subgrade for fill placement, or slab and pavement support. The inspector should look closely for buried rubble and debris, and explore where suspected, and remove where encountered.

B. Fill Placement and Compaction Monitoring

The Geotechnical Engineer or experienced soils inspector should witness all fill operations and take sufficient in-place density tests to verify that the specified degree of fill compaction is achieved. The inspector should observe and approve borrow materials used and should determine if their existing moisture contents are acceptable.

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C. Foundation Excavation Inspections

The Geotechnical Engineer should inspect all footing excavations for the structure. He should verify that the design bearing pressures are available and that no loose or soft areas exist beneath the bearing surfaces of the footing excavations.

D. Pavement System Inspection

Pavement subgrade soils should be inspected prior to the placement of pavement materials to verify that proper compaction has been achieved and that project specifications are being followed. A sufficient number of in place density tests should be performed to assure that the specified degree of compaction is achieved in the subbase stone layer and asphalt layers.

REMARKS

This report has been prepared solely and exclusively for George, Miles & Buhr, LLC. to provide guidance to design professionals in developing facilities plans for the Wallops Island UAS Runway and Port Integration project located in Wallops Island, Virginia. It has not been developed to meet the needs of others, and application of this report for other than its intended purpose could result in substantial difficulties. The Consulting Engineer cannot be held accountable for any problems which occur due to the application of this report to other than its intended purpose. This report in its entirety should be attached to the project specifications.

These analyses and recommendations are, of necessity, based on the concepts made available to us at the time of the writing of this report, and on-site conditions, surface and subsurface that existed at the time the exploratory borings were drilled. Further assumption has been made that the limited exploratory borings, in relation both to the areal extent of the site and to depth, are representative of conditions across the site. It is also recommended that we be given the opportunity to review all plans for the project in order to comment on the interaction of soil conditions as described herein and the design requirements.

Our professional services have been performed, our findings obtained and our recommendations prepared in accordance with generally accepted engineering principles and practices.

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APPENDIX

1. Investigative Procedures
2. Project Location Map
3. Boring Location Plans
4. Boring Logs
5. Earth Pressure Requirements for Below Grade Walls (Undrained)
6. California Bearing Ratio (CBR) Test Data (completed by Others)
7. Unified Soil Classification Sheet
8. Field Classification Sheet
9. Information Sheet

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INVESTIGATIVE PROCEDURES

SOIL TEST BORINGS

Soil drilling and sampling operations were performed in accordance with ASTM Specification D-1586. The borings were advanced by mechanically turning continuous hollow stem auger flights into the ground. At regular intervals, samples were obtained with a standard 1.4 inch I.D., 2.0 inch O.D. splitspoon sampler. The sampler was first seated 6 inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot is the "Standard Penetration Resistance". The penetration resistance, when properly evaluated, is an index to the soil's strength, density and behavior under applied loads. The soil descriptions and penetration resistances for each boring are presented on the Test Boring Records in the Appendix.

SOIL CLASSIFICATION

Soil classifications provide a general guide to the engineering properties of various soil types and enable the engineer to apply his past experience to current problems. In our investigation, jar samples obtained during drilling operations are examined in our laboratory and visually classified by the geotechnical engineer in accordance with ASTM Specification D-2488. The soils are classified according to the Unified Classification System (ASTM D-2487). Each of these classification systems and the in-place physical soil properties provides an index for estimating the soil's behavior.

ATTERBERG LIMITS TEST

Portions from representative soil samples obtained during drilling operations were selected for Atterberg Limits tests. The Atterberg Limits are indicative of the soil's plasticity characteristics. The liquid limit is the moisture content at which the soil will flow as a heavy viscous fluid and is determined in accordance with ASTM Specification D-4318. The plastic limit is the moisture content at which the soil begins to lose its plasticity and is determined in accordance with ASTM Specification D-4318.

SIEVE ANALYSIS

Gradational analysis tests were performed to determine the particle size and distribution of the samples tested. The grain size distribution of soils coarser than a No. 200 sieve is determined by passing the sample through a standard set of nested sieves. The percentage of materials passing the No. 200 sieve is determined by washing the material over a No. 200 sieve. These tests are in accordance with ASTM D-421, D-422 and D-1140. The results are presented in the Appendix to our report.

NATURAL MOISTURE TEST

Portions from representative soil samples obtained during drilling operations were selected for Natural Moisture Content testing. The Natural Moisture Content Test determines the moisture content of soils by drying the sample in an oven with a standard drying temperature of 110 °C. The loss of mass drying the sample, is used to determine the moisture content into the soil. The natural moisture content of the sample is calculated in percentage as the weight of water divided by the weight of dry soil times 100. The natural moisture content of soils is determined in accordance with ASTM Specification D-2216.

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INVESTIGATIVE PROCEDURES (CONTINUED)

CALIFORNIA BEARING RATIO

The results of the compaction testing described above were utilized in compacting samples for the laboratory California Bearing Ratio tests. The California Bearing Ratio, abbreviated as CBR, is a punching shear test. It provides data that are a semi-empirical index of the strength and deflection characteristics of a soil that has been correlated with pavement performance. This correlation has resulted in the establishment of design curves for pavement thickness.

The test is performed on a 6-inch diameter, 5-inch thick, disc of compacted soil which is confined in a steel cylinder. The specimens are first tested immediately after compaction and then soaked for four (4) days to simulate a saturated pavement subgrade.

A 1.95-inch diameter piston is forced into the soil at a standard rate and the resistance of the piston penetration is measured. The CBR is the ratio expressed as a percentage of the load at 1.0-inch piston penetration compared to the load required to produce the same penetration in a standard crushed stone.

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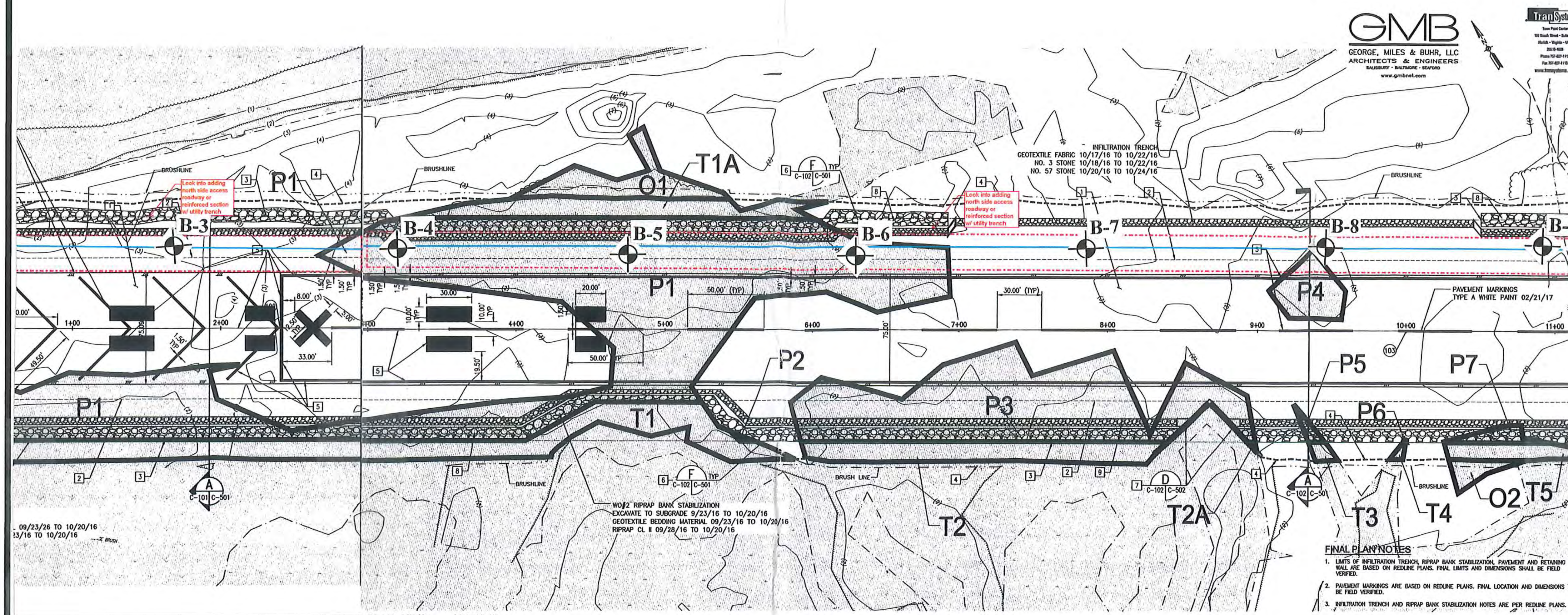
JOHN D. HYNES & ASSOCIATES, INC. 32185 Beaver Run Drive • Salisbury, Maryland 21804 410-546-6462 / Fax: 410-548-5346	**Date: February 22, 2021** **Scale: 1 in. = 2,000 ft.** **Drawn: ADC Map**
Project Location Map Wallops Island UAS Runway and Port Integration Project Wallops Island, Virginia	**DWG. No.** **JDH-10/20/271-A**



PLAN VIEW – AIRSTRIP

SCALE: 1" = 25'

SHEET NOTES:

1. REFER TO SHEET C-001 FOR LEGEND, GENERAL NOTES AND ABBREVIATIONS.
2. REFER TO SHEET C-002 FOR EXISTING SURVEY CONTROL, KEY PLAN, SURVEY NOTES AND STRUCTURE DATA.
3. REFER TO SHEET B-101 FOR SITE GEOTECHNICAL INFORMATION.
4. REFER TO SHEETS E-001 THROUGH E-601 FOR ELECTRICAL UTILITY CONSTRUCTION.
5. REFER TO SHEET C-101 FOR CONSTRUCTION LAYOUT COORDINATE TABLE.

KEY NOTES:

[1] BITUMINOUS CONCRETE SURFACE COURSE. VDOT SM-9.5A – 3" THICK OVER 8" THICK AGGREGATE BASE COURSE – VDOT 21A

[2] 2-20' WIDE GRASS SHOULDER

[3] 150' WIDE RUNWAY SAFETY AREA/EDGE OF VEGETATIVE BUFFER

[4] CLEARING LIMITS (WIDTH VARIES)

[5] WHITE PAINT PAVEMENT MARKINGS

[6] INFILTRATION TRENCH

[7] SEGMENTAL CONCRETE BLOCK RETAINING WALL

[8] RIPRAP BANK STABILIZATION. SEE DETAIL ON C-503.

WETLANDS PERMANENT DISTURBANCE		
NO.	CLASSIFICATION	ACREAGE
P1	PEM	39,678.48 SF
P2	PEM	32.37 SF
P3	PEM	12,773.76 SF
P4	PEM	1,512.78 SF
P5	PEM	147.82 SF
P6	PEM	2.30 SF
P7	PEM	410.41 SF

WETLANDS TEMPORARY DISTURBANCE		
NO.	CLASSIFICATION	ACREAGE
T1	PEM	12,284.34 SF
T1A	PEM	3,022.24 SF
T2	PEM	3,261.51 SF
T2A	PEM	23.62 SF
T3	PEM	176.05 SF
T4	PEM	58.83 SF
T5	PEM	1,296.12 SF

WETLANDS ORPHANED DISTURBANCE		
NO.	CLASSIFICATION	ACREAGE
O1	PEM	2,133.23 SF
O2	PEM	485.51 SF

COMMONWEALTH OF VIRGINIA – STEPHEN LEONARD MARSH – Lic. No. 032841 – 1-3-12 – PROFESSIONAL ENGINEER

C-102

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
WALLOPS FLIGHT FACILITY
WALLOPS ISLAND, VIRGINIA 23337

DATE	LET.	REVISIONS	CK.	AP.

PROJECT ENGINEER ____ DATE : ____
SUBMITTED BY ____ DATE : ____
PROJECT MANAGER
NASA SAFETY ____ DATE : ____
FIRE PROTECTION ____ DATE : ____
CONSTRUCTION MANAGEMENT ____ DATE : ____
O & M ____ DATE : ____
ENGINEERING APPROVAL ____ DATE : ____
ENGINEERING GROUP LEADER
BRANCH APPROVAL ____ DATE : ____
BRANCH HEAD

GRAPHIC SCALE 1"=25' 0' 25' 50'

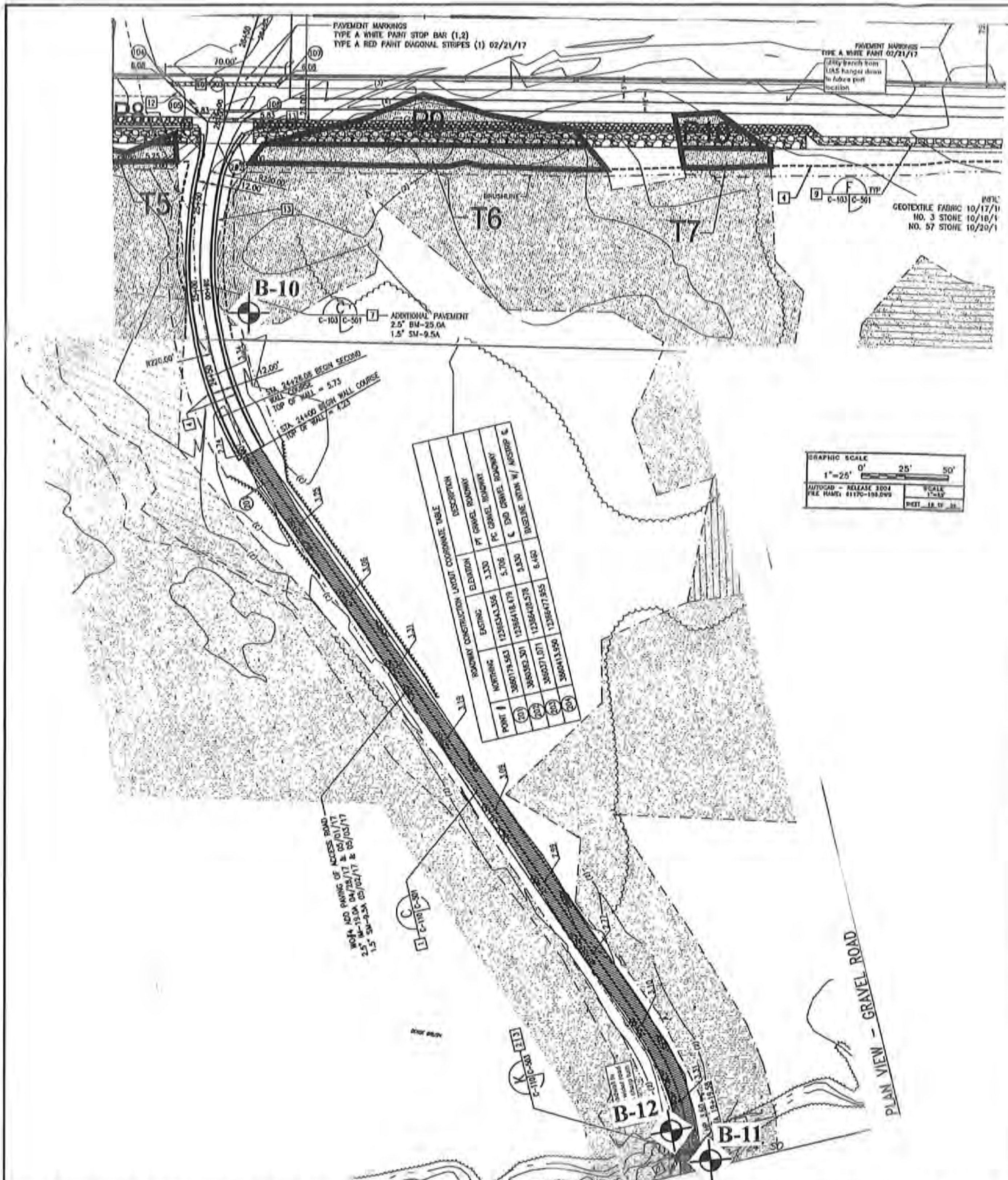
AUTOCAD – RELEASE 2004
FILE NAME: 0117C-102.DWG

SCALE 1"=25'
SHEET 15 OF 39

UAS AIRSTRIP – FINAL PLANS
PLAN VIEW – AIRSTRIP

PROJECT NUMBER: P307100117
DR. RSP | DATE: DEC 5, 2012
CK. MWB | REVISED:
DRAWING NO 1613[illegible]

HYNES **JOHN D. HYNES & ASSOCIATES, INC.** 32185 Beaver Run Drive • Salisbury, Maryland 21804 410-546-6462 / Fax: 410-548-5346	Boring Location Plan Wallops Island UAS Runway and Port Integration Project Wallops Island, Virginia	**Date: February 22, 2021** **Scale: As Shown** **Drawn: GMB** **DWG. No. JDH-10/20/271- B-1**

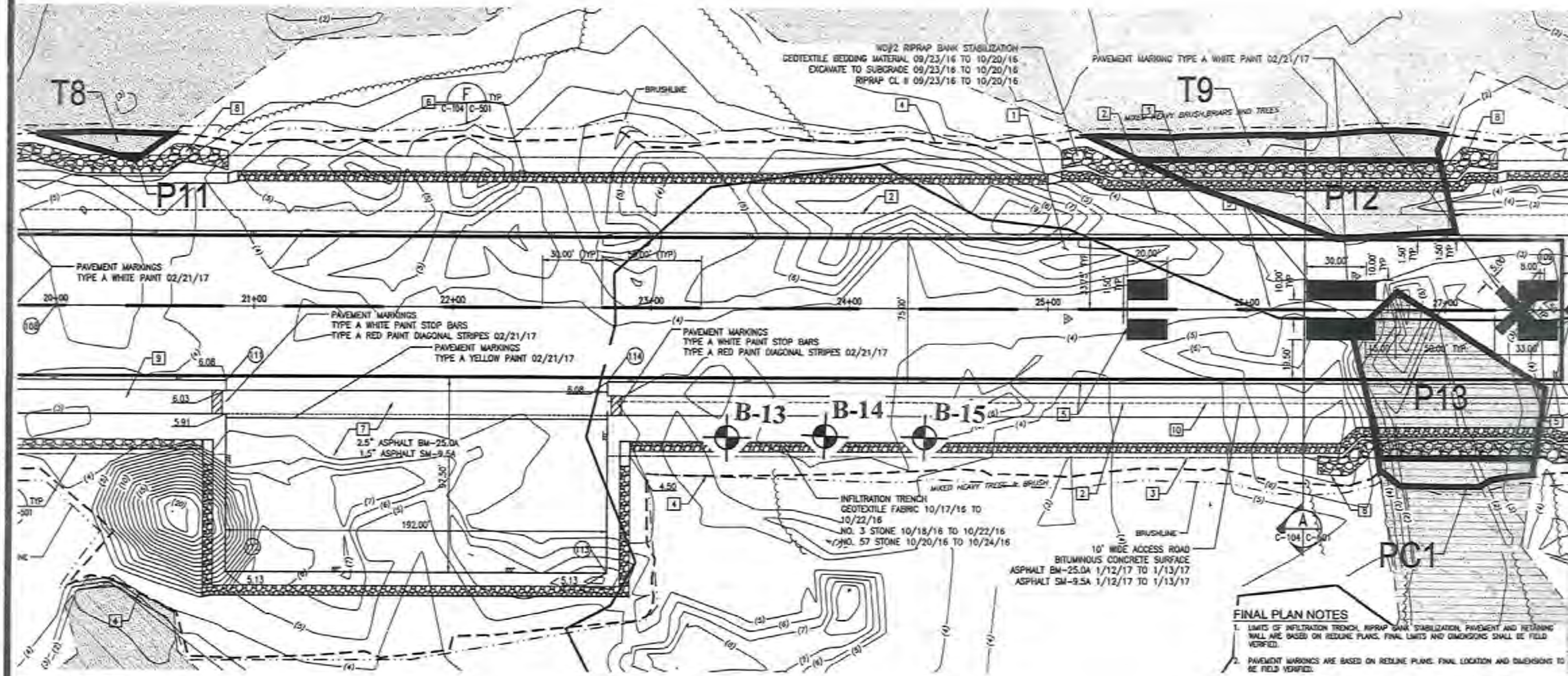


HYNES JOHN D. HYNES & ASSOCIATES, INC.
32185 Beaver Run Drive • Salisbury, Maryland 21804
410-546-6462 / Fax: 410-548-5346

Date: February 22, 2021
Scale: as shown.
Drawn: GMB

Boring Location Plan
Wallops Island UAS Runway and Port Integration Project
Wallops Island, Virginia

DWG. No.
JDH-10/20/271-B-2



W - AIRSTRIP

FINAL PLAN NOTES

1. LIMITS OF INFILTRATION TRENCH, RIPRAP BANK STABILIZATION, PAVEMENT AND RETAINING WALL ARE BASED ON REDLINE PLANS. FINAL LIMITS AND DIMENSIONS SHALL BE FIELD VERIFIED.
2. PAVEMENT MARKINGS ARE BASED ON REDLINE PLANS. FINAL LOCATION AND DIMENSIONS TO BE FIELD VERIFIED.
3. INFILTRATION TRENCH AND RIPRAP BANK STABILIZATION NOTES ARE PER REDLINE PLANS.

OTES:

ET C-001 FOR LEGEND, GENERAL NOTES AND ABBREVIATIONS.
ET C-002 FOR EXISTING SURVEY CONTROL, KEY PLAN, SURVEY NOTES AND STRUCTURE DATA.
ET B-101 FOR SITE GEOTECHNICAL INFORMATION.
ETS E-001 THROUGH E-601 FOR ELECTRICAL UTILITY CONSTRUCTION.
ET C-101 FOR CONSTRUCTION LAYOUT COORDINATE TABLE.

KEY NOTES:

1. BITUMINOUS CONCRETE SURFACE COURSE, VDOT SM-9.5A – 3" THICK OVER 8" THICK AGGREGATE BASE COURSE – VDOT 21A
2. 20' WIDE GRASS SHOULDER
3. 150' WIDE RUNWAY SAFETY AREA/EDGE OF VEGETATIVE BUFFER
4. CLEARING LIMITS (WIDTH VARIES)
5. WHITE PAINT PAVEMENT MARKINGS
6. INFILTRATION TRENCH
7. 192' X 96' BITUMINOUS CONCRETE PAD. 8" THICK VDOT 21A AGGREGATE BASE COURSE. SEE SHEET C-503
8. RIPRAP BANK STABILIZATION. SEE SHEET C-503
9. 12' WIDE ACCESS ROAD, BITUMINOUS CONCRETE SURFACE. SEE DETAIL ON SHEET C-502
10. 10' WIDE ACCESS ROAD, BITUMINOUS CONCRETE SURFACE. SEE DETAILS ON SHEET C-502

WETLANDS PERMANENT DISTURBANCE		
NO.	CLASSIFICATION	ACREAGE
P11	PEM	12.84 SF
P12	PEM	4,179.39 SF
P13	PSS	5,566.92 SF

WETLANDS TEMPORARY DISTURBANCE		
NO.	CLASSIFICATION	ACREAGE
T8	PEM	472.29 SF
T9	PEM	2,096.42 SF

WETLANDS PERMANENT CONVERSION		
NO.	CLASSIFICATION	ACREAGE
PC1	PSS	945.47 SF

COMMONWEALTH OF VIRGINIA — STEPHEN LEONARD MARSH — Lic. No. 032841 — PROFESSIONAL ENGINEER

C-104

...CS AND SPACE ADMINISTRATION
...SPACE FLIGHT CENTER
...S FLIGHT FACILITY
...LAND, VIRGINIA 23337

DATE | LTR. | REVISIONS | CK. | AP. | PROJECT ENGINEER | NASA SAFETY | CONSTRUCTION MANAGEMENT | ENGINEERING APPROVAL

GRAPHIC SCALE 0' 25' 50' 1"=25'

UAS AIRSTRIP – FINAL PLANS
PLAN VIEW – AIRSTRIP

DRAWING NO. 16140

HYNES
JOHN D. HYNES & ASSOCIATES, INC.
32185 Beaver Run Drive • Salisbury, Maryland 21804
410-546-6462 / Fax: 410-548-5346

Project Location Map
Wallops Island UAS Runway and Port Integration Project
Wallops Island, Virginia

Date: March 23, 2021
Scale: As Shown
Drawn: GMB
DWG. No. JDH-10/21/271-B-3

HYNES & ASSOCIATES

LOG OF BORING B-3

George, Miles & Buhr
206 West Main Street
Salisbury, Maryland 21801

Wallops Island UAS Runway/Port Integration

Project No.: JDH-10/20/271

Date Completed:	: February 22, 2021
Logged By:	: A. Kus
Drilled By:	: M. Hynes
Drilling Method:	: Hand Auger
Total Depth:	: 5.5 feet

Depth in Feet	DESCRIPTION	GRAPHIC	USCS	Sample	REMARKS
0–4	Brown, wet, fine to medium SAND, with little to trace silt		SP-SM	1, 2	Scale 1" ~ 7.75 feet Approximately 4 inches of organic bearing soil was encountered at the ground surface. Groundwater was encountered at 4.5 feet during drilling operations. Laboratory Test Results Sample No. 2 From 2 to 4 feet Natural Moisture = 21.3%
4–5.5	Brown, saturated, fine to medium SAND, with trace silt		SP	3	
5.5	Boring terminated at 5.5 feet.				

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52

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HYNES & ASSOCIATES

LOG OF BORING B-4

George, Miles & Buhr
206 West Main Street
Salisbury, Maryland 21801

Wallops Island UAS Runway/Port Integration

Project No.: JDH-10/20/271

Date Completed: : February 22, 2021
Logged By: : A. Kus
Drilled By: : M. Hynes
Drilling Method: : Hand Auger
Total Depth: : 5.5 feet

Depth in Feet	DESCRIPTION	GRAPHIC	USCS	Sample	REMARKS
0–4	Brown, wet, fine to medium SAND, with little to trace silt		SP-SM	1, 2	Scale 1" ~ 7.75 feet Approximately 4 inches of organic bearing soil was encountered at the ground surface. Groundwater was encountered at 5 feet during drilling operations.
4–5.5	Gray to brown, wet to saturated, fine to medium SAND, with trace silt		SP	3	
5.5	Boring terminated at 5.5 feet.				

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52

HYNES & ASSOCIATES

LOG OF BORING B-5

George, Miles & Buhr
206 West Main Street
Salisbury, Maryland 21801

Wallops Island UAS Runway/Port Integration

Project No.: JDH-10/20/271

Date Completed: : February 22, 2021
Logged By: : A. Kus
Drilled By: : M. Hynes
Drilling Method: : Hand Auger
Total Depth: : 5.5 feet

Depth in Feet	DESCRIPTION	GRAPHIC	USCS	Sample	REMARKS
0–4	Brown, wet, fine to medium SAND, with little to trace silt		SP-SM	1, 2	Scale 1" ~ 7.75 feet Approximately 3 inches of organic bearing soil was encountered at the ground surface. Groundwater was encountered at 4 feet during drilling operations.
4–5.5	Gray, saturated, fine to medium SAND, with trace silt		SP	3	
5.5	Boring terminated at 5.5 feet.				

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52

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HYNES & ASSOCIATES

LOG OF BORING B-6

George, Miles & Buhr
206 West Main Street
Salisbury, Maryland 21801

Wallops Island UAS Runway/Port Integration

Project No.: JDH-10/20/271

Date Completed:	: February 22, 2021
Logged By:	: A. Kus
Drilled By:	: M. Hynes
Drilling Method:	: Hand Auger
Total Depth:	: 5.5 feet

Depth in Feet	DESCRIPTION	GRAPHIC	USCS	Sample	REMARKS
0–2	Brown, wet, fine to medium SAND, with little to trace silt		SP-SM	1	Scale 1" ~ 7.75 feet
2–4	Brown, wet, fine to medium SAND, with trace silt		SP	2	Approximately 3 inches of organic bearing soil was encountered at the ground surface.
4–5.5	Brown, saturated, fine to medium SAND, with little to trace silt		SP-SM	3	Groundwater was encountered at 4 feet during drilling operations.
5.5	Boring terminated at 5.5 feet.				

Laboratory Test Results

Sample No. 2
From 2 to 4 feet

Sieve Analysis

Sieve Size	Passing %
No. 4	100
No. 10	99.8
No. 20	98.6
No. 40	93.4
No. 60	75.4
No. 100	23.5
No. 200	9.0

Natural Moisture = 13.6%

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52

HYNES & ASSOCIATES

LOG OF BORING B-7

George, Miles & Buhr
206 West Main Street
Salisbury, Maryland 21801

Wallops Island UAS Runway/Port Integration

Project No.: JDH-10/20/271

Date Completed: : February 22, 2021
Logged By: : A. Kus
Drilled By: : M. Hynes
Drilling Method: : Hand Auger
Total Depth: : 5.5 feet

Depth in Feet	DESCRIPTION	GRAPHIC	USCS	Sample	REMARKS
0–4	Brown, wet, fine to medium SAND, with little to trace silt		SP-SM	1, 2	Scale 1" ~ 7.75 feet Approximately 3 inches of organic bearing soil was encountered at the ground surface. Groundwater was encountered at 4 feet during drilling operations. Laboratory Test Results Sample No. 2 From 2 to 4 feet Natural Moisture = 20.5%
4–5.5	Brown, saturated, fine to medium SAND, with little silt		SM	3	
5.5	Boring terminated at 5.5 feet.				

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52

HYNES & ASSOCIATES

LOG OF BORING B-8

(Page 1 of 1)

George, Miles & Buhr
206 West Main Street
Salisbury, Maryland 21801

Wallops Island UAS Runway/Port Integration

Project No.: JDH-10/20/271

Date Completed: : February 22, 2021
Logged By: : A. Kus
Drilled By: : M. Hynes
Drilling Method: : Hand Auger
Total Depth: : 5.5 feet

Depth in Feet	DESCRIPTION	GRAPHIC	USCS	Sample	REMARKS
0	Brown, wet, fine to medium SAND, with little silt		SM	1	Scale 1" ~ 7.75 feet
2				2	Approximately 3 inches of organic bearing soil was encountered at the ground surface.
4	Brown to gray, saturated, fine to medium SAND, with little silt		SM	3	Groundwater was encountered at 4 feet during drilling operations.
6	Boring terminated at 5.5 feet.				
8					
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52					

HYNES & ASSOCIATES

LOG OF BORING B-9

George, Miles & Buhr
206 West Main Street
Salisbury, Maryland 21801

Wallops Island UAS Runway/Port Integration

Project No.: JDH-10/20/271

Date Completed:	: February 22, 2021
Logged By:	: A. Kus
Drilled By:	: M. Hynes
Drilling Method:	: Hand Auger
Total Depth:	: 5.5 feet

Depth in Feet	DESCRIPTION	GRAPHIC	USCS	Sample	REMARKS
0–2	Brown, wet, fine to medium SAND, with little to trace silt		SP-SM	1, 2	Scale 1" ~ 7.75 feet
2–4	Dark brown, wet, fine to medium SAND, with little silt		SM	3, 4	Approximately 2 inches of organic bearing soil was encountered at the ground surface.
4–5.5	Brown, saturated, fine to medium SAND, with little to trace silt		SP-SM	5	Groundwater was encountered at 4 feet during drilling operations.
	Boring terminated at 5.5 feet.				Laboratory Test Results Sample No. 4 From 3 to 4 feet Natural Moisture = 26.8%

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52

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HYNES & ASSOCIATES

LOG OF BORING B-10

George, Miles & Buhr
206 West Main Street
Salisbury, Maryland 21801

Wallops Island UAS Runway/Port Integration

Project No.: JDH-10/20/271

Date Completed: : February 23, 2021
Logged By: : A. Kus
Drilled By: : B. Hynes
Drilling Method: : HSA (Geoprobe 7822 DT)
Total Depth: : 20.5 feet

Depth in Feet	DESCRIPTION	USCS	Sample	Blow Count	REMARKS
0–5.5	Brown, saturated, loose to medium dense, fine to medium SAND, with little silt	SM	1 2	3-4-4 3-5-6	Scale 1" ~ 7.75 feet Approximately 3 inches of organic bearing soil was encountered at the ground surface. Groundwater was encountered at 1 foot during drilling operations. At completion, water was at 1 foot; boring caved in at 3.5 feet.
5.5–8.5	Gray, saturated, loose, fine to medium SAND, with some silt, trace clay	SM	3	4-3-5	
8.5–12	Gray, saturated, very stiff, clayey SILT, with little fine to medium sand	ML	4	6-8-10	
12–20.5	Gray, saturated, loose, fine to medium SAND, with little to trace silt	SP-SM	5 6	5-4-3 3-3-3	

Boring terminated at 20.5 feet.

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HYNES & ASSOCIATES

LOG OF BORING B-11

George, Miles & Buhr
206 West Main Street
Salisbury, Maryland 21801

Wallops Island UAS Runway/Port Integration

Project No.: JDH-10/20/271

Date Completed: : February 23, 2021
Logged By: : A. Kus
Drilled By: : B. Hynes
Drilling Method: : HSA (Geoprobe 7822 DT)
Total Depth: : 50.5 feet

Depth in Feet	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
0	Gray, saturated, loose to medium dense, fine to medium SAND, with little silt		SM	1	--	Scale 1" ~ 7.75 feet
				2	1-5-7	Approximately 2 inches of gravel was encountered at the ground surface.
				3	2-2-3	Groundwater was encountered at 3 feet during drilling operations.
8	Gray, saturated, very loose, fine to medium SAND and SILT, with trace clay		SM-ML	4	1-2-2	Boring caved in at 1 foot. Laboratory Test Results
12	Gray, saturated, very soft, silty CLAY, with trace fine to medium sand		CL	5	WOH/18"	Sample No. 5 From 14 to 15.5 feet Atterberg Limits Liquid Limit = 49 Plasticity Index = 26 Natural Moisture = 41.0%
				6	1-1-1	
				7	1-1-1	
				8	1-2-1	
				9	1-1-2	
37	Gray, saturated, stiff to very stiff, silty CLAY, with trace fine to medium sand		CL	10	4-6-9	
				11	4-7-7	
				12	6-7-8	

Boring terminated at 50.5 feet.

HYNES & ASSOCIATES

LOG OF BORING B-12

George, Miles & Buhr
206 West Main Street
Salisbury, Maryland 21801

Wallops Island UAS Runway/Port Integration

Project No.: JDH-10/20/271

Date Completed: : February 23, 2021
Logged By: : A. Kus
Drilled By: : B. Hynes
Drilling Method: : HSA (Mobile B-47 HD)
Total Depth: : 50.5 feet

Depth in Feet	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
0	Gray, saturated, loose, fine to medium SAND, with little silt		SM	1	--	Scale 1" ~ 7.75 feet
4				2	4-3-3	Approximately 3 inches of gravel was encountered at the ground surface.
7				3	4-5-5	Groundwater was encountered at 3 feet during drilling operations.
8.5	Gray, saturated, soft to very soft, silty CLAY, with little fine to medium sand		CH			Boring caved in at 1 foot.
10				4	1-2-2	Laboratory Test Results Sample No. 4 From 9 to 10.5 feet Atterberg Limits Liquid Limit = 76 Plasticity Index = 44 Natural Moisture = 55.3%
15				5	1-1-1	
20				6	WOH/12"-1	
25				7	WOH/18"-1	
27	Gray, saturated, soft to very soft, silty CLAY, with trace fine to medium sand		CL			
30				8	1-1-1	
35				9	1-2-2	
37	Gray, saturated, very stiff, silty CLAY, with trace fine to medium sand		CL			
40				10	5-8-9	
46				11	6-7-9	
50				12	7-7-7	
50.5	Boring terminated at 50.5 feet.					

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HYNES & ASSOCIATES

LOG OF BORING B-13

George, Miles & Buhr
206 West Main Street
Salisbury, Maryland 21801

Wallops Island UAS Runway/Port Integration

Project No.: JDH-10/20/271

Date Completed: : February 22, 2021
Logged By: : A. Kus
Drilled By: : M. Hynes
Drilling Method: : HSA (Mobile B-47 HD)
Total Depth: : 20.5 feet

Depth in Feet	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
0–8.5	Brown to gray, saturated, medium dense, fine to medium SAND, with little silt, trace gravel		SM	1	6-6-7	Scale 1" ~ 7.75 feet
				2	9-6-12	Approximately 4 inches of gravel was encountered at the ground surface.
				3	8-10-12	Groundwater was encountered at 3 feet during drilling operations.
8.5–12	Brown to gray, saturated, dense, fine to medium SAND, with little silt		SM	4	11-14-18	At completion, water was at 3 feet, boring caved in at 3 feet.
12–17	Gray, saturated, medium dense, fine to medium SAND and SILT, with trace clay		SM-ML	5	4-7-9	Laboratory Test Results Sample No. 2 From 3 to 4.5 feet Natural Moisture = 24.5%
17–20.5	Gray, saturated, medium stiff, clayey SILT, with trace fine to medium sand		ML	6	3-3-4	

Boring terminated at 20.5 feet.

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52

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HYNES & ASSOCIATES

LOG OF BORING B-14

George, Miles & Buhr
206 West Main Street
Salisbury, Maryland 21801

Wallops Island UAS Runway/Port Integration

Project No.: JDH-10/20/271

Date Completed: : February 22, 2021
Logged By: : A. Kus
Drilled By: : M. Hynes
Drilling Method: : HSA (Mobile B-47 HD)
Total Depth: : 50.5 feet

Depth in Feet	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
0	Brown, saturated, medium dense, fine to medium SAND, with little silt, trace gravel		SM	1	5-8-8	Scale 1" ~ 7.75 feet
4				2	7-10-14	Approximately 4 inches of gravel was encountered at the ground surface.
5.5	Gray, saturated, medium dense, fine to medium SAND, with trace silt		SP	3	7-7-6	Groundwater was encountered at 3 feet during drilling operations.
9				4	7-4-5	At completion, water was at 3 feet, boring caved in at 3 feet.
12	Gray, saturated, medium dense, fine to medium SAND, with some to little silt, trace clay		SM	5	4-5-6	Laboratory Test Results Sample No. 6 From 19 to 20.5 feet Atterberg Limits
17	Gray, saturated, very soft to soft, silty CLAY, with trace fine to medium sand		CL	6	2-2-2	Liquid Limit = 36 Plasticity Index = 15 Natural Moisture = 31.9%
24				7	2-1-2	
29				8	2-2-3	
32	Gray, saturated, stiff, silty CLAY, with trace fine to medium sand		CL	9	2-4-8	
37	Gray, saturated, very stiff, clayey SILT, with little fine to medium sand		ML	10	8-9-10	
42	Gray, saturated, very stiff, silty CLAY, with little shells, trace fine to medium sand		CL	11	6-9-11	
49				12	9-9-10	
50.5	Boring terminated at 50.5 feet.					

HYNES & ASSOCIATES

LOG OF BORING B-15

George, Miles & Buhr
206 West Main Street
Salisbury, Maryland 21801

Wallops Island UAS Runway/Port Integration

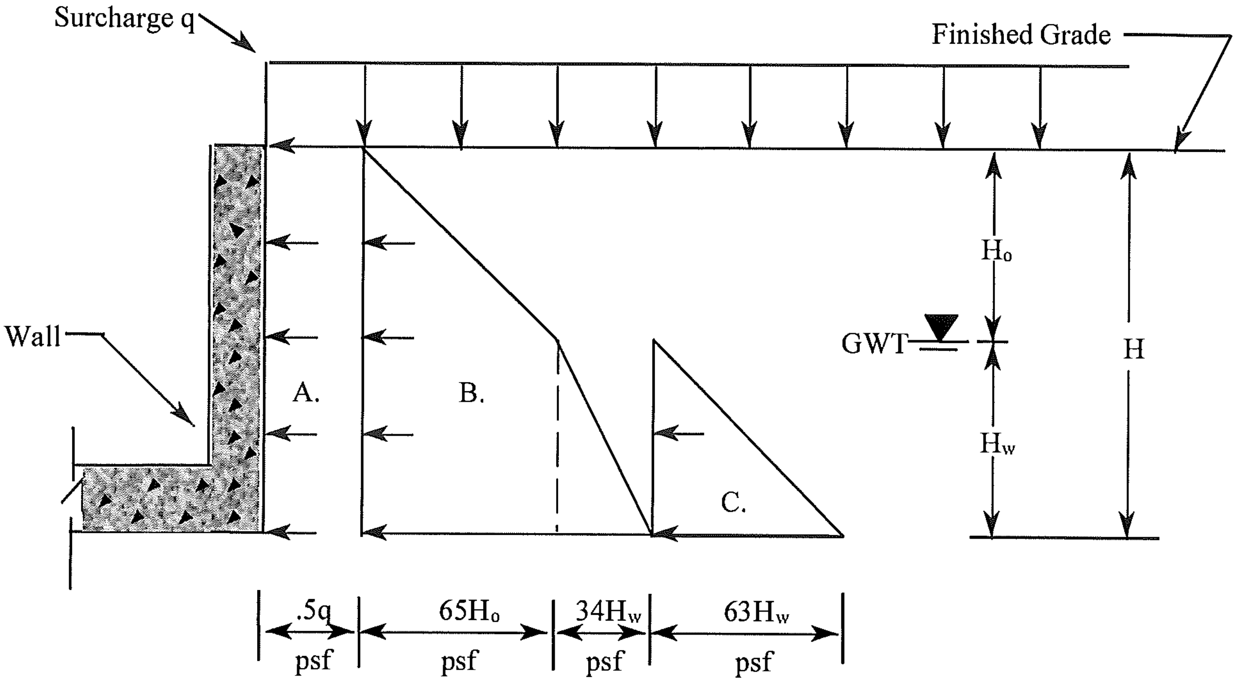
Project No.: JDH-10/20/271

Date Completed:	: February 22, 2021
Logged By:	: A. Kus
Drilled By:	: M. Hynes
Drilling Method:	: HSA (Mobile B-47 HD)
Total Depth:	: 50.5 feet

Depth in Feet	DESCRIPTION	GRAPHIC	USCS	Sample	Blow Count	REMARKS
0	Brown, gray, saturated, medium dense, fine to medium SAND, with little to trace silt		SP-SM	1	5-6-8	Scale 1" ~ 7.75 feet Approximately 4 inches of gravel was encountered at the ground surface. Groundwater was encountered at 3 feet during drilling operations. At completion, water was at 3 feet, boring caved in at 3 feet.
4				2	8-7-7	
6	Gray, saturated, medium dense, fine to medium SAND, with little silt, trace clay		SM	3	8-12-14	
10	Gray, saturated, medium dense, fine to medium SAND, with trace silt		SP	4	4-7-9	
12	Gray, saturated, medium dense, fine to medium SAND, with little silt, trace clay		SM	5	5-7-9	
18	Gray, saturated, loose, fine to coarse SAND, with little shells, trace silt		SP	6	9-3-3	
20	Boring terminated at 20.5 feet.					

Depth in Feet: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52

EARTH PRESSURE REQUIREMENTS FOR BELOW GRADE WALLS (UNDRAINED)



A. Lateral Surcharge
B. Lateral Soil Pressure
C. Hydrostatic Pressure

1. Pressure diagram assumes undrained soil conditions.

2. Pressure diagram assumes at rest soil pressures on cantilevered walls or walls with one support level.

3. For backfill, use non-plastic SP or better quality material (ASTM D-2487).

4. Compact backfill in maximum 8-inch loose lifts to 92 to 95 percent maximum dry density (ASTM D-1557).

5. Use only light-duty hand operated compaction equipment within 10 feet of walls.

6. For surcharge q, consider the greater of the maximum expected construction equipment live loads or permanent structure dead and live loads.

7. For temporary retaining walls used for excavation support, use 2/3 of the above values for lateral surcharge and soil pressures. This reflects the active soil pressure condition.

HYNES
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Date: March 30, 2021
Scale: Not to Scale
DRAWN: JDH

Earth Pressure Requirements for Below Grade Walls (Undrained)
Wallops Island UAS Runway and Port Integration Project
Walops Island, Virginia

DWG. No.
JDH-10/20/271-C

SUMMARY OF LABORATORY CBR TEST RESULTS

UAS RUNWAY - WALLOPS ISLAND FLIGHT FACILITY
WALLOPS ISLAND, VIRGINIA
MTL PROJECT 10-12537

			ATTERBERG LIMITS (ASTM D 4318)				SOIL CLASSIFICATION	MOISTURE DENSITY TEST (VTM-1)		CALIFORNIA BEARING RATIO TEST (VTM-8)		
SAMPLE NO.	SAMPLE DEPTH (FT.)	NATURAL PERCENT MOISTURE (ASTM D 2216)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PERCENT FINER THAN A #200 SIEVE (ASTM D 1140)	AASHTO M 145 (ASTM D 2487)	MAXIMUM DRY DENSITY (PCF)	OPTIMUM MOISTURE (%)	SOAKED C.B.R. VALUE	PERCENT COMPACTION BEFORE SOAKING	PERCENT SWELL
CBR-1	0.3 - 1.3	1.9	17	NP[1]	NP[1]	0.9	A-3 (SP)	94.1	16.2	18.4	100.0	-0.033
CBR-2	0.3 - 1.3	24.7	17	NP[1]	NP[1]	4.0	A-3 (SP)	94.5	15.7	16.9	99.9	-0.083
CBR-3	0.5 - 1.5	28.6	17	NP[1]	NP[1]	10.6	A-2-4 (SP-SM)	99.1	15.2	15.0	98.6	-0.100
CBR-4	0.2 - 1.2	9.0	16	NP[1]	NP[1]	0.9	A-3 (SP)	95.9	18.9	19.0	99.0	-0.067
CBR-5	0.2 - 1.2	2.8	17	NP[1]	NP[1]	0.7	A-3 (SP)	94.9	18.8	17.2	99.6	-0.050
CBR-6	0.2 - 1.2	18.6	16	NP[1]	NP[1]	0.9	A-3 (SP)	95.1	18.3	20.0	99.9	-0.117
CBR-7	0.2 - 1.2	1.1	16	NP[1]	NP[1]	1.4	A-3 (SP)	94.1	19.5	20.5	100.0	+0.017
CBR-8	0.2 - 1.2	12.7	17	NP[1]	NP[1]	1.7	A-3 (SP)	98.5	17.2	17.0	99.0	-0.150
CBR-9	0.2 - 1.2	8.7	17	NP[1]	NP[1]	23.9	A-2-4 (SM)	119.4	10.1	14.2	97.7	-0.017
CBR-10	0.2 - 1.2	5.5	17	NP[1]	NP[1]	3.8	A-3 (SP)	106.5	14.3	19.6	99.9	-0.117
CBR-11	0.2 - 1.2	9.1	17	NP[1]	NP[1]	2.5	A-3 (SP)	96.6	19.2	16.3	98.9	+0.050
CBR-12	0.2 - 1.2	3.8	16	NP[1]	NP[1]	1.0	A-3 (SP)	96.7	17.5	20.3	99.0	-0.067

Notes: 1) Denotes Non-Plastic Soils

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FIELD CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

NON-COHESIVE SOILS
(Silt, Sand, Gravel and Combinations)

DENSITY

Very Loose	- 5 blows/ft. or less
Loose	- 6 to 10 blows/ft.
Medium Dense	- 11 to 30 blows/ft.
Dense	- 31 to 50 blows/ft.
Very Dense	- 51 blows/ft. or more

RELATIVE PROPORTIONS

Descriptive Term	Percent
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

PARTICLE SIZE IDENTIFICATION

Boulders	- 8 inch diameter or more
Cobbles	- 3 to 8 inch diameter
Gravel	- Coarse - 1 to 3 inch
	- Medium - 1/2 to 1 inch
	- Fine - 4.75 mm to 1/2 inch
Sand	- Coarse - 2.0 mm to 4.75 mm
	- Medium - 0.425 mm to 2.0 mm
	- Fine - 0.075 mm to 0.425 mm
Silt	- 0.075 mm to 0.002 mm

COHESIVE SOILS
(Clay, Silt and Combinations)

CONSISTENCY

Very Soft	- 3 blows/ft. or less
Soft	- 4 to 5 blows/ft.
Medium Stiff	- 6 to 10 blows/ft.
Stiff	- 11 to 15 blows/ft.
Very Stiff	- 16 to 30 blows/ft.
Hard	- 31 blows/ft. or more

PLASTICITY

Degree of Plasticity	Plasticity Index
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	over 22

Classification on logs are made by visual inspection of samples unless a sample has been subjected to laboratory classification testing.

Standard Penetration Test - Driving a 2.0" O.D., 1-3/8" I.D., splitspoon sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. It is customary to drive the spoon 6 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and making the test are recorded for each 6 inches of penetration on the drill log (Example - 6/8/9). The standard penetration test value (N - value) can be obtained by adding the last two figures (i.e. 8 + 9 = 17 blows/ft.). (ASTM D-1586)

Strata Changes - In the column "Soil Descriptions," on the drill log, the horizontal lines represent strata changes. A solid line (—) represents an actually observed change, a dashed line (----) represents an estimated change.

Groundwater - Observations were made at the times indicated. Porosity of soil strata, weather conditions, site topography, etc. may cause changes in the water levels indicated on the logs.

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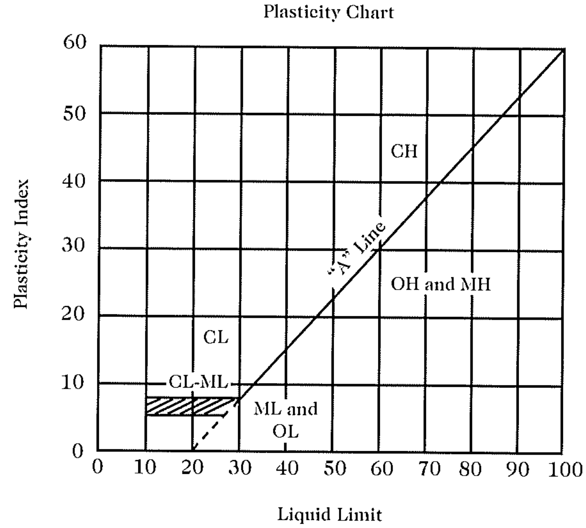
JOHN D. HYNES & ASSOCIATES, INC.

Geotechnical and Environmental Consultants
Monitoring Well Installation
Construction Inspection and Materials Testing

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions			*Group Symbols*	*Typical Names*	*Laboratory Classification Criteria*		
Coarse-grained soils (More than half of material is larger than No 200 sieve size)	Gravels (More than half of coarse fraction is larger than No 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No 200 sieve size), coarse grained soils are classified as follows: Less than 5 percent GW, GP, SW, SP; More than 12 percent GM, GC, SM, SC; 5 to 12 percent *Borderline cases requiring dual symbols*[b]	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	Poorly graded gravels, gravel sand mixtures, little or no fines		Not meeting all graduation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM[a] d / u	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands,		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	Poorly graded sands, gravelly sands, little or no fines		Not meeting all graduation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM[a] d / u	Silty sands, sand-silt mixtures		Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols.
			SC	Clayey sands, sand-clay mixtures		Atterberg limits above "A" line with P.I. greater than 7	
Fine-grained soils (More than half material is smaller than No 200 sieve)	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity			
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL	Organic silts and organic silty clays of low plasticity			
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH	Inorganic clays of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity, organic silts			
Highly organic soils			Pt	Peat and other highly organic soils			

Plasticity Chart



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Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GBC GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

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ATTACHMENT 3: DREDGING ESTIMATES MEMORANDUM

Wallops Island Northern Development (WIND) Project

DRAFT Memorandum: Dredge Estimates

6/5/2022

Introduction

Estimates of future maintenance dredging volumes have been developed for the proposed vessel approach channel for the Wallops Island Northern Development project. The estimates were divided geographically into two regions due to differing hydrodynamic and sediment conditions. The first region is in the inlet area which corresponds to the north/south alignment of the proposed vessel approach channel that would connect to the federal navigation channel in the vicinity of Buoy 11 (see Figure 1). This section of the channel is also designated in Figure 2 with the solid lined red rectangle. The second region, which corresponds to the east/west alignment of the proposed vessel approach channel, is also shown in Figure 2 and is designated by the dashed black rectangle. The proposed vessel approach channel would be 100 feet (ft) wide and is expected to be dredged initially to 9 ft below Mean Lower Low Water (MLLW). In a subsequent phase, the channel would be dredged to 12 ft below MLLW. Both depths are designated the maximum dredge depth and include any advanced dredging and over-dredging.

Figure 1. Location of Proposed Vessel Approach Channel tie-in to Federal Navigation Channel

In Region 1, sediment transport is influenced by both tidal and wind driven currents and waves generated offshore and propagating into the bay. Region 2 is more sheltered, and less influenced by waves.

For Region 1, the federal navigation channel maintenance dredge records were used to develop estimates of future dredging requirements for the proposed vessel approach channel. The federal navigation channel has similar dimensions to the proposed channel for both width and depth, and its dredging history can be considered a surrogate estimating future maintenance dredging for the proposed Region 1 channel. In addition to the historic dredge records, survey data at the north end of the proposed channel was reviewed to gain insight into potential future dredging needs. Surveys were conducted in both 2019 and 2021 and the changes in the bathymetry based on those surveys provides another estimate of future dredging volume.

For Region 2, the basis of estimates is the channel dredging records near Harbor Refuge. The Harbor Refuge has similar sheltering conditions and provides a surrogate for estimating future dredging requirements for Region 2 of the proposed vessel approach channel.

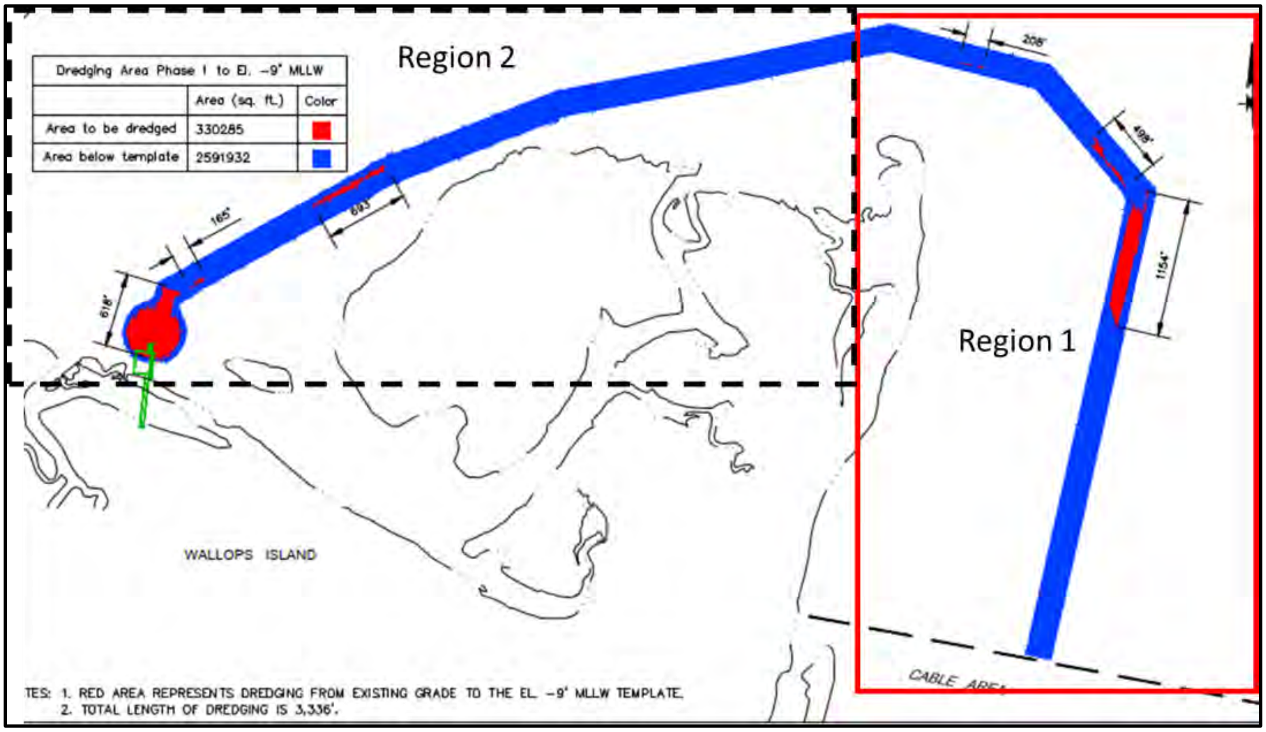


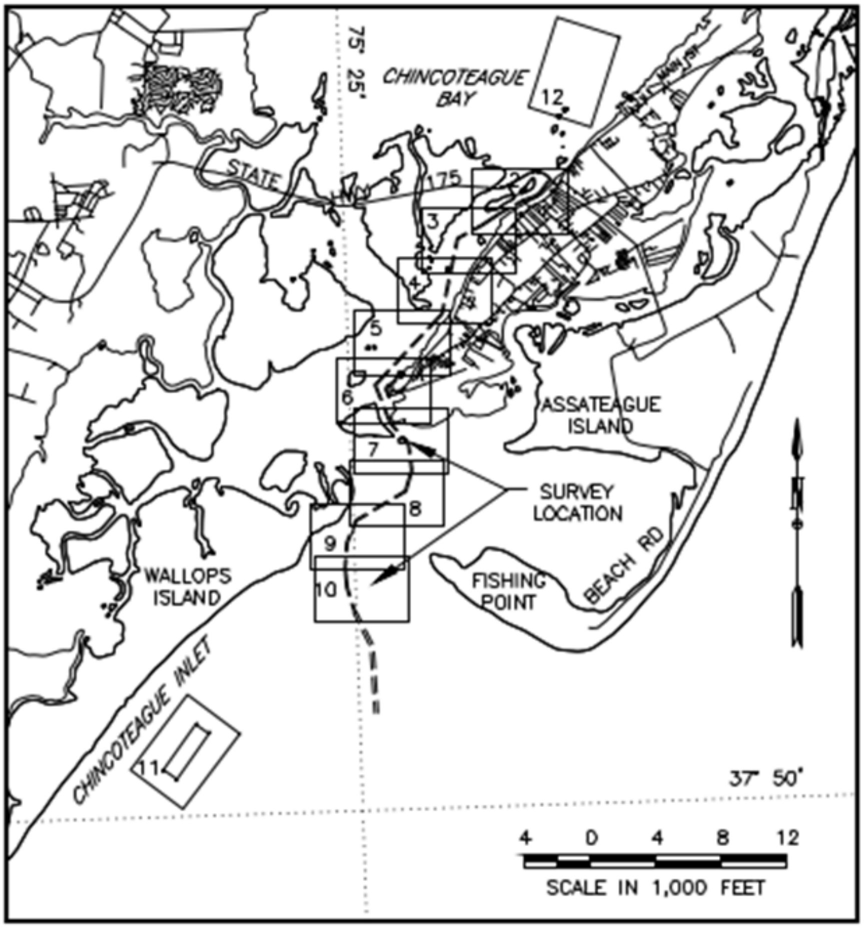
Figure 2. Division of Proposed Channel into two Regions for Dredge Analysis

Dredging Estimates for Region 1

Historic dredging records for the federal navigation channel were made available by the USACE Norfolk District. The data was provided in various formats, including contour plots of pre- and post-survey data, summaries of historic dredging volumes in PowerPoint files and Excel sheets with contract data and dredge volume data. Of the data provided, a table in one of the PowerPoint files, shown below in Figure 3, and a few of the pre-dredge survey documents provided the most useful data. The other source of data were the pre-dredge surveys, which included estimates of the dredge volumes by section. An example of the data is shown in Figure 4.

Project	FY	Start	End	Days	CY	Method
CHINCOTEAGUE INLET	1993	06-MAR-93	19-MAR-93	13	112,169	Contract
CHINCOTEAGUE INLET	1994	26-MAR-94	08-APR-94	13	123,333	Contract
CHINCOTEAGUE IN. OCEAN BAR	1995	15-MAR-95	05-APR-95	21	120,835	Contract
CHINC INLET - OCEAN BAR	1996	22-JUN-96	21-JUL-96	29	120,079	Contract
CHINC. INLET OCEAN BAR	1997	01-OCT-97	09-NOV-97	39	122,898	Contract
CHINC. BAY GREENBACKVILLE	1997	20-MAY-97	22-MAY-97	2	9,605	Contract
CHINC. HBR. REFUGE	1997	24-MAY-97	25-MAY-97	1	4,771	Contract
CHINCOTEAGUE INLET OCEAN BAR	1998	16-JUL-98	31-JUL-98	15	72,592	Contract
Chincoteague Inlet	2002	01-SEP-02	31-OCT-02	60	91,292	Contract
Chincoteague Bay	2002	10-SEP-02	17-OCT-02	37	11,422	Contract
Chincoteague Harb. of Refuge	2003	03-AUG-03	10-AUG-03	7	11,885	Contract
Chincoteague Inner Channel	2003	30-NOV-03	10-DEC-03	10	12,261	Contract
Chincoteague, VA	2005	16-MAR-05	27-MAR-05	11	12,455	Currituck
Chincoteague Inlet Ocean Bar	2006	01-MAR-06	24-MAR-06	23	71,009	Contract
Chincoteague Coast Guard	2007	15-OCT-07	15-DEC-07	61	10,347	Contract
Chincoteague, VA	2007	23-AUG-07	11-SEP-07	19	28,345	Contract
Chincoteague Inlet Ocean Bar	2008	20-FEB-08	06-MAR-08	15	63,841	Contract
Chincoteague Bay Channel	2009	08-SEP-09	20-NOV-09	73	13,353	Contract
Chincoteague Harbor of Refug	2009	02-SEP-09	17-OCT-09	45	5,558	Contract
Chincoteague, VA	2009	29-NOV-08	20-DEC-08	21	32,545	Currituck
Chincoteague, VA	2010	02-JUL-10	22-JUL-10	20	41,275	Currituck
Chincoteague, VA	2011	08-MAR-11	30-MAR-11	22	54,380	Currituck
Chincoteague, VA	2011	27-SEP-11	30-SEP-11	3	3,075	Currituck
Chincoteague, VA	2012	11-MAR-12	17-MAR-12	6	9,680	Currituck
Chincoteague, VA	2012	30-JAN-12	10-FEB-12	11	1,550	Currituck
Chincoteague, VA	2012	13-SEP-12	21-SEP-12	8	13,390	Currituck
Chincoteague, VA	2012	18-DEC-11	19-DEC-11	1	1,270	Currituck
Chincoteague, VA	2013	13-DEC-12	19-DEC-12	6	17,795	Currituck
Chincoteague, VA	2014	05-NOV-13	09-NOV-13	4	3,575	Murden
Chincoteague, VA	2014	20-FEB-14	03-MAR-14	11	11,015	Murden
Chincoteague Inlet, VA	2014	11-AUG-14	04-SEP-14	24	24,315	Murden
Chincoteague, VA	2014	19-DEC-13	30-JAN-14	42	29,505	Murden
Chincoteague, VA	2015	15-JAN-15	15-FEB-15	31	13,300	Murden
Chincoteague, VA	2016	15-DEC-15	29-DEC-15	14	3,600	Murden
Chincoteague, VA	2017	5-NOV-16	7-NOV-16	2	2,195	Currituck
Chincoteague, VA	2017	08-DEC-16	11-DEC-16	3	3,960	Currituck

Figure 3. Norfolk District Dredging Records



DREDGING AREA LOCATION	STATION TO STATION	CUBIC YARDS PLACE MEASUREMENT		
		TO 9 FT	2 FT O.D. ALLOWABLE	TOTAL
INNER CHANNEL	56+00 – 65+00	200	3,000	3,200
INNER CHANNEL	90+00 – 101+00	3,000	3,200	6,200
INNER CHANNEL	250+00 – 264+00	10,800	9,800	20,600
INNER CHANNEL	299+00 – 306+00	1,400	2,900	4,300
ESTIMATED ACCRETION TO NOV 2013		0,000	0,000	3,000
TOTAL		15,400	18,900	37,300

Figure 4. Example of Dredge Estimate data from Norfolk District

One of the difficulties in analyzing the data is relating the location of the recorded or estimated dredge data to the physical location along the channel. This is necessary to assure that only dredge data pertaining to Region 1 is used. The channel length of interest extends from Buoy 11 at the south end to approximately Buoy 16 at the north end. For the digital files with the estimated dredging requirements (pre-dredge surveys), the data could be reasonably located using the along-channel station-to-station information provided both in the volume estimate table and on the survey sheets. For the historic dredge data table, the only indicator is the project name, which provides some indication of the location but is not definitive.

Therefore, two approaches were used to provide maintenance dredging estimates. In the first, the dredge estimates from the pre-dredge surveys were combined with data from the historic data table. When using data form the historic data table, only those projects indicated as Chincoteague Inlet were used, and only those after 2002. In the second estimate, all the data in the historic data table that included the project name Chincoteague, VA or Chincoteague Inlet were used.

The data from the pre-dredge surveys and limited records from the Historic Dredge Table are summarized in Table 1. The data indicate an average annual dredging requirement of 14,569 cubic yards (cy). The data also indicate variable intervals between dredging, on the order of 1 and 4 years. Note that these volumes correspond to maintaining a navigable depth of 9 feet below MLLW and include a 2-ft over-dredge (to 11' MLLW). The dredging for the proposed vessel approach channel is to 9' MLLW including over-dredging. Thus, the volumes presented in Table 1 are likely high for the proposed channel and need to be reduced to account for the difference in dredge depths between the proposed channel and federal channel (maximum of 9' vs. 9'+2').

Table 1. Summary of Dredge Records for Region 1 using Approach 1 (11-ft depth)

Year	Volume (cy)	Annualized (cy/yr)
2002	-	-
2009	92,161	13,166
2013	24,900	6,225
2014	24,315	24,315
	Average	**14,569**

The 2013 pre-dredge survey provided dredging estimates for both a 9-ft targeted depth and the additional volume associated with the over dredging to 11 ft below MLLW within the Region 1 footprint. This data provides a basis for estimating the dredge volumes for the 9' proposed channel based on volumes recorded for the federal channel of 11' (9'+2'). The volume required to reach 9-ft below MLLW was 10,800 cy and to reach 11 ft below MLLW was 24,000 cy. These data indicate that the estimated dredge volumes for a 9' depth below MLLW is 48.9% of the volume dredged to reach 11' below MLLW. This percentage was used to estimate the proposed channel volumes using the federal channel volumes. The final values are summarized in Table 2 and were calculated by multiplying the value sin Table 1 by 48.9%.

Table 2. Summary of Dredge Records for Region 1 using Approach 1 (9-ft depth)

Year	Volume (cy)	Annualized (cy/yr)
2002	-	-
2009	44,237	6,320
2013	11,952	2,988
2014	11,671	11,671
average	**22,620**	**6,993**

The data for the second approach for Region 1 is summarized in Table 3. The data based on the federal channel dredge records were reduced by 48.9% to estimate the volumes associated with the 9' depth (below MLLW). The data indicate an average annual dredging requirement of 12,109 cy, with annual rates ranging from 1,793 cy to 33,570 cy. The interval between dredging events ranges from 1 year to 3 years.

Table 3. Summary of Dredge Records for Region 1 using Approach 2 (9 ft below MLLW depth)

Year	Volume (cy)	Annualized (cy/yr)
2002	-	-
2002	-	-
2005	6,203	2,068
2007	14,116	7,058
2009	16,207	8,104
2010	20,555	20,555
2011	28,613	28,613
2012	12,893	12,893
2013	8,862	8,862
2014	33,570	33,570
2015	6,623	6,623
2016	1,793	1,793
2017	3,065	3,065
average	**13864**	**12109**

A subsequent phase of the project includes dredging the vessel approach channel to 12 ft below MLLW (with an additional 2-ft over-dredge). The 2013 data used to convert 11 dredge depths to 9-foot dredge depths was also used to convert from the 11-foot to 12-foot dredge depths. The analysis indicates that the 12-foot dredge depth is approximately 1.25 times the 11-foot dredge depth, or 2.56 times the 9-foot dredge depth. The estimated values are summarized in Table 4.

Table 4. Summary of Region 1 Annual Average Maintenance Dredging Requirements

Estimated Dredge Requirements	9'(cy/yr)	12' (cy/yr)
Approach 1	6,993	17,902
Approach 2	12,109	30,999

The January 2019 and January 2021 bathymetric survey data provide additional insight into future dredging requirements in Region 1. The 2019 and 2021 survey extent and track lines are shown in **Figure 5** (Panel A) and the survey data are contoured in **Figure 5** (Panels C and D). The proposed channel alignment, as indicated in **Figure 5** (Panel C) was selected to follow the deepest bathymetry (red and green regions) and runs between two shoals (blue areas in contour plot). The 2021 survey (Panel D) indicates significant changes in the local bathymetry, with sediment shoaling along the proposed channel. The two survey data sets were plotted along three channel transects, one along the channel (brown line in Panel B) and two cross-channel transects (T1 and T2 in Panel D).

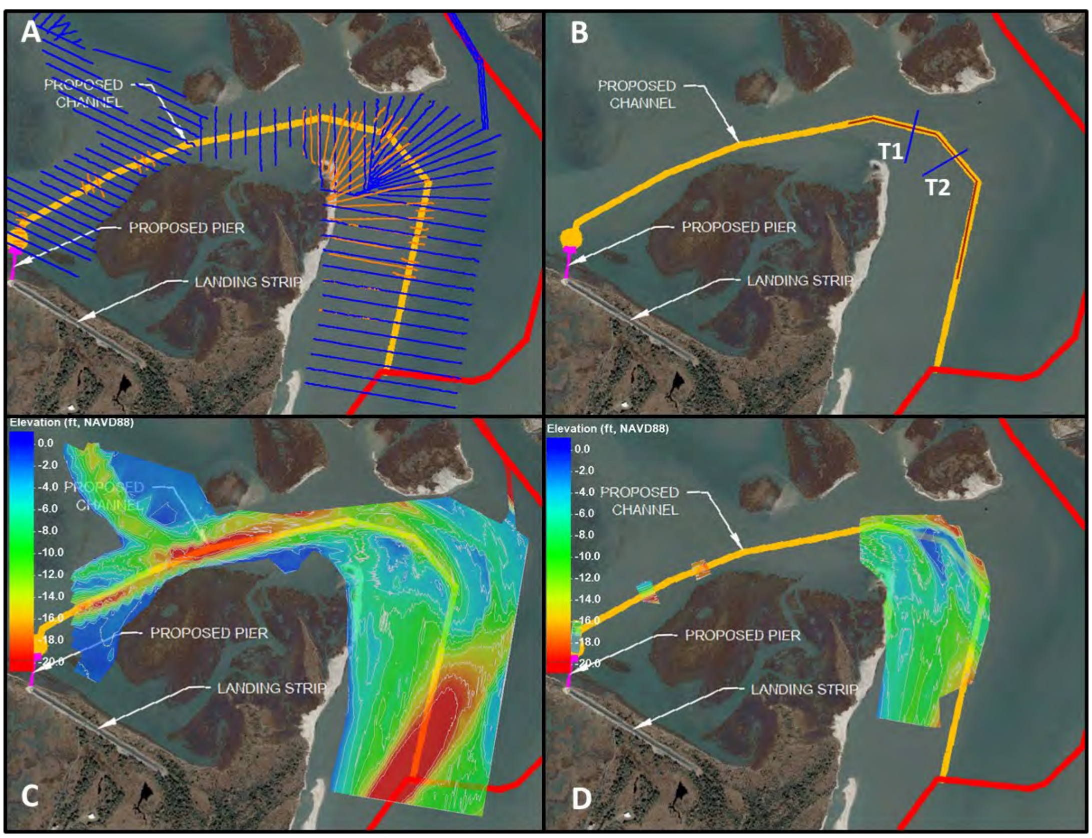


Figure 5. 2019 and 2021 Survey Data (Panel A: blue = 2019, orange = 2021)

The cross-channel transect data are shown in **Figure 6** and indicate significant shoaling along the proposed channel alignment, which is in the vicinity of 800 feet along the transect. The changes are on the order of 6 to 10 feet of accretion. A plot of the survey data along the channel is shown in **Figure 7**. The plot also includes the 9-ft and 12-ft below MLLW elevations representing the Phase 1+2 and Phase 3 channel elevations. The shoaling is very evident in the 1,000 to 3,000-ft range and represents a considerable impact to the maintenance dredging. An estimate of the potential maintenance dredging, represented by the 2019 to 2021 bathymetric changes, was made by considering the 2021 survey elevations above the 9-ft and 12-ft below MLLW elevations. The green shaded area represents the amount of dredging needed to return the proposed channel to the 9 ft below MLLW elevation. Assuming a 100-ft wide channel, the associated volume is approximately 59,500 cy. A similar analysis was applied to the 12-ft below MLLW elevation, yielding a dredge volume of 104,500 cy.

The primary forcing causing these significant changes has not been identified, but several storms passed through the area during the interval between the two surveys, including Tropical Storm Fay in July 2020, Hurricane Isaias in August 2020, and a nor'easter on December 16, 2020. The annualized dredging requirements for the bathymetric changes is 29,700 cy for 9 ft below MLLW and 52,200 cy for 12 ft below MLLW channel elevation. These values are higher than those obtained using the federal channel dredging records. However, the approach implicit in the calculation of these values does not reflect the channel re-alignment strategy used by the USACE which, if implemented, would likely lead to smaller dredge volumes.

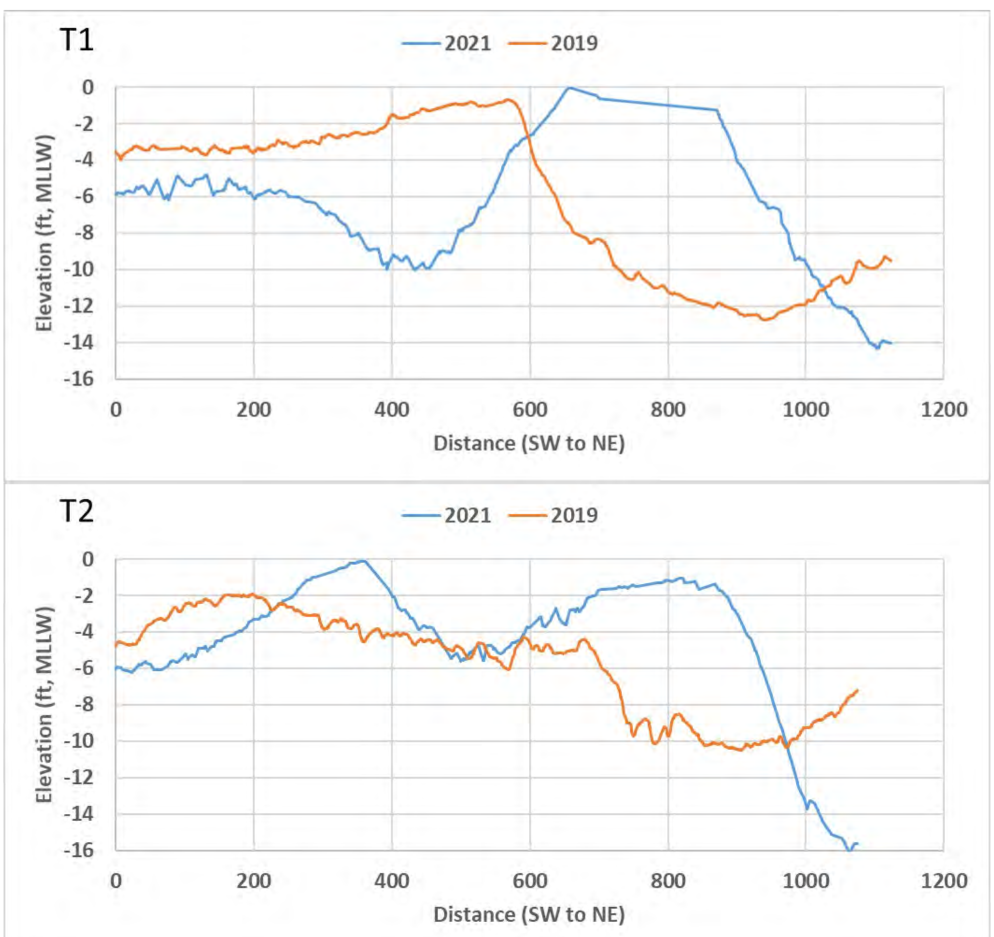
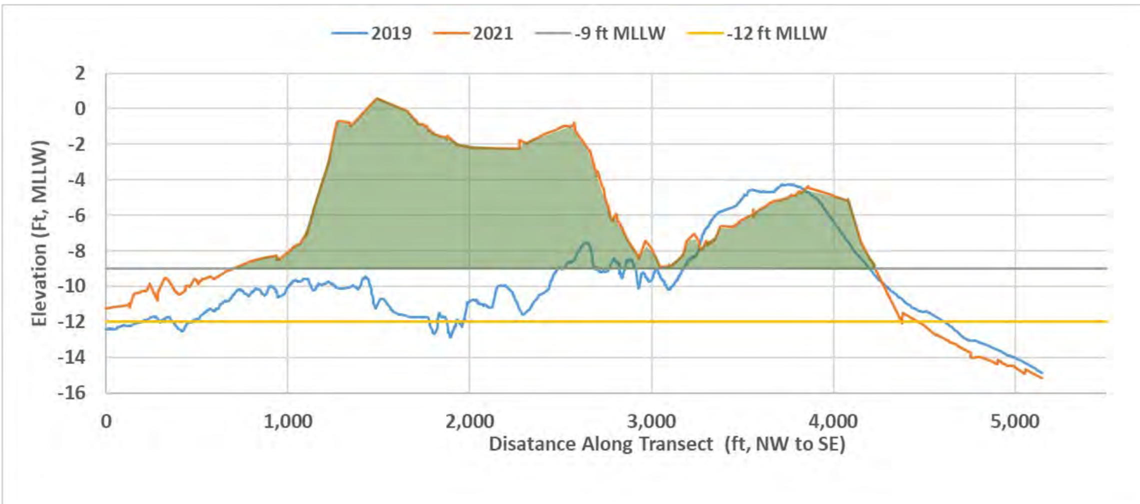


Figure 6. Survey Data Along Cross-Channel Transects



Dredging Estimates for Region 2

A similar procedure to that applied in Region 1 was applied to Region 2, using the records from Harbor Refuge. This area is sheltered from significant wave action, much like the Region 2 section of the proposed channel and is the best available data. A summary of the available data and associated annual average dredge volumes is provided in Table 5.

Table 5. Summary of Dredge Records for Harbor of Refuge (8' +2')

Year	Volume (cy)	Annualized (cy/yr)
1997	-	-
2003	11,885	1,981
2009	5,558	926
	Average	**1,454**

The data need to be adjusted to account for channel length and dredge depths. The federal navigation channel in the vicinity of Harbor of Refuge is 8 ft below MLLW.

As pointed out previously, the exact location of the historic dredging is not clear. Therefore, an approximately 4,000-ft length of channel associated with the dredge events was estimated based on engineering judgement. The length of the proposed vessel approach channel in Region 2 is approximately 6,000 feet. Thus, the historic volumes need to be adjusted upwards by approximately 50% to account for the differences in channel lengths.

To account for the difference in channel depths, the same strategy used for Region 1 adjustments from 11' to 9' were applied, but in this case are from 10' to 9', yielding an adjustment of 65.7%. Applying the length and depth adjustments yields a total annual average maintenance dredge volume of 1,432 cy/yr.

According to the historic records, dredging is required on the average every six years. At that interval, it is expected that 8,600 cy would need to be dredged every six years (on average).

For the 12-ft below MLLW proposed channel depth, the same approach used for Region 1 was also applied, yielding an annual average maintenance dredge volume of 2,400 cy/yr.

Summary

Estimates of future maintenance dredging requirements have been made using historic dredge records made available by the Norfolk District of the USACE. The Wallops Island Northern Development Project proposed vessel approach channel was divided into two regions for analysis, based on hydrodynamic forcing considerations. Historic dredge data relevant to each area was revised and used to estimate future dredging requirements for the channel sections within each region.

The estimated volumes are provided on an annual average basis. The dredging interval is likely to be highly variable, based on the historic data. The federal navigation channel dredging records indicate that channel migration has occurred, and the 2019 and 2021 survey data show large naturally occurring changes in the bathymetry that could require dredging to maintain the proposed channel alignment.

The Federal channel is re-aligned periodically to follow the migrating, naturally deep channel and to minimize dredging quantities. VA Space is proposing to permit a similar channel re-alignment strategy in the “Region 1” area of the proposed channel. Thus, the USACE dredging records are a reasonable surrogate for Region 1.

It is recommended that the estimated maintenance dredge volumes be used to support cost projections. However, the dredging interval, volume, and location of the actual dredging would vary, and it is not feasible to make projections for the locations and volumes in any more detail.

ATTACHMENT 4: BATHYMETRY INFORMATION

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GBA
ENGINEERS ★ SURVEYORS

January 10, 2020

Mr. Nathan Overby, PE
Virginia Commercial Space Flight Authority (VCSFA)
4111 Monarch Way, Suite 303
Norfolk, VA 23505

Subject: Mid-Atlantic Regional Spaceport (MARS)
Wallops Island M95 Intermodal Barge Service Project
IDIQ Task No 1 of Task Order 01 Preliminary Small Vessel Channel

Dear Mr. Overby,

Gahagan & Bryant Associates, Inc. (GBA) is providing the following engineering assessment for the Small Vessel Approach Channel and Basin as required by Task 1 of Task Order 01 under Contract VCSFA-GBA-08012019.

This report satisfies Task 1 of Task Order 01, the Preliminary Small Vessel Approach Channel/Harbor Engineering. The completion of Task 2 of Task Order 01, the Pre-joint Application Meeting and Support Planning, has been extended until spring 2020 when VCSFA, NASA and the agencies begin formal discussions for the Environmental Assessment.

This engineering assessment for the Small Vessel Approach Channel and Basin is intended to assist with project planning and budgeting. We are looking forward to continued involvement during the Environmental Assessment process, as well as, the additional pending Task Orders for the other design elements.

Feel free to contact me if you have any questions or if we can provide further assistance.

Kind regards,
GAHAGAN & BRYANT ASSOCIATES, INC.

William A. Murchison
Senior Associate

IDIQ Task No 01
Subtask 1 PRELIMINARY SMALL VESSEL APPROACH CHANNEL/HARBOR ENGINEERING

Introduction

The Virginia Commercial Space Flight Authority (VCSFA) is developing a harbor and improving existing waterfront facilities for use with unmanned vehicle test systems and operations, including a small barge and research vessel access channel leading to a pier and combination dock/ramp for loading. VCSFA has requested GBA to prepare a preliminary engineering assessment for the Small Vessel Channel.

Subtask 1.1 Geotechnical Data Review and Planning

GBA researched existing geotechnical data for the area in the vicinity of the proposed Wallops Island Intermodal Port Access Channel. While the United States Army Corps of Engineers (USACE) designates two waterways in this area (Chincoteague Inlet Channel and Chincoteague Inlet to Bogues Bay Connecting Waters), no USACE boring data has yet to be found for this area. NASA has proposed two borings independent of the Intermodal Port project, one of which may provide useful data on the material in and around the proposed turning basin. These borings may be seen in Appendix A (pg. 6).

GBA collected grab samples of the bottom surface material while performing the initial single beam hydrographic survey of areas of interest surrounding Wallops Flight Facility. The grab samples closest to the proposed access channel were determined to be predominantly sand, while material from more distant sampling sites included silty sand and silt. Note that the surface grab samples represent the surface layers of channel material and material characteristics can vary with depth at a location.

Silty sand is used as an approximation for the material consistency of the recommended dredging areas. Material is expected to vary across the dredging areas, with higher sand content near the inlet and higher silt and organic content close to wetlands.

While the grab samples provide information for a preliminary dredging assessment, more detailed geotechnical work will be required to effectively progress to the feasibility and design phases for dredging. A proposed scope of work for initial geotechnical investigations was submitted to VCSFA in September 2019, and examples of proposed boring locations are provided in Appendix A (pg. 2-4):

Subtask 1.2 Preliminary Small Vessel Approach Channel and Basin Layout

GBA performed a preliminary engineering assessment based on a review of the range of VCSFA small vessel dimensions and operational needs required to develop a preliminary layout for the Small Vessel Channel and Basin. A variety of shallow draft (2 to 4 feet) manned and unmanned vessels will be serviced by the port. The major navigational service, for the initial phase of the project, will be a tug and barge configuration of an approximate 150 x 40 foot deck barge propelled by a coastwise tug boat requiring approximately 8 ft. of draft.

The small vessel approach channel will interface with the Chincoteague Inlet Federal Channel and the Bogues Bay Connecting Waterways. The engineering assessment determined that the US Army Corps of Engineers (Corps) is authorized to maintain Chincoteague Inlet to a depth of 12 ft. The Corps is also authorized to maintain the Bogues Bay Connecting Waterway Channel although our research did not indicate any records of past dredging in the connecting waterway. The Corps maintains the Chincoteague Inlet Bar Channel to a depth of 12 ft.; however, the Corps only maintains the interior channel to a depth of 9 ft. It seems that this decision is predominantly driven by budgetary constraints. The Corps faces a continuing challenge obtaining funds for dredging minor channels such as Chincoteague Inlet.

The channel evaluated in this engineering assessment has been selected at a depth of 12 ft. with a width of 100 ft. This channel is adequate for a tug and barge operation required for servicing the facility and the 100-foot width is consistent with the dimensions of the Federal Channel. The surveys conducted in January 2019 and used for this assessment indicate that there is sufficient water depth in the Federal Channel for a 12 ft. channel; however, discussions with the Corps will need to address any future maintenance dredging that may be required in the interior sections of the Chincoteague Channel that are presently only maintained to a depth of 9 ft. in the event of any shoaling.

The 12 ft. channel selected for this evaluation is a suitable solution to the phased approach for this project in order to be prepared for future expansion of the facility to allow for larger vessels. However, in the short term, a shallower draft channel may be prudent if the viability of the larger scale port seems unlikely. The 12 ft. channel is used for the calculation of the budgetary dredging and construction costs as well as for the basis of the scope of work for the Environmental Assessment.

The width of the channel can be adjusted as the project design matures and more information is determined about the possible future port expansion as well as the exact vessel dimensions that will service the facility. It is anticipated that these details will be addressed as the project moves toward final design and detailed construction cost estimates are prepared.

For the purpose of this preliminary layout, GBA evaluated an access channel from the USACE Chincoteague Inlet Channel to the proposed pier. The channel layout includes a turning basin at the end of the pier with a 200 ft. radius.

The proposed channel extends through and around Gunboat Point, turning south and intercepting the USACE designated Chincoteague Inlet Channel. An overview of this channel can be seen in Appendix A (pg. 1). This channel path was chosen to minimize the dredging necessary while maintaining a depth consistent with the Intermodal Port's intended uses. Soundings for the existing conditions throughout the proposed channel can be seen in Appendix A (pg. 2-4).

Figure 1 – Proposed Channel

During future design efforts two alternative pier designs will be assessed. The two alternative piers presented in Figure 2 are 620 ft. and 1,260 ft. The longer pier length would reach into existing deeper water and remove or significantly reduce the initial need for dredging a turning basin. This pier layout is shown in Appendix A (pg. 2).

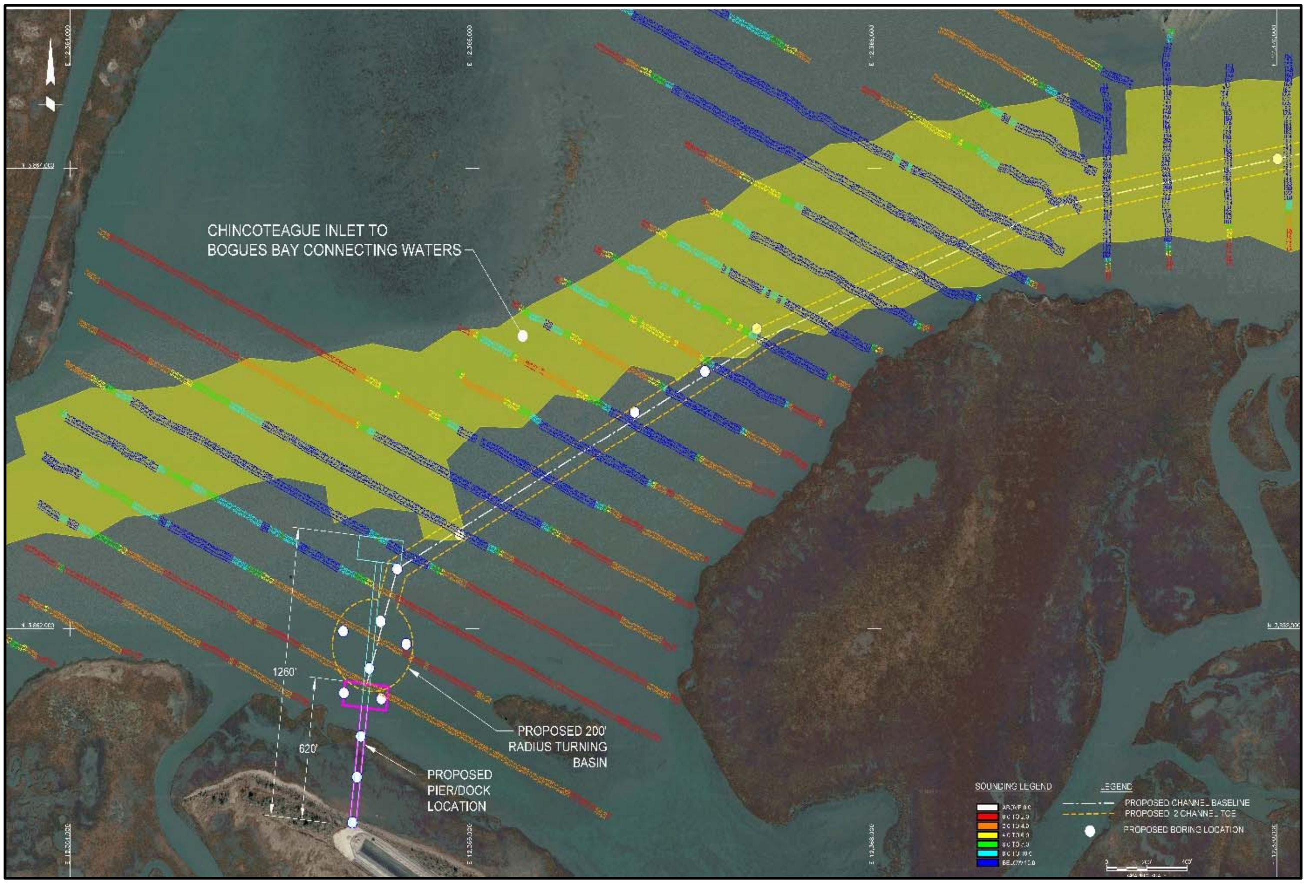


Figure 2 – Pier Layout

The preliminary layout of the access channel follows a similar route to the unmaintained, USACE designated Chincoteague Inlet to Bogues Bay Connecting Waters, shown in Appendix A (pg. 2-5). Furthermore, where the 12 ft. proposed channel ties into the Chincoteague Inlet Channel, the federal channel has only been maintained in recent years to 9 ft.; however, the channel is authorized to 12 ft. USACE surveys show that this channel currently exceeds its authorized depth at the intersection with the proposed channel. Chincoteague Outer/Bar Channel, which feeds into the south end of Chincoteague Inlet Channel, is maintained to 12 ft., but currently exceeds its authorized depth.

Note: Any preliminary channel path is tentative. While existing conditions favor the current baseline, hydrodynamic modelling may reveal more advantageous alignments to minimize long term maintenance dredging.

It is extremely important that the sedimentation for various channel alignments and the existing Chincoteague Inlet Channel be evaluated for typical seasonal/tidal movement, as well as for major storm events. The modeling that will be performed as part of the Environmental Assessment should evaluate expected sedimentation for the channel and pier length configurations presented as design alternatives in the 30% design. The results of this modeling will influence the final design.

Subtask 1.3 Dredge Quantity Calculations

GBA performed single beam hydrographic surveys in the area surrounding Wallops Island on January 15-18, 2019, using an ODOM CV-200 echosounder. Soundings were then used to calculate the depth of material above the proposed template depths of 12 ft. and 18 ft. and the area which this material covered. The dredging volumes are provided in the table below.

TABLE 1:

Channel Area	12 ft. Template	18 ft. Template
200 ft. Radius Turning Basin	64,007 CY	104,928 CY
100 ft. Wide Access Channel	126,895 CY	413,016 CY
Total Volume:	190,902 CY	517,944 CY

A survey for the required dredging to achieve the 12 ft. template is included in Appendix A (pg. 5).

Figure 3 – Proposed Alignment of Small Vessel Channel

Subtask 1.4 Identify Three (3) Potential Dredged Material Placement Locations

GBA assessed the available options for dredged material placement near Wallops Island and identified three potential placement sites, shown in the table below. "Sail distance" corresponds to the length of the path via water required to reach the placement site from the centroid of dredging in the proposed turning basin or access channel, in statute miles. "Pipe distance" refers to the length of pipe required to reach the placement site from the centroid of dredging *or* from the anchorage for a vessel loaded with dredged material. Detail for each site, as well as relative distance to the proposed dredging location, is shown in Appendix B. Note there is the possibility of beneficial use of the sandy material on local shorelines while transporting fine grained material to the placement options once the material characteristics are better known. GBA has identified the following three placement locations for evaluation purposes and this report does not address any possible beneficial use locations.

Figure 4 – Material Placement Sites

TABLE 2: Dredged Material Placement Locations

Site	Description	Sail Distance from Basin	Pipe Distance from Basin	Sail Distance from Channel	Pipeline Distance from Channel
Wallops Open Ocean Dredge Material Placement Area	Open water placement site, closer than Lewis Creek or Norfolk Ocean disposal sites	6.1 miles	--	4.4 miles	--
MARS Flood Protection Zone	Reuse of material for flood mitigation through upland placement at site identified by VCSFA team members	--	2,800 ft.	0.0 miles	12,040 ft.
Greenbackville Dredged Material Containment Facility	Upland DMCF run by USACE, requires both navigation of Chincoteague Channel and pumping on location	11.3 miles	--	9.5 miles	650 ft.

The geotechnical investigation and associated physical and chemical laboratory analysis of the sediment samples will be the determining factor for the viability of the placement options for the dredged material. The sediment characterization is a key component of the Environmental Assessment and Tier III Elutriate, Bioassay and Bioaccumulation testing will need to be performed if open water placement for the dredged material is being considered. GBA has identified three potential open water placement sites and developed dredging costs for one of these sites in this report.

The testing required for open water placement is costly and time consuming; however, open water placement is typically the lowest cost alternative for dredging projects. This detail will be a focus during the pre-permit application discussions with stakeholders and a key factor in developing the overall project budget.

Subtask 1.5 Develop Budgetary Dredging Cost Estimates

TABLE 3: Summary of Budgetary Dredging Costs for Three Placement Alternatives:

Cost Option	Description	Equipment Type	Placement Method	Mob. & Demob. Lump Sum Amount	Dredging Qty. (Cy)	Dredging Unit Price	Dredging Amount	Contingent	Total Amount
1	**Wallops Open Ocean Dredged Material Placement Area**	Mechanical Dredge	Bottom Dump	$1,100,000	190,000	$13.50	$2,565,000	$300,000	$3,965,000
2	**Flood Protection/Upland Placement on MARS Site**	Cutter Suction Dredge	Direct Pump	$2,250,000	190,000	$7.50	$1,425,000	$1,000,000	$4,675,000
3	**Greenbackville Dredge Material Containment Facility**	Mechanical	Hydraulic Unloader	$2,500,000	190,000	$26.00	$4,940,000	$500,000	$7,940,000

Option 1: Wallops Open Ocean Dredge Material Placement Area

GBA identified three possible Open Water Placement Areas in the vicinity of the site. For the purpose of this preliminary analysis, we have evaluated the site that is located just offshore of Wallops Island with a transportation distance of the dredged material of approximately 4.4 miles (3.8 nautical miles). The other Wallops Open Water Placement Area is located inside Chincoteague Inlet and slightly farther away from the project site. A third open water location is the Norfolk Open Water Dredged Material Site is approximately 50 miles from the site and has not been considered in this preliminary cost analysis due to the long distance from the project location.

The Open Water placement options present the lowest cost dredging option and also allows for the widest array of dredging equipment ranging from clamshell dredges to barge mounted excavators supplying dump barges or specially modified deck barges that are towed by tugboats to the dredged material placement site.

As mentioned in Subtask 1.4, there will be permitting challenges and associated costs regarding the determination of the suitability of dredged material for open water placement that must be considered. Additionally, these open water placement locations are controlled by the US Army Corps of Engineers (Corps) and permission will need to be granted for the use of these sites. The possibility of this permission should be a priority in the early stages of stakeholder involvement and the results of this early engagement can influence the Environmental Assessment budget as it pertains to sediment testing. The Corps is mandated to explore the beneficial reuse of dredged material wherever possible and it is for this reason that the other placement alternatives may be selected.

Option 2: Flood Protection/Upland Placement on MARS Site

The second possible dredged material placement option evaluated in this report is the beneficial reuse of material for flood mitigation through upland placement in low lying areas on the MARS site. Specifically, there are low lying areas in the vicinity of the culvert crossing the main access road to the runway. GBA has evaluated this cost option on the basis of having a cutter suction dredge pump the material into this area. This option should be addressed during the Environmental Assessment and will require developing containment measures for the dredged material in the form of containment dikes constructed from on-site (or off-site material) and the channeling of the effluent and its return into Bogues Bay. This effluent is the water that is used in the dredging process to transport the dredged material in slurry form to the placement location.

The budgetary cost estimate presented for this option is based on using the low-cost method of using on-site material for containing the dredged material and constructing swales or channels for channeling the effluent (return water) into the surrounding waters. These considerations should be presented and evaluated during the early stages of stakeholder involvement and permitting.

Other alternatives could include thin layer placement for marsh enhancement in marsh areas a similar distance to the dredging location, or the use of geotubes, or synthetic membranes, for containing the dredged material. Each of these methods has additional costs above the cost presented for this option; however, these methods may present the best practice for obtaining the permit and provide the most viable solution. Additionally, clean sand may be used beneficially on eroding shoreline.

Option 3: Greenbackville Dredged Material Containment Facility

The third dredged material placement option evaluated is the use of the upland Dredged Material Containment Facility (DMCF) owned and managed by the US Army Corps of Engineers (Corps). The Corps places material dredged from the upper reaches of the Chincoteague Channel into this DMCF and the Corps recently repaired and upgraded the weir structure for controlling the effluent from this facility.

This is the highest cost alternative evaluated because this method will require using a mechanical dredge to load the dredged material removed from the access channel into barges. These barges will then be towed a distance of 11.3 miles (9.8 nautical miles) to the DMCF. A specialized hydraulic unloader will be required to hydraulically unload the dredged material from the transport barges and pump the material into the DMCF. This method requires a considerable amount of equipment for the process and generates the lowest production rates which drives the higher relative cost.

Another potential cost factor associated with this alternative, that has not been included in the budgetary cost estimate for this option, is that the Corps can apply a disposal or “tipping” fee for the use of their facilities. This is another factor that should be discussed during the early stages of the stakeholder process and the VCSFA should leverage their state and federal affiliations in these discussions. It seems likely to receive good overall Corps support for this project as it increases the use of Chincoteague Inlet and Channel and this additional use should provide value to the Corps when seeking maintenance dredging funding for the Chincoteague Channel, which is drastically underfunded.

SUMMARY:

GBA has identified several alternatives for dredged material placement. Each alternative will need to be considered in the scope of the Environmental Assessment and the feedback from the initial meetings with the regulatory agencies and stakeholders will influence the final dredged material placement location decision.

Future studies, including hydrodynamic and morphodynamic modeling associated with various alternative channel geometries and alignments and pier lengths will help define the optimum channel location. Future alternatives analysis will consider the following: environmental impacts, initial dredging costs, maintenance dredging costs, pier costs and other study elements associated with the Environmental Assessment.

At this stage, it seems appropriate to apply the budgetary dredging cost estimate for Option 2, Flood Protection/Upland Placement on MARS Site in the amount of **$4,675,000** million as a planning budget for the dredging cost.

ATTACHMENT 5: EFH MAPPER AND SPECIES LIST

EFH Data Notice: Essential Fish Habitat (EFH) is defined by textual descriptions contained in the fishery management plans developed by the regional Fishery Management Councils. In most cases mapping data can not fully represent the complexity of the habitats that make up EFH. This report should be used for general interest queries only and should not be interpreted as a definitive evaluation of EFH at this location. A location-specific evaluation of EFH for any official purposes must be performed by a regional expert. Please refer to the following links for the appropriate regional resources.

Greater Atlantic Regional Office
Atlantic Highly Migratory Species Management Division

Query Results

Degrees, Minutes, Seconds: Latitude = 37º53'26" N, Longitude = 76º33'31" W
Decimal Degrees: Latitude = 37.89, Longitude = -75.44

The query location intersects with spatial data representing EFH and/or HAPCs for the following species/management units.

*** W A R N I N G ***

Please note under "Life Stage(s) Found at Location" the category "ALL" indicates that all life stages of that species share the same map and are designated at the queried location.

EFH

Show	Link	Data Caveats	Species/Management Unit	Lifestage(s) Found at Location	Management Council	FMP
			Atlantic Herring	Adult	New England	Amendment 3 to the Atlantic Herring FMP
			Windowpane Flounder	Adult	New England	Amendment 14 to the Northeast Multispecies FMP
			Winter Skate	Adult Juvenile	New England	Amendment 2 to the Northeast Skate Complex FMP
			Clearnose Skate	Adult Juvenile	New England	Amendment 2 to the Northeast Skate Complex FMP
			Sandbar Shark	Juvenile Neonate	Secretarial	Amendment 10 to the 2006 Consolidated HMS FMP: EFH
			Smoothhound Shark Complex (Atlantic Stock)	ALL	Secretarial	Amendment 10 to the 2006 Consolidated HMS FMP: EFH
			Sand Tiger Shark	Neonate/Juvenile Adult	Secretarial	Amendment 10 to the 2006 Consolidated HMS FMP: EFH
			Bluefish	Adult Juvenile	Mid-Atlantic	Bluefish
			Atlantic Butterfish	Adult Juvenile	Mid-Atlantic	Atlantic Mackerel, Squid,& Butterfish Amendment 11
			Summer Flounder	Juvenile Adult	Mid-Atlantic	Summer Flounder, Scup, Black Sea Bass
			Black Sea Bass	Juvenile Adult	Mid-Atlantic	Summer Flounder, Scup, Black Sea Bass

HAPCs

Show	Link	Data Caveats	HAPC Name	Management Council
			Summer Flounder (Mid Atlantic)	MAFMC

EFH Areas Protected from Fishing

No EFH Areas Protected from Fishing (EFHA) were identified at the report location.

Spatial data does not currently exist for all the managed species in this area. The following is a list of species or management units for which there is no spatial data. **For links to all EFH text descriptions see the complete data inventory: open data inventory -->
Mid-Atlantic Council HAPCs, No spatial data for summer flounder SAV HAPC.

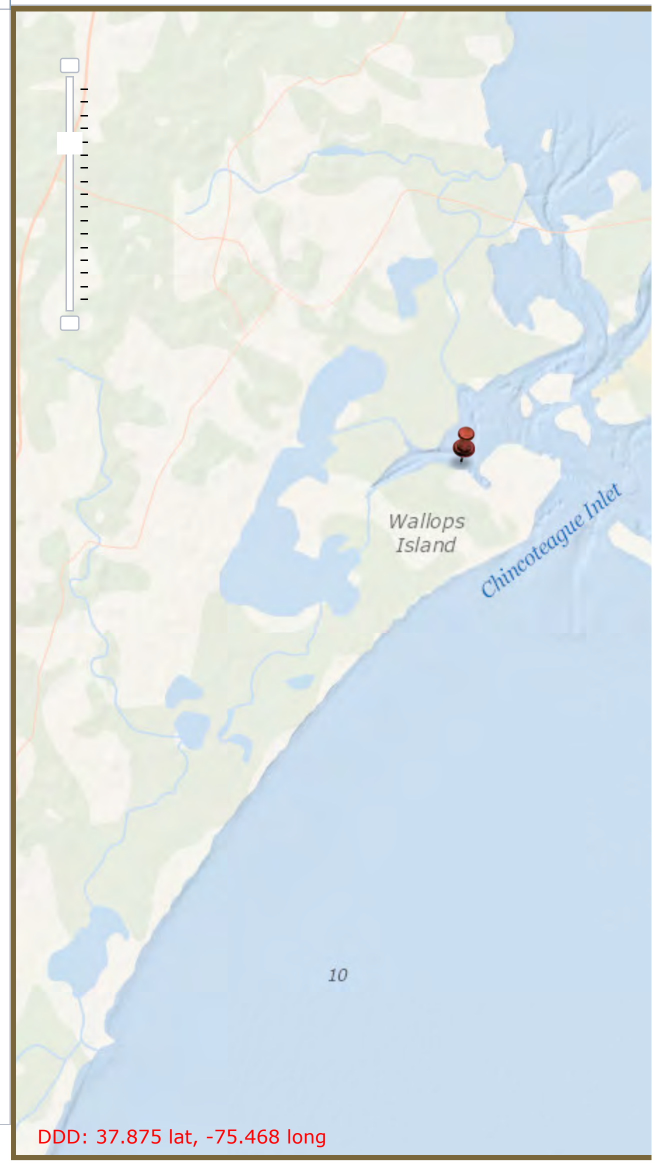
EFH View Tool | Data Query Tool

location.

EFH

Show	Link	Data Caveats	Species/Management Unit	Lifestage(s) Found at Location	Management Council	FM
			Atlantic Herring	Adult	New England	Amend 3 to Atlar Herring
			Windowpane Flounder	Adult	New England	Amend 14 to North Multisp FM
			Winter Skate	Adult Juvenile	New England	Amend 2 to North Ska Comp FM
			Clearnose Skate	Adult Juvenile	New England	Amend 2 to North Ska Comp FM
			Sandbar Shark	Juvenile Neonate	Secretarial	Amend 10 to 200 Consoli HMS F EFI
			Smoothhound Shark Complex (Atlantic Stock)	ALL	Secretarial	Amend 10 to 200 Consoli HMS F EFI

Zoom: Extent: Location Query:



ATTACHMENT 6: BENTHIC COMMUNITY ASSESSMENT

AECOM Imagine it. Delivered.

NASA Wallops

Benthic Infauna Community Assessment

February 14, 2021

Quality information

Prepared by	Checked by	Verified by	Approved by
Darron Kreigel	Pamela Neubert	Erika Grace	Bobbie Hurley

Revision History

Revision	Revision date	Details	Authorized	Name	Position
1	2/14/2021	Review of Original	Pamela Neubert	Pamela Neubet	Vice President

Distribution List

# Hard Copies	PDF Required	Association / Company Name

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Table of Contents

Figures

Tables

1. Introduction

A benthic macrofaunal survey was performed at a proposed project location on Wallops Island to construct a new runway for the U.S. National Aeronautical and Space Administration (NASA). This study was performed to determine existing conditions of benthic community structure in an area proposed to be dredged. This study provides documentation for benthic infaunal abundance, species richness and diversity. Benthic infaunal organisms have been documented as providing prey for fish and invertebrate species and can be used to infer sediment and water quality. Benthic samples were obtained in the area of potential effects (APE) for the proposed Wallops Flight Facility (WFF) intermodal barge service pier (the pier). The APE is defined as the area delineated within the 5280 foot (ft) by 300 ft. (1609.3 meter [m] by 91.4 m), pier construction corridor. As part of the proposed project, there will also be a geophysical and archeological assessment, however this report presents results from the benthic infaunal studies, only. The geophysical study will assess approximately 36.3 ac. (14.7 ha) and consist of approximately 7 linear miles (11.3 kilometers) of survey transects spaced at 50-ft. (15.2-m) intervals with event marks spaced every 100 ft. (30.48 m) collected in the State Plane Virginia South projection using the North American Datum 1983 (NAD 83) coordinate system. In addition, transects will be set and surveyed using the same geophysical instruments in a grid spaced 50-ft. (15.2 m) for an alternative pier location in proximity to the UAS airstrip. Benthic samples were obtained during the geophysical investigation.

2. Survey Methodology

AECOM performed a benthic macrofaunal survey within the proposed project area (Figure 2.1). AECOM's study collected six (6) samples from locations within representative areas where the proposed project plans to alter the habitat, either by filling and/or dredging. Samples were obtained from subtidal areas adjacent to wetlands and beachfront habitat.

Bottom samples were collected using a 0.04 m^2 ponar grab. Upon grab retrieval, the entire sample was fixed in formalin buffered with sodium borate (Borax) and sent to the AECOM benthic ecology laboratory located in Pocasset, MA without sieving. Upon receipt at the AECOM laboratory, the samples were sieved on a 500 micron (µm) mesh screen and transferred to a solution of 70% ethanol.

Benthic macrofaunal samples were stained in the AECOM laboratory using vital dye (rose bengal) following transfer of material from formalin to ethanol and subsequently sorted under dissecting microscopes. Identifications were performed by AECOM's in-house benthic taxonomists to the lowest practical taxonomic level. The following metrics were analyzed: abundance of organisms by Family, and density of individuals. Primer E statistical software package was used to calculate univariate metrics including species richness, abundance, Pileou's Evenness (J'), and Shannon-Wiener diversity (log_e) (H').

Community Metrics

Abundance: The number of individuals observed within a sample collected from a station.

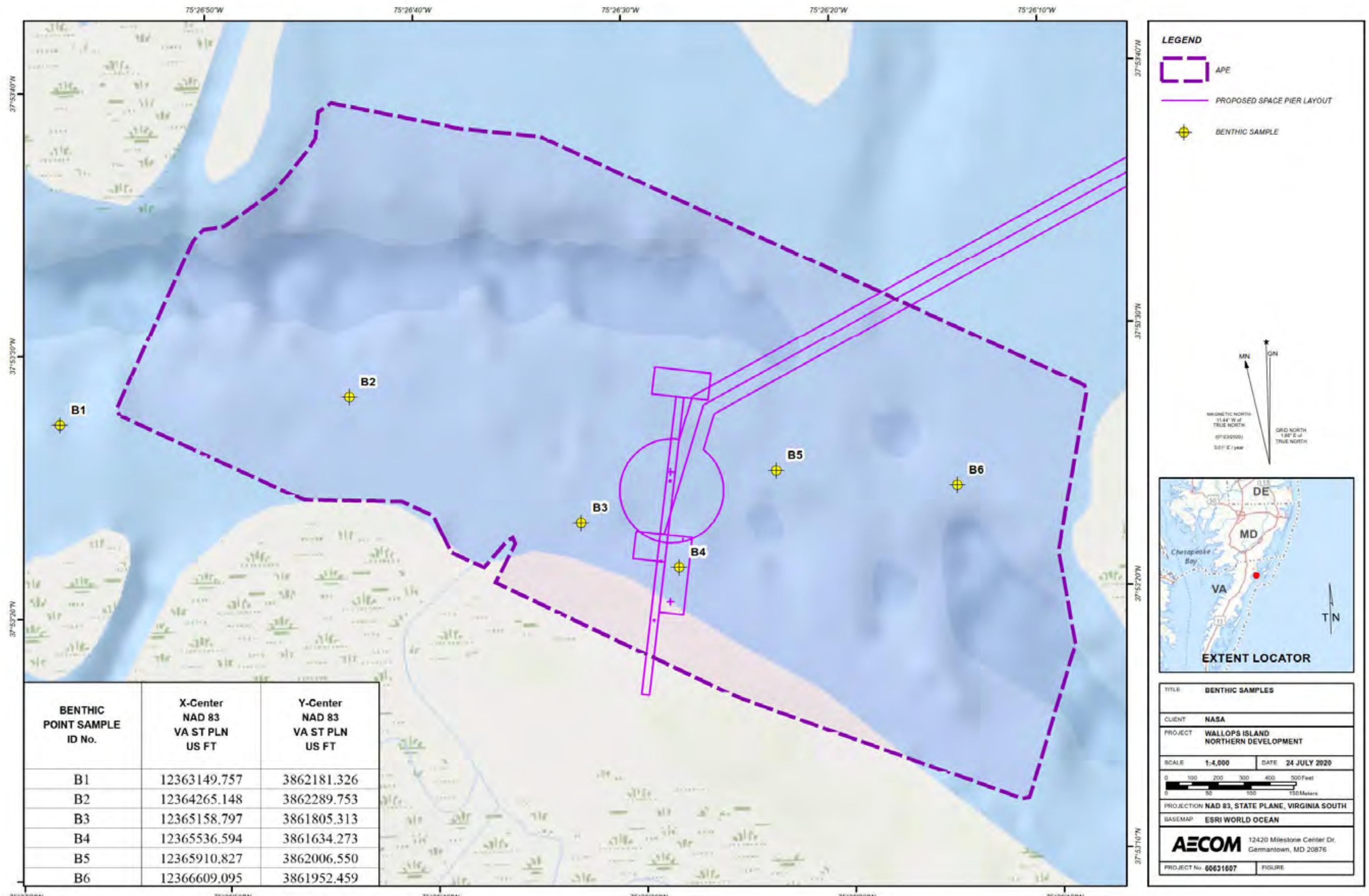
Density: The extrapolated number of individuals per square meter

Species richness: The number of species in a sample collected from a station.

Pileou's Evenness (J'): The equality of species distribution within a collected sample. Evenness is calculated between 0 and 1. Stations with low evenness values (closer to 0) share few species and are considered to have higher diversity. Stations with high evenness values (closer to 1) share many similar taxa and are considered to have lower diversity.

Shannon-Weiner Diversity: The Shannon-Wiener diversity index (H) is a measure of diversity that combines species richness (the number of species in a given area) and their relative abundances.

Figure 2-1 Sample locations



BENTHIC POINT SAMPLE ID No.	X-Center NAD 83 VA ST PLN US FT	Y-Center NAD 83 VA ST PLN US FT
B1	12363149.757	3862181.326
B2	12364265.148	3862289.753
B3	12365158.797	3861805.313
B4	12365536.594	3861634.273
B5	12365910.827	3862006.550
B6	12366609.095	3861952.459

3. Results

Infaunal organisims identified from the six benthic samples collected were representative of typical estuarine habitat. The six (6) benthic samples had a total of 540 individuals from thirty four (34) different taxonomic groups. Some individual organisms were readily identifiable to the species level while others remained at a higher classification to expedite sample analysis while balancing level of taxonomic effort. Annelida (Polychaeta) were the dominant taxonomic group and comprised 55% of the identified individuals. Bivalves were the second most abundant and comprised 26% of the identified individuals. The three polychaete Families Capitellidae, Spionidae Cirratulidae and one mollusk Family Tellinidae were consistently present within the six samples.

Abundances varied among the stations with the lowest abundance from Station 3 with 31 individuals to the highest abundance of 232 individuals from Station 2. The average abundance was 94 individuals per station (Table 3.1) The density of organisms was calculated based on the sampled area of the grab with the lowest density 3,823 individuals/m^2 (Station 2) to 28,608 individuals/m^2 (Station 2). The mean density from the six (6) stations combined was 11,612 individuals/m^2 (table 3.2), which is typical for having high abundances but lower diversity due to the extreme and harsh conditions common to intertidal estuarine habitat. A photo log of the grab surface from each of the 6 samples collected is presented in Appendix A. Table 3-3 presents univariate diversity metrics calculated for each station. The stations sampled had similar evenness and Shannon-Wiener diversity calculations. Diversity was uniformly low across the locations, which is typical for highly dynamic estuarine habitat that is characterized by extreme changes in salinity, temperature, and turbidity temporally and spatially. The organisms identified were largely opportunistic species such as spionid and capitellid polychaetes that recolonize disturbed habitats rapidly.

Table 3-1 Abundance of infaunal organisms per station.

Sum of Count	Column Labels						
Row Labels	1	2	3	4	5	6	Grand Total
Annelida	**49**	**132**	**21**	**68**	**16**	**61**	**347**
Capitellidae	7	21	8	20	3	29	88
Cirratulidae	21	13	1	13	2	6	56
Dorvilleidae				1			1
Glyceridae	1				1		2
Lumbrineridae	2			5	1		8
Maldanidae	1			2			3
Nephtyidae						1	1
Orbiniidae				1	2	1	4
Paraonidae				1			1
Phyllodocidae				1	1	5	7
Spionidae	12	82	12	15	4	10	135
Syllidae		5					5
Oligochaeta	5	11		9	2	9	36
Arthropoda	**5**	**8**	**3**	**19**		**14**	**49**
Ampeliscidae	3	2				6	11
Corophiidae			1	14			15
Gammaridae						7	7
Idoteidae	1	5	1			1	8
Melitidae			1	5			6
Mysidae		1					1
Phoxichilidiidae	1						1
Hemichordata		**1**					**1**
Mollusca	**4**	**90**	**4**	**5**	**36**	**23**	**162**
Pectinidae				1			1
Acteonidae		4					4
Arcidae					2		2
Bivalvia			1				1
Columbellidae		2					2
Mactridae						2	2
Nassariidae				2	2	2	6
Pyramidellidae		2					2
Solecurtidae	1	2				3	6
Tellinidae	3	80	2	2	32	16	135
Nudibranchia			1				1
Nemertea		**1**					**1**
Platyhelminthes			**1**		**1**	**1**	**3**
Sipuncula			**2**				**2**
Golfingiidae			2				2
Grand Total	**58**	**232**	**31**	**92**	**53**	**99**	**565**

Table 3-2 Density of infaunal organisms

Station	1	2	3	4	5	6	Average
Abundance of individuals	58	232	31	92	53	99	94
Density per meter^2	7152	28608	3823	11344	6535	12208	11612

Table 3-3. Diversity metrics

	Species Richness	Abundance	Pileou's Evenness (J')	Shannon-Wiener Diversity (J')
Station 1	12	56	0.77	1.92
Station 2	15	227	0.64	1.74
Station 3	10	29	0.78	1.79
Station 4	15	85	0.83	2.24
Station 5	12	50	0.66	1.64
Station 6	15	93	0.83	2.25

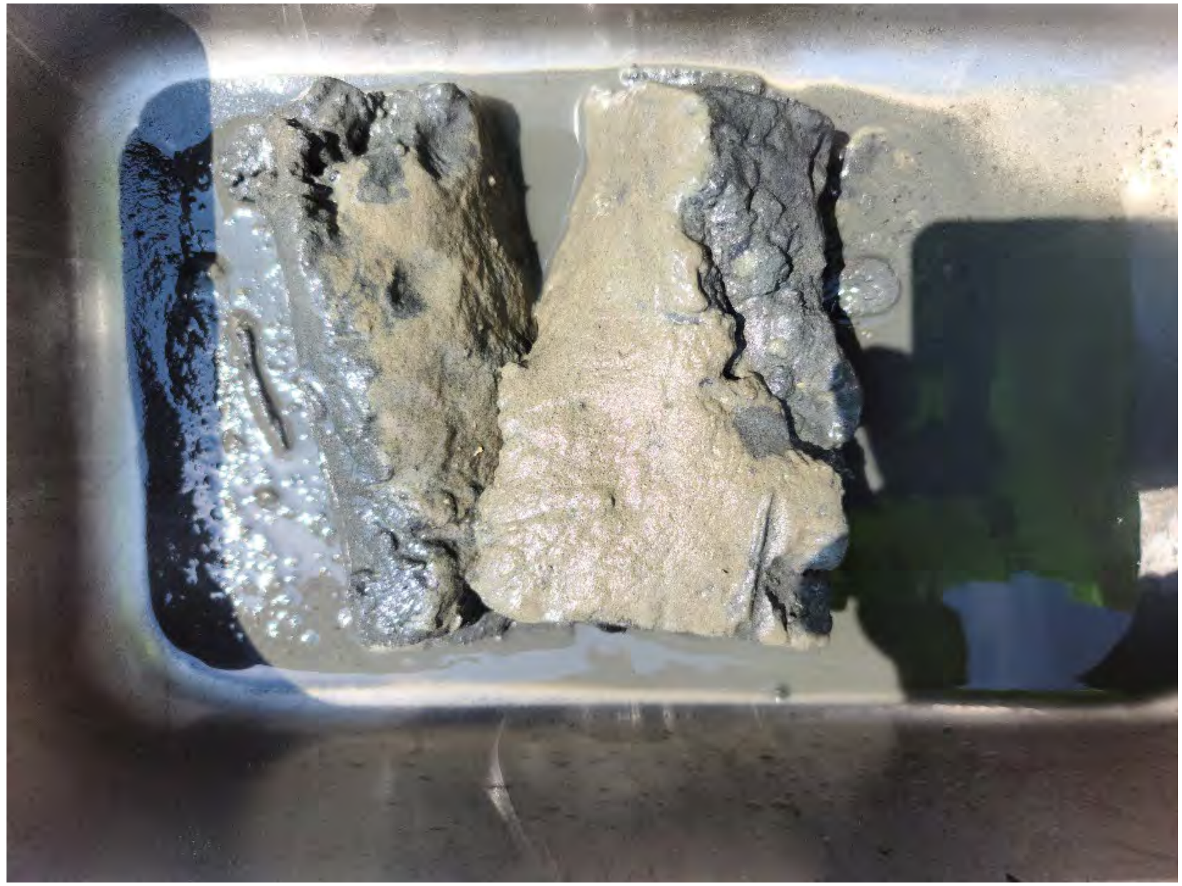
Taxa from groups at higher taxonomic level with likely more than one species, juveniles, and damaged individuals were not included in diversity calculations

4. Discussion

The majority of organisms in the benthic samples were deposit feeders that either sit with their anterior ends at the surface or make shallow head-down burrows into the sediment. These organisms are categorized as being highly opportunistic and have the ability to rapidly recolonize disturbed areas. There were omnivorous amphipods and filter feeding bivalves but fewer in abundance than the polychaete worms. These organisms consuming bacteria, detritus and nutrients in the sediment and can be prey for higher trophic levels but overall abundances of these organisms were low as was diversity, which is typical for estuarine and anthropogenically disturbed environments. The majority of the polychaetas identified were threadlike capitellids and small spionidae together they composed approximately 40% of the identified individuals but have a small, overall percentage of the biomass obtained at the time of sampling, therefore are not a substantial component of food. It is likely that opportunistic bottom grazing fish consume these organisms and subsequent to the temporary Project activities proposed, these same species will recolonize the area from the surrounding habitat. For example, more than one-third (39%) of the identified organisms from the six samples consisted of two (2) opportunistic species: 1. capitellids and 2. spionids (*Streblospio benedicti*). These two taxa are well documented as being typically found in areas of anthropogenic disturbance, have high tolerance to dredging and disposal, are some of the first species to recolonize areas following anoxic events, and are able to repopulate habitats that experience extreme fluctuations in conditions. The six (6) samples collected had hydrogen sulfide odor that suggested the sediments were either anoxic or hypoxic at the time they were sampled. Hypoxia is not uncommon in intertidal and shallow subtidal estuaries along the eastern U.S. coastline due to high levels of organic content in the sediment as a consequence of excess nitrogen from anthropogenic sources (eutrophication) as well as decaying salt marsh peat material. Impacts associated with the proposed Project will not significantly impact the benthic communities in Project vicinity as abundances and diversity of benthic infaunal organisms was low and dominated by opportunistic species that will rapidly recolonize habitat when the proposed Project has been completed. .

Appendix A Photo Log

Photograph: 1	**Date:** 07/21/2020
Feature ID: Benthic 1	
Time: 11:44	
Description: Densely packed sand with some organic material **Sampling Equipment:** Petite ponar **Color:** Light gray top layer, darker gray below, suggesting a thin layer of oxidized sediment over a hypoxic or anoxic layer **Moisture:** Saturated **Benthic Fauna:** None observed **Odors:** Hydrogen sulfide suggesting hypoxia or anoxia at time of sampling.	



Photograph: 2

Date: 07/21/2020

Feature ID: Benthic 2

Time: 11:59

Description: Sand with organic material, less dense than Station 1 with higher water content.

Sampling Equipment: Petite ponar

Color: Gray at surface and to depth of sample collection suggesting anoxic or hypoxic sediments

Moisture: Saturated

Benthic Fauna: None observed

Odors: Hydrogen sulfide suggesting anoxic or hypoxic sediments

Photograph: 3	**Date:** 07/21/2020
Feature ID: Benthic 3	
Time: 11:19	

Description: Large amount of seaweed (assuming Gracillaria) present in sample; sand, less dense than sample 1, higher water content

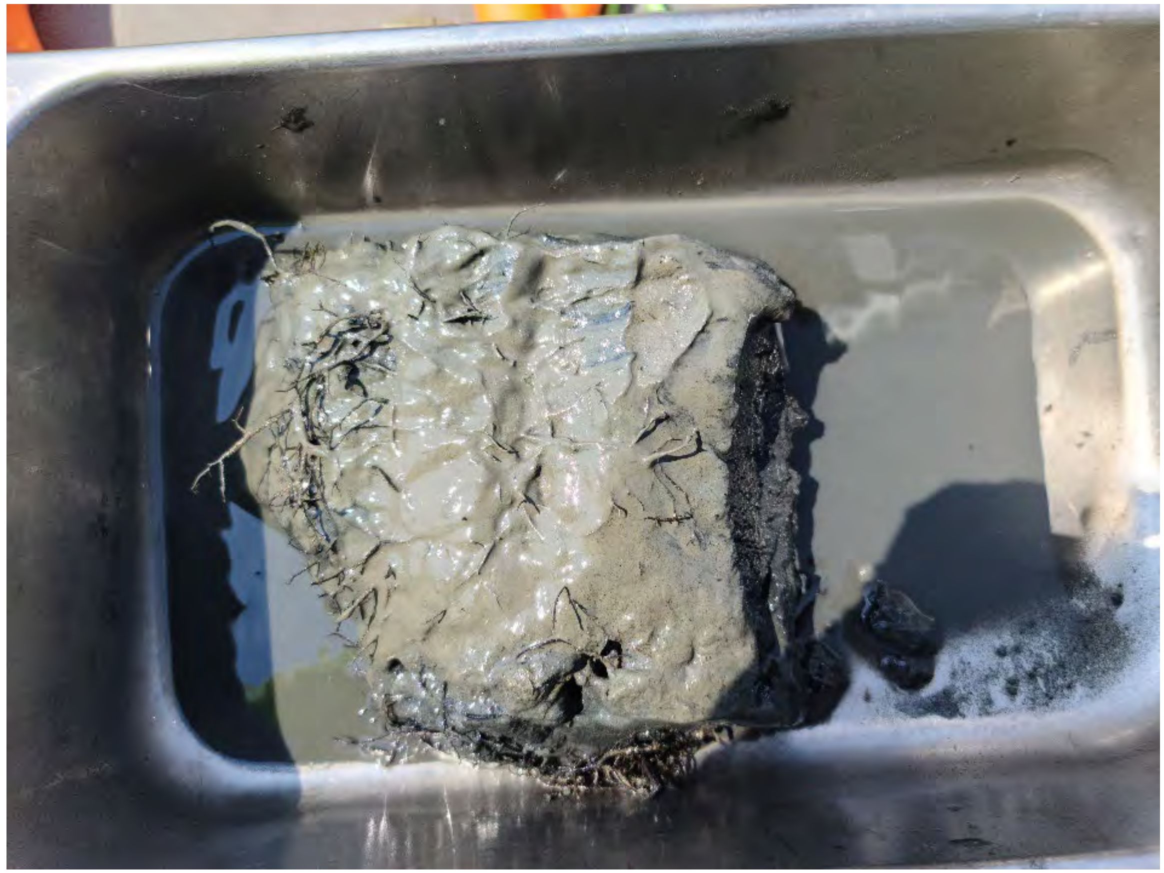
Sampling Equipment: Petite ponar

Color: Gray at surface and to depth of sample collection suggesting anoxic or hypoxic sediments

Moisture: Saturated

Benthic Fauna: None observed

Odors: Hydrogen sulfide suggesting anoxic or hypoxic sediments

Photograph: 4	**Date:** 07/21/2020	
Feature ID: Benthic 4		
Time: 11:15		
Description: Seaweed (assuming Gracillaria) present in sample; densely packed sand with organic material **Sampling Equipment:** Petite ponar **Color:** Gray at surface and to depth of sample collection suggesting anoxic or hypoxic sediments **Moisture:** Saturated **Benthic Fauna:** None observed **Odors:** Hydrogen sulfide suggesting anoxic or hypoxic sediments		

<table>
<tr><td>Photograph:
5</td><td>Date:
07/21/2020</td><td rowspan="4"></td></tr>
<tr><td colspan="2">Feature ID:
Benthic 5</td></tr>
<tr><td colspan="2">Time:
11:05</td></tr>
<tr><td colspan="2">Description: Seaweed (assuming Gracillaria and Ulva) present in sample; densely packed sand with organic material

Sampling Equipment: Petite ponar

Color: Gray at surface and to depth of sample collection suggesting anoxic or hypoxic sediments

Moisture: Saturated

Benthic Fauna: None observed

Odors: Hydrogen sulfide suggesting anoxic or hypoxic sediments</td></tr>
</table>

Photograph: 6	Date: 07/21/2020	
Feature ID: Benthic 6		
Time: 10:40		
Description: Seaweed (assuming Gracillaria) present in sample; densely packed sand with organic material **Sampling Equipment:** Petite ponar **Color:** Gray at surface and to depth of sample collection suggesting anoxic or hypoxic sediments **Moisture:** Saturated **Benthic Fauna:** None observed **Odors:** Hydrogen sulfide suggesting anoxic or hypoxic sediments		

aecom.com

From:	Miller, Shari A. (WFF-2500) <shari.a.miller@nasa.gov>
Sent:	Wednesday, November 10, 2021 12:05 PM
To:	Karen.Greene@noaa.gov
Cc:	Nate Overby; Finio, Alan (MARAD); brian.c.denson@usace.army.mil; Brian Hopper (Brian.D.Hopper@noaa.gov); Finch, Kimberly (GSFC-2500); Meyer, T J (WFF-2500); David O'Brien (david.l.obrien@noaa.gov); Levine, Lori M. (GSFC-2500)
Subject:	Project Review Request, Wallops Island Northern Development, NASA WFF
Attachments:	NASA WFF_NorthDevelop - NOAA_EFH Consult Ltr_111021.pdf

Dear Ms. Greene:

The National Aeronautics and Space Administration (NASA) Wallops Flight Facility (WFF) and the Virginia Commercial Space Flight Authority (VCSFA, VA Space) propose to construct a pier for barge access and berthing and to dredge a vessel approach channel connecting to the Chincoteague Inlet Federal Channel. NASA is the lead agency for the National Environmental Policy Act (NEPA) process and for this Essential Fish Habitat (EFH) consultation. As the Department of Transportation's Maritime Administration (MARAD) and the U.S. Army Corps of Engineers (USACE) are serving as Cooperating Agencies on this project, this consultation also serves to fulfil their requirements.

Based on the attached EFH assessment, NASA has determined that the effects of the Proposed Action on EFH would not be substantial. I certify that we have used the best scientific and commercial data available to complete this assessment and request your concurrence with this determination. If you have any questions or require additional information, please contact me at Shari.A.Miller@nasa.gov or (757) 824-2327.

Thank you.

Shari A. Miller
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"Remember there's no such thing as a small act of kindness. Every act creates a ripple with no logical end." —Scott Adams

National Aeronautics and Space Administration

Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337

Reply to Attn of: 250.W November 10, 2021

Ms. Karen Greene
Mid-Atlantic Field Office Supervisor and EFH Coordinator
Greater Atlantic Regional Fisheries Office
NOAA Fisheries
55 Great Republic Drive
Gloucester, MA 01930

Subject: Project Review Request, Wallops Island Northern Development, NASA Wallops Flight Facility, Accomack County, Virginia

Dear Ms. Greene:

The National Aeronautics and Space Administration (NASA) Wallops Flight Facility (WFF) and the Virginia Commercial Space Flight Authority (VCSFA, VA Space) propose to construct a pier for barge access and berthing and to dredge a vessel approach channel connecting to the Chincoteague Inlet Federal Channel (**Figures 1 and 2**). NASA is the lead agency for the National Environmental Policy Act (NEPA) process and for this Essential Fish Habitat (EFH) consultation. As the Department of Transportation's Maritime Administration (MARAD) and the U.S. Army Corps of Engineers (USACE) are serving as Cooperating Agencies on this project, this consultation also serves to fulfil their requirements.

NASA is preparing an Environmental Assessment (EA) in compliance with NEPA to analyze the potential effects of the proposed action on the environment. The EA will be tiered from the May 2019 *NASA WFF Site-Wide Programmatic Environmental Impact Statement* (PEIS), in which NASA evaluated the environmental consequences of constructing and operating new facilities and infrastructure at WFF.

The purpose of this letter is to provide information about the proposed project and to request your concurrence with our determination regarding potential effects on EFH. NASA has evaluated the potential for the project to adversely affect EFH in accordance with the Magnuson-Stevens Fishery Conservation and Management Act (MSA). NASA used the Greater Atlantic Regional Fisheries Office EFH Assessment Worksheet to evaluate potentially affected EFH, and we are submitting our evaluation and findings for your review. The EFH Assessment Worksheet is provided in **Attachment 1**. We have determined that the impact of the Proposed Action on EFH would not be substantial and request an abbreviated EFH consultation.

Background

The goal of the MARAD Marine Highway Program is to expand the use of America's navigable waterways; to develop and increase marine highway service options; and to facilitate their further integration into the current U.S. surface transportation system, especially where water-based transport is the most efficient, effective, and sustainable option (MARAD 2019a). The M-95 Marine Highway Corridor includes the Atlantic Ocean coastal waters; Atlantic Intracoastal Waterway; and connecting commercial navigation channels, ports, and harbors spanning 15 states including Virginia. The proposed Wallops Island M-95 Intermodal Barge Service project has the potential to support the growth of existing operations at WFF, enhance science, technology, engineering, and math (STEM) research opportunities, and spur high-tech/high-paying jobs in a predominantly rural area (MARAD 2019b).

VCSFA was created in 1995 by the General Assembly of the Commonwealth of Virginia to promote the development of the commercial space flight industry, economic development, aerospace research, and STEM education throughout the Commonwealth. In 1997, the VCSFA entered into a Reimbursable Space Act Agreement with NASA, which permitted the use of land on Wallops Island for launch pads. VCSFA also applied for and was granted a Federal Aviation Administration (FAA) license for launches to orbital trajectories. This led to the establishment of the Mid-Atlantic Regional Spaceport (MARS) which is owned and operated by VCSFA.

Development of a port and operations area to support the activities of NASA, WFF tenants, and MARS at the north end of Wallops Island was evaluated at a programmatic level of detail in the 2019 *Final Site-wide PEIS* (NASA 2019). NASA has several long-term tenants and customers that use the WFF research airport and Wallops Island launch range, its facilities, and airspace.

Description of the Proposed Action

Under the Proposed Action, the MARS Port, including a 1,305-ft fixed pier and turning basin, would be constructed adjacent to the UAS airstrip located at the north end of Wallops Island (**Figures 1 and 2**). The MARS Port would provide a port and operations area along with associated capabilities for VCSFA, NASA WFF, and other customers. The MARS Port would also serve as a new intermodal facility as part of the MARAD M-95 Marine Highway Corridor. Infrastructure (new upland facilities and improvements to the existing access road, airstrip, and utilities) would likewise be constructed or installed as part of the Proposed Action. Access road improvements would include widening of an existing culvert. Although shown for completeness in **Figure 2**, upland activities that would not affect essential fish habitat are not discussed further.

The Proposed Action would also include the dredging of a new and existing channel to enhance the vessel approach to the pier (**Figure 3**). The vessel approach channel, which interfaces with two Federal waterways, the Chincoteague Inlet Channel and the Chincoteague Inlet to Bogues Bay connecting waters would initially be used by a variety of shallow-draft, manned and unmanned vessels. Ultimately, the proposed channel would have a length of approximately 12,800 ft, a width of 100 ft, and a final depth of 12 ft below mean lower low water (MLLW). Components of the Proposed Action are further described below.

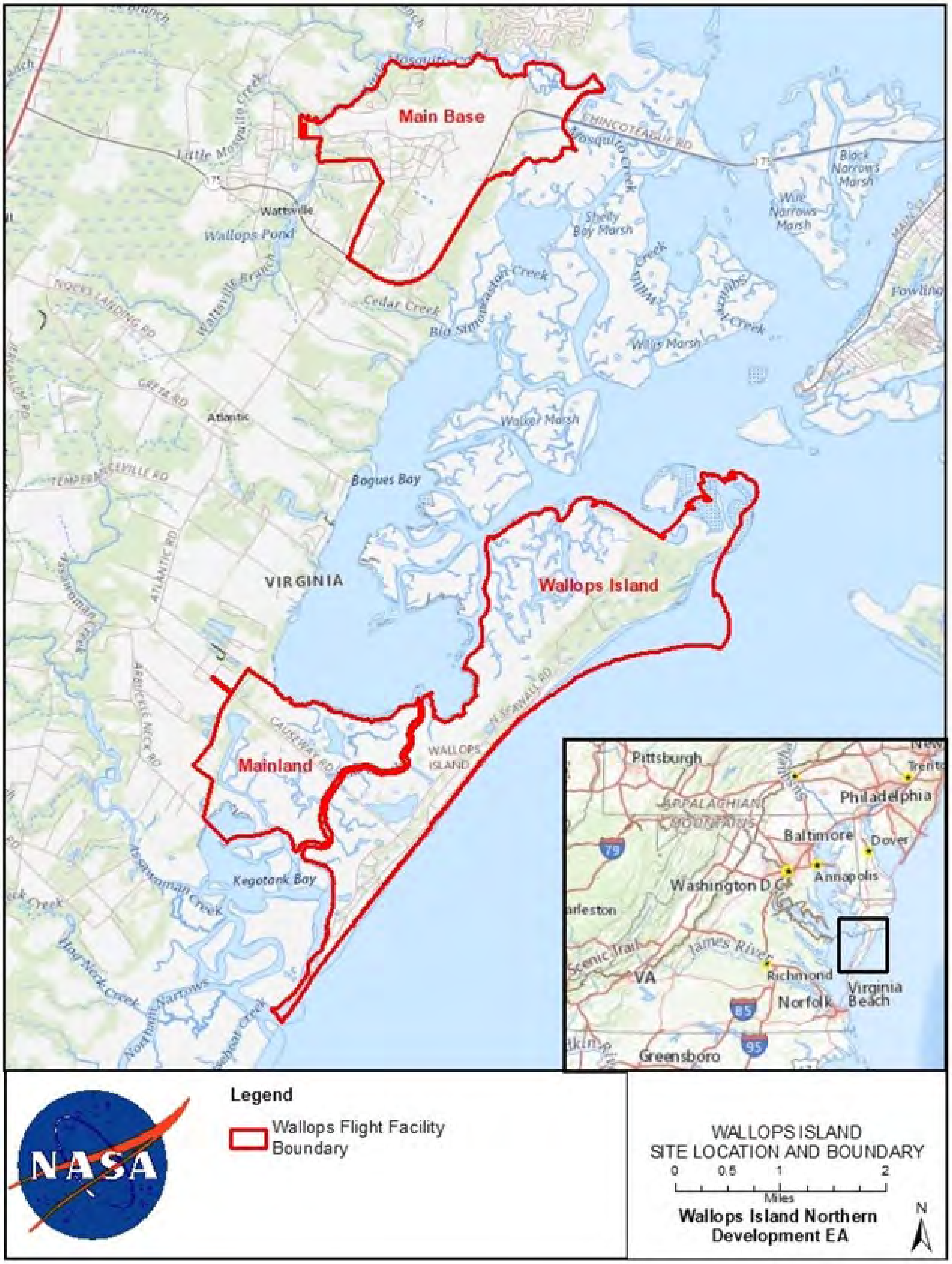

Figure 1. NASA WFF Location

Figure 2. Proposed MARS Port and Infrastructure Components

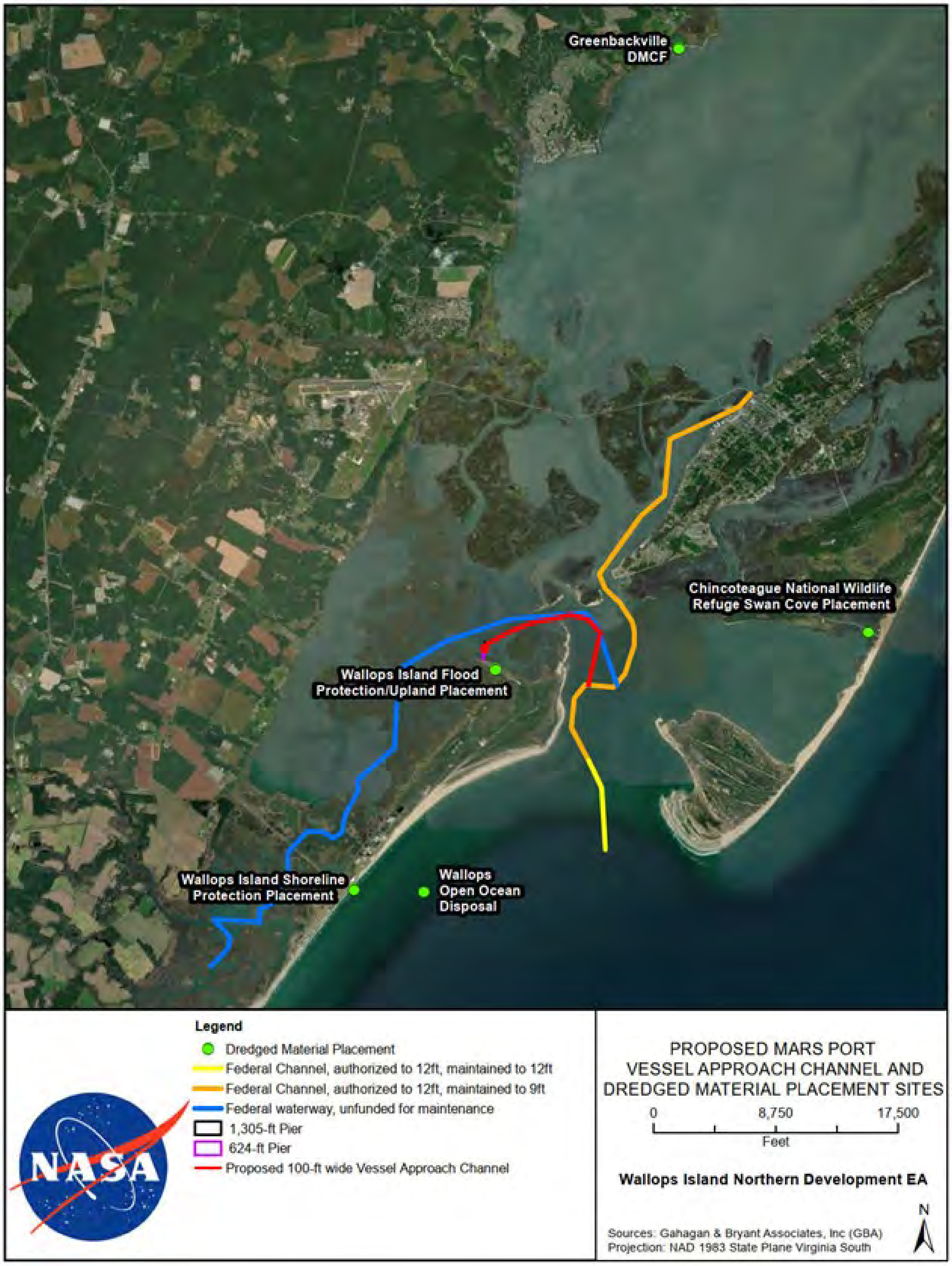

Figure 3. Proposed MARS Port Vessel Approach Channel and Dredged Material Placement Sites

Proposed Action In-Water Components

The MARS Port, including a 1,305-ft fixed pier and turning basin would be constructed on (and within the vicinity of) the UAS Airstrip located at the north end of Wallops Island. The MARS Port would provide a port and operations area along with associated capabilities for MARS, NASA WFF, and other customers. The MARS Port would also serve as a new part of the MARAD M-95 Marine Highway Corridor. Upland infrastructure (new facilities and improvements to the existing access road, airstrip, and utilities) would likewise be constructed and installed as part of the Proposed Action.

The Proposed Action would also include the dredging of an existing channel for enhanced vessel approach purposes. The vessel approach channel, which would interface with both the Chincoteague Inlet Federal Channel and the Bogues Bay connecting waterways, would be used by a variety of manned and unmanned vessels. It would be approximately 12,800 ft long, 100 ft wide, and would have a final depth of 12 ft below MLLW.

Construction of the Proposed Action would be carried out in three phases:

- **Phase 1** would be construction of a 624-ft fixed pier, a 200-ft-radius turning basin 9 ft deep below MLLW and dredging of the vessel approach channel to a final depth of 5 ft to 9 ft below MLLW (red outline in **Figure 4**). The area dredged would total approximately 34 ac. Additionally, a 130-ft long segment of the existing paved UAS Airstrip access road would be widened from 15 ft to 30 ft in conjunction with the widening of the culvert over which the road crosses a headwater drainage channel to Cow Gut.

- **Phase 2** would be construction of a 676-ft extension of the fixed pier to a total length of 1,305 ft and dredging of a 200-ft-radius turning basin (located at the end of the pier extension; shaded pink on **Figure 4**) to a final depth of 9 ft below MLLW. The area dredged would total approximately 4 ac.

- **Phase 3** of construction would be additional dredging of the turning basin and vessel approach channel to a final depth of 12 ft below MLLW, specifically the portion of the channel from the Phase 2 turning basin to where it meets the Chincoteague Inlet Federal Channel (shaded blue on **Figure 4**). The previously dredged area that would be dredged again to increase its depth would total approximately 33 ac.

The portion of the channel shown in pink on **Figure 4**, which connects the vessel approach channel to the Phase 2 turning basin, is naturally deeper than 9 feet below MLLW and, therefore, would not require any dredging during Phase 2. The estimated timeline for construction of the Proposed Action would have Phase 1 beginning in 2022 and being completed by 2024, with subsequent phases occurring approximately 1 to 2 years after completion of the prior phase. Additional information about the proposed piers and other port components is provided in Chapter 2 of the Draft EA.

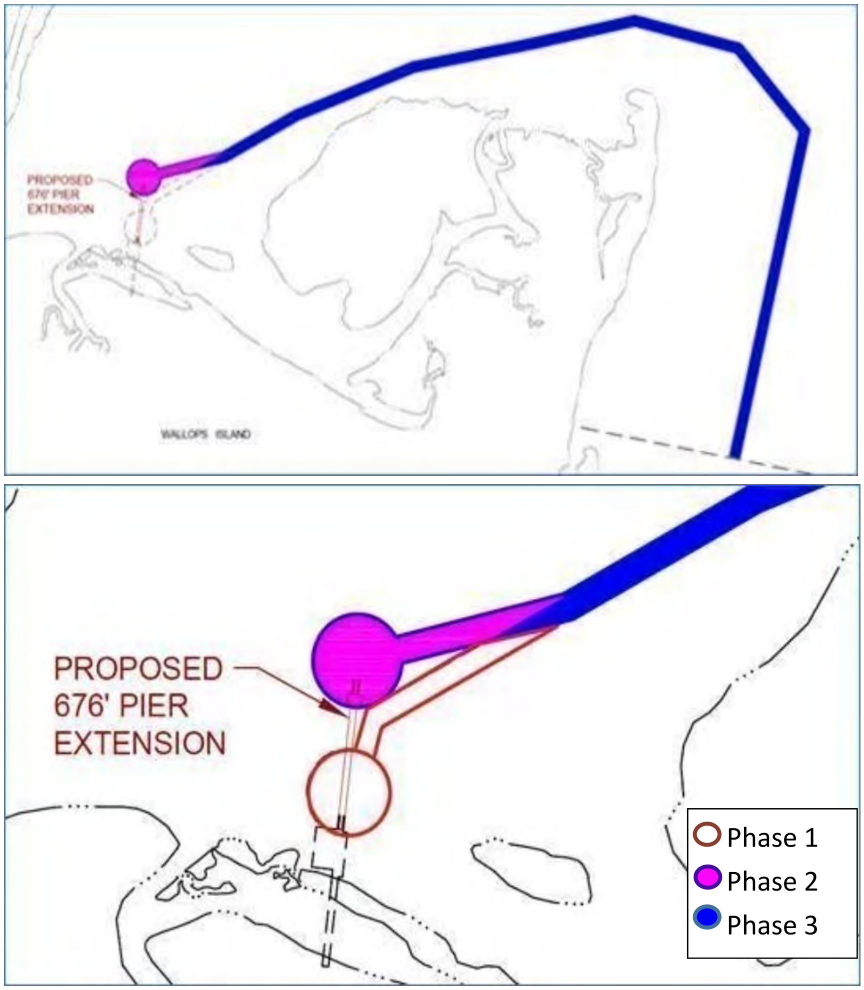

Figure 4. Diagram of Proposed Phased Construction

A variety of shallow-draft (2- to 4-ft), manned and unmanned vessels would be serviced by the port. The major navigational service would be a tug and barge configuration of an approximately 150-ft by 40-ft deck barge propelled by a tugboat requiring approximately 8 ft of draft. The vessel approach channel would intersect with the Chincoteague Inlet Federal Channel and the Bogues Bay connecting waterways (**Figure 3**). The proposed width of the approach channel, approximately 100 ft, is consistent with the dimensions of the Federal Channel. Estimated dredging volumes for the vessel approach channel and turning basin are provided in **Table 1**.

Table 1. Estimated Dredging Volumes

	Phase 1	Phase 2	Phase 3
Channel depth (depth below MLLW)	9 ft	9 ft	12 ft
Channel length	12,800 ft	11,800 ft	11,800 ft
Channel dredging volume	15,100 yd^3	0	34,600 yd^3
Turning basin dredging volume	40,500 yd^3	800 yd^3	3,200 yd^3
Total volume per phase	55,600 yd^3	800 yd^3	37,800 yd^3
		Total Volume (Phases 1–3):	**94,200 yd^3**

yd^3 = cubic yards

Five potential sites for the placement of dredged material are summarized in **Table 2** and shown on **Figure 3**. Currently, it is estimated that between 56,000 CY and 57,000 CY of material would be dredged during the initial dredging event. VCSFA intends to utilize Option 1, the Wallops Open Ocean Dredge Material Placement Area, as the initial dredge material placement site. When compared to Options 2 through 5, Option 1 is the most economical solution as it offers the lowest estimated mobilization costs, as well as the lowest unit costs for dredging, transport, and placement. The Open Ocean site is also the fastest path towards construction as it is already permitted by the USACE and has capacity for the proposed initial dredge material. While the Greenbackville DMCF (Option 3) is also already permitted by the USACE, it is not anticipated to have available capacity to handle the initial projected volume of material due to its expected use by USACE. Lastly, the dredged material is expected to be of similar physical and chemical characteristics as the material currently dredged from the Chincoteague Channel by the USACE. Dredged material placed within the Wallops Island nearshore zone is required to have the same physical characteristics (90%+ sand) as the natural bottom and anything with a higher fine-grained content would not be suitable. Based on the geotechnical borings for the proposed project, the material is anticipated to be compromised of approximately 95% sand and, therefore, would be suitable for the Open Ocean site.

For future maintenance dredging events, the Project may use Option 2, Wallops Island Flood Protection/Upland Placement. Keeping this as an option allows for future beneficial re-use of the dredge material on Wallops Island to provide resiliency to the MARS UAS Airfield. The cost of this option is higher as it would require additional studies, design, and construction to contain and shape the pumped discharge. Option 2 may also have impacts to the wetlands north of the UAS Airfield. Further analysis would be required for this impact and depending on the results, thin layer deposition or the use of geotubes could be required to hold the material. Lastly, the UAS Airfield is currently not permitted for material placement; the permitting process would require a longer timeframe than Option 1. If selected for placement during future maintenance dredging events, designs, impact analysis, and permitting would be required and would be performed at that time.

Table 2. Potential Dredged Material Placement Sites							
Option	**Site**	**Description**	**Sail Distance from Basin[1]**	**Pipe Distance from Basin[2]**	**Sail Distance from Channel**	**Pipeline Distance from Channel**	**Description**
1	Wallops Open Ocean Dredge Material Placement Area	Open water placement site, closer than Lewis Creek or Norfolk Ocean disposal sites	6.1 mi	--	4.4 mi	--	This area is located just offshore of Wallops Island with a transportation distance of the dredged material of approximately 4 nautical mi. Open water placement options typically present the lowest cost dredging option and allows for the widest array of dredging equipment ranging from clamshell dredges to barge mounted excavators supplying dump barges or specially modified deck barges that are towed by tugboats to the dredged material placement site. Open water placement locations are controlled by the USACE and a CWA Section 404 permit would be required for the use of this site
2	Wallops Island Flood Protection/ Upland Placement	Reuse of material for flood mitigation through upland placement at site identified by NASA	--	2,800 ft	--	12,040 ft	This option involves the beneficial reuse of material for flood mitigation through upland placement in low lying areas on Wallops Island. For example, there are low lying areas in the vicinity of the culvert crossing the main access road to the UAS airstrip. This option was evaluated based on having a cutter suction dredge pump the material into this area. This option would also require development of containment measures for the dredged material in the form of containment dikes and the channeling of the effluent and its return into Bogues Bay. This effluent is the water that is used in the dredging process to transport the dredged material in slurry form to the placement location. Other alternatives could include thin layer placement for marsh enhancement in marsh areas a similar distance to the dredging location, or the use of geotubes, or synthetic membranes, for containing the dredged material.

Table 2. Potential Dredged Material Placement Sites							
Option	**Site**	**Description**	**Sail Distance from Basin[1]**	**Pipe Distance from Basin[2]**	**Sail Distance from Channel**	**Pipeline Distance from Channel**	**Description**
3	Greenbackville Dredged Material Containment Facility (DMCF)	Upland DMCF run by USACE, requires both navigation of Chincoteague Channel and pumping on location	11.3 mi	--	9.5 mi	650 ft	The third dredged material placement option identified is the use of the upland Dredged Material Containment Facility (DMCF) owned and managed by the USACE. The USACE places material dredged from the upper reaches of the Chincoteague Channel into this DMCF. This option, which would require the USACE to first verify capacity and permit use of this site, would utilize a mechanical dredge to load the dredged material removed from the approach channel into barges. These barges would then be towed approximately 10 nautical mi to the DMCF. A specialized hydraulic unloader would be required to discharge the dredged material from the transport barges and pump the material into the DMCF. However, according to USACE, this site has limited capacity for material and may not be suitable.
4	Wallops Island Shoreline Protection Placement	Reuse of material for shoreline protection and beach repair	7.5 mi	--	6 mi	--	This option would involve the beneficial reuse of clean, compatible sand from the dredged material to repair and protect areas of the shoreline within the Launch Range area on Wallops Island. If dredged material is determined to be compatible with the current shoreline sand, the material would be placed along the seawall to protect the beach from tidal impacts or ocean overwash from coastal storms such as hurricanes and Nor'easters. This option would require using a mechanical dredge to load the dredged material removed from the approach channel into barges. These barges would then be towed approximately 6 nautical mi to the shoreline. A specialized hydraulic unloader would be required to discharge the dredged material from the transport barges and pump the material onto the placement areas.

Table 2. Potential Dredged Material Placement Sites

Option	Site	Description	Sail Distance from Basin[1]	Pipe Distance from Basin[2]	Sail Distance from Channel	Pipeline Distance from Channel	Description
5	Chincoteague National Wildlife Refuge Swan Cove Placement	Reuse of material for habitat restoration	-	9 km (5.6 mi)	-	6.9 km (4.3 mi)	This option would involve the beneficial reuse of the dredged material for the Swan Cove Pool Restoration Project located in the Chincoteague National Wildlife Refuge (NWR). If dredged material is determined to be compatible, it would be used by USFWS to create berms and enhance and/or restore currently degraded areas of the estuarine-salt marsh habitat that have been negatively impacted by an under sized culvert restricting sediment deposition and tidal flow. Although USFWS would prefer material with a high proportion of sand, they will also accept dredge material containing high organic matter content. This option was evaluated based on having a cutter suction dredge pump the material to this area. Once pumped, USFWS will assume responsibility for sediment placement and is in the process of securing appropriate permits.

[1] Sail distance = the length of the path via water required to reach the placement site from the centroid of dredging in the proposed turning basin or approach channel (statute miles)
[2] Pipe distance = the length of pipe required to reach the placement site from the centroid of dredging or from the anchorage for a vessel loaded with dredged material
DMCF = Dredged Material Containment Facility

Summary of Proposed Action Construction Activities

Construction of the Proposed Action would involve: (1) construction of the pier components that would make up the MARS Port, (2) dredging of the vessel approach channel, turning basin, and placement of dredged material, and (3) construction or improvement of the proposed onshore facilities and infrastructure.

The estimated timeframe for construction of the Proposed Action would have Phase 1 beginning in 2022 and being completed by 2024, with subsequent phases occurring approximately 1 to 2 years after completion of the prior phase. It is assumed that construction of all proposed onshore project components and infrastructure would be completed during Phase 1 (although the North Island Operations Center may be constructed later). With two crews (10 persons each), working 5 days per week (10-hour days), construction of the 624-ft long pier under Phase 1 would take approximately 12 months to complete and construction of the 676-ft long pier extension under Phase 2 (for a total pier length 1,305 ft) would take approximately 9.5 months to complete.

Phase 1 dredging activities (turning basin and channel) would take approximately 30 days to complete; Phase 2 dredging (turning basin) would take approximately 7 days, and Phase 3 dredging (turning basin and channel) would take 30 days. Work would be performed 24 hours a day, seven days a week with two crews each working 12-hour shifts.

Typical equipment used during construction would include crane barges, material barges, tugboat, vibratory pile hammer, diesel impact hammer, concrete truck, concrete pump truck, concrete vibrator, generator, welding machines, cutting torches, and various small tools.

Summary of Proposed Action Operational Activities

VCSFA/MARS currently has a facilities team that mows grass once per week, monitors for eagles twice per week during nesting season, periodically removes tree and weed growth, and inspects the infiltration trench and fencing around the Revolutionary War Earthworks. During summer months, a mosquito fogging service truck sprays the airfield once every 2 weeks. The pier structure would also require quarterly structural inspections.

Potential usage of the MARS Port facility during its operation is provided in **Table 3**.

Table 3. Potential MARS Port Operations/Facility Usage

Potential Facility Usage	Vessel Type	Quantity Assumptions	Total Barge / Vessel Trips	Phase Associated with Usage
Medium Class ELV 1st stage (core) and 2nd stage	Shallow Draft Deck Barge & Inland Pushboat	3 launches per year; Each comes w/ ~4-6 truckloads of parts and equipment plus 2 heavy haulers	3	1

Table 3. Potential MARS Port Operations/Facility Usage				
Potential Facility Usage	**Vessel Type**	**Quantity Assumptions**	**Total Barge / Vessel Trips**	**Phase Associated with Usage**
Venture Class ELV	Shallow Draft Deck Barge & Inland Pushboat	Potential for 12 launches per year; 3 trucks per launch	12	1
Venture Class 2 ELV	Shallow Draft Deck Barge & Inland Pushboat	9 launches per year; 1 truck per stage, 3-5 trucks for equipment	9	1
Venture Class Heavy ELV	Deck Barge & 1000-1200 HP Tugboat	3 launches per year, 3 first stage cores per launch w/ 1 truck each plus 3-5 trucks for equipment	3	2
Minotaur Class	Deck barge & 1000-1200 HP tugboat	4 launches per year, 3 stage/cores per launch w/ 1 truck each; 3-5 additional trucks for equipment	4	2
Recovery effort	Shallow-draft deck barge & inland push boat	1 per launch	12	1
Autonomous Surface Vehicle (ASV)	Trailered vessel	1 deployment per month; each deployment has 5-10 vehicles included	12	1
Autonomous Underwater Vehicle (AUV)	Trailered vessel	1 deployment every other month; each deployment has 5-10 vehicles included	6	1
Miscellaneous usage	Shallow-draft vessel	1 deployment every other month	6	2
Research usage	Small research vessel	1 deployment every 4 months; each deployment has 5-10 vehicles included	3	2
Other government research & testing	Trailered vessel	1 deployment every other month	12	2
Other Site-wide PEIS construction/expansion	Deck barge & ocean tug	2 large/oversized deliveries per year	1	2
Commodity delivery	Deck barge & ocean tug	16 total barges	16	3
Total Barge / Vessel Trips			**99**	

EFH Assessment

The MSA defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity,” and it requires federal agencies to consult with NOAA Fisheries when proposing activities that may adversely affect EFH. To facilitate consultation, NOAA Fisheries provides an online mapping tool (the EFH Mapper) that can be queried to identify designated EFH species and life stages potentially occurring near the proposed project area (NOAA Fisheries 2020a). Information provided by the EFH Mapper for the action area is included in **Attachment 2**. The Proposed Action includes the construction of a pier and dredging of channels and turning basins in open tidal waters off the north end of Wallops Island. The action area is defined as “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). For this project, the action area includes the north end of Wallops Island surrounding the UAS airstrip including the surrounding waters from Chincoteague Inlet to the east and north to Bogues Bay to the west – the offshore areas potentially affected by pier construction, dredging of channels and turning basins, placement of dredged sediment, and vessels transiting between the proposed pier and the existing Chincoteague Inlet Federal Channel.

The Proposed Action area is geographically coincident with EFH for one or more life stages of 11 federally-managed fish species. These species and life stages are listed in **Table 4**.

Table 4. Species and Life Stages with Designated EFH in Waters of the Action Area

Species	Eggs	Larvae/ Neonates[1]	Juveniles	Adults
Atlantic butterfish (*Peprilus triacanthus*)			X	X
Atlantic herring (*Clupea harengus*)				X
Black sea bass (*Centropristis striata)*			X	X
Bluefish (*Pomatomus saltatrix*)			X	X
Clearnose skate (*Raja eglanteria*)			X	X
Sand tiger shark (*Carcharias taurus*)[2]		X	X	X
Sandbar shark (*Charcharinus plumbeus*)[2]		X	X	
Smoothhound shark complex – Atlantic stock (*Mustelus canis*)[2]		X	X	X
Summer flounder (*Paralicthys dentatus*)			X	X
Windowpane flounder (*Scophthalmus aquosus)*				X
Winter skate (*Leucoraja ocellata*)			X	X

Notes:
1. An “X” indicates that EFH has been designated within the project area for that species and life stage.
2. The three shark species bear live young (neonates) and thus, do not have a free-swimming larval stage.

Source: NOAA Fisheries (2020a)

The offshore habitats within the action area include tidal marsh communities and the estuarine surface waters of Chincoteague Inlet, Bogues Bay, Ballast Narrows, and other waterways. The nearest beds of submerged aquatic vegetation are approximately 3 miles north of the project area. Waters in the project area contain public and private harvesting areas for shellfish (oysters and clams). These aquaculture areas are mapped in **Figure 5**.

Figure 5. Aquaculture Areas Near Wallops Island

The benthic invertebrate community of the Project Area may be an important EFH component that provides a food source for managed fish species. A benthic macroinvertebrate survey was performed in July 2020 to characterize the existing community in a portion of the Project Area at the north end of Wallops Island. Sediment samples were collected at six locations along an east-west transect through the area where the proposed pier would be constructed. These locations were considered to be representative of the area that includes the pier and the areas to be dredged for the turning basins and western end of the approach channel. The benthic samples were collected from subtidal areas at locations ranging from approximately 130 ft to 930 ft offshore of the tidal marsh.

The majority of organisms in the benthic samples were polychaete worms, which were the dominant taxonomic group and composed 55 percent of the identified individuals. Polychaetes are highly opportunistic and have the ability to rapidly recolonize disturbed areas. The next most abundant taxa were bivalve molluscs (26 percent of identified individuals), followed by amphipods. These organisms live in and on the bottom sediment, where they consume bacteria and detritus in the sediment and can be prey for higher-trophic-level predators. The overall abundance and diversity of these organisms were low, which is typical for estuarine and anthropogenically disturbed environments. The majority of the polychaetes identified were small, threadlike species, and although they composed approximately 40 percent of the individual organisms counted, they made up only a small percentage of the overall biomass in the samples. Therefore, they are unlikely to be a substantial component of the diet of bottom-feeding fish (AECOM 2021).

More than one-third (39%) of the identified organisms from the six samples consisted of two opportunistic polychaete taxa that are well documented as being typically found in areas of anthropogenic disturbance, have high tolerance to dredging and disposal, are some of the first species to recolonize areas following anoxic events, and are able to repopulate habitats that experience extreme fluctuations in conditions. The six samples collected had a hydrogen sulfide odor that suggested the sediments were either anoxic or hypoxic at the time they were sampled. Hypoxia is not uncommon in intertidal and shallow subtidal estuaries along the eastern U.S. coastline due to high levels of organic content in the sediment as a consequence of excess nitrogen from decaying salt marsh peat material and possibly anthropogenic sources. The benthic infaunal community of the Project Area was low in abundance of organisms and diversity of taxa. The community was dominated by opportunistic species that can rapidly recolonize disturbed habitat from surrounding habitats (AECOM 2021).

In accordance with the EFH Final Rule published in the *Federal Register* on 17 January 2002, federal agencies may incorporate an EFH assessment into documents prepared for another purpose, such as an EA, provided the EFH assessment is clearly identified as a separate and distinct section of the document. The information presented in this letter is based on the analysis provided in the EFH Assessment Worksheet (NOAA Fisheries 2020b) prepared for this consultation (**Attachment 1)**. The four primary elements of the EFH assessment are summarized below:

1. A description of the Proposed Action.

    Provided above; a more detailed description will be provided in the EA concurrently being prepared for the Proposed Action by NASA in compliance with NEPA.

2. An analysis of the potential adverse effects of the Proposed Action on EFH and the managed species.

    Briefly summarized in the EFH Assessment Worksheet (**Attachment 1**) and discussed in more detail below:

    A 1,305-ft fixed pier would be constructed in the northwest portion of the Project Area. It would extend from salt marsh/intertidal habitat through subtidal habitat and into estuarine habitat. A turning basin would be constructed around the pier, impacting estuarine habitat. A vessel approach channel approximately 12,800 ft long and 100 ft wide would be dredged to a final depth of 12 ft below MLLW in estuarine habitat.

    The salt marsh and estuarine habitat within the footprint of the pilings supporting the pier would be permanently converted. These habitats beneath the pier would be shaded, inhibiting plant growth. The submerged structure of the pier would provide substrate for colonization by invertebrates and shelter and foraging habitat for fish. Pier construction and channel/basin dredging could result in temporary, localized impacts from increased noise, turbidity, and sedimentation.

    The benthic community and associated EFH in the vicinity of the proposed pier and dredging would be disturbed. The area of marsh and open water bottom beneath the pier would be approximately 1 acre (ac) in Phase 1 and 1.5 ac in Phase 3. The areas to be dredged, including turning basins and channels, would be approximately 34 ac in Phase 1, 4 ac in Phase 2, and 33 ac in Phase 3. In Phase 3, previously dredged areas would be re-dredged to increase their depth. Thus, the maximum area of bottom to be directly removed by dredging through all phases of the Proposed Action would be approximately 34 ac, and the total area affected by both the pier and dredging would be approximately 35.5 ac. Maintenance dredging of the basin and channel would be repeated periodically as necessary to maintain the required depth and is expected to be infrequent and of short duration.

    Dredging impacts to fish and benthic invertebrate prey would occur from direct entrainment (being captured by the dredge bucket). Eggs, larval stages, and sessile or sedentary prey species typically are most susceptible to entrainment. Entrainment rates tend to be low but are typically found to be more problematic in cutter/suction dredging, due to its continuous nature, than in clamshell bucket dredging.

    Pile driving and dredging during construction of the Proposed Action and maintenance dredging during operation of the pier facility would resuspend sediment in the water column and produce turbidity due to suspended particles and subsequent sedimentation. Generally, high levels of suspended solids and long exposure times produce the greatest mortality. Decreased visibility from increased turbidity could lead to increased predation risk for some species and could impact species that rely on phytoplankton and filter feeding by damaging feeding structures or reducing feeding efficiency (Erftemeijer and Lewis 2006). Temporary turbidity and sedimentation effects from dredging along the channel and basin may impact nearby privately leased oyster beds (aquaculture).

The re-suspension of anoxic sediments can also reduce dissolved oxygen content in the immediate vicinity of the dredging operation, with deeper areas typically having lower dissolved oxygen than surface areas (LaSalle et al. 1991). This impact is generally short-lived due to mixing. Relatively immobile fish larvae or benthic invertebrate prey could be adversely impacted if extended periods of low dissolved oxygen occur.

Adverse impacts on shellfish from turbidity and sedimentation are unlikely, as the dredging activity would be short in duration and would not cover a large area of shellfish habitat. Additionally, increases in turbidity from dredging are generally similar to those that occur during strong storm events; thus, estuarine organisms have adapted to a wide range of turbidities.

It is expected that there would be a temporary impact on benthic invertebrate prey within the area of pile driving and dredging activities as a result of turbidity and sediment deposition, including anoxic sediments. As discussed above, the benthic infaunal community of the Project Area is low in abundance of organisms and diversity of taxa. The community is dominated by opportunistic species, mainly polychaete worms, that can rapidly recolonize disturbed habitat (AECOM 2021). Therefore, it is anticipated that this area would be recolonized within a short period of time after completion of the project. Additionally, conditions would return to a pre-disturbance state once particles disperse in the water column and/or settle to the bottom. Any effects on water quality from construction activities or increases in turbidity would be highly localized and temporary. Because the disturbance of benthic habitat would affect a relatively small amount of the Project Area and given the temporary nature of the disturbance, the Proposed Action is expected to result in negligible reductions in benthic invertebrate populations that may be prey for managed fish species (NOAA Fisheries 2020c).

In addition, turbidity control measures, such as turbidity curtains (also referred to as sediment curtains) could be implemented to prevent suspended sediments from exceeding water quality standards. The use of turbidity curtains around the pier construction area and the basin and access channel dredging areas would reduce or eliminate the potential impacts from sediments that may be released at the point of construction. Frequent monitoring would be performed during construction to ensure the effectiveness of suspended sediment containment. Thus, the areas of EFH that would be affected by turbidity from the Proposed Action would be minimal in comparison to the extensive surrounding areas, and effects on EFH that may occur in the Project Area would be of short duration.

Portions of the EFH surrounding Ballast Narrows could be disturbed by the movement and anchoring of barges. Barges would be positioned, and barge anchors deployed in such a manner as to avoid disturbance to oyster beds to the maximum extent practicable. Disturbance of the subaqueous bottom would not affect the long-term viability of the benthic community or associated EFH in those areas.

Accidental spills of fuel, oil, hydraulic fluid, or other potentially hazardous substances would be prevented or minimized through the contractor's adherence to spill prevention and control measures, as specified in WFF's Integrated Contingency Plan and the project-specific Spill Prevention, Control, and Countermeasure Plan.

Ambient noise levels would increase near construction and dredging locations. Some fish and invertebrate prey may be directly affected through their avoidance of noise. Abundance of prey species may also be altered temporarily within the Project Area as prey species migrate away from the construction and dredging activities. Noise effects on aquatic species would be temporary and would occur during limited periods while the equipment is being operated. However, impacts would be temporary and confined to EFH in the immediate vicinity of activities in Ballast Narrows and Chincoteague Inlet.

A small area of EFH would be affected by a proposed improvement to a road. A 130-ft segment of the existing paved access road for the UAS Airstrip would be widened from 15 ft to 30 ft and, in conjunction, the culvert over which the road crosses a drainage channel to Cow Gut would be widened (lengthened). The diameter of the culvert would remain the same. Extending the culvert would not interfere with fish passage within this headwater drainage and would have a negligible impact on EFH.

3. Conclusions regarding the effects of the Proposed Action on EFH.

   Provided in the EFH Assessment Worksheet (**Attachment 1**) and briefly summarized as follows: NASA has determined that potential adverse effects on EFH from the Proposed Action would be minimal and temporary. The overall determination is that adverse effects on EFH would not be substantial.

4. Proposed mitigation measures.

- In accordance with wetland permitting requirements, wetland mitigation may be required to compensate for impacts to tidal marsh within the footprint of the proposed pier.
- NASA would implement BMPs, described above and in the EFH Assessment Worksheet (**Attachment 1**), to minimize temporary adverse effects, which are briefly summarized as follows:
  - Impacts from sedimentation and erosion would be prevented or minimized through BMPs, which could include turbidity curtains, silt fence, and/or other approved measures to control erosion, turbidity, and sedimentation.
  - Revegetation of areas in the salt marsh using onsite excavated plant material disturbed

by construction or materials staging, in accordance with NASA WFF vegetation management policies, would further minimize potential adverse effects on EFH.

Conclusions

Based on this assessment, NASA has determined that the effects of the Proposed Action on EFH would not be substantial. I certify that we have used the best scientific and commercial data available to complete this assessment and request your concurrence with this determination.

If you have any questions or require additional information, please contact me at Shari.A.Miller@nasa.gov or (757) 824-2327.

Sincerely,

Shari A. Miller

Shari A. Miller
Center NEPA Manager and
Environmental Planning Lead

Enclosures:
Attachment 1: EFH Assessment Worksheet
Attachment 2: EFH Mapper query results

cc:
250/Ms. K. Finch
250/Mr. T. Meyer
MARAD/Mr. A. Finio
NMFS/Mr. D. O'Brien
NMFS/Mr. B. Hopper
USACE/Mr. B. Denson
VCSFA/Mr. N. Overby

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ATTACHMENT 1: EFH WORKSHEET

NOAA Fisheries Greater Atlantic Regional Fisheries Office
Essential Fish Habitat (EFH) Assessment & Fish and Wildlife Coordination Act (FWCA) Worksheet

This worksheet is your essential fish habitat (EFH) assessment. It provides us with the information necessary to assess the effects of your action on EFH under the Magnuson Stevens Fishery Conservation and Management Act and on NOAA trust resources under the Fish and Wildlife Coordination Act (FWCA). Consultation is not required if:

1. there is no adverse effect on EFH or NOAA trust resources (see page 10 for more info).
2. no EFH is designated and no trust resources may be present at the project site.

Instructions

Federal agencies or their non-federal designated lead agency should email the completed worksheet and necessary attachments to nmfs.gar.efh.consultation@noaa.gov. Include the public notice (if applicable) or project application and project plans showing:

- location map of the project site with area of impact.
- existing and proposed conditions.
- all waters of the U.S. on the project site with mean low water (MLW), mean high water (MHW), high tide line (HTL), and water depths clearly marked.
- sensitive habitats mapped, including special aquatic sites (submerged aquatic vegetation, saltmarsh, mudflats, riffles and pools, coral reefs, and sanctuaries and refuges), hard bottom or natural rocky habitat areas, and shellfish beds.
- site photographs, if available.

We will provide our EFH conservation recommendations and recommendations under the FWCA, as appropriate, within 30 days of receipt of a complete EFH assessment (60 days if an expanded consultation is necessary). Please submit complete information to minimize delays in completing the consultation.

This worksheet provides us with the information required[1] in an EFH assessment:

1. A description of the proposed action.
2. An analysis of the potential adverse effects on EFH and the federally managed species.
3. The federal agency's conclusions regarding the effects of the action on EFH.
4. Proposed mitigation, if applicable.

Your analysis **should focus on impacts that reduce the quality and/or quantity of the habitat or result in conversion to a different habitat type** for all life stages of species with designated EFH within the action area.

Use the information on the HCD website and NOAA's EFH Mapper to complete this worksheet. If you have questions, please contact the appropriate HCD staff member to assist you.

[1] The EFH consultation process is guided by the requirements of our EFH regulation at 50 CFR 600.905.

EFH ASSESSMENT WORKSHEET

General Project Information

Date Submitted:

Project/Application Number:

Project Name: Wallops Island Northern Development

Project Sponsor/Applicant: National Aeronautics and Space Administration (NASA)

Federal Action Agency (if state agency acting as delegated):

Fast-41 or One Federal Decision Project: ☐ Yes ☑ No

Action Agency Contact Name:

Contact Phone: Contact Email:

Latitude: 37.89 Longitude: -75.44

Address, City/Town, State:

NASA Wallops Flight Facility, Accomack County, Virginia

Body of Water: Ballast Narrows near Chincoteague Inlet

Project Purpose:

To construct and operate a port facility to increase safety and reduce costs, traffic, congestion, and air emissions.

Project Description:

The Proposed Action at the Wallops Island Northern Development is the construction of a port: a pier, and an operation area to provide barge access and berthing for offload of large launch vehicle components and related equipment for NASA and the Mid-Atlantic Regional Spaceport (MARS). A vessel approach channel (mostly existing channels) and turning basin would be dredged. The project would be executed in three phases. Construction of a 624-ft long pier under Phase 1 would take approximately 12 months and construction of a 676-ft long pier extension under Phase 2 (for a total pier length 1,305 ft) would take approximately 9.5 months. Phase 1 dredging activities (turning basin and channel) would take approximately 30 days; Phase 2 dredging (turning basin) would take approximately 7 days, and Phase 3 dredging (turning basin and channel) would take 30 days. Work would be performed 24 hours a day, seven days a week with two crews each working 12-hours.

Anticipated Duration of In-Water Work or Start/End Dates:

Phase 1 in 2021-2023 and approx. 1-2 years between it and Phases 2 and 3

Habitat Description

EFH includes the biological, chemical, and physical components of the habitat. This includes the substrate and associated biological resources (e.g., benthic organisms, submerged aquatic vegetation, shellfish beds, salt marsh wetlands), the water column, and prey species.

Is the project in designated EFH[2]?	☑ Yes	☐ No
Is the project in designated HAPC[2]?	☐ Yes	☑ No
Is this coordination under FWCA only?	☐ Yes	☑ No

Total area of impact to EFH (indicate sq ft or acres): 1,669,077 sq ft

Total area of impact to HAPC (indicate sq ft or acres): N/A

Current water depths: ~1-9 ft Salinity: ~20-30 ppt Water temperature range: ~6-30 C

Sediment characteristics[3]: Silt and sand

What habitat types are in or adjacent to the project area and will they be permanently impacted? Select all that apply. Indicate if impacts will be temporary, if site will be restored, or if permanent conversion of habitat will occur. A project may occur in overlapping habitat types.

	Habitat Type	**Total impact (sq ft/acres)**	**Impacts are temporary**	**Restored to pre-existing conditions**	**Permanent conversion of all or part of habitat**
☐	Marine				
☑	Estuarine	1,669,077/38			X
☐	Riverine (tidal)				
☐	Riverine (non-tidal)				
☑	Intertidal	14,341/0.33			X
☑	Subtidal	1,654,736/38			X
☐	Water column				
☑	Salt marsh/ Wetland (tidal)	221,720/5.1			X
☐	Wetland (non-tidal)				

---

[2] Use the tables on pages 7-9 to list species with designated EFH or the type of designated HAPC present.
[3] The level of detail is dependent on your project – e.g., a grain size analysis may be necessary for dredging.

	Habitat Type	Total impact (sq ft/acres)	Impacts are temporary	Restored to pre-existing conditions	Permanent conversion of all or part of habitat
☐	Rocky/hard bottom[4]:				
☐	Sand				
☐	Shellfish beds or oyster reefs				
☐	Mudflats				
☐	Submerged aquatic vegetation (SAV)[5], macroalgae, epifauna				
☐	Diadromous fish (migratory or spawning habitat)				

Indicate type(s) of rocky/hard bottom habitat (pebble, cobble, boulder, bedrock outcrop/ledge) and species of SAV:

N/A

Project Effects

Select all that apply	Project Type/Category
☑	Hatchery or Aquaculture
☐	Agriculture
☐	Forestry
☐	Military (e.g., acoustic testing, training exercises)
☐	Mining (e.g., sand, gravel)
☐	Restoration or fish/wildlife enhancement (e.g., fish passage, wetlands, beach renourishment, mitigation bank/ILF creation)

[4] Indicate type(s). The type(s) of rocky habitat will help you determine if the area is cod HAPC.
[5] Indicate species. Provide a copy of the SAV report and survey conducted at the site, if applicable.

Select all that apply	Project Type/Category
✔	Infrastructure/transportation (e.g., culvert construction, bridge repair, highway, port)
☐	Energy development/use
☐	Water quality (e.g., TMDL, wastewater, sediment remediation)
✔	Dredging/excavation and disposal
✔	Piers, ramps, floats, and other structures
☐	Bank/shoreline stabilization (e.g., living shoreline, groin, breakwater, bulkhead)
☐	Survey (e.g., geotechnical, geophysical, habitat, fisheries)
☐	Other

Select all that apply	Potential Stressors Caused by the Activity
✔	Underwater noise
✔	Water quality/turbidity/ contaminant release
✔	Vessel traffic/barge grounding
☐	Impingement/entrainment[6]
☐	Prevent fish passage/spawning
✔	Benthic community disturbance
☐	Impacts to prey species

Select all that apply and if temporary or permanent		Habitat alterations caused by the activity
Temp	Perm	
☐	✔	Water depth change
☐	☐	Tidal flow change
☐	☐	Fill
☐	✔	Habitat type conversion
☐	☐	Other:
☐	☐	Other:

[6] Entrainment is the voluntary or involuntary movement of aquatic organisms from a water body into a surface diversion or through, under, or around screens and results in the loss of the organisms from the population. Impingement is the involuntary contact and entrapment of aquatic organisms on the surface of intake screens caused when the approach velocity exceeds the swimming capability of the organism.

Details: project impacts and mitigation

The level of detail that you provide should be commensurate with the magnitude of impacts associated with the proposed project. Attach supplemental information if necessary.

Describe how the project would impact each of the habitat types selected above. Include temporary and permanent impact descriptions and direct and indirect impacts.

A 1,305-ft fixed pier would be constructed in the northeast portion of the Project Area. It would extend from salt marsh/intertidal habitat, through subtidal habitat and into estuarine habitat. A turning basin would be constructed around the pier impacting estuarine habitat. A vessel approach channel approximately 12,800 ft long and 100 ft wide would be dredged to a final depth of 12 ft below mean lower low water in estuarine habitat. The salt marsh and estuarine habitat within the footprint of the pilings supporting the pier would be permanently converted. These habitats beneath the pier would be shaded, inhibiting plant growth. The submerged structure of the pier would provide substrate for colonization by invertebrates and shelter and foraging habitat for fish.

What specific measures will be used to avoid impacts, including project design, turbidity controls, acoustic controls, and time of year restrictions? If impacts cannot be avoided, why not?

NASA will use a combination of BMPs, including temporary access matting, turbidity curtains, and soft-start procedures with bubble curtains during pile driving.

What specific measures will be used to minimize impacts?

NASA will use a combination of BMPs, including temporary access matting, turbidity curtains, and soft-start procedures with bubble curtains during pile driving.

Is compensatory mitigation proposed? ☑ Yes ☐ No

If no, why not? If yes, describe plans for mitigation and how this will offset impacts to EFH. Include a conceptual compensatory mitigation and monitoring plan, if applicable.

In accordance with NASA WFF vegetation management policies, vegetation would be re-established in areas of temporary impact. In accordance with wetland permitting requirements, wetland mitigation may be required for impacts to tidal marsh.

Federal Action Agency's EFH determination (select one)	
☐	There is no adverse effect[7] on EFH or EFH is not designated at the project site. EFH Consultation is not required. This is a FWCA-only request.
☑	The adverse effect[7] on EFH is not substantial. This means that the adverse effects are no more than minimal, temporary, or can be alleviated with minor project modifications or conservation recommendations. This is a request for an abbreviated EFH consultation.
☐	The adverse effect[7] on EFH is substantial. This is a request for an expanded EFH consultation. We will provide more detailed information, including an alternatives analysis and NEPA document, if applicable.

EFH and HAPC designations[8]
Use the EFH mapper to determine if EFH may be present in the project area and enter all species and lifestages that have designated EFH. Optionally, you may review the EFH text descriptions linked to each species in the EFH mapper and use them to determine if the described habitat is present. We recommend this for larger projects to help you determine what your impacts are.

Species	**EFH is designated/mapped for:**				**Habitat present based on text description (optional)**
	EFH: eggs	**EFH: larvae**	**EFH: juvenile**	**EFH: adults/ spawning adults**	
Atlantic butterfish (Peprilus triacanthus)	☐	☐	☑	☑	☐
Atlantic herring (Clupea harengus)	☐	☐	☐	☑	☐
Black sea bass (Centropristis striata)	☐	☐	☑	☑	☐
Bluefish (Pomatomus saltatrix)	☐	☐	☑	☑	☐

[7] An **adverse effect** is any impact that reduces the 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. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.
[8] Within the Greater Atlantic Region, EFH has been designated by the New England, Mid-Atlantic, and South Atlantic Fisheries Management Councils and NOAA Fisheries.

Species	EFH is designated/mapped for:				Habitat present based on text description (optional)
	EFH: eggs	EFH: larvae	EFH: juvenile	EFH: adults/ spawning adults	
Clearnose skate (Raja eglanteria)	☐	☐	☑	☑	☐
Sand tiger shark (Carcharias taurus)	☐	☑	☑	☑	☐
Sandbar shark (Charcharinus plumbeus)	☐	☑	☑	☐	☐
Smoothhound shark complex - Atlantic stock (Mustelus canis)	☐	☑	☑	☑	☐
Summer flounder (Paralicthys dentatus)	☐	☐	☑	☑	☐
Windowpane flounder (Scophthalmus aguosus)	☐	☐	☐	☑	☐
Winter skate (Leucoraia ocellata)	☐	☐	☑	☑	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
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	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

HAPCs

Select all that are in your action area.

☐	Summer flounder: SAV[9]	☐	Alvin & Atlantis Canyons
☐	Sandbar shark	☐	Baltimore Canyon
☐	Sand Tiger Shark (Delaware Bay)	☐	Bear Seamount
☐	Sand Tiger Shark (Plymouth-Duxbury-Kingston Bay)	☐	Heezen Canyon
☐	Inshore 20m Juvenile Cod	☐	Hudson Canyon
☐	Great South Channel Juvenile Cod	☐	Hydrographer Canyon
☐	Northern Edge Juvenile Cod	☐	Jeffreys & Stellwagen
☐	Lydonia Canyon	☐	Lydonia, Gilbert & Oceanographer Canyons
☐	Norfolk Canyon (Mid-Atlantic)	☐	Norfolk Canyon (New England)
☐	Oceanographer Canyon	☐	Retriever Seamount
☐	Veatch Canyon (Mid-Atlantic)	☐	Toms, Middle Toms & Hendrickson Canyons
☐	Veatch Canyon (New England)	☐	Washington Canyon
☐	Cashes Ledge	☐	Wilmington Canyon

[9] Summer flounder HAPC is defined as all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile summer flounder EFH. In locations where native species have been eliminated from an area, then exotic species are included. Use local information to determine the locations of HAPC.

More information

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) mandates that federal agencies conduct an essential fish habitat (EFH) consultation with NOAA Fisheries on any actions they authorize, fund, or undertake that may adversely affect EFH. An **adverse effect** is any impact that reduces the 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. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

We designed this worksheet to help you to prepare EFH assessments. It is important to remember that an adverse effect determination is a trigger to consult with us. It does not mean that a project cannot proceed as proposed, or that project modifications are necessary. It means that the effects of the proposed action on EFH must be evaluated to determine if there are ways to avoid, minimize, or offset adverse effects.

This worksheet should be used as your EFH assessment or as a guide to develop your EFH assessment. At a minimum, you should include all the information required to complete this worksheet in your EFH assessment. The level of detail that you provide should be commensurate with the magnitude of impacts associated with the proposed project. If your answers in the worksheet and supplemental information you attach do not fully evaluate the adverse effects to EFH, we may request additional information to complete the consultation.

You may need to prepare an expanded EFH assessment for more complex projects to fully characterize the effects of the project and the avoidance and minimization of impacts to EFH. While the EFH assessment worksheet may be used for larger projects, the format may not be sufficient to incorporate the extent of detail required, and a separate EFH assessment may be developed. However, regardless of format, you should include an analysis as outlined in this worksheet for an expanded EFH assessment, along with any additional necessary information. This additional information includes:

- the results of on-site inspections to evaluate the habitat and site-specific effects.
- the views of recognized experts on the habitat or the species that may be affected.
- a review of pertinent literature and related information.
- an analysis of alternatives that could avoid or minimize the adverse effects on EFH.

Please contact our Greater Atlantic Regional Fisheries Office, Protected Resources Division regarding potential impacts to marine mammals or threatened and endangered species.

Useful Links
National Wetland Inventory Maps
https://www.fws.gov/wetlands/
EPA's National Estuary Program (NEP)
https://www.epa.gov/nep/local-estuary-programs
Northeast Regional Ocean Council (NROC) Data Portal
https://www.northeastoceandata.org/
Mid-Atlantic Regional Council on the Ocean (MARCO) Data Portal
http://portal.midatlanticocean.org/

Resources by State

Maine
Maine Office of GIS Data Catalog
https://geolibrary-maine.opendata.arcgis.com/datasets#data
Town shellfish information including shellfish conservation area maps
https://www.maine.gov/dmr/shellfish-sanitation-management/programs/municipal/ordinances/towninfo.html
State of Maine Shellfish Sanitation and Management
https://www.maine.gov/dmr/shellfish-sanitation-management/index.html
Eelgrass maps
https://www.maine.gov/dmr/science-research/species/eelgrass/index.html
Casco Bay Estuary Partnership
https://www.cascobayestuary.org/
Maine GIS Stream Habitat Viewer
https://www.arcgis.com/home/item.html?id=5869c2d20f0b4c3a9742bdd8abef42cb

New Hampshire
NH's Statewide GIS Clearinghouse, NH GRANIT
http://www.granit.unh.edu/
NH Coastal Viewer
http://www.granit.unh.edu/nhcoastalviewer/
State of NH Shellfish Program
https://www.des.nh.gov/organization/divisions/water/wmb/shellfish/

Massachusetts
MA Shellfish Sanitation and Management Program
https://www.mass.gov/shellfish-sanitation-and-management
MassGIS Data, Including Eelgrass Maps
http://maps.massgis.state.ma.us/map_ol/oliver.php
MA DMF Recommended TOY Restrictions Document
https://www.mass.gov/files/documents/2016/08/ry/tr-47.pdf
Massachusetts Bays National Estuary Program
https://www.mass.gov/orgs/massachusetts-bays-national-estuary-program
Buzzards Bay National Estuary Program
http://buzzardsbay.org/
Massachusetts Division of Marine Fisheries

https://www.mass.gov/orgs/division-of-marine-fisheries
Massachusetts Office of Coastal Zone Management
https://www.mass.gov/orgs/massachusetts-office-of-coastal-zone-management

Rhode Island
RI Shellfish and Aquaculture
http://www.dem.ri.gov/programs/fish-wildlife/marine-fisheries/shellfish-aquaculture.php
RI Shellfish Management Plan
http://www.shellfishri.com/
Eelgrass Maps
http://edc.maps.arcgis.com/apps/View/index.html?appid=db52bb689c1e44259c06e11fd24895f8
RI GIS Data
http://ridemgis.maps.arcgis.com/apps/webappviewer/index.html?id=87e104c8adb449eb9f905e5f18020de5
Narragansett Bay Estuary Program
http://nbep.org/
Rhode Island Division of Marine Fisheries
http://www.dem.ri.gov/programs/fish-wildlife/marine-fisheries/index.php
Rhode Island Coastal Resources Management Council
http://www.crmc.ri.gov/

Connecticut
CT Bureau of Aquaculture
https://www.ct.gov/doag/cwp/view.asp?a=3768&q=451508&doagNav=
CT GIS Resources
https://www.ct.gov/deep/cwp/view.asp?a=2698&q=323342&deepNav_GID=1707
Natural Shellfish Beds in CT
https://cteco.uconn.edu/viewer/index.html?viewer=aquaculture
Eelgrass Maps
https://www.fws.gov/northeast/ecologicalservices/pdf/wetlands/2012_CT_Eelgrass_Final_Report_11_26_2013.pdf
Long Island Sound Study
http://longislandsoundstudy.net/
CT GIS Resources
http://cteco.maps.arcgis.com/home/index.html
CT DEEP Office of Long Island Sound Programs and Fisheries
https://www.ct.gov/deep/site/default.asp
CT River Watershed Council
https://www.ctriver.org/

New York
Eelgrass Report
http://www.dec.ny.gov/docs/fish_marine_pdf/finalseagrassreport.pdf
Peconic Estuary Program
https://www.peconicestuary.org/
NY/NJ Harbor Estuary
https://www.hudsonriver.org/estuary-program

New York GIS Clearinghouse
https://gis.ny.gov/

New Jersey
Submerged Aquatic Vegetation Mapping
http://www.crssa.rutgers.edu/projects/sav/
Barnegat Bay Partnership
https://www.barnegatbaypartnership.org/
NJ GeoWeb
https://www.nj.gov/dep/gis/geowebsplash.htm
NJ DEP Shellfish Maps
https://www.nj.gov/dep/landuse/shellfish.html

Pennsylvania
Delaware River Management Plan
https://www.fishandboat.com/Fish/Fisheries/DelawareRiver/Documents/delaware_river_plan_exec_draft.pdf
PA DEP Coastal Resources Management Program
https://www.dep.pa.gov/Business/Water/Compacts%20and%20Commissions/Coastal%20Resources%20Management%20Program/Pages/default.aspx
PA DEP GIS Mapping Tools
https://www.dep.pa.gov/DataandTools/Pages/GIS.aspx

Delaware
Partnership for the Delaware Estuary
http://www.delawareestuary.org/
Center for Delaware Inland Bays
http://www.inlandbays.org/
Delaware FirstMap
http://delaware.maps.arcgis.com/home/index.html

Maryland
Submerged Aquatic Vegetation Mapping
http://web.vims.edu/bio/sav/
MERLIN
http://dnrweb.dnr.state.md.us/MERLIN/
Maryland Coastal Bays Program
https://mdcoastalbays.org/

Virginia
Submerged Aquatic Vegetation mapping
http://www.mrc.virginia.gov/regulations/Guidance_for_SAV_beds_and_restoration_final_approved_by_Commission_7-22-17.pdf
VDGIF Time of Year Restrictions (TOYR) and Other Guidance
https://www.dgif.virginia.gov/wp-content/uploads/VDGIF-Time-of-Year-Restrictions-Table.pdf

ATTACHMENT 2: EFH MAPPER

EFH Data Notice: Essential Fish Habitat (EFH) is defined by textual descriptions contained in the fishery management plans developed by the regional Fishery Management Councils. In most cases mapping data can not fully represent the complexity of the habitats that make up EFH. This report should be used for general interest queries only and should not be interpreted as a definitive evaluation of EFH at this location. A location-specific evaluation of EFH for any official purposes must be performed by a regional expert. Please refer to the following links for the appropriate regional resources.

Greater Atlantic Regional Office
Atlantic Highly Migratory Species Management Division

Query Results

Degrees, Minutes, Seconds: Latitude = 37º53'26" N, Longitude = 76º33'31" W
Decimal Degrees: Latitude = 37.89, Longitude = -75.44

The query location intersects with spatial data representing EFH and/or HAPCs for the following species/management units.

*** W A R N I N G ***

Please note under "Life Stage(s) Found at Location" the category "ALL" indicates that all life stages of that species share the same map and are designated at the queried location.

EFH

Show	Link	Data Caveats	Species/Management Unit	Lifestage(s) Found at Location	Management Council	FMP
			Atlantic Herring	Adult	New England	Amendment 3 to the Atlantic Herring FMP
			Windowpane Flounder	Adult	New England	Amendment 14 to the Northeast Multispecies FMP
			Winter Skate	Adult Juvenile	New England	Amendment 2 to the Northeast Skate Complex FMP
			Clearnose Skate	Adult Juvenile	New England	Amendment 2 to the Northeast Skate Complex FMP
			Sandbar Shark	Juvenile Neonate	Secretarial	Amendment 10 to the 2006 Consolidated HMS FMP: EFH
			Smoothhound Shark Complex (Atlantic Stock)	ALL	Secretarial	Amendment 10 to the 2006 Consolidated HMS FMP: EFH
			Sand Tiger Shark	Neonate/Juvenile Adult	Secretarial	Amendment 10 to the 2006 Consolidated HMS FMP: EFH
			Bluefish	Adult Juvenile	Mid-Atlantic	Bluefish
			Atlantic Butterfish	Adult Juvenile	Mid-Atlantic	Atlantic Mackerel, Squid,& Butterfish Amendment 11
			Summer Flounder	Juvenile Adult	Mid-Atlantic	Summer Flounder, Scup, Black Sea Bass
			Black Sea Bass	Juvenile Adult	Mid-Atlantic	Summer Flounder, Scup, Black Sea Bass

HAPCs

Show	Link	Data Caveats	HAPC Name	Management Council
			Summer Flounder (Mid Atlantic)	MAFMC

EFH Areas Protected from Fishing

No EFH Areas Protected from Fishing (EFHA) were identified at the report location.

Spatial data does not currently exist for all the managed species in this area. The following is a list of species or management units for which there is no spatial data. ****For links to all EFH text descriptions see the complete data inventory: open data inventory -->**
Mid-Atlantic Council HAPCs, No spatial data for summer flounder SAV HAPC.

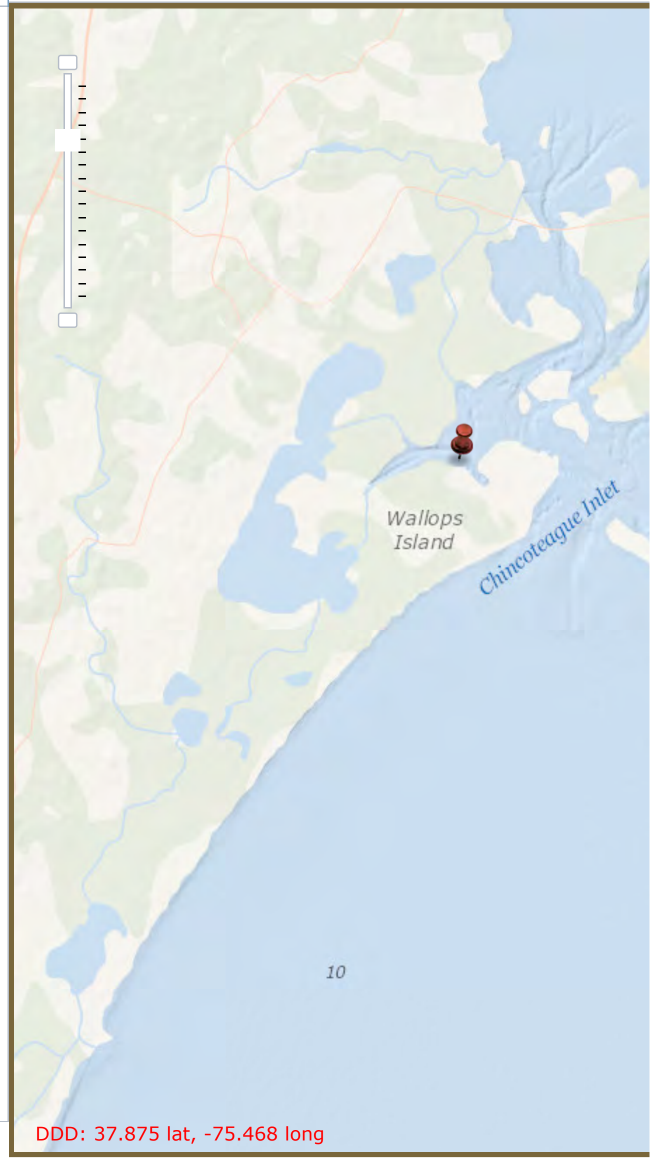
EFH View Tool | Data Query Tool

Zoom: Extent: Location Query:

location.

EFH

Show	Link	Data Caveats	Species/Management Unit	Lifestage(s) Found at Location	Management Council	FM
			Atlantic Herring	Adult	New England	Amend 3 to Atlar Herring
			Windowpane Flounder	Adult	New England	Amend 14 to North Multisp FM
			Winter Skate	Adult Juvenile	New England	Amend 2 to North Ska Comp FM
			Clearnose Skate	Adult Juvenile	New England	Amend 2 to North Ska Comp FM
			Sandbar Shark	Juvenile Neonate	Secretarial	Amend 10 to 200 Consoli HMS F EFI
			Smoothhound Shark Complex (Atlantic Stock)	ALL	Secretarial	Amend 10 to 200 Consoli HMS F EFI



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