WEST BAY

SANITARY DISTRICT

SAN MATEO COUNTY, CALIFORNIA

FLOW EQUALIZATION AND RESOURCE RECOVERY FACILITY LEVEE IMPROVEMENTS PROJECT

Menlo Park, California

ADDENDUM #1

WBSD Project No. 1762.0

This Addendum forms a part of the Contract Documents. All bidders submitting a bid to perform work on this project shall acknowledge receipt of this Addendum by completing the RECEIPT OF ADDENDA Specification Section 3.09, submitted as part of their bid. If a bidder does not acknowledge receipt of this Addendum on the Proposal submitted as part of their bid, the bidder will be deemed non-responsive or a non-responsible bidder and will be disqualified.

PRE-BID:

The Contractor's attention shall be directed to the following information discussed at the non-mandatory pre-bid meeting held on July 11, 2023 at 10:00 am at the project site, the District's Flow Equalization and Resource Recovery Facility at the north end of Bedwell Bayfront Park in Menlo Park in person. The following items were discussed during the pre-bid meeting:

1. Sign in - Please sign in by inputting your name, company name, telephone number and email address on the sign in sheet.

2. The project includes the flood protection of the District's Flow Equalization and Resource Recovery Facility (FERRF) against the FEMA floodplain and Sea Level Rise. The project consists of installing sheet pile walls along the western edge of the site and dual buried sheet pile walls along the levee crest. The dual buried sheet pile walls along the northeast side of the site will allow for placement of fill along the levee crest. Marsh Road approximately 300 feet from the FERRF entrance will be raised. Storm drainage infrastructure will be installed along Marsh Road and outfall into Westpoint Slough. An ecotone slope / living shoreline will be constructed along the northeast edge of the site. Oyster Reef structures will be placed along Flood Slough and Westpoint Slough. At the northeast corner of the site a dual storm drainage pipe will be installed along with improvement to the existing drainage ditch adjacent to eastern Bedwell Bayfront Trail. Additional storm drainage improvements will be installed on the south side of the FERRF site and outfall into Pond 1.

3. If contractors still have questions after this meeting to clarify the project specifications, they may contact the District for additional information in writing at least 5 days before the bid opening. Questions can be submitted to Fariborz Heydari at email address: FHeydari@westbaysanitary.org. Bid Opening is August 1, 2023, at 2:00 PM.

4. It was mentioned that Sandbar Oyster Company out of North Carolina is a potential source for the Oyster Reefs shown on the project plans.

5. Sealed proposals will be opened and read in person at 2:00 PM on August 1, 2023, at the West Bay Sanitary District office. Contractors have option to attend in person or via Zoom. Zoom information to attend the bid-opening virtually is:

   Topic: FERRF Levee Improvements Project Bid Opening
   Time: August 1, 2023, 02:00 PM Pacific Time (US and Canada)

   Join Zoom Meeting
   https://us06web.zoom.us/j/81511722976?pwd=enlLSXZMUURodExPWlRzbVRXKzM5Zz09

   Meeting ID: 815 1172 2976
   Passcode: 911921

   One tap mobile
   +16694449171,,81511722976#,,,,*911921# US
   +16699006833,,81511722976#,,,,*911921# US (San Jose)

   Dial by your location
   • +1 669 444 9171 US
   • +1 669 900 6833 US (San Jose)
   • +1 253 205 0468 US
   • +1 253 215 8782 US (Tacoma)
   • +1 346 248 7799 US (Houston)
   • +1 719 359 4580 US
   • +1 689 278 1000 US
   • +1 929 205 6099 US (New York)
   • +1 301 715 8592 US (Washington DC)
   • +1 305 224 1968 US
   • +1 309 205 3325 US
   • +1 312 626 6799 US (Chicago)
   • +1 360 209 5623 US
   • +1 386 347 5053 US
   • +1 507 473 4847 US
   • +1 564 217 2000 US
   • +1 646 931 3860 US

   Meeting ID: 815 1172 2976
   Passcode: 911921

6. The engineer’s Opinion of Probable Cost is $10,700,000

The Contractor's attention shall be directed to the following responses to questions received by West Bay Sanitary District prior to and during the non-mandatory pre-bid meeting:

1. When we reviewed the specification for the project, we noticed that the BCDC Permit No. 2022.001.00 only has even pages for review, please send us the odd pages 1-65.

    a. Acknowledged, please see attachments in addendum providing the full BCDC permit.

2. Going through the specs on page A3 section 2.0-4 subsurface and soil data, we don't see that this information is available in the spec. Please let us know where we can find it.

    a. Acknowledged, please see attachments in addendum providing geotechnical reports that include subsurface and soil data.

3. In the specifications a Biologist was mentioned to be needed to be onsite for any construction activity. Is it up to the contractor to provide the biologist? And if so, who will cover the expenses for the biologist?

    a. Contractors do not need to provide their own biologist, SWCA the project's environmental consultant will be the biologist onsite.

4. Is there a project schedule that can be provided to the contractors?

    a. It is up to the contractors to provide a project schedule. There are restrictions that will need to be considered. Please review section 8.17 in the specifications along with mitigation measures mentioned in the Final Environmental Impact Report and environment permits. Project needs to be completed by January 2025. Installation of west outboard, north-east inboard and north-east outboard sheet pile walls shall occur within the first year of construction.

5. Could WBSD pay in advance for the sheet pile walls ordered by the Contractor?

    a. It would be the Contractor's responsibility to order the sheet pile walls and WBSD could pay in advance at a reduced markup / overhead charge.

6. Could WBSD procure the sheet pile walls?

    a. WBSD is willing to pay for the sheetpile in advance of installation. WBSD requires some sort of Purchase Order or Invoice from the sheetpile manufacturer in order to pay for the sheet pile walls. However, WBSD would prefer if the Contractor procures the sheet piles.

7. Can you elaborate about the temporary sheet piles needed?

    a. The temporary sheet piles are for the temporary cofferdam that will need to be installed at the edge of the project site area for the ecotone slope / living shoreline. Please refer to BCDC permit along with Technical Specification Section 31 11 00 Site Preparation.

8. Is it up to the contractor to conduct the engineering for the sheet piles.

    a. No, engineering analysis for the sheet pile walls along the west outboard, north-east inboard and north-east outboard have been completed. Please refer to structural drawings and Technical Specifications Section 31 62 16 Steel Sheet Piles.

9. Is this a balanced site?

    a. No, engineered fill will need to be imported onsite.

10. Will the oyster reef structures be anchored down to mud flat?

    a. Oyster reef structures will be set down in the mud flat.

11. Can the west outboard sheet pile walls be installed simultaneously with the north-east inboard and north-east outboard sheet pile walls?

    a. Yes, sheet pile walls can be installed simultaneously as long as all mitigation measures mentioned in the environmental impacts report and the environmental permits are complied with.

12. Can stockpile be used for the specific fill requirements?

    a. Stockpile has not been tested to confirm if it can be utilized for the construction of the ecotone slope / living shoreline. Stockpile can be utilized for construction inboard of the top of bank. WBSD is currently working on getting testing completed to confirm if the stockpile material can be utilized for the construction of the ecotone slope / living shoreline.

13. Are there fill requirements?

    a. Please refer to the draft report titled Quality Assurance Project Plan for West Bay Sanitary District Flow Equalization and Resource Recovery Facility Flood Protection Project provided in attachments for fill requirements for the construction of the ecotone slope / living shoreline. For fill requirements inboard of the top of bank please refer to Technical Specification Section 31 00 00 Earthwork.

14. Can you provide further clarification on how the District would like us to Bid for this project?

    a. Bidders shall consider fill for the construction of the ecotone slope / living shoreline to be imported fill that fulfills requirements listed under the Draft Quality Assurance Project Plan (QAPP) for West Bay Sanitary District Flow Equalization and Resource Recovery Facility Flood Protection Project. As quantified in the bidding schedule, any soil excavated from the Bay is to be exported from the site. That material can be stockpiled on site and tested and if found to meet the requirements of the QAPP, can be replaced in the Bay. However, fill for the construction of the ecotone slope / living shoreline is shown as exported in the bidding schedule. Bidders shall also consider excavated borrow material on-site from stockpiles to be used for any construction inboard of the top of bank. Please see revised Bid Item Descriptions.

15. Does the excavated bay mud need to be dried?

    a. In the event the excavated bay mud is not suitable for reuse in the Bay, bay mud should be dried and hauled offsite. If the bay mud can be reused for the Bay then it does not need to be dried.

16. Is temporary irrigation going to be needed for the Bay Mud and salvaged native plant?

    a. Water for irrigation of bay mud and salvaged native plants should be brackish water.

17. Can matchlines be provided within sheets to understand earthwork needs?

    a. Please refer to sheet C1.0, C1.1 and C2.0.

18. Can you provide further clarification on working hours, Bedwell Bayfront Park hours and how they align with two hours before and after high tide?

    a. Please refer to BCDC permit. Work shall not be conducted within two hours before or after extreme high tides unless the work area is protected by a cofferdam and/or wildlife exclusion fencing, and a biological monitor is present. Bedwell Bayfront Park opens at 7 AM and closing varies throughout the year. If the contractor needs earlier access to the site, the contractor can coordinate with WBSD. Please see revised Spec Section B 8.14 Project Work Hours.

19. Are there specific fill requirements needed for Pond 3?

    a. For fill requirements inboard of the top of bank please refer to Technical Specification Section 31 00 00 Earthwork.

20. Can you clarify the need for over excavating where there are pipe crossings?

    a. To reduce pipe settlement over excavation is needed for areas where pipes are present, and fill is being added. The new backfill material shall consist of flowable fill. Please See revised details 4 and 5 on sheet C16.4.

21. Is the over excavation of Bay Mud required to be taken to a certain elevation?

    a. Please refer to sheets L3.1 and L3.2 for over excavation of bay mud.

The Contractor’s attention is directed to the following modifications to the Contract Documents:

PLANS

REPLACE Pages C16.4 (Details – 4) with C16.4 – Addendum 1

SPECIFICATIONS

REPLACE Page A1 (Section A1 NOTICE REQUESTING BIDS) with PAGE A1-Addendum 1. Bid Opening Date updated.

REPLACE Page B37 (Section B8.14, PROJECT WORK HOURS) with Page B37- Addendum 1. Project work hours updated.

REPLACE Page C15 and C19 through C20 (Section C2.06 MEASUREMENT AND PAYMENT) with Pages C15-Addendum 1 and C19-Addendum 1 through C20-Addendum 1. Measurement and Payment section updated to provide additional context on Bid Items 11, Bid Item 39, Bid Item 40, and Bid Item 41.

REPLACE BCDC Permit No. 2022.001.00 with Attached full BCDC Permit.

REPLACE Clean Water Act Section 401 Water Quality Certification and Order for Flow Equalization and Resource Recovery Facility (FERRF) Levee Improvements Project with Attached full Clean Water Act Section 401 Water Quality Certification and Order for Flow Equalization and Resource Recovery Facility (FERRF) Levee Improvements Project.

ADD Geotechnical Engineering Investigation Living Shoreline Cut and Fill Analysis Levee Design Project.

ADD Geotechnical Memorandum WBSD Flow Equalization and Resource Recovery Facility Improvements Project Menlo Park, California.

ADD Geotechnical Memorandum Flow Equalization and Resource Recovery Facility Levee Improvement and Bayfront Recycled Water Facility Project West Bay Sanitary District Menlo Park, California.

ADD Draft Quality Assurance Project Plan for the West Bay Sanitary District Flow Equalization and Resource Recovery Facility Flood Protection Project, Menlo Park, San Mateo County, California.

WEST BAY SANITARY DISTRICT

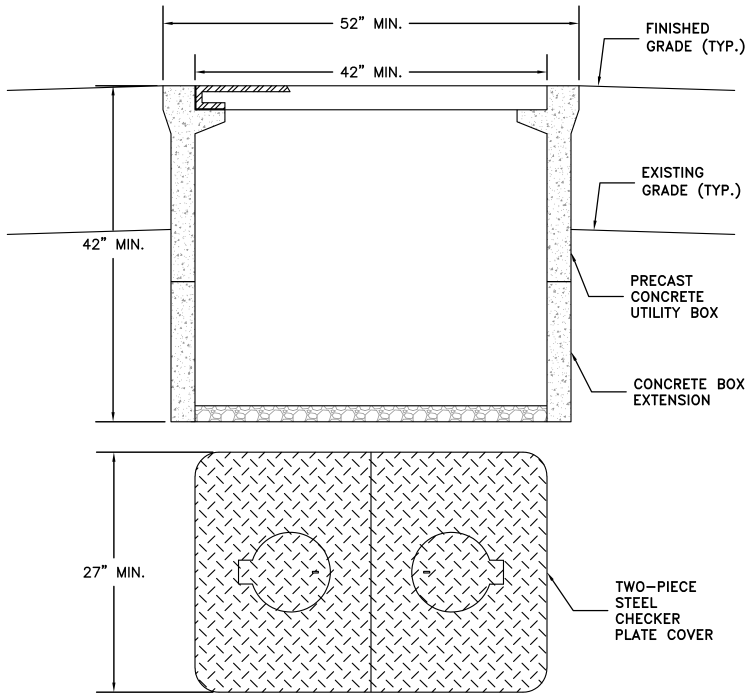
Flow Equalization and Resource Recovery Facility Levee Improvements Project (1762.0)
Pre-Bid Conference Documented Attendance

Location: **District's Boardroom – 500 Laurel Street, Menlo Park & Zoom**

Date/Time: **July 11, 2023, 10:00 a.m. – 11:00 a.m.**

NAME	AGENCY/COMPANY
FARIBORZ HEYDARI	WBSD
YUTAIN LEI	WBSD
JASON FEUDALE	WBSD
HEATH CORTEZ	WBSD
LISANDRO MARQUEZ	WBSD
RICH LAURETA	F&L
LORRAINE HTOO	F&L
FERNANDO MONROY	F&L
BEN SNYDER	SWCA
BOB ALTON	HANFORD ARC
SCOTT SCHUMACHER	ANDERSON PACIFIC
ANDREW SCHUMACHER	ANDERSON PACIFIC
SAM DUCKWORTH	ANDERSON PACIFIC

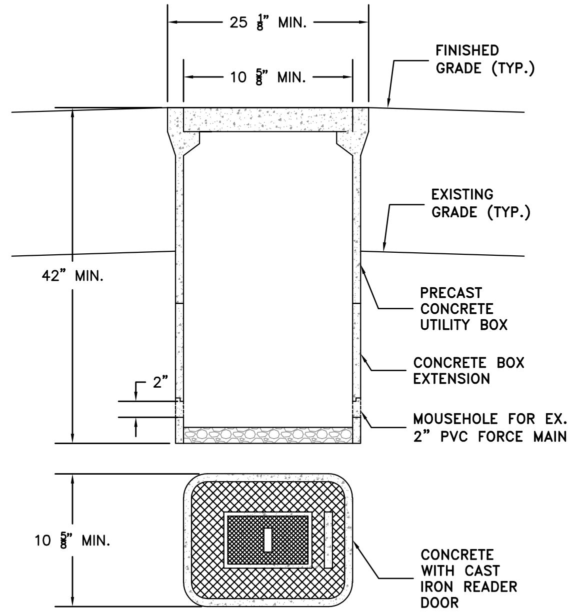
***** END OF ADDENDUM *****



NOTES:

1. CONTRACTOR TO PROTECT EXISTING LEACHATE PIPING IN PLACE.
2. CONTRACTOR TO REPLACE EXISTING VAULT WITH NEW CONCRETE VAULT AS SHOWN. TOP OF VAULT SHALL BE TO FINISH GRADE.
3. REFER TO LEACHATE CONTROL SYSTEM SITE PLAN FOR THE CITY OF MENLO BAYFRONT PARK PLANS FOR EXISTING VAULT LOCATION.

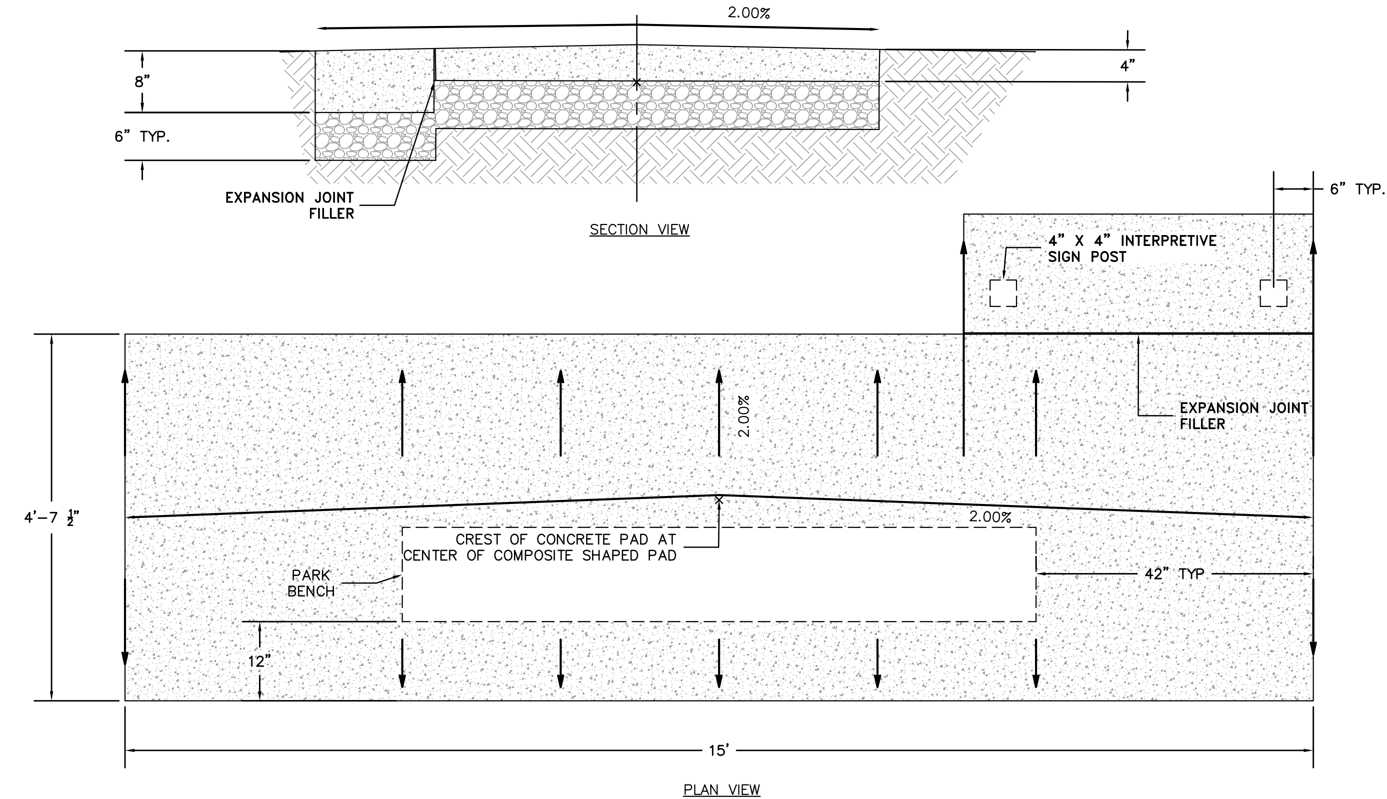
1 LEACHATE SUMP PUMP 4 UTILITY BOX RISER DETAIL



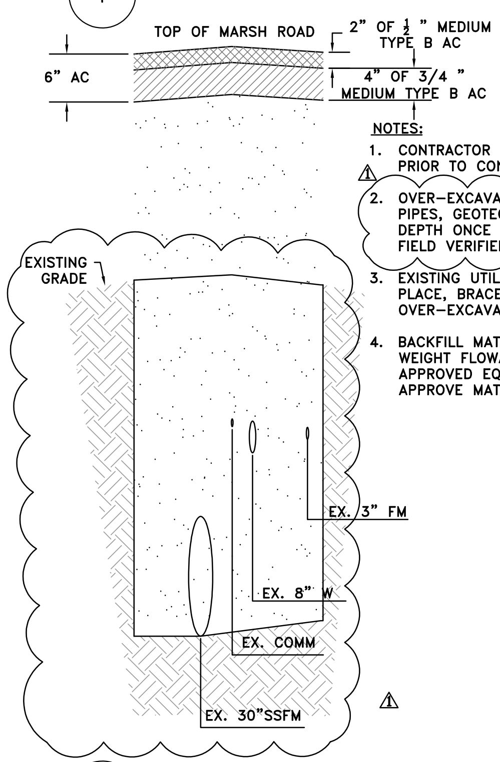
NOTES:

1. CONTRACTOR TO PROTECT EXISTING FORCEMAIN PIPING AND COMMUNICATION WIRING IN PLACE.
2. CONTRACTOR TO REPLACE EXISTING VAULT WITH NEW CONCRETE VAULT AS SHOWN. TOP OF VAULT SHALL BE TO FINISH GRADE.
3. REFER TO LEACHATE CONTROL SYSTEM SITE PLAN FOR THE CITY OF MENLO BAYFRONT PARK PLANS FOR EXISTING UTILITY BOX LOCATIONS.

2 UTILITY BOX RISER DETAIL



3 CONCRETE PAD DETAIL



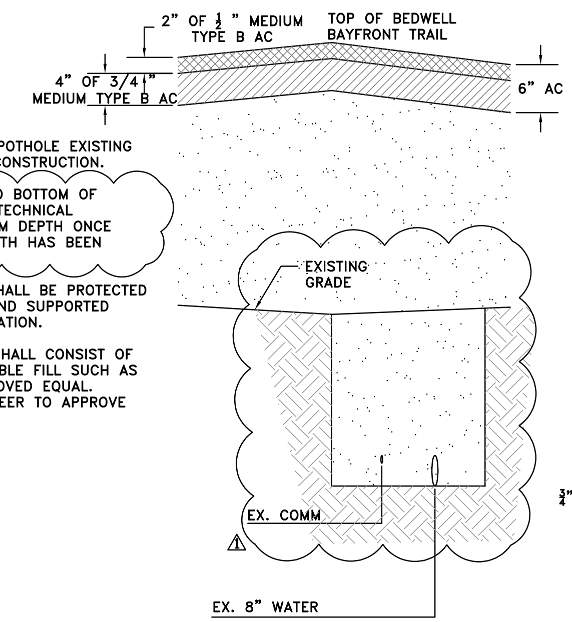
NOTES:

1. CONTRACTOR SHALL POTHOLE EXISTING UTILITIES PRIOR TO CONSTRUCTION.
2. OVER-EXCAVATION TO BOTTOM OF EXISTING PIPES, GEOTECHNICAL ENGINEER TO CONFIRM DEPTH ONCE EXISTING UTILITY DEPTH HAS BEEN FIELD VERIFIED.
3. EXISTING UTILITIES SHALL BE PROTECTED IN PLACE, BRACED AND SUPPORTED DURING OVER-EXCAVATION.
4. BACKFILL MATERIAL SHALL CONSIST OF LIGHT WEIGHT FLOWABLE FILL SUCH AS ELASTIZELL OR APPROVED EQUAL. GEOTECHNICAL ENGINEER TO APPROVE MATERIAL.

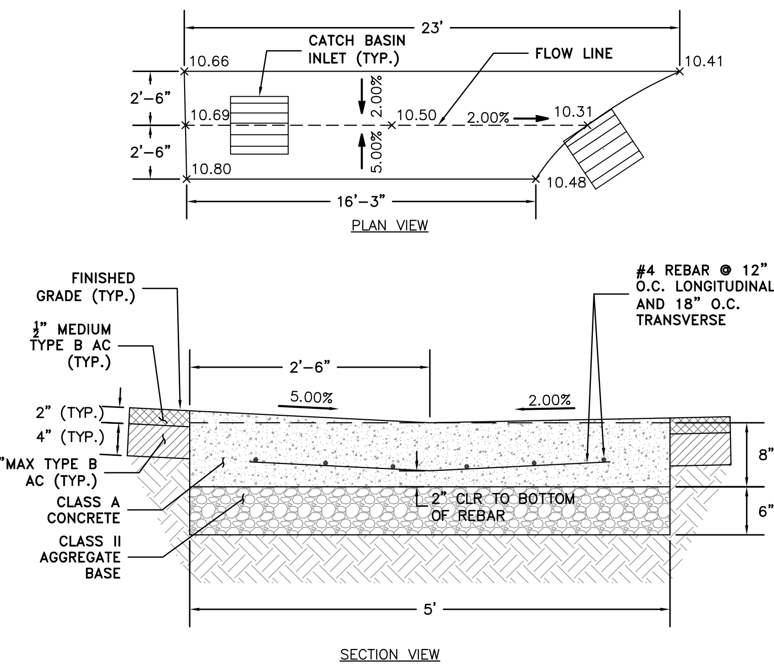
4 MARSH ROAD OVEREXCAVATION DETAIL

NOTES:

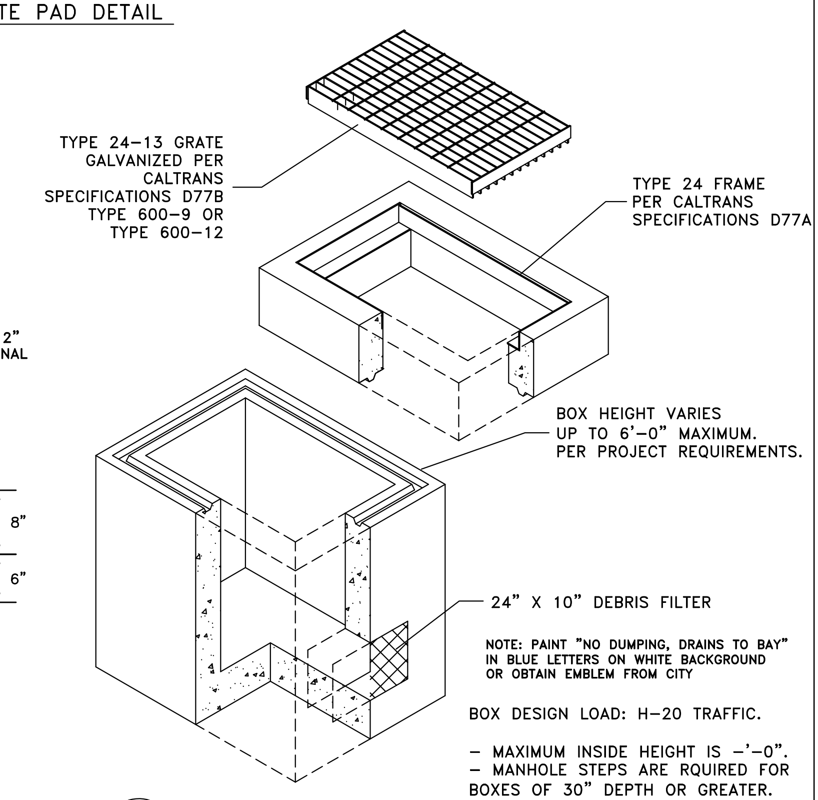
1. CONTRACTOR SHALL POTHOLE EXISTING UTILITIES PRIOR TO CONSTRUCTION.
2. OVER-EXCAVATION TO BOTTOM OF EXISTING PIPES, GEOTECHNICAL ENGINEER TO CONFIRM DEPTH ONCE EXISTING UTILITY DEPTH HAS BEEN FIELD VERIFIED.
3. EXISTING UTILITIES SHALL BE PROTECTED IN PLACE, BRACED AND SUPPORTED DURING OVER-EXCAVATION.
4. BACKFILL MATERIAL SHALL CONSIST OF LIGHT WEIGHT FLOWABLE FILL SUCH AS ELASTIZELL OR APPROVED EQUAL. GEOTECHNICAL ENGINEER TO APPROVE MATERIAL.



5 BEDWELL BAYFRONT TRAIL OVEREXCAVATION DETAIL



6 VALLEY GUTTER DETAIL



7 SWALE CATCH BASIN DETAIL

DATE: 06/23/2023		06/23/2023	BID SET	
SCALE: AS NOTED		07/13/2023	⚠ ADDENDUM 1	
DESIGNED: LFH & FYM				
DRAWN: FYM & MPM				
CHECKED: LFH				
PROJ. ENGR: RJL				
	BY	DATE	DESCRIPTION OF REVISIONS	APP'D

FREYER & LAURETA, INC.
CIVIL ENGINEERS • SURVEYORS • CONSTRUCTION MANAGERS
150 Executive Park Blvd #4200 • San Francisco, CA 94134
(415)534-7070 • www.freyerlaureta.com

WEST BAY SANITARY DISTRICT
SAN MATEO COUNTY
PROJECT No. 1762.0

FLOW EQUALIZATION AND RESOURCE RECOVERY FACILITY LEVEE IMPROVEMENTS PROJECT

DETAILS - 4

MENLO PARK, CALIFORNIA

SHEET C16.4

JOB NO. 1079

SECTION A1 - NOTICE REQUESTING BIDS

WEST BAY SANITARY DISTRICT PROJECT
FLOW EQUALIZATION AND RESOURCE RECOVERY FACILITY LEVEE IMPROVEMENTS PROJECT

Sealed proposals for the FLOW EQUALIZATION AND RESOURCE RECOVERY FACILITY LEVEE IMPROVEMENTS PROJECT will be received at the West Bay Sanitary District, 500 Laurel Street, Menlo Park, California 94025 until **2:00 PM on Tuesday, August 1, 2023** at which time they will be publicly opened and read. Bids shall be labeled "West Bay Sanitary District, Proposal for "FLOW EQUALIZATION AND RESOURCE RECOVERY FACILITY LEVEE IMPROVEMENTS PROJECT".

This project includes the flood protection of the District's Flow Equalization and Resource Recovery Facility (FERRF) against the FEMA floodplain and Sea Level Rise. The FERRF is a District multi-use facility that provides temporary storage of wastewater during wet weather events, storage of District vehicles and equipment, and includes a nursery for Save the Bay vegetation to be used in restoration projects. The Work will include the furnishing of all labor, materials and equipment, and other appurtenances for the raising of grades along Marsh Road, Bedwell Bayfront Park trails, levee crest and FERRF access roads, raising of existing vaults/manholes, construction of the living shoreline, valley gutter, headwalls, oyster reef structures, public access area, installation of sheet pile walls, of storm drainage infrastructure, of fencing, of erosion control measures, of temporary irrigation system, planting, and of erosion control seed mix and improvements to an existing drainage ditch as indicated on the project plans. The project is to start September 2023 and be completed by January 31, 2025, in conformance with permits and grant obtained for the project.

The contract documents may be inspected at the office of the West Bay Sanitary District, 500 Laurel St, Menlo Park, California 94025; San Francisco Builders Exchange, Attn: Deanna Johnson, 850 So. Van Ness Avenue, San Francisco, California 94110; Peninsula Builders Exchange, Attn: Andrea Nettles, 282 Harbor Blvd, Belmont, California 94002; Santa Clara Builders Exchange, Attn: Kanani Fonseca, 400 Reed Street, Santa Clara, California 95050; Bay Area Builders Exchange Attn: Jeannie Kwan, 3055 Alvarado Street, San Leandro, California 94577; Construction Bidboard Incorporated, Attn: Plan Room, 11622 El Camino Real, Suite 100, San Diego, CA 92130.

Questions shall be directed in writing to:
Fariborz Heydari, P.E.
Project Manager
Email: fheydari@westbaysanitary.org

Copies of the Contract Documents may be obtained at the office of the West Bay Sanitary District upon payment of a check or money order in the amount of $60.00 for each set. The check or money order must be issued to the West Bay Sanitary District. All payments are nonrefundable.

A pre-bid meeting will be held at **10:00 am on Tuesday, July 11, 2023** at the project site, the District's Flow Equalization and Resource Recovery Facility at the north end of Bedwell Bayfront Park in Menlo Park.

Each bid proposal shall be accompanied by a certified or cashier's check or a proposal guaranty bond payable to the order of the West Bay Sanitary District in an amount not less than ten percent (10%) of the amount of the bid as a guaranty that the bidder will execute the contract if it be awarded to him in conformity with the proposal. The successful bidder will be required to furnish a performance bond in an amount not less than one hundred percent (100%) of the contract price and a labor and material bond in an amount equal to one hundred percent (100%) of the contract price.

The Traffic Control Plan shall conform to the standards of the jurisdiction in which the work is located. The Traffic Control plan must conform to Caltrans Standards.

8.12 WORK PLAN

The Contractor shall submit, within 10 days prior to the pre-construction conference to be scheduled by the District, a project Work Plan locating all planned lay-down areas for pipe and other equipment and materials, pull and launching pits for trenchless construction, and planned ingress and egress routes to project work areas.

Prior to start of construction, contractor will be required to demonstrate his proposed method(s) for sewage bypass to the satisfaction of the District.

8.13 PROJECT LOCATION

The work under this contract will be performed in sections of:

City of Menlo Park:
Along Marsh Road approximately 300 feet south of WBSD FERRF property located at 1700 Marsh Road, along Bedwell Bayfront Park trail from Marsh Road adjacent to WBSD FERRF, along Bedwell Bayfront Park trail adjacent to the Eastern property line of WBSD FERRF, western side of WBSD FERRF, access roads within WBSD FERRF from Marsh Road, along the existing levee crest adjacent to the northern property line, along the eastern side of WBSD FERRF, into City of Menlo Park and State Lands property in between the levee crest and Westpoint Slough, into City of Menlo Park and State Lands property adjacent to northwestern corner of WBSD FERRF property.

8.14 PROJECT WORK HOURS

Work shall be constructed between the operating hours of Bedwell Bayfront Park in all areas. If access is needed prior to operating hours of Bedwell Bayfront Park, the contractor shall coordination with WBSD a minimum of 48 hours prior to early access date. Work adjacent to marsh habitat including but limiting to sheetpiling shall not be conducted within two hours before or after extreme high tides, however if the work area is protected by a cofferdam, work can be conducted with a biological monitor present onsite. Refer to Final Environmental Impact Report and environmental permits in the Appendix for additional information.

Precipitation forecasts shall be considered when planning construction activities. The Contractor shall monitor the 72-hour forecast from the National Weather Service at https://www.nws.noaa.gov. The Contractor shall remove all equipment from waters of the State and implement erosion and sediment control measure when there is forecast of more than 50% chance of at least 0.25 inches of rain. For all other construction activities, when there is a forecast of more than 50% chance of rain, or at the onset of unanticipated precipitation, the Contractor shall remove all equipment from water of the State, implement erosion control and sediment measures, and cease all Project activities. If any construction activities will occur after October 31, a Winterization Plan shall be submitted to the San Francisco Bay Regional Water Quality Control Board for review and acceptance. Refer to environmental permits.

The Contractor shall be off the project site at the end of the designated time stated.

standards are within trench limits, the contractor shall relocate the light standard to the satisfaction of the agency that has jurisdiction.

Item 9 - Potholing Utilities

Each item will be counted and payment for the actual number of potholes required and **approved** by the District. Potholing to locate laterals is not included in the item. Only **approved** potholes will be paid for.

Payment will be made at the unit price bid for each pothole. Payment shall include compensation for all labor, materials, tools, equipment, incidentals, work and appurtenances required for the potholing of utilities not on the project plans including: saw-cutting; the removal of surplus or unsuitable earth, pavement and concrete, excavation, backfilling and compacting, and all other tasks and costs incidental and necessary to complete the item.

Item 10–Easement/Landscape Restoration

Measurement and payment for this item shall be on a lump sum basis. Payment for this item of work shall include the furnishing and installation of all materials, equipment, and labor necessary to the installation of hydroseeding inboard of the top of bank, along Marsh Road and within Bedwell Bayfront Park, replacement and restoration of all landscaped surfaces including but not limited to grass, bushes, and trails to the condition existing prior to the beginning of work or to a better condition or as directed by the District. Work shall also include proposed site grading. All work will be subject to the requirements of the jurisdiction, as specified by the District.

Item 11 –WBSD and Menlo Park Excavation, Fill and Grading

Measurement and payment for this item shall be on a lump sum basis. Payment for this item of work shall include the furnishing and installation of all on-site and imported materials including but not limited to structural fill, lightweight flowable fill, Class II aggregate base, equipment, and labor necessary to raise the grades of levee improvements inboard of the outer edge of the top of levee within the FERRF, along Marsh Road, along and along Bedwell Bayfront Park's Trail, excavate borrow material on-site inboard of top of bank, placement and compaction of borrow material on-site inboard of new top of bank, placement and compaction of imported material, placement of hydroseeding, placement of Class II aggregate base as shown on the plans, and all other tasks and costs incidental and necessary to complete the item as specified herein.

Item 12 - Sheeting/ Shoring/ Bracing

Measurement and payment for this item shall be on a lump sum basis. Payment for this item shall include full compensation for all work, materials and appurtenances required for sheeting, shoring and bracing all trenching and excavation work five feet and deeper in accordance with California Labor Code Section 6707.

Item 13 – Pavement Restoration –Menlo Park Right of Way

Measurement and payment for this item shall be on a square foot basis. Payment for this item of work shall include the furnishing and installation of all materials, equipment, and labor necessary for the replacement and restoration of all paved surfaces including concrete, asphalt concrete, trials and pavement markings and striping at least to the condition existing prior to the beginning of work or to a better condition or as directed by the District and as shown on detail sheets. All work will be subject to

Item 32 – North-East Outboard Sheet Pile Walls 44’-6”

Measurement and payment for these items shall be on a lump sum basis. Payment for this item shall include full compensation for all labor, materials, tools, equipment, incidentals, work and appurtenances required for the mobilization and demobilization, welding, pile driving, assembly of sheet pile walls; and all other tasks and costs incidental and necessary to complete the item as specified herein.

Item 33 – Sheet Pile Wall Strut Connections

Measurement and payment for these items shall be on a per each struct connection from the buried inboard sheet pile wall to the buried outboard sheet pile wall basis. Payment for this item shall include full compensation for all labor, materials, tools, equipment, incidentals, work and appurtenances required for the mobilization and demobilization, welding, assembly of strut connections, and all other tasks and costs incidental and necessary to complete the item as specified herein.

Item 34 – Chain Link Fencing and Gates

Measurement and payment for these items shall be on a per linear foot for temporary and permanent fencing shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for doing all work involved in placing concrete and assembling the structure, and securing the premises and site from trespass during new wall construction as shown on the plans, specified in the Manufacturer’s Specifications, Standard Specifications and these Technical Specifications.

Item 35 – Pedestrian Overlook

Measurement and payment for these items shall be on a lump sum basis. Payment for this item shall include full compensation for all labor, materials, tools, equipment, incidentals, work and appurtenances required for the mobilization and demobilization, excavation backfilling and compacting materials; concrete materials and installation, formwork, steel reinforcing, and installation of the bench onto the proposed concrete pad, installation of interpretive sign onto the proposed concrete pad, and costs incidental and necessary to complete the item as specified herein.

Item 36– Readjusting Existing Utility Vaults, Manhole and Cabinet

Measurement and payment for this item shall be on a lump sum basis. Payment for this item of work shall include the furnishing and installation of all materials, equipment, work and appurtenances for the raising of finished grade for existing utility vaults, manhole and cabinet and all other tasks and costs incidental and necessary to complete the item as specified herein.

Item 37 – Excavation of Bay Mud & Salvage Native Plant Harvest

Measurement and payment for this item shall be on a cubic yard basis. Payment for this item shall include full compensation for all labor, materials, tools, equipment, incidentals, work and appurtenances required for the excavation of Bay Mud within the ecotone slope/ living shoreline area outboard of the top of bank, removal and salvaging of native plants, drying out of Bay Mud and hauling to a dump site.

Item 38 – Ecotone Slope / Living Shoreline Excavation

Measurement and payment for this item shall be on a cubic yard basis. Payment for this item shall include full compensation for all labor, materials, tools, equipment, incidentals, work and appurtenances required for the excavation of soil within ecotone slope / living shoreline area outboard of the new top of bank, drying out of material and hauling to a dump site and all other tasks and costs incidental and necessary to complete the item as specified herein.

Item 39 – Fill – Engineered / Structural Fill for Ecotone Slope / Living Shoreline

Measurement and payment for this item shall be on a cubic yard basis. Payment for this item of work shall include full compensation for all labor, import of fill material that fulfill Quality Assurance Project Plan for West Bay Sanitary District Flow Equalization and Resource Recovery Facility Flood Protection Project requirements, tools, equipment, incidentals, work and appurtenances required to add imported fill material in the Bay to construct the ecotone slope / living shoreline area outboard of the new top of bank and all other tasks and costs incidental and necessary to complete the item as specified herein.

Item 40 – Fill – Bay Mud

Measurement and payment for this item shall be on a cubic yard basis. Payment for this item of work shall include full compensation for all labor, import of material that fulfill Quality Assurance Project Plan for West Bay Sanitary District Flow Equalization and Resource Recovery Facility Flood Protection Project requirements, tools, equipment, incidentals, testing under Quality Assurance Project Plan for West Bay Sanitary District Flow Equalization and Resource Recovery Facility Flood Protection Project, work and appurtenances required to add imported Bay Mud material in the Bay to construct the ecotone slope / living shoreline area outboard of the top of bank and all other tasks and costs incidental and necessary to complete the item as specified herein

Item 41 – Fill – Topsoil Placement

Measurement and payment for this item shall be on a cubic yard basis. Payment for this item of work shall include full compensation for all labor, imported material that fulfill Quality Assurance Project Plan for West Bay Sanitary District Flow Equalization and Resource Recovery Facility Flood Protection Project requirements, tools, equipment, incidentals, testing under Quality Assurance Project Plan for West Bay Sanitary District Flow Equalization and Resource Recovery Facility Flood Protection Project, work and appurtenances required to add 18” of imported top soil material to construct the ecotone slope / living shoreline area outboard of the top of bank and all other tasks and costs incidental and necessary to complete the item as specified herein

Item 42 – Upland / Native Erosion Control Seed Mix

Measurement and payment for this item shall be on an acre basis. Payment for this item of work shall include full compensation for all labor, materials, tools, equipment, incidentals, work and appurtenances required for placement of erosion control seed mix within the upland/native areas of the ecotone slope/living shoreline and all other tasks and costs incidental and necessary to complete the item as specified herein.

Item 43 – Oyster Reef Structures

Measurement and payment for this item shall be on a per each basis. Payment for this item of work shall include full compensation for all labor, materials, tools, equipment, incidentals, work and appurtenances required to install oyster reef structures and all other tasks and costs incidental and necessary to complete the item as specified herein.

Item 44 – Planting & Irrigation System

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San Francisco Bay Conservation and Development Commission
375 Beale Street, Suite 510, San Francisco, California 94105 tel 415 352 3600 fax 888 348 5190
State of California | Gavin Newsom – Governor | info@bcdc.ca.gov | www.bcdc.ca.gov

Transmitted Via Electronic Mail

April 18, 2023

TO: West Bay Sanitary District
500 Laurel Street
Menlo Park, CA 94025

FROM: Lawrence J. Goldzband, Executive Director (415/352-3653; larry.goldzband@bcdc.ca.gov)

SUBJECT: Instructions for Completing BCDC Permit No. 2022.001.00; Flow Equalization and Resource Recovery Facility Levee Improvement Project

Dear BCDC Permit Holder:

Enclosed please find a PDF copy of your BCDC Permit, executed by the Executive Director.

All permittees must (1) **complete** the acknowledgment section of the permit[1], which indicates that you have read and that you understand all of the terms and conditions of the permit, and (2) **return** the entire permit within the ten-day time period (see Standard Conditions IV-A). The Notice of Completion and Declaration of Compliance form, shall be returned to the Commission upon project completion.

Furthermore, your permit contains special conditions which require you to take certain specific actions. Please understand that **no** work may commence on the project until the permit is executed and returned to the Commission. Until the Commission receives the executed permit, the permittee does not have the necessary authorization for the work authorized under the permit. The commencement of any work within the Commission's jurisdiction without the necessary authorization from the Commission is a violation of the McAteer-Petris Act and could subject you to substantial fines.

If you should have any questions regarding the permit or the procedure outlined above, please contact our staff at 415-352-3600 or info@bcdc.ca.gov.

[1] For your convenience, you will receive an email copy of the permit via DocuSign for your acknowledgement and e-signature.

San Francisco Bay Conservation and Development Commission
375 Beale Street, Suite 510, San Francisco, California 94105 tel 415 352 3600 fax 888 348 5190
State of California | Gavin Newsom – Governor | info@bcdc.ca.gov | www.bcdc.ca.gov

PERMIT NO. 2022.001.00

(Issued on April 18, 2023)

West Bay Sanitary District
500 Laurel Street
Menlo Park, CA 94025

On April 6, 2023, the San Francisco Bay Conservation and Development Commission, by a vote of 18 affirmative, 0 negative, and 1 abstention, approved the resolution pursuant to which this permit is hereby issued.

I. Authorization

A. Authorized Project

Subject to the conditions stated below, the permittee, the West Bay Sanitary District (WBSD), is granted permission to do the following in the Bay and within the 100-foot shoreline band, at 1700 Marsh Road, in the City of Menlo Park, San Mateo County, each as described more thoroughly in Exhibits A and B to this permit.

1. In the Bay
   a. Ecotone Levee - Shoreline Protection
   Excavate approximately 1,358 cubic yards of sediment and place approximately 3,249 cubic yards of soil fill to construct an approximately 48,835-square-foot (1.12-acre) portion of an ecotone levee slope along 598 linear feet of shoreline. Setback an approximately 739-linear foot section of the levee to allow room for 0.65 acres of new tidal marsh habitat.

   b. Oyster Reef
   Install approximately 7,946square feet (0.18 acres), 280 cubic yards of reef structures along approximately 836 linear feet of shoreline on the northern and western sides of the project site;

c. Cap and Reroute Onsite Stormwater Discharge
Cap the old 30-inch-diameter stormwater discharge pipe leading into Westpoint Slough and reroute the flow into the flow equalization basins. Two18-inch diameter stormwater discharge pipes will be installed in the northeast corner, one 18-inch diameter stormwater discharge pipe will be installed along Marsh Road to provide drainage for the Bedwell Bayfront Park stormwater drainage system; and

d. Temporary Cofferdam
Temporarily install approximately 1,491 linear feet of sheet pile walls during construction activities to isolate the 1.12 acres disturbance area and dewater the area of rainwater or groundwater as necessary.

2. Within the 100-foot Shoreline Band

a. Shoreline Protection
Place approximately 11,700 cubic yards of soil to raise the grade of the new levee system and improvements at Marsh Road within Bedwell Bayfront Park. This fill involves raising the levee from elevations ranging from +10.5 to +12.5 feet NAVD88 to a final elevation of approximately +15 feet NAVD88, including raising an existing 10,540-square-foot, earthen helipad on the northern point of the project site;

b. Sheet Pile Walls
Place approximately 3,700 linear feet of permanent sheet pile walls along the perimeter of the facility, including the section on the western side of the project with an approximately 1,350-linear-foot section of permanent above grade sheet pile wall that is visible;

c. Setback Levee and Marsh Habitat Creation
Excavate and setback an approximately 739-linear-foot section of the existing levee on the northeastern portion of the project site and place approximately 222 cubic yards of onsite soil fill to construct an approximately 28,314-square-foot (0.65-acre) portion of the new tidal marsh habitat;

d. Setback Levee Transition Zone Habitat Creation
Place approximately 208 cubic yards of on-site soils to construct the approximately 24,540-square-foot (0.56-acre) of transition zone behind the new tidal marsh habitat within an existing upland area of the northern levee;

e. Raise Existing Roadway and Segments of Public Access Trails
Improve approximately 40,861 square feet of existing roadways and existing trail, which includes raising the grade of approximately 160 linear feet of the Marsh Road access point from an average elevation of +10 feet NAVD88 to a final elevation of approximately +15 feet NAVD88, and raising two sections of adjacent trail, including a 150-foot section and 200-foot section from an average elevation of +11 feet NAVD88 to a final elevation of approximately +15 feet NAVD88;

f. Cap and Reroute Discharge Pipe
Cap and reroute the abandoned stormwater drainage system from West Bay Sanitary District that discharges into Westpoint Slough and build a connection back to the FERRF Basins for any water that is residually collected in the pipes so that it can enter the conveyance system and be treated at the Silicon Valley Clean Water Wastewater Treatment Plant in Redwood City;

g. Temporary Trail Closure
Temporarily close an approximately 400-linear-foot section of the Bay Trail; and

h. Public Access Improvements
Install and maintain a minimum of one permanent bench and one interpretive sign at the northwestern corner of Bedwell Bayfront Park.

B. Permit Application Date

This authority is generally pursuant to and limited by the application dated January 18, 2022, including all accompanying and subsequently submitted correspondence and exhibits, subject to the modifications required by conditions hereto.

C. Deadlines for Commencing and Completing Authorized Work

Work authorized herein must commence prior to June 1, 2024, or this permit will lapse and become null and void. All work authorized herein must be completed by November 30, 2027, unless an extension of time is granted by amendment of the permit. Once commenced, all work authorized or required by this permit must be diligently pursued to completion and must be completed within three years of commencement, unless an extension of time is granted by amendment of the permit.

D. Project Summary

The project would improve shoreline protection around the northern and western perimeters of the West Bay Sanitary District FERRF to gain FEMA accreditation and account for future sea level rise at the facility that is located in the City of Menlo Park, San Mateo County. The project includes shoreline protection infrastructure, placing Bay fill to create habitats and transition zone areas, installing recreational amenities, and creating new tidal marsh habitat.

1. Bay Fill

   The project involves new solid Bay fill for the construction of the ecotone levee slope on the northern portion of the FERRF facility. The ecotone construction requires removal of approximately 1,358 cubic yards of sediment, which will be reused onsite, to prepare the ecotone area for fill placement. Approximately 3,249 cubic yards of soil would be placed over approximately 48,835-square-foot (1.12 acres) of the Bay to construct the ecotone levee slope along approximately 598 linear feet of shoreline. The project also includes placing less than 280 cubic yards (836 linear feet; 7,946 square feet) of fill (mix of coconut coir, Portland cement, and Baycrete) for the oyster reef framework cantilevered over the mudflats. The project involves setting back an approximately 739-linear-foot section of the existing levee to expand the Bay by approximately 28,315 square feet (0.65 acres) and creating tidal marsh habitat within that area, plus 0.56 acres of ecotone transition habitat. Additionally, temporary fill is required to construct a cofferdam around the 1.12 acres of tidal marsh habitat during the ecotone levee construction, but this fill would be removed following the project. The net fill for the project includes approximately 3,529 cubic yards over an approximately 28,314-square-foot area, which includes the total fill area of 1.3 acres (56,628 square feet) minus the 0.65 acres (28,223 square feet) of newly created marsh habitat area. However, much of the ecotone fill area is expected to vegetate and turn into tidal marsh habitat in the near-term (2-3 years) and will also allow space for marsh migration with sea level rise. A majority of the fill material would come from existing stockpiles of soils or from the reuse of excavated soils/sediment from the project.

   Additionally, the project involves the placement of approximately 11,700 cubic yards of soils along 3,700 linear feet of the shoreline band for installing sheet pile walls, raising levee crowns, raising existing roads and segments of public trails, and other work.

2. Public Access

   There currently is no existing public access to the FERRF and it is fenced off from the adjacent Bedwell Bayfront Park by chain link fencing. There is an existing segment of the Bay Trail that runs around the perimeter of Bedwell Bayfront Park and portions of the trail would be temporary impacted and require detours during some construction activities. Due to the use of the FERRF as an overflow area for raw wastewater, the site is not suitable for public access due to public health concerns. However, the adjacent park is a well-used. The project includes the placement of one bench and one interpretive sign in the northwesternmost corner of Bedwell Bayfront Park (Exhibit A) to create a viewing area for the public out onto Westpoint Slough and the nearby Greco Island restoration project. Content for the interpretive sign would be developed with further community input.

II. Special Conditions

The authorization made herein shall be subject to the following special conditions, in addition to the standard conditions in Part IV:

A. Specific Plans and Plan Review

1. Construction Documents
   The development authorized herein shall be built generally in conformance with the following plan sets:

   a. 65% plan set entitled "West Bay Sanitary District Ecotone Levee Project – Menlo Park," prepared by Freyer & Laureta, Inc. and SCWA, dated August 10, 2022 (the "Construction Documents"), as submitted as part of the application for this project; and

   b. 65% plan set for the facility entitled "West Bay Sanitary District Flow Equalization and Recovery Facility Levee Improvements Project" prepared by Freyer & Laureta, Inc. dated September 2, 2022 (the "Construction Documents"), as submitted as part of the application for this project.

   The permittees are responsible for assuring that the Construction Documents accurately and fully reflect the terms and conditions of this permit and any legal instruments submitted pursuant to this authorization. No substantial changes shall be made to these documents without prior review and written approval by or on behalf of the Commission through plan review or a permit amendment.

2. Plan Review and Approval
   No work whatsoever shall commence pursuant to this permit until final construction documents regarding authorized activities are approved in writing by or on behalf of the Commission, through staff or third-party review. Documents submitted shall be accompanied by a written request for plan approval, identifying the type of plans submitted, the portion of the project involved, and indicating whether the plans are final or preliminary. All documents are reviewed within 60 days of receipt. To save time, preliminary documents may be submitted prior to the submittal of final documents. If final construction document review is not completed by or on behalf of the Commission within the 60-day period, the permittees may carry out the project authorized herein in a manner substantially consistent with the plans referred to in Special Condition II.A.1 of this permit.

a. Document Details
Construction documents shall be labeled, as appropriate, with: the Mean High Water line or the upland extent of marsh vegetation no higher than +5 feet above Mean Sea Level and the tidal datum reference (NAVD88 or, if appropriate, Mean Lower Low Water (MLLW)); the corresponding 100-foot shoreline band; property lines; the location, types, and dimensions of materials, structures, and project phases authorized herein; grading limits; and the boundaries of Public Access Areas and view corridor(s) required herein. Construction documents for shoreline protection projects must be dated and include the preparer's certification of project safety and contact information. No substantial changes shall be made to these documents without prior review and written approval by or on behalf of the Commission through plan review or a permit amendment.

b. Conformity with Final Approved Documents
All authorized development and uses shall conform to the final documents. Prior to use of the facilities authorized herein, the appropriate professional(s) of record shall certify in writing that the work covered by the authorization has been implemented in accordance with the approved criteria and in substantial conformance with the approved documents. No substantial changes shall be made to these documents without prior review and written approval by or on behalf of the Commission through plan review or a permit amendment.

c. Discrepancies between Approved Plans and Special Conditions
In case of a discrepancy between final approved documents and the special conditions of this permit or legal instruments, the special condition shall prevail.

d. Reconsideration of Plan Review
The permittees may request reconsideration of a plan review action taken pursuant to this special condition within 30 days of a plan review action by submitting a written request for reconsideration to the Commission's Executive Director. Following the Executive Director's receipt of such a request, the Executive Director shall respond to the permittee within 30 days with a determination on whether the plan review action in question shall remain unchanged or an additional review and/or action shall be performed by or on behalf of the Commission, including, but not limited to, an amendment to the permit and/or consultation with the Commission Design Review Board.

3. Progress Report and Final As-Built Report
The permittee shall prepare and submit any progress reports report(s) to the Commission for review and approval within 60 days after completing construction activities in any given calendar year and shall submit the final and a final as-built report following completion of all construction activities. The report(s) shall clearly

identify and illustrate the progress of the project, and the locations where any impacts to the Bay or habitats have occurred. The as-built report(s) shall include the 100 percent construction plans marked with the contractor's field notes that clearly depict any deviations made during construction from the designs reviewed by or on behalf of the Commission.

B. Public Access

1. Area

   The approximately 300-square-foot area, along the shoreline as generally shown on Exhibit A shall be made available exclusively to the public for unrestricted public access for sitting, viewing, and related purposes. If the permittee(s) wishes to use the public access area for other than public access purposes, it must obtain prior written approval by or on behalf of the Commission. The permittee shall only be responsible for the improvements specified in Special Condition II.B.5 and not the entire viewing area.

   In an already dedicated public access area (BCDC Permit No. 1970.018.04) to be improved: 300 square feet of the northwestern corner of Bedwell Bayfront Park for a viewing area. The City of Menlo Park would remain responsible for maintaining all other areas and amenities specified in their existing BCDC permit and not including the improvements specified in Special Condition II.B.5.

2. Public Access Plan and Outreach

   The permittee shall submit the design plans for the public access improvements within nine months of beginning the project construction. The plans shall be reviewed and approved pursuant to the plan review specified in Special Condition II.A.2 and the construction of the public access amenities shall substantially conform to the approved plans. As part of the development of the content for the interpretive sign, the permittee shall conduct additional outreach and engagement to the public, which may include such groups as park users, environmental nonprofits, nearby community members, and native American tribes if tribal resources are located in the area. Such engagement shall include a minimum of one additional public meeting about the project and seeking feedback on the content and appropriate languages to be used on the interpretive sign. In addition, the sign content shall be coordinated with other interpretive signage that may exist in Bedwell Bayfront Park, to the extent feasible.

3. Improvements Within the Total Public Access Area
   Prior to the use of any structure authorized herein, the permittee shall install the following improvements, as generally shown on attached Exhibit A:

   (a) In an approximately 300-square-foot viewing area sited to provide views of the Bay and with a minimum of one, ADA-compliant bench and one interpretive sign at the location generally shown on Exhibit A. The exact location and orientation of the public access amenities will be determined through the submittal of public access plans pursuant to Special Condition II.A.2;

   (b) Replace the existing chain link fence and barbed wire that is falling down with new fencing as approved pursuant to Special Condition II.A.2; and

4. Maintenance
   The improvements within the total 300-square-foot area shall be permanently maintained by and at the expense of the permittee(s) or its assignees. Such maintenance shall include, but is not limited to, repairs or replacement as needed of any public access amenities such as signs, benches, fencing, etc.; periodic cleanup of litter and other materials deposited within the access areas; removal of any encroachments into the access areas. Within 30 days after notification by staff, the permittee(s) shall correct any maintenance deficiency noted in a staff inspection of the site.

5. Construction Detour
   The permittee shall provide an ADA-accessible alternative route around the project site on Bedwell Bayfront Park consistent with the "Proposed Public Access to Shoreline During Construction – Figure 1" prepared by Freyer & Laureta, Inc. and dated December 21, 2022. The permittee shall post clearly marked signs at and nearby the construction zone to notify the public of any temporary closures of the public access area, the length of time that the access will be closed, and the location of the temporary detour. Where an alternative route in proximity to the closed public access area is not feasible, the construction zone shall accommodate the public access route and the permittee shall employ strategies to ensure public safety to maintain connections and access throughout the duration of the project.
   Any public access trails or areas that are to be fully closed to the public during construction shall be approved through plan review and shall be reopened to the public during periods when construction is not occurring for stretches of time.
   Any impacted trails or public access areas shall be fully restored to the original condition or better following the completion of construction and the reopening of the public access area.

6. Assignment

   The permittee shall transfer maintenance responsibility to a public agency or another party acceptable to the Commission at such time as the property transfers to a new party in interest but only provided that the transferee agrees in writing, acceptable to counsel for the Commission, to be bound by all terms and conditions of this permit.

7. Reasonable Rules and Restrictions

   The permittee(s) may impose reasonable rules and restrictions for the use of the public access areas to correct particular problems that may arise. Such limitations, rules, and restrictions shall have first been approved by or on behalf of the Commission upon a finding that the proposed rules would not significantly affect the public nature of the area, would not unduly interfere with reasonable public use of the public access areas, and would tend to correct a specific problem that the permittee(s) has both identified and substantiated. Rules may include restricting hours of use and delineating appropriate behavior.

C. Habitat and Species Protections

1. Environmental Work Window.

   The permittee shall conduct the installation and removal of the temporary cofferdam and all in-water work authorized, including the installation of the sheet pile walls, between June 1st and November 30th to protect California Coast steelhead and North American green sturgeon. Construction activities in and adjacent to marsh habitat for California Ridgway's rail and California black rail shall occur generally between September 1st through January 14th. However, work outside of these time periods may be approved if the permittee seeks and obtains approval by the Executive Director to work outside this window, and consults with the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), and the California Department of Fish and Wildlife (CDFW) regarding additional minimization and avoidance measures that are necessary for the work.

2. Marsh and Upland Plant Protection During Construction.

   The work authorized by this permit shall be performed in a manner that will prevent, avoid, or minimize to the extent possible any significant adverse impact on any tidal marsh, other sensitive wetland resources, and existing native upland vegetation. If any unforeseen adverse impacts occur to any such areas as a result of the activities authorized herein, the permittee shall restore the area to its previous condition, including returning the disturbed area to its original elevation and soil composition and, if the area does not revegetate to its former condition within one year, the permittee shall seed all disturbed areas with appropriate vegetation consistent with plans approved by or on behalf of the Commission. The permittee shall employ mitigation measures to minimize impacts to wetland areas, such as: (1) minimizing all traffic in marsh/mudflat areas; and (2) carefully removing, storing, and replacing wetland vegetation that has been removed or "peeled back" from construction areas as soon as possible following construction.

3. Areas Adjacent to the Cofferdam
   The permittee shall monitor the habitat areas adjacent to the temporary cofferdam during construction activities to determine if any unforeseen habitat impacts are occurring. If unforeseen impacts do occur, then the permittee shall consult with the regulatory agencies on how to resolve such issues and restore those habitats.

4. Work within Two Hours of Extreme Tides
   The permittee shall not conduct work within two hours before or after extreme high tides (6.5 feet or above as measured at the Golden Gate Bridge) when the marsh is inundated. However, if the work area is protected by a cofferdam or wildlife exclusion fencing, the work can continue with a biological monitor present and as required by the USFWS.

5. Non-daylight Work and Lighting Plan
   The permittee shall limit all project and construction lighting to reduce impacts on special-status species and other native species. If work is necessary during early morning, early evening, or at night, then the permittee shall prepare a lighting plan for review and approval by the USFWS, CDFW, and BCDC. Any 24-hour work shall also require preparation, implementation, and approval of the lighting plan.

6. Artificial Lighting
   Any lighting used during construction or permanent light installed within 200 feet of the marsh shall be low-intensity lighting or low-dispersion lighting that is oriented inward toward the project area (not directed towards the marsh), and downward.

7. Noise Minimization
   The permittee shall install all sheet piles using a soft-start method by pausing after the first 15 seconds at a reduced energy and do this twice before vibrating the sheet piles in at full capacity.

8. Pre-construction Surveys
   The permittee shall have a biological monitor conduct pre-construction surveys for salt marsh harvest mouse, California Ridgway's rail and California black rail, as necessary. The permittee shall coordinate the survey protocols with the USFWS and CDFW as appropriate but shall generally follow the protocols outlined in the permit application. Areas within the cofferdam and wildlife exclusion fence areas do not require a pre-construction survey.

9. USFWS Consultation
   The permittee shall adhere to the conservation measures, including best management practices and worksite protocols, to protect the California Ridgway's rail, salt marsh harvest mouse, and other species in the vicinity of the project site as stated in the December 1, 2022 Formal Consultation and Biological Opinion (Reference No. 2022-0007925-S7-001), unless it is modified by the USFWS. The permittee shall submit any amendment or modification to the USFWS biological opinion to the Commission.

10. NMFS Consultation
   The permittee shall adhere to the avoidance and minimization measures to minimize potential project impacts to federally-listed fish species and their habitat as described in the Letter of Concurrence dated December 5, 2022 (Reference No. WCRO-2022-03046), issued by the NMFS, or as modified by NMFS. The permittee shall submit any amendment or modification to the NMFS consultation to the Commission.

11. Biological Monitor
   The permittee shall have a qualified biologist or biological monitor present during all construction activities, including cofferdam installation, vegetation removal, work occurring during extreme tides, etc., within the marsh and in vegetated areas within five feet of the marsh to ensure that impacts to salt marsh harvest mouse, Ridgway's rail, and black rail are minimized during construction, unless the work site occurs behind the cofferdam or exclusion fencing installed to ensure that species do not enter the work site. If any special-status species are located near the construction work, the work shall be stopped, and the individual animal shall be allowed to leave the area on their own. Work may be moved to another location in the marsh to ensure that no impacts to special-status species occurs. The biological monitor shall have authority to stop any work if any special-status species is detected in any area where it may be injured or killed by construction activities.

12. Fish Relocation
   As the cofferdams are being placed, a qualified biologist shall be onsite and shall relocate any stranded fish to suitable habitat outside of the work area. The method of relocation shall be determined by the approved biological monitor, in consultation with NMFS and/or CDFW (as appropriate), based on site conditions and species present.

13. Protection of Nesting Shorebirds
   No work on the project site shall occur during the nesting season (February 1st through September 15th) for nesting birds in San Mateo County that are protected under the Migratory Bird Treaty Act and the California Fish and Game Code. If work

is to occur in the nesting season, then the qualified biological monitor shall conduct pre-construction surveys no more than five (5) days prior to the initiation of any site disturbance activities and equipment mobilization. If an active nest is found, then the qualified biological monitor shall determine the extent of the construction-free buffer zone to be established around the nest (typically up to 1,000 feet for raptors and up to 250 feet for other species). Active nests shall continue to be monitored for impacts and the buffer changed as necessary to prevent disturbance-related nest failure. Within the buffer zones, no site disturbance or mobilization of heavy equipment shall occur until the chicks have fledged.

14. Vegetation Removal
The permittee shall limit all vegetation removal activities in salt marsh habitat on the adjacent levees to removal with hand tools prior to the any grading or additional construction work that may occur. Other methods of vegetation removal may be utilized with the presence of the biological monitoring and incorporating any minimization measures suggested by the biological monitor to reduce impacts to species. The vegetation removal shall also be limited to the minimum amount necessary to complete the project. The biological monitor shall be present during all vegetation removal.

15. Exclusion Fencing
Following the vegetation removal, the permittee shall install temporary exclusion fencing around the outer boundary of the work area near salt marsh harvest mouse habitat to exclude species from the work area. However, if the cofferdam is installed in a manner that excludes species, then the exclusion fencing shall not be necessary. The installation, inspection, and removal of any exclusion fencing shall be overseen by the biological monitor.

D. **Water Quality**

The permittee shall ensure that project construction and operations for the work authorized by this permit are in compliance with the Regional Water Quality Control Board (Water Board) Water Quality Certification (Place ID: 880734; WDID#2 CW4474846) issued for the project on December 21, 2022, unless modified by the Water Board. The permittee shall submit any amendment or modification to the Water Quality Certification to the Commission. The permittee shall also comply with the following:

1. Dewatering Plan
The permittee shall submit a dewatering plan to the Commission for review and approval no later than 30 days prior to the start of any construction activity that requires temporary dewatering of Bay waters. The dewatering plan shall include the area(s) to be dewatered, timing of dewatering, and method of dewatering to be

implemented. The dewatering plan shall include water quality monitoring and reporting sufficient to ensure all dewatering discharges and bypassed flows meet applicable water quality requirements. All temporary dewatering methods shall be designed to minimize impacts to the Bay and the immediate work area. All dewatering methods shall be installed such that natural flow is maintained upstream and downstream of the work area. Any temporary dams or diversions shall be installed such that the diversion does not cause sedimentation, siltation, or erosion upstream or downstream of the work area.

2. Best Management Practices
All construction operations shall be performed to prevent construction materials from falling into the Bay. In the event that such material escapes or is placed in an area subject to tidal action of the Bay, the permittee shall immediately retrieve and remove such material at their expense. The permittee shall also employ best management practices, such as compaction, soil fences, burlap or jute wrapped straw wattles, etc. to assure that material placed to create the ecotone levee and habitat features will not erode into the Bay shortly after placement, and will remain in place long enough to allow for revegetation to occur. Areas cleared of vegetation or other substrates shall be stabilized as quickly as possible to prevent erosion and runoff.

3. Spill Prevention
The permittee shall notify the Commission and the Water Board of any petroleum hydrocarbon, or other chemical contamination spills that occur during the project activities and consult with staff on the appropriate response actions to implement to remedy the situation. The permittee shall ensure that fueling, cleaning, and maintenance of vehicles or equipment during construction do not take place in areas where contaminants may discharge into aquatic habitats. Construction materials and heavy equipment shall be stored outside of the Bay waters.

E. Imported and Onsite Fill and Quality Assurance Project Plan (QAPP)

For any imported soil/sediment or reused onsite soils, the permittee shall implement the testing requirements and handling techniques as specified in the draft *Quality Assurance Project Plan for the West Bay Sanitary District Flow Equalization and Resource Recovery Facility Flood Protection Project, Menlo Park, San Mateo County* (QAPP) prepared by SWCA Environmental Consultants and dated August of 2022, or the most current revised/approved version. The permittee shall submit a final QAPP to the Commission for review and approval no later than 60 days before construction is anticipated to begin and pursuant to the plan review condition contained herein.

1. Testing, Reporting, and Approval
   The permittee shall characterize the quality of all fill soils for the project (ecotone levees, habitat creation areas, etc.) that will have the potential to come in contact or discharge into the Bay. The permittee shall prepare a technical report with testing results and submit the report to the Commission at least 30 days prior to the proposed date for placing the material for review and approval. The permittee shall obtain written approval by or on behalf of the Commission for the use of the soil prior to placing it. The technical report shall demonstrate that the chemical concentrations for the soils comply with the protocols contained in the QAPP. The permittee shall not import or reuse any soils that contain contaminants with concentrations that do not meet the acceptance screening level criteria in the QAPP, unless otherwise approved pursuant to Special Condition II.E.3 below. Any soils that will be transported offsite for upland, non-hazardous or hazardous landfill disposal shall be taken outside the Commission's jurisdiction.

2. Wetland Foundation Quality Soils
   If the permittee proposes to bring wetland foundation quality soils on site for ecotone construction, the permittee shall provide the test results and project plans describing how the foundation quality soils will be isolated as described in the QAPP and covered with three feet of wetland cover quality soil, and the Commission staff will review the documents within 30 days of submittal.

3. Requests for Exceptions to QAPP
   If the permittee requests exceptions to the acceptance criteria outlined in the QAPP, it shall provide the request to Commission staff for review and approval simultaneously with the request to the Water Board for review and approval.

4. Weed Free Soils
   No soil from weed-infested areas shall be utilized as topsoil cover for newly filled areas. Any soil from weed-infested areas shall be disposed offsite at an appropriate location, or buried under at least 2.5 feet of weed-free soil if used for any of the project elements, including the ecotone levee, road fill, restored habitat, etc.

5. Quarterly Reporting
   The permittee shall submit quarterly progress reports to the Commission that provide information on the borrow sites, quantities of wetland cover and foundation fill, fill movement and placement activities, remaining borrow quantity, and supporting documentation, including maps, field notes, truck logs, test results, and fill approvals.

F. **Debris Removal**

All construction debris and any uncovered debris, such as concrete, asphalt, wood, plastics, etc., shall be removed from the project site for proper disposal outside of the Commission's jurisdiction. Excavated debris may be temporarily stored within the Commission's jurisdiction, provided measures are employed to assure that material does not wash or erode into the surrounding marsh or waterways. In the event that any such material is placed in any area within the Commission's jurisdiction for an extended period (i.e., more than 60 days), the permittee, its assigns, or successors in interest, or the owner of the improvements, shall remove such material, at their expense, within ten days after they have been notified by the Executive Director of such placement.

G. **Habitat Plantings**

The permittee shall prepare a final planting plan and submit this to the Commission for review and approval through plan review at least 60 days ahead of any construction. Following construction, the permittee shall inspect the stability of the ecotone slope and prepare the area for plantings. The ecotone slope and newly created tidal marsh habitat area, including the mitigation area, shall be planted with salvaged marsh vegetation collected and peeled back during the construction activities and shall also utilize other native plantings.

H. **Mitigation, Monitoring, and Reporting**

The permittee shall conduct post-construction monitoring for a minimum ten-year period, as generally described in the draft *West Bay Sanitary District Flow Equalization and Resource Recovery Facility Levee Improvement Project – Adaptive Management and Monitoring Plan* (AMMP) dated August 2022 and prepared by SWCA Environmental Consultants, as required below, and as modified and approved in the final AMMP. The permittee shall submit the final AMMP that contains quantitative and qualitive success criteria related to plant cover and species composition; marsh morphology, including sedimentation, channel formation and sinuosity; invasive species control; and erosion monitoring to the Commission for review and approval within 60 days of the issuance of this permit. The permittee shall monitor the areas of temporary impacts, permanent impacts, and mitigation according to the final approved AMMP and the requirements below.

1. Mitigation Areas and Habitat Creation

   The permit shall construct 0.65 acres of new tidal marsh habitat to compensate for the conversion of approximately 0.05 acres of tidal slough to tidal marsh and 0.06 acres of tidal marsh habitat to uplands during the construction of the ecotone levee slope. The newly created tidal marsh habitat shall meet the success criteria required in the final approved AMMP. If the performance and success criteria are not met during the monitoring period, then the permittee shall notify the agencies through annual reporting and recommend any corrective adaptive management actions, as necessary, for review and approval by the Commission. If at the end of the monitoring period, the success criteria are not met or there remain any unmitigated impacts, then additional compensatory mitigation shall be required and/or the monitoring period may be extended.

2. Identification of a Suitable Reference Site
The permittee shall identify nearby reference sites that shall be evaluated as part of the monitoring program and shall provide the reference sites in the final AMMP.

3. Success Criteria
   a. Tidal Wetlands
   The permittee shall ensure that total percent cover of vegetation (as measured by absolute cover) in temporary impact areas and the mitigation area meets the performance and success criteria in the final approved AMMP. If the monitoring results indicate that the percent vegetation cover (absolute cover) is lower than the performance and success criteria, the permittee shall consult with the Commission, as appropriate, and other agencies to determine if adaptive management actions are necessary. The permittee shall take corrective or adaptive management actions as specified by or on behalf of the Commission.

   b. Water Quality
   The permittee shall monitor the water quality, including salinity, temperature, pH, dissolved oxygen, and turbidity post-construction to ensure that water quality conditions are suitable for aquatic species post-project.

   c. Adjacent Tidal Slough and Wetlands
   The permittee shall monitor the adjacent portions of Greco Island South, Westpoint Slough and Flood Slough, and the tidal marsh adjacent to the project site for any significant changes in the elevation, flow patterns, or geomorphology of the habitats that may be the result of the newly created ecotone levee through visual assessment (e.g., photo documentation and observations). Any significant impacts may require adaptive management actions be taken after consultation with regulatory agencies. The permittee shall take corrective or adaptive management actions as specified by or on behalf of the Commission.

   d. Invasive Species
   The permittee shall monitor for invasive plant species such as pepperweed (*Lepidium latifolium*), stinkwort (*Dittrichia graveolens*), and other high priority weeds according to the AMMP to ensure that these species make up less than five (5) percent total cover in the marsh located within the work limit of the site during the ten-year monitoring period. All invasive plant removal occurring in or

near tidal marsh areas shall be conducted using hand, low impact mechanical equipment, and/or herbicide application methods approved by the resource agencies.

e. Oyster Reefs
The project shall create approximately 0.18 acres of low-relief, native oyster reef habitat along 836 linear feet of shoreline near the northern point of the project site. If the approved success criteria are not met by the end of the monitoring period, the permittee shall be required to remove the oyster reef elements if they are causing detrimental impacts to the environment.

f. Geomorphology
The permittee shall monitor the geomorphology and development of the ecotone slope, created tidal marsh habitat, and tidal channels to ensure that elevations, sediment deposition, and channel formation are on track to meet the success criteria and that there is no significant erosion or wave energy increase leading to shoreline recession. Additionally, if foundation quality sediment is used in the core of the ecotone levee, then the permittee shall monitor the levee for any potential areas of erosion or cracking that may expose any foundation quality material and shall ensure that the foundation sediment remains covered by at least three feet of cover quality fill. If the success criteria in the final AMMP are not met, then adaptive management actions shall be required after consultation with regulatory agencies. The permittee shall take corrective or adaptive management actions as specified by or on behalf of the Commission.

g. Marsh Transgression
The monitoring program shall include a simple process (such as the use of physical markers) for monitoring marsh transgression along the transition habitat ramp over a 15-year monitoring period with monitoring events occurring at years 5, 10, and 15. Such provisions shall include an assessment of the limits of tidal marsh vegetation along the habitat ramp and how wetland species have migrated up the ramp. Results of the assessment shall be submitted graphically (e.g., aerial photography, cross section plan, etc.) with a brief narrative of the transgression of the marsh over time. This assessment may be combined into the annual report, or as a separate report, such as the 15-year report.

4. Annual Monitoring Report
The permittee shall submit annual monitoring reports, starting the year following construction completion and for the following ten-year period. The permittee shall submit each annual monitoring report by January 31st following the monitoring year after project completion to the Commission for review and approval. The annual monitoring report shall include, at a minimum: (1) results of the monitoring results

for that year, as required above and as described in the final AMMP, (2) a comparison of the data to monitoring results from previous years, (3) a description of the progress towards meeting final performance criteria for the project, (4) a description of any maintenance related to the project, and (5) any adaptive management or corrective actions necessary. The final annual monitoring report shall discuss the overall site function and conditions and determine if any additional corrective actions are necessary. Should adverse conditions be identified during the ten-year monitoring period, the permittee shall take corrective or adaptive management actions as specified by or on behalf of the Commission.

5. Adaptive Management
   The permittee shall consult with the Commission and other regulatory agencies, as appropriate, on adaptive management actions that may be necessary based upon monitoring results and shall submit information on the adaptive management activities to the Commission for review and approval at least 60 days prior to conducting the adaptive management activities. If any adverse impacts to the Bay are identified during the monitoring period, then compensatory mitigation shall be required by the Commission, including, but not limited to, extension of the monitoring period or other adaptive management actions.

6. Regional Project Database (EcoAtlas Project Tracker)
   Within 90 days of permit issuance the permittee shall enter project details into the regional project database (EcoAtlas Project Tracker, https://ptrack.ecoatlas.org/) for tracking such efforts. After the project has been constructed, the permittee shall update project details in the regional project database to reflect as-built conditions and statuses. The permittee shall also periodically upload all relevant project monitoring reports to the regional project database according to the schedule required under Special Conditions II.H.4, in addition to submitting documents directly to Commission staff. For guidance on data entry requirements and instructions for uploading documents to the regional project database, please visit BCDC's website or contact Commission staff.

I. **Removal of Temporary Fill**

The permittee shall removal all temporary fill, such as cofferdams and other equipment used during construction, within 60 days of completion of the construction and plantings of the ecotone levee, or within the next environmental work window, if required by the resource agencies. The area shall be restored to tidal action, following completion of the ecotone construction and plantings.

J. **In-kind Maintenance and Repairs**
Any in-kind repair and maintenance work authorized herein shall not result in an enlargement of the authorized structural footprint and shall only involve construction materials approved for use in San Francisco Bay. Work shall occur during periods designated to avoid impacts to fish and wildlife. The permittees shall contact Commission staff to confirm current restricted periods for construction.

K. **Helipad Use**
Unless approved by or on behalf of the Commission, the permittee shall ensure that there are no changes in the frequency of use of the helipad on the northmost point of the project site as a result of this project and shall ensure that use of the helipad is limited to the U.S. Coast Guard for the purposes of emergencies and by the Invasive Spartina Project for the purposes of conducting surveys, invasive species eradication, or other such purposes. No other users shall be allowed, and the frequency shall remain the same as the pre-project condition.

L. **Hold Harmless and Indemnify**
The permittee shall hold harmless and indemnify the Commission, all Commission members, Commission employees, and agents of the Commission from any and all claims, demands, losses, lawsuits, and judgments accruing or resulting to any person, firm, corporation, governmental entity, or other entity who alleges injuries or damages caused by work performed in accordance with the terms and conditions of this permit. This condition shall also apply to any damage caused by flooding of or damage to property that is alleged to be caused as a result of some action or lack of action by the Commission growing out of the processing of and issuance of this permit.

M. **Commission Jurisdiction Over Fill Area**
Notice is hereby given that, under the McAteer-Petris Act, the area of the approved project that is within the Commission's jurisdiction under Section 66610(a) remains within that jurisdiction even after fill or substantial change in use, authorized by the Commission, may have changed the character of the area; so that the permittee(s) or the permittee's successors in interest will require further action by or on behalf of the Commission prior to any future change of use or work within areas filled pursuant to this authorization.

N. **Sea Level Rise Adaptation**

1. Flood Reporting
If any portion of the project, including the required public improvements as defined in Special Condition II.B, is subject to coastal flooding that results in its closure in whole or in part, the permittee shall submit to the Commission a written report within 30 days after the flooding with documentation of the date and duration of

the closure, the location of the affected site, the recorded water levels during the closure period, the source of flooding (e.g., coastal flooding, stormwater backup, or overland flow), the resulting damage or cleanup, and illustrative photographs with site details. Coastal flooding is defined as Bay overtopping of the shoreline during tides, storms, or both.

2. Risk Assessment and Adaptive Management Plan
   Within the second year of construction, or by January 31, 2025, whichever is earlier, the permittee shall prepare a formal risk assessment and adaptive management plan (RAAMP) prepared by a qualified engineer to understand the flooding risk to the life of the project to 2070 and any potential adaptation pathways that may be necessary beyond that timeframe out to 2100. The plan shall be reviewed and approved by or on behalf of the Commission, pursuant to Special Condition II.A.2.

3. Risk Assessment and Adaptative Management Plan 5-year Assessment and Monitoring Report
   Every 5 years following the approval of the formal RAAMP and for the life of the project, the permittee shall prepare an assessment to determine if an update to the RAAMP for the project approved by or on behalf of the Commission, or any subsequent update, is necessary given the status of the following (compared to the approved RAAMP): (i) The best available science, including: up-to-date sea level rise projections; tidal datum and extreme tides datum; available modeling of tidal dynamics and Bay hydrological process; tide gauge data over the subject five-year period; (ii) The most up-to-date sea level rise guidance from state and federal agencies, including, but not limited to, the Commission, the State of California, the U.S. Army Corps of Engineers and Federal Emergency Management Agency (FEMA); (iii) Documentation of any occurrences of flooding at the public access areas, as required in Special Condition II.N.1; (iv) The current FEMA flood maps and accreditation; (v) Land settlement of the levee system at the project site or required public access improvements; and (vi) Regional planning efforts.

   By January 31, 2030, and by January 31 of every fifth year thereafter, the permittee shall submit for review by or on behalf of the Commission, pursuant to Special Condition II.A.2, the assessment, including a determination of whether an update to the RAAMP is necessary at that time. The assessment shall include a monitoring report that summarizes all of the flood events reported pursuant to Special Condition II.N.1 since the last update to the RAAMP. If the assessment, following review and approval by or on behalf of the Commission, makes a determination that an update is necessary, the permittee shall prepare an update to the RAAMP pursuant to Special Condition II.N.3.

The permittee may submit update assessments to the Commission sooner than required. The permittee may also request time extensions to the deadlines for providing assessment documentation, to be reviewed and approved by or on behalf of the Commission pursuant to the procedures in Special Condition II.A.2.

4. Risk Assessment and Adaptive Management Plan Updates
If an update to the RAAMP for the project is determined necessary by the permittee or by or on behalf of the Commission pursuant to Special Condition II.N.2, within six months of determination, the permittee shall prepare and submit an update to the RAAMP for review and approval by or on behalf of the Commission pursuant to the procedures in Special Condition II.A.2.

Each update to the RAAMP shall include a determination of whether adaptation is expected to be necessary within the following five years from the time of the completion of the RAAMP update, for the shoreline protection or public access required by the project in Special Condition II.B to remain resilient to flooding during a 100-year storm event, including wave runup, that takes into account the best estimates of sea level rise. If the updated RAAMP, following review and approval by or on behalf of the Commission, makes a determination that adaptive measures are necessary within the next five years, the permittee shall prepare and implement an adaptation work plan pursuant to Special Condition II.N.5.

The permittee may update the RAAMP for the project sooner than required. The permittee may also request time extensions to the deadlines for providing their assessment documentation, to be reviewed and approved by or on behalf of the Commission pursuant to the procedures in Special Condition II.A.2.

5. Sea Level Rise Adaptation Planning and Implementation

a. **Work Plan.** Within six months of approval by or on behalf of the Commission of the updated RAAMP for the project, if the determination is made by the updated RAAMP that adaptation is expected to be necessary within the following five years for the shoreline protection or public access required by the project in Special Condition II.B to remain resilient to flooding during a 100-year storm event, including wave runup, pursuant to Special Condition II.N.3 or to maintain the health of the Bay and prevent a spill, the permittee shall prepare and submit a work plan. The work plan shall describe the planning process to identify proposed adaptation measures to address the risk of flooding from sea level rise and storms, and to protect the Bay and required public access improvements and provide a timeline for permitting and implementation of those measures. Any adaptation measures proposed pursuant to the planning process required in this condition shall not result in a reduction of the size or usability of the public access required herein or, if reduction of the size or usability of the public access is unavoidable, equivalent access must be provided nearby. The permittees shall obtain additional Commission review and approval of any such changes to the public access required herein.

b. **Review and Approval.** The submitted work plan shall be reviewed by or on behalf of the Commission pursuant to the procedures in Special Condition II.A.2. Review of adaptation timelines proposed in the work plan should take into account any records of flooding at the project site, as reported according to Special Condition II.N.1.

c. **Implementation.** Following approval of the adaptation work plan by or on behalf of the Commission, the permittee shall implement that work consistent with timeline proposed in the work plan. Depending upon the scope of the work and locations, it may require approval by or on behalf of the Commission through plan review or an amendment to this permit.

d. **Time Extensions.** The permittee may request time extensions to the deadlines for providing their work plan documentation or implementing adaptation measures, to be reviewed and approved by or on behalf of the Commission, pursuant to the procedures in Special Condition II.A.2.

Review by or on behalf of the Commission of the submittals required in parts II.N.2, II.N.3, and II.N.4, of this special condition shall consider, among other things, the best available science, most recent state and federal guidance, and BCDC policies then in-effect. The Commission may: (i) accept the submittals and recommend no changes to the permittees' approach; (ii) recommend revisions to submittals on the basis that they are incomplete; or (iii) require revisions based on findings and information that they are necessary to protect the Bay and public access of the size and usability required by this permit.

O. **Property Interest**

The permittee shall provide all relevant property interest documents (deeds, leases, easements, etc.) for all parcels within the Commission's jurisdiction prior to conducting any construction within the Commission's jurisdiction. No installation of the oyster reef framework shall occur until such time as this habitat element has been approved by the State Lands Commission as part of lease agreement, and that agreement has been submitted to the Commission.

III. Findings

This authorization is given on the basis of the Commission's findings and declarations that the work authorized herein is consistent with the McAteer-Petris Act, the San Francisco Bay Plan (Bay Plan), the California Environmental Quality Act (CEQA), and the Commission's amended coastal zone management program for San Francisco Bay for the following reasons:

A. Existing Conditions and Use

The project is located in the southwest portion of the San Francisco Bay in Menlo Park, San Mateo County along the shoreline and adjacent to Bedwell Bayfront Park. The site is approximately 30-acres in size, with approximately 5.66 acres of the site in the Commission's Bay jurisdiction and approximately 6.09 acres within the 100-foot shoreline band, and contains the Flow Equalization and Resource Recovery Facility (FERRF) owned and operated by the West Bay Sanitary District (WBSD).

The upland portions of site currently support three open air overflow basins (Basins 1, 2, and 3), a maintenance yard and small operation office for WBSD, the remnants of a decommissioned wastewater treatment plant, a small native plant nursery operated by a nonprofit, and a return pump that is used to return any overflow raw wastewater back into the conveyance system and to the Silicon Valley Clean Water Wastewater Treatment Plant in Redwood City (Redwood City Treatment Plant) for treatment when it is safe to do so. The FERRF is a critical overflow storage facility for 55,000 residents within the service area and holds up to 23.5 million gallons of raw wastewater. The FERRF is currently protected from the Bay by earthen berms around the perimeter of the facility. Basins 1 and 2 are typically used for the flow equalization for the raw wastewater conveyance system and Basin 3 is used for emergency storage of wastewater in the event Basins 1 and 2 are being repaired or are otherwise not available. After the entire wastewater conveyance system normalizes, the wastewater stored at the FERRF is then pumped back into the conveyance system through the Menlo Park Pump Station and then to the Redwood City Treatment Plant for treatment and eventual discharge into the Bay.

The FERRF is currently located in the 100-year flood zone and the existing earthen levees around the perimeter of the facility do not meet current Federal Emergency Management Agency (FEMA) standards. The FERFF is currently at high risk of flooding during a 50-year storm event and has the potential to release raw wastewater into the Bay if the berms failed or the basins became inundated. This flood and inundation risk will increase and be exacerbated with sea level rise. Shoreline protection improvements are required if the site is to meet FEMA standards for flood protection of this critical infrastructure and to protect San Francisco Bay from a potential release of raw wastewater that could impact sensitive habitats, threaten wildlife, and impact public health. In addition, maintaining the protection and capacity of the FERRF is important for preventing wastewater from backing up into nearby communities, including East Palo Alto, which the Commission's Community Vulnerability Mapping Tool identifies as having residents with moderate to high social vulnerability.

Around the existing FERRF site, the shoreline and Bay support a number of other uses and habitats. To the north is Westpoint Slough, which is a tidal slough and bounded on the opposite bank by a large tidal marsh area called Greco Island. To the east and south of the project area is the Bedwell Bayfront Park, which is a 160-acre municipal park constructed on a closed landfill and that offers recreational opportunities for hiking, running, bicycling, walking and many other activities. To the west is Flood Slough, which is a tidal slough that also conveys floodwaters from Atherton and nearby areas and is bounded on the opposite bank by a series of salt ponds owned and operated by the Cargill, Incorporated.

The existing habitats within the project site and adjacent areas include tidal sloughs, mudflats, high-quality tidal salt marsh, and upland portions of the earthen levee that are dominated by ruderal vegetation. The project site provides habitat for many native species that rely on the Bay, mudflats, tidal marsh, and upland habitats, and may provide habitat for federally- and state-listed species. These species all use the site for a variety of needs including foraging, roosting, nesting, etc. For example, the mudflats and tidal marsh in this area provide foraging habitat for common shorebirds, herons, egrets, and many others, as well as foraging habitat for fish during periods when the mudflat is inundated. During extreme high tides, the tidal marsh habitat is completely inundated, and many of the non-aquatic species may seek refuge from the high-tide in the upland ruderal vegetation.

As stated previously, the site is currently used as a part of a wastewater conveyance and treatment system that appears to have started sometime prior to the establishment of BCDC. Historically, the project site appears to have been part of extensive tidal marsh habitat that was later closed off from the Bay with the construction of levees sometime prior to the 1940s. The historical maps from USGS in 1953 show the site labelled as "sewage disposal" and surrounded by levees. It appears there was a treatment plant located at the project site at some point, but that has since been decommissioned and the basins at the site are now used for the overflow storage capacity for raw wastewater when the conveyance system to the Redwood City Treatment Plant is at capacity or during needed maintenance. The existing earthen levees appear to have been built sometime in the 1950s and are not currently FEMA certified.

In the near future, the WBSD plans on developing a portion of the upland areas into a recycled water facility that can supply water to the residents and customers within the WBSD service area. However, that project is still in the planning process and not included in this project. The purpose of this project is to improve the current shoreline protection system around the northern and western sides of the FERRF to ensure that the site is not flooded while it continues to be used as part of the wastewater conveyance system storage basins and later for potential development of a recycled water facility on the site.

The project site itself is not located within a Bay Plan designated Priority Use Area, but the adjacent Bedwell Bayfront Park is designated as a Waterfront Park, Beach Priority Use Area, and also Greco Island is designated as a Wildlife Priority Use Area and part of the Don Edwards National Wildlife Refuge.

B. Benefits, Purposes, and Manner of Filling (Bay Fill)

Applicable Policies

Section 66605 of the McAteer-Petris Act provides that further filling of the Bay may be authorized if a project meets the following criteria: a) the public benefits of the fill should clearly exceed the public detriment from the loss of water area and the fill should be limited to water-oriented uses (such as water-oriented recreation, wildlife refuges, or public assembly…) or “minor fill for improving shoreline appearance or public access”; (b) fill in the Bay should be approved only when “no alternative upland location” is available; (c) fill should be “the minimum amount necessary to achieve the purpose of the fill”; (d) “the nature, location, and extent of any fill should be such that it will minimize harmful effects to the Bay area, such as, the reduction or impairment of the volume, surface area or circulation of water, water quality, fertility of marshes or fish or wildlife resources, or other conditions impacting the environment…”; (e) “[t]hat public health, safety, and welfare require that fill be constructed in accordance with sound safety standards which will afford reasonable protection to persons and property against the hazards of unstable geologic or soil conditions or of flood or storm waters…”; (f) “fill should be authorized when the filling would, to the maximum extent feasible, establish a permanent shoreline”; and (g) “fill should be authorized when the applicant has such valid title to the properties in question that he or she may fill them in the manner and for the uses to be approved.”

1. Authorized Fill

   A majority of the project is located within the Commission’s Bay and 100-foot shoreline band jurisdictions. The project includes the construction of approximately 3,700 linear feet of improved shoreline protection and habitat enhancements around the FERRF to remove the areas from the FEMA 100-year flood zone and address future sea level rise. The project involves the following: (1) installation of sheet pile walls along the northern and western perimeter levees of the FERRF, (2) using onsite soils/sediment to raise the grade along the northern perimeter levee, (3) raising the grade of the site access road (160 linear feet) and two sections of adjacent Bay Trail (150 linear feet and 200 linear feet) within Bedwell Bayfront Park, (4) constructing an ecotone levee bayward of an existing segment of the northern levee, (5) setting back a portion of the northern levee to make room for Bay waters and create tidal marsh habitat, and (6) installing a low-relief oyster reef framework over the mudflats at the northern point of the project site.

The project would result in the placement of new Bay fill (soils/sediment) for the construction of the ecotone levee and the installation of the oyster reef framework. During the construction of the ecotone levee, the project would remove existing tidal slough, tidal marsh habitat, and upland habitat and excavate approximately 1,340 cubic yards (cy) of sediment to prepare the area for ecotone construction. Then the area would be backfilled with approximately 3,249 cubic yards of onsite soil to create the 20:1 (horizontal to vertical) ecotone slope over approximately 1.12 acres (48,787 square feet; along 598 linear feet of shoreline) of existing Bay habitats. The ecotone would have a layer of the excavated Bay sediment placed on top and be replanted with marsh sod and other plantings following the construction. For the oyster reef framework, the structure would be made up of a modular units of coconut coir, Portland cement, and Baycrete and constructed more in the shape of a ladder sitting over the mudflat. The reef framework would be elevated off of the mudflats and be supported by the ends of each modular unit, which will be inserted to an appropriate depth into the mudflats. This reef design has a much smaller footprint than some of the other oyster reef balls or similar structures that the Commission has permitted around the Bay. In total it was estimated that the oyster reef framework would be cantilevered over an area of approximately 0.18 acres (7,946 square feet; along 836 linear feet) of mudflat with a volume of less than 280 cy of new Bay fill. The volume is a very conservative estimate of fill that the permittee calculated by assuming the entire structure is solid, but the actual fill will be much smaller given the shape and ladder-like design of the oyster reef framework units. Additionally, this project requires the installation of a temporary cofferdam that is approximately 1,491 feet long and covers the same area as the footprint of the ecotone levee.

The net fill for the project is calculated to be approximately 3,529 cy of new Bay fill (solid and cantilevered) over approximately 1.3 acres (56,628 square feet) of the Bay to create the ecotone and the oyster reef framework enhancements. This assumes that much of the excavated sediments from the tidal marsh will be reused within the Bay as part of the habitat enhancements. It should be noted that much of the ecotone levee fill is expected to revegetate quickly (within 2-3 years) and allow for the tidal marsh and upland habitats to come back. Following construction, the cofferdam will be completely removed, and the habitats will be monitored for recovery. Therefore, the cofferdam is not considered part of permanent Bay fill and not in the calculated net fill.

As part of the project, an approximately 739-linear-foot portion of the northeastern perimeter levee will be setback into the project site and allow for the creation of approximately 0.65 acres (28,314 square feet) of tidal marsh habitats and 0.56 acres (28,314 square feet) of transition zone in an area that is currently within the Commission's 100-foot shoreline band jurisdiction. The levee would be excavated and moved back into the site and the grade will be lowered to about one foot below anticipated tidal marsh habitat. Then the area will be backfilled with excavated sediment and be planted with marsh sod and plantings to ensure the area vegetates. On the backside of the marsh, the new levee segment will be constructed also with ecotone transition build at a 20:1 slope. All this excavation and fill work will occur within the 100-foot shoreline band until the construction is complete and the temporary cofferdam is removed to open the area up to the Bay. Therefore, none of the excavation of soil/sediment placement for the created tidal marsh was calculated into the total Bay fill. However, it should be noted that this new area will be opened to the Bay as a result of the project. Creating this new marsh habitat does not change the total Bay fill for the project, but this does offset some of the area of tidal marsh that was filled.

Additionally, the project involves extensive work in the 100-foot shoreline band to raise the levees around the site. This work specifically includes installation of sheet pile walls all within the existing levees on the northern and western perimeter of the site, using onsite soils. For this activity, approximately 11,700 cy will be used to raise the levee crowns to approximately +15 feet NAVD88, and additional fill may also be used to raise existing roads and segments of trail to the same elevation and perform other work within the approximately 3,700-linear foot section of shoreline.

2. Public Benefits versus Detriments and Water-Oriented Use

The project involves the placement of approximately 3,529 cubic yards of new Bay fill over 1.3 acres (56,628square feet) of the Bay. The current wastewater overflow facility with the detention basins is required as part of the WBSD system that is needed to respond high-capacity periods and store some of the raw wastewater until such time as capacity at the treatment facility is restored. The construction of improved shoreline protection around the facility is necessary for flood control purposes and to protect public health, human safety, and the environment by preventing raw sewage release into San Francisco Bay. Construction of an ecotone levee along a portion of the facility aims to meet regional and state goals for resilience to sea level rise and using infrastructure that can also help preserve habitat functions that may otherwise be threatened or lost by sea level rise in the future. Additionally, habitat enhancements like the oyster reef framework are also aimed at testing and supporting regional goals for developing native Olympia oyster habitat.

While the fill placed for the ecotone levee slope will impact 1.12 acres of existing habitats, including 0.06 acres of tidal slough/mudflat, 0.91 acres of impacts to tidal marsh habitat, and 0.15 acres of upland/developed habitat, much of the area and habitats are expected to revegetate in the near-term (next 2-3 years) and re-establish the habitat benefits that were lost with the fill placement. However approximately 0.11 acres of the impacted habitats are considered permanent impacts due to the fact that they will not re-establish in the near-term and are being converted to another habitat type. This includes 0.06 acres of existing tidal slough that will be filled and turned into salt marsh habitat and 0.05 acres of existing salt marsh that will be filled and turned into uplands in the near-term. Modeling performed by the permittee indicates that as sea levels rise, most of the existing marsh habitat at the site will be inundated and much of the habitat would be lost in the next 30 years, if the marsh is not able to accrete sediment at a rate that allows it to keep pace with sea level rise and unless other management actions are taken. As sea level rises, it is expected that these areas of habitat conversion will convert back to the current habitats and then continue to evolve into new habitats with greater amounts of sea level rises. The project will also be offsetting/mitigating the near-term habitat conversion by creating 0.65 acres (28,314 square feet) of new tidal marsh in the setback levee area of the north perimeter levee.

Previously, the Commission has authorized the excavation/dredging of sediment from within a 284-acre tidal marsh area near the mouth of Sonoma Creek (BCDC Consistency Determination No. C2014.004.00) to improve the tidal flow to an area that had poor tidal circulation and to reuse the sediment on the back side of the tidal marsh to create transition zone habitat. This was one of the very first projects approved to construct an ecotone levee slope out onto existing tidal marsh habitat., which impacts current habitat but can provide long-term resilience. Originally the project included an ecotone levee covering 25 areas of existing marsh habitat, but after discussions with Commission Staff the ecotone slope was reduced down to 10 acres with a three percent slope (about 30:1 ratio) to minimize impacts and keep the ecotone footprint within an area where there was less functional tidal marsh habitat. The Commission approved the 10-acre ecotone levee slope as the minimum amount of fill necessary to create transitional habitat based upon findings that the size/scale was necessary to provide value to marsh-dependent wildlife and improve drainage and habitat conditions. Prior to that approval, ecotone slopes had only been approved by the Commission for construction behind levees in diked Baylands and salt ponds and in areas that were to eventually be opened up to the Bay. The Commission recognized in the Sonoma Creek project, and others, that ecotone levees provide opportunities for marsh migration as sea level rises and the public benefits of the fill for that project outweighed the detriments of placing the fill.

The current project would similarly build an ecotone levee onto existing marsh habitat, but there are a number of differences that need to be considered. The impact area for this project is much smaller (1.12 acres) than the impact area for Sonoma Creek project, but the entire marsh is much smaller (about four acres in size), and unlike Sonoma Creek, which was done specifically to improve a poorly functioning marsh habitat, the purpose of this project is specifically for shoreline protection that will provide habitat. The existing marsh habitat north of the FERRF is healthy marsh, which will be impacted in the near-term by the construction of the ecotone slope. Although the proportional impacts of the fill are taking up a significant portion of the existing outboard marsh for this project, some of the near-term impacts are being offset by creating new marsh habitat and the fact that much of the ecotone slope and new marsh area are anticipated to vegetate quickly and establish functional habitat for marsh-dependent species within the next 2-3 years. Additionally, Greco Island to the north of Westpoint Slough is a large tidal marsh area that will provide some habitat for species while the ecotone and new marsh area are getting established. The rate of sedimentation on the marshes north of the project site as sea levels rise is also unknown, but without additional natural sedimentation or management actions to help raise the elevations, the tidal marshes in this area may be lost and converted to other habitats in the next 30 years according to modeling done by the permittee. Given all of these considerations, the public benefits of the fill for the ecotone levee and the added capacity for sea level rise resilience, as well as the oyster reef elements, outweigh the detriments of placing the fill.

Regarding water-oriented uses, the Commission has in the past (BCDC No. 1980.024.09 for the Sausalito-Marin City Sanitary District) determined that neither the Bay Plan nor the McAteer-Petris Act include sewage treatment plants as water-oriented uses for which Bay fill can be placed. The McAteer-Petris Act section 66605(a) specifically identifies some water-oriented uses, including “ports, water-related industry, airports, bridges, wildlife refuges, water-oriented recreation, and public assembly, water intake and discharge lines for desalinization plants and power generating plants requiring large amounts of water for cooling purposes.” However, some fill for the treatment plant in Marin County was still approved because it was necessary for the health, safety, and welfare of the entire Bay Area because the facility was an important component of the regional wastewater program for the entire Bay Area and there was no reasonable alternative upland location to the fill. While the upland use within the FERRF project site is a pre-existing use for the wastewater treatment system, the main purpose of the Bay fill associated with this project is not to change the pre-existing use or expand capacity, but is to provide shoreline protection from flooding for the upland uses and to also provide habitat benefits. The permanent fill placed in the Bay would be fill for shoreline protection to ensure that the health of the Bay and the public is maintained now and as sea levels rise, and the temporary fill in the Bay would be associated with environmental protection measures. The fill for the shoreline protection is determined to be for a water-oriented use.

3. Alternative Upland Location

McAteer-Petris Act Section 66605(b) requires that fill in the Bay should only be authorized when there is no alternative upland location for such purpose. The project involves the placement of approximately 3,529 cubic yards of Bay fill over approximately 1.3 acres to create shoreline protection and habitats on the northern portion of the existing FERRF site. As mentioned before, the use at the site is pre-existing and is a critical overflow storage area for the WBSD wastewater conveyance and treatment system. The current earthen berms around the facility are insufficient to provide flood protection to the facility and are subject to overtopping at a current 50-year flood. Improved shoreline protection is required to remove the site from the current FEMA 100-year flood zone and also to address future sea level rise that may impact the area over the life of the project (50 years).

For shoreline protection projects, the Bay Plan Shoreline Protection policies say that new shoreline protection projects should be the appropriate type of protective structure for the site conditions and that all shoreline protection projects should evaluate the use of natural and nature-based features, such as levees with ecotone habitat, oyster reef elements and other habitat features and incorporate them to the greatest extent practicable. The policies further go on to say that the "[e]cosystem benefits, including habitat and water quality improvement, should be considered in determining the amount of fill necessary for the project purpose. Suitability and sustainability of proposed shoreline protection and restoration strategies at the project site should be determined using the best available science on shoreline adaptation and restoration." The requirement to consider nature-based options as part of the shoreline protection for a site was incorporated into the Bay Plan as part of the Fill for Habitat Bay Plan Amendment that was completed in October 2019. Pursuant to the updated Shoreline Protection policies, the Commission Staff ask project proponents if they have considered nature-based options and whether they are appropriate and feasible for a given project site.

Given the need to raise and improve the existing levees for flood protection and sea level rise, the WBSD originally developed a shoreline protection project that included the use of sheet pile walls that originally did not include any nature-based or habitat features. During an interagency meeting on the project, it was suggested that the project team evaluate whether nature-based methods were feasible. The WBSD evaluated the feasibility of these options and determined that they could include habitat elements into their shoreline protection project. The WBSD prepared an alternatives analysis to evaluate the spectrum of green to gray options that may be feasible at the site and the potential impacts and benefits of each option.

The WBSD evaluated a variety of different shoreline protection alternatives that included a no project alternative; offsite alternative; sheetpile walls only; and sheetpile walls plus construction of a shallow sloping ecotone levee on the northern portion of the site with additional habitat enhancements on the northern point; and some other alternatives. Through this alternatives analysis, it was shown that the no project alternative did not achieve the project purpose. Additionally, finding an offsite location was not feasible because the WBSD does not own other properties that can accommodate the facilities and this would require additional land acquisition and construction of all new infrastructures to meet this need. Further analysis was done on the other project alternatives.

The WBSD determined that both the “sheetpile only alternative” and an ecotone levee (one section at 20:1 and one at 40:1) plus oyster reef framework were feasible alternatives. The sheetpile only alternative would have much fewer habitat impacts but does not provide any habitat benefits for the adjacent marsh, which is expected to be lost in 30 years if the rate of sedimentation does not keep pace with sea level rise. The ecotone levee plus oyster reef framework alternative was also feasible, but had more near-term impacts to the environment from the ecotone construction, but would allow the marsh habitat to persist and keep pace with future sea level rise through the 50-year life of the project. The WBSD selected the ecotone levee and oyster reef framework as the preferred alternative that went into further design.

This first iteration of the ecotone slope design was submitted to the reviewing agencies, and it appeared to impact almost the entirety of the marsh outboard along Westpoint Slough. All of the regulatory agencies expressed some concern with this design because the near-term impacts would affect nearly the entire marsh area (about four acres), which would eventually vegetate, but this appeared to be too large of an impact area and loss of habitat in the near-term, even given the potential long-term sea level rise benefits of the project. Additionally, some agencies like the U.S. Army Corps of Engineers are not currently authorized to consider sea level rise and the long-term benefits of a project over the near-term impacts. All the agencies requested that WBSD further investigate whether it was possible to setback the ecotone levee into the project site to further reduce impacts to the existing healthy marsh habitat, especially because the staff noticed some portions of the upland areas of the site appeared to be vacant or under-utilized currently. The agencies also asked about the feasibility of relocating or reconfiguring the overflow basins, and deepening the basins or raising the levees around them to maintain capacity while also allowing for the shoreline protection to be set back on the site.

WBSD reconsidered the project design and looked at setting the ecotone back entirely, however WBSD needs to maintain enough capacity and redundancy in their overflow basins to ensure they can meet the demands of the wastewater conveyance and treatment system. They are required to maintain capacity for up to 23.5 MG of raw wastewater storage and setting the entire levee back into Basins 2 and 3 would not allow WBSD to comply with their current agreements with the treatment facility and accommodate as much raw wastewater during flow equalization, as well as there being engineering technology constraints. In addition, WBSD currently also uses the FERRF site as extra office space and an auxiliary corporation yard for equipment and material storage, training exercises, pump repair workshop, Capital Improvement Project staging area, and salt marsh plant propagation area with a nonprofit, and has very preliminary future plans for developing a recycled water facility on the project site.

However during their analysis, WBSD determined that it was feasible to setback the northeastern portion (739 linear feet) of the ecotone levee into Basin 3 approximately 13 to 37 feet and reduce the slope of the ecotone levee to 20:1 over most of the levee, but it was not feasible to setback the entire levee and still maintain the capacity needed for the basins nor to reconfigure or deepen/raise the berms around the ponds themselves because of engineering and technology constraints. This setback levee area would allow for the creation of about 0.65 acres of new tidal marsh habitat and 0.56 acres of transition zone habitat. All of these adjustments were made to further minimize impacts to existing habitat and the slough channels at the site, while also trying to maximize the long-term habitat and flood protection benefits. The project design will result in the loss of approximately 0.64 MG of functional capacity for wastewater storage in Basin 3, but is the preferred alternative design because it accomplishes a number of goals, including meeting the capacity obligations for the FERRF, minimizing near-term impacts to existing marsh habitat, providing an opportunity for on-site mitigation to offset the permanent habitat conversion during ecotone construction, and providing sea level rise resilience to the tidal marsh habitat in the area. There is no upland alternative location for the shoreline protection to be located in a manner that is feasible for WBSD and would further minimize near-term impacts while also maximizing long-term habitat benefits.

4. Minimum Amount Necessary
   The McAteer-Petris Act 66605(c) states, in part, that fill should be "the minimum amount necessary to achieve the purpose of the fill…" The project will provide shoreline protection that also offers habitat benefits. The current shoreline protection is not at a sufficient height to provide flood protection against a 100-year flood at the project site, and it not designed to accommodate future sea level rise. The project would raise the entire perimeter levee from the current elevation of +10 to +12 feet NAVD88 to a final elevation of +15 feet NAVD88 to address the flooding issue. Due to the site constraints explained in the section above, the site is limited in the uplands and setting back the shoreline protection entirely into the site is not feasible from a technology and engineering perspective.

   While the permittee could simply accomplish the flood protection goal without creating habitat features and using traditional flood protection measures, the permittee determined that it is feasible to include nature-based shoreline protection in the form of an ecotone levee and to also provide some additional habitat for Olympia oysters as part of the project. The total amount of Bay fill will be approximately 3,529 cubic yards of Bay fill over approximately 1.3 acres. This impact will be offset by opening up approximately 0.65 acres of new area to the Bay and creating tidal marsh habitat. The majority of the fill includes mostly solid, soils for the ecotone levee construction and there will be a small amount of fill, less than 280 cubic yards of fill (coconut coir, Portland cement, and Baycrete), constructed over approximately 0.18 acres of the mudflats near the northern point of the site. The WBSD initially proposed larger amounts of fill to create a more gradual sloping ecotone habitat, but the regulatory agency staff were concerned with the amount of proportional impacts to the existing marsh habitat and request further analysis and reduction of near-term impacts. The result of that analysis is the proposed project, which constitutes the minimum amount of fill necessary to provide the shoreline protection, minimize near-term habitat impacts, and maximize the space tidal marsh habitat has to migrate as sea level rises.

5. Effects on Bay Resources
   McAteer-Petris Act Section 66605(d) requires that fill only be approved if "the nature, location, and extent of any fill should be such that it will minimize harmful effects to the Bay area, such as, the reduction or impairment of the volume, surface area or circulation of water, water quality, fertility of marshes or fish or wildlife resources, or other conditions impacting the environment…"

Currently there is approximately 3.78 acres of high-quality tidal marsh habitat that exists outboard of the existing levee and within the project footprint, and there are two tidal sloughs that run along the western portion of the site (Flood Slough) and along the northern portion of the site (Westpoint Slough). The WBSD would construct shoreline protection all around the FERRF site, with the northern portion of the shoreline protection including an approximately 598-linear-foot ecotone levee built out into the Bay onto existing healthy marsh habitat and also an oyster reef framework being placed over the mudflats of the northern point. Additionally, the eastern portion of the northern levee will be setback into Basin 3 to create 0.65 acres of new tidal marsh area with and ecotone slope. The proposed project would impact 1.3 acres of existing habitats in the near-term (2-3 years) but includes the re-establishment of those habitats on the ecotone slope and the creation of new tidal marsh habitat in the Bay, as well as enhancing habitat diversity with the oyster reef framework.

Following the revegetation of the ecotone slope, the project would result in approximately 1.54 acres of salt marsh habitat and 0.73 acres of additional upland habitat in the ecotone levee. Additionally, the permittee will be creating approximately 0.65 acres of mid to high marsh habitat to offset the 0.18 acres of permanent impacts to tidal slough/mudflat and tidal marsh caused during the ecotone levee construction, and also creating 0.56 acres of transition zone behind the new marsh..

a. Tidal Marshes, Tidal Flats, and Subtidal Areas

The Bay Plan policies on Tidal Marshes and Tidal Flats say that these areas should be conserved to the fullest extent possible, and that filling that would substantially harm tidal marshes and tidal flats should "be allowed only for purposes that provide substantial public benefits and only if there is no feasible alternative." Additionally, Tidal Marshes and Tidal Flats Policy No. 2 states, in part, that a project should be thoroughly evaluated to ensure that "…the effect of the project on tidal marshes and tidal flats, and designed to minimize, and if feasible, avoid any harmful effects" and that "[p]rojects should be sited and designed to avoid, or if avoidance is infeasible, minimize adverse impacts on any transition zone present between tidal and upland habitats. Where a transition zone does not exist and it is feasible and ecologically appropriate, shoreline projects should be designed to provide a transition zone between tidal and upland habitats." Additionally, Policy No. 10 states that "[b]ased on scientific ecological analysis, project need, and consultation with the relevant federal and state resource agencies, fill may be authorized for habitat enhancement, restoration, or sea level rise adaptation of habitat." Finally, Policy No. 12 states, in part, that the Commission should also encourage and support "[h]abitat restoration, enhancement, and creation approaches, including strategies for: increasing resilience to sea level rise, placing fill, evaluating habitat type conversion, enhancing habitat connectivity, and improving transition zone design."

For any projects involving habitat creation, the Commission's Bay Plan policies on Tidal Marshes and Tidal Flats Policy No. 6 says that "[a]ny habitat project should include clear and specific long-term and short-term biological and physical goals, success criteria, a monitoring program, and as appropriate, an adaptive management plan. Design and evaluation of the project should include an analysis of: (a) how the project's adaptive capacity can be enhanced so that it is resilient to sea level rise and climate change; (b) the impact of the project on the Bay's and local embayment's sediment transport and budget; (c) localized sediment erosion and accretion; (d) the role of tidal flows; (e) potential invasive species introduction, spread, and their control; (f) rates of colonization by vegetation; (g) the expected use of the site by fish, other aquatic organisms and wildlife; (h) an appropriate buffer, where feasible, between shoreline development and habitats to protect wildlife and provide space for marsh migration as sea level rises; (i) site characterization; (j) how the project adheres to regional restoration goals; (k) whether the project would be sustained by natural processes; and (l) how the project restores, enhances, or creates connectivity across Bay habitats at a local, sub-regional, and/or regional scale." In addition, these policies go on to say that "[i]f a habitat project's success criteria have not been met, benefits and impacts should be analyzed to determine whether appropriate adaptive measures should be implemented. If substantial adverse impacts to the Bay and/or native or commercially important species have occurred, the project should be further modified to reduce its impacts."

The San Francisco Estuary Institute's Adaptation Atlas defines ecotone levees to be "gentle slopes or ramps (with a length to height ratio of 20:1 or gentler) bayward of flood risk management levees and landward of a tidal marsh. They stretch from the levee crest to the marsh surface, and can provide wetland-upland transition zone habitat when properly vegetated with native clonal grasses, rushes, and sedges. They can attenuate waves, provide high-tide refuge for marsh wildlife, and allow room for marshes to migrate upslope with sea level rise." Ideally the construction of the ecotone levee would occur landward of existing marsh because much of the much of the Bay "has been disconnected from the marshes by the construction of flood risk management levees in the historical marshes and mudflats." The Adaptation Atlas identifies a portion of the area of the north levee and Bedwell Bayfront Park and the FERRF as an opportunity area with appropriate conditions for the construction of an ecotone levee slope and for tidal marsh habitat. The Adaptation Atlas also mentions that the particular operational landscape unit where the project is located does not have many opportunities for natural marsh migration and that hybrid solutions such as ecotone levees may be suitable for helping to manage flood risk in low-lying communities.

The current coastal marsh habitat within the entire project site is estimated to be approximately 4.85 acres and a majority, 3.78 acres, of the marsh habitat occurs outboard of the northern perimeter levee. There is an estimated 1.15 acres of tidal sloughs and mudflats also present within the project site. The construction of the ecotone levee slope (20:1 slope ratio) for the shoreline protection will have 1.12 acres of impact, including 0.06 acres of tidal slough/mudflat, 0.91 acres of salt marsh habitat, and 0.15 acres of upland habitat, to the existing habitat in the area by completely removing the existing vegetation and placing fill to raise the grade of the ecotone slope. The area will be planted after construction with marsh sod and additional plantings to ensure that the area revegetates quickly and as required in Special Condition II.G. Additionally, the project includes the creation of 0.65 acres of new tidal marsh habitat in an area that is currently uplands and this mitigation is required in Special Condition II.H. The mitigation area will also be planted with marsh sod from the site and native plantings. Monitoring for revegetation for the impacted habitats and the mitigation area is required to occur consistent with an approved Adaptive Management and Monitoring Plan.

To understand the potential future habitat benefits, the WBSD performed habitat modeling to look at the differences in different habitat types immediately post-construction, then at 2050, and 2070 for the different design alternatives, that were considered. The WBSD assessed alternatives that included a sheetpile wall only, the original living shoreline with a more gradual slope, and the proposed project with the steeper living shoreline with a setback section. If WBSD used the sheetpile wall only to raise the berm heights, the project would have minimal impacts on the existing marsh, but there would be less room for marsh habitat to persist in the future when compared to the other alternatives. The more gradual ecotone levee slope would impact almost the entire marsh area outboard of the project site in the near-term but would provide the most habitat area as sea level rises. The current project balances both the near-term impacts and long-term gains by having a steeper ecotone slope (20:1) for most of the slope, and a 4:1 slope above the ecotone and up to the crest of the levee to cover less of outboard tidal marsh and minimize near-term impacts. The project will not provide as much future habitat with sea level rise as the more gradual ecotone levee but does provide more resilience than the strictly sheetpile wall alternative. Therefore, the project design of the ecotone levee avoids and minimizes the potential impacts to tidal marsh to the extent feasible and the impacts that cannot be avoided and minimized will be mitigated by the creation of 0.65 acres of tidal marsh area.

During construction, the proposed project will require installation of a cofferdam but this will not cause any additional area of impact beyond the disturbance footprint. Special Condition II.I requires that the cofferdam and all other temporary fill be removed following the project construction. In addition, Special Conditions II.C.2-3 require the permittee to conduct the construction in a manner that minimizes impacts to tidal marsh and restores any unforeseen impacts to marsh or upland habitats, and to monitoring the areas adjacent to the cofferdam to ensure that it is not causing erosion or other impacts to the habitats that are located outside of the cofferdam. If any dewatering is necessary during the cofferdam installation, the permittee is required to submit a dewatering plan for review and approval prior to conducting the activity pursuant to Special Condition II.D.1. Following the installation of the cofferdam, the work area will be isolated from the Bay and other tidal marsh species and most of the work would be conducted within the cofferdam area, with the exception of the oyster reef framework installation. The cofferdam is a necessary environmental protection measure to minimize water quality and habitat impacts and is also required to be completely removed following the project.

The ecotone levee will be constructed using soils that are were stockpiled onsite from other projects, mainly nearby soils areas or those that are excavated during removal of a segment of the existing levee, and sediments excavated from the marsh in the area of the ecotone levee. The permittee prepared a Quality Assurance Protection Plan (QAPP) for the site and any materials used for the project or any new soils brought onsite will need to comply with the QAPP, pursuant to Special Condition II.E. Additionally, the top layer of sediment under the marsh sod will be excavated down 12 inches and this sediment will then be used to form the top layer of coverage on the ecotone levee, which should allow for the marsh sod and other native tidal marsh plantings to establish quickly in this native sediment. The permittee anticipates that saltmarsh vegetation will begin to establish between 0.1 to 1.0 feet above the high tide line relatively quickly (within 2-3 years), including species such as pickleweed, saltgrass, big saltbrush , and marsh gumplant.

The shoreline morphology and the presence of Greco Island leads to most waves and currents being concentrated on the northern point of the project site, which is also exposed to the greatest wind fetch of all areas of the project site. Hydrodynamic modeling done for the project indicates that the project design will not significantly impact that hydrology of either Flood Slough or Westpoint Slough and is not likely to cause erosion in the immediately adjacent marsh or on Greco Island. The ecotone levee is designed in a manner that minimizes impacts on the localized erosion and accretion processes and the tidal flows, and will also help provide additional adaptive capacity to the tidal marsh and tidal marsh dependent species in the area.

Similar to the Tidal Marshes and Tidal Flats policies, the Bay Plan Subtidal Areas Policy No. 1 directs that impacts to subtidal areas should be avoided and minimized, and that any proposed filling should be evaluated to determine the local and Bay-wide effects of the project on the spread of invasive species, tidal hydrology and sediment movement, aquatic organisms and wildlife aquatic plants, and the Bay bathymetry. Subtidal Areas Policy No. 3 requires that subtidal habitat projects should be designed and evaluated based upon the ecological need for the project, effects of relative sea level rise, potential impact to sediment transport and any erosion or accretion, tidal flows, spread of invasive species, expected use by aquatic organisms and wildlife, local bathymetric changes, the best available science, and if they would be sustained by natural processes.

The project would install approximately 836 linear feet of oyster reef habitat over 0.18 acres of mudflat habitat. The project site is located in an area that is sheltered from direct waves of the Bay by Greco Island and thus the oyster reefs are not required to provide additional shoreline protection for the project but would provide potential habitat for oysters and other sessile species in the area. The primary goal of the oyster reefs framework is to provide additional diversity and habitat at the site to attract native Olympia oysters. When the oyster reef units are placed, there will be a minor conversion of mudflat habitat to the hard structures of the oyster reef that are designed to be supported and sit well above the mudflat. The oyster reef units will be prefabricated by Sand Bar Oyster Company and made with a combination of Bay Mud, Portland cement and coconut coir and be placed between MLLW to MSL (-1.18 ft to 3.35ft NAVD88) and be relatively low-relief structures that form the framework that sits over the mudflat and is anchored in the mud by the ends of the framework pushed into the mud and a geotextile cloth over the mudflat to prevent subsidence of the structure.

The proposed design has been tested on the East Coast in areas of low wave action and is a bit different than other oyster reef structures that are currently being tested around the Bay. The San Francisco Bay Shoreline Adaptation Atlas identifies the northern levee of the FERRF site as an area potentially suitable for living shorelines, however, nearshore reefs were mentioned as having limited suitability for this particular area of the shoreline. However, the site is located in the South Bay, which is an area that the "Guide to Olympia Oyster Restoration and Conservation" (Wasson et al 2015)[1] indicates may support oyster populations, but that recruitment may very low and near zero in some years.

The reef units are lightweight, modular, and designed to be in an open reef framework that will be anchored into the mud. The materials for the structures are intended to slowly degrade over time and leave only oyster shells behind and forming the reef over the mudflat. The final design of the oyster reefs, including location, will be provided with the final plan set that is required to go through plan review. These structures are also required to be monitored for their success pursuant to Special Condition II.H.3. If the structures do not meet the success criteria, then they shall be required to be removed pursuant to the special condition.

The mudflats on the northern point of the project site help attenuate wave action and provide a broad shelf that can support oyster reef elements. Additionally, the oyster reef framework will be located in an area that benefits from lower wave action due to the waves being attenuated by Greco Island. The oyster reefs are also likely to further help attenuate waves in the near-term, but the degree of the oyster reef contribution to wave attenuation is not known or calculated at this time. Unlike the ecotone slope, the oyster reef habitats will not be moved upslope as sea level rises and there will be a time when perhaps these structures may not provide oyster reef habitat any longer due to the periods and depths of inundation, but they may become habitat for other species if they remain in place long-term.

Based upon the information above and the special conditions required herein, the project is avoiding and minimizing the impacts of the Bay fill on tidal marshes, tidal flats, and subtidal areas to the extent feasible, while also setting up the habitats in the area with long-term elevation capital to allow the habitats to migrate with sea level rise.

[1] Wasson, K, C. Zabin, J. Bible, S. Briley, E. Ceballos, A. Chang, B. Cheng, A. Deck, T. Grosholz, A. Helms, M. Latta, B. Yednock, D. Zacherl, and M. Ferner. 2015. A Guide to Olympia Oyster Restoration and Conservation – Envrionmental Conditions and Sites that Support Sustainable Populations. Elkhorn Slough National Estuarine Research Reserve Report

b. Fish, Other Aquatic Organisms and Wildlife.

Fish, Other Aquatic Organisms, and Wildlife Policy No. 6 states, in part, that "[a]llowable fill for habitat projects in the Bay should (a) minimize near term adverse impacts to and loss of existing Bay habitat and native species; (b) provide substantial net benefits for Bay habitats and native species; and (c) be scaled appropriately for the project and necessary sea level rise adaptation measures in accordance with the best available science…" Policy No. 1 requires in part that "the Bay's tidal marshes, tidal flats, and subtidal habitat should be conserved, restored and increased" and Policy No. 2 requires that native species, including special-status species, and any species providing "substantial public benefit, as well as specific habitats that are needed to conserve, increase, or prevent the extinction of these species, should be protected, whether in the Bay or behind dikes. Protection of fish, other aquatic organisms, and wildlife and their habitats may entail placement of fill to enhance the Bay's ecological function in the near-term and to ensure that they persist into the future with sea level rise." Also, in Policy No. 4, the Commission is directed to consult with the California Department of Fish and Wildlife, the USFWS, and NMFS when a proposed project may adversely affect an endangered or threatened species and to give appropriate considerations to their recommendations.

The project will include near-term habitat loss for some marsh-dependent species living in the habitat area. However, the creation of additional marsh habitat areas adjacent to the impact site will help compensate for those impacts. Additionally, the ecotone levee slope has a net benefit for these species by allowing the tidal marsh to persist and provide high-tide refugia and a wildlife corridor as sea levels rise over the life of the project. Following the project, the project area will have a mosaic of mudflat, low marsh, high marsh, and transition zone habitat that will increase the habitat complexity for native and special-status species present at the project site. In addition, it is likely that the oyster reef structures will provide new habitat area for native oysters to develop in the project area, as well as many other sessile invertebrates.

Currently the areas surrounding the site provide habitat for many federally- and state-listed species, including California least tern, California Ridgway's rail, California black rail, salt marsh harvest mouse, Central California Coast steelhead, North American green sturgeon, and longfin smelt, as well as many native species of fish, birds, mammals, invertebrates, and plants that rely on the Bay, mudflats, tidal marsh, and upland habitats. Many of the different species in and around the site use specific habitats for foraging, roosting, nesting, and other activities essential for life.

During construction of the project, there is the potential for there to be impacts from noise, physical disturbance to existing habitats utilized by these species, and visual disturbance. These impacts are likely to be the result of the sheetpile driving, vegetation removal techniques, grading, dewatering, and artificial lighting. As a result, the WBSD consulted with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) on the potential impacts the project may have on special status species, their critical habitat, and essential fish habitat. Minimization measures consistent with those required in Special Conditions II.C were incorporated into the project to limit the impacts to these species during construction. Additionally, the plantings required in Special Condition II.G will help re-establish functional habitat as quickly as possible and the monitoring required in Special Condition II.H will allow for the progress of the habitat establishment to be tracked.

On December 1, 2022, the USFWS issued a Biological Opinion for the project that determined that the project is not likely to adversely affect the California least tern, western snowy plover, but was likely to affect the California Ridgway's rail and the salt marsh harvest mouse. USFWS evaluated the potential construction associated impacts to species in the area. The USFWS found that the project would likely result in some habitat and construction related impacts and could lead to local and temporary declines in Ridgway's rail and salt marsh harvest mouse populations, but that the effects would be minimized with the implementation of the conservations measures, which are similar to the requirements within Special Condition II.C. The findings were based upon the fact that WBSD expects that foraging and habitat functionality for the revegetated/planted ecotone to be near pre-disturbance conditions within a few years.

USFWS also determined that the successful restoration and revegetation of habitats will also serve the purpose of reducing habitat loss over time. The USFWS found that the project is not likely to jeopardize the continued existence of either species, and provided an incidental take statement that requires the implementation of all conservation measures. Evaluation of the ongoing helipad operations/use was not considered by the USFWS in the Biological Opinion, however the raising of the helipad is included in the project description. Because the use/operations and potential impacts were not evaluated by USFWS, Special Condition II.K restricts the use of the helipad the pre-existing frequency and users. No other users are authorized. The permittee is required in Special Condition II.C.9 to comply with the requirements of the USFWS Biological Opinion.

On December 5, 2022, the NMFS issued a Letter of Concurrent and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Response for the project. NMFS concurred that the project is not likely to adversely affect Central California Coast steelhead or North American Green Sturgeon and their critical habitat based upon the timing of installation of the cofferdam during low tides and beyond that no in-water work is planned. NMFS determined effects to these species is unlikely and discountable. NMFS found that the oyster reef framework may improve habitat for intertidal invertebrates and enhance the prey availability for various fish in the project area. NMFS found that the proposed project contains adequate measures to avoid and minimize adverse effects to EFH and there were no conservation recommendations provided. The WBSD is required in Special Condition II.C.10 to comply with the requirements of the Letter of Concurrence and EFH response.

The California Department of Fish and Wildlife does not have a regulatory nexus for requiring a permit for this project. However, CDFW did comment on the Draft EIR and provided additional input on the project construction and impacts analysis, as well as the minimization measures.

Pursuant to Special Conditions II.C.1-15, the WBSD district is required to implement the measures to reduce impacts to any fish and wildlife that may be present or nearby during the construction activities. These conditions are coordinated and complimentary to the requirements of the NMFS and USFWS.

c. Water Quality

The Bay Plan Water Quality Policy No. 1 states, in part, that "[b]ay water pollution should be prevented to the greatest extent feasible. The Bay's tidal marshes, tidal flats, and water surface area and volume should be conserved and, whenever possible, restored and increased to protect and improve water quality." Policy No. 2 states, in part, that "[w]ater quality in all parts of the Bay should be maintained at a level that will support and promote the beneficial uses of the Bay…" and "[t]he policies, recommendations, decisions, advice and authority of the State Water Resources Control Board and the Regional Board, should be the basis for carrying out the Commission's water quality responsibilities." Additionally, Policy No. 3 states, in part, that "[n]ew projects should be sited, designed, constructed and maintained to prevent or, if prevention is infeasible, to minimize the discharge of pollutants into the Bay by: (a) controlling pollutant sources at the project site; (b) using construction materials that contain nonpolluting materials; and (c) applying appropriate, accepted and effective best management practices…"

On December 21, 2022, the San Francisco Bay Regional Water Quality Control Board (Water Board) issued a Water Quality Certification for the project and the applicant is required in Special Condition II.D to comply with these requirements, including the preparation of a dewatering plan, if one is necessary, use of erosion control methods during construction and before any of the areas have had time to revegetate, and ensuring that there is a spill prevention plan. The Bay fill (soils) necessary for construction of the ecotone levee will come from fill that has been stockpiled onsite. All fill used in the construction of the ecotone levee and used during construction will be handled and installed according to the *Quality Assurance Project Plan (QAPP) for the West Bay Sanitary District Flow Equalization and Resource Recovery Facility Flood Protection Project, Menlo Park, San Mateo County* that was prepared by SCWA and dated August 2022, as required in Special Condition II.E. The project currently does not plan to use soils that are classified as "wetland foundation" quality soils; however, such use is included in the QAPP as a potential option. If foundation soils are used in areas like the core of the ecotone levee, the applicant is required to ensure that those soils are covered by at least three feet of clean fill material and will be required to monitor the levee for any signs of erosion of the clean surface fill. If any erosion occurs on the ecotone levee, then the applicant will be required to take adaptive management measures to ensure that additional clean soil is added, and the area vegetates in order to minimize the chances of erosion. During construction of the project, all construction activities will be occurring behind the cofferdam, which will reduce any potential turbidity concerns during construction.

In addition to constructing the shoreline protection, the project includes the decommissioning of a former outfall/drainage system that was used when there was a former treatment plant located at the site. There is no longer a need for the outfall and so it will be capped, and the stormwater drainage onsite will be reconfigured so that stormwater drains into the open air basins onsite and then is eventually pumped out to the treatment plant with the wastewater for treatment.

Special Conditions II.D and II.E ensure that the applicant will comply with the water quality requirements and minimize impacts to the Bay.

d. Mitigation

The Bay Plan Mitigation Policy No. 1 states, in part, that "…[w]henever adverse impacts cannot be avoided, they should be minimized to the greatest extent practicable. Finally, measures to compensate for unavoidable adverse impacts to the natural resources of the Bay should be required." Policy No. 2 also states that "[i]ndividual compensatory mitigation projects should be sited and designed within a Baywide ecological context, as close to the impact site as practicable, to: (1) compensate for the adverse impacts; (2) ensure a high likelihood of long-term ecological success; and (3) support the improved health of the Bay ecological system..." When determining what is appropriate mitigation for project impacts, Policy No. 4 directs the Commission to "…consider potential effects on benefits provided to humans from Bay natural resources, including economic (e.g., flood protection, erosion control) and social (e.g., aesthetic benefits, recreational opportunities) benefits and whether the distribution of such benefits is equitable." And Policy No. 5 states that "[t]he amount and type of compensatory mitigation should be determined for each mitigation project based on a clearly identified rationale that includes an analysis of: the probability of success of the mitigation project; the expected time delay between the impact and the functioning of the mitigation site; and the type and quality of the ecological functions of the proposed mitigation site as compared to the impacted site."

These policies also direct that resource restoration is preferred over creation of new habitats, where practicable, and that transition zones and buffers should be included in mitigation projects where feasible and appropriate. According to Policy No. 6, the "mitigation site selection should consider site specific factors that will increase the likelihood of long-term ecological success, such as existing hydrological conditions, soil type, adjacent land uses, and connections to other habitats." And Policy 8 states that, "…[w]here appropriate, the mitigation program should describe the proposed design, construction and management of mitigation areas and include: (a) Clear mitigation project goals; (b) Clear and measurable performance standards for evaluating the success of the mitigation project, based on measures of both composition and function, and including the use of reference sites; (c) A monitoring plan designed to identify potential problems early and determine appropriate remedial actions…The Commission may require financial assurances, such as performance bonds or letters of credit, to cover the cost of mitigation actions based on the nature, extent and duration of the impact and/or the risk of the mitigation plan not achieving the mitigation goals..."

The project will have approximately 1.12 acres of habitat impacts to tidal slough, tidal marsh, and upland habitats as a result of the ecotone levee construction within the Bay jurisdiction. Some upland habitats will also be impacted during construction activities. The ecotone levee will be constructed out onto existing healthy habitats and have a slope of approximately 20:1 and the lower portions of the levee will be at elevations between 0.1 to one foot above the high tide line to allow for occasional inundation and establishment of high marsh species.

Much of the lower portions of the ecotone levee are anticipated to revegetate quickly and provide tidal marsh and upland habitats for species onsite. However, 0.11 acres of the existing habitats (approximately 0.05 acres of salt marsh will be converted to uplands on the northwestern side of the project and approximately 0.06 acres of tidal slough/mudflat habitat impacts will be converted to salt marsh habitat) will not be restored in the near-term and therefore are considered permanent impacts from the project.

To compensate for the permanent impacts of the project, the WBSD plans to create approximately 0.65 acres of additional new tidal marsh habitat within an area that is currently uplands on the northeastern portion of the perimeter levee. This will be accomplished by the project setting back an approximately 739-linear-foot segment of the existing levee into Basin 3 to make additional space for new tidal marsh habitat to be established. The new marsh habitat area will be located 13 to 37 feet inland of the current Bay shoreline and would also include an ecotone transition zone on the back of the newly created marsh habitat.

The ensure the success of the created tidal marsh, the existing setback levee area would be over excavated by approximately 12 inches. This area would be backfilled with Bay sediment that has been excavated from existing marsh areas during construction and be planted with some marsh sod that is salvaged/ removed from the impacted marsh areas in the ecotone levee footprint and also planted with seeds and some container plantings. The marsh sod will be maintained onsite in a nursery owned by Save-the-Bay and will be replanted into the tidal marsh/mitigation area to increase the chances of successful revegetation of habitats.

The 0.65 acres of new tidal marsh habitat created directly adjacent to an area of healthy salt marsh should also help enhance the opportunity for plants from the adjacent habitat to colonize the newly created habitat. Additionally, the final grading elevations for the new marsh habitat creation area were selected to be close to or slightly above the high tide line to match the elevations of the existing hydrology at the site to ensure sufficient frequency and length of tidal inundation for tidal marsh habitat to establish. The success of the new tidal marsh area and transition zone habitat areas will be monitored along with entire ecotone habitat areas according to an Adaptive Management and Monitoring Plan (AMMP), as required in Special Condition II.H. The WBSD needs to revise the draft AMMP pursuant to the comments from the Commission Staff and other agencies. The final version will require submittal and approval by or on behalf of the Commission. The WBSD is required to do post-construction monitoring and maintenance of the site to ensure success and establishment of the habitat areas, including the newly created marsh habitat, and has secured approximately $5,000,000 to help complete the project, which includes the onsite mitigation.

e. Monitoring

The Bay Plan Tidal Marshes and Tidal Flats, Subtidal Areas, and Mitigation policies state that habitat projects and mitigation areas should include success criteria to monitor projects. The Tidal Marshes and Tidal Flats Policy No. 6 states, in part, that “[a]ny habitat project should include clear and specific long-term and short-term biological and physical goals, success criteria, a monitoring program, and as appropriate, an adaptive management plan…” Subtidal Areas Policy No. 4 requires that “[i]f a habitat project’s success criteria have not been met, benefits and impacts should be analyzed to determine whether appropriate adaptive measures should be implemented. If substantial adverse impacts to the Bay or native or commercially important species have occurred, the project should be further modified to reduce its impacts.” The Bay Plan Mitigation policies requires that mitigation areas be monitored and that “…monitoring and reporting should be of adequate frequency and duration to measure specific performance standards and to assure long-term success of the stated goals of the mitigation project…” and that there should be a “…contingency plan to ensure the success of the mitigation project, or provide means to ensure alternative appropriate measures are implemented if the identified mitigation cannot be modified to achieve success…”

The WBSD project includes both the creation of new habitat project elements that need to be monitored and a mitigation area to offset some of the project impacts. The permittee prepared a draft Adaptive Management and Monitoring Plan (AMMP) titled *West Bay Sanitary District Flow Equalization and Resource Recovery Facility Flood Protection Project, Menlo Park, San Mateo County, California* prepared by SCWA and dated August 2022. The project will be monitored annually for a ten-year period to ensure that the habitat areas and the mitigation area are establishing as anticipated. The draft AMMP is well developed, but the Commission Staff is still working out the specific quantitative success criteria with the WBSD to ensure that the habitat elements and mitigation areas are on a trajectory for success and providing high quality habitat in the near future. Special Condition II.H requires monitoring of a number of physical and biological characteristics of the project site, including water quality, the geomorphology of the different habitats and the adjacent areas, success of revegetation efforts, success of the oyster reef framework, and monitoring every five years for potential marsh transgression for 15 years. If any of the criteria are not being met, then adaptive management actions, such as additional plantings or measures to adjust the elevation of a habitat area, may be necessary. The results of the monitoring will inform any future decisions on whether adaptive management is necessary to meet the habitat success criteria. The permittee is required in Special Condition II.H.5 to review any proposed adaptive management strategies with the appropriate regulatory agencies prior to taking any such action.

Additionally, to better understand the impact of shoreline protection measures and habitat restoration and mitigation over time, the project impact on adjacent and nearby areas, and the regional context for sea level rise adaptation, Special Condition II.H.6 is included to require the WBSD to contribute information about the project and all relevant plans and monitoring reports to the regional project database (EcoAtlas, ptrack.ecoatlas.org), which has been developed to catalog such information. The entry of project details will be used by the Commission and partner agencies to support regional decision-making and planning, adaptive management suggestions and to better understand cumulative impacts of projects involving shoreline protection and habitat restoration, in support of Bay Plan policies including Shoreline Protection Policies Nos. 1(e), 1(f), and 4, Climate Change Policy No. 3, and Tidal Marshes and Tidal Flats Policies Nos. 7, 8, and 9.

6. Safety of Fills and Shoreline Protection

McAteer Petris Act Section 66605(e) requires "that fill be constructed in accordance with sound safety standards which will afford reasonable protection to persons and property against the hazards of unstable geologic or soil conditions or of flood or storm waters." The existing FERRF is within the current 100-year floodplain due to the low elevation of the existing earthen berms around the facility. As sea level rises, the issue of flooding will only be exacerbated. The project design includes the installation of approximately 3,700 linear feet of sheetpile walls into the existing western and northern perimeter levees around the FERRF to raise the elevations from the existing +10 to +12 feet NAVD88 to a final elevation of +15 feet NAVD88. The sheet pile walls will be approximately 3/8-inch thick, 12-inch-wide, and 35-foot-long steel metal plates. To provide seismic stability and support for the ecotone levee, double sheetpile walls will be installed along much of the northern ecotone levee. The sheetpile walls will be buried into the existing levees within the 100-foot shoreline band. Additionally, the project includes raising approximately 160 linear feet of the Marsh Road entrance to the FERRF and two sections of the Bay Trail (150 linear feet and 200 linear feet) as part of the project.

The Bay Plan Shoreline Protection Policy No. 1 states that "[n]ew shoreline protection projects and the maintenance or reconstruction of existing projects and uses should be authorized if: …(c) the project is properly engineered to provide erosion control and flood protection for the expected life of the project based on a 100-year flood event that takes future sea level rise into account…" and that "[p]rofessionals knowledgeable of the Commission's concerns, such as civil engineers experienced in coastal processes, should participate in the design." Additionally, Shoreline Protection Policy No. 5 states, in part, that "[a]ll shoreline protection projects should evaluate the use of natural and nature-based features such as marsh vegetation, levees with transitional ecotone habitat, mudflats, beaches, and oyster reefs, and should incorporate these features to the greatest extent practicable. Ecosystem benefits, including habitat and water quality improvement, should be considered in determining the amount of fill necessary for the project purpose. Suitability and sustainability of proposed shoreline protection and restoration strategies at the project site should be determined using the best available science on shoreline adaptation and restoration…" and Policy No. 7 states that "The Commission should encourage pilot and demonstration projects to research and demonstrate the benefits of incorporating natural and nature-based techniques in San Francisco Bay."

The Safety of Fills Policy No. 1 discusses the process for taking a project to the Commission's Engineering Criteria Review Board for consideration and input on the safety provisions of most major projects, however this project provided a geotechnical report and project plans for the ecotone levee that was reviewed by the staff engineer and did not raise significant engineering issues regarding the fill to be placed and there will be no public accessing the site. Therefore, this project was not taken to the ECRB for further review. Additionally, a similar project for the construction of an ecotone slope at Sonoma Creek had a much larger project footprint for the ecotone levee and did not go through review with the ECRB, but did provide geotechnical information for Commission staff review.

The applicant estimates that the expected life of the project is 50 years and will be utilizing both nature-based and traditional methods of shoreline protection. The life of project is largely defined by the minimum service life of the sheetpile walls, as well as considerations of the elevation needed to provide FEMA-certified flood protection in the future with sea level rise. However, in reality it is likely that the shoreline protection would continue to persist beyond 2070. Most of the shoreline protection structure would be installed within the existing footprint of the berms around the site and mainly focus on the installation of sheetpile walls. However, there will be Bay fill placed to construct the 20:1 ecotone levee outboard of the northern perimeter levee. Additionally, a portion of the northern levee will also be reconstructed and setback into the site to provide additional area for the creation of new tidal marsh habitat.

The geotechnical report and investigation for the project design included ground water considerations, geology, static and seismic stability analysis, and tsunami and seiches. The report concluded that project was feasible from a geotechnical perspective, but that adding additional fill on top of the levees could create greater instability. However, the report concluded that sheetpile walls should be installed through the existing levee fill and Bay mud and should penetrate into stiffer Old Bay mud to improve the stability of the levee under seismic conditions. Due to the potential static and seismic stability concern on the northern levee with the construction of the ecotone levee, two rows of sheetpile walls are needed to address the proposed fill. The geotechnical report also mentions that the placement of additional fill, may cause some additional settlement at the site, including that any new fills on the site should be anticipated to settle approximately one foot, while the rest of the existing site may only continue to experience 2 to 4 inches of settlement from the original fill that was placed to create the site. The report recommends the use of soils with some fines to inhibit seepage and tidal water migration and that if Bay mud is used that it be spread out over broad areas away from the levees and mixed with more appropriate soils. The applicant considered all of the geotechnical recommendations and the project design addresses these issues.

The ecotone slope, sheetpile walls, and oyster reef elements were designed based upon current bathymetry data, topography, wind records from SFO, tide records from NOAAs Redwood City tide gauge, tidal datums, and extreme tide elevations. In addition, sea level rise projections for the 2018 OPC Guidance were also used to design the project to be resilient to 2050 and beyond, but there may be some slight overtopping at 2070. Beyond this 2070, additional adaptation measures may be needed or the potential relocation of the FERRF.

Additionally, the permittee conducted an analysis of the potential wave formation offshore of the ecotone levee to assess the potential erosion of the ecotone levee and to design this element of the project. This analysis found that along the ecotone, the Greco Island tidal marsh plain helps significantly reduce wave formation when the water level is at or below the marsh plain elevation. The graded surfaces of the ecotone levee were design to withstand significant waves and the establishment of marsh vegetation on the slope should further help reduce potential wave action and erosive forces on the ecotone slope. However, Greco Island is at about a current elevation of about +7 feet NAVD88 and with future sea level rise at 2050, the

MHHW will be about two feet higher than Greco Island. If the island does not accumulate sediment and accrete with sea level rise, then a high tide and wind event may result in significant wave action on the face of the ecotone levee.

All perimeter berms will have sheetpile walls that will be driven or vibrated into the existing earthen berms and will be approximately 30 feet deep. The ecotone levee areas on the northern perimeter will have a double sheetpile wall driven into the existing berm prior to additional soil being place on top of the existing structure to raise the elevation, as well as soil used for construction an ecotone levee at a 20:1 slope outboard of the existing levee. Additionally, a portion of the northern levee will be setback and reconstructed inland of the existing berm. On the western side of the project site, the elevations of the berm range from +10 to +12 feet NAVD88. The berm in this area will be raised solely with the installation of sheet pile walls and approximately 3-5 feet of the top of the sheetpile walls may remain visible above the ground. The ecotone slope will be constructed using onsite, stockpiled soils, however dredged sediment that underlies the current tidal marsh habitat may be placed on the surface of the ecotone slope and mitigation area to ensure that tidal marsh vegetation can be established, but this would be a relatively thin layer spread over a large area. Additionally, marsh sod will be placed right after construction to enhance the chances of vegetation quickly establishing on the ecotone levee slope and helping to stabilize the fill.

The permittee also conducted hydrodynamic modeling to analyze any potential impacts of project design on the adjacent areas. The potential 100-year tide and different fluvial flows, plus sea level rise, were used to develop the project design and analyze the effects of the ecotone slope on hydraulic conditions in the area. Modeling indicated that there was almost no impact in depth, water surface elevations, velocity, and shear stress in Flood Slough, Westpoint Slough or the adjacent marsh plains at the project site and Greco Island as a result of the project. Although there may be a slight increase in the shear stress (erosive force) in Westpoint Slough, this would still be lower than the critical shear stress for Bay mud and should not cause the channel to shift from being depositional to incising. The widening of the tidal marsh in the mitigation area will also lead to a small decrease in the shear stress along the tidal marsh and slough channel. This should also not change much of the geomorphology of the adjacent slough or habitat areas. Monitoring required herein will help track the geomorphology of the ecotone levee and adjacent areas to ensure it is meeting success criteria and not causing significant erosion or other issues. If issues do arise, the WBSD may be required to take adaptive management measures.

7. Permanent Shoreline

The McAteer-Petris Act Section 66605 (f) The Bay Plan Shoreline Protection Policy No. 1 states, in part, that "[n]ew shoreline protection projects and the maintenance or reconstruction of existing projects and uses should be authorized if:…(b) the type of the protective structure is appropriate for the project site, the uses to be protected, and the causes and conditions of erosion and flooding at the site;…(e) the protection is integrated with current or planned adjacent shoreline protection measures; and (f) adverse impacts to adjacent or nearby areas, such as increased flooding or accelerated erosion, are avoided or minimized. If such impacts cannot be avoided or minimized, measures to compensate should be required…"

The Bay Plan Climate Change Policy No. 6 states that while the Region is working on formulating a regional sea level rise adaptation strategy that it should consider a number of strategies and goals, including "…(c) integrate the protection of existing and future shoreline development with the enhancement of the Bay ecosystem, such as by using feasible shoreline protection measures that incorporate natural Bay habitat for flood control and erosion prevention;…"

As stated above, this project includes nature-based shoreline protection features. Hydrodynamic modeling was done to evaluate the potential impacts of the project on adjacent areas and the results indicated that there should be no significant changes to flow, waves, or sediment processes in the nearby habitat and adjacent shoreline areas from the project. Additionally, the shoreline protection will be integrated into the existing adjacent areas of the shoreline that make up portions of Bedwell Bayfront Park. The project establishes a permanent shoreline.

Additionally, Special Condition II.H requires the applicant to input project information into the regional project database to provide context into how protection is integrated with current and/or planned adjacent shoreline protection measures and maintained over time and thus helps inform the determination if the project avoids and minimizes adverse impacts to adjacent or nearby areas in relation to adjacent and nearby shoreline protection. Additionally, entering such details into the regional project database helps ensure that the project can be found consistent with Shoreline Protection Policy 1 (e) and (f) as described above. In addition, and as further discussed below, the applicant did not prepare a formal sea level rise risk assessment that was submitted to the Commission, but did design their project to be resilient to a 100-year flood, plus wave runup and sea level rise for the medium-high risk aversion and high emission scenario at 2050. For the life of the project, which is 2070, the project still appears to be resilient to still water elevations that would occur at that time, but the potential flooding caused by wave runup is not incorporated. After 2070, additional adaptation measures may be required.

Since the applicant did not prepare a risk assessment and adaptation plan, Special Condition II.N includes a requirement that a formal risk assessment and sea level rise adaptation plan be developed and submitted within two years of the issuance of the permit or by January 31, 2025. Additionally, this condition requires flood monitoring reports be uploaded to a regional database. This condition ensures that data collected as part of any adaptive management activities or monitoring program is accessible to the Commission, public, and qualified professionals for use in evaluating and minimizing flood risk to adjacent and nearby areas. The special condition requires this information be included in a regional database to better understand and adaptively manage for the long-term flooding impacts of this project, ensuring consistency with Shoreline Protection Policies 1(e), (f) and 4. Historically, there is a gap in information on what shoreline protection projects have been implemented on which sections of the Bay shoreline. By integrating project details into a regional database these policies can be effectuated. Additionally, the project proponent's contribution to this database supports regional knowledge and BCDC's goals to support research that provides information useful for planning and development related to shoreline flooding, as well as information and tools to integrate regional climate change adaptation planning into the design, as described in Climate Change Policy 6."

8. Valid Title
McAteer-Petris Act Section 66605(g) requires that "fill should be authorized when the applicant has such valid title to the properties in question that he or she may fill them in the manner and for the uses to be approved." The permittee owns a majority of the property site and submitted the relevant property documentation to the Commission. However, some portions of the project would occur on State Lands Commission property and City of Menlo Park property. On February 28, 2023, the State Lands Commission (SLC) voted to approve a lease agreement for the small Bayward portion of the project, with the exception of the oyster reef elements, which the SLC determined that they needed additional information for this project element before the SLC would incorporate this into the project. However, the WBSD is working with the SLC to provide the needed information to update the lease agreement and include the oyster reef framework into the lease. Special Condition II.O requires the submittal of any additional property interest required for the project prior to beginning construction. Additionally, the applicant needs to obtain additional approval from the SLC before the oyster reef framework can be included in the project.

Additionally, at the time of mailing of the staff recommendation, the applicant was working on obtaining the City of Menlo Park's encroachment agreement for the project, which is likely to be issued in early April, but had not yet been issued at the time of this mailing. The Commission Staff understands that the City of Menlo Park is supportive of the project and is likely to approve the encroachment agreement in very near future.

As conditioned, the Commission finds that the project is consistent with the McAteer-Petris Act and Bay Plan policies on allowable fill of the Bay.

C. Public Access

The McAteer-Petris Act Section 66602 states, in part, that "…existing public access to the shoreline and waters of the…[Bay] is inadequate and that maximum feasible public access, consistent with a proposed project, should be provided." Section 66632.4 states, in part, that "[w]ithin any portion or portions of the shoreline band that are located outside the boundaries of water-oriented priority land uses…the commission may deny an application for a permit for a proposed project only on the grounds that the project fails to provide maximum feasible public access, consistent with the proposed project, to the bay and its shoreline." Additionally, Section 66605.1, states in part, that "to make San Francisco Bay more accessible for the use and enjoyment of the people, the bay shoreline should be improved, developed, and preserved…" When the activity under consideration is proposed by a public agency, such as the West Bay Sanitary District, the Commission also evaluates whether the proposed public access is reasonable in light of the project scope.

1. Protection of Existing Public Access
   The project is located adjacent to Bedwell Bayfront Park and the Bay shoreline. To the north of the site is Westpoint Slough and to the west is Flood Slough and the Cargill salt ponds. Bedwell Bayfront Park is located to the east and south of the FERRF facility. Bedwell Bayfront Park is a well-used municipal park that was constructed by the City of Menlo Park through the filling of approximately 69 acres of former salt pond and landfill area to establish the public park. Additionally, the City of Menlo Park is required in BCDC permit No. 1970.18.04 to maintain the shoreline park for public use for general recreation. The park includes a segment of the Bay trail, other walking trails, hilltops for viewing, birdwatching, and views of the Bay. The outer perimeter loop around the park is part of the Bay Trail at the site and includes a segment that runs along Marsh Road.

   During construction of the shoreline protection project, construction vehicles will be accessing the project site via Marsh Road and are likely to impact the Bay Trail use in this area. With the heavy vehicle traffic, it is likely going to be difficult for pedestrians to walk along Marsh Road and the Bay Trail running along the southern and eastern portions of the site. However, the permittee has prepared a conceptual detour plan, Exhibit B, and is required to submit a final detour plan for Commission

Review and approval pursuant to Special Condition II.B.5. To the extent feasible, the permittee is required to maintain pedestrian access on the Bay Trail, but if closures are necessary, the detour route shall be implemented along with any required signage showing the detour route. The public access trails are also required to be reopened at times when it is feasible to do so in between construction activities. Additionally, Special Condition II.B.5 also requires that any impacted public access areas be restored to their original condition or better following construction.

2. Public Access Improvements

Bay Plan policies on Public Access state, in part, that "[a] proposed fill project should increase public access to the Bay to the maximum extent feasible" (Policy No. 1), "maximum feasible access to and along the waterfront and on any permitted fills should be provided in and through every new development in the Bay or on the shoreline" (Policy No. 2), and "[w]henever public access to the Bay is provided as a condition of development, on fill or on the shoreline, the access should be permanently guaranteed" (Policy No. 7). Further, Public Access Policy No. 6 states that "[p]ublic access should be sited, designed, managed and maintained to avoid significant adverse impacts from sea level rise and shoreline flooding." Additionally, Shoreline Protection Policy No. 1 states, in part, that new shoreline protection projects should be approved if "…d) the project is properly designed and constructed to prevent significant impediments to physical and visual public access…"

The current FERRF site and use as a raw wastewater overflow storage area makes the perimeter berms around the facility incompatible with public access due to public health concerns. Staff believes that given the extensive area of public access at the adjacent Bedwell Bayfront Park and the potential health concerns with onsite access, that public access is not feasible on the project site and that in-lieu public access options in other adjacent areas is appropriate for the project. The adjacent Bedwell Bayfront Park already includes a segment of the Bay Trail and areas for general recreation use. While the West Bay Sanitary District is not able to provide public access directly within the project site, they have worked with the City of Menlo Park to further developing a concept for a viewpoint in the northern corner of Bedwell Bayfront Park (Exhibit A). Special Condition II.B.2 requires the WBSD to submit public access construction plans to the Commission for review and approval. As in-lieu public access, the WBSD agreed that it is feasible to contribute an ADA-accessible bench and interpretive sign at the viewing area directly adjacent to the project site and on the City's property. Although the WBSD does not yet have an encroachment agreement from the City of Menlo Park, the Commission Staff has talked with the City Staff and the City is in agreement with the proposed public access improvements being located on their property. Additionally, the City and WBSD have both indicated that the encroachment agreement makes clear that the

WBSD is expected to maintain the public access improvements in perpetuity. Special Conditions II.B.3-4 require WBSD to provide the public access improvements at the viewing area and to maintained in perpetuity.

The required public access associated with the project includes improvements, one bench and one interpretive sign, that will be placed over an approximately 300-square-foot area of the shoreline at the viewing area at Bedwell Bayfront Park to the east of the FERRF and close to the Bay as shown on Exhibit A. The elevation of the viewpoint is at approximately +15 feet NAVD88 and allows the public better vantage point of the Bay and adjacent habitats. The WBSD is required to maintain the public access amenities in perpetuity pursuant to Special Condition II.B.4. Given that this area is approximately the same elevation as the shoreline protection along the northern perimeter of the project area, the public access is likely to have a similar sea level rise resilience as the ecotone levee slope. Meaning that the public access area should be resilient at 2050 with a 100-year flood, wave-runup, and medium-high risk aversion and high emissions planning scenario. Additionally, the area is also likely to be resilient to 2070 still water elevations that include sea level rise, storm surge and a 100-year storm, but the contribution of wave runup is not known. The permittee is required to prepare a formal risk assessment and adaption plan that identifies the potential flooding risk, including groundwater, at the project site and public access area and to develop a plan for adapting the project site and public access amenities beyond mid-century and out to 2100. Additionally, Special Condition II.N requires preparation of the adaption plan and 5-year assessments of the flooding risks at the site and monitoring of any flooding that begins to occur at the project site and adjacent public access area as sea level rises.

Comparable Projects Approved by the Commission
The Commission considers its previous actions on comparable projects to help inform a decision about whether public access proposed as part of a project represents the maximum feasible scope and type consistent with the project. The Commission has in many instances required public access around wastewater treatment facilities, such as the Bay Trail constructed and maintained by the East Bay Regional Park District adjacent to the Oro Loma Treatment Plant (M1983.052), Sewerage Agency of Southern Marin Facility (1980.021.04), and others. However, in some locations where there has been a justifiable public health, safety, or security concern, the Commission has required the permittee to provide in-lieu public access. Given the existing Bay Trail and large recreational area at the adjacent Bedwell Bayfront Park and the public health concerns with having people walk near raw wastewater ponds, it seems reasonable that additional improvements to the existing Bedwell Bayfront Park in lieu of onsite improvements would be appropriate in this instance. Additionally, the construction of the shoreline protection is not impacting

the present or possible future public access to the Bay at the project site and is not going to change the frequency of use of the shoreline area at the FERRF because it is currently inaccessible.

As conditioned, the Commission finds that the project is consistent with the McAteer-Petris Act and Bay Plan policies on maximum feasible public access consistent with the project.

D. Environmental Justice and Social Equity

Bay Plan policies on Environmental Justice and Social Equity state, in part, that "[e]quitable, culturally-relevant community outreach and engagement should be conducted by local governments and project applicants to meaningfully involve potentially impacted communities for major projects and appropriate minor projects in underrepresented and/or identified vulnerable and/or disadvantaged communities, and such outreach and engagement should continue throughout the Commission review and permitting processes. Evidence of how community concerns were addressed should be provided. If such previous outreach and engagement did not occur, further outreach and engagement should be conducted prior to Commission action." (Policy No. 3) "If a project is proposed within an underrepresented and/or identified vulnerable and/or disadvantaged community, potential disproportionate impacts should be identified in collaboration with the potentially impacted communities. Local governments and the Commission should take measures through environmental review and permitting processes, within the scope of their respective authorities, to require mitigation for disproportionate adverse project impacts on the identified vulnerable or disadvantaged communities in which the project is proposed." (Policy No. 4)

The primary purpose of the project is for shoreline protection around the existing overflow facility in the wastewater conveyance system that serves many of the surrounding areas, including communities such as East Palo Alto. The project site is located about 0.8 miles away from the nearest residences. According to the Commission's Community Vulnerability Mapping Tool's 2020 census data, the project is not located within an area that is identified as having high or moderate social or contamination vulnerability. However, many of the surrounding areas and areas serviced by the FERRF are identified as areas that have moderate to high social vulnerability and also moderate to high contamination vulnerability. In the surrounding areas, the most significant indicators of social vulnerability are residents with the following general characteristics: renters, single parent homes, person of color, having very low income, being over 65 and living alone, having no high school diploma, having limited English proficiency, and others. In addition, one of the adjacent census blocks that also encompasses the Cargill Redwood City salt ponds indicates that residents of that census block also have a rating of highest contamination vulnerability. However, a majority of the other census blocks around the project site appear to have low contamination vulnerability.

The WBSD began the planning for the project in 2017. As part of the CEQA Environmental Impact Report development process, the WBSD sent letters to a number of tribes, including Amah Mutsun Tribal Band of Mission San Juan Bautista, Costanoan Rumsen Carmel Tribe, Indian Canyon Mutsun Band of Costanoan, Muwekma, Ohlone Indian Tribe of the San Francisco Bay Area, The Ohlone Indian Tribe, as well as emails and telephone reaching out to these tribes. No written responses were received from the tribes regarding the project, but two tribal contacts were reached by phone. The concerns of the tribe members mainly focused on the potential presence of Native American burial sites near the project and the recommendation that archeological and Native American monitors be present during ground-disturbing activities. In response to the issues raised, the WBSD included an additional mitigation measure in the Final EIR related to monitoring during ground disturbing activities in certain areas and actions to halt work if a significance resource was identified within a certain distance of the work. In addition, if the resource is suspected to be Native American in origin, then a geographically and culturally affiliated Native American monitor would be retained to assess the discovery and make recommendations, and to include updates about how the discovery should be handled.

During the CEQA, the WBSD also held a public stakeholder meeting and the comments provided at the meeting were considered during the development of the Draft EIR. Only two members of the public joined the meeting. The comments at the meeting were mainly related to the location of one of the recycled water distribution pipelines, which was since removed from this project and not included in this permit application. There were also some additional comments asking about what sea level rise scenarios were being used to develop the levee improvement height. Additionally, the District also participated in two interagency meetings (August 2018 and July 2019) and hosted two site visits to gain input from regulatory agency staff on the project. The site visits were mainly with the Regional Water Quality Control Board and USFWS staff. Additionally, following the submittal of the application to BCDC, a number of other interagency discussions were held on the proposed project design. The agency staff were mainly concerned with the proposed project design and the amount of impacts to the existing outboard marsh along Westpoint Slough. In response, the WBSD reassessed the project design and came up with the current proposal, which includes a slightly steeper (20H:1V) ecotone slope and setting back a portion of the northern levee to allow for creation of marsh habitat to compensate for project impacts.

Additionally, during the project planning phase, the COVID-19 pandemic made in person meetings and outreach limited. The WBSD did some targeted outreach to vulnerable and disadvantaged communities through Facebook and YouTube advertisements, although the success of this outreach is unknown. Although the public outreach and engagement for this project has been somewhat limited due to the pandemic, the public access required for the project is being built within an existing park area that is well used by the public and the Commission staff thought this may offer an additional opportunity for public engagement and outreach to park users, the general public, environmental non-profits, the local community, and other potential groups. Special Condition II.B.2 requires the permittee to conduct additional public outreach and engagement and hold at least one meeting to get feedback from the community on the content and to understand the languages/symbols that they are interested in seeing on the interpretive sign that is required at the viewing point at Bedwell Bayfront Park for this project.

E. Flooding and Sea Level Rise

The Bay Plan Climate Change Policy No. 2 states, in part, that "[w]hen planning shoreline areas or designing larger shoreline projects, a risk assessment should be prepared by a qualified engineer and should be based on the estimated 100-year flood elevation that takes into account the best estimates of future sea level rise and current flood protection and planned flood protection that will be funded and constructed when needed to provide protection for the proposed project or shoreline area. A range of sea level rise projections for mid-century and end of century based on the best scientific data available should be used in the risk assessment. Inundation maps used for the risk assessment should be prepared under the direction of a qualified engineer. The risk assessment should identify all types of potential flooding, degrees of uncertainty, consequences of defense failure, and risks to existing habitat from proposed flood protection devices." Policy No. 3 also state that "[t]o protect public safety and ecosystem services, within areas that a risk assessment determines are vulnerable to future shoreline flooding that threatens public safety, all projects—other than repairs of existing facilities, small projects that do not increase risks to public safety, interim projects and infill projects within existing urbanized areas—should be designed to be resilient to a mid-century sea level rise projection. If it is likely the project will remain in place longer than mid-century, an adaptive management plan should be developed to address the long-term impacts that will arise based on a risk assessment using the best available science-based projection for sea level rise at the end of the century." The Bay Plan Safety of Fills Policy No. 4 also states, in part, that "[n]ew projects on fill or near the shoreline should either be set back from the edge of the shore [and] be built so the bottom floor level of structures will be above a 100-year flood elevation that takes future sea level rise into account for the expected life of the project, be specifically designed to tolerate periodic flooding, or employ other effective means of addressing the impacts of future sea level rise and storm activity."

To initially understand the potential overtopping risk at the project site, the applicant used the "Sea Level Rise & Overtopping Analysis for San Mateo County's Bayshore" Final Report (San Mateo County Final Report) dated May 2016, which was developed using BCDC's Adapting to Rising Tides methodology. The San Mateo County Final Report is for planning-level assessments only and further analysis for engineering and design is required to be done by a qualified engineer to understand the actual flooding risk from coastal, fluvial, and any potential groundwater conditions on the site. As part of the engineering and design process, the WBSD developed a basis of design report that included an assessment of the resilience of the project design to FEMA 100-year storm conditions and sea level rise, including wave run-up on the ecotone levee. This design report included engineering analysis of the potential wave effects (wind setup, wave period, significant wave height, the one percent wave height, and wave runup) on the integrity of the ecotone levee berm stability to erosion and flooding at 2050, but this did not include: discussion or maps for potential sea level rise impacts on the shoreline protection beyond 2050, evaluation of groundwater rise with sea level rise, assessment of how subsidence may impact overtopping and inundation in the future, and the adaptive capacity or adaptation plan beyond 2070 and to 2100.

In analyzing a project's risk of flooding and the adaptive capacity as sea level rises, the Commission currently relies on the sea level rise estimates provided in the 2018 California Sea Level Rise Guidance from the Ocean Protection Council and Natural Resources Agency ("2018 State Guidance"), which currently represents the best available science. The 2018 State Guidance recommends the use of probabilistic projections to understand potential sea level rise impacts, which associate a likelihood of occurrence with projected sea level increases and rates tied to a range of emission scenarios.

The 2018 State Guidance provides an approach that requires establishing the level of risk aversion that can be tolerated for the project given the consequences of future flooding, then making use of probabilistic projections of sea level rise that relate to the chosen degree of risk aversion. An "extreme risk aversion" projection should be used for projects where no adaptive capacity exists, the onsite assets would be irreversibly destroyed or prohibitively costly to relocate or repair, or considerable health, safety, or environmental impacts might occur as a result of the flooding. A "medium/high risk aversion" projection has a 1-in-200 chance of occurring and should be used for projects where there may be low adaptive capacity, or the area is more vulnerable to flooding and the consequences of underestimating sea level rise could result in medium to high impacts. In analyzing the safety of this shoreline protection project with regards to future sea level rise and flooding, the Commission staff analyzed the "medium/high risk aversion" scenario and high emissions planning scenario because this project includes elements that will protect both the FERRF, habitats, and the public access adjacent to the site. Since the FERRF currently stores raw wastewater at the site during times when the system is at capacity the medium-high risk assessment and high emissions planning scenario is appropriate given the current use and consequences of potentially flooding could be high. Additionally, the WBSD project team let Commission staff know that they used the medium-high risk aversion and high emissions planning scenario when designing the project.

The current still water elevations at the site include Mean High Water (MHW) at approximately +6.5 feet NAVD88, Mean Higher High Water (MHHW) at approximately +7.1 feet NAVD88, 100-year flood level at approximately +10.7 feet NAVD88 (Station ID 757; FEMA/AECOM SF Bay Tidal Datums Study, 2016). Additionally, the project site is in a FEMA AE zone, which indicates the area may experience wave heights that are less than 3 feet. The majority of the site and Flood Slough are in an area with a Base Flood Elevation (BFE) of +11 feet NAVD88, but the Westpoint Slough along where the ecotone levee would be constructed has a FEMA BFE of +12 feet NAVD88, and Commission staff used the more conservative FEMA BFE in Westpoint Slough. Employing the medium-high risk aversion and high emissions scenario at the project site and the public access area, the future anticipated still water levels at mid-century and over the 50-year life of the project include:

- At 2050, with an anticipated rise in sea level of 1.9 feet, the MHHW level will be +9.0 feet NAVD88. The water level during a 100-year (1 percent likelihood) still water elevation of +12.6 feet NAVD88, and a BFE of approximately +13.9 feet NAVD88.
- At 2070, assuming a high-emissions scenario with an anticipated rise of sea level of approximately 3.5 feet of sea level rise, the MHHW level will be +10.6 feet NAVD88. The water level during a 100-year (1 percent likelihood) still water elevation of +14.2 feet NAVD88, and a BFE of approximately +15.5 feet NAVD88.

The shoreline protection around the facility was designed to take into account the still water elevation plus any wave runup through 2050 and provide plenty of free board to prevent any flooding. Additionally, the public access area is at the same elevation as the shoreline protection, but in the adjacent park, and the wave runup analysis did not extend to this area. Although the wave runup analysis has not been done for the public access area, the still water elevations at 2050 indicates that the public access area would not be overtopped and would remain usable during normal daily tides, during a

100-year storm, and at the FEMA BFE. Beyond 2050 further analysis is needed to understand the flood risk with wave runup over the life of the project and beyond that time.

At 2070, however, the shoreline protection and public access area will still provide ample protection from overtopping during normal daily high tides (MHHW) and likely during a 100-year storm. However, the contribution of any wave runup and subsidence to potential overtopping during a 100-year storm and the potential flooding from groundwater at 2070 was not analyzed and is not known at this time. Additionally, the BFE for Westpoint Slough would be above the elevation of the shoreline protection and public access area and likely lead to overtopping, which would dissipate once the storm conditions ceased, but some damage may occur to the FERRF site and the public access area.

The WBSD has mentioned that the beyond 2070 and to 2100, the sheetpile walls and potentially the ecotone levee could be raised to new elevations. However, a new analysis would be required to understand the risk to the facility and what elevations and designs might be appropriate for the facility at that time. Since a formal risk assessment was not prepared, but much of the engineering analysis was provided up to 2050 and the permittee has some idea of the potential adaptation pathways for the site in the future, the WBSD is required in Special Condition II.N to develop a formal risk assessment for the period of time beyond 2050 and out to 2100, and to submit this to the Commission Staff for review and approval. Additionally, this condition requires the WBSD to also develop an adaptive management plan for sea level rise and to provide this to the Commission for review and approval. Special Condition II.N requires flood monitoring and reporting and five-year reassessments of the risk assessment to understand if any conditions are changing at the site over the life of the project and such that the risk assessment and adaptive management plan should be updated, or if it appears that adaptation measure may need to be implemented. This condition also requires implementation and adaption of the public access areas and the shoreline protection, if it appears that they are at risk of flooding in the future or being damaged by overtopping.

F. Public Trust Uses

The activities authorized herein are located on filled former tidelands subject to the public trust. The project is consistent with public trust needs for the area, as it provides recreation and open space improvements.

G. Review Boards

The project was not reviewed by the Design Review Board or the Engineering Criteria Review Board, as the project did not raise significant public access design issues and the project did not involve significant fill or safety of fills concerns, as most of the shoreline protection is being built in the shoreline band and has a simply design, with the exception of the ecotone levee slope, which was analyzed during the geotechnical analysis provided for the project.

H. Coastal Zone Management Act

The Commission further finds, declares, and certifies that the activity or activities authorized herein are consistent with the Commission's Amended Management Program for San Francisco Bay, as approved by the Department of Commerce under the Federal Coastal Zone Management Act of 1972, as amended.

I. Environmental Review

Pursuant to the California Environmental Quality Act (CEQA), an Environmental Impact Report (EIR) was prepared for the Flow Equalization and Resource Recovery Facility Levee Improvements and Bayfront Recycled Water Facility Project, which included the FERRF Levee Improvement Project and FERRF site that is the subject of this permit. The Final EIR was prepared by the West Bay Sanitary District and was adopted on May 12, 2021. The FEIR found that the project may result in some potentially significant impacts to aesthetics, biological resources, cultural, historical, and tribal cultural resources, and geology and soils, but all of the impacts were determined to be less than significant with the mitigation measures that were incorporated into the project.

J. Enforcement Program and Civil Penalties

The Commission has an enforcement program that reviews its permits for compliance. The Commission may issue cease and desist and civil penalty orders if violations are discovered. The McAteer-Petris Act provides for the imposition of administrative civil penalties ranging from $10 to $2,000 per day up to a maximum of $30,000 per violation. The Act also provides for the imposition of court-imposed civil penalties of up to $30,000 in addition to any other penalties, penalties for negligent violations of between $50 and $5,000 per day, knowing and intentional penalties of between $100 and $10,000 per day, and exemplary penalties, which are supplemental penalties, in an amount necessary to deter future violations. In addition, anyone who places fill, extracts materials, or makes any substantial change in use of any water, land or structure within the area of the Commission's jurisdiction without securing a permit from the Commission is guilty of a misdemeanor.

IV. Standard Conditions

A. Permit Execution

This permit shall not take effect unless the permittees execute the original of this permit and return it to the Commission within ten days after the date of the issuance of the permit. No work shall be done until the acknowledgment is duly executed and returned to the Commission.

B. Notice of Completion

The attached Notice of Completion and Declaration of Compliance form shall be returned to the Commission within 30 days following completion of the work.

C. Permit Assignment

The rights, duties, and obligations contained in this permit are assignable. When the permittees transfer any interest in any property either on which the activity is authorized to occur or which is necessary to achieve full compliance of one or more conditions to this permit, the permittees/transferors and the transferees shall execute and submit to the Commission a permit assignment form acceptable to the Executive Director. An assignment shall not be effective until the assignees execute and the Executive Director receives an acknowledgment that the assignees have read and understand the permit and agree to be bound by the terms and conditions of the permit, and the assignees are accepted by the Executive Director as being reasonably capable of complying with the terms and conditions of the permit.

D. Permit Runs with the Land

Unless otherwise provided in this permit, the terms and conditions of this permit shall bind all future owners and future possessors of any legal interest in the land and shall run with the land.

E. Other Government Approvals

All required permissions from governmental bodies must be obtained before the commencement of work; these bodies include, but are not limited to, the U. S. Army Corps of Engineers, the State Lands Commission, the Regional Water Quality Control Board, and the city or county in which the work is to be performed, whenever any of these may be required. This permit does not relieve the permittees of any obligations imposed by State or Federal law, either statutory or otherwise.

F. **Built Project must be Consistent with Application**

Work must be performed in the precise manner and at the precise locations indicated in your application, as such may have been modified by the terms of the permit and any plans approved in writing by or on behalf of the Commission.

G. **Life of Authorization**

Unless otherwise provided in this permit, all the terms and conditions of this permit shall remain effective for so long as the permit remains in effect or for so long as any use or construction authorized by this permit exists, whichever is longer.

H. **Commission Jurisdiction**

Any area subject to the jurisdiction of the San Francisco Bay Conservation and Development Commission under either the McAteer-Petris Act or the Suisun Marsh Preservation Act at the time the permit is granted or thereafter shall remain subject to that jurisdiction notwithstanding the placement of any fill or the implementation of any substantial change in use authorized by this permit. Any area not subject to the jurisdiction of the San Francisco Bay Conservation and Development Commission that becomes, as a result of any work or project authorized in this permit, subject to tidal action shall become subject to the Commission's "bay" jurisdiction.

I. **Changes to the Commission's Jurisdiction as a Result of Natural Processes**

This permit reflects the location of the shoreline of San Francisco Bay when the permit was issued. Over time, erosion, avulsion, accretion, subsidence, relative sea level change, and other factors may change the location of the shoreline, which may, in turn, change the extent of the Commission's regulatory jurisdiction. Therefore, the issuance of this permit does not guarantee that the Commission's jurisdiction will not change in the future.

J. **Violation of Permit May Lead to Permit Revocation**

Except as otherwise noted, violation of any of the terms of this permit shall be grounds for revocation of the permit. The Commission may revoke the permit for such violation after a public hearing held on reasonable notice to the permittees or their assignees if the permit has been effectively assigned. If the permit is revoked, the Commission may determine, if it deems appropriate, that all or part of any fill or structure placed pursuant to this permit shall be removed by the permittees or their assignees if the permit has been assigned.

K. Should Permit Conditions be Found to be Illegal or Unenforceable

Unless the Commission directs otherwise, this permit shall become null and void if any term, standard condition, or special condition of this permit shall be found illegal or unenforceable through the application of statute, administrative ruling, or court determination. If this permit becomes null and void, any fill or structures placed in reliance on this permit shall be subject to removal by the permittees or their assignees if the permit has been assigned to the extent that the Commission determines that such removal is appropriate. Any uses authorized shall be terminated to the extent that the Commission determines that such uses should be terminated.

L. Permission to Conduct Site Visit

The permittees shall grant permission to any member of the Commission's staff to conduct a site visit at the subject property during and after construction to verify that the project is being and has been constructed in compliance with the authorization and conditions contained herein. Site visits may occur during business hours without prior notice and after business hours with 24-hour notice.

M. Abandonment

If, at any time, the Commission determines that the improvements in the Bay authorized herein have been abandoned for a period of two years or more, or have deteriorated to the point that public health, safety or welfare is adversely affected, the Commission may require that the improvements be removed by the permittees, their assignees or successors in interest, or by the owner of the improvements, within 60 days or such other reasonable time as the Commission may direct.

N. Best Management Practices

1. Debris Removal
   All construction debris shall be removed to an authorized location outside the jurisdiction of the Commission. In the event that any such material is placed in any area within the Commission's jurisdiction, the permittees, their assignees, or successors in interest, or the owner of the improvements, shall remove such material, at their expense, within ten days after they have been notified by the Executive Director of such placement.

2. Construction Operations
   All construction operations shall be performed to prevent construction materials from falling, washing or blowing into the Bay. In the event that such material escapes or is placed in an area subject to tidal action of the Bay, the permittees shall immediately retrieve and remove such material at their expense.

Executed at San Francisco, California, on behalf of the San Francisco Bay Conservation and Development Commission on the date first above written.

DocuSigned by:
Larry Goldzband
FD166E908010417...

LAWRENCE J. GOLDZBAND
Executive Director
San Francisco Bay Conservation
and Development Commission

LJG/AL/ra

cc: U. S. Army Corps of Engineers, Attn.: Regulatory Functions Branch
San Francisco Bay Regional Water Quality Control Board, Attn.: Certification Section
Environmental Protection Agency
City and County of San Francisco Planning Department

* *

Receipt acknowledged, contents understood and agreed to:

Executed at 1:42PM

On May 4, 2023

West Bay Sanitary District
Permittee

Sergio Ramirez
Digitally signed by Sergio Ramirez
DN: cn=Sergio Ramirez, o=West Bay Sanitary District, ou=Personal, email=sramirez@westbaysanitary.org, c=US
Date: 2023.05.04 13:41:47 -07'00'

Signature

Sergio Ramirez
Print Name

General Manager
Title

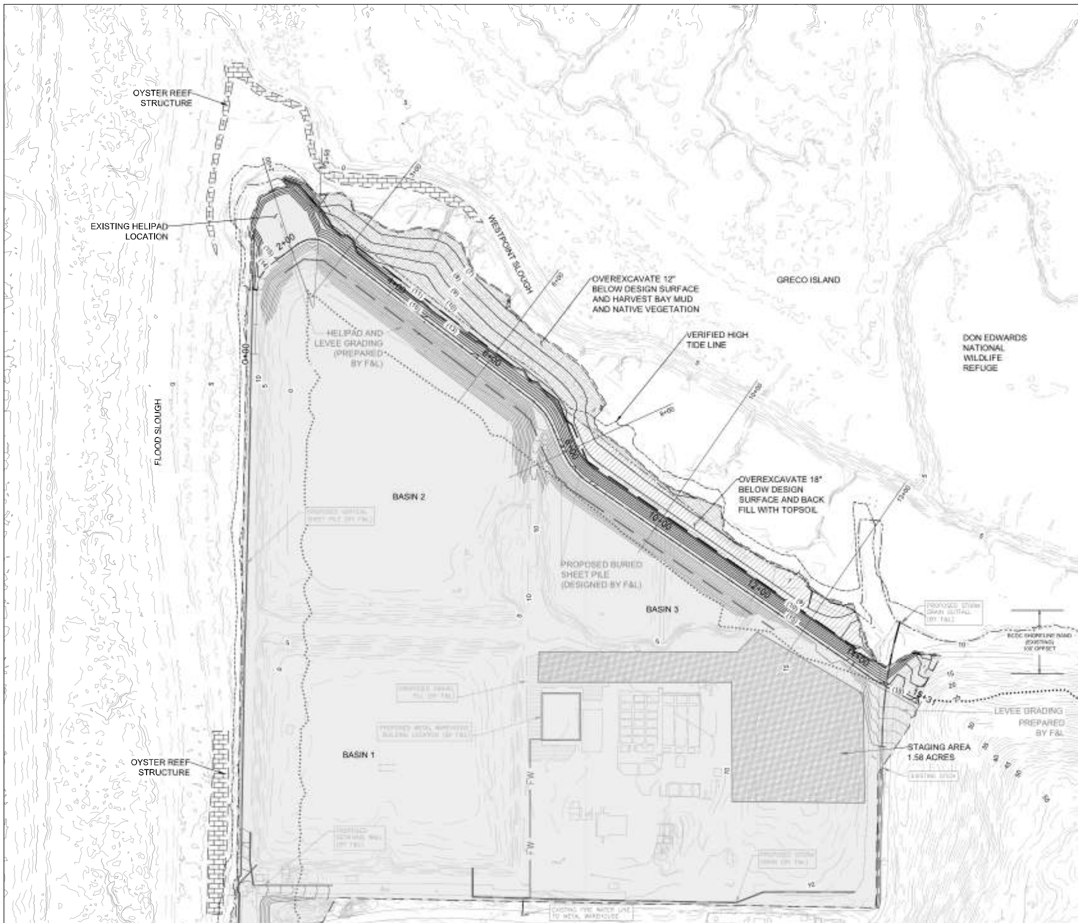
NOTES

1. Proposed location of ADA complaint viewing area with bench and interpretive signage.
2. Emergency Helipad. Restricted access.
3. Active Wastewater and Construction Storage Facility (For Health & Safety, No Public Access)

Photo 1. Approximate view from proposed vantage point (1).

Proposed Public Access to Shoreline Post Construction		FIGURE 2
JOB NO.: 001079	DATE: 01/10/2022	

BCDC PERMIT NO. 2022.001.00 - SITE PLAN - EXHIBIT B



PLAN LEGEND

- LIMIT OF DISTURBANCE
- LIMIT OF GRADING DESIGNED BY SWCA
- PROPOSED VERTICAL SHEET PILE LOCATION
- PROPOSED BURIED SHEET PILE LOCATION
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- VERIFIED HIGH TIDE LINE (HTL)
- EXISTING BCDC BAY SHORELINE (MSL + 5')
- EXISTING BCDC SHORELINE BAND (100' OFFSET FROM MSL + 5')
- OYSTER REEF STRUCTURE
- SECTION LINE AND STATION
- STAGING AREA
- AREA AND FEATURES DESIGNED BY SITE ENGINEERS FREYER & LAURETA, INC (F&L)
- AREA TO OVER EXCAVATE 18" BELOW DESIGN SURFACE AND BACK FILL WITH TOPSOIL
- AREA TO OVER EXCAVATE 12" BELOW DESIGN SURFACE AND HARVEST BAY MUD AND NATIVE VEGETATION

TIDAL DATUM					
FEET-NAVD88					
MLLW	MSL	MHW	MHHW	MSL+5' (BCDC BAY SHORELINE)	HTL (SECTION 401/404)
-1.18	3.35	6.51	7.12	8.35'	AS SHOWN ON PLAN / FIELD VERIFIED

NOTE:

1. SOIL SPECIFICATIONS FOR ALL IMPORTED FILL MATERIAL FOR THE ECOTONE SLOPE/LIVING SHORELINE AND TIDAL MARSH CREATION AREA, INCLUDING GENERAL FILL, BAY MUD TOPSOIL, AND UPLAND TOPSOIL, WILL BE SUBMITTED TO THE WATER BOARD FOR APPROVAL PRIOR TO CONSTRUCTION.
2. INSTALL OYSTER REEF STRUCTURES IN BETWEEN MLLW AND MSL (-1.18 TO 3.35 FEET-NAVD 88).
3. FINAL LIMIT OF GRADING AND DISTURBANCE TO BE STAKED IN THE FIELD BY THE PROJECT BIOLOGIST PRIOR TO CONSTRUCTION TO MINIMIZE / AVOID TEMPORARY IMPACTS TO EXISTING MARSH HABITAT.
4. LIMIT OF DISTURBANCE AT THE ECOTONE SLOPE/LIVING SHORELINE AND TIDAL MARSH CREATION AREA IS 2 FEET OFFSET OF LIMIT OF GRADING.

SCALE (34"X22"): 1" = 80'
SCALE (17"X11"): 1" = 160'

0 80 160
SCALE IN FEET

DATE: 08/10/2022	JYZ	08/10/2022	65% DESIGN	BSS
SCALE: AS NOTED				
DESIGNED: JYZ				
DRAWN: JYZ				
CHECKED: BSS				
PROJ. ENGR: BSS				
	BY	DATE	DESCRIPTION OF REVISIONS	APP'D

FREYER & LAURETA, INC.
CIVIL ENGINEERS • SURVEYORS • CONSTRUCTION MANAGERS
150 Executive Park Blvd #4200 • San Francisco, CA 94134
(415)534-7070 • www.freyerlaureta.com

SUBCONSULTANT
SWCA ENVIRONMENTAL & ENGINEERING
2996 107th Avenue, Oakland, CA 94605
(650)440-4160 www.swca.com

WEST BAY SANITARY DISTRICT
SAN MATEO COUNTY
PROJECT No. 1762.0

FLOW EQUALIZATION AND RESOURCE RECOVERY FACILITY LEVEE IMPROVEMENTS AND BAYFRONT RECYCLED WATER FACILITY PROJECT
PROPOSED GROUND OVERVIEW
MENLO PARK, CALIFORNIA

SHEET 2 OF 7 SHEETS
JOB NO. 1079

CLEAN WATER ACT SECTION 401 WATER QUALITY CERTIFICATION AND ORDER FOR THE

Flow Equalization and Resource Recovery Facility (FERRF) Levee Improvements Project

San Mateo County

Sent via electronic mail: No hard copy to follow

Effective Date: December 21, 2022
RM: 447484
Place ID: 880734
WDID No. 2 CW447484
Corps File No.: 2018-00371S

Applicant: West Bay Sanitary District
500 Laurel Street
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Certification and Order Coverage

This Clean Water Act (CWA) section 401 Water Quality Certification (Certification) and Order (Order) is issued to the West Bay Sanitary District (Permittee or WBSD).

Pursuant to CWA section 404, the Permittee requested authorization to fill and discharge to waters of the U.S. from the U.S. Army Corps of Engineers (Corps), Regulatory Branch, under an Individual Permit (Corps File No. 2018-00371S).

The Permittee applied to the San Francisco Bay Regional Water Quality Control Board (Water Board) requesting Certification verifying the Flow Equalization and Resource Recovery Facility (FERRF) Levee Improvements Project (Project) does not violate State water quality standards. The application for Certification was initially received on April 18, 2022. The Corps deemed the reasonable period of time for this Certification to be April 18, 2023.

The following sections are derived from the Application.

1. Project

The Project will protect the WBSD's flow equalization capacity from being lost to inundation under both current conditions and future sea level rise.

1.1 Site Description

The Project site is located off Marsh Road in the City of Menlo Park, San Mateo County (Lat. 37.495927, Long. -122.175889). The approximately 20-acre site is bordered by Westpoint Slough and the Don Edwards National Wildlife Refuge to the north, Bedwell Bayfront Park to the east, and Flood Slough and salt evaporation ponds to the west. The site contains a satellite maintenance corporation yard and small operations office, the remnants of a decommissioned wastewater treatment plant (WWTP), and a small native plant nursery operated by Save the Bay. The Permittee owned and operated FERRF is also situated at the Project site. The FERRF consists of three basins (Basins 1 - 3) and a return pump station.

The FERFF currently provides critical overflow wastewater storage within the three basins when the WBSD conveyance system to the waste treatment plant is at capacity or undergoing maintenance or repairs. WBSD's collection system drains into a pump station (Menlo Park Pump Station) near the entry into Bedwell Bayfront Park. Under normal flow conditions, the Menlo Park Pump Station pumps wastewater to the Silicon Valley Clean Water (SCVW) Treatment Plant in Redwood City. During high flow events (wet weather flows) when collected wastewater exceeds the capacity of either the plant or the conveyance system to the plant, wastewater is diverted from the Menlo Park Pump Station to the FERRF. When wastewater flow to the Menlo Park Pump Station normalizes, the wastewater stored at the FERRF is then pumped back to the Menlo Park Pump Station. Basins 1 and 2 are used for flow equalization and Basin 3 is used for emergency storage and storage of wastewater in the event Basins 1 and 2 are being repaired. Levees currently surround the perimeter of the site on 2 sides (north and west) to separate the facility from adjacent lands and waters.

Currently, the FERRF is in the 100-year flood zone and at high risk of flooding which will only increase with sea level rise (SLR). The existing earthen levees are failing and do not meet Federal Emergency Management Agency (FEMA) standards. If the existing levees failed, up to 23.6 million gallons of raw wastewater could enter the San Francisco Bay (Bay), contaminating sensitive habitats and threatening wildlife while damaging critical community infrastructure. The Project is being undertaken to comply with FEMA standards and to protect the Bay from raw wastewater contamination.

1.2 Background

With projected SLR at the Project site, most of the existing tidal marsh habitat on the FERFF's Bay side will be lost due to inundation, as modeled by the Permittee in their basis of design report. Without the Project and with projected SLR, most of the existing vegetated salt marsh habitat on the north side of the FERFF would be converted to mudflat and open water habitat over time, resulting in a permanent loss of vegetated marsh and upland refugia.

The San Francisco Bay Shoreline Adaptation Atlas[1], identifies effective shoreline adaptation strategies that are appropriate for specific settings and takes advantage of natural processes. The report divides the Bay shoreline into 30 operational landscape units (OLUs) which are connected geographic areas that share common physical characteristics that would benefit from being managed as individual units. The report identifies the shoreline along the northern levee of the FERRF site as potentially suitable for an ecotone slope/living shoreline that can address coastal risks including storm surge, erosion, and short-term and long-term SLR. The Project's ecotone slope[2] is expected to provide resilience against SLR by maintaining tidal marsh and upland habitat for special-status species that would otherwise eventually be converted to mudflat and open water habitat over time. The resulting shoreline will include a mosaic of mudflat, low marsh, high marsh, and transition zone habitats that will help to increase habitat complexity for special-status species adjacent to the project site. Oyster reef structures will be installed along the northern edge of the marsh area to provide ecological uplift.

1.3 Alternatives Analysis

The Permittee evaluated Project alternatives, pursuant to CWA Section 404(b)(1), in their *Alternatives Analysis for the West Bay Sanitary District Flow Equalization and Resource Recover Facility Flood Protection Project, San Mateo County, California* (SWCA, August 2022) (Alternatives Analysis). In the Alternatives Analysis, the Permittee evaluated eight alternative designs (Alternatives A – H). Of the Alternatives evaluated, Alternative F would eliminate impacts to waters of the State while still providing habitat value through the creation of an ecotone slope.

Alternative F would have relocated the ecotone slope further inland by reducing Basins 1 and 2's capacity. This alternative was eliminated from further consideration due to engineering and

[1] Published by the San Francisco Estuary Institute (SFEI) and San Francisco Bay Area Planning and Urban Research Association (SPUR) in 2019.

[2] Traditionally the term "ecotone" references areas that are constructed in uplands or diked Baylands. The "ecotone slope" referred to and authorized in this Certification is specific to the site-constraints and is not intended to combine the traditionally accepted ecotone term with the one presented herein.

technology constraints. The reduction in wastewater storage capacity in Basins 1 and 2 is not feasible due to the contractual obligation the WBSD has with the SCVW and from within the WBSD's service area. Basins 1 and 2 accommodate about 8 to 10 and 9.94 million gallons (MG) of raw wastewater storage, respectively. If the regional treatment plan were to shut down due to unforeseen reason during a storm event, Basin 2 would be activated for additional storage, an event that occurred approximately 12 years ago. WBSD was a contractual obligation to have Basin 2 available as an overflow to Basin 1 for regional treatment flows.

Other Alternatives would have more impacts to waters of the State, or have little to no impacts to waters of the State but would not provide habitat value. The Permittee chose to move forward with Alternative E, the design presented in this Certification. The Project's limit of grading was intentionally pulled back from this existing slough channel to conserve most of the existing vegetated salt marsh, which will help to stabilize the ecotone slope's toe, minimize disturbance of the adjacent channel, and provide intact habitat immediately adjacent to the project while the ecotone slope habitats develop over time. The Project was also shifted south from the originally proposed design, resulting in a reduction of approximately 0.64 MG of functional capacity in Basin 3. The final design of Alternative E minimized impacts to waters of the State.

1.4 Construction Summary

The Project will install sheet pile walls along the site's perimeter, raise the grades along the perimeter access road and portions of two adjacent trails, construct an ecotone slope, and install oyster reef structures to increase ecosystem benefits. Project construction will mostly occur on upland levee slopes that are engineered and contain numerous invasive species, but the ecotone slope construction and oyster reef structure installation will impact waters of the State.

Sheet Piles, Perimeter Access Roads, and Adjacent Trails

Approximately 3,700 linear feet (LF) of double wall sheet pile walls will be installed into the existing earthen levee roads along the site's western and northeast perimeter. The sheet pile walls, consisting of 3/8-inch thick, 12-inch-wide, 35-foot-long steel metal plates, will be buried into the existing levee road, landward and above the high tide line. The grades along the perimeter access roads and portions of two adjacent trails within Bedwell Park will be raised along approximately 160 LF, 150 LF, and 200 LF, respectively.

Ecotone Slope

The Permittee will create an ecotone slope/living shoreline along a portion of the Bay shoreline adjacent to the FERFF site to help protect the WBSD's existing facilities, underserved residents, and Bay water quality from the current 100-year flood zone and future SLR. Approximately 598 feet of ecotone slope will be created.

To construct the ecotone levee, cofferdams will first be installed at low tide to temporarily isolate the area from tidal action and facilitate dry construction conditions. The cofferdams, consisting of sheet piles, will be installed using a vibratory hammer, or similar machinery, staged on top of the existing levee. Dewatering may be necessary to remove residual water from precipitation and groundwater intrusion (see Condition 10). The site will then be cleared and grubbed, any existing marsh vegetation will be salvaged and preserved onsite, watered, and protected so that it can be used to revegetate the ecotone levee.

Import fill from on-site will be used to raise the existing levee and ecotone levee to an elevation of 15 feet[3]. All fill used onsite will be handled and installed in accordance with the Project's *Quality Assurance Project Plan for the West Bay Sanitary District Flow Equalization and Resource Recovery Facility Flood Protection Project, Menlo Park, San Mateo County, California* (SWCA, August 2022) (QAPP). The slope will be graded to an approximately 20:1 (horizontal:vertical) maximum slope, resulting in lower elevations ranging from 0.1 to 1.0 feet above the high tide line. This will allow for occasional to regular tidal inundation and result in natural sedimentation and establishment of halophytic (salt-tolerant) species, such as pickleweed (*Salicornia virginica*), saltgrass (*Distichlis spicata*), big saltbrush (*Atriplex lentiformis*), and marsh gumplant (*Grindelia stricta*). Establishment of this vegetation will provide suitable habitat for salt marsh harvest mouse, California Ridgway's rail, and other shorebird and migratory bird species. Once grading is completed, the area will be inspected for stability and prepared for planting. After construction of the ecotone slope/living shoreline and tidal marsh at the north point, salvaged marsh vegetation and other native plants will be installed on the ecotone slope surface After the ecotone is revegetated, the cofferdam will be removed to restore tidal action in the ecotone area.

Oyster Reefs

Oyster reef elements will be placed, between elevations of 2 to 5 feet, along the perimeter of the northern restoration area as well as along Flood Slough near the entrance to the site. The reef elements consist of prefabricated "Oyster Catcher" reef products developed by Sand Bar Oyster. The prefabricated structures are biodegradable, constructed of a combination of locally sourced Bay Mud, Portland cement, and coir fabric. As the structures degrade slowly over time, they leave only oyster shells behind. These structures are lightweight, modular, and designed to be slightly elevated off the ground surface with anchoring elements to increase the development of pre-seeded oysters on the structures. In total, the oyster reef elements are anticipated to provide approximately 0.36 acre and 1,116 LF of native oyster habitat.

2. Impacts to Waters of the State

The Water Board has independently reviewed the Project record to analyze impacts to water quality and the environment and designated beneficial uses within the Project's watershed.

2.1 Fill and Discharge

The Project will permanently and temporarily impact approximately 0.12 acre and 1.07 acre of waters of the State, respectively, as shown in Tables 1 and 2.

[3] Elevations are reported using the North American Vertical Datum 88.

Table 1: Summary of the Project's permanent impacts to waters of the State.

Activity	Aquatic Resource Type[1]	Specific Habitat Type	Impact Type	Acres
Ecotone Creation	Wetland	Tidal Slough	Physical Loss	0.07
		Northern Coastal Salt Marsh	Physical Loss	0.05
			Total	**0.12**

[1]The Aquatic Resource Type is specific to CIWQS reporting purposes.

Table 2: Summary of the Project's temporary impacts to waters of the State.

Activity	Aquatic Resource Type[1]	Specific Habitat Type	Impact Type	Acres
Ecotone Creation	Wetland	Northern Coastal Salt Marsh	NA	0.71
Oyster Shell Reef		Tidal Slough	NA	0.36
			Total	**1.07**

[1]The Aquatic Resource Type is specific to CIWQS reporting purposes.

The Project's permanent impacts will occur from the conversion of 0.06 acre of dendritic channels within marsh habitat to salt marsh habitat and 0.05 acre of existing salt marsh habitat to uplands within the ecotone slope footprint. The Project's temporary impacts to waters of the State will occur from construction of the ecotone slope and installation of oyster shell reefs. However, these impacted areas are considered temporary because it is anticipated they will be re-established after the Project is completed.

3. Mitigation

The Permittee will mitigate the Project's permanent and temporary impacts to waters of the State. The Project's permanent impacts will be mitigated by the creation of approximately 0.65 acre of salt marsh habitat. The Permittee's temporary impacts to waters of the State are expected to be mitigated by the successful re-establishment of mudflat, low marsh, and high marsh that is anticipated to occur once the ecotone slope is constructed, revegetated, and functional. To verify the created salt marsh habitat extent and functions and the temporarily impacted areas are re-established as intended, the Permittee will monitor the impacted areas for a minimum 10-year period (see Section 6.5). In addition, the footprint of the reefs will be documented and monitored for a minimum 10-year period. Lastly, the Permittee shall monitor the adjacent wetland and mudflat habitat at the site to confirm that the Project does not adversely affect waters of the State beyond the impacts reported herein (see Section 6.5).

The anticipated ecological uplift from the ecotone slope, provided by the transitional habitat, and created marsh habitat are anticipated to mitigate any temporal loss of functions, values, or acreage, associated with the temporal impact that will occur from the time that impacts to waters of the State occur and when the mitigation area and ecotone slope area are constructed and established.

4. California EcoAtlas

Regional, state, and national studies have determined that tracking of mitigation and restoration projects must be improved to better assess the performance of these projects, following monitoring periods that last several years. To effectively carry out the State's Wetlands Conservation Policy of no net loss to wetlands, the State needs to closely track both losses and successes of mitigation and restoration projects affecting wetlands and other waters of the State. The Water Board must also track project performance in Bay Area creeks subject to routine repair and maintenance activities, such as recurring instabilities. Therefore, we adopted the digital interactive mapping tool called *EcoAtlas*.[1] *EcoAtlas* is a web-based tool that integrates maps, project plans, site conditions, restoration efforts, and other elements on a project-by-project basis based on data inputs. Accordingly, we require the Permittee to upload their Project information to *EcoAtlas* with the *Project Tracker* tool at https://ptrack.ecoatlas.org (see Condition 10). The San Francisco Estuary Institute developed *EcoAtlas* and maintains detailed instructions for *Project Tracker* on its website at https://ptrack.ecoatlas.org/instructions.

5. CEQA Compliance

The Permittee, as lead agency, evaluated the Project's potentially significant environmental effects pursuant to the California Environmental Quality Act (CEQA), title 14, California Code of Regulations (14 CCR). The Project's environmental effects were evaluated in a CEQA document prepared for the Project, *Flow Equalization and Resource Recovery Facility Levee Improvements and Bayfront Recycled Water Facility Project, Draft Environmental Impact Report* (West Bay Sanitary District, December 2020) (DEIR) (State Clearinghouse No. 2020050414). The Permittee filed a Notice of Determination (NOD) for the Project on May 18, 2021. The Water Board, as a responsible agency under CEQA, has reviewed the DEIR and the Project's potentially significant effects under our purview and concurs that the NOD is appropriate.

6. Conditions

I, Eileen White, Executive Officer, do hereby issue this Order certifying that any discharge from the proposed Project will comply with the applicable provisions of CWA sections 301 (Effluent Limitations), 302 (Water Quality Related Effluent Limitations), 303 (Water Quality Standards and Implementation Plans), 306 (National Standards of Performance), and 307 (Toxic and Pretreatment Effluent Standards), and with other applicable requirements of State law. This discharge is also regulated under State Water Resources Control Board Order No. 2003-0017-DWQ, "General Waste Discharge Requirements for Dredge and Fill Discharges That Have Received State Water Quality Certification," which requires compliance with all conditions of this Order, including the following:

[1] Source: California Wetlands Monitoring Workgroup (CWMW). EcoAtlas. Accessed March 12, 2019. https://www.ecoatlas.org. CWMW includes SFEI, State Board, U.S. EPA Region IX, and other agencies with similar goals to track effects of projects in wetlands and other aquatic habitats.

6.1 Regulatory Compliance and Work Windows

1. **Design Conformance.** The Project work shall be constructed in conformance with the Application materials, including supplemental information, and as described in this Certification. Any changes to the Project that may impact waters of the State must be accepted by the Executive Officer before they are implemented. To request Executive Officer acceptance, the Permittee shall submit the proposed revisions, clearly marked and described, to the attention of the Water Board staff listed on the cover page of this Certification. The Permittee shall not implement the proposed revisions until notified that they have been accepted by the Executive Officer.

   Rationale: *This condition is necessary to ensure compliance with the permit and applicable conditions and to ensure that the proposed work and final restoration work has been conducted in accordance with the permit and all applicable conditions. (California Water Code (CWC) section 13264).*

2. **Corps Permit Compliance.** The Permittee shall adhere to the conditions of the Project's CWA section 404 NWP (Corps File No. 2018-00371S).

   Rationale: *This condition is required pursuant to 23 CCR section 3856(e), which requires that copies be provided to the Water Boards of "any final and signed federal, state, and local licenses, permits, and agreements (or copies of the draft documents, if not finalized) that will be required for any construction, operation, maintenance, or other actions associated with the activity."*

3. **Special Status Species.** This Certification does not allow for the take, or incidental take, of any special status species. The Permittee shall request appropriate protocols prescribed from the United State Fish and Wildlife (USFWS) and/or National Marine Fisheries Service (NMFS) to ensure that Project activities do not impact the Beneficial Use of the Preservation of Rare and Endangered Species, and shall implement the provided protocols, as appropriate;

   Rationale: *This condition is necessary to ensure avoidance and minimization of impacts to waters of the State and associated Beneficial Uses from construction activities (CWC Section 13369(b)(1)(B) and (C); Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan) Section 4.19).*

4. **Precipitation and Construction Planning.** Precipitation forecasts shall be considered when planning construction activities. The Permittee shall monitor the 72-hour forecast from the National Weather Service at https://www.nws.noaa.gov. For construction of the box culvert/outlet structure within and along the shoreline of Lake Merced's Impound Lake, within the dewatered work area the Permittee shall remove all equipment from waters of the State and implement erosion and sediment control measures when there is a forecast of more than 50% chance of at least 0.25 inches of rain. For all other construction activities, when there is a forecast of more than 50% chance of rain, or at the onset of unanticipated precipitation, the Permittee shall remove all equipment from waters of the State, implement erosion and sediment

control measures (e.g., jute, straw, coconut fiber erosion control fabric, coir logs, straw), and cease all Project activities. If any construction activities will occur after October 31, a Winterization Plan shall be submitted to the Executive Officer for review and acceptance and contain, but not be limited to, the following:

a) Activities and Timeline Description—for any proposed activity that will begin or end after October 31, the activity and its respective construction timeline, from start to finish, shall be described in detail.

b) Erosion Control Measures—all erosion control measures shall be described in detail, including, but not limited to, the type of erosion control measure and its material, implementation timeline, and best management practices to be used during and after implementation;

Rationale: *This condition is necessary to ensure avoidance and minimization of impacts to waters of the State from construction activities (CWC section 13376 et seq.).*

5. **Work Windows**: To work outside of October 31, the Permittee must meet the precipitation and construction planning requirement specified in this Certification (see Condition 4);

Rationale: *This condition is necessary to ensure avoidance and minimization of impacts to waters of the State from construction activities (CWC section 13376 et seq.).*

6.2 General Construction

6. **Discharge Prohibition.** No unauthorized construction-related materials or wastes shall be allowed to enter into or be placed where they may be washed by rainfall or runoff into waters of the State. When construction is completed, any excess material shall be removed from the work area and any areas adjacent to the work area where such material may be discharged to waters of the State;

Rationale: *This condition is necessary to ensure that contaminated material is not placed within waters of the State (Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan) sections 3.3.12, 3.3.19, and 4.19).*

7. **Equipment Maintenance Prohibition.** No fueling, cleaning, or maintenance of vehicles or equipment shall take place within waters of the State, or within any areas where an accidental discharge to waters of the State may occur; and construction materials and heavy equipment must be stored outside of waters of the State. When work within waters of the State is necessary, best management practices shall be implemented to prevent accidental discharges;

Rationale: *This condition is necessary to ensure avoidance and minimization of impacts to waters of the State and associated Beneficial Uses from construction activities (CWC section 13369(b)(1)(B) and (C); Basin Plan section 4.19).*

8. **Beneficial Use Impacts.** All work performed within waters of the State shall be completed in a manner that minimizes impacts to beneficial uses and habitat; measures shall be employed to minimize disturbances along waters of the State that will adversely impact the water quality of waters of the State. Disturbance or removal of vegetation shall not exceed the minimum necessary to complete Project implementation;

   Rationale: *This condition is necessary to ensure minimization of impacts to waters of the State and to ensure successful restoration of all temporary impacts authorized (State Board Resolution No. 68-16; 40 CFR Part 131.12 (a)(1); CWC sections 13264 and 13369; Basin Plan Ch. 3 and 4).*

6.3 Pre-Construction Reporting and Other Requirements

9. **Construction General Permit.** The Permittee shall obtain coverage for the Project under the General Permit for Discharges of Storm Water Associated with Construction and Land Disturbance Activities, Order No. 2009-0009-DWQ (Construction General Permit), as amended, and Order No. 2022-0057-DWQ consistent with its effective date of September 1, 2023.

   Rationale: *This condition is necessary to ensure avoidance and minimization of impacts to waters of the State from construction activities (CWC section 13376 et seq.).*

10. **Dewatering Plan.** The Permittee shall submit, acceptable to the Executive Officer, a dewatering plan, including the area to be dewatered, timing of dewatering, and method of dewatering to be implemented. The dewatering plan shall be submitted no later than 14 days prior to the start of any construction activity that requires temporary dewatering of waters of the State. The dewatering plan shall include water quality monitoring and reporting sufficient to ensure all dewatering discharges and bypassed flows meet applicable receiving water limits and water quality objectives in the Basin Plan. All temporary dewatering methods shall be designed to have the minimum necessary impacts to waters of the State to isolate the immediate work area. All dewatering methods shall be installed such that natural flow is maintained upstream and downstream of the work area. Any temporary dams or diversions shall be installed such that the diversion does not cause sedimentation, siltation, or erosion upstream or downstream of the work area. All dewatering methods shall be removed immediately upon completion of Project activities. The Dewatering Plan shall be submitted, via email to RB2-401Reports@waterboards.ca.gov, or by mail to the attention of 401 Certifications Reports (see address on the letterhead), and include **DewateringPlan_ 447484_ Flow Equalization and Resource Recovery Facility (FERRF) Levee Improvements Project** in the email subject line when sent electronically or in the cover letter for hard copy submissions

Rationale: *This condition is necessary to minimize adverse impacts to water quality from construction activities to the maximum extent practicable (State Board Resolution No. 68-16; 40 CFR Part 131.12 (a)(1); CWC section 13369; Basin Plan Section 2.1.14).*

11. **EcoAtlas Form.** The Permittee shall input Project information into *EcoAtlas* no later than 14 days from this Certification's issuance date, consistent with Section 4 herein. The Project information shall be added to the *Project Tracker* tool in *EcoAtlas* online at https://ptrack.ecoatlas.org. Instructions for adding information to *EcoAtlas* are available at https://ptrack.ecoatlas.org/instructions, or by contacting the Water Board staff listed on the cover page of this Certification. The Permittee shall notify the Water Board and submit documentation demonstrating the Project has been successfully added to EcoAtlas via email to RB2-401Reports@waterboards.ca.gov, or by mail to the attention of 401 Certifications Reports (see address on the letterhead), and include **EcoAtlas_447484_Flow Equalization and Resource Recovery Facility (FERRF) Levee Improvements Project**;

   Rationale*: This condition is necessary to ensure compliance with the permit and applicable conditions (CWC section 13267).*

12. **Start of Construction.** The Permittee shall submit a Start of Construction (SOC) Report acceptable to the Executive Officer. The SOC Report shall be submitted no later than seven days prior to start of initial ground disturbance activities and notify the Water Board at least 48 hours prior to initiating in-water work and any stream diversions. Notification may be via telephone, email, delivered written notice, or other verifiable means. The SOC Report shall be submitted in same timeframe specified herein for multiple construction seasons, if necessary, via email to RB2-401Reports@waterboards.ca.gov, or by mail to the attention of 401 Certifications Reports (see address on the letterhead), and include **SOC_447484_ Flow Equalization and Resource Recovery Facility (FERRF) Levee Improvements Project**;

   Rationale: *This condition is necessary to assist in scheduling compliance inspections to ensure compliance with the permit and applicable conditions (CWC section 13267).*

13. **Photo-Documentation Points.** Prior to the start of construction, the Permittee shall establish a minimum of 12 photo-documentation points at each location where Project related impacts to waters of the State occur. The points shall be used to track the Project's construction impacts, the pre- and post-construction condition, and overall Project success. The Permittee shall prepare a site map with the photo-documentation points clearly marked. Prior to and following construction, the Permittee shall photographically document the immediate pre- and post-Project condition at locations where impacts to waters of the State occur, including temporary impacts. These post-construction photographs and map shall be submitted, along with the as-built and construction completion reports (See Conditions 15and 16);

Rationale: *This condition is necessary to assist in scheduling compliance inspections to ensure compliance with the permit and applicable conditions (CWC section 13267).*

6.4 Active Construction and Post-Construction Reporting Requirements

14. **Quality Assurance Protection Plan (QAPP).** The Permittee shall implement the prepared Quality Assurance Project Plan for the West Bay Sanitary District Flow Equalization and Resource Recovery Facility Flood Protection Project, Menlo Park, San Mateo County, California (SWCA, August 2022) (QAPP). If necessary, the QAPP shall be revised to ensure the appropriate procedures and screening guidelines are used to reuse on-site soil or imported soil at the Project area. Existing guidance for the beneficial reuse of sediments establishes numeric screening guidelines for the placement of sediments in direct contact with water or the burial of sediments beneath a cover layer. Any revisions to the QAPP shall be submitted to the Executive Officer for review and approval no later than 90 days before construction is initiated, and the revised QAPP shall not be implemented until the Executive Officer finds it acceptable.

    The Permittee shall characterize the quality of all fill material proposed for use as fill prior to placement at the Project area in a technical report that shall be submitted to the Executive Officer for review and acceptance. No later than 60 days prior to placing any imported or excavated soil fill material at the Project area, including all placement of fill in the ecotones' footprints, on levees, and at any other location where the fill is a discharge to or has the potential to discharge to any waters of the State. The technical report shall demonstrate that the chemical concentrations in the imported or excavation soil fill comply with the protocols specified in the following documents that are appropriate to each source of material. The Permittee shall not import contaminated soil for use at the Project area nor reuse any contaminated soil excavated within the Project area that does not meet acceptance screening level criteria for its intended reuse. Soil to be transported offsite shall be for non-hazardous or hazardous landfill disposal, as appropriate.

    Rationale: *This condition is necessary to ensure avoidance and minimization of impacts to waters of the State and associated Beneficial Uses from construction activities (CWC section 13369 and (C); Basin Plan section 4.8).*

15. **As-Built Report.** The Permittee shall prepare an as-built report(s) acceptable to the Executive Officer in each year that Project activities occurred. The as-built report(s) shall be submitted to the Water Board through the duration of the Project no later than 60 days after completing construction activities in a given calendar year. The report(s) shall include a description of the areas of actual disturbance during Project construction and the photographs and map specified in Condition 13. The report(s) shall clearly identify and illustrate the Project site, and the locations where impacts to waters of the State occurred. The as-built report(s) shall include the 100 percent construction plans marked with the contractor's field notes that clearly depict any deviations made during construction from the designs reviewed by the Water Board.

The as-built report(s) shall be sent via email to RB2-401Reports@waterboards.ca.gov, or by mail to the attention of 401 Certifications Reports (see address on the letterhead), and include **As-Built_ 447484_ Flow Equalization and Resource Recovery Facility (FERRF) Levee Improvements Project** in the email subject line when sent electronically or in the cover letter for hard copy submissions;

Rationale: *This condition is necessary to assist in scheduling compliance inspections to ensure compliance with the permit and applicable conditions (CWC section 13267).*

16. **Project Construction Completion Report.** The Permittee shall submit a Notice of Project Construction Completion (NOC) acceptable to the Executive Officer to notify the Water Board that the Project has been completed. The Completion Notice shall be submitted to the Water Board no later than 60 days after completing all Project construction activities. The Completion Notice shall include the as-built reports (see Condition 14), the post-construction photographs (see Condition 13), the date of the first Project-related disturbance of waters of the State occurred, and the date construction was completed for each Project activity. The Completion Notice shall be sent via email to RB2-401Reports@waterboards.ca.gov, or by mail to the attention of 401 Certifications Reports (see address on the letterhead), and include **NOC_447484_ Flow Equalization and Resource Recovery Facility (FERRF) Levee Improvements Project** in the email subject line when sent electronically or in the cover letter for hard copy submissions;

    Rationale: *This condition is necessary to ensure compliance with the permit and applicable conditions and to ensure that the proposed work and restoration work has been conducted in accordance with the permit and all applicable conditions (CWC section 13267).*

6.5 Mitigation and Monitoring Requirements

17. **Revised Mitigation and Adaptive Management Plans.** The Permittee shall revise both the *West Bay Sanitary District Flow Equalization and Resource Recovery Facility Flood Protection Project, Menlo Park, San Mateo County, California* (SWCA, August 2022) (Mitigation Plan), and *West Bay Sanitary District Flow Equalization and Resource Recovery Facility Levee Improvements Project, Adaptive Management and Monitoring Plan, Menlo Park, San Mateo County, California* (SWCA, August 2022) (Adaptive Management Plan) and submit them to the Water Board for review, acceptable to the Executive Officer. These final Mitigation and Adaptive Management Plans shall be submitted to the Water Board no later than 60 days following this Certification's issuance date. The final Mitigation and Adaptative Management Plans shall be revised to include monitoring of the adjacent wetlands and mudflats as well as corresponding performance and success criteria, and specific final success criteria for each performance criterion listed therein. The final success criteria shall be used by the Executive Officer in the final monitoring year to

determine whether the temporary impact area has been restored, the mitigation area is successful, and the Project's impacts have been sufficiently mitigated;

Rationale: *This condition is necessary to ensure compliance with the permit and applicable conditions and to ensure that the proposed work and restoration work has been conducted in accordance with the permit and all applicable conditions (CWC section 13267).*

18. **Mitigation and Monitoring Requirements.** The Permittee shall implement and be responsible for all mitigation measures presented in the final Mitigation and Adaptive Management Plans (see Condition 17), including contracting directly for services necessary for earthwork, site preparation, revegetation, monitoring, adaptive management, and contingency measures, and as described herein. Any changes to the Mitigation or Adaptive Management Plans, including changes to the success criteria or timelines, must be submitted to the Executive Officer for review and approval before being implemented.

    The Permittee shall monitor the Project's temporary impact and mitigation areas for a minimum 10-year period following the Project's completion, including all construction activities, until the mitigation requirements set forth herein are achieved. The Permittee shall submit annual monitoring reports to the Water Board (see Condition 22) to demonstrate the Project's impacts have been sufficiently and appropriately mitigated and beneficial uses have not been adversely affected. The monitoring shall be implemented in accordance with the final Mitigation and Adaptive Management Plans (see Condition 17), and as specified herein. If any signs of instability or inadequate restoration or reestablishment are observed at the site, the Permittee shall document these observations in the annual reports and make recommendations for adaptive management or corrective actions, as necessary. If any adverse impacts to waters of the State are observed during the monitoring period, compensatory mitigation may be required by the Executive Officer, including, but not limited to, extension of the monitoring period;

    Rationale*: This condition is necessary to ensure compliance with the permit and applicable conditions and to ensure that the proposed work and restoration work has been conducted in accordance with the permit and all applicable conditions (CWC section 13267).*

19. **Mitigation Performance Criteria.** The Permittee shall evaluate the temporary impact and mitigation areas during the monitoring period by using the performance criteria specified in the final Mitigation Plan (see Condition 17), and as described herein. The performance criteria shall be used to track annual progress towards meeting the final success criteria (Condition 20). If the performance criteria are not met during the monitoring period or indicate the final success criteria may not be met by the end of the monitoring period, the Permittee shall describe the deficiencies that led to the underperformance and recommend corrective or adaptive management actions, as necessary, to ensure the final success criteria are met. The Permittee shall

also use the performance criteria specific to the adjacent wetlands and mudflats during the monitoring period to verify that additional impacts to waters of the State have not occurred;

Rationale: *This condition is necessary to ensure compliance with the permit and applicable conditions and to ensure that the proposed work and restoration work has been conducted in accordance with the permit and all applicable conditions (33 CFR part 332.4; 33 CFR part 332.6).*

20. **Final Success Criteria.** The areas temporarily impacted by the Project and the Project's mitigation success shall be evaluated using the final success criteria specified in the final Mitigation Plan (Condition 17) and as described herein. The Executive Officer shall determine whether the final success criteria were met in the final monitoring year and whether any additional unmitigated impacts have otherwise occurred as a result of the Project. If the final success criteria are not met or additional impacts to waters of the State have otherwise occurred, the Executive Officer may require the Permittee provide additional compensatory mitigation and/or extend the monitoring period;

    Rationale: *This condition is necessary to ensure compliance with the permit and applicable conditions and to ensure that the proposed work and restoration work has been conducted in accordance with the permit and all applicable conditions (33 CFR part 332.4; 33 CFR part 332.6).*

21. **Adaptive Management.** The Permittee shall use the Adaptive Management Plan during the monitoring period for guidance on making corrective actions to the temporary impact and mitigation areas, as necessary, to ensure the Mitigation Plan's final success criteria will be met and that no adverse effects to waters of the State occur. Any adaptive management actions proposed by the Permittee must be accepted by the Executive Officer and other resource agencies before being implemented;

    Rationale: *This condition is necessary to ensure compliance with the permit and applicable conditions and to ensure that the proposed work and restoration work has been conducted in accordance with the permit and all applicable conditions (33 CFR part 332.4; 33 CFR part 332.6).*

22. **Annual Monitoring Reports.** The Permittee shall submit annual monitoring reports, acceptable to the Executive Officer, by January 31 following each monitoring year's completion. The first monitoring year commences in the calendar year after the Project is completed. At the time of this Certification, the Project is anticipated to commence in 2023 and completed by 2024. Therefore, the first annual monitoring report shall be due on January 31, 2026, unless the Project is completed at a different time. Annual reports shall include, but not be limited to, the following:

    a) *Photographs*: photographs taken during the monitoring year from the photo-documentation points specified in Conditions 13 shall be included in each annual monitoring report, and updated as appropriate. The photographs shall include captions with respect to the photograph's point of view, direction of flow, when applicable, locations of Project activities, location of the photo-documentation point, and date photographed.

b) *Activities and Impacts*: the Project activities completed in the monitoring year and their respective impacts to waters of the State shall be included in each annual monitoring report. The final monitoring report shall include all Project activities and their impacts for the duration of the Project. The monitoring reports shall also reference the activities and impacts in relation to the limits covered in this Certification. If limits for any Project activity are exceeded, the Permittee may need to submit a report of waste discharge and shall be required to provide compensatory mitigation for the impacts to waters of the State that exceed the limits authorized in this Certification.

c) *Environmental Drivers*: each monitoring report shall describe the precipitation events that occurred at the site during the monitoring year. The effects of the Project and environmental drivers (e.g., precipitation events, drought events) on site conditions shall be described in reference to the monitoring year's precipitation events.

d) *Cumulative Monitoring*: each annual report shall summarize all data from previous monitoring reports in addition to the current year's monitoring data, including the need for, and implementation of, any remedial actions. Monitoring data may include all relevant qualitative and quantitative data necessary to determine whether the site is stable. The final monitoring report shall document whether the temporarily impacted areas were restored to their pre-Project condition.

The overall Project and mitigation success shall be determined by, and acceptable to, the Executive Officer. If monitoring indicates that beneficial uses have been, or have the potential to be, adversely affected, the Permittee shall, in consultation with the appropriate agencies, identify remedial measures to be undertaken, including compensatory mitigation and extension of the monitoring and reporting period until the final success criteria are met. If an adaptive management action is required and approved by the Executive Officer, the Permittee shall implement the action in a timely manner. Annual monitoring reports shall be submitted via email to RB2-401Reports@waterboards.ca.gov, or by mail to the attention of 401 Certifications Reports (see the address on the letterhead), and include **AMR_447484_ Flow Equalization and Resource Recovery Facility (FERRF) Levee Improvements Project** in the email subject line when sent electronically or in the cover letter for hard copy submissions (*CWC section 13267; 33 CFR Parts 332.4(a)(C)(4) and 332.6(a)(1)*);

Rationale: *This condition is necessary to ensure compliance with the permit and applicable conditions and to ensure that the proposed work and restoration work has been conducted in accordance with the permit and all applicable conditions (33 CFR parts 332.4 and 332.6).*

6.6 Administrative and General Compliance

23. Site Access. The Permittee shall grant Water Board staff or an authorized representative, upon presentation of credentials and other documents as may be required by law, permission to: (1) enter upon the Project site or compensatory mitigation site(s) where a regulated facility or activity is located or conducted, or where records are kept; (2) have access to and copy any records that are kept and are relevant to the Project or the requirements of this Order; (3) inspect any facilities, equipment, practices, or operations regulated or required under this Order; and (4) sample or monitor for the purposes of assuring Order compliance;

Rationale: *This condition is necessary to assist in scheduling compliance inspections and to ensure compliance with the permit and applicable conditions (CWC section 13267).*

24. Certification and Order at Site. A copy of this Order shall be provided to any consultants, contractors, and subcontractors working on the Project. Copies of this Order shall remain at the Project site for the duration of this Order. The Permittee shall be responsible for work conducted by its consultants, contractors, and any subcontractors;

Rationale: *This condition is necessary to ensure compliance with the permit and applicable conditions (CWC sections 13170 and 13245).*

25. Ownership Change Notification. The Permittee shall provide a signed and dated notification to the Water Board of any change in ownership or interest in ownership of any Project area at least 10 days prior to the transfer of ownership. The purchaser shall also submit a written request to the Water Board to be named as the permittee in an amended order. Until this Order has been modified to name the purchaser as the permittee, the Permittee shall continue to be responsible for all requirements set forth in this Order;

Rationale: *This condition is necessary to ensure compliance with the permit and applicable conditions (CWC section 13264).*

26. Water Quality Violations Notification. The Permittee shall notify the Water Board of any violations of water quality standards, along with the cause of such violations, as soon as practicable (ideally within 24 hours). Notification may be via telephone, email, delivered written notice, or other verifiable means;

Rationale: *This condition is necessary to minimize adverse impacts to water quality (CWC sections 13385 and 13267).*

27. **Discharge Change Notification.** In accordance with Water Code section 13260, the Permittee shall file with the Water Board a report of any material change or proposed change in the ownership, character, location, or quantity of this waste discharge. Any proposed material change in operation shall be reported to the Executive Officer at least 30 days in advance of the proposed implementation of any change. Changes to discharges include, but are not be limited to, significant new soil disturbances, proposed expansions of development, or any change in drainage characteristics at the Project site. For the purpose of this Order, this includes any proposed change in the boundaries of the area of wetland/waters of the State to be impacted;

28. **Submittal of Reports.** Where this Certification requires submittal of reports, including plans, reports, or related information, the submitted reports shall be acceptable to the Executive Officer;

    Rationale: *This condition is necessary to ensure compliance with the permit and applicable conditions (CWC section 13267).*

29. **Individual Waste Discharge Requirements.** Should new information come to our attention that indicates a water quality problem with this Project, the Water Board may issue Waste Discharge Requirements pursuant to CWC sections 13263 and/or 13377 and 23 CCR section 3857;

30. **Expiration.** This Order shall continue to have full force and effect regardless of the expiration or revocation of any federal license or permit issued for the Project;

    Rationale: *This condition is necessary to ensure compliance with the permit and applicable conditions (CWC sections 13170 and 13245).*

6.7 Standard Conditions

31. **Certification and Order Modification.** This Order is subject to modification or revocation upon administrative or judicial review, including review and amendment pursuant to CWC sections 13320 and 13330 and 23 CCR section 3867;

32. **Hydroelectric Facilities.** This Order does not apply to any discharge from any activity involving a hydroelectric facility requiring a Federal Energy Regulatory Commission (FERC) license or an amendment to a FERC license, unless the pertinent certification application was filed pursuant to 23 CCR subsection 3855(b) and that application specifically identified that a FERC license or amendment to a FERC license for a hydroelectric facility was being sought;

33. **Application Fee.** This Certification and Order is conditioned upon full payment of the required fee, including annual fees, as set forth in 23 CCR section 3833. The required $25,637 fee, calculated using the 2021/2022 Water Quality Certification Dredge and Fill Application Fee Calculator, Category A– *Fill and Excavation Discharges*, was received by the Water Board on October 17, 2022;

Rationale: *Conditions 31, 32, and 33 are standard conditions that "shall be included as conditions of all water quality certification actions" (23 CCR section 3860(a)).*

6.8 Annual Fees

34. Annual Fee. In accordance with 23 CCR section 2200, the Permittee shall pay an annual fee to the Water Board each fiscal year (July 1 – June 30) until Project construction activities are completed and an acceptable Notice of Project Construction Completion is received by the Water Board. If monitoring is required, the Permittee shall pay an annual fee to the Water Board until monitoring activities are completed and an acceptable Notice of Mitigation Monitoring Completion is received by the Water Board (Note: the Annual Post Discharge Monitoring Fee may be changed by the State Water Board; at the time of Certification it was $2,297 per year for Category A projects). Annual fees will be automatically invoiced to the Permittee. **The Permittee must notify the Water Board at Project and mitigation completion with a final report in order to request to terminate annual billing.** Notification shall reference **NOT_ 447484_ Flow Equalization and Resource Recovery Facility (FERRF) Levee Improvements Project** and should be sent to the staff listed at the bottom of this Certification and to RB2-401Reports@waterboards.ca.gov. Water Board staff will verify the conditions of the Certification have been met and may request a site visit at that time to confirm the Project's status and compliance with the Certification (*23 CCR sections 3833(b)(3) and 2200 (a)(3);CWC section 13267*).

This Order applies to the Project as proposed in the application materials and designs referenced above in the conditions of Certification. Be advised that failure to implement the Project in conformance with this Order is a violation of this Certification. Any violation of Certification conditions is a violation of State law and subject to administrative civil liability pursuant to CWC sections 13350, 13385, or 13399.2. Failure to meet any condition of this Certification may subject the Permittee to civil liability imposed by the Water Board to a maximum of $25,000 per day of violation and/or $25 for each gallon of waste discharged in violation of this action above 1000 gallons. Any requirement for a report made as a condition to this Certification (e.g., conditions 4, 10-22 and 25-27) is a formal requirement pursuant to CWC sections 13267 and 13383, and failure or refusal to provide, or falsification of such required report, is subject to civil liability as described in CWC section 13268 and criminal liability under 13387. The burden, including costs, of these reports bears a reasonable relationship to the need for the report and the benefits to be obtained. Should new information come to our attention that indicates a water quality problem with this Project, the Water Board may issue Waste Discharge Requirements.

If you have any questions concerning this Order, please contact Tahsa Sturgis of my staff at (510) 622-2316 or tahsa.sturgis@waterboards.ca.gov. All future correspondence regarding this Project should reference **RM 447484** indicated at the top of this letter.

Sincerely,

Lisa Horowitz McCann

Digitally signed by Lisa Horowitz McCann
Date: 2022.12.21 16:07:03 -08'00'

Water Boards

for Eileen White
Executive Officer

cc: SWRCB, DWQ, stateboard401@waterboards.ca.gov
Water Board, Victor Aelion, victor.aelion@waterboards.ca.gov
BCDC: Anniken Lydon, anniken.lydon@bcdc.ca.gov
U.S. EPA, Region IX:
Region IX Mailbox, r9cwa401@epa.gov
Jennifer Siu, siu.jennifer@epa.gov
Corps, SF Regulatory Branch:
Katerina Galacatos, katerina.galacatos@usace.army.mil
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BAGG ENGINEERS
▸Geotechnical ▸Geoenvironmental ▸Special Inspection

April 9, 2021
BAGG Job No: FREYE-18-01

Mr. Lorraine Htoo, P.E.
Freyer & Laureta, Inc.
144 North San Mateo Drive
San Mateo, California 94401

Geotechnical Engineering Investigation
Living Shoreline Cut and Fill Analysis
Levee Design Project
West Bay Sanitary District
Menlo Park, California

Dear Ms. Htoo:

Transmitted herewith is our geotechnical engineering investigation report for the above captioned project. The following report summarizes the results of our subsurface investigation and laboratory testing, which formed the basis of our conclusions, and presents our recommendations related to the geotechnical engineering aspects pertaining to the project site.

Thank you for the opportunity to perform these services. Please do not hesitate to contact us, should you have any questions or comments.

Very truly yours,
BAGG Engineers

REGISTERED PROFESSIONAL ENGINEER
MICHAEL G. MATUSICH
3013
Expires 12/31/21
GEOTECHNICAL
STATE OF CALIFORNIA

Michael Matusich
Sr. Geotechnical Engineer

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REPORT
GEOTECHNICAL ENGINEERING INVESTIGATION
LIVING SHORELINE CUT AND FILL ANALYSIS
LEVEE DESIGN PROJECT
WEST BAY SANITARY DISTRICT
MENLO PARK, CALIFORNIA

For Freyer & Laureta, Inc.

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ASFE document titled "Important Information About Your Geotechnical Engineering Report"

REPORT
GEOTECHNICAL ENGINEERING INVESTIGATION
LIVING SHORELINE CUT AND FILL ANALYSIS
LEVEE DESIGN PROJECT
WEST BAY SANITARY DISTRICT
MENLO PARK, CALIFORNIA

For Freyer & Laureta, Inc.

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering investigation services for the site improvements planned at the former West Bay Sanitary District (WBSD) Wastewater Treatment Plant in Menlo Park, California. The following report describes our approach, investigative procedures, the results of our field mapping, subsurface explorations, and laboratory testing as well as our conclusions and recommendations pertaining to the project site. BAGG previously provided geotechnical investigations and consultations at the project site in 2018 and has incorporated that information in this report as well. The attached Plate 1, Vicinity Map, shows the general location of the site, and Plate 2, Site Plan depicts the layout of the site and the location of our exploratory borings and cone penetrometer tests (CPT) performed at the site under the direction of BAGG Engineers.

2.0 SITE AND PROJECT DESCRIPTION

The site consists of the former West Bay Sanitary District (WBSD) Wastewater Treatment Plant in Menlo Park, California. The property consists of about a 24-acre trapezoidal-shaped area located within the marshland on the southwest shore of San Francisco Bay. An existing levee is situated on the northeast and west sides of the site. The east south and east sides of the site are concealed by man-made fill used to form Bedwell Bayfront Park which reaches an elevation of about 80 feet approximately 650 feet southeast of the site. The site contains several basins whose side slopes conform with the inboard slopes of the perimeter levee, and remnant buildings and facilities of the former WBSD plant. Top of levee elevations on the west and northeast sides of the site range from about 10 to 12 feet above mean sea level, respectively. Bottom of basin elevations reach down to about 3 feet below mean sea level.

Currently, the South Bayside System Authority's (SBSA) Flow Equalization Facility (FEF) occupies a 3.6 acre basin on the southwest quadrant of the site. WBSD manages the overall former treatment plant property while SBSA and WBSD jointly maintain and operate the existing FEF.

We understand that it is desired to raise grades on the northeast levee to elevation of 15 feet and to include a sheet pile wall on the outboard side of the west levee with a top of sheetpile elevation of 15 feet for flood control purposes. No fill is planned on the west levee, however, about 5 feet of fill will be included at the southwest corner of the site to create a ramp to conform the 15 feet top of sheetpile elevation with the Bedwell Bayfront Park fill. Similarly, the proposed levee fill on the northeast side of the site will be extended southeastward and tie-in to the Bedwell Bayfront Park fill at a top of levee elevation of 15 feet. New embankment fills will have gradients of 3 horizontal to 1 vertical (3H:1V).

Additionally, a living shoreline feature with a gradient of 10H:1V is planned on the northeast side of the site which will consist of a blanket of fill extending on the existing marshland. The living shoreline fill will be comprised of native Bay Mud materials, and will conform with the northeast top of levee grade. The proposed improvements are shown on the attached Plate 2, Site Plan.

3.0 PREVIOUS STUDIES

Previous borings and cone penetrometer tests (CPT) were advanced under the direction of DCM Consulting, Inc (DCM) in 2013, on the levees at several locations on the west side of the subject property. The borings and CPTs revealed 5 to 11 feet of fill underlain by 13 to 19 feet of soft Young Bay Mud deposits, which in turn was underlain by generally stiff Old Bay Mud deposits down to the maximum explored depth of 40 feet below the ground surface.

Laboratory unconfined compressive strengths of the Young Bay Mud ranged from 350 psf to 470 psf with unit weights ranging from 50 to 61 pcf and moisture contents ranging from 69 to 84 percent. The underlying Old Bay Deposits had dry unit weights of about 92 to 104 with moisture content ranging from 23 to 33 percent and unconfined compressive strengths ranging from about 750 psf to 2,700 psf. Limited laboratory testing of the fill material yielded a dry density of 104 pcf, and unconfined compressive strength of about 2,500 psf.

4.0 PURPOSE AND SCOPE OF SERVICES

The purpose of our services has been to prepare a geotechnical report that summarizes our findings and recommendations to date and to develop further recommendations that address geotechnical aspects of FEMA CFR 65.10. To this end, our report was tailored to address the following:

- Geologic site conditions and seismicity of the project site, a discussion of the site geology and seismicity with distance to the active faults in the region, as well as the probability of a major earthquake on each fault;
- Specific subsurface conditions discovered by the borings such as expansive, loose, saturated, collapsible, or soft surface and subsurface soils that may require special mitigation measures or impose restrictions on the project, including the thickness and consistency of existing fill soils, and depth to groundwater;
- Criteria for site grading, excavation and backfill, including the suitability of the excavated soils from the site for re-use as fill and backfill material;
- Geotechnical aspects covering the general requirements of FEMA CFR 65.10 regarding closures, embankment protection, embankment and foundation stability and effects of seepage, settlement, and interior drainage;
- Slope stability analyses of the levees with proposed fill added, design parameters for sheetpiling to help improve stability of the levees under static and seismic conditions;
- Recommendations and design criteria for retaining walls;
- Estimate of the post-construction total and differential settlements under newly imposed fill loads; and
- General provisions for the control of surface and subsurface drainage.

To fulfill the above purpose, the scope of our services consisted of the following specific tasks:

1. Review available geologic maps and reports pertinent to the site and the immediate vicinity, as well as subsurface and laboratory data from site investigations performed by BAGG in 2018 and DMC in 2013;
2. Mark a supplemental boring location in the field, coordinate the field exploration with the client representatives, and notify Underground Service Alert (USA) at least 72 hours in advance.
3. Provide drilling notification to the San Mateo County Department of Environmental Health per our annual drilling permit with them.
4. Perform a supplemental field exploration by drilling, logging, and sampling one boring to a depth of about 40 feet using a truck-mounted drilling rig at the southwest entrance of the site to supplement our previous borings and CPTs. Obtain soil samples using Standard Penetration Test and Modified California liner sampling equipment at 3 to 5 foot vertical intervals. Measure the depth to groundwater, if encountered, and backfill the borings with neat cement grout. The drilling spoils were spread out on site at locations designated by the client.
5. Perform a soil mechanics laboratory testing program on the collected soil samples to evaluate the geotechnical engineering characteristics of the subsurface soils. Tests included direct shear tests at natural and artificially increased moisture content, Atterberg Limits, grain-size analyses, consolidation, unconsolidated undrained triaxial shear strength tests, moisture-density measurements, and corrosion tests as judged appropriate.
6. Consult, as-needed, with the project structural and civil engineer with respect to the project needs.
7. Perform engineering analyses based on the results obtained from the above tasks and oriented towards the above-stated purpose of the investigation; and
8. Prepare a geotechnical engineering report containing the results of our investigation and reviews, summarizing our findings and recommendations for the subject project, and including a vicinity map, a site plan, an area geologic map, a fault map, the boring logs, cross sections laboratory test results, and the results of slope stability plots. The report is presented herein in draft form for your review and comment, so that appropriate edits can be made, as needed, to reflect the final design.

5.0 FIELD EXPLORATION AND LABORATORY TESTING

Subsurface conditions were explored intermittently by BAGG Engineers from April 2018 through November 2020 by advancing a total of 11 borings, B-1 through B-11, to depths ranging from 8½ to 50 feet below the ground surface (bgs) with a truck-mounted hollow stem auger drilling rig. On April 26 and 27, 2018, borings B-1 through B-7 were advance to depths ranging from about 30 to 50 feet bgs on the west and northeast levees and on the east and south sides of the site; on November 2, 2018, borings B-8 through B-10 were each advanced to depths of 8½ feet in the southern central portion of the site; and on November 2, 2020, boring B-11 was advanced to approximately 40 feet bgs at the southwest corner site entry.

The borings were advanced with a truck-mounted drilling rig equipped with 8-inch diameter hollow stem augers. Samples of the earth materials encountered in the borings were obtained with the aid of a wire-line and pulley system attached to a 140-lb drop-hammer. One of our geologists/engineers technically directed the exploration, maintained a continuous log of the boring, and obtained relatively undisturbed ring and Standard Penetration Test (SPT) samples for laboratory testing and visual examination in accordance with the sampling method described on Plate 8, Key to Symbols. Additionally, the shear strength of selected soil samples was measured with a hand-held torvane device in the field.

The subsurface materials were visually classified in the field; the classifications were then checked by visual examination of samples in the laboratory. In addition to sample classification, the boring logs contain interpretation of where stratum changes or gradational changes occur between samples. The boring logs depict BAGG's interpretations of subsurface conditions only at the location indicated on Plate 2, Site Plan, and only on the dates noted on the logs. The boring logs are intended for use only in conjunction with this report, and only for the purposes outlined by this report.

Selected undisturbed samples were tested in direct shear to evaluate the strength characteristics of the subsurface materials. Direct shear tests were performed under natural and artificially increased moisture contents, while under various surcharge pressures. Atterberg Limits tests were performed on clayey samples of the site materials to help define the expansion characteristics of the soil and to aid in the soil classification. The moisture content and dry density of several undisturbed samples were also measured to aid in correlating their engineering properties. The results of our laboratory strength tests, Atterberg Limits tests, and moisture-density measurements, are summarized on the boring logs and/or the plates described below.

The graphical representation of the materials encountered in the borings, and the results of laboratory tests as well as explanatory/illustrative data are attached, as follows:

- Plate 5, Unified Soil Classification System, illustrates the general features of the soil classification system used on the boring logs.
- Plate 6, Soil Terminology, lists and describes the soil engineering terms used on the boring logs.
- Plate 7, Boring Log Notes, describes general and specific conditions that apply to the boring logs.
- Plate 8, Key to Symbols, describes various symbols used on the boring logs.
- Plates 9 through 19, Boring Logs, describe the subsurface materials encountered, show the depths and blow counts for the samples, and summarize results of the strength tests and moisture-density data.
- Plate 20, Plasticity Data, summarize the Atterberg Limits test results which provide an indicator of the soils' degree of plasticity and shrink-swell characteristics.
- Plate 21, Unconsolidated Undrained Triaxial Shear Strength Results, summarize undrained shear strength test data from the laboratory.
- Plates 22 through 24, Consolidation Test Results, provide information regarding soil compressibility

In addition to the borings, five (5) cone penetrometer tests (CPT) were advanced to depths ranging from about 30 to 50 feet bgs. The CPTs consist of a hydraulically advanced rod with a conical tip equipped with a transducer that continuously reads tip resistance, sleeve friction and pore pressure. The data is then correlated and used to develop soil behavior types and soil strength data. The approximate location of the CPTs are shown on the attached Plate 2, Site Plan. The CPT results are presented on the Appendix A.

Additional geotechnical data used for the project is presented in Appendix B which includes geotechnical subsurface data developed by DCM Consulting, Inc. (DCM) as well as the results of laboratory tests performed on soil samples from the site by Cooper Testing Labs. Appendix B includes the logs of three borings, B-1 through B-3, and 6 CPTs, CPT-1 through CPT-6 advanced on the western side of the site by DMC in February 2013. DMC also constructed wells for groundwater level observations in borings B-1 and B-2. Additionally, Appendix B includes the results of laboratory tests performed on collected soil samples from the site by DCM which consist of moisture-density measurements, unconfined compressive strength tests, fines content analyses, consolidation tests, and Atterberg Limits. Also included in Appendix B are the results of laboratory tests performed on soil samples from the site by Cooper Testing Labs which consist of consolidation, permeability, and corrosivity tests.

6.0 GEOLOGY AND SEISMICITY

6.1 Regional Geology

The site is located in the San Francisco Bay Area which lies within the Coast Ranges geomorphic province, a series of discontinuous northwest trending mountain ranges, ridges, and intervening valleys characterized by complex folding and faulting. The site is located along the southwestern edge of the San Francisco Bay within the limits of marshland associated with tidal sloughs and channels. To the south, San Francisquito and Los Trancos Creeks form the boundary between San Mateo and Santa Clara Counties. The foothills of the northern Santa Cruz Mountains are separated from the main mass of the mountains by two northwest-striking faults, the San Andreas and Pilarcitos, which are located to the southwest. The adjoining areas are divided into three structural blocks juxtaposed along these faults. The site is located on the San Francisco Bay Block which lies to the east of the San Andreas fault. The Pilarcitos Block is situated between the San Andreas and the Pilarcitos faults and the La Honda Block, which includes the main mass of the Santa Cruz Mountains, lies beyond the Pilarcitos fault to the west. The western boundary of the La Honda structural block is marked by the Seal Cove-San Gregorio fault (Nilsen and Brabb, 1979).

Pre-late Pleistocene Cenozoic rocks of the foothills have been compressed into northwest-striking folds, which have been overridden by Mesozoic rocks along southwest-dipping, low angle faults. Coarse- to fine-grained late Pleistocene and Holocene alluvial and estuarine deposits, eroded from the foothills and comprising the alluvial plain located along the eastern foothills of the mountains, are essentially un-deformed. Most of the alluvial plain and some parts of the marshland that borders the Bay along its western side have been reclaimed and filled to allow the construction of residential and commercial development. A large marsh area to the west of the site has been diked off and utilized as salt evaporating ponds, and the area to the east has been filled to form Bedwell Bayfront Park .

6.2 Site and Area Geology

The site area has been mapped by the California Division of Mines and Geology (1961), Brabb and Pampeyan (1972 and 1983), LaJoie et al. (1974), Helley et al. (1979), Pampeyan (1994), Knudsen et al. (1997), and Brabb et al. (1998) to be underlain by Holocene-age (younger than 11,000 years [USGS, 2006]) younger Bay mud deposits. However, fill has been placed atop these Bay mud deposits and basin excavations had been made to allow for the construction for the existing facility.

The site is bordered to the west by Flood Slough, the northeast by Westpoint Slough and on the south and east sides by reclaimed and filled marshland which is now Bedwell Bayfront Park. The site is located outside (east of) the former shoreline of the San Francisco Bay in an area that used to be blanketed chiefly by marshland crossed by anastomosing and meandering tidal channels and sloughs in a modern brackish to saline estuary and lagoon-like setting. Brabb, et al (1994) describes the young Bay Mud deposits as follows:

Bay Mud (Holocene) – Water-saturated estuarine mud, predominantly gray, green and blue clay and silty clay underlying marshlands and tidal mud flats of San Francisco Bay, Pescadero, and Pacifica. The upper surface is covered with cordgrass (Spartina sp.) and pickleweed (Salicornia sp.). The formation also contains a few lenses of well-sorted, fine sand and silt, a few shelly layers (oysters), and peat. The mud interfingers with and grades into fine-grained deposits at the distal edge of Holocene fans, and was deposited during the post-Wisconsin rise in sea-level, about 12 ka to present (Imbrie and others, 1984). Mud varies in thickness from zero, at the landward edge, to as much as 40 meters near north County line.

Thickness of the young Bay mud is reported to be on the order of about 20 feet below the original ground surface by Goldman (1969) and McDonald et al. (1978). This coincides with the thickness of the young Bay mud encountered in our previous borings and cone penetrometer tests (CPT), which revealed the thickness of Bay Mud underlying the fill at the site ranges from about 10 to 20 feet. The young Bay mud is underlain by more consolidated old Bay Mud and alluvial deposits and the bedrock depths in this general area are greater than about 290 feet in depth by Goldman (1969) and about 450 feet by Hensolt and Brabb (1990).

DCM Consulting, Inc. previously directed the advancement of 3 borings and 6 CPTs throughout the site. They also encountered 5 to 10 feet of fill underlain by 13 to 19 feet of Young Bay Mud deposits which generally conforms with our previous findings as well.

The site area consists of a combination of relatively level areas and basin excavations. The larger basins are respectively up to about 4 and 5 acres in area and occupy the northwest and southwest quadrants of the site. The basin sideslopes are up to 12 feet in height with gradients of up to 2 horizontal to 1 vertical (2H:1V) and are comprised of artificial fill in the upper portion of the slope and partially consolidated Bay Mud in the lower portion. The outboard levee sideslopes that are bounded by Flood Slough on the west and Westmont Slough on the northeast sides of the site are about 5 feet in height with gradients of ranging from about 2H:1V to 3H:1V trending down to marshland areas covered with pickleweed and other wild grasses. The west and northeast side slopes are covered with grassy vegetation with sparse riprap and concrete rubble. Artificial fill is described by Brabb, et al (1998) as follows:

Artificial Fill (Historic) – Loose to very well consolidated gravel, sand, silt, clay, rock fragments, organic matter, and man-made debris in various combinations. Thickness is variable and may exceed 30 meters in places. Some is compacted and quite firm, but fill made before 1965 is nearly everywhere not compacted and consists simply of dumped materials.

6.3 Seismic Setting

The subject site is not situated within the limits of the Alquist-Priolo Earthquake Fault Zone (AP Zone) established by the CGS around active faults and where detailed evaluation and characterization of fault activity and potential for ground surface rupture is required. Three, northwest-trending major earthquake faults that comprise the San Andreas fault system, extend through the Bay Area. They include the San Andreas fault, the Hayward fault, and the Calaveras fault, respectively located about 11 km to the southwest, approximately 18 km northeast of the site, and about 28 km to the east-northeast. One of the many traces of the Monte Vista – Shannon fault zone is also mapped about 13 km southwest of the site. This fault is a splinter fault off of the main trace of the San Andreas.

TABLE 1
SIGNIFICANT EARTHQUAKE SCENARIOS

Fault	Approximate Distance from Site (kilometers)[1]	Direction from Site	Probability of $M_W \geq 6.7$ within 30 Years[2]
San Andreas (Entire)	11	SW	33%
San Andreas (Peninsula)	11	SW	9%
Monte Vista – Shannon	13	S-SW	1%
Hayward –Rogers Creek	18	NE	32%
San Gregorio	26	SW	5%
Calaveras	28	NE	25%

[1]USGS Fault files from Google Earth, and CGS Fault Activity Map of California
[2]Working Group on California Earthquake Probabilities, 2014.

While the site is not within the Alquist-Priolo Earthquake Fault Zone designated by the California Geological Survey, the San Andreas and Hayward faults are believed to be the principal seismic hazards in this area because of their activity rates and proximity to the site. The Working Group on California Earthquake Probabilities (2013) has estimated that the probability for a major earthquake (M_W 6.7 or greater) within 30 years on the nearby San Andreas fault is about 33 percent and about 32 percent on the Hayward fault. They also estimate there is a 72% chance there will be a magnitude 6.7 or greater earthquake somewhere within the Bay Area within the next 30 years.

The attached Plate 4, Regional Fault Map, depicts the major active fault locations with respect to the subject site.

7.0 FIELD CONDITIONS

7.1 Surface Conditions

The levee roads are mostly covered with gravel as is the perimeter roadway on the east side of the site and the east end of the south side perimeter roadway. Asphaltic concrete pavements comprise the central and western portion of the south side perimeter roadway. The bottom of the northwest basin is brackish with a red-colored pond at the bottom and its side slopes are sparsely vegetated. The bottom of the southwest basin appears less brackish without ponded water and with side slopes containing abundant grassy vegetation. The outboard levee side slopes adjacent to the marshlands north and west of the site are well-vegetated and contain trace amounts of concrete debris. The levee roads have a surface elevation ranging from about 10 to 12½ feet above mean sea level per the attached Plate 2, Site Plan, which utilizes a topographic base map provided by Freyer & Laureta, Inc. The maximum elevation of about 12½ feet occurs at the northwest corner of the site and the minimum elevation of 10 feet occurs at the southwest corner entry to the site.

7.2 Subsurface Conditions

The levees and adjacent areas at similar surface grades are underlain by 5 to 10 feet of fill which, in turn are underlain by 10 to 19½ feet of Bay Mud. The Bay Mud, in turn, is underlain by Older Bay Deposits down to the maximum explored depth of 50 feet. A discussion of these soil types is presented as follows.

7.3 Fill Soils

The fill at the site consisted predominantly of stiff to very stiff clayey soil with variable sand and gravel content. The fill was thickest at the northeast corner of the site where boring B-4 revealed roughly 11 feet of fill, and thinnest at the southwest corner of the site where boring B-11 revealed about 5 feet of fill. We note that the upper 4 feet of fill encountered in boring B-11 consisted of the only sandy fill encountered in our borings and is believed to be backfill material for an underground pipe that enters the site from Marsh Road. The CPTs revealed some scattered sandy lenses, less than a foot in thickness, throughout the predominantly clayey fill. The sandy portion of the fill had a medium dense to dense consistency.

7.4 Young Bay Mud

The Young Bay Mud consisted of soft to very soft fat clay. Direct shear strength tests of the Bay Mud revealed undrained shear strength tests ranging from 115 to 250 psf. Triaxial compressive strength tests revealed undrained shear strengths ranging from 170 to 435 psf; CPT data revealed underained shear strengths in the Bay Mud ranging from about 400 to 700 psf. Additionally, torvane tests on several Bay Mud samples resulted in undrained shear strengths ranging from 350 to 470 psf.

7.5 Old Bay Deposits

Old Bay Deposits consisted predominantly of stiff clayey soils down to the maximum explored depth of 50 feet. Minor, discontinuous, localized sandy soil lenses were encountered between

27 to 34 feet bgs in boring B-3, between 24½ to 26½ feet bgs in boring B-5, and between 36½ to 39½ feet bgs in boring B-11. The localized sandy soil lense in boring B-1 was medium dense between 27 and 32 feet bgs and dense between 32 and 34 feet bgs. The localized sandy soil lenses in borings B-5 and B-11 had a medium dense consistency.

7.6 Groundwater

Groundwater was encountered roughly 6 to 12 feet below the top of the existing levees in our borings. However, the very low permeability of Bay Mud and the sealing effects of the augers while they are advanced into the formation greatly inhibit the intrusion of groundwater into the bore hole, making it impractical to wait for stable groundwater readings. We note that pore pressure data revealed groundwater levels roughly at depths of 5 to 8 feet below the top of the levees. Additionally, we observed water levels in the adjacent sloughs rise and fall between high tide and low tide, however, the bottom of the basins remained more or less dry with minor ponding during that time. Therefore, groundwater levels do not appear to be significantly affected by changes in tide. However, groundwater levels typically fluctuate due to seasonal changes such as variations in rainfall and temperature, hydrogeological variations such as groundwater pumping or recharging, and/or other factors not evident at the time of exploration.

8.0 GEOLOGIC HAZARDS

8.1 Liquefaction Potential

Soil liquefaction is a condition where saturated granular soils near the ground surface undergo a substantial loss of strength due to increased pore water pressure resulting from cyclic stress applications induced by earthquakes or other vibrations. In the process, the soil acquires mobility sufficient to permit both vertical and horizontal movements, if not confined. Soils most susceptible to liquefaction are loose, uniformly graded, fine-grained, sands, and loose silts with very low cohesion. In general, liquefaction hazards are most severe in the upper 50 feet of the soil profile. In the deeper deposits the greater overburden soils tend to isolate the ground surface from any liquefaction and the overburden pressures tends to limit shear strains that occur during liquefaction.

The State of California Seismic Hazards Zones Palo Alto Quadrangle Official Map, Released October 18, 2006 indicates that the site is in a liquefaction hazard zone and should be evaluated for liquefaction potential.

Youd and Perkins (1987) show the potential for liquefaction at the site to range between low to moderate but may be locally high near active and abandoned stream channels where many of the latter may be buried and undetectable. Knudsen et al. (1997 and 2000) and Witter et al. (2006) indicate that the potential for liquefaction for the mapped Holocene Bay mud is expected to be in the high range if the groundwater is less than 10 feet in depth. Free groundwater was encountered at about 6 feet bgs in our recent borings drilled at the site.

There is no history of liquefaction or historic ground failures associated with earthquakes at the site and the closest location of reported historic ground failures associated with earthquakes along the western margin of the Bay is located beyond the San Mateo Bridge to the north (Youd and Hoose, 1978).

None of our borings encountered liquefiable material with the exception of some minor localized medium dense well-graded sand encountered from about 27 to 32 feet bgs in boring B-3 and some loose silty sand from about 38 to 39 ½ feet bgs in boring B-11. Similarly, the CPTs revealed minor, localized medium dense silty sand Settlement calculations in accordance with Idriss and Boulanger (2008) suggest the soil could settle on the order of about 1 inch or less. Given the depth of these deposits and their localized discontinuous nature, the measurable settlement at the ground surface would be very small and/or aerial in nature, producing minimal effects at the ground surface. As such, the potential for liquefaction to adversely impact the project is considered to be low.

8.2 Fault-Related Ground Surface Rupture

The site is not situated within an Alquist-Priolo Earthquake Fault Zone established by the CGS around faults that are considered as active (CGS, 2000). The closest active and zoned fault to the site is the San Andreas fault, which is located about 6.4 km to the southwest. Therefore, it is our opinion that the potential for fault-related ground surface rupture at the school campus is minimal.

8.3 Lateral Spreading

The sloughs adjacent to the northeast and west sides of the site are relatively shallow compared to the depth of minimal liquefiable material encountered in our borings and CPTs. Approximately 27 feet of overburden covers the localized discontinuous sandy deposits. Based on this information, the potential for lateral spreading to occur at the site is considered minimal.

8.4 Slope Instability

The *State of California Seismic Hazards Zones Palo Alto Quadrangle Official Map, Released October 18, 2006* indicates that the site is not within a seismic hazard zone for landslides, however, as noted previously, the levee inboard slopes are up to 15 feet in height and nearly 2 ½ H:1V in gradient and underlain by soft, weak Bay Mud, therefore, there is a potential for slope instability during a design level earthquake. Slope stability analyses were performed by our office and the results are summarized in the following Section along with a discussion of remedial measures that include using sheetpiling driven through the levees and underlying Bay Mud and into the Older Bay Deposits to help maintain stable levee side slopes.

8.5 Tsunami and Seiches

The Tsunamis are seismic sea waves that are typically an open ocean phenomena caused by underwater landslides, volcanic eruptions, or seismic evens. They primarily impact low-lying coastal areas.

Seiches are earthquake-generated waves or oscillations (sloshing) of the water surface in restricted bodies of water, such as the San Francisco Bay. The 1868 earthquake on the Hayward fault is reported to have generated seiche activity in the Bay. Seiches are extremely rare in the Bay, which generally attenuates such activity due to its irregular shape and shallow shoreline.

Ritter and Dupre (1972) indicate that the coastal lowland areas, immediately adjacent to San Francisco Bay and the Pacific Ocean coastline, are subject to possible inundation from a tsunami with a run up height of 20 feet at the Golden Gate Bridge. Ritter and Dupre's 1972 map show the site area to be located along the edge of areas that could become inundated by tsunami waves. The California Emergency Management Agency in concert with the CGS and University of Southern California (2009) indicate that the site is located just outside the limits of areas that may be inundated by tsunami waves. Based on this information and the noted elevation of the site (5 feet [USGS, 1980] above mean sea level), we judge the potential for tsunami and seiche related flooding to occur at the site to be moderate.

9.0 SLOPE STABILITY ANALYSIS

9.1 General

The stability of the site slopes was evaluated with the conventional method of limit equilibrium stability analysis on two dimensional slope cross-sections with the aid of the computer program PCSTABL developed by Purdue University in 1988. Our analysis used the Modified Bishop Method, which is based on vertical equilibrium of the individual slices, into which the soil mass above the failure surface is divided, and on overall moment equilibrium. Various trial failure surfaces are analyzed in this manner until a minimum factor of safety is obtained.

The two dimensional cross-sections used for stability evaluation included: Cross Section A-A' through the area of the planned residence and detached garage; Cross Sections B-B' through the proposed leach field area and driveway, and Cross Section C-C', through the greater portion of the hill side. The extents of Sections A-A' and B-B' are limited to the site area only; therefore, they were constructed using the Topographical map of the site produced by Roger E. Dodge, 1997. Section C-C', which extends through the entire hillside and way beyond the property area, was constructed using USGS topographic base map.

9.2 Subsurface Strength Parameters

The subsurface soils were assigned strength values based on CPT data, laboratory direct shear and unconsolidated undrained triaxial compressive strength tests, torvane shear strength values, and unconfined compressive strength tests. A summary of the strength parameters of the subsurface materials is presented on the following Table 2.

TABLE 2
SUMMARY OF SUBSURFACE STRENGTH PARAMETERS

Material	Moist Unit Weight (pcf)	Angle of Internal Friction (degrees)	Cohesion (psf)
Fill	120	32	100
Bay Mud	90	0	220-470*
Old Bay Deposits	120	24	100

*Strength of Bay Mud layers which were variable throughout the site. See results of slope stability analyses in Appendix for assigned Bay Mud Strength values.

9.3 Groundwater

Based on our review of groundwater data, the highest groundwater levels were encountered by our borings and CPTs was about 6 feet below the existing top of the levees. Therefore, for purposes of this analyses groundwater was assumed to be 5 feet below the existing top of levee surface for static and seismic analyses. For rapid drawn down analyses, groundwater was assumed to be at finish grade elevation.

9.4 Static Slope Stability Analysis and Rapid Drawdown

Based on the noted strength parameters, assumed groundwater depths, and the subsurface conditions at the southwest side entrance (Cross Section A-A'), the west side levee (Cross Section B-B') and the northeast levee (Cross Section I-I') Cross Sections A-A', B-B', and C-C', the results of our slope stability analyses yielded safety factors of greater than 1.0 indicating that the subject slopes should be stable under static and rapid drawdown conditions. The results of our static stability analysis using the proposed finish grades shown on Plate 2, Site Plan, are summarized in Table 3.

TABLE 3
SUMMARY OF STATIC
SLOPE STABILITY ANALYSIS RESULTS

CROSS SECTION	DESCRIPTION OF AREA	SAFETY FACTOR	
		STATIC	RAPID DRAWDOWN
A-A'	Site Entrance fill with outboard slip plane	2.05	1.67
C-C'	West Levee with inboard slip plane	1.81	1.72
I-I'	Northeast Levee with outboard slip plane	3.04	2.72
	Northeast Levee with inboard slip plane	1.16	1.02

9.5 Seismic Slope Stability Analysis

The seismic stability of the slopes was analyzed using a pseudo-static approach per the general guidelines included in CGS Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California, 2008. Earthquake Engineering Research Institute has published a screen analysis procedure for seismic slope stability (Stewart, Blake, and Hollingsworth, 2003), that takes into account local variations in the seismicity as presented by the earthquake magnitude, as well as the distance from the fault that most significantly contribute to the ground motion hazard at the site. The screen procedure is based on a statistical relationship previously developed by Bray and Rathji (1998) between seismic slope displacement (u), peak amplitude of shaking in the slide mass (kmax), significant duration of shaking (D5-95), and the ratio of slope resistance to peak demand (ky/kmax, where ky is the yield acceleration, or the horizontal acceleration required to reduce the safety factor to unity). A tolerable seismic slope displacement (u) for residential range from 5 cm to 15 cm. A safety factor of 1 is the minimum required for passing the screen.

Using the slope screen procedure, a pseudo-static coefficient (ky) of 0.23g was established for the analysis based on respective deformation of up to 15 cm. Based on the results of our pseudo-static stability analysis, slope conditions represented by Cross Sections A-A', C-C' and I-I' do not pass the seismic screening analysis associated with a design-level seismic event. Using methods by Bray and Rathji (1998) we calculated seismic slope deformations of 9 inches toward the outboard side of the newly proposed fill embankment at the site entry utilizing Cross Section A-A' and 10 inches toward the inboard side of west levee utilizing Cross Section C-C'. Larger slope deformations of up to 6 feet toward the inboard side and 1.8 feet toward the outboard side were calculated for the northeast levee represented by Section I-I'. The results of the seismic slope stability analyses are presented in Table 4 below and slope stability plots are presented in Appendix C.

TABLE 4
SUMMARY OF SEISMIC
SLOPE STABILITY ANALYSIS RESULTS

CROSS SECTION	DESCRIPTION OF AREA	SEISMIC SAFETY FACTOR (ky = 0.23)	SLOPE DEFORMATION
A-A'	Site Entrance with outboard slip plane	0.91	9 inches
C-C'	West Side Levee with inboard slip plane	0.90	10 inches
I-I'	Northeast Levee with outboard slip plane	0.79	1.8 feet
	Northeast Levee with inboard slip plane	0.65	6 feet

To help improve the seismic stability of the levees and entry embankment and to address the failed seismic screening analysis, sheetpiling may be driven into the inboard and outboard toes of the northeast levee, the outboard edge of the west levee, and the outboard toe of the entrance embankment fill. The recommended alignment of the sheet piling is shown on the attached Remedial Site Plan and Cross Sections. We note that driving the sheetpiling down through the Bay Mud and into the underlying Old Bay Deposits should improve the seismic safety factors to 1.0 or greater with the exception of the outboard side of the northeast levee where a safety factor of 0.82 still remains. To improvement the seismic safety factor of the outboard side of the northeast levee, the proposed outboard fill thickness should be reduced at the outboard toe of the existing levee in addition to the installation the recommended sheetpiling. A summary of the seismic stability analysis results with the recommended sheetpiling and modification to proposed grading is presented in the following Table 5. Respective slope stability plots are presented in Appendix C.

TABLE 5
SUMMARY OF SEISMIC
SLOPE STABILITY ANALYSIS RESULTS

CROSS SECTION	DESCRIPTION OF AREA	SEISMIC SAFETY FACTOR (ky = 0.23)	SLOPE DEFORMATION
A-A’	Site Entrance outboard slip plane with sheetpiling along outboard toe of embankment	1.0	< 6 inches
C-C’	West Side Levee inboard slip plane with sheetpiling along outboard edge of levee	1.0	< 6 inches
I-I’	Northeast Levee outboard slip plane and sheetpiling along outboard toe of levee with outboard fill similar to existing levee fill material	0.81	12 inches
	Northeast Levee outboard slip plane with sheetpiling along outboard toe of levee and proposed fill thickness reduced by 3 feet over outboard toe of levee	1.0	< 6 inches
	Northeast Levee outboard slip plane with sheetpiling along inboard toe of levee and outboard fill comprised of native soils	1.0	< 6 inches

Note: Slope deformation < 6 inches represents passing of seismic screening analysis per Special Publication 117A

Recommended sheetpiling alignments and embedments are shown on the attached remedial site plan and cross sections. Geotechnical recommendations for the sheetpiling are presented in the conclusions and recommendations section of this report.

10.0 CONCLUSIONS AND RECOMMENDATIONS

10.1 General

Based on the findings of our subsurface exploration, research and reviews, it is our opinion that the subject project is feasible from a geotechnical standpoint. The primary geotechnical constraint associated with the project is potential instability of the existing levees. Slope stability analyses of the site levees result in generally low safety factors under seismic conditions. The addition of fill to the top of the levees will create greater instability. Sheetpiling for flood control appears to be a viable option on the outboard edge of the levee on the west side of the site. The sheetpiling should extend through the fill and Bay Mud and should penetrate into the stiffer Old Bay Mud deposits to improve the stability of the levee under seismic conditions.

We note, however, due to environmental constraints, raising the top of levee grade by about 3 to 5 feet and adding fill to create a living shoreline on the northeast levee is planned on the northeast levee. The presence of soft, weak Bay Mud deposits at the site are highly sensitive to the weight of new fills. Our slope stability analyses incorporating the proposed grading on the northeast levee results in unacceptable safety factors under static and seismic conditions. Placing sheetpiling through the fill and Bay Mud and into the underlying stiffer Old Bay Mud deposits appears to improve the stability under static and seismic conditions. Two rows of sheetpiling are necessary to address the proposed fill. Additionally, some modification of the proposed living shoreline grading will be necessary to address seismic stability of the living shoreline fill (outboard side of the northeast levee).

Operation of the facility may be impacted by future settlement of the compressible Bay Mud that is present beneath the site. There still remains some residual settlement from the original fill placed at the site, and additional fill will exacerbate the condition. Underground piping will need to consist of flexible joints to accommodate settlement and repairs and reconnects may need to be planned for in the future depending on how the project will develop. The primary areas of concern are the 3 to 5 feet of fill proposed on the northeast side levee. Additionally, there is about 5 feet of fill planned at the site entrance for a new fill embankment. Settlements for the new fill are to be on the order of about 1 foot while the site as a whole may have 2 to 4 inches of settlement remaining from the original fill placed throughout the site. Additionally, we note that the east portion of the site which consisted of a basin previously has been infilled and grades have been raised up to 7 feet about the adjacent grading of the old fill. This area has not been studied but will likely have settlements of up to one foot.

Materials used for new levee fill should consist of soils of adequate strength but with some plastic fines to inhibit seepage and migration of tidal water. New levee fill generally may consist of on-site or imported soils that have a plasticity index ranging from 10 to 20, a Liquid Limit less than 40, and an angle of internal friction greater than 32 degrees. It should be free of excessive organic matter and rock fragments greater than 3 inch size. Imported aggregate baserock is typically heavier than soils available in the Santa Clara Valley and generally should not be used as fill material at the site.

The use of Bay Mud should be used sparingly because it is generally low strength and may be mixed with other soil fill pending approval by the geotechnical engineer. If used as fill, Bay Mud should be spread out over very broad areas away from the levees and mixed with more competent soils. Bay Mud can also be treated with lime to create more workable conditions and more competent fill material that can be used in the construction of levee fills.

Where the grade of existing levees needs to be raised, imported light weight fill material such as Elastizell will likely be necessary in keyways at the toe of the levees that are in Bay Mud so that a stable base is available on which to place engineered fill. Elastizell pours like concrete and the unit weight can vary from 30 pounds per cubic foot to 90 pcf. If utilized on the site, a minimum 70 pcf unit weight would be specified in order to resist potential hydrostatic uplift from rises in sea level and groundwater table. Alternately, keyways can be stabilized by lime treatment as well.

Construction equipment should be utilized on or near the tops of levees and kept out of the basin areas as much as practical. Equipment should be kept out of the basin's which are comprised of a relatively thin Bay Mud crust that could become disturbed by the wheel loads or track equipment. Should it be necessary to drive equipment in the basin areas, the low pressure equipment such as a Mud Cat with wide tracks should be utilized for grading of the basins such as excavating keyways for new levee fill. A contractor experienced in working under such conditions should be retained.

Sheet piles can be installed by either vibration or driving. We note that some patches of riprap were encountered at the base of the existing levee fills which could hinder the advancement of the sheet piling. Driving sheetpiles under these conditions would likely be more productive than vibrating methods, however, vibrating the sheetpiling could also work but could take longer.

Low pressure, wide track construction equipment will be necessary when working along the toe of levee slopes and in existing basin excavations and in the mudflats located to the northeast of the site. No heavy, rubber tire trucks should be allowed in the basins or in the mudflat areas. Heavy rubber tire trucks can be used along the top of the levees. Some areas on the east side levee and near the northeast corner of the property may not be accessible during the winter months due to poor drainage and excessively soft and wet soil conditions.

New structures will typically require pile support that extends through the existing fill and soft Bay Mud, and into the stiff underlying older bay deposits. Piles will need to embedded roughly 25 to 35 feet below the bottom of the Bay Mud to resist downdrag from settlement of new fills. Approximately 3 to 6 inches of settlement should be anticipated for 1 foot of new fill added. Piles are typically driven with diesel or other fuel driven equipment and the process is very noisy. In the case of sheetpiles, embedment into the stiff alluvial would be limited to about 5 feet.

The fill, Bay Mud, and underlying stiff alluvial soils are predominantly clayey soils which can generally be more easily penetrated by driven piles than by vibrated piles. While piles can be advanced through clayey soils by vibrating, vibrating generally works better for granular soils. Additionally, significant resistance was encountered on the west side levee in one of our borings between the bottom of the fill and the underlying soft Bay Mud. Driven piles should be able to push large debris aside into the underlying soft Bay Mud, while vibrating piles would likely require more effort to displace. The foundation contractor should be consulted with and should be allowed to review our borings and CPTs to assess the feasibility of vibrating piles.

Very light structures may be supported on mat foundations which should be relatively quiet during construction, however, some settlement should be anticipated for structures supported on mat foundations. The building loads should be provided to this office to calculate settlements which can then be reviewed by the structural engineer and client for acceptance. is to use Pile driving/vibrating equipment along with earth moving equipment create emissions, however, pile driving would likely present the greatest noise constraint. A summary of pile depths and vertical capacities reflecting the subsurface conditions at each of the borings are presented in the following table.

TABLE 6
SUMMARY
PRELIMINARY VERTICAL CAPACITIES
FOR DEEP FOUNDATIONS

Boring	Fill Thickness (feet)	Bay Mud Thickness (feet)	Depth of pile/pier to resist downdrag (feet)	Depth of 12-inch square PCP for 50 kip vertical capacity (feet)
B-1	6	15.5	31.1	49.2
B-2	7.5	19.5	39.1	57.2
B-3	6.5	15.5	32.1	50.2
B-4	10.5	16.5	40.8	58.9
B-5	6	10	24	42.1
B-6	9.5	11.5	32.5	50.6
B-7	7.5	14	32	50.1

Drilled piers are another alternate relatively quiet application compared to driving piles. However, it would require installing casing that extends through the fill and into the Bay Mud, preferably to or near the bottom of the Bay Mud to maintain a stable pier excavation while advancing it to the required depth into the stiffer formation below. Since the bottom of the Bay Mud ranges from about 16 to 27 feet below the ground surface, this approach would likely not be practical because it would be difficult to install and remove casing to depths of 16 to 27 feet.

Auger cast piles are another method of deep foundation installation consisting of drilling the hole with a hollow stem auger that is shaped in a way that displaces the soil as it is advanced into the ground and creates less auger spoils than drilled piers. A grout mixture is then pumped through the auger shaft down to the tip of the auger while the auger is slowly removed from the hole, all the while keeping the tip of the auger below the level of the grout. Once the auger is completely removed and the hole is filled with grout a steel cage installed roughly to about half the depth of the pier and a dewey dag bar is installed in the middle of the shaft for its full depth. This is a relatively new type of foundation system and vertical load tests have shown that it is capable of supporting vertical loads accurately. However, little to no data is available to indicate that they can provide the lateral capacity of drilled piers or driven piles.

We note that cutting, filling and offhauling all require rather large trucks and earth moving equipment. This equipment will emit gas fumes and create some noise, however, the primary constraint is that traffic on the existing levees should be limited. Dump trucks should be allowed one at a time to unload imported fill material and it would be preferable to have a single piece of earth moving equipment spreading and compacting fill material.

The addition of fill will create settlement, below ground pipes and structures may be impacted if the fill is placed over them. Below grade structures or pipes should not feel the effect of the new fill provided the edge of the new fill does not encroach the below grade pipe or structure. Driving or vibrating piles should not have an impact on existing structures provided they are setback to avoid conflicting with them.

10.2 Sheetpiling Design Criteria

Sheetpiles will be used as a flood wall and a protector of the levee from a stability standpoint on the west side of the site. Additionally, sheetpiling should be advanced along the northeast side of the site and at the site entrance as shown on the Remedial Site Plan and Remdial Cross Sections in order to address potential seismic slope instability. Sheetpiling should be designed to resist active earth pressures in addition to dynamic pressures induced by seismic ground shaking. The active and dynamic earth pressures can be resisted by passive pressures acting on the opposite side of the sheet pile. The following parameters should be incorporated in the design of the sheetpiling.

NORTHEAST SHEETPILES

INBOARD

Driving Active Pressure + Dynamic Pressures

55 pcf active in fill
90 pcf active in young bay mud
105 pcf active in old bay deposits
150 pcf dynamic acting from ground surface to bottom of Bay Mud.

Resisting Passive Pressures
160 pcf in fill
90 pcf in young bay mud
190 pcf in old bay deposits

OUTBOARD

Driving Active Pressure + Dynamic Pressures
45 pcf active in fill
90 pcf active in young bay mud
105 pcf active in old bay deposits
150 pcf dynamic acting from ground surface to bottom of Bay Mud.

Resisting Passive Pressures
150 pcf in fill
90 pcf in young bay mud
190 pcf in old bay deposits

WESTERN SHEETPILES

INBOARD

Driving Active Pressure + Dynamic Pressures
40 pcf active in fill
90 pcf active in young bay mud
105 pcf active in old bay deposits
150 pcf dynamic acting from ground surface to bottom of Bay Mud.

Resisting Passive Pressures
350 pcf in fill
90 pcf in young bay mud
190 pcf in old bay deposits

ENTRY EMBANKMENT SHEETPILES

OUTBOARD

Driving Active Pressure + Dynamic Pressures

55 pcf active in fill
90 pcf active in young bay mud
105 pcf active in old bay deposits
150 pcf dynamic acting from ground surface to bottom of Bay Mud.

Resisting Passive Pressures
160 pcf in fill
90 pcf in young bay mud
190 pcf in old bay deposits

Sheetpiling should be designed by the project structural engineer utilizing the above parameters. Sheetpiles should be advanced a minimum 5 feet below the bottom of bay mud, into the stiff older bay deposits below, unless the design of the structural engineer warrants deeper embedement.

10.3 Site Grading

The majority of site grading will consist of adding fill for the raising of grades and widening of existing levees on the northeast side of the site, in addition to constructing a new embankment fill at the site entrance. As used in this report, the term "compact" and its derivatives mean that all on-site soils should be compacted to a minimum of 90 percent of maximum dry density, as determined by ASTM D1557 laboratory test method, at a moisture content that is over optimum. The exception being vehicle subgrades which should be compacted to not less than 95 percent relative compaction at above optimum moisture content. Site grading is recommended as follows:

- Areas to receive fill should be stripped of surficial organics and improvements and hauled off site, or stockpiled for future use in landscape areas only. Stripping depth is estimated to be about 4 to 6 inches. The depth of stripping should be verified by the Geotechnical Engineer in the field.
- The exposed surfaces created by the above actions should be cleaned of loose soils to competent material as judged by the geotechnical engineer in the field, scarified to a depth of 8 inches, moisture conditioned and compacted to a minimum of 90 percent relative compaction in building footprint areas and 95 percent relative compaction in traffic areas. Further over-excavate as necessary

any area still containing weak and/or yielding (pumping) soils, or excessively dry soils as determined in the field by the Geotechnical Engineer.

- Subsequent fill should be placed in thin horizontal lifts not exceeding 8 inches in loose thickness and compacted to a minimum 90 percent relative compaction at not less than optimum moisture and to a minimum of 95 percent relative compact when with 8 inches of vehicular subgrades.

- Subsequent fill should be placed in thin horizontal lifts not exceeding 8 inches in loose thickness and compacted to a minimum 90 percent relative compaction at not less than 3 percent over optimum moisture content.

- Fill slopes constructed to widen levee banks should be initiated on level areas or cut benches at least 15 feet wide when on sloping ground; if soft areas encountered, the area could be overexcavated a minimum depth of 18 inches and 15 feet in width, and backfilled with light weight flowable fill; alternately, the area could be treated with lime.

- On-site soils may be used as fill provided they contain no Rocks or cobbles larger than 3 inches in maximum dimensions which should be removed from the fill, unless they can be crushed in-place by the construction equipment.

- Fill slopes constructed to widen levee banks should be constructed at a maximum gradient of 2.5:1 (horizontal to vertical). Fill slopes should be constructed by overfilling and cutting the slope to final grade. "Track walking" of a slope to achieve compaction is not an acceptable procedure for slope construction.

- Erosion protection of finish graded slopes is the responsibility of the grading contractor. As a minimum, finish graded slopes should be planted with deep-rooted, fast-growing vegetation.

All aspects of site grading including clearing/stripping, demolition and placement of fills or backfills should be performed under the observation of BAGG's field representatives. It must be the contractor's responsibility to select equipment and procedures that will accomplish the grading as described above. The contractor must also organize his work in such a manner that one of our field representatives can observe and test the grading operations, including clearing, excavating, and compaction of fills, backfills, and subgrades.

10.4 Slabs-on-Grade and Exterior Flatwork

Concrete slabs and flatwork should be supported on a subgrade that has been prepared as recommended under "Site Grading." The subgrade soils should be maintained at a moisture content that is above optimum, and should be approved by the Geotechnical Engineer immediately before the slab is poured. In general concrete slab-on-grade should not span across bedrock and soil, because the concrete slab may crack at the transition. For a uniform support, the bedrock should be excavated and replaced with soil over the entire slab footprint. The amount of over excavation will depend on the thickness of the soil mantle.

It is recommended that the floor slabs and flatwork should be underlain with at least 4 inches of free draining ¾-inch compacted crushed rock. Beneath the garage slab and where the slab will be subject to vehicular loads, the crushed rock should be replaced with 6-inches of Caltrans Class 2 aggregate base compacted to 95 percent. The base course is intended to serve as a capillary break; however, moisture may accumulate in the base course zone. Therefore, a Class A (ASTM E 1745) vapor barrier of at least 15 mil thickness, such as Stegowrap Vapor Barrier, or approved equal, should be placed on the rock where moisture protection is desired and a damp slab is not acceptable.

Where exterior concrete slabs-on grade will be constructed adjacent to irrigated landscape areas, or where natural runoff will drain toward the pavement area, a vertical curb extending at least 2 to 3 inches below the subgrade (bottom of aggregate base) level would minimize water intrusion into the subgrade soils and maximize the serviceable life of the slab-on-grade.

10.5 Flexible Pavements

The driveway pavements may consist of asphaltic concrete, and/or concrete slabs, and/or pavers. Based on the type and shallow depth of the bedrock, for design purposes we have assumed a subgrade R-Value of 15 to develop preliminary pavement sections tabulated below. R-value is used to characterize the supporting subgrade soils, while the traffic loading conditions for a pavement design are characterized by a Traffic Index. A Traffic Index (TI) of 4.5 is frequently used for areas subject to automobile traffic only, such as parking stalls. A TI of 6.0 is usually appropriate where the pavement will be subject to frequent use by vans or light delivery trucks with only occasional heavy truck traffic, such as from weekly garbage trucks.

TABLE 7
FLEXIBLE PAVEMENT SECTIONS
(SUBGRADE R-VALUE=15)

Pavement Component	TI = 4.5		TI = 5.0		TI = 6.0	
Asphaltic Concrete (AC) in Inches	6	2½	7	3	8 ½	3 ½
Class II Aggregate Base (R_{Min}=78) in Inches	--	8	--	8	--	11
Total Thickness in Inches	6	10½	7	11	8 ½	14 ½

The above pavement sections were calculated using the procedure described in CalTrans Highway Design Manual, Topic 604, dated December 20, 2004. The design pertains to a life expectancy of 20 years for the pavements.

All materials and construction procedures, including placement and compaction of pavement components, should be performed in accordance with the requirements of the Santa Clara County, in conformance with the grading criteria presented previously, and in conformance with the latest edition of the CalTrans Standard Specifications (except that compaction should be performed in accordance with ASTM Test Method D1557). The upper 12 inches of the pavement subgrade should be compacted to at least 95 percent of maximum dry density. Compaction below a depth of 12 inches in the pavement subgrade areas should be carried out to a minimum of 90 percent relative compaction, as previously described.

10.6 Drainage

Measures to control and collect surface run-off should be considered an integral part of the proposed residential project. The ground surface adjacent to all sides of structures should be sloped to drain away from foundations. Unpaved and landscaped areas should slope at least 5 percent to a distance of 5 feet away from the sides of structures. The run-off from the roof of the buildings and intercepted water from surface and subsurface drainage should be discharged to suitable outfall locations in a manner that will not allow ponding adjacent to foundations or erosion on slopes. Any area where surface run-off becomes concentrated should be provided with a catch basin that drains to a suitable discharge point. Surface and subsurface drainage facilities and catchment areas should be checked frequently and cleaned or maintained throughout the project life, as necessary.

10.7 Trench Backfill

Vertical trenches deeper than 5 feet will require temporary shoring. Where shoring is not used, the sides should be sloped or benched, with a slope gradient of at least 1:1 (horizontal: vertical). The trench spoils should not be placed closer than 3 feet (or one-half of the trench depth) from the trench sidewalls. All work associated with trenching must conform to the State of California, Division of Industrial Safety requirements. In our opinion, the soils in the upper 5 feet of the site levees can be classified as "Type B Soil." Soils below this depth should be classified as type C.

Trench backfill materials and compaction should conform to the following:

- In general, soils used for trench backfill shall be free of debris, roots and other organic matter, debris, and rocks or clay clumps exceeding 4 inches in greatest dimension. The on-site soils can be used for trench backfill, but not for pipe bedding or shading.

- Compaction shall be performed to a minimum of 90% relative compaction in accordance with ASTM D1557, at a moisture content recommended previously. In pavement areas, the upper 24 inches of the backfill (below the pavement subgrade) shall be compacted to 95% of the maximum dry density. Jetting shall not be allowed.

- To help reduce the potential for rain and irrigation to migrate under the buildings on-site clayey soils should be used to backfill utility trenches entering the building footprint for a distance of at least 5 feet extending in and out of the building footprint. Controlled density fill (CDF) may be used in lieu of clayey soils.

10.8 Plan Review

It is recommended that the Geotechnical Engineer (BAGG Engineers) be retained to review the grading, foundation and improvement plans for the subject project. This review is to assess general suitability of the earthwork, foundation, and drainage recommendations contained in this report and to verify the appropriate implementation of our recommendations into the project plans and specifications.

10.9 Observation and Testing

It is recommended that the Geotechnical Engineer (BAGG) be retained to provide observation and testing services during site grading, excavation, backfilling, and foundation construction phases of work. This is intended to verify that the work in the field is per our recommendations and in accordance with the approved plans and specifications, and more importantly verify that subsurface conditions encountered during construction are similar to those anticipated during the design phase. Unanticipated soil conditions may warrant revised recommendations. Therefore, BAGG cannot accept responsibility for the recommendations contained in this report if we are not retained to provide observation and testing services during construction.

11.0 CLOSURE

This report has been prepared in accordance with generally-accepted engineering practices for the strict use of Freyer & Laureta, Inc., and other professionals associated with the specific project described in this report. The recommendations presented in this report are based on our understanding of the proposed project as described herein, and upon the soil conditions encountered by widely spaced borings and CPTs advanced for this investigation. The recommendations contained in this report are intended to improve the stability of the levees while increasing their capacity and creating the living shoreline on the northeast side of the site.

The conclusions and recommendations contained in this report are based on subsurface conditions revealed by widely spaced borings and CPTs, limited laboratory test data, and on a review of available geotechnical and geologic literature pertaining to the project vicinity. It is not uncommon for unanticipated conditions to be encountered during site grading, sheetpile driving and/or foundation excavations and it is not possible for all such variations to be found by a field exploration program appropriate for this type of project. The recommendations contained in this report are therefore contingent upon the review of the final grading, drainage, and foundation plans by this office, and upon geotechnical observation and testing by BAGG of all pertinent aspects of site grading, including placement of fills and backfills, and foundation construction.

Subsurface conditions and standards of practice change with time. Therefore, we should be consulted to update this report, if grading and construction does not commence within 6 months from the date this report is submitted or next winter. Additionally, the recommendations of this report are only valid for the proposed development as described herein. If the proposed project is modified, our recommendations should be reviewed and approved or modified by this office in writing.

Attachments:

Plate 1	Vicinity Map
Plate 2	Site Plan
Plate 3	Area Geologic Map
Plate 4	Regional Fault Map
Plate 5	Unified Soil Classification System
Plate 6	Soil Terminology
Plate 7	Boring Log Notes
Plate 8	Key to Symbols
Plate 9 through 19	Logs of Boring B-1 through B-11

Plate 20	Plasticity Data
Plate 21	Triaxial Test Results
Plate 22 through 24	Consolidation Test Results
Plate 25	Cross Sections A-A' through D-D'
Plate 26	Cross Sections E-E' through H-H'
Plate 27	Cross Section I-I'
Plate 28	Remedial Cross Sections A-A' through D-D'
Plate 29	Remedial Cross Sections E-E' through H-H'
Plate 30	Remedial Options for Cross Section I-I'
Plate 31	Remedial Site Plan

Appendix A	Cone Penetrometer Test Results
Appendix B	Geotechnical Subsurface and Laboratory by Others
Appendix C	Results of Slope Stability Analyses

ASFE document titled "Important Information About Your Geotechnical Engineering Report"

12.0 REFERENCES

Association of Bay Area Governments (ABAG), 2003, *Modeled Shaking Intensity Maps.*

Brabb, E. E., Graymer, R.W. Jones, D.L., 1998, Geology of the Palo Alto 30 X 60 Minute Quadrangle, California: a digital database, U.S. Geological Survey Open File Report 98-348.

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Computer slope stability program PCSTABL developed by Purdue University in 1988 and improved with a smart editor developed by Harald Van Aller 1996.

E.E. Brabb, R.W. Graymer, and D.L. Jones, 2000, Geologic Map and Map Database for the Palo Alto 30'x60' Quadrangle, California, Miscellaneous Field Studies Map MF-2332, U.S.G.S.

Keefer, D.K., 1984, Landslides caused by earthquakes: Geological Society of America Bulletin, v. 95, no. 4, p. 406-421.

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Recommended Procedures for Implementation of DMG Special Publication 117 Guidelines for Analyzing and Mitigating Landslide Hazards in California, Southern California Earthquake Center, June 2002.

Working Group on Northern California Earthquake Potential, *Database of Potential sources for Earthquake Larger Than Magnitude 6 in Northern California*, Open-File Report 96-705, U.S. Geological Survey, 1996.

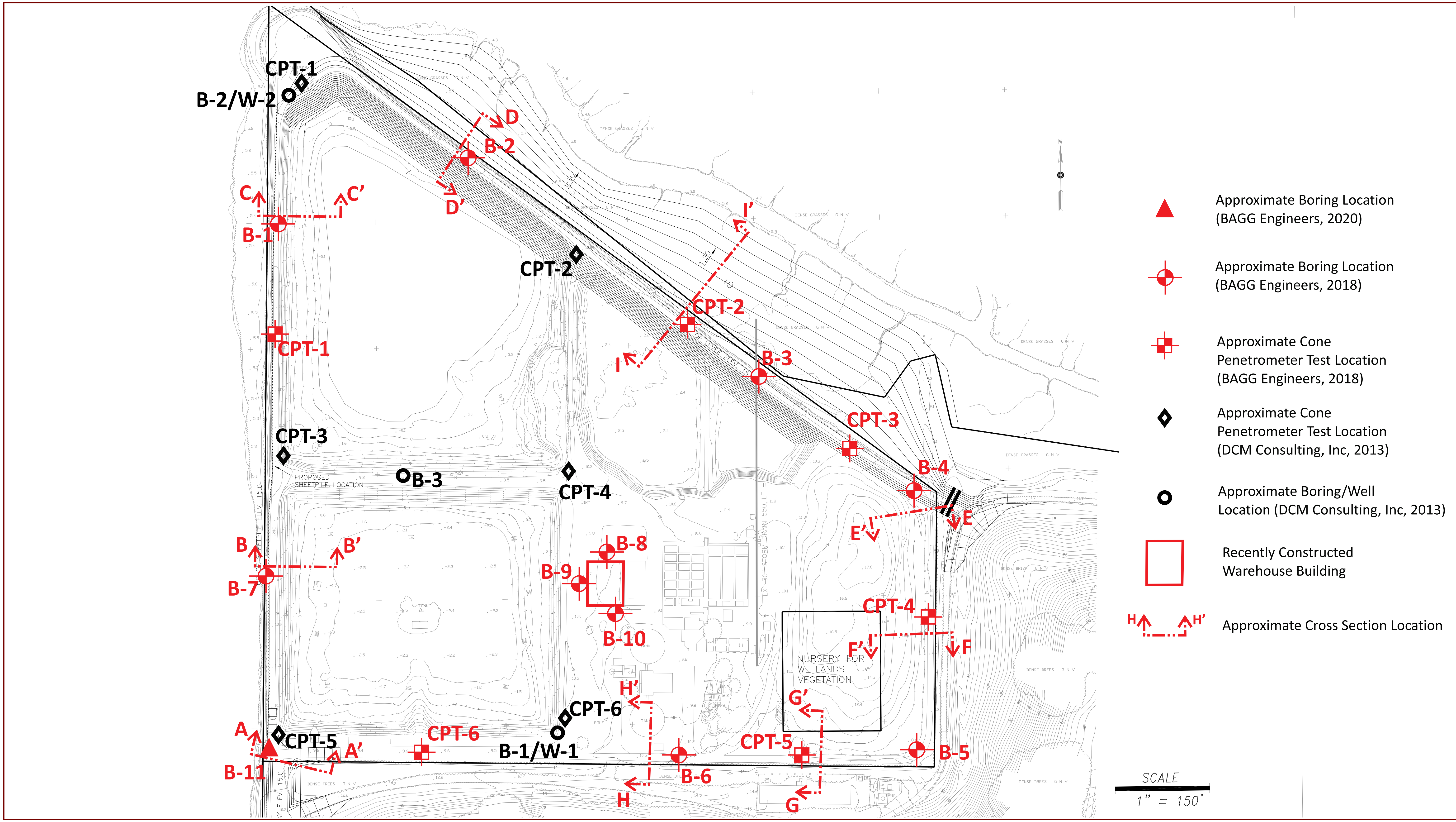
Working Group on California Earthquake Probabilities, 2008, *The Uniform California Earthquake Rupture Forecast, Version 2 (UCERF2)*, U. S. Geological Survey Open File Report 2007-1437.

GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED SHEETPILE FLOOD WALL
FLOW EQUALIZATION FACILITY
WEST BAY SANITARY DISTRICT
MENLO PARK, CALIFORNIA

BAGG ENGINEERS

VICINITY MAP

DATE:	JOB NUMBER:	PLATE:
November 2020	FREYE-18-01	1



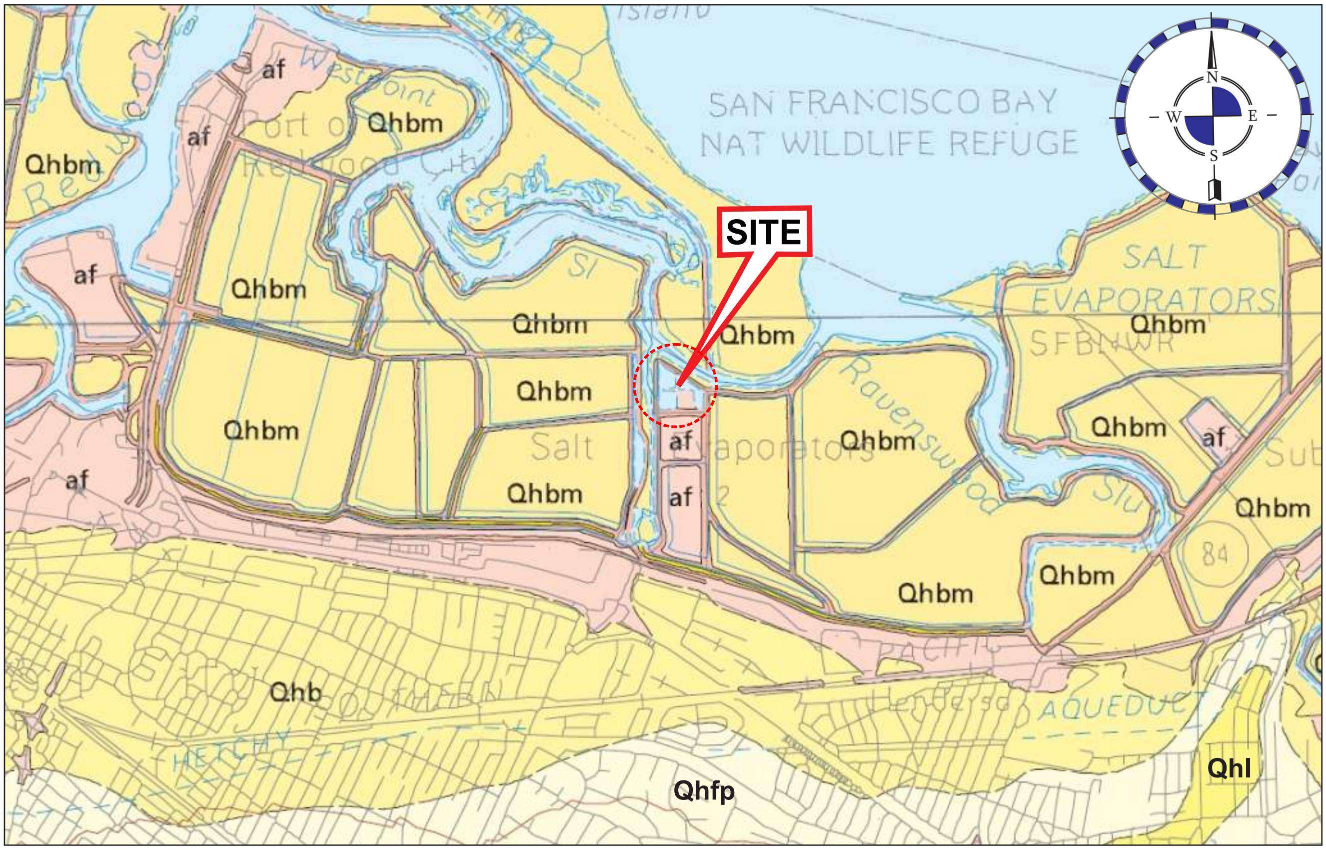
Base: "Living Shoreline Cut and Fill Analysis," Levee Design Project, West Bay Sanitary District, Menlo Park, CA, Job No. 001079, Sheet 1 of 1, by Freyer Laureta, Inc., dated 2/13/20.

GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED SHEETPILE FLOOD WALL
FLOW EQUALIZATION FACILITY
WEST BAY SANITARY DISTRICT
MENLO PARK, CALIFORNIA

BAGG ENGINEERS

SITE PLAN

JOB NUMBER:	SCALE:	DATE:	PLATE
FREYE-18-01	as indicated	November 2020	2



LEGEND

af — **Artificial fill (Historic) –** Loose to very well consolidated gravel, sand, silt, clay, rock fragments, organic matter, and man-made debris in various combinations. Thickness is variable and may exceed 30 m in places. Some is compacted and quite firm, but fill made before 1965 is nearly everywhere not compacted and consists simply of dumped materials.

Qhbm — **Bay mud (Holocene) –** Water-saturated estuarine mud, predominantly gray, green and blue clay and silty clay underlying marshlands and tidal mud flats of San Francisco Bay, Pescadero, and Pacifica. The upper surface is covered with cordgrass (Spartina sp.) and pickleweed (Salicornia sp.). The mud also contains a few lenses of well-sorted, fine sand and silt, a few shelly layers (oysters), and peat.

Qhb — **Basin deposits (Holocene) –** Very fine silty clay to clay deposits occupying flat-floored basins at the distal edge of alluvial fans adjacent to the bay mud (Qhbm).

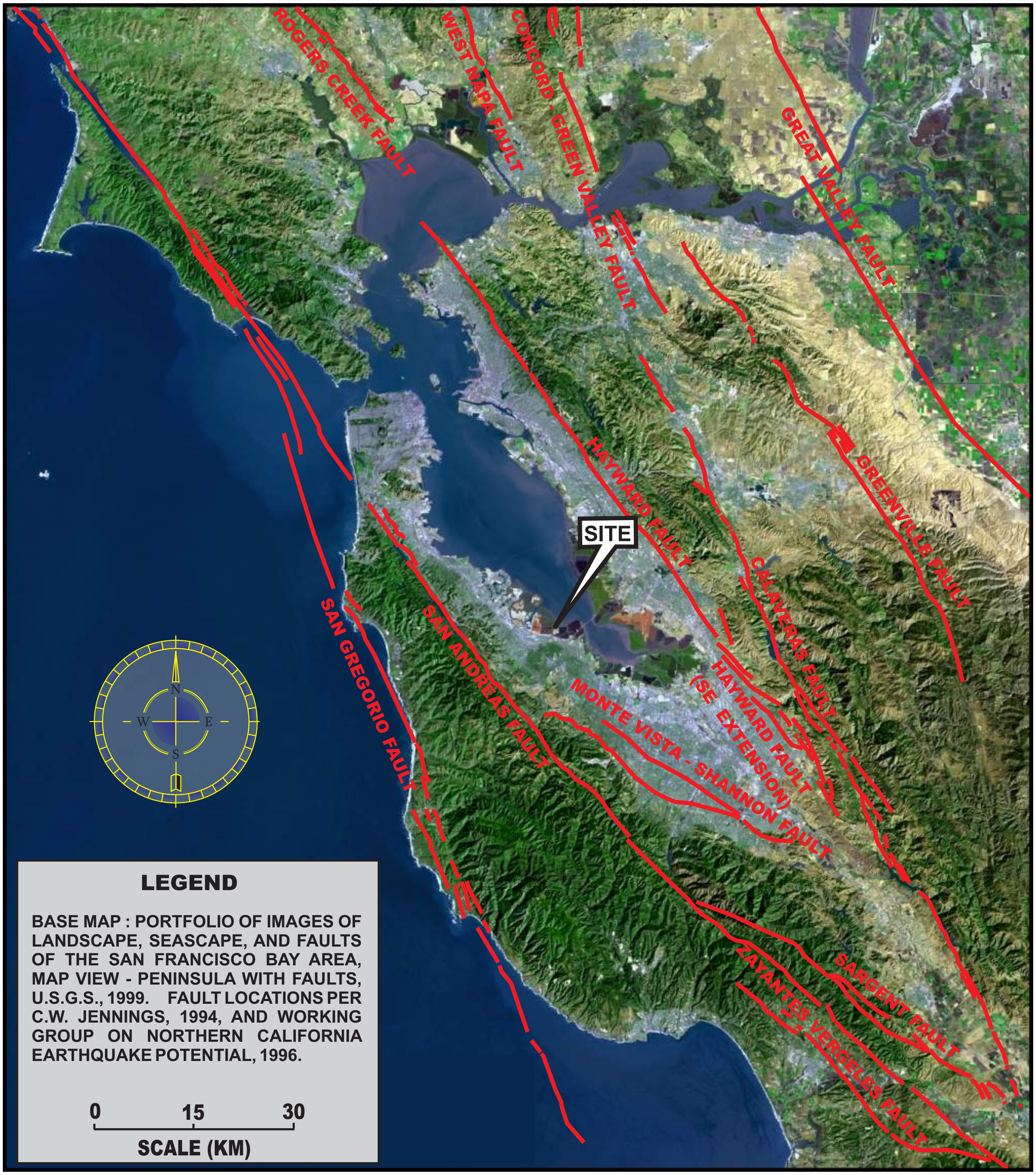
Qhfp — **Floodplain deposits (Holocene) –** Medium to dark gray, dense, sandy to silty clay. Lenses of coarser material (silt, sand, and pebbles) may be locally present.

Qhl — **Natural levee deposits (Holocene) –** Loose, moderately to well-sorted sandy or clayey silt grading to sandy or silty clay.

Reference: *Geology of the Onshore Part of San Mateo County, California: Derived from the Digital Database Open-File 98-137,* by Brabb et al., 1998.

GEOTECHNICAL ENGINEERING INVESTIGATION PROPOSED SHEETPILE FLOOD WALL FLOW EQUALIZATION FACILITY WEST BAY SANITARY DISTRICT MENLO PARK, CALIFORNIA	AREA GEOLOGIC MAP		
	DATE: November 2020	JOB NUMBER: FREYE-18-01	PLATE: 3

BAGG ENGINEERS



GEOTECHNICAL ENGINEERING INVESTIGATION PROPOSED SHEETPILE FLOOD WALL FLOW EQUALIZATION FACILITY WEST BAY SANITARY DISTRICT MENLO PARK, CALIFORNIA	REGIONAL FAULT MAP		
	DATE: November 2020	JOB NUMBER: FREYE-18-01	PLATE 4

COARSE-GRAINED SOILS

LESS THAN 50% FINES*

GROUP SYMBOLS	ILLUSTRATIVE GROUP NAMES	MAJOR DIVISIONS
GW	Well graded gravel Well graded gravel with sand	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size
GP	Poorly graded gravel Poorly graded gravel with sand	
GM	Silty gravel Silty gravel with sand	
GC	Clayey gravel Clayey gravel with sand	
SW	Well graded sand Well graded sand with gravel	SANDS More than half of coarse fraction is smaller than No. 4 sieve size
SP	Poorly graded sand Poorly graded sand with gravel	
SM	Silty sand Silty sand with gravel	
SC	Clayey sand Clayey sand with gravel	

NOTE: Coarse-grained soils receive dual symbols if:
(1) their fines are CL-ML (e.g. SC-SM or GC-GM) or
(2) they contain 5-12% fines (e.g. SW-SM, GP-GC, etc.)

FINE-GRAINED SOILS

MORE THAN 50% FINES*

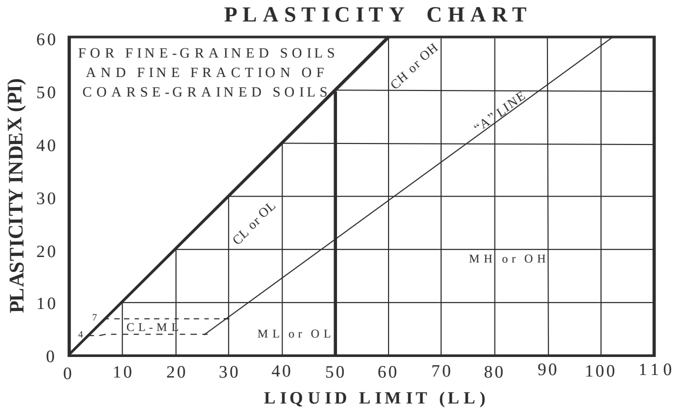
GROUP SYMBOLS	ILLUSTRATIVE GROUP NAMES	MAJOR DIVISIONS
CL	Lean clay Sandy lean clay with gravel	SILTS AND CLAYS liquid limit less than 50
ML	Silt Sandy silt with gravel	
OL	Organic clay Sandy organic clay with gravel	
CH	Fat clay Sandy fat clay with gravel	SILTS AND CLAYS liquid limit more than 50
MH	Elastic silt Sandy elastic silt with gravel	
OH	Organic clay Sandy organic clay with gravel	
PT	Peat Highly organic silt	HIGHLY ORGANIC SOIL

NOTE: Fine-grained soils receive dual symbols if their limits in the hatched zone on the Plasticity Chart(L-M)

SOIL SIZES

COMPONENT	SIZE RANGE
BOULDERS	ABOVE 12 in.
COBBLES	3 in. to 12 in.
GRAVEL	No. 4 to 3 in.
Coarse	¾ in to 3 in.
Fine	No. 4 to ¾ in.
SAND	No. 200 to No.4
Coarse	No. 10 to No. 4
Medium	No. 40 to No. 10
Fine	No. 200 to No. 40
*FINES:	BELOW No. 200

NOTE: Classification is based on the portion of a sample that passes the 3-inch sieve.



Reference: ASTM D 2487-06, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

GENERAL NOTES: The tables list 30 out of a possible 110 Group Names, all of which are assigned to unique proportions of constituent soils. Flow charts in ASTM D 2487-06 aid assignment of the Group Names. Some general rules for fine grained soils are: less than 15% sand or gravel is not mentioned; 15% to 25% sand or gravel is termed "with sand" or "with gravel", and 30% to 49% sand or gravel is termed "sandy" or "gravelly". Some general rules for coarse-grained soils are: uniformly-graded or gap-graded soils are "Poorly" graded (SP or GP); 15% or more sand or gravel is termed "with sand" or "with gravel", 15% to 25% clay and silt is termed clayey and silty and any cobbles or boulders are termed "with cobbles" or "with boulders".

UNIFIED SOIL CLASSIFICATION SYSTEM

BVGG ENGINEERS

SOIL TYPES (Ref 1)

Boulders: particles of rock that will not pass a 12-inch screen.

Cobbles: particles of rock that will pass a 12-inch screen, but not a 3-inch sieve.

Gravel: particles of rock that will pass a 3-inch sieve, but not a #4 sieve.

Sand: particles of rock that will pass a #4 sieve, but not a #200 sieve.

Silt: soil that will pass a #200 sieve, that is non-plastic or very slightly plastic, and that exhibits little or no strength when dry.

Clay: soil that will pass a #200 sieve, that can be made to exhibit plasticity (putty-like properties) within a range of water contents, and that exhibits considerable strength when dry.

MOISTURE AND DENSITY

Moisture Condition: an observational term; dry, moist, wet, or saturated.

Moisture Content: the weight of water in a sample divided by the weight of dry soil in the soil sample, expressed as a percentage.

Dry Density: the pounds of dry soil in a cubic foot of soil.

DESCRIPTORS OF CONSISTENCY (Ref 3)

Liquid Limit: the water content at which a soil that will pass a #40 sieve is on the boundary between exhibiting liquid and plastic characteristics. The consistency feels like soft butter.

Plastic Limit: the water content at which a soil that will pass a #40 sieve is on the boundary between exhibiting plastic and semi-solid characteristics. The consistency feels like stiff putty.

Plasticity Index: the difference between the liquid limit and the plastic limit, i.e. the range in water contents over which the soil is in a plastic state.

MEASURES OF CONSISTENCY OF COHESIVE SOILS (CLAYS) (Ref's 2 & 3)

Very Soft	N=0-1*	C=0-250 psf	Squeezes between fingers
Soft	N=2-4	C=250-500 psf	Easily molded by finger pressure
Medium Stiff	N=5-8	C=500-1000 psf	Molded by strong finger pressure
Stiff	N=9-15	C=1000-2000 psf	Dented by strong finger pressure
Very stiff	N=16-30	C=2000-4000 psf	Dented slightly by finger pressure
Hard	N>30	C>4000 psf	Dented slightly by a pencil point

*__N__=blows per foot in the Standard Penetration Test. In cohesive soils, with the 3-inch-diameter ring sampler, 140-pound weight, divide the blow count by 1.2 to get N (Ref 4).

MEASURES OF RELATIVE DENSITY OF GRANULAR SOILS (GRAVELS, SANDS, AND SILTS) (Ref's 2 & 3)

Very Loose	N=0-4**	RD=0-30	Easily push a ½-inch reinforcing rod by hand
Loose	N=5-10	RD=30-50	Push a ½-inch reinforcing rod by hand
Medium Dense	N=11-30	RD=50-70	Easily drive a ½-inch reinforcing rod
Dense	N=31-50	RD=70-90	Drive a ½-inch reinforcing rod 1 foot
Very Dense	N>50	RD=90-100	Drive a ½-inch reinforcing rod a few inches

**__N__=Blows per foot in the Standard Penetration Test. In granular soils, with the 3-inch-diameter ring sampler, 140-pound weight, divide the blow count by 2 to get N (Ref 4).

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Ref 1: ASTM Designation: D 2487-06, **Standard Classification of Soils for Engineering Purposes** (Unified Soil Classification System).

Ref 2: Terzaghi, Karl, and Peck, Ralph B., **Soil Mechanics in Engineering Practice,** John Wiley & Sons, New York, 2nd Ed., 1967, pp. 30, 341, and 347.

Ref 3: Sowers, George F., **Introductory Soil Mechanics and Foundations: Geotechnical Engineering,** Macmillan Publishing Company, New York, 4th Ed., 1979, pp. 80, 81, and 312.

Ref 4: Lowe, John III, and Zaccheo, Phillip F., **Subsurface Explorations and Sampling,** Chapter 1 in "Foundation Engineering Handbook," Hsai-Yang Fang, Editor, Van Nostrand Reinhold Company, New York, 2nd Ed, 1991, p. 39.

SOIL TERMINOLOGY

GENERAL NOTES FOR BORING LOGS:

The boring logs are intended for use only in conjunction with the text, and for only the purposes the text outlines for our services. The Plate "Soil Terminology" defines common terms used on the boring logs.

The plate "Unified Soil Classification System," illustrates the method used to classify the soils. The soils were visually classified in the field; the classifications were modified by visual examination of samples in the laboratory, supported, where indicated on the logs, by tests of Liquid Limit, Plasticity Index, and/or gradation. In addition to the interpretations for sample classification, there are interpretations of where stratum changes occur between samples, where gradational changes substantively occur, and where minor changes within a stratum are significant enough to log.

There may be variations in subsurface conditions between borings. Soil characteristics change with variations in moisture content, with exchange of ions, with loosening and densifying, and for other reasons. Groundwater levels change with seasons, with pumping, from leaks, and for other reasons. Thus boring logs depict interpretations of subsurface conditions only at the locations indicated, and only on the date(s) noted.

SPECIAL FIELD NOTES FOR THIS REPORT:

1. Borings B-1 through B-7 were advanced in April 2018 under the direction of BAGG Engineers; borings B-8 through B-10 were advanced in November 2018 under the direction of BAGG Engineers; and boring B-11 was advanced on November 18, 2020 under the direction of BAGG Engineers. The borings were advanced using a truck-mounted drilling rig with 8-inch diameter hollow stem augers provided and operated by Exploration Geoservices, Inc. The boreholes were backfilled with cement grout per standard protocol.

2. The boring locations were approximately located using a measuring tape and existing site features such as fences, concrete pads, etc.

3. The soils’ Group Names [e.g. LEAN CLAY] and Group Symbols [e.g. (CL)] were determined or estimated per ASTM D 2487, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System, see Plate 5). Other engineering terms used on the boring logs are defined on Plate 6, Soil Terminology.

4. Groundwater was encountered in the borings on the date and at the depths noted on the boring logs.

5. The soil samples were obtained using the sampler types noted on the boring logs and described on Plates 8-A and 8-B, Key to Symbols.

6. The “Blow Count” Column on the boring logs indicates the number of blows required to drive the Modified California and/or Standard Penetration Test samplers below the bottom of the boring, with the blow counts given for each 6 inches of sampler penetration.

7. The tabulated strength values on the boring logs are peak strength values.

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KEY TO SYMBOLS

Symbol	Description

Strata symbols

- Poorly graded gravel (FILL)
- Borderline gravelly clay to clayey gravel
- High plasticity (fat) clay with gravel (FILL)
- High plasticity (fat) clay
- Lean Clay
- Well graded sand
- Clayey sand
- Poorly graded gravel with silt and sand
- Poorly graded sand with silt and gravel
- Sandy lean clay
- Poorly graded sand with clay
- Silty sand

Symbol	Description

Misc. Symbols

- Water first encountered during drilling
- Boring continues

Soil Samplers

- Modified California Sampler: 2.375" ID by 3" OD, split-barrel sampler driven w/ 140-pound hammer falling 30 inches
- Undisturbed, thin-wall Shelby tube (ASTM D 1587-00)
- Standard Penetration Test: 1 3/8" ID by 2" OD, split-spoon sampler driven with 140-pound hammer falling 30" (ASTM D 1586-99)

Line Types

- Denotes a sudden, or well identified strata change
- Denotes a gradual, or poorly identified strata change

Laboratory Data

Symbol	Description
DS	Direct shear test performed on a sample at natural or field moisture content (ASTM D2166).
DSX	Direct shear test performed after the sample was submerged in water until volume changes ceased (ASTM D2166).
PI	Plasticity Index established per ASTM D4318 Test Method.
LL	Liquid Limit established per ASTM D4318 Test Method.
Fines	Percent soil particles finer than a No. 200 sieve (ASTM D1140)

KEY TO SYMBOLS

Symbol	Description
Laboratory Data	
AC	Asphaltic concrete
AB	Aggregate base
CONS	Consolidation Test performed per ASTM D2435
Cc'	Compression Ratio
Torvane	Undrained shear strength established with hand held testing device (ASTM D8121)

BORING LOG

Boring No. B-1

JOB NAME: Proposed Sheetpile Wall
CLIENT: Freyer & Laureta, Inc.
LOCATION: North End Marsh Road, Menlo Park, California
DRILLER: Exploration Geoservices, Inc.
DRILL METHOD: 8-inch diameter hollow stem augers

JOB NO.: FREYE-18-01
DATE DRILLED: 4/26/18
ELEVATION: 10.0±feet
LOGGED BY: MM

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
						0		GP	POORLY GRADED GRAVEL, gray, dry, dense, with asphaltic concrete (AC) fragments, medium to fine grained	FILL
							14, 18, 20	CL		
DSX	320	30.2	630	27.5	93.5			CH	LEAN CLAY, yellow brown, moist, very stiff, with sand, trace gravel and AC fragments	1.2% swell
						3	9, 16, 17		FAT CLAY, olive brown, moist, very stiff, with silt and fine sand, trace gravel, trace orange mottling	
DSX	600	23.4	1350	20.1	101				...oversize debris encountered from 5 to 6 feet	1.0% swell
						6		CH	BAY MUD: Fat Clay, gray, saturated, soft, with silt and trace very fine sand, trace rootlets, slightly oxidized	NATIVE
						9	1, 1, 1			
DS	1000	NAT	290	93.3	45.2					
						12				
									...very soft, no oxidation stains noted	100 to 200 psi to advance sampler
TXUU CONS	300	NAT	265	75.9 87.2	52.7 49.2	15				LL=80 PI=49 Cc'=0.30
						18	2			

BORING LOG

Boring No. B-1

JOB NAME: Proposed Sheetpile Wall   *JOB NO.:* FREYE-18-01

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
				86.7	48.7		2, 2			
						21				
								CL	LEAN CLAY, gray, saturated, very stiff, with silt, some fine sand	
DS	1600	NAT	1375	24.7	97.4	24	7, 8, 15			
						27				
DS	2100	NAT	1375	20.9	106	30	8, 10, 13			
									Boring terminated at 30 feet. Groundwater encountered at 10 feet. Boring backfilled with neat cement grout immediately after last sample taken.	
						33				
						36				
						39				

BORING LOG

Boring No. B-2

JOB NAME: Proposed Sheetpile Wall
CLIENT: Freyer & Laureta, Inc.
LOCATION: North End Marsh Road, Menlo Park, California
DRILLER: Exploration Geoservices, Inc.
DRILL METHOD: 8-inch diameter hollow stem augers

JOB NO.: FREYE-18-01
DATE DRILLED: 4/26/18
ELEVATION: 12.0±feet
LOGGED BY: MM

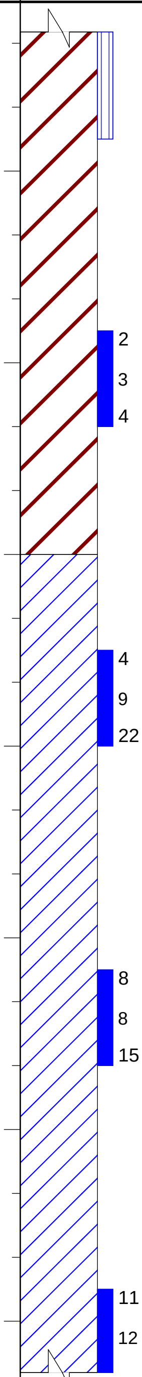
Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
						0		CL	LEAN CLAY, brown, moist, very stiff, some sand and silt, trace gravel	FILL
DSX DSX DSX	320 500 1000	17.8 18.0 17.5	430 660 715	11.4 13.4 11.6	108 110 105		7 9 17			
						3				
DSX DSX DSX	600 1500 2000	15.7 33.3 20.9	970 1090 2085	11.4 30.1 19.2	116 85 105		17 19 23		...light brown mottling, increase in sand content	
						6				
								CH	BAY MUD: Fat Clay, dark gray to medium gray, very moist, soft, with silt and very fine sand	NATIVE
				86.2	48.8	9	1 1 1			
						12			...saturated below 12 feet	
				88.3	48.9	15	1 1 2			
						18				100 to 200 psi to advance sampler

BORING LOG

Boring No. B-2

JOB NAME: Proposed Sheetpile Wall   *JOB NO.:* FREYE-18-01

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
TXUU CONS	450	NAT	170	93.4 87.6	46.5 48.9					LL=88 PI=55 Cc'=0.247
						21				
						24	2 3 4			
TXUU	600	NAT	250	57.1	64.2					
						27		CL	LEAN CLAY, blue gray, saturated, stiff to very stiff, with silt and little fine sand ...color change to yellow brown with faint blue gray discolorations, very stiff	
DS	2200	NAT	2650	23.8	102		4 9 22			
						30				
						33			...color change to olive brown, stiff, with trace oxidation stains	
DS	2800	NAT	2280	25.0	97.4		8 8 15			
						36			...more plastic below 37 feet, some silt, trace fine sand, trace oxidation stains	
						39	11 12			



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BORING LOG

JOB NAME: Proposed Sheetpile Wall

JOB NO.: FREYE-18-01

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
DS	3400	NAT	890	29.6	92.1		14			
						42				
							8 10			
DS	4000	NAT	1000	32.0	88.6		13			
						45				
						48				
							11 12			
DS	4600	NAT	1545	25.2	98.5		17			
									Boring terminated at 50 feet. Groundwater encountered at 12 feet. Boring backfilled with neat cement grout immediately after last sample was taken.	
						51				
						54				
						57				
						60				

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BORING LOG

Boring No. B-3

JOB NAME: Proposed Sheetpile Wall
CLIENT: Freyer & Laureta, Inc.
LOCATION: North End Marsh Road, Menlo Park, California
DRILLER: Exploration Geoservices, Inc.
DRILL METHOD: 8-inch diameter hollow stem augers

JOB NO.: FREYE-18-01
DATE DRILLED: 4/26/18
ELEVATION: 11.7±feet
LOGGED BY: MM

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
						0		CL	LEAN CLAY, brown, moist, very stiff, some sand, trace gravel	FILL
				16.6	96.8		8 8 22			
						3				
				11.2	100		9 10 12			
						6		CH	BAY MUD: Fat Clay, gray, very moist, soft, with silt and trace fine sand, trace dark discolorations	NATIVE
				85.9	50.1	9	3 3 2			
						12			...saturated below 12 feet	
				88.7	48.9	15				150 to 200 psi required to advance Shelby Tube
						18	2			

BORING LOG

Boring No. B-3

JOB NAME: Proposed Sheetpile Wall

JOB NO.: FREYE-18-01

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
				93.8	46.6		2, 3			
						21				
								CL	LEAN CLAY, blue gray, saturated, very stiff with sand, trace fine gravel	
						24	8, 10, 22			
				16.5	114					
						27		SW	POORLY GRADED GRAVEL, blue gray, medium dense, fine gravel with some poorly sorted sand	
				18.3	111		8, 10, 12			8% fines
						30				
									...very dense below 32 feet	
						33				
				20.9	106		30, 50/6"			13% fines
				29.6	92.7			CL	LEAN CLAY, olive brown, saturated, hard, with silt and fine sand	
									Boring terminated at $34\frac{1}{2}$ feet. Groundwater encountered at 12 feet. Boring was backfilled with neat cement grout immediately after last sample was taken.	
						36				
						39				

BORING LOG

JOB NAME: Proposed Sheetpile Wall
CLIENT: Freyer & Laureta, Inc.
LOCATION: North End Marsh Road, Menlo Park, California
DRILLER: Exploration Geoservices, Inc.
DRILL METHOD: 8-inch diameter hollow stem auger

JOB NO.: FREYE-18-01
DATE DRILLED: 4/27/18
ELEVATION: 12.0±feet
LOGGED BY: MM

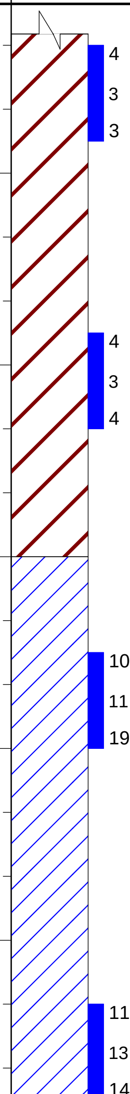
Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
						0		CL	LEAN CLAY, yellow brown, moist, very stiff, with sand and trace gravel	FILL
						3	11, 12, 12			
DSX	1000	81.9	350	83.3	50.1				...locally mottled with bay mud	
						6				
						9	7, 8, 10			
DS	1300	NAT	1860	13.1	111					
								CH	BAY MUD: Fat Clay, very dark gray, very moist, stiff (Bay Mud crust)	NATIVE
						▽ 12				
							4, 3, 3			
				53.2	69.0	15				
						18				

BORING LOG

JOB NAME: Proposed Sheetpile Wall

JOB NO.: FREYE-18-01

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
				86.7	50.6	21	4 3 3			
				66.2	59.6	24	4 3 4			
						27		CL	LEAN CLAY, blue gray, saturated, very stiff, with sand, trace oxidation stains, trace caliche	
				21.6	106	30	10 11 19			
						33				
				21.2	102	36	11 13 14		Boring terminated at 35½ feet. Groundwater encountered at 12 feet. Boring backfilled with neat cement grout immediately after last sample was taken.	
						39				



BORING LOG

JOB NAME: Proposed Sheetpile Wall
CLIENT: Freyer & Laureta, Inc.
LOCATION: North End Marsh Road, Menlo Park, California
DRILLER: Exploration Geoservices, Inc.
DRILL METHOD: 8-inch diameter hollow stem auger

JOB NO.: FREYE-18-01
DATE DRILLED: 4/27/18
ELEVATION: 12.0±feet
LOGGED BY: MM

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
						0		CL	LEAN CLAY, dark yellow brown, moist, very stiff with silt and some sand, trace gravel	FILL
						3	11 13 16			
DSX	3000	18.4	2255	10.2	118					
						6		CH	BAY MUD: Fat Clay, gray, very moist, medium stiff to soft with silt and trace very fine sand, trace rootlets and oxidation stains	NATIVE
				140	31.0	9	4 4 4			
									...no rootlets	200 psi needed to advance Shelby Tube
CONS				92.5	48.2					Cc'=0.28
TXUU	250	NAT	115	92.4	47.5	12				LL=91 PI=57 TXUU sample disturbed
							3 3 3			
				105	42.4					
						15				
								CL	LEAN CLAY, dark brown, saturated, very stiff, with silt and trace fine sand	
						18	12			

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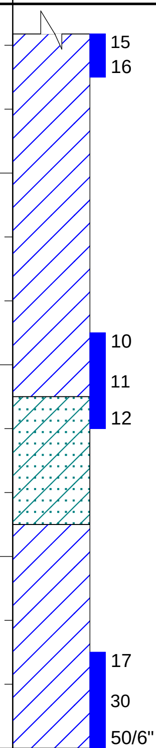
BORING LOG

JOB NAME: Proposed Sheetpile Wall

JOB NO.: FREYE-18-01

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
DS	1500	NAT	970	33.3	85		15, 16			
						21			...color change to blue gray, increase in sand content, stiff	
DS	1800	NAT	1000	24.0	103	24	10, 11, 12		...color change to olive brown	
								SC	CLAYEY SAND, olive brown, saturated, medium dense, medium to fine grained sand	
						27		CL	LEAN CLAY, yellow brown, saturated, very stiff to hard, with silt and sand some blue gray discolorations	
				20.4	107		17, 30, 50/6"			
						30			Boring terminated at 30 feet. Groundwater encountered at 12 feet. Boring backfilled with neat cement grout immediately after last sample was taken.	
						33				
						36				
						39				



BORING LOG

Boring No. B-6

JOB NAME: Proposed Sheetpile Wall
CLIENT: Freyer & Laureta, Inc.
LOCATION: North End Marsh Road, Menlo Park, California
DRILLER: Exploration Geoservices, Inc.
DRILL METHOD: 8-inch diameter hollow stem auger

JOB NO.: FREYE-18-01
DATE DRILLED: 4/27/18
ELEVATION: 10.5±feet
LOGGED BY: MM

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
						0		CH	FAT CLAY, dark brown, moist, very stiff, with silt, trace fine gravel	FILL
				22.2	105.5	3	10, 11, 15			
						6				
				82.3	48.7	9	11, 7, 5	CH	BAY MUD: Fat Clay, gray to dark gray, very moist, medium stiff to soft	NATIVE
						12				
				88.6	43.9	15	3, 4, 4			
						18	3			

BORING LOG

JOB NAME: Proposed Sheetpile Wall

JOB NO.: FREYE-18-01

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
				86.8	48.8		4 4			
						21		CL	LEAN CLAY, blue gray, saturated, very stiff, with silt and fine sand, trace oxidation stains, trace caliche	
				20.7	103.6	24	10 11 12			
									Boring terminated at 25 feet. Groundwater encountered at 6 feet. Boring backfilled with neat cement grout.	
						27				
						30				
						33				
						36				
						39				

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BORING LOG

JOB NAME: Proposed Sheetpile Wall
CLIENT: Freyer & Laureta, Inc.
LOCATION: North End Marsh Road, Menlo Park, California
DRILLER: Exploration Geoservices, Inc.
DRILL METHOD: 8-inch diameter hollow stem augers

JOB NO.: FREYE-18-01
DATE DRILLED: 4/27/18
ELEVATION: 9.9±feet
LOGGED BY: MM

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
						0		GP	POORLY GRADED GRAVEL, light gray, slightly moist to dry, dense, medium to fine grained, with sand	FILL
				32.4	85.1	3	9, 10, 11	CL	LEAN CLAY, yellow brown, moist, very stiff, with sand, trace gravel, and dark mottling	
						6				
				43.4		9	8, 5, 3	CH	BAY MUD: FAT CLAY, dark gray, very moist, medium stiff, little silt, trace fine sand ...soft below 9 feet	NATIVE
						12				
				94.0	45.6	15	3, 3, 3			
						18	3			

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BORING LOG

JOB NAME: Proposed Sheetpile Wall

JOB NO.: FREYE-18-01

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
				94.3	44.0		4 4		...medium stiff	
						21				
								CL	LEAN CLAY, yellow brown, saturated very stiff, with silt and sand	
						24	10 12 14			
				22.2	98.6					
						27				
				19.5	107		15 21 30			
						30			Boring Terminated at 30 feet. Groundwater encountered at 12 feet. Boring backfilled with neat cement grout immediately after last sample was taken.	
						33				
						36				
						39				

BvGG ENGINEERS

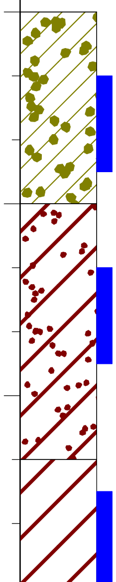
BORING LOG

Boring No. B-8

JOB NAME: Proposed Sheetpile Wall
CLIENT: Freyer & Laureta, Inc.
LOCATION: North End Marsh Road, Menlo Park, California
DRILLER: Exploration Geoservices, Inc.
DRILL METHOD: 8-inch diameter hollow stem auger

JOB NO.: FREYE-18-01
DATE DRILLED: 11/2/18
ELEVATION: 9±feet
LOGGED BY: MM

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
						0		CL	LEAN CLAY, brown, moist, very stiff, with fine sand, trace AC fragments	FILL
DS	320	NAT	1490	24.1	96.9		6, 13, 16			
						3		CH	FAT CLAY, dark gray to black, moist stiff, little silt and fine sand, trace brown mottling	
DS	500	NAT	920	37.0	82.2		6, 8, 10			
						6				
							2, 2, 2	CH	BAY MUD: FAT CLAY, gray, very moist, soft, trace rootlets	NATIVE
DS	1000	NAT	260	91.3	46.6	9			Boring terminated at 9 feet. Groundwater was not encountered. Boring was backfilled with neat cement grout.	
						12				
						15				
						18				



BORING LOG

JOB NAME: Proposed Sheetpile Wall
CLIENT: Freyer & Laureta, Inc.
LOCATION: North End Marsh Road, Menlo Park, California
DRILLER: Exploration Geoservices, Inc.
DRILL METHOD: 8-inch diameter hollow stem augers

JOB NO.: FREYE-18-01
DATE DRILLED: 11/2/18
ELEVATION: 9±feet
LOGGED BY: MM

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
						0				
DS	1500	DS	1830	19.8	101.5		7, 14, 14	CL	LEAN CLAY, dark brown, moist, very stiff, little silt and fine sand, trace fine gravel, trace black mottling	FILL
						3		CH	FAT CLAY, dark brown, moist, stiff, little fine sand and silt, trace fine gravel, trace yellow brown mottling	
DS	700	NAT	800	29.4	89.4	6	4, 4, 6			
								CH	BAY MUD: FAT CLAY, gray, very moist, soft, trace rootlets	NATIVE
DS	950	NAT	320	84.1	49.8	9	2, 2, 2			
									Boring was terminated at $9\frac{1}{2}$ feet. Groundwater was not encountered. Boring was backfilled with neat cement grout.	
						12				
						15				
						18				

BORING LOG

Boring No. B-10

JOB NAME: Proposed Sheetpile Wall
CLIENT: Freyer & Laureta, Inc.
LOCATION: North End Marsh Road, Menlo Park, California
DRILLER: Exploration Geoservices, Inc.
DRILL METHOD: 8-inch diameter hollow stem augers

JOB NO.: FREYE-18-01
DATE DRILLED: 11/2/18
ELEVATION: 9±feet
LOGGED BY: MM

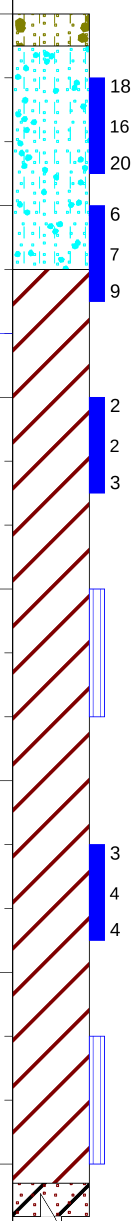
Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
						0		CL	LEAN CLAY, dark yellow brown, moist, very stiff, with fine sand and silt, trace fine gravel, trace brick fragments	FILL
DS	2000	NAT	1970	21.2	105		5 9 11			
						3				
							3 3 4	CH	FAT CLAY, very dark gray to black moist, medium stiff, little fine sand and silt, trace fine gravel	
DS	600	NAT	630	30.4	91.2					
						6				
							2 2 2	CH	BAY MUD: FAT CLAY, gray, very moist, soft, trace silt and fine sand, trace rootlets	NATIVE
DS	900	NAT	145	90.5	49.4					DS sample disturbed
									Boring terminated at $8\frac{1}{2}$ feet. No groundwater encountered. Boring backfilled with neat cement grout.	
						9				
						12				
						15				
						18				

BORING LOG

JOB NAME: Proposed Sheetpile Wall
CLIENT: Freyer & Laureta, Inc.
LOCATION: North End Marsh Road, Menlo Park, California
DRILLER: Exploration Geoservices, Inc.
DRILL METHOD: 8-inch diameter hollow stem augers

JOB NO.: FREYE-18-01
DATE DRILLED: 11/18/20
ELEVATION: 9±feet
LOGGED BY: JL

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	USCS	Description	Remarks
						0	GP-GM	POORLY GRADED GRAVEL with SILT and SAND: gray, medium dense, dry to moist, subangular to subrounded fine gravel, few coarse gravel, few well-graded sand	FILL
						3	SP-SM	POORLY GRADED SAND with SILT and GRAVEL: brown, medium dense, moist, fine to medium sand, few to little subangular fine gravel	
DSX DSX	400 2000	19.0 18.5	240 1030	16.8 11.8	95 101		CH	BAY MUD: FAT CLAY, blue-gray, very soft to soft, moist, few fine sand	NATIVE
DS DS	600 2000	NAT NAT	190 260	85.8 80.0	50 53	6			Torvane=350 psf
						9		... very soft to soft, moist to wet	100 psi needed to advance Shelby Tube
TXUU	420	NAT	435	46.2	91.3				
						12		... very soft to soft, moist to wet	
DS	800	NAT	130	93.9	47				Torvane=470 psf DS sample disturbed
DS	900	NAT	130	89.6	48	15		... soft to medium stiff	100 to 200 psi needed to advance Shelby Tube DS sample disturbed
						18	CH	SANDY FAT CLAY, dark	



BORING LOG

BVGG ENGINEERS

JOB NAME: Proposed Sheetpile Wall

JOB NO.: FREYE-18-01

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
				33.6	88		9, 12, 13		olive-gray to dark gray, medium stiff to stiff, moist, mostly fine sand with little coarse sand, contains fine sand pockets	Torvane=1,125 psf
						21		CL	SANDY LEAN CLAY: olive-gray, stiff, moist, well-graded sand, trace fine gravel	
DS	1200	NAT	980	23.8	104	24	12, 18, 37			
						27				
DS	1500	NAT	1130	22.0	105		9, 15, 19		... mottled olive-gray and brown, stiff, moist to wet, few fine sand, few coarse sand, trace subangular fine gravel	
						30				
DS	1800	NAT	1030	19.0	110		6, 11, 17		... brown to yellow-brown, medium stiff to stiff, moist to wet, fine sand, few coarse sand	
						33				
DS	2100	NAT	980	25.8	98	36	9, 9, 12		... yellow-brown, medium stiff, moist to wet, mostly fine to medium sand, little coarse sand, trace fine gravel	
								SP-SC	POORLY GRADED SAND with CLAY: brown, medium dense, wet, fine to medium sand, few coarse sand, few subangular fine gravel	
						39	6, 7	SM	SILTY SAND: brown, medium	

BORING LOG

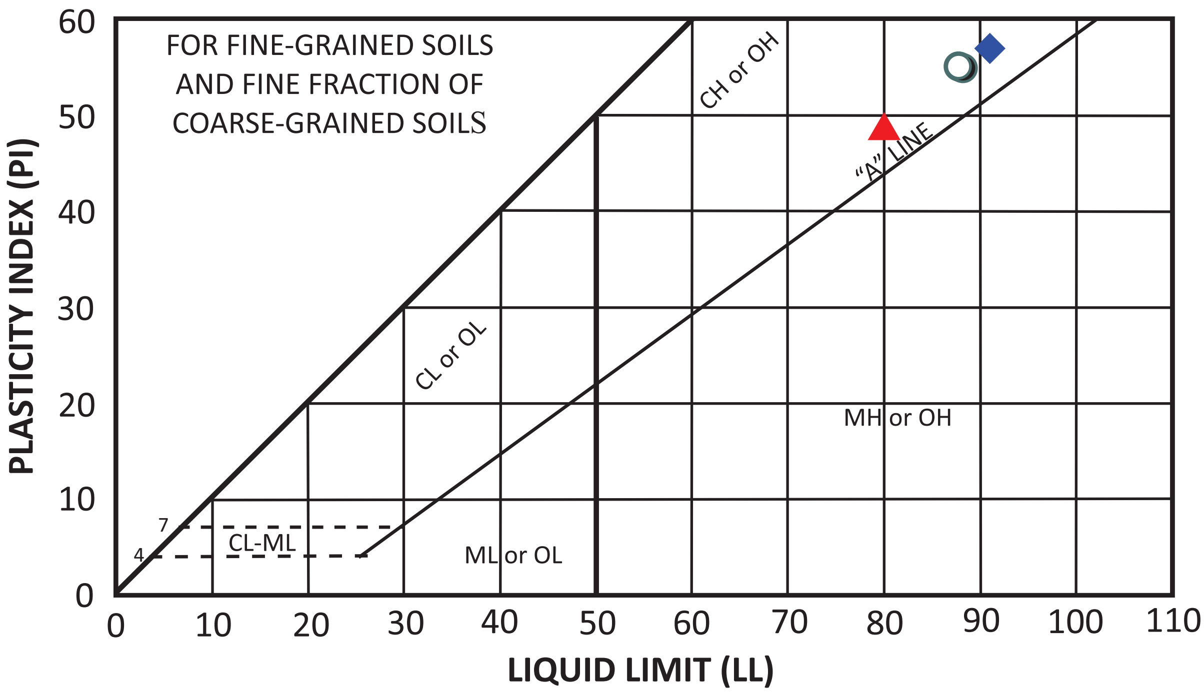
Boring No. B-11

JOB NAME: Proposed Sheetpile Wall

JOB NO.: FREYE-18-01

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
				24.5			9	CH	dense, wet, fine sand, few coarse sand, few fine gravel, contains clay	
									SANDY FAT CLAY: brown to yellow-brown, medium stiff, wet, fine sand	
						42			Boring Terminated at 40 feet. Groundwater encountered at 5 feet. Boring backfilled with cement grout immediately after last sample was taken.	
						45				
						48				
						51				
						54				
						57				
						60				

PLASTICITY CHART



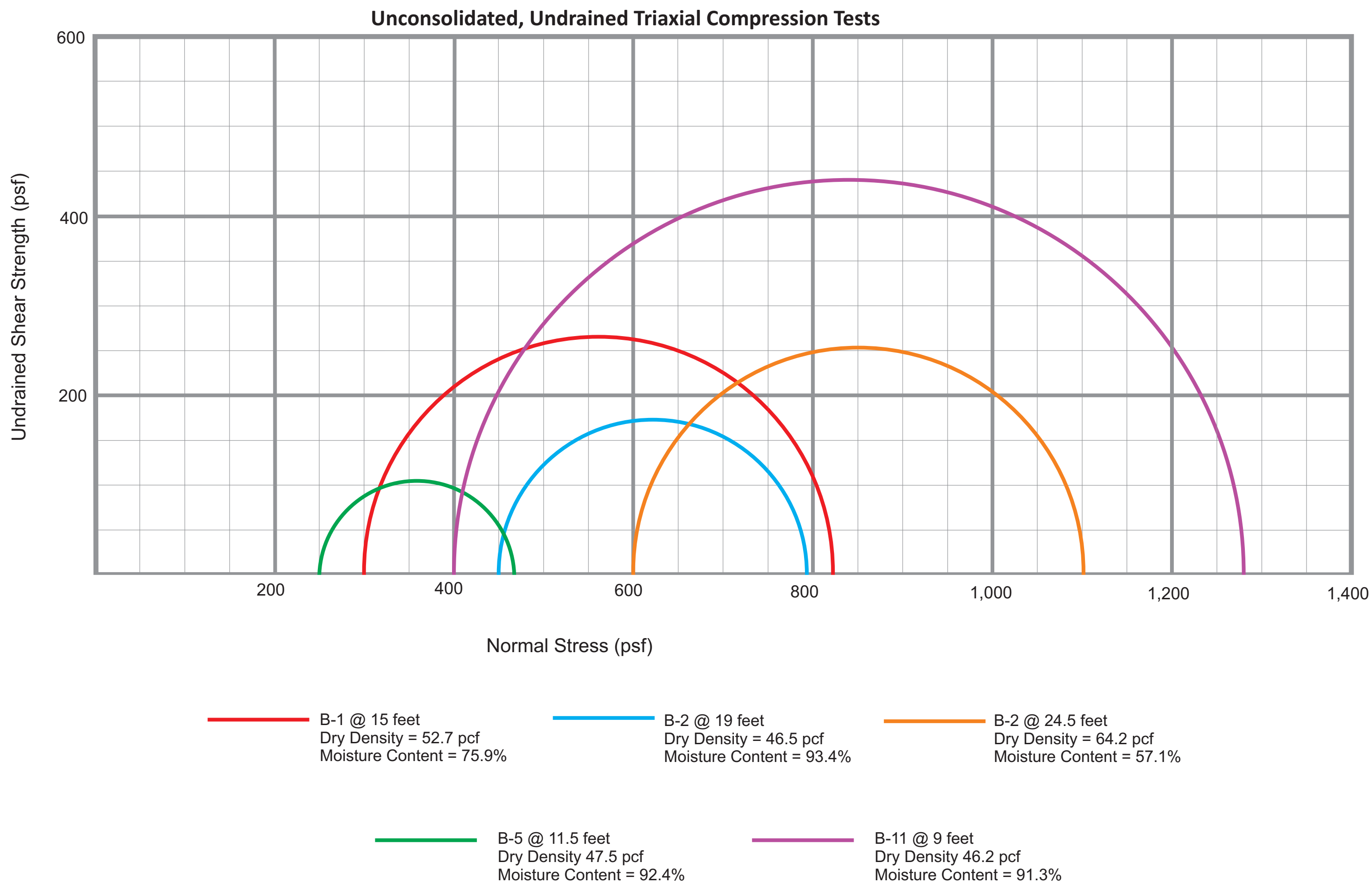
SYMBOL	SAMPLE SOURCE	DEPTH (FEET)	NATURAL WATER CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SOIL DESCRIPTION
▲	Boring B-1	13½ - 16	75.9	80	31	49	Gray Fat Clay (Bay Mud, CH)
○	Boring B-2	18 - 20½	93.4	88	33	55	Gray Fat Clay (Bay Mud, CH)
◆	Boring B-5	10 - 12½	92.4	91	34	57	Gray Fat Clay (Bay Mud, CH)

GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED SHEETPILE FLOOD WALL
FLOW EQUALIZATION FACILITY
WEST BAY SANITARY DISTRICT
MENLO PARK, CALIFORNIA

PLASTICITY DATA

DATE:	JOB NUMBER:	PLATE
November 2020	FREYE-18-01	20

BAGG ENGINEERS

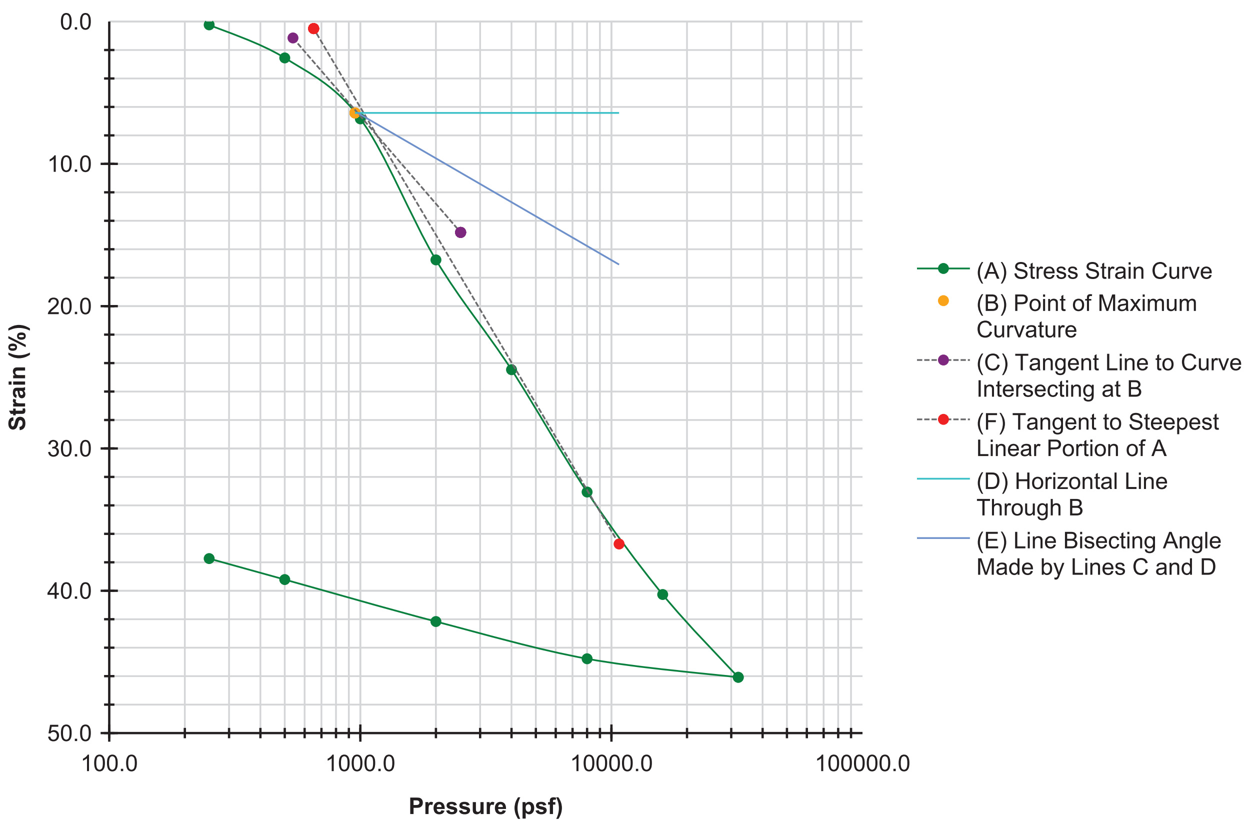


GEOTECHNICAL ENGINEERING INVESTIGATION **PROPOSED SHEETPILE FLOOD WALL** **FLOW EQUALIZATION FACILITY** **WEST BAY SANITARY DISTRICT** **MENLO PARK, CALIFORNIA**	BAGG ENGINEERS	**UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR STRENGTH RESULTS**

DATE:	JOB NUMBER:	PLATE:
November 2020	FREYE-18-01	21

Percent Strain [Log]

ASTM D2435



Preconsolidation Stress (psf)	1060.78	Cc	0.963	Cr	0.403

	BEFORE	AFTER	Liquid Limits	0	Test Date 5/25/2018
Moisture (%)	87.2	50.0	Plastic Limits	0	
Dry Density (pcf)	49.2	73.0			
Saturation (%)	95.6	100.0			
Void Ratio	2.57	1.41	Specific Gravity	2.815	ASSUMED

Sample Description				
Project Number	FREYE-01-00	Depth (ft)	14.75	Remarks
Sample Number	4	Boring Number	B1	
Project	SHEETPILE FLOOD WALL			
Client				
Location	FORMER WEST BAY SANITARY DISTRICT PROPERTY			

GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED SHEETPILE FLOOD WALL
FLOW EQUALIZATION FACILITY
WEST BAY SANITARY DISTRICT
MENLO PARK, CALIFORNIA

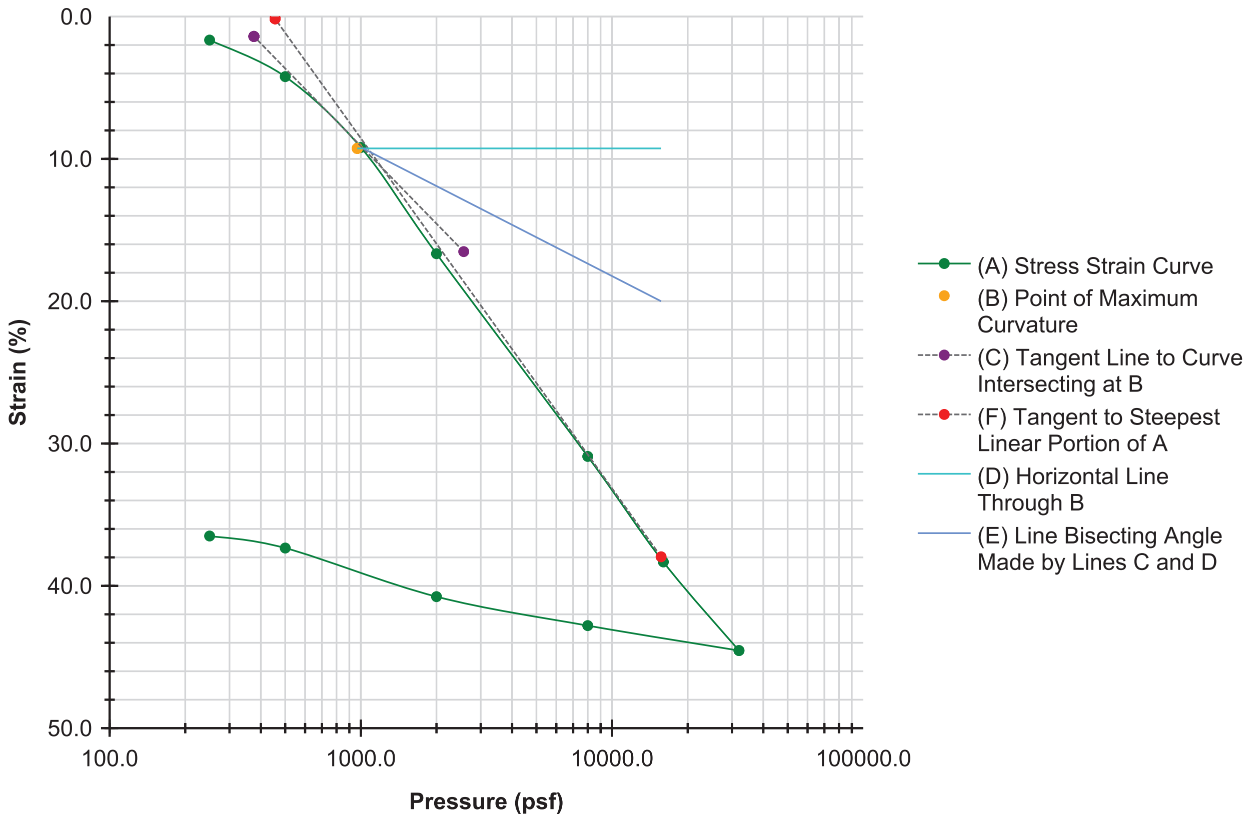
CONSOLIDATION TEST DATA

DATE:	JOB NUMBER:	PLATE
November 2020	FREYE-18-01	22

BAGG ENGINEERS

Percent Strain [Log]

ASTM D2435



Preconsolidation Stress (psf)	1097.57	**Cc**	0.887	**Cr**	0.463

	BEFORE	AFTER			
			Liquid Limits	0	**Test Date** 5/29/2018
Moisture (%)	87.6	50.9	**Plastic Limits**	0	
Dry Density (pcf)	48.9	71.9			
Saturation (%)	95.4	100.0			
Void Ratio	2.55	1.41	**Specific Gravity**	2.782	ASSUMED

Sample Description	DARK GRAY BAY MUD			
Project Number	FREYE-01-00	**Depth (ft)**	19.25	**Remarks**
Sample Number	5	**Boring Number**	B2	
Project	SHEETPILE FLOOD WALL			
Client				
Location	FORMER WEST BAY SANITARY DISTRICT PROPERTY			

GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED SHEETPILE FLOOD WALL
FLOW EQUALIZATION FACILITY
WEST BAY SANITARY DISTRICT
MENLO PARK, CALIFORNIA

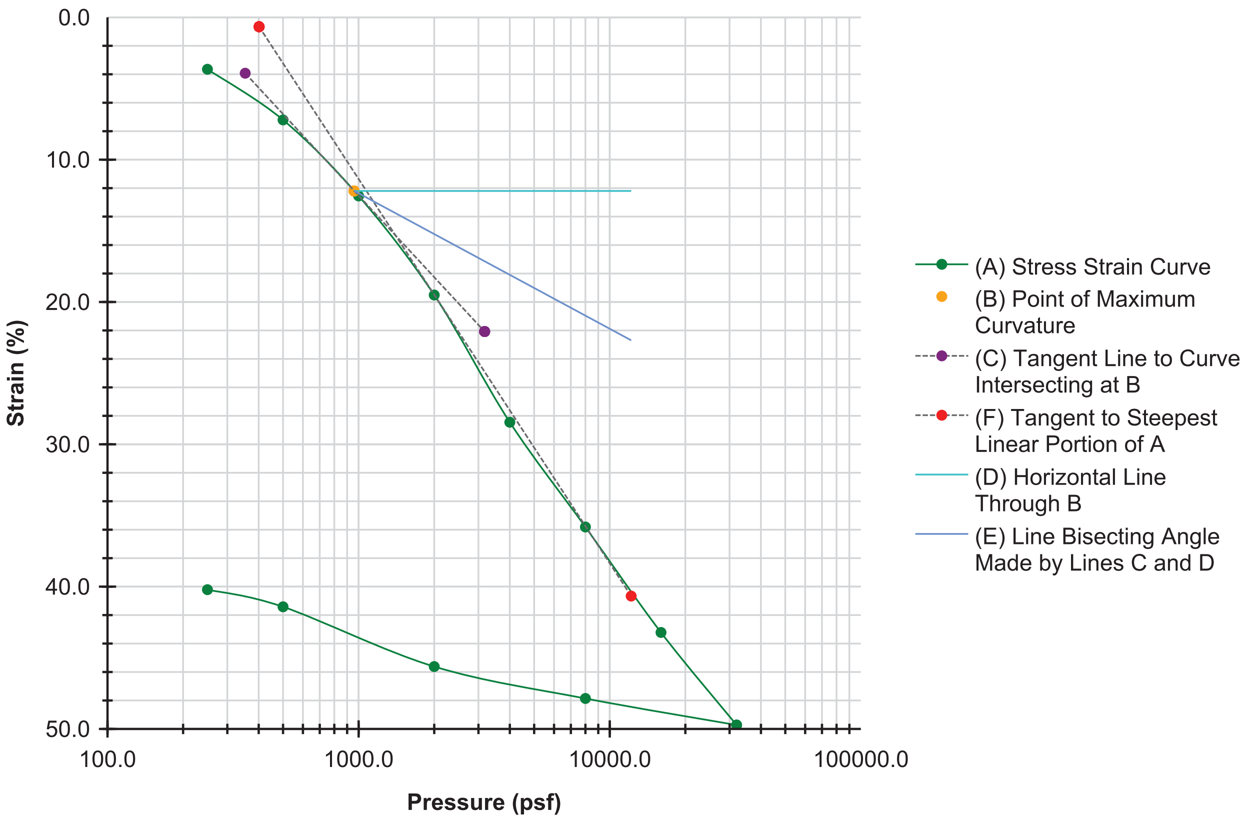
CONSOLIDATION TEST DATA

DATE:	JOB NUMBER:	PLATE
November 2020	FREYE-18-01	23

BAGG ENGINEERS

Percent Strain [Log]

ASTM D2435



Preconsolidation Stress (psf)	1141.20	**Cc**	0.945	**Cr**	0.570

	BEFORE	AFTER			
			Liquid Limits	0	**Test Date** 5/29/2018
Moisture (%)	92.5	51.4	**Plastic Limits**	0	
Dry Density (pcf)	48.2	75.8			
Saturation (%)	94.0	100.0			
Void Ratio	3.17	1.66	**Specific Gravity**	3.226	ASSUMED

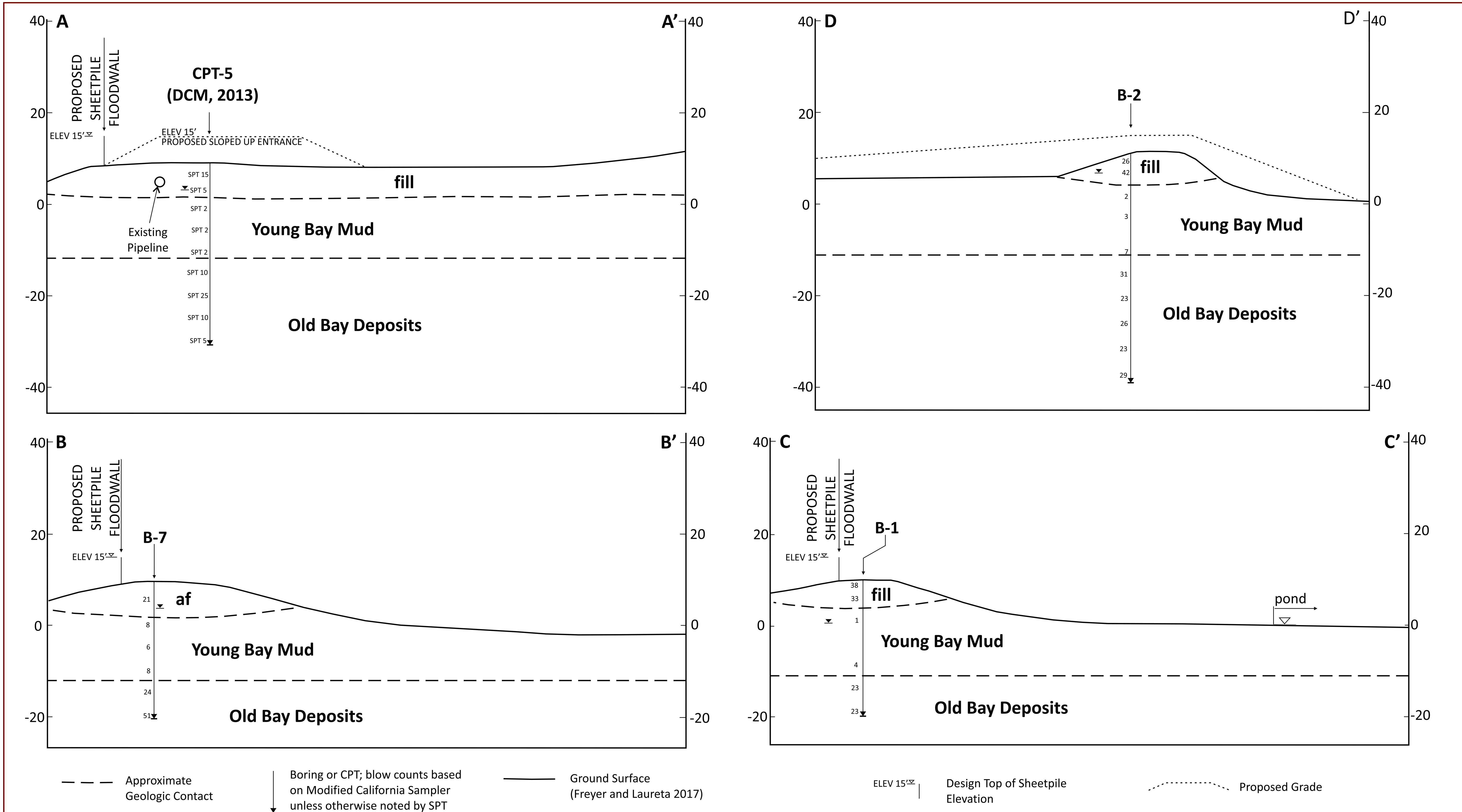
Sample Description				
Project Number	FREYE-01-00	**Depth (ft)**	11.25	**Remarks**
Sample Number	3	**Boring Number**	B5	
Project	SHEETPILE FLOODWALL			
Client				
Location	FORMER WEST BAY SANITARY DISTRICT PROPERTY			

GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED SHEETPILE FLOOD WALL
FLOW EQUALIZATION FACILITY
WEST BAY SANITARY DISTRICT
MENLO PARK, CALIFORNIA

CONSOLIDATION TEST DATA

DATE:	JOB NUMBER:	PLATE
November 2020	FREYE-18-01	24

BAGG ENGINEERS



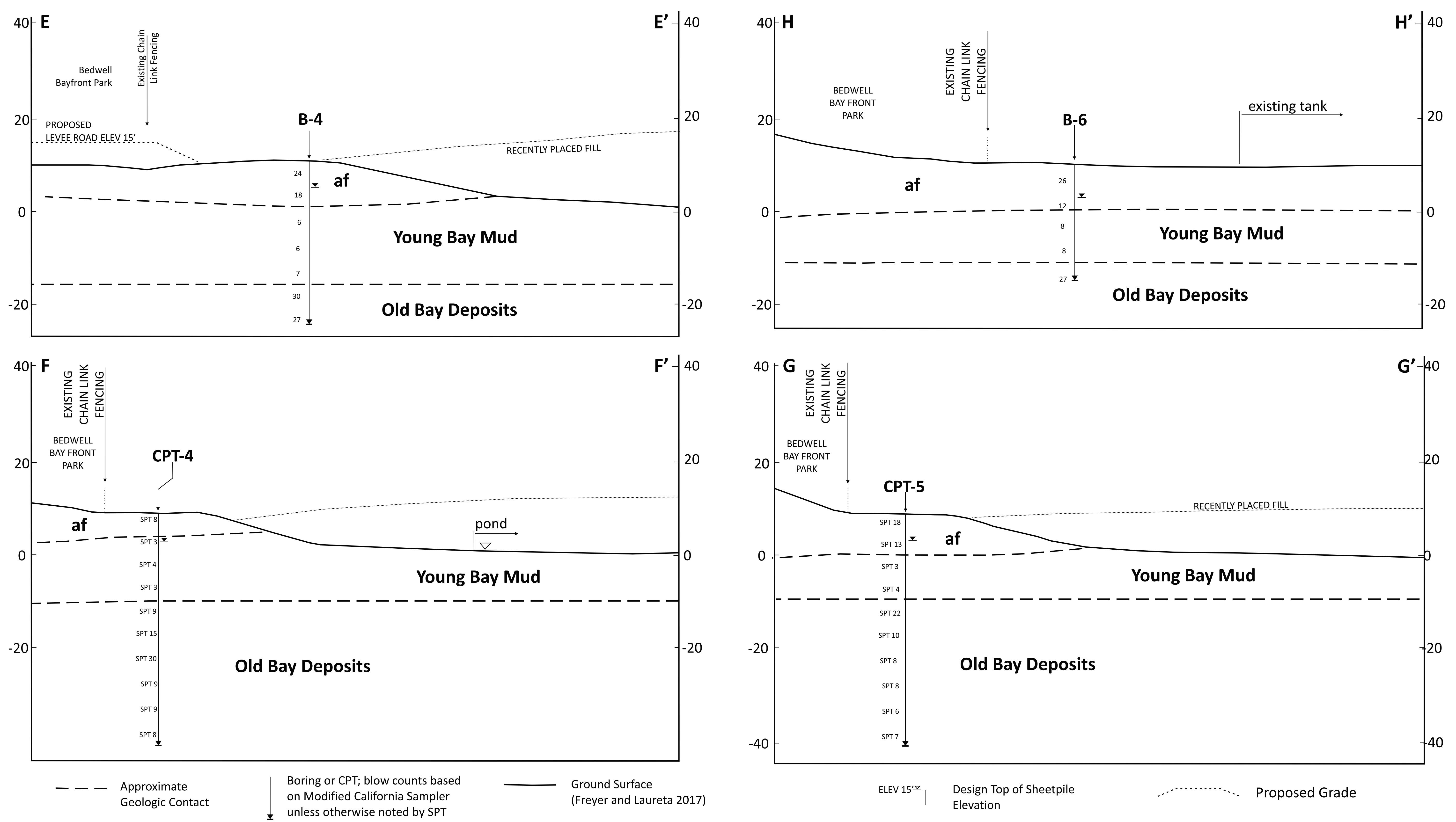
Base Map: Blow counts shown on Borings/CPT are based on driving Modified California Samplers unless otherwise noted by SPT (Standard Penetration Test). SPT blow counts shown on CPT-5 are average blow counts estimated for every five feet of CPT penetration.

GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED SHEETPILE FLOOD WALL
FLOW EQUALIZATION FACILITY
WEST BAY SANITARY DISTRICT
MENLO PARK, CALIFORNIA

BAGG ENGINEERS

CROSS SECTIONS A-A' THROUGH D-D'

JOB NUMBER:	SCALE:	DATE:	PLATE
FREYE-18-01	as indicated	November 2020	25



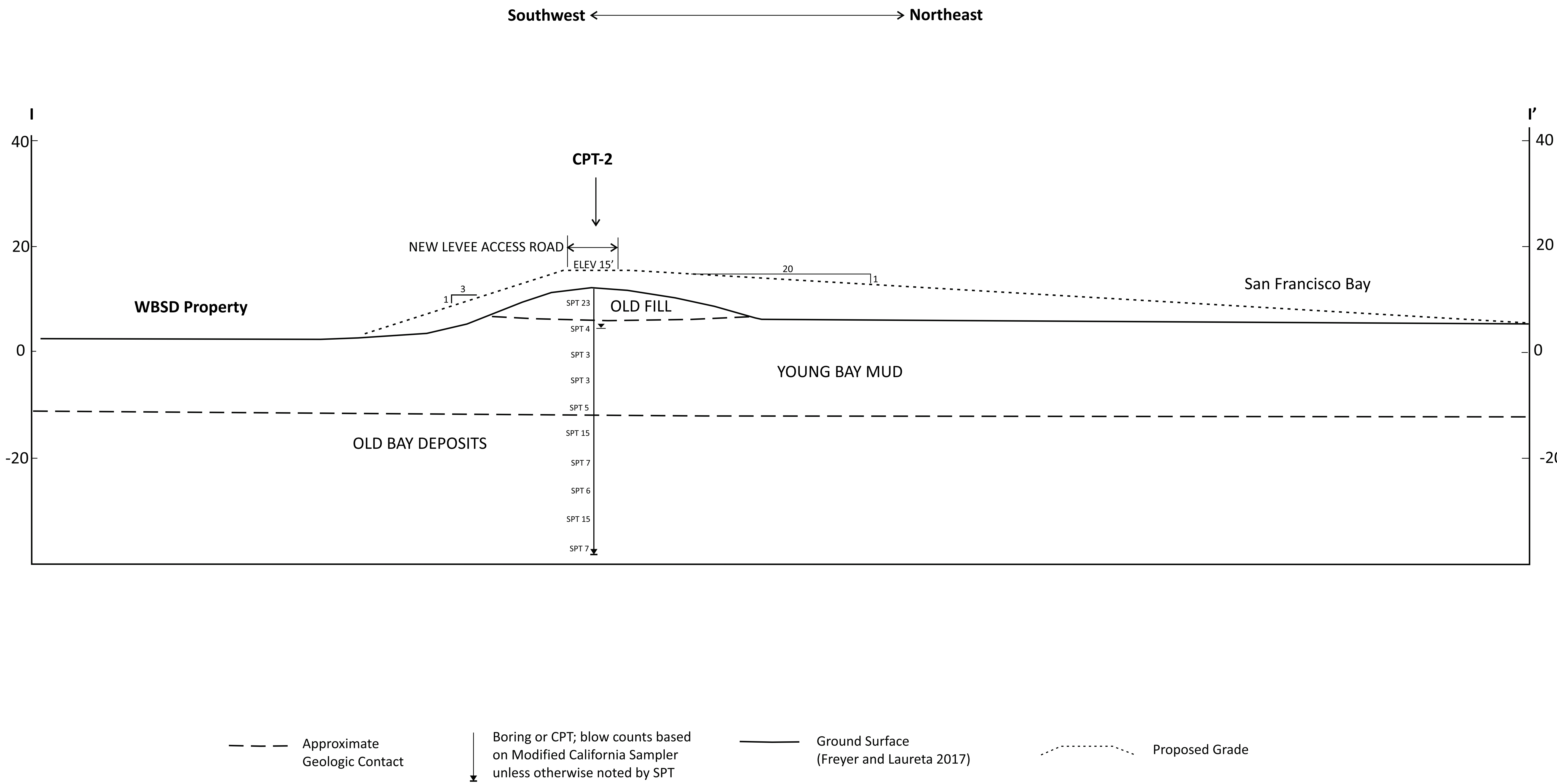
Base Map: Blow counts shown on Borings/CPT are based on driving Modified California Samplers unless otherwise noted by SPT (Standard Penetration Test). SPT blow counts shown on CPT-4 & CPT-5 are average blow counts estimated for every five feet of CPT penetration.

GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED SHEETPILE FLOOD WALL
FLOW EQUALIZATION FACILITY
WEST BAY SANITARY DISTRICT
MENLO PARK, CALIFORNIA

BAGG ENGINEERS

CROSS SECTIONS E-E' THROUGH H-H'

JOB NUMBER:	SCALE:	DATE:	PLATE
FREYE-18-01	as indicated	November 2020	26



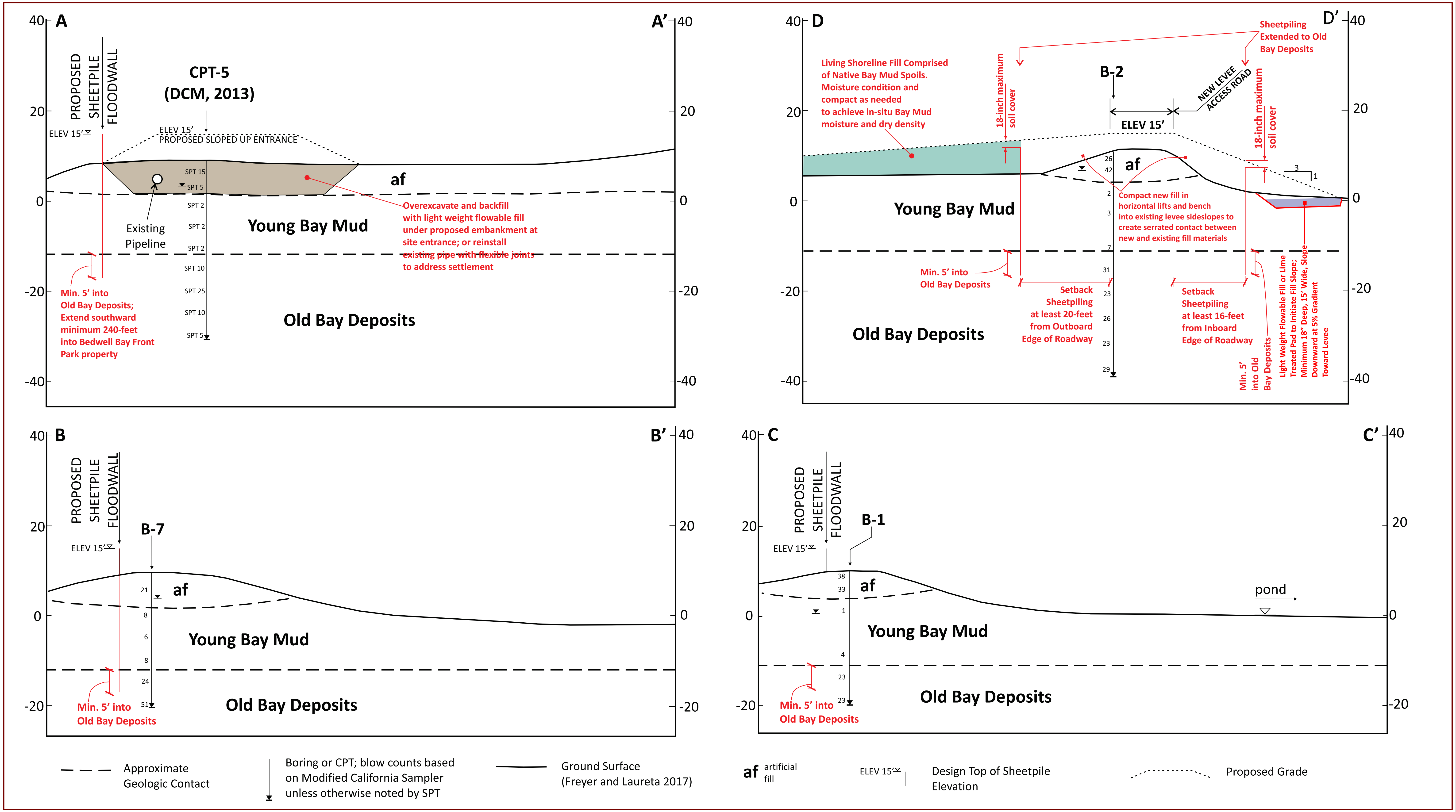
Base Map: Blow counts shown on Borings/CPT are based on driving Modified California Samplers unless otherwise noted by SPT (Standard Penetration Test). SPT blow counts shown on CPT-2 are average blow counts estimated for every five feet of CPT penetration.

PROPOSED LEVEE IMPROVEMENTS
PROPOSED SHEETPILE FLOOD WALL
FLOW EQUALIZATION FACILITY
WEST BAY SANITARY DISTRICT
MENLO PARK, CALIFORNIA

BAGG ENGINEERS

CROSS SECTION I-I'(Northeast Levee)

JOB NUMBER:	SCALE:	DATE:	PLATE
FREYE-18-01	as indicated	DECEMBER 2020	27



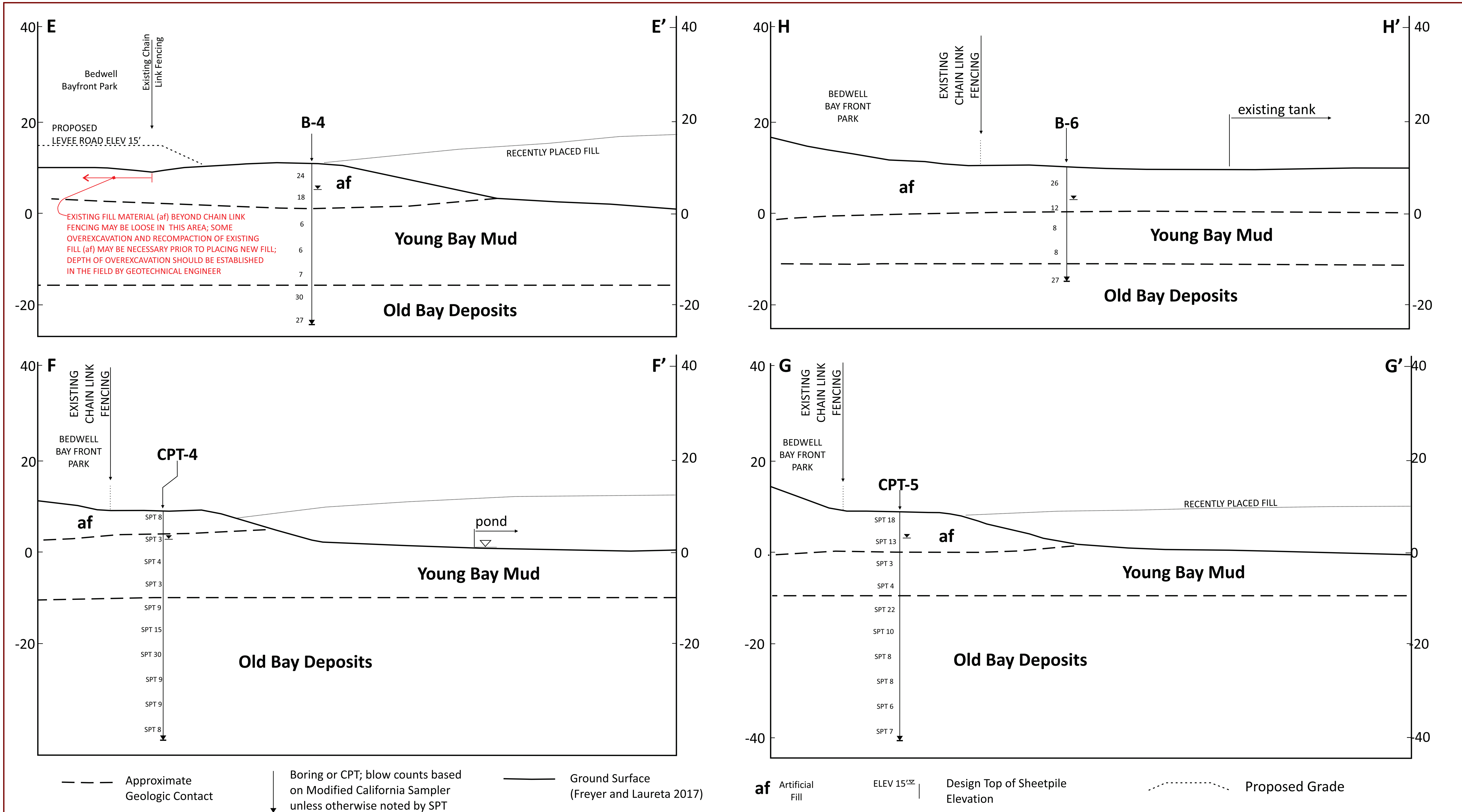
Base Map: Blow counts shown on Borings/CPT are based on driving Modified California Samplers unless otherwise noted by SPT (Standard Penetration Test). SPT blow counts shown on CPT-5 are average blow counts estimated for every five feet of CPT penetration.

GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED SHEETPILE FLOOD WALL
FLOW EQUALIZATION FACILITY
WEST BAY SANITARY DISTRICT
MENLO PARK, CALIFORNIA

BAGG ENGINEERS

REMEDIAL CROSS SECTIONS A-A' THROUGH D-D'

JOB NUMBER:	SCALE:	DATE:	PLATE
FREYE-18-01	as indicated	November 2020	28



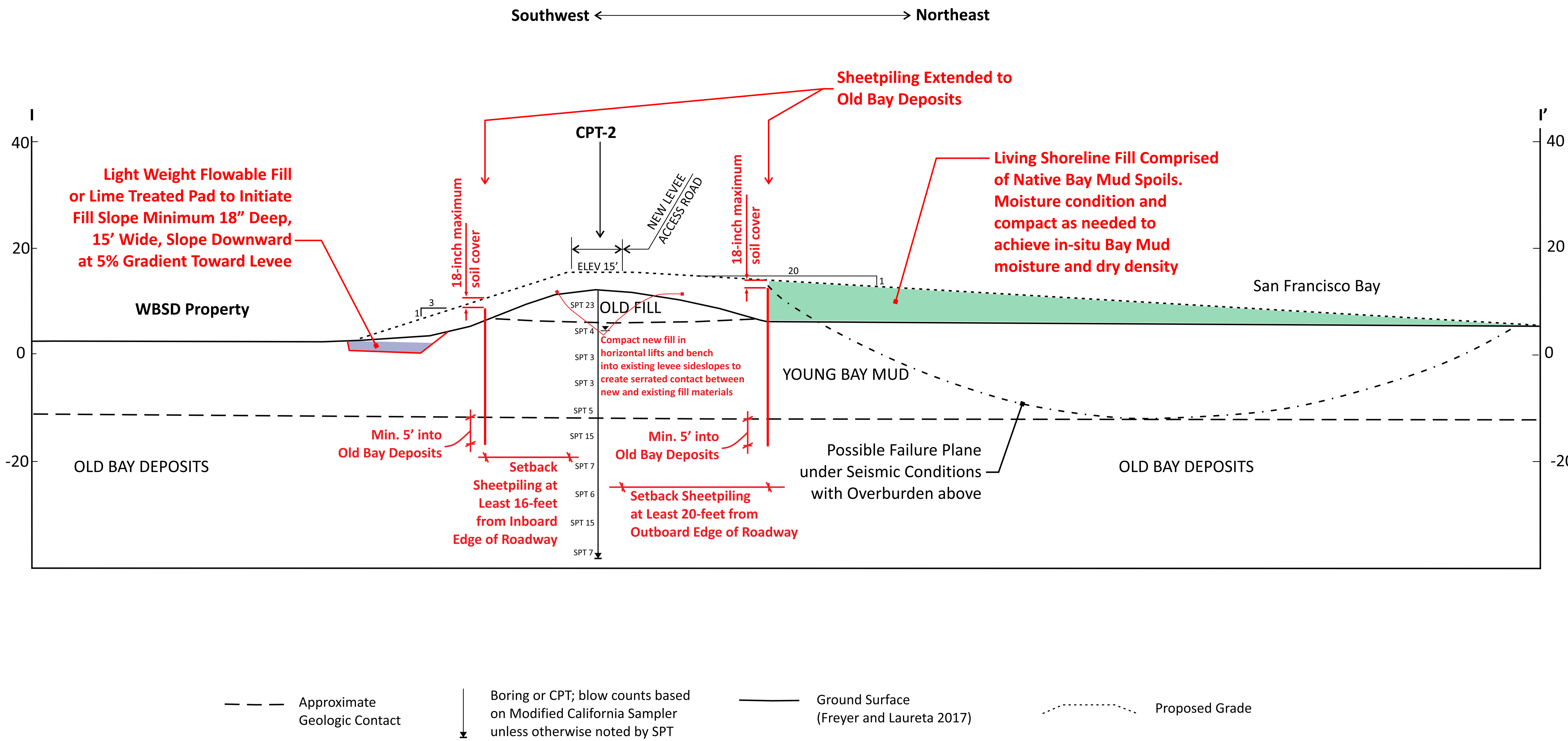
Base Map: Blow counts shown on Borings/CPT are based on driving Modified California Samplers unless otherwise noted by SPT (Standard Penetration Test). SPT blow counts shown on CPT-4 & CPT-5 are average blow counts estimated for every five feet of CPT penetration.

GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED SHEETPILE FLOOD WALL
FLOW EQUALIZATION FACILITY
WEST BAY SANITARY DISTRICT
MENLO PARK, CALIFORNIA

BAGG ENGINEERS

REMEDIAL CROSS SECTIONS E-E' THROUGH H-H'

JOB NUMBER:	SCALE:	DATE:	PLATE
FREYE-18-01	as indicated	November 2020	29



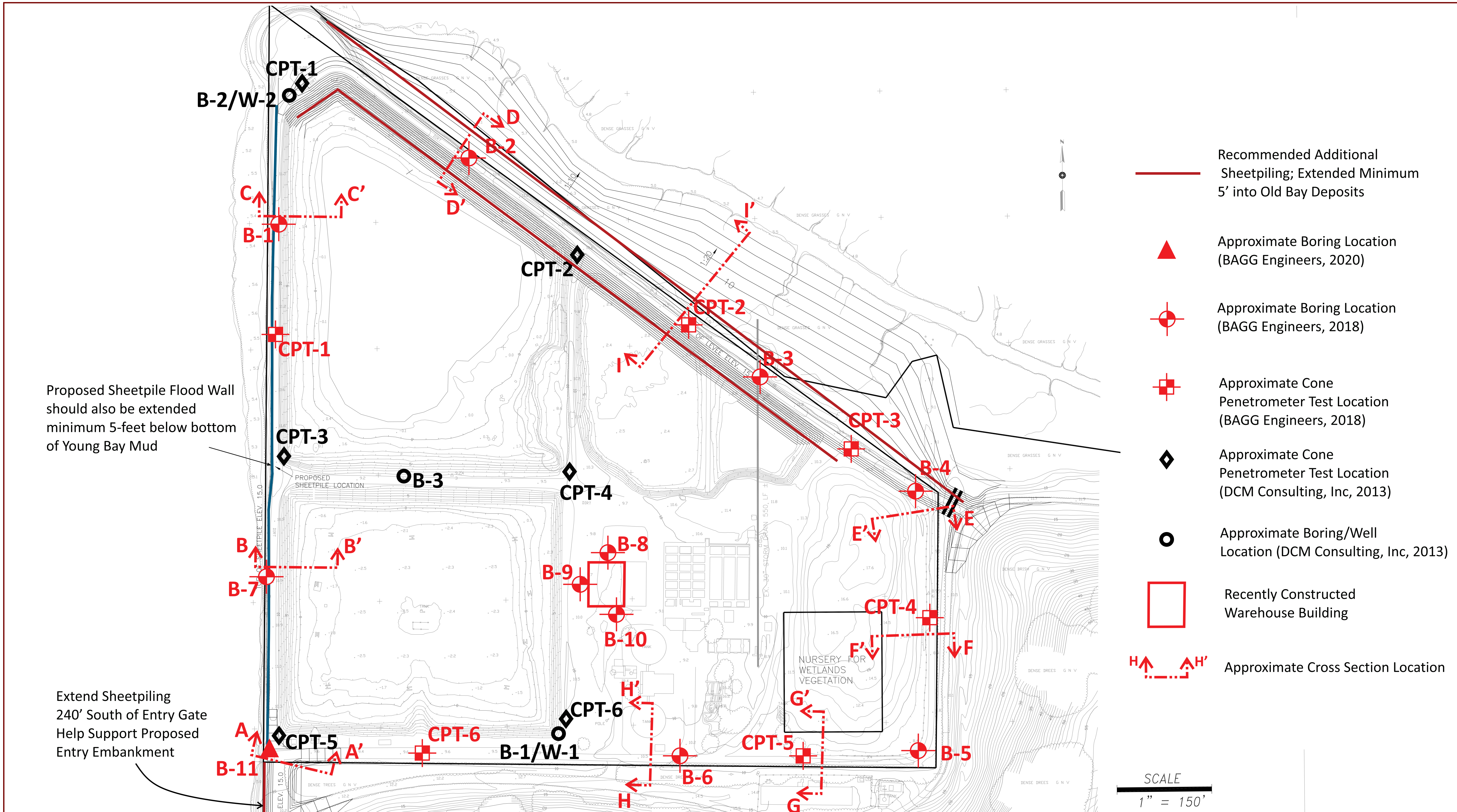
Base Map: Blow counts shown on Borings/CPT are based on driving Modified California Samplers unless otherwise noted by SPT (Standard Penetration Test). SPT blow counts shown on CPT-2 are average blow counts estimated for every five feet of CPT penetration.

PROPOSED LEVEE IMPROVEMENTS
PROPOSED SHEETPILE FLOOD WALL
FLOW EQUALIZATION FACILITY
WEST BAY SANITARY DISTRICT
MENLO PARK, CALIFORNIA

BAGG ENGINEERS

REMEDIAL CROSS SECTION I-I’(Northeast Levee)

JOB NUMBER:	SCALE:	DATE:	PLATE
FREYE-18-01	as indicated	MARCH 2021	30



Base: "Living Shoreline Cut and Fill Analysis," Levee Design Project, West Bay Sanitary District, Menlo Park, CA, Job No. 001079, Sheet 1 of 1, by Freyer Laureta, Inc., dated 2/13/20.

GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED SHEETPILE FLOOD WALL
FLOW EQUALIZATION FACILITY
WEST BAY SANITARY DISTRICT
MENLO PARK, CALIFORNIA

BAGG ENGINEERS

REMEDIAL SITE PLAN

JOB NUMBER:	SCALE:	DATE:	PLATE
FREYE-18-01	as indicated	November 2020	31

APPENDIX A

CONE PENETROMETER TEST RESULTS

By Middle Earth GeoTesting

Sheetpile Wall at WBSD Property

Project ID: BAGG Engineering
Data File: SDF(047).cpt
CPT Date: 5/1/2018 8:36:30 AM
GW During Test: 6 ft

Sounding ID: CPT-01
Project No: FREYE-18-01
Cone/Rig: DDG1418

. Depth ft	. qc PS tsf	* qc1n PS -	. q1ncs PS -	* qt PS tsf	. Slv Stss tsf	. pore prss (psi)	. Frct Rato %	* Material Behavior Description	. Unit Wght pcf	. Qc to N	* SPT R-N1 60%	. SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	. Und Shr tsf	. OCR - -	* Fin Ic %	* Ic SBT Indx	* Nk -
0.33	19.3	31.0	98.4	19.3	0.5	0.1	2.7	clayy SILT to silty CLAY	115	2.0	15	10	8	-	-	1.4	9.9	34	2.58	15
0.49	18.6	29.8	-	18.6	0.6	0.3	3.3	clayy SILT to silty CLAY	115	2.0	15	9	8	-	-	1.3	9.9	38	2.65	15
0.66	20.1	32.3	106.2	20.1	0.6	-0.1	3.0	clayy SILT to silty CLAY	115	2.0	16	10	8	-	-	1.4	9.9	35	2.59	15
0.82	12.2	19.5	-	12.2	0.5	0.3	3.9	silty CLAY to CLAY	115	1.5	13	8	6	-	-	0.9	9.9	48	2.83	15
0.98	10.3	16.4	-	10.1	0.5	-7.8	4.4	silty CLAY to CLAY	115	1.5	11	7	5	-	-	0.7	9.9	54	2.93	15
1.15	9.2	14.8	-	9.1	0.5	-6.7	5.6	silty CLAY to CLAY	115	1.5	10	6	5	-	-	0.6	9.9	61	3.03	15
1.31	15.3	24.6	-	15.4	0.6	0.6	3.8	clayy SILT to silty CLAY	115	2.0	12	8	7	-	-	1.1	9.9	43	2.75	15
1.48	13.6	21.9	-	13.6	0.4	-2.2	3.2	clayy SILT to silty CLAY	115	2.0	11	7	6	-	-	1.0	9.9	43	2.75	15
1.64	10.4	16.7	-	10.3	0.8	-7.1	7.8	silty CLAY to CLAY	115	1.5	11	7	6	-	-	0.7	9.9	65	3.09	15
1.80	16.0	25.7	-	16.0	1.0	-0.1	6.4	silty CLAY to CLAY	115	1.5	17	11	8	-	-	1.1	9.9	51	2.89	15
1.97	28.3	45.4	-	28.3	1.3	0.2	4.6	clayy SILT to silty CLAY	115	2.0	23	14	12	-	-	2.0	9.9	36	2.61	15
2.13	29.4	47.1	-	29.4	1.4	-0.1	4.7	clayy SILT to silty CLAY	115	2.0	24	15	12	-	-	2.1	9.9	36	2.61	15
2.30	26.2	42.0	-	26.2	1.4	-0.3	5.5	silty CLAY to CLAY	115	1.5	28	17	11	-	-	1.8	9.9	40	2.70	15
2.46	22.2	35.5	-	22.1	0.8	-1.3	3.7	clayy SILT to silty CLAY	115	2.0	18	11	9	-	-	1.6	9.9	37	2.63	15
2.62	19.4	31.1	-	19.4	0.6	-2.1	3.1	clayy SILT to silty CLAY	115	2.0	16	10	8	-	-	1.4	9.9	36	2.62	15
2.79	27.0	43.2	118.9	26.9	0.8	-1.4	3.0	clayy SILT to silty CLAY	115	2.0	22	13	10	-	-	1.9	9.9	31	2.50	15
2.95	29.7	47.6	107.3	29.7	0.7	-0.1	2.2	silty SAND to sandy SILT	120	3.0	16	10	11	43	43	-	-	26	2.39	16
3.12	17.0	27.2	-	17.0	0.6	0.2	3.8	clayy SILT to silty CLAY	115	2.0	14	8	7	-	-	1.2	9.9	41	2.72	15
3.28	10.7	17.2	-	10.7	0.4	-0.8	3.4	silty CLAY to CLAY	115	1.5	11	7	5	-	-	0.7	9.9	49	2.85	15
3.45	10.4	16.6	-	10.3	0.2	-3.7	2.1	clayy SILT to silty CLAY	115	2.0	8	5	5	-	-	0.7	9.9	42	2.74	15
3.61	7.0	11.2	-	6.9	0.6	-4.5	8.3	silty CLAY to CLAY	115	1.5	7	5	4	-	-	0.5	9.9	76	3.24	15
3.77	7.0	11.3	-	7.0	0.7	-3.6	9.9	silty CLAY to CLAY	115	1.5	8	5	4	-	-	0.5	9.9	80	3.29	15
3.94	51.2	82.1	100.3	51.2	0.4	-1.9	0.8	clean SAND to silty SAND	125	5.0	16	10	16	61	45	-	-	11	1.93	16
4.10	46.7	74.9	90.2	46.7	0.3	0.2	0.7	clean SAND to silty SAND	125	5.0	15	9	14	57	44	-	-	11	1.92	16
4.27	33.7	54.1	115.4	33.7	0.8	0.0	2.3	silty SAND to sandy SILT	120	3.0	18	11	12	47	42	-	-	25	2.35	16
4.43	36.6	58.8	100.4	36.6	0.6	0.1	1.6	silty SAND to sandy SILT	120	3.0	20	12	13	49	42	-	-	20	2.22	16
4.59	29.5	47.3	121.6	29.5	0.8	0.1	2.9	clayy SILT to silty CLAY	115	2.0	24	15	11	-	-	2.1	9.9	29	2.46	15
4.76	20.0	32.1	-	20.0	0.9	-0.4	4.6	silty CLAY to CLAY	115	1.5	21	13	9	-	-	1.4	9.9	42	2.72	15
4.92	22.7	36.3	90.5	22.6	0.4	-1.7	2.0	silty SAND to sandy SILT	120	3.0	12	8	9	34	39	-	-	28	2.44	16
5.09	6.4	10.3	-	6.5	0.3	1.0	5.0	silty CLAY to CLAY	115	1.5	7	4	4	-	-	0.4	6.8	68	3.13	15
5.25	5.8	9.4	-	5.9	0.2	3.3	4.4	silty CLAY to CLAY	115	1.5	6	4	3	-	-	0.4	6.0	68	3.14	15
5.41	5.4	8.7	-	5.5	0.2	2.3	4.6	silty CLAY to CLAY	115	1.5	6	4	3	-	-	0.4	5.4	71	3.17	15
5.58	5.6	9.0	-	5.6	0.2	2.0	3.9	silty CLAY to CLAY	115	1.5	6	4	3	-	-	0.4	5.4	67	3.12	15
5.74	5.1	8.2	-	5.1	0.2	1.0	3.5	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	4.7	68	3.13	15
5.91	4.1	6.6	-	4.1	0.1	0.9	3.6	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.3	3.6	75	3.22	15
6.07	3.6	5.8	-	3.7	0.1	1.1	3.3	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	3.1	77	3.25	15
6.23	3.4	5.5	-	3.5	0.1	1.4	3.9	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.9	82	3.32	15
6.40	3.4	5.5	-	3.4	0.1	2.1	3.3	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.8	79	3.28	15
6.56	3.8	6.1	-	3.9	0.1	2.5	3.1	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	3.1	74	3.22	15
6.73	3.5	5.6	-	3.6	0.1	2.6	2.7	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.8	75	3.23	15
6.89	3.2	5.2	-	3.3	0.1	2.8	2.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.5	76	3.24	15
7.05	3.0	4.8	-	3.0	0.1	3.0	2.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.3	78	3.26	15
7.22	2.9	4.6	-	2.9	0.1	3.4	2.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.2	79	3.27	15
7.38	2.8	4.5	-	2.9	0.1	3.6	2.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.0	81	3.30	15
7.55	2.8	4.5	-	2.9	0.0	4.1	2.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.0	79	3.27	15
7.71	3.0	4.9	-	3.1	0.1	4.7	2.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.2	76	3.23	15
7.87	2.9	4.7	-	3.0	0.1	5.3	2.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.0	78	3.27	15
8.04	2.9	4.6	-	3.0	0.1	5.4	2.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.0	80	3.29	15
8.20	2.9	4.7	-	3.0	0.1	5.6	2.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.0	82	3.31	15
8.37	2.8	4.5	-	2.9	0.1	5.7	2.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.9	82	3.31	15
8.53	2.7	4.3	-	2.8	0.0	5.8	2.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.8	83	3.32	15
8.69	2.5	4.1	-	2.7	0.0	6.6	2.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	85	3.35	15
8.86	2.5	3.9	-	2.6	0.0	6.8	2.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.5	87	3.37	15
9.02	2.4	3.9	-	2.5	0.0	7.0	2.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.5	89	3.39	15
9.19	2.4	3.8	-	2.5	0.0	7.3	2.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.4	89	3.39	15
9.35	2.4	3.8	-	2.5	0.0	7.4	2.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.4	87	3.37	15
9.51	2.4	3.9	-	2.6	0.0	7.7	1.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.4	85	3.35	15
9.68	2.5	4.0	-	2.6	0.0	7.8	1.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.4	83	3.32	15
9.84	2.4	3.9	-	2.6	0.0	8.0	1.8	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.4	84	3.34	15
10.01	2.4	3.8	-	2.5	0.0	8.2	1.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.3	87	3.36	15
10.17	2.5	3.9	-	2.6	0.0	8.4	2.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.4	86	3.36	15
10.34	2.4	3.9	-	2.6	0.0	8.6	1.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.3	86	3.35	15
10.50	2.4	3.8	-	2.5	0.0	8.8	2.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.3	91	3.41	15
10.66	2.7	4.3	-	2.9	0.0	8.9	1.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.5	82	3.31	15
10.83	2.6	4.2	-	2.8	0.0	8.2	2.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.4	84	3.33	15
10.99	2.5	3.9	-	2.6	0.0	8.6	1.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.3	84	3.33	15
11.16	2.4	3.9	-	2.6	0.0	8.9	1.8	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.2	86	3.36	15
11.32	2.5	4.0	-	2.6	0.0	9.2	2.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.2	89	3.40	15
11.48	2.5	4.0	-	2.7	0.1	9.5	2.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.2	93	3.44	15
11.65	2.6	4.1	-	2.7	0.1	9.6	3.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.3	94	3.45	15
11.81	2.6	4.2	-	2.8	0.1	9.7	3.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.3	93	3.44	15
11.98	2.4	3.8	-	2.6	0.1	9.2	3.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.1	95	3.48	15
12.14	2.1	3.3	-	2.3	0.0	9.5	2.6	silty CLAY to CLAY	115	1.5	2	1	2	-	-	0.1	0.9	95	3.52	15
12.30	1.7	2.7	-	1.9	0.0	9.4	2.9	silty CLAY to CLAY	115	1.5	2	1	1	-	-	0.1	0.6	95	3.68	15
12.47	1.7	2.7	-	1.9	0.0	8.8	2.6	silty CLAY to CLAY	115	1.5	2	1	1	-	-	0.1	0.6	95	3.66	15
12.63	2.0	3.2	-	2.2	0.0	10.2	2.1	silty CLAY to CLAY	115	1.5	2	1	2	-	-	0.1	0.8	95	3.51	15
12.80	2.3	3.7	-	2.5	0.0	11.1	1.9	silty CLAY to CLAY	115	1.5	2	2	2	-	-	0.1	1.0	92	3.42	15
12.96	2.4	3.8	-	2.6	0.0	11.5	2.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.0	94	3.44	15
13.12	2.5	4.0	-	2.7	0.0	13.0	2.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.1	94	3.44	15
13.29	2.6	4.2	-	2.9	0.0	12.9	2.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.1	90	3.40	15
13.45	2.6	4.2	-	2.8	0.0	12.4	2.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.1	89	3.39	15
13.62	2.5	4.0	-	2.8	0.0	12.8	2.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.0	89	3.39	15
13.78	2.6	4.2	-	2.8	0.0	13.0	2.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.1	88	3.38	15
13.94	2.6	4.2	-	2.8	0.0	13.2	2.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.1	90	3.40	15
14.11	2.5	4.0	-	2.8	0.0	13.5	2.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.0	94	3.45	15
14.27	2.5	4.1	-	2.8	0.0	14.0	2.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.0	95	3.47	15
14.44	2.5	4.1	-	2.8	0.1	14.0	3.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.0	95	3.48	15
14.60	2.7	4.3	-	3.0	0.0	13.5	2.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.1	92	3.42	15
14.76	2.7	4.4	-	3.0	0.1	13.4	2.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.1	92	3.43	15
14.93	2.8	4.6	-	3.1	0.1	13.9	2.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.1	88	3.39	15
15.09	2.9	4.6	-	3.2	0.1	14.2	2.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.1	88	3.38	15
15.26	2.8	4.4	-	3.1	0.1	14.6	2.8	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.1	92	3.42	15
15.42	2.9	4.7	-	3.2	0.1	14.8	3.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.1	91	3.42	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

Sheetpile Wall at WBSD Property

Project ID: BAGG Engineering
Data File: SDF(047).cpt
CPT Date: 5/1/2018 8:36:30 AM
GW During Test: 6 ft

Sounding ID: CPT-01
Project No: FREYE-18-01
Cone/Rig: DDG1418

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Depth ft	qc PS tsf	qc1n PS -	q1ncs PS -	qt PS tsf	Slv Stss tsf	pore prss (psi)	Frct Rato %	Material Behavior Description	Unit Wght pcf	Qc to N	SPT R-N1 60%	SPT R-N 60%	SPT IcN1 60%	Rel Den %	Ftn Ang deg	Und Shr tsf	OCR -	Fin %	Ic SBT Indx	Nk -
15.58	3.2	5.2	-	3.5	0.1	14.5	3.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	87	3.37	15
15.75	3.3	5.3	-	3.5	0.1	13.1	2.7	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.3	83	3.32	15
15.91	3.0	4.9	-	3.3	0.0	12.9	2.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	83	3.33	15
16.08	2.8	4.5	-	3.1	0.0	13.2	1.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.0	85	3.35	15
16.24	2.7	4.4	-	3.0	0.0	13.7	2.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.0	87	3.37	15
16.40	2.7	4.4	-	3.0	0.0	14.2	1.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.0	87	3.37	15
16.57	2.7	4.4	-	3.0	0.0	14.6	1.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.9	87	3.37	15
16.73	2.7	4.3	-	3.0	0.0	14.9	1.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.9	88	3.39	15
16.90	2.7	4.3	-	3.0	0.0	15.3	2.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.9	91	3.42	15
17.06	2.9	4.5	-	3.2	0.0	15.7	2.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.0	88	3.38	15
17.23	2.9	4.5	-	3.2	0.0	15.9	2.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.0	88	3.38	15
17.39	2.7	4.2	-	3.0	0.0	16.1	2.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.9	93	3.44	15
17.55	2.6	4.1	-	3.0	0.0	16.6	1.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	91	3.42	15
17.72	2.6	3.9	-	2.9	0.0	17.0	2.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.46	15
17.88	2.6	4.0	-	3.0	0.0	17.5	2.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.46	15
18.05	2.7	4.2	-	3.1	0.0	17.9	2.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.9	95	3.49	15
18.21	2.8	4.2	-	3.2	0.0	18.3	2.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.9	94	3.45	15
18.37	2.8	4.2	-	3.2	0.0	18.5	2.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.9	92	3.43	15
18.54	2.8	4.1	-	3.2	0.0	18.7	2.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	92	3.43	15
18.70	2.8	4.1	-	3.1	0.0	19.3	2.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	94	3.45	15
18.87	2.8	4.0	-	3.2	0.0	19.7	2.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.46	15
19.03	2.8	4.1	-	3.2	0.0	20.2	2.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.45	15
19.19	2.8	4.0	-	3.2	0.0	20.6	2.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.46	15
19.36	2.7	3.9	-	3.2	0.0	20.7	2.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.47	15
19.52	2.8	3.9	-	3.2	0.0	21.0	2.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.49	15
19.69	2.8	4.0	-	3.2	0.0	21.3	2.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.48	15
19.85	2.9	4.1	-	3.3	0.0	21.4	2.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.8	95	3.48	15
20.01	2.9	4.1	-	3.4	0.0	21.8	2.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.8	95	3.46	15
20.18	3.0	4.2	-	3.4	0.0	22.0	2.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.9	95	3.46	15
20.34	3.0	4.2	-	3.5	0.0	22.1	2.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.9	94	3.45	15
20.51	3.1	4.3	-	3.5	0.0	22.4	2.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.9	92	3.43	15
20.67	3.1	4.3	-	3.6	0.0	22.7	2.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.9	92	3.42	15
20.83	3.1	4.2	-	3.5	0.0	23.2	2.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.8	92	3.43	15
21.00	3.1	4.2	-	3.6	0.0	23.8	2.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.8	92	3.42	15
21.16	3.1	4.2	-	3.6	0.0	24.3	2.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.8	92	3.43	15
21.33	3.2	4.2	-	3.7	0.0	24.7	2.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.9	95	3.46	15
21.49	3.3	4.3	-	3.8	0.0	25.1	2.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.9	92	3.43	15
21.65	3.3	4.3	-	3.8	0.0	25.5	2.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.9	90	3.41	15
21.82	3.3	4.3	-	3.8	0.0	25.5	2.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.9	90	3.41	15
21.98	3.2	4.2	-	3.7	0.1	26.0	3.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.8	95	3.53	15
22.15	3.6	4.7	-	4.1	0.2	25.1	7.1	Organic SOILS - Peats	100	1.0	5	4	2	-	-	0.3	1.0	95	3.64	10
22.31	4.5	5.9	-	4.9	0.3	16.3	9.2	Organic SOILS - Peats	100	1.0	6	5	3	-	-	0.4	1.4	95	3.59	10
22.47	5.2	6.7	-	5.4	0.4	11.0	9.9	Organic SOILS - Peats	100	1.0	7	5	3	-	-	0.5	1.7	95	3.54	10
22.64	7.0	8.9	-	7.2	0.5	9.0	8.4	silty CLAY to CLAY	115	1.5	6	5	4	-	-	0.4	2.4	88	3.38	15
22.80	8.1	10.4	-	8.3	0.5	7.7	7.8	silty CLAY to CLAY	115	1.5	7	5	4	-	-	0.5	2.9	81	3.30	15
22.97	8.9	11.3	-	9.0	0.5	7.0	7.3	silty CLAY to CLAY	115	1.5	8	6	4	-	-	0.6	3.2	76	3.24	15
23.13	10.1	12.8	-	10.3	0.6	8.9	6.7	silty CLAY to CLAY	115	1.5	9	7	5	-	-	0.7	3.7	71	3.17	15
23.30	11.5	14.5	-	11.7	0.6	11.0	6.2	silty CLAY to CLAY	115	1.5	10	8	5	-	-	0.8	4.2	66	3.11	15
23.46	12.9	16.1	-	13.2	0.6	12.9	5.6	silty CLAY to CLAY	115	1.5	11	9	5	-	-	0.9	4.8	61	3.03	15
23.62	13.3	16.5	-	13.6	0.6	12.2	5.1	silty CLAY to CLAY	115	1.5	11	9	5	-	-	0.9	4.9	58	3.00	15
23.79	13.5	16.6	-	13.7	0.6	12.4	4.8	silty CLAY to CLAY	115	1.5	11	9	5	-	-	0.9	4.9	57	2.98	15
23.95	14.5	17.9	-	14.8	0.6	14.5	4.4	silty CLAY to CLAY	115	1.5	12	10	5	-	-	1.0	5.3	54	2.93	15
24.12	16.3	19.9	-	16.6	0.6	15.8	4.2	silty CLAY to CLAY	115	1.5	13	11	6	-	-	1.1	6.0	51	2.88	15
24.28	16.1	19.6	-	16.4	0.6	16.0	4.3	silty CLAY to CLAY	115	1.5	13	11	6	-	-	1.1	5.9	51	2.89	15
24.44	14.8	17.9	-	15.1	0.7	15.1	4.8	silty CLAY to CLAY	115	1.5	12	10	6	-	-	1.0	5.4	56	2.96	15
24.61	14.7	17.7	-	15.0	0.6	15.3	4.3	silty CLAY to CLAY	115	1.5	12	10	5	-	-	1.0	5.3	54	2.93	15
24.77	14.7	17.6	-	15.0	0.6	16.3	4.5	silty CLAY to CLAY	115	1.5	12	10	5	-	-	1.0	5.2	55	2.94	15
24.94	15.0	17.9	-	15.4	0.6	18.2	4.6	silty CLAY to CLAY	115	1.5	12	10	6	-	-	1.0	5.3	55	2.94	15
25.10	19.8	23.5	-	20.3	0.6	22.7	3.4	clayy SILT to silty CLAY	115	2.0	12	10	7	-	-	1.3	7.2	44	2.76	15
25.26	20.2	23.9	-	20.7	0.6	24.8	3.1	clayy SILT to silty CLAY	115	2.0	12	10	7	-	-	1.4	7.3	42	2.73	15
25.43	18.2	21.3	-	18.6	0.6	23.5	3.8	silty CLAY to CLAY	115	1.5	14	12	6	-	-	1.2	6.5	48	2.83	15
25.59	19.0	22.1	-	19.5	0.7	28.5	3.8	silty CLAY to CLAY	115	1.5	15	13	6	-	-	1.3	6.7	47	2.81	15
25.76	26.1	30.3	-	26.7	0.7	33.3	2.8	clayy SILT to silty CLAY	115	2.0	15	13	8	-	-	1.8	9.4	36	2.61	15
25.92	31.4	32.8	93.7	32.0	0.7	29.1	2.2	clayy SILT to silty CLAY	115	2.0	16	16	8	-	-	2.2	9.9	31	2.52	15
26.08	22.2	25.5	-	22.3	0.5	5.9	2.5	clayy SILT to silty CLAY	115	2.0	13	11	7	-	-	1.5	7.9	37	2.64	15
26.25	19.8	22.7	-	19.9	0.5	6.7	2.5	clayy SILT to silty CLAY	115	2.0	11	10	6	-	-	1.3	6.9	40	2.69	15
26.41	17.2	19.6	-	17.4	0.5	9.3	3.3	silty CLAY to CLAY	115	1.5	13	11	6	-	-	1.2	5.9	47	2.82	15
26.58	20.2	22.9	-	20.5	0.5	17.8	2.9	clayy SILT to silty CLAY	115	2.0	11	10	6	-	-	1.4	7.0	42	2.73	15
26.74	23.8	26.8	-	24.2	0.6	20.6	2.9	clayy SILT to silty CLAY	115	2.0	13	12	7	-	-	1.6	8.3	39	2.66	15
26.90	22.7	25.4	-	23.1	0.6	22.3	3.0	clayy SILT to silty CLAY	115	2.0	13	11	7	-	-	1.5	7.8	40	2.70	15
27.07	24.9	27.8	-	25.4	0.6	24.9	2.4	clayy SILT to silty CLAY	115	2.0	14	12	7	-	-	1.7	8.6	36	2.61	15
27.23	24.8	26.3	-	25.3	0.5	25.6	2.2	clayy SILT to silty CLAY	115	2.0	13	12	7	-	-	1.7	8.5	36	2.60	15
27.40	22.1	24.4	-	22.6	0.5	24.5	2.5	clayy SILT to silty CLAY	115	2.0	12	11	6	-	-	1.5	7.5	39	2.67	15
27.56	19.8	21.8	-	20.4	0.5	32.1	2.8	clayy SILT to silty CLAY	115	2.0	11	10	6	-	-	1.3	6.6	42	2.74	15
27.72	19.1	21.0	-	19.8	0.5	32.1	3.0	clayy SILT to silty CLAY	115	2.0	10	10	6	-	-	1.3	6.3	44	2.77	15
27.89	17.4	19.0	-	18.0	0.5	30.5	3.3	silty CLAY to CLAY	115	1.5	13	12	5	-	-	1.2	5.7	48	2.83	15
28.05	17.3	18.8	-	17.9	0.5	30.4	3.2	silty CLAY to CLAY	115	1.5	13	12	5	-	-	1.2	5.6	47	2.82	15
28.22	16.0	17.3	-	16.6	0.5	28.4	3.2	silty CLAY to CLAY	115	1.5	12	11	5	-	-	1.1	5.1	49	2.86	15
28.38	14.9	16.0	-	15.4	0.4	27.3	3.1	silty CLAY to CLAY	115	1.5	11	10	5	-	-	1.0	4.7	51	2.88	15
28.54	13.7	14.6	-	14.2	0.4	26.4	3.2	silty CLAY to CLAY	115	1.5	10	9	4	-	-	0.9	4.2	53	2.92	15
28.71	12.0	12.8	-	12.5	0.3	25.8	3.3	silty CLAY to CLAY	115	1.5	9	8	4	-	-	0.8	3.6	58	2.99	15
28.87	11.7	12.4	-	12.2	0.3	26.4	3.4	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.5	59	3.01	15
29.04	11.5	12.1	-	12.0	0.5	26.7	5.0	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.7	3.4	67	3.11	15
29.20	12.3	13.0	-	12.9	0.4	29.2	3.4	silty CLAY to CLAY	115	1.5	9	8	4	-	-	0.8	3.7	58	2.99	15
29.36	15.6	16.3	-	15.8	0.3	13.8	2.3	clayy SILT to silty CLAY	115	2.0	8	8	5	-	-	1.0	4.8	46	2.80	15
29.53	10.2	10.6	-	10.3	0.3	4.9	3.8	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	2.9	66	3.10	15
29.69	9.2	9.5	-	9.3	0.4	7.7	5.3	silty CLAY to CLAY	115	1.5	6	6	4	-	-	0.6	2.6	76	3.23	15
29.86	10.5	10.9	-	10.7	0.3	7.7	3.9	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	3.0	65	3.10	15
30.02	17.8	18.3	-	17.9	0.3	4.3	2.1	clayy SILT to silty CLAY	115	2.0	9	9	5	-	-	1.2	5.4	42	2.73	15
30.19	9.8	10.0	-	9.8	0.2	4.2	3.1	silty CLAY to CLAY	115	1.5	7	7	3	-	-	0.6	2.7	63	3.07	15
30.35	8.2	8.4	-	8.4	0.2	7.4	2.4	silty CLAY to CLAY	115	1.5	6	5	3	-	-	0.5	2.2	65	3.10	15
30.51	7.9	8.0	-	8.0	0.1	8.4	1.8	silty CLAY to CLAY	115	1.5	5	5	3	-	-	0.5	2.0	63	3.06	15
30.68	8.1	8.2	-	8.3	0.1	8.8	1.3	silty CLAY to CLAY	115	1.5	5	5	3	-	-	0.5	2.1	57	2.98	15
30.84	7.3	7.4	-	7.5	0.1	10.1	2.1	silty CLAY to CLAY	115	1.5	5	5	3	-	-	0.4	1.8	68	3.13	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Sheetpile Wall at WBSD Property

. . Depth ft	. qc PS tsf	* qc1n PS -	. q1ncs PS -	* qt PS tsf	. Slv Stss tsf	. pore prss (psi)	. Frct Rato %	* Material Behavior Description	. Unit Wght pcf	. Qc to N	* SPT R-N1 60%	. SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	. Und Shr tsf	. OCR - -	* Fin Ic %	* Ic SBT Indx	* Nk - -
31.01	7.1	7.1	-	7.3	0.2	10.8	2.8	silty CLAY to CLAY	115	1.5	5	5	3	-	-	0.4	1.8	74	3.21	15
31.17	7.6	7.6	-	7.8	0.2	11.9	3.3	silty CLAY to CLAY	115	1.5	5	5	3	-	-	0.5	1.9	74	3.22	15
31.33	8.6	8.6	-	8.9	0.2	13.3	3.3	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.5	2.2	70	3.16	15
31.50	9.9	9.8	-	10.2	0.2	14.4	3.0	silty CLAY to CLAY	115	1.5	7	7	3	-	-	0.6	2.6	64	3.08	15
31.66	11.6	11.5	-	12.0	0.3	19.7	2.8	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.2	58	2.99	15
31.83	13.1	12.9	-	13.6	0.3	23.7	2.7	silty CLAY to CLAY	115	1.5	9	9	4	-	-	0.9	3.7	54	2.94	15
31.99	14.5	14.1	-	15.0	0.4	26.8	2.9	silty CLAY to CLAY	115	1.5	9	10	4	-	-	1.0	4.1	53	2.91	15
32.15	15.4	15.0	-	16.0	0.4	30.3	3.0	silty CLAY to CLAY	115	1.5	10	10	4	-	-	1.0	4.3	52	2.90	15
32.32	15.7	15.2	-	16.3	0.5	29.6	3.4	silty CLAY to CLAY	115	1.5	10	10	5	-	-	1.0	4.4	53	2.92	15
32.48	14.7	14.2	-	15.3	0.5	27.8	3.7	silty CLAY to CLAY	115	1.5	9	10	4	-	-	1.0	4.1	57	2.98	15
32.65	13.8	13.3	-	14.3	0.5	26.0	4.0	silty CLAY to CLAY	115	1.5	9	9	4	-	-	0.9	3.8	60	3.02	15
32.81	12.4	11.8	-	12.8	0.4	22.8	4.2	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.3	64	3.08	15
32.97	11.6	11.0	-	12.0	0.4	22.0	4.2	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.7	3.0	66	3.11	15
33.14	10.3	9.8	-	10.6	0.4	16.5	4.4	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	2.6	71	3.18	15
33.30	9.7	9.2	-	10.1	0.3	17.7	4.2	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.4	72	3.19	15
33.47	9.9	9.3	-	10.3	0.3	19.0	4.1	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.5	71	3.17	15
33.63	9.7	9.1	-	10.1	0.3	19.1	3.8	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.4	71	3.17	15
33.79	9.1	8.5	-	9.5	0.3	18.6	4.0	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.2	74	3.21	15
33.96	8.6	8.0	-	8.9	0.3	18.5	4.1	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.5	2.0	77	3.25	15
34.12	8.7	8.1	-	9.1	0.2	19.2	3.6	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.5	2.1	74	3.21	15
34.29	9.1	8.4	-	9.5	0.3	19.6	3.8	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.2	74	3.21	15
34.45	9.1	8.4	-	9.5	0.3	18.6	4.0	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.2	75	3.22	15
34.61	9.8	9.0	-	10.2	0.3	18.5	3.9	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.4	71	3.18	15
34.78	11.0	10.1	-	11.4	0.3	19.2	3.7	silty CLAY to CLAY	115	1.5	7	7	3	-	-	0.7	2.7	67	3.12	15
34.94	11.5	10.5	-	12.0	0.3	20.8	3.6	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.7	2.9	65	3.09	15
35.11	12.0	10.8	-	12.4	0.4	22.4	3.5	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.8	3.0	64	3.08	15
35.27	11.7	10.5	-	12.2	0.3	23.7	3.4	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.7	2.9	64	3.08	15
35.43	12.4	11.1	-	12.9	0.3	26.2	2.8	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.8	3.1	59	3.00	15
35.60	12.4	11.1	-	13.0	0.3	30.3	2.5	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.8	3.1	57	2.98	15
35.76	12.1	10.8	-	12.7	0.3	32.2	2.7	silty CLAY to CLAY	115	1.5	7	8	3	-	-	0.8	3.0	59	3.01	15
35.93	13.1	11.6	-	13.7	0.3	33.1	2.7	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.8	3.2	57	2.98	15
36.09	13.8	12.2	-	14.5	0.3	32.1	2.9	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.9	3.4	57	2.97	15
36.26	14.4	12.6	-	15.0	0.3	32.9	2.8	silty CLAY to CLAY	115	1.5	8	10	4	-	-	0.9	3.6	55	2.95	15
36.42	15.0	13.1	-	15.7	0.4	34.2	2.7	silty CLAY to CLAY	115	1.5	9	10	4	-	-	1.0	3.7	54	2.93	15
36.58	15.9	13.9	-	16.7	0.4	37.2	2.6	silty CLAY to CLAY	115	1.5	9	11	4	-	-	1.0	4.0	52	2.90	15
36.75	16.6	14.5	-	17.4	0.4	41.5	2.7	silty CLAY to CLAY	115	1.5	10	11	4	-	-	1.1	4.2	51	2.88	15
36.91	17.4	15.1	-	18.3	0.4	43.5	2.6	silty CLAY to CLAY	115	1.5	10	12	4	-	-	1.2	4.4	50	2.86	15
37.08	18.2	15.7	-	19.0	0.4	44.4	2.7	silty CLAY to CLAY	115	1.5	10	12	5	-	-	1.2	4.6	49	2.86	15
37.24	18.7	16.1	-	19.6	0.4	44.0	2.6	clayy SILT to silty CLAY	115	2.0	8	9	5	-	-	1.2	4.7	48	2.84	15
37.40	18.8	16.1	-	19.7	0.4	45.1	2.6	clayy SILT to silty CLAY	115	2.0	8	9	5	-	-	1.2	4.7	48	2.83	15
37.57	18.4	15.7	-	19.3	0.5	48.8	2.8	silty CLAY to CLAY	115	1.5	10	12	5	-	-	1.2	4.6	50	2.87	15
37.73	18.3	15.6	-	19.2	0.5	48.8	2.8	silty CLAY to CLAY	115	1.5	10	12	5	-	-	1.2	4.5	50	2.87	15
37.90	18.4	15.6	-	19.4	0.4	49.9	2.5	clayy SILT to silty CLAY	115	2.0	8	9	5	-	-	1.2	4.5	48	2.84	15
38.06	17.9	15.1	-	18.9	0.4	51.1	2.4	clayy SILT to silty CLAY	115	2.0	8	9	4	-	-	1.2	4.4	48	2.84	15
38.22	17.8	15.0	-	18.9	0.4	58.0	2.3	clayy SILT to silty CLAY	115	2.0	7	9	4	-	-	1.2	4.3	48	2.83	15
38.39	19.2	16.1	-	20.5	0.4	64.9	2.3	clayy SILT to silty CLAY	115	2.0	8	10	5	-	-	1.3	4.7	46	2.81	15
38.55	22.0	18.4	-	23.2	0.4	62.0	2.0	clayy SILT to silty CLAY	115	2.0	9	11	5	-	-	1.5	5.4	42	2.72	15
38.72	19.2	16.0	-	20.2	0.4	49.4	2.2	clayy SILT to silty CLAY	115	2.0	8	10	5	-	-	1.3	4.7	46	2.80	15
38.88	15.1	12.5	-	15.9	0.3	41.6	2.4	silty CLAY to CLAY	115	1.5	8	10	4	-	-	1.0	3.5	53	2.92	15
39.04	13.3	11.0	-	14.0	0.3	34.2	2.4	silty CLAY to CLAY	115	1.5	7	9	3	-	-	0.9	3.0	57	2.98	15
39.21	11.1	9.2	-	11.8	0.2	36.7	2.4	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.4	62	3.06	15
39.37	10.1	8.3	-	10.8	0.2	35.4	2.2	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.1	65	3.09	15
39.54	9.3	7.6	-	10.1	0.1	36.6	2.0	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.9	66	3.11	15
39.70	8.9	7.2	-	9.6	0.2	38.7	3.2	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.5	1.8	76	3.24	15
39.86	9.4	7.7	-	10.2	0.2	41.6	2.5	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.9	70	3.16	15
40.03	14.4	11.6	-	15.3	0.2	44.9	1.7	clayy SILT to silty CLAY	115	2.0	6	7	3	-	-	0.9	3.2	51	2.88	15
40.19	13.4	10.8	-	14.0	0.3	31.0	2.3	silty CLAY to CLAY	115	1.5	7	9	3	-	-	0.9	2.9	57	2.97	15
40.36	12.4	10.0	-	13.2	0.3	38.4	2.9	silty CLAY to CLAY	115	1.5	7	8	3	-	-	0.8	2.7	63	3.07	15
40.52	14.2	11.4	-	15.0	0.4	41.0	3.2	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.9	3.1	61	3.03	15
40.68	15.1	12.0	-	15.9	0.4	38.8	3.4	silty CLAY to CLAY	115	1.5	8	10	4	-	-	1.0	3.4	60	3.02	15
40.85	14.6	11.6	-	15.3	0.5	34.9	3.8	silty CLAY to CLAY	115	1.5	8	10	4	-	-	0.9	3.2	63	3.06	15
41.01	13.5	10.7	-	14.1	0.5	30.9	4.2	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	2.9	67	3.13	15
41.18	12.5	9.9	-	13.1	0.4	32.4	4.2	silty CLAY to CLAY	115	1.5	7	8	3	-	-	0.8	2.6	70	3.16	15
41.34	12.3	9.7	-	12.9	0.4	30.0	4.2	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.6	70	3.17	15
41.50	11.0	8.6	-	11.7	0.4	32.9	4.1	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.2	74	3.21	15
41.67	10.2	8.0	-	10.8	0.3	31.1	4.1	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	2.0	77	3.25	15
41.83	9.1	7.1	-	9.7	0.3	29.7	4.2	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.7	82	3.31	15
42.00	8.6	6.7	-	9.2	0.2	29.3	3.8	silty CLAY to CLAY	115	1.5	4	6	3	-	-	0.5	1.6	83	3.32	15
42.16	8.6	6.7	-	9.2	0.2	30.2	3.1	silty CLAY to CLAY	115	1.5	4	6	3	-	-	0.5	1.6	79	3.27	15
42.32	8.5	6.6	-	9.2	0.2	32.9	2.9	silty CLAY to CLAY	115	1.5	4	6	3	-	-	0.5	1.6	78	3.27	15
42.49	8.6	6.6	-	9.3	0.2	33.7	2.9	silty CLAY to CLAY	115	1.5	4	6	3	-	-	0.5	1.6	78	3.26	15
42.65	9.0	6.9	-	9.7	0.2	35.2	3.2	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.5	1.7	78	3.26	15
42.82	9.5	7.3	-	10.2	0.2	37.4	3.1	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.8	75	3.23	15
42.98	9.6	7.3	-	10.3	0.2	37.7	3.2	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.8	76	3.23	15
43.15	9.8	7.4	-	10.6	0.2	40.2	3.4	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	1.8	76	3.24	15
43.31	10.6	8.0	-	11.5	0.3	41.9	3.4	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.7	2.0	73	3.20	15
43.47	11.3	8.5	-	12.1	0.3	40.7	3.4	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.2	71	3.17	15
43.64	11.6	8.7	-	12.4	0.3	39.9	3.7	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.2	72	3.19	15
43.80	11.4	8.6	-	12.2	0.4	40.7	3.9	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.2	74	3.21	15
43.97	12.0	9.0	-	12.8	0.4	37.6	3.9	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.3	72	3.19	15
44.13	12.0	8.9	-	12.7	0.4	37.6	4.3	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.3	74	3.21	15
44.29	11.9	8.8	-	12.6	0.4	34.7	4.7	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.3	76	3.24	15
44.46	12.0	8.9	-	12.7	0.4	35.0	4.5	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.3	75	3.23	15
44.62	13.0	9.5	-	13.6	0.4	32.8	4.1	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.5	70	3.17	15
44.79	12.6	9.2	-	13.3	0.4	36.3	3.9	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.4	71	3.17	15
44.95	12.0	8.8	-	12.7	0.4	35.1	3.9	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.3	72	3.19	15
45.11	11.3	8.2	-	12.0	0.3	35.8	3.9	silty CLAY to CLAY	115	1.5	5	8	3	-	-	0.7	2.1	75	3.22	15
45.28	10.8	7.9	-	11.5	0.3	34.6	3.8	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.7	2.0	76	3.24	15
45.44	10.7	7.7	-	11.4	0.3	37.0	4.2	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.7	1.9	79	3.27	15
45.61	11.9	8.6	-	12.8	0.4	41.9	4.3	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.2	75	3.23	15
45.77	13.9	10.0	-	14.7	0.5	43.2	4.1	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	2.7	69	3.15	15
45.93	15.1	10.8	-	16.0	0.5	46.2	4.1	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	3.0	67	3.12	15
46.10	15.8	11.3	-	16.7	0.5	47.3	4.1	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.0	3.1	65	3.10	15
46.26	16.7	12.0	-	17.8	0.6	53.2	4.1	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.1	3.3	64	3.07	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Sheetpile Wall at WBSD Property

Project ID: BAGG Engineering
Data File: SDF(047).cpt
CPT Date: 5/1/2018 8:36:30 AM
GW During Test: 6 ft

Sounding ID: CPT-01
Project No: FREYE-18-01
Cone/Rig: DDG1418

. Depth ft	. qc PS tsf	* qc1n PS -	. q1ncs PS -	* qt PS tsf	. Slv Stss tsf	. pore prss (psi)	. Frct Rato %	* Material Behavior Description	. Unit Wght pcf	. Qc to N	* SPT R-N1 60%	. SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	. Und Shr tsf	. OCR - -	* Fin Ic %	* Ic SBT Indx	* Nk - -
46.43	16.7	11.9	-	17.6	0.6	47.0	4.3	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.1	3.3	65	3.09	15
46.59	15.6	11.1	-	16.4	0.6	40.5	4.3	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	3.0	67	3.12	15
46.75	14.7	10.4	-	15.4	0.5	35.5	4.4	silty CLAY to CLAY	115	1.5	7	10	4	-	-	0.9	2.8	69	3.15	15
46.92	14.1	9.9	-	14.8	0.5	35.4	4.2	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	2.6	70	3.16	15
47.08	14.0	9.9	-	14.7	0.5	36.6	4.3	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	2.6	71	3.17	15
47.25	13.9	9.7	-	14.6	0.5	34.8	4.7	silty CLAY to CLAY	115	1.5	6	9	4	-	-	0.9	2.6	73	3.20	15
47.41	13.4	9.4	-	14.1	0.5	34.4	4.9	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.5	75	3.22	15
47.57	13.4	9.3	-	14.0	0.5	32.1	5.1	silty CLAY to CLAY	115	1.5	6	9	4	-	-	0.8	2.5	76	3.24	15
47.74	13.7	9.5	-	14.4	0.5	35.8	4.6	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.9	2.5	73	3.20	15
47.90	13.6	9.4	-	14.2	0.5	32.4	4.6	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.9	2.5	74	3.21	15
48.07	14.9	10.3	-	15.7	0.5	40.9	4.2	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	2.8	69	3.14	15
48.23	15.8	10.9	-	16.7	0.6	46.4	4.2	silty CLAY to CLAY	115	1.5	7	11	4	-	-	1.0	3.0	67	3.12	15
48.39	16.4	11.3	-	17.3	0.6	41.9	4.1	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.1	3.1	65	3.10	15
48.56	16.2	11.1	-	17.0	0.5	42.4	3.7	silty CLAY to CLAY	115	1.5	7	11	4	-	-	1.0	3.0	64	3.08	15
48.72	16.3	11.1	-	17.2	0.5	46.3	4.0	silty CLAY to CLAY	115	1.5	7	11	4	-	-	1.0	3.0	65	3.10	15
48.89	17.2	11.7	-	18.2	0.6	51.9	4.0	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.1	3.2	64	3.08	15
49.05	18.3	12.4	-	19.3	0.6	49.9	4.0	silty CLAY to CLAY	115	1.5	8	12	4	-	-	1.2	3.5	62	3.05	15
49.22	18.7	12.6	-	19.7	0.6	54.4	3.7	silty CLAY to CLAY	115	1.5	8	12	4	-	-	1.2	3.5	60	3.02	15
49.38	18.1	12.2	-	19.2	0.6	52.3	4.0	silty CLAY to CLAY	115	1.5	8	12	4	-	-	1.2	3.4	62	3.06	15
49.54	17.9	12.0	-	19.0	0.6	55.0	4.0	silty CLAY to CLAY	115	1.5	8	12	4	-	-	1.2	3.3	63	3.06	15
49.71	17.2	11.5	-	18.1	0.6	44.5	4.2	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.1	3.2	65	3.10	15
49.87	15.7	10.5	-	16.5	0.5	41.1	4.0	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	2.8	67	3.12	15
50.04	14.6	9.7	-	15.4	0.4	37.9	3.8	silty CLAY to CLAY	115	1.5	6	10	3	-	-	0.9	2.6	68	3.14	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

Sheetpile Wall at WBSD Property

Project ID: BAGG Engineering
Data File: SDF(048).cpt
CPT Date: 5/1/2018 9:12:38 AM
GW During Test: 8 ft

Sounding ID: CPT-02
Project No: FREYE-18-01
Cone/Rig: DDG1418

. . Depth ft	. qc PS tsf	* qc1n PS -	. q1ncs PS -	* qt PS tsf	. Slv Stss tsf	. pore prss (psi)	. Frct Rato %	* Material Behavior Description	. Unit Wght pcf	. Qc to N	* SPT R-N1 60%	. SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	. Und Shr tsf	. OCR - -	* Fin Ic %	* Ic SBT Indx	* Nk - -
0.33	21.6	34.7	-	21.6	0.9	0.0	4.1	clayy SILT to silty CLAY	115	2.0	17	11	9	-	-	1.5	9.9	39	2.66	15
0.49	54.9	88.1	161.6	54.9	1.6	1.4	2.8	silty SAND to sandy SILT	120	3.0	29	18	19	63	48	-	-	21	2.26	16
0.66	56.1	89.9	206.4	56.1	2.4	2.8	4.3	clayy SILT to silty CLAY	115	2.0	45	28	21	-	-	4.0	9.9	26	2.40	15
0.82	56.9	91.3	222.2	57.0	2.7	6.0	4.8	very stiff fine SOIL	120	1.0	91	57	21	-	-	2.0	9.9	28	2.43	30
0.98	61.2	98.1	212.9	61.2	2.6	3.3	4.2	very stiff fine SOIL	120	1.0	98	61	22	-	-	2.2	9.9	25	2.36	30
1.15	60.8	97.5	206.9	60.8	2.4	2.7	4.0	clayy SILT to silty CLAY	115	2.0	49	30	22	-	-	4.3	9.9	24	2.35	15
1.31	55.3	88.7	164.7	55.3	1.6	2.1	2.9	silty SAND to sandy SILT	120	3.0	30	18	19	63	48	-	-	21	2.27	16
1.48	40.0	64.1	157.1	40.0	1.4	2.4	3.6	clayy SILT to silty CLAY	115	2.0	32	20	15	-	-	2.8	9.9	28	2.43	15
1.64	34.7	55.6	147.9	34.7	1.2	0.9	3.6	clayy SILT to silty CLAY	115	2.0	28	17	13	-	-	2.4	9.9	30	2.48	15
1.80	42.0	67.4	160.9	42.0	1.5	1.1	3.6	clayy SILT to silty CLAY	115	2.0	34	21	16	-	-	3.0	9.9	27	2.42	15
1.97	34.0	54.6	170.7	34.1	1.6	2.4	4.7	clayy SILT to silty CLAY	115	2.0	27	17	14	-	-	2.4	9.9	34	2.57	15
2.13	29.1	46.7	-	29.2	1.5	3.2	5.1	clayy SILT to silty CLAY	115	2.0	23	15	12	-	-	2.0	9.9	37	2.64	15
2.30	31.3	50.2	-	31.4	1.6	4.5	5.1	clayy SILT to silty CLAY	115	2.0	25	16	13	-	-	2.2	9.9	36	2.62	15
2.46	32.3	51.8	-	32.4	2.3	2.4	7.1	silty CLAY to CLAY	115	1.5	35	22	14	-	-	2.3	9.9	41	2.72	15
2.62	57.2	91.7	218.1	57.4	2.6	7.9	4.6	very stiff fine SOIL	120	1.0	92	57	21	-	-	2.0	9.9	27	2.42	30
2.79	116.9	187.5	260.2	117.0	3.3	7.6	2.9	silty SAND to sandy SILT	120	3.0	62	39	38	88	48	-	-	15	2.06	16
2.95	112.4	180.2	258.4	112.5	3.4	8.1	3.0	silty SAND to sandy SILT	120	3.0	60	37	37	86	48	-	-	15	2.09	16
3.12	94.0	150.8	234.3	94.2	3.0	6.8	3.2	silty SAND to sandy SILT	120	3.0	50	31	31	81	48	-	-	17	2.15	16
3.28	60.6	97.3	198.5	60.8	2.3	8.0	3.7	silty SAND to sandy SILT	120	3.0	32	20	22	66	46	-	-	24	2.33	16
3.45	40.3	64.6	172.2	40.4	1.7	6.0	4.2	clayy SILT to silty CLAY	115	2.0	32	20	16	-	-	2.8	9.9	30	2.48	15
3.61	29.8	47.8	138.2	29.9	1.1	7.2	3.6	clayy SILT to silty CLAY	115	2.0	24	15	12	-	-	2.1	9.9	32	2.52	15
3.77	28.2	45.3	91.2	28.4	0.5	10.1	1.7	silty SAND to sandy SILT	120	3.0	15	9	10	41	42	-	-	23	2.32	16
3.94	26.4	42.4	96.2	26.6	0.5	7.4	2.0	silty SAND to sandy SILT	120	3.0	14	9	10	39	41	-	-	26	2.39	16
4.10	43.6	69.9	159.6	43.6	1.5	1.6	3.4	clayy SILT to silty CLAY	115	2.0	35	22	16	-	-	3.1	9.9	26	2.39	15
4.27	42.5	68.1	155.3	42.5	1.4	1.9	3.3	clayy SILT to silty CLAY	115	2.0	34	21	16	-	-	3.0	9.9	26	2.39	15
4.43	47.5	76.1	142.0	47.5	1.2	2.8	2.5	silty SAND to sandy SILT	120	3.0	25	16	17	58	44	-	-	22	2.27	16
4.59	14.9	23.9	-	15.1	0.8	6.0	5.6	silty CLAY to CLAY	115	1.5	16	10	7	-	-	1.0	9.9	51	2.88	15
4.76	15.4	24.8	-	15.6	0.7	7.6	4.6	silty CLAY to CLAY	115	1.5	17	10	7	-	-	1.1	9.9	46	2.81	15
4.92	24.1	38.6	105.8	24.1	0.6	1.3	2.6	clayy SILT to silty CLAY	115	2.0	19	12	9	-	-	1.7	9.9	30	2.49	15
5.09	15.5	24.9	-	15.6	0.4	3.2	2.8	clayy SILT to silty CLAY	115	2.0	12	8	7	-	-	1.1	9.9	39	2.67	15
5.25	10.3	16.4	-	10.4	0.3	6.5	3.3	silty CLAY to CLAY	115	1.5	11	7	5	-	-	0.7	9.9	49	2.86	15
5.41	7.3	11.7	-	7.4	0.3	5.2	3.8	silty CLAY to CLAY	115	1.5	8	5	4	-	-	0.5	7.3	59	3.01	15
5.58	5.0	8.0	-	5.1	0.2	3.7	4.1	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	4.7	71	3.18	15
5.74	4.2	6.8	-	4.3	0.2	4.7	4.1	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	3.8	77	3.24	15
5.91	4.0	6.4	-	4.1	0.1	3.8	4.1	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.3	3.5	78	3.27	15
6.07	4.0	6.3	-	4.1	0.1	4.9	3.8	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.3	3.4	77	3.25	15
6.23	4.0	6.5	-	4.2	0.1	8.9	3.6	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.3	3.3	75	3.23	15
6.40	3.5	5.7	-	3.7	0.1	8.5	3.5	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.8	79	3.28	15
6.56	3.1	5.0	-	3.3	0.1	8.5	3.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.3	83	3.32	15
6.73	3.0	4.7	-	3.1	0.1	8.6	3.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.2	85	3.35	15
6.89	3.1	5.0	-	3.3	0.1	8.8	3.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.2	83	3.32	15
7.05	3.4	5.4	-	3.6	0.1	8.8	3.6	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.4	82	3.31	15
7.22	3.4	5.4	-	3.6	0.1	8.7	3.9	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.3	83	3.33	15
7.38	3.2	5.1	-	3.3	0.1	8.7	4.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.1	88	3.38	15
7.55	2.9	4.6	-	3.1	0.1	8.4	4.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.8	93	3.43	15
7.71	2.8	4.6	-	3.0	0.1	8.4	4.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.8	95	3.46	15
7.87	2.7	4.3	-	2.9	0.1	8.3	4.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	93	3.44	15
8.04	2.4	3.9	-	2.6	0.1	8.5	3.8	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.4	95	3.47	15
8.20	2.4	3.8	-	2.5	0.1	8.6	3.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.3	95	3.48	15
8.37	2.3	3.8	-	2.5	0.1	8.9	3.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.3	95	3.48	15
8.53	2.4	3.8	-	2.5	0.1	9.0	3.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.3	95	3.47	15
8.69	2.3	3.8	-	2.5	0.1	9.0	3.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.3	95	3.50	15
8.86	2.3	3.7	-	2.5	0.1	9.1	3.8	silty CLAY to CLAY	115	1.5	2	2	2	-	-	0.1	1.2	95	3.51	15
9.02	2.3	3.6	-	2.4	0.1	9.2	3.5	silty CLAY to CLAY	115	1.5	2	2	2	-	-	0.1	1.2	95	3.50	15
9.19	2.2	3.5	-	2.3	0.1	9.8	3.8	silty CLAY to CLAY	115	1.5	2	1	2	-	-	0.1	1.1	95	3.55	15
9.35	2.1	3.4	-	2.3	0.1	9.9	3.8	silty CLAY to CLAY	115	1.5	2	1	2	-	-	0.1	1.0	95	3.56	15
9.51	1.8	2.8	-	1.9	0.1	9.2	4.5	Organic SOILS - Peats	100	1.0	3	2	2	-	-	0.1	0.8	95	3.69	10
9.68	1.9	3.1	-	2.1	0.1	9.5	3.8	silty CLAY to CLAY	115	1.5	2	1	2	-	-	0.1	0.9	95	3.61	15
9.84	2.2	3.6	-	2.4	0.1	10.0	3.7	silty CLAY to CLAY	115	1.5	2	1	2	-	-	0.1	1.1	95	3.54	15
10.01	2.5	4.1	-	2.8	0.1	10.4	3.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.3	94	3.45	15
10.17	2.6	4.2	-	2.8	0.1	10.6	3.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.3	95	3.46	15
10.34	2.7	4.3	-	2.9	0.1	11.1	3.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	92	3.42	15
10.50	2.8	4.5	-	3.0	0.1	11.4	3.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.4	89	3.39	15
10.66	2.7	4.4	-	3.0	0.1	11.7	3.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	91	3.42	15
10.83	2.7	4.4	-	3.0	0.1	12.0	3.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	93	3.43	15
10.99	2.9	4.6	-	3.1	0.1	12.3	3.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.4	91	3.41	15
11.16	2.9	4.6	-	3.1	0.1	12.6	3.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.4	90	3.41	15
11.32	2.9	4.6	-	3.1	0.1	12.8	3.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	93	3.44	15
11.48	2.9	4.7	-	3.2	0.1	13.1	3.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	88	3.38	15
11.65	2.8	4.4	-	3.0	0.1	13.3	3.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	93	3.43	15
11.81	2.7	4.3	-	3.0	0.1	13.2	3.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	94	3.45	15
11.98	2.9	4.6	-	3.1	0.1	13.5	3.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	92	3.42	15
12.14	2.7	4.3	-	2.9	0.1	13.6	4.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.1	95	3.50	15
12.30	2.6	4.2	-	2.9	0.1	13.6	4.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.1	95	3.54	15
12.47	2.9	4.7	-	3.2	0.1	14.2	4.8	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	95	3.49	15
12.63	3.0	4.8	-	3.3	0.1	13.8	4.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	95	3.47	15
12.80	3.0	4.8	-	3.2	0.1	13.3	4.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	95	3.46	15
12.96	2.8	4.4	-	3.0	0.1	13.0	4.8	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.1	95	3.52	15
13.12	2.8	4.6	-	3.1	0.1	13.0	4.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	95	3.47	15
13.29	2.9	4.7	-	3.2	0.1	13.2	3.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	93	3.44	15
13.45	2.8	4.4	-	3.0	0.1	13.2	3.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.1	94	3.45	15
13.62	2.5	4.0	-	2.8	0.1	13.5	3.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.9	95	3.50	15
13.78	2.4	3.8	-	2.6	0.1	13.9	3.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.53	15
13.94	2.4	3.8	-	2.7	0.1	14.2	3.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.54	15
14.11	2.3	3.8	-	2.6	0.1	14.5	3.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.55	15
14.27	2.4	3.9	-	2.7	0.1	15.0	3.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.53	15
14.44	2.4	3.9	-	2.7	0.1	15.4	4.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.59	15
14.60	2.4	3.9	-	2.8	0.1	15.8	3.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.55	15
14.76	2.5	3.9	-	2.8	0.1	16.2	3.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.9	95	3.53	15
14.93	2.4	3.8	-	2.8	0.1	16.5	3.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.57	15
15.09	2.5	3.9	-	2.8	0.1	16.8	4.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.59	15
15.26	2.5	3.9	-	2.9	0.1	17.0	4.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.57	15
15.42	2.5	3.9	-	2.9	0.1	17.2	4.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.57	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

Sheetpile Wall at WBSD Property

Project ID: BAGG Engineering
Data File: SDF(048).cpt
CPT Date: 5/1/2018 9:12:38 AM
GW During Test: 8 ft

Sounding ID: CPT-02
Project No: FREYE-18-01
Cone/Rig: DDG1418

. Depth ft	. qc PS tsf	* qc1n PS -	. q1ncs PS -	* qt PS tsf	. Slv Stss tsf	. pore prss (psi)	. Frct Rato %	* Material Behavior Description	. Unit Wght pcf	. Qc to N	* SPT R-N1 60%	. SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	. Und Shr tsf	. OCR -	* Fin Ic %	* Ic SBT Indx	* Nk -
15.58	2.6	4.0	-	3.0	0.1	18.2	3.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.9	95	3.54	15
15.75	2.7	4.0	-	3.0	0.1	18.5	3.8	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.9	95	3.54	15
15.91	2.7	4.0	-	3.0	0.1	18.7	3.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.9	95	3.54	15
16.08	2.6	3.9	-	3.0	0.1	19.0	3.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.55	15
16.24	2.6	3.9	-	3.0	0.1	19.3	3.8	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.56	15
16.40	2.7	3.9	-	3.1	0.1	19.5	3.8	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.55	15
16.57	2.7	3.9	-	3.1	0.1	19.7	3.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.56	15
16.73	2.7	3.9	-	3.1	0.1	20.0	3.8	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.56	15
16.90	2.7	3.9	-	3.1	0.1	20.3	3.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.56	15
17.06	2.7	3.9	-	3.2	0.1	20.6	3.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.55	15
17.23	2.7	3.9	-	3.1	0.1	20.7	3.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.56	15
17.39	2.7	3.8	-	3.1	0.1	21.1	3.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.57	15
17.55	2.7	3.8	-	3.1	0.1	21.5	4.8	Organic SOILS - Peats	100	1.0	4	3	2	-	-	0.2	0.8	95	3.63	10
17.72	2.7	3.8	-	3.2	0.1	21.8	3.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.57	15
17.88	2.7	3.8	-	3.2	0.1	22.1	3.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.56	15
18.05	2.6	3.7	-	3.1	0.1	21.5	4.0	silty CLAY to CLAY	115	1.5	2	2	2	-	-	0.1	0.7	95	3.62	15
18.21	2.8	3.8	-	3.2	0.1	21.9	3.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.58	15
18.37	2.7	3.8	-	3.2	0.1	22.2	4.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	0.8	95	3.61	15
18.54	2.7	3.6	-	3.1	0.1	22.2	4.1	silty CLAY to CLAY	115	1.5	2	2	2	-	-	0.1	0.7	95	3.63	15
18.70	2.4	3.3	-	2.9	0.1	21.5	5.7	Organic SOILS - Peats	100	1.0	3	2	2	-	-	0.2	0.6	95	3.76	10
18.87	2.5	3.4	-	2.9	0.1	18.8	5.5	Organic SOILS - Peats	100	1.0	3	3	2	-	-	0.2	0.6	95	3.73	10
19.03	2.7	3.6	-	3.0	0.1	16.0	4.8	Organic SOILS - Peats	100	1.0	4	3	2	-	-	0.2	0.7	95	3.67	10
19.19	2.2	3.0	-	2.5	0.1	12.0	5.8	Organic SOILS - Peats	100	1.0	3	2	2	-	-	0.2	0.5	95	3.84	10
19.36	1.9	2.6	-	2.1	0.1	10.2	7.2	Organic SOILS - Peats	100	1.0	3	2	2	-	-	0.1	0.4	95	4.01	10
19.52	2.3	3.0	-	2.4	0.1	9.8	4.9	Organic SOILS - Peats	100	1.0	3	2	2	-	-	0.2	0.5	95	3.81	10
19.69	2.4	3.2	-	2.6	0.1	10.1	4.6	Organic SOILS - Peats	100	1.0	3	2	2	-	-	0.2	0.6	95	3.74	10
19.85	2.6	3.4	-	2.8	0.1	11.4	3.9	silty CLAY to CLAY	115	1.5	2	2	2	-	-	0.1	0.6	95	3.66	15
20.01	3.1	4.0	-	3.3	0.1	13.2	3.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.8	95	3.52	15
20.18	3.3	4.2	-	3.6	0.1	14.9	2.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.9	95	3.46	15
20.34	3.3	4.2	-	3.6	0.1	16.3	2.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.9	95	3.47	15
20.51	3.3	4.2	-	3.6	0.1	17.5	3.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.9	95	3.48	15
20.67	3.4	4.3	-	3.8	0.1	18.5	3.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.9	95	3.47	15
20.83	3.5	4.4	-	3.9	0.1	19.5	3.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.0	95	3.45	15
21.00	3.5	4.4	-	3.9	0.1	20.4	3.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.0	95	3.46	15
21.16	3.6	4.5	-	4.0	0.1	21.4	3.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.0	95	3.46	15
21.33	3.6	4.6	-	4.1	0.1	21.7	3.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.0	94	3.45	15
21.49	3.6	4.4	-	4.0	0.1	21.8	3.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.0	95	3.46	15
21.65	3.4	4.2	-	3.8	0.1	22.8	3.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.9	95	3.51	15
21.82	3.4	4.1	-	3.8	0.1	23.5	3.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.9	95	3.51	15
21.98	3.4	4.1	-	3.8	0.1	24.2	3.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.8	95	3.51	15
22.15	3.3	4.1	-	3.8	0.1	26.4	3.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.8	95	3.51	15
22.31	3.3	4.0	-	3.8	0.1	27.3	3.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.8	95	3.53	15
22.47	3.3	4.0	-	3.9	0.1	28.0	3.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.8	95	3.52	15
22.64	3.4	4.1	-	4.0	0.1	28.6	3.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.8	95	3.51	15
22.80	3.5	4.1	-	4.0	0.1	29.3	3.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.8	95	3.51	15
22.97	3.5	4.1	-	4.1	0.1	30.1	3.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.8	95	3.52	15
23.13	3.6	4.2	-	4.2	0.1	31.0	3.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	0.9	95	3.51	15
23.30	3.8	4.5	-	4.4	0.2	32.0	6.8	Organic SOILS - Peats	100	1.0	4	4	2	-	-	0.3	1.0	95	3.64	10
23.46	5.3	6.2	-	6.0	0.3	34.2	7.4	Organic SOILS - Peats	100	1.0	6	5	3	-	-	0.5	1.5	95	3.50	10
23.62	8.9	10.4	-	9.4	0.4	24.0	6.0	silty CLAY to CLAY	115	1.5	7	6	4	-	-	0.6	2.9	74	3.22	15
23.79	10.0	11.6	-	10.4	0.6	20.5	6.4	silty CLAY to CLAY	115	1.5	8	7	4	-	-	0.6	3.3	72	3.19	15
23.95	12.5	14.4	-	12.9	0.6	25.1	5.4	silty CLAY to CLAY	115	1.5	10	8	5	-	-	0.8	4.2	63	3.06	15
24.12	13.8	15.8	-	14.3	0.7	25.3	5.4	silty CLAY to CLAY	115	1.5	11	9	5	-	-	0.9	4.7	60	3.03	15
24.28	14.5	16.6	-	15.0	0.6	25.5	4.9	silty CLAY to CLAY	115	1.5	11	10	5	-	-	1.0	4.9	58	2.99	15
24.44	15.3	17.4	-	15.8	0.6	25.9	4.6	silty CLAY to CLAY	115	1.5	12	10	5	-	-	1.0	5.2	55	2.95	15
24.61	15.8	17.8	-	16.2	0.7	24.9	4.7	silty CLAY to CLAY	115	1.5	12	11	6	-	-	1.1	5.4	55	2.95	15
24.77	15.7	17.7	-	16.1	0.7	22.0	5.1	silty CLAY to CLAY	115	1.5	12	10	6	-	-	1.0	5.3	57	2.97	15
24.94	16.5	18.5	-	17.0	0.8	22.8	5.0	silty CLAY to CLAY	115	1.5	12	11	6	-	-	1.1	5.6	55	2.95	15
25.10	22.6	25.1	-	23.0	0.8	21.9	3.6	clayy SILT to silty CLAY	115	2.0	13	11	7	-	-	1.5	7.8	43	2.75	15
25.26	19.7	21.9	-	19.9	0.7	9.0	4.0	silty CLAY to CLAY	115	1.5	15	13	6	-	-	1.3	6.7	48	2.83	15
25.43	18.7	20.7	-	19.0	0.8	15.7	4.4	silty CLAY to CLAY	115	1.5	14	12	6	-	-	1.3	6.3	51	2.88	15
25.59	18.9	20.8	-	19.3	0.8	19.6	4.4	silty CLAY to CLAY	115	1.5	14	13	6	-	-	1.3	6.3	50	2.87	15
25.76	20.0	21.9	-	20.8	0.8	38.4	4.5	silty CLAY to CLAY	115	1.5	15	13	6	-	-	1.3	6.7	50	2.86	15
25.92	22.0	23.9	-	22.8	1.0	40.7	4.8	silty CLAY to CLAY	115	1.5	16	15	7	-	-	1.5	7.4	49	2.85	15
26.08	23.9	25.9	-	24.8	1.1	45.4	4.8	silty CLAY to CLAY	115	1.5	17	16	7	-	-	1.6	8.0	47	2.82	15
26.25	28.5	30.7	-	29.1	1.1	32.2	4.2	clayy SILT to silty CLAY	115	2.0	15	14	8	-	-	1.9	9.6	42	2.72	15
26.41	26.9	28.9	-	27.5	1.1	27.4	4.2	silty CLAY to CLAY	115	1.5	19	18	8	-	-	1.8	9.0	43	2.75	15
26.58	23.4	25.0	-	23.5	1.0	6.5	4.8	silty CLAY to CLAY	115	1.5	17	16	7	-	-	1.6	7.7	48	2.83	15
26.74	22.1	23.5	-	22.2	1.0	6.7	4.8	silty CLAY to CLAY	115	1.5	16	15	7	-	-	1.5	7.2	49	2.86	15
26.90	21.1	22.4	-	21.3	0.9	6.5	4.8	silty CLAY to CLAY	115	1.5	15	14	7	-	-	1.4	6.8	50	2.87	15
27.07	21.6	22.8	-	21.8	0.9	9.5	4.6	silty CLAY to CLAY	115	1.5	15	14	7	-	-	1.5	7.0	49	2.86	15
27.23	28.9	30.3	-	29.2	1.0	18.5	3.6	clayy SILT to silty CLAY	115	2.0	15	14	8	-	-	2.0	9.5	40	2.68	15
27.40	32.5	33.9	-	32.9	1.0	23.5	3.3	clayy SILT to silty CLAY	115	2.0	17	16	9	-	-	2.2	9.9	37	2.62	15
27.56	31.0	32.3	-	31.4	1.0	20.2	3.6	clayy SILT to silty CLAY	115	2.0	16	16	8	-	-	2.1	9.9	38	2.66	15
27.72	30.8	31.9	-	31.3	1.0	23.9	3.3	clayy SILT to silty CLAY	115	2.0	16	15	8	-	-	2.1	9.9	37	2.64	15
27.89	28.3	29.1	-	28.7	0.9	24.2	3.4	clayy SILT to silty CLAY	115	2.0	15	14	8	-	-	1.9	9.1	39	2.68	15
28.05	26.3	27.0	-	26.8	0.9	27.8	3.6	clayy SILT to silty CLAY	115	2.0	13	13	7	-	-	1.8	8.4	42	2.73	15
28.22	27.1	27.7	-	27.8	0.9	33.0	3.7	clayy SILT to silty CLAY	115	2.0	14	14	8	-	-	1.8	8.6	42	2.72	15
28.38	28.8	29.3	-	29.3	0.9	26.3	3.2	clayy SILT to silty CLAY	115	2.0	15	14	8	-	-	2.0	9.1	38	2.66	15
28.54	29.7	30.1	-	30.3	0.8	28.0	2.9	clayy SILT to silty CLAY	115	2.0	15	15	8	-	-	2.0	9.4	37	2.63	15
28.71	28.4	28.6	-	28.9	0.7	28.8	2.7	clayy SILT to silty CLAY	115	2.0	14	14	7	-	-	1.9	8.9	36	2.62	15
28.87	27.6	27.7	-	28.4	0.6	43.0	2.4	clayy SILT to silty CLAY	115	2.0	14	14	7	-	-	1.9	8.6	36	2.61	15
29.04	25.9	25.9	-	26.9	0.6	46.1	2.5	clayy SILT to silty CLAY	115	2.0	13	13	7	-	-	1.8	8.0	37	2.64	15
29.20	24.0	23.9	-	24.9	0.6	43.7	2.9	clayy SILT to silty CLAY	115	2.0	12	12	6	-	-	1.6	7.3	41	2.71	15
29.36	22.8	22.6	-	23.6	0.7	40.7	3.2	clayy SILT to silty CLAY	115	2.0	11	11	6	-	-	1.5	6.9	44	2.76	15
29.53	21.7	21.5	-	22.4	0.7	31.3	3.5	silty CLAY to CLAY	115	1.5	14	14	6	-	-	1.5	6.5	46	2.80	15
29.69	19.4	19.0	-	19.9	0.7	27.7	3.7	silty CLAY to CLAY	115	1.5	13	13	6	-	-	1.3	5.7	50	2.86	15
29.86	17.9	17.5	-	18.4	0.7	26.5	4.5	silty CLAY to CLAY	115	1.5	12	12	5	-	-	1.2	5.2	55	2.94	15
30.02	17.2	16.7	-	17.7	0.7	26.9	4.4	silty CLAY to CLAY	115	1.5	11	11	5	-	-	1.1	5.0	56	2.96	15
30.19	17.5	17.0	-	18.0	0.6	24.7	4.0	silty CLAY to CLAY	115	1.5	11	12	5	-	-	1.2	5.1	53	2.92	15
30.35	16.7	16.2	-	17.2	0.5	21.6	3.5	silty CLAY to CLAY	115	1.5	11	11	5	-	-	1.1	4.8	53	2.91	15
30.51	14.5	14.0	-	15.0	0.5	22.8	3.6	silty CLAY to CLAY	115	1.5	9	10	4	-	-	1.0	4.1	56	2.97	15
30.68	12.8	12.3	-	13.2	0.4	21.0	3.5	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.8	3.5	60	3.02	15
30.84	11.3	10.7	-	11.6	0.3	19.2	3.5	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.7	3.0	63	3.07	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

Sheetpile Wall at WBSD Property

Project ID: BAGG Engineering
Data File: SDF(048).cpt
CPT Date: 5/1/2018 9:12:38 AM
GW During Test: 8 ft

Sounding ID: CPT-02
Project No: FREYE-18-01
Cone/Rig: DDG1418

. . Depth ft	. qc PS tsf	* qc1n PS -	. q1ncs PS -	* qt PS tsf	. Slv Stss tsf	. pore prss (psi)	. Frct Rato %	* Material Behavior Description	. Unit Wght pcf	. Qc to N	* SPT R-N1 60%	. SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	. Und Shr tsf	. OCR - -	* Fin Ic %	* Ic SBT Indx	* Nk - -
31.01	10.6	10.1	-	11.0	0.3	19.0	3.2	silty CLAY to CLAY	115	1.5	7	7	3	-	-	0.7	2.8	64	3.08	15
31.17	13.8	13.0	-	14.1	0.2	18.7	1.8	clayy SILT to silty CLAY	115	2.0	7	7	4	-	-	0.9	3.7	48	2.83	15
31.33	10.5	9.9	-	10.7	0.2	11.6	2.0	silty CLAY to CLAY	115	1.5	7	7	3	-	-	0.7	2.7	57	2.97	15
31.50	7.7	7.2	-	8.0	0.2	15.8	3.0	silty CLAY to CLAY	115	1.5	5	5	3	-	-	0.5	1.8	74	3.21	15
31.66	7.8	7.3	-	8.2	0.2	18.5	3.5	silty CLAY to CLAY	115	1.5	5	5	3	-	-	0.5	1.9	76	3.24	15
31.83	8.7	8.1	-	9.0	0.3	19.7	3.9	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.5	2.1	75	3.22	15
31.99	10.4	9.7	-	10.9	0.3	23.7	3.6	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.6	67	3.13	15
32.15	12.1	11.2	-	12.6	0.4	27.0	3.8	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.8	3.1	64	3.07	15
32.32	13.1	12.0	-	13.6	0.4	27.2	4.0	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.8	3.4	63	3.06	15
32.48	12.9	11.8	-	13.4	0.5	23.4	4.1	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.8	3.3	63	3.07	15
32.65	11.6	10.6	-	12.0	0.4	22.0	4.3	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.7	2.9	68	3.13	15
32.81	10.7	9.7	-	11.1	0.4	23.4	4.4	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.6	71	3.17	15
32.97	10.0	9.0	-	10.5	0.4	23.6	4.6	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.4	74	3.21	15
33.14	9.5	8.6	-	9.9	0.4	22.3	4.9	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.3	77	3.25	15
33.30	9.3	8.4	-	9.8	0.4	23.4	4.9	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.2	78	3.26	15
33.47	9.6	8.6	-	10.0	0.3	21.5	4.5	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.3	75	3.23	15
33.63	9.8	8.7	-	10.2	0.3	22.5	4.4	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.3	75	3.22	15
33.79	9.8	8.7	-	10.3	0.3	24.7	4.4	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.3	75	3.22	15
33.96	10.5	9.3	-	11.0	0.3	26.8	3.6	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.5	69	3.15	15
34.12	10.3	9.1	-	10.8	0.3	23.5	3.5	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.4	69	3.14	15
34.29	8.8	7.7	-	9.2	0.3	19.9	3.7	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.5	2.0	75	3.23	15
34.45	8.7	7.6	-	9.1	0.3	21.3	3.8	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.5	1.9	77	3.24	15
34.61	8.4	7.3	-	8.8	0.2	21.1	3.5	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.5	1.8	76	3.24	15
34.78	8.9	7.7	-	9.3	0.2	19.6	2.9	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.5	2.0	71	3.18	15
34.94	8.1	7.0	-	8.5	0.2	18.2	2.8	silty CLAY to CLAY	115	1.5	5	5	3	-	-	0.5	1.8	74	3.21	15
35.11	7.3	6.3	-	7.7	0.1	22.9	2.6	silty CLAY to CLAY	115	1.5	4	5	2	-	-	0.4	1.5	78	3.26	15
35.27	6.6	5.6	-	7.0	0.1	23.9	2.4	silty CLAY to CLAY	115	1.5	4	4	2	-	-	0.4	1.3	81	3.30	15
35.43	6.2	5.3	-	6.7	0.1	25.1	1.8	silty CLAY to CLAY	115	1.5	4	4	2	-	-	0.4	1.2	79	3.27	15
35.60	6.1	5.2	-	6.6	0.1	26.6	1.4	silty CLAY to CLAY	115	1.5	3	4	2	-	-	0.3	1.1	76	3.24	15
35.76	5.8	5.0	-	6.4	0.0	28.0	1.2	silty CLAY to CLAY	115	1.5	3	4	2	-	-	0.3	1.1	76	3.23	15
35.93	5.8	4.9	-	6.4	0.0	29.9	1.1	silty CLAY to CLAY	115	1.5	3	4	2	-	-	0.3	1.0	76	3.23	15
36.09	5.7	4.8	-	6.4	0.1	32.6	1.6	silty CLAY to CLAY	115	1.5	3	4	2	-	-	0.3	1.0	81	3.30	15
36.26	6.2	5.2	-	6.9	0.1	36.0	1.5	silty CLAY to CLAY	115	1.5	3	4	2	-	-	0.4	1.1	77	3.25	15
36.42	7.1	5.9	-	7.8	0.1	38.3	1.5	silty CLAY to CLAY	115	1.5	4	5	2	-	-	0.4	1.4	71	3.18	15
36.58	7.4	6.2	-	8.2	0.1	40.1	1.9	silty CLAY to CLAY	115	1.5	4	5	2	-	-	0.4	1.5	73	3.20	15
36.75	7.6	6.3	-	8.4	0.1	42.3	2.5	silty CLAY to CLAY	115	1.5	4	5	2	-	-	0.5	1.5	77	3.25	15
36.91	8.2	6.8	-	9.1	0.2	45.8	2.5	silty CLAY to CLAY	115	1.5	5	5	2	-	-	0.5	1.7	73	3.21	15
37.08	9.3	7.7	-	10.2	0.2	43.5	2.6	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	2.0	69	3.15	15
37.24	9.3	7.7	-	10.3	0.2	51.6	2.8	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	2.0	71	3.17	15
37.40	10.3	8.4	-	11.3	0.3	53.3	3.5	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.2	71	3.18	15
37.57	10.9	8.9	-	12.0	0.3	53.2	3.7	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.4	70	3.17	15
37.73	11.9	9.7	-	12.6	0.3	35.2	3.5	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.6	67	3.11	15
37.90	11.0	9.0	-	11.9	0.4	41.3	4.3	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.4	73	3.20	15
38.06	11.0	8.9	-	11.9	0.4	46.5	4.1	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.4	72	3.19	15
38.22	18.6	15.0	-	19.7	0.3	58.6	2.0	clayy SILT to silty CLAY	115	2.0	7	9	4	-	-	1.2	4.4	46	2.80	15
38.39	17.6	14.1	-	18.3	0.3	36.7	2.1	clayy SILT to silty CLAY	115	2.0	7	9	4	-	-	1.2	4.1	48	2.84	15
38.55	15.2	12.2	-	16.9	0.3	83.4	2.6	silty CLAY to CLAY	115	1.5	8	10	4	-	-	1.0	3.4	55	2.95	15
38.72	15.6	12.4	-	17.2	0.4	83.3	2.7	silty CLAY to CLAY	115	1.5	8	10	4	-	-	1.0	3.5	55	2.94	15
38.88	16.1	12.8	-	17.5	0.4	75.3	2.6	silty CLAY to CLAY	115	1.5	9	11	4	-	-	1.0	3.6	54	2.93	15
39.04	15.2	12.0	-	16.3	0.4	54.4	2.7	silty CLAY to CLAY	115	1.5	8	10	4	-	-	1.0	3.4	56	2.96	15
39.21	15.1	11.9	-	16.1	0.3	50.6	2.7	silty CLAY to CLAY	115	1.5	8	10	4	-	-	1.0	3.3	56	2.97	15
39.37	15.9	12.5	-	16.9	0.3	53.6	2.4	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.0	3.5	53	2.92	15
39.54	16.9	13.2	-	18.2	0.3	65.2	2.2	clayy SILT to silty CLAY	115	2.0	7	8	4	-	-	1.1	3.8	50	2.87	15
39.70	15.8	12.4	-	17.2	0.3	68.6	2.3	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.0	3.5	53	2.91	15
39.86	14.4	11.2	-	15.7	0.3	67.6	2.4	silty CLAY to CLAY	115	1.5	7	10	3	-	-	0.9	3.1	56	2.96	15
40.03	14.1	10.9	-	15.4	0.3	70.3	2.7	silty CLAY to CLAY	115	1.5	7	9	3	-	-	0.9	3.0	59	3.01	15
40.19	14.4	11.1	-	15.7	0.3	67.9	2.5	silty CLAY to CLAY	115	1.5	7	10	4	-	-	0.9	3.1	57	2.98	15
40.36	14.2	10.9	-	15.2	0.9	54.5	7.7	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	3.0	79	3.28	15
40.52	15.6	12.0	-	16.8	1.7	61.2	9.9	silty CLAY to CLAY	115	1.5	8	10	5	-	-	1.0	3.4	82	3.31	15
40.68	52.8	44.9	138.4	53.3	1.8	24.9	3.6	clayy SILT to silty CLAY	115	2.0	22	26	11	-	-	3.6	9.9	33	2.56	15
40.85	71.1	60.3	138.8	71.0	2.0	-6.6	2.9	silty SAND to sandy SILT	120	3.0	20	24	14	50	37	-	-	26	2.40	16
41.01	100.4	85.0	136.7	100.2	2.0	-7.3	2.0	silty SAND to sandy SILT	120	3.0	28	33	18	62	39	-	-	18	2.18	16
41.18	99.9	84.4	134.1	99.8	1.9	-7.8	1.9	silty SAND to sandy SILT	120	3.0	28	33	18	61	39	-	-	18	2.17	16
41.34	99.9	84.2	144.1	99.7	2.2	-8.2	2.3	silty SAND to sandy SILT	120	3.0	28	33	18	61	39	-	-	20	2.22	16
41.50	90.7	76.4	147.9	90.6	2.4	-5.1	2.7	silty SAND to sandy SILT	120	3.0	25	30	17	58	38	-	-	22	2.30	16
41.67	79.7	67.0	138.6	79.6	2.1	-6.5	2.7	silty SAND to sandy SILT	120	3.0	22	27	15	54	38	-	-	24	2.34	16
41.83	95.5	80.1	116.8	95.3	1.4	-7.0	1.5	silty SAND to sandy SILT	120	3.0	27	32	16	60	39	-	-	16	2.10	16
42.00	138.6	116.1	130.1	138.5	1.1	-6.7	0.8	clean SAND to silty SAND	125	5.0	23	28	21	72	41	-	-	9	1.82	16
42.16	162.1	135.6	135.6	162.1	0.8	-3.6	0.5	clean SAND to silty SAND	125	5.0	27	32	23	77	41	-	-	5	1.63	16
42.32	160.9	134.3	134.3	160.8	0.6	-4.9	0.4	clean SAND to silty SAND	125	5.0	27	32	23	77	41	-	-	5	1.58	16
42.49	154.4	128.6	128.6	154.3	0.7	-6.1	0.5	clean SAND to silty SAND	125	5.0	26	31	22	75	41	-	-	5	1.62	16
42.65	127.8	106.2	120.0	127.7	1.0	-6.0	0.8	clean SAND to silty SAND	125	5.0	21	26	20	69	40	-	-	9	1.83	16
42.82	84.6	70.2	108.0	84.6	1.2	-2.7	1.5	silty SAND to sandy SILT	120	3.0	23	28	15	55	38	-	-	17	2.14	16
42.98	43.5	36.0	105.2	43.7	1.0	7.7	2.5	clayy SILT to silty CLAY	115	2.0	18	22	9	-	-	3.0	9.9	32	2.53	15
43.15	23.2	16.9	-	23.5	0.7	11.8	3.6	silty CLAY to CLAY	115	1.5	11	15	5	-	-	1.5	5.0	52	2.90	15
43.31	13.5	9.8	-	14.2	0.5	34.1	4.8	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	2.6	73	3.19	15
43.47	12.5	9.0	-	13.2	0.5	34.5	5.1	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.4	77	3.24	15
43.64	12.0	8.6	-	12.5	0.5	28.3	5.2	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.2	79	3.27	15
43.80	11.5	8.2	-	12.0	0.5	29.2	5.5	silty CLAY to CLAY	115	1.5	5	8	3	-	-	0.7	2.1	81	3.31	15
43.97	11.6	8.2	-	12.1	0.5	29.3	5.3	silty CLAY to CLAY	115	1.5	5	8	3	-	-	0.7	2.1	81	3.29	15
44.13	12.0	8.6	-	12.6	0.5	28.1	4.9	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.2	78	3.26	15
44.29	11.8	8.4	-	12.3	0.4	28.5	4.7	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.2	78	3.26	15
44.46	11.7	8.3	-	12.3	0.5	31.2	5.1	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.1	80	3.28	15
44.62	11.6	8.1	-	12.2	0.5	30.4	5.2	silty CLAY to CLAY	115	1.5	5	8	3	-	-	0.7	2.1	81	3.30	15
44.79	11.6	8.2	-	12.3	0.4	33.4	4.9	silty CLAY to CLAY	115	1.5	5	8	3	-	-	0.7	2.1	79	3.28	15
44.95	12.0	8.4	-	12.7	0.4	33.8	4.6	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.2	77	3.25	15
45.11	11.8	8.2	-	12.6	0.4	40.9	4.5	silty CLAY to CLAY	115	1.5	5	8	3	-	-	0.7	2.1	78	3.26	15
45.28	11.8	8.2	-	12.6	0.4	39.7	4.5	silty CLAY to CLAY	115	1.5	5	8	3	-	-	0.7	2.1	77	3.26	15
45.44	11.9	8.3	-	12.7	0.4	42.2	4.4	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.1	77	3.25	15
45.61	12.1	8.4	-	13.0	0.5	44.3	4.8	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.2	78	3.26	15
45.77	12.8	8.9	-	13.8	0.5	47.3	4.9	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.3	76	3.24	15
45.93	14.2	9.8	-	15.2	0.5	49.6	4.7	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	2.6	72	3.19	15
46.10	15.3	10.5	-	16.3	0.6	54.3	4.8	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	2.9	70	3.16	15
46.26	16.1	11.0	-	17.0	0.6	47.5	4.7	silty CLAY to CLAY	115	1.5	7	11	4	-	-	1.0	3.0	68	3.14	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Sheetpile Wall at WBSD Property

Project ID: BAGG Engineering
Data File: SDF(048).cpt
CPT Date: 5/1/2018 9:12:38 AM
GW During Test: 8 ft

Sounding ID: CPT-02
Project No: FREYE-18-01
Cone/Rig: DDG1418

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. Depth ft	qc PS tsf	qc1n PS -	q1ncs PS -	qt PS tsf	Slv Stss tsf	pore prss (psi)	Frct Rato %	Material Behavior Description	Unit Wght pcf	Qc to N	SPT R-N1 60%	SPT R-N 60%	SPT IcN1 60%	Rel Den %	Ftn Ang deg	Und Shr tsf	OCR -	Fin Ic %	Ic SBT Indx	Nk -
46.43	16.4	11.2	-	17.2	0.6	44.7	4.6	silty CLAY to CLAY	115	1.5	7	11	4	-	-	1.1	3.1	68	3.13	15
46.59	16.4	11.2	-	17.2	0.6	42.0	4.7	silty CLAY to CLAY	115	1.5	7	11	4	-	-	1.1	3.1	68	3.14	15
46.75	16.7	11.3	-	17.7	0.6	51.8	4.6	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.1	3.1	67	3.12	15
46.92	17.1	11.6	-	18.1	0.7	49.3	4.7	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.1	3.2	67	3.12	15
47.08	16.7	11.3	-	17.7	0.7	46.8	4.9	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.1	3.1	69	3.14	15
47.25	16.6	11.2	-	17.4	0.6	40.6	4.6	silty CLAY to CLAY	115	1.5	7	11	4	-	-	1.1	3.1	68	3.13	15
47.41	16.1	10.8	-	16.9	0.6	38.3	4.4	silty CLAY to CLAY	115	1.5	7	11	4	-	-	1.0	3.0	68	3.13	15
47.57	14.8	9.9	-	15.5	0.6	39.8	4.8	silty CLAY to CLAY	115	1.5	7	10	4	-	-	0.9	2.7	72	3.19	15
47.74	13.8	9.2	-	14.7	0.6	44.9	5.2	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.9	2.4	76	3.24	15
47.90	13.8	9.2	-	14.4	0.5	32.8	4.9	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.9	2.4	75	3.23	15
48.07	13.1	8.7	-	13.8	0.4	37.8	4.3	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.3	75	3.22	15
48.23	12.5	8.3	-	13.4	0.4	48.5	4.5	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.1	77	3.25	15
48.39	12.7	8.4	-	13.7	0.5	51.6	4.7	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.2	78	3.26	15
48.56	13.9	9.1	-	14.8	0.5	47.4	4.6	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.9	2.4	74	3.21	15
48.72	14.5	9.5	-	15.4	0.6	48.1	4.7	silty CLAY to CLAY	115	1.5	6	10	3	-	-	0.9	2.5	73	3.21	15
48.89	14.8	9.7	-	15.6	0.5	41.6	4.3	silty CLAY to CLAY	115	1.5	6	10	3	-	-	0.9	2.6	71	3.17	15
49.05	14.8	9.6	-	15.6	0.5	43.5	4.2	silty CLAY to CLAY	115	1.5	6	10	3	-	-	0.9	2.6	71	3.17	15
49.22	14.5	9.4	-	15.3	0.7	45.0	6.1	silty CLAY to CLAY	115	1.5	6	10	4	-	-	0.9	2.5	79	3.28	15
49.38	14.4	9.3	-	15.1	0.8	39.3	7.3	silty CLAY to CLAY	115	1.5	6	10	4	-	-	0.9	2.5	84	3.33	15
49.54	25.2	16.3	-	26.0	0.8	37.3	3.4	silty CLAY to CLAY	115	1.5	11	17	5	-	-	1.7	4.8	52	2.90	15
49.71	19.3	12.5	-	19.3	0.6	1.1	3.6	silty CLAY to CLAY	115	1.5	8	13	4	-	-	1.3	3.5	60	3.02	15
49.87	15.7	10.1	-	15.8	0.4	3.6	2.9	silty CLAY to CLAY	115	1.5	7	10	3	-	-	1.0	2.7	63	3.06	15
50.04	13.9	8.9	-	14.2	0.3	15.7	2.7	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.9	2.3	65	3.10	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

Sheetpile Wall at WBSD Property

Project ID: BAGG Engineering
Data File: SDF(049).cpt
CPT Date: 5/1/2018 9:55:32 AM
GW During Test: 6 ft

Sounding ID: CPT-03
Project No: FREYE-18-01
Cone/Rig: DDG1418

Depth ft	qc PS tsf	* qc1n PS -	q1ncs PS -	* qt PS tsf	Slv Stss tsf	pore prss tsf (psi)	Frct Rato %	* Material Behavior Description	Unit Wght pcf	Qc to N	* SPT R-N1 60%	SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	Und Shr tsf	OCR - -	* Fin Ic %	* Ic SBT Indx	* Nk - -
0.33	46.3	74.2	200.9	46.3	2.2	0.9	4.8	clayy SILT to silty CLAY	115	2.0	37	23	18	-	-	3.3	9.9	30	2.49	15
0.49	86.1	138.1	246.3	86.2	3.3	2.9	3.9	stiff SAND to clayy SAND	115	5.0	28	17	30	78	48	-	-	21	2.24	16
0.66	99.8	160.1	254.9	99.9	3.5	3.1	3.5	stiff SAND to clayy SAND	115	5.0	32	20	34	83	48	-	-	18	2.17	16
0.82	97.6	156.5	236.8	97.6	3.0	4.2	3.1	silty SAND to sandy SILT	120	3.0	52	33	32	82	48	-	-	17	2.13	16
0.98	90.7	145.5	212.5	90.8	2.4	4.4	2.7	silty SAND to sandy SILT	120	3.0	48	30	30	79	48	-	-	16	2.10	16
1.15	79.0	126.7	189.4	79.1	2.0	2.2	2.5	silty SAND to sandy SILT	120	3.0	42	26	26	75	48	-	-	16	2.12	16
1.31	62.0	99.4	152.6	62.0	1.3	1.7	2.2	silty SAND to sandy SILT	120	3.0	33	21	21	67	48	-	-	17	2.14	16
1.48	46.9	75.1	123.8	46.9	0.9	0.7	1.9	silty SAND to sandy SILT	120	3.0	25	16	16	58	48	-	-	19	2.19	16
1.64	35.4	56.8	127.2	35.5	1.0	1.0	2.7	silty SAND to sandy SILT	120	3.0	19	12	13	48	47	-	-	26	2.38	16
1.80	30.4	48.7	142.2	30.4	1.1	1.5	3.7	clayy SILT to silty CLAY	115	2.0	24	15	12	-	-	2.1	9.9	32	2.53	15
1.97	34.3	55.1	151.9	34.4	1.3	0.9	3.8	clayy SILT to silty CLAY	115	2.0	28	17	13	-	-	2.4	9.9	31	2.50	15
2.13	36.9	59.2	164.4	36.9	1.5	2.8	4.1	clayy SILT to silty CLAY	115	2.0	30	18	14	-	-	2.6	9.9	31	2.50	15
2.30	34.3	55.0	182.2	34.4	1.8	3.9	5.2	clayy SILT to silty CLAY	115	2.0	28	17	14	-	-	2.4	9.9	35	2.60	15
2.46	33.1	53.0	-	33.1	2.0	2.5	6.0	silty CLAY to CLAY	115	1.5	35	22	14	-	-	2.3	9.9	38	2.65	15
2.62	32.9	52.7	-	32.9	2.0	1.1	6.1	silty CLAY to CLAY	115	1.5	35	22	14	-	-	2.3	9.9	39	2.66	15
2.79	28.2	45.2	-	28.2	1.5	1.7	5.5	silty CLAY to CLAY	115	1.5	30	19	12	-	-	2.0	9.9	39	2.67	15
2.95	23.0	36.8	-	23.0	1.9	1.8	8.5	silty CLAY to CLAY	115	1.5	25	15	11	-	-	1.6	9.9	50	2.87	15
3.12	24.7	39.7	-	24.8	2.2	1.1	9.1	silty CLAY to CLAY	115	1.5	26	16	12	-	-	1.7	9.9	50	2.88	15
3.28	53.8	86.3	213.3	53.9	2.5	1.5	4.7	clayy SILT to silty CLAY	115	2.0	43	27	20	-	-	3.8	9.9	28	2.44	15
3.45	34.3	55.0	-	34.3	2.6	0.9	7.7	silty CLAY to CLAY	115	1.5	37	23	15	-	-	2.4	9.9	42	2.73	15
3.61	31.0	49.8	-	31.1	1.8	2.5	5.7	silty CLAY to CLAY	115	1.5	33	21	13	-	-	2.2	9.9	38	2.66	15
3.77	28.3	45.4	140.9	28.4	1.1	2.5	3.9	clayy SILT to silty CLAY	115	2.0	23	14	11	-	-	2.0	9.9	34	2.56	15
3.94	31.0	49.8	-	31.1	1.5	3.4	4.8	clayy SILT to silty CLAY	115	2.0	25	16	13	-	-	2.2	9.9	36	2.60	15
4.10	40.5	65.0	149.5	40.6	1.3	3.4	3.2	clayy SILT to silty CLAY	115	2.0	32	20	15	-	-	2.8	9.9	26	2.40	15
4.27	67.8	108.8	160.6	67.9	1.4	0.3	2.1	silty SAND to sandy SILT	120	3.0	36	23	22	70	45	-	-	16	2.11	16
4.43	46.9	75.2	146.7	46.9	1.3	1.0	2.7	silty SAND to sandy SILT	120	3.0	25	16	17	58	44	-	-	23	2.30	16
4.59	24.0	38.5	-	24.1	1.3	5.5	5.3	silty CLAY to CLAY	115	1.5	26	16	10	-	-	1.7	9.9	41	2.71	15
4.76	22.8	36.6	114.1	23.0	0.7	6.7	3.1	clayy SILT to silty CLAY	115	2.0	18	11	9	-	-	1.6	9.9	34	2.56	15
4.92	18.8	30.2	75.2	18.9	0.3	5.5	1.5	silty SAND to sandy SILT	120	3.0	10	6	7	27	38	-	-	28	2.44	16
5.09	83.3	133.5	133.5	83.2	0.2	-1.3	0.2	clean SAND to silty SAND	125	5.0	27	17	22	77	46	-	-	5	1.46	16
5.25	79.5	127.5	164.1	79.5	1.3	-2.9	1.7	clean SAND to silty SAND	125	5.0	26	16	25	75	45	-	-	13	1.99	16
5.41	69.5	111.4	151.5	69.4	1.2	-2.0	1.8	silty SAND to sandy SILT	120	3.0	37	23	22	71	44	-	-	14	2.04	16
5.58	49.2	78.9	142.3	49.2	1.2	0.1	2.4	silty SAND to sandy SILT	120	3.0	26	16	17	59	43	-	-	21	2.25	16
5.74	8.3	13.3	-	8.4	0.9	3.7	9.9	silty CLAY to CLAY	115	1.5	9	6	5	-	-	0.6	7.8	76	3.24	15
5.91	8.7	14.0	-	8.8	0.4	5.1	4.2	silty CLAY to CLAY	115	1.5	9	6	4	-	-	0.6	8.0	57	2.98	15
6.07	4.9	7.9	-	5.0	0.3	4.8	6.2	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	4.3	80	3.29	15
6.23	7.9	12.7	-	8.0	0.4	3.8	5.1	silty CLAY to CLAY	115	1.5	8	5	4	-	-	0.5	7.0	63	3.07	15
6.40	4.9	7.8	-	5.0	0.3	4.8	7.3	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	4.1	84	3.34	15
6.56	10.2	16.4	-	10.3	0.3	2.9	3.5	silty CLAY to CLAY	115	1.5	11	7	5	-	-	0.7	8.9	51	2.88	15
6.73	7.5	12.1	-	7.5	0.2	-1.2	3.3	silty CLAY to CLAY	115	1.5	8	5	4	-	-	0.5	6.4	57	2.97	15
6.89	6.6	10.6	-	6.6	0.2	0.7	3.4	silty CLAY to CLAY	115	1.5	7	4	3	-	-	0.4	5.5	60	3.03	15
7.05	6.0	9.6	-	6.0	0.2	2.0	3.6	silty CLAY to CLAY	115	1.5	6	4	3	-	-	0.4	4.9	64	3.08	15
7.22	5.4	8.7	-	5.5	0.2	2.5	3.7	silty CLAY to CLAY	115	1.5	6	4	3	-	-	0.4	4.3	67	3.13	15
7.38	4.5	7.2	-	4.6	0.2	2.6	4.0	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	3.5	74	3.22	15
7.55	3.8	6.0	-	3.8	0.1	2.4	4.4	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	2.8	82	3.32	15
7.71	4.0	6.3	-	4.0	0.1	2.5	4.2	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.3	2.9	80	3.29	15
7.87	4.6	7.4	-	4.6	0.1	2.7	3.6	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	3.4	72	3.19	15
8.04	5.0	7.9	-	5.0	0.2	2.9	3.6	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	3.7	70	3.16	15
8.20	4.5	7.2	-	4.6	0.1	3.3	3.6	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	3.3	73	3.20	15
8.37	3.8	6.1	-	3.9	0.1	3.4	4.3	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	2.7	82	3.31	15
8.53	3.8	6.1	-	3.9	0.1	3.4	4.0	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	2.6	81	3.29	15
8.69	3.6	5.8	-	3.7	0.1	3.5	4.1	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.4	83	3.33	15
8.86	3.5	5.6	-	3.7	0.1	8.4	4.2	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.3	85	3.34	15
9.02	3.4	5.5	-	3.6	0.1	8.9	3.9	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.2	84	3.34	15
9.19	3.3	5.3	-	3.5	0.1	9.0	3.8	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.1	86	3.35	15
9.35	3.0	4.8	-	3.2	0.1	9.0	3.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.8	90	3.40	15
9.51	2.8	4.5	-	3.0	0.1	9.1	4.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.7	93	3.44	15
9.68	2.6	4.2	-	2.8	0.1	9.3	4.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.5	95	3.48	15
9.84	2.6	4.1	-	2.8	0.1	9.6	4.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.5	95	3.50	15
10.01	2.6	4.2	-	2.8	0.1	9.9	4.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.5	95	3.49	15
10.17	2.7	4.3	-	2.9	0.1	10.1	4.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.5	95	3.49	15
10.34	2.6	4.2	-	2.8	0.1	10.3	4.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.4	95	3.51	15
10.50	2.6	4.1	-	2.8	0.1	10.4	4.8	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.4	95	3.53	15
10.66	2.5	4.0	-	2.7	0.1	10.4	5.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.3	95	3.56	15
10.83	2.5	4.0	-	2.7	0.1	10.4	4.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.3	95	3.56	15
10.99	2.5	4.0	-	2.7	0.1	10.5	4.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.3	95	3.55	15
11.16	2.3	3.7	-	2.5	0.1	10.5	5.3	Organic SOILS - Peats	100	1.0	4	2	2	-	-	0.2	1.2	95	3.61	10
11.32	2.3	3.6	-	2.5	0.1	10.5	5.4	Organic SOILS - Peats	100	1.0	4	2	2	-	-	0.2	1.1	95	3.62	10
11.48	2.2	3.5	-	2.4	0.1	10.6	5.9	Organic SOILS - Peats	100	1.0	3	2	2	-	-	0.2	1.0	95	3.68	10
11.65	2.2	3.5	-	2.4	0.1	10.9	5.7	Organic SOILS - Peats	100	1.0	4	2	2	-	-	0.2	1.0	95	3.66	10
11.81	2.5	3.9	-	2.7	0.1	11.2	4.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.2	95	3.57	15
11.98	2.5	4.0	-	2.7	0.1	11.5	4.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.2	95	3.55	15
12.14	2.6	4.2	-	2.9	0.1	11.7	4.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	95	3.50	15
12.30	2.6	4.2	-	2.8	0.1	12.1	4.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.2	95	3.52	15
12.47	2.6	4.1	-	2.8	0.1	12.3	4.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.2	95	3.54	15
12.63	2.5	4.1	-	2.8	0.1	12.6	4.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.2	95	3.54	15
12.80	2.4	3.9	-	2.7	0.1	12.8	4.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.1	95	3.57	15
12.96	2.4	3.9	-	2.7	0.1	13.0	4.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.0	95	3.58	15
13.12	2.4	3.8	-	2.7	0.1	13.4	4.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.0	95	3.58	15
13.29	2.4	3.9	-	2.7	0.1	13.8	4.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.0	95	3.58	15
13.45	2.5	4.0	-	2.8	0.1	14.1	4.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.1	95	3.56	15
13.62	2.6	4.1	-	2.9	0.1	14.6	4.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.1	95	3.54	15
13.78	2.6	4.2	-	2.9	0.1	15.0	4.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.1	95	3.54	15
13.94	2.9	4.7	-	3.2	0.1	15.5	4.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	95	3.46	15
14.11	3.1	5.0	-	3.4	0.1	16.1	4.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.4	92	3.42	15
14.27	3.0	4.9	-	3.4	0.1	16.7	4.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	94	3.44	15
14.44	2.9	4.7	-	3.3	0.1	16.9	4.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	95	3.47	15
14.60	2.9	4.7	-	3.2	0.1	17.3	4.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	95	3.48	15
14.76	3.0	4.7	-	3.3	0.1	17.8	4.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	95	3.47	15
14.93	2.9	4.7	-	3.2	0.1	16.0	4.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	95	3.51	15
15.09	2.9	4.6	-	3.2	0.1	16.4	4.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.1	95	3.51	15
15.26	2.8	4.4	-	3.1	0.1	16.8	4.8	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.1	95	3.55	15
15.42	2.9	4.7	-	3.3	0.1	18.1	4.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.1	95	3.51	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

Project ID: BAGG Engineering
Data File: SDF(049).cpt
CPT Date: 5/1/2018 9:55:32 AM
GW During Test: 6 ft

Sounding ID: CPT-03
Project No: FREYE-18-01
Cone/Rig: DDG1418

. Depth ft	. qc PS tsf	* qc1n PS -	. q1ncs PS -	* qt PS tsf	. Slv Stss tsf	. pore prss (psi)	. Frct Rato %	* Material Behavior Description	. Unit Wght pcf	. Qc to N	* SPT R-N1 60%	SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	. Und Shr tsf	. OCR -	* Fin Ic %	* Ic SBT Indx	* Nk -
15.58	3.0	4.8	-	3.4	0.1	18.9	4.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	95	3.49	15
15.75	3.1	5.0	-	3.5	0.1	19.4	4.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	95	3.47	15
15.91	3.2	5.2	-	3.6	0.1	19.8	4.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	95	3.46	15
16.08	3.1	4.9	-	3.5	0.1	19.5	5.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	95	3.54	15
16.24	3.5	5.7	-	3.9	0.1	19.3	4.9	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.4	92	3.43	15
16.40	3.3	5.3	-	3.6	0.1	16.3	5.6	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.3	95	3.50	15
16.57	3.5	5.6	-	3.8	0.1	18.0	4.7	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.3	92	3.43	15
16.73	3.5	5.6	-	3.9	0.1	17.2	4.5	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.3	91	3.42	15
16.90	3.4	5.4	-	3.7	0.1	16.9	4.4	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.3	93	3.44	15
17.06	3.6	5.6	-	3.9	0.1	18.8	3.9	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.3	89	3.39	15
17.23	3.5	5.4	-	3.9	0.1	19.3	3.9	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.3	90	3.40	15
17.39	3.4	5.3	-	3.8	0.1	19.4	4.0	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.2	92	3.42	15
17.55	3.5	5.5	-	3.9	0.1	20.4	3.6	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.3	88	3.38	15
17.72	3.4	5.2	-	3.8	0.1	20.4	3.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	90	3.40	15
17.88	3.2	4.9	-	3.6	0.1	21.1	3.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.1	93	3.44	15
18.05	3.1	4.7	-	3.5	0.1	19.8	3.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.0	95	3.48	15
18.21	3.1	4.7	-	3.5	0.1	20.4	3.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.0	95	3.48	15
18.37	3.1	4.7	-	3.6	0.1	21.0	3.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.0	95	3.48	15
18.54	3.1	4.6	-	3.5	0.1	21.7	4.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.0	95	3.50	15
18.70	3.4	5.0	-	3.9	0.1	24.6	4.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.1	95	3.46	15
18.87	3.6	5.2	-	4.1	0.1	26.0	3.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	92	3.43	15
19.03	3.6	5.2	-	4.1	0.1	25.8	4.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	94	3.45	15
19.19	3.6	5.2	-	4.1	0.1	26.0	4.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	95	3.45	15
19.36	3.8	5.5	-	4.3	0.1	27.0	4.5	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	1.3	93	3.44	15
19.52	3.9	5.6	-	4.4	0.1	27.7	4.4	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	1.3	92	3.42	15
19.69	4.0	5.7	-	4.6	0.1	27.3	4.2	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	1.4	90	3.40	15
19.85	4.0	5.6	-	4.5	0.1	27.5	4.1	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	1.3	90	3.40	15
20.01	3.9	5.4	-	4.4	0.1	27.8	4.0	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	1.3	91	3.42	15
20.18	3.9	5.5	-	4.4	0.1	27.4	3.9	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	1.3	90	3.41	15
20.34	3.9	5.5	-	4.5	0.1	27.7	3.9	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	1.3	90	3.41	15
20.51	3.6	4.9	-	4.1	0.2	27.2	7.0	Organic SOILS - Peats	100	1.0	5	4	3	-	-	0.3	1.1	95	3.60	10
20.67	3.8	5.3	-	4.3	0.3	24.8	9.9	Organic SOILS - Peats	100	1.0	5	4	3	-	-	0.3	1.2	95	3.66	10
20.83	4.8	6.6	-	5.2	0.4	20.5	9.9	Organic SOILS - Peats	100	1.0	7	5	3	-	-	0.4	1.6	95	3.55	10
21.00	6.1	8.3	-	6.4	0.5	15.8	9.9	Organic SOILS - Peats	100	1.0	8	6	4	-	-	0.6	2.2	95	3.45	10
21.16	7.0	9.6	-	7.3	0.6	11.5	10.0	silty CLAY to CLAY	115	1.5	6	5	4	-	-	0.4	2.6	89	3.40	15
21.33	7.3	9.8	-	7.5	0.6	10.4	9.8	silty CLAY to CLAY	115	1.5	7	5	4	-	-	0.5	2.7	88	3.38	15
21.49	7.7	10.3	-	7.9	0.6	10.6	9.6	silty CLAY to CLAY	115	1.5	7	5	4	-	-	0.5	2.9	86	3.36	15
21.65	8.3	11.0	-	8.5	0.7	13.5	9.3	silty CLAY to CLAY	115	1.5	7	6	4	-	-	0.5	3.1	83	3.32	15
21.82	9.1	12.1	-	9.4	0.7	14.7	8.8	silty CLAY to CLAY	115	1.5	8	6	5	-	-	0.6	3.4	79	3.27	15
21.98	9.3	12.3	-	9.6	0.7	12.9	8.8	silty CLAY to CLAY	115	1.5	8	6	5	-	-	0.6	3.5	78	3.27	15
22.15	9.3	12.2	-	9.6	0.7	11.9	8.8	silty CLAY to CLAY	115	1.5	8	6	5	-	-	0.6	3.5	78	3.27	15
22.31	9.8	12.7	-	10.0	0.7	12.4	8.6	silty CLAY to CLAY	115	1.5	8	7	5	-	-	0.6	3.6	76	3.24	15
22.47	10.2	13.2	-	10.4	0.7	13.6	8.3	silty CLAY to CLAY	115	1.5	9	7	5	-	-	0.7	3.8	75	3.22	15
22.64	11.0	14.2	-	11.3	0.8	14.9	8.2	silty CLAY to CLAY	115	1.5	9	7	5	-	-	0.7	4.1	72	3.19	15
22.80	11.7	15.0	-	12.0	0.8	16.1	7.5	silty CLAY to CLAY	115	1.5	10	8	5	-	-	0.8	4.4	69	3.14	15
22.97	12.6	16.1	-	12.9	0.8	16.2	7.0	silty CLAY to CLAY	115	1.5	11	8	5	-	-	0.8	4.8	65	3.10	15
23.13	12.5	15.8	-	12.8	0.7	16.3	6.7	silty CLAY to CLAY	115	1.5	11	8	5	-	-	0.8	4.7	65	3.09	15
23.30	12.5	15.8	-	13.0	0.7	22.3	6.4	silty CLAY to CLAY	115	1.5	11	8	5	-	-	0.8	4.7	64	3.08	15
23.46	12.6	15.8	-	13.1	0.7	23.3	6.2	silty CLAY to CLAY	115	1.5	11	8	5	-	-	0.8	4.7	63	3.07	15
23.62	12.6	15.7	-	13.1	0.7	25.3	5.9	silty CLAY to CLAY	115	1.5	10	8	5	-	-	0.8	4.6	63	3.06	15
23.79	13.1	16.3	-	13.7	0.7	26.6	5.8	silty CLAY to CLAY	115	1.5	11	9	5	-	-	0.9	4.8	61	3.04	15
23.95	13.9	17.2	-	14.5	0.7	29.7	5.6	silty CLAY to CLAY	115	1.5	11	9	6	-	-	0.9	5.1	59	3.01	15
24.12	15.0	18.4	-	15.6	0.7	28.8	5.4	silty CLAY to CLAY	115	1.5	12	10	6	-	-	1.0	5.5	57	2.98	15
24.28	15.4	18.8	-	16.0	0.8	30.8	5.4	silty CLAY to CLAY	115	1.5	13	10	6	-	-	1.0	5.6	57	2.97	15
24.44	16.9	20.5	-	17.6	0.9	32.8	5.7	silty CLAY to CLAY	115	1.5	14	11	6	-	-	1.1	6.2	55	2.95	15
24.61	19.3	23.3	-	20.0	1.0	34.8	5.7	silty CLAY to CLAY	115	1.5	16	13	7	-	-	1.3	7.1	53	2.91	15
24.77	21.0	25.2	-	21.6	1.1	30.8	5.8	silty CLAY to CLAY	115	1.5	17	14	8	-	-	1.4	7.7	51	2.89	15
24.94	20.3	24.3	-	21.0	1.1	34.0	5.6	silty CLAY to CLAY	115	1.5	16	14	7	-	-	1.4	7.5	51	2.89	15
25.10	19.3	22.9	-	19.9	1.0	31.3	5.7	silty CLAY to CLAY	115	1.5	15	13	7	-	-	1.3	7.0	53	2.92	15
25.26	20.0	23.7	-	21.1	1.0	53.8	5.5	silty CLAY to CLAY	115	1.5	16	13	7	-	-	1.4	7.2	52	2.89	15
25.43	21.3	25.1	-	22.3	1.1	51.4	5.6	silty CLAY to CLAY	115	1.5	17	14	7	-	-	1.4	7.7	51	2.88	15
25.59	22.0	25.8	-	23.0	1.2	48.7	5.8	silty CLAY to CLAY	115	1.5	17	15	8	-	-	1.5	8.0	51	2.88	15
25.76	23.9	27.9	-	24.8	1.2	47.7	5.3	silty CLAY to CLAY	115	1.5	19	16	8	-	-	1.6	8.6	48	2.83	15
25.92	23.7	27.5	-	24.3	1.2	32.4	5.6	silty CLAY to CLAY	115	1.5	18	16	8	-	-	1.6	8.5	49	2.85	15
26.08	23.5	27.2	-	24.6	1.3	56.8	5.7	silty CLAY to CLAY	115	1.5	18	16	8	-	-	1.6	8.4	49	2.86	15
26.25	25.7	29.5	-	26.7	1.2	50.1	5.0	silty CLAY to CLAY	115	1.5	20	17	8	-	-	1.8	9.2	46	2.79	15
26.41	27.6	31.6	-	28.9	1.2	68.0	4.5	silty CLAY to CLAY	115	1.5	21	18	9	-	-	1.9	9.8	42	2.73	15
26.58	26.9	30.6	-	28.0	1.2	54.5	4.7	silty CLAY to CLAY	115	1.5	20	18	9	-	-	1.8	9.5	44	2.76	15
26.74	28.3	32.0	-	29.4	1.3	57.4	4.7	silty CLAY to CLAY	115	1.5	21	19	9	-	-	1.9	9.9	43	2.74	15
26.90	29.6	33.3	-	30.7	1.3	54.0	4.8	silty CLAY to CLAY	115	1.5	22	20	9	-	-	2.0	9.9	42	2.74	15
27.07	28.5	32.0	-	29.4	1.4	42.0	5.2	silty CLAY to CLAY	115	1.5	21	19	9	-	-	2.0	9.9	45	2.77	15
27.23	27.1	30.2	-	27.7	1.4	28.2	5.4	silty CLAY to CLAY	115	1.5	20	18	9	-	-	1.9	9.4	46	2.80	15
27.40	26.5	29.4	-	27.0	1.3	25.1	5.2	silty CLAY to CLAY	115	1.5	20	18	8	-	-	1.8	9.1	46	2.80	15
27.56	25.9	28.6	-	26.2	1.1	15.3	4.6	silty CLAY to CLAY	115	1.5	19	17	8	-	-	1.8	8.8	45	2.78	15
27.72	23.3	25.6	-	23.5	1.0	10.2	4.7	silty CLAY to CLAY	115	1.5	17	16	7	-	-	1.6	7.9	47	2.82	15
27.89	21.1	23.1	-	21.3	0.8	12.7	4.3	silty CLAY to CLAY	115	1.5	15	14	7	-	-	1.4	7.0	48	2.83	15
28.05	20.2	22.0	-	20.5	0.8	18.2	4.2	silty CLAY to CLAY	115	1.5	15	13	6	-	-	1.4	6.7	48	2.84	15
28.22	20.1	21.8	-	20.6	0.7	24.4	3.8	silty CLAY to CLAY	115	1.5	15	13	6	-	-	1.4	6.6	47	2.82	15
28.38	17.9	19.3	-	18.4	0.6	26.8	4.0	silty CLAY to CLAY	115	1.5	13	12	6	-	-	1.2	5.8	50	2.88	15
28.54	13.9	14.9	-	14.2	0.5	14.2	4.5	silty CLAY to CLAY	115	1.5	10	9	5	-	-	0.9	4.3	59	3.00	15
28.71	11.8	12.6	-	12.0	0.4	13.2	4.4	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.6	63	3.07	15
28.87	10.2	10.9	-	10.5	0.3	14.4	4.0	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	3.0	65	3.10	15
29.04	8.7	9.2	-	9.0	0.3	16.1	4.1	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.5	2.4	72	3.18	15
29.20	8.2	8.7	-	8.5	0.3	16.3	3.9	silty CLAY to CLAY	115	1.5	6	5	3	-	-	0.5	2.3	73	3.19	15
29.36	8.0	8.4	-	8.3	0.2	15.2	3.9	silty CLAY to CLAY	115	1.5	6	5	3	-	-	0.5	2.2	74	3.21	15
29.53	7.8	8.1	-	8.1	0.2	15.2	4.0	silty CLAY to CLAY	115	1.5	5	5	3	-	-	0.5	2.1	75	3.23	15
29.69	8.2	8.5	-	8.5	0.2	16.4	3.6	silty CLAY to CLAY	115	1.5	6	5	3	-	-	0.5	2.2	72	3.18	15
29.86	8.8	9.1	-	9.1	0.2	15.8	3.2	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.4	68	3.13	15
30.02	7.9	8.2	-	8.2	0.3	15.1	4.3	silty CLAY to CLAY	115	1.5	5	5	3	-	-	0.5	2.1	77	3.25	15
30.19	7.9	8.1	-	8.2	0.3	16.9	4.7	silty CLAY to CLAY	115	1.5	5	5	3	-	-	0.5	2.1	79	3.27	15
30.35	9.1	9.3	-	9.4	0.4	14.9	5.0	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.5	75	3.23	15
30.51	9.6	9.8	-	9.9	0.4	14.6	4.9	silty CLAY to CLAY	115	1.5	7	6	4	-	-	0.6	2.6	73	3.20	15
30.68	9.6	9.7	-	9.8	0.4	12.2	5.3	silty CLAY to CLAY	115	1.5	6	6	4	-	-	0.6	2.6	75	3.22	15
30.84	8.9	9.0	-	9.2	0.4	13.2	5.3	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.4	77	3.25	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Project ID: BAGG Engineering
Data File: SDF(049).cpt
CPT Date: 5/1/2018 9:55:32 AM
GW During Test: 6 ft

Sounding ID: CPT-03
Project No: FREYE-18-01
Cone/Rig: DDG1418

. Depth ft	. qc PS tsf	* qc1n PS -	. q1ncs PS -	* qt PS tsf	. Slv Stss tsf	. pore prss (psi)	. Frct Rato %	* Material Behavior Description	. Unit Wght pcf	. Qc to N	* SPT R-N1 60%	. SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	. Und Shr tsf	. OCR - -	* Fin Ic %	* Ic SBT Indx	* Nk - -
31.01	9.0	9.0	-	9.2	0.3	14.5	4.6	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.4	74	3.22	15
31.17	9.4	9.4	-	9.7	0.3	14.3	4.5	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.5	72	3.19	15
31.33	9.6	9.5	-	9.9	0.4	15.0	4.9	silty CLAY to CLAY	115	1.5	6	6	4	-	-	0.6	2.6	74	3.21	15
31.50	10.4	10.3	-	10.7	0.5	18.3	5.5	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	2.8	74	3.21	15
31.66	11.7	11.6	-	12.2	0.5	21.4	5.3	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.2	69	3.15	15
31.83	12.2	12.0	-	12.6	0.6	19.1	5.4	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.4	68	3.14	15
31.99	13.0	12.7	-	13.4	0.6	21.7	5.1	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.8	3.6	66	3.10	15
32.15	14.0	13.6	-	14.4	0.6	22.4	4.7	silty CLAY to CLAY	115	1.5	9	9	5	-	-	0.9	3.9	62	3.05	15
32.32	14.7	14.2	-	15.2	0.6	25.5	4.4	silty CLAY to CLAY	115	1.5	9	10	5	-	-	1.0	4.1	60	3.02	15
32.48	15.0	14.4	-	15.4	0.6	24.7	4.4	silty CLAY to CLAY	115	1.5	10	10	5	-	-	1.0	4.2	60	3.02	15
32.65	16.0	15.4	-	16.6	0.5	29.6	3.7	silty CLAY to CLAY	115	1.5	10	11	5	-	-	1.1	4.5	55	2.95	15
32.81	16.3	15.6	-	16.9	0.5	29.2	3.3	silty CLAY to CLAY	115	1.5	10	11	5	-	-	1.1	4.6	52	2.90	15
32.97	15.1	14.4	-	15.7	0.5	32.2	3.8	silty CLAY to CLAY	115	1.5	10	10	5	-	-	1.0	4.1	57	2.98	15
33.14	15.0	14.3	-	15.6	0.5	30.9	4.0	silty CLAY to CLAY	115	1.5	10	10	5	-	-	1.0	4.1	58	2.99	15
33.30	15.2	14.4	-	15.7	0.6	26.0	4.3	silty CLAY to CLAY	115	1.5	10	10	5	-	-	1.0	4.2	59	3.01	15
33.47	14.5	13.7	-	14.9	0.7	23.7	5.2	silty CLAY to CLAY	115	1.5	9	10	5	-	-	0.9	3.9	64	3.08	15
33.63	13.0	12.2	-	13.4	0.7	18.3	6.3	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.8	3.4	71	3.18	15
33.79	12.0	11.2	-	12.3	0.7	12.8	7.0	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.8	3.1	76	3.24	15
33.96	10.7	10.0	-	11.0	0.6	12.3	7.1	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	2.7	80	3.29	15
34.12	10.0	9.3	-	10.2	0.6	12.2	7.0	silty CLAY to CLAY	115	1.5	6	7	4	-	-	0.6	2.5	83	3.32	15
34.29	9.1	8.4	-	9.4	0.5	12.8	6.9	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.2	86	3.35	15
34.45	9.4	8.7	-	9.7	0.4	15.2	5.7	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.3	81	3.29	15
34.61	9.6	8.8	-	10.1	0.4	22.0	5.5	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.3	79	3.28	15
34.78	9.5	8.7	-	10.0	0.4	26.0	5.2	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.3	79	3.27	15
34.94	11.4	10.4	-	12.0	0.4	29.9	3.7	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.7	2.8	66	3.11	15
35.11	10.2	9.2	-	10.6	0.3	22.4	3.9	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.4	71	3.17	15
35.27	9.4	8.5	-	9.9	0.4	24.3	4.8	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.2	78	3.26	15
35.43	9.7	8.7	-	10.2	0.4	27.1	5.1	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.3	78	3.26	15
35.60	14.0	12.5	-	14.4	0.3	24.5	2.7	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.9	3.5	55	2.95	15
35.76	14.0	12.5	-	14.3	0.3	13.1	2.8	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.9	3.5	56	2.96	15
35.93	10.5	9.3	-	10.8	0.3	18.8	3.8	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.5	70	3.16	15
36.09	12.0	10.6	-	12.4	0.3	22.4	2.9	silty CLAY to CLAY	115	1.5	7	8	3	-	-	0.8	2.9	61	3.04	15
36.26	12.2	10.7	-	12.7	0.3	26.9	2.6	silty CLAY to CLAY	115	1.5	7	8	3	-	-	0.8	2.9	59	3.01	15
36.42	11.7	10.2	-	12.3	0.2	31.9	2.5	silty CLAY to CLAY	115	1.5	7	8	3	-	-	0.7	2.8	60	3.02	15
36.58	11.5	10.1	-	12.2	0.3	35.1	2.9	silty CLAY to CLAY	115	1.5	7	8	3	-	-	0.7	2.7	62	3.06	15
36.75	11.4	9.9	-	12.1	0.3	35.7	3.2	silty CLAY to CLAY	115	1.5	7	8	3	-	-	0.7	2.7	65	3.09	15
36.91	11.5	10.0	-	12.2	0.3	37.1	3.3	silty CLAY to CLAY	115	1.5	7	8	3	-	-	0.7	2.7	65	3.10	15
37.08	11.8	10.2	-	12.5	0.3	38.4	3.1	silty CLAY to CLAY	115	1.5	7	8	3	-	-	0.8	2.8	63	3.07	15
37.24	11.6	10.0	-	12.4	0.2	40.6	2.6	silty CLAY to CLAY	115	1.5	7	8	3	-	-	0.7	2.7	61	3.04	15
37.40	13.2	11.4	-	14.1	0.2	45.5	2.0	silty CLAY to CLAY	115	1.5	8	9	3	-	-	0.9	3.1	53	2.91	15
37.57	10.3	8.8	-	11.0	0.2	36.7	2.6	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.3	65	3.09	15
37.73	10.0	8.5	-	10.8	0.3	44.0	3.6	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.2	72	3.19	15
37.90	10.4	8.8	-	11.2	0.4	45.1	5.2	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.3	78	3.26	15
38.06	13.2	11.2	-	14.2	0.6	51.4	5.0	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.8	3.1	69	3.15	15
38.22	33.9	30.2	87.4	35.4	0.6	75.3	2.0	clayy SILT to silty CLAY	115	2.0	15	17	7	-	-	2.3	8.8	32	2.52	15
38.39	36.7	32.7	91.4	38.4	0.7	84.4	2.0	clayy SILT to silty CLAY	115	2.0	16	18	8	-	-	2.5	9.6	31	2.51	15
38.55	35.5	31.5	92.5	37.3	0.7	95.0	2.2	clayy SILT to silty CLAY	115	2.0	16	18	8	-	-	2.4	9.2	32	2.53	15
38.72	35.2	31.3	88.4	37.4	0.7	108.5	2.0	clayy SILT to silty CLAY	115	2.0	16	18	8	-	-	2.4	9.1	31	2.51	15
38.88	33.9	30.0	89.4	35.7	0.7	92.3	2.1	clayy SILT to silty CLAY	115	2.0	15	17	7	-	-	2.3	8.7	33	2.54	15
39.04	31.3	25.9	-	33.1	0.7	92.0	2.3	clayy SILT to silty CLAY	115	2.0	13	16	7	-	-	2.1	7.9	37	2.63	15
39.21	32.5	26.9	-	34.4	0.7	96.2	2.4	clayy SILT to silty CLAY	115	2.0	13	16	7	-	-	2.2	8.3	36	2.62	15
39.37	34.2	30.1	95.7	35.7	0.8	77.1	2.4	clayy SILT to silty CLAY	115	2.0	15	17	8	-	-	2.3	8.7	34	2.58	15
39.54	33.4	27.4	-	34.7	0.8	65.8	2.6	clayy SILT to silty CLAY	115	2.0	14	17	7	-	-	2.3	8.4	37	2.64	15
39.70	27.4	22.4	-	28.0	0.7	30.6	2.7	clayy SILT to silty CLAY	115	2.0	11	14	6	-	-	1.8	6.8	41	2.72	15
39.86	19.1	15.6	-	19.3	0.6	7.1	3.3	silty CLAY to CLAY	115	1.5	10	13	5	-	-	1.3	4.5	53	2.91	15
40.03	13.7	11.1	-	14.0	0.4	15.9	3.6	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	3.1	63	3.07	15
40.19	11.5	9.3	-	11.9	0.3	20.3	3.7	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.4	69	3.15	15
40.36	10.4	8.4	-	10.9	0.3	24.7	3.7	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.1	73	3.20	15
40.52	9.9	8.0	-	10.5	0.3	27.5	3.4	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	2.0	73	3.20	15
40.68	9.7	7.8	-	10.2	0.2	27.5	3.0	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.9	72	3.19	15
40.85	8.7	6.9	-	9.3	0.2	33.2	2.8	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.5	1.7	75	3.23	15
41.01	8.7	6.9	-	9.5	0.2	38.9	3.6	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.5	1.7	80	3.29	15
41.18	9.3	7.3	-	10.1	0.3	40.7	4.1	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.8	80	3.29	15
41.34	11.6	9.1	-	12.7	0.3	54.2	3.3	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.4	68	3.13	15
41.50	14.9	11.7	-	15.9	0.3	49.7	2.7	silty CLAY to CLAY	115	1.5	8	10	4	-	-	1.0	3.2	57	2.98	15
41.67	11.4	8.9	-	12.3	0.3	46.7	3.5	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.3	70	3.16	15
41.83	10.7	8.3	-	11.6	0.3	46.9	3.4	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.1	72	3.18	15
42.00	9.9	7.7	-	10.9	0.2	51.6	3.3	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	1.9	74	3.21	15
42.16	9.6	7.4	-	10.7	0.2	55.1	3.2	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.8	75	3.23	15
42.32	9.7	7.5	-	10.8	0.2	55.8	3.3	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.9	75	3.23	15
42.49	9.9	7.7	-	11.0	0.3	53.7	3.5	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	1.9	75	3.23	15
42.65	10.0	7.7	-	11.0	0.3	52.1	3.8	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	1.9	77	3.25	15
42.82	10.2	7.8	-	11.2	0.3	50.0	4.3	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	2.0	79	3.27	15
42.98	10.8	8.3	-	11.8	0.3	48.7	4.1	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.1	76	3.24	15
43.15	11.1	8.4	-	12.0	0.3	48.6	4.1	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.2	75	3.23	15
43.31	11.0	8.3	-	12.0	0.4	50.8	4.7	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.1	78	3.27	15
43.47	11.4	8.6	-	12.3	0.4	46.9	4.5	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.2	76	3.24	15
43.64	11.7	8.8	-	12.6	0.4	44.9	4.3	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.3	74	3.22	15
43.80	11.6	8.7	-	12.6	0.4	50.1	4.4	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.3	75	3.23	15
43.97	11.7	8.7	-	12.6	0.4	45.8	4.8	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.3	77	3.25	15
44.13	12.0	9.0	-	12.8	0.5	42.7	5.0	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.3	77	3.25	15
44.29	11.8	8.8	-	12.7	0.5	43.5	5.0	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.3	77	3.26	15
44.46	12.3	9.1	-	13.2	0.4	44.0	4.4	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.4	74	3.21	15
44.62	12.1	8.9	-	12.9	0.4	41.0	4.1	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.3	73	3.20	15
44.79	11.2	8.3	-	12.1	0.4	45.6	4.4	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.1	77	3.25	15
44.95	10.9	8.0	-	11.8	0.4	45.1	4.4	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.7	2.0	78	3.26	15
45.11	10.1	7.4	-	10.9	0.3	37.0	4.3	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	1.8	81	3.30	15
45.28	9.2	6.7	-	10.0	0.3	38.9	4.2	silty CLAY to CLAY	115	1.5	4	6	3	-	-	0.6	1.6	85	3.34	15
45.44	8.9	6.4	-	9.7	0.3	44.2	4.1	silty CLAY to CLAY	115	1.5	4	6	3	-	-	0.5	1.5	86	3.35	15
45.61	9.4	6.8	-	10.3	0.3	46.6	3.9	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.6	82	3.32	15
45.77	10.1	7.3	-	11.0	0.3	49.4	3.7	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	1.8	79	3.27	15
45.93	10.5	7.6	-	11.5	0.3	51.7	4.4	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	1.9	81	3.29	15
46.10	11.3	8.1	-	12.4	0.4	56.2	5.2	silty CLAY to CLAY	115	1.5	5	8	3	-	-	0.7	2.0	81	3.30	15
46.26	13.3	9.5	-	14.3	0.5	52.0	4.6	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.5	73	3.20	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Sheetpile Wall at WBSD Property

Project ID: BAGG Engineering
Data File: SDF(049).cpt
CPT Date: 5/1/2018 9:55:32 AM
GW During Test: 6 ft

Sounding ID: CPT-03
Project No: FREYE-18-01
Cone/Rig: DDG1418

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. Depth ft	qc PS tsf	qc1n PS -	q1ncs PS -	qt PS tsf	Slv Stss tsf	pore prss (psi)	Frct Rato %	Material Behavior Description	Unit Wght pcf	Qc to N	SPT R-N1 60%	SPT R-N 60%	SPT IcN1 60%	Rel Den %	Ftn Ang deg	Und Shr tsf	OCR -	Fin Ic %	Ic SBT Indx	Nk -
46.43	14.0	10.0	-	14.9	0.5	47.9	4.6	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	2.7	72	3.18	15
46.59	13.6	9.7	-	14.7	0.5	56.7	4.7	silty CLAY to CLAY	115	1.5	6	9	4	-	-	0.9	2.6	73	3.20	15
46.75	14.4	10.2	-	15.4	0.5	51.2	4.7	silty CLAY to CLAY	115	1.5	7	10	4	-	-	0.9	2.7	71	3.17	15
46.92	14.5	10.2	-	15.5	0.6	50.5	4.9	silty CLAY to CLAY	115	1.5	7	10	4	-	-	0.9	2.7	72	3.19	15
47.08	14.9	10.5	-	15.8	0.5	48.8	4.5	silty CLAY to CLAY	115	1.5	7	10	4	-	-	0.9	2.8	69	3.15	15
47.25	14.5	10.2	-	15.3	0.5	44.3	4.2	silty CLAY to CLAY	115	1.5	7	10	4	-	-	0.9	2.7	69	3.15	15
47.41	13.1	9.2	-	14.0	0.4	44.6	3.5	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.4	69	3.15	15
47.57	12.8	8.9	-	13.6	0.5	41.9	4.5	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.3	75	3.22	15
47.74	13.3	9.2	-	14.1	0.5	42.2	4.3	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.4	73	3.20	15
47.90	11.5	8.0	-	12.3	0.5	42.4	5.2	silty CLAY to CLAY	115	1.5	5	8	3	-	-	0.7	2.0	82	3.31	15
48.07	13.5	9.3	-	14.3	0.5	42.8	4.7	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.4	74	3.22	15
48.23	13.3	9.2	-	14.3	0.5	46.7	5.0	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.4	76	3.24	15
48.39	14.5	10.0	-	15.3	0.6	40.4	4.9	silty CLAY to CLAY	115	1.5	7	10	4	-	-	0.9	2.7	73	3.20	15
48.56	15.4	10.6	-	16.3	0.6	43.3	4.5	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	2.9	69	3.15	15
48.72	15.5	10.6	-	16.3	0.5	39.2	3.9	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	2.9	66	3.11	15
48.89	14.8	10.1	-	15.5	0.4	34.4	3.5	silty CLAY to CLAY	115	1.5	7	10	3	-	-	0.9	2.7	66	3.11	15
49.05	13.6	9.3	-	14.4	0.4	40.4	3.4	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.9	2.4	68	3.14	15
49.22	13.2	8.9	-	14.1	0.3	45.2	3.2	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.3	68	3.14	15
49.38	13.3	9.0	-	14.2	0.3	44.9	2.9	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.3	67	3.11	15
49.54	12.8	8.7	-	13.7	0.3	44.9	3.0	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.2	68	3.14	15
49.71	12.7	8.5	-	13.7	0.3	51.1	2.9	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.2	69	3.14	15
49.87	12.9	8.6	-	13.9	0.3	52.1	3.0	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.2	68	3.14	15
50.04	13.2	8.8	-	14.3	0.3	55.9	3.0	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.3	68	3.13	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

Sheetpile Wall at WBSD Property

Project ID: BAGG Engineering
Data File: SDF(050).cpt
CPT Date: 5/1/2018 10:33:01 AM
GW During Test: 6 ft

Sounding ID: CPT-04
Project No: FREYE-18-01
Cone/Rig: DDG1418

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.	qc	qc1n	q1ncs	qt	Slv	pore	Frct	Material	Unit	Qc	SPT	SPT	SPT	Rel	Ftn	Und	OCR	Fin	Ic	Nk
Depth	PS	PS	PS	PS	Stss	prss	Rato	Behavior	Wght	to	R-N1	R-N	IcN1	Den	Ang	Shr	-	Ic	SBT	-
ft	tsf	-	-	tsf	tsf	(psi)	%	Description	pcf	N	60%	60%	60%	%	deg	tsf	-	%	Indx	-
0.33	15.9	25.4	-	15.9	0.7	1.0	4.5	silty CLAY to CLAY	115	1.5	17	11	7	-	-	1.1	9.9	45	2.79	15
0.49	12.1	19.3	-	12.1	0.6	0.4	4.8	silty CLAY to CLAY	115	1.5	13	8	6	-	-	0.9	9.9	52	2.90	15
0.66	10.5	16.8	-	10.5	0.4	0.1	4.0	silty CLAY to CLAY	115	1.5	11	7	5	-	-	0.7	9.9	52	2.89	15
0.82	8.8	14.2	-	8.8	0.3	-0.6	3.9	silty CLAY to CLAY	115	1.5	9	6	4	-	-	0.6	9.9	55	2.95	15
0.98	6.6	10.6	-	6.5	0.3	-3.3	4.5	silty CLAY to CLAY	115	1.5	7	4	4	-	-	0.5	9.9	64	3.09	15
1.15	5.5	8.8	-	5.4	0.3	-2.9	5.0	silty CLAY to CLAY	115	1.5	6	4	3	-	-	0.4	9.9	71	3.18	15
1.31	4.3	6.8	-	4.2	0.3	-3.0	6.5	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	9.9	84	3.33	15
1.48	4.8	7.7	-	4.8	0.3	-2.8	6.5	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	9.9	81	3.29	15
1.64	5.1	8.1	-	5.0	0.3	-2.9	6.8	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.4	9.9	80	3.29	15
1.80	6.6	10.7	-	6.6	0.3	-2.6	4.5	silty CLAY to CLAY	115	1.5	7	4	4	-	-	0.5	9.9	64	3.09	15
1.97	5.5	8.8	-	5.4	0.3	-3.2	5.6	silty CLAY to CLAY	115	1.5	6	4	3	-	-	0.4	9.9	74	3.21	15
2.13	4.3	7.0	-	4.3	0.4	-3.3	8.4	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	9.9	90	3.40	15
2.30	6.6	10.5	-	6.5	0.4	-2.7	5.9	silty CLAY to CLAY	115	1.5	7	4	4	-	-	0.5	9.9	70	3.16	15
2.46	10.6	16.9	-	10.5	0.3	-2.8	3.2	silty CLAY to CLAY	115	1.5	11	7	5	-	-	0.7	9.9	48	2.83	15
2.62	6.9	11.0	-	6.8	0.3	-3.4	3.8	silty CLAY to CLAY	115	1.5	7	5	4	-	-	0.5	9.9	60	3.03	15
2.79	4.4	7.1	-	4.4	0.2	-3.1	4.3	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	8.8	75	3.22	15
2.95	3.8	6.1	-	3.7	0.2	-2.4	5.2	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.3	7.0	83	3.32	15
3.12	3.8	6.2	-	3.8	0.3	-1.6	7.4	silty CLAY to CLAY	115	1.5	4	3	3	-	-	0.3	6.8	91	3.42	15
3.28	6.0	9.7	-	6.0	0.3	-1.1	5.9	silty CLAY to CLAY	115	1.5	6	4	4	-	-	0.4	9.9	73	3.20	15
3.45	9.9	15.9	-	9.9	0.4	-1.3	4.2	silty CLAY to CLAY	115	1.5	11	7	5	-	-	0.7	9.9	54	2.93	15
3.61	9.4	15.1	-	9.4	0.4	-0.9	4.0	silty CLAY to CLAY	115	1.5	10	6	5	-	-	0.7	9.9	54	2.93	15
3.77	8.9	14.3	-	8.9	0.3	-0.6	3.9	silty CLAY to CLAY	115	1.5	10	6	4	-	-	0.6	9.9	55	2.95	15
3.94	8.1	13.0	-	8.1	0.3	-0.6	3.8	silty CLAY to CLAY	115	1.5	9	5	4	-	-	0.6	9.9	57	2.97	15
4.10	7.9	12.6	-	7.9	0.3	-0.4	3.6	silty CLAY to CLAY	115	1.5	8	5	4	-	-	0.5	9.9	57	2.97	15
4.27	7.3	11.7	-	7.3	0.3	-0.3	4.5	silty CLAY to CLAY	115	1.5	8	5	4	-	-	0.5	9.5	62	3.06	15
4.43	7.3	11.7	-	7.3	0.3	-0.2	4.4	silty CLAY to CLAY	115	1.5	8	5	4	-	-	0.5	9.1	62	3.05	15
4.59	6.8	11.0	-	6.8	0.3	0.0	4.2	silty CLAY to CLAY	115	1.5	7	5	4	-	-	0.5	8.2	63	3.06	15
4.76	6.0	9.6	-	6.0	0.2	0.0	4.2	silty CLAY to CLAY	115	1.5	6	4	3	-	-	0.4	6.9	66	3.11	15
4.92	5.1	8.2	-	5.1	0.2	0.3	3.8	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	5.7	69	3.14	15
5.09	4.7	7.6	-	4.7	0.2	0.4	3.8	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	5.0	71	3.18	15
5.25	4.4	7.0	-	4.4	0.1	0.4	3.6	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	4.4	73	3.20	15
5.41	4.0	6.4	-	4.0	0.1	0.4	3.6	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.3	3.9	75	3.23	15
5.58	3.7	6.0	-	3.7	0.1	0.5	3.8	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	3.5	79	3.27	15
5.74	3.4	5.4	-	3.4	0.1	0.5	4.0	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	3.1	83	3.33	15
5.91	3.0	4.8	-	3.0	0.1	0.5	4.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.6	90	3.41	15
6.07	3.0	4.8	-	3.0	0.1	0.7	4.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.5	89	3.39	15
6.23	3.2	5.2	-	3.2	0.1	0.9	3.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.7	84	3.33	15
6.40	3.3	5.3	-	3.4	0.1	1.1	3.6	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.8	82	3.31	15
6.56	3.3	5.3	-	3.3	0.1	1.1	3.6	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.7	82	3.32	15
6.73	3.4	5.4	-	3.4	0.1	1.2	3.5	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.7	81	3.30	15
6.89	3.3	5.3	-	3.3	0.1	1.3	3.4	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.6	81	3.30	15
7.05	3.1	5.0	-	3.2	0.1	1.4	3.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.4	85	3.34	15
7.22	3.1	5.0	-	3.2	0.1	1.5	3.8	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.4	86	3.35	15
7.38	3.2	5.2	-	3.3	0.1	1.6	4.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.4	86	3.36	15
7.55	3.4	5.4	-	3.4	0.1	1.6	4.0	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.5	84	3.34	15
7.71	3.4	5.5	-	3.5	0.1	1.7	4.0	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.6	84	3.33	15
7.87	3.3	5.2	-	3.3	0.1	1.9	4.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.4	86	3.35	15
8.04	3.2	5.2	-	3.3	0.1	1.9	4.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.3	86	3.36	15
8.20	3.3	5.4	-	3.4	0.1	2.0	3.8	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.4	84	3.33	15
8.37	3.2	5.2	-	3.3	0.1	2.1	3.8	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.2	85	3.35	15
8.53	3.0	4.8	-	3.0	0.1	2.2	4.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.0	90	3.40	15
8.69	2.9	4.6	-	2.9	0.1	2.2	4.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.9	92	3.42	15
8.86	3.0	4.8	-	3.0	0.1	2.4	4.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.9	91	3.42	15
9.02	3.1	5.0	-	3.2	0.1	2.5	3.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.0	88	3.38	15
9.19	3.0	4.8	-	3.1	0.1	2.6	4.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.9	91	3.42	15
9.35	3.2	5.2	-	3.3	0.1	3.9	4.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.1	88	3.38	15
9.51	4.0	6.4	-	4.0	0.1	4.2	3.6	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	2.6	78	3.26	15
9.68	4.1	6.5	-	4.2	0.1	4.4	3.5	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.3	2.7	76	3.24	15
9.84	3.7	6.0	-	3.8	0.1	4.6	3.8	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.3	81	3.30	15
10.01	3.7	6.0	-	3.8	0.1	4.7	3.5	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.3	79	3.28	15
10.17	3.6	5.8	-	3.7	0.1	4.8	3.7	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.2	82	3.31	15
10.34	3.4	5.5	-	3.5	0.1	4.9	3.8	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.1	84	3.33	15
10.50	3.4	5.4	-	3.5	0.1	5.0	3.8	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.0	85	3.35	15
10.66	3.3	5.2	-	3.4	0.1	5.1	3.8	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.9	86	3.36	15
10.83	3.1	5.0	-	3.2	0.1	5.1	3.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.8	89	3.39	15
10.99	3.1	4.9	-	3.2	0.1	5.2	3.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.7	90	3.40	15
11.16	3.0	4.9	-	3.1	0.1	5.3	3.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.7	91	3.41	15
11.32	2.9	4.7	-	3.0	0.1	5.4	4.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.5	94	3.45	15
11.48	3.0	4.8	-	3.1	0.1	5.6	4.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	94	3.45	15
11.65	3.2	5.1	-	3.3	0.1	5.7	4.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.7	90	3.41	15
11.81	3.1	5.0	-	3.2	0.1	5.8	4.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	91	3.41	15
11.98	3.1	5.0	-	3.2	0.1	6.0	3.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	88	3.38	15
12.14	3.2	5.1	-	3.3	0.1	6.2	3.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	87	3.37	15
12.30	3.1	5.0	-	3.2	0.1	6.3	3.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.5	89	3.39	15
12.47	3.0	4.8	-	3.1	0.1	6.6	3.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.5	90	3.40	15
12.63	3.0	4.9	-	3.2	0.1	7.3	3.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.5	89	3.39	15
12.80	3.0	4.8	-	3.2	0.1	7.4	3.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.4	89	3.39	15
12.96	3.1	4.9	-	3.2	0.1	7.6	3.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.5	88	3.38	15
13.12	3.0	4.8	-	3.2	0.1	7.8	3.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.4	89	3.39	15
13.29	3.0	4.8	-	3.2	0.1	8.0	3.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.4	89	3.39	15
13.45	3.0	4.9	-	3.2	0.1	8.1	3.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.4	89	3.40	15
13.62	3.0	4.9	-	3.2	0.1	8.3	3.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.4	89	3.39	15
13.78	3.0	4.8	-	3.2	0.1	8.5	3.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	90	3.40	15
13.94	3.0	4.8	-	3.1	0.1	8.7	3.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	90	3.41	15
14.11	3.0	4.8	-	3.2	0.1	8.9	3.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	91	3.41	15
14.27	3.0	4.8	-	3.2	0.1	9.1	3.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	90	3.41	15
14.44	3.0	4.9	-	3.2	0.1	9.3	3.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	90	3.41	15
14.60	3.1	5.0	-	3.3	0.1	9.5	4.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	92	3.43	15
14.76	3.1	5.0	-	3.3	0.1	9.6	5.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	95	3.51	15
14.93	3.8	6.1	-	4.0	0.2	9.9	5.6	silty CLAY to CLAY	115	1.5	4	3	3	-	-	0.2	1.7	92	3.42	15
15.09	4.5	7.3	-	4.7	0.2	10.6	5.7	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	2.1	85	3.35	15
15.26	4.7	7.5	-	4.9	0.2	11.0	6.5	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	2.1	87	3.37	15
15.42	4.9	7.8	-	5.1	0.2	11.4	6.2	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	2.2	84	3.34	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

Project ID: BAGG Engineering
Data File: SDF(050).cpt
CPT Date: 5/1/2018 10:33:01 AM
GW During Test: 6 ft

Sounding ID: CPT-04
Project No: FREYE-18-01
Cone/Rig: DDG1418

. . Depth ft	. qc PS tsf	* qc1n PS -	. q1ncs PS -	* qt PS tsf	. Slv Stss tsf	. pore prss (psi)	. Frct Rato %	* Material Behavior Description	. Unit Wght pcf	. Qc to N	* SPT R-N1 60%	. SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	. Und Shr tsf	. OCR - -	* Fin Ic %	* Ic SBT Indx	* Nk - -
15.58	5.0	8.0	-	5.2	0.2	11.8	6.0	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	2.3	83	3.32	15
15.75	4.8	7.8	-	5.1	0.2	12.9	6.2	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	2.2	85	3.34	15
15.91	4.8	7.6	-	5.0	0.2	13.2	5.8	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	2.1	84	3.33	15
16.08	4.6	7.3	-	4.8	0.2	13.3	5.6	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	2.0	85	3.34	15
16.24	4.3	6.9	-	4.6	0.2	13.3	4.9	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	1.8	84	3.34	15
16.40	3.9	6.2	-	4.1	0.1	13.2	4.9	silty CLAY to CLAY	115	1.5	4	3	3	-	-	0.2	1.6	88	3.38	15
16.57	3.6	5.8	-	3.9	0.1	13.3	4.7	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.4	91	3.42	15
16.73	3.6	5.8	-	3.9	0.1	13.6	4.7	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.4	91	3.41	15
16.90	3.7	5.9	-	4.0	0.1	14.0	4.7	silty CLAY to CLAY	115	1.5	4	2	3	-	-	0.2	1.4	90	3.40	15
17.06	3.9	6.2	-	4.2	0.1	14.4	4.5	silty CLAY to CLAY	115	1.5	4	3	3	-	-	0.2	1.5	87	3.37	15
17.23	4.1	6.5	-	4.4	0.1	14.7	4.6	silty CLAY to CLAY	115	1.5	4	3	3	-	-	0.2	1.6	86	3.36	15
17.39	4.4	6.9	-	4.7	0.2	15.2	4.6	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	1.8	84	3.33	15
17.55	4.8	7.5	-	5.1	0.2	15.7	4.6	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	1.9	80	3.29	15
17.72	4.4	6.8	-	4.7	0.2	15.7	5.3	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	1.7	87	3.37	15
17.88	3.7	5.6	-	4.0	0.2	14.4	7.4	Organic SOILS - Peats	100	1.0	6	4	3	-	-	0.3	1.3	95	3.54	10
18.05	3.5	5.4	-	3.8	0.2	13.7	8.8	Organic SOILS - Peats	100	1.0	5	4	3	-	-	0.3	1.3	95	3.61	10
18.21	3.8	5.7	-	4.0	0.3	13.6	9.7	Organic SOILS - Peats	100	1.0	6	4	3	-	-	0.3	1.4	95	3.61	10
18.37	4.1	6.2	-	4.4	0.3	13.2	9.9	Organic SOILS - Peats	100	1.0	6	4	3	-	-	0.4	1.5	95	3.58	10
18.54	4.5	6.7	-	4.7	0.4	13.3	9.9	Organic SOILS - Peats	100	1.0	7	4	3	-	-	0.4	1.7	95	3.54	10
18.70	4.9	7.3	-	5.2	0.4	13.5	9.9	Organic SOILS - Peats	100	1.0	7	5	3	-	-	0.4	1.9	95	3.50	10
18.87	5.5	8.1	-	5.7	0.4	13.3	9.6	Organic SOILS - Peats	100	1.0	8	5	4	-	-	0.5	2.1	94	3.45	10
19.03	6.3	9.3	-	6.6	0.4	15.2	8.6	silty CLAY to CLAY	115	1.5	6	4	4	-	-	0.4	2.5	87	3.36	15
19.19	7.2	10.5	-	7.5	0.5	15.2	8.1	silty CLAY to CLAY	115	1.5	7	5	4	-	-	0.5	3.0	81	3.30	15
19.36	7.6	11.1	-	7.9	0.5	14.8	8.2	silty CLAY to CLAY	115	1.5	7	5	4	-	-	0.5	3.1	79	3.28	15
19.52	8.0	11.7	-	8.3	0.6	14.2	8.2	silty CLAY to CLAY	115	1.5	8	5	4	-	-	0.5	3.3	78	3.26	15
19.69	8.5	12.3	-	8.8	0.6	14.0	8.0	silty CLAY to CLAY	115	1.5	8	6	5	-	-	0.6	3.5	76	3.23	15
19.85	8.8	12.6	-	9.1	0.6	14.1	7.9	silty CLAY to CLAY	115	1.5	8	6	5	-	-	0.6	3.6	75	3.22	15
20.01	9.2	13.1	-	9.5	0.6	14.5	7.5	silty CLAY to CLAY	115	1.5	9	6	5	-	-	0.6	3.8	72	3.19	15
20.18	9.2	13.0	-	9.5	0.6	15.2	7.6	silty CLAY to CLAY	115	1.5	9	6	5	-	-	0.6	3.7	73	3.20	15
20.34	9.5	13.4	-	9.8	0.6	16.1	7.2	silty CLAY to CLAY	115	1.5	9	6	5	-	-	0.6	3.9	71	3.17	15
20.51	10.2	14.3	-	10.5	0.6	16.7	6.7	silty CLAY to CLAY	115	1.5	10	7	5	-	-	0.7	4.2	68	3.13	15
20.67	11.0	15.3	-	11.4	0.6	18.8	6.4	silty CLAY to CLAY	115	1.5	10	7	5	-	-	0.7	4.5	65	3.09	15
20.83	12.2	16.9	-	12.6	0.6	20.2	5.8	silty CLAY to CLAY	115	1.5	11	8	5	-	-	0.8	5.0	60	3.03	15
21.00	13.1	18.0	-	13.5	0.7	20.6	5.5	silty CLAY to CLAY	115	1.5	12	9	6	-	-	0.9	5.4	58	2.99	15
21.16	13.1	17.9	-	13.5	0.7	20.6	5.6	silty CLAY to CLAY	115	1.5	12	9	6	-	-	0.9	5.3	58	3.00	15
21.33	13.6	18.4	-	14.0	0.7	23.2	5.3	silty CLAY to CLAY	115	1.5	12	9	6	-	-	0.9	5.5	56	2.97	15
21.49	14.5	19.5	-	14.9	0.7	23.7	5.2	silty CLAY to CLAY	115	1.5	13	10	6	-	-	1.0	5.9	55	2.94	15
21.65	15.3	20.6	-	15.8	0.7	25.0	4.7	silty CLAY to CLAY	115	1.5	14	10	6	-	-	1.0	6.2	52	2.90	15
21.82	15.6	20.8	-	16.1	0.7	26.0	4.7	silty CLAY to CLAY	115	1.5	14	10	6	-	-	1.0	6.3	51	2.89	15
21.98	16.5	21.9	-	17.1	0.7	29.1	4.7	silty CLAY to CLAY	115	1.5	15	11	6	-	-	1.1	6.7	50	2.87	15
22.15	17.3	22.8	-	17.9	0.8	30.8	5.1	silty CLAY to CLAY	115	1.5	15	12	7	-	-	1.2	7.0	51	2.89	15
22.31	19.9	26.0	-	20.4	0.8	28.3	4.5	silty CLAY to CLAY	115	1.5	17	13	7	-	-	1.3	8.0	46	2.80	15
22.47	23.4	30.5	-	23.9	0.9	28.8	3.9	clayy SILT to silty CLAY	115	2.0	15	12	8	-	-	1.6	9.5	41	2.70	15
22.64	19.8	25.7	-	20.4	0.8	30.3	4.5	silty CLAY to CLAY	115	1.5	17	13	7	-	-	1.3	7.9	46	2.81	15
22.80	21.4	27.5	-	22.0	0.9	31.8	4.3	silty CLAY to CLAY	115	1.5	18	14	8	-	-	1.5	8.5	44	2.77	15
22.97	21.3	27.3	-	22.3	0.9	51.1	4.5	silty CLAY to CLAY	115	1.5	18	14	8	-	-	1.4	8.5	45	2.78	15
23.13	23.9	30.5	-	25.1	1.0	62.7	4.3	silty CLAY to CLAY	115	1.5	20	16	8	-	-	1.6	9.5	42	2.73	15
23.30	26.9	34.1	-	28.1	1.2	64.0	4.6	silty CLAY to CLAY	115	1.5	23	18	9	-	-	1.8	9.9	41	2.71	15
23.46	27.1	34.2	-	28.1	1.3	51.8	4.9	silty CLAY to CLAY	115	1.5	23	18	9	-	-	1.9	9.9	42	2.73	15
23.62	26.3	33.0	-	27.1	1.3	41.9	5.3	silty CLAY to CLAY	115	1.5	22	18	9	-	-	1.8	9.9	44	2.77	15
23.79	26.1	32.5	-	27.1	1.3	52.1	5.2	silty CLAY to CLAY	115	1.5	22	17	9	-	-	1.8	9.9	44	2.77	15
23.95	28.0	34.7	-	28.8	1.2	42.2	4.5	silty CLAY to CLAY	115	1.5	23	19	9	-	-	1.9	9.9	41	2.70	15
24.12	24.7	30.5	-	25.2	1.0	25.7	4.3	silty CLAY to CLAY	115	1.5	20	16	8	-	-	1.7	9.5	42	2.74	15
24.28	19.2	23.6	-	19.6	0.8	22.1	4.7	silty CLAY to CLAY	115	1.5	16	13	7	-	-	1.3	7.2	49	2.85	15
24.44	16.2	19.8	-	16.6	0.7	20.0	4.6	silty CLAY to CLAY	115	1.5	13	11	6	-	-	1.1	6.0	52	2.91	15
24.61	13.4	16.3	-	13.8	0.6	17.0	4.7	silty CLAY to CLAY	115	1.5	11	9	5	-	-	0.9	4.8	57	2.98	15
24.77	11.7	14.1	-	12.0	0.5	15.1	4.5	silty CLAY to CLAY	115	1.5	9	8	5	-	-	0.8	4.1	60	3.02	15
24.94	10.8	13.0	-	11.1	0.3	15.5	3.2	silty CLAY to CLAY	115	1.5	9	7	4	-	-	0.7	3.7	56	2.97	15
25.10	10.6	12.7	-	10.9	0.2	15.8	2.3	silty CLAY to CLAY	115	1.5	8	7	4	-	-	0.7	3.6	52	2.90	15
25.26	8.3	9.8	-	8.5	0.2	14.5	3.1	silty CLAY to CLAY	115	1.5	7	6	3	-	-	0.5	2.7	64	3.08	15
25.43	6.8	8.1	-	7.1	0.2	16.0	4.6	silty CLAY to CLAY	115	1.5	5	5	3	-	-	0.4	2.1	78	3.26	15
25.59	8.1	9.6	-	8.5	0.4	20.7	6.0	silty CLAY to CLAY	115	1.5	6	5	4	-	-	0.5	2.6	78	3.26	15
25.76	8.9	10.4	-	9.3	0.4	20.6	5.1	silty CLAY to CLAY	115	1.5	7	6	4	-	-	0.6	2.9	72	3.18	15
25.92	12.8	15.0	-	13.2	0.3	20.3	2.7	silty CLAY to CLAY	115	1.5	10	9	4	-	-	0.8	4.4	50	2.87	15
26.08	8.6	9.9	-	8.9	0.3	15.3	4.6	silty CLAY to CLAY	115	1.5	7	6	4	-	-	0.5	2.7	71	3.17	15
26.25	8.2	9.5	-	8.6	0.4	19.1	6.3	silty CLAY to CLAY	115	1.5	6	5	4	-	-	0.5	2.6	79	3.28	15
26.41	11.3	13.0	-	11.7	0.5	19.6	4.6	silty CLAY to CLAY	115	1.5	9	8	4	-	-	0.7	3.7	63	3.07	15
26.58	13.7	15.6	-	14.1	0.4	23.8	3.7	silty CLAY to CLAY	115	1.5	10	9	5	-	-	0.9	4.6	54	2.93	15
26.74	13.3	15.1	-	13.5	0.4	12.4	3.3	silty CLAY to CLAY	115	1.5	10	9	5	-	-	0.9	4.4	53	2.92	15
26.90	9.9	11.2	-	10.3	0.3	20.0	3.4	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.6	3.1	62	3.05	15
27.07	8.8	9.9	-	9.2	0.3	19.8	3.6	silty CLAY to CLAY	115	1.5	7	6	3	-	-	0.6	2.7	67	3.12	15
27.23	7.9	8.9	-	8.3	0.2	21.8	3.7	silty CLAY to CLAY	115	1.5	6	5	3	-	-	0.5	2.3	71	3.17	15
27.40	8.0	8.9	-	8.4	0.3	22.7	4.6	silty CLAY to CLAY	115	1.5	6	5	3	-	-	0.5	2.4	75	3.22	15
27.56	8.7	9.6	-	9.1	0.3	22.4	4.6	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.5	2.6	72	3.19	15
27.72	9.1	10.1	-	9.5	0.4	21.9	5.9	silty CLAY to CLAY	115	1.5	7	6	4	-	-	0.6	2.7	76	3.24	15
27.89	10.1	11.1	-	10.6	0.5	26.8	5.6	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	3.1	72	3.18	15
28.05	11.0	12.1	-	11.4	0.5	18.5	5.7	silty CLAY to CLAY	115	1.5	8	7	4	-	-	0.7	3.4	69	3.15	15
28.22	11.0	12.0	-	11.4	0.5	23.0	5.5	silty CLAY to CLAY	115	1.5	8	7	4	-	-	0.7	3.4	69	3.15	15
28.38	11.3	12.3	-	11.8	0.6	21.5	5.8	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.7	3.5	69	3.15	15
28.54	12.3	13.3	-	12.8	0.6	25.3	5.8	silty CLAY to CLAY	115	1.5	9	8	5	-	-	0.8	3.8	67	3.12	15
28.71	14.6	15.7	-	15.1	0.7	26.5	5.2	silty CLAY to CLAY	115	1.5	10	10	5	-	-	1.0	4.6	60	3.03	15
28.87	15.4	16.5	-	16.0	0.7	28.0	5.0	silty CLAY to CLAY	115	1.5	11	10	5	-	-	1.0	4.9	58	3.00	15
29.04	15.4	16.4	-	16.0	0.7	29.9	4.8	silty CLAY to CLAY	115	1.5	11	10	5	-	-	1.0	4.8	58	2.99	15
29.20	15.3	16.2	-	15.9	0.6	30.4	4.7	silty CLAY to CLAY	115	1.5	11	10	5	-	-	1.0	4.8	57	2.99	15
29.36	14.3	15.1	-	14.9	0.6	31.8	4.7	silty CLAY to CLAY	115	1.5	10	10	5	-	-	0.9	4.4	59	3.01	15
29.53	13.2	13.8	-	13.7	0.6	28.0	5.1	silty CLAY to CLAY	115	1.5	9	9	5	-	-	0.9	4.0	63	3.07	15
29.69	12.0	12.5	-	12.5	0.6	26.7	5.9	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.5	69	3.15	15
29.86	12.1	12.6	-	12.6	0.6	25.3	6.0	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.6	69	3.15	15
30.02	14.2	14.7	-	14.7	0.7	26.8	5.5	silty CLAY to CLAY	115	1.5	10	9	5	-	-	0.9	4.3	63	3.07	15
30.19	16.9	17.4	-	17.5	0.7	30.4	4.9	silty CLAY to CLAY	115	1.5	12	11	5	-	-	1.1	5.2	57	2.97	15
30.35	24.2	24.9	-	25.0	1.3	38.2	5.6	silty CLAY to CLAY	115	1.5	17	16	7	-	-	1.6	7.6	51	2.88	15
30.51	28.1	28.7	-	28.6	1.6	26.5	6.2	silty CLAY to CLAY	115	1.5	19	19	8	-	-	1.9	8.9	50	2.86	15
30.68	49.2	48.2	140.9	51.0	1.7	91.1	3.6	clayy SILT to silty CLAY	115	2.0	24	25	12	-	-	3.4	9.9	32	2.53	15
30.84	86.4	84.4	134.6	86.3	1.7	-2.4	2.0	silty SAND to sandy SILT	120	3.0	28	29	18	61	40	-	-	18	2.17	16

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

Sheetpile Wall at WBSD Property

Project ID: BAGG Engineering
Data File: SDF(050).cpt
CPT Date: 5/1/2018 10:33:01 AM
GW During Test: 6 ft

Sounding ID: CPT-04
Project No: FREYE-18-01
Cone/Rig: DDG1418

. Depth ft	qc PS tsf	* qc1n PS -	q1ncs PS -	* qt PS tsf	Slv Stss tsf	pore prss (psi)	Frct Rato %	* Material Behavior Description	Unit Wght pcf	Qc to N	* SPT R-N1 60%	SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	Und Shr tsf	OCR - -	* Fin Ic %	* Ic SBT Indx	* Nk - -
31.01	117.1	114.2	139.6	117.1	1.4	-0.5	1.2	clean SAND to silty SAND	125	5.0	23	23	22	71	41	-	-	11	1.93	16
31.17	128.5	125.1	143.6	128.5	1.3	0.1	1.0	clean SAND to silty SAND	125	5.0	25	26	23	74	42	-	-	9	1.85	16
31.33	142.6	138.4	153.1	142.5	1.4	-3.2	1.0	clean SAND to silty SAND	125	5.0	28	29	25	78	42	-	-	8	1.80	16
31.50	165.8	160.4	160.4	165.7	0.9	-4.8	0.5	clean SAND to silty SAND	125	5.0	32	33	27	83	43	-	-	5	1.59	16
31.66	181.4	175.2	175.2	181.4	1.1	-3.2	0.6	clean SAND to silty SAND	125	5.0	35	36	30	86	43	-	-	5	1.60	16
31.83	178.0	171.4	171.4	177.9	1.1	-5.1	0.6	clean SAND to silty SAND	125	5.0	34	36	29	85	43	-	-	5	1.60	16
31.99	167.8	161.2	161.2	167.7	0.9	-2.6	0.5	clean SAND to silty SAND	125	5.0	32	34	27	83	43	-	-	5	1.58	16
32.15	159.4	152.7	152.7	159.5	0.7	7.9	0.5	clean SAND to silty SAND	125	5.0	31	32	26	81	43	-	-	5	1.56	16
32.32	139.5	133.3	133.3	139.5	0.4	3.2	0.3	clean SAND to silty SAND	125	5.0	27	28	22	76	42	-	-	5	1.53	16
32.48	132.6	126.4	126.4	132.5	0.3	-3.0	0.2	clean SAND to silty SAND	125	5.0	25	27	21	75	42	-	-	5	1.49	16
32.65	115.8	110.1	110.1	115.7	0.4	-4.3	0.3	clean SAND to silty SAND	125	5.0	22	23	19	70	41	-	-	5	1.61	16
32.81	87.6	83.1	101.5	87.6	0.7	-2.4	0.8	clean SAND to silty SAND	125	5.0	17	18	16	61	40	-	-	11	1.93	16
32.97	50.3	47.6	86.5	50.3	0.7	3.2	1.3	silty SAND to sandy SILT	120	3.0	16	17	10	42	36	-	-	21	2.26	16
33.14	26.5	25.0	-	26.7	0.6	11.1	2.4	clayy SILT to silty CLAY	115	2.0	13	13	7	-	-	1.8	7.7	37	2.64	15
33.30	16.4	15.4	-	16.7	0.5	15.1	3.3	silty CLAY to CLAY	115	1.5	10	11	5	-	-	1.1	4.5	53	2.91	15
33.47	11.8	11.1	-	12.4	0.4	33.4	3.9	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.8	3.1	65	3.09	15
33.63	12.8	11.9	-	13.5	0.4	39.6	3.6	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.8	3.3	61	3.04	15
33.79	13.2	12.3	-	14.0	0.4	37.4	3.8	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.9	3.5	61	3.04	15
33.96	13.3	12.3	-	14.0	0.5	36.4	4.1	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.9	3.5	62	3.06	15
34.12	13.3	12.3	-	14.0	0.5	33.2	4.3	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.9	3.5	63	3.07	15
34.29	13.0	11.9	-	13.5	0.5	27.1	4.4	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.8	3.3	65	3.09	15
34.45	12.3	11.3	-	12.8	0.5	24.6	4.6	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.1	67	3.13	15
34.61	11.7	10.7	-	12.3	0.4	31.1	4.4	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.7	2.9	68	3.14	15
34.78	12.4	11.3	-	13.0	0.4	29.8	3.9	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.1	64	3.08	15
34.94	12.9	11.7	-	13.5	0.4	28.8	3.4	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.8	3.3	61	3.03	15
35.11	11.0	9.9	-	11.6	0.4	28.5	4.0	silty CLAY to CLAY	115	1.5	7	7	3	-	-	0.7	2.7	69	3.14	15
35.27	11.5	10.3	-	12.2	0.4	36.2	3.7	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.7	2.8	66	3.11	15
35.43	11.6	10.4	-	12.3	0.4	36.6	3.8	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.7	2.8	66	3.11	15
35.60	11.4	10.1	-	12.1	0.4	39.4	4.1	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.7	2.7	69	3.14	15
35.76	11.2	9.9	-	11.9	0.4	37.2	4.5	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	2.7	71	3.18	15
35.93	11.2	9.9	-	11.8	0.4	35.0	4.5	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	2.7	71	3.18	15
36.09	10.8	9.5	-	11.5	0.4	33.8	4.8	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.5	73	3.21	15
36.26	10.4	9.1	-	11.0	0.4	34.0	4.9	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.4	76	3.23	15
36.42	10.3	9.0	-	10.9	0.4	31.8	4.7	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.4	75	3.23	15
36.58	10.0	8.7	-	10.6	0.4	30.4	4.7	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.3	77	3.25	15
36.75	10.5	9.1	-	11.0	0.4	24.9	4.2	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.4	72	3.19	15
36.91	9.7	8.4	-	10.1	0.3	17.8	4.2	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.2	76	3.23	15
37.08	8.8	7.5	-	9.1	0.3	17.8	5.3	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.5	1.9	84	3.34	15
37.24	9.3	8.0	-	9.7	0.3	22.2	4.9	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	2.0	80	3.29	15
37.40	10.0	8.6	-	10.5	0.3	21.4	4.4	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.2	76	3.23	15
37.57	12.3	10.4	-	12.7	0.3	23.2	2.8	silty CLAY to CLAY	115	1.5	7	8	3	-	-	0.8	2.8	61	3.04	15
37.73	11.6	9.8	-	12.0	0.3	22.3	3.0	silty CLAY to CLAY	115	1.5	7	8	3	-	-	0.7	2.6	64	3.08	15
37.90	10.0	8.4	-	10.6	0.3	34.6	3.5	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.2	72	3.18	15
38.06	10.8	9.1	-	11.6	0.4	39.4	4.8	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.4	75	3.23	15
38.22	13.6	11.5	-	14.5	0.4	45.5	3.4	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.9	3.2	62	3.04	15
38.39	13.7	11.4	-	14.2	0.4	29.0	3.9	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.9	3.2	64	3.08	15
38.55	12.8	10.7	-	13.6	0.5	40.1	4.4	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.8	2.9	68	3.14	15
38.72	16.0	13.3	-	16.8	0.4	40.9	2.8	silty CLAY to CLAY	115	1.5	9	11	4	-	-	1.0	3.8	54	2.93	15
38.88	15.6	12.9	-	15.9	0.4	15.4	2.9	silty CLAY to CLAY	115	1.5	9	10	4	-	-	1.0	3.7	55	2.95	15
39.04	11.8	9.7	-	12.4	0.4	32.0	3.8	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.6	68	3.14	15
39.21	11.6	9.5	-	12.5	0.4	43.8	4.0	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.5	70	3.16	15
39.37	12.5	10.2	-	13.6	0.4	56.0	3.9	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.8	2.8	67	3.12	15
39.54	13.0	10.6	-	13.7	0.4	39.1	4.0	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.8	2.9	67	3.12	15
39.70	12.6	10.3	-	13.7	0.5	55.5	4.4	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.8	2.8	69	3.15	15
39.86	13.2	10.7	-	14.3	0.5	55.7	4.5	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.8	2.9	69	3.14	15
40.03	13.5	10.9	-	14.6	0.5	53.8	4.5	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	3.0	68	3.13	15
40.19	13.7	11.1	-	14.8	0.5	51.9	4.4	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	3.0	67	3.12	15
40.36	14.4	11.5	-	15.5	0.5	56.9	4.4	silty CLAY to CLAY	115	1.5	8	10	4	-	-	0.9	3.2	66	3.10	15
40.52	15.4	12.3	-	16.5	0.6	59.3	4.3	silty CLAY to CLAY	115	1.5	8	10	4	-	-	1.0	3.4	63	3.07	15
40.68	16.0	12.7	-	17.1	0.6	59.0	4.2	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.0	3.6	62	3.05	15
40.85	16.3	13.0	-	17.5	0.6	59.9	4.2	silty CLAY to CLAY	115	1.5	9	11	4	-	-	1.1	3.7	61	3.04	15
41.01	16.3	12.9	-	17.7	0.6	70.2	4.1	silty CLAY to CLAY	115	1.5	9	11	4	-	-	1.1	3.6	61	3.04	15
41.18	16.4	12.9	-	17.7	0.6	64.4	4.4	silty CLAY to CLAY	115	1.5	9	11	4	-	-	1.1	3.7	63	3.06	15
41.34	16.3	12.8	-	17.6	0.7	64.5	4.7	silty CLAY to CLAY	115	1.5	9	11	4	-	-	1.1	3.6	64	3.08	15
41.50	16.2	12.6	-	17.4	0.6	61.4	4.5	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.1	3.6	64	3.08	15
41.67	15.4	12.0	-	16.3	0.6	49.3	4.7	silty CLAY to CLAY	115	1.5	8	10	4	-	-	1.0	3.3	66	3.11	15
41.83	14.6	11.4	-	15.8	0.6	58.2	4.6	silty CLAY to CLAY	115	1.5	8	10	4	-	-	0.9	3.1	67	3.12	15
42.00	14.8	11.5	-	15.8	0.5	52.6	4.4	silty CLAY to CLAY	115	1.5	8	10	4	-	-	1.0	3.2	66	3.11	15
42.16	14.2	11.0	-	15.3	0.5	56.0	4.7	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	3.0	69	3.14	15
42.32	14.1	10.8	-	15.1	0.5	54.5	4.5	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	3.0	68	3.14	15
42.49	14.1	10.8	-	15.1	0.5	51.8	4.5	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	3.0	68	3.14	15
42.65	13.3	10.1	-	14.4	0.5	56.4	4.4	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.8	2.7	70	3.16	15
42.82	13.1	10.0	-	14.1	0.5	55.1	4.4	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.8	2.7	71	3.17	15
42.98	12.6	9.6	-	13.8	0.4	58.5	4.4	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.5	72	3.18	15
43.15	12.3	9.3	-	13.3	0.4	51.8	4.5	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.4	73	3.21	15
43.31	12.2	9.2	-	13.2	0.5	53.8	5.0	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.4	76	3.23	15
43.47	12.3	9.3	-	13.5	0.5	58.6	5.1	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.4	76	3.24	15
43.64	12.5	9.4	-	13.5	0.5	53.6	5.3	silty CLAY to CLAY	115	1.5	6	8	4	-	-	0.8	2.5	77	3.24	15
43.80	12.3	9.2	-	13.3	0.5	49.8	5.3	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.4	77	3.25	15
43.97	12.1	9.0	-	13.1	0.5	50.2	5.6	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.4	79	3.27	15
44.13	12.5	9.3	-	13.5	0.5	50.7	5.4	silty CLAY to CLAY	115	1.5	6	8	4	-	-	0.8	2.4	77	3.25	15
44.29	12.8	9.5	-	13.7	0.5	45.8	5.3	silty CLAY to CLAY	115	1.5	6	9	4	-	-	0.8	2.5	76	3.24	15
44.46	12.7	9.4	-	13.6	0.5	46.6	5.0	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.5	75	3.23	15
44.62	12.6	9.2	-	13.5	0.5	46.6	4.8	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.4	75	3.22	15
44.79	12.1	8.8	-	12.9	0.4	45.5	4.7	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.3	76	3.24	15
44.95	11.9	8.7	-	12.9	0.4	50.8	4.7	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.3	76	3.24	15
45.11	12.8	9.4	-	13.9	0.4	53.5	4.3	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.5	72	3.19	15
45.28	13.5	9.8	-	14.4	0.5	46.8	4.3	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	2.6	71	3.17	15
45.44	13.7	9.9	-	14.9	0.6	58.9	5.1	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	2.7	74	3.21	15
45.61	15.4	11.1	-	16.4	0.6	55.3	5.0	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	3.0	70	3.16	15
45.77	16.0	11.5	-	16.8	0.7	40.6	4.9	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.0	3.2	68	3.14	15
45.93	15.1	10.8	-	16.1	0.6	52.6	5.0	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	2.9	70	3.17	15
46.10	14.7	10.5	-	15.7	0.6	50.1	4.7	silty CLAY to CLAY	115	1.5	7	10	4	-	-	0.9	2.9	70	3.16	15
46.26	15.1	10.7	-	16.1	0.5	50.7	4.3	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	2.9	68	3.13	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

Sheetpile Wall at WBSD Property

Project ID: BAGG Engineering
Data File: SDF(050).cpt
CPT Date: 5/1/2018 10:33:01 AM
GW During Test: 6 ft

Sounding ID: CPT-04
Project No: FREYE-18-01
Cone/Rig: DDG1418

. . Depth ft	. qc PS tsf	* qc1n PS -	. q1ncs PS -	* qt PS tsf	. Slv Stss tsf	. pore prss (psi)	. Frct Rato %	* Material Behavior Description	. Unit Wght pcf	. Qc to N	* SPT R-N1 60%	. SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	. Und Shr tsf	. OCR - -	* Fin Ic %	* Ic SBT Indx	* Nk - -
46.43	15.2	10.8	-	16.4	0.5	57.0	4.2	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	2.9	67	3.12	15
46.59	16.3	11.5	-	17.3	0.6	53.2	4.7	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.0	3.2	67	3.12	15
46.75	18.2	12.8	-	19.3	0.6	58.2	3.8	silty CLAY to CLAY	115	1.5	9	12	4	-	-	1.2	3.6	60	3.03	15
46.92	22.9	16.1	-	23.2	0.5	15.6	2.6	clayy SILT to silty CLAY	115	2.0	8	11	5	-	-	1.5	4.7	48	2.83	15
47.08	17.4	12.2	-	18.1	0.5	35.3	3.1	silty CLAY to CLAY	115	1.5	8	12	4	-	-	1.1	3.4	58	3.00	15
47.25	15.3	10.7	-	16.3	0.4	52.4	3.1	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	2.9	62	3.05	15
47.41	15.6	10.9	-	16.7	0.4	53.0	3.0	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	3.0	61	3.03	15
47.57	15.7	10.9	-	16.8	0.4	56.9	3.1	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	3.0	61	3.04	15
47.74	17.0	11.8	-	18.2	0.5	62.6	3.3	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.1	3.3	60	3.03	15
47.90	17.8	12.3	-	18.9	0.5	55.0	3.4	silty CLAY to CLAY	115	1.5	8	12	4	-	-	1.2	3.4	60	3.02	15
48.07	17.2	11.9	-	18.3	0.6	57.4	3.9	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.1	3.3	63	3.07	15
48.23	20.3	14.0	-	21.6	0.5	66.1	2.8	silty CLAY to CLAY	115	1.5	9	14	4	-	-	1.3	4.0	53	2.91	15
48.39	21.3	14.6	-	22.4	0.5	55.8	2.5	clayy SILT to silty CLAY	115	2.0	7	11	4	-	-	1.4	4.2	50	2.86	15
48.56	18.8	12.8	-	19.9	0.5	56.5	3.0	silty CLAY to CLAY	115	1.5	9	13	4	-	-	1.2	3.6	56	2.96	15
48.72	19.0	12.9	-	20.3	0.4	68.7	2.6	silty CLAY to CLAY	115	1.5	9	13	4	-	-	1.2	3.6	54	2.93	15
48.89	18.9	12.8	-	20.1	0.3	63.0	2.1	clayy SILT to silty CLAY	115	2.0	6	9	4	-	-	1.2	3.6	51	2.88	15
49.05	16.2	11.0	-	17.4	0.3	59.9	2.4	silty CLAY to CLAY	115	1.5	7	11	3	-	-	1.0	3.0	57	2.98	15
49.22	14.0	9.5	-	15.3	0.3	68.1	2.7	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.9	2.5	64	3.08	15
49.38	13.9	9.4	-	15.3	0.3	72.4	2.7	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.9	2.5	64	3.08	15
49.54	12.4	8.3	-	13.9	0.3	73.2	3.3	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.1	71	3.18	15
49.71	11.8	7.9	-	13.3	0.3	73.4	3.5	silty CLAY to CLAY	115	1.5	5	8	3	-	-	0.7	2.0	75	3.22	15
49.87	11.7	7.8	-	13.0	0.3	69.6	3.8	silty CLAY to CLAY	115	1.5	5	8	3	-	-	0.7	1.9	77	3.25	15
50.04	11.4	7.6	-	12.7	0.3	70.0	3.8	silty CLAY to CLAY	115	1.5	5	8	3	-	-	0.7	1.9	78	3.26	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

Sheetpile Wall at WBSD Property

Project ID: BAGG Engineering
Data File: SDF(051).cpt
CPT Date: 5/1/2018 11:14:16 AM
GW During Test: 5 ft

Sounding ID: CPT-05
Project No: FREYE-18-01
Cone/Rig: DDG1418

Depth ft	qc PS tsf	* qc1n PS -	q1ncs PS -	* qt PS tsf	Slv Stss tsf	pore prss (psi)	Frct Rato %	* Material Behavior Description	Unit Wght pcf	Qc to N	* SPT R-N1 60%	SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	Und Shr tsf	OCR -	* Fin Ic %	* Ic SBT Indx	* Nk -
0.33	21.5	34.5	89.2	21.5	0.4	0.4	2.0	silty SAND to sandy SILT	120	3.0	11	7	8	32	48	-	-	29	2.46	16
0.49	14.4	23.1	-	14.4	0.4	1.0	3.1	clayy SILT to silty CLAY	115	2.0	12	7	6	-	-	1.0	9.9	41	2.71	15
0.66	8.7	13.9	-	8.7	0.5	1.7	6.2	silty CLAY to CLAY	115	1.5	9	6	5	-	-	0.6	9.9	64	3.08	15
0.82	8.6	13.8	-	8.7	0.6	1.9	7.4	silty CLAY to CLAY	115	1.5	9	6	5	-	-	0.6	9.9	68	3.13	15
0.98	10.2	16.3	-	10.2	0.8	1.4	7.5	silty CLAY to CLAY	115	1.5	11	7	5	-	-	0.7	9.9	64	3.08	15
1.15	10.5	16.8	-	10.5	0.7	1.4	6.9	silty CLAY to CLAY	115	1.5	11	7	6	-	-	0.7	9.9	62	3.05	15
1.31	10.1	16.2	-	10.1	0.7	1.6	6.7	silty CLAY to CLAY	115	1.5	11	7	5	-	-	0.7	9.9	62	3.05	15
1.48	9.4	15.0	-	9.4	0.6	0.3	6.0	silty CLAY to CLAY	115	1.5	10	6	5	-	-	0.7	9.9	61	3.04	15
1.64	8.3	13.3	-	8.3	0.5	1.1	6.2	silty CLAY to CLAY	115	1.5	9	6	5	-	-	0.6	9.9	65	3.09	15
1.80	8.9	14.3	-	9.0	0.6	2.5	6.3	silty CLAY to CLAY	115	1.5	10	6	5	-	-	0.6	9.9	64	3.07	15
1.97	12.0	19.2	-	12.0	0.5	2.7	4.3	silty CLAY to CLAY	115	1.5	13	8	6	-	-	0.8	9.9	50	2.87	15
2.13	11.2	17.9	-	11.2	0.4	1.1	3.9	silty CLAY to CLAY	115	1.5	12	7	5	-	-	0.8	9.9	50	2.86	15
2.30	7.6	12.2	-	7.6	0.6	0.3	8.2	silty CLAY to CLAY	115	1.5	8	5	4	-	-	0.5	9.9	73	3.21	15
2.46	11.7	18.7	-	11.7	0.8	3.5	6.9	silty CLAY to CLAY	115	1.5	12	8	6	-	-	0.8	9.9	60	3.02	15
2.62	18.8	30.2	-	18.9	1.1	5.1	5.6	silty CLAY to CLAY	115	1.5	20	13	9	-	-	1.3	9.9	46	2.80	15
2.79	20.1	32.3	-	20.2	1.1	3.2	5.3	silty CLAY to CLAY	115	1.5	22	13	9	-	-	1.4	9.9	44	2.77	15
2.95	18.1	29.1	-	18.2	1.0	1.2	5.7	silty CLAY to CLAY	115	1.5	19	12	8	-	-	1.3	9.9	47	2.82	15
3.12	16.4	26.3	-	16.4	1.0	1.0	6.0	silty CLAY to CLAY	115	1.5	18	11	8	-	-	1.1	9.9	50	2.87	15
3.28	15.7	25.2	-	15.8	1.0	5.3	6.5	silty CLAY to CLAY	115	1.5	17	10	8	-	-	1.1	9.9	52	2.90	15
3.45	25.6	41.0	-	25.7	1.1	5.3	4.4	clayy SILT to silty CLAY	115	2.0	21	13	11	-	-	1.8	9.9	37	2.63	15
3.61	45.7	73.2	144.5	45.7	1.2	3.6	2.7	silty SAND to sandy SILT	120	3.0	24	15	16	57	44	-	-	23	2.31	16
3.77	50.5	81.0	151.3	50.6	1.4	5.3	2.7	silty SAND to sandy SILT	120	3.0	27	17	18	60	45	-	-	22	2.27	16
3.94	30.6	49.1	149.2	30.6	1.2	0.9	4.0	clayy SILT to silty CLAY	115	2.0	25	15	12	-	-	2.1	9.9	33	2.55	15
4.10	24.7	39.6	-	24.7	1.0	2.7	4.2	clayy SILT to silty CLAY	115	2.0	20	12	10	-	-	1.7	9.9	37	2.63	15
4.27	13.9	22.3	-	14.0	1.0	4.4	7.1	silty CLAY to CLAY	115	1.5	15	9	7	-	-	1.0	9.9	56	2.97	15
4.43	13.5	21.6	-	13.6	1.0	5.5	7.4	silty CLAY to CLAY	115	1.5	14	9	7	-	-	0.9	9.9	58	2.99	15
4.59	13.8	22.1	-	13.9	1.0	4.1	7.4	silty CLAY to CLAY	115	1.5	15	9	7	-	-	1.0	9.9	58	2.99	15
4.76	12.0	19.3	-	12.1	1.2	4.2	9.9	silty CLAY to CLAY	115	1.5	13	8	7	-	-	0.8	9.9	67	3.12	15
4.92	12.0	19.3	-	12.1	1.1	6.2	9.3	silty CLAY to CLAY	115	1.5	13	8	7	-	-	0.8	9.9	65	3.10	15
5.09	31.3	50.1	119.3	31.4	0.8	8.8	2.6	silty SAND to sandy SILT	120	3.0	17	10	12	44	41	-	-	27	2.42	16
5.25	62.4	100.1	115.7	62.5	0.5	2.6	0.8	clean SAND to silty SAND	125	5.0	20	12	19	67	44	-	-	10	1.86	16
5.41	42.1	67.5	104.8	42.1	0.6	2.8	1.5	silty SAND to sandy SILT	120	3.0	22	14	14	54	42	-	-	17	2.15	16
5.58	29.3	47.0	96.5	29.3	0.5	2.8	1.8	silty SAND to sandy SILT	120	3.0	16	10	11	42	40	-	-	24	2.33	16
5.74	20.0	32.0	92.9	20.0	0.4	2.3	2.3	clayy SILT to silty CLAY	115	2.0	16	10	8	-	-	1.4	9.9	32	2.53	15
5.91	6.5	10.4	-	6.6	0.5	5.9	8.5	silty CLAY to CLAY	115	1.5	7	4	4	-	-	0.4	6.5	79	3.28	15
6.07	9.9	15.9	-	10.0	0.4	5.8	3.7	silty CLAY to CLAY	115	1.5	11	7	5	-	-	0.7	9.9	52	2.90	15
6.23	12.3	19.7	50.9	12.4	0.1	4.3	0.8	silty SAND to sandy SILT	120	3.0	7	4	5	13	35	-	-	29	2.46	16
6.40	127.6	204.6	204.6	127.5	0.1	-3.6	0.1	grvly SAND to dense SAND	130	6.0	34	21	31	91	47	-	-	5	1.20	16
6.56	95.6	153.4	153.4	95.6	0.2	-3.8	0.2	clean SAND to silty SAND	125	5.0	31	19	24	81	46	-	-	5	1.40	16
6.73	65.2	104.6	157.0	65.2	1.4	-3.8	2.1	silty SAND to sandy SILT	120	3.0	35	22	22	68	44	-	-	17	2.12	16
6.89	73.9	118.5	145.1	73.9	1.0	-0.8	1.3	clean SAND to silty SAND	125	5.0	24	15	23	73	44	-	-	11	1.94	16
7.05	37.8	60.6	168.2	37.8	1.6	-0.1	4.2	clayy SILT to silty CLAY	115	2.0	30	19	15	-	-	2.6	9.9	31	2.50	15
7.22	12.7	20.3	-	12.7	0.9	1.2	7.6	silty CLAY to CLAY	115	1.5	14	8	7	-	-	0.9	9.9	60	3.03	15
7.38	19.1	30.6	-	19.1	0.7	2.6	3.9	clayy SILT to silty CLAY	115	2.0	15	10	8	-	-	1.3	9.9	40	2.69	15
7.55	16.7	26.8	-	16.8	0.7	3.2	4.2	silty CLAY to CLAY	115	1.5	18	11	7	-	-	1.2	9.9	44	2.76	15
7.71	23.9	38.3	92.8	23.8	0.5	-3.5	2.0	silty SAND to sandy SILT	120	3.0	13	8	9	35	38	-	-	28	2.43	16
7.87	15.6	25.0	-	15.5	0.5	-2.9	3.3	clayy SILT to silty CLAY	115	2.0	13	8	7	-	-	1.1	9.9	41	2.71	15
8.04	7.9	12.7	-	7.9	0.7	-0.6	10.0	silty CLAY to CLAY	115	1.5	8	5	5	-	-	0.5	6.6	78	3.26	15
8.20	9.8	15.7	-	9.8	0.8	-0.2	9.0	silty CLAY to CLAY	115	1.5	10	7	6	-	-	0.7	8.1	70	3.16	15
8.37	12.6	20.3	-	12.6	1.8	0.1	9.9	silty CLAY to CLAY	115	1.5	14	8	7	-	-	0.9	9.9	66	3.11	15
8.53	44.1	69.0	147.4	44.1	1.3	-0.2	3.0	silty SAND to sandy SILT	120	3.0	23	15	16	55	41	-	-	25	2.35	16
8.69	34.6	53.8	128.1	34.6	1.0	-2.6	2.8	clayy SILT to silty CLAY	115	2.0	27	17	13	-	-	2.4	9.9	27	2.42	15
8.86	7.0	11.3	-	7.1	0.3	0.8	3.9	silty CLAY to CLAY	115	1.5	8	5	4	-	-	0.5	5.5	62	3.05	15
9.02	5.5	8.8	-	5.5	0.2	2.6	4.7	silty CLAY to CLAY	115	1.5	6	4	3	-	-	0.4	4.1	72	3.19	15
9.19	5.5	8.8	-	5.5	0.2	2.9	3.9	silty CLAY to CLAY	115	1.5	6	4	3	-	-	0.4	4.0	69	3.14	15
9.35	4.5	7.3	-	4.6	0.2	3.1	4.1	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	3.2	76	3.23	15
9.51	4.0	6.4	-	4.0	0.1	3.2	4.4	silty CLAY to CLAY	115	1.5	4	3	3	-	-	0.3	2.7	81	3.31	15
9.68	4.0	6.4	-	4.0	0.1	3.3	4.3	silty CLAY to CLAY	115	1.5	4	3	3	-	-	0.3	2.7	81	3.30	15
9.84	4.6	7.3	-	4.6	0.2	3.7	3.8	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	3.1	74	3.21	15
10.01	4.9	7.9	-	5.0	0.2	4.0	3.5	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	3.4	70	3.17	15
10.17	4.8	7.7	-	4.9	0.1	4.4	3.5	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	3.2	71	3.18	15
10.34	4.4	7.1	-	4.5	0.1	4.6	3.6	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	2.9	75	3.22	15
10.50	4.4	7.0	-	4.4	0.1	4.7	3.4	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	2.8	74	3.21	15
10.66	4.2	6.7	-	4.3	0.1	5.0	3.3	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.3	2.6	75	3.22	15
10.83	3.8	6.1	-	3.9	0.1	5.2	3.6	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	2.4	80	3.28	15
10.99	3.6	5.7	-	3.7	0.1	5.4	3.3	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.1	80	3.29	15
11.16	3.5	5.7	-	3.6	0.1	5.6	3.4	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.1	82	3.31	15
11.32	3.7	5.9	-	3.8	0.1	5.9	3.3	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.2	80	3.28	15
11.48	3.7	6.0	-	3.9	0.1	6.0	3.3	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.2	79	3.28	15
11.65	3.7	6.0	-	3.8	0.1	6.3	3.2	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.1	79	3.28	15
11.81	3.6	5.8	-	3.8	0.1	6.5	3.3	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.1	80	3.29	15
11.98	3.5	5.6	-	3.6	0.1	6.6	3.1	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.9	81	3.30	15
12.14	3.3	5.3	-	3.5	0.1	6.8	2.9	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.8	82	3.31	15
12.30	3.3	5.3	-	3.4	0.1	7.9	2.8	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.8	82	3.31	15
12.47	3.2	5.1	-	3.3	0.1	8.3	3.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	84	3.34	15
12.63	3.2	5.2	-	3.4	0.1	8.5	3.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.7	84	3.34	15
12.80	3.2	5.2	-	3.4	0.1	8.8	3.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	84	3.34	15
12.96	3.2	5.2	-	3.4	0.1	9.0	3.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	85	3.34	15
13.12	3.2	5.2	-	3.4	0.1	9.4	3.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	86	3.36	15
13.29	3.4	5.5	-	3.6	0.1	9.7	3.1	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.7	83	3.32	15
13.45	3.6	5.7	-	3.7	0.1	10.0	3.1	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.8	81	3.30	15
13.62	3.5	5.6	-	3.7	0.1	10.3	3.0	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.7	82	3.31	15
13.78	3.3	5.3	-	3.5	0.1	10.7	3.7	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.6	88	3.38	15
13.94	3.3	5.2	-	3.5	0.1	11.0	2.8	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.5	83	3.32	15
14.11	3.2	5.2	-	3.5	0.1	11.3	2.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.5	84	3.34	15
14.27	3.3	5.2	-	3.5	0.1	11.4	3.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.5	85	3.34	15
14.44	3.3	5.3	-	3.5	0.1	11.7	3.1	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.5	85	3.34	15
14.60	3.5	5.6	-	3.7	0.1	12.1	3.0	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.6	82	3.32	15
14.76	3.6	5.7	-	3.8	0.1	12.6	3.9	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.6	86	3.36	15
14.93	4.1	6.6	-	4.4	0.1	13.5	3.8	silty CLAY to CLAY	115	1.5	4	3	3	-	-	0.3	1.9	80	3.29	15
15.09	4.8	7.7	-	5.0	0.2	14.1	4.9	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	2.3	80	3.29	15
15.26	5.5	8.8	-	5.8	0.2	15.2	4.2	silty CLAY to CLAY	115	1.5	6	4	3	-	-	0.3	2.7	72	3.19	15
15.42	6.0	9.6	-	6.3	0.2	17.6	3.9	silty CLAY to CLAY	115	1.5	6	4	3	-	-	0.4	3.0	68	3.13	15

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The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

Sheetpile Wall at WBSD Property

Project ID: BAGG Engineering
Data File: SDF(051).cpt
CPT Date: 5/1/2018 11:14:16 AM
GW During Test: 5 ft

Sounding ID: CPT-05
Project No: FREYE-18-01
Cone/Rig: DDG1418

Depth ft	qc PS tsf	* qc1n PS -	q1ncs PS -	* qt PS tsf	Slv Stss tsf	pore prss (psi)	Frct Rato %	* Material Behavior Description	Unit Wght pcf	Qc to N	* SPT R-N1 60%	SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	Und Shr tsf	OCR -	* Fin Ic %	* Ic SBT Indx	* Nk -
15.58	5.9	9.4	-	6.2	0.2	19.8	3.4	silty CLAY to CLAY	115	1.5	6	4	3	-	-	0.4	2.9	66	3.11	15
15.75	5.1	8.2	-	5.5	0.1	19.5	3.3	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	2.4	70	3.16	15
15.91	4.6	7.3	-	4.9	0.1	19.1	3.3	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	2.1	74	3.21	15
16.08	4.3	6.9	-	4.7	0.1	19.7	3.4	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	1.9	77	3.25	15
16.24	4.3	6.9	-	4.7	0.1	19.7	3.6	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	1.9	78	3.26	15
16.40	4.5	7.2	-	4.9	0.1	20.0	3.4	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	2.0	75	3.23	15
16.57	4.7	7.5	-	5.1	0.1	20.4	3.3	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	2.0	73	3.21	15
16.73	4.6	7.3	-	5.0	0.1	21.3	3.5	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	2.0	75	3.23	15
16.90	4.4	7.1	-	4.8	0.1	21.5	3.5	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	1.9	77	3.25	15
17.06	4.5	7.3	-	5.0	0.1	22.1	3.9	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	1.9	78	3.26	15
17.23	5.0	8.0	-	5.5	0.2	22.4	4.1	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	2.2	75	3.23	15
17.39	5.2	8.3	-	5.6	0.2	23.4	3.8	silty CLAY to CLAY	115	1.5	6	3	3	-	-	0.3	2.2	73	3.20	15
17.55	4.6	7.4	-	5.0	0.1	22.3	4.1	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	1.9	79	3.27	15
17.72	4.1	6.6	-	4.5	0.1	21.8	4.6	silty CLAY to CLAY	115	1.5	4	3	3	-	-	0.2	1.6	86	3.35	15
17.88	3.9	6.1	-	4.3	0.2	22.2	7.0	silty CLAY to CLAY	115	1.5	4	3	3	-	-	0.2	1.5	95	3.49	15
18.05	4.5	7.0	-	4.9	0.3	22.1	9.2	Organic SOILS - Peats	100	1.0	7	4	3	-	-	0.4	1.8	95	3.50	10
18.21	5.4	8.4	-	5.8	0.4	20.0	9.9	Organic SOILS - Peats	100	1.0	8	5	4	-	-	0.5	2.2	94	3.45	10
18.37	6.5	10.0	-	6.9	0.5	20.9	9.9	silty CLAY to CLAY	115	1.5	7	4	4	-	-	0.4	2.8	87	3.37	15
18.54	7.3	11.2	-	7.6	0.6	19.3	9.9	silty CLAY to CLAY	115	1.5	7	5	5	-	-	0.5	3.2	84	3.33	15
18.70	7.3	11.2	-	7.6	0.7	16.8	9.9	silty CLAY to CLAY	115	1.5	7	5	5	-	-	0.5	3.2	84	3.33	15
18.87	7.6	11.6	-	7.9	0.8	12.3	9.9	silty CLAY to CLAY	115	1.5	8	5	5	-	-	0.5	3.3	83	3.32	15
19.03	8.0	12.1	-	8.2	0.8	12.4	9.9	silty CLAY to CLAY	115	1.5	8	5	5	-	-	0.5	3.4	81	3.31	15
19.19	8.6	12.9	-	8.9	0.8	15.3	9.9	silty CLAY to CLAY	115	1.5	9	6	5	-	-	0.6	3.7	79	3.28	15
19.36	9.2	13.7	-	9.5	0.8	16.5	9.9	silty CLAY to CLAY	115	1.5	9	6	5	-	-	0.6	4.0	78	3.26	15
19.52	9.9	14.8	-	10.2	0.9	13.9	9.8	silty CLAY to CLAY	115	1.5	10	7	5	-	-	0.7	4.3	75	3.23	15
19.69	10.3	15.2	-	10.6	0.9	14.8	9.4	silty CLAY to CLAY	115	1.5	10	7	6	-	-	0.7	4.5	73	3.21	15
19.85	10.6	15.5	-	10.9	0.9	16.7	9.1	silty CLAY to CLAY	115	1.5	10	7	6	-	-	0.7	4.6	72	3.19	15
20.01	11.1	16.2	-	11.4	0.8	16.7	8.5	silty CLAY to CLAY	115	1.5	11	7	6	-	-	0.7	4.8	70	3.16	15
20.18	11.2	16.2	-	11.5	0.8	16.6	8.3	silty CLAY to CLAY	115	1.5	11	7	6	-	-	0.7	4.8	69	3.14	15
20.34	11.4	16.4	-	11.7	0.8	17.7	7.5	silty CLAY to CLAY	115	1.5	11	8	6	-	-	0.8	4.9	66	3.11	15
20.51	11.6	16.7	-	12.0	0.7	18.0	7.2	silty CLAY to CLAY	115	1.5	11	8	6	-	-	0.8	4.9	65	3.09	15
20.67	11.6	16.5	-	12.0	0.7	23.0	7.1	silty CLAY to CLAY	115	1.5	11	8	6	-	-	0.8	4.9	65	3.10	15
20.83	12.5	17.7	-	12.9	0.8	23.3	7.4	silty CLAY to CLAY	115	1.5	12	8	6	-	-	0.8	5.3	64	3.08	15
21.00	13.0	18.3	-	13.5	0.9	24.8	7.5	silty CLAY to CLAY	115	1.5	12	9	6	-	-	0.9	5.5	64	3.08	15
21.16	13.6	19.0	-	14.1	0.9	23.5	7.3	silty CLAY to CLAY	115	1.5	13	9	6	-	-	0.9	5.7	62	3.05	15
21.33	14.4	20.0	-	14.9	0.9	27.1	6.9	silty CLAY to CLAY	115	1.5	13	10	6	-	-	1.0	6.0	60	3.02	15
21.49	14.8	20.4	-	15.4	0.9	31.9	6.7	silty CLAY to CLAY	115	1.5	14	10	7	-	-	1.0	6.2	59	3.00	15
21.65	15.7	21.6	-	16.3	0.9	30.9	6.2	silty CLAY to CLAY	115	1.5	14	10	7	-	-	1.1	6.6	56	2.96	15
21.82	16.4	22.3	-	17.0	0.9	30.7	6.1	silty CLAY to CLAY	115	1.5	15	11	7	-	-	1.1	6.8	55	2.94	15
21.98	15.9	21.5	-	16.8	0.9	47.1	6.1	silty CLAY to CLAY	115	1.5	14	11	7	-	-	1.1	6.5	56	2.96	15
22.15	16.1	21.6	-	16.9	0.9	43.8	6.2	silty CLAY to CLAY	115	1.5	14	11	7	-	-	1.1	6.6	56	2.96	15
22.31	16.9	22.7	-	18.1	1.0	59.4	6.2	silty CLAY to CLAY	115	1.5	15	11	7	-	-	1.1	6.9	55	2.94	15
22.47	19.6	26.2	-	20.8	1.2	59.0	6.4	silty CLAY to CLAY	115	1.5	17	13	8	-	-	1.3	8.1	52	2.91	15
22.64	22.1	29.3	-	23.2	1.2	52.6	6.0	silty CLAY to CLAY	115	1.5	20	15	9	-	-	1.5	9.1	49	2.85	15
22.80	26.2	34.5	-	27.1	1.3	45.8	5.3	silty CLAY to CLAY	115	1.5	23	17	10	-	-	1.8	9.9	43	2.75	15
22.97	26.4	34.6	-	27.3	1.3	47.7	5.3	silty CLAY to CLAY	115	1.5	23	18	10	-	-	1.8	9.9	43	2.75	15
23.13	24.8	32.3	-	25.7	1.4	45.2	6.1	silty CLAY to CLAY	115	1.5	22	17	9	-	-	1.7	9.9	47	2.82	15
23.30	23.4	30.3	-	24.4	1.5	51.9	6.7	silty CLAY to CLAY	115	1.5	20	16	9	-	-	1.6	9.4	50	2.87	15
23.46	23.9	30.7	-	24.9	1.5	51.2	6.7	silty CLAY to CLAY	115	1.5	20	16	9	-	-	1.6	9.6	50	2.87	15
23.62	26.4	33.9	-	27.5	1.5	52.4	6.0	silty CLAY to CLAY	115	1.5	23	18	10	-	-	1.8	9.9	46	2.80	15
23.79	28.0	35.7	-	29.2	1.5	58.7	5.5	silty CLAY to CLAY	115	1.5	24	19	10	-	-	1.9	9.9	44	2.76	15
23.95	29.2	37.0	-	30.4	1.5	57.9	5.4	silty CLAY to CLAY	115	1.5	25	19	10	-	-	2.0	9.9	43	2.74	15
24.12	29.2	36.8	-	30.3	1.5	56.5	5.5	silty CLAY to CLAY	115	1.5	25	19	10	-	-	2.0	9.9	43	2.75	15
24.28	29.5	37.0	-	30.5	1.5	51.8	5.3	silty CLAY to CLAY	115	1.5	25	20	10	-	-	2.0	9.9	42	2.74	15
24.44	33.7	42.1	-	35.0	1.5	66.8	4.8	clayy SILT to silty CLAY	115	2.0	21	17	11	-	-	2.3	9.9	38	2.66	15
24.61	42.3	45.7	148.8	43.4	1.7	56.3	4.1	clayy SILT to silty CLAY	115	2.0	23	21	12	-	-	2.9	9.9	35	2.59	15
24.77	41.4	47.1	-	42.2	1.9	38.6	4.6	clayy SILT to silty CLAY	115	2.0	24	21	12	-	-	2.9	9.9	36	2.62	15
24.94	48.6	52.3	168.2	49.2	2.2	30.0	4.6	clayy SILT to silty CLAY	115	2.0	26	24	13	-	-	3.4	9.9	34	2.58	15
25.10	47.6	51.1	159.8	47.6	2.0	-2.6	4.3	clayy SILT to silty CLAY	115	2.0	26	24	13	-	-	3.3	9.9	34	2.57	15
25.26	43.0	46.1	151.9	43.0	1.8	-0.3	4.2	clayy SILT to silty CLAY	115	2.0	23	22	12	-	-	3.0	9.9	35	2.60	15
25.43	36.8	44.4	-	36.9	1.5	5.1	4.2	clayy SILT to silty CLAY	115	2.0	22	18	11	-	-	2.5	9.9	35	2.60	15
25.59	33.0	39.7	-	33.0	1.3	-2.3	4.1	clayy SILT to silty CLAY	115	2.0	20	17	10	-	-	2.3	9.9	37	2.64	15
25.76	29.8	35.6	-	29.8	1.3	1.5	4.5	silty CLAY to CLAY	115	1.5	24	20	10	-	-	2.0	9.9	40	2.70	15
25.92	28.4	33.8	-	28.6	1.3	6.8	4.9	silty CLAY to CLAY	115	1.5	23	19	9	-	-	1.9	9.9	43	2.74	15
26.08	29.9	35.4	-	30.1	1.2	7.4	4.2	clayy SILT to silty CLAY	115	2.0	18	15	9	-	-	2.1	9.9	39	2.68	15
26.25	33.4	39.3	-	33.8	1.2	21.5	3.8	clayy SILT to silty CLAY	115	2.0	20	17	10	-	-	2.3	9.9	36	2.61	15
26.41	28.5	33.3	-	28.6	1.1	8.1	4.2	clayy SILT to silty CLAY	115	2.0	17	14	9	-	-	2.0	9.9	41	2.70	15
26.58	26.9	31.3	-	27.1	0.9	8.0	3.7	clayy SILT to silty CLAY	115	2.0	16	13	8	-	-	1.8	9.8	40	2.68	15
26.74	23.3	27.0	-	23.6	0.8	12.5	3.6	clayy SILT to silty CLAY	115	2.0	14	12	7	-	-	1.6	8.3	42	2.72	15
26.90	20.7	23.9	-	21.3	0.7	26.6	3.6	clayy SILT to silty CLAY	115	2.0	12	10	7	-	-	1.4	7.3	44	2.77	15
27.07	19.0	21.8	-	19.3	0.7	18.2	4.1	silty CLAY to CLAY	115	1.5	15	13	6	-	-	1.3	6.6	48	2.84	15
27.23	17.8	20.4	-	17.9	0.7	5.7	4.4	silty CLAY to CLAY	115	1.5	14	12	6	-	-	1.2	6.1	51	2.88	15
27.40	16.0	18.2	-	16.0	0.7	1.9	5.0	silty CLAY to CLAY	115	1.5	12	11	6	-	-	1.1	5.4	56	2.96	15
27.56	17.0	19.2	-	17.5	0.6	29.3	4.1	silty CLAY to CLAY	115	1.5	13	11	6	-	-	1.1	5.7	51	2.88	15
27.72	16.2	18.2	-	16.7	0.6	26.9	4.0	silty CLAY to CLAY	115	1.5	12	11	5	-	-	1.1	5.4	52	2.90	15
27.89	13.2	14.8	-	13.6	0.5	18.6	4.1	silty CLAY to CLAY	115	1.5	10	9	5	-	-	0.9	4.3	57	2.98	15
28.05	10.4	11.6	-	10.5	0.4	9.0	4.1	silty CLAY to CLAY	115	1.5	8	7	4	-	-	0.7	3.2	64	3.08	15
28.22	7.8	8.7	-	8.0	0.3	12.3	4.5	silty CLAY to CLAY	115	1.5	6	5	3	-	-	0.5	2.3	76	3.23	15
28.38	6.9	7.6	-	7.1	0.2	11.7	4.3	silty CLAY to CLAY	115	1.5	5	5	3	-	-	0.4	1.9	79	3.28	15
28.54	6.9	7.5	-	7.1	0.2	13.3	4.3	silty CLAY to CLAY	115	1.5	5	5	3	-	-	0.4	1.9	80	3.28	15
28.71	7.6	8.3	-	8.0	0.2	20.1	4.2	silty CLAY to CLAY	115	1.5	6	5	3	-	-	0.5	2.1	76	3.24	15
28.87	8.6	9.4	-	9.0	0.3	20.9	4.2	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.5	2.5	71	3.18	15
29.04	9.3	10.1	-	9.7	0.3	21.6	4.5	silty CLAY to CLAY	115	1.5	7	6	4	-	-	0.6	2.7	70	3.17	15
29.20	9.9	10.6	-	10.3	0.4	22.6	4.7	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.6	2.9	69	3.15	15
29.36	10.4	11.1	-	10.8	0.4	23.5	5.0	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	3.1	69	3.15	15
29.53	10.6	11.3	-	11.0	0.5	24.4	5.5	silty CLAY to CLAY	115	1.5	8	7	4	-	-	0.7	3.1	71	3.17	15
29.69	10.8	11.4	-	11.1	0.5	17.1	5.5	silty CLAY to CLAY	115	1.5	8	7	4	-	-	0.7	3.2	70	3.17	15
29.86	10.8	11.4	-	11.0	0.5	12.3	5.4	silty CLAY to CLAY	115	1.5	8	7	4	-	-	0.7	3.2	70	3.16	15
30.02	10.4	11.0	-	10.7	0.4	13.0	4.9	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	3.0	69	3.15	15
30.19	10.9	11.5	-	11.2	0.4	13.5	4.6	silty CLAY to CLAY	115	1.5	8	7	4	-	-	0.7	3.2	67	3.12	15
30.35	11.4	11.9	-	11.6	0.4	13.6	4.4	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.7	3.3	65	3.09	15
30.51	11.9	12.3	-	12.2	0.4	17.8	4.3	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.5	63	3.07	15
30.68	12.6	13.1	-	13.1	0.5	22.3	4.2	silty CLAY to CLAY	115	1.5	9	8	4	-	-	0.8	3.7	61	3.04	15
30.84	13.3	13.7	-	13.9	0.4	31.3	3.8	silty CLAY to CLAY	115	1.5	9	9	4	-	-	0.9	3.9	58	3.00	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

. Depth ft	. qc PS tsf	* qc1n PS -	. q1ncs PS -	* qt PS tsf	. Slv Stss tsf	. pore prss (psi)	. Frct Rato %	* Material Behavior Description	. Unit Wght pcf	. Qc to N	* SPT R-N1 60%	. SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	. Und Shr tsf	. OCR - -	* Fin Ic %	* Ic SBT Indx	* Nk - -
31.01	14.3	14.7	-	15.0	0.4	36.6	3.5	silty CLAY to CLAY	115	1.5	10	10	5	-	-	0.9	4.2	55	2.94	15
31.17	14.3	14.6	-	15.0	0.4	38.1	3.4	silty CLAY to CLAY	115	1.5	10	10	4	-	-	0.9	4.2	55	2.94	15
31.33	13.5	13.7	-	14.2	0.4	37.8	3.2	silty CLAY to CLAY	115	1.5	9	9	4	-	-	0.9	3.9	55	2.95	15
31.50	13.3	13.5	-	14.1	0.4	40.0	3.4	silty CLAY to CLAY	115	1.5	9	9	4	-	-	0.9	3.9	57	2.97	15
31.66	12.3	12.4	-	13.0	0.4	34.9	3.8	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.5	61	3.04	15
31.83	12.2	12.3	-	12.8	0.4	27.4	4.2	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.4	63	3.06	15
31.99	12.1	12.1	-	12.7	0.4	28.8	4.2	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.4	64	3.07	15
32.15	11.2	11.2	-	11.7	0.4	21.6	4.8	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	3.1	68	3.14	15
32.32	10.7	10.6	-	11.2	0.4	29.6	5.1	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	2.9	71	3.18	15
32.48	10.9	10.8	-	11.4	0.5	25.3	5.0	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	2.9	70	3.17	15
32.65	10.9	10.7	-	11.4	0.4	23.6	4.9	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	2.9	70	3.16	15
32.81	11.2	10.9	-	11.7	0.4	27.1	4.5	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	3.0	68	3.13	15
32.97	11.6	11.3	-	12.1	0.4	28.6	4.2	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.7	3.1	66	3.10	15
33.14	11.8	11.4	-	12.4	0.4	33.6	4.2	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.2	65	3.10	15
33.30	12.1	11.7	-	12.8	0.4	36.2	4.1	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.2	64	3.08	15
33.47	12.3	11.8	-	13.0	0.5	35.2	4.5	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.3	65	3.10	15
33.63	12.1	11.6	-	12.8	0.5	32.5	4.6	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.2	66	3.11	15
33.79	12.6	12.0	-	13.3	0.5	32.7	4.5	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.4	65	3.09	15
33.96	13.9	13.2	-	14.5	0.4	34.7	3.8	silty CLAY to CLAY	115	1.5	9	9	4	-	-	0.9	3.7	59	3.01	15
34.12	15.5	14.7	-	16.0	0.4	24.3	2.9	silty CLAY to CLAY	115	1.5	10	10	4	-	-	1.0	4.2	52	2.90	15
34.29	13.2	12.4	-	13.8	0.4	29.9	3.2	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.9	3.5	58	2.99	15
34.45	11.0	10.3	-	11.5	0.3	28.6	3.8	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	2.8	67	3.12	15
34.61	9.8	9.2	-	10.6	0.3	38.7	4.1	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.4	72	3.18	15
34.78	10.2	9.5	-	11.2	0.3	52.2	3.9	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.5	70	3.16	15
34.94	10.6	9.9	-	11.6	0.3	48.5	4.0	silty CLAY to CLAY	115	1.5	7	7	3	-	-	0.7	2.6	69	3.15	15
35.11	10.8	10.0	-	11.8	0.4	50.7	4.0	silty CLAY to CLAY	115	1.5	7	7	3	-	-	0.7	2.7	69	3.15	15
35.27	10.7	9.8	-	11.6	0.4	45.3	4.4	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	2.6	71	3.17	15
35.43	10.4	9.5	-	11.2	0.4	40.3	4.8	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.5	74	3.21	15
35.60	10.4	9.5	-	11.1	0.4	35.7	5.0	silty CLAY to CLAY	115	1.5	6	7	4	-	-	0.7	2.5	75	3.22	15
35.76	10.6	9.6	-	11.2	0.4	31.0	4.9	silty CLAY to CLAY	115	1.5	6	7	4	-	-	0.7	2.6	74	3.21	15
35.93	10.4	9.4	-	11.1	0.4	34.9	5.0	silty CLAY to CLAY	115	1.5	6	7	4	-	-	0.7	2.5	75	3.23	15
36.09	10.8	9.7	-	11.5	0.4	39.1	4.6	silty CLAY to CLAY	115	1.5	6	7	4	-	-	0.7	2.6	72	3.19	15
36.26	12.3	11.0	-	13.2	0.4	45.4	3.9	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.8	3.0	65	3.09	15
36.42	17.7	15.8	-	18.8	0.4	60.6	2.6	clayy SILT to silty CLAY	115	2.0	8	9	5	-	-	1.2	4.6	48	2.84	15
36.58	18.2	16.3	-	19.4	0.6	58.1	3.7	silty CLAY to CLAY	115	1.5	11	12	5	-	-	1.2	4.7	53	2.92	15
36.75	22.7	20.2	-	24.5	0.6	90.9	3.1	clayy SILT to silty CLAY	115	2.0	10	11	6	-	-	1.5	6.0	45	2.79	15
36.91	25.2	22.3	-	26.2	0.6	48.2	2.8	clayy SILT to silty CLAY	115	2.0	11	13	6	-	-	1.7	6.7	42	2.73	15
37.08	22.6	20.0	-	23.6	0.5	47.7	2.7	clayy SILT to silty CLAY	115	2.0	10	11	6	-	-	1.5	6.0	44	2.76	15
37.24	18.6	16.4	-	19.3	0.5	35.9	2.9	silty CLAY to CLAY	115	1.5	11	12	5	-	-	1.2	4.8	49	2.86	15
37.40	16.5	14.4	-	17.1	0.5	30.3	3.2	silty CLAY to CLAY	115	1.5	10	11	4	-	-	1.1	4.1	54	2.93	15
37.57	15.4	13.5	-	16.0	0.4	26.4	3.0	silty CLAY to CLAY	115	1.5	9	10	4	-	-	1.0	3.8	55	2.95	15
37.73	13.6	11.8	-	14.2	0.4	33.0	3.2	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.9	3.3	60	3.02	15
37.90	10.7	9.3	-	11.6	0.4	42.0	4.9	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.4	75	3.23	15
38.06	10.3	8.9	-	11.2	0.3	47.1	4.2	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.3	73	3.21	15
38.22	12.6	10.9	-	13.4	0.5	40.7	5.0	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.8	3.0	70	3.17	15
38.39	14.5	12.4	-	15.4	0.5	44.1	4.4	silty CLAY to CLAY	115	1.5	8	10	4	-	-	0.9	3.5	64	3.08	15
38.55	24.8	21.1	-	25.5	0.5	34.8	2.4	clayy SILT to silty CLAY	115	2.0	11	12	6	-	-	1.7	6.3	41	2.70	15
38.72	36.6	32.7	82.8	36.7	0.6	5.6	1.7	silty SAND to sandy SILT	120	3.0	11	12	8	30	34	-	-	29	2.45	16
38.88	24.8	21.0	-	24.9	0.8	7.1	3.3	clayy SILT to silty CLAY	115	2.0	10	12	6	-	-	1.7	6.3	46	2.80	15
39.04	21.2	17.8	-	21.8	0.6	34.6	3.0	silty CLAY to CLAY	115	1.5	12	14	5	-	-	1.4	5.3	48	2.84	15
39.21	31.9	28.4	85.8	33.0	0.6	55.1	2.0	clayy SILT to silty CLAY	115	2.0	14	16	7	-	-	2.2	8.2	33	2.55	15
39.37	36.0	32.0	79.4	36.0	0.5	1.8	1.5	silty SAND to sandy SILT	120	3.0	11	12	8	29	33	-	-	28	2.44	16
39.54	22.4	18.6	-	22.4	0.4	3.1	2.2	clayy SILT to silty CLAY	115	2.0	9	11	5	-	-	1.5	5.5	42	2.73	15
39.70	15.4	12.8	-	15.7	0.4	15.8	3.4	silty CLAY to CLAY	115	1.5	9	10	4	-	-	1.0	3.6	58	3.00	15
39.86	12.8	10.6	-	13.5	0.5	38.5	4.3	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.8	2.9	68	3.14	15
40.03	13.2	10.9	-	14.0	0.5	37.5	4.5	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.8	3.0	68	3.14	15
40.19	12.9	10.6	-	13.6	0.5	34.1	4.7	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.8	2.9	70	3.16	15
40.36	12.9	10.6	-	13.6	0.5	31.8	4.7	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.8	2.9	70	3.16	15
40.52	12.5	10.2	-	13.1	0.5	28.2	5.2	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.8	2.7	73	3.20	15
40.68	12.3	10.0	-	12.8	0.6	25.9	5.7	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.8	2.7	76	3.23	15
40.85	13.0	10.5	-	13.4	0.6	24.3	5.6	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.8	2.8	74	3.21	15
41.01	13.7	11.0	-	14.2	0.6	25.1	5.0	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	3.0	70	3.16	15
41.18	13.4	10.8	-	13.9	0.6	26.2	5.3	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	2.9	72	3.18	15
41.34	12.9	10.4	-	13.5	0.5	30.0	5.1	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.8	2.8	72	3.19	15
41.50	13.1	10.4	-	13.6	0.5	25.0	4.8	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.8	2.8	71	3.17	15
41.67	12.7	10.1	-	13.3	0.5	30.2	4.8	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.8	2.7	72	3.18	15
41.83	12.2	9.6	-	12.8	0.4	31.9	4.6	silty CLAY to CLAY	115	1.5	6	8	4	-	-	0.8	2.6	73	3.20	15
42.00	11.8	9.3	-	12.3	0.4	29.6	4.7	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.4	75	3.22	15
42.16	11.5	9.1	-	12.1	0.4	33.7	4.6	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.4	75	3.22	15
42.32	11.8	9.3	-	12.5	0.4	35.0	4.5	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.4	74	3.21	15
42.49	11.5	9.0	-	12.1	0.4	32.9	4.8	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.3	76	3.23	15
42.65	11.4	8.9	-	12.1	0.4	33.6	4.5	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.3	75	3.22	15
42.82	11.0	8.6	-	11.7	0.4	37.2	4.4	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.2	76	3.24	15
42.98	10.5	8.1	-	11.3	0.4	40.4	4.5	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	2.0	78	3.27	15
43.15	10.0	7.7	-	10.7	0.3	37.3	4.4	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	1.9	80	3.28	15
43.31	9.6	7.4	-	10.2	0.3	35.6	4.5	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.8	82	3.31	15
43.47	9.4	7.2	-	10.1	0.3	37.4	4.2	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.7	82	3.31	15
43.64	9.4	7.2	-	10.2	0.3	38.7	3.8	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.7	79	3.28	15
43.80	9.4	7.1	-	10.2	0.3	40.1	3.7	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.7	80	3.28	15
43.97	9.3	7.1	-	10.2	0.3	44.9	3.9	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.7	81	3.30	15
44.13	9.7	7.4	-	10.6	0.3	46.4	4.5	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.8	82	3.31	15
44.29	10.5	7.9	-	11.5	0.4	48.8	4.6	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	2.0	80	3.28	15
44.46	11.3	8.5	-	12.2	0.5	46.1	5.2	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.2	80	3.28	15
44.62	11.3	8.5	-	12.1	0.5	43.9	5.2	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.2	80	3.28	15
44.79	11.4	8.5	-	12.2	0.4	39.4	4.8	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.2	78	3.26	15
44.95	10.6	7.9	-	11.4	0.4	41.5	4.9	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.7	2.0	81	3.30	15
45.11	10.4	7.7	-	11.3	0.4	48.0	4.8	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	1.9	82	3.31	15
45.28	11.0	8.1	-	11.9	0.4	49.1	4.3	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.7	2.0	78	3.26	15
45.44	11.7	8.6	-	12.7	0.4	48.0	4.1	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.2	74	3.22	15
45.61	12.2	9.0	-	13.3	0.4	56.6	4.2	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.3	73	3.20	15
45.77	13.7	10.0	-	14.9	0.4	61.5	3.6	silty CLAY to CLAY	115	1.5	7	9	3	-	-	0.9	2.7	67	3.11	15
45.93	14.0	10.3	-	15.2	0.4	56.6	3.8	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	2.7	67	3.12	15
46.10	12.9	9.4	-	14.1	0.4	64.1	4.3	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.5	72	3.19	15
46.26	13.5	9.8	-	14.5	0.5	55.0	4.2	silty CLAY to CLAY	115	1.5	7	9	3	-	-	0.9	2.6	70	3.17	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Sheetpile Wall at WBSD Property

Project ID: BAGG Engineering
Data File: SDF(051).cpt
CPT Date: 5/1/2018 11:14:16 AM
GW During Test: 5 ft

Sounding ID: CPT-05
Project No: FREYE-18-01
Cone/Rig: DDG1418

. Depth ft	. qc PS tsf	* qc1n PS -	. q1ncs PS -	* qt PS tsf	. Slv Stss tsf	. pore prss (psi)	. Frct Rato %	* Material Behavior Description	. Unit Wght pcf	. Qc to N	* SPT R-N1 60%	. SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	. Und Shr tsf	. OCR - -	* Fin Ic %	* Ic SBT Indx	* Nk - -
46.43	13.7	9.9	-	14.7	0.5	51.5	4.1	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	2.6	70	3.16	15
46.59	12.9	9.3	-	14.0	0.4	60.0	4.2	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.4	72	3.19	15
46.75	12.7	9.1	-	13.7	0.4	49.7	4.2	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.4	73	3.20	15
46.92	12.4	8.9	-	13.4	0.4	52.8	3.8	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.3	72	3.19	15
47.08	12.2	8.7	-	13.3	0.4	57.3	3.8	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.2	72	3.19	15
47.25	13.0	9.2	-	14.3	0.4	66.2	3.6	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.4	70	3.16	15
47.41	14.2	10.1	-	15.4	0.4	62.3	3.6	silty CLAY to CLAY	115	1.5	7	9	3	-	-	0.9	2.7	67	3.11	15
47.57	15.0	10.6	-	16.0	0.4	51.8	3.3	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	2.9	63	3.07	15
47.74	15.6	11.0	-	16.7	0.4	56.4	3.1	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	3.0	61	3.04	15
47.90	15.5	10.9	-	16.7	0.4	62.3	3.1	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	3.0	62	3.04	15
48.07	15.3	10.8	-	16.6	0.3	63.5	2.7	silty CLAY to CLAY	115	1.5	7	10	3	-	-	1.0	2.9	60	3.02	15
48.23	15.7	11.0	-	17.2	0.4	73.7	2.7	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	3.0	59	3.01	15
48.39	15.0	10.5	-	16.4	0.3	72.3	2.7	silty CLAY to CLAY	115	1.5	7	10	3	-	-	1.0	2.8	60	3.03	15
48.56	15.2	10.6	-	16.5	0.3	67.5	2.5	silty CLAY to CLAY	115	1.5	7	10	3	-	-	1.0	2.8	59	3.00	15
48.72	14.2	9.9	-	15.6	0.3	70.7	3.0	silty CLAY to CLAY	115	1.5	7	9	3	-	-	0.9	2.6	64	3.08	15
48.89	14.3	9.9	-	15.8	0.5	75.1	4.3	silty CLAY to CLAY	115	1.5	7	10	4	-	-	0.9	2.6	70	3.17	15
49.05	16.5	11.4	-	18.1	0.4	80.8	3.3	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.1	3.1	61	3.04	15
49.22	23.4	16.1	-	24.7	0.5	64.8	2.6	clayy SILT to silty CLAY	115	2.0	8	12	5	-	-	1.5	4.7	48	2.84	15
49.38	21.2	14.5	-	22.3	0.7	58.3	3.6	silty CLAY to CLAY	115	1.5	10	14	5	-	-	1.4	4.2	56	2.96	15
49.54	23.3	15.9	-	24.5	1.1	62.0	5.5	silty CLAY to CLAY	115	1.5	11	16	5	-	-	1.5	4.6	61	3.04	15
49.71	26.6	18.1	-	28.1	1.3	73.3	5.5	silty CLAY to CLAY	115	1.5	12	18	6	-	-	1.8	5.3	58	2.99	15
49.87	47.8	38.3	100.6	48.8	1.0	48.6	2.2	silty SAND to sandy SILT	120	3.0	13	16	9	35	34	-	-	29	2.47	16
50.04	27.2	18.4	-	27.1	0.7	-4.2	2.9	clayy SILT to silty CLAY	115	2.0	9	14	5	-	-	1.8	5.4	47	2.81	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

Sheetpile Wall at WBSD Property

Project ID: BAGG Engineering
Data File: SDF(052).cpt
CPT Date: 5/1/2018 11:56:11 AM
GW During Test: 6 ft

Sounding ID: CPT-06
Project No: FREYE-18-01
Cone/Rig: DDG1418

Depth ft	qc PS tsf	qc1n PS -	q1ncs PS -	qt PS tsf	Slv Stss tsf	pore prss (psi)	Frct Rato %	Material Behavior Description	Unit Wght pcf	Qc to N	SPT R-N1 60%	SPT R-N 60%	SPT IcN1 60%	Rel Den %	Ftn Ang deg	Und Shr tsf	OCR - -	Fin Ic %	Ic SBT Indx	Nk - -
.	.	*	.	*	.	.	.	*	.	.	*	.	*	*	*	.	.	*	*	*
0.33	188.8	302.8	302.8	188.9	2.0	5.3	1.1	clean SAND to silty SAND	125	5.0	61	38	51	95	48	-	-	5	1.59	16
0.49	116.0	186.0	227.2	116.1	2.3	3.0	2.0	clean SAND to silty SAND	125	5.0	37	23	36	87	48	-	-	11	1.93	16
0.66	59.1	94.8	170.2	59.2	1.7	4.6	2.9	silty SAND to sandy SILT	120	3.0	32	20	21	65	48	-	-	21	2.25	16
0.82	34.7	55.6	150.5	34.8	1.3	5.7	3.7	clayy SILT to silty CLAY	115	2.0	28	17	13	-	-	2.4	9.9	30	2.49	15
0.98	19.9	32.0	-	20.1	1.5	6.9	7.7	silty CLAY to CLAY	115	1.5	21	13	9	-	-	1.4	9.9	51	2.88	15
1.15	45.6	73.1	158.5	45.9	1.5	15.5	3.3	silty SAND to sandy SILT	120	3.0	24	15	17	57	48	-	-	25	2.36	16
1.31	37.7	60.5	191.3	37.8	2.0	3.1	5.3	clayy SILT to silty CLAY	115	2.0	30	19	15	-	-	2.7	9.9	34	2.57	15
1.48	28.9	46.4	-	29.1	2.2	6.8	7.5	silty CLAY to CLAY	115	1.5	31	19	13	-	-	2.0	9.9	44	2.77	15
1.64	63.1	101.2	190.6	63.3	2.1	10.3	3.4	silty SAND to sandy SILT	120	3.0	34	21	22	67	48	-	-	22	2.28	16
1.80	61.6	98.8	173.4	61.7	1.8	7.0	2.9	silty SAND to sandy SILT	120	3.0	33	21	21	67	48	-	-	20	2.23	16
1.97	49.4	79.2	164.0	49.4	1.6	2.2	3.2	silty SAND to sandy SILT	120	3.0	26	16	18	59	47	-	-	24	2.34	16
2.13	30.6	49.1	140.2	30.7	1.1	3.4	3.6	clayy SILT to silty CLAY	115	2.0	25	15	12	-	-	2.2	9.9	31	2.52	15
2.30	21.2	34.0	-	21.3	1.0	3.8	4.8	silty CLAY to CLAY	115	1.5	23	14	9	-	-	1.5	9.9	41	2.72	15
2.46	27.9	44.7	126.4	28.1	0.9	11.8	3.2	clayy SILT to silty CLAY	115	2.0	22	14	11	-	-	2.0	9.9	31	2.51	15
2.62	52.2	83.7	127.7	52.3	0.9	3.1	1.8	silty SAND to sandy SILT	120	3.0	28	17	17	61	46	-	-	17	2.14	16
2.79	30.4	48.7	108.3	30.4	0.7	2.6	2.2	silty SAND to sandy SILT	120	3.0	16	10	11	43	44	-	-	26	2.38	16
2.95	17.4	27.9	-	17.4	0.5	2.6	2.9	clayy SILT to silty CLAY	115	2.0	14	9	7	-	-	1.2	9.9	37	2.64	15
3.12	12.0	19.2	-	12.0	0.5	4.5	4.0	silty CLAY to CLAY	115	1.5	13	8	6	-	-	0.8	9.9	49	2.85	15
3.28	17.8	28.5	-	18.0	0.7	9.2	3.8	clayy SILT to silty CLAY	115	2.0	14	9	8	-	-	1.2	9.9	41	2.71	15
3.45	47.2	75.7	144.6	47.2	1.2	3.9	2.6	silty SAND to sandy SILT	120	3.0	25	16	17	58	45	-	-	22	2.29	16
3.61	47.8	76.6	156.2	47.8	1.4	1.9	3.0	silty SAND to sandy SILT	120	3.0	26	16	17	58	45	-	-	24	2.33	16
3.77	37.1	59.6	146.9	37.3	1.2	5.7	3.4	clayy SILT to silty CLAY	115	2.0	30	19	14	-	-	2.6	9.9	28	2.44	15
3.94	99.5	159.6	175.8	99.6	1.1	4.5	1.1	clean SAND to silty SAND	125	5.0	32	20	29	82	47	-	-	8	1.79	16
4.10	120.2	192.7	204.3	120.3	1.3	4.8	1.1	clean SAND to silty SAND	125	5.0	39	24	34	89	48	-	-	7	1.73	16
4.27	91.0	146.0	164.6	91.1	1.0	2.3	1.1	clean SAND to silty SAND	125	5.0	29	18	27	79	47	-	-	9	1.83	16
4.43	72.8	116.7	136.5	72.8	0.8	1.3	1.1	clean SAND to silty SAND	125	5.0	23	15	22	72	46	-	-	10	1.88	16
4.59	57.7	92.6	109.9	57.8	0.5	2.9	0.9	clean SAND to silty SAND	125	5.0	19	12	17	64	44	-	-	10	1.90	16
4.76	30.9	49.6	85.1	31.0	0.4	3.9	1.3	silty SAND to sandy SILT	120	3.0	17	10	11	44	41	-	-	20	2.22	16
4.92	21.5	34.5	-	21.5	0.9	2.3	4.1	clayy SILT to silty CLAY	115	2.0	17	11	9	-	-	1.5	9.9	39	2.66	15
5.09	34.0	54.5	114.4	34.0	0.8	-0.3	2.3	silty SAND to sandy SILT	120	3.0	18	11	12	47	41	-	-	24	2.34	16
5.25	24.9	39.9	106.1	24.9	0.6	-1.0	2.5	clayy SILT to silty CLAY	115	2.0	20	12	10	-	-	1.7	9.9	30	2.48	15
5.41	10.1	16.3	-	10.2	0.5	3.6	4.6	silty CLAY to CLAY	115	1.5	11	7	5	-	-	0.7	9.9	55	2.95	15
5.58	8.1	13.0	-	8.2	0.5	5.2	6.2	silty CLAY to CLAY	115	1.5	9	5	4	-	-	0.6	7.8	66	3.11	15
5.74	8.6	13.8	-	8.7	0.5	5.2	6.2	silty CLAY to CLAY	115	1.5	9	6	5	-	-	0.6	8.0	65	3.09	15
5.91	8.7	14.0	-	8.9	0.5	8.8	6.5	silty CLAY to CLAY	115	1.5	9	6	5	-	-	0.6	7.9	66	3.10	15
6.07	10.3	16.4	-	10.4	0.6	9.3	6.0	silty CLAY to CLAY	115	1.5	11	7	5	-	-	0.7	9.2	60	3.03	15
6.23	11.7	18.8	-	12.0	0.6	13.5	5.5	silty CLAY to CLAY	115	1.5	13	8	6	-	-	0.8	9.9	55	2.95	15
6.40	12.0	19.2	-	12.2	0.6	14.2	5.6	silty CLAY to CLAY	115	1.5	13	8	6	-	-	0.8	9.9	55	2.95	15
6.56	12.0	19.3	-	12.3	0.6	12.7	5.0	silty CLAY to CLAY	115	1.5	13	8	6	-	-	0.8	9.9	53	2.92	15
6.73	11.3	18.2	-	11.5	0.5	9.5	4.6	silty CLAY to CLAY	115	1.5	12	8	6	-	-	0.8	9.7	53	2.92	15
6.89	8.5	13.6	-	8.7	0.5	9.7	5.9	silty CLAY to CLAY	115	1.5	9	6	5	-	-	0.6	7.1	65	3.09	15
7.05	7.8	12.5	-	8.0	0.4	10.8	6.1	silty CLAY to CLAY	115	1.5	8	5	4	-	-	0.5	6.4	67	3.12	15
7.22	11.4	18.2	-	11.6	0.3	11.4	3.1	clayy SILT to silty CLAY	115	2.0	9	6	5	-	-	0.8	9.4	46	2.81	15
7.38	7.6	12.2	-	7.7	0.2	5.0	3.1	silty CLAY to CLAY	115	1.5	8	5	4	-	-	0.5	6.1	55	2.95	15
7.55	5.4	8.6	-	5.5	0.2	6.1	3.4	silty CLAY to CLAY	115	1.5	6	4	3	-	-	0.4	4.1	66	3.11	15
7.71	4.8	7.7	-	4.9	0.1	7.9	3.3	silty CLAY to CLAY	115	1.5	5	3	3	-	-	0.3	3.6	69	3.15	15
7.87	4.0	6.4	-	4.2	0.1	7.9	3.6	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.3	2.9	76	3.24	15
8.04	3.7	6.0	-	3.9	0.1	8.7	3.4	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.6	78	3.26	15
8.20	3.4	5.5	-	3.6	0.1	8.7	3.3	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	2.3	81	3.29	15
8.37	3.2	5.1	-	3.3	0.1	8.2	3.7	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.1	86	3.35	15
8.53	3.2	5.2	-	3.4	0.1	9.2	4.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.1	88	3.38	15
8.69	3.2	5.2	-	3.4	0.1	8.9	4.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.1	89	3.39	15
8.86	3.2	5.2	-	3.4	0.1	8.7	4.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	2.1	89	3.39	15
9.02	3.0	4.8	-	3.2	0.1	8.8	4.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.9	91	3.42	15
9.19	2.8	4.5	-	3.0	0.1	8.9	4.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.7	93	3.44	15
9.35	2.8	4.4	-	2.9	0.1	8.9	4.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	95	3.46	15
9.51	2.7	4.3	-	2.9	0.1	9.1	4.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	95	3.48	15
9.68	2.8	4.4	-	3.0	0.1	9.3	4.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	95	3.47	15
9.84	2.8	4.4	-	3.0	0.1	9.5	4.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	95	3.47	15
10.01	2.7	4.4	-	2.9	0.1	9.8	4.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.5	95	3.47	15
10.17	2.8	4.5	-	3.0	0.1	10.0	4.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	94	3.45	15
10.34	2.8	4.4	-	3.0	0.1	10.3	4.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.5	95	3.46	15
10.50	2.8	4.5	-	3.0	0.1	10.8	3.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.5	93	3.44	15
10.66	2.9	4.7	-	3.1	0.1	11.1	4.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	92	3.43	15
10.83	3.0	4.8	-	3.2	0.1	10.9	3.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	91	3.41	15
10.99	3.0	4.8	-	3.2	0.1	11.1	4.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	91	3.42	15
11.16	3.0	4.8	-	3.2	0.1	11.5	3.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	91	3.41	15
11.32	3.0	4.8	-	3.2	0.1	11.8	4.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	92	3.43	15
11.48	3.1	4.9	-	3.3	0.1	12.1	3.9	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.6	90	3.41	15
11.65	2.9	4.7	-	3.2	0.1	12.0	4.3	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.5	94	3.45	15
11.81	2.8	4.4	-	3.0	0.1	12.3	4.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	95	3.49	15
11.98	2.7	4.3	-	2.9	0.1	12.6	4.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	95	3.51	15
12.14	2.7	4.3	-	3.0	0.1	13.5	4.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	95	3.51	15
12.30	2.6	4.2	-	2.9	0.1	14.0	4.6	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.2	95	3.53	15
12.47	2.7	4.3	-	2.9	0.1	14.2	4.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	95	3.52	15
12.63	2.7	4.3	-	2.9	0.1	14.4	4.5	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	95	3.52	15
12.80	2.6	4.2	-	2.9	0.1	15.1	4.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.1	1.2	95	3.52	15
12.96	2.7	4.4	-	3.0	0.1	15.4	4.4	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.2	95	3.51	15
13.12	2.9	4.7	-	3.2	0.1	16.2	4.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.3	95	3.46	15
13.29	3.1	5.0	-	3.5	0.1	16.9	4.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.4	91	3.42	15
13.45	3.2	5.1	-	3.5	0.1	17.6	4.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.4	91	3.41	15
13.62	3.2	5.1	-	3.5	0.1	18.0	4.0	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.4	91	3.42	15
13.78	3.1	5.0	-	3.5	0.1	18.4	4.2	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.4	93	3.44	15
13.94	3.2	5.1	-	3.6	0.1	19.0	4.1	silty CLAY to CLAY	115	1.5	3	2	2	-	-	0.2	1.4	92	3.42	15
14.11	3.4	5.4	-	3.8	0.1	19.7	3.8	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.5	88	3.38	15
14.27	3.4	5.5	-	3.8	0.1	20.6	3.8	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.5	87	3.37	15
14.44	3.5	5.6	-	3.9	0.1	21.4	3.6	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.5	85	3.35	15
14.60	3.5	5.6	-	3.9	0.1	22.0	3.7	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.5	86	3.35	15
14.76	3.6	5.7	-	4.0	0.1	22.0	3.7	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.5	85	3.35	15
14.93	3.6	5.8	-	4.1	0.1	22.9	4.1	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.5	87	3.37	15
15.09	3.6	5.8	-	4.1	0.1	23.5	3.8	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.5	85	3.35	15
15.26	3.6	5.7	-	4.0	0.1	23.7	3.8	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.5	87	3.36	15
15.42	3.7	5.9	-	4.1	0.1	24.7	3.6	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.5	84	3.34	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

Sheetpile Wall at WBSD Property

Project ID: BAGG Engineering
Data File: SDF(052).cpt
CPT Date: 5/1/2018 11:56:11 AM
GW During Test: 6 ft

Sounding ID: CPT-06
Project No: FREYE-18-01
Cone/Rig: DDG1418

Depth ft	qc PS tsf	* qc1n PS -	q1ncs PS -	* qt PS tsf	Slv Stss tsf	pore prss (psi)	Frct Rato %	* Material Behavior Description	Unit Wght pcf	Qc to N	* SPT R-N1 60%	SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	Und Shr tsf	OCR -	* Fin Ic %	* Ic SBT Indx	* Nk -
15.58	3.6	5.8	-	4.1	0.1	24.8	3.6	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.5	85	3.34	15
15.75	3.5	5.6	-	4.0	0.1	25.4	3.7	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.4	87	3.36	15
15.91	3.4	5.5	-	4.0	0.1	26.4	3.8	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.4	88	3.38	15
16.08	3.6	5.8	-	4.2	0.1	27.4	3.7	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.4	85	3.35	15
16.24	3.7	5.9	-	4.3	0.1	27.9	3.6	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.5	84	3.34	15
16.40	3.7	5.9	-	4.3	0.1	28.4	3.8	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.4	85	3.35	15
16.57	3.7	5.9	-	4.3	0.1	29.4	3.7	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.5	85	3.34	15
16.73	3.8	6.0	-	4.4	0.1	29.8	3.9	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	1.5	85	3.35	15
16.90	3.8	6.0	-	4.4	0.1	30.0	3.4	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	1.5	83	3.32	15
17.06	3.8	5.9	-	4.4	0.1	30.8	3.4	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	1.5	83	3.32	15
17.23	3.7	5.7	-	4.3	0.1	29.7	3.6	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	1.4	86	3.36	15
17.39	4.2	6.4	-	4.8	0.1	30.1	3.1	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.3	1.6	78	3.27	15
17.55	3.9	5.9	-	4.5	0.1	30.5	3.6	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	1.4	85	3.34	15
17.72	3.9	5.9	-	4.5	0.1	31.1	3.6	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	1.4	85	3.34	15
17.88	4.0	6.0	-	4.6	0.1	31.3	3.6	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.2	1.5	84	3.34	15
18.05	3.9	5.8	-	4.5	0.2	31.1	6.3	silty CLAY to CLAY	115	1.5	4	3	3	-	-	0.2	1.4	95	3.49	15
18.21	4.2	6.3	-	4.8	0.3	30.8	9.4	Organic SOILS - Peats	100	1.0	6	4	3	-	-	0.4	1.6	95	3.55	10
18.37	5.1	7.6	-	5.6	0.4	21.8	9.9	Organic SOILS - Peats	100	1.0	8	5	3	-	-	0.5	2.0	95	3.49	10
18.54	5.8	8.5	-	6.1	0.5	15.2	9.9	Organic SOILS - Peats	100	1.0	8	6	4	-	-	0.5	2.3	93	3.44	10
18.70	6.0	8.7	-	6.2	0.6	11.8	9.9	Organic SOILS - Peats	100	1.0	9	6	4	-	-	0.6	2.4	92	3.43	10
18.87	6.1	8.9	-	6.4	0.6	14.7	9.9	Organic SOILS - Peats	100	1.0	9	6	4	-	-	0.6	2.4	92	3.42	10
19.03	6.2	9.0	-	6.5	0.6	13.7	9.9	Organic SOILS - Peats	100	1.0	9	6	4	-	-	0.6	2.5	91	3.42	10
19.19	6.5	9.3	-	6.7	0.6	14.4	9.9	silty CLAY to CLAY	115	1.5	6	4	4	-	-	0.4	2.6	90	3.40	15
19.36	6.9	9.9	-	7.2	0.6	15.9	9.9	silty CLAY to CLAY	115	1.5	7	5	4	-	-	0.4	2.7	88	3.38	15
19.52	7.3	10.4	-	7.6	0.7	14.6	9.9	silty CLAY to CLAY	115	1.5	7	5	4	-	-	0.5	2.9	86	3.36	15
19.69	7.8	11.0	-	8.0	0.7	12.8	9.9	silty CLAY to CLAY	115	1.5	7	5	4	-	-	0.5	3.1	84	3.34	15
19.85	8.7	12.3	-	9.0	0.7	15.1	9.6	silty CLAY to CLAY	115	1.5	8	6	5	-	-	0.6	3.5	80	3.29	15
20.01	9.4	13.2	-	9.7	0.8	13.6	9.2	silty CLAY to CLAY	115	1.5	9	6	5	-	-	0.6	3.8	77	3.25	15
20.18	10.1	14.0	-	10.4	0.8	15.6	9.1	silty CLAY to CLAY	115	1.5	9	7	5	-	-	0.7	4.1	75	3.22	15
20.34	10.7	14.8	-	11.0	0.9	15.4	9.0	silty CLAY to CLAY	115	1.5	10	7	5	-	-	0.7	4.4	73	3.20	15
20.51	11.4	15.7	-	11.7	0.9	14.0	8.6	silty CLAY to CLAY	115	1.5	10	8	6	-	-	0.8	4.6	70	3.17	15
20.67	12.1	16.5	-	12.4	0.9	15.1	8.1	silty CLAY to CLAY	115	1.5	11	8	6	-	-	0.8	4.9	68	3.13	15
20.83	13.0	17.6	-	13.3	0.9	16.0	7.7	silty CLAY to CLAY	115	1.5	12	9	6	-	-	0.9	5.3	65	3.09	15
21.00	14.7	19.8	-	15.0	1.0	17.9	7.1	silty CLAY to CLAY	115	1.5	13	10	6	-	-	1.0	6.0	60	3.03	15
21.16	17.5	23.5	-	17.8	0.9	18.9	5.4	silty CLAY to CLAY	115	1.5	16	12	7	-	-	1.2	7.2	51	2.89	15
21.33	20.9	27.9	-	21.3	0.9	23.0	4.5	silty CLAY to CLAY	115	1.5	19	14	8	-	-	1.4	8.7	45	2.78	15
21.49	19.8	26.3	-	20.2	0.9	19.8	4.6	silty CLAY to CLAY	115	1.5	18	13	7	-	-	1.3	8.1	46	2.81	15
21.65	20.0	26.4	-	20.4	1.0	18.2	5.3	silty CLAY to CLAY	115	1.5	18	13	8	-	-	1.4	8.2	49	2.85	15
21.82	20.1	26.3	-	20.8	1.1	37.0	5.6	silty CLAY to CLAY	115	1.5	18	13	8	-	-	1.4	8.1	50	2.86	15
21.98	20.7	27.0	-	21.2	1.1	23.3	5.7	silty CLAY to CLAY	115	1.5	18	14	8	-	-	1.4	8.4	50	2.86	15
22.15	20.1	26.1	-	20.8	1.1	34.7	6.0	silty CLAY to CLAY	115	1.5	17	13	8	-	-	1.4	8.1	51	2.89	15
22.31	20.9	27.0	-	21.8	1.1	45.0	5.5	silty CLAY to CLAY	115	1.5	18	14	8	-	-	1.4	8.4	49	2.85	15
22.47	25.8	33.1	-	26.8	1.1	50.4	4.5	silty CLAY to CLAY	115	1.5	22	17	9	-	-	1.8	9.9	42	2.72	15
22.64	25.1	32.0	-	25.6	1.1	25.9	4.6	silty CLAY to CLAY	115	1.5	21	17	9	-	-	1.7	9.9	43	2.74	15
22.80	26.3	33.3	-	26.7	1.2	24.4	4.7	silty CLAY to CLAY	115	1.5	22	18	9	-	-	1.8	9.9	42	2.73	15
22.97	24.0	30.3	-	24.5	1.1	26.3	5.0	silty CLAY to CLAY	115	1.5	20	16	9	-	-	1.6	9.4	45	2.78	15
23.13	27.7	34.8	-	28.3	1.1	29.2	4.1	clayy SILT to silty CLAY	115	2.0	17	14	9	-	-	1.9	9.9	39	2.67	15
23.30	23.2	29.0	-	23.5	1.1	18.6	4.8	silty CLAY to CLAY	115	1.5	19	15	8	-	-	1.6	9.0	45	2.79	15
23.46	20.6	25.6	-	21.5	1.2	44.0	6.0	silty CLAY to CLAY	115	1.5	17	14	8	-	-	1.4	7.9	52	2.89	15
23.62	27.4	33.8	-	28.5	1.2	56.2	4.6	silty CLAY to CLAY	115	1.5	23	18	9	-	-	1.9	9.9	41	2.72	15
23.79	26.1	32.0	-	26.5	1.1	23.1	4.6	silty CLAY to CLAY	115	1.5	21	17	9	-	-	1.8	9.9	43	2.74	15
23.95	23.3	28.5	-	24.0	1.1	33.4	4.8	silty CLAY to CLAY	115	1.5	19	16	8	-	-	1.6	8.9	45	2.79	15
24.12	20.1	24.5	-	20.9	1.1	38.4	5.6	silty CLAY to CLAY	115	1.5	16	13	7	-	-	1.4	7.5	51	2.89	15
24.28	19.6	23.8	-	20.2	1.0	26.6	5.3	silty CLAY to CLAY	115	1.5	16	13	7	-	-	1.3	7.3	51	2.88	15
24.44	17.3	20.9	-	17.6	0.9	13.5	5.6	silty CLAY to CLAY	115	1.5	14	12	6	-	-	1.2	6.3	55	2.94	15
24.61	18.0	21.6	-	18.4	0.7	16.3	4.4	silty CLAY to CLAY	115	1.5	14	12	6	-	-	1.2	6.6	50	2.86	15
24.77	16.7	19.9	-	17.1	0.7	21.3	4.5	silty CLAY to CLAY	115	1.5	13	11	6	-	-	1.1	6.0	52	2.90	15
24.94	15.9	18.8	-	16.4	0.7	24.5	4.8	silty CLAY to CLAY	115	1.5	13	11	6	-	-	1.1	5.7	54	2.93	15
25.10	16.0	18.8	-	16.5	0.7	24.4	4.8	silty CLAY to CLAY	115	1.5	13	11	6	-	-	1.1	5.7	54	2.94	15
25.26	16.2	19.0	-	16.7	0.7	26.8	4.5	silty CLAY to CLAY	115	1.5	13	11	6	-	-	1.1	5.7	53	2.92	15
25.43	17.8	20.8	-	18.1	0.7	17.2	4.1	silty CLAY to CLAY	115	1.5	14	12	6	-	-	1.2	6.3	49	2.86	15
25.59	15.2	17.7	-	15.6	0.7	18.2	5.1	silty CLAY to CLAY	115	1.5	12	10	6	-	-	1.0	5.3	57	2.98	15
25.76	16.8	19.4	-	17.3	0.8	25.6	5.2	silty CLAY to CLAY	115	1.5	13	11	6	-	-	1.1	5.8	55	2.95	15
25.92	18.0	20.7	-	18.3	0.8	19.1	5.0	silty CLAY to CLAY	115	1.5	14	12	6	-	-	1.2	6.2	53	2.91	15
26.08	18.6	21.2	-	18.9	0.8	15.2	4.8	silty CLAY to CLAY	115	1.5	14	12	6	-	-	1.2	6.4	51	2.89	15
26.25	18.4	21.0	-	19.0	0.7	29.4	4.4	silty CLAY to CLAY	115	1.5	14	12	6	-	-	1.2	6.4	50	2.87	15
26.41	18.5	20.9	-	19.1	0.8	33.2	4.5	silty CLAY to CLAY	115	1.5	14	12	6	-	-	1.2	6.3	51	2.88	15
26.58	18.3	20.6	-	19.0	0.7	36.4	4.2	silty CLAY to CLAY	115	1.5	14	12	6	-	-	1.2	6.2	50	2.87	15
26.74	17.9	20.1	-	18.7	0.8	41.4	4.6	silty CLAY to CLAY	115	1.5	13	12	6	-	-	1.2	6.1	52	2.90	15
26.90	17.4	19.5	-	18.2	0.8	41.7	5.1	silty CLAY to CLAY	115	1.5	13	12	6	-	-	1.2	5.8	55	2.94	15
27.07	18.0	20.0	-	18.7	0.9	34.8	5.3	silty CLAY to CLAY	115	1.5	13	12	6	-	-	1.2	6.0	55	2.94	15
27.23	17.1	19.0	-	17.6	0.9	25.0	5.6	silty CLAY to CLAY	115	1.5	13	11	6	-	-	1.1	5.7	57	2.98	15
27.40	16.2	17.9	-	16.8	0.8	26.4	5.7	silty CLAY to CLAY	115	1.5	12	11	6	-	-	1.1	5.3	59	3.01	15
27.56	16.2	17.7	-	16.8	0.8	33.4	5.7	silty CLAY to CLAY	115	1.5	12	11	6	-	-	1.1	5.3	59	3.00	15
27.72	18.2	19.9	-	19.2	0.8	47.3	4.6	silty CLAY to CLAY	115	1.5	13	12	6	-	-	1.2	6.0	52	2.91	15
27.89	16.7	18.1	-	17.2	0.7	24.4	4.7	silty CLAY to CLAY	115	1.5	12	11	6	-	-	1.1	5.4	55	2.94	15
28.05	14.1	15.3	-	14.6	0.5	22.7	4.3	silty CLAY to CLAY	115	1.5	10	9	5	-	-	0.9	4.5	58	2.99	15
28.22	12.5	13.5	-	12.9	0.5	19.6	4.6	silty CLAY to CLAY	115	1.5	9	8	4	-	-	0.8	3.9	62	3.05	15
28.38	11.3	12.1	-	11.7	0.4	21.5	4.5	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.7	3.4	65	3.09	15
28.54	11.3	12.0	-	11.8	0.4	28.1	4.6	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.7	3.4	65	3.09	15
28.71	10.8	11.5	-	11.3	0.4	24.2	4.8	silty CLAY to CLAY	115	1.5	8	7	4	-	-	0.7	3.2	67	3.13	15
28.87	10.6	11.2	-	11.2	0.4	29.3	4.7	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	3.1	68	3.13	15
29.04	11.6	12.2	-	12.2	0.5	30.2	4.7	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.5	65	3.10	15
29.20	12.9	13.4	-	13.5	0.5	33.6	4.7	silty CLAY to CLAY	115	1.5	9	9	4	-	-	0.8	3.9	62	3.06	15
29.36	13.8	14.4	-	14.4	0.6	29.0	4.8	silty CLAY to CLAY	115	1.5	10	9	5	-	-	0.9	4.2	61	3.03	15
29.53	14.4	15.0	-	15.0	0.6	29.7	4.8	silty CLAY to CLAY	115	1.5	10	10	5	-	-	1.0	4.4	60	3.02	15
29.69	13.7	14.1	-	14.2	0.6	27.7	5.1	silty CLAY to CLAY	115	1.5	9	9	5	-	-	0.9	4.1	63	3.06	15
29.86	13.1	13.5	-	13.5	0.6	20.7	5.6	silty CLAY to CLAY	115	1.5	9	9	5	-	-	0.9	3.9	66	3.10	15
30.02	11.9	12.2	-	12.4	0.6	23.9	6.1	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.4	70	3.17	15
30.19	11.8	12.0	-	12.3	0.6	24.2	6.2	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.4	71	3.18	15
30.35	11.6	11.7	-	12.0	0.6	23.6	5.8	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.7	3.3	71	3.17	15
30.51	12.3	12.4	-	12.8	0.5	28.5	5.0	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.5	66	3.11	15
30.68	13.7	13.7	-	14.2	0.5	28.8	3.8	silty CLAY to CLAY	115	1.5	9	9	4	-	-	0.9	3.9	58	2.99	15
30.84	12.9	12.9	-	13.4	0.5	27.5	4.2	silty CLAY to CLAY	115	1.5	9	9	4	-	-	0.8	3.7	62	3.05	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

Sheetpile Wall at WBSD Property

Project ID: BAGG Engineering
Data File: SDF(052).cpt
CPT Date: 5/1/2018 11:56:11 AM
GW During Test: 6 ft

Sounding ID: CPT-06
Project No: FREYE-18-01
Cone/Rig: DDG1418

Depth ft	qc PS tsf	* qc1n PS -	q1ncs PS -	* qt PS tsf	Slv Stss tsf	pore prss tsf (psi)	Frct Rato %	* Material Behavior Description	Unit Wght pcf	Qc to N	* SPT R-N1 60%	SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	Und Shr tsf	OCR -	* Fin Ic %	* Ic SBT Indx	* Nk -
31.01	12.2	12.2	-	12.7	0.4	24.2	4.2	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.4	63	3.07	15
31.17	11.9	11.8	-	12.3	0.4	21.8	3.8	silty CLAY to CLAY	115	1.5	8	8	4	-	-	0.8	3.3	62	3.06	15
31.33	9.9	9.8	-	10.3	0.3	19.5	4.1	silty CLAY to CLAY	115	1.5	7	7	3	-	-	0.6	2.6	70	3.16	15
31.50	8.9	8.8	-	9.3	0.3	21.0	4.3	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.3	74	3.22	15
31.66	8.6	8.5	-	9.1	0.3	25.7	4.7	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.5	2.2	77	3.25	15
31.83	8.8	8.6	-	9.4	0.3	29.2	4.1	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.5	2.2	74	3.21	15
31.99	7.8	7.6	-	8.2	0.3	21.1	4.5	silty CLAY to CLAY	115	1.5	5	5	3	-	-	0.5	1.9	81	3.29	15
32.15	6.8	6.5	-	7.2	0.2	24.4	4.9	silty CLAY to CLAY	115	1.5	4	5	3	-	-	0.4	1.6	88	3.39	15
32.32	6.3	6.1	-	6.8	0.2	26.2	4.6	silty CLAY to CLAY	115	1.5	4	4	3	-	-	0.4	1.4	90	3.41	15
32.48	6.4	6.2	-	6.9	0.2	26.4	3.7	silty CLAY to CLAY	115	1.5	4	4	3	-	-	0.4	1.4	85	3.35	15
32.65	6.3	6.1	-	6.8	0.2	26.2	3.4	silty CLAY to CLAY	115	1.5	4	4	2	-	-	0.4	1.4	84	3.34	15
32.81	6.0	5.7	-	6.6	0.2	28.0	3.8	silty CLAY to CLAY	115	1.5	4	4	2	-	-	0.4	1.3	89	3.39	15
32.97	6.9	6.6	-	7.6	0.2	31.3	3.5	silty CLAY to CLAY	115	1.5	4	5	3	-	-	0.4	1.6	81	3.30	15
33.14	7.7	7.3	-	8.4	0.2	34.9	4.1	silty CLAY to CLAY	115	1.5	5	5	3	-	-	0.5	1.8	80	3.29	15
33.30	9.0	8.5	-	9.7	0.3	37.9	4.4	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.2	76	3.24	15
33.47	10.3	9.7	-	11.0	0.4	35.4	4.3	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.6	71	3.17	15
33.63	10.8	10.1	-	11.5	0.4	34.9	4.4	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	2.7	70	3.16	15
33.79	10.6	9.8	-	11.3	0.4	35.4	5.0	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	2.6	73	3.20	15
33.96	10.8	10.0	-	11.5	0.4	36.0	4.9	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	2.7	72	3.19	15
34.12	10.8	10.0	-	11.5	0.4	33.1	5.1	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	2.7	73	3.20	15
34.29	10.4	9.5	-	11.0	0.4	32.7	5.3	silty CLAY to CLAY	115	1.5	6	7	4	-	-	0.7	2.5	75	3.23	15
34.45	10.2	9.3	-	10.8	0.4	30.4	5.4	silty CLAY to CLAY	115	1.5	6	7	4	-	-	0.6	2.5	77	3.25	15
34.61	9.1	8.2	-	9.6	0.4	28.0	6.0	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	2.1	83	3.33	15
34.78	8.9	8.0	-	9.5	0.4	32.6	5.5	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.5	2.1	83	3.32	15
34.94	10.4	9.4	-	11.1	0.4	38.4	4.5	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.5	73	3.20	15
35.11	11.1	10.0	-	11.9	0.4	40.2	4.1	silty CLAY to CLAY	115	1.5	7	7	4	-	-	0.7	2.7	69	3.15	15
35.27	12.1	10.9	-	12.7	0.4	29.3	4.0	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.8	3.0	66	3.10	15
35.43	11.7	10.4	-	12.3	0.4	32.0	4.1	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.7	2.8	67	3.13	15
35.60	10.7	9.5	-	11.4	0.5	36.7	5.5	silty CLAY to CLAY	115	1.5	6	7	4	-	-	0.7	2.5	76	3.24	15
35.76	11.6	10.2	-	12.4	0.5	44.8	5.0	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.7	2.8	72	3.19	15
35.93	12.4	10.9	-	13.1	0.5	36.3	4.5	silty CLAY to CLAY	115	1.5	7	8	4	-	-	0.8	3.0	68	3.14	15
36.09	11.1	9.7	-	11.7	0.4	34.9	5.0	silty CLAY to CLAY	115	1.5	6	7	4	-	-	0.7	2.6	74	3.21	15
36.26	9.5	8.4	-	10.4	0.5	43.7	7.1	silty CLAY to CLAY	115	1.5	6	6	3	-	-	0.6	2.2	87	3.37	15
36.42	10.8	9.5	-	11.9	0.5	54.4	5.4	silty CLAY to CLAY	115	1.5	6	7	4	-	-	0.7	2.5	76	3.24	15
36.58	18.4	16.0	-	19.4	0.5	46.3	2.8	silty CLAY to CLAY	115	1.5	11	12	5	-	-	1.2	4.7	49	2.86	15
36.75	13.3	11.5	-	13.6	0.5	17.5	4.1	silty CLAY to CLAY	115	1.5	8	9	4	-	-	0.9	3.2	65	3.09	15
36.91	16.4	14.1	-	16.9	0.3	29.2	2.2	clayy SILT to silty CLAY	115	2.0	7	8	4	-	-	1.1	4.1	49	2.84	15
37.08	15.5	13.3	-	15.8	0.3	16.6	2.1	clayy SILT to silty CLAY	115	2.0	7	8	4	-	-	1.0	3.8	49	2.86	15
37.24	11.0	9.4	-	11.5	0.3	25.5	3.1	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.5	66	3.10	15
37.40	8.9	7.6	-	9.7	0.2	38.9	3.5	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.5	1.9	76	3.23	15
37.57	9.1	7.7	-	9.9	0.2	38.9	3.5	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.9	75	3.22	15
37.73	8.9	7.6	-	9.9	0.3	48.5	4.0	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.5	1.9	79	3.27	15
37.90	9.7	8.2	-	10.6	0.3	45.1	4.4	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	2.1	77	3.25	15
38.06	10.7	9.0	-	11.6	0.3	42.8	3.0	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.4	67	3.12	15
38.22	10.0	8.4	-	10.7	0.2	37.6	2.8	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.6	2.2	68	3.13	15
38.39	8.5	7.1	-	9.3	0.2	41.6	3.0	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.5	1.7	76	3.23	15
38.55	7.8	6.5	-	8.6	0.2	42.0	3.3	silty CLAY to CLAY	115	1.5	4	5	3	-	-	0.5	1.5	81	3.30	15
38.72	7.6	6.3	-	8.4	0.2	42.8	3.4	silty CLAY to CLAY	115	1.5	4	5	3	-	-	0.5	1.5	83	3.32	15
38.88	7.6	6.3	-	8.4	0.2	44.7	3.6	silty CLAY to CLAY	115	1.5	4	5	3	-	-	0.4	1.5	84	3.34	15
39.04	7.6	6.3	-	8.5	0.2	44.7	3.6	silty CLAY to CLAY	115	1.5	4	5	3	-	-	0.5	1.5	84	3.34	15
39.21	7.5	6.1	-	8.3	0.2	43.9	3.7	silty CLAY to CLAY	115	1.5	4	5	3	-	-	0.4	1.4	85	3.35	15
39.37	7.2	5.9	-	8.1	0.2	45.9	3.8	silty CLAY to CLAY	115	1.5	4	5	2	-	-	0.4	1.3	88	3.39	15
39.54	7.4	6.0	-	8.3	0.2	46.6	3.8	silty CLAY to CLAY	115	1.5	4	5	2	-	-	0.4	1.4	87	3.37	15
39.70	7.5	6.1	-	8.5	0.2	48.5	3.9	silty CLAY to CLAY	115	1.5	4	5	3	-	-	0.4	1.4	87	3.37	15
39.86	7.7	6.2	-	8.6	0.2	49.3	4.4	silty CLAY to CLAY	115	1.5	4	5	3	-	-	0.5	1.4	89	3.39	15
40.03	8.0	6.4	-	8.9	0.3	47.5	4.8	silty CLAY to CLAY	115	1.5	4	5	3	-	-	0.5	1.5	89	3.39	15
40.19	8.0	6.4	-	9.0	0.3	48.0	5.0	silty CLAY to CLAY	115	1.5	4	5	3	-	-	0.5	1.5	90	3.40	15
40.36	8.0	6.4	-	8.9	0.3	44.7	4.7	silty CLAY to CLAY	115	1.5	4	5	3	-	-	0.5	1.5	89	3.39	15
40.52	8.0	6.4	-	9.0	0.2	47.8	3.9	silty CLAY to CLAY	115	1.5	4	5	3	-	-	0.5	1.5	85	3.35	15
40.68	7.9	6.2	-	8.8	0.2	50.3	3.3	silty CLAY to CLAY	115	1.5	4	5	2	-	-	0.5	1.4	83	3.32	15
40.85	7.8	6.2	-	8.8	0.2	51.6	3.2	silty CLAY to CLAY	115	1.5	4	5	2	-	-	0.5	1.4	83	3.32	15
41.01	7.8	6.1	-	8.8	0.2	53.0	3.5	silty CLAY to CLAY	115	1.5	4	5	2	-	-	0.5	1.4	85	3.34	15
41.18	8.0	6.3	-	9.0	0.2	53.2	3.9	silty CLAY to CLAY	115	1.5	4	5	3	-	-	0.5	1.5	86	3.35	15
41.34	8.0	6.3	-	9.1	0.3	56.3	4.7	silty CLAY to CLAY	115	1.5	4	5	3	-	-	0.5	1.5	90	3.40	15
41.50	9.3	7.3	-	10.4	0.3	53.5	4.6	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.8	83	3.32	15
41.67	10.3	8.0	-	11.2	0.4	49.1	4.8	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	2.0	80	3.29	15
41.83	10.7	8.3	-	11.6	0.4	47.3	4.9	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.1	79	3.28	15
42.00	10.8	8.3	-	11.7	0.4	47.3	5.1	silty CLAY to CLAY	115	1.5	6	7	3	-	-	0.7	2.1	80	3.28	15
42.16	10.3	7.9	-	11.1	0.4	41.8	5.2	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	2.0	82	3.31	15
42.32	10.0	7.7	-	10.8	0.4	42.4	5.0	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	1.9	83	3.32	15
42.49	9.4	7.2	-	10.2	0.4	41.0	5.1	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.8	85	3.35	15
42.65	8.9	6.8	-	9.8	0.4	44.8	5.6	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.5	1.6	90	3.40	15
42.82	9.3	7.1	-	10.3	0.4	48.7	5.8	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.7	89	3.39	15
42.98	10.2	7.7	-	11.1	0.4	46.9	5.4	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	1.9	84	3.34	15
43.15	10.2	7.7	-	11.0	0.4	41.8	5.2	silty CLAY to CLAY	115	1.5	5	7	3	-	-	0.6	1.9	83	3.33	15
43.31	9.6	7.2	-	10.5	0.3	47.2	4.9	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.8	85	3.34	15
43.47	9.2	6.9	-	10.1	0.3	46.8	4.9	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.7	86	3.36	15
43.64	9.0	6.7	-	10.0	0.3	49.8	4.6	silty CLAY to CLAY	115	1.5	4	6	3	-	-	0.5	1.6	87	3.36	15
43.80	8.3	6.2	-	9.3	0.3	48.8	5.1	silty CLAY to CLAY	115	1.5	4	6	3	-	-	0.5	1.4	92	3.43	15
43.97	9.1	6.8	-	10.1	0.3	49.9	4.3	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.5	1.6	85	3.34	15
44.13	8.6	6.4	-	9.7	0.3	52.6	5.1	silty CLAY to CLAY	115	1.5	4	6	3	-	-	0.5	1.5	91	3.41	15
44.29	9.6	7.1	-	10.7	0.4	57.7	5.6	silty CLAY to CLAY	115	1.5	5	6	3	-	-	0.6	1.7	88	3.38	15
44.46	11.6	8.6	-	12.8	0.5	62.2	5.0	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.7	2.2	79	3.27	15
44.62	12.9	9.5	-	14.1	0.5	60.0	5.3	silty CLAY to CLAY	115	1.5	6	9	4	-	-	0.8	2.5	76	3.24	15
44.79	13.2	9.7	-	14.5	0.5	62.6	5.1	silty CLAY to CLAY	115	1.5	6	9	4	-	-	0.8	2.6	75	3.22	15
44.95	13.9	10.2	-	15.3	0.6	71.7	5.0	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	2.7	73	3.20	15
45.11	14.9	10.8	-	16.3	0.7	69.1	5.3	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	3.0	71	3.18	15
45.28	15.1	10.9	-	16.1	0.7	51.8	5.7	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	3.0	73	3.20	15
45.44	14.7	10.6	-	15.4	0.7	38.6	5.8	silty CLAY to CLAY	115	1.5	7	10	4	-	-	0.9	2.9	74	3.21	15
45.61	13.0	9.4	-	13.7	0.7	36.6	6.4	silty CLAY to CLAY	115	1.5	6	9	4	-	-	0.8	2.5	81	3.29	15
45.77	11.9	8.6	-	12.7	0.7	38.3	7.1	silty CLAY to CLAY	115	1.5	6	8	4	-	-	0.7	2.2	86	3.36	15
45.93	12.7	9.1	-	13.5	0.7	38.7	6.8	silty CLAY to CLAY	115	1.5	6	8	4	-	-	0.8	2.4	83	3.32	15
46.10	13.6	9.7	-	14.4	0.7	37.1	6.7	silty CLAY to CLAY	115	1.5	6	9	4	-	-	0.9	2.6	80	3.29	15
46.26	13.0	9.2	-	13.6	0.7	33.6	7.3	silty CLAY to CLAY	115	1.5	6	9	4	-	-	0.8	2.4	84	3.33	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

Project ID: BAGG Engineering
Data File: SDF(052).cpt
CPT Date: 5/1/2018 11:56:11 AM
GW During Test: 6 ft

Sounding ID: CPT-06
Project No: FREYE-18-01
Cone/Rig: DDG1418

. . Depth ft	. qc PS tsf	* qc1n PS -	. q1ncs PS -	* qt PS tsf	. Slv Stss tsf	. pore prss (psi)	. Frct Rato %	* Material Behavior Description	. Unit Wght pcf	. Qc to N	* SPT R-N1 60%	. SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	. Und Shr tsf	. OCR - -	* Fin Ic %	* Ic SBT Indx	* Nk - -
46.43	15.7	11.2	-	16.6	0.7	42.3	5.6	silty CLAY to CLAY	115	1.5	7	10	4	-	-	1.0	3.1	72	3.19	15
46.59	16.0	11.3	-	17.1	0.8	55.7	5.8	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.0	3.1	72	3.19	15
46.75	17.3	12.2	-	18.4	0.8	56.0	5.5	silty CLAY to CLAY	115	1.5	8	12	4	-	-	1.1	3.4	68	3.14	15
46.92	17.5	12.3	-	18.6	0.8	54.1	5.7	silty CLAY to CLAY	115	1.5	8	12	4	-	-	1.1	3.4	69	3.15	15
47.08	16.8	11.8	-	17.8	0.9	50.4	6.1	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.1	3.3	72	3.19	15
47.25	16.6	11.6	-	17.4	0.8	39.9	5.7	silty CLAY to CLAY	115	1.5	8	11	4	-	-	1.1	3.2	71	3.17	15
47.41	14.1	9.8	-	14.7	0.7	33.0	6.3	silty CLAY to CLAY	115	1.5	7	9	4	-	-	0.9	2.6	78	3.27	15
47.57	12.9	9.0	-	13.6	0.6	36.1	5.8	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.3	80	3.29	15
47.74	11.8	8.2	-	12.5	0.5	38.0	5.6	silty CLAY to CLAY	115	1.5	5	8	3	-	-	0.7	2.1	83	3.32	15
47.90	11.6	8.0	-	12.5	0.5	44.9	5.4	silty CLAY to CLAY	115	1.5	5	8	3	-	-	0.7	2.0	82	3.32	15
48.07	12.4	8.5	-	13.4	0.5	49.6	5.5	silty CLAY to CLAY	115	1.5	6	8	3	-	-	0.8	2.2	81	3.30	15
48.23	16.3	11.2	-	17.4	0.6	55.0	4.2	silty CLAY to CLAY	115	1.5	7	11	4	-	-	1.0	3.1	66	3.11	15
48.39	19.7	13.5	-	20.4	0.5	40.1	3.0	silty CLAY to CLAY	115	1.5	9	13	4	-	-	1.3	3.8	55	2.95	15
48.56	18.4	12.5	-	18.6	0.4	12.4	2.8	silty CLAY to CLAY	115	1.5	8	12	4	-	-	1.2	3.5	56	2.96	15
48.72	14.5	9.9	-	15.3	0.4	42.8	3.3	silty CLAY to CLAY	115	1.5	7	10	3	-	-	0.9	2.6	66	3.10	15
48.89	14.8	10.0	-	16.0	0.3	60.8	2.8	silty CLAY to CLAY	115	1.5	7	10	3	-	-	0.9	2.7	62	3.06	15
49.05	14.5	9.8	-	15.3	0.3	40.2	2.7	silty CLAY to CLAY	115	1.5	7	10	3	-	-	0.9	2.6	63	3.06	15
49.22	14.2	9.6	-	15.1	0.3	44.6	2.8	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.9	2.5	64	3.07	15
49.38	13.3	8.9	-	14.2	0.3	48.1	3.1	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.3	68	3.13	15
49.54	13.3	8.9	-	14.3	0.3	48.9	3.0	silty CLAY to CLAY	115	1.5	6	9	3	-	-	0.8	2.3	67	3.12	15
49.71	14.3	9.5	-	15.3	0.4	50.9	3.1	silty CLAY to CLAY	115	1.5	6	10	3	-	-	0.9	2.5	66	3.11	15
49.87	15.0	10.0	-	15.9	0.4	48.5	3.1	silty CLAY to CLAY	115	1.5	7	10	3	-	-	1.0	2.7	64	3.08	15
50.04	16.2	10.8	-	17.3	0.3	54.5	2.5	silty CLAY to CLAY	115	1.5	7	11	3	-	-	1.0	2.9	59	3.00	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

APPENDIX B

SUBSURFACE AND LABORATORY DATA

By DCM Consulting, Inc.

And Cooper Testing Laboratory

KEY TO BORING LOGS

Symbol	Description	Symbol	Description
	Shelby tube sample	NSR	No sample recovery
	Grab sample	PP	Pocket Penetrometer (tsf = tons per square foot)
	1.4" I.D./2" O.D. Standard Penetration Test (ASTM D1586) sampler (SPT)		Groundwater level observed in boring at end of of drilling unless noted otherwise. Not to be interpreted as the equilibrium groundwater level.
	2.5" I.D./3" O.D. Modified California sampler (MCS) with brass liners		Groundwater seepage encountered during drilling
	2" I.D./2.5" O.D. Split Spoon sampler (SSS)		Planned pipeline I.D. (projected to boring) Planned casing I.D. (projected to boring)

RELATIVE DENSITY		CONSISTENCY		
SANDS AND GRAVELS	SPT, N	SILTS AND CLAYS	SPT, N	UNCONFINED COMPRESSIVE STRENGTH, TSF
VERY LOOSE	0-4	VERY SOFT	0-2	0-0.25
LOOSE	4-10	SOFT	2-4	0.25-0.50
MEDIUM DENSE	10-30	MEDIUM STIFF	4-8	0.50-1.00
DENSE	30-50	STIFF	8-15	1.00-2.00
VERY DENSE	50+	VERY STIFF	15-30	2.00-4.00
		HARD	30+	>4.00

Reference: Terzaphi, K. and Peck, R., SOIL MECHANICS IN ENGINEERING PRACTICE, 2ND ED., John Wiley and Sons, New York, 1967. Page 341 Table 45.1 and pp. 347 Table 45.2.

MOISTURE CONDITION	
DESCRIPTION	CRITERIA
DRY	Absence of moisture, dusty, dry to the touch
MOIST	Damp but no visible water
WET	Visible free water, usually soil is below water table

Reference: ASTM D2488, Table 3 – Criteria for Describing Moisture Condition

CONSTITUENT DESCRIPTIONS	
DESCRIPTION	CRITERIA
TRACE	Less than 5%
FEW	5% to 10%
LITTLE	15% to 25%
SOME	30% to 45%
MOSTLY	50% to 100%

Reference: ASTM D2488, Note 15

NOTES:

1. Lines separating strata in the logs represent approximate boundaries only and are dashed where strata change depth is less certain and queried where strata change depth is not known. Actual strata change may be gradual. No. warranty is provided as to the continuity of strata between borings. Logs represent the subsurface section observed at the boring location on the date of drilling only.
2. Penetration resistance (blows/ft.) are the last 12" of an 18" drive or the middle 12" of a 24" drive using a 140-pound hammer falling 30 inches per blow (Mobile B-24 rig) unless noted otherwise. The penetration resistance values noted on the logs are actual blows per foot of penetration for the respective sampler type (i.e., MCS sampler penetration resistance has not been reduced to an equivalent SPT "N" value).
3. Where noted on the boring logs, slough is defined as material from the bore hole walls which collapses or flows into and partially fills the bore hole on removal of the hollow-stem auger plug or solid-stem augers. The presence of slough within the bore hole can render drive sampling impossible (samplers fill entirely with slough) and invalidate the blow count.
4. Where noted on the boring logs, groundwater seepage is defined as the depths at which groundwater was first observed in project exploratory borings during drilling.

UNIFIED SOIL CLASSIFICATION SYSTEM

CRITERIA FOR ASSIGNING GROUP SYMBOLS AND GROUP NAMES[A]				GROUP SYMBOL	GROUP NAME[B]
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve	**GRAVELS** More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels < 5% fines[C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3[E]	GW	Well-graded gravel[F]
			Cu < 4 and/or 1 > Cc > 3[E]	GP	Poorly graded gravel[F]
		Gravels with Fines > 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	SANDS 50% or more of coarse fraction passes No. 4 sieve	Clean Sands < 5% fines[D]	Cu ≥ 6 and 1 ≤ Cc ≤ 3[E]	SW	Well-graded sand[I]
			Cu < 6 and/or 1 > Cc > 3[E]	SP	Poorly graded sand[I]
		Sands with Fines > 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve	**SILTS AND CLAYS** Liquid limit < 50	Inorganic	PI > 7 plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI < 4 plots below "A" line[J]	ML	Silt[K,L,M]
		Organic	$\frac{\text{Liquid limit-oven dried}}{\text{Liquid limit-not dried}} < 0.75$	OL	Organic Clay[K,L,M,N]
					Organic Silt[K,L,M,O]
	SILTS AND CLAYS Liquid limit > 50	Inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		Organic	$\frac{\text{Liquid limit-oven dried}}{\text{Liquid limit-not dried}} < 0.75$	OH	Organic Clay[K,L,M,P]
					Organic Silt[K,L,M,Q]
HIGHLY ORGANIC SOILS		Primarily organic matter, dark color and organic odor		PT	Peat

NOTES:

A Based on the material passing the 3-in. (75mm) sieve.

B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

C Gravels with 5% to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

D Sands with 5% to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

E $Cu = \frac{D_{60}}{D_{10}}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

F If soil contains ≥ 15% sand, add "with sand" to group name.

G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

H If fines are organic, add "with organic fines" to group name.

I If soil contains ≥ 15% gravel, add "with gravel" to group name.

J If Atterberg limits plot in hatched area, soil is a CL-ML (silty clay).

K If soil contains 15% to 29% plus No. 200, add "with sand" or "with gravel", whichever is predominant.

L If soil contains ≥ 30% plus No.200, predominantly sand, add "sandy" to group name.

M If soil contains ≥ 30% plus No.200, predominantly gravel, add "gravelly" to group name.

N PI ≥ 4 and plots on or above "A" line.

O PI < 4 or plots below "A" line.

P PI plots on or above "A" line.

Q PI plots below "A" line.

APPENDIX B

DEPTH (feet)	SAMPLE NO.	TYPE	PENETRATION RESISTANCE (blows/ft.)	GROUNDWATER	LOG OF BORING B-1/W-1 (1 of 2) Location: Southeast corner of South Pond Approximate Station: n/a Approximate Elevation: 6.0 **DESCRIPTION**		MOISTURE %	DRY DENSITY (lbs./ft.^{3})	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE GRAVEL % (>#4 sieve)	GRAIN SIZE SAND % (#4 to #200 sieve)	GRAIN SIZE FINES % (<#200 sieve)	UNCONFINED COMPRESSIVE STRENGTH (lbs./ft.^{2})	DIRECT SHEAR Cohesion (lbs./ft.^{2})	DIRECT SHEAR Angle of Internal Friction
1					FILL											
2					- mixed Silty Clay with Gravel - little to some gravel											
3					FILL											
4					- mixed Silty Clay with Gravel and Bay Mud											
5																
6	1		6		BAY MUD (CH)	PP=0	77	54						470		
7					- dark blue grey											
8					- high plasticity											
9					- wet											
10					- soft to very soft											
11	2		4		- matted roots of marsh grass in Sample No. 1 indicates original ground	PP=0	84									
12																
13																
14																
15																
16	3		2			PP=0	83	52	101	69	0	6	94			
17												41% Silt 53% Clay				
18																
19																
20																
21					Continued on (2 of 2)											
22																
23																
24																
25																

NOTES

1. Drilled on 2/15/13 using a CME 75 drill rig, 8" hollow-stem augers and 140-lb. hammer with 30" drop using an auto trip hammer.
2. See report text and Figures in Appendices A and C for definitions, lab results and additional soil descriptions.
3. PP = pocket penetrometer reading in TSF.
4. A groundwater monitoring well (W-1) was installed in this boring. See report text for depth to groundwater.
5. Cross-reference CPT-6.
6. Approximate elevation taken from site map by Freyer & Laureta dated 12/10/09.

DEPTH (feet)	SAMPLE NO.	TYPE	PENETRATION RESISTANCE (blows/ft.)	GROUNDWATER	LOG OF BORING B-1W-1 (cont'd) Location: Southeast corner of South Pond Approximate Station: n/a Approximate Elevation: 6.0 DESCRIPTION	MOISTURE %	DRY DENSITY (lbs./ft.^{3})	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE: GRAVEL % (>#4 sieve)	GRAIN SIZE: SAND % (#4 to #200 sieve)	GRAIN SIZE: FINES % (<#200 sieve)	UNCONFINED COMPRESSIVE STRENGTH (lbs./ft.^{2})	DIRECT SHEAR: Cohesion (lbs./ft.^{2})	DIRECT SHEAR: Angle of Internal Friction
21	4	■	20		OLD BAY CLAY (CH) PP=1.5 - dark olive brown - high plasticity - wet - medium stiff to stiff	31	93	61	37	0	6	94 39% Silt 55% Clay	2,710		
22															
23															
24															
25															
26	5	■	15		PP=1.0	23	104						751		
27															
28					Bottom of Boring at 26.5'										
29–34															
35–44					Groundwater Monitoring Well Construction: Below-Grade Casing: 5 feet of blank, 20 feet of perforated well screen. Backfill: 0' - 3' grout 3' - 4' bentonite chips 4' - 25' sand										
45															

NOTES

1. See notes on Figure B-1/W-1 (1 of 2).

DEPTH (feet)	SAMPLE NO.	TYPE	PENETRATION RESISTANCE (blows/ft.)	GROUNDWATER	LOG OF BORING B-2/W-2 (1 of 2) Location: Northwest corner of North Pond Approximate Station: n/a Approximate Elevation: 10.3 DESCRIPTION	MOISTURE %	DRY DENSITY (lbs./ft.³)	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE GRAVEL % (>#4 sieve)	GRAIN SIZE SAND % (#4 to #200 sieve)	GRAIN SIZE FINES % (<#200 sieve)	UNCONFINED COMPRESSIVE STRENGTH (lbs./ft.²)	DIRECT SHEAR Cohesion (lbs./ft.²)	DIRECT SHEAR Angle of Internal Friction
1					FILL										
2					- dark brown to black										
3					- mixed clayey sand and silty sand with gravel										
4					- little to some gravel										
5					- moist										
6	1		21		- stiff PP=1.5	21	104						2,520		
7															
8															
9															
10					BAY MUD (CH)										
11	2		7		- dark blue grey PP=0.25	69	61	112	75	0	0	100			
12					- high plasticity						39% Silt				
13					- wet						61% Clay				
14					- soft to very soft										
15															
16	3		4		PP=0	72	56						345		
17															
18															
19															
20															
21	4		2		PP=0	76	50								
22					Bottom of Boring at 21.5'										
23															
24															
25															

NOTES

1. Drilled on 2/15/13 using a CME 75 drill rig, 8" hollow-stem augers and 140-lb. hammer with 30" drop using an auto trip hammer.
2. See report text and Figures in Appendices A and C for definitions, lab results and additional soil descriptions.
3. PP = pocket penetrometer reading in TSF.
4. A groundwater monitoring well (W-2) was installed in this boring. See report text for depth to groundwater.
5. Cross-reference CPT-1.
6. Approximate elevation taken from site map by Freyer & Laureta dated 12/10/09.

LOG OF BORING B-2/W-2 (cont'd)

Location: Southeast corner of South Pond

Approximate Station: n/a
Approximate Elevation: 6.0

DEPTH (feet)	SAMPLE NO.	TYPE	PENETRATION RESISTANCE (blows/ft.)	GROUNDWATER	DESCRIPTION	MOISTURE %	DRY DENSITY (lbs./ft.³)	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE: GRAVEL % (>#4 sieve)	GRAIN SIZE: SAND % (#4 to #200 sieve)	GRAIN SIZE: FINES % (<#200 sieve)	UNCONFINED COMPRESSIVE STRENGTH (lbs./ft.²)	DIRECT SHEAR: Cohesion (lbs./ft.²)	DIRECT SHEAR: Angle of Internal Friction
21															
22															
23															
24															
25															
26															
27					Groundwater Monitoring Well										
28					Construction:										
29					<u>Below-Grade Casing</u>:										
30					5' of blank, 15' of perforated well										
31					screen.										
32					<u>Backfill</u>:										
33					0' - 3' grout										
34					3' - 4' bentonite chips										
35					4' - 20' sand										
36															
37															
38															
39															
40															
41															
42															
43															
44															
45															

NOTES

1. See notes on B-2/W-2 (1 of 2).

DEPTH (feet)	SAMPLE NO.	TYPE	PENETRATION RESISTANCE (blows/ft.)	GROUNDWATER	LOG OF BORING B-3 (1 of 2) Location: Midway on levee between of North and South Ponds Approximate Station: n/a Approximate Elevation: 6.7 DESCRIPTION	MOISTURE %	DRY DENSITY (lbs./ft.^{3})	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE: GRAVEL % (>#4 sieve)	GRAIN SIZE: SAND % (#4 to #200 sieve)	GRAIN SIZE: FINES % (<#200 sieve)	UNCONFINED COMPRESSIVE STRENGTH (lbs./ft.^{2})	DIRECT SHEAR: Cohesion (lbs./ft.^{2})	DIRECT SHEAR: Angle of Internal Friction
1–6	1	■	7		FILL - medium brown - mixed silty clay with gravel - little to some gravel	31	114								
7–20	2	■	4	▼ (9 ft)	BAY MUD (CH) - dark blue grey - high plasticity - wet - soft to very soft PP=0 - matted roots of marsh grass in Sample 1, organic content approximately 15%, indicates original ground										
21–25					Continued on (2 of 2)										

NOTES

1. Drilled on 2/15/13 using a CME 75 drill rig, 8" hollow-stem augers and 140-lb. hammer with 30" drop using an auto trip hammer.
2. See report text and Figures in Appendices A and C for definitions, lab results and additional soil descriptions.
3. PP = pocket penetrometer reading in TSF.
4. Groundwater in open borehole measured at a depth of 9 feet at end of drilling just prior to backfilling. Does not represent equilibrium groundwater depth.
5. Approximate elevation taken from site map by Freyer & Laureta dated 12/10/09.

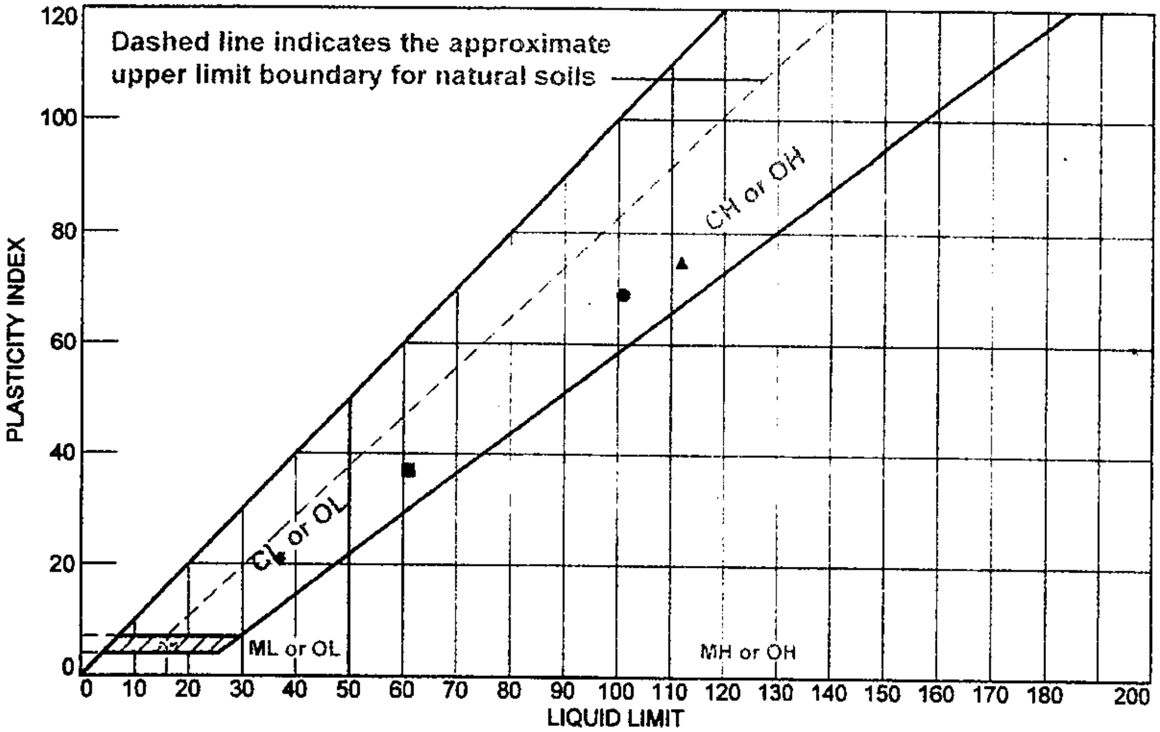
DEPTH (feet)	SAMPLE NO.	TYPE	PENETRATION RESISTANCE (blows/ft.)	GROUNDWATER	LOG OF BORING B-3 (cont'd) Location: Midway on levee between North and South Ponds Approximate Station: n/a Approximate Elevation: 6.7 **DESCRIPTION**	MOISTURE %	DRY DENSITY (lbs./ft.^{3})	LIQUID LIMIT	PLASTICITY INDEX	GRAIN SIZE GRAVEL % (>#4 sieve)	GRAIN SIZE SAND % (#4 to #200 sieve)	GRAIN SIZE FINES % (<#200 sieve)	UNCONFINED COMPRESSIVE STRENGTH (lbs./ft.^{2})	DIRECT SHEAR Cohesion (lbs./ft.^{2})	DIRECT SHEAR Angle of Internal Friction
21	3		10		OLD BAY CLAY (CH/CL) PP=0.5	33	92								
22					- medium brown to grey brown										
23					- silty clay with little fine sand										
24					- medium to high plasticity										
25					- wet										
26					- soft to medium stiff										
27															
28															
29											41% Silt				
30											36% Clay				
31	4		7		PP=0.5	26		37	21	0	23	77			
32					Bottom of Boring at 31.5'										
33															
34															
35															
36															
37															
38															
39															
40															
41															
42															
43															
44															
45															

NOTES

1. See notes on Figure B-3 (1 of 2).

APPENDIX C

LIQUID AND PLASTIC LIMITS TEST REPORT



	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●		B-1 3A	16'	83	32	101	69	CH
■		B-1 4A	21'		24	61	37	CH
▲		B-2 2A	11'	69	37	112	75	CH
◆		B-3 4	31'		16	37	21	CL

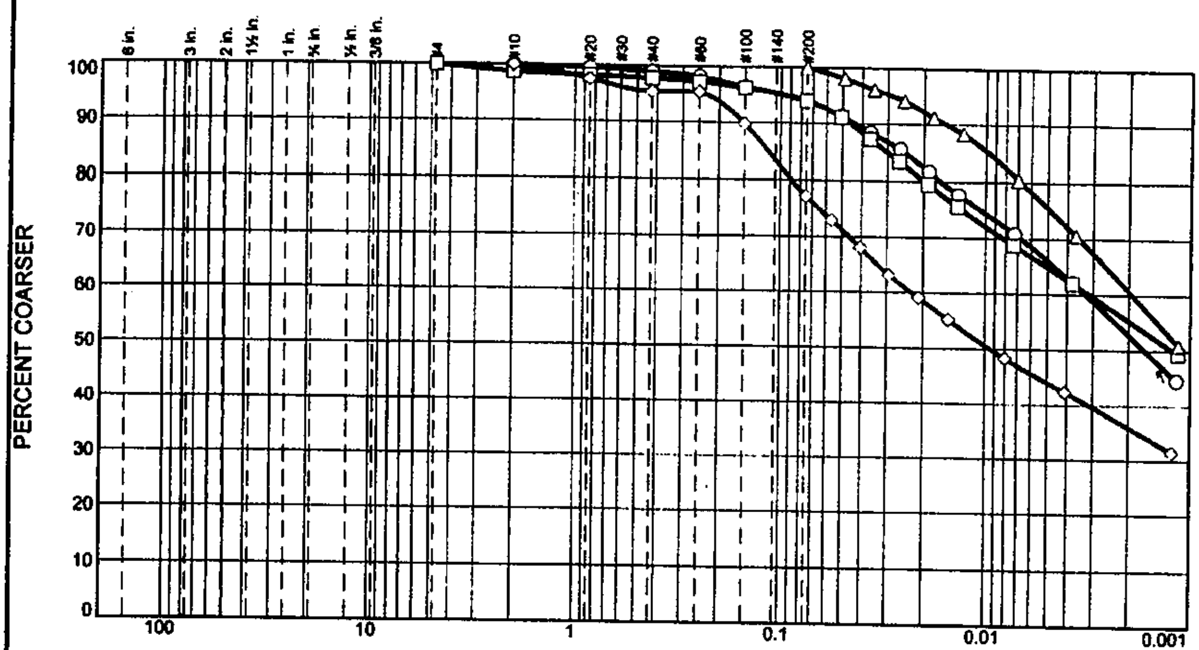
Soil Mechanics Lab

Oakland, California

Client: DCM Consulting,Inc.
Project: SBSA -FEF Facility
Project No.: 135 **Plate**

Tested By: MA

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	1.0	5.1	41.1	52.8
□	0.0	0.0	0.0	1.2	1.0	3.8	38.7	55.3
△	0.0	0.0	0.0	0.0	0.0	0.0	39.3	60.7
◇	0.0	0.0	0.0	0.0	4.6	18.2	41.2	36.0

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	101	32	0.0250	0.0033	0.0017					
□	61	24	0.0304	0.0031	0.0012					
△	112	37	0.0097	0.0019						
◇	37	16	0.1151	0.0226	0.0095					

Material Description	USCS	AASHTO
○ Dark grey FAT CLAY.	CH	A-7-5(76)
□ Stiff,very dark grey FAT CLAY(CH).	CH	A-7-6(39)
△ Dark grey FAT CLAY.	CH	A-7-5(92)
◇ Light brown sandy CLAY.	CL	A-6(15)

Project No. 135 **Client:** DCM Consulting,Inc.
Project: SBSA -FEF Facility
○ **Location:** B-1 **Depth:** 16' **Sample Number:** 3A
□ **Location:** B-1 **Depth:** 21' **Sample Number:** 4A
△ **Location:** B-2 **Depth:** 11' **Sample Number:** 2A
◇ **Location:** B-3 **Depth:** 31' **Sample Number:** 4

Remarks:
○F.M.=0.06
□F.M.=0.11
◇F.M.=0.20

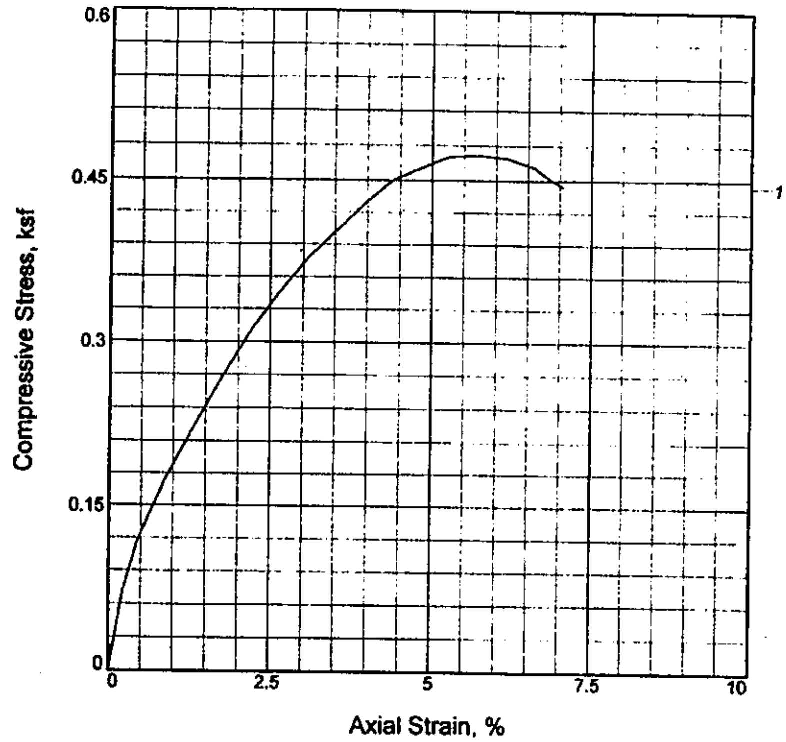
Soil Mechanics Lab

Oakland, California

Plate

Tested By: MA

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, ksf	0.471			
Undrained shear strength, ksf	0.235			
Failure strain, %	5.7			
Strain rate, in./min.	0.08			
Water content, %	76.7			
Wet density, pcf	94.8			
Dry density, pcf	53.7			
Saturation, %	96.8			
Void ratio	2.1408			
Specimen diameter, in.	2.42			
Specimen height, in.	4.54			
Height/diameter ratio	1.88			

Description: Soft,very dark grey FAT CLAY(CH)

LL =	PL =	PI =	Assumed GS= 2.70	Type:

Project No.: 135
Date Sampled:
Remarks:

Client: DCM Consulting,Inc.

Project: SBSA -FEF Facility

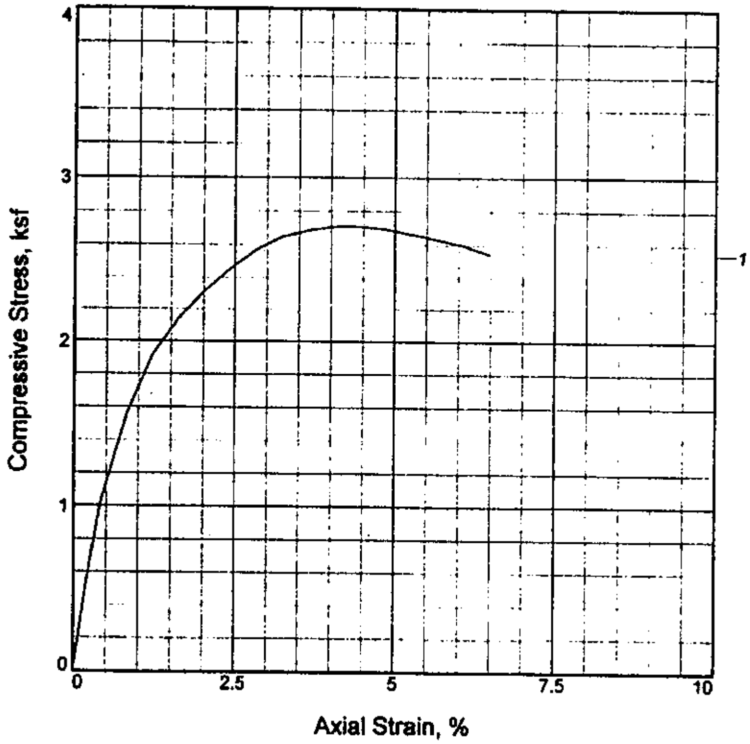
Location: B-1
Sample Number: 1A **Depth:** 6'

UNCONFINED COMPRESSION TEST
Soil Mechanics Lab
Oakland, California

Plate _______

Tested By: MA **Checked By:** ____________

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, ksf	2.710			
Undrained shear strength, ksf	1.355			
Failure strain, %	4.2			
Strain rate, in./min.	0.08			
Water content, %	30.8			
Wet density, pcf	121.6			
Dry density, pcf	93.0			
Saturation, %	102.4			
Void ratio	0.8129			
Specimen diameter, in.	2.42			
Specimen height, in.	4.95			
Height/diameter ratio	2.05			

Description: Stiff,very dark grey FAT CLAY(CH).

LL = 61	**PL** = 24	**PI** = 37	**Assumed GS=** 2.70	**Type:** Mod.Cal.

Project No.: 135
Date Sampled:
Remarks:

Client: DCM Consulting,Inc.

Project: SBSA -FEF Facility

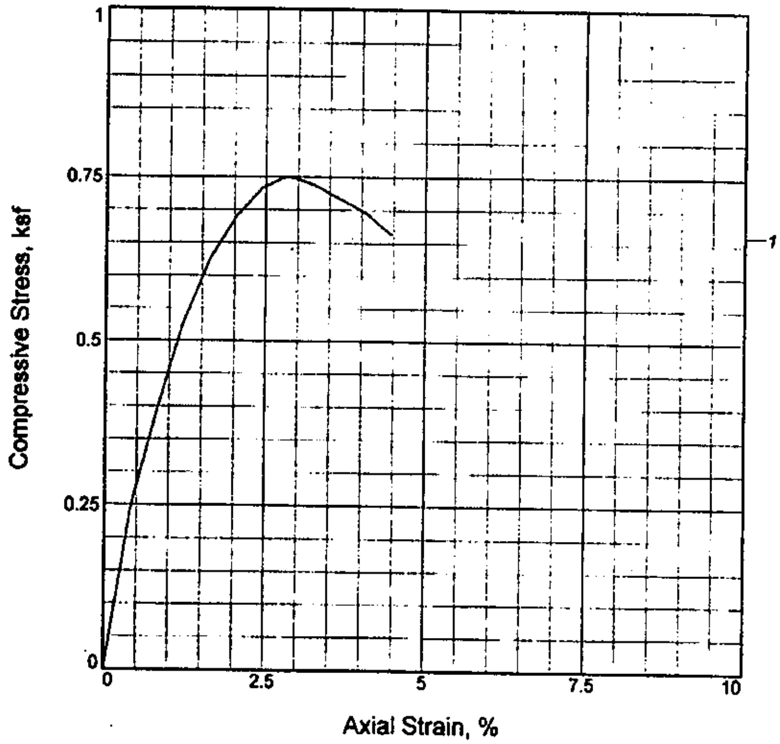
Location: B-1
Sample Number: 4A **Depth:** 21'

UNCONFINED COMPRESSION TEST
Soil Mechanics Lab
Oakland, California

Plate _______

Tested By: MA ____________ **Checked By:** ____________

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, ksf	0.751			
Undrained shear strength, ksf	0.375			
Failure strain, %	2.8			
Strain rate, in./min.	0.08			
Water content, %	22.9			
Wet density, pcf	127.9			
Dry density, pcf	104.1			
Saturation, %	99.8			
Void ratio	0.6198			
Specimen diameter, in.	2.42			
Specimen height, in.	4.93			
Height/diameter ratio	2.04			

Description: Soft,dark olive brown sandy CLAY(CL).Trace f-m caliche nodules.

LL =	PL =	PI =	Assumed GS= 2.70	Type: Mod.Cal.

Project No.: 135
Date Sampled:
Remarks:

Plate _______

Client: DCM Consulting,Inc.

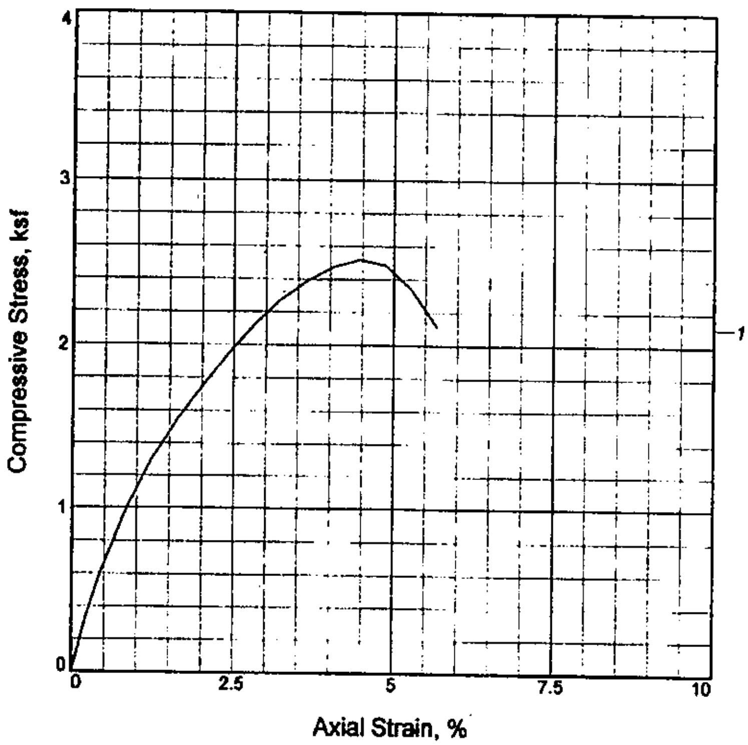
Project: SBSA -FEF Facility

Location: B-1
Sample Number: 5A **Depth:** 26'

UNCONFINED COMPRESSION TEST
Soil Mechanics Lab
Oakland, California

Tested By: MA **Checked By:** ____________

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, ksf	2.518			
Undrained shear strength, ksf	1.259			
Failure strain, %	4.5			
Strain rate, in./min.	0.08			
Water content, %	21.3			
Wet density, pcf	126.8			
Dry density, pcf	104.5			
Saturation, %	93.8			
Void ratio	0.6127			
Specimen diameter, in.	2.42			
Specimen height, in.	4.93			
Height/diameter ratio	2.04			

Description: Stiff,black becoming dark brown clayey SAND(SC)w/f-m gravel.Trace plastic trash*

LL =	PL =	PI =	Assumed GS= 2.70	Type: Mod.Cal.

Project No.: 135
Date Sampled:
Remarks:
*Probably fill material.

Plate _______

Client: DCM Consulting,Inc.

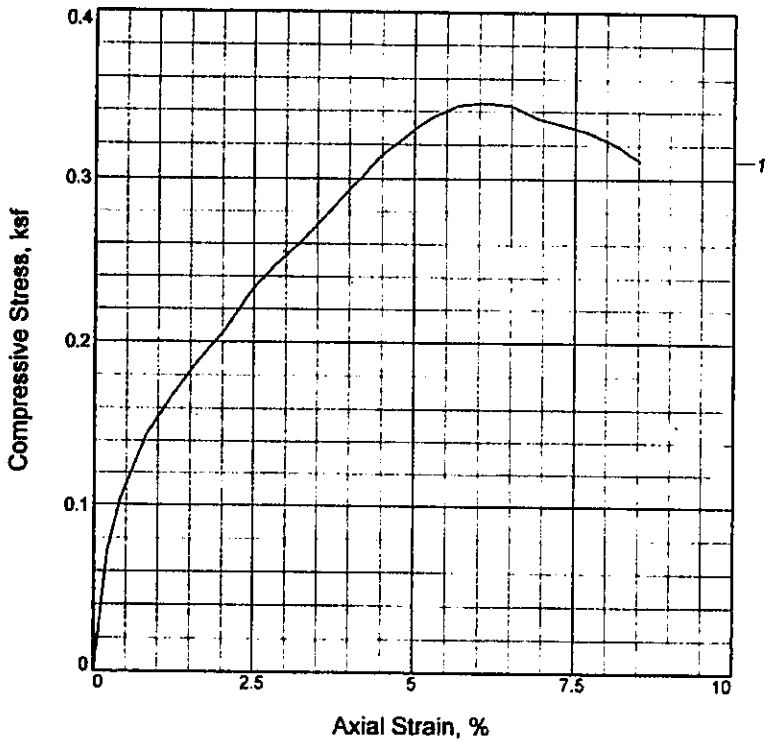
Project: SBSA -FEF Facility

Location: B-2
Sample Number: 1A **Depth:** 6'

UNCONFINED COMPRESSION TEST
Soil Mechanics Lab
Oakland, California

Tested By: MA **Checked By:** ____________

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, ksf	0.345			
Undrained shear strength, ksf	0.173			
Failure strain, %	6.1			
Strain rate, in./min.	0.08			
Water content, %	72.0			
Wet density, pcf	95.7			
Dry density, pcf	55.6			
Saturation, %	95.8			
Void ratio	2.0306			
Specimen diameter, in.	2.42			
Specimen height, in.	4.93			
Height/diameter ratio	2.04			

Description: Soft,dark grey FAT CLAY(CH)

LL =	PL =	PI =	Assumed GS= 2.70	Type: Mod.Cal.

Project No.: 135
Date Sampled:
Remarks:

Plate ______

Client: DCM Consulting,Inc.

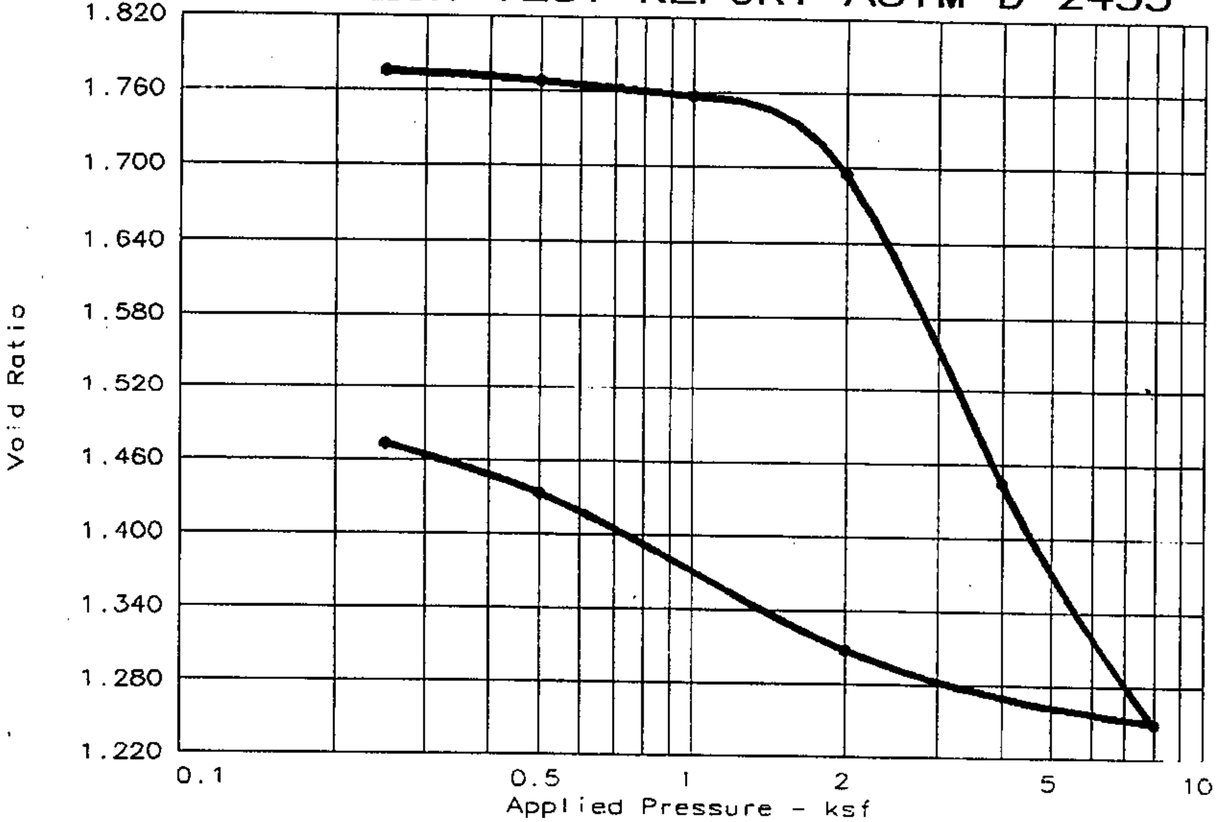
Project: SBSA -FEF Facility

Location: B-2
Sample Number: 3A **Depth:** 16'

UNCONFINED COMPRESSION TEST
Soil Mechanics Lab
Oakland, California

Tested By: MA ______ **Checked By:** ______

CONSOLIDATION TEST REPORT ASTM D 2435



Coeffs. of Consolidation (sq. in./min.) & Secondary Consolidation											
No.	Load	Cv	Cα	No.	Load	Cv	Cα	No.	Load	Cv	Cα

Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp.Gr.	Precons. (ksf)	C_c	e_o
104.9 %	69.0 %	60.7	112	75	2.700		0.84	1.7760

TEST RESULTS	MATERIAL DESCRIPTION
Compression Index = 0.84	Soft, dark grey FAT CLAY
	Class: CH

Project No.: 135
Project: SBSA-FEF Facility
Location: B-2 2A 11'

Date: 2-25-13

Remarks:

CONSOLIDATION TEST REPORT ASTM D 2435

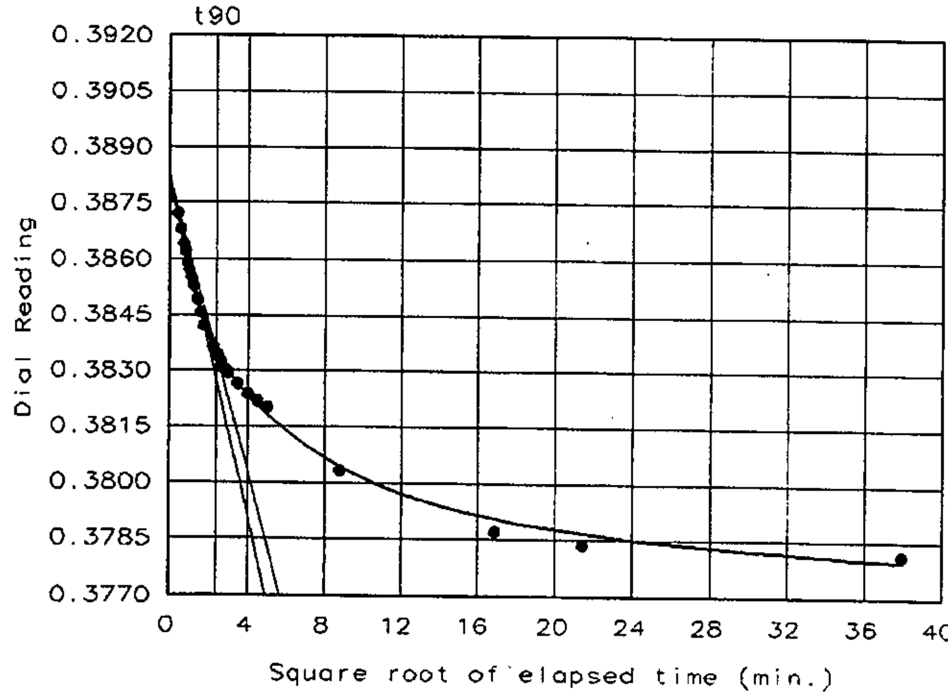
Soil Mechanics Lab

Fig. No. ____

Dial Reading vs. Time

Project No.: 135
Project: SBSA-FEF Facility
Location: B-2 2A 11'

Date: 2-25-13



Load No.= 4

Load= 2.00 ksf

D_0 = 0.3882

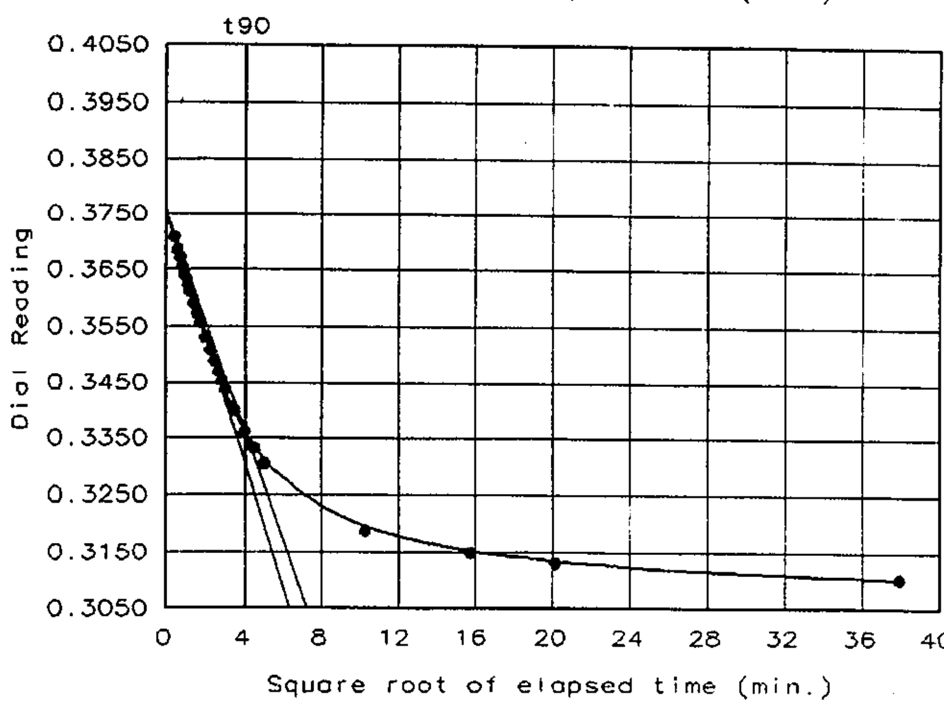
D_{90} = 0.3835

D_{100} = 0.3830

T_{90} = 5.54 min.

C_v @ T_{90} =

.021 in.^{2}/min.



Load No.= 5

Load= 4.00 ksf

D_0 = 0.3753

D_{90} = 0.3360

D_{100} = 0.3316

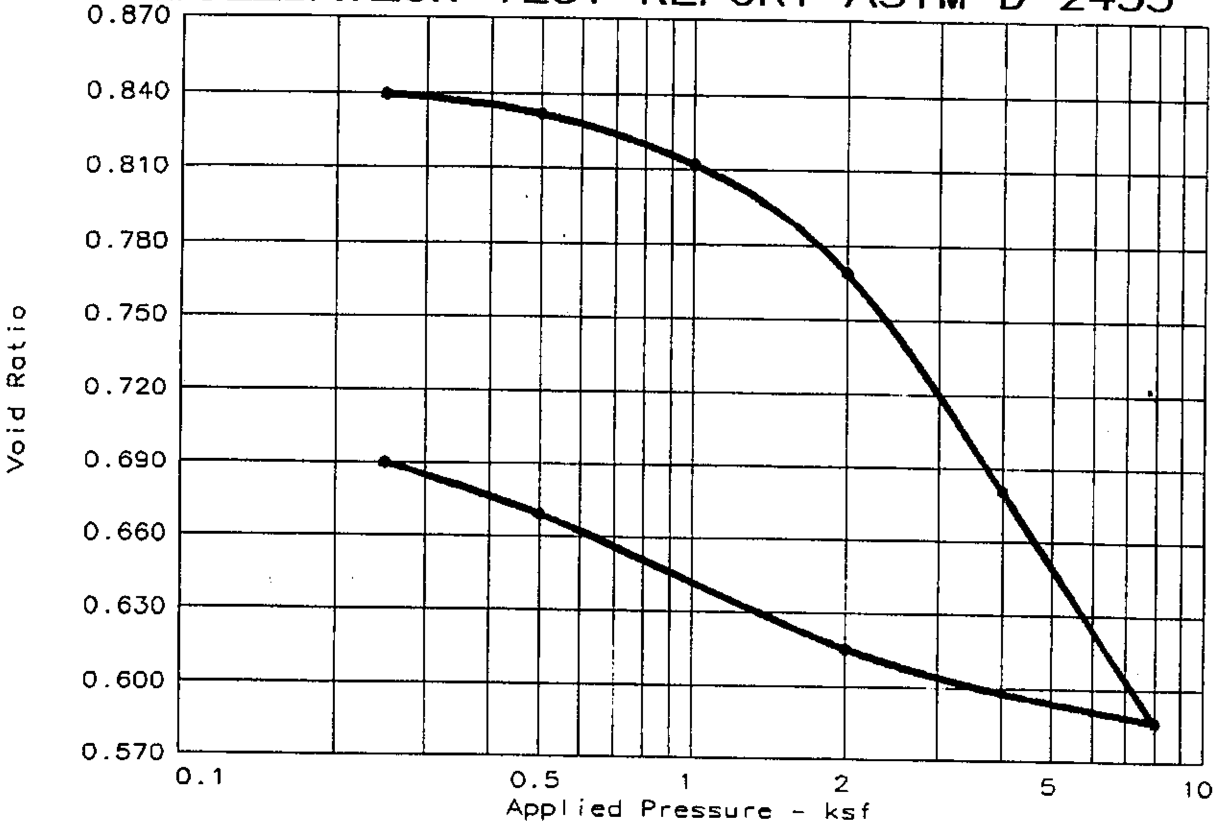
T_{90} = 16.38 min.

C_v @ T_{90} =

.006 in.^{2}/min.

Soil Mechanics Lab

CONSOLIDATION TEST REPORT ASTM D 2435



Coeffs. of Consolidation (sq. in./min.) & Secondary Consolidation											
No.	Load	Cv	Cα	No.	Load	Cv	Cα	No.	Load	Cv	Cα
4	2.00	0.006									
5	4.00	0.005									

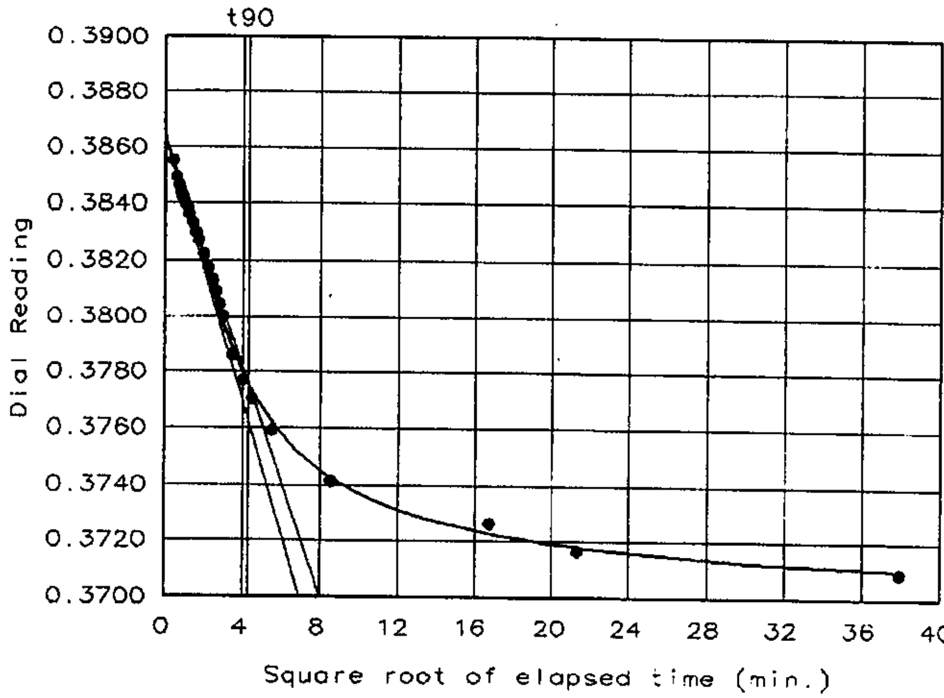
Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp.Gr.	Precons. (ksf)	C_c	e_o
107.0 %	33.3 %	91.6			2.700		0.31	0.8401

TEST RESULTS	MATERIAL DESCRIPTION
Compression Index = 0.31	Med.stiff,very dark grey FAT CLAY. Class: CH
Project No.: 135 Project: SBSA-FeF Facility Location: B-3 3A 21' Date: 2-25-13	Remarks:
CONSOLIDATION TEST REPORT ASTM D 2435 Soil Mechanics Lab	Fig. No. ______

Dial Reading vs. Time

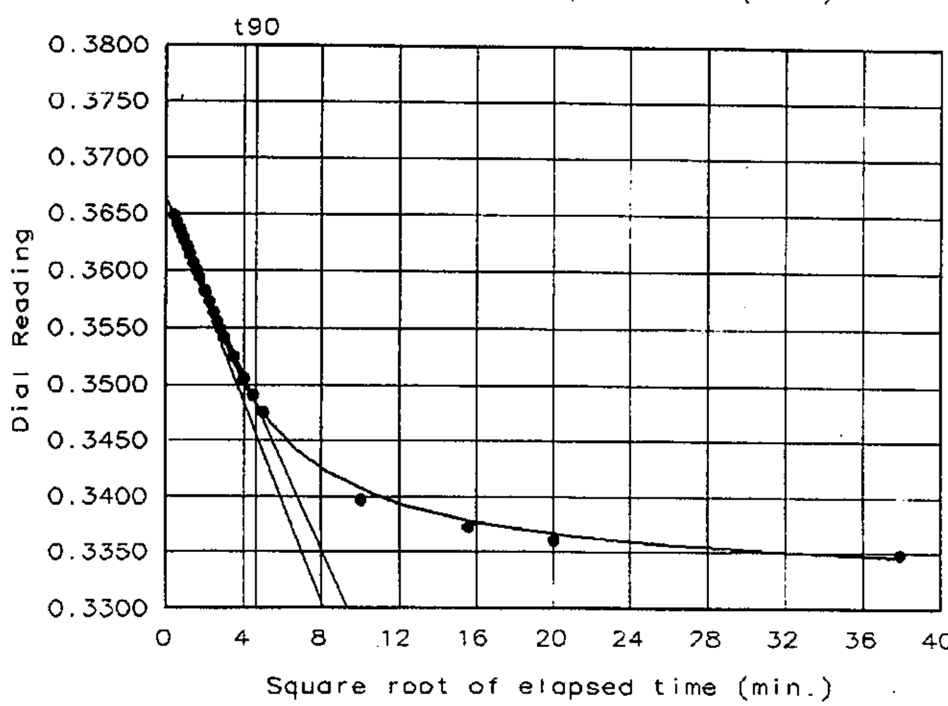
Project No.: 135
Project: SBSA-FeF Facility
Location: B-3 3A 21'

Date: 2-25-13



Load No.= 4
Load= 2.00 ksf
D_0 = 0.3864
D_{90} = 0.3776
D_{100}= 0.3766
T_{90}= 18.47 min.

C_v @ T_{90} =
.006 in.²/min.



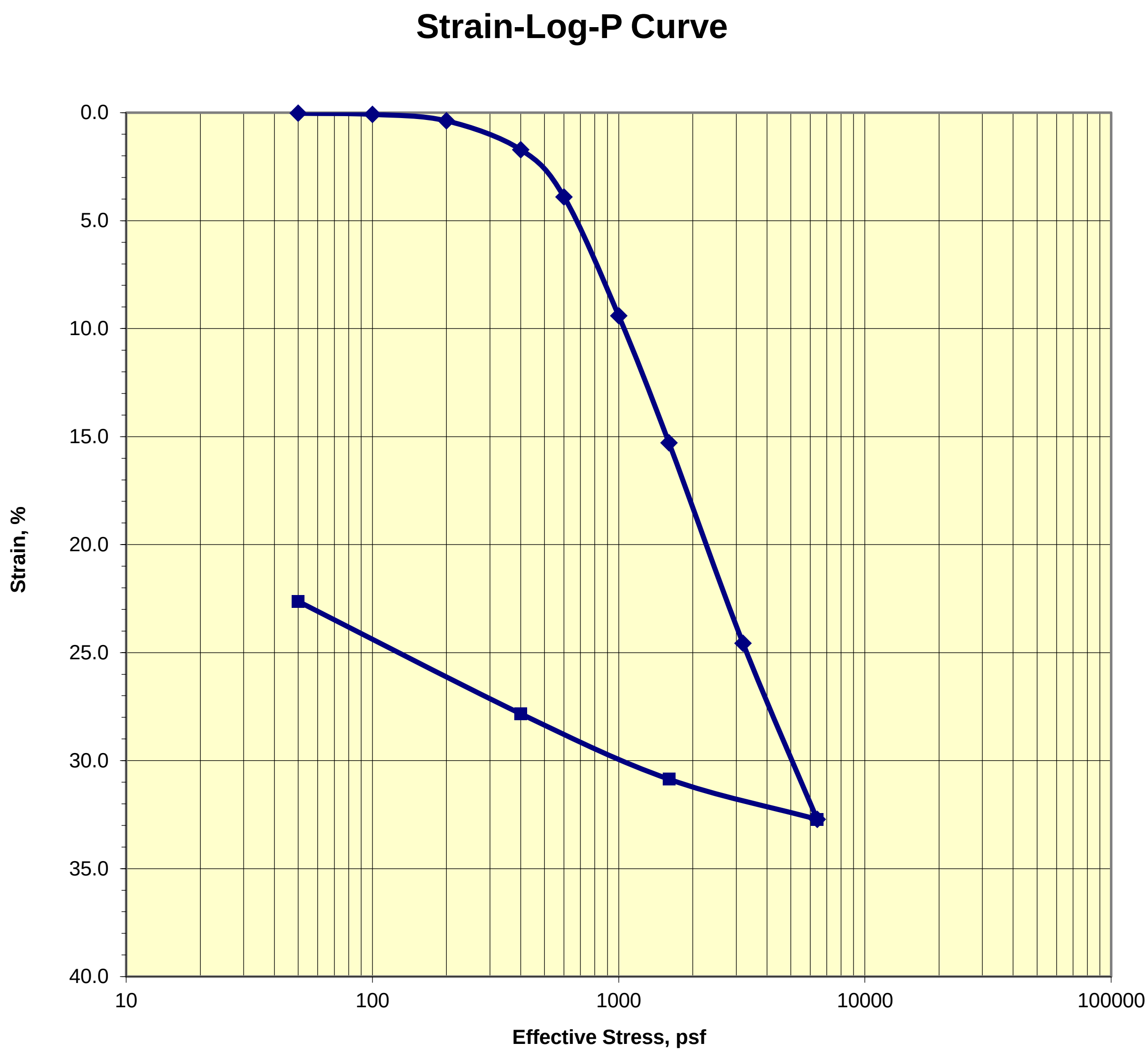
Load No.= 5
Load= 4.00 ksf
D_0 = 0.3664
D_{90} = 0.3485
D_{100}= 0.3465
T_{90}= 21.18 min.

C_v @ T_{90} =
.005 in.²/min.

Soil Mechanics Lab

Consolidation Test
ASTM D2435

Job No.:	011-883	**Boring:**	B-11	**Run By:**	MD
Client:	BAGG Engineers	**Sample:**	4	**Reduced:**	PJ
Project:	FREYE-18-01	**Depth, ft.:**	9(Tip-3")	**Checked:**	PJ/DC
Soil Type:	Greenish Gray CLAY w/ organics (Bay Mud)			**Date:**	12/8/2020



Assumed Gs 2.6	**Initial**	**Final**
Moisture %:	105.6	72.8
Dry Density, pcf:	42.9	56.1
Void Ratio:	2.788	1.892
% Saturation:	98.5	100.0

Remarks:

COOPER TESTING LABORATORY

Corrosivity Tests Summary

CTL # 011-883 **Date:** 12/2/2020 **Tested By:** JC **Checked:** PJ
Client: BAGG **Project:** Proposed Sheetpile Flood Wall **Proj. No:** FREYE-18-01
Remarks:

Sample Location or ID			Resistivity @ 15.5 °C (Ohm-cm)			Chloride	Sulfate		pH	ORP		Sulfide	Moisture	Soil Visual Description
			As Rec.	Min	Sat.	mg/kg	mg/kg	%		(Redox)		Qualitative	At Test	
						Dry Wt.	Dry Wt.	Dry Wt.		E_H (mv)	At Test	by Lead	%	
Boring	Sample, No.	Depth, ft.	ASTM G57	Cal 643	ASTM G57	ASTM D4327	ASTM D4327	ASTM D4327	ASTM G51	ASTM G200	Temp °C	Acetate Paper	ASTM D2216	
B-11	2C	1-4	-	-	266	2,610	355	0.0355	5.0	495	15	-	20.0	Dark Yellowish Brown Clayey SAND
B-11	5A	13.5	-	-	59	16,389	52	0.0052	8.2	247	15	-	95.1	Dark Greenish Gray CLAY w/ Sand
B-11	9A	27.5	-	-	126	4,535	725	0.0725	7.5	513	16	-	21.4	Olive Sandy CLAY

Hydraulic Conductivity
ASTM D 5084
Method C: Falling Head Rising Tailwater

Job No:	011-883	**Boring:**	B-11	**Date:**	12/09/20
Client:	BAGG Engineers	**Sample:**	1B	**By:**	MD/PJ
Project:	FREYE-18-01	**Depth, ft.:**	1.5	**Remolded:**	

Visual Classification: Olive Brown Silty SAND

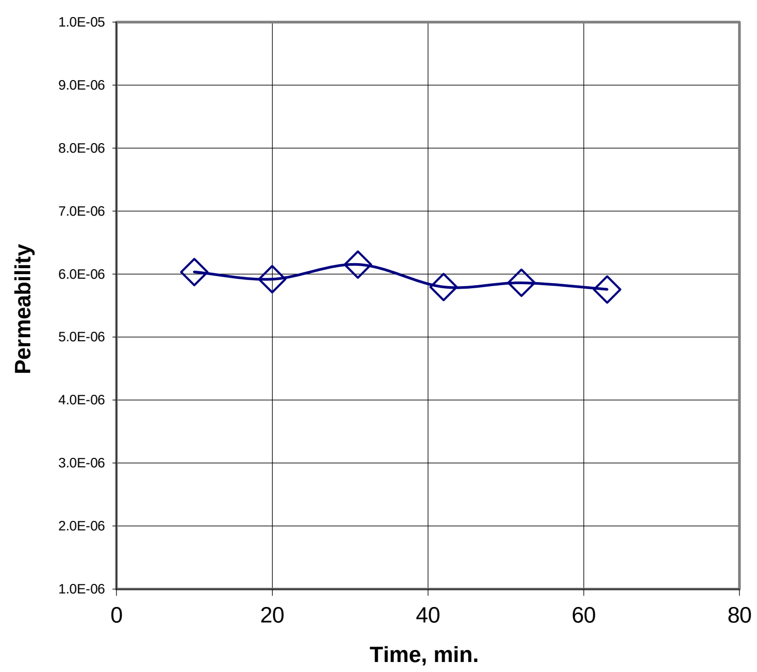
Max Sample Pressures, psi:

Cell:	Bottom	Top	Avg. Sigma3
84	79	79	5

B: = >0.95 **("B" is an indication of saturation)**

Max Hydraulic Gradient: = 5

Date	Minutes	Head, (in)	K,cm/sec
12/3/2020	0.00	12.50	**Start of Test**
12/3/2020	10.00	11.90	6.0E-06
12/3/2020	20.00	11.35	5.9E-06
12/3/2020	31.00	10.70	6.2E-06
12/3/2020	42.00	10.25	5.8E-06
12/3/2020	52.00	9.75	5.9E-06
12/3/2020	63.00	9.30	5.8E-06



Average Hydraulic Conductivity: 6.E-06 cm/sec

Sample Data:	Initial (As-Received)		Final (At-Test)
Height, in	2.50		2.42
Diameter, in	2.41		2.40
Area, in2	4.54		4.52
Volume in3	11.35		10.95
Total Volume, cc	186.0		179.4
Volume Solids, cc	113.5		113.5
Volume Voids, cc	72.5		65.9
Void Ratio	0.6		0.6
Total Porosity, %	39.0		36.7
Air-Filled Porosity (θa),%	17.7		0.9
Water-Filled Porosity (θw),%	21.3		35.8
Saturation, %	54.6		97.6
Specific Gravity	2.70	Assumed	2.70
Wet Weight, gm	346.1		370.8
Dry Weight, gm	306.5		306.5
Tare, gm	0.00		0.00
Moisture, %	12.9		21.0
Wet Bulk Density, pcf	116.1		129.0
Dry Bulk Density, pcf	102.8		106.6
Wet Bulk Dens.ρb, (g/cm^3)	1.86		2.07
Dry Bulk Dens.ρb, (g/cm^3)	1.65		1.71

Remarks:

Hydraulic Conductivity
ASTM D 5084
Method C: Falling Head Rising Tailwater

Job No:	011-883	**Boring:**	B-11	**Date:**	12/15/20
Client:	BAGG Engineers	**Sample:**	4	**By:**	MD/PJ
Project:	FREYE-18-01	**Depth, ft.:**	9	**Remolded:**	

Visual Classification: Greenish Gray CLAY w/ organics (Bay Mud)

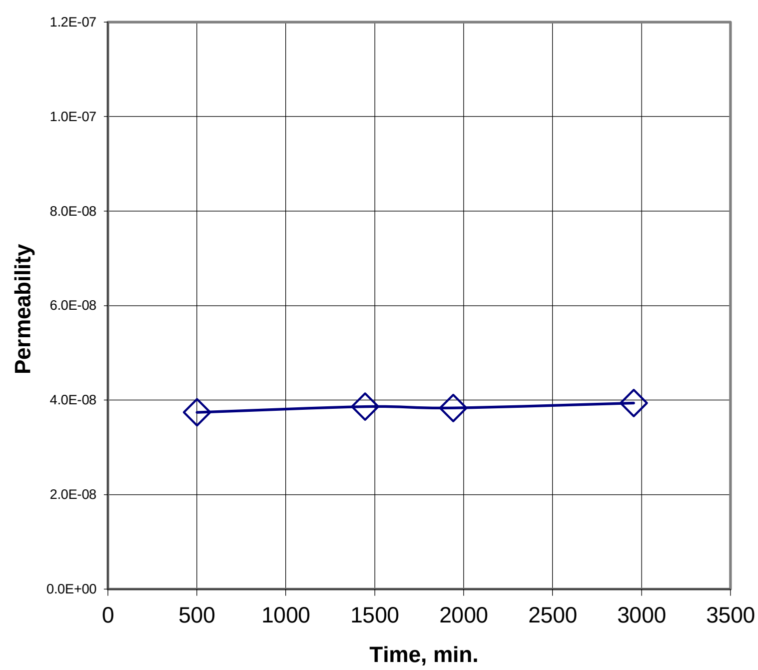
Max Sample Pressures, psi:

Cell:	Bottom	Top	Avg. Sigma3
53.5	49	48	5

B: = >0.95 ("B" is an indication of saturation)

Max Hydraulic Gradient: = 15

Date	Minutes	Head, (in)	K,cm/sec
12/9/2020	0.00	50.42	Start of Test
12/9/2020	501.00	49.69	3.7E-08
12/10/2020	1446.00	48.39	3.9E-08
12/10/2020	1942.00	47.64	3.8E-08
12/11/2020	2956.00	46.39	3.9E-08



Average Hydraulic Conductivity: 4.E-08 cm/sec

Sample Data:	Initial (As-Received)		Final (At-Test)
Height, in	3.56		3.43
Diameter, in	2.85		2.76
Area, in2	6.36		5.96
Volume in3	22.63		20.45
Total Volume, cc	370.9		335.1
Volume Solids, cc	96.0		96.0
Volume Voids, cc	274.9		239.1
Void Ratio	2.9		2.5
Total Porosity, %	74.1		71.3
Air-Filled Porosity (θa),%	1.2		0.6
Water-Filled Porosity (θw),%	72.9		70.7
Saturation, %	98.4		99.1
Specific Gravity	2.70	Assumed	2.70
Wet Weight, gm	529.7		496.2
Dry Weight, gm	259.2		259.2
Tare, gm	0.00		0.00
Moisture, %	104.4		91.4
Wet Bulk Density, pcf	89.1		92.4
Dry Bulk Density, pcf	43.6		48.3
Wet Bulk Dens.ρb, (g/cm^3)	1.43		1.48
Dry Bulk Dens.ρb, (g/cm^3)	0.70		0.77

Remarks:

Hydraulic Conductivity
ASTM D 5084
Method C: Falling Head Rising Tailwater

Job No:	011-883	**Boring:**	B-11	**Date:**	12/09/20
Client:	BAGG Engineers	**Sample:**	10B	**By:**	MD/PJ
Project:	FREYE-18-01	**Depth, ft.:**	32	**Remolded:**	

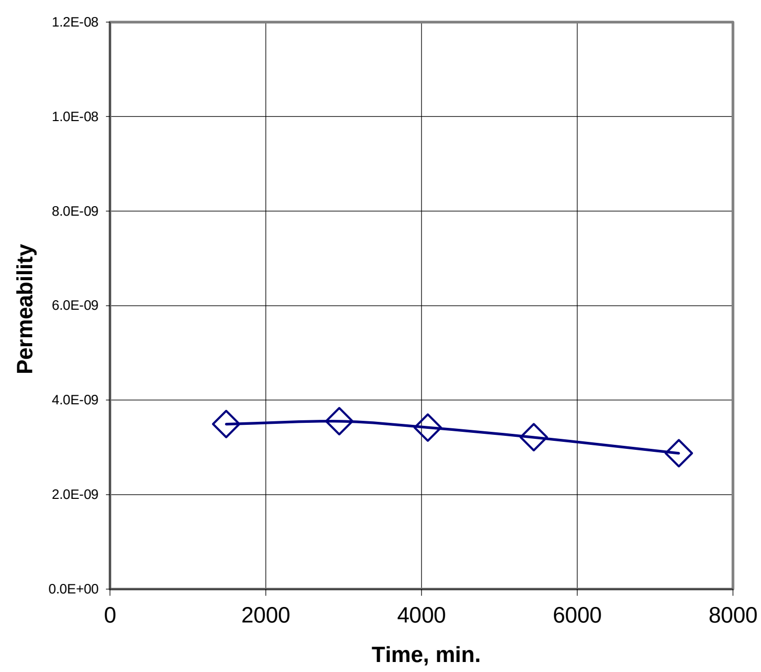
Visual Classification: Olive Sandy CLAY

Max Sample Pressures, psi:			
Cell:	**Bottom**	**Top**	**Avg. Sigma3**
83.5	49.5	47.5	35

B: = >0.95 **("B" is an indication of saturation)**

Max Hydraulic Gradient: = 28

Date	Minutes	Head, (in)	K,cm/sec
12/2/2020	0.00	70.38	**Start of Test**
12/3/2020	1494.00	70.08	3.5E-09
12/4/2020	2943.00	69.78	3.6E-09
12/5/2020	4081.00	69.58	3.4E-09
12/6/2020	5440.00	69.38	3.2E-09
12/7/2020	7303.00	69.18	2.9E-09



Average Hydraulic Conductivity: <1.E-08 cm/sec

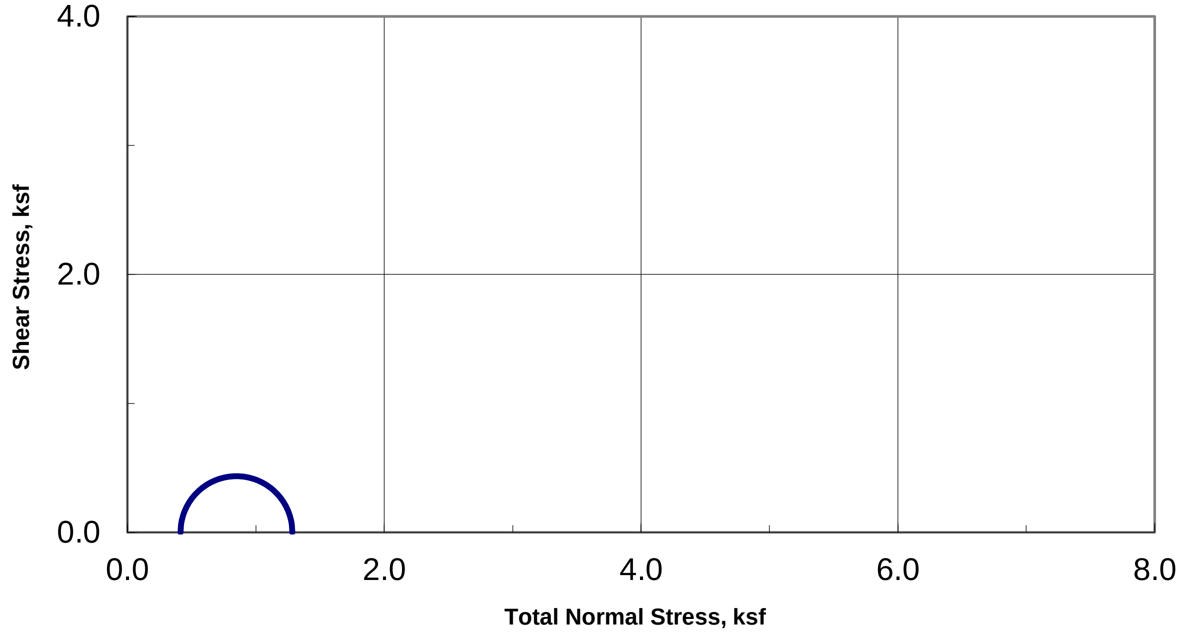
Sample Data:	Initial (As-Received)		Final (At-Test)
Height, in	2.51		2.53
Diameter, in	2.42		2.43
Area, in2	4.58		4.64
Volume in3	11.49		11.73
Total Volume, cc	188.3		192.3
Volume Solids, cc	117.0		117.0
Volume Voids, cc	71.2		75.3
Void Ratio	0.6		0.6
Total Porosity, %	37.8		39.1
Air-Filled Porosity (θa),%	0.4		0.4
Water-Filled Porosity (θw),%	37.4		38.8
Saturation, %	98.9		99.1
Specific Gravity	2.70	Assumed	2.70
Wet Weight, gm	386.4		390.5
Dry Weight, gm	315.9		315.9
Tare, gm	0.00		0.00
Moisture, %	22.3		23.6
Wet Bulk Density, pcf	128.1		126.7
Dry Bulk Density, pcf	104.7		102.5
Wet Bulk Dens.ρb, (g/cm^3)	2.05		2.03
Dry Bulk Dens.ρb, (g/cm^3)	1.68		1.64

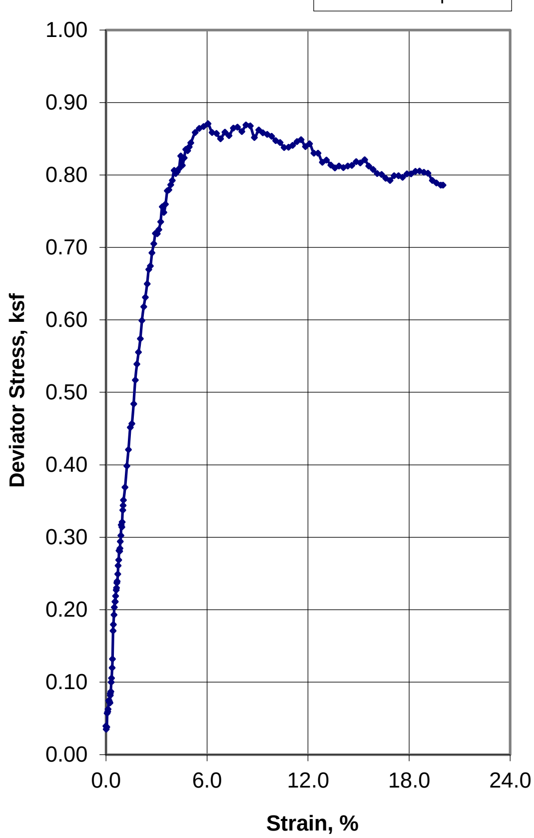
Remarks:

Cooper Testing Labs, Inc.
937 Commercial Street
Palo Alto, CA 94303

Unconsolidated-Undrained Triaxial Test

ASTM D2850





Sample Data	1	2	3	4
Moisture %	91.3			
Dry Den,pcf	46.2			
Void Ratio	2.652			
Saturation %	92.9			
Height in	6.00			
Diameter in	2.87			
Cell psi	2.9			
Strain %	6.05			
Deviator, ksf	0.871			
Rate %/min	1.00			
in/min	0.060			
Job No.:	011-883			
Client:	BAGG Engineers			
Project:	FREYE-18-01			
Boring:	B-11			
Sample:	4			
Depth ft:	9(Tip-4")			

Visual Soil Description

Sample #	
1	Greenish Gray CLAY w/ organics (Bay Mud)
2	
3	
4	

Remarks:

Note: Strengths are picked at the peak deviator stress or 15% strain which ever occurs first per ASTM D2850.

APPENDIX C

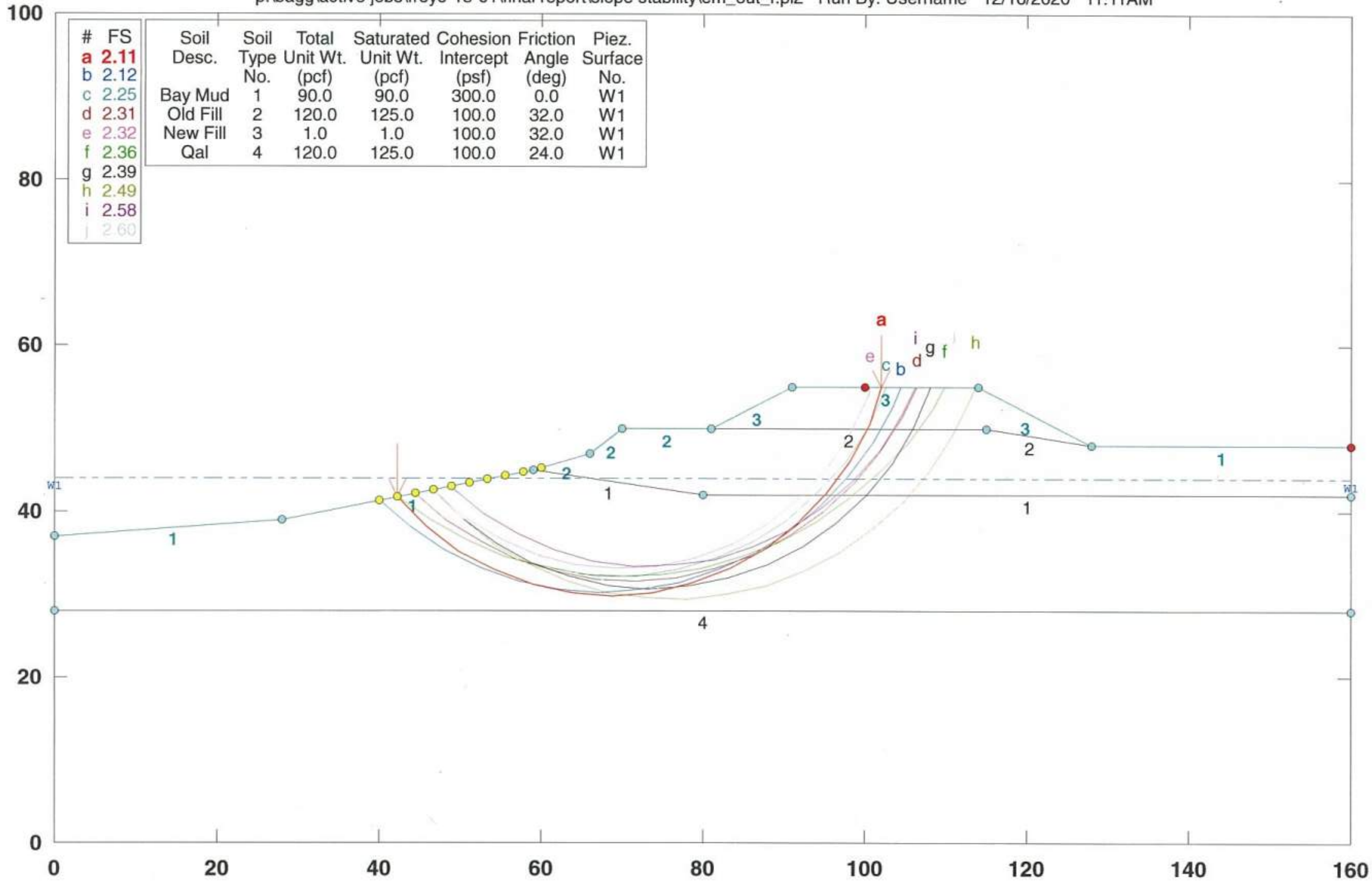
PLOTS OF SLOPE STABILITY ANALYSES

Entrance Embankment Outboard (Static) no sheetpiling

p:\bagg\active jobs\freye-18-01\final report\slope stability\em_out_f.pl2 Run By: Username 12/16/2020 11:11AM

#	FS
a	2.11
b	2.12
c	2.25
d	2.31
e	2.32
f	2.36
g	2.39
h	2.49
i	2.58
j	2.60

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Bay Mud	1	90.0	90.0	300.0	0.0	W1
Old Fill	2	120.0	125.0	100.0	32.0	W1
New Fill	3	1.0	1.0	100.0	32.0	W1
Qal	4	120.0	125.0	100.0	24.0	W1



PCSTABL5M/si FSmin=2.11
Safety Factors Are Calculated By The Modified Bishop Method

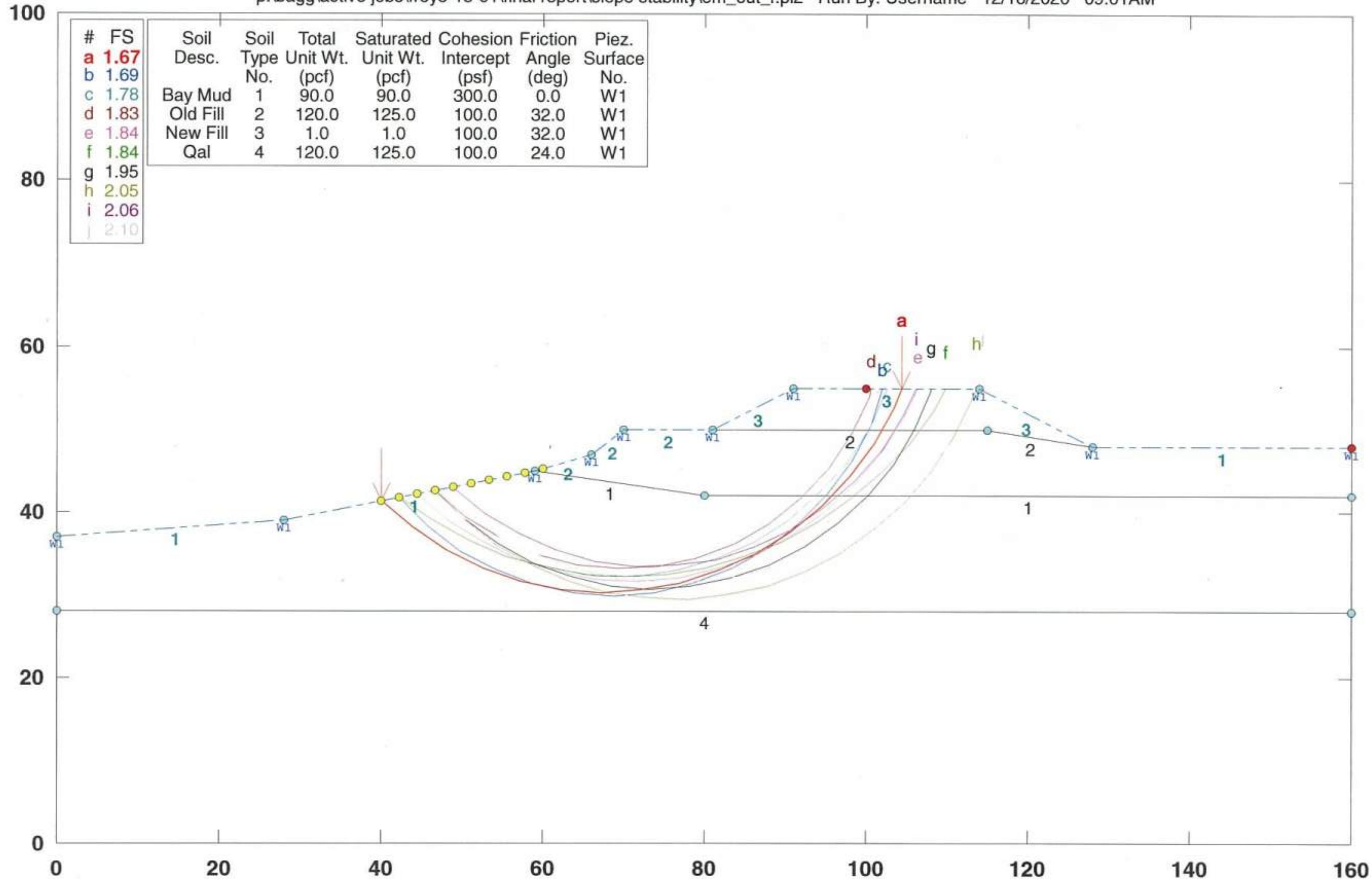
STED

Entrance Embankment Outboard (Rapid Drawdown) No Sheetpiling

p:\bagg\active jobs\freye-18-01\final report\slope stability\em_out_r.pl2   Run By: Username   12/16/2020   09:01AM

#	FS
a	1.67
b	1.69
c	1.78
d	1.83
e	1.84
f	1.84
g	1.95
h	2.05
i	2.06
j	2.10

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Bay Mud	1	90.0	90.0	300.0	0.0	W1
Old Fill	2	120.0	125.0	100.0	32.0	W1
New Fill	3	1.0	1.0	100.0	32.0	W1
Qal	4	120.0	125.0	100.0	24.0	W1



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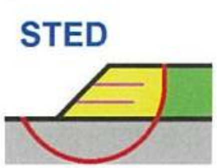
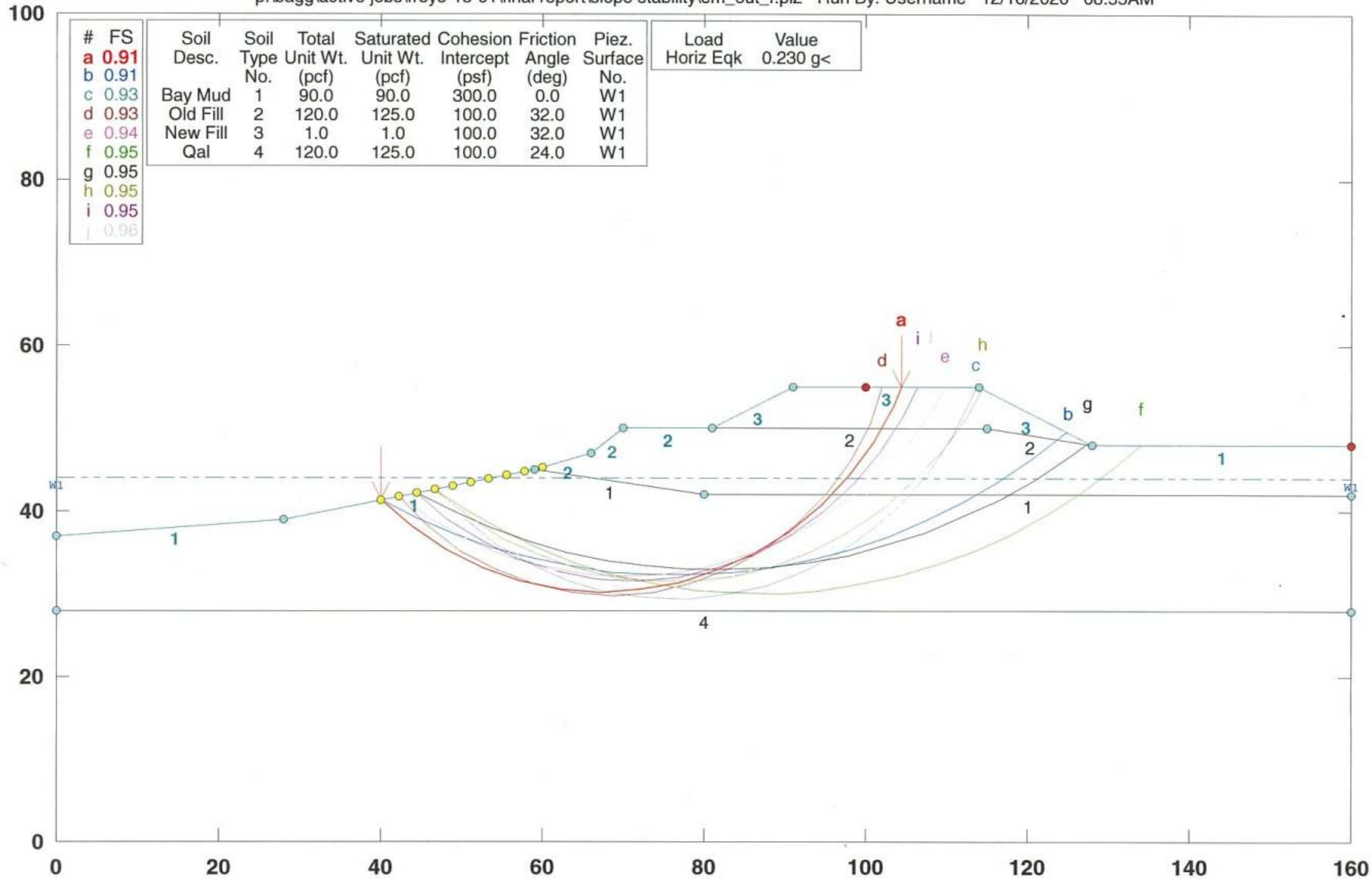
Safety Factors Are Calculated By The Modified Bishop Method



Entrance Embankment Outboard (Seismic) no sheetpiling

p:\bagg\active jobs\freye-18-01\final report\slope stability\em_out_f.pl2 Run By: Username 12/16/2020 08:55AM



PCSTABL5M/si FSmin=0.91

Safety Factors Are Calculated By The Modified Bishop Method

STED

Entrance Embankment outboard (Seismic) Sheetpiling at outboard toe of new fill

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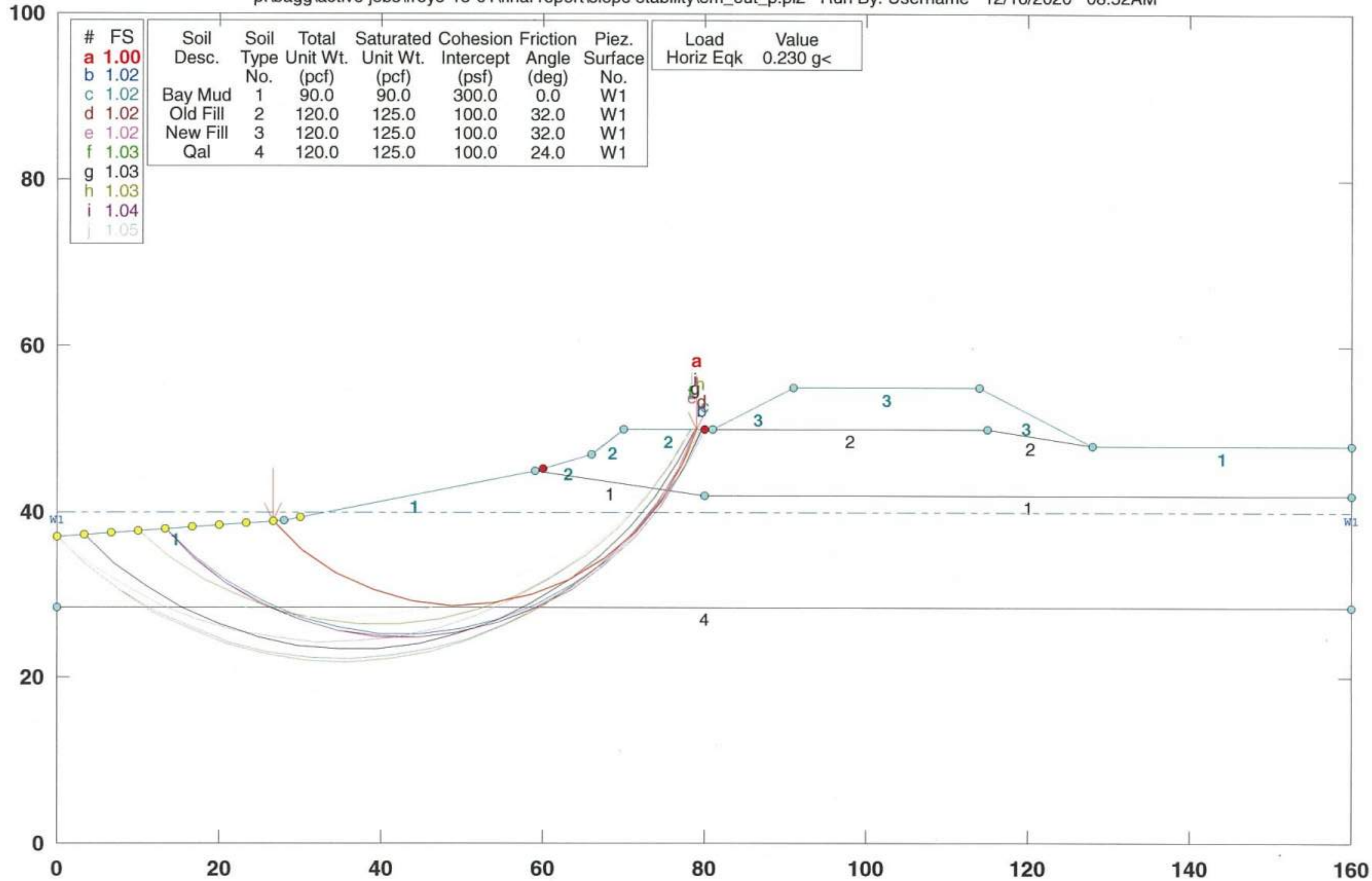
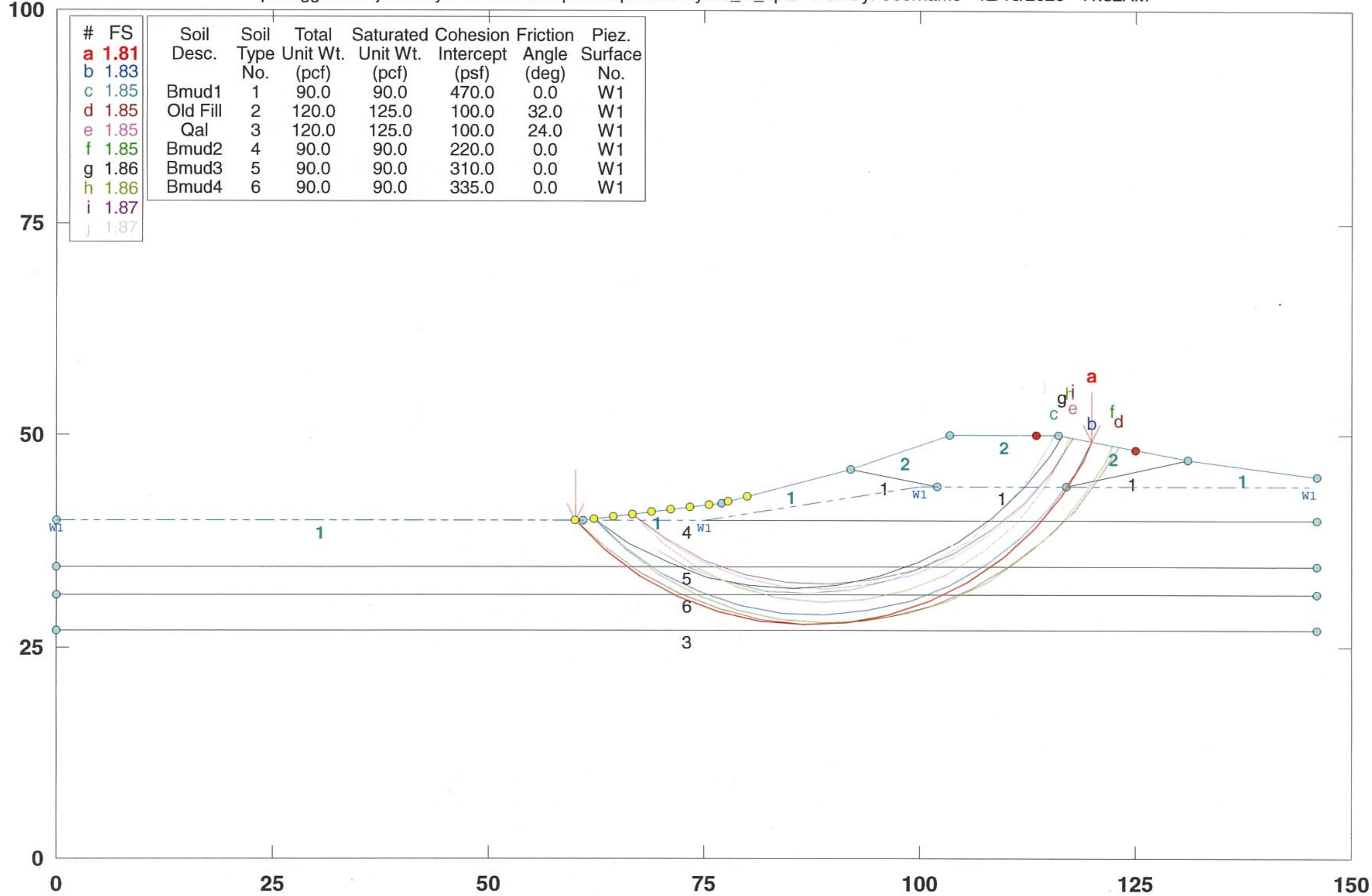


PCSTABL5M/si FSmin=1.00
Safety Factors Are Calculated By The Modified Bishop Method

STED

West Levee Inboard (Static) No Sheetpiling

p:\bagg\active jobs\freye-18-01\final report\slope stability\we_in_f.pl2 Run By: Username 12/16/2020 11:32AM



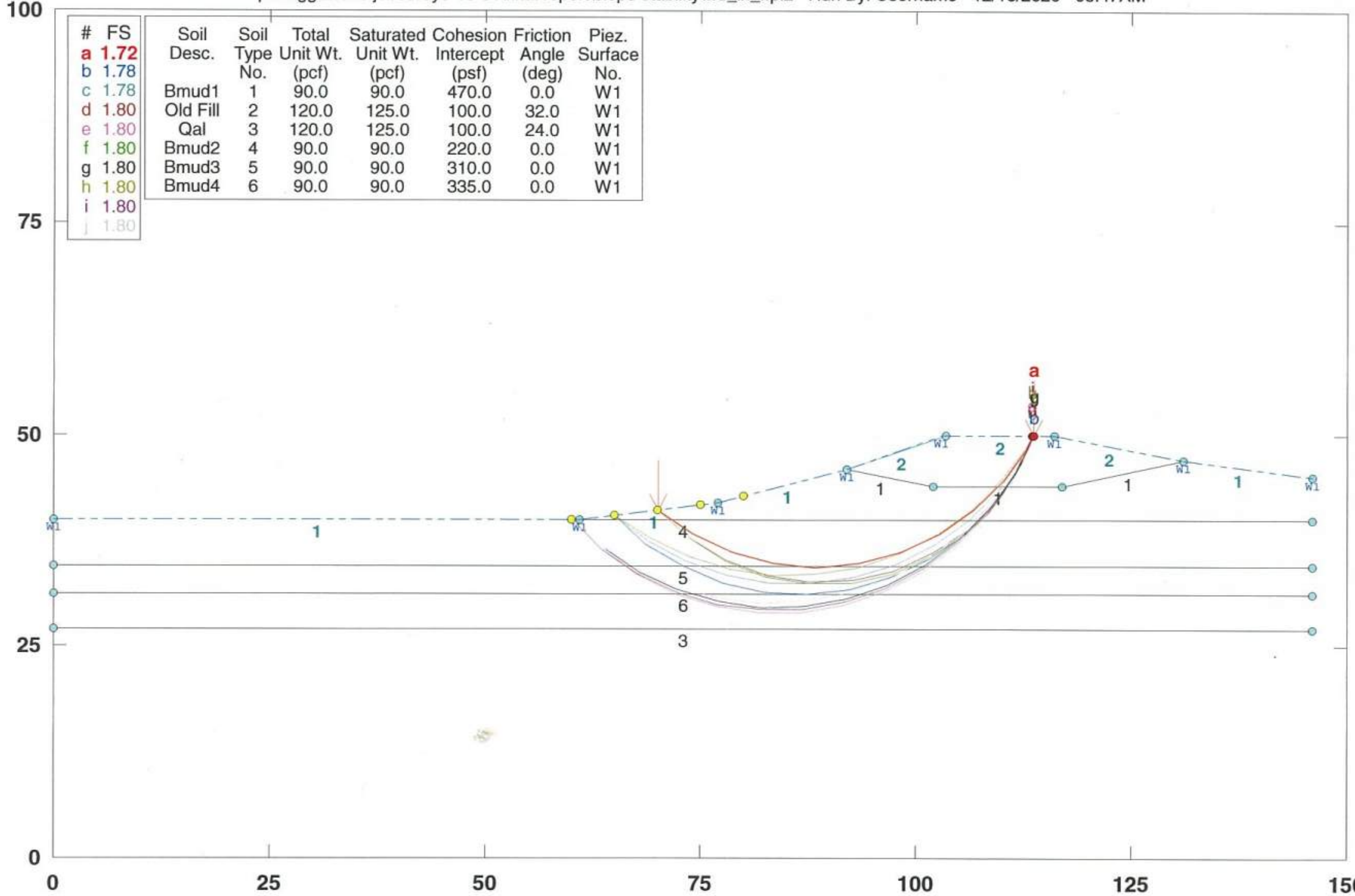
PCSTABL5M/si FSmin=1.81

Safety Factors Are Calculated By The Modified Bishop Method

STED

West Levee Inboard (Rapid Drawdown) no sheeptiling

p:\bagg\active jobs\freye-18-01\final report\slope stability\we_in_r.pl2 Run By: Username 12/16/2020 08:47AM



#	FS
a	1.72
b	1.78
c	1.78
d	1.80
e	1.80
f	1.80
g	1.80
h	1.80
i	1.80
j	1.80

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Bmud1	1	90.0	90.0	470.0	0.0	W1
Old Fill	2	120.0	125.0	100.0	32.0	W1
Qal	3	120.0	125.0	100.0	24.0	W1
Bmud2	4	90.0	90.0	220.0	0.0	W1
Bmud3	5	90.0	90.0	310.0	0.0	W1
Bmud4	6	90.0	90.0	335.0	0.0	W1

PCSTABL5M/si FSmin=1.72
Safety Factors Are Calculated By The Modified Bishop Method

STED

West Levee Inboard (Seismic) No Sheetpiling

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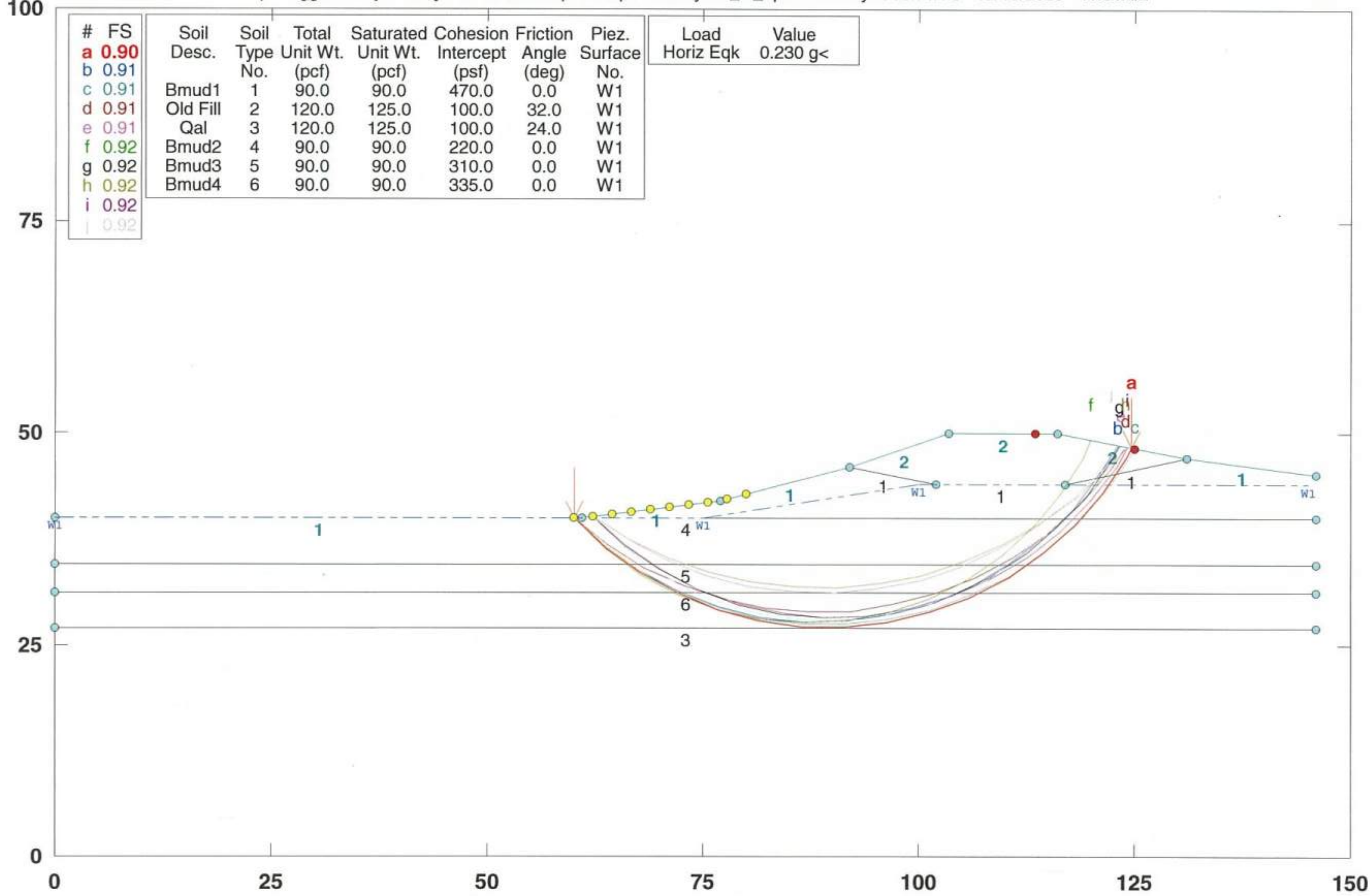


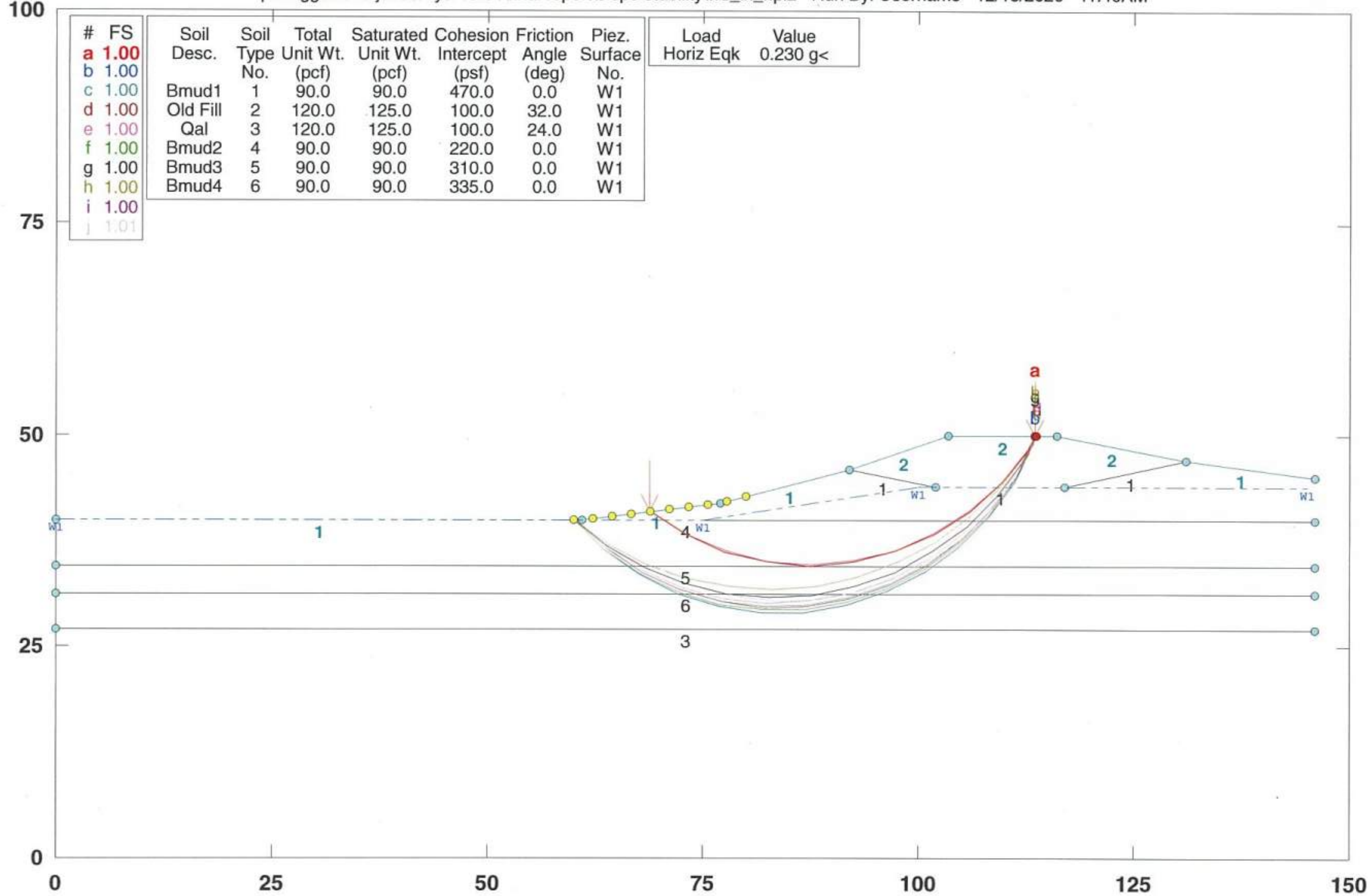
PCSTABL5M/si FSmin=0.90

Safety Factors Are Calculated By The Modified Bishop Method

STED

West Levee Inboard (Seismic) Sheetpiling at outboard edge of Levee

p:\bagg\active jobs\freye-18-01\final report\slope stability\we_in_f.pl2 Run By: Username 12/16/2020 11:40AM

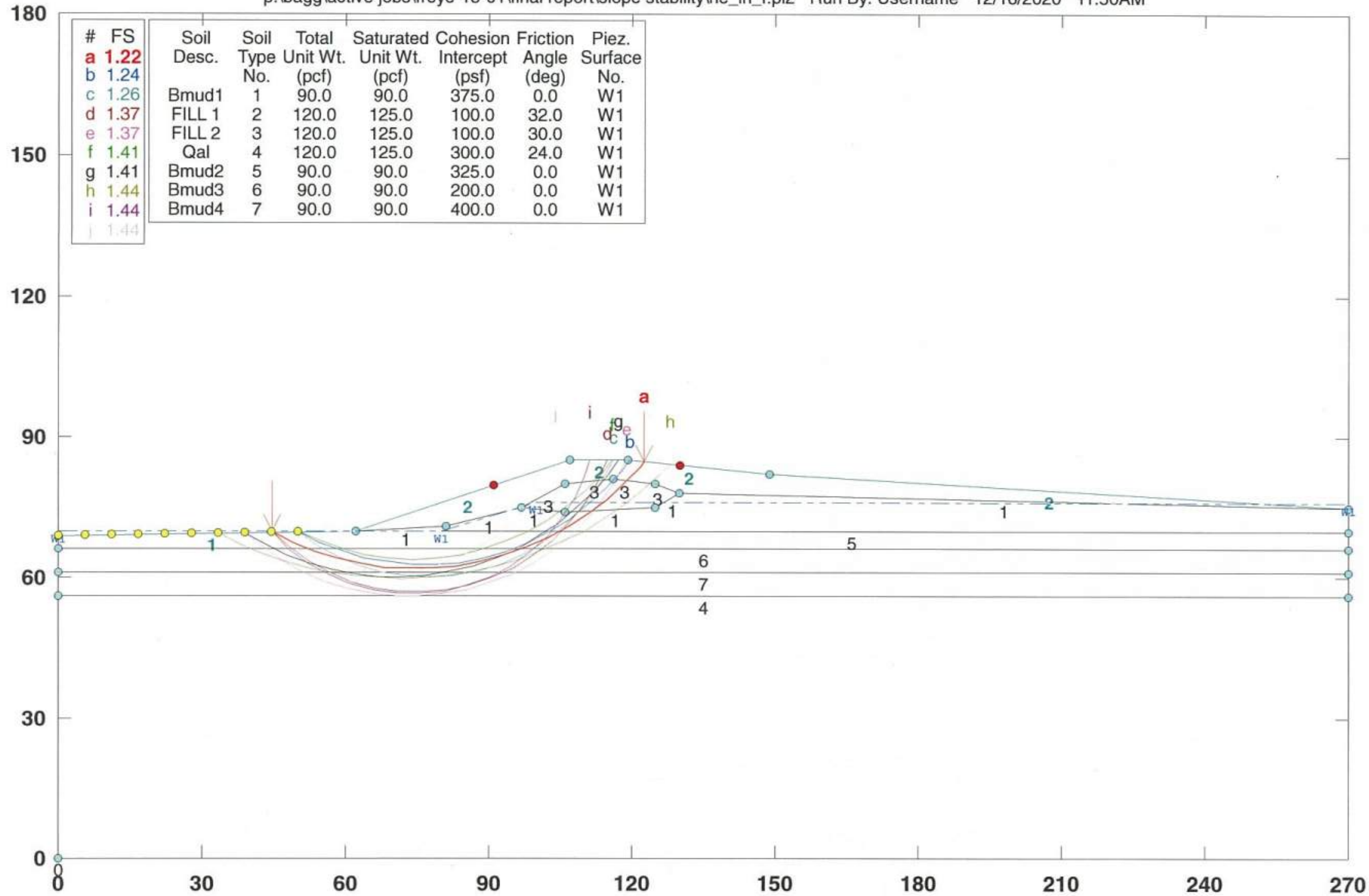


PCSTABL5M/si FSmin=1.00
Safety Factors Are Calculated By The Modified Bishop Method

STED

NE Levee Inboard (Static) No Sheetpiling

p:\bagg\active jobs\freye-18-01\final report\slope stability\ne_in_f.pl2 Run By: Username 12/16/2020 11:50AM



#	FS
a	1.22
b	1.24
c	1.26
d	1.37
e	1.37
f	1.41
g	1.41
h	1.44
i	1.44
j	1.44

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Bmud1	1	90.0	90.0	375.0	0.0	W1
FILL 1	2	120.0	125.0	100.0	32.0	W1
FILL 2	3	120.0	125.0	100.0	30.0	W1
Qal	4	120.0	125.0	300.0	24.0	W1
Bmud2	5	90.0	90.0	325.0	0.0	W1
Bmud3	6	90.0	90.0	200.0	0.0	W1
Bmud4	7	90.0	90.0	400.0	0.0	W1

PCSTABL5M/si FSmin=1.22

Safety Factors Are Calculated By The Modified Bishop Method

STED

NE Levee Inboard (Rapid Drawdown) No Sheetpiling

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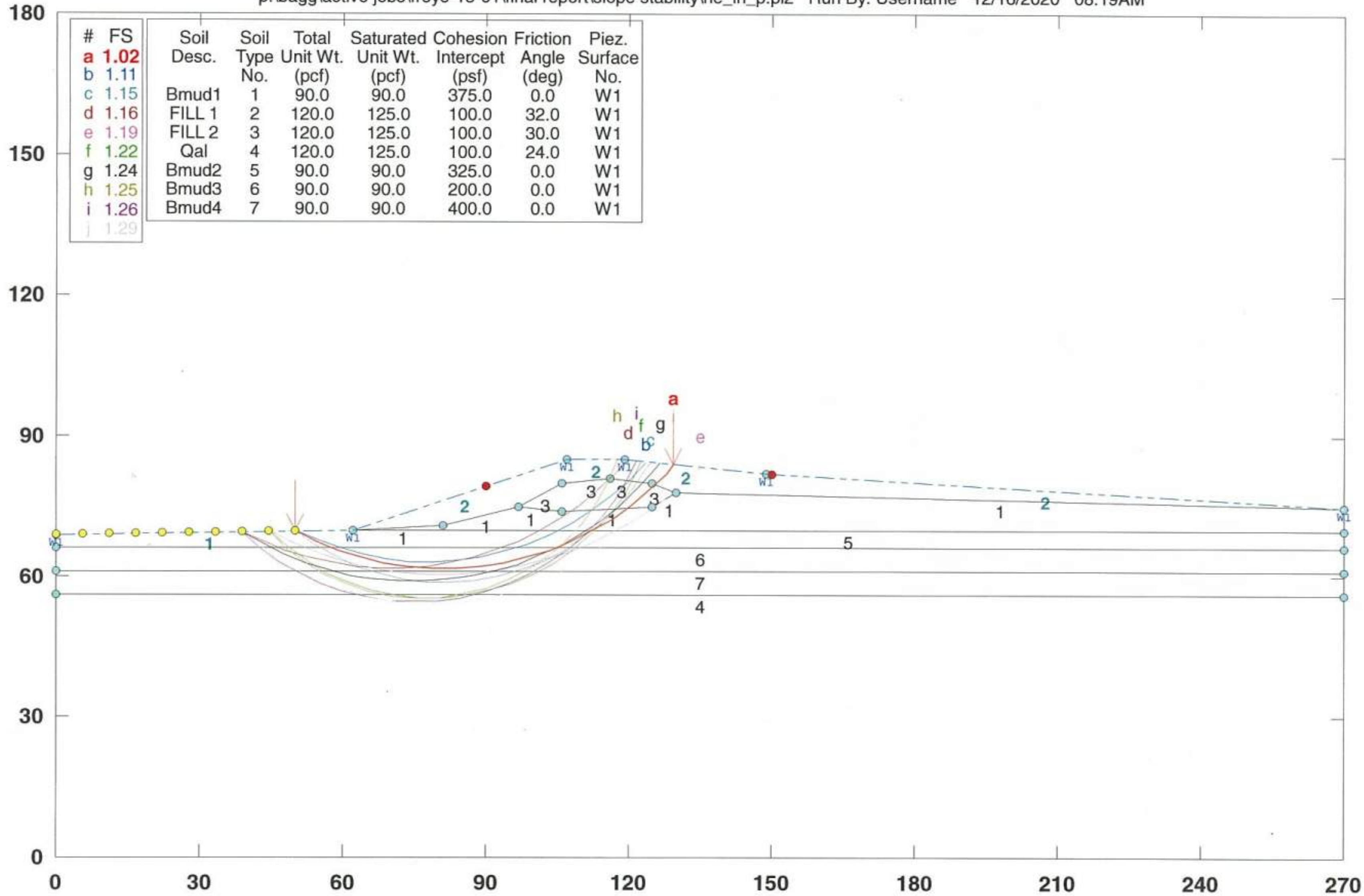

PCSTABL5M/si FSmin=1.02
Safety Factors Are Calculated By The Modified Bishop Method

STED

NE Levee Inboard (Seismic) No Sheetpiling

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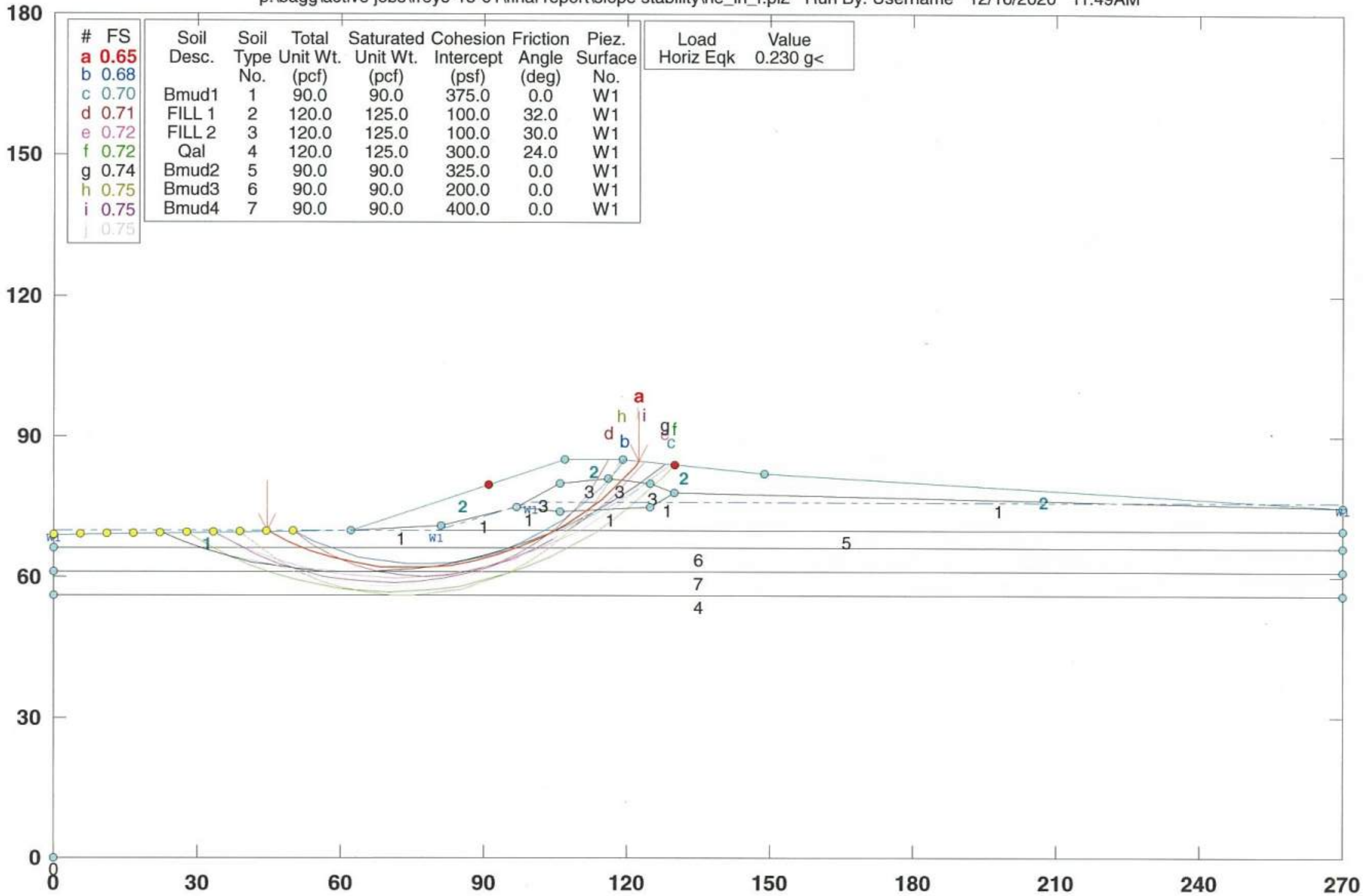

PCSTABL5M/si FSmin=0.65

Safety Factors Are Calculated By The Modified Bishop Method

STED

NE Levee Inboard (Seismic) Sheetpiling at inboard toe of levee

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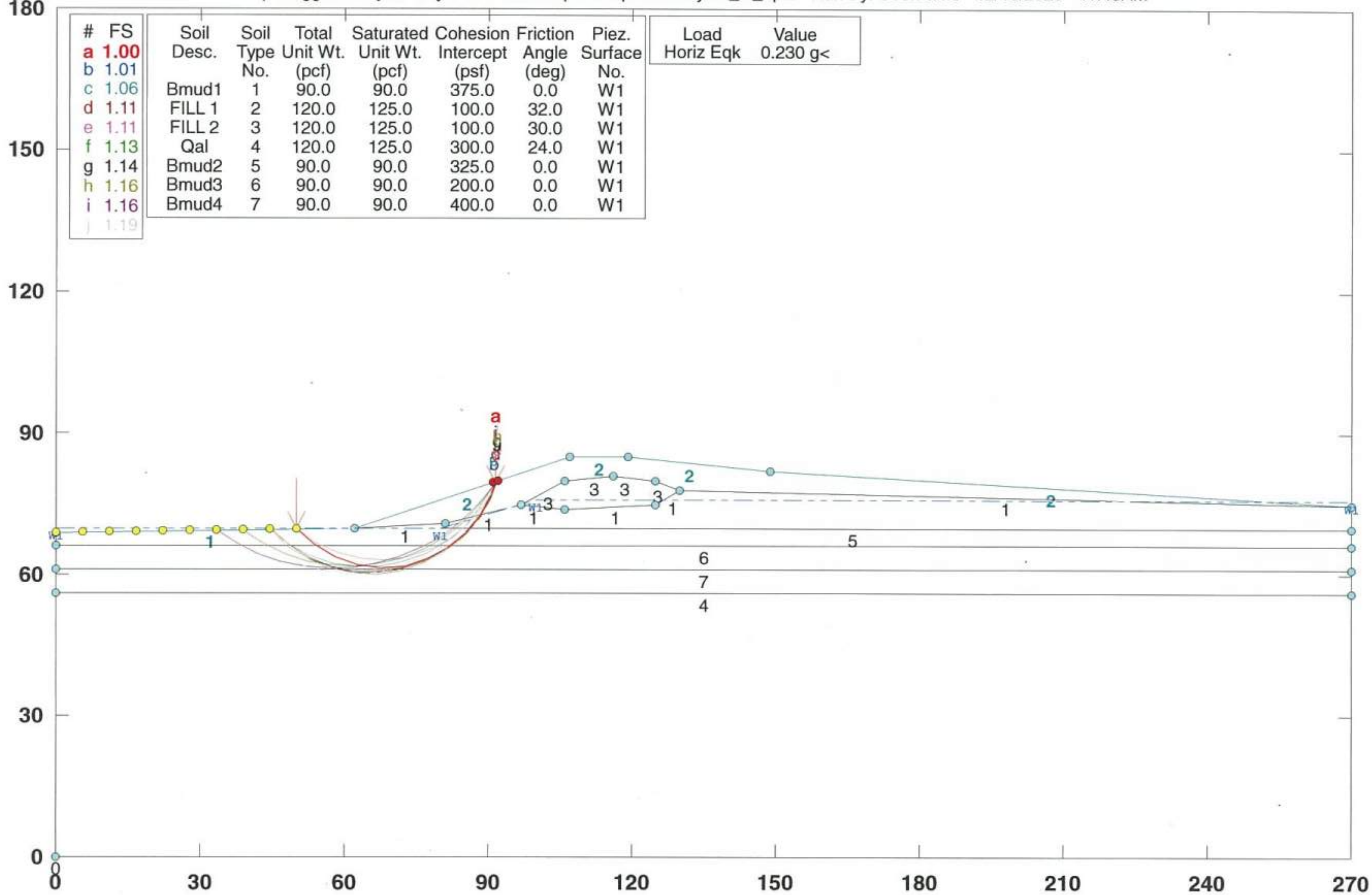

PCSTABL5M/si FSmin=1.00

Safety Factors Are Calculated By The Modified Bishop Method

STED

NE Levee Outboard (Static) No Sheetpiling

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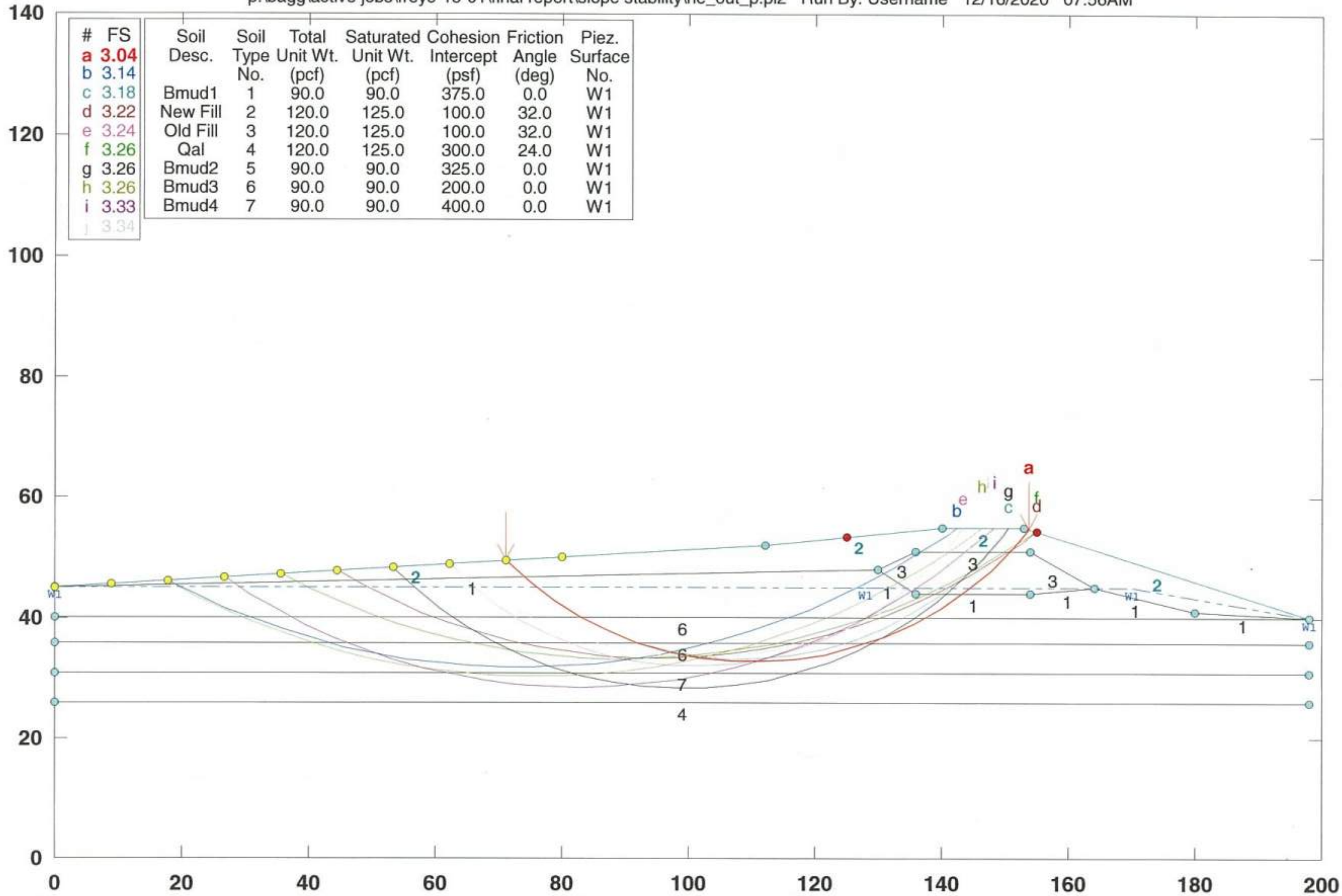

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Safety Factors Are Calculated By The Modified Bishop Method

STED

NE Levee Outboard (Rapid Drawdown) No Sheetpiling

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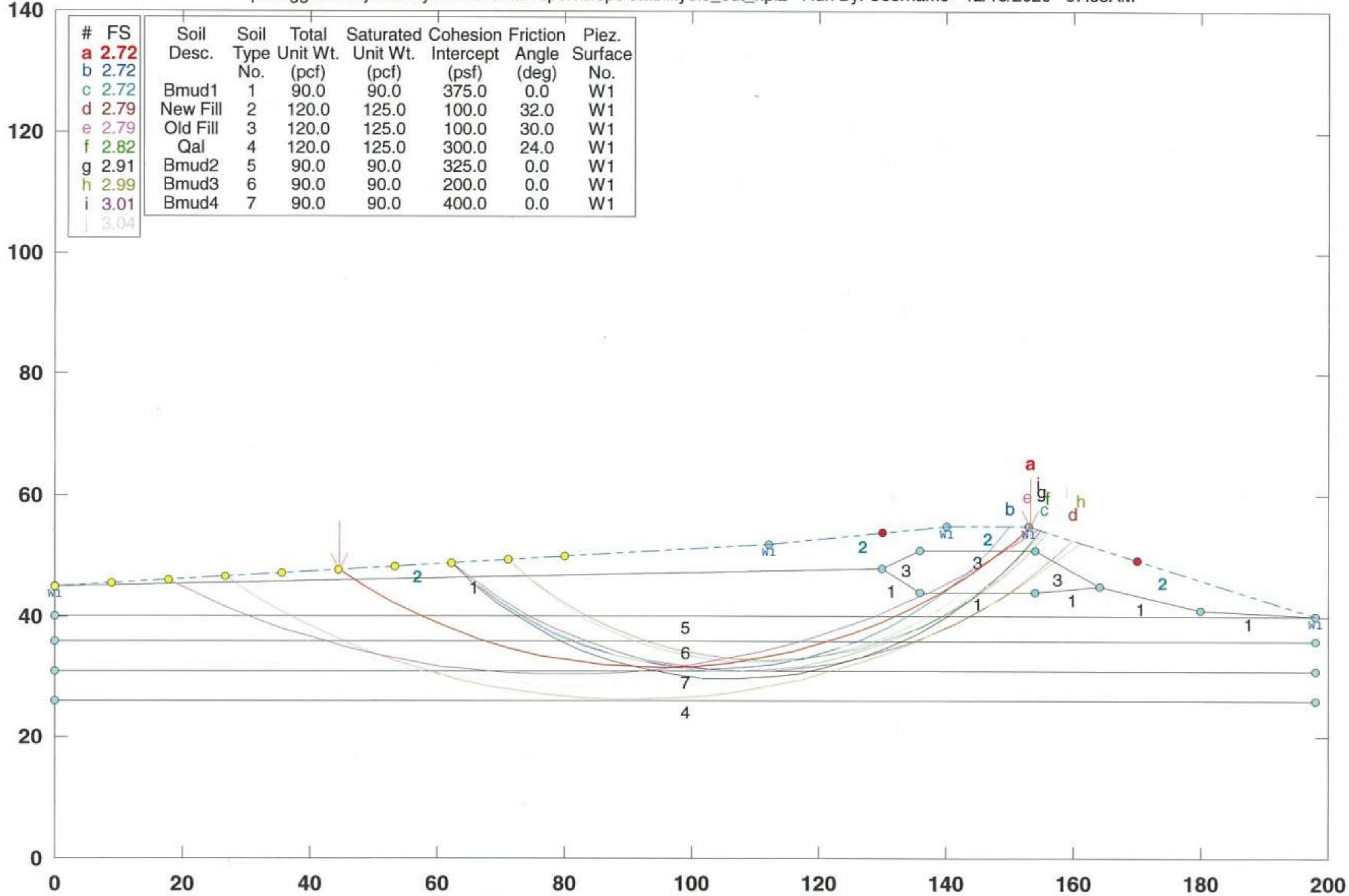

#	FS
a	2.72
b	2.72
c	2.72
d	2.79
e	2.79
f	2.82
g	2.91
h	2.99
i	3.01
j	3.04

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Bmud1	1	90.0	90.0	375.0	0.0	W1
New Fill	2	120.0	125.0	100.0	32.0	W1
Old Fill	3	120.0	125.0	100.0	30.0	W1
Qal	4	120.0	125.0	300.0	24.0	W1
Bmud2	5	90.0	90.0	325.0	0.0	W1
Bmud3	6	90.0	90.0	200.0	0.0	W1
Bmud4	7	90.0	90.0	400.0	0.0	W1

PCSTABL5M/si FSmin=2.72

Safety Factors Are Calculated By The Modified Bishop Method

STED

NE Levee Outboard (Seismic) No Sheetpiling

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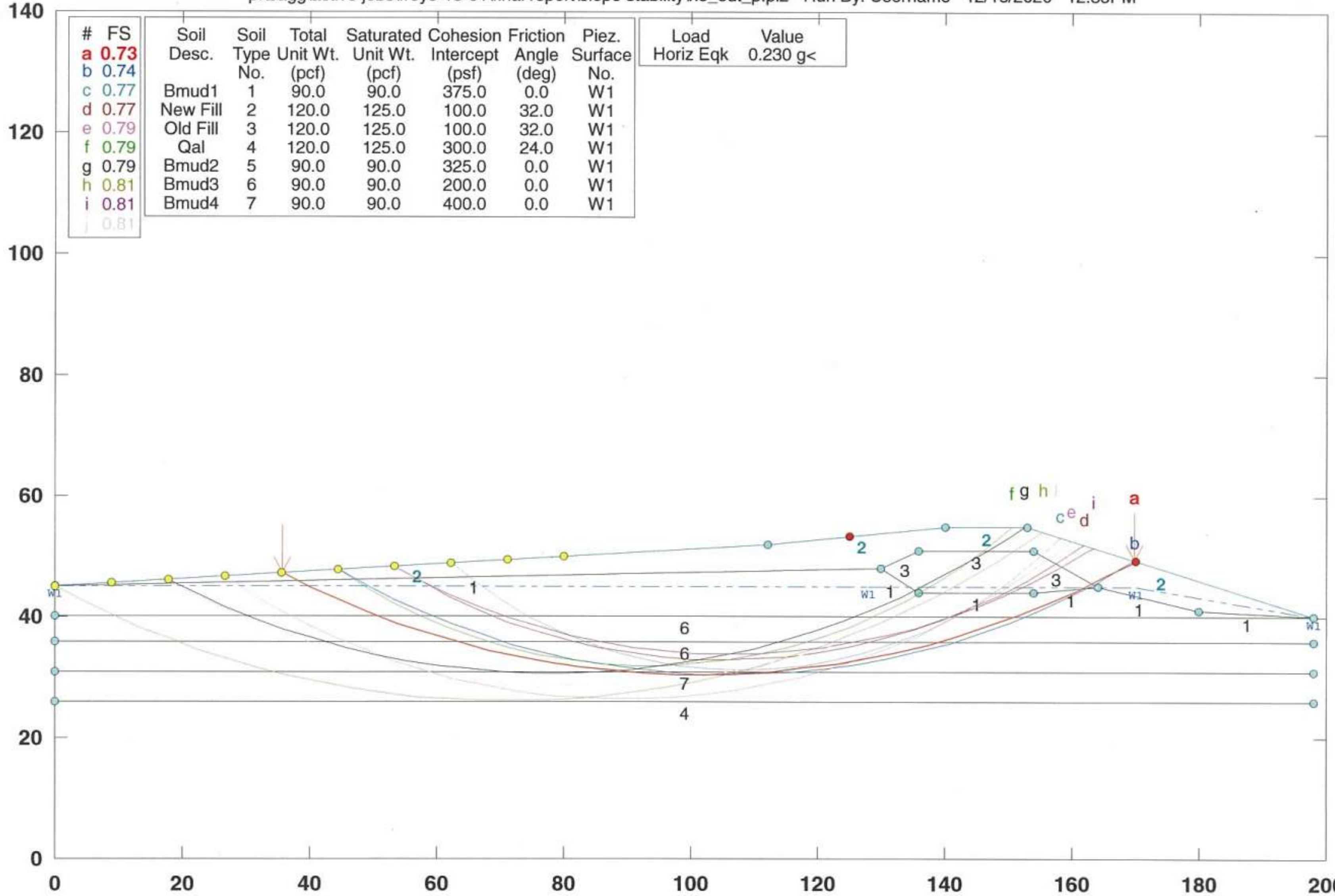


#	FS
a	0.73
b	0.74
c	0.77
d	0.77
e	0.79
f	0.79
g	0.79
h	0.81
i	0.81
j	0.81

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Bmud1	1	90.0	90.0	375.0	0.0	W1
New Fill	2	120.0	125.0	100.0	32.0	W1
Old Fill	3	120.0	125.0	100.0	32.0	W1
Qal	4	120.0	125.0	300.0	24.0	W1
Bmud2	5	90.0	90.0	325.0	0.0	W1
Bmud3	6	90.0	90.0	200.0	0.0	W1
Bmud4	7	90.0	90.0	400.0	0.0	W1

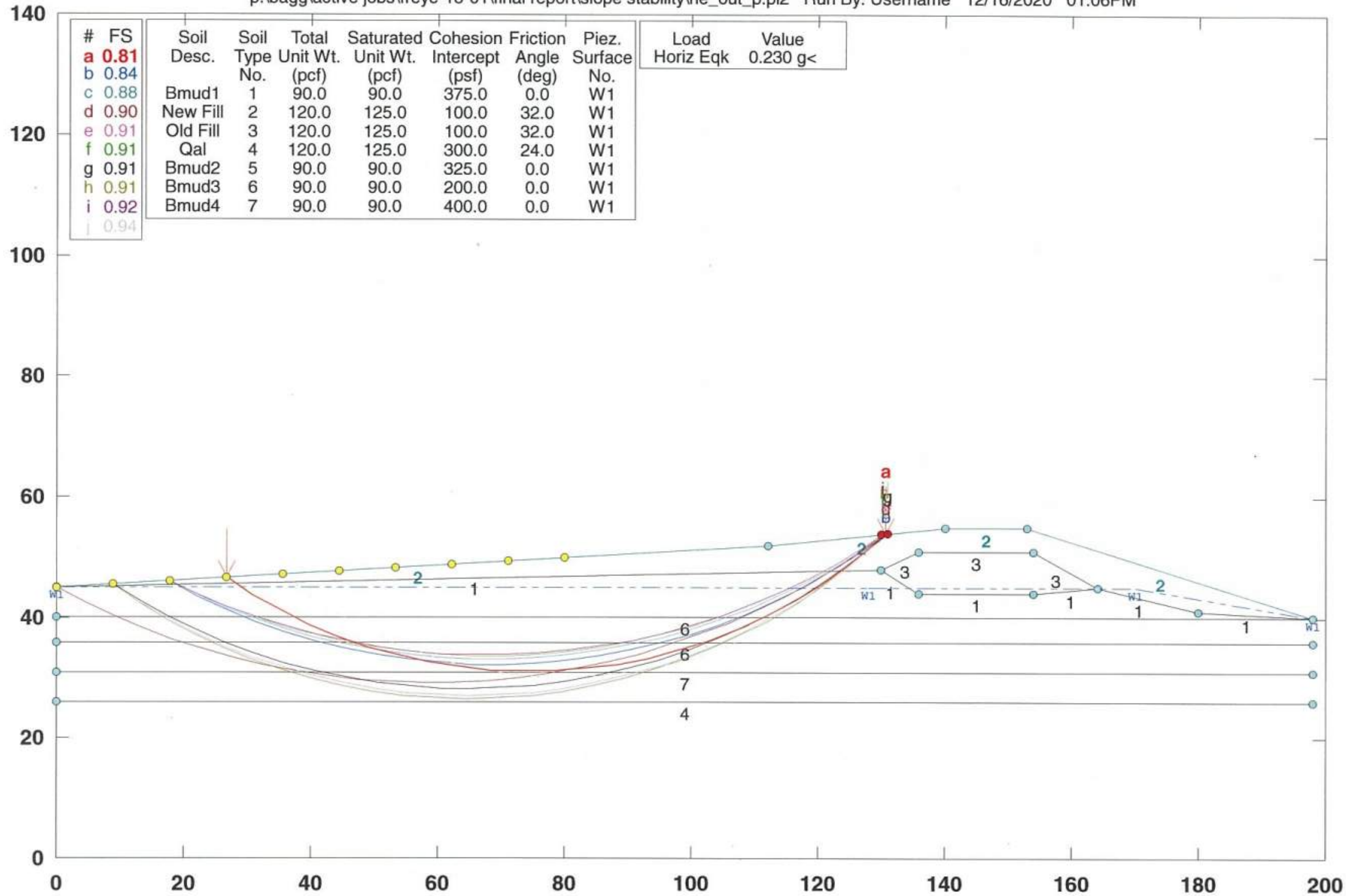
Load	Value
Horiz Eqk	0.230 g<

PCSTABL5M/si FSmin=0.73
Safety Factors Are Calculated By The Modified Bishop Method

STED

NE Levee Outboard (Seismic) Sheetpiling at outboard toe of levee

p:\bagg\active jobs\freye-18-01\final report\slope stability\ne_out_p.pl2 Run By: Username 12/16/2020 01:06PM



#	FS
a	0.81
b	0.84
c	0.88
d	0.90
e	0.91
f	0.91
g	0.91
h	0.91
i	0.92
j	0.94

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Bmud1	1	90.0	90.0	375.0	0.0	W1
New Fill	2	120.0	125.0	100.0	32.0	W1
Old Fill	3	120.0	125.0	100.0	32.0	W1
Qal	4	120.0	125.0	300.0	24.0	W1
Bmud2	5	90.0	90.0	325.0	0.0	W1
Bmud3	6	90.0	90.0	200.0	0.0	W1
Bmud4	7	90.0	90.0	400.0	0.0	W1

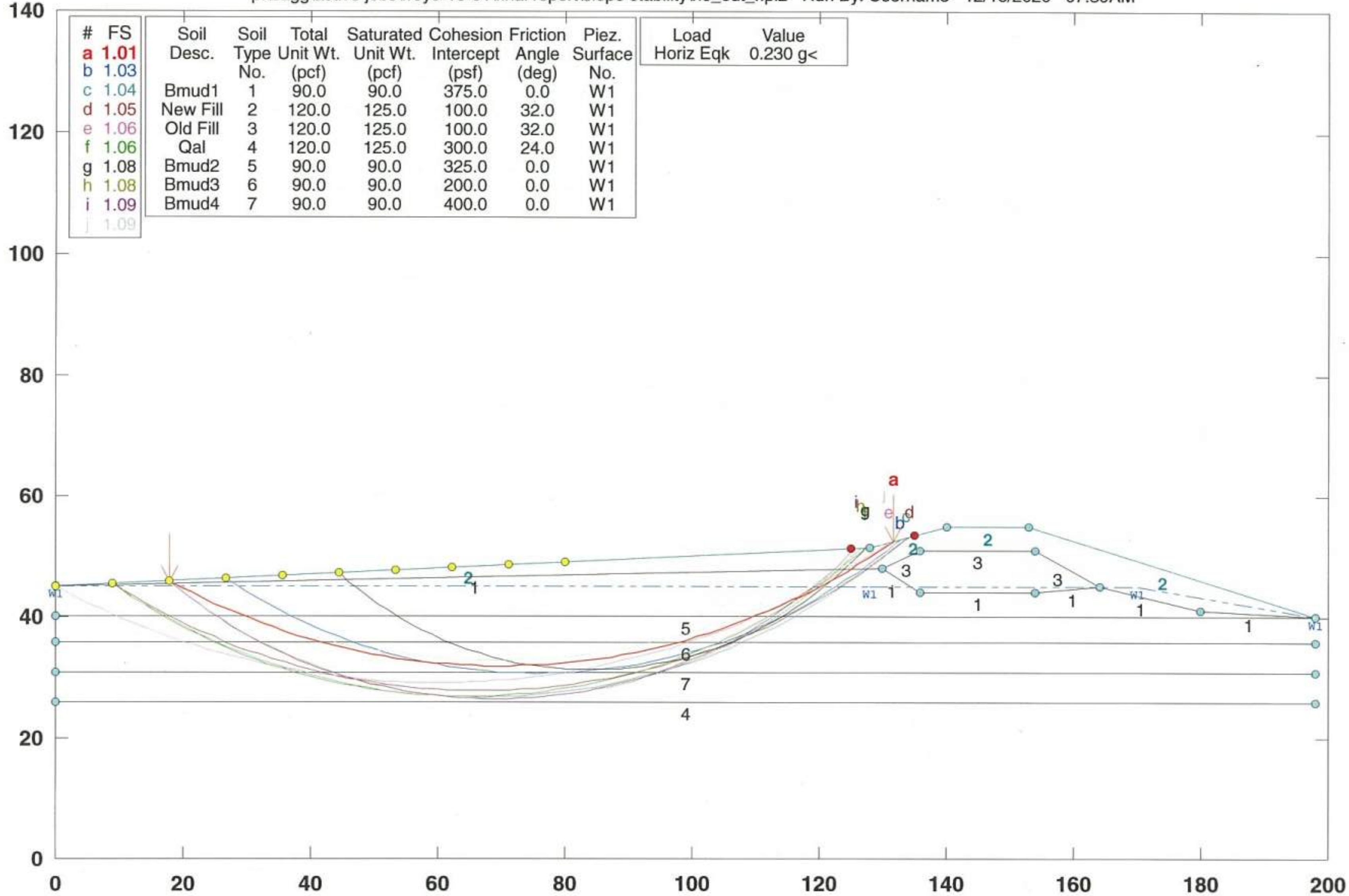
Load	Value
Horiz Eqk	0.230 g<

PCSTABL5M/si FSmin=0.81
Safety Factors Are Calculated By The Modified Bishop Method

STED

NE Levee outboard (Seismic) sheetpiling at outboard toe of levee (FG modified)

p:\bagg\active jobs\freye-18-01\final report\slope stability\ne_out_r.pl2 Run By: Username 12/16/2020 07:39AM



#	FS
a	1.01
b	1.03
c	1.04
d	1.05
e	1.06
f	1.06
g	1.08
h	1.08
i	1.09
j	1.09

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Bmud1	1	90.0	90.0	375.0	0.0	W1
New Fill	2	120.0	125.0	100.0	32.0	W1
Old Fill	3	120.0	125.0	100.0	32.0	W1
Qal	4	120.0	125.0	300.0	24.0	W1
Bmud2	5	90.0	90.0	325.0	0.0	W1
Bmud3	6	90.0	90.0	200.0	0.0	W1
Bmud4	7	90.0	90.0	400.0	0.0	W1

Load	Value
Horiz Eqk	0.230 g<

PCSTABL5M/si FSmin=1.01

Safety Factors Are Calculated By The Modified Bishop Method

STED

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.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in 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.

Geotechnical-Engineering 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 given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives 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 this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- 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. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include 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.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering 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 subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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e-mail: info@geoprofessional.org   www.geoprofessional.org

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Date: May 10, 2023
File No. File No. 20-648.1

To: Ms. Lorraine Htoo, PE - Freyer & Laureta, Inc.

Subject: **GEOTECHNICAL MEMORANDUM**
WBSD Flow Equalization and Resource Recovery Facility Improvements Project
Menlo Park, California

Crawford & Associates, Inc (Crawford) is pleased to submit this Geotechnical Memorandum (Memo) for the West Bay Sanitary District (WBSD) Flow Equalization and Resource Recovery Facility Improvements Project in Menlo Park, California. We prepared this Memo in accordance with our July 28, 2020 agreement.

1 PROJECT DESCRIPTION

We understand that WBSD plans to install an outfall in the northeast corner of the Menlo Park Facility, as shown in Photo 1 below. The outfall will consist of two 24-inch diameter pipelines and tide gates. In addition, the existing levee will be raised to satisfy FEMA requirements and the outfall will cross below the raised levee. The levee will be raised up to a maximum of approximately 6 feet, but only 5 feet at the proposed outfall location; finished levee slopes are proposed to be 2H:1V (horizontal to vertical). The waterside slope below the toe of the levee is tentatively planned to be a living shoreline, inclined at approximately a 20H:1V slope. WBSD also plans to develop the site for a recycled water facility in the future, however recommendations for future site development are beyond our scope of work.

Photo 1 Outfall Location Facing North

2 SITE DESCRIPTION

The site is located in Menlo Park, CA at approximate site coordinates latitude 37.4957° and longitude -122.1737°. Bedwell Bayfront Park neighbors the site to the east and south and a pedestrian walkway is located immediately east. The site is surrounded by the San Francisco Bay to the north and the existing treatment facility to the west. A vicinity map is included in the Exploration Map in Figure 1.

3 EXISTING INFORMATION

Previous boring logs from BAGG Engineers, were provided by Loraine Htoo, PE, and show the facility contains varying thicknesses of fill and is underlain by lean and fat clay. Using this information, we based our boring location for the outfall.

4 SITE GEOLOGY

The project is within the Coast Ranges Geomorphic Province of California[1], which is characterized by a series of northwest trending mountain ranges sub-parallel to the San Andres Fault. The northern and southern ranges are separated by a depression containing the San Francisco Bay. The Coast Ranges are composed of thick Mesozoic and Cenozoic sedimentary strata.

Published regional geologic mapping[2] shows surface materials mapped as Holocene Age estuarine organic clay and silty clay. This sediment is described to be extremely carriable, represents San Francisco Bay Mud, and includes areas modified to salt evaporation basins.

5 SUBSURFACE EXPLORATION

5.1 CRAWFORD BORINGS

Crawford retained Pitcher Services, LLC. (Pitcher) to drill one exploratory test boring at the proposed outfall location on October 21, 2020. Boring R-20-001 extended to a maximum depth of 41.5 feet. Pitcher used a Failing 1500 truck-mounted mud rotary drill rig equipped with an automatic hammer. Soil samples were retained using Modified California sampler with liners having an interior diameter of 2.4 inches and soft clay samples were retrieved using Shelby tubes with a 3.0-inch interior diameter. Blow counts shown on our boring logs are uncorrected field blow counts and the down pressure used to insert the Shelby tubes are shown on the remarks section of our boring logs. Pocket penetrometer and field Torvane shear results are also shown on our boring logs.

Crawford project engineer, Amando B. Castro, logged the exploratory borings consistent with the Unified Soil Classification System (USCS) and the Caltrans Geotechnical Manual. Crawford retained samples from the boring during drilling operations. The boring was backfilled following San Mateo County Environmental Health requirements.

[1] California Geologic Survey (2002), *California Geomorphic Province*, Note 36
[2] Pampeyan, E.H., 1994, Geologic map of the Montara Mountain and San Mateo 7.5' quadrangles, San Mateo County, California: U.S. Geological Survey, Miscellaneous Investigations Series Map I-2390, scale 1:24,000

5.2 PREVIOUS BORING BY OTHERS

We reviewed subsurface information on the boring logs produced by BAGG, Engineers. Boring B-4 was performed on April 17, 2018. The log shows boring B-4 was drilled with an 8-inch diameter hollow stem auger to an approximate depth of 35.5 ft below ground surface. The boring is located within the Menlo Park facility along the northeast corner of the property. We show the approximate location of boring B-4 on the Exploration Map in Figure 1.

6 SUBSURFACE

6.1 SUBSURFACE SOIL CONDITIONS

Earth materials encountered in the borings are considered generally consistent with the previous boring by others, published mapping, and our observations made at the site. We provided a breakdown of the soils encountered in Table 1 below. Refer to the attached boring logs for more specific soil descriptions, sampling methods, laboratory test results and uncorrected field blow count data.

Table 1: Subsurface Profile

Unit	Location	Depth to Bottom of Layer (feet)	General Soil Description
1	R-20-001	7.0	Fill – brown; dry to moist; medium dense poorly graded sand with silt and gravel and silty/clayey sand; SPT Blow Counts (N_{60}) range between 25 to 27 bpf.
2	R-20-001	25	Bay Mud – gray, moist, very soft to stiff, medium to high plasticity lean to fat clay; Pocket Penetrometer (PP) between 0 to 3.5 tsf; Torvane shear tests between 0.2 to 1.075 tsf; SPT Blow Counts (N_{60}) between 0 to 17.
3	R-20-001	41.5	Alluvium – gray, moist to wet, loose to medium dense clayey sand; SPT Blow Counts (N_{60}) range between 3 to 12; gray moist, medium stiff to very stiff sandy lean clay; Pocket Penetrometer (PP) between 0.5 to 3.5 tsf; Torvane shear between 0.45 to 1.075 tsf

6.2 GROUNDWATER

No groundwater observations were made at the time of field investigations due to the rotary drilling method. However, groundwater is considered to be generally consistent with Mean Sea Level, which is approximately elev +3 feet (North American Vertical Datum 1988).

7 LABORATORY TESTING

7.1 GEOTECHNICAL SOILS TESTING

We completed the following laboratory tests on representative soil samples obtained from the exploratory borings:

- Atterberg Limits (ASTM D4318)

- Constant Rate of Strain Consolidation Test (ASTM D4186)
- Moisture Content / Dry Density (ASTM D2216 / D2937)
- No. 200 Sieve Wash (ASTM D1140)
- pH/Minimum Resistivity (CTM 643)
- Sulfate/Chloride Content (CTM 417/422)

The test results are shown on the logs of the boring attached to this memo.

7.2 CORROSION TESTING RESULTS

Table 2 summarizes the results of soil corrosivity tests on a sample of the Bay Mud from our test boring.

Table 2: Soil Corrosion Test Summary

Boring / Sample Number	Depth (ft)	pH	Minimum Resistivity (Ohm-cm)	Chloride Content (ppm)	Sulfate Content (ppm)
R-20-001-3A	8.5	7.32	300	15,444	775

According to Caltrans Corrosion Guidelines,[3] a site is considered corrosive to foundation elements if one or more of the following conditions exist: Chloride concentration is greater than or equal to 500 ppm, sulfate concentration is greater than or equal to 1,500 ppm, or the pH is 5.5 or less[4]. In addition, ACI[5] considers soil with sulfate levels less than 1,000 ppm to have a negligible sulfate exposure.

Based on the soil types we encountered, low resistivity and high chloride contents, Caltrans guidelines, and USDA mapping, the Bay Mud at the project site is considered highly corrosive to ferrous materials. These tests are only an indicator of soil corrosivity and the designer should consult with a corrosion engineer if these values are considered significant.

8 CONCLUSIONS

Based on the field exploration and laboratory results, the site appears to be suitable for the proposed outfall. Key geotechnical considerations include the potential compressibility of the underlying Bay Mud and the slope stability for temporary construction slopes in Bay Mud. In addition, the Bay Mud will likely be unstable when placing fill above it.

8.1 SETTLEMENT

During our October 2020 field exploration, 7 ft of fill was encountered at the ground surface and was underlain by approximately 18 ft of soft, young Bay Mud. Based on the “Storm Water Outfall Cross Section” drawing, we understand the finished grade of the embankment will be raised approximately 5 ft from existing grade at the outfall. We used the results from our

[3] Caltrans Corrosion Guidelines Version 3.0, May 2021
[4] Caltrans, Memo to Designers 3-1, June 2014
[5] American Concrete Institute, Code 318, 2022

laboratory tests to model the settlement due to consolidation using Terzaghi's one dimensional consolidation settlement theory.

The results from our analysis reveal the young Bay Mud is normally consolidated. Based on the soil and groundwater conditions and proposed grade change, the settlement due to consolidation below the outfall is estimated to be up to approximately 8 inches. To maintain freeboard requirements over time, the design grade of the levee should be raised 8 inches to supplement for the potential compression of the soft clay at the outfall location.

8.2 TEMPORARY SLOPES

The Bay Mud also has a low shear strength and temporary construction slopes will likely fail. Excavations in or above the Bay Mud should be shored and temporary construction slopes in the Bay Mud should not be used.

9 RECOMMENDATIONS

9.1 CONSTRUCTION CONSIDERATIONS

9.1.1 DEWATERING

We did not observe groundwater at the time of our exploration, excavations below Mean Sea Level will likely encounter groundwater and dewatering may be needed.

The contractor will be responsible for designing and implementing a dewatering system to meet the requirements of the project. Dewatering operations should consider drawing down the groundwater to a minimum of 3 feet below the planned excavation during construction.

9.1.2 SHORING AND TEMPORARY CONSTRUCTION SLOPES

Based on the encountered material during our exploration, temporary construction slopes will likely not be stable. Therefore, we recommend the contractor utilize suitable shoring during construction.

The contractor is responsible for all shoring design based on actual excavation conditions encountered during construction. Shoring will need to be conducive to the contractor's approach to managing groundwater (where needed) and the excavation.

9.1.3 TRENCH BOTTOM STABILITY

The outfall trench will be excavated into Bay Mud, which will likely be unstable when pipe bedding is placed. We recommend a 2 ft layer of ¾" crushed rock wrapped in a stabilization fabric (Mirafi 600x or equivalent) be placed below the design trench section to stabilize the trench bottom. Crawford staff should observe the trench excavation and rock and fabric placement to confirm the conditions and be available if modifications are necessary.

9.1.4 GRADING RECOMMENDATIONS

Where referenced in this memo, use the most current ASTM D1557 procedures to determine relative compaction and optimum moisture. Based on our experience and the conditions observed during our fieldwork, the on-site soil should be excavatable with typical grading equipment such as dozers, backhoes, and excavators.

Prior to any site grading, demolish and clear the site to remove existing vegetation, tree roots, debris, soft or unstable soil areas, or other deleterious materials.

Based on our subsurface exploration and experience, the near surface soils should be excavatable using conventional trenching equipment such as backhoes and excavators.

The contractor is responsible for the safety of all temporary excavations and should provide excavation shoring in accordance with current Cal OSHA requirements.

9.1.5 FILL AND PLACEMENT

Prior to placement of fill, scarify and compact the exposed subgrade to a depth of approximately 8-inches, moisture condition to within 2% of optimum moisture content and compact it to a minimum 90% relative compaction. On-site soils may be used for fill provided they contains no gravel fragments larger than 3-inches in maximum dimension, are non-expansive, and are free of concentrations of debris and vegetation.

If import material is required, it should meet the following criteria:

- Contain no concentration of organics, debris or deleterious materials,
- Maximum particle size of 3-inches with at least 50% passing the No. 4 Sieve, and
- Plasticity Index <15

Place fill in maximum 8-inch loose lifts, moisture condition to within 2% of optimum and compact to a minimum 90% relative compaction. Compaction may be reduced to a minimum of 85% relative compaction in landscape areas.

9.1.6 OVER-OPTIMUM SOIL MOISTURE

Excessively over-optimum (wet) soil conditions can make proper compaction difficult or impossible. Wet soil is commonly encountered during the winter and spring months. Excessively over-optimum soil conditions are not expected but in general, wet soil above the Bay Mud can be mitigated by:

- Discing the soil during prolonged periods of dry weather,
- Overexcavating and replacing with drier material,
- Stabilizing using aggregate and/or stabilization fabric or grid.

If wet, unstable soil is encountered, Crawford should observe the conditions and provide more specific mitigation recommendations. Bay Mud in the outfall trench should be stabilized in accordance with Section 9.1.3 above.

10 RISK MANAGEMENT

Our experience and that of our profession clearly indicates that the risks of costly design, construction, and maintenance problems can be significantly lowered by retaining the geotechnical engineer of record to provide additional services during design and construction. For this project, Crawford should be retained to:

- Review and provide comments on the civil plans and specifications prior to construction.
- Update this report if design changes occur, 2 years or more lapses between this report and construction, and/or site conditions have changed.

If we are not retained to perform the above applicable services, we are not responsible for any other party's interpretation of our report, and subsequent addendums, letters, and discussions.

11 LIMITATIONS

Crawford based this report on the current site conditions. We assumed the soil and ground water conditions encountered, or not encountered, in our borings are representative of the subsurface conditions across the site. Actual conditions between borings could be different. If differing site conditions are encountered, please contact Crawford immediately to provide additional recommendations.

Crawford performed services in accordance with generally accepted geotechnical engineering principles and practices currently used in this area. Where referenced, we used ASTM standards as a general (not strict) guideline only. We do not warranty our services.

Boring logs are attached. The lines designating the interface between soil types are approximate. The transition between material types may be abrupt or gradual. Our recommendations are based on the final logs, which represent our interpretation of the field logs and general knowledge of the site and geological conditions.

Modern design and construction are complex, with many regulatory sources/restrictions, involved parties, construction alternatives, etc. It is common to experience changes and delays. The owner should set aside a reasonable contingency fund based on complexities and cost estimates to cover changes and delays.

Thank you for selecting Crawford to be on your design team. Please call with questions.

Sincerely,

CRAWFORD & ASSOCIATES, INC.,

Reviewed by,

Amando B. Castro, PE
Project Engineer

REGISTERED PROFESSIONAL ENGINEER
AMANDO BUENAVENTURA CASTRO
C 94561
CIVIL
STATE OF CALIFORNIA

Chris Trumbull, PE, GE, D. GE
Senior Project Engineer

REGISTERED PROFESSIONAL ENGINEER
CHRISTOPHER D. TRUMBULL
GE 2492
Exp. 6/30/23
GEOTECHNICAL
STATE OF CALIFORNIA

ATTACHMENTS

Figure 1: Exploration Map

Boring Log / Test Pit Legend and Soil Descriptions

Log of Boring R-20-001

Laboratory Test Results

Boring Log by Others

North

Source:
Basemap: AutoCAD Civil3D Geolocation Tool, using Bing Maps

Legend:
Crawford & Associates, Inc. Boring
BAGG Engineers Boring
Proposed Outfall Alignment

Crawford & Associates, Inc.
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WBSD Flow Equalization and Resource Recovery Facility Improvements

Menlo Park, CA

Figure 1
Exploration Map

Proj. No:	20-648.1
Scale:	1"=100'
Date:	09/17/20

UNIFIED SOIL CLASSIFICATION (ASTM D 2487-06)

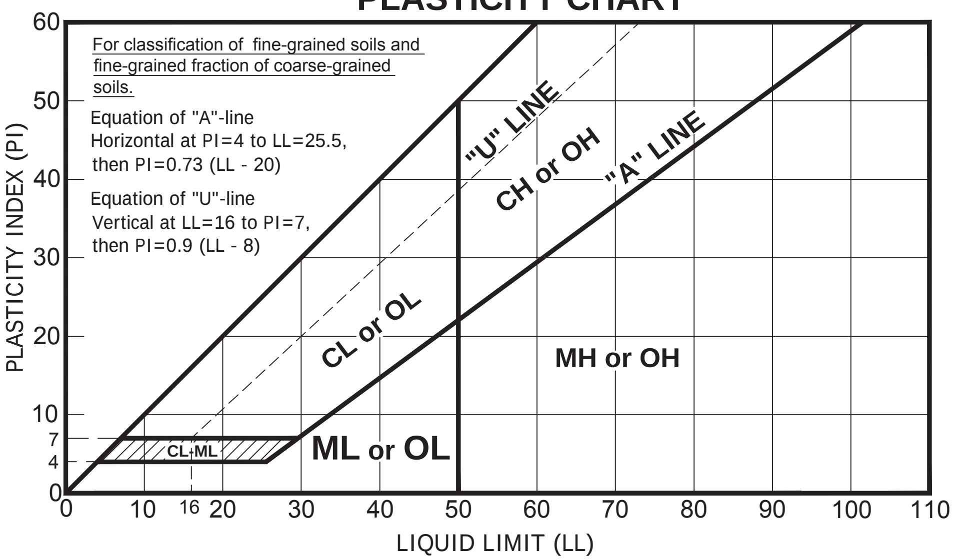
MATERIAL TYPES	CRITERIA FOR ASSIGNING SOIL GROUP NAMES			GRAPHIC SYMBOL	GROUP SYMBOL	SOIL GROUP NAMES
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE	**GRAVELS** >50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS <5% FINES	Cu $\geq$ 4 AND 1 $\leq$ Cc $\leq$ 3		**GW**	WELL-GRADED GRAVEL
			Cu < 4 AND/OR 1 > Cc > 3		**GP**	POORLY-GRADED GRAVEL
		GRAVELS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR MH		**GM**	SILTY GRAVEL
			FINES CLASSIFY AS CL OR CH		**GC**	CLAYEY GRAVEL
	SANDS <50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN SANDS <5% FINES	Cu $\geq$ 6 AND 1 $\leq$ Cc $\leq$ 3		**SW**	WELL-GRADED SAND
			Cu < 6 AND/OR 1 > Cc > 3		**SP**	POORLY-GRADED SAND
		SANDS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR MH		**SM**	SILTY SAND
			FINES CLASSIFY AS CL OR CH		**SC**	CLAYEY SAND
FINE-GRAINED SOILS >50% PASSING NO. 200 SIEVE	**SILTS AND CLAYS** LIQUID LIMIT <50	INORGANIC	PI>7 AND PLOTS ON OR ABOVE "A" LINE		**CL**	LEAN CLAY
			PI>4 AND PLOTS BELOW "A" LINE		**ML**	SILT
		ORGANIC	LL (oven dried)<0.75/LL (not dried)		**OL**	ORGANIC CLAY OR SILT
	SILTS AND CLAYS LIQUID LIMIT >50	INORGANIC	PI PLOTS ON OR ABOVE "A" LINE		**CH**	FAT CLAY
			PI PLOTS BELOW "A" LINE		**MH**	ELASTIC SILT
		ORGANIC	LL (oven dried)<0.75/LL (not dried)		**OH**	ORGANIC CLAY OR SILT
HIGHLY ORGANIC SOILS		PRIMARILY ORGANIC MATTER, DARK COLOR, ORGANIC ODOR			**PT**	PEAT

NOTE: $Cu = D_{60}/D_{10}$
$Cc = (D_{30})^2 / D_{10} \times D_{60}$

BLOW COUNT

The number of blows of a 140-lb. hammer falling 30-inches required to drive the sampler the last 12-inches of an 18-inch drive. The notation 50/4 indicates 4-inches of penetration achieved in 50 blows.

PLASTICITY CHART



SAMPLE TYPES

- Auger or backhoe cuttings
- Shelby tube
- Standard Penetration (SPT)
- Bulk Sample
- Modified California 2.5"
- California Standard 2"
- Rock core

ADDITIONAL TESTS

C - Consolidation
CP - Compaction Curve
CR - Corrosivity Testing
CU - Consolidated Undrained Triaxial
DS - Direct Shear
EI - Expansion Index
P - Permeability
PA - Partical Size Analysis
PI - Plasticity Index
PP - Pocket Penetrometer
R - R-Value
SE - Sand Equivalent
SG - Specific Gravity
SL - Shrinkage Limit
SW - Swell Potential
TV - Pocket Torvane Shear Test
UC - Unconfined Compression
UU - Unconsolidated Undrained Triaxial

GROUND WATER LEVELS

- Later water level after drilling
- Water level at time of drilling

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

BORING LOG / TEST PIT LEGEND AND SOIL DESCRIPTIONS

LOG OF BORING R-20-001

PROJECT NO: 20-648.1
PROJECT: WBSD Flow EQ & RR
LOCATION: Menlo Park, CA
CITY/COUNTY: San Mateo County
CLIENT: Freyer & Laureta, Inc.
LOGGED BY: AC
DEPTH OF BORING: 41.5 (ft)

BEGIN DATE: 10/21/2020
COMPLETION DATE: 10/21/2020
SURFACE ELEVATION: 11 (ft)*
SURFACE CONDITION: soil
WATER DEPTH: Not Encountered (ft)
READING TAKEN: 10/21/2020
HAMMER EFFICIENCY: 69 (%)

DRILLING CONTRACTOR: Pitcher Services LLC.
DRILLING METHOD: Mud Rotary (Side Discharge)
DRILL RIG: Failing 1500 Truck
HAMMER TYPE: Automatic, 140 lbs, 30" drop
SAMPLER TYPE & SIZE: Bulk, MCAL [ID 2.4"], Shelby
BOREHOLE DIAMETER: 4 inch
BACKFILL METHOD: Tremie; neat cement grout

ELEV (ft)	DEPTH (ft)	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	REMARKS
11–8.5	0–2.5	Bulk				Poorly graded SAND with SILT and GRAVEL (SP-SM); medium dense; brown; dry to moist; little fine GRAVEL; mostly medium to fine SAND; few fines [FILL].	100							
8	2.5–4	1	13 19 17	36			83				12.8	114.6		
7	4					CLAYEY SAND with GRAVEL (SC); medium dense; gray; moist; little coarse to fine GRAVEL; mostly fine SAND; some fines.								
6	5–6.5	2	0 0 0		0	Lean CLAY (CL); medium stiff; gray; moist; mostly low to medium plasticity fines; Trace rootlets.	56							Tv=0.35 tsf
4	7					Fat CLAY (CH); medium stiff; gray; mostly medium to high plasticity, low toughness fines.								Tv=0.35 tsf
3	7.5–9	3	0 0 0		0		100				63.5	60.6		CR Soil pH: 7.32 Min. Resistivity: 30 ohm-cm Chloride: 15,444.2 ppm Sulfate: 775.2 ppm 10-11.5' self push
1	10–12.5	4			0	soft	100							11.5-12.5 : 15 psi Tv= 0.20 tsf
-4	15–17.5	5			0	medium stiff	100		125	44	94.3	46.8		16.5-17.5 : 15 psi Tv= 0.35 tsf
-9	20–22.5	6			1.5	Stiff.	100							11-17" : 15 psi Max psi at 175 bottom 2" Tv= 0.60 tsf

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
	25		7			3.5		SANDY lean CLAY (CL); very stiff; greenish brown; some medium to fine SAND; mostly low to medium plasticity fines.	100				18.5	109.6	56			Driller note switch sampling to MCAL 6" : 100 psi 6-12 : 200 psi 12-24 : 400 psi Tv= 1.075 tsf
-16	27																	
	28							CLAYEY SAND (SC); loose; tan; moist to wet; mostly medium SAND; some fines.										
-18	29																	
	30		8	2 3 2	5				100									
-20	31																	
	32																	
-22	33							SANDY lean CLAY (CL); medium stiff; tan; moist; some fine SAND; mostly low to medium plasticity fines.										33-34' fine gravel in cuttings
	34																	34-35' Sandy clay
-24	35		9	9 10 13	23	0.5			44									Tv= 0.45 tsf
	36																	
-26	37																	
	38																	
-28	39																	
	40		10	6 7 9	16	1.25			100									Tv= 0.55 tsf
-30	41							CLAYEY SAND (SC); medium dense; tan; wet; mostly medium SAND; some fines.										

Bottom of borehole at 41.5 ft bgs

Groundwater Not Encountered due to Drilling Method

Boring terminated; Grouted per San Mateo Environmental Health Requirements

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: WBSD Flow Equalization and Resource Recovery
CAInc File No: 20-648.1
Date: 11/10/2020
Technician: LAD

MOISTURE-DENSITY TESTS - D2216/D7263

	1	2	3	4	5
Sample No.	R-20-001-1A	R-20-001-3	R-20-001-5	R-20-001-7	
USCS Symbol	SC	CL	CH	CL	
Depth (ft.)	3.5	8.5	17	27	
Sample Length (in.)	5.035	5.977	4.835	6.609	
Diameter (in.)	2.385	2.386	2.853	2.870	
Sample Volume (ft^3)	0.01302	0.01547	0.01789	0.02474	
Total Mass Soil+Tube (g)	1036.1	976.2	737.9	1457.8	
Mass of Tube (g)	272.6	281.3	0.0	0.0	
Tare No.	B5	G9	1001	2015	
Tare (g)	13.7	13.5	125.0	122.2	
Wet Soil + Tare (g)	70.8	60.4	390.8	471.1	
Dry Soil + Tare (g)	64.3	42.2	261.8	416.6	
Dry Soil (g)	50.6	28.7	136.8	294.4	
Water (g)	6.5	18.2	129.0	54.5	
Moisture (%)	**12.8**	**63.5**	**94.3**	**18.5**	
Dry Density (pcf)	**114.6**	**60.6**	**46.8**	**109.6**	

Notes:

Project Name: WBSD Flow Equalization and Resource Recovery
CAInc File No: 20-648.1
Date: 11/11/2020
Technician: LAD

200 Wash - ASTM D1140
Method A

Max Particle Size (100% Passing)	Standard Sieve Size	Recommended Min Mass of Test Specimens
2 mm or less	No. 10	20 g
4.75 mm	No. 4	100 g
9.5 mm	3/8 "	500 g
19.0 mm	3/4 "	2.5 kg
37.5 mm	1 1/2 "	10 kg
75.0 mm	3 "	50 kg

Table from 6.2 of ASTM D1140

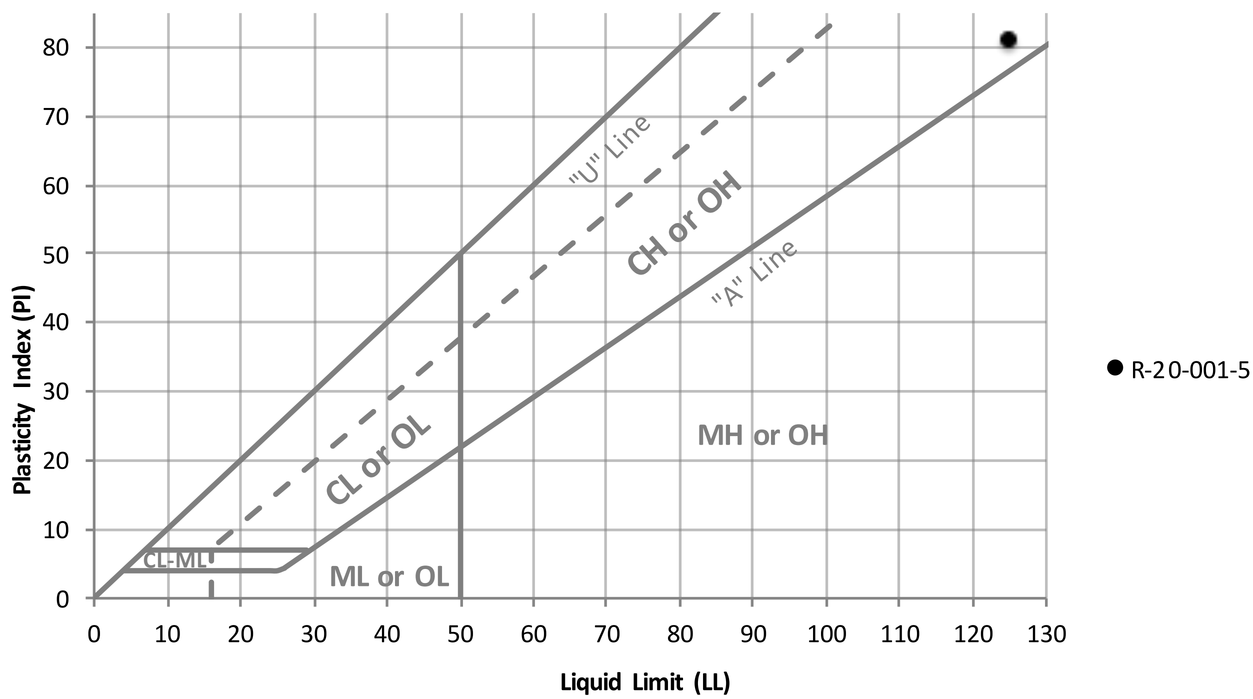
Sample No.	R-20-001-7				
USCS Symbol	CL				
Depth (ft.)	27				
Tare No.	2015				
Tare (g)	122.2				
Dry Soil + Tare (g)	416.6				
Dry Mass before (g)	294.4				
Dry Mass after (g)	130.6				
Percent Fines (%)	56				

Notes:

Project Name: WBSD Flow Equalization and Resource Recovery
CAInc File No: 20-648.1
Date: 11/11/20
Technician: LAD

Plasticity Index - ASTM D4318

Sample ID	Depth (ft)	Liquid Limit	Plastic Limit	PI
R-20-001-5	17	125	44	81



Plasticity Chart

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 11/06/2020
Date Submitted 11/03/2020

To: Carmelo Pagan
Crawford & Associates, Inc.
1100 Corporate Way Suite 230
Sacramento, CA 95831

From: Gene Oliphant, Ph.D. \ Randy Horney RH
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 20-648.1 Site ID : R20-001-3A@8.5F.
Thank you for your business.

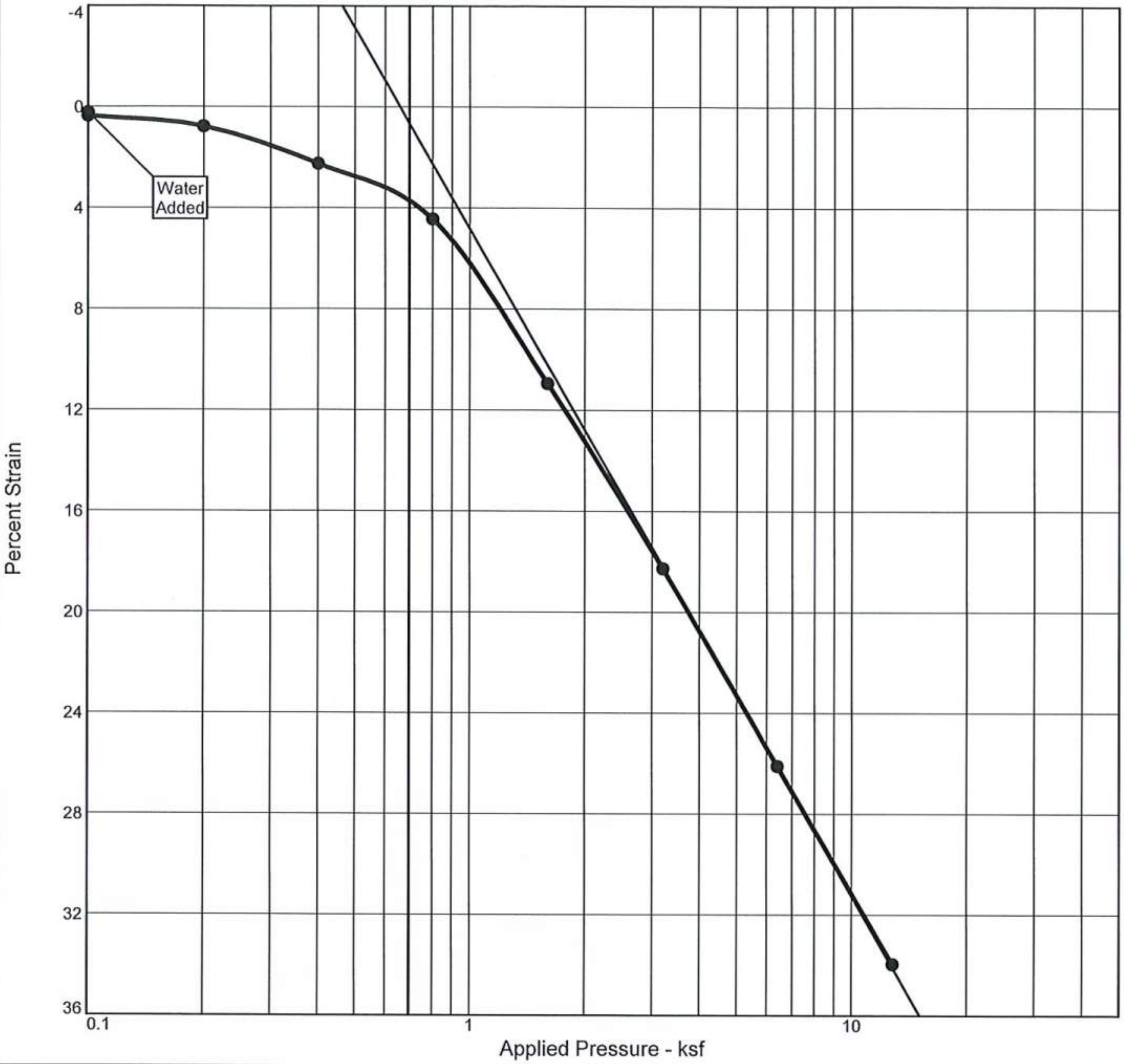
* For future reference to this analysis please use SUN # 83390-173989.

EVALUATION FOR SOIL CORROSION

Soil pH	7.32	
Minimum Resistivity	0.03 ohm-cm (x1000)	
Chloride	15444.2 ppm	1.54442 %
Sulfate	775.2ppm	0.07752 %

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P_c (ksf)	C_c	C_r	Swell Press. (ksf)	Clpse. %	e_o
Sat.	Moist.											
47.3 %	22.0 %	74.8			2.70	0	1.0	0.60			0.1	1.255

MATERIAL DESCRIPTION	USCS	AASHTO

Project No. 20-282 **Client:** Krazan & Associates

Project: WBSD Flow Equalization and Resource Recovery

Location: R-20-001-4 **Depth:** 10'-12.5' **Sample Number:** 60017

GS GULF SHORE EXPLORATION AND TESTING

Remarks:
Preliminary test results only. Moisture and Density are assumptions only.

Figure

Tested By: MPW **Checked By:** JML

BvGG ENGINEERS

BORING LOG

JOB NAME: Proposed Sheetpile Wall
CLIENT: Freyer and Laureta, Inc.
LOCATION:
DRILLER: Exploration Geoservices, Inc.
DRILL METHOD: 8-inch diameter hollow stem auger

JOB NO.: FREYE-18-01
DATE DRILLED: 4/27/18
ELEVATION: 12.0±feet
LOGGED BY: MM

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
						0		CL	LEAN CLAY, yellow brown, moist, very stiff, with sand and trace gravel	FILL
						3				
DSX	1000	81.9	340	83.3	50.1		11 12 12			
						6				
						9	7 8			
DS	1300	NAT	1850	13.1	111		10	CH	BAY MUD: Fat Clay, very dark gray, very moist, stiff (Bay Mud crust)	NATIVE
						12				
							4			
				69.0	53.2	15	3 3			
						18				

BORING LOG

Boring No. B-4

BVGG ENGINEERS

JOB NAME: Proposed Sheetpile Wall

JOB NO.: FREYE-18-01

Type of Strength Test	Test Surcharge Pressure, psf	Test Water Content, %	Shear Strength, psf	In-Situ Water Content, %	In-Situ Dry Unit Weight, pcf	Depth, ft.	Soil Symbols, Samplers and Blow Counts	USCS	Description	Remarks
				50.6	86.7		4, 3, 3			
						21				
				66.2	59.6	24	4, 3, 4			
						27		CL	LEAN CLAY, blue gray, saturated, very stiff, with sand, trace oxidation stains, trace caliche	
				21.6	106	30	10, 11, 19			
						33				
				21.2	102		11, 13, 14			
						36			Boring terminated at 35½ feet. Groundwater encountered at 12 feet. Boring backfilled with neat cement grout immediately after last sample was taken.	
						39				

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November 21, 2022
BAGG Job No: FREYE-18-01

Ms. Lorraine Htoo
Freyer & Laureta, Inc.
144 North San Mateo Drive
San Mateo, California 94401

DRAFT
Geotechnical Memorandum
Flow Equalization and Resource Recovery Facility Levee Improvement and Bayfront Recycled Water Facility Project
West Bay Sanitary District
Menlo Park, California

Reference: 1) Freyer and Laureta, Inc., Flow Equalization and Resource Recovery Facility Levee Improvements and Bayfront Recycled Water Facility Project, Proposed Ground Overview, Menlo Park, California, 65% Design, dated 8/10/2022

2) BAGG Engineers, draft report, Geotechnical Engineering Investigation, Living Shoreline Cut and Fill Analysis, Levee Design Project, West Bay Sanitary District, Menlo Park, California, December 15, 2020

Dear Ms. Htoo

This memorandum is to address the geotechnical aspects of the latest 65% draft design drawings (Reference 1) for the subject project. Geotechnical recommendations for the project were presented in a report by BAGG Engineers dated December 15, 2020 (Reference 2). The 65% plans still show finish top of levee and top of sheetpile floodwall finish grades at Elevation 15 feet, two rows of sheet piling confining the northeast side levee fill, a sheet pile flood wall along the northwest side of the site, and a sheetpile supporting the northwest side of the site entry fill ramp. However, the latest plans (Reference 1) show a shift of the southeast portion of the northeast levee with confining sheetpiles into the West Bay Sanitary District property. The current plans show filling on the northeast side of the northeast levee in the form of 10 horizontal to 1 vertical (10H:1V) to 20H:1V fill slopes extending downward to the northeast from the north east levee. We also note that retaining walls are necessary at the site entrance from Marsh Road to support a new 5 foot high ramp of fill to access the site from Marsh Road. A discussion of these geotechnical aspects of the subject project are presented as follows.

SETTLEMENT

We note, however, that the proposed fills, particularly along the southeastern portion of the northeast levee will cause significant settlement estimated to be up to about 27 inches. Therefore, additional fill will need to be added to help maintain the minimum Elevation 15 top of levee grade. The following table summarizes proposed fill thicknesses along various stations of the northeast levee along with estimated settlement.

TABLE

Summary of Settlement Analyses

Northeast Levee

STATION	Proposed Fill Thickness (feet)	Estimated Settlement Due to Addition of Design Fill (inches)	Recommended Additional Fill Thickness (inches)
2+00	3	4½	5
2+50	2½	3½	4
3+00	2½	3½	4
6+00	4½	9	11
8+00	12	27	31
10+00	12	27	31
13+00	2	3	3½

CONSTRUCTION CONSIDERATIONS

Regarding the construction of the levee/road crest and the ecotone fill slope, ideally it would be preferable to perform the earthwork and fill placement after the sheetpiling is installed since the sheet piling helps provide stability during fill placement and can also help reduce the potential development of mud waves that commonly occur from construction traffic and fill placement on soft Bay Mud. However, this may not be possible in many areas due to access constraints and the position and location of the sheetpiles. Much of the sheetpile will need to be installed near the toe of existing levee slopes where soft Bay Mud conditions are present. The following should be taken into consideration:

- Sheetpile driving equipment that is large enough could reach down to the toe of the levee or further to the flat areas near the toe of the levee and advance the sheetpiles. Cutsheets on the equipment including track widths, weights, etc. should be provided to our office for review to confirm that the existing levee can support the equipment.

- Temporary benches can be cut into the existing levee sides slope to allow for the set-up of smaller sheetpile driving equipment. In the existing levee fill, unsupported cuts no greater than 5 vertical height should be made, otherwise shoring would need to be utilized.

- Compaction of new levee fill slopes intiated on virgin ground near the toe of existing levee fill on the inboard side of the levee will need to be initiated on keyway excavations backfilled with light-weight flowable fill material, in order to provided a stable bottom that can allow for compaction equipment. Alternately, the upper 18 to 24 inches of the ground surface could be treated with lime and recompacted to create a stable surface on which to intiate new levee fill.

- Very light equipment should be used in the 12-inch overexcavation and harvesting of Bay Mud for the proposed ecotone slope such as a small D5 or D6 dozer with very wide tracks.

- A contractor experienced in working with soft Bay Mud conditions should be retained for this project.

SLOPE STABILITY

Based on our review, the reduced amount of fill on the northeast side of the northeast levee improvements addresses slope stability concerns discussed in our previous report due to the excess amount of fill previous planned in this area. The sheet piles shown on the current plans also improves slope stability during seismic events. Sheet piles should extend a minimum 5 feet below the bottom of Young Bay Mud.

RETAINING WALLS

We note that in the site entry area, about 5 feet of fill is planned to build up ramp access to the site via Marsh Road. The ramp will have north, south and east segments extending from the southwest corner of the property. Retaining walls are planned to support the east side of the north segment and the north side of the east segment. We estimate that 5 feet of fill could cause up to 11 inches of settlement which could damage underground pipelines at that location as well as the retaining walls if they are supported on conventional foundations. The retaining walls will need to be supported on deep foundations extending through the Young Bay Mud deposits and into more stiff Old Bay Deposits. Additionally, existing utilities would need to be replaced with flexible joints, if feasible, or they could be supported on piles too. The piles will need to resist downdrag caused by fill settlement and the compression of the Young Bay Mud deposits.

For the support of the noted retaining walls and utilities (if applicable) piles should be designed to resist a downdrag of 250 psf acting over the pile shaft down to an elevation of -12 feet. Below Elevation of -12 feet, a skin friction of 600 psf acting around the pile shaft could be assumed to resist downdrag and dead plus live loads associated with the retaining wall. The retaining wall should be designed to resist an active pressure of 45 pcf. In consideration of surcharge loads, a uniform pressure equal to 1/3 of the surcharge pressure should be assumed to act over the full height of the retaining wall. In consideration of seismic loads, a uniform pressure of 10H psf, where 'H' is the height of the retaining wall should be assumed to act over the full height of the retaining wall.

Lateral resistance may be assumed to act as passive pressure between the pile shaft and the adjacent soils. For design purposes passive pressures of 160 pcf in existing fill, 90 pcf in young bay mud, and 190 pcf in old bay deposits may be assumed for design purposes.

As an alternative to pile supports, the area under the proposed fill could be overexcavated down to the top of the young bay mud (about elevation 0 feet) and backfilled with a low density flowable fill material. This would relieve some of the surcharge on the compressible bay mud material. A flowable fill material with a unit weight of 65 pcf used to backfill such an overexcavation would reduce the settlement from about 11 inches to about 3 to 4 inches and would allow for the retaining walls to be founded on shallow spread footings.

This memorandum is based on our review of the referenced documents, and our experience with the site. We trust this memorandum provides you with the information required at this time. If you have any questions or require additional information, please feel free to contact us.

Very truly yours,
BAGG Engineers

Michael Matusich
Michael Matusich
Senior Engineer
GE 3013, Expires 12/31/23

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Quality Assurance Project Plan for the West Bay Sanitary District Flow Equalization and Resource Recovery Facility Flood Protection Project, Menlo Park, San Mateo County, California

AUGUST 2022

PREPARED FOR

U.S. Army Corps of Engineers
Regional Water Quality Control Board

PREPARED BY

SWCA Environmental Consultants

QUALITY ASSURANCE PROJECT PLAN FOR THE WEST BAY SANITARY DISTRICT FLOW EQUALIZATION AND RESOURCE RECOVERY FACILITY FLOOD PROTECTION PROJECT, MENLO PARK, SAN MATEO COUNTY, CALIFORNIA

Prepared for

U.S. Army Corps Engineers
450 Golden Gate Avenue
San Francisco, California 94102
Attn: Frances Malamud-Roam

Regional Water Quality Control Board
1515 Clay Street, Suite 1400
Oakland, California 94612
Attn: Tahsa Sturgis

Prepared by

Lauren Huff, M.S., Principal Restoration Ecologist
Charlotte Soergel, B.A., Biologist

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Half Moon Bay, California 94019
(650) 440-4160
www.swca.com

SWCA Project No. 59862

August 2022

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1 INTRODUCTION

1.1 Problem Definition

The West Bay Sanitary District (WBSD) Flow Equalization and Resource Recovery Facility (FERRF) Flood Protection Project (project) is located in Menlo Park, San Mateo County, California (Figure 1). WBSD proposes to create an ecotone slope/living shoreline to protect WBSD's existing facilities (including open air basins/ponds that can contain up to approximately 23.6 million gallons of wastewater), underserved residents (including the low-income community of East Palo Alto), and San Francisco Bay water quality from being adversely impacted by potential flooding events associated with the current 100-year floodplain and future sea level rise The FERFF project requires fill within U.S. Army Corps of Engineers (USACE) and Regional Water Quality Control Board (RWQCB) jurisdiction to construct the ecotone slope. Additional grading/earthwork is required to construct the salt marsh creation area, which is the compensatory mitigation required for the project. This Quality Assurance Project Plan (QAPP) has been prepared in compliance with the San Francisco Bay RWQCB requirements for projects that require imported fill and/or reuse of on-site fill materials.

1.2 Purpose of QAPP

The purpose of this QAPP is to comply with the process for evaluating fill sources and to ensure that any imported fill and or reuse of on-site material meet the RWQCB contaminant screening guideline requirements for the protection of aquatic life (RWQCB 2000). This QAPP describes the process and specifications for QAPP implementation and details the fill screening process, analysis of contaminant levels, and laboratory testing requirements required to meet RWQCB contaminant screening guidelines. This QAPP also describes the quality assurance measures that will be implemented during the transportation and placement of fill to prevent contamination. This QAPP only addresses fill that is within RWQCB jurisdiction or required for the compensatory mitigation for the project. All fill is currently proposed to be sourced on-site through existing stockpiles and soil excavated during construction activities for the ecotone slope and marsh creation area, and no imported fill is currently anticipated. Approximately 5,200 cubic yards (CY) of upland fill sourced from the project site is currently available and stockpiled at the project location. All remaining fill needed for the project will be obtained through excavation activities associated with the ecotone slope and salt marsh creation area, assuming that all fill meets RWQCB screening criteria.

1.3 QAPP Guidelines and Standards

Approval of the proposed fill materials is contingent upon this material meeting the contaminant level screening limits described in this QAPP. The screening limits provided are based on the San Francisco Bay RWQCB *Beneficial Reuse of Dredged Materials: Sediment and Testing Guidelines* (RWQCB 2000) for use of fill in wetland environments, RWQCB Environmental Screening Levels (RWQCB 2013), and RWQCB-approved *Quality Assurance Project Plan for Inner Bair Island Fill Import and Placement* (USFWS 2008), which provided a nearby reference site for this project. The project includes construction of an ecotone slope/living shoreline that will allow for salt marsh habitat migration over time.

RWQCB requires that all fill intended for current or future wetland habitat meet specific contaminant screening standards. However, upland portions of the ecotone slope that are part of long-term restoration plans will not be required to meet wetland screening criteria, given that they are not within the limits of RWQCB jurisdiction at the site.

Figure 1. Project Location.

Screening standards, testing guidelines, and environmental levels are periodically updated to reflect ongoing monitoring of ambient sediments in the San Francisco Bay and as needed for relevancy. This QAPP will follow the most up to date RWQCB screening standards and guidelines and screening standards may be updated in the future, as needed.

Screening methods included in this QAPP were developed using the California Department of Toxic Substance Control (DTSC) *DTSC Information Advisory Clean Imported Fill Material Fact Sheet* (DTSC 2001), the U.S. Environmental Protection Agency (EPA) *Guidance for Quality Assurance Project Plans* (EPA 2002), and the approved QAPP for Inner Bair Island Fill Import and Placement (USFWS 2008). This QAPP also includes ongoing agency consultation with USACE and RWQCB, as needed, and clearly defined roles, including, but not limited to, a quality assurance agent and contractor to delineate roles and responsibilities for consistency. Fill sources for the ecotone slope will be referred to as borrow sites throughout this QAPP.

1.4 Project Applicant

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1.5 Project Regulatory Permits

A list of all permits that guide the use and placement of fill necessary to implement the project will be included as an appendix to this document once they are received (Appendix A).

2 PROJECT ROLES AND RESPONSIBILITIES

This section identifies the parties involved with implementing this QAPP and their respective roles.

2.1 Project Management Team

The project management team will include key staff members from WBSD and project partners, such as agencies (e.g., RWQCB) and consultants. The purpose of this team is to manage staff and partners to ensure that all roles and responsibilities are performed. This team will also be responsible for reviewing progress reports and making recommendations, as needed.

2.2 Quality Assurance Agent

The quality assurance agent will be responsible for maintaining compliance with QAPP procedures and ensuring screening criteria are met. The quality assurance agent will review the results of the borrow material sample analyses. If it is determined that the borrow materials meets the screening criteria, the quality assurance agent will prepare a memo summarizing the borrow material characteristics, which will be submitted to the project management team for review. The quality assurance agent will be responsible for maintaining multiple tracking logs throughout the borrow material placement process and monitoring construction to verify that QAPP procedures are followed during excavation and fill placement. The quality assurance agent will prepare and submit progress reports, as necessary, and will be responsible for all coordination with the RWQCB, as needed.

2.3 Contractor

The contractor will be responsible for developing and implementing the sampling plan, selecting and evaluating potential borrow material sources, complying with the project QAPP procedures, delivering the borrow material samples to a laboratory approved by the quality assurance agent for screening, and submitting the analyses to the quality assurance agent.

2.4 Peer Reviewer

The peer reviewer will be responsible for reviewing all laboratory analysis methods, the sampling plan, and the borrow analysis results. The peer reviewer will be a consultant to the quality assurance agent and will not have direct involvement with other aspects of the project.

2.5 Persons Responsible for QAPP Update and Maintenance

Changes and updates to this QAPP will be made as needed after a review of the rationale for change by the quality assurance agent and with the concurrence of RWQCB and the project management team. The project management team will identify an agent (e.g., the quality assurance agent) to make changes to this QAPP, submit drafts for review, prepare a final copy, and submit the final version for review and approval by the RWQCB.

3 BORROW ANALYSIS AND SCREENING CRITERIA

3.1 Data Review and Borrow Suitability

3.1.1 Qualitative Analysis

Because the borrow locations for this project are from within the project site (i.e., soil stockpile and excavated material), a qualitative analysis is not necessary to ensure that the borrow site is suitable for use as a source for fill since the history of the project site is known to be acceptable for borrow material. If imported fill is required, an addendum to this QAPP will be submitted detailing the initial screening process for the off-site borrow location.

3.1.2 Quantitative Analysis

This analysis will include a quantitative assessment conducted by a qualified laboratory certified by the California Environmental Laboratory Accreditation Program (CA ELAP). The quality assurance agent will review sampling methods and lab results against the screening criteria, discussed below in Section 3.2. The contractor will be responsible for preparing a report that includes the sampling plan and methods, the laboratory testing methods and results, a conclusion with a summary of any contaminants exceeding the screening limits (if present), a location map of the samples from the borrow site, and recommended soil depths per the project contractor. The contractor is responsible for preparing and executing the sampling plan once it has been reviewed and approved by the contractor, quality assurance agent, and peer reviewer.

3.1.3 Sampling Plan

The contractor is responsible for developing the sampling plan prior to collecting any borrow material samples. The sampling plan will be reviewed and approved by the quality assurance agent and peer reviewer. The sampling plan should include an explanation for the selected sample locations in compliance with the DTSC and RWQCB recommendations shown in Table 1 (DTSC 2001; RWQCB 2006), a map with the coordinates of the borrow site with sample locations, the anticipated quantity available from the borrow site, and a detailed, step-by-step process for collecting samples (e.g., Global Positioning System [GPS] points, equipment, sampling procedures, depth of samples, sample handling requirements for the prevention of contamination and per the approved laboratory guidance, etc.). The sampling plan will also include the address and contact information for the approved laboratory where the borrow samples will be analyzed, a list of the parameters to be analyzed, a copy of the chain of custody form, lab drop-off procedures, and the lab screening limits as compared to the approved screening limits in this QAPP. If the lab limits exceed the contaminant screening criteria, method detection limits (MDLs) will be provided (see Section 3.3.2).

Table 1. Minimum Sampling Requirements

Borrow Volume	Samples per Volume
Up to 1,000 cubic yards	One sample per 250 cubic yards
1,000 to 5,000 cubic yards	Four samples for the first 1,000 cubic yards Plus one sample per each additional 500 cubic yards
Greater than 5,000 cubic yards	Twelve samples for the first 5,000 cubic yards Plus one sample per each additional 1,000 cubic yards
Borrow Area	**Samples per Area**
2 acres or less	Four samples
2 to 4 acres	One sample every 0.5 acre
4 to 10 acres	Eight samples

Sources: DTSC (2001); RWQCB (2006)

3.1.4 Borrow Approval or Rejection

The borrow material may be approved or rejected based on the results of the quantitative analysis. All borrow site samples must meet the screening contaminant criteria for wetland surface material (Section 3.2.1) in order to be used as wetland surface fill. If contaminant levels exceed this screening contaminant criteria, the samples may then be analyzed against the wetland foundation material criteria for potential use below the wetland surface material. The quality assurance agent will provide a map with the location, quantity, and extent of fill, and will identify which borrow samples meet wetland surface and/or foundation material criteria. The quality assurance agent will also make recommendations for additional sample requirements, if needed, to delineate the limits of each soil type (e.g., wetland surface, foundation material). If the quantitative analysis identifies any pesticides, the first 3 feet of fill may be rejected if the samples do not meet wetland screening criteria. Residual quantities of pesticides are common throughout the Southern Bay Area, which was historically used for agricultural purposes.

If the results of the quantitative analysis determine that the borrow site fill is acceptable as wetland surface material and/or wetland foundation material, the quality assurance agent will prepare a memo with a summary of the analysis results, which will be provided to the project management team, contractor, and RWQCB. The memo will describe the name and location of the borrow site, the quantity or volume and depth of material available, and the quantity of approved fill for surface or foundation material.

3.2 Contaminant Screening Criteria

The screening criteria for wetland surface and wetland foundation fill material are included in Sections 3.2.1 and 3.2.2, respectively. All fill used in the project area must meet the screening criteria for either wetland surface or foundation material. The screening criteria used in this QAPP are based on the San Francisco Bay RWQCB's *Beneficial Reuse of Dredged Materials: Sediment Screening and Testing Guidelines* (RWQCB 2000), which provides contaminant screening levels for physical, chemical, and biological quality requirements for reuse. Fill will be approved or rejected based on the RWQCB screening criteria. If the reporting limit exceeds screening criteria levels, the MDL and test result will be compared to the screening criteria. Screening levels for volatile organic compounds (VOCs) and total hydrocarbon were not covered in the 2000 RWQCB guidelines. Therefore, screening levels for VOCs are based on the RWQCB Environmental Screening Levels for the San Francisco Bay Region (RWQCB 2013), and total hydrocarbon components are based on the approved limits for the Inner Bair Island Fill Import and Placement (USFWS 2008). As previously mentioned, this QAPP is based on the most recent screening levels for ambient constituents in the Bay Area. If screening levels are updated during the course of the project, this QAPP will be modified to ensure compliance with the most up-to-date criteria.

3.2.1 Wetland Surface Fill

Wetland surface fill is fill that is suitable to support or come in direct contact with plants and wildlife that occur in wetland habitats. The RWQCB identifies limits for the allowable level of contamination for wetland surface material (RWQCB 2000). The purpose of the ecotone slope/living shoreline and salt marsh creation area is to support wetland habitat migration as sea level rises. However, upland portions of the ecotone slope will not be required to meet wetland screening criteria since these are not expected to be inundated by tidal action until future sea level rise and are not within the limits of RWQCB jurisdiction at the site. All wetland surface fill will be placed during the construction of the ecotone slope/living shoreline according to the project permits. Table 2 below shows the RWQCB contaminant screening criteria for wetland surface material.

3.2.2 Wetland Foundation Fill

Wetland foundation fill requires separation from direct contact with organism's due to potential biological impacts. The RWQCB has identified allowable contaminant limits for wetland foundation material (RWQCB 2000). Table 2 below shows the RWQCB contaminant screening criteria for wetland foundation material. VOCs are not as biologically significant in wetland foundation fill and were not included in the screening criteria.

Table 2. Screening Criteria for Wetland Surface and Foundation Material

Chemical Constituent	Wetland Surface Material	Wetland Foundation Material
Metals (mg/kg, dry weight)		
Arsenic	15.3 [A]	70 [A]
Cadmium	0.33 [A]	9.6 [A]
Chromium	112 [A]	370 [A]
Copper	68.1 [A]	270 [A]
Lead	43.2 [A]	218 [A]
Mercury	0.43 [A]	0.7 [A]
Nickel	112 [A]	120 [A]
Selenium	0.64 [A]	1.4 [B]
Silver	0.58 [A]	3.7 [A]
Zinc	158 [A]	410 [A]
Organochlorine Pesticides/Polychlorinated Biphenyls (µg/kg, dry weight)		
DDTs, sum	7.0 [A]	46.1 [A]
Chlordanes, sum	2.3 [A]	4.8 [A]
Dieldrin	0.72 [A]	4.3 [A]
Hexachlorocyclohexane, sum	0.78 [A]	0.99 [A]
Hexachlorobenzene	0.485 [A]	6 [A]
Polychlorinated biphenyls, sum	22.7 [A]	180 [A]
Polycyclic Aromatic Hydrocarbons (µg/kg, dry weight)		
Polycyclic Aromatic Hydrocarbons, total	3,390 [A]	44,792 [A]
Total Hydrocarbon Components (µg/kg, dry weight)		
Total Petroleum Hydrocarbons from Gasoline	100 [B]	400 [D]
Total Petroleum Hydrocarbons from Jet Fuel, Kerosene, Diesel Fuel, or Motor Oil	200 [B]	500 [D]
Volatile Organic Compounds (µg/kg, dry weight)		
Acetone	8.6 [C]	
Benzene	27 [C]	
Bromodichloromethane	605 [C]	
Bromoform (Tribromomethane)	1,210 [C]	
Bromomethane	14 [C]	
Carbon techtrachloride	17 [C]	
Chlorobenzene	55 [C]	
Chloroethane	2.4 [C]	
Chloroform	247 [C]	
Chloromethane	385 [C]	
Dibromochloromethane	5,148 [C]	
1, 2-dibromo-3-chloropropane	0.26 [C]	
1,2-Dibromoethane	393 [C]	
1,2-Dichlorobenzene	86 [C]	

Chemical Constituent	Wetland Surface Material	Wetland Foundation Material
1,3-Dichlorobenzene	398 [C]	
1,4- Dichlorobenzene	93 [C]	
1,1-Dichloroethane	15 [C]	
1,2-Dichloroethane	348 [C]	
1,1-Dichloroethane	15 [C]	
Cis-1,2- Dichloroethane	209 [C]	
Trans-1,2-Dichloroethane	310 [C]	
1,2-Dichloropropane	664 [C]	
1,3-Dichloropropene	11 [C]	
1,4-Dioxane	11,725 [C]	
Ethylbenzene	156 [C]	
Hexachlorobutadiene	270 [C]	
Hexachloroethane	2,400 [C]	
Methylene chloride	244 [C]	
Methyl ethyl ketone	630 [C]	
Methyl isobutyl ketone	228 [C]	
tert-Butyl methyl ether	480 [C]	
Naphthalene	286 [C]	
tert-Butyl alcohol	6,660 [C]	
1,1,1,2-Tetrachloroethane	873 [C]	
1,1,2,2-Tetrachloroethane	225 [C]	
Tetrachloroethene	186 [C]	
Toluene	237 [C]	
1,2,4-Trichlorobenzene	445 [C]	
1,1,1-Trichloroethane	68 [C]	
1,1,2-Trichloroethane	471 [C]	
Trichloroethene	598 [C]	
Vinyl chloride	145 [C]	
Xylenes	407 [C]	

Source: A = RWQCB (2000); B = RWQCB (1992); C = NOAA (2008); D = HDHH (2017)

Note: mg/kg = milligrams per kilogram; RWQCB = Regional Water Quality Control Board; THC = Total Hydrocarbon Components; µg/kg = micrograms per kilogram

3.3 Laboratory Analysis

The following sections describe the methods and protocols that will be implemented during the laboratory analysis of the borrow sources. Any suggested changes to the methodology must be approved by the quality assurance agent and RWQCB.

3.3.1 Chemical Constituents

All borrow samples will be collected and analyzed in compliance with the EPA's *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods (SW-846)* (EPA 1986). All analyses for compounds will be provided in dry weight. The methods listed below will be used to analyze the following materials:

- Metals will follow the EPA Methods 6000/7000 series
- Organochlorine pesticides will follow EPA Method 8081B
- Polychlorinated biphenyls will follow EPA Method 8082A
- Polycyclic aromatic hydrocarbons will follow EPA Method 8270
- VOC will follow EPA Method 8260B[1]

3.3.2 Method Detection Limit

The MDL is the lowest measurable concentration of a compound that can be reported with 99% confidence that the concentration is greater than zero. MDLs will be determined based on the pertinent Solid Waste (SW)-846 protocol (EPA 1986) or the method specified in Title 40 Code of Federal Regulations (CFR) Part 136, Appendix B (U.S. Government Publishing Office [GPO] 2011). The approved laboratory will select reporting limits (RL) representative of concentration levels that are easily replicable. The reporting limits will be below the screening criteria defined in Table 2, when possible. If it is not possible to get an RL less than the screening criteria, RWQCB will be contacted for approval to report down to the MDL, which should be below the screening criteria. The results of the laboratory analysis will be compared to the screening criteria to determine which contaminants are present in the borrow samples at a greater level than the screening criteria. RWQCB will be provided with a list of chemical constituents that are reported at levels above the MDL, but below the RL, which the agency can either approve or request to have additional testing conducted by a different method or lab. If the MDL continues to exceed the screening criteria for a specific constituent after additional testing, but the borrow source seems otherwise suitable for use at the site, the quality assurance agent will coordinate with RWQCB to determine whether the sample should be approved for use on-site.

3.3.3 Accuracy

Accuracy is the degree of closeness between laboratory contaminant concentration results and the actual contaminant concentrations in the samples. Accuracy will be assessed through the evaluation of the percent recoveries associated with laboratory control samples and matrix spikes. Accuracy is generally expressed as percent recovery (%R), which is defined as:

$$\%R = 100\% \times (s - C) / T$$

where:

s = measured spike sample concentration
C = sample concentration
T = true or actual concentration of the spike

Accuracy will be controlled by comparing percent recoveries to the acceptable control limits in the SW-846 tables (EPA 1986).

3.3.4 Precision

Precision is a measurement of the reproducibility of data under a specific set of conditions. Precision is a quantitative measure used to assess the variability of a data set in reference to the calculated average

[1] VOCs will only be analyzed if there is potential VOC contamination. VOC contamination is not suspected at the FERRF site.

value. Precision will be assessed by the evaluation of the day-to-day variances in the laboratory control samples and will be evaluated for matrix effects using the matrix spikes (MS)/matrix spike duplicates (MSD). Results of the duplicate analysis are used to calculate the relative percent difference (RPD) or relative standard deviation (RSD).

The RPD is defined as:

$$RPD = \frac{100\% \times (x1 - x2)}{(x1 + x2) / 2}$$

Where:

x_1 = first duplicate concentration and
x_2 = second duplicate concentration

The RSD is defined as:

$$RSD = 100\% \times (S / x_m)$$

Where:

S = standard deviation
x_m = arithmetic mean of replicate analysis

Precision will meet the acceptable levels as defined by SW-846 (EPA 1986).

3.4 Fill Transport and Placement

The following sections describe the processes and procedures that will be implemented to ensure that only approved fill is used for the construction of the ecotone slope/living shoreline and that all placement activities are in compliance with the project permits.

3.4.1 Agency Approval of Proposed Work

All required agency notification, coordination, and approvals will occur prior to fill activities. Agency notification will describe the purpose and amount of fill, the placement locations, and whether fill is intended for wetland surface or foundation use.

3.4.2 Fill Movement Protocols

Pending the results of the quantitative analysis, it is anticipated that all borrow materials will be sourced on-site. Fill will be separated into stockpiles according to fill type (e.g., surface, foundation) but will likely need to be transported via truck from the borrow location to the fill locations on-site. The quality assurance agent will be responsible for conducting visual inspections to verify that best management practices (BMPs) are being implemented. This includes verifying that trucks used for transportation are clear of debris, soil, and plant materials and are clean and in good condition prior to movement of fill on-site. If the quality assurance agent observes any non-compliant activities, all transport of fill will be stopped until the issue is resolved. If anomalous material is encountered, a separate stockpile will be created and clearly marked to identify unusable fill. The quality assurance officer will also inspect the separate wetland surface and foundation fill material and will verify that materials are being kept separate. Before the soil is moved to the fill location, a soil acceptance form that clearly states the fill material type and a unique ID tag will be assigned to each stockpile. This documentation will be checked before the fill is reused. The contractor will be responsible for maintaining a truck log to track the movement of fill throughout the project site and that fill is being separated and reused appropriately.

3.4.3 On-Site Fill Placement

The quality assurance agent will be responsible for monitoring fill placement activities throughout the duration of earthwork associated with the project. The agent will ensure all fill placement activities comply with this QAPP and will have stop work authority for fill placement if there are any concerns about the fill material, such as irregularities or anomalies.

3.4.3.1 OPERATIONAL ROLES AND RESPONSIBILITIES

The contractor will be responsible for all fill compliance on-site, including compliance with project permits, testing results and data, and agency notification and reporting. The contractor will also manage on-site stockpiles and fill placement during construction activities. All deliveries of approved wetland surface and foundation material to the project site will be tracked by the contractor. In addition, the contractor will ensure that wetland surface and foundation materials are kept at the approved locations in separate, clearly labeled stockpiles. The contractor will monitor all foundation material to ensure it is placed a minimum of 3 feet below all surface material and will not be mixed during placement activities. The contractor will provide documentation, including a fill tracking plan, to the quality assurance agent and project management team to demonstrate compliance regarding all fill placement.

3.4.3.2 FILL TRACKING

As discussed in the previous section, the contractor will be responsible for preparing a fill tracking plan throughout the fill placement process. The plan will include the borrow site location, fill volumes for both wetland surface and foundation fill, wetland and foundation stockpile locations, procedures to prevent surface and foundation fill from mixing, procedures to prevent foundation fill from entering waters of the State during placement activities, and the destination for surface and foundation fill within the project site. The contractor will provide weekly updates to the project management team to inform them of any changes regarding the type, quantity, or timing of fill being moved throughout the site.

3.4.3.3 TRACKING FILL MOVEMENT AND PLACEMENT

The contractor will be responsible for tracking and verifying the placement of surface and foundation wetland fill and that each is properly placed in its respective stockpile. Surface and foundation wetland fill should be kept in separate stockpiles at all times. The contractor will ensure that fill is placed in the approved stockpiles and confirm that foundation fill is placed a minimum of 3 feet beneath surface fill. Consistent with the stockpiles, no foundation and surface will be mixed during placement activities. If the contractor observes non-compliance with the movement or placement of fill material, the contractor will immediately contact the quality assurance agent, project manager, and/or RWQCB, as appropriate.

3.5 Reporting Requirements

WBSD will provide a quarterly progress report to RWQCB during project fill movement and placement. The progress reports will include the borrow site location, wetland surface and foundation fill quantities, fill movement and placement activities, remaining borrow quantity, and supporting documentation, including maps with borrow site and fill locations, team member field notes, truck logs (if any), test results, and fill approvals.

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APPENDIX A

Project Regulatory Permits

SEE CONSTRUCTION DOCUMENTS