BASIS OF DESIGN MEMORANDUM
SAN DIEGO SHIPYARD SEDIMENT SITE – SOUTH SHIPYARD

Prepared for

San Diego Bay Environmental Restoration Fund – South Trust

Prepared by

Anchor QEA, L.P.

27201 Puerta Real, Suite 350

Mission Viejo, California 92691

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LIST OF ACRONYMS AND ABBREVIATIONS

ATS	Active Treatment System
BMP	best management practice
BODM	Basis of Design Memorandum
CAO	Cleanup and Abatement Order
CCC	California Coastal Commission
CDFW	California Department of Fish and Wildlife
City	City of San Diego
cm	centimeter
COC	chemical of concern
cy	cubic yard
DMP	Dredging Management Plan
EDS	Environmental Data Solutions, Inc.
H:V	horizontal feet to vertical feet
HASP	Health and Safety Plan
HPAH	high-molecular weight polycyclic aromatic hydrocarbon
MLLW	mean lower low water
MMRP	Mitigation Monitoring and Reporting Program
NMFS	National Marine Fisheries Service
SIU	significant industrial user
NASSCO	National Steel and Shipbuilding Company
NPDES	National Pollutant Discharge Elimination System
PCB	polychlorinated biphenyl
Port	San Diego Unified Port District
QAPP	Quality Assurance Project Plan
RAP	Remedial Action Plan
RFP	Request for Proposal
RTK	Real-Time Kinematic
S-Lane	S-Lane Parcel
Site	San Diego Shipyard Sediment Site
SMA	Sediment Management Area
SMARTS	Storm Water Multi-Application and Report Tracking System

SMU	sediment management unit
SOP	Standard Operating Procedures
South Trust	San Diego Bay Environmental Restoration Fund – South Trust
SWAC	surface-weighted average concentrations
SWPPP	Stormwater Pollution Prevention Plan
TBT	Tributyltin
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USN	U.S. Department of the Navy
Water Board	San Diego Regional Water Quality Control Board
WDID	Waste Discharger Identification

1 INTRODUCTION

This Basis of Design Memorandum (BODM) documents the design elements associated with proposed remedial actions being conducted at the South Shipyard portion of the San Diego Shipyard Sediment Site (Site) for compliance with Cleanup and Abatement Order (CAO) No. R9-2012-0024 (Water Board 2012a) and the approved Remedial Action Plan (RAP; Anchor QEA 2012). As required by Section V.B.1 of Anchor QEA, L.P.'s Contract for Engineering Design Services with the San Diego Bay Environmental Restoration Fund – South Trust (South Trust; also known as the Owner) dated February 28, 2013, the BODM is part of the Draft Final Design comprised of this BODM, Contract Drawings, and Technical Specifications. This BODM, and the accompanying Draft Final Design, has been prepared by Anchor QEA on behalf of the South Trust.

The Draft Final Design and BODM will be included in the Dredging Contractor Request for Proposal (RFP) package due to be completed by June 28, 2013. With input from the Contractor, the results of the Value Engineering Study, and additional refinement of the Sediment Management Area (SMA), a Final Design will be completed on August 8, 2013. Construction activities are scheduled to begin on or before September 17, 2013.

The North Shipyard portion of the Site is addressed under a separate BODM and associated Draft Final Design.

1.1 Background

Discharges of metals and other pollutant wastes to San Diego Bay over the years have resulted in the accumulation of pollutants in marine sediments along the eastern shore of central San Diego Bay in San Diego, California. This accumulation resulted in conditions identified by the San Diego Regional Water Quality Control Board (Water Board) as adversely impacting beneficial uses (i.e., aquatic life, aquatic-dependent wildlife, and human health).

The Water Board identified affected areas such as waters adjacent to two adjoining, active shipyard facilities in San Diego Bay—the North Shipyard and the South Shipyard, together termed the Site. In March 2012, the Water Board issued CAO No. R9-2012-0024 (Water

Board 2012a) for the remediation of marine sediments containing elevated chemical concentrations within the Site. This BODM describes remedial design elements related specifically to the South Shipyard.

The South Shipyard is owned and operated by National Steel and Shipbuilding Company (NASSCO), a subsidiary of General Dynamics, and is a full-service ship construction, modification, repair, and maintenance facility that spans 126 acres of tidelands property (80 acres on land and 46 acres offshore). The South Shipyard serves the U.S. Navy and commercial customers, and activities have taken place at this location since at least 1960. Current site features include office buildings, warehouses, shops, steel fabrication facilities, a floating drydock, a graving dock, two shipbuilding ways, and five piers, providing 12 berthing spaces.

Figure 1 depicts the location of the Site and the layout of the North and South Shipyards. The remedial footprint extends from the U.S. Bulkhead Line (shoreline) to San Diego Bay's main shipping channel to the west.

1.2 Description of Remedial Action

Directive A.2 of the CAO states that "the Dischargers shall take all corrective actions necessary to remediate the contaminated marine bay sediment at the Shipyard Sediment Site" (Water Board 2012a). Several different remedial techniques were considered by the Water Board and the North and South Shipyards for their applicability to meeting this goal. The techniques considered include mechanical dredging, hydraulic dredging, subaqueous capping, natural recovery, confined aquatic disposal, and nearshore confined disposal. Further consideration was given to the final disposition of contaminated sediments, including treatment in-place, offshore disposal, nearshore disposal, beneficial reuse (beach renourishment), and off-site disposal. All of these techniques have been used successfully on other marine or waterfront remedial actions. After considering these corrective action alternatives, mechanical dredging with off-site disposal was selected as the remedial action for cleanup of the remedial footprint.

Dredging will be conducted to remove impacted sediments from all accessible portions of the Site. Dredged material will be offloaded to an onshore stockpiling area where it will be dewatered, loaded into trucks, and transported to one or more off-site disposal locations. Mechanical dredging will be supplemented, where necessary, by localized placement of sand cover in cleanup areas (depending on various factors, including the results of post-dredge confirmational sampling) as a mechanism for further enhancing the sediment surface. Cleanup areas below overwater structures will receive a cover layer of sand rather than being dredged, owing to accessibility issues and the need to maintain stability of the structures.

The target depth for remediation is the maximum depth of chemical exceedance relative to CAO target cleanup levels. Confirmational sampling will be conducted after dredging and may indicate that some areas require additional dredging and/or placement of sand cover materials.

In areas inaccessible to dredging (i.e., underpier areas), or require offsets to protect existing structures, a nominal (average) 12-inch-thick layer of sand cover will be placed with a minimum placement thickness of 6 inches required over the entirety of the placement area to promote physical isolation and stabilization of contaminated sediments. Isolation and stabilization will be achieved by the placement of 6 tons of sand cover material per 100 square feet of bottom surface.

A RAP was submitted by the North and South Shipyards to the Water Board in October 2012 in compliance with CAO Directive B.1 (Water Board 2012a). The RAP was subsequently approved by the Water Board.

The RAP describes the process by which cleanup of the Site will be managed, designed, planned, implemented, and monitored in accordance with the CAO and is consistent with the U.S. Environmental Protection Agency's (USEPA's) National Contingency Plan. The RAP also established the overall basis for design activities, which are described in detail in this BODM, and will be used to inform and control the remedial action to: 1) obtain construction bids; and 2) ensure that that project is implemented in a manner that achieves the directives of the CAO.

1.2.1 Cleanup Objectives and Cleanup Levels

The cleanup of sediments with primary chemicals of concern (COCs) must be completed to comply with cleanup objectives stipulated by the Water Board in the CAO, including the CAO's accompanying Exhibit B, the Mitigation Monitoring and Reporting Program (MMRP; Water Board 2012b). COCs with established cleanup levels include mercury, copper, high-molecular-weight polycyclic aromatic hydrocarbons (HPAHs), total polychlorinated biphenyls (PCBs), and tributyltin (TBT).

After implementation of the remedial action, post-remediation surface-weighted average concentrations (SWACs) of COCs are anticipated to meet cleanup objectives set forth in the CAO (Water Board 2012a) and detailed in Table 1. Post-dredging confirmational sampling will be conducted throughout remedial dredging areas to confirm the cleanup objectives have been met. Confirmational sampling protocols are described in Appendix C of the RAP (Anchor QEA 2012) and Section 34.1.2 of the Technical Report (Water Board 2012c).

Table 1
Cleanup Objectives Mandated by the CAO

Chemical	Units (dry weight)	Targeted Post-Remediation Dredge Area Concentrations	Estimated Post-Remediation SWAC	Post-Remediation Trigger Concentrations
Copper	mg/kg	121	159	185
Mercury	mg/kg	0.57	0.68	0.78
HPAH[1]	µg/kg	663	2,451	3,208
Total PCB Congeners[2]	µg/kg	84	194	253
TBT	µg/kg	22	110	156

Notes:
Table taken from the CAO (Water Board 2012a).
µg/kg = microgram per kilogram
mg/kg = milligram per kilogram
1 HPAHs = sum of six PAHs: Fluoranthene, Perylene, Benzo(a)anthracene, Chrysene, Benzo(a)pyrene, and Dibenzo(a,h)anthracene.
2 Total PCBs Congeners = sum of 41 congeners: 18, 28, 37, 44, 49, 52, 66, 70, 74, 77, 81, 87, 99, 101, 105, 110, 114, 118, 119, 123, 126, 128, 138, 149, 151, 153, 156, 157, 158, 167, 168, 169, 170, 177, 180, 183, 187, 189, 194, 201, and 206.

1.2.2 Remedial Area Footprint

The Site (both North and South Shipyards combined) was characterized in 2002 through a series of 65 sampling stations (surface samples and sediment cores) that were subjected to chemical and biological testing as part of a detailed sediment investigation (Exponent 2003). A limited set of supplemental samples were also obtained in July 2009. As a means of facilitating comparative evaluations of feasibility, environmental protectiveness, and cost, the Site was subdivided into a set of Thiessen polygons (bounded by half the distance between adjacent sampling stations), each represented by a single sampling station at or near its mid-point. The distribution and extents of Thiessen polygons at the Site are depicted on Figure 2.

Based on considerations of chemical and biological exposure and risk detailed in the Water Board's Technical Report (Water Board 2012c), the CAO identified 23 individual sampling stations and their accompanying Thiessen polygon areas for cleanup, with the goal of achieving the desired SWAC values across the Site (Water Board 2012a; see Table 1). Five areas are located within the South Shipyard, and one area is shared by both the North and South Shipyard (Figure 2). Based on available data, the proposed cleanup is intended to meet cleanup levels for primary COCs.

In the CAO (Water Board 2012a), individual cleanup areas were converted from their Thiessen polygon geometry to more realistic design/construction boundaries within the North and South Shipyards. Figure 2 depicts the relevant Thiessen polygons and assumed equivalent remedial extents for the North and South Shipyards. Figure 3 show the CAO-mandated remedial footprint subdivided into sediment management units (SMUs) for the South Shipyard.

The proposed remedial action identified in the CAO requires removing chemically impacted sediments from the remedial footprint to concentrations less than 120 percent of the post-remediation dredge area concentrations (defined in Table A.2.a of the CAO; Water Board 2012a).

1.2.3 Remedial Action Plan and Required Submittals

The RAP was submitted by the North and South Shipyards to the Water Board in October 2012 in compliance with CAO Directive B.1 (Water Board 2012a). The RAP, now approved, describes the process by which cleanup of the Site will be managed, designed, planned, implemented, and monitored in accordance with the CAO and is consistent with the USEPA's National Contingency Plan. The RAP also established the overall basis for design activities, which are described in detail in this BODM, and will be used to inform and control the remedial action to: 1) obtain construction bids; and 2) ensure that that project is implemented in a manner that achieves the directives of the CAO.

Ultimately, a series of deliverables is required for submission to the Water Board and regulatory agencies in accordance with the MMRP (Water Board 2012b). Certain elements of these required submittals are described in this BODM and the Contract Documents.

The information required for these submittals is often provided by the Contractor prior to construction; however, Anchor QEA will formulate draft versions of each submittal for verification by regulatory agencies prior to Contractor selection given the limited time available for the Contractors to prepare these submittals prior to the start of construction in September 2013. After a Contractor(s) has been selected, input will be obtained from the selected Contractor before these submittals are finalized.

A brief overview of submittals required by the MMRP (Water Board 2012b), and how they will be integrated into the design and contracting schedule moving forward, is provided below.

- **Parking Management Plan (MMRP Mitigation Measure 4.1.3).** Per the California Environmental Quality Act Addendum for the S-Lane Parcel (S-Lane), this mitigation measure does not apply to the SMA as it is not currently being used as a parking area. Therefore a Parking Management Plan is not required for the South Shipyard.
- **Weekly Water Quality Reports (MMRP Mitigation Measure 4.2.4).** During dredging and placement of a sand cover, water quality monitoring activities will be conducted and the Contractor or South Shipyard Representative will submit weekly water quality reports to the Water Board.

- **Dredging Management Plan with Standard Operating Procedures (MMRP Mitigation Measure 4.2.9 and 4.3.2).** Elements of this required submittal can be found in Section 352023 – Dredging of the Technical Specifications and in Section 3.3 (Sediment Handling, Transport, and Disposal) of this BODM. Anchor QEA will develop a draft Dredging Management Plan (DMP) which will be reviewed and adopted by the Contractor once selected. Separately the South Shipyard will coordinate with the U.S. Department of the Navy (USN) Naval Facility Southwest (NAVFAC SW) Division for munitions clearance. The Water Board will review and approve the DMP, and the USN must be provided the opportunity to review and comment on the DMP, especially as it relates to the ordnance and munitions found near the Site.
- **Stormwater Pollution Prevention Plan (MMRP Mitigation Measure 4.2.12).** Elements of this required submittal can be found in Section 015713 – Temporary Erosion and Sediment Control and Construction Stormwater Pollution Prevention of the Technical Specifications. As the water will be discharged through the City of San Diego's (City's) sewer system under a significant industrial user (SIU) permit, a National Pollutant Discharge Elimination System (NPDES) General Permit for stormwater discharges is not anticipated. If necessary, Anchor QEA and AMEC will develop permit application documents including a Notice of Intent, risk assessment, site map, and Stormwater Pollution Prevention Plan (SWPPP), while the South Shipyard will pay the annual fee and provide signed certification statements. If necessary, documents will be reviewed and adopted by the Contractor, and submittal of the documents to the Water Board will occur at least 7 days prior to the start of dewatering activities at staging areas. If necessary, receipt of a Waste Discharger Identification (WDID) number is required prior to commencing dewatering activities.
- **Contingency Plan (MMRP Mitigation Measure 4.3.3).** Elements of this required submittal can be found in Section 015719 – Temporary Environmental Controls of the Technical Specifications, as environmental contingency actions will be required of the Contractor. Anchor QEA will develop a draft Contingency Plan for use by the Water Board for verification purposes. The document will be reviewed and adopted by the Contractor.
- **Health and Safety Plan (MMRP Mitigation Measure 4.3.4).** A project Health and Safety Plan (HASP) was prepared and submitted to the Water Board as part of the

RAP. The Contractor will be required to develop a site-specific HASP consistent with the approved RAP.

- **Communication Plan (MMRP Mitigation Measure 4.3.5).** Elements of this required submittal can be found in Section 352023 – Dredging of the Technical Specifications. Anchor QEA will develop a draft Communications Plan for use by the Water Board for verification purposes. The document will be reviewed and adopted by the Contractor.
- **Sediment Management Plan (MMRP Mitigation Measure 4.3.6).** Elements of this required submittal can be found in Sections 352023 – Dredging and 360000 – Sediment Handling and Management of the Technical Specifications as well as in Section 3.3 (Sediment Handling, Transport, and Disposal) of this BODM. Anchor QEA will develop a draft Sediment Management Plan for use by the Water Board for verification purposes. The document will be reviewed and adopted by the Contractor.
- **Hazardous Materials Transportation Plan (MMRP Mitigation Measure 4.3.7).** Elements of this required submittal can be found in Sections 352023 – Dredging, 360000 – Sediment Handling and Management, and 024100 – Demolition and Debris Removal of the Technical Specifications. Anchor QEA will develop a draft Hazardous Materials Transportation Plan for review by the Water Board as well as for verification purposes. The document will be reviewed and adopted by the Contractor.
- **Traffic Control Plan (MMRP Mitigation Measure 4.3.7).** Anchor QEA will develop a Traffic Control Plan for submittal to and approval by the City and/or the City Traffic Engineer and for use by the Water Board for verification purposes. The document will then be reviewed and adopted by the Contractor.
- **Pre-Construction Eelgrass Survey Results and Final Eelgrass Mitigation Plan (MMRP Mitigation Measure 4.5.1).** A South Shipyard Consultant (Merkel & Associates, Inc.) will conduct a pre-construction eelgrass survey within 120 days of the proposed construction start date and will include results in the Final Eelgrass Mitigation Plan, which will be submitted to the Water Board and National Marine Fisheries Service (NMFS) for approval.
- **Post-Construction Eelgrass Survey Results (MMRP Mitigation Measure 4.5.1).** Merkel & Associates will conduct post-construction eelgrass surveys within 30 days of

completion of each dredging event for submittal to NMFS, U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW), the Executive Director of the California Coastal Commission (CCC), and the Water Board.

- **Project Biologist Training Log (MMRP Mitigation Measure 4.5.3).** During construction, the South Shipyard's designated Project Biologist will maintain a training log documenting regular meetings with the Contractor and crews to go over eelgrass bed locations and proper construction techniques. The Training Log will be submitted monthly to the Water Board for verification.
- **Project Biologist Monthly Monitoring Report (MMRP Mitigation Measures 4.5.5 and 4.5.6).** During construction, the South Shipyard's designated Project Biologist will prepare a Monthly Monitoring Report that will be submitted to the Water Board for verification. The Monthly Monitoring Report will contain the following elements:
  - Documentation of periodic confirmation that project-related barges and work vessels are being operated in a manner that eelgrass beds, sea turtles, and marine mammals are not impacted through grounding, propeller damage, excessive speed, or other activities that may disturb the seafloor.
  - Documentation of periodic confirmation that construction crews and work vessel crews are briefed daily on the potential for sea turtles and marine mammals to be present and are provided with identification characteristics of sea turtles, seals, sea lions, and dolphins.
- **Sea Turtle and Marine Mammal Incident Report (MMRP Mitigation Measure 4.5.8).** An Incident Report will be prepared by the South Shipyard's designated Project Biologist for any green sea turtle or marine mammal activity that occurs in the project area during construction. The draft will be submitted to the CDFW and NMFS within 24 hours of the occurrence. Additionally, a vessel operator and South Shipyard safety personnel will immediately notify NMFS and submit a written report within 24 hours if a sea turtle, pinniped, or cetacean is injured or killed due to a collision with a vessel.

1.3 Purpose and Report Organization

This BODM documents key technical elements that were evaluated, including pre-design investigations and engineering analyses, specifically as they relate to the South Shipyard and design of the remedial action to provide a feasible and constructible approach.

Specifically, this BODM summarizes the following aspects of the project:

- Section 2 – Pre-Design Investigations
- Section 3 – Sediment Management
- Section 4 – Dredge Design
- Section 5 –Sand Cover Placement Design
- Section 6 – Construction Sequencing and Anticipated Schedule
- Section 7 – References

This report also includes supporting data and information in a series of appendices, as follows:

- Appendix A – Results of the Site Surveys
- Appendix B – Results of Sediment Coring
- Appendix C – Geotechnical Explorations
- Appendix D – Technical Memorandum: Marine Structures Design Basis – South Shipyard

2 PRE-DESIGN INVESTIGATIONS

A series of pre-design investigations and surveys were conducted to better understand the specifics of the South Shipyard as necessary to prepare the Contract Drawings and Technical Specifications. Specifically, these pre-design activities included:

- Determining vertical extent of sediments that require removal
- Reviewing geotechnical information adjacent to structures
- Evaluating existing state of structures to establish setbacks
- Identifying the presence of debris
- Characterizing dredge material to support disposal options
- Performing bathymetric and topographic surveys

2.1 Site Surveying

Hydrographic and topographic surveys were conducted within the remedial footprint and the upland staging area. Environmental Data Solutions, Inc. (EDS) collected high-resolution, multi-beam bathymetric data; side-scan sonar imagery; and topographic survey data on the landside portion of the Site on April 10 and 11, 2013. These conditions surveys document bathymetric contours, debris on the bay floor, and certain submerged structures and infrastructure elements within the remedial area.

Results of site surveys are included in Appendix A and have also been incorporated into the Contract Drawings. The following subsections provide further detail on each survey and how results were incorporated into the design.

2.1.1 Bathymetric Survey

A multi-beam bathymetric survey was performed to delineate surface mudline elevations over the entirety of the remedial footprint. Areas up to 50 feet outside the remedial footprint were also surveyed to ensure dredging offsets and side slopes were captured. A maximum 50-foot transect spacing was maintained. Transects ran in the nearest safe vicinity of all piers, wharves, floating vessels, dry docks, and overwater structures to obtain bathymetric data to the fullest extent possible beneath these obstructions. In open-water areas

inaccessible to multi-beam survey equipment, supplementary leadlines were used to obtain bathymetric data.

Results of the bathymetric survey were used to generate contours of elevation (relative to mean lower low water [MLLW] vertical datum), which appear on the Contract Drawings. Contours are essential for depicting submerged terrain and elevations in both plan view form and in profiles (both used on the Contract Drawings) for development of the dredge design (see Section 4) and for the estimation of dredging volumes that are expected to result from the work.

2.1.2 Topographic Survey

Along the length of shoreline (between the edge of the seawall or the top of the slope to the shoreward extents of the bathymetric survey), topographic information was collected and spot elevations were obtained on a maximum 25-foot grid with more detail collected where needed to accurately delineate the shoreline revetment, shoreline features, existing facilities and structures, utilities, and other noteworthy site features located within and adjacent to the remedial footprint. Shoreline walls, bulkheads, and the top of bank along the entirety of shoreline were also surveyed, which ensured complete data coverage between the hydrographic survey and the land and allowed for full documentation of offshore and nearshore elevations on the Contract Documents and in the design.

At the SMA (commonly referred to as the S-Lane, the existence and location of key basemap features (e.g., structures, storm drains, curbs, manholes, electric boxes, visible utility lines, and fence lines) were verified to ensure these features are identified and accessible. Features not noted on the basemap initially provided by the South Shipyard were also located and identified for inclusion into the project basemap.

2.1.3 Side-Scan Sonar Survey

A side-scan sonar survey was performed over the entirety of the remedial footprint (to the full extent that areas were accessible) to identify objects (of approximately 1 cubic foot or larger) located on the bay floor, to locate and quantify debris that may be encountered during dredging operations, and to identify key submerged features located within or

adjacent to the remedial footprint (e.g., structures, piles, and/or rock). Key submerged features have been specifically identified for removal on the Contract Drawings.

2.2 Sediment Sampling

A sediment investigation was conducted to verify the vertical extent of sediments that require removal within each dredge area and support pre-approval for acceptance at a local disposal facility (such as the Otay Landfill in San Diego County).

A coring plan was developed for the South Shipyard, and 15 sediment cores were collected to obtain the following critical information:

- Thickness of soft, recently accumulated sediments over denser, native materials (generally termed "Bay Point Formation," the dominant geological layer underlying the Site)
- Concentrations of the five COCs at different depths, and in particular whether a "clean" horizon exists below which CAO levels are not exceeded, before the Bay Point Formation is encountered
- Chemical analyses of targeted sediment to support approval for off-site disposal

Between April 9 and 12, 2013, a total of 120 individual sediment samples were collected from 15 sampling locations distributed throughout the planned dredging area at the South Shipyard. At each location, vibracore samples ranging between 3.8 and 10 feet in length were collected and sub-sampled into 1-foot intervals. Each sediment core was advanced until refusal (typically at the soft sediment/native Bay Point Formation interface). Sediment coring and sample collection were completed in accordance with the RAP and its accompanying Sampling and Analysis Plan and Quality Assurance Project Plan (QAPP; Anchor QEA 2012). Figure 4 depicts the sampling locations, and Appendix B presents a summary of the sediment coring results.

All samples were archived (frozen at -18 degrees Celsius) at the analytical laboratory. Samples will be submitted for chemical analyses to support approval for disposal at a designated off-site disposal facility (e.g., the Otay Landfill in Chula Vista). These results will be incorporated in to the Final BODM.

Table 2 summarizes the penetration depth and apparent depth to native Bay Point Formation materials encountered in each core. This information was used to develop the sediment dredge design, as discussed in Section 4.

2.3 Geotechnical Data Review and Explorations

Pre-design activities at the South Shipyard included compilation and review of existing geotechnical information. Existing information included a collection of geotechnical and structural engineering reports with geotechnical boring logs, cone penetrometer logs, test pits, and laboratory data. A summary of existing explorations is provided on Figure 5.

After a review of existing geotechnical data, it was determined that additional explorations were necessary in certain locations to better understand the near-surface characteristics of the dredged material and the engineering properties of the underlying soils. The information collected was intended to supplement geotechnical data collected by others and confirm design assumptions for the dredge design. A total of three offshore borings were performed to a maximum depth of 36.5 feet below ground surface between the dates of May 6 and 8, 2013.

Offshore borings were advanced by Gregg Drilling & Testing. All explorations were advanced from the 80-foot long Research Vessel *Quin Delta*. Samples were obtained from the borings using both a 2-inch-outer-diameter Standard Penetration Test sampler and a 3-inch-outer-diameter "California Sampler." The samplers were advanced per ASTM D1586-11 by driving the sampler using a 140-pound hammer falling 30 inches. Soil samples obtained in the field were sealed, labeled, and transported to EG Laboratory for laboratory testing. All drilling and sampling operations were observed by a representative of Anchor QEA who logged soils encountered during drilling operations. As samples were received, the Anchor QEA representative classified the samples and selected specific samples for laboratory testing. A key to the exploration logs and a log for each exploration is presented in Appendix C. Laboratory test results are also presented in Appendix C.

Table 2
Sediment Coring Depths

Station	Date	Time	Water Depth (feet)	Tide (feet)	Mean Lower Low Water (feet)	Collection Coordinates Latitude WGS84 (dd°mm.mmm')	Collection Coordinates Longitude WGS84 (ddd°mm.mmm')	Attempt Number	Penetration Length (feet)	Penetration Mean Lower Low Water (feet)	Sediment Core Length (feet)	Refusal Type
SD-S-P-NASC01	4/11/2013	1335	25.0	3.1	21.9	32°41.3925	117°08.5745	1	10.0	31.9	8.2	Bay Point/Native
	4/11/2013	1407	24.8	2.6	22.2	32°41.3920	117°08.5740	2	10.0	32.2	8	Bay Point/Native
SD-S-P-NASC02	4/12/2013	0957	24.7	3.4	21.3	32°41.3809	117°08.5530	1	13.7	35.0	8.9	Bay Point/Native
	4/12/2013	1021	27.2	3.7	23.5	32°41.3811	117°08.5535	2	13.0	36.5	8.3	Bay Point/Native
SD-S-P-NASC03	4/12/2013	0751	16.8	1.0	15.8	32°41.3965	117°08.5485	1	15.0	30.8	10	Bay Point/Native
SD-S-P-NASC04	4/11/2013	0930	25.0	3.9	21.1	32°41.4133	117°08.3750	1	12.0	33.1	10	Clean Native
SD-S-P-NASC05	4/11/2013	0755	42.0	1.9	40.1	32°41.3960	117°08.3430	1	7.3	47.4	5.6	Bay Point/Native
SD-S-P-NASC06	4/11/2013	1134	20.3	4.6	15.7	32°41.3965	117°08.3226	1	0.0	15.7	0.0	Refusal at Surface
	4/11/2013	1138	21.0	4.5	16.5	32°41.3932	117°08.3237	2	3.0	19.5	1.7	Large Gravel/Rip Rap
	4/11/2013	1200	21.0	4.4	16.6	32°41.3888	117°08.3252	3	3.8	20.4	3.8	Clean Native
SD-S-P-NASC07	4/10/2013	1430	24.5	1.5	23.0	32°41.3216	117°08.3330	1	8.5	31.5	8.2	Clean Native
SD-S-P-NASC08	4/10/2013	0830	23.7	3.7	20.0	32°41.3186	117°08.3035	1	12.0	32.0	9.8	Clean Native
SD-S-P-NASC09	4/10/2013	1245	26.7	3.4	23.3	32°41.3025	117°08.3071	1	6.6	29.9	6.6	Not confirmed
	4/10/2013	1315	25.1	2.9	22.2	32°41.3021	117°08.3062	2	7.5	29.7	6.7	Hard/Dense Sand Plug
SD-S-P-NASC10	4/10/2013	0800	23.5	3.1	20.4	32°41.3093	117°08.2916	1	5.5	25.9	2.3	Sand and Gravel
	4/10/2013	1010	25.5	4.9	20.6	32°41.3085	117°08.2925	2	10.0	30.6	7.4	Not Confirmed
	4/10/2013	1045	25.5	4.9	20.6	32°41.3116	117°08.2924	3	8.5	29.1	4.5	Sand and Gravel
SD-S-P-NASC11	4/9/2013	1525	21.9	0.3	21.6	32°41.2963	117°08.2823	1	11.3	32.9	9.0	Clean Native (Gravel in Clay)
SD-S-P-NASC11B	4/12/2013	1300	26.8	3.9	22.9	32°41.2993	117°08.2898	1	9.7	32.6	7.8	Bay Point/Native
SD-S-P-NASC12	4/9/2013	1300	26.4	2.4	24.0	32°41.2756	117°08.2919	1	9.5	33.5	8.0	Refusal not met, no log
	4/9/2013	1410	25.6	1.0	24.6	32°41.2786	117°08.2950	2	8.5	33.1	7.8	Clean Native
SD-S-P-NASC13	4/9/2013	1055	30.4	4.9	25.5	32°41.2610	117°08.3397	1	8.5	34.0	7.0	Clean Native
SD-S-P-NASC14	4/9/2013	0815	29.4	4.5	24.9	32°41.2403	117°08.8538	1	6.5	31.4	4.2	Clean Native
SD-S-P-NASC15	4/9/2013	0915	32.0	5.1	26.9	32°41.2545	117°08.3650	1	6.5	33.4	2.6	Not Confirmed
	4/9/2013	0940	32.0	5.2	26.8	32°41.2548	117°08.3652	2	6.0	32.8	6.0	Clean Native

3 SEDIMENT MANAGEMENT

3.1 Description of Sediment Management Area

An upland SMA will be made available to the Contractor for dredged material and debris offloading, dewatering, and sediment management; haul truck loading; water management; and related staging activities.

The S-Lane has been identified as the available SMA. The S-Lane is owned by the U.S. Navy, and the South Trust is currently in the process of obtaining a lease agreement with the U.S. Navy to cover use of the property during construction operations.

Access to the SMA prior to September 15, 2013, will allow the Contractor to mobilize and fully prepare the SMA before commencing dredging. Similarly, access to the SMA after the close of the in-water construction window will allow the Contractor to have additional time for final dewatering, offhauling, and general SMA cleanup, provided that those activities can be accomplished without in-water work taking place. If such timing arrangements are agreed to in the final lease agreement, then these schedule allowances will be incorporated into the Contract Documents.

The SMA, depicted on Figure 6, measures approximately 620 feet by 115 feet (approximately 1.6 acres) and is located on the north side of Chollas Creek. The area will be free of any structures prior to the Contractor commencing construction. The Contractor will be responsible for installing and maintaining a suitable barrier around the perimeter of the SMA to avoid interference with ongoing shipyard activities.

The Contractor will access the SMA from the landside via East Harbor Drive and from water along the adjacent seawall. Trucks hauling sediment from the Site will follow a designated haul route from East Harbor Drive to Interstate 5. Temporary access from the S-Lane to the seawall has also been requested as part of the lease agreement with the U.S. Navy and the South Trust. This temporary access area, measuring approximately 34 feet by 500 feet, will be available to the Contractor for offloading activities (Figure 6). Current water depths within Chollas Creek adjacent to the 500-foot temporary access area at the S-Lane are

between -12 and -20 feet MLLW. Greater depths would be realized in this area if and when the USN performs planned dredging of the Chollas River mouth area.

Following completion of remedial activities, the Contractor will return the S-Lane and temporary access area to pre-construction conditions. Any sampling or restoration actions necessary per the South Trust's lease agreement for use of the SMA, are described in the Contract Documents.

3.2 Preparation of Sediment Management Area

The Contract Documents present the boundaries and characteristics of the SMA as well as limitations on its use (such as the required offsets and restrictions for construction equipment, as described in Section 3.3.1). The Contractor will ultimately be responsible for selecting how it plans to lay out and use the allowed area.

As part of SMA preparation activities, the Contractor is required to install a spill apron at the offloading point to minimize the amount of material that spills or falls into the water during offloading. The containment area will also be designed to restrict decanted water/stormwater to the land adjacent to the dewatering area and prevent water from flowing into San Diego Bay. These requirements, included in Section 360000 – Sediment Handling and Management of the Technical Specifications, are consistent with MMRP Mitigation Measures 4.2.5 and 4.2.10.

3.3 Sediment Dredging Considerations

Prior to performing any dredging operations, the Contractor will be required to submit a DMP in accordance with MMRP Mitigation Measure 4.2.9 that will contain the Contractor's Standard Operating Procedures (SOP) for preventing accidental oil/fuel spills and guidelines to follow in the event of an oil or fuel spill. As previously stated, this document will be drafted by Anchor QEA and modified by the Contractor as necessary following Contractor selection.

The DMP will also address identification of dredging needs, a methodology and process for determining dredging priorities and scheduling, alternatives for control and operation of

dredging equipment, and BMPs to implement in the event of equipment failure and/or repair. Because water discharges to San Diego Bay are prohibited, the Contractor shall implement measures to capture all water generated during construction and stormwater within the SMA boundaries to prevent discharge to San Diego Bay (see Section 3.4).

The Contractor shall prepare a Contingency Plan in accordance with MMRP Mitigation Measure 4.3.3 to address equipment and operational failures that could occur during dredging operations. The Contingency Plan will be drafted by Anchor QEA and modified by the Contractor as necessary following Contractor selection. The Contingency Plan will address the potential to encounter munitions or ordnances; measures to prevent release of hazardous materials during construction activities; actions to implement in the event of equipment failure, repair, or silt curtain breach; and incident reporting and review procedure to evaluate the causes of an accidental silt curtain breach and steps to avoid further breaches.

During dredging, water quality will be monitored by Shipyard Representatives, using a continuously automated monitoring system (consistent with MMRP Mitigation Measure 4.2.1), supplemented by manual measurements at selected times. The Contractor shall also conduct its own independent monitoring of water quality to confirm that water quality protection measures (i.e., BMPs) are performing effectively. The Technical Specifications for this contract require the Contractor to use key BMPs during its dredging operations (including surrounding the dredging equipment with a double silt curtain enclosure) to meet the requirements of MMRP Mitigation Measures 4.2.2, 4.2.3, and 4.2.6.

Dredging operations may be conducted up to 24 hours per day, 7 days per week. Consideration has been given to anticipated Contractor downtime due to regular equipment maintenance, movement and position of equipment to conduct dredging operations, movement of equipment to accommodate shipyard vessel traffic, and shift change for both the Contractor and South Shipyard personnel. Further discussion of the anticipated schedule is detailed in Section 6 of this BODM.

A QAPP was prepared as part of the RAP (Anchor QEA 2012a) to comply with regulatory requirements.

3.3.1 Sediment Handling

Sediment is anticipated to be transported from the dredge to the offloading area by sealed wide pocket haul barges. Ponded water on haul barges must be collected and stored in holding tanks (e.g., Baker tanks) near dredging operations for initial settling and avoidance of barge overflow or pumped directly to the water management facilities (to be placed either at the SMA or on a floating barge to maximize space at the SMA). BMPs will be employed to minimize the volume of water entrained during dredging operations (for further discussion of water management and treatment see Section 3.4).

Transport of haul barges from the location of dredging to the SMA will be coordinated with other vessels and marine activities in the shipyard and adjoining locations. Commercial activities taking place at the shipyard will have precedence over the Contractor's activities. Maintenance dredging is planned but not currently scheduled along the waterfront of S-Lane. Additional coordination of vessel traffic with the U.S. Navy will be necessary if maintenance dredging is in progress.

At the offloading area, haul barges will be staged along the seawall within the 500-foot temporary access zone. To maintain structural stability of the seawall along S-Lane, the Contractor shall remain at least 15 feet from the seawall with all heavy equipment. The Contractor shall verify stability of the seawall based on planned equipment use at the SMA.

Sediment will then be offloaded from the haul barges using a rehandling bucket, conveyor, or similar system and placed in the designated dewatering area. Alternatively, if additional passive dewatering is not necessary, or if water absorbent additives or cement are combined with the sediment in the barge, then the sediment could be placed directly into lined trucks for transport to the off-site disposal facility, provided that it passes the Paint Filter Liquid Test (conducted by a Shipyard Representative) before leaving the Site.

Spillage or discharge of dredged material into San Diego Bay will not be allowed during transfer of the sediment from the haul barge. A steel plate, or similar assembly, with secondary containment will be placed between the barge and shore to collect drippings or spillage and direct it back into the barge or upland collection point.

Sediment stockpiling activities shall be conducted by the Contractor fully within the limits of the SMA. The dewatering and stockpiling area shall be enclosed by a suitable barrier (e.g., "Ecology" blocks, K-rails, or similar method) that contains all free water within the dewatering and stockpiling area and prevents water from flowing into San Diego Bay or into the underlying ground. If a low permeability liner (e.g., geomembrane) is placed below the dewatering area, the Contractor shall provide an overlying layer of sand or gravel to provide a visual indicator of the location of the liner to prevent a breach in the dewatering pad. Passive dewatering is anticipated to be implemented by air-drying action supplemented by regular reworking of sediments and may be accelerated with the use of water absorbent additives or cement. The Contractor may choose to implement a more active dewatering process involving filter presses or other equipment.

During dewatering operations and in accordance with MMRP Mitigation Measure 4.2.12, the Contractor will comply with provisions of the NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (Order No. 2009-0009-DWQ, NPDES No. CAS000002) as necessary, and any subsequent permit, as it relates to activities conducted in the SMA. The Contractor will be required, if necessary, to submit permit registration documents, including a Notice of Intent, risk assessment, site map, SWPPP, annual fee, and signed certification statement to the State Water Resources Control Board via the Storm Water Multi-Application and Report Tracking System (SMARTS). As the water will be discharged through the City's sewer system under a SIU permit, a NPDES General Permit for stormwater discharges is not anticipated.

Additionally in accordance with MMRP Mitigation Measure 4.3.6, the Contractor will be required to implement BMPs and follow SOPs during sediment offloading, transport, drying/dewatering, and disposal operations for the duration of dredging.

3.3.2 Transport and Disposal

Dredged material and debris will be transported by truck for disposal to an upland Subtitle D disposal facility. If hazardous waste is encountered or generated as part of planned remedial activities, then the Contractor will be responsible for special handling, transport, and disposal considerations. In accordance with MMRP Mitigation Measure 4.3.7, the

Contractor will implement a Hazardous Materials Transportation Plan in coordination (if necessary) with the South Shipyard for the duration of the dredging operations that specifies procedures for sediment containment and emergency notifications. The Hazardous Materials Transportation Plan will be drafted by Anchor QEA and modified by the Contractor as necessary following Contractor selection.

Prior to sediment being hauled off site, a South Shipyard Representative will demonstrate the dredged material passes the Paint Filter Liquid Test in order to meet acceptance requirements for highway transport and the receiving disposal facility. Trucks will be loaded within the SMA boundary and will follow the designated truck haul routes depicted on Sheet G-1 of the Contract Drawings, consistent with MMRP Mitigation Measure 4.1.1. While on site, haul trucks will be operated in accordance with site requirements and will follow all of City ordinances and MMRP Mitigation Measures 4.4, 4.5, and 4.6, which pertain to idling, noise, and air emissions at all times.

Otay Landfill in Chula Vista, California, has been identified as a potential disposal location for dredged material and debris removed from the South Shipyard. Waste characterization samples have been collected and archived for use in obtaining pre-approval of the waste from the Site. It is expected that these samples will undergo analysis, and disposal approval obtained, prior to the commencement of construction.

To minimize sediment stockpile sizes at the SMA, transportation of dewatered sediments to the designated disposal facility must occur at a similar rate as dredging. The dredging production rate is anticipated to be approximately 1,200 cubic yards (cy) per day, assuming 24 hour per day dredging operations. Daily disposal capacity provided by Otay Landfill[1] is currently 2,000 tons (approximately 1,300 cy) per day for the combined Site (i.e., both North and South Shipyards) with the ability to increase this disposal capacity with prior notification. The Contractor must work with both the disposal facility and the selected Contractor for the North Shipyard remediation on transportation and disposal schedules. Sediment not loaded directly into trucks will be placed in stockpiles at the SMA.

[1] Otay Landfill is able to accept 2,000 tons of material per day, except on Thursdays when its can accept only 1,000 tons. The disposal facility is open from Monday through Friday (7 am to 4 pm) and Saturday (7 am to 2 pm) though other accommodations are available.

3.4 Water Management and Treatment

A water management system will be designed and operated by the Contractor to meet project requirements. The water management system will be of sufficient size to accommodate water generated during the Contractor's dredging operations as well as surface water runoff collected within the SMA. The system must be designed to meet the SIU permit requirements for both flow rate and chemistry (see MMRP Mitigation Measure 4.2.13). A Shipyard Representative will perform compliance water testing and will notify the Contractor when water meets the limits of the SIU permit. Anticipated constituents and limits are provided in Table 3, pending receipt of the City permit; these limits will be revised, as necessary, upon receipt of the final permit.

Table 3
Anticipated City of San Diego Wastewater Discharge Limits

Constituent	Limit
Arsenic	< 5 mg/L
Copper	< 11 mg/L
Lead	< 5 mg/L
Mercury	< 5 mg/L
Zinc	< 24 mg/L
TPH	< 500 mg/L
PCBs	<3 µg/L

Notes:
µg/L = micrograms per liter
mg/L = milligrams per liter
TPH = total petroleum hydrocarbon

Additionally, chemical oxygen demand and total suspended solids will be measured to assess discharge costs to the City.

Given the continuous collection and removal of water from dredged material barges, treatment of water through an Active Treatment System (ATS) is anticipated to keep up with dredging production rates. The ATS will use flocculants/coagulants to increase the efficiency of the water solids settling process. A conceptual water treatment configuration is provided on Figure 7. It will be operated continuously throughout the project to collect, treat, and

discharge water collected during dredging- and project-generated water. The ATS will be positioned either at the SMA or on a floating barge within San Diego Bay near dredging operations to minimize the distance for transporting water collected during dredging and to maximize the space at the SMA.

Treated water will be discharged to an approved sewer utility location at the Site following testing to verify that the water is in compliance with requirements of the project permits. Wastewater discharge to the City's sewer system will occur at manhole 138 (H24S138) within the SMA boundary. Discharge to the manhole will be limited to dry weather conditions. No discharge will be permitted during a rain event of 0.1 inch or greater, and all wastewater must be held until 24 hours after the last rain (City pers. comm. 2013).

Stormwater must also be appropriately managed throughout the SMA, per BMPs specified in the Contract Documents and project permits. All stormwater will be collected and routed through the ATS or a secondary water management system provided the ATS is located on a floating barge. Sediment and debris stockpiles will be covered as necessary to prevent runoff of impacted stormwater out of the SMA or into San Diego Bay waters.

4 DREDGE DESIGN

The development of the dredge plan accounted for technical feasibility and site restrictions that may affect the construction process and methods of meeting all cleanup objectives. Important design considerations include sediment properties, physical constraints, equipment selection, and dredging performance criteria. Sediments are anticipated to be dredged via mechanical means, dewatered, transported overland, and disposed of at one or more off-site solid waste disposal facilities.

To create an orderly and systematic dredge plan for a dredging Contractor's use, the remedial footprint was divided into separate units of dredging, termed SMUs. The SMU boundaries and cut elevations were established after considering a variety of physical and chemical properties of the sediment and the layout the remedial footprint.

4.1 Cut Depth

The cut depth for each SMU was based on a combination of existing site sediment data (both physical and chemical properties), bathymetry, structural protection limitations and the constraints of the anticipated dredging equipment (see Appendix D). Many SMUs were further divided during design into sub-SMUs to account for the variable bathymetry present throughout an SMU. Cut depths for each SMU or sub-SMU were developed by examining the existing sediment data locations present within the boundaries of the unit, and the apparent depth to native materials (Bay Point Formation) as evidenced by sample core refusal. Cut depths were then translated into cut elevations based on the elevation at which native materials were reached, as determined from the core log data.

Where significant bathymetric variation was present within the boundaries of a single SMU, the SMU was divided into sub-SMUs; each with the same cut depth that was translated to differing cut elevations based on the average surface elevation within the sub-SMU.

4.2 Slope Stability Analysis

In addition to the available geotechnical site data, three additional geotechnical borings were advanced by Gregg Drilling & Testing (Figure 4; see Section 2.3) to supplement understanding of the engineering properties of the subsurface sediments. In general, the soil

types encountered during pre-design investigation were similar to the soil units observed by others from previous site investigations. The following soil types are present at the South Shipyard from the mudline or ground surface down.

- **Fill.** Fill is present in the upland areas behind the bulkheads and structures. The fill material was typically described as loose to dense silty sand and sandy gravel with a variable amount of debris.
- **Bay Deposits.** Sediments covering the previously dredged surface are described by others as the Bay Deposits, or the Holocene Bay Deposits. Surface soils encountered by others described this soil unit as very soft dark gray to black clayey silt to silty clay with increasing sand content with depth approximately 8 to 15 feet thick (Woodward-Clyde 1983). Explorations during pre-design activities encountered similar conditions but the thickness of very soft sediment ranged from 2 to 7 feet thick. For the purposes of dredging slope evaluations, where this material is described as loose and sandy, an effective friction angle of 30 degrees was used to describe the relationship between effective stress and shear strength.
- **Bay Point Formation (Younger Terrace Deposits).** Underlying the Bay Deposits is the Bay Point Formation, which is sometimes referred to as the Younger Terrace Deposits. This unit is variously described as medium dense to dense sand with interbedded deposits of sand, silt, and clay. An effective friction angle of 35 degrees is reasonable to describe the relationship between effective stress and shear strength.
- **Older Terrace Deposits.** Underlying the Bay Point Formation, the Older Terrace Deposits were variously described as dense to very dense clayey to gravelly sand with zones of cemented sand and shells. An effective friction angle of 40 degrees is reasonable to describe the relationship between effective stress and shear strength.

The results of pre-design geotechnical investigations are summarized in Appendix C.

4.2.1 Dredge Prism Side Slopes

The geotechnical assessment of the dredge design includes slope stability evaluations for a variety of soil conditions and dredged slopes. Side slopes with inclinations ranging from 1 horizontal to 1 vertical (1H:1V), to 3H:1V were both assessed.

Representative soil conditions and parameters were applied, consistent with the design recommendations by others. Each evaluation of slope stability assumed an infinitely long homogeneous submerged slope. Separate slope stability evaluations were performed assuming that the dredged slope consisted of either a thick layer of loose Bay Deposits or alternatively the dense Bay Point Formation.

Immediately after dredging, or shortly thereafter, it is expected that sediment will undergo sloughing to achieve its final (long-term) angle of repose (final inclination). The Contractor will be required to dredge to a specified slope inclination rather than relying on this sloughing affect to occur, because it is possible that in some areas the sediment may not undergo sloughing immediately.

The long-term scenario, wherein sediments assume a stable inclination and state of equilibrium, is represented by the loading conditions following completion of dredging and residuals management activities and after a sufficient enough time has occurred to reconsolidate the disturbed undredged material on the dredged surface. Soils are assumed to fail under drained conditions and therefore drained strength parameters are assigned to the soil layers modeled. Table 4 summarizes the input values for the dredge slope evaluations.

Table 4
Input Parameters for Dredged Slope Evaluations

Soil Type	Unit Weight	Effective Friction Angle (degrees)
Fill	120	33
Bay Deposits	125	30
Bay Point Formation	130	35
Older Terrace Deposits	130	40

4.2.2 Recommended Slopes for Dredge Design

The lowest estimated factor of safety determined from stability evaluations was compared to performance standards. Table 5 presents the estimated factor of safety for a range of dredge

cuts for a range of soil conditions. Performance standards are based on the U.S. Army Corps of Engineers Slope Stability Guide (2003). For general analysis of permanent slopes involving cuts and fills not adjacent to structures, a minimum factor of safety of 1.3 is appropriate. In the nearshore area where critical structures are present and Bay Deposits are thicker, a dredge prism side slope no steeper than 3H:1V is used. In deeper water (particularly where the existing grade is steeper than 3H:1V) where surface soils are denser Bay Point Formation or Older Terrace Deposits, a dredge cut of 2H:1V was used.

Table 5
Factor of Safety Matrix for Slope Stability Results

Soil Type	Dredge Slope (H:V)	Long-Term Factor of Safety
Bay Deposits	1H:1V	0.6
	2H:1V	1.2
	3H:1V	1.7
Bay Point Formation	1H:1V	0.7
	2H:1V	1.4
	3H:1V	2.1
Older Terrace Deposits	1H:1V	0.8
	2H:1V	1.7
	3H:1V	2.5

4.3 Horizontal Extents of Sediment Management Units

The horizontal boundaries of SMUs shown on the Contract Drawings were developed based on the remedial footprint for the combined Site (i.e., North and South Shipyard), site physical boundaries such as the shoreline and existing structures, site bathymetry, and the vertical delineation of existing site sediment data. In particular, the results of sediment coring described in Section 2.2 and the observed depth to refusal in apparent native soils, informed the selection of dredging depths. Physical site boundaries such as shorelines, bulkheads, and existing structures were analyzed for structural stability of support piles and slope stability by examining the geotechnical properties of adjacent sediments.

Structural and slope stability analysis conducted by Anchor QEA and Triton Engineers yielded specific offsets and pile exposure limits as detailed below. The specific offsets were

then incorporated into the dredge plan so that the daylight limits of dredging operations would not encroach closer than the designated offset distances.

4.3.1 Structural Stability Analysis

Dredging near any shoreline structure, pile-supported marine structure, or armored shoreline slope has the potential to create an unstable condition due to the removal of soil that may contribute passive earth pressures. Under lateral loading conditions, caused by equipment operations, vessel docking, or seismic events, the soil adjacent to the pile provides passive resistance against the tendency of the structure to deform in a horizontal direction. Precautionary measures have been integrated into the design to retain the stability of the structures during dredging in their vicinity. The design involved analyzing the stability of the structures and slopes and determining specific offsets or pile exposure limits that should be maintained during dredging operations. To properly evaluate the structures and slopes, a variety of analytical models and programs were used to determine factors of safety and acceptable removal limits. Triton Engineers' technical details of the analytical evaluations are provided in Appendix D.

Five specific areas of concern were analyzed in the South Shipyard for stability and were assigned specific offsets to be incorporated into dredging design. The analysis and resultant offsets or pile exposure limits are summarized below.

4.3.1.1 Shoreline Sloped Revetment

In the various dredging areas adjacent to the shoreline of the South Shipyard where a sloped revetment with erosion protection armoring is present, slope stability evaluations were performed to determine an effective dredging offset from the toe of the rip-rap slopes which would not reduce the global stability of the slopes. A dredged slope of 3H:1V is typically flatter than the existing grade or is an appreciable distance away from shoreline structures such that the toe of the bank is not undermined. The dredge prism has been developed for the neatline slopes daylight a minimum of 10 feet from the edge of the sloped revetment so as to avoid removing rock riprap armoring, which provides erosive and slope stability benefits. Due to irregularities in the existing bathymetry in these areas, some slopes daylight at locations greater than 10 feet away from the edge of the revetment.

4.3.1.2 Required Offsets for Bulkheads and Piers

Where information regarding the embedment depths and design mudline elevation for a structural element (a bulkhead or pier) are unknown, appropriate offsets were developed using the passive wedge offset method. This method uses analytical programs that incorporated information regarding the configuration of the structural element and also the physical properties of the sediment. Rankine Theory was then used to estimate the width of soil adjacent to the structural element, which contributed to the passive pressure supporting the sheetpile wall.

The required horizontal offset was determined as the point at which the passive pressure envelope intersects the top of competent soils (excluding the surficial layer of soft sediments, which do not contribute an appreciable amount of structural resistance). A required offset from the structural element face to the top of the dredge cut slope is 20 feet, which is based on the determined passive wedge offset and a mudline elevation of -17 feet MLLW. Where the existing grade is steeper than 3H:1V, dredge cuts will match the existing grade.

4.3.1.3 Drydock Access Pier

Structural engineering analytical models were used to evaluate the Drydock Access Pier structure at the South Shipyard (see Appendix D for details). From the results of those evaluations, it was determined that up to 6 feet of sediment could be acceptably removed at the locations of certain nearshore piles. At all other locations of the Drydock Access Pier, it was determined that dredging should be offset from the piles so that it does not result in any increase in the amount of pile exposed above the current mudline. In these locations the slopes from the adjacent dredging cuts have been designed to daylight at, or away from, the edge of the structure.

4.3.1.4 Ways Extensions

Alternative evaluation methods were undertaken to determine acceptable dredging offsets from these structures. ALLPILE—a computer program that supports the evaluation of bending moments and pile deformations—was used to determine the depth of fixity for a given lateral loading event. Rankine Theory was used to estimate the wedge of soil, also known as the passive wedge, which provides support resistance to lateral loading. The

passive wedge envelope was integrated with knowledge of the overlying soft sediment presence determined during field sampling work. This information was used to establish an acceptable offset of 10 feet from the edge of structure for removal of material. Accordingly, the neatline dredge prism was designed so that the slopes from the adjacent dredge cuts daylight a minimum of 10 feet from the edge of the structures in all directions. See Figure 8 for a conceptual diagram of the required horizontal offset as determined by passive wedge calculations.

4.3.1.5 Cyclopean Wall

Little information is available for evaluation regarding the original design or construction conditions of the Cyclopean Wall structure at Berth 1. An assessment of sediment thicknesses in front of the wall indicated significant sediment accumulation in this area, which is likely to provide little or no structural support to the wall. Only a portion of this accumulated material (no more than six feet at the face of the wall) will be removed to protect the integrity of the wall and maintain a safe distance between the dredge bucket, and the wall face. Additional details regarding the evaluation of the wall are presented in Appendix D.

4.4 Constructability

The main challenges associated with dredging constructability involve limitations of the anticipated dredging equipment and dredging areas of existing slopes steeper than 3H:1V. Considering the anticipated mechanical dredging equipment that will be used to perform the dredging, the size of the dredging bucket, and the water depths in the remedial footprint, certain limitations were imposed on the dredge design to provide a feasibly achievable dredging template. The minimum dredge cut was determined to be 3 feet, and all cut elevations were rounded to the nearest foot to account for the expected precision of the dredging equipment. Additionally, SMU widths were defined within that range or wider, because typical dredging area widths are between 50 and 80 feet. SMUs with existing side slopes steeper than 3H:1V were assigned a required target inclination for the Contractor rather a single specific cut elevation or multiple adjacent cut elevations in a stair-stepping manner, both of which would be less practical ways of achieving the desired geometry. Slopes were either defined to match closely to existing bathymetry (though no steeper than

2H:1V) or by elevations at the top and bottom of slope with variable slopes over the area as necessary address the existing slope surface. Additionally, irregular boundary limits were avoided to the extent practical to allow for a more constructible final surface.

Figure 9 presents the SMUs at the South Shipyard. The result dredge design equates to an estimated design depth volume of approximately 52,600 cy sediments removed.

4.5 Equipment

Dredging operations will be conducted via barge-mounted, mechanical dredging equipment with a cable-arm bucket though digging buckets may be needed when cable-arm buckets are not capable of dredging hard materials or areas with debris. The capacity of the type of bucket that will be used for dredging operations will be determined based on the selected Contractor's equipment inventory and has been preliminarily estimated to be 10 to 12 cy for the purposes of the design. The wide pocket material barges or nearby support barge will be equipped with water storage tanks for the purposes of collecting and holding free water from the material barges that has been captured during dredging operations. A pump and hose system will be used to transfer water from the material barges to the dredge barge water storage tanks. The dredge will be equipped with Real-Time Kinematic (RTK) DGPS software (e.g., Clam Vision) for the operator of the dredge to monitor the position and elevation of the dredge bucket in real time.

The exact dimensions and capacities of the material barges to be used to transport dredged material from the dredging area to the SMA will be determined based on the available equipment fleet of the selected Contractor. The dimensions and transport volume of the material barges will be restricted by the Contractor's ability to access the sediment offloading area near the SMA. Barges larger than those that would be able to access the SMA fully loaded may be used at the Site assuming they are lightly loaded. Production and cost analyses for this design have assumed that 2,000 cy capacity barges will be used. Depending on the exact dimensions of the barges used by the Contractor for sediment transport and other offloading variables, between three and five barges are likely to be on site during dredging operations.

Tugboats will be used to transport loaded material barges from the dredging area to the offloading site and back to the dredging area once they are emptied. Two tugboats are anticipated to be active on site throughout dredging and sediment offloading operations. All tugboats will be equipped with GPS navigational equipment and radio communication equipment for tugboat positions to be monitored and for the tugboat operator to communicate with the dredge operator and shoreline personnel at all times.

Material barges will be offloaded from a designated offloading area at the SMA. Material barges will be offloaded mechanically, using either a crane or hydraulic excavator positioned within the SMA. During offloading activities, the Contractor will be required to place a spill plate between the material barge and shoreline to prevent spillage from falling directly into the water (see Section 3.1), in accordance with MMRP Mitigation Measure 4.2.5.

Works skiffs and survey vessels will be present at the Site throughout construction to support work and reporting activities. Survey requirements for daily reporting will be as specified in the Technical Specifications Section 017123 – Surveying and all surveys for payment purposes will be conducted by a pre-approved, third-party surveyor hired by the Contractor.

4.6 Residuals Management

Following completion of dredging operations within a given area (SMU, sub-SMU, or a combination) confirmational sampling and analysis will be conducted.

This confirmational sediment sampling will be performed as detailed in Appendix B of the RAP (Anchor QEA 2012). Samples will be selected that adequately represent each polygon targeted for remediation. Samples will be collected using a vibracore coring device or similar deployed from a winch line on a sampling vessel. Cores will be advanced to a minimum of 35 centimeters (cm) or until refusal to collect sediments that represent the first undisturbed depth beneath the dredge depth. The 30-cm layer below the residual (top 5 cm) horizon from the sediment core will be analyzed for the contaminants of concern. The top 5 cm will be archived and, consistent with the post-remediation program requirements and BMPs, may be used to determine the need for a sand cover.

In the event that results of the chemical analysis show the post-remediation SWACs are in compliance with CAO requirements detailed in Section 1, the SMU will be verified complete and no additional work or sampling will be conducted in the area. If the results of the chemical analysis show the post-remediation SWACs exceed one or more CAO requirement, then additional remedial action may include:

- Additional analysis of discrete archived samples if multiple samples collected within SMU and/or additional sample collection to better define extent of exceedance
- Additional dredging
- Placement of sand cover (if additional dredging is determined to be inefficient or infeasible)

4.6.1 Residual Dredging

Following confirmational sampling, sediment determined to exceed one or more CAO requirement may be designated by the Engineer for a residual dredging pass. Residual dredging pass cuts shall be 2 feet thick over the designated area. In the event of a residual pass, the Engineer will provide the Contractor with allowable dredging boundaries and coordinates. A smaller bucket than the one used for the initial dredging pass (i.e., 5 cy) is anticipated to be used to conduct the residual dredging pass. No overdepth allowance will be paid beyond the 2-foot cut designated for the residual pass.

4.6.2 Residual Sand Cover Placement

As an alternative to residual dredging, the Engineer may specify placement of sand cover over a designated area, if confirmational sampling indicates surface concentrations after dredging exceed CAO requirements. Similar to residual dredging operations, the Engineer will provide the Contractor with placement boundaries beyond which sand cover shall not be placed. The Contractor will be required to place 6 tons per 100 square feet of area, maintaining a minimum sand layer thickness of 6 inches, which will result in an average sand layer thickness of 12 inches.

5 SAND COVER PLACEMENT DESIGN

Sediment removal from below piers and overwater structures is technically infeasible and would threaten the structural stability of the structures; therefore, an alternative remedial approach was required to achieve cleanup objectives in these areas as identified in the CAO (Water Board 2012a). To promote physical isolation and stabilize contaminated sediments under piers and overwater structures within the remedial footprint, a nominal (average) 12-inch-thick layer of sand cover will be targeted for placement on the surface of the existing sediment layer with a minimum 6-inch placement thickness required everywhere (achieved by the placement of 6 tons per 100 square feet). Additionally as discussed in Section 4.6.2, sand cover may be applied in open-water areas to address residual management issues. Design and preparation of Technical Specifications for sand cover material (as documented in Section 352026 – Cover Material Placement) is intended to be consistent with the sand cover requirements, pertinent to design and placement, as required by MMRP Mitigation Measures 4.2.7 and 4.2.8.

Sand cover placement has been specified for four distinct areas in the South Shipyard:

- Beneath the Approach Pier in SMU-2 and immediately adjacent areas
- On top of the marine extensions from the Building Ways 4 and adjacent areas
- On top of the marine extensions from the Building Ways 3 and adjacent areas
- In the continuous open water area spanning SMUs 3C, 3D, 3G, and 3F including the riprap protection adjacent to the concrete slabs within the remedial footprint

The total placement area is depicted on Figure 10. Sand cover will be placed at a rate of 6 tons per 100 square feet over designated placement areas, To ensure full coverage of the identified areas, the Contractor will be required to lay down a minimum of 6 inches of sand cover everywhere (to be verified through a combination of surveys). Throughout placement operations, placement amounts will be monitored to verify that they meet the requirement of 6 tons per 100 square feet (through review of material tonnages), which averages to a nominal 12-inch layer of material.

Sand cover will be placed in underpier areas, extending out to the toe-of-slope of adjacent dredging cuts to achieve proper coverage and runout of the material (Figure 11). In open-

water areas, sand cover will be placed from the mean high tide line (elevation 5 feet MLLW) to the toe-of-slope of the adjacent dredging cut. In some locations, cover material will be placed over open-water areas (not below piers) due to the technical infeasibility of conducting dredging operations (in the case of concrete slabs or riprap) or where structural stability would be affected.

Two types of sand cover material will be used: sand material and gravelly sand material. The gravelly sand (containing 25 to 50 percent larger than 0.75 inches in size) will be used over sloping areas because of its higher internal friction angle and greater ability to remain positioned over sloping ground surfaces. Figure 10 shows the delineation between areas to receive sand cover and areas to receive gravelly sand cover.

Sand and gravelly sand cover materials will be acquired from a pre-approved, off-site source and transported to the Site by truck. Alternatively, cover material may be barged directly to the Site. Prior to placement in the remedial area, sand cover materials will be analyzed to verify geotechnical and chemical composition compliance with the requirements in Section 352026 – Cover Material Placement of the Technical Specifications. Following approval, the sand cover material is anticipated to be placed in the underpier areas using a telebelt, or similar equipment, operating from a barge. The use of alternative placement methods as opposed to mechanical placement with a dredging crane will be necessary to achieve coverage in the underpier areas without damaging the structures.

During placement, material delivery weigh tickets will be collected and tabulated to verify that the proper amount of sand cover has been placed in the underpier and open-water areas. Observation of material barges throughout placement operations will also be critical to determine the specified amount of material has been placed over a given area. Following material placement, single-beam sonar surveys will be conducted to provide verification that material placement has been adequately performed. Surveys may also be supplemented with divers for visual verification that the placement area and thickness of material is within placement limits.

One area was incorrectly designated as underpier placement area in the CAO, and has been removed from the placement plan in this design. This area is the timber pier located near the

northern (western) edge of the property, adjoining the North Shipyard. This pier will be demolished as part of the construction contract and will be dredged as shown on the Contract Drawings.

6 CONSTRUCTION SEQUENCING AND ANTICIPATED SCHEDULE

This section describes the planned construction sequencing for remedial activities planned at the South Shipyard. Construction activities are anticipated to commence in fall 2013 and will be performed in accordance with the in-water construction work window (typically runs from September 15 through March 31of each year) set forth in project permits. The work window allows for a 7-month construction season each year. Dredging construction activities can be performed 24 hours per day, 7 days per week, although sediment off-site hauling activities are required to take place only between the hours of 7 am and 7 pm, 6 days a week, per MMRP Mitigation Measure 4.4.1. Work may be conducted outside of these windows, but additional consultation and monitoring would likely be required and not anticipated.

Additional scheduling impacts may result from the variety of ongoing and planned shipyard activities. Known shipyard access restrictions include movement of vessel currently located at the graving dock on September 15, 2013, to accommodate the start of dredging operations on September 17 and the floating platform currently located near the dry dock access pier which will remain in place until late September. Additionally, the USN plans to perform dredging operations in Chollas Creek adjacent to the SMA although the exact dates for the dredging operations are unknown at this time. The Contractor will be required to prepare and implement a Communication Plan in accordance with MMRP Mitigation Measure 4.3.5 that provides operational guidelines between the San Diego Unified Port District (Port) and/or the Harbor Master and all vessel operators prior to the initiation of dredging to ensure the safe movement of project vessels from the dredge area to the offloading area. The Communication Plan will include identification of vessel speed limitations (wake/no wake) and notification to project personnel using air horns as necessary.

A production rate of approximately 1,200 cy per day is expected to be achieved by using the equipment, working schedule restrictions, and expected sediment management processes. Daily downtime will be experienced to perform standard maintenance/repair of equipment, to reposition the dredge following sediment removal in a given area, and to accommodate shift change procedures. Additional downtime will be experienced throughout the project to manage environmental controls, perform surveying work, and accommodate shipyard vessel

traffic and operations. Considering likely dredging production rates, construction sequencing, and inherent delays, dredging operations are anticipated to be conducted over a span of approximately 50 days and that all in-water construction work may be completed within one season. Weather delays are assumed to be minimal due to the weather patterns at the location of work.

The Contractor will be required to maintain an up-to-date detailed schedule of activities through construction as specified in the Technical Specifications and will be required to coordinate closely with the South Shipyard and Engineer throughout construction.

While the means and methods for construction will ultimately be the Contractor's decision and documented in their Remedial Action Work Plan, which will be subject to review and approval by the Engineer, Anchor QEA foresees the following sequence of activities, listed in order of operation:

1. Mobilization and setup of temporary facilities, including preparation of the SMA
2. Pre-construction survey
3. Demolition and identified debris removal
4. Dredging of contaminated sediments concurrently with dewatering, stockpiling and transportation to off-site disposal facility
5. Post-dredge survey and conformational sampling
6. Re-dredging and subsequent post-dredge survey, if required
7. Placement of sand cover underneath pier structures, along shoreline and within remedial footprint as required for residuals management
8. Post-cover survey
9. Project acceptance
10. Demobilization, including removal of temporary facilities and cleanup of the SMA and restoration to pre-construction conditions

7 REFERENCES

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Exponent, 2003. NASSCO and Southwest Marine Detailed Sediment Investigation. Volume 1. Prepared for NASSCO and Southwest Marina, San Diego, California. October 2003.

USACE (U.S. Army Corps of Engineers), 2003. "Engineering and Design – Slope Stability. October 31, 2003. Updated: January 2010. Cited: January 2012. Available from: www.wsdot.wa.gov/.../Chapter7.pdf.

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Water Board, 2012b. *Technical Report for Cleanup and Abatement Order No. R9-2012-0024 for the Shipyard Sediment Site*. March 14, 2012.

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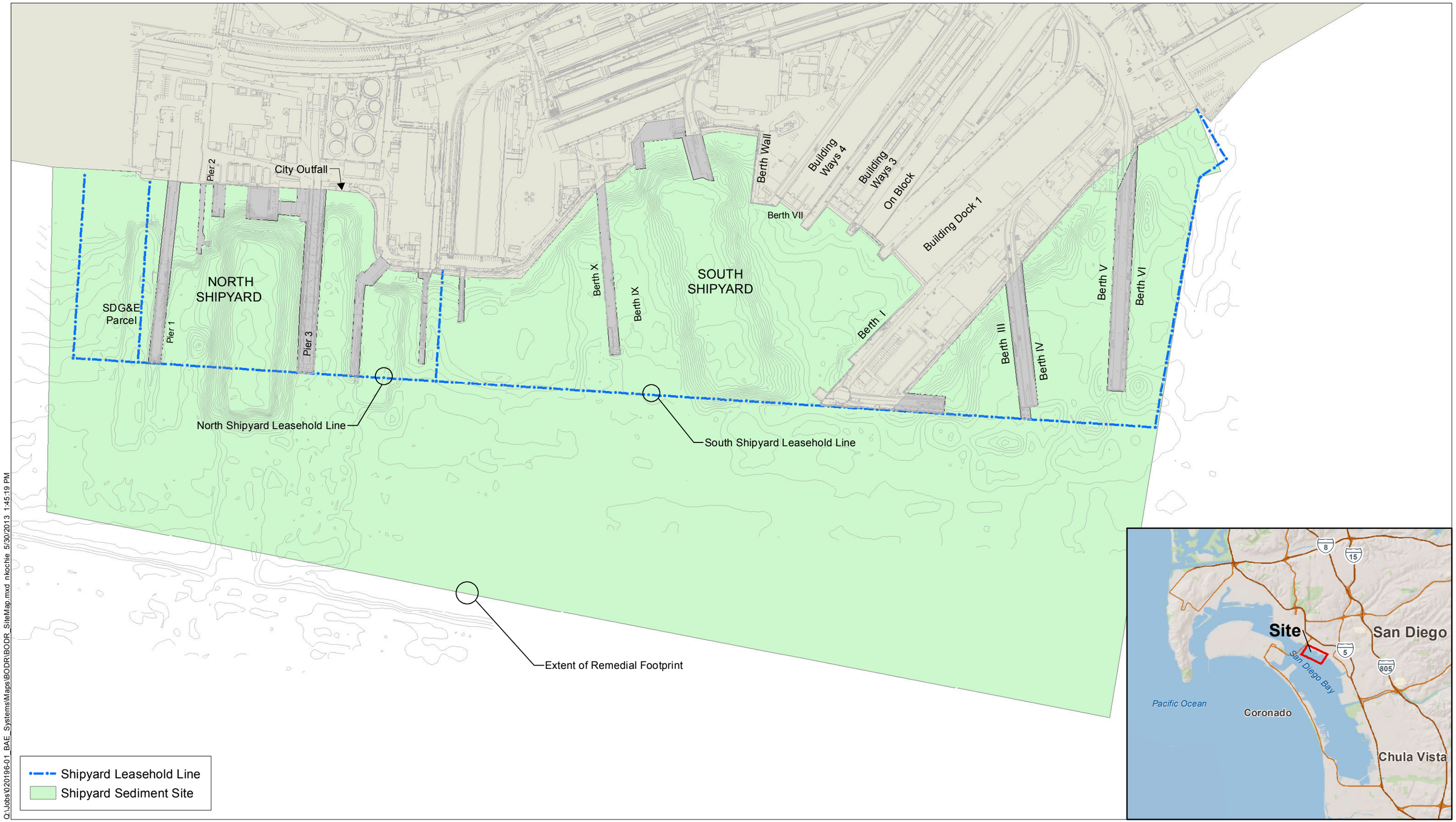
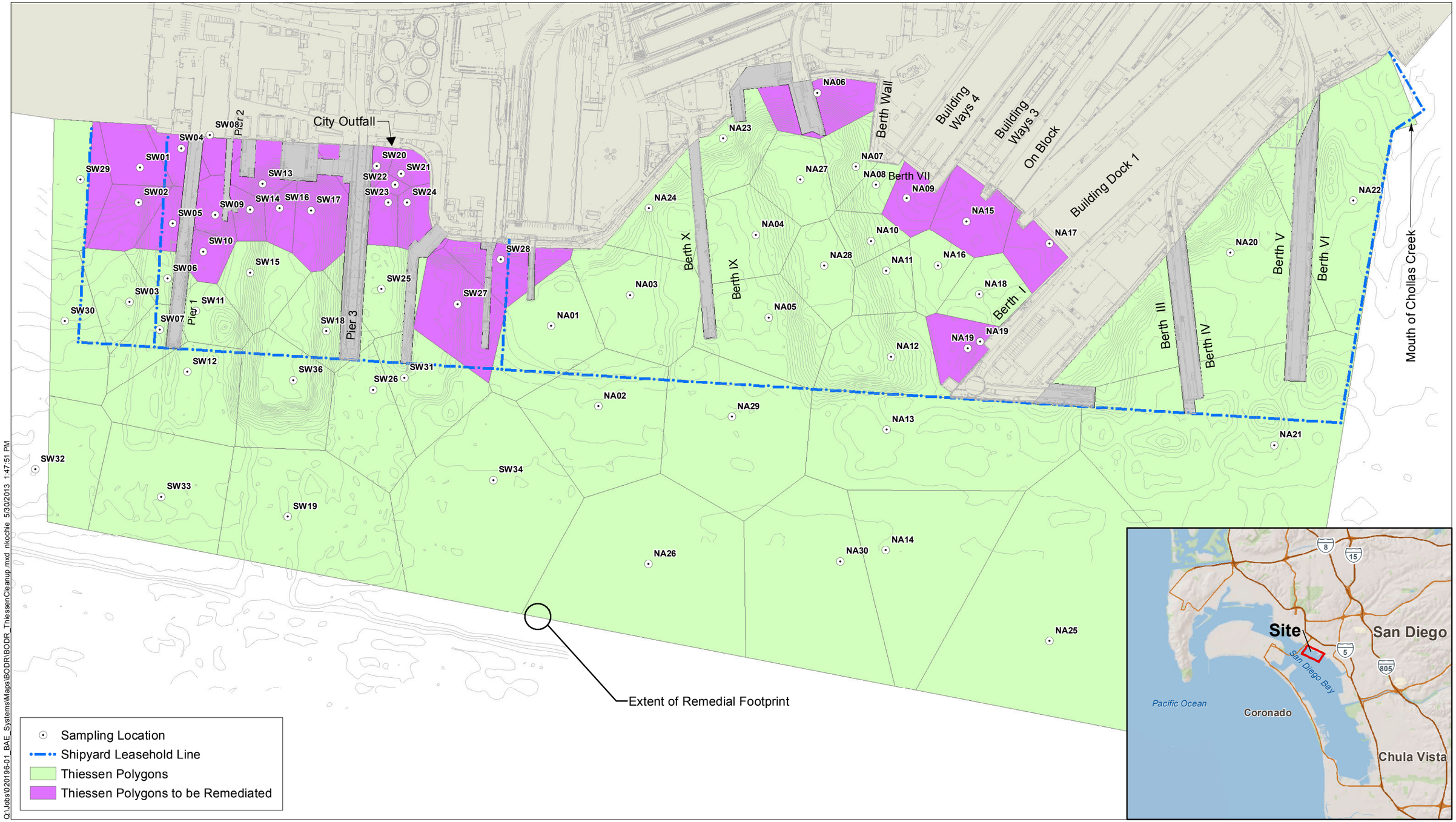
FIGURES



ANCHOR QEA

Feet
0 175 350 525 700

Figure 1
Site Map
San Diego Shipyard Sediment Site – South Shipyard



ANCHOR QEA

Feet
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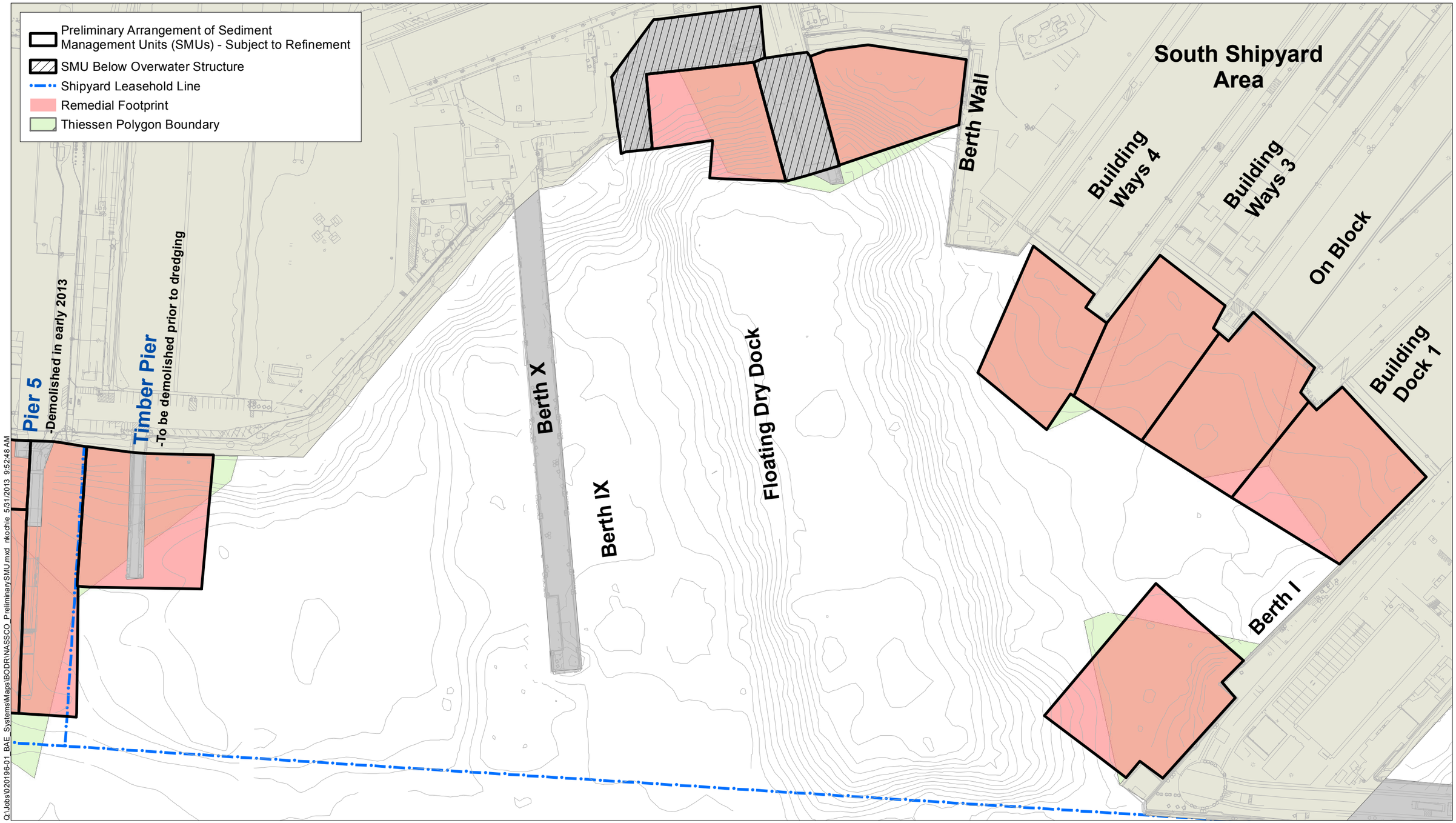
Figure 2
Thiessen Polygon Distribution and Required Cleanup Areas
San Diego Shipyard Sediment Site – South Shipyard



ANCHOR QEA

Feet
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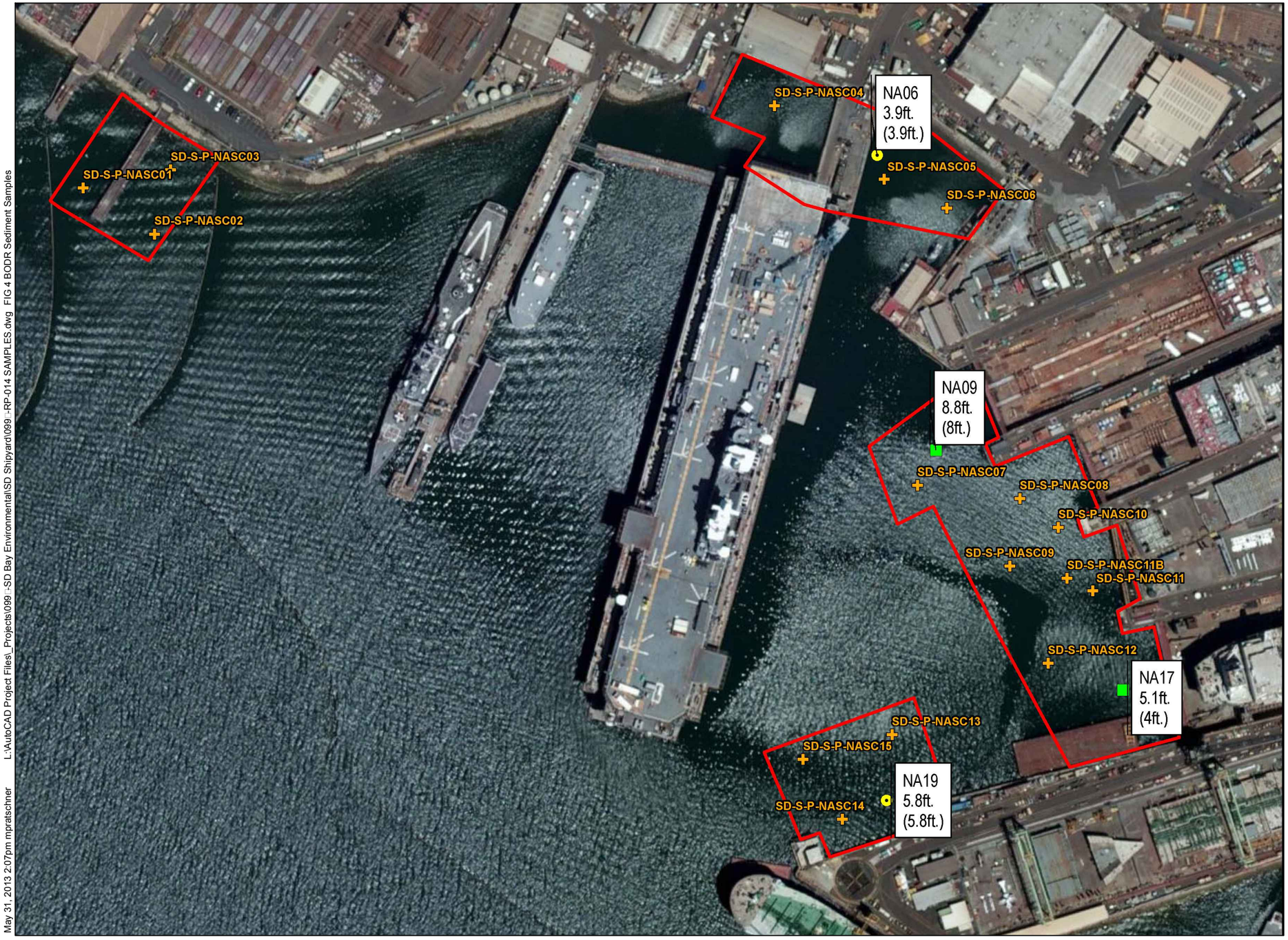
Figure 3
South Shipyard Remedial Footprint
San Diego Shipyard Sediment Site – South Shipyard



SOURCE: AMEC BAE_ShipyardSediment.m□d. Imagery provided by Digital Globe 4-9-2010.
HORIZONTAL DATUM: California State Plane Zone 6, NAD83, U.S. Feet.

LEGEND:

NASSCO Sample Points

Sample Type

- Clean Sediment Reached
- Did Not Reach Clean Sediment
- Sampling Locations
- NASSCO Remediation Area

NA06 — Station
3.9ft. (3.9ft.) — Core Penetration (Depth to Clean)*

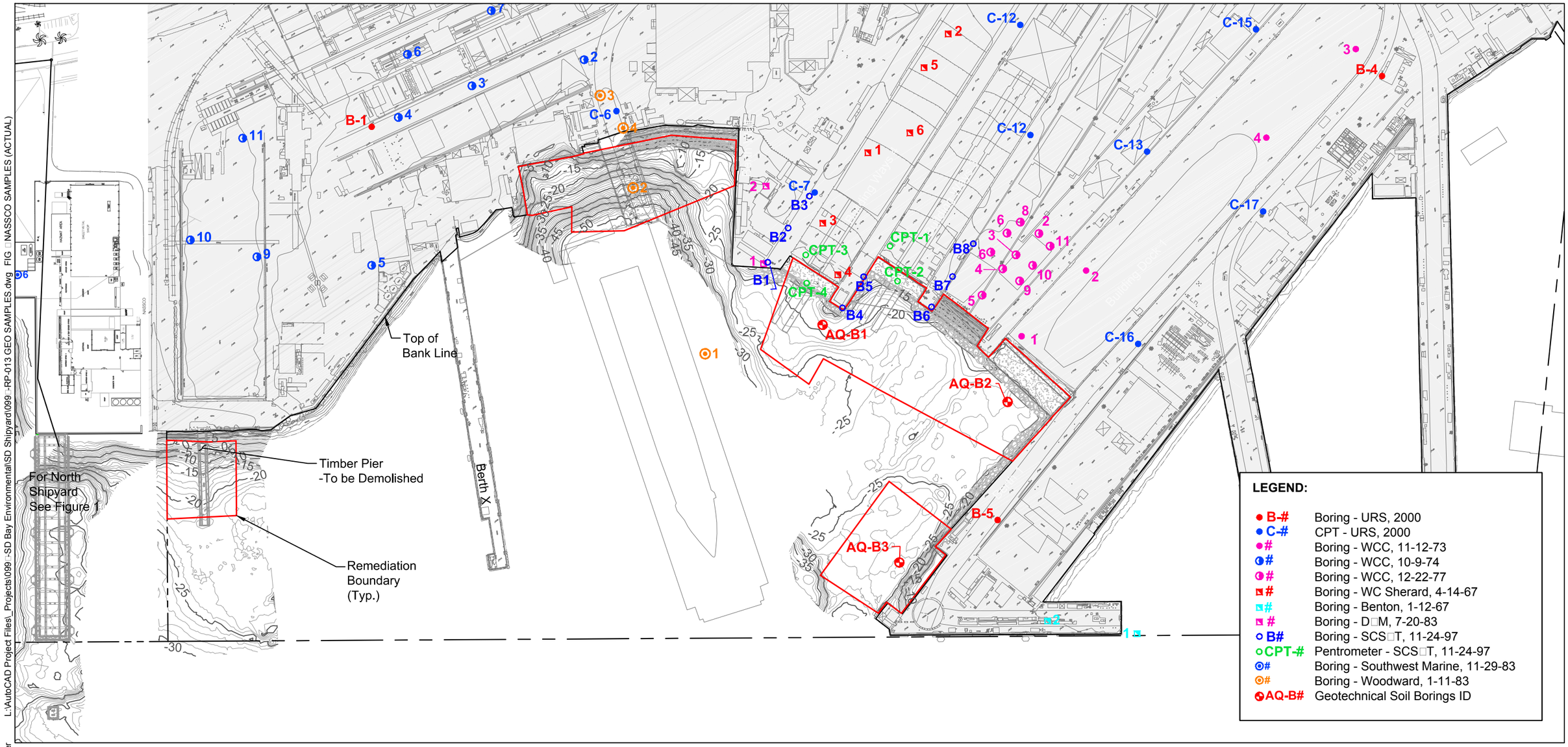
*on cores that did not reach clean sediment (⊙), unbounded contamination is assumed.

0 1□0
Scale in Feet

L:\AutoCAD Project Files_Projects\099□-SD Bay Environmental\SD Shipyard\099□-RP-014 SAMPLES.dwg FIG 4 BODR Sediment Samples
May 31, 2013 2:07pm mpratschner

ANCHOR QEA

Figure 4
Sediment Characteri□ation Sampling Locations
San Diego Shipyard Site - South Shipyard



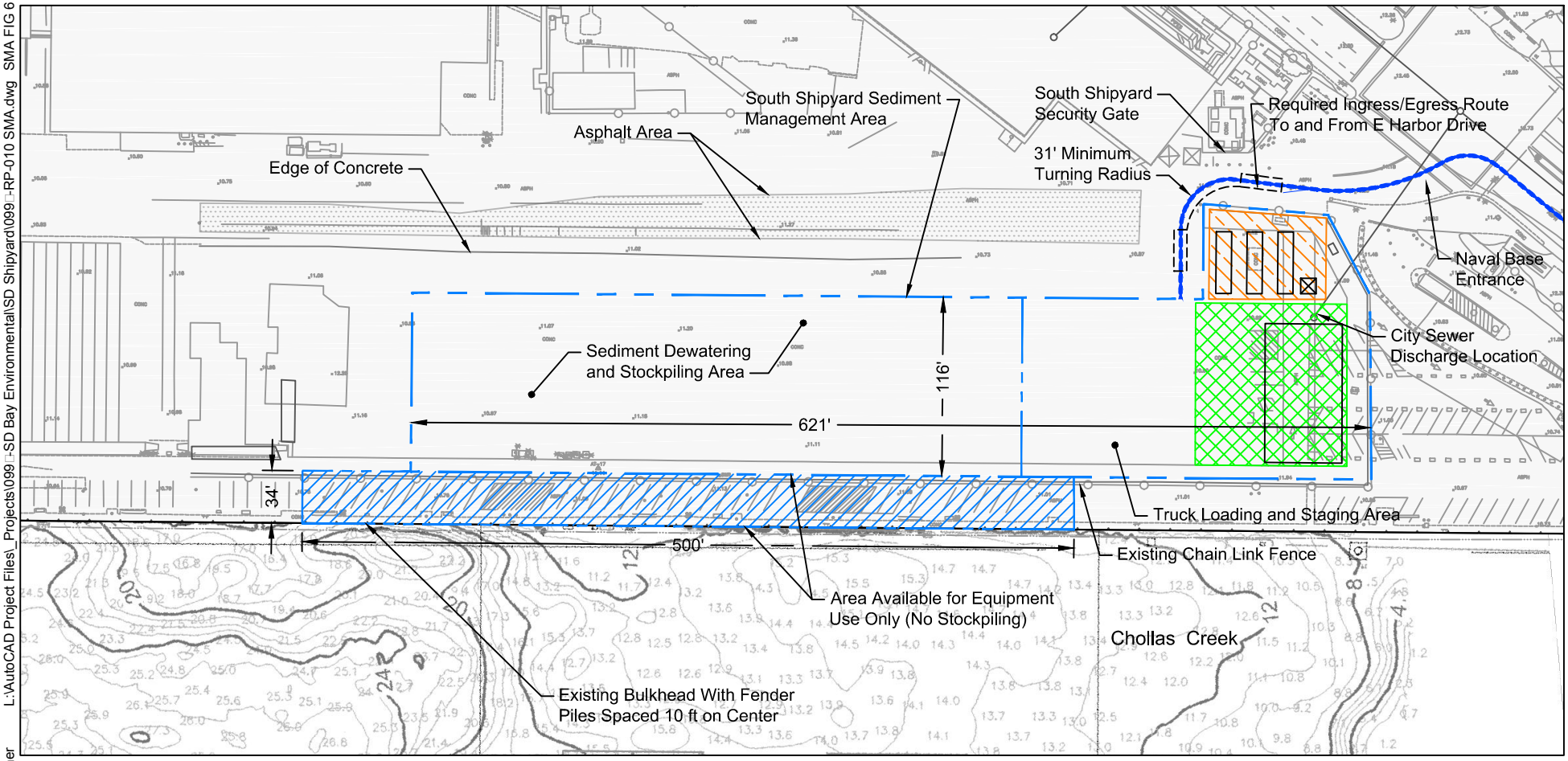
SOURCE: Aerial from Bing maps. Bathymetric contours provided by Environmental Data Solutions dated April 2 , 2013. Upland topography from Digital Mapping Inc., September, 2009, BAE dated March 8, 2013 and supplemented by Environmental Data Solutions dated April 13, 2013. Boring sources and dates are noted in the legend.
HORIZONTAL DATUM: California State Plane, Zone 6, NAD83, U.S. Feet.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

0 200
Scale in Feet

L:\AutoCAD Project Files_Projects\099 -SD Bay Environmental\SD Shipyard\099 -RP-013 GEO SAMPLES.dwg FIG NASSCO SAMPLES (ACTUAL)
May 31, 2013 3:20pm mpratschner

ANCHOR QEA

Figure 5
Geotechnical E plorations
San Diego Shipyard Sediment Site - South Shipyard



SOURCE: Bathymetric contours from Contract Drawing H-1 – Hydrographic Survey, Chollas Cree□, Pier 1 □ 2, Naval Base San Diego, California, NA□FAC Dwg. no. 18086973, Sheet 2of 8. Upland topography from Digital Mapping Inc., September, 2009, BAE dated March 8, 2013 and supplemented by Environmental Data Solutions dated April 13, 2013.
HORIZONTAL DATUM: California State Plane, Zone 6, NAD83, U.S. Feet.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

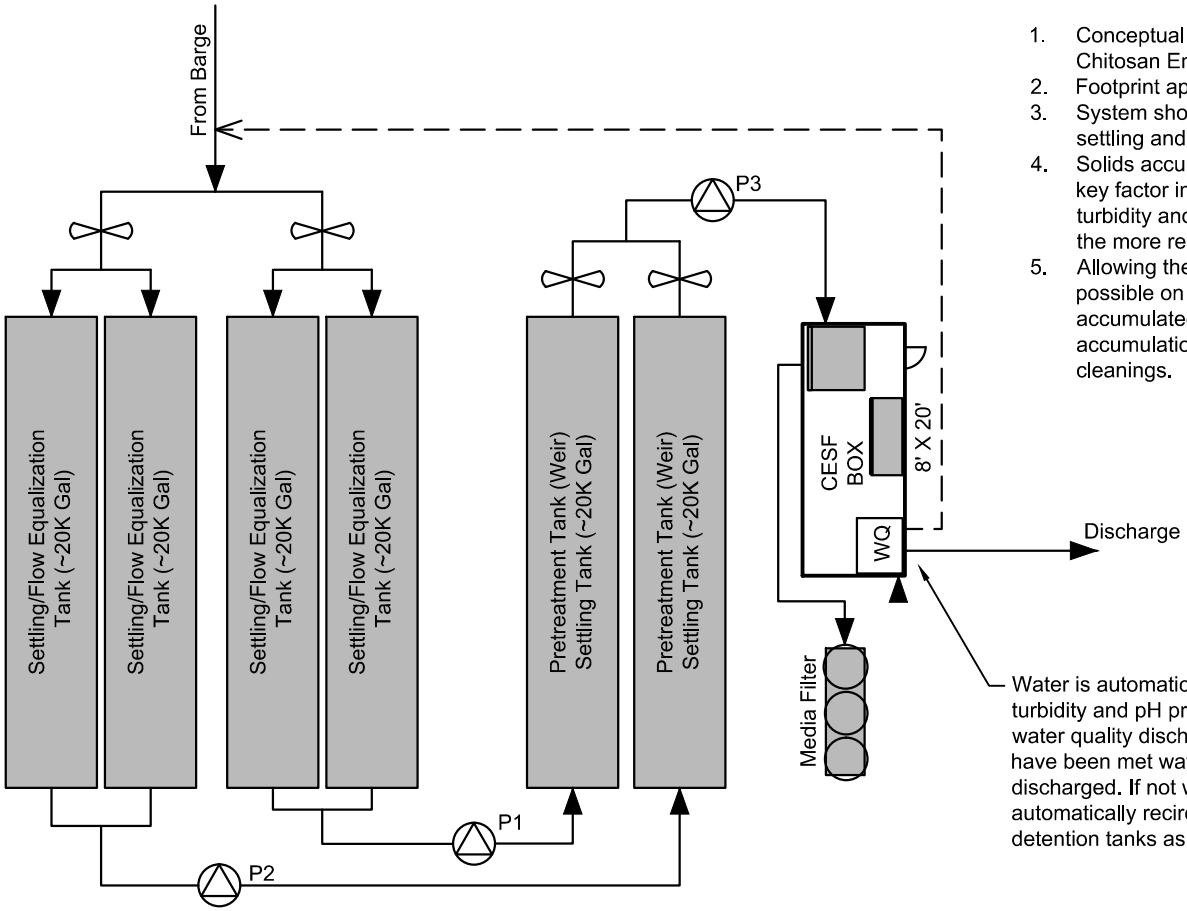
LEGEND:
- Sediment Management Area
- Temporary Access Area
- Site Facilities
- Storage and Water Treatment

0 100
Scale in Feet

L:\AutoCAD Project Files_Projects\099 □-SD Bay Environmental\SD Shipyard\099 □-RP-010 SMA.dwg SMA FIG 6
May 31, 2013 2:11pm mpratschner

ANCHOR QEA

Figure 6
Sediment Management Area
San Diego Shipyard Sediment Site - South Shipyard



NOTES:

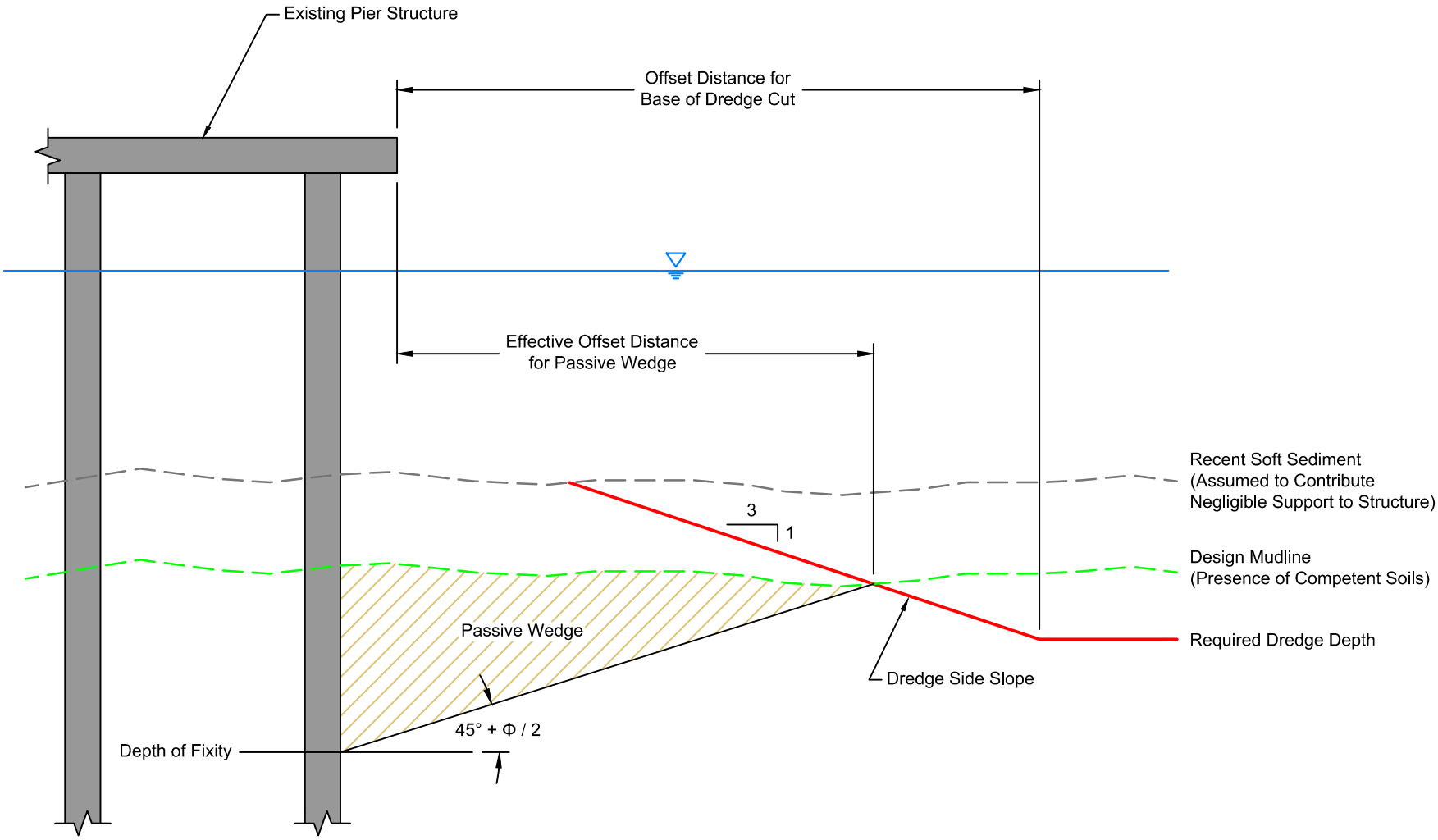
1. Conceptual configuration based on RoadSide ACIST Chitosan Enhanced Sand Filtration System (200 GPM).
2. Footprint approximately 90' x 50'.
3. System shown can be operated in batches to facilitate settling and accommodate solids removal.
4. Solids accumulation and removal from settling tanks is key factor in system performance. The lower the turbidity and flow rate of water entering settling tanks the more reliable the system will operate.
5. Allowing the dredged sediments to settle as much as possible on the barge and careful removal of accumulated fluid will significantly reduce solids accumulation in the system and frequency of tank cleanings.

Water is automatically analyzed for turbidity and pH prior to discharge. If water quality discharge parameters have been met water will be discharged. If not water will be automatically recirculated to the detention tanks as a safety measure.

May 31, 2013 2:12pm mpratschner L:\AutoCAD Project Files_Projects\099 - SD Bay Environmental\SD Shipyard\099 - RP-012 Treatment.dwg BODR South Figure 7

ANCHOR QEA

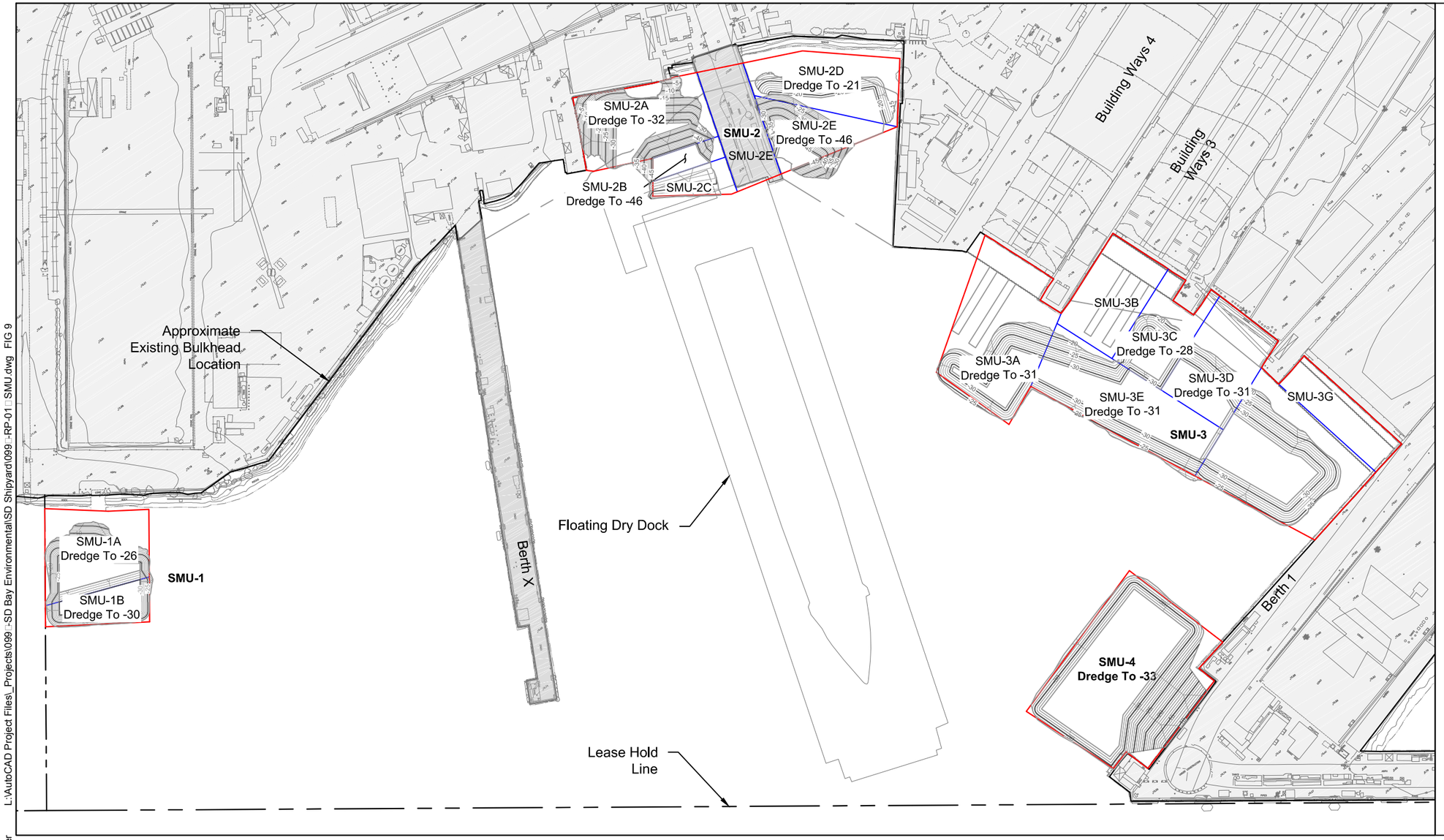
Figure 7
Conceptual Water Treatment Configuration
San Diego Shipyard Sediment Site - South Shipyard



May 31, 2013 2:11 pm mpratschner L:\AutoCAD Project Files_Projects\0994-SD Bay Environmental\SD Shipyard\0994-RP-014 Concept.dwg Figure 8 South

ANCHOR QEA

Figure 8
Dredge Offset for Structures
San Diego Shipyard Sediment Site - South Shipyard



LEGEND:

Remediation Boundary

Sub-SMU Boundary

-20 Proposed Dredging

SOURCE: Upland topography from Digital Mapping Inc., September, 2009 and supplemented by Environmental Data Solutions survey dated April 13, 2013.

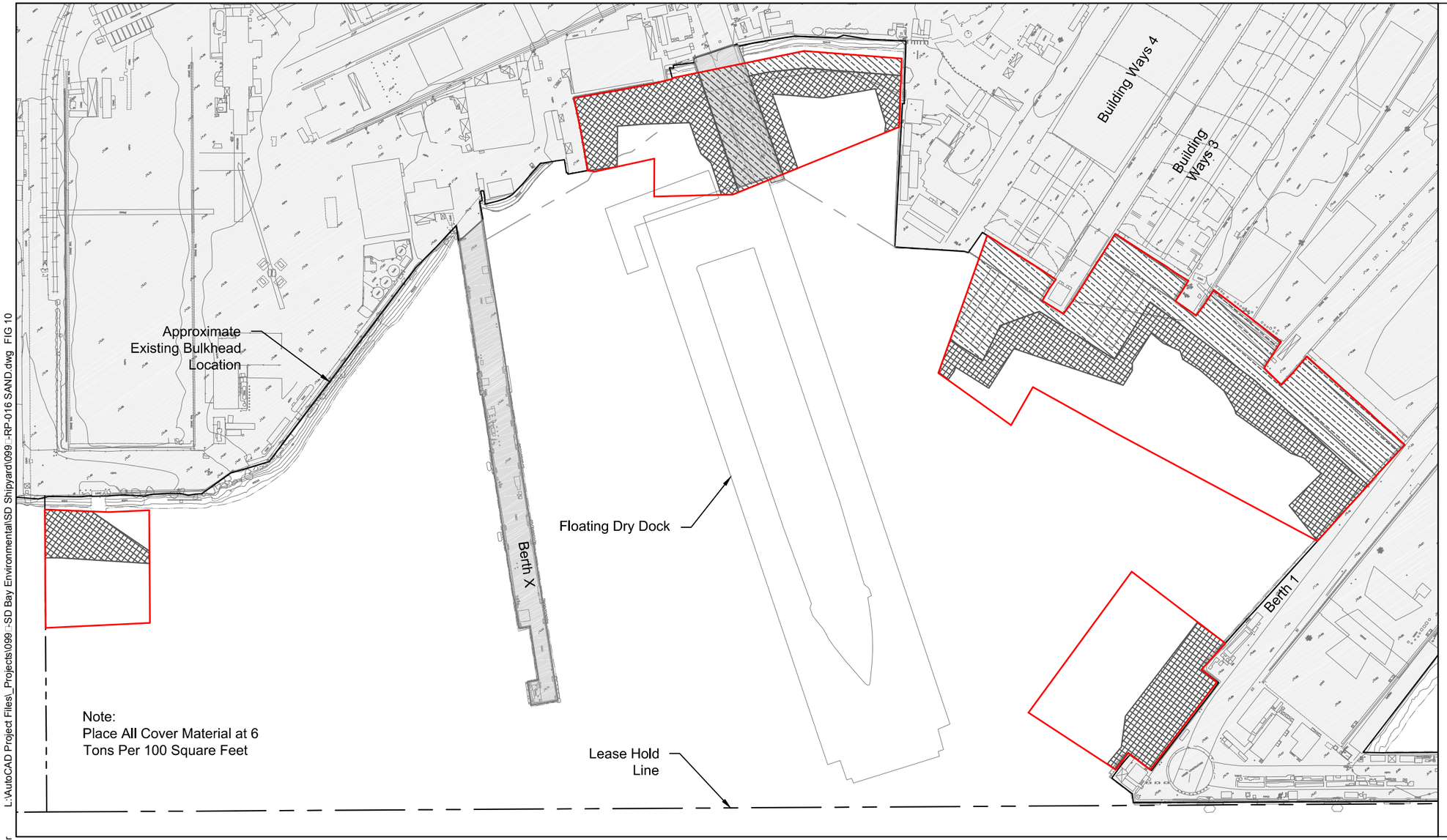
0 100
Scale in Feet

L:\AutoCAD Project Files_Projects\099 -SD Bay Environmental\SD Shipyard\099 -RP-01 SMU.dwg FIG 9

May 31, 2013 2:24pm mpratschner

ANCHOR QEA

Figure 9
Updated Sediment Management Units
San Diego Shipyard Sediment Site - South Shipyard



LEGEND:

- Remediation Boundary
- Sand Cover
- Gravelly Sand Cover

SOURCE: Upland topography from Digital Mapping Inc., September, 2009 and supplemented by Environmental Data Solutions survey dated April 13, 2013.

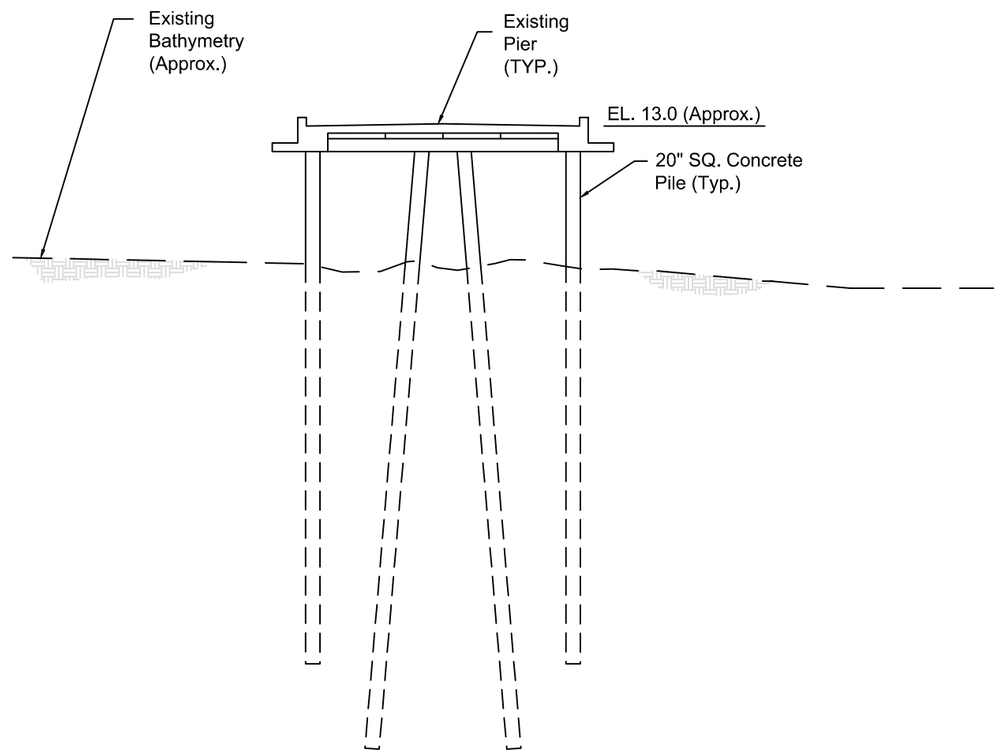
0 100
Scale in Feet

L:\AutoCAD Project Files_Projects\099 - SD Bay Environmental\SD Shipyard\099 - RP-016 SAND.dwg FIG 10

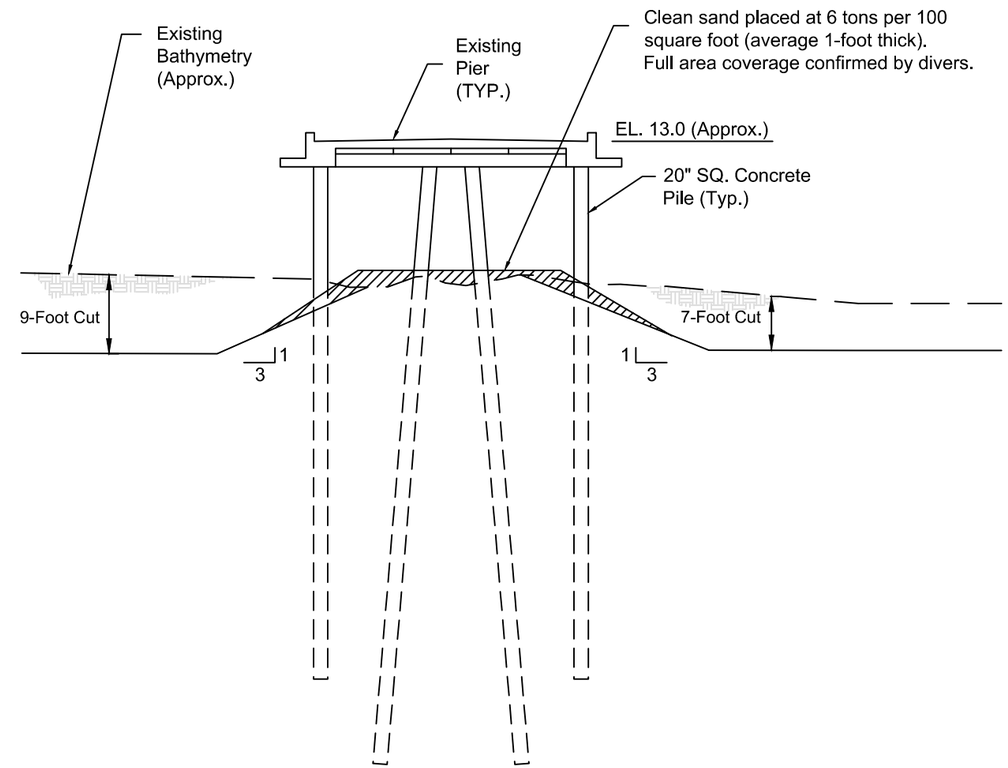
May 31, 2013 2:2 pm mpratschner

ANCHOR QEA

Figure 10
Sand Cover Placement
San Diego Shipyard Sediment Site - South Shipyard



Existing Conditions



Conditions Following Dredging and Sand Cover Placement

SOURCE: Pier data provided by Triton Engineering dated 2010.
HORIZONTAL DATUM: California State Plane, Zone 6, NAD83, U.S. Feet.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

LEGEND:

Sand Cover Placement

Not To Scale

L:\AutoCAD Project Files_Projects\0994-SD Bay Environmental\SD Shipyard\0994-RP-006 Pier 1 XSec.dwg FIG 11 BODR South

May 31, 2013 2:27pm mpratschner

ANCHOR QEA

Figure 11
Conceptual Underpier Sand Placement
San Diego Shipyard Sediment Site - South Shipyard

APPENDIX A
RESULTS OF SITE SURVEYS

DETAILS OF HYDROGRAPHIC MULTI-BEAM BATHYMETRIC SURVEY

A multi-beam survey is comprised of five components integrated into one robust, survey solution: 1) MBES transducer; 2) MBES processor; 3) motion reference unit; 4) GPS for position; and 5) data acquisition computer.

EDS' survey vessel was outfitted with a Reson 7101 shallow water multi-beam system. The 7101 system contains a transducer head, a topside high-speed processing unit connected to an Intel/Windows-based CPU and associated software: Hypack Version 2012 for navigation, sonar acquisition, and patch tests. The 7101 system was integrated with an Applanix POS/MV heading/heave/pitch/roll sections (motion reference unit) and a Real-Time Kinematic (RTK) GPS unit (Leica System 1200) for position and ellipsoid high updates. The 7101 system produces a swath of sonar approximately 3 to 4 times the water depth and collects approximately 50 soundings per square meter. Sound velocity was measured constantly at the transducer head using an Odom Digibar Pro Sound velocity meter.

Hypack Hysweep multi-beam processing software was used to process the multi-beam data. Elevation data was filtered to reject any values outside of that which is possible and then each survey line was individually examined for inconsistent and irregular values. Any anomalies were rejected and cleaned from the datasets. Once the dataset was thoroughly cleaned, it was exported from the Hypack software as a grid the XYZ text file format. The XYZ text file was imported into AutoCAD Civil 3D and converted to a point feature class and raster dataset. The final density level of data points within the survey areas is a 5-foot grid that was derived from data on a 1-foot grid. Raster and point data were reviewed for any remaining anomalies and exported as a final dataset.

The results of the hydrographic multi-beam bathymetry survey can be seen as contours on the Contract Drawings.

DETAILS OF TOPOGRAPHIC SURVEY

To collect topographic data and point descriptions, a combination of RTK GPS and traditional optical-based survey equipment (total station) was used. A Leica System 1200 RTK GPS system configured with hardware and software that enabled the use of the Russian

Global Navigation Satellite System (GLONASS) satellite network was used. Use of GLONASS-enabled receivers increases the number of available satellites from an average of 7 to 10 to an average of 15 to 20, thus enabling survey-grade lock in areas that have a limited view of the sky. RTK surveying used dual frequency L1/L2 GPS receivers: one receiver was set over a known point (base) and the other receiver (rover) collected position and elevation data as well as point metadata as the field surveyor traveled along the pre-determined survey transect. The base station receiver relayed satellite correction information to the rover via a multi-frequency Pacific Crest PDL radio modem.

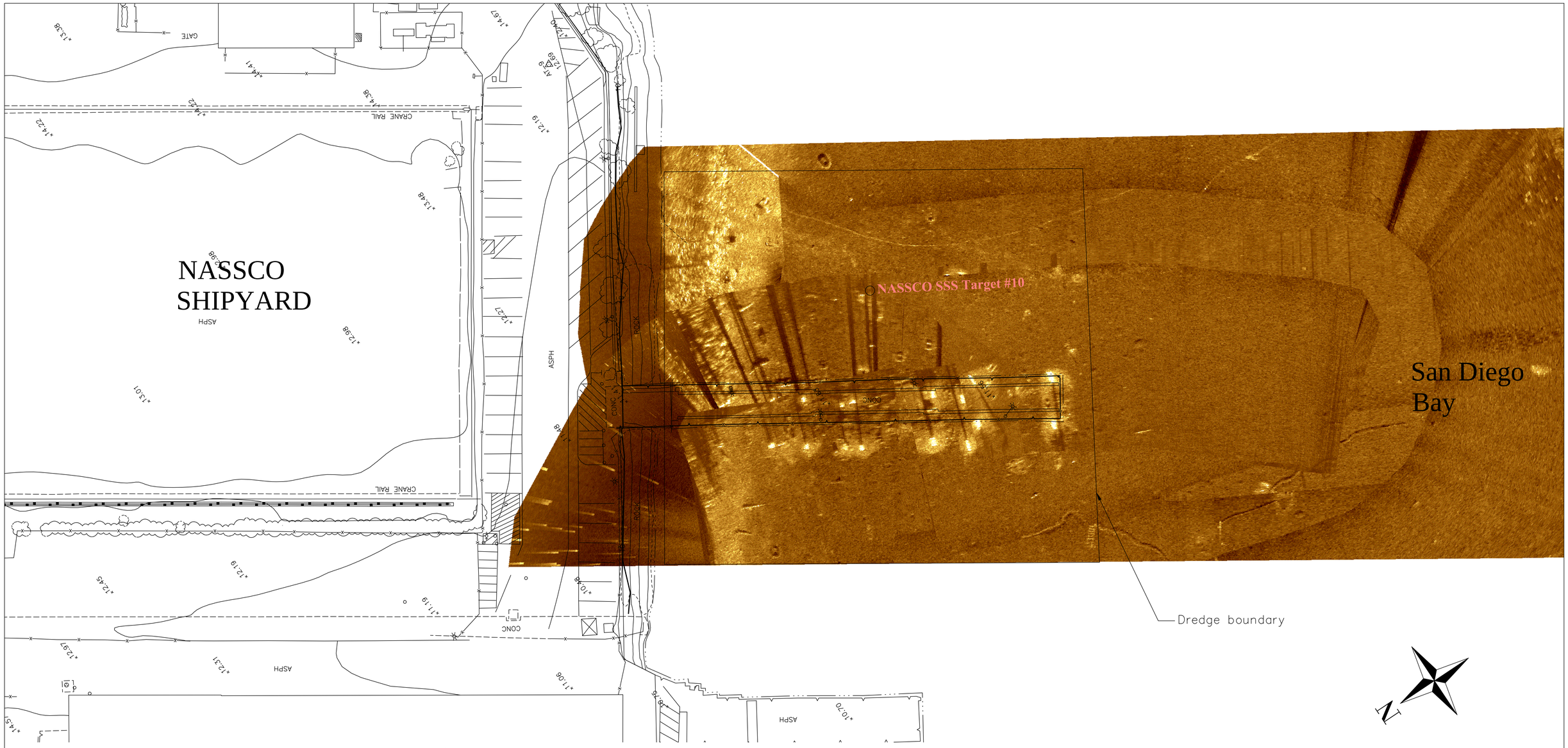
The results of the topographic survey can be seen as shoreline contours on the Contract Drawings.

DETAILS OF SIDE-SCAN SONAR SURVEY

Side-scan sonar emits fan-shaped sonar pulses (600 kilohertz [kHz]) through the water column to the seafloor across a wide angle perpendicular to the survey vessel path. Coupled with positioning data, side-scan imagery produces high-resolution, geo-rectified TIFFs of the bay floor.

A Teledyne Benthos SIS-1624 dual frequency (200 and 600 kHz) side-scan sonar was used for imagery acquisition. The SIS-1624 is a professional grade side-scan sonar survey system that includes a topside acquisition computer and tow cable. The range setting on the SIS-164 was set to 25 meters to maximize sonar imagery resolution. Planned side-scan survey lines were set at 10 meters to achieve 200 percent overlap on each survey swath. This protocol ensures that all sides of an object on the seafloor are illuminated by the side-scan sonar swath.

Side-scan imagery was acquired and processed using the software package Triton Isis v7.1 with final image mosaicking complete in Triton Map v3.1. Acquisition of side-scan images resulted in 17 files, each processed individually. Each individual side-scan image was reviewed for debris targets located within the survey area. Targets were identified based on reflectivity, which is indicative of hard objects, and shadow length. Once a target of interest was identified, a target file was created that comprised of a geo-rectified TIFF, a description, and a GPS way point of the target.



Sidescan Survey Notes:

1) The information depicted on this map represents the results of surveys made on the dates shown, and can only be considered as indicating the conditions at that time.
2) Sidescan imagery acquisition was accomplished using a combination a *SEA Swath* interferometric sonar and a *Benthos 1624* 600 KHZ Chirp sonar.
3) Imagery was produced using *Chesapeake Sonar Whiz* sonar reduction software.
4) Horizontal Positions are referenced to the California State Plane Coordinate System, Zone 6, Feet (NAD 83).
5) Weather Cond: Sunny, W wind, 5 Knots
6) The positions of shoreline features and other hard structures (that were not surveyed by EDS personnel and not called-out as such) shown on this base map are derived from procedures unknown to EDS, and as a result, EDS is not responsible for the accuracy of the background base map (which was supplied by Anchor QEA).

REVISION	DESCRIPTION	BY	DATE
2	general cartographic update	dsg	4/23/13

Environmental Data Solutions
818 Fifth Street
Suite 208
San Rafael, California 94901

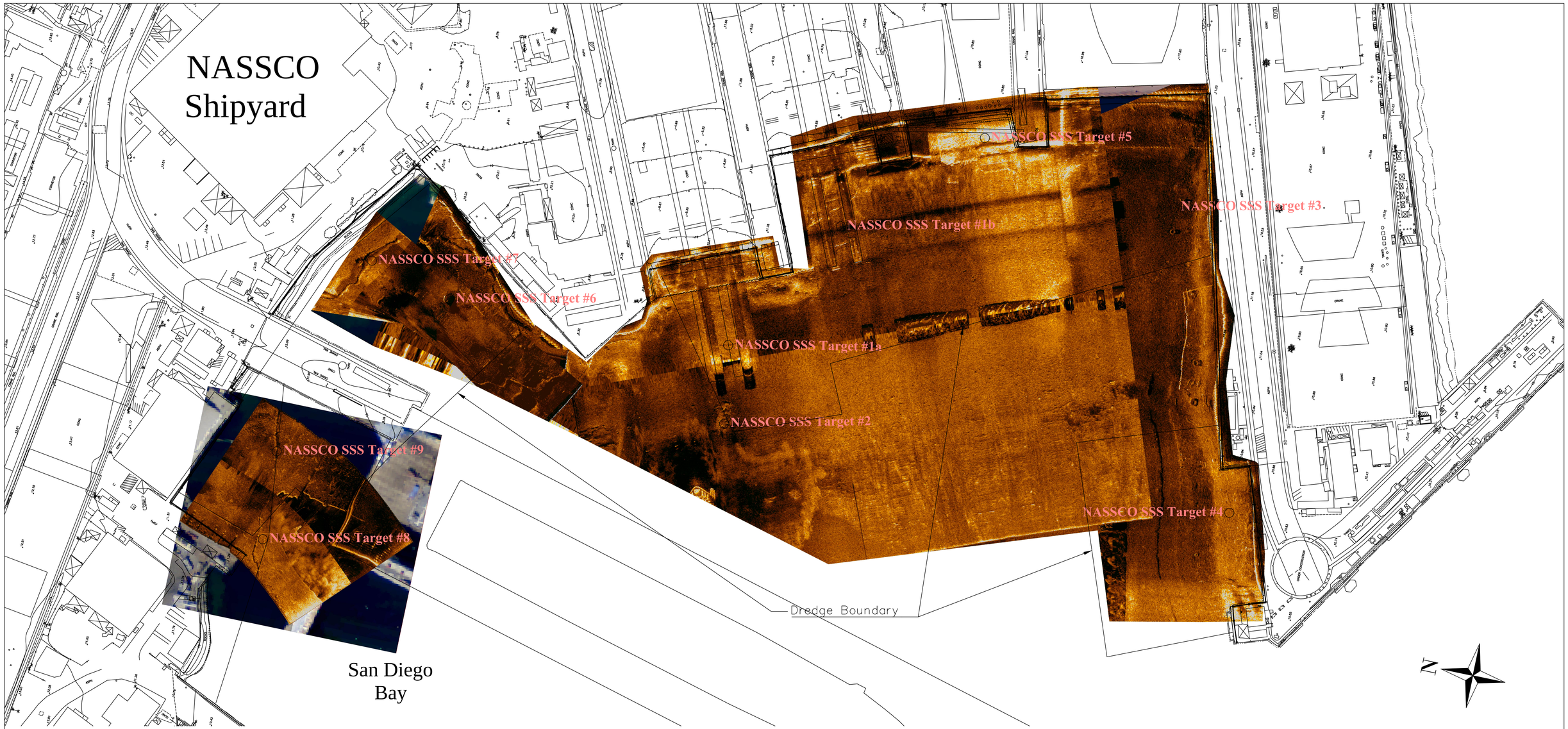
DSGN	DR DSG	CHK
JOB NO.	SUBMITTED BY	TITLE

NASSCO SHIPYARD
San Diego, California

Sidescan Sonar Survey
Full Mosaic
April 10-12, 2013

DATE 04:12:13
SHEET 2 OF 2

2



Sidescan Survey Notes:

1) The information depicted on this map represents the results of surveys made on the dates shown, and can only be considered as indicating the conditions at that time.
2) Sidescan imagery acquisition was accomplished using a combination a *SEA Swath* interferometric sonar and a *Benthos 1624* 600 KHZ Chirp sonar.
3) Imagery was produced using *Chesapeake Sonar Whiz* sonar reduction software.
4) Horizontal Positions are referenced to the California State Plane Coordinate System, Zone 6, Feet (NAD 83).
5) Weather Cond: Sunny, W wind, 5 Knots
6) The positions of shoreline features and other hard structures (that were not surveyed by EDS personnel and not called-out as such) shown on this base map are derived from procedures unknown to EDS, and as a result, EDS is not responsible for the accuracy of the background base map (which was supplied by Anchor QEA).

REVISION	DESCRIPTION	BY	DATE
2	general cartography	DSG	4/23/13

Environmental Data Solutions
818 6th Street
Suite 208
San Rafael, California 94901

DSGN	DR	CHK
	DSG	
JOB NO.	SUBMITTED BY	TITLE

NASSCO Shipyard
San Diego, California

Sidecan Sonar Survey
Full Mosaic
April 10-12

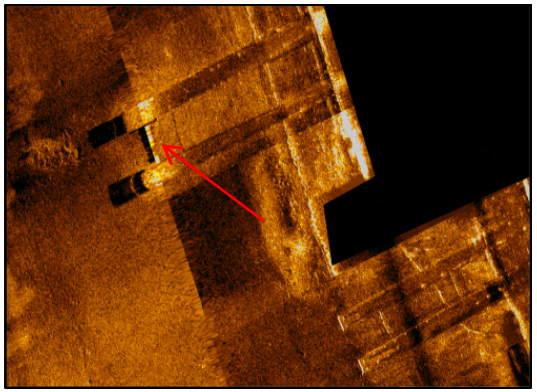
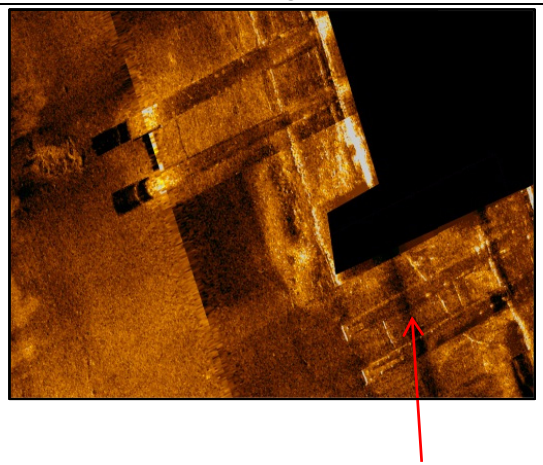
DATE 04:12:13

SHEET 1 OF 2

1

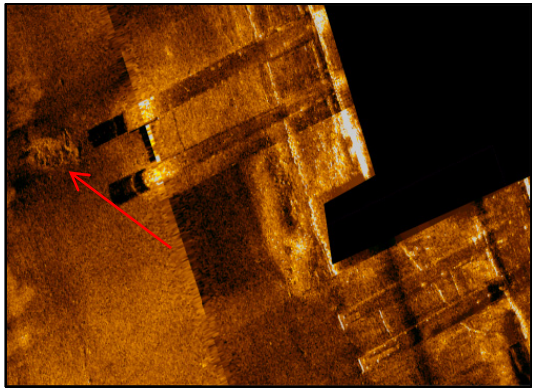
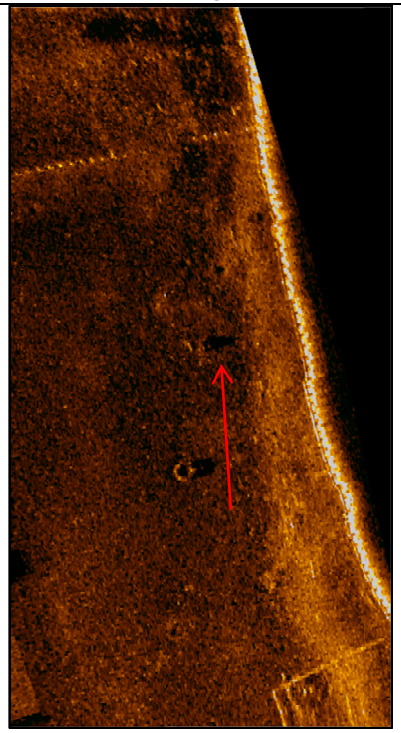
Environmental Data Solutions

Table 4 – NASSCO Shipyards Sidescan Sonar Target Identification

		State Plane Coordinates Zone 6 (NAD 83)				State Plane Coordinates Zone 6 (NAD 83)	
Target	**Image**	**N**	**E**	**Target**	**Image**	**N**	**E**
1a		1831604.50	6288197.67	**1b**		1831510.86	6288349.71
		Lat	**Long**			**Lat**	**Long**
		32° 41’ 20.0871”	117° 08’ 19.7424”			32° 41’ 19.1735”	117° 08’ 17.9542”
		Description				**Description**	
		Submerged dry dock skids (north pair – approximately 246 Ft. in length)				Submerged dry dock skids (south pair – approximately 246 Ft. in length)	

Environmental Data Solutions

Table 4 – NASSCO Shipyards Sidescan Sonar Target Identification

		State Plane Coordinates Zone 6 (NAD 83)				State Plane Coordinates Zone 6 (NAD 83)	
Target	**Image**	**N**	**E**	**Target**	**Image**	**N**	**E**
2		1831591.24	6288113.01	**3**		1831159.02	6288444.71
		Lat	**Long**			**Lat**	**Long**
		32° 41’ 19.9488”	117° 08’ 20.7316”			32° 41’ 15.7004”	117° 08’ 16.8077”
		Description				**Description**	
		Debris pile at end of NLY skids.				Small debris field with tires.	

Environmental Data Solutions

Table 4 – NASSCO Shipyards Sidescan Sonar Target Identification

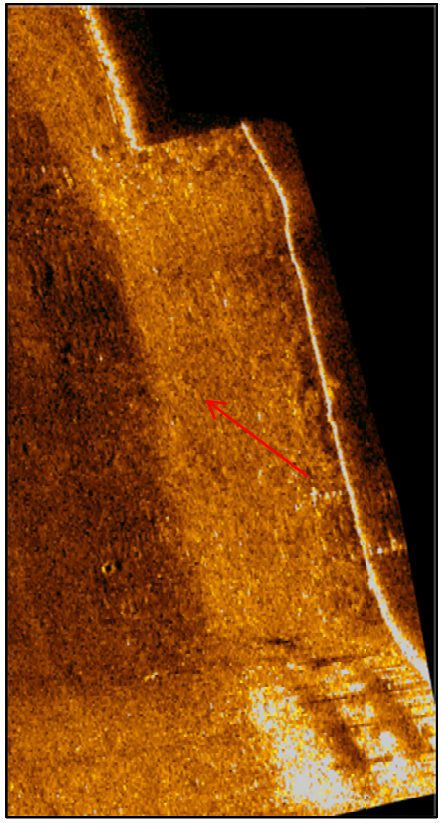
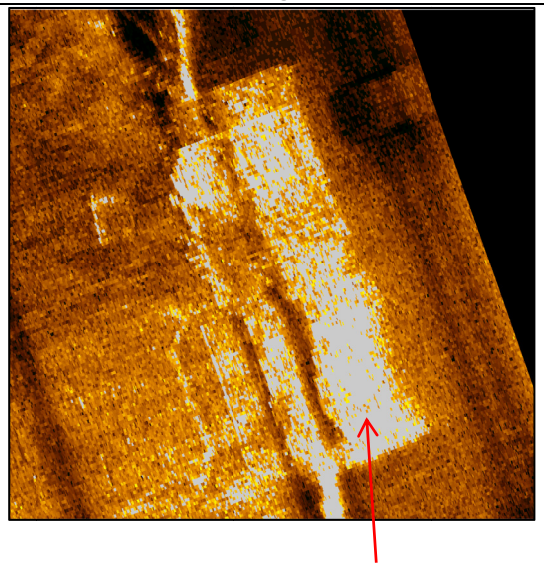
		State Plane Coordinates Zone 6 (NAD 83)				State Plane Coordinates Zone 6 (NAD 83)	
Target	**Image**	**N**	**E**	**Target**	**Image**	**N**	**E**
4		1831032.36	6288131.00	**5**		1831376.98	6288476.14
		Lat	**Long**			**Lat**	**Long**
		32° 41’ 14.4208”	117° 08’ 20.4654”			32° 41’ 17.8595”	117° 08’ 16.4617”
		Description				**Description**	
		High reflectance – rip rap slope.				High reflectance – rip rap slope.	

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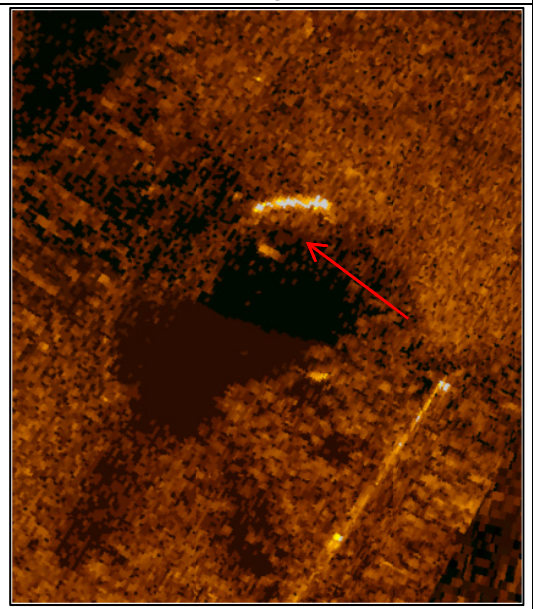
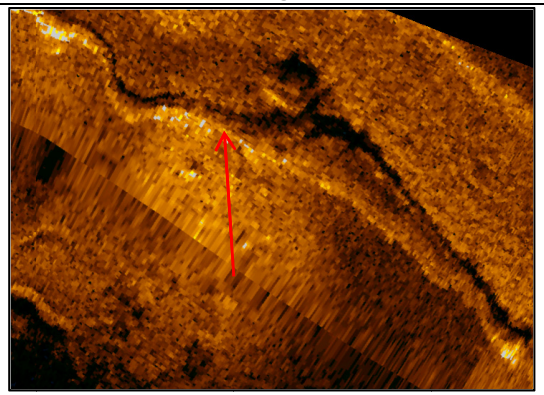
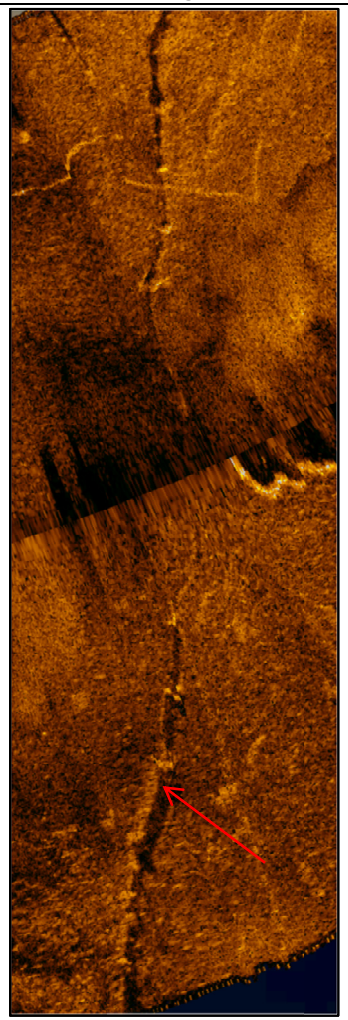
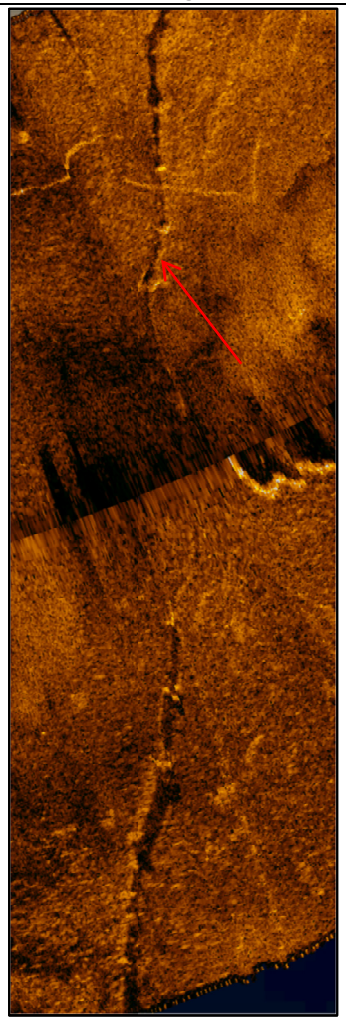
Table 4 – NASSCO Shipyards Sidescan Sonar Target Identification

		State Plane Coordinates Zone 6 (NAD 83)				State Plane Coordinates Zone 6 (NAD 83)	
Target	**Image**	**N**	**E**	**Target**	**Image**	**N**	**E**
6		1831912.15	6288184.49	**7**		1832003.49	6288208.09
		Lat	**Long**			**Lat**	**Long**
		32° 41’ 23.1299”	117° 08’ 19.9273”			32° 41’ 24.0356”	117° 08’ 19.6603”
		Description				**Description**	
		Unidentified object – tall shadow – high reflectance – possibly metallic in nature.				Linear object at toe of rip rap slope - approximately 110 Ft. in length.	

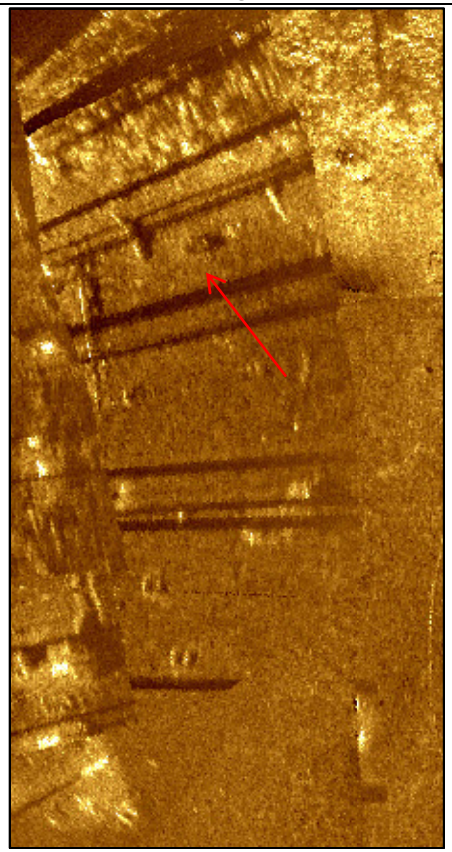
Environmental Data Solutions

Table 4 – NASSCO Shipyards Sidescan Sonar Target Identification

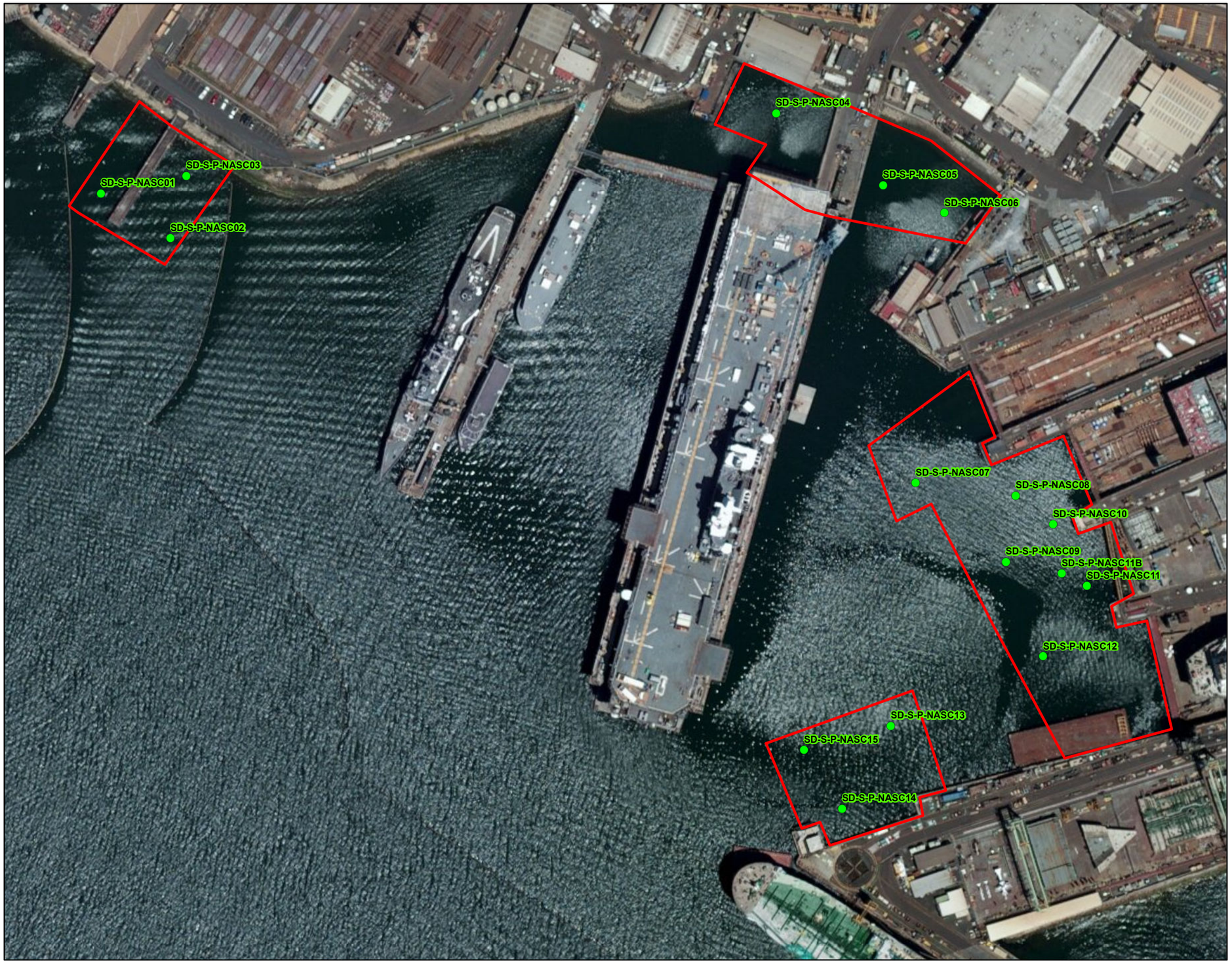
		State Plane Coordinates Zone 6 (NAD 83)				State Plane Coordinates Zone 6 (NAD 83)	
Target	**Image**	**N**	**E**	**Target**	**Image**	**N**	**E**
8		1832065.38	6287994.02	**9**		1832062.25	6287893.52
		Lat	**Long**			**Lat**	**Long**
		32° 41’ 24.6298”	117° 08’ 22.1712”			32° 41’ 24.5904”	117° 08’ 23.3467”
		Description				**Description**	
		Pipeline on surface – SLY – exposed reach – approximately 70 Ft. in length.				Pipeline on surface – NLY – exposed reach – approximately 90 Ft. in length. Note bent metal object on top of pipeline.	

Environmental Data Solutions

Table 4 – NASSCO Shipyards Sidescan Sonar Target Identification

		State Plane Coordinates Zone 6 (NAD 83)				State Plane Coordinates Zone 6 (NAD 83)	
Target	**Image**	**N**	**E**	**Target**	**Image**	**N**	**E**
10		1831999.85	6287060.61				
		Lat	**Long**				
		32° 41’ 23.9026”	117° 08’ 33.0856”				
		Description					
		Small debris field – approximately 4,220 Sq. Ft. Various linear objects, tires, construction debris (?).					

APPENDIX B
RESULTS OF SEDIMENT CORING



Legend

NASSCO Remediation Area

Map Notes:
CA State Plane 6 4060 (feet)
Imagery provided by Digital Globe 4-9-2010

GENERAL DYNAMICS nassco

amec

N W E S

0 100 200 300 400 Feet

Path: R:\2013\Aquatics\POSD\MXD\ReportFigures\ShipyardSediment\NASCO_Remediation_FinalSamplingPoints.mxd, jessie.lee 4/24/2013

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/11/2013 **Time:** 13:35

Latitude: 32°41.3925
Longitude: -117°08.5745
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 21.9

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0 – 0.8		Sandy Silt with Shell Hash	Very Dark Greenish-gray	Gley 1 5GY 3/1	None	
0.8 – 3.2		Silt with Sand				Dark streaks from 1.6' to 2.1'
3.2 – 4.8		Silt with Sand & Clay	Greenish-black	Gley 1 10y 2.5/1	Slight Hydrocarbon Odor	Shell Hash at 4.7'
4.8 – 5.0		Sandy Silt			None	

0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

Water Depth (ft): 25.0
Tide (ft): 3.1
Target Penetration (ft): To refusal
Actual Penetration (ft): 10.0
Recovered Core Length (ft): 8.2

Log of Station ID: SD-S-P-NASC01-Attempt 1

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/11/2013 **Time:** 13:35

Latitude: 32°41.3925
Longitude: -117°08.5745
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 21.9

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
5.0 – 5.5		Sandy Silt	Greenish-black	Gley 1 10y 2.5/1	None	
5.5 – 6.0		Very fine to fine grained Sand with Silt				
6.0 – 6.2		Silt with Clay				
6.2 – 7.0		Very fine to fine grained Sand with Silt & Shell Hash				Shell Hash size increases with depth
7.0 – 8.2		Silty Sand with Shell Hash				Bay Point/Native 1" to 2" gravel from 7.8' to 8.2
8.2 – 10.0						Refusal at 8.2'

Water Depth (ft): 25.0
Tide (ft): 3.1
Target Penetration (ft): To refusal
Actual Penetration (ft): 10.0
Recovered Core Length (ft): 8.2

Log of Station ID: SD-S-P-NASC01-Attempt 1

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/11/2013 **Time:** 14:07

Latitude: 32°41.3920
Longitude: -117°08.5740
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 22.2

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0 – 0.7		Sandy Silt with Shell Hash	Very Dark Greenish-gray	Gley 1 5GY 3/1	None	
0.7 – 2.7		Silt with Sand				
2.7 – 4.7		Silt with Sand & Clay				Shells at 4.0'
4.7 – 5.0		Sandy Silt				

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

Water Depth (ft): 24.8
Tide (ft): 2.6
Target Penetration (ft): To refusal
Actual Penetration (ft): 10.0
Recovered Core Length (ft): 8.0

Log of Station ID: SD-S-P-NASC01-Attempt 2

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/11/2013 **Time:** 14:07

Latitude: 32°41.3920
Longitude: -117°08.5740
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 22.2

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
5.0		Sandy Silt	Very Dark Greenish-gray	Gley 1 5GY 3/1	None	
		Sand with Silt & Clay				
5.5						Very dark gray streak (Gley 1 3/N) from 5.6' to 5.7'
6.0			Very Dark Grayish-brown	Gley 1 2.5Y 3/2		
		Clay with fine to very fine grained Sand & Shell Hash	Very Dark Greenish-gray	Gley 1 5GY 3/1		
6.5						Very dark gray streak (Gley 1 3/N) at 6.4'
		Silty coarse grained Sand with Shell Hash				Coarseness is the shell hash at 6.6'
7.0						Shell Hash increases with depth
7.5						Gravel up to 1" to 2" from 7.5' to end
8.0						Refusal at 8.0'
8.5						
9.0						
9.5						
10.0						

Water Depth (ft): 24.8
Tide (ft): 2.6
Target Penetration (ft): To refusal
Actual Penetration (ft): 10.0
Recovered Core Length (ft): 8.0

Log of Station ID: SD-S-P-NASC01-Attempt 2

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/12/2013 **Time:** 09:57

Latitude: 32°41.3809
Longitude: -117°08.5530
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 21.3

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0		Sandy Silt	Very Dark Greenish-gray	5GY 3/1	Slight Hydrocarbon Odor	
0.5						
1.0						
1.5		Silt with very fine to fine grained Sand & Clay				
2.0						
2.5						
			Very Dark Gray	Gley 1 3/N		
3.0			Very Dark Greenish-gray	5GY 3/1		Mussels down to 3.0' Material is dry & clumpy from 3.0' to 6.6' Odor decreases with depth
3.5						
4.0						
4.5						
5.0						

Water Depth (ft): 24.7
Tide (ft): 3.4
Target Penetration (ft): To refusal
Actual Penetration (ft): 13.7
Recovered Core Length (ft): 8.9

Log of Station ID: SD-S-P-NASC02-Attempt 1

Additional Notes: Soft plug

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/12/2013 **Time:** 09:57

Latitude: 32°41.3809
Longitude: -117°08.5530
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 21.3

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
5.0		Silt with very fine to fine grained Sand & Clay	Very Dark Greenish-gray	Gley 1 5GY 3/1	Slight Hydrocarbon Odor	
5.5			Olive	5Y 4/3	None	
6.0						
6.5						
7.0						Fine grained sand increases at 7.2'
7.5						Very fine to fine grained sand increases at 7.5'
8.0		Very fine to fine grained Sand with Silt				Shell Hash Bay Point/Native at 8.1'
8.5						
9.0						Refusal at 8.9'
9.5						
10.0						

Water Depth (ft): 24.7
Tide (ft): 3.4
Target Penetration (ft): To refusal
Actual Penetration (ft): 13.7
Recovered Core Length (ft): 8.9

Log of Station ID: SD-S-P-NASC02-Attempt 1

Additional Notes: Soft plug

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/12/2013 **Time:** 10:21

Latitude: 32°41.3811
Longitude: -117°08.5535
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 23.5

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0 – 1.3		Sandy Silt	Very Dark Greenish-gray	Gley 1 5GY 3/1	No Odor	
1.3 – 2.4		Silt with very fine to fine grained Sand & Clay	Very Dark Gray	Gley 1 3/N	Slight Hydrocarbon Odor	Mottled very dark gray/very dark greenish-gray from 1.3' to 2.4' Mussels at 1.7'
2.4 – 5.0			Very Dark Greenish-gray	Gley 1 5GY 3/1		Layer of mussels at 2.4' Piece of concrete with mussels on it at 2.6' Hydrocarbon odor decreases with depth

Water Depth (ft): 27.2
Tide (ft): 3.7
Target Penetration (ft): To refusal
Actual Penetration (ft): 13.0
Recovered Core Length (ft): 8.3

Log of Station ID: SD-S-P-NASC02-Attempt 2

Additional Notes: No plug

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/12/2013 **Time:** 10:21

Latitude: 32°41.3811
Longitude: -117°08.5535
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 23.5

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
5.0		Silt with very fine to fine grained Sand & Clay	Very Dark Greenish-gray	Gley 1 5GY 3/1	No Odor	
5.5						
6.0			Greenish-gray	10Y 5/1		
6.5						
7.0						
7.5		Very fine to fine grained Sand with Silt				Strata change at 7.2' Shell hash Shell hash increases in amount & size at 7.4' - Bay Point/Native
8.0		Fine Sand	Olive	5Y 4/3		
						Refusal at 8.3'
8.5						
9.0						
9.5						
10.0						

Water Depth (ft): 27.2
Tide (ft): 3.7
Target Penetration (ft): To refusal
Actual Penetration (ft): 13.0
Recovered Core Length (ft): 8.3

Log of Station ID: SD-S-P-NASC02-Attempt 2

Additional Notes: No plug

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/12/2013 **Time:** 07:51

Latitude: 32°41.3965
Longitude: -117°08.5485
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 15.8

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0		Sandy Silt	Very Dark Greenish-gray	Gley 1 5GY 3/1		Wood fragments in first foot - possible creosote to 3.0'
0.5						
1.0					Slight Hydrocarbon Odor	Shell hash at 1.0' Mussel bed at 1.2' & black streak
1.5						
2.0						
2.5					Strong Hydrocarbon Odor	Black streak at 2.6'
3.0		Silt with very fine to fine grained Sand & Clay				
3.5						
4.0						
4.5						Layer of shells - small fragments at 4.3'
5.0		Very fine to fine grained Sandy Silt				

Water Depth (ft): 16.8
Tide (ft): 1.0
Target Penetration (ft): To refusal
Actual Penetration (ft): 15.0
Recovered Core Length (ft): 10.0

Log of Station ID: SD-S-P-NASC03-Attempt 1

Additional Notes: Soft plug

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/12/2013 **Time:** 07:51

Latitude: 32°41.3965
Longitude: -117°08.5485
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 15.8

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
5.0		Very fine to fine grained Sandy Silt	Very Dark Greenish-gray	Gley 1 5GY 3/1	Strong Hydrocarbon Odor	Layer of shells at 5.0'
5.5, 6.0, 6.5		Silt with very fine to fine grained Sand & Clay	Dark Greenish-gray	Gley 1 5GY 4/1		
6.5, 7.0		Fine to very fine grained Sand with Silt & Gravel ~2"	Dark Grayish-brown	2.5Y 5/2	No Odor	New strata at 6.6'
7.0		Silt with Sand & Clay, gravel	Dark Greenish-gray	Gley 1 5GY 4/1		
7.5		Medium grained Sand w/ Silt & Shell Hash	Dark Grayish-brown	2.5Y 5/2		
7.5		Silt with Sand & Clay	Dark Greenish-gray	Gley 1 5GY 4/1		
7.5, 8.0, 8.5		Sand with Silt & Shell Hash, gravel	Dark Grayish-brown	2.5Y 5/2		
8.5, 9.0		Silt with Sand & Clay	Dark Greenish-gray	Gley 1 5GY 4/1		Layer of shells at 9.0'
9.0, 9.5, 10.0		Medium to fine grained Sand with Shell Hash	Grayish-brown	2.5Y 5/2		Shells increase in size - strong brown clay stringers, Bay Point/Native at 9.5' Refusal at 10.0'

Water Depth (ft): 16.8
Tide (ft): 1.0
Target Penetration (ft): To refusal
Actual Penetration (ft): 15.0
Recovered Core Length (ft): 10.0

Log of Station ID: SD-S-P-NASC03-Attempt 1

Additional Notes: Soft plug

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/11/2013 **Time:** 09:30

Latitude: 32°41.4133
Longitude: -117°08.3750
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 21.1

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0		Sandy Silt	Very Dark Greenish-gray	Gley 1 5GY 3/1	Strong Hydrocarbon Odor	
0.5			Black	Gley 1 2.5 /N		
						2" gravel at 0.8'
1.0						Small pieces of woody debris - creosote ?
1.5						
2.0						
2.5						
		Silt with Clay	Very Dark Greenish-gray	Gley 1 5GY 3/1		
						Black streak at 2.8'
3.0						
3.5						
		Sandy Silt			No Odor	
4.0		Silt with Clay				
		Sandy Silt				
4.5						
		Silt with Clay				
5.0						

Water Depth (ft): 25.0
Tide (ft): 3.9
Target Penetration (ft): To refusal
Actual Penetration (ft): 12.0
Recovered Core Length (ft): 10.0

Log of Station ID: SD-S-P-NASC04-Attempt 1

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/11/2013 **Time:** 09:30

Latitude: 32°41.4133
Longitude: -117°08.3750
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 21.1

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
5.0		Silt with Clay	Very Dark Greenish-gray	Gley 1 5GY 3/1	No Odor	
5.5						Black streak at 5.4'
			Dark Grayish-brown	2.5Y 4/2		
6.0						
6.5		Very fine to fine grained Sand with Silt, minor shell fragments				
7.0						
7.5						
8.0						
8.5						
9.0						
9.5						
		Clay with very fine grained Sand	Strong Brown	7.5YR 4/6		Clean/Native Refusal at 10.0'
10.0						

Water Depth (ft): 25.0
Tide (ft): 3.9
Target Penetration (ft): To refusal
Actual Penetration (ft): 12.0
Recovered Core Length (ft): 10.0

Log of Station ID: SD-S-P-NASC04-Attempt 1

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/11/2013 **Time:** 07:55

Latitude: 32°41.3960
Longitude: -117°08.3430
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 40.1

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0 – 3.0		Silt	Very Dark Greenish-gray	Gley 1 5GY 3/1	No Odor	
3.0 – 3.2		Silt with Sand				
3.2 – 3.3		Fine to medium grained Sand				
3.3 – 3.5		Silt			Slight Hydrocarbon Odor	(A) Sample collected of Hydrocarbon layer
3.5 – 3.7		Sandy Silt				
3.7 – 4.5		Silty Sand	Olive Brown	2.5Y 4/3	No Odor	Shell Hash at 3.7'
4.5 – 5.0		Silty Sand with Clay & Shell Hash				

Water Depth (ft): 42.0
Tide (ft): 1.9
Target Penetration (ft): To refusal
Actual Penetration (ft): 7.3
Recovered Core Length (ft): 5.6

Log of Station ID: SD-S-P-NASC05-Attempt 1

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/11/2013 **Time:** 07:55

Latitude: 32°41.3960
Longitude: -117°08.3430
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 40.1

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
5.0 – 5.5		Fine grained Sand with Silt & Clay, shell hash	Strong Brown	7.5YR 4/6	No Odor	Bay Point/Native
						Refusal at 5.6'

5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5, 10.0

Water Depth (ft): 42.0
Tide (ft): 1.9
Target Penetration (ft): To refusal
Actual Penetration (ft): 7.3
Recovered Core Length (ft): 5.6

Log of Station ID: SD-S-P-NASC05-Attempt 1

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/11/2013 **Time:** 11:34

Latitude: 32°41.3965
Longitude: -117°08.3226
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 15.7

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0						No penetration - Repositioning for 2nd attempt
0.5						
1.0						
1.5						
2.0						
2.5						
3.0						
3.5						
4.0						
4.5						
5.0						

Water Depth (ft): 20.3
Tide (ft): 4.6
Target Penetration (ft): To refusal
Actual Penetration (ft): 0.0
Recovered Core Length (ft): 0.0

Log of Station ID: SD-S-P-NASC06-Attempt 1

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/11/2013 **Time:** 11:38

Latitude: 32°41.3932
Longitude: -117°08.3237
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 16.5

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0 – 1.7		Silty Sand	Very Dark Greenish-gray	Gley 1 5GY 3/1		3" gravel piece/riprap at 1.2'
1.7 – 5.0						Refusal at 1.7'

Water Depth (ft): 21.0
Tide (ft): 4.5
Target Penetration (ft): To refusal
Actual Penetration (ft): 3.0
Recovered Core Length (ft): 1.7

Log of Station ID: SD-S-P-NASC06-Attempt 2

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/11/2013 **Time:** 12:00

Latitude: 32°41.3888
Longitude: -117°08.3252
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 16.6

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0		Silt	Very Dark Greenish-gray	Gley 1 5GY 3/1	No Odor	
0.5						Ghost shrimp at 0.6'
1.0		Silt with Sand				
		Silt				
1.5		Silt with Sand			Slight Hydrocarbon Odor	
2.0		Medium grained Sand with Silt	Black Streaks	Gley 1 2.5Y /N		Dry layer from 2.0' to 2.1' Black streaks from 2.0 to 2.2'
		Silty Sand mixed with Clay	Dark Greenish-gray	5GY 4/1		Paint (?) from 2.2' to 2.5'
2.5		Clay			No Odor	Clay at 2.5'
		Medium grained Silty Sand				3" Rock - concrete ? at 2.8'
3.0		Very fine to fine grained Sand with Silt & Clay				
3.5						Clean Native
						Refusal at 3.8'
4.0						
4.5						
5.0						

Water Depth (ft): 21.0
Tide (ft): 4.4
Target Penetration (ft): To refusal
Actual Penetration (ft): 3.8
Recovered Core Length (ft): 3.8

Log of Station ID: SD-S-P-NASC06-Attempt 3

Additional Notes: (A) collected at 2.2' to 2.5' due to what appeared to be paint in the core

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/10/2013 **Time:** 14:30

Latitude: 32°41.3216
Longitude: -117°08.3330
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 23.0

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0		Silt with Sand	Dark Greenish-gray	Gley 15GY 4/1		
0.5						
1.0			Very Dark Greenish-gray	Gley 1 5G 3/1		
1.5		Silt				
2.0						
2.5						
3.0		Silt with Clay			Slight Hydrocarbon Odor	
3.5						
4.0						
4.5						
5.0						

Water Depth (ft): 24.5
Tide (ft): 1.5
Target Penetration (ft): To refusal
Actual Penetration (ft): 8.5
Recovered Core Length (ft): 8.2

Log of Station ID: SD-S-P-NASC07-Attempt 1

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/10/2013 **Time:** 14:30

Latitude: 32°41.3216
Longitude: -117°08.3330
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 23.0

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
5.0		Silt with Clay	Very Dark Greenish-gray	Gley 1 5G 3/1	Slight Hydrocarbon Odor	
5.5						
6.0						
		Fine grained Sand with Silt & Clay				
6.5						
		Clay				
7.0						
		Silt with Clay				
		Clay				
7.5						Plug from 7.6' to 8.2'
		Fine to medium grained Sand	Strong Brown	7.5YR 4/6	No Hydrocarbon Odor	
8.0						Clean Native
						Refusal at 8.2'
8.5						
9.0						
9.5						
10.0						

Water Depth (ft): 24.5
Tide (ft): 1.5
Target Penetration (ft): To refusal
Actual Penetration (ft): 8.5
Recovered Core Length (ft): 8.2

Log of Station ID: SD-S-P-NASC07-Attempt 1

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/10/2013 **Time:** 08:30

Latitude: 32°41.3186
Longitude: -117°08.3035
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 20.0

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0		Sandy Silt with Shell Hash	Dark Greenish-gray	Gley 1 5GY 4/1	None	
0.5		Sandy Silt				
1.0			Very Dark Greenish-gray	Gley 1 5GY 3/1		
1.5						
2.0		Silt with Sand			Slight Hydrocarbon Odor	
2.5						
3.0		Silt with Clay			Hydrocarbon Odor Increases	
3.5						Black streak at 3.6', strong hydrocarbon odor
4.0						
4.5						
5.0						

Water Depth (ft): 23.7
Tide (ft): 3.7
Target Penetration (ft): To refusal
Actual Penetration (ft): 12.0
Recovered Core Length (ft): 9.8

Log of Station ID: SD-S-P-NASC08-Attempt 1

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/10/2013 **Time:** 08:30

Latitude: 32°41.3186
Longitude: -117°08.3035
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 20.0

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
5.0		Silt with Clay	Very Dark Greenish-gray	Gley 1 5GY 3/1	No Hydrocarbon Odor after 5.0'	
5.5						
6.0						
6.5						
7.0						
7.5						
8.0						
8.5						
9.0		Silty Sand with Clay	Dark Greenish-gray	Gley 1 5GY 4/1		More dry at 9.0'
9.5		Fine grained Silty Sand	Dark Olive Brown	2.5Y 3/3		Rubber o-ring gasket at 9.5' Clean Native
						Refusal at 9.8'
10.0						

Water Depth (ft): 23.7
Tide (ft): 3.7
Target Penetration (ft): To refusal
Actual Penetration (ft): 12.0
Recovered Core Length (ft): 9.8

Log of Station ID: SD-S-P-NASC08-Attempt 1

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/10/2013 **Time:** 12:45

Latitude: 32°41.3025
Longitude: -117°08.3071
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 23.3

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0 – 2.0		Silt	Very Dark Greenish-gray	Gley 1 5GY 3/1	None	
2.0 – 5.0		Silt with Clay			Slight Hydrocarbon Odor	

Water Depth (ft): 26.7
Tide (ft): 3.4
Target Penetration (ft): To refusal
Actual Penetration (ft): 6.6
Recovered Core Length (ft): 6.6

Log of Station ID: SD-S-P-NASC09-Attempt 1

Additional Notes: Hard Refusal

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/10/2013 **Time:** 12:45

Latitude: 32°41.3025
Longitude: -117°08.3071
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 23.3

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
5.0 – 6.5		Silt with Clay	Very Dark Greenish-gray	Gley 1 5GY 3/1	Slight Hydrocarbon Odor	
						Refusal at 6.6'

5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0

Water Depth (ft): 26.7
Tide (ft): 3.4
Target Penetration (ft): To refusal
Actual Penetration (ft): 6.6
Recovered Core Length (ft): 6.6

Log of Station ID: SD-S-P-NASC09-Attempt 1

Additional Notes: Hard Refusal

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/10/2013 **Time:** 13:15

Latitude: 32°41.3021
Longitude: -117°08.3062
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 22.2

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0 – 2.0		Silt	Very Dark Greenish-gray	Gley 1 5GY 3/1	None	
2.0 – 3.0		Silt with Sand			Slight Hydrocarbon Odor	
3.0 – 5.0		Silt with Clay				

Water Depth (ft): 25.1
Tide (ft): 2.9
Target Penetration (ft): To refusal
Actual Penetration (ft): 7.5
Recovered Core Length (ft): 6.7

Log of Station ID: SD-S-P-NASC09-Attempt 2

Additional Notes: Hard Refusal

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/10/2013 **Time:** 13:15

Latitude: 32°41.3021
Longitude: -117°08.3062
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 22.2

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
5.0		Silt with Clay	Very Dark Greenish-gray	Gley 1 5GY 3/1	Slight Hydrocarbon Odor	
5.5		Silt with fine grained Sand & Clay				
6.0		Fine to medium grained Sand with Silt	Dark Olive Gray	5Y 3/2	None	Little clay, density increase with depth from 6.0' to 6.3'
6.5						Very hard/dense plug from 6.6' to 6.7
						Refusal at 6.7', 2" gravel in plug material
7.0						
7.5						
8.0						
8.5						
9.0						
9.5						
10.0						

Water Depth (ft): 25.1
Tide (ft): 2.9
Target Penetration (ft): To refusal
Actual Penetration (ft): 7.5
Recovered Core Length (ft): 6.7

Log of Station ID: SD-S-P-NASC09-Attempt 2

Additional Notes: Hard Refusal

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/10/2013 **Time:** 08:00

Latitude: 32°41.3093
Longitude: -117°08.2916
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 20.4

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0 – 1.2		Silt with Sand	Very Dark Greenish-gray	Gley 1 5GY 3/1	None	
1.2 – 1.6		Sandy silt				
1.6 – 2.3		Medium to coarse grained Sand & Gravel				Gravel at 2'4"
2.3						Rock refusal met at 2.3'

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

Water Depth (ft): 23.5
Tide (ft): 3.1
Target Penetration (ft): To refusal
Actual Penetration (ft): 5.5
Recovered Core Length (ft): 2.3

Log of Station ID: SD-S-P-NASC10-Attempt 1

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/10/2013 **Time:** 10:10

Latitude: 32°41.3085
Longitude: -117°08.2925
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 20.6

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0		Sandy Silt	Very Dark Greenish-gray	Gley 1 5GY 3/1	None	
0.5						
1.0						
1.5		Silty Sand				
		Sand with Silt & Gravel				4" piece of gravel at 2.0'
2.0						
2.5						
3.0		Fine grained Sand				
3.5		Silt with Sand				
		Silt with Clay				
4.0						
						Streaks - black & olive brown from 4.3' to 5.5'
4.5						
5.0						

Water Depth (ft): 25.5
Tide (ft): 4.9
Target Penetration (ft): To refusal
Actual Penetration (ft): 10.0
Recovered Core Length (ft): 7.4

Log of Station ID: SD-S-P-NASC10-Attempt 2

Additional Notes: No solid end plug - HC odor at 7.4'

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/10/2013 **Time:** 10:10

Latitude: 32°41.3085
Longitude: -117°08.2925
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 20.6

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
5.0		Silt with Clay	Very Dark Greenish-gray	Gley 1 5GY 3/1	None	
5.5					Hydrocarbon Odor	
6.0						
6.5						
7.0						
7.5						Refusal at 7.4', bounded contamination ?
8.0						
8.5						
9.0						
9.5						
10.0						

Water Depth (ft): 25.5
Tide (ft): 4.9
Target Penetration (ft): To refusal
Actual Penetration (ft): 10.0
Recovered Core Length (ft): 7.4

Log of Station ID: SD-S-P-NASC10-Attempt 2

Additional Notes: No solid end plug - HC odor at 7.4'

Project Number:	1315100800		
Project Manager:	Barry Snyder	**Latitude:**	32°41.3116
Logged and Sampled By:	KG/TH/BL	**Longitude:**	-117°08.2924
Sample Type:	Vibracore	**Project Depth (ft MLLW):**	N/A
Date:	4/10/2013 **Time:** 10:45	**Mudline Elevation (ft MLLW):**	20.6

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0		Sandy Silt	Very Dark Greenish-gray	Gley 1 5GY 3/1	None	
0.5						
1.0		Silty Sand				
1.5						
2.0						
2.5						
		Sand with Silt & Gravel				Gravel-size is 2" to 3"
3.0						
3.5						
						Gravel stops at 3.8'
4.0						
4.5						Refusal at 4.5', refusal due to sand & gravel, bounded contamination ?
5.0						

Water Depth (ft):	25.5	**Target Penetration (ft):**	To refusal
Tide (ft):	4.9	**Actual Penetration (ft):**	8.5
		Recovered Core Length (ft):	4.5

Log of Station ID: SD-S-P-NASC10-Attempt 3

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/9/2013 **Time:** 15:25

Latitude: 32°41.2963
Longitude: -117°08.2823
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 21.6

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0		Silt	Very Dark Greenish-gray	Gley 1 5GY 3/1	None	
0.5						
1.0		Silt with fine grained Sand				
1.5						
2.0		Silt				
		Silt with fine grained Sand				
2.5						
3.0						
3.5		Silt with fine grained Sand & Clay			Organic Odor at 3.4'	
					None	
4.0						
4.5						
5.0						

Water Depth (ft): 21.9
Tide (ft): 0.3
Target Penetration (ft): To refusal
Actual Penetration (ft): 11.3
Recovered Core Length (ft): 9.0

Log of Station ID: SD-S-P-NASC11-Attempt 1

Additional Notes: Plug of large cobbles (4") & clay, clay appears "clean" jarred & called "native" but could not confirm

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/9/2013 **Time:** 15:25

Latitude: 32°41.2963
Longitude: -117°08.2823
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 21.6

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
5.0 – 8.5		Silt with fine grained Sand & Clay	Very Dark Greenish-gray	Gley 1 5GY 3/1	None	No photos taken of rocks covered in clay from 8.5' to 9.0', Clean Native, big rocks last 6" covered in clay
9.0						Refusal at 9.0'

5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0

Water Depth (ft): 21.9
Tide (ft): 0.3
Target Penetration (ft): To refusal
Actual Penetration (ft): 11.3
Recovered Core Length (ft): 9.0

Log of Station ID: SD-S-P-NASC11-Attempt 1

Additional Notes: Plug of large cobbles (4") & clay, clay appears "clean" jarred & called "native" but could not confirm

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/12/2031 **Time:** 13:00

Latitude: 32°41.2993
Longitude: -117°08.2898
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 22.9

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0 – 1.0		Silt with Sand	Dark Greenish-gray	Gley 1 10Y 4/1	Slight Hydrocarbon Odor	Sheen in water
1.0 – 5.0		Silt with Sand & Clay	Very Dark Greenish-gray	Gley 1 5GY 3/1		Core increases firmness with depth

Water Depth (ft): 26.8
Tide (ft): 3.9
Target Penetration (ft): To refusal
Actual Penetration (ft): 9.7
Recovered Core Length (ft): 7.8

Log of Station ID: SD-S-P-NASC11B-Attempt 1

Additional Notes: Follow up attempt for SD-S-P-NASC011 on 4-9-13

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/12/2031 **Time:** 13:00

Latitude: 32°41.2993
Longitude: -117°08.2898
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 22.9

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
5.0		Silt with Sand & Clay	Very Dark Greenish-gray	Gley 1 5GY 3/1	Slight Hydrocarbon Odor	
5.5						
6.0			Dark Gray	5Y 4/1		
6.5						
		Medium to fine grained Silty Sand with shell hash			None	
		Clay	Dark Grayish-brown	10YR 4/2		
7.0						
		Silty Sand with large gravel & shell hash & clay lenses				Gravel is 1" to 3"
7.5						Top of core mixed with water & silt from plug in container - dark greenish-gray mixed in from 7.4' to 7.8' Bay Point/Native
						Refusal at 7.8'
8.0						
8.5						
9.0						
9.5						
10.0						

Water Depth (ft): 26.8
Tide (ft): 3.9
Target Penetration (ft): To refusal
Actual Penetration (ft): 9.7
Recovered Core Length (ft): 7.8

Log of Station ID: SD-S-P-NASC11B-Attempt 1

Additional Notes: Follow up attempt for SD-S-P-NASC011 on 4-9-13

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/9/2013 **Time:** 13:00

Latitude: 32°41.2756
Longitude: -117°08.2919
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 24.0

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0						Refusal not met; therefore, core not logged but photos taken, discarded
0.5						
1.0						
1.5						
2.0						
2.5						
3.0						
3.5						
4.0						
4.5						
5.0						

Water Depth (ft): 26.4
Tide (ft): 2.4
Target Penetration (ft): To refusal
Actual Penetration (ft): 9.5
Recovered Core Length (ft): 8.0

Log of Station ID: SD-S-P-NASC12-Attempt 1

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/9/2013 **Time:** 14:10

Latitude: 32°41.2786
Longitude: -117°08.2950
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 24.6

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0 – 1.0		Very fine grained Sand with Silt	Dark Greenish-gray	Gley 1 5GY 4/1	Hydrocarbon Odor	
1.0 – 3.2			Very Dark Greenish-gray	Gley 1 5GY 3/1		
2.0 – 3.2		Silt with very fine grained Sand & Clay				
3.2 – 3.4		Medium to fine grained Sand with Silt				Lens of fine to medium grained sand from 3.2' to 3.4'
3.4 – 4.2		Silt with very fine grained Sand & Clay			Strong Hydrocarbon Odor	
4.2 – 4.5		Very fine grained Sand with Silt			None	
4.5 – 5.0		Clay with Silt, lenses of medium grained Sand				

Water Depth (ft): 25.6
Tide (ft): 1.0
Target Penetration (ft): To refusal
Actual Penetration (ft): 8.5
Recovered Core Length (ft): 7.8

Log of Station ID: SD-S-P-NASC12-Attempt 2

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/9/2013 **Time:** 14:10

Latitude: 32°41.2786
Longitude: -117°08.2950
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 24.6

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
5.0 – 5.5		Clay with Silt, lenses of medium grained Sand	Very Dark Greenish-gray	Gley 1 5GY 3/1	None	
5.5 – 6.0		Fine grained Sand with Silt				
6.0		Clay with very fine grained Sand	Strong Brown	7.5YR 4/6		Black streak (Gley 1 2.5N) at 6.0'
6.0 – 6.5		Fine grained Sand with Silt	Very Dark Greenish-gray	Gley 1 5GY 3/1		Black streak at 6.2'
6.5 – 7.5		Fine grained Sand with Silt & Clay	Strong Brown	7.5YR 4/6		Clean Native
7.5 – 10.0						Refusal at 7.8'

Water Depth (ft): 25.6
Tide (ft): 1.0
Target Penetration (ft): To refusal
Actual Penetration (ft): 8.5
Recovered Core Length (ft): 7.8

Log of Station ID: SD-S-P-NASC12-Attempt 2

Additional Notes:

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/9/2013 **Time:** 10:55

Latitude: 32°41.2610
Longitude: -117°08.3397
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 25.5

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0		Silt	Very Dark Greenish-gray	Gley 1 5GY 3/1	None	
0.5						
1.0						
1.5						Black streak of decomposed shells at 1.5'
2.0		Silt with Clay				
2.5						
3.0						
3.5						
4.0						
		Silty Sand	Olive Brown	2.5Y 4/3		Little gravel at 4.2'
4.5						
		Silty Sand with Clay				
5.0						

Water Depth (ft): 30.4
Tide (ft): 4.9
Target Penetration (ft): To refusal
Actual Penetration (ft): 8.5
Recovered Core Length (ft): 7.0

Log of Station ID: SD-S-P-NASC13-Attempt 1

Additional Notes: Windy, odors difficult to smell

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/9/2013 **Time:** 10:55

Latitude: 32°41.2610
Longitude: -117°08.3397
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 25.5

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
5.0		Silty Sand with Clay	Dark Greenish-gray	Gley 1 5GY 4/1	None	Gravel ~3.5" with clay around from 5.0' to 5.3'
			Olive Brown	2.5Y 4/3		
5.5		Fine grained Sand with Silt & Gravel				
6.0						
6.5		Fine & medium grained Sand	Strong Brown	7.5YR 4/6		Clean Native
7.0						Refusal at 7.0'
7.5						
8.0						
8.5						
9.0						
9.5						
10.0						

Water Depth (ft): 30.4
Tide (ft): 4.9
Target Penetration (ft): To refusal
Actual Penetration (ft): 8.5
Recovered Core Length (ft): 7.0

Log of Station ID: SD-S-P-NASC13-Attempt 1

Additional Notes: Windy, odors difficult to smell

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/9/2013 **Time:** 08:15

Latitude: 32°41.2403
Longitude: -117°08.3538
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 24.9

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0 – 0.7		Silty Sand with Shell Hash	Very Dark Greenish-gray	Gley 1 5GY 3/1	None	Increasing silt, unconsolidated silts at top
0.7 – 1.0		Silt with minor Shell Hash				
1.0 – 3.0		Silt with very fine grained Sand				
3.0 – 4.2		Very fine grained Sand with Clay	Dark Olive Brown	2.5Y 3/3		Core catcher plug from 3.9' to 4.2' Clean Native
4.2 – 5.0						Refusal at 4.2'

Water Depth (ft): 29.4
Tide (ft): 4.5
Target Penetration (ft): To refusal
Actual Penetration (ft): 6.5
Recovered Core Length (ft): 4.2

Log of Station ID: SD-S-P-NASC14-Attempt 1

Additional Notes: Windy, odors difficult to smell

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/9/2013 **Time:** 09:15

Latitude: 32°41.2545
Longitude: -117°08.3650
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 26.9

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0		Silt with very fine grained Sand	Very Dark Greenish-gray	Gley 1 5GY 3/1	None	
0.5		Silt				
1.0						
		Silty Sand, medium & fine grained Sand with Clay	Dark Olive Brown	2.5Y 3/3		Gravel piece at 1.3'
1.5			Dark Greenish-gray	Gley 1 10Y 4/1		
2.0						Increasing clay toward bottom
2.5						
						Refusal at 6.5, no plug - 2nd attempt made, material possibly lost from core due to lack of plug
3.0						
3.5						
4.0						
4.5						
5.0						

Water Depth (ft): 32.0
Tide (ft): 5.1
Target Penetration (ft): To refusal
Actual Penetration (ft): 6.5
Recovered Core Length (ft): 2.6

Log of Station ID: SD-S-P-NASC15-Attempt 1

Additional Notes: Windy, odors difficult to smell

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/9/2013 **Time:** 09:40

Latitude: 32°41.2545
Longitude: -117°08.3652
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 26.8

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
0.0		Silt with fine grained Sand	Dark Greenish-gray	Gley 1 4/1	None	Sheen in water
0.5						
1.0			Very Dark Greenish-gray	Gley 1 5GY 3/1		
1.5						
2.0						
2.5						
3.0			Black	Gley 1 2.5/N		Some shells
			Very Dark Gray	Gley 1 4/N		
3.5			Very Dark Greenish-brown	2.5Y 3/2		
4.0						Gravel ~2" long at 4.0'
						Copper battery terminal wire at 4.2'
4.5		Clay	Olive Brown & Strong Brown	2.5Y 4/3 & 7.5YR 4/6		
		Fine to medium grained Sand with Silt				
5.0						

Water Depth (ft): 32.0
Tide (ft): 5.2
Target Penetration (ft): To refusal
Actual Penetration (ft): 6.0
Recovered Core Length (ft): 6.0

Log of Station ID: SD-S-P-NASC15-Attempt 2

Additional Notes: Windy, odors difficult to smell

Project Number: 1315100800
Project Manager: Barry Snyder
Logged and Sampled By: KG/TH/BL
Sample Type: Vibracore
Date: 4/9/2013 **Time:** 09:40

Latitude: 32°41.2545
Longitude: -117°08.3652
Project Depth (ft MLLW): N/A
Mudline Elevation (ft MLLW): 26.8

Depth in Feet	Lithology	Sediment Description	Color	Munsell Color Notation	Odor	Remarks
5.0		Fine to medium grained Sand with Silt	Olive Brown & Strong Brown	2.5Y 4/3 & 7.5YR 4/6	None	
5.5		Fine grained Sand with Clay				Reddish streaks at 5.5' Clean Native
6.0						Refusal at 6.0'
6.5						
7.0						
7.5						
8.0						
8.5						
9.0						
9.5						
10.0						

Water Depth (ft): 32.0
Tide (ft): 5.2
Target Penetration (ft): To refusal
Actual Penetration (ft): 6.0
Recovered Core Length (ft): 6.0

Log of Station ID: SD-S-P-NASC15-Attempt 2

Additional Notes: Windy, odors difficult to smell

APPENDIX C
GEOTECHNICAL EXPLORATIONS

RESULTS OF GEOTECHNICAL EXPLORATIONS

SAN DIEGO SHIPYARD SEDIMENT SITE – SOUTH SHIPYARD

Prepared for

San Diego Bay Environmental Restoration Fund – South Trust

Prepared by

Anchor QEA, L.P.
26300 La Alameda, Suite 240
Mission Viejo, California 92691

August 2013

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Attachment A Laboratory Test Results

1 INTRODUCTION

This appendix documents the methods Anchor QEA used in determining the nature of the soils underlying the project site addressed by this report. The discussion includes information on the following subjects:

- Explorations and Their Location.
- The Use of Auger Borings.
- Standard Penetration Test (SPT) Procedures
- Laboratory Testing Program

2 GEOTECHNICAL EXPLORATIONS

2.1 Explorations and Their Location

Subsurface explorations for this project consisted of three offshore soil borings, performed by Gregg Drilling and Testing of Signal Hill, California, working as a subcontractor to Anchor QEA. The exploration logs within this appendix show our interpretation of the drilling, sampling, and testing data. They indicate the depth where the soils change. Note that the change may be gradual. In the field, we classified the samples taken from the explorations according to the methods presented on Figure A-1- Key to Exploration Logs. This figure also provides a legend explaining the symbols and abbreviations used in the logs.

Figure 5 of the Basis of Design Memorandum shows the location of the explorations performed. A Differential Global Positioning System was used to estimate the locations of the explorations. The method used determines the accuracy of the location and elevation of the explorations.

2.2 The Use of Auger Borings

Three Mud rotary auger borings, designated AQ-B1 through AQ-B3, were drilled from May 6 to May 8, 2013. Each exploration was completed to a depth of 36.5 feet below mudline. The borings were advanced with a vessel-mounted drill rig. The drilling was continuously observed by an Anchor QEA representative. Detailed field logs were prepared of each boring. Using the Standard Penetration Test (SPT), and thin-walled Shelby tubes, we typically obtained samples at 2-1/2- to 5-foot-depth intervals, although some samples were spaced at

10 foot intervals. The borings logs are presented on Figures A-2 through A-4 at the end of this appendix. All explorations were performed in-water with water depths typically greater than 25 feet.

2.3 Standard Penetration Test Procedures

This test is an approximate measure of soil density and consistency. To be useful, the results must be used with engineering judgment in conjunction with other tests. The SPT (as described in ASTM D 1587) was used to obtain disturbed samples. This test employs a standard 2-inch-outside diameter split-spoon sampler. Using a 140-pound hammer, free-falling 30 inches, the sampler is driven into the soil for 18 inches. The number of blows required to drive the sampler the last 12 inches only is the Standard Penetration Resistance. This resistance, or blow count, measures the relative density of granular soils and the consistency of cohesive soils. The blow counts are plotted on the boring logs at their respective sample depths. Soil samples are recovered from the split-barrel sampler, field classified, and placed into water tight containers. They are then taken to a geotechnical laboratory for further testing.

At the direction of the field engineer, a 3-inch-outer diameter split spoon sampler known as a California Modified split spoon sampler was used when gravels were believed to be present at the sample depth. Similar to soils recovered from the 2-inch-diameter split barrel sampler, soil samples recovered were sent to the laboratory for testing.

2.3.1 In the Event of Hard Driving

Occasionally very dense materials preclude driving the total 18-inch sample. When this happens, the penetration resistance is entered on logs as follows:

Penetration less than 6 inches.
The log indicates the total number of blows over the number of inches of penetration.

Penetration greater than 6 inches.
The blow count noted on the log is the sum of the total number of blows completed after the first 6 inches of penetration. This sum is expressed over the number of inches driven that

exceed the first 6 inches. The number of blows needed to drive the first 6 inches is not reported. For example, a blow count series of 12 blows for 6 inches, 30 blows for 6 inches, and 50 (the maximum number of blows counted within a 6 inch increment for SPT) for 3 inches would be recorded as 80/9

2.3.2 California Modified Split Spoon Sampler

Samples recovered using the 3-inch-diameter split barrel sampler were denoted with a unique symbol according to the Key to Exploration Figure. Blow counts for samples collected with the diameter sampler were observed to provide an estimate of soil density, but because methods do not follow ASTM standards for the Standard Penetration Test, blow counts were not reported in the boring logs.

3 LABORATORY TESTING PROGRAM

A laboratory testing program was performed for this study to evaluate the basic index and geotechnical engineering properties of the site soils. Laboratory samples were transported to Environmental Geotechnical Laboratory of Arcadia, California for testing. Due to the properties of soils encountered, only disturbed samples undisturbed samples were successfully collected. As a result only tests appropriate for disturbed samples were performed.

A summary of lab results are presented in the tables and figures attached to this appendix. The tests performed and the procedures followed are outlined below.

3.1 Soil Classification

Soil samples from the explorations were visually classified in the field and then taken to the selected laboratory where the classifications were verified in a relatively controlled laboratory environment. Field and laboratory observations include density/consistency, moisture condition, and grain size and plasticity estimates.

The classifications of selected samples were checked by laboratory tests such as Atterberg limits determinations and grain size analyses. Classifications were made in general accordance with the Unified Soil Classification (USC) System, ASTM D 2487.

3.2 Water Content Determinations

Upon sample arrival to the laboratory, water contents were determined for most samples recovered in the explorations in general accordance with ASTM D 2216. The results of these tests are presented at the respective sample depth on the exploration logs. In addition, water contents were routinely determined for samples subjected to other testing. These are also presented on the exploration logs.

3.3 Atterberg Limits

Atterberg limits were determined for selected fine-grained soil samples. The liquid limit and plastic limit were determined in general accordance with ASTM D 4318-84. The results of the Atterberg limit analyses and the plasticity characteristics are summarized in the lab report attached to this appendix. This relates the plasticity index (liquid limit minus the plastic limit) to the liquid limit. The results of the Atterberg limits tests are shown graphically on the boring logs as well as where applicable on figures presenting various other test results.

3.4 Grain Size Analysis

Grain size distribution was analyzed for representative samples in general accordance with ASTM D 422. Wet sieve analysis was used to determine the size distribution greater than the U.S. No. 200 mesh sieve. The size distribution for particles smaller than the No. 200 mesh sieve was determined by the hydrometer method for a selected number of samples. Grain size distribution curves for these tests are presented in the attached lab report to this appendix.

3.5 Percent Passing 200 Sieve and Hydrometer

The percent of particles passing the No. 200 sieve were analyzed on representative samples in general accordance with ASTM D 1140. Results of the percent passing the No. 200 sieve are presented in the summary table attached to this appendix. The size distribution for particles smaller than the No. 200 mesh sieve was determined by the hydrometer method for a selected number of samples. The results of the tests are presented as curves on selected figures presented as attachments to this appendix.

3.6 Specific Gravity

Specific gravity was for a representative samples in general accordance with ASTM D 854.

3.7 Torvane Maximum Shear

Because no undisturbed samples could be collected during drilling, Torvane Maximum Shear tests were performed as a proxy tri-axial shear testing, a more accurate method of estimating strength.

FIGURES

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density□consistency, moisture condition, grain si□e, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. □isual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
Density□consistency, moisture, color, minor constituents, MA□OR CONSTITUENT, additional remar□s.

Density/Consistency

Soil density□consistency in borings is related primarily to the Standard Penetration Resistance. Soil density□consistency in test pits is estimated based on visual observation and is presented parenthetically on the test pit logs.

Density SAND or Gravel	Standard Penetration Resistance (N) in Blows□Foot	SILT or CLA□ Consistency	Standard Penetration Resistance (N) in Blows□Foot	Appro□imate Shear Strength in TSF
□ery loose	0 - 4	□ery soft	0 - 2	□0.12□
Loose	4 - 10	Soft	0 - 4	0.12□ - 0.2□
Medium dense	10 - 30	Medium stiff	4 - 8	0.2□ - 0.□
Dense	30 - □0	Stiff	8 - 1□	0.□ - 1.0
□ery dense	□□0	□ery stiff	1□ - 30	1.0 - 2.0
		□ard	□30	□2.0

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible moisture, probably above optimum

Minor Constituents

	Estimated Percentage
Not identified in description	0 - □
Slightly (clayey, silty, etc.)	□ - 12
Clayey, silty, sandy, gravelly	12 - 30
□ery (clayey, silty, etc.)	30 - □0

Legends

Sampling Test Symbols

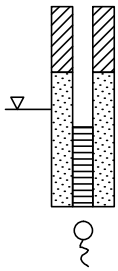
BORING SAMPLES

- Split Spoon
- Shelby Tube
- Cuttings
- Core Run
- California-modified Split Spoon
- ✳ No Sample Recovery
- P Tube Pushed, Not Driven

TEST PIT SAMPLES

- Grab (□ar)
- Bag
- Shelby Tube

Groundwater Observations



Surface Seal

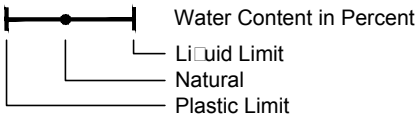
Groundwater Level on Date (ATD) At Time of Drilling

Observation Well Tip or Slotted Section

Groundwater Seepage (Test Pits)

Test Symbols

GS	Grain Si□e
Comp	Composite
Chem	Chemistry
NS	No Sheen
SS	Slight Sheen
MS	Moderate Sheen
□S	□eavy Sheen
TCD	Tra□ial Consolidated Drained
□U	Unconfined Compression
DS	Direct Shear
□	Permeability
PP	Poc□et Penetrometer - Appro□imate Compressive Strength in TSF
T□	Trovane - Appro□imate Shear Strength in TSF
AL	Atterberg Limits



PID	Photoioni□ation Detector Reading
CA	Chemical Analysis
DT	In Situ Density Test

May 31, 2013 3:□pm heri□sen \\socal2\disneyland\PRO□ECTS\NASSCO_BAE Systems\San_Diego_Shipyard_Sediment_Site(Attorney-Client Privilege)\Pre-Design_and_Design_S□E□ TO EXPLORATIONS.dwg 1

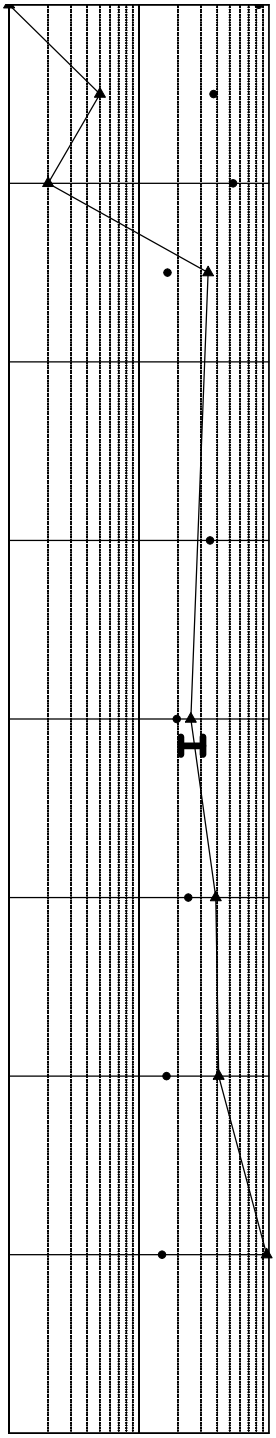
ANCHOR QEA

Figure 1
□ey to E□plorations
San Diego Shipyard Site - South Shipyard

Boring: AQ-B1

Northing (NAD83 WA SP S Feet):1831056.40
Easting (NAD83 WA SP S Feet):6288096.79
Water Depth:25
Mudline Elevation:19

Description	Depth in Feet	Elevation	Samples	Lab Test
Very soft, wet, dark gray very sandy CLAY with trace seashells (RECENT BAY DEPOSITS)	0	-20	S1	WC, HYD, SG = 2.79
Loose, wet, brown sandy GRAVEL.	5	-25	S2	WC
Dense, moist, brown silty sandy GRAVEL	10	-30	S3	WC
(Very dense), moist, dark brown silty SAND	15	-35	S4	WC
Medium dense, wet, brown very Clayey SAND	20	-40	S5	WC
Stiff, wet, brown very sandy CLAY	25	-45	S6	WC, GS, AL
Medium dense, wet, brown very Clayey SAND	30	-50	S7	WC, GS
Very dense, moist, coarse to fine brown very clayey SAND	35	-55	S8	WC, GS
Bottom of boring 36.5 ft. Completed 5/8/2013	40		S9	WC, GS



Notes:
1. Refer to Figure 1-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling or at the time and date specified. Groundwater level may vary with time.

● Moisture Content (percent)
▲ SPT Resistance (blows per foot)
H Atterberg Limit (AL)

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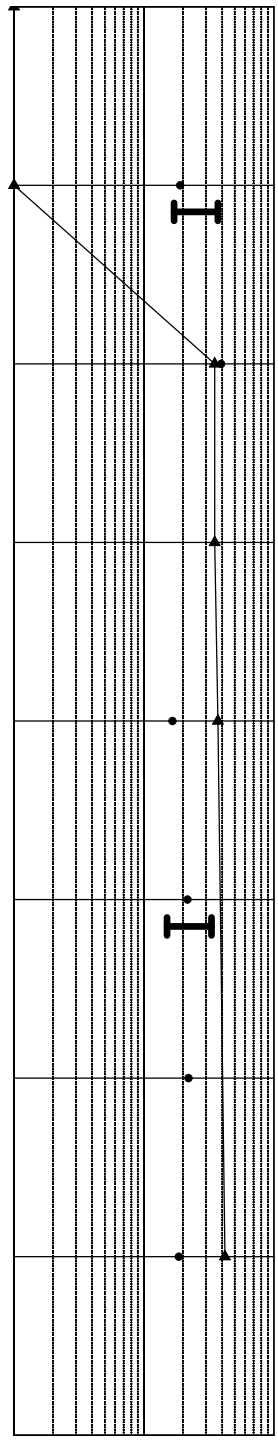
Figure 2
Boring Log AQ-B1
San Diego Shipyard Sediment Site - South Shipyard

Boring: AQ-B2

Northing (NAD83 WA SP S Feet):1831210.76
Easting (NAD83 WA SP S Feet):6288460.07
Water Depth:30
Mudline Elevation:23

Description	Depth in Feet	Elevation	Samples	Lab Test
Very soft, wet, dark gray sandy CLAY. (RECENT BAY DEPOSITS)	0	-25	S1	
Very soft, wet, black to dark gray clayey SAND. Trace seashells and angular gravel (RECENT BAY DEPOSITS)	5	-30	S2	WC, HYD, AL
Dense, moist, light brown fine-medium clayey SAND	10	-35	S3	WC
	15	-40	S4*	WC
Dense, wet, tan, coarse to fine slightly clayey SAND	20	-45	S5	WC
(Medium dense), tan, very clayey sandy GRAVEL to slightly gravelly sandy SILT	25	-50	S6	WC, GS, AL
(Very dense), moist, dark brown, very silty SAND	30	-55	S7	WC, GS
Dense, moist, dark brown very silty fine to medium SAND	35		S8	WC, P200
Bottom of boring 36.5 ft. Completed 5/7/2013	40	-60		

STANDARD PENETRATION RESISTANCE (blows per foot)



Notes:
1. Refer to Figure 1-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling or at the time and date specified. Groundwater level may vary with time.

● Moisture Content (percent)
▲ SPT Resistance (blows per foot)
H Atterberg Limit (AL)

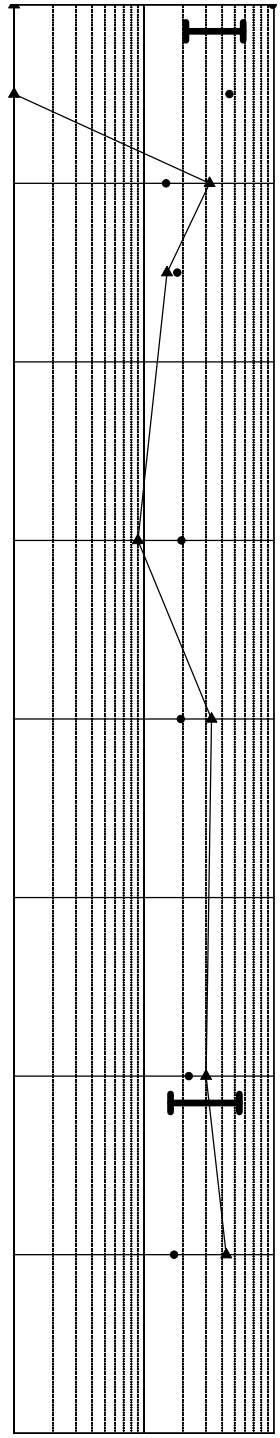
ANCHOR QEA

Figure 3
Boring Log AQ-B2
San Diego Shipyard Sediment Site - South Shipyard

Boring: AQ-B3

Northing (NAD83 WA SP S Feet):1831550.53
Easting (NAD83 WA SP S Feet):6288238.52
Water Depth:28
Mudline Elevation:27

Description	Depth in Feet	Elevation	Samples	Lab Test
Very soft, wet, dark gray very sandy CLAY (RECENT BAY DEPOSITS)	0		S1	WC, AL
Loose to medium dense gray silty SAND. (RECENT BAY DEPOSITS)	5	-30	S2	WC, GS
			S3	WC, GS
Dense, wet, tan SAND				WC
grades medium dense, tan to gray slightly silty SAND		-35	S4	WC
	10			
		-40		
grades loose	15		S5	WC, P200
		-45		
grades dense, slightly gravelly	20		S6	WC
		-50		
	25			
		-55		
Very stiff, moist, dark gray very sandy CLAY	30		S7	WC, TV, GS, HYD, AL
		-60		
Dense, moist, gray coarse to medium slightly clayey SAND	35		S8	WC
Bottom of boring 36.5 ft. Completed 5/7/2013		-65		
	40			



Notes:
1. Refer to Figure 1-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling or at the time and date specified. Groundwater level may vary with time.

● Moisture Content (percent)
▲ SPT Resistance (blows per foot)
H Atterberg Limit (AL)

ANCHOR QEA

Figure 4
Boring Log AQ-B3
San Diego Shipyard Sediment Site - South Shipyard

ATTACHMENT A
LABORATORY TEST RESULTS

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NAME: San Diego Shipyard - NASSCO

EGLAB JOB NO.: 13-129-001

PROJECT NO.: 131003-01.01

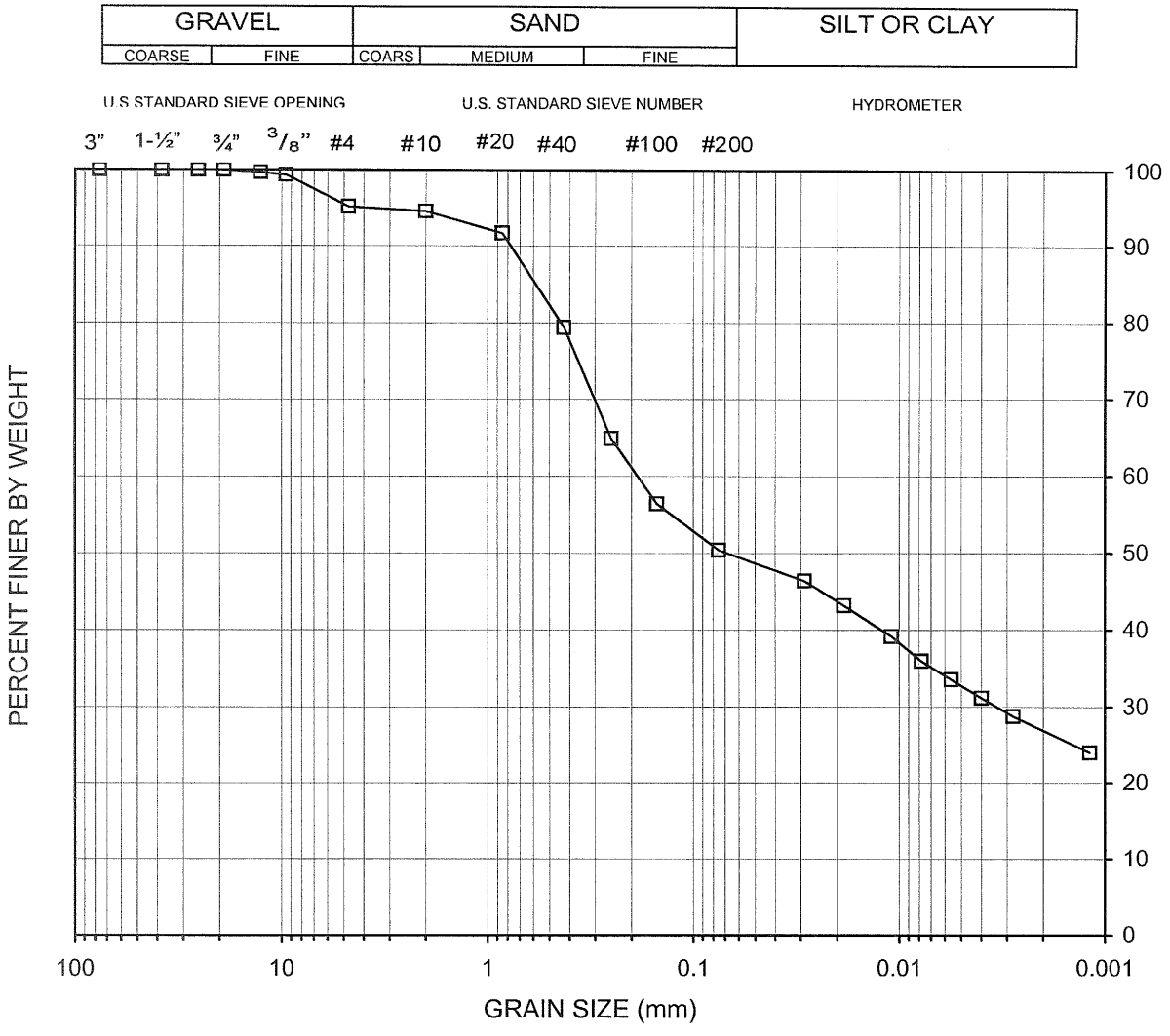
CLIENT: ANCHOR QEA, LLC

DATE: 5/16/2013

SUMMARIZED BY: JT

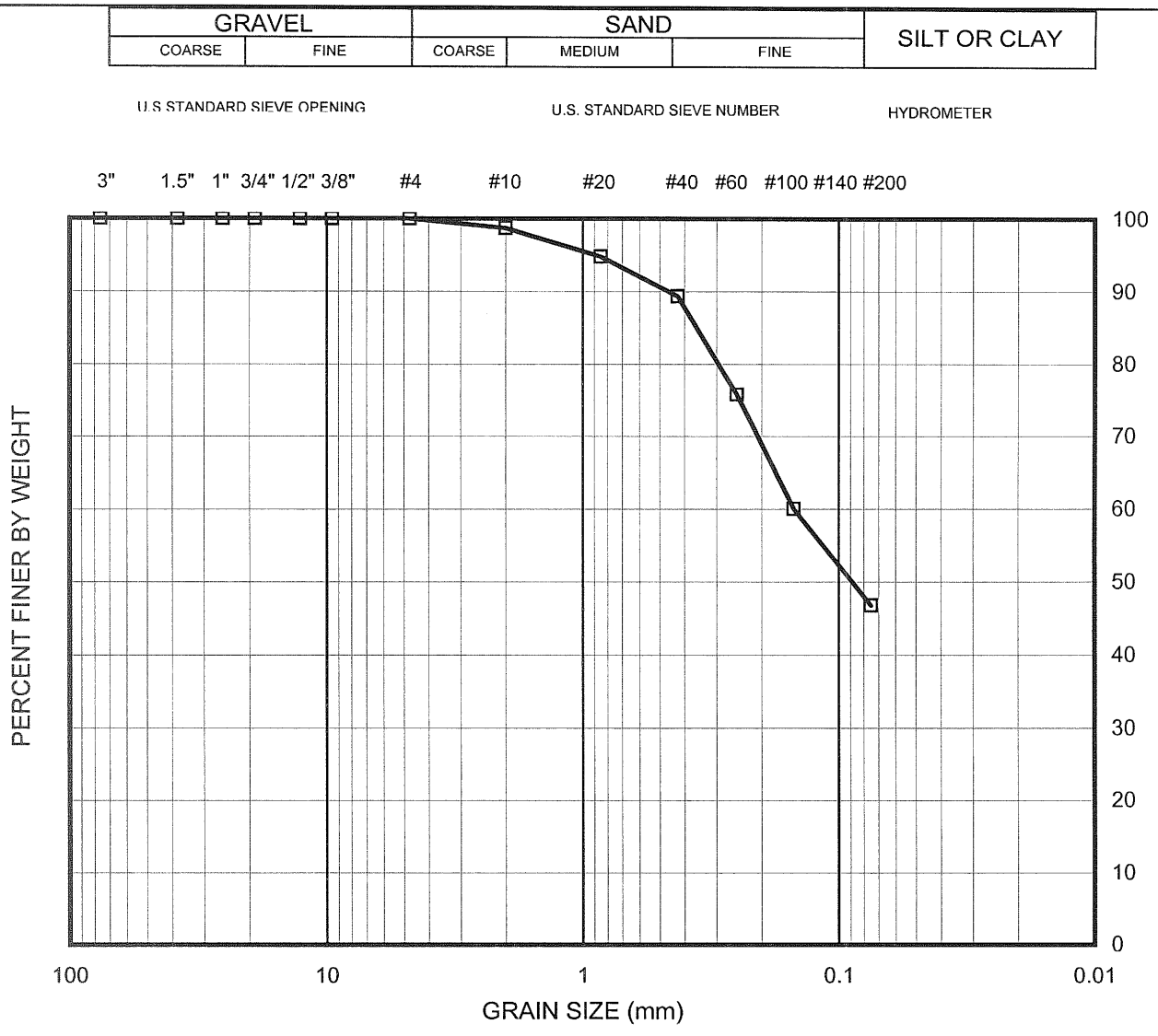
BORING NO.	SAMPLE NO.	DEPTH (ft)	MOISTURE CONTENT ASTM D2216 (%)	TORVANE MAXIMUM SHEAR VALUE (kg/cm^2)	SPECIFIC GRAVITY ASTM D854	%PASSING #200 ASTM D1140 (%)	ATTERBERG LIMITS ASTM D4318 *(LL,PL,PI)
AQ-B1	1	0-1.5	83.1		2.701		
AQ-B1	2	2.5-4	37.5				
AQ-B1	3	5-6.5	53.0				
AQ-B1	4	7.5-9	16.6				
AQ-B1	5	15-16.5	35.2				
AQ-B1	6A	20-21.5	23.4				
AQ-B1	6B	20-21.5	15.6				31,21,10
AQ-B1	7A	25-26.5	24.9				
AQ-B1	7B	25-26.5	23.2				Non Plastic
AQ-B1	8	30-31.5	16.3				
AQ-B1	9	35-36.5	15.0				
AQ-B2	2	5-6.5	46.0				34,17,17
AQ-B2	3	10-11.5	19.0				
AQ-B2	5	20-21.5	39.3				
AQ-B2	6A	25-26.5	19.6				33,15,18
AQ-B2	6B	25-26.5	21.6				
AQ-B2	7	30-31.5	22.0				
AQ-B2	8	35-36.5	18.6			34.0	
AQ-B3	1	0-1.5	97.8				58,21,37
AQ-B3	2	2.5-4	45.3				
AQ-B3	3	5-6.5	14.8				
AQ-B3	4	7.5-9	18.0				
AQ-B3	5	15-16.5	19.4			3.3	
AQ-B3	6	20-21.5	19.2				
AQ-B3	7	30-31.5	22.1	1.92			54,16,38
AQ-B3	8	35-36.5	17.0				

*LL,PL,PI = LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX



SYMBOL	SAMPLE LOCATION	SAMPLE No.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	AQ-B1	1	0-1.5	Bag	CL	N/A	N/A

EGLAB, INC.	Project Name: San Diego Shipyard - NASSCO Client: ANCHOR QEA, LLC Job No.: 131003-01.01 EGLAB Project No.: 13-129-001
05/17/13	**GRAINSIZE DISTRIBUTION CURVE** (ASTM D422) FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	AQ-B1	6A	20-21.5	Bag	SC	N/A	N/A

EGLAB, INC.

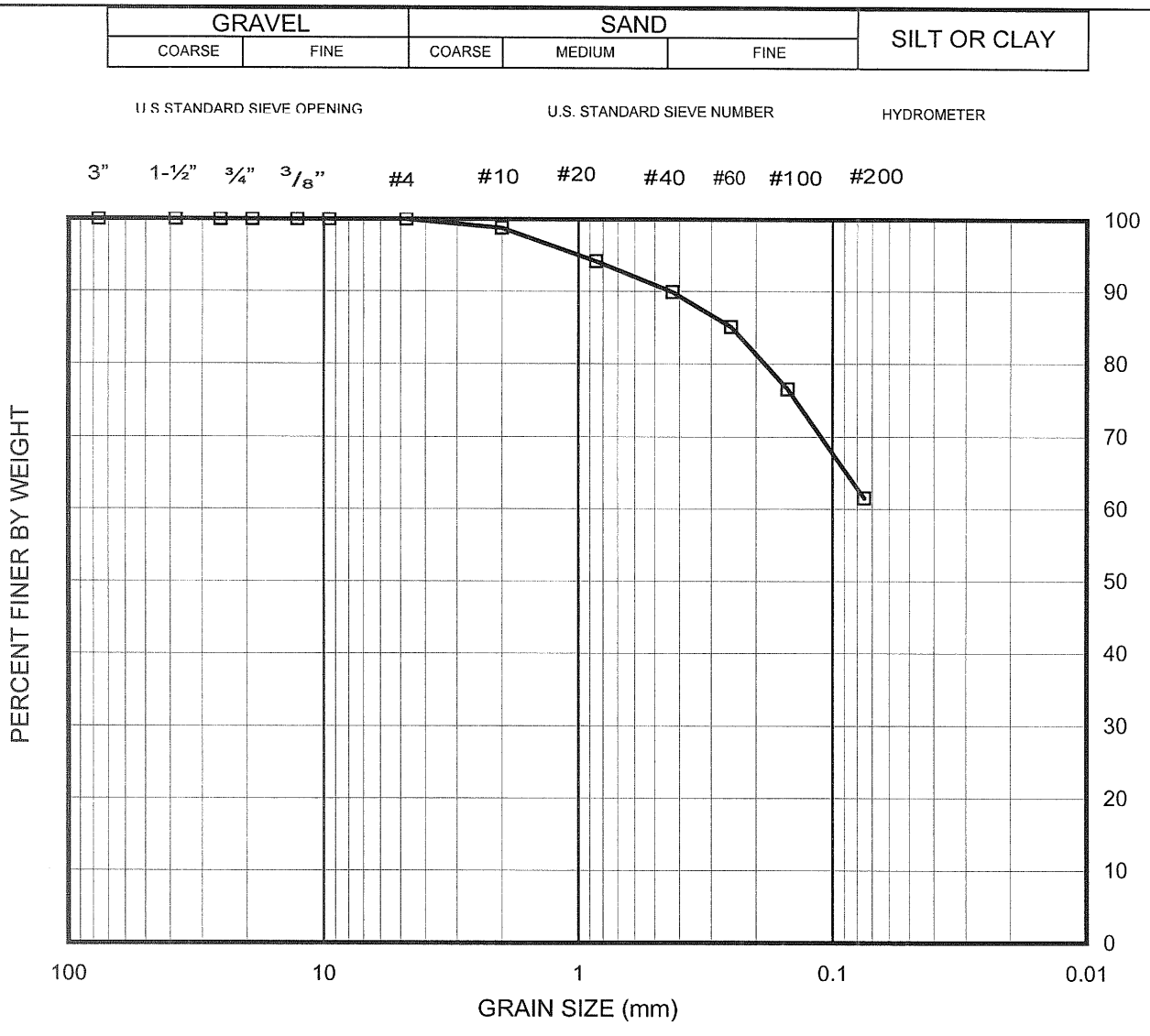
Project Name:
San Diego Shipyard - NASSCO

Client Job No.: 131003-01.01
Client Name: ANCHOR QEA, LLC
EGLAB Project No.: 13-129-001

GRAIN SIZE DISTRIBUTION CURVE
(ASTM D422)

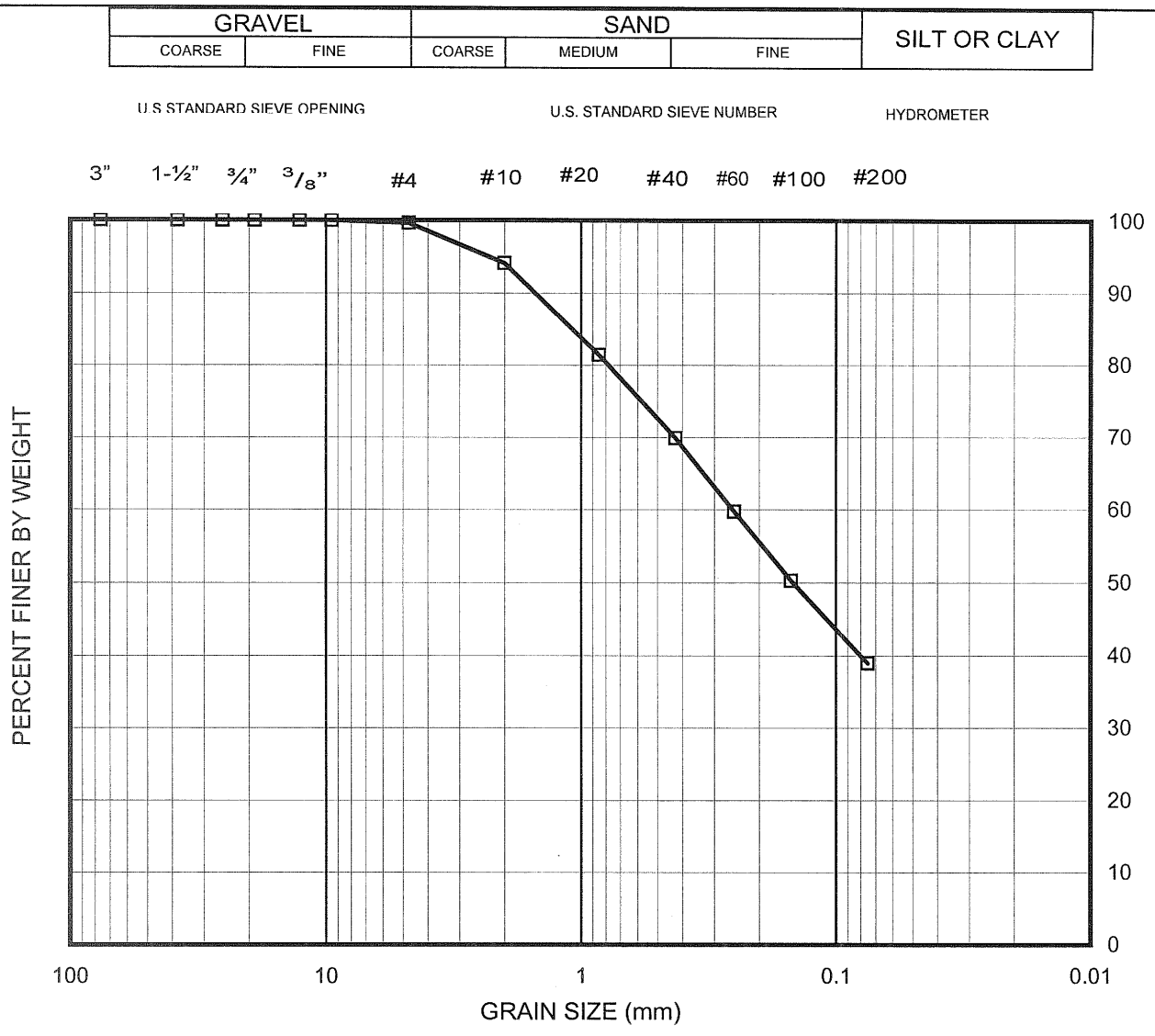
05/17/13

FIGURE



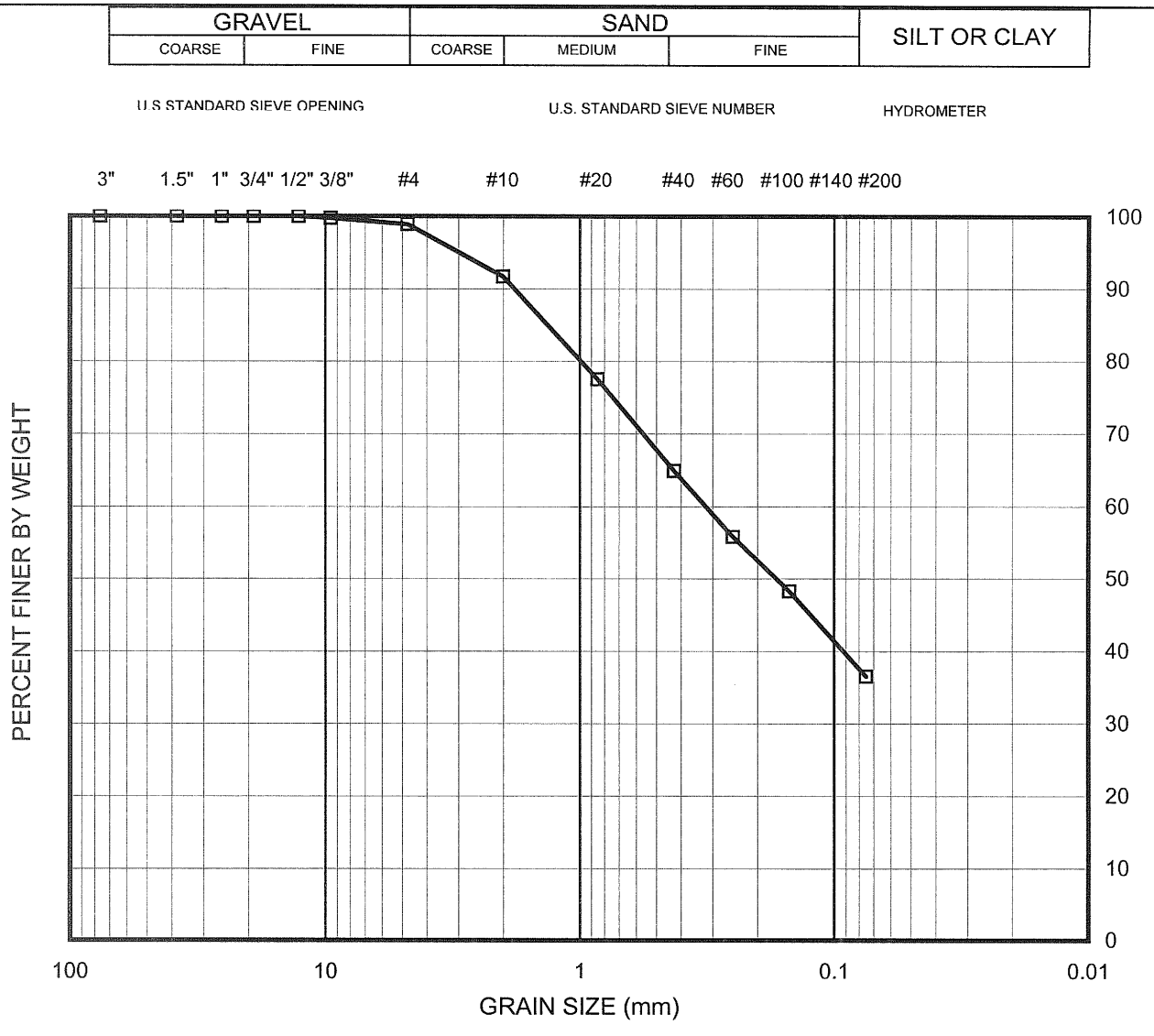
SYMBOL	BORING NO	SAMPLE NO	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	AQ-B1	7A	25-26.5	Bag	CL	N/A	N/A

EGLAB, INC.	Project Name: San Diego Shipyard - NASSCO Client Job No.: 131003-01.01 Client Name: ANCHOR QEA, LLC EGLAB Project No.: 13-129-001
05/17/13	**GRAIN SIZE DISTRIBUTION CURVE** (ASTM D422) FIGURE



SYMBOL	BORING NO	SAMPLE NO	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	AQ-B1	8	30-31.5	Bag	SC	N/A	N/A

EGLAB, INC.	Project Name: San Diego Shipyard - NASSCO Client Job No.: 131003-01.01 Client Name: ANCHOR QEA, LLC EGLAB Project No.: 13-129-001
05/17/13	**GRAIN SIZE DISTRIBUTION CURVE** (ASTM D422) FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	AQ-B1	9	35-36.5	Bag	SC-SM	N/A	N/A

EGLAB, INC.

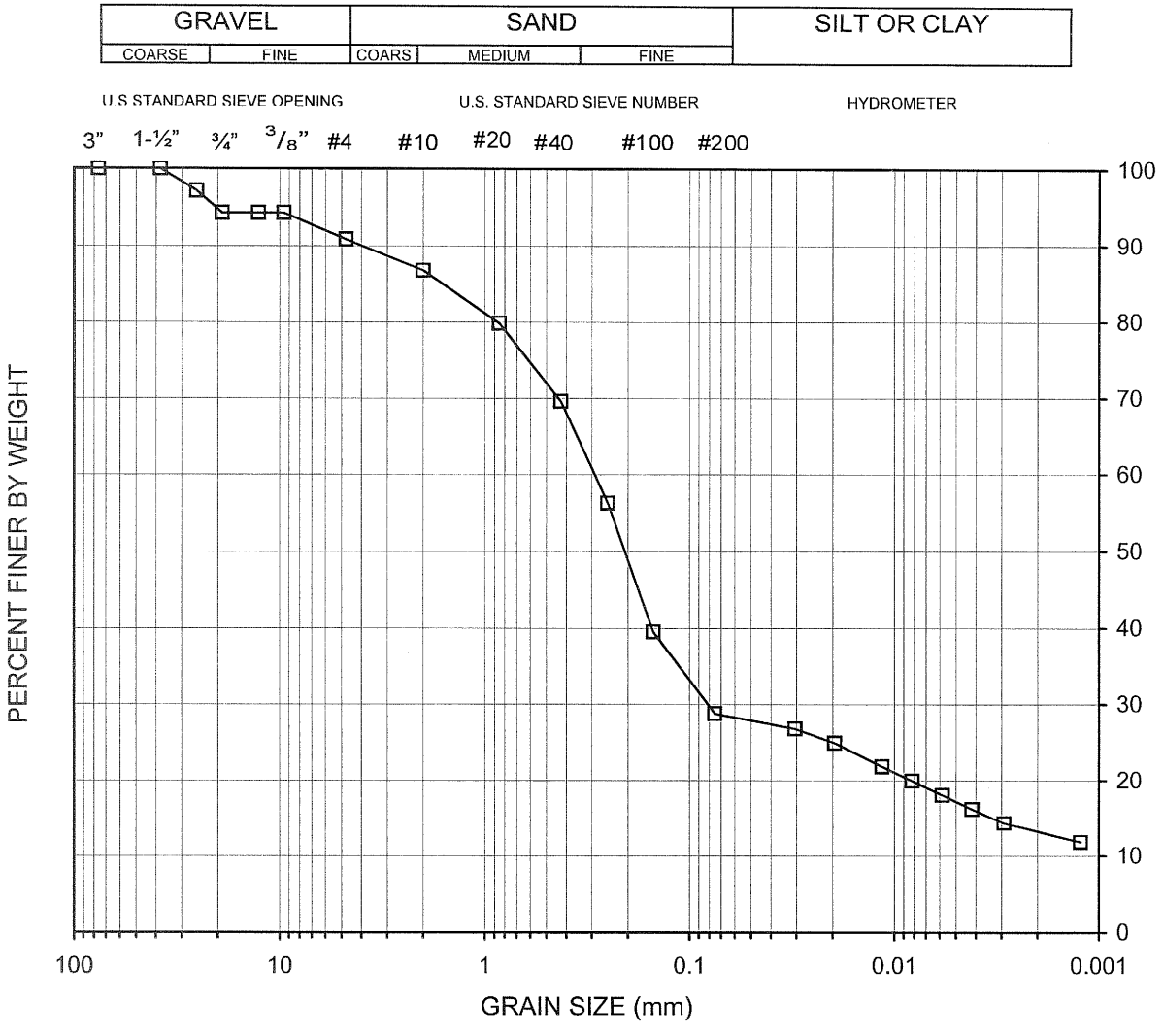
Project Name:
San Diego Shipyard - NASSCO

Client Job No.: 131003-01.01
Client Name: ANCHOR QEA, LLC
EGLAB Project No.: 13-129-001

GRAIN SIZE DISTRIBUTION CURVE
(ASTM D422)

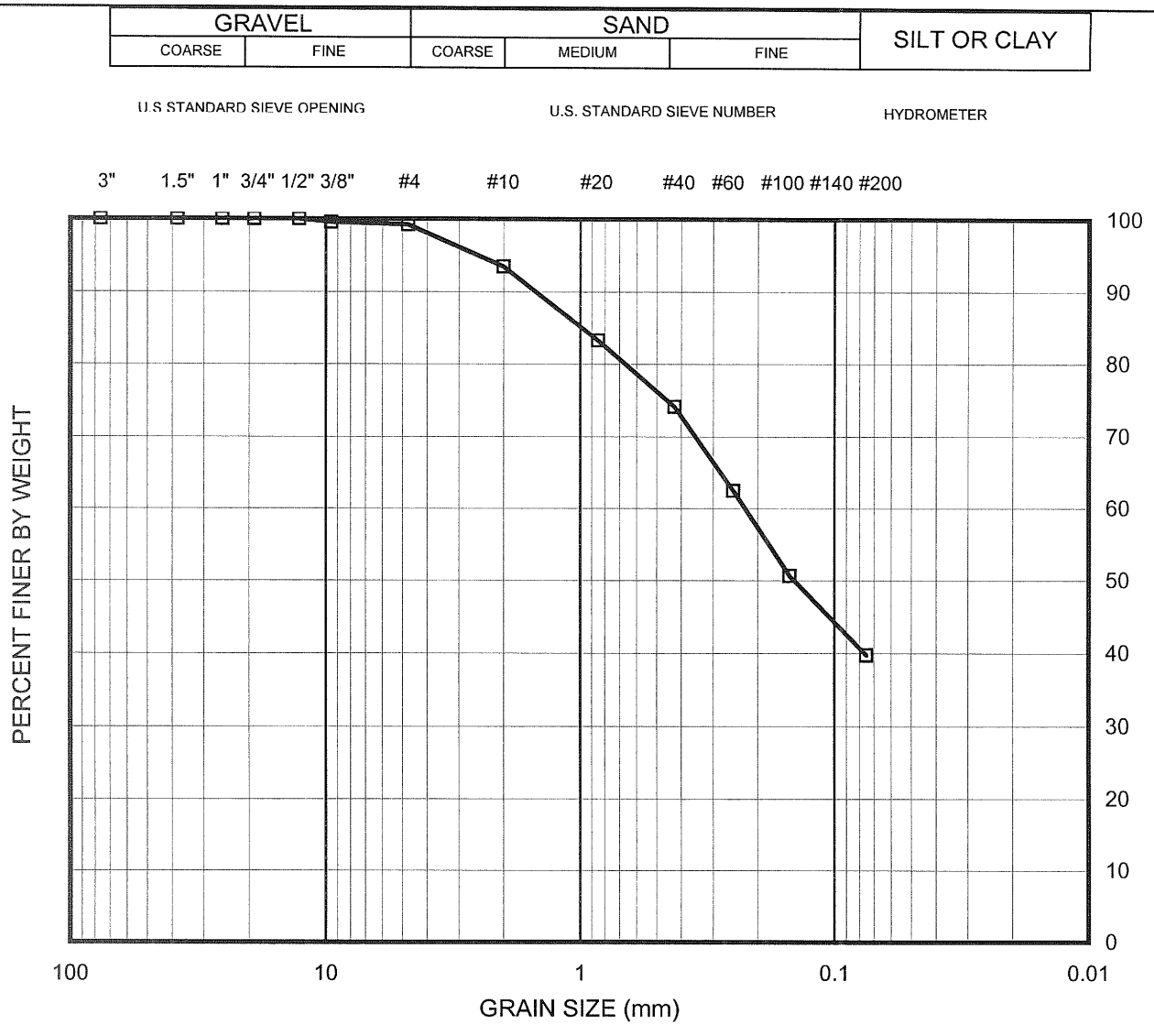
05/17/13

FIGURE



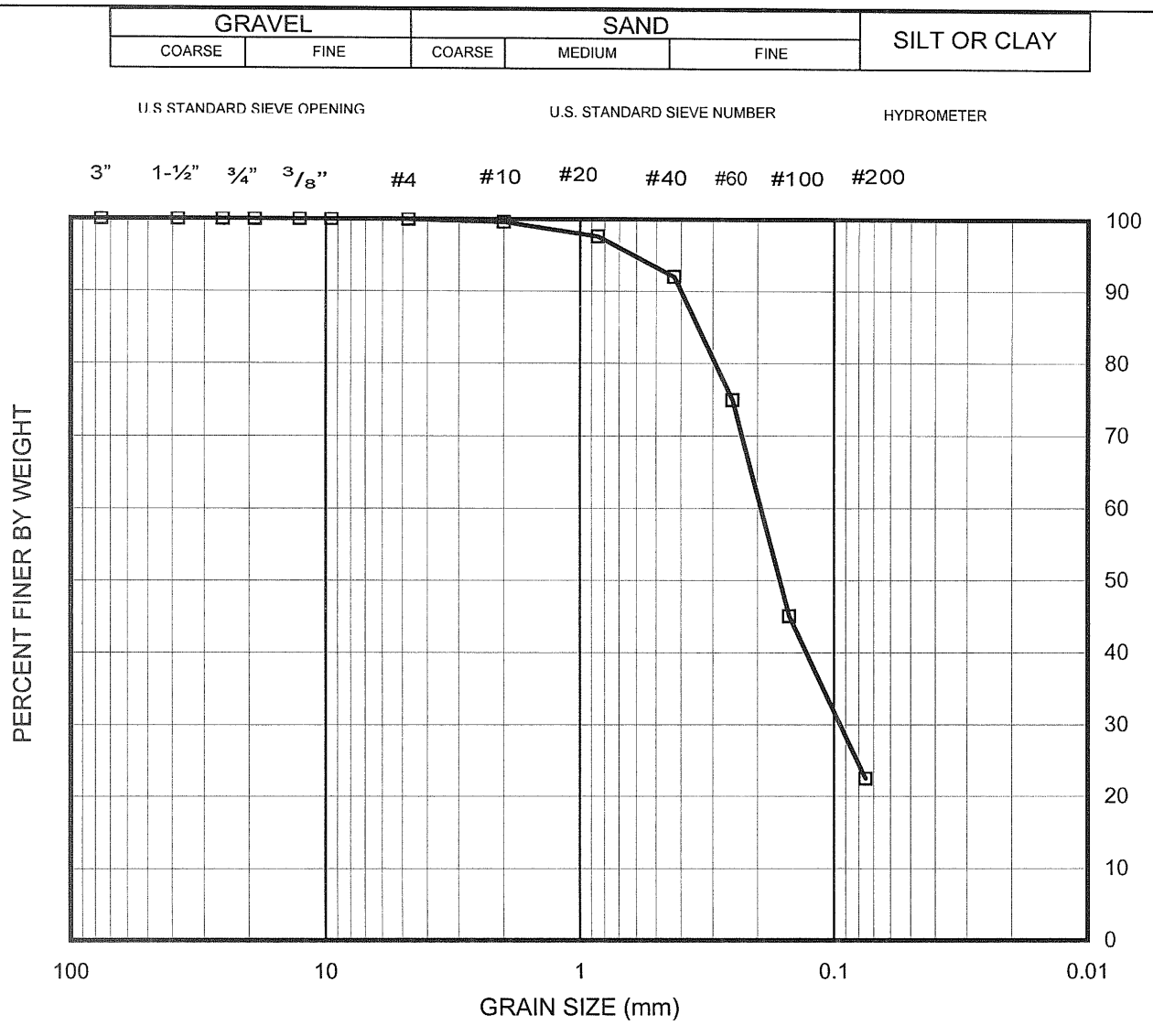
SYMBOL	SAMPLE LOCATION	SAMPLE No.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	AQ-B2	2	5-6.5	Bag	SC	34	17

EGLAB, INC.	Project Name: San Diego Shipyard - NASSCO Client: ANCHOR QEA, LLC Job No.: 131003-01.01 EGLAB Project No.: 13-129-001
05/17/13	**GRAINSIZE DISTRIBUTION CURVE** (ASTM D422) FIGURE



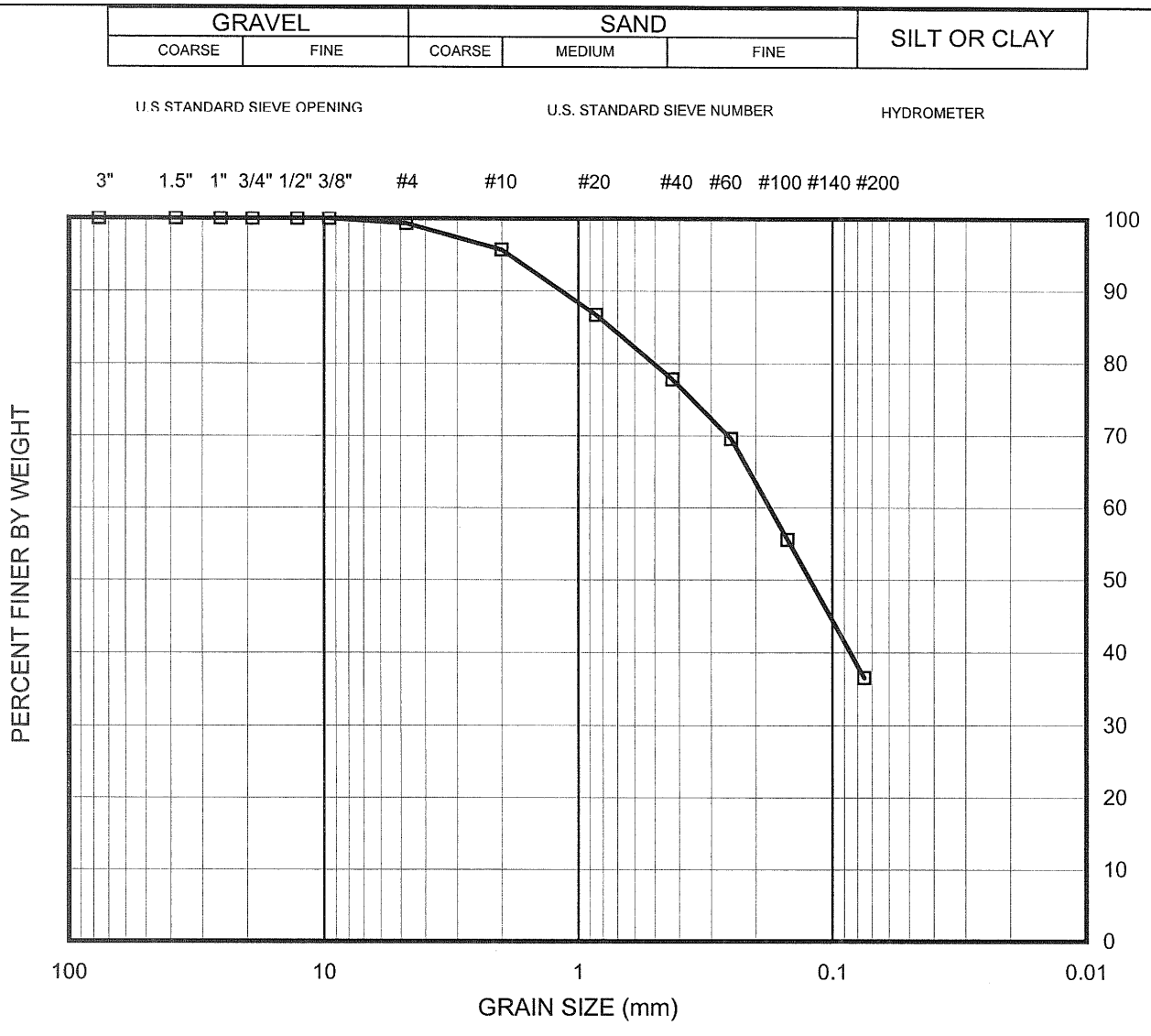
SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	AQ-B2	6B	25-26.5	Bag	SC	33	18

EGLAB, INC.	Project Name: San Diego Shipyard - NASSCO Client Job No.: 131003-01.01 Client Name: ANCHOR QEA, LLC EGLAB Project No.: 13-129-001
05/17/13	**GRAIN SIZE DISTRIBUTION CURVE** (ASTM D422) FIGURE



SYMBOL	BORING NO	SAMPLE NO	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	AQ-B2	7	30-31.5	Bag	SM	N/A	N/A

EGLAB, INC.	Project Name: San Diego Shipyard - NASSCO Client Job No.: 131003-01.01 Client Name: ANCHOR QEA, LLC EGLAB Project No.: 13-129-001
05/17/13	**GRAIN SIZE DISTRIBUTION CURVE** (ASTM D422) FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	AQ-B3	2	2.5-4	Bag	SC	N/A	N/A

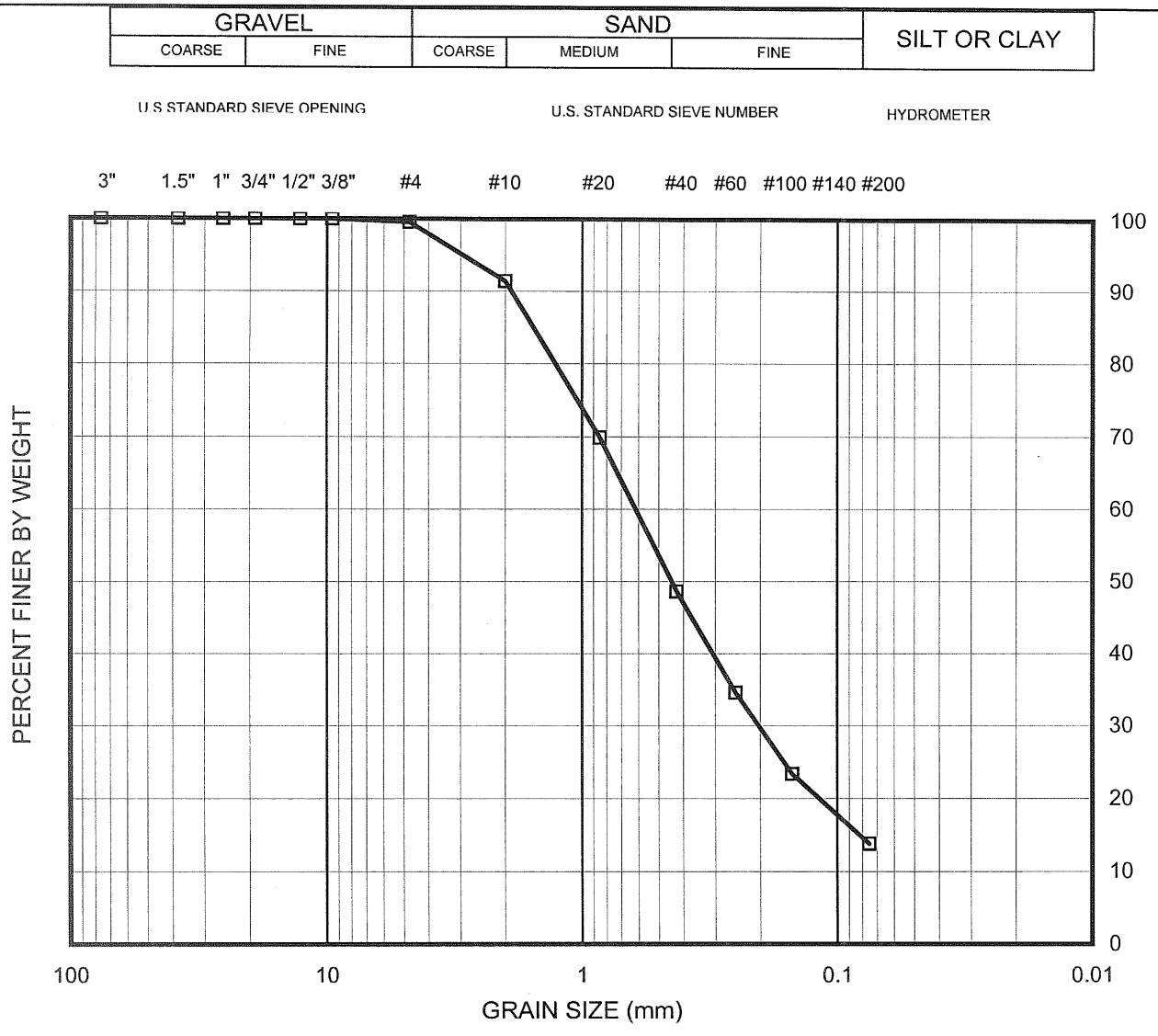
EGLAB, INC.

Project Name:
San Diego Shipyard - NASSCO
Client Job No.: 131003-01.01
Client Name: ANCHOR QEA, LLC
EGLAB Project No.: 13-129-001

GRAIN SIZE DISTRIBUTION CURVE
(ASTM D422)

05/17/13

FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	AQ-B3	4	7.5-9	Bag	SM	N/A	N/A

EGLAB, INC.

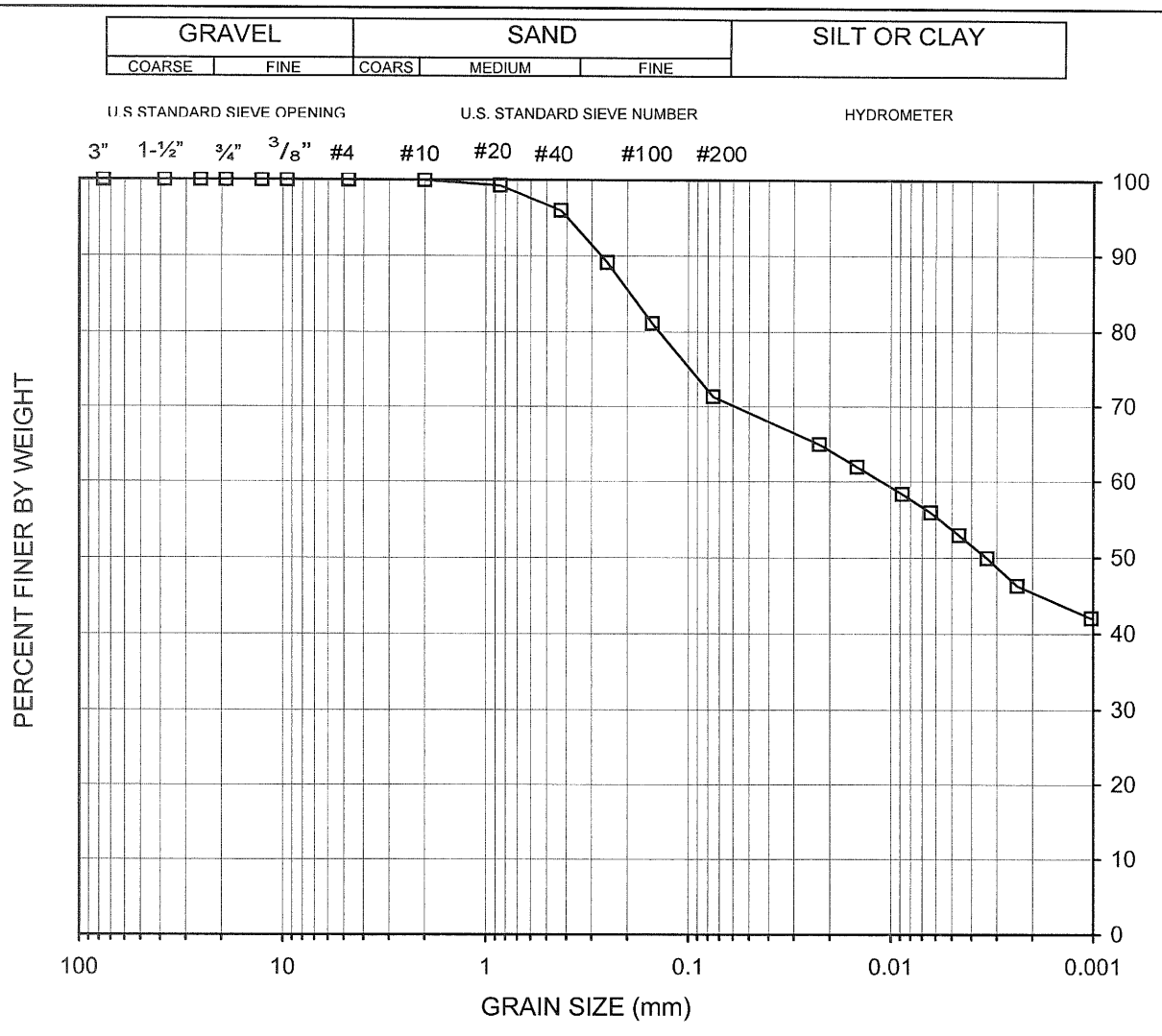
Project Name:
San Diego Shipyard - NASSCO

Client Job No.: 131003-01.01
Client Name: ANCHOR QEA, LLC
EGLAB Project No.: 13-129-001

GRAIN SIZE DISTRIBUTION CURVE
(ASTM D422)

05/17/13

FIGURE



SYMBOL	SAMPLE LOCATION	SAMPLE No.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
□	AQ-B3	7	30-31.5	Bag	CH	54	38

EGLAB, INC.	Project Name: San Diego Shipyard - NASSCO Client: ANCHOR QEA, LLC Job No.: 131003-01.01 EGLAB Project No.: 13-129-001
05/17/13	**GRAINSIZE DISTRIBUTION CURVE** (ASTM D422) FIGURE

APPENDIX D
TECHNICAL MEMORANDUM: MARINE STRUCTURES DESIGN BASIS – SOUTH SHIPYARD

Triton Engineers, Inc
2171 India Street, Suite D, San Diego CA 92101 USA
Tel 619- 231 1250 Fax 619- 231 1279
www.tritonengineers.com

Technical Memorandum

To	Michael Whelan, Anchor QEA		
From	Joe Perrone, Triton Engineers		
Copy		**Date**	June 27, 2013
Subject	Final - Marine Structures Design Basis – South	**Ref**	
Project	San Diego Bay Remediation	**Page**	1 of 12

1 INTRODUCTION

1.1 BACKGROUND AND OVERVIEW OF PROJECT

A site plan of the South Shipyard area is shown in Figure 1S. The remedial footprint(not shown on Figure 1S), extends from the shoreline across a portion of the current leasehold.

The South Shipyard is located at the bay end of 28th Street, between Chollas Creek and BAE Systems San Diego Ship Repair (North Shipyard). This facility serves the U.S. Navy and commercial shipping companies and ship building and maintenance activities have taken place at this site since the early 1900s. NASSCO has conducted shipyard operations at this location since 1960.

The facility has 12 berths, 6 piers, a large floating dry dock, 3 ship building ways, and approximately a mile of shoreline with various shore protection measures and sheet piled bulkheads.

2 SITE CONDITIONS

2.1 INTRODUCTION

This section describes the waterfront and marine structures in the remediation dredging zones that will impacted by remediation dredging. All elevations stated are referenced to Mean Lower Low Water (MLLW) tidal datum.

2.1.1 Building 19 Wharf

This area of the waterfront which adjoins a zone of remediation is located in the north

middle portion of the shipyard. There are two old pile supported wharf structures with the northern most wharf supporting Building 19 which is currently abandoned. The wharf to the west of Building 19 provides access to a small floating dock. The two wharves are supported mostly by timber piles but several steel HP piles exist at the out-board edge of the wharf that supports the building. The shoreline under the wharves slopes gently to just beyond the out-board edges of the structures then becomes steep as the slopes approach the upper reaches of the dredged slope that form the sides of the deep sump at the location of the floating dry dock. The revetment under the wharves consists of a mix of stone and small rock rip rap. The remediation area adjacent to the structures and shoreline described is designated as Sediment Management Unit 2. (SMU-2)

2.1.2 Revetment Between Building 19 and Berth VIII

This section of the shoreline consists of various forms of revetment including grout bags and graded stone and rock rip rap. This stretch of revetment is also bounded by SMU-2.

2.1.3 Berth VIII Bulkhead

This section of bulkhead which starts at the east end of the rip rap revetment is aligned approx. north-south and the section of bulkhead adjacent to the remediation zone (SMU-2) is approx. 75 ft long. The bulkhead consists of sheet piling driven to an elevation of approx. –48 ft and the sheets are restrained with a tie-back and deadman anchor system. A cross section depicted in Moffatt & Nichol's 2002 report, Review of Impacts to Waterfront Structures Subjected to Variable Dredging Depths, shows a rock rip rap buttress in front of the bulkhead. The buttress which is at a slope of 3:1 (horizontal to vertical) is depicted as having a flat bench at elevation of –15 ft and a sloping section that meets the mud line at an elevation of –25 ft approx. The rip rap was not noted by the divers during recent underwater surveys. Figure 2S illustrates a typical section across the sheet piled bulkhead along Berth VIII.

2.1.4 Building Ways 4

This facility, one of two inclined ship building ways at the South Shipyard, was constructed in stages between 1968 and 1997. The remediation zone, designated as part of SMU-3, spans almost the full width of the ways, a distance of approx. 115 ft and this zone extends sea ward approx. 200 ft from the gate which is located at the end of the ways. The main ways facility in-board of the gate and sill in its present form was built in 1972. Outboard of the sill structure there is a pair of pile supported concrete extensions that were built in 1998. The sill which is just out-board of the gate consists of a tremie concrete slab which was cast between a pair of sheet pile walls that formed a steel sheet

piled cofferdam that was built to facilitate the ways construction. The cofferdam sheets were cut-off at elevation –14 ft approx. but the original sheets below this level are still in place. The extension to the out-board ground ways consist of a pair of 100 ft long x 10 ft wide x 4 ft thick concrete beams supported by 18 inch diameter steel pipe piles. The beams are at a longitudinal inclination of 1:24 and the sea bed elevation at the end of the extensions is approx. - 22 ft. The top of the concrete beams at the ends of the extension is approx. 9 ft above the sea bed. The clear spacing between the ways extension beams is 20 ft. The pile supported ways extension is fully contained within the planned zone of remediation.

2.1.5 Mole Pier between Ways 3 and 4

This structure consisting of a steel sheet piled bulkhead is located between the south end of the Ways 4 sill and gate and the north end of the Ways 3 sill and gate structure. The mole structure is 35 ft wide at the west end and extends a distance of 130 ft to where it meets the end of Ways 3 on the north side of the ways. The mole bulkhead consists of a steel sheet piled wall restrained by tie-backs. The original drawings show a stone and rock rip rap buttress at the toe of the bulkhead.

2.1.6 Ways 3

This ship building ways is similar to Ways 4 and also include an underwater piled extension system out-board of the gate and sill identical to Ways 4. The remediation zone, part of SMU-3, spans the full width of the ways, a distance of 115 ft, and extends a distance of approx. 220 ft from the gate which is located at the end of the ways. The pile supported ways extension is fully contained within the planned zone of remediation.

2.1.7 On-Block Assembly

This section of the shoreline consisting of a rip rap revetment provides erosion protection to the seaward end of the On-Block area which is situated between Building Ways 3 and Dry Dock 1. The rip rap revetment is approx. 120 ft long and was installed as part of the reconstruction works performed to convert Building Ways 2 to a ship block assembly area in late 1994. The armoring layer of 2 ft minimum thickness and 1.5 to 1 slope, consists of rock with a median weight of 500 lbs. The toe of the revetment intersects with the sea bed at elevation –20 ft approx. The remediation zone, also part of SMU-3, extends approx. 180 ft seawards of the toe of the rip rap revetment.

2.1.8 Building Dock 1

Building Dock 1, also referred to as the Graving Dock, is located adjacent to the south

side of the On-Block Assembly area. The building dock is just over 1000 ft long and is 180 ft wide for most of its length. The entrance to the dock just out-board of the gate, includes a 2 ft thick tremie concrete sealed sill fronted by a rip rap revetment at a slope of 3 to 1. The sill was originally constructed as a bottom seal for a cofferdam which was built to permit dewatering and construction of the dock in the dry. The sill and steel sheet piling in front of the sill now serve to prevent erosion of the soils beneath the building dock concrete ground slab. The remediation zone, also part of SMU-3, extends approx. 150 ft sea ward from the out-board edge of the sill.

2.1.9 Berth 1

This facility is a steel sheet piled bulkhead that extends from the end of Building Dock 1 and borders the same remediation zone (SMU-3) that is at the end of the building dock. The length of Berth 1 impacted by the sediment remediation is approx. 170 ft. The bulkhead consists of steel sheet piles with tips at an elevation of –40 ft approx. The top of the sheet piles are capped with a concrete beam with the top of the wall set at elevation +11.5. The original drawings indicate a rock rip rap buttress in front of the sheet piles with a slope of 3 to 1. The top of the rip rap buttress is at an elevation of 16 ft approx. The rip rap was not visible during a recent diver survey but the divers did report the presence of hard material below the silty sea bed in front of the sheet piles. It is believed that the rip rap buttress exists but has been covered with a layer of silt and sediments. Figure 2S represents a typical section across the Berth 1 bulkhead.

2.1.10 Cyclopean Wall

This wall is located at the south-west end of Berth 1 and forms a recess to the projection of the face of the Berth 1 bulkhead. The remediation zone, designated as SMU-4, fronts a section of this wall which is approx. 150 ft long. The wall is a very old gravity supported structure consisting of a conglomerate of rocks and grout and as such does not contain any lateral restraints. A concrete bulkhead approx. 10 ft high ‘sits’ on top of the grouted rock structure There is only sketchy information available for this structure which has been included in various reports over the years. It is understood that the cyclopean wall turns the corner and continues as Berth II that runs along the property line at the south end of NASSCO’s property. A section across the Berth II cyclopean wall is included in Moffatt & Nichol’s 2002 report entitled; Review of Impacts to Waterfront Structures Subjected to Variable Dredging Depths, NASSCO. An older drawing of the wall was included in a report prepared by Christian Wheeler Engineering, in 1999 entitled ‘Report of Limited Soil Investigation, Proposed Mooring Foundation at Berth II, NASSCO. The drawings show the top of the wall at Elevation +12.0 ft and the sea bed in front of the wall

at Elevation –29 ft. A rock rip rap buttress is shown at the sea bed in front of the wall. It is expected that the cyclopean wall in the sediment remediation zone will have similar features to the Berth II wall since they would likely have been constructed around the same time. Based on recent bathymetric surveys and lead line measurements it appears that the sea bed in front of the wall has 'risen' and elevations are significantly higher than what is shown on original sketches. Natural deposition of silt and sediments have raised the sea bed along the cyclopean wall to elevations that vary from –19 ft to approx. –3 ft.

2.1.11 Approach Pier to Floating Dry Dock

This pier, consisting of a reinforced concrete deck supported by pre-stressed/pre-cast concrete piles, was constructed during late 1983 and early 1984. The pier which is 205 ft long is orientated approx. in a North-South direction and is connected to the land at its north end. The pier is 60ft wide for the majority of its length but reduces in width in a series of steps at the offshore end. The deck of the pier is at elevation +13.0 (MLLW) and the water depth varies from zero at the shoreline to approx. -55 ft at the end of the pier. There are a total of 75 - 20 inch square piles supporting the pier consisting of 24 batters and 51 vertical piles. The deck comprises a series of longitudinal and transverse pile cap beams which support a composite 17 inch thick deck consisting of pre-cast slabs and a cast-in-place concrete overlay. The depth of embedment of the piles into the sea bed varies from 35 ft at the offshore end to around 52 ft at the shore end of the pier. The pier is in remediation zone SMU-2.

3 BASIS OF DESIGN

3.1 TYPES OF STRUCTURES

Waterfront structures adjacent to and within the zone of remediation at the South Shipyard can generally be characterized as one of the following types;

1. Sloped revetment with erosion protection. This feature can be found at several locations along the shoreline and includes; the revetment below the wharf structure supporting Building 19, the rip rap slope between the dry dock approach pier and Berth 1, and the rip rap slope in front of the On-block Assembly.
2. Sheet piled vertical bulkheads. These bulkheads are located at Berths 1 and VIII and at the sides and ends of the moles between Ways 3 and 4.
3. Cyclopean Wall. This gravity structure forms the sea wall south of Berth 1 and continues around the corner and extends in south westerly direction along Berth II.
4. Sill structures at the sea ward ends of Ways 3, Ways 4 and the Building Dock. These structures, approx. 30 to 40 ft wide, consist of sheet pile walls in-infilled with soil

which is capped with a layer of concrete. The sills were constructed to facilitate the construction of the ship building ways and dock. The original drawings for the sills at each location show a sloped rip rap buttress at the sea ward side of the sill.

5. Pile supported pier with vertical and batter piles. This is typified by the floating dry dock approach pier.
6. Pile supported structure with vertical piles only. The pile supported extensions to Ways 3 and 4 are fall into this type of structure.

3.2 METHODOLOGY FOR PROTECTION OF STRUCTURES

The approach to determining the 'safe' offset for dredging from a specific structure depends on several factors including, type of structure, importance of structure and, the nature of soil at the toe or edge of the structure. The objective is to protect the structures in place rather than instigating measures to strengthen the structures or the use of techniques such as rock buttresses or sheet pile cut-off walls to allow removal of material at or immediately adjacent to structures. In some cases, such as pile supported structures or sheet pile bulkheads, removal of material surrounding the piles or dredging directly in front of sheet piles may be acceptable. For these components, the criteria for assessing 'safe' excavation limits at the piles is governed by the requirement to maintain adequate safety factors against overstressing or structural failure of the bearing piles or laterally loaded sheet piles. A summary of the analytical method used to determine limits of dredging for each type of structure is presented below;

Type 1- Sloped Revetment

The determination of the safe offset for dredging from the toe of a slope is based on preventing failure in a downward and outward movement of the mass of soil in the sloped embankment. The stability of a slope can be compromised and sliding of the soil mass can occur if the toe of the slope is undercut by excavation. There are numerous methods available for performing slope stability analysis and the majority of these may be categorized as limit equilibrium methods. For this project, slope stability evaluations were performed using SLIDE 6.0, a limit equilibrium geotechnical engineering computer program. The software and model allow the user to input soil engineering properties for user specified soil profile and geometry. The program allows for the evaluation of forces and moments contributing to and resisting slope movement and calculates the factor of safety with respect to slope movement. Soil strength and unit weight were selected based on review of available geotechnical reports and soil explorations, and these were modified as necessary based on the 3 soil borings recently completed at the South Shipyard.

Type 2 - Sheet piled vertical bulkheads.

The sheet pile bulkheads at the South Shipyard were evaluated using industry available analytical programs, including AMRetain and Rido 4.11. The analysis checked the sheet pile stresses and tie – forces for the existing conditions at the site. This involved the input of soil data based on information in available soils reports for the site and other parameters such as existing sea bed elevation at the front of the wall. Since the bulkheads are relatively old, assumptions were made on the extent of corrosion that would lead to reduction in section properties. Based on visual observations over the past several years the sheet piles are in reasonably good condition, however, corrosion is evident on the surface within the tidal zone. The tie-rods are buried and have not been inspected hence the condition of these elements is not known. Based on documented case histories of much older buried steel components, it is likely that the tie-rods are essentially intact. For a conservative approach it has been assumed that the sheet piles and tie-rods have lost 20% of their effective thickness and the remaining area, in the case of tie-rods, and the section modulus for sheet piles were used for analyses.

To establish safe offset for the start of a dredge slope, the program Rido 4.1 was used and the model included a horizontal bench immediately in front of the wall to simulate existing conditions. The bench was lowered incrementally to simulate dredging immediately in front of the wall until a dredge depth was attained that resulted in tie-rod stresses and sheet pile stresses below acceptable levels. It was found that the tie-rod stressed governed the design.

Type 4 - Cyclopean Wall

Gravity walls depend on their mass to resist pressure behind and this wall has a sloped back wall to improve stability. The available information indicates that the base of the wall does not extend more than a few feet below the original sea bed elevation at the front of the wall suggesting that the original design did not rely on lateral soil passive pressure for stability. The rock rip rap buttress, approx. 5 ft high shown on sketches to be at the toe of the wall would have provided no appreciable restraint to lateral movement of the wall. Failure of such a wall could occur if the soils in front of the wall within a potential slip surface were to be removed. The current condition based on sea bed elevation surveys indicates that a height of between 12 ft and 28 ft of soil provides additional lateral resistance over and above what existed when the wall was built. It can be summized then that soil can be removed from the front of the cyclopean wall without reducing the safety factors against overturning or sliding of the wall that existed when the wall was built. For

a conservative approach, it is assumed at up to 6 ft of sediment can be safely excavated at the face of the wall as part of the remediation dredging.

Type 5 - Sill Structures.

The sill structures at the ends of Ways 3 and 4 and at the end of Building Dock 1 are assumed to have a rip rap buttress on the sea ward side of the sill based on original drawings. The safe offset before the start of a dredge slope from the toe of the rip rap buttress was set at a minimum of 5 ft.

Type 6 - Pile supported pier with vertical and batter piles.

The Dry Dock Approach Pier at the South Shipyard that is in this group relies on the batter piles to resist lateral loads while vertical loads are carried by both the batter and vertical piles. The assessment to estimate allowable dredging depth at a particular pile or the safe offset from a pile is governed by the axial bearing capacity requirements of the vertical piles closest to the edge of the pier. The analysis that was performed included calculations to determine the existing ultimate axial compression capacity of piles adjacent to zones of remediation and then comparing the capacities to the loads that could be expected to be imposed on the piles.

The ultimate axial capacity of the piles is based on a combination of end bearing and friction and depends on several factors including, pile type and size, soil characteristics, and depth of embedment of the pile below the sea bed. The equation to determine the total axial capacity assumes that both the pile tip and the pile shaft have moved sufficiently with respect to the adjacent soil to simultaneously develop the ultimate tip and skin resistance. A key factor in the calculation of both the skin friction and the end bearing is the soil overburden pressure at the various points along the length of the pile. The method that was used is based on work done by Nordlund and the methodology is known as the Nordlund Method. The method is based on the results of several load test programs in cohesionless soils. Various design curves were used for the determination of coefficients and factors used for the axial capacities of the piles in the zone of remediation dredging. Soil properties such as the soil friction angle that are factored into the equations were obtained from available soil reports for the shipyard. Figure 3S illustrates how the approach leads to the offset for the limit of remediation dredging.

Type 7 - Pile supported structure with vertical piles only.

The pile supported extensions to Ways 3 and 4 fall into this category.

These structures rely on the passive resistance of the soil surrounding the pile to resist

lateral loads generated when a ship is launched while the vertical loads from the ship are carried by the soil friction and end bearing resistance of the piles. The pile supported ways extensions are critical structures and the assessment for dredging assumes that no loss of soil around the piles is acceptable. The determination of the safe offset for the start of dredging required an analysis to determine the location and geometry of the soil passive wedge. The analysis assumes that the passive wedge originating at some depth below the sea bed is not disturbed at the sea bed by excavation of the sea bed in front of the pile. The Windows-based program AllPile was used to determine the point of zero bending moment (Point of Contraflexure) in a pile subjected to a lateral load at the top of the pile. For the ways extension structures, the lateral load per foot from the original design calculations was used to establish the lateral load on a pair of piles that are fixed at the top. A single pile with half this load and with the pile head assumed to be fixed was modeled. The lateral force and the vertical load on a typical single pile were inputted into the AllPile program along with the strength properties of the soil surrounding the pile. The passive wedge using the friction angle of the soil was then superimposed on the pile with the corner of the triangle forming the wedge placed at the point of contraflexure. The safe offset for dredging was then determined by ensuring that the side opposite the right angle in the wedge can intersect the undisturbed sea bed. Dredge limits are established to ensure that the top of the dredged slope intersects the sea bed a foot or two away from where the passive wedge intersects the sea bed.

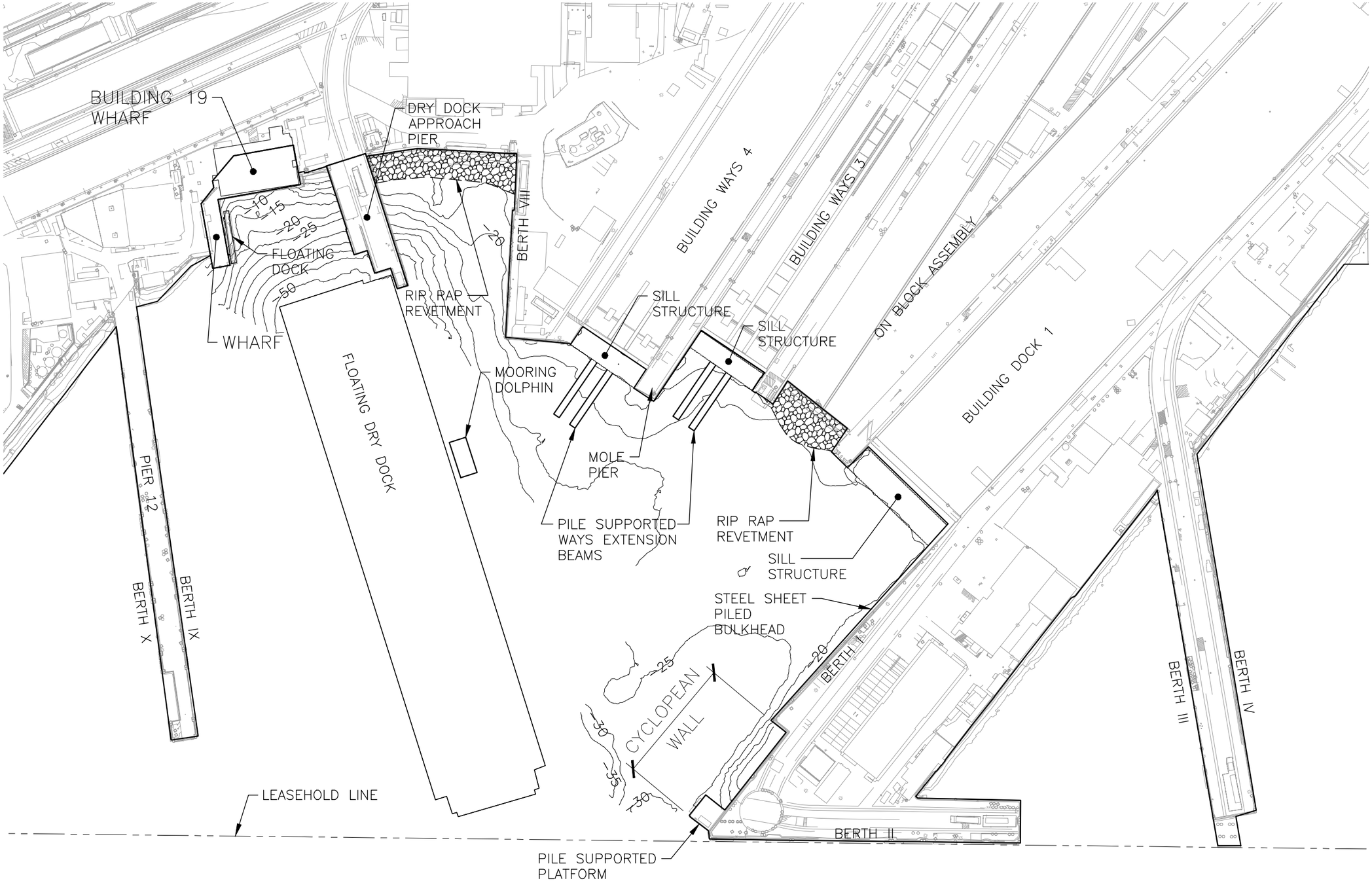


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FIGURE 1S

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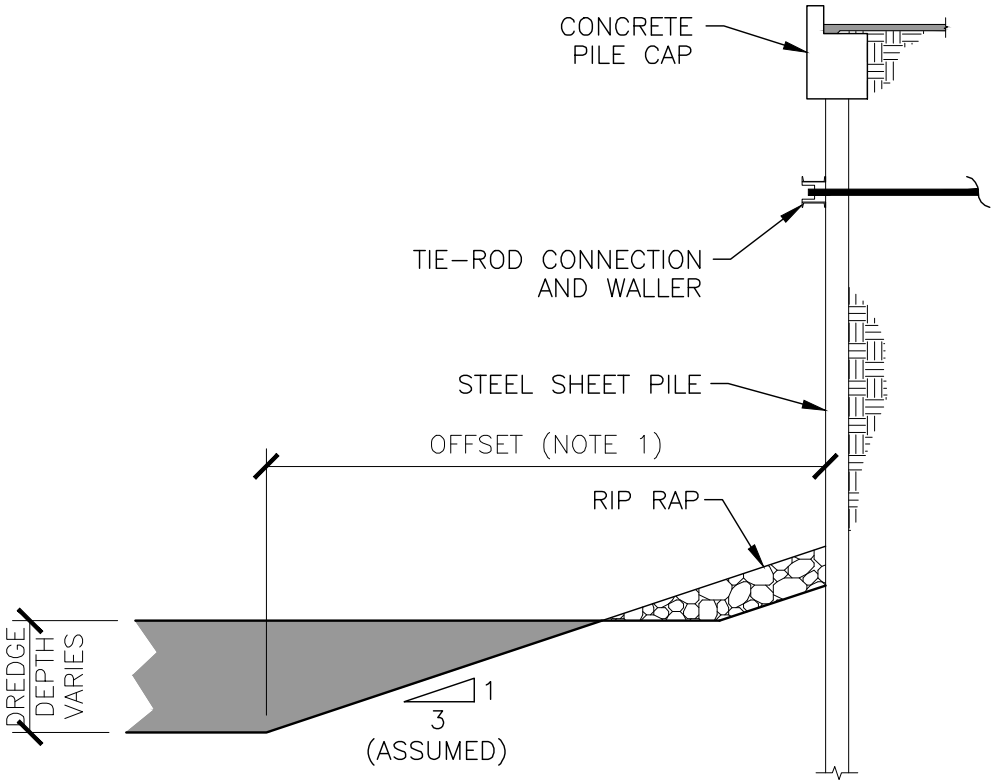
NOTE:
1. OFFSET TO EDGE OF SPECIFIED DREDGE CUT IS DEPENDENT ON DEPTH OF DREDGING



TYPICAL SECTION ACROSS SHEET PILED BULKHEAD

FIGURE 2S

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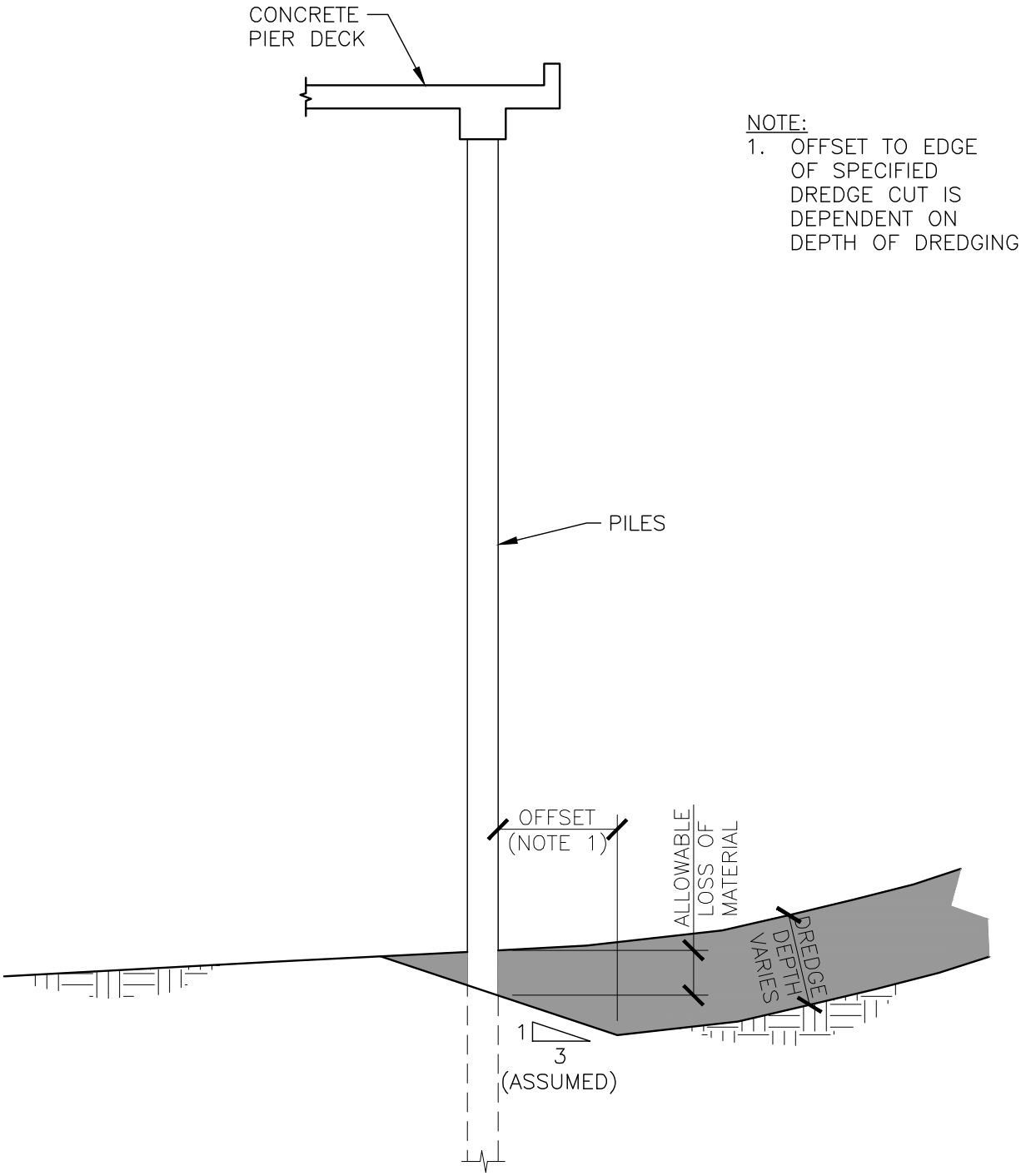

NOTE:
1. OFFSET TO EDGE OF SPECIFIED DREDGE CUT IS DEPENDENT ON DEPTH OF DREDGING

TYPICAL SECTION AT EDGE OF PILE SUPPORTED PIER

FIGURE 3S